Characterisation of Olive Ridley Nesting Beaches in Orissa using Remote Sensing

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Olive ridley turtles are known to nest in extremely high densities in Orissa (Pandav et al 1998). The turtles nest sporadically along the entire coast of Orissa, excepting the Balasore coast which is muddy. In recent years, three areas—Gahirmatha, Devi river mouth and Rushikulya—have received considerable attention due to the mass nesting of olive ridley turtles. The migration of olive ridleys from their feeding ground and the selection of these three rookeries as their breeding ground is an interesting phenomenon. It is believed that the physical conditions of these three rookeries —the availability of long beaches, presence of sand bars in the river mouths, beach composition, typical wave conditions, and suitable climatological parameters such as rainfall and temperature—may attract the turtles to these sites to mass-nest. Satellite remote sensing technology is a pioneering technology which can be used to characterise the land parameters of nesting habitats. Besides, other data can be integrated into a GIS environment to study the suitability of beaches for nesting.

Study Area and Methods

In this study, the characterisation of the nesting habitat of the olive ridley was carried out upto a 10-km stretch of land from the shoreline; extending from the Dhamra river mouth to the Rushikulya river mouth, and covering four coastal districts—Kendrapara, Jagatsinghpur, Puri and Ganjam.

A spatial database on land use/ land cover and coastal landforms of the study area was created using multi-date Indian Remote Sensing Satellite data, e.g. IRS-1A LISS II of the period 1990 and IRS-1D LISS III of the period 2000. Supervised classification system was adopted in two datasets (1990 and 2000) to classify the study area separately into

different land use/land cover classes; these were settlement with vegetation, plantation, coastal sands, aquaculture ponds, dense mangrove forest, degraded and mangrove swamp forest, dense forest, degraded forest, waterlogged and marshy land. Different layers of information such as power lines, drainage and canal systems, road and rail network, demarcated forest boundary, etc were superimposed on the classified map. The major geomorphological classes were visually delineated using IRS-1D LISS III data of 1998 and later, a coastal geomorphological map was prepared in a GIS environment based on 25 classes. The major classes identified were channel island, coastal sand dune, beach sand, beach ridge, strand line, fresh water creek, buried channel, mud flat, coastal plain, deltaic plain, etc. Non-spatial data such as rainfall, temperature, nesting population, mortality rate, movement of mechanised trawlers/boats were included in the GIS environment. The integration of a coastal geomorphological map with the two land use/land cover maps separately has identified the change in land use/land cover classes in each geomorphological unit.

Results

CHARACTERISATION OF THE GAHIRMATHA AND NASI ROOKERIES

The mass nesting of olive ridley turtles at Gahirmatha has been documented from 1974 (Shanker et al 2004). In the years 2000 and 2001, the turtles nested on four islands— Nasi I, Nasi II, Babubali (Long Wheeler Island) and a newly formed island. This area lies within $86^0 56'$– $87^0 06'$ E and $20^0 37'$–$20^0 46'$ N, covering an area of 20,107.85 hectares. The mainland Gahirmatha beach has a width of 60–120 m and 0–2 degree slope, with coarse to fine sand which turns clayey towards the land. The major settlements in this area are Gahirmatha, Ekakula, Kahnupur, Satabhaya, etc. The major land use/land cover classes of this area are settlements with vegetation, plantation, aquaculture ponds, dense mangrove forest, coastal sand and degraded mangrove swamp forest (Plates 14 and 15).

The major coastal geomorphological classes within this area are coastal sand dunes, beach sand, mangroves and channel islands (Plate 16). The satellite data shows that settlements with vegetation, degraded scrub forest, aquaculture ponds and agricultural land have increased in the ten years between 1990 to 2000. There is a decrease in degraded mangrove and swamp forest, coastal sand and coastal mudflats in this area (Tables 1 and 2). The characterisation of olive ridley nesting habitat in Gahirmatha and Nasi is shown in Plate 17.

Table 1. Land use / land cover classes of the three mass-nesting rookeries.

No.	Classes	Rushikulya		Devi river mouth		Gahirmatha	
		1990	2000	1990	2000	1990	2000
1	Settlement with vegetation	3.4	611	88.4	134.7	39.6	46.8
2	Agricultural land	5,757.1	4,759.4	5,326.4	4,962.8	2,641.6	2,938.8
3	Plantation	1,094.7	937.8	466.2	76.4	116.2	25.4
4	Dense forest	25.4	28.4	6.7	0	0	0
5	Degraded scrub forest	854	0	384.4	126.8	33.4	60.2
6	Dense mangrove forest	0	0	13.9	139	3,528.2	3,836.4

Table 1 (contd.)

No.	Classes	Rushikulya		Devi river mouth		Gahirmatha	
		1990	2000	1990	2000	1990	2000
7	Degraded mangrove forest	0	14.6	701.1	415.7	1,288.6	731.3
8	Waterlogged marshy land	252.1	593.8	264.9	151.2	0	32
9	Coastal mud flat	51.4	2.5	264.7	304	497.9	160.4
10	Aquaculture pond	0.2	28.3	2.6	165.7	10.4	16.3
11	Salt pan	189	324.3	0.1	102.8	0	0
12	Coastal sand	633.8	771.1	384.7	1,573.1	656.1	3,84.2
13	Waterbody	4,898.6	5,688.6	6,742.2	6,494.3	11,295.5	11,876
	Total	**13,759.7**	**13,759.7**	**14,646.4**	**14,646.4**	**20,107.9**	**20,107.9**

Table 2. Coastal geomorphology of the three mass-nesting rookeries.

No.	Geomorphology class	Rushikulya	Devi river mouth	Gahirmatha
1	Channel island		128.5	229.7
2	Mud flat	6.8	127.5	68.8
3	Structural hill	25.8		
4	Buried pediment	2,875.6		
5	Mangrove		194.2	4,159.8
6	Deltaic plain	1,192.1		
7	Channel bar		513.5	
8	Inselberg	9.3		
9	Residual hill	22.2		
10	Lagoon	229.9		
11	Coastal sand dunes	1,773.4	2,231.0	186.6
12	Coastal plain	2,023.2	3,685.8	3,199.4
13	Beach sand	124.1	332.7	103.9
14	Waterbody	5,517.4	7,433.3	12,159.7
	Total	**13,799.7**	**14,646.4**	**20,107.9**

CHARACTERISATION OF THE DEVI ROOKERY

An estimated 100,000 olive ridleys nested in a stretch of about four km, on Akashdia Island at the Devi river mouth when the rookery was discovered during 1981 (Kar 1982). This rookery has experienced many changes in the last two decades. A new river mouth was opened after the supercyclone of October 1999. This rookery lies within 86^0 18'–86^0 26'09"E and 19^0 56'–20^0 02' N, covering an area of 14,646.4 hectares. The width of the beach ranges from 200–250 metres with a 0-2 degree slope, the composition of the beach is mainly coarse to fine sand. The major settlements in this area are Dhanahar, Belati, Nuaghar, Madhupur, Sahan and Sudhikeswar. The major land use/land cover classes in this area are settlements with vegetation, plantation, aquaculture ponds, degraded forest and coastal sand. The major geomorphological classes are channel island, channel bar, coastal sand dune and beach sand (Tables 1 and 2) There has been an increase in settlements with vegetation, dense mangrove forests, coastal mudflats,

aquaculture ponds, coastal sand; and a decrease in agricultural land, plantation, degraded scrub forest, degraded mangrove swamp forest, waterlogged and marshy land from 1990 to 2000.

CHARACTERISATION OF THE RUSHIKULYA ROOKERY

The Rushikulya rookery was discovered in 1994 (Pandav et al 1994). The study area is located within 84^0 59'–85^0 07' E and 19^0 19'–19^0 25' N, covering an area of 13,759.73 hectares. The mass-nesting beach at Rushikulya is located along the southern Orissa coast in Ganjam district. It spreads over six kilometres from Purnabandha. The nesting beach is wide, more or less flat, with scattered sand dunes 1–2 m high. The average width of the beach is 200–250 m with a 0–3^0 slope; the beach composition is mainly coarse to fine sand. The major settlements within this habitat are Purnabandha, Kantiagarh and Mayurpada. The major land use/land cover classes of this area are settlement with vegetation, plantation, aquaculture pond, salt pan and coastal sand. Similarly the major landform classes are coastal sand dunes and beach sand (Tables 1 and 2). Between 1990–2000 there has been an increase in settlements with vegetation, waterlogged and marshy land, aquaculture ponds, salt pans and coastal sand; and a decrease in agricultural land, plantation and coastal mud flat.

Conclusion

The main spatial classes which occur in the coastal tract are plantation, mangrove, sand and agricultural land. Development activity close to the coast—such as construction of roads, tourist resorts and aquaculture ponds—results in the loss of nesting habitats. Plantations close to the nesting beaches have also resulted in drastic decline in nesting at these beaches. The mass-nesting beaches of olive ridleys at the three rookeries have similar land characteristics in many aspects. All the three rookeries are located at river mouths with a common distribution of land use/ land cover classes. Similarly the common geomorphological classes are coastal sand dunes, beach sand, channel islands, mangroves and channel bars. The integration of spatial and non-spatial databases of the existing nesting beaches in a GIS environment has identified suitable common parameters such as presence of river mouths and estuaries, undisrupted long beaches, beach composition varying from coarse to fine sand, slope of the beach ranging from 0–2 degrees, and availability of sand bars and strand line in the river mouths. Based on these parameters, two more sites, Jatadhar river mouth and Hansua river mouth, have been identified as potential nesting sites (Plates 18 and 19).

Literature Cited

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