

turtles tagged during an arribada at Rushikulya rookery on 2 and 3 February 1997 were recaptured while nesting in another arribada at Robert Island near Devi river mouth (220 km north of Rushikulya) on 17 March 1997. One of the turtles tagged during the arribada at Robert Island on 14 March 1997 was subsequently recaptured while nesting in a minor arribada at Gahirmatha (100 km north of Devi mouth) on 16 April 1997. The range of inter-rookery movement obtained during the present study varies from 35 to 220 km (n=6). Tag recoveries obtained from nesting sea turtles at Rushikulya suggest that the period between nesting is nearly annual (1.1 years, n=57). Males recaptured during offshore tagging at Gahirmatha also exhibited an annual

cycle (range 319-373 days, n=28). There have been only three international recaptures of the turtles tagged in Orissa. All three recaptures were from the eastern coast of Sri Lanka (range 1,800-1,900 km). These three tag recaptures suggest that ridleys move southward along the coast after the commencement of nesting season.

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Nesting Activity of Olive Ridleys, *Lepidochelys olivacea* (Eschscholtz), at Important Breeding Habitats of Andhra Pradesh Coastline, India

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Along the east coast of India, olive ridleys (*Lepidochelys olivacea*) nest in significant numbers (Arribada) at Gahirmatha Beaches and Rushikulya River mouth in the state of Orissa. During the winter months (December to March), breeding populations of olive ridleys, migrating from the Indian Ocean, traverse along the coasts of Tamilnadu and Andhra Pradesh States to reach the mass nesting sites in Orissa. During this migration many of these turtles stop and nest along the northern coastal areas of Andhra Pradesh. A status survey was conducted to assess the nesting activity of olive ridleys along the 286 km coastline from Godavari River to Vamsadhara River nearer to Rushikulya River of Orissa.

To estimate the nesting frequency and nest density, the entire coastline was divided into five major zones. In each zone the nesting activities were estimated by counting nesting crawls, freshly deposited nests, disturbed nests and successfully hatched nests. The density of nests and nesting frequency were very high on sandy spits at major river mouths and on remote islands in the vicinity of mangrove forests of the River Godavari in zone I and the Vamsadhara River of zone V. The remaining zones (II, III & IV) had medium density in less disturbed areas and the lowest along urban beaches.

Introduction

Olive ridley sea turtles have a world wide distribution ranging from the Pacific and South Atlantic Oceans to the Indian Ocean (Carr, 1952). It is one of the five endangered species of sea turtles found in Indian Ocean and was placed in Schedule I, of the Indian Wildlife (Protection) Act in 1972. Their largest rookery is on the east coast at Gahirmatha in the state of Orissa along the Northern Indian Ocean (Bay of Bengal) (Kar and Das, 1984).

In the winter months (December to March) olive ridleys migrate from the Indian Ocean along the coasts of Tamilnadu and Andhra Pradesh in order to reach their mass nesting (Arribada) sites in Orissa. During migration many of the turtles select nearby suitable coastal habitats for their nesting activity (Kar, 1983). This type of sporadic nesting has been gradually increasing in recent years along the Northern coastal areas of Andhra Pradesh at the larger river mouths (Godavari, and Vamsadhara) and on remote beaches where human interference is minimum.

Study Area

The coastline from Godavari River along the Southern point to Vamsadhara River of the Northern end [16°20'-18° 25' latitudes and 81°35'-84°10' longitudes], nearer to Orissa's coast, was monitored to assess the status of olive ridley nesting activity (**Fig. 1**). This 286 km coastline has a very diverse shore, ranging from rocky to shallow sandy shores in the northern part with several extensions of hill ranges projecting into the sea, while the southern side has a shallow shore line of sand dunes. For conducting the survey the study area was divided into five major zones :

Zones	Coastline status (km)	Geographical features	Field stations
I	14	Riverine habitats w/ mangrove vegetation	Hope Island Sacramento shoals
II, III, IV	246	Sandy & shallow rocky coast line	Uppada, Pentakota Dibbapalem, Visakhapatnam, & Kalingapatnam
V	26	Partial habitation	Riverine sand dunes Nagavali & Vamsadhara



Figure 1. Study area showing the northern coastline of Andhra Pradesh.

River Godavari (Zone 1) divides at the Southern point into two major channels, the Vasishta and Gautami Godavari. Between these two river channels, a network of creeks and streams flows through muddy flats occupied by extensive mangrove forests. In addition to the mangrove swamps, the mouth of Gautami Godavari has a number of intertidal shallow zones, sandy spit deposits (Hope Island) and Sacramento shoals. Zones II, III & IV have sandy and rocky shores mostly occupied by humans (agriculture, plantations, aquaculture and salt farming). Some of the areas in these zones are occupied by major industries and fishing harbors (Kakinada, Visakhapatnam and Kalingapatnam). At the northern end of Vamsadhara River [Zone V] is a shoreline of sand dunes with casuarine plantations in the background.

Observations

Since this coastline provides an important nesting habitat for olive ridley sea turtles, survey work was carried out from January to March, 1997 and 1998. Nesting activity and density of nests were estimated by counting nesting crawls, freshly laid nests and nests disturbed by predators or humans and were classified into the following categories

- Nest Crawl (NC) - well defined body pit with evidence of digging
- Crawl Tracks (CT) - evidence of digging but no nesting
- False Crawl (FC) - U or V turn without making any nesting attempt and
- Nest opened by predator or human (NOP) with no crawl track,

Olive ridley nesting activity begins in early January and continues until the end of March, with the peak nesting season during February. Olive ridleys used the fine sandy shores with gradual slopes, often bordered by small patches of ground vegetation. These nesting places are mainly dominated by grasses and creepers; *Spinifex littoreus*; *Ipomea pescaprae* and shore plant, *Pandanus fascicularis*.

The frequency of nesting varied between the different habitats: riverine, sandy beaches, and rocky shores. The highest density (25.68 nesting crawls/km) was observed along the 14 km shoreline of Hope Island and Sacramento Shoals of the Godavari River. The 26 km shoreline at Vamsadhara River was the next densest with 8.76 crawls/km. The remaining 286 km of shoreline recorded the lowest nesting crawl density of 3.76 crawls/km (Table 1 and 2).

Table 1. Nesting activity of olive ridleys at different zones of the study area during January to March, 1997 and 1998.

Year	Zones	Types of nesting Crawls				Total	Density of crawls /km Shoreline
		CT	FC	NC	NOP		
1997	I	68	25	189	65	347	24.78
	II, III, IV	190	64	480	136	870	3.53
	V	40	21	83	65	209	8.03
1998	I	52	34	214	72	372	26.57
	II, III, IV	217	90	513	166	986	4.00
	V	50	32	73	92	247	9.50

Table 2. Nesting density of olive ridleys at the study area during January to March, 1997 & 1998.

Years	Zones	Nests		Total Nests	Nest Density per (Km)
		Freshly laid	Disturbed		
1997	I	189	65	254	⊕20.00
	II, III, IV	480	136	316	⊕2.0
	V	83	65	118	> 5.0
1998	I	214	72	286	> 20.0
	II, III, IV	513	166	379	⊕2.0
	V	73	92	135	> 5.0

Discussion

Only olive ridleys were found during the present survey. Ridleys seemed to prefer river mouths of mangrove forests which is a favorite habitat for crabs, prawns and other invertebrates of which they depend for their food (Frazier, 1985). Similarly the Godavari River mouth and its mangrove forests attracted a large number of breeding olive ridleys. It was evident from the studies that the Godavari River mouth and Vamsadhara riverine habitats are strategic sites for the nesting olive ridleys, after Mahanadi and Rushikulya river mouths of Orissa.

A few decades ago there was very little nesting activity (an average nesting density of 2 nests/km) in these sporadic habitats, (Bhaskar, 1983 and Subba Rao *et al.*, 1987). One of the main reasons for the decreasing nesting activity at the major rookeries (Gahirmatha and Ekakulansi beaches) of Orissa is the high biotic interference (Pandav *et al.*, 1994) and frequent changes in the topography of the nesting areas which has caused some of the nesting population to search for other suitable habitats. Godavari Mangroves with its shallow shore environments (Hope Island and Sacramento Shoals) along with the Vamsadhara river habitats attract a large number of turtles to nest. Thus these sites are recommended for the Integrated Protected Area

Management Systems (IPAMS) of Andhra Pradesh Forest Department to strengthen the conservation of these nesting habitats of olive ridleys in this region.

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Leatherback (*Dermochelys coriacea*) Nesting on the North Vogelkop Coast of Irian Jaya, Indonesia

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The north Vogelkop coast of Irian Jaya is one of the world's major nesting areas for the leatherback (*Dermochelys coriacea*). Given the drastic declines of nesting populations in Malaysia and most recently, of the largest Pacific leatherback population in Mexico (Chan and Liew 1996; Sarti and Eckert 1996), these Indonesian rookeries may be the last remaining large leatherback population in the Pacific, with 3,000-5,000 nests reported annually. However, monitoring of these beaches has been inconsistent in recent years, and differences in timing and methods used in different beach censuses conducted between 1981 and 1996 make it difficult to determine current population trends.

Leatherback nesting on this coast is concentrated on the beaches of Jamursba Medi (18 km) during April-October and on War-Mon (4.5 km) during November-February. These dynamic beaches are located 30 km apart, and have nearshore water depths of >3,000 meters. Nesting was first reported along this coast in 1979 (van der Zon and Mulyana), and an aerial survey conducted in 1981 confirmed high density leatherback nesting of >4,000 nests (Salm *et al.* 1982). Subsequent nesting surveys were conducted in 1984-1985 and 1993-1996 (Bhaskar 1985; Nababan and Bakarbesy 1996; Starbird and Suarez 1994).

We have compiled and reanalyzed the available information from these previous leatherback nesting surveys conducted on Irian Jaya in the early 1980's and compared them with census data collected between 1993 and 1996. We have corrected for inconsistencies in census methods, and

applied confidence limits to the data in order to better understand the status and trends of this nesting population.

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