NATURAL BAR-BYPASSING OF SAND AT A TIDAL INLET

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ABSTRACT

Captain Sam's Inlet, a shallow unstable inlet, periodically migrates up to three kilometers (km) alongshore over a 30- to 40-year period. As the inlet migrates, sediment accumulates at the seaward terminus of the tidal inlet to form a wave-modified ebb-tidal delta that trends downdrift. Continued sediment accumulation on the tidal-delta shoal and subsequent lengthening of the tidal channel in a downdrift direction results in an unstable channel configuration. The ebb delta is eventually breached on its updrift side, releasing a sediment package for inlet bypassing.

The sediment-bypassing process was initiated at Captain Sam's Inlet after the final landfall of Hurricane DAVID in September 1979. Initially, the newly formed updrift hurricane channel scoured 1.1 m, migrated updrift, and became the predominant tidal channel at the inlet with eventual abandonment of the prehurricane, main ebb channel. These two channels outlined a portion of the ebb-tidal delta that was freed for bypassing. The initial sediment volume contained in the bypassing shoal, above the -0.6 m (-2 ft) MSL contour, was 47,000m^3. The sediment volume of the bypassing shoal did not change significantly until final attachment to Seabrook Island. This channel dominance and the wave-induced migration of the bypassing sediment package aided the bypassing of sand at the inlet. Immediately after filling of the prehurricane, main ebb channel on the delta, the downdrift beaches began accreting. The accretion continued throughout the bypassing process. The tidal prism and cross-sectional area reflected little change during the bypass, showing evidence of the system's overall stability.

INTRODUCTION

Sediment bypassing at tidal inlets is an essential process in maintaining a balanced sediment budget along a barrier island chain. Since bar-bypassing was first identified (Bruun and Gerritsen, 1959), few field studies have been conducted documenting the process.

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Captain Sam's Inlet, located on the central South Carolina coastline, is a small tidal inlet with a downdrift-trending ebb-tidal delta (Fig. 1). Previous studies of the inlet (Hubbard, 1977; FitzGerald, 1980) indicated that large volumes of sediment frequently migrate across the inlet. This sediment migrates in the form of a nearshore bar from the updrift side of the inlet to the downdrift side.

Continued sediment accumulation on the tidal delta and progressive extension of the main ebb channel in a downdrift direction results in an unstable channel configuration. The ebb delta is eventually breached on its updrift side, releasing a packet of sediment for inlet bypassing (Fig. 2).

Utilizing the previous material published on tidal inlet dynamics, work done by Bruun and Gerritsen (1959), who first identified tidal inlet sediment bypassing, and observations made by Hubbard (1977) and FitzGerald (1980) at Captain Sam's Inlet, a preliminary understanding of the sediment bypassing process was possible. Hubbard (1977) determined a simplified model of bar-bypassing from the observations made at Captain Sam's Inlet and other similar tidal inlets along the South Carolina coastline (Fig.2).

The objective of this study was to quantitatively study the actual process of bar-bypassing which occurred at Captain Sam's Inlet during the switch in channels due to Hurricane DAVID. Utilizing bathymetric maps, beach profiles, and current and tide data collected during the bypass, quantitative calculations of sediment volumes and tidal inlet hydraulics were possible.

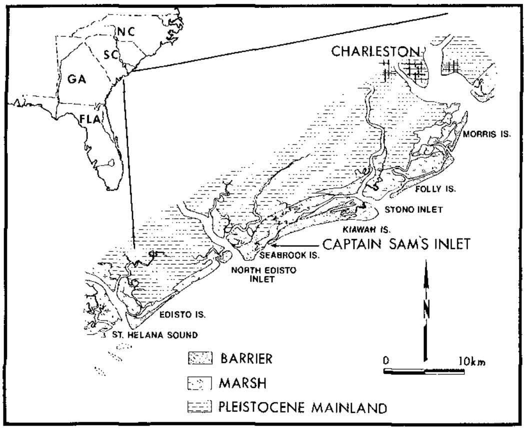

FIGURE 1. Location map of Captain Sam's Inlet, South Carolina. Captain Sam's Inlet is a small tidal inlet in comparison with its neighboring tidal inlets, Stono and North Edisto. The difference in inlet size is partially the result of the relationship between the cross-sectional geometry of the inlet and the back-barrier system.

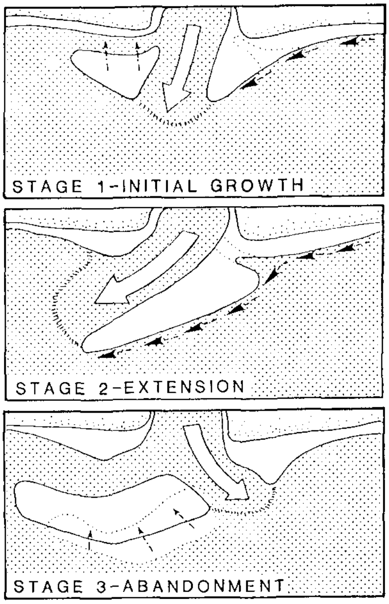

FIGURE 2.

A simplified three-stage model of bar-bypassing (after Hubbard, 1977):

1) Initial growth, sediments accumulating, forming a downdrift-trending delta.

2) Continued accretional growth, approaching an overextended configuration.

3) Breachment of the overextended delta, abandonment of the prebreachment main channel, followed by landward migration of the nearshore bar (swash bar).

PHYSICAL SETTING

The study area is influenced by prevailing winds from the south-southwest and storm winds generally from the northeast. Winds from the south-southwest occur 28 percent of the time. Even though northeast winds are less frequent than the prevailing south-southwest winds, their greater strength results in significant waves, energy flux, and longshore transport directed to the southeast in the study area (Finley, 1975).

Winds of hurricane strength [exceeding 75 miles per hour (mph)] have a frequency of occurrence along South Carolina of one event every 14 years (Myers, 1975). These winds are relatively rare at Captain Sam's Inlet, but can cause significant geomorphic changes on local beaches (Sexton and Moslow, 1981). Average wave heights on the South Carolina coastline are 50-60 centimeters (cm) (Finley, 1976; Kana, 1977). Tides at Captain Sam's Inlet range from 1.4 meters (m) (neap tide) to 2.2 m (spring tide) and are semidiurnal in nature. The tidal range is mesotidal (2-4 m), using Davies (1964) classification. These tides rarely reach heights above 2.2 m except during storm conditions.

Net longshore transport of sediment on the South Carolina coastline is predominantly from the northeast to the southwest (Finley, 1976; FitzGerald, 1977; Kana, 1977; Knoth and Nummedal, 1977). This dominance of southerly transport is evidenced by numerous south-southwest-trending geomorphic features (e.g., recurved spits, tidal inlets) along the South Carolina shoreline. Transport rates are on the order of 75,000-300,000 m^3/yr. These values are based on measurements taken during several studies on the South Carolina coast, both on central portions of barrier islands and near tidal inlets (Finley, 1976; Kana, 1977; FitzGerald, 1977; Knoth and Nummedal, 1979).

Sediments are fine-grained quartz sand (mean grain size = 2.82 phi units or 137 microns) and are well sorted. Samples taken at dunes were very well sorted, and sorting of the sand in the intertidal area of the inlet improved when exposed to active wave swash (e.g., top of bypassing shoal, active beach face).

DATA BASE

BATHYMETRIC MAPPING

Three bathymetric maps were produced from surveys of Captain Sam's Inlet during September 1979, January 1980, and June 1980. The inlet was surveyed with a Hewlett-Packard 1038 total-station microwave transit. This instrument has a horizontal accuracy of six millimeters (mm) per km and a vertical accuracy of 0.3 mm/km. The precise nature of these surveys allowed quantitative comparisons of sediment volumes at the inlet.

BEACH PROFILES

A sampling grid of 11 beach profile stations was established at the beginning of the study. Profiles of the beach and inlet configuration for the 11 stations were taken six times throughout the 10-month study using the Emery (1961) method.

CURRENT MEASUREMENTS

Tidal currents were monitored six times during the 10-month field study. The first five current surveys were taken using a ducted impellar current meter, modified after a design presented by Byrne and Boon (1973), whereas the final tidal current survey was conducted using a Marsh-McBirney Model 201 electromagnetic flowmeter. Tidal currents were monitored for a minimum of 13 hours during each survey, beginning one hour before slack low water and running until the next slack low.

AERIAL PHOTOGRAPHS AND COASTAL CHARTS

Historical shoreline changes at Captain Sam's Inlet were determined using 12 historical charts dating from 1696 to 1924 and seven photo mosaics dating from 1939 to 1979. Also during the 10-month bypass, seven overflights were made for observation and oblique photography.

BAR-BYPASSING AT CAPTAIN SAM'S INLET, SEPTEMBER 1979 THROUGH JUNE 1980

On 4 September 1979, Hurricane DAVID made final landfall on the southern portion of the South Carolina coast. The storm was a moderate hurricane and maximum winds reached 90 mph (Sexton and Moslow, 1981). The associated storm tides (0.5-1.0 m above normal), and waves caused considerable damage to the southern and central coastline of South Carolina. At Captain Sam's Inlet, a new channel was scoured through the ebb delta to the north of the previous main tidal channel (Fig. 3). This newly formed channel was important because, as shown in previous studies of the area (Hubbard, 1977; Hayes et al., 1979), it initiated the bar-bypassing process.

Within two weeks of the landfall of Hurricane DAVID, a field study was initiated to monitor the bar-bypass process. On September 17 and 18, detailed bathymetric surveys of the inlet were made (Fig. 4) and 11 beach profile stations were established on the adjacent beaches as shown in Figure 4.

Utilizing the bathymetric map surveyed during the study, the volume of sediment contained in the bypassing shoal above the -0.6 m (-2 ft) mean sea level (MSL) contour area shown on Figure 3 was calculated using the prismoidal formula (Hodgman, 1947):

$$V = 1/6\ H(S_0 + 4S_1 + S_2)$$

where V = shoal's volume
H = height of shoal (difference between top and base contours)
S = plane variable.

The total volume for the shoal, released for bar-bypassing above the -0.6 m contour, was 47,510 m³.

FIGURE 3. Photo mosaic of Captain Sam's Inlet and vicinity taken at low tide on 23 September 1979. The area mapped is bordered in black and the white arrow points to the hurricane channel.

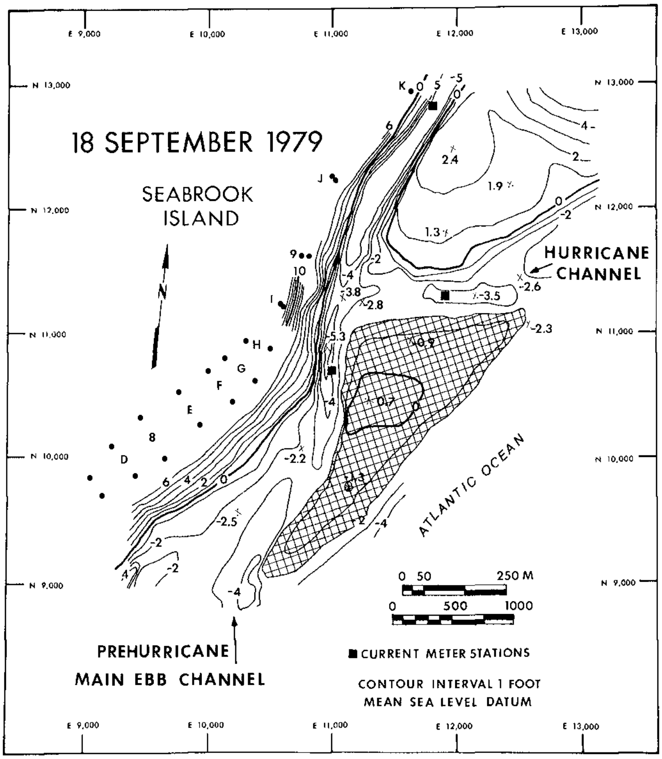

FIGURE 4. Bathymetric map of Captain Sam's Inlet, surveyed in September 1979, 14 days after hurricane landfall. Note the positions and depths of both the prehurricane, main ebb channel and hurricane channel. The hatched area on the delta was used for sediment-volume calculations and outlines the bypassing shoal.

Beach profiling across the ebb-tidal delta was quite unique and was possible only because of the shallow tidal channels at the inlet. Review of the beach profiles provides a cross-sectional view of the geomorphic form of the inlet whereas the bathymetric map is a plan view. From the beach profile data taken in September 1979, a variety of beach configurations were identified (Fig. 5).

The beach profile plot for Station E (Fig. 5) begins in a field of immature, prograding beach ridges and traverses a low-amplitude foredune ridge onto a steep beach face. Seaward of the active beach face lies a 110-m-wide bay that terminates at the toe of the southern portion of the delta at the inlet. Beach profile Station J (Fig. 5) is positioned along the most unstable section of coastline at Captain Sam's Inlet. Previous studies (Hayes et al., 1976; Sexton and Hayes, 1980) measured erosion rates of 40-60 m/yr in this vicinity. At Station J there is a large (2.5 m) erosional scarp with a narrow beach face that slopes into the Kiawah River. Seaward of the river lies the broad intertidal recurved spit platform.

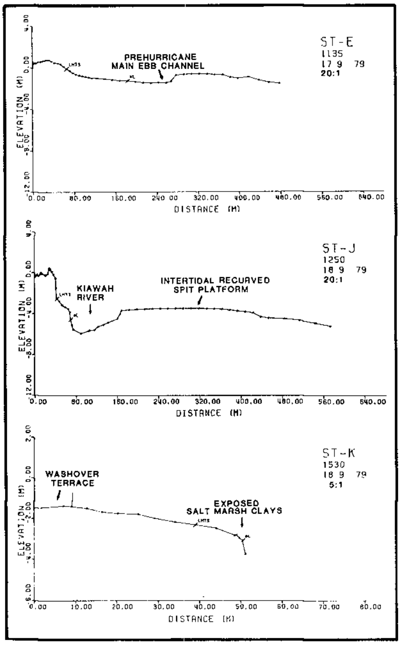

FIGURE 5.

Plots of beach profiles monitored in September 1979. Station locations are shown in Figure 4. The variety of beach configurations located in the small area indicate the high degree of variability in shoreline conditions. Also observe the total distance of each profile and the changes in vertical exaggeration (5:1; 2:1).

During the four months following the hurricane, the inlet was monitored closely to document the change that had occurred. In early January 1980, a second bathymetric map was constructed (Fig. 6). The morphology of the inlet area had changed significantly since September (Fig. 4). Some of the more outstanding changes were:

1) The hurricane channel had scoured 0.7 m deeper and had shifted 80 m to the north.

2) A new middle channel had formed, truncating the northern tip of the bypassing shoal.

3) The bypassing shoal had migrated 215 m landward and 164 m downdrift in a southwesterly direction.

4) The prehurricane, main ebb channel had been filled with as much as 1.3 m of sediment.

5) Sediment volumes contained in the bypassing shoal, the volume above the -0.6 m MSL contour, had not changed significantly since September remaining at approximately 50,000 m^3.

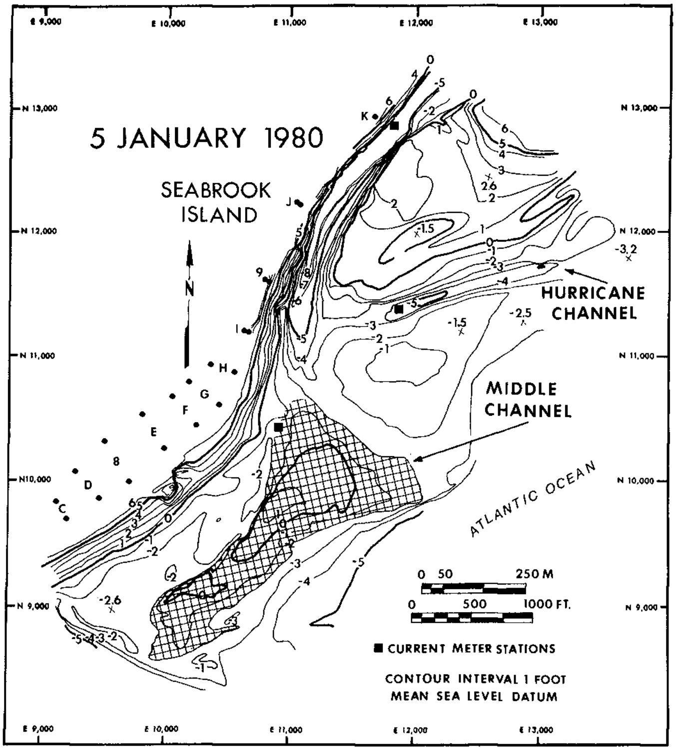

FIGURE 6. Bathymetric map of Captain Sam's Inlet surveyed in January 1980. The hatched area on the map was used for sediment-volume calculations for the bypassing shoal.

The tidal currents active in the tidal channels at the inlet had shown several distinct patterns. Shortly after the hurricane channel was formed, the current velocities in the channel were very erratic. Velocity changes of over 100 cm/sec were recorded in less than one hour while other channels were recording velocities of less than 50 cm/

sec during the same period. By December 1979, the current velocities in the hurricane channel were the same as those measured in the Kiawah River indicating that the hurricane channel was becoming the main channel for the inlet. The current velocities in the prehurricane, main ebb channel were flood dominant with low values when compared to the currents in the hurricane channel. This indicates that the prehurricane, main ebb channel was functioning as a marginal flood channel (Hayes, 1980). Also, during the first four months of the bypass, the cross-sectional area of the inlet's throat reduced slightly from 492.5 m^2 to 472m^2 or about four percent.

During the last six months of the monitoring program (January-June 1980), the bypass process was essentially completed. Results from the final bathymetric survey are shown in Figure 7. During the six month period since January 1980, the bypassing shoal had migrated onshore with little additional downdrift migration to the south. Previously (between September 1979 and early January 1980) shoal migration was dominantly in a downdrift direction. The bypassing shoal had attached to Seabrook Island on its northern end, and only a narrow trough separated the remaining portion of the shoal from the island. The newly formed middle channel was well formed, with the formation of an ebb-tidal delta seaward of the channel. The northern portion of the tidal delta, north of the middle channel, had accreted as evidenced by the filling of the hurricane channel. The volume of sediment contained in the bypassing shoal above the -0.6 m MSL contour was 34,817 m^3. The volume of sediment in the bypassing shoal had been reduced by 27 percent since January. The reduction of the total sediment volume in the ebb-tidal delta at the end of the process can be accounted for by accretion of the downdrift beaches where the shoal was attaching to the shoreline.

Results of the tidal currents monitored toward the end of the bar-bypassing process indicated that the tidal exchange measured in the inlet's throat closely resembled the currents monitored on the ebb delta in the middle channel. In conjunction with the current readings during the entire bypass, little change in the salinity of the seawater through the inlet was recorded, reading consistently around 32 parts per thousand.

The cross-sectional area of the tidal inlet throat had increased slightly by six percent to 503.5 m^2. The tidal inlet had once again regained a single channel configuration on its delta, similar to that prior to the landfall of Hurricane DAVID.

DISCUSSION AND SUMMARY

A review of the bar-bypassing process that occurred at Captain Sam's Inlet is shown in Figure 8. Prior to the bar-bypass process, the inlet had a single channel configuration on its delta (Fig. 8A). Through the process, the inlet had as many as three active channels on the delta (Fig. 8C). Toward the end of the bypass, the inlet once again regained a single channel configuration on its delta lobe (Fig. 8F).

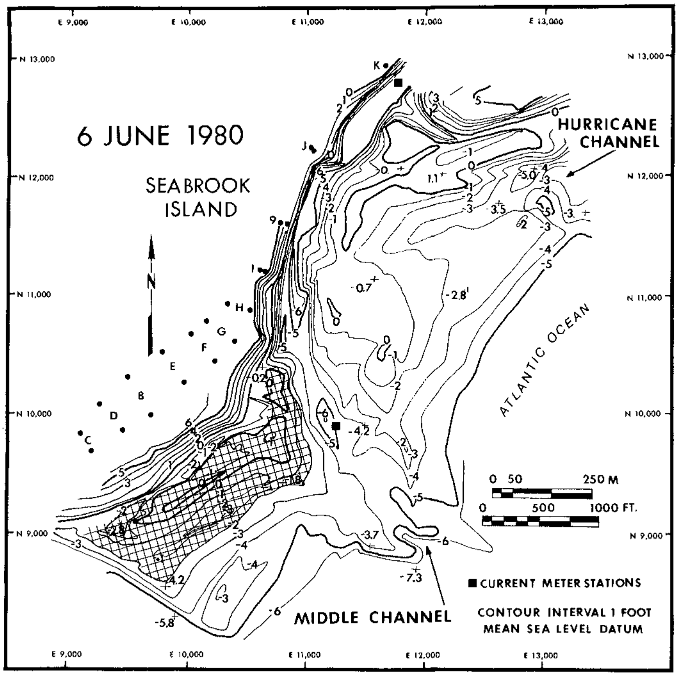

FIGURE 7. Bathymetric map of Captain Sam's Inlet in June 1980. The hatched area was used for sediment-volume calculations for the bypassing shoal. An ebb-tidal delta had formed seaward of the inlet at the location of the middle channel while the hurricane channel had been filling.

Sediment volumes calculated from the three bathymetric maps for the bypassing shoal is shown in Table 1. The volume of sediment contained in the bypassing shoal above the -0.6 MSL contour remained constant until the end of the bypass procedure. Stability in sediment volume was achieved even though the northern one-third of the bypass shoal was truncated from the main body of the shoal by the formation of the middle channel (Figs. 6 and 8C). Three possible explanations for the sediment volume stability are:

1) The addition of sediment to the bypassing shoal from longshore and onshore sand transport.

FIGURE 8A.

Low-tide photo of Captain Sam's Inlet taken on 7 December 1978. The inlet had only one channel active on the delta at this time.

FIGURE 8B.

Oblique low-tide photo taken on 6 September 1979, following Hurricane DAVID. The channel scoured by the storm is marked by the white arrow.

FIGURE 8C.

Aerial photo taken at low tide on 8 November 1979. The inlet had three channels active on the delta with the middle channel (marked by the white arrow) forming during the first two months of the bar-bypass.

FIGURE 8D.

Oblique aerial view of Captain Sam's Inlet taken on 21 December 1979. The prehurricane, main ebb channel was nearing abandonment.

FIGURE 8E.

Low-tide photo taken on 11 April 1980. The hurricane channel had filled with sediment and the middle channel was clearly the dominant channel active at the inlet.

FIGURE 8F.

Aerial photo taken at low tide on 29 May 1980 at Captain Sam's Inlet. Only a narrow trough separates the bypassing shoal from the mainland.

2) Movement of the bypassing shoal into shallow water, therefore exposing more of the shoal above the -0.6 m MSL contour.

3) The addition of sediment from the eroding scarp formed during the migration of the inlet system.

Of the three possible explanations, the third appears to be the most responsible for adding sediment to the system during the bypass. A total sediment volume of 43,152 m^3 (calculated from beach profile data) was eroded during the bypass due to the migration of the inlet system. This value would provide a substantial sediment supply to the bypassing shoal during the 10-month process.

TABLE 1. Sediment volume of the bypassing shoal, calculated above the -0.6 m ft) MSL contour at Captain Sam's Inlet.

MAP 1 September 1979	MAP 2 January 1980	MAP 3 June 1980
47,510 m^3	47,689 m^3	34,817 m^3

After the delta was breached during the hurricane, the shoal, freed for bar-bypassing at the inlet, migrated in a south-southwesterly direction for a total of 215 m (using the -0.6 m MSL contour), with the majority of the migration occurring during the first four months. Landward migration of the shoal caused 1.3 m of fill in the prehurricane, main ebb channel, but this tend was reversed toward the end of the study after the middle channel stabilized and scoured 1.2 m of sediment from the same general location at the inlet (Fig. 9).

Measurements made from the three bathymetric maps showed the hurricane channel initially scoured and migrated in a northerly direction. During the later stages of the bar-bypassing, the hurricane channel began to fill with sediment and migration continued to the north (a total of 175 m).

The currents monitored in the prehurricane, main ebb channel resembled that of an active marginal flood channel on an ebb-tidal delta (Hayes, 1980), which are dominated by flooding currents. The currents active in the marginal flood channel (prehurricane, main ebb channel) tended to lag in a flood direction, whereas currents in the main ebb channel were still flowing seaward. This flood dominance influenced the bar-bypassing procedure by assisting in the filling of the channel.

The cross-sectional area of the inlet below MSL showed little change throughout the study (Table 2). There was a slight overall enlargement of the inlet's throat toward the end of the study (31 m^2 or 6 percent). O'Brien (1969, 1972) found that, based on Pacific

Coast data, inlets tend to stabilize and balance by enlarging their cross-sections and varying the tidal prism and supply of sand to the inlet. This slight enlargement in the cross-section during the bypass may be the result of Captain Sam's Inlet regaining its single-channel, stable configuration. O'Brien and Dean (1972) also developed an index on the stability of tidal inlets to closure relative to deposition on filling with sediment. Essentially, they found that the stability or resistance of tidal inlet to closure depends on three main factors:

1) $\Delta L/L$ on the depositional length (L) of the inlet's channel.
2) The storage capacity of the inlet.
3) The inlets ability to transport sediment out of its channel.

These factors have a significant impact on Captain Sam's Inlet. When the inlet has a single channel on the tidal delta, the depositional length (total single channel length) of the channel is high; therefore, it would tend to be unstable. Also since the inlet is shallow and narrow, it would have a low storage capacity. When the length of the single channel on the delta is long, the frictional drag on the tide would reduce the efficiency of the tide to transport sediment out of the channel. These three principles are very important at Captain Sam's Inlet during the bar-bypass process.

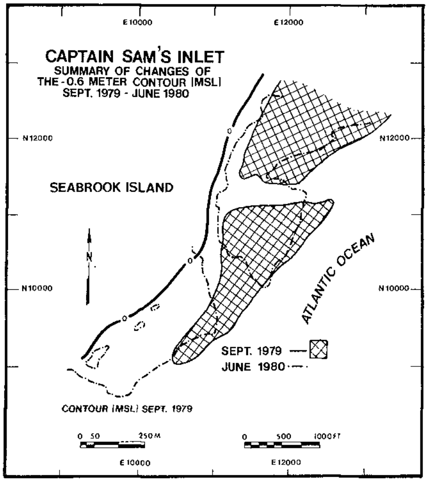

FIGURE 9.

Comparison map of the bathymetry of Captain Sam's Inlet showing changes in the -0.6 m (-2 ft) MSL contour, comparing maps surveyed in September 1979 with June 1980. Note the south-southwesterly migration of the bypassing shoal with eventual attachment to Seabrook Island.

TABLE 2. Values for the tidal prisms (in m^3) and cross-sectional areas (in m^2) for Current Station 3 (Fig. 4), the inlet's throat, at Captain Sam's Inlet.

Date	Tidal Prisms		Cross-Sectional Areas
	Ebb	Flood	
September '79	6,533,023 m^3	6,679,296 m^3	492.5 m^2
November '79	6,084,268 m^3	4,838,493 m^3	472.0 m^2
May '80	4,537,472 m^3	5,024,484 m^3	503.5 m^2

CONCLUSIONS

This paper documents sediment bypassing at a small, natural tidal inlet in South Carolina. The process of bar-bypassing occurs at Captain Sam's Inlet in conjunction with the continual migration of the entire inlet system.

The following conclusions are offered:

1) Periodically, Captain Sam's Inlet attains a long unstable, single-channel configuration that results in the formation of shorter, more efficient channels initiating bar-bypassing.

2) Channel formation and abandonment facilitate bar-bypassing at the inlet, as opposed to continuous channel migration.

3) In this study, the volume of sediment contained in the shoal that bypassed remained constant until final attachment to the mainland. This is partially due to the addition of sediment to the downdrift side of the inlet from erosion during overall inlet migration.

4) Major changes in the inlet tidal prisms or cross-sectional areas were not observed during the bar-bypass process, although a slight enlargement of the channel cross-section toward the end of the process could indicate inlet stability.

5) The bypassing of sand at the inlet did transfer significant amounts of sand (approximately 50,000 m^3) across the inlet to the downdrift barrier island, creating a zone of rapid accretion.

Although Captain Sam's Inlet exhibits many characteristics of a short-lived inlet (eventual closure), the stable nature of the inlet's throat indicates that the inlet attains a state of equilibrium despite the radical behavior of the delta portion of the system.

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REFERENCES CITED

Bruun, P. and F. Gerritsen, 1959, Natural bypassing sand at coastal inlets: in Proc. Jour. Waterways and Harbors Div., ASCE, Vol. 85(WW4), pp. 75-107.

Byrne, R. J. and J. D. Boon, III, 1973, An inexpensive, fast-response current speed indicator: Chesapeake Science, Vol. 14, pp. 217-219.

Davies, J. L., 1964, A morphogenic approach to world shorelines: Zeit. fur Geomorph., Vol. 8(Sp. No.), pp. 127-142.

Emery, K. O., 1961, A simple method of measuring beach profiles: Limnology and Oceanography, Vol. 6, pp. 90-93.

Finley, R. J., 1975, Hydrodynamics and tidal deltas of North Inlet, South Carolina: in L. E. Cronin (ed.), Estuarine Research, Vol. 2, Academic Press, New York, N.Y., pp. 227-292.

Finley, R. J., 1976, Hydraulics and dynamics of North Inlet, South Carolina, 1974-75: General Investigation of Tidal Inlets, Rept. No. 10, U.S. Army Corps of Eng., Coastal Eng. Res. Cent., Ft. Belvoir, Vir., 188 pp.

FitzGerald, D. M., 1977, Hydraulics, morphology, and sediment transport at Price Inlet, South Carolina: Ph.D. Dissert., Dept. Geol., Univ. South Carolina, Columbia, 84 pp.

FitzGerald, D. M. and M. O. Hayes, 1980, Tidal inlet effects on barrier island management: in Coastal Zone '80, Vol. III, ASCE, New York, N.Y., pp. 2355-2379.

Folk, R. L., 1974, Petrology of sedimentary rocks: Hemphill Publ. Co., Austin, Tex., 182 pp.

Hayes, M. O., 1980, General morphology and sediment patterns in tidal inlets: Sedimentary Geology, Vol. 26, pp. 139-156.

Hayes, M. O., et al., 1979, Assessment of shoreline changes, Seabrook Island, South Carolina: RPI Summary Rept. to Seabrook Island Co. (Charleston, S.C.), Research Planning Inst., Inc., Columbia, S.C., 82 pp.

Hodgman, C. D. (ed.), 1947, Handbook of chemistry and physics: The Chemical Rubber Publ. Co., Cleveland, Ohio, 30th Ed., 260 pp.

Hubbard, D. K., 1977, Tidal inlet variability in the Georgia embayment: Ph.D. Dissert., Dept. Geol., Univ. South Carolina, Columbia.

Kana, T. W., 1977, Suspended sediment transport at Price Inlet, South Carolina: in Proc. Coastal Sediments '77 Conf., ASCE, New York, N.Y., pp. 366-382.

Knoth, J. S. and D. Nummedal, 1977, Longshore sediment transport using fluorescent tracers: in Proc. Coastal Sediments '77 Conf., ASCE, New York, N.Y., pp. 383-398.

Myers, V., 1975, Storm-tide frequencies on the South Carolina coast: Natl. Weather Serv., Office of Hydrology, Silver Springs, Md., 79 pp.

O'Brien, M. P., 1969, Equilibrium flow areas of inlets on sand coasts: Jour. Waterways and Harbors Div., ASCE, New York, N.Y., Vol. 95, pp. 43-52.

O'Brien, M. P. and R. G. Dean, 1972, Hydraulics and sedimentary stability of coastal inlets: in Proc. 13th Coastal Eng. Conf., Vancouver, B.C., Canada, Vol. II, pp. 761-779.

Sexton, W. J. and M. O. Hayes, 1980, Beach erosion studies of Seabrook Island - December 1979 through October 1980: RPI Final Rept. to Seabrook Island Co. (Charleston, S.C.), Research Planning Inst., Inc., Columbia, S.C., 10 pp.

Sexton, W. J. and T. F. Moslow, 1981, Effects of Hurricane DAVID on the beaches of Seabrook Island: in Proc. NE Geol. Symp. on Barrier Islands, Philadelphia, Penn.