Shinnecock Flood Tidal Delta and Coastal Stabilization Problems West of Shinnecock Inlet

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INTRODUCTION

The shoreline along the south side of eastern Long Island changes regularly in character along an east-west traverse. From Montauk Point to Napeague Harbor it is characterized by cliffs up to 60 feet high overlooking narrow cobble beaches. A relatively short segment of the shore between Napeague Harbor and the village of East Hampton consists of a series of low dune ridges trending roughly parallel to the present water line. From East Hampton to Southampton Village is a sandy beach bordered landward by a single narrow dune ridge that rests on the truncated margin of a gently sloping outwash plain. Westward from Southampton the beach and dune ridge are separated from the rest of Long Island by a series of shallow bays. At one time this barrier island system was continuous to Fire Island Inlet, but is now interrupted by Shinnecock and Moriches Inlets.

Much of the shore zone from East Hampton westward is densely populated. The construction of numerous dwellings close to the water has caused much attention to be focused on the continual recession of the beaches in this area. This concern has resulted in periodic rather piecemeal beach nourishment programs as well as construction of groin fields to trap sand from the prevailing westerly littoral drift. Shoreline recession results from both natural processes and from works of man. An understanding of the causes should be helpful in determining where beach stabilization programs are needed, and to some degree, guide the selection of the kind of remedial action necessary.

On this trip stops will be visited along the segment of barrier island from Southampton to Moriches Inlet. The stops are designed to emphasize the nature of the problems facing this portion of the barrier island and the actions taken to solve these problems.

STOP #1 is located at the intersection of Halsey Neck Lane and Meadow Lane in the Village of Southampton. This stop is most easily reached via Route 27A which intersects Halsey Neck Lane at the western margin of the Village of Southampton.

This portion of the shoreline has experienced rapid recession over the last four years, and is an interesting locality to examine the buried record of storm events.

The second house to the east is owned by Nelson Levings and was located immediately behind the partially destroyed bulkheading that now extends out onto the beach. The house was moved during the winter of 1971 to avoid destruction. This occurred only two years after the construction of the protective bulkheading. Slightly further east is the beach pavilion of

Southampton Town, now perched at the edge of the dune line. To the west several large mansions are now dangerously close to the front of the dune line.

During the fall of 1972 a rather unique protective device was installed in front of the large pinkish buff home located nearest the dune line to the west. A trench was excavated in the dune and plasticized bags of woven nylon were pumped full of beach sand. The filled bags were placed in the trench and stacked up to provide a riprap for the dune face. The dune was then reconstructed over the riprap to protect them from vandalism. At the time of this writing they are not exposed but might be visible by the time this field trip is taken.

Excavation of the beach at this point usually exposes thick layers (2-6 inches) of heavy minerals (Plate 1A). These thick layers represent storm lag deposits and provide a handy reference of the beach profile under storm conditions. The location of the storm beach is of considerable importance when considering the depth to which bulkheading or riprap is to extend.

These layers are usually local, pinching out quickly along the stroke of the beach, but when present are useful indicators of storm conditions.

Thin heavy mineral layers (less than 2 inches) are common and frequently represent a wind lag deposit generated on the beach berm. In Plate 1B these berm layers have been truncated by a storm beach that has in its turn been buried by a wedge of light buff colored sand characteristic of rapid beach accretion.

Heavy mineral storm layers may be simple lenses rich in garnet and magnetite or they can exhibit the rather complicated scour and fill structure illustrated in Plate 2A and B. The latter are produced as a wave cut scarp which migrates up the beach face under storm conditions. Waves strike the scarp and scour out a shallow trough carrying off the lighter minerals and leaving behind a thin apron of heavy minerals. As the scarp and trough migrate up the beach the thin aprons of heavies coalesce to form the thick upper heavy mineral layer.

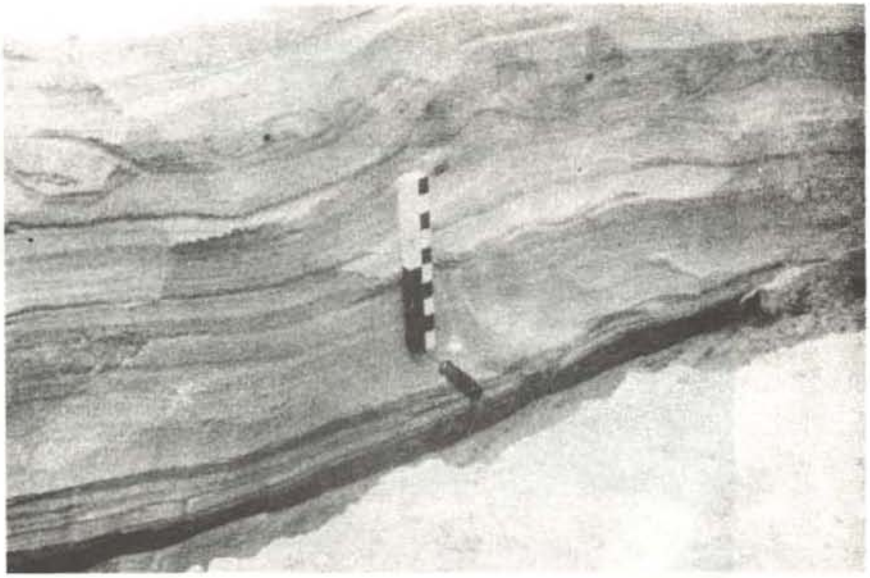
Layers of coarser sediment do not appear to be related to high energy conditions. Size seems to depend more on availability than energy on south shore beaches.

STOP #2 is the flood tidal delta at Shinnecock Inlet. The vehicles will proceed to the Marine Station at Southampton College where trip participants will board a boat for a trip to the tidal delta. The vehicles will then proceed to the west side of Shinnecock Inlet via Ponquogue bridge and wait for participants to return.

INTRODUCTORY STATEMENT

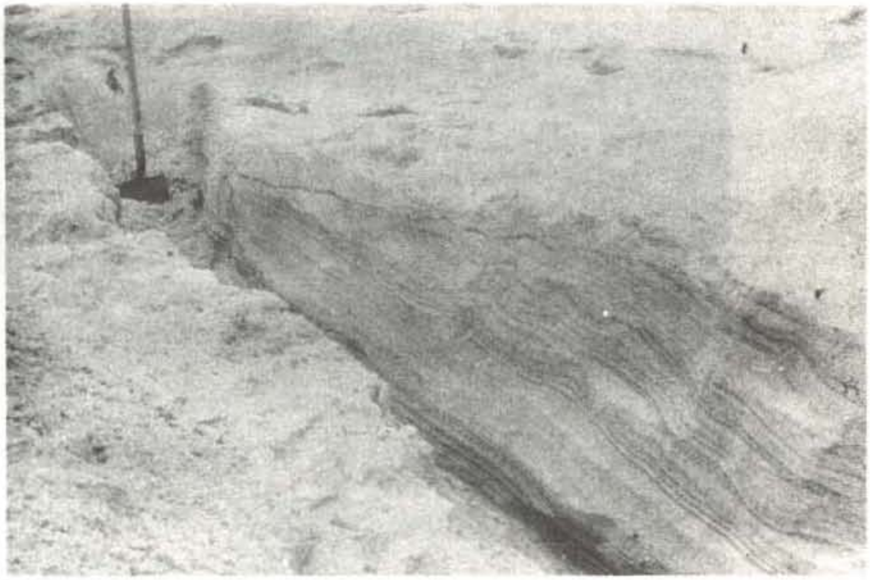
Prior to the first careful surveys of the Shinnecock area in 1838 an inlet existed about two miles east of the present location of Shinnecock Inlet. However, a map of the U. S. Coast and Geodetic Survey shows that it

PLATE 1A



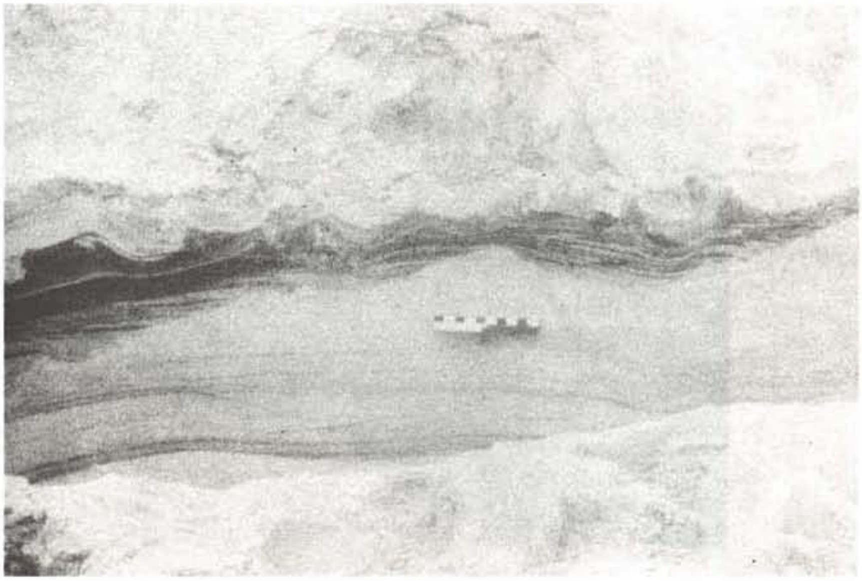
Storm lag layer of heavy minerals cutting across lighter color of sand in bottom of trench.

Plate 1B



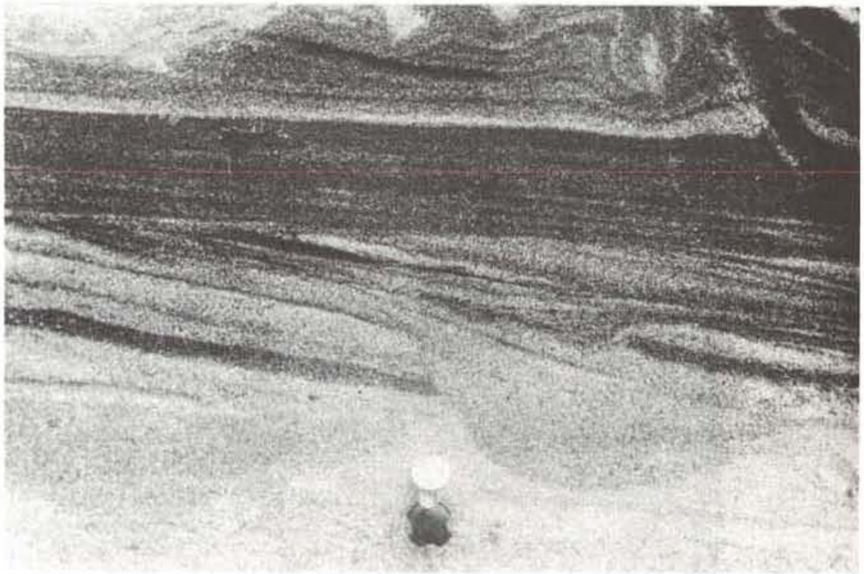
Berm wind lag layers cut by storm beach profile which is overlain by recent depositional packet of sand.

PLATE 2A



Scour and fill structure produced by retreat of scarp up the beach.

PLATE 2B



Close-up of scour and fill structure. Up beach is the right in photograph. Coin gives scale.

had closed by 1838. From Southampton west to Round Dune the barrier island was unbroken from 1838 until the hurricane of 1938.

During the storm of 1938 a washover channel developed and cut rapidly downward to produce a narrow channel that was ultimately deepened, widened and stabilized to form Shinnecock Inlet. Details of the change in the Inlet since 1939 are given in Figure 19 of Taney's publication "Geomorphology of the South Shore of Long Island." That figure is included here for the purpose of completeness. A small revetment was constructed on the west side of the Inlet in 1947, but it was not until 1952 that construction on the presently existing jetties was begun. Dredging of the channel before and after jetty construction has been carried on intermittently.

In 1938, when the Inlet was opened, some sand was carried inside the Inlet and deposited by the storm surge. Tidal currents sweeping in and out have added to that original sand mass and modified it to create the vast flood tidal delta that exists today. Similarly, sand being carried by the longshore currents was swept seaward to form a large asymmetric ebb tidal delta. The historical development of these deltas and the distribution of sediment on them is the subject of this stop.

DEVELOPMENT OF THE FLOOD TIDAL DELTA

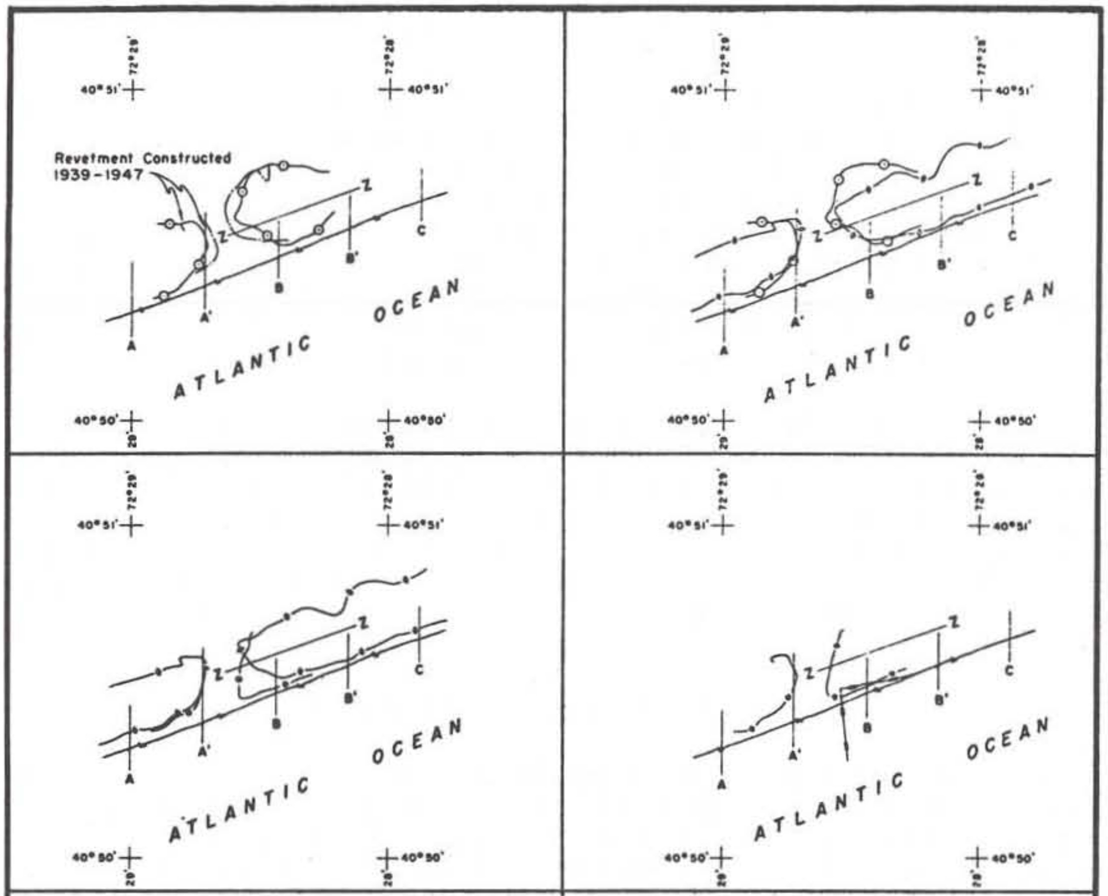
In 1950 Shinnecock Inlet was slightly less than half its present width (Plate 3A). The revetment constructed in 1947 is plainly visible in the aerial photo as well as a part of the flood tidal delta. A broad sand flat had encroached westward from the east side of the Inlet which would probably have closed the channel if it had been left unmodified. The sharp east margin of the channel suggests dredging took place at a relatively short time before the photo in Plate 3A was taken.

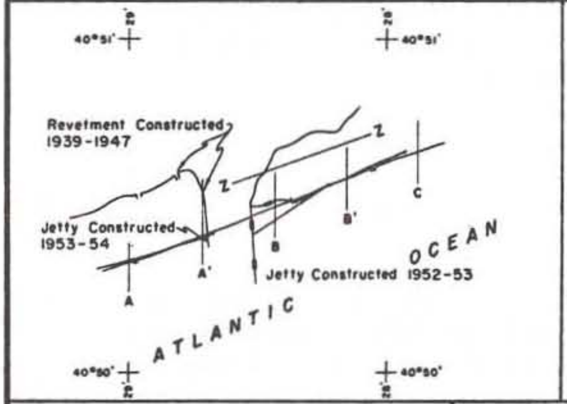
Part of the flood tidal delta may not be visible in Plate 3A due to the height of the tide. Nevertheless, a comparison of the 1950 photograph with one taken in 1955 (Plate 3B), after completion of jetty construction shows a number of interesting changes.

The tidal delta has approximately doubled its size during the five-year period between photographs. The broad shallow channel between Warner's Island and the delta shoaled to an intertidal sand flat and most other channels narrowed. The large area immediately north of the present jetties filled in closing the broad channel that existed in this area in 1950. The northern margin of the delta continued to build out into the bay.

It seems logical to conclude that increase in size of the Inlet and the broad channels that cut through the 1950 delta sharply increased the tidal flow into the bay. The increased tidal flow allowed for the transportation of a larger volume of sand through the Inlet. As water spread over the delta, current velocities were reduced and the sand came to rest. The upward growth of the delta and constriction of channels probably reduced the tidal flow and decreased the accretion rate so that changes in the delta following 1955 did not occur as rapidly.

To show the gross changes that have taken place on the tidal delta





AVERAGE HIGH WATER SHORE LINE CHANGE (IN FEET)

Interval	Range A	A'	B	B'	C	Mean
1933-1939		-300	-300			
1933-1949	-290			-50	-185	
1939-1940		-295	+40			
1940-1949		+40	-65			
1949-1951		+30	+255			
1949-1955	+250			+30		
1951-1952			-30			
1951-1955		+590				
1952-1955			+355			
* Net Change	-40	+65	+255	-20		

* From earliest to latest survey for each range
\+ Advancing shore line — Retreating shore line

LEGEND
HIGH WATER SHORE LINE

1955	———————	U.S.C.& G.S.
1952	——▬——▬——	"
1951	——•——•——	"
1949	——•——•——	"
1940	——⊙——⊙——	"
1939	——·——·——	"
1933	——w——w——	"

AVERAGE GROWTH PER YEAR OF SHINNECOCK INLET (LINE ZZ)

Interval	Growth in Feet	Average Growth Per Year in Feet
1955 - 1952	153	51
* 1952 - 1951	- 270	- 270
1951 - 1949	320	160
* 1949 - 1940	- 158	- 18
* 1940 - 1939	- 112	- 112
1955 - 1939	- 67	- 4

* Minus denotes retreat of point during interval.
Inlet opened September 1938

FIGURE 19. MIGRATION OF SHINNECOCK INLET, LONG ISLAND, NEW YORK AS SHOWN BY HIGH WATER SHORE LINE CHANGES 1938 - 1955

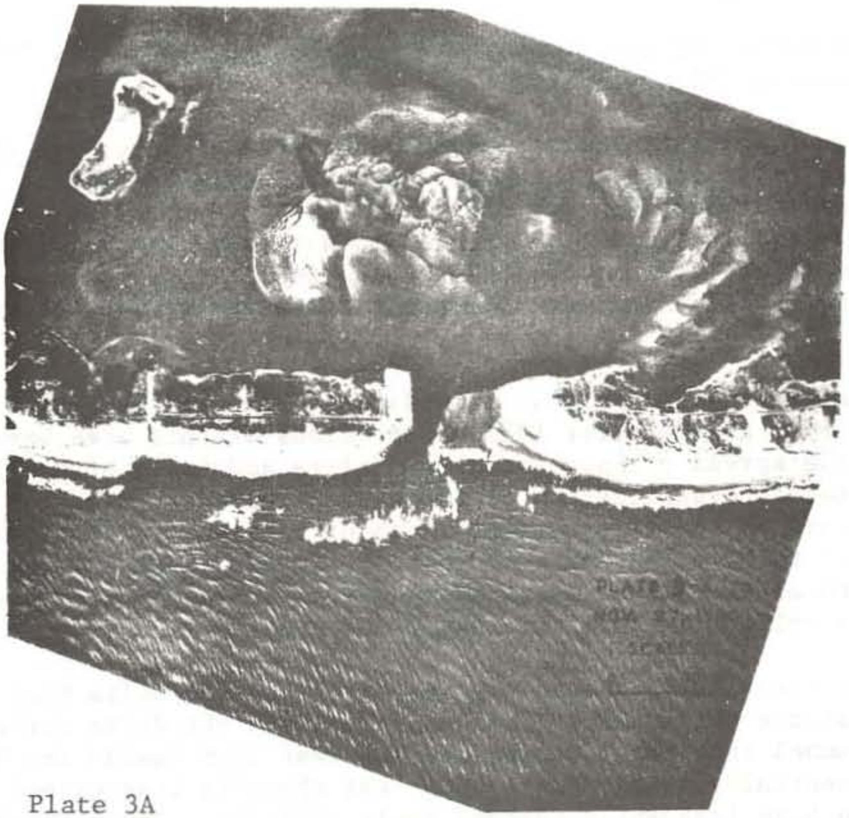


Plate 3A

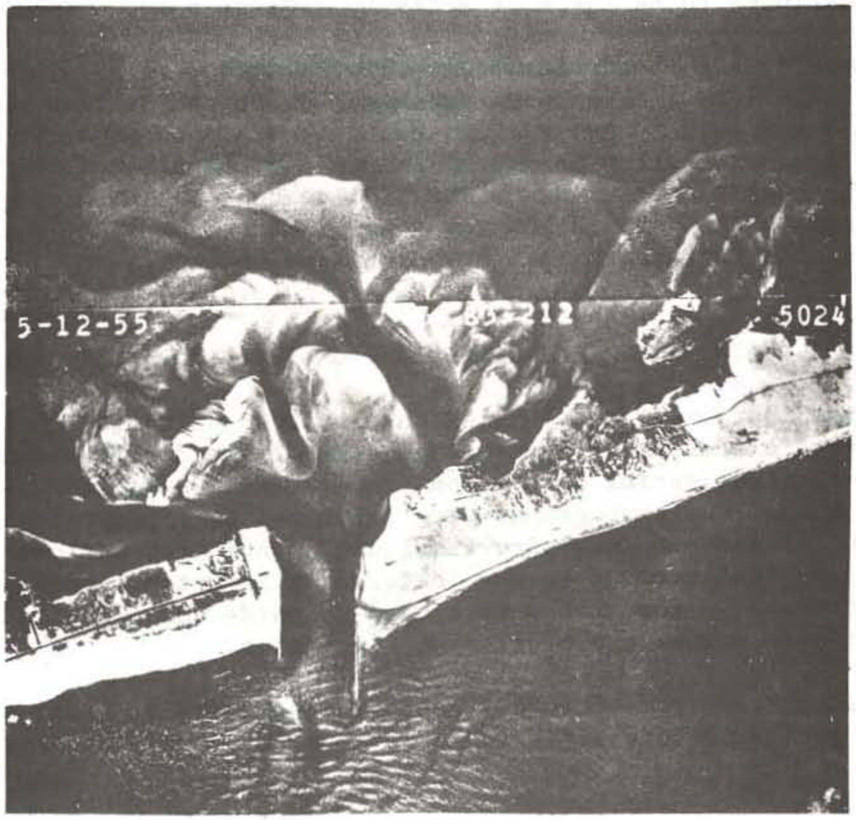


Plate 3B

since 1950 a series of aerial photographs taken in 1950, '55, '59, '61, and '69 were compared (Figure 1).

While the greatest changes occurred between 1950 and 1955 the northern margin of the delta migrated steadily into the bay after 1955. By measuring the area added between 1955 and 1969, and using a water depth of 10 feet at the delta margin, the volume of sand added was found to be 1.6 million cu. ft. /year. This figure does not include any vertical accretion over parts of the delta present in 1955, and must represent a minimum figure for total accretion.

The massive shoal area that extends eastward from Warner's Island did not undergo much change after 1955 and portions of this area have been stabilized by the spread of Spartina alterniflora and banks of Mytilus edulis. The first step in stabilization of these areas appears to be the growth of algal filaments in the first quarter inch of sediment. The algae act as a binding agent to hold the sediment until S. alterniflora can gain a foothold. Upward growth of stabilized areas continues as roots and rhizomes of salt marsh plants collect to form thin layers of peat.

Some of the tidal channels that pass through the delta have remained relatively stable while others have migrated over the delta surface (Figure 2). The channel that bends sharply to the west just inside the Inlet has remained essentially static since 1950, but channels that extend north to the delta margin have frequently changed their position. The area of most frequent change is within the zone that exhibited most of the accretion since 1955 and continues to be the most actively growing portion of the delta.

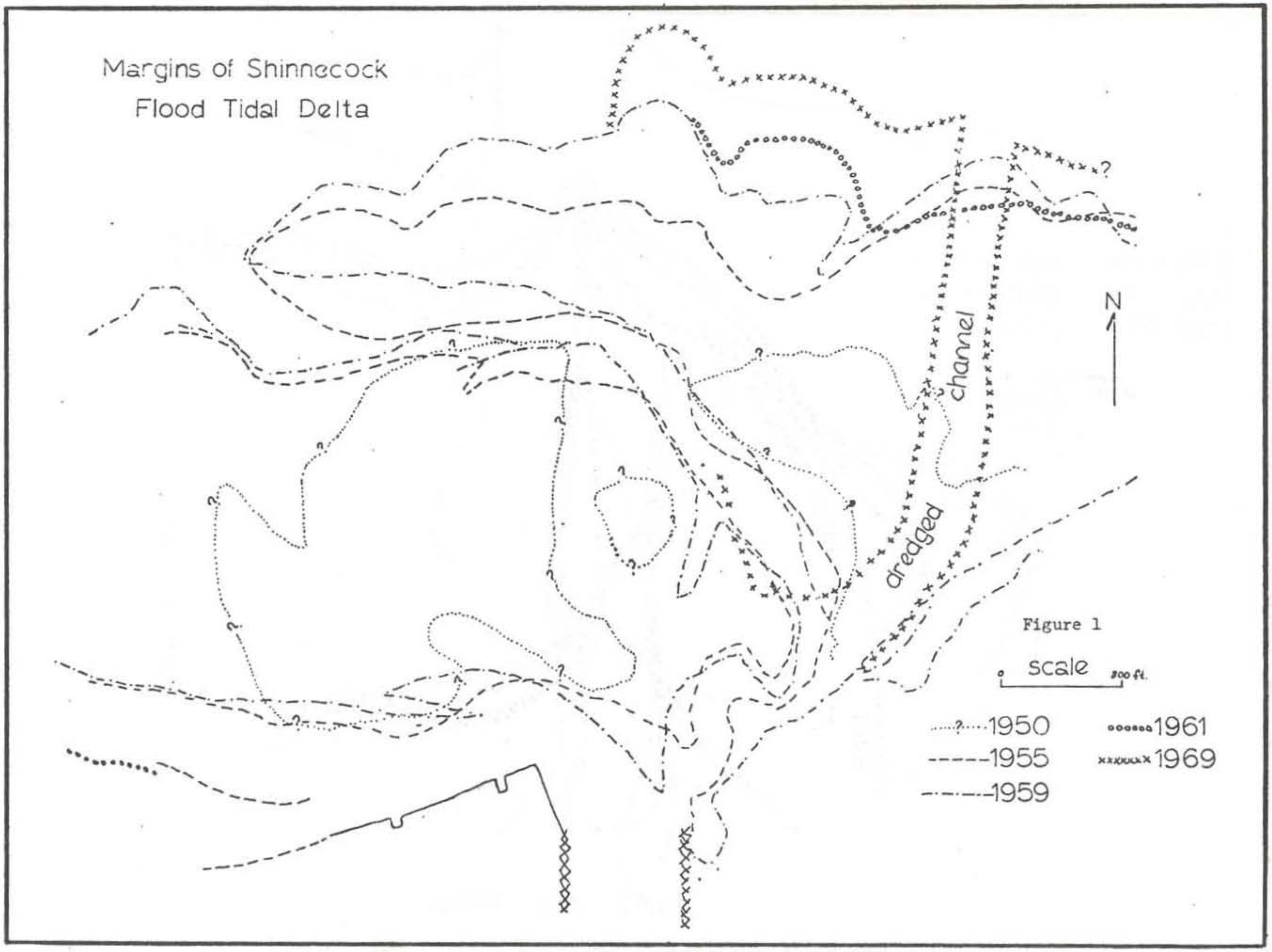
In summary, the flood tidal delta experienced slow growth from its beginning in 1938 until 1952 when construction of the jetties was begun. Between 1950 and 1955 it experienced rapid growth approximately doubling in size. The rapid accretion caused by increasing the size of the Inlet was slowed by gradual constriction of the tidal channels that cross the delta. The western portion of the delta was stabilized by spread of salt marsh grasses, but the northern margin has continued to grow.

DISTRIBUTION OF GRAIN SIZES ON THE FLOOD TIDAL DELTA

The distribution of grain sizes on the flood delta is complex. In an effort to give a reasonably accurate picture of the distribution of grain sizes, low altitude aerial photographs were used to guide sampling and final map preparation. The photographs were taken one week prior to sampling the sediment on the delta. A cursory examination indicated a close correlation between grain sizes present on the delta and slight tonal difference on the aerial photographs. The photos were used to guide the sampling and the location of each sample was plotted on the photos.

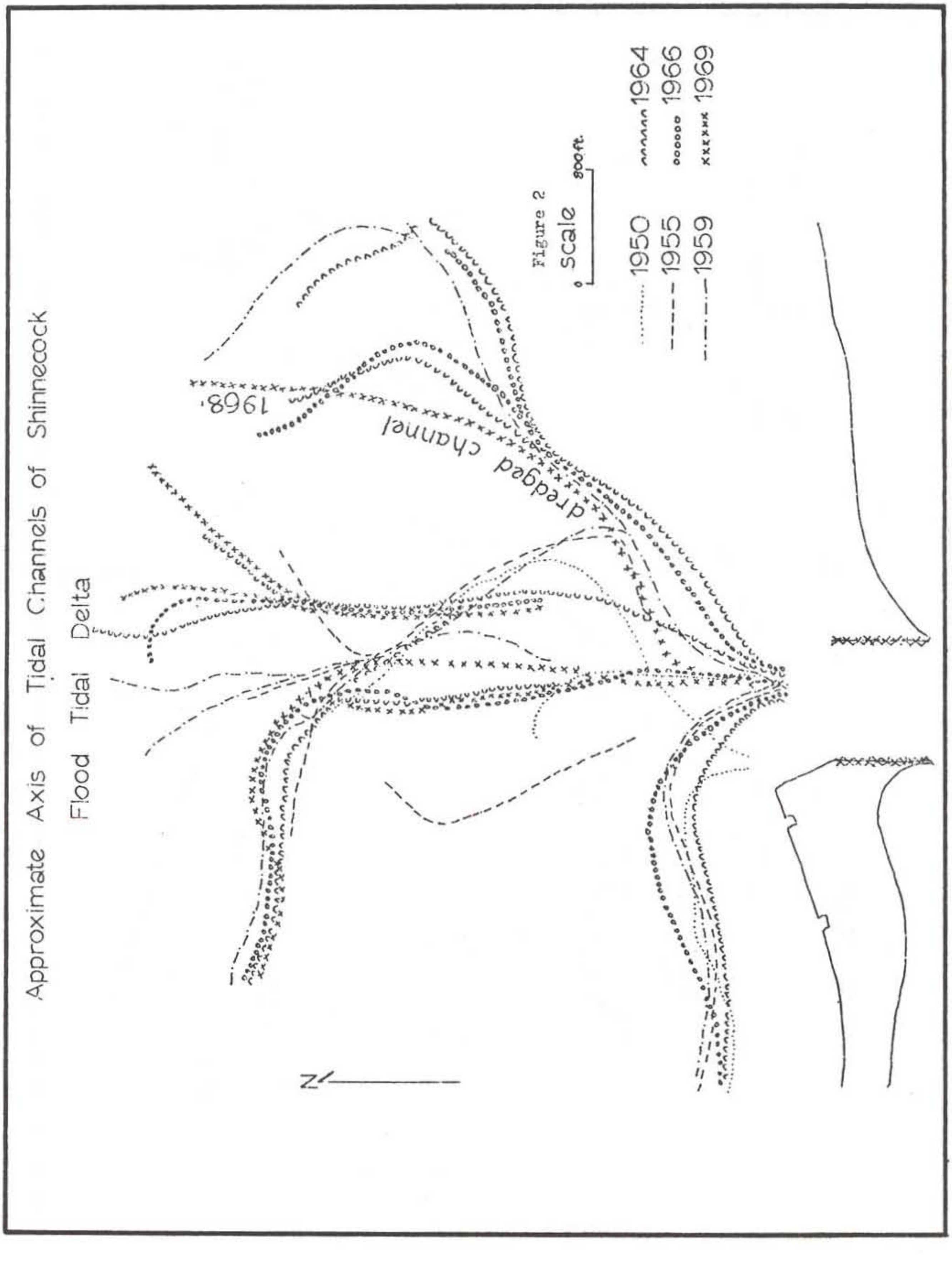
Each sample was run through a rapid sediment analyzer and all references to size of grains in this field guide is made in terms of hydraulic equivalence.

Final preparation of the sediment distribution maps relied heavily on aerial photographs to determine the boundaries of grain size classes.



Margins of Shinnecock Flood Tidal Delta

Figure 1



Approximate Axis of Tidal Channels of Shinnecock Flood Tidal Delta

Figure 2

For the purpose of explanation, the delta is divided into four parts, a western lobe, eastern lobe, northern lobe, and a rather small crescent shaped lobe located between the east and west lobes (Figure 3). Except for the north lobe and the curving shoal of sand that connects the east and central lobes, the areas mapped are usually slightly emergent at low tide. The channels were not sampled but the grain size distribution of the channel sediment is probably closely related to the sizes determined for the continuously submerged portions that were sampled.

The western lobe is bounded on the west by salt marsh vegetation. The rest of it is bordered by tidal channels. The mean grain size tends to decrease to the north and toward the center of the lobe. The decrease to the north is probably the result of lower current velocities associated with the distal portions of the delta. The decrease toward the center is related to the sharp reduction in current velocities over shoal areas. The protected interior of the west lobe acts as a settling basin for fine grained sediment, which is stabilized by growth of filamentous algae. The complex pattern along the east margin of the west lobe is created by several large scale sand waves that are migrating slowly to the north.

The same general pattern occurs on the east lobe. The area closest to the inlet is coarsest and grain size tends to decrease northward. The finest material is located centrally on the lobe, but in this instance the mud that covers much of the interior of the east lobe was deposited by the filtering action of Mytilus edulis.

The coarsest sediment occurs on the south margin of the east lobe, on the connection between the east and central lobes, and on the north lobe. These are the lowest areas on the flood delta exclusive of the channels. The association of the coarsest constituents with lower elevations on the delta surface suggests a vertical separation of grain sizes. If, as the data suggest, the finer sizes (mean size less than 1.5 phi) are restricted to areas toward the interior of sand flats that have built slightly above the level of mean low water one would expect the finer sediment to be only a surface veneer recording the last stage in the up-building of the delta surface before encroachment of salt marsh grasses. If this is the case, the coarser grain sizes (1.5 to 1.0 phi) are volumetrically much more important than the finer sizes.

The significance of this observation is that most of the material composing the delta is as coarse as material usually found on the beach and would be an excellent source of sand for beach nourishment programs. Figure 4 is a bar graph of the mean grain sizes of 81 samples taken at different times during 1970 and at locations scattered on the beach either side of the Inlet. The means that occur most commonly are in the range from 1.3 to 1.7 phi, very common sizes on the flood tidal delta.

EBB TIDAL DELTA

The form of the ebb tidal delta is much simpler than the flood delta. Its surface slopes gently seaward and is completely below sea level. Viewed from the air the margin of the delta is asymmetric beginning abruptly at the east jetty of the inlet and stretching westward far beyond the west jetty.

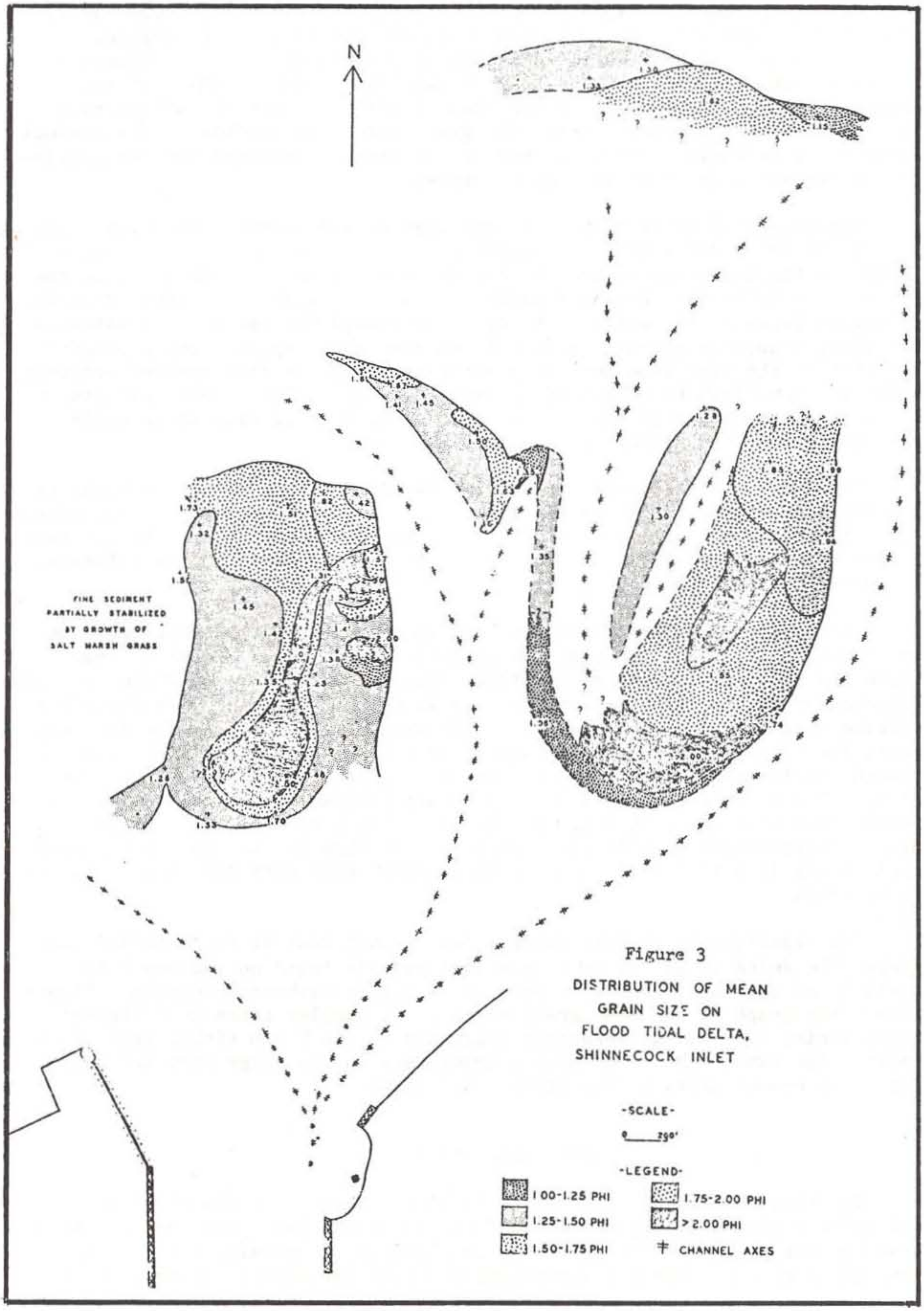
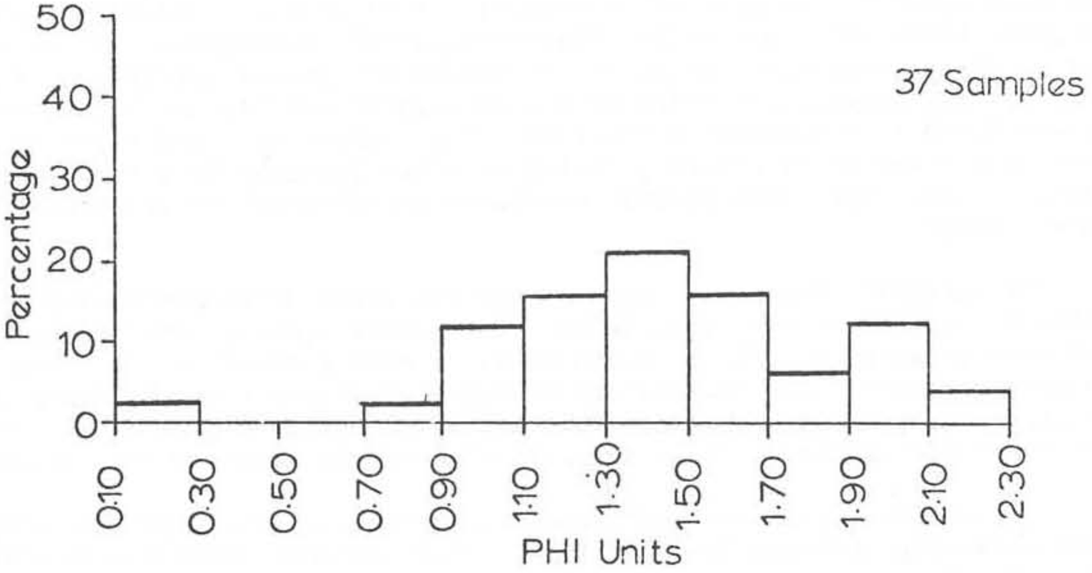


Figure 3

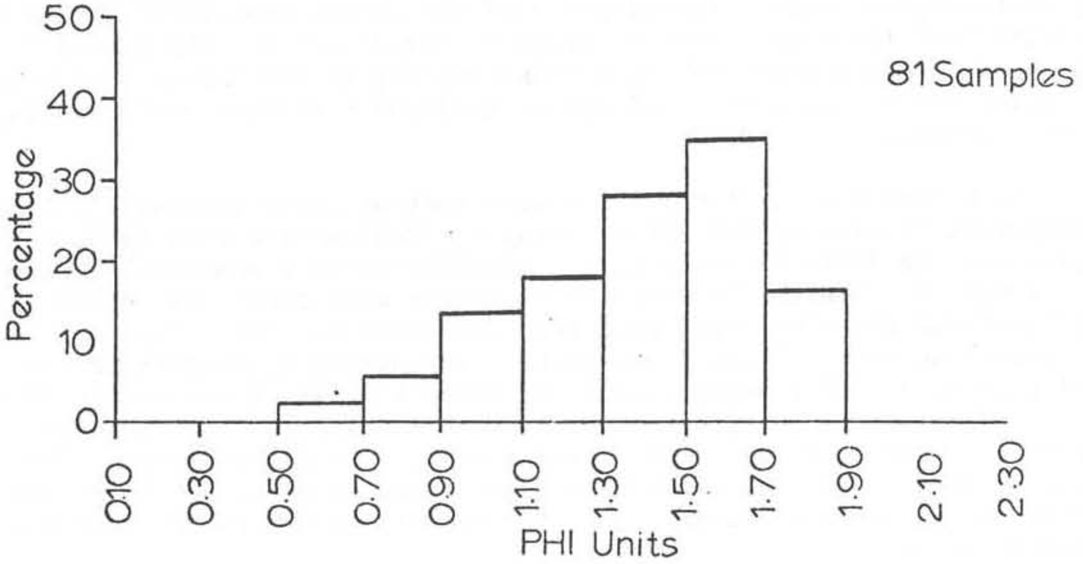
DISTRIBUTION OF MEAN GRAIN SIZE ON FLOOD TIDAL DELTA, SHINNECOCK INLET

Figure 4

HISTOGRAMS of MEAN GRAIN SIZES for BEACH and EBB DELTA SAMPLES



MEAN GRAIN SIZES for EBB DELTA SAMPLES



MEAN GRAIN SIZES for BEACH SAMPLES

The outer margin of the delta is frequently defined by a line of breakers that result from a rise at the edge of the delta. Much of the delta surface is within 10 feet of the surface at mean low water. It is shallower than this at the breaker line where incoming waves have piled up a lip of sand. The asymmetric form of the delta testifies to the dominance of westerly drift.

Little is known about the growth of the ebb tidal delta because it has not been carefully mapped and is usually not visible on aerial photographs. In 1950 (Plate 3A), the breaker line occupied the approximate position of the end of the present west jetty. On a 1966 aerial photograph (Plate 4A), the breaker line marking the delta margin is clearly visible and occurs approximately 2,400 feet seaward of the west jetty. Like the flood tidal delta, most of the ebb delta growth probably occurred immediately after stabilization of the Inlet, but slower continuous growth after inlet stabilization seems likely.

The distribution of sediment on the ebb tidal delta exhibits a simple pattern compared to the flood delta. Grain sizes grow progressively finer offshore (Figure 5). The isopleth lines of mean grain sizes are subparallel to isobath lines. The correlation of depth, distance from the Inlet, and decrease in grain size suggests that waning ebb tidal currents are responsible for the marked decrease in grain size at the margin of the delta.

The coarser sizes are restricted to the axis of the Inlet and a narrow zone extending westward from the Inlet. The coarsest samples were a mixture of sand and gravel size material too coarse to be run in the rapid sediment analyzer. To examine the nature of this unusual bimodal mixture, an underwater traverse was made from east to west across the delta surface. The mixture results from the bedform shown in Plate 4B. It shows small wave crests of sand with troughs of coarse gravel. Scattered Mytilus shells give the photograph a scale. Encrustation of the larger pebbles by marine growth indicate that the gravel size material is rarely moved. The gravel fraction represents a lag deposit that has found its way to the lowest position in the Inlet and occupies areas of active sediment transport just outside the Inlet entrance.

The westward bend of the grain size contour lines suggest the pattern of movement of sand at the Inlet entrance. Medium size sand (1.0 to 2.0 phi) approaches the Inlet from the east. Flooding tides sweep some of this material in through the Inlet. The coarsest fragments work their way to the bottom of the Inlet and the finer sand size fraction comes to rest along the sides of the Inlet and on the flood tidal delta. The ebbing tides jettison the fine sand (2.0 to 3.0 phi) seaward until it comes to rest on the margin of the delta. The location of the mixture of sand and lag gravels suggests that the thread of highest velocity ebb currents swings sharply westward. The sharp westward arch in the ebb currents may be caused by the high lip at the edge of the delta restricting seaward flow, and the stress applied by westerly moving longshore currents.

The ebb delta would make an excellent source of sand for beach nourishment programs. Except for sand at the extreme margin of the delta, the mean grain size of ebb delta sand is as large or larger than the most frequently encountered beach sand adjacent to the inlet.

Plate 4A

Plate 4B

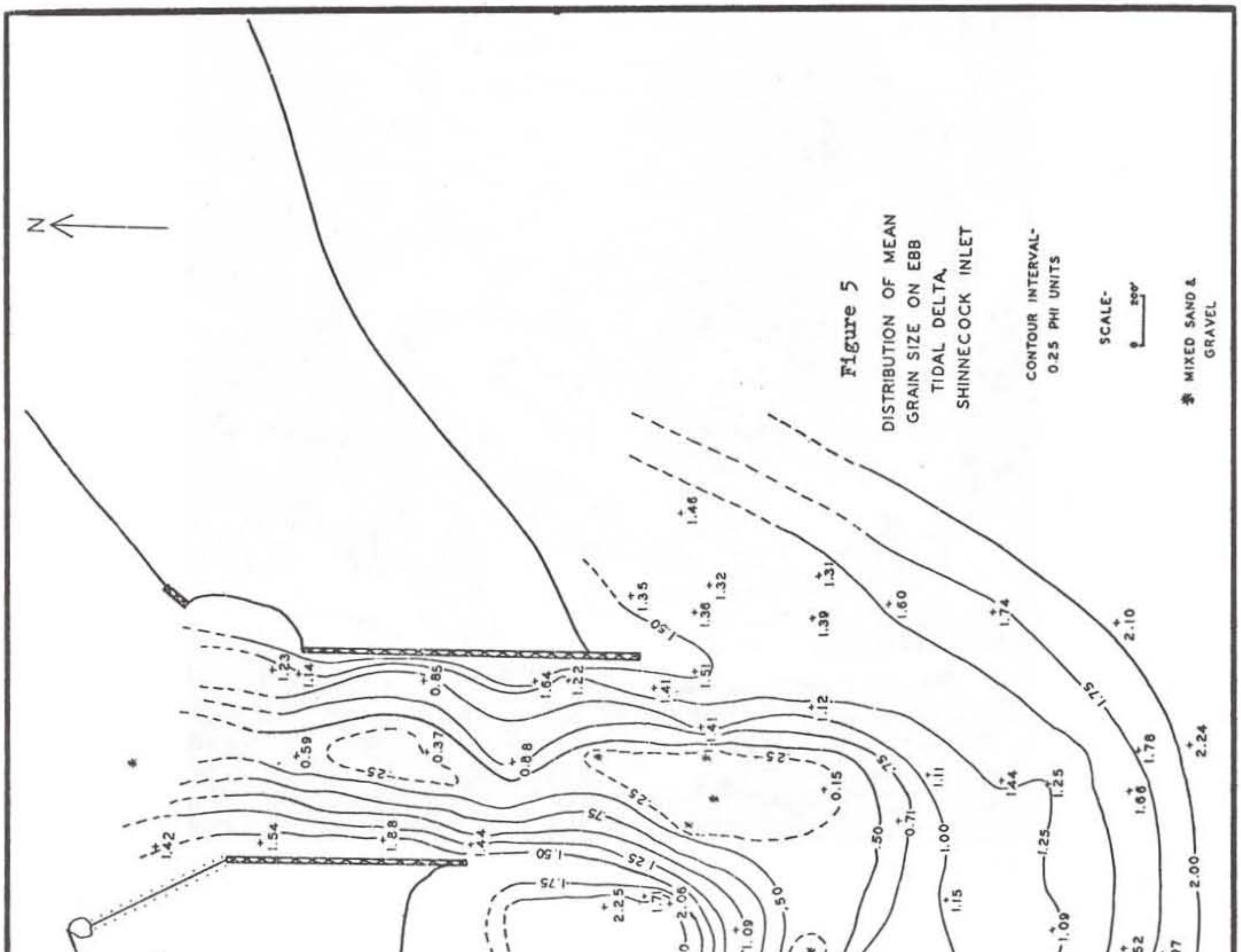


Figure 5

DISTRIBUTION OF MEAN GRAIN SIZE ON EBB TIDAL DELTA, SHINNECOCK INLET

CONTOUR INTERVAL- 0.25 PHI UNITS

SCALE- 0 200'

✱ MIXED SAND & GRAVEL

A comparison of the standard deviations of samples from the beaches, flood delta and ebb delta exhibit marked differences. From Figure 6, it is apparent that sand from the ebb and flood deltas is not as well sorted as beach sand.

In other words, the mean grain size of deltas and beaches is nearly the same while the deltas tend to have a broader range of sizes than the beaches. This fact may be of considerable importance in interpreting paleoenvironments, but it is probably of little significance in the consideration of the deltas as a sediment source for beach nourishment programs. In general, the delta sediment is only 1/10 phi unit less well sorted than beaches. While the difference is recognizable, it is unlikely that this small difference would cause significant variations in behavior between delta and beach sand.

STOP #3 is reached by proceeding westward on dune road from Shinnecock Inlet. Travel 1.1 miles west of the Inlet and stop on the newly paved section of Dune Road.

This is the site of a major storm washover created during the storm of February 18, 1972. The actual washover channel has been dammed with two parallel mounds of artificial fill and the road, destroyed during that washover, has been repaved. A small washover fan extends to the north of the road. The dune ridge normally present along the barrier island is nonexistent at this point.

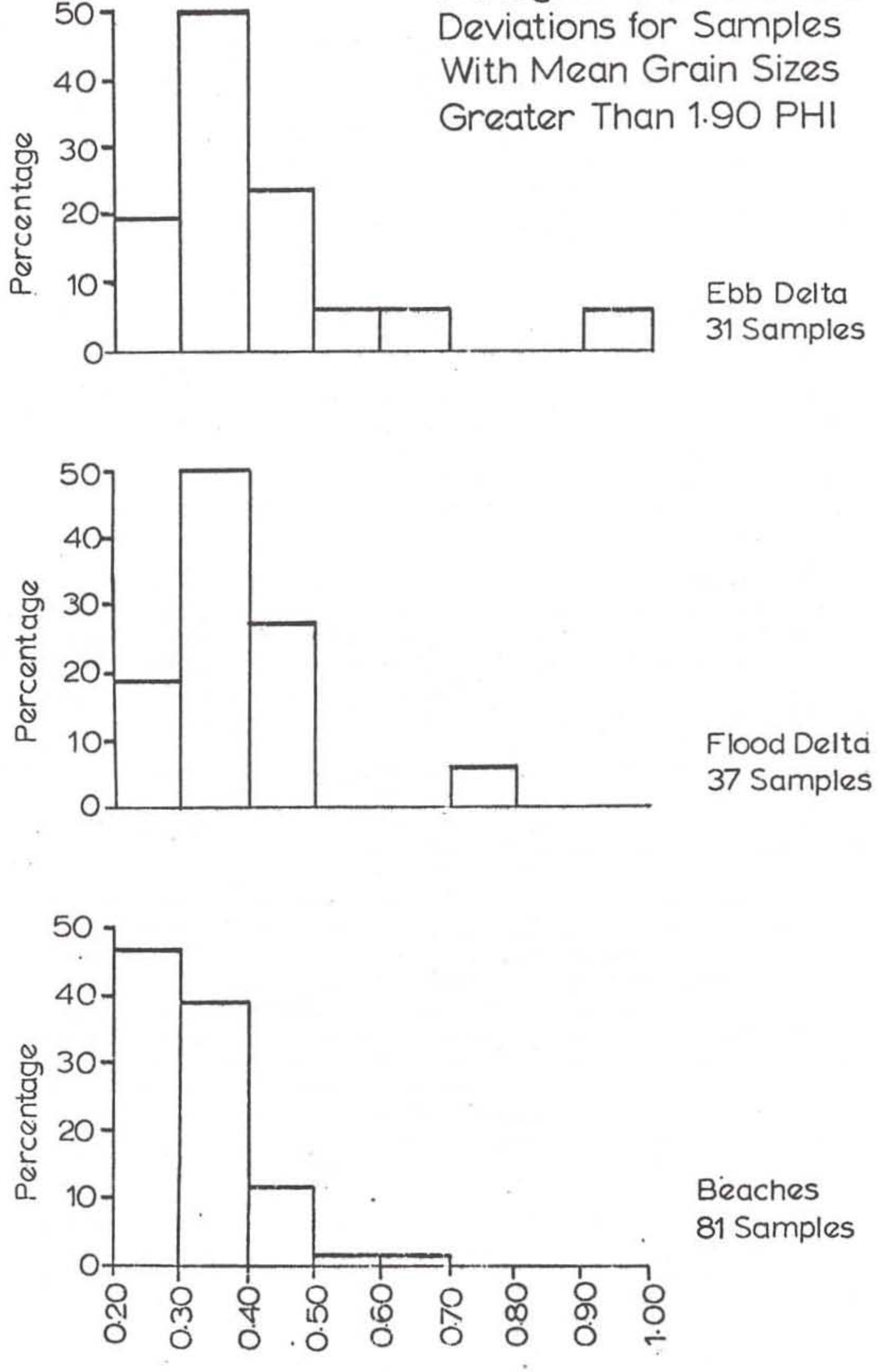
This weakened segment of the barrier island provides an excellent setting to discuss the dynamic nature of the barrier island system on eastern Long Island and causes of that dynamism. All of the basic elements that make up the barrier system are present at this spot or are visible nearby. The beach face, berm, washover channel and washover fan are present and dune ridges are visible a short distance to the east and west.

In order to provide information on this particular segment of the south shore barrier island and on barrier islands in general, I have quoted some information from a paper by McCormick (1973). These data should provide a basis for discussion of barrier island migration.

> Five surveys of the high water line from Montauk to Moriches Inlet were conducted by the United States Coast and Geodetic Survey and the Army Corps of Engineers in 1838, 1891, 1933, 1940 and 1956. The data pertinent to these areas are listed in Table 1. These figures represent changes in the shoreline for 41 points spaced approximately 1 mile apart between Napeague Harbor and a location 6 miles west of Moriches Inlet.
>
> Due to the short time interval the data for the 1933 to 1940 interval and 1940 to 1956 interval were combined into one time period from 1933 to 1956. The variations in character of the shoreline and the locations of the two artificially maintained inlets suggest a natural grouping of the data into three segments: (1) Napeague Harbor to East Hampton; (2) East Hampton to Shinnecock Inlet; (3) Shinnecock Inlet to a location 6 miles west of Moriches Inlet. The amount of advance or retreat for all points in each of the three areas was averaged and the yearly rate of advance or retreat was calculated for each interval

Figure 6

Histograms of Standard Deviations for Samples With Mean Grain Sizes Greater Than 1.90 PHI



between surveys. These rates and time intervals are given in Fugure 2. The shoreline westward from East Hampton has continuously retreated for the 188 year period between 1838 and 1956. During this period the rate of retreat between East Hampton and Shinnecock Inlet varied within the relatively narrow limits of 0.9 ft./yr. to 1.4 ft./yr. During the first 95 years of this period the erosion rate for the Shinnecock to Moriches segment varied from 1.6 ft./yr. to 0.7 ft./yr. However, during the period from 1933 until 1956 the Shinnecock to Moriches portion of the beach exhibited a dramatically increased rate of 6.8 ft./yr.

By comparison of aerial photographs from 1933 to 1960, the Soil Conservation Service reported a recession rate of 2.5 to 4.5 ft./yr. one mile east of Shinnecock Inlet and 8 to 12 ft./yr. at Tiana Beach west of the Inlet. This unpublished study corroborates the marked difference in erosional rates in the areas east and west of Shinnecock Inlet since 1933.

The first permanent natural break in the barrier island beach system west of Montauk Point is Fire Island Inlet and this opening has constantly migrated to the west in historic times. During the period since 1838 storms have caused breaks through the island at several points but none were stabilized by works of man and all have long since drifted closed.

Moriches Inlet opened in 1931, and except for a one year period, has remained open to the present. If it were not for attempts to stabilize this inlet in 1947 and 1952 it would probably have closed. Shinnecock Inlet has a similar history, it was opened in the hurricane of 1938 and by 1952 was stabilized by the construction of stone jetties. The close correlation between the time the inlets were opened and the abrupt change in the erosional rate of the beach between the inlets strongly suggests a causal relationship.

The artificially maintained inlets appear to have acted as barriers to the normal movement of sediment in the littoral drift. While the net littoral drift is to the west, easterly drift is experienced as well. As sediment is shifted past the mouths of the inlets, ebbing and flooding tides distribute it over ebb and flood tidal deltas. The sediment trapped by this process represents a net loss to the littoral drift and may explain the greatly accelerated erosion rate between the inlets ...

Perhaps the most apparent natural cause of shoreline recession is that material is being removed from a particular beach more rapidly than it is being supplied. This is certainly the case for the cliffs at Montauk where the prevailing westerly drift sweeps the finer detritus away and the only source for replacement is the cliff section backing the beach.

It is not possible to apply this explanation to the barrier island portion of the shoreline west of Southampton. The age of a peat layer at a depth of minus 7-1/2 feet mean sea level in Shinnecock Bay indicates that the bay and consequently the barrier island have been in existence for at least 2,300 years (personal communication Edward Belt, 1972). If the recession rate of the shore prior to establishment of the inlets is extrapolated backward and the barrier island has been in existence for

> several thousand years, it is not reasonable to explain recession of the beach as a function of the balance between erosion and deposition. This would have totally destroyed the island some time in the past. The only explanation that seems consistent with these observations is that the island is a migrating topographic form.
>
> Onshore winds remove sand from the berm and carry it into the dunes. Waves replenish this material and during storms may carry large quantities of sand through the dunes to form washover fans. The movement of material by these processes from the ocean side to the landward side of the island can be considered as a constant pressure applied to the island that results in the establishment of a natural migration rate. Viewed in this way a profile of the island represents a moving wave form, the details of which are in equilibrium with local climatic conditions and incident wave energy.
>
> A prerequisite for barrier island migration is that arrival and removal of sand on the beach face by longshore transport be in balance. An imbalance in either direction for a prolonged period will result in either advance of the shoreline or destruction of the barrier island. Because the source of sand for the barrier island is supplied by erosion of the cliffs to the east and the shoreline must be relatively straight to permit balance between arrival and removal of sand by longshore drift, the migration rate of the island must be dependent in large part upon the erosion rate of the Pleistocene deposits to the east.

The suggestion here is that the island migrates by the natural processes of dune growth and overwash, and it is now receding at an abnormally rapid rate due to the sand trapping effect of the inlets.

In addition to these causes, the shoreline might owe part of its recession rate to the "Bruun effect" (Schwartz, 1967). It is not possible at this time to assign values to the contribution each of these factors makes toward the total recession rate, but it seems fairly obvious that man's actions have had a substantial impact.

STOP #4 is located 11.0 miles west of Shinnecock Inlet on Dune Road. Any point along the road that allows access to the beach will satisfy the requirements for this stop.

The purpose of this stop is twofold: First to observe the solution that has been adopted to stem the problem of shoreline recession, and second, to allow participants an opportunity to contrast the condition of this protected segment of the barrier island with the unprotected portion downdrift of the last groin (STOP #5).

The groin field observed at this location was constructed under the authorization of the 1960 River and Harbor Act for the area from Fire Island Inlet to Montauk Point. The 1960 Act provided for the establishment of a continuous dune line to defend against flooding from storm surge and the establishment of sand bypass plants at Shinnecock and Moriches Inlets. In addition, provision was made for the construction of several groins and for a beach nourishment program. The federal government assumes the major share of the expense in construction of these groins in view of the broad protection that the hurricane protection portion of this program implies (approximately 70% federal funds). The level of federal funding is much reduced for erosion control (approximately 30% federal funds). The author is on public record as criticizing the 1960 plan for acting as an umbrella for local beachfront owners to obtain a high percentage of federal funding for what is essentially erosion control.

The piecemeal enactment of the 1960 plan which included groins almost as an afterthought, is brought about by the necessity for state and local authorization of funds prior to construction. At present none of the local governments have seen fit to provide the funding that would complete the broader aspects of the plan, and it is probably safe to assume public opinion will bar the complete enactment of the plan in the foreseeable future.

It is obvious that the structures protected by the present groins enjoy a more secure position on the barrier island than homes in unprotected areas. The abundance of shell material in the sediment of the dune ridge at this point is the result of being derived from dredged bay bottom, a practice often abhorrent to local baymen.

STOP #5 is located 13.9 miles west of Shinnecock Inlet on Dune Road immediately west of the last groin in the Westhampton Beach groin field. Here you will see evidence of recent washover, damage to local homes, and the absence of any substantial dune ridge. Of course all of this is directly attributable to the position of this beach with respect to the groin field. Starved for sand, it has receded at a very rapid rate.

Currently there is considerable pressure from homeowners and local government for the construction of six additional groins in this area in order to stabilize the beach to Moriches Inlet. The cost of this work will be approximately 10.5 million dollars and would be completed as part of the 1960 plan.

Consideration of how the natural system operates, the interference of man in this system, and interests of local property owners prompts a number of interesting questions.

Can local governmental units with sharp political boundaries deal intelligently with the management of natural systems that do not have the same boundaries?

Should federal projects of the type seen today be allowed to progress without any real assurance that funding will be provided to complete the project?

What will be the likely effect of the construction of six additional groins?

Can the public justify further coastal modifications on the basis of a realistic cost benefit ratio?

If the groin field were to be extended to Fire Island Inlet, would there be enough sand in the system to nourish the westernmost groin?

Does the public owe local homeowners west of the last groin for damages to their property?

To what extent is the damage produced by natural island migration and to what extent produced by the works of man?

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