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Nesting Biology and Site Selection of Olive Ridley—A Coherence of Nature

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Abstract

Nesting behaviour of sea turtles remains a subject to study, due to their enigmatic pattern of seasonal breeding activities. In the present study, characteristics of the breeding turtle, Olive Ridley (*Lepidochelys olivacea*) at Ramnagar along N-E coast of North Andaman Islands were investigated, for the nesting periods 2016-2017. Olive Ridley is the dominant sea turtles, with more than 300 individuals nesting every season with at least a 75% hatching success rate. It is one of the conducive, highly protective and undisturbed nesting sites for Olive Ridley on North Andaman coast. In the present study an initiative is made, to identify nature's cues and the biological characteristics of Olive Ridley, which leads it to nest at Ramnagar beach, with a high hatchling success rate.

Keywords

Sea Turtle, Olive Ridley, Ramnagar Beach, Nesting Beach, Sand Grain, Hatchling, North Andaman

1. Introduction

Marine turtle species are mosaic of individuals and populations, all of which may live in slightly different habitats. Every year, sea turtles migrate for thousands of kilometres exploiting a range of habitats from deep oceans to the shallow waters to feed themselves. This enormous range of movement makes them a key representative of a variety of habitats in the oceans, as well as coastal areas around the world. Favourable nesting habitat is important for sea turtle reproduction and long-term survival capacity of their juveniles. Coastal areas with sandy beaches are favourable nesting habitats for sea turtles [1].

India has a coastline of 7800 km in length, including the mainland and the

offshore Islands of Andaman and Nicobar, and Lakshadweep Islands. India has a unique status for the distribution of five species of sea turtles [2] [3] [4] [5] namely the Olive Ridley (*Lepidochelys olivacea*), Green Sea (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata*) and Loggerhead (*Caretta caretta*). Since sea turtles are one of the important biodiversity resources of Andaman and Nicobar Islands, these Archipelago beaches had gained more attention for sea turtle breeding, since 1990s [3] [6] [7], Historical accounts of sea turtles in these Islands dated back to 1883, onwards. The first survey on turtles in the Islands was dated in the late 1970s over two decades by Bhasker, *et al.* [3] from Andaman and Nicobar Environmental Team (ANET).

Thirty Islands are confined sea turtle nesting sites identified in Andaman and Nicobar Islands [3] [7]. Hawksbill population in Great Nicobar, India is the largest nesting location in the Northern Indian Ocean region. Leather back in Great Nicobar and Little Andaman Island is one of the 4 colonies identified in Indo-Pacific region [8]. Green Sea turtle is the most common species in these Islands, nesting almost year around Nicobar [3] [9] [10]. Key Olive Ridley nesting sites across India were identified as Calicut in Kerala, Siali in Orissa and Cuthbert Bay (Mayabunder) in Middle Andaman Island, Ramnagar and Kalipur beaches in North Andaman Islands. South and West Bay in Little Andaman has more leatherback and few Olive Ridley nesting were observed [11].

2. Global Status of Olive Ridley

The spectacular site of the mass congregation of Olive Ridley Sea turtles for nesting, enthralls both the scientists and the nature lovers throughout the world. Olive Ridley turtles are globally distributed and categorized as Vulnerable in the IUCN Red List [12] found place in Schedule-I of Indian Wild Life (Protection) Act, 1972 (amended 1991). Large nesting aggregations occur in Costa Rica and Mexico in the eastern Pacific and in the State of Orissa on the east coast of India. More than 100,000 turtles are believed to nest during mass nesting events or arribadas (Spanish for arrival) at Gahirmatha, the northernmost rookery in Orissa, and >10,000 nest at other rookeries, mainly the mouth of Devi River and Rushikulya [13]. Olive Ridleys in the Indian waters are genetically distinct from other global populations even from the Sri Lankan counterparts [14].

The population which nests on the Chennai coast is part of the same lineage which nests in Orissa. This population is considered to be globally significant as they are distinct from ancestral to Olive Ridleys found in Atlantic and Pacific Oceans [15] [16] [17]. Indian Ocean Olive Ridleys are smaller than individuals found in their counter parts in Indo-Pacific and Atlantic Oceans. The Olive Ridley sea turtle, also known commonly as the Pacific ridley sea turtle, is a species of turtle in the family Cheloniidae. The species is the second-smallest and most abundant of all sea turtles found in the world. The Olive Ridley's populations observed in small isolated group in Atlantics.

Recent studies have indicated the uniqueness of the Indian Olive Ridley pop-

ulation in comparison to other global populations [13]. Several thousand Ridleys nest in Andhra Pradesh [18] [19], Tamil Nadu [20] [21] and the Andaman and Nicobar Islands [5] [22]. Research has been carried out on various aspects such as reproductive biology, population biology, migration and evolutionary history [23]. Chattopadhyay *et al.* [24] reported that Odisha coast is significantly "arribada" process for Olive Ridley species till date. According to Adnyana *et al.* [25] reported that the Olive Ridley species nesting in Indonesia Papua and Sunda regions are genetically different and follows different patterns to migrate pathways. Carpio *et al.* [26] studied sea level oscillation in the coast of Ecuador and reported that future change in the sea level may affect the nesting ground significantly. The Olive Ridley nests observed in 30 islands and predominantly along the east coast of the Andaman Islands, specially 12 sites in North, Middle and South Andaman groups and 3 sites in Nicobar groups [9].

Ramnagar beach in North Andaman is one among the 12 sites of Olive Ridley nestling beach on the East Coast of Andaman [5]. The Leatherback and Green Sea turtles are also a rare visitors for nesting. Olive Ridley's are globally distributed and categorized as vulnerable in the IUCN Red List.

3. Olive Ridley—Known Biology

Scientific name: *Lepidochelys olivacea*
Conservation status: Vulnerable (Population decreasing)
Kingdom: Animalia
Phylum: Chordata
Order: Testudines
Family: Cheloniidae
Genus: *Lepidochelys*
Species: *olivacea*

Olive Ridley is the smallest and most abundant of all sea turtles, grows up to 80 cm and weighs less than or up to 50 kg. It gets its name due to the heart shaped, olive green coloured carapace. Male and female attain the same size. Female has slightly rounded carapace, 5 to 9 pairs of costal scutes and 1 or 2 claws in each flipper. Being omnivorous, they consume an assortment of prey such as crabs, mollusks, sponges, bryozoans, tunicates, sipunculids, ascidians, sea grasses, sea weeds, algae, lobster, and even puffer fish [27]. With the help of tailored jaws, they generally crush and grind the shells of its prey before intaking. To forage on benthic invertebrates, they can dive to depths of 500 feet [28]. Olive Ridleys nest during November to April with a peak from December to February [7]. The nest site selection by the female plays an important role in the survival of the hatchlings. Olive Ridley adopted three strategies for nesting such as arribada, solitary and mixed strategy. An arribada is a mass-nesting event when thousands of turtles come ashore at the same time to lay eggs on the same beach. More commonly, Olive Ridley turtles nest in a dispersed way, *i.e.* solitary (individual nesters are not synchronous). Some time it may take both strategies.

However, the reasons for each strategy are not understand clearly till date. The age of the turtle is highly difficult to measure in the wild. However, the estimates suggested that it may live around 60 years [29] [30]. The male and female identification is very difficult during the juvenile stage. During the sexual maturity based on its tail length, it may be identified as male or female.

The male have long, and curved one and female have short (less than 10 cm) tail. Every year individual sea turtle do not reproduce. Each female undergo active reproduction once in 2 to 6 years period [31] [32] [33]. It also found that, the genetical factors has not been act to determine their sex. The temperature during the time of hatching will determine the sex of the juvenile, *i.e.* the high temperature leads to female and low temperature provide male. So, climatologist worried about the increase of temperature during coming years may lead to full of female population instead of male, then it becomes a problem in future [34] [35]. Once the egg was laid in the nest, the female never returns to the nest. During the incubation, the embryo grows around 50 to 80 days, depend upon the environment, where the nest is available, and hatching begins. Using the keratinous bump on the tip of their snout, break the egg and come out. The hatching takes place almost synchronously along with the siblings and lead to simultaneous digging to make out of the nest faster. This activity is named as "Social Facilitation" and need three to five days of active digging the column of sand above the nest chamber and come out. Most of the time it happens in the cool night or evening and once the baby turtles emerge to the surface of the beach immediately it crawl to the ocean and swim to the sea [36] [37].

4. Olive Ridley—Biology and Nature

The known general biology of Olive Ridley turtle induce a lot of questions such as how long it takes to reproduce? How it will identify the right place for nesting along the coast? Whether it will come back to the same place for each nesting? Understand the above factors, authors (Malarvizhi *et al.* [38]) carried out study in this location using the grain size of the sediment available in the beach, and their depositional energy condition, the place of the nesting of each animal in the beach, *i.e.* distance from the low water mark, high tide level reaching on shore every day, had been carried out and elucidated that the energy level sufficient to carry the animal without any hindrance to nesting site is the important factor for nesting. The individual animal has preferred the destination where the condition favorable to reach the place. Now, in this article to validate the above findings, the biology of the species with reference to number of eggs and laying process has been correlated.

The total length of Ramnagar beach (1400 m) has been equally divided into five blocks and numbered as station I to V from south to north with an average length of 280 m each. Based on biological data, the Olive Ridley follows solitary strategy for nesting in this Island. The individual female lands on the shore and start nesting for its egg laying ceremony in the above blocks. The egg in each

clutch has approximately 90 - 120 numbers. The urge to release the egg is so intense that they are so oblivious of the presence of any foreigner, at the time of nesting. The period of nesting takes 45 to 55 minutes. After laying eggs, the female turtle fills up the pit with sand by the flippers and tries to camouflage the pit site and leave the nesting ground into deep sea. The nesting female leaves the 72 - 80 cm wide asymmetrical forelimb track marks. The tail drag marks are not observed in this location. Once the egg released and turtle left, the forest department personal, collect all the eggs from the clutch and recorded, Then it will be removed to the protected environment, above high tide line, where similar nest condition, the eggs kept and covered till the juveniles arrive from the clutch. Once the juveniles arrive the reed fence, which covered on the top of the nest, will be removed safely and release into the water, at the early morning of next day of hatching. All the above data was collected simultaneously for this work also.

Understand the biology of eggs available and its nesting behavior suggested the following interpretation how the animal goes along with the nature to reach its destination and produce progeny. The egg laying in the nests data has been presented in the Tables 1-5.

Table 1. Table represents the number of nests formed and its distribution in the stations during the month of December 2016 to March 2017, in the study area.

Station	Number of Nests Found				
	Dec-16	Jan-17	Feb-17	Mar-17	Total
I	15	26	30	10	81
II	16	67	25	04	112
III	30	39	18	07	94
IV	6	6	5	07	24
V	2	3	3	0	8
Total	69	141	81	28	319

Table 2. Table represents the number of eggs laid in a nest and its distribution in each stations of the study, during the month of December 2016.

Number of Eggs laid in each nests	Number of Nests in Each Station					
	I	II	III	IV	V	Total
<120	5	5	8	3	1	22
101 - 120	9	9	17	2	1	38
90 - 100	1	0	2	1	0	4
>90	0	2	3	0	0	5
TOTAL	15	16	30	6	2	69

Table 3. Table represents the number of eggs laid in a nest and its distribution in each stations of the study, during the month of January 2017.

Number of Eggs laid in each nests	Number of Nests in Each Station					
	I	II	III	IV	V	Total
<120	16	32	21	3	2	74
101 - 120	5	27	14	3	1	50
90 - 100	2	3	3	0	0	8
>90	3	5	1	0	0	9
TOTAL	26	67	39	6	3	141

Table 4. Table represents the number of eggs laid in a nest and its distribution in each stations of the study, during the month of February 2017.

Number of Eggs laid in each nests	Number of Nests in Each Station					
	I	II	III	IV	V	Total
<120	11	10	5	1	0	27
101 - 120	14	9	11	3	2	39
90 - 100	1	2	1	1	1	6
>90	4	4	1	0	0	9
TOTAL	30	25	18	5	3	81

Table 5. Table represents the number of eggs laid in a nest and its distribution in each stations of the study, during the month of March 2017.

Number of Eggs laid in each nests	Number of Nests in Each Station					
	I	II	III	IV	V	Total
<120	1	1	3	1	0	6
101 - 120	3	1	2	5	0	11
90 - 100	1	0	1	0	0	2
>90	5	2	1	1	0	9
TOTAL	10	4	7	7	0	28

Based on the **Table 1**, the nesting pattern suggested that the maximum nest available in the station 2 (112) followed by station 3 (94) and station 1 (81). However, the least nest found in the station 5 (8). Based on this data, the number of eggs found in the each nest was calculated and presented in **Tables 2-5**, with reference to month and stations (**Figures 1-4**). It is also found that the maximum number of eggs producing turtles (100 to 130 eggs) preferred to reach the stations number two, three and one in the descending orders. The remaining stations suggested it may prefer once or twice or nil times for nesting and laying more number of eggs.

If one consider the average weight of an egg as 17 g, around 130 eggs has a weight of 2210 g extra weight over and above the body weight of Olive Ridley

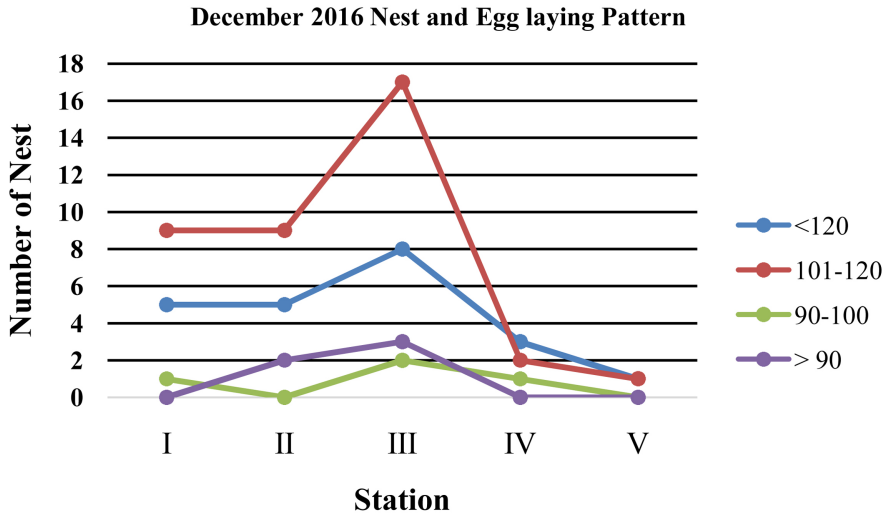

Figure 1. Nest and egg laying pattern in December 2016.

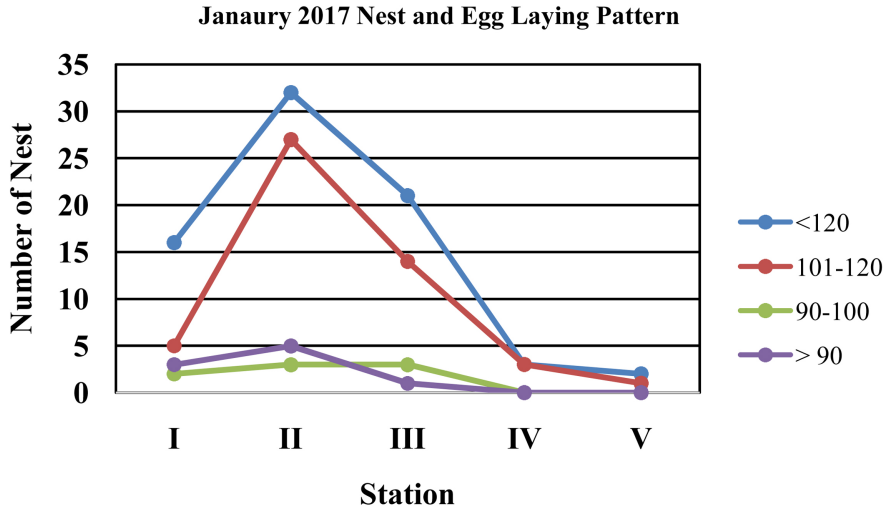

Figure 2. Nest and egg laying pattern in January 2017.

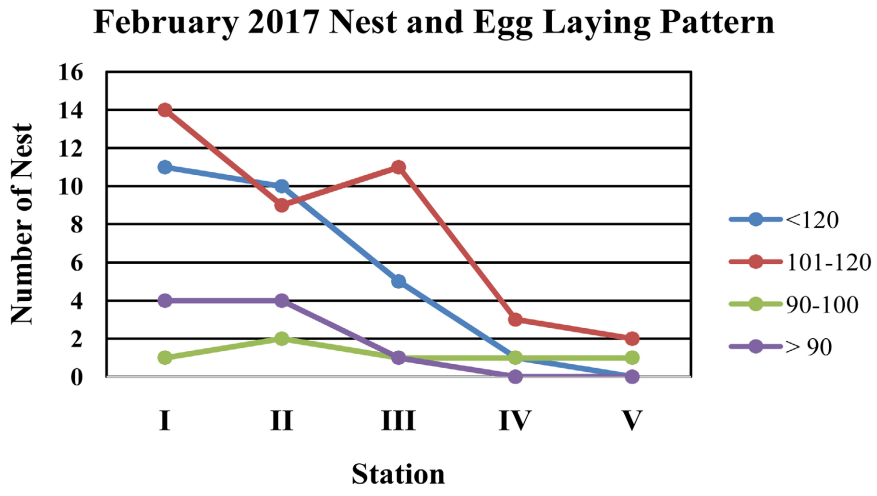

Figure 3. Nest and egg laying pattern in February 2017.

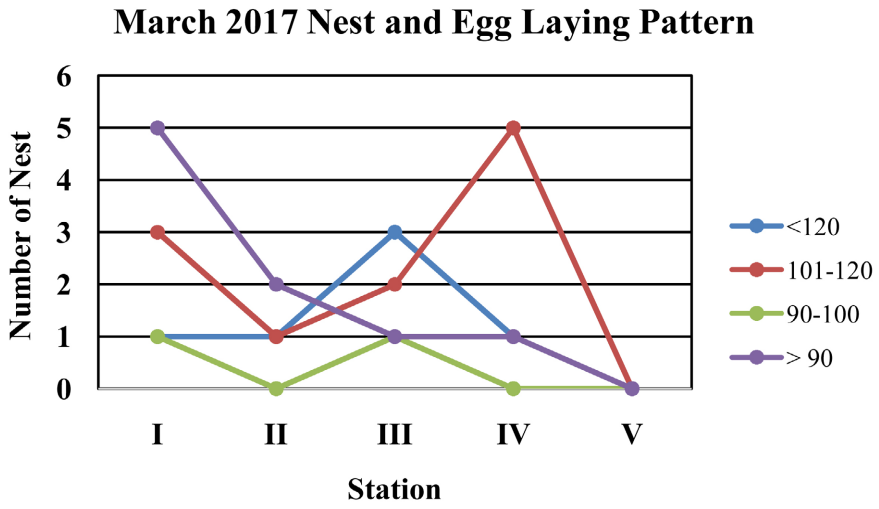

Figure 4. Nest and egg laying pattern in March 2017.

Table 6. The table provides the details of turtles visited, nested, egg laid and hatched in Ramnagar beach during the period 2016-2017.

Year	No. of turtles		No. of eggs laid	No. of hatched	Hatching %
	Visited	Nested			
2016-17	335	319	36,660	28,760	78.45%

turtle. This body weight needs more energy to move to shore and lay their eggs, without using its own biological energy to swim or walk. So, it waits till the energy level of water attains to carry it in suspension and reach the location of nesting spot. This will be more or less attained through the factors like the high tide, slope angle and sediment nature to reach the nesting location (Malarvizhi *et al.* [38]).

May be this phenomenon, *i.e.*, the water energy level does not reach to carry turtles with different body weight to nest at a single event, leads to absence of mass egg laying process (arribada). So, Olive Ridley turtles arrive at this location for solitary nature of egg laying ceremony. Whenever, the energy level match with the individual turtle body biology to carry as a suspension matter and leads to the nest site, during that particular time, that turtle alone comes to the shore and lay the egg. This may also be the reason, these turtles not minding the existence of foreigner in the coast during the nest building and laying eggs.

The details of number of Oliver Ridley turtle visited, nested, egg laid and hatched details presented in the Table 6 support the nature and biology coordinated effort to provide a 78% of success rate of baby turtle production in this region.

5. Conclusion

The present study provides an insight into Ramnagar beach morphology along with the water energy, which has provided the turtle biology to reach nesting lo-

cation with minimal effort and build the nest and lay the eggs. So, this beach environment may be considered for solitary egg laying ceremony of Olive Ridley turtle and produce maximum baby turtle to achieve its target for the maximum reproduction. Since, this study provides insight into Ramnagar beach, however, it is essential to study the nature of energy level and nature of biology of this species in other locations as well as for other turtle behaviour on the similar model for their nesting activities, to enhance the knowledge of turtle biology in future.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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