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Beach Processes and Shoreline Changes, Kouchibouguac Bay, New Brunswick*

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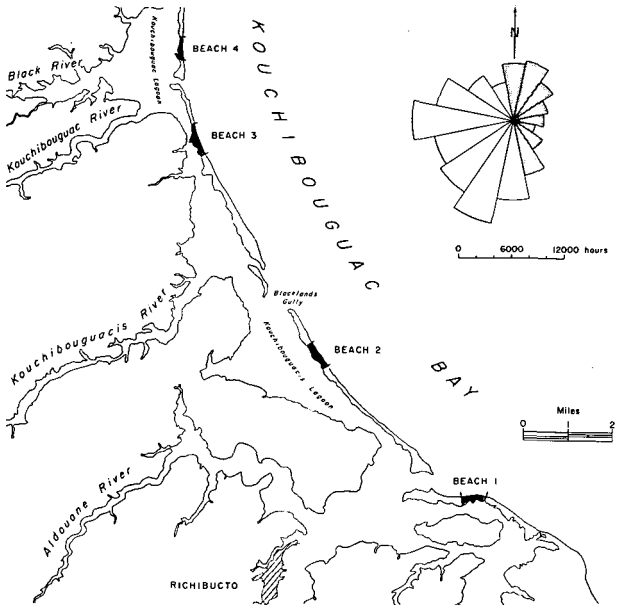
Kouchibouguac Bay, New Brunswick, offers a series of barrier islands which have a limited fetch window to waves from the Gulf of St. Lawrence. These islands are sheltered by the New Brunswick mainland and Prince Edward Island from all wind directions except the north-northeast. Despite this limited exposure, however, the barrier islands have been undergoing considerable changes in configuration, as is evidenced by maps, made since the 1880's, and by aerial photographs, taken since 1930. These changes are most evident around the inlets between the islands. The general aim of the present study is to provide an explanation, in process terms, of past changes and to give some indication of the likely future evolution of the shoreline. To this end an overall description of the present form and sediments of the island system will be provided, together with measures, both actual and derived, of certain of the process parameters - waves, wave induced currents and tidal currents.



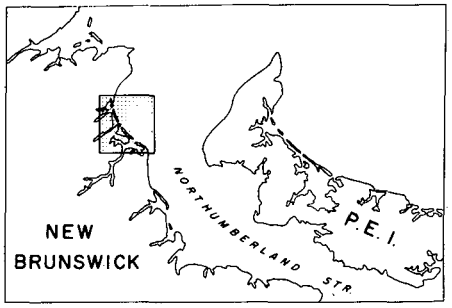


Figure 1. Location map of beaches with study area shown in the insert sketch. Wind rose represents 15 year-record of hourly data for area.

Field research in the area was commenced in the summer of 1970. Four sample study locations, named Beaches 1-4 on Figure 1, were chosen to represent typical sections of the beaches and the barrier island complex as a whole. More specifically, the study locations were selected to provide comparisons of beach sediments on both sides of certain inlets, to determine the nature of changes in sediment characteristics along the length of the barrier island system, and to show the characteristics of former inlets now infilled.

Beach 1 was chosen because it has a high wave-cut dune ridge, backed by the hummocky broken dune topography characteristic of this section of island complex. It also contains a recently infilled inlet and lies downdrift of the inlet of Richibucto Bar. Beach 2 has virtually the same characteristics except that it has in addition, the distinctive older dune ridges characteristic of North Beach. It also lies updrift from Richibucto inlet. Beach 3 represents the barrier in the central portion of the bay and is downdrift of the Kouchibouguac River inlet. It is characterized by lower relief than Beach 1 and 2 and has a very uniform, low back-dune and a higher wave-cut fore-dune. Beach 4 was chosen as it is updrift of Kouchibouguac River and shows the sharply eroded, narrow dune ridge that characterizes this section. Together these four beaches and associated backshore areas represent the form of the islands in Kouchibouguac Bay.

Samples of sand were collected systematically from different environments across the barrier islands, along several lines at each of the four study beaches for particle size and shape analysis. The sample design and analysis was directed towards finding changes between the sedimentary environments both across the barriers and more importantly between sampling areas. The sediments show considerable variation between beaches and within a single beach, but general trends are recognizable. It appears, for instance, that there is a change in beach sediment characteristics at about the location of the exit of the Kouchibouguac River, for to the south and north of this point grain size decreases. Grain size on all beaches appears to decrease across the beach towards the lagoon on the ocean side of the island, but then either increases slightly or remains the same in the dune areas. Except for Beach 4, the sediments in the tidal zone on the lagoon side are finer than those on the ocean side.

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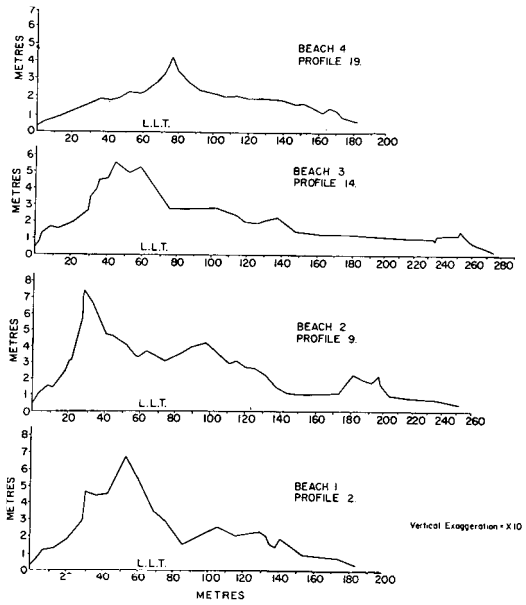

Figure 2. Topographic profiles of beaches studied (see Fig. 1).

Mapping of the beaches on the ocean side of the dunes was carried out at each study location, and topographic profiles were surveyed across the entire barrier. The mapping involved delineating four features of the beach which can be easily recognized on aerial photographs, so that the present position of shoreline features can be compared with former positions. The features delineated are as follows: the waterline, the berm or maximum high tide mark, the front base of the dune ridge, and the crest of the dune ridge.

Topographic profiles, which are representative of each study location are shown in Figure 2. These illustrate two points - firstly, that the barrier islands are undergoing active erosion of the frontal dunes, and, secondly, that there is a general trend of decrease in dune height and increase in beach width northwards. Profile 2 shows the distinct hummocky, dune topography of the barrier at Beach 1, and profile 9 shows a distinct dune ridge halfway across the barrier island at Beach 2. This profile also shows a distinct back dune on the lagoon side of the island. Profile 4 has a small back dune and shows a trend to more subdued relief, which becomes very evident on profile 19. These latter two profiles characterize long stretches of shore and provide a marked contrast with the irregularity of the profiles in the southern part of the bay.

The explanation of the changes on these beaches through time, and of differences between beaches, lies in the wave patterns and currents which operate in the bay. It is possible to make some assessment of these factors from consideration of wind records, wave records and derived wave statistics; and also by the construction of refraction diagrams. The wind rose, Figure 1, (based on 15 years of hourly wind data from Summerside, P.E.I.) shows that the predominant wind direction which affects the wave regime of this area is north to northeast. This direction coincides with the maximum fetch for Kouchibouguac Bay and with maximum wind velocities. It is hoped by using this wind data to be able to build up a model of wave direction, period, and height for Kouchibouguac Bay. Wave refraction patterns of these waves can then be produced and from these plots one can obtain distributions of wave energy along the shore and attempt to predict areas of maximum change in beach configuration. Some of this analysis has already been completed using computer programs devised by Wilson (1966) and Dobson (1967).

The field research program for the summer of 1971 has 3 main objectives: 1) the measurement of tidal currents and sediment movement in the inlets: the tidal range for this area is only 3-4 feet at maximum but the volume of water ponded in the lagoons at high tides can generate considerable current velocities in the narrow inlets, which appear to have a significant effect on sediment transport; 2) the measurement of wave induced longshore currents in the surf zone off the study beaches, for various important wave trains; and 3) the study areas of 1970 will be resampled and remapped in order to observe any seasonal or gross short term changes in these beaches.

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