

**Final Report to the National Marine Fisheries Service
Office of Protected Resources for Work Conducted Under
Contract #43AANF600211 and NMFS Permit No. 971**

In Water Population Survey of Sea Turtles of Delaware Bay

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Introduction:

Juvenile sea turtles occur in coastal bays and estuaries along the U.S. Atlantic coast from Massachusetts to Florida. In the southern portion of this range, where water temperatures are relatively warm throughout the year, sea turtles may remain resident in inshore areas. However, in the northern part of the range, where water temperatures vary seasonally, sea turtles migrate to and occupy inshore areas only during the Summer and early Fall. In recent years the inshore waters have been shown to be important “developmental habitats” for juvenile turtles, providing food and shelter for several species.

The Delaware Bay is an important sea turtle “developmental habitat”, however it has yet to be recognized as such despite the fact that it provides important habitat for threatened loggerhead sea turtles (*Caretta caretta*) and Kemp’s ridley sea turtles (*Lepidochelys kempii*). Juvenile sea turtles are known to occur in Delaware Bay annually between June and October where they presumably forage on the rich abundance of crabs as well as other marine invertebrates that occupy these waters. Until recently, nothing was known about the origins of Delaware Bay loggerhead turtles. Researchers conducting genetic studies have found that loggerheads stranded along the northeastern U.S. coast (Massachusetts through Maryland) are derived from nesting populations located in Mexico, Florida, Georgia, and South Carolina (Rankin-Baransky 1997). More recently, Plotkin and Spotila (unpublished data) tracked three post-nesting adult loggerhead turtles (using satellite transmitters) from their nesting beach in northern Georgia (Wassaw Island) to the mouth of the Delaware Bay, the eastern shore of Maryland, and to Chesapeake Bay respectively. These results demonstrate for the first time that northeastern U.S. coastal waters are not just “developmental habitat” for juvenile turtles, but that these coastal waters are also important for reproductively active adults.

We conducted the first systematic study of sea turtles in Delaware Bay from June 1997 to September 1997 to determine their distribution and abundance. We used three approaches to obtain data for this study. First, we conducted monthly aerial surveys of the Delaware Bay from June through August 1997 to determine locations of turtles and to estimate their abundance. Second, we conducted weekly in-water surveys from June through September 1997 using tangle nets to capture sea turtles in the areas where they were observed during aerial surveys. Last, we conducted a sea turtle sighting survey of the public users of Delaware Bay and placed posters and sea turtle sighting response cards at strategic locations along the New Jersey and Delaware sides

of the Bay .

Methods:

Aerial Surveys:

We conducted aerial surveys of Delaware Bay from a Cessna 172 flown at speeds ranging from 100 mph to 224 mph and at an altitude between 300 – 500 ft above sea level. Surveys were conducted along four transect lines that ran east-west in the lower Delaware Bay (Fig. 1). Two observers were seated on the left and right sides of the plane and a third person acted as a designated data recorder during the flights. Observers were capable of documenting sea turtles from the transect line out to a distance of 150 m in either direction from the transect line. Therefore, the strip transect we surveyed was approximately 300 m wide. Data recorded during aerial surveys included the locations of turtles sighted, species of turtles sighted, and the time that turtles were sighted. We used strip transect estimates of density (Epperly et al. 1995) to estimate the density of turtles per 100 km² .

In-Water Captures:

Tangle nets were used for in-water captures of sea turtles at various locations in Delaware Bay. Netting locations were chosen based on the locations of turtles sighted during our aerial surveys and from sea turtle sighting records obtained from public users of Delaware Bay. We used 2 different sized nets for turtle captures: 100 yd x 8 ft deep x 10 in mesh and 100 yd x 30 ft deep x 6 in mesh. Tangle nets were equipped with a foam core float line and a lead core sink line. Large surface bullet floats were attached to the float line approximately every 10 ft to facilitate visual detection of animals entangled in the net. Net deployment was conducted by boat during daylight hours with at least one boat monitoring the floats on the nets at all times. Nets were retrieved and checked for sea turtles and other organisms every 30 minutes. Turtles captured in nets were removed and brought onboard the vessel for processing. Processing included standard measurements (curved and straight-line carapace length and width, weight, etc.), visual evaluation of the condition of the turtle, photography, PIT tag injection and flipper tag application

Public Sea Turtle Sighting Survey:

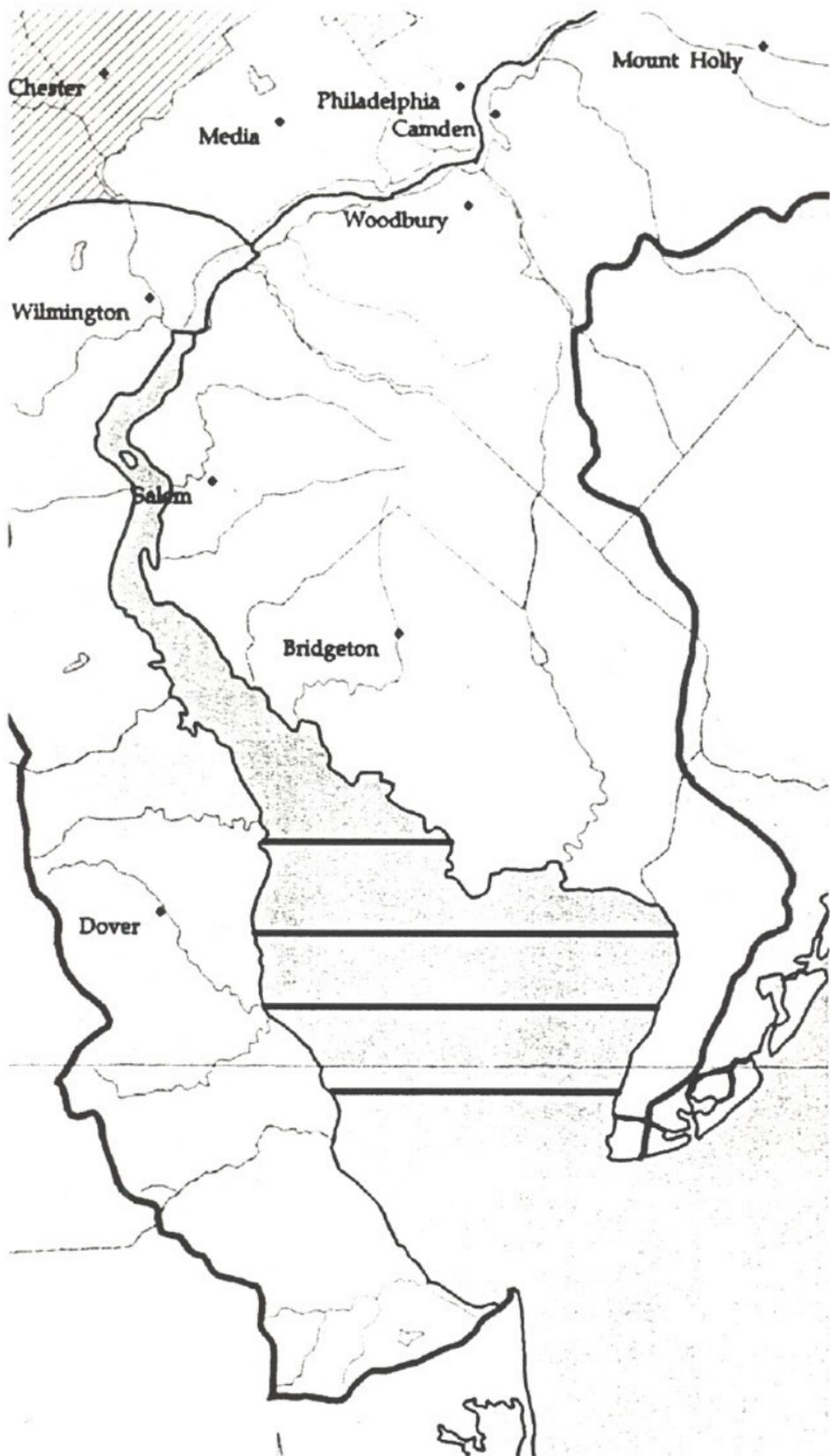


Figure 1. Delaware Bay and location of aerial surveys

We placed sea turtle sighting posters (Fig. 2) and postage-paid response cards (Fig. 3) at marinas, piers, and docks along the New Jersey and Delaware coasts to educate the public about sea turtles and to encourage them to report sea turtle sightings and strandings. The posters provided general information about sea turtles and their protected status, contact information for reports of stranded turtles, and line drawings of sea turtles. The postcards were attached to the posters and provided detailed information about each of the 5 sea turtle species that occur in the region as well as line drawings to facilitate the identification of each species. Specific information requested on the postcards included: date of the turtle sighting, location of sighting, species sighted, comments, and name and address of respondent. Comments requested from the sightings included: size, color and shape of the turtle; behavior and appearance of turtle; if the turtle was captured incidental to other activities and if so, the method of capture.

Results:

Aerial Surveys:

We conducted 3 aerial surveys on 20 June 1997, 31 July 1997, and 15 August 1997. The four transects flown during each survey were 31.1 km, 43.1 km, 45.7 km, and 20.6 km in length (Table 1). The total area surveyed per survey was approximately 42.15 km². We sighted 10 turtles during the first survey, 9 turtles during the second survey and 14 turtles during the third survey. A total of 33 loggerhead turtles were sighted during all three surveys (Figs. 4 and 5). Most of the loggerhead turtles were large adults and perhaps sub-adult as well. We estimate that there were 23.72 turtles/100 km² during the first survey, 21.35 turtles/100 km² during the second survey and 33.22 turtles/100 km² during the third survey (Table 1).

The estimated density of turtles in Delaware Bay based on our aerial survey data was comparable to or greater than density estimates (also based on aerial survey data) reported from areas along the southeastern U.S. (Table 2). For example, our sea turtle density estimates were greater than those reported for sea turtles in Pamlico Sound and Core Sound, North Carolina (Epperly et al. 1995).

In-Water Captures:

We deployed tangle nets at various locations of Lower Delaware Bay from June through

Table 1. Number of sea turtles sighted on the surface of Delaware Bay during aerial surveys and estimated densities: June – August 1997.

Survey Date	Transect	# Turtles sighted	Total distance surveyed (km)	Total area surveyed (km ²)	Turtle/km ²	Turtle/100 km ²
20 June 1997	1	0	31.1	9.33		
	2	7	43.1	12.93		
	3	3	45.7	13.71		
	4	0	20.6	<u>6.18</u>		
				42.15	0.237	23.72
31 July 1997	1	6	31.1	9.33		
	2	2	43.1	12.93		
	3	1	45.7	13.71		
	4	0	20.6	<u>6.18</u>		
				42.15	0.2135	21.35
15 August 1997	1	5	31.1	9.33		
	2	7	43.1	12.93		
	3	1	45.7	13.71		
	4	1	20.6	<u>6.18</u>		
				42.15	0.3322	33.22

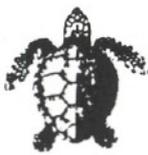
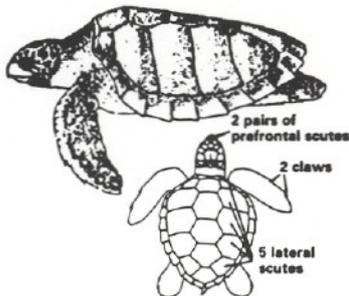
WANTED

SIGHTINGS OF SEA TURTLES

All Atlantic species of sea turtles are listed under the Endangered Species Act of 1973. Sea turtle stocks continue to dwindle. The National Marine Fisheries Service and Drexel University are conducting a study to determine what turtle species inhabit Delaware Bay waters and where they are commonly found. YOU can help. Take a card below. If you sight a live turtle, fill out the card as best as you can and drop it in the mail. If you sight a dead turtle, call Delaware Division of Fish and Wildlife at (302) 739-3441 or in New Jersey the Marine Mammal Stranding Center (609) 266-0538.

Loggerhead Sea Turtle

Caretta caretta caretta



LOGGERHEAD

- Reddish-brown shell with yellow underside
- Heart shaped shell
- May reach 4 feet
- May weigh up to 500 lbs
- Most common sea turtle in Delaware Bay
- Feeds on bottom-dwelling animals, jellyfish and vegetation



LEATHERBACK

- Black or dark brown leathery back
- Barrel shaped
- May reach 6 feet
- May weigh up to 2000 lbs
- Feeds on jellyfish and associated organisms



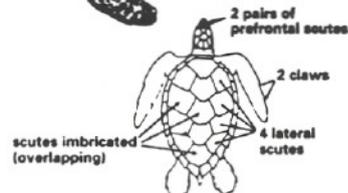
GREEN

- Olive-brown shell marked with darker streaks
- Smooth, oval-shaped shell
- May reach 4 feet
- May weigh up to 300 lbs
- Feeds on seagrasses and algae

Detach and Mail

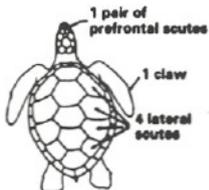
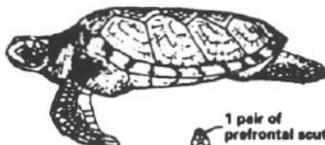
Hawksbill

Eretmochelys imbricata



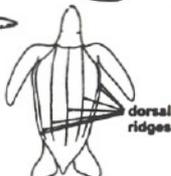
Green Sea Turtle

Chelonia mydas mydas



Leatherback

Dermochelys coriacea coriacea



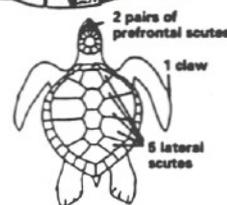
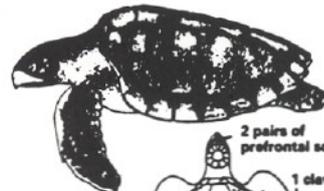
SEA TURTLE SIGHTINGS

Date	Location	Species	Comments

- Be as specific as possible for location (lat. and long. if available). If you are not absolutely sure of the species, leave that part blank and describe it under comments section (size, color, shape). Also, under comments section, note behavior and appearance of turtle. If the turtle was captured incidentally and any other observation - if any tags were noticed, please record tag number. Record only live turtle sightings. If you see a dead sea turtle, contact Marine Mammal Stranding Center (609) 266-0538 in New Jersey, or Delaware Division of Fish and Wildlife at (302) 739-3441 in Delaware.
- If you do not mind that we contact you for further information, please fill in your name and return address on reverse side.

Atlantic or Kemp's Ridley

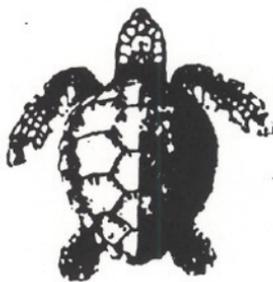
Lepidochelys kempii



WARNING: Sea turtles are protected by the Endangered Species Act of 1973, and unauthorized removal or handling of sea turtles is punishable under this law. The incidental taking of endangered sea turtles (Kemp's ridley, hawksbill, leatherback, and Florida breeding green turtles) is prohibited. The incidental taking of threatened sea turtles (loggerhead and green, other than the Florida breeding population of green sea turtles) during normal fishing activities not directed towards capturing turtles is allowed provided that: 1) any turtle so taken must be handled with due care to prevent injury to live specimens, and must be returned to the water immediately whether it is dead or alive unless it is a sea turtle which is alive and conscious, in which case before returning it to the water, resuscitation must be attempted, and 2) and turtle so taken must not be consumed, sold, landed, offloaded, transhipped, or kept below deck.

For further information please contact:
Sea Turtle Coordinator
Center for Biodiversity and Conservation
Drexel University
Philadelphia, PA 19104
(215) 895-2099





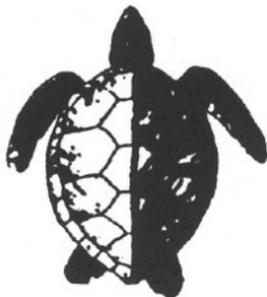
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SEA TURTLE SIGHTINGS

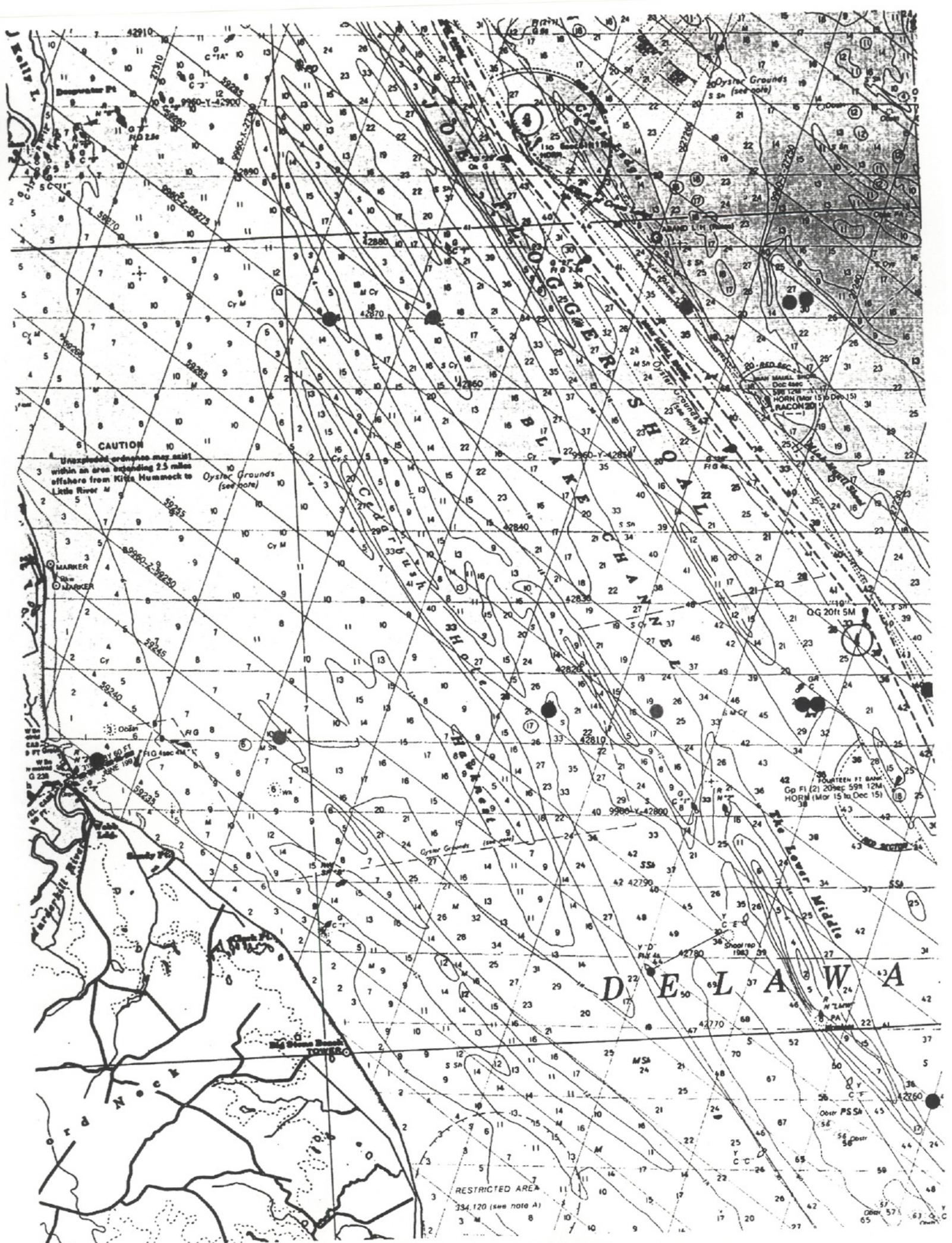
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- If you do not mind that we contact you for further information, please fill in your name and return address on reverse side.

Table 2. Sea turtle density estimates based on aerial surveys conducted in U.S. Atlantic coastal waters (strip transect estimates).

Location	Estimated Density of Turtles/100 km ²	Reference
Delaware Bay	21.35 – 33.22	This report
Lower Chesapeake Bay	0 - 57.4	Keinath et al. 1987
Mid Chesapeake Bay	0 – 8.5	Keinath et al. 1987
Pamlico Sound	0 – 6.53	Epperly et al. 1995
Core Sound	0 – 30.48	Epperly et al. 1995
Southern Georgia	0 – 62.02	Braun and Epperly 1996

Figures 4 and 5. Detailed maps of Delaware Bay showing the locations of sea turtles sighted during aerial surveys (red dots=20 June; yellow dots=31 July; blue dots=15 August)

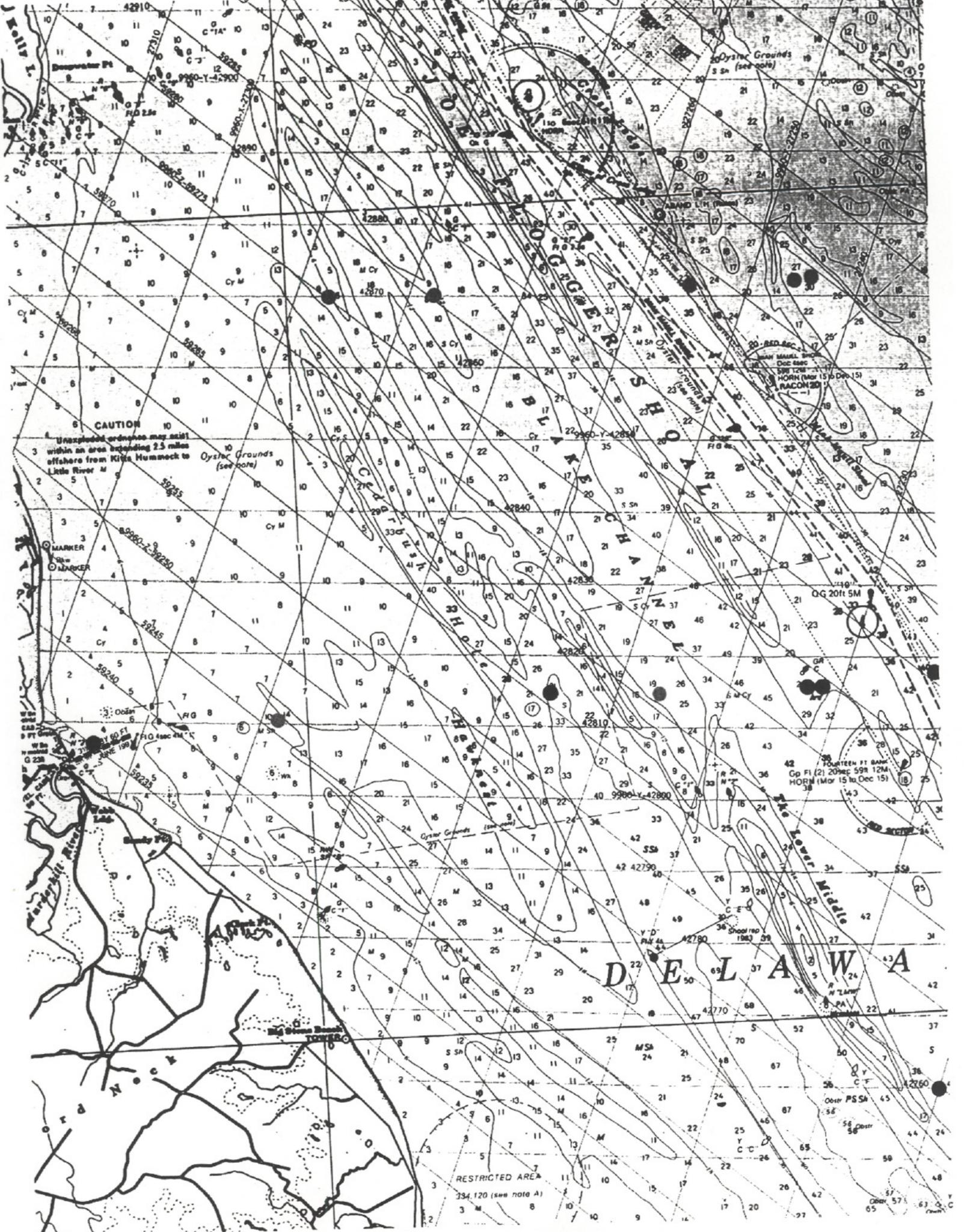


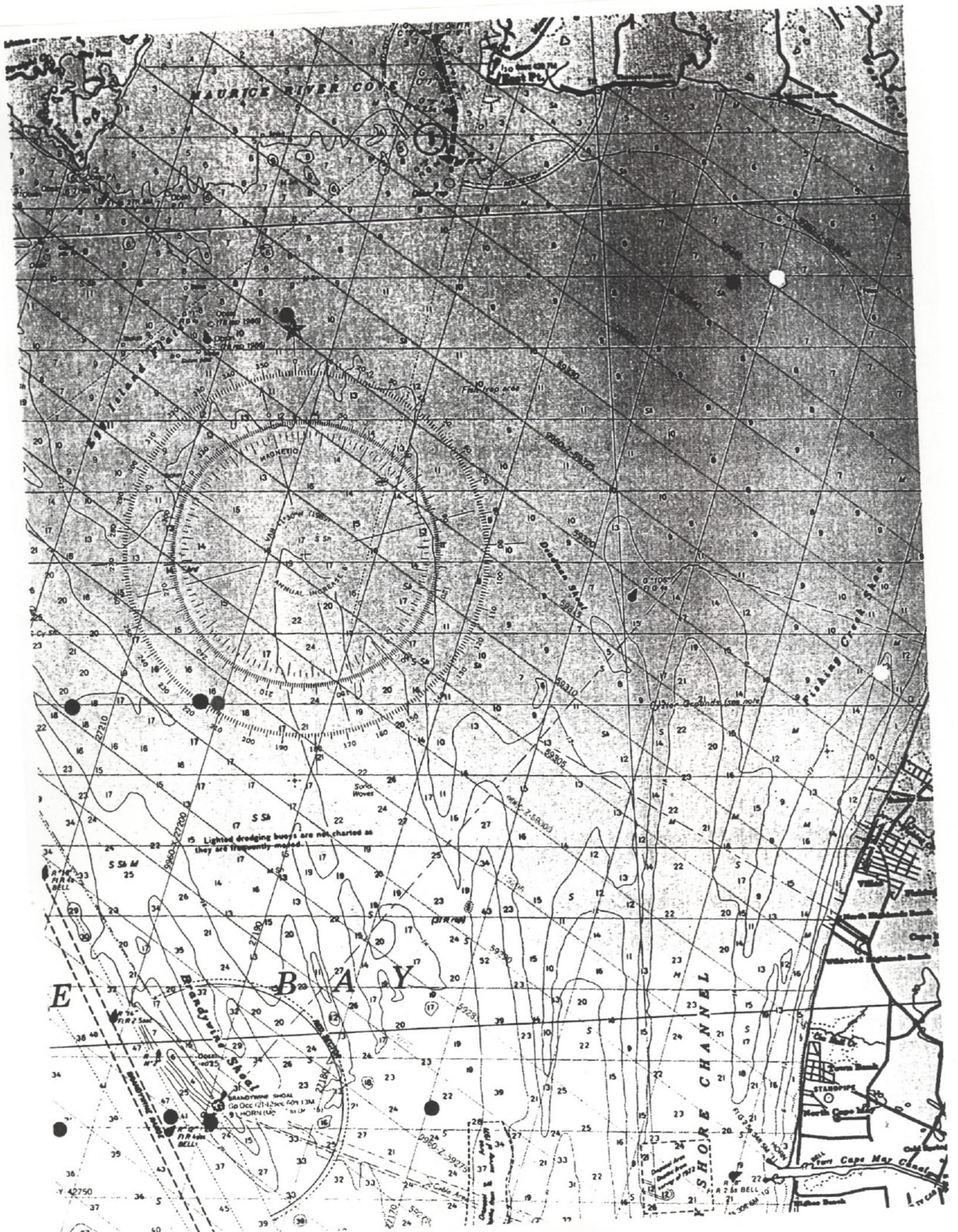
CAUTION
Unexploded ordnance may exist
within an area extending 2.5 miles
offshore from Kites Hummock to
Little River M

RESTRICTED AREA
334.120 (see note A)
3 M

FOURTEEN FT BANK
Go Fl (2) 20 sec 59R 12M
HORN (Mar 15 to Dec 15)

RED SEC
Go Fl (2) 20 sec 59R 12M
HORN (Mar 15 to Dec 15)





early September 1997. Most of the netting locations overlapped with areas where we had observed turtles during our aerial surveys. We deployed 2 nets on 21 different days for a total of 103 hours and 3 minutes (Table 3). During our in-water survey we observed 10 loggerhead turtles, captured 2 live male loggerheads, and found one half of a dead loggerhead floating in the water (Appendix I). The two live turtles captured in the nets were 90 cm and 108.2 cm curved carapace length and could not be lifted onboard the boat because of their weight. We attached NMFS flipper tags to both turtles and PIT-tagged one of the turtles. Turtles were released unharmed after they were tagged.

Public Sea Turtle Sighting Survey:

We received 60 postcard responses from public users of Delaware Bay (Table 4). Most respondents were recreational fishermen who were fishing in the lower Delaware Bay. A few sightings were reported by people travelling on the Ferry from Cape May, New Jersey to Lewes, Delaware. A total of 64 turtles were sighted and reported by the public. Loggerhead turtles were the most common species sighted (N=52), followed by hawksbill turtles (*Eretmochelys imbricata*) (N=4), and green turtles (*Chelonia mydas*) (N=2). Two turtles were not identified to species. We suspect that all of the hawksbill and green turtles reported by the public were actually loggerhead turtles because these species are uncommon in Delaware Bay. Second, the size and behavioral observations reported for some of the hawksbill and green turtles were not descriptive of either species (e.g. turtle was observed eating crabs, turtle weighed 300 lbs, “turtle spit out bait and hissed”).

Recreational fishermen reported the incidental capture of 12 loggerhead turtles of the 64 turtles sighted (18.8 %). All turtles were captured on hook and line. Some of the hooks were baited with squid, minnow, crab, and bloodworm. Turtles captured were hooked in the flipper (N=1) and presumably in the mouth (N=11) although this information was not specified on the response cards. Responses to the fate of the hooked turtles included: hook not removed (N=1); hook came loose at surface (N=1); line cut (N=1); turtle released unharmed (N=4); and no response provided (N=5).

Table 3. In Water Netting Survey of Delaware Bay June - September 1997.

Date	Time	Latitude	Longitude	Duration	Sea Turtles	
					Observed	captured
25 Jun	8:21	39°08.44'	75°12.04'	3h 54min	1	0
25 Jun	13:15	39°09.07'	75°11.21'	4h 23min	5	0
26 Jun	9:15	39°08.69'	75°11.46'	5h 45min	0	0
1 Jul	9:10	39°08.86'	75°11.38'	1h 50min	0	0
1 Jul	11:30	39°12.26'	75°14.67'	2h 15min	0	0
2 Jul	8:30	39°12.72'	75°14.91'	7h 1min	0	0
3 Jul	8:45	39°13.19'	75°15.52'	3h 15min	0	0
8 Jul	9:10	39°05.58'	75°09.70'	1h 20min	2	1
8 Jul	12:15	39°08.32'	75°11.31'	1h 1min	1	1
8 Jul	14:45	39°08.66'	75°11.16'	1h 15min	0	0
9 Jul	9:35	39°12.69'	75°14.76'	1h 29 min	0	0
9 Jul	11:36	39°10.44'	75°14.80'	2h 12min	0	0
10 Jul	9:05	39°10.71'	75°09.38'	2h 43min	0	0
10 Jul	12:19	39°07.91'	75°10.51'	2h 41min	0	0
15 Jul	9:34	39°01.20'	75°02.06'	0h 13min	0	0
15 Jul	11:44	39°59.10'	75°01.85'	1h 50min	0	0
15 Jul	14:34	39°06.36'	75°15.38'	2h 6min	0	0
16 Jul	8:38	39°11.05'	75°15.30'	2h 3min	0	0
16 Jul	11:05	39°09.62'	75°12.36'	3h 6min	0	0
17 Jul	9:38	39°06.89'	75°18.66'	4h 32min	0	0
29 Jul	9:27	39°08.88'	75°17.95'	2h 53min	0	0
29 Jul	13:37	39°18.63'	75°20.67'	1h 33min	0	0
30 Jul	9:00	39°11.91'	75°10.44'	2h 57min	0	0
30 Jul	12:26	39°05.60'	75°17.52'	5h 2min	1 (dead)	1 (dead)
					floating cut in half	
5 Aug	14:15	39°08.10'	75°05.64'	2h 46min	0	0
6 Aug	9:38	38°59.25'	75°06.62'	5h 50min	0	0
6 Aug	15:53	38°59.73'	75°04.08'	2h 47min	0	0
7 Aug	9:29	39°04.11'	75°15.28'	2h 3min	0	0
7 Aug	11:44	39°00.26'	75°16.24'	3h 10 min	0	0
7 Aug	11:57	39°00.48'	75°16.38'	3h 51min	0	0
8 Aug	8:52	39°07.42'	75°09.56'	1h 50min	0	0
8 Aug	11:26	38°59.00'	75°09.98'	2h 42min	0	0
19 Aug	11:32	39°07.42'	75°11.56'	2h17min	0	0
19 Aug	13:59	39°06.65'	75°09.97'	1h 6min	0	0
19 Aug	16:00	39°08.77'	75°10.70'	1h 9min	0	0
21 Aug	9:00	blown off water by storm				
22 Aug	10:01	38°59.58'	75°04.54'	1h 36min	0	0
22 Aug	12:23	38°59.09'	75°06.02'	1h 12min	0	0
5 Sep	11:40	39°26.54'	75°30.38'	1h 20min	0	0
5 Sep	14:05	39°26.03'	75°27.69'	2h 5min	0	0

Table 4. Public responses from sea turtle sighting survey of Delaware Bay 1997

Row #	Month	Day	Location	Spots	Number	Size	Sighting	Capture	Comments	Name	Address
1	7	17	1 mi offshore Fortescue, NJ	loggerhead	3	3 R +	1	1	Caught on top & bottom rig while fishing with peeler crab; hook not removed	Mal Monaco	710 Johnson Ave, Boothwyn, PA 19081 610-485-7614
2	6	4	39 08' N 75 00' W (no. 1)	loggerhead	100-150 lbs		1	1	Caught on fishing hook	Elaine Monaco	PO Box 72-22 Middle St., Halesville, NJ 08324
3	6	4	south of area (no. 1) where first turtle was captured (see recd)	loggerhead	100-150 lbs		1	1	Caught on fishing hook	Elaine Monaco	PO Box 72-22 Middle St., Halesville, NJ 08324
4	7	17	1.5 mi south of Fortescue, NJ 18 ft water	loggerhead	7		1	1	observed by fisherman	Danny Goodman	166 Creamford Dr., Marlton, NJ 08051
5	7	20	2 mi outside canal	loggerhead	7		1	1	observed by fisherman	Danny Goodman	PO Box 837, N. Cape May, NJ 08204
6	7	22	Fortescue, NJ 100 ft deep	loggerhead	7		1	1	observed swimming north	Schickel	PO Box 876, Elmer, NJ 08318
7	7	24	Five Fathom Bank, NJ	green			1	1	observed swimming north	Est Gifford	10 Monticello Dr., Millsboro, NJ 08332
8	7	24	Five Fathom Bank, NJ	loggerhead	150 lb		1	1	observed swimming north	JAN Duro	38 Cool Creek Manor Dr., Wingham, PA 17368
9	7	24	Five Fathom Bank, NJ	loggerhead	150 lb		1	1	observed swimming north	JAN Duro	38 Cool Creek Manor Dr., Wingham, PA 17368
10	7	27	Bury # 8, upper Bay	loggerhead	4 ft x 30 ft		1	1	observed when turtle surfaced	A.R. Criffey	510 Nassau Blvd., Prospect Park, PA 19078
11	8	14	Between Inlet Mouth Shoal and abandoned light house	loggerhead			1	1	hooked while hula fishing with squid; hook came loose at surface	Andy Mihor	114 Crafton Ave., Pisman, NJ 08071
12	8	14	Between Inlet Mouth Shoal and abandoned light house	loggerhead			1	1	observed swimming	Matt Aurilio	14 Brookdale Ct., Cherry Hill, NJ 08034
13	8	14	Between Inlet Mouth Shoal and abandoned light house	loggerhead			1	1	hooked on minnow	Matt Aurilio	14 Brookdale Ct., Cherry Hill, NJ 08034
14	8	31	27274/42898	loggerhead	3 ft		1	1	observed swimming	Matt Aurilio	14 Brookdale Ct., Cherry Hill, NJ 08034
15	8	31	27256/42888	loggerhead	3 ft		1	1	observed swimming	Matt Aurilio	14 Brookdale Ct., Cherry Hill, NJ 08034
16	8	30	Del Bay near Breakwater	loggerhead	36" diam.		1	1	observed in 1' deep water from a charter vessel	Steve Prestipino	359 ARTB, Lenexa, DE 19565
17	8	30	3/4 south of Inlet Mouth Shoal	loggerhead			1	1	observed near surface during 30 min period	Sebastian	223 Cherry St., Rtg. PA 19116-1906
18	8	30	3/4 south of Inlet Mouth Shoal	loggerhead			1	1	hooked turtle on fish with minnow; hook released unharmed; appeared healthy	Sebastian	223 Cherry St., Rtg. PA 19116-1906
19	8	30	3/4 south of Inlet Mouth Shoal	loggerhead			1	1	hooked turtle on fish with minnow; hook released unharmed; appeared healthy	Betsy Kordahl	64 Philadelphia Ave. #8, Egg Harbor, NJ 08025
20	8	30	3/4 south of Inlet Mouth Shoal	loggerhead			1	1	hooked turtle on fish with minnow; hook released unharmed; appeared healthy	Frank Bradin	3152 Dietson St., Philadelphia, PA 19149
21	8	30	1 mi south 2 mi offshore of E. Point Lighthouse	loggerhead	2.5 ft		1	1	observed swimming south; looked healthy	Craig Kermack	1439 S. Pleasant St., Fortescue, PA 19063
22	8	19	39 04' N 75 08' W	loggerhead?	3 ft long		1	1	observed at 1:30 pm with a horse-hoe crab in its mouth	John Carbone	PO Box 285, Halesville, NJ 08324-0285
23	8	19	39 04' N 75 08' W	loggerhead?	3 ft long		1	1	observed from ferry; turtle had a crab in its mouth	M. Di'Allo	Cape May Ferry, PO Box 837, North Cape May, NJ 08204
24	7	26	Curtis Bay Channel	loggerhead			1	1	observed from ferry; turtle had a crab in its mouth	Jim Reimer	R: 130 Reading Ave Apt F73, Gloucester, NJ 08030 609-742-0700
25	7	26	Delaware Bay	loggerhead			1	1	observed swimming next to fishing boat	Ginger & Randy Eckert	PO Box 244, South Dennis, NJ 08245
26	7	6	Bug Light, Delaware Bay off NJ coast	loggerhead	300 lbs		1	1	observed swimming next to fishing boat	N/A	
27	7	10	outside Gandy Beach; 2 mi offshore	loggerhead	3.3 ft long		1	1	observed swimming next to fishing boat	Richard Keen	Box 115, S. Dennis, NJ 08245
28	7	10	outside Gandy Beach; 2 mi offshore	loggerhead	3.3 ft long		1	1	observed swimming next to fishing boat	Richard Keen	Box 115, S. Dennis, NJ 08245
29	7	10	outside Gandy Beach; 2 mi offshore	loggerhead	125-150 lbs		1	1	observed swimming next to fishing boat	Robert Quindlen	23 Louisiana Ave, Box 319, Fortescue, NJ 08321
30	7	10	outside Gandy Beach; 2 mi offshore	loggerhead	50 lbs		1	1	observed swimming next to fishing boat	Cherise Lemanowicz	RR1 Box 559, Redbank, DE 19871
31	7	21	1 mi north of VRI buoy	loggerhead	2 ft diam.		1	1	turtle took fishing bait from line, came to the surface, spit out bait and headed	Stanley Symanski	5070 Aachen Rd., Vivaldum, NJ 08381
32	7	21	1 mi north of VRI buoy	loggerhead	2 ft diam.		1	1	observed in 6' deep water, 150' from shore, swimming towards shore	Mark Morre	320 Cherry Ln, Haverstron, PA 19083
33	7	21	1 mi north of VRI buoy	loggerhead	200 lbs +		1	1	observed and released healthy (method of capture not provided)	David Barnes	RD 4 Box 381, Bridgeton, NJ 08302
34	7	20	Southwest of Fortescue, NJ between the Shales and Flounder	loggerhead	3-4 ft long		1	1	observed and released healthy (method of capture not provided)	N/A	
35	7	20	27081/42838	loggerhead			1	1	observed at 4:10 pm swimming at surface	Scott Wiley	11810 Millbridge Rd, Lumbly, MA 20487
36	7	20	27081/42838	loggerhead			1	1	observed at 4:10 pm swimming at surface	Scott Wiley	11810 Millbridge Rd, Lumbly, MA 20487
37	7	16	Delaware Bay near Maurice River, NJ	loggerhead			1	1	observed on hook and line; turtle was set free without any harm	Steve Balabino	818 E. Oak St., Red Bank, MD 21870
38	7	16	Delaware Bay near Maurice River, NJ	loggerhead			1	1	observed on hook and line; turtle was set free without any harm	Steve Balabino	818 E. Oak St., Red Bank, MD 21870
39	8	22	Letto Egypt at mouth of Maurice River	loggerhead			1	1	observed surfacing about 75 ft from boat	Lawrence Monger	27 White Birch Rd, Lumbly, NJ 08012-1927
40	8	22	Letto Egypt at mouth of Maurice River	loggerhead			1	1	observed surfacing about 75 ft from boat	Betty Esposto	28 E. Millcreek Rd., Mount Holly, NJ 08060-5308
41	8	17	Between Ship John Shoal and # 10 buoy	loggerhead	70 lb		1	1	observed swimming	Ferrante James Brattler	1110 Redbank Ave., Thorofare, NJ 08068
42	7	27	South of Inlet, 1	loggerhead	3-3.5 ft		1	1	hooked, brought to boat	Francis LaGratta	322 Newport Hook Rd., Newport, NJ 08345
43	7	27	South of Inlet, 1	loggerhead	3-3.5 ft		1	1	hooked, brought to boat	Francis LaGratta	322 Newport Hook Rd., Newport, NJ 08345
44	6	16	Delaware Bay near anchorage	loggerhead			1	1	observed from boat; turtle was floating at surface and may have been dead	N/A	
45	6	16	Delaware Bay near anchorage	loggerhead			1	1	observed from boat; turtle was floating at surface and may have been dead	N/A	
46	6	16	Delaware Bay near anchorage	loggerhead			1	1	observed from boat; turtle was floating at surface and may have been dead	N/A	
47	8	18	9 buoy, Cape May Channel, south of Brandywine, 2 mi south of	loggerhead			1	1	observed at 11:15 AM, incoming tide with lots of jellyfish	Don McCracken	300 N. Division Ave., Grand Rapids, MI 49503
48	8	18	9 buoy, Cape May Channel, south of Brandywine, 2 mi south of	loggerhead			1	1	observed at 11:15 AM, incoming tide with lots of jellyfish	Don McCracken	300 N. Division Ave., Grand Rapids, MI 49503
49	7	18	39 07' N 75 14' 39 W	loggerhead			1	1	observed at 11:15 AM, incoming tide with lots of jellyfish	Charles Irving	74 Cool Run Rd., Bridgeton, NJ 08302
50	7	18	39 07' N 75 10' 21 W	loggerhead			1	1	observed surfacing near boat	Cherise Boat "LI-Mia"	PO Box 307, Fortescue, NJ 08321
51	8	10	39 10' 43 N 75 13' 48 W	loggerhead			1	1	observed surfacing near boat	Cherise Boat "LI-Mia"	PO Box 307, Fortescue, NJ 08321
52	8	10	39 10' 43 N 75 13' 48 W	loggerhead			1	1	observed surfacing near boat	Cherise Boat "LI-Mia"	PO Box 307, Fortescue, NJ 08321
53	8	9	38 47' N 75 07' W	loggerhead	2.3 ft		1	1	observed surfacing near boat	Robert Vance	301 Baywood Dr., N. Cape May, NJ 08204
54	8	2	38 57' N 75 12' 57 W	loggerhead	2.5 ft		1	1	observed from ferry; swim away as ferry approached; by buoy #2	Robert Vance	301 Baywood Dr., N. Cape May, NJ 08204
55	8	2	38 57' N 75 12' 57 W	loggerhead	4 ft		1	1	observed from ferry; swim away as ferry approached; by buoy #8	Robert Vance	301 Baywood Dr., N. Cape May, NJ 08204
56	8	2	38 57' N 75 12' 57 W	loggerhead	4 ft		1	1	observed from ferry; swim away as ferry approached; by buoy #8	Robert Vance	301 Baywood Dr., N. Cape May, NJ 08204
57	8	28	Fortescue, NJ just north off beach about 5-7 mi offshore	loggerhead			1	1	observed surfacing near boat	Richard DaYoung	8 Radnor Plaza, Newtown Square, PA 19073
58	7	6	Fortescue, NJ just north off beach about 5-7 mi offshore	loggerhead			1	1	observed surfacing near boat	Richard DaYoung	8 Radnor Plaza, Newtown Square, PA 19073
59	7	6	Fortescue, NJ just north off beach about 5-7 mi offshore	loggerhead			1	1	observed surfacing near boat	Richard DaYoung	8 Radnor Plaza, Newtown Square, PA 19073
60	8	26	Delaware Bay beach off inlet	loggerhead	200 lbs		1	1	observed on hook and line	N/A	
			1 mi from Fishing Creek, Fortescue, NJ	loggerhead	40 lb		1	1	observed on hook and line	N/A	
			bloodroom; turtle took bait with hook, was brought to side of boat and line was cut	loggerhead			1	1	observed on hook and line	Bob Pidgeon Sr.	18 Riverview Ave., Paulsboro, NJ 08066

Conclusions:

Our results from aerial surveys, in-water netting, and the public users survey demonstrate that from June through September the lower Delaware Bay provides important habitat for a large number of loggerhead turtles. We were surprised at the numbers of turtles sighted during aerial surveys and especially at the density estimates we derived from these data. Delaware Bay turtle density estimates are similar to the densities reported for Virginia, North Carolina and Georgia where turtles are presumably significantly more abundant.

Although we did not catch juvenile turtles during this study, we did observe 2 juvenile loggerheads (about 50 cm curved carapace length) while we were netting. We believe that most of the juvenile turtles went undetected by us because they were too small to observe during aerial surveys and because our netting efforts were concentrated in the deeper waters where the adult turtles appeared to be most abundant. Prior reports of juvenile Kemp's ridleys and loggerheads in Delaware Bay had already established this area as a potentially important "developmental habitat" for sea turtles. These juvenile loggerhead turtles are derived from nesting populations located in Mexico, SE Florida and Georgia-SC-Northern Florida (Rankin-Baransky 1997).

Our findings, in addition to the results from Plotkin and Spotila (unpublished data) who tracked three post-nesting loggerhead turtles from Wassaw Island, Georgia to the Delmarva Peninsula, demonstrate for the first time that northeastern U.S. coastal waters are inhabited seasonally by reproductively active loggerhead turtles. Furthermore, these results suggest that in order to recover the genetically distinct Georgia-SC-NFLA loggerhead nesting populations, we need to extend research, management and conservation efforts to areas as far north as Delaware Bay.

There are numerous documented and potential anthropogenic threats to sea turtles in Delaware Bay. First, results from this study demonstrate that a significant number of sea turtles are incidentally captured on hook and line by recreational fishermen and these turtles are injured or killed during this interaction. Second, because many of the turtles we sighted during aerial surveys were swimming in or near the ship channel, there is a potential for interaction between sea turtles and any channel dredging that may take place in the Delaware Bay. Third, collision with boats and their propellers may be a significant threat to Delaware Bay turtles, particularly because of the large amount of vessel traffic in and around the Delaware Ship Channel. We found the front half of a loggerhead turtle that appeared to have been cut in half by a ship or

boat's propellar blade (Appendix I). Fourth, the horseshoe crab (*Limulus polyphemus*) fishery in Delaware Bay has recently started using benthic trawls to harvest large numbers of crabs. These trawlers have been unregulated and have the potential to incidentally capture and kill sea turtles. Finally, the recent precipitous decline of horseshoe crabs in Delaware Bay, due to overcollecting of crabs on their nesting beaches and to overfishing in the Bay, probably threatens sea turtles by removing one of their important food sources.

Literature cited:

Braun, J. and S.P. Epperly. 1996. Aerial surveys for sea turtles in southern Georgia waters, June, 1991. *Gulf of Mexico Science*, 1996(1):39-44.

Epperly, S.P., J. Braun, and A.J. Chester. 1995. Aerial surveys for sea turtles in North Carolina inshore waters. *Fishery Bulletin* 93:254-261.

Keinath, J.A., J.A. Musick, and R.A. Byles. 1987. Aspects of the biology of Virginia's sea turtles:1979-1986. *Virginia Journal of Science* 38:329-336.

Rankin-Baransky , K. 1997. Origin of loggerhead turtles (*Caretta caretta*) in the western north Atlantic Ocean as determined by mtDNA analysis. Master of Science Thesis. Drexel University, PA.

Appendix I

NMFS/SEFC COOPERATIVE MARINE TURTLE TAGGING PROGRAM
TAGGING DATA (REHABILITATED, NETTED, OR OTHER RELEASE)

Tag Number(s) (RF) PPS-754 Species Caretta caretta ♂
(list all tag #s and letter prefix) _____ Date Released 7/8/97

Describe release location (be specific - include county and lat/long if available):
39°06'56"N 75°09'90"

Describe original stranding or capture location AND stranding or capture date (where did this turtle come from?):

10:30 AM 39°06'56"N 75°09'90"

Describe capture method and/or type of gear in use when turtle was caught (if applicable): Tangle Net

Carapace length straight line _____ cm _____ in

Carapace width straight line _____ cm _____ in

Carapace length over curve 90 cm _____ in

Carapace width over curve _____ cm _____ in

Weight _____ kg _____ lbs (Heavy)

Additional remarks or data (use back if necessary): Could not
lift on boat/flipper tag only / no blood sample

Organization Tagging (include area code/phone number): _____

Oxley University 215-895-2629

Mail completed forms to: NMFS - Miami Lab
Cooperative Marine Turtle Tagging Program
75 Virginia Beach Drive
Miami, FL 33149

NMFS/SEFC COOPERATIVE MARINE TURTLE TAGGING PROGRAM
TAGGING DATA (REHABILITATED, NETTED, OR OTHER RELEASE)

Male

Tag Number(s) PPS-755 (RF) Species Caretta caretta ♂
(list all tag # 's and letter prefix) PPS-756 (LF) Date Released 7/8/97

PIT 400-643-196A

over ~~right~~ LEFT HUMERUS

Describe release location (be specific - include county and lat/long if available):

39° 08.70'

75° 11.12'

Describe original stranding or capture location AND stranding or capture date (where did this turtle come from?):

1316T 39° 08.722' . 75° 11.633'

Describe capture method and/or type of gear in use when turtle was caught (if applicable):

Tangle Notch

Carapace length straight line _____ cm _____ in

Carapace width straight line _____ cm _____ in

Carapace length over curve 108.2 cm _____ in

Carapace width over curve _____ cm _____ in

Weight _____ kg _____ lbs

Additional remarks or data (use back if necessary):

4-5" notch on rear of CARAPACE / too large to be brought in boat

Organization Tagging (include area code/phone number):

Drexel University 215-895-2629

Mail completed forms to: NMFS - Miami Lab
Cooperative Marine Turtle Tagging Program
75 Virginia Beach Drive
Miami, FL 33149

**NMFS/SEFC COOPERATIVE MARINE TURTLE TAGGING PROGRAM
TAGGING DATA (REHABILITATED, NETTED, OR OTHER RELEASE)**

Tag Number(s)
(list all tag
#'s and letter
prefix)

~~_____~~
~~_____~~
~~_____~~

Species CC

Date Released left floating

30 July 97

Describe release location (be specific - include county and lat/long if available):

Describe original stranding or capture location AND stranding or capture date (where did this turtle come from?):

39° 05.06' x 75° 17.07'
Del Bay

Describe capture method and/or type of gear in use when turtle was caught (if applicable):

floating

Carapace length straight line _____ cm _____ in

Carapace width straight line _____ cm _____ in

Carapace length over curve _____ cm _____ in

Carapace width over curve 73 cm _____ in

Weight _____ kg _____ lbs

Additional remarks or data (use back if necessary):

front 1/2 of turtle found floating

Organization Tagging (include area code/phone number):

Drexel

Mail completed forms to: NMFS - Miami Lab
Cooperative Marine Turtle Tagging Program
75 Virginia Beach Drive
Miami, FL 33149