INTERSTATE FISHERIES MANAGEMENT PROGRAM IMPLEMENTATION FOR NORTH CAROLINA

By

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JOB 1: Evaluation of Modified Flounder Gillnets in Southeastern Pamlico Sound, NC

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ABSTRACT

During the fall of 2001, the National Marine Fisheries Service closed all of the potential fishing grounds in Pamlico Sound, North Carolina traditionally utilized by the deep water flounder gillnet fishery. The closure was aimed at preventing of sea turtle takes occurring in the fishery, where a take is defined as any interaction with a protected species (ESA 1973). Sea sampling during the 2000 fishing season indicated that fishing techniques utilized by the fleet contributed to both incidental sea turtle takes and mortality. A pilot study was conducted during 2001 to identify a gillnet modification that would maintain flounder catches, while reducing sea turtle takes. Two modified flounder gillnet designs were identified and evaluated during the 2001 fishing season. The first experimental gillnet was a low-profile net with a panel height of six feet, half the height of a standard flounder gillnet. The second experimental net was a double leadline configuration with the float line of the net replaced by another leadline. The control net was a standard deep water flounder gillnet with a panel height of approximately 12 ft with 3 ft tie-downs placed at regular intervals throughout the net. Thirty fishing trips were conducted between 19 October and 4 December 2001 aboard a commercial sink gillnet vessel on traditional deep water flounder gillnet fishing grounds in southeastern Pamlico Sound. A randomized block experimental design was utilized to compare flounder CPUEs and bycatch CPUEs among the experimental and control nets. The control net caught significantly more flounder (1,419.9 kg, $P<0.01$) than either the low-profile (1,021.6 kg) or the double leadline nets (798.1 kg). The low-profile net caught significantly less bycatch (1,044.2 kg $P<0.0001$) than the control net (2,078.5 kg) or the double leadline net (1,695.5 kg). Three Kemp's ridley sea turtles (*Lepidochelys kempii*) were observed in the control net, while one was observed in the double leadline net and none were observed in the low-profile net. Results of this study indicate that the low-profile gillnet design has the potential to be a viable deep water fishing gear that significantly reduces both sea turtle and finfish bycatch, while maintaining flounder catches. The identification of a modified flounder gillnet that prevents the bycatch of sea turtles, while maintaining flounder landings would allow highly productive Pamlico Sound fishing grounds to be reopened. This would avert user conflicts in adjacent fisheries and provide financial relief to those affected by the Pamlico Sound gillnet closure.

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Background

In November 1999, the North Carolina sea turtle stranding network noted significant increases in strandings of marine sea turtles in the southeastern portion of Pamlico Sound, NC. Aerial surveys of eastern Pamlico Sound along Ocracoke and Hatteras islands identified three active fisheries: the shrimp trawl fishery, large mesh ($\geq$ 5-inch stretched mesh) flounder gillnet fishery, and small mesh (< 5-inch stretched mesh) gillnet fishery targeting spotted seatrout (*Cynoscion nebulosus*).

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

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

On 5 October 2000, NMFS issued ITP #1259 to NCDMF (65 FR 65,840, 2 November 2000). Subsequently, observed levels of gillnet/ sea turtle interactions and strandings reached thresholds specified in the ITP for closure of the large mesh gillnet fishery on 25 October 2000. Fisheries monitored during the 2000 fishing season identified two separate large mesh gillnet fisheries that operated in both shallow and deep water areas of Pamlico Sound. Results of monitoring indicated that there were a greater number of interactions occurring in the deep water fishery (n = 14) than in the shallow water fishery (n = 4) (Gearhart 2001).

Considering these data, NMFS closed all potential fishing grounds utilized by the deep water large mesh gillnet fishery for the 2001 fishing season (Figure 2, 66 FR 50,350, 3 October 2001). During 2001, NCDMF again consulted with NMFS and prepared an application for an ITP under Section 10 of the ESA (66 FR 42,845, 15 August 2001). The NMFS issued ITP #1348 to NCMDF on 5 October 2001 (66 FR 51,023, 5 October 2001). The ITP authorized gillnet fisheries to be prosecuted within designated shallow water areas of Pamlico Sound (Figure 2). In addition to traditional fishing operations, the 2001 ITP also authorized the evaluation of two experimental gillnets fished on traditional deep water fishing grounds within Pamlico Sound.

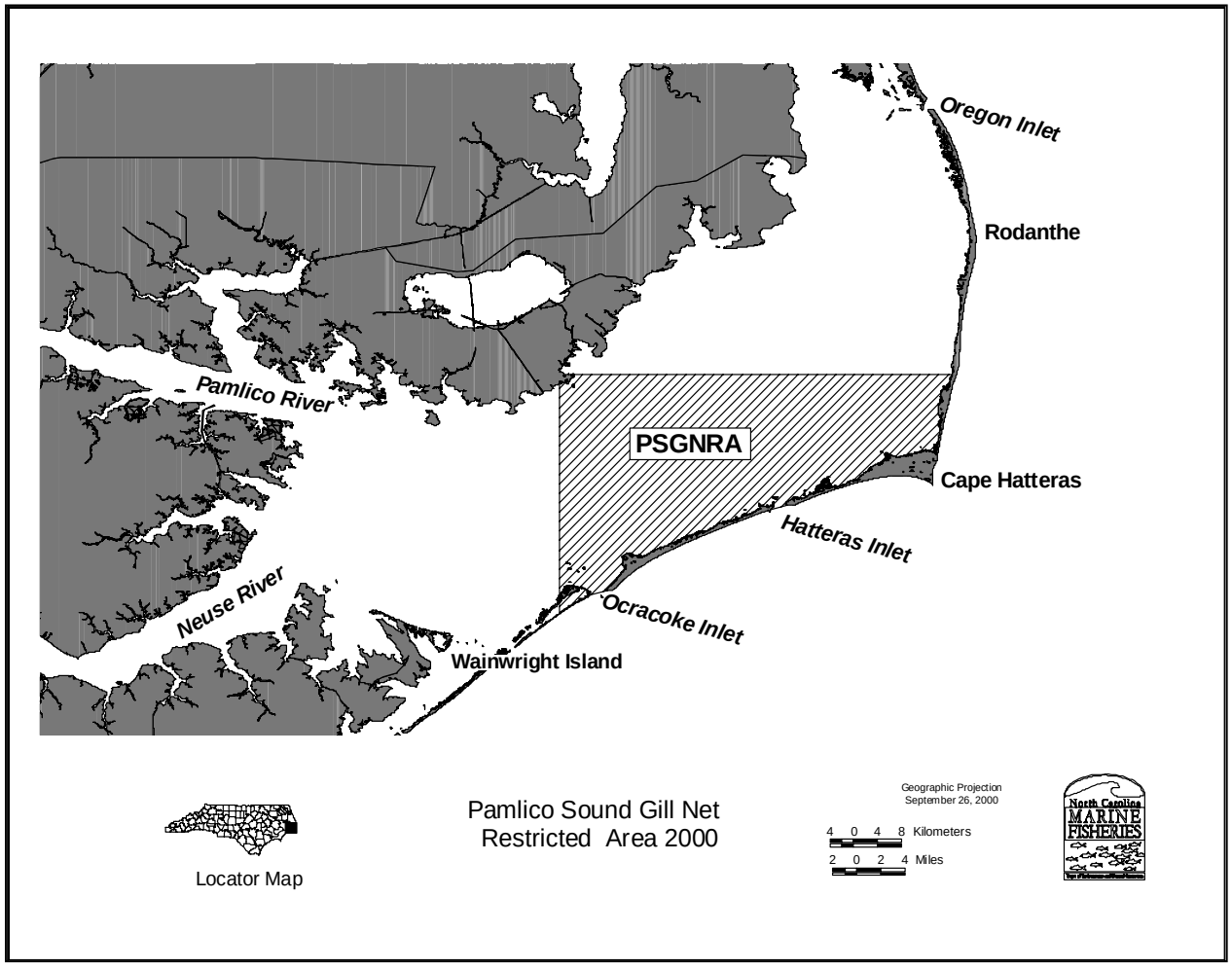

Figure 1. Map of southeastern Pamlico Sound and the 2000 Pamlico Sound Gillnet Restricted Area (PSGNRA).

Fishery Description

Monitoring conducted by NCDMF during the 2000 fishing season indicated that the Pamlico Sound large mesh gillnet fishery consisted of two major components. A traditional shallow water fishery occurs along the Outer Banks and a deep water fishery, that operates farther from shore along a slope adjoining the main basin of Pamlico Sound (Figure 3). Both fisheries target southern flounder (*Paralichthys lethostigma*). The deep water fishery developed approximately 10 years ago and has steadily expanded since its inception. Historically, pound nets had landed the majority of North Carolina's southern flounder. However, the development and expansion of the deep water large mesh gillnet fishery in Pamlico Sound during the early 1990's helped gillnets surpass pound nets as the dominant southern flounder fishing gear.

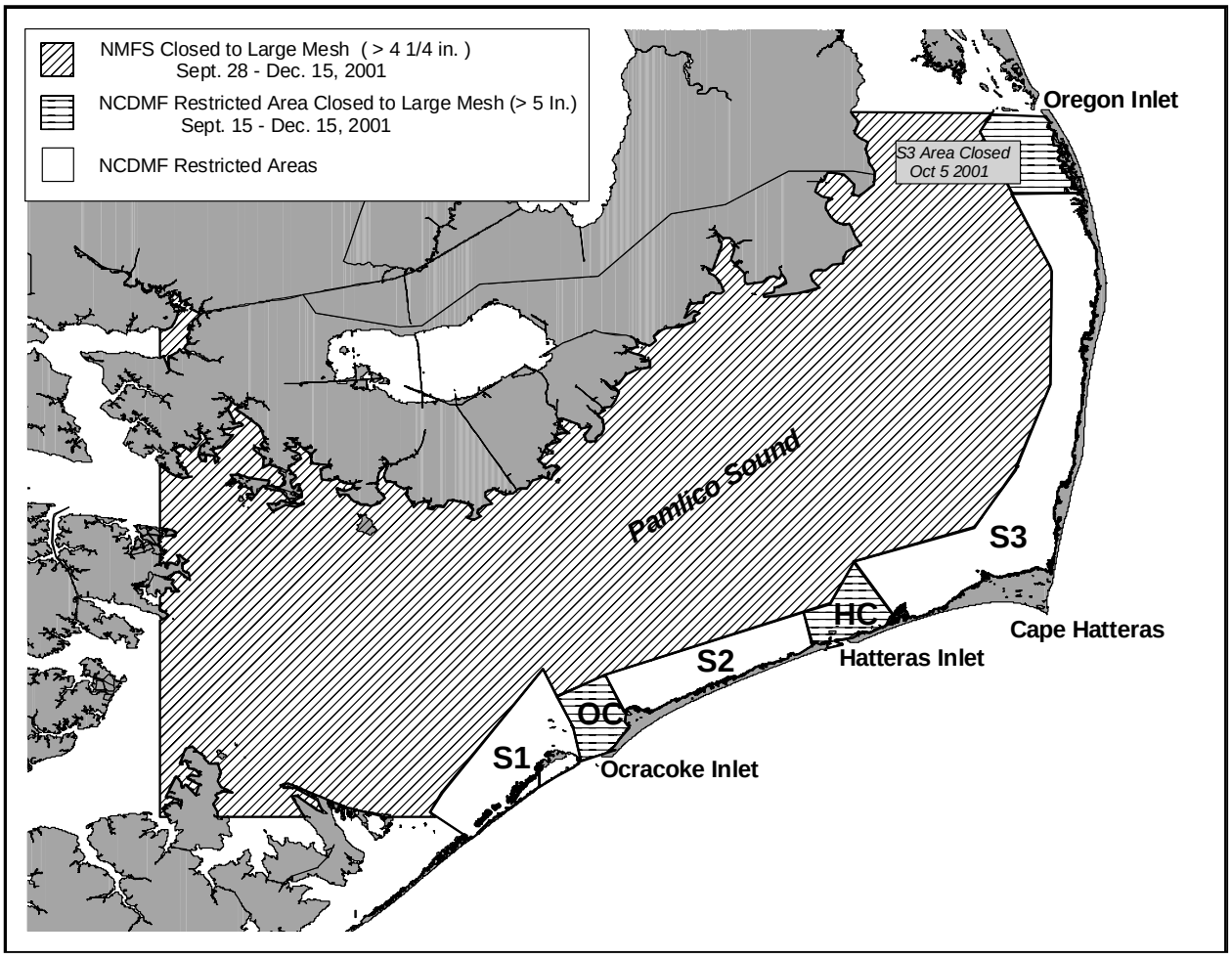

Figure 2. NCDMF 2001 Pamlico Sound Gillnet Restricted Area (PSGNRA) and NMFS closed area. S1=Shallow Water Gillnet Restricted Area 1; S2=Shallow Water Gillnet Restricted Area 2; S3=Shallow Water Gillnet Restricted Area 3; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor.

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

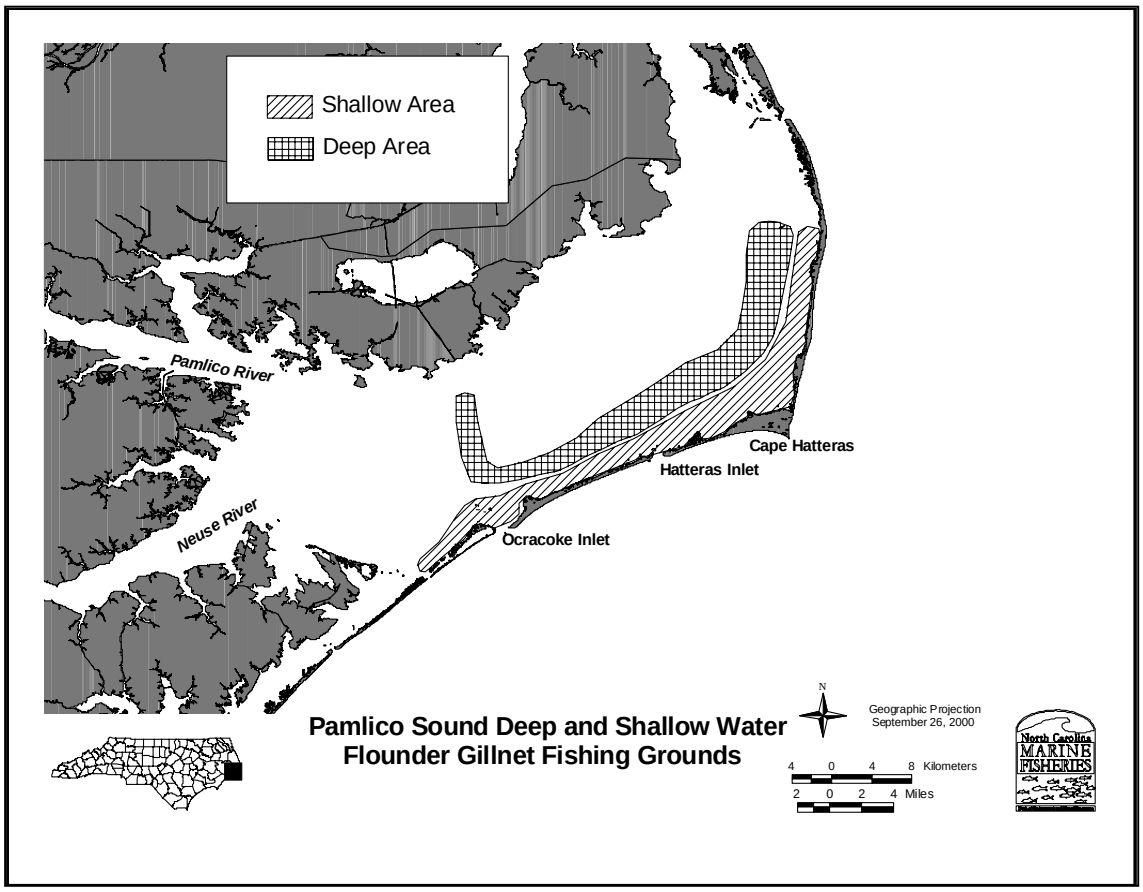

Figure 3. North Carolina estuarine flounder gillnet fishing grounds in southeastern Pamlico Sound.

Pilot Study

Results of sea turtle bycatch monitoring during the 2000 fall fishing season implicated the Pamlico Sound deep water flounder gillnet fishery with most of the interactions. This fishery incorporated tie-downs into their gear configuration. During the spring of 2001, a large sea turtle stranding event occurred along northern North Carolina ocean-facing beaches. The strandings consisted of several turtles with pieces of gillnet attached. Further inspection of the gear indicated that the monkfish (*Lophius americanus*) fishery was responsible for a portion of the strandings. This fishery also utilized large mesh (12 to 14 in stretched) gillnets and also incorporated tie-downs into their gear configuration. The implication of these two large mesh, tie-down gillnet fisheries prompted NCDMF and NMFS to conduct a pilot study designed to determine the effect of tie-down length on sea turtle entanglement rates. Results of the study indicated that the entanglement rate was inversely proportional to tie-down length with entanglements increasing as tie-down length decreased (Table 1). This result was attributed to the increasing depth of the webbing pocket produced by decreasing tie-down lengths. The turtle escapement rate, for turtles that entangled, decreased with the length of tie-down (Table 1).

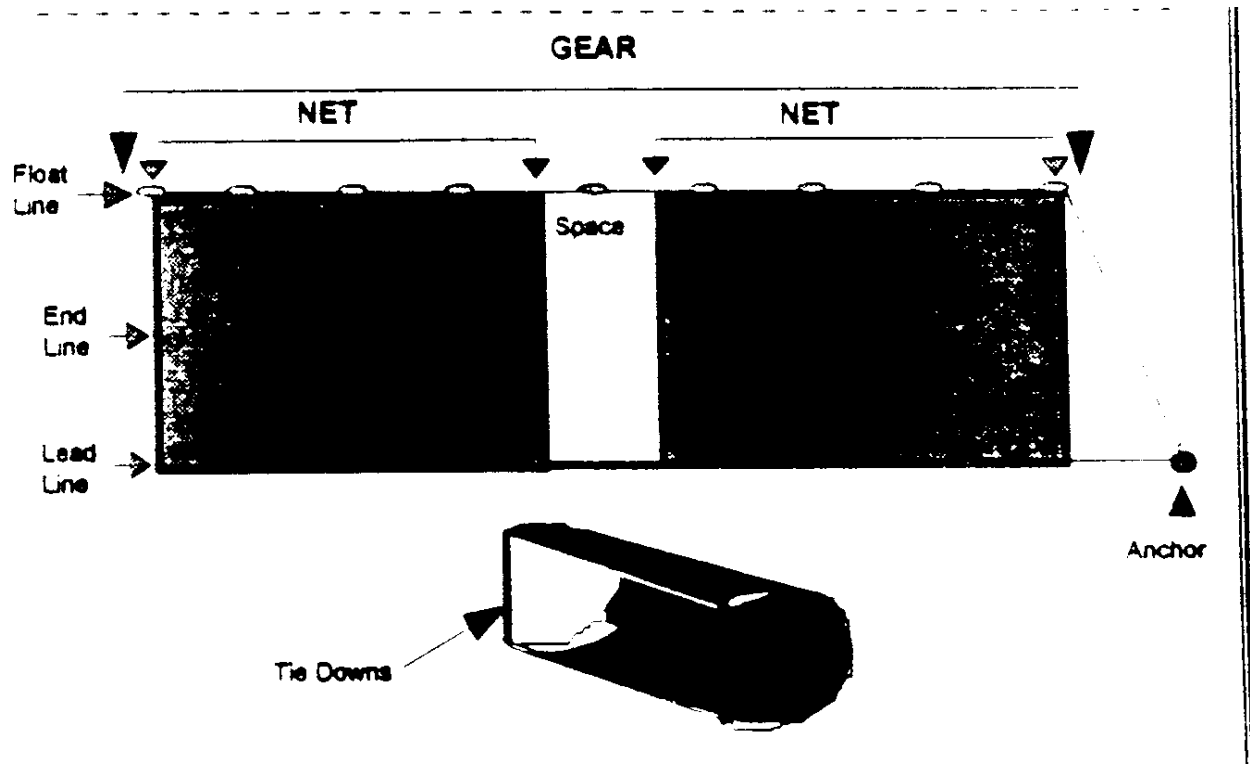

Illustration taken from Fisheries Sampling Branch Observer Manual, NMFS (1996)

Figure 4. Diagram of a sink gillnet. The sink gillnet is submerged below the water line and consists of several net panels attached together as a string. This gear can be modified with tie-downs to target bottom-dwelling fish.

Table 1. Sea turtle entanglement rates for three tie-down gillnet configurations.

Treatment	Panel Height	Depth of Pocket	n	Entanglement Rate	Entangled/Escaped Rate
Control Net	6 feet	0	42	47.6%	31.0%
1/3 Tie-Down Net	4 feet	1 foot	42	54.8%	25.0%
2/3 Tie-Down Net	2 feet	2 feet	41	68.3%	12.5%

Objectives

NCDMF designed an experiment to evaluate two modified gillnet configurations based on the results of the 2001 pilot study. The objectives of this study were:

- Compare flounder catch per unit effort (CPUE) among control and experimental nets.
- Compare bycatch CPUE among control and experimental nets.

METHODS

Thirty fishing trips were conducted between 19 October and 4 December 2001 on traditional deep water, flounder gillnet fishing grounds in southeastern Pamlico Sound (Figure 3). A commercial sink gillnet vessel was chartered to set and retrieve nets, which were soaked overnight and retrieved daily. Two experimental gillnet designs were compared to a standard control configuration.

The control net was a standard deep water flounder gillnet with a panel height of approximately 12 feet with 3 ft tie-downs placed at regular intervals throughout the net (Table 2). The first experimental gillnet was a low-profile net with a panel height of six feet, which was half the height of the control net (Table 2). The second experimental net was a double leadline configuration with the float line of the net replaced by another leadline. All other characteristics throughout the net were the same as the control net including panel height (Table 2).

Table 2. Net characteristics of three types of gillnet evaluated in southeastern Pamlico Sound during the 2001 flounder gillnet season from October 19-December 4.

Net Characteristics	Control	Low-Profile	Double Leadline
Webbing			
Mesh Size (in)	6	6	6
Twine Size(mm)	0.57	0.57	0.57
Panel Height (ft)	12	6	12
Hanging Ratio	½	1/2	1/2
Floatation	1 float/2 fathoms	5/16” Poly Line	65 lb/100 fathom
Leadline	65 lb/100 fathom	65 lb/100 fathom	65 lb/100 fathom
Tie-Down	3 feet/4 fathoms	None	None

A randomized block design was used to facilitate comparisons among nets. Each net type was randomly assigned to a position within each of three separate hauls. Each haul contained three 100 yd lengths of each net type for a total of 900 yards per haul. Three hauls were set and retrieved during each trip for a total of 2,700 yards per trip. Each haul was set in a traditional manner, perpendicular to shore just outside of the PSGNRA. An NCDMF observer was present during each trip and collected location, catch, and bycatch information for each net type within each haul. The 2001 Section 10 permit allowed 12 live and five lethal sea turtle takes of any species for the duration of the study (66 FR 42, 845, 15 August 2001). If these thresholds were exceeded, the experiment would be terminated. Catch and bycatch CPUEs among nets were compared using a Duncan’s multiple range test (Duncan 1955).

RESULTS

The control net caught 1,419.9 kg of flounder, the low-profile net caught 1,021.6 kg, and the double leadline net caught 798.1 kg (Figure 5). A significant difference between the control and experimental nets was detected ($P<0.01$), while no difference was found between the experimental nets (Figure 5).

The control net caught 2,078.5 kg of bycatch, the double leadline net caught 1,695.5 kg, and the low-profile caught 1,044.2 kg (Figure 6). A significant difference between the experimental nets was detected ($P<0.0001$), while no difference was found between the control and double leadline nets (Figure 6). Examination of the species composition for each net revealed that bycatch observed in the low-profile net was primarily due to reductions of marketable species, including horseshoe crabs (*Limulus polyphemus*) and weakfish (*Cynoscion regalis*) (Figure 7, Tables 3, 4, and 5). Bycatch in the double leadline net was not significantly different from the control net, more Atlantic menhaden (*Brevoortia tryrannus*) and bluefish (*Pomatomus saltatrix*) were observed in the double leadline net (Tables 3 and 5).

Four Kemp's ridley sea turtles (*Lepidochelys kempii*) were caught during the study and all died (Table 6). Three were caught in the control net and one was captured in the double leadline net (Table 6). All four were caught in the same area located just outside the PSGNRA north of Ocracoke Island (Figure 8).

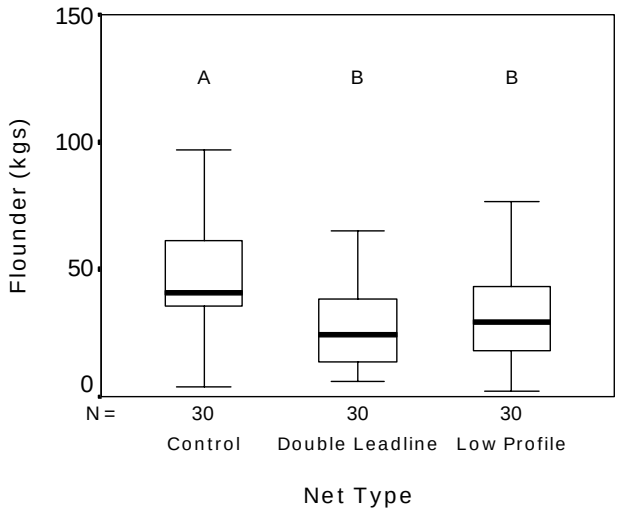

Figure 5. Flounder catch for a standard deep water flounder gillnet with tie-downs (control), a double leadline gillnet and a low-profile gillnet without tie-downs. Nets with the same letter are not significantly different from each other ($P<0.01$).

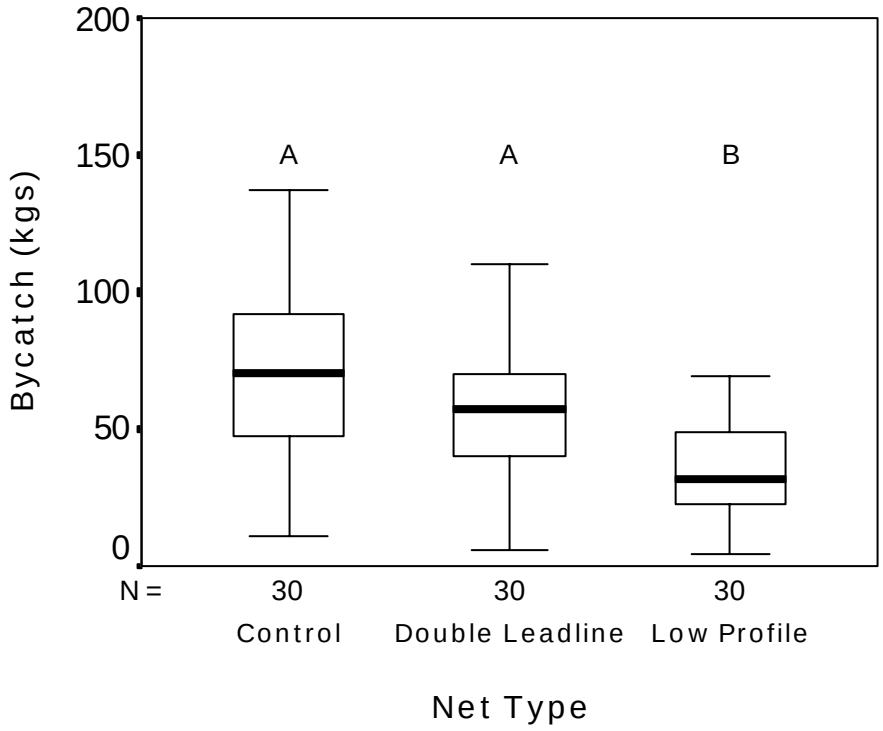

Figure 6. Bycatch for a standard deep water flounder gillnet with tie-downs (control), a double leadline, gillnet and a low-profile gillnet without tie-downs. Nets with the same letter are not significantly different from each other (P<0.0001).

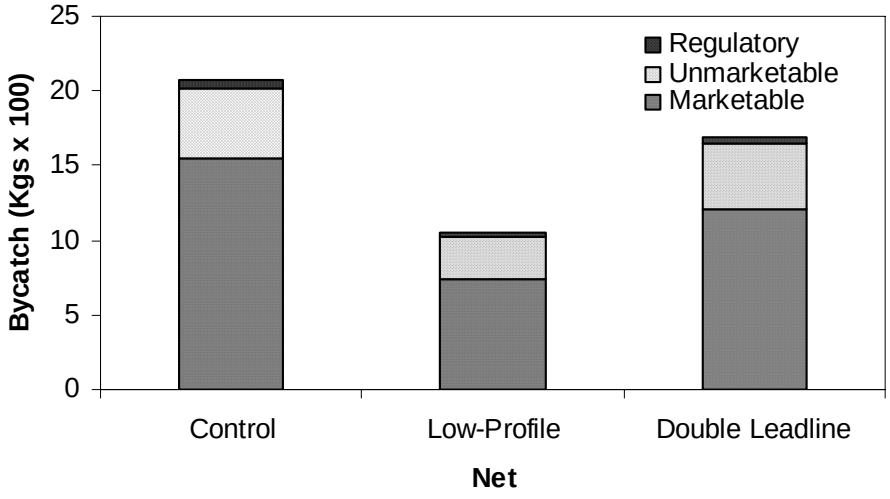

Figure 7. Bycatch components for a standard deep water flounder gillnet with tie-downs (control), a double leadline gillnet and a low-profile gillnet without tie-downs.

Table 3. Relative biomass (kg) and number of individuals collected by a standard flounder gillnet with tie-downs (control) for 30 trips in southeastern Pamlico Sound NC, 2001.

Scientific Name	Common Name	Weight (kgs)	% Weight	Number	% Number
Paralichthys lethostigma	Flounder, Southern	1,419.9	40.6	1,531	28.3
Limulus polyphemus	Crab, Horseshoe	1,049.1	30.0	494	9.1
Brevoortia tyrannus	Menhaden, Atlantic	582.7	16.7	2,372	43.8
Cynoscion regalis	Seatrout, Weakfish	198.1	5.7	608	11.2
Rhinoptera bonasus	Ray, Cownose	73.6	2.1	47	0.9
Raja eglanteria	Skate, Clearnose	25.6	0.7	18	0.3
Pomatomus saltatrix	Bluefish	23.8	0.7	58	1.1
Dasyatidae	Stingrays	19.9	0.6	27	0.5
Menticirrhus americanus	Kingfish, Southern	15.9	0.5	49	0.9
Dasyatis americana	Stingray, Southern	8.8	0.3	9	0.2
Rhizoprionodon terraenovae	Shark, Atlantic Sharpnose	8.4	0.2	3	0.1
Synodus foetens	Lizardfish, Inshore	7.4	0.2	23	0.4
Acipenser oxyrhynchus	Sturgeon, Atlantic	7.0	0.2	1	0.0
Astroscopus spp.	Stargazers (Astroscopus)	6.5	0.2	7	0.1
Phalacrocorax Auritus	Cormorant, Double Crested	6.4	0.2	8	0.1
Paralichthys dentatus	Flounder, Summer	6.3	0.2	12	0.2
Myliobatis freminvillei	Ray, Bullnose	4.6	0.1	4	0.1
Leiostomus xanthurus	Spot	4.2	0.1	23	0.4
Paralichthys albigutta	Flounder, Gulf	4.0	0.1	7	0.1
Micropogonias undulatus	Croaker, Atlantic	3.4	0.1	33	0.6
Busycon spp.	Whelks	3.2	0.1	12	0.2
Squalus acanthias	Dogfish, Spiny	2.2	0.1	1	0.0
Archosargus probatocephalus	Sheepshead	2.1	0.1	1	0.0
Gymnura spp.	Rays, Butterfly	1.7	0.0	9	0.2
Astroscopus y-graecum	Stargazer, Southern	1.6	0.0	5	0.1
Prionotus carolinus	Searobin, Northern	1.5	0.0	7	0.1
Orthopristis chrysoptera	Pigfish	1.3	0.0	7	0.1
Scophthalmus aquosus	Flounder, Windowpane	1.3	0.0	4	0.1
Menticirrhus saxatilis	Kingfish, Northern	1.0	0.0	3	0.1
Pogonias cromis	Drum, Black	1.0	0.0	1	0.0
Peprilus alepidotus	Harvestfish	0.8	0.0	4	0.1
Bairdiella chrysoura	Perch, Silver	0.6	0.0	4	0.1
Cnidaria	Jellyfish	0.5	0.0	1	0.0
Callinectes sapidus	Crab, Blue	0.5	0.0	3	0.1
Prionotus evolans	Searobin, Striped	0.4	0.0	2	0.0
Astroscopus guttatus	Stargazer, Northern	0.4	0.0	1	0.0
Peprilus triacanthus	Butterfish	0.4		2	0.0
Busycon carica	Whelk, Knobbed	0.3		2	0.0
Lagodon rhomboides	Pinfish	0.3		2	0.0
Menticirrhus littoralis	Kingfish, Gulf	0.3		1	0.0
Cynoscion nebulosus	Seatrout, Spotted	0.2		1	0.0
Sphoeroides maculatus	Puffer, Northern	0.2		1	0.0
Busycotypus canaliculatus	Whelk, Channeled	0.1		1	0.0
Callinectes similis	Crab, Lesser Blue	0.0		3	0.1
Lepidochelys kempi	Turtle, Kemp's Ridley			3	0.1

Table 4. Relative biomass (kg) and number of individuals collected by a modified low-profile flounder gillnet without tie-downs for 30 trips in southeastern Pamlico Sound NC, 2001.

Scientific Name	Common Name	Weight (kgs)	% Weight	Number	% Number
Paralichthys lethostigma	Flounder, Southern	1,021.6	49.4	1,098	35.2
Limulus polyphemus	Crab, Horseshoe	508.2	24.6	231	7.4
Brevoortia tyrannus	Menhaden, Atlantic	312.3	15.1	1,291	41.4
Cynoscion regalis	Seatrout, Weakfish	87.2	4.2	265	8.5
Rhinoptera bonasus	Ray, Cownose	30.8	1.5	20	0.6
Dasyatidae	Stingrays	18.2	0.9	25	0.8
Menticirrhus americanus	Kingfish, Southern	14.6	0.7	41	1.3
Pomatomus saltatrix	Bluefish	12.0	0.6	28	0.9
Morone saxatilis	Bass, Striped	10.4	0.5	1	0.0
Dasyatis americana	Stingray, Southern	7.6	0.4	6	0.2
Raja eglanteria	Skate, Clearnose	4.7	0.2	4	0.1
Paralichthys dentatus	Flounder, Summer	4.5	0.2	10	0.3
Archosargus probatocephalus	Sheepshead	4.0	0.2	2	0.1
Synodus foetens	Lizardfish, Inshore	3.9	0.2	12	0.4
Leiostomus xanthurus	Spot	2.8	0.1	9	0.3
Squalus acanthias	Dogfish, Spiny	2.8	0.1	1	0.0
Astroscopus spp.	Stargazers (Astroscopus)	2.6	0.1	3	0.1
Pogonias cromis	Drum, Black	2.5	0.1	2	0.1
Busycon spp.	Whelks	2.4	0.1	12	0.4
Micropogonias undulatus	Croaker, Atlantic	2.3	0.1	21	0.7
Menticirrhus spp.	Kingfishes	1.4	0.1	3	0.1
Paralichthys albigutta	Flounder, Gulf	1.3	0.1	2	0.1
Rhizoprionodon terraenovae	Shark, Atlantic Sharpnose	1.2	0.1	1	0.0
Cnidaria	Jellyfish	1.0	0.0	2	0.1
Orthopristis chrysoptera	Pigfish	0.8	0.0	4	0.1
Astroscopus guttatus	Stargazer, Northern	0.8	0.0	2	0.1
Scophthalmus aquosus	Flounder, Windowpane	0.8	0.0	3	0.1
Astroscopus y-graecum	Stargazer, Southern	0.7	0.0	1	0.0
Menticirrhus littoralis	Kingfish, Gulf	0.6	0.0	2	0.1
Tautoga onitis	Tautog	0.6	0.0	1	0.0
Prionotus carolinus	Searobin, Northern	0.5	0.0	2	0.1
Busycon carica	Whelk, Knobbed	0.4	0.0	2	0.1
Gymnura spp.	Rays, Butterfly	0.2	0.0	2	0.1
Gymnura micrura	Ray, Smooth Butterfly	0.2	0.0	1	0.0
Myliobatis freminvillei	Ray, Bullnose	0.2	0.0	1	0.0
Prionotus tribulus	Searobin, Bighead	0.2	0.0	1	0.0
Peprilus triacanthus	Butterfish	0.2		1	0.0
Ancylopsetta quadrocellata	Flounder, Ocellated	0.2		1	0.0
Busycotypus canaliculatus	Whelk, Channeled	0.1		1	0.0
Peprilus alepidotus	Harvestfish	0.1		1	0.0

Table 5. Relative biomass (kg) and number of individuals collected by a modified double leadline flounder gillnet for 30 trips in southeastern Pamlico Sound NC, 2001.

Scientific Name	Common Name	Weight (kgs)	% Weight	Number	% Number
Paralichthys lethostigma	Flounder, Southern	798.1	31.9	889	17.8
Brevoortia tyrannus	Menhaden, Atlantic	704.7	28.2	2,749	55.1
Limulus polyphemus	Crab, Horseshoe	565.9	22.6	332	6.7
Cynoscion regalis	Seatrout, Weakfish	173.5	6.9	498	10.0
Pomatomus saltatrix	Bluefish	56.8	2.3	131	2.6
Raja eglanteria	Skate, Clearnose	29.2	1.2	21	0.4
Menticirrhus americanus	Kingfish, Southern	25.0	1.0	80	1.6
Rhinoptera bonasus	Ray, Cownose	24.6	1.0	17	0.3
Dasyatidae	Stingrays	20.8	0.8	23	0.5
Synodus foetens	Lizardfish, Inshore	12.8	0.5	41	0.8
Phalacrocorax Auritus	Cormorant, Double Crested	11.2	0.4	10	0.2
Rhizoprionodon terraenovae	Shark, Atlantic Sharpnose	8.5	0.3	3	0.1
Astroscopus spp.	Stargazers (Astroscopus)	7.4	0.3	7	0.1
Paralichthys dentatus	Flounder, Summer	7.2	0.3	14	0.3
Acipenser oxyrhynchus	Sturgeon, Atlantic	6.0	0.2	1	0.0
Dasyatis americana	Stingray, Southern	5.5	0.2	6	0.1
Paralichthys albigutta	Flounder, Gulf	4.3	0.2	9	0.2
Astroscopus guttatus	Stargazer, Northern	4.0	0.2	7	0.1
Myliobatis freminvillei	Ray, Bullnose	3.9	0.2	4	0.1
Leiostomus xanthurus	Spot	3.8	0.2	17	0.3
Micropogonias undulatus	Croaker, Atlantic	3.7	0.1	35	0.7
Busycon spp.	Whelks	3.7	0.1	20	0.4
Orthopristis chrysoptera	Pigfish	2.8	0.1	14	0.3
Squalus acanthias	Dogfish, Spiny	2.3	0.1	1	0.0
Archosargus probatocephalus	Sheepshead	2.2	0.1	1	0.0
Busycon carica	Whelk, Knobbed	2.1	0.1	13	0.3
Lagodon rhomboides	Pinfish	1.8	0.1	10	0.2
Astroscopus y-graecum	Stargazer, Southern	1.2	0.0	3	0.1
Pogonias cromis	Drum, Black	0.8	0.0	2	0.0
Busycotypus canaliculatus	Whelk, Channeled	0.6	0.0	6	0.1
Menticirrhus spp.	Kingfishes	0.6	0.0	2	0.0
Menticirrhus littoralis	Kingfish, Gulf	0.6	0.0	2	0.0
Cnidaria	Jellyfish	0.5	0.0	1	0.0
Gymnura spp.	Rays, Butterfly	0.5	0.0	2	0.0
Prionotus carolinus	Searobin, Northern	0.4	0.0	2	0.0
Tautoga onitis	Tautog	0.4	0.0	1	0.0
Prionotus evolans	Searobin, Striped	0.3		2	0.0
Scophthalmus aquosus	Flounder, Windowpane	0.3		1	0.0
Prionotus tribulus	Searobin, Bighead	0.2		1	0.0
Cynoscion nebulosus	Seatrout, Spotted	0.2		1	0.0
Bairdiella chrysoura	Perch, Silver	0.2		2	0.0
Triglidae	Searobins	0.1		1	0.0
Peprilus triacanthus	Butterfish	0.1		1	0.0
Peprilus alepidotus	Harvestfish	0.1		1	0.0
Lepidochelys kempi	Turtle, Kemp's Ridley			1	0.0

Table 6. Sea turtle interactions observed by net type in southeastern Pamlico Sound NC, 2001.

Date	Net Type	Species	Carapace Length (mm)	Condition
10/21/2001	Control	Kemp's Ridley	370	Dead
10/22/2001	Control	Kemp's Ridley	380	Dead
11/07/2001	Double Leadline	Kemp's Ridley	375	Dead
11/07/2001	Control	Kemp's Ridley	355	Dead

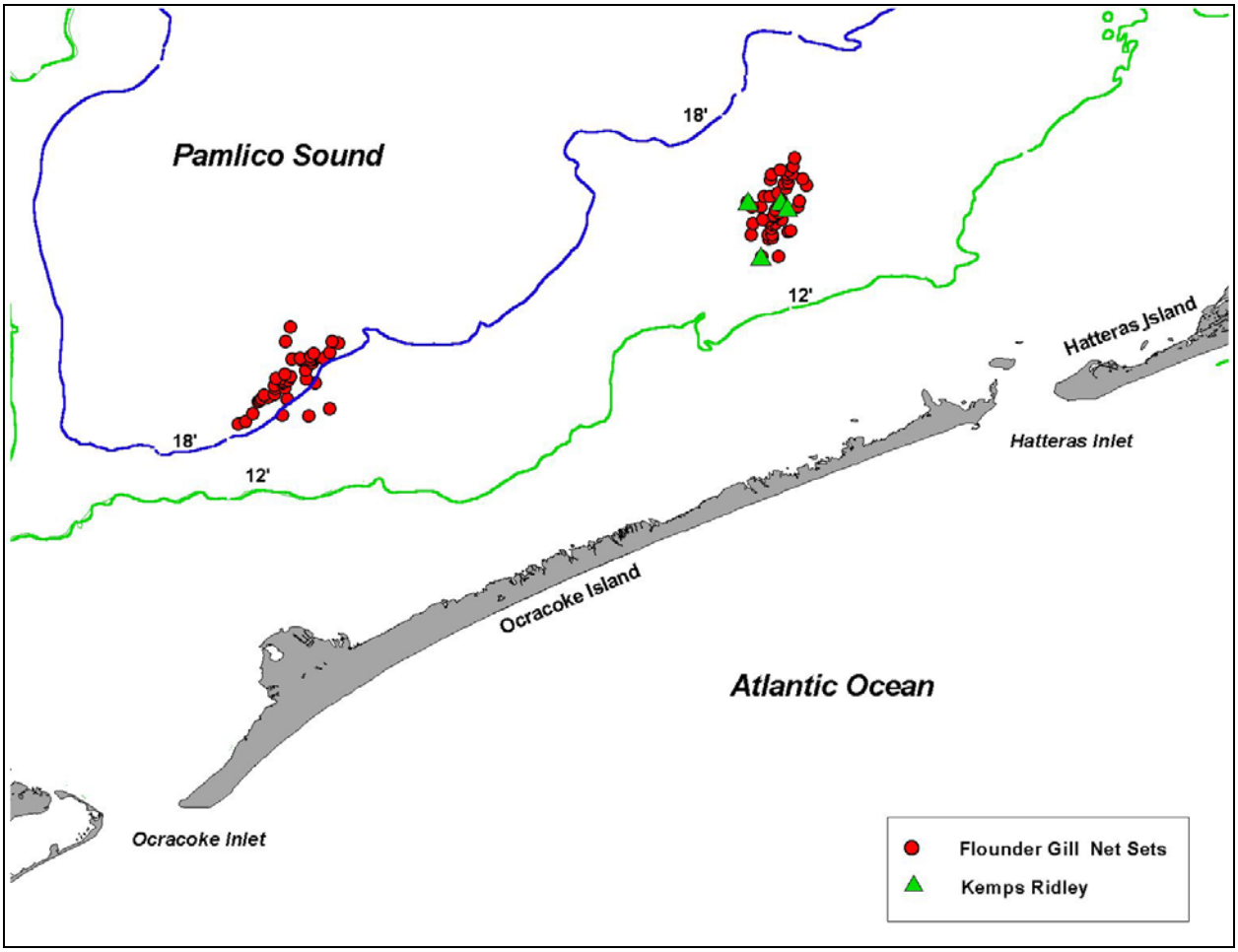

Figure 8. Locations of experimental flounder gillnet sets and sea turtle interactions in southeastern Pamlico Sound NC, 2001.

DISCUSSION

Gillnet management measures imposed by NCDMF and NMFS in Pamlico Sound during the 2001 fishing season were successful in reducing sea turtle bycatch, while allowing fisheries to operate. Observed takes of sea turtles in the PSGNRA during the 2001 season were down considerably from take levels observed in 2000. There were an estimated 122 live and 84 lethal takes in 2000, while 2001 take levels were estimated to be 46 live and 16 lethal. This 70% reduction in sea turtle bycatch came at the expense of the deep water flounder gillnet fishery, which was responsible for approximately 78% of the 2000 takes (Gearhart 2001). Fishing gear and techniques utilized by the deep water gillnet fleet such as tie-downs, multiple day soak times, and large amounts of fishing gear resulted in levels of sea turtle bycatch and mortality that were unacceptable to fishery managers and consequently caused the closure of Pamlico Sound to large mesh gillnets. Prior to the 2001 closure, NCDMF and NMFS conducted a joint study to determine the effect of tie-downs on turtle entanglement rates, which indicated that there was an inverse relationship between tie-down length and entanglement rate. Considering these results, two alternative gillnet configurations were tested during this study.

Each of the new configurations tested was designed to eliminate the pocket of webbing produced by tie-downs. The first experimental gillnet was a low-profile net with a panel height of six feet. This design reduced the amount of webbing by half and did not incorporate tie-downs. The second experimental net was a double leadline configuration with the float line of the net replaced by another leadline. This configuration was designed to eliminate the vertical wall of webbing and was developed to entangle bottom-dwelling flounder instead of gilling them.

Results indicate that the low-profile design may be a viable option for deep water fishermen, while the double leadline design needs further testing. Each of the experimental gillnets caught significantly fewer flounder than the control net. Catch rates observed in the low-profile net remained at acceptable levels, classifying the design as a potentially feasible gear. In addition, the low-profile net caught significantly less bycatch than both the control and double leadline nets, although most of the bycatch reduction was marketable. Four sea turtles were caught during this study; three in the control net, and one in the double leadline net. These results indicate that further testing of the low-profile net is needed to determine if sea turtle catch rates are significantly lower than those observed in the control net.

CONCLUSIONS AND RECOMMENDATIONS

Management of the Pamlico Sound gillnet fisheries in 2001 indicates that measures imposed were sufficient to reduce sea turtle strandings in the region. However, these reductions came at a severe cost to fishermen who participated in the deep water flounder gillnet fishery. The closure of this fishery resulted in significant economic hardship and shifted fishing effort into other coastal North Carolina fisheries causing gear conflicts and increased effort on other NCDMF/Atlantic States Marine Fisheries Commission managed species. The development of a modified flounder gillnet that prevents the bycatch of sea turtles, while maintaining an acceptable level of flounder landings, would allow this highly productive fishing area to be

reopened. This would avert user conflicts in adjacent fisheries and provide financial relief to those fishermen affected by the Pamlico Sound closure.

Results of this study indicate that the low-profile gillnet design has the potential to be a viable deep water fishing gear that significantly reduces both sea turtle and finfish bycatch, while maintaining targeted catch. Based on these results, NCDMF recommends the following:

- Conduct further testing on the low-profile gillnet design in deep water to determine if sea turtle bycatch rates are significantly less than those observed in the control net.

- Conduct further testing of the double leadline gillnet design in shallow water areas of Pamlico Sound to determine if flounder catch rates are comparable to standard nets used in those areas.

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