

CHANGES IN MIRAMAR-CARANZALEM BEACH, GOA, DURING THE PERIOD OF SHOALING IN AGUADA BAR

G. NARAYANA SWAMY

National Institute of Oceanography, Dona Paula, Goa.

ABSTRACT

The paper presents the results of the studies on changes in the beach features such as accretion and erosion, at four stations along Miramar — Caranzalem beach, Goa, during the southwest monsoon period of 1973. Starting from late May, erosion and accretion have alternately recurred with a periodicity of 15 — 20 days between an accretion and the next erosion, at all the four stations. During the observation period, the southern side of the Miramar beach had a net accumulation of beach material whereas the northern side suffered severe erosion, the remaining portions being eroded to a lesser degree. The cyclic changes in the beach reflect a shifting balance between the wave activity and the littoral currents associated with the anticlockwise gyral circulation in the nearshore regions of Miramar — Caranzalem beach, which is also responsible for the shoaling of the Aguada bar during the southwest monsoon.

INTRODUCTION

This work was carried out as a part of the programme to study the physical aspects of sediment transport leading to the formation of Aguada bar at the mouth of the river Mandovi, Goa, during the southwest monsoon. The shoaling of the Aguada bar has been hazardous for navigation in this river channel of heavy traffic during monsoon period. The river mouth is flanked by two promontories of Cabo Raj and Aguada headland. The southern side of the estuary is fringed by the Miramar and Caranzalem beaches, whereas the northern side is very rocky. The navigational channel in the Mandovi estuary is located close to the left bank with the shoals on either side of the channel. The Aguada bar is more prominently developed and projects seaward from Miramar. Some work directed towards understanding the sedimentation processes in this region has been done by Kidwai (1971), Murty and Das (1972), and Murty, *et al.* (1975). The present study aims at detection of possible large-scale changes in the nearby beaches during the period of shoaling in the area.

DATA AND ANALYSIS

Four stations were chosen on the Mira-

mar — Caranzalem beach (Fig. 1) and periodical beach-profile measurements were made using graduated staffs, from late May to early August, 1973. The observations on beach profiles were not continued beyond August due to the interference with the natural processes, as the whole area was levelled using bulldozers. Owing to poor visibility and constant rains profiling could not be carried out from early July to mid-July, but regular inspection of the site facilitated qualitative assessment.

Only that portion of the beach within 100 m from the reference point was considered for volumetric comparison. A common reference level for all the stations was arrived at by knowing the relative heights of the reference points of each of these stations from the lowest low-water level for that particular day (correction for the variations in the observation times for various stations being incorporated). The volume of beach material per unit length of the beach above this common reference level was calculated for each station graphically from Fig. 2. The temporal distribution of the volume of beach material at these stations was then plotted (Fig. 3, A). The figure depicts the cyclic fluctuations that occurred at the stations during the period of study.

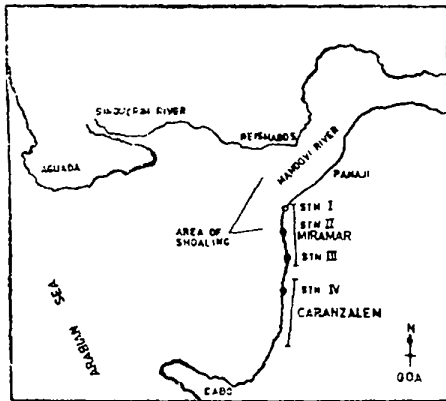


Fig. 1. Location map.

RESULTS AND DISCUSSION

It is seen that the beaches at all the four stations got eroded during the onset of the southwest monsoon (early June). The beach elevations were minimum around the middle of June. The beaches at all these stations had accretion towards the end of June and in early July, and erosion towards the end of July. There was accretion again at Stations II and III during early August, but Stations I and IV did not show any accretion (Figs. 2 & 3).

These common trends were found to be associated with the movement of berm crests towards the reference point during the period of erosion and away from the reference point during the period of accretion (Fig. 2).

These changes occurred with a general periodicity of 15-20 days between an accretion and the next erosion at all the stations. No clear-cut lag or lead in the occurrence of accretion/erosion among the four stations was noticed.

Studies on the comparative changes in the net volume of beach material show that the Station III had the maximum accretion during the observation period and Station I was found to be subject to maximum erosion (Fig. 3, A). In the case of Station III, the net accretion occurred mainly in August when Station I was still eroding. This shows that the restoring mechanism was yet to be operative at Station I in August, whereas it was most effective at Station III. Thus during the period of

study, beach material was accumulated at Station III whereas Station I suffered a net loss, the remaining stations being eroded to a lesser degree.

Changes in the beach profiles are associated with changing oceanographic and hydrographic conditions, and with the availability of beach material (King, 1972). The observed periodicity implies the existence of a transporting mechanism operating along Miramar — Caranzalem beach, changing its direction of action cyclically. The regular shift in the position of berm crests, which is largely due to a shift in the extent of wave activity across the beach, gives an indication that the erosion/accretion phenomena linked with the position of berm crests, are also associated with the extent of wave activity across the beach. One factor which determines individually the extent of wave activity is the tide. The day-to-day tidal ranges have been plotted in Fig. 3, B. Though the periodicity of spring and neap tides has been found to bear no direct correlation with the observed periodicity in the beach changes the tide might have contributed to the phenomenon in an indirect way. The cyclic pattern must be the result of the combined activities of waves, tides and river discharge.

The strong wave activity inside the river mouth during the onset of the monsoon (early June), might have caused the initial erosion of the beaches which might have continued till the middle of June. The beach material thus eroded and kept suspended in water along with the sediment load brought in by the flooded river and the land-drainage, might have been deposited in the nearshore regions of the river mouth. Although high wave activity in the area continues throughout the monsoon period, there has been considerable accretion at all the four stations towards the end of June and in early July. This may be attributed to the littoral currents associated with the anticlockwise gyral circulation (Murty, *et al.*, 1975) which bring the sediments from the nearshore regions and deposit them on the beaches. The storm wave activity predominates in the latter part of July resulting in net erosion of the beaches at all the four stations. Since the 'diamond-shaped' cells of wave crests advancing across the shoals can lock up ma-

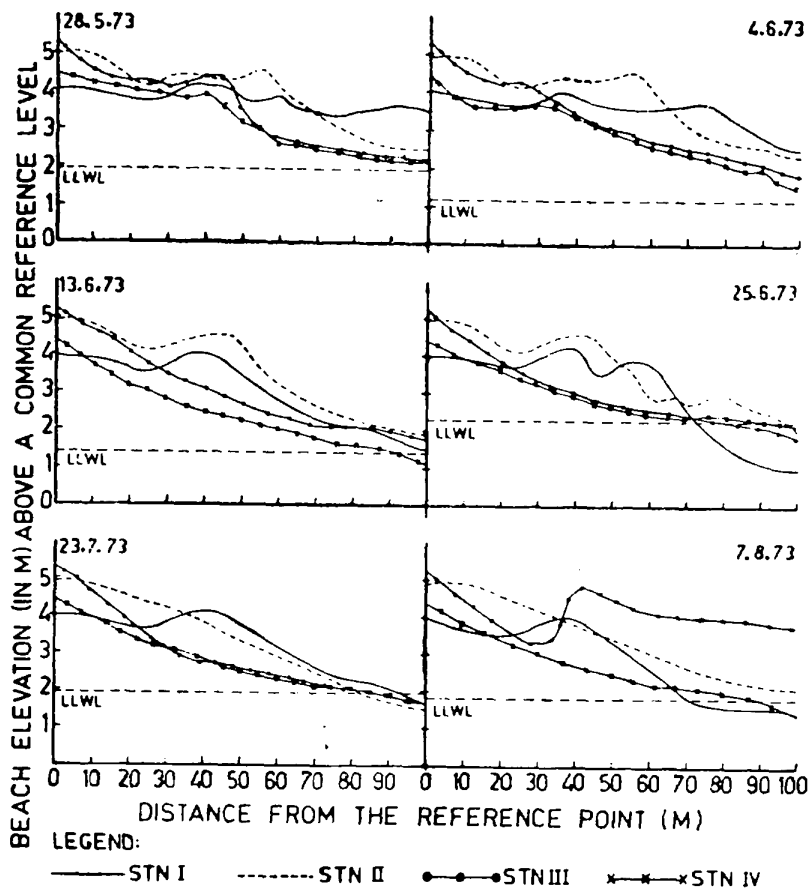


Fig. 2. Beach profiles.

terials at the river mouth causing further deposition in and around the mouth (Oertel, 1972), accretion might have taken place in the beaches again in early August.

These cyclic changes in the beaches may have to be taken into consideration in delineating the mechanism of spreading of Aguada bar opposite to Miramar beach, during the monsoon period. Since the longshore current is the main process that moves sand, and since many process variables affect the form of the beach and alter the environment (King and Mather, 1972), the cyclic changes in the beach reflect a shifting balance between the wave activity and the littoral currents associated with

the anticlockwise gyral circulation in the nearshore regions of Miramar — Caranzalem beach, which is responsible for the shoaling of the Aguada bar.

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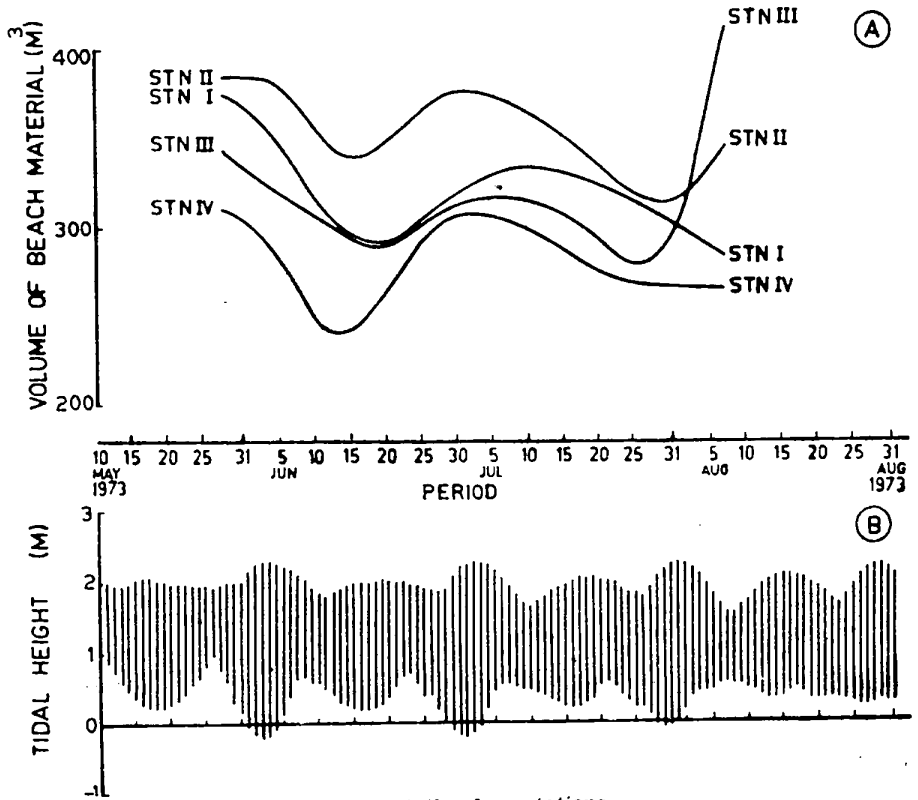


Fig. 3. Cyclic changes at the four stations.
 A — Volume changes.
 B — Day-to-day tidal variations.

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