

## Natural and anthropogenic threats to olive ridley sea turtles (*Lepidochelys olivacea*) at the rushikulya rookery of Orissa coast, India

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An assessment of various threats to the olive ridley turtles at Rushikulya rookery of Orissa in India was investigated during 2003-04 and 2004-05 seasons. Data on adult mortality, predation of eggs and juveniles, beach erosion and *Casuarina* plantation along the beach were collected. Turtle mortality was low at Rushikulya compared to rest of the Orissa coast. However, other anthropogenic pressures such as *Casuarina* plantation close to high tide level, beach erosion and artificial illumination that have emerged as visible threats at this rookery. Protection of nests and minimization of artificial illumination are some of the immediate steps required for safeguarding sea turtles at the Rushikulya rookery.

**[Keywords:** *Lepidochelys olivacea*, Threat, Fishing, *Casuarina* plantation, Erosion, Rushikulya, Orissa]

### Introduction

Similar to other long-lived species, the olive ridley turtles (*Lepidochelys olivacea*) are also prone to population decline because of slow intrinsic growth rate coupled with anthropogenic pressure. Degradation, transformation and destruction of natural conditions at nesting beaches from coastal developments continue to threaten the long-term survival of many olive ridley rookeries<sup>1</sup>. Orissa state along the east coast of India supports considerable global olive ridley sea turtle population that migrates for breeding and synchronized nesting takes place at some selected locations<sup>2</sup>. Olive ridleys are victim of several threats along the coast. Apart from offshore fishing related mortality, *Casuarina* plantation, beach erosion, artificial illumination and predation of eggs and hatchlings affects the animal directly through the loss of nesting habitat or indirectly through changes in the thermal profiles of the beach. The Rushikulya is a recent discovery along the Orissa coast to be one of the major olive ridley mass nesting sites<sup>3</sup> where several thousands of female olive ridley nests during "arribada" period. Natural and anthropogenic pressure at the turtle fauna at this rookery is mounting year after year. We have attempted to evaluate the various threats to the olive ridley turtles at the Rushikulya

rookery of Orissa coast during the breeding seasons 2003-04 and 2004-05.

### Materials and Methods

Field work at the Rushikulya sea turtle mass nesting site along the Orissa coast had been done in a spit beach. It is a 6 km sand spit beach along the northern side of the Rushikulya River mouth (Fig. 1). This rookery is close to three fishing villages (Kantiagarha, Gokhurkuda and Purunabandha). The Humma and Ganjam Townships are close to the nesting beach. A chloro-alkali plant (Jayshree Chemicals Limited) on the bank of River Rushikulya mouth at a distance of < 2 km from nesting beach. The National Highway No.5 runs parallel to the mass nesting beach at a distance of about one km. A part of the beach is backed by *Casuarina* (*Casuarina equisetifolia*) vegetation, mostly planted after the super cyclone of 1999 in Orissa.

The entire beach was monitored by foot once in a fortnight throughout the breeding season from November to April (2003-04 and 2004-05). Dead turtles washed ashore were marked on their carapace with synthetic paint to avoid duplication during subsequent counts. These stranded turtles were sexed using external characteristics. Curved Carapace Length (CCL) (anterior point at midline/nuchal scute to the posterior tip of the supra-caudal) and Curved Carapace Width (CCW) were measured for all the dead turtles following standard procedures suggested<sup>4</sup>.

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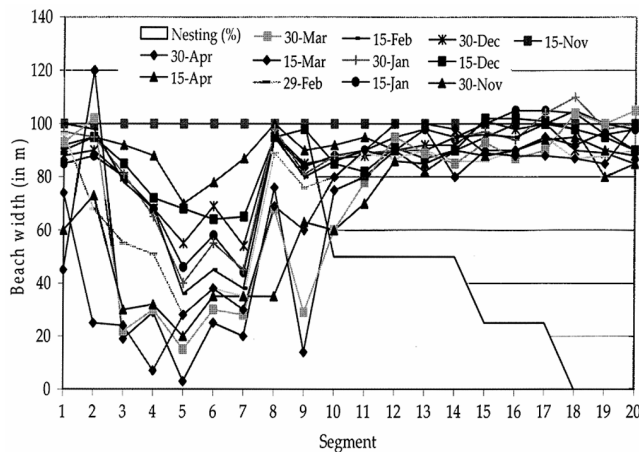


Fig. 1 — Beach profile of Rushikulya rookery during 2003-04 sea turtle nesting season

Predation on turtle eggs (nest predation) was documented for each breeding season from November to April. This study focused on the entire six km beach from the Rushikulya river mouth to Kantiagarh village. Signs of nesting on the beach were monitored every morning based on crawl marks. Turtle tracks do not always reliably distinguish true nests from pits where a female has come ashore, dug, but not laid. However, predation of eggs in the nest is a direct evidence of nesting. For some nests it was possible to record exactly the interval between egg laying and fresh predation. For others, a minimum interval from the date of nesting i.e., date at which the nest was found to the date of predation was recorded. Predation was determined by one or more of the following characteristics: paw prints on the sediment, sand thrown in one or more directions with a wide opening of the nest, egg shells scattered around the nest site and visually witnessing the predator in action<sup>5</sup>. Data were collected regularly from the beginning of sporadic nesting at the rookery till hatching. For the purpose of computing, nest predation of sporadic and arribada nests were calculated separately.

The beach profiling was done for the entire six km stretch beach on a fortnight basis from November to April following standard procedures suggested<sup>6</sup>. At every 100 m point a permanent landmark was fixed. These points were marked with a concrete pole/sandbag for subsequent monitoring. Beach width was measured perpendicular from the high tide line (HTL) to the permanent land mark.

The formula used for calculating the available nesting beach was as follows.

$$\text{Width of the beach } l = a \pm b$$

Where,  $b$  is the width of beach from its earlier fortnight observation ( $a$ ).

Finally, area available for nesting ( $N$ ) was calculated as average beach width ( $l$ ) x total length of the beach.

The various sources of illumination close to the nesting beach that might have some impact on turtles and their hatchlings were documented. The impact of *Casuarina* plantation on the nesting adults and hatchling were also taken into consideration by direct observations on their movement behaviour during breeding season.

## Results

During November-April of 2003-04 and 2004-05, 92 and 108 dead olive ridley turtles were counted reproductive seasons respectively. By the end of November 2003, two dead turtles were counted along this coast, After December the number of dead turtles started increasing (Fig. 2). Of the total dead turtles that were sexed, 37 (18.2%) were male, 134 (66.6%) were female and 30 were unidentified carcasses. There was no significant difference in size between male and female dead turtles (two-sample t-test,  $p > 0.05$ ) (Table 1; Fig. 3).

During 2003-04 season, the nesting beach underwent remarkable changes (Fig. 4). Considerable changes in beach profile was observed due to heavy natural erosion, and as a result more than 60% of the nests were washed along with the wave. In contrast, there was little change in beach geomorphology during 2004-05 (Fig. 5). Although the beach stretch beyond Gokhurkuda village suffered from erosion, there was no egg loss, it was so because mass nesting of 2005 was confined to beach immediate north of the Rushikulya river mouth (segment # 3-8) and there was no inundation of beach along this stretch during 2004-05 season.

The data on nest predation by non-human predators at the Rushikulya rookery shows a difference in predation level in both the years. While 71.69% and 83.53% of the sporadic nests were predated during 2003-04 and 2004-05 season respectively (Fig. 6), the level of predation to arribada nests was as low as 8.32% and 2.62% for these years. All the sporadic nests were found excavated by jackal, hyena and or feral dogs as evidenced from direct sightings and their footprints. The mean interval between nest laid and predation was 5.8 days. Of the 74 nests where egg laying was observed during night, it was attacked later

on the same night. On an average 48.43% of eggs in the nests (range 6 to 120 eggs) were found damaged by the predators. March and April months were the peak predation period for both the years. Hatchlings of turtles on the beach were found predated by feral dogs (*Canis familiaris*), house crows (*Corvus splendens*), Brahminy kites (*Haliastur indus*) and Brown-headed gulls (*Larus ridibundus*) mostly during early morning hours. On the beach, ghost crab (*Ocypoda ceratophthalma*), also a predator was found to be the common.

Of the 45 nests of 2003-2004 that were randomly observed, orientation data was collected from 4865 hatchlings. Of these, 78.24% ( $\pm 5.55$  SE) hatchlings

shown orientation towards sea, while only 21.76% ( $\pm 4.38$  SE) moved towards landward side of the beach. However, orientation of hatchlings towards land (towards the source of light) was very high during 2004-05 season (90.59%;  $n = 6094$ ) and only very few hatchlings moved towards the sea (9.24%). Majority of the hatchlings were seen crawling towards the land attracted by artificial illuminations from the Chloro-alkali plants and the nearby townships ( $\bar{x} = 83.94 \pm 26.5$  SD).

### Discussion

The Incidental capture of olive ridley turtles occurs worldwide in trawl fisheries, long-line fisheries, purse seines, gill net and other net fisheries and hook and line fisheries and considered to be serious threat to the species globally<sup>7</sup>. The Orissa olive ridley population has been subjected to high mortality in recent years; with over 10,000 turtles counted dead on the coast each year due to fishery related incidental mortality<sup>8</sup>. We have documented 200 dead turtles, which is quite low when compared to the mortality figures for the entire Orissa coast for any year. Comparatively low mortality of turtles along the Rushikulya rookery could be due to the unique fishing practice in the area. Monofilament gillnets are not known to harm turtles as they are soft and turtles can easily break the webbing. In contrast, Gahirmatha and its adjacent areas are subjected to high mortality during the breeding season, where intense shrimp trawling occurs. The average sizes of dead turtles during this study were marginally smaller than those reported in 1999 and 2002<sup>9,10</sup>.

While turtle-fisheries interface at the Rushikulya rookery is least compared to other rookeries in Orissa, other problems are mounting seriously at this rookery. Apart from the proposed developmental activities (proposed ports, oil refineries, coastal industries etc.), the immediate threats to turtles here are beach erosion, *Casuarina* plantation and mortality of hatchlings due to artificial illumination.

Nests deposited on shifting beaches are more susceptible to damage due to erosion. Almost 40-60% of the nests of leatherbacks laid on shifting beaches

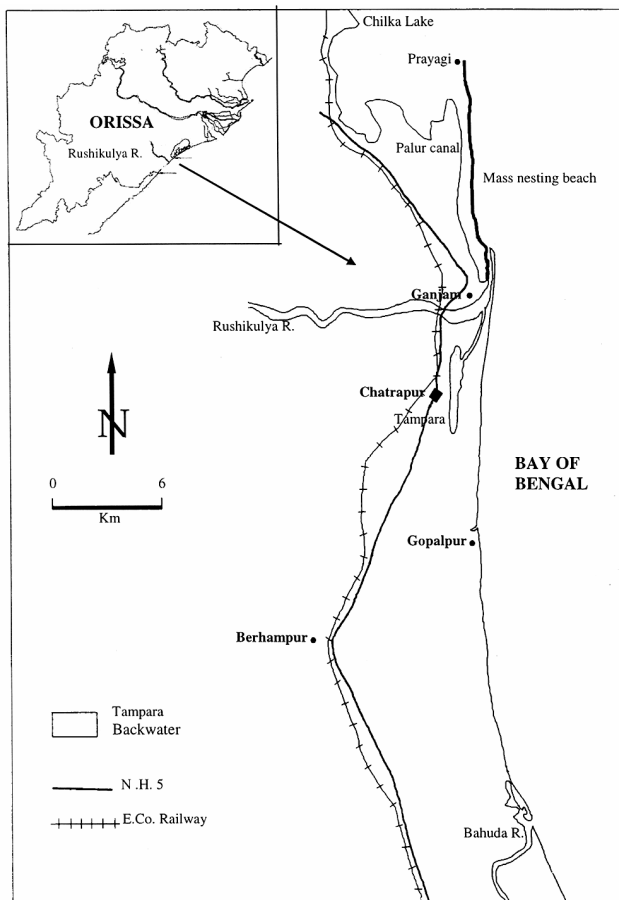


Fig. 2 — Map of Rushikulya sea turtle rookery, Orissa

Table 1 — Size measurements of male and female olive ridley turtles stranded on the beach along the Rushikulya rookery, Orissa coast.

Sex (n)	Curved Carapace Length		Curved Carapace Width	
	Mean $\pm$ S.E	Range	Mean $\pm$ S.E	Range
Males (37)	69.39 $\pm$ 0.5266	60.8 – 78.0	67.5 $\pm$ 0.6048	62.4 – 73.4
Females (134)	69.47 $\pm$ 0.6121	63.2 – 78.0	67.40 $\pm$ 0.5268	62.4 – 75.4
Unknown (30)	69.09 $\pm$ 0.6428	63.8 – 73.5	66.91 $\pm$ 0.7160	61.6 – 74.0

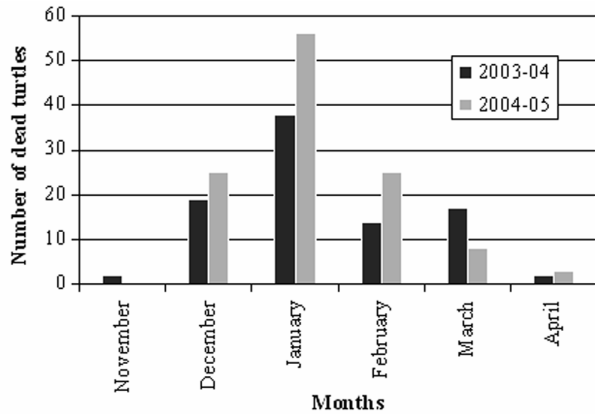


Fig. 3 — Month-wise dead olive ridley turtles washed ashore along the Rushikulya rookery

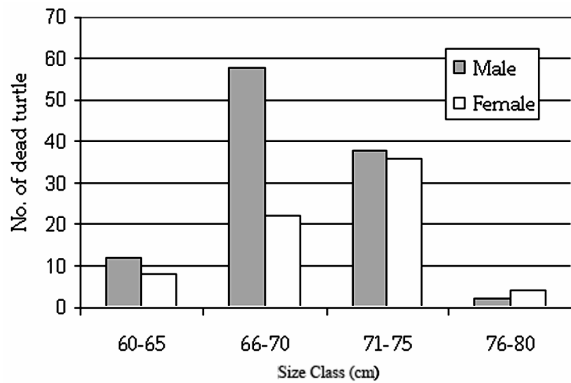


Fig. 4 — Size class of male and female olive ridleys washed ashore along the Rushikulya rookery

are reported to have been lost because of beach erosion<sup>11</sup>. The shifting of the Rushikulya river mouth from north to south and vice versa is known for a long time<sup>12</sup>. As a result of this, there has been a substantial loss of nesting habitat at this rookery. Dash and Kar (1990)<sup>2</sup>, Choudhury *et al.* (2003)<sup>13</sup>, Mortimer (1981)<sup>14</sup> and Cornelius and Robinson (1986)<sup>15</sup> have suggested that heavy loss of the post ovipositional eggs could occur as a result of beach erosion at mass nesting sites. Erosion of Gahirmatha beach after the 1970's was due to *Casuarina* plants planted along the coast<sup>2</sup>. Similar erosion had occurred at Rushikulya rookery in the last few years<sup>16</sup> affecting the nesting beach at Rushikulya.

The other factors that affect turtle eggs, juveniles and the hatchlings at Rushikulya are the non-human predation. Besides ghost crab, large numbers of nests were found predated by various mammalian species *viz.* feral dog, hyenas and jackals immediately after nesting was over. The nesting sites of sea turtles usually are islands, free from mammalian predators. Even mainland nesting populations often utilize

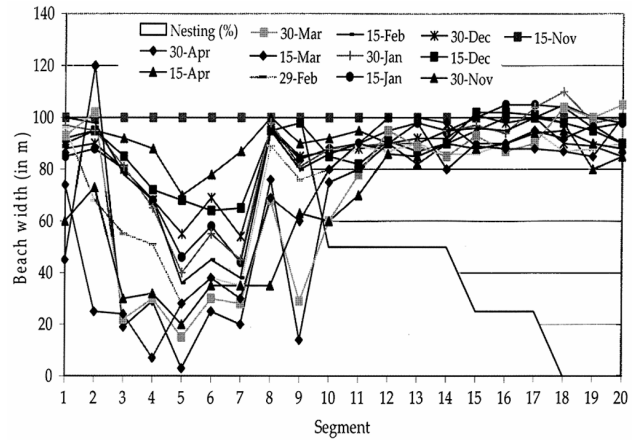


Fig. 5 — Beach profile of Rushikulya rookery during 2004-05 sea turtle nesting season

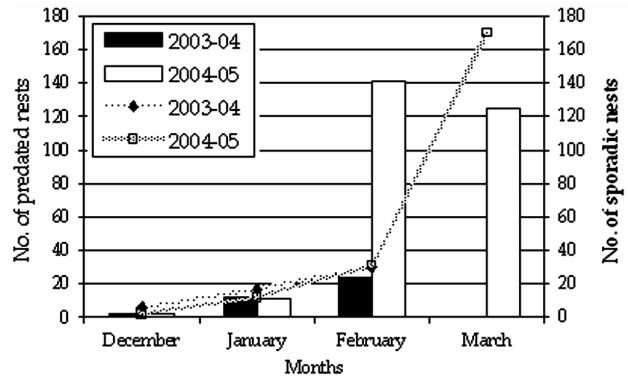


Fig. 6 — Non-human predation of olive ridley nests at the Rushikulya rookery

stretches relatively free from human use and terrestrial predators<sup>17</sup>. The Rushikulya rookery initially was separated from mainland by a channel, which become shallow and bridges were constructed at many places for accessing the beach for use by fisherfolk. This has allowed the mammalian predators to access the beach.

*Casuarina* trees have been extensively planted all along the coast of Orissa. While 50% of the mass nesting beach of Rushikulya is devoid of plantation, the rest areas are backed with dense *Casuarina* plantation. Those nests laid inside the *Casuarina* shrubs were immediately predated upon by jackals and dogs. *Casuarina* is known to be detrimental to the nesting sea turtle population in more than one way. Dense *Casuarina* causes excessive shading on the nesting beach. Studies in Florida suggest that nests laid in the shaded areas are subjected to lower incubation temperature and which can alter the sex ratio of the population<sup>18</sup>. There is report of declines in nesting activities of loggerhead in Everglades

National Park where dense stands of *Casuarina* took over the native beach vegetation<sup>19</sup>. The Supreme Court constituted the Central Empowerment Committee of India<sup>20</sup> has strongly recommended for the removal of *Casuarina* and the restoration of natural beach condition at three sea turtle mass nesting sites along the Orissa coast.

Under natural condition, sea turtle hatchlings move directly towards the sea after they emerge out from the nest. However, when any kind of artificial source of light present near the nesting beach, they tend to move towards the source of light as it disrupts the sea finding behaviour of the hatchlings<sup>21</sup>. The Rushikulya rookery beach is illuminated due to the presence of various artificial illumination sources which has caused disorientation of hatchlings leading to death on the beach.

The olive ridley sea turtles in Orissa are now exposed to many problems other than fishing related casualty and precautionary measures need to be taken by the wildlife and forest authority to safeguard the olive ridleys and their nesting habitat including the Rushikulya rookery of Orissa coast.

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