



**NCDMF Completion Report for Incidental Take Permit 1528**

**Sea Turtle Bycatch Monitoring of the 2005 Fall Gillnet Fisheries in Southeastern Pamlico Sound, North Carolina**

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## **Introduction**

The Pamlico Sound Gillnet Restricted Area (PSGNRA) has been in existence since 2000. This area was established based upon increased numbers of sea turtle strandings, and subsequent observed gillnet interactions in 1999 along the Outer Banks (Gearhart 2001). Management measures in the PSGNRA restrict areas, seasons, gear, mandate observer coverage, and weekly reporting requirements. These actions are designed to protect sea turtles, allow a limited shallow water gillnet fishery, and characterize catch, effort, and bycatch along the Outer Banks and mainland side of Pamlico Sound from September through December of each year.

Habitat Conservation Plans (HCPs) within Section 10 Incidental Take Permits (ITPs) have allowed establishment of an extensive monitoring program in this region since 2000 (Gearhart 2001, 2002, 2003; Price 2004, 2005). The primary goal each year in the management of the PSGNRA has been to monitor and reduce protected species interactions in commercial gillnets with the assumption that these will result in decreased sea turtle strandings in Pamlico Sound from September through December of each year.

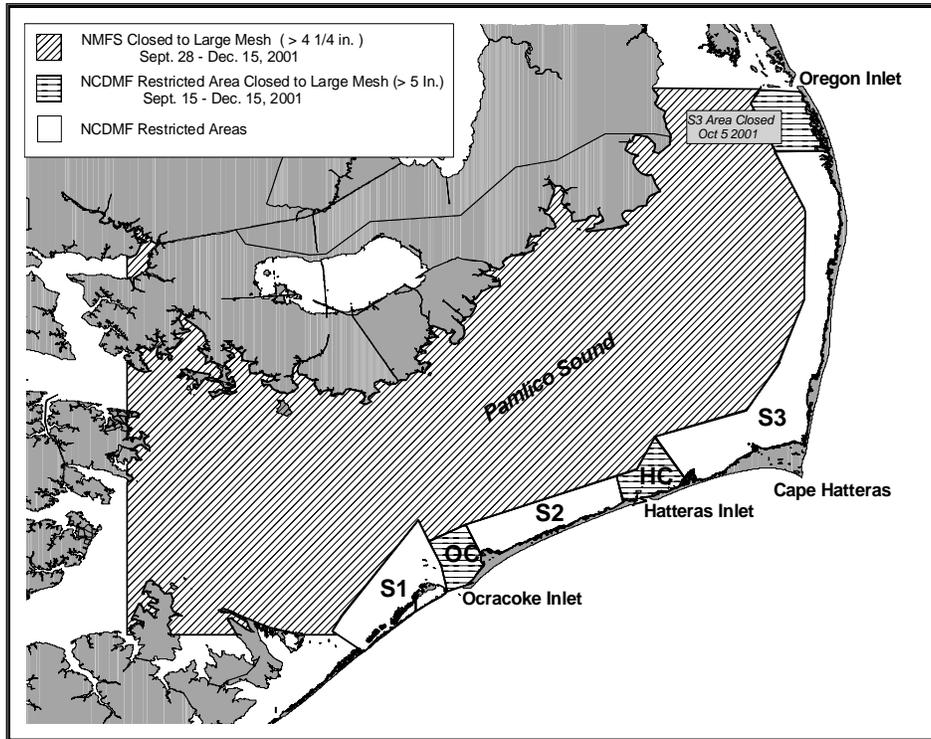
### *Incidental Take Permit History*

In consultation with the National Marine Fisheries Service (NMFS), the North Carolina Division of Marine Fisheries (NCDMF) has managed the PSGNRA under authority of Section 10 ITPs since 2000. Each of the ITPs issued from 2000 to present have all had the commonality of establishing an extensive monitoring, characterization, and reporting program to identify commercial gillnet and sea turtle interaction trends. These data have been used to appropriately direct resources, establish restricted fishing areas, promote better fishing practices, and to implement management measures that will reduce the potential for sea turtle takes.

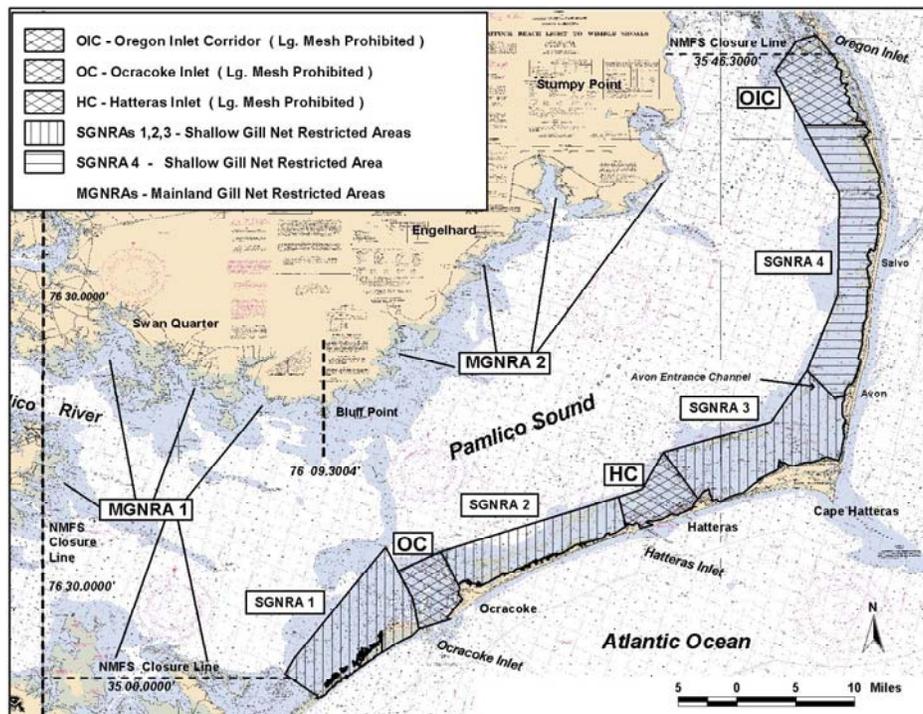
In 2000, ITP # 1259 marked the initial fishery characterization program, and identified small (< 5 inch stretch) and large ( $\geq$  5 inch stretch) commercial shallow water and deep-water gillnet fisheries along the Outer Banks. The deep-water large mesh gillnet fishery was observed with increased numbers of sea turtle interactions and subsequent mortalities. In 2001, ITP # 1348, established a deep-water closure, shallow water restricted fishing areas, and inlet corridors along the Outer Banks (Figure 1).

A three-year ITP # 1398 was authorized from 2002 – 2004, which maintained shallow water restricted fishing areas, inlet corridors along the Outer Banks, and allowed a shallow water restricted fishing area along the mainland side of Pamlico Sound (Figure 2). Similar management measures were utilized in this three-year period allowing a comprehensive assessment of the commercial gillnet effort, catch, bycatch, and protected species interactions.

In December 2004, NCDMF consulted with NMFS to begin preparation of another Section 10 ITP. Management measures imposed during the 2002 –2004 fall fishing seasons allowed for a more comprehensive assessment of directed resource use for the purpose of protecting sea turtles and maintaining a limited shallow water, fall gillnet fishery. In August 2005, ITP # 1528 was issued to NCDMF to manage the PSGNRA.



**Figure 1.** 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.



**Figure 2.** NCDMF 2004 Pamlico Sound Gillnet Restricted Area (PSGNRA). SGNRA1 – SGNRA4 =Shallow Water Gillnet Restricted Areas; MGNRA1 and MGNRA2 = Mainland Gillnet Restricted Areas; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor; OIC=Oregon Inlet Corridor.

## **Methods**

The management of the fishing season in the 2005 PSGNRA contained a comprehensive conservation plan similar to previous years (Gearhart 2001, 2002, 2003; Price 2004, 2005). Stipulations of the conservation plan included: weekly logbook reporting, mandatory observer coverage, an enforced violation system, NCDMF Marine Patrol monitoring, and immediate closure of the fishery should authorized sea turtle take levels be exceeded. Changes to the protocols from previous management years included redirecting observer coverage, eliminating mainland fisher permit requirements, and establishing increased surveillance.

### **2005 PSGNRA Management Measures**

There were a number of management changes to the HCP in 2005. First, ITP # 1528 was issued for a 6-year period. Secondly, a minimum goal of 2% observer coverage for the first (September 1 – September 15) and last (November 1 – November 30) weeks of the PSGNRA was established. This was established based on temporal trends in observed sea turtle interactions from 2000 to present. A goal of 10% coverage was maintained from September 16 – October 31 of each year. Third, NCDMF permits were not required for mainland fishermen operating along the mainland side of Pamlico Sound. Restricted fishing areas, gear restrictions, and mandatory observer coverage remained in effect along the mainland. In addition, only active fishermen were required to submit weekly reports as opposed to all permit holders throughout the PSGNRA. Further, NCDMF placed a state closure on top of the federal closure of the deep-water region of Pamlico Sound, which provided jurisdictional authority to NCDMF Marine Patrol officers. Finally, a system of NCDMF Marine Patrol spot checks, flyovers, fish house visits, and weekly reports was established to ensure industry compliance and maintain sea turtle protection.

### **Habitat Conservation Plan**

In August 2005, NCDMF issued proclamation M-8-2005, which established the PSGNRA. This proclamation closed all internal waters of Pamlico Sound south and west of the 35° 46.3000 N latitude line, east of the 76° 30.0000 W longitude line, and north of the 35° 00.0000 N latitude line except for the restricted areas SGNRA1 – SGNRA4, and a 200-yard corridor along the mainland side of the sound (Figure 3). Proclamation M-8-2005 also established gear restrictions including a 2,000-yard limit for all gillnet fishing operations and required small mesh gillnet attendance until November 1. Sea turtle interaction reporting was required. All fishermen along the Outer Banks utilizing large mesh (> 5 inch stretch) gillnets were required to obtain a PSGNRA permit from NCDMF. Provisions of the permit established mandatory logbooks, weekly reports from active fishermen, and observer coverage.

#### *Weekly Reporting*

Similar to previous management protocols, PSGNRA permit holders were required to submit weekly fishing reports to NCDMF, however during the 2005 season, only active fishermen operating in along the Outer Banks (SGNRA 1 – SGNRA4, Figure 3) were required to report weekly. Each fishing week began on Saturday and ended on Friday. Fishermen were

required to submit reports by 6:00 p.m. on Sunday for the previous weeks catch and effort information. Active permit holders reported the following information each week:

- 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
- Observer on board (yes or no)

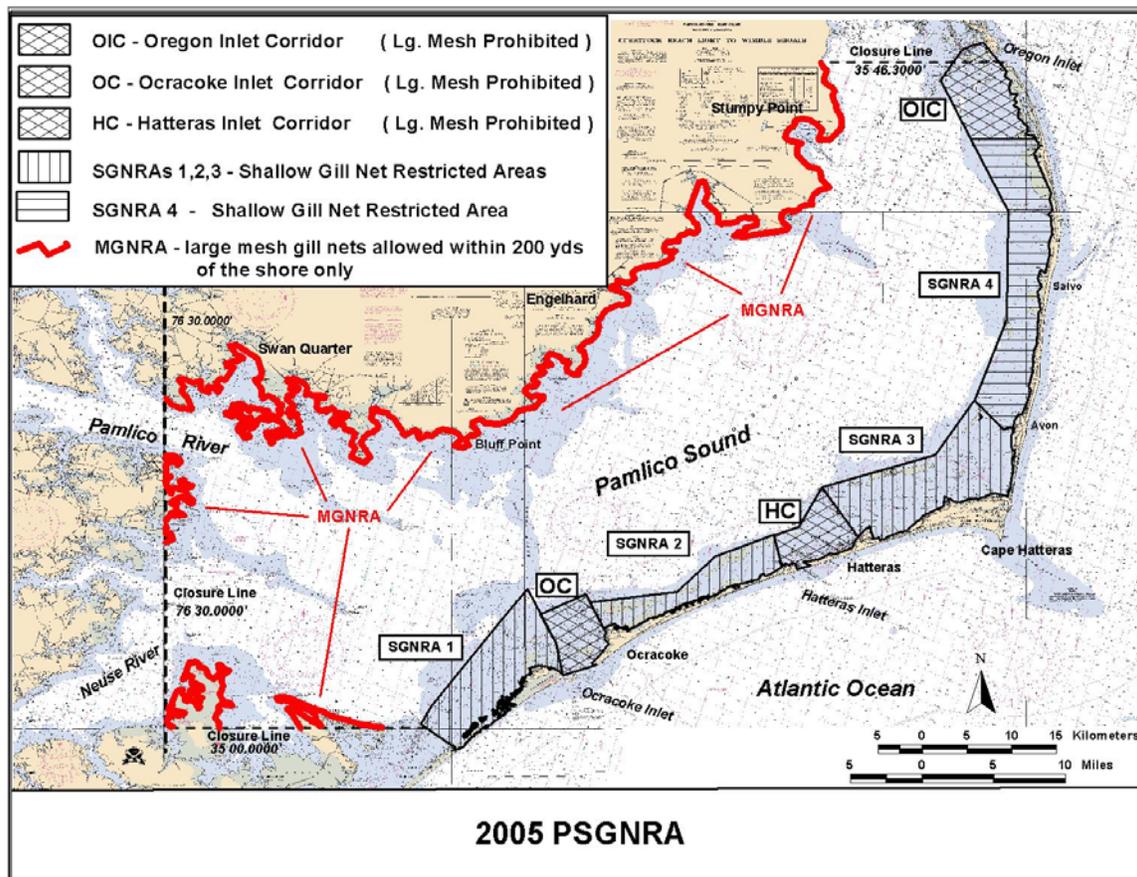
Failure to report accurate and timely information each week resulted in permit suspensions. Fishermen were required to report all sea turtle interactions to NCDMF within 24 hours. Penalties for late and non-reporting increased with subsequent offenses ranging from a 10-day suspension to a 6-month revocation. A system of back checks was implemented with NCDMF Marine Patrol during the 2005 PSGNRA fishing season to ensure industry compliance with reporting requirements.

#### *NCDMF Marine Patrol Checks*

New to the PSGNRA, a system of NCDMF observer and NCDMF Marine Patrol surveillance was established during 2005 to maintain sea turtle protection, ensure industry compliance, and validate the effectiveness of adaptive management measures. The following measures were taken:

- Weekly fish house visits
- Weekly boat patrols
- Regular aerial surveys
- PSGNRA Administrator and marine patrol coordination
- Fishermen spot checks
- Gear checks
- Outreach to industry

NCDMF observers and Marine Patrol officers obtained trip ticket information from all fish houses throughout the PSGNRA to cross-reference to the weekly reporting database and determine late reporters, accuracy of reports, and non-reporters. Observers scheduled these visits at the end of each fishing week. Boat patrols, aerial surveys, fishermen and gear checks were conducted regularly from September 1 – November 30, 2005. NCDMF Marine Patrol and staff were responsible for submitting weekly logs of these activities along with updated lists of violations. Establishing a state closure on top of the federal closure in Pamlico Sound during 2005 provided jurisdictional authority for these Marine Patrol surveys to be conducted and facilitated directed communications between the PSGNRA administrator and Marine Patrol officers. Finally, NCDMF has maintained outreach efforts to the commercial fishing industry and local communities along the Outer Banks and mainland side of Pamlico Sound providing the public with information pertaining to federal and state management measures to protect sea turtles. Outreach materials and information were provided through memos to fish dealers, letters to PSGNRA permit holders, public meetings, and daily personal communication with fishermen.



**Figure 3.** NCDMF 2005 Pamlico Sound Gillnet Restricted Area (PSGNRA). SGNRA1 – SGNRA4 =Shallow Water Gillnet Restricted Areas; MGNRA=Mainland Gillnet Restricted Area; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor; OIC=Oregon inlet Corridor.

### *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 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 2004 PSGNRA trip distribution among ports. Mainland observer coverage was proportionally allocated based on the 2004 trip distribution of flounder gillnet trips among ports derived from trip tickets. Proportional observer coverage along the Outer Banks was updated weekly based on the relative effort from the previous week. Observer coverage along the mainland was obtained through contacts during regular fish house visits, and use of the 2004 PSGNRA database.

Each observer was trained to identify, measure, resuscitate, and tag sea turtles by NMFS – Beaufort Lab and NCDMF. 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 (mm) 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 (kgs) 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.

A minimum goal of 2% coverage of the total large mesh gillnet fishing effort was set between September 1 – September 15, and from November 1 – November 30. A goal of 10% coverage of the total large mesh gillnet fishing effort was established from September 16 – October 31 2005. Observers were also required to obtain small mesh gillnet trips throughout the PSGNRA when feasible.

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 SGNRA1, SGNRA2, SGNRA3, SGNRA4, OIC, OC, and HC. Fishing effort was the product of net length (yds) and soak time (days). Total bycatch estimates were calculated weekly by adding estimates for each fishery within each restricted area. Estimates were cumulated each week to ensure authorized take levels were not being approached.

#### *Authorized Takes*

Take levels for the 2002 PSGNRA fishing season were based upon 2001 observations and utilized the upper 95% confident limits around the estimated mean number of takes to account for a worst case scenario. The authorized take levels established for 2002 remained consistent each year from 2002 – 2004 (Table 1).

**Table 1.** Maximum authorized lethal takes and live takes by species from September 1 through December 15 for the PSGNRA during the 2002 - 2004 fishing season.

Species	2002 - 2004 Max. Authorized Estimated Lethal Takes	2002 - 2004 Max. Authorized Estimated Live Takes	Total Estimated Take
Kemp's Ridley	25	80	105
Green	50	160	210
Loggerhead	25	80	105
<b>Species Aggregate</b>	<b>100</b>	<b>320</b>	<b>420</b>
Species			Total observed Take
Hawksbill	2 lethal or live, observed, all areas		2
Leatherback	2 lethal or live, observed, all areas		2
<b>Total Observed Take</b>	<b>4</b>		<b>4</b>
<b>Total Estimated and Observed Take</b>			<b>424</b>

For the 2005 PSGNRA, authorized takes were established based upon data collections and observed interactions from 2002 – 2004 utilizing the upper 95% confidence limits around the estimated mean number of takes as a worst case scenario. Streamlined management protocols (e.g., data collections, restrictions, and areas) from 2002 – 2004 allowed for refinement of anticipated take levels. Authorized take levels were significantly reduced for the 2005 PSGNRA season (Table 2).

### *Conference Calls*

NCDMF and NMFS held conference calls at the beginning, middle and closure of the 2005 PSGNRA fishing season. In addition, NCDMF maintained weekly communications with NMFS - Office of Protected Species (Silver Spring Md., and St. Petersburg, Fla.) via email, telephone, and weekly NCDMF summary reports. Communications were maintained as in previous management years, to discuss current catch, effort, and bycatch trends, evaluate observer coverage, industry compliance, enforcement, and to keep federal and state fishery managers apprised of events that may potentially impact the PSGNRA.

### *2005 ITP Protocols Summary*

In 2005, resources were more efficiently directed towards the management of the PSGNRA. These measures included: shifting observer coverage goals; eliminating permit requirements for mainland fishermen; modifying reporting requirements for Outer Banks fishermen; implementing a state closure and subsequent jurisdictional enforcement component; and visiting fish houses weekly to cross reference to the reporting database (Table 3). NCDMF, in consultation with NMFS, will continue to manage this fishery in this fashion, adjusting resources and implementing management measures to protect sea turtles.

**Table 2.** Maximum authorized lethal takes and live takes by species from September 1 through November 30 for the PSGNRA during the 2005 fishing season.

Species	2005 Max.	2005 Max.	Total
	Authorized Estimated Lethal Takes	Authorized Estimated Live Takes	Estimated Take
Kemp's Ridley <sup>1</sup>	14	27	41
Green	48	120	168
Loggerhead <sup>1</sup>	3	38	41
<b>Species Aggregate</b>	<b>65</b>	<b>185</b>	<b>250</b>
-----			
Species			Total Observed Take
Hawksbill	2 lethal or live, observed, all areas		2
Leatherback	2 lethal or live, observed, all areas		2
Kemp's ridley, green, loggerhead	6 lethal or live, any combination of species, observed, on the western shore of Pamlico Sound only		6
<b>Total Observed Take</b>	<b>10</b>		<b>10</b>
<b>Total Estimated and Observed Take</b>			<b>260</b>

<sup>1</sup> Kemp's ridley and Loggerhead estimated take will be based on a 3-year period (i.e. Kemp's ridley = 81 live, 42 lethal for 2005 - 2007 and 81 live, 42 lethal for 2008 - 2010; Loggerhead = 114 live, 9 lethal for 2005-2007 and 114 live, 9 lethal for 2008-2010) for purposes of exceeding the threshold. Estimated take of Kemp's ridleys and loggerheads varies greatly by year, thus combining years will account for some of the variability across years.

**Table 3.** Summary of management protocols from ITP # 1398 (2002 –2004) and ITP # 1528 (2005).

Management Protocols 2002 - 2004	Management Protocols 2005
3 year ITP	- 6 year ITP
Authorized take levels	- Authorized take levels reduced
NC PSGNRA permitted entry	- NC PSGNRA permitted entry except for mainland
Weekly reporting - all permit holders	- Weekly reporting - active fishermen
Mandatory observer coverage - Outer Banks/Mainland fishermen required to take observers	- Mandatory observer coverage - Outer Banks/Mainland fishermen required to take observers
10% observer coverage goal (Sept. 1 - Dec. 15)	10% observer coverage goal (Sept. 16 - Oct. 31) - Minimum of 2% Sept. 1 - Sept. 15 - Minimum of 2% Nov. 1 - Nov. 30
Observed turtle interactions result in increased coverage	- Observed turtle interactions result in increased coverage
Weekly/Annual NCDMF reporting	- Weekly/Annual NCDMF reporting
.	- NCDMF state closure on top of Federal closure
.	- NCDMF jurisdiction in deep-water region of Pamlico Sound
.	- NCDMF Marine Patrol surveillance (flyovers, patrols, spot checks)
.	- NCDMF Marine Patrol and observer weekly fish house visits
.	- Outreach - public meetings, flyers, memos, personal communication

\* Note: The 2005 fishing season ended on November 30 2005 due to the southern flounder *Paralichthys lethostigma* Fishery Management Plan.

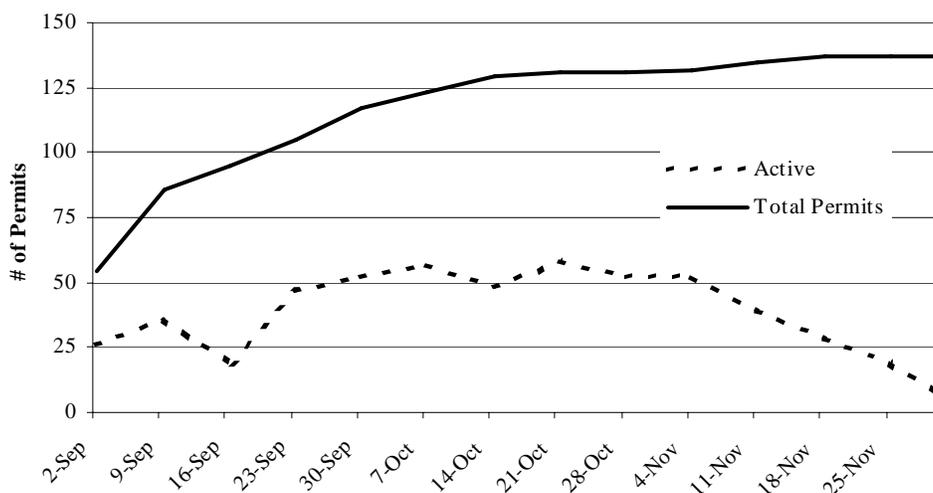
## Results

### Permit Activity

There were 143 permits issued throughout the course of the 2005 PSGNRA fishing season with the majority of fishermen not operating each week (Figure 4). A total of six fishermen surrendered their permits during the season. Inactive permits outnumbered active permits during 2005, with an average of 39 fishermen reporting each week. There was a general increasing number of active fishermen through mid-October with the highest number (n = 58) of reports during week 8 of the 2005 PSGNRA. Throughout November, fishing activity decreased ending with eight participants during the last week of the season.

### Compliance and Violations

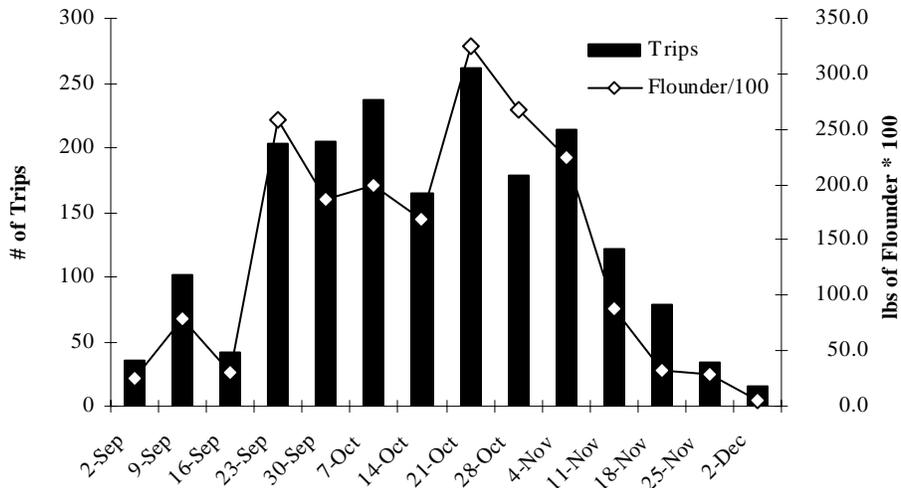
There were three notices of violations for late and non-reporting resulting in two 10-day suspensions, and one 30-day suspension of permits, respectively during the 2005 PSGNRA. In addition, two citations were issued to commercial fishermen for leaving small mesh gillnets unattended in the PSGNRA. There were also warnings issued to two commercial fishermen, who did not have copies of their PSGNRA permit on hand during routine Marine Patrol checks.



**Figure 4.** Number of valid and active PSGNRA permits by week for the 2005 fishing season.

### Catch and Effort

A total of 1,889 trips was reported during the 14-week 2005 PSGNRA with peak effort observed during the third week of October (Figure 5). A mean of 135 trips and an average of greater than 14,000 pounds of flounder landed were reported each week during 2005. Effort and landings were relatively high from the third week in September through the first week in November with a mean of 209 reported trips per week. Thereafter, a rapid decreasing trend was observed in the mean number of trips per week (n = 62) and flounder landed (Figure 5).



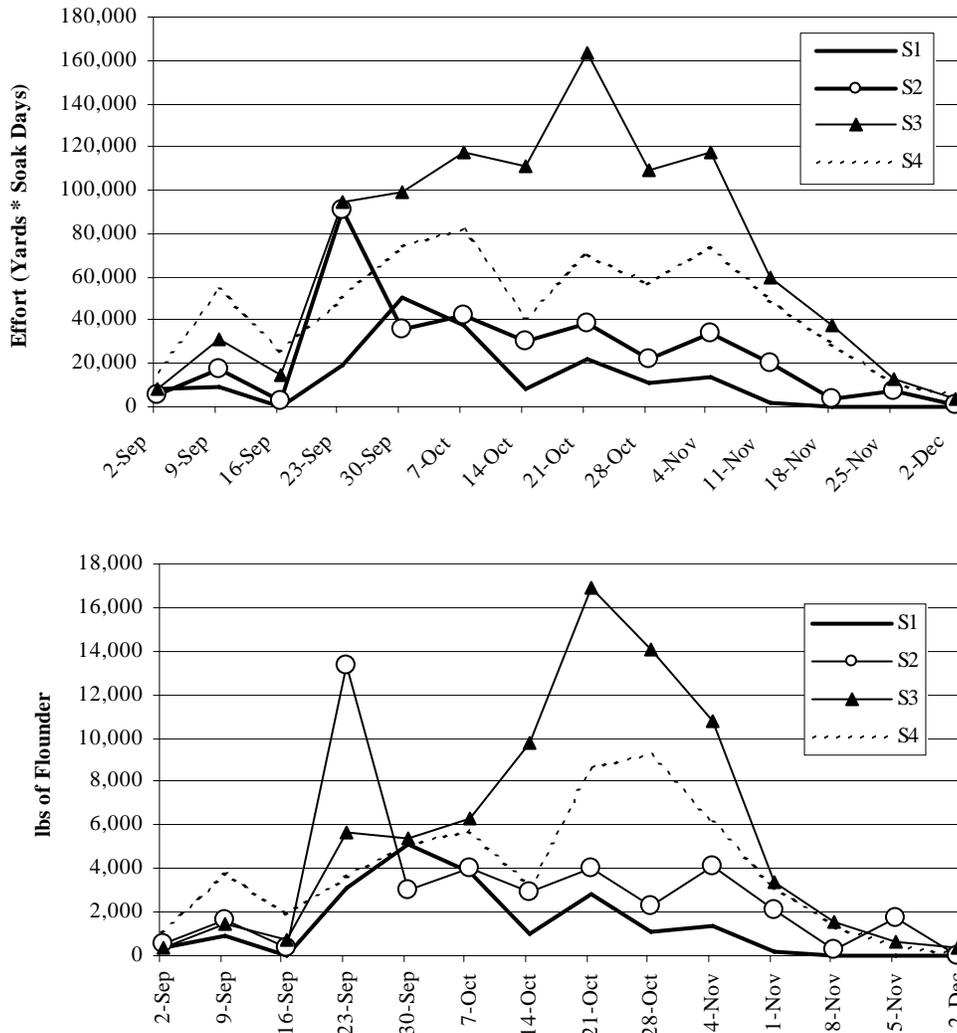
**Figure 5.** Total trips and pounds of flounder landed by week for the PSGNRA from September 1 – November 30, 2005.

There were more than two million yards of effort reported during the 14-week PSGNRA. The majority of effort and landings were reported from SGNRA3 and SGNRA4 (Table 4 and Figure 6). Collectively, these two areas represented 75% of the total reported effort and nearly 70% of the landings. During the fourth week of the PSGNRA, there were significant effort and landings reported from SGNRA2, however these remained reduced throughout the remainder of the season (Figure 6).

Peaks in effort and total flounder landed by week generally follow the same trends among all four restricted areas (Figure 6). There was increased effort and landings reported in SGNRA2 during week 4 of the 2005 PGNSRA. Thereafter, relatively low effort was reported from SGNRA2. The highest reported effort and landings were from SGNRA3 during week 8 of the 2005 PSGNRA. Effort in SGNRA3 was consistently high throughout October (Figure 6).

**Table 4.** Relative percent and total effort (yards \* soak days) and flounder landings for each restricted area in the PSGNRA from from September 1 – November 30, 2005.

Area	Effort	Landings	% Total Effort	% Total Landings
S1	182,075	19,934	8	10
S2	351,150	40,309	16	21
S3	980,400	77,460	46	41
S4	642,250	53,809	30	28
<b>Totals</b>	<b>2,155,875</b>	<b>191,512</b>		



**Figure 6.** Large mesh gillnet effort, and total pounds of flounder reported by week along the Outer Banks (areas S1 – S4) by week for the PSGNRA from September 1 – November 30, 2005.

### Observer coverage

There were 211 observed gillnet trips throughout the PSGNRA during the 2005 season, including 188 large mesh trips that covered more than 255,000 yards of gillnet effort. Observers achieved 11.9% coverage of the total large mesh gillnet effort along the Outer Banks. Coverage was more than 74% of the total effort during week 14 along the Outer Banks (Table 5 and Figure 7). Nine trips were observed along the mainland side of Pamlico Sound covering nearly 12,000 yards of gillnet effort. In addition, there were also three large mesh observer trips conducted outside of the PSGNRA in Core Sound. No observer trips were conducted during the first week (September 1 – September 2, 2005) of the PSGNRA because the season began on Thursday, September 1, and observers concentrated efforts in obtaining trips beginning on Saturday, September 3, 2005.

**Table 5.** Observed and reported large mesh gillnet trips and effort (yards \* soak days) with percent coverage by week for the PSGNRA from September 1 – November 30, 2005.

Week	WeekEnding	Observed		Reported		% Coverage	
		Trips	Effort	Trips	Effort	Trips	Effort
1	2-Sep	0	0	35	39	0	0
2	9-Sep	10	11	102	112	10	10
3	16-Sep	7	9	41	43	17	20
4	23-Sep	18	22	203	256	9	9
5	30-Sep	23	35	205	260	11	13
6	7-Oct	24	33	237	279	10	12
7	14-Oct	21	28	164	191	13	15
8	21-Oct	19	26	262	295	7	9
9	28-Oct	14	21	178	200	8	10
10	4-Nov	15	19	214	239	7	8
11	11-Nov	17	22	121	131	14	17
12	18-Nov	11	14	78	70	14	20
13	25-Nov	5	9	34	31	15	28
14	2-Dec	4	7	15	10	27	74
<b>Totals *</b>		<b>188</b>	<b>256</b>	<b>1,889</b>	<b>2,156</b>	<b>10</b>	<b>12</b>

\* The 10% and 12% coverage for both observed trips and observed effort refers to percent of total.

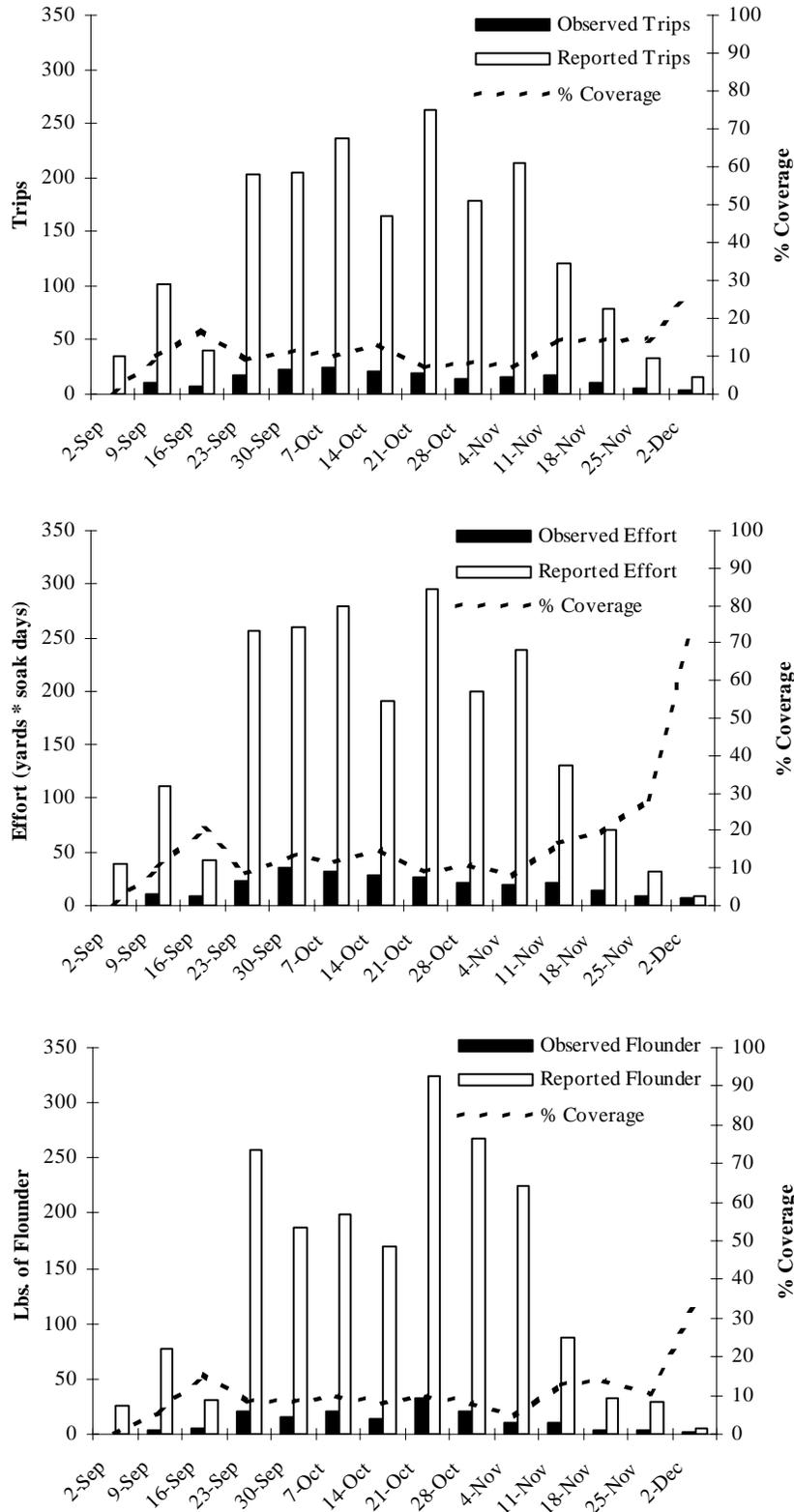
The percent coverage was calculated by the total number of trips, the total amount of effort, and the total amount of flounder landed. Observers achieved 10% coverage of the total reported trips, 12% coverage of the total reported effort, and 8.5% of the total reported flounder (Table 5 and Figure 7). The number of reported trips, effort, and landings all depict similar trends (Figure 7).

Observed catches and effort tracked closely between the fishermen logbooks and observed reports (Figure 8). There was a divergent trend in the observed and reported mean effort during the last two weeks when the total effort and number of observations were low at the end of the season. Combined with the percent coverage data, coverage of the fishery was exceptional, and fishermen logbooks appear accurate.

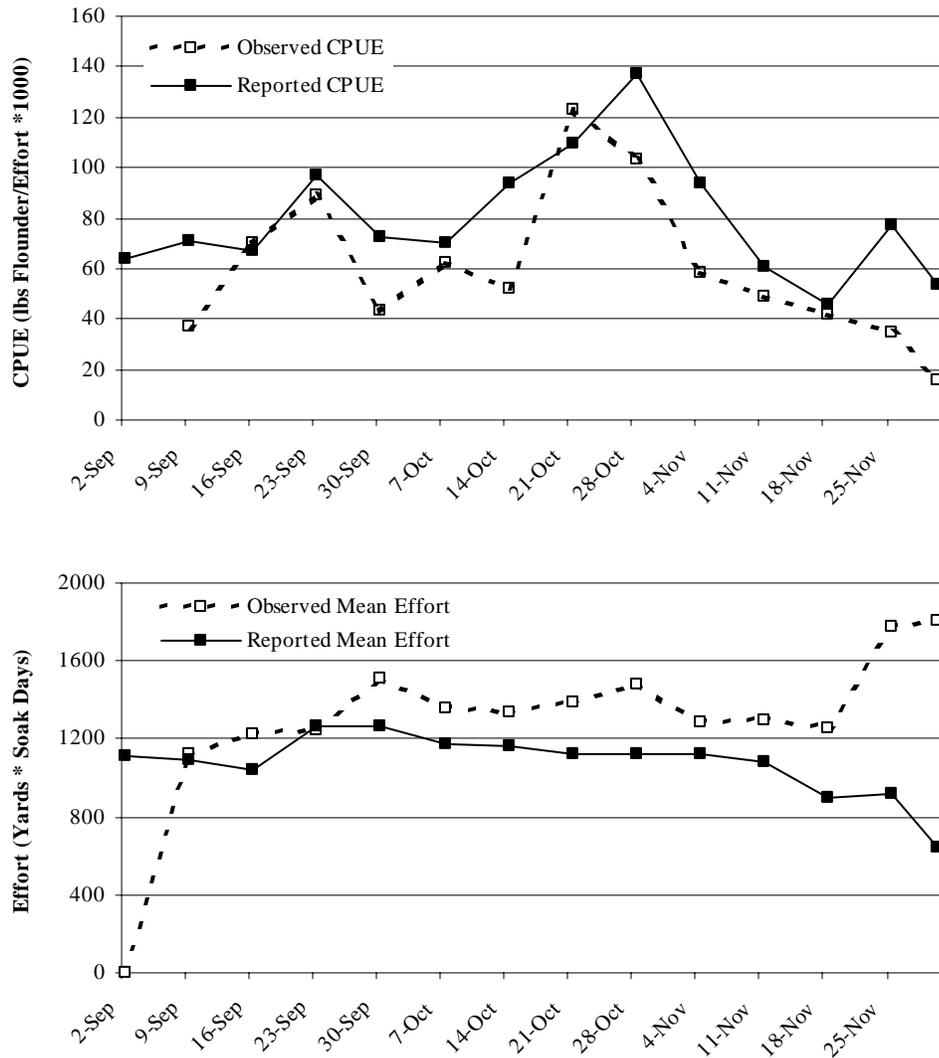
There was a total of 23 small mesh anchored gillnet trips observed, covering more than 14,000 yards of effort along the Outer Banks. There were no observed turtle interactions in the small mesh fishery (Table 6).

**Table 6.** Observed trips, effort and sea turtle interactions in the small mesh (< 5 in. stretch) gillnet fishery by week for the PSGNRA (areas SGNRA1 – SGNRA4) from September 1 – November 30, 2005.

Week	Date	Observed Trips	Observed Effort	Observed Turtles
2	9-Sep	1	1,200	0
4	23-Sep	2	2,600	0
5	30-Sep	2	800	0
8	21-Oct	2	800	0
10	4-Nov	2	400	0
11	11-Nov	4	2,550	0
12	18-Nov	6	3,820	0
13	25-Nov	1	350	0
14	30-Nov	3	1,500	0
<b>Totals</b>		<b>23</b>	<b>14,020</b>	<b>0</b>



**Figure 7.** Observed and reported large mesh trips, fishing effort (yards \* soakdays), and flounder landings (lbs) by week for the PSGNRA from September 1 – November 30, 2005.



**Figure 8.** Catch per unit effort (lbs of flounder\1000\day) and effort (yards \* soak days) for observed large mesh gillnet trips and fishermen logbooks PSGNRA from September 1 – November 30, 2005.

Spatial coverage of the large mesh gillnet fishery was concentrated along the shoreline throughout the PSGNRA during 2005 (Figure 9). Concentration of effort was near Avon, Hatteras, and Ocracoke, NC. Small mesh gillnet observations were reduced relative to large mesh observations (Figure 10).

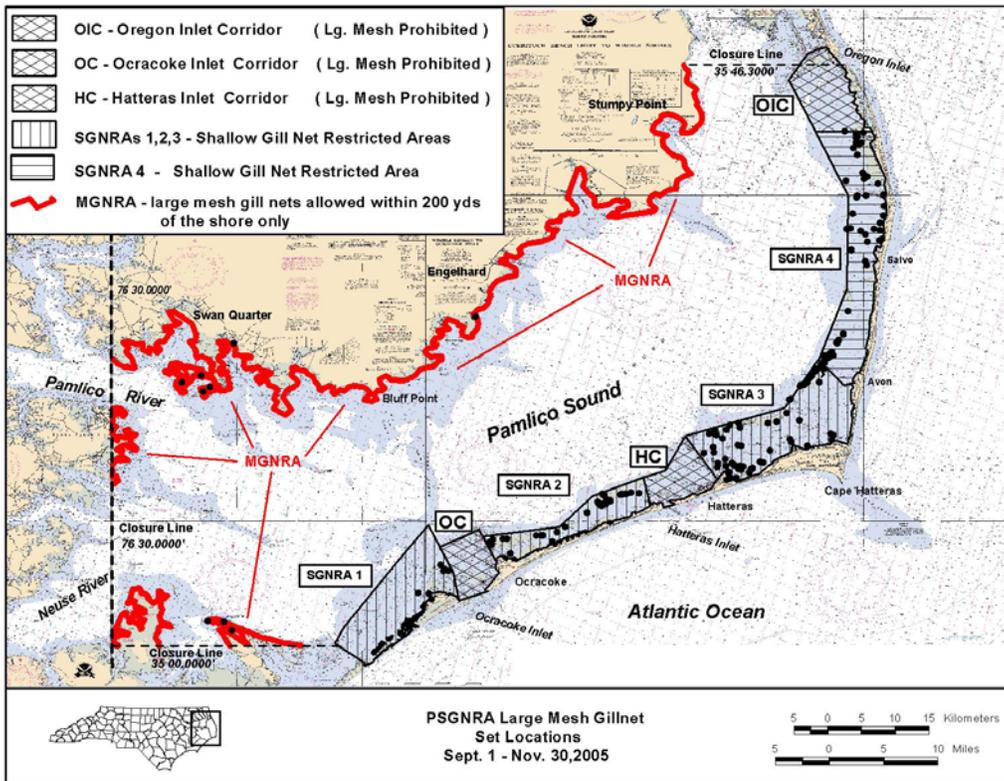


Figure 9. Observed large mesh gillnet sets in the PSGNRA from September 1 – November 30, 2005.

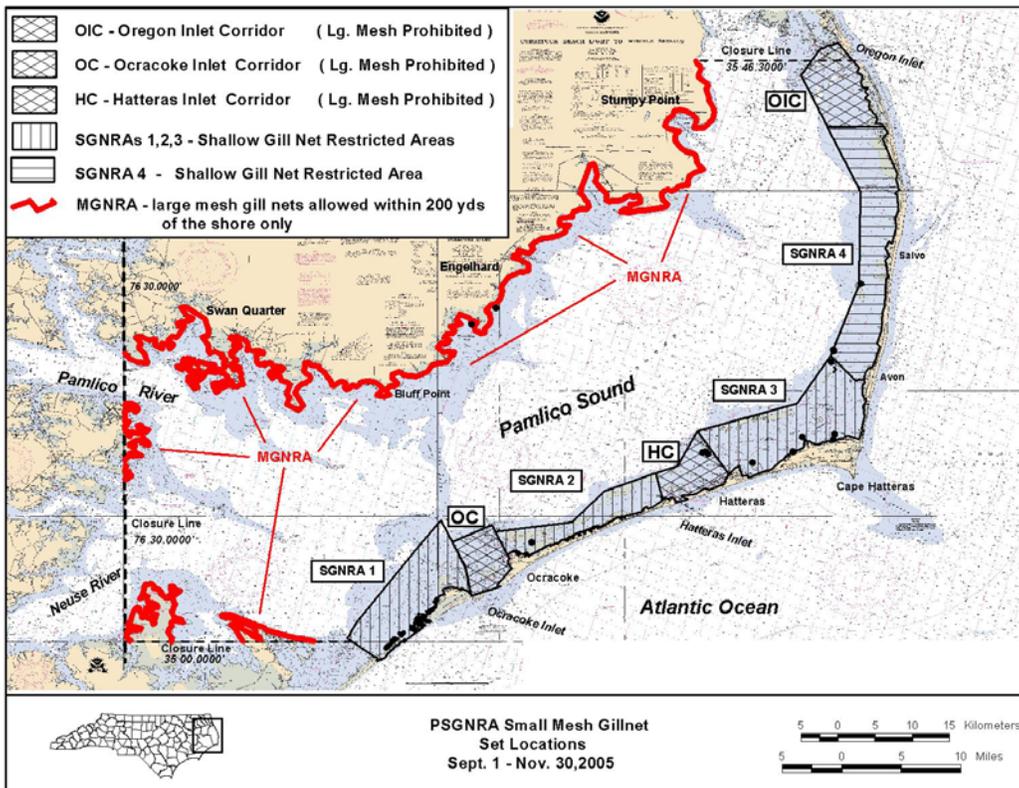


Figure 10. Observed small mesh gillnet sets in the PSGNRA from September 1 – November 30, 2005.

## Gillnet Parameters

Mesh sizes ranged from 2.88 to 8.75 inch stretched for the small and large mesh gillnet fisheries throughout the PSGNRA during 2005 (Table 7). Fishermen deployed approximately six inch stretch on average for large mesh, and 3.3 inch stretch on average for small mesh operations during 2005. Twine sizes ranged from 0.40 mm to 0.57 mm for the small and large mesh gillnet fisheries. Nets were deployed in water depths ranging from 0.1 m to 2.4 m in the large mesh gillnet fishery, and from 0.3 m to 3.0 m in the small mesh fishery. Mean soak times for both the large and small mesh gillnet fisheries were approximately 24 hours. An average of 1,200 yards of gillnet per trip was deployed in the large mesh fishery, while an average of 447 yards of gillnet per trip was deployed in the small mesh fishery (Table 7).

**Table 7.** Summary statistics for large and small mesh gillnet observations throughout the PSGNRA from September 1 – November 30, 2005.

Mesh Size	Net Type	Gear Parameter	N	Min	Mean	Max
Large Mesh	Set Net	Mesh Size (in)	2,172	5.00	5.96	8.75
		Twine Size (mm)	2,172	0.40	0.49	0.57
		Net Set Depth (m)	2,172	0.10	0.86	2.40
		Soak Time (hr)	2,172	6.00	24.28	81.33
		Yards/Trip	173	200	1,205	2,000
Small Mesh	Set Net	Mesh Size (in)	73	2.88	3.32	4.25
		Twine Size (mm)	73	0.47	0.52	0.57
		Net Set Depth (m)	73	0.30	1.60	3.00
		Soak Time (hr)	73	10.67	25.22	72.00
		Yards/Trip	22	100	447	1,000

## Bycatch

### *Finfish and Seabirds*

The majority of catches were paralichthid flounders representing approximately 63% of the catch by number and weight (Table 8). Red drum *Sciaenops ocellatus*, bluefish *Pomatomus saltatrix*, sheepshead *Archosargus probatocephalus*, and Atlantic menhaden *Brevoortia tyrannus* accounted for 22% of the total catch by weight. There were three striped bass *Morone saxatilis*, and five Atlantic sturgeon *Acipenser oxyrinchus* observed in large mesh gillnets during the 2005 PSGNRA. All five sturgeons were alive and released in good condition. Sea birds observed in large mesh gillnets during the 2005 season included: 66 double-brested cormorants *Phalacrocorax auritus*, 14 common loons *Gavia immer*, 3 brown pelicans *Pelecanus occidentalis*, 2 red breasted mergansers *Mergus serrator*, 1 red throated loon *Gavia stellata*, 1 lesser scaup *Aythya affinis*, and 1 bufflehead *Bucephala albeola* (Table 8).

**Table 8.** Species, biomass (kgs) and number of individuals sampled in the large mesh gillnet fishery in the PSGNRA from September 1 – November 30, 2005.

Scientific Name	Common Name	% Biomass	% Number	Total Number	Total Weight
Paralichthys spp.	Paralichthid flounders	62.75	62.98	7,799	7,232.77
Sciaenops ocellatus	red drum	12.44	6.78	839	1,434.09
Rhinoptera bonasus	cownose ray	9.29	5.21	645	1,070.76
Pomatomus saltatrix	bluefish	5.88	8.36	1,035	677.36
Archosargus probatocephalus	sheepshead	2.72	1.65	204	313.47
Limulus polyphemus	horseshoe crab	1.42	0.58	72	163.80
Brevoortia tyrannus	Atlantic menhaden	0.95	4.62	572	109.16
Leiostomus xanthurus	spot	0.74	2.11	261	85.22
Cynoscion regalis	weakfish	0.67	1.36	168	77.34
Pogonias cromis	black drum	0.55	0.33	41	63.86
Mugil cephalus	striped mullet	0.47	0.18	22	53.80
Chaetodipterus faber	Atlantic spadefish	0.38	0.46	57	43.30
Cynoscion nebulosus	spotted seatrout	0.37	0.32	40	43.10
Lagodon rhomboides	pinfish	0.16	0.68	84	18.59
Micropogonias undulatus	Atlantic croaker	0.15	0.35	43	16.92
Trachinotus carolinus	Florida pompano	0.14	0.11	14	16.20
Carcharhinus limbatus	blacktip shark	0.11	0.02	3	13.00
Morone saxatilis	striped bass	0.10	0.02	3	11.90
Gymnura spp.	butterfly rays	0.09	0.05	6	10.80
Synodus foetens	inshore lizardfish	0.09	0.24	30	10.69
Acipenser oxyrinchus	Atlantic sturgeon	0.07	0.03	5	8.00
Menticirrhus spp.	kingfishes	0.07	0.22	27	7.67
Malaclemys terrapin	diamondback turtle	0.06	0.05	6	6.90
Dasyatidae	stingrays	0.04	0.10	13	4.77
Elops saurus	ladyfish	0.03	0.05	6	3.70
Orthopristis chrysoptera	pigfish	0.02	0.08	10	2.70
Sela. Lamni. Scyliorhinoidei	cat sharks	0.02	0.01	1	2.40
Menticirrhus americanus	southern kingfish	0.02	0.06	8	2.40
Opsanus tau	oyster toadfish	0.02	0.03	4	2.30
Rachycentron canadum	cobia	0.02	0.02	3	2.30
Dorosoma cepedianum	gizzard shad	0.01	0.02	2	1.60
Caranx hippos	crevalle jack	0.01	0.02	2	1.50
Caranx spp.	Caranx jacks	0.01	0.02	2	1.00
Scophthalmus aquosus	windowpane	0.01	0.03	4	0.90
Chilomycterus atinga	spotted burrfish	0.01	0.01	1	0.70
Peprilus triacanthus	butterfish	0.00	0.02	2	0.40
Citharichthys macrops	spotted Whiff	0.00	0.02	2	0.40
Gymnura micrura	smooth butterfly ray	0.00	0.02	3	0.30
Strongylura spp.	Strongylura needlefishes	0.00	0.01	1	0.30
Syngnathus spp.	Syngnathus pipefishes	0.00	0.02	3	0.30
Selene vomer	lookdown	0.00	0.01	1	0.10
Squatina dumeril	Atlantic angel shark	.	0.01	1	.
Rajiformes	rays	.	0.11	14	.
Raja eglanteria	clearnose skate	.	0.05	6	.
Raja radiata	thorny skate	.	0.01	1	.
Dasyatis spp.	Dasyatis stingrays	.	0.36	45	.
Dasyatis americana	southern stingray	.	0.44	55	.
Dasyatis sabina	Atlantic stingray	.	0.69	85	.
Myliobatis freminvillei	bullnose ray	.	0.15	19	.
Alosa mediocris	hickory shad	.	0.10	13	.
Cyprinus carpio	common carp	.	0.01	1	.
Lobotes surinamensis	tripletail	.	0.01	1	.
Stenotomus chrysops	scup	.	0.01	1	.
Astroscopus spp.	Astroscopus stargazers	.	0.02	2	.
Peprilus spp.	Peprilus butterfish	.	0.01	1	.
Chrysemys scripta	yellowbelly turtle	.	0.02	2	.
Gavia Immer	common loon	.	0.11	14	.
Gavia Stellata	red throated loon	.	0.01	1	.
Pelecanus Occidentalis	brown pelican	.	0.02	3	.
Phalacrocorax Auritus	double-crested cormorant	.	0.53	66	.
Aythya Affinis	lesser scaup duck	.	0.01	1	.
Bucephala Albeola	Bufflehead	.	0.01	1	.
Mergus Serrator	red breasted merganser	.	0.02	2	.
Chelonia Mydas	green Turtle	.	0.02	4	.
Caretta caretta	loggerhead	.	0.01	2	.
Lepidochelys kempii	Kemp's ridley	.	0.01	1	.

Finfish species observed in small mesh gillnets were primarily Atlantic menhaden, hickory shad *Alosa mediocris*, spot *Leiostomus xanthurus*, bluefish, and striped mullet *Mugil cephalus* (Table 9). Collectively, these species represented more than 80% of the total catch by weight and number. There were 53 red drum and no striped bass observed in small mesh gillnets from September 1 – November 30, 2005 in the PSGNRA. Seabird bycatch included one brown pelican and one double-crested cormorant (Table 9).

**Table 9.** Species, biomass (kgs) and number of individuals sampled in the small mesh gillnet fishery in the PSGNRA from September 1 – November 30, 2005.

Scientific Name	Common Name	% Biomass	% Number	Total Number	Total Weight
<i>Brevoortia tyrannus</i>	Atlantic menhaden	34.54	55.80	2,017	385.84
<i>Alosa mediocris</i>	hickory shad	17.84	6.64	240	199.30
<i>Leiostomus xanthurus</i>	spot	11.68	12.50	452	130.53
<i>Pomatomus saltatrix</i>	bluefish	9.31	4.26	154	104.00
<i>Mugil cephalus</i>	striped mullet	7.13	3.73	135	79.61
<i>Cynoscion regalis</i>	weakfish	4.76	3.32	120	53.14
<i>Pogonias cromis</i>	black drum	3.85	5.31	192	43.04
<i>Sciaenops ocellatus</i>	red drum	3.76	1.47	53	42.04
<i>Cynoscion nebulosus</i>	spotted seatrout	1.21	0.39	14	13.50
<i>Menticirrhus</i> spp.	kingfishes	1.14	0.97	35	12.69
<i>Alosa pseudoharengus</i>	alewife	0.81	1.13	41	9.00
<i>Paralichthys</i> spp.	Paralichthid flounders	0.69	0.30	11	7.70
<i>Morone americana</i>	white perch	0.60	0.77	28	6.70
<i>Micropogonias undulatus</i>	Atlantic croaker	0.54	0.50	18	6.04
<i>Dorosoma cepedianum</i>	gizzard shad	0.47	0.53	19	5.20
<i>Orthopristis chrysoptera</i>	pigfish	0.47	1.16	42	5.20
<i>Acipenser oxyrhynchus</i>	Atlantic sturgeon	0.39	0.06	2	4.40
<i>Trachinotus carolinus</i>	Florida pompano	0.19	0.53	19	2.10
<i>Archosargus probatocephalus</i>	sheepshead	0.18	0.06	2	2.00
<i>Squalus acanthias</i>	spiny dogfish	0.17	0.03	1	1.90
<i>Alosa sapidissima</i>	American shad	0.15	0.03	1	1.70
<i>Peprilus triacanthus</i>	butterfish	0.06	0.17	6	0.70
<i>Ictalurus</i> spp.	<i>Ictalurus</i> catfishes	0.04	0.03	1	0.40
<i>Spherooides</i> spp.	<i>Spherooides</i> puffers	0.02	0.03	1	0.20
<i>Prionotus</i> spp.	<i>Prionotus</i> searobins	0.01	0.03	1	0.10
<i>Lagodon rhomboides</i>	pinfish	0.01	0.03	1	0.10
<i>Limulus polyphemus</i>	horseshoe crab		0.03	1	
<i>Petromyzon marinus</i>	sea Lamprey		0.03	1	
<i>Dasyatis sabina</i>	Atlantic stingray		0.03	1	
<i>Rhinoptera bonasus</i>	cownose ray		0.06	2	
<i>Cyprinus carpio</i>	common carp		0.03	1	
<i>Astroscopus</i> spp.	<i>Astroscopus</i> stargazers		0.03	1	
<i>Pelecanus Occidentalis</i>	brown pelican		0.03	1	
<i>Phalacrocorax Aurlitus</i>	double-crested cormorant		0.03	1	

## Sea Turtles

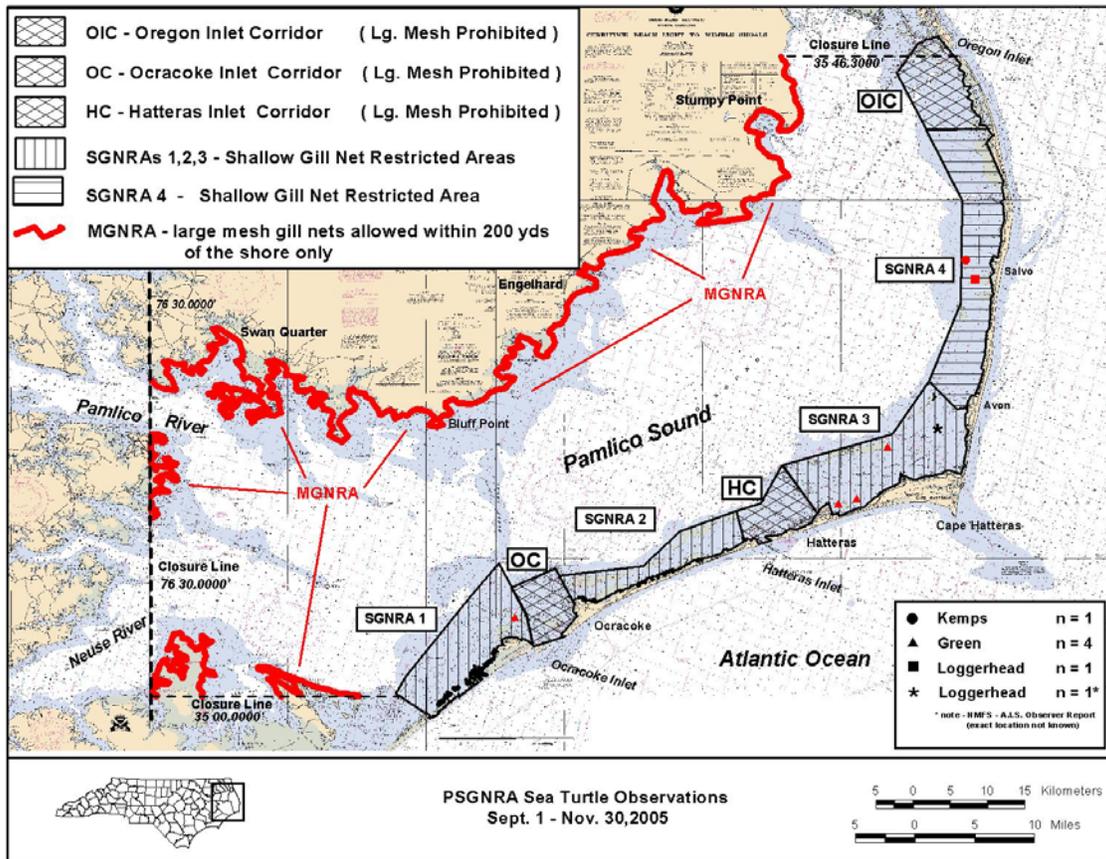
Seven sea turtles were observed from September 1 – November 30, 2005 in the PSGNRA, and all interactions occurred in large mesh gillnets (Table 10, Figure 11). All sea turtles were observed along the Outer Banks in restricted areas SGNRA4 (n = 2), SGNRA3 (n = 4), and SGNRA1 (n = 1). There were four live green turtles, one live Kemp’s ridley, one live loggerhead, and one dead loggerhead observed. NCDMF observers observed five of the seven turtles, while NMFS (A.I.S.) observers reported two of the interactions. The majority (71%) of interactions occurred between September 23 and November 1, 2005. One interaction occurred before and one occurred after this time frame, both with live individuals. All live individuals except one were sampled, tagged, and released in good condition at or near Hatteras or Ocracoke Inlet, NC. The live green turtle on 11 September 2005 appeared lethargic with labored breathing, and was transported to the Network for Endangered Sea Turtles (NEST) rehabilitation facility in Kill Devil Hills, North Carolina (Table 10).

There were three live green turtles observed in SGNRA3 and one live green observed in SGNRA1 (Figure 11). The one live Kemp’s ridley and one dead loggerhead were observed in SGNRA4. The other live loggerhead was observed in SGNRA3 in close proximity to the inlet, however a NMFS observer documented this turtle and no GPS location was recorded or provided to NCDMF. Thus, the location of this turtle, denoted on Figure 11 with an asterisk, is an approximate location. There were no turtles observed along the mainland side of Pamlico Sound, and no turtles observed in small mesh gillnets during 2005.

**Table 10.** Observed large mesh gillnet sea turtle interactions by species, condition, carapace length (mm), location, and date from September 1 – November 30, 2005 in the PSGNRA.

Date	Species	Cond.	Carapace Length	Restricted Area	Location	Inconel Tag 1	Inconel Tag 2	Pit Tag
9/10/2005	Kemp's	Alive	280	S4	N 35 30.148 W 75 30.203	PPX359	PPX358	433 049 494A
9/23/2005 *	Green	Alive	unknown	S3	N 35 13.5 W 75 40.3	unknown	unknown	unknown
9/24/2005	Loggerhead	Dead	725	S4	N 35 51.560 W 75 30.847	na	na	na
10/2/2005	Green	Alive	300	S3	N 35 18.375 W 75 36.686	PPX361	PPX362	433 97E 0C60
10/6/2005 *	Loggerhead	Alive	531	S3	unknown	RRH788	RRH789	na
11/1/2005	Green	Alive	312	S1	N 35 05.998 W 76 03.062	na	na	433 178 1023
11/11/2005	Green	Alive	312	S3	N 35 13.901 W 75 39.062	XXP501	XXP502	433 205 4C29

\* Observations made by NMFS (A.I.S.) observer and some information not provided.



**Figure 11.** Observed sea turtle interactions by species throughout the PSGNRA from September 1 – November 30, 2005.

### Sea Turtle Bycatch Estimates

Note: Weekly reports for sea turtle bycatch estimates were submitted, and there is a correction for the week 11 (November 5 – November 11). Specifically, effort from one observer had not been incorporated which thereby reduces bycatch estimates from the previous weekly report. Updated estimates are incorporated below, and a corrected week 11 report can be viewed in Appendix 1.

Sea turtle bycatch estimates were calculated using the stratified ratio method where the bycatch rate was determined from the number of sea turtles observed per unit of fishing effort by area (Table 11). Fishing effort was measured by the multiplication of total yards and soak days. Using this effort component has been agreed upon by NMFS and NCDMF as the least variable measure (Price 2005). This rate was then multiplied by the total fishing effort (yards \* soak days) reported for each area and each week. Restricted areas SGNRA1, SGNRA2, SGNRA3, and SGNRA4 spatially defined the strata. Total bycatch estimates were calculated weekly by adding estimates for each restricted area (Table 11). Total take estimates (live and lethal) were then calculated by adding weekly take estimates by species and area. This allowed for cumulative estimates to be monitored weekly and ensured numbers remained below authorized takes.

Total take estimates by species and disposition were 28 live green, four live Kemp's ridley, eight live loggerhead, and four dead loggerhead sea turtles (Table 12). Two significant digits are shown in Table 12 because both the Kemp's ridley and loggerhead estimates will be based on three-year cycles to account for annual variability and ensure authorized take thresholds are not exceeded.

**Table 11.** Observed large mesh gillnet sea turtle interactions by area and week with corresponding calculated bycatch rate, reported effort, and total bycatch estimates throughout the PSGNRA from September 1 – November 30, 2005.

Week	Area	Observed Turtles	Species	Observed Effort	Effort Bycatch Rate *	Reported Effort	Bycatch Estimate
3	S4	1	Kemp's	6,400	0.1563	25,900	4.0
4	S3	1	Green	10,924	0.0915	95,050	8.7
5	S4	1	Loggerhead *	21,100	0.0474	73,950	3.5
6	S3	1	Green	14,745	0.0678	117,550	8.0
6	S3	1	Loggerhead	14,745	0.0678	117,550	8.0
10	S1	1	Green	1,850	0.5405	13,500	7.3
11	S3	1	Green	13,794	0.0725	59,300	4.3

\* observed sea turtle mortality

**Table 12.** Allowable sea turtle take thresholds and bycatch estimates by species and disposition throughout the PSGNRA from September 1 – November 30, 2005.

Species	Authorized Threshold Live Takes	Effort Estimated Live Takes	Authorized Threshold Lethal Takes	Effort Estimated Lethal Takes
Green	120	28.3	48	0
Kemp's ridley <sup>1</sup>	27	4.0	14	0
Loggerhead <sup>1</sup>	38	8.0	3	3.5

<sup>1</sup> Kemp's ridley and Loggerhead estimated take will be based on a 3-year period (i.e, Kemp's ridley = 81 live, 42 lethal for 2005 - 2007 and 81 live, 42 lethal for 2008 - 2010; Loggerhead = 114 live, 9 lethal for 2005-2007 and 114 live, 9 lethal for 2008-2010) for purposes of exceeding the threshold. Estimated take of Kemp's ridleys and loggerheads varies greatly by year, thus combining years will account for some of the variability across years.

## NCDMF Marine Patrol Monitoring Summary

NCDMF Marine Patrol officers conducted numerous boat patrols and flight surveys assessing total effort, speaking with fishermen, and checking nets in the PSGNRA (Table 13). A total of 47 boat patrols was made from September 1 – November 30, 2005 and patrol officers observed 243 nets, checked 56 boats, and spoke with 71 individual fishermen on the water. Five violations were issued to commercial fishermen including two warnings for failure to have PSGNRA permits on hand, and three permit suspensions (including one citation) for late and non-reporting (Table 13).

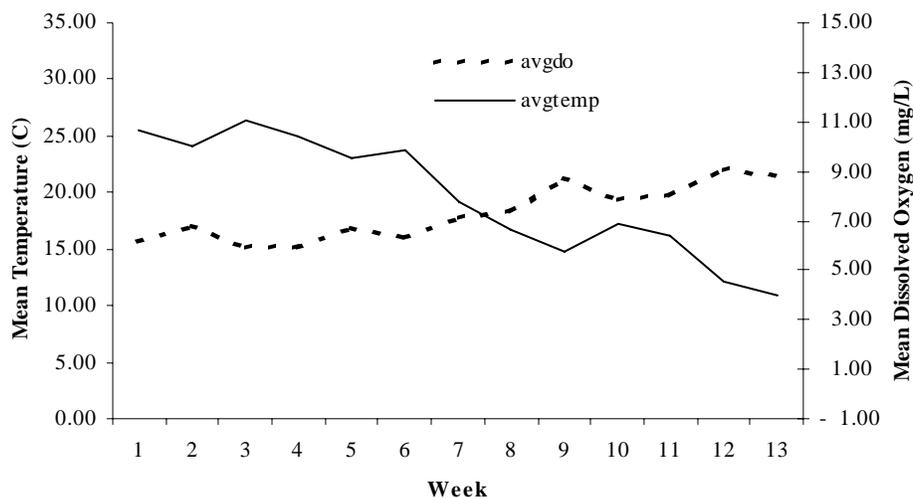
There were also 11 flight surveys conducted during the 2005 PSGNRA with an NCDMF pilot, the PSGNRA coordinator, and staff. Each of the flights originated in Beaufort, NC and commenced to survey Portsmouth Island, the Outer Banks, along the mainland side of Pamlico Sound, and transected in and out of the restricted fishing areas. Flight surveys were designed to assess relative effort by area each week and to search for activity outside of the restricted fishing areas. Location information was submitted to each district office and the NCDMF observers weekly to better direct subsequent weeks surveys and monitoring.

**Table 13.** NCDMF Marine Patrol surveillance summary throughout the PSGNRA from September 1 – November 30, 2005.

NCDMF Marine Patrol								
Week	Boat Patrols (#)	Boats Checked (#)	Fishermen Checked (#)	Flight Surveys (#)	Nets Observed (#)	Areas Surveyed (M, S1 -S4, OIC, HC, OC, PS)	Violations (#)	Comments/Flight Survey Information
1	5	5	7	0	3	S2,S3,S4,OIC,HC	0	in compliance
2	2	1	1	1	1	M, S1 - S4	0	in compliance; 55 nets observed during flight
3	0	0	0	0	0	0	0	adverse weather conditions prevented NCDMF Marine Patrol Surveys
4	4	8	10	2	12	M, S2 - S4, OIC, HC, OC, PS	0	in compliance; 2 small green turtles released; fishermen reported interactions; 14 vessels and 47 nets observed during flight
5	3	3	3	0	2	S1,S2,S3,S4,OIC	2	violations-issued warnings for not having permit at hand. Checked 14 net also, no yardage given
6	4	4	5	2	83	M, S2 - S4, OIC, HC, OC, PS	0	83 nets and 12 vessels observed during flight The Roanoke observed one boat in transit, weather was rainy and windy. 2nd flight covered PS only, and 1 boat observed
7	3	7	7	1	24	M, S2-S4, PS, HC, OC, OIC	0	saw some nets/in compliance on boat patrol and 9 vessels observed during flight. The Roanoke observed one boat in transit, weather was
8	2	2	2	2	23	M, S1 - S4, OIC, HC, OC, PS	0	flight number 1 observer 27 boats, 98 nets; flight number 2 observed 15 boats, 86 nets.
9	6	17	24	0	37	M, S1 - S4, OIC, HC, OC, PS	1	violaton: leaving small mesh unattended (S4); officers made 5 boat patrols checked several nets and fishermen
10	5	1	1	1	24	S1 - S4, OIC, HC, OC, PS	0	flight on mainland side of Pamlico Sound - no gillnet activity observed
11	6	5	8	1	20	M, S1 - S4, OIC, HC, OC, PS	1	1 NOV issued for late reporting; flight coverage - all areas; 17 boats observed (4 mullet fishermen, 1 pound net boat, 5 actively fishing gillnet, and 5 other boats in route); flight observed 66 nets
12	3	0	0	1	8	M,S3,S4,OIC,HC	0	flight coverage (S2, S3); observed 12 nets, 2 boats.
13	2	3	3	0	6	M,S2,S3,S4,HC	1	1 citation issued to Andy O'neal for non-reporting; NOV to follow
14	2	0	0	0	0	S3,S4,OIC,HC	0	low effort (week only partial through Wednesday)
<b>Totals</b>	<b>47</b>	<b>56</b>	<b>71</b>	<b>11</b>	<b>243</b>		<b>5</b>	

## Water Quality

The water quality parameters of temperature ( $^{\circ}\text{C}$ ), salinity (ppt), and dissolved oxygen (mg/L) were recorded weekly throughout the PSGNRA during 2005. Water temperature ranged from a high of  $27.9^{\circ}\text{C}$  in week 2 to a low of  $8.9^{\circ}\text{C}$  in week 14 of the PSGNRA season. Dissolved oxygen content ranged from a high of  $11.3\text{ mg/L}$  in week 11 to a low of  $4.7\text{ mg/L}$  in week 4 of the PSGNRA season. There was a decreasing trend in mean water temperature and an increasing trend in mean dissolved oxygen content from September 1 – November 30, 2005 in Pamlico Sound (Figure 12). The salinity content of the shallow water regions of Pamlico Sound remained relatively stable throughout the fall 2005 averaging approximately 20 ppt from September 1 – November 30.



**Figure 12.** Mean water quality parameters of temperature ( $^{\circ}\text{C}$ ) and dissolved oxygen in Pamlico Sound from September 1 - November 30, 2005.

## Sea Turtle Strandings Summary

Sea turtle strandings in North Carolina increased from 1995 – 2000. Prior to 1995, annual stranding totals averaged less than 200. Strandings reached their highest level in 2000 with 831 reported statewide. Strandings throughout North Carolina have remained relatively consistent since that time with an average of 443 strandings per year statewide from 2002 – 2005. Total reported strandings in 2005 were reduced from 447 in 2004 to 378 in 2005. The most common species of sea turtle stranded was the loggerhead representing 66% of the total strandings from 2002-2005 (North Carolina Wildlife Resources Commission Sea Turtle Stranding Network Database 2005).

## 2002 – Present Sea Turtle Take Estimate History

A total of 32 sea turtles has been observed in large mesh gillnets in the PSGNRA from 2002 – 2005 (Table 14). These included: 21 green sea turtles, four Kemp’s ridley sea turtles, and seven loggerhead sea turtles. More than 775,000 yards of large mesh gillnet effort was directly observed in four years of monitoring the PSGNRA (Price 2004, 2005; Gearhart 2002, 2003).

From 2002 to present, estimated sea turtle takes have remained well below authorized thresholds (Table 14). The majority (83%) of all sea turtle interactions have been with live individuals that were subsequently sampled and released in good condition. The most common species encountered has been small green sea turtles, which represented 66% of all interactions. There have been 53 estimated mortalities since 2002 comprised of 15 Kemp’s ridley, 34 green, and 4 loggerhead sea turtles (Table 14).

**Table 14.** Summary of authorized and estimated sea turtle takes by species, disposition and year from 2002 – present from September through December of each year in the PSGNRA.

Year	Species	Live			Lethal		
		Authorized	Observed	Estimated	Authorized	Observed	Estimated
2002	Kemp's	80	0	0	25	1	8
	Green	160	6	97	50	0	0
	loggerhead	80	5	65	25	0	0
2003	Kemp's	80	0	0	25	0	0
	Green	160	2	19	50	2	15
	loggerhead	80	0	0	25	0	0
2004	Kemp's	80	1	12	25	1	7
	Green	160	4	28	50	3	19
	loggerhead	80	0	0	25	0	0
2005	Kemp's <sup>1</sup>	27	1	4	14	0	0
	Green	120	4	28	48	0	0
	loggerhead <sup>1</sup>	38	1	8	3	1	4

<sup>1</sup> Kemp's ridley and Loggerhead estimated take will be based on a 3-year period (i.e, Kemp's ridley = 81 live, 42 lethal for 2005 - 2007 and 81 live, 42 lethal for 2008 - 2010; Loggerhead = 114 live, 9 lethal for 2005-2007 and 114 live, 9 lethal for 2008-2010) for purposes of exceeding the threshold. Estimated take of Kemp's ridleys and loggerheads varies greatly by year, thus combining years will account for some of the variability across years.

## Discussion

The PSGNRA has been managed effectively since 2000. The management of this region will continue to allow a limited shallow water gillnet fishery, and simultaneously offer increased protection for threatened and endangered sea turtles (ESA 1973). The resources obtained from this fall flounder fishery provide economic stability to the commercial fishermen and the local communities along the Outer Banks. In addition, this fishery allows for local seafood to enter state markets, restaurants and assists in minimizing reduced market values through import surplus. Thus, fishery managers and the state of North Carolina have a responsibility to maintain this fishery, while implementing measures to protect sea turtles.

Sea turtle interactions all occurred in large mesh gillnets along the Outer Banks during 2005, and remained well below authorized thresholds. The majority (n = 5, 71% of total) of these interactions were between September 23 and November 1, 2005. There was one interaction before and after this time frame with live individuals that were sampled and released. This temporal trend with peak interactions remains consistent since the inception of the PSGNRA. There were no interactions along the mainland side of Pamlico Sound or observed in small mesh gillnets during 2005. Attendance requirements in the small mesh fishery prior to November 1 of each year decrease the number of set gillnet fishermen. These measures combined with the smaller mesh greatly reduce sea turtle interaction potential in the small mesh fishery. Sea turtles have never been observed in small mesh gillnets in the PSGNRA (Price 2004, 2005; Gearhart 2001, 2002, 2003).

The species composition of observed sea turtles during 2005 remained relatively consistent with the past few years of monitoring in the PSGNRA with live green turtles representing the majority of interactions. However, there were two loggerhead sea turtle interactions, which have not been observed since 2002. In 2002, there were five observed live loggerhead interactions. Loggerhead interactions were not observed in 2001, 2003, and 2004 (Price 2004, 2005; Gearhart 2002).

There was only one sea turtle mortality observed in 2005, which was a dead loggerhead sea turtle that had been captured in a large mesh gillnet near Salvo, NC on the Outer Banks. This was the first loggerhead mortality observed from 2001 to present. The relative size of the loggerhead, and the shallow water depth in which the large mesh gillnet fishery is propagated has seemingly prevented mortalities in the fall shallow water gillnet fishery in Pamlico Sound. This mortality was observed in extenuating circumstances that are not typically documented. Specifically, the loggerhead sea turtle was observed in a large mesh gillnet that was inundated with sea grasses causing excessive weight in the net. A 180-degree wind shift from the time the gear was deployed and retrieved caused this to happen. The added weight prevented the turtle from surfacing. This scenario has not been observed in the past. Due to the relatively shallow water depth in which large mesh gillnets are deployed in the PSGNRA and the size of the loggerhead sea turtles, NCDMF does not anticipate an increase in loggerhead sea turtle interactions.

Management changes to the PSGNRA during 2005 proved effective in minimizing sea turtle interactions and subsequent mortalities, while allowing a limited shallow water large mesh gillnet fishery to operate. The management changes included; redirecting observer coverage by area and weight, eliminating the PSGNRA permit requirements for the mainland side of Pamlico

Sound, and only requiring active fishermen to report each week. In addition, NCDMF implemented a state closure, in conjunction with the federal closure throughout Pamlico Sound, which allowed NCDMF Marine Patrol officers enforcement jurisdiction throughout the PSGNRA. This also facilitated increased surveillance through boat patrols, fishermen checks, fish house visits, and aerial surveys. Collectively, these measures were a great addition to the PSGNRA, and designed to better direct resources to monitoring efforts along the Outer Banks and provide increased protection for sea turtles. The management measures during 2005 facilitated increased industry compliance and awareness, established new weekly operations (e.g., fish house visits, Marine Patrol surveys), and enabled NCDMF observers to obtain nearly 12% of the total large mesh gillnet effort throughout PSGNRA. This level of coverage has been unprecedented since the inception of this management regime.

There was also assistance from the NMFS observer program (Northeast Fishery Science Center) during 2005 as A.I.S. contracted observers obtained inshore large mesh gillnet trips in the PSGNRA and provided NCDMF with weekly debriefing information. This federal program is designed to obtain ocean-going commercial fishing trips, however federal observers will obtain inshore trips at times. The assistance from this program was greatly appreciated and contributed to the monitoring efforts and protection of sea turtles in the PSGNRA. NCDMF hopes these collaborative efforts will continue.

In May 2005, NCDMF conducted public meetings at fish houses along the Outer Banks and the mainland side of Pamlico Sound. These outreach meetings informed the industry of potential management changes, discussed the Endangered Species Act (1973), and increased awareness about protected species issues. NCDMF also provided the industry with summary information and sea turtle resuscitation protocols during these meetings, and via mail. In addition, daily communications were made with various industry representatives to keep the industry up-to-date on the PSGNRA management and industry requirements for the fall flounder fishery in Pamlico Sound. NCDMF will continue these outreach efforts to incorporate industry knowledge into management and make better management decisions.

## **Recommendations**

NCDMF requests federal funding assistance for this intensive monitoring program. Management changes have better directed resources, but have also required additional Marine Patrol expenditures. The PSGNRA is a federal closure designed to protect endangered and threatened species. NCDMF is committed to sea turtle protection and maintaining a limited shallow water gillnet fishery, which many fishermen and local communities depend upon. A long-term stable funding source through federal sea turtle monitoring allocations would allow increased observations, better characterization of fishery interactions, and protection of sea turtle populations.

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