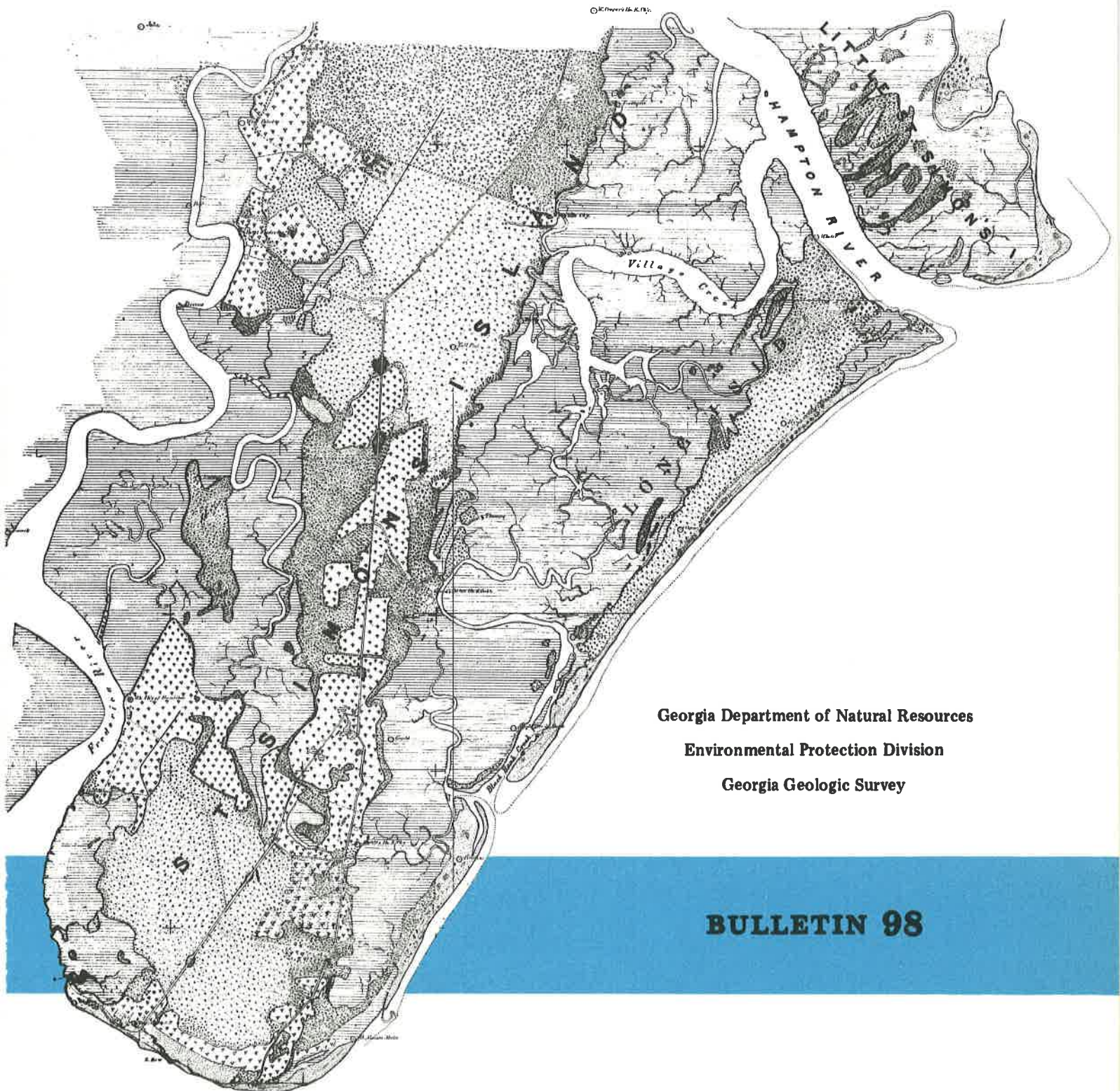


HISTORICAL CHANGES IN THE MEAN HIGH WATER SHORELINE OF GEORGIA, 1857-1982

Martha M. Griffin and Vernon J. Henry



Georgia Department of Natural Resources
Environmental Protection Division
Georgia Geologic Survey

BULLETIN 98

HISTORICAL CHANGES IN THE MEAN
HIGH WATER SHORELINE OF GEORGIA, 1857-1982

By

Martha M. Griffin
Georgia Geologic Survey

and

Vernon J. Henry
Geology Department
Georgia State University

Department of Natural Resources
J. Leonard Ledbetter, Commissioner

Environmental Protection Division
Harold F. Reheis, Asst. Director

Georgia Geology Survey
William H. McLemore, State Geologist

1984

Bulletin 98

CONTENTS

Abstract	1
Introduction.....	1
Geologic Setting.....	2
Physical Geography and Geology.....	2
Geologic History.....	5
Sediment Sources.....	5
Rivers.....	5
Tidal Inlets.....	6
Shelf.....	6
Littoral Currents.....	6
Offshore Bathymetry.....	7
Salt Marsh and Estuarine System.....	7
Hydrologic Setting.....	9
Sea Level Changes.....	9
Tides.....	9
Wind and Wave Climate.....	9
Winds.....	9
Waves.....	10
Hurricanes and Severe Storms.....	10
Effect of Man.....	10
Previous Work.....	12
Procedure.....	13
Materials.....	13
Methods.....	13
Historical Changes in the Mean High Water Shoreline.....	14
Tybee/Little Tybee Islands.....	14
General Description.....	14
Shoreline Change.....	15
Wassaw Sound.....	25
Wassaw Island.....	25
General Description.....	25
Shoreline Change.....	25
Ossabaw Sound.....	31

CONTENTS

Ossabaw Island.....	31
General Description.....	31
Shoreline Change.....	31
St. Catherines Sound.....	34
St. Catherines Island.....	38
General Description.....	38
Shoreline Change.....	38
Sapelo Sound.....	43
Blackbeard/Sapelo Islands.....	43
General Description.....	43
Shoreline Change.....	46
Doboy Sound and Wolf Island.....	51
Altamaha Sound.....	51
Little St. Simons Island.....	54
General Description.....	54
Shoreline Change.....	54
Sea Island/St. Simons Island.....	57
General Description.....	57
Shoreline Change.....	60
St. Simons Sound.....	66
Jekyll Island.....	68
General Description.....	68
Shoreline Change.....	68
St. Andrew Sound.....	70
Little Cumberland/Cumberland Islands.....	74
General Description.....	74
Shoreline Change.....	78
St. Marys Entrance.....	82
Summary and Conclusions.....	82
Acknowledgements.....	90
References Cited.....	91
Appendix.....	95

ILLUSTRATIONS

Figure 1	Location of Barrier Islands of Georgia.....	3
Figure 2	Nearshore Bathymetry of Georgia.....	4
Figure 3	Bottom Topography of the Continental Shelf off Georgia ...	8
Figure 4a	Tybee/Little Tybee Islands MHW Shoreline Change, 1866 - 1982.....	16
	b Tybee Island MHW Shoreline Change, 1866 - 1982.....	17
	c Little Tybee Island MHW Shoreline Change, 1866 - 1982.....	18
Figure 5	Tybee/Little Tybee Islands Net MHW Shoreline Change,	19
Figure 6	Tybee/Little Tybee Islands Net MHW Shoreline Change,	20
Figure 7	Tybee/Little Tybee Islands Net MHW Shoreline Change, 1925 - 1974.....	22
Figure 8	Tybee/Little Tybee Islands Net MHW Shoreline Change, 1866 - 1974.....	23
Figure 9	Wassaw Sound MHW Shoreline Change, 1866-1982.....	26
Figure 10	Wassaw Island MHW Shoreline Change, 1858-1982.....	27
Figure 11	Wassaw Island Net MHW Shoreline Change, 1924-1974.....	29
Figure 12	Wassaw Island Net MHW Shoreline Change, 1858-1974.....	30
Figure 13	Ossabaw Sound MHW Shoreline Change, 1859 - 1982.....	32
Figure 14	Ossabaw Island MHW Shoreline Change, 1858/60 - 1974.....	33
Figure 15	Ossabaw Island Net MHW Shoreline Change, 1924 - 1974.....	35
Figure 16	Ossabaw Island Net MHW Shoreline Change, 1858/60 - 1974.....	36
Figure 17	St. Catherines Sound MHW Shoreline Change, 1858/67 - 1982.....	37
Figure 18	St. Catherines Island MHW Shoreline Change, 1858/67 -1982.....	39
Figure 19	St. Catherines Island Net MHW Shoreline Change, 1924 - 1974.....	41

ILLUSTRATIONS

Figure 20	St. Catherines Island Net MHW Shoreline Change, 1858/67 - 1974.....	42
Figure 21	Sapelo Sound MHW Shoreline Change, 1857 - 1982.....	44
Figure 22	Blackbeard/Sapelo Islands MHW Shoreline Change, 1857/68 - 1974.....	45
Figure 23	Cabretta Inlet MHW Shoreline Change, 1868 - 1974.....	47
Figure 24	Blackbeard/Sapelo Islands Net MHW Shoreline Change, 1925 - 1974.....	49
Figure 25	Blackbeard/Sapelo Islands Net MHW Shoreline Change, 1857/68 - 1974.....	50
Figure 26	Doboy Sound MHW Shoreline Change, 1857 - 1982.....	52
Figure 27	Altamaha Sound MHW Shoreline Change, 1857/60 - 1982.....	53
Figure 28	Little St. Simons Island MHW Shoreline Change, 1860 - 1982.....	55
Figure 29	Little St. Simons Island Net MHW Shoreline Change, 1860 - 1924.....	56
Figure 30	Little St. Simons Island Net MHW Shoreline Change, 1924 - 1974.....	58
Figure 31	Little St. Simons Island Net MHW Shoreline Change, 1860 - 1974.....	59
Figure 32	Sea Island/St. Simons Island MHW Shoreline Change, 1857/60 - 1974/80.....	61
Figure 33	Goulds Inlet MHW Shoreline Change, 1860 - 1974.....	62
Figure 34	Sea Island/St. Simons Island Net MHW Shoreline Change, 1924 - 1974.....	64
Figure 35	Sea Island/St. Simons Island Net MHW Shoreline Change, 1857/60 - 1974.....	65
Figure 36	St. Simons Sound MHW Shoreline Change, 1857/60 - 1974.....	67
Figure 37	Jekyll Island MHW Shoreline Change, 1857/68 - 1980.....	69
Figure 38	Jekyll Island Net MHW Shoreline Change, 1924 - 1974.....	71
Figure 39	Jekyll Island Net MHW Shoreline Change, 1857/68 - 1974.....	72
Figure 40	St. Andrews Sound MHW Shoreline Change, 1868 - 1982.....	73

ILLUSTRATIONS

Figure 41a Little Cumberland/Cumberland Islands MHW Shoreline
Change, 1857/68 -1974 75

 b Little Cumberland/North Cumberland Islands MHW Shoreline
 Change, 1868 - 1982..... 76

 c Central/South Cumberland Island MHW Shoreline Change,
 1857 - 1982..... 77

Figure 42 Little Cumberland/Cumberland Islands Net MHW Shoreline
Change, 1924 - 1974..... 80

Figure 43 Little Cumberland/Cumberland Islands Net MHW Shoreline
Change, 1857/68 - 1974..... 81

Figure 44 St. Marys Entrance MHW Shoreline Change,1857 - 1982..... 83

Figure 45 Summary Map of Erosion/Accretion Trends of the Georgia
Coast, 1924 - 1974..... 85

Figure 46 Summary Map of Erosion/Accretion Trends of the Georgia
Coast, 1954/57 - 1974/80/82..... 86

ABSTRACT

A study of Georgia mean high water shoreline change from 1857 - 1982, based on available topographic, hydrographic, and orthophotographic maps and on controlled aerial photographs has yielded the following results:

(1) during the period from 1857 to 1925, in which several major hurricanes occurred in the late 1880's, approximately 80% of the Georgia coast prograded, due primarily to the great denudation of the Georgia Piedmont prior to soil conservation practices and to the damming of rivers for flood control;

(2) in the interval from 1924 to 1974, the Georgia coast was characterized by dynamic stability; erosion on St. Catherines and Tybee/ Little Tybee Islands was offset by deposition on Little St. Simons and Cumberland Islands, while each of the other islands maintained equilibrium;

(3) during the period from 1957 to 1974, which was characterized by accelerating erosion rates and a major hurricane, most of the major barrier islands nevertheless maintained a dynamic stability;

(4) during the interval from 1974 to 1982, partial photographic coverage of the Georgia coast indicated a continuation of erosion/accretion trends established prior to 1974, coupled with an apparent loss in linear extent of depositional sites along the shoreline.

Study results also indicate patterns of island rotation, spit cyclicity, island elongation, shifts about persistent nodal points, and southward migration. Such trends indicate that, presently, dynamic stability, marked by extreme local instability, characterizes 80% of the Georgia coast.

INTRODUCTION

The beaches and barrier islands which fringe the Atlantic coast of Georgia comprise one of the state's most valuable natural resources. The beaches are one of the state's greatest attractions for the tourism industry; Jekyll Island alone reported receipts for 4 1/2 million dollars for fiscal year 1981 (Georgia Dept. of Audits, 1982).

Human activity on the barrier islands dates back 4000 years and includes artifacts of the Guale Indian Nation, the settlement of Georgia under General Oglethorpe, the plantation era, and a period of ownership by wealthy industrialists. The "Golden Isles" of Georgia thus represent both a valuable natural resource and a rich cultural heritage for the citizens of Georgia.

Much of Georgia's coast is protected by federal and state agencies and, compared to other states, is relatively undisturbed by man; however, the aesthetic and socio-economic values of the coastal zone have in recent years attracted ever increasing numbers of people, resulting in intense land development pressure on three of the state's major barrier islands. Unfortunately, this development preceded understanding of the processes that shape this dynamic environment. Consequently, each of the developed barrier islands has severe erosion problems, many of which have been fostered in part by what are now considered to be unwise construction and development techniques.

In January 1982, the Georgia Geologic Survey addressed the issue of wise shoreline management with the adoption of the "Georgia Shoreline Study: Historical Change and Contemporary Patterns of Erosion and Accretion," submitted by the authors. The study was undertaken to develop a

broad coastal geology data base, emphasizing both (1) historical mean high water (MHW) shoreline change and (2) present-day patterns of shoreline recession and accretion. This publication is the culmination of the first project goal. The objectives of the study are as follows: (1) to illustrate historically stable and unstable sites; (2) to forecast long-term trends of erosion and accretion; (3) to evaluate natural processes and the influence of man; and (4) to provide a simplified shoreline history of Georgia that will be of interest and aid to archaeologists, geographers, coastal zone planners, and the public.

GEOLOGIC SETTING

PHYSICAL GEOGRAPHY AND GEOLOGY

Coastal Georgia is bordered by a series of short, wide barrier islands separated by relatively deep tidal inlets (Fig. 1). Extensive shoal systems are present seaward of the inlets and central sectors of the islands (Fig. 2).

Six of the eight major islands are composite barriers consisting of a core of beach and dune deposits formed during the previous, and slightly higher, Pleistocene sea-level still-stand, and fronted closely by analogous deposits formed during the present, or Holocene, sea-level rise. Tybee and Wassaw Islands are separated from Wilmington and Skidaway Islands, their respective Pleistocene counterparts, by earlier Holocene deltaic outbuilding of the Savannah River. A genetically similar, but smaller, separation is present just south of the Altamaha River at St. Simons Island, where Sea Island and Little St. Simons are the Holocene components. Salt marshes that formed contemporaneously with Pleistocene parts of the islands were reflooded during the Holocene sea level rise, creating an intricate

system of tidal streams, creeks, and marshes separating the barrier islands from the mainland.

Holocene and Pleistocene beach and dune sands are similar in texture. Holocene sands are light tan, unweathered, and composed mainly of fine, well-sorted, angular grains; shell material is abundant at mid-beach. Well-defined beach/dune-ridge complexes without obvious soil zones further distinguish Holocene deposits. Surficial Pleistocene deposits generally have well-developed podsoles and humate zones and are coarser grained. Shallow marine and estuarine fossils and sedimentary structures are abundant beneath the soil zone.

The regional climate is generally characterized by short, mild winters and warm, humid summers. The average temperature recorded on Sapelo Island is 66.2°F (19°C); the average rainfall is 48 in (122 cm) (National Climatic Center, 1977-81). Interiors of the islands are vegetated primarily by oak, pine, and palmetto forests. A variety of dune grasses and shrubs are found along inlet margins and wide sandy beaches; the major plants are sea oats (Uniola paniculata), sea croton (Croton punctatus), and salt meadow grass (Spartina patens). Marsh vegetation consists primarily of smooth cordgrass (Spartina alterniflora) fringed by black needlerush (Juncus roemerianus), spiked saltgrass (Distichlis spicata), and glassworts (Salicornia spp.) in higher areas.

A ridge of dunes parallel the shoreline immediately landward of the high spring tide level. Storm surges erode the seaward side of the dunes and remove irregularities; the landward side of the ridge is less regular and may be marked by washover fans behind breaches in the dune-ridge. Several dune-ridges may be developed, each recording the posi-

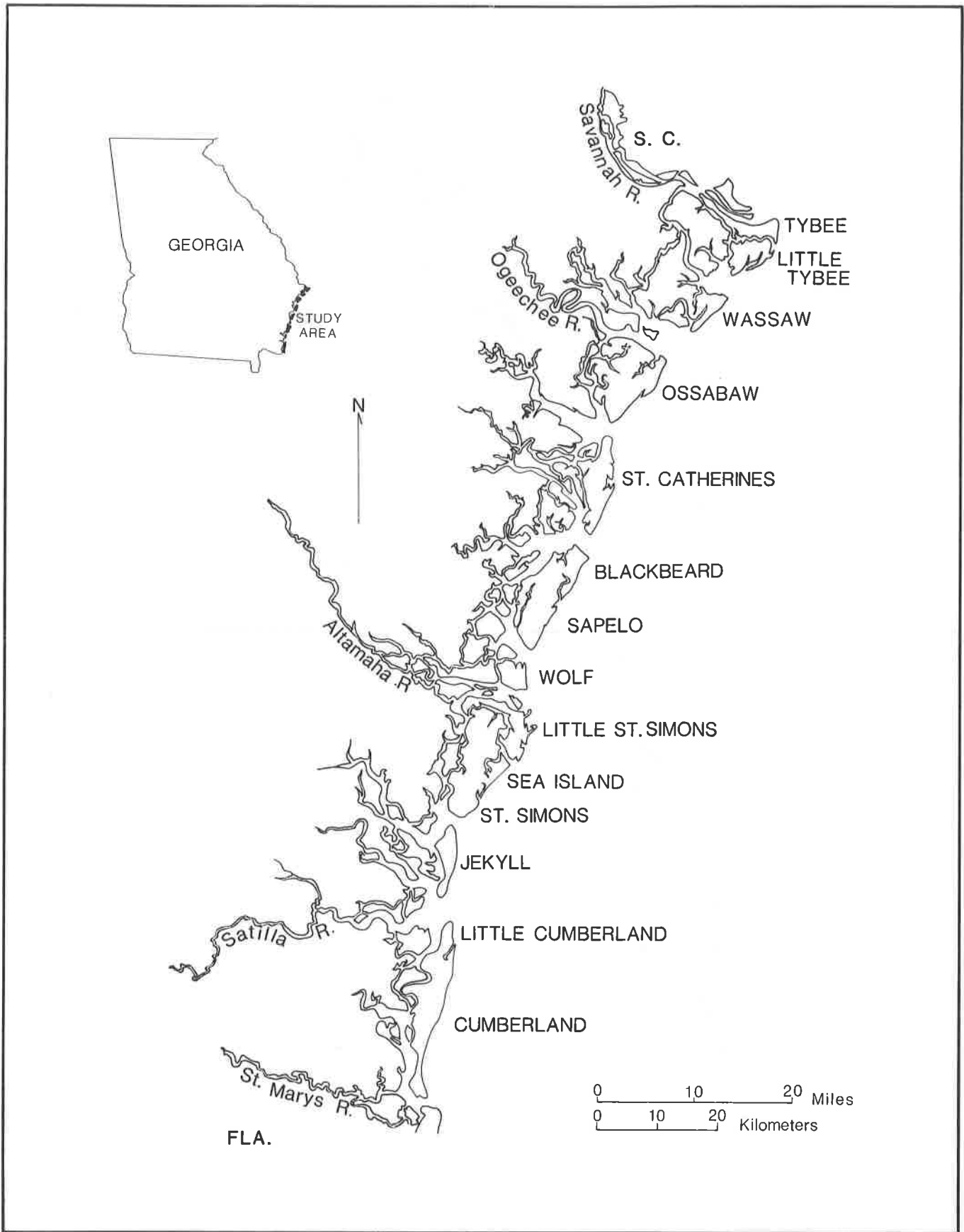


Figure 1. Location of Barrier Islands of Georgia.

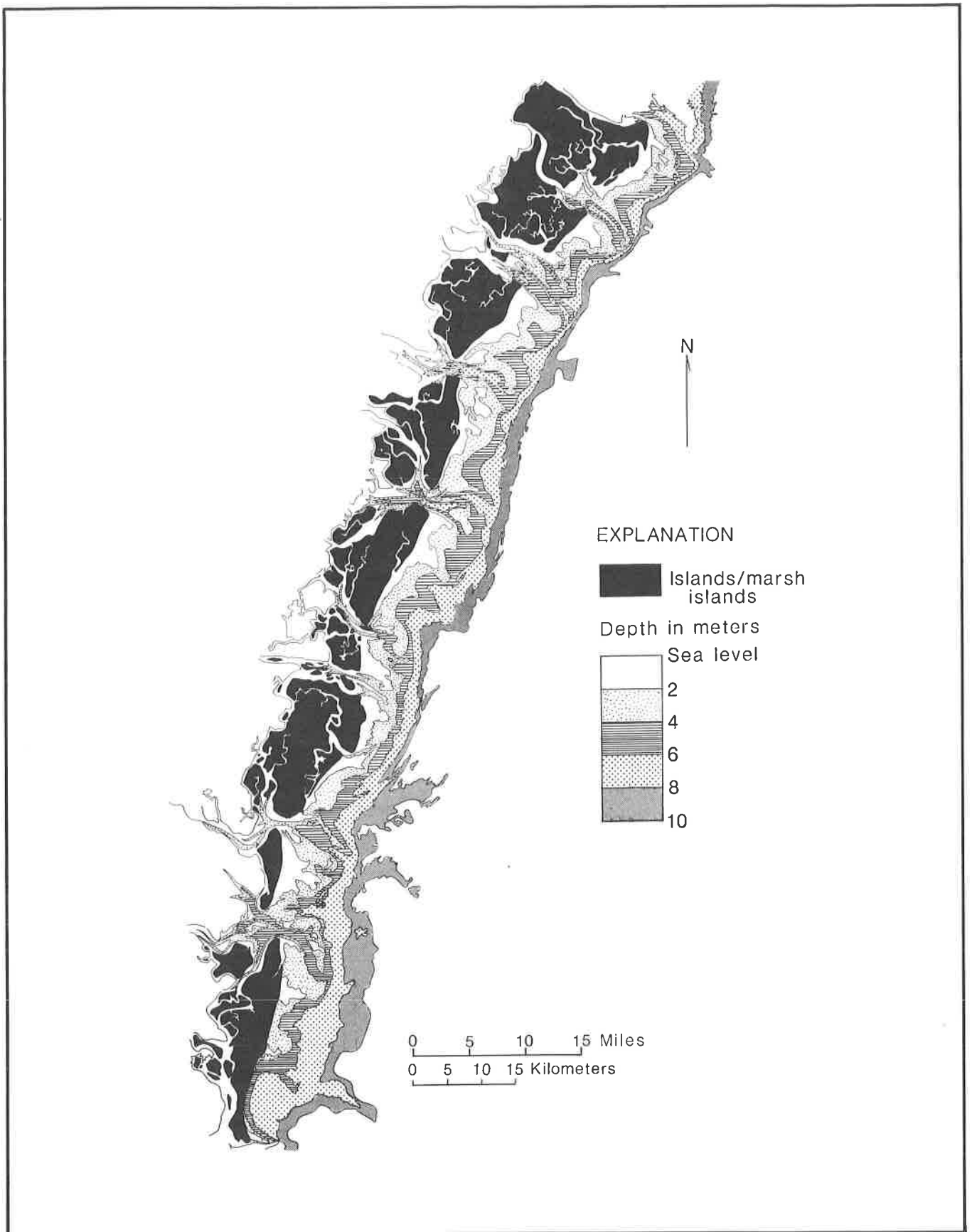


Figure 2. Nearshore Bathymetry of Georgia. (After Foley and Griffin, in prep.)

tion of the shoreline at the time of formation. Spacing of the ridges varies from a few yards to several hundred yards. The seaward ridge commonly truncates older ridges as a result of shoreline change. Successive dune-ridges curve around south ends of the islands, indicating a general southward movement. The slope of the beaches has an overall gradient of less than 1° ; the seaward dip rarely exceeds 5° (Henry and Hoyt, 1968). Except for Holocene dune-ridges, which may exceed 40 ft (12.5 m), the barrier islands have relatively low elevations, ranging from 15 - 25 ft (4.5 - 7.6 m) above mean sea level (MSL).

GEOLOGIC HISTORY

The history of the Georgia Pleistocene coast has been discussed by Hoyt et al (1966), Hoyt and Hails (1967), Hails and Hoyt (1969), and Henry et al (1973). The following history is based on that body of work.

Approximately 50,000 years before present (BP), eustatic, or worldwide, sea level was some 5 ft (1.5 m) above that of today. A combination of waves, currents, and depositional processes had resulted in the formation of beaches along the east coast of the United States from Cape Cod to the southern tip of Florida. Rising seas flooded a narrow strip of Coastal Plain behind the dunes, forming a series of lagoons. As sand accumulated and filled the lagoons, island formation along the southeast coast began. The name Silver Bluff has been given to the time during the Late Pleistocene in which these barrier islands formed.

Approximately 25,000 years BP, the growth of Late Pleistocene continental glaciers resulted in a worldwide lowering of sea-level. The Pleistocene islands, the adjacent salt marshes, and 80 mi (129 km) of

continental shelf to the east were literally left high and dry, as the sea retreated during the next several thousand years. Stream channels became deeply incised as rivers extended their courses across the newly exposed shelf. The islands and salt marsh deposits thus were exposed to subaerial weathering and erosion for the next 15,000 to 20,000 years. Stabilization of sea-level some 340 - 400 ft (103 - 122 m) below present marked the terminal phase of the Pleistocene Epoch.

The Holocene Epoch was initiated some 18,000 years BP by the worldwide retreat of continental ice sheets. As sea-level began to advance across the Pleistocene Coastal Plain, stream courses shortened and gradients decreased. Flood plain and deltaic deposits covered extensive areas as the ability of streams to carry large volumes of sediment decreased. Thousands of square miles of land were engulfed by the sea, and admixtures of marine, estuarine, and terrestrial material were deposited on the continental shelf.

Approximately 5000 years BP sea-level rise slowed allowing the formation of barrier islands. The Holocene portions of the islands formed in much the same way as their Pleistocene antecedents, but at a slightly lower sea-level stand. Younger materials accumulated on, and slightly seaward of, the erosionally-modified remnants of the Pleistocene islands and salt marshes, eventually forming the Holocene barrier island system.

SEDIMENT SOURCES

Rivers

In a study of river, beach, and dune sands of the southeast United States, Giles and Pilkey (1965) found that the mineralogy of beach and dune sands most closely resembled Piedmont

river sands. Other studies (Meade, 1969; and Pilkey and Field 1972) suggest that relatively little sand sized material is presently being deposited beyond the barrier islands onto the shelf. The Savannah and Altamaha Rivers have contributed sediment to the continental shelf, as suggested by the major lobate patterns south of their present positions (Kingery, 1973). Therefore, the possible importance of rivers as sedimentary contributors, prior to extensive damming, soil conservation programs, and navigation channel maintenance, must be considered.

Tidal Inlets

Tidal inlets and their associated ebb-tidal deltas function as barriers to longshore sediment movement, acting as both sediment sources and sinks for adjacent barrier islands. The ebb-tidal deltas reduce incident wave energy and alter wave-induced currents (Oertel and Howard, 1972). In the vicinity of inlets, shoreline changes of significantly greater magnitude than that of the central island areas occur in response to channel migration and shoal development.

Sand beaches and channel sands are deposited by the flood tide as much as a mile up the channel. Sand is also carried seaward by the ebb tide; extensive shoals flank the offshore inlet channel. In general, these shoals are better developed on the north side of the inlet than on the south, reflecting the usual north-to-south transport of sediment along the island front. Deposition of sand on the north side of the inlet dictates a gradual shift of the inlet to the south in order to maintain flow through the inlet (Hoyt and Henry, 1965).

Shelf

Although the importance of the shelf in any consideration of shoreline sedimentary budgets is of vital consideration, the processes which govern the movement of sediment from offshore areas to beaches are not well understood. Evidence does indicate, however, an onshore movement of sediments from the adjacent Atlantic shelf area. In a study of the mineralogy of river and beach sands of central South Carolina, Griffin (1981) reported that feldspar enrichment downdrift of the site of the ancestral Santee River suggested addition of sediments from the shelf. Schwartz and Musialowski (1977) reported that dredged material placed in a 705 ft (214 m) coastal reach between the 7 and 13 ft (2 and 4 m) depth contours migrated landward with a sporadic movement coinciding with periods of increased wave activity. Hunt (1974) observed sediment movement at 66 ft (20 m) during SCUBA dives 19 mi (31 km) off the central Georgia coast.

Although the contribution of shelf sediment to the inshore zone is highly speculative, Bruun (1962) stated that in the Georgia Bight the 59 ft (18 m) depth contour forms the approximate boundary between near-shore and deep sea littoral drift phenomena. The above-average, long-period waves occurring less than 50% of the time suggest that, at this depth, waves from the northeast would be capable of moving even coarse sediment (Nash, 1977).

Littoral Currents

Littoral currents are caused by waves breaking on the shore; littoral drift is the movement, by longshore transport, of sand suspended by breaking waves (Dean, 1973). The seaward extent of longshore drift is, therefore, largely confined within the surf zone (Shepard, 1963; U. S.

Army Corps of Engineers, 1966). According to Nash (1977), wave parameters for the Georgia coast indicate that the theoretical littoral current zone for "above-average waves" would extend to the 10 ft (3 m) depth and the 6 ft (1.8 m) depth for waves from the northeast and southeast respectively. Based on U. S. Army, Corps of Engineers (1971) dredging records for the St. Simons Island Entrance channel, the annual longshore drift in this area is estimated at 431,640 yd³ (327,615 m³). Although data suggest a southward longshore transport, it is significant to note that drift is sometimes to the north.

Southward sediment movement is indicated by the duration and intensity of the dominant northeast waves. Sedimentological studies by Bigham (1973) and Kingery (1973) indicate a net southward drift of fine-grained sediment, contributed by Georgia rivers to the shelf. Further evidence for southward drift is the general tendency for islands off the Georgia coast to migrate to the south, through erosion on their north ends and accretion to their south ends (Hoyt and Henry, 1967). This movement of sand along the shoreline in a predominantly down-current direction is generally referred to as the "river of sand" concept.

Oertel (1975) stated that the areally and temporally independent development of Holocene beach ridges along Georgia sounds indicates that semi-closed sedimentary cells may be present at each island inlet. This concept holds that sand is reworked within an inlet area, the extent of which is determined by the patterns and magnitudes of reversing inlet currents. Processes of the "river of sand" concept, as well as the "semi-closed cells" concept, transport sand along the coast of Georgia.

It is important to understand that as sediment sources from outside

the immediate shoreline segment, such as from rivers, updrift areas or offshore, are eliminated or decreased, erosion of that segment is the usual result. In essence, the shoreline "feeds" on itself and in areas where a negative sediment budget exists accretion occurs only through erosion of updrift segments. In such a closed system, erosion control starves downdrift shorelines.

OFFSHORE BATHYMETRY

The continental shelf off the coast of Georgia (Fig. 3) is broad, generally of low relief, and extends seaward 70 - 80 mi (113 - 129 km). Bottom gradients average from 2 - 4 ft/mi (0.4 - 0.8 m/km) (Hoyt and Henry, 1967). Ten miles (16 km) offshore, depths are only 40 - 45 ft (12 - 14 m). On the north coast of Georgia at Tybee Island, the slope of the nearshore zone to the 66 ft (20 m) depth contour is approximately 1.6 ft/mi (0.3 m/km). Southward, this slope increases gradually to 7.4 ft/mi (1.4 m/km) at Little Talbot Island, Florida (Hoyt and Henry 1971).

Near the major inlets, shallow depths extend farther seaward and distal shoals may be exposed at low water 3 - 4 mi (5-6 km) offshore. The sill depth of the inlets averages only 13 ft (4 m) below low water at a distance 5 mi (8 km) offshore. Inlets are 20 - 30 ft (6 - 9 m) deep, but scour holes may exceed 100 ft (30 m). Maximum depth in the inlets is near the mouth (Henry and Hoyt, 1968).

SALT MARSH AND ESTUARINE SYSTEM

The coast of Georgia is typified by an extensive Holocene salt marsh and estuarine system, which lies between the mainland and the barrier islands. The salt marsh-filled lagoons vary considerably in width and in some areas are 5 mi (8 km) wide. The salt marshes are crossed by a system of tidal channels, with depths

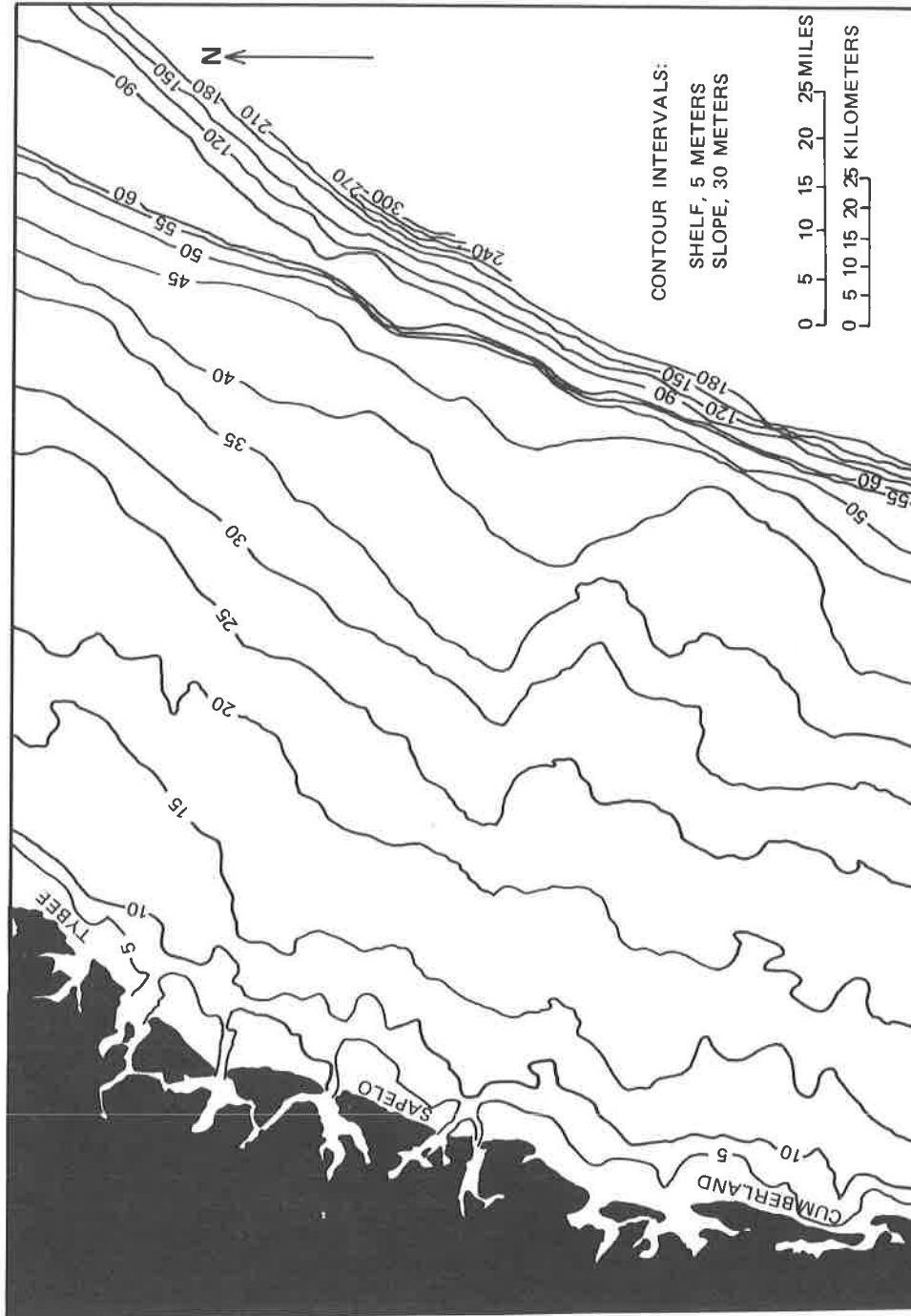


Figure 3. Bottom Topography of the Continental Shelf off Georgia. (After Giles and Pilkey, 1965.)

to 40 ft (12 m), which act as tributaries to the inlets. Point bars develop on the inside of meanders and the channels effectively rework the marsh sediments (Henry and Hoyt, 1968). An intricate tidal drainage system has been developed from tidal action.

The sediments in the lower marshes are predominantly clay and silt, with minor amounts of fine sand, while in the higher marsh area the predominant sediment is quartz sand (Edwards and Frey, 1977). Source of marsh sediments is attributed to fluvial transport from the Piedmont and Coastal Plain Provinces (Windom et al, 1971).

Georgia estuaries, where fresh and salt waters mix, are the sites of large water exchanges twice daily; the tides alternately flood and drain a back-barrier area of several hundred square miles of salt marshes and tidal creeks. Nearshore and estuarine waters are very turbid, largely because of suspended sediment and organic detritus derived from adjacent salt marshes. The waters are slightly less saline than waters farther offshore.

HYDROLOGIC SETTING

SEA-LEVEL CHANGES

Over the past 19,000 years there has been a eustatic sea-level rise of 404 ft (123 m) (Emery, 1967). On the east coast, a progressive rise of sea-level has occurred since 1890, when sea level reached its lowest point in the past 115 years (Bruun, 1962). A compilation of mean sea-level curves (Hicks, 1973) yielded a rate of 0.09 in/yr (0.229 cm/yr) for the period 1929 -1971 at the Fort Pulaski tide gauge situated at the mouth of the Savannah River. From 1940 to 1971, a lower rate of 0.08 in/yr (0.204 cm/yr) was recorded.

This relatively gradual rise is the single most important long term agent of shoreline erosion. Winter storm conditions essentially raise sea-level and cause erosion, while the more gentle summer waves reverse this process.

An additional tidal factor to be considered is the 18.6 year cycle of the Moon's nodes. Kaye and Stuckey (1973) demonstrated that the lunar cycle dominates the annual means of high water, low water, and range at U.S. east coast harbors. Increased MHW levels during the lunar node would expose additional land to wave attack and doubtless produce significant changes in the littoral zone at 18.6 year intervals. Recognition of the cyclical nature of tidal data both simplifies and clarifies assessment of longer term sea-level trends. The study pointed out the necessity of considering only multiples of entire lunar cycles in the computations of sea-level trends.

TIDES

The barrier islands of Georgia lie in a regional embayment of the southeast U.S. coast, known as the Georgia Bight. Because tidal effects are magnified by the embayment, Georgia has the highest tides of the entire southern U.S. coast (Hubbard et al, 1979). The semi-diurnal tides average 6.6 ft (2 m), and 10 ft (3 m) spring tides are frequent. Strong tidal currents scour and maintain channels to depths of 70 ft (21 m) within the constrictions of sounds and confluences of creeks. The Georgia coast is tide-dominated, as opposed to wave-dominated shorelines north and south of the Georgia Bight.

WIND AND WAVE CLIMATE

Winds

Dominant onshore winds are from the northeast and the southeast,

whereas dominant offshore winds are from the northwest and southwest. The dominance of northeast winds increases significantly when considering only onshore winds. According to the long term observations of the U.S. Naval Weather Service Command (1970), onshore winds from the northeast have higher velocities and predominate in autumn and late spring.

Waves

The Sea Islands of Georgia are located in an area having the lowest energy level recorded along the southeast Atlantic coast. Because the broad, shallow, gently sloping continental shelf dampens waves and wave energy, wave heights average between 9 in - 1 ft (23 - 30.5 cm) (Tanner, 1960).

Larger waves are predominantly from the northeast. Average sea heights range from 5 ft (1.5 m) for waves from the northeast to 3.5 ft (1.1 m) from the southeast. The duration of waves higher than 5.75 ft (1.75 m) is greatest from the northeast and north-northeast, primarily in September, October, and November. The duration of waves lower than 5.75 ft (1.75 m) is greatest from the south-southeast and south during the spring and summer (Nash, 1977). Wave heights are locally modified by shoaling and refraction.

HURRICANES AND SEVERE STORMS

Hurricanes may well account for much of the sediment distribution patterns that occur along shorelines. Direct modification of barrier islands generally occurs by erosion of the seaward sides and deposition by overwash and inlet flow on landward sides, resulting in landward migration. Such results are reduced in Georgia by the broad nature of the islands.

Major historical changes of the islands have likely resulted from

erosion of dune areas. Foredunes are often completely removed by storm waves, which breach primary dune lines and initiate formation of wash-over fans. Dune erosion is intensified in devegetated foredune areas. Large quantities of sand may be carried seaward or freed from foredune complexes and washed, or later blown, inland to destroy additional vegetative cover along and behind dune lines (Nash, 1977).

Because east coast hurricanes generally follow the path of warm air above the Gulf Stream, on an average only one "severe" hurricane strikes coastal Georgia every ten years (Carter, 1970). A considerably greater number of tropical cyclones have developed in the Atlantic, Caribbean Sea, and Gulf of Mexico and passed off the southeast coast without intensifying to hurricane status. An extremely severe hurricane passed through coastal Georgia in 1898. Several feet of water inundated the islands, and a hurricane surge of 35 ft (10.7 m) was recorded from Sapelo Island to the north (Nash, 1977).

Extratropical storms, or "Northeasters," are more frequent than hurricanes and generally occur during the autumn months. Although not as well documented as hurricanes, their erosion potential to the coastline is comparable, due to the longer duration and greater over-water fetch of winds associated with extratropical storms (Nash, 1977).

EFFECT OF MAN

Because most barrier islands and inlets exist in a state of dynamic equilibrium, man-made alterations may modify the sediment budget to varying degrees. Shoreline stability is thus affected by altered river systems, dredging operations, seawall construction, dune destruction, and emplacement of jetties and groins.

Roughly 50 percent of the drainage basins of the Savannah and Altamaha Rivers lie in the Piedmont Province. During the mid-eighteenth century, European settlers caused severe soil erosion through indiscriminate practices in forestry and agriculture. Trimble (1969) reported that between 1890 and 1940 eroded sediment rapidly choked Piedmont rivers. Since the eighteenth century, the average depth of soil eroded from the Georgia Piedmont is 7.5 in (19 cm). Trimble (1973) estimated that approximately 6.0 mi^3 (25 km^3) have been eroded from the southeastern Piedmont.

In recent decades, soil conservation programs, flood prevention reservoirs, and hydroelectric dams have slowed the erosive process considerably. Such programs must be considered to have significantly diminished sediment supply in the coastal zone. Meade (1976) has shown that the Hartwell and Clark Hill Reservoirs have essentially cut off the Piedmont sediment source from the lower reaches of the Savannah River.

Sedimentary contributions to the coastal zone are also affected by maintenance of navigational channels, as suggested by the summary records of the U.S. Army Corps of Engineers, 1872-1977. In the Savannah Harbor alone, more than seven million cubic yards of sediment have been dredged annually since 1970. At the mouth of the St. Marys River, more than 350,000 cubic yards ($270,000 \text{ m}^3$) of sediment are dredged yearly to facilitate navigation in the St. Marys Entrance Channel, and about the same amount is dredged from the Kings Bay Entrance Channel. At Brunswick Harbor about a million cubic yards have been dredged annually in recent years.

In their natural state, the ebb-tidal deltas that characterize Georgia inlets temporarily intercept

littoral drift before transporting sediment downcurrent. However, navigation projects such as Savannah Harbor, Brunswick Entrance Channel, and St. Marys Entrance significantly interrupt transport. The loss of dredged sediment from the littoral transport system results in sediment starvation on shorelines south of these inlets (Nash, 1977).

Presently, the coast of Georgia is marked by two jettied channels. At the Savannah River Harbor, jetties constructed between 1890 and 1898 extend seaward approximately 12,000 ft (3658 m). According to a 1970 U.S. Army Corps of Engineers report on Tybee Island, dredging by hopper dredge with disposal in deep water offshore "interrupts the normal movement of material across the inlet via the outer bar." In 1881, initiation of jetty construction at St. Marys Entrance reversed the erosive trend reported by the U.S. Army Corps of Engineers in 1875 and 1879. The north jetty, which extends 13,200 ft (4023 m) seaward from the south end of Cumberland Island has since caused the addition through accretion of nearly 500 acres (200 ha) adjacent to the jetty. At this writing, one groin exists on Tybee Island, although approximately 130 have been constructed on the beach since 1887. An 800 ft (243 m) terminal groin was emplaced on the north end of the island in 1975, as part of the beach renourishment project. Since 1975, considerable deposition has taken place on the Savannah River inlet shoreline north of the groin.

According to Nash (1977), side effects of jetty construction include: (1) a drastic alteration of the ebb-tidal delta system; (2) initially intensified deposition adjacent to the jetties; (3) probable elimination of downcurrent sediment transport; and (4) development of a vast sediment sink seaward of the jetties.

Although the lack of a dune system does not appear to interfere with processes of deposition along shorelines where sediment is abundant, dune destruction along unstable shorelines has been shown to increase susceptibility of the shoreline to erosion during storms. Despite long-standing recognition of the importance of coastal dunes, much of the dune system has been destroyed through development or over-grazing on Tybee, Ossabaw, Little St. Simons, St. Simons, Sea, and Jekyll Islands.

According to Oertel (1974), dunes along the Georgia coast have three principle functions: (1) dune-ridges serve as barriers to storm surges and prevent flooding of areas behind the beach; (2) storm wave energy is dissipated in the swales of the foredune field; and (3) dunes serve as important reservoirs of sand for the beach. During storms, energy is absorbed in the destruction of the dune-ridge, thus protecting the area landward of the beach.

The traditional approach for dealing with oceanfront erosion is to armor the beach and protect developed property. Consequently, protective structures now exist on Tybee, Sea, St. Simons, and Jekyll Islands. Unlike dunes, seawalls reflect energy rather than absorbing/dissipating it. Therefore, such structures not only degrade the aesthetic and recreational character of the shoreline, but also increase the natural rate of erosion. Although fixed shoreline structures can prevent the landward encroachment of the MHW shoreline, they generally accelerate erosion, either in the immediate vicinity of the protective structures or along adjacent downdrift shorelines (Kana, 1983). According to Pilkey et al (1981), side effects of shoreline defense structures include:

(1) acceleration of erosion through reduction of beach width; (2) steepening of offshore gradients; and (3) the increasing of wave heights.

PREVIOUS WORK

Of the relatively few publications concerned with shoreline changes along the Georgia coast, the majority are by the U. S. Army Corps of Engineers. However, their studies have been directed to small sections of the coast at which development has been damaged or threatened by a recession of the shoreline.

In a shore-erosion study of the coasts of Georgia and northwest Florida, Kaye (1961) described patterns of erosion and accretion along the shoreline of Georgia. Oertel (1973) effected a short term (30 year) history of the shoreline positions of Wassaw, Ossabaw, St. Catherines, Sapelo, Jekyll, and Cumberland Islands, in which erosion and accretion trends were graphically presented. Nash (1977) studied historical changes in the MHW shoreline of south Georgia and north Florida that occurred between the mid-1800's through 1973; the Georgia islands included in his study are St. Simons, Jekyll, and Cumberland. In a 1977 report for the Georgia Coastal Zone Management Program, Oertel illustrated shoreline changes on Tybee Island from 1907 to 1974 and on Little St. Simons Island from 1911 to 1974. In the 1980 U. S. Dept. of Interior coastal atlas of Georgia and South Carolina, Tybee/Little Tybee, St. Catherines, Little St. Simons, and Cumberland Islands are shown with historical shorelines from around 1850 and 1933 superimposed on 1974 maps.

PROCEDURES

Materials

The following sources were examined: U. S. Geological Survey 15 minute and 7 1/2 minute topographic and orthophotographic quadrangle sheets, National Ocean Survey/National Oceanic and Atmospheric Administration hydrographic and topographic original survey sheets, high-altitude controlled photographs from the Earth Resources Orbiting Satellite (EROS) Data Center and low-altitude controlled photographs from the Georgia Department of Transportation. A complete listing of maps and photographs is provided in the Appendix.

Interpretation of the maps and aerial photographs was aided by site visits to the majority of the islands in the study area and low-level helicopter overflights over the entire Georgia coast.

Methods

Because data of several formats and scales were utilized in the study, inherent errors and inaccuracies were unavoidable. The reader is directed to Nash (1977) for a lucid discussion of such problems, illustrated with specific examples.

All maps and charts were brought to a common scale of 1:24,000 through the use of a Map-O-Graph and a Saltzman Projector. The topographic quadrangle sheets of the mid-1950's were used as a datum for the positioning of earlier MHW shorelines. Old lighthouses, forts, dwellings, and road intersections were utilized whenever possible. On the few portions of maps lacking man-made landmarks, a "best-fit" method was employed, based on the beach ridge and creek meander patterns considered least subject to change. The estimated ground accuracy of time lines

drawn from original smooth sheets is ± 100 ft (30 m).

The high altitude aerial photographs taken in May 1982 by EROS provided partial coverage of the study area and indicated recent shoreline change. Because the scale of the aerial photographs only approximated 1:24,000, corrections were made by comparing measurements between identical points on the photographs and the orthophotographic quadrangle sheets. Aerial photographs (1:500 and 1:2500) taken in March and April of 1980 by the Georgia Department of Transportation provided shoreline change data for two islands. After bringing the photographs to scale with the Saltzman Projector, the 1980 and 1982 time lines were positioned onto the orthophotographic quadrangle maps. Primarily due to the difficulty in identification of the high tide swash line, ground accuracy for the 1980 and 1982 time lines is estimated at ± 65 ft (20 m).

The MHW shorelines mapped between 1857 and 1925 were drawn onto the mid-1950's topographic quadrangles; then, the available 1982 shoreline traced onto the 1979 orthophotographic quadrangles. Finally, all the timelines for each island were carefully traced onto appropriately registered vellum and inked. The resulting maps were photographically reduced to 10 in x 10 in size, from which the net MHW shoreline change maps were produced. In addition to the net shoreline change maps for the mid-1800 to 1974 study period, net change maps from 1924-1974 were produced. The latter maps are deemed superior for predictive purposes since the 1924-1974 interval is the most accurately represented period of the study, with an estimated ground accuracy of ± 25 ft (8 m). Additional net change maps were generated for those islands which illustrated particularly complex shoreline histories.

Inlets and sounds were drafted and reduced separately. This was because of the existence of greater map coverage for inlets, as opposed to central island areas, and the desire to better illustrate interaction between adjacent barrier islands.

HISTORICAL CHANGES IN THE MEAN HIGH WATER SHORELINE

TYBEE/LITTLE TYBEE ISLANDS

General Description

Tybee/Little Tybee Islands, the northernmost barrier island complex on the coast of Georgia, comprise a cusped foreland, or deltaic barrier, of the Holocene Savannah River delta. Tybee Island is bounded on the north by the Savannah River and separated from Little Tybee Island by Tybee Creek to the south. The island has a length of 2.75 mi (4.4 km) and a maximum width, including high ground and marsh, of 2.5 mi (4.0 km); elevations are generally less than 15 ft (4.6m). Because the island's sandy beachfront has long served as a recreational facility for the state and region, 1000 acres (400 ha) of high land have been developed (U.S. Dept. of the Interior, 1980).

The history of Tybee Island cannot be discussed apart from consideration of the history of the Savannah River. The drainage basin of the Savannah River extends from the Blue Ridge Province in North Georgia through the Piedmont Province to the Coastal Plain, a surface area of 10,576 mi² (27,392 km²). The discharge in the lower Savannah River averages 12,100 ft³/s (339 m³/s) (U.S. Geol. Survey, 1982). The river has several major dams and a long history of maintenance dredging. The combined total for sediment removed from the river by dams and dredges through 1976 represents approximately 0.65 billion yd³ (0.5 billion m³) (Oertel, 1977a).

The history of dredging in the Savannah River indicates that only minor quantities of sediment were removed between 1872 and 1915; however, dredging activities increased rapidly after 1915. Modern dredging activities have averaged over 7 million cubic yards a year since 1970 (Oertel, 1977a). As the amount of sediment being transported by the river to the coastal zone has reduced, corresponding erosion appears to have taken place on the island most affected, namely, downdrift Tybee Island.

As early as 1933, shoreline recession threatened development on the north end of the island, and a steel pile bulkhead was placed at this location. An additional timber pile bulkhead was installed in 1938, and a reinforced concrete seawall was constructed in 1941. By the late 1960's, the Atlantic Ocean was encroaching on the seawall, restricting recreational usage of the beach to periods of low water. In July 1975, a beach nourishment project was undertaken by the Corps of Engineers. In March 1976 the project was completed after 2.26 million yd³ (1.7 million m³) of sediment were pumped from the shoal system at the mouth of Tybee Creek and deposited along the ocean face of Tybee Island. The newly emplaced beach was bordered on the north by an 800 ft long (244 m) rock pile groin.

Oertel (1977b) monitored the after effects of the renourishment project for the Georgia Office of Planning and Budget; this paragraph is based on that report. Following nourishment, large quantities of sediment began appearing at the northern end of Tybee, outside the project area. The northern third of the strand area remained relatively stable during the year following nourishment. The central section of the recreational beach was a major accretional area in the same period. The 0.8 mile (1.3 km) section along the

the southern part of the project area underwent a substantial net loss. Erosion at the southern end of the island (outside the project area) was exacerbated by the northward shift of a new channel that developed across the shoal at the nourishment project borrow site. As the distal shoal forming the seaward side of the channel moved landward, the channel narrowed and caused flood currents to accelerate.

Little Tybee Island is a marsh island located between Tybee Island to the north and Wassaw Island to the south. The island is separated from Tybee Island by Tybee Creek and from Wassaw Island by Wassaw Sound. The 5.5 mi (9.0 km) long island has a discontinuous sandy beachfront 5.0 mi (8.1 km) in length; its maximum width is 3.3 mi (5.3 km).

Little Tybee consists of narrow washover beaches backed by a large marsh that surrounds isolated Holocene beach ridges. Elevations on the island range from sea level to 10 ft (3.0 m) at the top of the beach ridges. There are 6,780 acres (2744 ha) of land on the island, of which 600 acres (243 ha) are high land and 6180 acres (2503 ha) are marsh (Warner and Strouss, 1976).

The Kerr-McGee Corporation of Oklahoma owns the island, which is underlain by phosphate deposits (Furlow, 1969). In 1968, the corporation applied for a mineral lease to strip-mine phosphate deposits from the marsh surrounding the island. The lease was denied and the island has remained in a largely natural state.

In 1982, Little Tybee Island was included by the Dept. of Interior in the Coastal Barrier Resources Act, S.1018, making construction on the island ineligible for Federal Flood Insurance and other financial aid.

The large, accreting sand spit near the southern end of Little Tybee is known as Williamson Island. It is actually an extension of the island's shoreline that formed between 1957 and 1960, when an inlet formed at its northern end and isolated it from Little Tybee. In 1980, the spit was reported to be 1.7 mi (2.7 km) long by 0.2 mi (0.3 km) wide (U.S. Dept. of the Interior, 1980).

Shoreline Change

Historical records of the MHW shoreline of Tybee Island (Fig. 4a-c) illustrates two major trends in shore development, net accretion from 1866 to 1913 and net erosion from 1913 to 1982. During the period 1866 - 1913, prior to significant dredging activities in the Savannah River, the island enlarged considerably (Fig. 5). Although the northeast end of the island shifted inland, resulting in maximum erosion rates of 22 ft/y (6.7 m/y) at this location, accretion along the strand and on the downdrift end suggest that the Savannah River was contributing sediment generously to the island system during this period. Accretion rates along the strand in this interval ranged from minimum rates of 2 ft/y (.6 m/y) at the southern strand to a maximum rate of 20 ft/y (6.1 m/y) at the northern third of the strand. The most rapid widespread accretion on the island was on the southern end, with rates to 34 ft/y (10 m/y). Between 1866 and 1913 (Fig. 5), sediment gains along the central and southern shores of the island were greater than the losses along the northeast shore, producing a net increase in the size of the island.

Between 1913 and 1925 (Fig. 6), erosion took place along the entire length of the seaward facing strand; even the generally stable downdrift inlet shoreline eroded. The MHW line of the 1913 map does not extend into the Savannah River inlet, but ac-

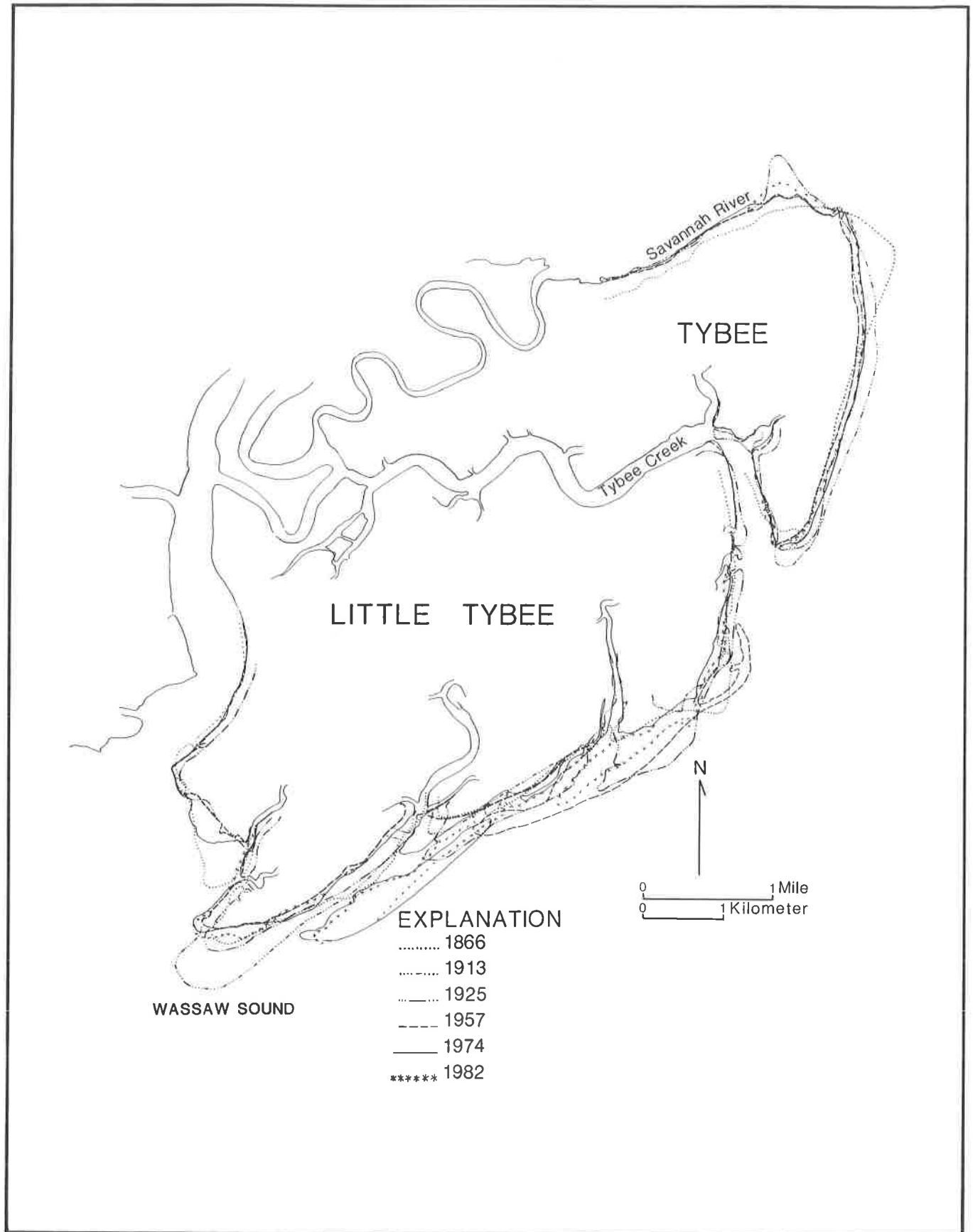


Figure 4.a Tybee/Little Tybee Islands MHW Shoreline Change, 1866-1982.

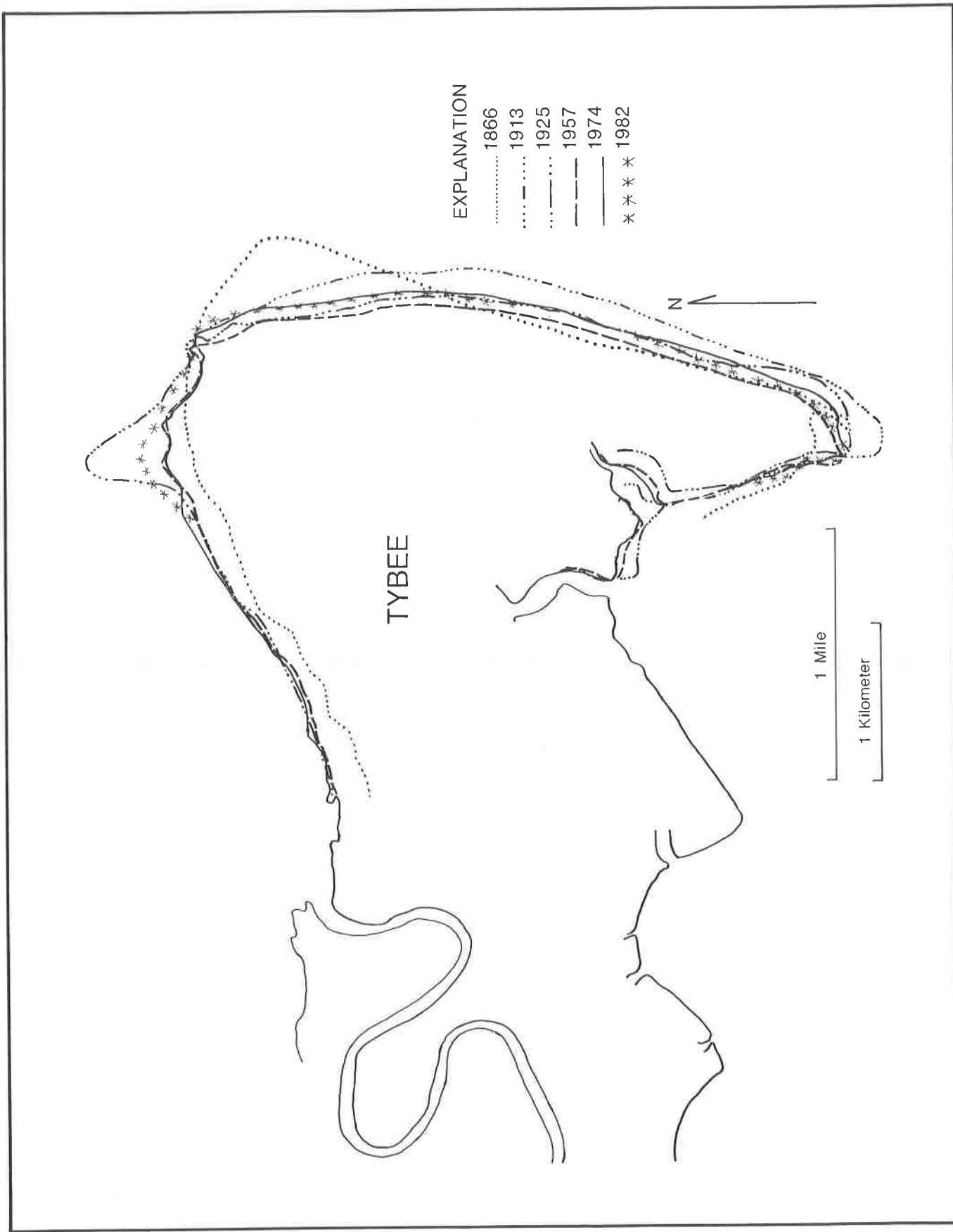


Figure 4.b Tybee Island MHW Shoreline Change, 1866-1982.

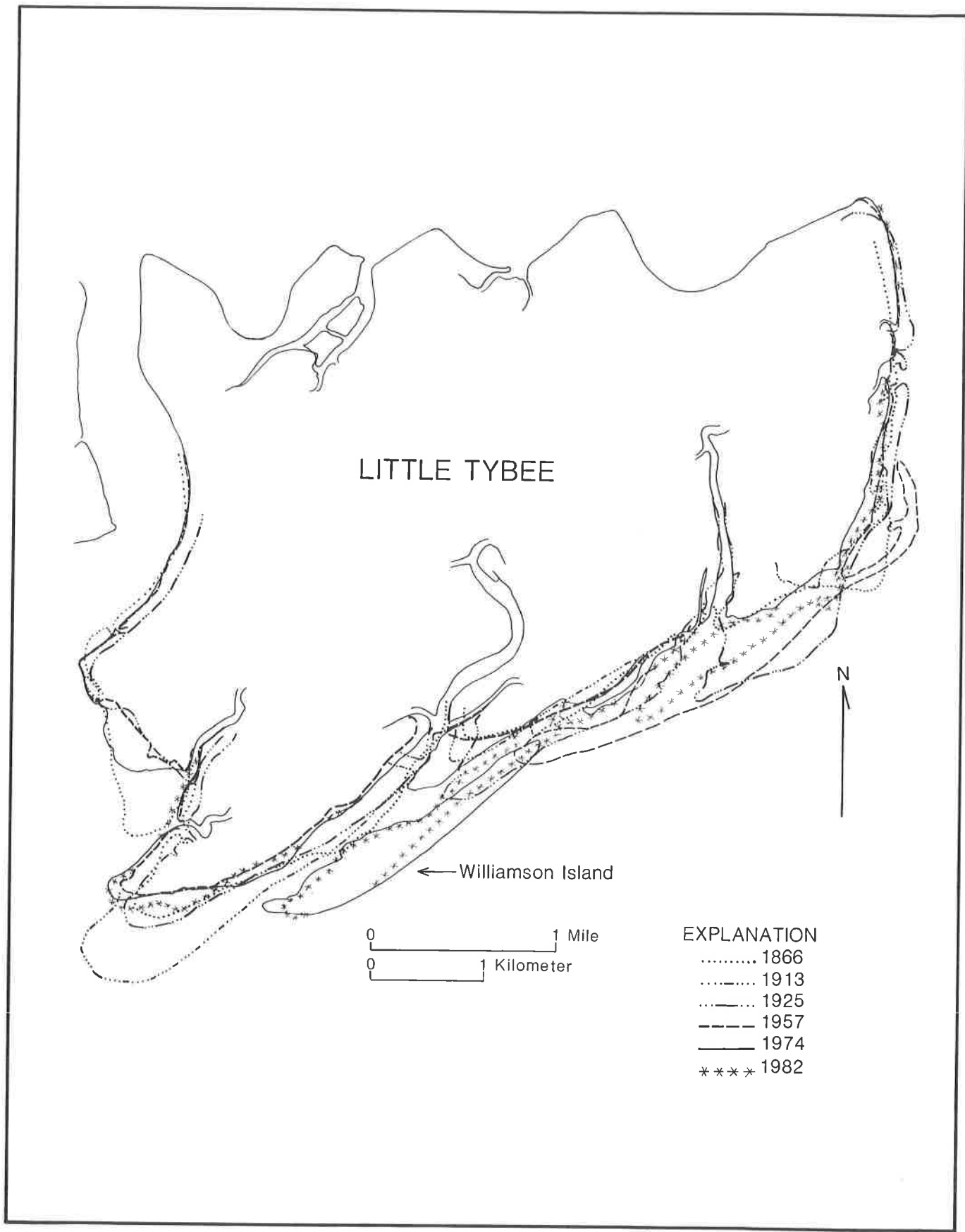


Figure 4.c Little Tybee Island MHW Shoreline Change, 1866-1982.

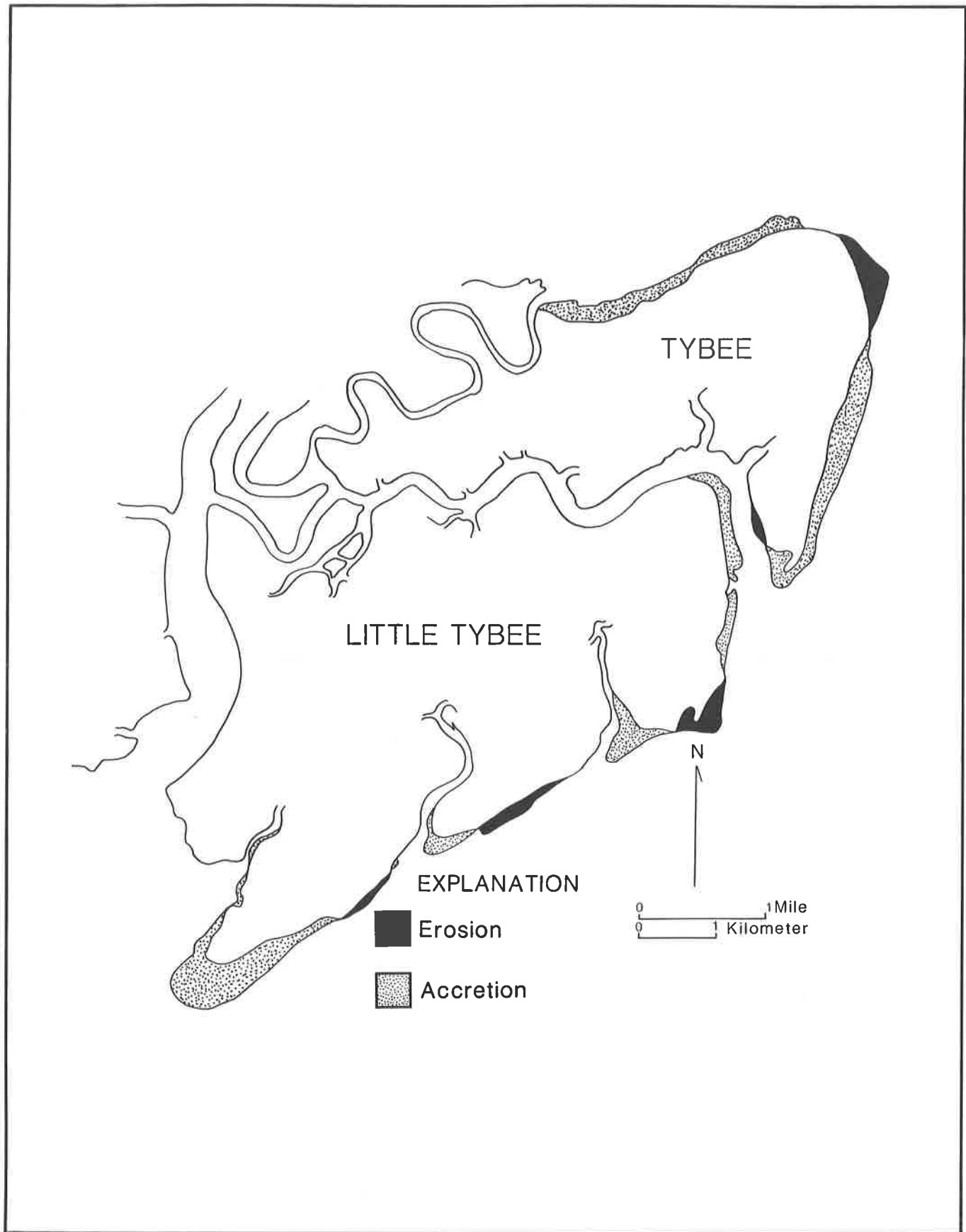


Figure 5. Tybee/Little Tybee Islands Net MHW Shoreline Change, 1866-1913.

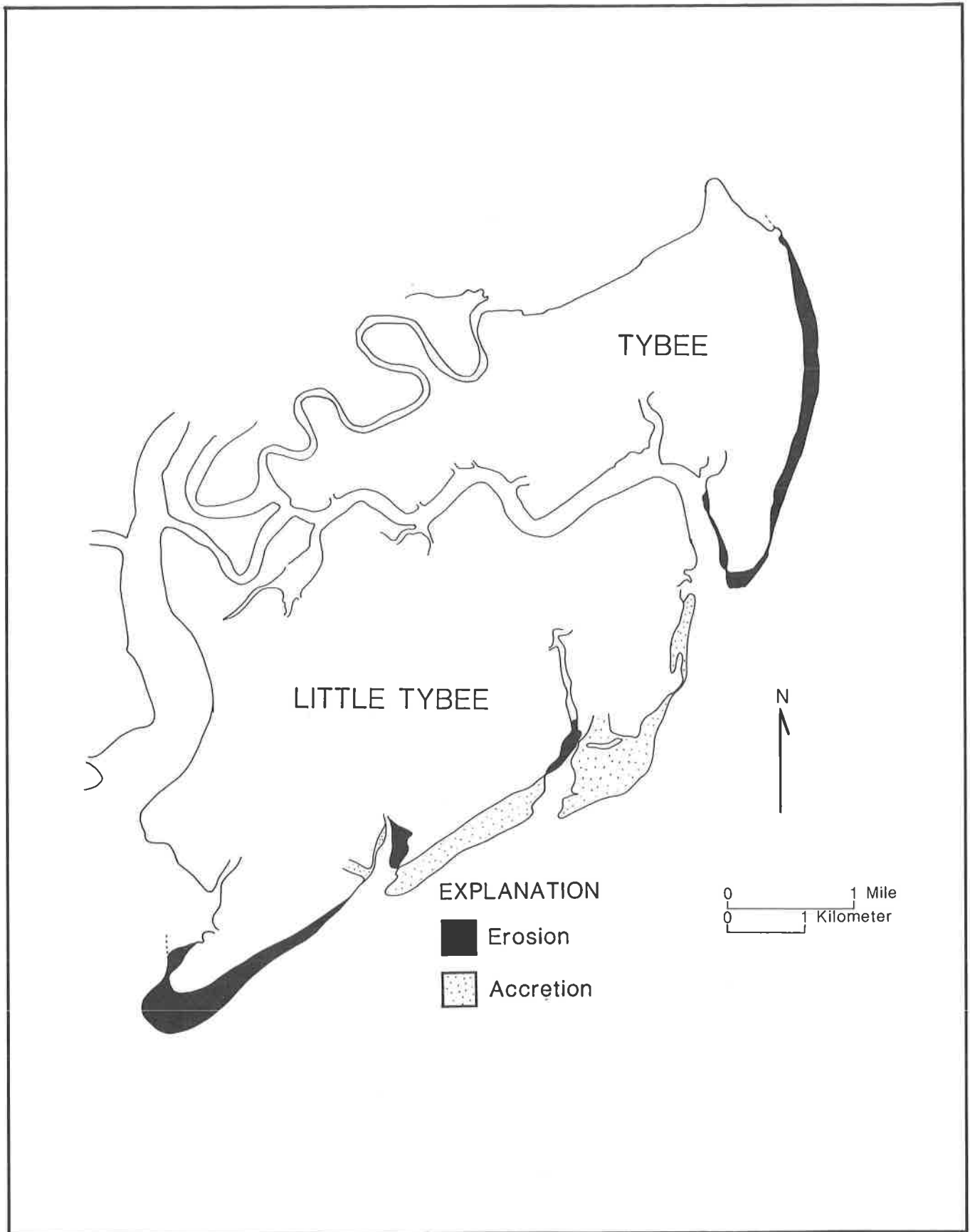


Figure 6. Tybee/Little Tybee Islands Net MHW Shoreline Change, 1913-1925.

cretion rates of 3 - 37 ft/y (1 - 11.3 m/y) between 1866 - 1925 indicate a depositional trend in this area. Along the seaward facing beach, however, the north and central areas of the strand both retreated a maximum of about 600 ft (183 m) in the 12 year study period. Maximum erosion at the southern end was 54 ft/y (16 m/y). The only stable part of the beach was a small quarter mile stretch on the southern strand. Because this atypical erosion took place prior to dam construction and adoption of soil conservation practices and during a period in which the majority of other island systems in Georgia were rapidly accreting, the losses may be related to the dredging activities initiated in 1919.

Between 1925 and 1957, Tybee Island continued to erode along the strand, and, for the first time, erosion commenced in the Savannah River inlet. The northwest trending spit, an area that had been shifting inland since the early 1900's was effectively truncated as it cut back at rates approaching 60 ft/y (18 m/y). The strand continued to migrate landward at rates averaging 6 ft/y (1.8 m/y), while the downdrift end eroded at rates of 9 - 16 ft/y (2.7 - 5 m/y).

Shoreline changes between 1957 - 1974 and 1974 - 1982 reflected the effects and after-effects of the beach nourishment project completed in early 1976. During the period of 1957 - 1974, the river inlet stabilized and even accreted in isolated areas at rates to 15 ft/y (4.5 m/y). During the same period, the entire strand built seaward between 200 - 400 ft (61 - 122 m), while the inlet-facing south end lengthened between 90 - 300 ft (27.4 - 91.4 m).

The 1982 time line, drawn from EROS high altitude photographs, indicated that the Savannah River inlet

remained stable from 1974 to 1982, and a spit built rapidly to the northwest at rates from 12.5 - 15 ft/y (4 - 4.6 m/y). This spit, located at the site of the 1924 spit, apparently built from the renourishment sand, which, as Oertel (1977b) reported, had moved through and over the terminal groin. During the same period, all of the strand, except a small area south of the terminal groin location, eroded rapidly at rates to 22 ft/y (6.7 m/y). On the southeast end of the island, the post-1957 accretion trend reversed, and losses averaged from 6 - 26 ft/y (1.8 - 8 m/y). Meanwhile, the southwest end of the island accreted at rates from 12 - 25 ft/y (3.7 - 7.6 m/y).

When net MHW shoreline change on Tybee Island is considered for the period 1925 - 1974 (Fig. 7), it is apparent that the island has undergone a net retreat over this period. Erosion at the Savannah River inlet took place to a maximum of 1840 ft (560.8 m). The northern half of the beachfront accreted to a maximum of 240 ft (73.2 m), while the central area was generally stable. A small area on the south-central strand advanced to 180 ft (54.9 m), but the south beach and the Tybee Creek inlet shoreline retreated a maximum of 300 ft (91.4 m).

Consideration of net shoreline change on Tybee Island from 1866 to 1974 (Fig. 8) illustrates relatively little change, due to the fact that post-1913 erosion has been masked by the rapid deposition that took place prior to the initiation of significant dredging activities in the Savannah River. Accretion all along the Savannah River inlet shoreline ranged from 320 ft (97 m) to 780 ft (237.7 m). The maximum retreat occurred on the northeast beachfront at rates up to 14 ft/y (4.3 m); however, the remainder of the strand area advanced at rates up to 4 ft/y (1.2

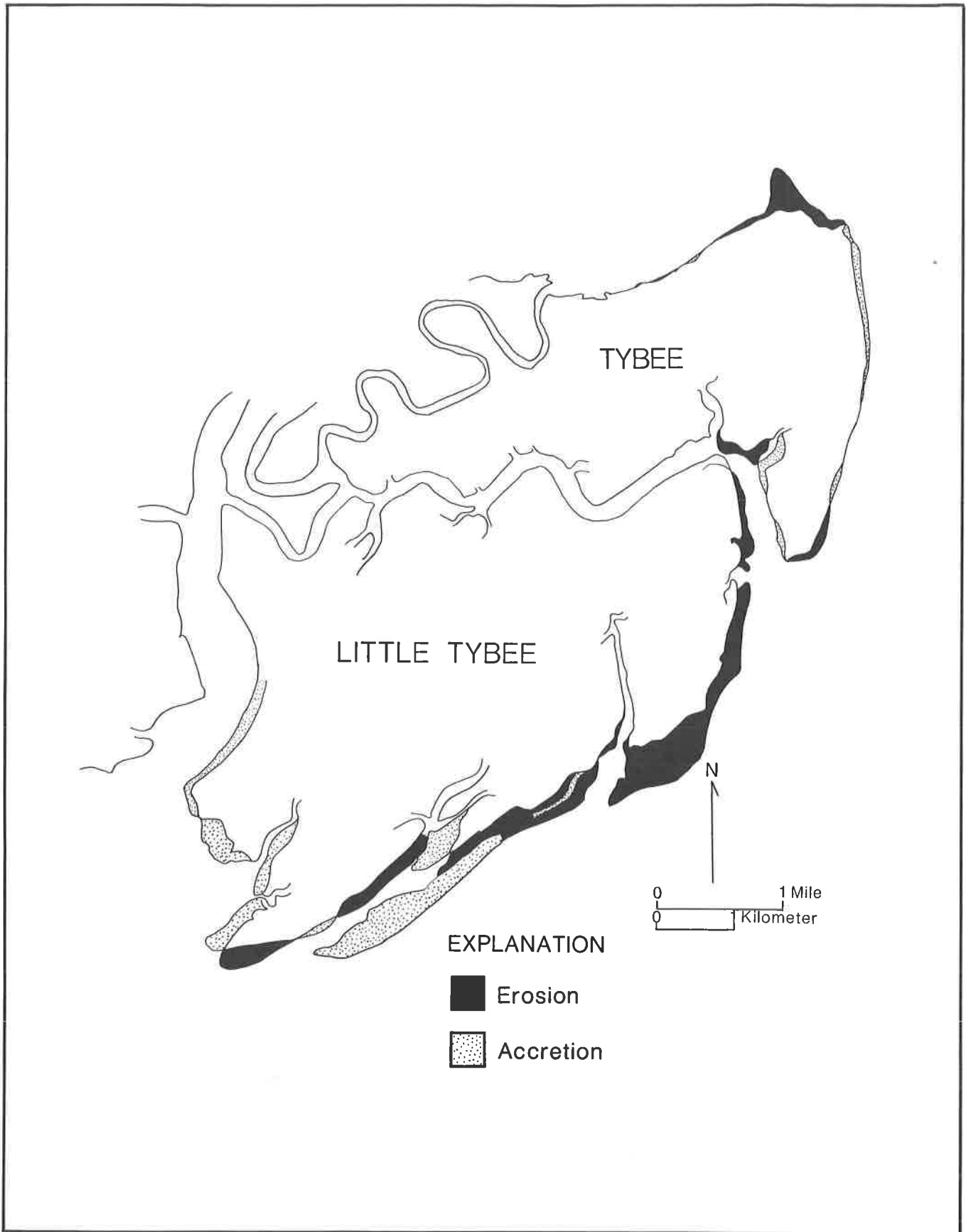


Figure 7. Tybee/Little Tybee Islands Net MHW Shoreline Change, 1925-1974.

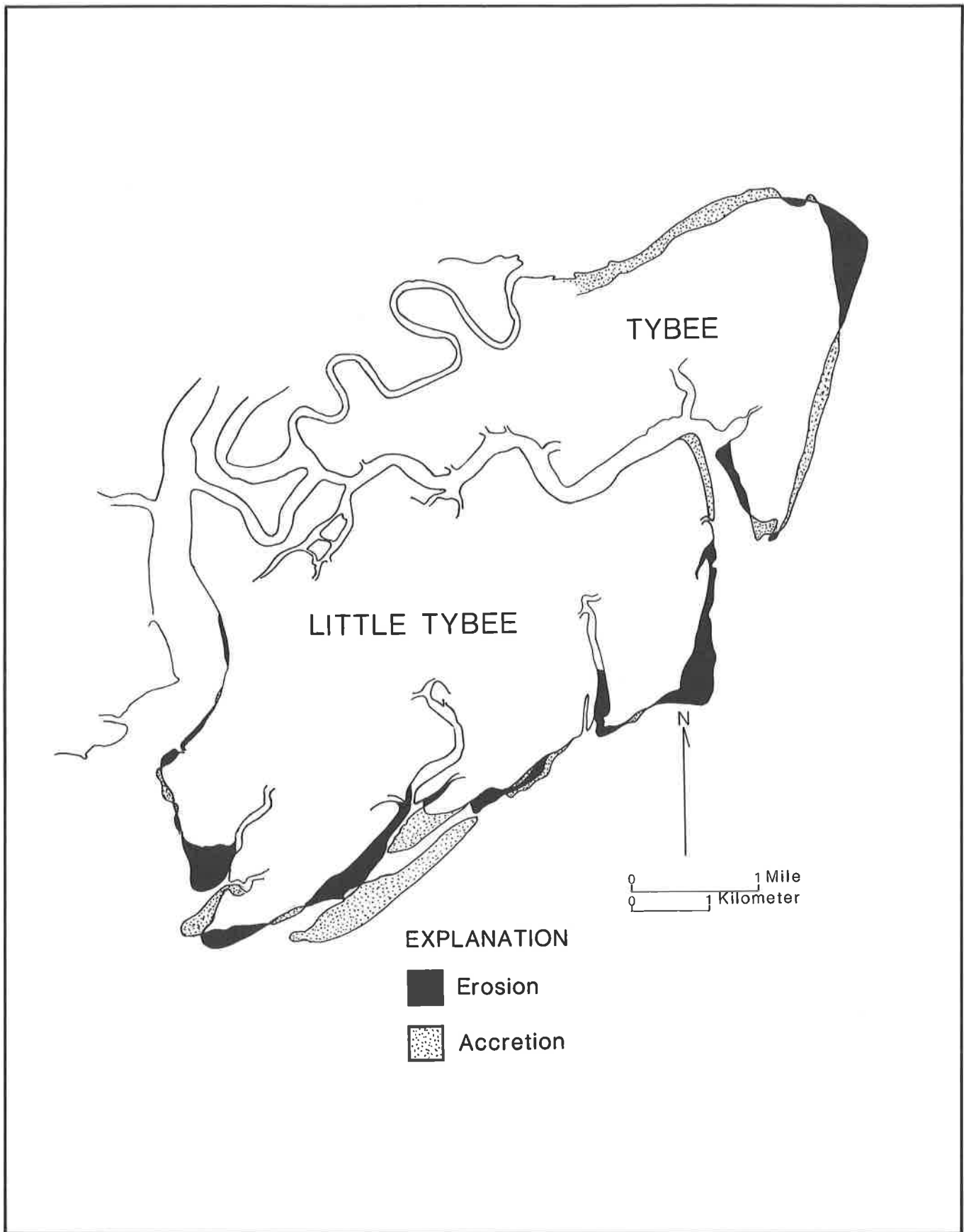


Figure 8. Tybee/Little Tybee Islands Net MHW Shoreline Change, 1866-1974.

m/y). Deposition also occurred on the southern end of the island, with a maximum advance of 580 ft (176.8 m). The island complex neither migrated southward nor elongated; its maximum length decreased about 0.08 mi (0.13 km). For this 108 year study period, Tybee Island appears to have maintained a tenuous dynamic stability.

Little Tybee has had an unstable shoreline since 1866, with periodic advances and retreats occurring on the north, central, and south portions of the island. The island advanced considerably during the period of 1866 - 1913 (Fig. 5) on all three segments. The north segment evidenced a shifting pattern, with northeast and southwest accretion exceeding erosion to the southeast; there was a maximum advance of 2300 ft (701 m) on the downdrift end. A shifting pattern also took place on the central portion in this period, with a maximum retreat of 440 ft (134 m) and a maximum advance to 780 ft (237.7 m). On the Wassaw Sound shoreline, accretion took place at rates of 40 ft/y (12.2 m/y).

Between 1913 and 1925, the north segment continued to accrete at rates of up to 100 ft/y (30.5 m/y). The central section accreted all along the beachfront, with the average advance amounting to about 1000 ft (304.8 m). On the south portion, erosion commenced at maximum rates of 183 ft/y (55.8 m/y). In the interval between 1925 - 1957, the beachfront of the north section evidenced great instability, with a maximum advance of 1000 ft (304.8 m) and a maximum retreat of 1400 ft (426.7 m). The southward migration of a spit attached to the north lobe progressed at an average rate of 172 ft/y (52.4 m/y). Meanwhile, the central section eroded from 22 - 50 ft/y (6.7 - 15.2 m/y), and the south segment eroded at rates from 18 - 35 ft/y (5.5 - 10.7 m/y).

In the interval between 1957 and 1974, the elongated spit of the north segment was truncated, apparently prior to 1960, and migrated south to become what is presently known as Williamson Island. Meanwhile, the central section evidenced a maximum advance of nearly 2000 ft (610 m) on the south end. The shoreline of the south segment was marked by stability and accretion, with a maximum advance of 380 ft (115.8 m).

The MHW shoreline drawn from 1982 EROS high altitude photos suggests stability and/or accretion for Little Tybee Island for the period of 1974 - 1982. Some of this accretion may have resulted from longshore transport of sediment from the renourishment project completed in 1976 on Tybee Island. The north segment advanced a maximum of 450 ft (137.2 m), and a newly formed spit extended 6200 ft (1890 m) south of the 1975 terminus of this segment of the island. The central lobe advanced a maximum of 350 ft (106.7 m) for the period, while the south lobe illustrated a broad shifting pattern and counterclockwise rotation, with little, if any, net change evident. Williamson Island both narrowed and shortened in this interval, with maximum retreats of 450 ft (137.2 m) and 560 ft (170.7 m), respectively; the north end of the small island shifted landward up to 300 ft (91.4 m).

Net change on Little Tybee Island for the period 1925 - 1974 (see Fig. 7) indicates that the island has retreated. The greatest erosion for the period is seen on the north segment, where the maximum retreat was about 1800 ft (548.6 m). Losses on the central section are balanced by gains on Williamson Island, an extension of the island's shoreline. On the south portion, the sandy beachfront has eroded to a maximum retreat of 900 ft (274.3 m), although there were gains in the marsh to the southwest.

WASSAW SOUND

Wassaw Sound (Fig. 9), the tidal inlet separating Little Tybee and Wassaw Islands, reflects the shoreline changes seen on the Tybee/Little Tybee system. Inlet constriction between 1866 and 1913 confirms the availability of an ample sediment supply for this period, while subsequent inlet enlargement from 1913 to 1974 suggests a reduction in available sediment. The 1982 shoreline illustrates a slight narrowing of the inlet, perhaps related to the previously discussed beach nourishment project on Tybee Island.

From 1866 to 1913, Wassaw Sound narrowed considerably, for the southwest end of Little Tybee advanced to a maximum of 2200 ft (670.6 m) and the north end of Wassaw accreted a maximum of 700 ft (213.4 m) to the northeast. The inlet therefore narrowed during this period at an average rate of 58 ft/y (17.7 m/y). The greatest period of erosion for the islands bounding Wassaw Sound was from 1913 - 1925, when the inlet enlarged a total of 2180 ft (664.5m). During this period, the southwest end of Little Tybee retreated 1700 ft (518.2 m), while the northeast end of Wassaw had a maximum retreat of 560 ft (170.7 m).

From 1925 to 1957, erosion continued at a lesser rate. The southern end of Little Tybee evidenced a maximum retreat of 880 ft (268.2 m), while the north end of Wassaw Island had a maximum retreat of 240 ft (73.2 m). During the period 1957 - 1974, the southern end of Little Tybee advanced a maximum of 360 ft (110 m) to the southwest, while the north end of Wassaw sustained a maximum loss of 420 ft (128 m), leaving the width of the inlet little changed.

The 1974 - 1982 time span indicates that accretion occurred on the southward portion of Little Tybee at

rates of 12.5 - 32.5 ft/y (3.8 - 10 m/y) and on the north end of Wassaw at rates of 19 - 34 ft/y (5.8 - 10.4 m/y), initiating another period of inlet constriction. This trend may prove to be a short-lived phenomenon, associated with the Tybee Island beach renourishment project.

WASSAW ISLAND

General Description

Wassaw Island is a Holocene beach ridge island 2.0 mi (3.2 km) in width located between Little Tybee Island to the north and Ossabaw Island to the south. The island is separated from Little Tybee Island by Wassaw Sound and from Ossabaw Island by Ossabaw Sound. The island has a sandy beachfront along its entire length of 5.4 mi (8.7 km). There are 2,358 acres (954 ha) of high ground and 7,692 acres (3,113 ha) of marsh. Elevations on the island range from sea level to 13 ft (4.0 m). There are 5 acres (2 ha) of developed land on the island (U.S. Department of Interior, 1980).

Wassaw was purchased by the Nature Conservancy and turned over to the U.S. Fish and Wildlife Service in 1969. The island is now managed as a National Wildlife Refuge, while the previous owners retain 290 acres (117 ha) in private holdings through the Wassaw Island Trust (Warner and Strouss, 1976). In 1982, Wassaw Island came under the "Coastal Barrier Resource Act" (S.1018), an act which denies new Federal Flood Insurance and thus discourages future development.

Shoreline Change

Wassaw Island (Fig. 10) illustrates a history of deposition from 1858/ 1866 to 1913, after which a pattern of erosion to the northeast and accretion to the southwest was established. Wassaw enlarged considerably during the period 1866 -

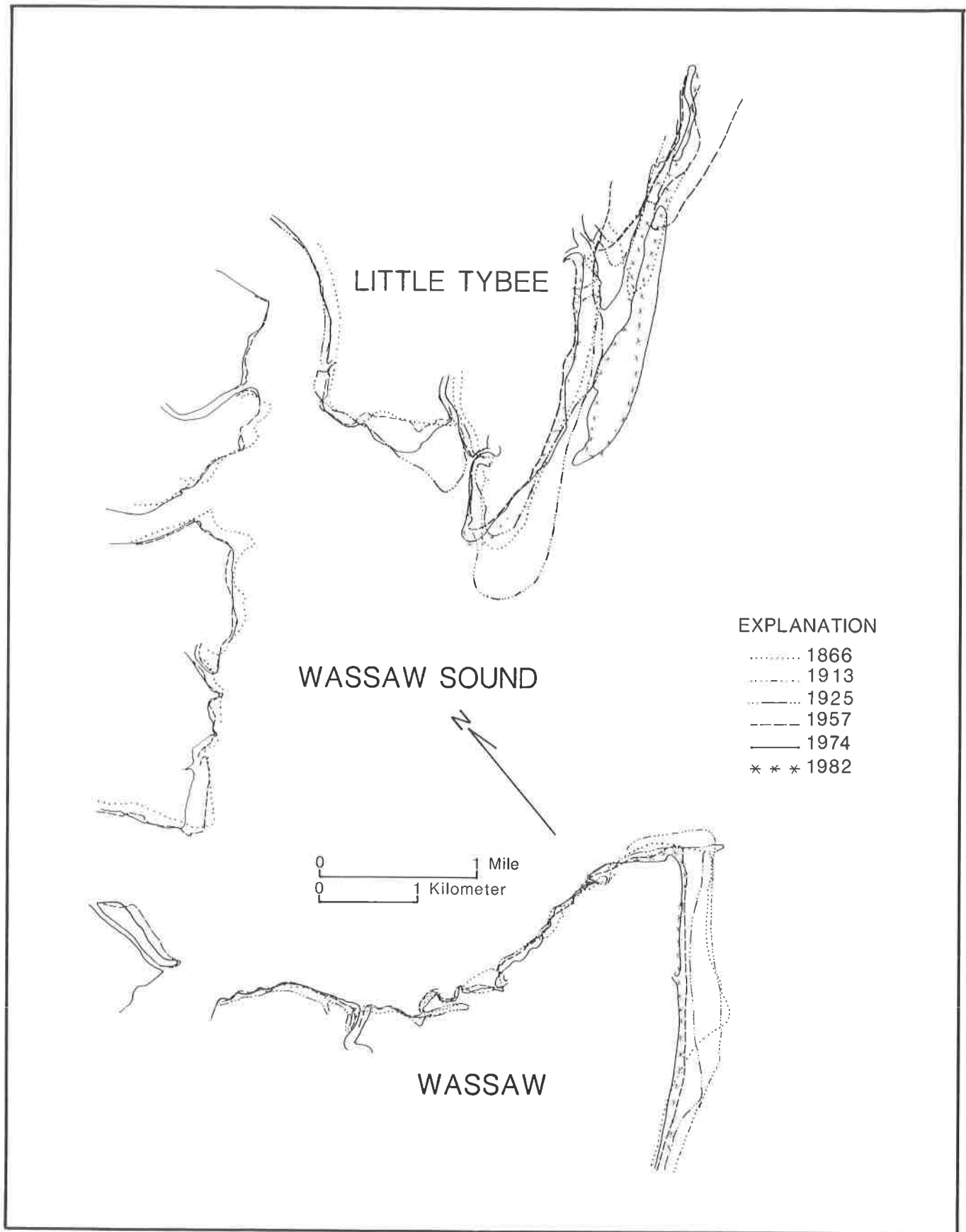


Figure 9. Wassaw Sound MHW Shoreline Change, 1866-1982.

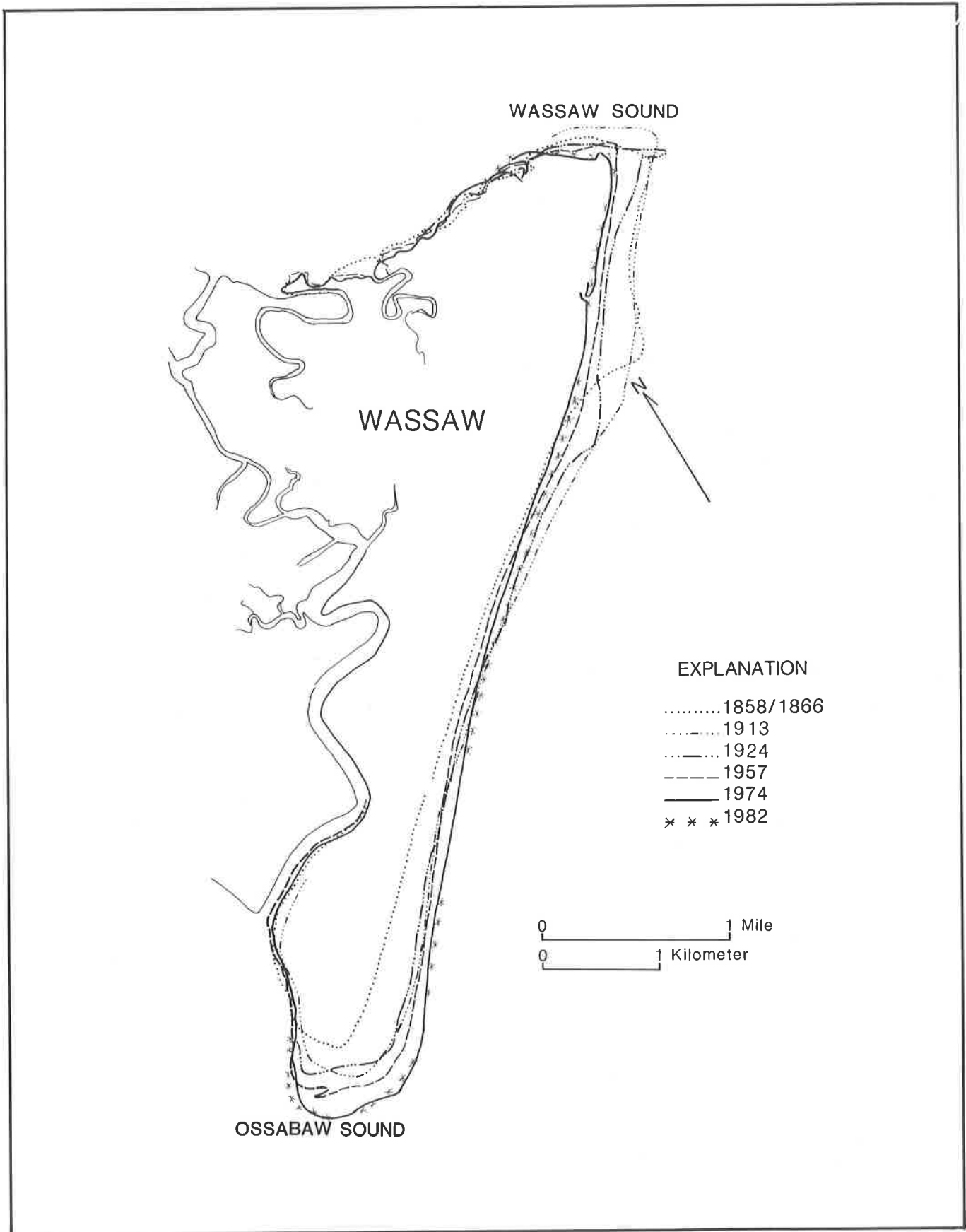


Figure 10. Wassaw Island MHW Shoreline Change, 1858-1982.

1913. The maximum advance on the updrift (northeast) end was 660 ft (201.2 m), while the north-central portion evidenced a maximum gain of 1100 ft (335.3 m). Between 1858 and 1913, the southern strand advanced to a maximum of 700 ft (213.4 m), while the southern end gained a maximum of 1040 ft (317 m) for the period.

During the period 1913 - 1924, the island assumed a pattern of northern erosion and southern accretion. The entire Wassaw Sound shoreline eroded 400 ft (122 m) or more in this period, while the northern fourth of the island underwent a maximum retreat of 950 ft (289.6 m). The central strand was relatively stable; the maximum retreat was 160 ft (48.8 m). The southern end of the strand gained about 190 ft (58 m), while erosion and accretion along the Ossabaw Sound shoreline were balanced.

Between 1924 and 1957, the northern half of the island continued to erode, with a maximum Wassaw Sound shoreline loss of 550 ft (167.6 m) and a northern shoreline retreat of 660 ft (201.2 m). The southern half of the island, in contrast, accreted a maximum of 240 ft (73.2 m) on the strand and 650 ft (198.1 m) along the Ossabaw Sound shoreline.

For the period 1957 - 1974, erosion slowed on the northern part of Wassaw Island. The Wassaw Sound shoreline eroded between 106 - 445 ft (32.3 - 135.6 m), while the maximum retreat on the northern portion was about 400 ft (122 m). Accretion rates slowed, as well, along the central and south-central strands, with a maximum advance of about 100 ft (30.5 m). The maximum gain on the Ossabaw Sound shoreline was 840 ft (256 m).

If net shoreline change on Wassaw Island for the period 1924 - 1974 (see Fig. 11) is considered, the

island appears to be in equilibrium. Minor accretion toward Wassaw Sound and major deposition on the southern strand just balance minor recession on the Ossabaw Sound shoreline and major losses to the north. Wassaw Island illustrates drastic change in this brief 50 year study period with a maximum northern retreat of 1080 ft (329.2 m) and a maximum southern advance of 1360 ft (414.5 m), resulting in a strong counterclockwise rotation pattern.

The MHW shoreline drawn from 1982 aerial photographs indicates slight gains in the Wassaw Sound inlet and continued erosion on the adjacent seaward shoreline at rates up to 10 ft/y (3.0 m/y) for the period 1974 - 1982. Accretion appears to be progressing along most of the remainder of the beach, with a maximum advance of about 100 ft (30.5 m). On the southern end, erosion to the southeast appears to be balanced by accretion to the southwest. This erosion/accretion pattern is similar to that of the 1913 - 1925 study period.

If net shoreline change on Wassaw Island (see Fig. 12) is considered for the entire study period of 1858 - 1974, it is obvious that the island has undergone net accretion during the 116 years. Losses at the northern end at a maximum rate of 13.8 ft/y (4.2 m/y) have been exceeded by gains along the remainder of the beachfront at rates up to 17 ft/y (5.2 m/y). The advance of Wassaw Island that occurred between 1858 and 1913, coupled with the lesser gains of 1913 - 1924, has masked much of the post-1924 northern erosion. In summary, Wassaw Island has a history of deposition from 1858 to 1924 and dynamic stability from 1924 to 1974, resulting in net accretion from 1858 to 1974.

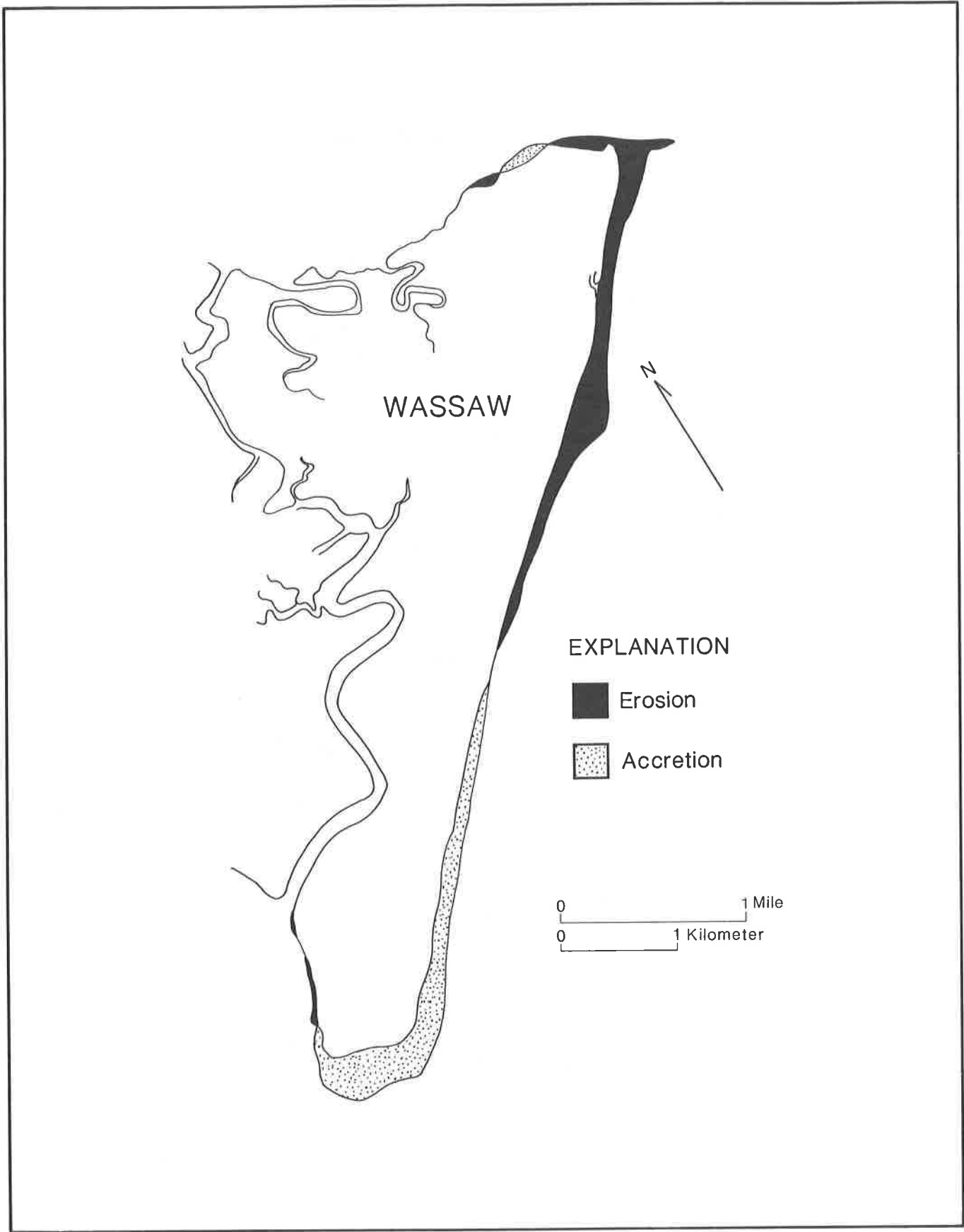


Figure 11. Wassaw Island Net MHW Shoreline Change, 1924-1974.

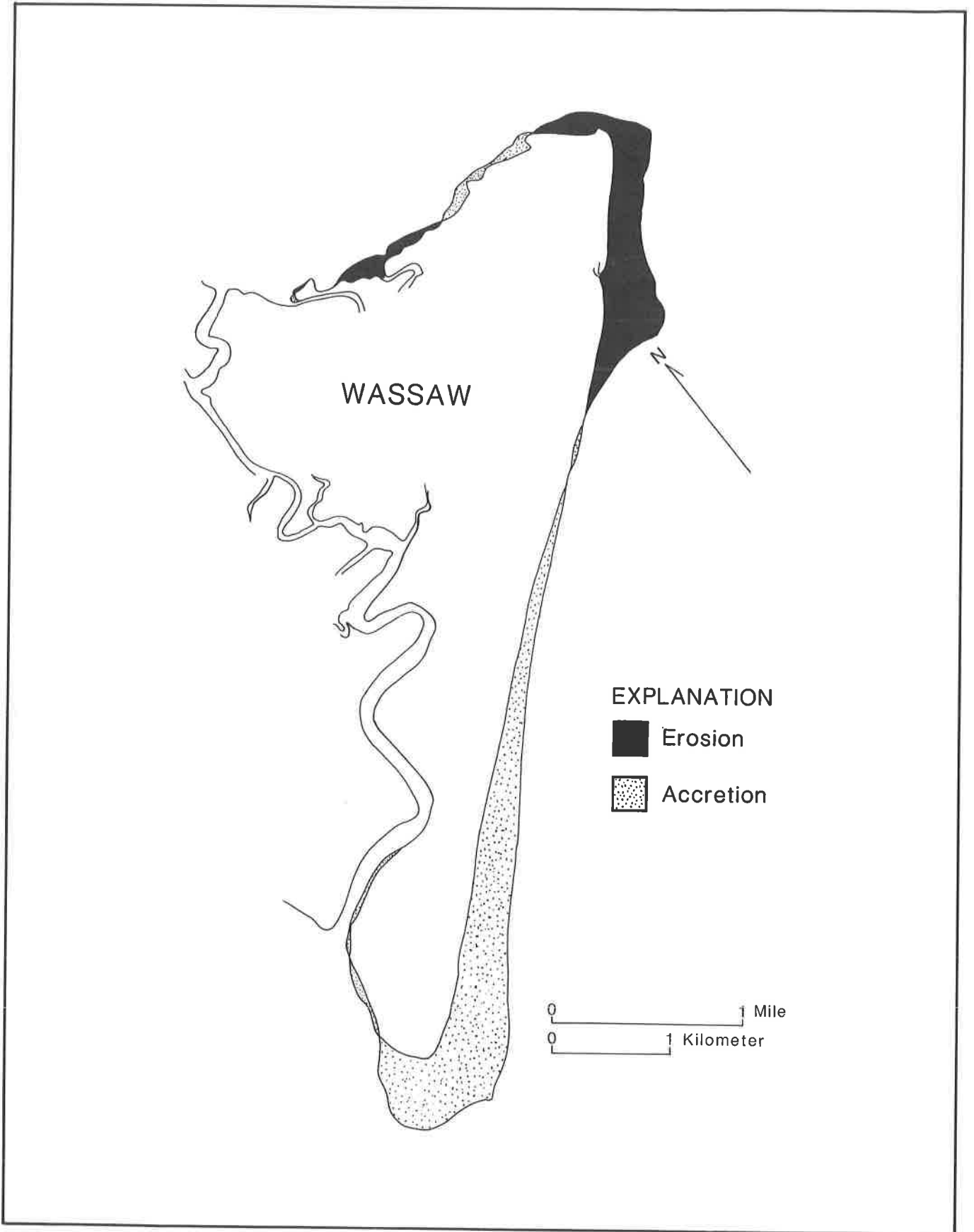


Figure 12. Wassaw Island Net MHW Shoreline Change, 1858-1974.

OSSABAW SOUND

Ossabaw Sound (Fig. 13), separating Wassaw Island to the north and Ossabaw Island to the south, is a broad river inlet associated with the mouth of the Ogeechee River. The major river channel, with depths to 26.3 ft (8 m), lies between Raccoon Key and Ossabaw Island. The headwaters of the Ogeechee rise in the southern Piedmont Province, and its average discharge is calculated at 2,358 ft³/s (66.8 m³/s) (U.S. Geol. Survey, 1982). The river is not dammed, and continued deposition on the northern end of Ossabaw Island since 1924 indicates that the Ogeechee River may seasonally contribute sediment to the Georgia coast.

Ossabaw Sound has a history of continuous constriction for the study period of 1859 - 1982. The southern end of Wassaw Island has advanced at rates up to 16.3 ft/y (5 m/y); the northern end of Ossabaw Island evidences an atypical accretion at rates up to 8.8 ft/y (2.7 m/y). Ossabaw Sound has narrowed a maximum of 3000 ft (914.4 m) for the study period.

OSSABAW ISLAND

General Description

Ossabaw Island, a Pleistocene island with a Holocene beach ridge fringe, is located between Wassaw Island to the northeast and St. Catherines Island to the southwest. The island is separated from Wassaw Island by Ossabaw Sound and from St. Catherines Island by St. Catherines Sound. A sandy beachfront stretches along its 9.1 mi (14.6 km) length. Its maximum width, including high ground and marsh, is 5.4 mi (8.7 km). Between 50 - 100 acres (20 - 40 ha) are developed (Warner and Strouss, 1976). Elevations on the island range from sea level to 15 ft (4.6 m). The western Pleistocene portion of the island is character-

ized by broad, flat ridges and shallow depressions; the eastern Holocene section is marked by steep, parallel duneridges. There are approximately 25,000 acres (10,117 ha), including 11,800 acres (4775 ha) of uplands, the remainder being salt marsh (Ga. Dept. of Natural Resources, 1982).

Ossabaw Island became Georgia's first State Heritage Preserve through a combination gift and purchase (Ga. Heritage Trust Act, 1975) in May of 1978. The island is in custodianship of the Georgia Department of Natural Resources and is presently managed by the Game and Fish Division of that department. Mrs. Eleanor Torrey West, President of the Ossabaw Island Foundation, has retained a life estate of 23 acres (9.3 ha) (Ga. Dept. of Natural Resources, 1982).

Shoreline Change

The shoreline history of Ossabaw Island from 1858/1860 to 1974 (Fig. 14) is characterized by deposition at the north, central, and south portions of the beachfront coupled with erosion at the north-central and south-central portions of the strand. Wide-ranging shifts along the shoreline of Ossabaw have taken place about persistent nodal points, or relatively stable strandline locations about which large fluctuations of erosion and accretion have occurred.

Between 1858/60 and 1924, the northern end of the island shifted landward, resulting in a maximum gain to the northwest of 1280 ft (390.1 m). North of the nodal point located on the northeast end of the island, there was a maximum loss of 570 ft (173.7 m); a half mile south of the nodal point (node #1), the maximum accretion was 820 ft (250 m). The central portion of the beach accreted to a maximum of 2050 ft (624.8 m) in this interval. Meanwhile, shifts about the nodal point on the south-

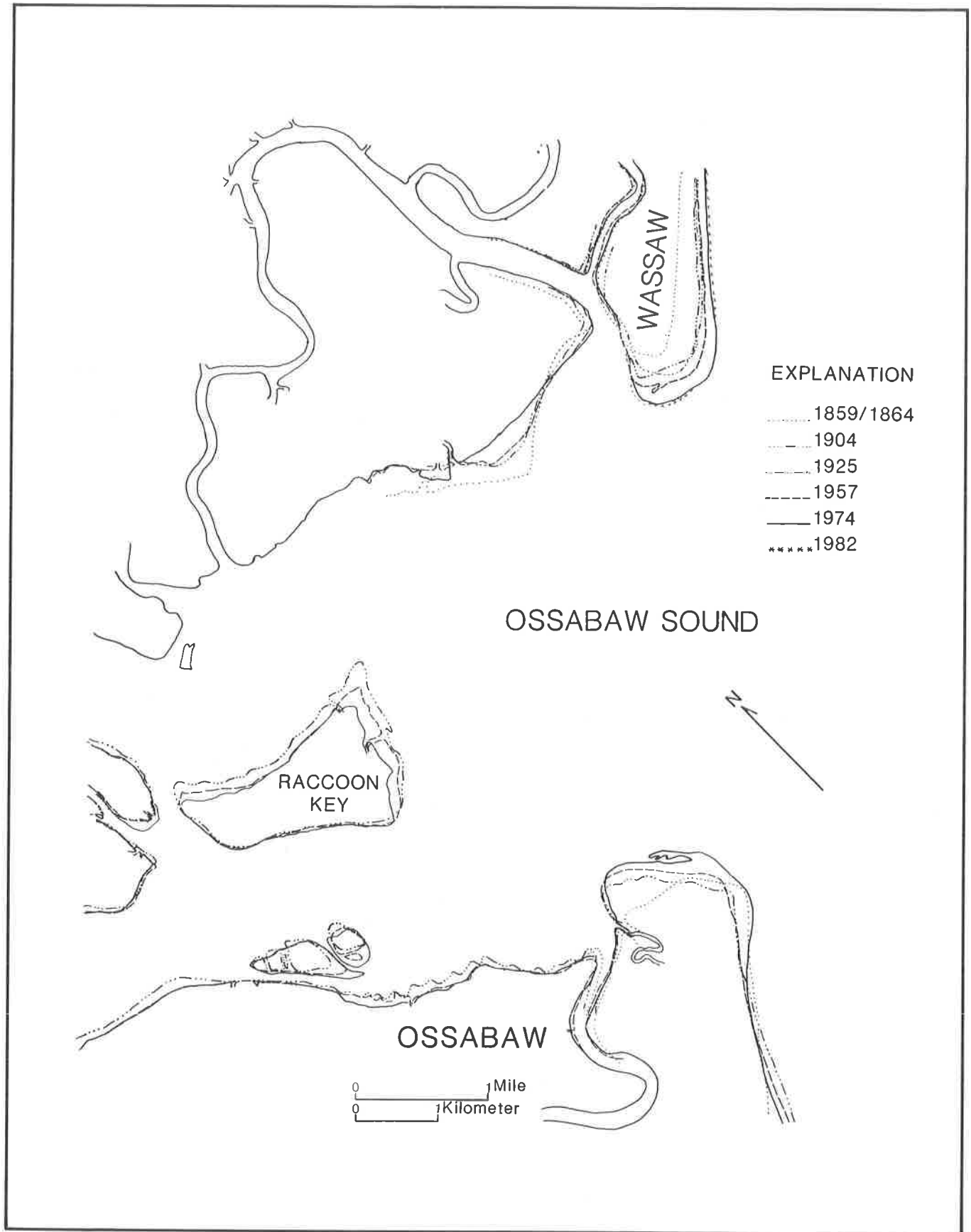


Figure 13. Ossabaw Sound MHW Shoreline Change, 1859-1982.

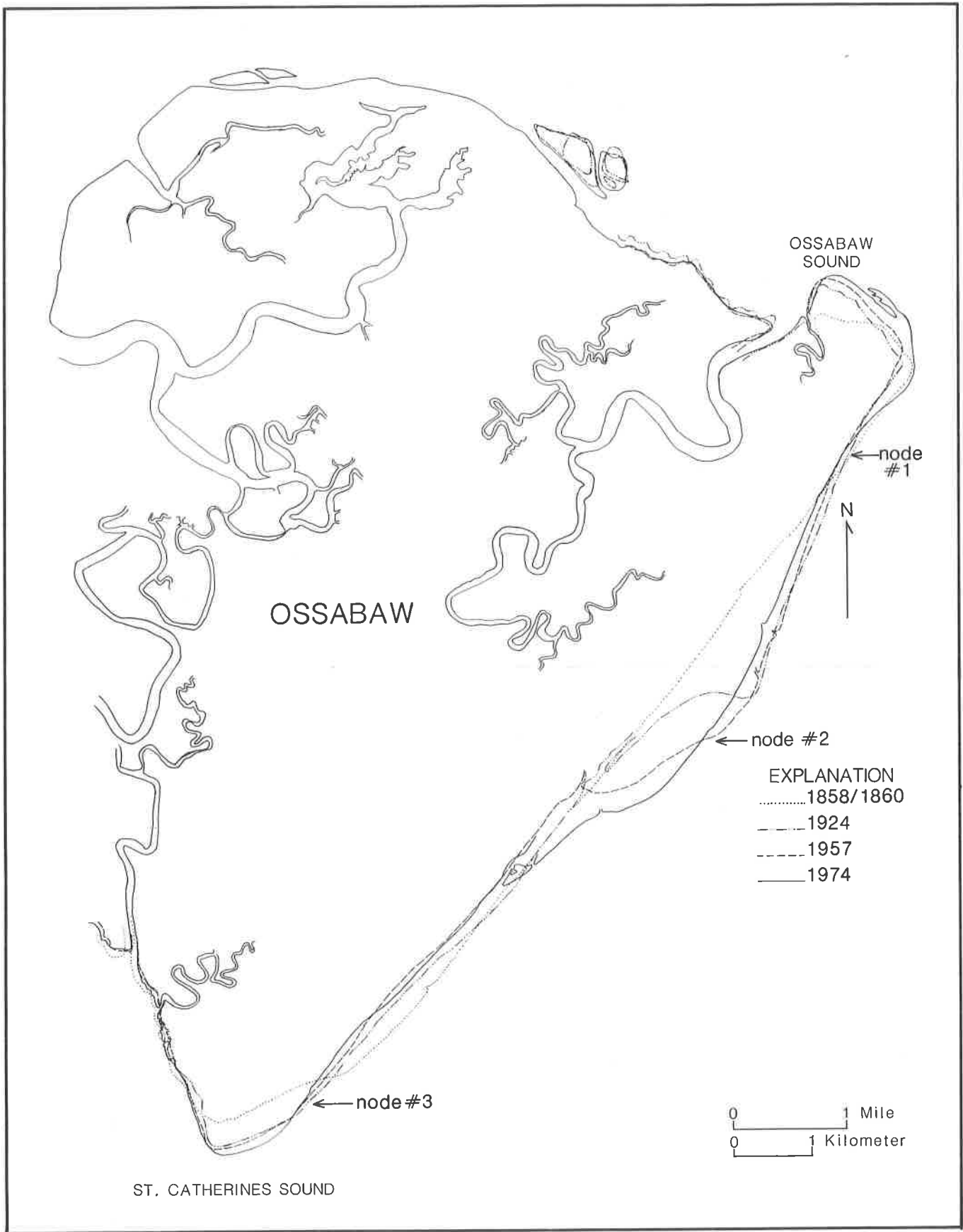


Figure 14. Ossabaw Island MHW Shoreline Change, 1858/60-1974.

east end of the island (node #3) amounted to maxima of 650 ft (198.1 m) erosion north of the node and 1360 ft (414.5 m) accretion south of the node.

For the period 1924 - 1957, northward accretion continued to a maximum gain of 1080 ft (329.2 m); continued landward shifting of the northeast end resulted in a maximum loss of 240 ft (73.2 m) on the adjacent seaward-facing beach. Erosion continued on both the north-central and south-central strand, at respective maximum rates of 10.6 ft/y (3.2 m/y) and 14.5 ft/y (4.4 m/y). Greatest accretion was again at the central strand, with a maximum advance of 1800 ft (548.6 m). Less change occurred on the southern end, where erosion to a maximum of 280 ft (85.3 m) north of the node was balanced by accretion south of the node to a maximum of 260 ft (79.2 m).

Between 1957 and 1974, the up-drift inlet shoreline of Ossabaw Island reversed its long-standing landward progress and shifted seaward, resulting in a maximum advance of 820 ft (250 m) at the northeast updrift end. North of node #1 on the upper strand, a maximum advance of 880 ft (268.2 m) occurred; just south of this point, the beach eroded to a maximum of about 300 ft (91.4 m). During this period, a major shift took place on the central strand, resulting in a maximum retreat of 690 ft (210.3 m) north of node #2 and a maximum advance of 840 ft (256 m) south of the node. Shifts about the southernmost nodal point (node #3) amounted to 220 ft (67.1 m) of up-drift erosion and 360 ft (109.7 m) of downdrift accretion.

Net MHW shoreline change on Ossabaw Island between 1924 and 1974 (Fig. 15) indicates that the island maintained a dynamic stability during this period. Maximum net gains of 1220 ft (372 m) occurred on the Ossa-

baw Sound shoreline, 1240 ft (378 m) on the central strand, and 465 ft (141.7 m) on the St. Catherines Sound shoreline. Maximum net losses took place on the north-central and south-central strands at respective rates to 10.4 ft/y (3.2 m/y) and 7.2 ft/y (2.2 m/y).

When net MHW shoreline change is considered for the entire study period of 1858/1860 to 1974 (Fig. 16), it is apparent that the Ossabaw Island shoreline underwent a net advance. Erosion on both the northeast strand to 370 ft (112.8 m) and on the south-central strand to 1150 ft (350.5 m) was outpaced by deposition on the remaining sandy beachfront. For the 116 year period, the following maximum advances took place: 1840 ft (560.8 m) on the Wassaw Sound shoreline, 2450 ft (746.8 m) on the central strand, and 1620 ft (493.8 m) on the St. Catherines Sound shoreline.

In summary, the MHW shoreline history of Ossabaw Island is one of deposition between 1858 - 1924 and dynamic stability between 1924 - 1957. The considerable accretion that took place on the island in the period 1957 - 1974 indicates that the Ogeechee River may be presently contributing sediment to the island.

ST. CATHERINES SOUND

St. Catherines Sound (Fig. 17), the tidal inlet separating Ossabaw Island to the north and St. Catherines Island to the south, is the smallest sound on the coast of Georgia. The Medway River, which flows through the sound, heads in the marshes and has no river source. The history of the sound shoreline is one of southward migration, due to accretion on the sound end of Ossabaw and erosion on the north end of St. Catherines, coupled with considerable losses on the small marsh islands associated with the inlet.

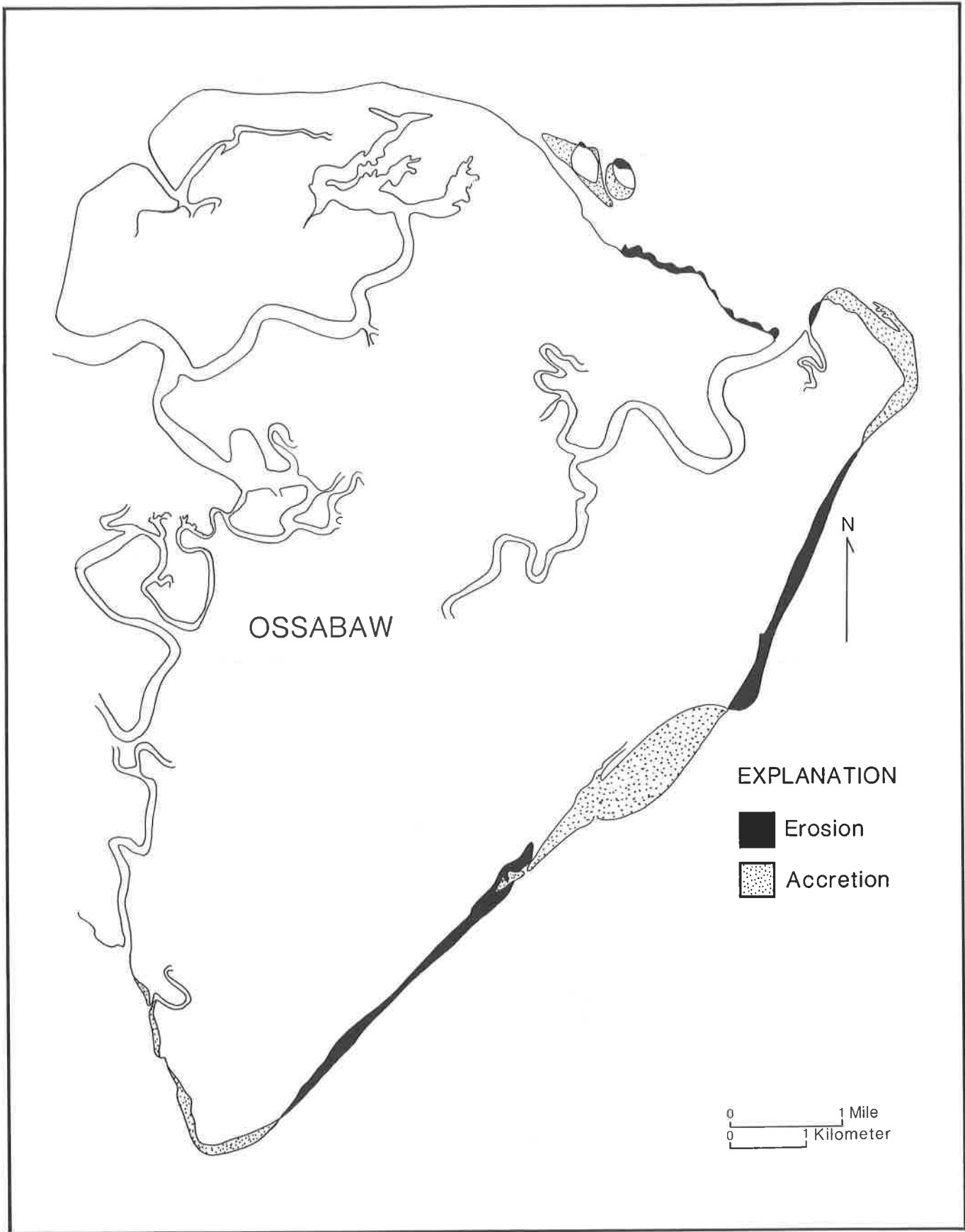


Figure 15. Ossabaw Island Net MHW Shoreline Change, 1924-1974.

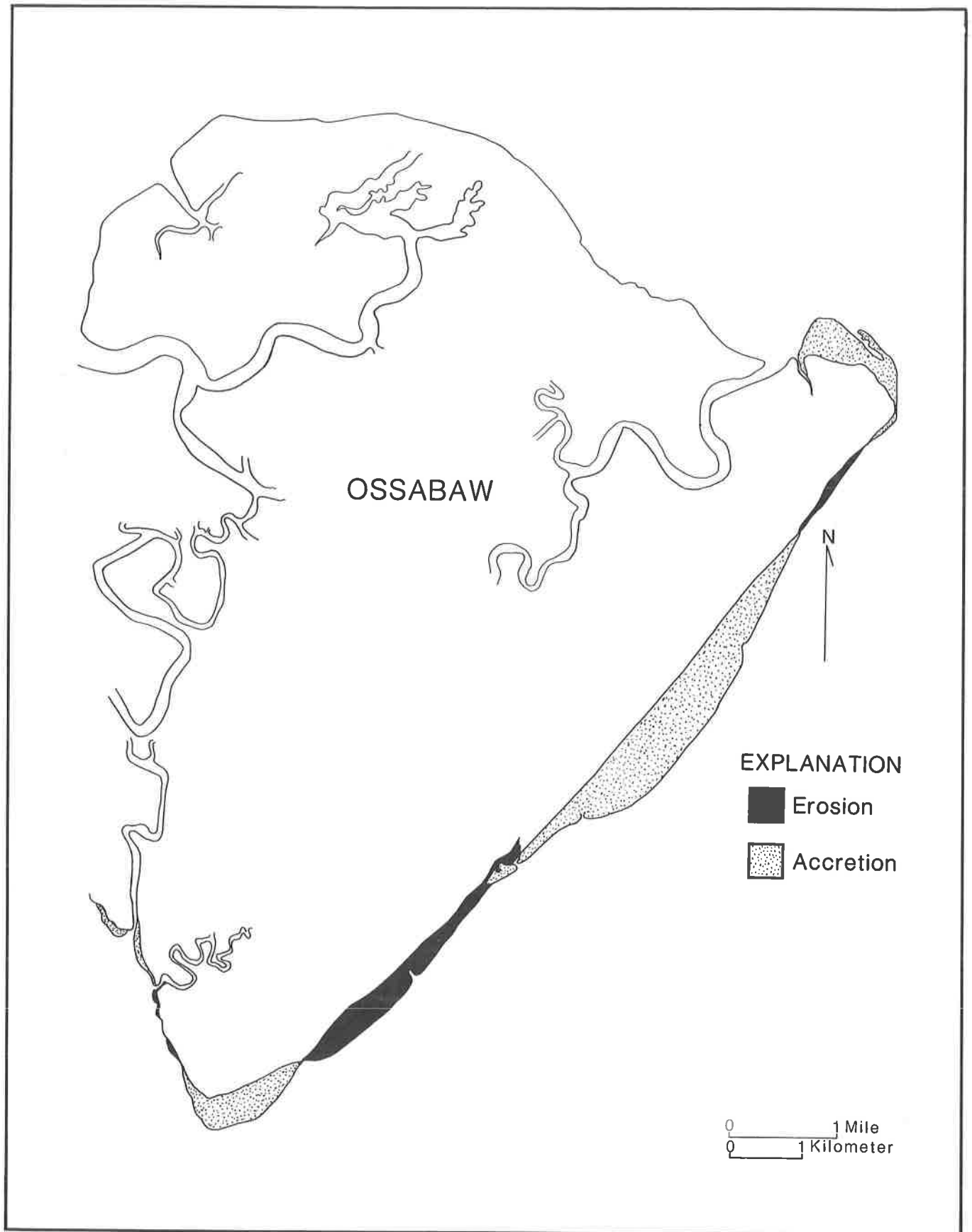


Figure 16. Ossabaw Island Net MHW Shoreline Change, 1858/60-1974.

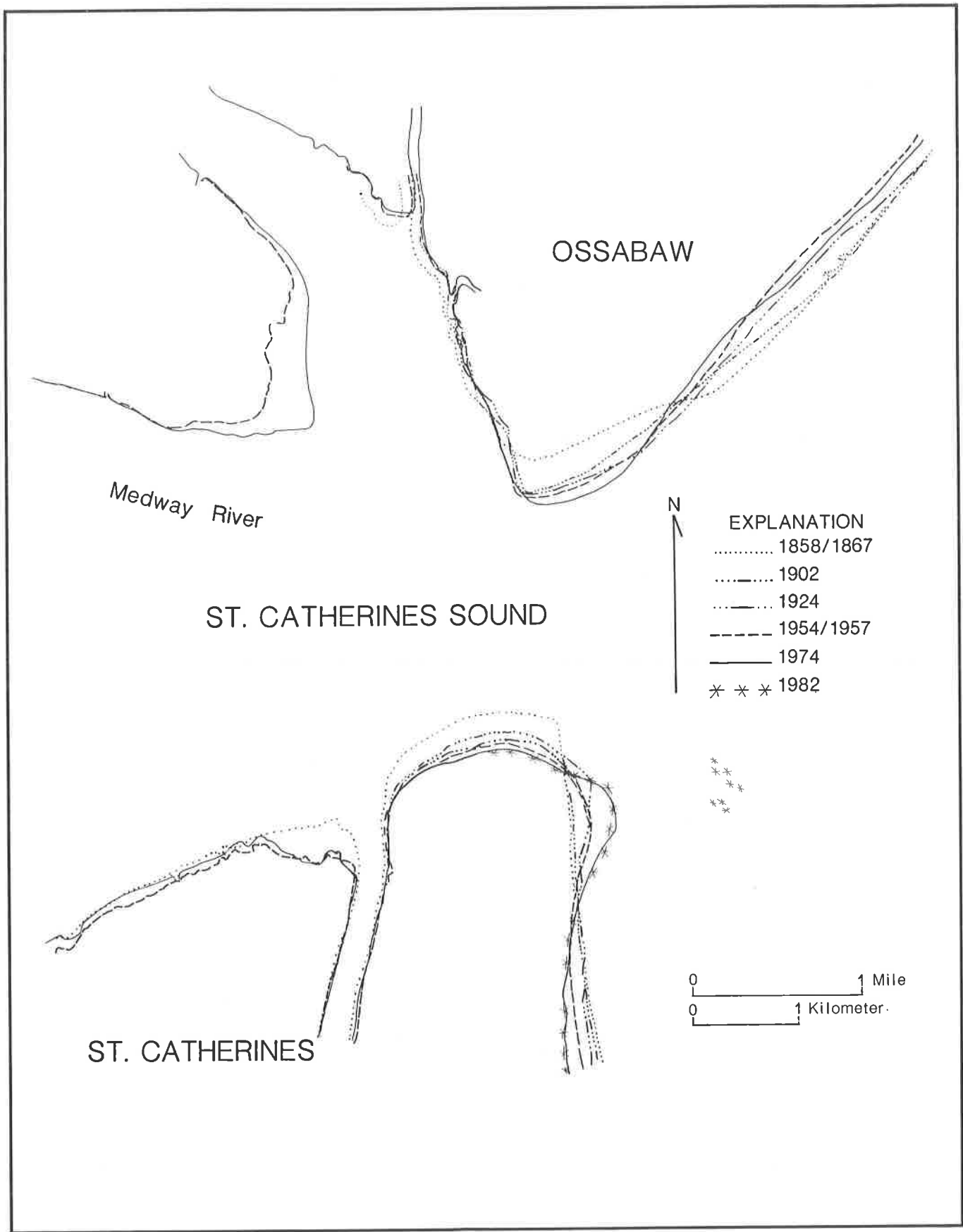


Figure 17. St. Catherines Sound MHW Shoreline Change, 1858/67-1982.

The south end of Ossabaw Island has accreted steadily since 1867, to a maximum advance of 1600 ft (487.7 m) by 1974. In contrast, erosion on the north end of St. Catherines has taken place, amounting to a maximum loss of 1300 ft (396.2 m) from 1867 - 1974. In spite of these changes, the narrowest inlet width in 1974 was 1.45 mi (2.33 km), the same measurement recorded in 1867.

ST. CATHERINES ISLAND

General Description

St. Catherines Island lies midway between the Savannah and Altamaha Rivers. Approximately 10.2 mi (16.4 km) long and 1.2 - 3.0 mi (2 - 5 km) wide and oriented NNE by SSW, St. Catherines is separated from the mainland by an expanse of salt marsh 3.7 - 6.2 mi (6 - 10 km) wide. Elevations are to 20 ft (6 m). The island is bounded by two tidal inlets: St. Catherines Sound to the north separates the island from Ossabaw Island, and Sapelo Sound to the south separates it from Blackbeard and Sapelo Islands. These sounds are the lower reaches of salt water estuaries, i.e., marine embayments lacking true river input (Wadsworth, 1981). There are 14,642 acres (5,928 ha) of land on the island, of which about 100 acres of high ground are developed (U.S. Dept. of Interior, 1980).

St. Catherines is owned by the John Noble Foundation, which sponsors research projects in archaeology, terrestrial animal populations, and breeding of rare and endangered species. Presently, the New York Museum of Natural History and the New York Zoological Society are funded by the foundation. Access to the island is restricted (Warner and Strouss, 1976).

Shoreline Change

The shoreline history of St. Catherines Island (Fig. 18) is one of widespread retreat from 1858/1867 to 1982 on the north, north-central, and south segments of the sandy beachfront. The central and south-central strand areas were more stable until 1924; since that time, however, shoreline recession has occurred here as well.

From 1867 to 1902/1904, erosion occurred on the St. Catherines Sound shoreline to a maximum of 825 ft (251.5 m). Meanwhile, the north segment retreated at rates to 6.0 ft/y (1.8 m/y) and the north-central lobe eroded at rates to 11.4 ft/y (3.5 m/y). The island evidenced a degree of stability from 1858 to 1902/1904 along the central and south-central strand. Maximum erosion on the central strand was 120 ft (36.6 m), while maximum accretion on the south-central strand was 220 ft (67.1 m). The Sapelo Sound shoreline of St. Catherines suffered atypical erosion to a maximum retreat of 1080 ft (329.2 m), or an average rate of retreat of up to 24.5 ft/y (7.5 m/y).

From 1902/1904 to 1924, erosion on the north beachfront continued at a lesser rate with a maximum retreat of 260 ft (79.3 m). The small, persistently stable area on the northeast end of St. Catherines accreted to a maximum of 760 ft (231.6 m). Meanwhile, erosion continued on the north lobe at rates to 12.0 ft/y (3.7 m/y) and on the north-central lobe at rates to 30.0 ft/y (9.1 m/y). A rare depositional event took place on the island between 1902 and 1924, when the central strand area accreted to a maximum advance of 750 ft (228.6 m). However, the south-central strand eroded to a maximum of 370 ft (112.8 m), and the Sapelo Sound inlet shoreline retreated another 980 ft (298.7 m) at an average rate of 42 ft/y (12.8 m/y).

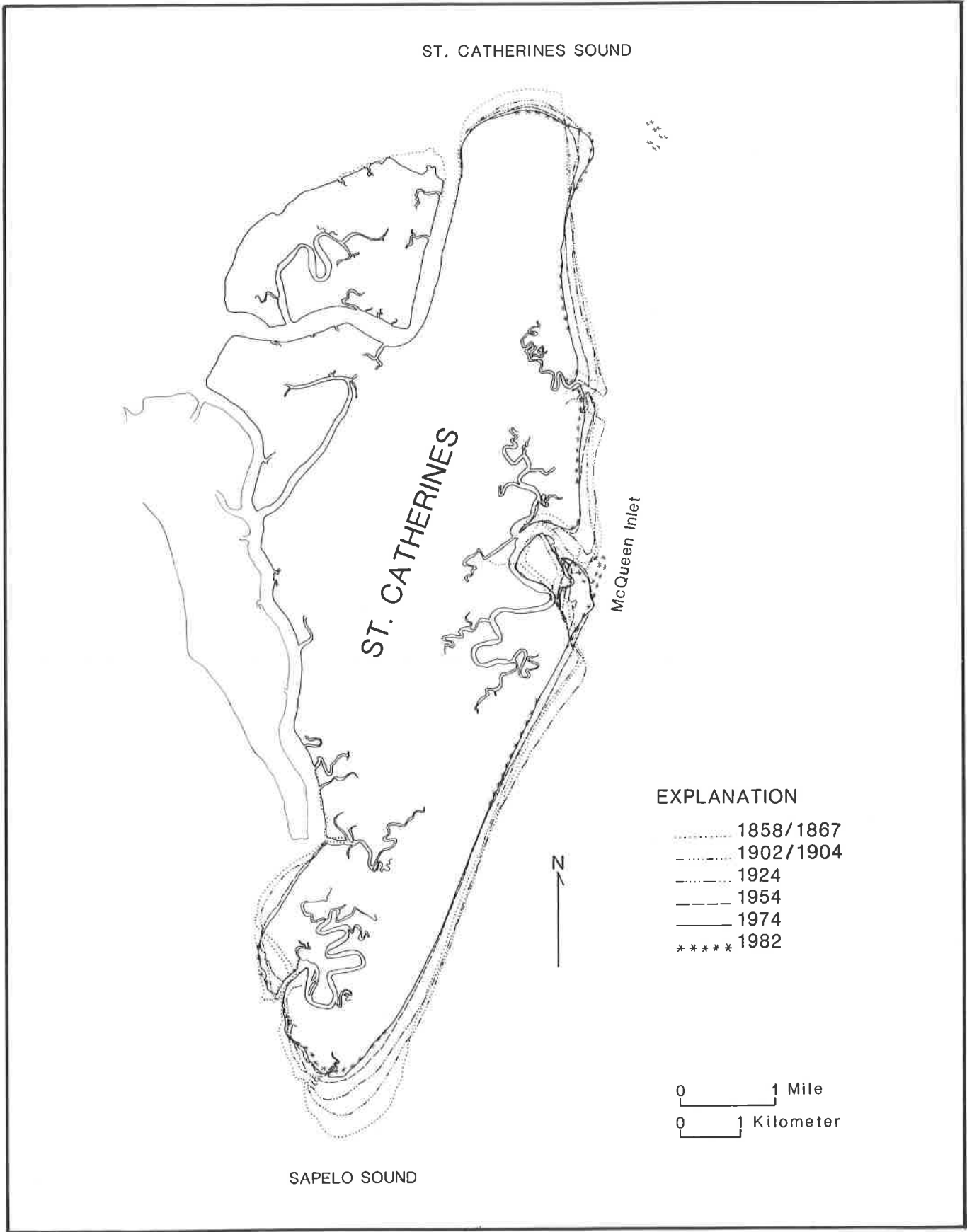


Figure 18. St. Catherines Island MHW Shoreline Change, 1858/67-1982.

From 1924 to 1954, erosion progressed on the St. Catherines Sound shoreline with a maximum retreat of 420 ft (128.0 m). On the north and north-central segments, maximum losses were 550 ft (167.6 m) and 800 ft (243.8 m), respectively. Maximum erosion evidenced on the central strand was 1220 ft (371.9 m), at a site just south of McQueen Inlet. Losses on the south-central strand were up to 680 ft (207.3 m), while the Sapelo Sound shoreline eroded a maximum of 850 ft (259.1 m) at an average rate of 21.7 ft/y (6.6 m/y).

From 1957 to 1974, the St. Catherines Sound shoreline eroded to a maximum of 190 ft (58 m). Although the small, stable northeast area of the strand advanced to a maximum of 850 ft (259 m), the rest of the north sector strand eroded an average of 400 ft (122 m). The central sector continued to retreat, with maximum losses of 450 ft (137 m) to the north and 210 ft (64 m) to the south. On the beach south of McQueen Inlet, losses were in the range of 200-400 ft (61-122 m). The south and south-central strand was more stable, illustrating approximate losses of 75-200 ft (23-61 m). The greatest retreat took place on the Sapelo Sound shoreline, where up to 590 ft (180 m) eroded.

The 1982 time line, drawn from high altitude photographs, suggests no major change in erosion/accretion patterns for the 1974-1982 interval on St. Catherines, except for accelerated erosion on the south end of the island. Note in Figure 17 that erosion proceeded on the updrift end, while the small, historically accreting area to the northeast migrated landward about 100 ft (30.5 m), resulting in equal amounts of accretion north and south of the newly eroded area. Most of the beach on the north strand eroded to a maximum of about 150 ft (45.7 m). The north-central lobe eroded all along the

entire strand, with maximum losses amounting to about 280 ft (85.3 m). In McQueen Inlet, an area of frequent change, a narrow fish hook spit built north some 1000 ft (304.8 m), while the southern strand was fairly stable. The greatest losses on the island were at the Sapelo Sound shoreline, with losses to 240 ft (73.2 m), or a maximum retreat of 34.3 ft/y (10.5 m/y).

When net MHW shoreline change on St. Catherines is considered for the 50 year period 1924 - 1974 (Fig. 19), it is apparent that the island suffered severe losses. Maximum losses on the St. Catherines Sound shoreline were 575 ft (175.3 m). The small stable area on the northeast end of the island accreted a maximum of 820 ft (250 m), while maximum losses on the North segment were 940 ft (286.5 m). The entire north-central section eroded a maximum of 1150 ft (350.5 m). A second small gain on St. Catherines was made in McQueen Inlet to 1610 ft (490.7 m), but just south of the inlet losses were to 1580 ft (481.6 m). The entire south-central and south portions of the sandy beachfront eroded 820 ft (250 m) and 1190 ft (362.7 m), respectively.

A consideration of net MHW shoreline change on St. Catherines Island for the entire study period of 1858/1867 to 1974 (Fig. 20) illustrates severe erosion along almost all of the island's sandy beachfront. The island eroded at the updrift end 1240 ft (378.0 m), while maximum erosion on the north segment was about 1200 ft (365.8 m). During the same period, the small, advancing area on the northeast strand accreted to a maximum of about 1500 ft (457.2 m). Maximum erosion on the north-central section took place at rates of 14 ft/y (4.3 m/y). The second small area of accretion, the McQueen Inlet area, illustrated a maximum advance of 1575 ft (480.1 m); however, just south of this inlet, losses were

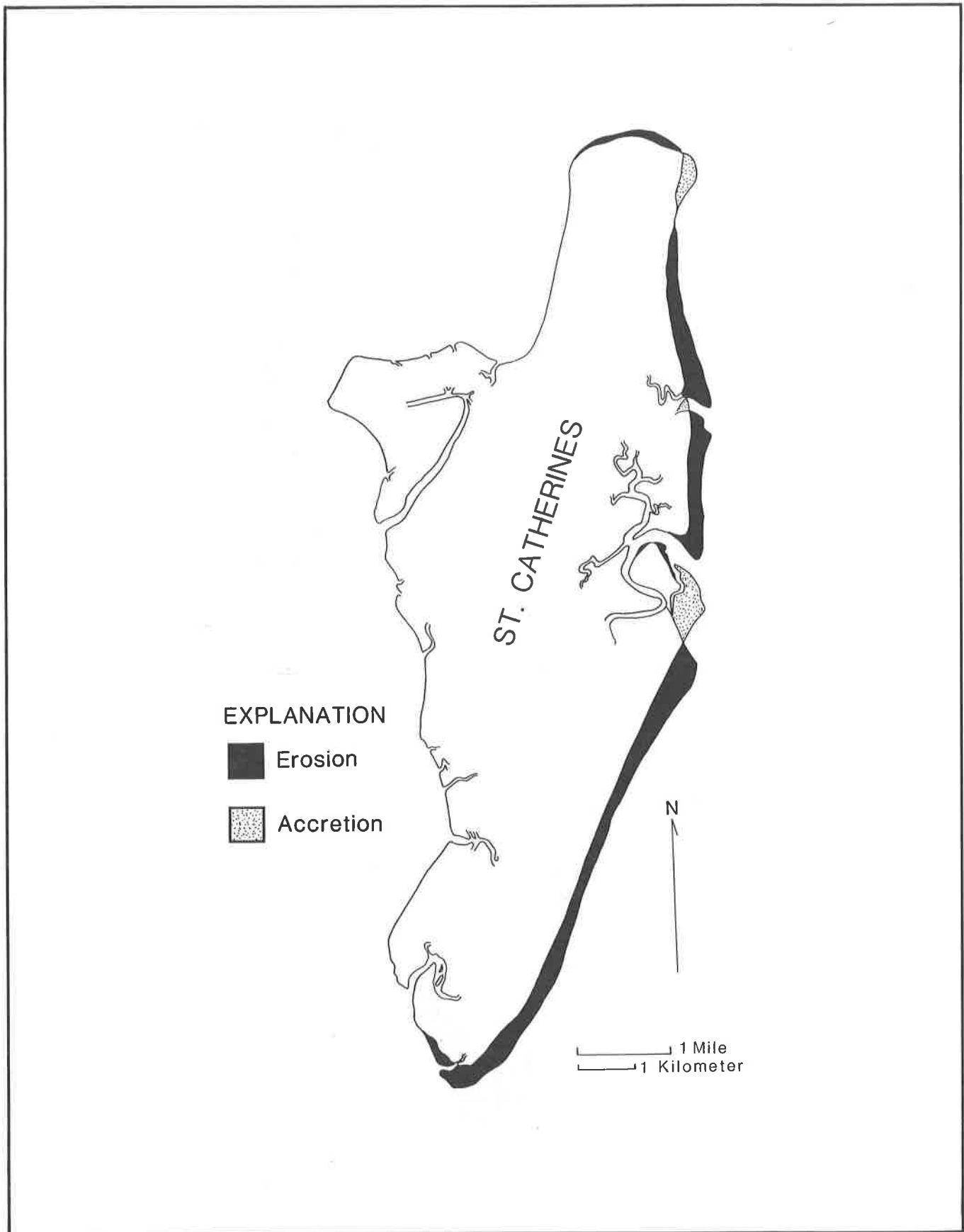


Figure 19. St. Catherines Island Net MHW Shoreline Change, 1924-1974.

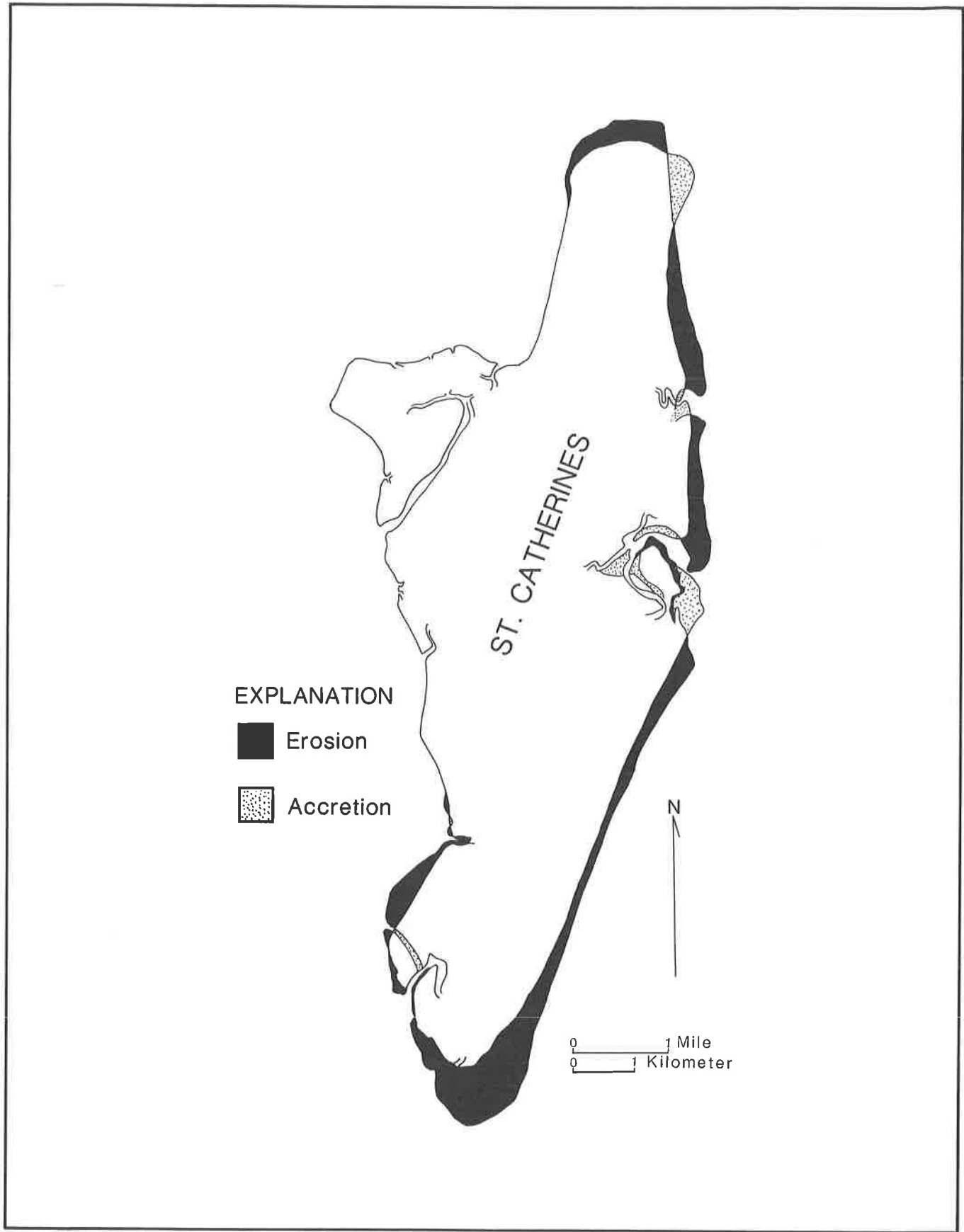


Figure 20. St. Catherines Island Net MHW Shoreline Change, 1858/67-1974.

to 1020 ft (310.9 m). On the south and south-central areas of the strand, the maximum retreats were 620 ft (189.0 m) and 950 ft (289.6 m), respectively. The greatest erosion took place along the Sapelo Sound shoreline, with the maximum retreat amounting to 3100 ft (945 m).

St. Catherines Island's unique shoreline history is one of nearly unbroken retreat for 124 years, resulting in a considerably narrowed and shortened barrier island. Recent field observations and aerial photographs fail to suggest any deceleration of this erosional trend. This apparently natural erosion on an island located in a generally stable system may be due to the fact that, of all the Georgia barrier islands, St. Catherines lies at the greatest distance from a major river.

SAPELO SOUND

Sapelo Sound (Fig. 21) is a narrow tidal inlet separating St. Catherines Island to the north from Blackbeard and Sapelo Islands to the south. The Sapelo River, which flows through the sound, heads in the marshes and has no river source.

For the study period of 1858 - 1974, Sapelo Sound illustrates a history of inlet widening, for both the south end of St. Catherines Island and the north end of Blackbeard Island have eroded over time. The rate of retreat for the inlet shoreline of St. Catherines has been up to 26.7 ft/y (8.1 m/y) for the study period, while the inlet shoreline of Blackbeard has retreated at rates to 15 ft/y (4.6 m/y). Due to the distance from a sediment source and the locally high velocities during tidal exchange, the narrowest transect across Sapelo Sound has enlarged by about 0.6 mi (1.0 km) during the 116 year study period.

BLACKBEARD/SAPELO ISLANDS

General Description

The large barrier island system designated as Blackbeard and Sapelo Islands is approximately 11.9 mi (19.0 km) long and 4.7 mi (7.6 km) wide (Fig. 22). It is separated from St. Catherines Island to the north by Sapelo Sound and from Wolf Island to the south by Doboy Sound. The main portion of the island system is late Pleistocene in age and is flanked on the seaward side by a narrow Holocene salt marsh, a Holocene barrier island, and a Holocene beach-dune system (Hoyt and Henry, 1967). The Duplin River and a broad expanse of marsh separate the island complex from the mainland.

Blackbeard Island is the larger Holocene beach ridge island of this system, separated from St. Catherines Island by Sapelo Sound and from Sapelo Island by Blackbeard Creek and Cabretta Inlet. The island has a length of 6.4 mi (10.3 km) and a maximum width of 2 mi (3.2 km). Elevations on the island range to 15 ft (4.5 m). There are approximately 3,620 acres (1,466 ha) of high land and 2,000 acres (810 ha) of marsh (U.S. Dept. of Interior, 1980). About 15 acres (6 ha) on the back-barrier side of the island have been developed for U.S. Fish and Wildlife staff housing and for a small campground.

Parts of Blackbeard Island have been in Federal ownership since 1800. R. J. Reynolds owned a large part of the island until the late 1940's, at which time he traded his holdings to the Federal Government for Federal land on Sapelo Island. Presently, the island is owned and managed by the U.S. Fish and Wildlife Service as a National Wildlife Refuge. Much of the island is classified as wilderness, which limits the intensity and nature of utilization (Warner and Strouss, 1976).

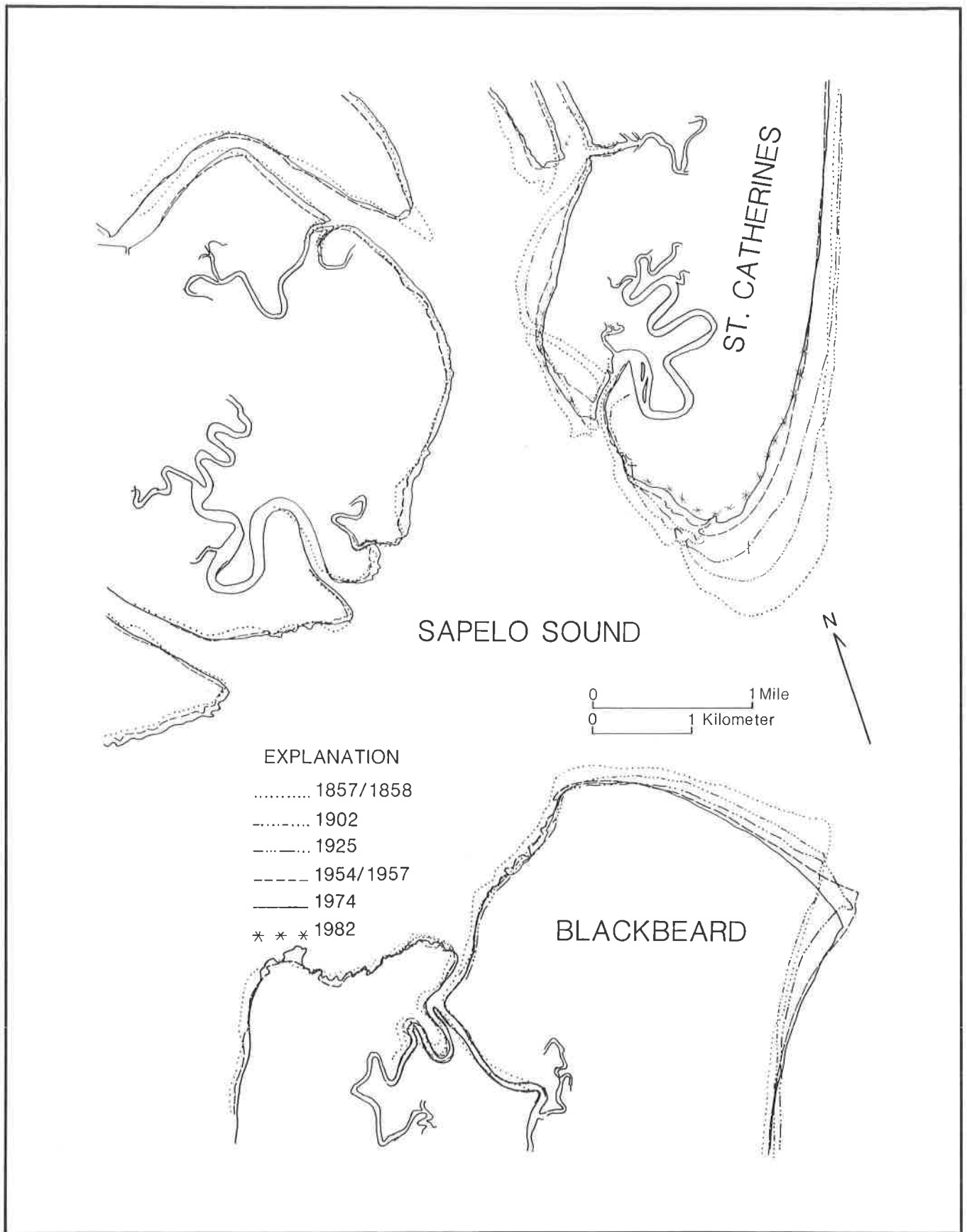


Figure 21. Sapelo Sound MHW Shoreline Change, 1957/58-1982.

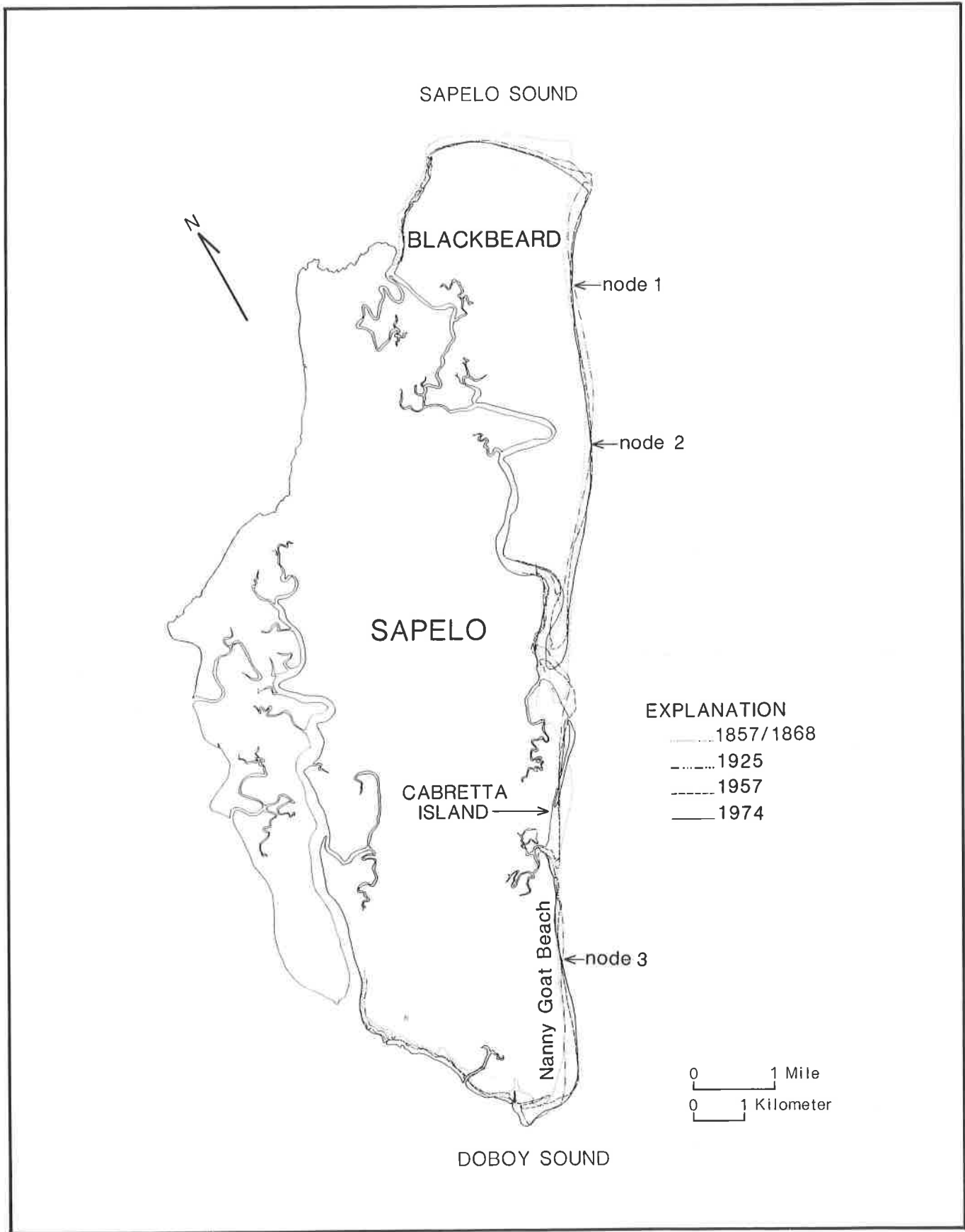


Figure 22. Blackbeard/Sapelo Islands MHW Shoreline Change, 1857/68-1974.

Sapelo Island, the largely Pleistocene "core" of the island, is separated from Blackbeard Island by Blackbeard Creek. On Sapelo Island, a narrow salt marsh separates the Pleistocene area of the island from a strip of Holocene beach and dune sediments, which borders the Atlantic Ocean. Elevations on the island range to 23 ft (7.5 m) at the top of the beach ridge. There are 18,849 acres (7,628 ha) on Sapelo Island, of which 11,589 acres (4,689 ha) are high ground. Some 200 - 300 acres (81 - 121 ha) are developed (U.S. Dept. of Interior, 1980).

The State of Georgia currently owns most of Sapelo Island. The only remaining land in private ownership is the 434 acres (176 ha) which comprises the Hog Hammock community (Kinsey, 1982). The island is part of the Sapelo Island National Estuarine Sanctuary. The University of Georgia Marine Institute is located on the southern tip of the island, adjacent to the Duplin River and Doboy Sound.

Shoreline Change

The MHW shoreline history of Blackbeard/ Sapelo Islands from 1857-1868 to 1974 (Fig. 22) indicates that this island system advanced between 1858 and 1925 and has since maintained a state of dynamic stability. The Blackbeard/ Sapelo shoreline is characterized by three persistent nodal points and a highly unstable inlet (Fig. 23).

Between 1857 and 1925, the entire Sapelo Sound shoreline eroded between 220 -960 ft (67.1 - 292.6 m). A seaward shift of the north end of the island resulted in a maximum advance of 1260 ft (384 m) on the northeast end. The entire north-central strand accreted to rates as much as 5.5 ft/y (1.7 m/y). From 1868 to 1925, the central strand of Blackbeard accreted to 480 ft (146.3

m) above a nodal point and eroded to 520 ft (158.5 m) below the node. The elongated, downdrift Blackbeard spit of 1868 (Fig. 22) was truncated during this period (probably in the 1898 hurricane) with losses of 5820 linear ft (1774 m).

Meanwhile, the central segment of Sapelo Island beach, Cabretta Island, built out into the inlet once claimed by Blackbeard Spit at rates to 43.7 ft/y (13.3 m/y). During the same period of 1868 - 1925, the southern end of this sector retreated a maximum of 800 ft (243.8 m). The southern portion of Sapelo Island, known as Nanny Goat Beach, was generally stable, accreting up to 460 ft (140.2 m) on the strand and 780 ft (237.7 m) on the south end. (An incomplete 1857 time line for Doboy Sound, shown on Fig. 26, indicates that between 1857 and 1868, maximum advances of 730 ft (222.5 m) on the southern strand and 1660 ft (506 m) on the inlet shoreline took place.)

During the period 1925 - 1957, the Sapelo Sound shoreline of Blackbeard continued its seaward shift, resulting in erosion up to 425 ft (129.5 m) on the inlet-facing shore and deposition on the northeast strand up to 720 ft (219.5 m) above node #1; below the nodal point, the maximum retreat was to 490 ft (149.4 m). The central Blackbeard strand accreted up to 370 ft (112.8 m), while the Cabretta Inlet spit rapidly rebuilt with a maximum advance of 3080 ft (938.8 m), or at rates to 96.3 ft/y (29.3 m/y).

Cabretta Island advanced between 1925 and 1957 (Fig. 23). There was a maximum advance of 640 ft (195 m) at Cabretta Inlet, while the central and south-central strand evidenced stability, with gains averaging less than 75 ft (23 m). Nanny Goat Beach, to the south, underwent a considerable shift in this interval, resulting in erosion north of node #3 to

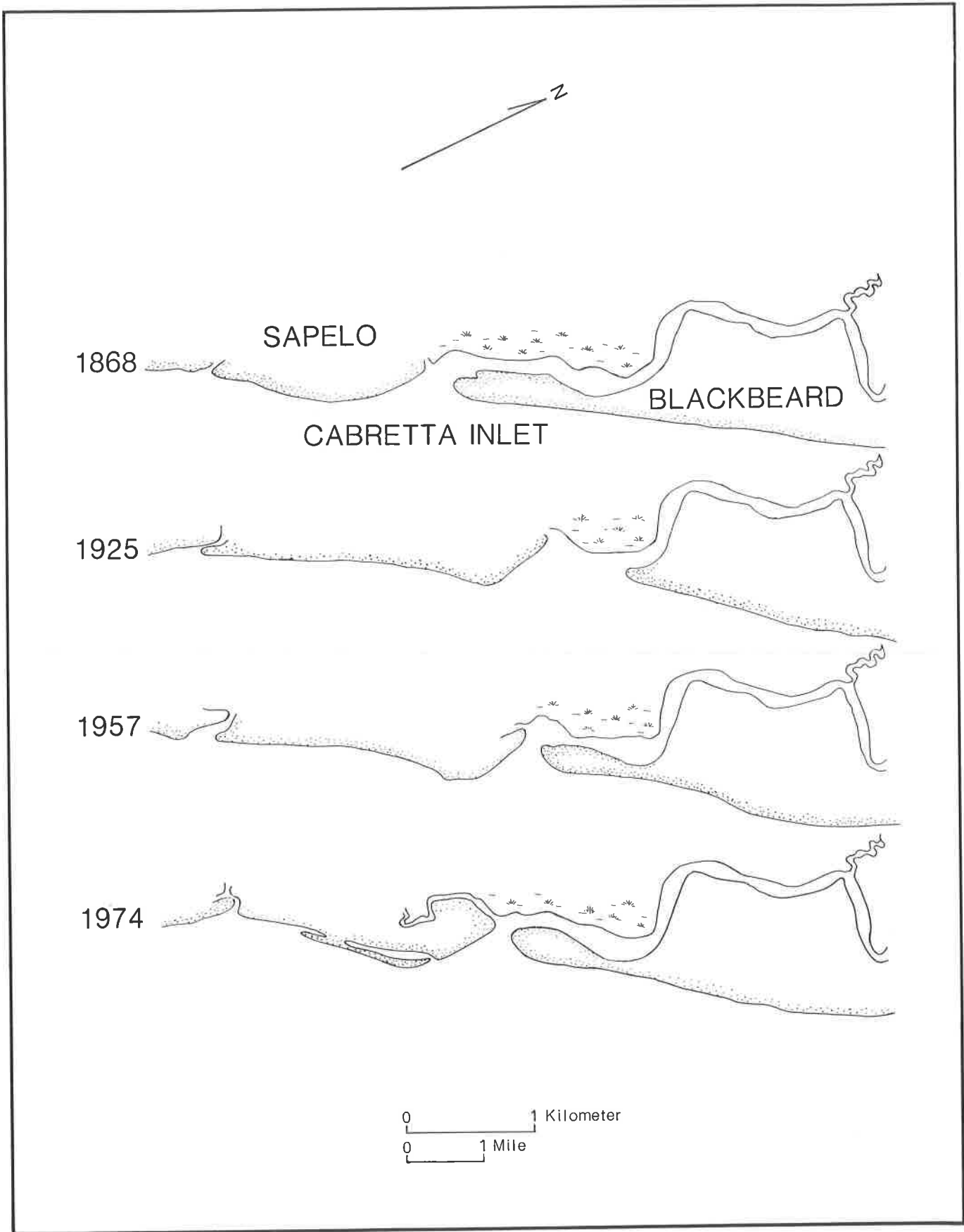


Figure 23. Cabretta Inlet MHW Shoreline Change, 1868-1974.

350 ft (106.7 m) and accretion south of node #3 to 780 ft (237.7 m). On the Doboy Sound shore of Sapelo, most of the gains made between 1857 and 1925 were lost as the island here retreated to a maximum of 1020 ft (311 m). This atypical southern erosion may be related to the hurricane of 19 October 1944, which inundated Brunswick to 2 ft (0.6 m). (U.S. Army Corps of Engineers, 1970).

In the interval 1957 - 1974, shifting about the two nodes on Blackbeard continued, along with further southward lengthening of the spit and huge losses on Cabretta Inlet. The seaward-shifting pattern of the north end of Blackbeard was somewhat slowed; maximum erosion on the Sapelo Sound shoreline was 740 ft (225.6 m). On the north and north-central strand, gains to 160 ft (48.8 m) north of node #1 were exceeded by losses south of the node to 220 ft (67.1 m). On the central and south-central strand, the greatest loss north of node #2 was 125 ft (38.1 m), while the maximum gain south of the nodal point was 440 ft (134.1 m). The Blackbeard spit continued its rapid southern migration at rates of up to 38 ft/y (11.6 m/y), resulting in a linear gain of 1230 ft (374.9 m) for the 17 year period.

Almost as rapidly as the Blackbeard spit advanced, the northern end of Cabretta Island retreated, to a maximum of 1990 ft (606.6 m) in the interval 1957 - 1974. The southern end of Cabretta migrated landward, resulting in a maximum retreat of 760 ft (231.6 m) during this interval. On Nanny Goat Beach, losses above the node of 200 ft (61 m) were exceeded by gains of 280 ft (85.3 m) south of the node. The Doboy Sound shoreline of Sapelo Island re-occupied its approximate 1925 shoreline position, as it accreted at rates of up to 61.2 ft/y (18.6 m/y).

The MHW shoreline history from 1925 to 1974 of the Blackbeard/Sapelo

Islands system (Fig. 24) illustrates a complex history of the following: Sapelo Sound inlet erosion, a seaward shift of the north end of the system, significant changes about three nodal points, gains on Blackbeard spit reflected in losses on Cabretta Island, and slight gains on the southern, Doboy Sound shore of Sapelo.

The Sapelo Sound shoreline underwent a maximum retreat of 700 ft (213.4 m) from 1925 to 1974, while the seaward shift of the northeast end of Blackbeard resulted in gains of up to 630 ft (192 m). The central strand retreated to 600 ft (182.9 m), while the south-central strand made gains to 460 ft (140.2 m). Blackbeard spit, which was cut prior to 1925, rebuilt rapidly to a maximum advance of 4760 ft (1450.8 m), or at rates of 97.0 ft/y (29.5 m/y).

From 1925 to 1974, Cabretta Island retreated rapidly. The greatest erosion took place along the inlet shoreline, where 1025 linear ft (312.4 m) eroded. Although central Cabretta stabilized and enlarged slightly, south Cabretta underwent a maximum retreat of 1550 ft (472.4 m). Nanny Goat Beach eroded 520 ft (158.5 m) above the node and accreted to 810 ft (246.9 m) to the south of the nodal point. The Doboy Sound shoreline of Sapelo accreted to 180 ft (54.9 m) in this interval.

Consideration of the net MHW shoreline change on the Blackbeard/Sapelo Islands system for the entire study period of 1857 - 1974 (Fig. 25) indicates that the island shoreline accreted. Continued retreat of the Sapelo Sound shoreline resulted in losses of up to 1790 ft (545.6 m), while the seaward shift of north Blackbeard resulted in accretion to 1225 ft (373.4 m). Losses on the central strand of Blackbeard Island of up to 150 ft (45.7 m) were greatly exceeded by a maximum gain on the south-central strand of 450 ft (137.2

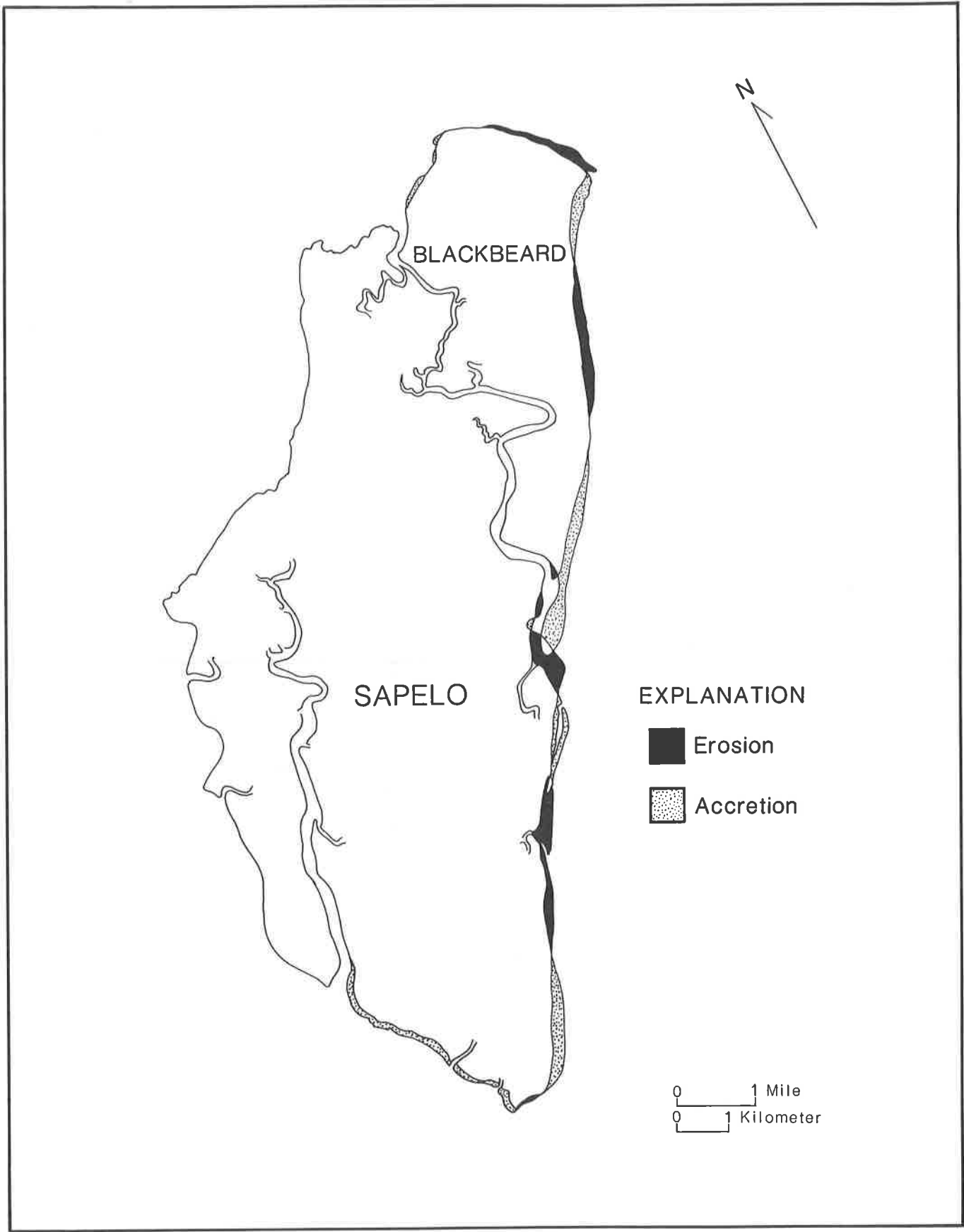


Figure 24. Blackbeard/Sapelo Islands Net MHW Shoreline Change, 1925-1974.

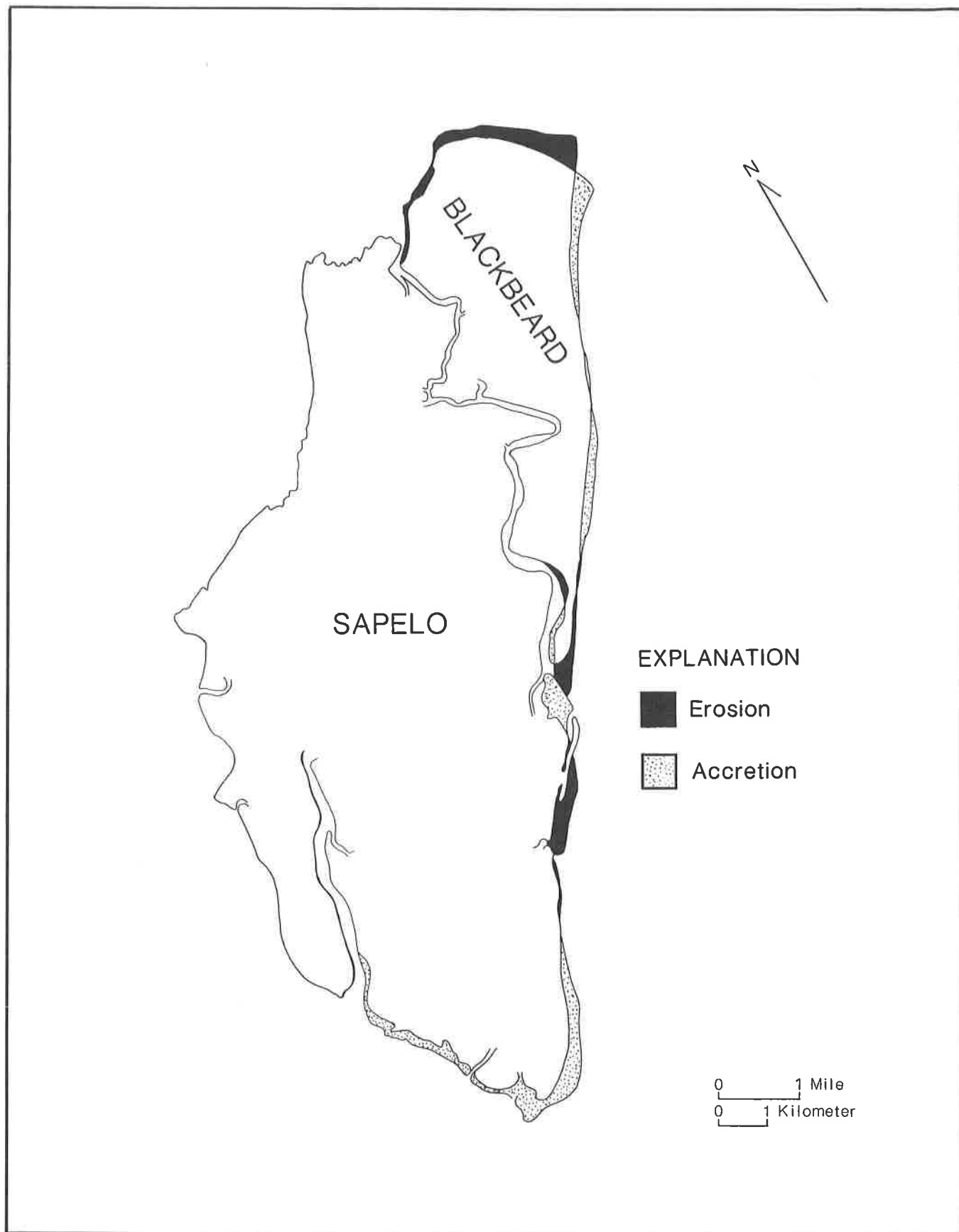


Figure 25. Blackbeard/Sapelo Islands Net MHW Shoreline Change, 1857/68-1974.

m). Blackbeard spit, breached prior to 1925, nevertheless accreted to 2880 ft (877.8 m) during the 116 year study period.

Considerable losses on Cabretta Island after 1925 are largely masked when the entire study period is considered. This segment of Sapelo Island accreted up to 1550 ft (472.4 m) toward Cabretta Inlet, while the central strand remained stable. The south end, however, eroded to 1080 ft (329.2 m). On Nanny Goat Beach, minimal erosion above the node to a scant 50 ft (15.2 m) was exceeded by accretion of 1120 ft (341.4 m) south of the nodal point. On the Doboy Sound shoreline, the beach has accreted 1680 ft (512.1 m).

DOBOY SOUND AND WOLF ISLAND

Doboy Sound (Fig. 26) is the tidal inlet separating Sapelo Island from Wolf Island. Wolf Island, a small, Holocene marsh island, lies between Doboy Sound to the north and Altamaha Sound to the south. The island is 3 mi (4.8 km) long and 2.7 mi (4.3 km) wide; the shore is a thin veneer of sand that washes over the marsh interior. Elevations range to 5 ft (1.5 m) at the top of the dune-ridge.

Wolf Island has been federally owned since 1928. Acquired by the Nature Conservancy, the U.S. Fish and Wildlife Service manages the island as a National Wildlife Refuge. Congress has designated Wolf Island as a wilderness area, which severely limits its use (Warner and Strouss, 1976).

Note in Figure 26 that the Doboy Sound shoreline of Sapelo Island illustrates a maximum advance of 2580 ft (786.4 m) between 1857 and 1974, an accretionary period that has masked the retreat of 1080 ft (329.2 m) that occurred between 1925 and 1957. During the period 1857 - 1982, Wolf Island has experienced continued

erosion. The greatest losses took place on the northeast end of Wolf Island, where the maximum retreat amounted to 3350 ft (1021.0 m). Mid-island losses were to 1450 ft (442.0 m) during 1857 - 1982. Note that the small marsh islands in Doboy Sound have migrated to the southwest over time.

In 1857, the entrance to Doboy Sound was about 1.34 mi (2.16 km) wide; in 1974, the passage into the inlet had narrowed to about 1.13 mi (1.8 km).

ALTAMAHA SOUND

Altamaha Sound (Fig. 27), separating Wolf Island to the north and Little St. Simons Island to the south, is an inlet associated with the mouth of the Altamaha River. The Altamaha is a major river, possessing a drainage basin of 14,399 mi² (37,294 km²), 39% in the Piedmont and 61% in the Coastal Plain. The average discharge is 13,730 ft³/s (389 m³/s) (U.S. Geol. Survey, 1982). The river has three major dams on its tributaries, Sinclair Dam and Wallace Dam on the Oconee River and Lloyd Shoals Dam on the Ocmulgee River. Because no serious sedimentation problem exists in the dams, the Altamaha River remains in a relatively undisturbed state. The river is not actively dredged, and the lower section of the river channel is characterized by numerous small islands and sand bars. While the channel depth is generally less than -10 ft (-3.0 m) mean low water (MLW), scoured areas occasionally reach depths greater than -20 ft (-6.1 m) MLW (Oertel, 1977).

Note in Figure 26 that the southeast seaward-facing beach of Wolf Island retreated to a maximum of 700 ft (213.4 m) between 1860 - 1982, while the downdrift inlet shoreline of the island has undergone relatively little change. In Altamaha Sound,

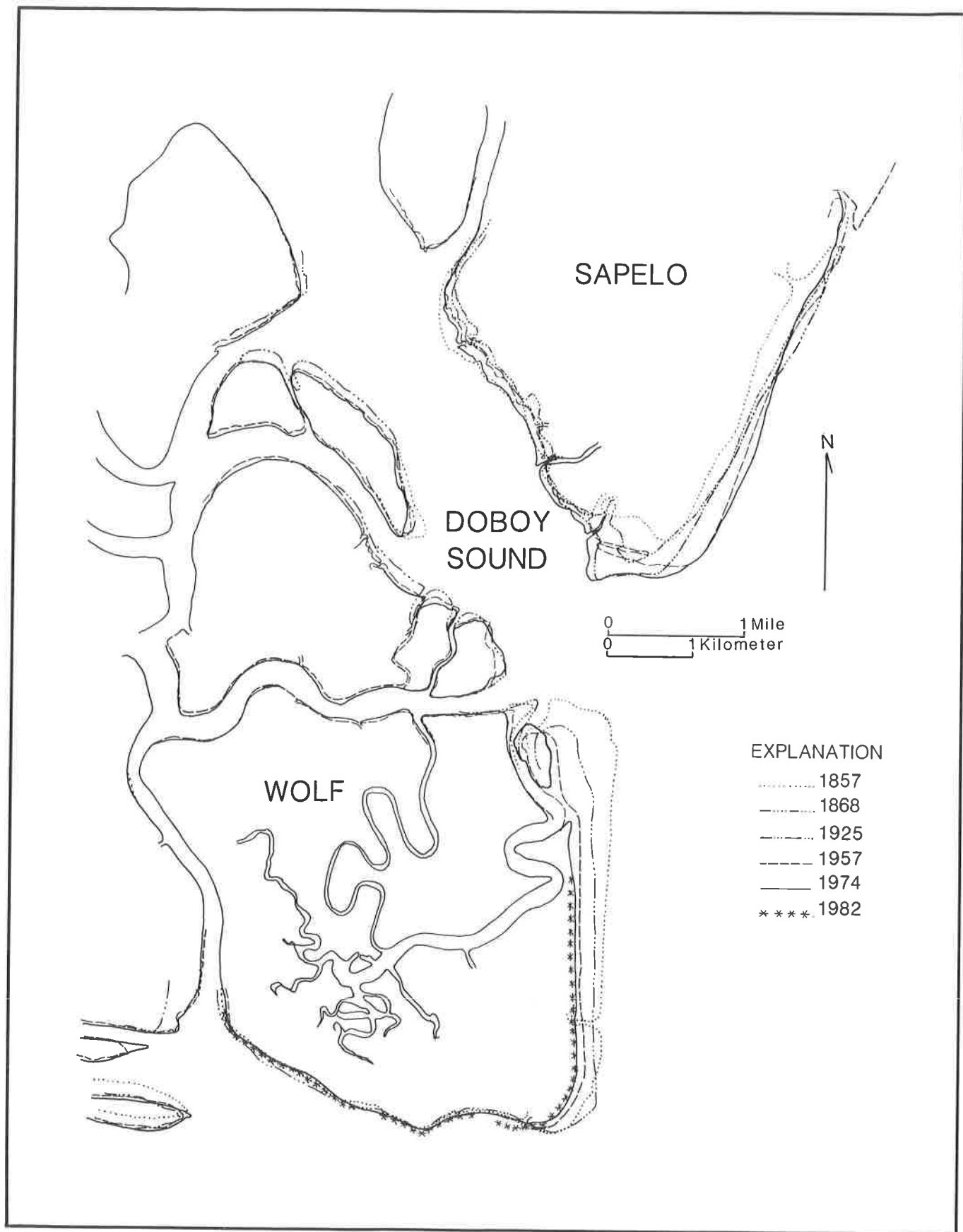


Figure 26. Dobby Sound MHW Shoreline Change, 1857-1982.

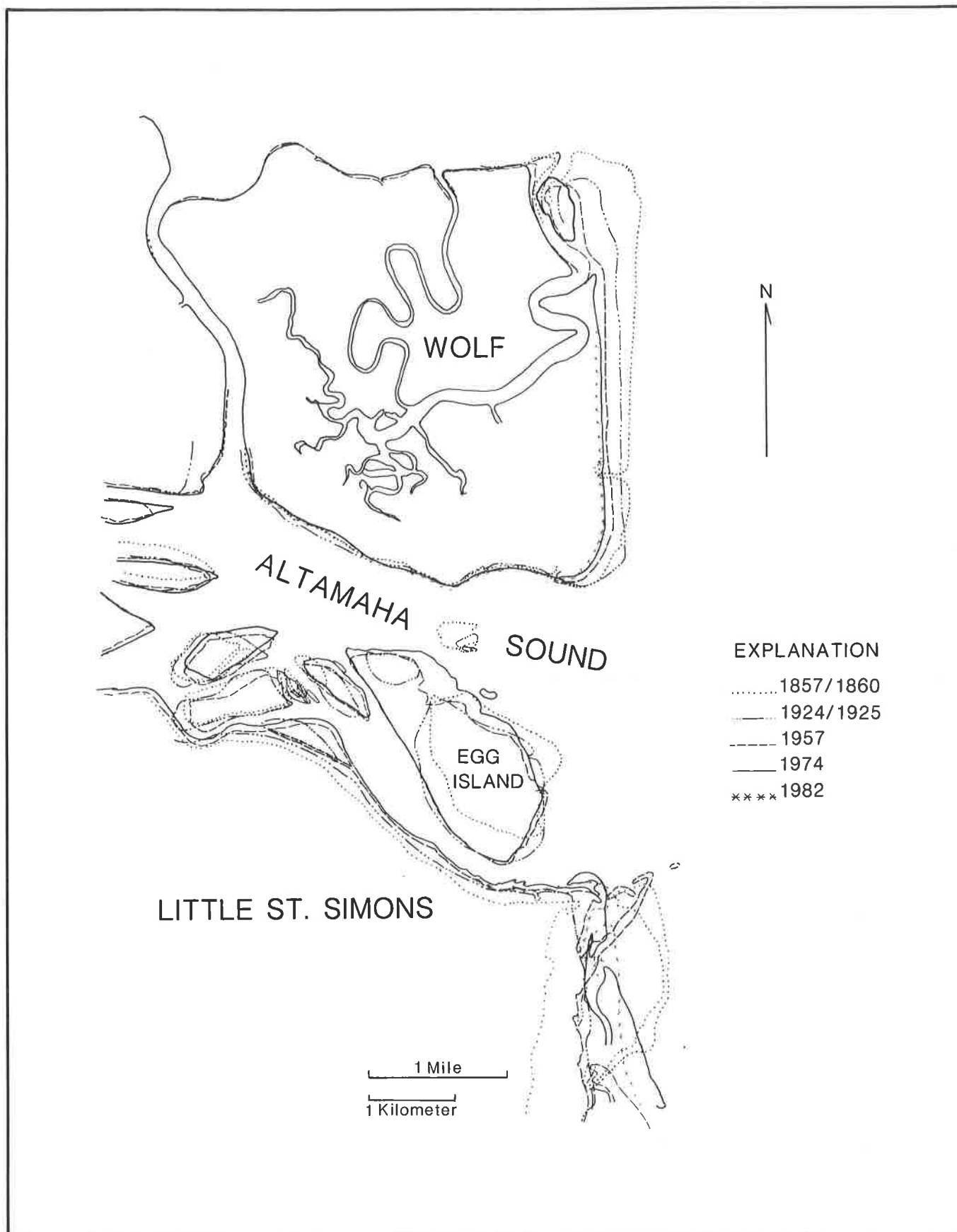


Figure 27. Altamaha Sound MHW Shoreline Change, 1857/60-1982.

small islands have consolidated and enlarged over time; the largest of these, Egg Island, has shifted as much as 1080 ft (329.2 m) to the southwest since 1857, while greatly increasing its surface area.

From 1860 to 1974, the updrift inlet shoreline of Little St. Simons has built into the inlet 880 ft (268.2 m), although the 1982 time line suggests a reversal of this trend. The persistence of north-trending fishhook spits on the north and central portions of the island indicates a long-standing reversal of the southern longshore transport direction at this location.

In 1857, the entrance to Altamaha Sound was about 2.3 mi (3.7 km) in width; by 1974, the entrance had narrowed to about 2.14 mi (3.4 km). This constriction of Altamaha Sound, coupled with great gains on downdrift Little St. Simons, indicates that the Altamaha River is actively contributing sediment to the coast of Georgia.

LITTLE ST. SIMONS ISLAND

General Description

Little St. Simons Island is the northernmost segment of the major barrier island complex formed by Little St. Simons, Sea Island, and St. Simons Island (see Fig. 1). Little St. Simons is a cusate foreland, or deltaic barrier, of the Holocene river delta of the Altamaha River. The island is separated from Wolf Island to the north by Altamaha Sound and from St. Simons and Sea Island to the south by the Hampton River. The island is 5.2 mi (8.4 km) long by 3.6 mi (5.8 km) wide and has a sandy beachfront of 5.4 mi (8.7 km). There are 8,800 acres (3,578 ha) of land, of which 2300 acres (931 ha) are high ground (U.S. Dept. of Interior, 1980). Elevations range to 28.0 ft (8.5 m).

The island was purchased by the Berolzheimer family in the early 1900's with the intent of logging the red cedars for pencil slats, but the gnarled trees of Little St. Simons proved unsuitable. The Berolzheimers have since retained the island for limited cattle production and the operation of a small resort. Although only a few acres on the back-barrier side of the island have been developed, the free ranging cattle, horses, and imported fallow deer have altered historic vegetation patterns on Little St. Simons. Consequently, a primary dune system, and accompanying sea oats, exist only on the southernmost third of the island, which is relatively inaccessible to the introduced grazing animals.

In 1982, Little St. Simons Island was included by the Dept. of Interior to the "Coastal Barriers Resource Act" (S.1081), which provides for the limitation of federal expenditures on undeveloped barrier islands.

Shoreline Change

The MHW shoreline history of Little St. Simons from 1860 to 1982 (Fig. 28) is one of nearly unbroken deposition. The considerable seaward progradation that took place on the coast of Georgia prior to 1925 continued unabated on this island through 1954, after which deposition has progressed at a moderate rate. The only retreat prior to 1982 illustrated on Little St. Simons appears to be sporadic and related to channel migration of the Hampton River.

During the period 1860 - 1924, (Fig. 29) Little St. Simons had the following maximum advances: 460 ft (140.2 m) on the Altamaha River inlet, 2150 ft (655.3 m) on the north-central strand, 3850 ft (1173.5 m) on the south-central strand, 2800 ft (853.4 m) on the south lobe, and 720 ft (219.5 m) on the Hampton River

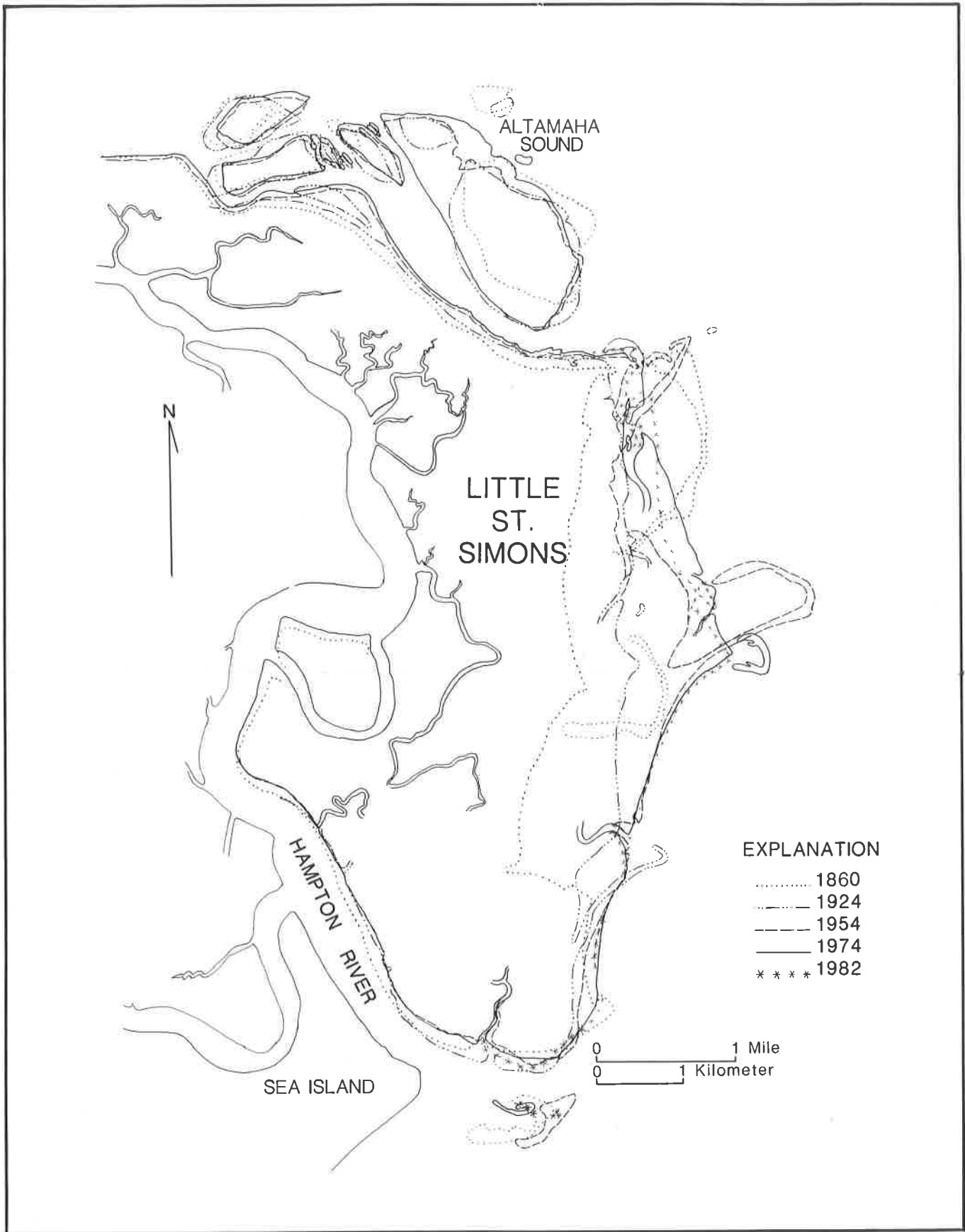


Figure 28. Little St. Simons Island MHW Shoreline Change, 1860-1982.

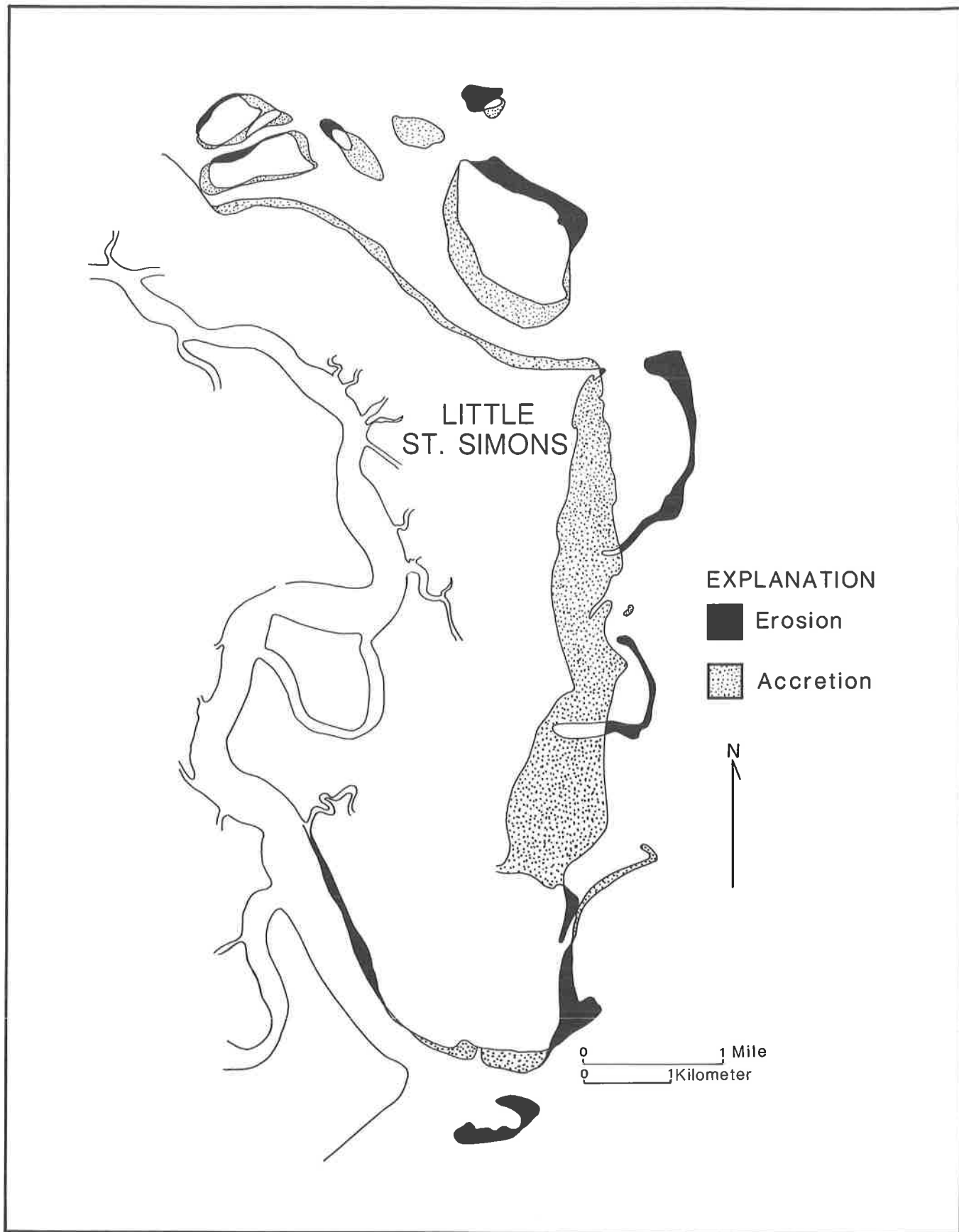


Figure 29. Little St. Simons Island Net MHW Shoreline Change, 1860-1924.

inlet shore. Figure 29 illustrates the significant deposition that took place on the island in 64 years.

Maximum gains made from 1924 to 1954 were as follows: 380 ft (115.8 m) on the updrift inlet, 2650 ft (807.7 m) on the north-central strand, 1680 ft (512.1 m) on the south-central strand, and 1220 ft (371.9 m) on the south lobe. Erosion did occur, however, at the Hampton River inlet to a maximum of 760 ft (231.6 m).

In the interval 1954 - 1974, maximum accretion, although slowed, occurred as follows: 210 ft (64.0 m) on the Altamaha River inlet, 2520 ft (768.1 m) at the north-central strand, 1820 ft (554.7 m) at the central strand, and 620 ft (189.0 m) on the south lobe. The maximum retreat on the south end was 370 ft (112.8 m).

Aerial photographs taken in 1982 suggest a new instability on the updrift inlet shoreline of Little St. Simons (Fig. 28). Since 1974, there was a gain of about 200 ft (61.0 m) on the northeast, balanced by equivalent losses further south. The north-trending spit of 1974 migrated updrift about 620 ft (189.0 m), while shifting landward some 840 ft (256.0 m). Accretion continued to 150 ft (45.7 m) on the south central strand, but erosion occurred on the south lobe of the island to a maximum of 180 ft (54.9 m). Southward, the 1924 - 1974 erosional trend on the Hampton River shoreline reversed, with maximum gains of 380 ft (115.8 m), possibly indicating a southwest shift of the river channel.

Net shoreline change on Little St. Simons from 1924 - 1974 (Fig. 30) indicates that the island has advanced at a rate far exceeding that of other islands in the study area. The northeast end of the island advanced at rates of 23 ft/y (7.3 m/y), while

the north-central strand prograded at rates of 41 ft/y (12.5 m/y). Greatest gains were seen on the central strand, which advanced at rates of 76.4 ft/y (23.3 m/y). The beach on the southern lobe prograded more slowly, at rates of up to 19 ft/y (5.8 m/y). The only erosion of consequence for the study period took place on the Hampton River inlet shoreline, at rates of up to 11.6 ft/y (3.5 m/y).

When net MHW shoreline change on Little St. Simons is considered for the period 1860 - 1974 (Fig. 31), the island's 114 year seaward progradation is indicative of the sediment supply delivered by the Altamaha River. During this period, gains at the updrift inlet were made at rates to 6.6 ft/y (2.0 m/y). Greatest gains were made on the central and south-central strand, at rates of up to 44.6 ft/y (13.6 m/y) and 37.3 ft/y (11.4 m/y), respectively. On the beach of the southern portion of the island, gains were to 34 ft/y (10.4 m/y). Along the Hampton River shoreline, accretion to the southeast at rates of up to 1.8 ft/y (0.6 m/y) was exceeded by erosion to the southwest at rates of up to 4.2 ft/y (1.3 m/y).

SEA ISLAND AND ST. SIMONS ISLAND

General Description

Sea Island is the smallest segment of the large, segmented barrier island complex formed by Little St. Simons, Sea Island, and St. Simons. This Holocene island is separated from Little St. Simons to the north by the Hampton River, and from St. Simons to the west and south by Village Creek, Blackbank River, and Goulds Inlet. Sea Island is 5.1 mi (8.2 km) long by 2.1 mi (3.4 km) wide; there are 1100 acres (445 ha) of high land and better than 800 acres (324 ha) of marsh. Elevations on the beach ridge island are up to 16 ft (5.0 m). Presently, 736 acres

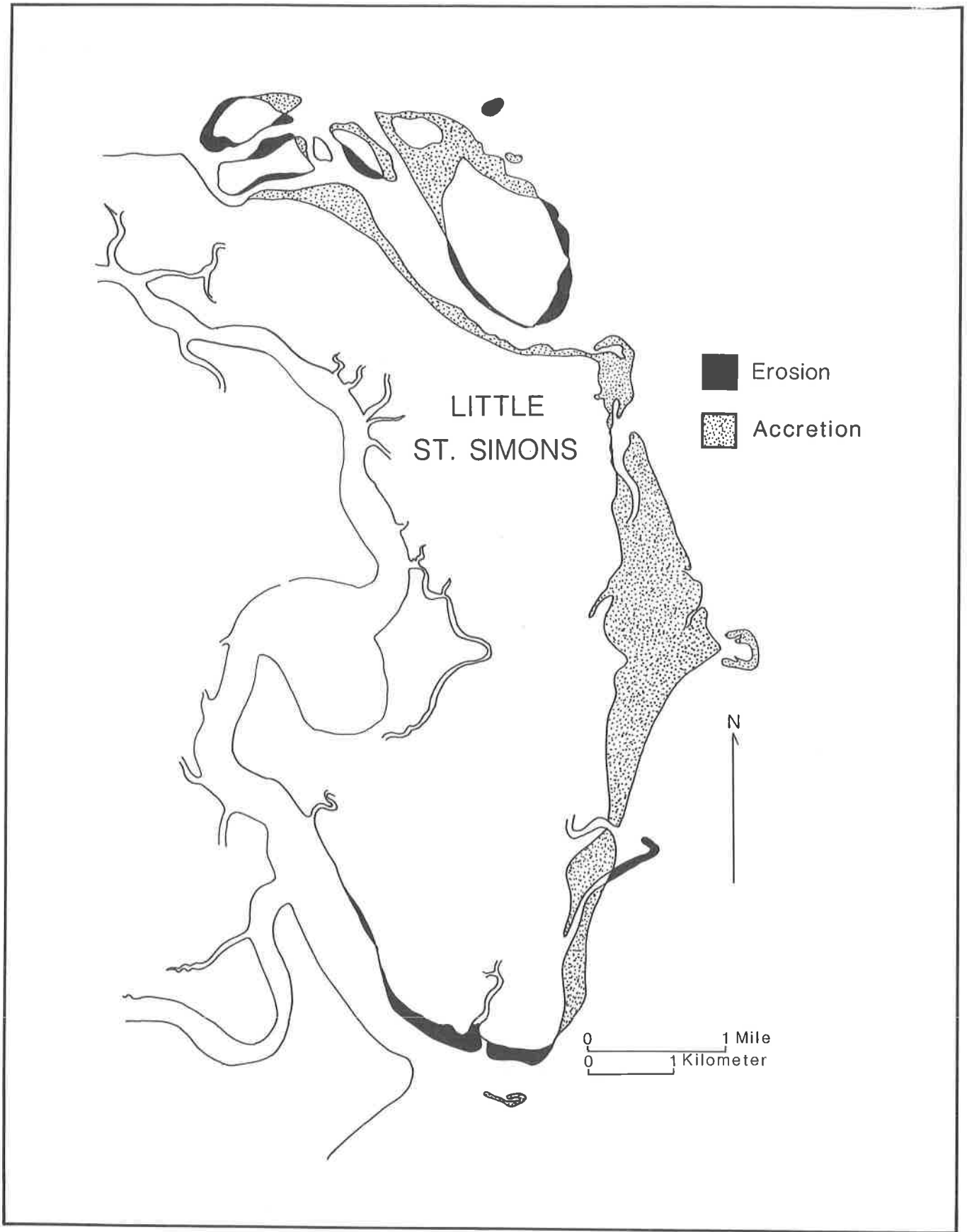


Figure 30. Little St. Simons Island Net MHW Shoreline Change, 1924-1974.

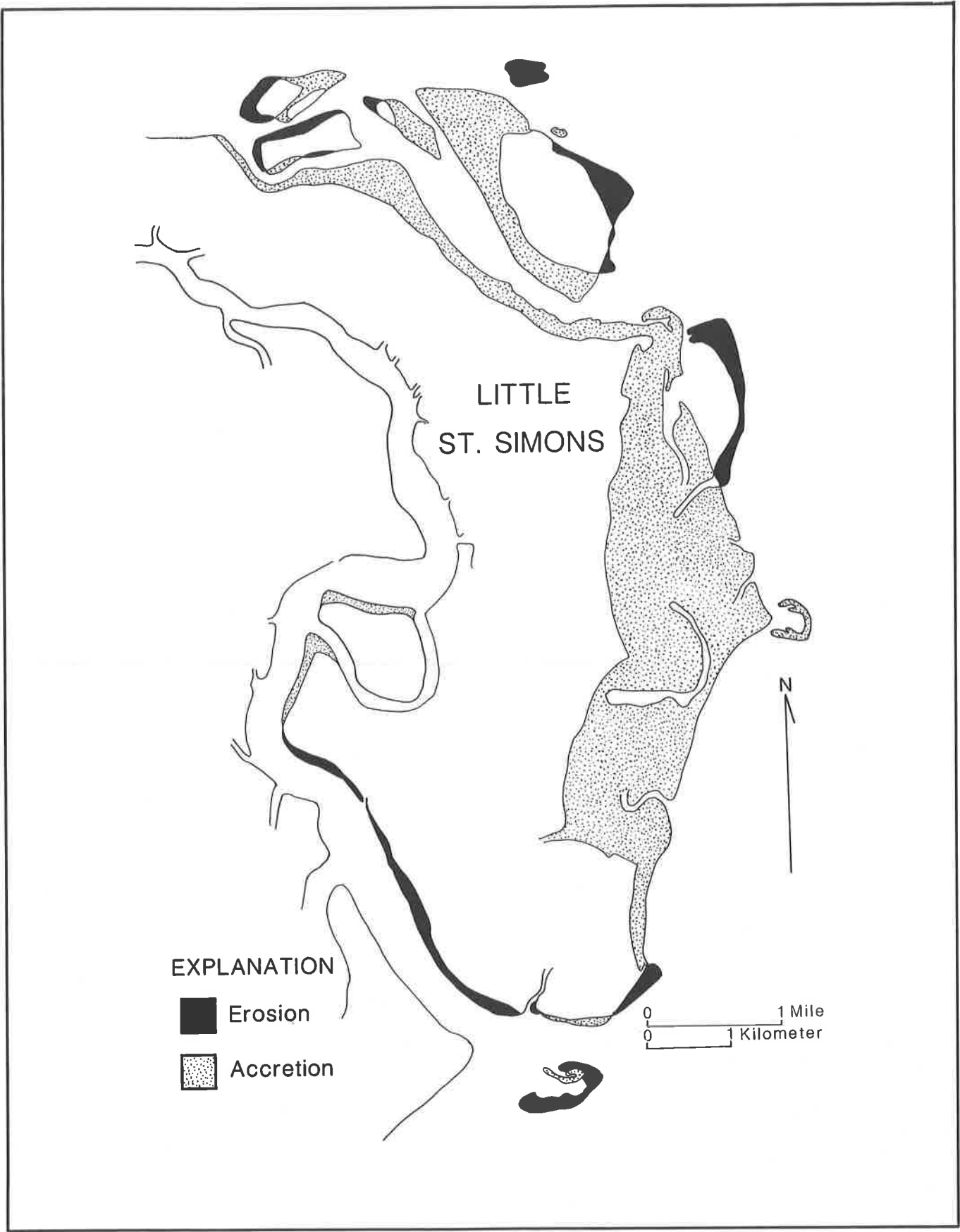


Figure 31. Little St. Simons Island Net MHW Shoreline Change, 1860-1974.

(298 ha) are developed (U. S. Dept. of Interior, 1980).

Sea Island, owned by the Sea Island Company, is a private resort; there is no public access to the beach. Prior to 1979, the shoreline seaward of the Cloister and a few private homes was protected; since then, the remainder of the developed area has been fronted by protective structures. In 1982, the "Sea Island Unit," or spit south of the Cloister resort, was included in the "Coastal Barrier Resource Act" by the U. S. Dept. of Interior, making construction on the spit ineligible for Federal Flood Insurance and other financial aid.

St. Simons Island is the large Pleistocene "core" to which its Holocene counterparts, Little St. Simons and Sea Island, are attached. The island is separated from Sea Island and Little St. Simons to the north by Goulds Inlet and Hampton River, respectively, and from Jekyll Island to the south by St. Simons Sound. St. Simons Island is 11.6 mi (18.7 km) long by 3.8 mi (6.1 km) wide and has an area of about 36 mi² (94 km²). Elevations on the island range from sea level to 21 ft (6.5 m) at the top of the dune-ridges. Except for a relatively undisturbed area on the southwest, adjacent to the beach, extensive recreational and residential development has destroyed much of the primary dune system along the island's 3.0 mi (4.8 km) beach.

Between 1924 and 1934, construction of bulkheads and stone and rubble revetments stabilized the shoreline on the southwest end of the island. After the passage of Hurricane Dora in 1964, which caused severe damage to residential and commercial structures (U.S. Army Corps of Engineers, 1970), additional rubble mound seawalls were constructed on the southeast end of the island.

Shoreline Change

The shoreline history of Sea Island and St. Simons Island from 1857 to 1924 (Fig. 32) is one of widespread erosion on Sea Island and rapid growth of the Sea Island spit, coupled with a southeast erosion and southwest accretion on the inlet shore of St. Simons Island.

During the interval 1860 - 1924, substantial accretion occurred on both Sea Island and St. Simons in spite of erosion on the north end of Sea Island and on the St. Simons beach adjoining Goulds Inlet. The Hampton River shore of Sea Island eroded to a maximum of 320 ft (97.5 m), while the northeast tip of the strand retreated up to 1970 ft (600.5 m). On Sea Island, the north-central part of the strand was stable, and the central and south beaches everywhere accreted about 200 - 250 ft (61 - 76.2 m). The greatest accretion on Sea Island was seen in the rapid elongation of the spit to a maximum of 4440 ft (1353.3 m) (Fig. 33).

During the same period on St. Simons Island, the greatest change was at Goulds Inlet, in response to the aforementioned spit progradation. Here, the Goulds Inlet shore retreated to a maximum of 640 ft (195.1 m), while the seaward facing shore south of the inlet advanced up to 780 ft (237.7 m). (Note similar pattern at Cabretta Inlet illustrated in Fig. 23.) Just south of the small inlet which closed prior to 1955, the beach advanced a maximum of 240 ft (73.2 m). On the St. Simons Sound shore, a maximum advance of 460 ft (140.2 m) on the southwest was exceeded by a maximum retreat of 750 ft (228.6 m) on the southeast.

Between 1924 and 1955, Sea Island accreted both north and south, while its central strand eroded. On St. Simons, deposition took place to the east and southwest, while erosion

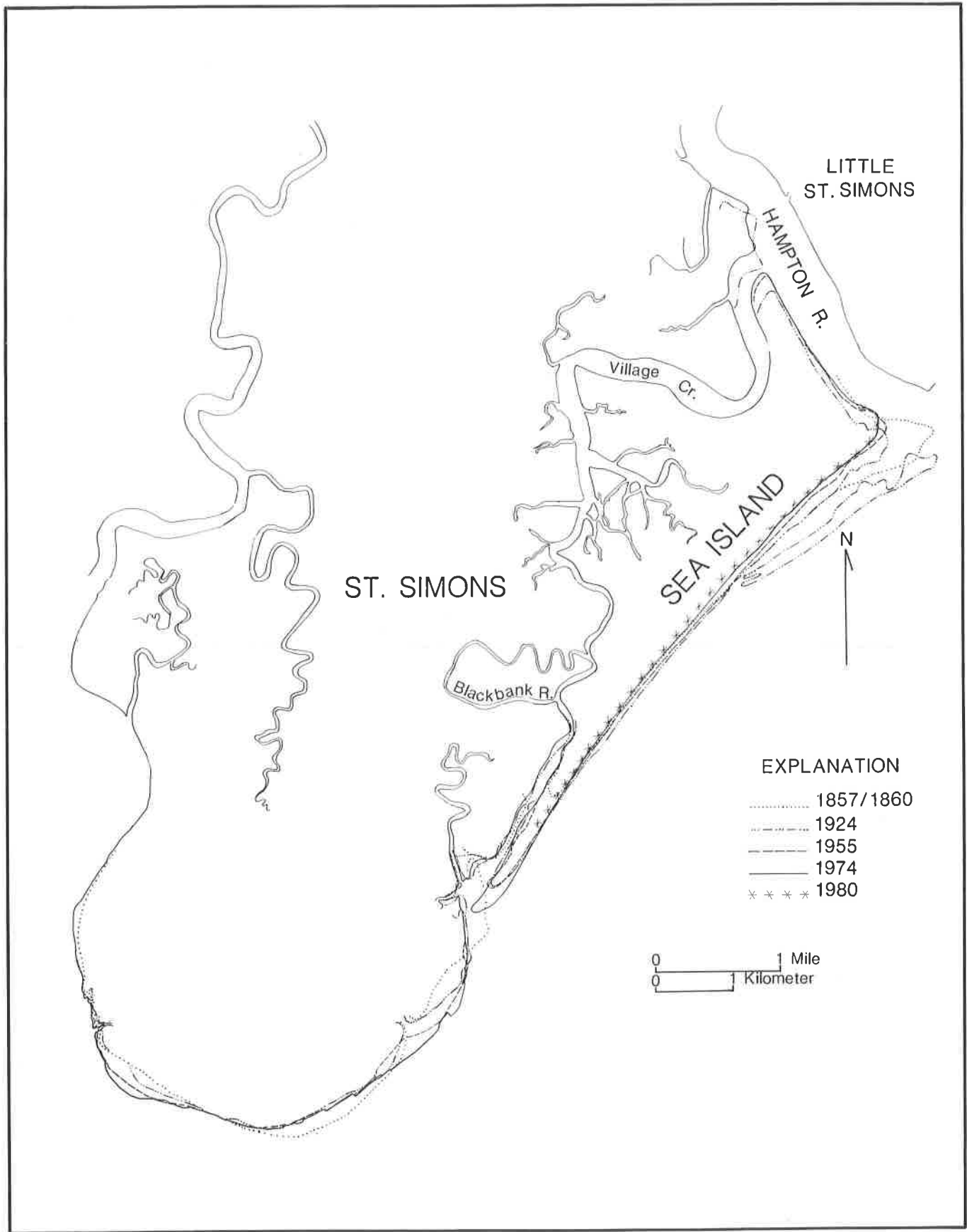


Figure 32. Sea Island/St. Simons Island MHW Shoreline Change, 1857/60-1974/80.

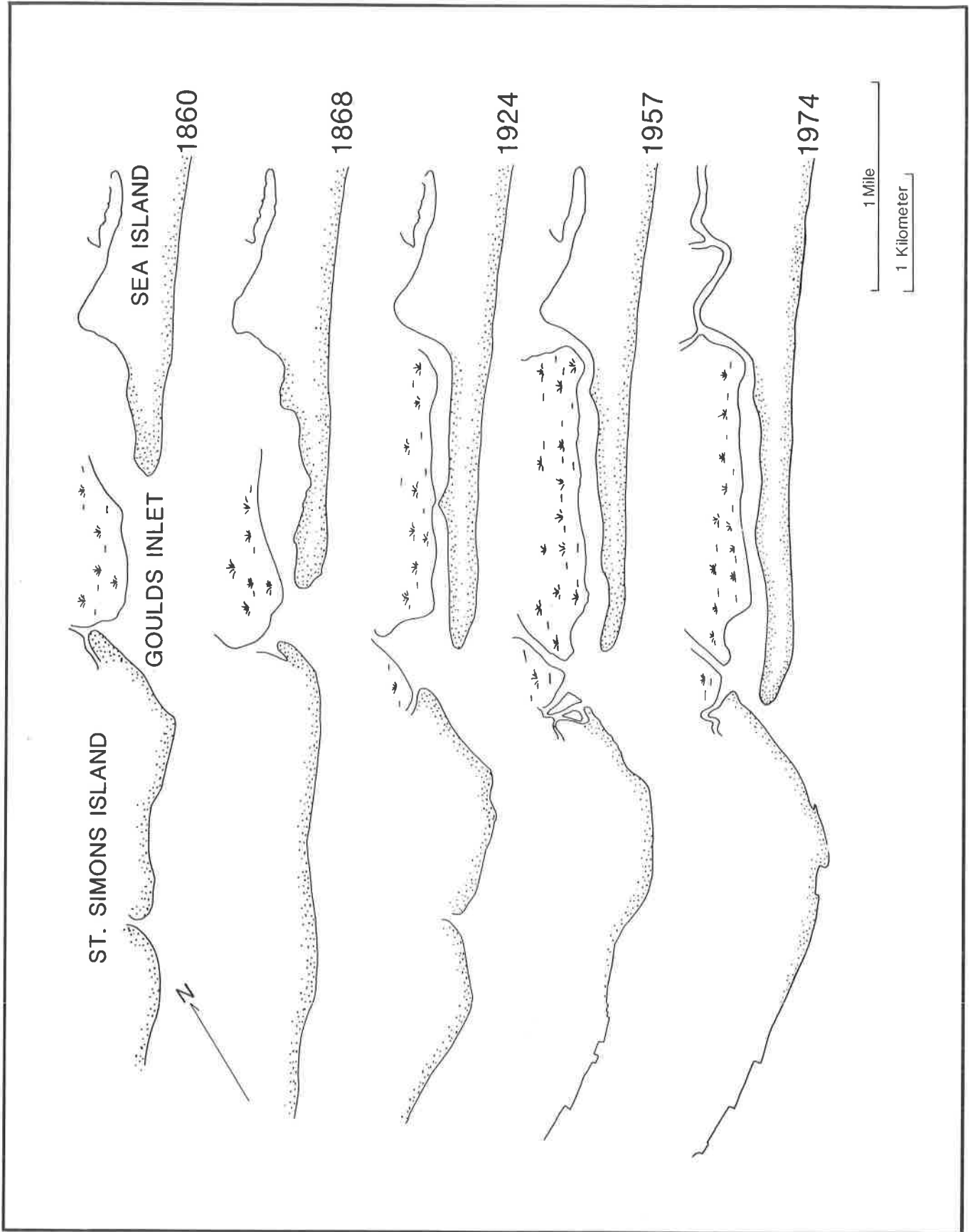


Figure 33. Goulds Inlet MHW Shoreline Change, 1860-1974.

continued to the southeast. On northern Sea Island, there was a maximum advance of 600 ft (182.9 m) toward the inlet. On the northeast end and the north strand of Sea Island, losses were to 620 ft (189 m) and 475 ft (144.8 m), respectively; the entire central and south-central strand retreated, as well, from 200 - 250 ft (61 - 76.2 m). At Goulds Inlet, the spit advanced a maximum of 190 ft (57.9 m).

On St. Simons Island during the same 1924 to 1955 interval, the shore facing Goulds Inlet again retreated south some 650 ft (198.1 m), accompanied by a seaward advance of 550 ft (167.6 m) just south of the inlet. On the beach adjacent to St. Simons Sound, the southeast portion continued to retreat at rates of up to 11.6 ft/y (3.5 m/y) and accretion on the southwest section progressed at rates of up to 21.5 ft/y (6.6 m/y).

During the interval 1955 - 1974, the erosion/accretion patterns established between 1924 and 1955 were basically unchanged. On Sea Island, the Hampton River shoreline advanced a maximum of 220 ft (67.1 m), while the major deposition occurred at Goulds Inlet with advances to 1225 ft (373.4 m). The northeast tip of the island retreated another 350 ft (106.7 m), while the north and north-central strand eroded at rates from 13.7 ft/y (4.2 m/y) to 20 ft/y (6.1 m/y), respectively. Erosion rates were slower on the south and south central beach, from 4 - 6.3 ft/y (1.2 - 1.9 m/y).

On St. Simons, in the same interval, the area adjoining Goulds Inlet stabilized, and accretion south of the inlet took place with advances from 300 - 630 ft (91.4 - 192.0 m). On the St. Simons Sound shoreline, accretion continued on the southwest with a maximum advance of 360 ft (109.7 m); the eroding area to the southeast was largely stabilized by the sea wall constructed in 1965.

The partial coverage provided by 1980 aerial photographs indicated a shoreline recession of Sea Island's beachfront. Along the Hampton River inlet shoreline, 40-60 ft (12-18 m) of erosion took place. The maximum retreats, ranging from 50-175 ft (15-53 m), occurred on the central and north-central beaches. On the south and south-central strand, the maximum retreat was 80 ft (24 m). The incomplete time line indicated that shoreline recession is taking place on the south-trending spit.

When net shoreline change on Sea Island and St. Simons is considered for the study period 1924 - 1974 (Fig 34) the islands appear to have undergone little, if any, net loss. On Sea Island, the Hampton River shore accreted from 150 - 880 ft (45.7 - 268.2 m), while the northeast end of the island retreated to a maximum of 720 ft (219.5 m). Along the strand, retreats were to maxima of 380 ft (115.8 m) along the north and central strands; the south strand eroded as well, to a maximum of 300 ft (91.4 m). As the strand eroded, the down-drift spit elongated rapidly at rates of up to 27 ft/y (8.3 m/y). On St. Simons, there were losses of 120 ft (36.6 m) at Goulds Inlet, but a 320 ft (97.5 m) advance took place when a small inlet closed. The southwest area on St. Simons Sound advanced a maximum of 640 ft (195.1 m), while the eroding area to the southeast, stabilized by sea wall construction, accreted slightly in a few areas (less than 150 ft (45.7 m)).

Consideration of the MHW net shoreline change of Sea Island and St. Simons Island for the entire study period of 1857 - 1974 (Fig. 35) indicates that: (1) Sea Island eroded to the north and all along the strand, while its spit rapidly elongated; and (2) St. Simons Island underwent major change at Goulds Inlet (in response to growth of the Sea Island spit), while the south end of the island shifted landward through ero-

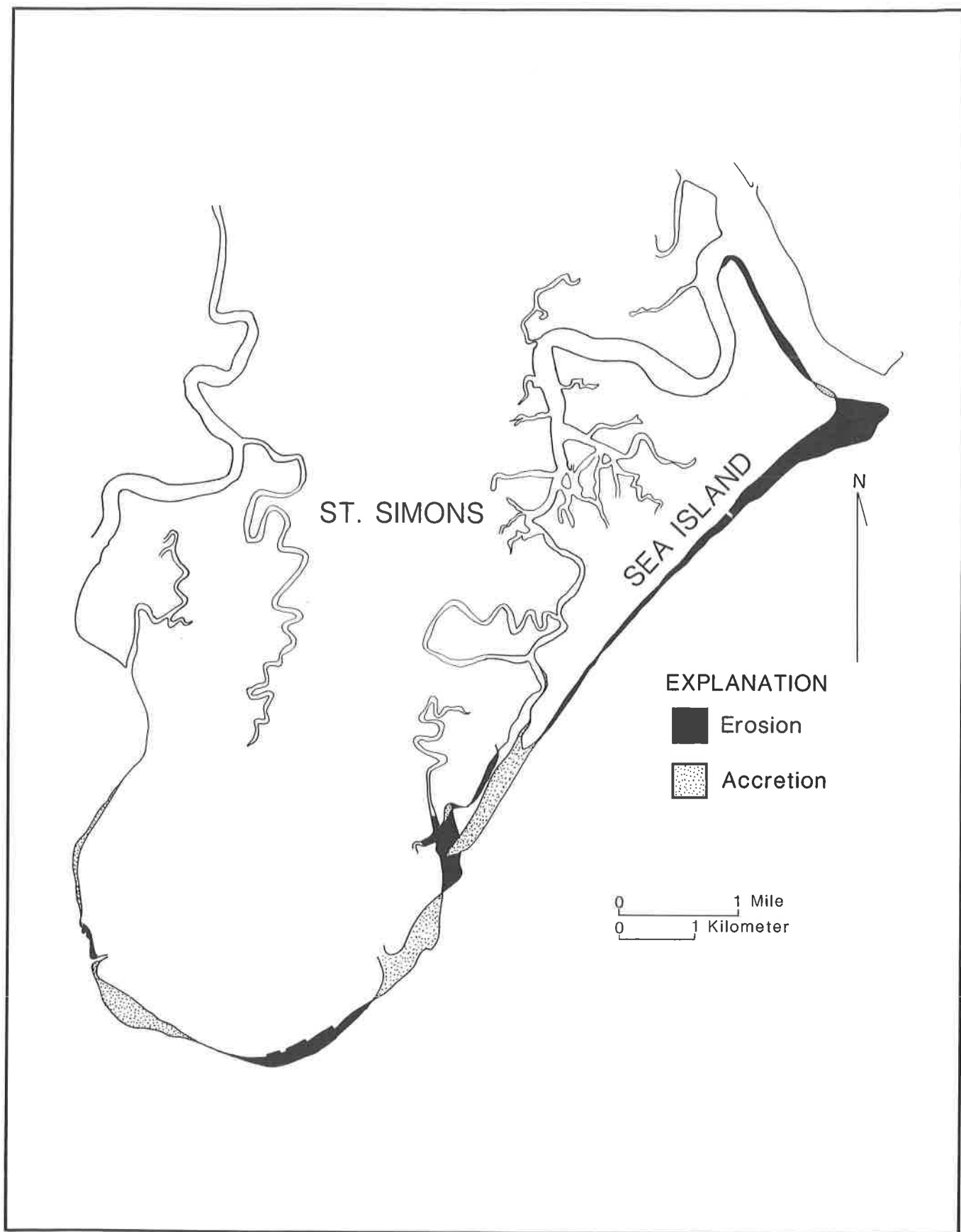


Figure 34. Sea Island/St. Simons Island Net MHW Shoreline Change, 1924-1974.

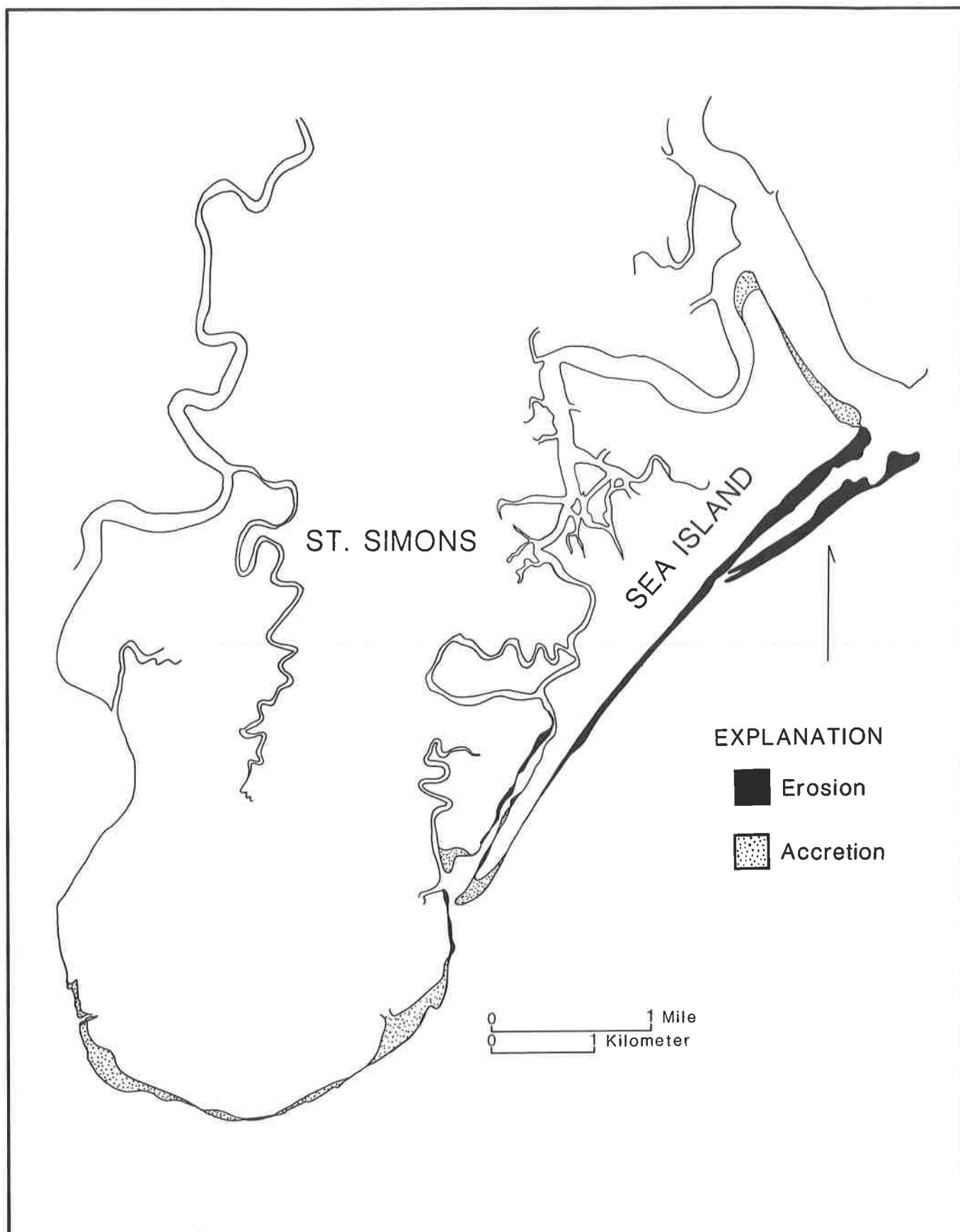


Figure 35. Sea Island/St. Simons Island Net MHW Shoreline Change, 1857/60-1974.

sion at the southeast coupled with accretion on the southwest shore. Losses on Sea Island during the 117 year study period were greatest on the north end of the island, where the maximum loss on the northeast end was 2240 ft (682.8 m) and the north-central strand retreated to a maximum of 560 ft (170.7 m). Erosion on the remainder of the strand did not exceed 50 ft (15.2 m). The only accreting area of the strand was the southern spit, which lengthened 5840 ft (1780.0 m), at rates of up to 50 ft/y (15.2 m/y).

During the same 117 year interval, the St. Simons beach adjoining Goulds Inlet was greatly altered; the inlet-facing shore retreated to 1640 ft (499.9 m); and, just south of this point, accretion was to 1150 ft (350.5 m). On the St. Simons Sound shore, a major shift occurred when maximum losses to 625 ft (190.5 m) on the southeast were far exceeded by gains to 1060 ft (323.1 m) on the southwest. The inland shift of the southern end of St. Simons Island may be linked to the dredging of the Brunswick Harbor entrance channel; dredging was here initiated in 1904 and, in recent years, has amounted to more than 700,000 yd³ (535,220 m³) a year (U.S. Army, Corps of Engineers annual reports).

In summary, for the period 1860 to 1974, Sea Island appears to have suffered slight losses, while St. Simons maintained an overall equilibrium. If the entire Little St. Simons/Sea Island/ St. Simons barrier island complex is considered, it is apparent that the system has advanced since 1860.

ST. SIMONS SOUND

St. Simons Sound, separating St. Simons Island to the north from Jekyll Island to the south, is a tidal inlet with no river input. The

shoreline history of this sound (Fig. 36) probably has been altered by dredging activities designed to facilitate boat traffic into Brunswick Harbor. Although dredging began in the East River in 1880 and in Turtle River in 1908, more important to St. Simons Sound was the dredging of the Brunswick Harbor Entrance Channel to -32 ft (-9.8 m) MLW in 1937. This channel is oriented NW-SE and extends to within 1.3 mi (2.1 km) of the south end of St. Simons island. From 1968 to 1977, average annual dredging in this channel amounted to 729,135 yd³ (557,467 m³). In 1976, however, more than one million cubic yards of sediment were dredged, followed by removal of over one and a half million cubic yards in 1977 (U. S. Army, Corps of Engineers annual reports).

Note in Figure 36 that the south end of St. Simons Island accreted between 1857/1860 and 1899, with a maximum advance of 680 ft (207.3 m). Following 1899, erosion commenced on the southeast shore through 1924 at rates to 19.3 ft/y (5.9 m/y). Erosion to the southwest was not as widespread; here, the maximum retreat was at rates of 12.5 ft/y (3.8 m/y). Between 1924 - 1957, erosion continued to the southeast at a more moderate rate; by 1974, the shore had been stabilized by seawall construction. On the southwest shore, accretion continued unbroken from 1924 to 1974 at rates of up to 21.6 ft/y (6.6 m/y).

On the north end of Jekyll Island, erosion progressed steadily from 1860 to 1974, resulting in a maximum retreat of 850 ft (259.1 m) for the study period. On the northwest back-barrier shoreline of Jekyll, up to 580 ft (176.8 m) were lost in the same interval. Because the northwest erosion pattern was evident in the 1857-1899 period, it is probably a natural response to ebb tidal flow from the Brunswick River.

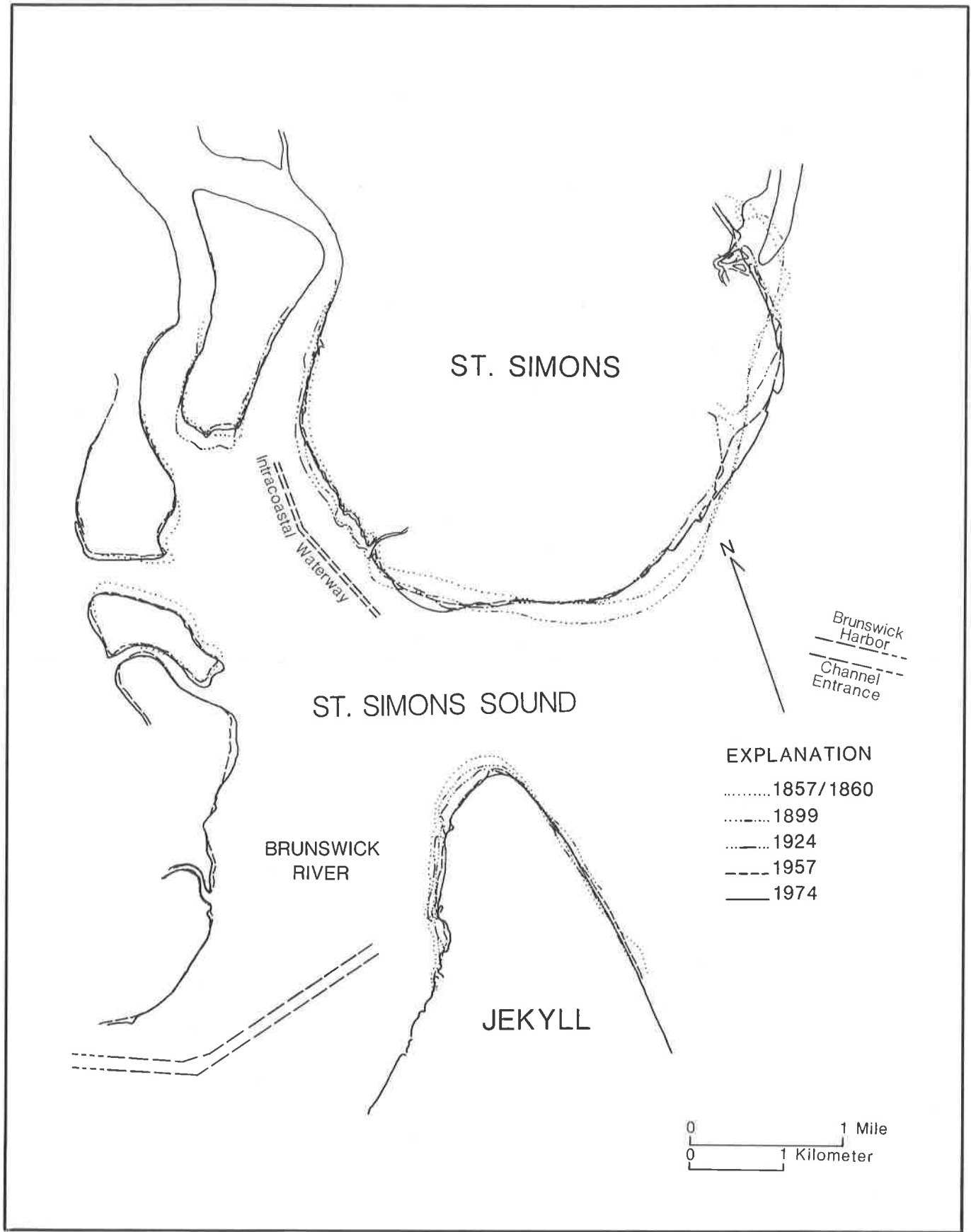


Figure 36. St. Simons Sound MHW Shoreline Change, 1857/60-1974.

JEKYLL ISLAND

General Description

Jekyll Island, composed of a Pleistocene core and Holocene beach ridges on the north and south portions of the island, is separated from St. Simons Island to the northeast by St. Simons Sound and from Little Cumberland Island to the south by St. Andrew Sound. The island is about 7.4 mi (11.9 km) long by 2.3 mi (3.7 km) wide; elevations are to 30 ft (9 m). There are 4300 acres (1740 ha) of high land and 1400 acres (567 ha) of marsh. Approximately 3700 acres (1498 ha) were developed in 1976 (Warner and Strouss, 1976).

In 1947, the State of Georgia purchased Jekyll Island to be operated as a state park by the Jekyll Island Authority. Since construction of a bridge and causeway linking the island to the mainland in 1954, rapid development has taken place. Along the central strand, roads, parking lots, and residences have replaced much of the dune system. On the north third of the island, which is relatively free of construction, a few, small discontinuous dunes exist. On the southern shore, which is largely undeveloped, an active beach/dune ridge system exists.

The passage of Hurricane Dora in 1964 caused considerable erosion and property damage, particularly in the central and north-central sectors. Consequently, two sets of rubble mound seawalls, totalling nearly 7000 yd (6400 m) in length, were constructed to stabilize the shoreline (Nash, 1977).

Shoreline Change

The shoreline history of Jekyll Island from 1857/1868 to 1980 (Fig. 37) illustrates that the island's shoreline has undergone the least net changes of Georgia's major barrier

islands for the study period. Jekyll Island's relative stability may be due to the fact that it lies in the very apex of the Georgia Embayment. Lying downdrift of a tidal inlet, the island has migrated southward through erosion on the north end and accretion on the south end; however, the island's maximum length has not changed during the study period. Shifts about the persistent nodal points on the strand are more subtle than those seen on other Georgia islands.

From 1857/1868 to 1924, erosion on the St. Simons Sound shore proceeded to a maximum of 525 ft (160.0 m) while the north and north-central beaches retreated at rates of up to 2.0 ft/y (0.6 m/y) and 6.3 ft/y (1.9 m/y), respectively. The central area of the strand was stable in this period and, south of this stable sector, the island advanced. The maximum advance on the south beach was 550 ft (167.6 m), while the St. Andrew Sound shoreline extended to a maximum of 720 ft (219.5 m).

From 1924 to 1957, recession proceeded on the St. Simons Sound shoreline at rates to 11.5 ft/y (3.5 m/y), but the north strand accreted to a maximum of 185 ft (56.4 m). During this interval, stability characterized the north-central strand, and deposition occurred on the central strand with advances from 180 - 250 ft (54.9 - 76.2 m). Erosion took place on the south-central strand at rates to 8.0 ft/y (2.4 m/y). Further south, stability was maintained and the St. Andrew Sound shoreline extended a maximum of 390 ft (118.9 m).

During the interval 1957 to 1974, the north inlet shoreline of Jekyll eroded at rates to 15.6 ft/y (4.8 m/y). A comparison of this figure with erosion rates of 7.8 ft/y (2.4 m/y) from 1857 to 1924 and 11.5 ft/y (3.5 m/y) from 1924 to 1957 indicates a rapidly accelerating re-

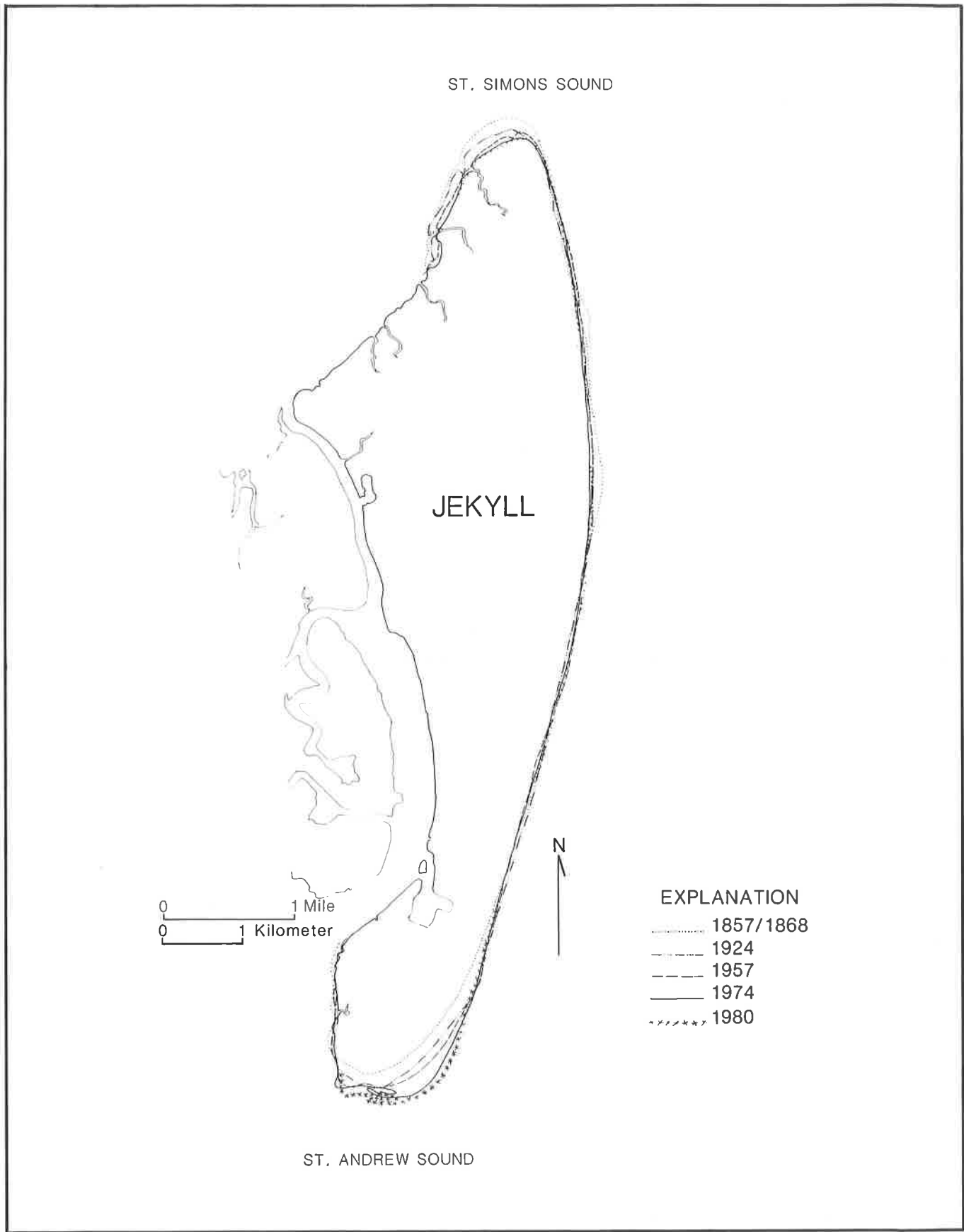


Figure 37. Jekyll Island MHW Shoreline Change, 1857/68-1980.

treat at this area. Erosion on the north and north-central strand took place from 40 ft (12.2 m) to 160 ft (48.8 m), respectively, while the maximum retreat on the central strand was 120 ft (36.6 m). On the stable south beach, advances were made to 160 ft (48.8 m). The downdrift end continued to build southward, with a maximum advance of 650 ft (198.1 m). Note that the downdrift deposition rate also accelerated over time, from maximum advances of 12.6 ft/y (3.9 m/y) during 1868 - 1924 and 11.8 ft/y (3.6 m/y) during 1924 - 1957 to a maximum of 38.2 ft/y (11.7 m/y) between 1957 and 1974.

The MHW shoreline drawn from 1980 1:500 aerial photographs indicated a continuation of post-1857 shoreline trends, i.e., erosion to the northwest and accretion to the southeast. On the north end of Jekyll, erosion progressed on the St. Simons Sound shoreline at about 5-10 ft/y (1.5-3 m/y). On the seaward-facing north strand, a 1800 ft (550 m) stretch of beach advanced a maximum of 60 ft (18 m). The central third of the island was largely stable, with segments of the beach advancing between 40-60 ft (12-18 m). On the southern third of Jekyll, a shoreline retreat of 35-70 ft (10-21 m) was exceeded by a maximum advance of 220 ft (67 m) farther south. Along the St. Andrew Sound shoreline, deposition ranged from 160-360 ft (48-110 m).

When net MHW shoreline change on Jekyll Island (Fig. 38) is considered for the period 1924 - 1974, the island appears to have maintained equilibrium; losses are greater to the northwest than along the strand, while downdrift accretion is considerable. Maximum losses on St. Simons Sound were 450 ft (137.2 m) in this interval, while the northeast strand accreted to a maximum of 200 ft (61.0 m). Below the stable area on the north beach, the maximum erosion was 120 ft (36.6 m). The cent-

ral strand made gains to 150 ft (45.7 m), while the south beach eroded in comparable amounts. At the St. Andrew Sound shoreline, deposition progressed to a maximum advance of 950 ft (289.6 m) during this 50 year period.

Consideration of net MHW shoreline change for the entire study period of 1857/1867 to 1974 (Fig. 39) indicates that Jekyll Island retreated slightly during this period. This is due to the fact that Jekyll, unlike most islands on the Georgia coast, did not advance between 1857 and 1924. During the 117 year study period, erosion along the St. Simons Sound shoreline amounted to a maximum of 950 ft (289.6 m). A small area on the northeast beach advanced to a maximum of 160 ft (48.8 m), but the north-central strand retreated to a maximum of 450 ft (137.2 m). Erosion progressed along the central and south-central shores to maximum retreats of 560 ft (170.7 m) and 160 ft (48.8 m), respectively. The southern shore was stable in this interval, while the St. Andrew Sound inlet shoreline accreted a maximum of 1420 ft (432.8 m).

ST. ANDREW SOUND

St. Andrew Sound (Fig. 40), separating Jekyll Island to the north from Little Cumberland Island to the south, is the largest inlet on the coast of Georgia. Here the Satilla River, a coastal plain river with an average discharge of 2229 ft³/s (63.1 m³/s) (U.S. Geol. Survey, 1982), meets the Atlantic. In addition, the Little Satilla and Cumberland Rivers, both of which head in the marshes, flow through St. Andrew Sound. The dredged channel of the Intracoastal Waterway, north of Cumberland Sound, extends to the deep gorge of the main inlet channel. The inlet has narrowed by some 0.2 mi (0.3 km) between 1868 and 1974, primarily due to deposition on the south end of Jekyll Island.

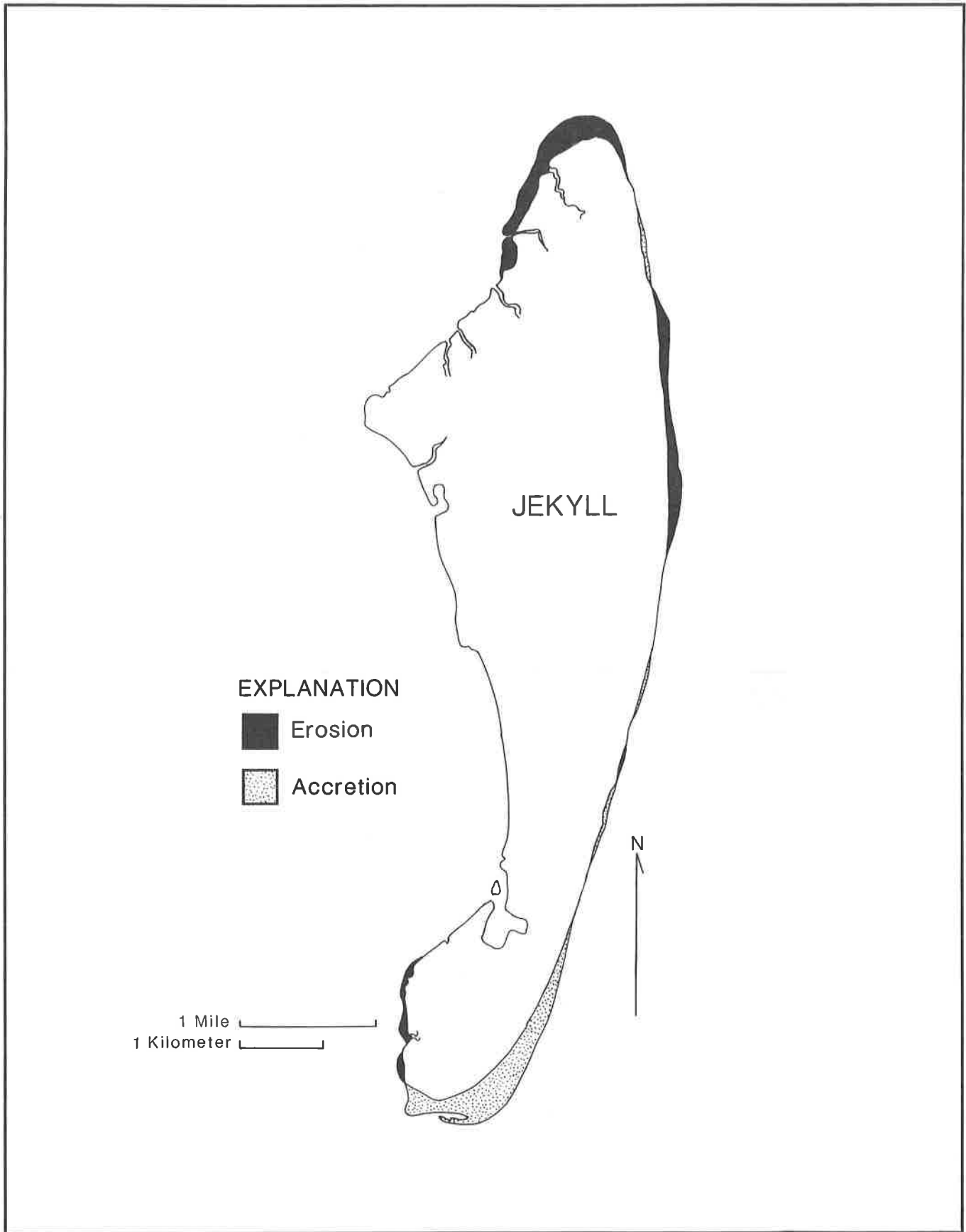


Figure 38. Jekyll Island Net MHW Shoreline Change, 1924-1974.

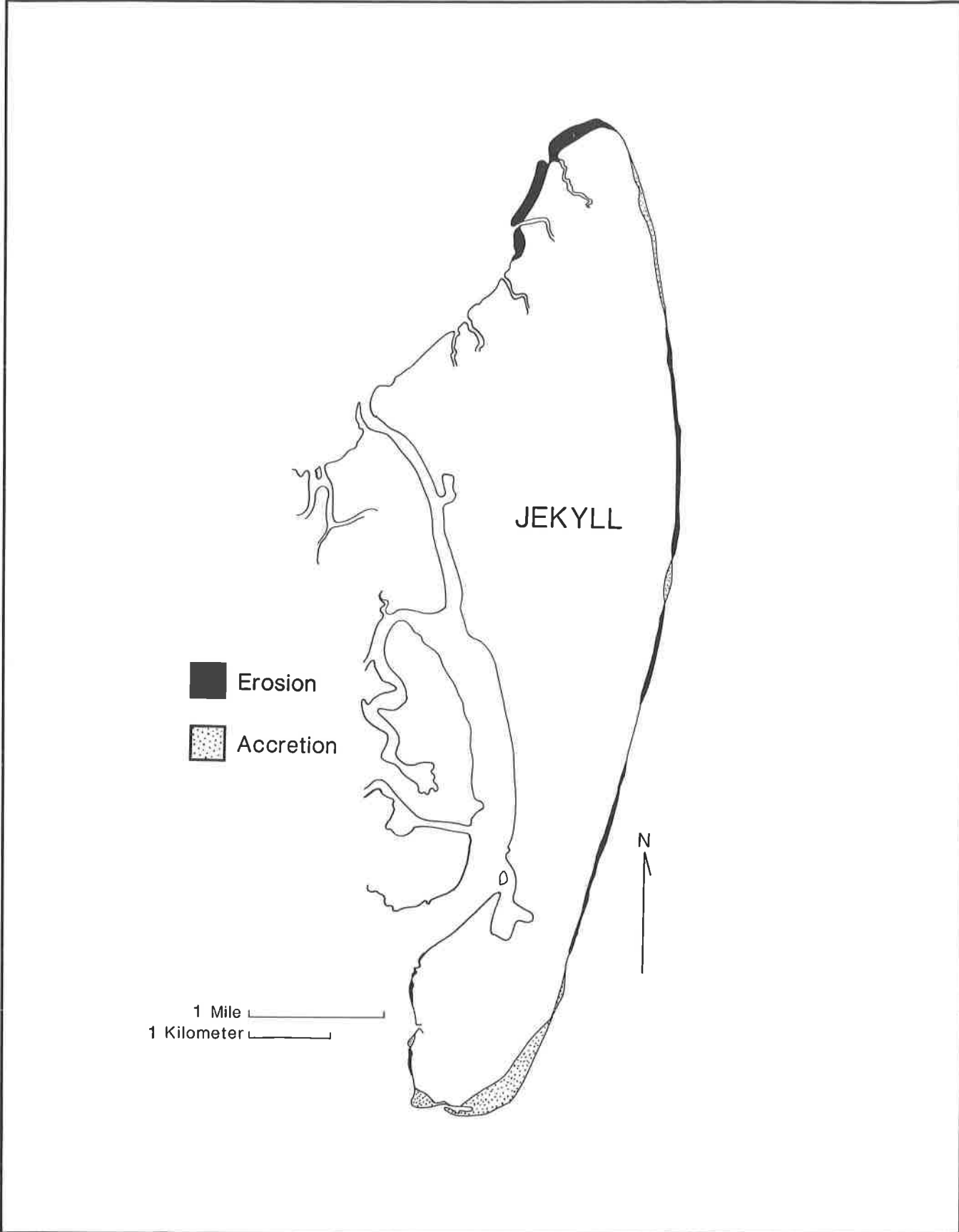


Figure 39. Jekyll Island Net MHW Shoreline Change, 1857/68-1974.

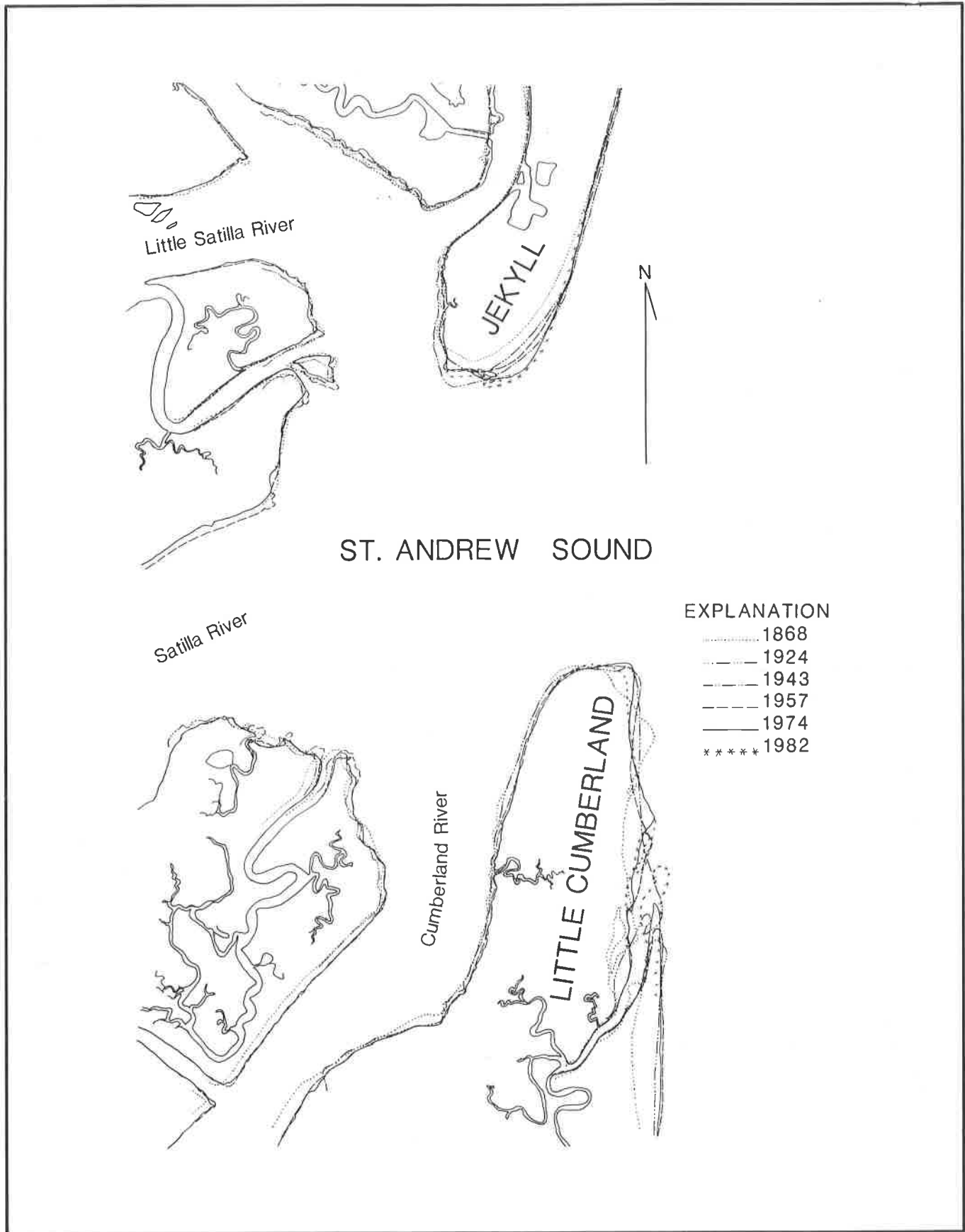


Figure 40. St. Andrew Sound MHW Shoreline Change, 1868-1982.

Note that the south end of Jekyll advanced at a maximum rate of 12.7 ft/y (3.9 m/y) between 1867 - 1982, gaining up to 1460 ft (445.0 m) during the 115 year study period. On Little Cumberland Island, the northwest shore eroded 440 ft (134.1 m), while the northeast shore advanced 1150 ft (350.5 m) during the 1868 - 1974 time span. The 1982 time line indicates that the northeast tip of Little Cumberland is being rapidly truncated at rates up to 55 ft/y (16.8 m/y), but that deposition is taking place at the north and northwest shore of Little Cumberland Island at rates to 22.5 ft/y (6.9 m/y).

LITTLE CUMBERLAND/CUMBERLAND ISLANDS

General Description

The Little Cumberland/Cumberland barrier island system is the largest of the Georgia coastal islands; it is separated from Jekyll Island to the north by St. Andrew Sound and from Amelia Island, Florida, to the south by St. Marys Entrance. The island complex is approximately 18.5 mi (29.8 km) long by 3.7 mi (6 km) wide, with an area of roughly 61.8 mi² (160 km²), of which nearly two-thirds is above spring tide. Elevations range from sea level to 43 ft (13 m). The island has a Pleistocene core with a Holocene beach ridge fringe along much of the ocean shoreline.

Holocene Little Cumberland Island, 3.5 mi (5.6 km) long and 1.3 mi (2.1 km) wide, is nearly completely separated from Cumberland Island by a small, but active, tidal inlet. The island is privately owned by a group of conservationists, collectively designated as the Little Cumberland Island Association. Little Cumberland is included as part of the Cumberland Island National Seashore, operated by the National Park Service. The Association is permanently preserving approximately three-quarters of the island as wilderness.

Development of the remaining one-quarter of the island is limited by covenants and deed restrictions mutually agreed upon by the Park Service and the Association (U. S. Dept. of Interior, 1980). In 1982, the island was included in the "Coastal Barrier Resources Act," making it ineligible for federal flood insurance.

Cumberland Island, the main body of the barrier island system, is separated from Little Cumberland by Christmas Creek. The island is 16.4 mi (26.4 km) long and 3.7 mi (6 km) wide. The island's broad beaches merge into extensive but discontinuous dune systems up to 43 ft (13 m) in height which extend inland for approximately 0.6 mi (1 km). Much of the dune system has been altered by the early introduction of livestock, primarily hogs and horses; effects of domestic animal traffic, rooting, and overgrazing have resulted in the formation of large migrating dunes and deflation areas. The island has had a long history of human occupation, and today exists in a semi-wild state, although greatly modified by the continuing effects of the land use and management practices of earlier inhabitants (Nash, 1977).

The south end of the island has been influenced by the emplacement of large jetties, extending 2.5 mi (4.0 km) and 1.5 mi (2.4 km) seaward from the south end of Cumberland and the north end of Amelia Island, Fla., respectively. Early reports by the U.S. Army Corps of Engineers (1875 and 1879) state that the south end of Cumberland was eroding; however, initiation of jetty construction in 1881 reversed this trend. During the passage of the severe hurricane of 1898, the now extinct meander of Beach Creek was cut through to the sea. After a dike was constructed in 1904 off the shore end of the jetty, the beach in that area rapidly accreted, and the meander was abandoned (Nash, 1977).

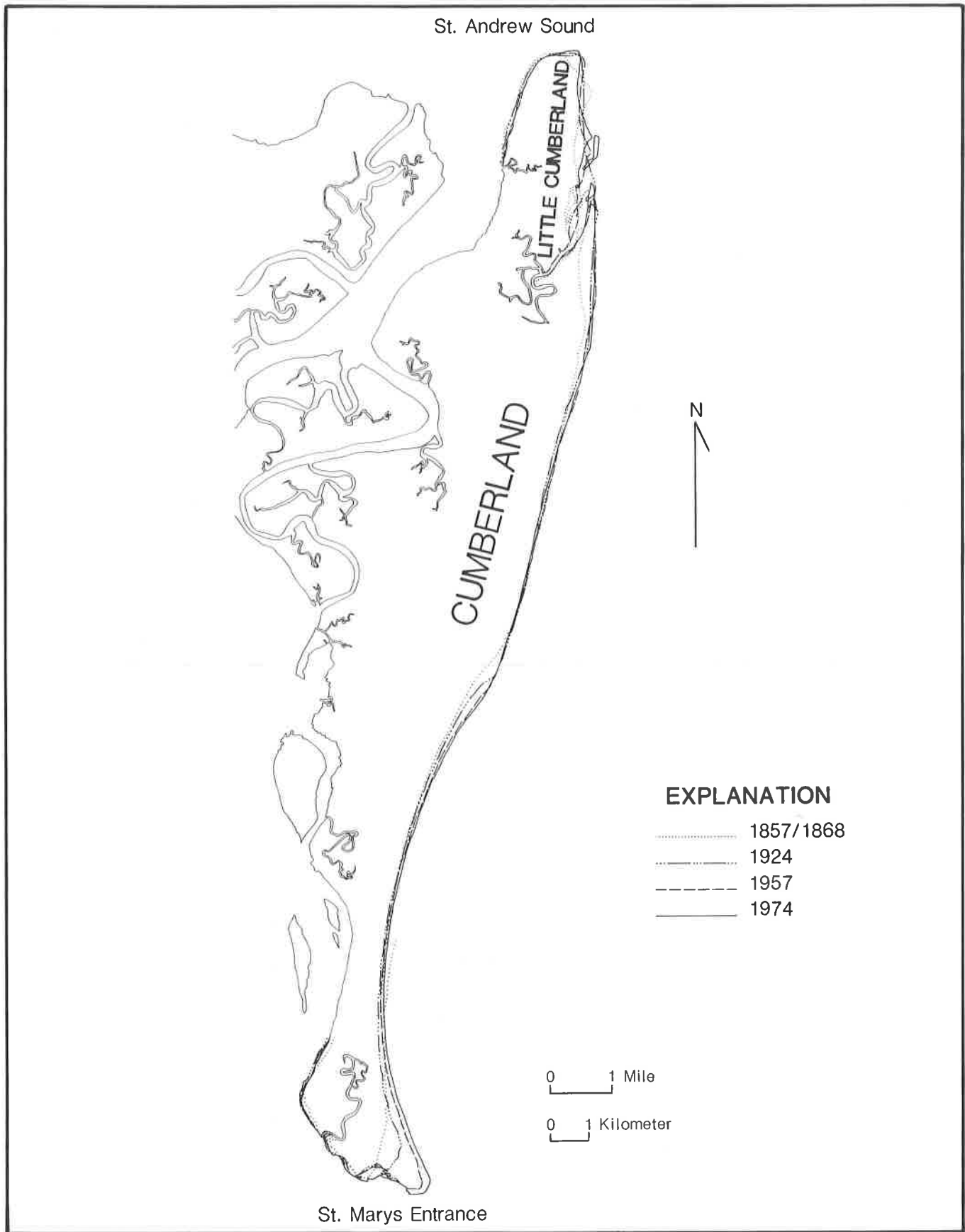


Figure 41.a Little Cumberland/Cumberland Islands MHW Shoreline Change, 1857/68-1974.

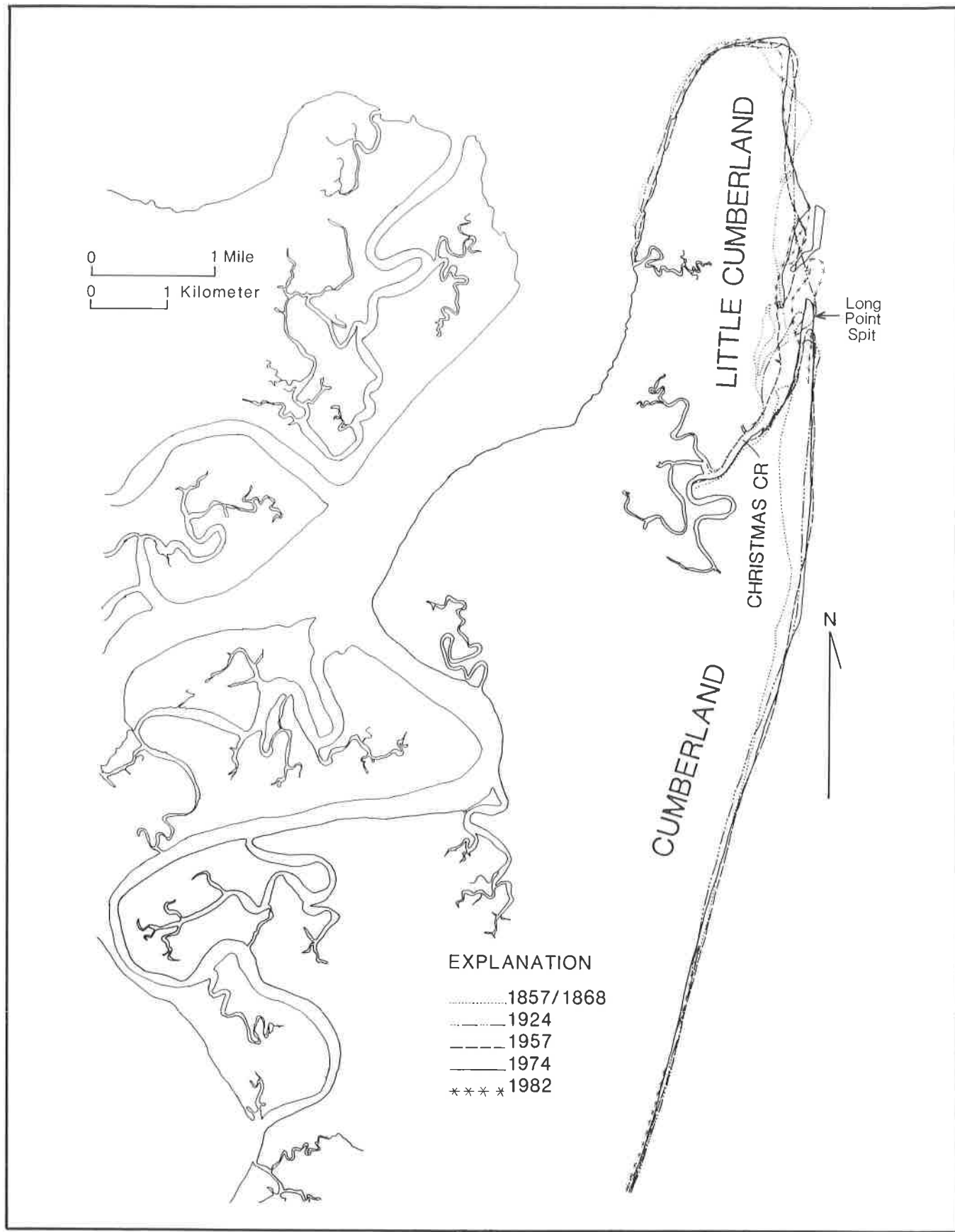


Figure 41.b Little Cumberland/North Cumberland Islands MHW Shoreline Change, 1868-1982.

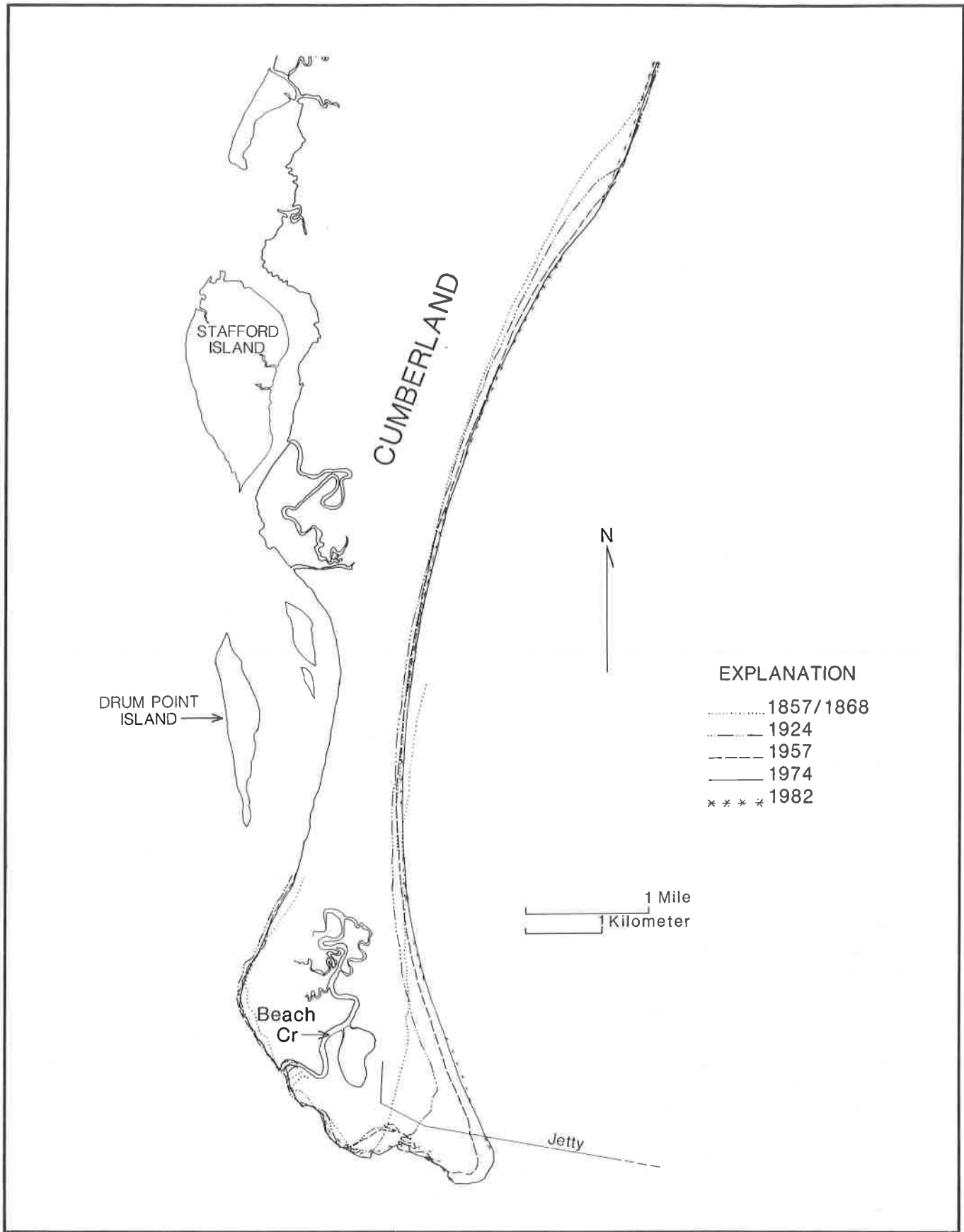


Figure 41.c Central/South Cumberland Island MHW Shoreline Change, 1857-1982.

The National Park Foundation began acquiring land on Cumberland Island in 1962. In 1972, the 15,554 acres (6297 ha) acquired by the Foundation became part of the National Park Service, designated as Cumberland Island National Seashore. The area included in the National Park System presently comprises 18,019 acres (7295 ha) of uplands. Approximately 1804 acres (730 ha) remain in private ownership. The U.S. Army Corps of Engineers owns 647 acres (262 ha) for dredge spoil disposal; this land includes Drum Point Island and the Beach Creek marsh area (U.S. Dept. of Interior, 1983).

Shoreline Change

The 1857/68 - 1982 MHW shoreline history (Fig. 41a-c) of the Little Cumberland/Cumberland Island system is characterized by the following: (1) reverses in shoreline recession and accretion patterns on Little Cumberland; (2) the northward migration of the Long Point spit at Christmas Creek inlet; (3) pre-1957 accretion and post-1957 erosion along the north and north-central strand of Cumberland; (4) accretion on the south-central and south strand of Cumberland; and (5) deposition on the St. Marys Entrance shore.

Between 1868 and 1924, a seaward shift of the north end of Little Cumberland resulted in gains of 960 ft (292.6 m) to the northeast and losses of 370 ft (112.8 m) to the northwest. Along the beach of the island, north strand erosion of 750 ft (228.6 m) was far exceeded by a maximum accretion of 1360 ft (414.5 m) farther south. During this interval, the Long Point spit built rapidly seaward and northward, at rates up to 18 ft/y (5.5 m/y) and 38.9 ft/y (11.9 m/y), respectively. On the north strand of Cumberland Island, the maximum advance was 1160 ft (353.6 m); the north-central strand was less stable, suffering losses to

350 ft (106.7 m). The greatest accretion on the strand took place adjacent to the historically stable area associated with Stafford Shoals (McLemore et al, 1980), where the maximum advance was 1250 ft (381.0 m). During the interval 1857 - 1924, erosion took place on the south strand to a maximum retreat of 480 ft (146.3 m). Downdrift, the maximum advance was 1700 ft (518.2 m).

The period 1924 - 1957 was largely accretional; isolated areas to the northwest, on the Little Cumberland beach, and on the north central beach of Cumberland were the only eroding sectors during this interval. The seaward shift of the north end of Little Cumberland resulted in northwest retreats between 60-210 ft (18.3 - 64.0 m) and a maximum northeast advance of 390 ft (118.9 m). On the Little Cumberland beach, maximum losses were of up to 400 ft (121.9 m) to the north and 1620 ft (493.8 m) to the south. During this interval, the Long Point spit continued its northward migration with an advance of 430 ft (131.1 m). The north and north-central beach areas were characterized by deposition to maximum advances of 260 ft (79.2 m) and 300 ft (91.4 m), respectively. The St. Marys Entrance shoreline of Cumberland meanwhile prograded at rates of up to 92.4 ft/y (28.2 m/y).

Between 1957 and 1974, the updrift end of the system began to migrate landward, reversing the seaward progradation of the 1868 - 1924 period. Along the main body of the island, shoreline recession was initiated on the north strand, while accretion progressed to the south. The westward shift of the north end of Little Cumberland resulted in gains of up to 50 ft (15.2 m) to the northwest and erosion on the northeast to a maximum retreat of 410 ft (125.0 m). The Little Cumberland beach was marked by instability; the central area accreted a maximum of

620 ft (189.0 m), but the areas north and south eroded to maxima of 400 ft (122.0 m) and 480 ft (146.3 m), respectively. The Long Point spit experienced rapid growth to the north at rates to 73 ft/y (22.3 m/y), well exceeding previous growth rates of 31.5 ft/y (9.6 m/y) recorded between 1868 and 1924. Shifts around a nodal point on north Cumberland resulted in losses of up to 160 ft (48.8 m) and gains of up to 380 ft (115.8 m). On the north-central strand, the maximum retreat was 240 ft (73.2 m), while the central and south beach areas made gains between 150-220 ft (45.7 - 67.1 m). At St. Marys Entrance, accretion slowed to 40 ft/y (12.2 m/y).

The 1974 - 1982 MHW shoreline history of Little Cumberland/Cumberland Islands (Fig. 41 b-c) is incomplete, for much of the 1982 photo coverage does not extend to the shoreline. On Little Cumberland Island, the northward landward shift has accelerated, with losses up to 35 ft/y (10.7 m/y). On the Little Cumberland beach, the maximum retreat was 250 ft (76.2 m) to the north and the maximum advance was 150 ft (45.7 m) on the north-central strand. Note that a great deal of change occurred at the Christmas Creek inlet area in the 8 year study period. The small, unattached spit of 1974 has migrated inland and attached to the beach; the Long Point spit has built northward another 1700 ft (518.2 m) and migrated landward about 200 ft (61.0 m). North of the stable central area on Cumberland Island, retreats were as great as 150 ft (45.7 m), while advances south of this sector were up to 75 ft (22.9 m). The south-central beach accreted to 80 ft (24.4 m), but the south shoreline retreated a maximum of 60 ft (18.3 m). At the St. Marys Entrance shoreline, accretion slowed to a maximum rate of 18.5 ft/y (5.6 m/y). Note the area just south of the jetty, where the maximum retreat was about 100 ft (30.5 m);

shoreline recession along the south inlet took place to a maximum of 320 ft (97.5 m). This newly receding shoreline may be a consequence of an altered channel, for St. Marys Entrance was dredged from its 1957 - 34 ft (-10.4 m) MLW depth to -40 ft (-12.2 m) MLW in 1979.

When net MHW shoreline change on the Little Cumberland/Cumberland Islands is considered for the period 1924 - 1974 (Fig. 42), it is apparent that the barrier island system has enlarged during the 50 year interval. On Little Cumberland, maximum northward accretion amounted to 210 ft (64.0 m). Maximum recession and accretion along the small island's beach was 550 ft (167.6 m) and 380 ft (115.8 m), respectively. During this interval, the Long Point spit built northward 1760 ft (536.4 m). On the north strand of Cumberland Island, the maximum advance was 280 ft (85.3 m), while on the north-central strand area maximum gains were to 380 ft (115.8 m). Note that, due to the 1924 - 1957 deposition rates, the 1957 - 1974 erosion on north Cumberland is not apparent on a net change map. The central beach of Cumberland was relatively stable, while the south and south-central areas of the beach advanced to maxima of 860 ft (262.1 m) and 900 ft (274.3 m), respectively. On the St. Marys Entrance shoreline, the maximum advance was 3550 ft (1082.0 m) for the 50 year period.

Consideration of net shoreline change on Little Cumberland/Cumberland for the period 1857/68 - 1974 (Fig. 43) illustrates a greater advance than that seen in the 1924 - 1974 period. On Little Cumberland, a site of frequent reversals in recession and accretion, maximum shoreline fluctuations are slightly greater than 1100 ft (335.3 m). The Long Point spit migrated 3920 ft (1194.8 m) to the north, while enlarging seaward 1280 ft (390.1 m). On the

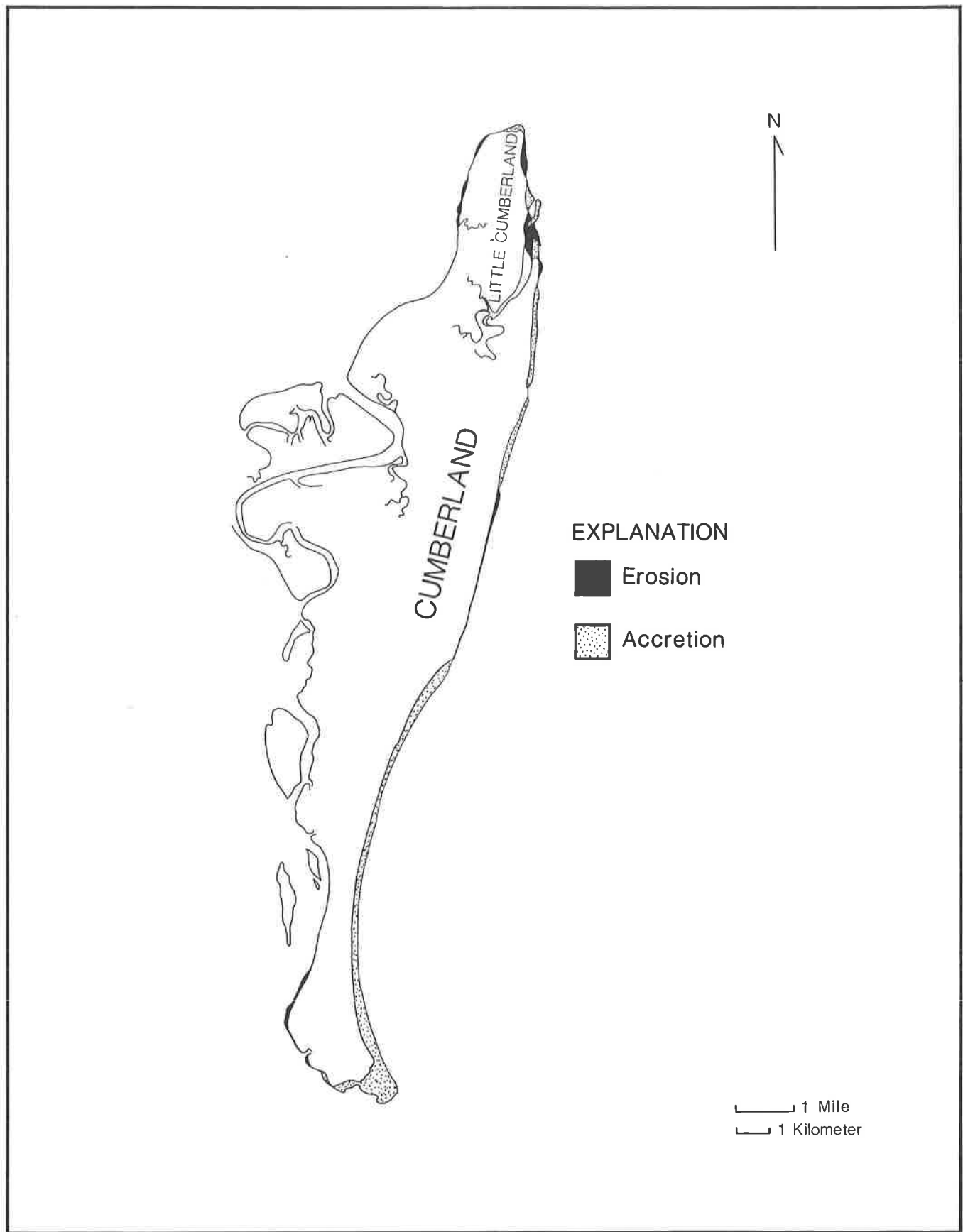


Figure 42. Little Cumberland/Cumberland Islands Net MHW Shoreline Change, 1924-1974.

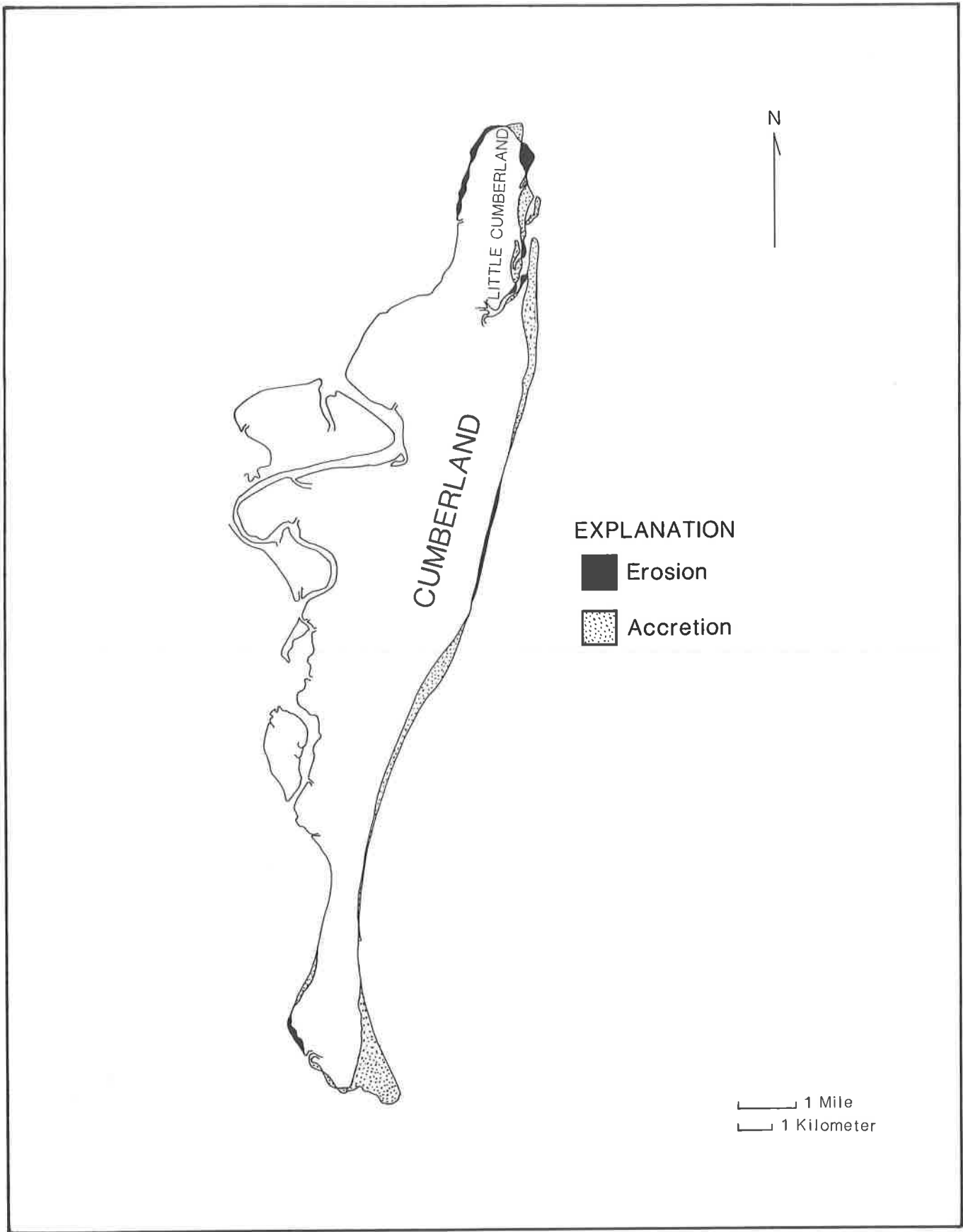


Figure 43. Little Cumberland/Cumberland Islands Net MHW Shoreline Change, 1857/68-1974.

north beach of Cumberland Island, the maximum retreat was 1200 ft (365.8 m); on the north-central area of the strand, gains were to 520 ft (158.5 m). The greatest deposition along the strand took place at the central area, where the maximum advance was 1360 ft (414.5 m). During the interval 1857 - 1974, the south and south-central sectors of the beach were stable, with accretion not exceeding 80 ft (24.4 m). The maximum accretion along the St. Marys Entrance shoreline was 3900 ft (1188.7 m).

ST. MARYS ENTRANCE

St. Marys Entrance (Fig. 44), separating Cumberland Island, Georgia, to the north from Amelia Island, Florida, to the south, is the smallest inlet on the coast of Georgia. It is here that the St. Marys River, a small Coastal Plain river with an average discharge of $673 \text{ ft}^3/\text{s}$ ($19.1 \text{ m}^3/\text{s}$) (U.S. Geol. Survey, 1982), meets the Atlantic. This inlet has been greatly modified by the previously described jetty construction on Cumberland and Amelia Islands, as well as dredging activities in the sound initiated in 1903. Between 1903 and 1979, the channel of the inlet was gradually deepened to -40 ft (-12.2 m) MLW. Between 1965 and 1979, average annual dredging amounted to better than $300,000 \text{ yd}^3$ ($229,368 \text{ m}^3$) (U.S. Army, Corps of Engineers, 1872 - 1977). In addition, the dredged channel of the Intracoastal Waterway, south of Cumberland Sound, extends to the deep gorge of the main channel.

Note that both the south end of Cumberland and the north end of Amelia have shifted seaward during the 116 year study period. The maximum eastward advances for downdrift Cumberland and updrift Amelia were 4800 ft (1463.0 m) and 2580 ft (786.3 m), respectively. The south end of Cumberland has prograded steadily throughout the study period at rates

up to 33.6 ft/y (10.2 m/y). The north and northwest area of Amelia eroded during this interval, with a maximum retreat of 820 ft (250 m); however, the island accreted to the northeast, with a maximum advance of 3400 ft (1036.3 m) adjacent to the jetty. Note that the 1982 time line for south Cumberland (unavailable for north Amelia Island) indicates erosion on the inlet-facing shore for the first time; this may be due to the fact that St. Marys Entrance was deepened in 1979. St. Marys Entrance was 1 mi (1.6 km) wide in 1857 but has since narrowed nearly 0.4 mi (0.6 km), due to the effects of jetty construction.

It should be mentioned that over 23 mi (37 km) of navigation channel, with a proposed controlling depth in excess of -55 ft (-17 m) MLW and a bottom width of 400-600 ft (120-180 m), is proposed for the King's Bay Submarine Support Base. This project may cause changes in sites of erosion and deposition along the adjacent shorelines. Nash (1977) speculated that, as a result, at least the estuarine shoreline adjacent to St. Marys Entrance would undergo increased erosion.

SUMMARY AND CONCLUSIONS

The following evaluation of the stability of the Georgia coast is based on a qualitative knowledge of the sediment transport characteristics and the long-term net shoreline changes. Although a quantitative knowledge of the available energy and sediment budget would result in a more accurate assessment, sufficient field data to evaluate these factors does not exist. Sediment sources and sinks must be considered in terms of the potential transporting agents (waves, winds, tidal and non-tidal currents) and the interrelationship of these agents. When the supply and loss of material are equal and constant, the shoreline will attain

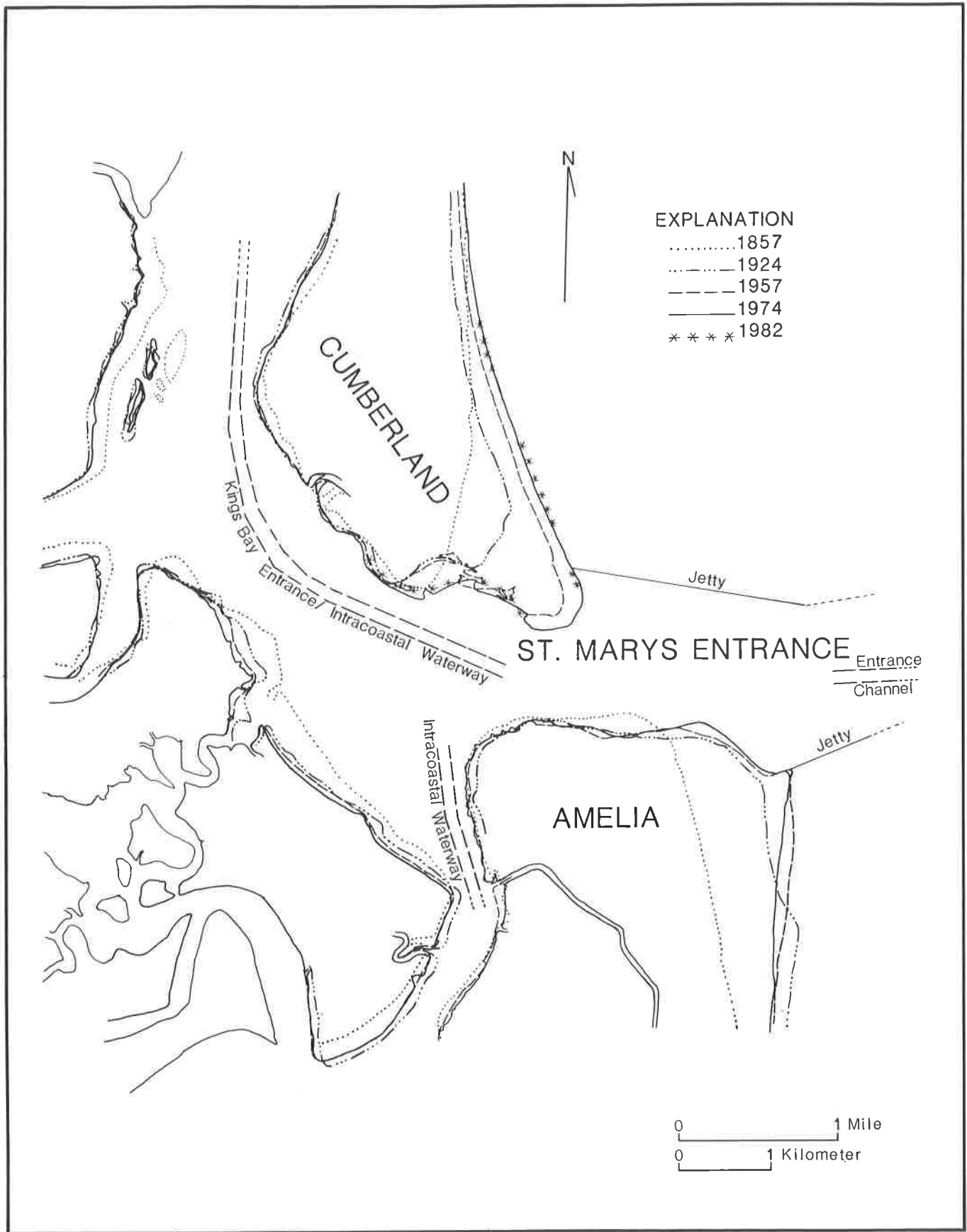


Figure 44. St. Marys Entrance MHW Shoreline Change, 1857-1982.

stability; however, because the primary sources of energy, tides and waves, are variable, the shoreline can only attain a state of dynamic stability. Therefore, even given a constant supply and loss of materials, the shoreline will never appear stable, even for a period of months or years. For this reason, trends in recession and accretion should only be seriously considered over scores or hundreds of years. The term "net shoreline change" may be misleading, as it is not indicative of the actual extent to which a shoreline may recede in a major storm. In the following paragraphs, a brief assessment of the entire Georgia coast will be presented for the major intervals of the study period. Finally, a summary of major change on each of the eight major barrier islands is provided.

During the period 1857-1925, shoreline accretion above the MHW line was dominant. Major deposition occurred on Little St. Simons, Ossabaw, Wassaw, and Cumberland Islands. Rapid advances on the Tybee/Little Tybee Islands system slowed after 1913, possibly due to heavy dredging in the Savannah Harbor dating from 1919. The only islands that did not advance in this interval were Jekyll and St. Catherines. This significant period of deposition on the coast of Georgia may be attributed to the following factors: the 1890 sea level stand, lowest of 115 years (Bruun, 1962); soil erosion (Trimble, 1969, 1973) which choked the Piedmont rivers with sediment, thereby greatly increasing the sediment supply to the coast; and the fact that Savannah River had not yet been impounded. Although major hurricanes occurred in 1893, 1896 and 1898, the coast of Georgia prograded prior to 1924.

During the interval from 1924 to 1954-57 (Fig. 45), dynamic stability characterized the Georgia coast. The only barrier island systems that evi-

denced net retreat were Tybee/Little Tybee and St. Catherines Islands. Although erosion occurred on the central strand of Sea Island and southeast St. Simons, continued gains on Little St. Simons and southwest St. Simons prevented a net retreat for the barrier island complex. New sites of beach erosion appeared on north-central Ossabaw Island and along the north and north-central areas of the Jekyll Island beach. Shoreline recession occurred on the north half of Cumberland Island, although the island advanced as a whole due to major deposition on the south end. The only hurricane of this period, which occurred in October 1944, had a negligible long-term effect.

The period from 1954/57 to 1974 (Fig. 46) was marked by accelerating recession rates and a major hurricane in 1964. Protective seawall construction on Sea Island, St. Simons, and Jekyll Island during this interval, as well as the 1974-76 beach renourishment project on Tybee Island, mask the true 1974 MHW shoreline on the developed islands. New sites of shoreline recession appeared at former sites of accretion, such as central Wassaw, central Ossabaw, and the north end of Little Cumberland; previously documented erosional trends progressed along the developed beaches and on St. Catherines Island. Major accretion again occurred on Little St. Simons, offsetting losses along developed beaches of the Little St. Simons/Sea Island/St. Simons system. Although six of the eight major barrier islands of Georgia appear to have maintained equilibrium through 1974, accelerating erosion rates and the initiation of erosion at long established sites of accretion on undeveloped islands combine to suggest that beach erosion on the coast of Georgia will worsen in the future.

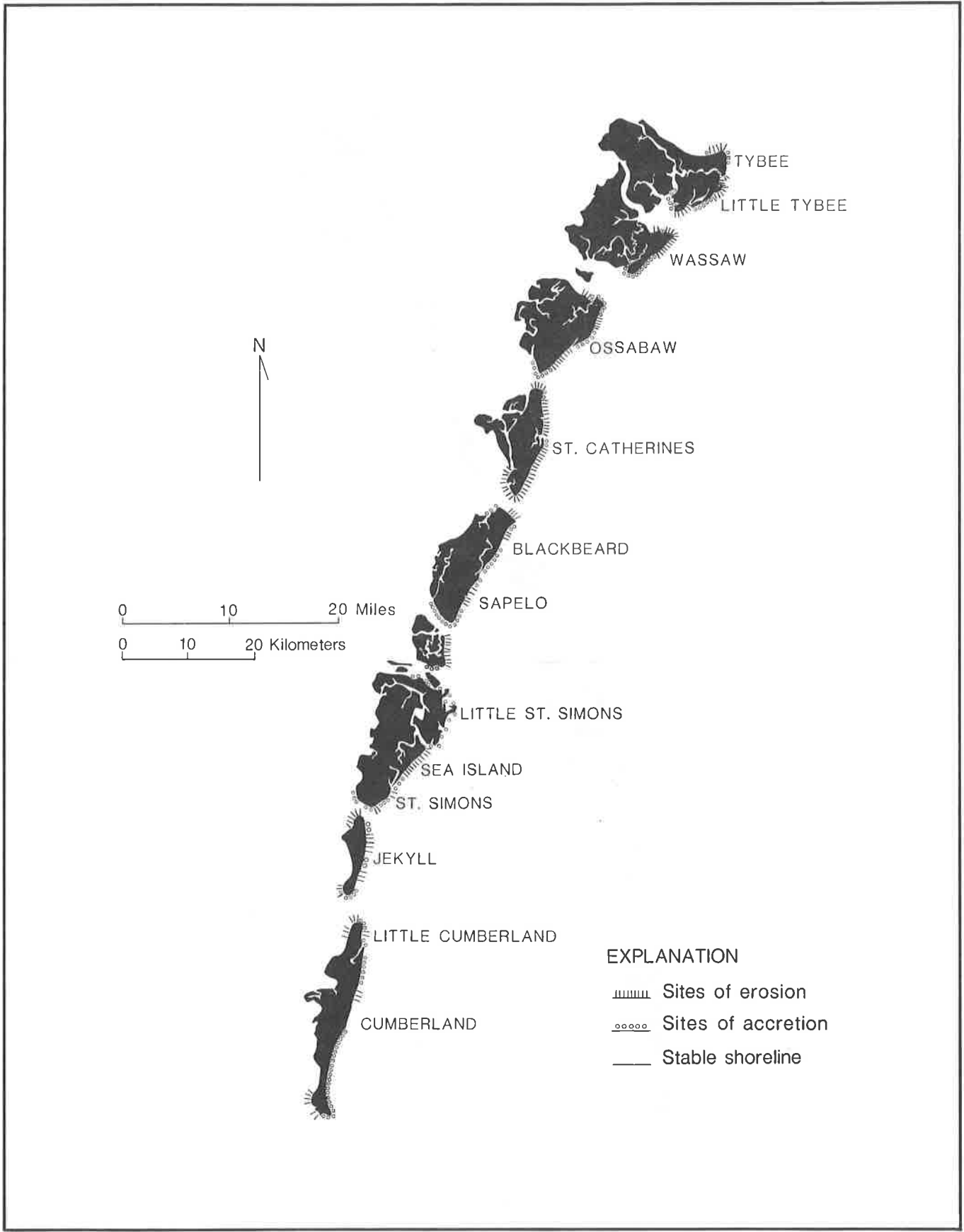


Figure 45. Summary Map of Erosion/Accretion Trends of the Georgia Coast, 1924-1974.

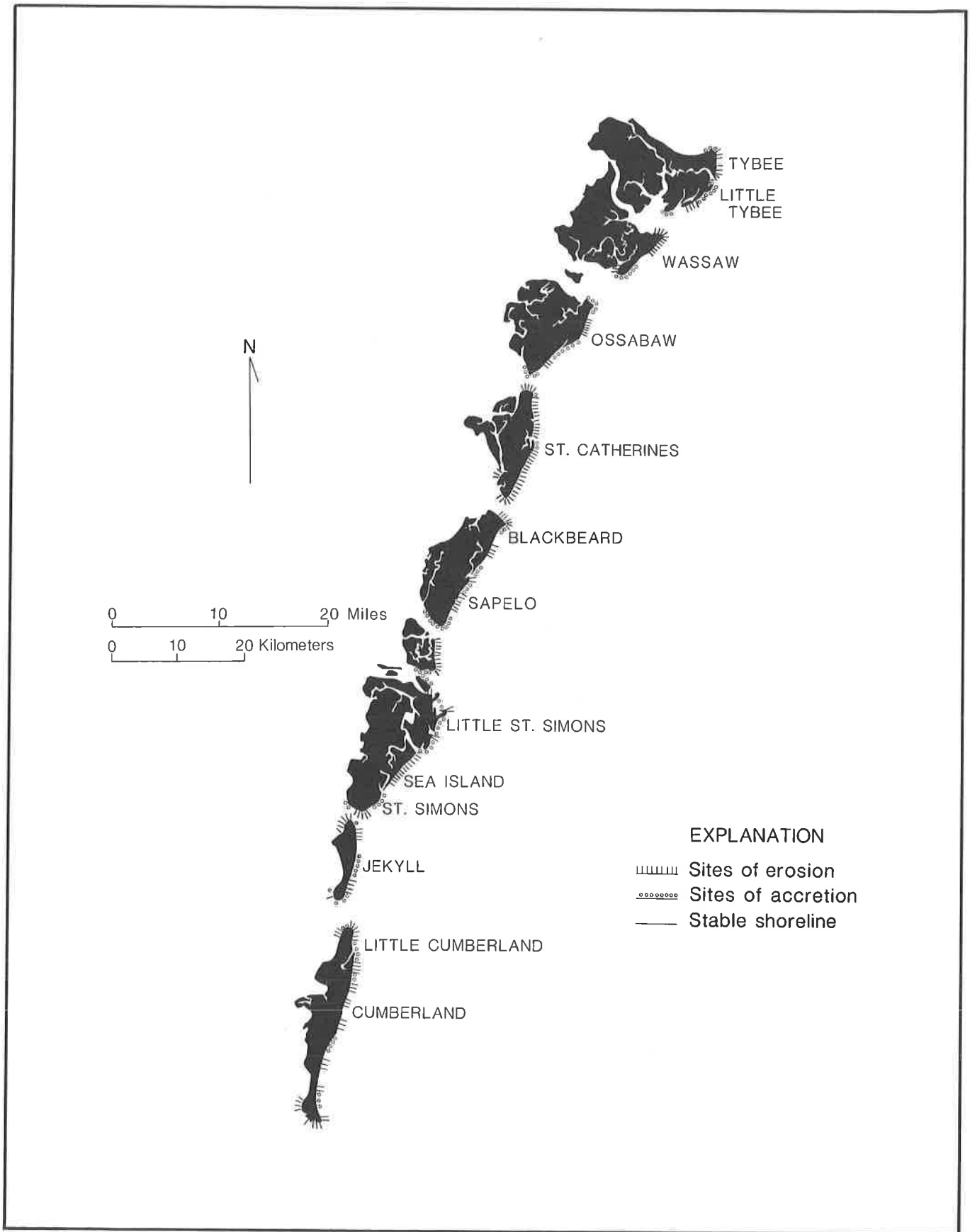


Figure 46. Summary Map of Erosion/Accretion Trends of the Georgia Coast, 1954/57-1974/80/82.

The partial 1980/82 coverage of the Georgia coast indicates an overall continuation of erosion/accretion patterns established prior to 1974. Departures from these patterns on Tybee/ Little Tybee Islands, such as accretion on northwest Tybee and the north segment of Little Tybee, could be after-effects of the Savannah Beach renourishment project. New sites of shoreline recession appeared on Cumberland Island north and south of the jetty and along the St. Marys Entrance.

The Tybee/Little Tybee Islands system has been so altered by development, shoreline structures, damming on the Savannah River and dredging in the Savannah Harbor that it is no longer possible to consider or assess the island complex as a natural system. The two islands advanced significantly between 1866 and 1913, a fact testifying to the former sediment supply of the Savannah River. Since 1913, however, net retreat of the island system has progressed, in spite of the limited success achieved by the Savannah Beach renourishment project to reclaim the Tybee Island beachfront. Further beach erosion is to be expected under present conditions.

Wassaw Island illustrates a shoreline history of erosion on the north half of the beach, initiated in 1866 on the northeast strand and in 1925 on the north-central strand, and accretion, ongoing since 1866, on the southern half of the island. The stable mid-island nodal point is probably associated with the well developed central shoal area shown on Figure 2. The island has maintained a strong counterclockwise rotation pattern, while migrating southward through a combination of updrift erosion and downdrift accretion. Between 1858 and 1974, the island elongated 0.33 mi (0.5 km). In spite of great local change along the strand, Wassaw Island maintained a dynamic stability through 1982.

From 1858 through 1974, Ossabaw Island has evidenced an unbroken history of accretion on the central, north and south areas of the beach, in increasing order of magnitude; the island lengthened 0.35 mi (0.6 km) in the 116 year study period. These accreting areas are believed to be associated with the island's three offshore shoaling areas (see Fig. 2). From 1858 to 1974, the north-central and south-central sectors of the strand eroded. The island advanced from 1858 to 1925 and maintained a dynamic stability through 1974; field surveys, however, indicate a retreat of the central sector. Seasonable contributions of sediment from the Ogeechee River, suggested by significant deposition on the north end should prolong the island's dynamic stability.

St. Catherines Island, with the exception of its central shoaling area, has eroded from 1858 to 1982. Atypical south end erosion has greatly exceeded losses on the north end. The island has shortened by about 1.3 mi (2.1 km), or 13% of its maximum length, during the 124 year study period and is rapidly retreating at the present time. This erosion may be due to the fact that St. Catherines Island lies at the greatest distance from a major river of all the Georgia islands. Continued erosion may be anticipated along almost all of the St. Catherines shoreline.

In the interval from 1857/68 to 1974, the Blackbeard/Sapelo Islands system has evidenced a complex shoreline history of (1) southward migration through erosion at Sapelo Sound and accretion at Doboy Sound, both moderate; (2) wide ranging shifts about three nodal points; and (3) major changes in the vicinity of Cabretta Inlet. In addition, the island complex elongated approximately 0.25 mi (0.4 km) during the study period. The island accreted between 1857/68 and 1925 and has since main-

tained a dynamic stability. Minor erosion on the Sapelo Sound shoreline, coupled with a seaward shift of north Blackbeard, has kept pace with modest deposition on the Doboy Sound shoreline; the net result has been a barely perceptible southward migration of the island system. The history of Cabretta Inlet illustrates the relationship between a southward building spit and the adjacent down-drift beach. Although breaching of the Blackbeard Spit appears imminent, the proximity of the Blackbeard/Sapelo Islands system to the mouth of the Altamaha River is expected to prolong the present-day dynamic stability.

The barrier island complex formed by Little St. Simons/Sea Island/St. Simons Islands has the largest areal extent of Georgia's barrier islands and is situated downdrift of the Altamaha River, a major Piedmont river which exists in a relatively unaltered state. The complex advanced until 1924 and has since undergone local erosion on Sea Island and St. Simons; nevertheless, the system has elongated about 0.46 mi (0.7 km) since 1860. Because Little St. Simons is the site of greatest accretion on the Georgia coast for the study period, gains here offset post 1924 losses along central Sea Island and southeast St. Simons. Other sites of deposition include the Sea Island spit and the north and southwest shores of St. Simons. Reversals in erosion adjacent to seawalls and dredged channels are not anticipated, and Little St. Simons will likely continue its seaward progradation.

The shoreline of Jekyll Island has undergone the least net change on the coast of Georgia for the study period. This may be attributed to the fact that the island lies deepest in the Georgia Bight and is fronted by an extensive sand sheet (Fig. 2) extending seaward nearly 4 mi (6.4 km). Unlike most of Georgia barrier

islands, Jekyll did not advance between 1857 and 1924, but maintained a dynamic stability; during this interval, the island's pattern of erosion to the northwest and along the north and north-central beach was established, as well as the trend of accretion to the southeast. Although the island has clearly migrated southward, its maximum length has not changed. Except for the southern end, the seaward facing beach has been relatively stable over time; shifts around nodes are far more subtle than those seen on other Georgia islands. After 1955, rapid development on the island, which included the destruction of much of the primary dune system, preceded the accelerating erosion rates recorded on Jekyll from 1957-1974. Nevertheless, the island achieved equilibrium during the 1974-1980 interval. Jekyll Island's present-day erosion/accretion patterns appear to represent a long-term trend, i.e., erosion to the northwest, accretion to the southeast, and reversals in recession and accretion along the strand.

The history of the Little Cumberland/Cumberland Islands system has been characterized by net accretion, due in large part to accumulation of sediment around the dike/jetty structure on the south end of Cumberland. During the study period, the island complex has elongated 0.26 mi (0.4 km), although southward migration has not taken place. Considered alone, Little Cumberland has a history of dynamic stability marked by frequent reversals of erosion and accretion along the beach. At Christmas Creek inlet, the Long Point spit has built northward throughout the study period. North of the stable, mid-island beach adjacent to the large shoaling area (Fig. 2), the Cumberland Island beach has alternately advanced and retreated (not exceeding 20 ft/y (6 m/y) during the study period. Through 1974, the remainder of the beach has been mark-

ed by deposition, with the greatest accretion at the central and southern areas of the beach. Recent 1982 evidence, however, indicates sites of shoreline recession on the south end of the island and along the St. Marys Entrance shoreline. It is not possible to make meaningful predictions of future patterns of deposition and erosion on Little Cumberland/Cumberland Islands, since effects of the dredging associated with the operation of the nearby King's Bay submarine base are unknown.

Major conclusions are as follows:

- (1) There has been no discernible net MHW shoreline erosion on the coast of Georgia for the entire study period of 1857-1974/80/82. This is due in large part to the major accretional period of 1857 - 1925, which resulted in the progradation of six of the eight major barrier islands of the Georgia coast. However, significant erosion-related problems are present where shoreline stabilization projects have been placed to protect developed segments of the shoreline. Such structures fix the shoreline position but generally degrade the recreational quality of the beach and minimize the availability of sand to downdrift areas.
- (2) Results of the 1924 to 1974 shoreline change study (Fig. 45) indicate that the Georgia barrier island system, as a whole, maintained a dynamic stability for this 50 year interval. Considerable deposition on Little St. Simons and on the south end of Cumberland Island balanced erosion on Tybee/Little Tybee and St. Catherines Islands, while each of the other islands maintained a dynamic equilibrium.
- (3) The most recent study period of 1954/57 to 1974/80/82 (Fig. 46) indicates accelerating erosion rates. While much of the Georgia coastline remained essentially unchanged during this relatively brief study interval, note in Figure 46 that the linear extent of the accreting shoreline decreased relative to the 1924 to 1974 interval. This recent trend, coupled with a rising sea level, suggests that accelerated erosion could occur on the coast of Georgia.
- (4) Island elongation has taken place on the majority of barrier islands during the study period. Of the state's eight major barrier islands, five have elongated between 0.3 - 0.5 mi (0.5 - 0.8 km) during the study period. Two islands, both of which are possibly affected by the dredging of adjacent inlets, have deviated little from their mid-1800's maximum lengths. One island, however, has lost 13% of its mid-1800's maximum length.
- (5) Both barrier islands and inlets of the Georgia coast are characterized by their relatively stable positions along the shoreline. Only three of the eight major barrier islands have migrated southward through processes of erosion to the north and deposition to the south during the study period. Two of the nine inlets considered in the study have migrated southward from 0.1 - 0.2 mi (0.2 - 0.3 km).
- (6) Inlet constriction, in the range of 0.2 - 0.6 mi (0.3 - 1.0 km), has occurred in five of the nine inlets considered in the study. Two inlets have retained their approximate mid-1800's width, and two have enlarged from 0.06 - 0.6 mi (0.1 - 1.0 km). Because one enlarged inlet is dredged and one constricted inlet is jettied, the apparent general trend of inlet constriction for the study period is ambiguous.

- (7) Fairly persistent nodal points have been identified on all major barrier islands. The shifts about these generally stable areas are wide-ranging on islands south of major rivers. On islands at distance from major rivers, fluctuations in advances and retreats of the MHW shoreline are far more subtle. No correlation exists between the extent to which an island shoreline has fluctuated over time and its overall stability. Therefore, the criteria for development should not be based on net shoreline change, but upon the maximal extent to which a shoreline has fluctuated.

ACKNOWLEDGEMENTS

The authors wish to express thanks to Frank Drago, Georgia State University Department of Geography, for invaluable instruction and assistance in the use of the Map-O-Graph and Saltzman projector, as well as advice and aid in photographic methods of reduction and reproduction. James L. Sadd, Georgia State University Department of Geology, offered assistance in the printing of EROS negatives.

REFERENCES CITED

- Bigham, G. N., 1973. Zone of influence - inner continental shelf of Georgia: *Jour. of Sed. Petrology*, 43:207-214.
- Bruun, P. M., 1962. Sea level rise as a cause of shore erosion: *Jour. Waterways and Harbors, Div. Am. Soc. Proc.* 88:117-130.
- Carter, H. S., 1970. Georgia tropical cyclones and their effect on the state: U. S. Dept. of Commerce, E. S. S. A. Tech. Mem. EDSTM 14, 33 p.
- Dean, R. G., 1973. Heuristic models of sand transport in the surf zone: in *proc. of Conf. on Eng. Dynamics in the Surf Zone, Sydney, Australia*, p. 208-214.
- Edwards, J. M., and Frey, R. W., 1977. Substrate characteristics within a Holocene salt marsh, Sapelo Island, Georgia: *Senckenbergiana Martima*, 9:215-259.
- Emery, K. O., 1967. Some stages in the development of knowledge of the Atlantic coast of the United States: *Progress in Oceanography*, 4:307-322.
- Foley, M. M., and Griffin, M.M. (in prep.) *Geologic atlas of coastal Georgia: Georgia Geologic Survey, Atlanta, Ga.*
- Furlow, J. W., 1969. Stratigraphy and economic geology of the eastern Chatham County phosphate deposits. Georgia Dept. of Mines, Mining and Geology: *Bull.* 82, 40 p.
- Georgia Dept. of Audits, 1982. *Jekyll Island Authority Audit, FY 1981*, 46 p.
- Georgia Dept. of Natural Resources, 1982. *Ossabaw Island, Chatham Co., Ga. (Plate)*
- Giles, R. T., and Pilkey, O.H., 1965. Atlantic beach and dune sediments of the southern United States: *Jour. of Sed. Petrology*, 4(4):900-910.
- Griffin, M. M., 1981. Feldspar distributions in river, delta, and barrier sands of central South Carolina: Univ. of South Carolina, unpub. M.S. Thesis.
- Hails, J. R., and Hoyt, J. H., 1969. An appraisal of the evolution of the lower coastal plain of Georgia: *U. S. A. Trans. Inst. British Geog.*, 44:133-139.
- Henry, V. J., and Hoyt, J. H., 1968. Quaternary paralic and shelf sediments of Georgia. *Southeastern Geology, Vol 9*, 4:195-214.
- _____, Giles, R. T., and Woolsey, J. R., 1973. *Geology of the Chatham County area, Georgia: Contribution No. 270, Univ. Georgia Marine Institute, Sapelo Island, Ga., p. 67-80.*
- Hicks, S. D., 1973. Trends and variability of yearly mean sea level, 1893-1971: *NOAA Tech. Memo, NOS 12*, 14 p.
- Hoyt, J. H., and Henry, V. J., 1965. Significance of inlet sedimentation in the recognition of ancient barrier islands, in *Sedimentation of Late Cretaceous and Tertiary Outcrops, Rock Springs Uplift*, p. 190-194.

- _____, Henry, V. J., and Howard, J. D., 1966. Guidebook for Field Trip No. 1, Geological Society of America, Southeast Section: Pleistocene and Holocene sediments, Sapelo Island, Georgia and vicinity, 81 p.
- _____, and Hails, J. R., 1967. Pleistocene shoreline sediments in coastal Georgia: deposition and modification. *Science*, 155:1541-1543.
- _____, and Henry, V. J., Jr., 1967. Influence of island migration on barrier island sedimentation: *G.S.A. Bull.*, 78:77-86.
- _____, and Henry, V. J., Jr., 1971. Origins of capes and shoals along the southeastern coast of the United States. *G.S.A. Bull.*, 82:59-66.
- Hubbard, D. K., Oertel, George, and Nummedal, Dag, 1979. The role of waves and tidal currents in the development of tidal-inlet sedimentary structures and sand body geometry: Examples from N. Carolina, S. Carolina, and Georgia. *Jour. of Sed. Petrology*, 49(4):1073-1092.
- Hunt, J. L., 1974. The geology and origin of Gray's Reef, Georgia continental shelf: Univ. of Georgia, unpub. M.S. Thesis.
- Kana, T. W., 1983. Soft engineering alternatives for shoreline protection, in ASCE Conference Proceedings of Coastal Zone '83.
- Kaye, C. A., 1961. Shore-erosion study of the coasts of Georgia and northwest Florida. U.S. Geol. Survey, Washington, D.C., 73 p.
- Kingery, F. A., 1973. Textural analysis of shelf sands off the Georgia coast: California State Univ., unpub. M.S. Thesis.
- Kinsey, Barbara, 1982. Sapelo Island Handbook. Univ. Georgia Marine Institute, Sapelo Island, Ga., 47 p.
- McLemore, W. H., Swann, C. T., Wigley, P. B., Turlington, M. C., Henry, V. J., Nash, G. J., Martinez, J., Carver, R. E., and Thurmond, J. T., 1981. Geology as applied to land-use management on Cumberland Island, Georgia: Georgia Geologic Survey, 174 p.
- Meade, R. H., 1969. Landward transport of bottom sediments in estuaries of the Atlantic Coastal Plain: *Jour. of Sed. Petrology*, 39:222-234.
- _____, 1976. Sediment Problems in the Savannah River Basin: In proceed. of symposium at Hickory Knob State Park, McCormick, S.C., Oct. 14-15, 1975, Clemson Univ. S.C., p. 105-129.
- Nash, G. J., 1977. Historical changes in the mean high water shoreline and nearshore bathymetry of South Georgia and North Florida: Univ. of Georgia, unpub. M.S. Thesis.

- National Climatic Center, 1977-81. Climatological data annual summaries: Georgia, Asheville, N.C.
- Oertel, G. F., and Howard, J. D., 1972. Water circulation and sedimentation at estuary entrances on the Georgia coast, in D. J. P. Swift, D. B. Duane, and O. H. Pilkey (eds.) Shelf Sediment Transport. Dowden, Hutchinson, and Ross, Inc., Stroudsburg, Pa. p.411-427.
- _____, 1973. Observations of net shoreline positions and approximations of barrier island sediment budgets: Tech. Rep. 73-2, Georgia Marine Science Center, Skidaway Island, Ga., 23 p.
- _____, 1974. A review of the sedimentologic role of dunes in shoreline stability, Georgia coast. Bull. of the Georgia Academy of Science, v. 32, 3 & 4, p.48-56.
- _____, 1975. Post Pleistocene island and inlet adjustment along the Georgia coast, Jour. of Sed. Petrology, 45:150-159.
- _____, 1977a. Report on the historical sediment budgets of the Savannah and Altamaha Rivers: for the Georgia Office of Planning and Budget and the Coastal Zone Management Program, Skidaway Institute of Oceanography, Savannah, Ga., Vol. 1, 30 p.
- _____, 1977b. Report on the monitoring program of the Tybee Island nourishment project: for the Georgia Office of Planning and Budget and the Coastal Zone Management Program, Skidaway Institute of Oceanography, Savannah, Ga., Vol. 2, 52 p.
- Pilkey, O. H., and Field, M. E., 1972. Onshore transportation of continental shelf sediments: Atlantic Southeastern United States: in D. J. P. Swift, D. B. Duane and O. H. Pilkey (eds) Shelf Sediment Transport, Dowden, Hutchinson and Ross, Inc., Stroudsburg, Pa., p. 429-446.
- _____, et al., 1982. Saving the American beach: a position paper by concerned coastal geologists, Shore and Beach, April 1982, p.3-8.
- Schwartz, R. K., and Musialowski, F. R., 1977. Nearshore disposal: onshore sediment transport, Coastal Sediments '77, p. 85-101.
- Shepard, F. P., 1963. Submarine Geology: Harper and Row, New York, 557 p.
- Trimble, S. W., 1969. Culturally accelerated sedimentation of the middle Georgia Piedmont: Univ. of Georgia, Unpub. M.S. Thesis.
- _____, 1973. A geographic analysis of erosive land use on the Southern Piedmont, 1700 - 1970: Univ. of Georgia, Unpub. Ph.D. Dissertation.
- Tanner, W. F., 1960. Florida coastal classification: Gulf Coast Assoc. Geol. Socs. Trans. 10:259-266.
- U. S. Army Corps of Engineers, 1872-1977. Annual report of the Chief of Engineers on civil works activities: Washington, D.C. (Series).
- _____, 1875. Information in relation to the practicality of improving the channel of entrance to Cumberland Sound: Senate Ex. Doc. No. 152, 46th Congress, 2nd session.

- _____, 1879. Survey of entrance to Cumberland Sound, Florida and Georgia: Senate Ex. Doc. No. 152, 46th Congress, 2nd session.
- _____, 1966. Shore protection planning and design: CERC Tech. Rept. No. 4, Washington, D.C.
- _____, 1970. Sea Island and St. Simons Island, Georgia; beach erosion control and hurricane protection: Serial No. 61, Savannah, Ga., 55 p.
- _____, 1970. Tybee Island, Georgia; beach erosion control and hurricane protection: Serial No 63, Savannah, Ga., 78 p.
- _____, 1971. National shoreline study: regional inventory report, South Atlantic Div., 367 p.
- U. S. Dept. of the Interior, 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia: Vol. 1, 212 p.
- _____, 1983. Cumberland Island National Seashore land protection plan summary. Unpublished data.
- U. S. Geological Survey, 1982. Water resources data, Georgia: Wateryear 1981., 446 p.
- U.S. Naval Weather Service Command, 1970. Summary of synoptic meteorological observations: North America coastal marine areas, Vol. 4, Area 11-Jacksonville.
- Wadsworth, J. R., Jr., 1981. Structural control of drainage morphology of salt marshes on St. Catherines Island, Georgia: Tech. Rept. No. 82-1, Georgia Marine Science Center, Univ. System of Georgia, Skidaway Island, Ga., 43 p.
- Warner, L. and Strouss, D., 1976. Inventory of the status of the barrier islands of the Southeast: Open Space Inst., New York, 300 p.
- Windom, H. L., Neal, W. J., and Beck, K. C., 1971. Mineralogy of sediments in three Georgia estuaries: Jour. of Sed. Petrology, 41(2): 497-504.

APPENDIX

MAPS, CHARTS AND PHOTOGRAPHS USED IN THE STUDY

I. Hydrographic Survey Maps and Charts from the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey

Chart #	Description	Scale	Date
H - 810	Little St. Simons, Sea, St. Simons Islands	1:20,000	1860
H - 904a	Little Tybee, Wassaw Islands	1:20,000	1866
H - 944	Tybee Island	1:20,000	1866
H - 2573	St. Catherines, Blackbeard Islands	1:20,000	1902
H - 2687	Ossabaw, St. Catherines Islands	1:20,000	1904
H - 4481	Tybee, Little Tybee Islands	1:20,000	1925

II. Topographic Survey Maps from the U. S. Department of Commerce National Oceanic and Atmospheric Administration, National Ocean Survey

Survey #	Description	Scale	Date
T - 613	Cumberland, Amelia Islands	1:10,000	1857
T - 678	Blackbeard, Sapelo, Wolf Islands	1:10,000	1857
T - 706	Wassaw, Ossabaw, St. Catherines Islands	1:10,000	1858
T - 721	St. Catherines, Blackbeard Islands	1:20,000	1858
T - 750	St. Simons, Jekyll Islands	1:20,000	1857
T - 841	Ossabaw Island	1:20,000	1860
T - 1060	St. Catherines, Ossabaw Islands	1:20,000	1867
T - 1080	Blackbeard, Sapelo Islands	1:20,000	1868
T - 1108	Little St. Simons, Sea, St. Simons Islands	1:20,000	1869
T - 1114	Little St. Simons	1:20,000	1869
T - 1145	Jekyll, Cumberland Islands	1:20,000	1870
T - 1152	Cumberland, Amelia Islands	1:20,000	1870
T - 2372	St. Simons, Jekyll Islands	1:10,000	1899
T - 3412	Tybee, Little Tybee, Wassaw Islands	1:20,000	1913
T - 4095	Cumberland Island	1:20,000	1924
T - 4106	Jekyll, Cumberland Islands	1:20,000	1924
T - 4118	Little St. Simons, Sea, St. Simons Islands	1:20,000	1924
T - 4121	St. Catherines, Blackbeard, Sapelo Islands	1:20,000	1925
T - 4122	Sapelo, Wolf, Little St. Simons Islands	1:20,000	1924
T - 4123	Ossabaw, St. Catherines Islands	1:20,000	1925
T - 4131	Wassaw, Ossabaw Islands	1:20,000	1925
T - 4132	Ossabaw, St. Catherines Islands	1:20,000	1925
T - 4481	Wassaw Island	1:20,000	1925

III. Topographic Quadrangle Maps

Name	Scale	Date
Department of the Interior, U. S. Geological Survey		
Tybee Island North, Ga. - S. C.	1:24,000	1955
Tybee Island South, Ga.	1:24,000	1957
Wassaw Sound, Ga.	1:24,000	1957
Raccoon Key, Ga.	1:24,000	1957
St. Catherines Sound, Ga.	1:24,000	1954
Sapelo Sound, Ga.	1:24,000	1954
Cabretta Inlet, Ga.	1:24,000	1954
Doboy Sound, Ga.	1:24,000	1954
Altamaha Sound, Ga.	1:24,000	1954
Brunswick East, Ga.	1:24,000	1956
Sea Island, Ga.	1:24,000	1955
Jekyll Island, Ga.	1:24,000	1957
Cumberland Island North, Ga.	1:24,000	1958
Cumberland Island South, Ga.	1:24,000	1958
Fernandina Beach, Fla. - Ga.	1:24,000	1958

IV. Orthophotographic Quadrangles from the Department of the Interior, U. S. Geological Survey

Name	Scale	Date
Fort Pulaski, Ga.	1:24,000	1979
Tybee Island North, Ga. - S.C.	1:24,000	1979
Tybee Island South, Ga.	1:24,000	1979
Wassaw Sound, Ga.	1:24,000	1979
Raccoon Key, Ga.	1:24,000	1979
St. Catherines Sound, Ga.	1:24,000	1979
Shellman Bluff, Ga.	1:24,000	1979
Sapelo Sound, Ga.	1:24,000	1979
Oak Level, Ga.	1:24,000	1979
Doboy Sound, Ga.	1:24,000	1979
Cabretta Inlet, Ga.	1:24,000	1979
Altamaha Sound, Ga.	1:24,000	1979
Brunswick East, Ga.	1:24,000	1979
Sea Island, Ga.	1:24,000	1979
Jekyll Island, Ga.	1:24,000	1979
Cumberland Island North, Ga.	1:24,000	1979
Cumberland Island South, Ga.	1:24,000	1979
Fernandina Beach, Fla. - Ga.	1:24,000	1979

For convenience in selecting our reports from your bookshelves, they are color-keyed across the spine by subject as follows:

Red	Valley and Ridge mapping and structural geology
Dk. Purple	Piedmont and Blue Ridge mapping and structural geology.
Maroon	Coastal Plain mapping and stratigraphy.
Lt. Green	Paleontology
Lt. Blue	Coastal Zone studies
Dk. Green	Geochemical and geophysical studies.
Olive	Economic geology
Dk. Blue	Mining directory
	Hydrology
Yellow	Environmental studies
	Engineering studies
Dk. Orange	Bibliographies and lists of publications
Brown	Petroleum and natural gas
Black	Field trip guidebooks
Dk. Brown	Collections of papers

Colors have been selected at random and will be augmented as new subjects are published.

Publications Editor: Eleanore Morrow

Front Cover: Map of St. Simons Island, 1869.

The Department of Natural Resources is an Equal Opportunity employer and employs without regard to race, color, sex, religion, and national origin.