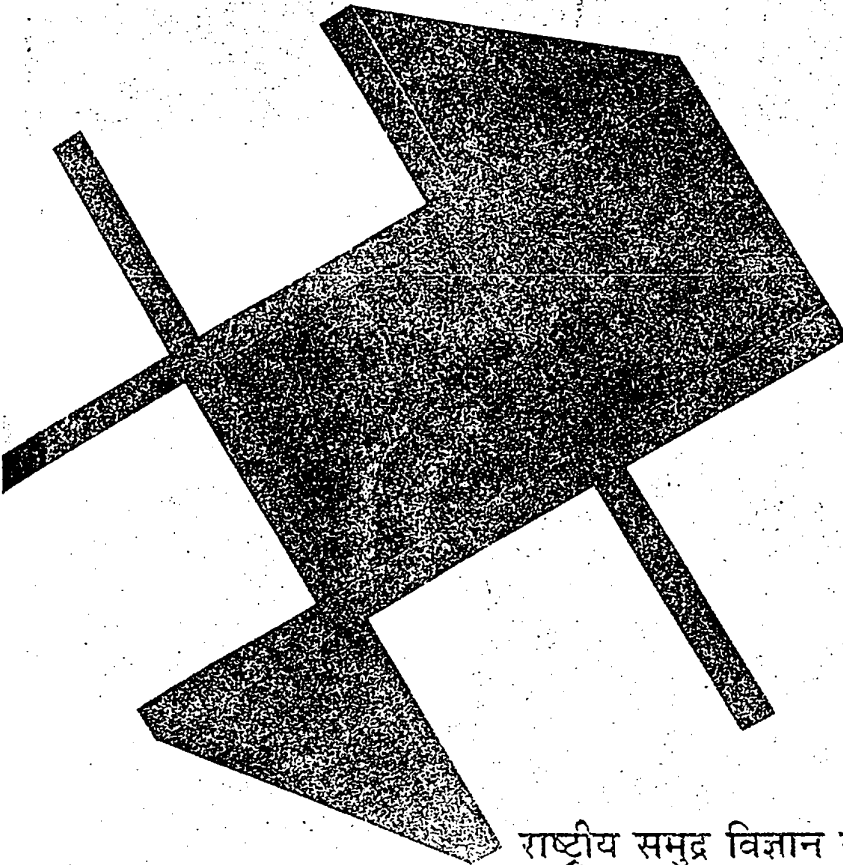


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**Coastal Environment Series**

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Sand Dune Systems of Rajebhag  
(Nagorcem), Canacona, Goa

November 1998



राष्ट्रीय समुद्र विज्ञान संस्थान

**NATIONAL INSTITUTE OF OCEANOGRAPHY**

DONA PAULA, GOA - 403 004, INDIA

Coastal Environment Series

**THE DISTRIBUTION OF AND IMPACTS ON SAND DUNE  
SYSTEMS OF RAJEBHAG (NAGORCEM), CANACONA, GOA**

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## INTRODUCTION

In 1996, the National Institute of Oceanography, Goa, played an important role in the formulation of the Coastal Zone Management Plans (CZMP) of Goa by delineating ecosensitive areas along the coast. These studies were carried out on a regional scale. The present report deals with microscale studies of the coastal zone of Goa to assess the health of coastal ecosystems, the sand dunes in particular, sectorwise, as a follow up of the above. The coastal belt of Rajebhag (Nagorcem, Canacona Taluka) is the first in this series. The main objectives of this work are to identify and document: (1) the nature, extent and distribution of sand dunes at Rajebhag, and (2) human interference and impacts on these dune systems, if any.

## METHODOLOGY

Field work along the coast of Rajebhag was conducted on 8 and 30 October 1998. Several transects, parallel and perpendicular to the coast, were undertaken. These include detailed physical observations of geomorphic features present. Photography of intrinsic elements was carried out and violations of coastal regulations were noted. In this report, the Rajebhag temple has been considered as a reference point.

Topographic maps in the scale of 1:50,000 of the year 1981, Sheet 48 J/1, published by the Surveyor General of India, have been used in the study. In addition, aerial photographs of the year 1972 and IRS 1C satellite imageries of March 1997 have also been utilised for the identification of geomorphological features.

## DESCRIPTION AND GEOLOGY OF THE AREA

Rajebhag area is bounded by Talpona river in the south, a creek in the north, the Arabian Sea in the west, and a tarred village road in the hinterland in the east (Figure 1). An ancient temple is located about 125 m from the main road, and about 400 m from the beach (high water line), these distances are based on the Survey of India toposheets. A house with a barbed wire fencing is located behind the temple, close to the river bank. The sea shore comprises a linear sandy beach, more than 50 m wide, with a rather steep gradient towards the sea. Casuarina vegetation is prominent along the entire beach just above the high water line, also identified with the help of satellite imageries. A small rocky headland is found further north where a shallow creek opens into the sea. The southern part of the beach, an area of heavy siltation terminates into a conspicuous sandy spit distinctly observed on the satellite pictures; this accretion-prone feature virtually blocks the mouth of Talpona river (Figure 1), leaving only a narrow and shallow passage which is used as a navigational channel by small boats. A scarp with a wave-cut platform extending about 100 m north was identified along the beach indicating that erosive processes are also operational particularly in the northern half of the beach (Photo 1). The bank of the river (bay) bordering Rajebhag is mostly built up; however, the bank on either side of the jetty is dotted by luxuriant mangroves which extend upstream beyond the railway bridge. Shoals and mangrove islands are seen within the estuary.

Beyond the beach and landward, the entire area from the creek in the north (Photo 2) to the river in the south comprises an undulating and distinct sand dune field, being more conspicuous in the southern part of the area. This feature is also identified in the satellite imageries. The landward limit of sand dunes can be fixed slightly beyond the temple which is located about 400 m from the beach according to Survey of India toposheets. No sand dunes were observed east of the road although the entire area is sandy. In general, sand dunes are rather low, but at places the dunes rise to more than

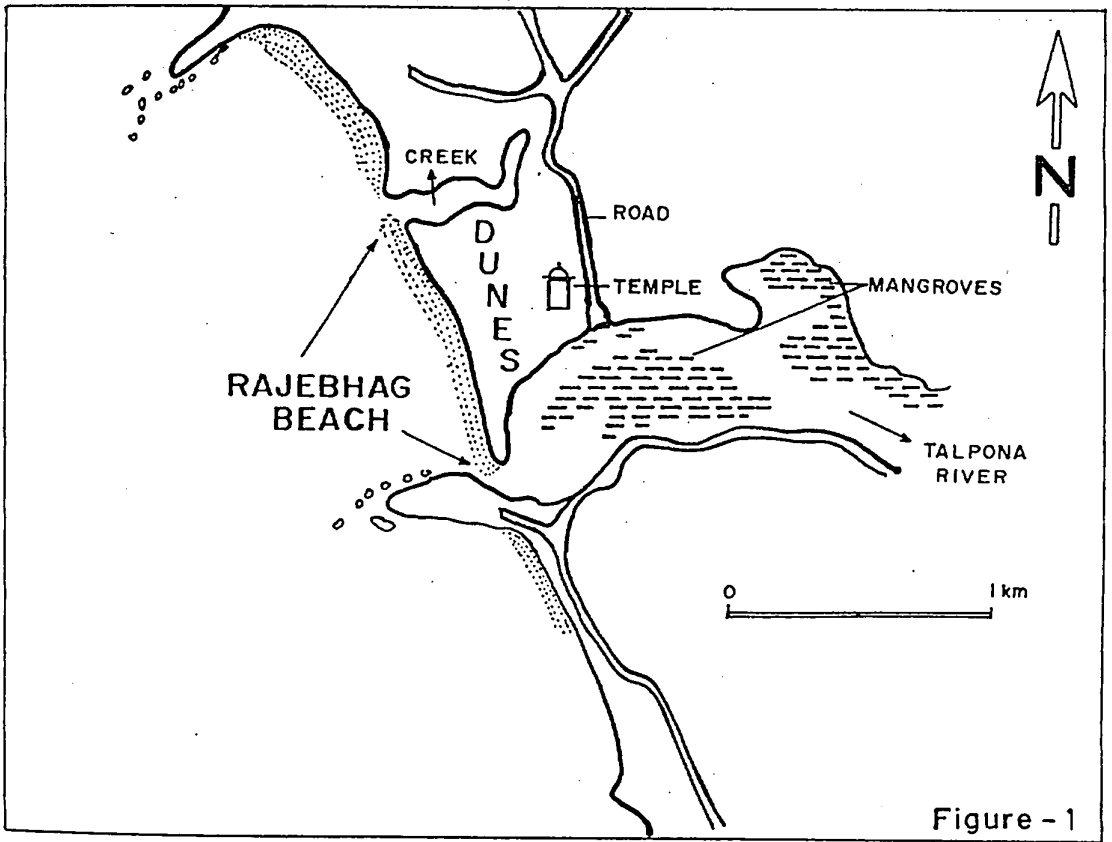


Figure - 1

MAP OF THE STUDY AREA

- Source : 1. Toposheet 48 J/1  
 2. Field data

2. meters from their base, as is the case behind the temple. Sand dune vegetation is rather sparse in the northern part but is found to be more prominent in the southern part. A chain of dunes covered with vegetation were also identified along the spit. Of the entire area studied, the dune belt adjacent to the beach is largely pristine and unsullied (Photo 3). Therefore, majority of the sand dunes which extend more than 400 m from the high water line in the area surveyed can be termed as stable in nature.

A new road leading towards the river and the beach is being constructed, starting from the main village road in front of the temple. The new road is in the process of being laid using road metal mixed with mud; a roller has been used to compact the surface. Mud used consists of brownish yellow mud with metamorphic rock pieces. This road skirts the river bank and leads towards the beach. The road which continues along the river bank terminates about 100 m from the beach. The entire stretch of the road, from the temple towards the beach, passes over a pre-existing sandy terrain.

A characteristic feature of this area is that sand dunes back the beach as well as the creek in the north and the river bank in the south; moreover, mangroves inhabit the bank on either side of the jetty where swamps are identified. Such a ecologically sensitive set-up qualifies the entire area under CRZ I category according to the Notification of 1991. Detailed guidelines which also include the Nagorcem coast as CRZ I are laid down in the CZMP approval Notification of 26 September 1996, issued by the Ministry of Environment and Forests, the prevailing regulations which govern coastal activities in Goa.

### **HUMAN IMPACTS ON SAND DUNES AT RAJEBHAG**

Distinct human interference on sand dunes of the area has been observed at several spots (Photos 4 - 8):

1. A significant area occupied by sand dunes has been bulldozed and razed. In fact, when we visited the site on 8 October 1998, we observed a bulldozer in operation and in the process of levelling dunes (Photo 4). This spot is now flat, disrobed of dune vegetation, and hence sand lies exposed. This site which is now severely degraded is located behind the temple (Photo 5).
2. By 30 October 1998, a huge pile of dune sand was found behind the temple where some construction material was also observed. Also, sand dunes in the north-eastern corner, seaward of the village road, were completely cleared and stripped of bushes and related dune vegetation (Photo 6). This patch now lies bare and altered.
3. The new road which is being constructed repeatedly cuts across sand dunes (Photo 7). As a consequence, these sand edifices are also damaged at many places along this road. This is because the sloping faces of the dunes have been levelled to facilitate laying of the road leading towards the beach. At three places where sand dunes are obliterated, loose sand has been rendered mobile, has covered the new road, and has also slipped into the adjacent river (Photo 8). This portion of the road bordering the river faces an imminent collapse; sand bags are seen supporting the river-face of the road embankment.
4. Some dunes located on the spit were also found tampered with. There are signs which show that sand has been mined and removed. This situation is however not alarming as in the case of (1) and (2) above.

## **SYNTHESIS**

The coastal belt of Rajebhag is characterised by a wide sandy beach (including a spit) backed by vegetated sand dunes, and mangroves within the river and along the banks. Coastal ecosystems such as sand dunes show a dynamic behaviour which has to be to be understood, respected and not

contradicted by anthropogenic influences. If not, their intrinsic value is lost. Coastal dune belts for example, are among the most diverse landscapes in the world, they have multiple functions and are hence of immense value to coastal populations.

The role of sand dune ecosystems can be summarised as follows: (i) The beach - dune environment is a highly organised system, features of coastal stability, the result of a delicately balanced ecological equilibrium between the forces of the ocean and loose coastal sediments, (ii) The dune environment is classified as edifices of extreme fragility, sensitive and vulnerable due to its propensity for changes under even slight environmental stress, (iii) Sand dune chains, as high as 10 m, are categorised as Nature's line of defense as they arrest blowing sand, deflect wind upwards, assist in the retention of fresh water and protect the hinterland from attack by waves, (iv) Coastal sand dunes serve as "sand banks", are sources of beach nourishment and also neutralize and dissipate wave and current energy in the coastal zone and maintain the sedimentary and dynamic equilibrium of the dune - beach ecosystem, (v) Dune vegetation acts as sand binders and preclude loose sand from advancing inland and thus menacing coastal populations, (vi) Dunes protect the hinterland from winds and other forces and hence make the zones behind dunes as areas of peace and tranquillity, (vii) Sand dunes of Goa are about 5000 years old, but can be as old as 6400 years, (viii) The predicted sea level rise is bound to inundate coastal areas with a profound effect on the coastal zone; dunes stand guard against any sea level rise as they will act as Nature's wall of defense. Therefore, these geomorphic edifices have to be preserved at all costs.

## CONCLUSIONS

1. A large part of the coastal zone of Rajebhag is pristine and unsullied. This observation is supported by ground (physical) data as well as satellite imageries.



2. Sand dunes with vegetation characterise the entire area between the temple and the beach; prominent dunes, at places more than 2 meters high, extend even beyond the temple located 400 meters from the beach; most of these sand edifices appear stable.
3. There are signs of a major construction activity behind the temple.
4. A significant area comprising sand dunes was demolished (using a bulldozer) and flattened between 8 and 30 October 1998; now the dunes, particularly those behind the temple are severely obliterated. Loose sand is likely to blow inland during heavy winds.
5. Sand dunes are also found to be damaged at many places along the new road that is being constructed; human intervention has resulted in the mobility and consequent loss of sand, observed at three spots along the river bank.
6. Natural erosive processes are in operation along the northern part of the beach whereas accretion is observed along the spit in the south.
7. Since the Rajebhag coastal area has been classified under CRZ I category by the Ministry of Environment and Forests, the levelling of sand dunes and construction of a road along the river bank tantamount to blatant violations of prevailing CRZ laws.

### **ACKNOWLEDGEMENTS**

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Photo 1: A wave-cut scarp (and a berm) which run more than 100 m along the beach indicating natural erosional activity. Sand dune vegetation along the high tide line is intact. The accretion-prone spit is seen in the background (30 October 1998).

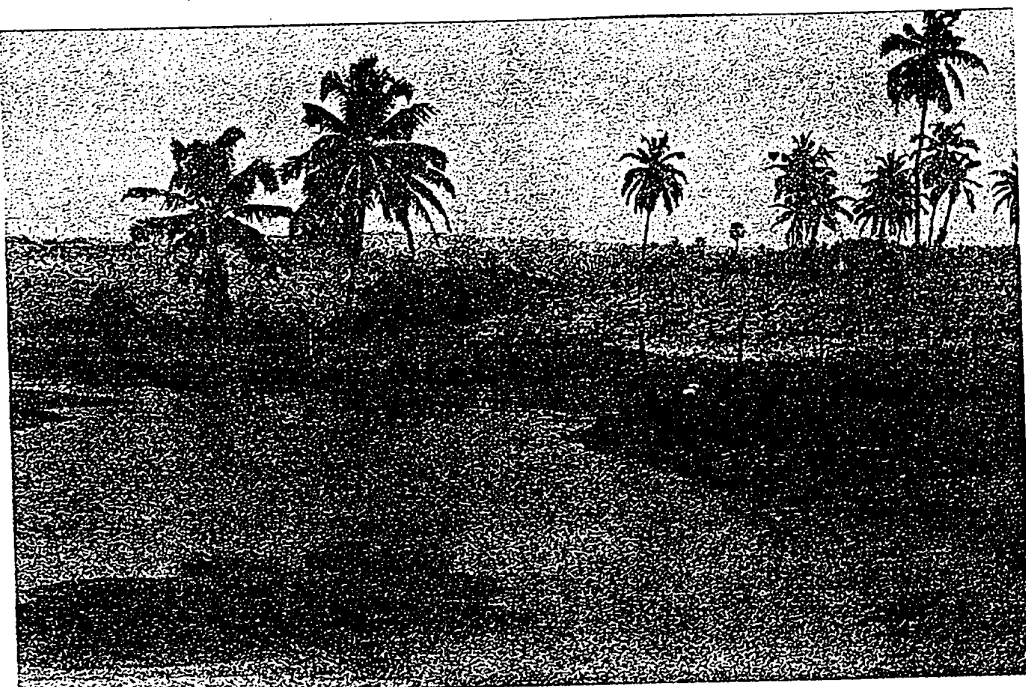


Photo 2: High sand dunes are identified up to and along the creek in the northern part. Dune vegetation is rather sparse here (30 October 1998).

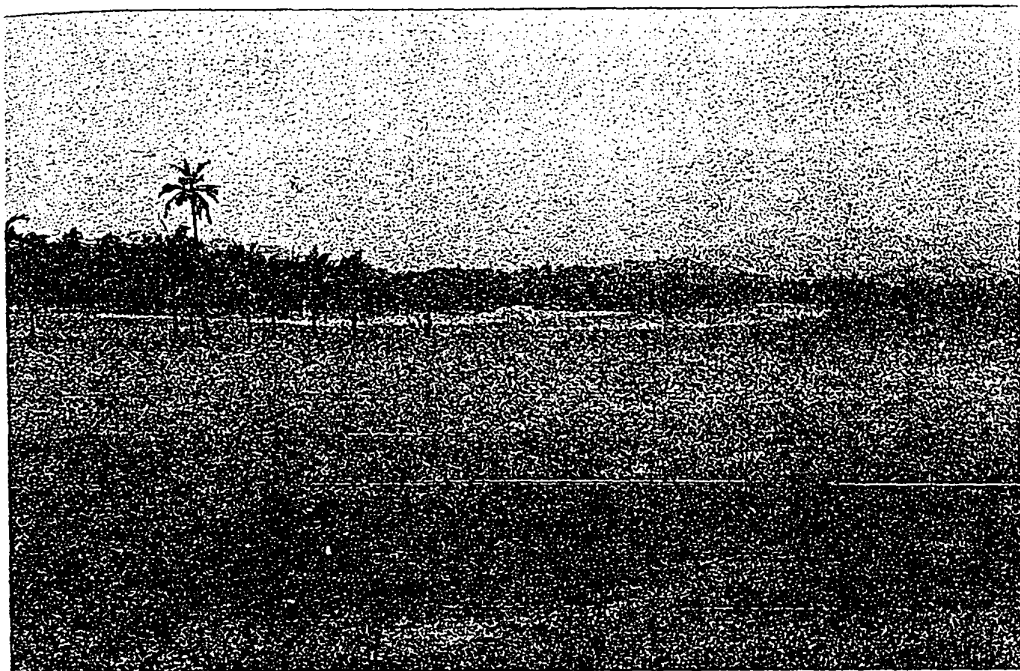


Photo 3: The coastal dune strip adjacent to the beach (foreground) is largely pristine and unsullied. Disturbed dunes are seen in the background (30 October 1998).

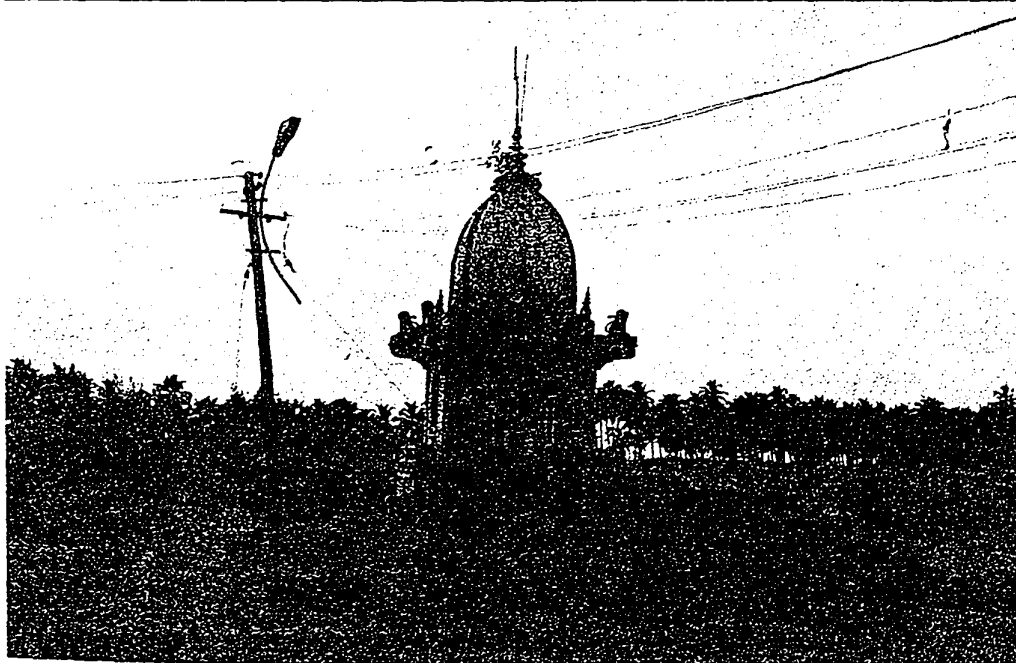


Photo 4: A large area (behind the temple) comprising 2 to 3 m high sand dunes is being demolished and levelled using a bulldozer (seen in the photo). This activity is a violation of CRZ rules (8 October 1998).

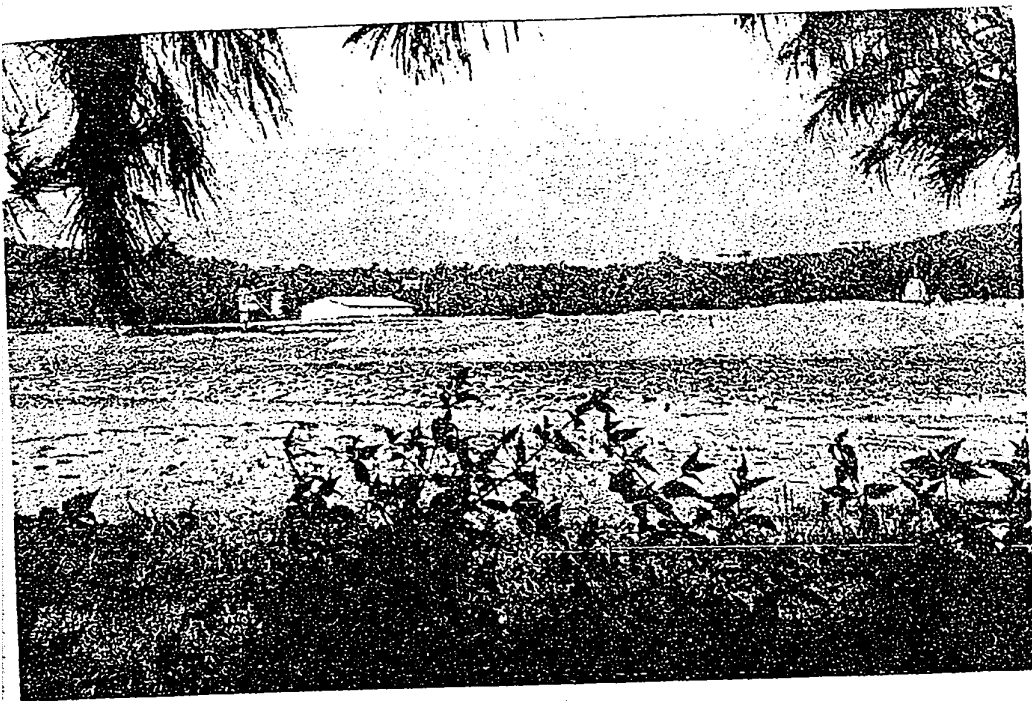


Photo 5: Signs of heavy anthropogenic activity over a large area where sand dunes have been razed, as viewed from the beach. Some structures (left) and the dome of the temple (right) can be identified (30 October 1998).

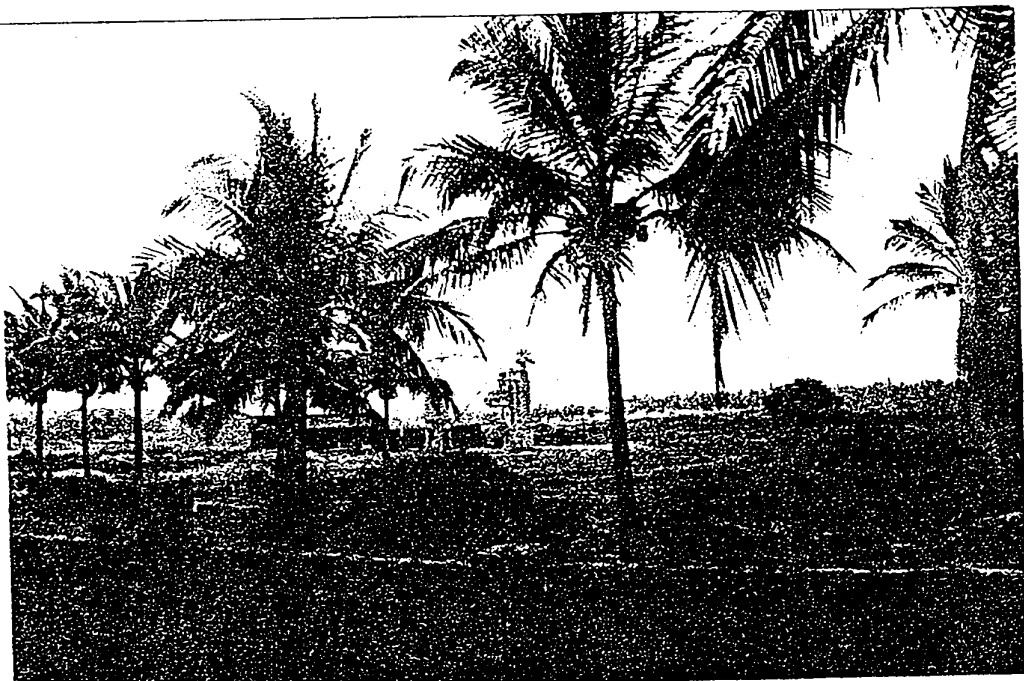


Photo 6: The north-eastern corner of the study area, seaward of the existing village road, where dune bushes have been completely cleared. The entire area now lies bare (30 October 1998).

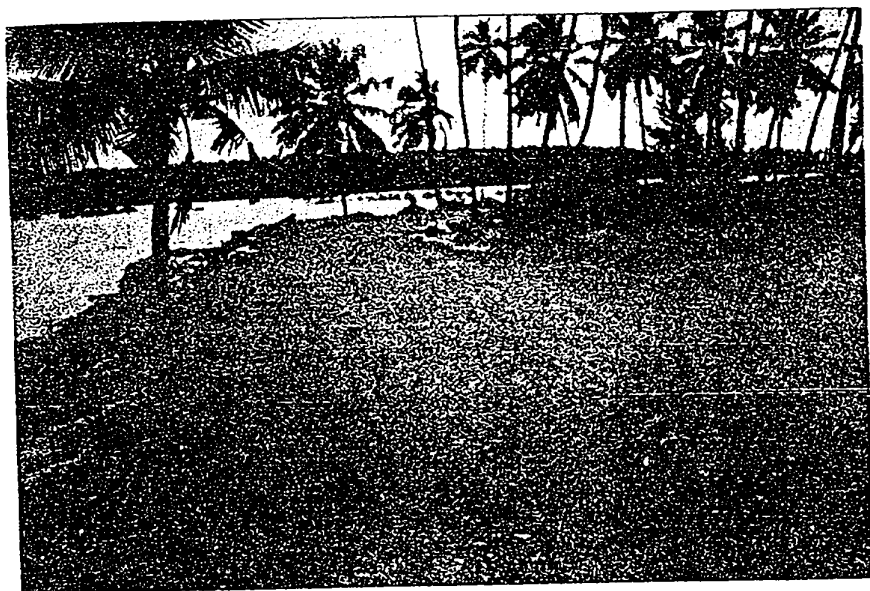


Photo 7: A new road is being constructed over vegetated sand dunes. This road skirts the bank of river Talpona inhabited by mangroves (on the left); sand dunes are seen on the right. This activity is a violation of CRZ laws (8 October 1998).

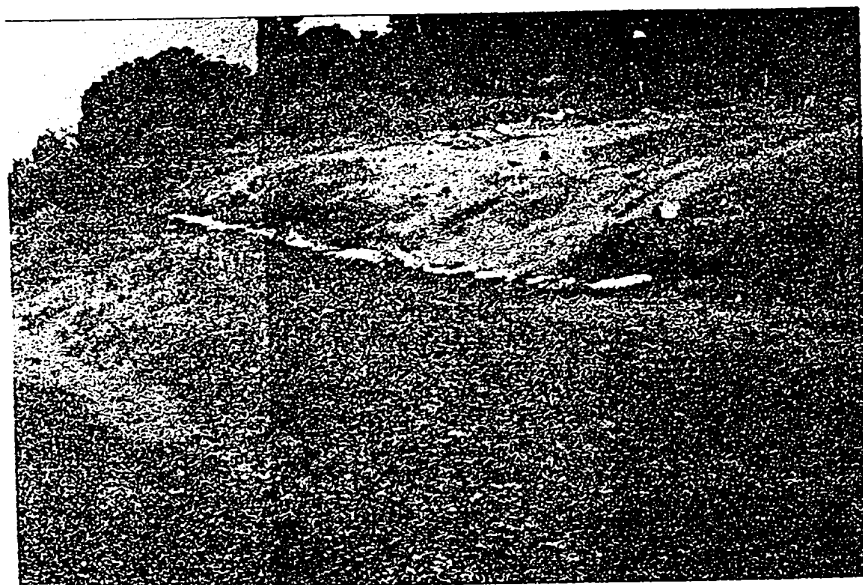


Photo 8: Further towards the beach, the road has been laid by levelling sand dunes thus damaging them. This spot, stripped of vegetation, is now bare. A large quantity of sand has slipped into the river (on the left) (8 October 1998).