

Disastrous Effects of Transgressing Sea over Coastal Area-A Case Study of Dwarka and Beyt Dwarka

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Evidences of the transgression of the sea on the land are given in the history. The ancient shore line recorded in maps, deeds and other documents do not coincide with the modern one. Comparison of shore lines of Dwarka coast from the Admiralty Chart of 1848 and Indian Hydrographic Office Chart of 1977 respectively shows that during the intervening period of 130 years the coast line has retreated by about 550 m. Dwarka coast on the Gulf region has been eroding at the rates of approximately 4 m per year since the turn of century. It is the most active coastal erosion site along the gulf region of Gujarat coast. Assuming this rate of erosion to have prevailed in the past, the causes of the destruction by the sea of the ancient Dwarka have been suggested and its possible extent inferred.

INTRODUCTION

The coastal areas of Dwarka and Beyt Dwarka have been subjected to extensive archaeological studies which have provided the information regarding the ancient monuments, their submergence and reclamation several times in the past 2500 years (Rao, 1983:51)(Fig. 1). It is further evident from these studies that the barriers were raised to protect the city and the structures. Archaeological studies also showed the possibility of coastal erosion in this area. However no attempt has been made so far to study the coastal erosion from oceanographic point of view.

The objective of this paper is to study the recession along the coast of Dwarka and Beyt Dwarka in view of their important historical association. The observations are intended not only to characterise the magnitude of recession that occurred along these sections of the coast but also to search for long term trend and its relation to the possible extent of ancient Dwarka.

HISTORY

The Sabhaparva of Mahābhārata depicts that 'Dwarka' was built by Lord Krishna on the ruins of an earlier town known as Kuśasthālī after reclaiming a part of the sea. The other holy place associated with Lord Shri Krishna is Sankhodhara also known as Beyt Dwarka and situated off port Okha. It is believed that Dwarka, being a port, was the main way (*dwāra*) of India some 3000 years ago (Rao, 1987:22). It seems that the sea engulfed the city several times but the land was reclaimed and temples were built and rebuilt.

In his report Rao (1983:35) has mentioned the destruction of Dwarka by the sea atleast twice before Christian era and three times later (between the 1st and 13th century AD). The reasons of constant reclamation and rebuilding of Dwarka must be associated with the influence of religious faith. The Samudranarayana Temple confirms that Dwarka was a port.

PHYSICAL SETTING AND ENVIRONMENT

The Gulf of Kutch lies between the coast of Saurashtra peninsula and southern coast of Rann of Kutch. Dwarka situated on the north western coast is perhaps more permanently scarred by storms. A brief summary of the relevant data related to storms and waves is shown in Fig.2 and Fig.3 respectively. The study area is divided into two physiographic provinces - Dwarka and Beyt Dwarka.

Dwarka region is a low level coast. The coast rises to 16 m above mean sea level at Okha point. The area between the northern bank of Gomti creek in the south to Rupan creek in the north extends westwards and in this paper it is referred as headland. In the north of it the barrier section extends westward. The area is cut into a sandy gently seaward sloping outwash plain, which is truncated at the shoreline. The unprotected dunes reach maximum elevation of about 6 m in the north of Dwarka. Some of the ancient coastal protective structures to control the erosion are also visible at the lowest low water. There are a few offshore cliffs and muddy stretches interrupted by small creeks. Except Dwarka area there are very few inlets of note on this coast. On the whole the coast presents a remarkable straight and unbroken line with coral reefs (Fedden, 1884: 41).

In Beyt Dwarka the shoreline zone typically consists of a marshy sediment which extends between the shoreline and adjacent upland. There are wide tidal flats on southern side of the island for which the sediments are mainly derived from shore erosion (Wagle, 1979: 123). The eastern end of Beyt Dwarka or Sankhodhara is composed of sandy hills. North of Hanuman point a reef known as Hanuman danda extends from northeast to southwest. Between the sandy south-eastern side of Beyt island and mainland of Okhamandal the passage is very shallow. There is a bank in mid channel which becomes dry at low tide. The water deepens towards the south of the island but the many submerged rock outcrops make it unsafe for navigation. The Beyt

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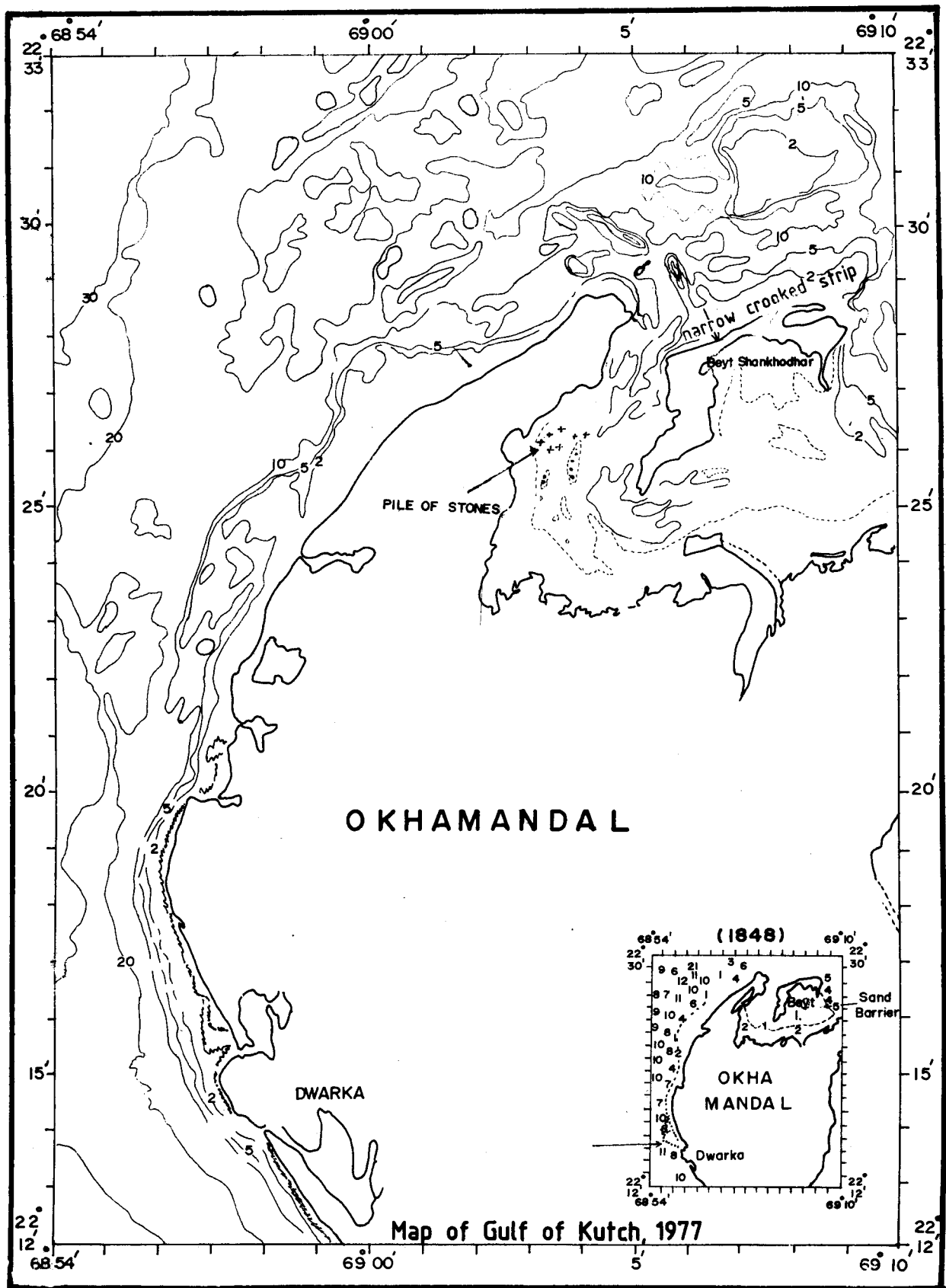


Fig. 1 Map of Gulf of Kutch, 1977

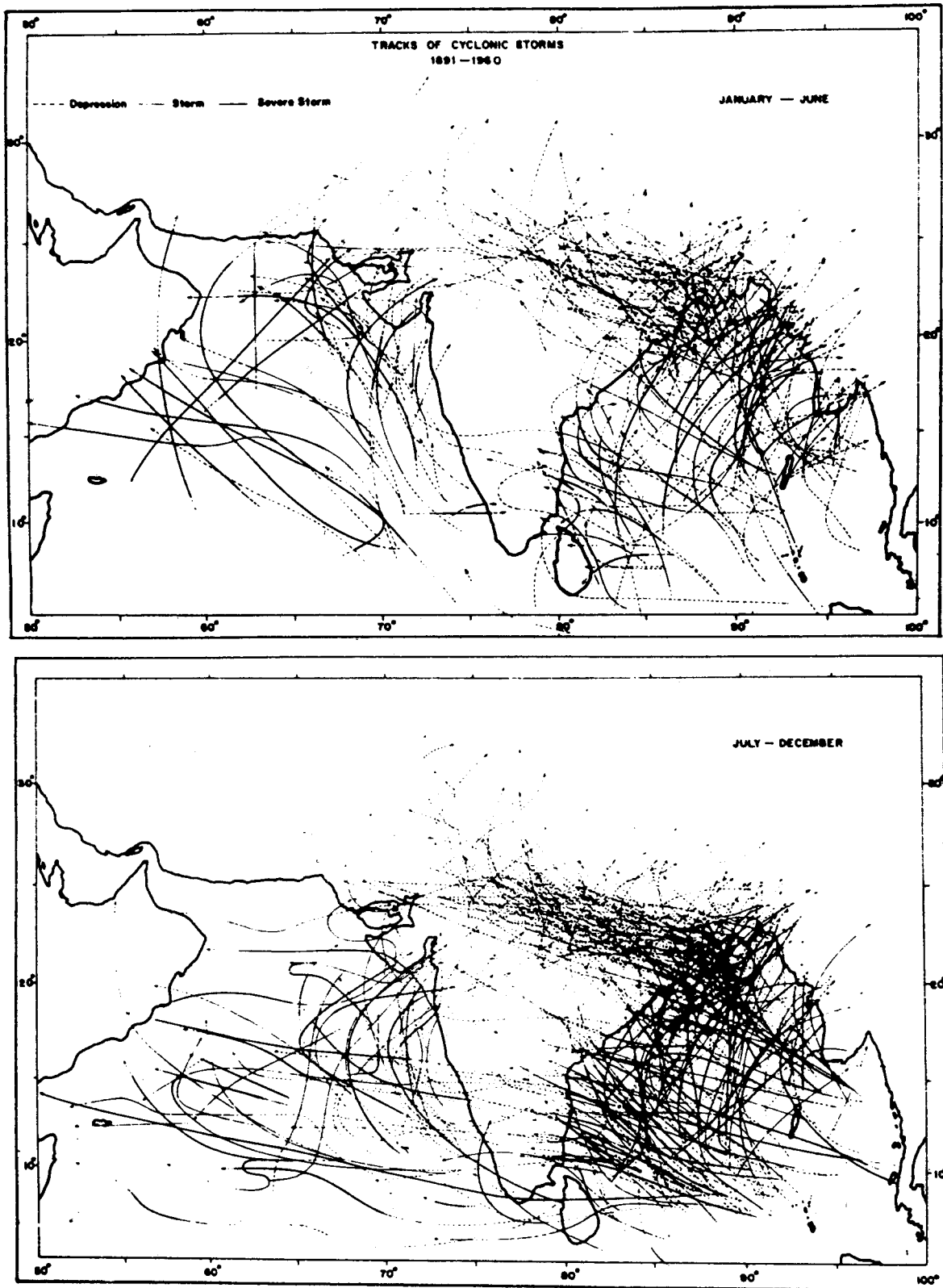


Fig. 2 Tracks of cyclonic storms in the Bay of Bengal and Arabian Sea for the period 1891 - 1960 (After India Meteorological Department 1964).
a. January - June. b. July - December.

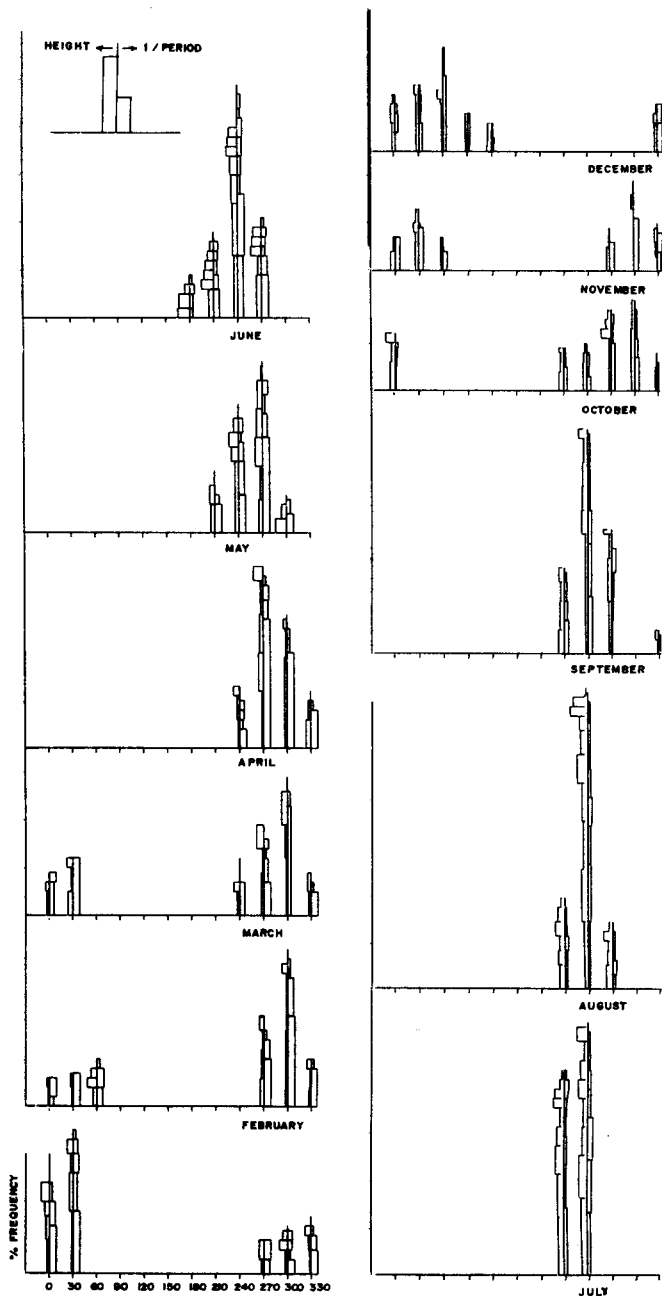


Fig. 3 Wave direction vs percentage frequency of occurrence off Dwarka

bar with eastern sandy point Okhamandal is in line with Beyt.

METHODOLOGY

The study of the shoreline recession was carried out by comparing earlier and existing hydrographic bathymetric and topographic maps. Shoreline erosion was measured from the Admiralty chart of 1848 and the Indian Hydrographic Office chart of 1977. It offers an insight from direct comparison of different periods. The key approach involves compiling charts of different

data sets on a common scale and map projection. This allows superimposition of any pair of maps to document periodic changes of shoreline defined as the mean high water line (Fig. 4). The charts of 1848 and 1977 were selected due to their availability and accuracy. Shore line of 1848 and 1977 charts were digitized and reproduced on a larger scale map using the Benson digitizer on common scale.

RESULTS AND DISCUSSION

Over the course of study of the two charts it has been observed that the area surrounding Dwarka i.e. from Rupan creek in the north to Gomti river in the south is protruding out like ‘headland’ compared to the general coastline. The shape and the extent of this is different on both the charts. To find out this recession in the study area is calculated from both charts and it was found that there is a difference of 3.43 km (Fig. 4). The coastlines were measured on both the charts by taking the geographical grid 22°15' N and 69°00' E as reference. It shows a difference of around 550 m between this period of 130 years, by this difference we get 4 m per year denudation rate.

The headland section of Dwarka suffered erosional losses over its length due to its exposure to sea without any natural barriers. It is seen that coral reefs are abruptly terminating in this particular area. The area is cut into a gently seaward sloping plain which truncated at the shoreline. Ancient man made structures confirm that the area was erosion prone. Whatever the success of defences, they were inadequate for coping up with the erosion. In fact these very structures were helpful to erode the shoreline as after three destruction these became the barriers for the sediment coming from the offshore. The severity and the lack of sediment of erosion for which the dynamic tidal barrier is attributed and the lack of sediment is primarily responsible for the erosion. (Nair *et al*, 1982: 77; Hashimi and Nair, 1988). Along with this, study area has also been dominated by storm events. These storms might have contributed to the recession process along the coastline from time to time (Fig. 2). As long as unprotected sediments are exposed to wave action shoreline recession would be expected. Taking into consideration Lord Krishna’s period and refraining from mixing in such a conjectural factor as some difference between the sea level in Ist century BC and present times, the shoreline of ancient Dwarka could be expected at 8 km. offshore from the present coastline.

A spit like structure shown in the Admiralty chart of 1848 at the depth of 20 m and about 3 km off from the existing shoreline also indicating some possible remains of ancient settlement, further down in the sea. Since no such spit formation is possible at that depth and direction from prevailing oceanographic conditions, it is suggested that this site should be explored for archaeological remains.

In the Beyt Dwarka the recession rate was of the order of approximately 2 m per year. In a single period of 130 years the island had been shown to be receding at an average rate of 8307 m²per year in the north to 4673 m²per year in south Beyt island.

A sand barrier is present to the east of the Beyt protruding the south side of Beyt where the water depth is nearly 0.3 m below the chart datum. A heap of stones about 500 m off the present coast is shown in the chart are probably the remains of some ancient

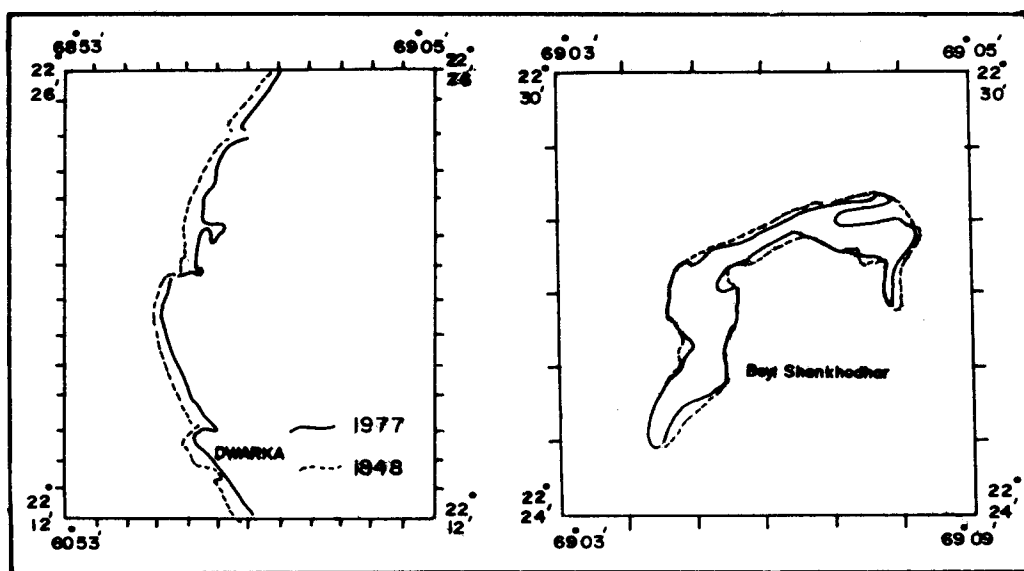


Fig. 4 Map of Dwarka and Beyt Dwarka produced by Benson plotter.

structures (Fig. 1). The barrier which was protecting the shallow portion of south Beyt is also being eroded and a deeper contour of 2 m forms at the edge of the barrier. If we carefully study the features of the area, it seems that the Beyt was not an island infact it was a part of mainland connected to Okhamandal.

The north east portion of the Beyt is also being eroded rapidly. A tongue-like structure which was not existing earlier is shown in the 1977 chart (Fig. 1). If the present rate of erosion continues, the Beyt island perhaps may break into two islands at the narrow crooked strip (Fig. 1).

Apart from the Dwarka and Beyt Dwarka, Positra, Pindara, and Mota Asota (Fig. 5) on the southern coast of Gulf of Kutch were also severely eroded under similar conditions. It is presumed that archaeological remains of this area also might have been destroyed by advancing Gulf. An archaeological excavation may reveal many interesting features.

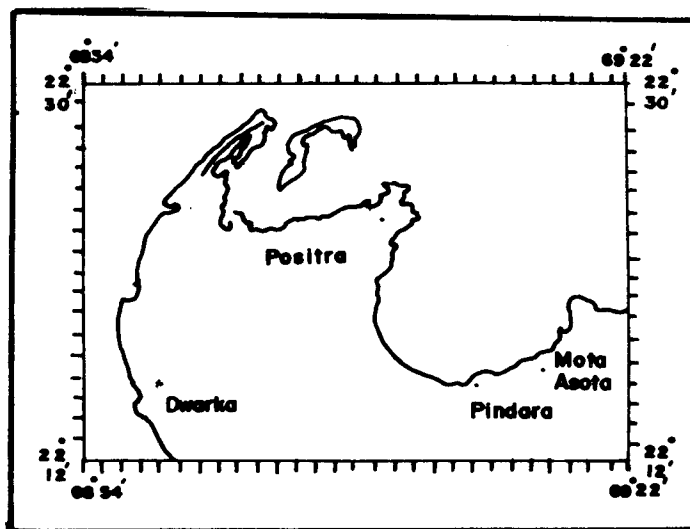


Fig. 5 Map showing Positra, Pindara and Mota Asota area in Gulf of Kutch

CONCLUSION

Charts dating from nineteenth century through present indicate that substantial changes have occurred (Fig. 4). Shoreline changes at Dwarka and Beyt Dwarka have been punctuated by periods of erosion. Even after extending the seawalls shoreline retreat has been dominant. The cause of erosion here is natural. The major factor however is the reduction of sediment transport to this part of the coast.

Shoreline erosion has been very rapid and extensive. Shoreline retreat was 550 m between 1848 to 1977 which represents an average of approximately 4 m per year.

The site is instructive in assessing the role of post occupational disturbance process. The severe retreat of the shoreline over the last 130 years indicate that the process of erosion is uninterrupted.

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