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South Carolina Sea Grant

BEACH EROSION INVENTORY OF CHARLESTON COUNTY, SOUTH CAROLINA:

A PRELIMINARY REPORT

Michael F. Stephen
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South Carolina Sea Grant
Technical Report Number 4

March, 1975
SC-SG-75-4

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South Carolina Sea Grant Program
South Carolina Marine Resources Center
Charleston, South Carolina 29412

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ABSTRACT

Rates of shoreline change measured from vertical aerial photographs between the years 1939 and 1973 allow classification of the Charleston County, South Carolina, coastline into four categories:

Areas of long term erosion: areas which have undergone relatively continuous erosion over the study interval.
Areas of long term accretion: areas which have undergone relatively continuous deposition over the study interval.
Unstable areas: areas with fluctuations in position of the shoreline greater than 50 ft over the study interval.
Stable areas: areas with fluctuations in position of the shoreline of less than 50 ft over the study interval.

Beach erosion and deposition trends are closely tied to the occurrence and morphological variations of tidal inlets. Shoreline sediment type and modifications made by man also strongly affect erosion and deposition trends. Limits for set back lines and areas suitable and unsuitable for development can be defined directly from the erosion-deposition graphs presented.

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INTRODUCTION

The purpose of this report is to provide a preliminary summary of beach erosional-depositional trends for Charleston County, South Carolina. These trends were measured from sequential vertical aerial photographs covering the period 1939 to 1973. The Charleston County shoreline, which consists primarily of a series of transgressive barrier islands separated by tidal inlets, is primarily dominated by erosional trends. In order to assess shoreline changes for the state of South Carolina as a whole, a beach erosion inventory for the entire coast was undertaken beginning July 1, 1974. As the project continues, erosional inventory reports similar to this one will be published for the rest of the coastal counties of the state. In addition, the final report for the contract will include an analysis of seasonal changes that occur along a state-wide beach profile network plus long term erosion trends compiled from coastal charts dating back to 1661.

ACKNOWLEDGMENTS

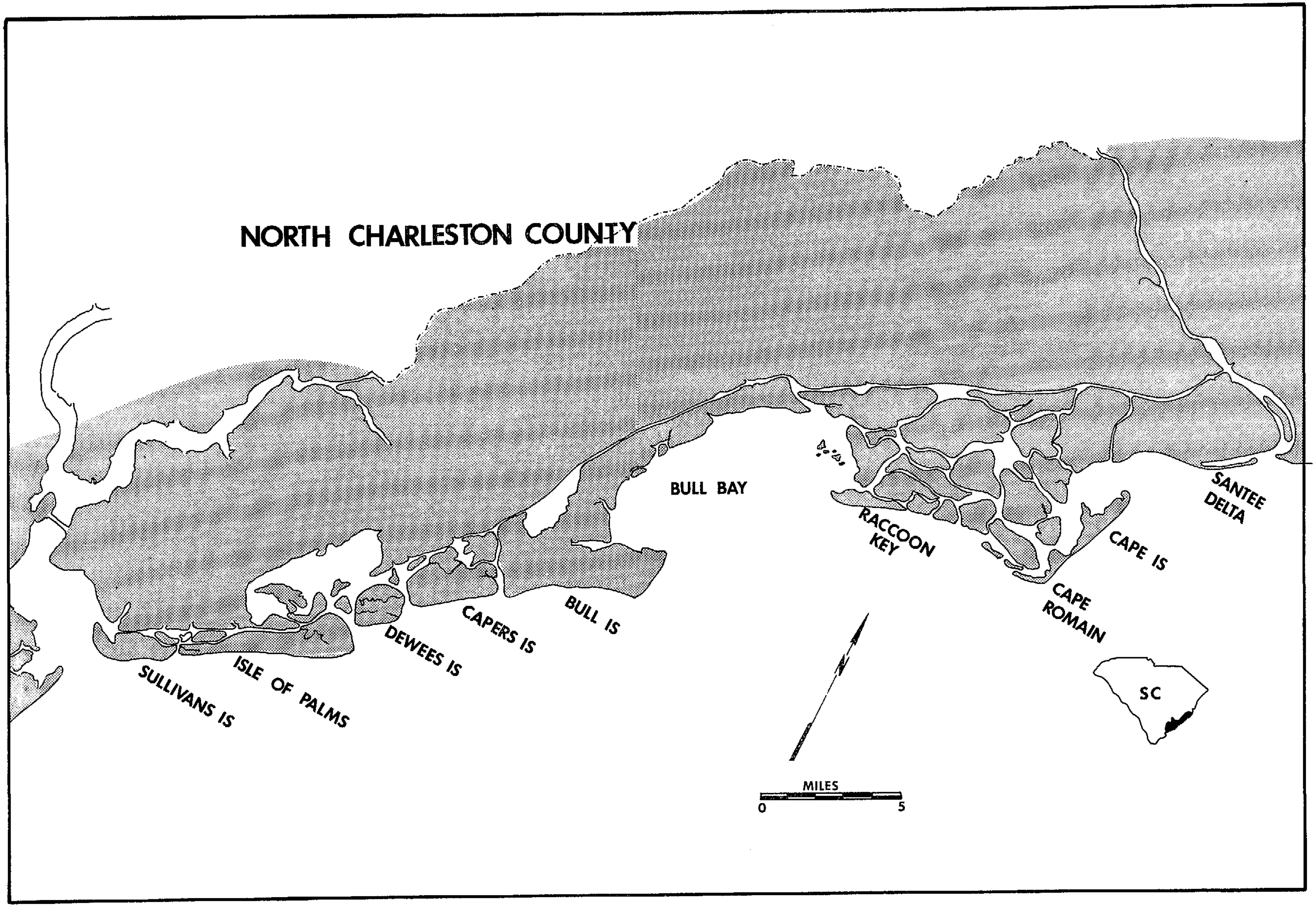
This project was supported by the National Oceanic and Atmospheric Administration, Sea Grant Program, project number R-CZ-1, Miles O. Hayes, principal investigator, and the South Carolina Wildlife and Marine Resources Department. Additional funds were provided by the University of South Carolina. Photographs were obtained from the Eastern Aerial Photographic Laboratory, Agricultural Stabilization and Conservation Service, the United States Geological Survey, and the National Archives, to whom we extend our gratitude for their valuable cooperation. Thanks are also extended to the members of the Coastal Research Division, Geology Department, University of South Carolina, for their help and cooperation in the preparation of this report.

STUDY PROCEDURE

Overlapping photo coverage to allow stereoscopic veiwing and to avoid edge distortion in measurements was obtained for Charleston County, South Carolina, for the years 1949, 1953, 1957, 1963, and 1973 at a nominal scale of 1667 feet per inch. 1941 photographic coverage was obtained for the coastline north of Charleston (Fig. 1). 1939 photographic coverage was obtained for the coastline south of Charleston (Fig. 2). This allows for comparison of changes over five year intervals for the past twenty-four years and changes over eight to ten year intervals for the period prior to 1949.

Selected reference points, identifiable from year to year on the photographs, were established. Permanent structures or fixed points, such as intersections and ends of beach ridges, were used. The distance from the reference point to the beach was measured to the nearest .01 inch. The difference, after scale corrections, between measurements from two successive photographs is the amount of erosion or deposition which occurred during the time interval under consideration. Scale corrections were calculated by using a ratio comparing

Figure 1. Location map showing position of barrier islands in North Charleston County



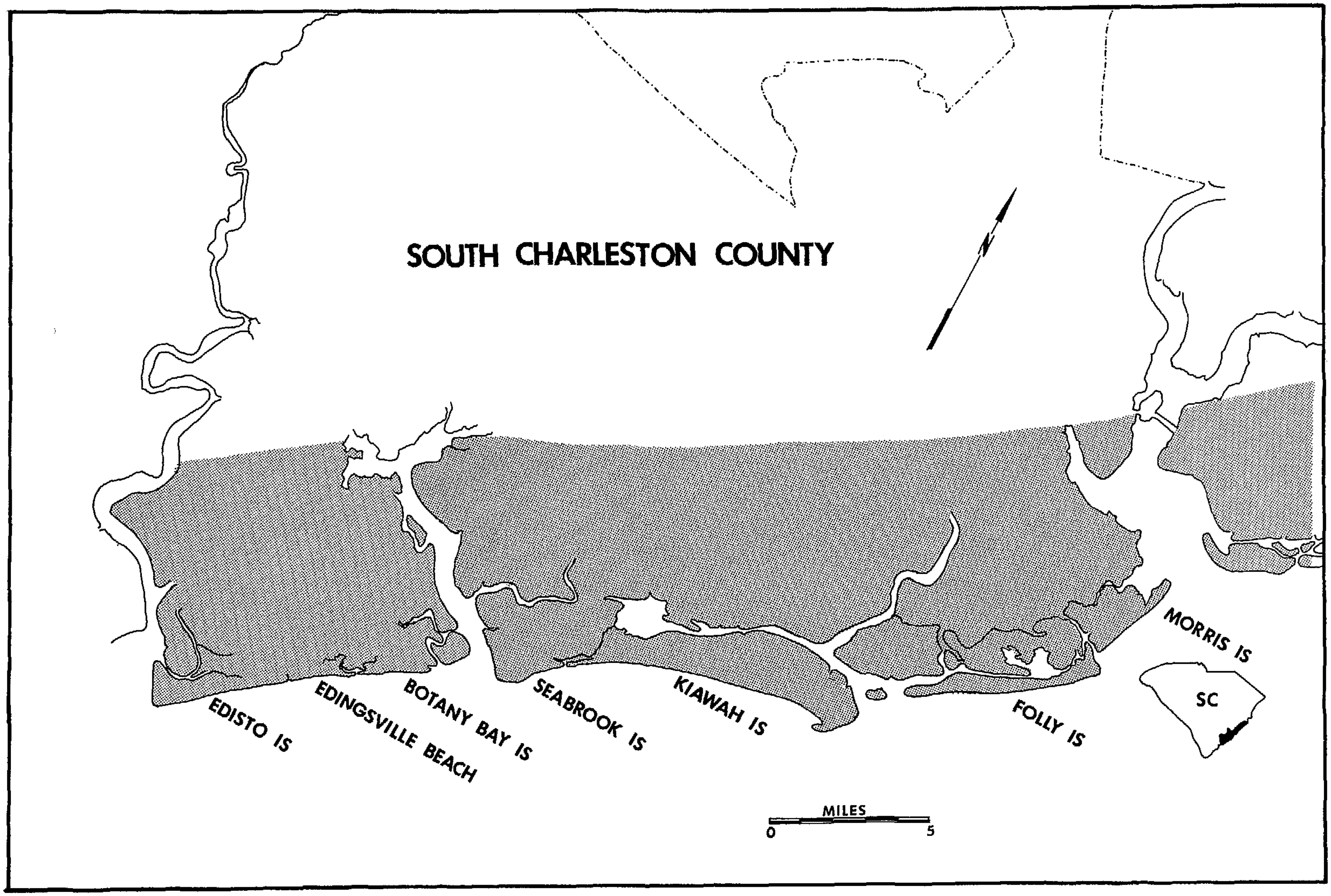


Figure 2. Location map showing position of barrier islands in South Charleston County.

the distance between two fixed reference points on photographs of known scale to the distance between the same reference points on the successive photographs. Stafford (1971) has shown that errors in measurements using photographs at a scale of 1 inch = 1667 ft are insignificant when dealing with large mean rates of change such as those that generally occur in South Carolina.

Methods employed in this study follow closely those outlined by Stafford (1971). For details concerning error analysis, uses of aerial photographs, and methods employed in this study, it is recommended that the reader refer to Stafford's presentation.

DATA PRESENTATION

The information in this report is presented at three levels. A general management map is provided on which areas of coastline that have undergone a) long term erosion, b) long term accretion, c) periods of both accretion and erosion (instability), and d) stable trends are delineated. These terms are defined as follows:

long term erosion: areas which have undergone relatively continuous erosion over the study interval.

long term accretion: areas which have undergone relatively continuous deposition over the study interval.

unstable: areas with fluctuations greater than 50 ft over the study interval.

stable: areas with fluctuations in position of the shoreline of less than 50 ft over the study period.

Use of this map allows for a rapid determination of the general character of any stretch of shoreline in Charleston County. These maps are presented in Figures 3-15. A second series of figures (16-28) presents the cumulative trends for the migration of the shoreline at selected reference points. These graphs are of value to anyone interested in coastal development, because the migrational trends for very short stretches of beach (1000-2000 ft) are clearly shown. All the interested party need do is study the graphs for the section of beach of concern and he can immediately see if it has had an erosional, depositional, or stable history between 1939-41 and the present. These graphs can be used in establishing development setback lines. Finally, the incremental change between photographic years, as well as the total amount of change at each reference point, is presented as tables in Appendix 1.

DESCRIPTION OF EROSION-DEPOSITION TRENDS

Santee Delta (Murphy Island)

The behavior of the shoreline of the southern Santee Delta is related to the interaction between river discharge, tidal currents, and wave action. This shoreline has been gradually erosional since diversion of the Santee River in 1942 reduced the input of river sediments. However, shoals which appeared south of the mouth of the lower Santee in 1953 protected the beach from

Figures 3-15. Barrier Island Management Maps.

Shaded areas indicate the observed trends over a particular section of beach.

1. Long term erosion: general erosion throughout the study interval.
2. Long term accretion: general accretion throughout the study interval.
3. Unstable: shoreline location fluctuation, resulting from alternate erosion and deposition, is greater than 50 ft.
4. Stable: shoreline location fluctuation, resulting from alternate erosion and deposition, is less than 50 ft.

Numbered points are selected reference points. They are repeated on the erosion-deposition graphs (Figs. 16-28) and in Appendix 1.

Figure 3.

SANTEE DELTA

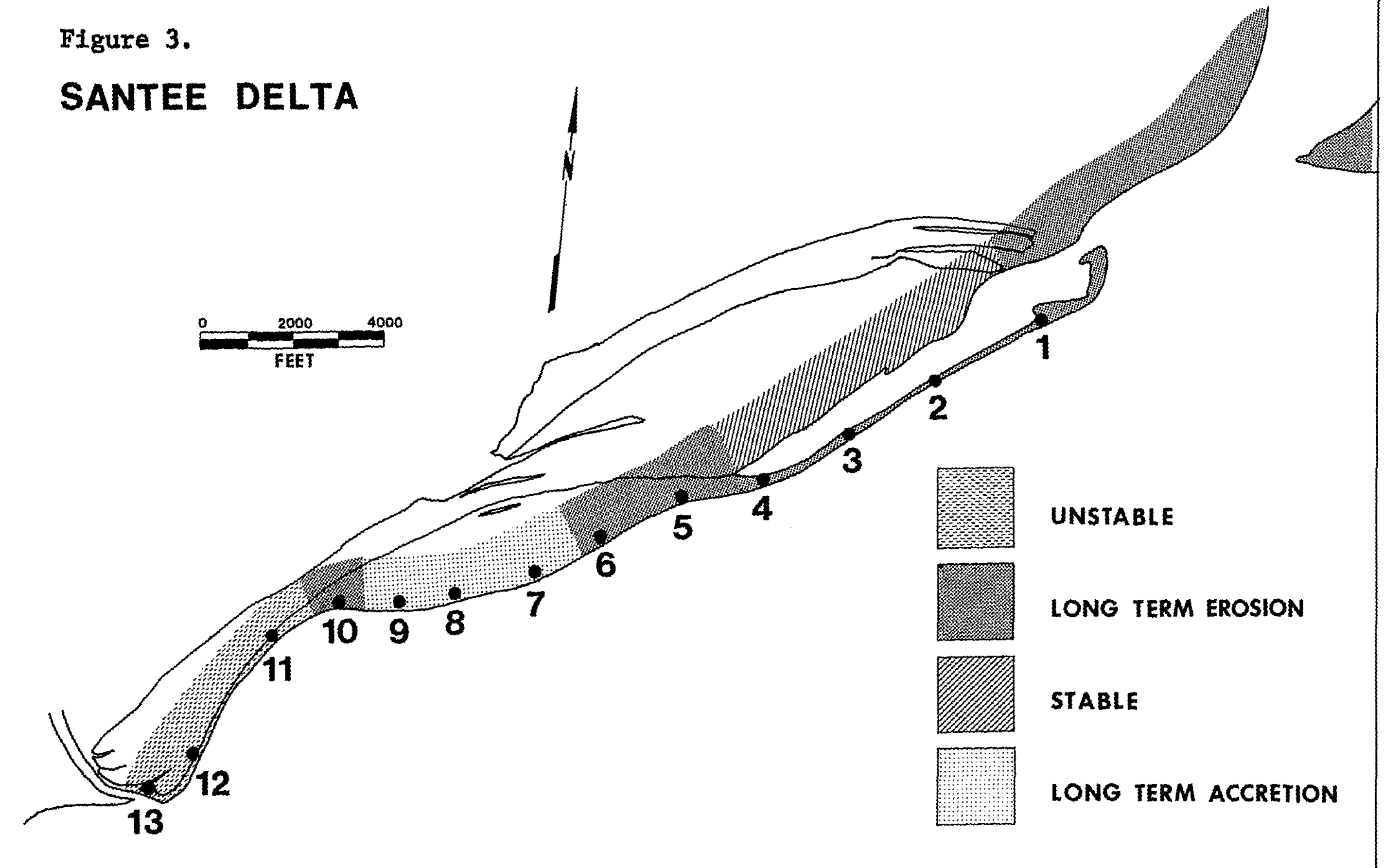
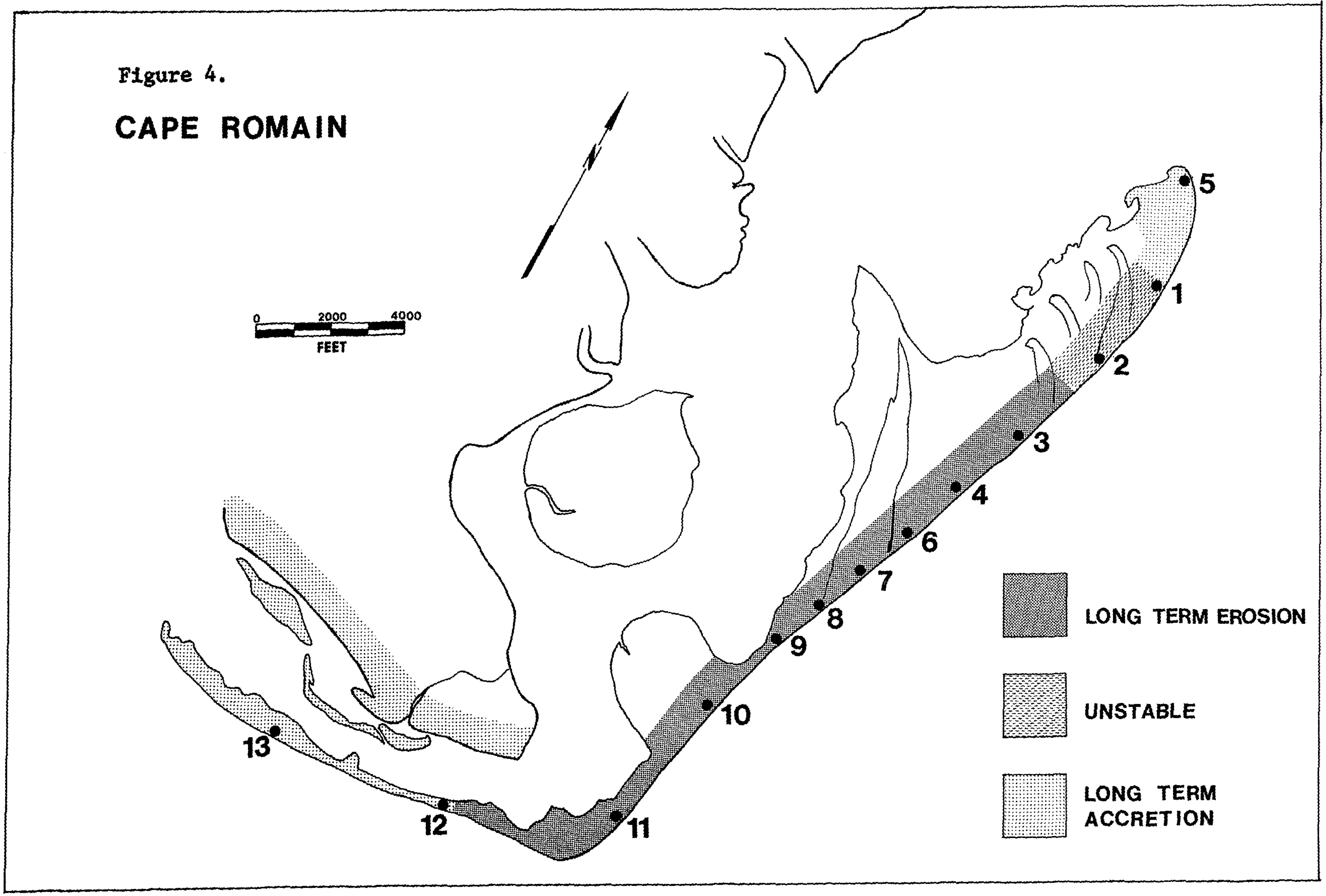


Figure 4.


CAPE ROMAIN
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FEET
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5
6
7
8
9
10
11
12
13
LONG TERM EROSION
UNSTABLE
LONG TERM ACCRETION

Figure 5.

RACCOON KEY

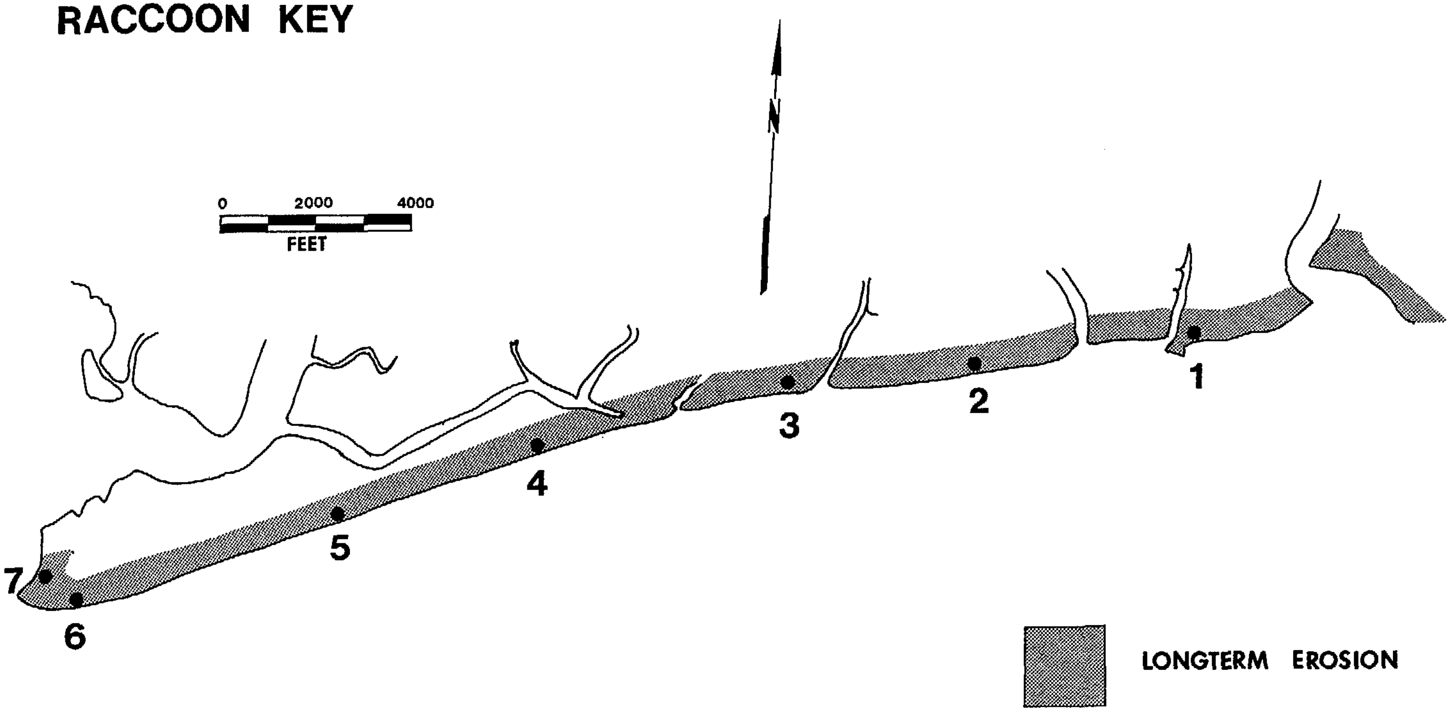


Figure 6.

BULL ISLAND

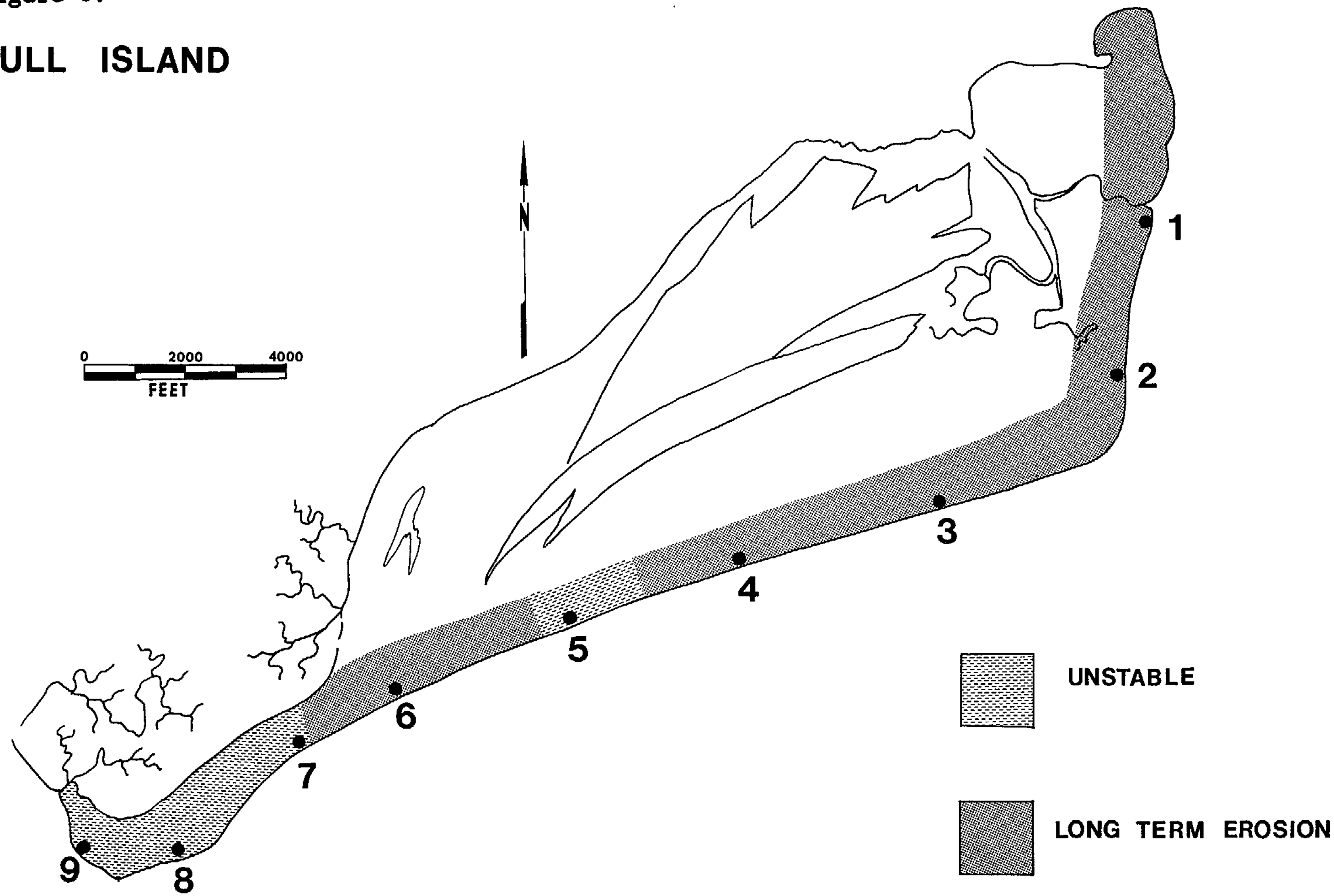
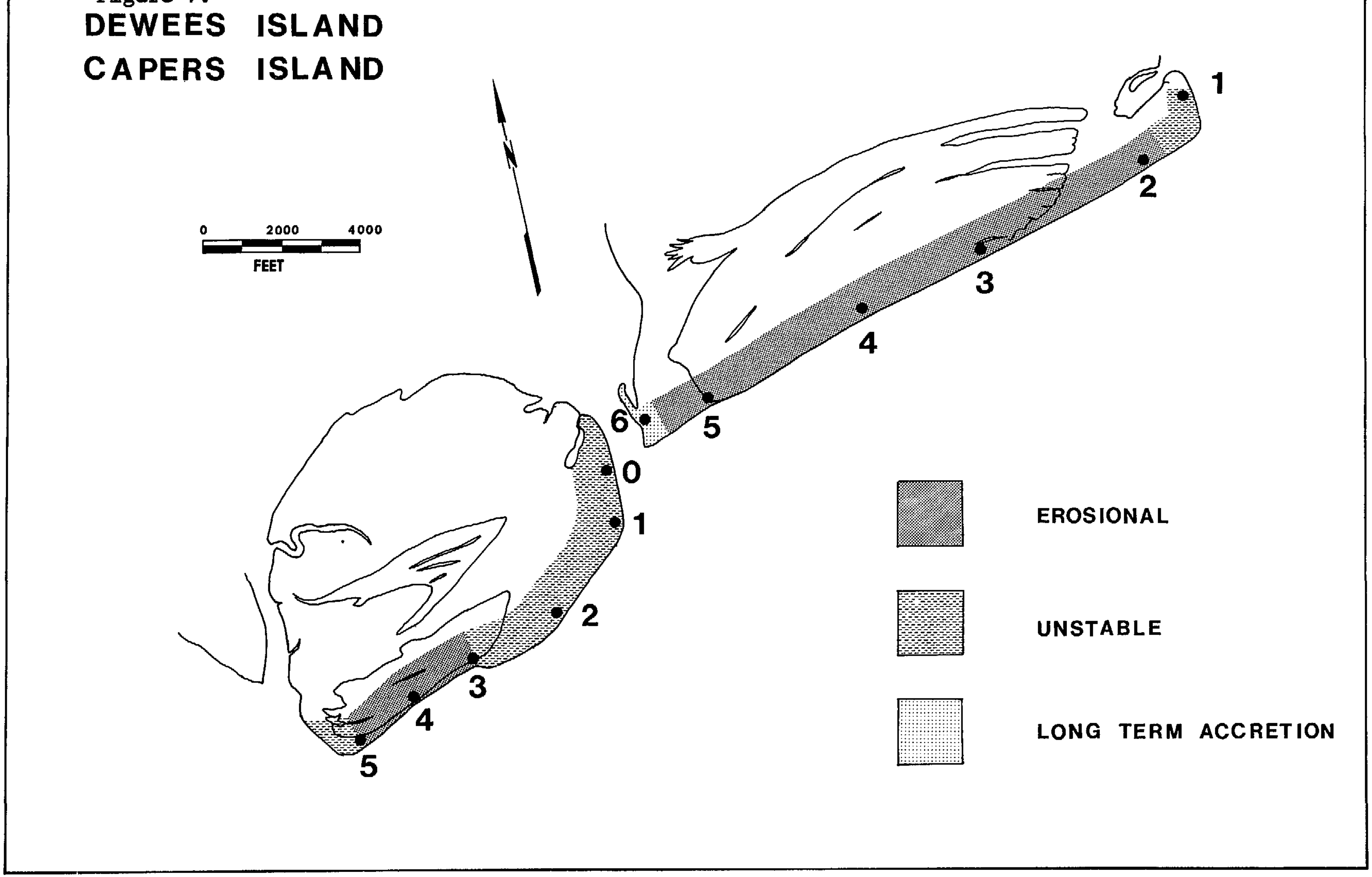


Figure 7.



DEWEES ISLAND
CAPERS ISLAND
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FEET
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2
3
4
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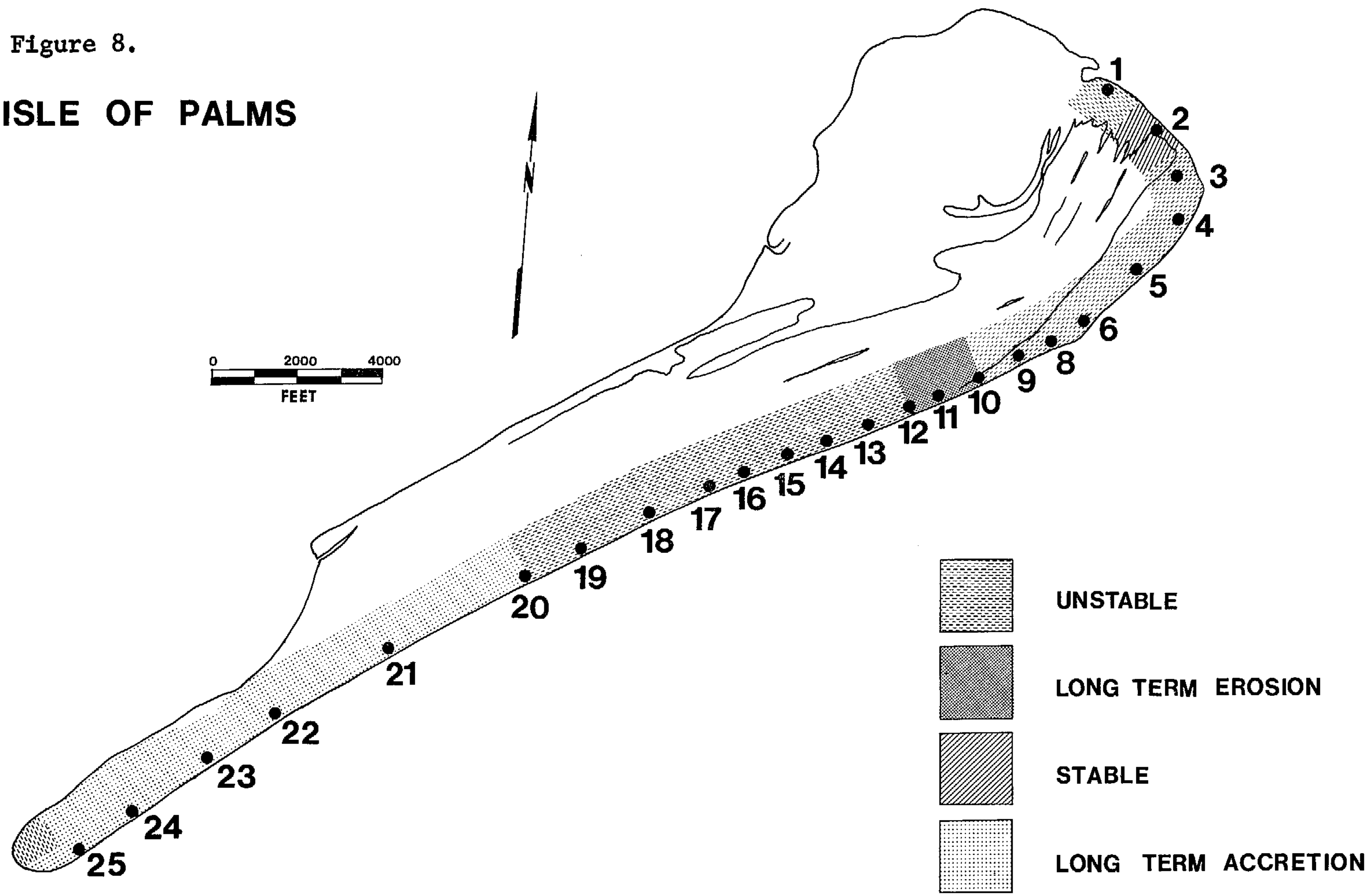
6
0
1
2
3
4
5
EROSIONAL
UNSTABLE
LONG TERM ACCRETION

Figure 8.

ISLE OF PALMS



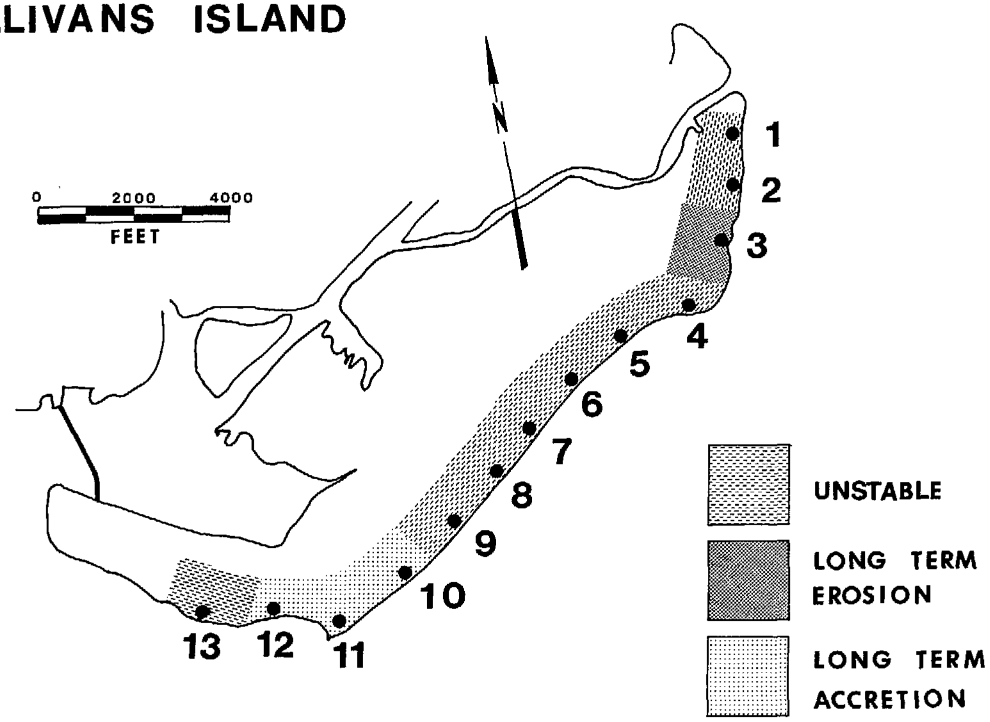
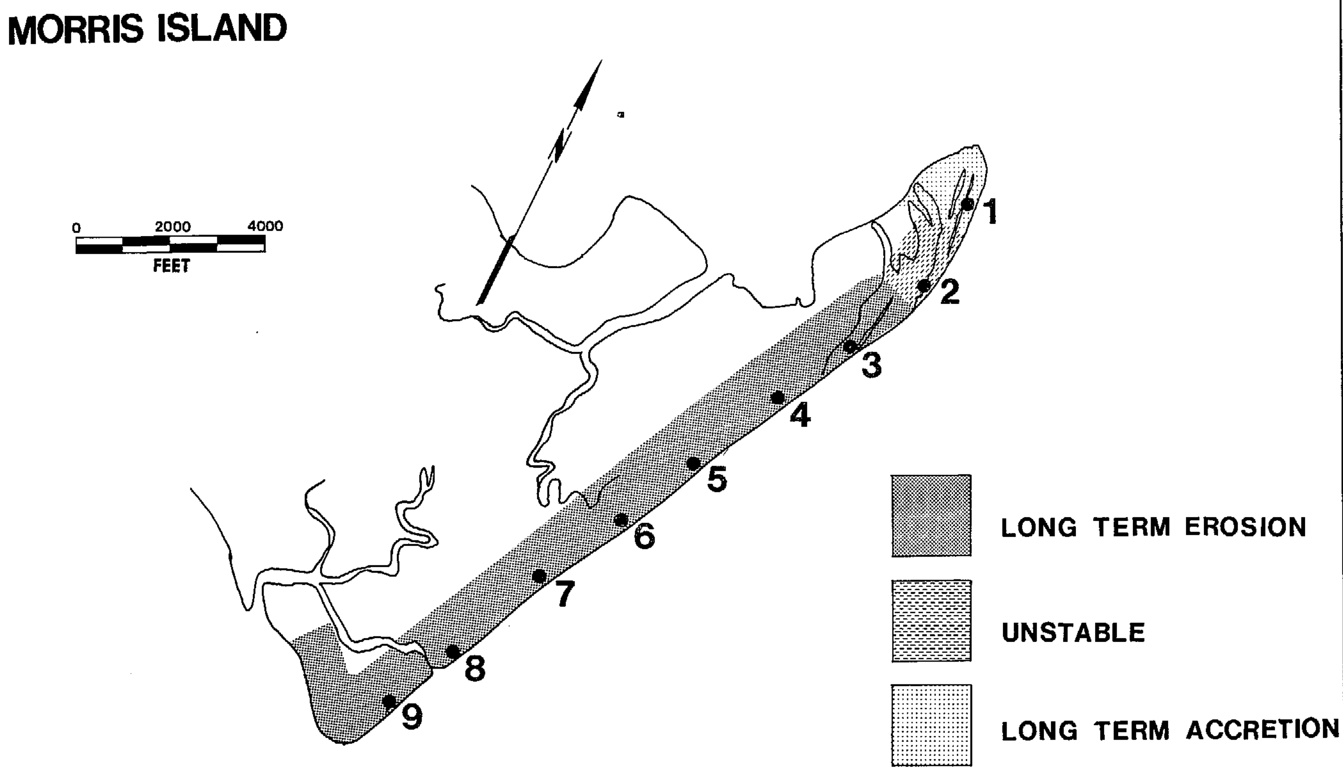


Figure 9.
SULLIVANS ISLAND

Figure 10.


MORRIS ISLAND
0
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4000
FEET
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3
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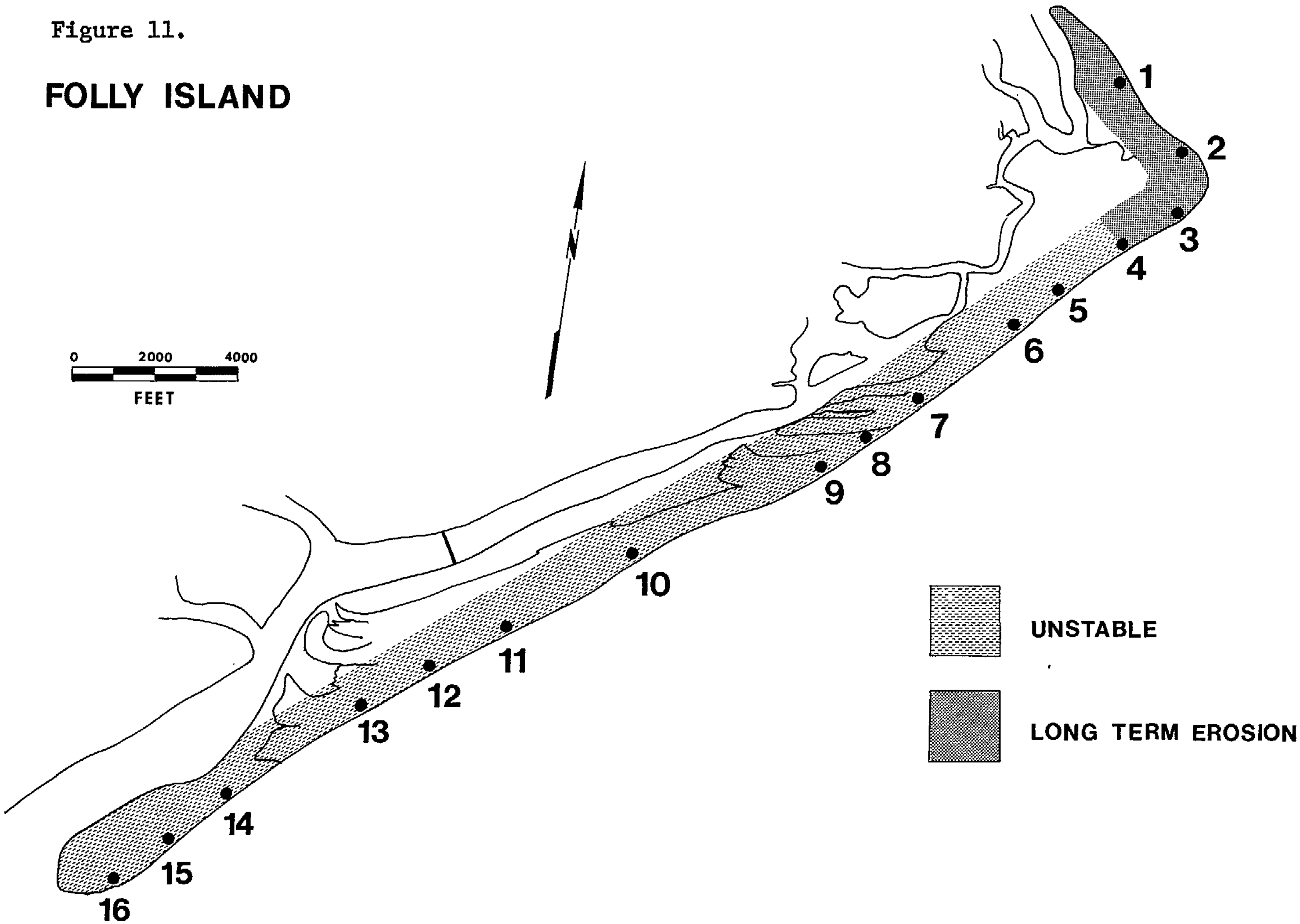
5
6
7
8
9
LONG TERM EROSION
UNSTABLE
LONG TERM ACCRETION

Figure 11.


FOLLY ISLAND
0
2000
4000
FEET
1
2
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4
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6
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8
9
10
11
12
13
14
15
16
UNSTABLE
LONG TERM EROSION

Figure 12.

KIAWAH ISLAND

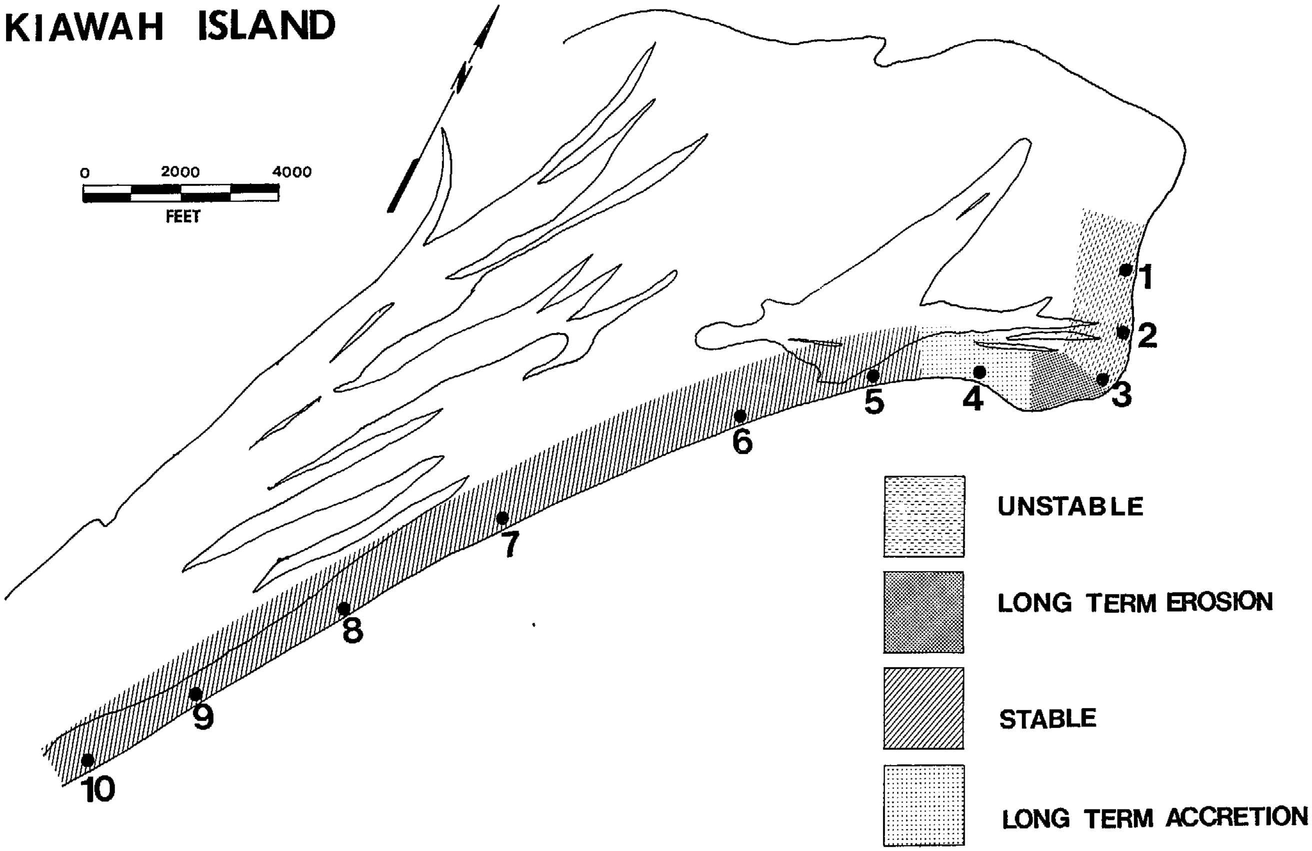
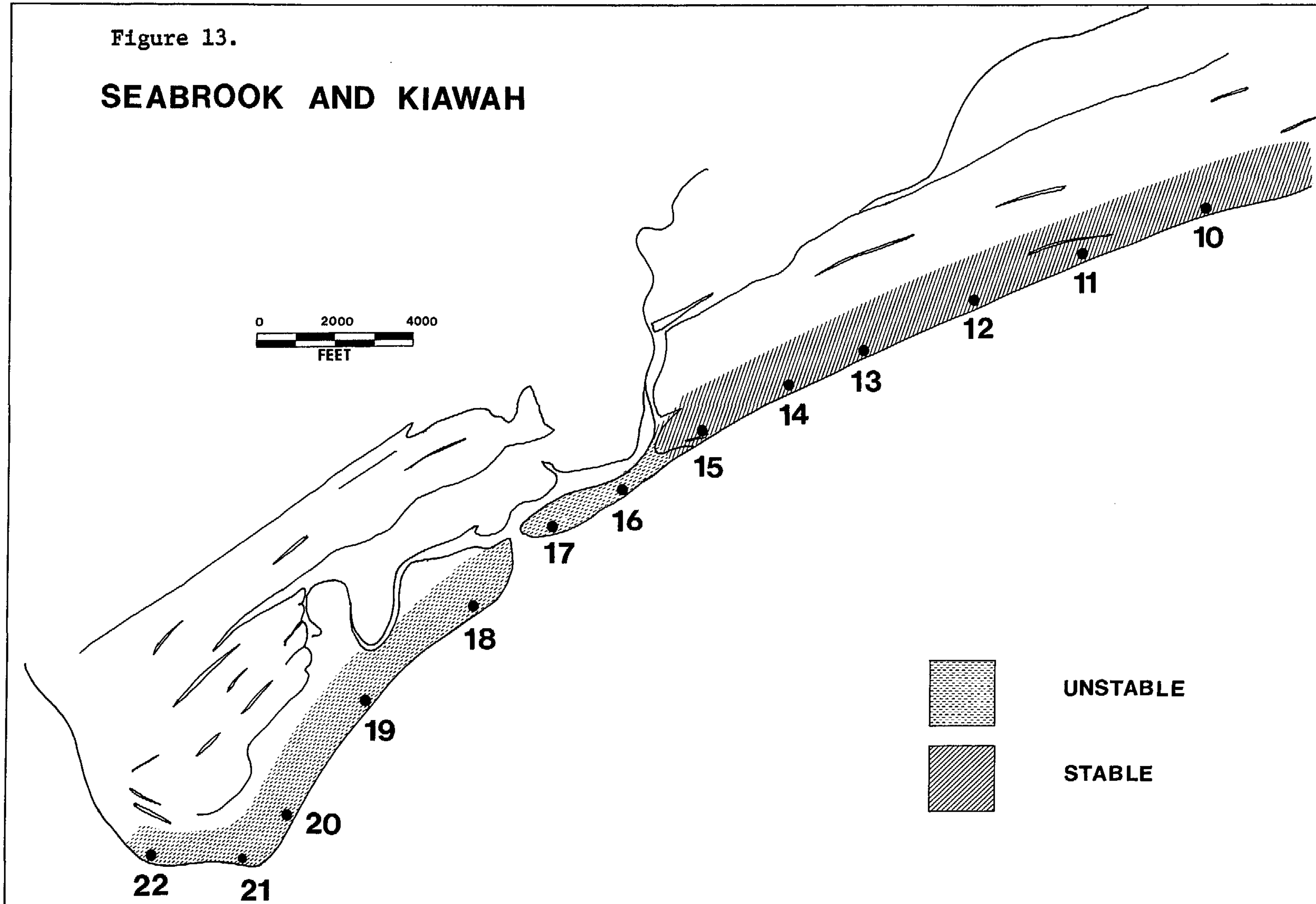


Figure 13.

SEABROOK AND KIAWAH



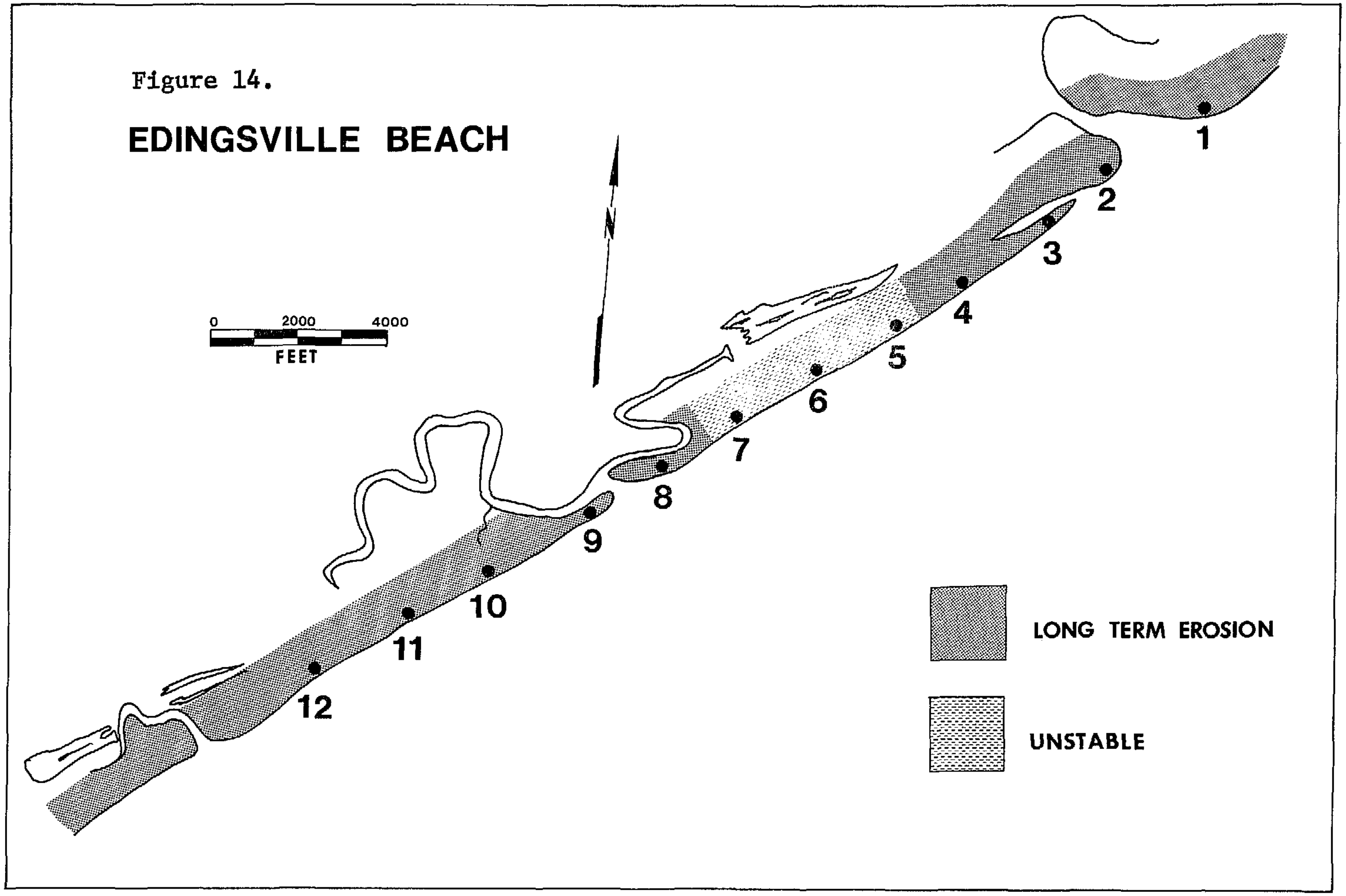


Figure 14.

EDINGSVILLE BEACH

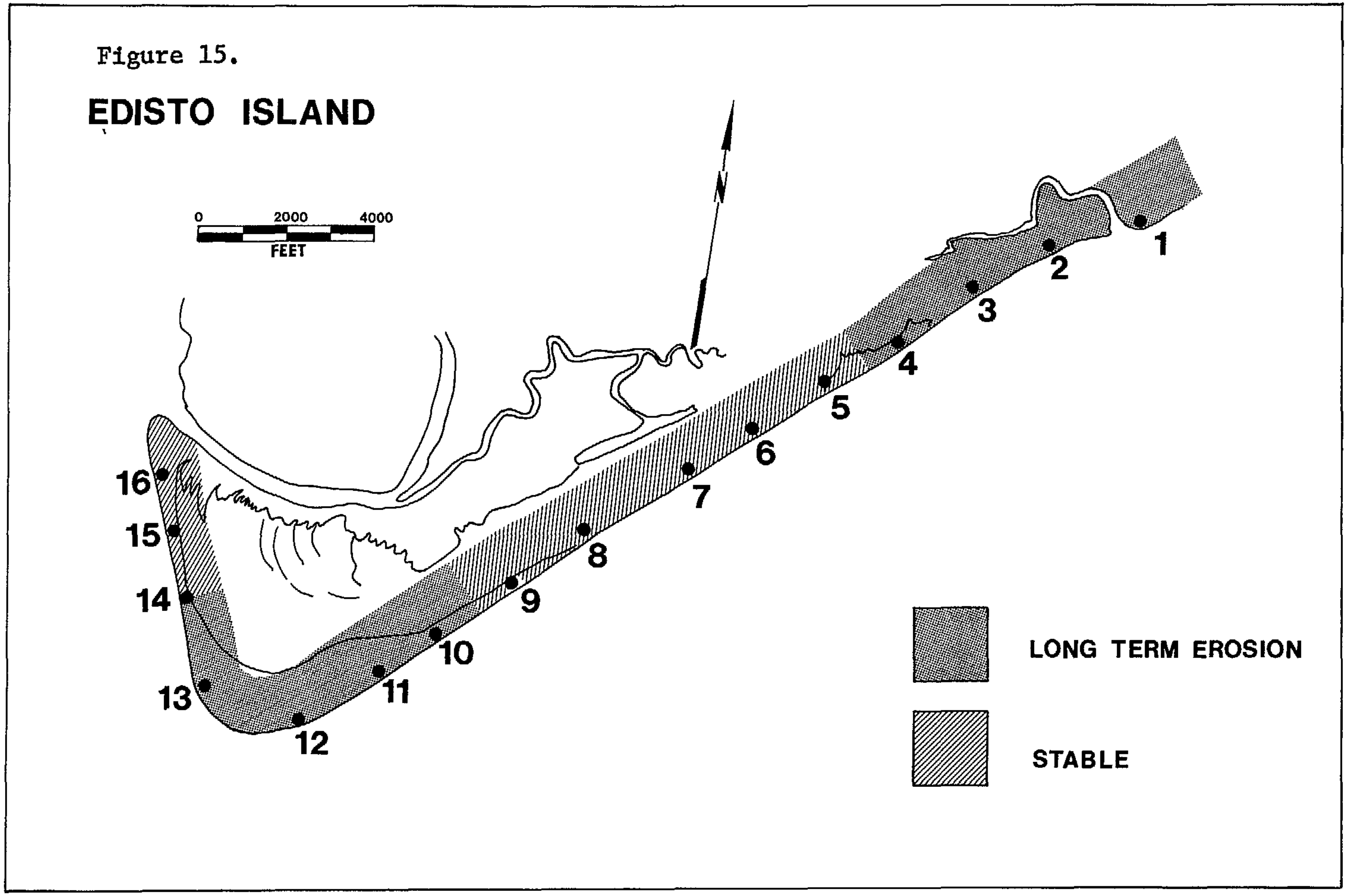


Figure 15.

EDISTO ISLAND

erosion and gradually migrated onto the beach causing the depositional trends shown in graphs 1, 2, and 3 (Fig. 16). Over 1000 ft of accretion also occurred in a reentrant about one mile to the south of the area covered by graph 9 because of swash bars filling the reentrant and straightening the shoreline. Some of this sediment was possibly derived from the erosional areas to the northeast (graphs 4-7) which lost up to 300 ft of beach during the study interval. The southwestern portion of this island has been eroding for the past ten years.

Cape Romain

Cape Romain has undergone steady erosion during the interval of study. Sediment eroded from the vicinity of the Cape moves away in two directions, forming recurved spits to the north and to the west. At location 5 (Fig. 17), over 2000 ft of accretion has occurred since 1941; 450 ft of accretion has occurred at location 1. The remainder of the reference localities are erosional. Measured erosion rates are given in Appendix 1. Selected erosion graphs (Fig. 17) show the transitions that occur along the beach. Graphs 2 and 3 are similar; graphs 7 and 8 are similar; graphs 9 and 10 are similar; and graphs 10 and 11 are identical. Location 12 is stable in position. The recurved spit at location 13 was not present during the interval 1941-1963. This spit, which is over 4000 ft long, accumulated between 1941 and 1968 and grew at an average rate of about 145 ft per year.

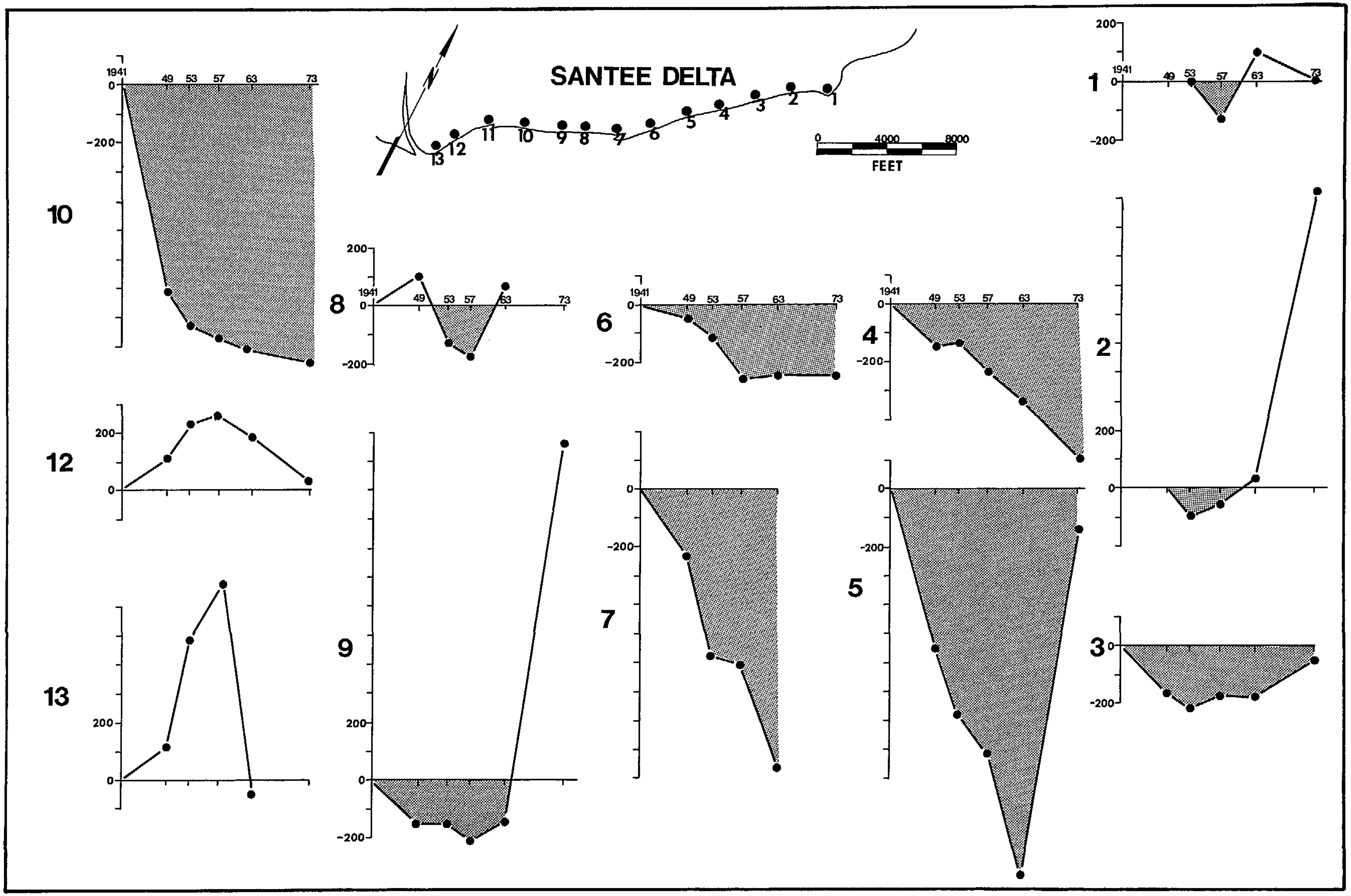
Raccoon Key

Raccoon Key is a transgressive shoreline whose beaches consist of eroding marsh mud, a low sand and shell berm, and washover terraces. Measured erosion rates range between 600 and 1500 ft. Graphs 1-6 (Fig. 17) clearly indicate long term erosional trends.

Bull Island

The northern end of Bull Island is comprised of vegetated beach ridges interspersed with low marsh. This end of the island, facing Bull Bay and the open ocean beyond, is directly exposed to wave attack and consequently has suffered over 350 ft of long term erosion, as is illustrated in graphs 1-4 (Fig. 18). The south central portion of the island is characterized by alternate erosion and deposition (graphs 5-9). In this area, as much as 200 ft of deposition or erosion may occur over a five year period. This section of beach is influenced by changes in the morphology of Price Inlet (Figs. 29 and 30), which is located two and one-half miles to the south. As the northern side of Price Inlet builds out by accumulating recurved spit systems, a zone of deposition migrates north along the beach (see Fig. 31). When the southern side of the inlet begins to accrete, the northern side erodes. This erosional trend often progresses up the beach away from the inlet. These large scale fluctuations are quite apparent close to the inlet (graphs 8 and 9). As much

Figure 16. Erosion-deposition graphs for Santee Delta area. Graph numbers indicate reference points located on the map at the top of the page. Erosional areas are shaded. Specific incremental erosion-deposition rates are listed in Appendix 1. Note the extreme variability among the graphs.


SANTEE DELTA
0
4000
8000
FEET
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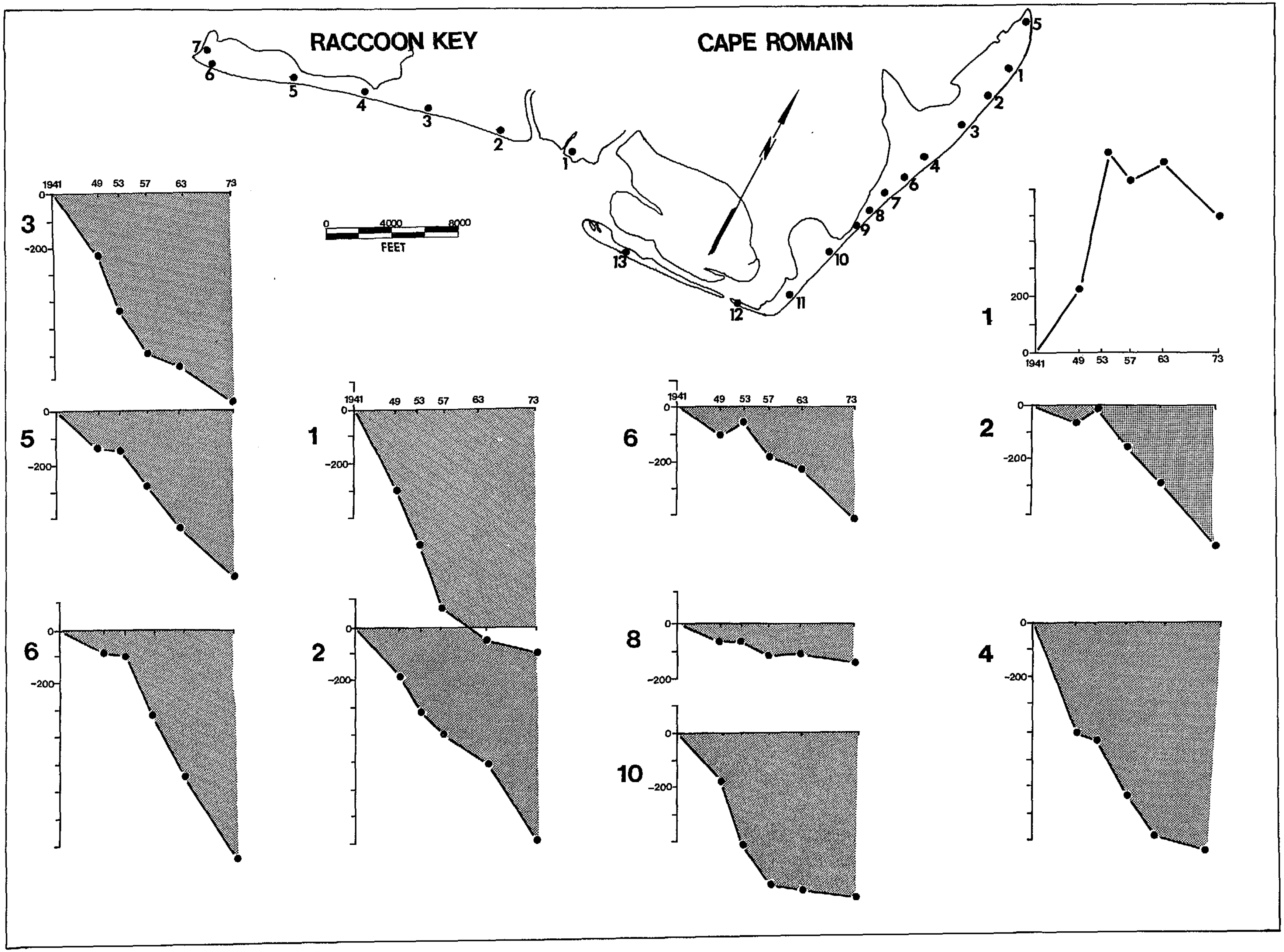
2
3
4
5
6
7
8
9
10
11
12
13
1941
49
53
57
63
73
200
0
-200

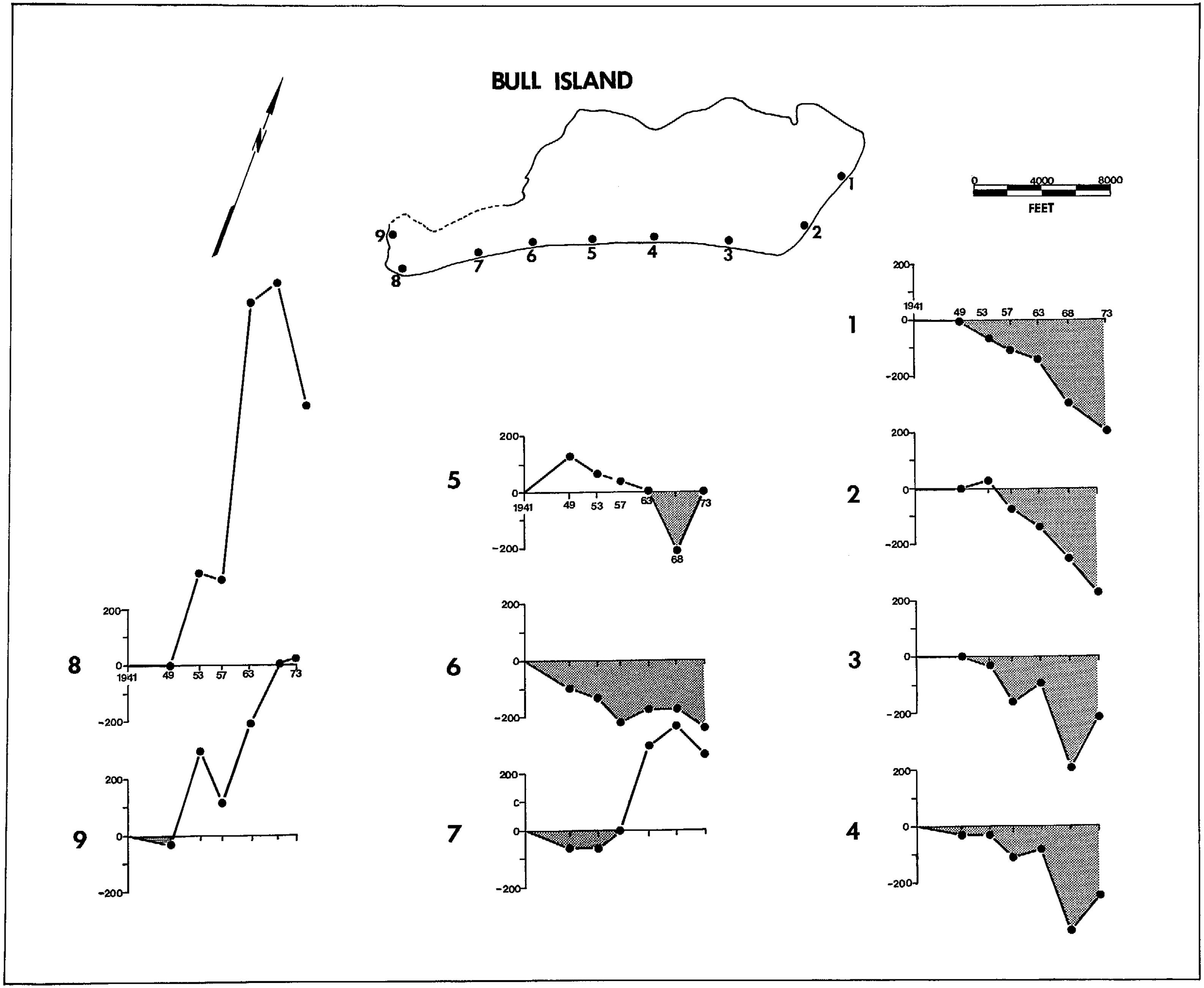
Figure 17. Selected erosion-deposition graphs for the Cape Romain-Raccoon Key area. Graph numbers for Cape Romain (1,2,4,6,8, and 10) refer to reference points 1-13 located on the map at the top of the graphs. Presented graphs are representative of trends which occur on the island. Specific shoreline change values are available for all reference points in Appendix 1. Shaded areas are erosional.

Raccoon Key graph numbers refer to reference points 1-7 on the map at the top of the graphs. Erosional areas are shaded. Specific incremental erosion-deposition rates are included in Appendix 1. Note the general erosional character of the profiles.



RACCOON KEY
CAPE ROMAIN
0 4000 8000
FEET
1941 49 53 57 63 73
0
-200
200

Figure 18. Erosion-deposition graphs for Bull Island. Graph numbers refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Note the extensive erosion at the north end of Bull Island, which is open from all sides to wave attack. Incremental rates and total erosion values are tabulated in Appendix 1.


BULL ISLAND
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FEET
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3
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5
6
7
8
9
200
0
-200
1941
49
53
57
63
68
73

as 1000 ft of deposition occurred between 1958 and 1963 at location 8 (Fig. 18). Tidal inlets and their associated sand bodies play a primary role in beach erosion and deposition and exert considerable control over barrier island morphology in South Carolina (Hayes, Hulmes, and Wilson, 1974).

Capers Island

This short, stubby barrier island has undergone erosion over most of its beaches during the entire time interval covered by this study. The beach face of Capers Island is covered with fallen dead trees, which have been uprooted from the eroding beach ridges along the island. Graph 1 (Fig. 19) is measured northeast into the inlet and exhibits erosion and deposition associated with slight oscillations of the inlet channel. The erosional trends of the seaward side of the island are clearly shown by graphs 2-5, which show beach erosion ranging between 300 and 1000 ft over the study period and acceleration of erosion with time as indicated by a steepening of the downcurve. Graph 6 measures the accretion of a spit system which is building into Capers Inlet to the southwest. The trend for graph 6 indicates a southward migration of Capers Inlet between 1949 and 1958, then a gradual retreat to the north over the past fifteen years.

Dewees Island

The erosional-depositional history of Dewees Island has been governed by the previously mentioned migrations of Capers Inlet. The southerly shift of Capers Inlet caused approximately 1400 ft of erosion on the northern end of Dewees Island (see graph 1, Fig. 20) by 1949. Sand transported from the northern end by a combination of tidal currents and wave driven longshore currents formed a bulge in the north central portion in 1949 (graph 2, Fig. 20). In subsequent years, wave refraction (Fig. 29) around the inlet ebb-tidal delta deposits caused localized reversals in the direction of longshore currents which began to move sediment northward. Recurved spits extended north from the bulge and a minor beach recovery occurred. The central and southern portions of Dewees Island are very erosional, having receded over 900 ft during the study interval.

Isle of Palms

The Isle of Palms has a large bulbous northern end which gradually narrows southward. The southern half of the island (Fig. 32) has been formed by the southerly migrations of sand building recurved ridges as Breach Inlet migrated south. A total of twenty-six reference points were measured on the Isle of Palms (Figs. 21 and 22). In scanning all the graphs one can observe a number of clusters or groups of similar erosion-deposition graphs. Such groups occur for all islands that have data points as closely spaced as the reference points on the Isle of Palms. Because of the large number of graphs, the island had to be divided into two portions (Figs. 21 and 22).

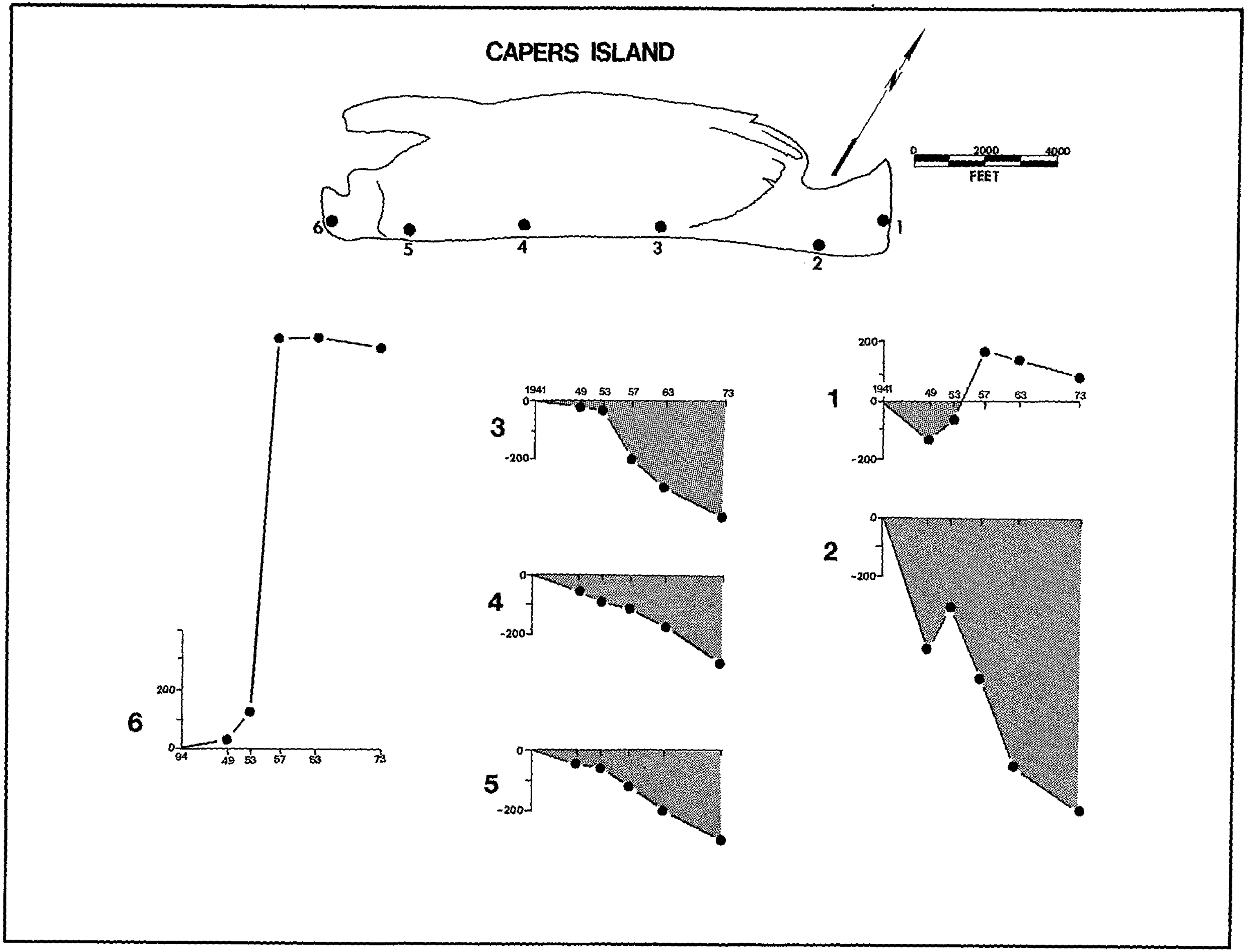
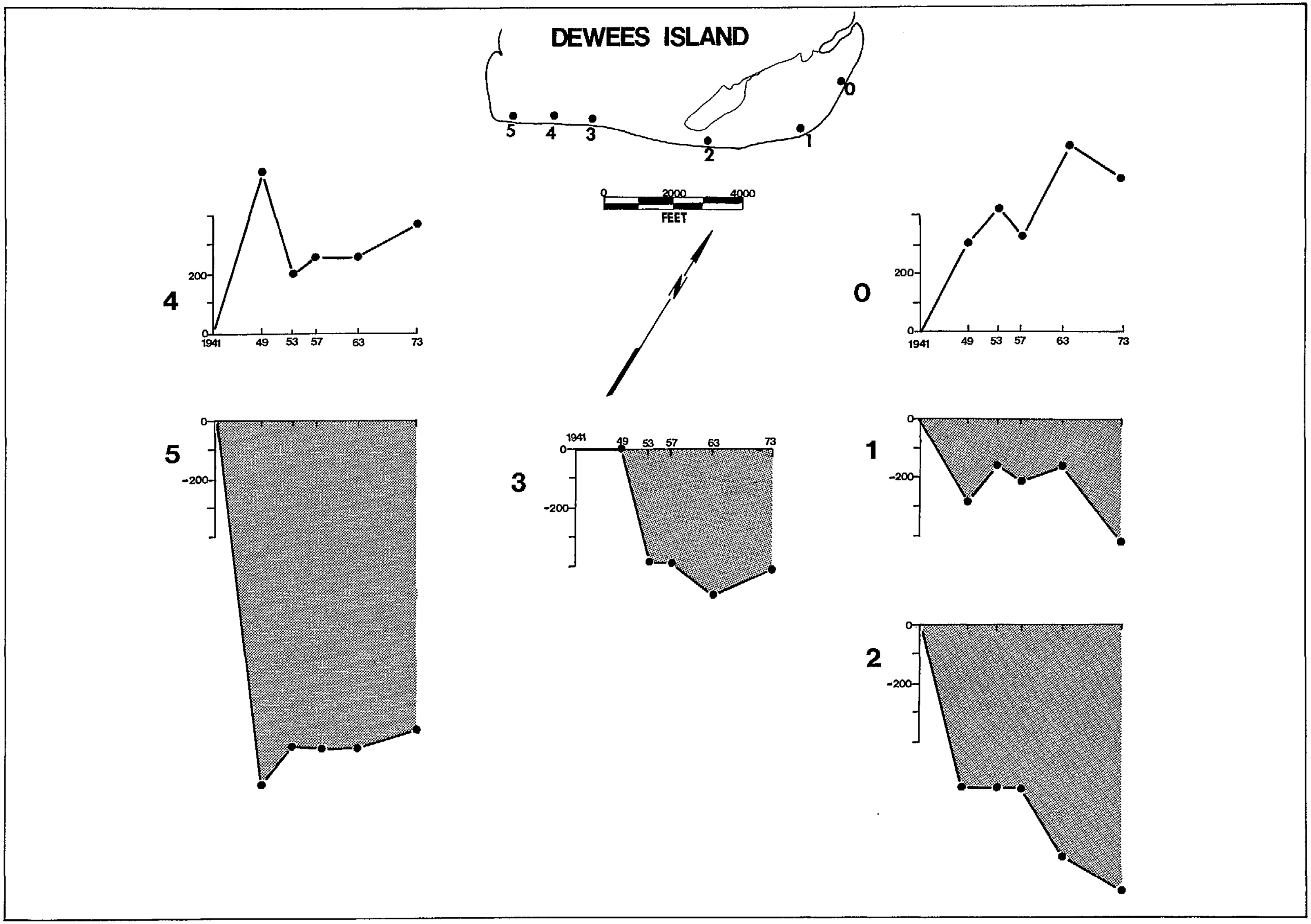


Figure 19. Erosion-deposition graphs for Capers Island. Graph numbers indicate the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the unstable character of the curves adjacent to Price Inlet and the general erosional trends along the central portion of the island.

Figure 20. Erosion-deposition graphs for Dewees Island. Numbers indicate the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the variable trends on the graphs. This island has been strongly affected by the migrations of Dewees Inlet to the north.


DEWEES ISLAND
0
2000
4000
FEET
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4
3
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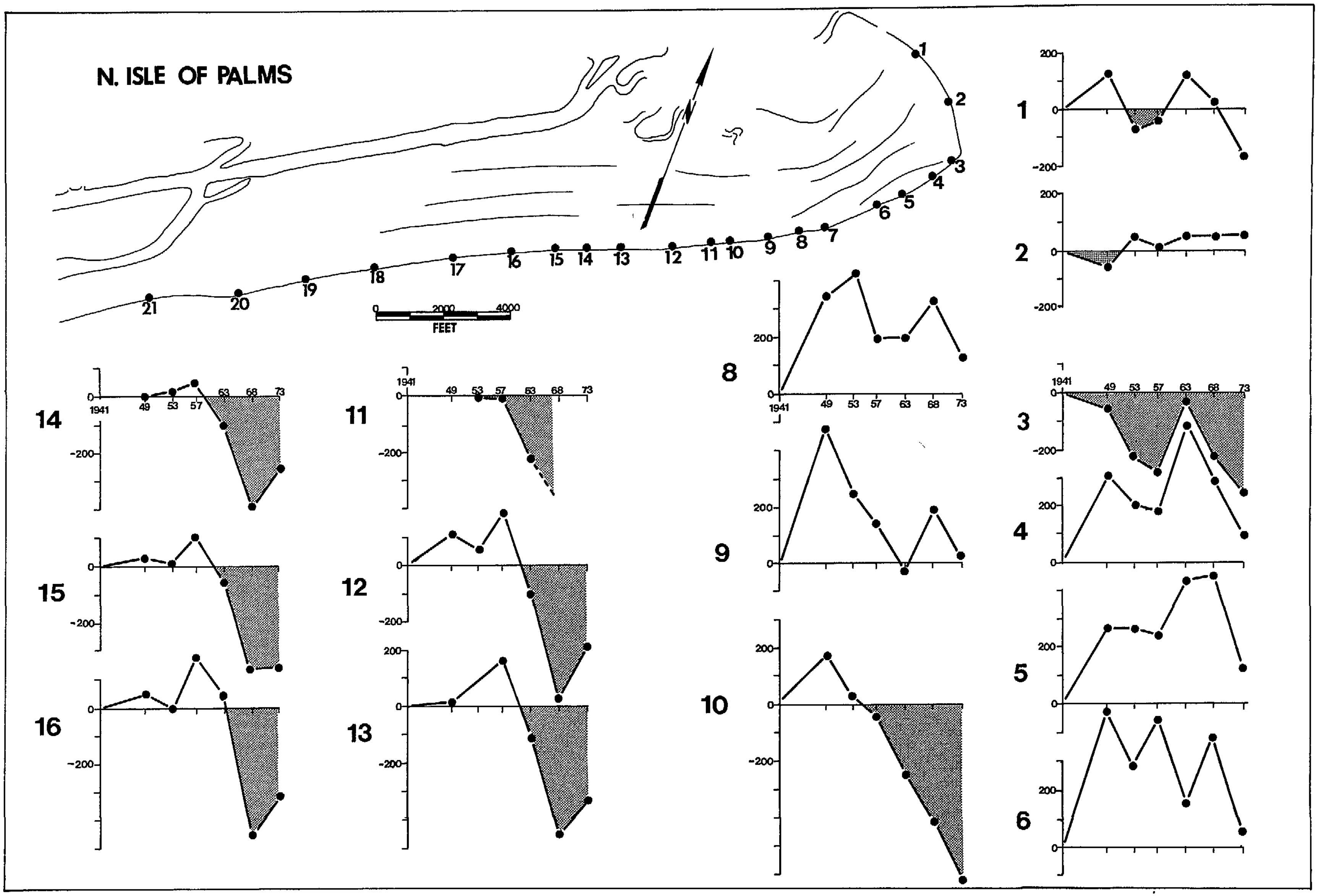
1
0
200
1941
49
53
57
63
73
-200

Figure 21. Erosion-deposition graphs for the North Isle of Palms area. Graph numbers indicate the corresponding reference points illustrated on the above map. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the extremely unstable graphs (1-8) at the far northern end of the island. Also of interest is the repetitive nature of several of the closely spaced graphs (e.g., 2-3, 5-6, and 11-15).



N. ISLE OF PALMS
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9
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11
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14
15
16
17
18
19
20
21
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FEET
1941
49
53
57
63
68
73
200
0
-200

The northern half of the island has been very unstable during the study interval. Measured erosion-deposition rates fluctuate wildly over the years studied. Graphs 6, 7, and 8 (Fig.21) show shoreline fluctuations of hundreds of feet back and forth. Because this portion of the island is adjacent to a tidal inlet, these fluctuations are not unexpected. Several years of deposition followed by several years of erosion are common in such areas. Graphs 9 and 10 show long term erosion, over 600 ft since 1949. These profiles are located in an area where longshore current direction reversals due to wave refraction are common. Sand is being carried away from this area in both directions. This point will migrate laterally along the beach as the ebb-tidal delta and the northern end of the island change shape. Graphs 11 to 15 show an unstable shoreline with erosion values as high as 500 to 600 ft between 1958 and 1968. Groins established in this area in the 1960's have stabilized the shoreline somewhat.

The southern end of the Isle of Palms is a large accretional recurved spit (Fig. 32). Breach Inlet lies directly southwest. The unstable areas (graphs 17, 18, and 19; Fig. 22) indicate gradual erosion following what had been relatively long accretional trends. Further south the graphs indicate long term deposition. The similarity of adjacent curves in Figure 22 indicates a high degree of accuracy.

Sullivans Island

This small island is nearly totally developed. Erosion at the northern end, due to southerly migration of Breach Inlet, has caused over 400 ft of beach loss (graphs 1-3, Fig. 23). Where the southern marginal lobe of the Breach Inlet ebb-tidal delta meets the beach, the shoreline trends are again highly unstable. Fluctuations up to 400 ft have occurred between 1963 and 1973 (graph 4, Fig. 23). Graphs 10-12 illustrate deposition of sand in front of and around the breakwater at the north side of Charleston Harbor. The breakwater undoubtedly acts as a barricade to sediment transport and has been a factor in the 700 and 800 foot accretional values. The graph for station 13 shows changes of the shoreline inside the harbor which is stabilized by riprap seawalls.

Morris Island

A detailed explanation of the causes of the severe erosion on Morris Island is given under the section on effects of modifications by man. Figure 24 speaks for itself. With the exception of the recurved spit building at the north end of the island, all of Morris Island is undergoing incredible erosion. Over 1600 ft of shoreline has been lost since 1939 at the southern end of the island (Fig. 33). This is an average of over 45 ft per year and, in our opinion, can be at least in part related to the construction of the Charleston Harbor jetties.

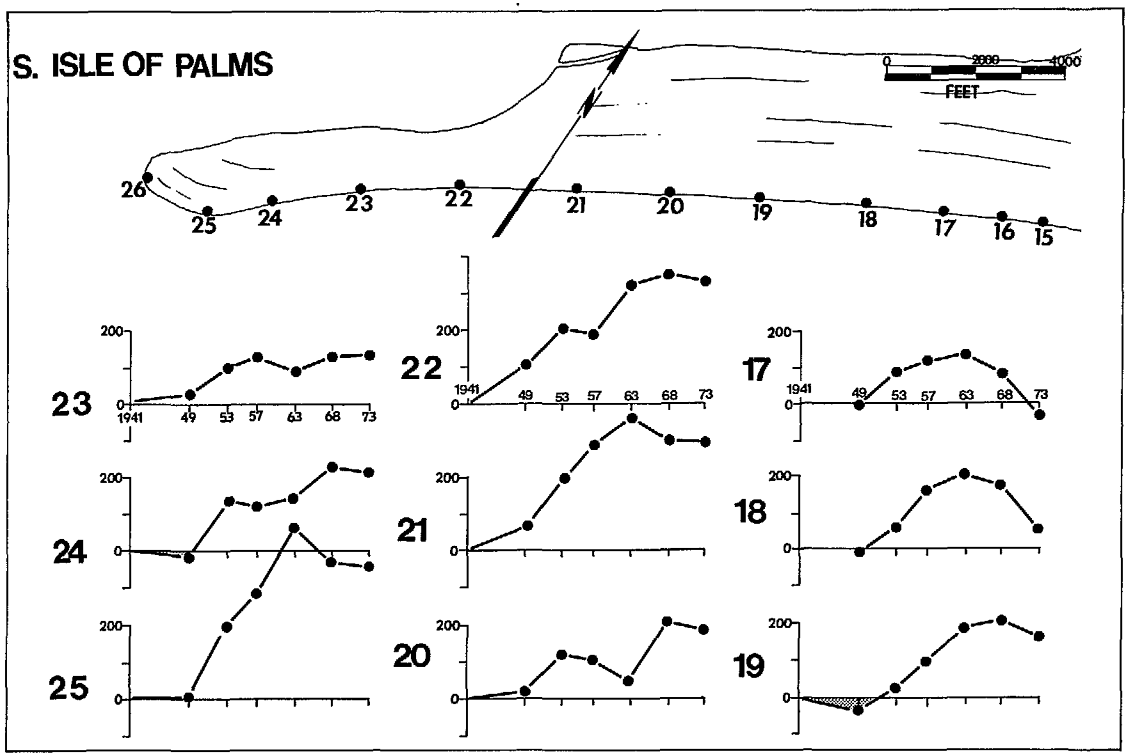


Figure 22. Erosion-deposition graphs for the South Isle of Palms area. Graphs number refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the accretional character of this end of the island. Deposition occurs as recurved spits weld to the beach. Again we must emphasize the repetitive nature of the closely spaced reference points. For this reason, several graphs have been omitted to avoid clutter in some of the more variable areas of coastline.

Figure 23. Erosion-deposition graphs for Sullivans Island. Graph numbers refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the erosion (graphs 1-3) due to southerly migration of Breach Inlet. Graphs 10-12 indicate accretion in the vicinity of the northern Charleston Harbor jetty.

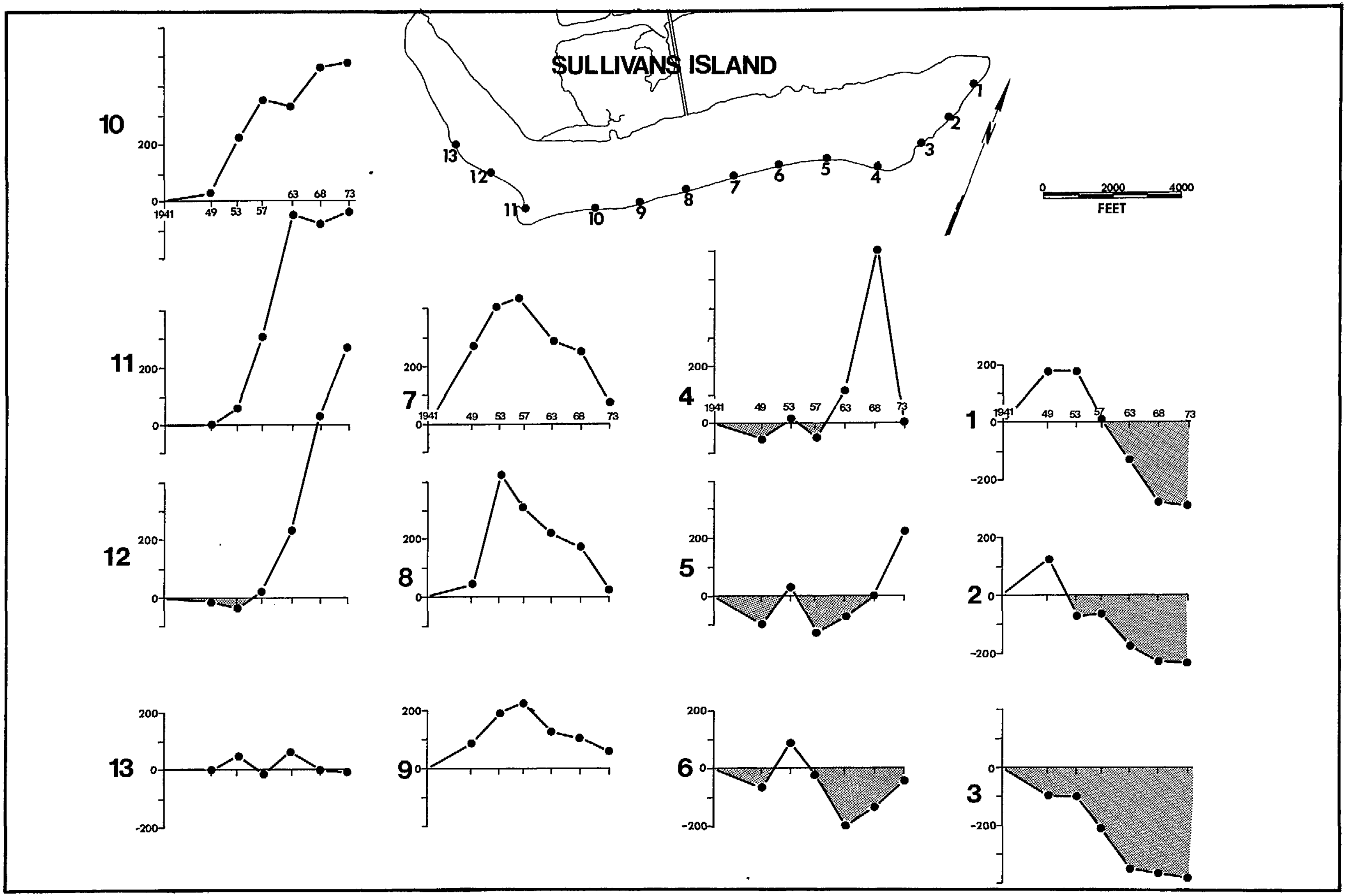
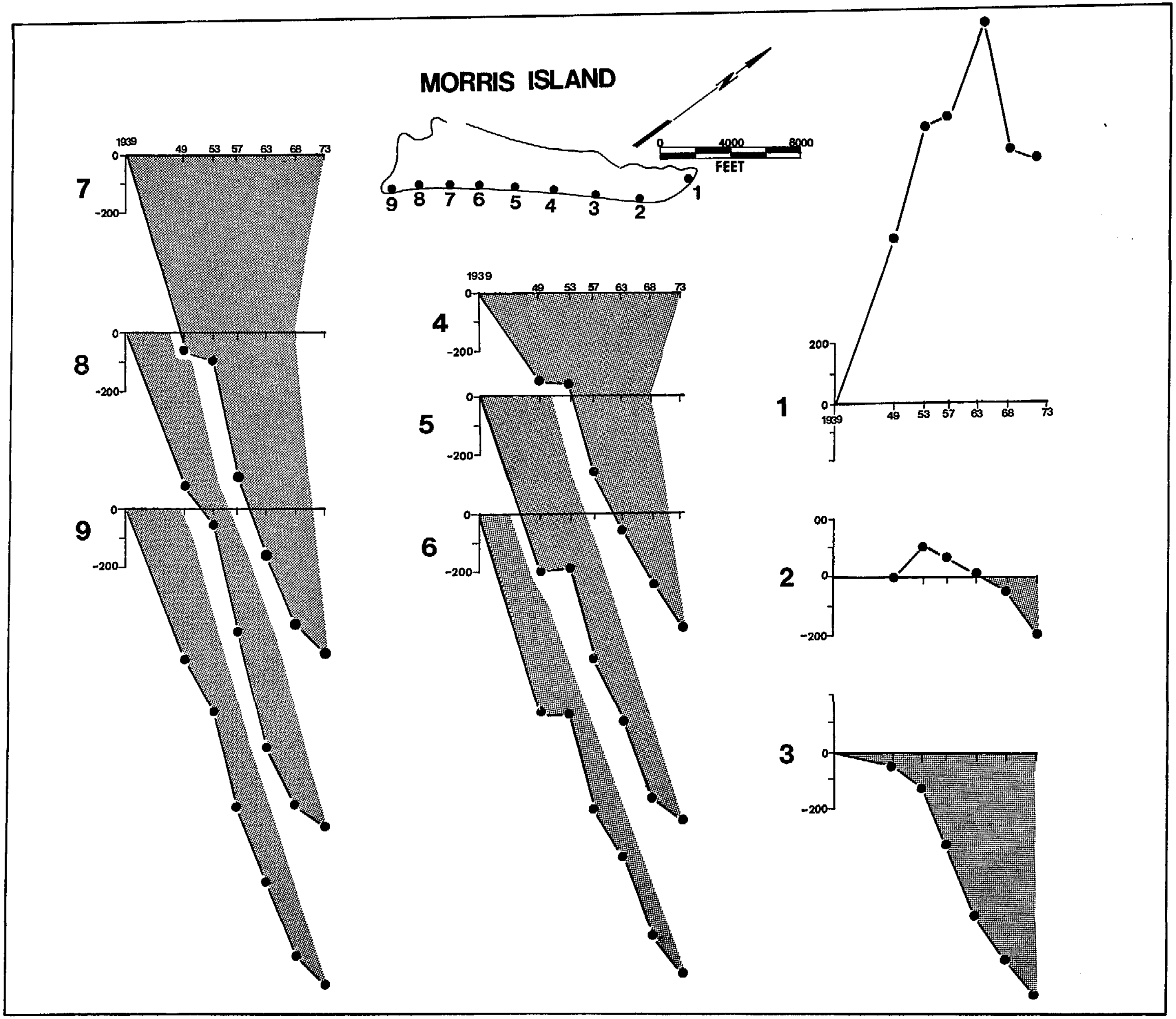

SULLIVANS ISLAND
1
2
3
4
5
6
7
8
9
10
11
12
13
0
2000
4000
FEET
200
0
-200
1941
49
53
57
63
68
73

Figure 24. Erosion-deposition graphs for Morris Island. Graph numbers refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Graph 1 represents deposition of a recurved spit prograding into Charleston Harbor. The extremely large erosion values are due to changes in tidal current patterns and erosion because of the construction of the Charleston Harbor jetties.


MORRIS ISLAND
0 4000 8000
FEET
9 8 7 6 5 4 3 2 1
1939 49 53 57 63 68 73
0
-200
200
7
8
9
4
5
6
1
2
3

Folly Island

Prior to construction of the Charleston Harbor jetties, sand shoals offshore protected Folly Island from wave attack. If erosion did occur, the beaches had material nearby to replenish them. Since construction of the jetties, erosion has been extensive (see discussion below). As the island developed, roads and houses were placed relatively near the beach.

Jetty construction, loss of protective sand shoals to erosion, and reductions of longshore transport past Charleston Harbor have caused erosion on Folly Beach similar to that described above for Morris Island. Fortunately, on Folly Island the effects have not continued to be as severe as on Morris Island. Folly Beach now seems relatively stabilized. Only hurricanes severely affect most of the island. In 1940, a hurricane caused an average recession of 75 ft along the beach front, and in 1959 hurricane erosion varied between 35 and 50 ft (U.S. Army Corps of Engineers, 1965). Because of the spacing of the photographic years, it is difficult to identify these specific erosion periods on the graphs in Figure 25. However, a general erosional or unstable trend is apparent in most of the graphs. Gradual southerly migration of Lighthouse Inlet is illustrated in graphs 1 and 2 (Fig. 25). The recession rates of up to 1000 ft shown in graphs 3 and 4 are a result of inlet migrations. The remaining graphs indicate slightly unstable to stable conditions.

Kiawah and Seabrook Islands

Kiawah Island, unlike many of the barrier islands in Charleston County, has a relatively stable shoreline. The northeastern end of this barrier island has accreted approximately 4000 ft during the period 1890 to 1940 (FitzGerald, in press). The sediment involved in this deposition process is thought to have been derived from erosion of the islands to the north, Morris and Folly. Starting in the late 1930's, the beach at localities 1-3 (Fig. 26) began to erode and has continued at an average rate of 55 ft per year, resulting in approximately 1900 ft of erosion and a general straightening of this section of the shoreline. Present day erosion is evidenced by exposed marsh clays outcropping on the beachface.

Graphs 5-15 illustrate the present relative stability of the central portion of the island away from the influence of Stono Inlet to the north and Kiawah River Inlet which separates Kiawah and Seabrook islands. Between 1890 and 1940, this section of coast accreted 400 ft at location 14 and approximately 2000 ft at location 5 (FitzGerald, in press).

One severe shoreline change, which the erosion-deposition graphs do not clearly show but which is indicated in the tables in Appendix 1, is the lateral migration of Kiawah River Inlet. Between 1939 and 1973 the inlet has migrated up and down the beach in the vicinity of locations 15, 16, and 17. During periods of constructional wave activity, the inlet migrates southwestward in the direction of dominant longshore transport (Fig. 35). When storm waves are

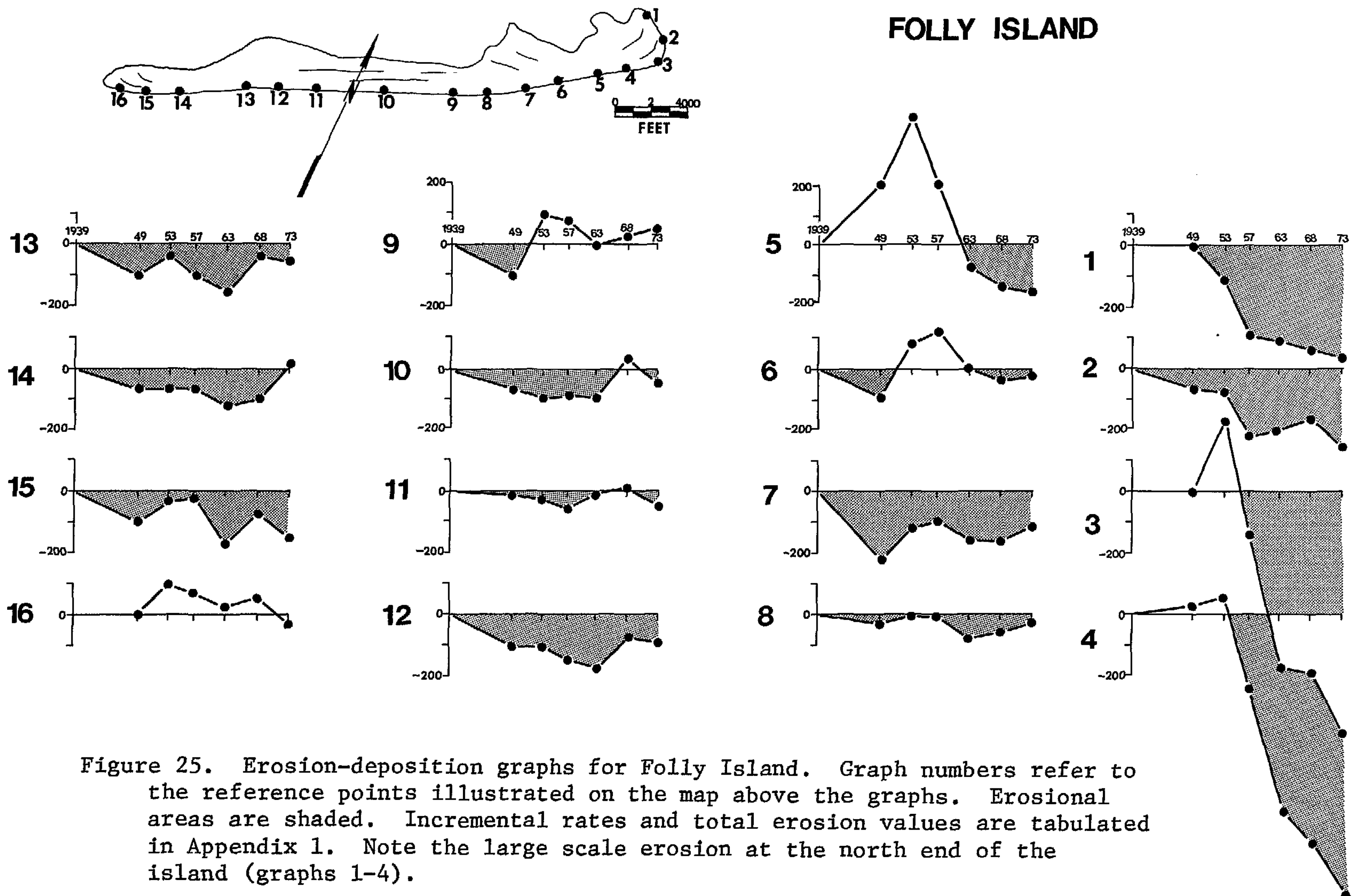
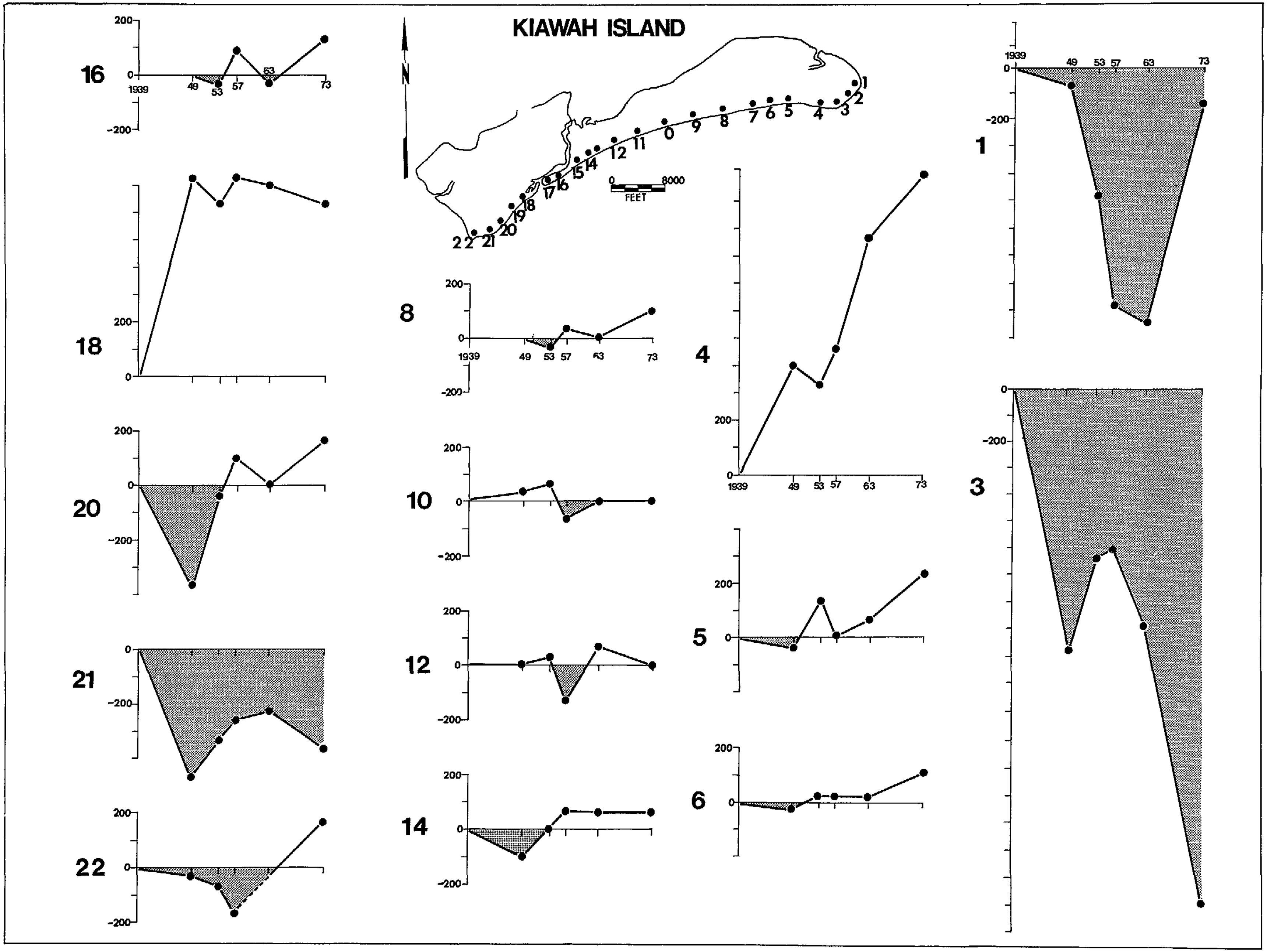


Figure 25. Erosion-deposition graphs for Folly Island. Graph numbers refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the large scale erosion at the north end of the island (graphs 1-4).

Figure 26. Erosion-deposition graphs for Kiawah Island. Graph numbers refer to the reference points illustrated on the map above the graphs. Erosional areas are shaded. Incremental rates and total erosion values are tabulated in Appendix 1. Note the large scale erosional (graphs 1 and 3) and depositional (graph 4) trends at the north end of Kiawah Island. These fluctuations are related to changes in Stono Inlet. The midsection of Kiawah Island is stable.


KIAWAH ISLAND
N
0
8000
FEET
1
2
3
4
5
6
7
8
9
10
11
12
14
15
16
17
18
19
20
21
22
200
0
-200
1939
49
53
57
63
73

prevalent, the recurved spit may be breached or eroded back.

The beaches of Seabrook Island are unstable, as shown in graphs 20-22 (Fig. 26), and are strongly influenced by Edisto River Inlet which forms its southwestern boundary.

Edingsville Beach - Botany Bay Island

The overall character of this section of shoreline has been one of continued erosion. The beaches consist of sand and reworked shell material eroded from oyster beds exposed on the beach face as the shoreline transgresses over tidal marsh (Fig. 36). Storm waves overtop the low berm, producing a 20-50 meter wide washover terrace. Marsh clays outcrop along the beach face. Erosion-deposition graphs on Figure 27 indicate 200-300 ft of erosion at all localities except graph 6. Between 1949 and 1954, the closing of a small inlet permitted accretion of over 200 ft at station 6. This area has eroded approximately 500 ft since that time.

The tidal inlets in this area are created when the shoreline recession causes the beach to intersect tidal creeks in the marsh. These inlets are too small to have ebb-generated sand deltas of sufficient size to act as natural breakwaters, cause significant wave refraction, or afford protection to adjacent beaches.

Edisto Island

Edisto Island, stabilized by man made groins and seawalls, was extremely stable during the study interval. Graphs 3-11 (Fig. 28) show less change than at any other locality in Charleston County. Small scale erosion has occurred near an inlet at the northern end of the island where the island sediment grades into the marsh complex of Edingsville Beach to the north. The only significant erosion on Edisto Island occurs at the southern tip, which is exposed to the open waters of the Atlantic Ocean and St. Helena Sound. Graphs 12 and 13 both indicate over 200 ft of erosion during the study interval. One hurricane, which occurred in 1940, caused erosion ranging between 30 and 100 ft at Edisto Beach (U. S. Army Corps of Engineers, 1967). However, recovery had occurred between the years of photographic coverage so the presented graphs do not show this change.

MODIFICATIONS BY MAN

In Charleston County, South Carolina, the largest structures actually affecting erosion and deposition in the coastal zone are the Charleston Harbor jetties. Built at the turn of the century between 1896 and 1904, they have caused profound changes in the character of the shoreline south of Charleston for a distance of 10-15 miles. Prior to jetty construction, a large shoal built by tidal currents ebbing out of Charleston Harbor extended 5-6 miles south of the harbor entrance. This shoal acted as a buffer against

Figure 27. Erosion-deposition graphs for Edingsville Beach. Graph numbers indicate the reference points illustrated on the map above the graph. Erosional areas are shaded. To avoid repetition, selected graphs are presented. Refer to Appendix 1 for a complete tabulation of erosion values and total erosion for all reference points. This section of coastline has undergone continual erosion throughout the entire study interval.

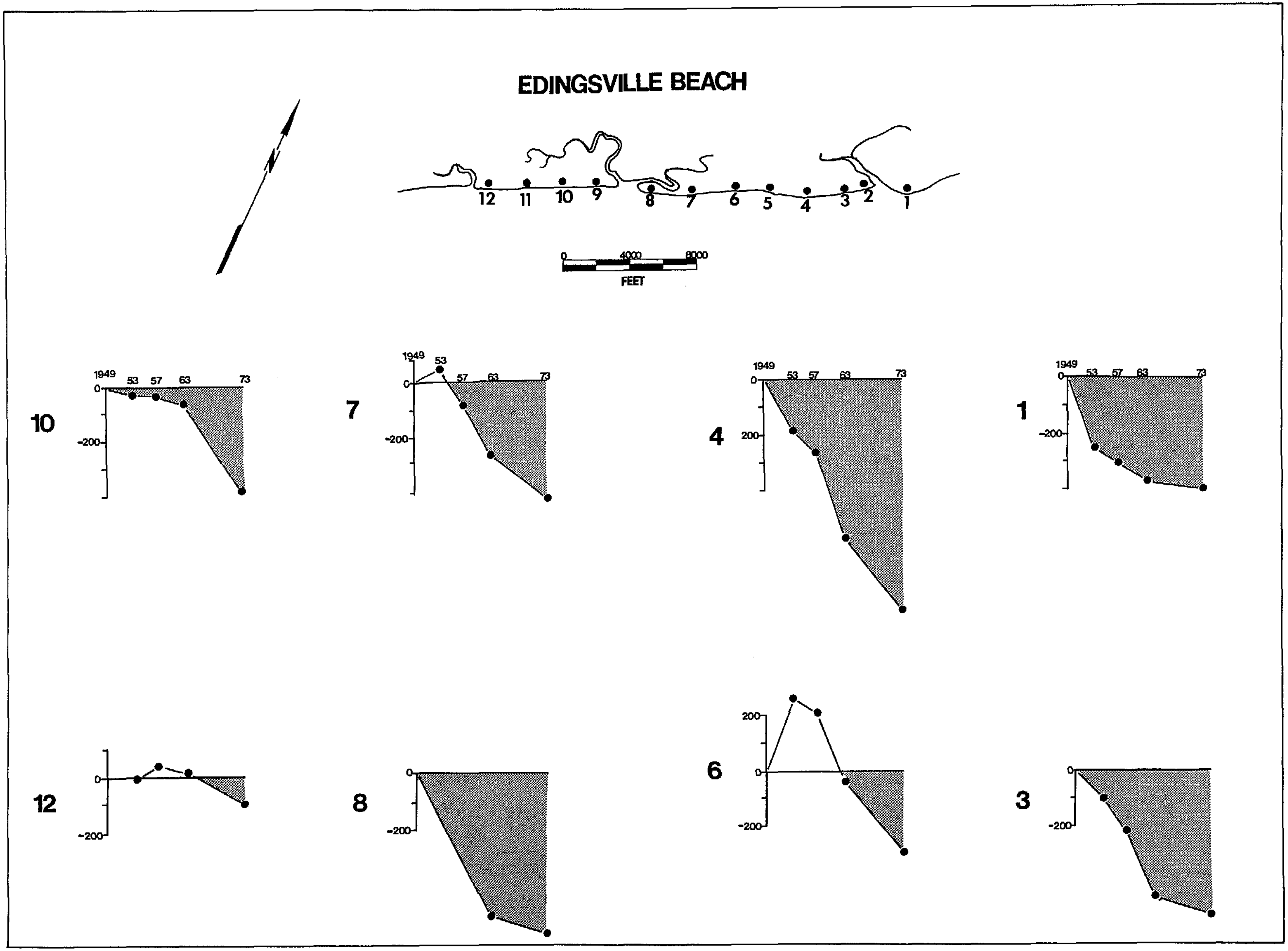
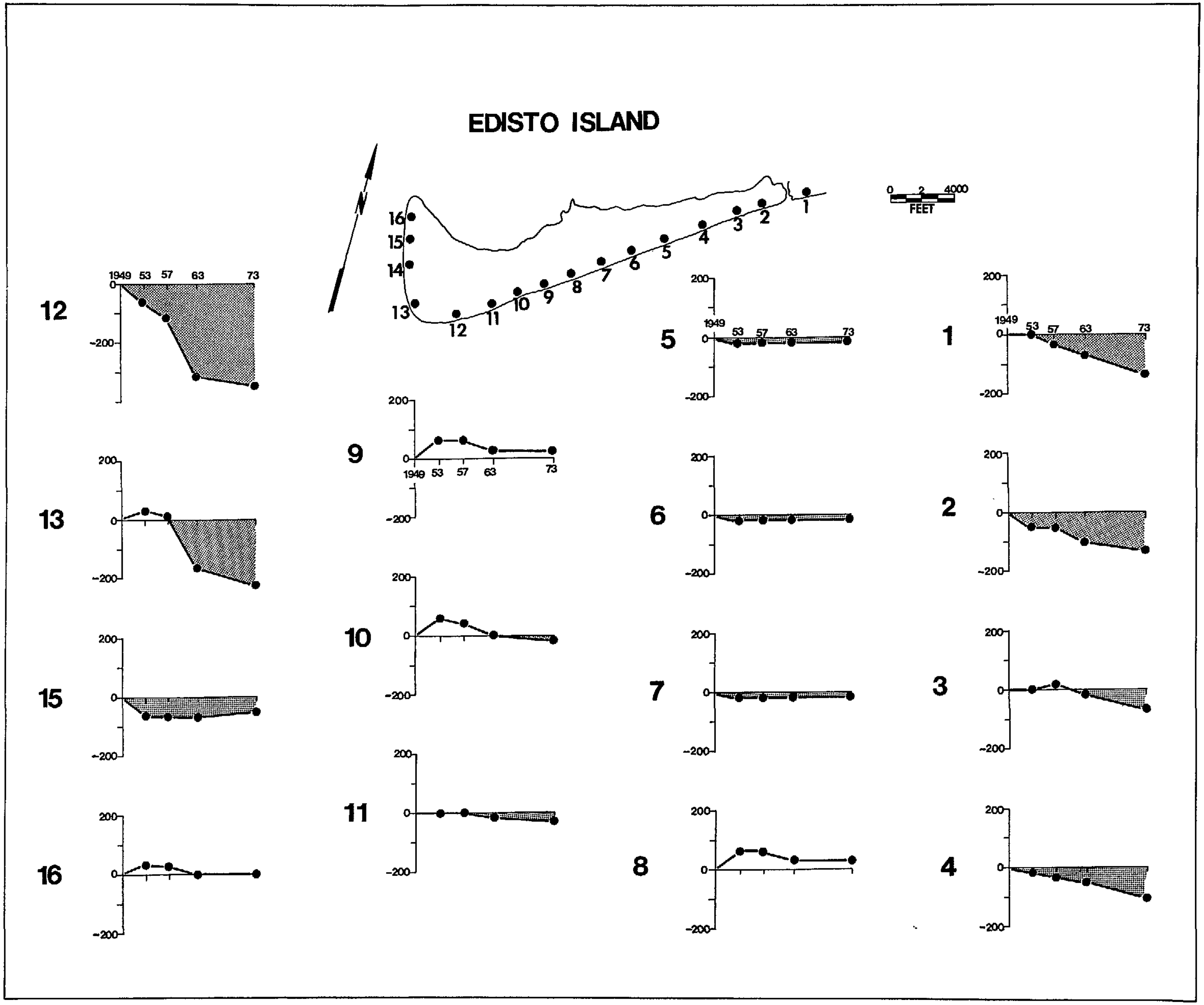

EDINGSVILLE BEACH
12 11 10 9 8 7 6 5 4 3 2 1
0 4000 8000
FEET
10
7
4
1
12
8
6
3
1949
53
57
63
73
0
-200
200

Figure 28. Erosion-deposition graphs for Edisto Island. Graph numbers indicate the reference points illustrated on the map above the graph. Erosional areas are shaded. Refer to Appendix 1 for a tabulation of incremental erosion for each reference point. Note the overall stability (graphs 5-11) of this island. The beach is dotted with a series of groins which help stabilize the shoreline.


EDISTO ISLAND
0 2 4000
FEET
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
1949 53 57 63 73
200
0
-200

wave attack along the coast and provided a tremendous reservoir of sand. Since construction of the jetties, the tidal current patterns and wave driven currents which maintained the shoal have been altered, causing erosion and loss of this shoal. In addition, sediment which accumulates in the modern Harbor entrance is dredged and dumped offshore, effectively reducing the supply of sand needed to maintain beach equilibrium to the south. These activities have no doubt accentuated the incredible erosion rates observed on Morris Island (Fig. 24) and the erosion which occurs on Folly Island (Fig. 25). Some of the sediment eroded from these islands has been trapped in Stono River Inlet and ultimately added to the north end of Kiawah Island. Design criteria for structures of this type to be built on the South Carolina coast in the future should allow for such predictable side effects. Sand by-pass systems have been employed in some areas of the country to prevent erosion after jetty construction.

Other protective structures common in Charleston County are groins and seawalls. Groins are present on the south end of Edisto Beach, Folly Beach, and on a small section along the north central part of the Isle of Palms. Their general effect is to stabilize the coastline. However, groins are not effective in all cases. A series of groins placed along the north side of Sullivans Island to prevent erosion by the migration of Breach Inlet has had little effect.

Seawalls are present along some sections of developed beaches in Charleston County. Seawalls stabilize the position of the shoreline but often cause an overall lowering or flattening of the beach profile. At high tide, the waterline is up against the concrete or riprap which forms the seawall, and, as a result, these areas are unsuitable for swimming and sunbathing.

Erosion rates measured in northern Charleston County along the Santee Delta and Cape Romain are partially due to man's influence. Sediment supplied to this area was reduced when dams were constructed on the rivers, and the course of the Santee River was diverted into Charleston Harbor. Prior to the diversion, the Santee River provided sediment to the Santee Delta and Cape Romain areas.

Modifications to the shoreline by man can have serious harmful effects on adjacent beaches. Such modifications should be made only when absolutely necessary. Structures such as groins and seawalls should be used judiciously, for their implementation sometimes causes more problems than benefits.

GENERAL SUMMARY

Certain generalizations are possible regarding the overall trends of erosion and deposition in Charleston County. Depositional trends are most likely to occur at the downdrift ends of barrier islands. Although drift reversals do occur, over most of South Carolina the trend of longshore sediment transport is to the south. Deposition occurs as sediment in recurved spits is welded to the shoreline as spits successively migrate southward. At Cape Romain recurved spits have prograded in two opposite directions because of the unusual shoreline orientations at the Cape.

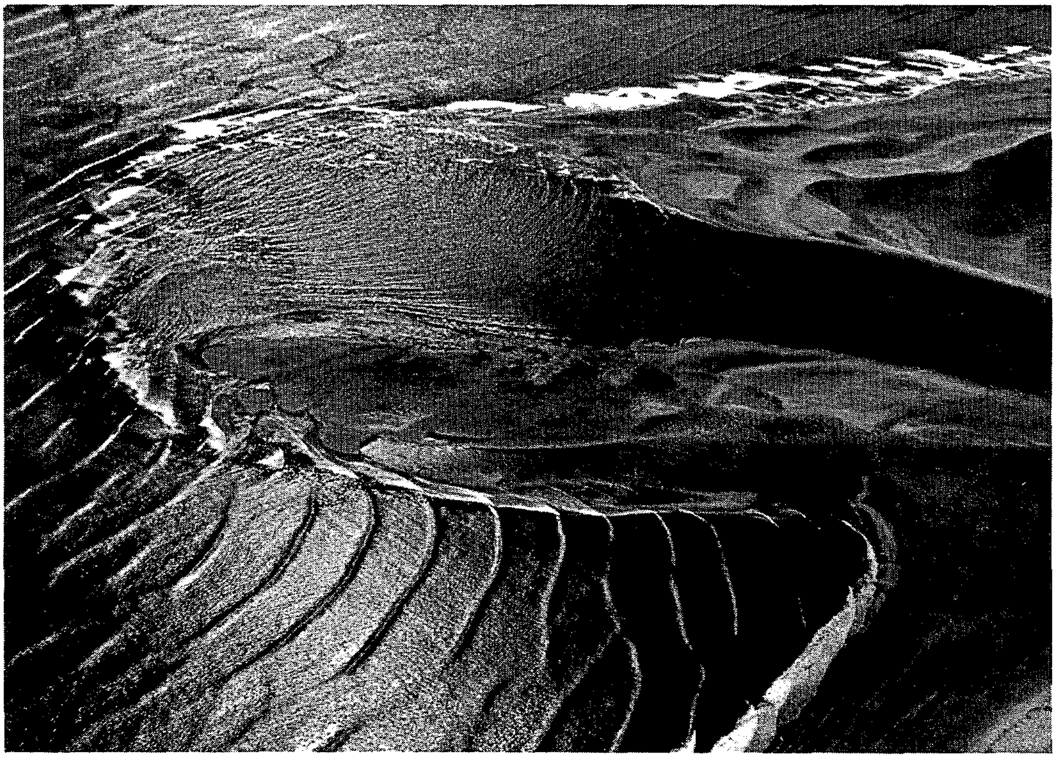
Erosional areas are related to several factors. At Cape Romain, Raccoon Key, Morris Island, and Edingsville Beach, erosion is taking place along marsh shorelines. Erosion at the Santee Delta, Cape Romain, and on Morris Island can be related to the reduction of sediment supply discussed in the previous section on modifications by man. In other areas the erosion is related to the fact that the beaches are exposed to severe wave attack from large stretches of open water. This is true for northern Bull Island, Cape Romain, and the southern tip of Edisto Beach.

Without exception, highly unstable areas are related to the presence of tidal inlets. Lateral migration of inlets, wave refraction around inlet-associated shoals and changes in inlet morphology all cause rapid and large scale erosional-depositional fluctuations in areas associated with inlets. In places, such as at Bull Island, these effects can modify the beaches up to two miles away from the inlet.

Stable shorelines occur along the central portions of the larger islands. These beaches are far away from tidal inlets. Also, some stable areas are the result of large monetary expenditures to construct groins and seawalls to hold the sand in place and prevent movement of the shoreline position.

Figure 29. Price Inlet, South Carolina. Wave crests of incoming waves are refracted (bent) as they move over and around shoals formed by ebb-tidal currents at the mouth of the inlet. View looks south. Photograph taken January 7, 1975.

Figure 30. Ebb-tidal delta sand body, Price Inlet, South Carolina. Ebb-tidal currents flowing out of the straight central channel deposit sand which forms the large lobate shoal shown in the photograph. Note wave refraction and recent deposition on the upper side of the inlet. View looks south. Photograph taken January 7, 1975.



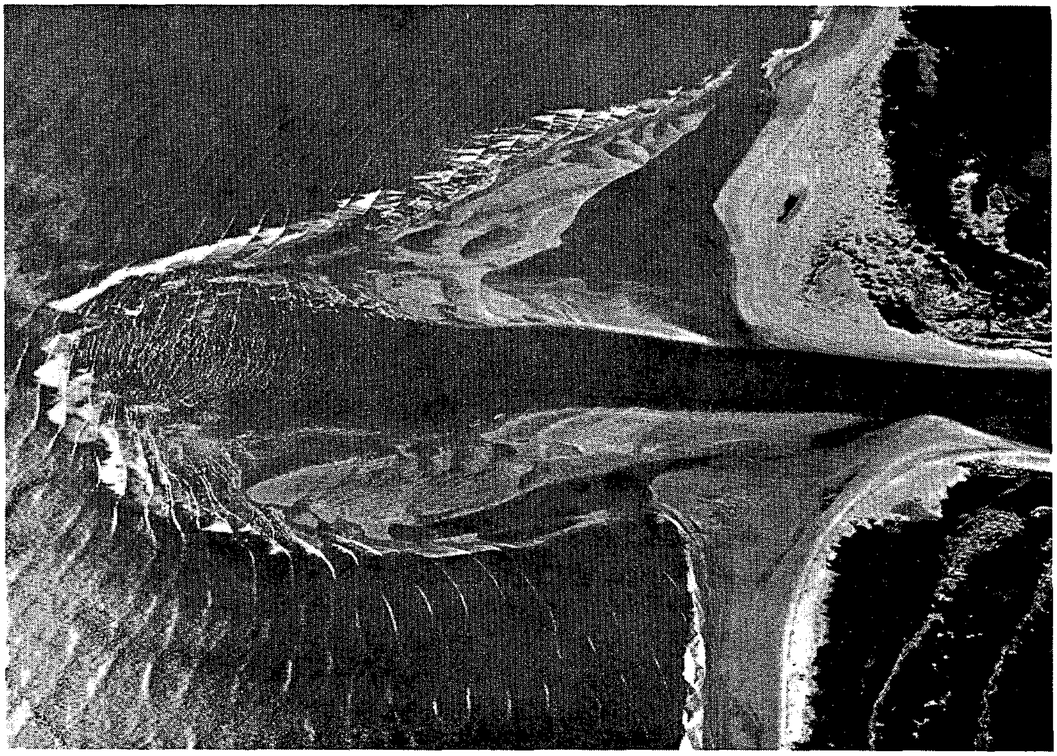


Figure 31. The location of 1896 shoreline is shown by the black line on this recent photograph of Bull Island, South Carolina, taken in January, 1975. As the inlet morphology changed, the north side of the inlet prograded seaward as a series of curving beach ridges. These ridges are now truncated by erosion as the inlet morphology continues to change. View looks north.

Figure 32. South end of Isle of Palms. Southerly migration of Breach Inlet has allowed the deposition of a recurved spit at the south end of the Isle of Palms. Note houses built on older recurves. Large open area is where a developer has flattened the sand dunes. View looks north. Photograph taken January 7, 1975.

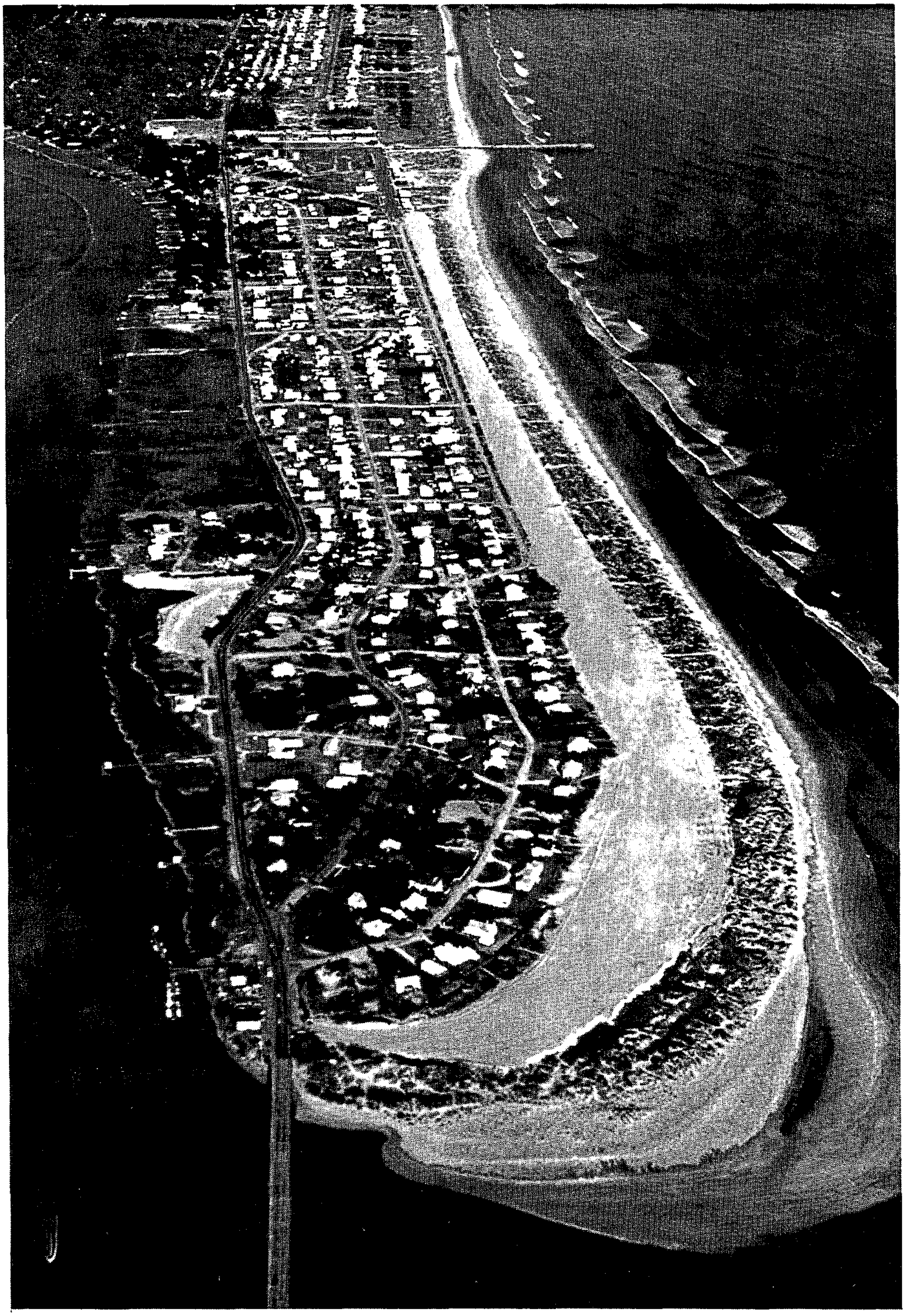


Figure 33. Morris Island light. The lighthouse was located on the beach at the south end of Morris Island in 1939. Over 1600 feet of erosion has occurred since that date. This erosion is in part related to the construction of jetties at Charleston Harbor to the north. Photograph taken January 7, 1975.

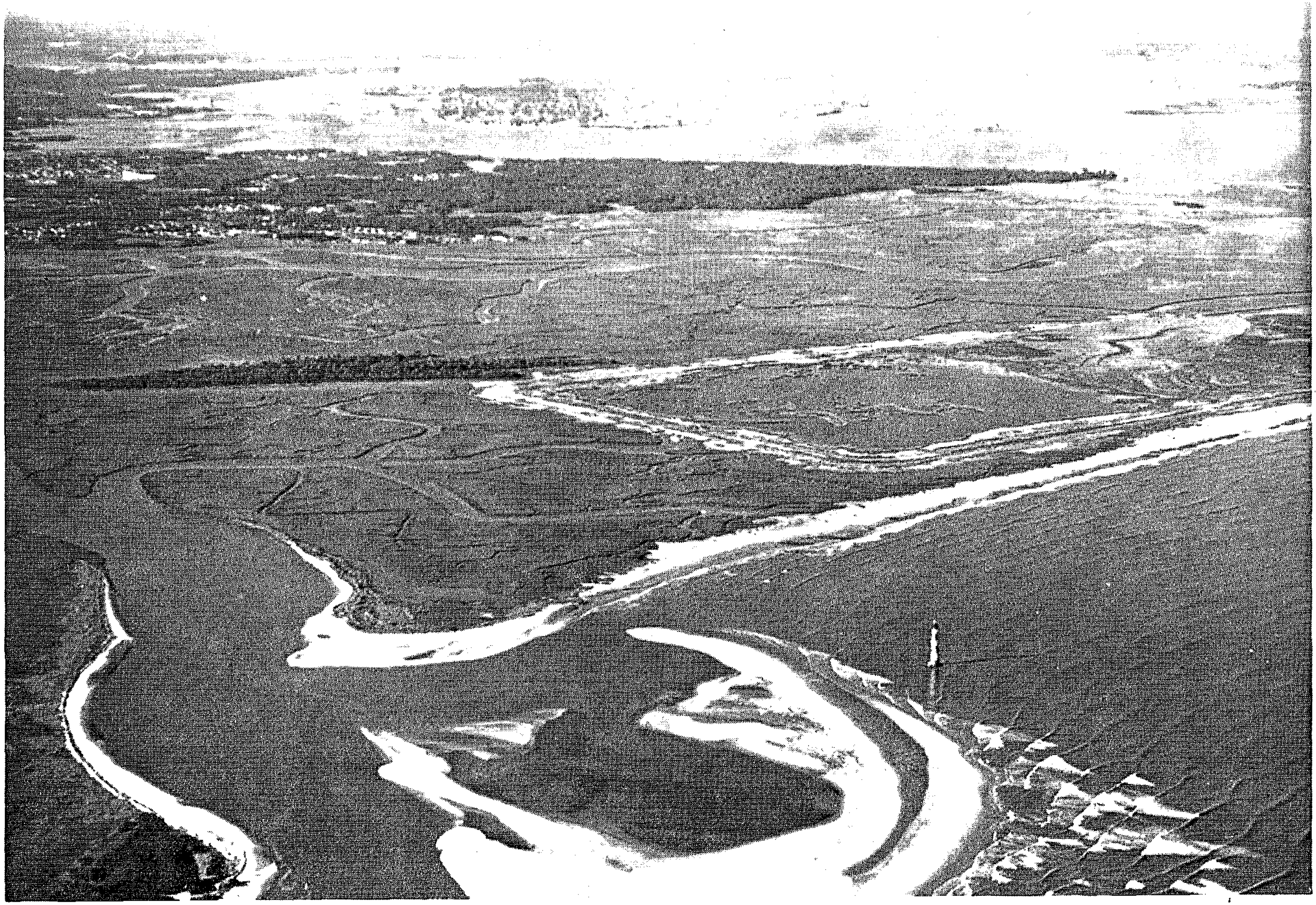


Figure 34. Groins on Folly Beach. The shoreline of Folly Beach has been stabilized by construction of this series of groins. Note the houses on the beach just beyond the pier. View looks south. Photograph taken January 7, 1975.

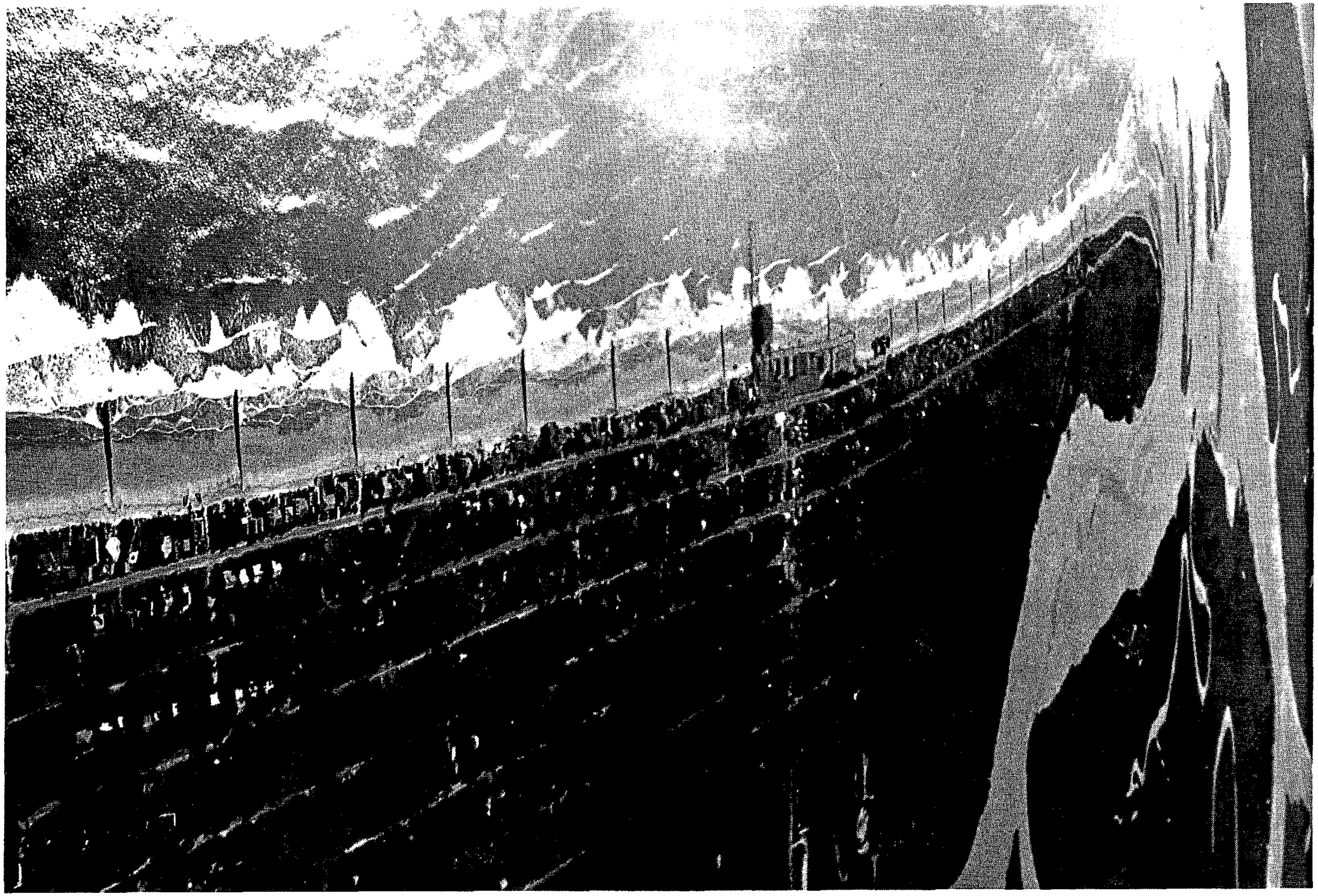
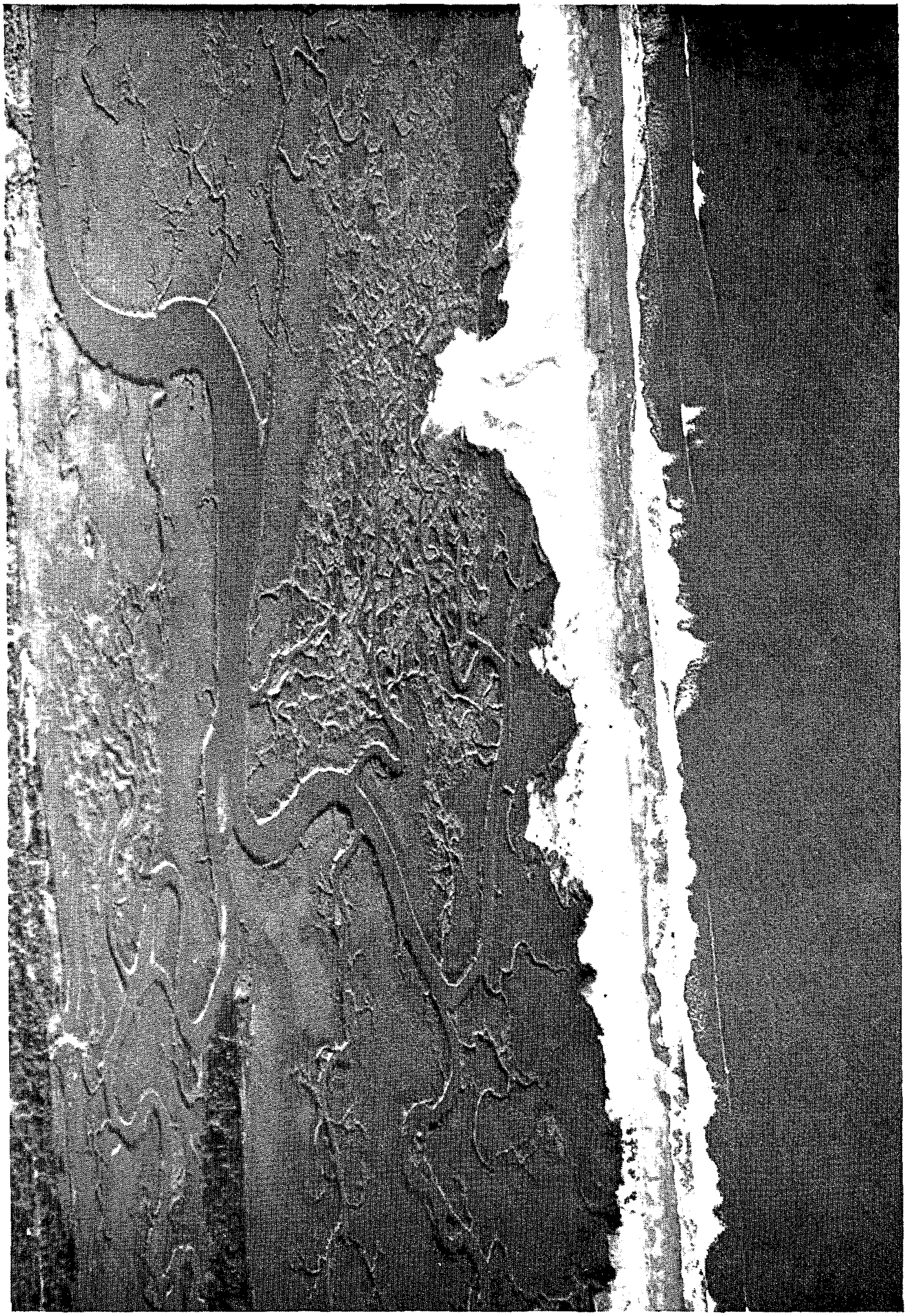


Figure 35. South end of Kiawah Island. The lateral migration of Kiawah River Inlet has resulted in deposition of this classic recurved spit. View looks northeast towards Kiawah Island. This section of coastline has been highly variable through time. Photograph taken January 7, 1975.

Figure 36. Edingsville Beach. This seriously eroding shoreline is eating away at the marsh. As erosion occurs, sediment washes over the beach and into the marsh forming a washover terrace. Note marsh sediments (peat) exposed on the beach face. Photograph taken January 7, 1975.



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U. S. Army Corps of Engineers. Interim Hurricane Survey of Edisto and Hunting Island Beaches, South Carolina. House Document No. 100, 90th Congress, April 5, 1967.

APPENDIX 1

Tabulated Incremental Erosion-Deposition Rates and Total Change for all Reference Points

LOCATION: SANTEE DELTA

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1963-73	Change 1939-73
1	0	-584.1	0	-133.2	+233.2	no data	-100	-2166.5
2	0	+33.3	-100	+40.3	+92.9	no data	+999.9	+750
3	0	-166.6	-49.9	+37.34	-4.1	no data	+133.4	-50
4	0	-150	+16.7	-109.2	+109.3	no data	-200	333.2
5	0	-49.9	-66.7	-149.6	+16.6	no data	0	-249.8
6	0	-550	-200	-133.3	-479.3	no data	+1100	-166.6
7	0	-233.3	-350	-29.1	-352.2	no data	+50	+433.4
8	0	+99.9	-233.3	-52.6	+252.6	no data	+233.4	+299.9
9	0	-150	0	-66.6	+67.2	no data	+1283.3	+1116.7
10	0	-750	-83.4	-44.5	-38.9	no data	-83.3	-833.3
11	0	+40.1	+109.9	+6.24	-39.5	no data	-166.7	-50
12	0	+108.3	+125	+26.1	-76.1	no data	-150	+33.3
13	0	+116.7	+366.7	+194	-727.3	no data	0	-49.9

LOCATION: CAPE ROMAIN

Reference Point	1941 Baseline	Change 1941-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1941-73
1	0	+230	+500	-100	+66	no data	-200	+486
2	0	-66	+60	-150	-130	no data	-230	-516
3	0	-100	-33	-133	0	no data	-120	-386
4	0	-400	-30	-200	-150	no data	-50	-830
5	0	-400	+1600	+230	+300	no data	+430	+2160
6	0	-100	+50	-130	-50	-16	-100	-406
7	0	-115	0	-50	0	-16	-16	-197
8	0	-65	0	-50	0	-16	-16	-147
9	0	-65	-200	-116	0	-16	-16	-413
10	0	-180	-230	-150	-16	-33	-33	-642
11	0	-180	-230	-150	-16	-33	-33	-642
12	0	-16	+50	+16	0	0	-16	-34
13	0	-30	+100	+130	+33	+2000	-100	+2133

LOCATION: RACCOON KEY

Reference Point	1941 Baseline	Change 1941-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1941-73
1	0	-300	-200	-230	-115	-16	-33	-894
2	0	-180	-130	-80	-115	+50	-230	-785
3	0	-230	-200	-165	-50	+65	-130	-710
4	0	-115	-50	-215	-65	-65	-115	-625
5	0	-130	-16	-130	-250	-50	-130	-706
6	0	-803	-16	-215	-230	-165	-130	-1589
7	0	-130	-365	-730	-333	-150	-365	-2073

LOCATION: BULL ISLAND

Reference Point	1941 Baseline	Change 1941-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1941-73
1	no data	0	no data	-100	-33	-159	-75	-367
2	no data	0	+33	-100	-66	-115	-119	-367
3	no data	0	-30	-133	+66	-308	+175	-230
4	0	-33	0	-100	+33	-291	+124	-267
5	0	+132	-66	-33	-30	-220	+220	+3
6	0	-99	-35	-85	+50	0	-67	-236
7	0	-66	0	+64	+300	+68	-100	+266
8	0	0	+333	-17	+1000	+71	-441	+946
9	0	-33	+333	-181	+281	+209	+20	+629

LOCATION: CAPERS ISLAND

Reference Point	1941 Baseline	Change 1941-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1963-73	Change 1941-73
1	0	-130	+66	+233	-30	no data	-60	+79
2	0	-450	+150	-230	-300	no data	-200	-1050
3	0	-16	-16	-165	-100	no data	-100	-397
4	0	-60	-30	-30	-60	no data	-130	-310
5	0	-50	-16	-66	-83	no data	-100	-315
6	0	+33	+115	-1433.3	0	no data	-30	+1551

LOCATION: DEWEES ISLAND

Reference Point	1941 Baseline	Change 1941-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1941-73
0	0	+300	+130	-100	+330	no data	-120	+540
1	0	-1400	+160	+30	0	no data	+70	-1140
2	0	+550	-350	+50	0	no data	+110	+360
3	0	-380	0	0	-160	no data	+65	-475
4	0	-560	0	0	-230	no data	-120	-910
5	0	-280	+130	-66	+50	no data	-280	-446

LOCATION: ISLE OF PALMS

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1939-73
1	0	+130	-197	+30	+164	-92	-182	-148
2	0	-54	+100	-45	+42	-4	+7	stable
3	beach	-56	-178	-50	+256	-201	-133	-362
4	beach	+310	-110	-20	+305	-194	-192	+99
5	0	+275	0	-20	+186	+21	-322	+140
6	0	+480	-196	+176	-300	+230	-323	+67
7		reference point invalid						
8		+342	+91	-235	0	+137	-196	+139
9	0	+480	-230	-105	-174	+229	-166	+34
10	0	+176	-143	-75	-207	-175	-207	-631
11	0	0	-3	0	-222	-181	no data	-406
12	0	+117	-50	+130	-290	-364	+186	-271
13	0	+16	+68	+66	-273	-346	+120	-349
14	0	0	+18	+28	-151	-301	+139	-267
15	0	+30	-15	+96	-165	-301	+6	-349
16	0	+48	-48	+180	-134	-495	+149	-300
17	0	0	+84	+34	+15	-60	-108	-35
18	0	0	+67	+104	+46	-30	-121	+66
19	0	-33	+66	+71	+95	+20	-53	+166
20	0	+100	+100	-13	+130	+36	-20	+333
21	0	+67	+133	+92	+75	-64	-3	+300
22	0	+33	+100	-10	-57	+158	-25	+199
23	0	+33	+66	+24	-40	+40	+5	+128
24	0	-17	+150	-8	+24	+73	-6	+216
25	0	0	+200	+87	+179	-85	-14	+380

LOCATION: SULLIVANS ISLAND

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1939-73
1	0	+180	0	-164	-148	-151	-10	-293
2	0	+126	-200	+10	-115	-53	-7	-239
3	0	-104	0	-120	-140	-34	-38	-436
4	0	-60	+70	-60	+184	+500	-621	+13
5	0	-100	+135	-160	+70	+66	+230	+241
6	0	-60	+150	-111	-178	+66	+87	-46
7	0	+280	+140	+30	-153	-37	-178	+82
8	0	+50	+380	-110	-92	-50	-144	+34
9	0	+88	+105	+30	-96	-16	-55	+56
10	0	+28	+200	+130	-20	+133	+30	+55
11	0	-10	+70	+250	+431	-33	+40	+748
12	0	-3	-30	+60	+209	+400	+241	+877
13	0	0	+50	-60	+72	-63	-13	-14

LOCATION: MORRIS ISLAND

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1939-73
1	0	+544	+389	+33	+333	-433	-34	+832
2	0	-5	+105	-33	-50	-65	-150	-198
3	0	-42	-74	-200	-233	-151	-116	-816
4	0	-297	-7	-300	-200	-184	-150	-1138
5	0	-600	+16	-280	-200	-267	-67	-1398
6	0	-683	0	-333	-167	-267	-133	-1583
7	0	-670	-33	-400	-266	-233	-100	-1702
8	0	-533	-134	-366	-400	-200	-67	-1700
9	0	-523	-177	-333	-250	-249	-100	-1632

LOCATION: FOLLY BEACH

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1968-73	Change 1939-73
1	0	0	-110	-180	-25	-34	-37	-386
2	0	-66	-8	-145	+18	+34	-80	-247
3	0	0	+230	-370	-432	-17	-200	-789
4	0	+33	+60	-300	-400	-100	-158	-865
5	0	+200	+220	-220	-269	-66	-18	-153
6	0	-100	+180	+40	-127	-33	+17	-23
7	0	-233	+114	+20	-65	0	+47	-117
8	0	-33	+30	0	-80	+20	+37	-26
9	0	-100	+200	-20	-80	+30	+28	+58
10	0	-69	-30	+10	-8	+130	-82	-49
11	0	-17	-10	-30	+50	+16	-60	-51
12	0	-100	-4	-40	-25	+100	-18	-87
13	0	-100	+60	-60	-55	+115	-22	-62
14	0	-66	0	0	-60	+30	+111	+15
15	0	-100	+70	+8	-149	+100	-82	-153
16	0	0	+100	-25	-49	+30	-79	-23

LOCATION: KIAWAH ISLAND

Reference Point	1939 Baseline	Change 1939-49	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1963-73	Change 1939-73
1	0	-66	-400	+400	-60	no data	+800	-133
2	0	-633	-269	+266	+266	no data	+400	-866
3	0	-960	+333	+33	-260	no data	-1033	-7899
4	0	+400	-66	+133	+367	no data	+266	+1018
5	0	-33	+133	0	+66	no data	+233	+400
6	0	-33	+66	0	0	no data	+100	+133
7	0	inlet migration	+133	+33	0	no data	+66	+233
8	0		-33	+33	0	no data	+100	+100
9	0	0	-66	+33	-66	no data	+133	+33
10	0	+33	+66	-66	0	no data	0	+33
11	0	0	-33	-100	+33	no data	-33	-133
12	0	0	+33	-133	+66	no data	0	-33
13	0	0	0	-66	0	no data	+66	0
14	0	-100	0	+66	+66	no data	+66	+100
15	0	-100	0	+33	+66	no data	+66	+66
16	0	inlet breached	-33	+100	-33	no data	+133	+166
17	0	+233	-100	0	inlet	no data	-166	-33
18	0	+733	-100	+100	-33	no data	-133	+566
19	0	+100	-66	+66	+66	no data	-66	+100
20	0	-366	+333	+133	-100	no data	+166	+166
21	0	-466	+133	+66	+33	no data	-133	-366
22	0	-33	-33	-100	-	no data	+333	+166

LOCATION: EDINGSVILLE BEACH

Reference Point	1949 Baseline	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-68	Change 1963-73	Change 1949-73
1	0	-250	-50	-66	no data	-33	-399
2	0	-330	-200	-150	no data	-100	-780
3	0	-100	-120	-230	no data	-60	-510
4	0	-180	-80	-300	no data	-250	-810
5	0	+210	-50	-200	no data	-200	-240
6	0	+260	-50	-250	no data	-250	-290
7	0	+45	-130	-180	no data	-160	-425
8	0	inlet opened		-500	no data	-60	-560
9	0	-33	-33	-266	no data	inlet opened	-332
10	0	-33	0	+33	no data	-300	-366
11	0	-33	-66	-60	no data	-230	-389
12	0	0	+33	-16	no data	-115	-98

LOCATION: EDISTO BEACH

Reference Point	1949 Baseline	Change 1949-53	Change 1953-57	Change 1957-63	Change 1963-73	Change 1949-73
1	0	0	-33	-33	-60	-132
2	0	-50	0	-49	-30	-129
3	0	0	+16	-33	-30	-47
4	0	-16	-16	-16	-50	-98
5	0	-16	0	0	0	-16
6	0	-16	0	0	0	-16
7	0	-16	0	0	0	-16
8	0	-16	0	0	-16	-32
9	0	+60	0	-33	0	-27
10	0	+60	-16	-40	-16	-12
11	0	0	0	-16	-16	-32
12	0	-66	-50	-200	-30	-346
13	0	+33	-16	-150	-60	-200
14	0	0	0	-16	0	-16
15	0	-66	0	0	+16	-50
16	0	+33	0	-33	0	0