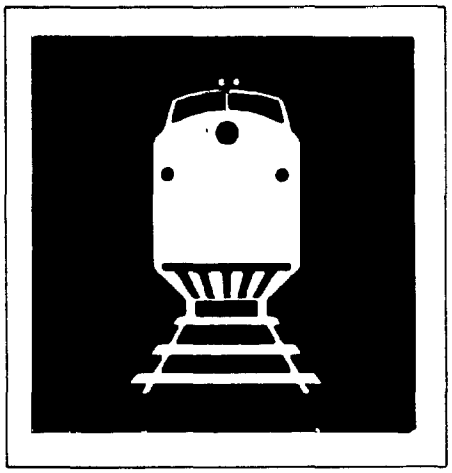

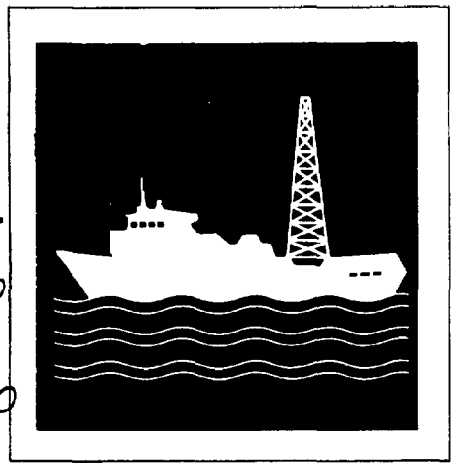

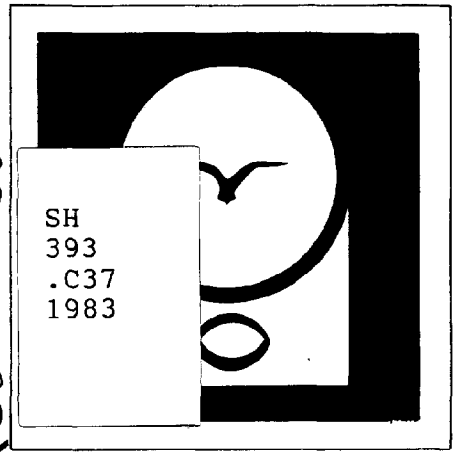

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Mapping of Submerged Grass Beds in Core and Bogue Sounds, Carteret County, North Carolina, by Conventional Aerial Photography

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Richard J. Carraway
Loie J. Priddy
Office of Coastal Management
Morehead City, N. C.

NOVEMBER 1983

North Carolina
Coastal Energy Impact Program
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MAPPING OF SUBMERGED GRASS BEDS IN CORE AND BOGUE SOUNDS CARTERET COUNTY, NORTH CAROLINA BY CONVENTIONAL AERIAL PHOTOGRAPHY

BY

Richard J. Carraway and Loie J. Priddy
North Carolina Office of Coastal Management
N. C. Department of Natural Resources and Community Development

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Jim Smith and Jill Miller of the North Carolina Office of Coastal Management.

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SUMMARY AND CONCLUSIONS

This project was an effort to produce accurate detailed maps showing the location, size, and distribution of submerged grassbeds in Bogue and Core sounds in Carteret County, North Carolina. The use of conventional aerial photography was considered by the authors to be an effective and economical method of mapping the large areas involved.

Several conditions were noted during this study which must be considered when attempting to take aerial photography of submerged grass beds. Tide stage should be as low as possible; visibility must not be reduced by haze or weather; frames must be generously overlapped to help prevent "blind spots" in the photo coverage caused by sun reflection and to aid in location and horizontal control. Ground truthing is also a very critical element of the mapping of submerged grass beds, not only to verify interpretation of the photography, but to confirm location and density data. ("Ground truthing" means verification of photo-interpretation by visiting or sampling the actual site photographed.)

The base photography for this mapping was scaled aerial natural color photography flown by the North Carolina Department of Transportation. This photography was analyzed for locations of submerged grass beds, which were then field checked by investigating personnel. Biological information and consultation was provided by the Fisheries Management Section of the North Carolina Division of Marine Fisheries. Once identified and checked, these grass beds were mapped on U.S. Geological Survey 7 1/2 minute series quadrangle sheets. The areas in acres and the North Carolina Grid Coordinates of the center of each bed were then computed by the Land Resources Information System.

19,458 acres of grass beds were identified and mapped within a total water area of 104,840 acres. These beds are shown and described in the maps and tables on pages 5 through 84 of this report.

This study has shown that conventional aerial photography, when taken under proper conditions of tide and visibility, and coupled with ground truthing, is a practical cost-effective means of mapping submerged grass beds within shallow estuarine lagoons such as Core and Bogue sounds.

PURPOSE AND OBJECTIVES

Submerged marine grass beds of eelgrass (Zostera marina) and shoalgrass (Halodule wrightii) are necessary to the survival of several commercially and ecologically important species of marine life in Core and Bogue sounds and their adjacent waters. These species include the bay scallop, pink and brown shrimp, blue crab, and ten or more species of fish. Other marine species, as well as several species of waterfowl, also utilize these grass beds. Submerged grass beds provide nursery areas to many of these marine species, and are critical to their survival and propagation.

These grass beds are fragile and sensitive to the silting and excavation activities associated with the construction and maintenance of submerged pipelines. Oil spills or pipeline leakage present a great hazard to these grass beds and to the marine life which inhabits them. The mapping of these unique biological areas will provide an accurate base in order to mitigate damage to them from siltation, excavation, or oil spillage. Having precise locations of these beds will allow the erection of physical barriers (silt screens, containment apparatus, etc.) to reduce or block the flow of silt, sediment, or spilled oil into them. These maps, when used with wind, tide, and current data, will aid in plans for quick response to oil spills by identifying those areas which should be given protection priority. Pipeline routes may be aligned or re-aligned to mitigate damage to these beds caused by construction, maintenance, or by accidental leakage or rupture.

A major objective of this project was to determine the suitability of conventional color aerial photography, at scales of 1000 feet or less per inch, as base mapping information for submerged grass beds. Other objectives included determination of suitable conditions for taking this photography, methods of producing accurate final maps, and techniques for accurate computation of acreages and location coordinates.

PROCEDURES

Aerial Photography

The base aerial photography for this project was flown May 12-22, 1981, by the North Carolina Department of Transportation, Photogrammetry Section. A Wild-Heerbrug RC-10 aerial camera with a 6-inch focal length lens was used, with Kodak # 2445 Aerocolor Negative Film with haze filters. The base prints provided from this flight were 9-inch by 9-inch natural color contacts, color-corrected and balanced, at a scale of 1000 feet per inch. These base prints were not rectified. A frame overlap of 60% was used to avoid "blind spots" caused by sun reflection.

Interpretation and Identification

Initially, interpretation consisted of constructing mosaics from the color contact prints. Clear acetate sheets were overlaid on each mosaic, and grass beds an shoreline details were traced in black ink onto the acetate overlays. Known horizontal control stations were added to the overlays to be used for location and in the rectification of the interim maps. During this mapping, groundtruthing was used to confirm densities and to confirm or delete questionable areas.

Densities were delineated in three classes: scattered, moderate, and dense. Scattered indicates grass beds in which the grasses cover less than 20% of the bottom area within the bed. Moderate indicates coverage of 20% to 75%, and coverage greater than 75% is labelled dense. It should be noted that these densities will vary seasonally. No attempt was made to determine species mix or percentage in the grass beds.

Mapping

Photographic negatives were made of the acetate overlays. These negatives were then used to produce rectified prints at a scale of 2000 feet per inch (1:24,000) to match the U. S. Geological Survey 7 1/2 minute quadrangle sheet series. The mapped grass beds were then transferred to the USGS 7 1/2 minute quad sheets by direct tracing, producing a series of master maps.

Computations

These master maps were then sent to the Land Resources Information Service, Division of Land Resources, North Carolina Department of Natural Resources and Community Development. Data on grass beds were entered into the LRIS computer system using a Talos 660-B digitizer and a Data General Eclipse S-230 computer. This system provided printouts giving the acreage of each grass bed and the North Carolina Grid Coordinates of the center of each bed.

RESULTS

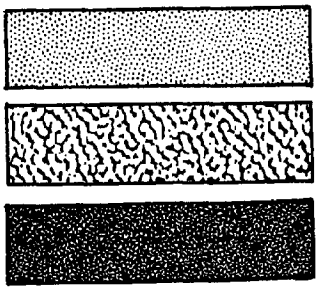
The final maps and data tables are included in this report in pages 5 through 84. The conventional aerial photography method enabled the authors to identify and map 623 grass beds totaling 19,458 acres within a total water area of 104,840 acres. The authors feel that the results were most satisfactory in this area and that the same good results may be obtained in similar shallow estuarine areas if certain conditions are met. These conditions are discussed on page 85 below.

DISCUSSION

The maps that follow in pages 5 through 84 are drawn on portions of USGS 7 1/2 minute quad sheets. North is oriented at the top of all maps except the index sheet. Each map is faced by a table showing pertinent data on each bed or portion of bed shown on that map. In all cases, data given applied to each bed in total. The reader should not add data from sheet to sheet where portions of beds are shown.

On each map grass beds are shaded to indicate grass density according to the following key:

MAP KEY
(MAPS 1-40, pages 5 through 84)



SCATTERED (less than 20% bottom coverage)

MODERATE (20% to 75% bottom coverage)

DENSE (over 75% bottom coverage)

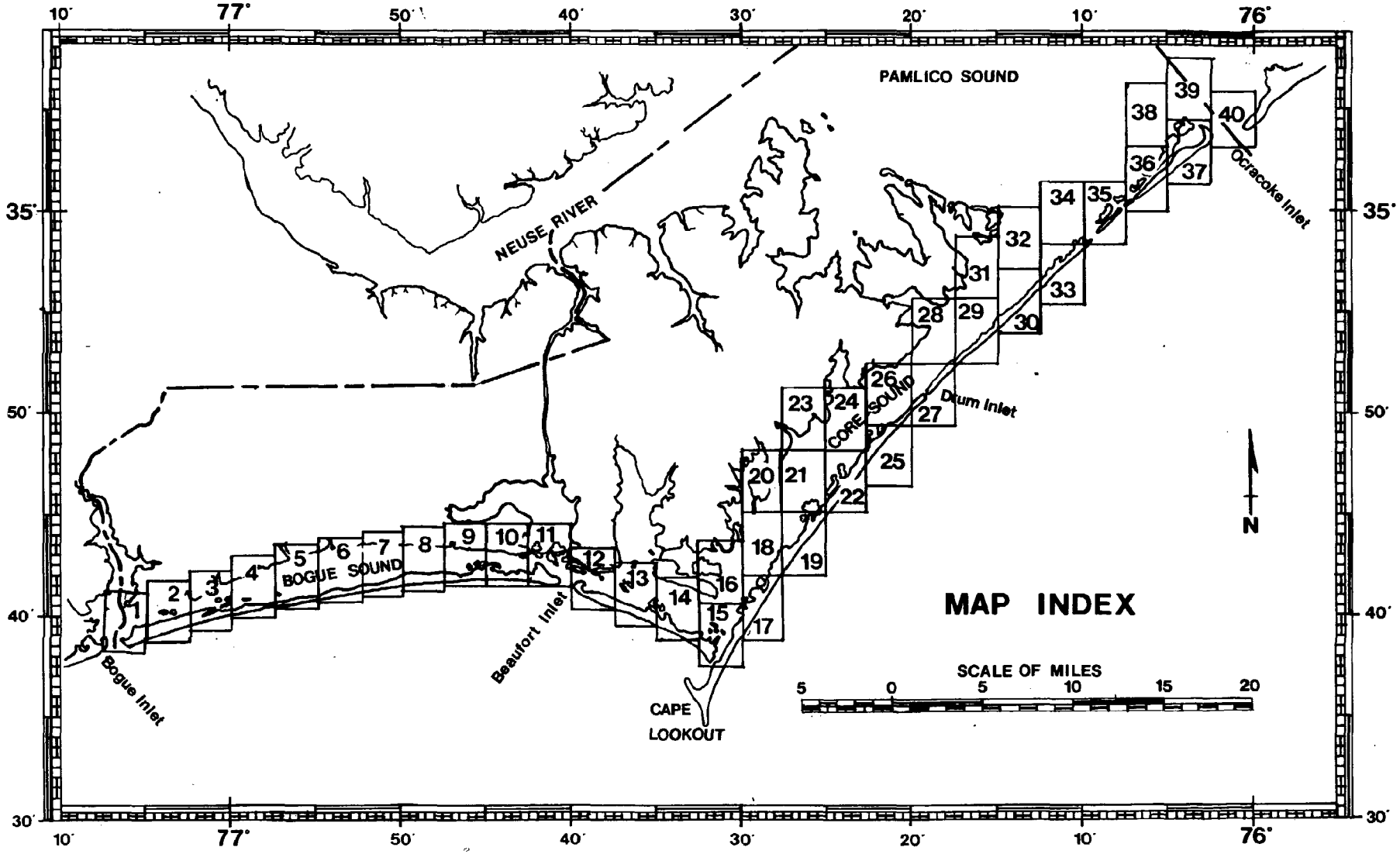
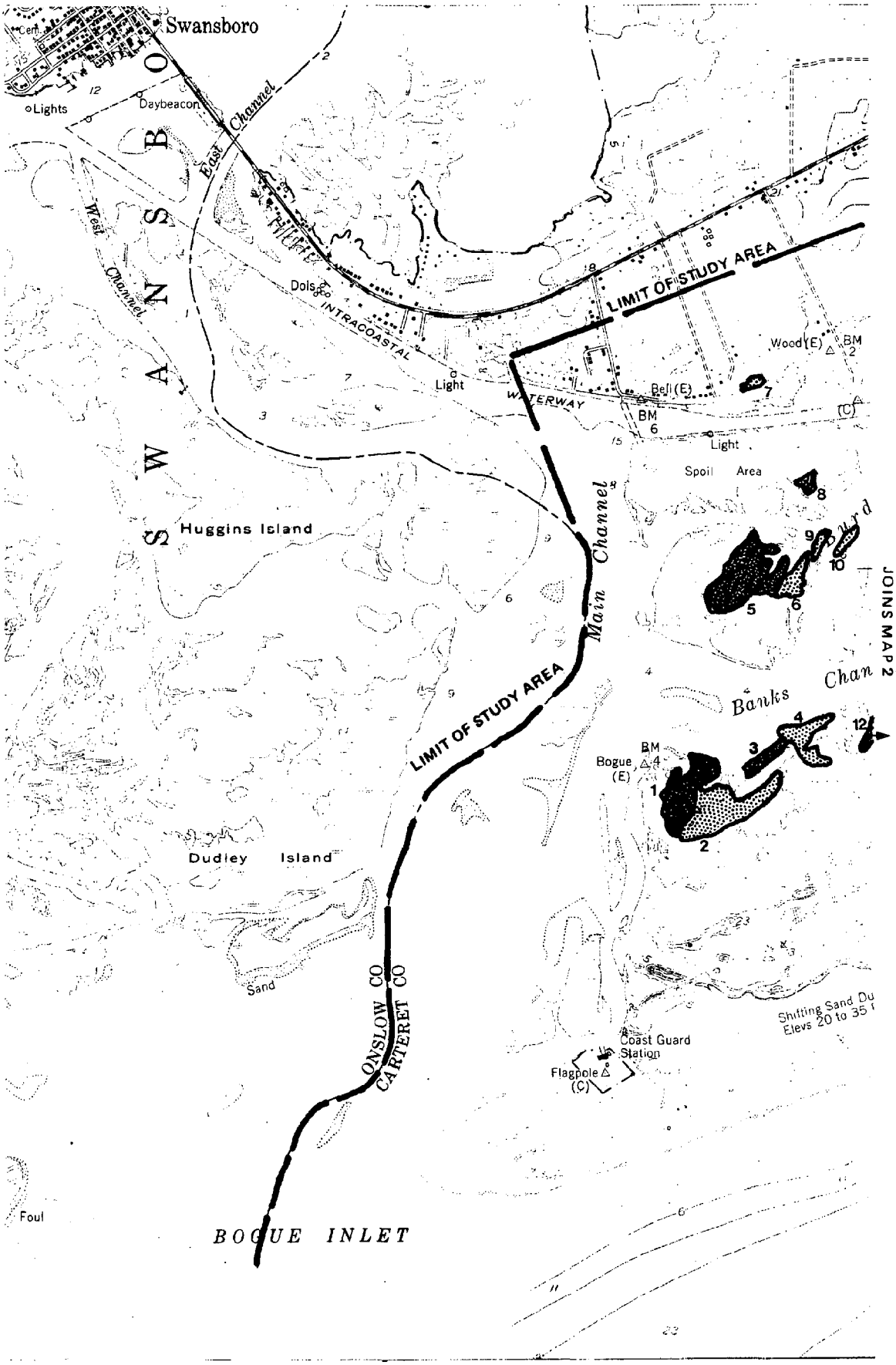

10'
77°
50'
40'
30'
20'
10'
76°
35°
50'
40'
30°
PAMLICO SOUND
NEUSE RIVER
BOGUE SOUND
CORE SOUND
Drum Inlet
Ocracoke Inlet
Bogue Inlet
Beaufort Inlet
CAPE LOOKOUT
N
MAP INDEX
SCALE OF MILES
5 0 5 10 15 20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

TABLE NUMBER 1

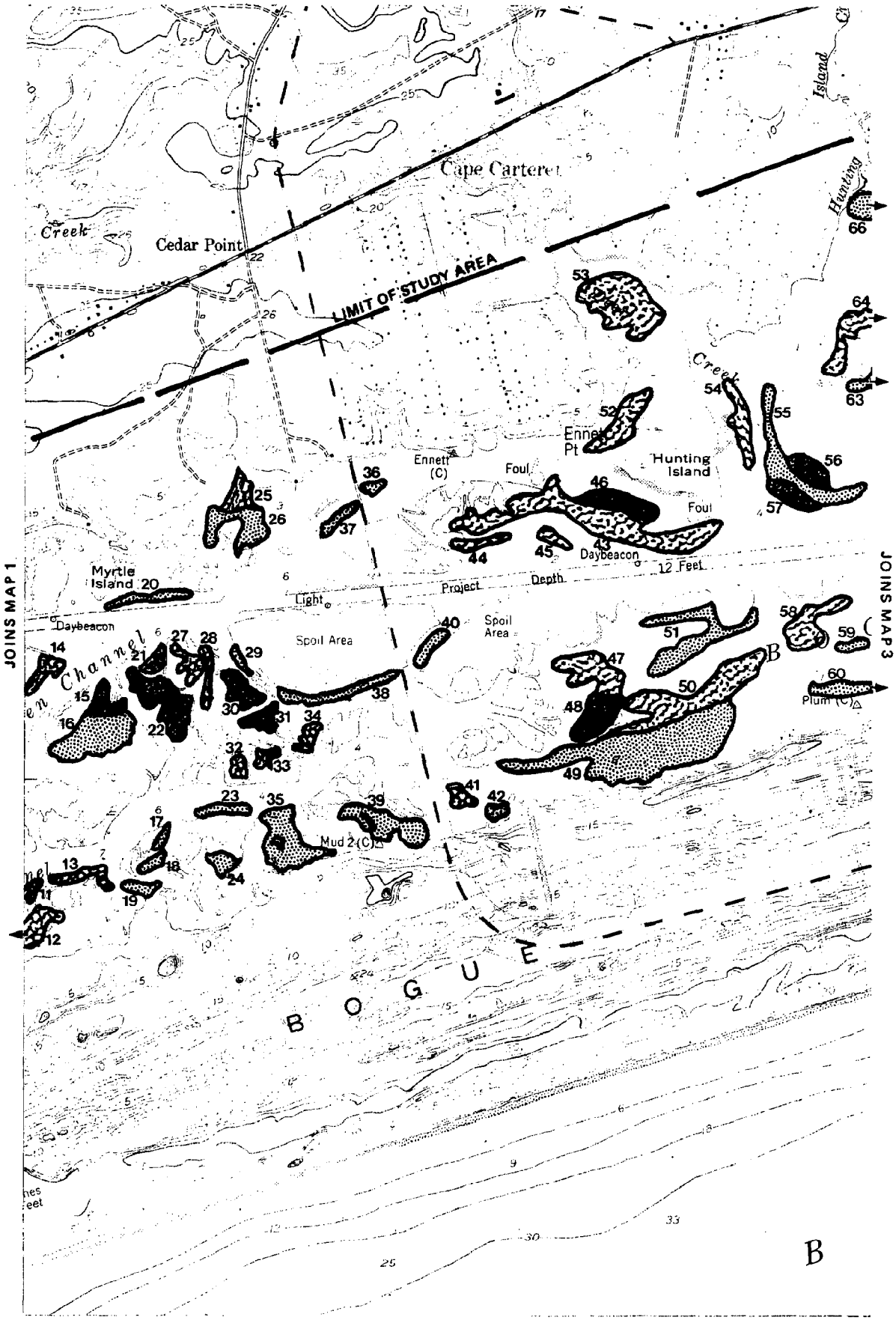
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
1	DENSE	2573491	335960	10.0
2	SCATTERED	2574094	335810	13.6
3	DENSE	2574726	336473	2.4
4	SCATTERED	2575211	336749	4.7
5	DENSE	2574426	339076	14.7
6	SCATTERED	2575178	339051	2.6
7	SCATTERED	2574527	341712	0.6
8	MODERATE	2575256	340387	1.0
9	SCATTERED	2575515	339472	0.9
10	SCATTERED	2575898	339548	1.0
12	MODERATE	2576399	336966	4.8


Swansboro
Lights
Daybeacon
East Channel
West Channel
BOGUE SOUND
Dols
INTRACOASTAL WATERWAY
Light
LIMIT OF STUDY AREA
Wood (E)
BM 2
Bell (E)
BM 6
Light
Spoil Area
Huggins Island
Main Channel
LIMIT OF STUDY AREA
Banks Chan
Bogue (E)
BM 4
Dudley Island
Sand
ONSLOW CO
CARTERET CO
Coast Guard Station
Flagpole (C)
Shifting Sand Du
Elevs 20 to 35
Foul
BOGUE INLET
JOINS MAP 2

MAP NUMBER 1

TABLE NUMBER 2

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
11	MODERATE	2576427	337524	0.7
12	MODERATE	2576399	336966	4.8
13	MODERATE	2576922	337762	3.0
14	MODERATE	2576464	340667	3.3
15	DENSE	2577441	340358	3.3
16	SCATTERED	2577220	339824	12.6
17	SCATTERED	2578347	338384	0.6
18	SCATTERED	2578194	338000	1.4
19	SCATTERED	2577941	337617	1.6
20	SCATTERED	2577941	341841	3.7
21	MODERATE	2578184	340943	1.9
22	DENSE	2578508	340286	9.3
23	SCATTERED	2579103	338789	2.4
24	SCATTERED	2579212	338023	2.2
25	MODERATE	2579353	343378	3.3
26	SCATTERED	2579562	342872	7.8
27	MODERATE	2578652	340868	2.6
28	MODERATE	2578982	340773	2.0
29	SCATTERED	2579416	340952	1.0
30	DENSE	2579421	340501	3.8
31	DENSE	2579697	340118	2.6
32	MODERATE	2579449	339404	1.1
33	MODERATE	2579761	339518	1.1
34	MODERATE	2580432	339843	1.9
35	SCATTERED	2579890	338656	10.6
36	SCATTERED	2581286	343484	0.9
37	SCATTERED	2580803	343035	1.9
38	SCATTERED	2581131	340591	4.4
39	SCATTERED	2581572	338624	8.2
40	SCATTERED	2582160	341210	1.6
41	MODERATE	2582711	339067	1.8
42	SCATTERED	2583205	338857	1.1
43	MODERATE	2584497	343326	27.1
44	MODERATE	2582724	342741	2.2
45	MODERATE	2583915	342825	1.7
46	DENSE	2584971	343298	6.0
47	MODERATE	2584592	340864	8.3
48	DENSE	2584670	340270	6.1
49	SCATTERED	2585356	339948	36.5
50	MODERATE	2586357	340653	18.2
51	SCATTERED	2586141	341428	12.5
52	MODERATE	2585012	344541	6.8
53	MODERATE	2584784	346168	16.7
54	MODERATE	2586713	344540	4.7
55	SCATTERED	2587211	344257	10.8
56	DENSE	2587662	343858	4.2
57	DENSE	2587385	343552	3.5
58	MODERATE	2587676	341705	7.5
59	SCATTERED	2588359	341402	1.1
60	SCATTERED	2589699	340919	5.9
63	SCATTERED	2588722	345379	3.1
64	MODERATE	2588226	345749	6.0
66	SCATTERED	2589350	346471	29.3



Cape Carteret
Cedar Point
Creek
LIMIT OF STUDY AREA
Island
Hunting
Creek
Ennett Pt
Ennett (C)
Foul
Hunting Island
Foul
Daybeacon
12 Feet
Depth
Project
Light
Myrtle Island
Daybeacon
Spoil Area
Spoil Area
Channel
Mud 2 (C)
Plum (C)
B O G U E
JOINS MAP 1
JOINS MAP 3
B

MAP NUMBER 2

TABLE NUMBER 3

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
60	SCATTERED	2589699	340919	5.9
61	SCATTERED	2590860	341297	3.8
62	MODERATE	2589280	342228	7.9
63	SCATTERED	2588722	345379	3.1
64	MODERATE	2588226	345749	6.0
65	MODERATE	2589037	346322	2.7
66	SCATTERED	2589350	346471	29.3
67	SCATTERED	2589304	345097	5.7
68	MODERATE	2590208	344895	4.7
69	SCATTERED	2591002	342682	5.0
70	SCATTERED	2592243	341515	1.9
71	SCATTERED	2592626	342685	2.9
72	MODERATE	2592984	343333	7.6
73	SCATTERED	2592745	343795	4.7
74	SCATTERED	2592208	344018	4.4
75	SCATTERED	2592595	345549	16.4
76	SCATTERED	2593220	345271	5.1
77	MODERATE	2594846	345080	22.7
78	MODERATE	2594268	343212	6.5
79	SCATTERED	2595337	342594	8.4
80	SCATTERED	2597962	342035	16.3
81	SCATTERED	2597198	343030	1.6
82	MODERATE	2598155	343219	47.8
83	SCATTERED	2597110	344519	47.7
84	SCATTERED	2595337	344644	17.5
85	MODERATE	2593794	346154	26.2
86	MODERATE	2592968	346926	2.5
87	SCATTERED	2594039	347649	3.4
88	MODERATE	2594054	347216	4.9
89	SCATTERED	2594348	347033	3.0
90	SCATTERED	2594915	346909	2.5
91	SCATTERED	2595457	347149	2.4
92	SCATTERED	2596216	347726	3.9
93	SCATTERED	2595855	348949	4.3
94	SCATTERED	2596656	349986	3.4
95	SCATTERED	2597122	347433	3.0
96	SCATTERED	2597121	346734	0.9
97	DENSE	2596979	345249	14.9
98	DENSE	2598480	342535	4.8
99	SCATTERED	2600059	341999	4.8
100	MODERATE	2599932	342625	4.9
101	DENSE	2600287	343805	3.2
102	DENSE	2598978	345296	132.8
103	MODERATE	2600083	347163	52.2
104	SCATTERED	2601772	348258	27.4
105	MODERATE	2601350	342448	14.5

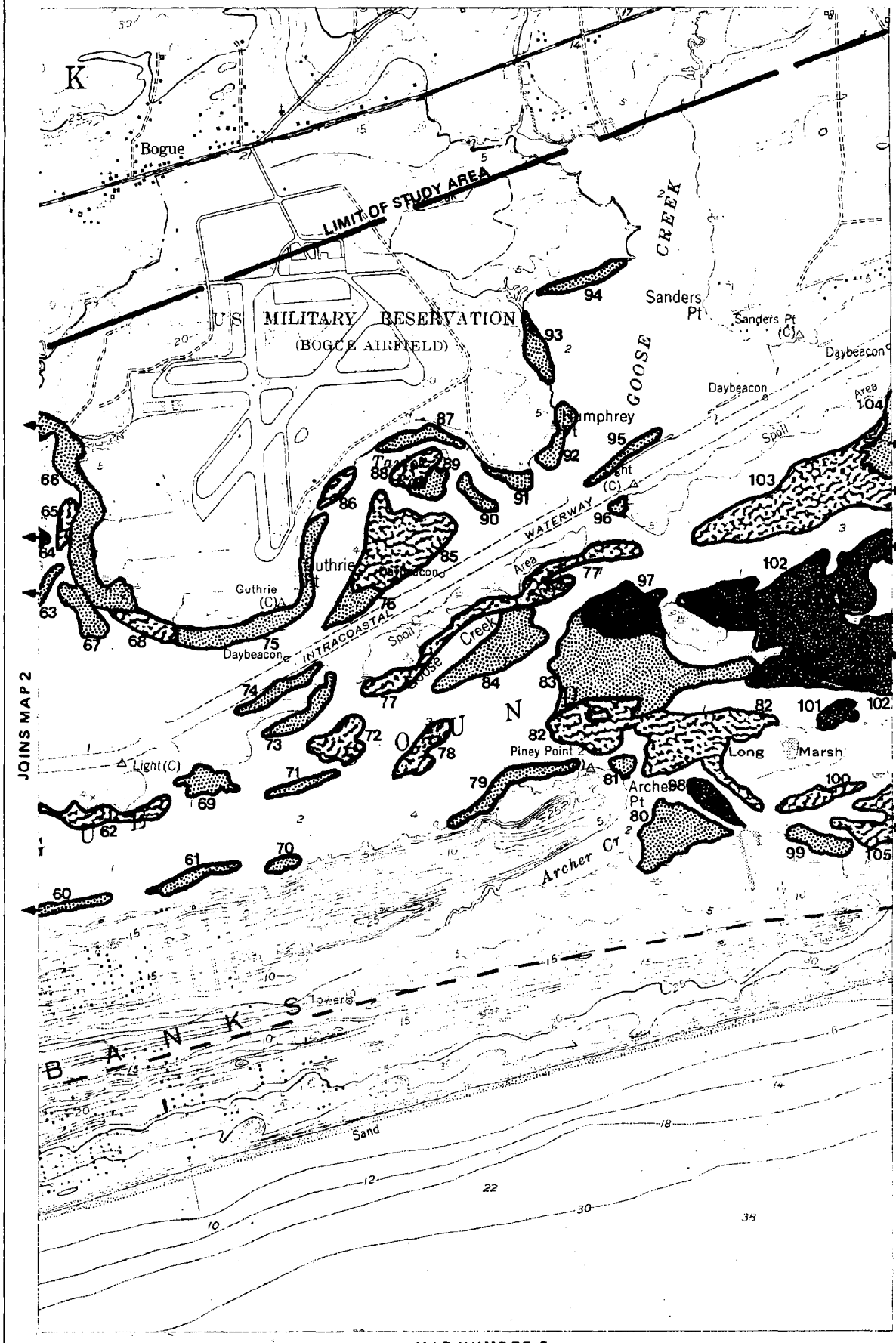

JOINS MAP 2
JOINS MAP 4
LIMIT OF STUDY AREA
U.S. MILITARY RESERVATION
(BOGUE AIRFIELD)
Bogue
GOOSE CREEK
Sanders Pt
Sanders Pt (C)
Daybeacon
Humphrey
Spoil Area
WATERWAY
INTRACOASTAL
Guthrie
Guthrie (C)
Goose Creek
Piney Point
Light (C)
Long Marsh
Archer Pt
Archer Cr
B A N K S
Towers
Sand
MAP NUMBER 3

TABLE NUMBER 4

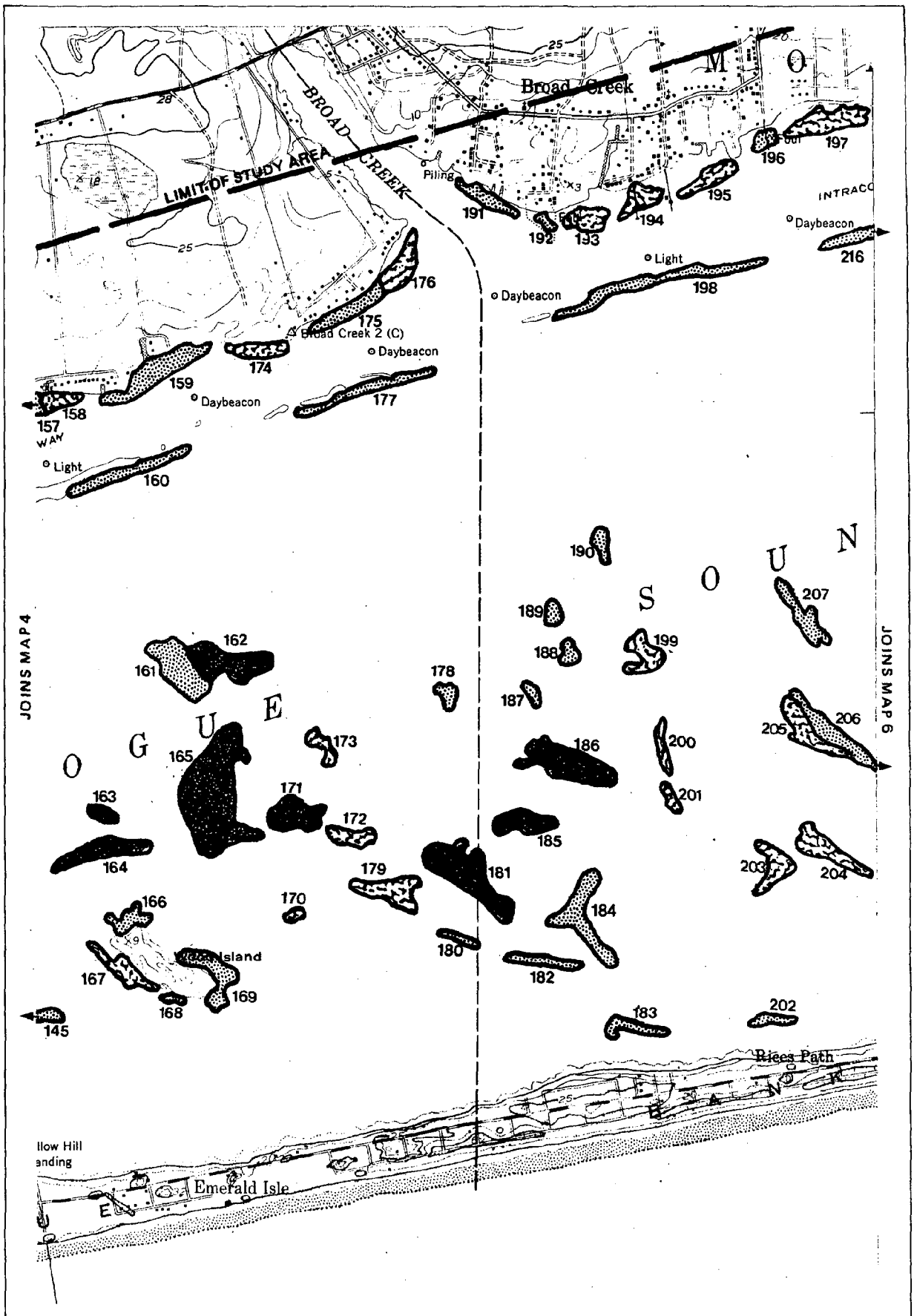
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
102	DENSE	2598978	345296	132.8
103	MODERATE	2600083	347163	52.2
104	SCATTERED	2601772	348258	27.4
105	MODERATE	2601350	342448	14.5
106	DENSE	2601859	343237	16.7
107	SCATTERED	2602527	343086	11.7
108	SCATTERED	2602548	344327	9.2
109	DENSE	2602817	344920	16.5
110	DENSE	2603017	348259	105.6
111	DENSE	2601946	348815	5.6
112	SCATTERED	2603708	346199	5.8
113	DENSE	2604732	346484	17.0
114	MODERATE	2604623	346043	23.3
115	MODERATE	2604954	345595	10.2
116	SCATTERED	2604651	345069	12.1
117	MODERATE	2603883	344569	6.2
118	MODERATE	2603364	343917	5.3
119	SCATTERED	2604081	343343	5.8
120	SCATTERED	2605824	346031	2.1
121	SCATTERED	2604115	348177	8.0
122	MODERATE	2604995	348142	3.4
123	SCATTERED	2606569	347825	13.4
124	DENSE	2605529	349856	50.4
125	SCATTERED	2606937	350732	40.9
126	MODERATE	2608219	351653	26.2
127	DENSE	2608436	350505	7.2
128	MODERATE	2607883	347668	3.8
129	SCATTERED	2607633	344919	6.9
130	SCATTERED	2602019	350498	1.6
131	SCATTERED	2603275	351094	2.8
132	SCATTERED	2605296	352211	3.0
133	MODERATE	2608479	353564	2.9
134	SCATTERED	2608831	354330	4.9
135	SCATTERED	2610520	354401	6.6
136	SCATTERED	2610399	352505	4.7
137	SCATTERED	2611362	352945	1.1
138	MODERATE	2610539	351951	1.2
139	SCATTERED	2610118	350744	12.2
140	MODERATE	2609820	348366	8.7
141	DENSE	2610358	347471	50.9
142	DENSE	2609723	346324	2.4
143	SCATTERED	2611552	346210	7.2
144	DENSE	2610917	344498	6.7
145	SCATTERED	2613349	345375	14.0
146	DENSE	2612892	347796	14.7
147	SCATTERED	2611601	348538	1.2
148	DENSE	2612455	349277	25.2
149	MODERATE	2611395	350439	3.6
150	MODERATE	2612749	350216	2.7
151	MODERATE	2611472	350921	1.7
152	MODERATE	2613198	350894	3.1
153	MODERATE	2611689	351626	2.9
154	MODERATE	2613170	351554	7.3
155	MODERATE	2612889	353412	7.9
156	SCATTERED	2611948	354538	3.4
157	SCATTERED	2613157	355189	5.0

Mon 13 (E)
Mon 14 (E)
Ocean
LIMIT OF STUDY AREA
W H I T E O A K
Sanders Ct
INTRACOASTAL
WATER
Daybeacon
Spoil Area
Long Island
Bank (C)
JOINS MAP 3
JOINS MAP 5
B
G

MAP NUMBER 4

TABLE NUMBER 5

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
145	SCATTERED	2613349	345375	14.0
157	SCATTERED	2613157	355189	5.0
158	MODERATE	2613791	355245	4.0
159	SCATTERED	2615303	355697	9.7
160	SCATTERED	2614952	354379	6.3
161	SCATTERED	2615739	351391	9.9
162	DENSE	2616499	351515	10.6
163	DENSE	2614663	349279	1.4
164	DENSE	2614654	348664	6.5
165	DENSE	2616419	349639	29.8
166	SCATTERED	2615085	347771	3.1
167	MODERATE	2615002	347062	4.4
168	SCATTERED	2615740	346616	0.7
169	SCATTERED	2616252	347099	6.4
170	MODERATE	2617521	347842	0.8
171	DENSE	2617520	349348	6.5
172	MODERATE	2618337	348998	3.5
173	MODERATE	2617861	350415	2.3
174	MODERATE	2616822	356069	4.2
175	SCATTERED	2618170	356732	4.9
176	MODERATE	2618877	357370	5.7
177	SCATTERED	2618436	355570	5.3
178	SCATTERED	2619694	351065	1.7
179	MODERATE	2618834	348180	6.4
180	SCATTERED	2619964	347547	1.4
181	DENSE	2620079	348409	13.6
182	SCATTERED	2621234	347239	3.3
183	SCATTERED	2622606	346301	3.3
184	SCATTERED	2621783	347877	9.6
185	DENSE	2620938	349268	5.1
186	DENSE	2621504	350171	12.1
187	SCATTERED	2620984	351132	1.3
188	SCATTERED	2621545	351775	1.8
189	SCATTERED	2621280	352339	1.6
190	SCATTERED	2621967	353328	1.8
191	SCATTERED	2620177	358321	3.1
192	SCATTERED	2621039	358011	0.9
193	MODERATE	2621639	358057	4.8
194	MODERATE	2622451	358310	3.4
195	MODERATE	2623456	358707	5.1
196	SCATTERED	2624297	359280	1.4
197	MODERATE	2625255	359600	6.9
198	SCATTERED	2622800	357195	10.7
199	MODERATE	2622603	351794	4.2
200	MODERATE	2622908	350220	1.6
201	MODERATE	2623073	349681	1.2
202	SCATTERED	2624661	346444	1.7
203	MODERATE	2624630	348678	3.9
204	MODERATE	2625494	348766	6.3
205	MODERATE	2624997	350515	6.2
206	SCATTERED	2625546	350569	9.0
207	SCATTERED	2624968	352416	4.6
216	SCATTERED	2627815	358233	28.1

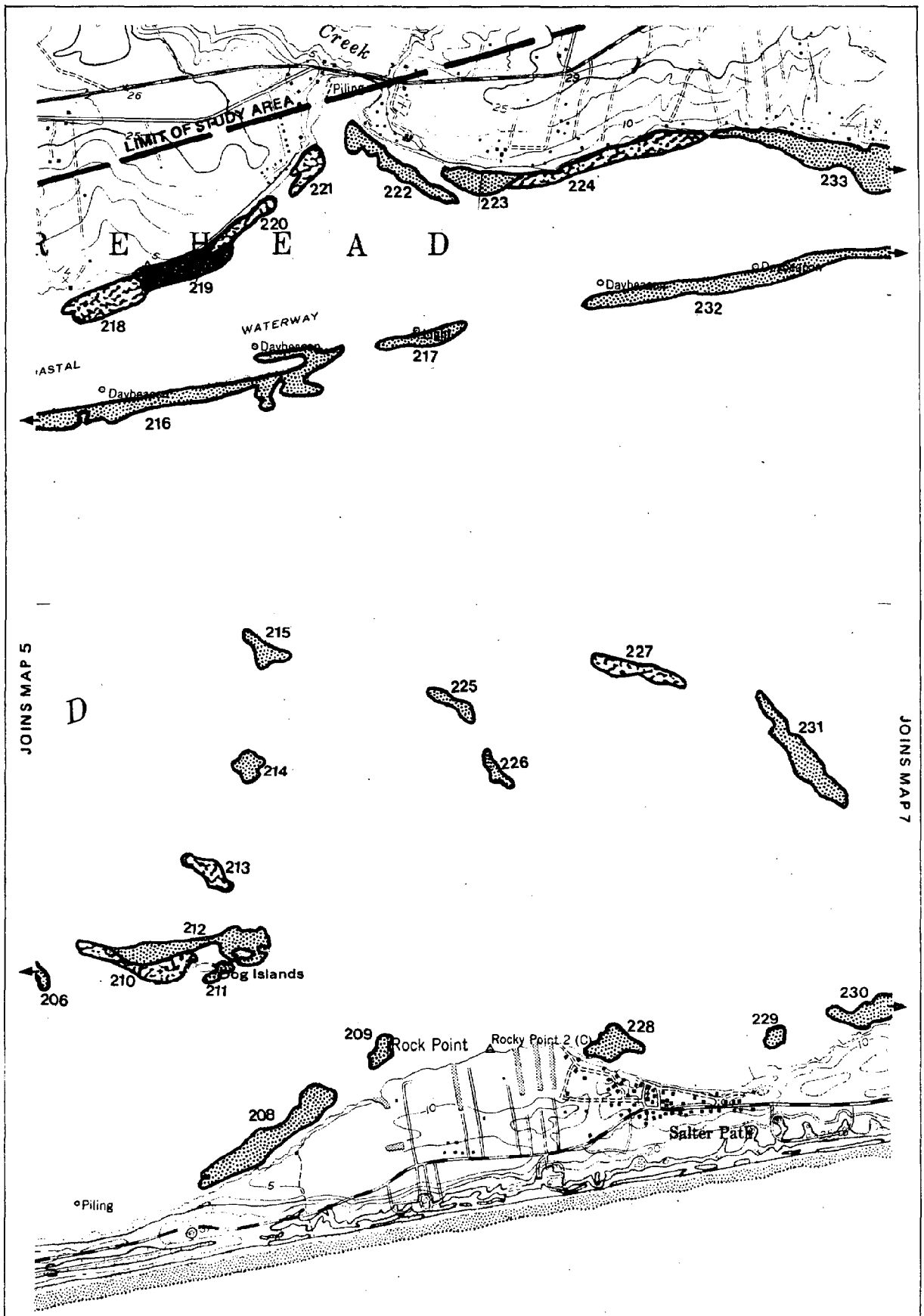


Broad Creek
BROAD CREEK
LIMIT OF STUDY AREA
Piling
Daybeacon
Light
Broad Creek 2 (C)
INTRACO
JOINS MAP 4
JOINS MAP 6
Island
Rices Path
Emerald Isle

MAP NUMBER 5

TABLE NUMBER 6

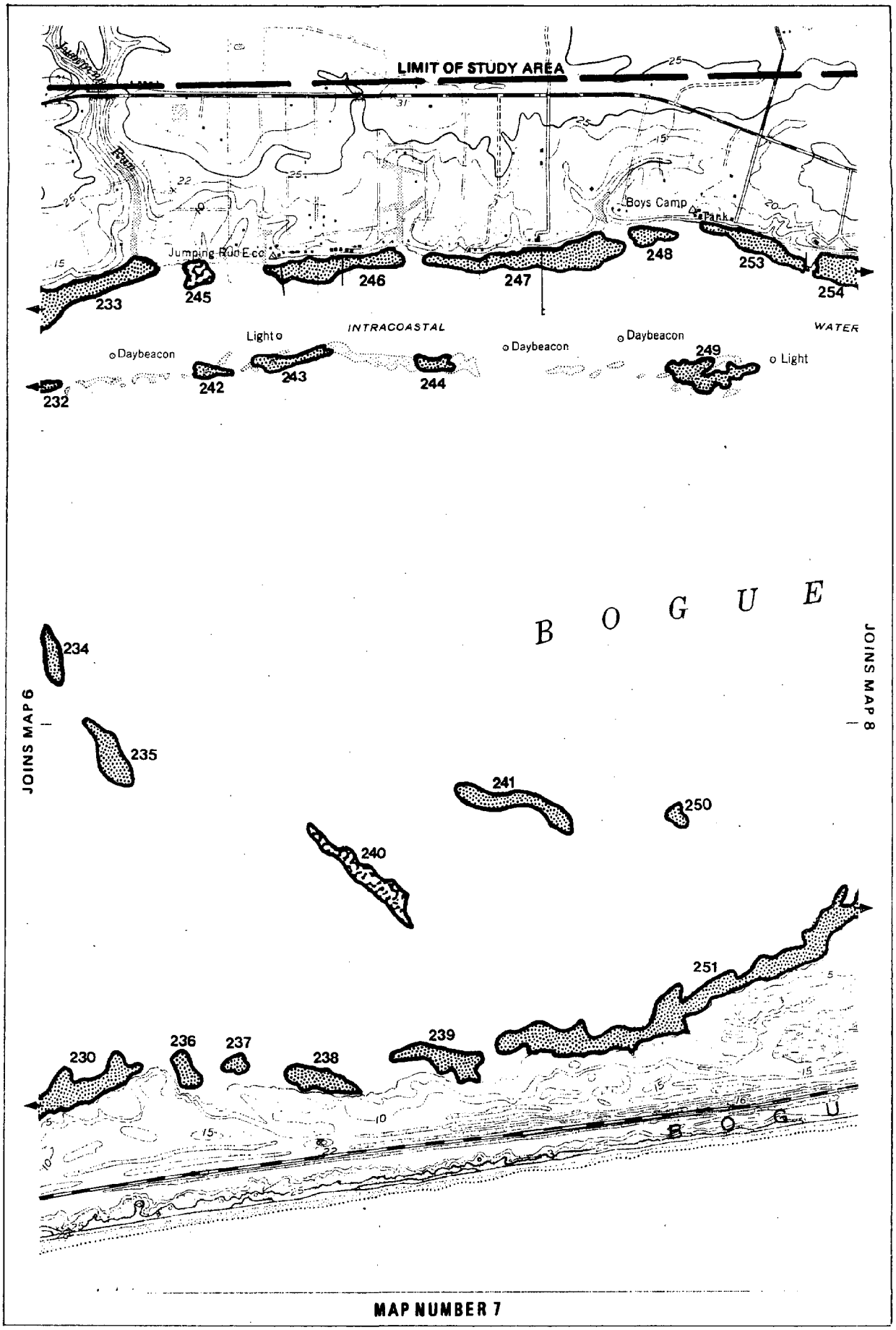
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
206	SCATTERED	2625546	350569	9.0
208	SCATTERED	2629600	347769	15.7
209	SCATTERED	2631213	349032	2.1
210	MODERATE	2627624	350119	8.1
211	SCATTERED	2628789	350178	0.9
212	SCATTERED	2628395	350510	12.9
213	MODERATE	2628598	351516	3.9
214	SCATTERED	2629161	353087	3.0
215	SCATTERED	2629414	354735	3.2
216	SCATTERED	2627815	358233	28.1
217	SCATTERED	2631573	359256	4.7
218	MODERATE	2627002	359688	10.8
219	DENSE	2628063	360194	7.9
220	MODERATE	2628827	360719	6.0
221	MODERATE	2629888	361552	4.2
222	SCATTERED	2631277	361615	8.2
223	SCATTERED	2632464	361530	6.9
224	MODERATE	2634313	361858	13.8
225	SCATTERED	2632130	353999	2.7
226	SCATTERED	2632823	352972	1.6
227	MODERATE	2634861	354581	5.7
228	SCATTERED	2634612	349213	5.1
229	SCATTERED	2636977	349343	1.5
230	SCATTERED	2638367	349963	18.4
231	SCATTERED	2637291	353483	11.1
232	SCATTERED	2636220	360194	21.1
233	SCATTERED	2638249	362040	35.5


Creek
LIMIT OF STUDY AREA
Piling
R E H E A D
WATERWAY
ASTAL
Dayboaron
Dog Islands
Rock Point
Rocky Point 2 (C)
Salter Path
Piling
JOINS MAP 5
JOINS MAP 7
D
206
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233

MAP NUMBER 6

TABLE NUMBER 7

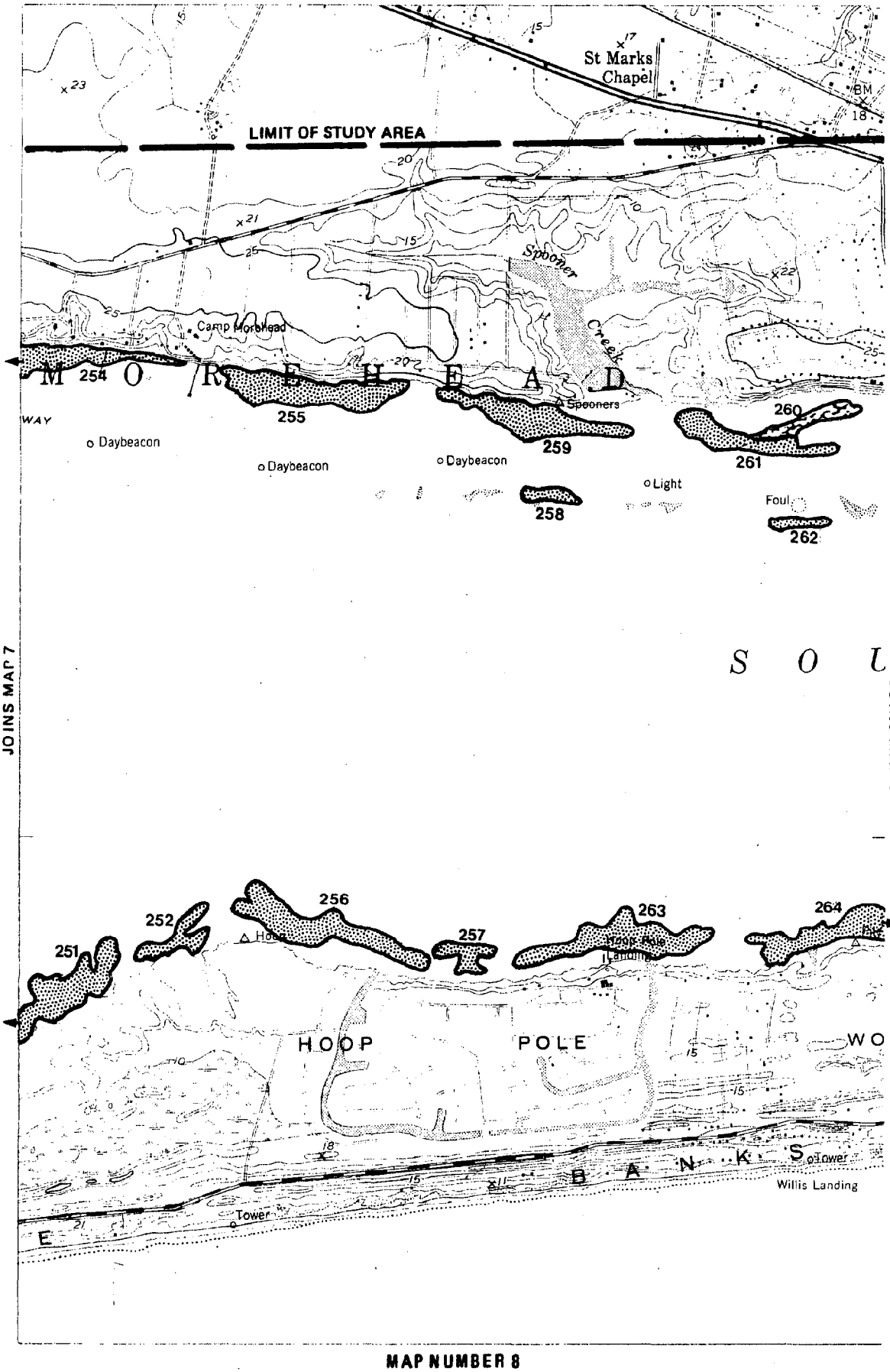
BED NUMBER	DENSITY	N.C.GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
230	SCATTERED	2638367	349963	18.4
232	SCATTERED	2636220	360194	21.1
233	SCATTERED	2638249	362040	35.5
234	SCATTERED	2638782	356644	3.9
235	SCATTERED	2639682	355192	7.7
236	SCATTERED	2640964	350456	3.7
237	SCATTERED	2641727	350564	1.4
238	SCATTERED	2643046	350355	7.1
239	SCATTERED	2644754	350656	8.6
240	MODERATE	2643562	353406	9.9
241	SCATTERED	2645913	354663	9.1
242	SCATTERED	2641159	360919	1.8
243	SCATTERED	2642342	361131	4.2
244	SCATTERED	2644558	361068	1.7
245	MODERATE	2640867	362360	3.4
246	SCATTERED	2642953	362539	12.2
247	SCATTERED	2645856	362797	20.2
248	SCATTERED	2647841	363068	3.3
249	SCATTERED	2648780	361017	7.6
250	SCATTERED	2648394	354437	1.4
251	SCATTERED	2649163	351938	65.2
253	SCATTERED	2649355	362982	9.2
254	SCATTERED	2651855	362637	19.0


LIMIT OF STUDY AREA
Boys Camp
Park
Jumping Rod Ecc
Daybeacon
Light
INTRACOASTAL
WATER
Daybeacon
Daybeacon
Light
233
245
246
247
248
253
254
232
242
243
244
249
B O G U E
JOINS MAP 6
JOINS MAP 8
234
235
241
250
240
251
230
236
237
238
239
B O G U E

MAP NUMBER 7

TABLE NUMBER 8

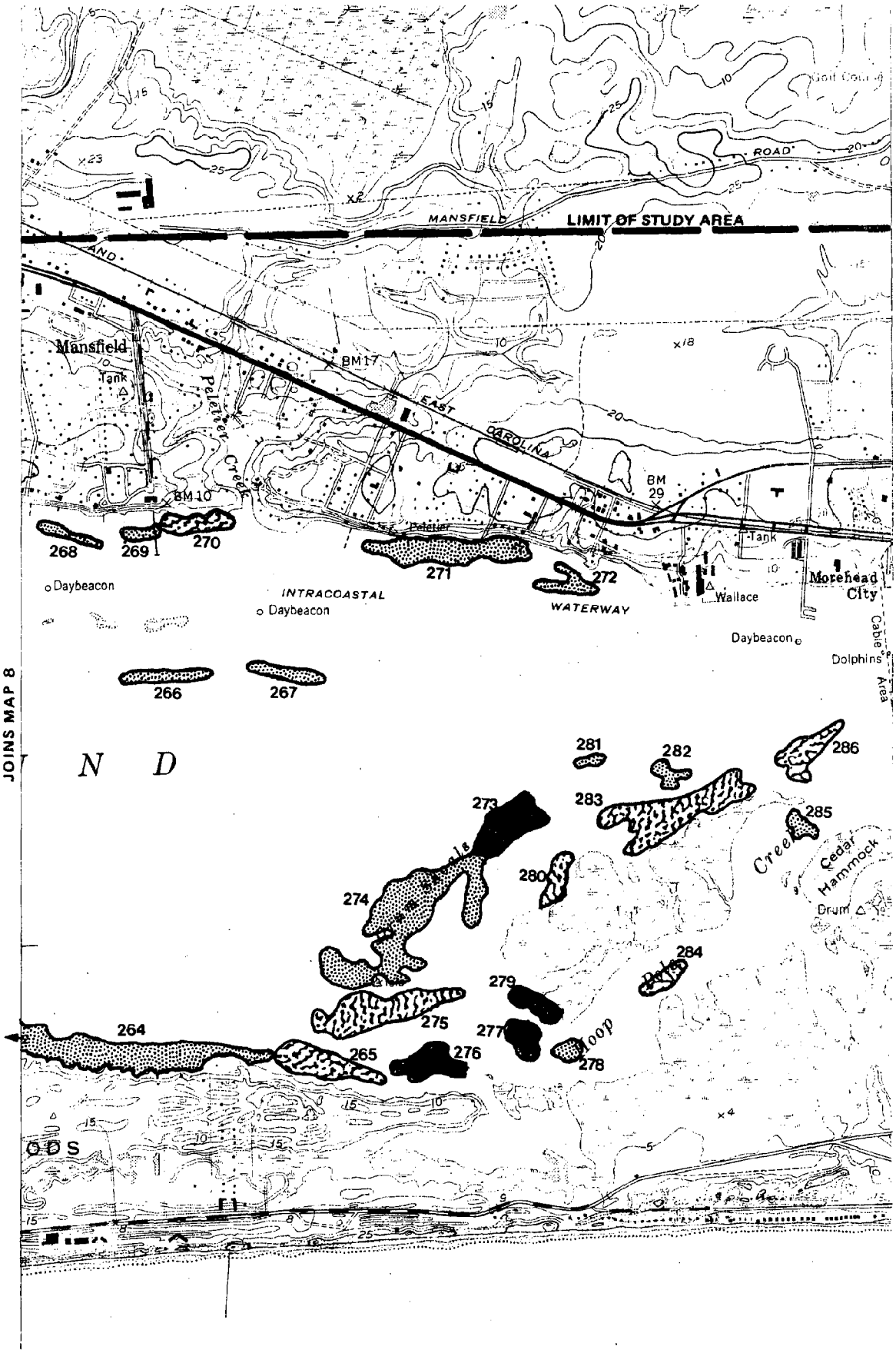
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
251	SCATTERED	2649163	351938	65.2
252	SCATTERED	2653437	354350	7.2
254	SCATTERED	2651855	362637	19.0
255	SCATTERED	2655263	362298	23.8
256	SCATTERED	2655666	354706	23.1
257	SCATTERED	2657627	354294	5.1
258	SCATTERED	2658685	360873	2.8
259	SCATTERED	2658445	362006	19.8
260	MODERATE	2662280	361989	6.6
261	SCATTERED	2661685	361663	12.1
262	SCATTERED	2662285	360571	2.2
263	SCATTERED	2659787	354609	22.4
264	SCATTERED	2664489	354716	43.2


St Marks Chapel
LIMIT OF STUDY AREA
Spooner Creek
Camp Morehead
M 254 O R E H E A D
Spooners
255
259
260
261
258
262
Daybeacon
Daybeacon
Daybeacon
Light
Foul
JOINS MAP 7
JOINS MAP 9
251
252
256
257
263
264
HOOP POLE
B A N K S
Tower
Willis Landing
Tower

MAP NUMBER 8

TABLE NUMBER 9

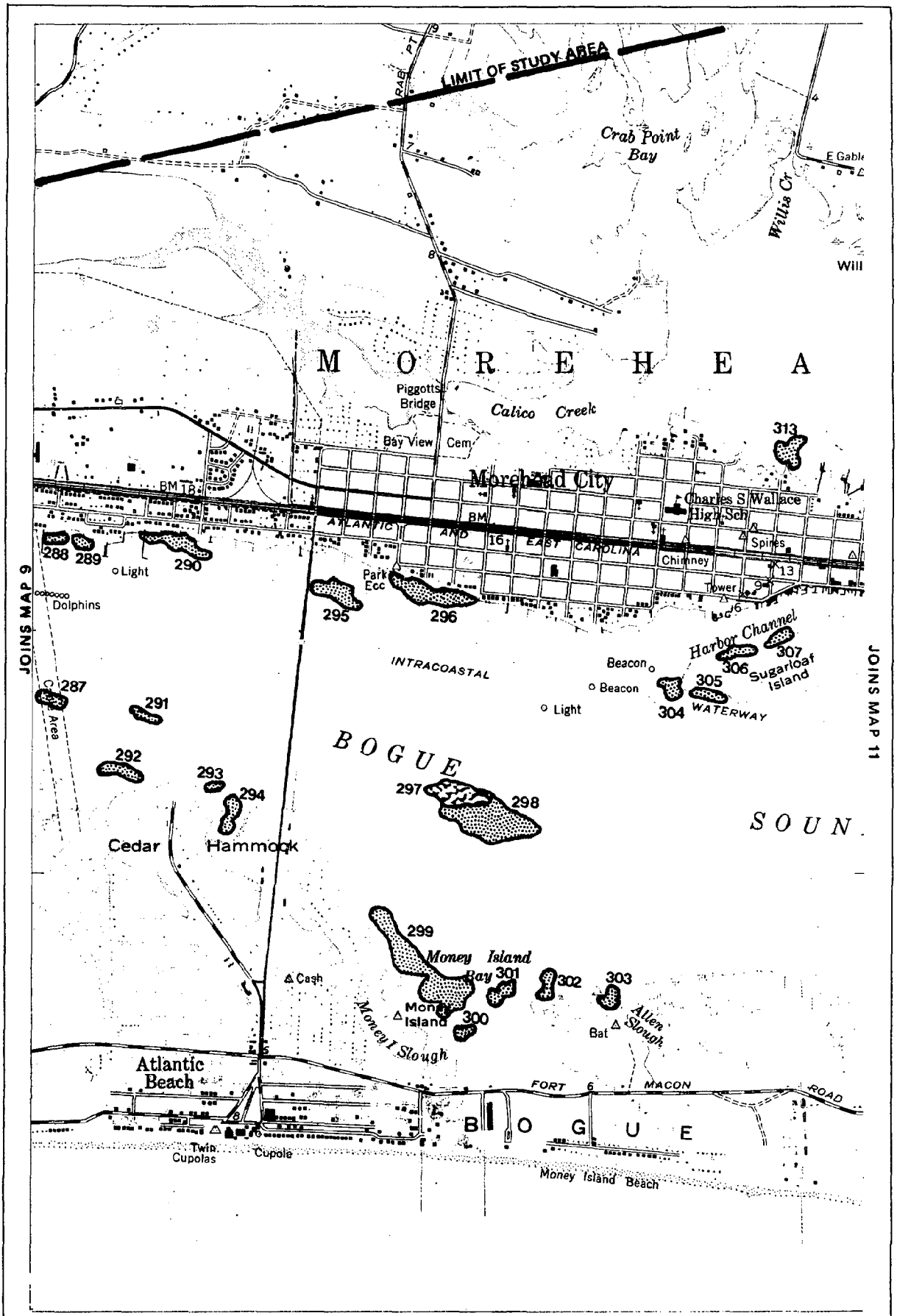
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
264	SCATTERED	2664489	354716	43.2
265	MODERATE	2668145	354604	11.3
266	SCATTERED	2665667	359978	3.9
267	SCATTERED	2667389	360066	2.7
268	SCATTERED	2664283	361940	2.4
269	SCATTERED	2665256	361983	1.5
270	MODERATE	2666068	362162	5.0
271	SCATTERED	2669690	361829	15.9
272	SCATTERED	2671349	361398	3.8
273	DENSE	2670635	358004	11.3
274	SCATTERED	2669190	356624	36.7
275	MODERATE	2668954	355329	15.6
276	DENSE	2669562	354625	7.5
277	DENSE	2670904	354935	4.8
278	SCATTERED	2671527	354852	1.6
279	DENSE	2671097	355462	4.0
280	MODERATE	2671334	357264	3.4
281	SCATTERED	2671787	358951	1.5
282	SCATTERED	2672941	358743	2.2
283	MODERATE	2673010	358215	19.2
284	MODERATE	2672876	355871	3.1
285	SCATTERED	2674856	358068	2.3
286	MODERATE	2674926	359134	7.8


LIMIT OF STUDY AREA
MANSFIELD
ROAD
Mansfield
Tank
Peletier Creek
BM17
EAST CAROLINA
BM 29
BM10
Peletier
Tank
Morehead City
Wallace
Daybeacon
INTRACOASTAL
WATERWAY
Daybeacon
Daybeacon
Dolphins
Cable Area
JOINS MAP 8
JOINS MAP 10
268
269
270
271
272
266
267
281
282
286
283
273
285
280
274
Cedar Hammock
Drum
284
279
275
277
264
265
276
278
Hoop
ODS

MAP NUMBER 9

TABLE NUMBER 10

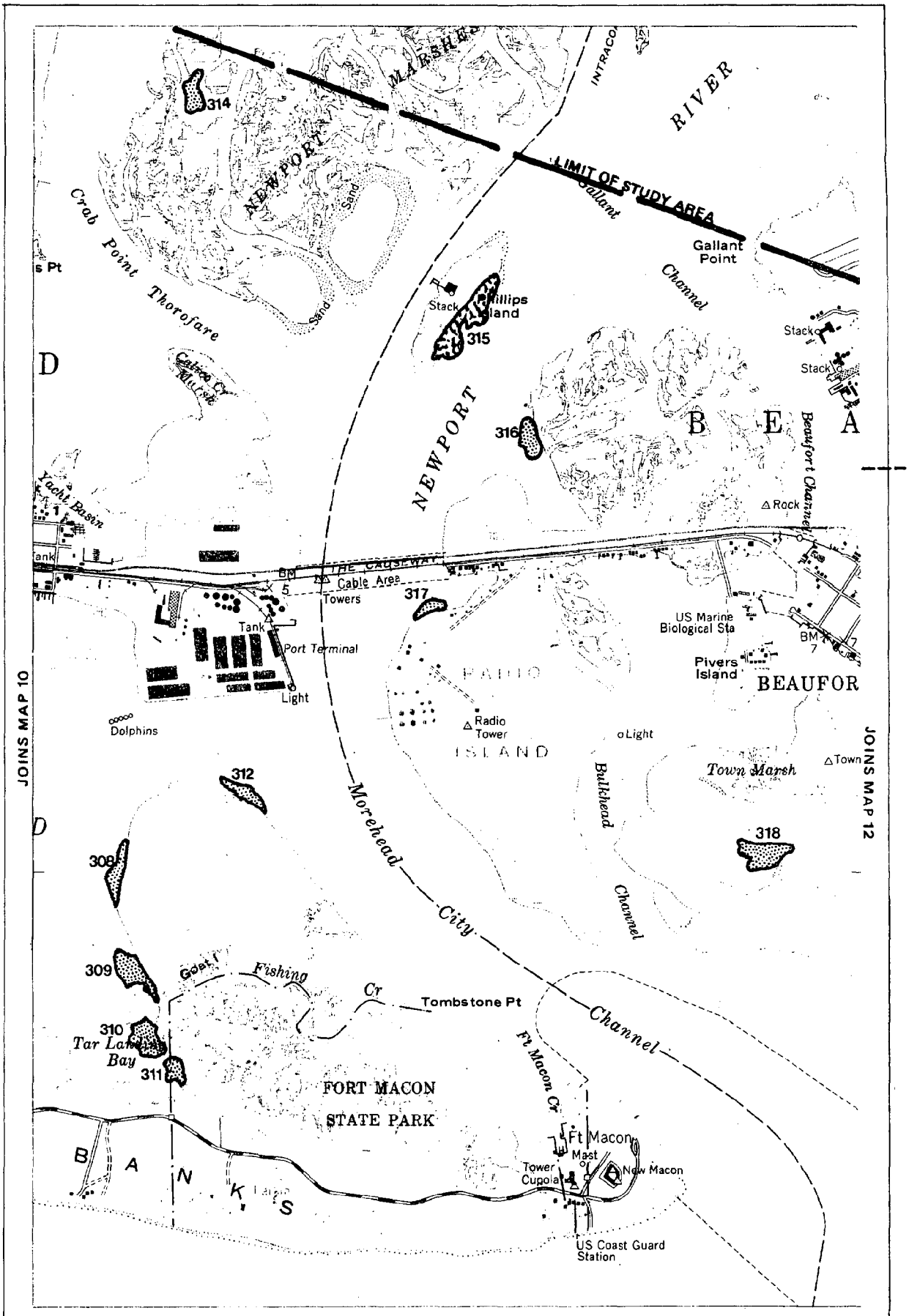
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
287	SCATTERED	2676403	355927	1.5
288	SCATTERED	2676438	358335	1.1
289	SCATTERED	2676818	358258	1.2
290	SCATTERED	2678206	358275	4.7
291	SCATTERED	2677855	355750	1.4
292	SCATTERED	2677492	354883	2.4
293	SCATTERED	2678917	354712	0.6
294	SCATTERED	2679165	354290	2.3
295	SCATTERED	2680666	357590	4.0
296	SCATTERED	2682098	357716	6.8
297	MODERATE	2682591	354700	5.4
298	SCATTERED	2683056	354388	13.0
299	SCATTERED	2682090	352166	14.3
300	SCATTERED	2682753	351186	0.9
301	SCATTERED	2683306	351766	1.6
302	SCATTERED	2683977	351921	1.6
303	SCATTERED	2684929	351761	1.3
304	SCATTERED	2685736	356319	1.7
305	SCATTERED	2686296	356258	1.1
306	SCATTERED	2686739	356881	1.5
307	SCATTERED	2687366	357115	1.2
313	SCATTERED	2687403	359833	2.8



MAP NUMBER 10

TABLE NUMBER 11

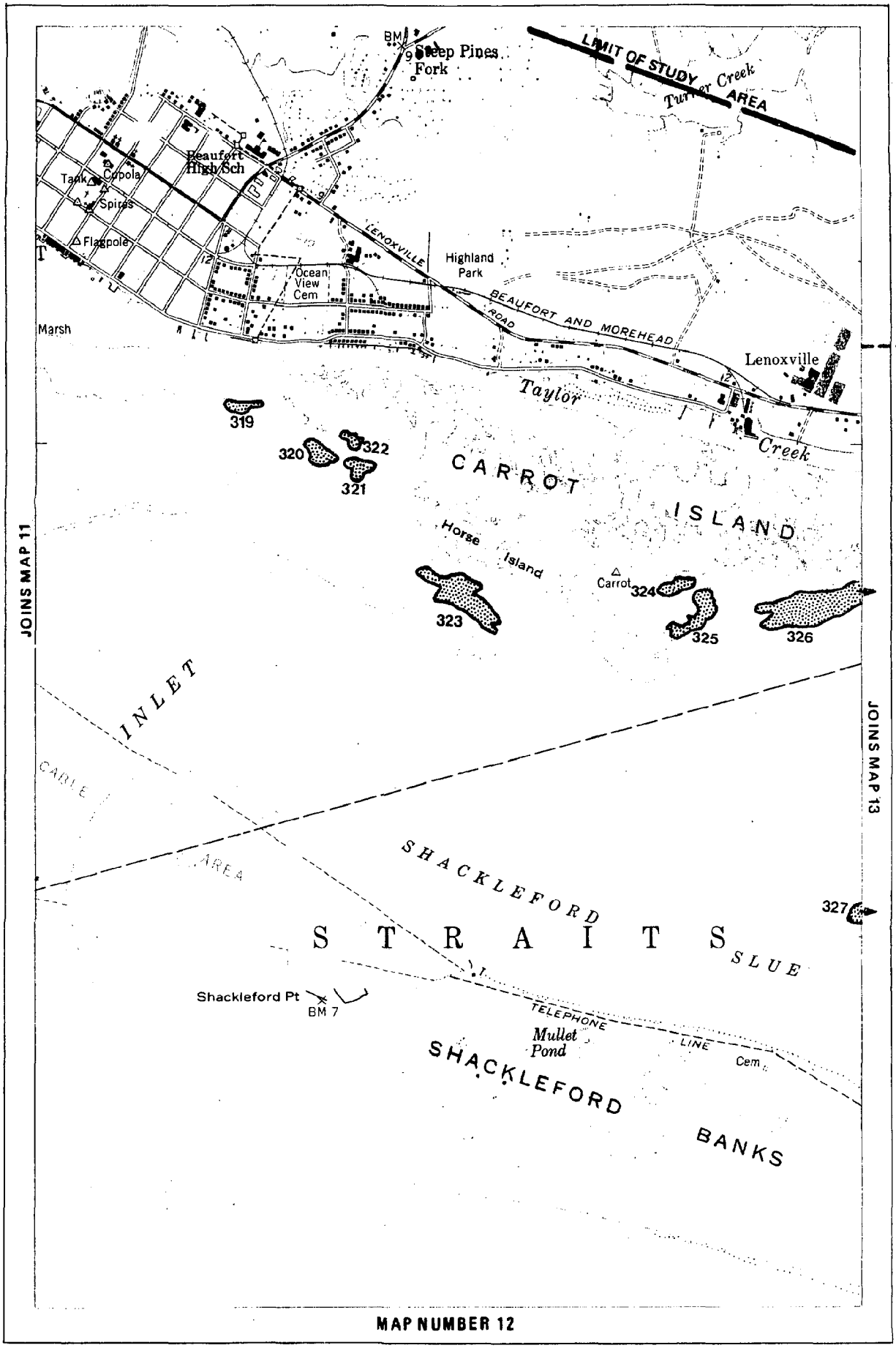
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
308	SCATTERED	2690010	353758	2.8
309	SCATTERED	2690343	352217	4.7
310	SCATTERED	2690516	351297	4.3
311	SCATTERED	2690946	350813	1.8
312	SCATTERED	2691885	354932	2.4
314	SCATTERED	2690918	365309	2.4
315	MODERATE	2695092	362077	9.1
316	SCATTERED	2696101	360288	3.2
317	SCATTERED	2694689	357760	1.5
318	SCATTERED	2699789	354194	5.2



MAP NUMBER 11

TABLE NUMBER 12

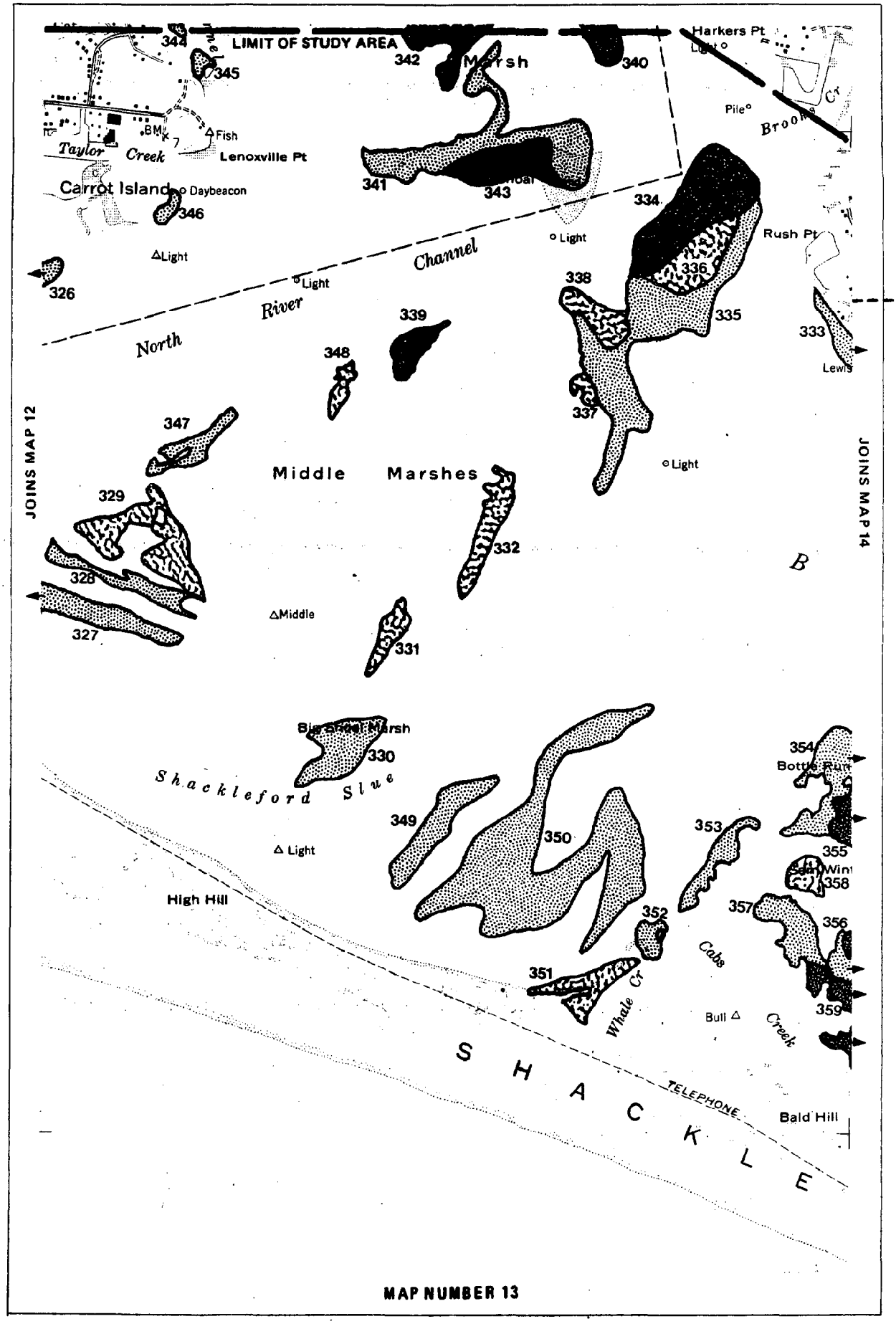
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
319	SCATTERED	2704407	354592	1.5
320	SCATTERED	2705597	353951	2.5
321	SCATTERED	2706191	353700	1.9
322	SCATTERED	2706043	354155	0.9
323	SCATTERED	2707718	351820	9.8
324	SCATTERED	2711006	352086	1.9
325	SCATTERED	2711260	351499	4.9
326	SCATTERED	2713039	351867	18.5
327	SCATTERED	2714456	350029	16.0



MAP NUMBER 12

TABLE NUMBER 13

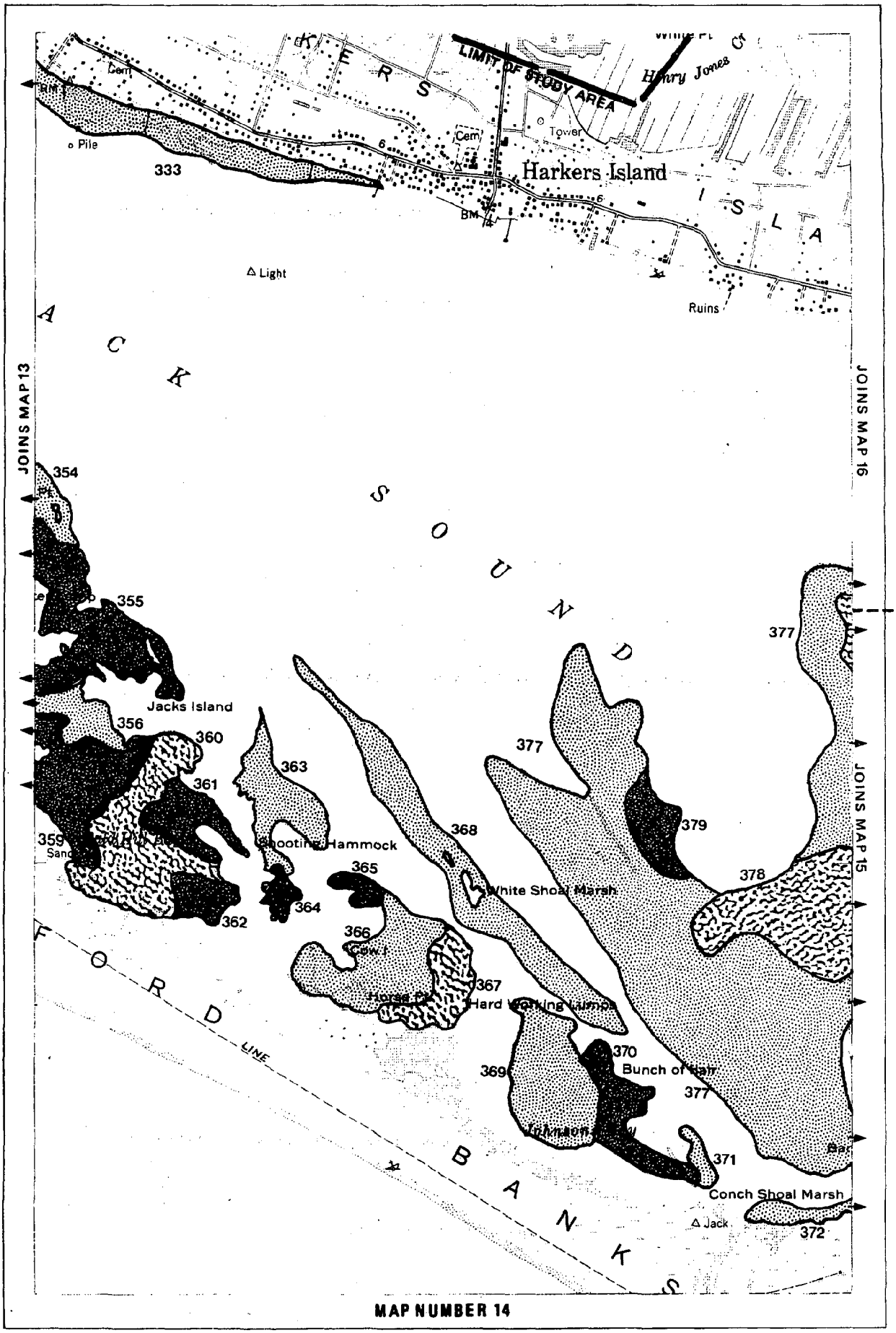
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
326	SCATTERED	2713039	351867	18.5
327	SCATTERED	2714456	350029	16.0
328	SCATTERED	2714947	350588	11.4
329	MODERATE	2715035	351136	24.9
330	SCATTERED	2718469	348036	17.1
331	MODERATE	2719182	349776	6.6
332	MODERATE	2720658	351383	11.6
333	SCATTERED	2726728	353968	45.7
334	DENSE	2723679	356303	38.9
335	MODERATE	2722280	354298	58.6
336	MODERATE	2723762	355687	16.3
337	MODERATE	2722298	353589	2.4
338	MODERATE	2722370	354657	9.4
339	DENSE	2719306	354100	7.4
340	DENSE	2722170	359034	11.4
341	SCATTERED	2720324	357191	36.2
342	DENSE	2719621	359044	40.5
343	DENSE	2720664	357014	16.9
344	SCATTERED	2715634	359055	1.5
345	SCATTERED	2716074	358351	1.8
346	SCATTERED	2715644	356199	1.8
347	SCATTERED	2716037	352642	9.6
348	MODERATE	2718365	353499	3.8
349	SCATTERED	2719919	346837	17.0
350	SCATTERED	2721561	346952	107.2
351	MODERATE	2721952	344540	10.8
352	SCATTERED	2723305	345306	4.3
353	SCATTERED	2724308	346460	9.3
354	SCATTERED	2726610	347742	27.8
355	DENSE	2727048	346362	66.7
356	SCATTERED	2726737	344842	19.3
357	SCATTERED	2725645	345488	14.5
358	MODERATE	2725671	346330	5.4
359	DENSE	2726776	343725	55.0



MAP NUMBER 13

TABLE NUMBER 14

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
333	SCATTERED	2726728	353968	45.7
354	SCATTERED	2726610	347742	27.8
355	DENSE	2727048	346362	66.7
356	SCATTERED	2726737	344842	19.3
359	DENSE	2726776	343725	55.0
360	MODERATE	2727630	343089	68.3
361	DENSE	2728597	343181	18.7
362	DENSE	2729055	342014	13.6
363	SCATTERED	2730012	343619	29.5
364	DENSE	2730290	342170	5.3
365	DENSE	2731680	342186	6.6
366	SCATTERED	2730921	341276	48.7
367	MODERATE	2732930	340908	23.6
368	SCATTERED	2732641	342876	72.3
369	SCATTERED	2734332	339496	49.7
370	DENSE	2735528	338929	27.2
371	SCATTERED	2736816	338281	5.0
372	SCATTERED	2738263	337552	10.9
377	SCATTERED	2742626	340747	749.2
378	MODERATE	2737950	341981	106.7
379	DENSE	2735944	343287	18.1



MAP NUMBER 14

TABLE NUMBER 15

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
372	SCATTERED	2738263	337552	10.9
373	SCATTERED	2740441	337692	16.9
374	DENSE	2740242	338524	3.8
375	DENSE	2739339	339823	7.9
376	DENSE	2739701	340014	9.1
377	SCATTERED	2742626	349747	749.2
378	MODERATE	2737950	341981	106.7
380	MODERATE	2739166	346017	24.5
381	MODERATE	2742207	345236	81.7
382	SCATTERED	2744729	343724	8.8
383	DENSE	2744899	339524	6.9
384	DENSE	2744062	339643	16.0
385	DENSE	2741237	339204	126.5
386	MODERATE	2742520	338559	17.5
387	SCATTERED	2742886	337481	54.4
388	SCATTERED	2744067	338065	4.6
389	SCATTERED	2744170	337227	2.6
390	DENSE	2744645	337007	1.7
391	SCATTERED	2742716	335558	5.9
392	SCATTERED	2742547	334878	2.2
393	SCATTERED	2743228	334595	1.8
394	SCATTERED	2743929	334205	1.8
395	SCATTERED	2744365	333962	1.3
396	SCATTERED	2745563	334551	1.7
397	SCATTERED	2748029	334900	3.2
398	SCATTERED	2744451	335490	1.3
399	SCATTERED	2745210	336054	21.9
400	SCATTERED	2746449	337249	2.6
401	MODERATE	2748469	337344	2.6
402	SCATTERED	2748668	338095	6.0
403	DENSE	2747120	338832	3.5
404	DENSE	2746598	339420	51.1
405	SCATTERED	2746257	340804	10.0
406	MODERATE	2747467	341181	11.3
407	SCATTERED	2749031	340933	112.4
408	MODERATE	2750595	340826	15.2
409	MODERATE	2748440	343514	112.7
410	DENSE	2751344	343420	116.1
411	DENSE	2749934	344949	89.5
412	SCATTERED	2746141	345647	251.8
413	DENSE	2749434	346316	18.7

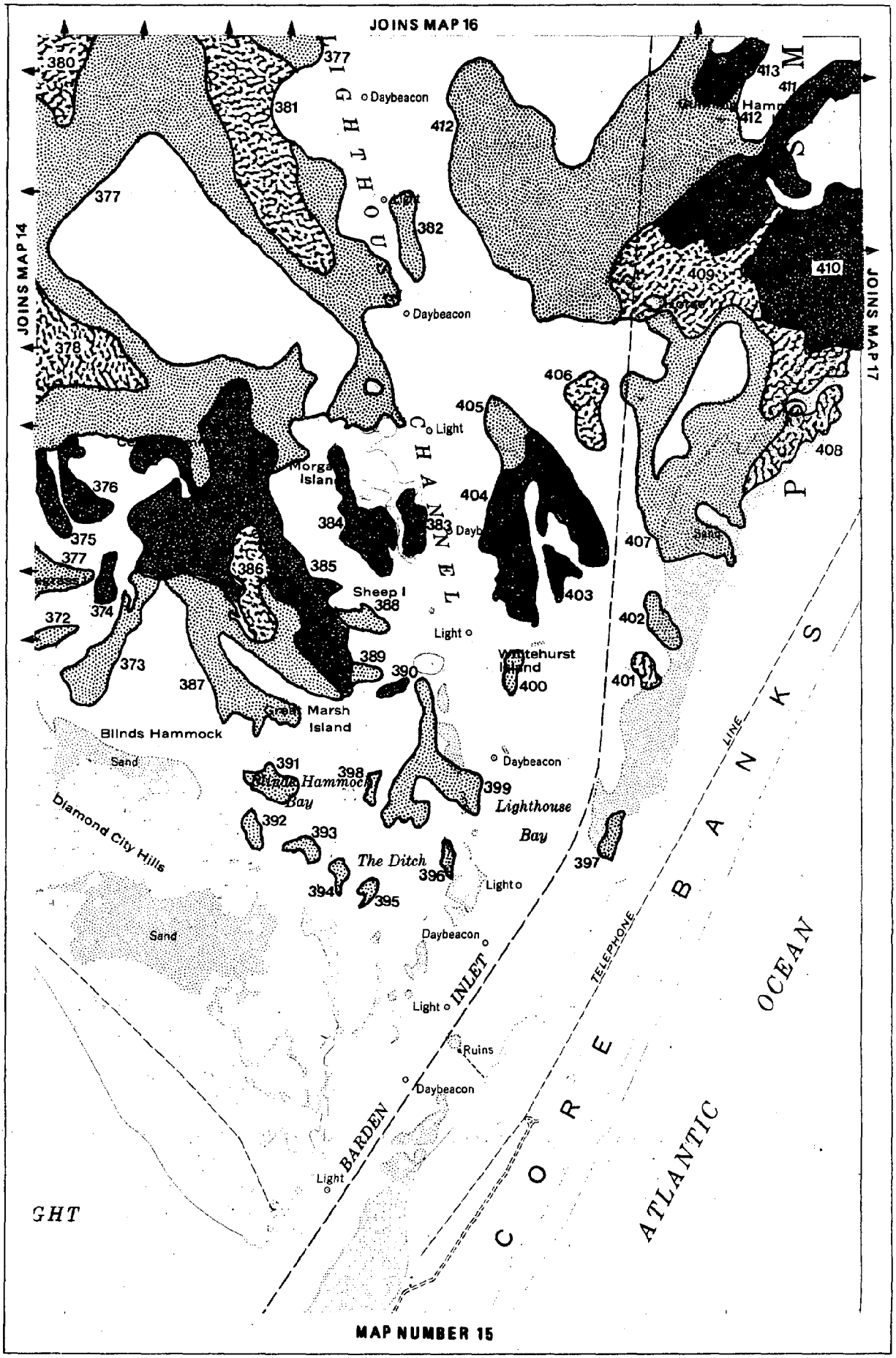

JOINS MAP 16
JOINS MAP 14
JOINS MAP 17
LIGHTHOUSE CHANNEL
Daybeacon
Light
Morgan Island
Sheep I
Whitehurst Island
Great Marsh Island
Blinds Hammock
Sand
Blinds Hammock Bay
Lighthouse Bay
Diamond City Hills
The Ditch
Ruins
INLET
BARDEN
TELEPHONE LINE
CORE BANKS
ATLANTIC OCEAN
PAMLICO SOUND
MAP NUMBER 15

TABLE NUMBER 16

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
377	SCATTERED	2742626	340747	749.2
381	MODERATE	2742207	345236	81.7
412	SCATTERED	2746141	345647	251.8
414	MODERATE	2750084	347706	18.2
416	DENSE	2573411	348127	144.6
417	DENSE	2752288	350502	49.4
418	MODERATE	2752816	351972	37.0
419	SCATTERED	2753236	355896	299.8
420	SCATTERED	2742382	349354	3.4
421	SCATTERED	2742544	352793	3.1
422	SCATTERED	2741619	353152	4.3
423	DENSE	2739526	359521	2.5
424	MODERATE	2741060	360686	10.2
425	DENSE	2743190	359879	4.1
426	DENSE	2743744	360404	8.0
427	MODERATE	2744638	358749	7.6
428	MODERATE	2744161	362774	6.2
429	MODERATE	2748987	365138	3.4

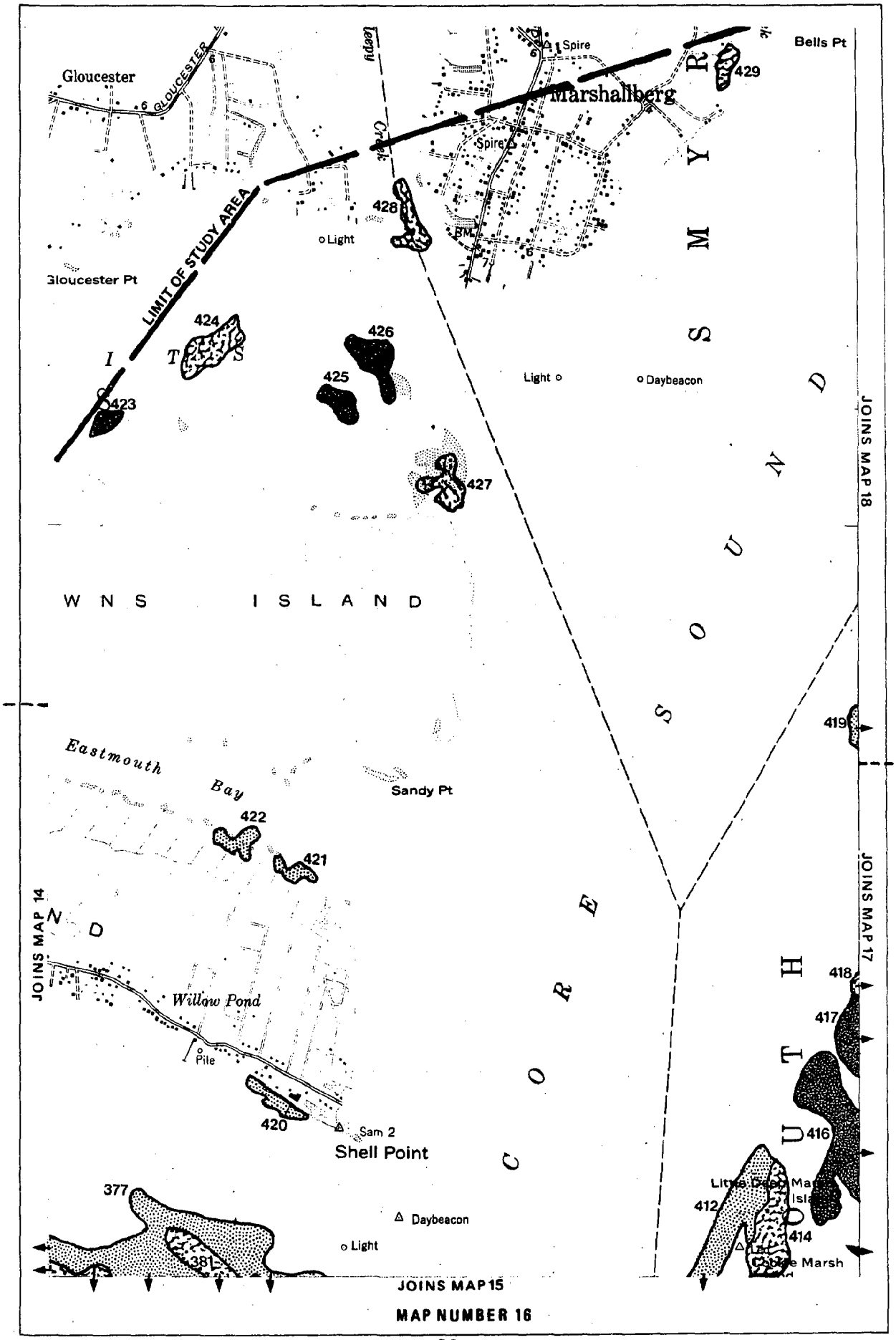
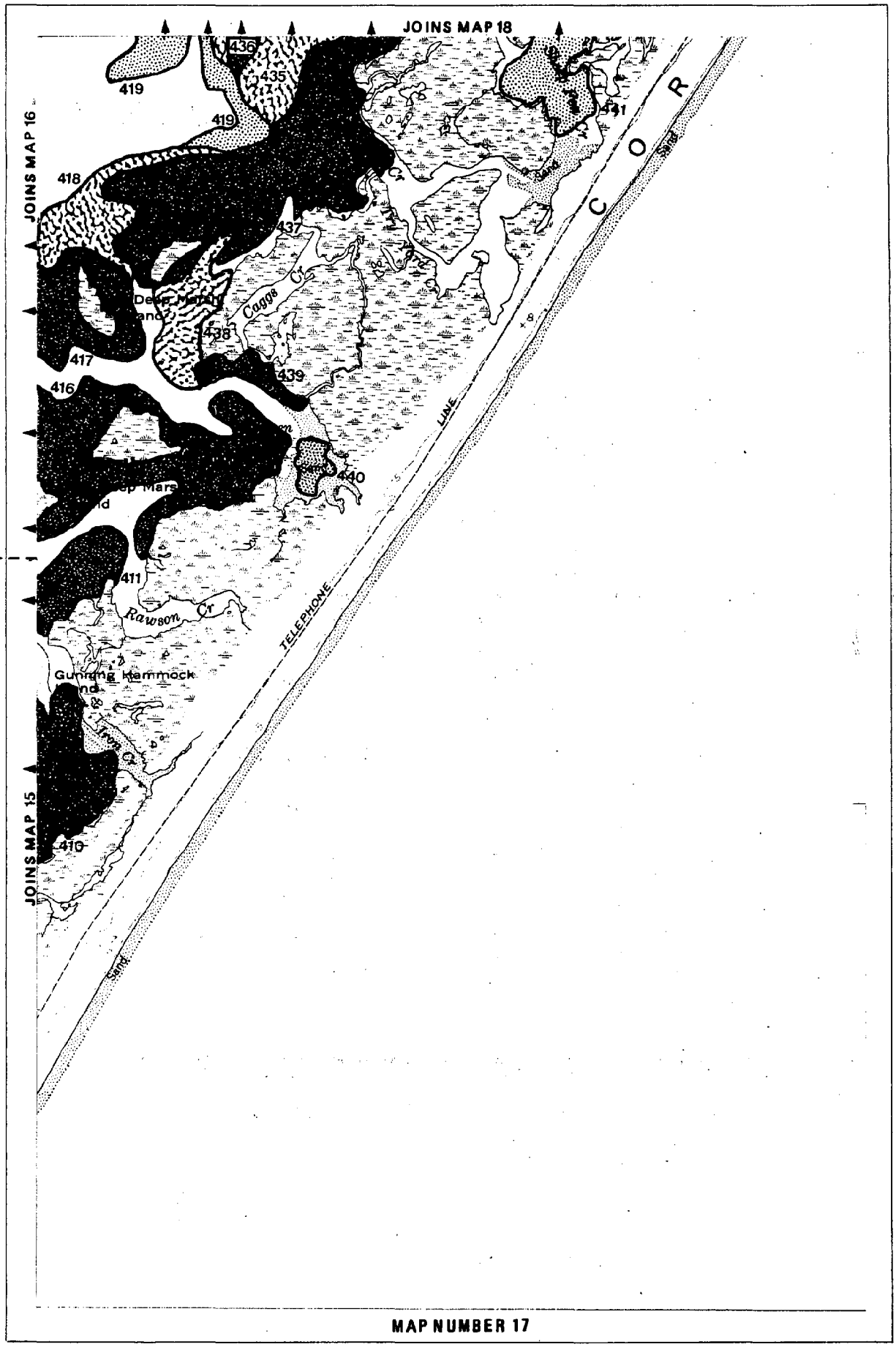

Gloucester
GLOUCESTER
Gloucester Pt
LIMIT OF STUDY AREA
Light
Spire
Marshallberg
Bells Pt
429
428
424
426
425
423
427
Light
Daybeacon
WNS ISLAND
JOINS MAP 18
Eastmouth Bay
Sandy Pt
422
421
419
JOINS MAP 14
Willow Pond
Pile
420
Sam 2
Shell Point
418
417
416
414
377
381
Daybeacon
Light
JOINS MAP 15
JOINS MAP 17
MAP NUMBER 16

TABLE NUMBER 17

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
410	DENSE	2751344	343420	116.1
411	DENSE	2749934	344949	89.5
416	DENSE	2753411	348127	144.6
417	DENSE	2752288	350502	49.4
418	MODERATE	2752816	351972	37.0
419	SCATTERED	2753236	355896	299.8
435	MODERATE	2755103	355050	89.3
436	DENSE	2754484	354486	6.5
437	DENSE	2761040	362348	1672.3
438	MODERATE	2753812	350503	33.0
439	DENSE	2754744	349505	11.3
440	SCATTERED	2755729	348233	7.6
441	SCATTERED	2759141	354115	34.0



MAP NUMBER 17

TABLE NUMBER 18

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
419	SCATTERED	2753236	355896	299.8
431	MODERATE	2751410	368187	35.3
433	SCATTERED	2751099	370722	90.9
434	DENSE	2755201	356815	5.9
435	MODERATE	2755103	355050	89.3
436	DENSE	2754484	354486	6.5
437	DENSE	2761040	362348	1672.3
441	SCATTERED	2759141	354115	34.0
442	MODERATE	2759533	356321	1.7
443	MODERATE	2759860	356737	2.5
444	MODERATE	2759740	357378	2.2
445	DENSE	2759327	357959	20.2
446	MODERATE	2760491	360624	18.8
447	DENSE	2762342	361530	3.9
448	DENSE	2763415	362115	8.6
449	MODERATE	2762324	362676	7.8
450	DENSE	2763238	363133	1.6
451	MODERATE	2763590	363003	3.3
452	MODERATE	2763557	364107	5.2
454	SCATTERED	2759419	364039	67.3
455	MODERATE	2762869	365768	28.9
460	SCATTERED	2760665	368421	415.4
461	MODERATE	2762175	368867	6.8

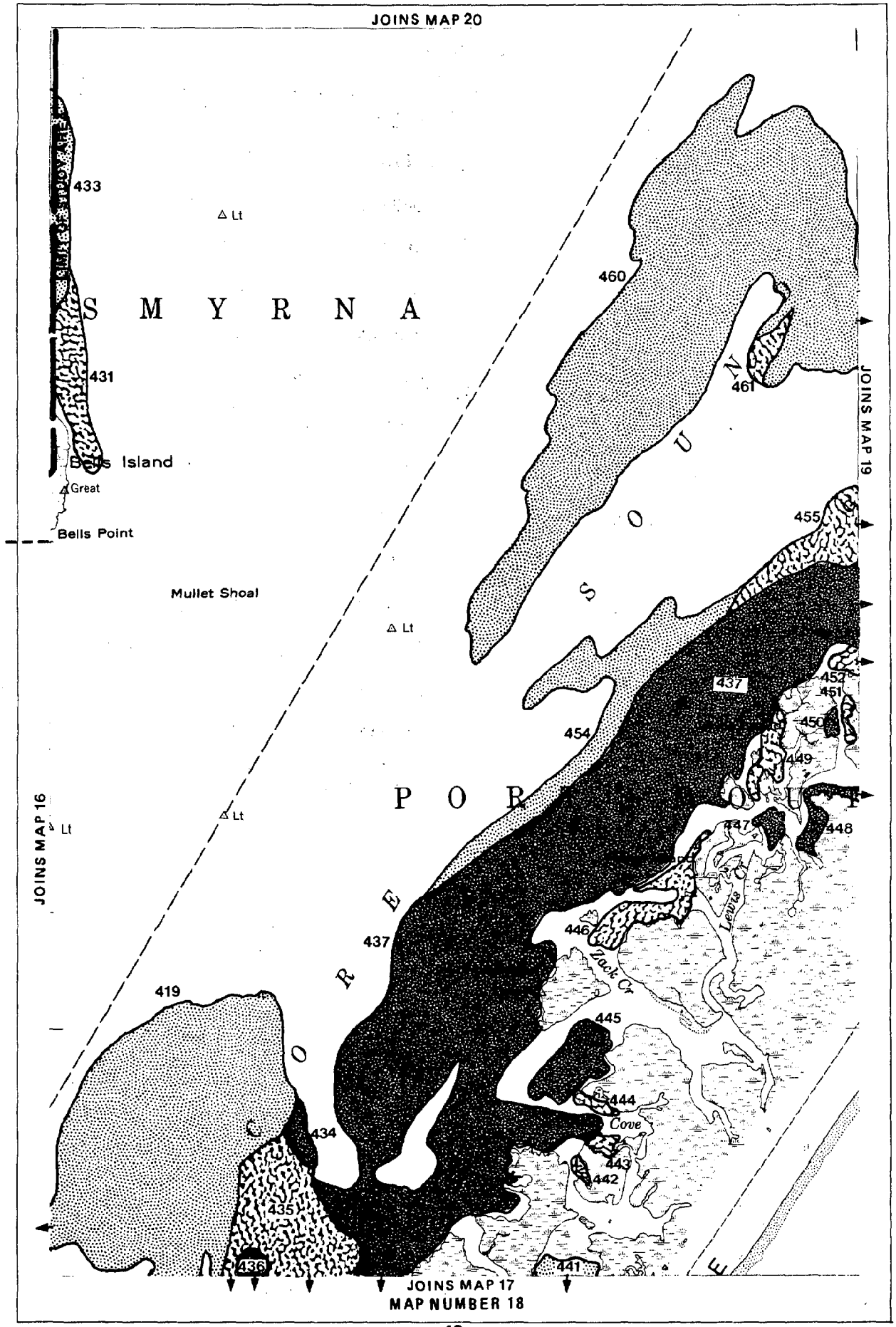
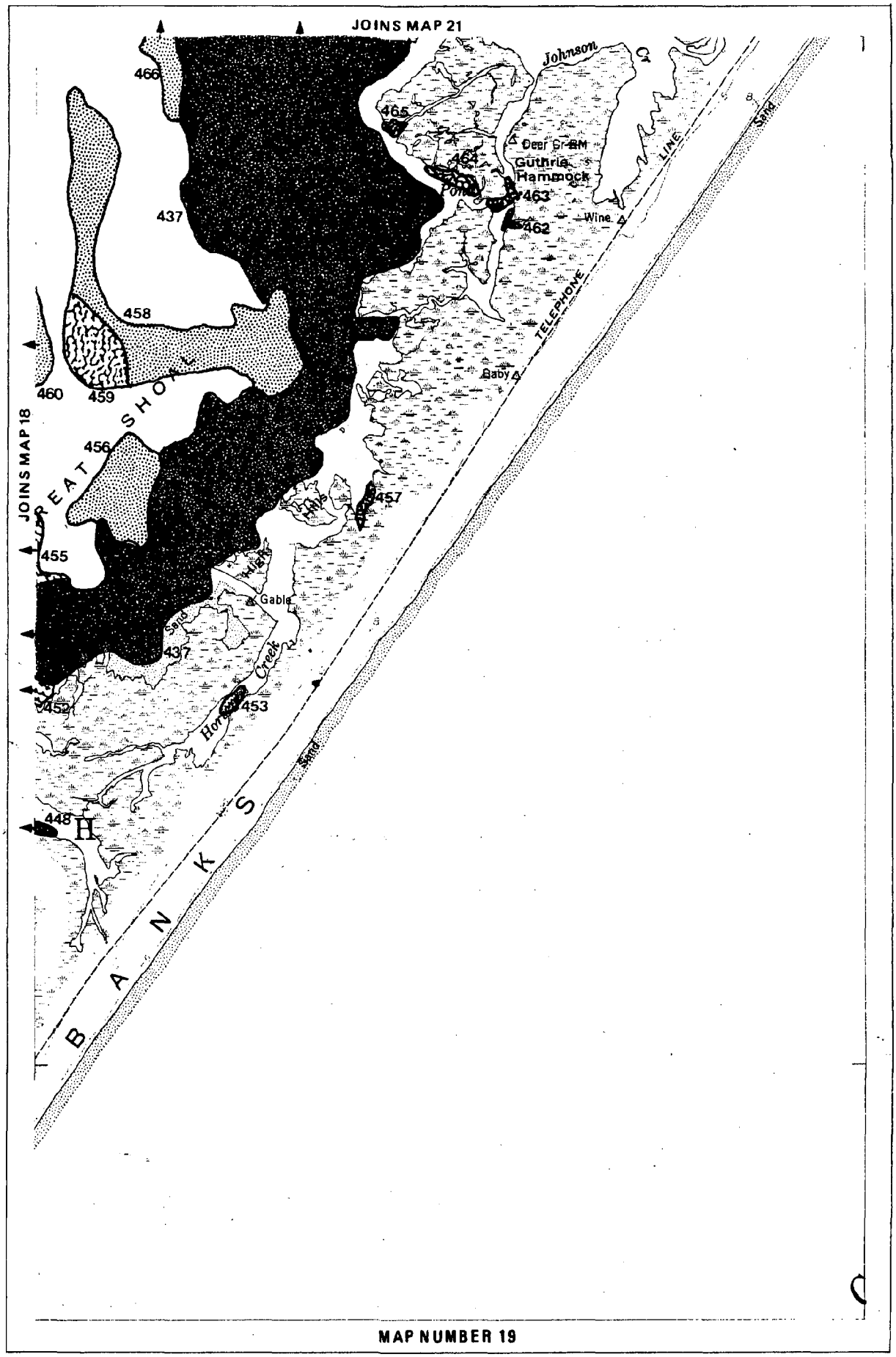

JOINS MAP 20
433
Lt
S M Y R N A
431
Bells Island
Great
Bells Point
Mullet Shoal
Lt
460
461
JOINS MAP 19
455
S O U N
437
452
451
450
454
449
P O R
447
448
Lt
Lt
JOINS MAP 16
Lewis Cr
446
Zack Cr
437
419
445
C O R E
444
Cove
434
443
442
435
436
441
JOINS MAP 17
MAP NUMBER 18

TABLE NUMBER 19

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
437	DENSE	2761040	362348	1672.3
448	DENSE	2763415	362115	8.6
452	MODERATE	2763557	364107	5.2
453	SCATTERED	2766468	363845	3.0
455	MODERATE	2762869	365768	28.9
456	SCATTERED	2764777	367105	28.9
457	MODERATE	2768567	366950	1.7
458	SCATTERED	2765752	369064	92.5
459	MODERATE	2764412	369257	18.9
460	SCATTERED	2760665	368421	415.4
462	MODERATE	2770700	371223	1.3
463	MODERATE	2770510	371438	2.2
464	MODERATE	2769756	371761	3.1
465	MODERATE	2768897	372520	1.3
466	SCATTERED	2766133	375409	32.4



MAP NUMBER 19

TABLE NUMBER 20

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
476	SCATTERED	2754433	378599	17.3
477	SCATTERED	2755566	378144	4.8
478	DENSE	2760553	384653	10.3
479	SCATTERED	2762015	387557	13.3

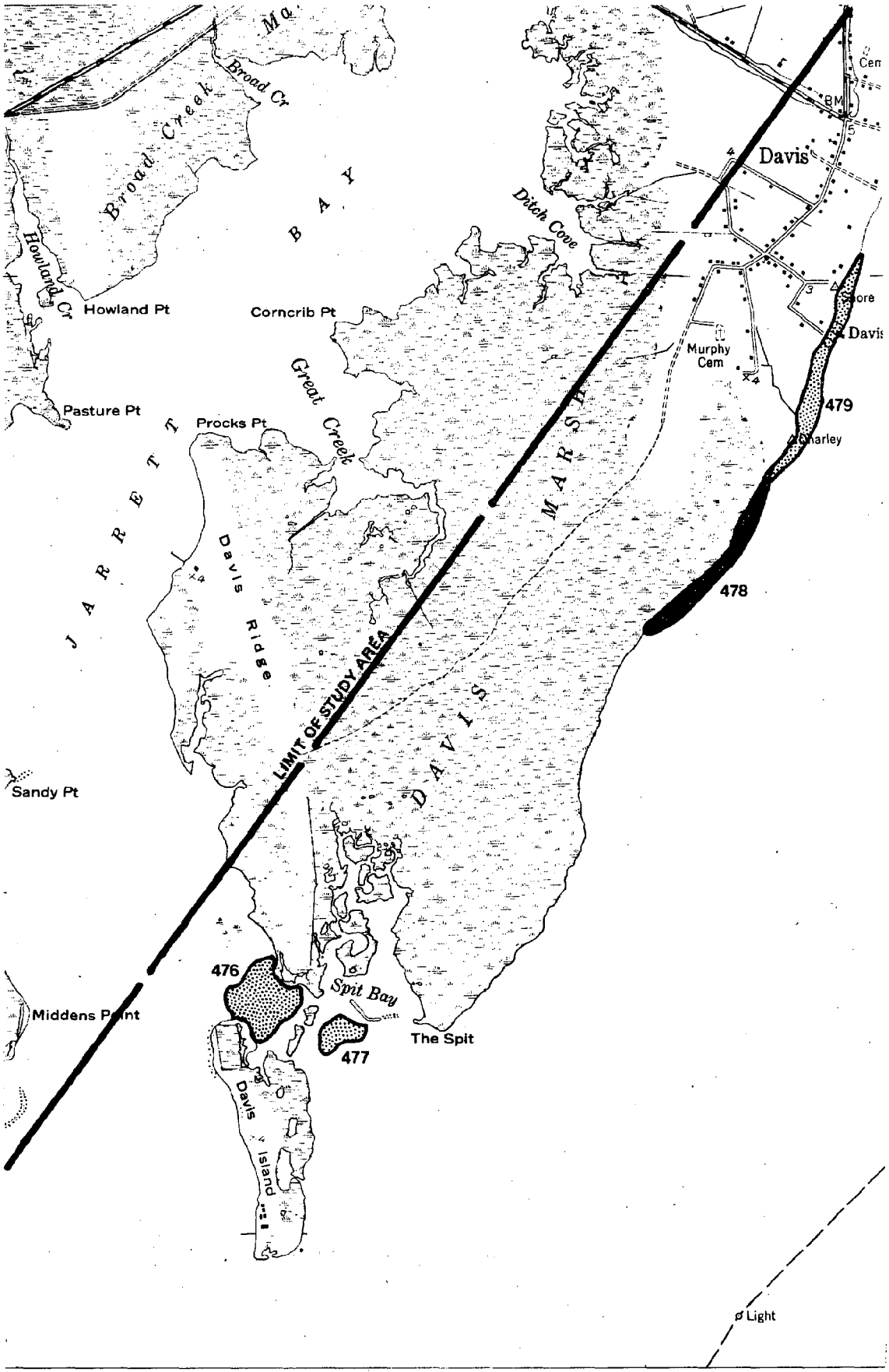
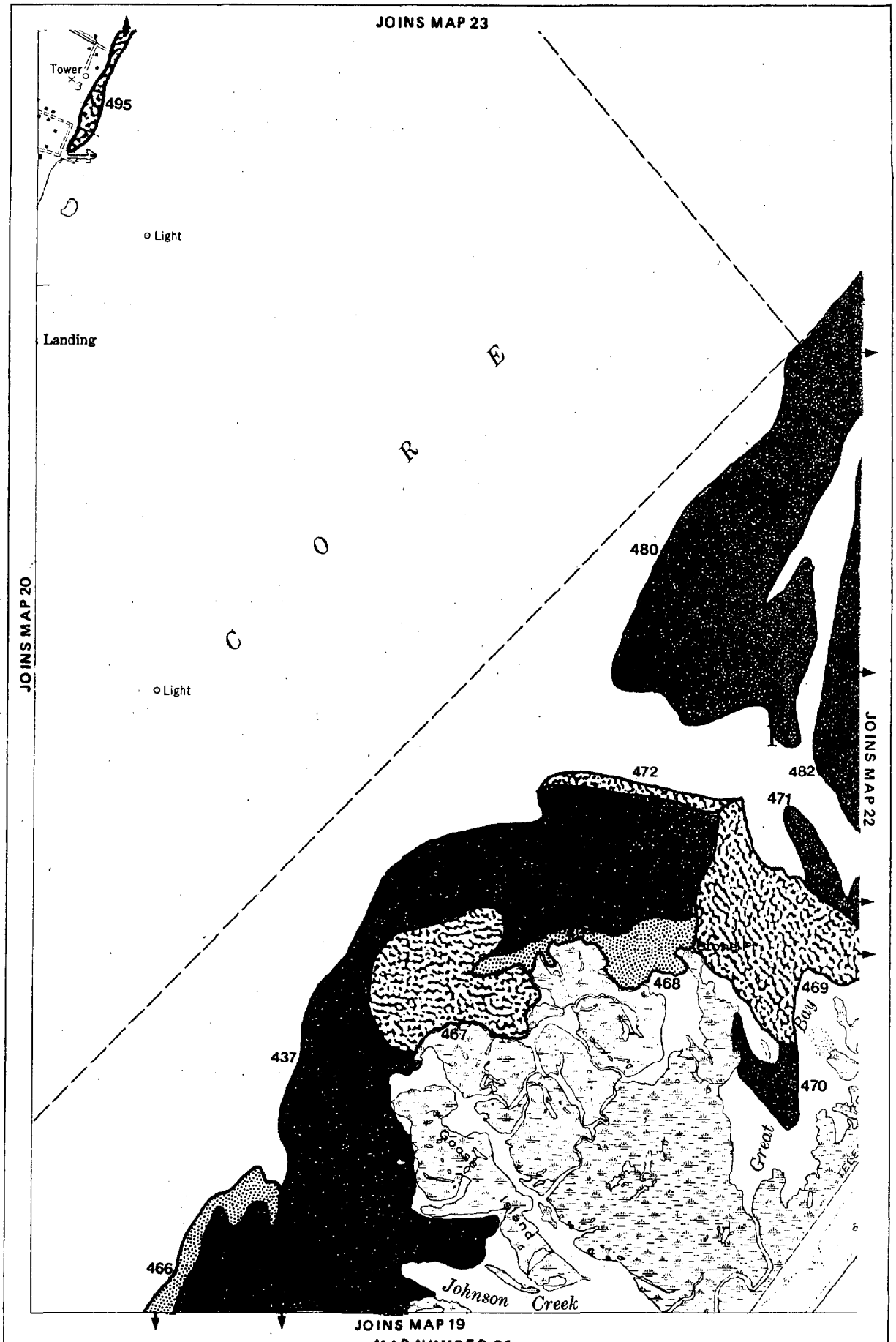

Broad Creek
Broad Cr
Howland Cr
Howland Pt
Corncrib Pt
BAY
Ditch Cove
Davis
Murphy Cem
Pasture Pt
Procks Pt
Great Creek
JARRETT
Davis Ridge
MARSH
LIMIT OF STUDY AREA
DAVIS
Sandy Pt
476
Spit Bay
477
The Spit
Middens Point
Davis Island
478
479
Charley
Light
JOINS MAP 21
JOINS MAP 18
MAP NUMBER 20

TABLE NUMBER 21

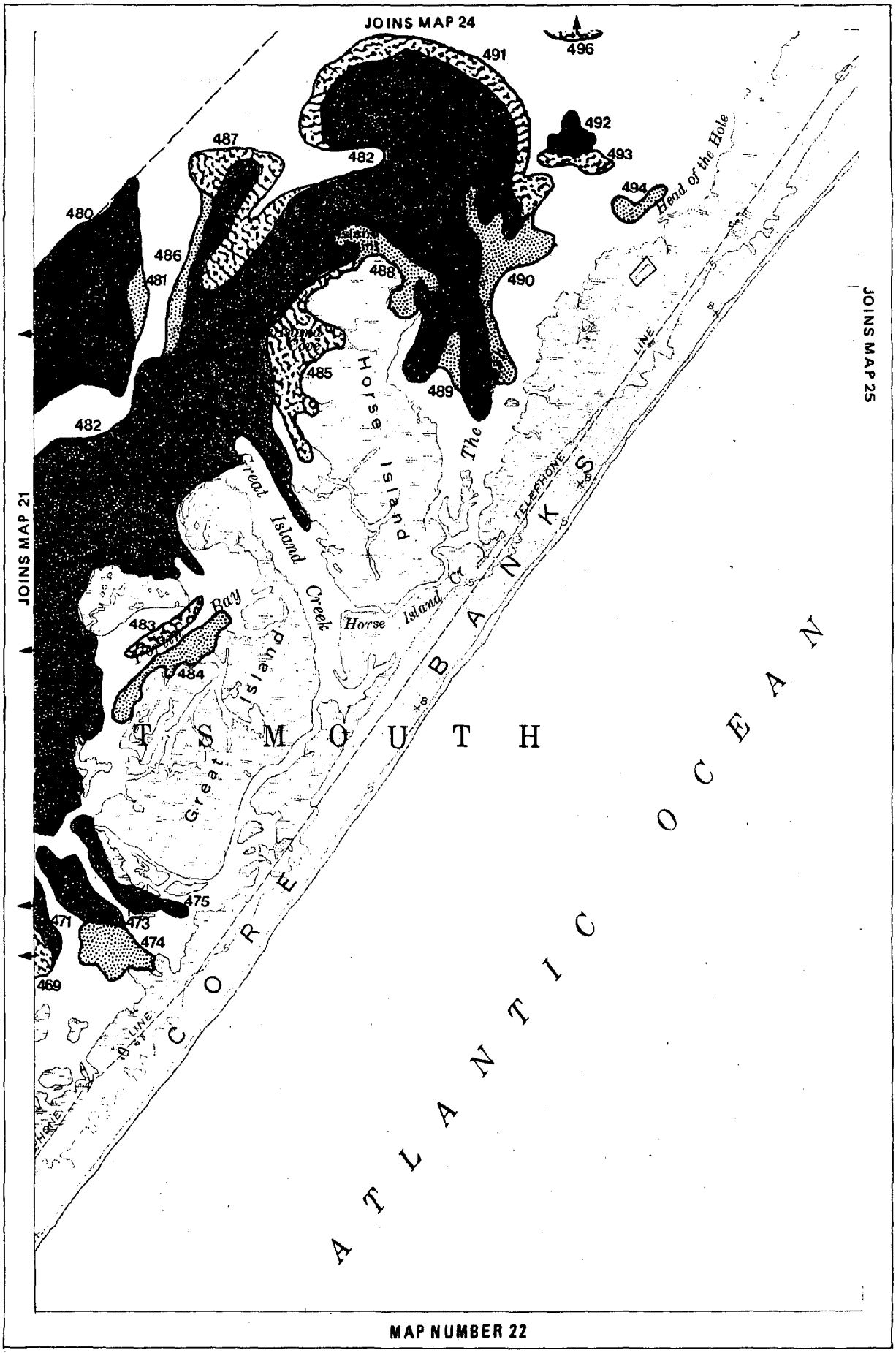
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
437	DENSE	2761040	362348	1672.3
466	SCATTERED	2766133	375409	32.4
467	MODERATE	2769644	378790	84.3
468	SCATTERED	2771571	379496	35.1
469	MODERATE	2774634	379797	108.8
470	DENSE	2774363	377594	16.2
471	DENSE	2775362	380401	21.4
472	MODERATE	2772360	381651	12.7
480	DENSE	2774470	386622	344.3
482	DENSE	2778871	388452	584.0
495	MODERATE	2764492	393147	33.0



MAP NUMBER 21

TABLE NUMBER 22

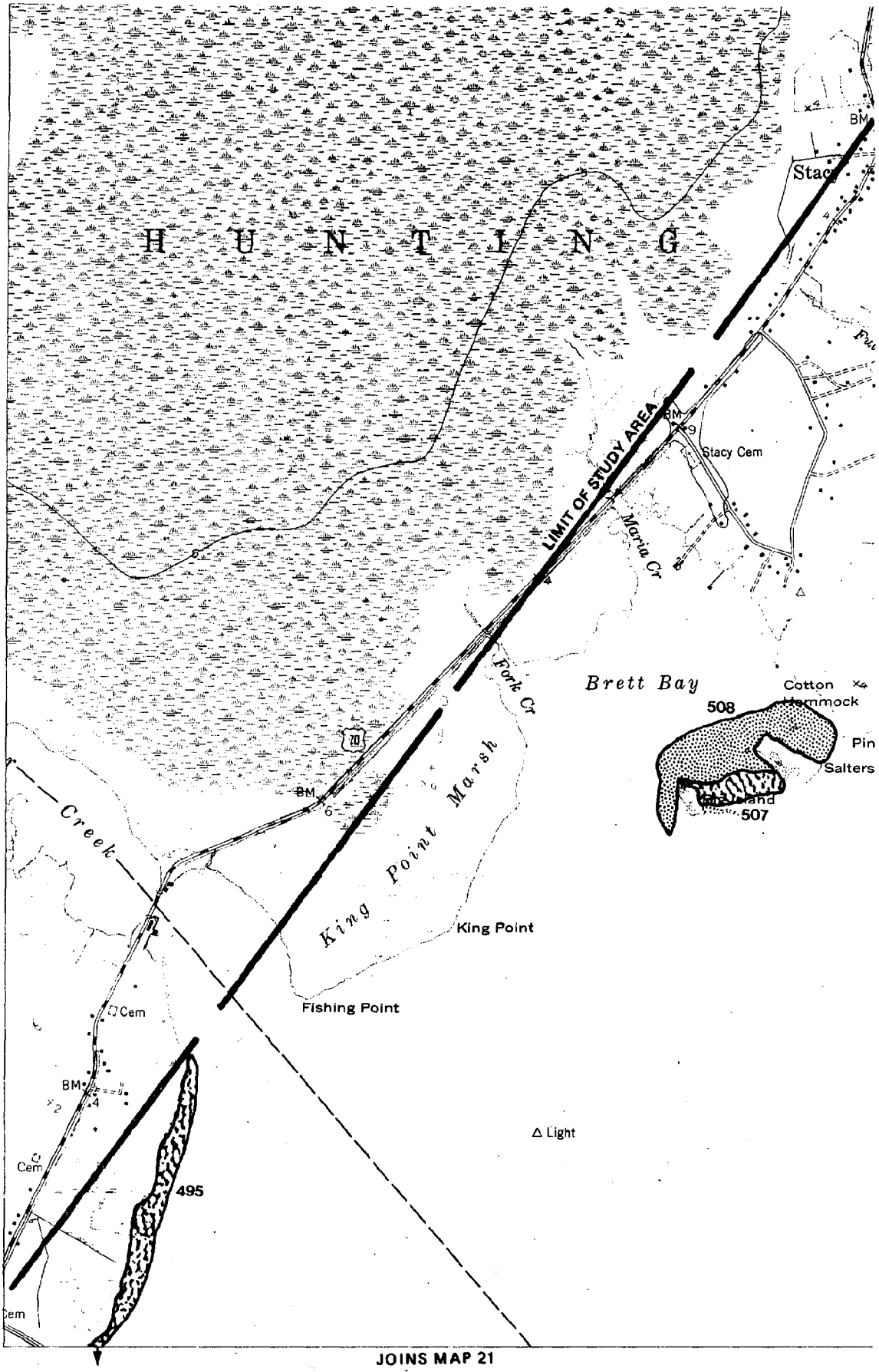
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
469	MODERATE	2774634	379797	108.8
471	DENSE	2775362	380401	21.4
473	DENSE	2776374	380351	15.3
474	SCATTERED	2777005	379427	14.6
475	DENSE	2777153	380155	11.6
480	DENSE	2774470	386622	344.3
481	SCATTERED	2777019	388999	6.4
482	DENSE	2778871	388452	584.0
483	MODERATE	2777581	384263	4.9
484	SCATTERED	2777716	383674	14.3
485	MODERATE	2779653	388270	31.3
486	SCATTERED	2777781	389473	9.8
487	MODERATE	2778662	390309	31.3
488	SCATTERED	2780809	389910	17.0
489	SCATTERED	2781791	388312	4.6
490	SCATTERED	2782670	388316	28.2
491	MODERATE	2781383	392884	35.8
492	DENSE	2783521	391688	6.1
493	MODERATE	2783611	391277	5.9
494	SCATTERED	2784588	390679	5.1
496	MODERATE	2783073	393491	15.5



MAP NUMBER 22

TABLE NUMBER 23

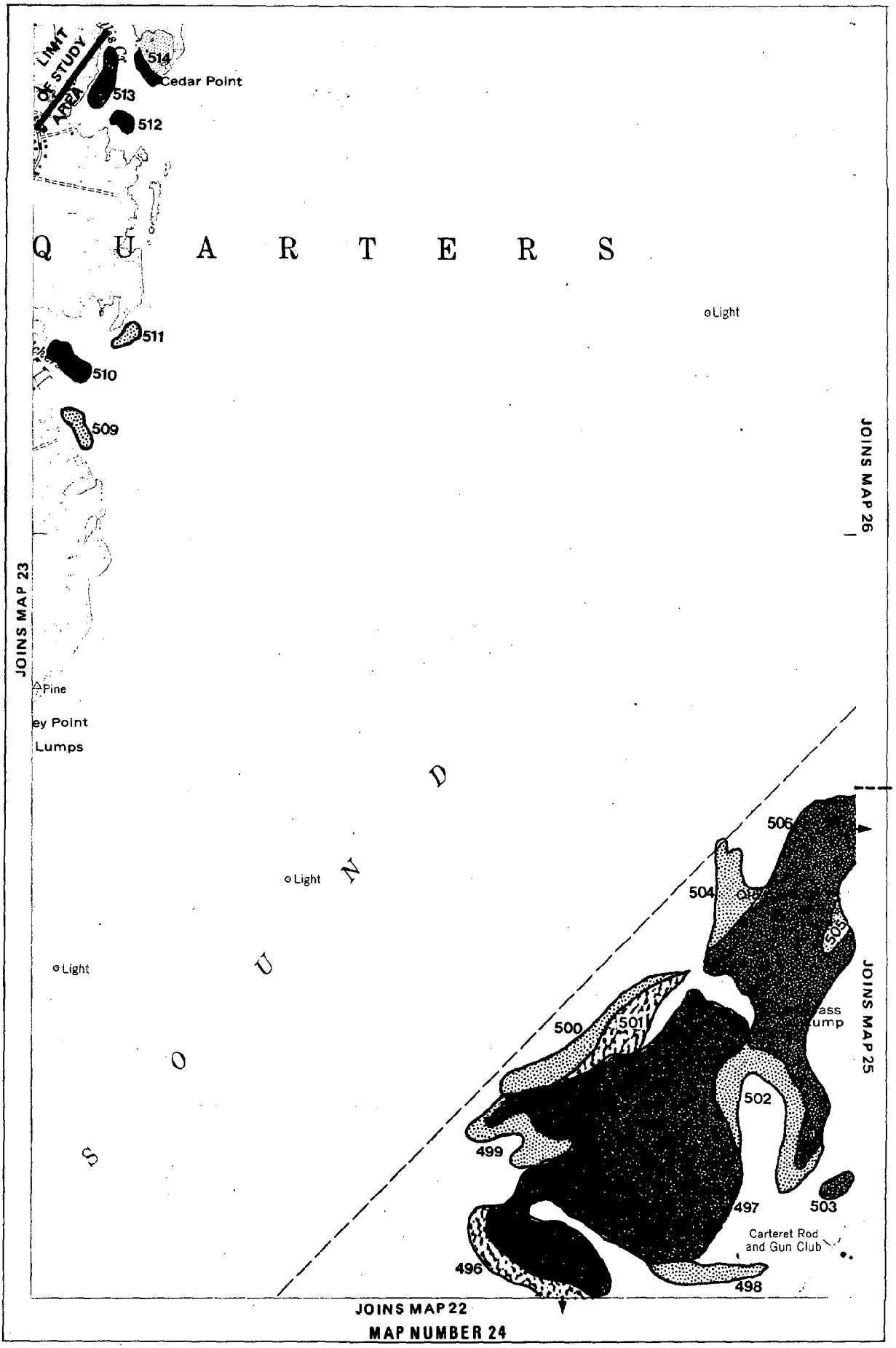
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
495	MODERATE	2764492	393147	33.0
507	MODERATE	2773120	400832	10.1
508	SCATTERED	2773359	401103	40.3



MAP NUMBER 23

TABLE NUMBER 24

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
496	MODERATE	2783073	393491	15.5
497	DENSE	2784205	395538	235.1
498	SCATTERED	2785655	393637	8.9
499	SCATTERED	2782748	395677	13.4
500	SCATTERED	2783717	397156	16.9
501	MODERATE	2784199	397235	16.5
502	SCATTERED	2786505	396537	26.0
503	DENSE	2787597	395024	2.9
504	SCATTERED	2785936	399249	14.7
505	SCATTERED	2787478	398902	4.3
506	DENSE	2786605	398019	309.8
509	SCATTERED	2775728	405965	2.9
510	DENSE	2775604	406946	4.0
511	SCATTERED	2776431	407348	1.7
512	DENSE	2776276	410500	1.6
513	DENSE	2775950	411164	3.6
514	DENSE	2776661	411308	1.5



MAP NUMBER 24

TABLE NUMBER 25

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
506	DENSE	2786605	398019	309.8
521	MODERATE	2788516	400915	17.8
522	SCATTERED	2790020	401568	16.5
523	DENSE	2790418	399580	13.1
524	SCATTERED	2790101	398640	19.1

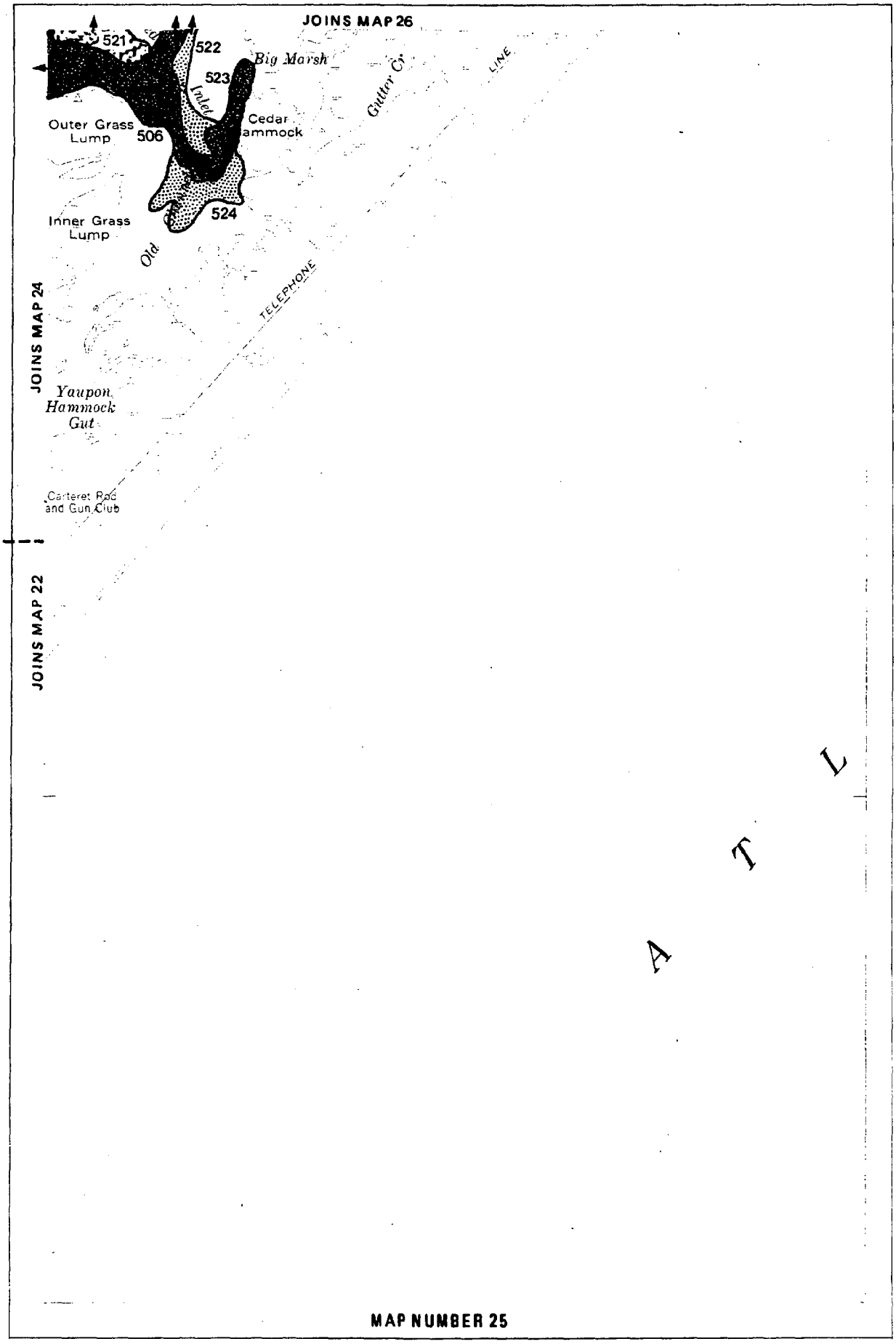

JOINS MAP 26
521
522
523
524
506
Big Marsh
Inlet
Cedar Hammock
Outer Grass Lump
Inner Grass Lump
Old
Gutter Ci
LINE
TELEPHONE
JOINS MAP 24
Yaupon Hammock Gut
Carteret Rod and Gun Club
JOINS MAP 22
A T L
MAP NUMBER 25

TABLE NUMBER 26

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
506	DENSE	2786605	398019	309.8
516	SCATTERED	2787821	417325	8.7
517	SCATTERED	2788944	418913	10.1
518	MODERATE	2791497	419169	28.6
519	SCATTERED	2788756	403073	60.5
520	SCATTERED	2788602	401437	20.4
521	MODERATE	2788516	400915	17.8
522	SCATTERED	2790020	401568	16.5
525	SCATTERED	2792285	402230	25.5
526	DENSE	2792322	401941	5.8
527	DENSE	2793761	401685	2.2
528	SCATTERED	2793912	404913	232.7
529	DENSE	2794992	404157	32.2
530	SCATTERED	2797794	406250	37.0
531	DENSE	2797543	406554	13.4
532	SCATTERED	2800300	409266	79.0

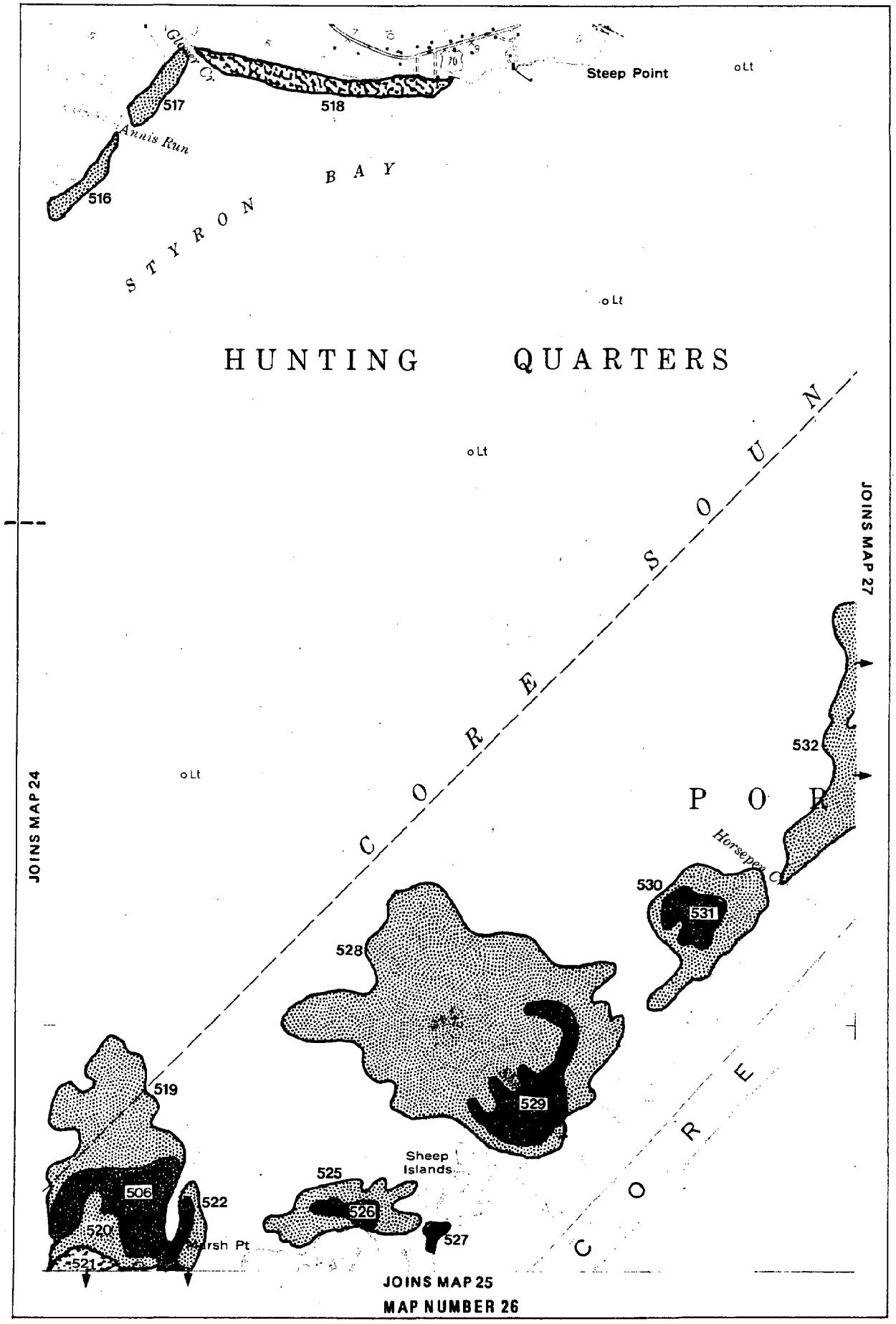
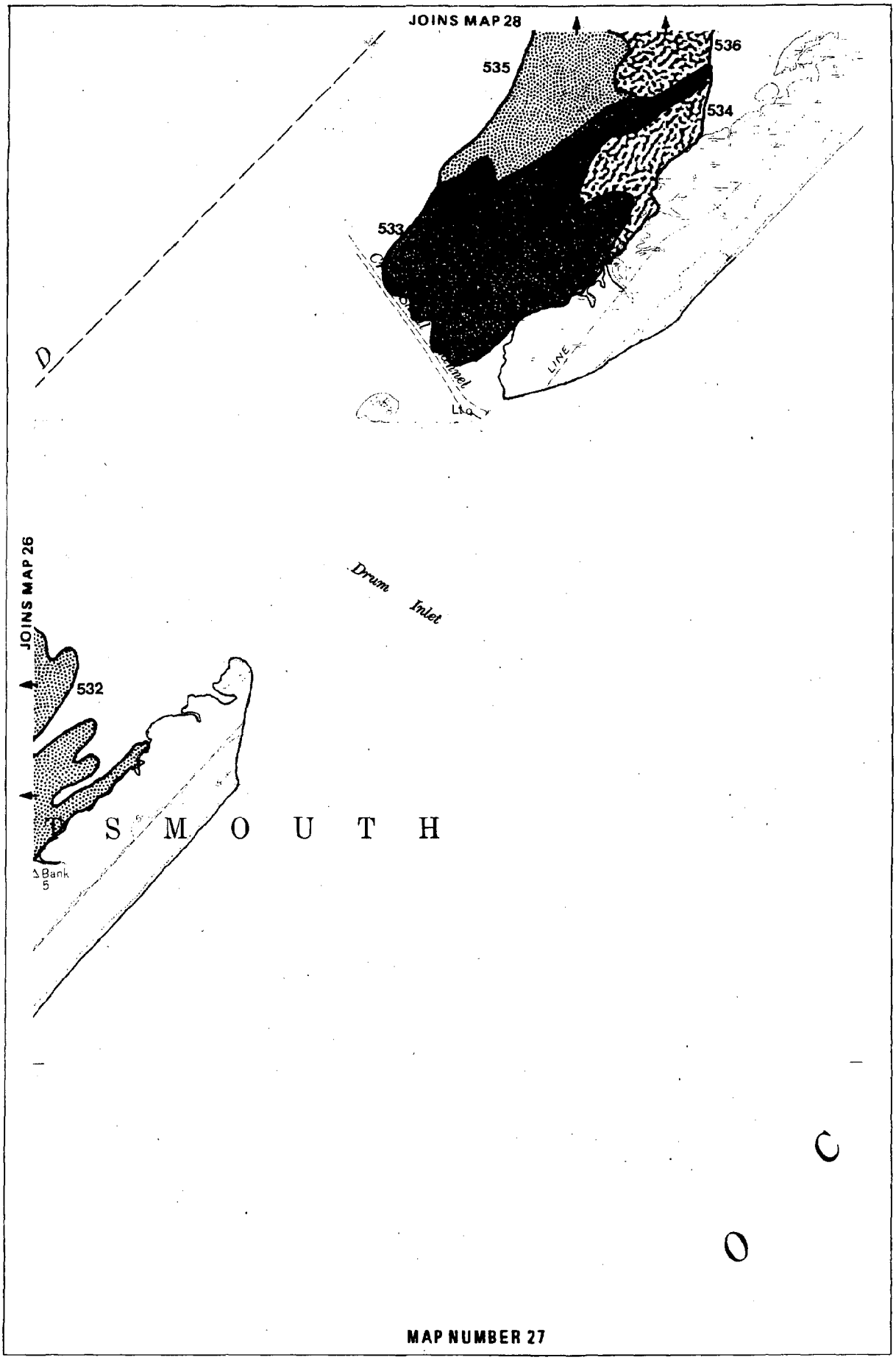

Steep Point
o Lt
517
518
Annis Run
516
B A Y
S T Y R O N
o Lt
HUNTING QUARTERS
o Lt
C O R E S O U N
JOINS MAP 27
532
o Lt
JOINS MAP 24
P O R
Horsepen C
530
531
528
529
519
506
522
520
525
526
527
Sheep Islands
Marsh Pt
521
C O R E
JOINS MAP 25
MAP NUMBER 26

TABLE NUMBER 27

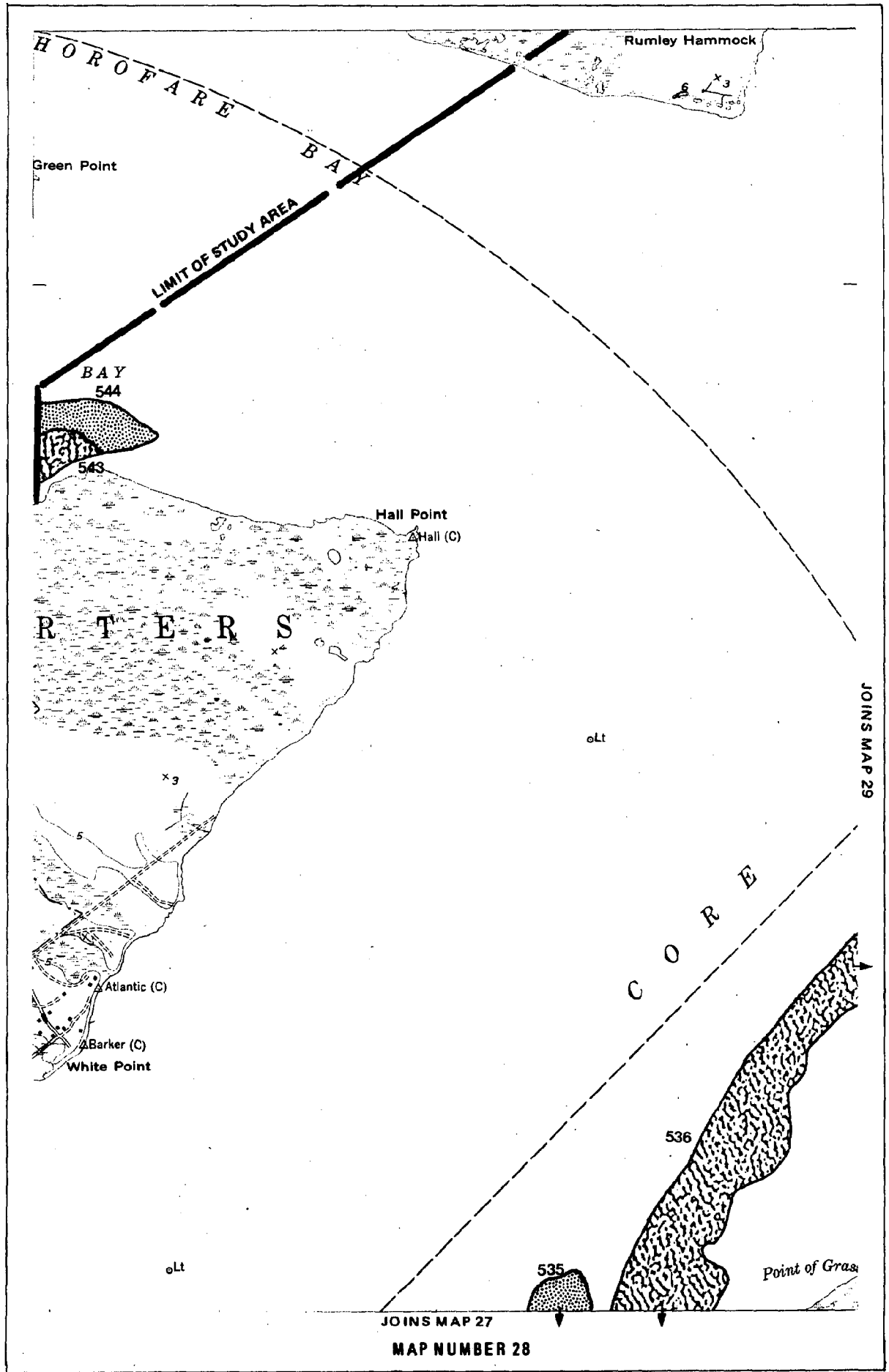
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
532	SCATTERED	2800300	409266	79.0
533	DENSE	2807087	417339	177.2
534	MODERATE	2808629	418102	32.1
535	SCATTERED	2807224	419220	83.6
536	MODERATE	2811037	423367	199.3



MAP NUMBER 27

TABLE NUMBER 28

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
535	SCATTERED	2807224	419220	83.6
536	MODERATE	2811037	423367	199.3
543	MODERATE	2799879	432788	13.4
544	SCATTERED	2799068	433116	58.1



MAP NUMBER 28

TABLE NUMBER 29

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
536	MODERATE	2811037	423367	199.3
537	SCATTERED	2816678	425476	2.2
538	MODERATE	2815812	426428	13.1
539	MODERATE	2816816	426862	4.1
540	MODERATE	2814619	427591	49.4
541	MODERATE	2816230	429051	130.1
545	MODERATE	2821849	431520	290.1
546	MODERATE	2825290	437886	85.3

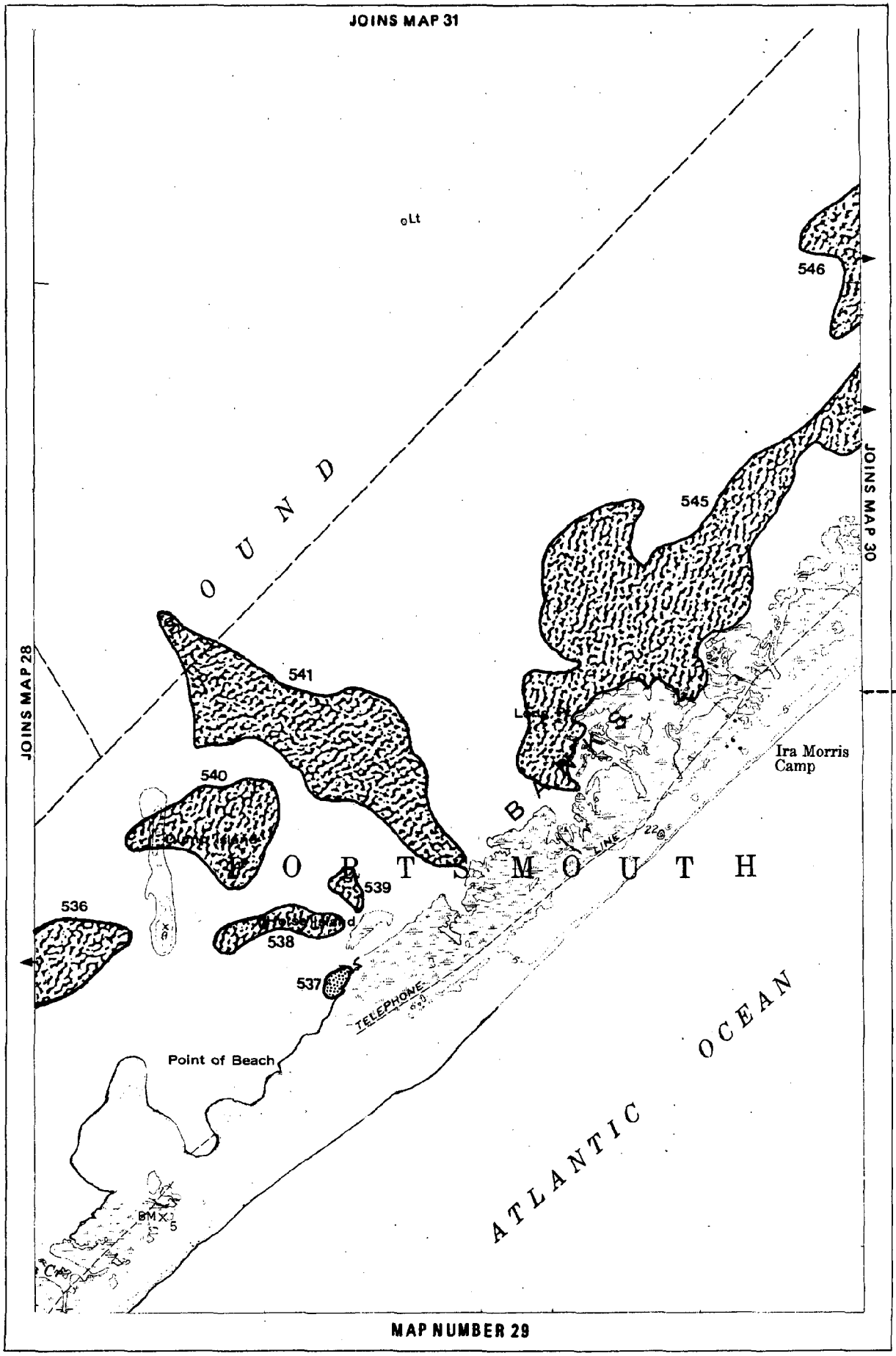

JOINS MAP 31
JOINS MAP 28
JOINS MAP 30
OUND
546
545
541
540
539
538
537
536
Ira Morris Camp
FORTSMOUTH
TELEPHONE
LINE
Point of Beach
ATLANTIC OCEAN
BM
MAP NUMBER 29

TABLE NUMBER 30

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
545	MODERATE	2821849	431520	290.1
546	MODERATE	2825290	437886	85.3
548	MODERATE	2830208	441716	248.6
549	SCATTERED	2833788	448326	158.0
550	SCATTERED	2832581	448716	102.8

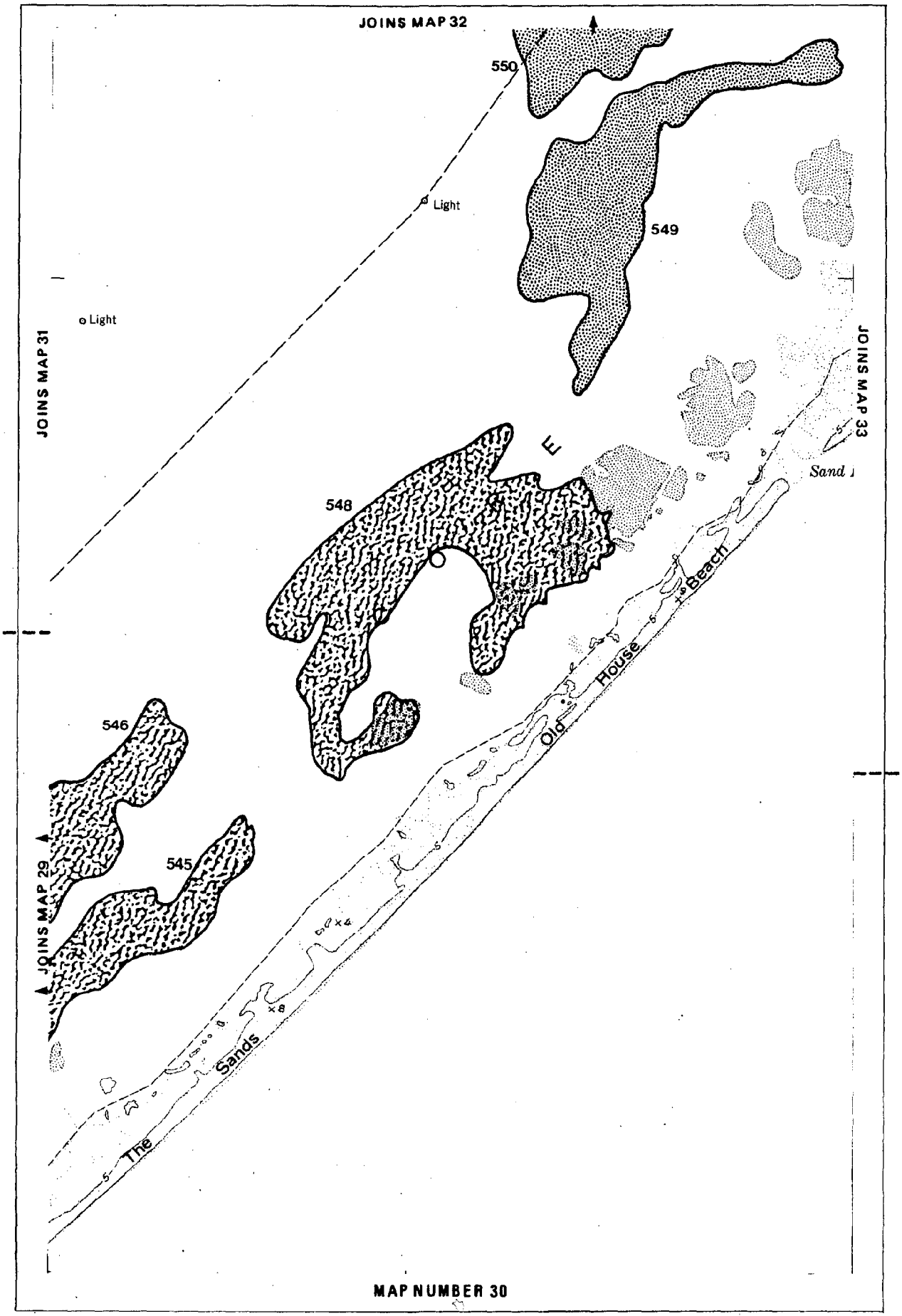
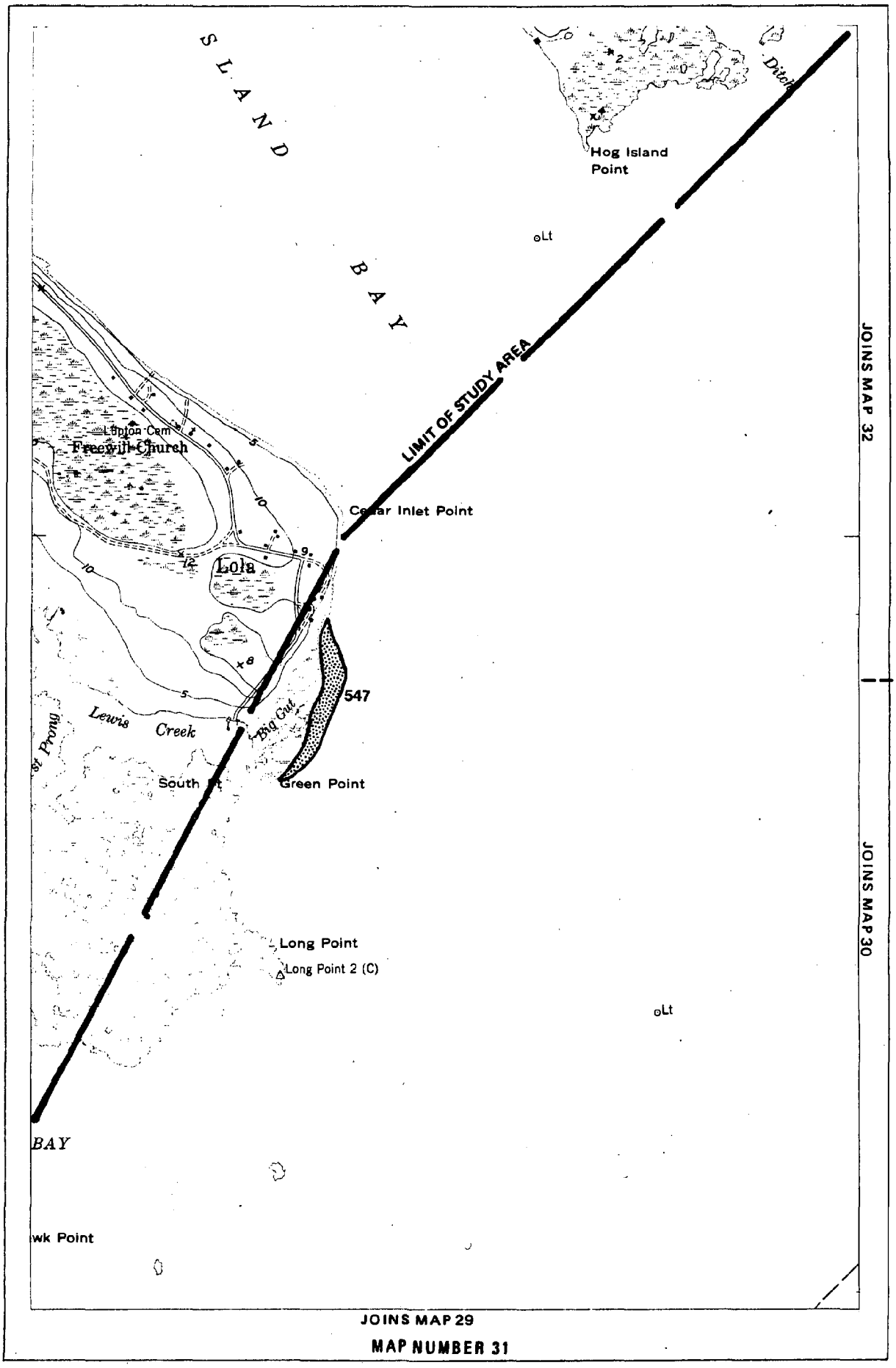

JOINS MAP 32
550
549
Light
Light
JOINS MAP 31
JOINS MAP 33
548
546
545
JOINS MAP 29
Old House Beach
The Sands
MAP NUMBER 30

TABLE NUMBER 31

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
547	SCATTERED	2816547	448722	11.8



MAP NUMBER 31

TABLE NUMBER 32

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
550	SCATTERED	2832581	448716	102.8
551	MODERATE	2834805	451733	98.7
552	DENSE	2837164	452633	219.9
553	MODERATE	2840720	456757	969.6
557	SCATTERED	2837315	459545	154.0
561	DENSE	2834517	461094	9.6
563	DENSE	2835590	462626	10.7
564	SCATTERED	2834040	461978	66.5
565	DENSE	2833175	461135	12.2
566	SCATTERED	2833759	465926	337.1
567	DENSE	2832235	464021	43.6
568	SCATTERED	2827588	464018	81.8
569	DENSE	2827156	462337	16.9
570	MODERATE	2825144	459588	33.6
571	SCATTERED	2825048	460728	73.1

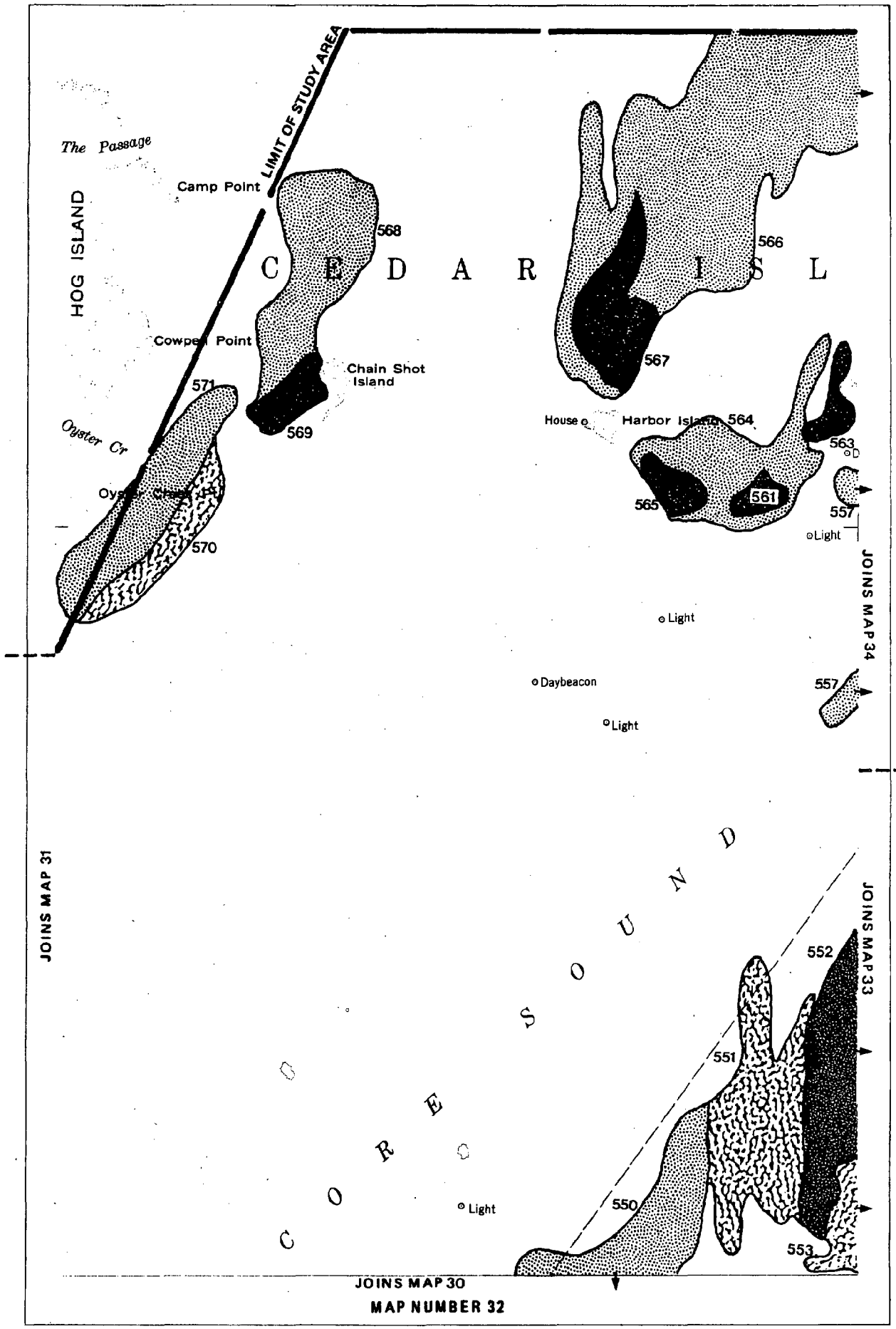

LIMIT OF STUDY AREA
The Passage
Camp Point
HOG ISLAND
C E D A R I S L
568
566
567
Cowpen Point
Chain Shot Island
571
569
Oyster Cr
Oyster Creek
570
House
Harbor Island
564
563
D
565
561
557
Light
JOINS MAP 34
Light
Daybeacon
557
Light
JOINS MAP 31
S O U N D
C O R E
552
551
JOINS MAP 33
Light
550
553
JOINS MAP 30
MAP NUMBER 32

TABLE NUMBER 33

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
552	DENSE	2837164	452633	219.9
553	MODERATE	2840720	456757	969.6
554	DENSE	2840296	454874	4.9
555	DENSE	2839676	457177	46.4
558	MODERATE	2837215	457065	30.5
573	SCATTERED	2844247	458638	160.5

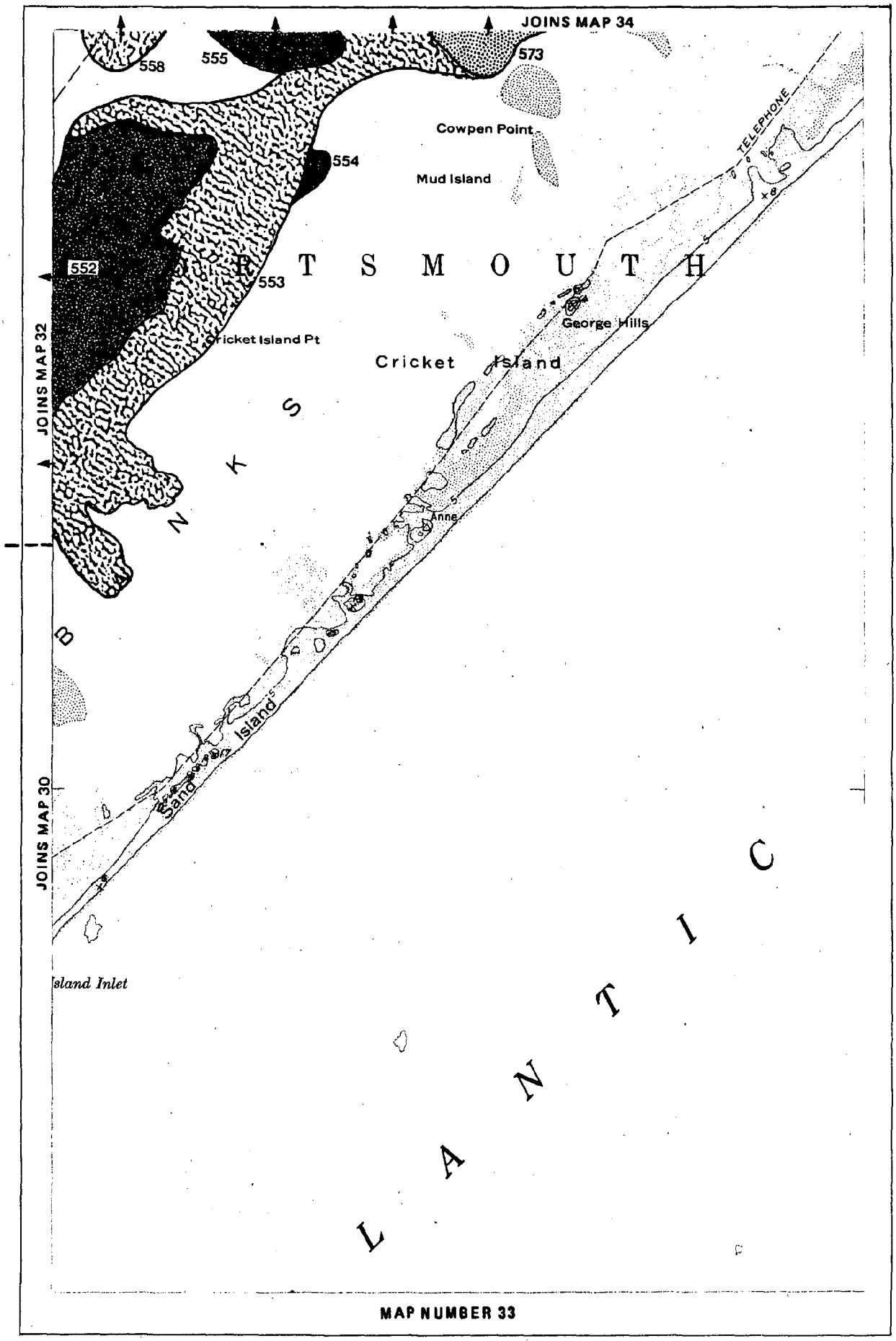

JOINS MAP 34
558
555
573
Cowpen Point
554
Mud Island
TELEPHONE
552
553
PORTSMOUTH
George Hills
Cricket Island Pt
Cricket Island
JOINS MAP 32
BANKS
Anne
Sand Island
JOINS MAP 30
Island Inlet
ATLANTIC
MAP NUMBER 33

TABLE NUMBER 34

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
553	MODERATE	2840720	456757	696.6
555	DENSE	2839676	457177	46.4
556	DENSE	2841178	457954	20.7
557	SCATTERED	2837315	459545	154.0
558	MODERATE	2837215	457065	30.5
559	DENSE	2837326	457544	16.2
560	DENSE	2837537	462597	66.1
562	DENSE	2843337	462404	21.3
566	SCATTERED	2833759	465926	337.1
572	DENSE	2842984	459907	20.7
573	SCATTERED	2844247	458638	160.5
574	MODERATE	2848417	467374	1403.6
575	DENSE	2845046	463387	77.3
576	SCATTERED	2843664	464932	31.9
577	DENSE	2847182	466838	36.3
579	SCATTERED	2848148	461423	18.5
580	DENSE	2848125	465780	22.4
582	MODERATE	2842850	471196	733.6

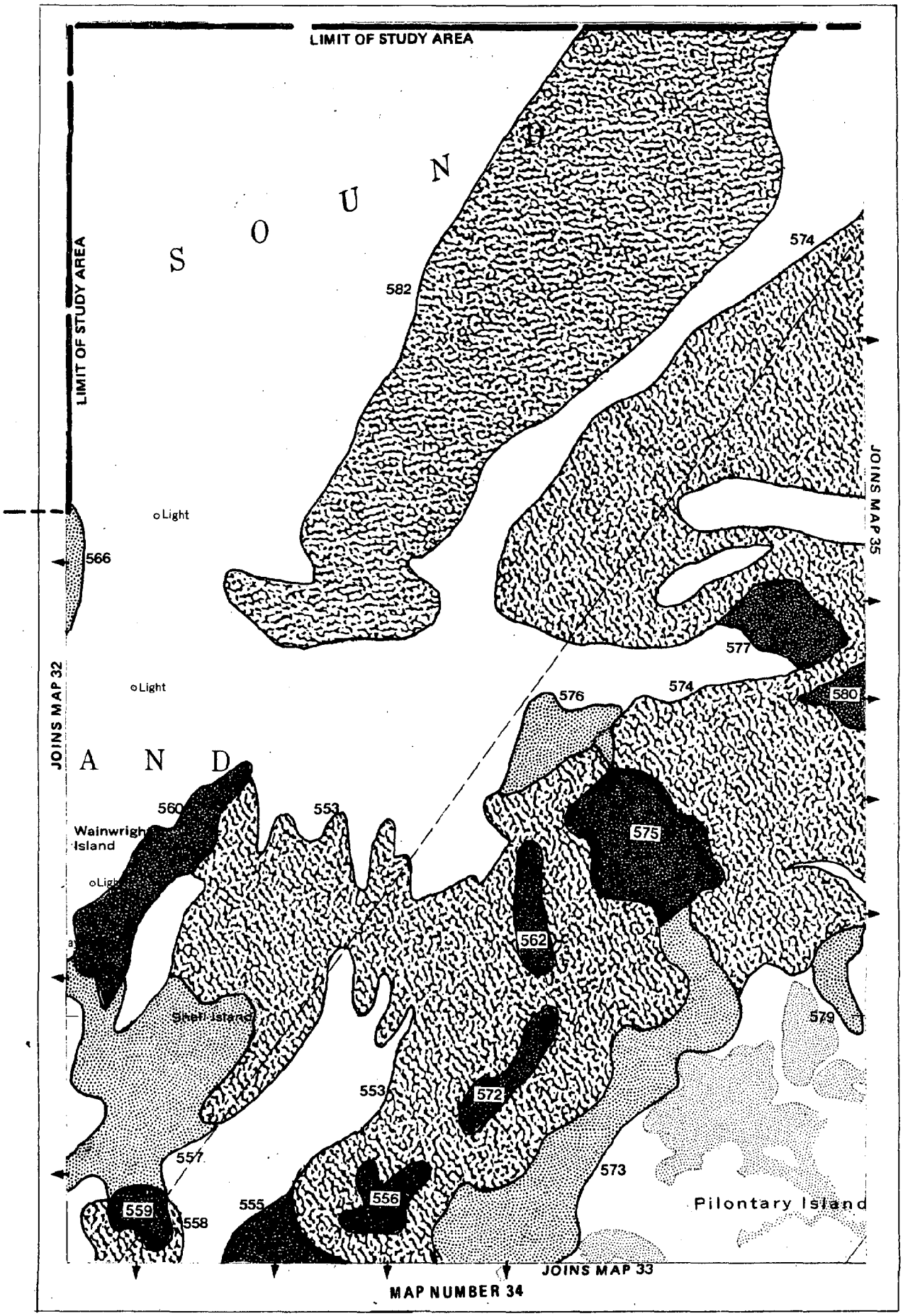
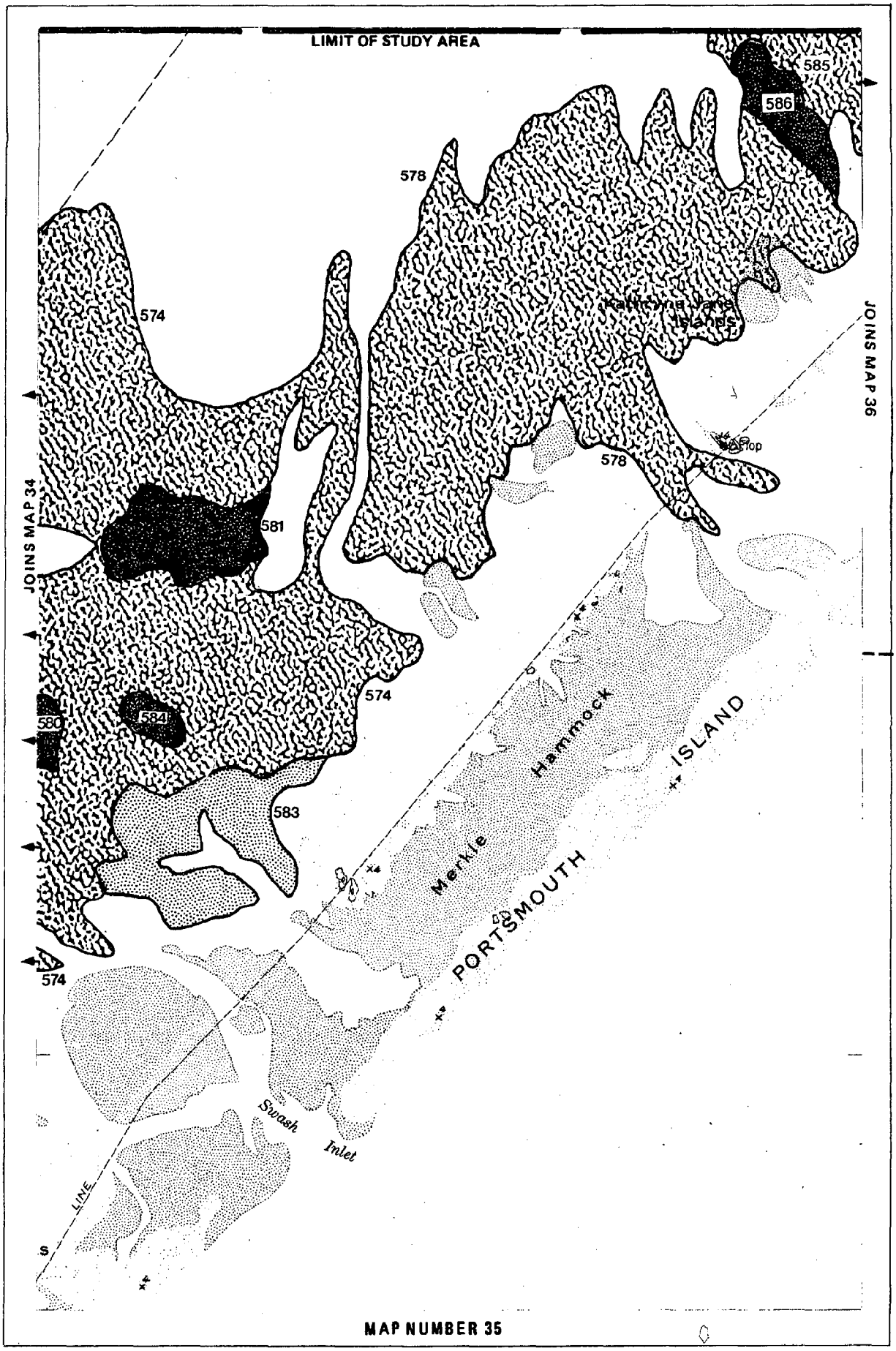

LIMIT OF STUDY AREA
LIMIT OF STUDY AREA
S O U N D
A N D
582
574
566
Light
Light
JOINS MAP 35
JOINS MAP 32
577
574
576
580
560
553
Wainwright Island
575
562
Shell Island
579
553
572
557
573
559
558
555
556
Pilontary Island
JOINS MAP 33
MAP NUMBER 34

TABLE NUMBER 35

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
574	MODERATE	2848417	467374	1403.6
578	MODERATE	2856582	471858	691.3
580	DENSE	2848125	465780	22.4
581	DENSE	2850576	468757	59.9
583	SCATTERED	2851098	463570	97.8
584	DENSE	2850169	466002	10.6
585	MODERATE	2861858	476424	145.2
586	DENSE	2859485	475100	34.8



MAP NUMBER 35

TABLE NUMBER 36

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
585	MODERATE	2861858	476424	145.2
587	SCATTERED	2862301	475633	117.1
588	DENSE	2863985	477667	8.7
589	DENSE	2864884	478599	9.9
590	MODERATE	2863746	483051	213.1
591	SCATTERED	2861849	480788	133.5
592	DENSE	2861110	479588	33.8
593	MODERATE	2866313	484929	149.3
594	MODERATE	2866211	480494	11.2
595	SCATTERED	2867809	483267	44.1
596	SCATTERED	2863499	486527	149.5
597	MODERATE	2868776	485939	93.9
598	SCATTERED	2868313	485318	22.6
599	DENSE	2869489	487705	99.3

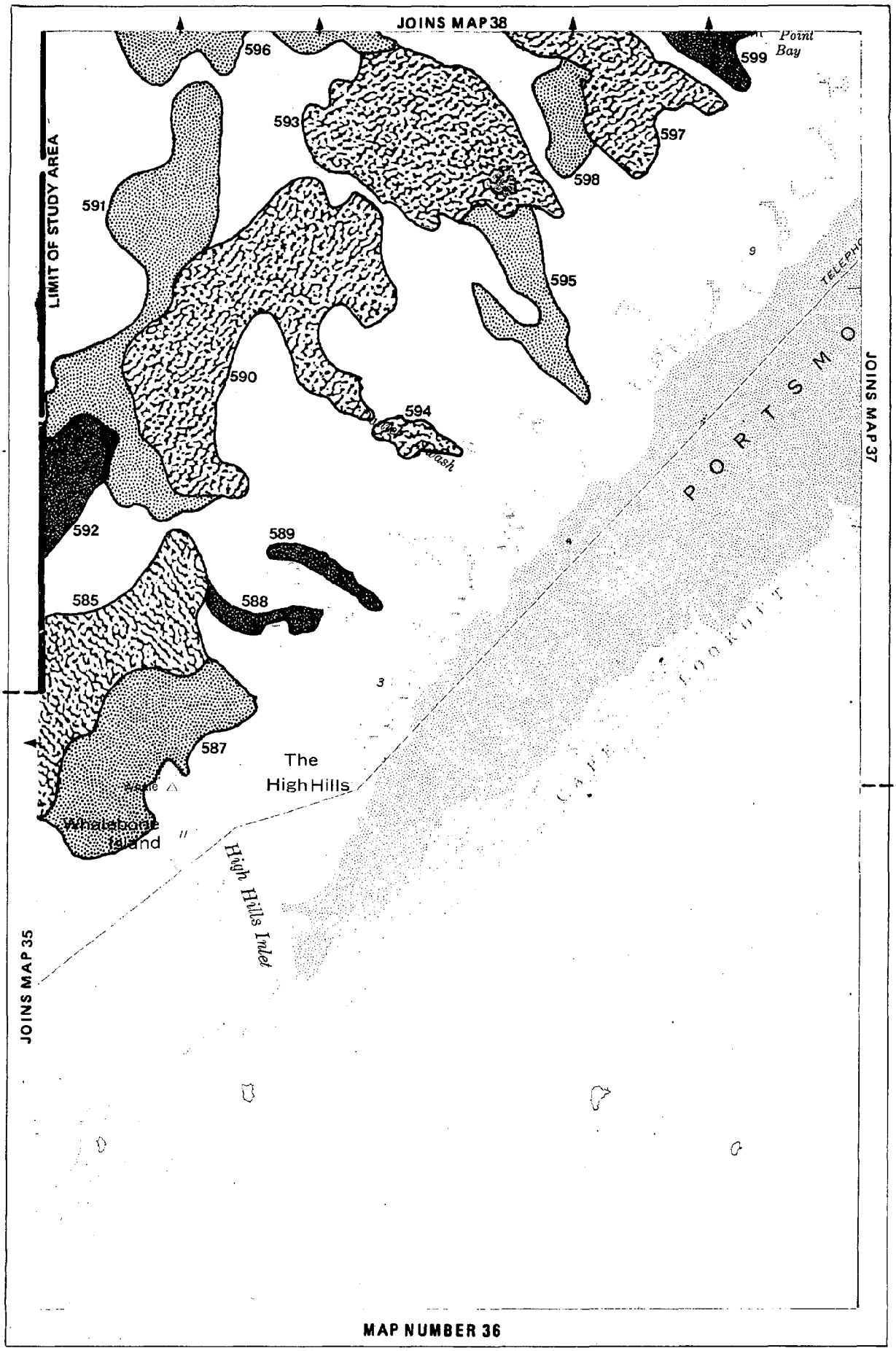

JOINS MAP 38
LIMIT OF STUDY AREA
596
593
591
590
592
589
585
588
587
594
595
597
598
599
Point Bay
The High Hills
Whalebone Island
High Hills Inlet
JOINS MAP 35
JOINS MAP 37
PORTSMO
MAP NUMBER 36

TABLE NUMBER 37

BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
623	MODERATE	2873943	494656	281.6
624	SCATTERED	2872822	493295	86.0

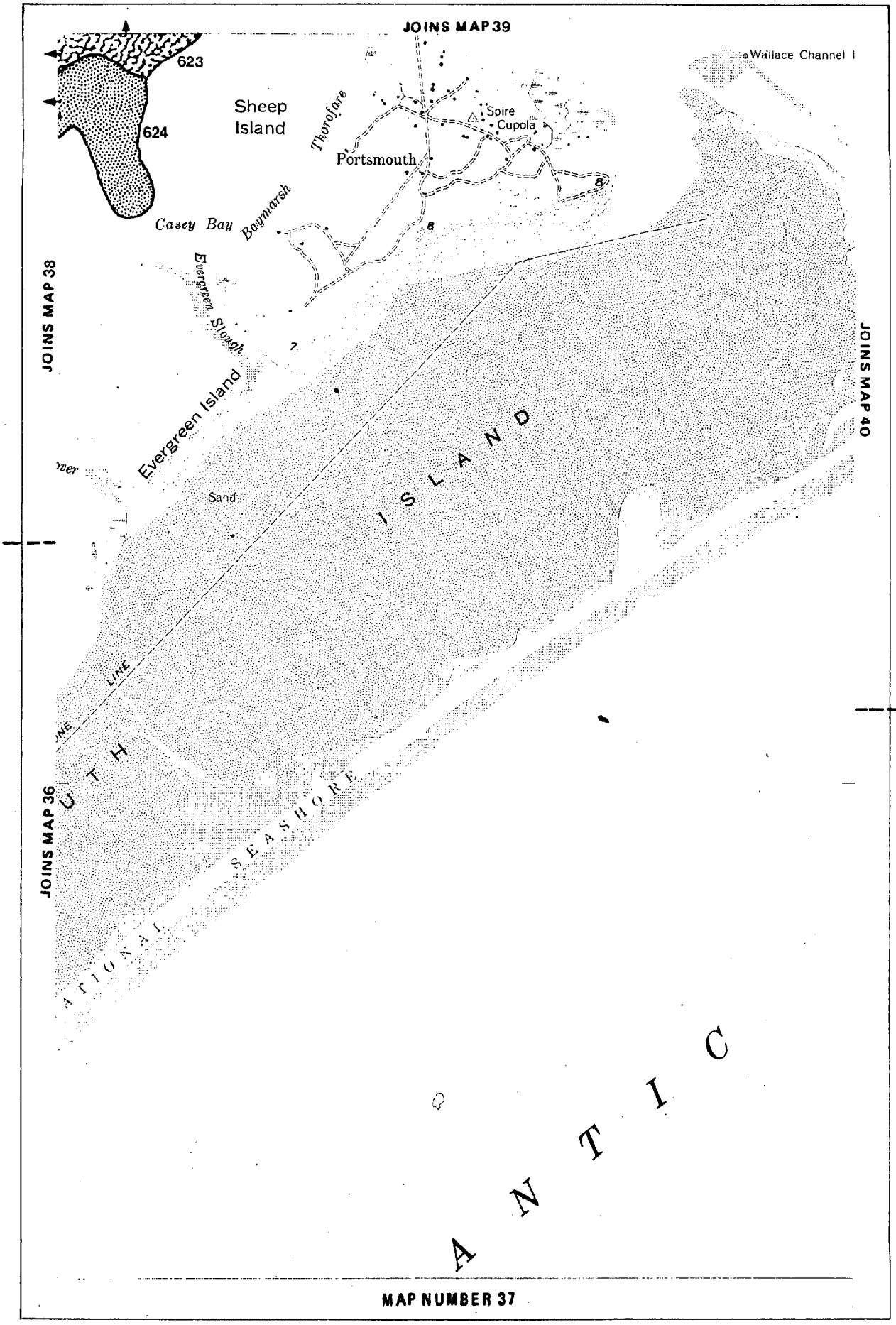
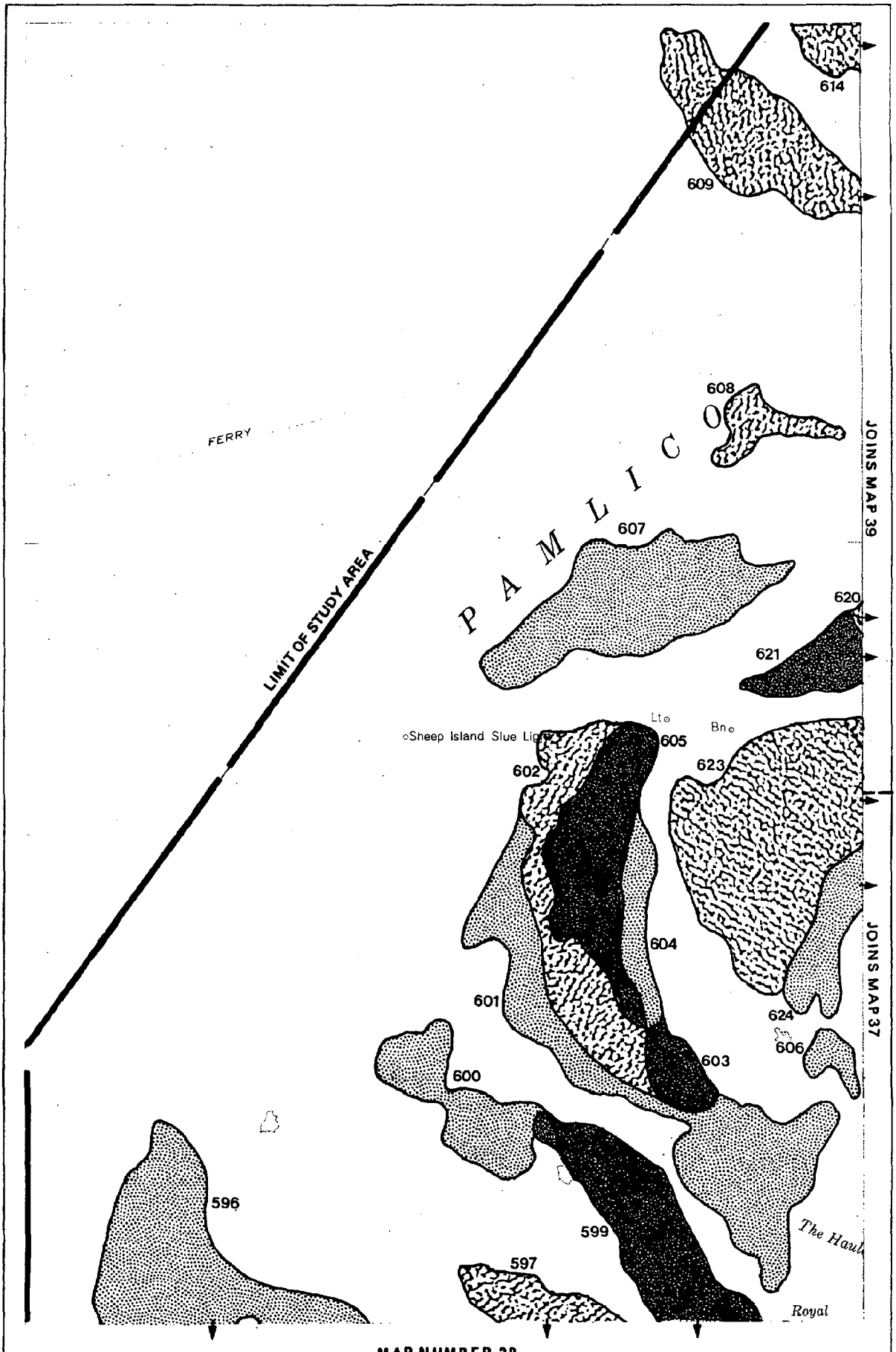

JOINS MAP 39
623
624
Sheep Island
Thorofare
Spire
Cupola
Portsmouth
Wallace Channel
Casey Bay
Baymarsh
JOINS MAP 38
Evergreen Slough
Evergreen Island
JOINS MAP 40
Sand
I S L A N D
LINE
JOINS MAP 36
SEASHORE
A N T I C
MAP NUMBER 37

TABLE NUMBER 38

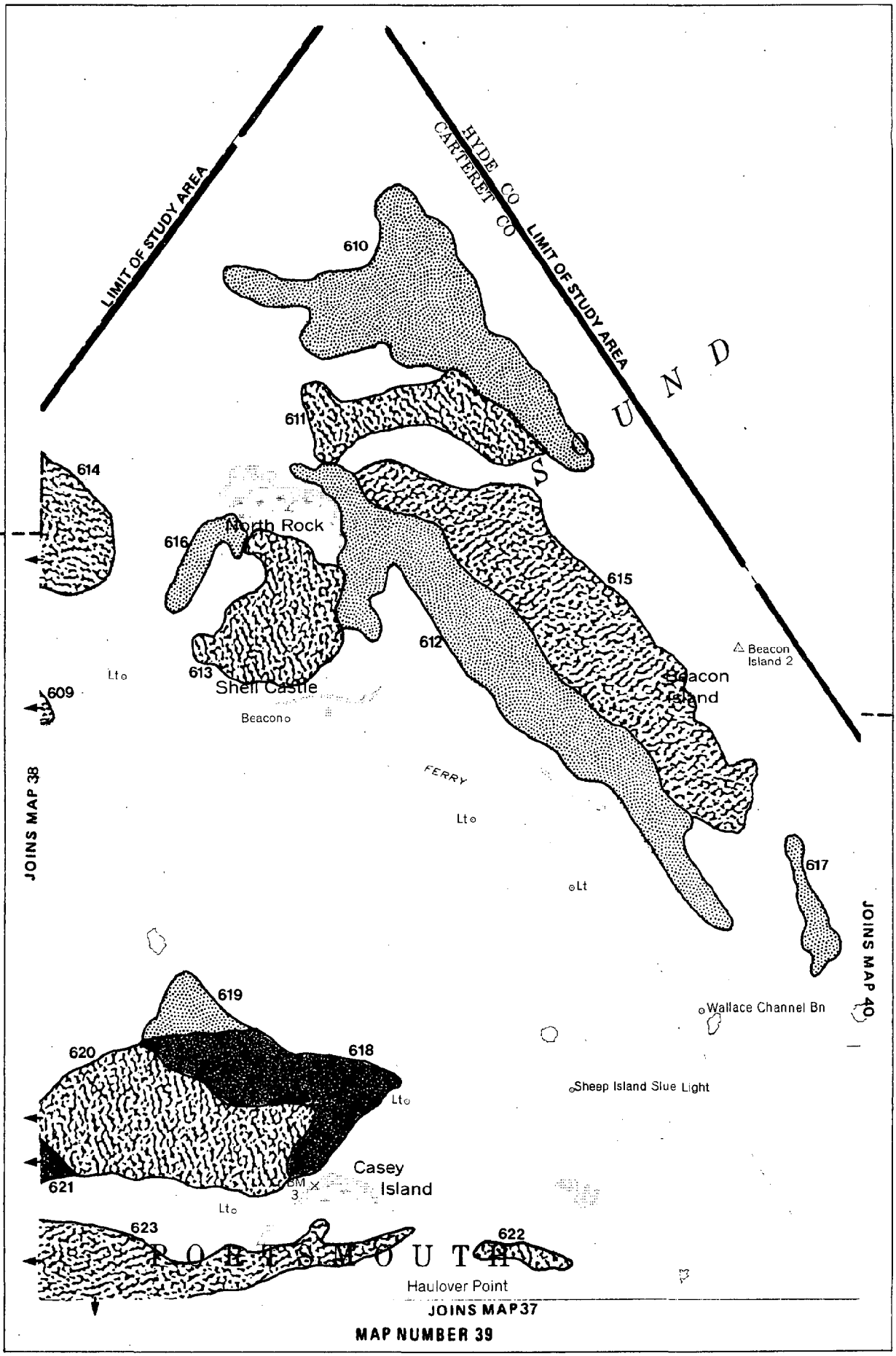
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
596	SCATTERED	2863499	486527	149.5
597	MODERATE	2868776	485939	93.9
599	DENSE	2869489	487705	99.3
600	SCATTERED	2866687	489787	54.7
601	SCATTERED	2869483	489896	147.4
602	MODERATE	2868534	491275	80.3
603	DENSE	2870000	490355	21.6
604	SCATTERED	2869345	492547	25.3
605	DENSE	2868646	493145	85.7
606	SCATTERED	2872187	490460	9.6
607	SCATTERED	2869118	497024	117.3
608	MODERATE	2871134	499755	19.2
609	MODERATE	2870836	504185	96.5
614	MODERATE	2872148	506442	93.3
620	MODERATE	2874480	497094	138.5
621	DENSE	2871919	496426	31.2
623	MODERATE	2873943	494656	281.6
624	SCATTERED	2872822	493295	86.0



MAP NUMBER 38

TABLE NUMBER 39

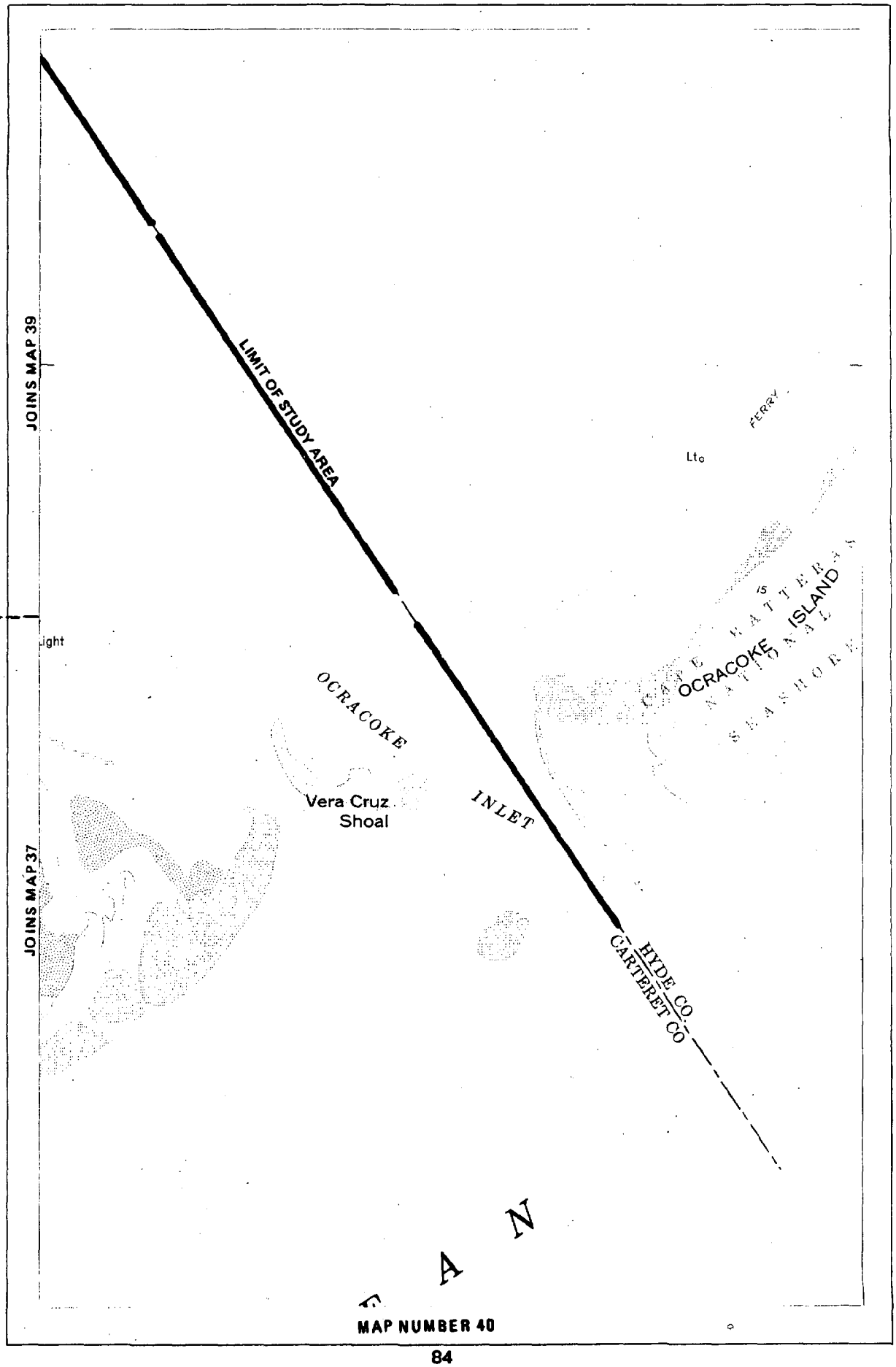
BED NUMBER	DENSITY	N.C. GRID COORDINATES (FEET) X COORDINATE	Y COORDINATE	ACRES
609	MODERATE	2870836	504185	96.5
610	SCATTERED	2877686	508982	152.5
611	MODERATE	2877965	507685	58.3
612	SCATTERED	2879470	503566	188.4
613	MODERATE	2875713	504729	71.5
614	MODERATE	2872148	506442	93.3
615	MODERATE	2880077	504314	207.3
616	SCATTERED	2874743	505350	14.6
617	SCATTERED	2884116	500552	13.2
618	DENSE	2876020	497378	77.2
619	SCATTERED	2874883	498728	18.2
620	MODERATE	2874480	497094	138.5
621	DENSE	2871919	496426	31.2
622	MODERATE	2879899	495234	8.4
623	MODERATE	2873943	494656	281.6



MAP NUMBER 39

TABLE NUMBER 40

NO BEDS WERE EVIDENT IN THE AREA SHOWN BY MAP NUMBER 40.


JOINS MAP 39
LIMIT OF STUDY AREA
FERRY
Lt
ight
OCRACOKE ISLAND
OCRACOKE
Vera Cruz
Shoal
INLET
HYDE CO
CARTERET CO
JOINS MAP 37
N
MAP NUMBER 40

RECOMENDATIONS

The authors recommend the use of conventional color aerial photography as a base for mapping submerged grass beds in shallow coastal waters. Since the accuracy of interpretation depends on the clarity of the photographs, certain conditions should be met:

(1) Atmospheric conditions must be clear with minimal haze.

(2) Haze filters should be used to prevent bluish tints.

(3) Frames must be generously overlapped to avoid blind spots caused by sun reflection, and photography should not be taken when the sun angle is very high or very low.

(4) Wind-caused wave action should not be present.

(5) Tide stage must be at or near its lowest ebb. In areas where muddy bottoms may cause turbidity on ebb tides, observations should be made to determine the period when water clarity is greatest.

(6) The time of year should be chosen to match peak growth of the beds.

(7) Altitude should be low enough to provide a negative scale of not more than 1000 feet per inch (1:12,000).

(8) Accurate rectification of the master màps is critical to the accuracy of the final data.

While this technique worked very well in the shallow waters (less than six feet at low tide) with sand bottoms, this method would not be suitable for deep or turbid areas. Since the grass beds mapped in this project occur on shallow sandy bottoms, water depth and turbidity presented little problem during this study.

The successful mapping of the grass beds in Core and Bogue Sounds by conventional aerial photography suggests many other projects which can be performed by the same method. Obviously, periodic remapping would give valuable information on the permanence of these grass beds, serving to monitor their increase or decline. Photography flown during various seasons of the year would provide information on seasonsal growth variations. Additional projects in other shallow estuaries similar to Core and Bogue Sounds would provide additional base maps.

The North Carolina Office of Coastal Management and the U.S. Army Corps of Engineers have already used information from this study in permit decisions on channelization projects in the mapped area. The N. C. Division of Marine Fisheries also used this information to determine areas where certain types of bottom-disturbing fishing gear should not be allowed. The Division of Marine Fisheries has also expressed interest in periodic mapping of these grass beds to monitor the effects of the use of certain types of fishing gear on the.

The total cost of this project was approximately $16,800. Repeating the project in the same area with the same coverage would cost less--perhaps $10,000 to 12,000--because of the one-time special costs for basemaps and software for the present, pilot project. The use of the Land Resources Information Service (LRIS) computerized mapping system was clearly cost-effective and also had the advantage of preserving the mapping data in easy-to-retrieve and easy-to-manipulate form.

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