

# Assessment of Conservation Measures for Olive Ridley Sea Turtle (*Lepidochelys Olivacea*) Along Rushikulya Rookery, Ganjam District, Odisha, India

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## Abstract

Every year, between October and April, Gahirmatha beach in Odisha becomes the nesting ground for Olive Ridley Turtles. These beautiful creatures are an endangered species, and this area is the world's largest known rookery of the marine animals. Over 600,000 turtles come here together for nesting, but this area has not always been the safe haven for hatching the situation exists today. According to the International Union for Conservation of Nature and Natural Resources (IUCN), Olive Ridley Turtles are classed as a "vulnerable" marine species [1]. They derive their name from their heart-shaped, olive green-coloured shells. This mass nesting, popularly known as 'arribada' (a Spanish term used for en masse laying eggs by turtle species) is a yearly phenomenon. More than 4, 00,000 turtles arrive for nesting each year, each laying around 100–150 eggs in pits dug out instantly just before laying. The eggs, after an incubation period of 45 – 60 days, are hatched out yielding 60,000,000 hatchlings, which find their way to seas again.

Only one in a thousand hatchlings survives. They take 25–30 years to reach maturity, and on attaining maturity, which usually takes 25 – 30 years the females then return to the same beach where they were born to lay their own eggs. The turtles migrate hundreds of kilometres for mating and nesting in this yearly breeding season, and every effort is initiated to ensure the mission successful. The Odisha government imposed a 7-month ban on fishing from November 2017 to protect the turtles following as the Orissa Marine Fishing Regulation Act, 1982, and Wildlife Protection Act, 1972. Nets are ensconced along the length of the beach to prevent the hatchlings from accidentally heading to the land instead of the sea.

The Rushikulya Sea Turtle Protection Committee and The Orissa Marine Resources Conservation Consortium work towards conservation of the Olive Ridley Turtles proactively through formation of monitoring units at nesting sites, conduct regular beach patrols and training of guards and volunteers. They also publish and distribute educational material, conduct field trips and promote exhibitions during beach festivals to sensitize the public on the issue through sculptures and sand art.

Many villagers are volunteers who are the go-to persons for fisheries, coast guards, forest departments, biologists, researchers and tourists. and are involved in turtle protection works for decades. They know exactly when the turtles will arrive, the best places to view them, where not to tread to avoid trampling the eggs incubating under the sand and when to expect the hatchlings. May 23, World Turtle Day is celebrated in these villages as 'Turtle ka Birthday,' a reminder of the millions of hatchlings that have made it safely to the water from these shores.

**Key words:** Olive Ridley; Gahirmatha; Rushikulya Rookery; vulnerable; Arribada; Turtle ka Birthday; IUCN;

## Introduction

Sea turtles have been used since time immemorial for food (oil and protein) and other commodities (bone, leather, oil and shell). Their importance in trade dates back millennia, whether it was calipee, leather live turtle, meat, oil or tortoise shell that was trafficked. Recently, sea turtles have become important for non-consumptive uses such as tourism, educational and scientific research, activities that provide opportunities for employment and information services, as well as other economic gains. In addition to their values as material resources, these animals have immeasurable worth as cultural assets. Diverse societies have

traditionally held sea turtles as central elements in their respective customs and beliefs. Out of the seven species of sea turtles, five species which are available in the Indian Seas are all endangered. Again of the five species, the olive ridley sea turtle *Lepidochelys olivacea* is known for mass nesting along the 480 km stretch of Orissa from late December to April. The fluctuation in the number of incoming nest building sea turtles is primarily due to human intervention, which includes sudden spurt in commercialization and tourism, uncontrolled egg collection, indiscriminate killing of adults for meat and skin along with accidental drowning of countless turtles due to fishing activities. These reptiles are

unique components of complex ecological systems, the vitality of which is linked to various exploitable products as well as to ecosystem services. Considering their charismatic nature, intriguing life cycle, their importance as indicators of health of coastal and marine ecosystem, policy decision needs to be developed at all level to save this unique creature from extinction.

Diversity is a characteristic feature of organisms. Every organism has its own individuality. Sea turtles form a unique group which belongs to Class-Reptilia including animals which are cold blooded (poikilothermic) and terrestrial or aquatic living. The systematic position of turtle places them in Phylum - Chordata, Subphylum-Vertebrate, Division-Gnathostomata, Class-Reptilia, Subclass-Anaspida, Order- Chelonia Family- a) Chelonidae and b) Dermochelidae. In a recent review on the taxonomy, evolution and Zoo-geography of turtles published in turtle perspective and research, Pritchard (1979) mentioned that turtle being poikilothermic, laying cleidic eggs and having typically scaled integument are unquestionably reptiles.

### Difference between Turtle and Tortoise

There is simple difference between the turtle and the tortoise. Tortoises are land dwellers while the turtles live in water. There

are also some physical differences between these two. The most notable is that all tortoises have wrinkled skin and columnar legs with nails supporting dome shaped bodies whereas turtle shells are sleek and their limbs are flattened and webbed-paddles for swimming in water. In sea turtles, the paddles appear to be almost wing like. Tortoises are vegetarians whereas most of the turtles are carnivores, feeding on fish, and other organisms. Turtles being reptiles and attached to the terrestrial environment for ovipositor are generally assumed to have had terrestrial origin. However, sea turtles are basically creatures that spend their entire life in marine/estuarine habitat except nesting period.

### Types of sea turtle

Out of seven species of living sea turtle in the world, there are five species of sea turtles in the Indian seas and all are considered endangered and placed in Schedule-I of the Indian wild life (protection) Act, 1972. These species are also listed in Appendix-I of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) which prohibits trade in turtle products by member countries. Sea turtles are included under family Chelonidae & Dermochelidae. The family Chelonidae includes four species whereas family Dermochelidae include one species as given in the (Table 1).

**Table 1:** Different species of Turtle under Chelonid and Dermochelidae family

SL NO	Family	Scientific Name	Common name
1	Chelonidae	<i>Chelonia mydas</i>	Green sea turtle
2		<i>Eretmochelys imbricata</i>	Hawksbill sea turtle
3		<i>Lepidochelys olivacea</i>	Olive ridley sea turtle
4		<i>Caretta caretta</i>	Loggerhead sea turtle
5	Dermochelidae	<i>Dermochelys coriacea</i>	Leatherback sea turtle

None of the five species is endemic and may undertake long migration to feeding and breeding ground often across the international boundaries. There are recent suggestions on the existence of non-migratory population (or) population segments. During their life history, sea turtle passes through various ecosystems and this diversity form the nesting beaches of their feeding ground and back to nesting beaches is a complicated one. This has not been properly understood for any species of sea turtle. During all stages of life cycle, they are vulnerable to heavy natural predation and exploitation by man. In nature recruitment to adults is extremely low and large-scale mortality occurs even before the hatchlings enter the sea and inshore water. A perusal of the literature shows that from the early seventies a greater awareness on sea turtles has been evinced in India by workers from within and outside the country. Many of the earlier reports recorded the occurrence of sea turtle, their capture and trade (or) describing observations on nesting.

### Distribution of sea turtles in India

While reviewing the exploitation of marine turtles in Indian oceans, Frazier (1980) has summarized the earlier information

available on sea turtles in Indian Ocean based on public literature. Among various species the *Lepidochelys olivacea* is the commonest sea turtle in Indian sea. It has a large head with heart shaped body. The five species of Olive ridley sea turtle are well distributed in the entire Indian Ocean and particularly in the Bay of Bengal. In India along, west coast Olive ridley and Green turtles are common in Gujarat whereas Hawksbill and Leatherbacks are rarely found. In Goa the most frequently found turtle is the Leather back where as in Kraal we found all species of sea turtle except Leatherback among which Olive ridley is commonest one. The same also happens in Lakshadweep. In Karnataka coast turtles are found in very less number. In east coast of India Olive ridley is the only dominant species found among others. It is mainly found in the coast of Orissa, Andhra Pradesh, Tamilnadu, West Bengal and Andaman and Nicobar Islands.

### Distribution of sea turtles in Orissa

Out of 480 km stretch of Orissa coast the olive ridley turtles come for mass nesting to the Gahirmatha beach, Devi river mouth and Rushikulya rookery. The sea turtle population which visit Orissa coast is a globally significant population representing about

50% of the total world production. Among the four species of sea turtles occur in coastal water of Orissa, the Loggerhead (*Caretta caretta*) however does not occur in this coast. Till date nesting of only one species i.e. Olive ridley (*Lepidochelys olivacea*) has been confirmed along Orissa coast. Olive ridley is the commonest species and it is sporadically nests all along Orissa coast however there is a suitable sandy beach available for nesting. Thus Orissa has become a total paradise of Olive ridley sea turtle of the world particularly the Gahirmatha in the Bhitarkanika sanctuary in Cuttack district of Orissa, Rushikulya river mouth of Ganjam district and in Devi river mouth of undivided Cuttack district. Mass mating occurs during November and December and mass nesting on sandy beach occurs from late December to April. Thousands of sea turtle is seen floating on the surface of sea during the breeding season. The reproductive aggregations of turtles are known as "Morrimas", "Arriba zones" and Arribada. (A Spanish term means arrival). There are two terms of Arribada that is 'mini arribada' for nesting aggregation involving 100 – 1000 nesters in a particular night on stretch of less than 10 kms of beach and "Arribada" involving more than 1000 turtles.

But today their numbers are drastically reduced to a point that all seven-remaining species of sea turtles are considered as either threatened or endangered on a worldwide basis. Undoubtedly, human interference is the main cause of this decline. The challenges that sea turtle now face from human activities impact at every stage of their life cycle starting from loss of nesting beach and foraging habitats to mortalities in the near shore, coastal waters, off shore waters and on the high seas through intense pelagic as well as benthic fishery practices. They are also harmed by increasing loads of non-biodegradable waste and pollutants that oceans and coastal zone now receive from various types of industries and mega industries coming up along the coastal areas.

Sea turtles are vulnerable to predation at all stages of their life cycle whether it may be the eggs, hatchlings, sub adults or adults. The eggs are used as cheap protein source of human being and life stock in many coastal regions. The meat consumed by the man, the cartilage of Green sea turtle is the source of green turtle soup. The scutes of the carapace, particularly of Hawksbill are used for jeweler, eye glass frame, Japanese ceremonial combs and their items. Natural predators that feast on sea turtle's eggs and hatchlings include jackal, mongoose, lizards, dogs, crabs, crow and eagle. The hatchlings after their entry to the sea are predated by a number of predatory fishes like cat fishes etc. It has been estimated that the rate of hatchlings surviving to adulthood is as low as 1% or less. This is how millions of years the turtles have encountered the threats remarkably. The fluctuation in the number of sea turtles coming for nesting in different year is not probably understood or may due to advent of commercial interest in those animals and sudden spurt in tourism has more or less sealed the fate of those animals. Uncontrolled egg collections, the killing of hundreds of thousands adults for meat and skin, the accidental drowning of countless turtles in fishing activities are

present considered to be a major threat to sea turtle population.

### Area of Abundance

One of the important maritime states in India, Orissa has a coast line of 480 kms, stretching from east of the Subarnarekha River mouth, near Udaipur village bordering West Bengal, to the marshes of Ichchapuram in Andhra Pradesh. The coast line transverses six coastal districts of Orissa i.e. Balasore (80 kms), Bhadrak (50 kms), Kendrapada (68 kms), Jagatsingpur (67 kms), Puri (155 kms) and Ganjam (60 kms). The coastal zone of Orissa state located in the eastern coast of Indian peninsula is the combination of eight major deltas of varied shapes and sizes formed by the major rivers such as Subarnarekha, Budhabalaga, Brahmani, Baitarani, Mahanadi, Devi and Rushikulya. Other minor rivers which drain into the Bay of Bengal are Hansua, Kadua, Kushabhadra and Bahuda.

To cover the entire Orissa coast systematically, the study area was divided into the following eight sectors on the basis of the major geological features such as river mouth, sand spit, bays, and other coastal land marks. The eight sectors are Balasore, Gahirmatha, Kujang, Paradeep, Devi, Puri, Chilika and Ganjam coast. Out of this coast mass nesting of Olive ridley mainly occurs in Gahirmatha beach, Devi River and Rushikulya rookery.

This study i.e. Rushikulya rookery is a part of Ganjam coast line which has turned out to be the most important nesting ground of Olive ridleys after Gahirmatha. The rookery is located on the Rushikulya river-mouth and is only 1 km east of the Chennai-Kolkata NH-5 and the South-Eastern Railway line near Ganjam town, 12 km north of Gopalpur sea beach and 300 kms south of Gahirmatha mass nesting beach. Collection of data is purely done following a field survey method with prior selection of sites.

The study area i.e. Rushikulya rookery was selected because not much work has been done on sea turtles in this area. The rookery is spread over 6 kms from the village Punabandha (1 km north of the Rushikulya river-mouth) to Kantiagada village and it is intercepted by two rivers Rushikulya and Bahuda.

### Biology

Sea turtles, whose lifecycles are intricately linked to both onshore and offshore coastal habitats, can be important indicators of impact, since their survival is dependent on the well being their habitat. The turtles have long been recognized as the order of Class-Reptilia and the most commonly utilized name for that Order include the pre-Linnaean Testudinata (Klein,1751), first adopted post-Linnaeus by Opperl (1811), Testudines (wagler,1830) and Chelonii (Brongi art, 1890), Bour and Dubois (1985) presented a well argued case for utilization of Chelonii as the valid ordinal name today. Out of seven species of sea turtles found in the world, five species inhabit the Indian coastal waters. Of these four species are found in Orissa coast. They are Leatherback (*Dermochelys coriacea*), Green (*Chelonia mydas*), the Hawksbill (*Eretromochelys imbricata*) and the Olive ridley (*Lepidochelys olivacea*) sea turtles. The turtles are the only

reptiles which have a shell and are still living. The sea turtles mainly live in marine system and which are different from the land dwellers called tortoise.

The actual biological status of marine turtles is a topic of considerable complexity. Marine species are faced with problems of over harvest, or population collapse and “commercial extinction” among which olive ridley is one? The Olive ridley (*Lepidochelys olivacea*) also known as the pacific ridley is one the smallest species of sea turtle. It is named for the olive colour of its hearts shaped shell and has large head.

### Food and feeding habitats

Olive ridley are omnivores feeding on crabs, shrimps, rock lobster, marine algae, sea grass, snails, fish eggs, sipunculides and ascidians and small invertebrate. They also feed on jelly fish and other molluscans having toxic glands which hamper the marine ecosystem. Due to this feeding habit Olive turtle plays a vital role in food chain as well as ecological balance of marine ecosystem [2].

### Sexual dimorphism

1. Males smaller than female
2. Males possess curved claws in for flipper in order grasp the females during mating whereas female have flat nails
3. Tails of males are longer than female.
4. Plastron concave (ventral part) in male in comparison to female

### Life Cycle

#### Reproduction

Males and females begin the reproductive cycle by migrating from their feeding grounds to breeding grounds. Feeding and breeding grounds may be separated by several thousand kilometers. Courtship and mating occur primarily in the offshore waters of the breeding ground during December to March the male mounts the female, holding her with claws in his fore flipper and proceeds to mate. Both males and females may mate with several different individuals.

#### Nesting behavior

Several weeks after mating, the females come ashore to nest, mostly at night. They crawl above the high-water mark, find a suitable nesting site, clear away the surface sand (making a body pit), and out a flask shaped nest with their hind flipper. This may be two to three feet deep depending on the size of the turtle. They lay about 100-150eggs in the nest and fill it with sand; some species thump the nest with their body to compact their nest. (Once the turtle starts laying eggs, they go into a ‘nesting trance’ and are less easily disturbed during this stage). They then throw sand around the nest for camouflage and return to the sea. Most turtle nest more than once during a season, with roughly two weeks separating each nesting event. After they have

completed nesting, they return to their feeding grounds until the next breeding migration, which may be a year or several years later [3].

### Development of Hatchlings

The hatchling develops in their nest over a period of 7 to 10 weeks (45-50 days). They hatch simultaneously over a period of a few days and then emerge from the nest together (to swamp predators) usually at night shown in. Predators include crabs, birds, jackals, feral dogs, and many fish once they are in the sea. The hatchlings spend the first couple of days of their lives in a “swimming frenzy” when they used stored energy reserve to get into the open sea. Beyond this, they spend many years in a variety of juvenile habits until they join other adults at feeding areas. **Less than one in a thousand hatching is believed to survive to adulthood.**

### Temperature dependent Sex Determination

Lower temperature produces males, higher temperature produced females. The pivotal temperature (i.e. the temperature that produced equal numbers of males and females) varies among species and population, although it is usually around 28-32°C. The sex of the hatching is determined during the second trimester of development. Sex ratio is likely to vary over the course of a nesting season and also between nesting beaches.

### Orientation and Navigation

Hatching emergence is nocturnal to avoid predators and sunlight. Sea finding is visual; the hatchlings seek a “Brighter horizon” which is usually the moon or straight reflecting off the surface sea. They also use silhouettes of sand dune and trees to orient themselves away from land and towards the sea as soon as they enter the sea, they orient themselves to wave direction, swimming against the direction of the waves. During this time, they also get imprinted on the earth’s geomagnetic field. Hatchlings and adults are sensitive to both magnetic field intensity and magnetic inclination angle, and therefore have a compass sense that enables them to migrate to their natal beaches as adults.

### Philopatry

Sea turtle usually travel 100s to 1000s of kilometers from feeding to breeding ground. It has long been believed that sea turtle return to their natural beach (the beach where they were born) or group of beaches to lay eggs as adults. As olive riddle migrate from Srilanka to Orissa for nesting.

### Nest Site Fidelity

Most turtle lay all their clutches within the same general area (0 to 10 km.) during the nesting season. In some cases, such as with Olive riddle turtle in Orissa, they may travel larger distance (a few 100 km) for nesting. Some Leatherbacks have nested on beaches separated by more than 700 km.

### **Beach selection**

Olive riddle generally construct nest in the beach having following characteristics

1. Beach must be accessible from sea.
2. It should be high enough to prevent inundation of eggs by high tide.
3. The substrate must facilitate gas diffusion and be moist and fine to prevent collapse of Eggs.
4. The coastal water should be low salinity and high humidity

### **Research Activities Undertaken**

In India most of information on sea turtle has been generated in Orissa. The long-term research activities of Wildlife wing of Orissa, from 1976 to till date, has contributed a lot to understand the basic biology of Olive ridley, which otherwise is very much critical for the successful management and conservation. However, still a lot of program oriented, scientific study needs to be conducted to understand the life cycle, behavior, population structure, lost year mystery and activities of sea turtles in the sea. In the last quarter century of the second millennium most of the research activities on marine turtle along the Orissa coast were land based and have largely been confirmed to the world's largest Know sea turtle rookery of Gahirmatha. In the last one decade, studies have been initiated at Rushikulya mass nesting site and in last few years a very important beginning have also been made by initiating long term offshore studies to reveal many interesting and unknown facts about the activities of sea turtle at sea through involvement of Wildlife Institute of India, Dehradun; National Institute of Ocean Technology of Department of Ocean Development, Government of India as well as other national and international agencies. The sea turtle research activities in Orissa in the last two and half decades have been as follows:

- (i) Status survey along the entire Orissa coast
- (ii) Monitoring of nesting activities at Gahirmatha Coast
- (iii) Monitoring of dead/stranded sea turtles
- (iv) Tagging i.e. Mark- recapture to study migration and other aspects of Life cycle

Through involvement of Government of India / FAO / UNDP and the State Government of Orissa a long term tagging Program of sea turtle was initiated in 1978 at Gahirmatha coast, Orissa. Through the above tagging program a total of 16,753 adult female Olive ridley sea turtle have been tagged using saline resistance Monel metal tags. The tag recovery data from re nesting females have confirmed --

- Annual nesting in olive ridleys
- Return of ridley Females to Gahirmatha coast during successive years
- Group nesting and Group maintenance behavior in Olive

ridleys

- Multiple nesting of individuals in the same years during different Arribadas
- Multiple nesting by the same nesting female over several nesting seasons
- Homing instinct and a strong tendency towards nesting site fixity in Olive ridleys
- Staying of Olive ridleys in the coastal waters off Gahirmatha for extended periods in between mass mating and different Arribadas (i.e. from October to May)
- Migratory path and behavior in Olive ridleys

The evidence of offshore recovery of a Gahirmatha tagged turtle bearing tag No. 14398 during January, 1978 was caught in a shore seine net at Peddamylavani lanka about 24 Km. South of Narasapur (Andhra Pradesh) and another turtle bearing tag No.11777 was caught from coastal water of Jaffna (Sri lanka) [11] combined with earlier sighting records of north ward mass migration of ridleys in the Bay of Bengal .This indicated that prior to Arribadas in Orissa at least a part of the ridley population probably covered the entire length of east coast of India to reach the mass nesting beaches in Orissa coast with stray individual nesting on the Tamil Nadu, Kerala and Andhra Pradesh coasts during the breeding migration.

As a part of Wildlife Institute of India's sea turtle research program in Orissa, a total of 13,600 Olive ridley were tagged over three breeding seasons (1996-97 to 1998-99). About a dozen of international recoveries were mad from Sri Lankan coastal waters supporting the above observation of migration of ridleys in the Bay of Bengal (Pandav, Pers.Comm.).This has suggested that the entire sea turtle population using the Orissa Coast for nesting should be considered as a single conservation unit and protection of their nesting beaches as well as the coastal waters off nesting beaches are crucial for the survival of sea turtle in Orissa which could well be a single population.

### **(v) Some other research activities on sea turtle of Orissa coast have been as follows --**

- Nesting ecology of Olive ridley at Gahirmatha rookery
- Food, feeding habits and food related growth in captivity
- Egg collection and egg incubation
- Development of egg hatchery management
- Ecological relationship of sea turtle with coastal estuarine mangrove ecosystem
- Captive rearing to study Growth, maturity etc
- Embryonic Development of sea turtle

Embryonic development and temperature dependent sex determination of Olive ridley sea turtles and its implication for

conservation have been studied (Mohanty- Hejmadi), 1992; Mohanty- Hejmadi and Diamond, 1986; Mohanty- Hejmadi et al (1994-1985).

#### **(vi) Karyotype-patterns of the olive ridleys**

The Karyotype Patterns of the Olive ridley *Lepidochelys olivacea* has been studied by [12].

#### **(vii) Conservation genetics of the Olive ridley**

Studies made by [20] on the population genetic structure of Olive ridleys on the east coast of India which involved three sites in Orissa have been done with a view to evolving conservation genetics for these turtles. This study has indicated that the dominant halo type is the most ancient lineage in ridleys, suggesting that the Olive ridley population on the east coast of India could be the source for contemporary global population of ridleys. This increases the conservation importance of this population of Olive ridleys migrating to Orissa and suggests that this population could have been the ancestral source for global ridley population.

#### **(viii) Offshore studies on sea turtle**

From December 1998 onwards Scientists and Officials of Wildlife Wing of Forest Department of Govt. of Orissa led by C.S.Kar have participated in the Cruise Programme of CRV SAGAR PURVI of NIOT/DOD for off shore observation of marine turtle along Orissa coast and for coastal oceanographic surveys [15].

#### **(ix) Management Oriented Research**

- Regular monitoring of important sea turtle nesting beaches as well as off shore and aerial monitoring to get the population trend
- Satellite telemetry and tagging program to study the distribution of sea turtles and other related biological aspects
- Determining the impact of off shore fishing operation and coastal development activities on marine turtle

#### **Conservation Analysis**

Sea turtles are clearly in of conservation today. However, without data that provides knowledge of occurrence, biology, it is very hard to frame appropriate management strategies. Therefore, data for previous eight years was collected from the Divisional Forest Office, Berhampur regarding the mass nesting and mortality of Olive ridley sea turtle that occurs in Rushikulya rookery in successive years (Table 1).

The reason of mass nesting in the rookery is due to --

1. Availability of abundant food for the huge population (lakhs of male & female) in the offshore and estuarine zone during the mating period
2. Undisturbed beach

3. Good beach profile and favorable climatic condition (temp, humidity, rainfall, soil texture)
4. Devoid of tourism and urbanization
5. Absence of *casuarina* plantation
6. No fishing jetties are present

#### **Existing Acts and Rules for Protection of Sea Turtles and their Habitat in Orissa**

1. The Wild Life (Protection) Act, 1972 (Amended, 1991)
2. The Wild Life (Protection) (Orissa) Rules, 1974
3. The Central Water Pollution Act, 1974
4. The Central Water Pollution (Amendment) Act, 1978
5. The Environmental (Protection) Act, 1986 It includes coastal Regulation zones (CRZ I, II,III)
6. The Orissa Marine Fishing Regulation Act 1982
7. The Orissa Marine Fishing Regulation Rules 1982
8. Coastal Zones illumination (Prevention and Control) Act, and Rules (Proposed).
9. Declaration of 3 major turtle congregation sites as "No Fishing Zone" (1984)
10. Formation of High Power Committee for sea turtles the chairmanship of Chief Secretary, Orissa (1997)

Abide these acts and rules there are various direct and indirect threats affecting the sites and mortality of olive ridley sea turtles along Rushikulya coast.

#### **Direct threats**

1. Human interference: It is a major threat which is increasingly problematic for turtle population. While interacting with local coastal inhabitants it was come to know that the eggs were consumed as it is rich source of protein but meat is not preferred. But some of the place like China and other Asian countries used to consume the meat and make the soup of the carapace. The carapace has also medicinal value as referred by various pharmaceutical industries.
2. Mortality of Olive ridley mainly occurs due to the incidental catch in mechanized vessels (West Bengal vessel) during mass congregation period in off shore region.
3. Natural predator like jackal, feral dogs' hyenas and mongoose feed on the eggs soon after they are laid by the turtles.
4. The hatchlings are also predated by cat fish and sharks during their immature stages in the water body.
5. Establishment of new jetties in Kantiagada region which occupies a major place of nesting site.

Year	Mass nesting (no's)	Mortality (no's)
2000-2001	1,59,000	86
2001-2002	35,000	112
2002-2003	2,08,000	103
2003-2004	74,890	423
2004-2005	89,300	217
2005-2006	1,98,794	87
2006-2007	74,000	-
2007-2008	1,80,426	335
2008 - 2009	59,000	74
2009 - 2010	89,000	102
2010 - 2011	1,34,000	65
2011 - 2013	65,000	59
2014 - 2015	78,000	89

### Indirect threats

1. Loss of nesting beaches is by natural erosion and sand mining used for construction of building and other infrastructures.
2. Pollution of beach as well as marine habitat is observed by the presence of marine debris such as plastic bags; tar balls thermocouple pieces and raw plastic pallets.
3. High illumination disorients both adult and hatchling (Table 2).

### Observations of Mass Nesting and Mortality Year wise

Focusing on the increasing threats towards the endangered Olive ridley the conservation program was divided in two general categories --

1. Protection of animals
2. Protection of their habitat.

As observed the conservation program was carried out by --

#### Govt. of Orissa (Forestry & Department Fisheries)

The forestry department maintains a regular patrolling during mating season (December – February). Strict patrolling and vigil are maintained from Kantiagada to Gokharkuda region as the mating takes place in this region, 3 km. off the shore.

The Fisheries department declared the major congregation site i.e. 5 Kms off shore (Kantiagada region), as “No Fishing” Zone and in case of violation the concerned vessels are seized and the persons concerned are penalized for their offence.

#### Local NGOs (Operation Kachhapa, RSTPC)

A broad conversation with local NGOs and the local people regarding the Operation Kachhapa (OpK). This operation was launched by the Wild Life Protection Society of India in 1998

along with the collaboration of Wild Life Society of Orissa and The Orissa Forest Department. Operation Kachhapa (OpK) has since successfully built public image for sea turtle conservation in Orissa. The objective of OpK is to -

- Reduce turtle mortality and to protect nesting site
- Supporting legal action on turtle conservation issues and fishing law violation.
- Building up public support and awareness of sea turtle conservation issues, sensitizing to media, enforcement agencies and the judiciary about the large-scale turtle death

The Rushikulya sea turtle protection committee (RSTPC) is working as NGOs under the guidance of Basudev Tripathy (Sea Turtle Project) who is currently surveying and playing an important role in conservation of the sea turtle throughout the Orissa coast.

The NGOs work dedicatedly on this program from starting of the October to end of May. During the peak season of the nesting, the volunteers are placed in every 100 meter stretches of the beach throughout the day and night in order to carry out easy nesting and avoidance of feral dogs and other predators hampering the site.

#### Fishermen folk and communities

Success of any conservation program is dependent more on the co - operation and co - ordination of local coastal inhabitants and fishermen communities. It was realized that conservation of turtle has had a direct interference on the livelihood of the coastal inhabitants as the three villages under study (Purnabandha, Kantiagada and Gokharkuda, in Orissa state, India) completely dependent on fishing as primary occupation. Regarding this constraint, a NGO named United Artist Association (UAA) plays an important role in the upliftment of fisher flock by providing alternative engagement during “No Fishing” as the fisher folk are solely dependent on turtle and they're by - products to carry out their livelihood.

#### Conclusion and Suggestions

Sea turtle have been used since time immemorial for food (oil and protein) and for preparation of other by products like bone, leather, oil and shell from specific parts of the body. Their importance in trade dates back to the time not known to us. Whether it was calipee, leather, live turtle, meat, oil or tortoise shell that was trafficked. Recently, sea turtle has become an important item for non - consumptive uses such as tourism, educational and scientific research, creation of employment opportunities and information services, as well as a lot other economic gains. These reptiles are unique components of a complex eco- system, the vitality of which is linked to exploitable products (including fishes, mollusks and mangroves) as well as to “ecosystem services” (e.g., stabilizing coastal areas). As they migrate thousands of kilometers and take decades to mature, turtle serve as important indicators of the health of coastal

and marine environment on both local and global scales. In addition to their values as material resources, these animals have immeasurable worth as cultural assets. Diverse societies were being traditionally held sea turtle as central elements in their respective customs and beliefs. In industrialized societies these reptiles also play significant role due to their charismatic nature and intriguing life cycle – also ideal for educational and research activities.

Sea turtles being a timid and slow moving aquatic animal vulnerable to predators at all stages of life cycle. The actual biological status of marine turtles is a topic of considerable complexity. The Olive Ridley is the commonest one in Indian water thriving along the coast of Orissa for mass nesting during the month of December to march. Observations made during the study period showed that after south west monsoon i.e. during the winter month, Olive ridleys are found approaching the beaches for mass nesting. Courtship and mating occurs near the shore in the month of December to march during the first ovipositional cycle of the season. The male's exhibit fidelity to specific courtship areas in successive migration again astonishingly the female appears the same site throughout its life to lay eggs. The general nesting process such as beaching, digging, laying, filling in, returning was closely observed for the Olive ridley during the observation period. The typical nesting process of olive ridley is confirmed by similar observation made by another worker [4,10]. The marine turtles are omnivores in nature and prefer marine algae, sea grass, crustaceans, sciacnids, molluscan etc.

The coastal ecosystem of Orissa and its diverse habitats which supports the world biodiversity hot spot areas are very much a place of choice in demand for the olive ridley as nesting habitat. But these areas encounter problems like erosion, siltation, pollution, flooding, salt water intrusion, cyclones and super cyclones, storm surges, casuarinas plantation, artificial lightening, over fishing, changing land and sea use pattern and above all the ever-increasing human settlements [15]. The operation of trawlers and fishing boats are responsible to a large extent for obstruction of sea turtles to their nesting ground and very often find them in their fishing nets to be killed, consumed or thrown dead into the sea.

In view of the said observations certain conservation measures has been suggested pertaining to local conditions for protection of nesting grounds of Olive ridley as below -

1. Awareness is to be developed among peoples to protect and conserve endangered species.
2. Local collage/universities should be involved in the conservation programs.
3. Offshore patrolling is to be done by different law enforcing agencies like coast guards of Indian navy, defense and custom department of central government and state govt.
4. Regular survey is to be undertaken every year in order to assess the number of nesting, dead turtles and to monitor the

threats to the population.

5. NGOs & Govt. can appoint the local folks for management and conservation of turtle under legal salary.
6. Hatcheries should be established with proper monitoring and in-situ and ex-situ conservation practices should be developed.
7. Illumination of light near the nesting beach should be stop or controlled.
8. Use of TED (Turtle excluder device) should be more encouraged during trawling operation,
9. Fishing/trawling near the shore during Olive Radley's nesting season should be banned [8]
10. The existing laws and rules for the protection of olive ridley sea turtles need to be properly executed.
11. More research and study is to be carried out to establish the missing link and to know the dark part of their life cycle so as to take effective measures of their protection.
12. Control of deforestation and anthropogenic activities at the beach sites
13. Restriction on encroachment of natural water bodies
14. Alternate fishing ground during closed season
15. The site may be declared as sanctuary
16. One of the most challenging issues facing the conservation Management of marine turtles is the long term effect of the rise of sea level as part of the green house effect [9]

Due to increased level of CO<sub>2</sub> which absorbs the heat, leading to rise in temperature of earth. The predicted increase in temperature will affect sex ratio of hatchlings, with more female being produced, which is damaging to the existing population. Again, the armoring due to submergence is destroying the turtle habitat. The changes in current pattern due to the temperature rise affect the migration and forage ground ecology. So, the conservation management should look at providing human interference less areas in the nesting zone without any direct or indirect pollution and creation of awareness among the public about the importance of these endangered sea turtles. Necessary steps are also required to enforce the existing Acts and Rules for protection of sea turtles and their habitat in Orissa as conserving this reptile means protecting the seas & coastal areas which in turn means protecting a complex, interconnected ecosystem on which human depends.

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