

Sand Fences: An Environment-Friendly Technique to Restore Degraded Coastal Dunes

ANTONIO MASCARENHAS

National Institute of Oceanography, Dona Paula – 403 004

Email: mascarenhas@nio.org

Abstract: An experiment to rebuild a dune field is attempted at Miramar beach, Goa. Installation of sand fences, a simple, cheap and environment friendly method of inducing accretion of sand is proposed as a remedial management option.

Keywords: Sand fences, Coastal dunes, Environment, Goa.

An experiment to rebuild a dune field is attempted at Miramar beach, Goa (Fig.1). Although sand dunes are generally low and covered by creepers, prominent bushy dunes 5 m high are found. This stretch constitutes the only dune belt within the estuaries of Goa (Mascarenhas, 2002).

Extensive use of beaches for recreation has resulted in dramatic modifications of the sea front. Sand dunes have borne the maximum brunt of human activities. Miramar beach, one of the most frequented beaches of Goa, is often crowded, overused, and is hence under stress. Large volumes of sand are blown inland (Fig.1), creating hazardous conditions for public. Aeolian transport of beach sand was noticed since 1977 (*see* Mascarenhas, 2002), and is thus occurring over the last 30 years. This paper describes an environment friendly technique to curtail loss of beach sand by wind, and to regenerate damaged sand dunes.

Field investigations at Miramar indicate that a 400 m long strip of beach, from the traffic circle, children's park and the local school is degraded. However, the problematic part is the large open patch west of the circle (Fig.1). The experimental site comprises a total of ~37200 m² of beach space from the low water line up to the road. Within this area, a N-S strip of 160 m x 60 m, contiguous with the existing sand dune strip is presently devoid of a dune ridge and is lacking in dune vegetation. Of the total area, about 23200 m² constitutes the dry beach. The backshore, adjacent to the roundabout, is again flat and devoid of trees.

During the year, the predominantly southwesterly wind blows at a speed of 10 to 14 km/h on an average. In comparison, wind speed doubles during June to August.

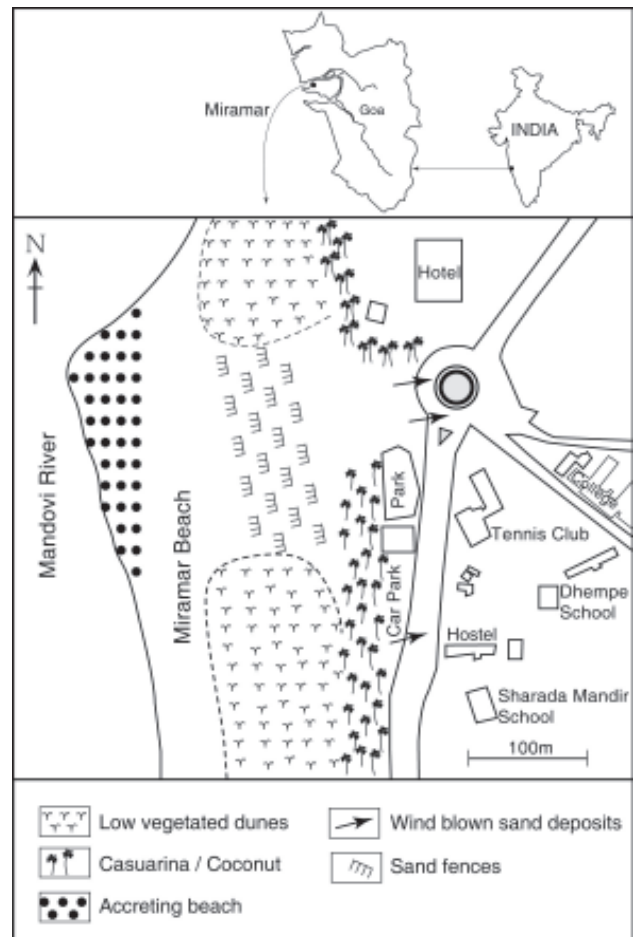


Fig.1. Map showing the area of concern on Miramar beach where a 160 m long dune link is missing. Arrows indicate wind direction as well as spots where aeolian sand deposition is most pronounced. The (length of and space between) fences are not to scale.

On 2 July 1998, wind speed had attained 25 km/h (IMD, on phone). Wind blown sand had gathered on the adjacent traffic circle. Field estimates revealed that a minimum of 2 to 4 cubic meters of sand had deposited at the traffic circle by the afternoon. Similarly, on 16-17 June 2004, a more intense episode was monitored. Wind speeds crossed 36 km/h (IMD, on phone). Sand blown landwards got trapped wherever obstructions such as pillars, benches or road dividers were encountered. By estimating the approximate volume of each sand mound, and comparing it with the amount of sand removed, our field investigations indicated over 25 cubic meters (five truck loads) of sand had deposited on the traffic circle, on an area of 29000 m², in two days. The road was not motorable.

The 160 m long stretch of Miramar beach from where sand is transferred inland appears to be a former dune complex that has disappeared subsequently (Mascarenhas, 2002). Our assertion that this flat and bare gap represents a discontinuity of the linear dune is evidenced by the presence of low vegetated dunes, both north and south. Uprooting of vegetation and flattening of the dunes is attributed to continuous movement of pleasure seekers, trampling and obliteration of dune topography. Since dune vegetation is absent, the binding capacity of the vegetal species is lost. Destruction of dune vegetation is the primary cause due to which movement of sand is activated (Mendelsohn et al. 1991; Miller et al. 2001).

Our prime concern is that sand blown on the adjacent road creates nuisance to beach users and a hazard to traffic. Therefore, sand movement has to be blocked at the beach itself, sites where original dunes are flattened or degraded (Fig.1).

Installation of sand fences, a simple, cheap and environment-friendly method of inducing accretion of sand, is proposed as a remedial management option. Fences provoke winds to deposit their sand content. Forced accumulation of sand can be achieved by erecting 1 m high fences, made of 5 cm wide vertical bamboo slats, oriented perpendicular to the direction of prevailing winds (Matias et al. 2005). Our observations show that sand gets deposited 2 to 6 m downwind behind artificial barriers lying on the beach. A series of fences can therefore intercept wind-blown sand over a considerable area along the frontal beach (Mendelsohn et al. 1991; Miller et al. 2001; Matias et al. 2005). Therefore, sand can be trapped on the beach itself, which leads to the formation of new dunes.

Following several field checks, and in collaboration with the municipal authorities, it was decided, on an experimental basis, to erect parallel rows of 3 m long fences with 2 m wide passages in between. Fences were oriented in a NNW-SSE direction. The second row was placed 25 m behind the frontal row. The southern end of the frontal fence was fixed about 55 m from the water line and about 30 m behind the existing dune line so that the fence is



Fig.2. Two frontal rows of sand fences, fixed in April 2007. Maximum amount of sand was trapped by the second row of fences. Around 2 cubic meters of sand accumulated behind a single fence by 20 July 2007 (Photo: Sheikh Karim, NIO).

oriented perpendicular to the dominant wind direction. By 15 April 2007, seven rows of fences, covering most of the barren beach, were fixed.

Three months later (July 2007), encouraging results were recorded: (1) All fences trapped sand, as evidenced by the dunes formed behind each fence (Fig.2); (2) The second row of fences accreted maximum sand; (3) About 2 cubic meters of sand accumulated behind a single fence in three months (Fig.2); (4) There was no sand accumulation on the traffic circle, although wind speeds as high as 60 km/h were occasionally recorded; (5) In October 2007, ipomoea creepers that have taken root on several sand mounds confirms the initiation of dune formation.

In summary, our endeavor on the restoration of coastal

dunes assumes significance for several reasons: (a) The remarkable performance of sand fences endorses the success of our dune building initiative; (b) Regeneration of damaged dunes is a unique concept, never attempted in India; (c) Miramar is a high-value tourist coast and hence calls for an integrated management approach; (d) The scheme offers scope to monitor sand accumulation through a natural process, but fashioned artificially; (e) Restoration of coastal dunes can be adopted wherever these features are damaged due to natural processes or human interference.

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