APPENDICES

Appendix 1: Mechanical Clam Harvest

ISSUE

The number of participants and trips in the mechanical clam fishery 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 caused the division to re-examine if this fishery should still operate.

ORIGINATION

DMF

BACKGROUND

Historical Importance

Historically, the harvest of hard clams by mechanical methods made up an significant portion of the commercial fishery on public bottom from its advent in the mid-1940s all the way through the early-2010's. As detailed in section 7.1, the 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 (Section 7.1.2).

Historical mechanical harvest data are sparse until 1950 when commercial reporting became more regular. The mechanical harvest from the early 1950s was massive compared to recent decades, exceeding 35 million hard clams in 1951 (Figure X.X). 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 became inaccessible in the northeastern states 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, increase in closures of shellfish waters from pollution, changing market demand, several major storms, and a red tide event in 1987.

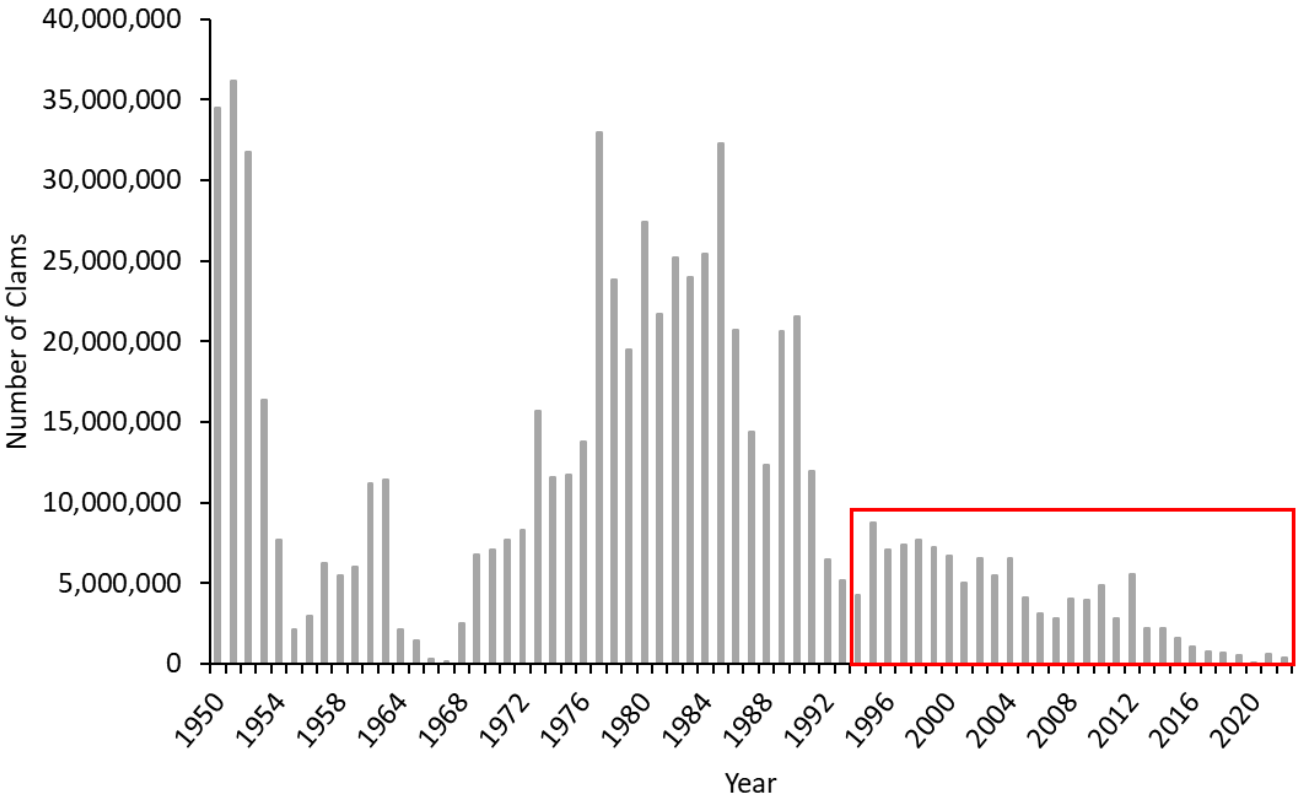

Figure X.X. Hard clam landings (number of clams) using mechanical gears by year, 1950-2022. TTP data is presented in the red box.

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 X.X1). The 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 until less than 10 participants per year were active in the fishery from 2019 to 2022.

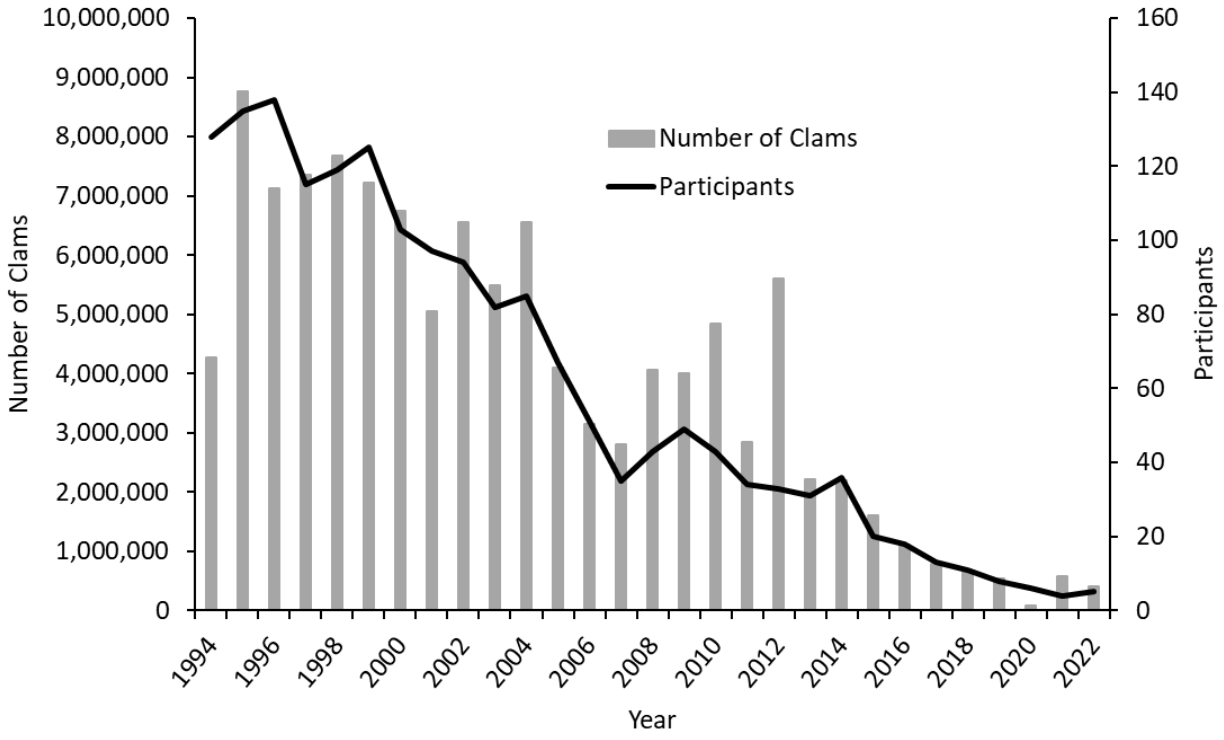

Figure X.X1. Hard clam landings (number of clams) and number of participants using mechanical gears by year, 1994-2022.

As detailed in section 7.1, 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 X.X2). The New River was the most important waterbody for mechanical harvest from 2000 to 2016, when Core Sound overtook it. The New River has seen a consistent decline since 2012, with the exception of 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 the New River, and caused fishermen to move to new waterbodies or transition to other fisheries.

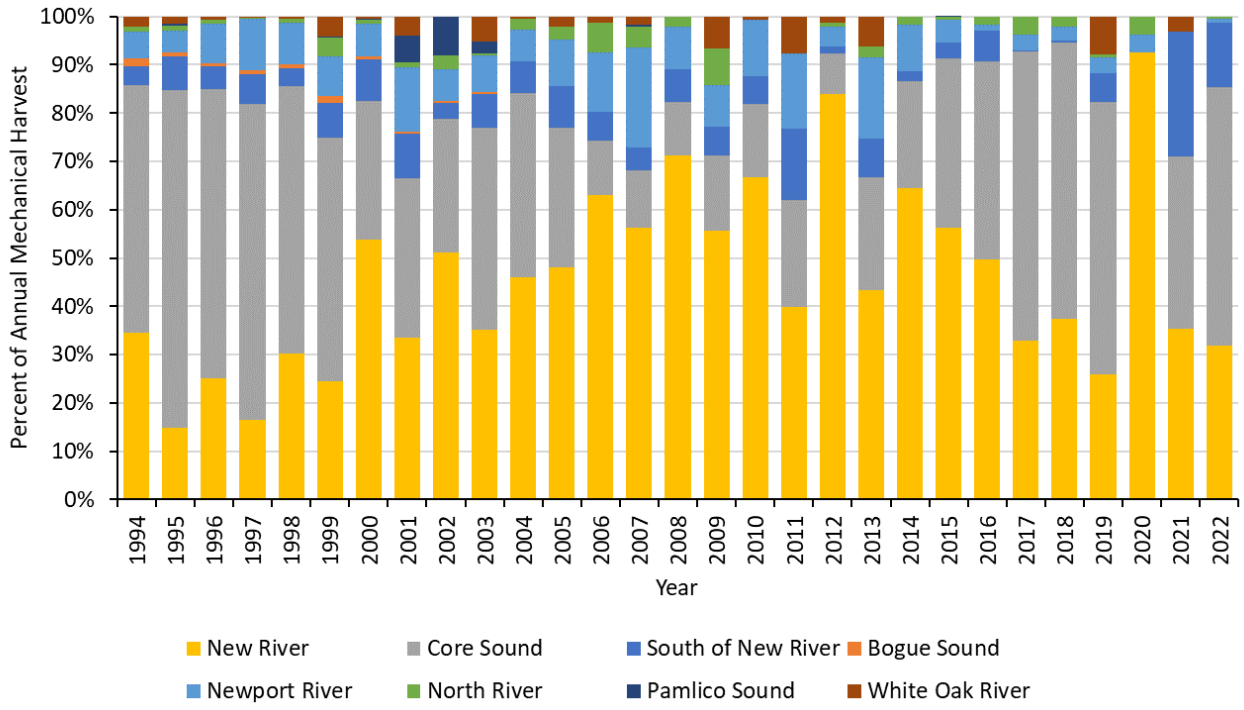

Figure X.X2. Percentage of annual mechanical hard clam harvest in NC by waterbody and year, 1994-2022.

Enforcement

Each year the Division 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 to access 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 division, 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 division believes it may be appropriate to further reduce, phase out, or eliminate the mechanical clam harvest fishery due to habitat concerns with mechanical gears, a 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

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). The 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. Clam trawling, or kicking, began in Core Sound with a method involving the scouring of bottom sediment with a prop wash while towing a trawl. Anecdotal accounts indicate that significant negative impacts occurred to oyster rocks prior to marking and closing areas to mechanical harvest of clams. 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.

The division 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 division 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 can be seen in Figure X.X4. Due to the large extent of overlap with SAV, the entire mechanical clam harvest area in Bogue Sound was eliminated (Figure X.X5).

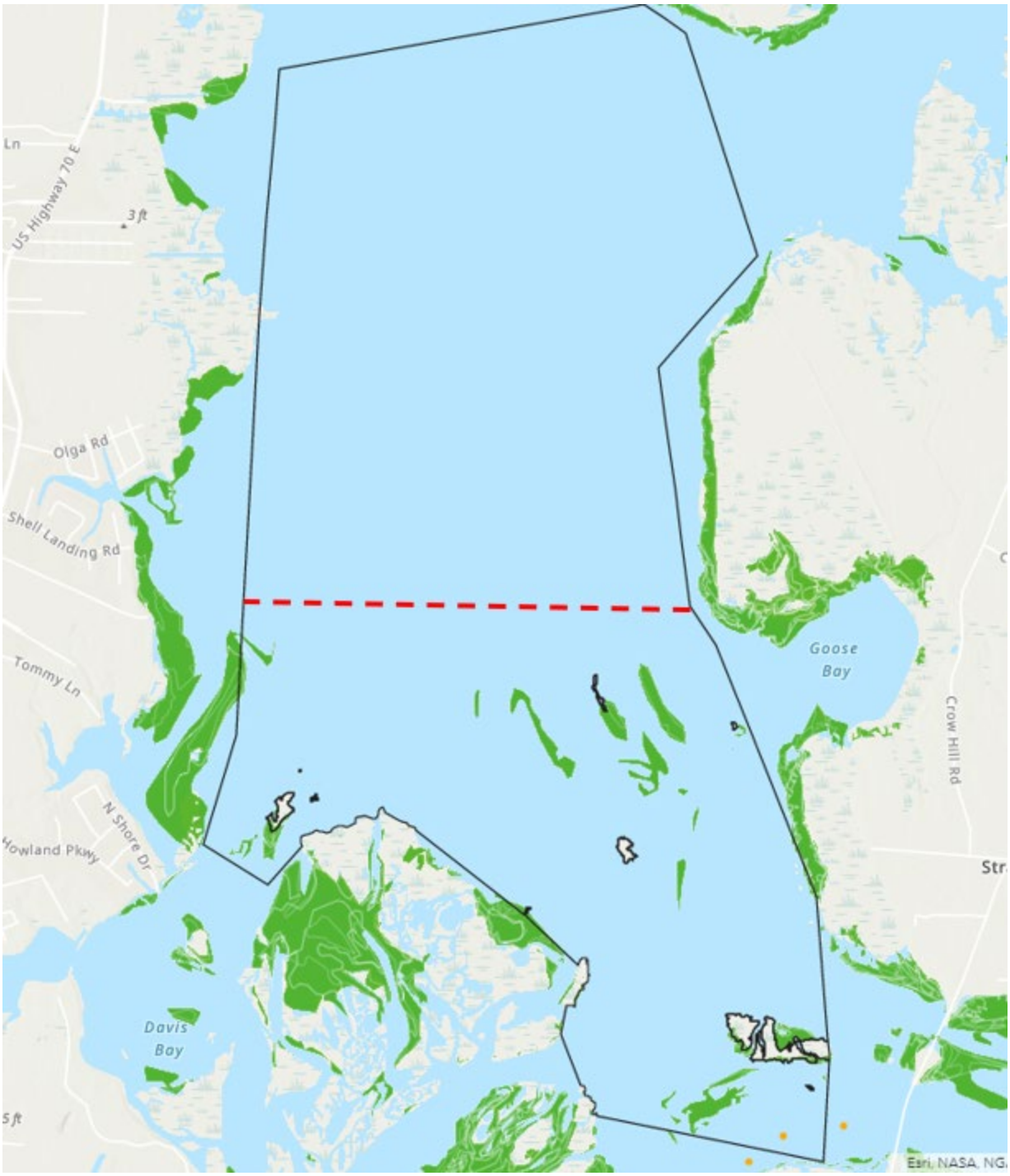

Figure X.X4. Map of North River mechanical clam harvest area (black line) overlaid with SAV mosaic (in green; APNEP 2022) to show SAV overlap. The dotted red line is where the new area boundary was established..

Figure X.X5. Map of Bogue Sound mechanical clam harvest area (black line) overlaid with SAV mosaic (in green; APNEP 2022) to show 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. 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. Annual economic contributions from the clam mechanical harvest commercial fishery to the state of North Carolina from 2012-2022 reported in 2022 dollars

Year	Trips	Participants	Ex-Vessel Value	Job Impacts	Income Impacts	Value Added Impacts	Sales Impacts
2022	41	3	$34,986	4	$44,522	$92,392	$105,235
2021	72	3	$74,217	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 division uses a large amount of staff and financial resources to monitor, manage, and enforce this fishery. These costs may be difficult to justify for a fishery with such 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). The fishermen that currently participate in the mechanical 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 the declining nature of the greater mechanical clam harvest fishery as whole, is unlikely to see much use in the future.

Management options

Due to dwindling participation and landings, significant cost to demarcate, maintain, and enforce the fishery, as well as habitat concerns regarding SAV and oyster overlap, as well as turbidity and sedimentation, the division believes it is necessary to examine the validity of this fishery.

Possible management options include, but not limited to; status quo, Further limiting the MCHAs, phasing out the fishery, and ending the fishery immediately.

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 with bottom disturbing gears would not be addressed.

Mechanical clam harvest areas could be further limited to try to create buffers around critical habitat and protected delicate habitats from sedimentation associated with bottom disturbing devices. As with status quo, The fishermen currently operating in the fishery could continue, and new harvesters could join. The cost to the state for demarcation and 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. It is important to note that similar options for the shrimp fishery did not have much public support and failed to move forward through MFC adoption.

The MCH fishery could be phased out over a set timeframe such as two or three years, 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 hopefully allow current mechanical harvesters ample time to get rid of gear and transition to other fisheries to subsidize their income. This option would address the division's cost concerns with demarcation and enforcement, as well as the habitat concerns. This option would comply with G.S. 113-221 (d), as it gives "a future effective date so as to minimize undue potential economic loss to fishermen".

Due to concerns over compliance with G.S. 113 221 (d), the division does not think the MCH fishery could be ended abruptly at the 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".

MANAGEMENT OPTIONS

- Status quo
- Further limit MCH areas to protect habitat
    - 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
- Phase out MCH
    - The only option to end MCHA that complies with G.S. 113-221 (d)

- Would allow fishermen to plan ahead and sell gear, transition to other fisheries
- Could be set as 2 or 3 years similar to the shellfish relay program

RECOMMENDATIONS

*This section will be completed as PDT recommendations and then replaced with DMF recommendations and other appropriate levels. Final version will be MFC recommendations and reference the Summary of Recommendations Appendix (see *Estuarine Striped Bass Amendment 2*).*

REFERENCES

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NCDMF. 2022. SAV Onslow 2021 Final. Available: https://data-ncdenr.opendata.arcgis.com/datasets/ncdenr::sav-onslow-2021-final/about