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Reconnaissance Survey of Hog Island, Prince Edward Island*

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Hog Island, on the north coast of Prince Edward Island, is a 10-mile (16 km) long barrier island which separates Malpeque Bay from the open waters of the Gulf of St. Lawrence (Fig. 1). It extends in a southeast-northwest direction from Malpeque Harbour inlet in the south to Conway Inlet in the north and is never more than .5 miles (4 km) wide, being in some places narrower than 200 yards (183 m) from oceanside HWM (high water mark) to lagoon HWM. The island exhibits all the characteristic features of the sand beach and dune barriers of Prince Edward Island and, being relatively inaccessible, is in a fairly natural state.

A field reconnaissance of the island was carried out in May, 1971, by R. Davidson-Arnott and B. Greenwood of the University of Toronto and E.A. Bryant, P.J. Howarth and S.B. McCann of McMaster University. The aims were twofold - to provide basic information from which to develop a full research program and to prepare for a field excursion for the Coastal Commission of the International Geographical Union in 1972. This report embodies the results of the reconnaissance and later study of the aerial photographs by J.W. Armon and the sediment samples by R. Davidson-Arnott, who contributed the report on the textural characteristics of the sediments.

The principal features of the island are shown in Figure 2, which is a simplified version of a map prepared from the 1968 aerial photography. Basically it consists of a series of vegetated dune ridges, with associated marsh areas at the rear, the continuity of the main dune ridges being broken by two large washover fans. In detail the physiography of the island is complex, but for purposes of description it can be divided conveniently into three sections.

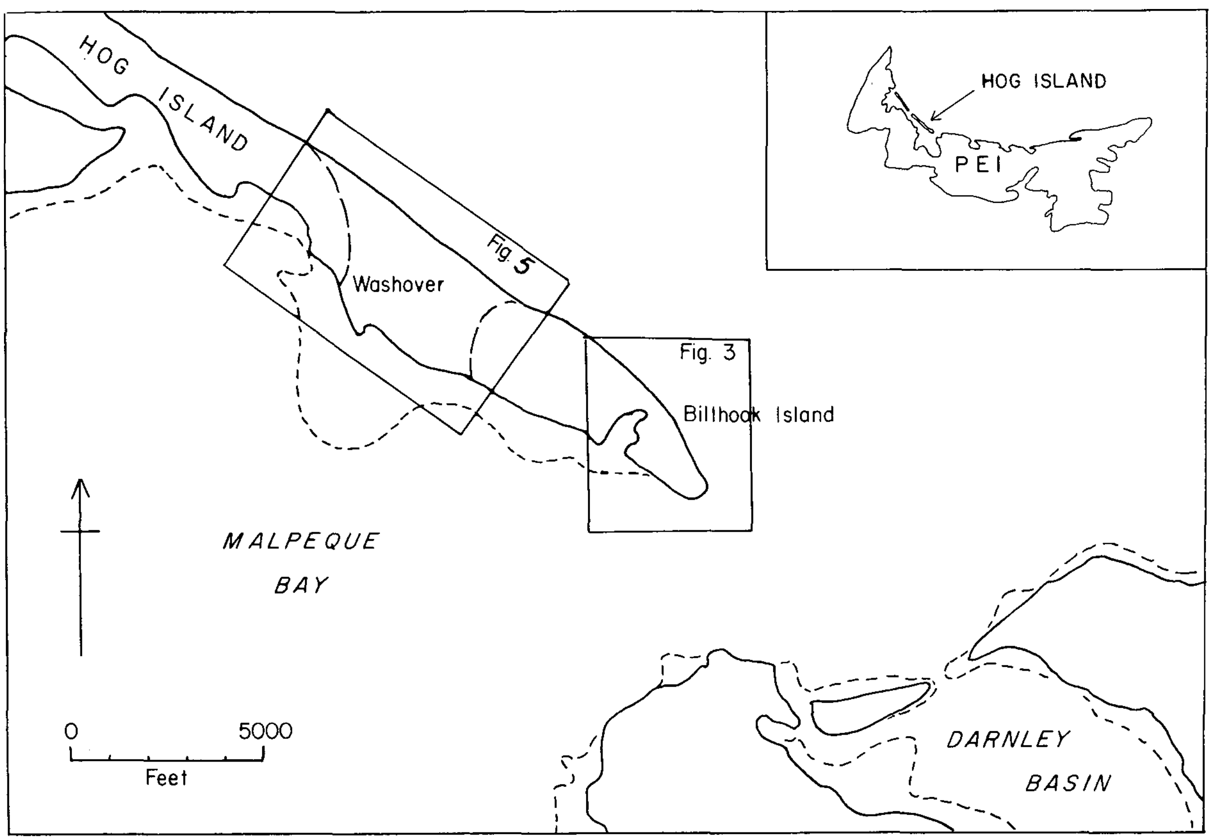

Figure 1 - Location map of Hog Island, with rectangles showing area of Figs. 3 & 5.

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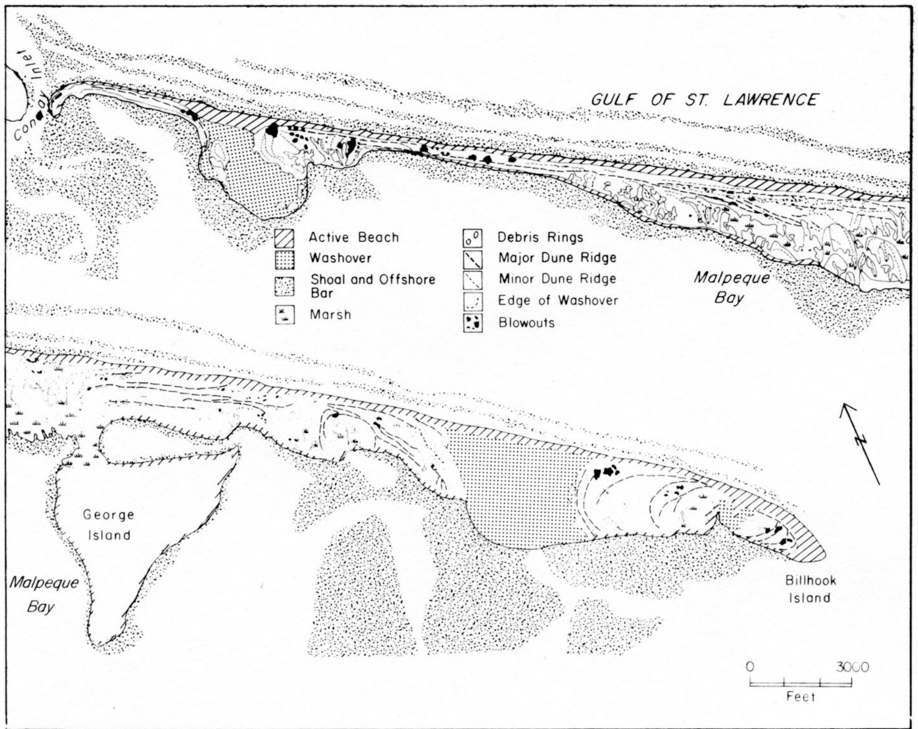

Figure 2 - Principal physiographic features of Hog Island.

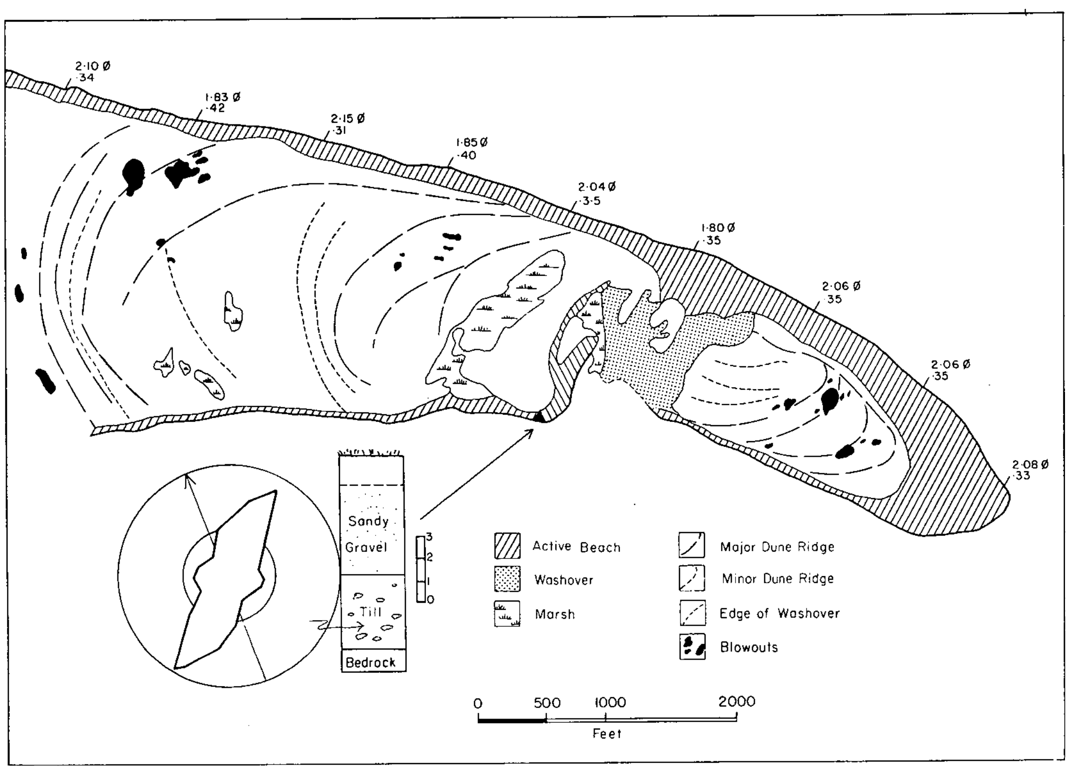

Figure 3 - Occurrences and textural details of dunes southeast of large washover fan; Hog Island (see Fig. 1 for location).

1. Southeast of the large washover fan. This area is shown at a larger scale in Figure 3 and is crossed by two of the section lines shown on Figure 4, AA[1] and BB[1]. The dune ridges rise to 30 ft (about 10 m) and there are conspicuous blowouts in some of the higher dunes, which are sometimes recolonized by vegetation other than the dominant dune grass. A break in the dunes and vegetation occurs at the small washover fan about .5 miles (1.8 km) from the southeast end of the island. To the west of this feature, on the inner lagoon side of the barrier, rock outcrops on the foreshore and is overlain by 10 ft (about 3 m) of till and gravels cut into a low cliff. A fabric analysis of the larger stones in the till gives a pronounced stone orientation in a northeast-southwest direction which accords with striae directions measured by Prest (1962, 1972) elsewhere on the northern shore.

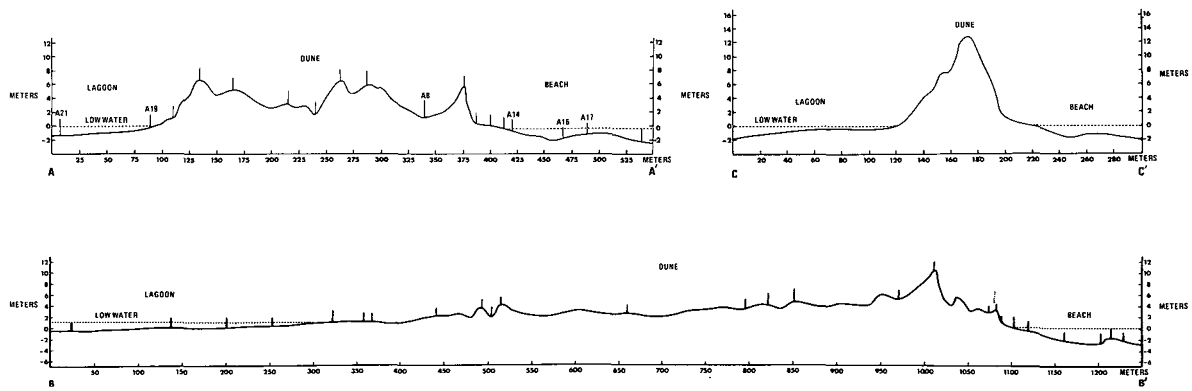

Figure 4 - Two section lines which cross dune ridges southeast of large washover fan, Hog Island.

The end of the island has undergone considerable changes since 1935 (Fig. 5), the main trend being an extension of the shoreline for 600 ft (183 m) in a southeast direction. There has been an associated 200-foot (61 m) extension of the dune area in this direction, but this has been accompanied by a marked retreat of the seaward dunes. Sand accumulation has also occurred in the small washover. The larger washover fan, which separates this 1.5-mile (2.4 km) stretch from Hog Island proper, has decreased in size progressively since 1935 with the growth of new dunes at both ends (Fig. 6). A landward movement of the shoreline and seaward dune limit is again noticeable. This large washover fan represents an infilled inlet which is now undergoing some accretion in the form of low dunes. However, the area is still overwashed during storms since it is only 1.5 to 2 m above lowest tide levels.

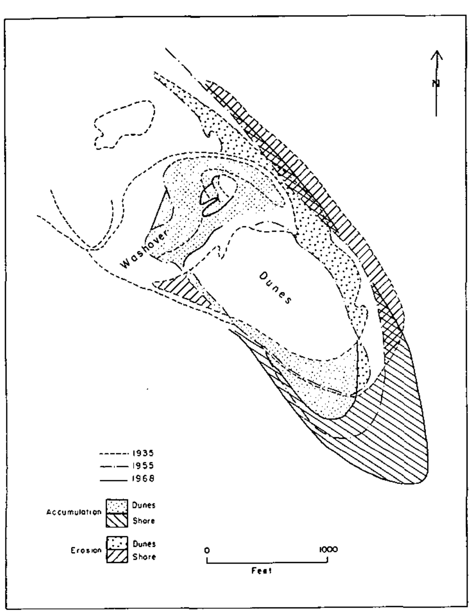

Figure 5 - Extension of shoreline of Hog Island for 600 in southeast direction.

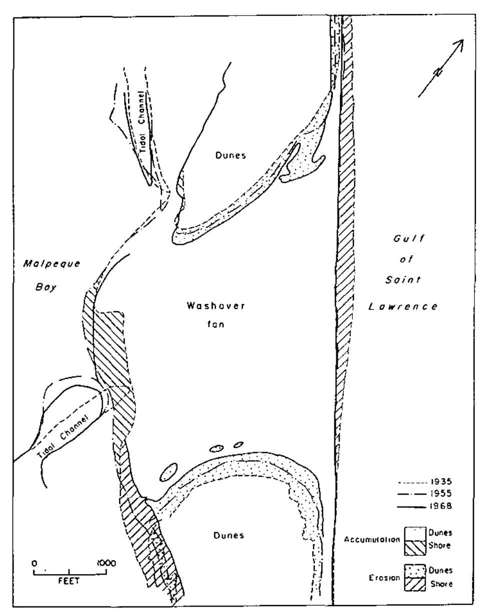

Figure 6 - Decrease in large washover fan with growth of new dunes, Hog Island.

2. Central section, between the two large washovers. West of this area there are two sets of recurved dune ridges extending to George Island, which is mainly rock (sandstone with some volcanics). The easterly set of these ridges recurves tightly around a low marsh area and grades into older dune ridges towards the lagoon. The recurved ridges towards the washover area in the east have been truncated on the ocean side by a linear ridge and show evidence of old blowouts along their crests. The western set of ridges are separated by a washover cut from the eastern one. They are more linear and somewhat higher, and their parallelism is evidence of progradation of the barrier island seawards. These ridges contain blowouts and recurve to the west into a complex area of old dune ridges, marsh and very linear modern ridges. This area extends 1.75 miles (2.8 km) westwards and consists of a dissected, subdued line of old dunes on the lagoon side which is traversed by marshy channels rising towards the ocean. These channels appear to be remnants of overwash channels formed when the ocean dune ridges were either non-existent or very low in elevation. The interfluves represent dune ridges which have been built up parallel to the channels and which in the past have been forested to some extent. The width of marsh area decreases to the northwest where it is succeeded on the ocean side by another set of prograding, parallel, linear ridges which have been much dissected by recent blowout activity.

These ridges meet at a nodal point halfway up Hog Island proper and from there northwestwards the barrier island consists of one or two very narrow dune ridges, which rise up to 14 m or more in elevation and which show a good sequence of dune vegetation from the ocean to the lagoon. These ridges either merge north into, or truncate, a series of older lower recurved dune ridges which again have channels between them grading into marsh areas towards the lagoon.

3. Northeast. Up to this point the barrier island is backed by narrow sandy tidal flats but northwestwards these flats increase in width and merge with the sand areas of Conway Inlet proper and of the infilled inlet to the south. This latter area shows little dune growth, is wind swept and has experienced extensive overwashing into the lagoon; there is a series of defunct tidal deltas and channels. Between the old inlet, and Conway Inlet the barrier island is again narrow with only one high dune ridge which is dissected by blowouts. The ridge recurves into the modern inlet but recent erosion has truncated about 0.5 km at the northeastern end. This section of the island when compared with the middle part has a steeper dune cliff and shows older exposed marsh deposits on the ocean side of the barrier.

Overall, Hog Island shows a tendency to become narrower, less complex, more susceptible to erosion and greater in elevation northwestwards. The Island contains most of the barrier island forms found in the Maritime Provinces as well as a good record of coastal evolution in the trend of the dune ridges, and in overwash channels which cut across many sectors of the barrier.

Textural characteristics of sediments

Results of textural analysis of 47 samples taken along lines A and B across the Hog Island barrier complex are summarized in Table 1. All the samples fall within the sand class and are generally well sorted. There is little variation in sorting across the sedimentary environments although the dune sands tend to be the most homogeneous: an examination of the 5th and 95th percentile values shows that only a very limited size range of particles is present in all samples. This is a reflection of the source material, which is principally well sorted medium grained sandstones and Pleistocene beach and dune deposits, and of the constant reworking of the barrier island sediments by wind and wave action.

Table 1 - Size Frequency Statistics for 47 Samples Taken Along Two Lines Across SE End of Hog Island.

Sedimentary Environment	No. of Samples	Size-frequency statistics				
		$m\phi$	$s\phi$	$sk\phi$	5th Percentile	95th Percentile
Lagoon	8	1.99 to 2.36	0.30 to 0.41	-0.25 to -3.06	1.50ϕ to 1.75ϕ	2.60ϕ to 2.77ϕ
Dune	25	1.78 to 2.35	0.25 to 0.32	0.36 to -0.43	1.26ϕ to 1.86ϕ	2.34ϕ to 2.75ϕ
Beach	14	1.95 to 2.36	0.27 to 0.48	0.01 to -3.03	1.27ϕ to 1.77ϕ	2.48ϕ to 2.96ϕ

All the samples contain less than one per cent of heavy minerals, and quartz is the chief mineral component. A few shell fragments may be present but total carbonate content is generally less than one per cent.

Dune sediments

The dune sands are very well sorted and slightly negatively skewed. The consistency of sorting and skewness values can be seen by the clustering of the dune sediments in the bivariate plot of sorting versus skewness (Fig. 7), which distinguishes the aeolian from submarine environments. There appears to be no significant variation of textural parameters between dune crest and dune slack areas. Along line A a slight increase in mean size towards the lagoon was noted but no such trend was evident along line B.

Lagoon sediments

The lagoon samples are generally well sorted and slightly more negatively skewed than the dune samples though two of them possess a high negative skewness (Fig. 7). The samples were all obtained from shallow sandy areas free of lagoon grasses. Silts and clays derived from rivers flowing into Malpeque Bay are present in the deeper parts of the bay and lagoons, particularly in the Bideford estuary (Buckley, 1969). However, the lagoon sediments in the area sampled are subject to considerable wave-action and are probably derived from reworking of the barrier island beach and dune sands and thus have similar textural characteristics.

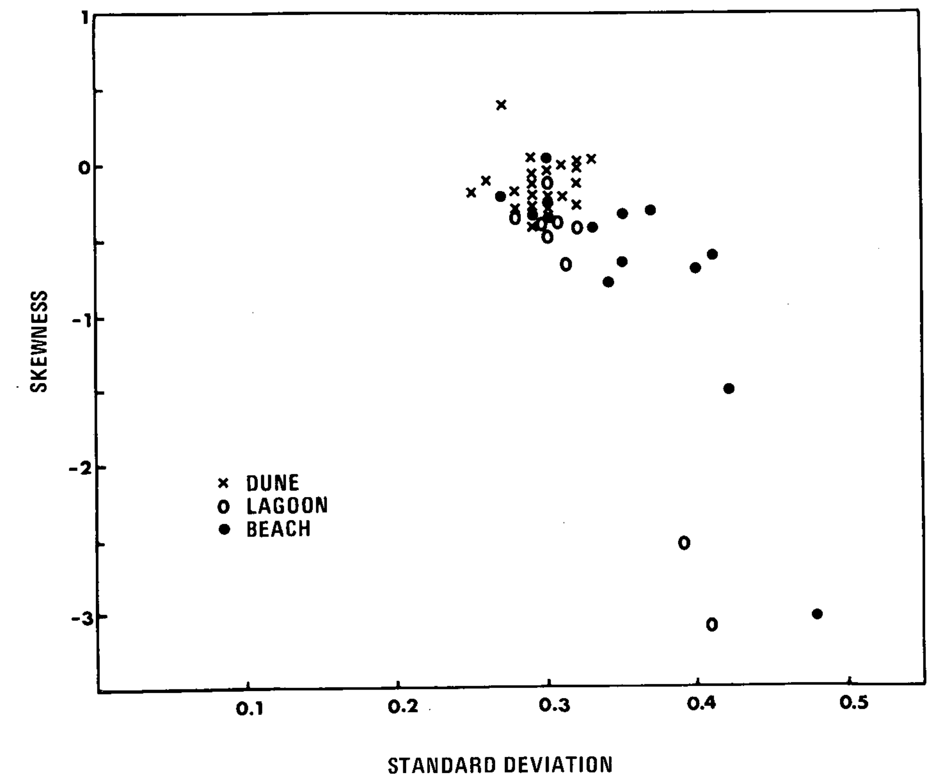

Figure 7 - Bivariate plot of sorting (standard deviation) vs. skewness for the lagoon, beach and dune samples.

Beach and nearshore samples

The beach and nearshore area exhibits the greatest variation of the environments sampled though the variation is still comparatively small. The patterns of mean size and sorting are similar to those found by Greenwood and Davidson-Arnott (1972) in Kouchibouguac Bay, New Brunswick, but the variability is not as pronounced due to the limited range of particle sizes available. An examination of size, sorting, and skewness values across the beach and nearshore area along line A (Fig. 8) shows that the mean size is greatest in the breaker zone where coarse particles are concentrated at the foot of the step. Sediments are finer on the swash slope and foreshore and become finer in the trough and on the offshore bar. Sorting is best on the offshore bar and the swash zone with poorest sorting in the breaker zone and in the trough closest to the offshore bar. Swash and offshore bar sediments are only slightly negatively skewed but higher values are found in the breaker zone and trough where there is some accumulation of coarse particles.

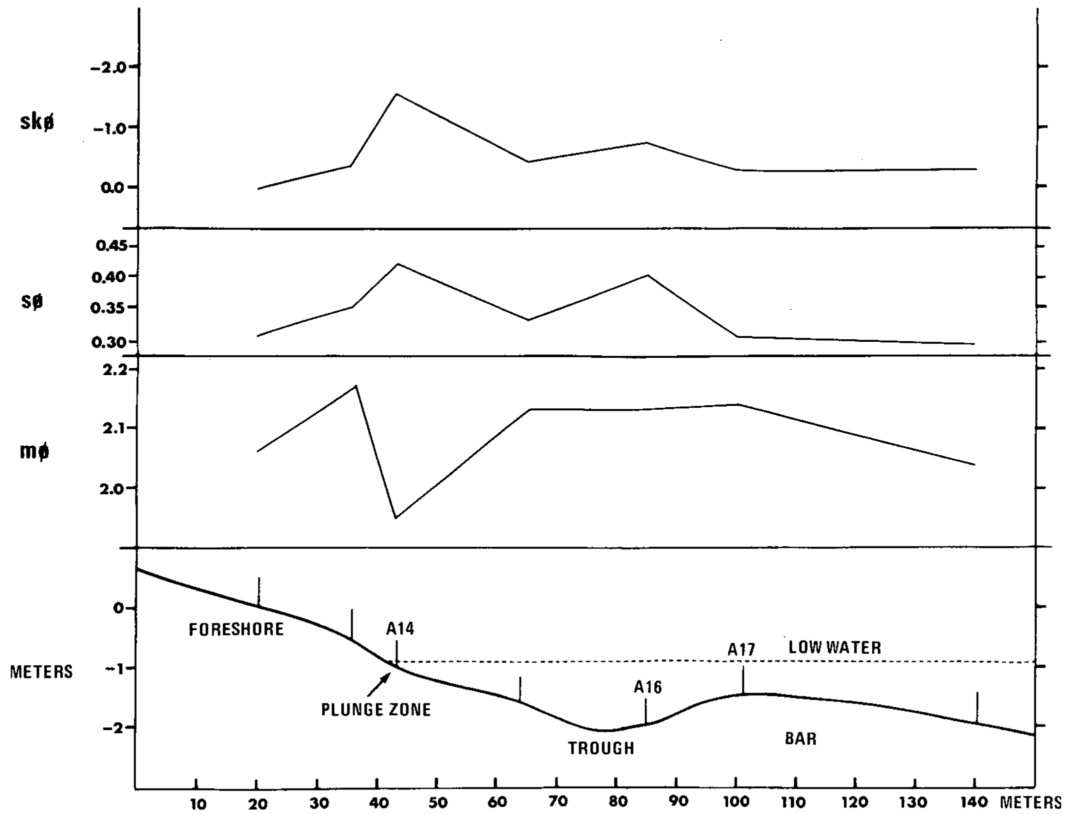

Figure 8 - Part of profile along line A from top of beach to seaward of first offshore bar showing the size characteristics of samples taken along the line.

Size frequency curves for the beach foreshore, breaker zone, trough (closest to the offshore bar), offshore bar, dune and two lagoon samples have been plotted on arithmetic probability paper and log-normal components of each curve have been drawn in by eye (Fig. 9). Using the method of Visher (1969) these log-normal components can be related to transportation by suspension, saltation and traction. All the samples illustrated have one dominant component (saltation population) but differ in the presence or absence of secondary components (traction or suspension populations).

The sample from the beach foreshore consists essentially of a single saltation population virtually identical with that for the offshore bar. No secondary saltation population which Visher associated with swash-backwash components is present. The absence of a secondary saltation population may be due to the fact that the sample was taken above the limit of effective backwash action or to the presence of a single stable size-population on the swash slope (Moss, 1963).

The breaker zone sample, as would be expected, has a dominant saltation population with a secondary one also present, and a distinct traction component. No suspension population is present. The trough sample is similar to the breaker zone sample with a dominant saltation population and a distinct traction population probably resulting from coarse particles rolling over the offshore bar and being trapped in the trough.

The offshore bar, like the beach foreshore, has a single saltation population. The absence of a traction population is probably due to the large particles being rolled into the trough whilst the constant winnowing of waves would cause any finer suspension population to be moved offshore.

The dune sample has a characteristic dominant saltation population with a small but distinct suspension population also present.

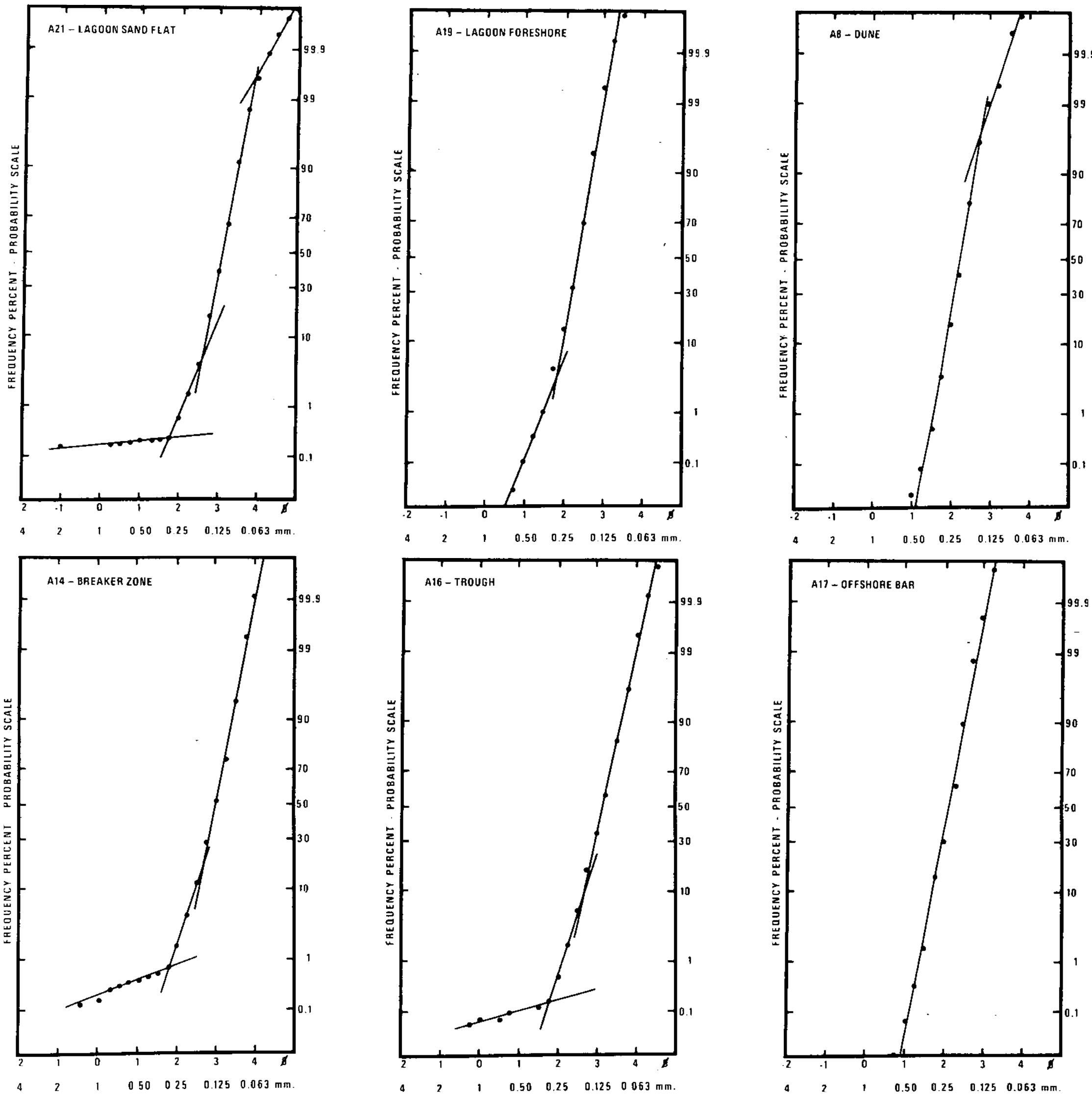

Figure 9 - Size frequency characteristics of selected samples plotted on arithmetic probability paper. Log normal components of each sample have been drawn in by eye. The locations of the three beach samples (A14, A16, A17) are shown in Fig. 4.

The lagoon foreshore has a dominant saltation population with a secondary saltation population but no traction or suspension components are present. However, the lagoon sand flat sample has a similar saltation population but is also characterized by the presence of a suspension and a traction population.

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