



NCDMF Completion Report for Incidental Take Permit 1398

Sea Turtle Bycatch Monitoring of the 2002 Fall Gillnet Fisheries in Southeastern Pamlico Sound, North Carolina

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BACKGROUND

In November 1999, the North Carolina sea turtle stranding network noted significant increases in strandings in the southeastern portion of Pamlico Sound. Aerial surveys of eastern Pamlico Sound along Ocracoke and Hatteras Islands conducted by National Marine Fisheries Service (NMFS) and NCDMF Marine Patrol identified three active fisheries; the shrimp trawl fishery, large mesh (\geq 5-inch stretched mesh) flounder gillnet fishery, and small mesh ($<$ 5-inch stretched mesh) spotted seatrout (*Cynoscion nebulosus*) gillnet fishery.

Subsequent at-sea monitoring aboard gillnet vessels conducted by NCDMF Fisheries Management staff revealed two sea turtle takes in the flounder fishery and no takes in the spotted seatrout fishery. Considering these data, NMFS issued an emergency rule closing southeastern Pamlico Sound to gillnets larger than 5-inch stretched mesh to protect endangered and threatened sea turtles (64 FR 70,196, December 16, 1999).

During 2000, NCDMF, consulted with NMFS and prepared an application for an Incidental Take Permit (ITP) under Section 10 of the Endangered Species Act (ESA) (65 FR 47,715, August 3, 2000). The ITP authorized the implementation of management measures to protect threatened and endangered sea turtles, while allowing gillnet fisheries to be prosecuted within designated areas of Pamlico Sound. The ITP contained a comprehensive conservation plan, which established the Pamlico Sound Gillnet Restricted Area (PSGNRA) and imposed strict gillnet fishery management measures (Figure 1). The primary goal of this plan was to reduce strandings along the outer banks by 50% relative to 1999.

On October 5, 2000, NMFS issued ITP #1259 to NCDMF (65 FR 65,840, November 2, 2000). Subsequently, observed levels of gillnet/sea turtle interactions and strandings reached thresholds specified in the ITP for closure of the large mesh gillnet fishery on October 25, 2000. The NCDMF closed the PSGNRA to the use of large mesh gillnets effective October 27, 2000. Results of monitoring conducted aboard commercial vessels during the 2000 fishing season indicated that there were a greater number of interactions occurring in the deep water flounder gillnet fishery (n=14) than in the shallow water fishery (n=4, Gearhart 2001).

Considering the 2000 monitoring data, NMFS closed all potential fishing grounds utilized by the deep water flounder gillnet fishery for the 2001 fishing season (Figure 2, 66 FR 50,350, October 3, 2001). In 2001, NCDMF again consulted with NMFS and prepared an application for an ITP under Section 10 of the ESA (66 FR 42,845, August 15, 2001). The NMFS issued ITP #1348 to NCDMF on October 5, 2001 (66 FR 51,023, October 5, 2001) The ITP authorized management measures during the fall of 2001 to protect sea turtles while allowing gillnet fisheries to be prosecuted within Pamlico Sound (Figure 2). Observed levels of gillnet/sea turtle interactions during the 2001 season remained below thresholds specified in the ITP. Five sea turtle takes were observed and all were taken in the large mesh fishery with four of the turtles released alive (Gearhart 2002).

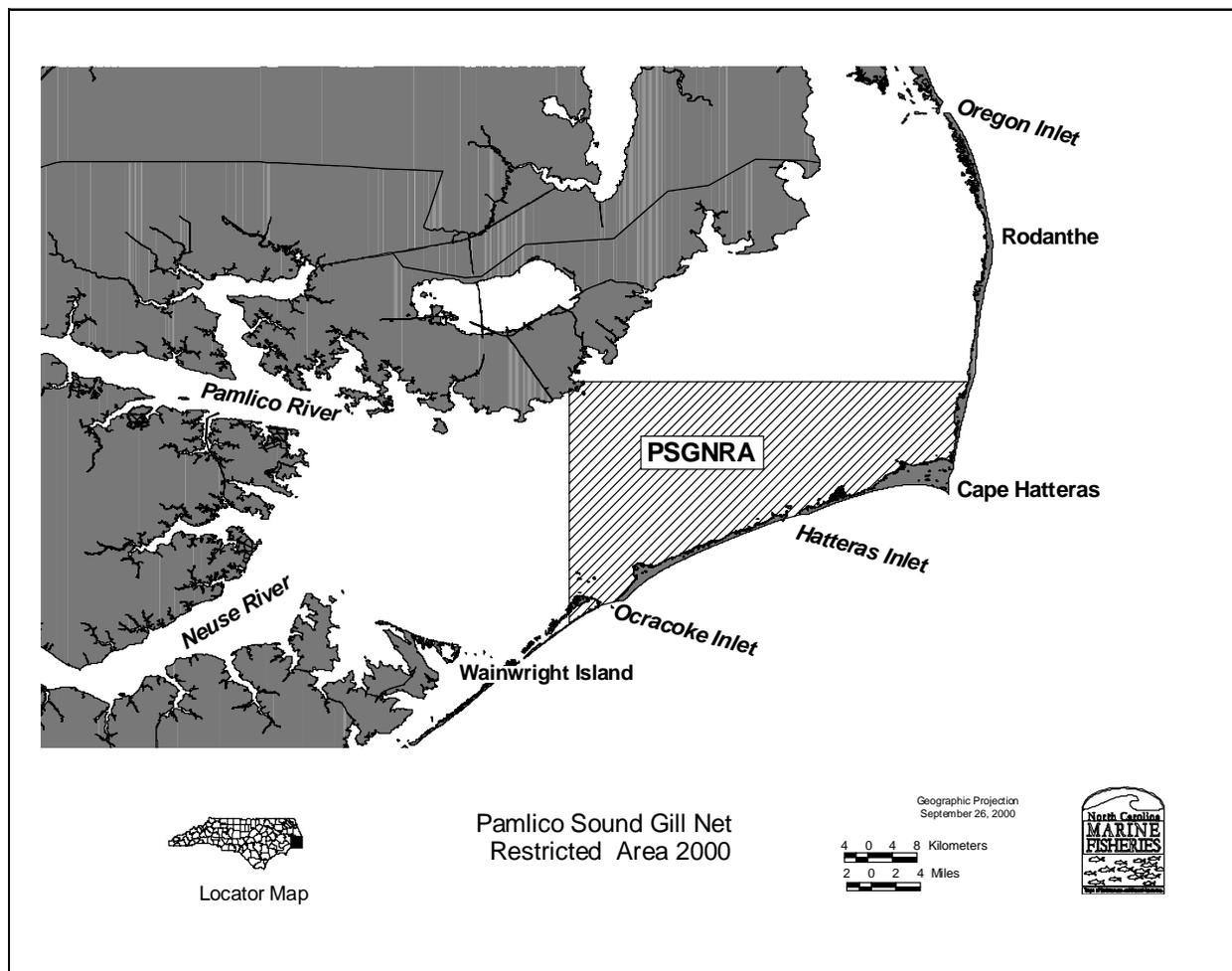


Figure 1. Map of southeastern Pamlico Sound and the 2000 Pamlico Sound Gillnet Restricted Area (PSGNRA).

Fisheries Description

Monitoring conducted by NCDMF during the 2000 fishing season indicated that the Pamlico Sound large mesh gillnet fishery consisted of two major components. First, a shallow water fishery, which occurred along the Outer Banks and a deep water fishery, which operated farther from shore along a slope adjoining the main basin of Pamlico Sound (Figure 3). Both of these fisheries target southern flounder (*Paralichthys lethostigma*). The deep water fishery developed approximately 10 years ago and had steadily expanded since its inception. Historically, pound nets have landed the majority of North Carolina's southern flounder. However, the development and expansion of the deep water large mesh gillnet fishery in Pamlico Sound during the early 90's caused gillnets to surpass pound nets as the dominant southern flounder fishing gear. Monitoring during the 2000 fishing season also identified two small mesh gillnet fisheries, which operated along the Outer Banks in the same areas that the shallow water large mesh fishery operated.

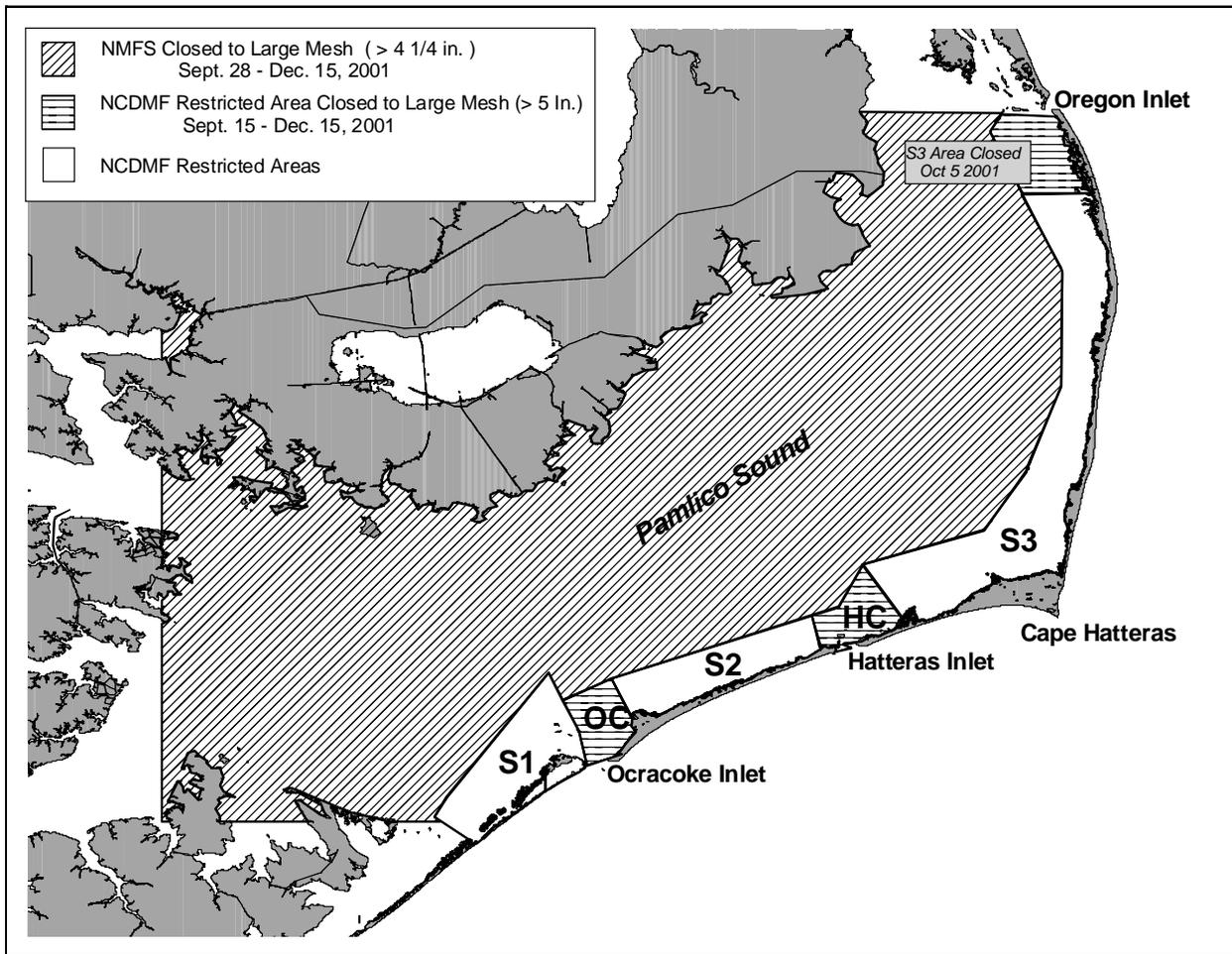


Figure 5. NCDMF 2001 Pamlico Sound Gillnet Restricted Area (PSGNRA) and NMFS closed area. S1=Shallow Water Gillnet Restricted Area 1; S2=Shallow Water Gillnet Restricted Area 2; S3=Shallow Water Gillnet Restricted Area 3; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor.

Deep Water Large Mesh Gillnet Fishery

The deep water fishery operated from September through December with fishermen setting nets along a slope adjacent to the main basin of Pamlico Sound (Figure 3). Fishing depths in this area range from 10 to 20 feet. Vessels were typically ocean sink gillnet boats ranging from 25 to 45 feet in length, each with two-man crews. Each fishing operation set between 2,000 and 3,000 yards of large mesh (5.5 to 6.5 inch) gillnet, which were soaked for up to three days and retrieved with the aid of net reels. Sets were composed of 200 to 600 yard lengths of gillnet with most constructed of 0.5 mm twine. Net depths ranged from 8 to 12 feet with 2 to 4 feet tie-downs attached to the float and lead lines at 50 feet intervals along the net. Tie-downs were used in this fishery to produce a bag or pocket of webbing, which increased catch efficiency of bottom dwelling flounder (Figure 4). There were 25 active participants in this fishery during the 2000 fishing season with most trips originating from Engelhard or Swan Quarter and a small portion leaving from Hatteras.

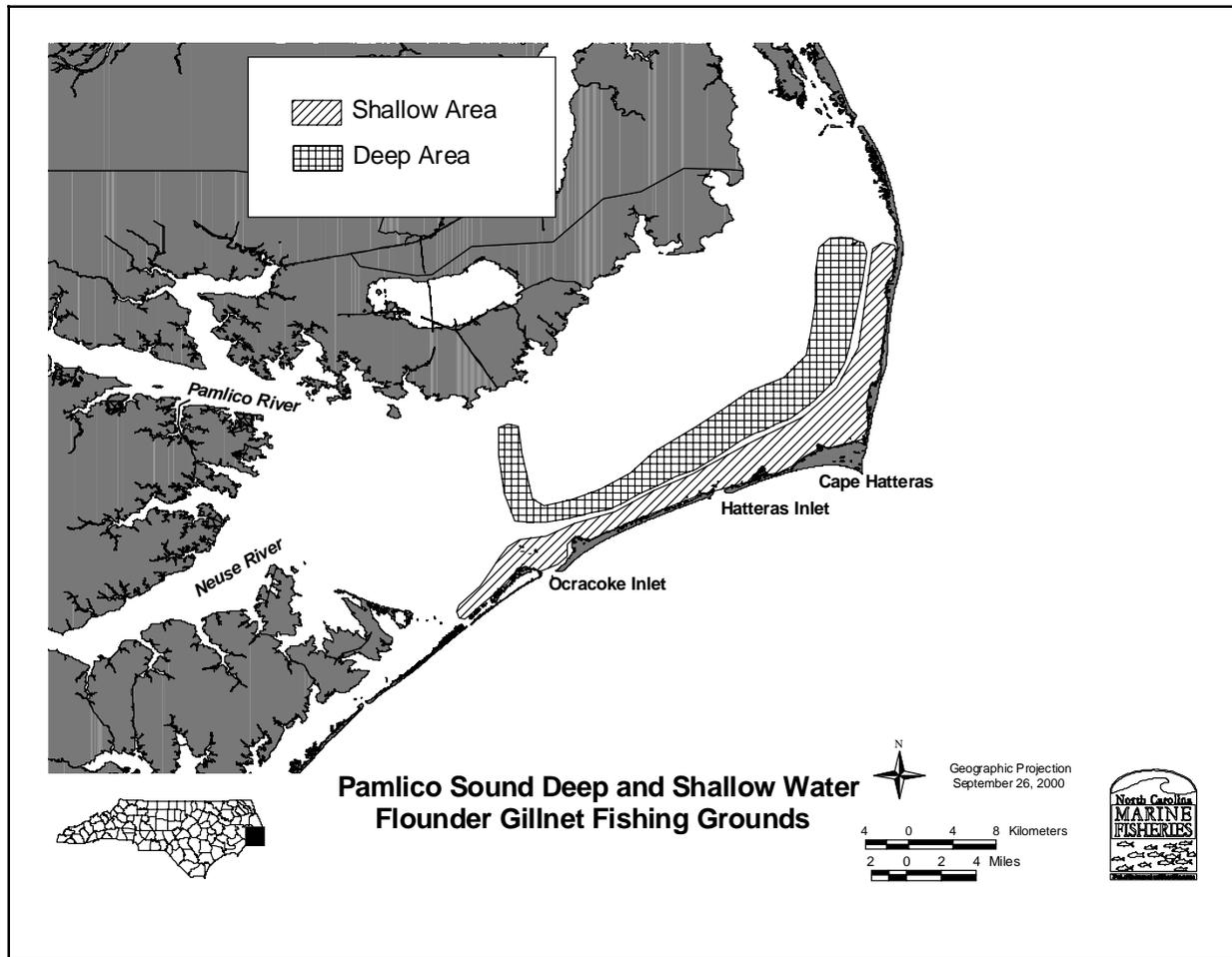


Figure 6. North Carolina estuarine flounder gillnet fishing grounds in southeastern Pamlico Sound.

Shallow Water Large Mesh Gillnet Fishery

The shallow water fishery operates from April through December in areas next to the barrier islands in Pamlico Sound (Figure 3). Fishing depths in these areas are typically less than three feet. Vessels are usually open skiffs ranging from 15 to 25 feet in length with one or two man crews. Each fisherman sets 500 to 2000 yards of large mesh (5.5 to 7.0 inch) gillnet, which are soaked overnight and retrieved by hand. Sets are composed of many short lengths of gillnet with most constructed of 0.5 mm twine. Tie-downs are not used in this fishery, but net depths range from 6 to 11 feet with sets occurring in depths less than 3 feet. This combination of water depth and net depth provides the same bag effect as the tie-down in the deep water fishery. Ninety-five active participants fished within the PSGNRA during the 2001 fishing season (Gearhart 2002). This is the traditional flounder fishery, which extends both north and southwest of the PSGNRA along the Outer Banks.

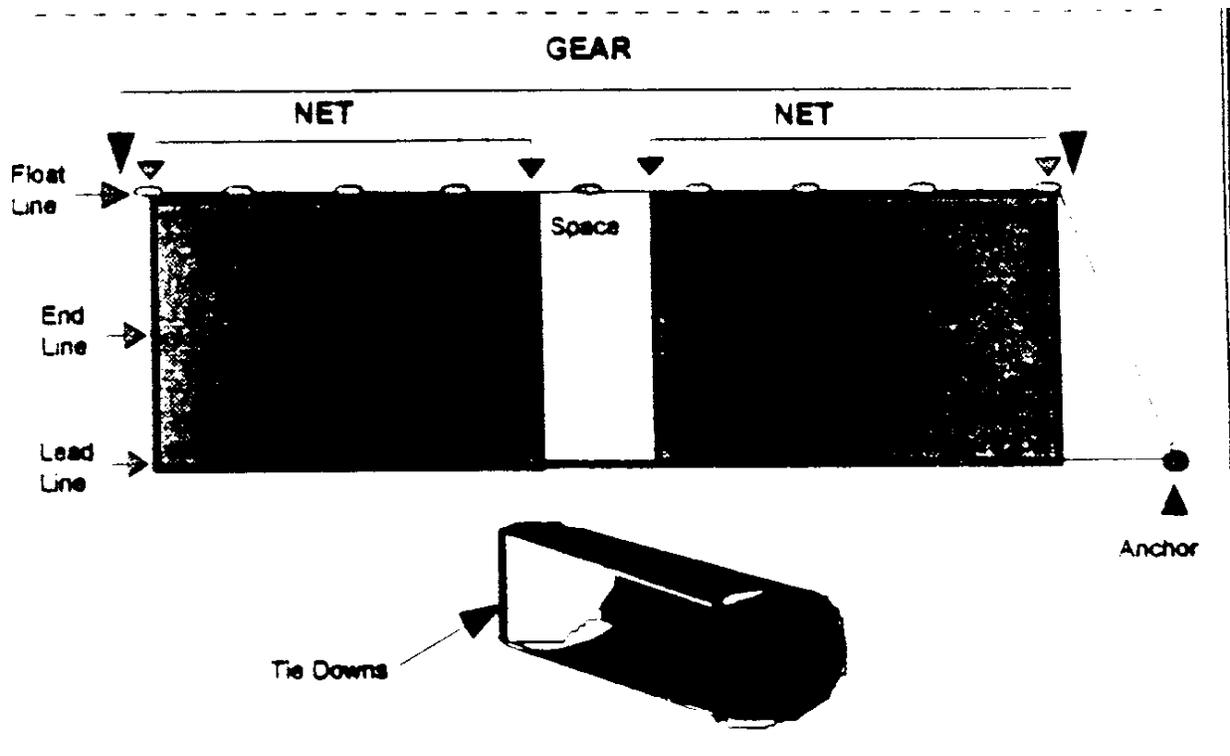


Illustration taken from Fisheries Sampling Branch Observer Manual, NMFS (1996)

Figure 7. Diagram of a sink gillnet. The sink gillnet is submerged below the water line and consists of several net panels attached together as a string. This gear can be modified with tie-downs to target bottom-dwelling fish.

Shallow Water Small Mesh Gillnet Fisheries

The shallow water small mesh fishery is composed of two separate fisheries each with different modes of operation; the “runaround” and “set” gillnet fisheries. The runaround gillnet fishery targets striped mullet (*Mugil cephalus*) and operates year round with most of the effort occurring during the fall from September through November when prices are high due to increased roe content of spawning females. The Pamlico Sound fishery operates in the shallow water areas next to the barrier islands (Figure 3). Vessels are usually open skiffs ranging from 15 to 25 feet in length with one or two-man crews. Fishermen set out in search of schools of striped mullet. Once a school is sighted, one end of the runaround gillnet is deployed with a buoy and a small weight (< 3 lb.). The weight creates drag, which enables the rest of the net to be fed out as the fisherman encircles the school of fish. The net is set in a closed circle and fishes the entire water column. Nets are typically 100 - 1000 yd. in length with a stretched mesh of 3.5 to 4.5 inches. The primary retrieval technique is the open retrieve method where the net is immediately hauled back into the boat starting with the terminal end. A second retrieval technique involves setting only part of the net in a circle and then ‘corkscrewing’ the remainder of the net around inside the circle. This method compresses the fish into smaller areas that forces them to hit the net where they are gilled. Soak times for this fishery are typically less than four hours and nets are attended during the entire operation.

The shallow water small mesh set gillnet fishery operates along the Outer Banks with most of the effort occurring from October through early December. Nets are anchored overnight similar to the large mesh fishery for flounder that occurs in the same area. Vessels are usually open skiffs ranging from 15 to 25 feet in length with one or two-man crews. Each fishing operation sets 500 to 2000 yards of small mesh (3 to 4.5 inch) gillnet, which are retrieved by hand. Sets are composed of many short lengths of gillnet with most constructed of 0.5 mm twine or smaller. Tie-downs are not used in this fishery, but net depths range from 6 to 11 feet with sets occurring in depths less than 3 feet. This combination of water depth and net depth provides the same bag effect as the tie-down in the deep water large mesh fishery. Target species include striped mullet, spotted seatrout, weakfish (*Cynoscion regalis*), and bluefish (*Pomatomus saltatrix*). Sets are made along the sandbar or “reef” the separates the shallow and deep water areas along the barrier islands. In recent years, NCDMF has enacted rules designating small mesh (< 5 inch stretched) attendance areas along the Outer Banks from March 1 through October 31 to minimize red drum bycatch and subsequent discard mortality (Rule 15A NCAC 3J .0103 (h) in NCMFC 2002). This rule requires small mesh gillnet fishermen to remain within 100 yards of their net at all times. Because of this requirement many fishermen set outside of the attendance area just beyond the reef or wait until November 1 to employ this method of fishing when they are no longer required to attend their nets.

METHODS

During 2002, NMFS reviewed NCDMF monitoring data and chose to issue a final rule that would implement the Pamlico Sound large mesh (> 4 ¼ inch) gillnet closure each year from September 1 through December 15 (Figure 5, 67 FR 56,931, September 6, 2002). Corresponding, to the development of the NMFS final rule, NCDMF again prepared an application for an ITP under Section 10 of the ESA (67 FR 49,009, July 29, 2002). After reviewing the 2000 and 2001 monitoring data, several changes were made to the 2002 application.

First, the application was for three years, while previous permits had only covered one fishing season. Sea turtle interactions during the 2001 fishing season remained below authorized takes levels specified in the ITP indicating that the management measures imposed were sufficient to reduce takes below acceptable levels. Based on this information, the permit was expanded to cover the 2002-2004 fishing seasons, which would allow NCDMF to establish a comprehensive conservation plan and establish a long term monitoring program.

The second change was the designation of the PSGNRA from September 1 through December 15, 2002 (Figure 5). The initial restriction date was moved ahead two weeks from September 15 to capture fishing effort and possible interactions that might occur during the first two weeks of September. Many of the 2000 and 2001 shallow water gillnet interactions occurred early in the season (Gearhart 2001, 2002). In addition, shallow water gillnet effort peaked during the first week (Sep. 15-22) of the 2001 fishing season, indicating that a substantial amount of effort occurs prior to September 15 (Gearhart 2002).

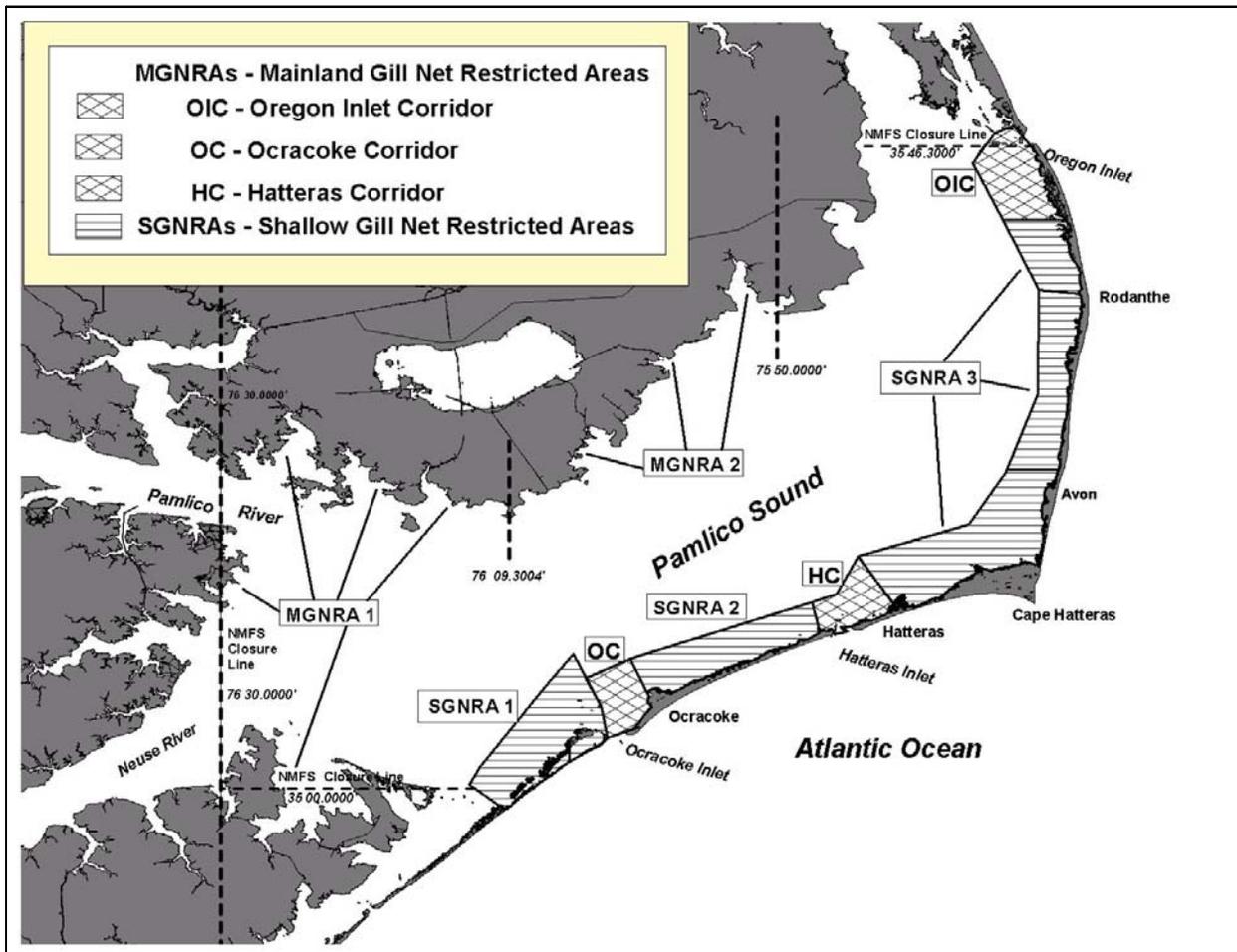


Figure 8. NCDMF 2002 Pamlico Sound Gillnet Restricted Area (PSGNRA) and NMFS closed area. SGNRA1=Shallow Water Gillnet Restricted Area 1; SGNRA2=Shallow Water Gillnet Restricted Area 2; SGNRA3=Shallow Water Gillnet Restricted Area 3; MGNRA1=Mainland Gillnet Restricted Area 1; MGNRA2=Mainland Gillnet Restricted Area 2; OIC=Oregon Inlet Corridor; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor.

The third change to the 2002 application was the addition of Mainland Gillnet Restricted Areas (MGNRAs) to the PSGNRA (Figure 5). During the 2001 fishing season, many nearshore flounder gillnet fishermen from mainland areas of Pamlico Sound complained about the complete closure of their fishing grounds. An informal investigation of the fishery concluded that it was similar to the Outer Banks fishery with nearly all of the fishing effort occurring in nearshore, shallow water areas. Considering this information, two adjacent MGNRAs were established along the western shore of Pamlico Sound, from the shoreline out to 200 yards, west of the 75° 50' longitude line (Figure 5).

The fourth management change was the creation of the Oregon Inlet Corridor (OIC, Figure 5). The area just south of Oregon Inlet was closed during the 2001 season, due to a number of sea turtle interactions that occurred in close proximity to the inlet (Gearhart 2002).

For the 2002 season, this area was expanded to encompass the entire inlet and large mesh gillnets were prohibited in this area for the entire season.

The final change to 2002-2004 ITP application was the removal of small mesh gillnets from the PSGNRA permitting requirements. This gear was dropped for two reasons. First, the addition of the MGNRAs would result in a substantial increase in the number of permits and subsequent logbook reports required to monitor fishermen in the new areas. Secondly, the lack of observed interactions in the small mesh fishery during the 2000 and 2001 fishing seasons indicate that takes are nonexistent in this gear and more effort should be placed on providing better coverage of the large mesh fisheries, which have historically had more interactions.

On November 4, 2002, NMFS issued ITP #1398 to NCDMF (67 FR 67,150, November 4, 2002). A key component of the permit was a comprehensive conservation plan. The primary goal of this plan was to reduce sea turtle takes in Pamlico Sound from September 1 through December 15 for the 2002-2004 fishing seasons.

ITP Conservation Plan

In August 2002, NCDMF issued proclamation M-10-2002, which established the PSGNRA including three inlet corridors. The Oregon Inlet (OIC), Ocracoke Inlet (OC) and Hatteras Inlet Corridors (HC) were established and large mesh gillnets were prohibited in these zones for the entire fishing season (Figure 5). The proclamation also set a 2,000 yard limit for all gillnet fishing operations and required attendance of small mesh gillnets until November 1. Sea turtle interaction reporting was required and all fishermen utilizing large mesh (≥ 5 -inch mesh) gillnets were required to obtain a permit from NCDMF. Provisions of the permit established mandatory logbooks, weekly reports, and observer coverage.

Logbook Reporting

Permitted fishermen were required to provide weekly reports to NCDMF. The following information was provided by each fishermen for each large mesh gillnet fishing trip conducted within the PSGNRA between September 1 and December 15, 2002.

- Port of landing
- Restricted area fished
- Flounder landings (lbs)
- Yards of gillnet fished
- Soak time in days
- Number of sea turtles caught
- Condition of sea turtles caught

Reports were submitted to NCDMF by 6:00 p.m. on Sunday during each week of the fishing season. Failure to comply with these reporting requirements or providing false information resulted in permit suspension. In addition, fishermen were required to report all sea turtle interactions to NCDMF within 24 hours. Penalties for non-reporting were:

- First offense non-reporting 10 day suspension
- Second offense non-reporting 30 day suspension
- Third offense non-reporting 6 month revocation

Penalties for late reporting were:

- First offense late reporting Courtesy call
- Second offense late reporting 10 day suspension
- Third offense late reporting 30 day suspension
- Fourth offense late reporting 6 month revocation

Sea Sampling

The PSGNRA permit established mandatory observer coverage for the large mesh gillnet fishery. Permit holders were required to allow NCDMF fishery observers aboard their vessels to monitor catches. Failure to comply with this permit provision resulted in permit suspension. A list of permit holders was utilized to randomly assign observers to vessels by area (Outer Banks or Mainland) and port. Outer Banks ports included Rodanthe, Avon, Buxton, Hatteras, Ocracoke, and Cedar Island. Mainland ports included Stumpy Point, Engelhard, Gull Rock, Swan Quarter, Rose Bay, Germantown, and Hobuken. Outer Banks observer coverage was proportionally allocated based on the 2001 PSGNRA trip distribution among ports. Mainland observer coverage was proportionally allocated based on the 2000 trip distribution of flounder gillnet trips among ports derived from trip tickets.

The goal of the observer program was to provide 10% coverage of both the large and small mesh gillnet fisheries from September 1 through December 15, 2002. Funding for the program was provided by NMFS. Each observer was trained to identify, measure, resuscitate, and tag sea turtles. Date, time, tag numbers, location (latitude and longitude, when possible), condition (e.g., no apparent harm, injury including a description of the nature of the injury, or mortality), species, sex (if determinable), and curved carapace length were recorded for each turtle observed. Dead sea turtles were brought to shore when feasible. All live, debilitated sea turtles were brought to shore for examination and treatment. Carcasses not brought in for post-mortem examinations were marked with external flipper tags or spray-painted before disposal overboard. Observers collected data on location, gear parameters, catch, and bycatch for each haul. The landed catch was sampled throughout each trip and total flounder weights were obtained. Data were coded on NCDMF data sheets, double keyed, visually proofed, and uploaded to NCDMF Biological Database for analysis. All observers were debriefed within 24 hours of each trip to obtain data on flounder catch, set locations, gear parameters, and sea turtle interactions to provide estimates of sea turtle bycatch.

The total bycatch of sea turtles in the PSGNRA was estimated using the stratified ratio method. The bycatch rate (sea turtles caught per unit of fishing effort), estimated from observer data, was multiplied by the total fishing effort reported by the fishermen for each fishery. Strata consisted of the restricted areas MGNRA1, MGNRA2, SGNRA1, SGNRA2, SGNRA3, OIC, OC, and HC. Fishing effort was the product of yards and soak time (days). Total bycatch estimates were calculated weekly by adding estimates for each fishery within each restricted area.

Authorized Incidental Take Levels

During the 2000 fishing season, a multilevel management approach was devised to achieve the goal of 50% reduction of sea turtle strandings relative to the 1999 season. Maximum stranding levels were set by species and reflected 50% reductions for each, while maximum lethal take levels were calculated based on the assumption that one in four turtles captured at sea would strand. Maximum live takes were established assuming 50% discard mortality (Table 1).

Table 1. Sea turtle strandings by species from Sep. 15 to Dec. 15, 1999 in southeastern Pamlico Sound. Maximum authorized strandings, estimated lethal takes, and live takes for the same period and area during the 2000 fishing season.

Species	1999 Strandings	2000 Max. Authorized Strandings	2000 Max. Authorized Lethal Takes	2000 Max. Authorized Live Takes
Kemp's Ridley (<i>Lepidochelys kempii</i>)	46	24	96	192
Green (<i>Chelonia mydas</i>)	20	9	36	72
Loggerhead (<i>Caretta caretta</i>)	31	14	56	112
Species Aggregate	97	45	175	350

During the 2000 fishing season, the estimated lethal take level for green turtles was reached six weeks into the fishing season requiring NCDMF to close the PSGNRA to large mesh gillnets (Gearhart 2001). Strandings during this period were variable with many suspected cold stun mortalities occurring. For this reason, strandings were not used as a measure of management success during the 2001 fishing season. Instead, a more conservative single level management approach was chosen, which utilized observer data and logbooks to estimate live and lethal takes in the PSGNRA. The 2001 allowable take levels were based on 2000 levels, but required many assumptions.

For 2001, new management measures had to be considered, which included: the elimination of the deep water flounder gillnet fishery; expansion of the shallow water area covered by the ITP; and addition of the small mesh gillnet fishery. It was assumed that these modifications would not change to the amount of gear covered by the ITP, but the removal of the deep water fishery was expected to significantly reduce mortality. New take levels were set for the 2001 season based on these management changes and assumptions (Table 2). Maximum allowable take levels remained nearly constant, while allowable lethal takes were reduced significantly.

Table 2. Maximum authorized lethal and live takes by species from September 15 through December 15 for the PSGNRA during the 2001 fishing season.

Species	2001 Max. Authorized Lethal Takes	2001 Max. Authorized Live Takes
Kemp's Ridley	24	164
Green	24	164
Loggerhead	24	164
Species Aggregate	72	492

Live and lethal takes for all species remained below allowable levels during the 2001 fishing season (Gearhart 2002). Indicating that the management measures imposed were successful in reducing sea turtle takes, while allowing gillnet fisheries to operate. Management

changes to the 2002 ITP included removal of the small mesh gillnet fishery from permitting requirements and the addition of two new mainland restricted areas. It was assumed that these modifications would not change the amount of gear covered by the ITP. Subsequently, takes and mortalities were also assumed to remain relatively constant when compared to 2001. Considering this information, the authorized live and lethal take levels were established for each species based on 2001 observations (Table 3). If any of these take levels were reached during the season, the incidental take authorization would end and require NCDMF to close the PSGNRA to all gillnets for the remainder of the season. In addition to the take levels established for the three most common species encountered, two observed takes of both leatherback (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) were also allowed under the 2002 ITP.

Table 3. Maximum authorized lethal takes and live takes by species from September 1 through December 15 for the PSGNRA during the 2002 fishing season.

Species	2002 Max. Authorized Lethal Takes	2002 Max. Authorized Live Takes
Kemp's Ridley	25	80
Green	50	160
Loggerhead	25	80
Species Aggregate	100	320

RESULTS

Gillnet fishery monitoring began September 1, 2002 and ended December 15, 2002. Monitoring consisted of assigning permits, collecting logbook reports, and deploying observers in the large and small mesh gillnet fisheries. All reporting and observer deployment and debriefing were done weekly to provide timely estimates of sea turtle bycatch.

Permit Reporting

There were 161 PSGNRA permits issued during the 15 week season with 112 participants reporting fishing activity. Compliance with reporting requirements was satisfactory with only 9.2% reporting late and 2.5% failing to report with 13 reports still outstanding (Figure 6). Over the entire season, 100 courtesy calls were made for first offense late reporting and 27 permit suspensions were issued for both multiple offense late and non-reporting.

Fishing Activity

Inactive permits outnumbered active permits throughout the season (Figure 7). Many fishermen feared a limited entry management approach and obtained a permit but never fished within the PSGNRA. This large number of inactive participants inflated the number of noncompliant permit reporters with greater than 95% of the late and failed reports represented by inactive permits.

Flounder fishing effort peaked during the middle of September with over 60 permitted fishermen conducting nearly 250 trips in the PSGNRA (Figures 7 and 8). Conversely, landings peaked during the middle of October with over 25,000 pounds of flounder landed each week (Figure 8).

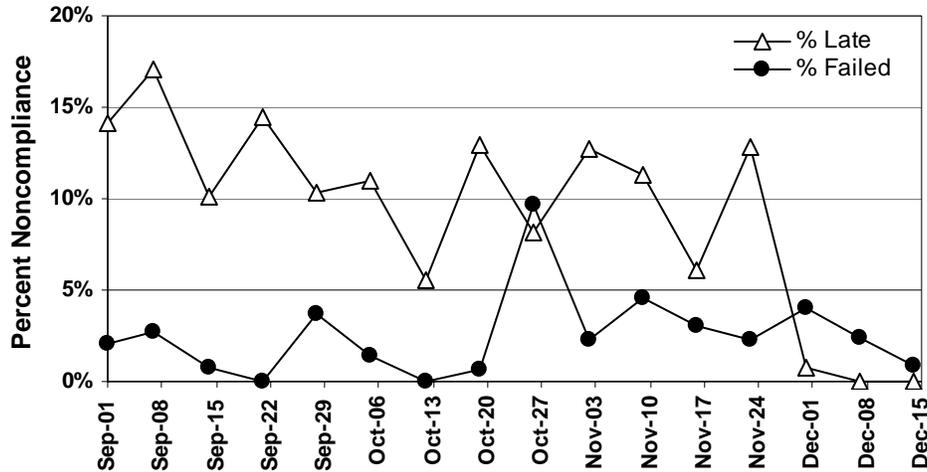


Figure 9. Percent late and failed PSGNRA permit reporting by week for the 2002 fishing season.

The majority of PSGNRA large mesh fishing effort and landings occurred in SGNRA3 with 59% of all permitted fishermen conducting 65% of all trips in that area, which produced 69% of all PSGNRA flounder landings. The influence of SGNRA3 on PSGNRA effort and landings is indicated through the similarities in trends. Peaks in SGNRA3 fishing effort occurred during the fourth week of the season, while landings exhibited a small initial spike during September and a larger peak during October (Figure 9). Both flounder landings and effort dropped sharply in SGNRA3 during the last week of October in response to the closure of the southern portion of that area to large mesh gillnets. Proclamation M-12-2002 was issued on October 20, 2002 as a consequence of numerous sea turtle interactions observed near Hatteras Inlet. Large mesh gillnets were prohibited in the southern portion of SGNRA from October 20 through December 15, 2002.

Effort and landings in SGNRA1 and SGNRA2 exhibited trends similar to SGNRA3 with a small peak occurring in September and a larger spike visible during October (Figure 9). Unlike SGNRA3, peaks in fishing effort in SGNRA1 and SGNRA2 coincided with peaks in flounder landings, which occurred during October (Figure 9). Late season effort and landings were similar among all areas with steady declines taking place in November and very little activity occurring in December (Figure 9).

Mainland catch and effort were substantially lower than the outer banks areas. The majority of the effort and landings in the mainland areas occurred in MGNRA1 with peaks in effort and landings taking place in September (Figure 10). Fishing effort gradually declined but continued through November and December despite the relatively low catch rates reported during this period (Figure 10).

Sea Sampling

Observer trips in the PSGNRA totaled 174 during the 2002 fishing season, including 145 large mesh trips. Fishermen reported 1,860 large mesh gillnet trips in the PSGNRA applying 2,205,420 yards/soak day of fishing effort resulting in 175,840 pounds of flounder landed.

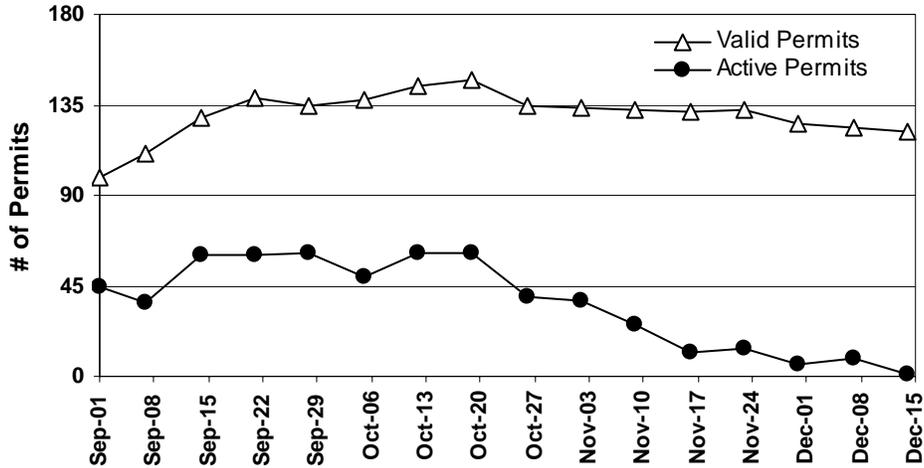


Figure 10. Number of valid and active PSGNRA permits by week for the 2002 season.

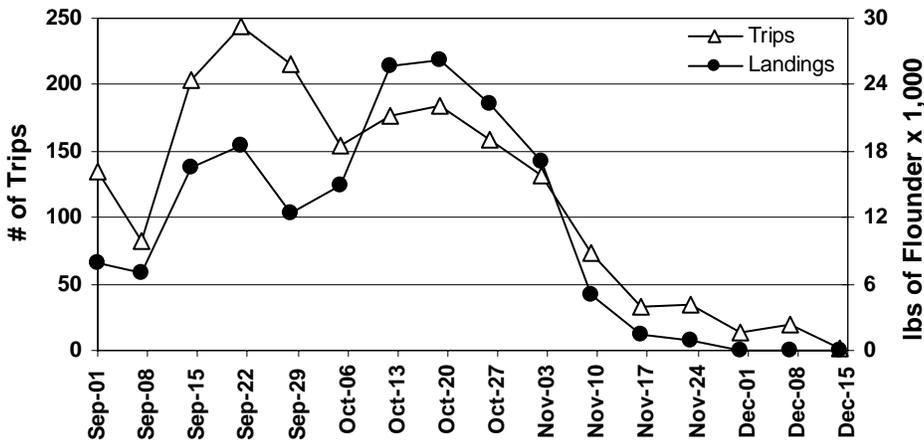


Figure 11. Number of PSGNRA large mesh gillnet trips and flounder landings by week for the 2002 season.

Observers were present on 145 large mesh fishing trips achieving 7.8% coverage (Figure 11). Coverage of fishing effort was similar with observers sampling over 197,000 yards/soak day resulting in 7.5% coverage (Figure 11). Landings coverage was nearly identical to fishing effort coverage with observers sampling 13,389 pounds of flounder representing 7.6% coverage (Figure 11). Coverage of the fishery appeared to be adequate with observed effort and CPUEs tracking closely with those reported by fishermen (Figure 12). These results also indicate that fishermen logbook reports were reliable with observed effort and CPUEs verifying the reports.

Yards of gillnet fished was a less variable measure of fishing effort when compared to total flounder landings (Figure 13). Weekly coefficients of variation (CVs) for yards of gillnet fished remained below 50% for most weeks and averaged 42% while landings CVs exceeded 50% for all weeks and averaged 77% (Figure 13).

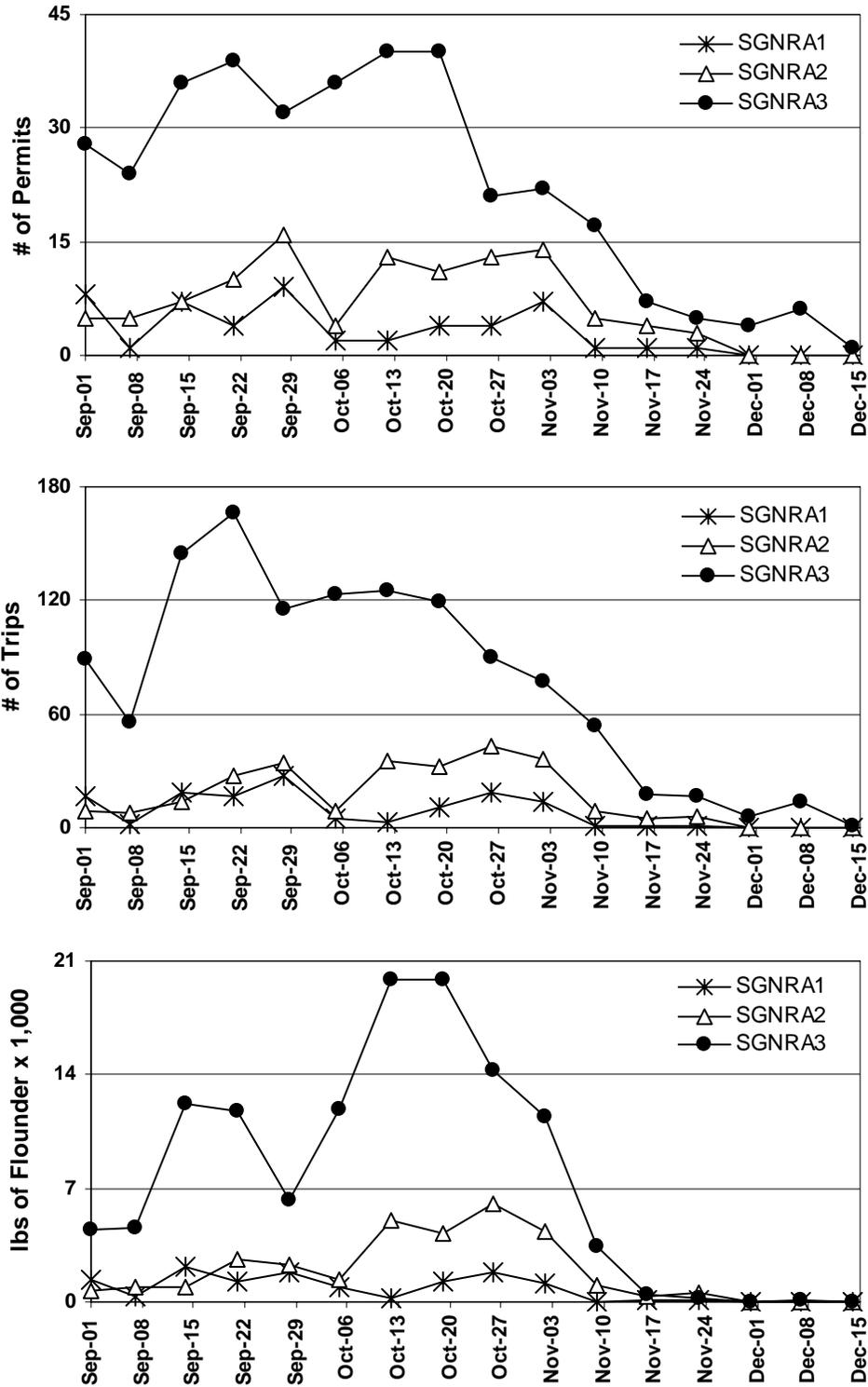


Figure 12. Number of Outer Banks PSGNRA permits, trips and pounds of flounder landed by week during the 2002 season. Note: the southern portion of SGNRA3 was closed on October 20 through December 15.

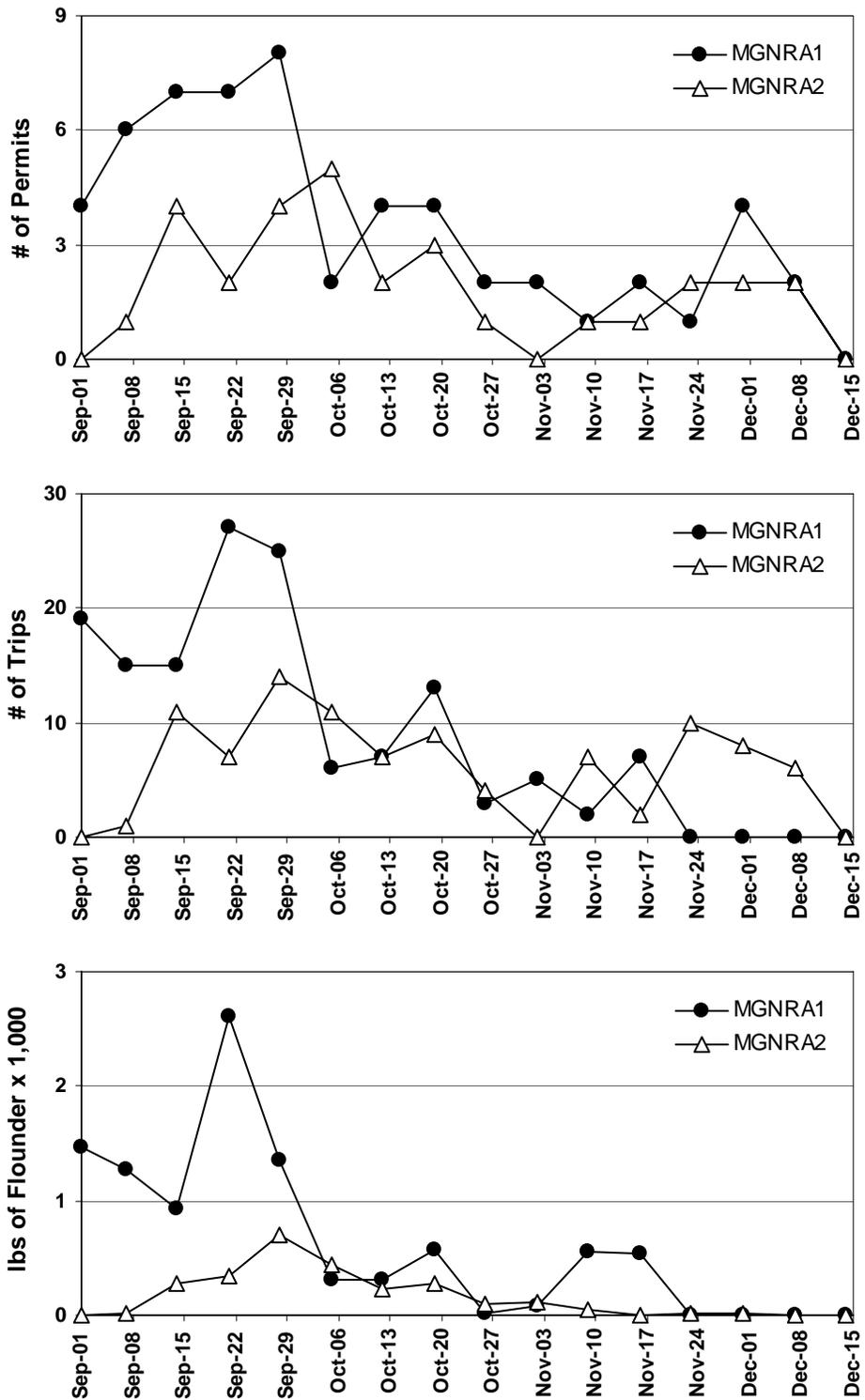


Figure 13. Number of Mainland PSGNRA permits, trips and pounds of flounder landed by week during the 2002 season.

Small mesh observer trips in the PSGNRA totaled 29 with eight small mesh runaround trips conducted prior to November 1 and 21 set net trips conducted after November 1 (Figures 14 and 15). Small mesh gillnet fishermen were not required to obtain a PSGNRA permit; therefore no logbook reports were available from these fisheries. Both observed catches and effort in the runaround gillnet fishery were highly variable, which was due in part to the small sample size obtained, but was also consistent with the fishing method (Figure 15). Observed catches in the set gillnet fishery were also highly variable, while observed effort remained relatively stable (Figure 14).

Similar to large mesh gillnets, yards of gillnet fished was a less variable measure of fishing effort when compared to total landings for both runaround and small mesh set gillnets (Figure 16). Weekly coefficients of variation (CVs) for yards of gillnet fished remained below 50% for most weeks and averaged 34% for set gillnets and 47% for runaround gillnets, while landings CVs were higher averaging 66% for runaround and 78% for set gillnets (Figure 16).

Gear Parameters

Mesh sizes observed in the large mesh fishery ranged from 5 to 7 inch stretched mesh with most fishermen using 5.75 inch (Table 4). Small mesh set nets ranged from 3.25 to 4.89 inch and averaged 3.81 inch, while mesh sizes for runaround gillnets were 3.13 to 4 inches and averaged 3.84 (Table 4). Twine sizes for all three fisheries averaged 0.47 mm, while mean net depth was 2.79 m for large mesh set nets, 2.05 m for small mesh set nets, and 3.12 m for small mesh runaround nets (Table 4). Soak times for the set net fisheries averaged 21.12 hrs for large mesh fishery and 19 hours for the small mesh fishery (Table 4). Runaround sets averaged less than one hour and ranged from 0.33 to 1.5 hours (Table 4). The amount of large mesh gillnet fished per trip ranged from 175 to the maximum allowable 2,000 yards and averaged 1,158 yards (Table 4). Small mesh set nets ranged from 55 to 1,310 yards per trip and averaged 964 yards (Table 4). Runaround gillnet yardage averaged 484 yards and ranged from 375 to 800 yards per trip (Table 4).

Finfish and Sea Bird Bycatch

Catches in the large mesh fishery were dominated by Paralichthid flounders, which represented 68.4% of the catch by weight (Table 5). Black drum, red drum, bluefish, and Atlantic menhaden were the next four most common species encountered (Table 5). Red drum were ranked third with 586 fish caught on 145 trips, while striped bass were ranked twentieth with only one observed in the large mesh gillnet fishery (Table 5). Sea bird bycatch observed in the large mesh fishery included 162 double-crested cormorants, 15 common loons, 6 laughing gulls, and 2 brown pelicans (Table 5).

Red drum dominated small mesh set net catches making up 30.1% of the catch by weight (Table 6). Atlantic menhaden were second representing 24.4% followed by spot making up 16.8%, and striped mullet, which accounted for 10.5% of the catch (Table 6). There were 74 red drum caught on 21 trips and no striped bass were observed in the small mesh set net fishery. There were no sea birds observed in the small mesh set net fishery. Striped mullet was the most common species observed in the small mesh runaround gillnet fishery representing 99.5% of the catch by number with only 2 stingrays observed as bycatch on the eight trips sampled (Table 7).

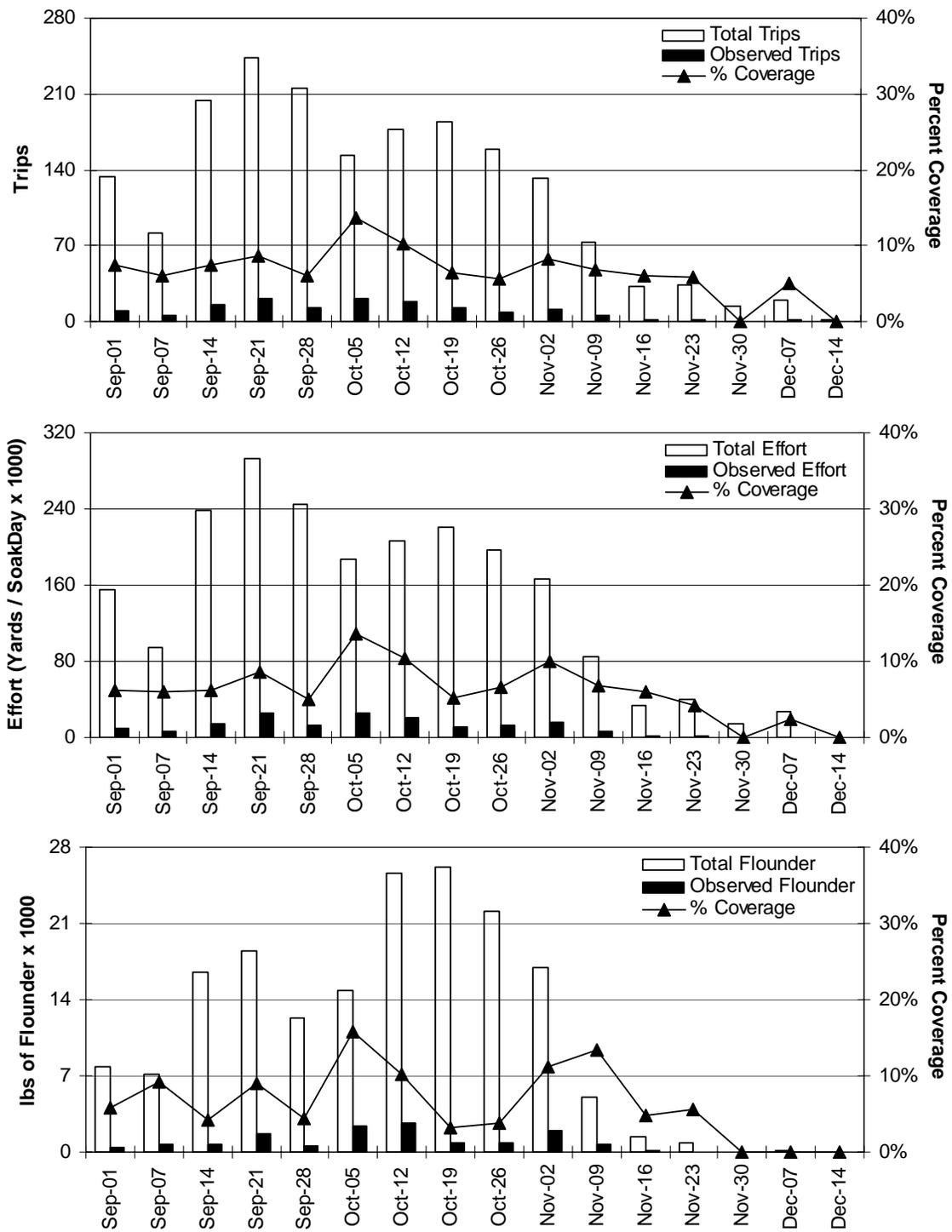


Figure 14. Large mesh trips, fishing effort (yards x soak days), and flounder landings (lbs) observed and reported by week for the 2002 fishing season.

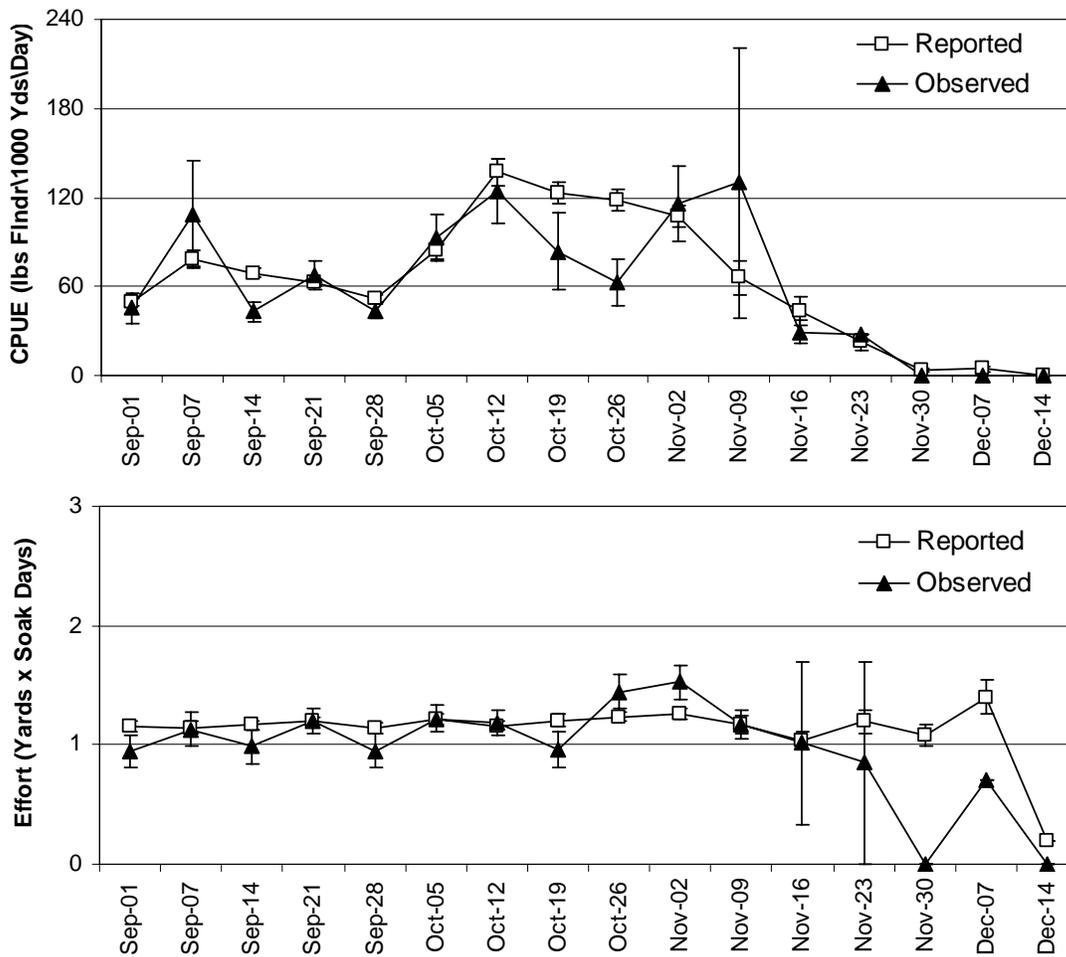


Figure 15. Mean CPUEs (lbs of flounder\1000 yards\day) and effort (yards x soak days) for logbook reports and observed large mesh gillnet trips by week for the 2002 fishing season. Error bars represent standard errors of weekly means.

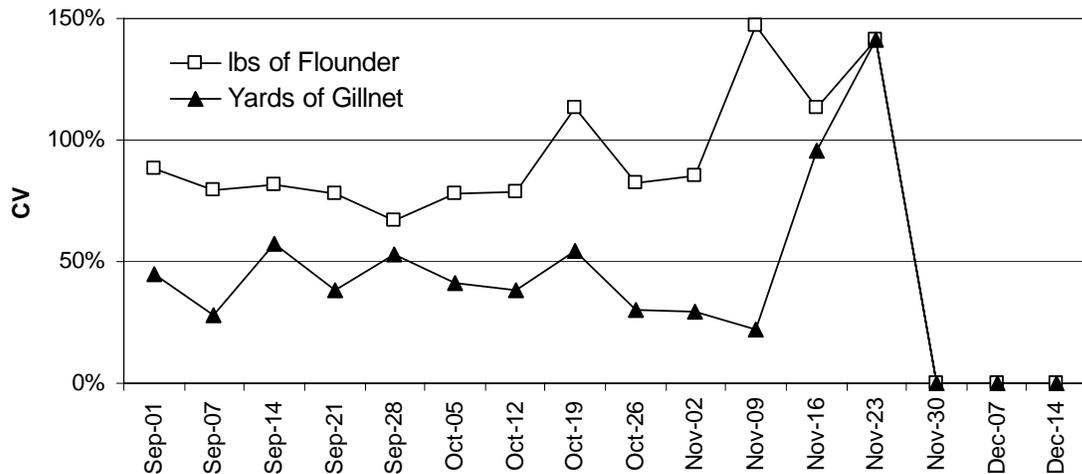


Figure 16. Coefficients of variation (CVs) by week for two measures of large mesh fishing effort (lbs of flounder landed vs. yards of gillnet fished) observed during the 2002 fishing season.

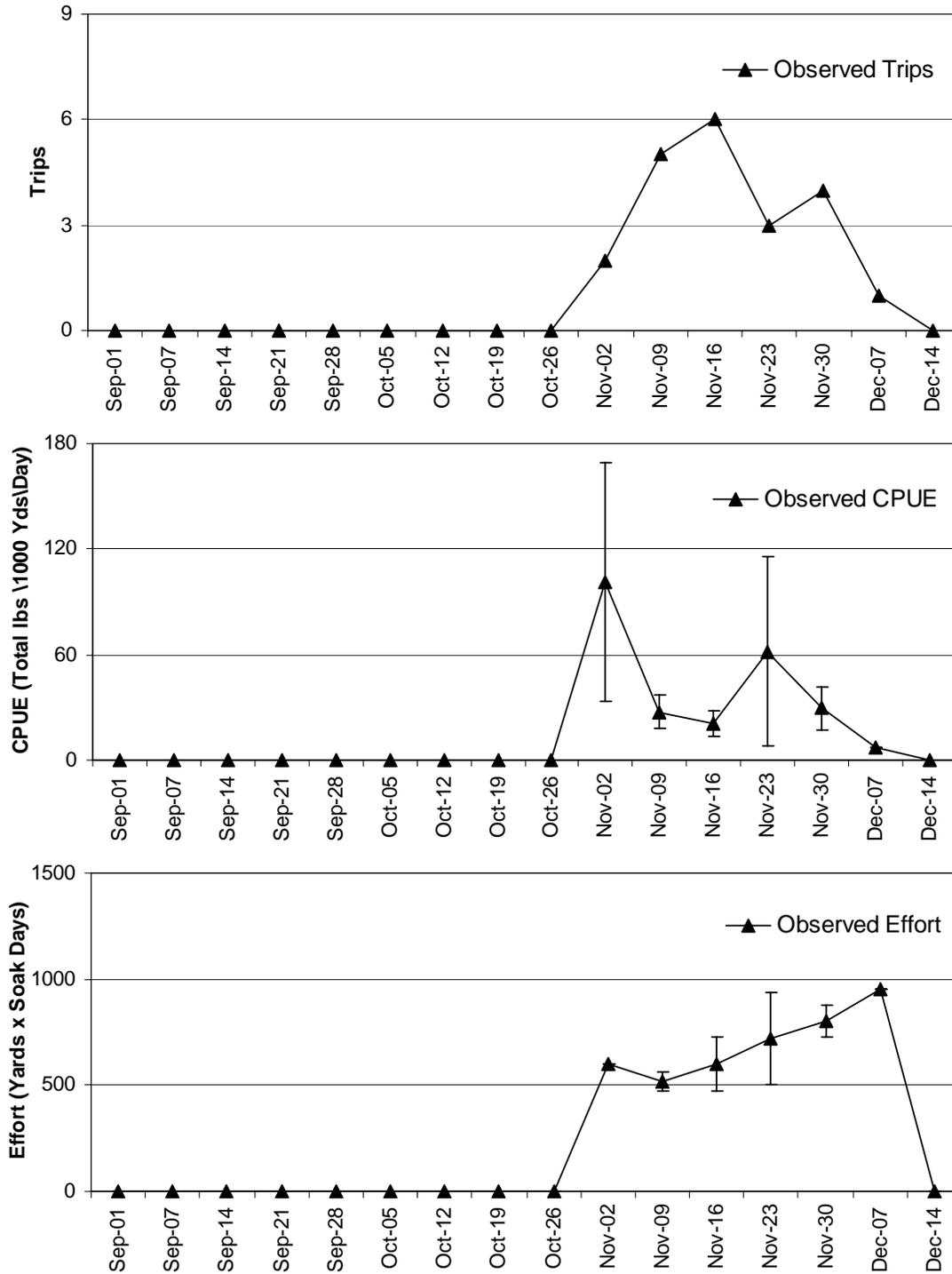


Figure 17. Observed trips, mean CPUEs (Total catch lbs\1000 yards\day) and effort (yards x soak days) for small mesh set gillnet trips by week for the 2002 fishing season. Error bars represent standard errors of weekly means.

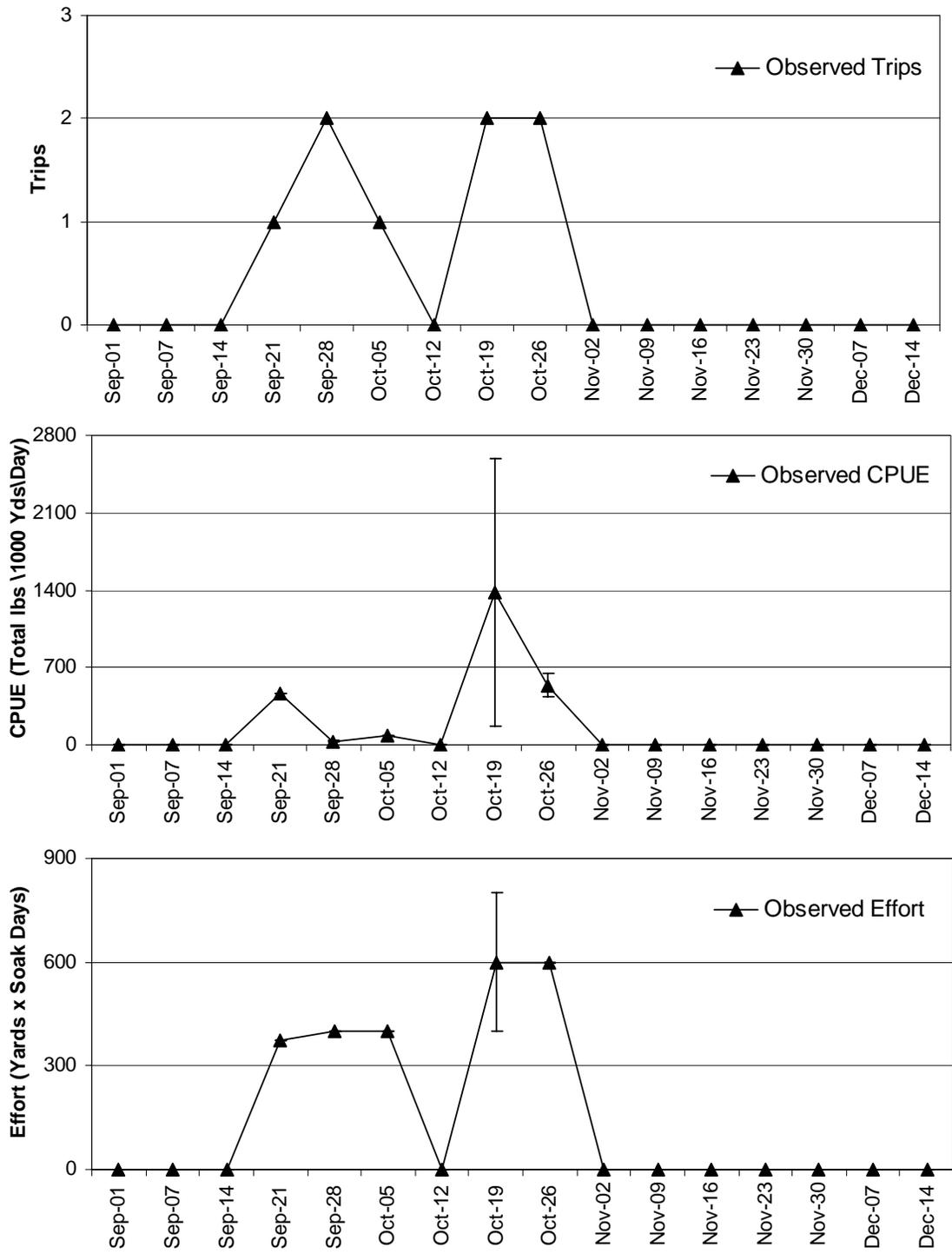


Figure 18. Observed trips, mean CPUEs (Total catch lbs\1000 yards\day) and effort (yards x soak days) for small mesh runaround gillnet trips by week for the 2002 fishing season. Error bars represent standard errors of weekly means.

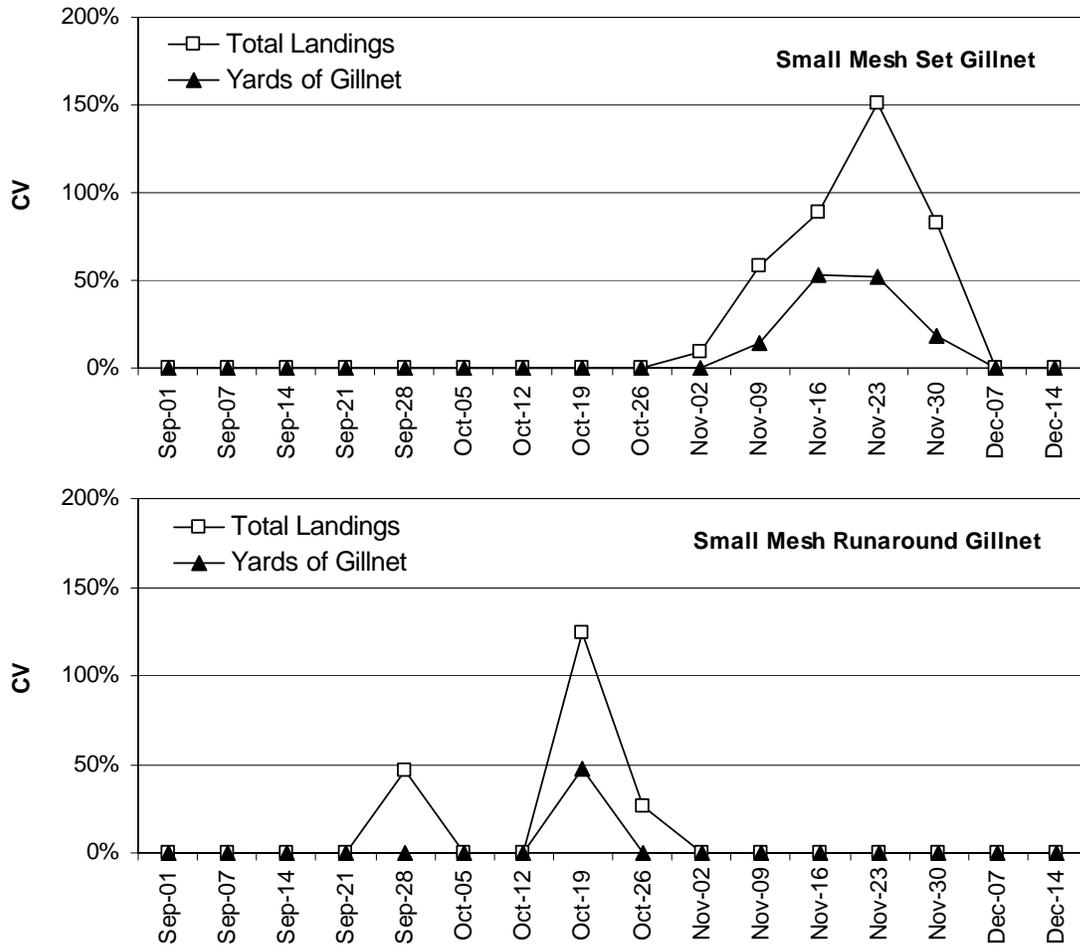


Figure 19. Coefficients of variation (CVs) by week for two measures of fishing effort (total landings vs. yards of gillnet) observed in the small mesh set and runaround gillnet fisheries during the 2002 fishing season.

Table 4. Summary statistics for gear parameters observed in the large and small mesh set gillnet fisheries and small mesh runaround gillnet fishery during the 2002 season.

Mesh Size	Net Type	Gear Parameter	N	Min	Mean	Max
Large Mesh	Set Net	Mesh Size (in)	278	5.00	5.75	7.00
		Twine Size (mm)	278	0.33	0.47	0.90
		Net Depth (m)	278	0.66	2.79	4.83
		Soak Time (hrs)	278	12.00	21.12	48.00
		Yards/Trip	145	175	1,158	2,000
Small Mesh	Set Net	Mesh Size (in)	40	3.25	3.81	4.89
		Twine Size (mm)	40	0.40	0.47	0.52
		Net Depth (m)	40	1.73	2.05	2.72
		Soak Time (hrs)	40	12.00	19.00	24.00
		Yards/Trip	21	55	964	1,310
Small Mesh	Runaround	Mesh Size (in)	15	3.13	3.84	4.00
		Twine Size (mm)	15	0.39	0.47	0.52
		Net Depth (m)	15	1.54	3.12	4.39
		Soak Time (hrs)	15	0.33	0.54	1.50
		Yards/Trip	8	375	484	800

Sea Turtle Bycatch

Six green turtles, five loggerheads, and one Kemp's ridley were observed in the large mesh gillnet fishery during the 2002 fishing season (Table 8). Two turtles were observed during the first week of monitoring including one green and one loggerhead turtle, while one loggerhead and one Kemp's ridley were observed during the fourth week of the season (Table 8). Two turtles were observed during the fifth week including, one green and one loggerhead with two more green turtles observed during the sixth week (Table 8). Finally, four turtles were observed during the seventh week of the season consisting of two green and two loggerhead turtles (Table 8). All but one of the turtles were released alive, with the Kemp's ridley being the only observed mortality (Table 8). All of the green turtles observed were small with carapace lengths ranging from 261mm to 355mm (Table 8). The loggerheads observed were larger with carapace lengths ranging from 546mm to 687 mm (Table 8). All of the green and loggerhead turtles were observed in SGNRA3 in the area behind Cape Hatteras between Hatteras Inlet and Avon (Figures 17 and 18). This area was closed to large mesh gillnets on October 20 through the end of the season to prevent any further takes from occurring. The Kemp's ridley turtle was observed on the mainland side of Pamlico Sound in MGNRA1 near the head of Rose Bay (Figure 17). No turtles were observed in small mesh gillnets and no other turtles were observed in the large mesh fishery for the remainder of the season (Figures 19 and 20).

Sea Turtle Bycatch Estimates

Sea turtle bycatch was estimated using the stratified ratio method where the bycatch rate was calculated from the number of sea turtles observed per unit of fishing effort. Fishing effort was measured by either effort (yards x soak days) or pounds of target species landed. Flounder landings were used for the large mesh gillnet fishery. The bycatch rate was then multiplied by the total fishing effort (effort or pounds landed) reported by the fishermen for each fishery. The strata were spatially defined by restricted areas SGNRA1, SGNRA2, SGNRA3, MGNRA1, and MGNRA2. Total bycatch estimates were calculated weekly by adding estimates for each fishery and restricted area. Sea turtle takes were observed during the first, fourth, fifth, sixth, seventh and eighth weeks of the season. One of the interactions was observed in MGNRA1, while the remaining 11 occurred in the large mesh fishery in SGNRA3 (Table 9). Bycatch rates for these weeks were calculated for both observed effort and landings by area and species (Table 10). Bycatch rates were comparable between effort measures with weekly landings estimates tending to be slightly higher than those based on fishing gear effort (Tables 9 and 10). Due to the variability associated with landings, NMFS and NCDMF agreed on using gear effort as the primary measure of effort for bycatch estimates. Total lethal and live take estimates were calculated by adding weekly take estimates by species and area. Total take estimates are 97 live green turtles, 65 live loggerheads, and eight lethal Kemp's ridley takes, which were all within the allowable take thresholds established in the ITP (Table 11). Landings based estimates yielded slightly lower live takes estimates and much higher lethal take estimates (Table 11).

Core Sound Monitoring

A total of 16 sea sampling trips were conducted in Core Sound through the fourth week of the 2002 fishing season (Figure 21). Observers sampled 34,130 yards of gillnet and observed 1,288 lbs of flounder (Figure 21). Landings were the least variable measure of fishing effort when compared with gear effort (Figure 22). Mesh size ranged from 5.25 to 6.25 inches and averaged 5.88 inches, while twine size ranged from 0.4 to 0.52 mm and averaged 0.47 mm

Table 5. Tabulation, by species, of relative biomass (kgs) and number of individuals observed aboard large mesh gillnet vessels for 145 trips in Pamlico Sound during the 2002 season. All species are ranked by relative biomass (% biomass).

Scientific Name	Common Name	Biomass (kgs)	% Biomass	Number	% Number
<i>Paralichthys spp.</i>	Paralichthid flounders	6,675.78	68.26	6,670	52.73
<i>Pogonias cromis</i>	black drum	810.17	8.28	717	5.67
<i>Sciaenops ocellatus</i>	red drum	703.18	7.19	586	4.63
<i>Pomatomus saltatrix</i>	bluefish	548.22	5.61	636	5.03
<i>Brevoortia tyrannus</i>	Atlantic menhaden	530.17	5.42	2,234	17.66
<i>Archosargus probatocephalus</i>	sheepshead	166.32	1.70	100	0.79
<i>Cynoscion regalis</i>	weakfish	74.16	0.76	136	1.08
<i>Leiostomus xanthurus</i>	spot	54.90	0.56	196	1.55
<i>Cynoscion nebulosus</i>	spotted seatrout	53.98	0.55	59	0.47
<i>Mugil cephalus</i>	striped mullet	36.80	0.38	27	0.21
<i>Chaetodipterus faber</i>	Atlantic spadefish	34.01	0.35	35	0.28
<i>Micropogonias undulatus</i>	Atlantic croaker	28.18	0.29	71	0.56
<i>Chelonia Mydas</i>	green turtle	13.50	0.14	6	0.02
<i>Astroscopus spp.</i>	Astroscopus stargazers	13.00	0.13	13	0.10
<i>Trachinotus carolinus</i>	Florida pompano	10.11	0.10	10	0.08
<i>Sela. Lamni. Scyliorhinoidei</i>	cat sharks	8.75	0.09	5	0.04
<i>Menticirrhus spp.</i>	kingfishes	4.73	0.05	11	0.09
<i>Lagodon rhomboides</i>	pinfish	4.27	0.04	23	0.18
<i>Lepidochelys kempii</i>	Kemp's ridley turtle	3.00	0.03	1	0.01
<i>Morone saxatilis</i>	striped bass	1.70	0.02	1	0.01
<i>Sphoeroides maculatus</i>	northern puffer	1.56	0.02	5	0.04
<i>Scomberomorus maculatus</i>	Spanish mackerel	1.50	0.02	1	0.01
<i>Menticirrhus americanus</i>	southern kingfish	0.80	0.01	3	0.02
<i>Orthopristis chrysoptera</i>	pigfish	0.73	0.00	4	0.03
<i>Cypselurus melanurus</i>	Atlantic flyingfish	0.25	0.00	1	0.01
<i>Mugil spp.</i>	mulletts	0.20	0.00	1	0.01
<i>Rhinoptera bonasus</i>	cownose ray	.	.	440	3.48
<i>Dasyatidae</i>	stingrays	.	.	162	1.28
<i>Phalacrocorax Auritus</i>	double-crested cormorant	.	.	162	1.28
<i>Raja eglanteria</i>	clearnose skate	.	.	123	0.97
<i>Callinectes sapidus</i>	blue crab	.	.	73	0.58
<i>Rajiformes</i>	rays	.	.	41	0.32
<i>Limulus polyphemus</i>	horseshoe crab	.	.	22	0.17
<i>Gavia Immer</i>	common loon	.	.	15	0.12
<i>Synodus foetens</i>	inshore lizardfish	.	.	9	0.07
<i>Evorthodus lyricus</i>	lyre goby	.	.	9	0.07
<i>Larus Atricilla</i>	laughing gull	.	.	6	0.05
<i>Mustelus canis</i>	smooth dogfish	.	.	5	0.04
<i>Caretta caretta</i>	loggerhead turtle	.	.	5	0.03
<i>Dasyatis sabina</i>	Atlantic stingray	.	.	4	0.03
<i>Peprilus spp.</i>	Peprilus butterfish	.	.	4	0.03
<i>Peprilus triacanthus</i>	butterfish	.	.	4	0.03
<i>Dasyatis americana</i>	southern stingray	.	.	3	0.02
<i>Stenotomus caprinus</i>	longspine porgy	.	.	2	0.02
<i>Pelecanus Occidentalis</i>	brown pelican	.	.	2	0.02
<i>Busycon spp.</i>	whelks	.	.	1	0.01
<i>Callinectes similis</i>	lesser blue crab	.	.	1	0.01
<i>Ginglymostoma cirratum</i>	nurse shark	.	.	1	0.01
<i>Carcharhinus limbatus</i>	blacktip shark	.	.	1	0.01
<i>Gymnura spp.</i>	butterfly rays	.	.	1	0.01
<i>Dorosoma cepedianum</i>	gizzard shad	.	.	1	0.01
<i>Opsanus tau</i>	oyster toadfish	.	.	1	0.01
<i>Prionotus spp.</i>	Prionotus searobins	.	.	1	0.01
<i>Selene vomer</i>	lookdown	.	.	1	0.00
<i>Trinectes maculatus</i>	hogchoker	.	.	1	0.00
<i>Sphoeroides spp.</i>	Spherooides puffers	.	.	1	0.00

Table 6. Tabulation, by species, of relative biomass (kgs) and number of individuals observed aboard small mesh set gillnet vessels for 21 trips in Pamlico Sound during the 2002 season. All species are ranked by relative biomass (% biomass).

Scientific Name	Common Name	Biomass (kgs)	% Biomass	Number	% Number
<i>Sciaenops ocellatus</i>	red drum	91.49	30.07	74	10.95
<i>Brevoortia tyrannus</i>	Atlantic menhaden	74.20	24.39	371	54.88
<i>Leiostomus xanthurus</i>	spot	51.15	16.81	110	16.27
<i>Mugil cephalus</i>	striped mullet	31.94	10.50	37	5.47
<i>Cynoscion regalis</i>	weakfish	18.55	6.10	23	3.40
<i>Cynoscion nebulosus</i>	spotted seatrout	17.83	5.86	25	3.70
<i>Paralichthys spp.</i>	Paralichthid flounders	13.05	4.29	17	2.51
<i>Pomatomus saltatrix</i>	bluefish	2.97	0.98	3	0.44
<i>Pogonias cromis</i>	black drum	2.40	0.79	4	0.59
<i>Menticirrhus spp.</i>	kingfishes	0.68	0.22	1	0.15
<i>Astroscopus spp.</i>	Astroscopus stargazers			5	0.74
<i>Callinectes sapidus</i>	blue crab			3	0.44
<i>Peprilus triacanthus</i>	butterfish			3	0.44

Table 7. Tabulation, by species, of relative biomass (kgs) and number of individuals observed aboard small mesh runaround gillnet vessels for 8 trips in Pamlico Sound during the 2002 season. All species are ranked by relative biomass (% biomass).

Scientific Name	Common Name	Biomass (kgs)	% Biomass	Number	% Number
<i>Mugil cephalus</i>	striped mullet	4,498.56	100.00	3,882	99.95
<i>Dasyatidae</i>	stingrays			2	0.05

(Table 12). Net depths ranged from 1.7 to 3.2 meters and averaged 2.1 meters. Soak times ranged from 11 to 21 hours and average 15.4 hours with yards of gillnet fished ranging from 1,300 to 3,400 yards averaging 2,339 yards (Table 12).

Catches in the large mesh fishery were dominated by Paralichthid flounders, which represented 83.1 % of the catch by weight (Table 13). Atlantic menhaden, bluefish, black drum, and Atlantic croaker were the next four most common species encountered (Table 13). Red drum were ranked the seventh most common species with seven fish caught on 16 trips (Table 13). No sea bird bycatch was observed on any of the trips, while one sea turtle was encountered (Table 13). One loggerhead sea turtle was capture and released alive near the mouth of Jarrett's Bay on September 27 (Table 14 and Figure 23).

DISCUSSION

The gillnet management measures imposed by NCDMF and NMFS in Pamlico Sound during the 2002 fishing season were successful in reducing sea turtle bycatch, while allowing fisheries to operate. Although observed takes of sea turtles were up from levels observed in 2001, mortalities were down. There were an estimated 46 live takes and 16 lethal takes in 2001 compared to 162 live and 8 lethal takes in 2002. This translates to a 25.8% mortality rate for 2001 versus a 4.7% mortality rate for 2002. This change can be attributed to the increased number of takes observed in 2002 (12) compared to 2001 (5) with the number of mortalities (1)

Table 8. Sea turtle takes observed in the large mesh flounder gillnet fishery in Pamlico Sound during the 2002 fishing season. Carapace lengths are curved notch-to-notch measurements.

Date	Species	Condition	Curved Carapace Length (mm)	Location	Inconel Tag #1	Inconel Tag #2	Pit Tag #
9/6/2002	Green	ALIVE	310	35 16.885 75 41.370	XXP454	XXP451	NA
9/6/2002	Loggerhead	ALIVE	NA	35 16.759 75 40.746	NA	NA	NA
9/21/2002	Loggerhead	ALIVE	675	35 14.257 75 39.894	XXP446	XXP447	4330673123
9/25/2002	Kemps	DEAD	300	35 26.863 76 25.508	NA	NA	NA
9/28/2002	Green	ALIVE	290	35 13.359 75 41.610	XXP339	NA	4332310258
10/2/2002	Loggerhead	ALIVE	546	35 16.470 75 38.790	XXP436	XXP437	433571566B
10/8/2002	Green	ALIVE	340	35 19.654 75 35.743	XXP488	XXP489	4339646A68
10/10/2002	Green	ALIVE	355	35 18.464 75 35.146	XXP455	NA	43303D2043
10/17/2002	Green	ALIVE	261	35 15.882 75 40.536	XXP491	XXP490	4330084674
10/17/2002	Loggerhead	ALIVE	687	35 16.507 75 41.199	XXP492	XXP493	4339672975
10/17/2002	Loggerhead	ALIVE	NA	35 21.940 75 33.471	NA	NA	NA
10/19/2002	Green	ALIVE	NA	35 22.315 75 33.223	NA	NA	NA

remaining the same for each year (Table 8, Gearhart 2002). The increased number of interactions cannot be attributed to the substantial expansion of the PSGNRA, which includes the mainland side of Pamlico Sound. Only one of the 2002 takes occurred in the MGNRA, while 11 takes occurred in the southern portion of SGNRA3 (Figures 17 and 18). All of the takes observed occurred in large mesh gillnets and the southern portion of SGNRA3 was closed to large mesh gillnets on October 20 and remained closed for the remainder of the season.

No sea turtle interactions were observed in the small mesh gillnet fisheries during either the 2001 or 2002 fishing seasons. During each of these years, attendance requirements prior to November 1 reduced small mesh set net effort and the primary mode of fishing was the runaround method. Characteristics of the runaround method include visually targeting schools of fish, short soak times (<1 hr), and shallow water depths (<3 ft). All of these characteristics help to minimize bycatch and reduce mortality.

Eleven of the 12 sea turtles observed in the large mesh gillnet fishery during the 2002 season were released alive (Table 8). During the 2001 season, four of the five sea turtles observed were released alive, while three of four sea turtles observed in 2000 were released alive (Gearhart 2002, Gearhart 2001). These high survival rates can be credited to the fishing practices

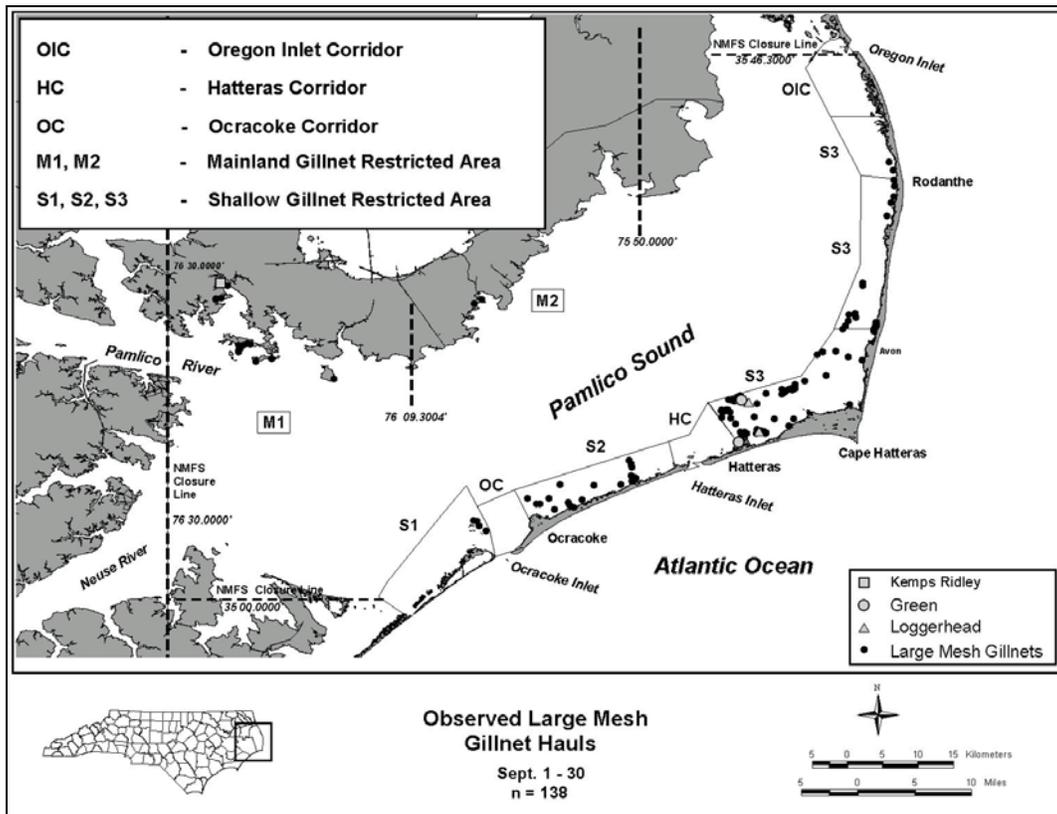


Figure 20. Observed sea turtle interactions and large mesh gillnet sets in Pamlico Sound Gillnet Restricted Areas from September 1-30, 2002.

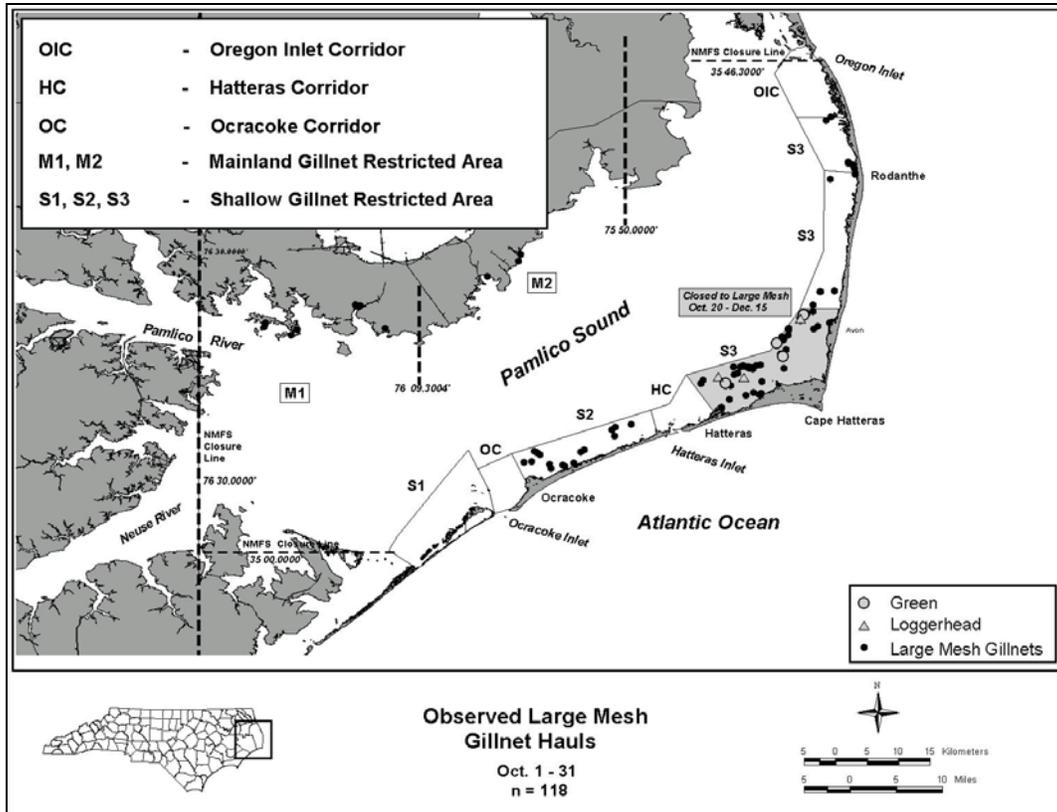


Figure 21. Observed sea turtle interactions and large mesh gillnet sets in Pamlico Sound Gillnet Restricted Areas from October 1-31, 2002.

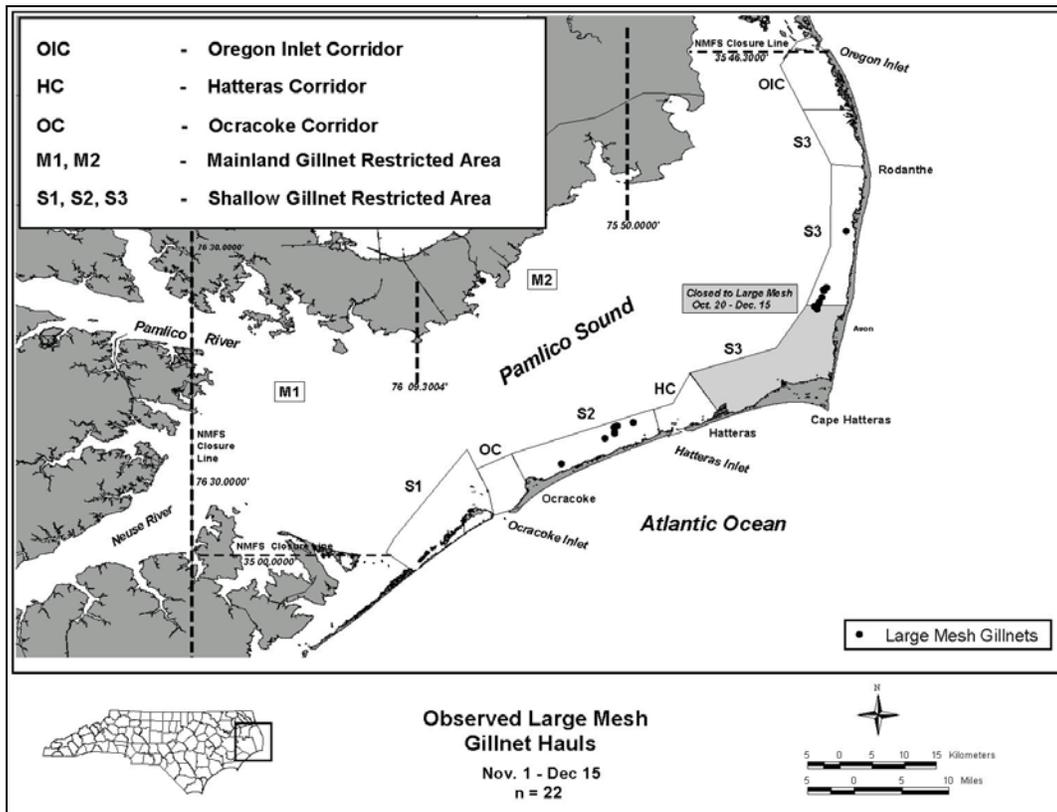


Figure 22. Observed large mesh gillnet sets in Pamlico Sound Gillnet Restricted Areas from November 1 through December 15, 2002.

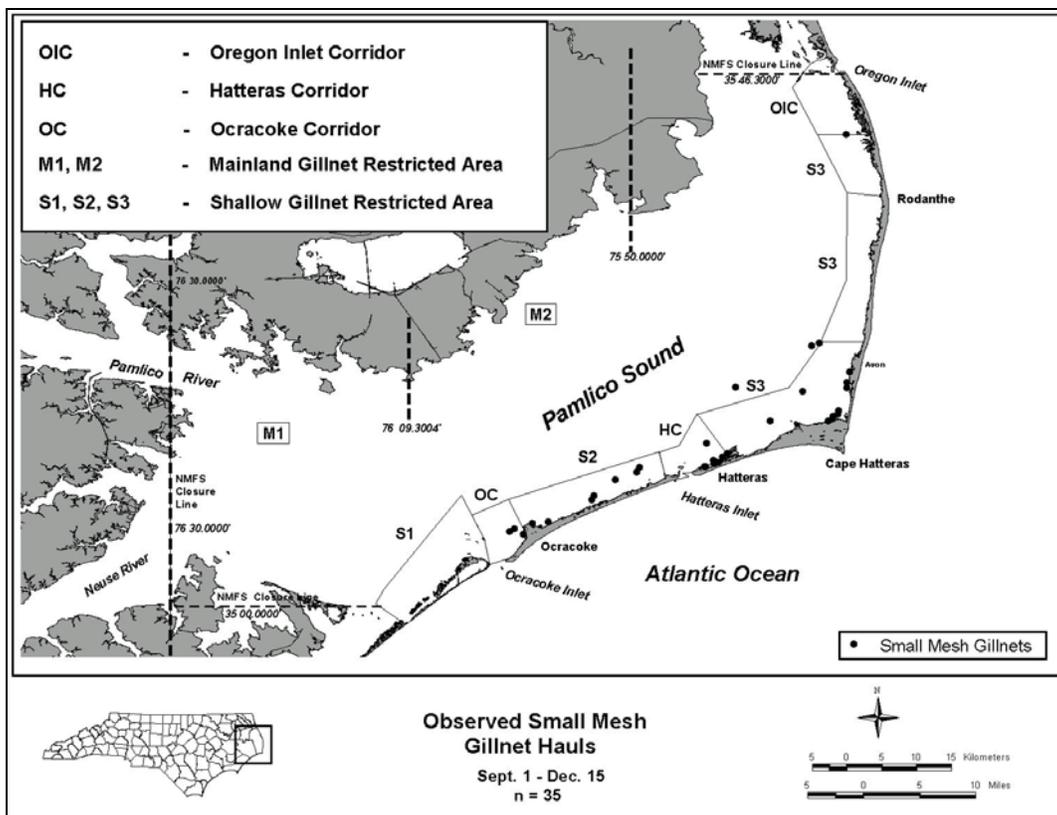


Figure 23. Observed small mesh gillnet sets in Pamlico Sound Gillnet Restricted Areas from September 1 through December 15, 2002.

Table 9. Observed large mesh gillnet sea turtle interactions, fishing effort (yards x soak days), flounder landings (lbs), and sea turtle bycatch rates based on fishing effort and flounder landings for each week and area where interactions occurred during the 2002 fishing season.

Week	Area	Observed Turtles	Species	Observed Effort (Yards x Soak days)	Observed Flounder Landings (lbs)	Effort Bycatch Rate (Takes\1000yds\day)	Landings Bycatch Rate (Takes\100lbs)
1	SGNRA3	1	Green	7,115	347	0.141	0.288
1	SGNRA3	1	Loggerhead	7,115	347	0.141	0.288
4	SGNRA3	1	Loggerhead	14,300	1,020	0.070	0.098
4	MGNRA1	1	Kemp's ridley	5,400	122	0.185	0.820
5	SGNRA3	1	Green	9,315	420	0.107	0.238
5	SGNRA3	1	Loggerhead	9,315	420	0.107	0.238
6	SGNRA3	2	Green	17,450	1,638	0.115	0.122
7	SGNRA3	1	Green	10,925	1,663	0.092	0.060
7	SGNRA3	2	Loggerhead	10,925	1,663	0.183	0.120
8	SGNRA3	1	Green	3,400	483	0.294	0.207

Table 10. Reported large mesh gillnet fishing effort (yards x soak days), flounder landings, and sea turtle bycatch estimates based on effort and landings for the 2002 fishing season. Estimates were calculated with bycatch rates listed in Table 10.

Week	Area	Observed Turtles	Species	Reported Effort (Yards x Soak days)	Reported Flounder Landings (lbs)	Effort Bycatch Estimate	Landings Bycatch Estimate
1	SGNRA3	1	Green	83,950	4,449	11.8	12.8
1	SGNRA3	1	Loggerhead	83,950	4,449	11.8	12.8
4	SGNRA3	1	Loggerhead	186,650	11,702	13.1	11.5
4	MGNRA1	1	Kemp's ridley	44,100	2,610	8.2	21.4
5	SGNRA3	1	Green	130,375	6,232	14.0	14.8
5	SGNRA3	1	Loggerhead	130,375	6,232	14.0	14.8
6	SGNRA3	2	Green	144,210	11,821	16.5	14.4
7	SGNRA3	1	Green	144,550	19,806	13.2	11.9
7	SGNRA3	2	Loggerhead	144,550	19,806	26.5	23.8
8	SGNRA3	1	Green	140,045	19,897	41.2	41.2

Table 11. Allowable take thresholds and effort and landings based estimated lethal and live takes by species from September 1 through December 15, 2002 in the PSGNRA.

Species	Allowable Threshold Live Takes	Effort Estimated Live Takes	Landings Estimated Live Takes	Allowable Threshold Lethal Takes	Effort Estimated Lethal Takes	Landings Estimated Lethal Takes
Kemp's Ridley	80	0	0	25	8	21
Green	160	97	95	50	0	0
Loggerhead	80	65	63	25	0	0
Species Aggregate	320	162	158	100	8	21

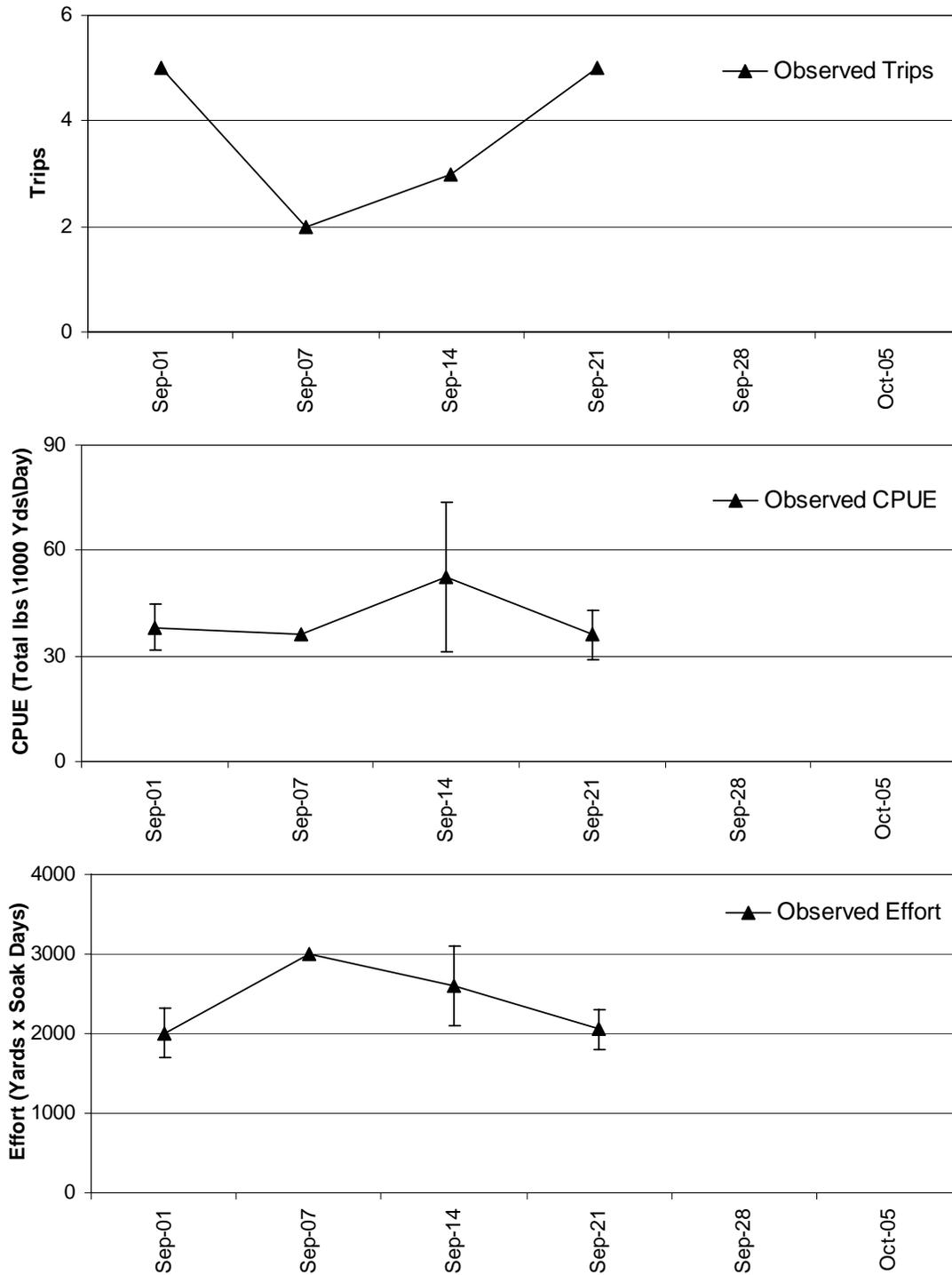


Figure 24. Observed trips, mean CPUEs (flounder landings lbs\1000 yards\day) and effort (yards x soak days) for Core Sound large mesh gillnet trips by week for the 2002 fishing season. Error bars represent standard errors of weekly means.

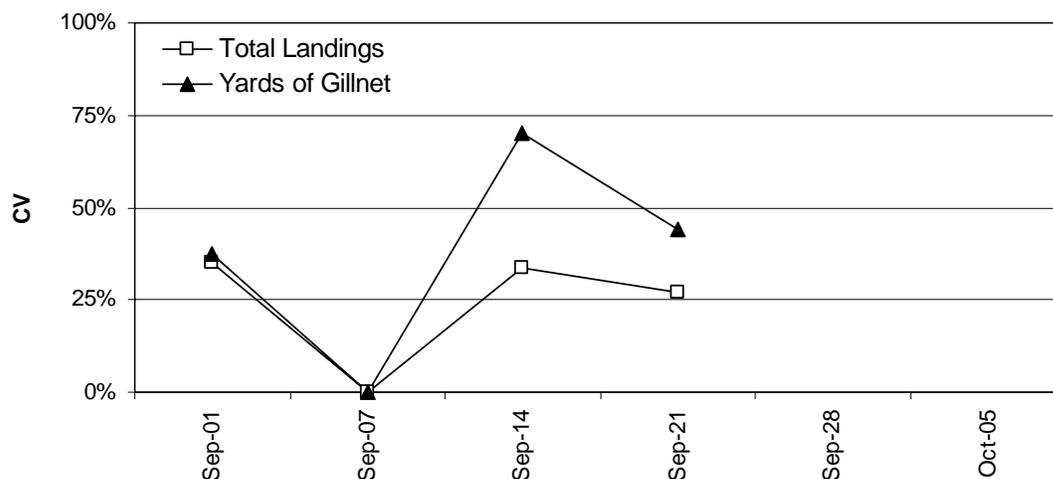


Figure 25. Coefficients of variation (CVs) by week for two measures of fishing effort (Total landings vs. yards of gillnet) observed in the Core Sound large mesh gillnet fishery during the 2002 fishing season.

Table 12. Summary statistics for gear parameters observed in the Core Sound large mesh set gillnet fishery during the 2002 season.

Mesh Size	Net Type	Gear Parameter	N	Min	Mean	Max
Large Mesh	Set Net	Mesh Size (in)	60	5.25	5.88	6.25
		Twine Size (mm)	60	0.40	0.47	0.52
		Net Depth (m)	60	1.73	2.14	3.16
		Soak Time (hrs)	60	11.00	15.40	20.54
		Yards/Trip	16	1300	2,339	3,400

Table 13. Tabulation, by species, of relative biomass (kgs) and number of individuals observed aboard large mesh gillnet vessels for 16 trips in Core Sound during the 2002 season. All species are ranked by relative biomass (% biomass).

Scientific Name	Common Name	Biomass (kgs)	% Biomass	Number	% Number
<i>Paralichthys spp.</i>	Paralichthid flounders	717.95	83.12	883	62.76
<i>Brevoortia tyrannus</i>	Atlantic menhaden	50.56	5.85	244	17.34
<i>Pomatomus saltatrix</i>	bluefish	46.42	5.37	84	5.97
<i>Pogonias cromis</i>	black drum	13.30	1.54	14	1.00
<i>Micropogonias undulatus</i>	Atlantic croaker	10.34	1.20	43	3.06
<i>Archosargus probatocephalus</i>	sheepshead	5.75	0.67	5	0.36
<i>Sciaenops ocellatus</i>	red drum	4.60	0.53	7	0.50
<i>Orthopristis chrysoptera</i>	pigfish	4.37	0.51	19	1.35
<i>Leiostomus xanthurus</i>	spot	3.57	0.41	12	0.85
<i>Cynoscion regalis</i>	weakfish	3.50	0.41	5	0.36
<i>Cynoscion nebulosus</i>	spotted seatrout	2.97	0.34	3	0.21
<i>Menticirrhus spp.</i>	kingfishes	0.40	0.05	2	0.14
<i>Rhinoptera bonasus</i>	cownose ray			29	2.06
<i>Dasyatidae</i>	stingrays			26	1.85
<i>Raja eglanteria</i>	clearnose skate			12	0.85
<i>Lagodon rhomboides</i>	pinfish			11	0.78
<i>Limulus polyphemus</i>	horseshoe crab			2	0.14
<i>Majidae</i>	spider crabs			1	0.07
<i>Synodus foetens</i>	inshore lizardfish			1	0.07
<i>Menticirrhus americanus</i>	southern kingfish			1	0.07
<i>Scomberomorus maculatus</i>	Spanish mackerel			1	0.07
<i>Sphoeroides maculatus</i>	northern puffer			1	0.07
<i>Caretta caretta</i>	loggerhead			1	0.07

Table 14. Sea turtle takes observed in the large mesh flounder gillnet fishery in Core Sound during the 2002 fishing season.

Date	Species	Condition	Curved Carapace Length (mm)	Location	Inconel Tag #1	Inconel Tag #2	Pit Tag #
9/27/2002	Loggerhead	ALIVE	NA	34 44.814 76 29.961	NA	NA	NA

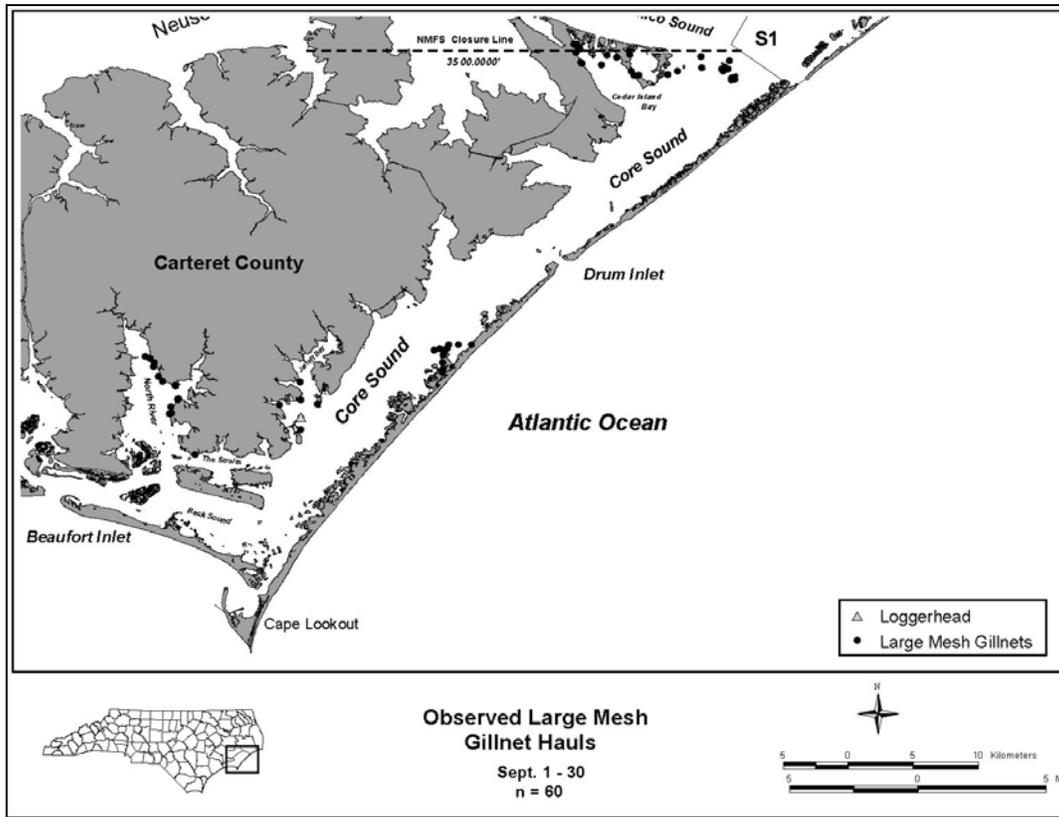


Figure 26. Observed sea turtle interactions and large mesh gillnet sets in Core Sound during the 2002 fishing season.

of the fleet, which include fishing nets daily and setting in shallow (< 3 ft) areas of the sound (Table 5). The shallow water depths provide incidentally captured sea turtles with the ability to reach the surface while entangled and the shorter soak times reduce the amount of time in the net.

During the 2000 season, all of the turtles observed in the shallow water large mesh gillnet fishery were green sea turtles, while takes in the deep water fishery were composed primarily of Kemp’s ridley and loggerheads (Gearhart 2001). Four green turtles and one hawksbill were observed in the shallow water large mesh gillnet fishery during 2001, while four turtles observed during the 2001 deep water gear testing were all Kemp’s ridley (Gearhart 2002). The species composition of incidental captures during the 2002 season consisted of 6 green, 5 loggerheads, and 1 Kemp’s ridley (Table 8). The Kemp’s ridley was captured on the mainland side of Pamlico Sound, while the loggerheads and greens were captured along the Outer Banks.

All of the 2002 interactions occurred prior to October 20 (Table 8). During 2000, four green turtles were observed before October 6, while four of the five 2001 takes occurred before October 1 (Table 9). Given this temporal trend in incidental captures, it appears that the first six to eight weeks of the shallow water flounder gillnet season presents the highest potential for sea turtle interactions.

According to 2001 and 2002 PSGNRA permit reports the first few weeks of the season is also the portion with largest amount of fishing effort and landings (Figure 7, Figure 8, and Gearhart 2002). Notably, the weeks with the highest number of trips during both the 2001 and 2002 fishing seasons were the first few weeks of the season. This means that there are probably large mesh gillnet trips occurring several weeks prior to September. It is clear that the first few weeks of the season are the most critical. If large mesh gillnet effort is significant prior to September then interactions are likely occurring.

CONCLUSIONS AND RECOMMENDATIONS

Successful management of the Pamlico Sound gillnet fisheries in 2002 indicates that the management measures imposed will be sufficient for future use to reduce sea turtle strandings in the region. Further reductions may also be realized through increasing the time frame of the management measures to include the last few weeks of August, which would maximize coverage of the large mesh fishery.

The NCDMF 2002 monitoring program was comprehensive but was also costly and labor intensive. A cooperative effort including Marine Patrol, Fisheries Management, Information Technology, and License and Statistics Sections was needed to successfully administer the program. Nearly all the NCDMF employees that worked on the monitoring program suspended their existing duties to complete tasks required. The NMFS should establish long term funding sources that provide states with the means necessary to institute long-term comprehensive monitoring programs intended for sea turtle conservation. This would enable NCDMF to establish a program dedicated to monitoring fisheries in Pamlico Sound as well as others throughout the state.

Finally, since a successful management strategy has been identified through NCDMF data collections, future management plans for this area should be long term (>3 years) and should seek to minimize intensive monitoring. The large area covered by the management measures require a large number of observer trips to achieve adequate coverage. A more efficient monitoring strategy could utilize stranding network data to identify "hot spots," which trigger intensive observer monitoring in the vicinity of stranding events. This would provide a means of identifying causes related to future stranding events and allow for more efficient use of staff.

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