SURVEY FOR WINTERING MARINE TURTLES IN SOUTH CAROLINA AND GEORGIA

Report to

National Marine Fisheries Service
75 Virginia Beach Drive
Miami, Florida 33145
Contract No. 03-78-D08-0062

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SUMMARY

A survey for possible overwintering marine turtles and turtle hibernacula was conducted within nearshore waters of Georgia and South Carolina during February and March of 1979. Six shipping channels, artificially deepened by hopper dredging, and two undisturbed sounds were chosen as study sites. Forty-nine drags, distributed among the 8 study sites, were completed during the survey, using a 60-foot commercial shrimping vessel, pulling a standard, 50-foot commercial crab net. No marine turtles were captured or observed during the survey. A poll of local commercial shrimpers also produced no evidence of marine turtles in nearshore waters of Georgia and South Carolina from December through March.

PREFACE

This study was conducted for the National Marine Fisheries Service under contract number 03-78-D08-0062. We are grateful for the capable liaison services of Mr. Fred Berry and Mr. Larry Ogren of National Marine Fisheries Service to Southeastern Wildlife Services during the course of study.

Our greatest appreciation goes to Captain Beau Sam McGowan, owner of the Miss Vivian, and his assistant and crew, Mr. Lamar Hilton. At one time, these men stayed with their vessel around-the-clock for 22 continuous days while foul weather persisted in blocking all attempts to sample. Dragging in unknown waters is hazardous for any captain and owner; Captain McGowan persevered throughout the trip, modifying rigging and changing techniques as conditions dictated.

Numerous agencies and individuals contributed in various ways to the study, greatly facilitating data collection. We thank the Georgia Department of Natural Resources, Division of Game and Fish, for logistical assistance. Ms. Ouida Fry (Law Enforcement) maintained radio contact and assisted with notification of law enforcement personnel concerning the location of the vessel, Miss Vivian, during survey activities in Georgia. Mr. Ron Odom, Office of Non-Game/Endangered Species assisted with necessary permits. The Marine Extension Service, University of Georgia, and the Coastal Resources Division, Department of Natural Resources, assisted with planning.

We appreciate assistance from the South Carolina Wildlife and Marine Resources Department. Mr. Ken Stansell and Ms. Sally Hopkins (Non-game and Endangered Species) and Mr. Glen Ulrich (Marine Resources) helped with trip planning and permits in South Carolina. Personnel with the Department's Beaufort Radio Station maintained contact with the vessel Miss Vivian in South Carolina waters and notified law enforcement personnel as to the vessel's whereabouts and activity schedule.

The success of this study was largely due to the enthusiastic cooperation of shrimp trawler owners, captains, strikers and commercial dock owners along the South Carolina and Georgia coasts. Docking facilities were made available at every stop. Shrimpers provided hours of professional advice as to bottom conditions, hangs, and dangerous currents. The time saved by avoiding problem hangs was of inestimable value to the success of the survey. Special thanks go to Mr. Kerry Abraham (Ladies Island, S.C.) and Mr. David Bogan (Port Royal, S.C.) professional shrimp captains who donated their time as navigator during several days of sampling in Port Royal Sound. These men guided the Miss Vivian around lethal hangs through rain and fog, helped locate drag positions on charts, and permitted the survey to continue when persistent foul weather was threatening to cancel the entire operation.

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INTRODUCTION

Since the discovery of overwintering marine turtles in Florida estuaries (Ehrhart, 1977) and the Canaveral Harbor shipping channel (unpublished report to Paul Hooker from Larry Ogren, 13 June 1978), the question of marine turtles hibernating in nearshore localities along the Atlantic east coast has been raised. All species of North Atlantic marine turtles, not given protection in 1973, were added to the list of threatened and endangered species in 1978. The Endangered Species Act of 1973 requires federal regulatory agencies to look for additional winter hibernacula and/or groups of overwintering marine turtles within jurisdictional territory. Winter hibernacula, if found, must be considered for "critical habitat" designation and receive appropriate protection. The objective of this study was to search for evidence of overwintering marine turtles within the nearshore waters of coastal Georgia and South Carolina and, if warranted, to recommend for further study areas of potential "critical habitat" for wintering turtles.

STUDY AREAS

Because of the experience with the Cape Canaveral turtles, a special effort was made to survey shipping channels that might approximate conditions found at Canaveral. Areas selected for intensive survey included:

South Carolina:

Winyah Bay; Georgetown Harbor entrance channel

Cooper River; Charleston Harbor entrance channel

Port Royal Sound; Port Royal Harbor entrance channel

Calibogue Sound

Georgia:

Savannah River; Savannah River entrance channel

St. Simon's Sound; Brunswick Harbor entrance channel

St. Andrew Sound

St. Mary's Entrance; Fernandina Harbor entrance channel

Harbor entrance channels included in this survey normally extend 4 to 11 miles offshore through seaward shoals and sandbars, which block access to natural harbors. The conditions generated by an artificially deepened channel (deep water, low turbulence, high vertical relief) are possibly sufficient to entice marine turtles to hibernate in the bottom sediment, if the sediment is warm enough to protect the turtles from critically low winter temperatures.

St. Andrew and Calibogue Sounds were surveyed because of their proximity to the dredged shipping channels included in this report and because they contain comparably deep holes and

channels, naturally maintained by the scouring action and high velocity of tidal currents. It is not known if the currents associated with naturally deep holes preclude the presence of wintering turtles in the bottom sediment.

Winyah Bay, SC. (Georgetown Harbor entrance channel)

The Georgetown Harbor entrance channel is located on the coast of South Carolina, 50 miles northeast of Charleston Harbor and 90 miles southwest of the entrance to the Cape Fear River in North Carolina. The channel is authorized to be maintained at a minimum depth of 27 feet MLW (mean low water), with varying widths of 400 to 600 feet, from the Atlantic Ocean to U.S. Highway 17, a total of 18 miles. The variable depths of the entrance channel (inside quarters)[1] from the sea buoy to the Georgetown lighthouse range from 24 to 29 feet MLW. An average of 317,000 cu. yd. (cubic yards) of sediment have been removed annually from the entrance channel between 1964 and 1976 (Appendix I).

Cooper River, SC. (Charleston Harbor entrance channel)

The Charleston Harbor entrance channel is located at the mouth of the Cooper River on the coast of South Carolina about

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[1]An entrance channel is partitioned conceptually into four longitudinal strips or quarters. The inside quarters represent a combined path equal to half the channel width and located in the center of the channel.

15 miles south of the midpoint of the coastline, 50 miles southwest of Georgetown Harbor, and 80 miles northeast of the Savannah River. The entrance channel is maintained from deep water in the Atlantic Ocean to the mouth of Goose Creek, a total distance of 21.9 miles, at a minimum depth of 37 feet MLW (inside quarters) and width of 800 feet. A 40-foot deep channel (MLW) has been authorized to be dredged, if found necessary in the interests of national defense, from the 40-foot contour in the Atlantic Ocean to the U.S. Naval Base. From 1964 to 1976, between 200,000 and 1,656,000 cu.yd. of sediment were removed annually from the entrance channel by hopper dredge, an average of 902,000 cu.yd. per year (Appendix I).

Port Royal Sound, SC. (Port Royal Harbor entrance channel)

The Port Royal Harbor entrance channel is located on the coast of South Carolina 57 miles southwest of Charleston Harbor and 23 miles northeast of the entrance to the Savannah River. The channel is maintained across the ocean bar and through Port Royal Sound for approximately 12.7 miles at 27 feet minimum depth (MLW) and 500 feet width. It continues through Beaufort River and Battery Creek for 8.3 miles at a minimum depth of 24 feet and a width of 300 feet. From 1964 to 1976, an average of 333,000 cu.yd. of sediment were removed annually from the entrance channel by hopper dredge (Appendix I).

Calibogue Sound, SC

Calibogue Sound is located on the coast of South Carolina 14 miles southwest of Port Royal Sound and 6 miles north of the entrance to the Savannah River. There are no shipping lanes or dredged channels within Calibogue Sound nor any connecting Calibogue Sound with the Atlantic Ocean. Calibogue represents a somewhat landlocked body of water with depths in excess of 50 feet MLW at several locations. Ocean access to Calibogue Sound is across a shallow bar which averages 10 feet MLW in depth.

Savannah River, SC/GA. (Savannah Harbor entrance channel)

The Savannah Harbor entrance channel is located 75 miles southwest of Charleston Harbor and 70 miles northeast of Brunswick Harbor, Georgia. The channel, extending approximately 11 miles from the sea buoy to the entrance of the Savannah River, is authorized for maintenance at a depth of 40 feet MLW and a width of 600 feet. Mean inside quarter depths range from 38 to 42 feet MLW. From 1964 to 1976, between 97,000 and 2,142,000 cu.yd. of sediment were removed annually by hopper dredge from the entrance channel, an average of 531,000 cu.yd. per year (Appendix I). There was no hopper dredging activity in 1969 and 1974.

St. Simon's Sound, GA. (Brunswick Harbor entrance channel)

The Brunswick Harbor entrance channel is located 70 miles southwest of the Savannah River entrance and 25 miles north of St. Mary's entrance and the Fernandina Harbor entrance channel. The Brunswick channel is maintained across the seaward bar at a depth of 32 feet MLW and a width of 500 feet. The channel passes through St. Simon's Sound, Brunswick River, and East River, maintaining a minimum depth of 30 feet MLW and a width of 400 feet. The Brunswick Harbor entrance channel extends approximately 7.5 miles from St. Simon's lighthouse to the sea buoy. The inside quarters of the channel along this stretch vary in depth from 32 - 33 feet MLW. Hopper dredges have annually removed from 161,000 to 2,100,000 cu.yd. of sediment from the entrance channel, an average of 694,000 cu.yd. per year from 1964 to 1976 (Appendix I).

St. Andrew Sound, GA

St. Andrew Sound is located 79 miles southwest of the Savannah River entrance and 20 miles north of the Fernandina Harbor shipping channel at St. Mary's entrance. There are no channels maintained by dredging in St. Andrew Sound. The natural channel entrance extends from the seaward bar to the southern tip of Jekyll Island, a distance of 12 miles. Depths along this channel range from 15 to 65 feet MLW.

St. Mary's Entrance, GA/FL. (Fernandina Harbor entrance channel)

The Fernandina Harbor entrance channel is located on the Georgia/Florida border 95 miles southwest of the Savannah River entrance and 175 miles north of the Canaveral Harbor entrance channel. Prior to recent developments at the King's Bay Terminal submarine facility, the Fernandina channel was maintained at a depth of 32 feet MLW and a width of 300 - 400 feet from the seaward bar to the junction of Lanceford Creek with Amelia River, a distance of seven miles. From 1964 to 1976, between 43,000 and 525,000 cu.yd. of sediment were removed annually by hopper dredge, averaging 193,000 cu.yd. per year (Appendix I). An intensive effort is now underway to enlarge the St. Mary's entrance channel to a depth of 40 feet MLW and a width of 400 feet, from the ocean bar to the King's Bay facility. Since overdredging may exceed permit specifications by 2 feet and an additional 2 - 4 feet may be required for advanced maintenance dredging, future channel depths in this area could be expected to reach 46 feet MLW.

METHODS

Six shipping channels and two sounds were dragged for wintering turtles during February and March, 1979. All work was performed with the commercial shrimp trawler Miss Vivian, owned and operated by Mr. Beau Sam McGowan of Jekyll Island, Georgia. The Miss Vivian is a 60-foot, wood-hulled trawler fitted with twin 45-foot outriggers and powered by twin GMC diesels.

A single commercial crab net, with 4-inch stretched mesh and a 50-foot width, was used for each drag. The crab net was equipped with oversized doors to ensure that it stayed down on the sediments. Bottom fishing efficiency was checked after each drag by recording the presence of benthic organisms in the catch and by checking the amount of abrasion (polished steel) and/or mud on the lead line (tickler chain).

In order to pull a single net during the survey, the towing cable was run from the winch through a temporary block, chained midway along the starboard outrigger. A short snatch-line cable, fixed high on the main boom, was attached at its other end to the inside line of the bridle by means of a sliding shackle. As the towing warp and gear were put out, the shackle slid along the inside bridle line to a point where the bridle is spliced to the warp. At that point, the snatch line picked up the full load of the trawl, thereby shifting the load to a central point over the transom rather than a lateral point on the outrigger. Such an arrangement permitted tight turns in either direction. Whenever the net was retrieved, the load was shifted back to the starboard outrigger, while the snatch cable, now in an idle capacity, slid along the inside bridle line until the doors reached the surface.

Individual drags were located within each study site according to existing constraints of time, distance, and local bottom conditions. Considerable portions of each site could not be dragged because of hangs, bottom trash, soft muck ("quick sand"), limestone rock ("coral rock"), and sharply

irregular relief, left from recent hopper dredging activities. In every case, drags attempted during the study in areas not normally fished by commerical boats were prematurely terminated because of hanging, usually with a concomitant loss of time and damage to gear. (The continual occurrence of these logistical problems was in sharp contrast to the virtually hang-free condition of the Canaveral Harbor entrance channel.) Areas which could not be dragged included:

a. the vicinity of a channel marker or line-of-sight between two channel markers, because of lost and abandoned buoy anchors
b. on the north side of channels receiving frequent dredging, where the channel wall is steep and south flowing currents deposit soft mud (which will bury a set of doors)
c. near rock jetties, where large granite boulders have been lost, scattered, or otherwise abandoned
d. within very deep holes (± 60-feet) where vast quantities of trash accumulate
e. in specific "dumping" areas (usually deep holes) where commercial shrimpers, by common agreement, deposit transportable hangs, such as portions of sunken boats and waterlogged trees picked up in their nets
f. in most of the channel within the entrance to large harbors where military vessels and

commercial freighters have dumped unwanted steel superstructures and other large portions of abandoned junk

g. in areas of extreme bottom currents, where soft sediments have been removed and sharp limestone, called "coral rock", is exposed

h. in any areas recently deepened by hopper dredges, where hangs have been exposed by removal of bottom sediment, where clay chunks or other dislodged pieces of bottom sediment have accumulated, or where highly irregular bottom conditions occur as a result of erratic movements by the dredge boom, setting up the situation where a set of doors can bury themselves into a near verticle wall of sediment.

For maximum survey efficiency and safety, local shrimpers were contacted at each study site prior to actual survey efforts. Based on the suggestions of these professional fishermen, a series of "safe" drags were located on the charts. At no time did it appear that shrimpers were directing the survey efforts away from favored fishing areas. In fact, because of their conviction that this survey would not find winter dormant turtles, these men went out of their way to direct the Miss Vivian to safe drags within favored fishing areas. On three different survey days within the Port Royal and Savannah entrance channels, a local commerical shrimp fisherman accompanied the Miss Vivian during the day, acting as guide and spotter for destructive hangs.

Surface water temperatures were taken with a standard mercury and glass thermometer. Water depths at sampling locations were recorded with a digital display Fathometer, which registered the depth of the water column in feet below the keel. Readings have been adjusted by adding four feet to account for displacements by the hull of the Miss Vivian. Estimating mean low (MLW) levels from Fathometer readings was less precise because of varying delays in the tidal cycle within the shipping channels. For example, low water at the Georgetown lighthouse was delayed 54 minutes relative to the south jetty entrance, a distance of 4 miles within the Georgetown Harbor study area. Therefore, Fathometer readings were converted to MLW values by interpolating time and amplitude between two known tide stations and by applying cosine function to estimate tidal rates of change.

Each drag, its position and length, was recorded on standard NOAA navigational charts. The position of the vessel at any particular time was determined by radar and visual orientation to shoreline landmarks and channel buoys. Because navigational buoys are frequently shifted and some drags were many miles offshore, the positioning of the drag paths on the charts must be considered a best estimate. There was a poor correlation between duration and length of drag. This occurred because of the swift tidal currents encountered at every location. Over dangerous terrain, drag paths were oriented into the current to reduce the speed of the net over the bottom. Where the terrain was safe, drag paths were oriented with the current to maximize the area covered.

RESULTS

There was no evidence of wintering marine turtles in any of the six shipping channels and two sounds surveyed. Forty-nine drags were completed in the 24 days of sampling (Table 1). The mean length of these drags was 1.2 miles, the duration 20 minutes, and the water depth 31 feet MLW. A summary of results by study area follow. Drag locations are mapped in Appendix IV.

Winyah Bay, SC. (Georgetown Harbor entrance channel)

Six drags were completed on 16 February within the Georgetown channel. Four of these were located between the sea buoy and the eastern extremity of the south jetty, and two were located in Winyah Bay near the Georgetown lighthouse. Drags ranged in depth from 27 to 38 feet MLW. Nowhere within the channel did water depths appear to exceed 40 feet MLW. Surface water temperature on 16 February was 8.4^{o} C at the jetty.

The seaward half of the entrance channel was inaccessible for dragging on 16 February because of activity in that area by the hopper dredge Hyde. Due to rocks and numerous snags, dragging was impossible in portions of the channel known as Range B, South Island Bend, and Range C. A brief drag was attempted within South Island Bend, which resulted in the destruction of a new $350 crab net by an unknown hang within five minutes of touching the bottom. Swift tidal current made dragging anywhere within the jetties a very hazardous operation;

Table 1. A descriptive summary of drags conducted during the survey for marine turtles in South Carolina and Georgia, February - March, 1979.

Date		Drag No.	Start	Finish	Depth Conversion	** Depth (MLW) Max.	Min.	Ave.	C° Temp.	*Dist. Length Of Drag	Time Length Of Drag	Channel Location
Feb.	14	15-1	10:15	10:40	-3.2	22.8	12.8	19.3	11.0°	2560	25	Brunswick
	14	15-2	11:15	11:55	-2.2	22.8	4.8	14.2	11.0°	2560	40	Brunswick
	16	16-1	13:25	13:50	+ .9	43.9	38.9	41.4	10.6°	3970	25	Savannah
	16	16-2	14:00	14:25	+1.8	23.8	15.8	20.5	10.8°	2970	25	Savannah
	16	16-3	14:40	15:10	+2.9	42.9	38.9	40.9	10.8°	3470	30	Savannah
	16	16-4	15:25	15:45	+3.6	44.6	35.6	41.1	10.9°	3020	20	Savannah
	16	16-5	Drag aborted									
	21	21-1	9:50	10:10	+4.0	27.0	18.0	24.3	8.5°	1420	20	Port Royal
	21	21-2	10:25	10:45	+3.8	24.8	20.8	22.6	8.5°	1830	20	Port Royal
	21	21-3	11:35	11:55	+1.6	33.6	25.6	29.3	7.5°	3000	20	Port Royal
	21	21-4	13:05	13:35	- .7	35.3	25.3	30.3	7.8°	2880	30	Port Royal
	21	21-5	14:25	14:40	-1.6	34.4	29.4	31.9	7.8°	1100	15	Port Royal
	27	27-1	12:25	12:50	+2.7	36.7	28.7	33.2	8.4°	3090	25	Georgetown
	27	27-2	13:05	13:35	+3.7	37.7	28.7	33.0	8.4°	1850	30	Georgetown
	27	27-3	13:40	14:00	+4.0	37.0	28.0	31.0	8.4°	1150	20	Georgetown
	27	27-4	14:50	14:55	+3.2	34.2	29.2	21.7	8.4°	440	5	Georgetown

Table 1 (continued).

Date		Drag No.	Start	Finish	Depth Conversion	** Depth (MLW) Max.	Min.	Ave.	C° Temp.	*Dist. Length of Drag	Time Length of Drag	Channel Location
Feb.	27	27-5	16:15	16:20	+3.4	27.4	27.4	27.4	8.4°	770	5	Georgetown
	27	27-6	16:45	16:49	+2.6	30.6	28.6	29.6	8.4°	500	4	Georgetown
March	1	1-1	9:00	9:15	-2.5	23.5	18.5	20.5	9.3°	1170	15	Charleston
	1	1-2	9:35	9:55	-2.8	33.2	18.2	22.7	9.3°	1490	20	Charleston
	1	1-3	10:35	10:50	-2.5	27.5	23.5	25.5	9.5°	1580	15	Charleston
	1	1-4	11:05	11:25	-2.0	31.0	23.0	26.0	9.5°	1580	20	Charleston
	1	1-5	11:30	11:45	-1.5	30.5	24.5	27.0	9.5°	1620	15	Charleston
	1	1-6	11:55	12:20	- .6	26.4	22.4	23.8	10.5°	2770	25	Charleston
	1	1-7	12:35	12:45	+ .2	39.2	36.2	37.7	10.5°	1440	10	Charleston
	1	1-8	13:00	13:10	+1.0	42.0	41.0	41.5	10.5°	1540	10	Charleston
	1	1-9	14:00	14:30	+2.9	26.9	19.9	23.9	10.0°	1260	30	Charleston
	6	6-1	7:55	8:10	+4.0	36.0	32.0	34.3	11.9°	1280	15	Port Royal
	6	6-2	8:30	8:45	+3.9	30.9	25.9	28.1	11.9°	2510	15	Port Royal
	6	6-3	8:55	9:15	+3.5	33.5	24.5	27.9	11.9°	1280	20	Port Royal
	6	6-4	9:25	9:50	+3.1	52.1	42.1	48.5	11.3°	1420	25	Port Royal
	6	6-5	10:10	10:25	+2.4	34.4	29.4	31.7	11.3°	1230	15	Port Royal
	6	6-6	10:35	10:50	+2.0	32.0	20.0	27.4	10.6°	1550	15	Port Royal
	7	7-1	8:15	8:35	+3.5	44.5	26.5	34.8	13.5°	2060	20	Calibogue
	7	7-2	8:45	9:05	+3.8	35.8	25.8	32.2	13.5°	2080	20	Calibogue
	7	7-3	9:20	9:25	+4.0	62.0	52.0	57.9	13.5°	1050	5	Calibogue

Table 1 (continued).

Date	Drag No.	Start	Finish	Depth Conversion	** Depth (MLW) Max.	Min.	Ave.	C° Temp.	*Dist. Length of Drag	Time Length of Drag	Channel Location
March 7	7-4	10:05	10:25	+3.8	35.8	26.8	29.8	13.5°	1780	20	Calibogue
7	7-5	10:40	10:55	+3.5	31.5	29.5	30.8	13.5°	780	15	Calibogue
13	13-1	8:30	9:00	-2.7	42.3	32.3	36.9	12.2°	2700	30	Brunswick
13	13-2	9:15	10:05	-1.6	38.4	26.4	34.0	12.2°	4550	50	Brunswick
13	13-3	10:15	10:40	- .1	34.0	30.0	31.8	13.5°	3060	25	Brunswick
13	13-4	11:10	11:30	+1.1	22.1	21.1	21.4	13.5°	1810	20	Brunswick
13	13-5	11:35	11:55	+2.0	28.0	21.0	24.6	13.5°	2560	20	Brunswick
13	13-6	13:00	13:15	+3.7	20.7	16.7	18.0	14.1°	1550	15	St. Andrew
13	13-7	14:05	14:35	+4.0	47.0	33.0	38.8	14.1°	2010	30	St. Andrew
13	13-8	14:55	15:25	+3.7	31.7	15.7	23.0	16.6°	2100	30	St. Andrew
13	13-9	16:00	16:25	+3.4	32.4	22.4	28.1	17.0°	2540	25	St. Andrew
14	14-1	8:55	9:05	-2.2	48.8	27.8	36.5	14.5°	870	10	Fernandina
14	14-2	9:10	9:15	-2.1	44.9	42.9	43.9	14.5°	320	5	Fernandina
14	14-3	12:20	12:45	+ .7	43.7	10.7	27.8	15.6°	4390	25	St. Andrew
Max.					62.0	52.0	57.9		4550	50	
Min.					20.7	4.8	14.2		320	4	
Mean					34.7	26.5	30.6		1970	20.2	

* meters
** feet

if a shrimp vessel the size of the Miss Vivan should hang its gear and turn sideways to the current, it could easily capsize.

Cooper River, SC (Charleston Harbor entrance channel)

Nine drags were completed in the Charleston entrance channel (Fort Sumter Range) and surrounding areas on 1 March. Four drags were located within the channel, and two drags in the South Cut, a natural channel which transects the south jetty. Surveyed areas ranged in depth from 18 to 42 feet MLW. Water temperatures on 1 March ranged from 9.3° to 10.5° C.

No drags were attempted inside the jetties of Charleston Harbor because of dangerous conditions. Accumulations of trash in the shipping channel precluded dragging a fragile crab net through the area. Also, lateral to the channel and just inside the jetties are areas where shrimpers traditionally deposit moveable snags which have become caught in their nets.

Port Royal Sound, SC (Port Royal Harbor entrance channel)

Five drags on 21 February and six on 6 March were completed in the Port Royal area. Seven of these drags were located along and within the Entrance Channel and a seaward portion of the Baypoint Reach in Port Royal Sound. The remaining four drags were located within the Beaufort River. Drags in Port Royal Sound varied in depth from 20 to 52 feet MLW, averaging

33 feet MLW. Approximately four miles of the channel known as Bayport Beach were inaccessible for dragging because of rocks, quicksand, and unknown hangs. Water temperatures ranged from 7.5° to 8.5° C on 21 February and 10.6° to 11.9° C on 6 March.

Calibogue Sound, SC

Five drags were completed in Calibogue Sound on 7 March. The drags were distributed throughout the sound and ranged in depth from 26 to 62 feet MLW, averaging 37 feet MLW. During one drag at the 60 foot MLW depth, the gear was nearly lost when the net became too loaded with "trash" to be retrieved. Water temperature within the sound on 7 March was 13.5° C.

Savannah River, SC/GA (Savannah Harbor entrance channel)

Four drags were completed in and adjacent to the Savannah River entrance channel on 16 February. One drag was located within the jetties; the remainder were distributed seaward to the sea buoy. A fifth drag was lost when the net buried in soft mud; the bag had to be released before the net could be retrieved. Drag depths in the channel ranged from 32 to 39 feet MLW, averaging 36 feet MLW. Water temperature on 16 February ranged from 10.6° C to 10.9° C.

St. Simon's Sound, GA (Brunswick Harbor entrance channel)

Two drags were completed within St. Simon's Sound on 14 February, and five drags were completed in the entrance channel on 13 March. Except for approximately four miles of rocky bottom in the vicinity of the north end of Jekyll Island, most of the Brunswick channel could be dragged as long as local hangs were identified and avoided. Drag depths ranged from 21 to 42 feet MLW, averaging 30 feet MLW. Water temperature was 11.0° C on 14 February and 12.2° C on 13 March.

St. Andrew Sound, GA

Four drags were completed in St. Andrew Sound on 13 March and one drag on 14 March. Three drags were located in the entrance channel; they ranged in depth from 16 to 47 feet MLW, averaging 26 feet MLW. One drag was completed in the Satilla River and one in the Cumberland River; the average depth for both of these drags was 38 feet MLW. Deeper areas within the St. Andrew Sound entrance channel could not be dragged because of sunken boats and barges, rocks, abandoned buoy anchors, and other trash capable of destroying a trawl net. Water temperatures on 13 March ranged from 14.1° C to 17.0° C.

St. Mary's Entrance, GA/FL (Fernandina Harbor entrance channel)

One drag was successfully completed at the seaward extremity of the entrance channel on 14 March. Depths ranged from 28 to 49 feet MLW, averaging 37 feet MLW. A second drag was terminated

in less than 5 minutes when the net filled with clay chunks dislodged during current dredging operations. Six dredges were active in the St. Mary's channel on 14 March, making additional sampling impossible because of the highly disturbed bottom terrain. Water temperature in the entrance channel was 14.5° C on 14 March.

Foul weather, dense fog, ice storms, gale winds, and heavy seas, proved to be a disruptive factor throughout the survey (Appendix III). Whenever possible, bad weather days were used for travel between study sites, but 9 days out of 24 were idled because of intolerable dragging conditions. Plans to cruise the Gulf Stream edge for offshore turtles had to be abandoned because of the erratic, frequently violent, weather which characterized February and March.

DISCUSSION AND RECOMMENDATIONS

There was no evidence acquired during this survey that would support the existence of hibernating marine turtles in nearshore waters of Georgia and South Carolina. The implication remains that marine turtles move away from estuarine areas during cold water months of December through March. The Cape Canaveral hibernating turtles would appear to be an exception rather than a rule.

The bottom drags conducted during this survey barely covered the vast estuarine areas included in the survey area. Most of the drags were within or proximate to shipping channels

in order to duplicate the Canaveral situation as closely as possible. Most of the drags were located in areas also dragged by commercial shrimpers; this was done to reduce the risk of hanging the gear in unknown waters. Furthermore, the commercial shrimpers were eager to have us drag their favorite sites. They were convinced no winter turtles would be found during the survey, and they viewed the survey as a means of clearing their nearshore winter dragging activities of any suspicion that winter turtles were present and being caught.

Many deep, potential hibernacula were not dragged because of the impossibility of dragging a net through the areas. If turtles are present in these areas, they would be free from shrimper disturbance since most deep holes, harbors, and channels within the jetties are never trawled by the shrimpers.

Hopper dredges perform annual maintenance dredging within the entrance channel of all shipping channels surveyed in this report. Dredging activities usually last from one to three months each year, and the frequency of dredging during cold-water, winter months appears no different from other months of the year. The amount of material removed by hopper dredging appears usually to range between 100,000 and 1,000,000 cu.yd. per entrance channel per year. Hopper dredges appear to confine their activities to shallow shoaling areas and to the "up-stream" or north side of the channels, places where sediments collect most rapidly. The effect of hopper dredging on a channel is to form steep lateral banks and an irregular bottom of humps and hollows. Professional shrimpers claim that it takes a

year or more, after hopper dredging activities have occurred, before trawl gear can be deployed without a high risk of loss. The most predictable manner in which gear is lost is doors ploughing into surface irregularities, such as high-relief banks and holes.

Six years out of ten, on the average, individual entrance channels receive some hopper dredge activity during the cold water months of December through March. This rate would appear to have a determining effect on the possibility of winter hibernating turtles, except that the Canaveral Harbor entrance channel has a history and schedule of dredging similar to that of the other channels surveyed (Appendix I). The relationship between hopper dredging and turtle hibernacula is too obscure to draw conclusions. St. Mary's Entrance, the shipping channel closest to Canaveral, is presently being enlarged to 45-foot depths characteristic of the Canaveral channel. St. Mary's Entrance may become a suitable habitat for winter turtles; this area should be carefully monitored in the future.

LITERATURE CITED

Ehrhart, Llewellyn M. 1977. Cold water stunning of marine turtles in Florida East Coast lagoons: rescue measures, population characteristics, and evidence of winter dormancy. 57th Annual Meeting of the Society of Ichthyologists and Herpetologists, University of Florida, Gainesville, FL. (Abst.).

Appendix 1. A 13-year summary of material (cubic yards of sediment) removed by hopper dredges from harbor entrance channels surveyed in this report and, for comparison, from Canaveral Harbor entrance channel, FL. Information from the Annual Reports of the Chief of Engineers on Civil Works Activities, Department of the Army, Washington, DC 20314.

Fiscal Year	Activity Period	Material Removed (cu.yd.)
Georgetown Harbor entrance channel		
1976	June - Aug. 1976 Sept. - Dec. 1975	414,748
1975	Jan. - Feb. 1975 Sept. 1974	642,291
1974	--	--
1973	Sept. - Dec. 1972	360,836
1972	Dec. 1971	56,289
1971	Dec. 1970 - Jan. 1971	212,530
1970	Aug. - Oct. 1969	307,128
1969	Dec. 1968 - Feb. 1969	277,629
1968	Jul. - Sept. 1968	312,753
1967	Jul. - Sept. 1966	432,551
1966	Sept. - Nov. 1965	361.904
1965	Sept. 1964 - Jan. 1965	582,147
1964	May - June 1964	155,284
Brunswick Harbor entrance channel		
1976	May - June 1976 Jan. - Mar. 1976 Sept. - Nov. 1975	170,090 1,630,594 291,737
1975	Sept. 1974 - Jan. 1975 Apr. - May 1975	158,579 81,370

Appendix 1 (continued).

Fiscal Year	Activity Period	Material Removed (cu.yd.)
1974	Apr. - Jan. 1974	505,775
1973	Jan. - Feb. 1973	545,496
1972	Apr. - May 1972	616,837
1971	Mar. - Apr. 1971	865,514
1970	Oct. - Dec. 1969 May - June 1970	127,970 415,723
1969	Sept. 1968 Jan. - Feb. 1969	 1,348,752
1968	Dec. 1967 - Jan. 1968	691,970
1967	Mar. 1967	161,150
1966	May - June 1966	438,397
1965	Mar. - Apr. 1965	554,221
1964	Mar. 1964	423,093
Savannah Harbor entrance channel		
1976	Jul. - Sept. 1976 Mar. - Apr. 1976 Apr. - May 1976 May - June 1976	738,632 580,562 485,462 240,603
1975	Nov. 1974 - Jan. 1975	96,503
1974	--	--
1973	Feb. - Mar. 1973	648,144
1972	Mar. 1972 Jan. 1972	125,136 179,269
1971	Feb. - Mar. 1970	582,442
1970	Apr. - May 1970	565,329
1969	Aug. 1968	375,872

Appendix 1 (continued).

Fiscal Year	Activity Period	Material Removed (Cu. yd.)
1968	Oct. - Nov. 1967	431,046
1967	--	--
1966	Apr. - May 1966	711,046
1965	June 1965	504,254
1964	Dec. 1963 - Feb. 1964	645,095
Canaveral Harbor entrance channel		
1976	Jul. - Sept. 1976	425,644
1975	July 1975	504,282
	Oct. - Nov. 1974	223,986
	May 1975	349,276
1974	July 1974	352,018
	Feb. - Mar. 1974	74,603
1973	June - July 1973	
	Dec. 1972 - Jan. 1973	1,126,410
1972	Nov. - Dec. 1971	716,952
1971	Jan. - Feb. 1971	240,070
1970	Mar. - Apr. 1970	505,281
	Aug. - Oct. 1969	1,277,533
1969	--	--
1968	May - June 1968	1,117,760
1967	Oct. - Nov. 1966	490,009
	Feb. - Mar. 1967	1,120,749
1966	Aug. - Sept. 1965	438,875
1965	Sept. - Oct. 1964	602,510
	Dec. 1964 - Feb. 1965	529,192
1964	Nov. 1963 - Jan. 1964	563,948

Appendix 1 (continued).

Fiscal Year	Activity Period	Material Removed (cu.yd.)
Port Royal Harbor entrance channel		
1976	Nov. - Dec. 1975	283,542
1975	Aug. - Sept. 1975	607,938
1974	Jan. - Feb. 1974	101,408
1973	Dec. 1972	82,205
1972	Mar. - Apr. 1972	291,005
1971	Jan. - Apr. 1971	324,482
1970	Dec. 1969 - Jan. 1970	274,902
1969	Apr. - May 1969	515,947
1968	Sept. - Oct. 1967	305,550
1967	Mar. - Apr. 1967	218,966
1966	Nov. 1965 - Jan. 1966	430,929
1965	Aug. - Oct. 1964	444,675
1964	Feb. 1964	448,372
Charleston Harbor entrance channel		
1976	May - July 1976	1,618,770
1975	Feb. - Mar. 1975	334,696
1974	May - June 1974	369,073
1973	Mar. - June 1973	1,158,962
1972	Jan. - Mar. 1972	949,922
1971	July 1970	262,532
1970	June 1970	200,000
1969	July - Aug. 1968 May - June 1969	1,408,427

Appendix 1 (continued).

Fiscal Year	Activity Period	Material Removed (cu.yd.)
1968	May 1968	275,000
1967	Apr. - June 1967	1,655,557
1966	May - June 1966	1,316,324
1965	Jan. - Mar. 1965	1,053,486
1964	Mar. - May 1964	1,135,456

Fernandina Harbor entrance channel

1976	Jan. - Feb. 1976	108,557
1975	Jan. - Feb. 1975	75,915
1974	Feb. 1974	42,693
1973	Jan. 1973 June 1973	72,250 452,988
1972	--	--
1971	--	--
1970	July 1969	263,565
1969	June 1969	291,187
1968	Oct. - Nov. 1967	221,728
1967	Dec. 1966	114,800
1966	Mar. - May 1966	178,557
1965	Nov. - Dec. 1964	160,967
1964	July 1963	523,680

Appendix 2. DRAG LOG. Descriptions of 50 drags (length, depth, time, surface water temperature, contents of the catch) completed during February and March, 1979, in South Carolina and Georgia.

Drag No.	Description
15-1	Feb. 14, 10:15, St. Simon's Sound. Purpose of drag to test deployment of gear. Fathometer: 26' (10:15), 16' (10:25), 22' (10:35), 26' (10:40). Rough bottom. Drag terminated when net closed with a heavy load of mud. Contents: a few blue crab, white shrimp, and flounder.
15-2	Feb. 14, 11:15, St. Simon's Sound. Purpose of drag to test gear. Fathometer: 12' (11:15), 24' (11:18), 18' (11:25), 7' (11:30) staying inside channel marker to avoid hang, 25' (11:40), 14' (11:50), 15' (11:55) net up. Cables of bridle badly twisted, need reworking. Water temperature 11.0° C.
16-1	Feb. 16, 12:25, Savannah River entrance channel. Fathometer: depth estimated at 38' to 43'. Net up at 13:50. Mud bottom. Contents: Approximately 50 horseshoe crabs. Water temperature 10.6° C.
16-2	Feb. 16, 14:00, Savannah River channel (Tybee Roads). Fathometer: 22' (14:00), 19' - 20' (14:10), 14' - 15' (14:20), net up (14:25). Contents: mud, horseshoe crabs, blue crabs, sand dollars. Water temperature 10.8° C.
16-3	Feb. 16, 14:40, Savannah River mid-channel. Fathometer: 40' (15:00), 36' (15:10) net up. Contents: horseshoe crabs, sand dollars, flounder, whelks.
16-4	Feb. 16, 15:25, Savannah River channel. Fathometer: 32' - 36' (15:25), 41' (15:45) net up. Contents: 50 horseshoe crabs, whelks, crabs, fish, mud. Net is definitely fishing hard on the bottom. Water temperature 10.9° C.
16-5	Feb. 16, 16:20, Savannah River channel (south side). Net snagged; released only after strong pulling; net probably buried in mud. Boom slightly bent from pulling. Return to port to add additional cable

Appendix 2 (continued).

Drag No.	Description
	stay from mast to point on boom where cable snatch block is located. Bag already untied when brought aboard; drag abandoned.
21-1	Feb. 21, 09:50, Beaufort River (west edge of channel). Fathometer: 14' (09:50), 21' (10:00), 23' (10:05), 23' (19:10) net up. Mud bottom. Contents: 10 horseshoe crabs, sponges, starfish, 3 blue crabs. Water temperature 8.5°C.
21-2	Feb. 21, 10:25, Beaufort River (Chowan Creek). Fathometer: 20' (10:25), 17' (10:30), 17' (10:35), 21' (10:45) net up. Contents: crabs, sponges, some trash.
21-3	Feb. 21, 11:35, entrance to Beaufort River (mid-channel). Fathometer: 24' (11:35), 27' (11:45), 32' (11:50), net up at 11:55. Rough bottom. Contents: ectoprocts, a diversity of crab species, flounder, cockles, sea whips, starfish, some mud. Water temperature 7.5° C.
21-4	Feb. 21, 13:05, Port Royal Sound (south side of Baypoint Reach near seaward end). Fathometer: 26'-28' (13:05), 30'-33' (13:15), 34'-36' (13:25), 30'-31' (13:30), 31' (13:35) net up. Contents: horseshoe crabs, sponges, various crabs, starfish, etc. Water temperature 7.8° C. Light rain; fog settling in.
21-5	Feb. 21, 14:25, Port Royal Sound (mouth of Beaufort River). Fathometer: 31' (14:25), down to 36'. Drag terminated after 15 minutes when net started to bog down in mud. Heavy fog; rain; zero visibility; return to port by radar.
27-1	Feb. 27, 12:25, Georgetown Harbor entrance (sea bouy). Fathometer: 30' (12:25), 26'-34' (12:30), 32' (12:35), 28'-32' (12:45), net up (12:50). Contents: 2 horseshoe crabs, miscellaneous crabs, and starfish. Net definitely on the bottom. Water temperature 8.4° C.
27-2	Feb. 27, 13:05, Georgetown Harbor entrance (sea bouy). Fathometer: 31'-33' (13:05), 27'-32' (13:10), 26'-33' (13:20), 28'-34' (13:25), 25'-30' (13:30), 26'-27' (13:35) net up. Very

Appendix 2 (continued).

Drag No.	Description
	rough bottom. Contents: diversity of crabs, mantid shrimp, whelks, several flounder, other bottom fish.
27-3	Feb. 27, 13:40, Georgetown Harbor entrance (sea buoy). Fathometer: 27'-33' (13:40), 25'-28' (13:50), 24'-25' (13:55), net up 14:00 because of dangerous proximity to hopper dredge Hyde working area. Contents: mostly wood fragments.
27-4	Feb. 27, 14:50, Georgetown Harbor (south edge of channel at jetty entrance). Fathometer: 26'-31' (14:50). Net bogged down and retrieved within 5 minutes. Contents: masses of water-logged wood fragments. Extremely swift current makes dragging inside the jetties very dangerous.
27-5	Feb. 27, 16:15, Winyah Bay (north-east edge of channel near Georgetown lighthouse). Fathometer: 24' (16:15), net up at 16:20. Contents: blue crabs, flounder, fresh-water catfish.
27-6	Feb. 27, 16:45, Winyah Bay (south-west edge of channel near southern tip of North Island). Fathometer: 26'-28' (16:45), net snagged and torn beyond repair at approximately 16:49. Pocket retrieved with lazy line. Contents: hundreds of blue crabs, much other trash.
1-1	March 1, 09:00, Charleston Harbor entrance (South Cut). Fathometer: 26' (09:00), 23' (09:05), 22' (09:10), 21' (09:15) net up. Contents: 4 horseshoe crabs, 2 menhaden, 2 blue crabs, 4 channel whelks, some trash and cans. Water temperature 9.3° C.
1-2	March 1, 09:35, Charleston Harbor entrance (South Cut). Fathometer: 25'-36' (09:35), 25'-30' (09:40), 24'-25' (09:45), 23'-24' (09:50), 21'-22' (09:55), net up. Contents: similar in composition to drag No. 1-1.
1-3	March 1, 10:35, Charleston Harbor entrance channel. Fathometer: 27'-28' (10:35), 26'-30' (10:45), 27'-30' (10:50) net up. Contents: channel whelks, sponges, tunicates, 2 flounder, blue crabs. Water temperature: 9.5° C.

Appendix 2 (continued).

Drag No.	Description
1-4	March 1, 11:05, Charleston Harbor entrance channel. Fathometer: 25'-33' (11:05), 25'-29' (11:20), 26'-30' (11:25) net up. Contents: same as No. 1-3.
1-5	March 1, 11:30, Charleston Harbor entrance channel. Fathometer: 26'-30' (11:30), 26'-32' (11:45) net up. Contents: cockles, horseshoe crabs, trash, whiting, flounder, sea pork, sea whips.
1-6	March 1, 11:55, Charleston Harbor entrance channel. Fathometer: 24'-25' (11:55), 23'-24' (12:10), 23'-25" (12:15), 24'-27' (12:20) net up. Contents: miscellaneous crabs, horseshoe crabs, cockles, sponges, etc. Water temperature 10.5° C.
1-7	March 1, 12:34, Charleston Harbor entrance channel. Fathometer: 36'-39' (12:45) net up. Contents: sharks, miscellaneous crabs, trash.
1-8	March 1, 13:00, Charleston Harbor entrance channel. Fathometer: 40'-41' (13:00). Ten minute drag. Net up 13:10. Contents: sharks, skate, sponges, tunicates, flounder, trash, crabs, horseshoe crabs, etc.
1-9	March 1, 14:00, Charleston Harbor entrance channel. Fathometer: 24' (14:00), 22' (14:20), 17' (14:30). Contents: same as No. 1-8. Water temperature 10.0° C.
6-1	March 6, 07:55, Port Royal entrance channel. Fathometer: 30'32' (07:55), 30'-32' (08:00), 28'-30' (08:10) net up. Contents: 2 founder, 2 blue crabs, 25 horseshoe crabs. Water temperature 11.9° C. Raining.
6-2	March 6, 08:30, Port Royal entrance channel. Fathometer: 25'27' (08:30), 23'-25' (08:40), 22'-23' (08:45) net up. Contents: 12 horseshoe crabs, 2 founder, 1 shark, 1 stingray, 3 whelks, no junk or trash.
6-3	March 6, -8:55, Port Royal entrance channel. Fathometer: 21'-23' (08:55), 21'23' (09:00), 24'-25' (09:05), 28'-30' (09:15) net up. Contents: 2 sharks, 3 horseshoe crabs, stingray, sea pork, blue crab, no trash.

Appendix 2 (continued)

Drag No.	Description
6-4	March 6, 09:25, Port Royal entrance channel. Fathometer: 39'42' (09:25), 45'-46' (09:35), 47'-48' (09:45), 47'-49' (09:50). Contents: 24 horseshoe crabs, 2 blue crabs, spider crabs, shark, no trash. Water tempterature 11.3° C.
6-5	March 6, 10:10, Port Royal entrance channel. Fathometer: 30'32' (10:10), 27'-28' (10:20), 29'-30' (10:25) net up. Contents: lots of jellyfish, 1 horseshoe crab, starfish, sand dollars.
6-6	March 6, 10:35, Port Royal entrance channel. Fathometer: 18'-21' (10:35), 25'-26' (10:40), 30' (10:45), 26'-27' (10:50) net up. Contents: 6 horseshoe crabs, 6 blue crabs, starfish, other crabs, no trash. Water temperature 10.6° C.
7-1	March 7, 08:15, Calibogue Sound. Fathometer: 23' (08:15), 27'-28' (08:20), 40'-41' (08:25), 32' (08:30), 33'34' (08:35) net up. Contents: a bag full of horseshoe crabs, 6 blue crabs, 1 stone crab. Water temperature 13.5° C.
7-2	March 7, 08:45, Calibogue Sound. Fathometer: 22' (08:45), 29'-30' (08.50), 29' (08:55), 29'-30' (09:00), 32' (09:00), 32' (09:05) net up. Contents: 3 whelks, blue crabs, 6 horseshoe crabs, whiting, trash.
7-3	March 7, 09:20, Calibogue Sound. Fathometer: 55'-56' (09:20), 48'-49' (09:22), 55'-58' (09:23), 55' (09:24) net hung up! Incredible amounts of trash, old sea whips, worn tubes, and anaerobic mud.
7-4	March 7, 10:05, Calibogue Sound. Fathometer: 23' (10:05), 32' (10:12), 24' (10:20), 25' (10:24) net up. Contents: 1 sturgeon, 12 blue crabs, 5 horseshoe crabs, whelk, flounder, trash. Water temperature 13.5° C.
7-5	March 7, 10:42, Calibogue Sound. Fathometer: 28' (10:42), 26'-27' (10:55) net up. Contents: crabs, etc.
13-1	March 13, 08:30, St. Simon's entrance channel. Fathometer: 35'-39' (08:30), 39'-40' (08:35), 37'-39' (08:40), 37'-39' (08:45), 44'-45' (08:55), 40'-41' (09:00) net up. Contents: 12 horseshoe crabs, 20

Drag No.	Description
	blue crabs, lots of jellyfish, clam shells, whelks, black mud, rocks, fossil whale vertebrae. Water temperature 12.2° C.
13-2	March 13, 09:15, St. Simon's entrance channel. Fathometer: 40' (09:15), 36'37' (09:30), 32'-34' (09:40), 28'-38' (09:50) rough bottom, (10:05) net up. Contents: 20 horseshoe crabs, 10 blue crabs, spider crabs, 4 flounder, whelks, starfish, no trash.
13-3	March 1, 10:15, St. Simon's entrance channel. Fathometer: 34'-35' (10:15), 31'-33' (10:35), 31'-33' (10:40) net up. Contents: 15 horseshoe crabs, numerous spider crabs, 1 flounder, starfish, no trash. Water temperature 13.5° C.
13-4	March 13, 11:10, St. Simon's entrance channel. Fathometer: 20'-21' (11:10), 20' (11:30) net up. Contents: bag almost empty, 2 horseshoe crabs, 6 spider crabs, 1 fragment of wood.
13-5	March 13, 11:35, St. Simon's entrance channel. Fathometer: 19'-20' (11:35), 21' (11:40), 23'-25' (11:50), 26' (11:55) net up. Contents: 10 horseshoe crabs, blue crabs, spider crabs, jellyfish, sea pork, ear snails, flounder, trash.
13-6	March 13, 13:00, St. Andrew entrance channel. Fathometer: 13' (13:00), 13'-15' (13:05), 16'-17' (13:10), 13'-14' (13:15) net up. Contents: 1 large stingray, jellyfish, spider crabs, no trash. Water temperature 14.1° C.
13-7	March 13, 14:05, St. Andrew entrance channel. Fathometer: 37'-43' (14:05), 32'-39' (14:10), 34'-35' (14:15), 29'-30' (14:25), 34'-35' (14:30, (14:35) net up. Contents: trash, mud, spider crabs, sea cucumbers, whelks, 4 horseshoe crabs, etc.
13-8	March 13, 14:55, St. Andrew entrance channel. Fathometer: 12' (14:55), 15'-16' (15:00), 14' (15:05), 22' (15:10), 25'26' (15:15), 25'-28' (15:20), (15:25) net up. Contents: 20 horseshoe crabs, 75 blue crabs, spider crabs, trash, starfish, 1 sturgeon. Water temperature 16.6° C.
13-9	March 13, 16:00, St. Andrew entrance channel. Fathometer: 25' (16:00), 26'29' (16:09), 26'33'

Appendix 2 (continued).

Drag No.	Description
	(16:10), 19'-21' (16:15), 22'-23' (16:20), 23'-24' (16:25) net up. Contents: 1 sturgeon (24"). 8 catfish, 50 blue crabs, 1 whiting, shrimp, spider crabs, trash. Water temperature 17.0° C.
14-1	March 14, 08:55, St. Mary's entrance. Fathometer: 30'-32' (08:55), 34'-36' (09:00), 49'51' (09:05). Contents: sea cucumbers, blue crabs, mud starfish, no trash. Water temperature 14.5° C.
14-2	March 14, 09:10, St. Mary's entrance. Fathometer: 45'-47' (09:10), net hung up (09:15). Net filled with large lumps of grey clay. Impossible to drag anywhere west of channel markers #4 and #5. At least 4 dredges have been working the entrance channel (per information of local shrimpers contacted by radio).
14-3	March 14, 12:20, Brickhill River at Cumberland River. Fathometer: 10'-12' (12:20), 29'-43' (12:25), 30'-31' (12:30), 36'-37' (12:35), 26'-27' (12:40), 27' (12:45) net up. Contents: lots of junk, blue crabs, sea whips, 6 horseshoe crabs, starfish, catfish, shrimp. Water temperature 15.6° C.

Appendix III. TRIP LOG. A description of the daily activities by vessel Miss Vivian during 24 days of the survey for wintering marine turtles in South Carolina and Georgia, February to March, 1979.

February 14: Weather: clear and calm. Depart from Jekyll Island dock for St. Simon's Sound at 09:00. Completed two trial drags in St. Simon's Sound to test gear. Cables badly twisted; return to Jekyll for gear modifications. Pick up fuel and ice at Brunswick. Return to Jekyll Island dock by 16:00.

February 15: Weather: clear and calm. Depart from Jekyll 05:30; arrive Thunderbolt (Savannah) 16:00. Talk with local shrimpers 16:00 to 18:00 about dragging Tybee Roads and Savannah Entrance Channel. Thunderbolt shrimpers drag Wassaw Sound; they advise we proceed to Lazaretto Creek shrimp docks.

February 16: Weather: clear and calm. Depart Thunderbolt 07:00; arrive Lazaretto Creek 11:00. Obtain services ($50.00) of a local shrimper to navigate around hangs in Savannah channel. Four drags completed 13:25 to 15:45. Fifth drag hung at 16:20; starboard outrigger bent while freeing gear from mud; bag torn open by weight of mud. Return Lazaretto Creek for repairs. Plan for a second day of dragging in Savannah channel on 17 February.

February 17: Weather: gale force winds. Install additional towing boom topping stay to prevent boom from bending. Repair broken towing warp. Weather conditions make towing impossible.

February 18: Weather: gale force winds turning to freezing rain and ice. No dragging possible

February 19: Weather: freezing rain and ice until noon, melting and clearing in afternoon. Plan for Savannah channel dragging on 20 February.

February 20: Weather: windy with heavy seas. Dragging impossible. Decision to travel north during bad weather. Depart Lazaretto Creek 08:00, arrive Von Harden's Shrimp Dock, Ladies Island (Beaufort, SC), by 16:00. Talk with local shrimper about Port Royal Sound until 20:00.

February 21: Weather: overcast, seas calm. Depart Von Harden's dock 09:00 with Capt. Kerry Abraham as navigator to drag Port Royal Sound. Complete five drags 09:50 to 14:40. Visibility down to zero. Return to Von Harden's dock by radar through rain and heavy fog; arrive 15:00.

February 22: Weather: rain and heavy fog. Remain at Von Harden's dock for day. Several hours spent adjusting rigging.

February 23: Weather: rain and heavy fog. Move by radar navigation to shrimp co-op dock at Port Royal to be closer to sampling area. Contact Capt. David Bogan to go February 24 as navigator.

February 24: Weather: thunderstorm, rain, heavy fog. No dragging possible.

February 25: Weather: fog, heavy seas with small craft advisory. No dragging possible; plan to continue Port Royal Sound on return trip. Depart from Port Royal 07:00; arrive Mt. Pleasant Boat Building Co., dock (Shem Creek, Charleston) at 17:00 through thunderstorm and heavy seas.

February 26: Weather: gale winds, heavy seas. No dragging possible; continue travelling. Depart from Mt. Pleasant dock 08:00, arrive McClellanville (South Carolina Crab Co. dock) at 15:30.

February 27: Weather clear, moderating seas. Depart from McClellanville 06:30, arrive Georgetown (Gulf Auto Marine Service dock) 09:00. Confer with shrimpers for 2 hours about Georgetown Harber entrance channel, then depart for Winyah Bay entrance. Complete 5 drags from 12:25 to 16:20. Sixth drag lost at 16:45; net destroyed on hang. Return to Gulf Auto Marine dock by 18:30 to replace gear.

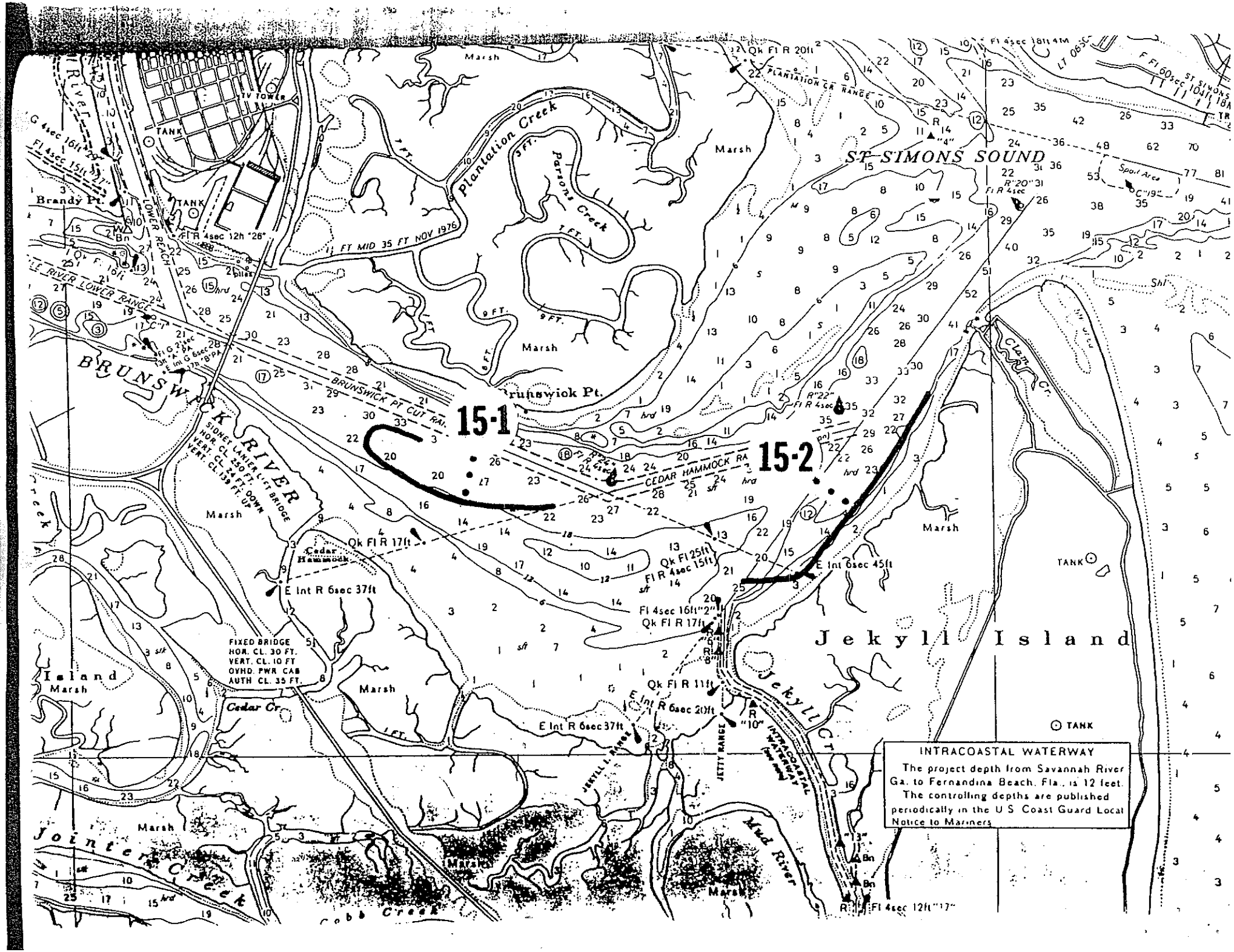
Appendix III. Continued

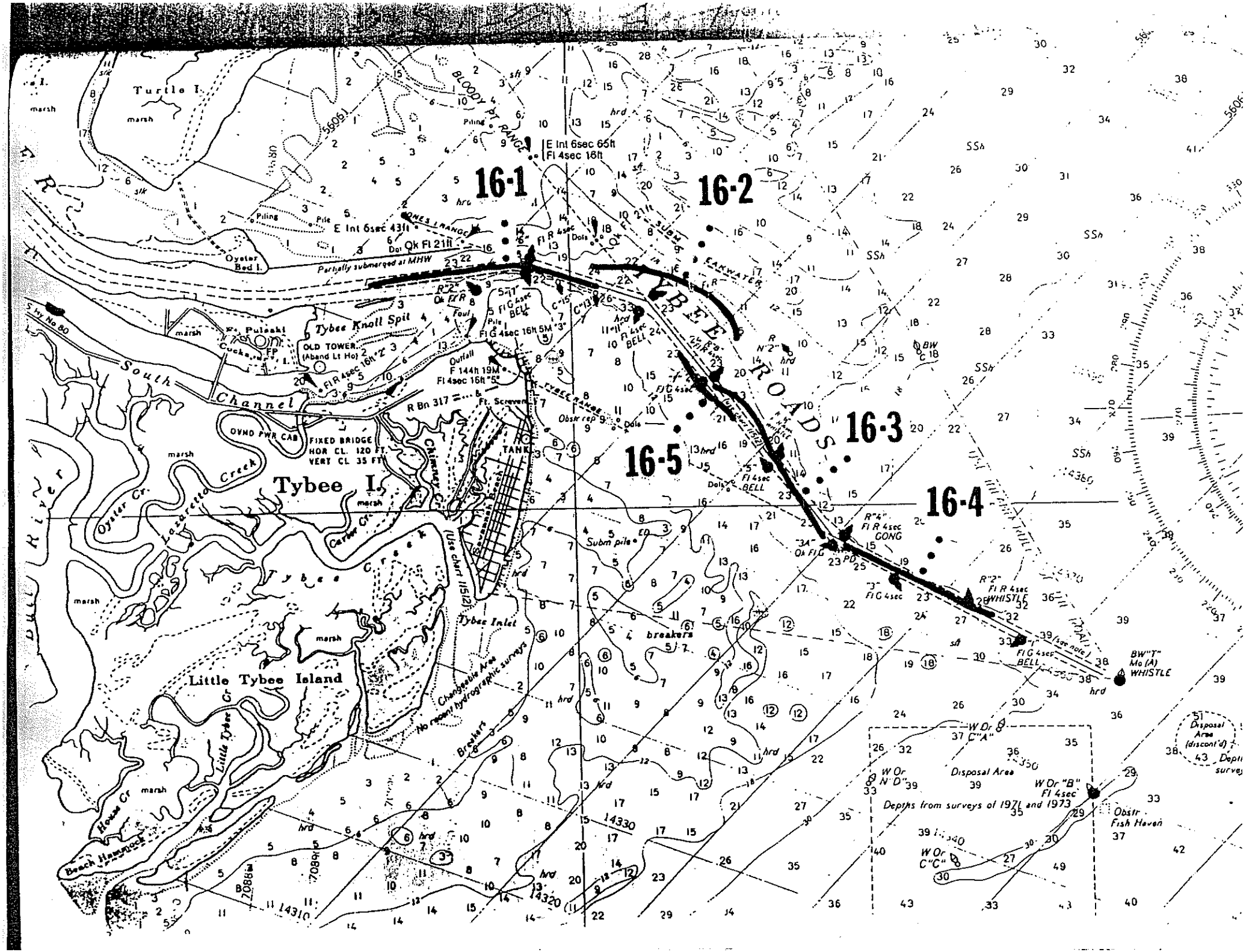
February 28:	Weather: clear and calm. Depart from Georgetown 06:00, arrive Shem Creek (Charleston) by 12:30. Spent afternoon contacting shrimpers to obtain navigator (no luck) and information on Charleston Harbor channel. Arrange to have Sally Hopkins and Glen Ulrich join trip on morning of March 1.
March 1:	Weather: clear and calm. Nine drags completed in Charleston Harbor entrance channel from 09:00 to 14:30. Remainder of day spent talking with shrimpers at Shem Creek docks about hibernating turtles at Canaveral.
March 2:	Weather: clear and calm. Depart Shem Creek at 06:00, arrive Port Royal co-op dock by 14:00. Spend remainder of afternoon talking with local shrimpers about Port Royal channel.
March 3:	Weather: windy and raining; heavy seas. Depart Port Royal dock with Capt. David Bogan as navigator for Port Royal entrance channel. Heavy seas; towing warp broken; return to Port Royal dock because of impossible dragging conditions and for repairs.
March 4:	Weather: windy, heavy seas. No dragging possible.
March 5:	Weather: calm; dense fog; zero visibility. No dragging possible.
March 6:	Weather: overcast, rain, moderate visibility. Depart for Port Royal entrance channel at 07:00. Six drags completed 07:55 to 10:50. Return to Port Royal dock by 13:00 because of deteriorating weather conditions.
March 7:	Weather: clear and calm. Depart Port Royal co-op docks by 06:00; arrive Calibogue Sound by 08:00. Five drags completed from 08:15 to 11:00. Captain must return to Brunswick. Arrive Jekyll Island dock by 22:00.
March 13:	Weather: clear and calm. Depart from Jekyll Island dock for St. Simon's Sound at 07:45. Complete five drags in Brunswick Harbor entrance channel from 08:30 to 12:00. Complete four drags in St. Andrew Sound from 13:00 to 16:30. Return to Jekyll Island dock by 17:30.

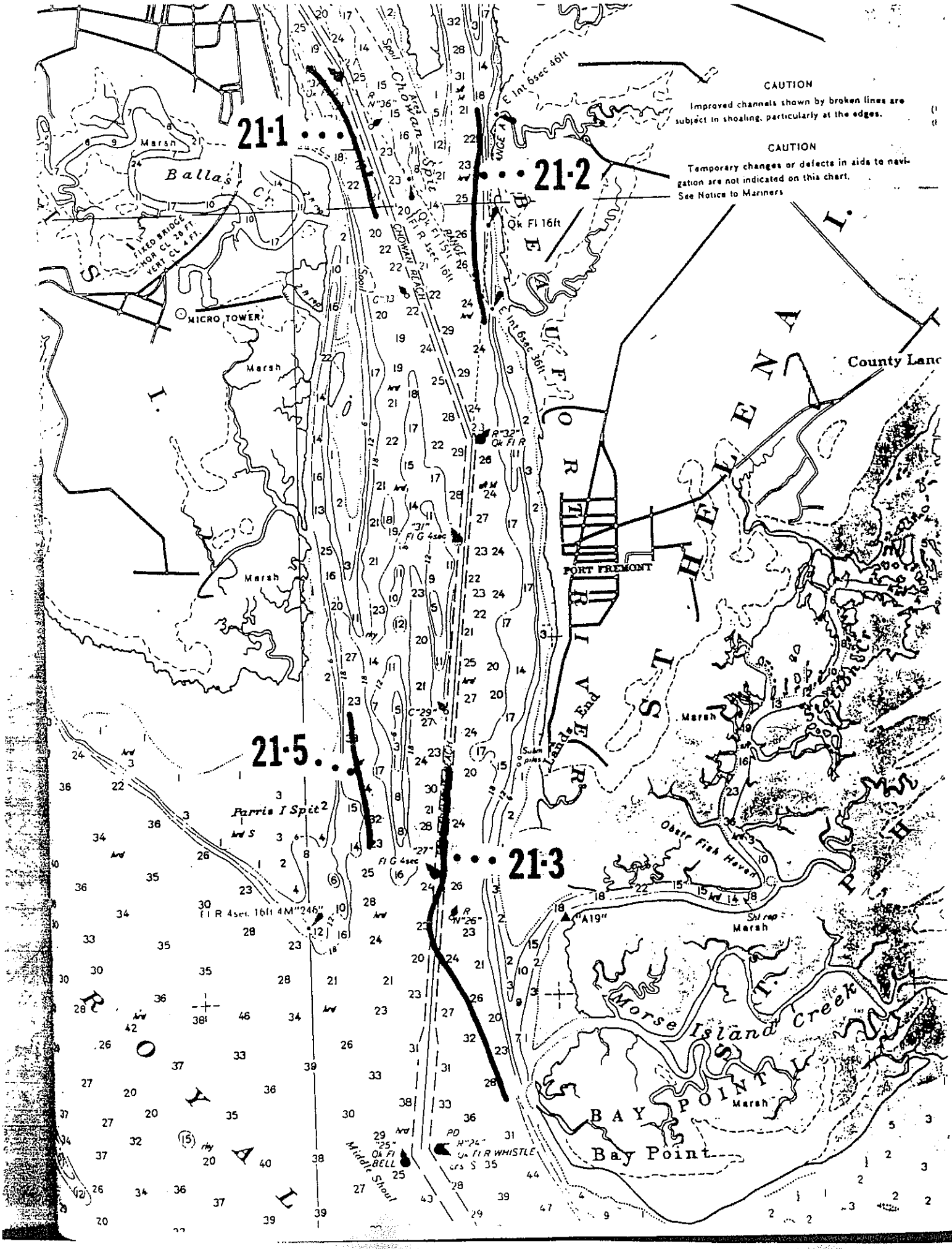
March 14:	Weather: calm and clear. Depart from Jekyll Island dock at 05:30. Complete two drags in St. Mary's Entrance from 08:55 to 09:20. No further drags possible because of dredge operations in the channel for King's Bay modifications. Complete one drag in St. Andrew Sound at 12:20. Return to Jekyll Island dock by 14:00.

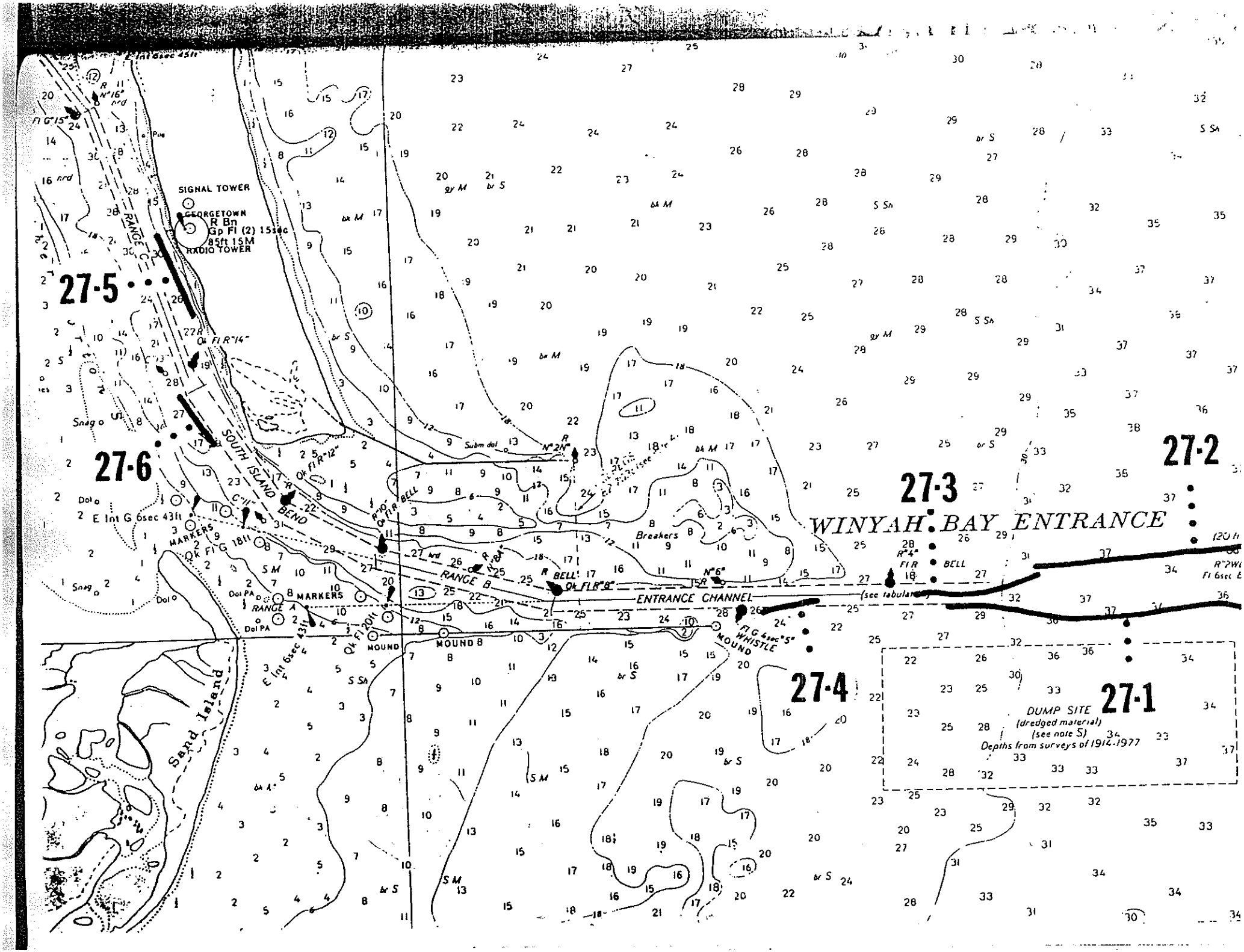
Appendix IV. Mapped locations for drags completed during February and March, 1979. The identification numbers for individual drags follow from Table 1.

Location	Date	NOAA Chart No.	Scale	Drags
Brunswick	14 February	11506	1:40,000	15-1, 15-2
Savannah	16 February	11513	1:80,000	16-1 thru 16-5
Port Royal	21 February	11516	1:40,000	21-1 thru 21-3, 21-5 (single)
Georgetown	27 February	11532	1:40,000	27-1 thru 27-6
Charleston	1 March	11521	1:80,000	1-1 thru 1-9
Port Royal	6 March	11513	1:80,000	21-4 (single) 6-1 thru 6-6
Calibogue	7 March	11513	1:80,000	7-1 thru 7-5
Brunswick	13 March	11502	1:80,000	13-1 thru 13-5
St. Andrew	13 March	11502	1:80,000	13-6 thru 13-8
St. Andrew Fernandina	13 March 14 March	11504 11504	1:40,000 1:40,000	13-9 (single) 14-3 (single)
Fernandina	14 March	11502	1:80,000	14-1, 14-2

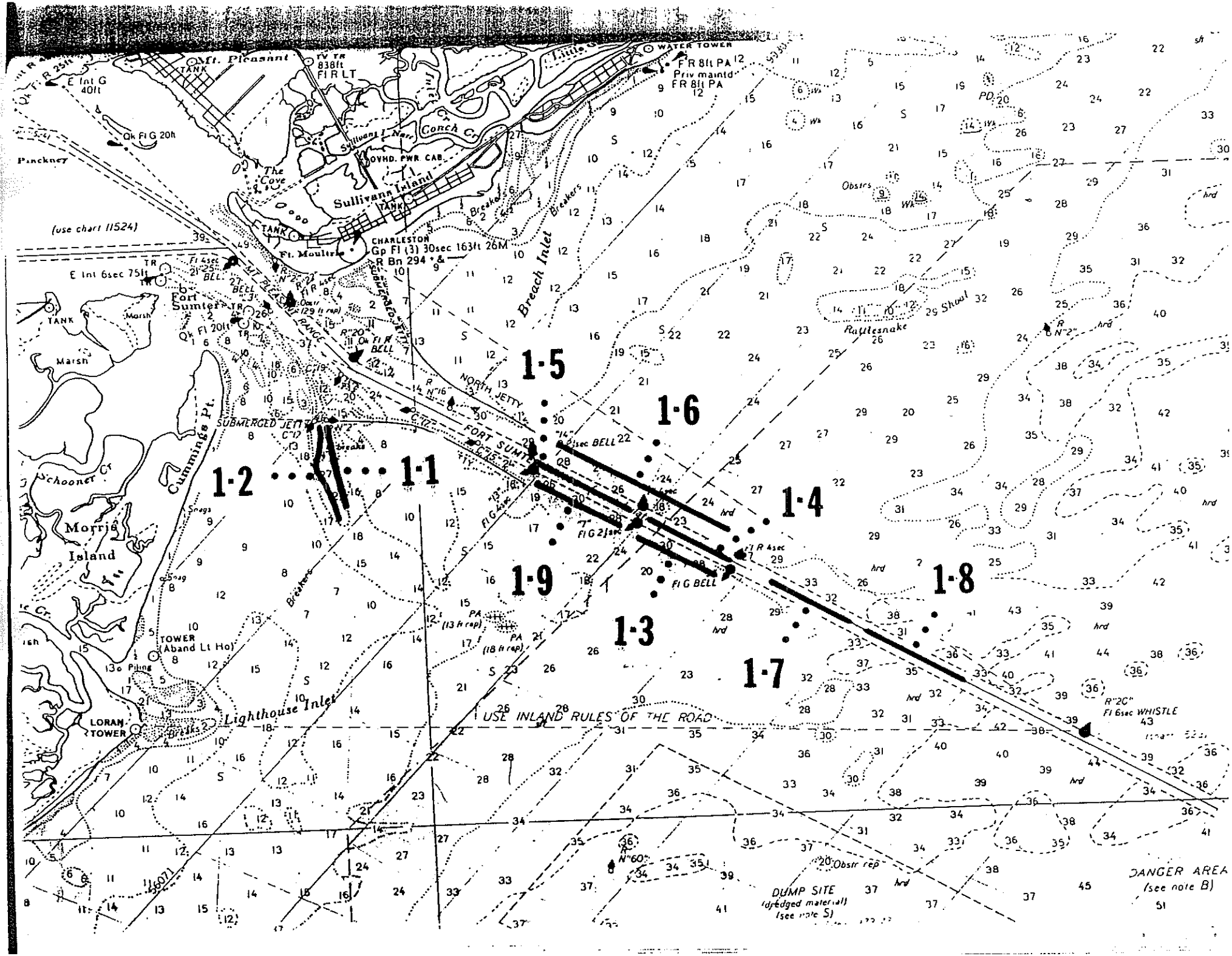

ST SIMONS SOUND
Jekyll Island
BRUNSWICK RIVER
Brunswick Pt.
Brandy Pt.
Plantation Creek
Parsons Creek
Cedar Hammock
Cedar Cr.
Jointer Creek
Cobb Creek
Mud River
Clark Cr.
Island
Marsh
TANK
TV TOWER
15-1
15-2
BRUNSWICK PT CUT RA.
CEDAR HAMMOCK RA
PLANTATION CR RANGE
LOWER RIVER RANGE
JEKYLL I. RANGE
JETTY RANGE
INTRACOASTAL WATERWAY
SIDNEY LANIER LIFT BRIDGE
HOR. CL. 250 FT.
VERT. CL. 24 FT. DOWN
VERT. CL. 139 FT. UP
FIXED BRIDGE
HOR. CL. 30 FT.
VERT. CL. 10 FT
OVHD. PWR. CAB
AUTH. CL. 35 FT.
Spoil Area
INTRACOASTAL WATERWAY
The project depth from Savannah River Ga. to Fernandina Beach, Fla., is 12 feet. The controlling depths are published periodically in the U S Coast Guard Local Notice to Mariners


16-1
16-2
16-3
16-4
16-5
TYBEE ROADS
Turtle I.
Oyster Bed I.
Tybee Knoll Spit
OLD TOWER (Aband Lt Ho)
South Channel
Tybee I.
Little Tybee Island
Tybee Creek
Tybee Inlet
Oyster Cr.
Lazaretto Creek
Little Tybee Cr
Beach Hammock
Chimney Cr.
Savannah Beach
Ft. Screven
TANK
FIXED BRIDGE HOR CL. 120 FT. VERT CL. 35 FT.
OVND PWR CAB
Partially submerged at MHW
E Int 6sec 65ft
Fl 4sec 16ft
E Int 6sec 43ft
Qk Fl 21ft
Fl G 4sec 16ft 5M
F 144ft 19M
Fl 4sec 16ft
Fl R 4sec 16ft
Fl G 4sec BELL
Fl 4sec BELL
Fl R 4sec GONG
Fl G 4sec
Fl R 4sec WHISTLE
Fl G 4sec BELL
BW "T" Mo (A) WHISTLE
Obstr rep
Subm pile
breakers
Changeable Area
No recent hydrographic surveys
Breakers
Disposal Area
Depths from surveys of 1971 and 1973
Obstr Fish Haven
Disposal Area (discont'd)
W Or "B" Fl 4sec
W Or C"A"
W Or N"D"
W Or C"C"
Bull River
Oyster Bed I.
Pulaski
Cockspur I.
S Hy No 80
BLOODY PT RANGE
TYBEE RANGE
SUBM EAKWATER
(Use chart 11512)
marsh
hrd
sft
SSh
14330
14320
14310

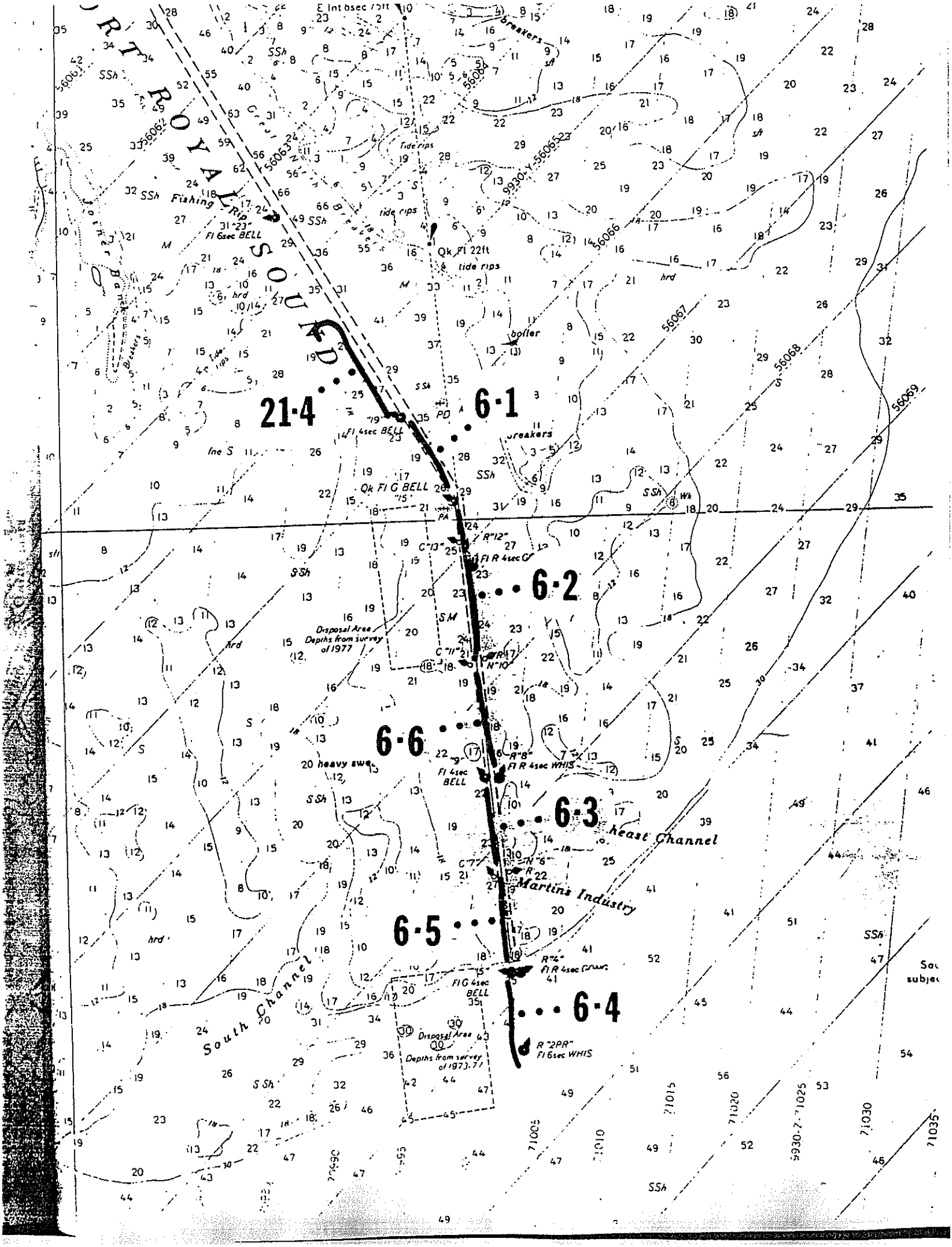

CAUTION
Improved channels shown by broken lines are subject to shoaling, particularly at the edges.
CAUTION
Temporary changes or defects in aids to navigation are not indicated on this chart.
See Notice to Mariners
21-1
21-2
21-3
21-5
Ballas Cr.
Marsh
FIXED BRIDGE HOR CL 26 FT. VERT CL 4 FT.
MICRO TOWER
Chowan Spit
CHOWAN BEACH
Spoil
Qk Fl 16ft
E Int 6sec 46ft
E Int 6sec 36ft
BEAUFORT RIVER
ST HELENA I.
County Lanc
PORT FREMONT
Lands End
Parris I Spit
Obstr Fish Haven
Morse Island Creek
BAY POINT I.
Bay Point
ROYAL
Middle Shoal
Qk Fl R WHISTLE
Qk Fl BELL



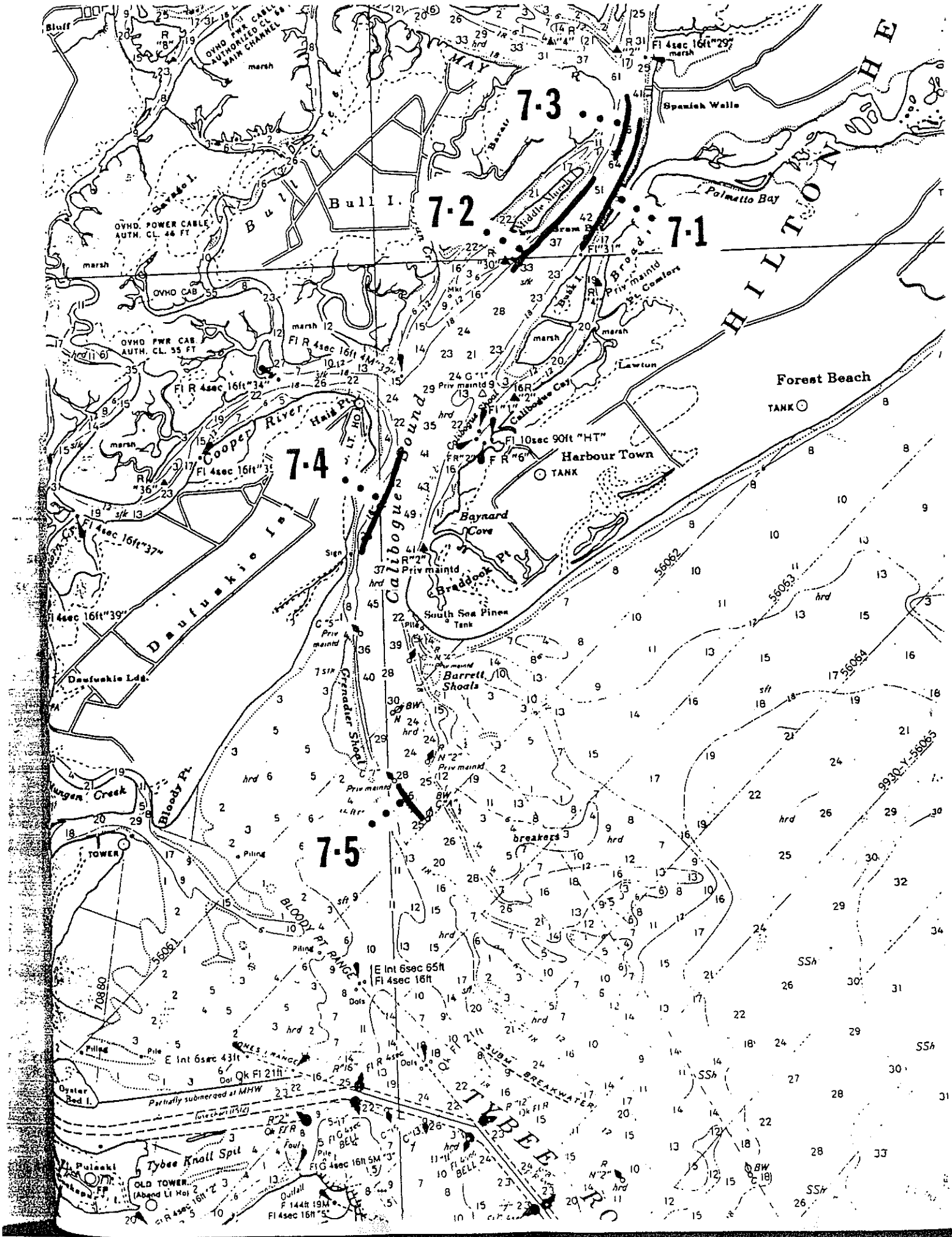
27-5
27-6
27-3
27-2
27-4
27-1
WINYAH BAY ENTRANCE
SIGNAL TOWER
GEORGETOWN
R Bn
Gp Fl (2) 15sec
85ft 15M
RADIO TOWER
RANGE C
SOUTH ISLAND BEND
RANGE B
RANGE A
ENTRANCE CHANNEL
MARKERS
MOUND
WHISTLE
Breakers
Sand Island
DUMP SITE
(dredged material)
(see note 5)
Depths from surveys of 1914-1977



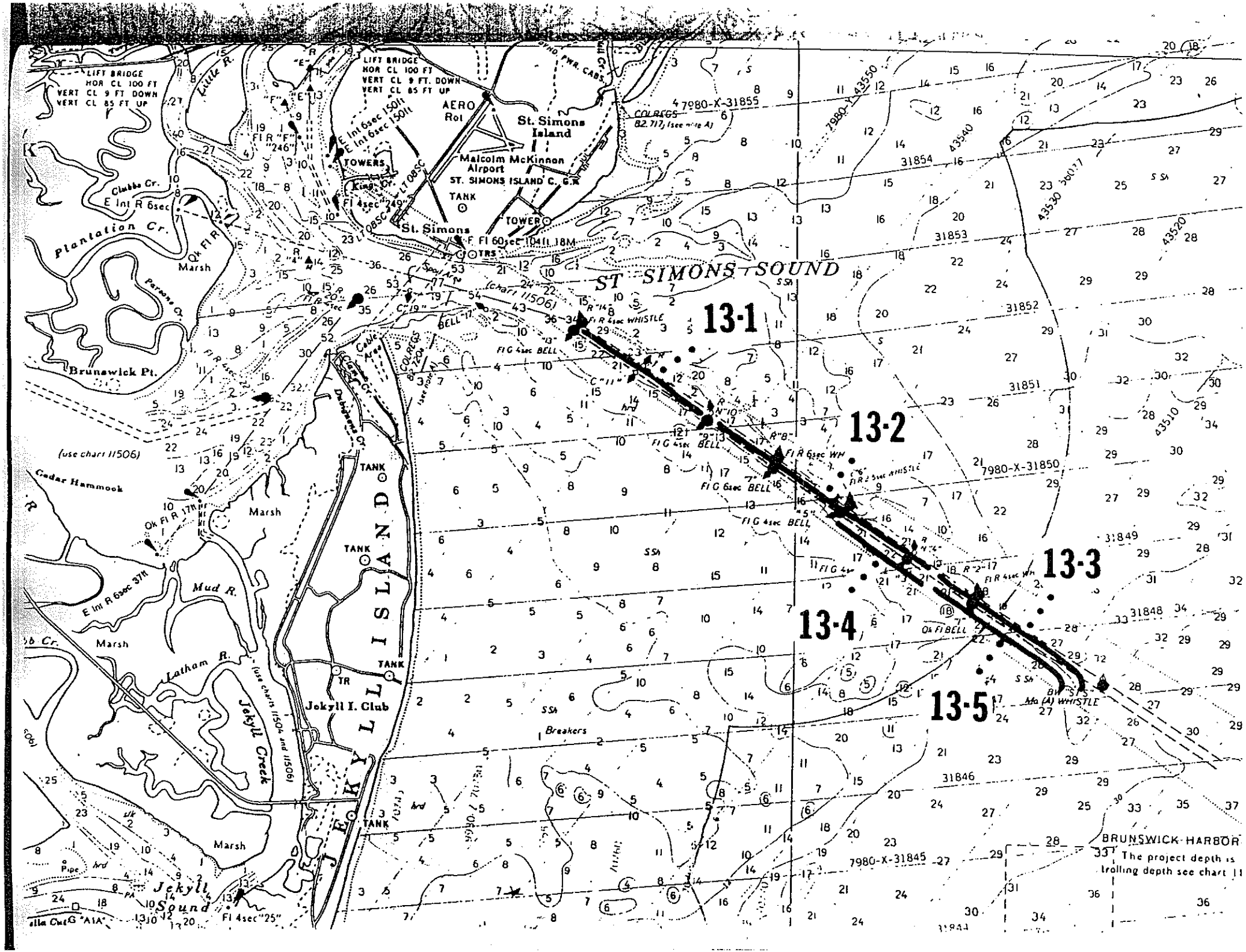
1·1
1·2
1·3
1·4
1·5
1·6
1·7
1·8
1·9
Mt. Pleasant
Sullivans Island
Ft. Moultrie
Fort Sumter
Morris Island
Cummings Pt.
Breach Inlet
Lighthouse Inlet
Rattlesnake Shoal
Pinckney
The Cove
Conch Cr.
Schooner Cr.
NORTH JETTY
SUBMERGED JETTY
FORT SUMTER
CHARLESTON
Gp Fl (3) 30sec 163ft 26M
R Bn 294
WATER TOWER
OVHD. PWR. CAB.
TOWER (Aband Lt Ho)
LORAN TOWER
USE INLAND RULES OF THE ROAD
DUMP SITE (dredged material) (see note S)
DANGER AREA (see note B)
(use chart 11524)

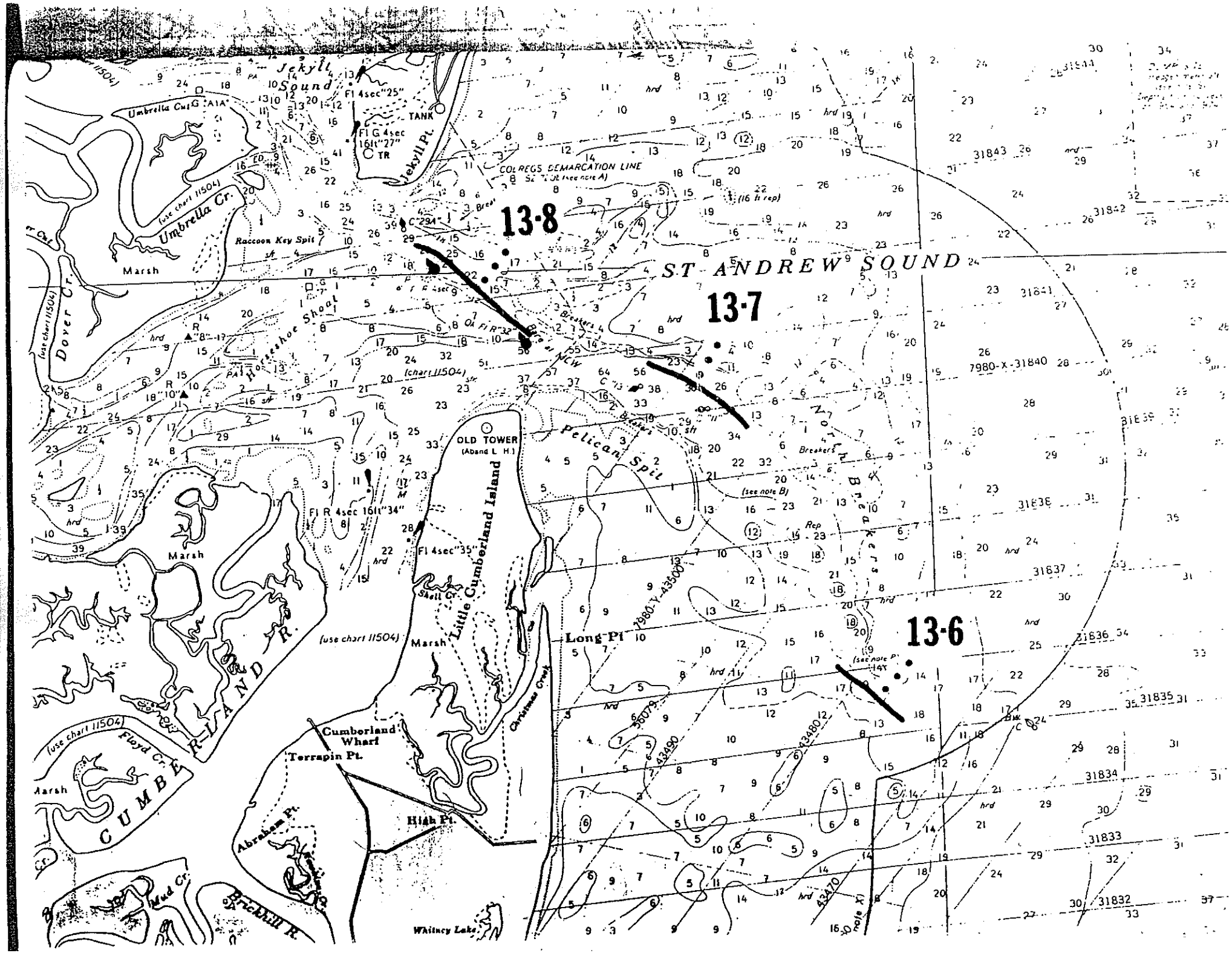


ROYAL SOUND
21·4
6·1
6·2
6·6
6·3
6·5
6·4
Fishing Rip
Fl 6sec BELL
Qk Fl 22ft
tide rips
boiler
breakers
Fl 4sec BELL
Qk Fl G BELL
Fl R 4sec G
Disposal Area
Depths from survey of 1977
heavy swe
Fl 4sec BELL
Fl R 4sec WHIS
heast Channel
Martins Industry
South Channel
Fl G 4sec BELL
Disposal Area
Depths from survey of 1973-77
R "2PR"
Fl 6sec WHIS

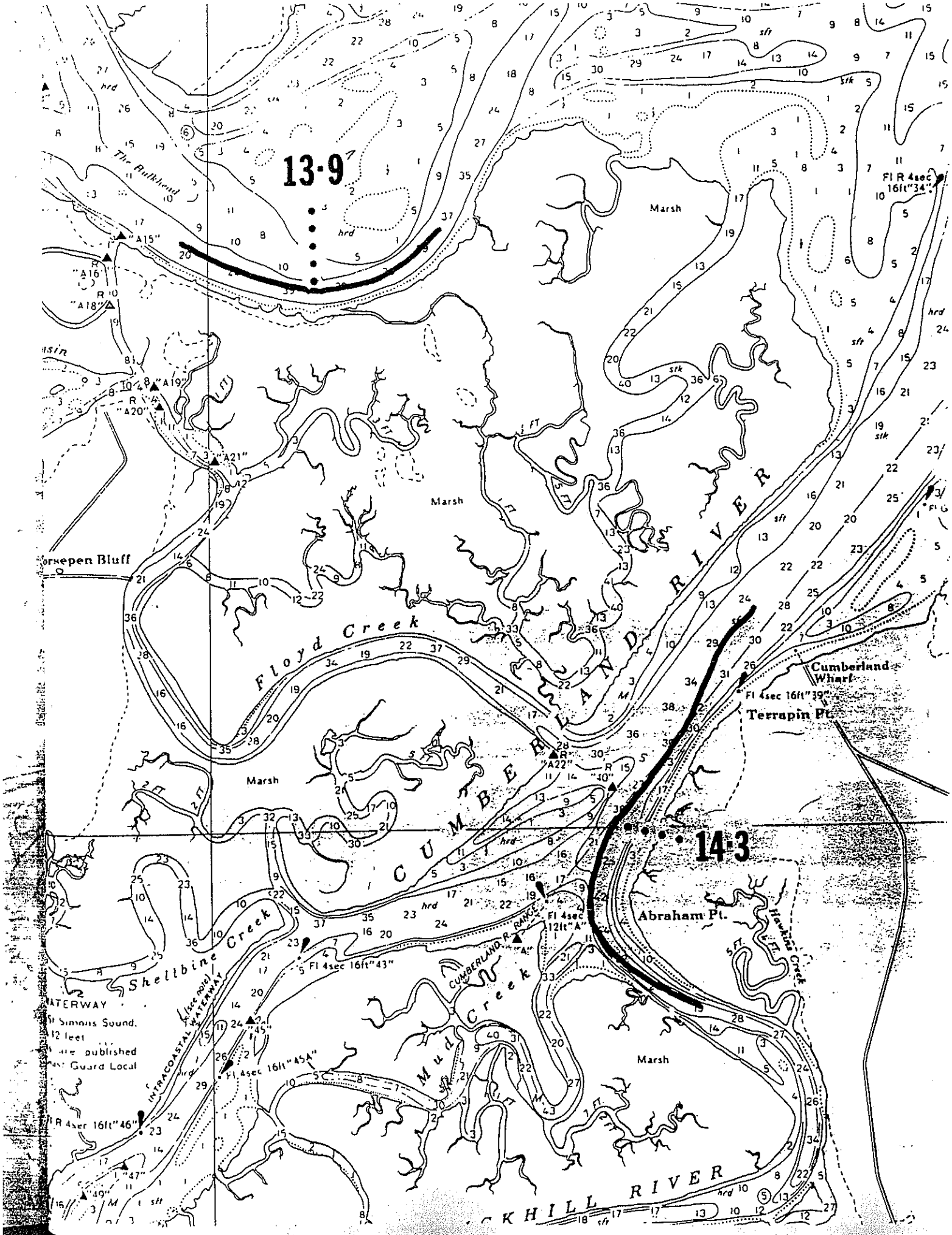


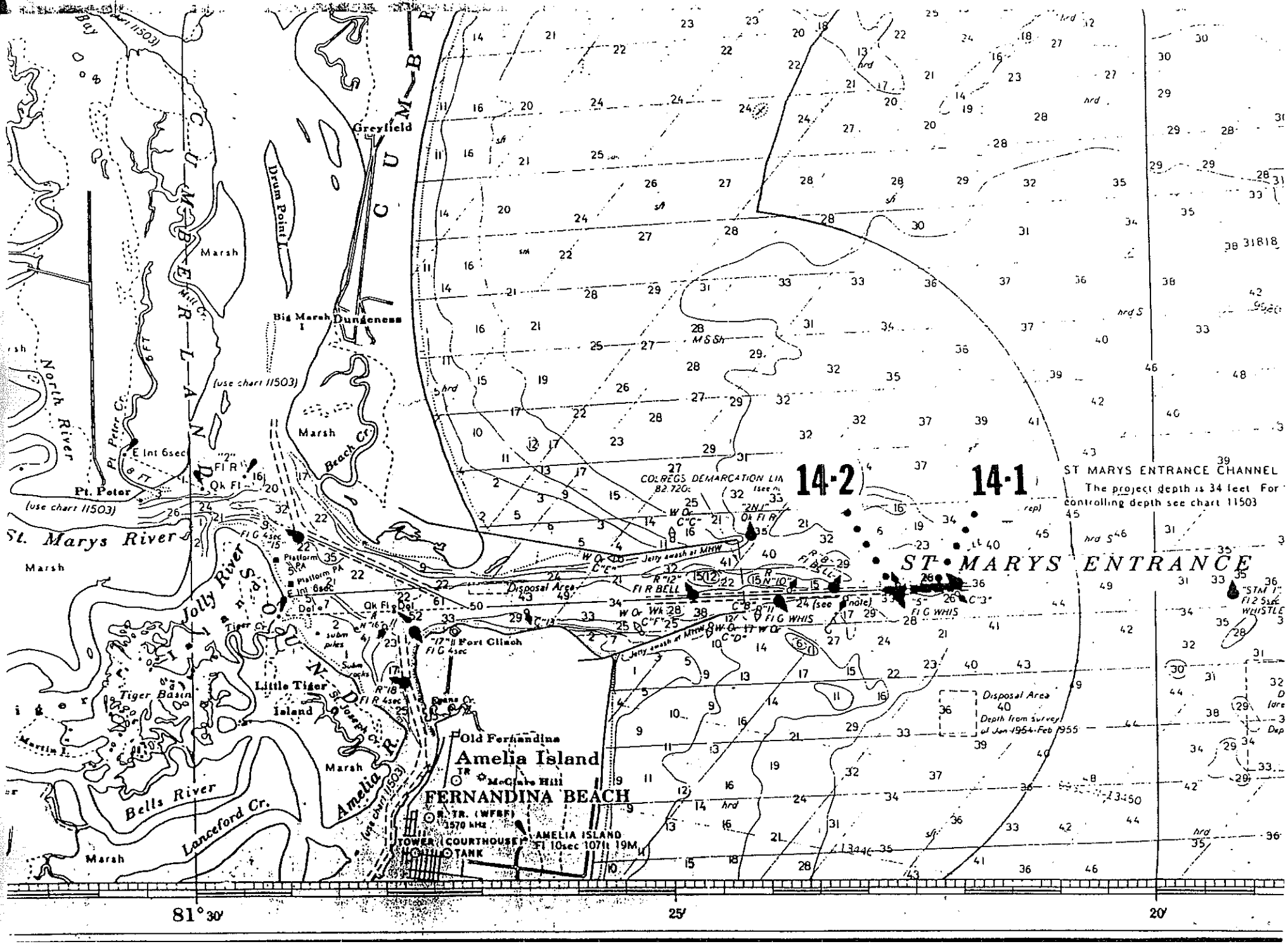
7-1
7-2
7-3
7-4
7-5
Bull I.
Bull Creek
Savage I.
OVHD. POWER CABLE AUTH. CL. 46 FT
OVHD PWR CABLE AUTHORIZED CL 55 MAIN CHANNEL
OVHD PWR CAB. AUTH. CL. 55 FT
Cooper River
Haig Pt.
Daufuskie Is.
Daufuskie Ldg.
Calibogue Sound
Calibogue Cay
Harbour Town
Forest Beach
Palmetto Bay
Spanish Wells
Broad Pt.
Lawton
Baynard Cove
Braddock Pt.
South Sea Pines
Barrett Shoals
Grenadier Shoal
Bloody Pt.
Hungen Creek
BLOODY PT RANGE
TYBEE RO
Tybee Knoll Spit
Oyster Bed I.
Pulaski
OLD TOWER (Abend Lt Ho)
Partially submerged at MHW
SUBM BREAKWATER
TOWER
TANK
Fl 4sec 16ft "29"
Fl R 4sec 16ft "34"
Fl 4sec 16ft "37"
Fl 4sec 16ft "39"
Fl 10sec 90ft "HT"
E Int 6sec 65ft
Fl 4sec 16ft
E Int 6sec 43ft
Qk Fl 21ft
Fl G 4sec 16ft 5M "3"
F 144ft 19M
Fl 4sec 16ft "5"


13-1
13-2
13-3
13-4
13-5
ST SIMONS SOUND
St. Simons Island
Malcolm McKinnon Airport
ST. SIMONS ISLAND C. G.R
AERO Rot
LIFT BRIDGE
HOR CL 100 FT
VERT CL 9 FT. DOWN
VERT CL 85 FT UP
TOWERS
TANK
TOWER
St. Simons
Little R.
Clubb Cr.
Plantation Cr.
Marsh
Brunswick Pt.
(use chart 11506)
Cedar Hammock
Mud R.
Latham R.
Jekyll Creek
Jekyll I. Club
JEKYLL ISLAND
Jekyll Sound
Breakers
BRUNSWICK HARBOR
The project depth is
trolling depth see chart 11



13-8
13-7
13-6
ST ANDREW SOUND
Jekyll Sound
Jekyll Pt.
Umbrella Cut
Umbrella Cr.
Raccoon Key Spit
Marsh
Dover Cr.
Horseshoe Shoal
COLREGS DEMARCATION LINE
OLD TOWER
(Aband L. H.)
Pelican Spit
North Breakers
Breakers
Little Cumberland Island
Shell Cr.
Long Pt
Christmas Creek
Cumberland Wharf
Terrapin Pt.
High Pt.
Abraham Pt.
Floyd Cr.
CUMBERLAND R.
Mud Cr.
Brickhill R.
Whitney Lake
(use chart 11504)
(chart 11504)
(see note B)
(see note P)
7980-X-31840
7980-Y-43500


13·9
14·3
The Bulkhead
Marsh
Marsh
Marsh
Marsh
Floyd Creek
CUMBERLAND RIVER
Shellbine Creek
Mud Creek
Cumberland Wharf
Terrapin Pt.
Abraham Pt.
Hawkins Creek
CUMBERLAND R. RANGE
INTRACOASTAL WATERWAY
(see note)
Fl R 4sec 16ft"34"
Fl 4sec 16ft"39"
Fl 4sec 12ft"A"
Fl 4sec 16ft"43"
Fl 4sec 16ft"45A"
Fl R 4sec 16ft"46"
"A15"
"A16"
"A18"
"A19"
"A20"
"A21"
"A22"
"40"
"45"
"47"
"49"
WATERWAY
St Simons Sound.
12 feet
are published
Guard Local
KHILL RIVER



14-2
14-1
ST MARYS ENTRANCE CHANNEL
The project depth is 34 feet For controlling depth see chart 11503
ST MARYS ENTRANCE
COLREGS DEMARCATION LIN
Disposal Area
Depth from survey of Jan 1954-Feb 1955
Greyfield
Dungeness
Big Marsh I
Drum Point I
Marsh
North River
Pt. Peter
St. Marys River
Jolly River
Little Tiger Island
Tiger Basin
Bells River
Lanceford Cr.
Amelia R.
Old Fernandina
Amelia Island
McClure Hill
FERNANDINA BEACH
R. TR. (WFBF)
1570 kHz
TOWER (COURTHOUSE)
TANK
AMELIA ISLAND
Fl 10sec 107ft 19M
Fort Clinch
Platform PA
Beach Cr.
Tiger Cr.
Egans Cr.
Martin I.
Bay
(use chart 11503)
81° 30'
25'
20'

May 31, 1979

Mr. Larry Ogren
National Marine Fisheries Service
Panama City Laboratory F125
P.O. Box 4218
Panama City, Florida 32401

Dear Larry:

Enclosed are two copies of the final report for Contract No. 03-78-D08-0062, a Survey for Wintering Marine Turtles in South Carolina and Georgia. As per your phone conversation of 18 May, I am forwarding a third copy to Fred Berry.

We have refined the objectivity of the report by including only the results of the drag surveys. Appended to this letter are some additional comments of my own. These comments deal with shrimper opinion, Cape Lookout observations, and my personal opinions about the location of wintering turtles.

We are enclosing an invoice for the remainder of the payment on this contract. Also, per your phone conversation of 18 May, we have considered the Georgetown and Charleston extension as part of a total contract for $19,892.00.

Let us know if there is anything more we can do.

Sincerely,

James I. Richardson
Principal Investigator

JIR/ps

Enclosures: 3

Southeastern Wildlife Services, Inc.
Gaines School Road · Athens, Georgia 30605 · (404) 353-2503

Contact With Commercial Shrimpers

Shrimpers were questioned throughout the survey concerning the presence of marine turtles in coastal waters during cold water months of December, January, February, and March. Discussions were led by Captain McGowan and usually took place at an informal gathering on-board the Miss Vivian at various commercial docks along the route, including Georgetown (SC), McClellanville (SC), Shem Creek (Mount Pleasant, SC), Ladies Island (Beaufort, SC), Port Royal (SC), Lazaretto Creek (Savannah, GA), Thunderbolt (GA), Brunswick (GA), Jekyll Island (GA), and St. Mary's (GA).

Discussions With Shrimpers

Discussions covered a wide range of subjects, including winter turtles, incidental capture, net mortality, critical habitat (restricted fishing areas), and the role of NMFS in the marine turtle/shrimper conflict. There appeared to be a concensus among fishermen. Their answers appeared forthright and honest. They expressed concern that marine turtle regulations would be economically damaging to their profession. They did understand the purpose of this winter habitat survey and were exceptionally helpful with their advice and assistance. Some topics and conclusions are summarized below. For purposes of discussion, warm water months were taken to be April through November and cold water months from December through March.

Hibernacula: No shrimpers had ever heard or seen evidence of marine turtles buried in nearshore mud during cold water months in Georgia or the Carolinas. With the exception of Charleston shrimpers (Shem Creek docks at Mt. Pleasant, SC), none had ever seen a "black turtle" stained in a manner shown to them in color photographs, from Canaveral channel. Several of the Charleston shrimpers were familiar with "black turtles", which they had caught at Canaveral in previous years. Shrimpers from the Shem Creek docks evidently have a tradition of dragging in the Canaveral channel in the offseason. The exact year that "black turtles" first were seen at Canaveral was not determined. Mr. Glen Ulrich, SC Wildlife and Marine Resources Department, is currently pursuing this information.

Winter Turtles in Nearshore Waters: None of the shrimpers contacted during the survey had ever caught a marine turtle in nearshore waters of South Carolina and Georgia during cold water months, while all of them readily admitted to capturing turtles from April to November. Some had heard of other shrimpers having caught an occasional winter turtle, but this was very rare, and they could give no specifics. A number of shrimpers drag for blue crabs during cold water months in nearshore and sound waters; these individuals stated that they had never caught a winter turtle.

Winter Turtles in Offshore Waters: A number of shrimpers fish for snapper and scallops during the winter months in water 20 to 100 miles offshore. These fishermen capture turtles in their nets and also observe turtles on the surface near the Gulf Stream margin of influence. These turtles appear to be floating passively at the surface, but they actively dive when approached by a boat. This information corroborates observations by divers with the Georgia Office of Coastal Resources who observe lethargic to comatose marine turtles during winter months in offshore waters. These animals are seen off the Georgia coast under rocky shelves and live reefs at 100-120 feet of water. Evidence such as this supports the theory that loggerhead turtles summer in coastal estuaries and winter on hard bottom, live reefs in offshore waters; movements across the continental shelf may be temperature regulated.

Cape Lookout Survey

There has been an unconfirmed report for several years that marine turtles have been observed hibernating at Cape Lookout Bight. This small, semienclosed body of water is bounded by Cape Lookout to the south and east and by Shackleford Bank to the north. The turtles were purportedly observed by research biologists from the University of North Carolina Marine Sciences Laboratory at Beaufort, NC. There are a number of deep water holes within the Bight that would appear suitable for hibernacula.

A trip to Cape Lookout on 15 November 1978 produced no confirmation of the wintering turtle report. Discussion was held with Superintendent Mac Riddle and staff of the Cape Lookout National Seashore and with local shrimpers and crabbers from Beaufort. None of these individuals were cognizant of wintering turtles in the immediate area, and none had ever seen stained turtles like the Canaveral turtles. Those who trawl for blue crabs during the winter reported no captures of marine turtle from December through March. Shrimpers appeared very guarded during the conversations, perhaps because of the presence of NPS personnel at the discussion; confidence in their remarks should be taken accordingly.

An aerial survey by helicopter of Cape Lookout, Shackleford Banks, the Beaufort Harbor shipping channel, and Cape Lookout Bight produced no sighting of live marine turtles. The survey was flown on 16 November on a clear, warm day with perfect visibility. Local water temperatures on that day were 16° C; resident turtles should have been visible on the surface during the flight. Park personnel have continued these flights into the winter; no sightings were reported.

The presence of winter turtles in Cape Lookout Bight has again been noted by a recent employee of the UNC Marine Science Laboratory. The individual who supposedly made the

actual observations was Mr. Val Klump, a chemical oceanographer at the Marine Science Lab. In a follow-up phone conversation, Mr. Klump reported sighting a single marine turtle on the bottom of Cape Lookout Bight in November (no date given); the turtle actively swam away from the diver.

The combined evidence would indicate that there are no wintering turtles within Cape Lookout Bight, yet rumors of their existence persist. It is possible that the presence of wintering turtles in the Bight is being concealed for various unknown reasons. Investigation of wintering turtles at Cape Lookout Bight should continue.

Conclusions

There appears little evidence to support the need for marine turtle winter critical habitat in estuarine areas of Georgia and South Carolina. Offshore live bottom reefs may be important wintering habitats for marine turtles. Offshore drilling and mining permits should consider live reef from the 10 to 40 fathom line as potential critical habitat for marine turtles. Marine turtles have been captured in 180 feet of water (Dave Harrington - pers. comm). A program of onboard observers with snapper boats might be productive. Diving studies of marine turtles on live reefs, as planned by Georgia Office of Coastal Resources on reefs in 120 feet of water, should be encouraged.