FISHERY MANAGEMENT PLAN UPDATE
HARD CLAM
AUGUST 2018

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	August 2001
Amendments:	Amendment 1 – June 2008 Amendment 2 – February 2017
Revisions:	None
Supplements:	None
Information Updates:	None
Schedule Changes:	None
Next Benchmark Review:	2022

The 2001 N.C. Hard Clam Fishery Management Plan (FMP) recommendations included adding a new mechanical clam harvest area in Pamlico Sound and rotating openings in this area with northern Core Sound, decreasing the daily harvest limit for mechanical harvest in Core Sound, changing some of the lease requirements, increasing relay of clams, and increasing funding for Shellfish Sanitation (NCDMF 2001).

The N.C. Hard Clam FMP Amendment 1, adopted in 2008 recommended the hard clam fishery from public bottom continue harvesting at current daily limits, eliminating the mechanical clam harvest rotation in Pamlico Sound, instituting a resting period in the northern Core Sound mechanical clam harvest area, and developing sampling programs to collect information necessary for the completion of a hard clam stock assessment (NCDMF 2008). Amendment 1 also endorsed several changes to the shellfish lease program to increase the accountability of the leaseholders and to improve public acceptance of the program.

The N.C. Hard Clam FMP Amendment 2, adopted by the N.C. Marine Fisheries Commission (NCMFC) in February 2017 recommended maintaining status quo on recreational harvest limits, eliminating mechanical harvest in Pamlico Sound by rule, instituting shading requirements for harvesters from April 1 to September 30, implementing modifications to shellfish lease provisions, and adding to convictions of theft on shellfish leases and franchises to the types of violations that could result in license suspension or revocation.

Life History

Hard clams (Mercenaria mercenaria) are mostly estuarine-dependent, filter-feeding shellfish found in sandy and vegetated bottoms from Prince Edward Island, Canada to the Yucatan Peninsula, Mexico. Spawning occurs from May through November when water temperatures are between 68 degrees and 86 degrees Fahrenheit. The larvae go through several stages before settling onto a suitable bottom. During the juvenile stages, hard clams tend to be dominantly male and then become either male or female as they mature into adults. Sexual maturity is reached in hard clams when individuals reach a certain size, and the timing is therefore dependent on the rate of growth. Growth rates are highly variable because of temperature, food availability, and genetic disposition. Legal size (one inch thick) is typically reached at age 3 in North Carolina, with the oldest individual known living to 46 years.

Management Unit

All hard clams (*Mercenaria mercenaria*) occurring within North Carolina coastal waters.

Goal and Objectives

The goal of N.C. Hard Clam FMP is to manage hard clam stocks in a manner that achieves sustainable harvest and protects its ecological value. To achieve this goal, it is recommended that the following objectives be met:

1. Protect the hard clam stock from overfishing, while maintaining levels of harvest at sustained production, providing sufficient opportunity for both recreational and commercial hard clamming, and aquaculture.

2. Identify, develop, and promote research to improve the understanding of hard clam biology, ecology, population dynamics, and aquaculture practices.

3. Initiate, enhance, and continue studies to collect and analyze economic, social, and fisheries data needed to effectively monitor and manage the hard clam fishery.

4. Identify, develop and promote efficient hard clam harvesting practices while protecting habitat.

5. Promote the protection, restoration, and enhancement of habitats and water quality so that the production of hard clams is optimized.

6. Consider the socioeconomic concerns of all hard clam resource user groups, including market factors.

7. Promote public awareness regarding the status and management of the North Carolina hard clam stock.

STATUS OF THE STOCK

Stock Status

The status of the hard clam stock in North Carolina is unknown due to the paucity of data available to assess the population, therefore benchmark reference values could not be determined for the stock (NCDMF 2017). 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.

The statutory obligation to manage hard clams according to sustainable harvest cannot be met until the appropriate data are collected. While landings records reflect population abundance to some extent, the relationship is confounded by changes in harvest effort and efficiency.

Stock Assessment

Data limitations prevent North Carolina Division of Marine Fisheries (NCDMF) from conducting a hard clam stock assessment and calculating sustainable harvest. Currently, the only data available for the stock in most areas are the commercial landings and associated effort. For this reason, the current assessment focused on trends in catch rates in the commercial hard clam fishery from 1994 through 2013 (NCDMF 2017). Commercial landings of clams are considered a biased index of population size. Fisheries-dependent data are often not proportional to population size due to a number of caveats (e.g. area closures and market fluctuations) and should be interpreted with caution if the interest is relative changes in the population.

The North Carolina commercial hard clam fishery is subject to trip limits, which could bias catch rates (Mike Wilberg, University of Maryland Center for Environmental Science, personal communication; John Walter, National Oceanic and Atmospheric Administration Fisheries, personal communication); that is, the trip limits can affect the amount of catch that is observed per unit effort, preventing the true value of the variable from being observed. A censored regression approach was applied to calculate an unbiased index of relative abundance using data collected from a fishery with trip limits. Preliminary analysis found that for years in which greater than or equal to 50 percent of transactions equaled or exceeded the trip limit in a particular water body, the censored regression produced nonsensical results. For this reason, such years were removed from those water bodies where this occurred. (Note: this was only an issue for mechanical harvest data)

Data were obtained from the North Carolina Trip Ticket Program for 1994 through 2013. The censored response variable (catch per unit effort—the number of clams per transaction) was fit within a Generalized Additive Models for Location Scale and Shape framework using the ‘gamlss.cens’ (Stasinopoulos et al. 2014) and ‘survival’ (Therneau 2014) packages in R (R Core Team 2014). Catch rates were estimated for both hand harvest and mechanical harvest in each of the major water bodies from which hard clams are harvested, and where sufficient data were available (see previous paragraph). Hand harvest occurs year-round and is summarized by calendar year. The majority of mechanical harvest occurs from December through March with some harvest occasionally allowed during other times of the year in specific areas; therefore,

mechanical harvest is summarized by fishing year (December through March). Only landings from public bottom were examined because planting of seed clams, grow-out availability, and market demand often artificially drives landings from private leases. Fisheries-dependent catch rates were expressed as numbers harvested per transaction. Catch rates were consistently higher for mechanical harvest than for hand harvest.

The Mann-Kendall test was performed to evaluate trends in the annual percentages. The Mann-Kendall test is a non-parametric test for monotonic trend in time-ordered data and allows for missing values (Gilbert 1987). The test was applied to the percentage of trip limits for hand harvest and mechanical harvest by area. Trends were considered statistically significant at $\alpha = 0.05$.

Based on the Mann-Kendall test, there were significant increasing trends over time detected in eight areas for hand harvest: Bogue Sound, Core Sound, Inland Waterway, New River, Newport River, North River/Back Sound, Shallotte River, and White Oak River. A significant decreasing trend was found in the hand harvest catch rates in Pamlico Sound. The remaining water bodies showed no trend in hand harvest catch rates over time. The Intercoastal Waterway, New River, Newport River, North River/Back Sound, and Stump Sound demonstrated significantly increasing trends in mechanical harvest catch rates over time. No trends were detected in Bogue Sound, Core Sound, or White Oak River catch rates for mechanical harvest.

Trends observed in fishery-dependent indices must be interpreted with strong caveats. In order for a fisheries-dependent index to be proportional to abundance, fishing effort must be random with respect to the distribution of the population and catchability must be constant over space and time. Other factors affecting the proportionality of fishery-dependent indices to stock size include changes in fishing power, gear selectivity, gear saturation and handling time, fishery regulations, gear configuration, fishermen skill, market prices, discarding, vulnerability and availability to the gear, distribution of fishing activity, seasonal and spatial patterns of stock distribution, change in stock abundance, and environmental variables. Many agencies, such as the NCDMF, do not require fishermen to report records of positive effort with zero catch; lack of these "zero catch" records in the calculation of indices can introduce further bias.

STATUS OF THE FISHERY

Current Regulations

Hard clams cannot be taken from any public or private bottom in areas designated as prohibited (polluted) by proclamation except for special instances for: Shellfish Management Areas (NCMFC Rule 15A NCAC 03K .0103), with a permit for planting shellfish from prohibited areas (NCMFC Rule 15A NCAC 03K .0104), and for the depuration of shellfish (NCMFC Rule 15A NCAC 03K .0107). Hard clams cannot be taken between the hours of sunset and sunrise of any day. Beginning in April 2014, time and temperature control measures were initiated for hard clams to prevent post-harvest growth of naturally-occurring bacteria that can cause serious illness in humans.

Public Bottom

The minimum size limit for hard clams is one-inch thickness (shell width). Daily commercial harvest limits on public bottom are no more than 6,250 hard clams (25 bags at 250 clams per bag) per fishing operation in any coastal fishing waters regardless of the harvest methods employed. Size, daily harvest limits, and season and area limitations do not apply in some situations on public bottom for: 1) temporary openings made on the recommendation of shellfish sanitation; and 2) maintenance dredging operations, where waste of the hard clam resource is apparent due to these activities and Shellfish Sanitation deem the area safe from public health risks.

The daily hand harvest limit on public bottom is 6,250 hard clams and the fishery is open year-round. Rakes no more than 12 inches in width or weighing no more than six pounds can be used to take hard clams in any live oyster bed, in any established bed submerged aquatic vegetation or in an established bed of salt water cordgrass.

The public mechanical hard clam harvest season can occur from December 1 through March 31, and is opened by proclamation to only very specific locations. The mechanical harvest season usually begins the second Monday in December and extends through the week of March 31st. 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 25th for the remainder of the open harvest season.

Internal waters that can open to public mechanical hard clam harvest can only be in areas in Core and Bogue sounds, Newport, North, White Oak and New rivers and the Intracoastal Waterway north of "BC" Marker at Topsail Beach which have been opened at any time from January, 1979, through September, 1988. Public hard clam mechanical daily harvest limits vary by waterbody. In some instances mechanical harvest areas are rotated (alternately open and close) with other areas (Table 1). The White Oak River, New River, and the Intracoastal Waterway of Onslow and Pender counties (Marker 65 to the BC Marker at Banks Channel) are fished mainly with escalator dredges and are rotated on a yearly basis with maximum daily limits of 6,250 hard clams (25 bags at 250 hard clams per bag) per operation. The mechanical harvest area from Marker 72A to the New River Inlet is opened annually with a maximum daily harvest limit of 6,250 hard clams. The maximum daily harvest of 3,750 hard clams is allowed in North River, Newport River, and Bogue Sound (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 portion is opened annually. Each area in Core Sound has a daily harvest limit of 5,000 hard clams per operation.

Recreational harvest limits from public bottom are 100 hard clams per person per day and no more than 200 hard clams per vessel. Hard clams can only be taken by hand for recreational purposes.

Private Bottom

Leases and franchises in internal waters must adhere to the minimum one-inch thick size limit for the sale of hard clams for consumption. There is no daily maximum harvest limit applied to the taking of hard clams from private bottom in internal waters. Public bottom must meet certain criteria in order to be deemed suitable for leasing for shellfish cultivation and there are specific planting, production, and marketing standards for compliance to maintain a shellfish lease or franchise. Also, there are management practices that must be adhered to while the lease is in operation, such as: marking poles and signs, spacing or markers, and removal of markers when the lease is discontinued.

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

There is a specific application process to obtain a lease and a public comment process that is required before a shellfish lease is granted, allowing any member of the public to protest the issuance of a lease. Owners of shellfish leases and franchises must provide annual production reports to the NCDMF. Failure to furnish production reports can constitute grounds for termination. Cancellation proceedings will begin for failure to meet production requirements and interfering with public trust rights. Corrective action and appeal information is given prior to lease termination A lease may be transferred to a new individual before the contract terms ends, however there are specific requirements to do so.

Commercial Landings

Hard clam harvest has fluctuated historically, often in response to changes in demand, improved harvesting, and increases in polluted shellfish area closures. Since 2007 it is known that about 90 percent (2007-2016 combined estimates) (NCDMF 2017) of the total commercial hard clam harvest come from public bottom in North Carolina. It is assumed that trends in hard clam landings from both sources (private and public bottom) combined can be attributed to changes in hard clam landings from public bottom since they make up the largest component to the overall harvest. Adverse weather conditions (i.e., hurricanes, heavy rain events) can impact the annual landings. One of the greatest impacts to clam harvest occurred in 1987-1988 due to red tide. The red tide was a dinoflagellate bloom that caused the closure of over 361,000 acres of public bottoms to shellfish harvest from November 1987 to May 1988. These closures affected 98 percent of the clam harvesting areas, and had its greatest impact on the clam fishermen. The dinoflagellate responsible for the red tide, *Karenia brevis*, produced a neurotoxin, which was concentrated in shellfish, making them unfit for consumption. Ten tropical cyclones (hurricanes and tropical storms) have made landfall in North Carolina since 1996 (http://www.nc-climate.ncsu.edu). Freshwater runoff after storm events often increase shellfish harvest area closures and causes a reduction in hard clam harvest effort for short term periods. Hard clams are a live product that have to go to market relatively quickly after harvest. Competition with hard

clams grown in private culture from other states is also a known contributor to reduced market demand for wild harvested hard clams since a more consistent product can be provided from private grow out facilities.

Annual average hard clam landings from 2008-2017 was 18.4 million clams (Figure 1). Annual landings in 2017 were the lowest on record since 1975 at 14.4 million clams. There was a slight uptick in hard clam landings from 2011 to 2014, followed by a gradual decline through 2017. The landings during this period hover around only one-fourth of their peak in the 1980s. Hard clams are a live product and must to go to market and sold relatively quickly after harvest because of a short shelf life. Competition with hard clams grown in private culture from other states is also a known contributor to reduced market demand for hard clams in the wild since a more consistent product can be provided from private growers.

Hand Harvest Fishery Off Public Bottom

Hand harvest from public areas is a year-round fishery and has average landings of 14.4 million clams a year (2008-2017) (Figure 2; NCDMF 2017). Most hand harvest for clams occurs in the spring and summer when warm water is conducive to wading. Annual public hand harvest for hard clams has remained fairly constant overall, with some yearly fluctuations from 2008 to 2017 (Figure 2; NCDMF 2017).

Mechanical Harvest Fishery Off Public Bottom

Hard clam landings from public harvest, using mechanical methods, has average landings of 2.3 million clams each fishing year (2008-2017) (Figure 2). 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. 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. Since 1994, when the public mechanical harvest area of New River is open, 48 to 97 percent of the total mechanical harvest landings are from this area (NCDMF 2017).

Private Culture

The NCDMF administers the shellfish lease program whereby state residents may apply to lease estuarine bottom and water columns for the commercial production of shellfish. The NCDMF does not differentiate between clam, oyster, bay scallop, and mussel leases; therefore allowing shellfish growers to grow out multiple species simultaneously or as their efforts and individual management strategy allows. For the period of 2007-2013, roughly 35 percent of all private culture operations harvested only clams (NCDMF 2017).

Private enterprise has provided over 10 percent of the total commercial hard clam harvest in North Carolina between 2008 and 2017 (Figure 3). The annual average hard clam landings from 2008 to 2017 from private production were 1.8 million clams.

Recreational Landings

The recreational harvest of hard clams in North Carolina does not require a fishing license, and due to this the total amount of recreational landings cannot be estimated and remains unknown. However, a mailout survey has been used since 2010 to estimate harvest from Coastal Recreational Fishing License 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. In 2010, surveys were only mailed out November and December, so harvest and effort estimates are very low (Table 2). Effort has been consistent in all full years of the survey (2011-2017). Harvest and catch rate have seen minimal fluctuations, except for 2016, which was well below average for both. This is most likely due to large rainfall events in July and August which caused widespread shellfish closures.

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Currently, the only data available for the stock in all areas are the commercial landings and associated effort from the Trip Ticket Program. Sampling of commercial catches of hard clams has been ongoing in the Southern District, Morehead City Office since 1998. Additional sampling of other areas followed later as funding became available for expansion. Hard clam catches are sampled at the dealers year round when available. Trip ticket information is also obtained of the total catch in the trip. Information on the location(s) of the catch also is obtained in as much detail as possible (e.g. water body, nearest landmark, marker number, etc.). Questions to the fisherman include: What gear or gears were used, gear parameters, (i.e. length of teeth, width of escalator, headrope length), how many minutes fished with each gear, location and depth of water fished. Additional questions include whether the catch came from public bottom or leased bottom, and if catch originated from a NCDMF Shellfish Rehabilitation area. Biological information on landed catch of hard clams is collected, including: shell length (mm) and shell width (depth; in mm) by market grade.

A total of 53,773 hard clams were measured from 2008 to 2017 at fish houses (Table 3). Mean shell length has ranged from 60 mm (2.4 inches) to 73 mm (2.9 inches) in that timeframe with a minimum shell length of 27 mm (1.1 inch) to a maximum shell length of 173 mm (6.8 inches) for clams measured at the fish house (Table 3).

Fishery-Independent Monitoring

A fisheries-independent monitoring program (Program 640) is currently underway in Core Sound to provide baseline data on hard clam abundance and gather environmental information. In the future, it may be possible to expand this sampling into other areas to evaluate the entire population. Thirty randomly selected stations are sampled each year within three strata. The three designated strata were: Shellfish Mapping Strata (ST), Known Fishing Areas (FA), and Closed Shellfish Areas (CA). Sampling is performed at each station location within each stratum using small patent tongs on a 25-ft flat bottom boat. The patent tongs have an opening of 0.51 square meters. Samples are by station and three samples at each station are taken.

All hard clams are measured for thickness and length to the nearest millimeter using calipers. Environmental data collected includes depth (in meters), surface and bottom salinity (parts per thousand), surface and bottom temperature (degrees Celsius), surface and bottom dissolved oxygen (milligrams per liter), secchi depth (meter), weather and wind elements, water level, distance from shore (meters), and altered state. Sediment type is qualitatively described.

Very few hard clams are caught in this program due to the nature of the gear and random stratified sampling design. The Catch per Unit Effort (CPUE) or number of clams per station has ranged annually from 0.39 to 1.27 clams per station from 2008 to 2017 (Table 4). No trend is apparent from this sampling, but it is considered a short time series with only 11 years in development (Figure 4).

MANAGEMENT STRATEGY

There are no management triggers or methods to track stock abundance, fishing mortality, or recruitment between benchmark reviews from the current FMP. Landings and effort have decreased over time. There are no data to track the recreational fishery.

Amendment 2 was adopted in February 2017 with rule changes in effect May 1, 2017. The selected management strategies of the Marine Fisheries Commission from Amendment 2 for hard clams taken from public bottom included:

- removing the Pamlico Sound mechanical clam harvest areas in rule no longer in use
- taking latitude/longitude coordinates of the poles marking the open mechanical clam harvest area in New River

For private culture of hard clams, the preferred management options in draft Amendment 2 included:

- adding convictions for theft of shellfish from leases or franchises to the list of convictions that may result in revocation of fishing licenses to implement stronger deterrents to shellfish theft and intentional aquaculture gear damage
- clarifying how production and marketing rates are calculated for shellfish leases and franchises to meet minimum production requirements
- expanding the maximum proposed lease size to 10 acres in all areas
- specifying criteria that allow a single extension period for shellfish leases of no more than two years per contract period to meet production and marketing requirements in the case of unforeseen circumstances, and reorganize the rules for improved clarity.

Amendment 2 also recommended implementing shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock from June through September.

See Table 5 for Marine Fisheries Commission selected management options under Amendment 2.

RESEARCH NEEDS

The specific research recommendations from Amendment 2, with its priority ranking are provided below. The prioritization of each research recommendation is designated either a HIGH, MEDIUM, or LOW standing. A low ranking does not infer a lack of importance but is either already being addressed by others or provides limited information for aiding in management decisions. A high ranking indicates there is a substantial need, which may be time sensitive in nature, to provide information to help with management decisions. Proper management of the hard clam resource cannot occur until some of these research needs are met, the research recommendations include:

- Support all proposed implementation actions under the priority habitat issue on sedimentation in the CHPP – HIGH (Ongoing)
- Improve the reliability for estimating recreational shellfish harvest – HIGH (Incomplete)
- Survey commercial shellfish license holders without a record of landings to estimate hard clam harvest from this group – MEDIUM (Incomplete)
- Determine the consequences to hard clams from impacts to habitat due to harvest practices – LOW (Incomplete)
- Develop regional juvenile and adult abundance indices – HIGH (Incomplete)
- Complete socioeconomic surveys of recreational clam harvesters – MEDIUM (Incomplete)
- Continue to complete socioeconomic surveys of commercial clam fishermen – LOW (Incomplete)
- Support collaborative research to more efficiently track bacterial sources for land-based protection and restoration efforts – MEDIUM (Ongoing)
- Quantify the relationship between water quality parameters and the cumulative effect of shoreline development units - MEDIUM (Incomplete)
- Investigate impacts of clam trawls and escalator dredges on sandy bottom environments – LOW (Incomplete)
- Investigate the effects of mechanical harvest on clam recruitment and clam mortality in the mechanical harvest areas – MEDIUM (Incomplete)

FISHERY MANAGEMENT PLAN RECOMMENDATION

Recommend maintain the current timing of the Benchmark Review. Amendment 2 of the N.C. Hard Clam FMP was adopted by the NCMFC in February 2017 with rule changes in effect on May 1, 2017.

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TABLES

Table 1. Current daily mechanical hard clam harvest limits by water body. Season can only be opened from December 1 through March 31 by proclamation.

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	Limit reduced from 6,250 in 2001. Open annually
North River	3,750	Open annually
Newport River	3,750	Open annually
Bogue Sound	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 the White Oak River and the ICW in the Onslow/Pender counties areas
New River Inlet	6,250	Open annually from Marker 72A to the New River Inlet
ICW 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.

Table 2. Estimated number of trips, number of clams harvested, and catch rate (clams per trip) per year of Coastal Recreational Fishing License holders, 2010-2017

Year	Number Trips	Clam Harvest	Catch Rate
2010	528	8731	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

Table 3. Observed annual mean, minimum and maximum shell length (mm) of hard clams measured from commercial catches at the dealer, 2008 – 2017.

Year	Mean Shell Length	Min Shell Length	Max Shell Length	Total Number measured
2008	69	41	120	1,383
2009	64	39	112	1,862
2010	63	39	104	5,358
2011	64	38	111	10,670
2012	62	40	109	5,851
2013	63	40	108	4,750
2014	60	27	115	7,447
2015	60	34	111	6,218
2016	60	30	105	6,460
2017	73	41	173	3,774
10 year average	64	27	173	53,773

Table 4. Independent hard clam sampling (Program 640) annual estimates of catch per unit effort (CPUE=Number of clams per station) and their standard deviations, 2007 to 2017 for Core Sound.

Year	Total number of stations	Number of stations with zero catch	Number of clams	CPUE (Number of clams/station)	Standard deviation
2007	30	22	20	0.67	1.54
2008	31	24	12	0.39	0.80
2009	30	15	38	1.27	1.82
2010	30	19	22	0.73	1.36
2011	30	26	14	0.47	2.03
2012	30	17	21	0.70	1.21
2013	30	25	16	0.53	1.53
2014	30	24	21	0.70	1.78
2015	30	22	15	0.50	0.50
2016	30	22	16	0.53	0.23
2017	30	22	35	1.17	2.57

Table 5. Summary of the Marine Fisheries Commission selected management strategies from Amendment 2 of the N.C. Hard Clam Fishery Management Plan.

Management strategies	Implementation status
MANAGEMENT OF PUBLIC BOTTOM	
1. Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 per clams per vessel per day)	No action required
2. Status quo (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)	No action required
3. Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use	Rule change to 15A NCAC 03K .0302 in effect May 1, 2017
4. 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	Completed in 2015
5. Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs	No action required
6. Status quo (Maintain current definitions and enforcement of hand harvest methods)	No action required

Management strategies	Implementation status
7. Allow Shellfish License holders to be eligible to acquire a Standard Commercial Fishing License after they show a history of sale of shellfish. Continue to allow commercial harvest of all other shellfish (clams included) as currently allowed	No action required
PRIVATE CULTURE	
1. Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at $500 for the first violation and $1,000 for the second violation	Amend G.S. 113-208 and G.S. 113-269
2. Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments	Amend G.S. 113-269
3. Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so that a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee	Rule change to 15A NCAC 03O .0114 in effect May 1, 2017
4. Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following measure identified in the interim)	No action required
5. Continue the moratorium of shellfish leases in Brunswick County	No action required
6. Establish a rule to support extensions for where “Acts of God” prevent lease holder from making production, with a two year extension and only one extension allowed per term	Rule change 15A NCAC 03O .0201 in effect on May 1, 2017
7. Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers	Amend G.S. 113-202
8. Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices	Ongoing
9. Allow a maximum of ten acres in both mechanical methods prohibited areas and mechanical methods allowed areas	Rule change 15A NCAC 03O .0201(a)(3) in effect on May 1, 2017
ENVIRONMENT AND PUBLIC HEALTH	
1. Implement 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 by proclamation annually.	Existing proclamation authority, implemented beginning April 1, 2017

FIGURES

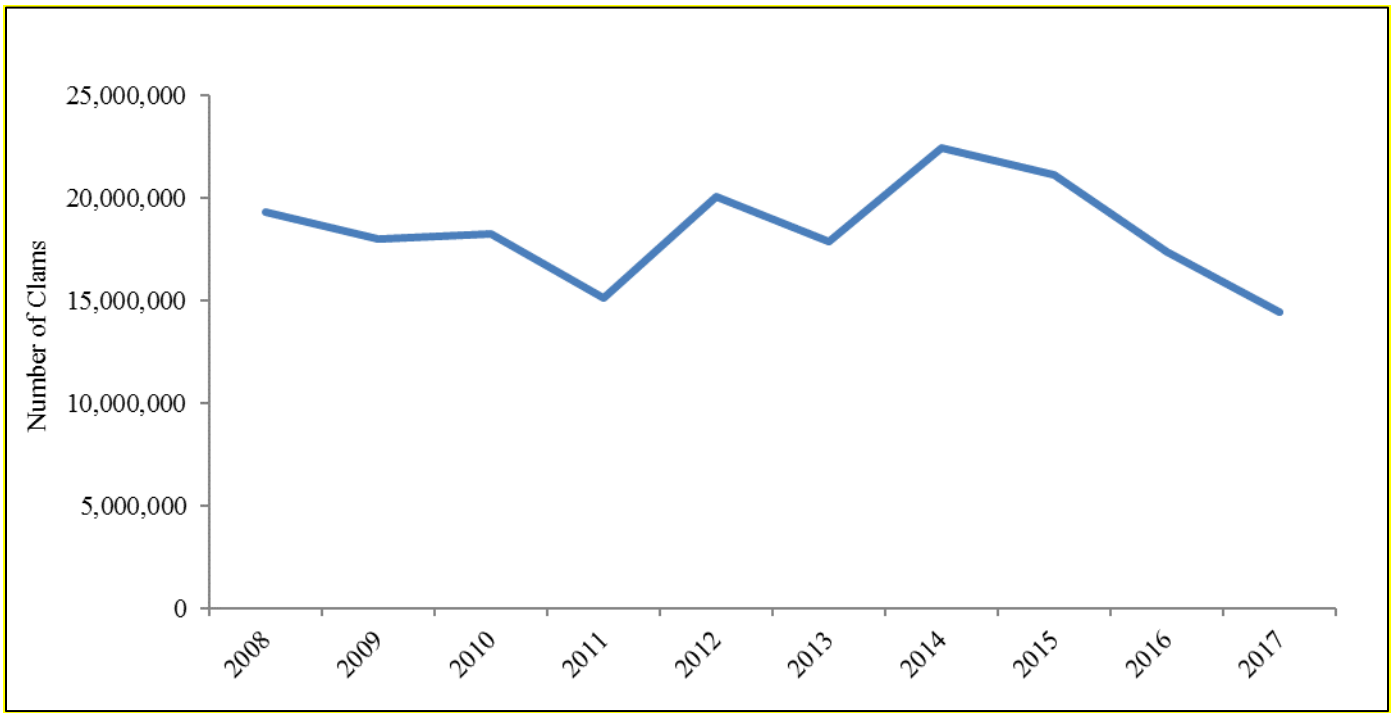

Figure 1. Annual hard clam landings (millions of clams) from private and public bottom in North Carolina, 2008 - 2017.

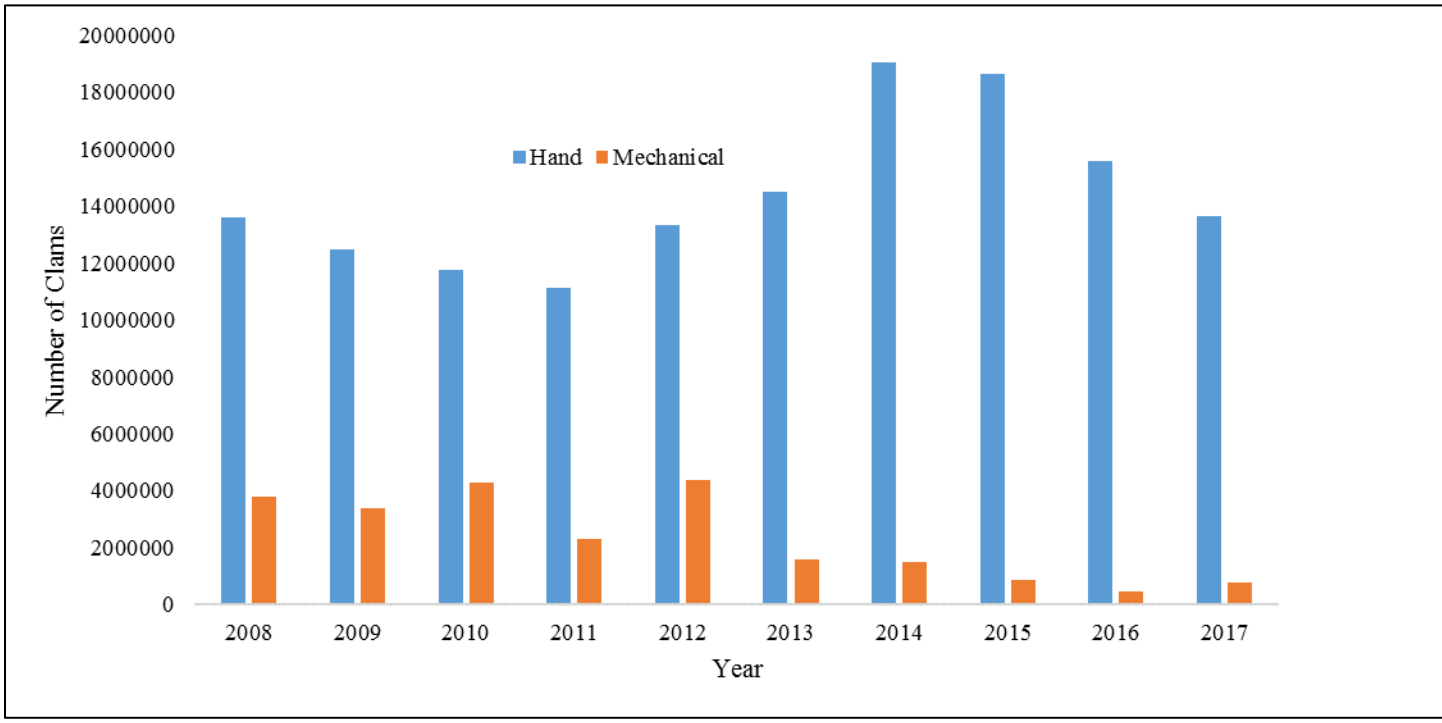

Figure 2. Annual hard clam landings (Number of clams) from hand and mechanical harvest off of public bottom, 2008 - 2017.

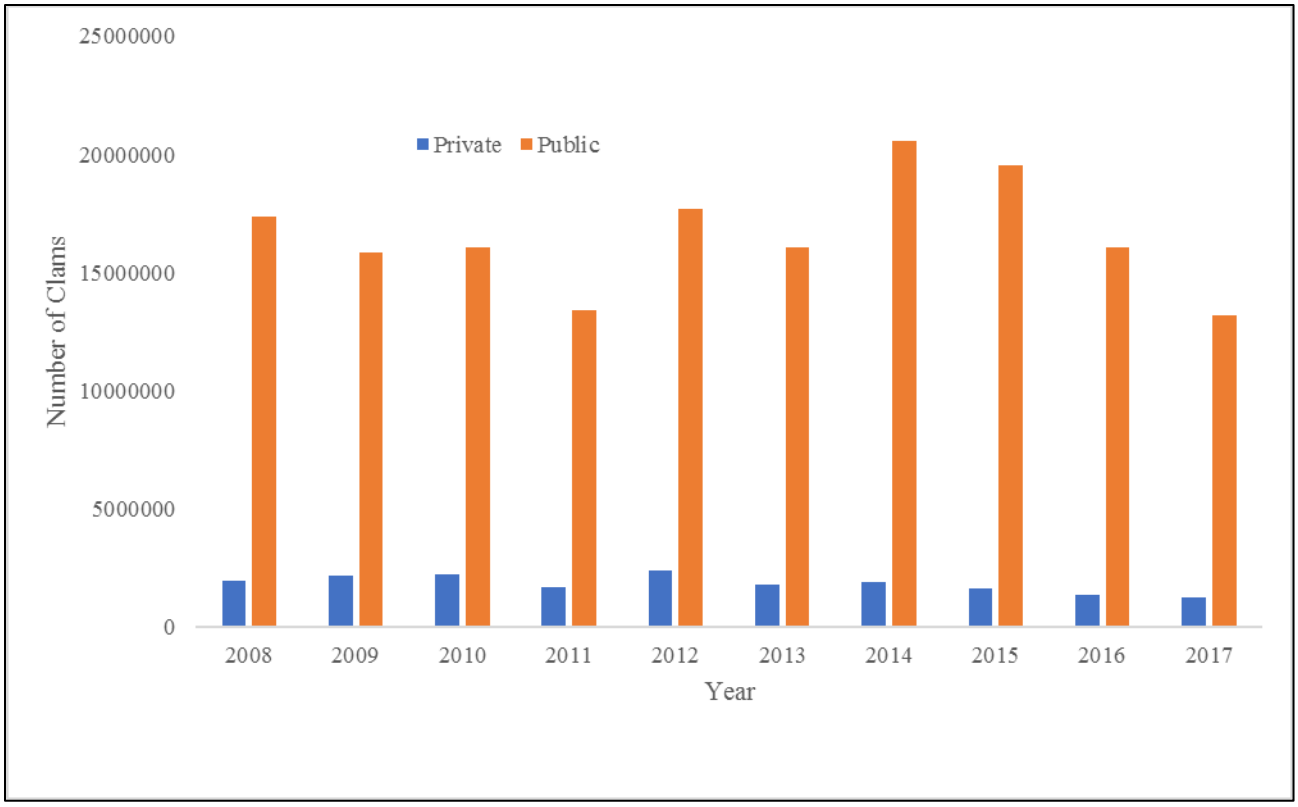

Figure 3. Annual hard clam landings (Number of clams) from private and public bottom, 2008 - 2017.

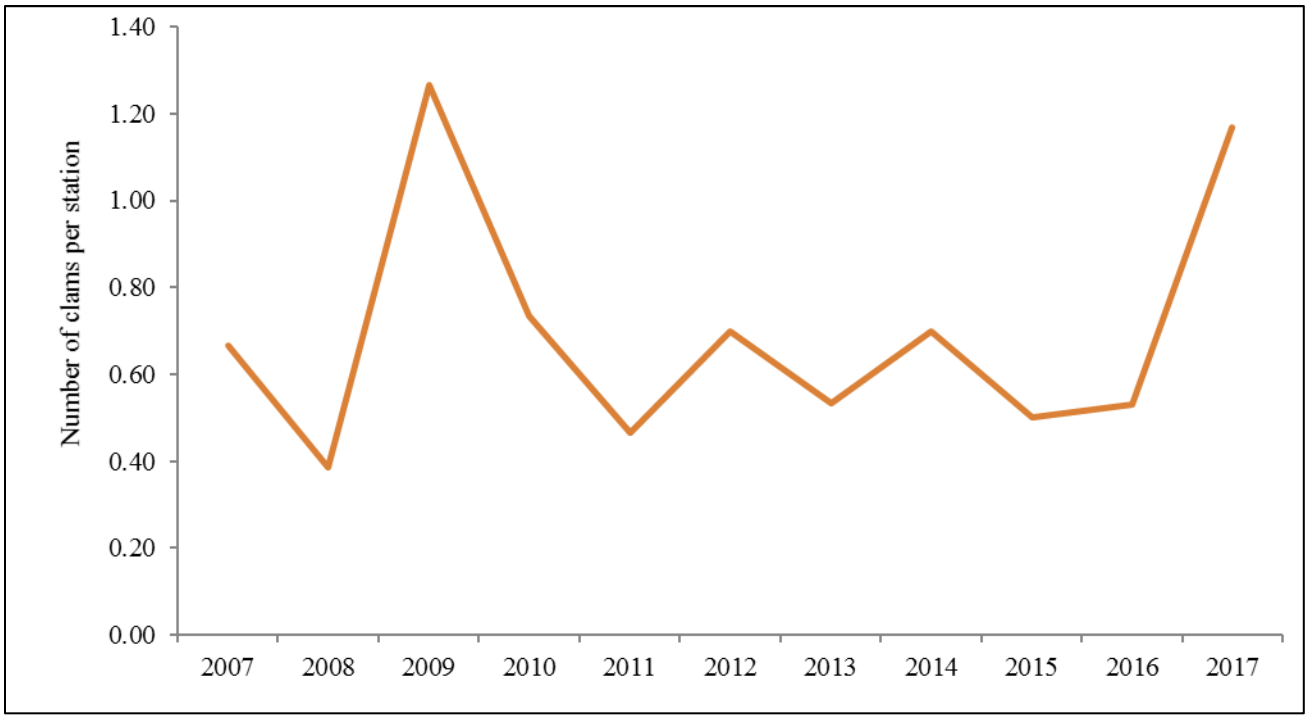

Figure 4. Annual catch per unit effort (Number of clams per stations) of hard clams in Core Sound from the independent sampling program 640, 2007 - 2017.