STUDY ON MIGRATION OF SEA TURTLES AND THEIR CONSERVATION PLAN AT ANDHRA PRADESH

PROJECT: DEVELOPMENT OF NON – MAJOR PORT AT RAMAYAPATNAM, PRAKASAM DISTRICT, ANDHRA PRADESH

Reply to MoEF&CC: Sea Turtle conservation plan

For

ANDHRA PRADESH MARITIME BOARD
GOVERNMENT OF ANDHRA PRADESH

Through

RITES
THE INFRASTRUCTURE PEOPLE

RITES LIMITED, GURGAON

DECEMBER 2021

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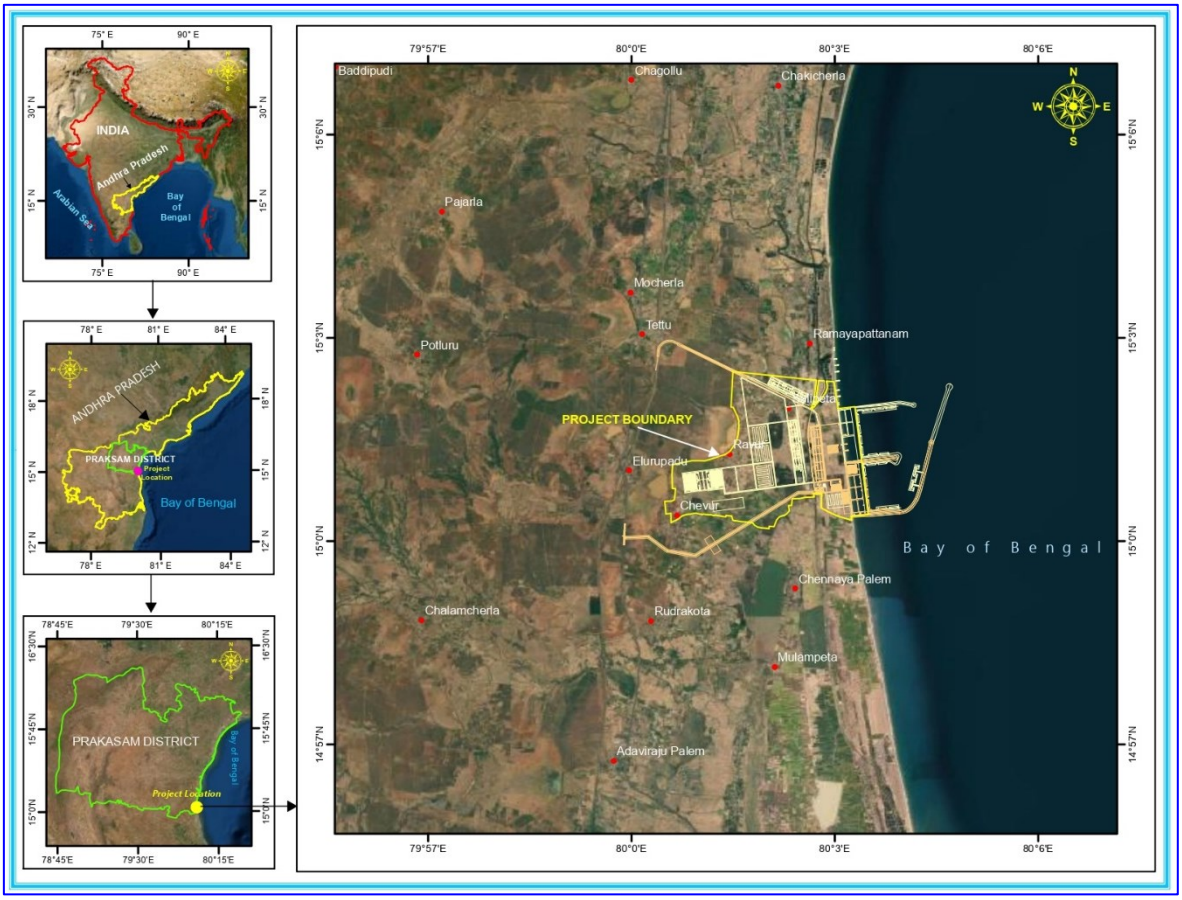
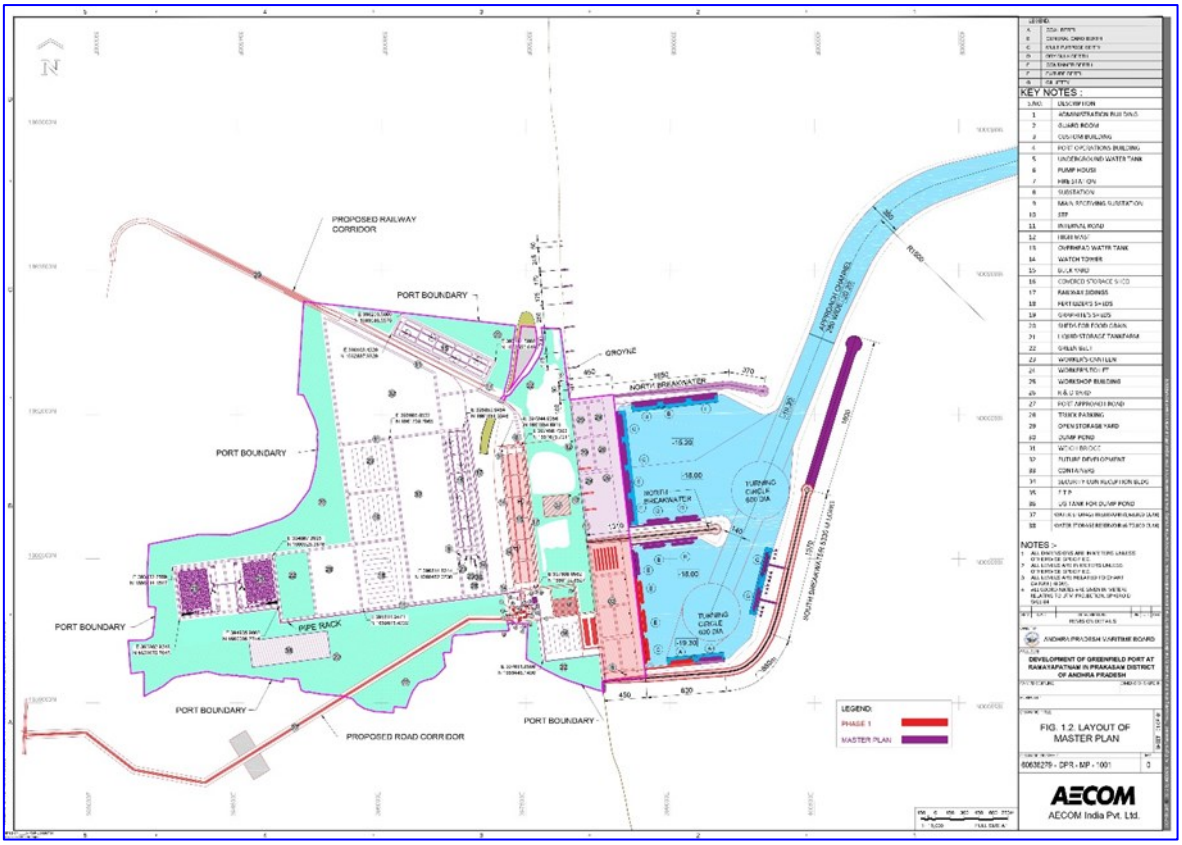
1. Background of the Project

Andhra Pradesh Maritime Board, Government of Andhra Pradesh has proposed to develop a Greenfield Non-major port at Ramayapatnam in Andhra Pradesh to meet the ever-increasing cargo demand in the State and Hinterland. The location of proposed Ramayapatnam port spreads centering on Latitude: 15°01'09" N and Longitude 80°03'09" E. It is located at southeast corner of Prakasam District in Gudlur Mandal, 2 km east of Tettu Village. Location map of the proposed project is shown below.



Location Map

It will be an all-weather port with state of art terminal facilities to meet the present and future needs of trade. The port has been planned to handle total cargo of 138.54 MTPA. The layout of the proposed port is shown below.



Proposed Layout

Need for the report

The CRZ recommendation from Andhra Pradesh Coastal Zone Management Authority for the proposal, Development of Greenfield Non-Major Port at Ramayapatnam in Prakasam District of Andhra Pradesh was obtained on 18 September, 2021. The Environmental and CRZ clearance from MoEF&CC was sought on 5 October, 2021 through Parivesh portal by submitting all necessary essential details.

Environmental and CRZ clearance for the proposed development of port was sought during the 278th meeting of the Expert Appraisal Committee (EAC) of Infra 1 on 27.10.2021. The EAC, taking into account the revised submission made by the project proponent had a detailed deliberation and deferred the proposal for want of additional information. On seeking additional information the committee has asked for 'PP has to submit the data of Sea turtle movement and nesting sites with the help of Andhra Pradesh forest department and Wildlife institute of India. The data should be not only for the sea turtle nesting sites but also its movement in near shore areas including impact of proposed ship traffic on sea turtle movement.' under item no. 3.1.30 (i) in the Minutes of Meeting.

Accordingly, Sea Turtle Conservation Plan has been prepared by Indomer Coastal Hydraulics (P) Ltd., Chennai, which is an ISO 9001:2015 organization and QCI - NABET accredited organization vide NABET/EIA/2023/RA 0207 dt. 29.07.2021.

The data of sea turtle nesting sites provided by Conservator of Forest, Guntur Circle, Guntur is used for preparation of this report in various places and detail is attached as **Annexure I**.

2. Sea turtles

Turtles are most primitive groups of vertebrates in existence and are found on every continent except Arctic & Antarctica. The most ancient turtle fossil dates from the Triassic period, nearly 230 million years ago. Sea turtles, along with other aquatic turtles and tortoises, are members of the Order *Testudines*. Sea turtles constitute a single radiation that became distinct from the other turtles during the early Cretaceous period approximately 110 million years ago. Sea Turtles have remarkable life cycles which makes them fascinating to both biologists and wildlife enthusiasts. It is found in all tropical and subtropical waters. Sea turtles are air breathing reptiles spending most of their lives at sea. The majority of species inhabit shallow waters along coasts and around islands, but most are highly migratory, particularly as juveniles, and are found in the deep sea.

Turtles are easily distinguished by the presence of flippers, paddle-like forelimbs that unite their elongated digits, helping them to adapt to their predominately marine life. These powerful flippers, along with a more streamlined shell, enable them to become fast swimmers and carry out extensive migrations. Sea turtles are toothless, but have powerful jaws to crush, bite, and tear their food. It is believed that a sea turtle spends its first few years drifting in the open ocean. However, juveniles and adults are known to congregate in foraging (feeding) and mating areas, as well as at nesting grounds. Generally, sea turtles spend most of their life at sea, although females must occasionally emerge to lay their eggs on the beach. They typically show a slow growth-rate, a long life-span, a high age at maturity and are highly migratory, making them generally vulnerable to anthropogenic impacts (i.e. over exploitation and the loss of nesting beaches due to the developmental activities). Hindu mythology worships sea turtles as an incarnation of one of their gods. Thus, most fishing communities along the coast, do not consume turtle eggs or meat.

Sea turtles are mostly carnivorous and some species are omnivorous while the green sea turtles are herbivorous in the juvenile stage and changes later on. Sea turtles are large marine reptiles with adults averaging about >50 g at infant stage and >40 kg at adult stage. Sea turtle plays an important role as leading species for diverse habitats such as coral reef ecosystems, sea grass meadows, open seas and sandy beaches. Sea turtles are a classic example of a broadly distributed group that has historically suffered population declines, as a result of, for example, accidents due to marine traffic, bycatch and harvesting adults and eggs.

During the breeding/nesting seasons, both sexes typically aggregate in the waters close to the nesting beaches. Sea turtles migrate hundreds or even thousands of kilometers between established feeding and breeding sites. All sea turtle species lay their eggs on land, typically on sandy beaches. The location at which sea turtles lay their eggs is called turtle nesting grounds. Turtles nesting are happening in narrow beaches where it can lay eggs and suitable environment for hatching of young ones. Costa Rica, Nicaragua, Panama, Mexico, Surinam and India are the popular beaches for turtle nesting.

Turtle nesting grounds are on land, and they are typically sandy beaches. The seven different species of sea turtles occupy different, although often overlapping, geographic ranges. In general, sea turtles occupy a wide range of oceanic habitats and will travel widely in their lifetimes. Turtles have various ecological roles, including nutrient cycling, which is crucial for the coastal ecosystem,

and maintenance of sea grass beds, coral reefs and beach dunes. Aside from the obvious ecological services, sea turtles contribute to tourism, due to their charismatic nature, yielding great economic benefits.

Marine turtles are highly migratory and represent an open-access resource. Many countries recognize the need to reduce marine turtle mortality from human sources and have provided partial or total legal protection for marine turtles. However, attempts to exclude users and reduce human impacts have met limited success, particularly in countries where funds to enforce restrictive legislation is scarce.

In general, the survival of sea turtle has been threatened by loss of their habitat. It is widely observed that, the turtle population and its nesting beaches are declining due to manmade activities and sea level rise. IUCN has classified the marine turtle species under red list, endangered and vulnerable species. In India, many turtle species have been protected under Schedule 1 of the Indian Wild Life (Protection) Act, 1972. Party to CITES, ratified the Convention on Biological Diversity (CBD) and related treaties, implementing National Biodiversity Act. Areas of turtle nesting site have been classified under sanctuaries and National marine parks. Appendix I include over 820 plant and animal species, including all seven marine turtle species that are threatened with extinction and are or may be affected by trade. International trade in these species is subject to particularly strict regulation in order to avoid further endangering their survival. International commercial trade in Appendix I species of CITES and its products are prohibited. Non-commercial trade may be authorized in exceptional circumstances, such as for specimens acquired before the Convention entered into force, for personal or household effects, or for specimens bred in captivity, according to definitions adopted by the Conference of the Parties. Schedule I items of CITES shall possess export documents to the standard format recognized for international trade with non-CITES Parties. Irrespective of the prohibition of international trade on a commercial scale, marine turtles continue to be taken incidentally or opportunistically for domestic use and turtle products are traded illegally within the region and exported illegally. Each shipment must be authorized and accompanied by an export permit from the country of origin, or re-export certificate from the country of re-export, as well as an import permit issued by the importing country.

To protect the turtles and their population, India is implementing many initiatives including banning of fishing turtle breeding season around nesting sites, practice of using Turtle Excluding Device (TEDs) in fishing nests to avoid by-catch of turtles, awareness campaign etc. Turtle nesting grounds have been classified as Ecologically Sensitive Area (ESA) under CRZ 2011 and the activities in turtle nesting area have been prohibited and regulated. Sustainability of turtle population has been pressurized by various anthropogenic activities in turtle nesting sites. Though, trafficking of sea turtle products is illegal, poverty of the third world countries or developing countries are driving the market. In recent decades, there has been increased recognition that economic factors are behind many human activities that cause declines in habitats and species.

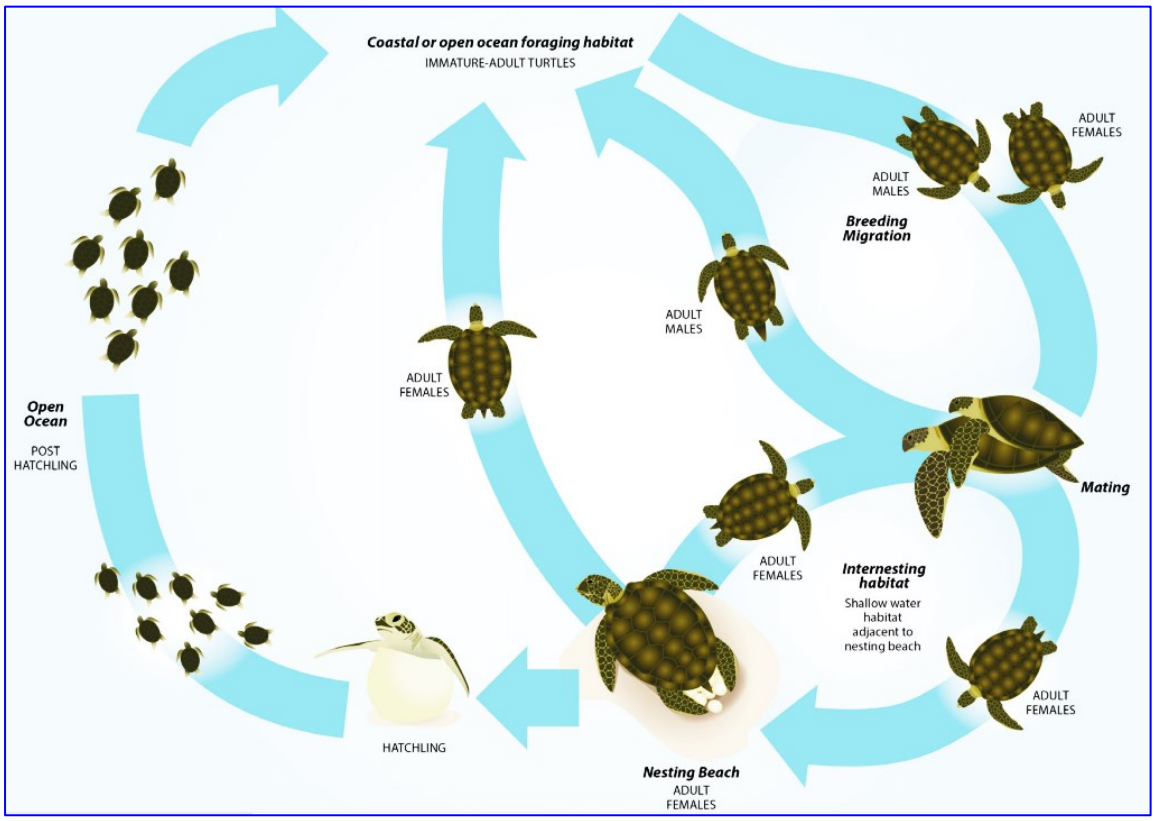
Quantification of the economic consequences of marine turtle use and conservation contributes significantly to our understanding of use options and their ecological impacts, and hence further the process of defining adequate management policies. Expressing the economic value of various

uses and benefits of turtle nesting grounds shall be a tool to raise awareness and convey its (relative) importance to general public and policy makers. These values shall help to make decisions about allocation of resources between competing uses. Accordingly, in this chapter, various goods and services of turtle nesting ground were identified and economic values of the above services have been fixed using benefit cost transfer method and other valuation methods. Application of economic value to turtle nesting grounds of India for policy decisions has been discussed.

Turtle nesting in beaches shall have the following main environmental variables for oviposition they include fine sands, moderate slopes, good humidity and drainage, etc. Turtles nesting grounds are the specific places where turtle population can be increased. To protect the turtle population, nesting grounds shall be essentially protected. Consumptive and non-consumptive economic valuation studies on turtle nesting sites shall provide an opportunity to create markets for conservation of turtle nesting grounds and to analyse the impacts of externalities. This shall lead to enhance our knowledge on total flow of benefits from turtle nesting ground. In view of the above, economic valuation of turtle nesting ground covers turtles and it's nesting beaches.

3. Life history of sea turtles

Sea Turtles during their lifetime, travel several thousands of kilometres from their feeding grounds to breeding and nesting grounds. Male and female turtles begin the reproductive cycle by migrating from their feeding grounds to breeding grounds. There is a belief that sea turtles return to their natal beach or group of beaches to lay eggs as adults. Courtship and mating occur primarily in the offshore waters of the breeding ground.



Life cycle of Sea Turtles

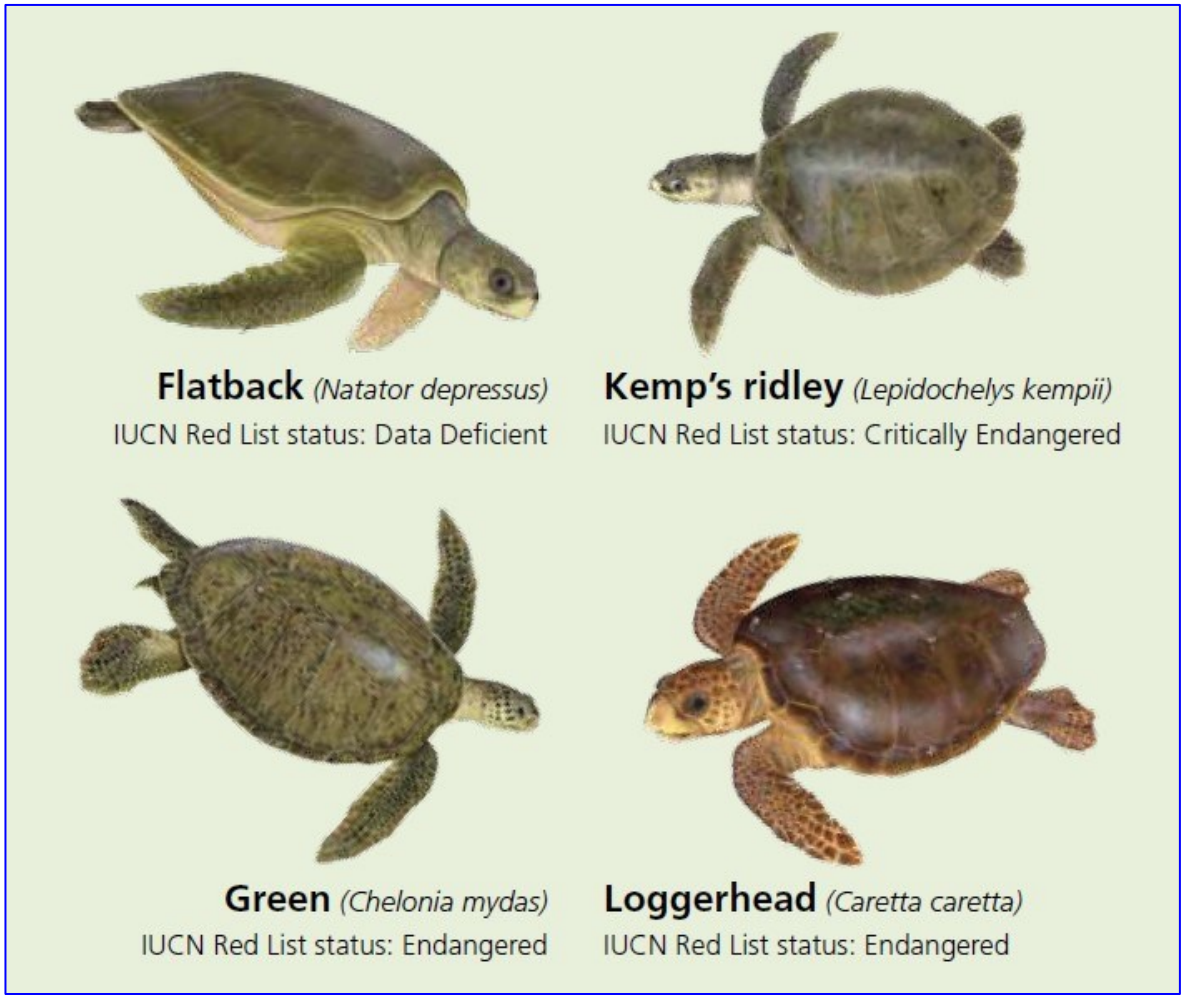
Females come ashore to nest and return to the natal beach at night. They crawl above the high water mark (High tide line), find a suitable nesting site, clear away the surface sand and dig out a flask-shaped nest with their hind flippers. The nest may be two to three feet deep depending on the size of the turtle.

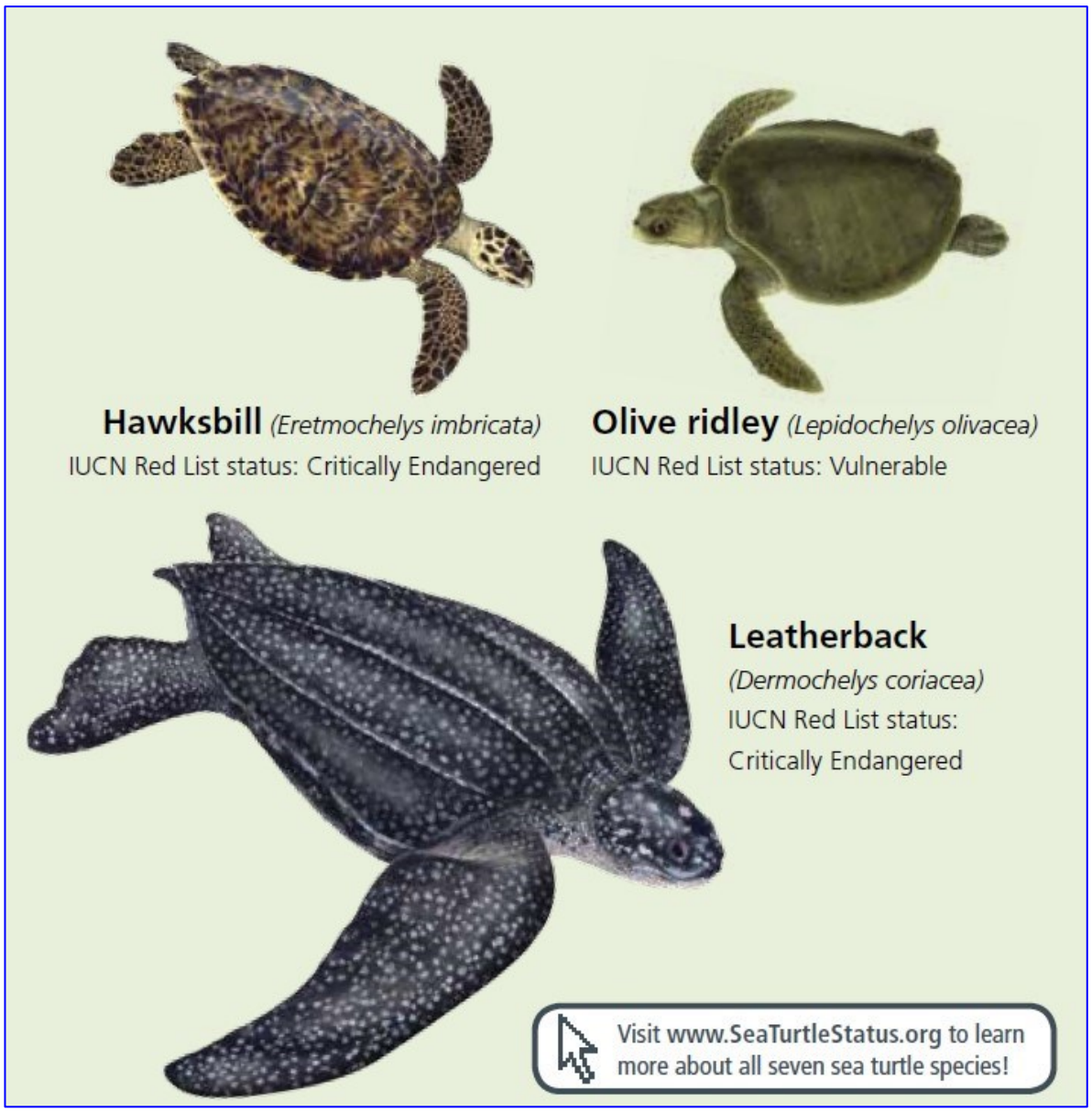
The number of clutches and the number of eggs per clutch may vary in different species. The different species lay about 80-120 eggs in the nest. Beach selection is determined by the accessibility of the beach as well as height and substrate. Different turtles prefer different types of beaches to nest. The Olive Ridleys and leatherbacks prefer wide beaches and sand bars at river mouths, while Hawksbills and Green turtles prefer small island beaches. After nesting, they return to their feeding grounds until the next breeding migration, which may be a year.

Hatchlings develop in their nest over a period of 7 to 10 weeks. They hatch simultaneously over a period of a few days and then emerge from the nest together usually at night. Hatchling

development is nocturnal to avoid predators and sunlight. They also use silhouettes of sand dunes 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 and start to swim against it. 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

The sex of a hatchling is determined by nest temperature. Sex ratios are likely to vary over the course of a nesting season and also between nesting beaches. Once in the sea, hatchlings spend the first few days of their lives in a 'swimming frenzy' when they use stored energy reserves to get into the open sea. Beyond this, they spend many years in a variety of juvenile habitats until they join other adults at feeding areas. Young turtles spend their lives in a variety of foraging habitats. The hatchlings are usually carried on trans-oceanic gyres and currents. The juveniles and sub-adults spend many years in near shore till they reach pelagic stage. Once they have reached sexual maturity, these turtles will migrate to their breeding grounds during the mating season to breed.





Source: SWOT report 'State of The World's Sea Turtles' – 2011

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 kilometres. Courtship and mating occur primarily in the offshore waters of the breeding ground; 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.

Several weeks after mating, the females come ashore to nest, mostly at night. They crawl above the high watermark, find a suitable nesting site, clear away the surfaces and (making a body pit), and dig out a flask shaped nest with their hind flippers. This may be two to three feet deep depending on the size of the turtle. They lay about 100-150 eggs 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 turtles 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.

Development of hatchlings

The hatchlings develop in their nest over a period of 7 to 10 weeks. They hatch simultaneously over a period of a few days and then emerge from the nest together (to swamp predators) usually at night. Predators include crabs, birds, jackals, feral dogs, and many fishes once they are in the sea. Once in the sea, the hatchlings spend the first couple of days of their lives in a "swimming frenzy" when they use stored energy reserves to get into the open sea. Beyond this, they spend many years in a variety of juvenile habitats until they join other adults at feeding areas. ***Less than one in a thousand hatchlings is believed to survive to adulthood.***

Temperature dependent Sex Determination

Lower temperatures produce males, higher temperatures produce females. The pivotal temperature (i.e. the temperature that produced equal numbers of males and females) varies among species and populations, although it is usually around 28-32°C. The sex of the hatchling 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

Hatchling emergence is nocturnal to avoid predators and sunlight. Sea finding is visual; the hatchlings seek a "brighter horizon" which is usually the moon or starlight reflecting off the surface of the 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.

The Lost Year and beyond

Young turtles spend their lives in a variety of foraging habitats. The hatchlings are usually carried on transoceanic gyres and currents. *Sargassum* drift lines (seaweed rafts) and FADs (Fish Aggregating Devices) have been found to beparticularly important. Convergence fronts have also been found to be important foraging habitats for juveniles. Loggerheads are known to make trans-pacific journeys (southern California to Japan) in the course of their development. For very long, this pelagic phase of their life was a complete mystery to biologists and was known as the 'lost year'. The juveniles and sub adults of some species spend many years in near-shore developmental habitats after the pelagic stage. Development to maturity may take 10 to 15 years in most turtles and maybe 30 years or more in the herbivorous green turtles.

Philopatry

Sea turtles usually travel 100s to 1000s of kilometers, from feeding to breeding ground. It has long been believed that sea turtles return to their natal beach (the beach where they were born) or group of beaches to lay eggs as adults. Recent genetic studies have substantiated this; some species (like green turtles) show greater precision in natal homing than others (like leatherbacks and Olive Ridley).

Nest Site Fidelity

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

700 km.

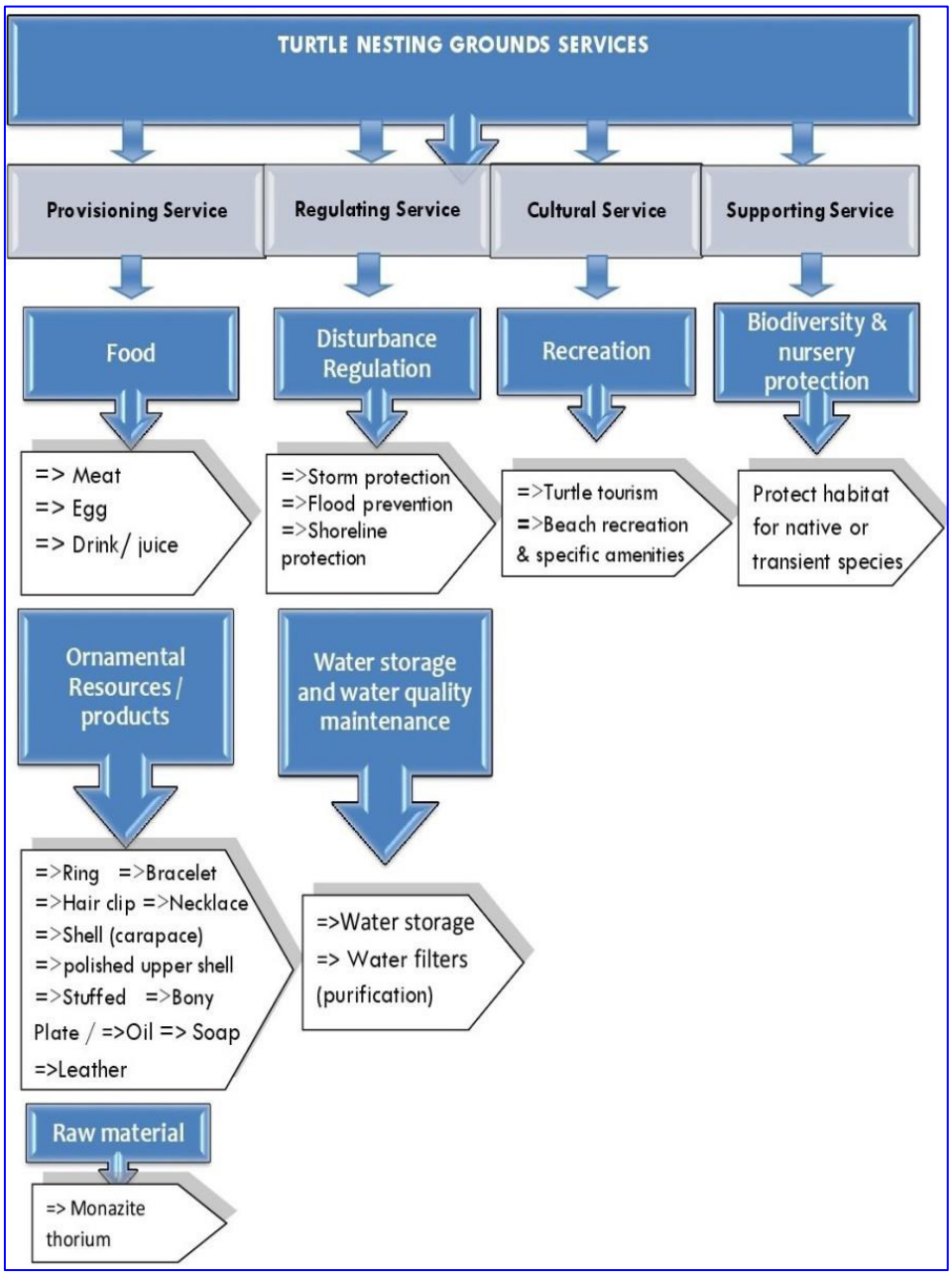
Beach selection is affected by accessibility of the beach as well as height and substrate. Different turtles prefer different types of beaches to nest. For example, Olive Ridley and leatherbacks prefer wide beaches and sand bars at river mouths, while hawksbills and green turtles prefer small island beaches

The seven sea turtle species that grace our oceans belong to a unique evolutionary lineage that dates back at least 110 million years. Sea turtles fall into two main subgroups: the unique family Dermochelyidae, which consists of a single species, the leatherback; and the family Cheloniidae, which comprises the six species of hard-shelled sea turtles such as Flatback turtle (Natator depressus), the Green turtle (Chelonia mydas), the Hawksbill turtle (Eretmochelys imbricata), the Loggerhead turtle (Caretta caretta), the Kemp's Ridley turtle (Lepidochelys kempii) and the Olive Ridley turtle (Lepidochelys olivacea).

4. Importance of Sea turtles

Sea turtles are part of two vital ecosystems, beaches and marine systems. If sea turtles become extinct, both the marine and beach ecosystems will weaken. And since humans use the ocean as an important source for food and use beaches for many kinds of activities, weakness in these ecosystems would have harmful effects on humans. Though sea turtles have been living and thriving in the world's oceans for 150 million years, they are now in danger of extinction largely because of changes brought about by humans. If we alter the oceans and beaches, it's enough to wipe out sea turtles.

As the turtle nesting grounds have ecological and habitat significance by supporting the sustenance of large number of biological organisms, its existence and protection value is worth to incorporate under supportive service.



4.1. Provide nutrients to coastal vegetation

Beaches and dune systems do not get very many nutrients during the year, so very little vegetation grows on the dunes and no vegetation grows on the beach itself. This is because sand does not hold nutrients very well. The turtle eggs directly influence the growth of vegetation's of beaches by supplying a concentrated source of high-quality nutrients in the sand. Limited nutrients in dune ecosystems, such as nitrogen, phosphorus and potassium, are partially provided to the ecosystem by un-hatched sea turtle eggs. These vital nutrients allow for the continued growth of vegetation and subsequent stabilization of beach dunes. Sea turtles use beaches and the lower dunes to nest and lay their eggs. Sea turtles lay around 100 eggs in a nest and lay between 3 and 7 nests during the summer nesting season. Not every nest will hatch, not every egg in a nest will hatch, and not all of the hatchlings in a nest will make it out of the nest. All the unhatched nests, eggs and trapped hatchlings are very good sources of nutrients for the dune vegetation. Even the left-over egg shells from hatched eggs provide nutrients.

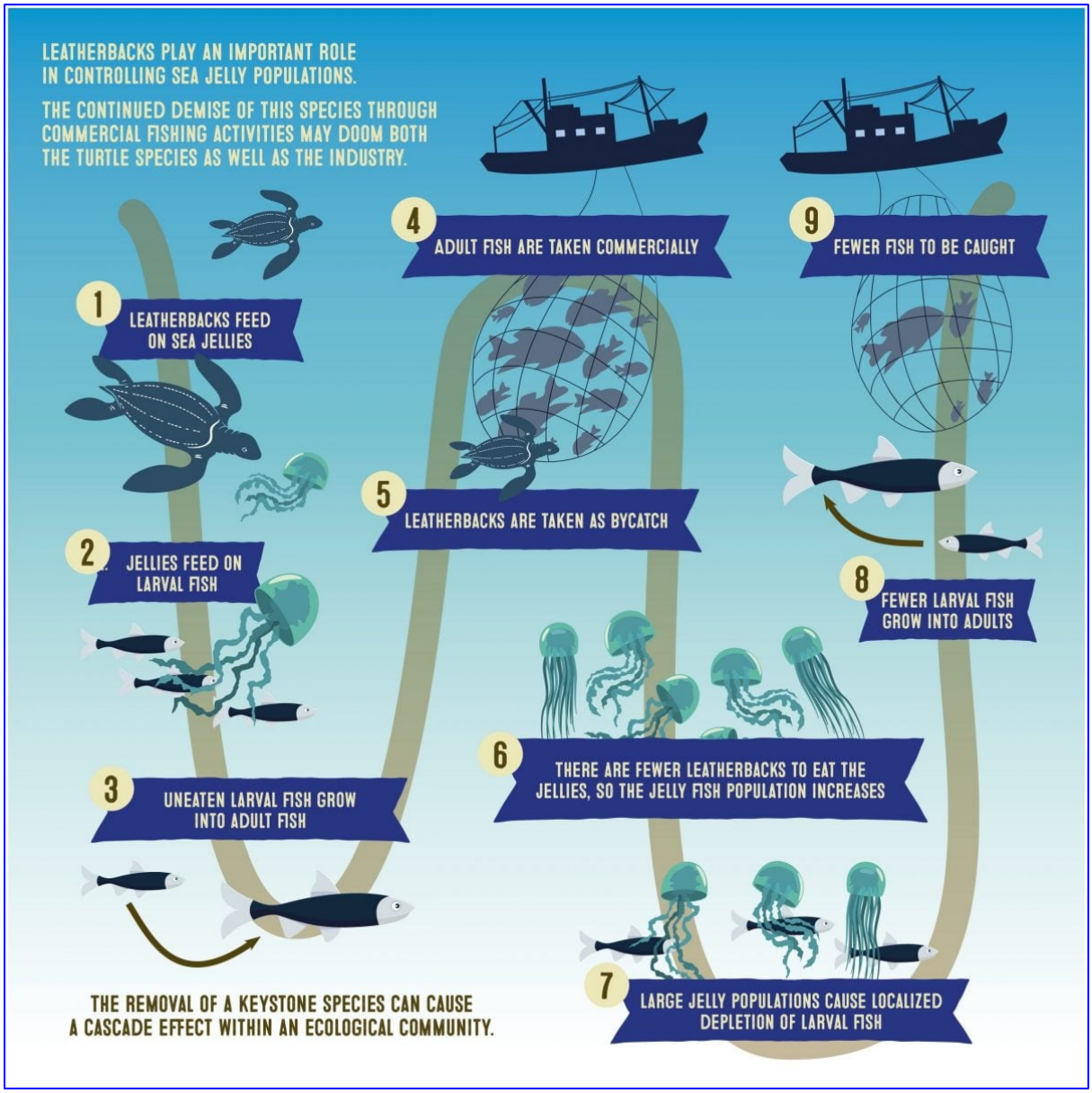
Dune plants use the nutrients from turtle eggs to grow and become stronger. As the dune vegetation grows stronger and healthier, the health of the entire beach/dune ecosystem becomes better. Healthy vegetation and strong root systems hold the sand in the dunes and protect the beach from erosion. As the number of turtle's declines, fewer eggs are laid in the beaches, providing less nutrients. If sea turtles went extinct, dune vegetation would lose a major source of nutrients and would not be healthy or strong enough to maintain the dunes, allowing beaches to wash away.

4.2. Stabilizing the Ecosystem

Sea turtles eat jellyfish, preventing the large "blooms" of jellyfish – including stinging jellyfish – that are increasingly wreaking havoc on fisheries, recreation and other maritime activities throughout the oceans.

Research has shown that sea turtles often act as keystone species. Sea grass beds grazed by green sea turtles are more productive than those that aren't. Hawksbill turtles eat sponges, preventing them from out-competing slow-growing corals. Both of these grazing activities maintain species diversity and the natural balance of fragile marine ecosystems. If sea turtles go extinct, it will cause declines in all the species whose survival depends on healthy seagrass beds and coral reefs. That means that many marine species that humans harvest would be lost.

Sea turtles, and many species that are affected by their presence or absence, are an important attraction for marine tourism, a major source of income for many countries.



Contribution of turtles in Ecological stabilization

4.3. Goods and Services

In the turtle nesting grounds, turtles are the key stone species and the nesting area has the qualities of general beaches hence it provides different services. Based on the research studies, the turtle fleshes have been consumed and its body parts have been used for ornamental purposes. The turtle nesting grounds have rare earth mineral deposits which has huge potential in the international market. The turtle nesting grounds also protect the coastal communities from hazards and thus increase real estate value. In addition, the turtle nesting grounds are a source of freshwater and minerals to the coastal communities. More than above, in Hindu mythology, turtles are second incarnation of Lord Vishnu and have great spiritual and cultural value for coastal communities. In addition, the turtle nesting ground support the fishermen to land their boats, dry their harvests and it also acts as a market place. The turtle eggs and carcass are food for many

vertebrates and invertebrates food web and are very significant to biodiversity and has significant scientific value. The scientific studies and research reports on turtle nesting grounds opened much information of the services provided by turtle nesting grounds. The services have been classified as (i) Provisional service (ii) Regulation services (iii) Cultural services and (iv) Supporting services. The following chart exhibits the various services and functions of turtle nesting grounds and the estimated value for various services.

4.4. Cultural services

Turtles are playing an important cultural, traditional, social and economic role in India. Turtle nesting grounds are sandy beaches that are the place for recreation and relaxation. It is a popular place for peacefulness, nature appreciation and play games and sports. Along with the turtle tourism, beach recreation increases the economic value of turtle nesting ground beaches. Turtles have spiritual value in Hindu mythology. According to Hindu mythology, the Indian deity Vishnu was reincarnated as "Kachhapa" – a turtle, holding the burden of the world on its back. In Hinduism, Kurma (Sanskrit: कूर्म; Kurma, lit. turtle) is the second avatar of Vishnu. Three temples in India have special spiritual relationship with turtles and they are popular pilgrimage sites. The temples dedicated to Kurma are located in Kurmai in Chittoor district, Andhra Pradesh, Srikurmam in Srikakulam District, Andhra Pradesh and Gavirangapur in Chitradurg District of Karnataka. In addition the nesting areas offer recreation function. Among the cultural services, turtle nesting grounds providing recreation function and spiritual function.

Kurma (turtle) temple at Chittoor district, Andhra Pradesh

4.5. Supporting service

Supporting services of turtle nesting grounds does not necessarily have direct economic benefit but shall provide for ecosystem functioning, processes, maintenance of integrity, resilience, and so the delivery of other benefits, including soil, mineral, gas formation and water recycling. It is also an essential habitat for plants and invertebrates such as shellfish, birds, rodents, and ungulates. The turtle species of Olive Ridley nesting at Orissa is genetically distinct from other

populations, and may even be the ancestral stock of other Olive Ridley turtle populations in other oceans. Hence, the Olive Ridley population reaching Orissa coast has special biological and scientific importance. In some research states that, the presence of green turtles contributes to healthy seagrass beds. The sea turtles' grazing activity in sea grass beds control and stabilize the distribution and diversity of sea grasses and disburses nutrition to other organisms and ecosystems. Nesting females are important food for many vertebrates living at the shore. The sea turtles have been attacked and eaten by jaguars, tigers and hyenas. The high protein eggs are an important food for several animals including jackals, mongooses, foxes, opossums, vultures, crows, lizards, snakes, crabs, and ants.

Sea turtles play several ecological roles such as maintaining the health of seagrass beds and coral reefs, they also provide habitats for marine organisms, aid in maintaining balanced marine food webs and promote nutrient cycling from marine to terrestrial ecosystems.

5. Global migration route of sea turtles

Movement is among the most basic and conspicuous characteristics of life. Some of the most impressive movements in the animal kingdom are those undertaken by long distance migrants such as sea turtles. Sea turtles are known to routinely swim distances that may span over 10,000 km, the distance between the eastern and western shores of the Pacific Ocean, when migrating from nesting to foraging areas. These epic migrations are understandably a central feature of the life-history of long-distance migrants. Knowledge of the factors governing migratory behavior can provide wide-ranging insights into their ecology and is often invaluable for conservation management.

5.1. Evolution of migratory behaviour in sea turtles

Of the seven extant species of sea turtle, each has been recorded conducting routine long-distance migrations. The prevalence of migratory behaviour in sea turtles stems partially from their evolutionary heritage. Sea turtles, like many reptiles, lay hard-shelled amniotic eggs. The capacity to lay such eggs evolved when the earliest reptiles diverged from primitive amphibians about 300 million years ago. The membrane-lined amniotic egg protected the embryo from desiccation, freeing reptiles from the need to return to water for reproduction as is still the case for all modern amphibians. With this novel adaptation, reptiles were able to rapidly spread across terrestrial environments. However, about 110 million years ago the ancestors of all sea turtles returned to the sea and readapted to life in marine habitats. Extant sea turtles now have a range of adaptation specifically suiting them to a life at sea, such as flipper shaped limbs, lungs that can survive the intense pressures experienced while diving down the water column, and specialized glands for removing the excess salt intake that is a consequence of inhabiting marine environments. One trait for terrestrial living that has been retained is the requirement to lay their eggs on dry land. Even though sea turtles are now able to feed, breed, and even mate in the water, adult females still emerge on sandy beaches worldwide to nest in the dry sand away from the water's edge. Nevertheless, the environmental conditions that create a suitable nesting beach do not necessitate that a productive foraging area will be available in nearby waters. As a result, sea turtles evolved the capacity to conduct routine migrations to-and-from their distant foraging areas and nesting rookeries.

Leatherback turtles are listed on the IUCN as globally vulnerable and populations in the Pacific Ocean, Indian Ocean, and Southern Atlantic Ocean are of special concern. During the latter half of the 20th century, egg poaching was the primary factor leading to the rapid decline of many leatherback turtle populations. Although in many cases this issue has now been addressed, many populations have continued to decline and this has been largely attributed to mortality associated with fisheries by-catch. Leatherback turtles are often caught or entangled in nets or on hooks intended for commercial species, such as tuna or swordfish. Many of these individuals die as a result of not being able to return to the water's surface to breathe, are injured as they try to free themselves, ingest fishing gear that may potentially suffocate them or form a blockage in their digestive system, or are injured when they are brought onboard the fishing vessel. Global estimates predict that over 50,000 leatherback turtles a year are caught as bycatch.

To protect sea turtles from incidental fisheries bycatch, the first step is to identify interaction of hot-spots between fisheries and turtles. This can be achieved by comparing data on the spatio-temporal distribution of both sea turtles and fisheries. In turn, this information can be used to determine the most effective methods for minimizing sea turtle by-catch. In some instances this may involve spatially or temporally explicit fisheries closures, restrictions or modifications to fishing gear, or changes in the depth as which fishing gear is set. A program called Turtle Watch even devised a program, founded on knowledge of the environmental habitat preferences of loggerhead sea turtles *Caretta caretta*, which provides fisheries with daily recommendations on to fish to minimize sea turtle bycatch based on remotely-sensed oceanographic conditions

5.2. Nesting phenology - being in the right place at the right time

The ultimate goal of migration is to maximize (life-time) reproductive output and is achieved through optimally managing the time spent in discrete habitats. In other words, arrival at each location of the migratory cycle should be coordinated with periods of favorable conditions, while departure ought to occur before the environment becomes too deleterious. The importance of timing in migratory behavior is particularly evident in sea turtle nesting phenology.

Sea turtles nest on sandy tropical and sub-tropical beaches worldwide. Nesting is typically seasonal, lasting between 2 to 6 months of each year, however, strong variation exists in both the onset and duration of the nesting season between populations. These differences are probably driven by spatial variation in the climatic and oceanographic phenomena that influence the success of incubating sea turtle nests. Nesting sea turtles bury their eggs at depths between 30 and 80 cm, depending on the species. After this, the eggs receive no parental care and so conditions within the nest are largely governed by ambient environmental conditions. Arguably, the most important environmental parameter is temperature, and the eggs must remain between 24 and 36 °C to hatch successfully. Temperature also dictates the gender of the developing embryos with males being produced at lower temperatures and females at higher temperatures. For most species, the pivotal temperate at which 50 % females are produced occurs between 27 and 31 °C. Consequently, there are only a small range of climatic conditions that can successfully support populations of nesting sea turtles. These generally only occur in the warmest months at temperate or sub-tropical latitudes and the coldest-months in equatorial latitudes.

Nest temperatures are understandably tied to local air temperatures, but they are also linked to precipitation patterns. In fact, local precipitation patterns can be a better predictor of hatching success than air temperatures. This is probably because the rainfall influences sand temperature and moisture levels, with the latter having additional impacts on hatching success. Moisture levels could even alter hatchling fitness, as seen in other Testudines. Despite the effect that the timing of the nesting season has on the success of the incubating eggs, little is known about the mechanisms that turtles use to coordinate the timing of the nesting season or their pre-nesting migrations. Some studies have found correlations between the onset of the nesting season in loggerhead and green turtles (*Chelonia mydas*) and sea surface temperature of the waters both near the nesting ground and in the foraging areas. However, leatherback turtles are uniquely able, among sea turtles, to maintain body temperatures significantly elevated above ambient conditions

through a series of adaptations termed gigantothermy. The effect of temperature on the nesting phenology of leatherback turtles may therefore be less distinct.

Moreover, the migratory phenology of leatherback turtles identified that the onset of their pre-nesting migrations were more closely correlated with surface chlorophyll concentrations (used as a proxy for food availability) at their foraging areas than sea surface temperature. Leatherback turtles the timing of the pre-nesting migrations, which in turn dictate the timing of the nesting season, is influenced by foraging success. Simply put, animals with higher foraging success are able to acquire the necessary resources to nest earlier than animals with lower foraging success. Additional factors that may play an important role in controlling the migratory phenology of leatherback turtles, although their effects have not been previously studied, are population size or demography. Turtles that have nested previously are known to nest earlier than neophyte nesters The ratio of experienced to neophyte nesters in a population could therefore influence the timing of the nesting season. Alternatively, many bird species are known to have higher mating success when populations are larger and, in turn, this also lead to earlier nesting seasons. If population size also influences nesting phenology in sea turtles the effects could be substantial, especially considering that many sea turtle populations world-wide have experienced large declines or impressive recoveries in recent years. Interestingly, increases were observed in the population size of many sea turtle populations were recent advances have been observed in the timing of the nesting season.

The mechanisms that govern the timing of the nesting season in sea turtles are not currently well understood however, understanding how sea turtle nesting phenology is likely to change in the future can play an important role in predicting how sea turtles will adapt to climate change. As global temperatures increase, this is likely to lead to increasingly female biased sex ratios in sea turtles and overall decreases in hatching success, unless sea turtles are able to shift the timing of the nesting season towards cooler seasonal conditions. If food availability controls the timing of the nesting season, then global shifts may be seen in nesting seasons depending on how climate change impacts food supplies. Alternatively, if population size or demography is more important than the potential for adaptation may be more dependent on other conservation strategies, such as nest shading.

5.3. Behavioural changes during the migratory cycle

Most turtles spend the majority of their time in the upper 200 m of the water column, but leatherback turtles have been recorded diving to depths of up to 1280 m. One of the main reasons that leatherback turtles dive to such extreme depths is to search the water column for diel-migrating gelatinous zooplankton. Gelatinous zooplankton are the predominant food source for leatherback turtles and due to their low-energy content it is estimated leatherback turtles must consume about 100 kg per day to survive. The movement patterns of leatherback turtles are therefore intrinsically linked to the distribution of gelatinous zooplankton in the world's oceans. Considering that gelatinous zooplankton form a major component of most marine ecosystems, often prey on or compete with commercially important fish species, and pose risks to human health for beach-goers and swimmers, leatherback turtles can function as relevant indicators of broad-scale ecosystem functioning and health.

Leatherback turtles are often found associated with dynamic oceanographic features, such as fronts or seasonal upwelling sites that promote the formation of mass aggregations, or blooms, of gelatinous zooplankton. However, these blooms are largely ephemeral in nature and the exact oceanographic conditions required for a bloom to form are not completely. In response to such dynamic prey-scapes, leatherback turtles conduct flexible foraging migrations that can encompass entire ocean basins. These migrations are very different to the common 'shuttling' migrations observed in loggerhead or green turtles (*Chelonia mydas*), where animals migrate between specific locations along a relatively-straight and generally consistent route and instead have been described as being more akin to a 'prolonged sojourn in a vast feeding area'. When analyzing the broad-scale movements of leatherback turtles, many studies have employed a range of statistical tools to determine when a switch has occurred from migrating to foraging.

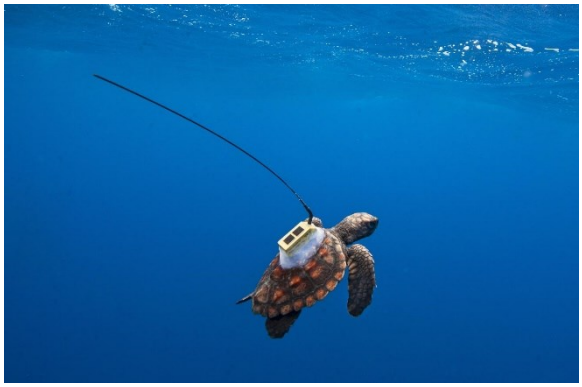
Specifically, if an animal has slow horizontal movement speeds and large turn angles between subsequent locations it is considered to be foraging, while if movement speeds are high and turn angles between subsequent locations are low then it considered that the animal is migrating. Although this rule is generally true for terrestrial animals, it needs to be remembered that diving

marine species move in a fully 3D environment. Furthermore, it has been demonstrated that changes in diving behavior can occur independently of horizontal movement patterns and may even provide better indicators of foraging behavior. As a result, there is a need for new statistical tools to be developed that are able to identify behavioral shifts in migratory marine species from both their horizontal movement patterns and their diving behavior.

5.4. Tracking animal movement through multiple methods

It is almost impossible to visually track movements of marine species over long periods of time. As such, the migratory patterns of most marine species were largely unknown until the development of animal-borne satellite telemetry devices in the early 1980s. These devices were able to relay the location of an animal anywhere in the globe, but only if the transmitter's antenna was above the surface of the water. They were particularly suited to tracking the movements of air-breathing marine animals as they must periodically return to the surface, and the first marine animal to be successfully satellite tracked was a loggerhead turtle. Since these early beginnings, the use of satellite telemetry to study the movement of marine megafauna has expanded exponentially and the variety of species that have been tracked in this manner is continually increasing Satellite transmitters have now been deployed on all seven species of sea turtle and the insights these devices have provided into the ecology of these species have been invaluable. Yet concurrently a wide range of chemical and isotopic tools have been developed that also have the capacity to provide information on the migratory patterns of marine megafauna. Of these, perhaps the most widely used technique is stable isotope analysis. The use of stable isotope analysis for animal tracking relies on the principle that animals foraging in different locations will incorporate the unique stable isotopic signatures of the areas in which they are foraging. Stable isotope analysis might not be able to currently provide as fine-scale tracking information as can be achieved by satellite telemetry, but it does have some alternative benefits. Firstly, C and N stable isotope analysis is far cheaper (approx. $10 per sample) than satellite transmitters (between $1000-5000 per unit).

As a result, stable isotope analysis is far more suited, than satellite telemetry, for studies that require large sample sizes. A second benefit of stable isotope analysis is that they inform you where an animal was previously. Consequently, the inferences gained from stable isotope analysis should be affected by the sample collection. Lastly, stable isotope analysis can provide additional insights into not only the movements of the sampled animal but also its diet. Although the vast potential utility of stable isotope analysis in animal tracking, the foraging locations of an animal can only be determined by stable isotope analysis if the isotopic signatures of different foraging locations are known. In addition, spatial patterns in stable isotopic signatures or isoscapes of marine megafauna are currently only known for a few species in a few regional locations. To this extent, stable isotope analysis often must be validated by combining it with other tracking methods, such as satellite telemetry. Once the isoscape has been established, it can then help provide information for tracking a wide range of animals and even provide information on broad-scale oceanographic patterns.



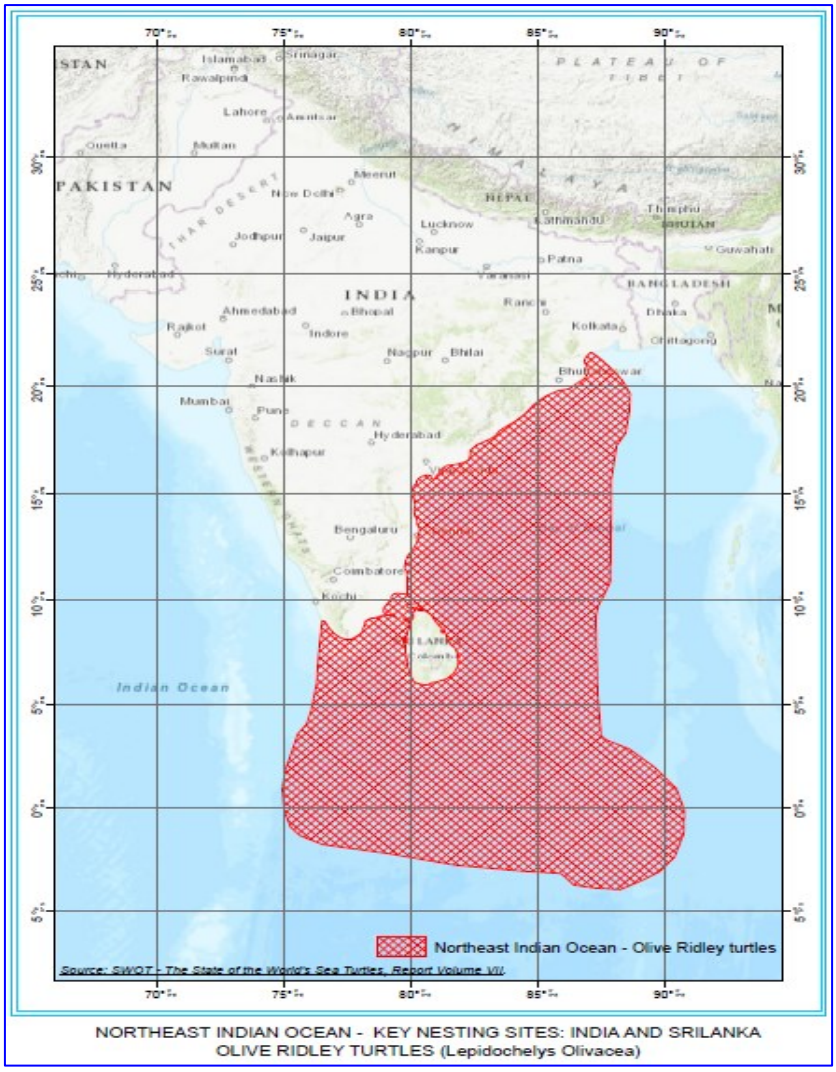
5.5. Migration routes

1. Olive Ridley turtles

Northeast Indian Ocean

Given the massive numbers of Olive Ridley that nest in a few locations in India each year, the place of Olive Ridley among the most endangered populations in the world might seem hard to believe. However, because of extremely intense pressures from trawl bycatch and consumption of turtle eggs and meat, the seemingly abundant Ridley have declined dramatically region wide both at mass nesting sites and at beaches where turtles nest in smaller numbers. More recently, development of major shipping ports along the coast of India has become a major cause of concern for these populations.

Key nesting sites: India and Sri Lanka



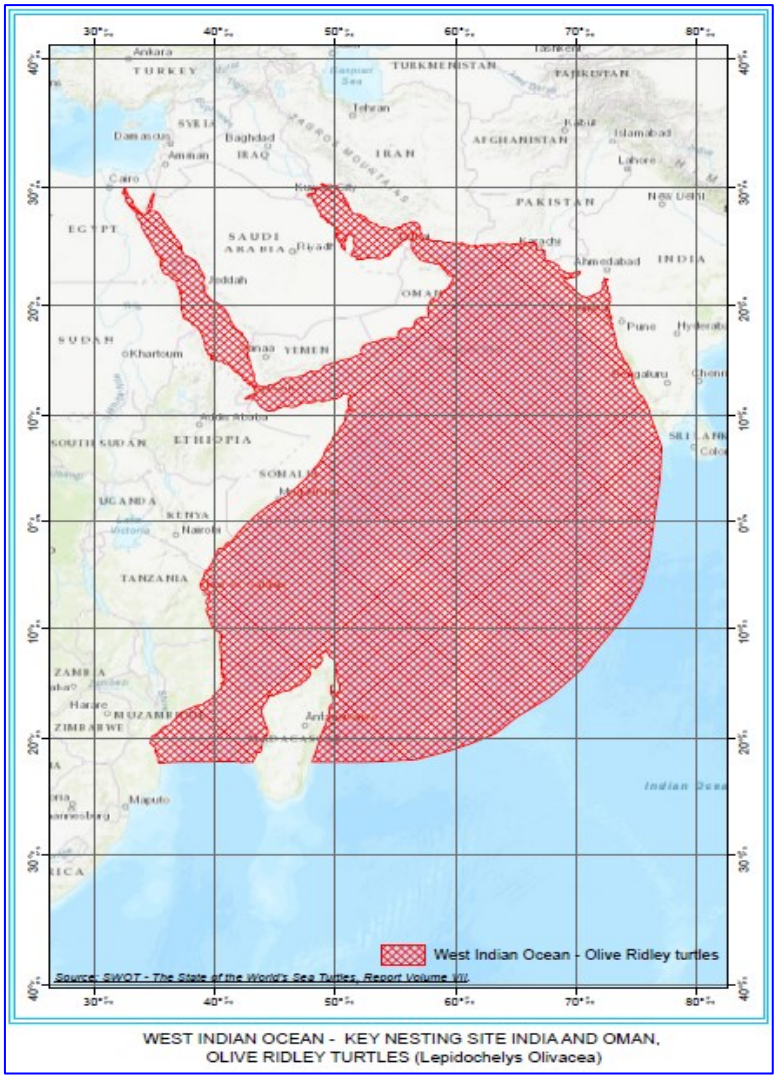
NORTHEAST INDIAN OCEAN - KEY NESTING SITES: INDIA AND SRILANKA
OLIVE RIDLEY TURTLES (Lepidochelys Olivacea)

Source: SWOT report 'State of The World's Sea Turtles' – 2011

West Indian Ocean

Although Olive Ridley nest sites are scattered all along the coast of India and in other countries, Olive Ridley turtles nest only in small numbers throughout the region. They have been declining because of intense trawl bycatch and consumption of turtle eggs and meat, especially in India. In addition, these Olive Ridley are threatened on land and in the water by coastal development and shipping.

Key nesting sites: India and Oman



WEST INDIAN OCEAN - KEY NESTING SITE INDIA AND OMAN,
OLIVE RIDLEY TURTLES (Lepidochelys Olivacea)

Source: SWOT report 'State of the World's Sea Turtles' – 2011

2. Loggerhead turtles

Northeast Atlantic Ocean

Although relatively abundant, Cape Verde loggerheads have a limited distribution and have been threatened for decades by consumption of meat and eggs, as well as bycatch in Cape Verde and in feeding areas along the African mainland coast.

Key nesting site: Cape Verde

Northeast Indian Ocean

This very small population has not been monitored consistently, so we do not know much about it. These turtles make this list because they are under high threat, mostly because of fisheries bycatch in trawls and nets, as well as ongoing development of coastal areas where they nest.

Key nesting sites: Sri Lanka, Bangladesh, and Myanmar

North Pacific Ocean

The trans-Pacific migrations of loggerheads between reproduction sites in Japan and feeding areas in Hawaii and Mexico are among the best known for ocean going animals. However, bycatch throughout their range especially in Japan and Mexico coupled with coastal development at nesting sites in Japan has caused this population to decline. International conservation efforts give hope for the future of loggerheads in this region.

Key nesting site: Japan

Northeast Atlantic Ocean

Northeast Indian Ocean Migration routes

North Pacific Ocean

3. Hawksbill turtles

East Atlantic Ocean

This poorly studied, small population nests at only a few sites scattered along the West African coast. It is under severe threat from coastal net bycatch and consumption of eggs and meat, as well as from exploitation of shell material for handicrafts and jewellery.

Key nesting sites: Republic of the Congo, São Tomé and Príncipe

East Pacific Ocean

Until a few years ago, marine turtle experts knew virtually nothing about this population. Thanks to recent collaborative efforts by regional conservationists to locate and protect them, hawksbills appear to be hanging on in the East Pacific. However, their use of habitats previously unknown to scientists (mangrove estuaries), extremely low numbers, and severe threats of coastal bycatch and egg consumption earn them a spot on this list.

Key nesting sites: El Salvador, Nicaragua, and Ecuador

Northeast Indian Ocean

Like loggerheads and Olive Ridley in this region, this hawksbill population has been depleted by severe threats. Compounding these problems, the size and status of this population is poorly known, making monitoring and conservation work very important for its continued survival.

Key nesting sites: India, Sri Lanka, and Bangladesh

West Pacific Ocean

Hawksbill populations worldwide have declined, in large part because of enormous demand for their beautiful shells, which provide "tortoiseshell" material used to make highly valuable handicrafts and jewellery. This hawksbill population, in particular, has suffered greatly because of exploitation of its shell material. Although international trade of hawksbill products is illegal, it continues to be a major threat to hawksbills around the world, especially in this region. In addition, future climate change effects could be another serious issue for this population.

Key nesting sites: Malaysia, Indonesia, and the Philippines

East Atlantic Ocean

East Pacific Ocean

Northeast Indian Ocean

West Pacific Ocean

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 (individual nesters are not synchronous). In certain places, some females can use both strategies. The time period between nesting events is approximately 14 days for solitary nesters and 28 days for arribada nesters.

6. Status of Sea Turtles

Sea turtles are believed to have originated in the lower Mesozoic era and evolved from land-based turtles. During the late Cretaceous period (65 million years ago), four distinct families of sea turtles are believed to have existed. However only two families survived into the current era: Dermochelyidae and Cheloniidae with seven species which is clearly recognized by many authorities in the world. The current rate of decline in the populations of these species have motivated worldwide conservation efforts since 1950. Efforts included various beach protection measures including protection of nesting sites and eggs from predators, strict fisheries by catch regulations and the establishment of community involved marine protected areas through Eco Development Committees (EDCs) and Biodiversity Management Committees (BMCs). Global Sea Turtle Habitat & Distribution is given in the table below.

S.NO	SPECIES	HABITAT	DISTRIBUTION
1	Green sea turtle	Bays, protected shores	West coasts of North and South America from Baja California to Peru.
2	Loggerhead sea turtle	Tropical, Subtropical and sometimes temperate waters, to boundaries of warm currents, prefers bays, but found in coastal streams, creeks, sometimes open ocean.	Worldwide.
3	Kemp's Ridley sea turtle	Shallow areas with sandy or muddy bottoms rich in crustaceans.	Adults usually occur in the Gulf of Mexico. Juveniles and immatures range between temperate and tropical coastal areas of the northwestern Atlantic Ocean. Occasionally young turtles reach northern European waters and as far south as Moroccan coast
4	Olive Ridley sea turtle	Mostly costal, does not go beyond the continental shelf.	Tropical regions of the Atlantic, Indian, and Pacific Oceans (rarely to central California), nearly unknown around oceanic islands.
5	Hawksbill sea turtle	Throughout central Atlantic and Indo-Pacific regions, most tropical of all sea turtles.	Throughout central Atlantic and Indio-Pacific regions; most tropical of all sea turtles.
6	Flatback sea turtle	Completely costal; does not go beyond the continental shelf.	Indigenous to northwestern, northern, and northeastern regions of Australia, the most restricted range of all sea turtle species

7	Leatherback sea turtle	Highly oceanic, approach coastal waters only during breeding season.	Widest distribution of all sea turtles. In the northeastern Pacific from the Gulf of Alaska south of the Bering Sea to the southeastern Pacific near Chile. In the Barents Sea, Newfoundland, and Labrador in the North Atlantic, around Argentina and South Africa in the South Atlantic. Throughout the Indian Ocean; and to Tasmania and New Zealand in the southwestern Pacific. This species is found farther north than any other reptile, marine or terrestrial.

6.1. Global Scenario

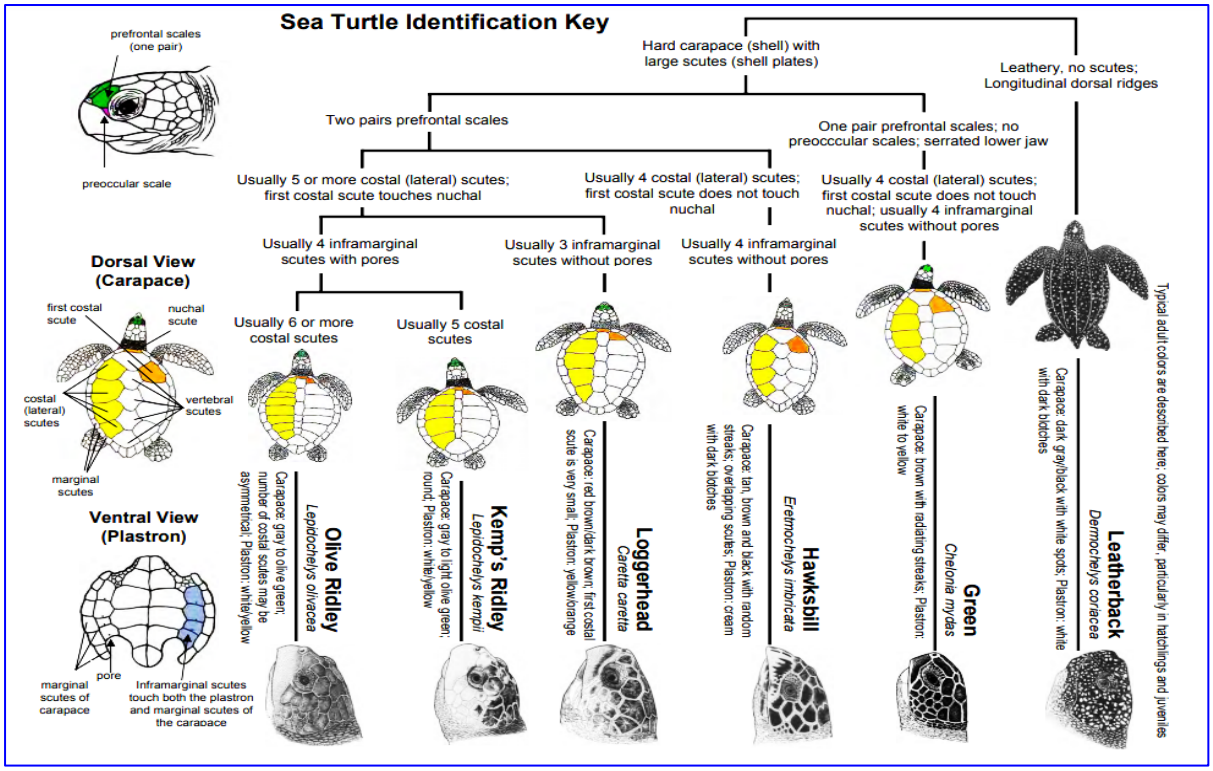
Two sea turtle families can be found in the world's ocean: Cheloniidae and Dermochelyidae. The Cheloniidae contain six extant species within five genera: the Flatback turtle (*Natator depressus*), the Green turtle (*Chelonia mydas*), the Hawksbill turtle (*Eretmochelys imbricata*), the Loggerhead turtle (*Caretta caretta*), the Kemp's Ridley turtle (*Lepidochelys kempii*) and the Olive Ridley turtle (*Lepidochelys olivacea*). The Dermochelyidae contain a single extant species within a single genus: the leatherback turtle (*Dermochelys coriacea*).

Leatherback, Loggerhead, Kemp's Ridley, Green, Olive Ridley, and Hawksbill are found in every ocean except the Arctic and Antarctic, as they are cold-blooded animals, and they need the heat to survive. The flat back turtle lives only in the waters around Australia. Adult sea turtles can be found in all the oceans of the world except for the polar region as they are too cold. Leatherback and Olive Ridley turtles are largely pelagic and their foraging movements can encompass entire ocean basins. Green, hawksbill, and flat back turtles reside in near-shore habitats. Loggerhead turtles appear to be able to combine both coastal and pelagic life-history.

The sources included research articles published in peer-reviewed scientific journals and further extracted citations from the available IUCN reports.

Marine turtle species	IUCN Red List (2012)	CITES listing	CMS listing	Indian Wildlife (Protection) Act, 1972.
Leatherback turtle (*Dermochelys coriacea*)	Critically Endangered	Appendix I	Appendix 1 & 2	Schedule I
Hawksbill turtle (*Eretmochelys imbricata*)	Critically Endangered	Appendix I	Appendix 1 & 2	Schedule I
Kemp's Ridley turtle	Critically Endangered	Appendix I	Appendix 1 & 2	Not Present

(*Lepidochelys kempii*)				
Green turtle (*Chelonia mydas*)	Endangered	Appendix I	Appendix 1 & 2	Schedule I
Loggerhead turtle (*Caretta caretta*)	Endangered	Appendix I	Appendix 1 & 2	Schedule I
Olive Ridley turtle (*Lepidochelys olivacea*)	Vulnerable	Appendix I	Appendix 1 & 2	Schedule I
Flat back turtle (*Natator depressus*)	Data Deficient	Appendix I	Appendix 1 & 2	Not Present



Identification key of sea turtles

Green Turtle (*Chelonia mydas*, Linnaeus, 1758)

Green sea turtles are a cosmopolitan species found in tropical and subtropical waters. This species breeds during the months of June through August. The green turtles can be separated into two species or races: the green turtle (*Chelonia mydas mydas*) and the East Pacific green turtle or black turtle (*Chelonia mydas agassizii* Bocourt, 1868).

Carapace: Green turtles actually have brownish coloured carapaces with yellowish plastrons. Carapace is broadly oval, margins are sometimes scalloped but not serrated, and not incurved above hind limbs; four pairs of costal scutes; straight carapace length (SCL) is about 120 cm. Adult green turtles are between 80 and 120 cm in straight-line carapace length (SCL). The black turtle is distinguished by the dark black colour of both the carapace and plastron in the adult form. Black turtles tend to be smaller at 65 to 90 cm SCL and weighing between 50 and 150 kg. *Head*: anteriorly

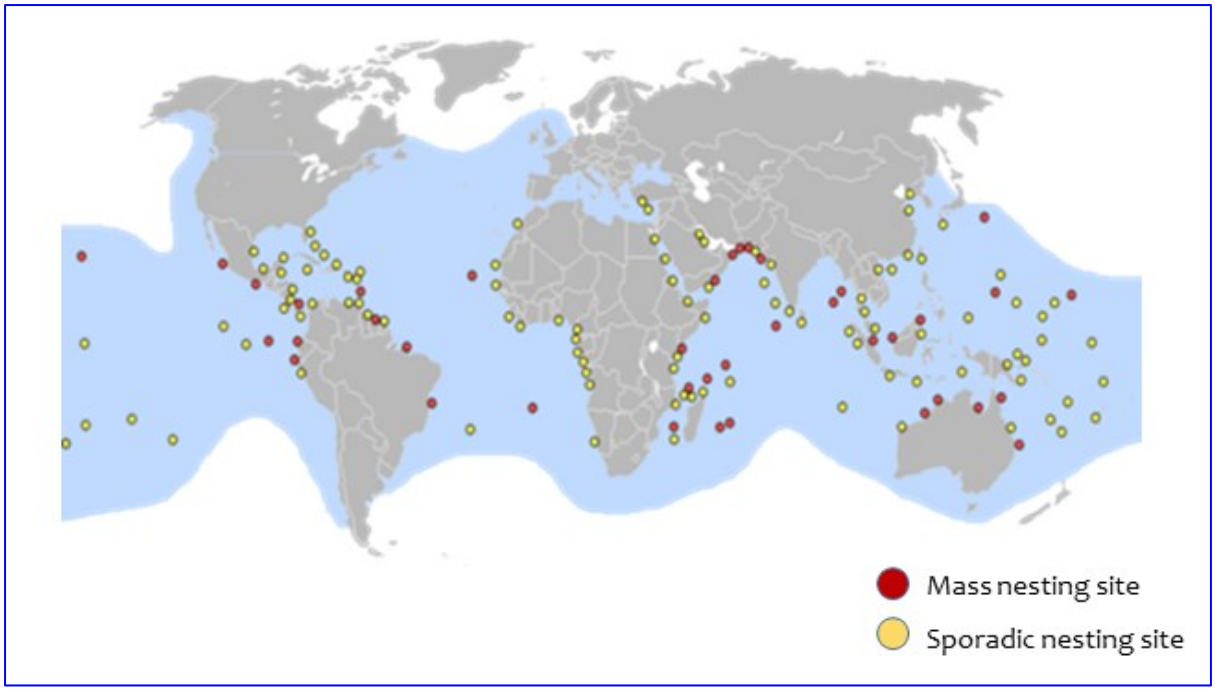
rounded; width is 15 cm; one pair of prefrontal scales; four pairs of postorbital scales. *Limbs*: single claw on each flipper. *Coloration*: Pale to very dark green and plain to very brilliant yellow, brown and green tones with radiating stripes. The plastron varies from white, dirty white or yellowish in the Atlantic populations to dark grey-bluish-green in the Pacific populations.

***Geographic distribution*:** Large nests on both mainland beaches and remote oceanic islands. All tropical and subtropical ocean beaches including Atlantic, Pacific, and Indian oceans; Mediterranean and Red seas.

***Preferred beach type*:** Ranges from large, open beaches to small cove beaches; preferably with an open offshore approach. Nesting intervals are about every 2 years, with wide year-to-year fluctuations. Nests range between 3 to 5 times per season. Lays an average of 115 eggs in each nest, with the eggs incubating for about 60 days.

Common name	Green Turtle
Scientific name	Chelonia mydas
Nest on	Tropical beaches worldwide, mainland and remote islands
Occur in	Tropical and subtropical waters
Weight	250 kg
Carapace	
Length	90 - 120 cm
Shape	Broadly oval; margin scalloped but not serrated

Costal scutes	4 pairs
Coloration	Brown with radiating streaks in juveniles. Variable in adults
Head	
Shape	Anteriorly rounded
Prefrontal scales	1 pair
Limbs	Single claw on each flipper
Plastron	White in hatchlings, yellowish in adults
Other features	Vertebrals (centrals) large, so that first costal does not contact nuchal scute
Period of nesting	Night
Clutch/Season	4-6
Renesting interval	10 - 14 days
Remigration interval	3 - 5 years
Clutch size	100 - 120 eggs



Genus: *Lepidochelys*

The genus *Lepidochelys* is comprised of two species, the Kemp's Ridley and the Olive Ridley turtles. Interestingly, the Kemp's Ridley is the rarest sea turtle whereas the Olive Ridley is the most abundant. Both Kemp's and Olive Ridleys have drab-olive coloured carapaces and yellowish-white plastrons. Ridleys are the only turtles to nest both solitarily and as part of arribada assemblages. The largest arribadas occur at Orissa, India and at this site over 100 000 Olive Ridley turtles have been recorded emerging in a single night.

Kemp's Ridley (*Lepidochelys kempii*, Garman, 1880)

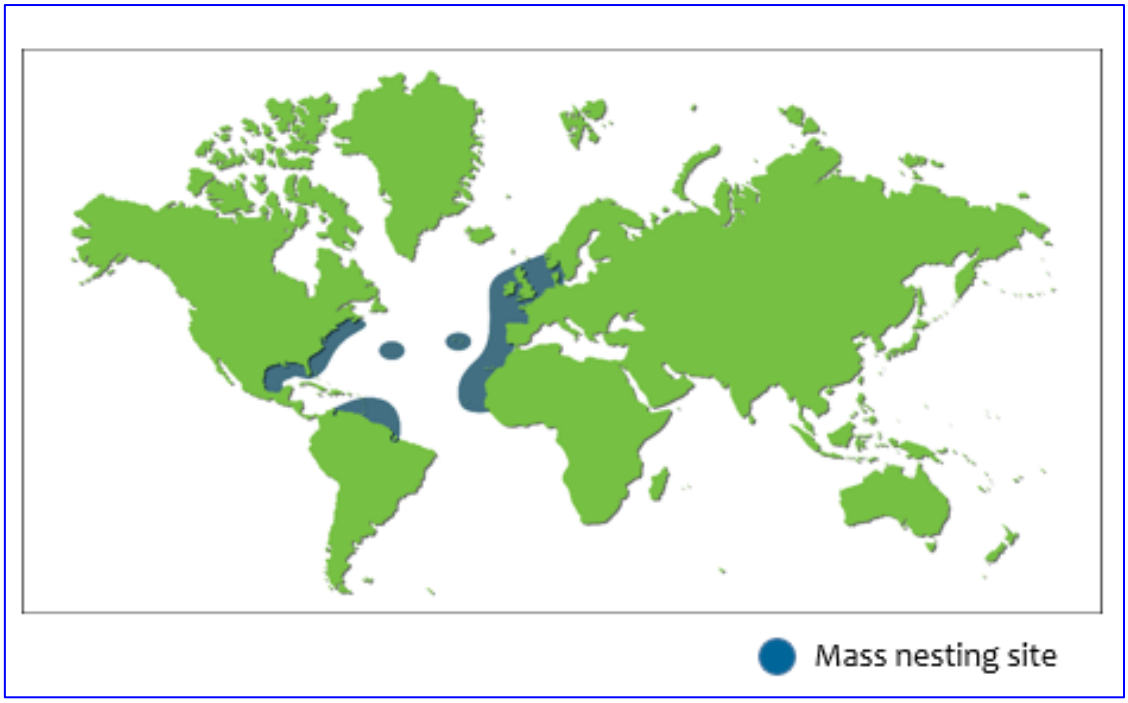
Carapace: Round (width of carapace about 95% of its length) bony without ridges and has large, non-overlapping scutes (scales). Carapace has 5 lateral scutes and is very rounded, straight carapace length (SCL) is up to 72 cm. Front flippers have 1 claw, while the rear flippers has 1 or 2 claws. Adults have a dark grey green carapace with a white or yellowish plastron, while the hatchlings are jet black. *Head*: large, subtriangular with convex sides; width to 13 cm; two pairs of prefrontal scales. *Limbs*: two claws on each flipper. *Coloration*: dorsally plain olive-grey in immatures, light olive-green in adults; underside white in immatures, yellow in adults. Plastron: a distinct, small pore near rear margin of each of the four inframarginal scutes.

Geographic distribution: Gulf of Mexico, eastern USA, occasionally western Europe.

***Preferred beach type*:** Wide, extensive, and continuous beaches with scrubby dune vegetation on mainland shores and barrier islands. Only two significant breeding rookeries for Kemp's Ridley turtles exist, Rancho Nuevo, Mexico and South Padre Island, USA, with arribadas only occurring on Rancho Nuevo. Kemp's Ridleys nest more often than other species, every 1 to 3 years on average and nest 2 - 3 times each season. They lay an average of 110 eggs in each nest and the eggs incubate for about 55 days.

Kemps Ridley	
Scientific name	Lepidochelys kempii
Distribution	Mexico
Weight	50 kg
Period nesting	Day

Clutch/Season	1 - 3
Renesting interval	17 - 30 days
Remigration interval	1 -2 years
Clutch size	100-120 eggs



Olive Ridley Turtle (*Lepidochelys olivacea*, Eschsholtz, 1829)

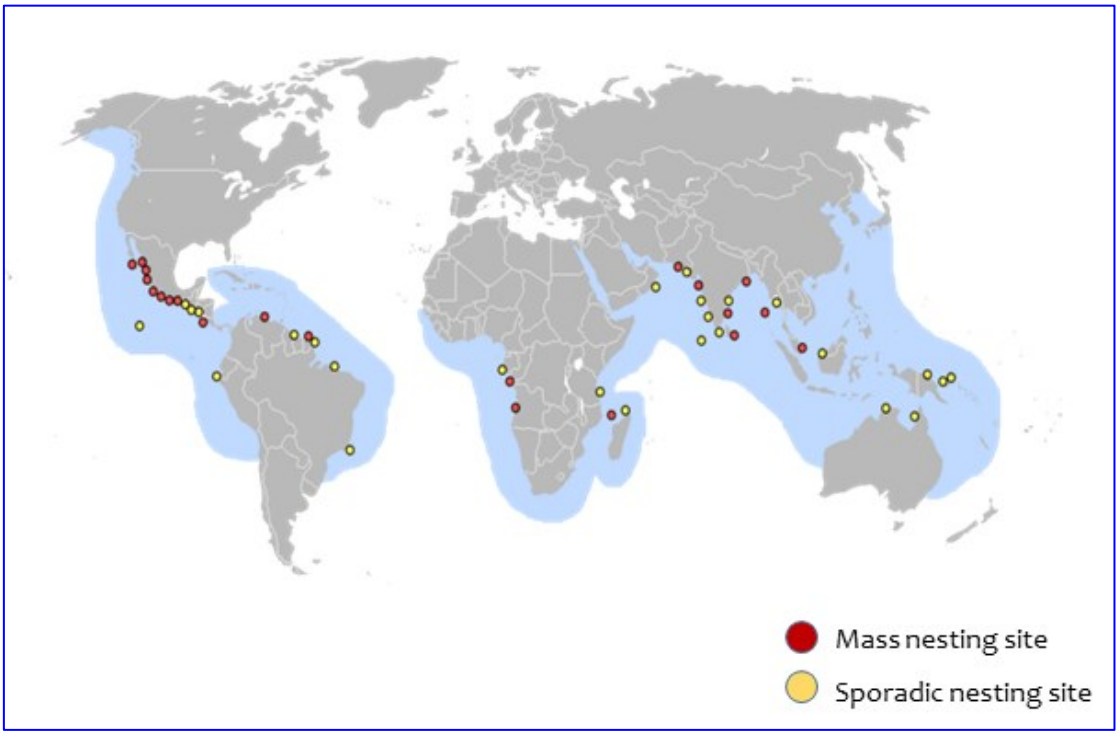
***Carapace*:** Upturned on lateral margins, flat on top; short and wide, but narrower and higher, five to nine pairs of costal scutes (usually six to eight); carapace scutes slightly overlapping in juveniles, non-overlapping in adults; straight carapace length (SCL) up to 72 cm. *Head*: relatively large, triangular from above; width up to 13 cm; two pairs of prefrontal scales. *Limbs*: two claws on each flipper. *Coloration*: dorsally grey in immatures, mid to dark live-green in adults; underside white in immatures, cream-yellow in adults. Plastron: a distinct, small pore near rear margin of each of the four inframarginal scutes.

Geographic distribution: Eastern Pacific (Baja California and Sinaloa, Mexico to Colombia), south Atlantic (Guyana to Brazil and West Africa), northern Indian Ocean (especially Orissa India), and western Pacific (Malaysia and Thailand).

Preferred beach type: tropical mainland shores and barrier islands, often near river mouths. Nests every year in mass synchronized nesting called arribadas. Nests 2 times each season. An average clutch size is over 110 eggs which require a 52 to 58 days incubation period.

Common Name	Olive Ridley
Scientific name	*Lepidochelys olivacea*
Nest on	Tropical beaches worldwide
Occur in	Tropical waters
Weight	50 kg
Carapace	
Length	60- 70 cm
Shape	Short and wide, carapace smooth but elevated, tectiform (tent shaped)
Costal scutes	5 – 9 pairs asymmetrical
Coloration	Mid to dark olive green
Head	
Shape	Large, triangular

Prefrontal scales	2 pairs
Limbs	Two claws on each flipper
Plastron	Pore near rear margin of infra marginal; Creamy yellow
Period of nesting	Night
Clutch/season	1-3
Re-nesting interval	20 - 28 days
Re-migration interval	1 - 2 years
Clutch size	100 - 120 eggs



Hawksbill Turtle (*Eretmochelys imbricata*, Linnaeus, 1766),

The hawksbill is one of the smaller sea turtles. The hawksbill turtle gets its name from its narrow, elongated jaw that resembles the beak of a raptor. Adult hawksbill turtles have highly variable shell lengths ranging from 50 to 90 cm in SCL and weigh between 40 and 80 kg as adults.

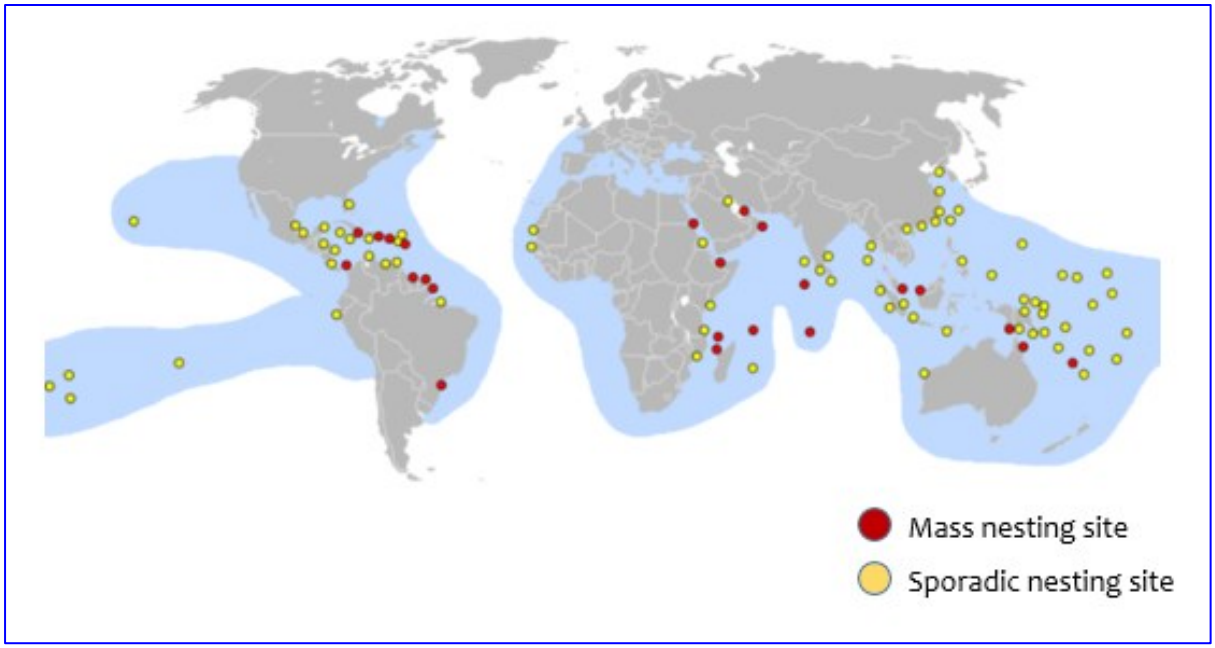
***Carapace*:** Carapace length of adults cordiform or elliptical, its width 70 to 79% of its total length. bony without ridges and has large; elliptical in shape, with a strongly serrated posterior margin and thick overlapping (imbricate) scutes (except in hatchlings and some adults); four pairs of costal scutes, each with a slightly "ragged" posterior border; straight carapace length (SCL) to about 90 cm. The carapace of a hawksbill turtle is mottled black, brown, and yellow, while the plastron is bright yellow to beige. *Head*: relatively narrow; width up to 12 cm; with a straight bird-like beak; two pairs of prefrontal scales. *Limbs*: front flippers are medium length compared to other species; two claws on each flipper. *Coloration*: orange, brown or yellow and hatchlings are mostly brown with pale blotches on scutes. Plastron: four pairs inframarginal scutes.

***Geographic distribution*:** Tropical mainland and island beaches in the Atlantic, Pacific, and Indian oceans, and Red Sea. The largest remaining populations occur in Australia, Mexico, Seychelles, and Indonesia. Small populations of hawksbills have also been recently discovered in the Eastern Pacific Ocean.

***Preferred beach type*:** Almost exclusively tropical; often use narrow beaches on islands or mainland shores with reefs obstructing offshore approach. Hawksbill nesting habitat is often separated (spatially or temporally) from that used by other turtle sea species. Egg size and number: egg diameter typically 32-36 mm. Average clutch size varies from 70-90 in the Arabian Peninsula to 110-180 elsewhere.

Common name	Hawksbill
Scientific name	*Eretmochelys imbricata*
Nest on	Tropical beaches worldwide, mainly remote islands
Occur in	Tropical waters
Weight	150 kg
Carapace	
Length	80 - 100 cm
Shape	Oval, strong serrated posterior margin, thick over lapping (imbricate) scutes
Costal scutes	4 pairs (ragged posterior border)
Coloration	Brown, badly marked with amber and brown variegations
Head	
Shape	Narrow, straight bird like beak
Prefrontal scales	2 pairs

Limbs	Two claws on each flipper
Plastron	Light Yellow to White
Other features	Night/day
Period of nesting	Night
Clutch/Season	3 - 5
Re-nesting interval	12 - 14 days
Remigration interval	2 - 5 years
Clutch size	120 - 150 eggs (Up to 180 eggs)



Loggerhead Turtle (*Caretta caretta*, Linnaeus, 1759)

They are named loggerhead because they have the largest head and jaw, relative to body size, of all sea turtles. Loggerhead turtles conduct one of the longest migrations in the animal kingdom.

***Carapace*:** Loggerhead turtles have a dark-brown to maroon carapace and yellow plastrons. Bony without ridges and has large (incomplete); Heart-shaped in dorsal view, width about 86% of total length. Moderately broad; lightly serrated posterior margin in immatures; five pairs of costal scutes, the first (anterior) pair the smallest; straight carapace length (SCL) up to 105 cm and weight Between 60 and 200 kg. *Head*: large and broadly subtriangular in shape; width up to 28 cm (23 to 28% carapace length) two pairs of prefrontal scales. Horny beak very strong, thicker. *Limbs*: front flippers relatively short compared to other species, two claws on each flipper. *Coloration*: dorsally Light to dark brown in hatchlings, generally unmarked reddish-brown in sub adults and adults; underside brown in hatchlings, yellow to orange in sub adults and adults. Plastron: three pairs inframarginal scutes.

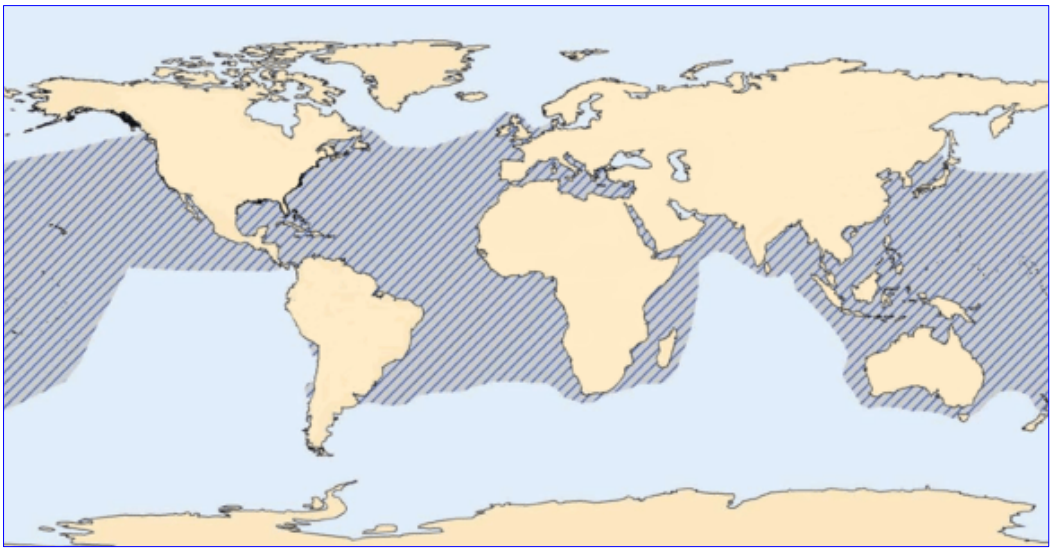
Geographic distribution: Nests most abundantly in subtropical and temperate areas (southeast USA, Oman, temperate Australia, South Africa, eastern and southern Mediterranean, Japan,

southern Brazil), occasionally in the tropics (Belize and Colombia), and sometimes on islands (New Caledonia, Solomon Islands).

Preferred beach type: Extensive mainland beaches and barrier islands; moderately steep beach profile preferred. Intervals of nest are 2 to 4 years. They lay 3 to 6 nests per season, approximately 12 to 14 days apart. Lays on an average between 100 and 126 eggs in each nest. Eggs incubate for about 60 days.

Common name	Loggerhead
Scientific name	*Caretta caretta*
Nest on	Temperate and subtropical beaches
Occur in	Temperate, sometimes subtropical and tropical waters
Weight	200 kg
Carapace	
Length	80 - 100 cm
Shape	Moderately broad, lightly serrated posterior margin in immature, thickened area of carapace at base of 5th vertebral in adults
Costal scutes	5 pairs
Coloration	Generally unmarked reddish brown in sub adults and adults
Head	
Shape	Large and broadly triangular
Prefrontal scales	2 pairs
Limbs	Two claws on each flipper
Plastron	Yellow to orange
Other features	Vertebral (centrals) narrow, so that first costal contacts nuchal scute
Period of nesting	Night

Clutch/Season	3 - 5
Renesting interval	12 - 16 days
Remigration interval	2 - 3 years
Clutch size	100 - 120 eggs



Flat back Turtle (*Natator depressus*, Garman, 1880)

***Carapace*:** Bony without ridges and very broad and rounded, body is very flat, with upturned lateral margins at the posterior of the animal; four pairs of costal scutes are oily and relatively thin; scutes very thin and with a softer texture than in other cheloniid turtles, with seams often disappearing in old adults; curved carapace length (CCL) to about 100 cm and weigh between 60 and 100 kg. *Head*: wide, broad, flat and subtriangular in shape; width to 13 cm in adults; three pairs of postorbital scales; one pair of prefrontal scales. *Limbs*: large scales present only on the edges of the front flippers, with most of the flipper covered by wrinkled skin or very fine scales; single claw on each flipper. *Coloration*: The carapace is a dull olive-grey and the plastron is a pale-cream, dorsally uniform olive-green in hatchlings and adults; yellowish ventrally. Distribution: confined to waters of tropical Australia and possibly southern New Guinea.

***Geographic distribution*:** The flat back turtle has a very limited distribution and is only found in the shallow, protected coastal waters off Northern Australia and Gulf of Carpentaria. Significant breeding rookeries are similarly found along the northern coasts of Australia. This species is not highly migratory and completes all of its life cycle within zones close to their nesting beaches.

***Preferred beach type*:** fairly large open beaches, on mainland or large islands; reef habitat avoided. Clutch size averages about 50-55 eggs. Nests 4 times per season. Lays an average of 50 eggs at time. The eggs incubate for about 55 days.

Common name	Flat back
Scientific name	*Natator depressa*
Distribution	Australia
Weight	200 kg
Period nesting	Night/Day
Clutch/Season	2 - 4
Re-nesting interval	13 - 18 days
Remigration interval	~ 3 years
Clutch size	50 - 60 egg

Leatherback Turtle (*Dermochelys coriacea*, Vandelli, 1761)

Leatherback turtles are the largest and most visually distinct of the extant sea turtle species.

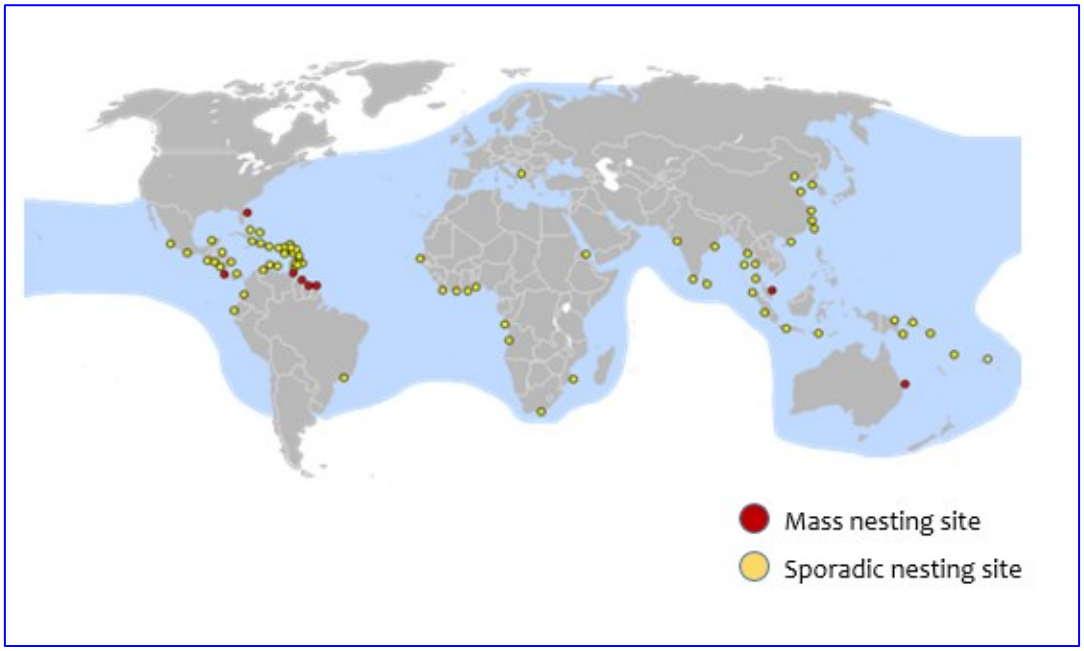
Carapace: Elongate with seven prominent longitudinal keels (ridges); adults with smooth skin, straight carapace length (SCL) up to 180 cm and can weigh up to 500 kg. They do not have the characteristic 'hard-shell' of the Cheloniidae and instead their shell consists of cartilaginous osteoderms beneath a layer of leathery skin. *Head*: broad triangular shape and scale less, 17 to 22.3% carapace length. Beak feeble, lacking crushing surfaces but sharp-edged; upper jaw with 2 pointed cusps at front; lower jaw with single, pointed central hook that fits between upper cusps when mouth closed. *Limbs*: forelimbs extremely long; unscaled skin in adults; all limbs clawless. *Coloration*: dorsally predominantly black, with white or paler spotting; spots may be bluish or pink on neck and base of flippers; light pigment predominating on plastron. *Plastron*: relatively small, distensible.

Geographic distribution: Primarily occupy pelagic environments. Isolated mainland beaches in tropical oceans; mainly Atlantic and Pacific and few in Indian Ocean and temperate oceans (south west Indian Ocean). Some low-density nesting on islands (Greater and Lesser Antilles, Solomon Islands, and islands of the Bismarck Sea).

Preferred beach for nesting: Wide, long, tropical beaches with steep slope, deep rock-free sand, and an unobstructed deep water or soft mud bottom approach.

Common name	Leatherback turtle
Scientific name	*Dermochelys coriacea*
Nest on	Tropical beaches worldwide
Occur in	All oceans, sub-arctic to tropical waters absent
Weight	250 kg

Carapace	
Length	140-170 cm
Shape	Elongate with seven prominent dorsal ridges; scutes always absent
Coloration	Mostly black with white spotting, pink or bluish spots on base of neck and flippers
Head	
Shape	Triangular; two maxillary cusps
Limbs	Forelimbs extremely long
Plastron	Relatively small and distensible
Period of nesting	Night
Clutch/Season	4-6
Re-nesting interval	9-14 days
Remigration interval	2-3 years
Clutch size	80-100 eggs



6.2. Indian Scenario

Five of seven known species of sea turtles, Leatherback turtle (*Dermochelys coriacea*), Hawksbill turtle (*Eretmochelys imbricata*), Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelonia mydas*) and Olive Ridley turtle (*Lepidochelys olivacea*) are reported from the Indian coastal waters. All the species of sea turtles found in India are presently declared as "endangered" and are protected by law under Schedule I of Indian Wildlife (Protection) Act, 1972. The sea turtles in India were considered as a part of the marine fisheries for a long time.

Among various species the Olive Ridley turtle (*Lepidochelys olivacea*) is the commonest sea turtle in Indian sea. It has a large head with heart shaped body. All the five species of sea turtles are well distributed along the entire Indian Ocean and particularly in the Bay of Bengal.

India has a coastline of 7516.6 km, including the mainland coastline of 6632 km and offshore islands of Andaman and Nicobar and Lakshadweep. Four species of turtles including the Olive Ridley, Green turtle, Leatherback and Hawksbill nest on Indian coasts.

Among various species the *Lepidochelys olivacea* is the commonest sea turtle in both east and west coasts of the Indian mainland, as well as on the beaches of Sri Lanka, Bangladesh and Pakistan, and on India's offshore islands. There are a few reports of loggerheads from Indian waters, but no known records of nesting.

Olive Ridleys nest on both east and west coasts of the Indian mainland/offshore islands as well as on the beaches of Sri Lanka, Bangladesh and Pakistan. The Olive Ridley rookeries in Odisha are of obvious global significance since they constitute one of the major mass nesting sites in the world. Few thousands of Olive Ridleys may also nest annually outside of Odisha, particularly in Andhra Pradesh, Tamil Nadu and the Andaman and Nicobar Islands. Large nesting leatherback populations in India are restricted to Great and Little Nicobar Islands. But a few turtles are found to nest in the Andamans.

Green turtles nest in Gujarat on the west coast of India, Lakshadweep Islands and Andaman and Nicobar Islands in India and Pakistan and Sri Lanka coasts as well. Hawksbills nest are relatively large in numbers and they are only in Andaman Islands. But some nesting occurs in Nicobar and Lakshadweep Islands of India and in Sri Lanka.

In west coast of India Olive Ridley and Green turtles are common in Gujarat whereas Hawksbill and Leatherbacks are rarely found. Leatherback is the most frequently found turtle in Goa waters where as in Kerala all sea turtle species are found except Leatherback among which Olive Ridley is commonest one. The same also happens in Lakshadweep. In Karnataka coast, turtles are found in very less numbers. In east coast of India Olive Ridley is the only dominant species found among others. It is mainly found in the coasts of Orissa, Andhra Pradesh, Tamil Nadu, West Bengal and Andaman and Nicobar Islands.

Marine Turtles in India

The Indian coastal waters supports five species of sea turtles found worldwide. These are the Olive Ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*) and Loggerhead (*Caretta caretta*). These five species of sea turtles that occur in Indian coastal waters are protected under Schedule I of the Wildlife (Protection) Act, 1972.

India is home to the largest known nesting population of olive Ridley turtles. Except Loggerhead turtles, the remaining four species (Leatherback, Hawksbill, Green and Olive Ridley turtles) nest along the Indian coastline and islands of India. About 40,000 to 11,00,000 turtles nest every year on the beaches of India. Number of turtles nesting varies between years and the success of sporadic nests have been observed to decline due to predations and habitat degradation. Numerous direct and indirect pressures arising from various factors adversely impact marine turtle populations and their habitat. This also includes natural disasters such as tsunamis, cyclones, hurricanes and storms

Marine turtles have a major influence on the structure and function of marine biodiversity and play an important role in shaping the behavior and life history traits of prey species and predators that is critical for the sustainability of fisheries in the region. Factors like climate change, unsustainable resource use, marine litter and pollution affect marine turtles and their habitats.

Marine turtles play a variety of ecological roles for maintaining healthy marine habitats like controlling prey populations, supporting coastal vegetation through their hatchlings etc. Their presence is an indicator of healthy marine ecosystems and provide a source of revenue for local communities through tourism. Marine turtles thus present themselves as a key indicator of healthy marine habitats and an opportunity for conservation of associated species.

Despite the immense economic, ecological and cultural values of marine habitats in India, marine mega fauna species and marine turtles face a wide variety of challenges including stranding and entanglement. Managing such challenging situations requires coordination, action and people's participation which would help in the long-term conservation of marine species and their habitats.

Important Marine Turtle Habitats in India

S.No	State	No. of sites	Area (ha)	Common species
1	Gujarat	13	399.51	Olive Ridley, Green turtle
2	Maharashtra	14	202.20	Olive Ridley
3	Goa	6	25.54	Olive Ridley
4	Kerala	4	116.61	Olive Ridley
5	Lakshadweep	5	992.15	Olive Ridley, Green turtle and Hawksbill turtle

6	Tamil Nadu	6	263.08	Olive Ridley
7	Pondicherry	2	15.79	Olive Ridley
8	Andhra Pradesh	12	1374.69	Olive Ridley
9	Odisha	11	872.93	Olive Ridley
10	West Bengal	4	265.48	Olive Ridley
11	Andaman & Nicobar	102	13344.06	Olive Ridley, Green turtle, Hawksbill and Leatherback
Total		**179**	**17,872.05**	Olive Ridley, Green turtle, Hawksbill and Leatherback

Source: Turtle nesting grounds report by NCSCM report, 2018-2019

Turtle Nesting Grounds – Indian Coastal Districts

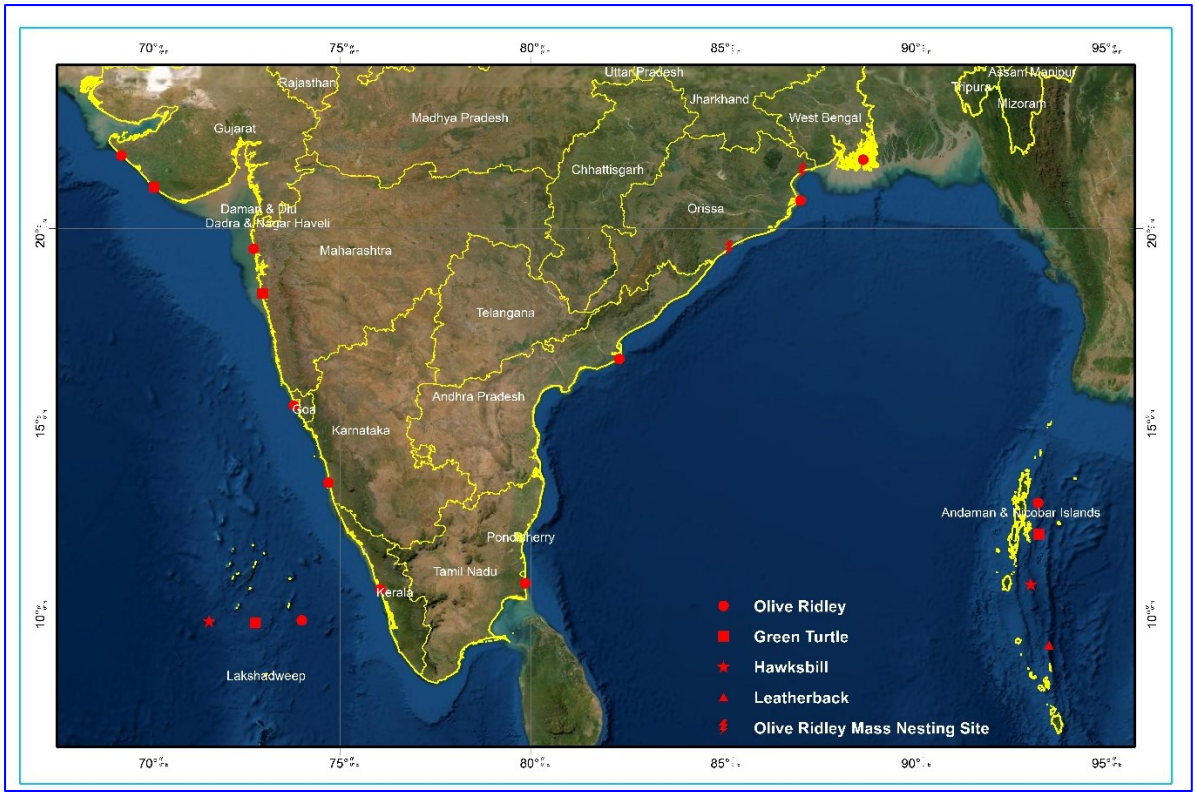
Sl. No	State / Union Territory	District	Patches in coastal areas	Turtle Nesting Grounds (ha)	Turtle density	Common sp.
1	**Gujarat**	Devbhumi Dwarka	Lamba-Sethala Mata Mandir	32.55	31	Olive Ridley, Green turtle
2			Mithapur-Mojap	12.57	24	
3			Sethala Mata Mandir-Harshad Mata Mandir	13.99	33	
4			Okhamadhi-Kharakhetar	33.41	16	
5			Mojap-Shivrajpur	13.14	32	
6			Kharakhetar-Kuranga	25.57	20	
7			Navadra-Lamba	40.44	34	
8			Nearby Shivrajpur Beach	6.98	NA	
9		Junagadh	Shil-Lohej	50.82	42	Olive Ridley, Green turtle
10			Mangrol-Mangrol Bara	20.57	37	
11		Porbandar	Ratadi–Kantela	47.43	29	Olive Ridley, Green turtle
12			Kantela-Kuchhadi	50.55	37	
13			Navibandar-Ratiya	51.52	15	
Sub total			13	399.51	350	Olive Ridley, Green turtle

14	**Maharashtra**	Ratnagiri	Kolthare	5.09	2	Olive Ridley
15			Sandkhol	4.32	NA	
16			Velaas	8.59	7	
17			Guhagar	48.91	1	
18			Kelashi	17.00	0.33	
19			Dabhol	6.00	2	
20			Bankot fort	1.52	NA	
21			Bag beach Guhagar	6.64	NA	
22		Raygad	Murud janjira	2.79	NA	Olive Ridley
23			Diveagar	73.70	1	
24			Harihareshwar	13.04	1	
25			Maeal	7.16	NA	
26			Shining sands beach	0.08	NA	
27			Velas beach	7.37	NA	
Sub total			14	202.20	14	Olive Ridley
28	**Goa**	North goa	Mandrem (Nearby Junos Vaddo village)	2.28	NA	Olive Ridley
29			Morjim (Morjim South)	3.11	NA	
30			Mandrem	2.46	1	
31			Morjim (Morjim North)	0.86	2	
32		South goa	Agonda	11.90	3	Olive Ridley
33			Galgibaga	4.90	3	
Sub total			6	25.54	9	Olive Ridley
34	**Kerala**	Kozhikode	Kolavipalam	70.86	NA	Olive Ridley
35		Malappuram	Alunga	9.25	NA	
36		Kasargod	Thaikkadappuram	20.32	NA	
37			Hosdurg Beach	16.18	NA	
Sub total			4	116.61	NA	Olive Ridley
38	**Lakshadweep**	Lakshadweep	Suheli Valliakara	58.33	NA	Green turtle
39			Karingikuppu	24.20	NA	Green turtle
40			Tinnakara	52.36	NA	Green turtle
41			Minicoy group	513.16	NA	Olive Ridley, Green turtle
42			Agatti	344.10	NA	Olive Ridley, Green turtle and Hawks bill
Sub total			5	992	NA	Olive Ridley, Green turtle

						and Hawks bill
43	**Tamil Nadu**	Chennai	Marina - Neelankarai (Urrur kuppam-Kaveri Nagar)	67.69	8	Olive Ridley
44			Marina - Neelankarai (Marina - Srinivasa Puram)	86.06	8	
45			Pattinapakkam	13.46	NA	Olive Ridley
46		Cuddalore	(Nearby Mandalpattu village)	3.95	NA	Olive Ridley
47		Kanchipuram	Alikuppam	44.17	NA	Olive Ridley
48			Neelankarai - Uthandi	47.74	1	Olive Ridley
Sub total			6	263.08		Olive Ridley
49	**Pondicherry**	Pondicherry	Nearby village Nallavadu	3.46	NA	Olive Ridley
50			Nearby village Panithittu	12.34	NA	Olive Ridley
Sub total			2	**15.79**	NA	Olive Ridley
51	**Andhra Pradesh**	East Godavari	Gautami Godavari - Nilarevu	360.94	68	Olive Ridley
52			Hope Island	61.72	7	
53			Sacremento Island	74.36	373	
54		Guntur	Krishna - Lankavanidibba	172.53	10	Olive Ridley
55		Krishna	Elichetladibba	346.96	31	Olive Ridley
56		Nellore	Pennaru - Mypadu	63.30	7	Olive Ridley
57			Sriharikota - Durgarajupatnam	88.67	8	
58		Srikakulam	Bahuda - Kapaskuddi	85.24	40	Olive Ridley
59			Vamsadhara Bandaruvanipeta	37.39	55	
60			Rajaram Puram Beach	10.03	NA	
61			Kunduvanipeta - Nagavali	46.83	50	
62		Visakhapatnam	Muthiyavanipalem	26.70	32	Olive Ridley
Sub total			12	1374.69	681	Olive Ridley
63	**Odisha**	Baleshwar	Digha (Nearby	14.89	NA	Olive Ridley

			Digha village)			
64		Ganjam	Rushikulya	121.93	16667	Olive Ridley
65			Bahuda - Kapaskuddi	72.69	55	Olive Ridley
66		Jagathsinghpur	Akashdia Island (Devi)	314.45	10000	Olive Ridley
67		Kendrapara	Gahirmatha (Wheeler, Ekakula, Habalikati)	154.11	33333	Olive Ridley
68			Agarnasi	127.88	NA	Olive Ridley
69			Pentha	66.99	NA	Olive Ridley
Sub total			11	873	60055	Olive Ridley
70	**West Bengal**	Purba Midnapore	Dadanpatra	51.10	NA	Olive Ridley
71			Junput	146.88	NA	Olive Ridley
72			Digha (Jagai Basan-Digha)	50.14	NA	Olive Ridley
73			Shankarpur	17.36	NA	Olive Ridley
Sub total			4	265.48	NA	Olive Ridley
74	**Andaman & Nicobar**	Andaman& Nicobar	Andaman & Nicobar	13344	8026	Olive Ridley, Green turtle, Hawksbill and Leatherback
Sub total			102	13344	8026	Olive Ridley, Green turtle, Hawksbill and Leatherback
Total			**179**	**17872.05**	**69152**	**Olive Ridley, Green turtle, Hawksbill and Leatherback**

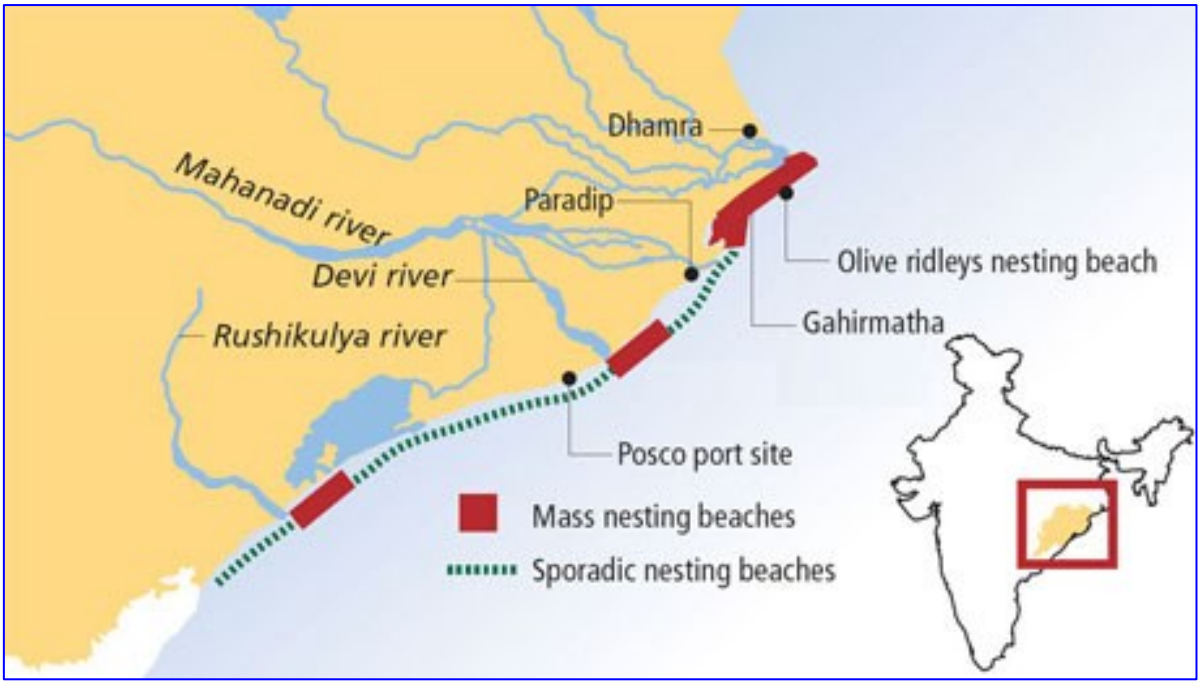
Source: Turtle nesting grounds report by NCSCM report, 2018-2019



Nesting distribution of sea turtles in India

6.3. Mass turtle nesting sites in India

Five of the seven species occur along the Indian coast. Out of these five reported species, four species nests along Indian coast. But the Loggerhead which has been reported along the Indian coast has not been found to nest. While Olive Ridleys nest both on the east and west coasts of India. During the breeding season, thousands of olive Ridleys congregate in favourable coastal waters and synchronized nesting involving thousands of individuals take place in suitable nesting beaches. At present, very few sites are left in the world where Olive Ridleys congregate in such large numbers for nesting. Of the six known major mass nesting sites of Olive Ridleys, three are located in India and all these three-mass nesting rookeries such as Gahirmatha rookery, Devi rookery (Devi river mouth) and Rushikulya rookery (Rushikulya river mouth) are located along Orissa coast. The world's largest known rookeries of Olive Ridleys are at Gahirmatha along the northern Orissa coast. The turtle nesting season in Orissa begins in October and ends in April, when the hatchlings leave the nesting beaches. The female Ridleys come ashore to nest, usually at night. The female turtles climb ashore several times during the nesting period. Except for the Gahirmatha rookery, the nesting beaches are located close to fishing villages. 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.



Olive Ridley mass nesting sites- Odisha

Gahirmatha rookery

The first scientific publication of 'mass nesting' of Olive Ridley sea turtles along Gahirmatha coast in Kendrapara district of Odisha was in 1974 (Bustard, 1974). During the above period it was taking place in the mainland, between the Maipura river mouth (20˚43'25.51" N 87˚04'01.86" E) and Satabhaya (20˚36'48.97" N 86˚53'13.22" E). Sporadic nesting was taking place further south up to Chinchiri mouth. This entire coastline of about 35 km length was, therefore, included under the Bhitarkanika Wildlife Sanctuary which happens to be the first designated Wildlife Sanctuary of the state of Odisha. The present rookery is only about 4–5 km long and fragmented into two sand spits, measuring roughly 2 km in length and 100 m in width

Devi (Astarang) Rookery

The Devi rookery (19˚57'54.25" N 86˚21'55.16" E) was discovered in 1981 by Dr. C. S. Kar and is located at the mouth of the river Devi, along the central Orissa coast. However, after 1981 the nesting population at this rookery and 'mass nesting' was reported till about 1997 in an island off Petaphutei near the Devi river mouth. The nesting beach extends from the Devi to Kadua river mouths, and is a sandy beach of approx. 20 km long and bordered.

Rushikulya Rookery

The third mass nesting site of Rushikulya rookery was discovered in 1994 north of the Rushikulya river mouth in the Ganjam District (19˚ 21'20.49" N 85˚ 02'48.62" E). The rookery area is about 6 km long starting from the Purunabandha village, just north of the Rushikulya river mouth, crossing

Gokharkuda village and extending up to the north of Kantiagada (Podampeta) village. The beach here is very conducive for nesting, being wide.

Olive Ridley mass nesting

Hatchling

6.4. Andhra Pradesh Scenario

The state of Andhra Pradesh has one of the largest coastlines in the country, and lies adjacent to the mass nesting grounds of Olive Ridley turtles in Odisha. Owing to its location, and considerably high sporadic nesting numbers, the coast of Andhra Pradesh is considered to be an important Olive Ridley nesting habitat. A significant portion of Olive Ridley population migrates every winter to the Indian coastal waters to the mass nesting beaches in Odisha coasts, simultaneously also utilizes the beaches of Northern and Central Andhra Pradesh coasts for their nesting activity.

Earlier studies reported by Kar and Bhaskar (1982) and Tripathy et al (2003), it is the only other place on the Indian mainland where the occurrence of five species of sea turtles; leatherback, hawksbill, loggerhead, green and Olive Ridley turtles except Tamil Nadu. However, nesting of only Olive Ridleys has been recorded in the state.

Olive Ridley nesting was also recorded along the coast during the 1980s. Southern most rookeries have been reported 50 km from Odisha-Andhra border. Their sporadic and high intensity nesting was recorded in the north coastal region. Only sporadic nesting was reported across the Andhra Pradesh coast during intensive beach studies of GOI-UNDP 2000-2001 sea turtle project. Sporadic nesting was also documented in Sriharikota of southern coast. Records of turtle mortality along the Andhra Pradesh coast and exploitation of sea turtle meat and eggs in northern Andhra Pradesh coast has been reported by Rajasekar and Subba Rao (1993), and Tripathy et al (2006).

Northern Andhra Pradesh Coast

The coastline of northern Andhra Pradesh is about 390 km in length and extends from Bahuda river mouth to Godavari river mouth. It is predominantly a rocky coast with small stretches of sandy beaches. The major rivers that flow towards the sea are Bahuda, Vamsadhara, Nagavali and small rivers such as Champavati, Gostani, Sarada, Varaha, Tandava and Yeluru flow to the Bay of Bengal. The beach here is sandy and sand dunes are found between Vamsadhara – Nagavalli and few patches of intertidal rocks in Kalingapatnam and Visakhapatnam. Nesting and mortality survey was carried out from Bahuda river mouth to Vamsadhara river mouth (130 km), and to Nagavalli river mouth (28kms). Similarly, surveys were also carried out from Nagavalli river mouth to Gostani river mouth and to Visakhapatnam beach.

Central Andhra Pradesh Coast

The central Andhra Pradesh coast extends between the river mouths of Godavari and Krishna with a total length of 250 km. It has good patches of mangrove vegetation which are seen around Coringa Wildlife Sanctuary (CWLS) near Kakinada, and Nagayalanka near Krishna deltaic region. Godavari and Krishna are the two major rivers that flow into central Andhra Pradesh coast. These rivers are further divided into small rivers like Vriddha and Vainateya. The beaches throughout this zone are wide and sandy with mangrove forests standing in Gautami Godavari river mouth at Coringa. The dense mangrove forest between False Divi point and the Krishna river mouths are protected under the Krishna Wildlife Sanctuary. The beaches are covered with extensive Casuarina plantations.

In the central Andhra Pradesh coast, the Andhra Pradesh Forest Department has initiated in-situ and ex-situ conservation of Olive Ridley turtle nesting in selected localities with the support of their staff and by employing local fishermen as turtle watchers throughout the nesting season. The nesting information of Olive Ridley turtle was obtained from the AP Forest Department, Eluru division.

Southern Andhra Pradesh Coast

The southern Andhra Pradesh coast extends from Krishna river mouth to Pulicat lagoon near the Tamil Nadu border and is 310 km in length. The rivers that flow into the Bay of Bengal are Pennaru, Gondlakamma, Musi, Palleru, Swarnamukhi and Kandaleru. Mangrove vegetation was observed in Krishna river mouth from Nizampatnam to Gondlakamma. Sand dunes, rising to about 20 to 50 mts were observed from Musi to Pennaru river mouths. Olive Ridley turtle in-situ and exsitu conservation has been initiated in Nellore district by Tree Foundation with the support of Andhra Pradesh Forest Department.

Nesting beaches

Muthiyavanipalem in Visakhapatnam, Hope island near Kakinada, Sacramento Island near Coringa Wildlife Sanctuary and Elichetladibba, Lankavanidippa near Krishna mouths, Ramachandrapuram, Lakshmipuram, Isakapalli and Mypadu in Nellore Districts are the sporadic nesting beaches of the three zones.

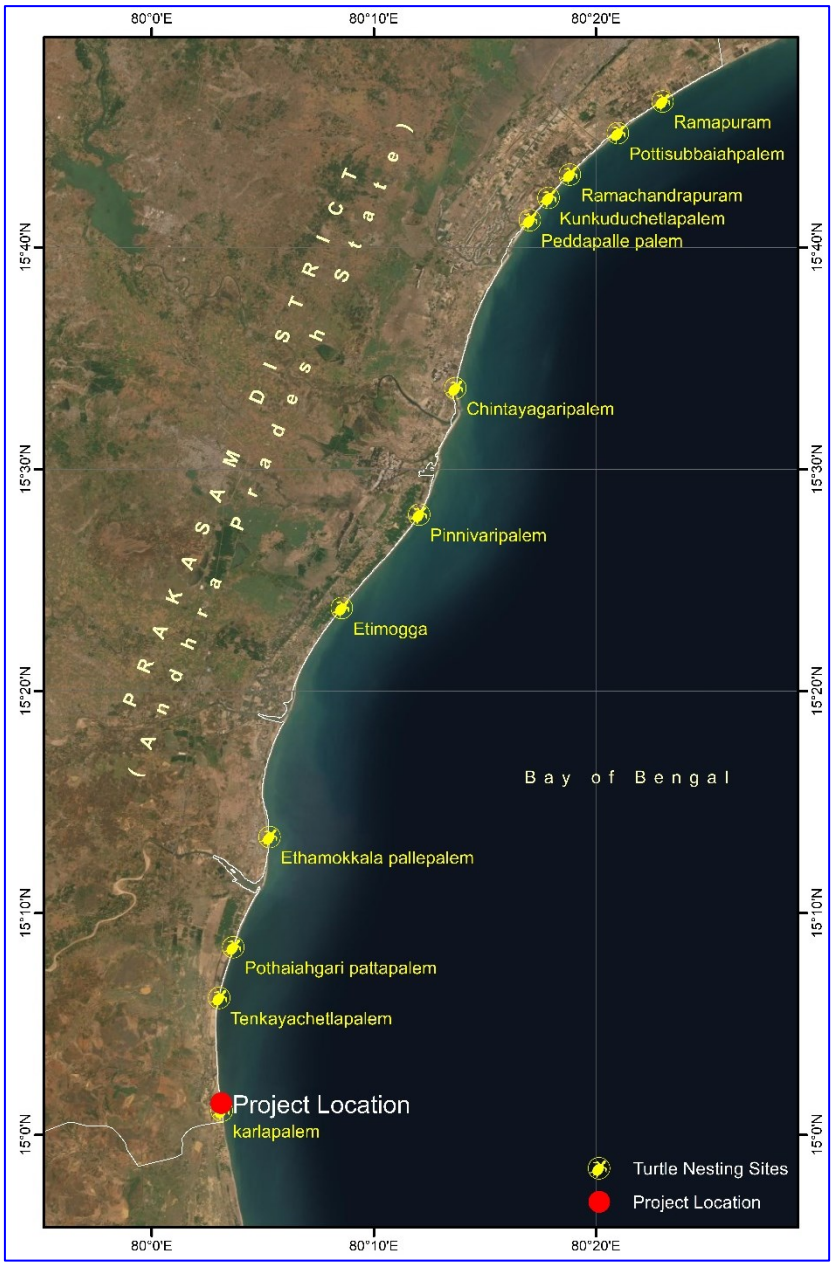
The Google maps below show the coastal districts and coordinates of the beaches as given in Table 1 with higher intensity of nesting turtles. Fishing villages along the nesting locations have also been listed.

Turtle nesting grounds identified by NCSCM

S. No.	District	Patches in coastal areas	Area of Turtle Nesting Grounds (ha.)
1	East Godavari	Gautami Godavari - Nilarevu	360.94
		Hope Island	61.72
		Sacremento Island	74.36
2	Guntur	Krishna - Lankavanidibba	172.53
3	Krishna	Elichetladibba	346.96
4	Nellore	Pennaru - Mypadu	63.30
		Sriharikota - Durgarajupatnam	88.67
5	Srikakulam	Bahuda - Kapaskuddi	85.24
		Vamsadhara Bandaruvanipeta	37.39
		Rajaram Puram Beach	10.03

		Kunduvanipeta - Nagavali	46.83
6	Visakhapatnam	Muthiyavanipalem	26.70

Only Olive Ridley turtles are identified in Andhra Pradesh



Turtle nesting grounds in Guntur Forest Division (Source: AP Forest Department, Guntur)

6.5. Ramayapatnam - Project Region

There are no notified turtle nesting areas in Prakasam district as per the assessment of turtle nesting grounds in Andhra Pradesh by NCSCM 2018-2019 report. However, Andhra Pradesh Forest department developed turtle nesting hatchery for sporadic nesting around project region. Turtle hatchery along the project region was set up as an experimental measure to observe and record sporadic turtle nesting in the region if any and conserve those eggs. A permanent hatchery will only be developed adjacent to a rookery which is not noticed within Prakasam District.

Temporary Experimental turtle hatchery developed by AP Forest Department

As the turtle sightings near the project region is comparatively much lower to north of the project region, Andhra Pradesh Forest Department has planned to move the existing hatchery to further north.

Present status of temporary turtle hatchery developed by AP Forest Department

7. Threats to Sea Turtles

Sea turtles journey between land and sea and swim thousands of ocean miles during their long lifetimes. They wait decades until they can reproduce, returning to the same beaches where they were born to lay their eggs. Females can lay hundreds of eggs in one nesting season, yet few will yield hatchlings that survive their first year of life. Beyond these significant natural challenges, sea turtles face multiple threats caused by humans, such as bycatch in commercial fishing gear, illegal trade, consumption, and climate change.

Worldwide sea turtles are threatened by a variety of natural and anthropogenic factors. The major threats causing the decline in the populations of sea turtle are similar across the species, but the rate of decline is greater for some populations than others. Currently, the main threats to sea turtles are incidental catches during fishing operations, human consumption of meat, nearby coastal construction, climate change, pollution, and exposure to pathogens. Because they use of a variety of habitats like beaches to open oceans to near shore environments, sea turtles are vulnerable to human impacts at all life stages, although natural mortality is believed to decline with age (increasing size). Natural mortality factors include the destruction of eggs on the beach by inundation or erosion, predation at all life stages, extreme temperatures, and disease. The primary cause of mortality among juvenile and adult is drowning after becoming entangled in fishing gear. Other significant causes of mortality include direct take (poaching) of eggs and turtles and the destruction or degradation of their habitat.

The World Conservation Union (IUCN) has identified five major hazards to sea turtles:

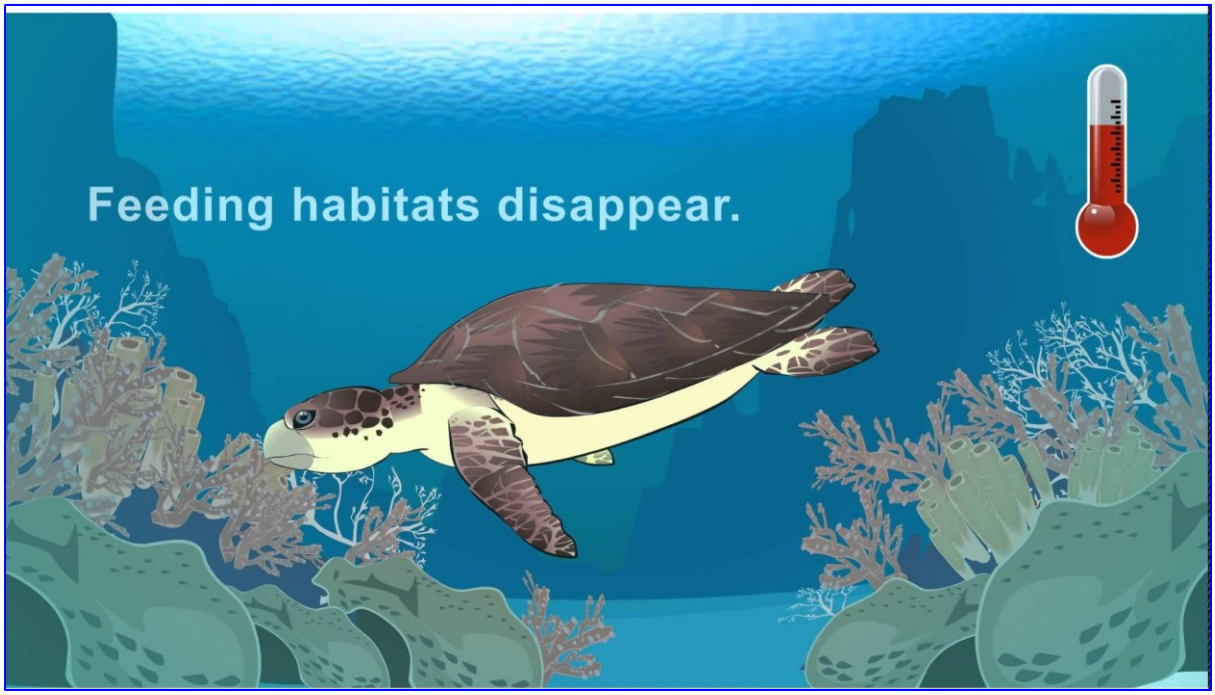
Fisheries: Sea turtles virtually everywhere are affected by fisheries, especially longlines, gill nets, and trawls. The most severe of these impacts are death after entanglement, habitat destruction and food web changes.

Direct Take: Sea turtles and their eggs are killed by people throughout the world for food, and for products including oil, leather and shell.

Coastal Development: Sea turtle habitats are degraded and destroyed by coastal development. This includes both shoreline and seafloor alterations, such as nesting beach degradation, seafloor dredging, vessel traffic, construction, and alteration of vegetation.

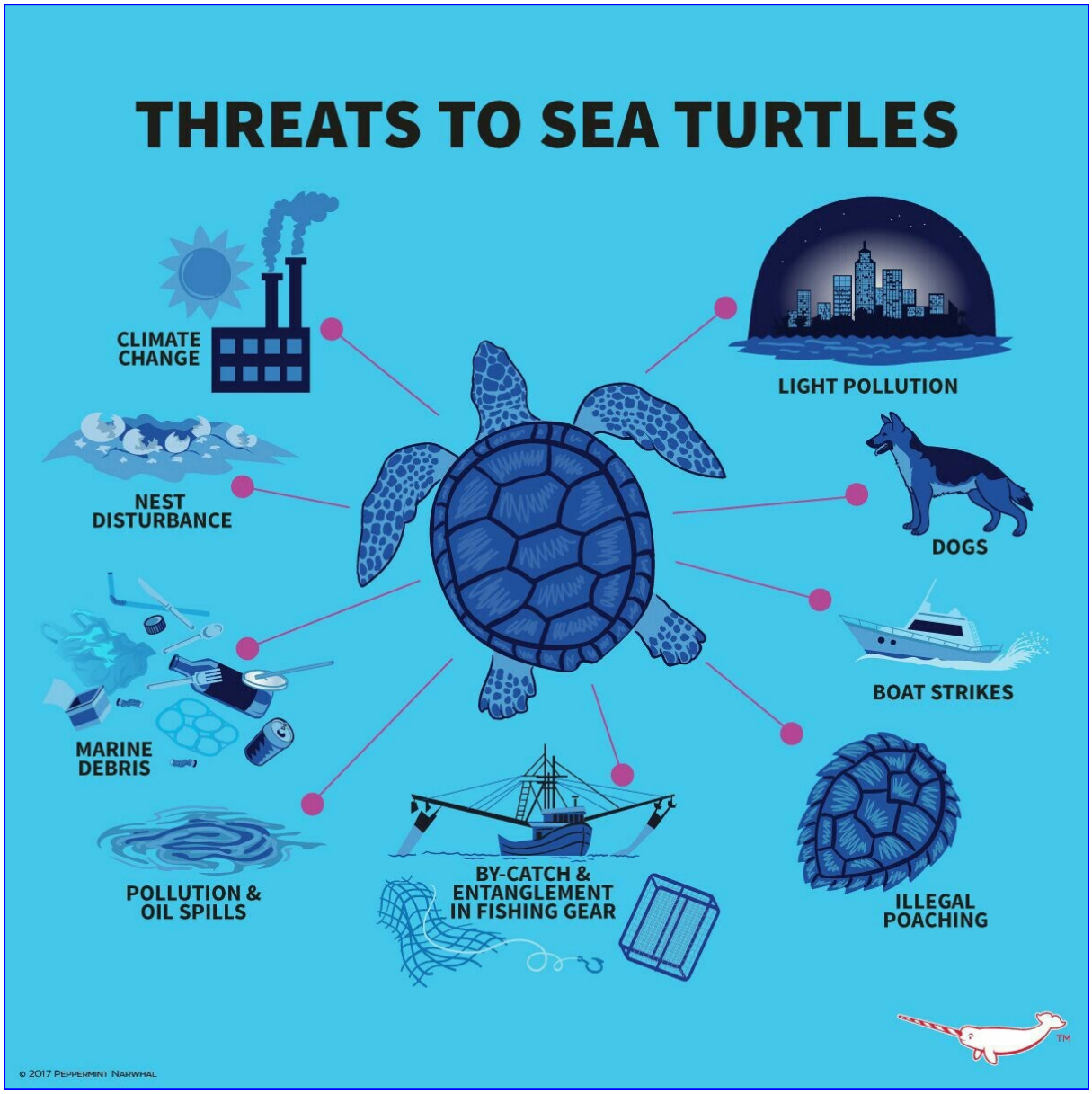
Pollution: Plastics, discarded fishing gear, petroleum by-products, and other debris harm and kill sea turtles through ingestion and entanglement. Light pollution disrupts nesting behavior and causes hatchling death by leading them away from the sea. Chemical pollutants can weaken sea turtles' immune systems, making them susceptible to disease.

Climate change: Climate change will increase the frequency of extreme weather events, result in loss of nesting beaches, and cause other alterations to critical sea turtle habitats and basic oceanographic processes. It may impact natural sex ratios of hatchlings and increase the likelihood of disease outbreaks for sea turtles.

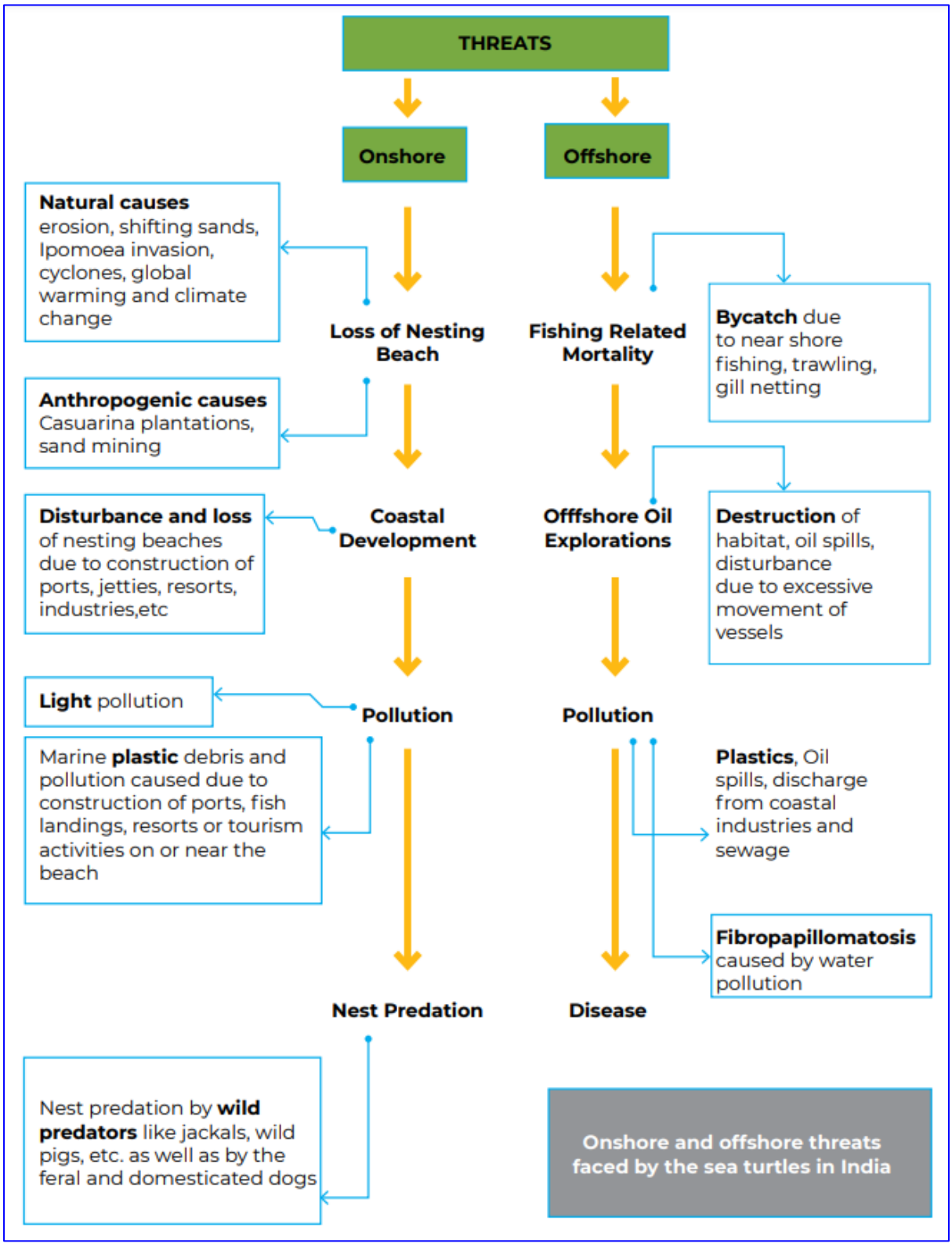


Key threats to sea turtles

- Entanglement in fishing gears
- Consumption and illegal trade of eggs and meat
- Coastal development and changing beach profile
- Plastic and other marine debris
- Global warming
- Turtle shell Trade



Onshore and offshore threats to Sea Turtles



Source: *National Marine Turtle Action Plan Ministry of Environment, Forest & Climate Change Government of India (2021-2026)*

7.1. Natural Threats

Egg Loss

Turtle eggs are subject to a variety of both natural and anthropogenic impacts. High tides or storms can drown the eggs, cause beach erosion, and wash away nests, and beach accretion can prevent access between nesting areas and the water.

Predation

Marine turtles, their eggs, hatchlings and habitat can be impacted by introduced and native predators, such as foxes, cats, dogs, dingoes, monitors and goannas, silver gulls or nankeen night herons, bandicoots, water rats, ghost crabs on shore to tarpon, and hermit crabs, jacks, sharks, and other fish in the waters near shore. Predation impacts occur either directly through disturbance of the nest and consumption of eggs, or consumption of hatchlings as they emerge. By developing from the nest at night, turtle hatchlings reduce their risk of predation, but they still must run a gauntlet of predators between the nest and sea-from raccoons, birds, and ghost crabs on shore to tarpon, jacks, sharks, and other fish in the waters near shore. When hatchlings were regularly released into the water at the same location and same time, predatory fish would gather in high numbers for their scheduled meal. Larger juveniles and adults may be eaten by sharks and other large predatory fish, though predation decreases as turtles' size increases.

Vessel Strikes

Vessel strikes are a threat to sea turtles near ports and waterways along developed coastlines throughout their range. Various types of watercraft can strike sea turtles when they are at or near the surface, resulting in injury or death. High boat traffic areas such as marinas and inlets present a higher risk. Adult sea turtles, in particular nesting females, are more susceptible to vessel strikes when making reproductive migrations and while they are nearshore during the nesting season.

Hypothermia

Another natural source of mortality in sea turtles is hypothermia. Water temperatures that dip below 8° to 10°C affect primarily juvenile and sub-adult turtles residing in near shore waters, causing them to become lethargic and buoyant until they float at the surface in a condition known as cold-stunning. The animals can no longer swim or dive, they become vulnerable to predators, and they may wash up on shore, where they are exposed to even colder temperatures.

Disease

A number of diseases and infections have been identified in marine turtles, many of which are caused or exacerbated by water quality problems. Bacterial infections are rare in free-roaming sea turtle populations but higher under captive conditions. Parasitic infections are common, however. This parasite damage may then permit a variety of bacterial infections, including such species as *Salmonella* and *E. coli*. Another risk comes from red tides (dinoflagellate blooms), which are occurring in increasing numbers around the world as excess nutrient loads pollute coastal waters,

conditions that can lead to health problems and mortality in many marine species. Because immediate effects result from aerosol transport, the sea turtles' mode of respiration-inhaling rapidly to fill the lungs before a dive-puts them at particular risk.

Temperature-dependent sex determination

The temperature of the incubating eggs is what decides whether the offspring will be male or female. This is called temperature-dependent sex determination, or TSD. Research shows that if a turtle's eggs incubate below 81.86° Fahrenheit, the turtle hatchlings will be male. If the eggs incubate above 87.8° Fahrenheit, the hatchlings will be female. Temperatures that fluctuate between the two extremes will produce a mix of male and female baby turtles. Researchers have also noted that the warmer the sand, the higher the ratio of female turtles. As the Earth experiences climate change, increased temperatures could result in skewed and even lethal incubation conditions, which would impact turtle species.

7.2. Anthropogenic Threats (human threats)

Fisheries By-catch

Longline fishing is a technique where many kilometers of a single fishing line with fishhooks is released into the water to be trawled in days later. Long lines used in the tuna and swordfish fishery kills high numbers of sea turtles each year due to by catch. In addition to trawl entanglement, sea turtles have also been killed after becoming entangled in other types of fishing gear, such as purse seines, gill nets and lobster or crab pot lines.

Marine debris

Floating non-degradable debris, such as lost or discarded fishing gear such as discarded nets, crab pots, synthetic ropes, floats, hooks, fishing line and wire trace, land-sourced garbage (plastic bags and bottles) and ship-sourced materials disposed of at sea (fiberglass, insulation) can pose a threat to marine turtles at all life stages through entanglement and ingestion. While large numbers of marine turtles are known to ingest plastic, the stock level risk from ingestion is, at this stage unknown.

Pollution

Pollution of seas and nesting beaches has a critical impact on the sea turtles. Anthropogenic contaminants can make their way into the marine environment from a wide range of agricultural, industrial and domestic sources, and can have direct impacts on marine turtles and their habitats.

Beach developments & changing beach profile

A major impact of land-based construction on marine turtles is direct destruction and alteration of dunes and coastal vegetation on nesting beaches. This can reduce the suitability of beaches for nesting and incubation of eggs or cause the loss of nesting beaches through beach armouring. Anthropogenic impacts on nesting beaches may affect nesting females, eggs and hatchlings. Nesting beaches are threatened due to the development of hotels, resorts, marinas and other structures associated with coastal tourism. Beach armouring, such as seawalls, rock revetments, and sandbagging installed to protect oceanfront property, may prevent females from accessing nesting beaches. Construction of new buildings is replacing vegetation and decrease the size of the nesting beach and result in more use of artificial lighting. In some areas, sand may erode completely on the ocean side of structures, leaving no nesting beach at all.

Tourism

The observation of nesting sea turtles has become a great tourist attraction for coastal area visitors. Participation in this activity is important because it provides people with a deeper knowledge of sea turtles, thus increasing public awareness in general and the number of people protecting and caring for sea turtles. This activity also generates an important source of employment and income for the local population. However, the presence of humans on the beach can also be harmful to nesting females, if bothered they can abort their nesting process. It is extremely important to promote programs using certified guides who have adequate training and follow certain codes of conduct when observing nesting turtles.

Threats to sea turtles in Andhra Pradesh coast

In India, few studies are available which discussed about direct and indirect threats to sea turtles and their habitats. Sea turtles nest on a variety of beach characteristics. Beach features, such as length, width, height, slope, orientation and vegetation provide the required habitat for turtle nesting. Major natural threats include loss of nesting beaches due to erosion, global warming as well as interference of human on their nesting sites which may be either through direct influence or due to many developmental activities on the coastline. The existing natural threats envisaged in the nesting sites all along the coast of Andhra Pradesh are predation of the turtle eggs along with associated predators like dogs. Other major human threats include pollution on the shoreline, exotic tree plantations, light pollution on the beaches, etc. Light pollution can be addressed through developing golden illumination as done in the Damra Port, Odisha which does not distract the turtles and the hatchlings.

The major threats include pollution of marine areas, over exploitation and associated human activities. Local communities believe that the land use changes along the coast are not conducive for more nesting. The man made threats on nesting beaches include changes in the land-use pattern adjoining to beaches, lightings along the shoreline, solid pollutants thrown on the beaches, man-made hard engineering structures along coasts, overgrowths of Ipomea climbers on nesting beaches, predation of turtle nests by feral dogs and people, beach vehicles, incidental killings of turtles during fishing and unregulated tourism on the nesting beaches.

It is estimated that only one out of 1,000 hatchlings survives to be an adult. They have many natural predators including birds, crabs, fish, and mammals like racoons. But the female adults can lay thousands of eggs over their lifetimes, so at least a few of them survive to maintain the species.

8. Conservation Status of Sea Turtle of Project Region

Four of the above five species of sea turtles found in India are reported to occur in the coastal waters of Andhra Pradesh. These include Olive Ridley (*Lepidochelys olivacea*), Green turtles (*Chelonia mydas*), Hawksbill turtles (*Eretmochelys imbricata*) and Leatherback (*Dermochelys coriacea*). However, nesting of only one species viz., Olive Ridley turtle, has been reported from Andhra Pradesh coast, while the other three species are occasionally sighted by local fishermen.

Marine Turtle Management Plan focuses on managing potential impacts to marine turtles associated with the development of new port at Ramayapatnam village, Andhra Pradesh.

The conservation status of sea turtles of project region as per Wildlife Protection Act, 1972, CITES and IUCN is given below.

Name of the species/ Common Name	Wildlife Production Act, 1972	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	International Union for Conservation of Nature (IUCN) Status
Olive Ridley Turtle (*Lepidochelys olivacea*)	Schedule I	I	Vulnerable

Taxonomic position of Olive Ridley Turtle

Kingdom : Animalia
Phylum : Chordata
Class : Reptilia
Order : Testudines
Suborder : Cryptodira
Superfamily : Chelonioidea
Family : Chelonioidea

Carapace of adults nearly round, upturned on lateral margins, flat on top. Head with 2 pairs of prefrontal scales. Olive Ridley turtles are found in warm pelagic waters in the Atlantic, eastern Pacific, and northern Indian Oceans. Significant Olive Ridley rookeries are found on the Pacific coast of Central America, western Africa, eastern India, and the tropical Atlantic coasts of South America.

IUCN Status: **Endangered.**

i) Lepidochelys olivacea (Olive Ridley Turtle)

Olive Ridley turtle is distributed throughout the East and West coasts of India, Andaman and Nicobar Islands and Lakshadweep. Observations made by researchers in Andhra coastal areas states that most sightings were recorded in rich coastal vegetation areas with sandy beaches. The nesting seasons for Olive Ridley turtles in Andhra coast are unpredictable but nesting between the months of January-April is observed.

Nesting takes place between early January and late April, with a peak nesting activity usually during February to March, when the air temperature gradually increases. Intensive sporadic nesting activity may be observed between February and March of every year while there is a gradual decrease of nesting activity by late April. The maximum nesting activity of Olive Ridleys usually observed for four months, starting from the beginning of January and ending with April. Local community say that peak nesting takes pace during Maha Sivarathri festival season.

Identification characters in the field: The Olive Ridley has a slightly deeper body. In adults, carapace is nearly round, upturned on the lateral margins and flat on top, its width 90% of its length. Head is subtriangular and moderate sized. Scales and scutes have the same configuration as in the Kemp's Ridley, but the lateral scutes are often more than five pairs, the first pair is always in touch with the precentral scute. This species also has openings of the Rathke's glands on the plastral bridges, through a pore on the rear part of each infra marginal scute. Four flippers with one or two visible claws on the anterior border and sometimes another small claw in the distal part are present, rear flippers have two claws. As in other turtle species, males have larger and more strongly curved claws, as well as a longer tail. It is smallest of the marine turtles. The maximum

shield length is about 790 mm. There are more than five pairs of costal. Plastron is with two tuberculate ridges and is smooth in adult. Carapace of the adult is uniformly grey. Adults are plain olive gray above and creamy or whitish, with pale grey margins underneath. New born hatchlings, when wet, are almost completely black, sometimes with greenish sides, and general become dark gray after drying. With growth, they change to gray dorsally and white underneath.

Distribution: East and West coast of India, Andaman and Nicobar Islands and Lakshadweep.

Ecology: The Olive Ridley turtle is common among the four species of sea turtles found along the Odisha coast of India. Some information is known about their mating areas, nesting areas, nesting behaviors, migrations and post nesting migrations. Further, in the study area migrating Olive Ridleys are reported prior to October–November and after the April–May nesting season. Many sea turtles undertake migration from their breeding ground to a single foraging area, where they remain more or less resident until the next breeding season comes. Shoreline vegetation found on the nesting beaches are mostly dominated by Sea pinks (*Spinifex littoreus*), Horse shoe creeper (*Ipomoea pes-caprae*), Screw pine (*Pandanus fascicularis*), and Sand binder (*Launaea sarmentosa*) though several other plant species also coexist. Shoreline fauna of the nesting beaches mostly consists of Ghost crabs (*Ocypode ceratophethalmus*), Sand crabs (*Ovalepis austariliensis*), and insects like mites, ants and maggot larvae. Birds such as Cranes (*Grus communis*), Sea gulls (*Larus brunnicephalus*), Pond herons (*Ardeola grayii*), House crows (*Carvus splendens*) and mammals such as Domestic dogs (*Canis familiaris*) and Pigs (*Sus scrofa*) were reported in the study area. Nesting takes place between early January and late March, with a peak nesting activity usually during March and April, when the air temperature gradually increases. Intensive sporadic nesting activity may be observed between February and March of every year while a gradual decrease of nesting activity during April. The maximum nesting activity of Olive Ridleys usually observed for three months, starting from the beginning of February and ending with April. Plants such as *Ipomoea pescaprae*, *Spinifex littoreus* and *Cyperus arenarius* are the coastal flora found in abundance here and serve as the natural nesting sites for turtles. The nest depth reported to range from 40 to 75 cm while the maximum number of nests usually occurs at a depth range of 50 to 60 cm. The clutch size is reported to be 80 to 120 eggs/nest.

9. Conservation Action Plan

9.1. Objectives

- Protect, conserve and rehabilitate marine turtle habitats
- Reduce direct and indirect causes of marine turtle mortality
- Improve understanding of marine turtle ecology and populations through research, monitoring and information exchange
- Increase public awareness of the threats to marine turtles and their habitats, and enhance public participation in conservation activities

i) Beach Monitoring

Whilst several management options can preserve beach area, the best considered option is that preserving the beaches in a natural state, maintaining shore vegetation, sand characteristics and morphology. This is an important role of project proponent in consultation with Forest Department in the study area. Also, to prevent the predation of eggs, nests and hatchlings, regular patrolling of the beaches during nights with the help of local fishermen community who are also the members of Vana Samrakshana Samiti (VSS) and Eco Development Committee (EDC) and Biodiversity Management Committee (BMC) and Wildlife Conservation NGOs and protect the nests in their natural (in situ) condition as well as if necessary, the nests may be relocated to nearby protected beaches for ex situ conservation and management. The goals of conservation should ideally be to ensure that deterioration of the nesting sites does not occur that ecological systems can function naturally and protected. Also, implementation, and enforcement, of coastal regulations and coastal realignment have the potential to help fulfil these aims by preserving sufficient beach habitat to perform those ecological and economic roles.

ii) Nest Protection

The following are the suggestions for manually managing the natural vegetation on the turtle nesting beaches. Beach dunes are dynamic ecosystems that are driven, in part, by the natural disturbance of the sand erosion–accretion cycle. This cycle is known to benefit turtle productivity by effectively cleansing the sand of the previous season's roots, vines, and old nest debris as well as maintaining an open beach with a vegetation boundary. Broadly, the nests laid in or near dense vegetation should be considered at risk and possibly relocated. When the seaward spread of the vegetation on nesting beaches is large and nest relocation is necessary, small sections may be cleared of surface vegetation and roots completely removed to create small nest relocation sites. Mechanical removal of the vegetation, including a complete removal of the roots and seeds combined with placement of a physical root barrier along the edges of a prepared plot to prevent the encroachment of roots from adjacent vegetation, might be effective. Establishing root free relocation plots would require significant investments in time, effort, and equipment. However, once in place, maintenance to remove any vegetation encroachment should be minimal if it is

performed regularly. Training programmes on capacity building of local community on conservation of nesting sites and handling the eggs during relocation and protection from predators in collaboration with the Andhra Pradesh Forest Department (APFD) will be undertaken by the project proponent.

iii) Retain natural nest habitat

Eco-friendly vegetation of the coastal sand dunes should be promoted. As a policy, no exotic species should be planted in CRZ areas so as to prevent unknown/ unforeseen ecological impacts. To prevent the predation of eggs, nests and hatchlings, regular patrolling of the beaches during nights with the help of local fishermen community and NGOs may be organized and protect the nests in their natural (in situ) state. Plantation of exotic vegetation should be avoided. Even plantation of *Prosopis* sp., which is relished by small ruminants should be avoided which can be counterproductive for turtle conservation in the project areas. Apart from the high prioritized sea turtle nesting beaches where no plantation should be taken up, in sporadic sea turtle nesting areas, plantations should be carried out beyond 200 m from high tide line (HTL) and on the landward side slope of the berm, thereby setting aside enough space for sea turtles to nest. In already known sea turtle nesting sites, invasive alien and exotic plantations should be gradually removed to restore the nesting beaches to their former natural state.

iv) Hatchery Development

All important nesting beaches of moderate intensity must be identified and should be free from beach armouring as sea turtles normally prefer gentle sloping seaward sand dunes rather than

eroded beaches. Freshly laid nests of Olive Ridleys in low lying areas may be relocated to the nearby suitable protected beaches for *ex-situ* management. Before establishing a hatchery, it is advisable to consider whether it is feasible to move threatened nests to other, safer natural locations rather than using a hatchery. The only valid reason for moving a nest from its original location is that the hatch success is threatened in one or the other way. In addition, the hatchery should preferably not take up space in a natural nesting area, or block access to natural nesting areas. As much as possible the area choses for hatchery should be conforming to species specific parameters, such as sand temperature and moisture content. Plastic garden mesh may be used for fencing the hatchery and for the nest fences.

Sea turtle hatchery

Location of the hatchery

The best location for a hatchery is at a site that is as similar as possible to the habitat of the nesting site of the turtles. Hence, hatcheries should be located on the nesting beach, and if the beach is sufficiently long, several hatcheries should be established. This makes the transport of eggs less labour intensive, and makes it possible to transplant eggs into hatcheries relatively quickly. Several programmes have failed only because eggs had to be transported to hatcheries several kilometers away. One alternative that combines aspects of in situ and ex situ practices, is to simply transplant a clutch of eggs several meters up the beach from where the nest was originally laid.

Hatcheries also need to be located close to the nesting beach to minimize trauma during transportation of eggs to reduce the time between collection and relocation, to provide an opportunity for the hatchlings to imprint on their natal beach and to facilitate hatchling release. The hatchery should be located well above the high tide line, but not too far inland as to be in heavily shaded areas, or sand with a high humus/ organic soil content.

The hatchery can be enclosed by chain link fence or wire mesh. Inexpensive wooden poles, cane and bamboo or slats can also be used. To prevent the entry of crabs and other burrowing predators, chicken wire mesh (or any small mesh material) can be buried to a depth of 0.5 metres along the inside of the fence. This measure is often essential to ensure the success of the hatchery.

Ideally, the hatchery should be located and oriented in such a manner to provide the greatest diversity of microhabitats for the nests. The shape of the hatchery often depends on local conditions. If the beach is narrow, then the hatchery perforce has to be rectangular with the long side parallel to the sea. Circular shapes provide the greatest area for a given perimeter, and hence a polygon provides more space to relocate nests especially if availability of perimeter fencing is a constraint. To prevent infestation from fungus and bacteria, the hatchery should not be at the same site during two consecutive seasons.

Collection and Transport

Sea turtles are very sensitive and may return to the sea without nesting if they are disturbed while stranding or excavating the nest. During this period, workers should be very careful not to disturb the turtle with lights or movement. Once egg laying (oviposition) begins, the turtles goes into a ‘nesting trance’. During oviposition, the turtle will usually not react even if she is handled gently, though some species (and Individuals) are more sensitive than others. Collection of eggs, tagging and tissue sample collection can all be carried out during this time, or if possible, after she has finished laying eggs.

Ideally, eggs should be collected, transported and placed in the hatchery within 2 hours after egg deposition. Eggs collected within 8 - 10 hours (ie. same night as deposition) generally have a good chance of survival, if handled carefully. If eggs are collected more than 10 hours after laying, great care should be taken during collection, transport and relocation.

Only nests that are threatened by flooding, erosion or high levels of predation by humans and feral animals should be collected. Eggs can be collected in a plastic or cloth bag, either directly from beneath the turtle while she is lying, or dug out from the nest after she has laid and left the nest. The bags or buckets need to be clean and not contaminated. For smaller turtles like Ridleys and hawksbills, eggs are fairly easy to locate. However, with larger turtles, although nests are easy to find, the eggs can be difficult to locate once the turtle has covered up the nest, and if the workers find a nesting turtle, it is best to collect the eggs during oviposition. Alternately, a small rope or coloured tape can be inserted into the nest so that it extends to the surface and once the turtle has competed nesting, the nest can be located by following the tape.

If eggs are transported and relocated more than 10 hours after laying, they should be handled very carefully and should not be rotated or jarred. This can be done by marking the eggs on top with a pencil and placing them in a rigid container (i.e. bucket or tray, not a bag) with some moist sand from the nest to ensure that they do not move during transport.

Relocation

Each clutch should be relocated within the hatchery in a microhabitat as similar as possible to the natural nest. They should be buried at the same depth as the natural nest, which can vary depending on the species of turtle. The nest should be constructed in the shape of the natural nest ie. With a narrow neck and a flask shaped bottom. The eggs should be carefully placed in the nest and then covered first with moist and then dry sand on the very top. The latter should not contact the eggs. Nests should be relocated in low densities in the hatchery, with at least 1 meter between nests (and up to 2 meters if space permits) so that they do not affect each other during development and so that hatchery workers can move about without stepping on the nests.

Each nest should be numbered and recorded in a data sheet or book (in particular the date of laying and number of eggs), so that the date of emergence can be estimated with accuracy, and for other research purposes. Data such as clutch size, nest location, date of collection need not be posted on the signboard near the nest. Rather, each nest should have a place marker with a number, and associated data can be entered in a data book. The marker can be a wooden stick (with or without a small signboard) placed beside the nest. Another aid to locate the nest is to use a coloured tape, extending just to or just below the surface. This is also a good way to mark nests in situ, without attracting the attention of egg collectors or curious passersby.

Nest enclosures in the hatchery

Some hatcheries use mesh enclosures for each nest to restrain hatchlings after they emerge to facilitate data collection and release. However, hatchlings should be released immediately after they emerge from the nest. So, unless the hatcheries are constantly manned, hatchlings may remain within the enclosure for extended periods, which can cause exhaustion or death, especially if there is bright sunlight. Chicken wire mesh should not be used for these nest enclosures. Hatchlings are easily cut by the wire when they put their flippers and heads through the mesh. Thatch baskets work better, and also shade the nest towards the end of incubation, which can help to reduce mortality especially during summer. However, the nests should not be shaded too early

during incubation, as this could affect sex ratios. In populated areas, thatch baskets can be stolen from the hatchery, and this can be countered by making a hole at the bottom of the basket, hence making them useless for any other purpose. If enclosures are used primarily to restrain hatchlings for data collection and release, they only need to be placed during the end of incubation.

Hatchling release

Hatchery personnel should anticipate hatching for each nest. Expected dates of hatchling emergence can be estimated from date of collection (and will vary depending on species and time of year), and can also be predicted by the 'caving in' of sand surface above the nest when hatching begins. Hatchlings will usually begin to emerge from the nest two to three days after hatching begins. Hatchlings should be released into the sea in groups immediately after emergence, but at different times of the night and at different points to prevent the creation of feeding stations (fish will learn that hatchlings are released at a particular point and may wait for them). Hatchlings should be allowed to crawl across the beach to allow imprinting. However, it is best not to subject them to this if there is bright sun or hot sand. If and when immediate release is not possible, hatchlings should be kept in soft, damp cloth or sack in a cool and dark place. They should not be placed in buckets of water as they will engage in swim frenzy behavior in the bucket and exhaust their yolk reserves. They need both the yolk reserves and swim frenzy behavior to help them to swim past the breakers.

v) Preservation of Eggs/Hatchlings

If a nest must be moved, it is preferable that it be moved within two hours of egg laying. Special care is needed when handling eggs that are more than two hours old. Each nest that is put into the hatchery should be numbered and associated with a standard data record form. Releases should be done at different parts of the beach each time, and each release should occur at a point at least one hundred meters from previous release points. When a clutch of eggs is placed in the hatchery, the data must be recorded on a Hatchery Data Sheet.

vi) Beach Cleaning and protection of nesting beaches

As the nesting beaches are subjected to frequent erosion and tidal inundation, beach cleaning and protection of nesting beaches is necessary. Usually during March to April the south west winds may erode the nesting beaches and the surface sand layers reduce the sand layers. Sand erosion and depletion can be prevented through rehabilitation of native characteristic beach vegetation from foreshore to sand dune region with species including Sand binders, Sea pink and Screw pines, etc.

The human predation for turtle eggs are mostly prevalent near nesting beaches either for personal consumption or for sale in local markets during nesting season. Awareness generation among the local communities with the involvement of all age groups were conducted and succeeded in the subsequent years with gradual decrease in poaching of eggs from the nesting beaches and selling in local markets. Predation on nesting beaches is more intensive during the nesting season from January to April. The vertebrate predators were frequently encountered at the nesting sites of the nesting beaches. To prevent the predation of eggs, nests and hatchlings, regular patrolling of the beaches during nights with the help of local fishermen community was organized and protected the nests in their natural (under *in situ*) state and relocated to nearby protected beaches for ex situ conservation and management.

vii) Fishermen awareness campaigns

The congregations of turtle breeding populations are mostly observed up to eight nautical miles near the coast. The mortality rate of breeding turtles in any congregation was very high due to incidental capture. It is reported that the gill net mortality is the highest and where as other nets like purse seines recorded less. As the migratory breeding populations, travel along the coast line to reach the mass nesting sites, these populations are subjected to exposure to threats at offshore water. The incidental capture and mortality of the Olive Ridley breeding population in the area can be reduced through implementation of Turtle Exclusive Device (TED) to the bottom trawl nets and motorized boats which operate gill nets. To prevent mortality of Olive Ridley turtles in the sea and to involve fishermen in using the TED device regular awareness and capacity building campaign is necessary. Also, to stop the poaching of eggs by human regular awareness campaign is necessary.

The human predation for turtle eggs may be prevalent near nesting beaches either for personal consumption or for sale in local markets during nesting season. Awareness generation among the local communities with involvement of all age groups needs to be conducted to achieve reduction in poaching of eggs from the nesting beaches and selling in local markets. This awareness campaign is to make the egg collectors aware that the collection of eggs is illegal, and to acquaint them with the wildlife laws.

9.2. Action Plan

With a view to conserve marine turtles, associated species and their habitats, the following action plan is proposed to be adopted at the National and State Government level.

- To reduce direct and indirect causes of marine turtle mortality, the possible threats to marine turtle populations and their habitats are to be identified, documented and best practice approaches to mitigate those threats to be implemented. It is proposed to undertake management of oceanic marine plastic debris and coastal clean-up for enabling the survival of marine turtles.

- Protection, conservation and rehabilitation of marine turtle habitats is key for long term survival of marine turtles. Towards meeting this objective, areas of critical habitat such as migratory corridors, nesting beaches, inter-nesting and feeding areas to be identified and managed, while degraded marine turtle habitats are to be rehabilitated.

- In order to improve the understanding of marine turtle ecology and populations, studies on marine turtles and their habitats targeted towards conservation and management through research, monitoring and information exchange to be taken up through involvement of scientific institutes and universities. It is proposed that proper exchange of scientific and technical information and expertise among scientific institutions, civil society and other agencies is ensured, in order to develop and implement best practice approaches to conservation of marine turtles and their habitats.

- People's participation is imperative for successful conservation interventions. It is therefore envisaged to increase awareness of marine turtles and their habitats, conservation needs and threats, amongst the wider public, including school children, to enhance public participation in conservation activities. Setting up of turtle conservation clubs at taluk or district or state levels, declaration of marine turtle day, conduct special events related to marine turtle conservation are few activities proposed in this direction. Turtle conservation clubs can also be set up in local schools and colleges. In addition, developing alternate livelihood opportunities and better fishing practices for local communities to be encouraged for active participation in conservation efforts that also generate livelihoods like eco-tourism (e.g. turtle tourism). All relevant stakeholders, including local communities should be involved in planning and implementation of conservation and management measures.

- National, regional and international cooperation is an integral part of marine turtle conservation. The existing mechanisms for cooperation at the sub-regional level to be strengthened to enhance coordination in management of turtle habitats. A web based information resource for marine turtle conservation to be developed, besides creating networks for cooperative management of shared populations, within or across sub-regions, and, where appropriate. Adequate and regular training on marine turtle conservation and management techniques to relevant agencies, individuals and local communities to be provided through identified scientific institutes.

- To strengthen law enforcement activities, a coordinated effort to be taken up amongst relevant stakeholders

Recommendations

Given the issues, challenges and threats to Sea Turtle conservation and management there is a need for a dynamic strategy that can protect these turtles throughout their nesting and inter-nesting habitat on the east coast of India. Such a strategy would require high levels of coordination between governmental agencies such as the Forest and Fisheries Departments, Coast Guard and Navy as well as non-governmental agencies and local communities. Such a network requires a good communication and awareness of the issues amongst all stakeholders.

Incidental catch has been a major cause of sea turtle mortality in India and international waters in the past (Hillestaad et al. 1982; Silas 1982; James et al. 1989) and continues to be a major threat (Rajagopalan et al. 1996. Rajagopalan et al. 2001). With respect to related mortality of sea turtles along the Andhra coast, the mortality was higher along the northern Andhra coast, though the number of boats operating from the southern Andhra coast (from Machilipatnam, Nizampatnam and Krishnapatnam) is higher. This is likely to be due to the higher density of turtles along the northern and central Andhra coast. Also, along the southern Andhra coast, fishermen use sting ray fishing gill net, but release turtle which get entangled in the nets.

No Fishing Zone in sea turtle nesting areas: Declaring No-Fishing zones during the nesting season in areas where sea turtle nesting concentration is high and near high density nesting beaches such as the river mouths. Govt. of Orissa has declared closure of fishing within 20 km of coast at the river mouths Dhamra, Devi and Rushikulya, during 1.11.2021 to 31.5.2021 marking the beginning of the mass nesting season of the endangered Olive Ridley. It is also well known that a blanket ban on sea fishing remains enforced round the year at Gahirmatha coast, in order to protect the mass nesting turtles. Similar closure of fishing may be considered at Andhra Pradesh coasts, where considerable turtle nesting are observed.

Strict enforcement and implementation of Andhra Pradesh Marine Fishing Acts: The Andhra Pradesh Marine Fishing (Regulation) Rules, 1995, states that mechanized vessels may not operate within 8 km of the coast and mechanized vessels above 15 meters in length may not operate within 25 km of the coast. Shrimp trawlers engaged in fishing without Turtle Excluder Device (TED) shall be liable for confiscation of entire catch and impose a fine of Rs. 2,500/-. However, the law is not enforced effectively, and mechanized fishing was reported close to the shore during the present study, leading to high mortality of sea turtles.

Habitat degradation and beach plantation: Habitat degradation remains one of the biggest threats on the Andhra coast. Extensive shrimp seed collection along the coast and shrimp hatcheries and prawn farms close to the nesting beach pose a major threat, particularly along the central Andhra coast. Human disturbance and lighting from aquaculture industries was very high along much of the coast and pose a serious threat to turtle nesting habitats. Casuarina and Palmyra plantations close to the beach render the habitat unsuitable for nesting and also provide shelter to egg and hatchling predators, particularly jackals.

Monitoring during breeding and nesting season: The nesting habitat of Olive Ridley along Andhra Pradesh coast is intensifying in recent years. Therefore to know nesting status of sea turtles, continuous monitoring of beach during the breeding and nesting season should be undertaken by Forest (Wildlife wing) Department of Andhra Pradesh.

Involvement of Non-Government Organizations: It is clear that the major threats to Olive Ridley on the Andhra Pradesh coast are trawling related mortality and developmental activities in the nesting habitats. Conservation strategies must take into account the fact that sea turtles along the east coast belong to the same population and might use new nesting beaches. For this, monitoring and evaluation are extremely important and are best carried out by the local Forest (Wildlife wing) Department involving the non-governmental organizations. Their continued involvement provides a source of data in the future as well as inroads into other aspects of turtle conservation such as the involvement of local communities. Conservation efforts should include the people living around turtle nesting beaches. Most of the local fishermen are not aware of the status of sea turtles and their legal status. Nor are they aware of fishing regulations that protect the rights of traditional fishing communities. The involvement of these communities and their welfare may be critical to the long-term preservation of marine turtles as well as coastal habitats along the coast.

1. The ongoing efforts by Forest Department should include further training to staff and should be assigned for in situ and ex situ conservation of marine turtles. These efforts should involve local networks in monitoring turtle nesting, mortality, and for beach patrolling across the state.

2. Local community including Eco-Development Committees (EDCs), Vana Samrakshana Samithis (VSSs) and Biodiversity Management Committees (BMCs) and must be involved and empowered for monitoring beaches during the nesting season. Initiatives such as establishment of in-situ conservation of turtle nesting through hatcheries across the state by Forest Department and education programmes among fisher folk conducted by NGOs like Tree Foundation (Nellore district), VSPCA (Visakhapatnam district) and Green Mercy (Srikakulam district) on the importance of marine ecosystem has helped create some awareness. Through these NGOs few fishermen have also found employment opportunity by engaging in turtle nest monitoring.

3. Incentives to fishing community have to be provided in order to follow sustainable fishing practices, particularly during turtle nesting seasons. So far, there have been limited efforts, which should be strengthened by employing the fishers as turtle watchers or protectors in their villages during nesting seasons.

4. Compulsory use of Turtle Excluder Devices (TED) has to be implemented through the Fisheries Department in mechanized boats to reduce the incidental catches during fishing. According to Fisheries Department of Andhra Pradesh, it is compulsory for all mechanized boats/ trawls, especially during turtle nesting season to use TED (The TED regulation under the Marine Fisheries Regulation Act of Andhra Pradesh). However, implementation is not effective. Nevertheless, it is positive to note that there is less resistance to TED from fishermen in Andhra Pradesh. Therefore, awareness on TEDs must be taken up on a continuous basis in major fishing harbors such as Nizampatnam, Vodareru, Kakinada and Visakhapatnam.

5. Coastal Regulation Zone (CRZ) has to be strengthened and enforced with the joint efforts of the State Government. Policies should be put in place for beach sand mining that are affecting turtle nesting ground as well as harming the coastal ecology. A community based coastal zone conservation programme with special reference to sea turtle across the state should be implemented by the Forest Department with support of credible NGOs.

6. In addition to the existing efforts of turtle conservation organisations in Andhra Pradesh, research and monitoring study of Olive Ridley turtle population and migration should be initiated and furthered by institutions like CMFRI, WWF India and Forest Department during nesting season in the state.

Detailed Recommendations developed as part of the UNDP – GEF EGREE Project is given below which has already been submitted to MoEF&CC in 2015

"VIZAG DECLARATION: 2015

"For reducing Sea Turtles mortalities along the Indian Coasts"

Noting that the sea turtles mortality along the Indian coasts is increasing during the recent years which are accorded highest degree of protection.

Knowing that the sea turtles in India are also conserved under Multilateral Environmental Agreements like the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Convention on Conservation of Migratory Species (C MS) through Memorandum of Understanding for the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia, wherein India is a signatory.

Conscious that the marine turtles are important indicators of healthy coastal and marine ecosystems and knowing that increasing mortality of the sea turtles is not a good sign of sustainable management in consonance with code of conduct of responsible fisheries of FAO.

Realizing that a large number of fishing communities are dependent on coastal and marine resources for their livelihoods and also considering that there is an immediate need to mitigate the alarming rate of sea turtles mortalities along the Indian coasts.

Aware that the large scale developmental, industrial and economic activities are rampantly increasing in coastal areas and being aware that these developmental activities are posing challenges to the coastal and marine biodiversity conservation including sea turtles.

Recognizing that the plethora of legislations and policies related to conservation and sustainable management of coastal and marine biodiversity and environmental regulation of developmental activities like Wild Life (Protection) Act, 1972, Indian Forest Act,1927, Biological Diversity Act, 2002, Coast Guard Act, 1950, Environment (Protection) Act, 1986, Indian Fisheries Act, 1897, Indian Ports Act, 1908, Marine Fishing Regulation Act, 1978, Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1976, Merchant Shipping Act, 1958, Tourism Policy, 1998, Deep Sea Fishing Policy, 1991 and rules made thereunder the respective legislations, relevant International Regulations, etc., are in place.

Acknowledging the concerns and sentiments of the fishing community dependent on the fishery resources along the Indian coasts and aware on the methods of fishing practiced by the fishing vessels and the gears in use.

Also acknowledging that the provisions of usage of Turtle Excluding Devises (TEDs) during fishing are well incorporated in the legislation of majority of the Indian Maritime States and are facing enforcement challenges.

EGREE FOUNDATION, An initiative of GoI-UNDP-GEF-GoAP Project: 'Mainstreaming Coastal and Marine Biodiversity Conservation into Production sectors in the East Godavari River Estuarine Ecosystem of Andhra Pradesh' in collaboration with WWF, Terra Marine Research Institute – TeMI, Olive Ridley Project, Turtle Action Group, India and Blue Cross of Hyderabad organized a Turtle Conservation Workshop of East Coast States of India to "Address Increasing Mortalities of Sea Turtles along the East Coast of India" from 15th to 17th April 2015 at Visakhapatnam.

Wherein all concerned stakeholders including enforcement agencies, civil society organizations, fishermen associations, industries, researchers, scientists, institutions, communities, students, student networks, media, lawyers, international development organizations and relevant line departments participated.

Taking into cognizance of all the above aspects and legal provisions available and contributions made by all the workshop participants, the following recommendations are proposed for due consideration and for further implementation by concerned agencies and stakeholders for long term actions towards effectively mitigating turtles mortalities along the Indian coasts:

- ✓ All the Indian Maritime States and Union Territories are encouraged to prepare better, comprehensive action plans or review the existing action plans for effective long - term conservation of sea turtles and their habitats. They are also encouraged to set up an institutional frame work involving concerned Governmental line departments, non-governmental organizations and local communities' groups at state and district level to monitor sea turtle conservation.

- ✓ Ensure while taking up developmental/industrial/economic activities like ports, shipping, dredging, power plants, sea erosion hard structures, extractive industries including mining etc., that the existing and potential turtle nesting beaches should be excluded.

- ✓ Identify, map and notify important turtle nesting beaches as ecological sensitive areas under the Environment (Protection) Act, 1986 and take measures to protect from all kinds of infringement and encroachments with adequate legal support.

- ✓ Utilize turtle nesting sites as ecotourism spots with due involvement of local communities for encouraging turtle walks along the Indian coasts, ensuring no damage is caused to the turtles and their habitats.

- ✓ Effluents and other discharges that are causing damage to the sea turtles and their habitats are to be pre-treated properly without violating the existing pollution laws.

- ✓ Involve and empower other enforcement agencies like Indian Navy, Indian Coast Guard, , marine and civil police for implementation of TED related and turtle

conservation enforcement provisions existing under Marine and Fishing Regulations Acts and Wild Life (Protection) Act, 1972.

- ✓ Various agencies shall take necessary measures for effective implementation of TED usage through conducting awareness programmes using print and electronic media.

- ✓ Provide market linked sustainable fisheries resource based, multiple livelihood options to fishing communities to encourage sea turtle conservation along Indian coasts by promoting the eco-labelling.

- ✓ Take necessary measures to avoid beach erosion and encourage conservation of existing natural sand dunes, sand spits, sand bars and avoid exotic plantation activities in existing and potential nesting areas.

- ✓ Install/replace with Gold Standard illumination lighting system near the turtle nesting beaches, which should be made mandatory along the Indian Coasts to avoid illumination impact on sea turtles.

- ✓ Establish marine fauna stranding rescue and rehabilitation centres with facilities of veterinary care supported by team of veterinarians, para-Veterinarians and volunteers especially trained in turtle care and develop a set of guidelines that has to be adopted by the local community for turtle conservation.

- ✓ Ensure implementation of Coastal Regulation Zone guidelines for conservation of sand beaches and turtle nesting sites along the Indian coasts through a transparent and participatory mechanism with due involvement of stakeholders including local communities.

- ✓ Establish interagency coordination mechanism through Central Operation Room (COR) with due participation of concerned enforcement agencies like the Indian Coast Guard, Indian Navy, Marine Police, Fisheries Department, Forest Department, Port Authorities, Marine Biologists along with experts from Civil Society to develop and monitor measures to prevent offshore and onshore activities that are detrimental to turtle conservation particularly during mating and nesting seasons from November to May considering extending the No-Trawling Zone to at least 10 nautical miles.

- ✓ Turtle Task Forces and/or Turtle technical support groups are to be constituted with the help of local communities and civil societies for effective monitoring and protection of sea turtles along the Indian coasts.

- ✓ Necessary measures are to be adopted to address predation on sea turtles and avoid prevalence of ghost nets in sea to prevent entanglement of sea turtles by involving animal welfare groups.

- ✓ Bring out a suitable policy on reducing by catch including turtles for conservation of marine biodiversity along the Indian coast

- ✓ Seaworthy patrolling boats are to be deployed by respective State enforcement agencies along the coast during turtle breeding and nesting seasons

- ✓ Provide financial and technical assistance to various agencies in taking up research and conservation activities for addressing turtle mortalities and for effective turtle conservation along the Indian coasts by initiating 'Project Turtle' on the lines of 'Project Tiger' and 'Project Elephant'.

- ✓ Sensitizing and capacity development of Policy Makers, Judiciary and other stakeholders should be initiated on the need to conservation of turtle breeding and nesting sites.

- ✓ Traditional knowledge of fishing community in turtle conservation should be properly documented and has to be utilized for the conservation of sea turtles along the Indian coasts. Organize regional level consultations with stakeholders including fishing communities periodically.

- ✓ Conduct studies and evaluate the ecosystem services of marine life with particular reference to turtles and take measures to disseminate this information.

- ✓ Conduct studies to assess the role played by the marine life particularly turtles in addressing Climate Change concerns.

- ✓ Develop appropriate compensatory mechanisms to fishermen involved in sea turtle conservation along the Indian coastal states with the support of corporate social responsibility funds and other funding sources.

- ✓ Provide mechanism for promoting and implementing sustainable fisheries management practices including use of "TED" and addressing the issues of by-catches with adequate enforcement of laws.

- ✓ Develop a comprehensive database of nesting and mortality and post it on public domain.

Pictorial turtle guides comprising their migratory routes and patterns, life history and their role in the ecosystem have to be brought out in vernacular/local languages regularly for the use of various stakeholders for long term conservation of sea turtles.

9.3. Laws for Conservation of Sea Turtles in India

Government of India has given high priority to conserve the sea turtles and all the five species are protected as they are placed in Schedule I of the Indian Wildlife (Protection) Act 1972 as per the Amendments made to the Schedule in September 1977. Sea turtles are venerated in Hindu mythology and those accidentally caught are usually released back into the sea by the local fishermen. In South India, majority of the coastal people believed that turtles are bad omens and cannot be brought into the house.

Likewise, turtle meat consumption is forbidden among muslims while only certain christian and tribal communities in India are not averse to consuming their eggs and meat. Thus, socio-religious importance for turtles in India goes a long way in the implementation of conservation measures. The Government of India constituted an Expert Scientific Panel (ESP) on 10 July 1998 to conduct a study on the distribution of sea turtles, their incidental mortalities in fishing nets, use of TED in fishing waters, etc. which submitted its report in March 2000. Two important recommendations made by ESP were:

(i) Declaration of mass nesting areas as marine sanctuaries,

(ii) Mandatory implementation of turtle excluder devices (TEDs) in all mechanized trawlers operating in areas of mass nesting where incidental mortalities have been recorded, in order to bring down incidental catch and mortality of sea turtles. It identified both the areas and the period as follows:

- Entire coast of Odisha during the period from November to April,
- Coast of Midnapore District in West Bengal during December-March,
- Coast of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts in Andhra Pradesh during November to April,
- Coast of Nagapattinam, Turticorin, Ramanathapuram and Tirunelveli districts in Tamil Nadu during December to April,
- Coast of Puducherry, excluding areas off the coast of Mahe, Karaikal and Yanam, during December-April.
- Coast of Kollam and Trivandrum districts in Kerala, during December-March.

Marine Product Export Development Authority (MPEDA) was entrusted with the responsibility of the development and promotion of TED designed by ICAR-Central Institute of Fisheries Technology (CIFT).

Laws that govern marine turtle conservation in India include

1. Wildlife (Protection) Act - 1972
2. Ratification of the CITES - 1976
3. Ratification of Bon Convention – 1981
4. Environment (Protection) Act - 1986
5. The Biological Diversity Act, 2002

6. The Wildlife Protection Amendment Act- 2002
7. The Marine Fishing Policy, 2004
8. Marine Fisheries (Regulation and Management) Bill, 2009
9. Coastal Regulation Zone Notification, 2011
10. State Fisheries Policies and Laws

Conservation and Management measures by Andhra Pradesh Government

Mypadu a fishing village in Nellore district is one of the sporadic nesting sites with less than 10 nesting of Olive Ridley turtles. The state government is promoting tourism in the beach. Trammel net ('Disco net') used to catch shrimp particularly *Penaeus indicus* by the artisanal fishermen occasionally trapped juvenile Olive Ridley and caused much damage to the nets.

Presently, fishermen are avoiding the place where turtles are found and entangled juvenile turtles are also immediately released back to the sea to prevent damage to nets. ICAR-Central Marine Fisheries Research Institute (CMFRI) which extensively studied the trawl by-catch in Andhra Pradesh during December 2013 to December 2014 reported that bycatch of turtles in trawl net was < 0.5%. As per the Andhra Pradesh Marine Fishing Regulation Act, 1994 trawlers are mandated to use TED and the shrimp trawlers fishing without Turtle Excluder Device (TED) shall be liable for confiscation of entire catch and impose a fine of ₹ 2500. Community Based Sea Turtle Protection and Conservation Programme has been taking place for the past 21 years jointly by Andhra Pradesh Forest Department and Visakha Society for Protection and Care of Animals to protect and conserve the sea turtles. Village level sea turtle protection committees are constituted at each Nesting Beach Zone for the protection of nesting turtles, nests, eggs and hatchlings.

As per CRZ notification 2011, areas which were sea turtle nesting areas could be declared as CRZ – I areas, which are ecologically sensitive areas. In these regions no development or new constructions could take place as per this notification.

10. Impact and mitigation measures on Turtle nesting sites for construction of port

Construction activity of port, harbor and jetty involves lots of movements and create disturbance near the shore area by dredging, constructing breakwater and using heavy machineries. All these activities will cause major impact on turtles.

10.1. Impacts

Impact due to port construction

- Dredging activity will cause severe injuries to turtles, sometime it will kill turtles too.
- Movements of workers and heavy machineries in the turtle nesting zone during the construction phase.
- Solid and liquid waste created during the construction phase will create direct and indirect impacts on turtle habitat.
- Artificial lightings used during the construction phase will affect the turtle breeding.
- Exposed turtle nest during construction phase may be hunted by predators.

Impact during operational phase

Impact during operational phase of port is mainly caused due to the accidental spill happened during cargo handling and due to ship movements.

- Impact on turtle habitat due to accidental spill of dry and liquid cargo during handling at terminals.
- Lighting from the port will impact turtle nesting.
- Marine traffic will impact the movement of turtle movements.
- Solid and liquid waste discharge from vessel will impact turtles.

10.2. Mitigations

Mitigation measures during construction

- Finding the best alternative location to avoid the turtle zone.
- Avoiding construction activities during turtle breeding periods.
- Marking of boundaries along the area to avoid disturbance to turtles due to movement of workers and construction activities.
- Brief the workers and contractors on the importance of turtles to restrict the unwanted damage.
- Providing separate zone for turtle nesting.
- Cleaning up the work filed as soon as the construction is over.
- Avoiding heavy beam lights to avoid the disturbance to turtles during construction.

Mitigation measures during operation

- Finding the best alternative location to avoid the turtle zone.
- Collection of spilled oil on water using equipment such as booms and skimmers
- Use of Chemical dispersants to avoid oil reaching shore.
- Vacuuming can be used to remove pooled oil or thick oil accumulations from the sediment surface, depressions, and channels.
- Taking rescued turtles to wildlife rehabilitation centres to be cleaned and cared for.
- Monitoring nesting beaches to safeguard incubating nests.
- Providing EMP and Monitoring program for turtle conservation.

11. Budget for Conservation

For conservation of sea turtles the project proponent is to form a separate turtle conservation cell in consultation with Forest Department of Andhra Pradesh. This cell should consist Environmental Coordinator, Environmental Engineer, Marine Biologist, Veterinary care unit, NGO (if needed), Environmental Consultant and Additional staffs from local. The cost for monitoring and the conservation actions for sea turtles for every year from commencement of project is given in the table below.

Budget allocation for Turtle conservation Plan

S. No.	Particulars		Cost in lakhs (₹)
1	Beach monitoring on the turtle nesting sites		
	Beach cleaning		1.5
	Watch keeping during turtle nesting season		2.5
2	Setting up of turtle hatchery		
	Creation of hatchery		5.0
	Watch keeping		2.0
	Egg collection		1.5
	Protection and release of hatchlings		1.5
3	Education and awareness program		
	Installation of awareness board in English & regional languages		1.5
	Educate fishermen and other locals in the vicinity		1.5
	Create short awareness films to publish in social media		1.0
4	Implementation of Environmental cell		
	Environmental Coordinator	(12 x 50000)	6.0
	Environmental Engineer	(12 x 25000)	3.0
	Marine Biologist	(12 x 25000)	3.0
	Additional staffs from local of 5 nos.	(12 x 15000)	9.0
5	Veterinary care unit for turtle		1.0
6	Involvement of NGO		5.0
7	Involvement of Environmental Consultant		5.0
Total			50

12. Conclusion

There is plenty of evidence that human activities have seriously diminished sea turtle populations. Although the majority of these actions are unintentional, for example coastal development, pollution and incidental capture, many intentional threats such as direct take of sea turtles and egg harvesting are evident.

Although many important research efforts were initiated over half a century ago, there is much to learn about the life cycle of these marine reptiles. For example, relatively little is known about their migratory routes, use of different habitats and their spatial and temporal distributions. In order to have successful conservation programs, one must improve existing knowledge on sea turtles through increased scientific research and technical capacity using standardized methodologies that recognize economic and cultural forces behind threats, encourage active participation of local communities and regional coordination of conservation efforts between governments, researchers, and NGOs.

One way to protect nesting beaches is to declare them as protected areas, applying the pre-existing management categories of each country; for example, creating marine protected areas. A declaration of this type establishes the legal and administrative competencies, in the terrestrial as well as marine environments, necessary to comply with the legislation, thus allowing the necessary measures to be taken for sea turtle conservation and protection. Often wildlife laws do not protect sea turtles throughout their entire range of action therefore, their application is not very effective.

As the turtle sightings near the project region is comparatively much lower to north of the project region, Andhra Pradesh Forest Department has planned to move the existing hatchery to further north. The project proponent has come forward to collaborate with Andhra Pradesh Forest Department in conserving the sporadic turtle nesting with an allotted budget of ₹ 50 lakhs every year.

Conservation programs to be implemented will be different in every country or region, depending on the variety of factors previously discussed. Nevertheless, the need to act is urgent at all levels worldwide in order to prevent the current population decline of sea turtles.

13. Acknowledgements

We thank the Director, Dr. Dhananjai Mohan, Wildlife Institute of India (Dehradun) and Forest Department of Andhra Pradesh for providing scientific support.

We would like thank honorable Chairman and Committee members of MoEF&CC for pointing out the need of conservation plan for turtles in this proposed project. It was a wonderful opportunity to make an extensive study of sea turtles in and around the project site.

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Annexure I

GOVERNMENT OF ANDHRA PRADESH
FOREST DEPARTMENT

From
Sri Y. Srinivasa Reddy, IFS.,
Conservator of Forests,
Guntur Circle, Guntur.

To
The Prl.Chief Conservator of Forests &
(Wild life and Chief Wild life Warden),
AranyaBhavan, Andhra Pradesh,
K.M.Munshi Road, Guntur –522 004.

Rc.No.2326/2020/M5, Dt:03-12-2021.

Sir,

Sub:- APFD – Wildlife – Development of Greenfield Non-Major Port at Ramayapatnam in Prakasam District of Andhra Pradesh – **Data of Sea Turtle movement and nesting sites – Occurrence, movement and known locations of Whale Sharks and marine mammals – Greenbelt Development Plan** – With the help of Forest Department & WII, Dehradun – Report – Submission of Reg.

Ref:- 1.Prl.CCF, A.P, Guntur Rc.No.10788/2021/WL-2, Dt.24.11.2021.
2.CF Guntur Rc.No.2330/2021/M5,dt:24-11-2021.
3.DFO Giddalur Rc.No1740/2021/TA,dt:25-11-2021.
4.CF Guntur Rc.No.2330/2021/M5,dt:03-12-2021.

&&&

With reference to the above, it is submitted that vide ref 1st cited, the Prl.Chief Conservator of Forests, Andhra Pradesh, Guntur has called for point wise information on the subject matter. The same was communicated to the Divisional Forest Officer, Giddalur with instructions to submit the reply.

In the ref.3rd cited, the Divisional Forest Officer, (T) Giddalur has submitted point wise information as follows.

Sl. No	Item		Reply
1	Data on Sea Turtle nesting sites and their movement in nearshore areas along the coast and impact of the proposed ship traffic on sea turtle movement.	:	It is submitted that the Divisional Forest Officer, Giddalur has submitted that the data on Sea Turtle nesting sites in nearshore area of Ongole Forest Range, Giddalur Division along the coast is submitted (copy enclosed.) The Divisional Forest Officer, Giddalur has reported that, southern portion of project falls in the jurisdiction of Nellore Forest Division. The undersigned has given instructions to Divisional Forest Officer, Nellore for submitting the report vide reference 4th cited, after receiving the report same will be submitted. Further, it is submitted the study on "impact of the proposed ship traffic on sea turtle movement" may be entrusted to any of the reputed Wildlife Institution viz., WII, Dehradun.

2	Map showing the occurrence of whale sharks and other marine mammals, their season of migration and nesting sites along the coast.	:	It is submitted that the Divisional Forest Officer, Giddalur has reported that there is no information readily available in the office and requested to a detailed study may be entrusted to any of the reputed Wildlife Institute viz., WII, Dehradun for furnishing the above details and preparation of "Map showing the occurrence of whale sharks and other marine mammals, their season of migration and nesting sites along the coast".
3	Impact of the proposed project on the said species/marine mammals due to ship traffic and underwater noise.	:	It is submitted that Divisional Forest Officer, Giddalur has reported that there is no information readily available in the office and requested to a detailed study may be entrusted to any of the reputed Wildlife Institute viz., WII, Dehradun for furnishing the above details and study on the "Impact of the proposed project on the said species/marine mammals due to ship traffic and underwater noise".
4	Verify the Greenbelt Development Plan prepared by the A.P.Maritime Board and ensure that the plan must include native species and as well as measures for sand dune protection and restoration measures.	:	It is submitted that the Divisional Forest Officer, Giddalur has reported that he has verified the Greenbelt Development Plan prepared by the A.P. Maritime Board and the plan has included most of the native species and requested to approve the plan.

It is submitted that the report of the Divisional Forest Officer, Giddalur along with its enclosures is herewith submitted for kind information.

This is submitted for favour of kind information and necessary action.

Yours faithfully,
Sd/- Y. Srinivasa Reddy,
Conservator of Forests,
Guntur Circle, Guntur.

GOVERNMENT OF ANDHRA PRADESH
FOREST DEPARTMENT

From
Sri.G.Satish, S.F.S.,
Divisional Forest Officer,
GIDDALUR – 523 357.

To
The Conservator of Forests,
Guntur Circle,
GUNTUR.

Rc.No.1740/2021/TA, Dated:25-11-2021.

Sir,

Sub:- APPD – Wildlife – Development of Greenfield Non-Major Port at Ramayapatnam in Prakasam District of Andhra Pradesh – Data of Sea Turtle movement and nesting sites – Occurrence, movement and known locations of Whale Sharks and marine mammals – Greenbelt Development Plan – With the help of Forest Department & WII, Dehradun – Report – Submission of Reg.

Ref:- Prl.CCF, A.P, Guntur Rc.No.10788/2021/WL-2, Dt.24.11.2021

&&&

With reference to the cited, it is submitted that the point wise information relating to Data on Sea Turtle movement and nesting sites, occurrence, marine mammals and Greenbelt Development Plan regarding Development of Greenfield Non-Major Port at Ramayapatnam in Prakasam District of Andhra Pradesh is submitted hereunder.

Sl. No	Item		Reply
1	Data on Sea Turtle nesting sites and their movement in nearshore areas along the coast and impact of the proposed ship traffic on sea turtle movement.	:	Data on Sea Turtle nesting sites in nearshore area of Ongole Forest Range, Giddalur Division along the coast is enclosed herewith. Further, in this regard the Southern portion of proposed Ramayapatnam port project falls in Nellore Forest Division where sea turtle conservation works are going on and the details of the same may be obtained from the Divisional Forest Officer, SPSR Nellore. Further, it is submitted the study on "impact of the proposed ship traffic on sea turtle movement" may be entrusted to any of the reputed Wildlife Institution viz., WII, Dehradun.

Sl. No	Item		Reply
2	Map showing the occurrence of whale sharks and other marine mammals, their season of migration and nesting sites along the coast.	:	There is no information readily available in this office. A detailed study may be entrusted to any of the reputed Wildlife Institute viz., WII, Dehradun for furnishing the above details and preparation of "Map showing the occurrence of whale sharks and other marine mammals, their season of migration and nesting sites along the coast".
3	Impact of the proposed project on the said species/marine mammals due to ship traffic and underwater noise.	:	There is no information readily available in this office. A detailed study may be entrusted to any of the reputed Wildlife Institute viz., WII, Dehradun for furnishing the above details and study on the "Impact of the proposed project on the said species/marine mammals due to ship traffic and underwater noise".
4	Verify the Greenbelt Development Plan prepared by the A.P.Maritime Board and ensure that the plan must include native species and as well as measures for sand dune protection and restoration measures.	:	I have verified the Greenbelt Development Plan prepared by the A.P. Maritime Board and the plan has included most of the native species. The plan may be approved.

This is submitted for favour of kind information and neccssary action.

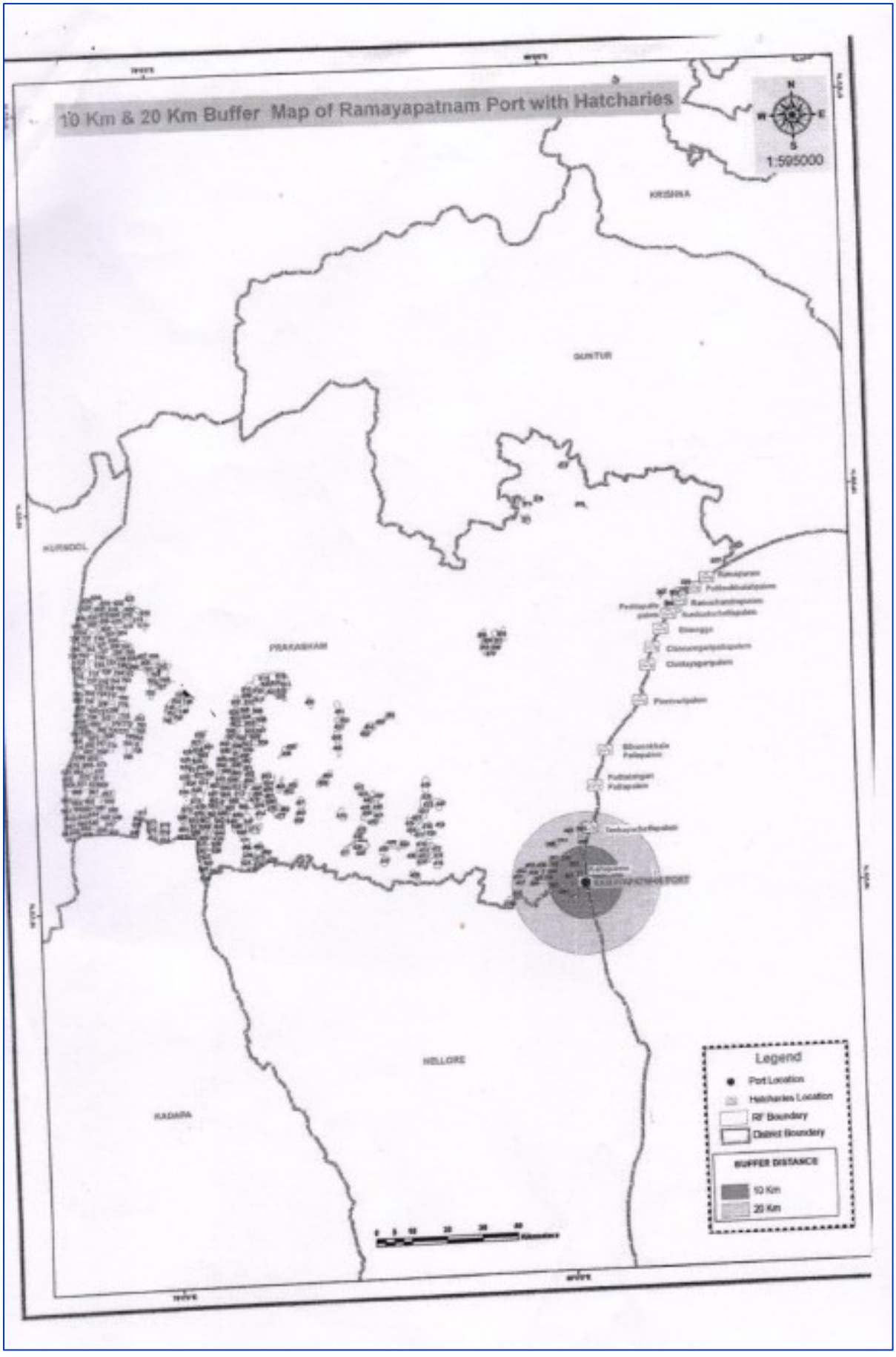
Encl:- As above.

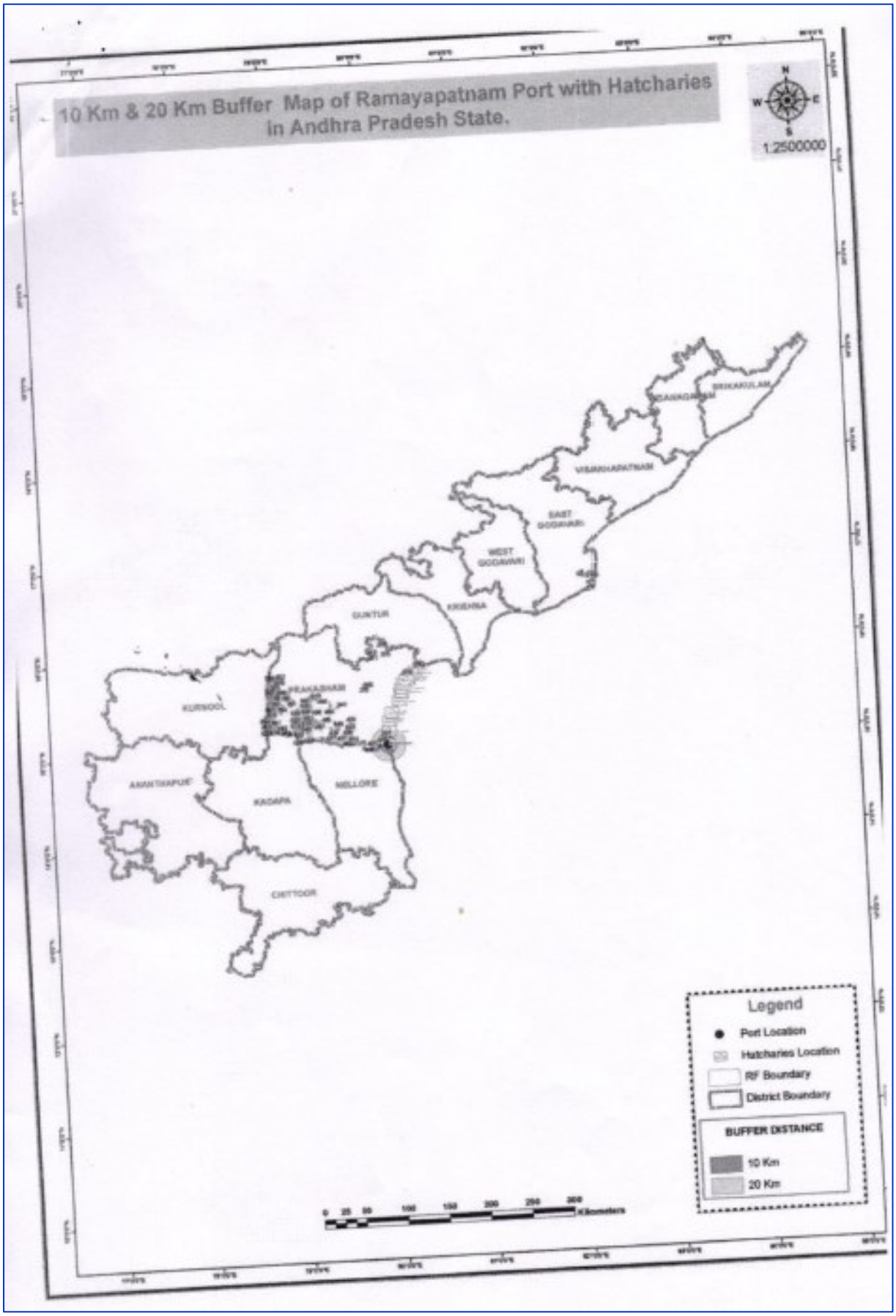
Yours faithfully,

25/11/21

Divisional Forest Officer (T),
Giddalur.

25/11/2021


10 Km & 20 Km Buffer Map of Ramayapatnam Port with Hatcharies
1:595000
KRISHNA
GUNTUR
PRAKASHAM
NELLORE
KADAPA
Legend
Port Location
Hatcharies Location
RF Boundary
District Boundary
BUFFER DISTANCE
10 Km
20 Km


10 Km & 20 Km Buffer Map of Ramayapatnam Port with Hatcharies in Andhra Pradesh State.
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1:2500000
SRIKAKULAM
VISAKHAPATNAM
EAST GODAVARI
WEST GODAVARI
KRISHNA
GUNTUR
PRAKASAM
KURNOOL
ANANTHAPUR
KADAPA
NELLORE
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Port Location
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District Boundary
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10 Km
20 Km
Kilometers