

## PRELIMINARY INVESTIGATIONS ON TRANSIENT EROSION AT KALPAKKAM BEACH, EAST COAST OF INDIA DURING JUNE 1990

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### ABSTRACT

Rapid erosion experienced at the southern end of Kalpakkam beach, east coast of India during June, 1990 with relatively calm sea conditions is found to be related to an imbalance caused by the unusual run-off through Palar river due to an unseasonal cyclone that occurred in May, 1990 and the prevailing longshore currents. The bar at the Palar river mouth was washed away due to river discharge, and the place where the bar situated acted as a sediment trap, thereby cutting off sand supply to the northern beaches. The erosion shifted northwards, but with reduced intensity. The beach got built up from the south progressively.

*Key-words:* Beach erosion, wave refraction, Kalpakkam beach, east coast of India

Kalpakkam is situated about 60 km south of Madras, near Sadras in the east coast of India (Fig.1). Severe erosion occurred on the southern part of Kalpakkam beach during June, 1990. Palar river joins Bay of Bengal on the southern part of Kalpakkam. There are normally two sand bars at the Palar river mouth, of which one is of large size. The depth contours run almost parallel to the coast except near the river mouth, where it flattens offshore. The coastal currents off this area are reported to be of the order of 0.5 knot towards north from February to July, and of the same magnitude towards south from October to December (Hydrographic Chart No. 357, published by NHO).

A severe beach erosion was experienced on 10th June, 1990 at Kalpakkam (near station B, marked in Fig.1). By 20th June, the erosion had advanced northwards causing damages to the coastal properties and continued over the next few days. It was also observed that as the erosion shifted northwards, there was a gradual build-up of the stretch through sand redeposit from the southern end of the affected area. The rate of sand deposition was slow. Within months all the eroded portions were rebuilt to the original width but with diminished elevation (Krishnakumar, Narayana Swamy, Sastry and Krishna, 1992). Even after one year, the affected area could not recoup completely.

These rapid coastal changes occurred at a time when the sea was relatively calm and did not exhibit any unusual activity. Further, there was no report of a similar incidence at this site for the past 25 years at least. The copious rainfall brought by the

cyclonic weather caused unprecedented fresh water discharges from the Palar river in May 1990 (normally dry during that period). This washed out the sand bar at the river mouth. The removal of Palar river mouth bar may be due to heavy run-off and created a trap for the northward bound littoral transport, resulting in the immediate leeward beach section to starve for nourishment causing erosion. As there was no recorded data on waves, littoral currents and bar formation in this region, an attempt was made to study first the littoral transport through wave refraction analysis.

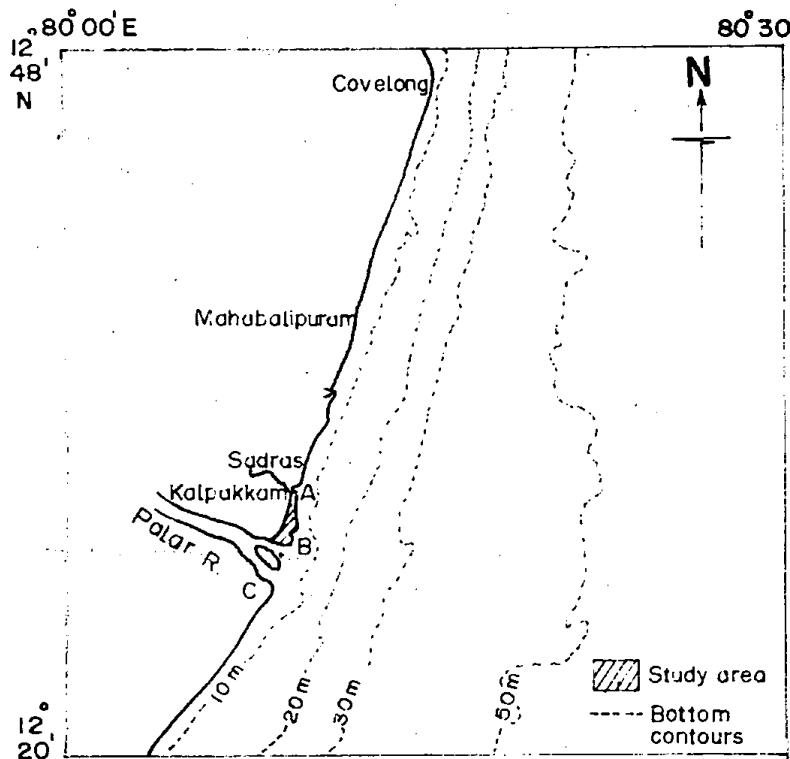


Fig. 1. Location map showing the study area.

Details of waves in the region off Kalpakkam from the reports of NIO (1982) and Chandramohan, Sanil Kumar, Nayak and Anand (1990) show that the predominant directions of offshore wave approach are  $30-90^\circ$  from January to February. These directions slowly change through  $90-180^\circ$  to  $180-270^\circ$  during the next few months, upto September. In October a confused sea state prevails and the November-December directions are  $0-90^\circ$ . The wave periods range between 5 and 15 sec throughout the year and have no consistency over any particular month. The wave climate data documented in these reports are averages of wave data reported by ships of opportunity over many years, further averaged for a  $5^\circ$  lat-lon square. For June, 1990 the offshore wave directions have been reported to be  $180-270^\circ$  and the wave periods 5 - 14 sec.

To accommodate all the possible directions of wave approach in the wave refraction analysis, two extreme directions (ESE and ENE) and the normal direction (E) were selected. Also the most frequent wave periods (8, 10 and 12 sec) were considered. The bathymetric data used are from the available hydrographic charts of this region. The stretch of the beach extended over three arbitrary stations A, B and C was selected for the study (Fig.1). The numerical method of wave refraction as given by Mahadevan (1983) was followed.

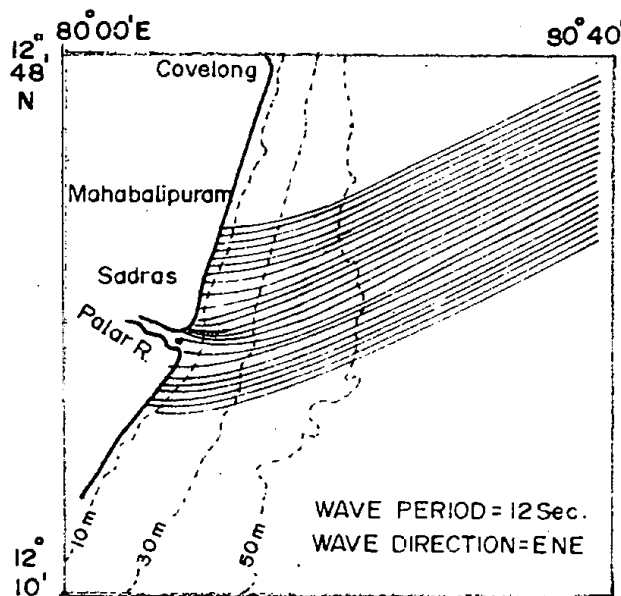


Fig. 2. Refraction diagram for ENE waves with 12 sec period.

Wave refraction diagrams were constructed for the three wave directions with different periods but those for 12 sec period alone are presented here (Figs. 2-4) as typical cases. ENE waves show no appreciable refraction upto 30 m water depth but change their path thereafter (Fig. 2). Wave rays converge at the northern bank of Palar river (at station B) indicating a wave energy concentration. On either side of convergence there is divergence of wave rays showing less wave energy impact. Interestingly 8 and 10 sec period waves approaching from ENE also have similar characteristics.

Fig. 3 shows wave refraction pattern for waves approaching from East with a period of 12 sec. Wave energy concentration is similar to those of ENE waves at station B. Convergence could be noticed at station C also. There are divergence zones on both sides of the convergence.

Fig. 4 is the wave refraction diagram for waves from ESE with 12 sec period. Wave energy convergence at station B is similar to those of earlier cases. Compared to 8 and 10 sec period waves, 12 sec waves show a much refracted pattern with sharp

convergence at station B and slight convergences at the southern part of Mahabalipuram and southern bank of Palar river mouth. Divergence zones can be noticed on both sides of station B.

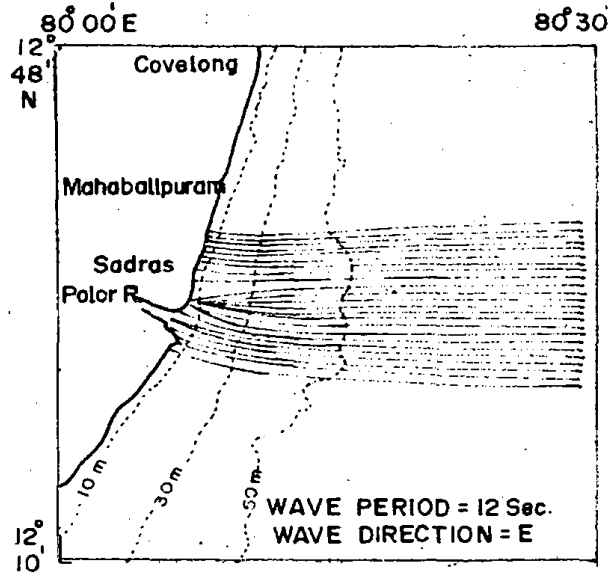


Fig. 3. Refraction diagram for E waves with 12 sec period.

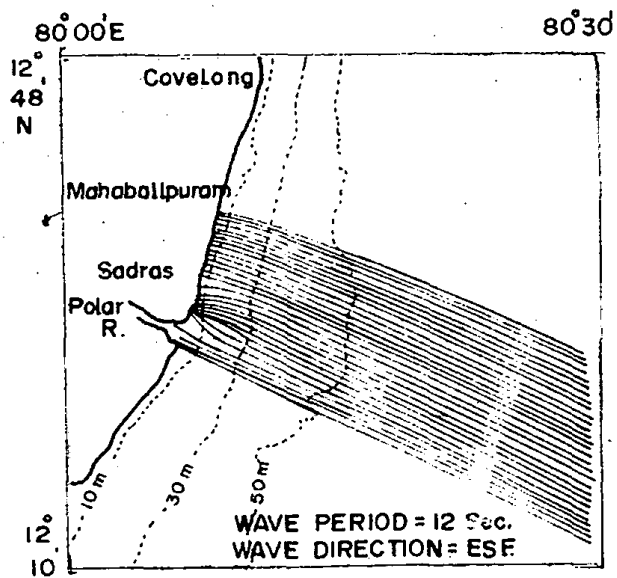


Fig. 4. Refraction diagram for ESE waves with 12 sec period.

One could thus see a definite wave energy concentration, irrespective of wave direction and period at station B with divergence on either side. Higher waves, compared to those at other regions, could be expected at station B for any wave direction and period. For 12 sec wave period, higher waves could be expected on the southern side of Mahabalipuram and near station C also. It is noted that the degree of refraction increases with an increase in wave period. The asymmetric distribution of wave heights along this stretch would give rise to longshore currents. One can expect flows from station B to either side and also towards offshore between stations A and B, and B and C. High wave energy concentration will always keep sediments in suspension at station B.

Portions of Kalpakkam beach are always under the threat of erosion and will show up the tendency when the longshore sediment drift is not sufficient to keep up the dynamic equilibrium. A combination of physical factor could conjure up to create the transient phenomenon similar to that in May, 1990. During the subsequent year (1991) when there was no cyclonic activity similar to the one in 1990, the beach was intact. However, the damage occurred during the previous year had not nullified fully.

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