



Regional Media Briefing Workshop on  
Coasts, Coastal Populations and their Concerns  
Goa, 13-14 August 2010

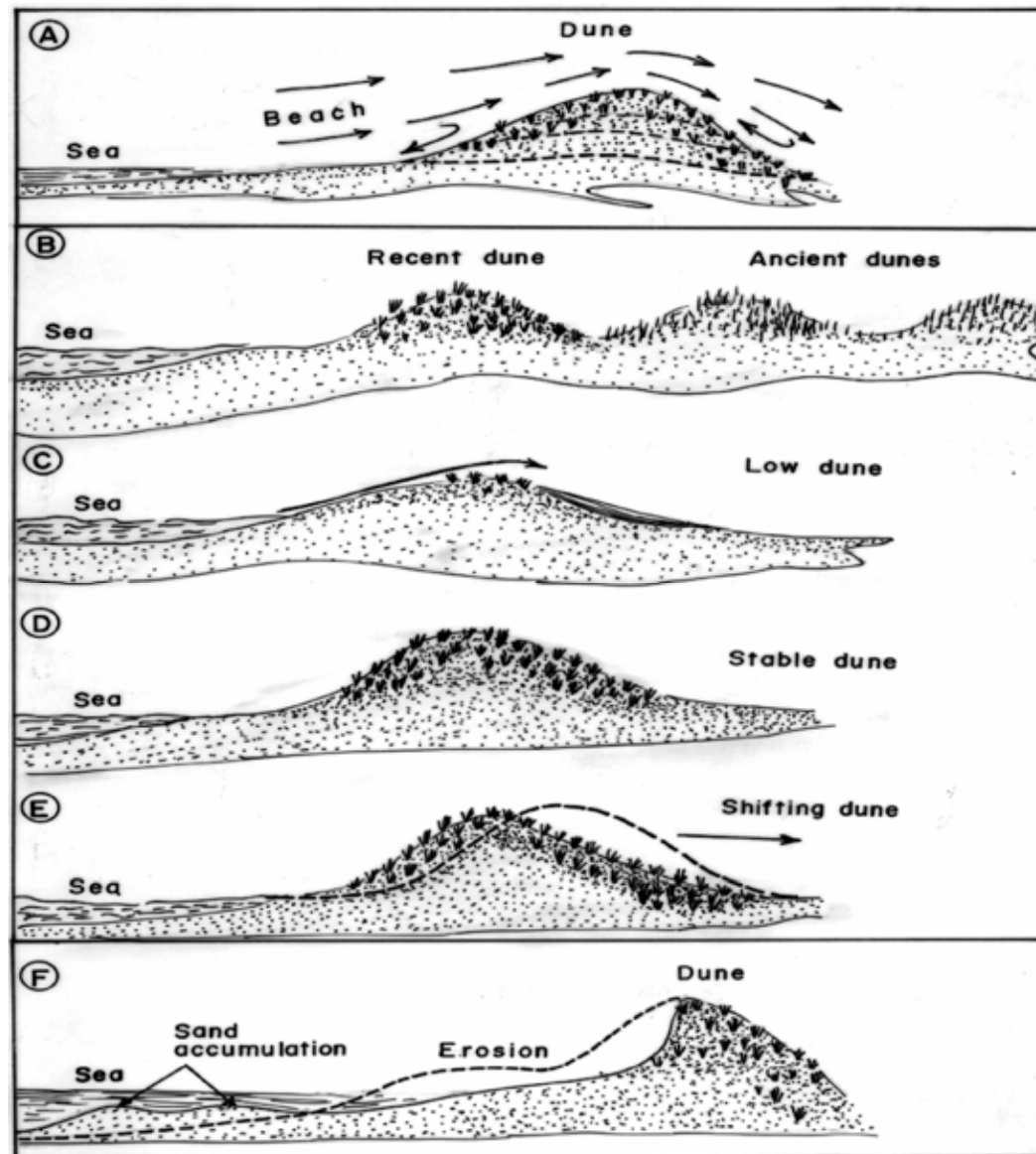
**The state of coastal sand dunes of Goa:  
anthropogenic impacts and management**

**Antonio Mascarenhas**  
**NIO, Goa**

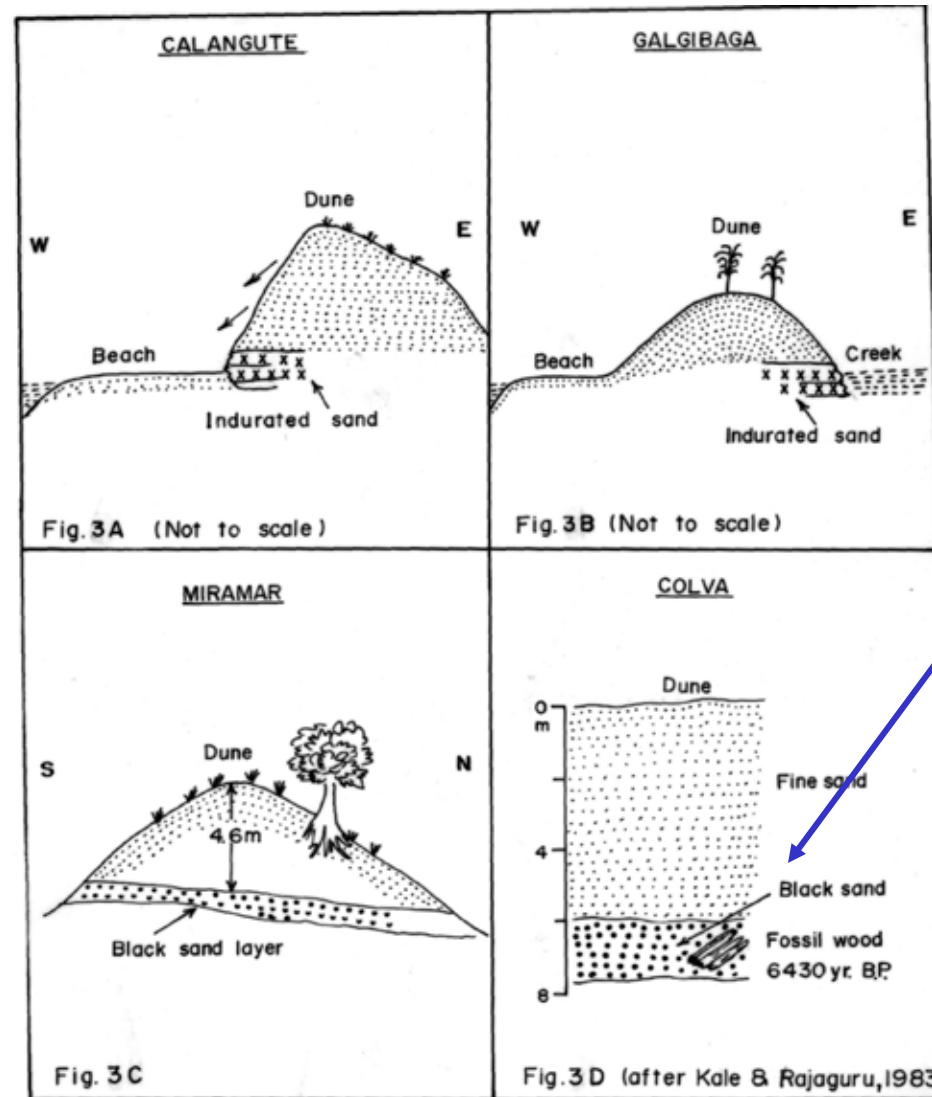
## **Components of this presentation**

- **Geological evolution and functions of coastal sand dunes**
- **Examples of human interference on coastal landforms**
- **Comments on coastal erosion**
- **Conservation and management needs**

# Geological evolution of coastal sand dunes



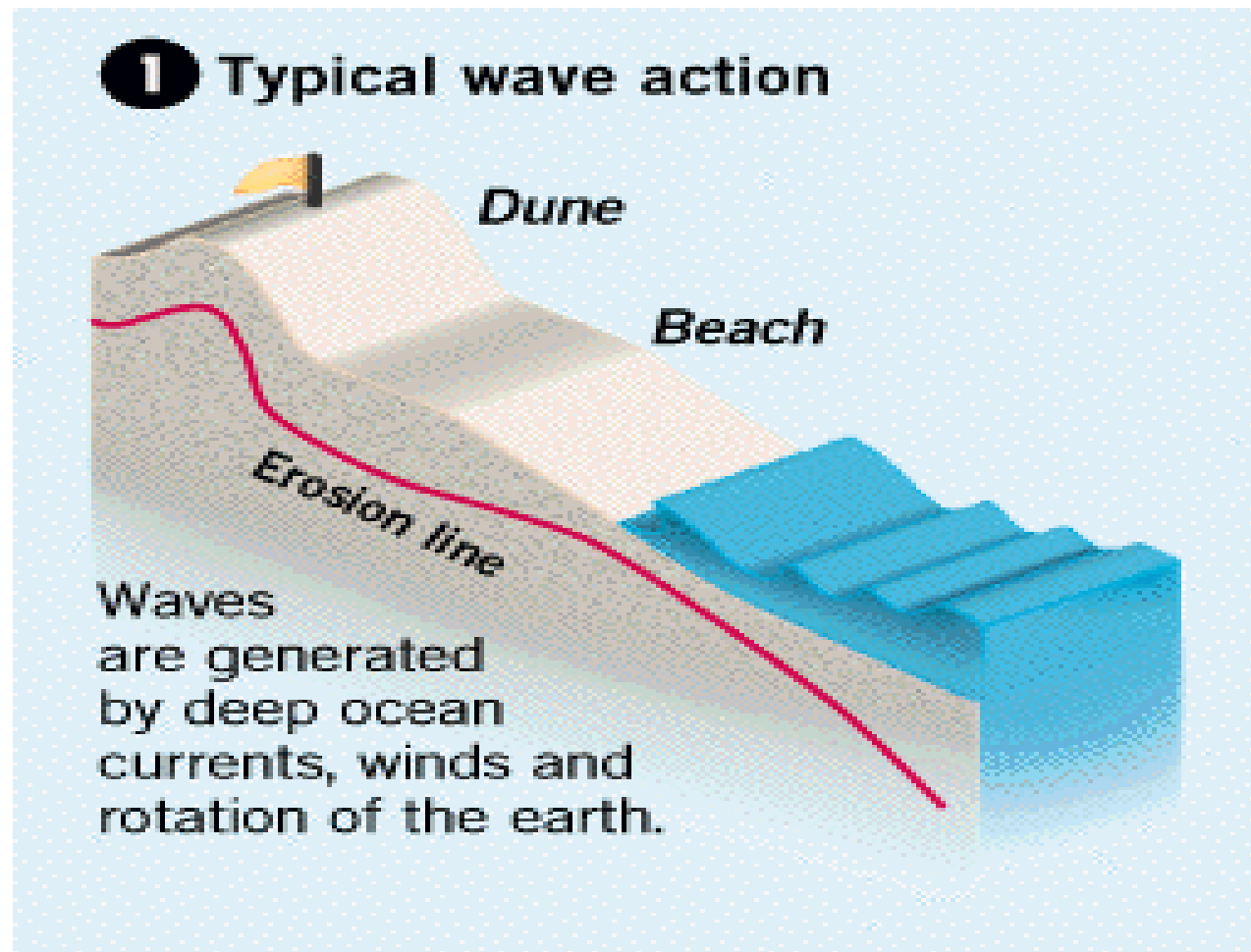
# Age of coastal dunes of Goa: A natural heritage



# Functions Of Coastal Sand Dunes

- Nature's first line of defense
- Serve as sand "banks"
- Sources of beach nourishment
- Dissipate wave energy
- Maintain coastal equilibrium
- Protect coasts from erosion
- Ecological storehouses
- Features of coastal stability
- Guard against sea level rise
- Shield mankind from forces of the ocean

# Wave dissipation by sand dunes

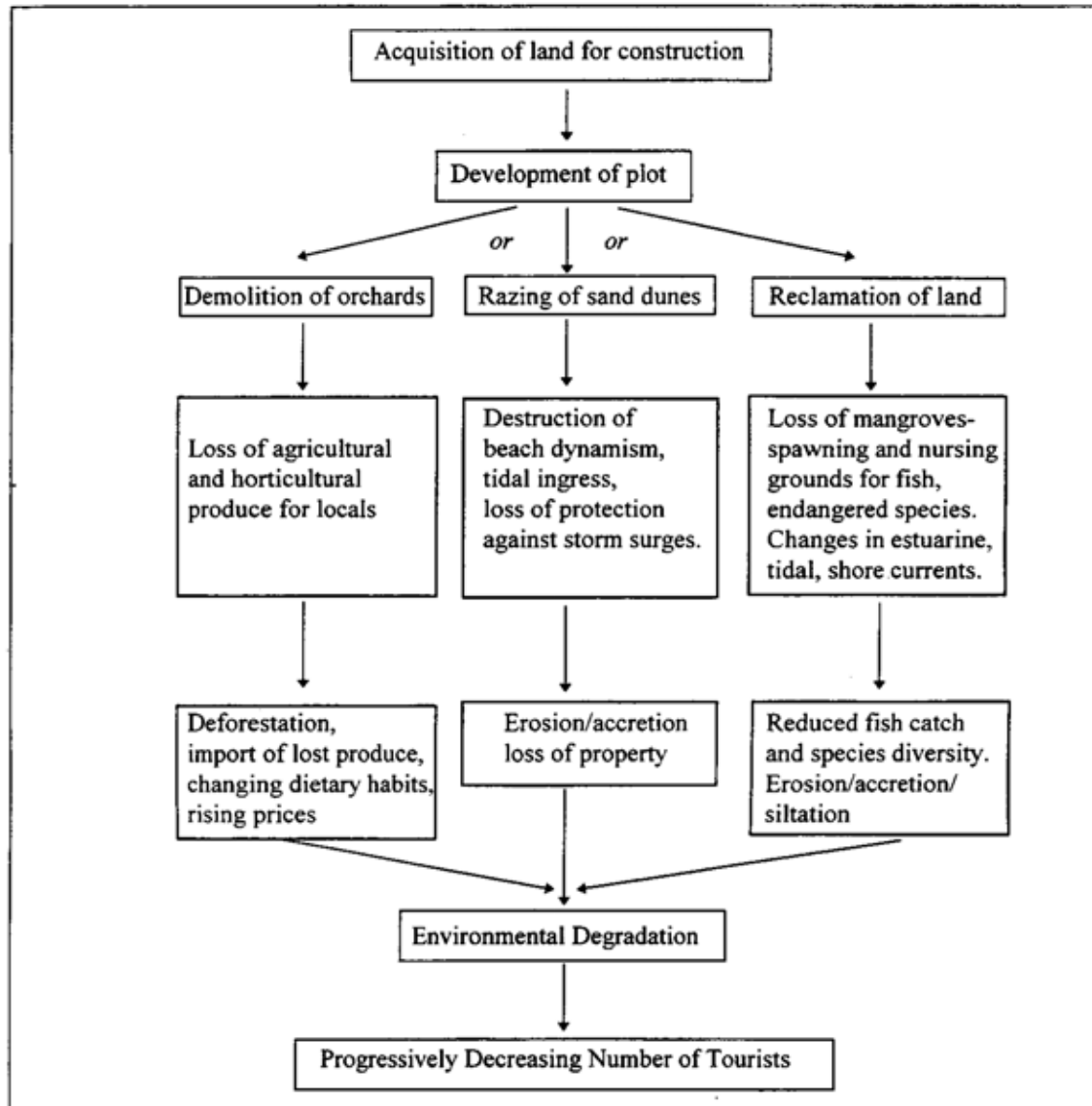


# **Human interference on coastal dunes**

- **CRZ Violations in every respect**
  - **Constructions / Buildings on Dune Fields**
  - **Dune Sand Extraction**
  - **Roads on Sand Dunes**
  - **Beach Shacks**
  - **Uprooting of Dune Vegetation**
  - **Salt Water Extraction / Ingress**
  - **Recreation on Dunes**
  - **Litter on Beaches**
- 

## IMPACTS OF CONSTRUCTION ACTIVITIES IN CLOSE PROXIMITY TO THE MARINE ENVIRONMENT

The field surveys undertaken during the survey of ecosensitive coastal areas of Goa show trends outlined in the flowchart depicted below:



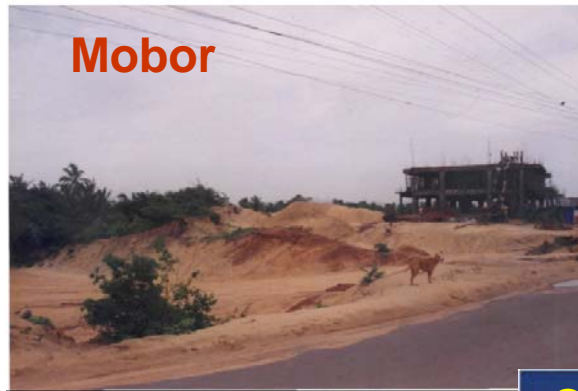
Source:  
Sawkar et al., 1998

Source: National Institute of Oceanography of India. 1996b. *Comments on the Coastal Zone Management Plans of Goa*. Report submitted to India, Ministry of Environment and Forests. New Delhi.

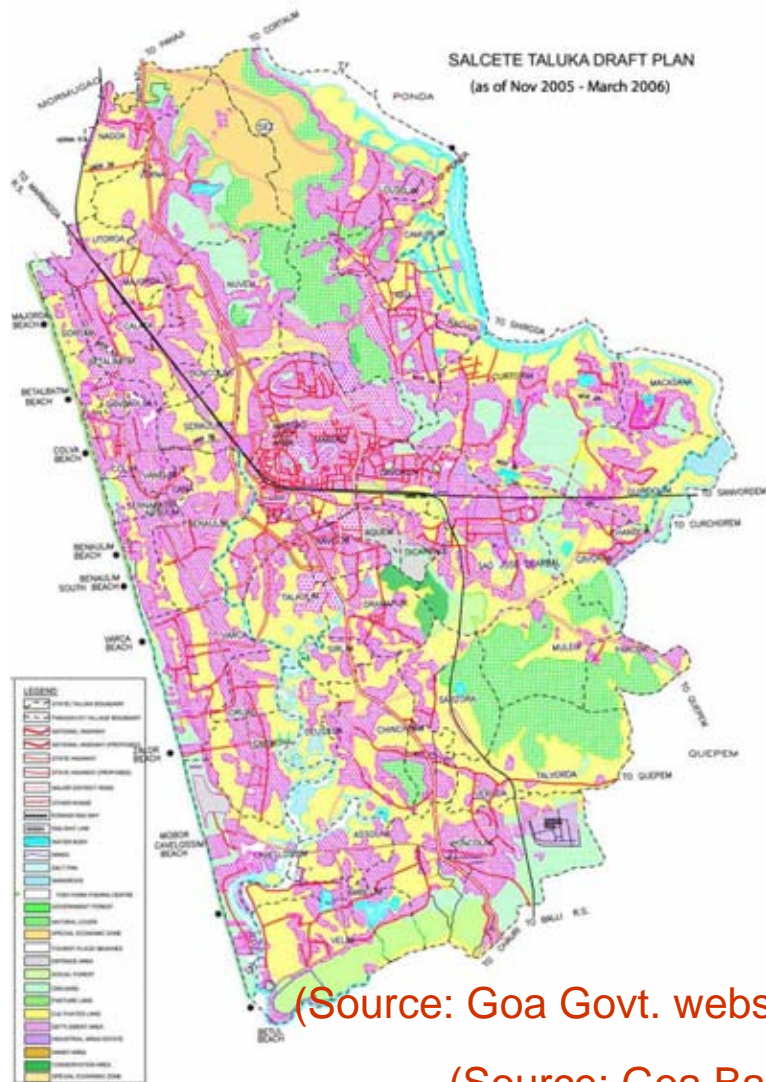


# Human impacts on coastal dunes of Goa

## How it started - scenario in 1996

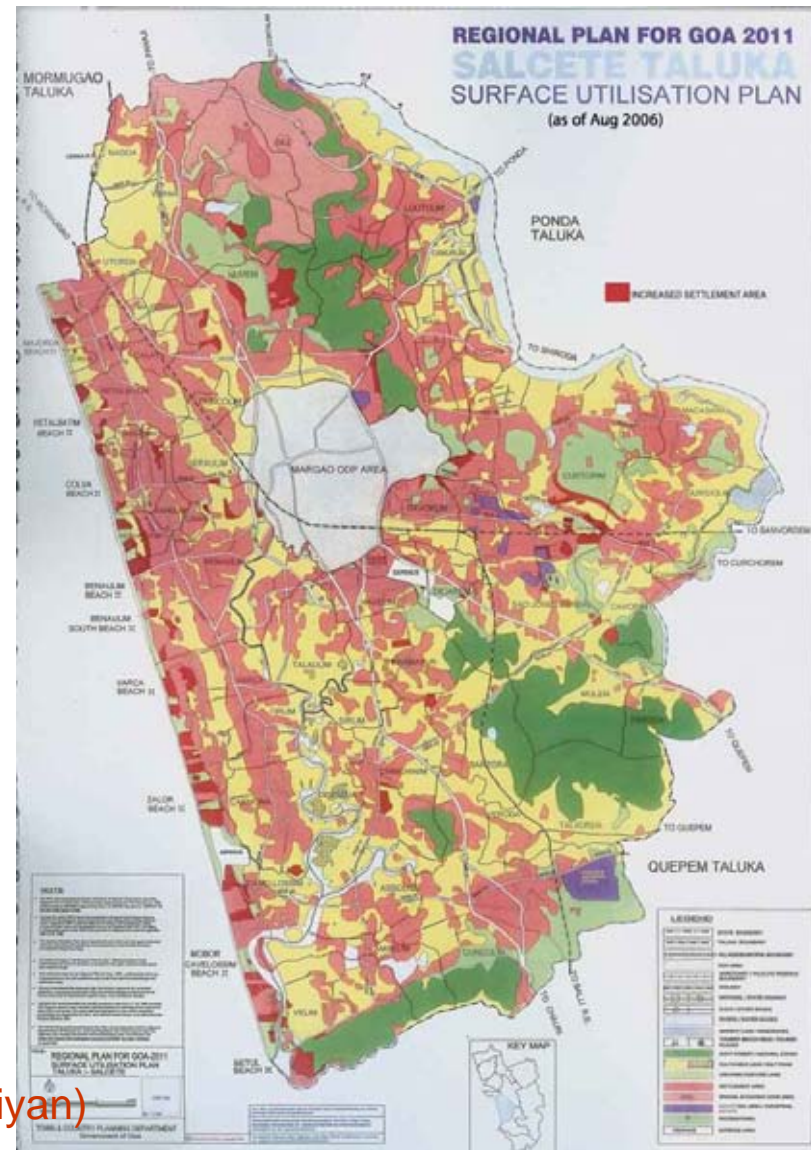


# Draft RP vs. Final RP



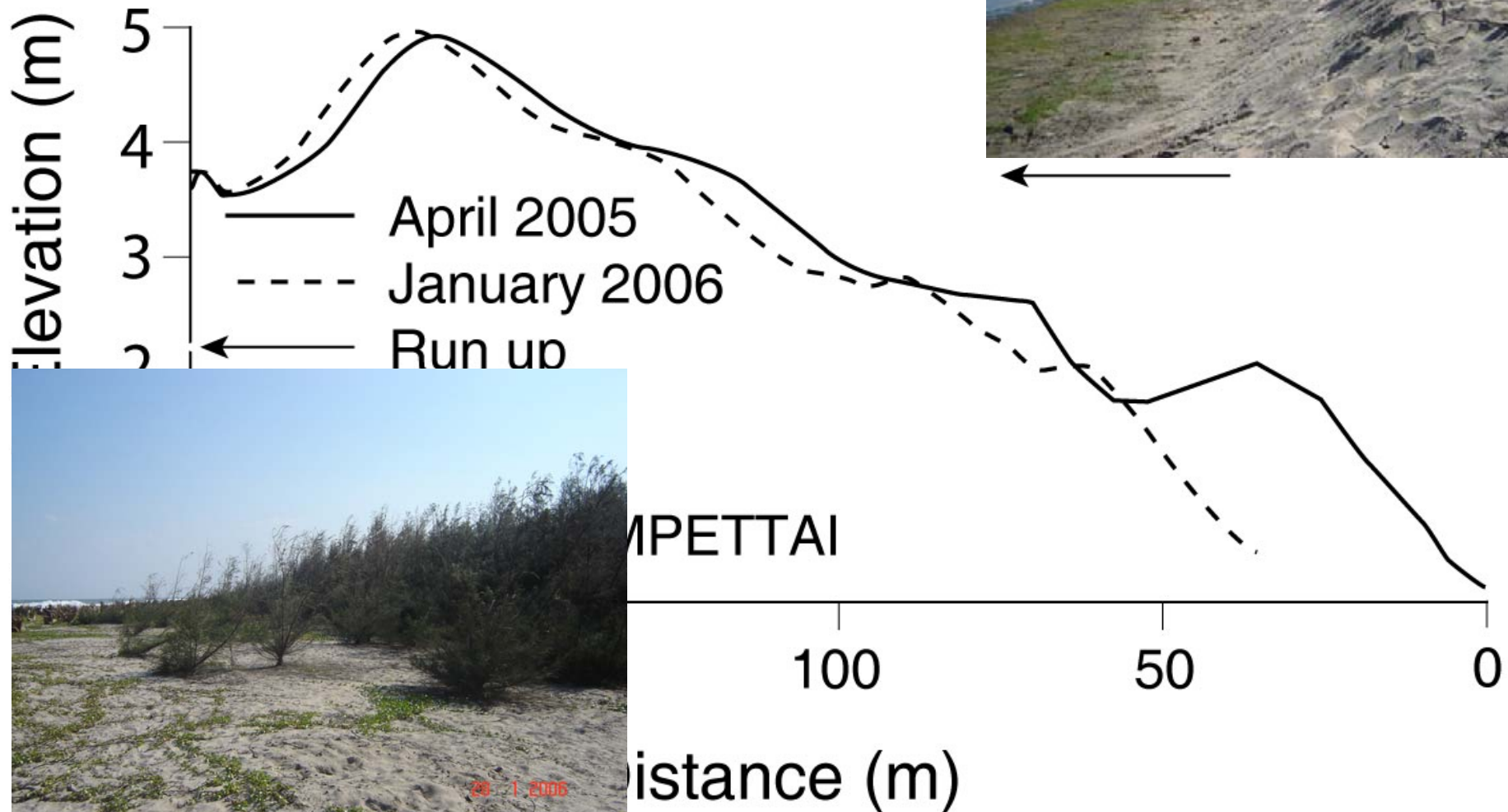
(Source: Goa Govt. website)

(Source: Goa Bachao Abhiyan)





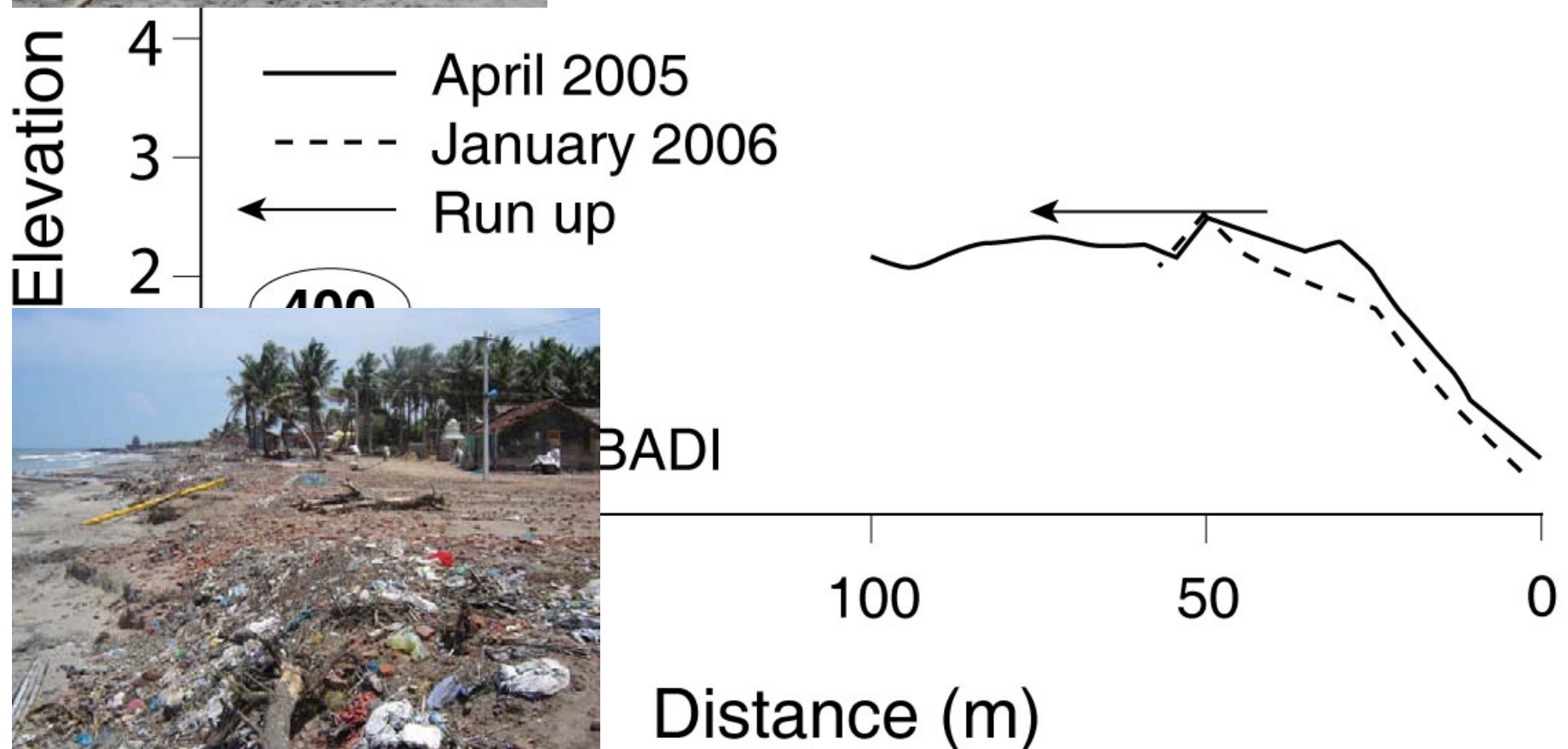
**Example: Natural landforms saved life and property as  
behind high vegetated dunes are all intact  
gaps on dunes however facilitated ma**



(Source: Mascarenhas and Jayakumar, 2008)



**atural protection is the cause of disaster; all beach were smashed; loss of life was heavy; served as a pathway for tsunami water**



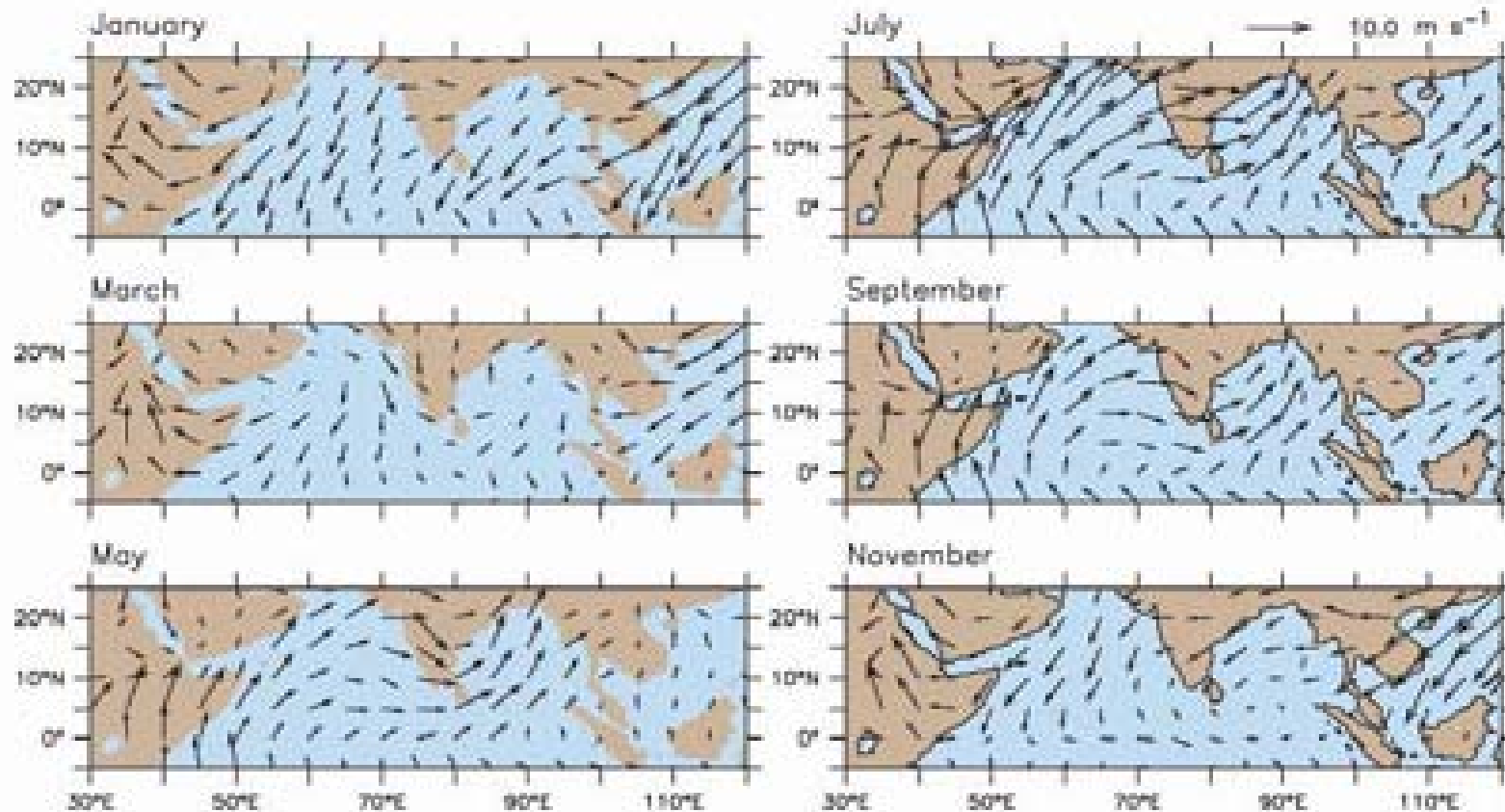
(Source: Mascarenhas and Jayakumar, 2008)

# Coastal erosion – historical

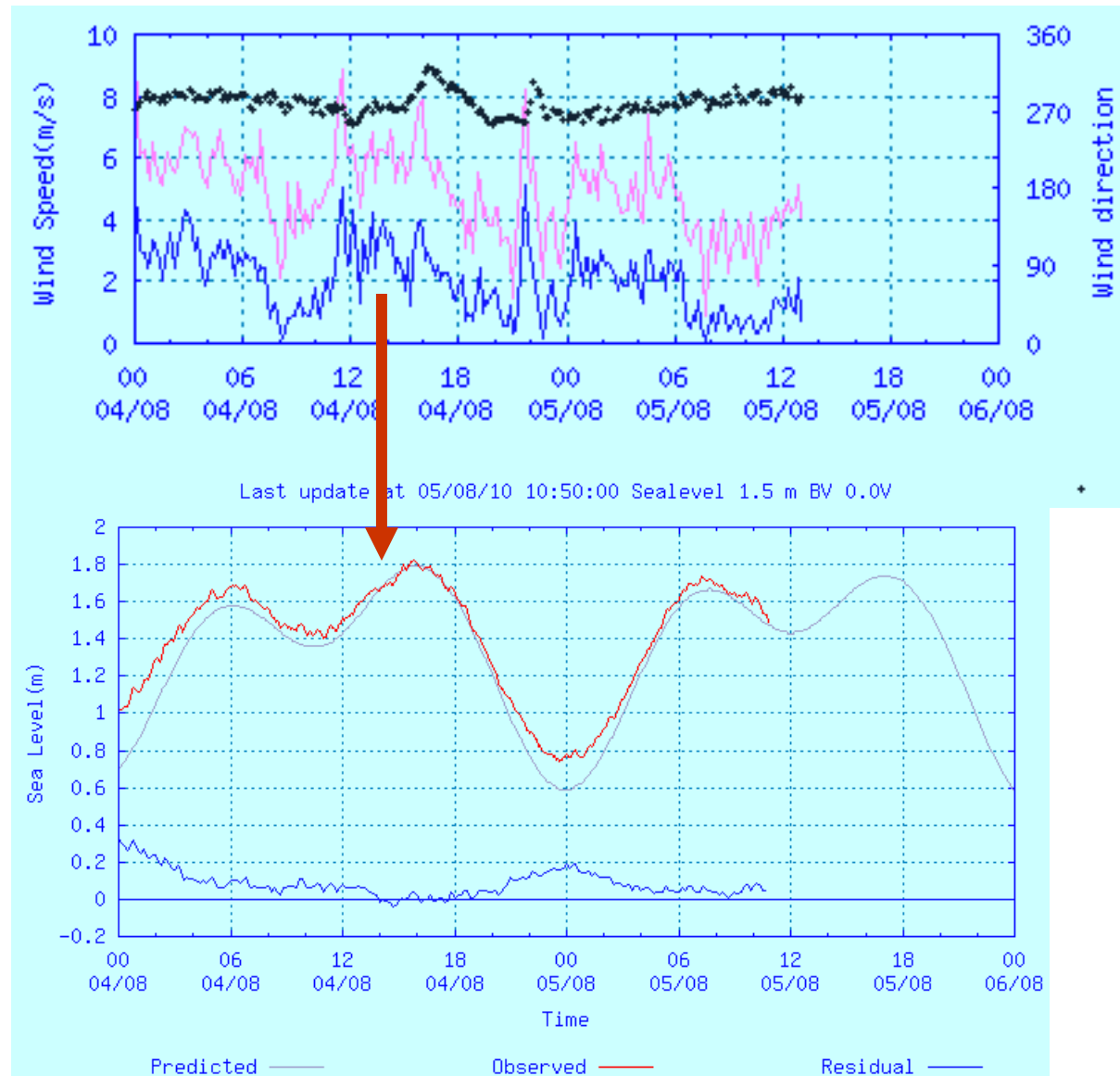
(ongoing work / unpublished data)

Year	Site	Impacts	Reference
1932	Caranzalem	Sea wall eroded	Lobo, 1985
1966	Colva	Beach scarps	
1974	Miramar	Coconut trees collapsed	Untawale, 19xx
1996	Anjuna	Dunes leveled	
1996?	Rajbag	1m high scarp in dune	Field observations
2002	Dona Paula	Collapse of a laterite sea cliff	Field observations
2004	Coco beach		
2005			
2006	Sinquerim Kerim		Goa Gov website
2007	Sinquerim Galgibaga Kerim	Casuarina trees Casuarina trees 1600 m of coast	Goa Gov website
2008	Sinquerim	Massive erosion, 60-90 m shift in coastline	Babu et al., unpublished data
2009	- Anjuna - Sinquerim - Majorda - Agonda - Galgibaga	Coastal laterite sea cliff Dunes ?????? 1m high scarp in dune Coastal trees uprooted Casuarina trees	Herald Field observations Herald Herald Herald The Navhind Times
2010	- Sinquerim - Utorda - Majorda		Herald Herald, 23 July Herald

# Wind direction and intensity

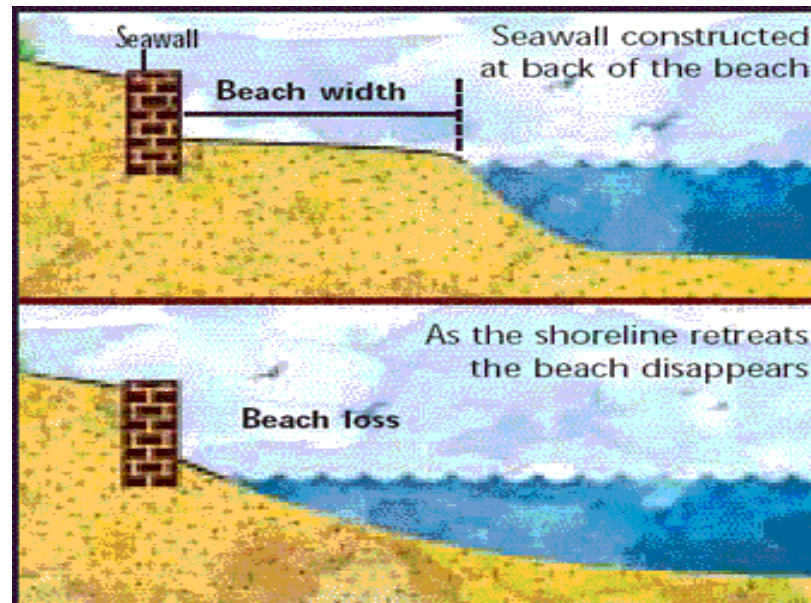
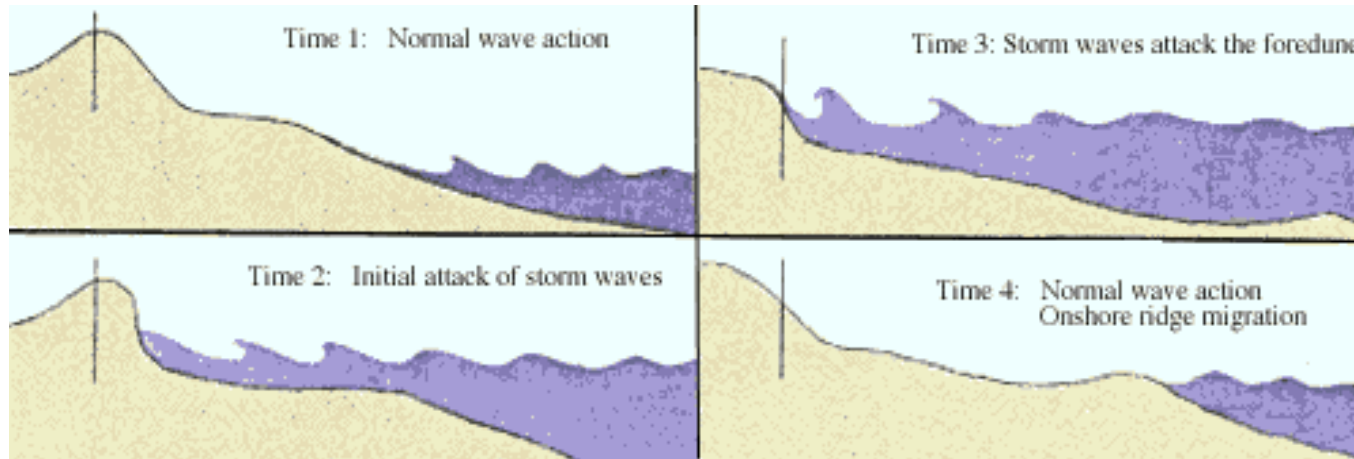


# Winds, tides, erosion



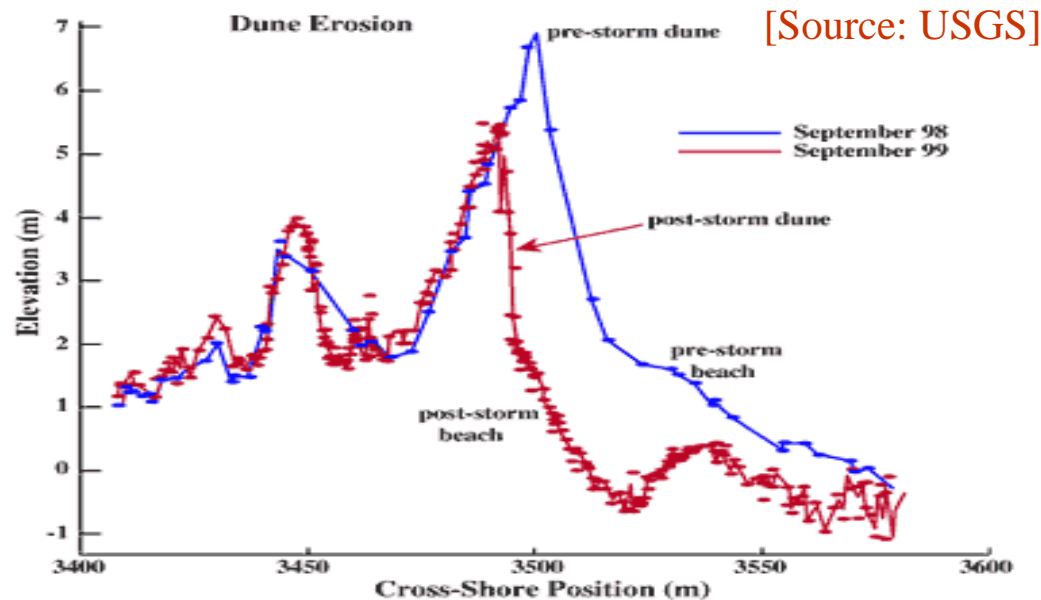
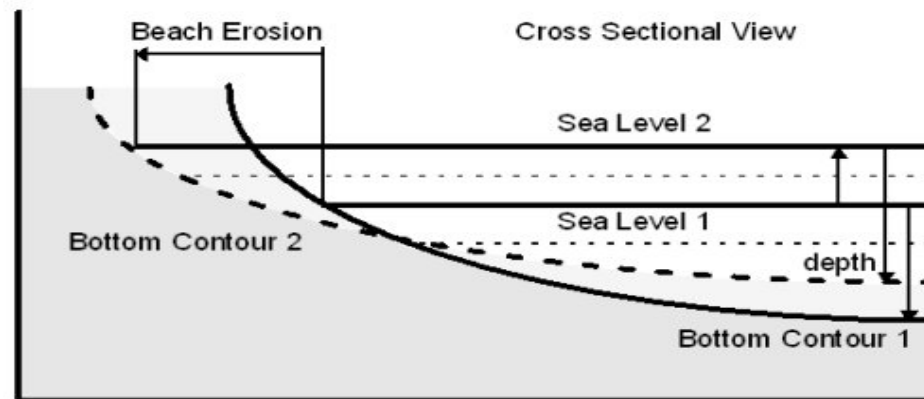


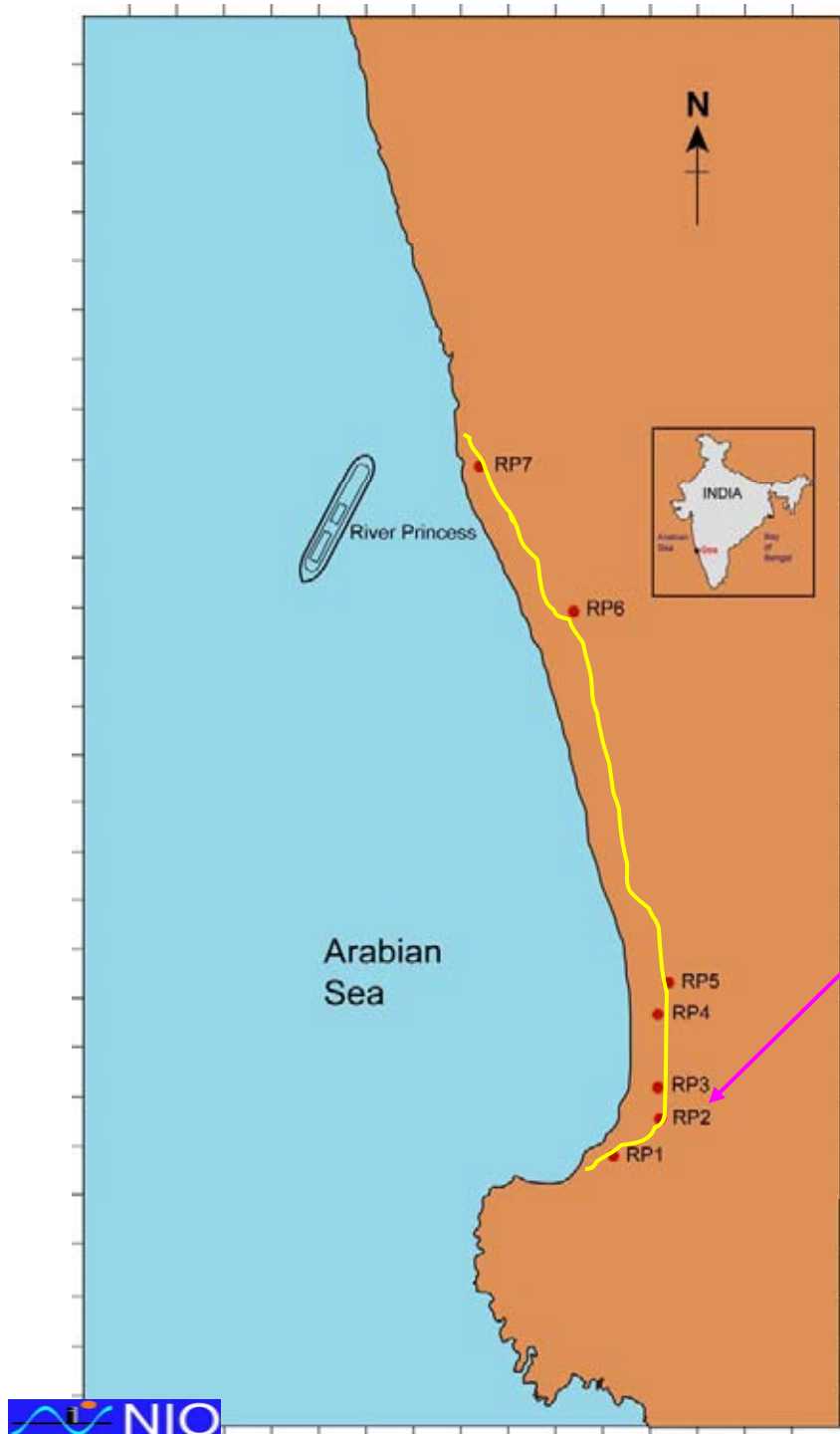
## Effects of storm waves on : (1) dune coasts, (2) built-up coasts





# Sand dunes: before and after a (natural) extreme event

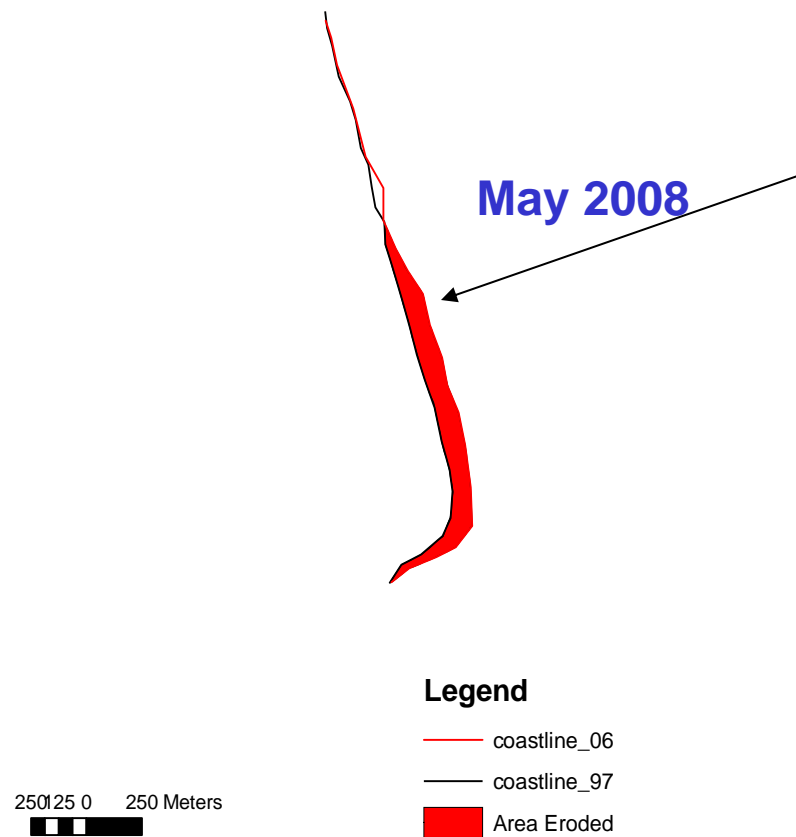




**Severe coastal retreat due to erosion at Siquerim (2007)  
(unpublished data)**



# Sinquerim coast - area eroded



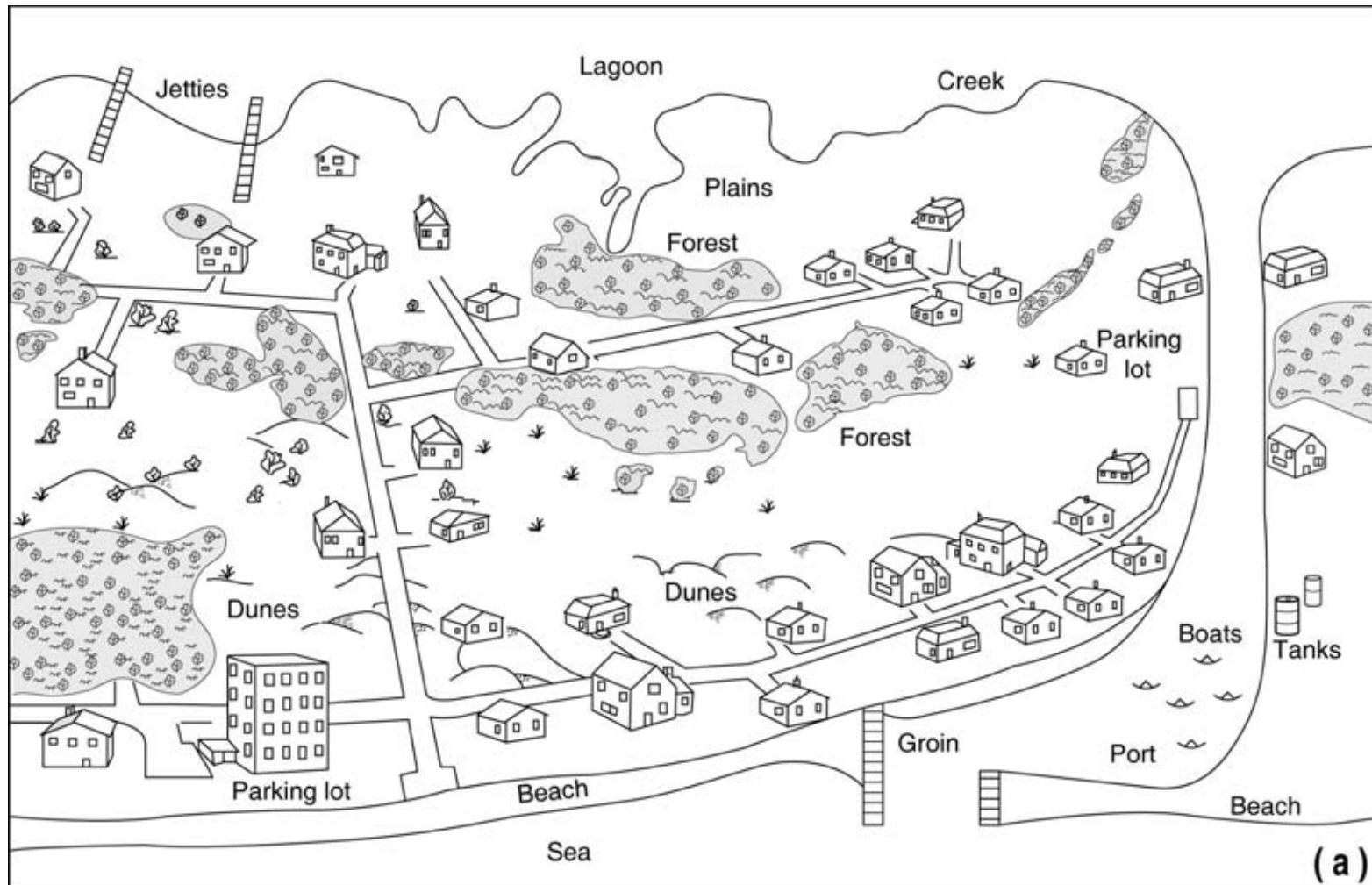
(unpublished data)

# Installation of geotubes or sea walls: Is this the management option ?

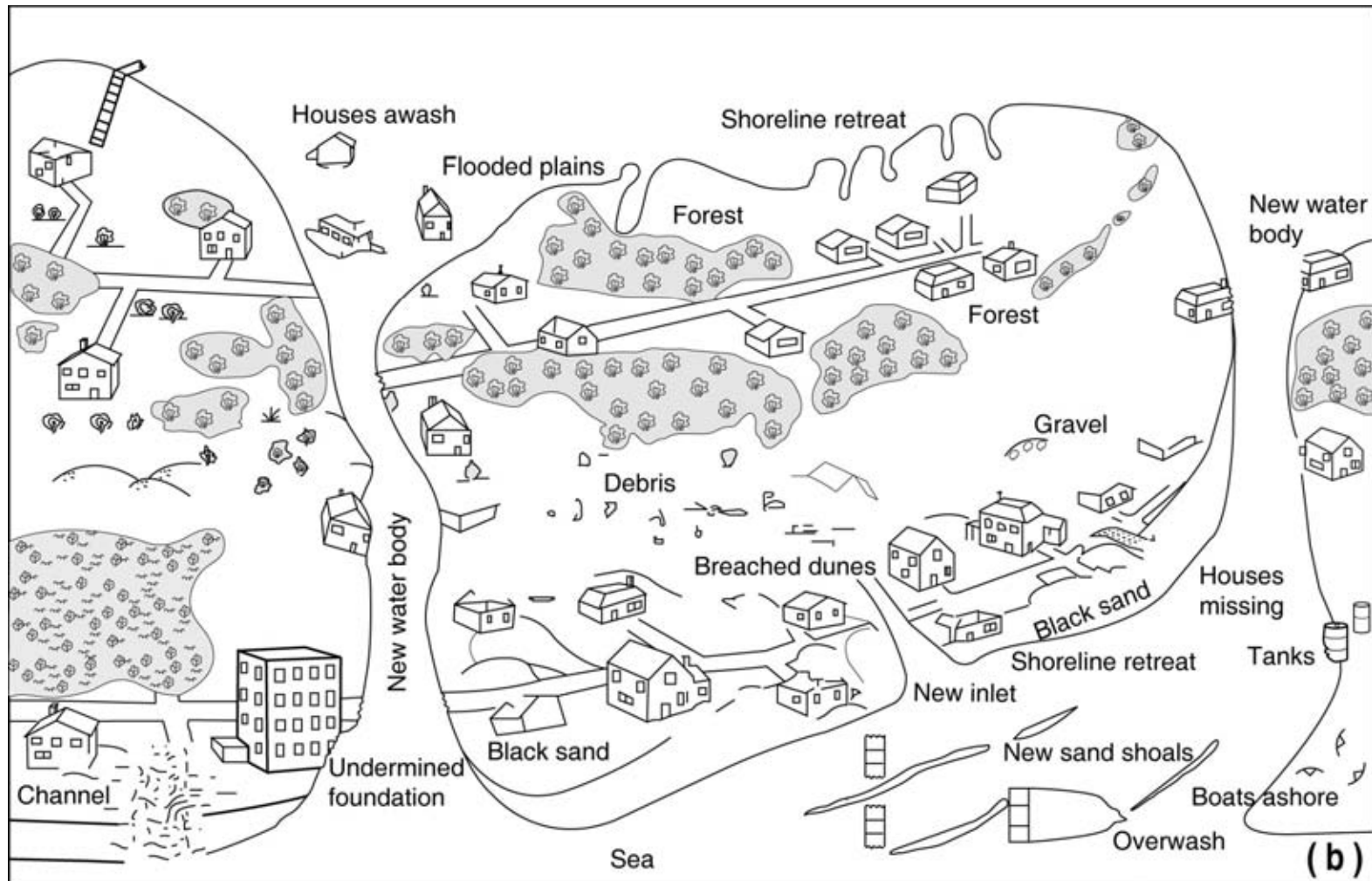




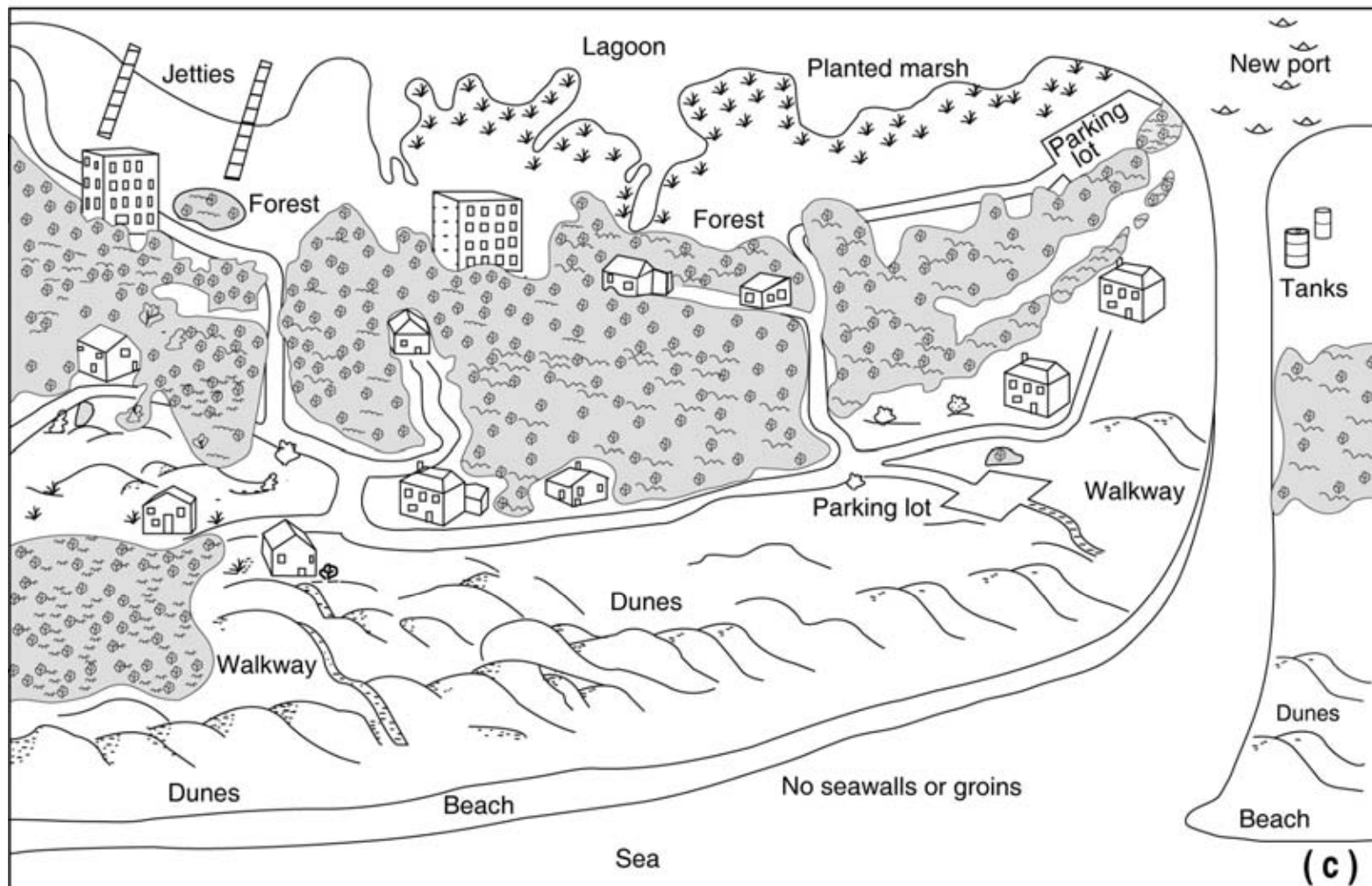
**Scenario 1: A human altered coast- dunes are leveled, forests are cleared, dwellings too close to water line, setbacks lacking**



**Scenario 2: Drastic landform changes after extreme events – breaching of dunes, formation of new water bodies, demolition of sea front structures, uprooting of sea walls**



**Scenario 3: Restoration of a damaged coast – dunes are rebuilt, forests are extended, roads are redesigned, buildings are relocated, adequate buffer zones are designated**





# The lost dune at Miramar







# Dune restoration < SOFT OPTIONS >



# Natural coastal ecosystems, hazard rating, adaptation

Environments			Physical processes and natural hazards							Natural protection		Hazard rating	
			Wind	Waves	Storm surge	Tsunami	Ebb surge	Runoff	Tides	Currents	Protective elevation		Protective vegetation
Ocean side	Suburban to urban development	Nearshore (subtidal)											Extreme
		Inlet											
		Beach											
Frontal dune												High	
Overwash fan													
Interior	Coastal plain / grassland												Low
	Interior dune												
	Maritime shrub thicket Occasional freshwater ponds Maritime forest												
	Mainland forest												

(Source: Pilkey et al., 2000, modified)

## **In Summary**

**Considering the inherent natural protective ability of coastal landforms,**

**I fervently appeal to the media to make a very strong case for coastal sand dunes of India**

**So that these features can be preserved for posterity**

**NIO, GOA**



**That's All Folks**

**THANK YOU**