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NESTING OF *LEPIDOCHELYS OLIVACEA* ALONG THE SOUTHERN CHENNAI COAST, WITH EMPHASIS ON HABITAT CHARACTERISTICS

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(with three text-figures)

ABSTRACT.– The nesting of olive ridley turtles (*Lepidochelys olivacea*) along a 50 km of beach south of Chennai, Tamil Nadu, India, was studied from January to March 2004. Fortnightly surveys were done on foot between 0600 and 0830 h on five consecutive days to locate tracks, nests, and carcasses of turtles that had been washed ashore. Nest location with respect to the distance from high tide line, river mouth and nearest village were recorded. Coastal vegetation was sampled every 500 m and at each site used for nesting. Peak nesting was observed in the first fortnight of March, and estimated nesting density was 10.8 nests/km. A total of 135 carcasses of ridleys were located and mortality was largely from incidental catch in fishing gears. Number of nests located was negatively correlated with various distance categories from nearest village ($r = -0.443$, $p = 0.050$, $n = 20$), high tide ($r = -0.628$, $p = 0.039$, $n = 11$) and river mouth ($r = -0.316$, $p = 0.034$, $n = 44$). Turtles preferred to nest near *Ipomoea pescaprae* ($sw = 0.445$) compared to *Spinifex littoreus* ($sw = 0.207$). Further studies on nest site selection would provide pertinent information for both sea turtle conservation and plans for coastal development.

KEY WORDS.– Sea turtle, nest site preference, coastal vegetation, environmental factors, stranding.

INTRODUCTION

Globally, seven species of sea turtles are recognized (Pritchard and Mortimer, 1999) five (*Dermochelys coriacea*, *Caretta caretta*, *Eretmochelys imbricata*, *Lepidochelys olivacea*, *Chelonia mydas*) of which are found in Indian waters. All five species are listed in the Indian Wildlife Protection Act, 1972. It is reported that marine turtles are declining worldwide largely due to egg collection, catching turtles on land and in the sea, marine pollution, and incidental catch in fishing gear (Limpus, 1995; Renaud et al., 1997). The nature of the offshore approach to nesting beaches, slope of the beach, vegetation, texture of the sand and illumination from inland are important factors influencing the selection of nesting sites by sea turtles (Mortimer,

1995). For many areas, habitat characteristics of turtle nesting beaches are poorly understood and available information is sketchy, although remarkably in the case of Tamil Nadu, there is mention in 4th Century Tamil Sangam poem that turtles nest among the ground glory, *Ipomoea* sp. (Sanjeevaraj, 1958). Based on the locations of mass nesting areas in Orissa, it is speculated that ridleys nesting in other parts of India would select beaches close to river mouths, but data, in this regard, are lacking (Tripathy et al., 2003a). The olive ridley sea turtle (*Lepidochelys olivacea*) is widely distributed throughout the tropics and subtropics, and it nests sporadically all over coastal India, with the exception of Orissa, where mass nesting occurs at three localities (Pandav, 2000; Shanker et al., 2003). While in-

formation on the nesting of ridleys in India is available with some details for mass nesting areas (Kar and Bhaskar, 1982; Pandav et al., 1997, 1998; Pandav, 2000; Tripathy et al., 2003b), data from other areas are limited (Banugopan and Davidar, 1999; Bhupathy and Karunakaran, 2003; Tripathy et al., 2003a).

Monitoring of turtle nesting was initiated three decades ago along the Chennai coast, and has been continued on a yearly basis with relocation of eggs to beach hatcheries and release of hatchlings into the sea (Valliapan and Whitaker, 1974; Whitaker, 1977; Silas and Rajagopalan, 1984; Abraham, 1990; Shanker, 2003). Information on turtle nesting sites in relation to the location of villages, river mouths and plantations are pertinent for both sea turtle conservation and coastal area development. In the present paper, we provide data on the ridleys nesting along the southern Chennai coast and relate these to select habitat parameters.

MATERIALS AND METHODS

The Mamallapuram–Pondicherry coast is an extension of the southern Chennai coast, Tamil Nadu (Fig. 1), and 50 km coast (12° 31'–12° 8'N; 80° 10'–79° 56'E) was monitored for turtle nesting from January to March 2004. This coast is sandy without notable rocky outcrops. The Palar and Marakkanam backwaters are major fresh/ brackish water bodies that join the sea (Bay of Bengal). Twenty-one fishing villages are located along the study zone, and the density of all fishing vessels averaged 63/village, including 33.8 *catamarans* and 29.2 mechanised boats. The dominant coastal vegetation of the area includes *Ipomoea pescaprae*, *Spinifex littoreus*, *Pandanus tectornis* and *Casuarina equisetifolia*.

The study area (50 km) was divided into five equal (10 km) sectors using a Global Positioning System (GPS). Fortnightly surveys were done on foot between 0600 and 0830 h and each sector was covered on five consecutive days for locating turtle tracks, nests and carcasses washed ashore. Turtle carcasses were marked with enamel paint to avoid repeat counts. Nesting was confirmed following tracks, nesting site, body pit and egg chamber, and status of the same was assessed based on signs of predation

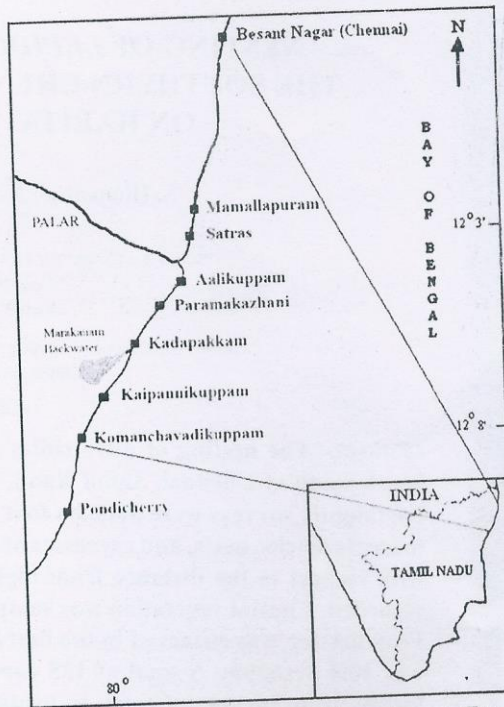


Figure 1. Map of the southern Chennai coast, Tamil Nadu, showing study area and major localities mentioned in the text.

including nest exploitation by humans. None of the nest was opened as it would spoil the developing eggs and enhance predation. However, presence of eggs in the nest was confirmed. Crawls or nests counted during each surveys

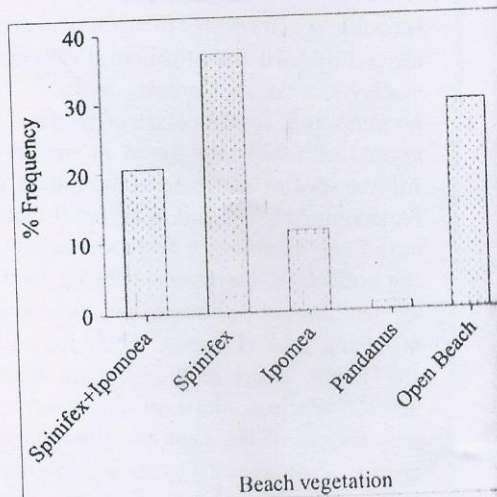


Figure 2. Relative abundance of beach vegetation along the southern Chennai coast, Tamil Nadu, based on point sample method; sample size (n) = 101.

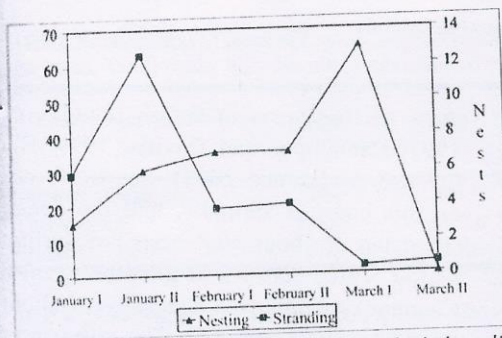


Figure 3. Nesting and stranding of *Lepidochelys olivacea* along the southern Chennai coast, Tamil Nadu during January – March 2004.

were considered new, as the interval between surveys was 10–15 days and tracks were obliterated during the survey.

Vegetation was evaluated at every 500 m along the entire beach using point sample method. At each site, the presence of vegetation along the perpendicular line from the high tide up to 25 m inland was noted. Based on the representation of each or combination of plant species in the samples ($n = 101$), proportion of the same was calculated and considered as their availability. Plant species found within a 5 m radius of each nesting site was enumerated and proportion of the same was considered as utilization by turtles. Data on nest site with respect to distance from high tide line was measured using a flexible tape and nearest river mouth and village in most cases were recorded using a GPS.

Number of nests (estimated) along the beach surveyed during the study was calculated as

$$N = n \times d \times t$$

(Bhupathy and Karunakaran, 2003),

where N = total nesting, n = average nesting of the day/10 km, d = number of sectors surveyed, and t = study period (in days).

Preference of nesting sites by turtles with respect to ground vegetation was calculated based on the availability and utilization of ground vegetations.

$w = r/a$ and, further standardized as $B = w/\sum w$, where a = ratio of availability of one or combination of plant species and r = ratio of utilization of the locations with one or combination of plant species by turtles for nesting.

The beach was divided into various sectors such as 0–50 m, 50–100 m, etc, with respect to

the distance from river mouth and village, and inland perpendicular to high tide line as 5 m, 10 m, 15 m, etc. Number of nests located in the above sectors was correlated with distance categories using Pearson correlation (SPSS, version 6).

RESULTS

Beach vegetation.— About 70% of the sample points had vegetation within 25 m from the high tide line. Major shore vegetations of the area were *Spinifex littoreus* followed by a mixture of *S. littoreus* and *Ipomoea pescaprae* (Fig. 2). Sand bars without any terrestrial vegetation was found near river mouth. About 50–100 m away from high tide line, *Casuarina* plantations and *Pandanus* were common. *Casuarina* plantations are a part of the coastal shelterbelt programme for protecting the mainland from natural calamities, such as cyclones. Human settlements and agriculture largely affect the area farther inland in the area. Major occupations of the inhabitants of the coastal villages are fishing, and their fishing boats were left on the shore itself. Nest predators, such as jackals (*Canis aureus*) and domestic dogs (*Canis familiaris*) inhabit the *Casuarina* plantations and human settlements, respectively.

Nesting and mortality.— A total of thirty eight turtle tracks was recorded in the fortnightly sampling from January to March 2004, of which 36 nests had eggs. Egg shells found nearby predated nests and signs of animals/humans indicated the status of the nest. Number of eggs in the nests robbed by humans was confirmed through interviews with villagers with the help of the field assistant from this study. Peak nesting was observed in the first fortnight of March (Fig. 3). Estimated number of nests for January–March was 540, which worked out to be 10.8 nests / km (Table 1).

Of the 36 nests observed, 25 (69.4%) were found depredated. Among the depredated nests, based on signs found nearby, jackals and domestic dogs contributed 54.2% and 33.3%, respectively, and human about 12.5% of the nests pilfered eggs. Native communities such as Iru-las consume turtle eggs occasionally. Carcasses of 134 ridleys and five green turtles, *Chelonia mydas* were observed during this investigation.

Turtle mortality was mainly due to drowning in the fishing gears as fresh carcasses had injuries and prolapsed internal organs. Fishermen in this region often chop off the flippers or club the head of the entangled turtles to remove them without damage to the nets or to the fishermen themselves. Peak mortality of turtles was observed during January, which gradually reduced (Fig. 3).

Nest site characteristics.— Data on nest site with respect to distance from the nearest river mouth, village and high tide line are given in Table 2. Distance from the nest to village varied from 10 to 2000m (mean = 758.6 m, SD = 586 m, n = 36). The correlation of number of nests located and various distance categories from the closest village was negative, but weakly significant ($r = -0.443$, $p = 0.05$, $n = 20$). Similarly, the number of nests found and various distance category from river mouth was also negatively related ($r = -0.316$, $p = 0.034$, $n = 44$) showing more turtle nests were found in close vicinity to river mouth. The mean distance of the location turtle nest from the high tide line was 17.2 m (range 0–100 m). Significant negative correlation was obtained between number of nests located and distance categories from high tide line ($r = -0.628$, $p = 0.039$, $n = 11$, Table 2), indicating that the number of nests were reduced with distance.

Vegetation data based on point sampling showed that *Spinifex littoreus* covered a larger proportion of the area followed by open sandy beaches without any vegetation (Table 3). Preference index calculated from available proportion of various ground vegetations with respect to nest location (utilization) showed that locations with *Ipomoea pescaprae* was most preferred ($sw = 0.445$) for nesting, followed by open beach without any ground vegetation ($sw = 0.256$). Use of locations with *I. pescaprae* for nesting was high compared to its availability (Table 3). *S. littoreus* covered a considerable proportion (38%) of the beach studied, but were poorly utilized ($sw = 0.207$) by turtles for nesting.

DISCUSSION

Nesting of ridleys during January–March along the southern Chennai coast is similar to other parts of the east coast of India, including the

mass nesting areas in Orissa (Pandav et al., 1997; Banugopan and Davidar 1999; Bhupathy and Saravanan, 2002). Sea turtle nesting on this coast is sporadic, and the density is estimated at about 10.8 nests/km during this period. Three decades of monitoring on 6 km Chennai coast showed a density of about 9.5 nests/km (Shanker, 2003). The estimated nesting density based on fortnightly sampling in the present study is similar to that of the daily monitoring by the Students' Sea Turtle Conservation Network (SSTCN) along a small sector (6 km) Chennai coast.

Kar and Bhaskar (1982) estimated 100 nests/km along the southern Chennai coast during early eighties. Drastic reduction of nests within two decades is to be noted, and this reduction could be largely due to incidental mortality of a large number of adult turtles in fishing gears. Decline of ridley populations worldwide have been largely attributed to incidental mortality (Limpus, 1995; Renaud et al., 1997; Hays et al., 2003; Shanker et al., 2003). Based on studies along the Virginia, North Carolina and Gulf of Mexico coasts, it has been estimated that the number of dead turtles that have been washed ashore represented a maximum of 7–13% of the total mortality (Epperly et al., 1996). This indicates that carcasses found on the beaches are only a fraction of the number of turtles that died in high seas. A record of 134 ridley carcasses in 50 km sporadic nesting area within one breeding season is a matter of concern and requires conservation attention.

Table 1. Nesting of *Lepidochelys olivacea* along the southern Chennai coast, Tamilnadu during January – March 2004. For nest estimation procedures, see data analysis

Fortnight	Number of nests	Average nesting/ day/10km
January I	3	0.6
January II	6	1.2
February I	7	1.4
February II	7	1.4
March I	13	2.6
March II	0	0
Total	36	7.2
	Average nesting/ day/10km	1.2
	Estimated nests (for January – March)	540
	Nest/km	10.8

Table 2. Relationship of nests of *Lepidochelys olivacea* with various habitat parameters along the southern Chennai coast, Tamil Nadu. SD= Standard deviation, n = sample size, r = correlation, p = significance.

Distance from nest (m)	Mean	SD	Range	Pearson correlation		
				n	r	p
Nearest village	758.6	586.7	10–2000	20	-0.443	0.050
River mouth	4783.3	3973.6	100–13000	44	-0.316	0.034
High tide line	17.2	21.01	0–100	11	-0.628	0.039

Table 3. Nest site preference of *Lepidochelys olivacea* with respect to ground vegetation along the southern Chennai coast, Tamil Nadu.

Beach vegetation	Proportion of availability (a)	Proportion of use (r)	Preference (w) Index	Standardised Index (B)
<i>Spinifex littoreus</i>	0.375	0.343	0.92	0.207
<i>Ipomoea pescaprae</i>	0.115	0.228	1.98	0.445
Mixed vegetation (<i>Spinifex + Ipomoea</i>)	0.210	0.086	0.41	0.092
Open sandy beach (No vegetation)	0.300	0.343	1.14	0.255

Nest depredation by both wild and domestic animals, and pilfering by humans have been reported in sporadic nesting areas along the Chennai (Whitaker, 1977) and Nagapattinam (Bhupathy and Karunakaran, 2003) coasts, and predation may be as high as 90% in localities such as the latter one. However, the present study area (southern Chennai coast) appears largely undisturbed with respect to illegal egg collection. Native communities, such as Irulas, occasionally use turtle eggs, but do not consume turtles, as done by the inhabitants around Gulf of Mannar (Bhupathy and Saravanan, 2003). Human consumption of turtle eggs is common throughout the nesting area of the ridleys, including the Indian coast (Frazier, 1980).

Factors such as beachfront illumination, topography, grain size of the sand, and vegetation may influence the selection of nest site by turtles (Mortimer, 1995). However, in general, studies on these aspects are scanty. Nest sites that provide optimum condition for developing eggs and hatchling dispersal are important for the survival of populations. In the present study, relationship between the nest location and distance from coastal villages was marginally significant, but negative ($r = -0.443$, $p = 0.05$). This could be due to the limited impact of these coastal villages on nesting turtles as they were devoid of artificial illumination during night. It has been reported that artificial beachfront illuminations disorient both adults and hatchlings (Mortimer, 1995; Tripathy et al., 2003b).

Selection of nest sites close to high tide line would have greater chance of inundation, but farther inland would result in higher predation of hatchlings during their emergence and movement towards the sea. Apart from this, sites further inland from the high tide line may be dry and this condition would lead to desiccation of eggs and poor hatching. Other factors, such as topography (elevation) of the beach, which were not studied during this study, may play a role in the selection of nest sites by turtles. Significant negative correlation ($r = -0.316$, $p = 0.034$, $n = 45$) between number of nests located in various distance categories from river mouth showed that turtles nested close to river mouth, and this corroborates the popular belief that ridleys largely nest close to river mouths. Factors such as grain size, moisture content and chemical nature of the sand would also be deterministic in this regard. However, further investigations are required on this direction.

Vegetation of the southern Chennai coast is largely psammophytes, which are similar to other parts of the east coast (Pandav et al., 1997; Bhupathy and Karunakaran, 2003). The role of beach vegetations in nest site selection by turtles is unclear, but views on the same are contradictory (see Mortimer, 1995). We speculate that the root of *Ipomoea pescaprae* may help bind the sand and prevent collapse of nests while under construction. The grass *Spinifex littoreus* has runners and grows in comparatively drier zones of the beach, and has a thick network of roots.

The grass may hinder the movement of both adults and hatchlings as reported recently (Tripathy et al., 2003b). This may partially explain the presence of a fewer nests near *S. littorens*. Nesting of turtles near *Ipomoea* had been mentioned in the Tamil Sangam literature (~400 AD; Sanjeevaraj, 1958), which is perhaps the oldest literature available hitherto on turtle nesting.

The southern Chennai coast is an important area for sea turtle conservation along the east coast as human disturbance to turtle nests is low and artificial illumination on the beach is absent. The negative aspect of this area is high mortality of turtles due to incidental catch in gill nets and trawlers. Turtle mortality due to fishing activities is a global concern and must be addressed continually to prevent further population decline (Renaud et al., 1997). One of the options available is effective use of Turtle Excluder Device (TED) in trawlers. Indigenously developed TED is being promoted along the Andhra Pradesh coast (Bhavani Sankar and Raju, 2003) and may be expanded to other Indian states. Effect of TED in minimizing the mortality of *Caretta caretta* and *Lepidochelys kempii* has been reported recently (Lewison et al., 2003). Sea turtle awareness programmes along coastal areas, involving local communities, would yield the desired results. Information on the relationship between nest site preference and various environmental parameters are pertinent, with respect to both sea turtle conservation and coastal area development.

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