

## **APPENDICES**

### **Appendix 3: Intertidal Oyster Commercial Harvest Management**

#### **ISSUE**

Addressing management needs for intertidal oyster stocks in North Carolina.

#### **ORIGINATION**

The Division of Marine Fisheries and the North Carolina Marine Fisheries Commission selected management strategies from the Eastern Oyster Fishery Management Plan (FMP) Amendment 4.

#### **BACKGROUND**

The North Carolina Eastern Oyster Fishery Management Plan Amendment 5 is focused on the management of wild oyster stocks, and this information paper does not pertain to farm raised or private cultured oysters.

North Carolina's wild oyster stocks are composed of both intertidal (exposed to air during portions of the tidal cycle) and subtidal (continuously submerged) populations. Oyster populations in the southern region of the state (Onslow, Pender, New Hanover, and Brunswick counties) are primarily intertidal reefs. There is not currently a stock assessment or fishery independent sampling programs for intertidal oysters in the state.

Commercial harvest of oysters in North Carolina requires a Standard or Retired Commercial Fishing License (SCFL, RSCFL) with a shellfish endorsement, or a commercial shellfish license. The number of SCFL/RSCFL available within the state is capped, placing a limit on the total potential amount of participation from these license holders. The commercial Shellfish License is not limited to a maximum number of participants and is available at a much lower cost than the SCFL or RSCFL to any resident of the state. Harvest is limited to hand methods from Core Sound south to the NC/SC state line, with harvesters walking out onto exposed oyster reefs to manually collect legal sized (3" shell length or greater) oysters. Exposed intertidal oyster reefs are easily accessible to harvest by hand and are vulnerable to impacts from harvest pressure.

The southern region of North Carolina contributes consistently to the overall public landings of oyster within the state (Figure 1). From 1994 to 2022 the southern region produced 51% of the state's total oyster harvest, contributing between 20 and 91% of the harvest annually. The southern region of the state encompasses just 5.7% of the total coastal water body area yet has contributed over half of the total oyster landings since 1994.

The North Carolina Eastern Oyster FMP Amendment 4 examined increasing landings and participation from commercial Shellfish License holders with decreasing catch per unit effort (average bushels landed per trip), and the potential of effectively open entry on a finite fishery resource via the shellfish commercial license as management issues. For more information see the following issue papers in Amendment 4 of the Eastern Oyster FMP: Assessing and Mitigating Harvest Effort Impacts on Oyster Resources in the Southern Region and Consider Elimination of the Shellfish License and Require All Shellfish Harvesters to Have a SCFL or RSCFL. To address these concerns, the Marine Fisheries Commission (MFC) adopted specific management strategies. These included reducing the daily oyster harvest limit for commercial Shellfish License holders from five bushels to two. Additionally, the MFC recommended excluding oysters harvested from public bottoms as eligible for harvest with the commercial Shellfish License. They also proposed the development of a fishery independent sampling program for intertidal oysters in the southern region. Beginning in October of the 2017-2018 season, hand harvest for Shellfish License holders was limited to two bushels of oyster per person per day, not to exceed four bushels per vessel per day if two or more Shellfish License holders are onboard the vessel via proclamation. The elimination of oyster from the commercial Shellfish License requires legislative action.

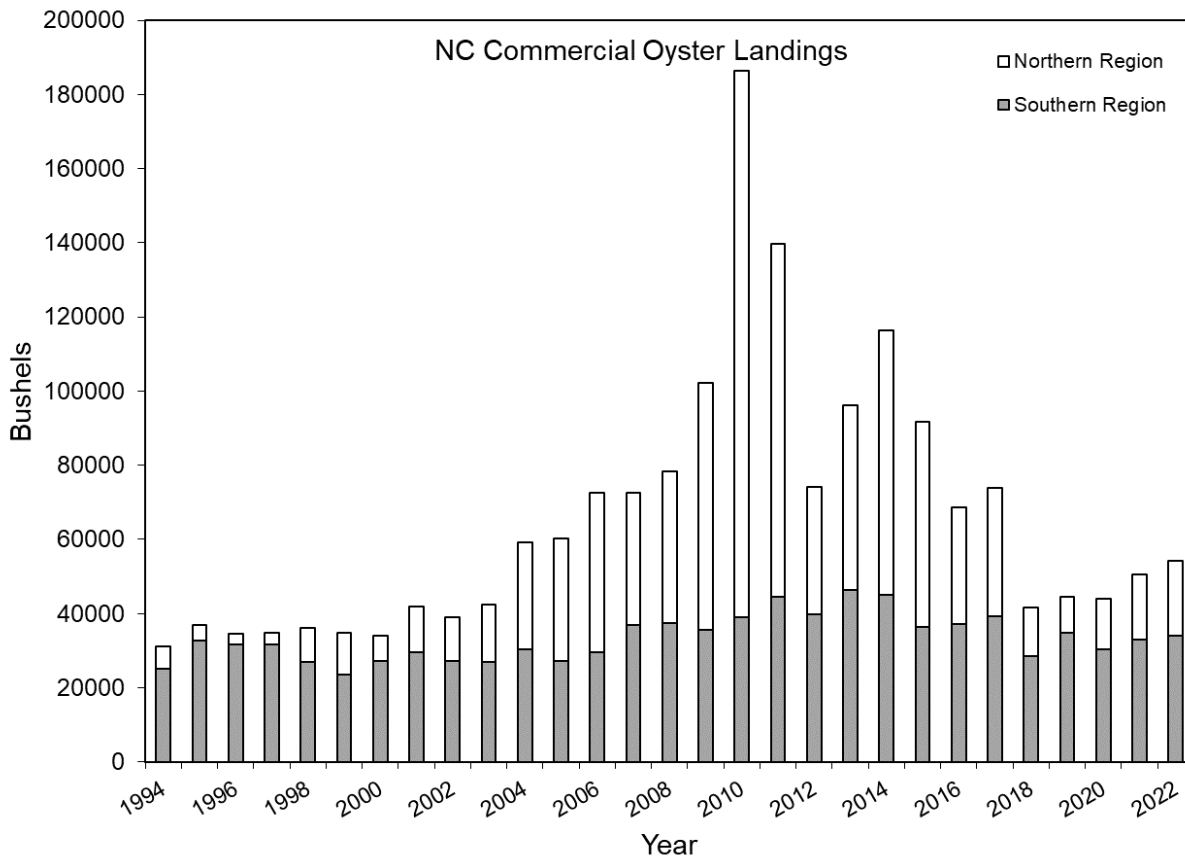


Figure 1. Commercial landings of oysters from public bottom in North Carolina from 1994 to 2022, showing the total annual landings (entire bar height) and the proportion of landings contributed by the southern region (waterbodies south of Bogue Sound) as dark gray, and proportion from the northern region as white.

Effort in the commercial oyster fishery in the southern region experienced a period of growth between 2000 and 2014, with the total amount of trips nearly doubling during that time (Figure 2). The increase in participation was primarily driven by increasing participation from harvesters with commercial Shellfish Licenses, with a 388% increase in trips by commercial Shellfish License holders over that period. The number of trips made by Shellfish License holders declined sharply in 2018. This coincides with NCDMF enacting the bushel reduction limit for Shellfish License holders as recommended by the MFC.

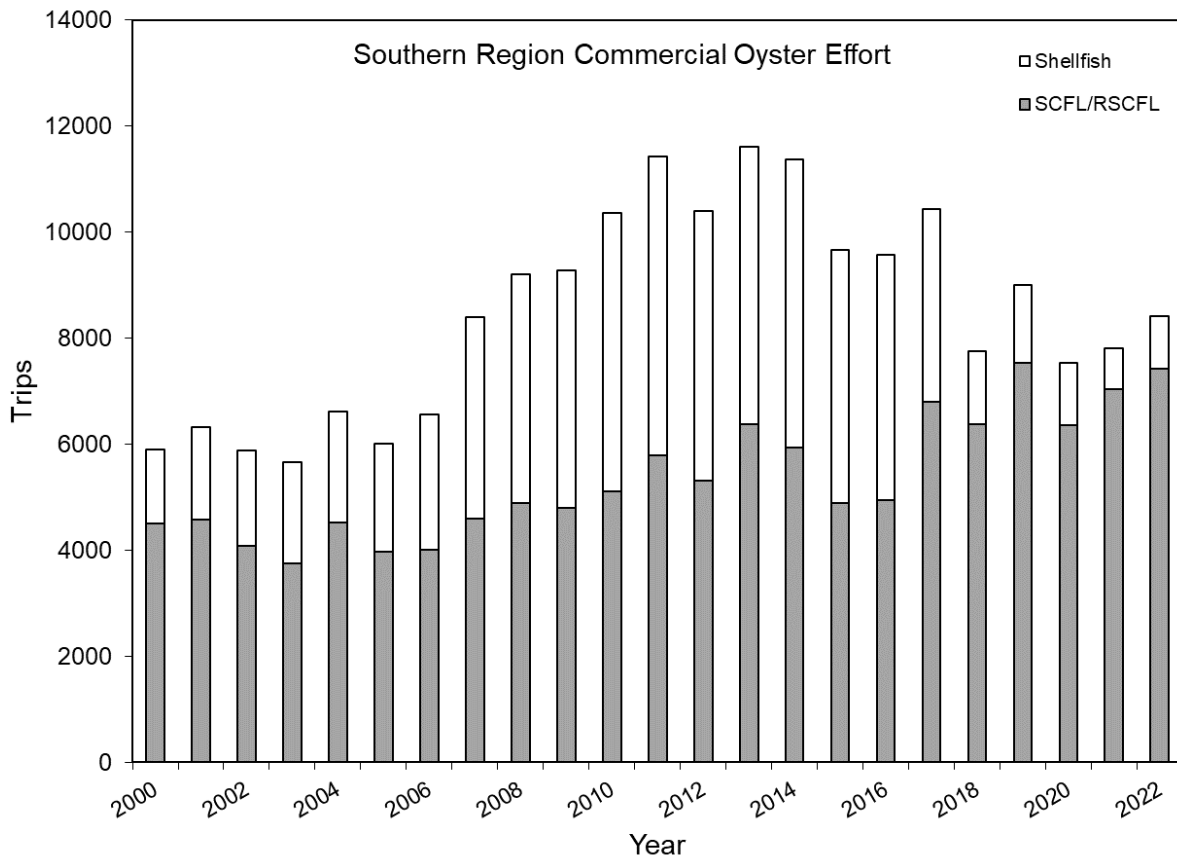


Figure 2. Effort in trips for the southern region (waterbodies south of Bogue Sound) commercial oyster fishery from 2000 to 2022. Total annual number of trips is represented

by the entire bar height, with the proportion of trips made by Shellfish License holders shown as white and the proportion of trips made by SCFL/RSCFL holders as dark gray.

Since there is currently no independent sampling or stock assessment for intertidal oysters in the southern region of North Carolina, one way to gauge the health of the oyster stocks is by looking at the average catch per effort (CPUE) of commercial fishers. This is measured by the average annual number of bushels landed per fishing trip, as recorded in the NC Trip Ticket Program (TTP). Since 1994, all commercially harvested oysters in North Carolina must be reported through the NC TTP. However, it's important to interpret CPUE data from commercial fisheries cautiously because factors like regulations, market demands, and weather can all influence fishing behavior and catch levels. In the case of oyster, if declines in the average number of bushels landed while fishers are expending the same amount of effort (trips) are observed, there may be cause for concern that the resource may not be able to sustain the amount of harvest pressure that is occurring. However, without any fisheries independent data to provide information about oyster abundance or population structure, it is impossible to verify that trends in fisheries dependent data reflect what is happening with the oyster population.

From 2000 to 2006, the average number of bushels landed per trip by SCFL/RSCFL holders in the southern region remained relatively close to the trip limit of 5 bushels, averaging 4.6 bushels per trip (Figure 3). However, starting in 2007, the average annual bushel amount landed per trip began to decline, reaching 3.7 bushels per trip by 2010. Between 2008 and 2017, the average annual bushel amount fluctuated but remained below 4 bushels per trip. Beginning in 2018 after the bushel limit for Shellfish License holders was reduced, there was an annual increase in the average annual bushels per trip, reaching 4.6 annual average bushels per trip by 2023.

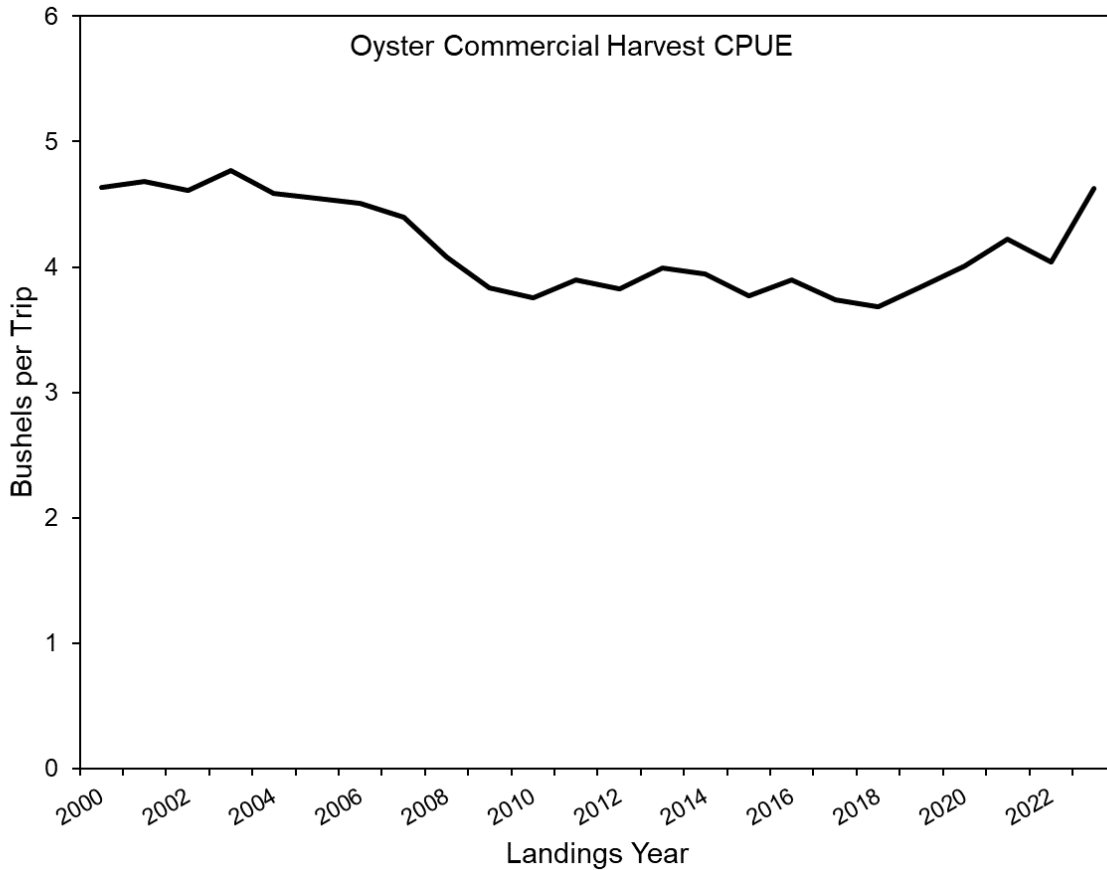


Figure 3. The catch per unit effort (CPUE) for oyster commercial harvest in the southern region (waterbodies south of Bogue Sound) from 2000 to 2023. The black line represents the average annual bushel amount landed per trip of SCFL/RSCFL holders.

Four waterbodies, Lockwood Folly River, Shallotte River, Masonboro Sound, and Topsail Sound contributed 68% of the region's total commercial oyster landings from public bottom since 1994 and are representative of the intertidal hand harvest fishery in the region. Since 2000, landings trends from these areas fluctuated annually, Topsail and Masonboro sounds showed increasing landings until a decline begins in 2014; however, Lockwood Folly and Shallotte rivers were more variable. (Figures 4 – 7). Yearly changes in landings from these water bodies generally reflect the number of participants in the fishery annually (Figures 4 – 7). Like the rest of the region, generally increasing numbers of Shellfish License holders participated in the fishery until 2018. Despite variation in trends in participation and landings across the region, the number of bushels landed per commercial trip decreased between 2000 and 2010. This decrease in CPUE was concurrent with the overall increase in participation and effort in the oyster fishery for these waterbodies, with lowest average bushels per trip landed during periods of highest participation. (Figure 8). Lockwood Folly and Shallotte rivers both showed increased annual average bushels per trip in recent years as participation decreased, while Masonboro and Topsail Sound showed relatively flat trends in bushels per trip.

The NCDMF Shellfish Rehabilitation Program carries out annual efforts to plant cultch (material suitable for oyster spat settlement, including oyster shell or limestone marl) in the southern region of the state. Cultch reefs are created in waters open to shellfishing to improve oyster recruitment and increase biomass in areas where suitable substrate is otherwise limited. For more information on the Division's cultch planting program see Appendix 4: Habitat Enhancement Programs. The quantity of material planted each year varies considerably based on availability and funding. Between 2000 and 2022, a total of 1,054,243 bushels of cultch material were planted, and 744,311 bushels of oyster were commercially harvested across the entire southern region of the state (Figure 9). The return in commercial harvest per unit of cultch planted remains unknown and likely varies across different planting sites. The impact of cultch plantings on oyster landings isn't immediate, as it typically takes between 1 and 3 years after planting for new cultch material to yield legal-sized oysters. While some cultch planting sites have relatively short lifespans, others have been observed to continue yielding harvests for decades.

The existing management strategy in the southern region relies on the Marine Fisheries Director's authority to close the oyster season before March 31<sup>st</sup> by proclamation. In the Pamlico Sound mechanical oyster fishery, a mechanical harvest monitoring program is used to regulate fishing activity to protect oyster habitat during the harvest season. For additional information see Appendix 1: Pamlico Sound Oyster Mechanical Harvest Management. Currently, no harvest monitoring program or closure trigger exists for hand harvest areas. In Brunswick County, waterbodies close to oyster harvest on March 15<sup>th</sup> due to concerns stemming from excessive harvest pressure in past years.

NCDMF has implemented a pilot fishery independent sampling program to monitor the intertidal oyster resource. Fifteen sentinel sites have been proposed across the southern region of the state to represent the intertidal oyster population. Sites include areas both open and closed to shellfish harvest. These sentinel sites will be surveyed by using UAS (uncrewed aerial systems; drones), allowing for high-resolution repeated mapping, as well as traditional sampling for biological and water quality data. Sampling is planned to occur before and after the open harvest season, to allow the division to develop fishery independent indices and assess fishing impacts on the oyster resource.

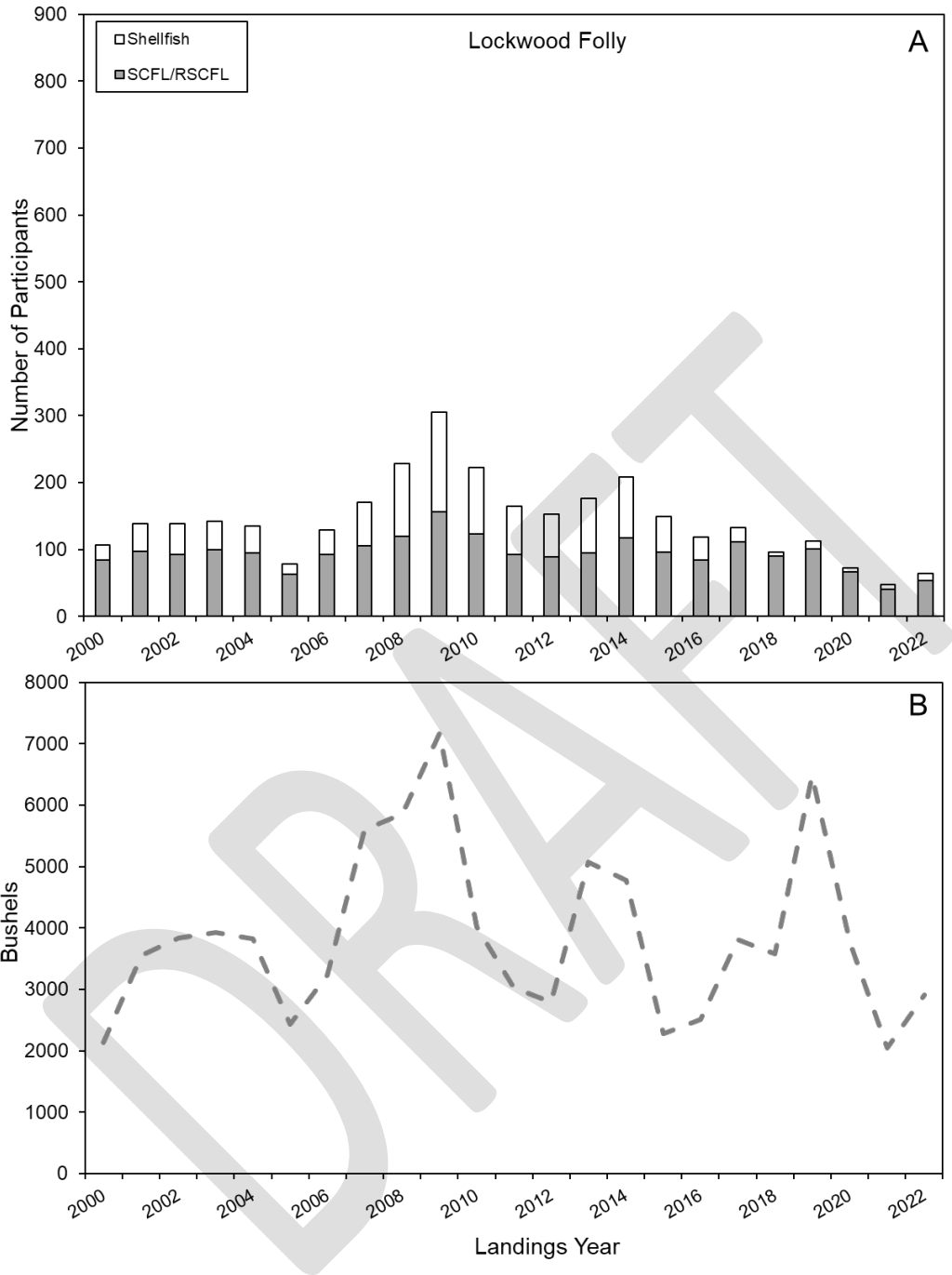


Figure 4. (A) Annual number of participants with oyster landings for Lockwood Folly River, the entire bar height shows total number of participants, with the proportion of participants with Shellfish Licenses shown as white, and the proportion with SCFL/RSCFL shown as grey. (B) Total commercial landings of oyster in bushels by year for the Lockwood Folly River.

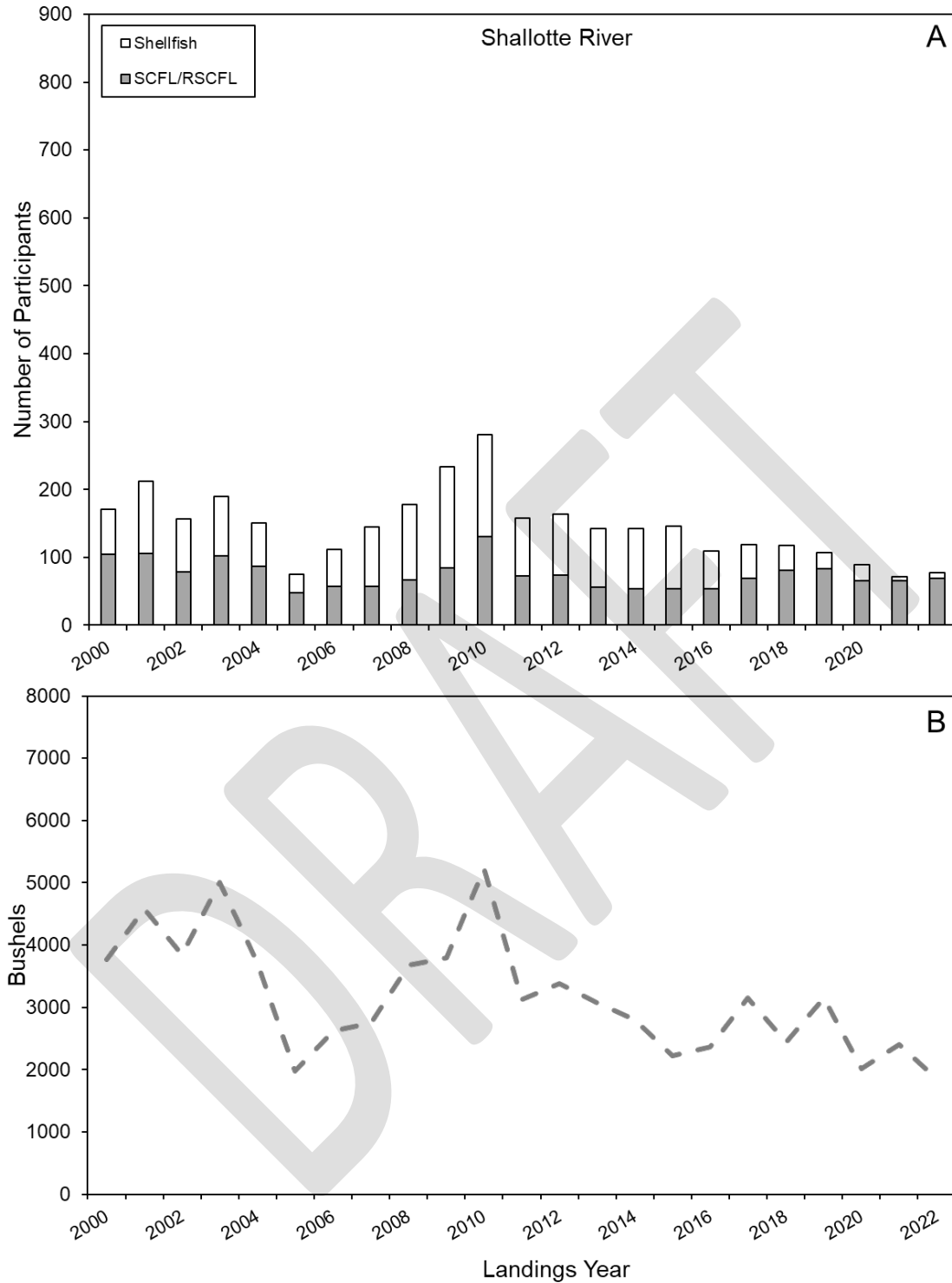


Figure 5. (A) Annual number of participants with oyster landings for Shallotte River, the entire bar height shows total number of participants, with the proportion of participants with Shellfish Licenses shown as white, and the proportion with SCFL/RSCFL shown as grey. (B) Total commercial landings of oyster in bushels by year for the Shallotte River.



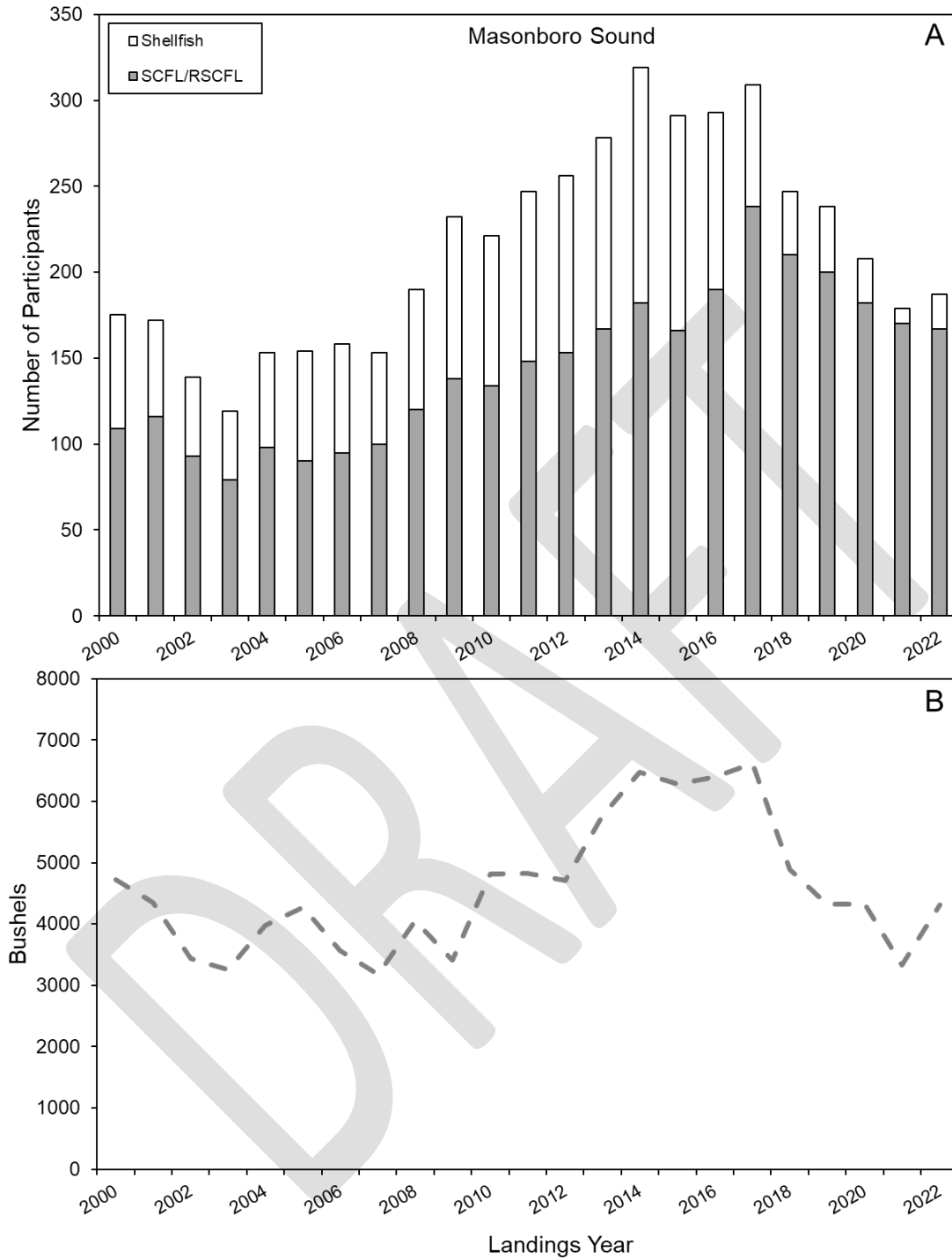


Figure 6. (A) Annual number of participants with oyster landings for Masonboro Sound, the entire bar height shows total number of participants, with the proportion of participants with Shellfish Licenses shown as white, and the proportion with SCFL/RSCFL shown as grey. (B) Total commercial landings of oyster in bushels by year for Masonboro Sound.

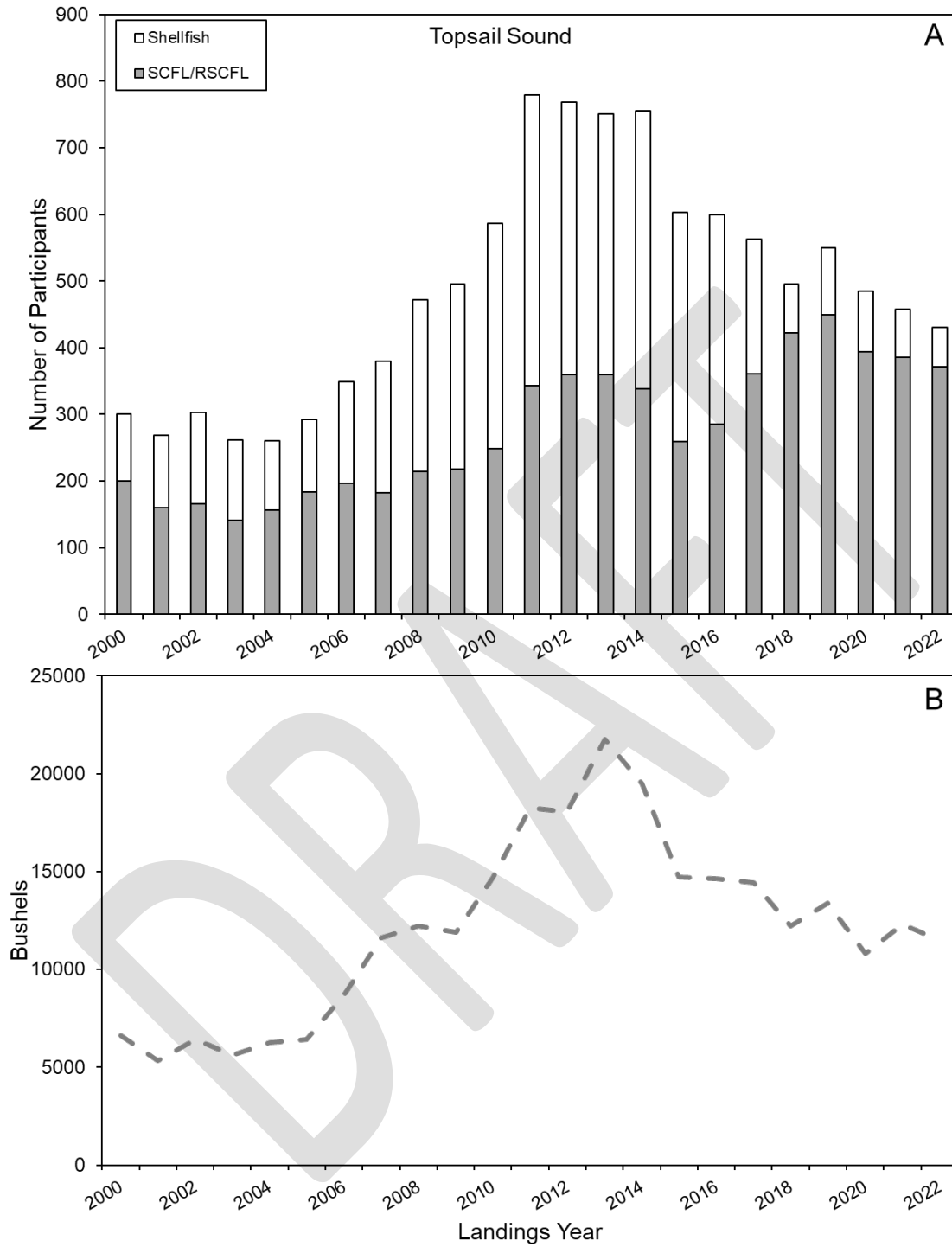


Figure 7. (A) Annual number of participants with oyster landings for Topsail Sound, the entire bar height shows total number of participants, with the proportion of participants with Shellfish Licenses shown as white, and the proportion with SCFL/RSCFL shown as grey. (B) Total commercial landings of oyster in bushels by year for Topsail Sound.

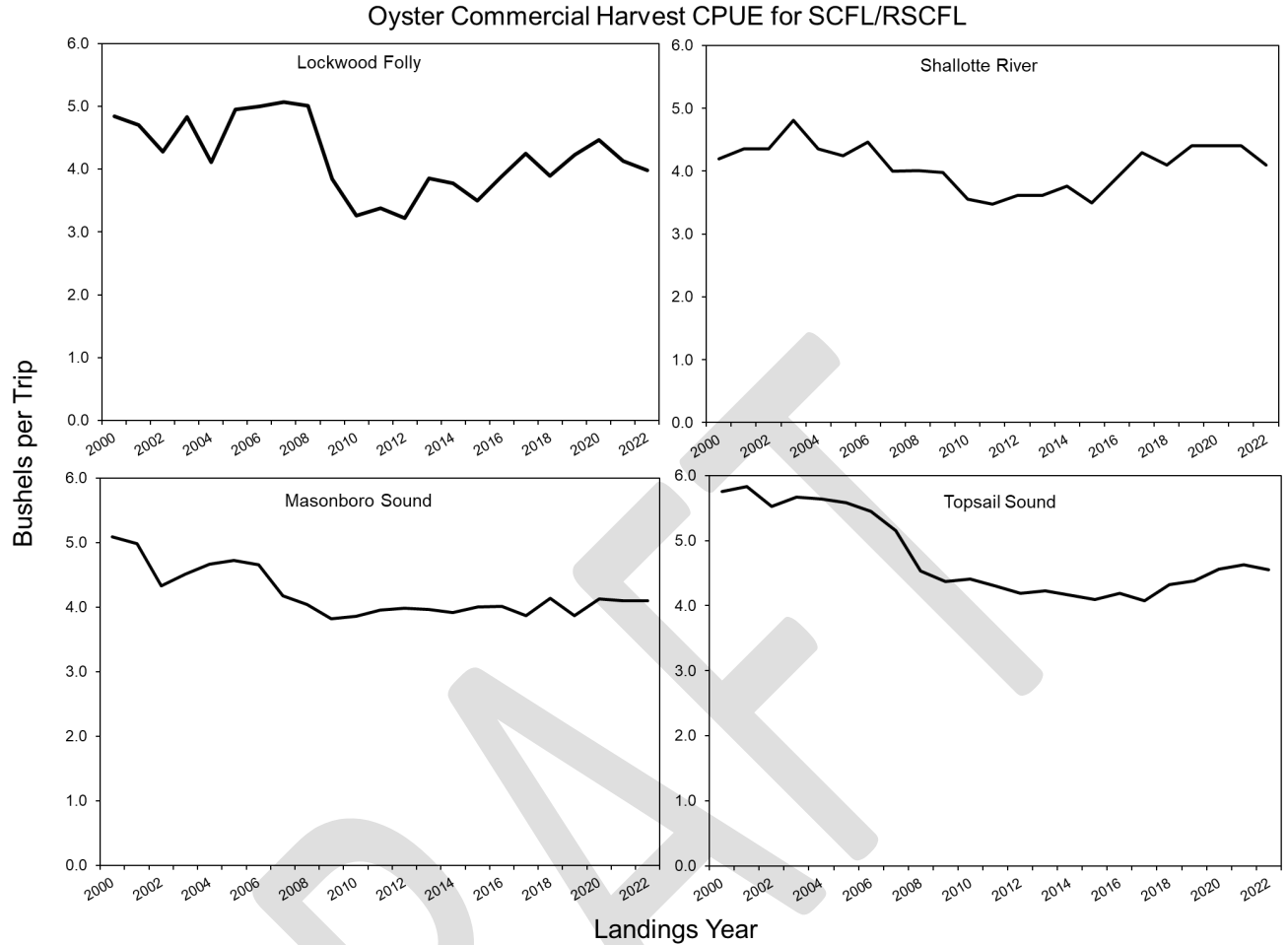


Figure 8. The catch per unit effort (CPUE) for oyster commercial harvest in Lockwood Folly River, Shallotte River, Masonboro Sound, and Topsail Sound from 2000 to 2022. The black line represents the average annual bushel amount landed per trip for SCFL/RSCFL holders, separated by waterbody into individual panels.

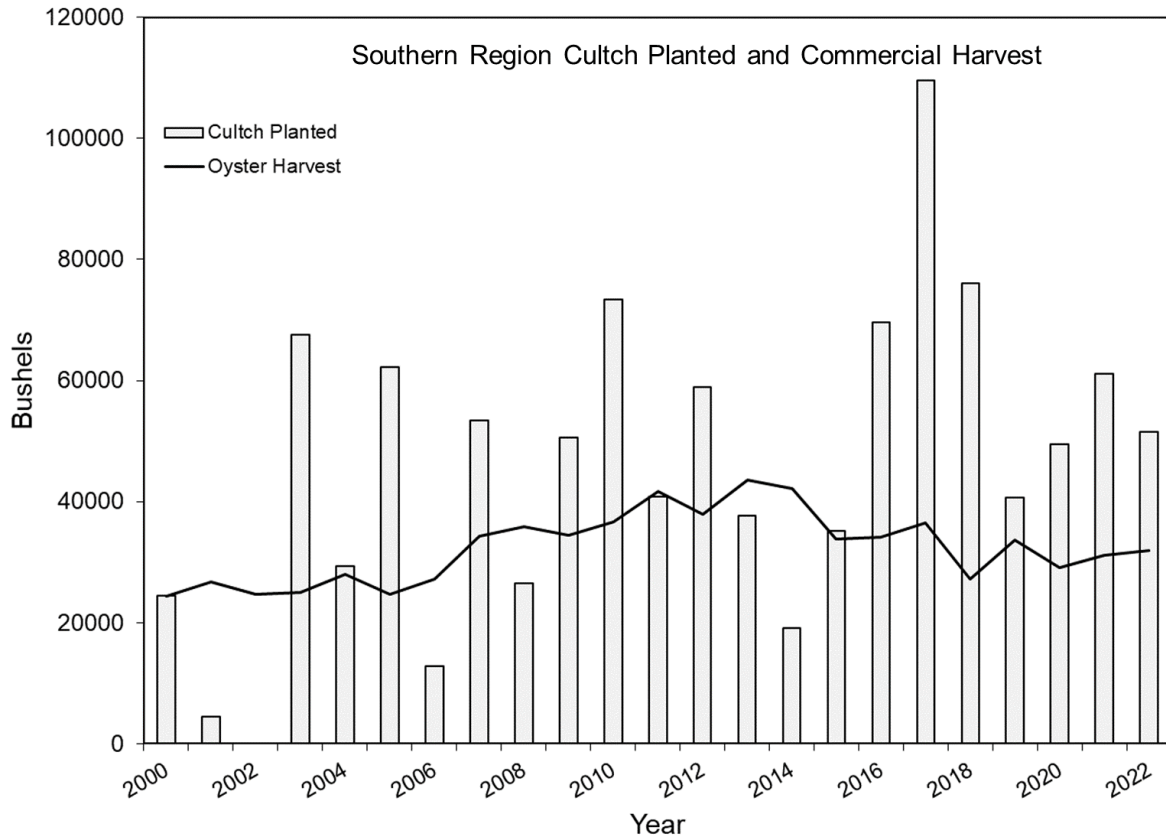


Figure 9. Annual amounts of cultch planted (shown as light grey bars) and amount of oyster commercially harvested (shown as black line) in bushels for the southern region (waterbodies south of Bogue Sound).

**AUTHORITY**

This section is the only section not formatted as Normal  
N.C. General Statute

113 134 Rules

113 182 Regulation of fishing and fisheries

113-201 Legislative findings and declaration of policy; authority of Marine Fisheries Commission.

113-221.1 Proclamations; emergency review

143B-289.52 Marine Fisheries Commission – powers and duties.

N.C. Rule

North Carolina Marine Fisheries Commission Rules (15A NCAC)

03K .0201 Open Season and Possession Limit

03K .0202 Size Limit and Culling Tolerance

## DISCUSSION

Landings in the intertidal hand harvest commercial oyster fishery, in the southern region of the state, tend to generally follow trends in effort/participation, with periods of higher participation resulting in greater landings. Without fishery independent indices of oyster abundance, it is currently unclear whether fluctuations in oyster abundance influence or are influenced by effort in the fishery. When looking at trends in CPUE, it becomes apparent that periods of greater effort/participation result in lower annual average bushels landed per trip (Figures 2 & 3). This may be interpreted as when the oyster resource can support the amount of harvest pressure exerted, fishers are easily able to land a full limit of oysters each trip. As the oyster resource becomes impacted by additional harvest pressure, it becomes harder for all fishers to land a full limit each trip, and the average number of bushels landed per trip decreases. Because exposed intertidal oysters are relatively easy to find and harvest, reefs in the southern region are at risk of suffering impacts due to harvest pressure. To prevent excessive damage to these reefs, a minimum size limit of 3 inches was established. This rule ensures that smaller mature oysters are left unharvested and can remain to act as breeding stock or sites for future oyster recruitment. As reefs become depleted of legal sized oysters during the harvest season and greater effort is required to find legal oysters, fishers generally move to more productive areas. As participation in the fishery increases, harvesters may have trouble finding areas with legal oysters and be willing to exert more effort to thoroughly harvest one reef, causing greater damage to the resource.

Considering the rising effort and declining CPUE observed in the southern region before the development of the Eastern Oyster FMP Amendment 4 in 2015, the Marine Fisheries Commission chose management strategies focused on curbing the increase in effort from Shellfish License holders. This sector of the oyster fishery is potentially open to all state residents and was experiencing rapid growth. In an attempt to limit landings and effort from the Shellfish License holders, in October of 2017 the bushel limit was reduced from five bushels per day to two only for those license holders. After this was implemented, the number of trips made by Shellfish License holders in the region quickly dropped, resulting in lower overall effort (Figure 2). Some Shellfish License holder participants did transition to SCFL, and this resulted in a slight increase in average trips and participants from 2018 onward with SCFL/RSCFL when compared to the years just prior to the limit reduction. In all four waterbodies examined, numbers of participants with Shellfish Licenses dropped notably after 2017 (Figures 4 – 7). This management approach appeared to have the desired effect on the region, decreasing overall commercial oyster effort (Figure 2). Additionally, the CPUE for the region increased in the years following 2017 (Figure 3). When CPUE is examined on a waterbody scale, Lockwood Folly and Shallotte Rivers show increasing trends, while CPUE in Masonboro and Topsail Sounds has remained relatively consistent (Figure 8), indicating that they may continue to experience elevated effort despite some reductions in participation.

In the southern region, 1.42 times more bushels of cultch material has been planted compared to bushels of oysters commercially harvested between 2000 and 2022. While

the cultch planting program in this region is not designed to function as direct replacement for oysters harvested in this region, the goal is to at least mitigate the amount of shell removed by commercial harvest and provide adequate substrate for oyster spat to settle on. On a regional scale, the cultch planting program has been able to keep up with or exceed the amount of shell removed from the system via harvest overall. However, due to logistic constraints the cultch material is not distributed across all waterbodies, creating localized cultch surpluses and deficits when compared to harvest amounts. Recent cultch planting locations in the southern region have been limited to areas near one of two current cultch stockpile locations, Mile Hammock Bay (Onslow County), or Morris Landing (Onslow County). With the deployment of the R/V Oyster Creek for the 2024 cultch planting season, cultch planting efforts in the southern region can be extended to sites in Pender, New Hanover, and Brunswick Counties. Cultch planting efforts statewide are reliant on continued funding.

With the implementation of the fishery independent sentinel site monitoring program for intertidal oysters in the southern region, NCDMF will be able to use trends in oyster abundance and changes in demographics to inform future management options. This program will need several years of data collection to be able to observe trends and create indices needed to take management actions. Management strategies informed by this new program can be developed in a future amendment of the Eastern Oyster FMP.

## REFERENCES