



**Sea Turtle Bycatch Monitoring of the 2007 Fall Gillnet Fisheries in Southeastern  
Pamlico Sound, North Carolina**

**Completion Report for Activities Under  
Endangered Species Act  
Section 10 Incidental Take Permit # 1528**

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## **Introduction**

The Pamlico Sound Gillnet Restricted Area (PSGNRA) originated in 2000, and has been managed since under protocols established by the North Carolina Division of Marine Fisheries (NCDMF) and the National Marine Fisheries Service (NMFS). The PSGNRA is a permanent closure of Pamlico Sound to large mesh gillnets (> 4 ¼ in. stretch mesh, FR Vol. 67, No 173 56931), established due to increased observations of sea turtle strandings, and subsequent observed gillnet interactions in 1999 along the Outer Banks (Gearhart 2001). A limited, shallow water gillnet fishery continues to operate through Section 10 Incidental Take Permits (ESA 1973) along the mainland side and Outer Banks of Pamlico Sound.

Habitat Conservation Plans (HCPs) within Section 10 Incidental Take Permits (ITPs) allowed establishment of an extensive monitoring program in this region since 2000 (Gearhart 2001, 2002, 2003; Price 2004, 2005, 2006, 2007). The primary goal each year in the management of the PSGNRA was to monitor and reduce sea turtle 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. Fishery management measures within HCPs restrict areas, seasons, gear, mandate observer coverage, and require weekly reporting. These actions 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.

In December 2004, NCDMF consulted with NMFS to begin application for resulting Section 10 ITP #1528 (ESA 1973). Management measures imposed during the 2002 –2004 fall fishing seasons allowed for a 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. The ITP #1528 was authorized for six years and will expire December 31, 2010. Since 2005, management methods throughout the PSGNRA have been consistent.

## **Methods**

The management of the PSGNRA during the 2007 fishing season was consistent with measures established in ITP # 1528 (ESA 1973) and remained similar to previous years (Gearhart 2001, 2002, 2003; Price 2004, 2005, 2006, 2007). 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.

### *Habitat Conservation Plan*

In August 2007, NCDMF issued proclamation M-12-2007, 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<sup>o</sup> 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 1). Proclamation M-12-2007 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 ( $\geq 5$  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*

PSGNRA active permit holders operating along the Outer Banks (SGNRA1 – SGNRA4, Figure 1) were required to submit weekly fishing reports to NCDMF. 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, yards of gillnet fished, soak time (days), number and disposition of sea turtles caught, and whether the fishermen had taken an observer during the week.

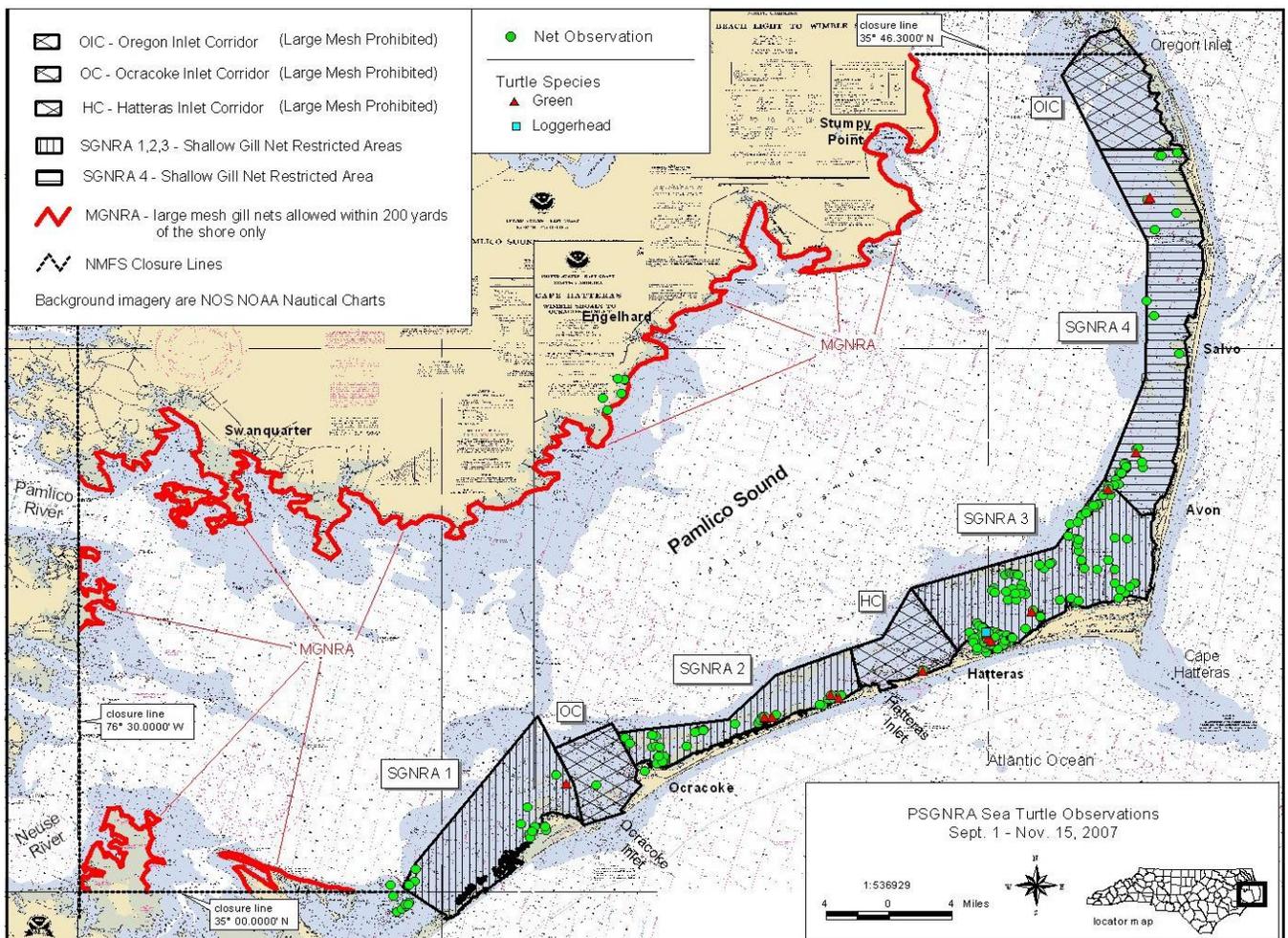
Failure to report accurate and timely information each week resulted in permit suspensions. Fishermen were required to report all sea turtle interactions to NCDMF within 24 hours. Penalties for late and non-reporting increased with subsequent offenses ranging from a 10-day suspension to a 6-month revocation. A cross-reference system was implemented with NCDMF Marine Patrol and local community fish house reports in 2005 and continued in the 2007 PSGNRA fishing season to ensure industry compliance with reporting requirements.

### *Compliance Checks*

NCDMF observers and NCDMF Marine Patrol conducted weekly fish house visits, boat patrols, fisherman spot checks, gear checks, and continued outreach to the industry for the purpose of ensuring industry compliance and communicating efforts throughout the PSGNRA (e.g., timely/accurate reporting, proper gear use). Aerial surveys were scheduled for the 2007 season.

NCDMF observers obtained trip ticket information from all fish houses throughout the PSGNRA to cross-reference with a weekly reporting database and determine late reporters, accuracy of reports, and non-reporters. Boat patrols, fishermen and gear checks were conducted regularly from September 1 – November 15, 2007 by NCDMF Marine Patrol. 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 of Pamlico Sound has provided jurisdictional authority for Marine Patrol surveys to be conducted and facilitated direct communication between the PSGNRA administrator and Marine Patrol officers. Outreach efforts to the commercial fishing industry and local communities along the Outer Banks and mainland side of Pamlico Sound continued to provide 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 1.** NCDMF 2007 Pamlico Sound Gillnet Restricted Area (PSGNRA). SGNRA1 – SGNRA4 = Shallow Water Gillnet Restricted Areas; MGNRA = Mainland Gillnet Restricted Area; OC = Ocracoke Corridor; HC = Hatteras Corridor; OIC = Oregon Inlet Corridor.

## *Sea Sampling*

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. Carcasses not brought in for post-mortem examinations were marked with external flipper tags or spray-painted before disposal overboard. All live, debilitated sea turtles were brought to shore for examination and treatment. 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.

The ITP required 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 2007. Observers were also required to obtain small mesh gillnet trips throughout the PSGNRA when feasible.

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 2006 PSGNRA trip distribution among ports. Mainland observer coverage was proportionally allocated based on the 2006 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 PSGNRA database.

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 2007 PSGNRA fishing season were the same as the 2006 season and based upon 2002 through 2004 observations using the upper 95% confidence limits around the estimated mean number of takes to account for a worst case scenario. The authorized take levels established in ITP # 1528 are scheduled to remain consistent each year from 2005 through 2010 (Table 1).

**Table 1.** Authorized sea turtle takes under ITP # 1528 (ESA 1973) for the 2007 PSGNRA fishing season.

Species	Maximum Authorized Estimated Lethal Takes	Maximum Authorized Estimated Live Takes	Total Authorized 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.

*Conference Calls/Consultations*

Conference calls were conducted between NCDMF and NMFS-Office of Protected Resources (Silver Spring, Md., and St. Petersburg, Fla.) at regular intervals throughout the 2007 PSGNRA season. Additional consultations were necessary during and following the 2007 PSGNRA season due to an increased number of observed sea turtle interactions and a resulting early season closure.

## Results

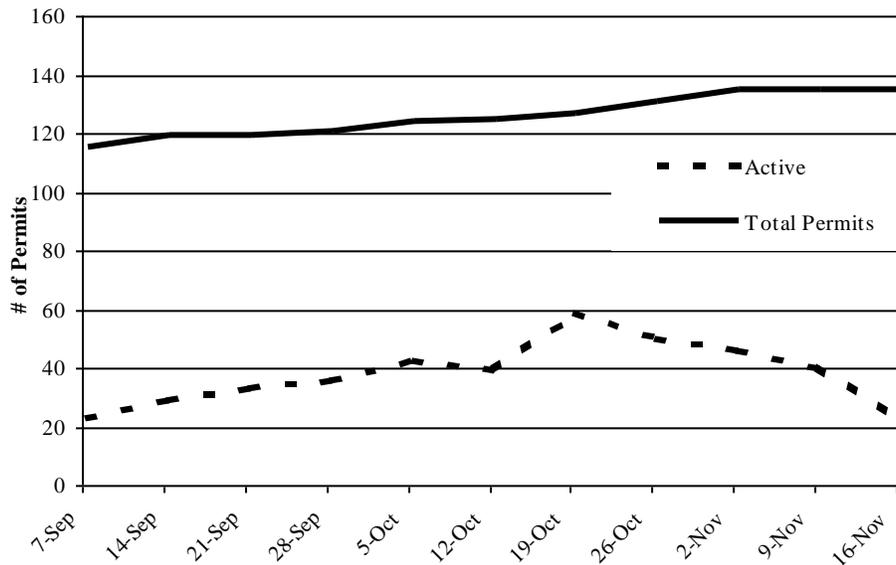
### 2007 Season Closure

The PSGNRA ended two weeks early on November 15 2007 due to increased observed and estimated live green sea turtle *Chelonia mydas* interactions. Total catches, and effort trends were affected by this early closure.

### Permit Activity

There were 135 permits issued throughout the 2007 PSGNRA season with a maximum number of 59 permits reporting activity during week 7 (Figure 2). An average of 38 fishermen reported weekly activity during the 11-week 2007 PSGNRA. Peak activity occurred during the first week and last two weeks of October.

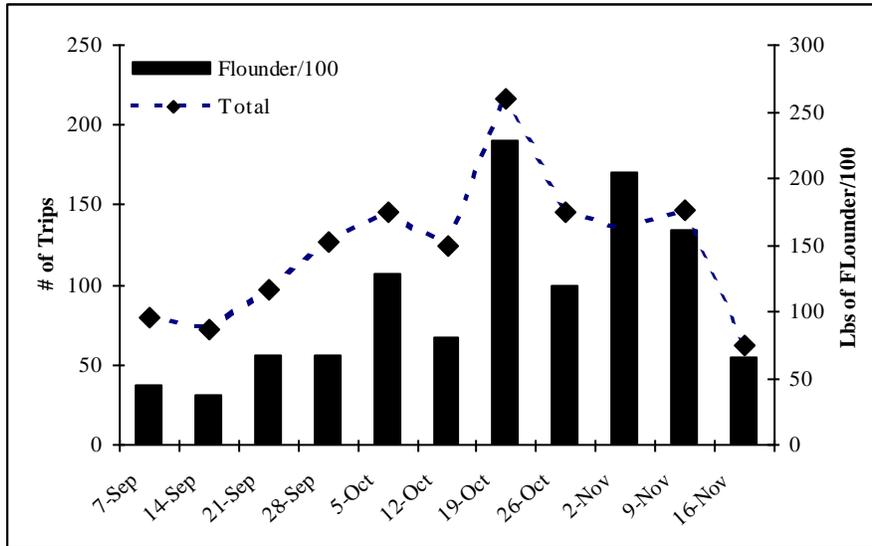
Fishermen remained compliant throughout the 2007 fishing season with weekly reporting and observer requirements. One notice of violation was submitted during the 2007 PSGNRA season, but follow up with the circumstances validated terminating the violation process in this matter. NCDMF maintained weekly boat patrols and fish house visits during the 2007 PSGNRA.



**Figure 2.** Number of total and active PSGNRA permits by week from September 1 – November 15 2007.

### Catch and Effort

There were 1,620 reported large mesh gillnet trips along the Outer Banks (SGNRA 1 – SGNRA4) during the 2007 PSGNRA (Figure 3). The maximum number of trips (n = 259) was reported during the third week of October with an average of 147 trips reported weekly during the season. Less than 100 trips were reported during the first two and last week of the 2007 PSGNRA season (Figure 3).



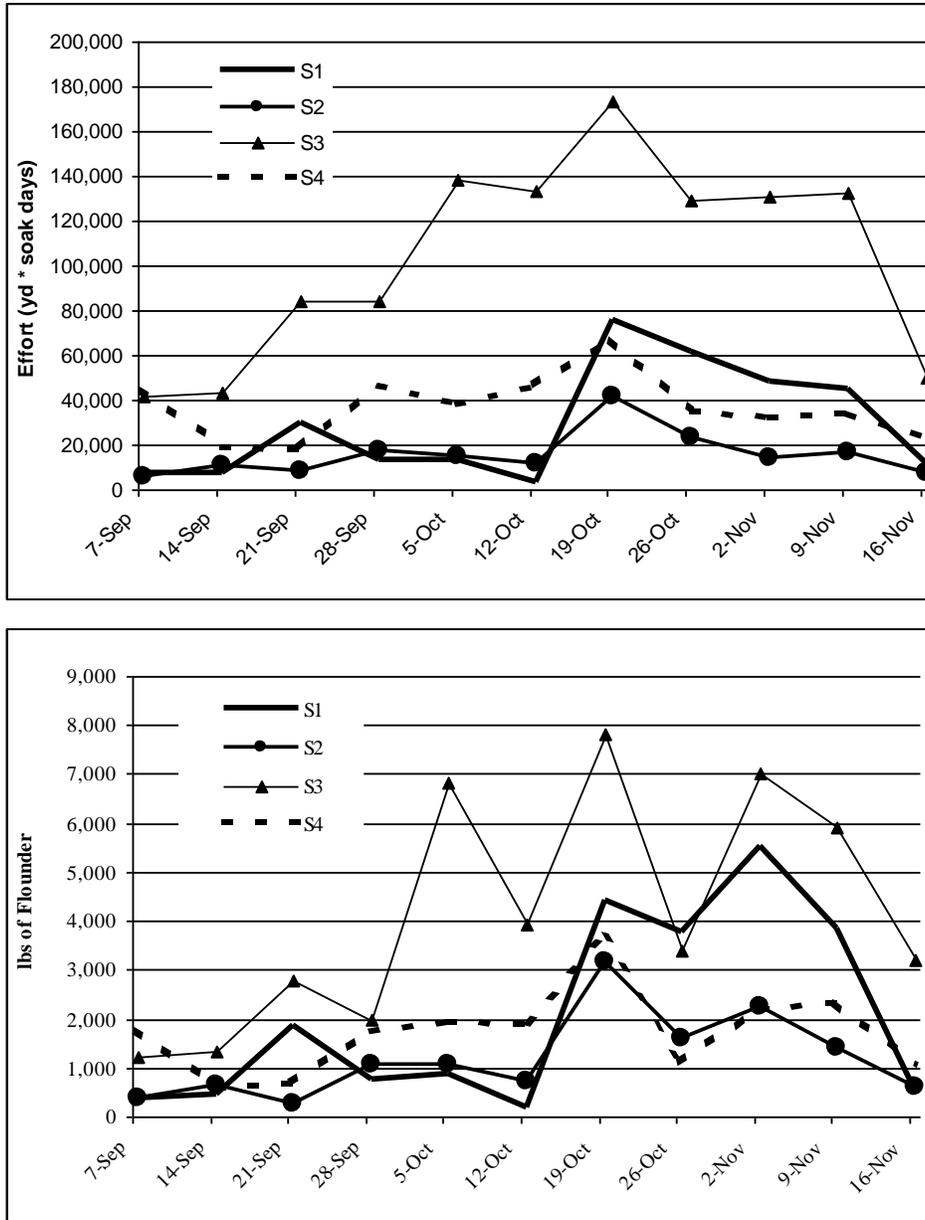
**Figure 3.** Total trips and pounds of southern flounder landed in the PSGNRA by week from September 1 – November 15 2007.

Fishermen reported approximately 2 million yards of large mesh gillnet effort landing 100,000 pounds of flounder (Table 2). The majority (56%) of the total effort, and nearly one-half (45%) of the total landings were reported from the backside of Hatteras Island in area SGNRA3 (S3). Effort and landings were relatively similar in SGNRA1 and SGNRA4. Reduced effort relative to other areas was reported from Ocracoke in SGNRA2 (Table 2).

**Table 2.** Percent of total effort (yds \* soak day) and total flounder landings (lbs) by area in the PSGNRA from September 1 – November 15 2007.

Area	Effort	Landings	% Total Effort	% Total Landings
S1	316,985	22,684	16	23
S2	172,825	13,153	8	13
S3	1,141,090	45,433	56	45
S4	404,300	19,047	20	19
<b>Totals</b>	<b>2,035,200</b>	<b>100,317</b>		

Weekly reported effort from SGNRA3 increased from the beginning of the season until the third week in October when a decreasing trend was observed for the remainder of the 2007 PSGNRA season (Figure 4). Weekly effort in SGNRA1, SGNRA2, and SGNRA4 remained relatively consistent and comparatively reduced throughout the season. There were peaks in effort in all areas during the third week in October. Greater than 100,000 yards of effort were observed weekly on average in SGNRA3, while weekly effort in the other areas averaged less than 37,000 yards (Figure 4). Combining all areas and weeks, weekly effort along the Outer Banks (SGNRA1 – SGNRA4) averaged 185,000 yards.



**Figure 4.** Large mesh gillnet effort and pounds of flounder by week from September 1 – November 15 2007.

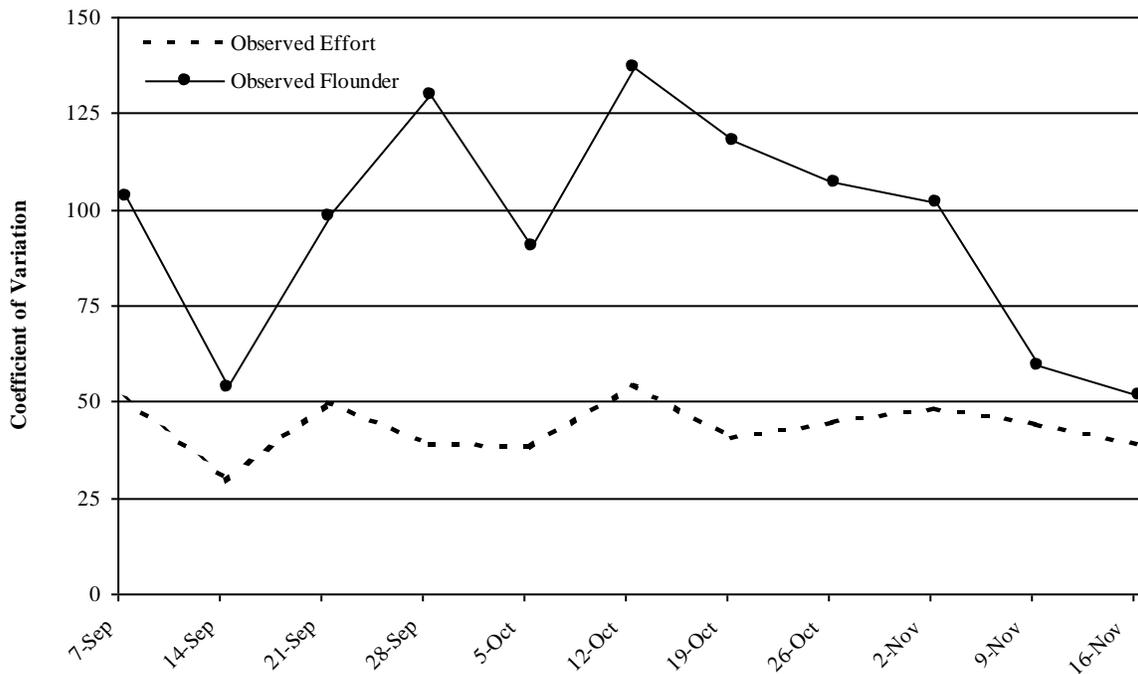
### Observer Coverage

There were a total of 143 observer trips conducted throughout the 2007 PSGNRA season (Table 3). These were comprised of 133 large mesh gillnet observations (representing > 157,000 yards of effort) along the Outer Banks (SGNRA1 – SGNRA4), four mainland side of Pamlico Sound, four Core Sound, and two small mesh gillnet trips. Percent coverage of the total fishing effort ranged from 3.0% - 11.1% weekly during the 2007 season. Observers obtained an overall 7.7 % coverage of the total fishing effort, which accounted for 8.2% of the total reported gillnet trips (Table 3).

**Table 3.** Observed and reported large mesh gillnet trips and effort (yds \* soak day) with relative percent coverage by week in the PSGNRA from September 1 – November 15 2007.

Week	Observed		Reported		% Coverage	
	Trips	Effort	Trips	Effort	Trips	Effort
7-Sep	4	3,000	95	99,050	4.2	3.0
14-Sep	6	5,415	86	81,575	7.0	6.6
21-Sep	12	12,110	117	140,215	10.3	8.6
28-Sep	14	16,175	152	162,105	9.2	10.0
5-Oct	11	13,725	175	204,975	6.3	6.7
12-Oct	13	14,955	150	195,295	8.7	7.7
19-Oct	21	27,320	259	357,105	8.1	7.7
26-Oct	16	19,935	175	248,360	9.1	8.0
2-Nov	12	15,065	161	225,970	7.5	6.7
9-Nov	20	25,250	176	228,450	11.4	11.1
16-Nov	4	4,400	74	92,100	5.4	4.8
<b>Totals</b>	<b>133</b>	<b>157,350</b>	<b>1,620</b>	<b>2,035,200</b>	<b>8.2</b>	<b>7.7</b>

Coefficients of variation (CV) were calculated for both observed effort (yds\* soak day) and flounder (lbs) for comparison. This was done to highlight the increased variation weekly in observed flounder pounds relative to observed effort (Figure 5). Yards of gillnet effort remained a significantly less variable measure with CV's remaining below 50% and averaging 43% throughout the 2007 PSGNRA. Landings display much more variability on a weekly basis with CV's averaging 95% throughout the season (Figure 5).

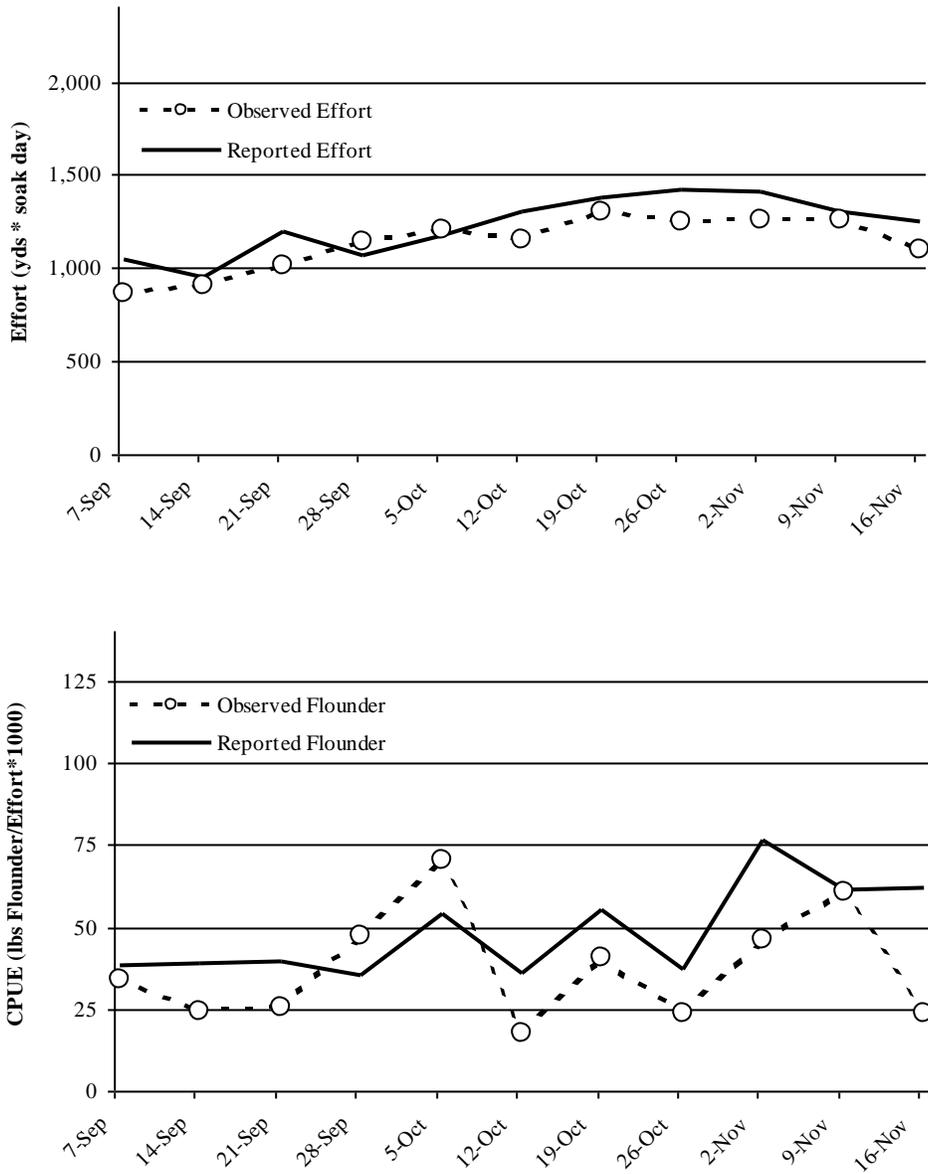


**Figure 5.** Coefficients of variation (CVs) by week for two measures of large mesh gillnet fishing effort (lbs of flounder landed vs. effort (yds \* soak days) observed in the PSGNRA from September 1 – November 15 2007.

Observations and fishermen weekly reports for catches and effort tracked closely throughout the 2007 PSGNRA season (Figure 6). During the last week of the 2007 PSGNRA a relative divergent trend in observed and reported catches was apparent, but this has been typical of later season observations in the PSGNRA since 2001 (Gearhart 2002, Price 2007).

Coverage of the reported effort was concentrated in SGNRA3 around Hatteras Island (Figure 1). There were decreased observations in both Core Sound, and along the mainland side of Pamlico Sound (n = 4 for each location) relative to previous years. Along the mainland side of Pamlico Sound weekly contacts were made in addition to fish house visits both confirming the relative lack of effort in the 200 yd corridor along this side of the sound. Core Sound observations were also reduced as resources necessitated increased weekly coverage along the Outer Banks.

Fishermen logbooks appear accurate (Figure 6), and representative coverage of the fishery was obtained during the 2007 PSGNRA season.



**Figure 6.** Effort (yds \* soak days) and catch per unit effort (CPUE: lbs flounder\1000yds\day) for observed large mesh gillnets trips and fishermen logbooks in the PSGNRA from September 1 - November 15 2007.

### Gear Characteristics

The most common large mesh gillnet observed was a 6-inch stretch mesh with 0.49 mm twine that soaked for nearly 24 hr (Table 4). The average yards of gillnet deployed per trip was greater than 1,300 yd. Soak times remained shorter relative to previous PSGNRA observations, averaging 22.5 hr. A maximum 2-day soak was observed. Large mesh nets were generally deployed in water less than 1 m in depth, but up to 4 m sets were observed. Some sets were observed in 0.1 m depths.

Small mesh observations consisted primarily of 3.2-inch stretched mess gillnet where fishermen deployed approximately 1,000 yds per trip (Table 4). Small mesh twine sizes were typically 0.47 mm, and these nets were primarily deployed in 2.7 m of water. Soak times were 24-hr for these observations.

**Table 4.** Summary statistics for large (> 5 in stretch) and small (< 5 in stretch) mesh gillnet observations in the PSGNRA from September 1 – November 15 2007.

Mesh	Gear Parameter	N	Min	Mean	Max
Large	Mesh Size (in)	1,605	5.50	6.05	7.00
	Twine Size (mm)	1,605	0.33	0.49	0.57
	Set Depth (m)	1,605	0.10	0.90	4.00
	Soak Time (hr)	1,605	0.80	22.50	48.00
	Yards/Trip	121	400	1,321	2,000
Small	Mesh Size (in)	23	2.60	3.20	4.00
	Twine Size (mm)	23	0.42	0.47	0.52
	Set Depth (m)	23	0.60	2.67	4.50
	Soak Time (hr)	23	24.00	24.00	24.00
	Yards/Trip	5	100	1,005	1,900

### Species Composition

The majority (47%) of catch observed in the large mesh gillnet fishery by number was paralichthid flounders (Table 5). Other top finfish observed and accounting for 32% of the total catch by number included red drum *Sciaenops ocellatus*, cownose ray *Rhinoptera bonasus*, bluefish *Pomatomus saltatrix*, and horseshoe crab *Limulus polyphemus*. There were no striped bass *Morone saxatilis* or Atlantic sturgeon *Acipenser oxyrhynchus* observed during the 2007 PSGNRA season. Sea bird bycatch included six common loons *Gavia immer*, and 44 double-crested cormorants *Phalacrocorax auritus* (not shown on Table) (Table 5).

**Table 5.** Species, biomass sampled (kg) and number of individuals observed in large mesh gillnets in the PSGNRA from September 1 – November 15 2007.

Scientific Name	Common Name	% Biomass	% Number	Total Number	Weight (kg) *
<i>Paralichthys</i> spp.	Paralichthid Flounders	41.9	47.0	3,387	3,182.1
<i>Sciaenops ocellatus</i>	Red Drum	13.5	6.3	455	1,027.6
<i>Rhinoptera bonasus</i>	Cownose Ray	10.9	8.5	611	824.1
<i>Pomatomus saltatrix</i>	Bluefish	10.7	15.5	1,114	811.4
<i>Limulus polyphemus</i>	Horseshoe Crab	5.5	1.8	127	419.1
<i>Dasyatis americana</i>	Southern Stingray	5.0	1.9	135	378.0
<i>Pogonias cromis</i>	Black Drum	2.9	1.9	135	223.1
Dasyatidae	Stingrays	2.1	2.2	156	156.0
<i>Archosargus probatocephalus</i>	Sheepshead	1.9	1.6	116	141.7
<i>Cynoscion nebulosus</i>	Spotted Seatrout	1.0	0.9	67	75.7
<i>Chelonia mydas</i>	Green Turtle	0.7	0.3	19	50.4
<i>Dasyatis sabina</i>	Atlantic Stingray	0.6	1.0	71	42.6
<i>Gymnura micrura</i>	Smooth Butterfly Ray	0.5	0.8	59	35.4
<i>Mugil cephalus</i>	Striped Mullet	0.5	0.2	14	33.8
<i>Brevoortia tyrannus</i>	Atlantic Menhaden	0.4	2.3	168	33.6
<i>Micropogonias undulatus</i>	Atlantic Croaker	0.3	0.7	52	19.9
<i>Cynoscion regalis</i>	Weakfish	0.3	0.5	38	20.1
<i>Trachinotus carolinus</i>	Florida Pompano	0.2	0.2	17	18.3
<i>Leiostomus xanthurus</i>	Spot	0.2	1.1	81	17.2
<i>Lagodon rhomboides</i>	Pinfish	0.2	1.0	71	15.5
<i>Astroscopus</i> spp.	Astroscopus Stargazers	0.2	0.3	23	15.3
<i>Synodus foetens</i>	Inshore Lizardfish	0.2	0.6	44	14.3
<i>Gymnura</i> spp.	Butterfly Rays	0.1	0.1	6	6.0
<i>Menticirrhus</i> spp.	Kingfishes	0.1	0.2	14	4.7
<i>Alectis ciliaris</i>	African Pompano	0.1	0.1	4	4.8
<i>Menticirrhus americanus</i>	Southern Kingfish	0.1	0.1	7	3.7
<i>Malaclemys terrapin</i>	Diamondback Turtle	0.0	0.0	3	2.9
<i>Orthopristis chrysoptera</i>	Pigfish	0.0	0.2	13	2.6
<i>Rachycentron canadum</i>	Cobia	0.0	0.0	1	1.9
<i>Chaetodipterus faber</i>	Atlantic Spadefish	0.0	0.1	7	1.4
<i>Caranx</i> spp.	Caranx Jacks	0.0	0.0	3	1.3
<i>Pseudopleuroonectes americanus</i>	Winter Flounder	0.0	0.0	3	1.2
<i>Lachnolaimus maximus</i>	Hogfish	0.0	0.1	4	0.9
<i>Stenotomus chrysops</i>	Scup	0.0	0.0	1	0.7
<i>Aluterus</i> spp.	Aluterus Filefishes	0.0	0.0	1	0.5
<i>Libinia</i> spp.	Libinia Spider Crabs	.	0.0	2	0.0
<i>Selene vomer</i>	Lookdown	.	0.0	1	0.3
<i>Chilomycterus schoepfii</i>	Striped Burrfish	.	0.0	1	0.3
<i>Raja eglanteria</i>	Clearnose Skate	.	0.6	44	.
<i>Callinectes sapidus</i>	Blue Crab	.	0.3	24	.
<i>Gavia immer</i>	Common Loon	.	0.1	6	.
<i>Rhizoprionodon terraenovae</i>	Atlantic Sharpnose Shark	.	0.1	4	.
<i>Mustelus canis</i>	Smooth Dogfish	.	0.0	3	.
<i>Megalops atlanticus</i>	Tarpon	.	0.0	3	.
<i>Synodus</i> spp	Synodus Lizardfishes	.	0.0	3	.
<i>Reptilia anapsida</i>	Turtle	.	0.0	3	.
<i>Chelydra serpentina</i>	Common Snapping Turtle	.	0.0	3	.
<i>Leucoraga radiata</i>	Thorny Skate	.	0.0	2	.
<i>Myliobatis freminvillei</i>	Bullnose Ray	.	0.0	2	.
<i>Elops saurus</i>	Ladyfish	.	0.0	2	.
<i>Carcharhinus</i> spp.	Requiem Sharks	.	0.0	2	.
<i>Scyliorhinidae</i>	Cat Sharks	.	0.0	1	.
<i>Squalus acanthias</i>	Spiny Dogfish	.	0.0	1	.
<i>Dasyatis</i> spp.	Dasyatis Stingrays	.	0.0	1	.
<i>Dorosoma cepedianum</i>	Gizzard Shad	.	0.0	1	.
<i>Caretta caretta</i>	Loggerhead	.	0.0	1	.

Small mesh gillnet observed catches primarily consisted of Atlantic menhaden *Brevoortia tyrannus* (Table 6). Other species observed included bluefish, weakfish *Cynoscion regalis*, and kingfish *Menticirrhus* spp. (Table 6). There were reduced observations of small mesh operations and few species in large numbers were observed.

**Table 6.** Species, biomass sampled (kg) and number of individuals observed in small mesh gillnets in the PSGNRA from September 1 – November 15 2007.

Scientific Name	Common Name	% Biomass	% Number	Total Number	Weight (kg)
<i>Brevoortia tyrannus</i>	Atlantic Menhaden	89.40	93.19	3,490	988.83
<i>Pomatomus saltatrix</i>	Bluefish	3.17	0.96	36	35.06
<i>Cynoscion regalis</i>	Weakfish	2.27	1.63	61	25.14
<i>Menticirrhus</i> spp.	Kingfishes	2.01	2.30	86	22.20
<i>Cynoscion nebulosus</i>	Spotted Seatrout	1.80	0.48	18	19.91
<i>Pogonias cromis</i>	Black Drum	0.81	0.77	29	8.91
<i>Micropogonias undulatus</i>	Atlantic Croaker	0.15	0.16	6	1.68
<i>Menticirrhus americanus</i>	Southern Kingfish	0.14	0.13	5	1.50
<i>Paralichthys</i> spp.	Paralichthid Flounders	0.11	0.11	4	1.20
<i>Leiostomus xanthurus</i>	Spot	0.06	0.11	4	0.67
<i>Archosargus probatocephalus</i>	Sheepshead	0.05	0.05	2	0.60
<i>Alosa mediocris</i>	Hickory Shad	0.04	0.03	1	0.40
Scyliorhinidae	Cat Sharks	.	0.03	1	.
<i>Lagodon rhomboides</i>	Pinfish	.	0.05	2	.

### *Protected Species Bycatch*

There were no marine mammal interactions observed in the 2007 PSGNRA season. There were 20 sea turtles observed in large mesh gillnets from September 1 – November 15 2007 (Table 7, Figure 1). All interactions were observed along the Outer Banks in SGNRA1 (n = 1), SGNRA2 (n = 5), SGNRA3 (n = 9), and SGNRA4 (n = 5), and the majority (75%) were with live sea turtles that were subsequently tagged and released. There were 19 green sea turtle *Chelonia mydas*, and one loggerhead *Caretta caretta* observed. Five of the green sea turtle interactions resulted in mortalities, while all other interactions were with live individuals.

**Table 7.** Observed large mesh gillnet sea turtle interactions by date, species, condition, carapace length (mm), area and location in the PSGNRA from September 1 – November 15 2007.

Date	Species	Condition	Carapace Length	Restricted Area	Location	Inconel Tag 1 (Right Rear)	Inconel Tag 2 (Left Rear)	Pit Tag
15-Sep	Green	Alive	310	S1	N 35 05.964 W 76 03.129	XXP667	XXP668	na
25-Sep	Loggerhead	Alive	750	S3	N 35 14.312 W 75 40.066	XXP 614	XXP 613	433 86F1 A2C
30-Sep	Green	Alive	293	S3	N 35 12.246 W 75 43.579	TTS 710 *	XXP653	485 215 4425 *
10-Oct	Green	Alive	337	S4	N 35 24.276 W 75 31.871	XXP526	XXP527	433 048 495E
15-Oct	Green	Dead	280	S2	N 35 09.676 W 75 51.872	na	na	na
17-Oct	Green	Alive	275	S2	N 35 10.720 W 75 48.172	XXP615	XXP616	433 05A 4876
24-Oct	Green	Alive	330	S3	N 35 14.000 W 75 39.885	XXP619	XXP620	na
24-Oct	Green	Alive	335	S3	N 35 13.995 W 75 39.998	XXP617	XXP618	na
1-Nov	Green	Alive	255	S2	N 35 09.630 W 75 52.218	XXP622	XXP621	na
1-Nov	Green	Dead	324	S4	N 35 38.248 W 75 31.204	na	na	na
1-Nov	Green	Dead	325	S4	N 35 38.344 W 75 31.108	na	na	na
1-Nov	Green	Dead	287	S4	N 35 38.344 W 75 31.108	na	na	na
1-Nov	Green	Dead	300	S4	N 35 38.353 W 75 31.095	na	na	na
5-Nov	Green	Alive	310	S2	N 35 09.672 W 75 52.278	na	na	na
5-Nov	Green	Alive	305	S3	N 35 22.258 W 75 33.415	na	XXP531	433979D3874
7-Nov	Green	Alive	266	S3	N 35 14.266 W 75 40.070	na	XXP529	43143B2A75
8-Nov	Green	Alive	277	S3	N 35 15.512 W 75 37.567	na	XXP530	4851501052
8-Nov	Green	Alive	355	S3	N 35 15.485 W 75 37.607	na	na	na
9-Nov	Green	Alive	335	S3	N 35 13.876 W 75 39.861	na	na	na
13-Nov	Green	Alive	290	S2	N 35 10.917 W 75 48.646	XXP654	XXP655	49317F4A29

\* Left Rear Inconel Tag present upon capture, and Pit tag present upon capture.

### Sea Turtle Bycatch Estimates

Estimates of weekly sea turtle interactions were made using the stratified ratio method where the rate was determined from observations by area and week (Table 8). Fishing effort was measured by the yards multiplied by soak days. The bycatch rate was multiplied by the total reported effort for each area and each week that sea turtle interactions occur. Estimates were then compiled by species and disposition and added cumulatively. These estimates were tracked closely each week to ensure action could be taken when thresholds were exceeded (Table 8).

Collectively, a total of 125 live green sea turtle interactions were estimated from September 1 - November 15, 2007, when the PSGNRA was closed due to the threshold being surpassed. There were also 30 mortalities of green sea turtles estimated throughout the 2007 season (Table 8, 9).

**Table 8.** 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 15 2007.

Week	Area	Observed Turtles	Species *	Observed Effort	Effort Bycatch Rate **	Reported Effort	Bycatch Estimate
3	S1	1	Green	2,800	0.3571	30,200	11
4	S3	1	Loggerhead	11,005	0.0909	84,250	8
5	S3	1	Green	10,100	0.0990	138,200	14
6	S4	1	Green	4,120	0.2427	46,385	11
6	S2	1	Green *	1,420	0.7042	11,850	8
7	S2	1	Green	5,350	0.1869	41,350	8
8	S3	2	Green	12,135	0.1648	129,150	21
9	S2	1	Green	900	1.1111	14,450	16
9	S4	4	Green *	5,810	0.6885	32,120	22
10	S2	1	Green	3,450	0.2899	17,000	5
10	S3	5	Green	20,100	0.2488	132,850	33
11	S2	1	Green	1,300	0.7692	7,600	6

\* Denotes mortality

\*\* Effort bycatch rate (# sea turtles/observed effort) is presented per 1,000 yards here.

In addition to green sea turtle take estimates there were also four live Kemp's ridley, 23 live loggerheads and four dead loggerheads (Table 9). There were no observed Kemp's ridley interactions, and no observed loggerhead mortalities in the 2007 PSGNRA, but these two species (Kemp's ridley and loggerhead) are estimated on a 3-year basis and estimates are cumulative from 2005 (Table 9).

**Table 9.** Allowable sea turtle take thresholds and bycatch estimates by species and disposition in the PSGNRA from September 1 – November 15 2007. Note: Kemp's ridley and loggerhead sea turtle estimates are cumulative from 2005 as defined by Section 10 ITP # 1528 (ESA 1973).

<b>Species</b>	<b>Authorized Threshold Live Takes</b>	<b>Effort Estimate Live Takes</b>	<b>Authorized Threshold Lethal Takes</b>	<b>Effort Estimated Lethal Takes</b>
Green	120	125	48	30
Kemp's Ridley1 *	27	4	14	0
Loggerhead1 **	38	23	3	4

1 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.

\* There were no Kemp's Ridley sea turtle interactions observed in 2006 or 2007; estimates cumulative from 2005.

\*\* There were no dead loggerhead sea turtle interactions observed in 2006 and 2007; estimates cumulative from 2005.

**Note: Season closure occurred on November 15, 2007 due to live green sea turtle interaction estimates.**

### *NCDMF Marine Patrol Monitoring*

NCDMF Marine Patrol officers conducted boat patrols, aerial surveys, checked gillnets in the water, boarded vessels, and visited fish houses weekly throughout the 2007 PSGNRA season (Table 10). There were 43 boat patrols, and 4 aerial surveys conducted during this time and officers observed 224 vessels and checked 119 of these. A total of 18 violations consisting of warnings, and minor citations were issued throughout the 2007 PSGNRA season. The violations also include recreational fishermen infractions and participants in other fisheries (e.g., shrimp trawlers) operating in Pamlico Sound from September 1 – November 15 2007.

**Table 10.** NCDMF Marine Patrol activity summary throughout the PSGNRA from September 1 – November 15 2007.

Week	Boat Patrols	Aerial Patrols	Vessels Observed	Boats Checked	Violations	Areas Surveyed (M,S1,S2,S3,S4,OIC, HC,OC,PS)	Comments
1	0	0	0	0	0	n/a	no patrols reported; other NCDMF Marine Patrol obligations
2	4	0	57	1	0	M,S1, S3, S4,OIC, HC, PS	mostly shrimp trawlers and recreational fishermen
3	1	0	17	6	1	S1, S2, S3, M, PS	observed multiple large mesh gillnets in M area
4	4	2	32	8	4	S2, S3, S4, M, PS, OC, HC	mostly shrimp trawlers; boarded multiple PSGNRA gillnet vessels
5	2	0	1	1	0	M	observed multiple gillnets in M area - no violations
6	8	0	24	24	5	S1, S2, OC, HC, M, PS	boarded multiple gillnet vessels - 2 violations
7	11	1	55	49	5	S1, S2, S3,S4, M, OC, PS	14 PSGNRA vessels boarded - 4 violations; 35 recreational boats boarded - 1 violation
8	4	0	22	22	2	S2, S3, OC, HC	9 recreational boats boarded - 2 violations; 10 PSGNRA fishing vessels boarded - no violations
9	0	0	0	0	0	n/a	no patrols reported; other NCDMF Marine Patrol obligations
10	0	0	0	0	0	n/a	no patrols reported; other NCDMF Marine Patrol obligations
11	5	0	0	0	0	n/a	<b>Season closure on November 15, 2007</b>
12	3	0	5	0	0	S2, S3, S4, OC, HC	vessels observed - pound netters and recreational fishermen
13	0	0	0	0	0	n/a	no patrols reported; other NCDMF Marine Patrol obligations
14	0	1	3	0	1	S2, S4, OIC, HC	recreational fisherman - 1 violation
15	1	0	8	8	0	S4, OIC, PS	recreational and crab boats only
<b>Totals</b>	<b>43</b>	<b>4</b>	<b>224</b>	<b>119</b>	<b>18</b>		

## *Sea Turtle Strandings Summary*

Reported 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 399 strandings per year statewide from 2001 – 2007. Total reported strandings in 2007 increased slightly from 321 in 2006 to 342 in 2007. The most common species of sea turtle stranded was the loggerhead representing 62% of the total strandings from 2001-2007 (North Carolina Wildlife Resources Commission Sea Turtle Stranding Network Database 2007).

## *Industry Outreach*

As with previous management years, regular outreach to the commercial gillnet fishermen and dealers along the Outer Banks, mainland side of Pamlico Sound, and Core Sound was conducted throughout the season, and following the early closure of the PSGNRA. The outreach was conducted at local fish houses, through a series of public meetings, and mail outs. These efforts were designed to communicate the importance of the Endangered Species Act (1973) to convey necessary management protocols throughout the PSGNRA, and to solicit ideas from the industry concerning ways to reduce sea turtle interaction potential.

Collectively, industry concerns and public meeting summaries were provided to NMFS and discussed by NMFS and NCDMF staff to discern the practicality of alternative management measures for the 2008 PSGNRA season. These discussions were also summarized and provided back to the commercial fishing industry via mail.

Communicating with the PSGNRA fishermen has been productive over the years to inform individuals about sea turtle conservation, and to encourage collaborative efforts in the PSGNRA and in other seasonal fisheries throughout the state.

## **Discussion**

The purpose for NMFS/NCDMF discussions following outreach to the industry was to review the 2005 – 2007 data, convey concerns, identify trends, and discuss potential management changes to the PSGNRA. This process allowed for review of data, and continues to be integral in the Section 10 ITP process to streamline efforts towards a continuing fishery with simultaneous protection of endangered species.

Observer coverage of the fishery has ranged from 8% (2007) to 11% (2005) and has been adequate from 2005 – 2007 with observers achieving an overall 10% coverage of the fishery for the three years combined. Southern flounder catches remained relatively high in 2005, and 2006, but in 2007 were reduced by nearly 50% (~100,000

lbs) compared to previous management years. While flounder catches were decreased in 2007, total effort remained about the same and has averaged about 2.2 million yards of gillnet effort from September 1 – November 30 of each year. The number of PSGNRA participants has remained consistent with 135 PSGNRA permits issued in 2006, and 2007. Of the 135 permits issued, less than 70 fishermen participate on a weekly basis during the PSGNRA season. Typically, the industry lands greater than 200,000 lbs of flounder during the PSGNRA season, supporting not only local communities and individuals, but contributing greatly to economic stability regionally. This may have been attributable to the increased amount of “animal grasses” (Byrozoan) prevalent (observed, and fishermen reports) throughout the PSGNRA during the season

Sea turtle observations and estimated take remained well below authorized thresholds in 2005, and 2006 (Price 2006, 2007). However, in 2007 observations and estimates of live green sea turtle interactions surpassed authorized levels, and the season was closed two weeks early on November 15 2007 (NCDMF proclamation M-19-2007). The species composition of sea turtle interactions has been predominantly with small, live green sea turtles. Specifically, there have been a total of 34 sea turtle interactions observed from 2005 – 2007 with 29 (85%) of these small green sea turtles. The remaining five sea turtles were one Kemp’s ridley (live in 2005), and four loggerhead (3 live (2005-2007), 1 dead (2005)) sea turtles. The majority (74%) of sea turtles were observed alive, were tagged and released in good condition.

Management protocols implemented in 2005 have remained consistent for the past three years, and despite the early closure in 2007, there were no recommended changes to the management of the PSGNRA at this time. Currently, ITP # 1528 authorizes activities in the PSGNRA through 2010. There were more observed interactions during 2007 (n = 20), than in the two previous years combined, while the total fishing effort, and observer coverage remained constant and comparable to previous years. This may suggest an increase in green sea turtle population numbers in Pamlico Sound during the fall of 2007.

As sea turtle conservation efforts continue and presumably sea turtle populations begin to increase, fishery managers will increasingly be faced with the challenge of balancing sustaining commercial and recreational fisheries with maintaining continued protection of endangered or threatened species. Seasonal and area closures have the benefit of providing protection for endangered or threatened species, but often eliminate fisheries. The PSGNRA remains an example of establishing a limited fishery legally under a Section 10 ITP (ESA 1973), and also allotting continued protection for sea turtles.

The management of the PSGNRA is scheduled to adhere to existing protocols for the fall 2008 season. However, due to the increased takes observed in 2007, NMFS and NCDMF will work closely on a weekly basis in 2008 to implement any necessary changes during and following the 2008 PSGNRA.

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