

Conservation Strategy and Action Plan for the Marine Turtles and their Habitats in Puducherry



May 2017



सत्यमेव जयते
Government of Puducherry



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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Summary

Puducherry, is a small but beautiful Union Territory of India, located along the southern east coast of India with coastline of 45 km. This coastline is being used for nesting of sea turtles, especially Olive Ridley and Green Sea turtles. Their sporadic nesting is at peak during November to February along Puducherry and Karaikal coasts. High sporadic nesting of sea turtles were observed on the beaches along Nallavadu/Moorthikuppam villages (Puducherry) and beaches around Arasalar River (Karaikal), therefore, these two beaches have been identified as 'Important Sea turtle Habitats of Puducherry' and recommended to be declared as the 'Community or Conservation Reserves' as per the Wildlife (Protection) Act, 1972. Further, it is recommended to manage these two beaches with active participation of local communities by promoting the turtle conservation as well as eco-tourism.

Land use/land cover patterns along the coastal areas of Puducherry and Karaikal was significantly changed between 2004 and 2015. Larger portion of agricultural lands adjoining to nesting beach were converted for aquaculture and built up areas, that deterred sea turtles use of beaches for nesting. It was also found that arable lands along turtle nesting beaches were shrunk due to demand from other developing sectors such as aquaculture, tourism and real estate. Therefore, it is proposed to declare remaining critical sea turtle nesting beaches of Puducherry such as Nallavadu, Pannithittu, Narambi and Moorthikuppam villages (Puducherry) and beaches around Arasalar River (Karaikal) as 'Eco-sensitive Zones' under relevant sections of the Environment (Protection) Act, 1986.

A significant proportion of world's Olive Ridley population migrates every winter from the Southern Indian ocean (near Sri Lanka) to Odisha, where they do mass nesting. Puducherry coastline is being used as a migratory route by these sea turtles. Off coast of Puducherry especially 60 - 400 km stretch from the shore were largely used by the migratory sea turtles during the month of October to April in every year. Further, few hundreds of sea turtles that are seems to be resident to Puducherry off coast, breed and nest along its coasts. Some of these breeding sea turtles have been incidentally killed by fishing nets especially between December and January. Turtles eggs are also predated by dogs and other animals on the shore. Therefore, it is proposed to strengthen the ongoing *ex-situ* turtle conservation programme of State Forest Department by facilitating the safe hatchings of turtle eggs through the artificial hatcheries. In this context, it is recommended to create two permanent hatcheries in these proposed two conservation reserves and involve local communities in the turtle monitoring and conservation programme. Moreover, Turtle Excluder Device (TED) should be made mandatory for all trawlers fishing along the Puducherry coasts.

Beach erosion due to natural phenomena as well as urbanization, have reduced the nesting habitats and resulted in a drastic reduction in sea turtle nesting along Puducherry coast. Moreover, beach armoring with exotic plantations, artificial illumination and tourism are few other threats to the nesting beaches and hatchlings. Hence, it is recommended to continuously monitor the nesting beaches and avoid exotic plantation within 500 m from the high tide line and also manage vegetations on the beaches. Further, it is recommended to constitute an Authority with multi-stakeholders to protect the beaches and its biodiversity of Puducherry. It is also suggested to create a 'Puducherry Sea Turtle and Coastal Research and Monitoring Cell' at the Forest Department for the long term conservation of coastal biodiversity and livelihoods of people of Puducherry.

1. Introduction

Sea turtles are large, air-breathing reptiles that inhabit tropical and subtropical seas throughout the world. Seven species of sea turtles are found worldwide. They belong to two families- Cheloniidae and Dermochelyidae. The Green, Loggerhead, Kemp's ridley, Olive ridley, Hawksbill and Flatback turtles belong to the family Cheloniidae and the Leatherback turtle belongs to the family Dermochelyidae. The shells of Cheloniidae turtles consist of a Carapace (the upper part) and Plastron (the lower part). Hard scales (or scutes) cover their entire shells, and these scute counts determine different species of sea turtles. Sea turtle species vary a lot as far as their sizes and weights are concerned, for example, the olive ridley turtles weigh approximately 25-46 kg with an average carapace length of 60-70cm whereas leatherback turtles weigh up to 650 kg and grow to 2.13 m in length (McClain et al., 2015). Even though their streamlined bodies and large flippers make them remarkably adapted to life at sea, the sea turtles maintain close ties to the land. Females must come ashore to lay their eggs in the sand; therefore, all sea turtles begin their lives as tiny hatchlings on land.



Figure 1 Olive Ridley sea turtle

1.1. Life history and biology of sea turtles

Sea turtles are known to travel hundreds to thousands of kilometres from their feeding to breeding grounds. There is a belief that sea turtles return to their natal beach (the beach where they were born) or group of beaches to lay eggs as adults. Genetic studies have confirmed that such return migrations do occur in several sea turtle populations. Strong natal homing was observed in the Green turtles in Australia, Suriname and Ascension Island (Carr, 1975, Limpus et al., 1992).

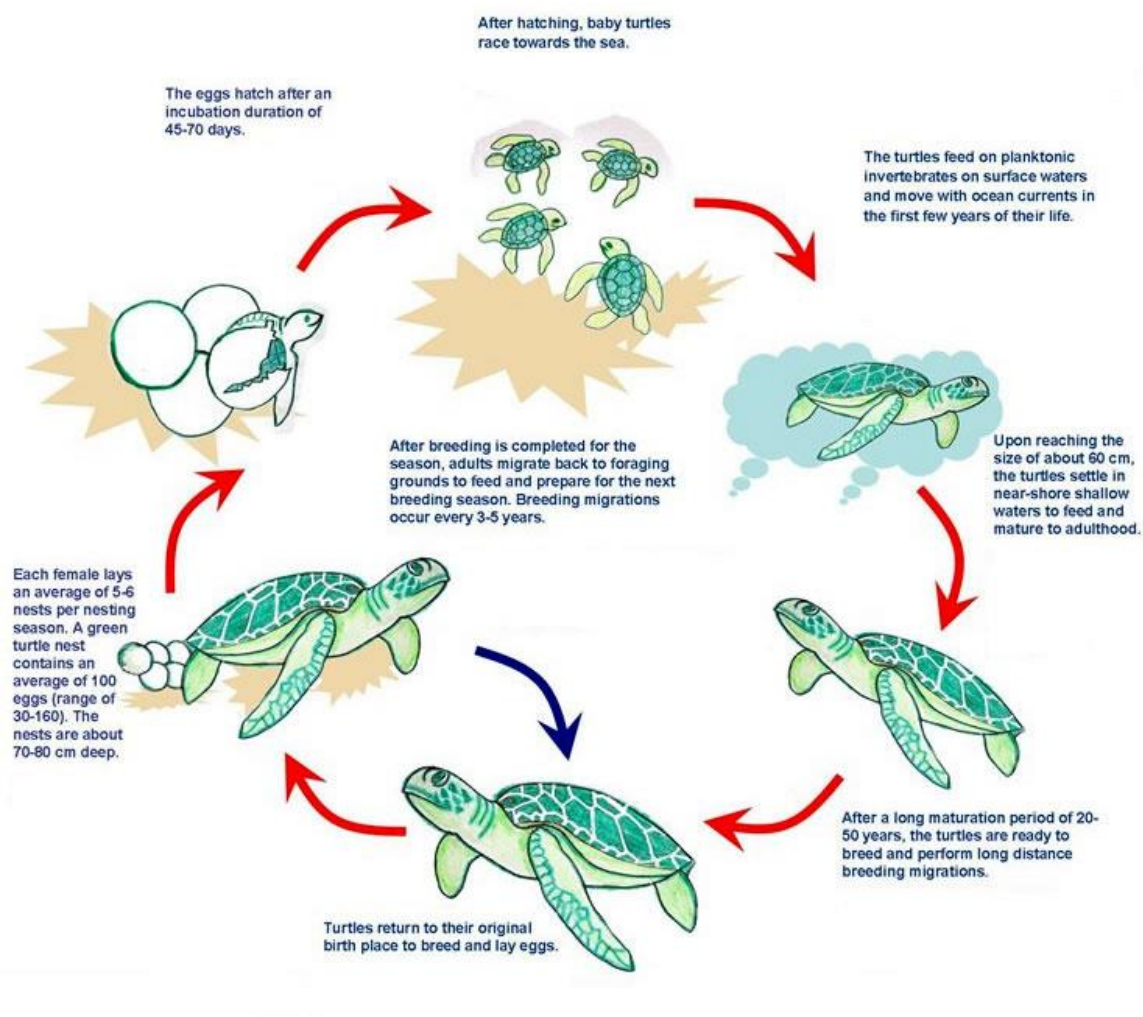


Figure 2 The life cycles of sea turtles (Source: <http://www.srilankaseaturtles.com/varieties.html>)

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, only females come ashore to nest; males rarely return to land after crawling into the sea as hatchlings. Most females return to the natal beach at night. They crawl above the high water mark, find a suitable nesting site, clear away the surface sand (making a body pit), 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 clutches and the number of eggs per clutch may vary in different species. The different species lay about 80-130 eggs in the nest and fill it with sand; they thump the nest with their body to compact the nest (Hirth, 1980). 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 to camouflage it and return to the sea. Beach selection is affected by the accessibility of the beach as well as height and substrate. Different turtles prefer different types of beaches to nest. For example, olive ridleys and leatherbacks prefer wide beaches and sand bars at river mouths, while Hawksbills and Green turtles prefer small island beaches. Most turtles nest more than once during a season, with roughly two weeks separating each nesting event. After they complete nesting, they return to their feeding grounds until the next breeding migration, which may be a year or several years later. 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 re-nesting. Some leatherbacks have nested on beaches separated by more than 700 km.

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 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 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. Less than one in a thousand hatchlings is believed to survive to adulthood.

The sex of a hatchling is determined by incubation (nest) temperature. Lower temperatures produce males; higher temperatures produce females. The pivotal temperature (i.e. the temperature that produces equal numbers of males and females) varies among species and populations but is usually around 28–32°C. The sex of the hatchling is determined during the second trimester of development. Sex ratios are likely to vary over the course of a nesting season and also between nesting beaches. Influences on nest temperature (e.g. rise in temperature from impacts of climate change) can result in skewed sex ratios – more males than females or vice versa.

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. Sargassum drifts lines (seaweed rafts), and FADs (fish aggregating devices) have been found to be particularly 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. They grow slowly and take between 15 and 50 years to reach reproductive maturity, depending on the species. There is no way to determine the age of a sea turtle from its physical appearance. Once they have reached sexual maturity, these turtles will migrate to their breeding grounds during the mating season to breed.

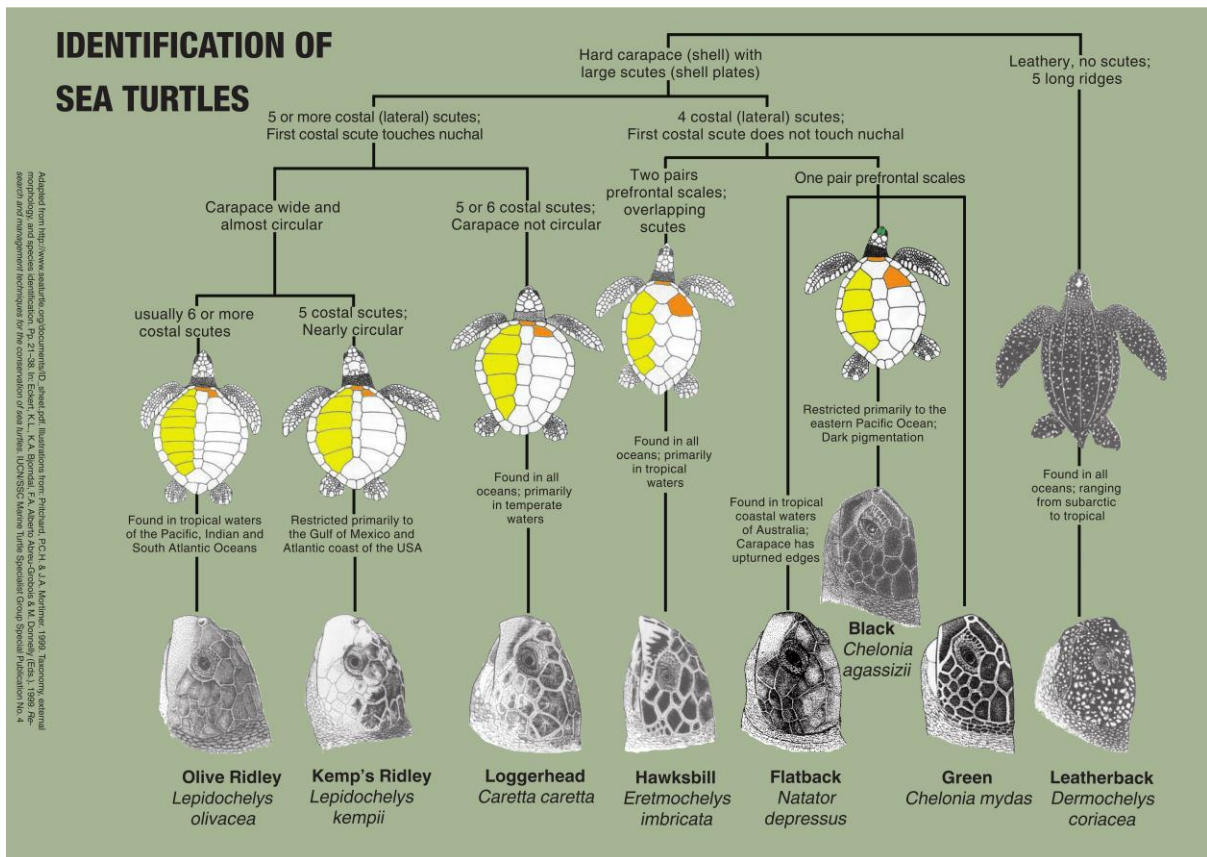
1.2. Ecosystem services provided by the sea turtles

According to the study carried out by Bjorndal & Jackson, 2003, removing the sea turtles from the existing food web or reducing their numbers to drastic levels may result in a collapse of the entire marine ecosystems and commercial fisheries. Sea turtles serve as substrate and transport for a diverse array of epibionts. For example, loggerheads nesting in Georgia had 100 species of epibionts from 13 phyla (Frick et al., 1998), and loggerheads are nesting at Xcacel, Mexico, carried 37 taxa of algae in total, with up to 12 species of an

individual turtle (Senties et al., 1999). Sea turtles can transfer substantial quantities of nutrients and energy from nutrient-rich foraging grounds to nutrient-poor nesting beaches. In the study carried out by Bouchard & Bjorndal in the year 2000, less than one-third of the energy and nitrogen contained in eggs deposited by loggerheads in Melbourne Beach, FL, was recorded to have returned to the ocean in the form of hatchlings. Loggerheads have also been found to modify the physical structure of their habitat in some ways, including digging trenches through soft substrates in search of infauna prey (Preen, 1996).

Several studies show the seagrass systems face a massive decline due to increasing in sulfide toxicity, self-shading, hypoxia, and infection by the slime mould (*Labyrinthula* spp.) when the grazers controlling these factors are removed on a large scale from the system. Hence, restoring consumer populations to an abundance necessary to be ecologically functional is of utmost importance and is still possible because most of these species still exist, at much-reduced levels (Jackson et al., 2001).

A pictorial guide for the identification of sea turtles



1.3. Sea turtles in India

Among the seven species of sea turtles found worldwide, five species are reported to occur in Indian coastal waters. These are the Olive ridley turtle, Green turtle, Hawksbill turtle, Leatherback turtle and Loggerhead sea turtle. Except for the Loggerhead, the remaining four species nest along the Indian coastline.

Leatherback turtles are found to be nesting on Andaman and Nicobar islands. Main nesting sites are Galathea on the east coast and several beaches on the west coast of Great Nicobar, Little Nicobar and Little Andaman islands. Green turtle nests mainly in Gujarat state on the mainland and Lakshadweep and Andaman islands. Hawksbill turtles nest in Lakshadweep, Andamans and a few beaches in Nicobar such as Indira Point in the Great Nicobar. Loggerhead turtle nesting has not been recorded from India. Olive ridley turtles nest throughout the Indian mainland, Andaman and Nicobar islands and to a lesser extent, in Lakshadweep islands (Anon, 2011). A significant proportion of world's olive ridley population migrates every winter to the Indian coastal waters to nest on these beaches in Odisha and along other parts of Indian coast.

Table 1. Conservation status of India sea turtles.

| Sr. No. | Common name | Scientific name | IUCN Status |
|---------|---------------------|-------------------------------|-----------------------|
| 1 | Olive Ridley turtle | <i>Lepidochelys olivacea</i> | Vulnerable |
| 2 | Green turtle | <i>Chelonia mydas</i> | Endangered |
| 3 | Leatherback turtle | <i>Dermochelys coriacea</i> | Vulnerable |
| 4 | Hawksbill turtle | <i>Eretmochelys imbricate</i> | Critically Endangered |
| 5 | Loggerhead turtle | <i>Caretta caretta</i> | Vulnerable |

Green Turtle *Chelonia mydas*



Hawksbill Turtle *Eretmochelys imbricata*



Leatherback Turtle *Dermochelys coriacea*



© Virginia Herpetological Society

Olive Ridley Turtle *Lepidochelys olivacea*



© Sajan John

Loggerhead Turtle *Caretta caretta*



1.4. Economic and cultural significance of sea turtles in India

In Hindu mythology the world is thought to rest on the backs of four elephants that stand on the shell of a turtle. In Hinduism, Akuparais a tortoise who carries the world on his back, upholding the Earth and the sea. One Avatar of lord Vishnu is the giant turtle Kurma. In northern Andhra Pradesh, there is a caste named after the turtle (*kurma kulam*). Besides, there is an ancient temple near Srikakulam, *Kurmanaswamy*, is believed to have originated from the sea in this area. For this reason people do not kill turtles or eat turtle meat and eggs in this area. This temple situated close to the coast and also has a good population of star tortoises (*Geochelone elegans*). However, few fishing communities do collect turtle eggs for local consumption. In few other fishing villages in northern Andhra Pradesh coast, an extract of sea turtle liver and bile is used to treat pregnancy related and rheumatic diseases (Tripathy et al. 2006).

1.5. Sea turtles and their habitat in Puducherry

All the four species of marine turtles are found in the waters of the Bay of Bengal near Puducherry off coast. However, limited information is available on the sighting records of the hawksbill turtle, loggerhead turtle and the leatherback turtles from the Pondicherry coast. But, the olive ridley turtles, the smallest and the most numerous of the seven species of sea turtles are nesting sporadically on the beaches of Puducherry.

This species is well known for its synchronous nesting behaviour, which is known as *arribada* (“arrival” in Spanish) in which several hundred thousand of female turtle nest *en-masse* (Pandav et al., 2006, Valverde and Gates, 1999). It is the most widely occurring species that nest at several sites in the western Indian Ocean, Indian subcontinent, and Southeast Asia. The major nesting aggregations for olive ridley occur in few beaches of Costa Rica and Mexico in the east Pacific and Odisha on the east coast of India. The breeding season for olive ridley in Odisha spreads from November to April during which mating, egg-laying and hatching take place (Behera et al. 2010). Tag recovery, satellite telemetry, and the genetic study suggest that olive ridleys along the east coast of India form part of a single large population (Shanker et al. 2004; Tripathy and Pandav, 2008, Behera et al. 2010). Among breeding males and females, males remained sexually active for a longer period (up to 50 days) compared to females (7-10 days) (Pandav and Choudhury, 2006). Olive ridley turtle nest on an average of 1.5 times within a season and nesting intervals at Galathea in Great Nicobar Island range from 13 to 28 days (Andrews et al. 2006).

The olive ridley turtle is capable of foraging at great depth (up to 150 m or even more) in tropical neritic waters and undertake long journeys in search of suitable feeding grounds. They swim over considerable distances offshore and float calmly over deep sea waters, waiting for certain crustaceans which emerge to the surface of water only during the night (Eckert et al., 1999). This is largely carnivorous turtle feeds on dead fish, crabs and other crustacean, jellyfishes and molluscs (Behera, 2015). The most comprehensive feeding study in Australia documented diet of this species includes mostly gastropod and bivalve molluscs (Conway 1994). Also, Crabs, shrimp, tunicates, jellyfish, salps, and algae have been reported in their diet (Behera et.al. 2014). In India, the Gulf of Mannar is a major feeding ground for olive ridleys (Bhupathy and Saravanan, 2006).

Pandav and Choudhury (2006) reported that tagged male and females showed fidelity to breeding ground in Odisha coast. Both males and females showed annual re-migration to the same courtship areas every year (Pandav et al. 2000). Female's movement recorded between the different nesting beaches in Odisha, both within a breeding season as well as between seasons (Tripathy and Pandav, 2007). The distance of inter rookery movement varied from 35 to 220 km (Pandav 2000; Tripathy and Pandav, 2008). Female turtles move southward along the coast after completing nesting (Pandav and Choudhury, 2006).

Habitat characteristics of turtle nesting beaches are poorly understood and available information is unelaborated. Large number of olive ridleys travel through the offshore waters of Tamil Nadu, Puducherry and Andhra Pradesh when traversing to and from the mass-nesting beaches of Odisha (Tripathy et al. 2003; Tripathy et al. 2006). It was reported that some of the turtles that nest in Odisha may be feeding off the coast of Sri Lanka and Tamil Nadu (Pandav, 2000; Bhupathy and Saravanan, 2006).

The coast between Puducherry and Chennai has approximately 75 km of sandy beach suitable for turtle nesting, with an average of 9.8 nests/ km/ season (Bhupathy & Saravanan 2001; Shanker 2003). Nesting starts in the middle of December and lasts till the end of March, attaining its peak in February (Bhupathy & Saravanan 2001). The population which nests on the Chennai coast is part of the same lineage which nests in Orissa; this population is considered to be globally significant as they are distinct from, and ancestral to, olive ridleys found in the Atlantic and Pacific Oceans (Shanker *et al.* 2004).

1.6. Necessity of the Conservation Action Plan

A significant proportion of world's olive ridley population migrate every winter to the Indian coastal waters to nest on the beaches in Odisha, Gujarat, Puducherry, Andaman and other parts of Indian coast. All the five species of sea turtles that occur in Indian coastal waters are protected under Schedule I of the Indian Wildlife Protection Act (1972), as well as listed in Appendix I of Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) which prohibits trade in turtle products by signatory countries. All species of sea turtles occurring in the Indo-Pacific region are a priority for conservation under the "Convention on the Conservation of Migratory Species of Wild Animals (CMS)" and are listed on both Appendices I and II. At present there are no commercial or international trade

of marine turtles or turtle products in India. However, incidental fishing related mortality of marine turtles which is globally well documented is also a matter of great concern for India.

The Olive ridley is considered to be the most abundant sea turtle in the world. Among the five species which occur in India, only olive ridley is found to be nesting along Nallavadu, Pannithittu and Narambi villages in Puducherry coastline. These turtle typically nests on ocean beaches near river mouth, above the high tide line and the front of the primary dune. Beaches of Puducherry serve as the main protective bulwark property along the shores of ocean, is also perhaps used for recreation. Puducherry beach habitat is critical for the recovery and maintenance of threatened Olive ridley turtle populations. State Forest department and NGO's have taken up protection of sea turtle nests primarily of sporadic nests of Olive ridley in Puducherry. The nests are invariably predated either by wild predators or by the large number of feral dogs that live on the coast. These nests are relocated to a hatchery where the hatchlings are subsequently released into the sea. While these initiatives are definitely helpful, there are no systematic or proper management of the hatcheries. There have been several guidelines for hatcheries elsewhere in the world especially that hatchling sex ratio are dependent on the temperatures that they develop in and this raises concern.

Human activities have resulted in a wide variety of direct and indirect impacts to this important habitat. In addition to that, the construction of jetties and shipping channels have altered natural sand movement patterns and increased erosion on some beaches. Direct impacts on beach dune habitats includes coastal development and construction activities such as beach nourishment projects, shoreline stabilization (rock armouring), home construction, artificial lighting, and increased recreational activities. Although there are numerous laws and agencies to protect marine habitats, the overview of researches suggests that the legal regime on marine areas is comprehensive in its nature and scope, but in reality there is inadequate in management of marine ecosystem. This is due to several reasons including involvement of multiple agencies, lack of coordination between stakeholder, inadequate scientific research and lack of integration of policy and science of marine conservation.

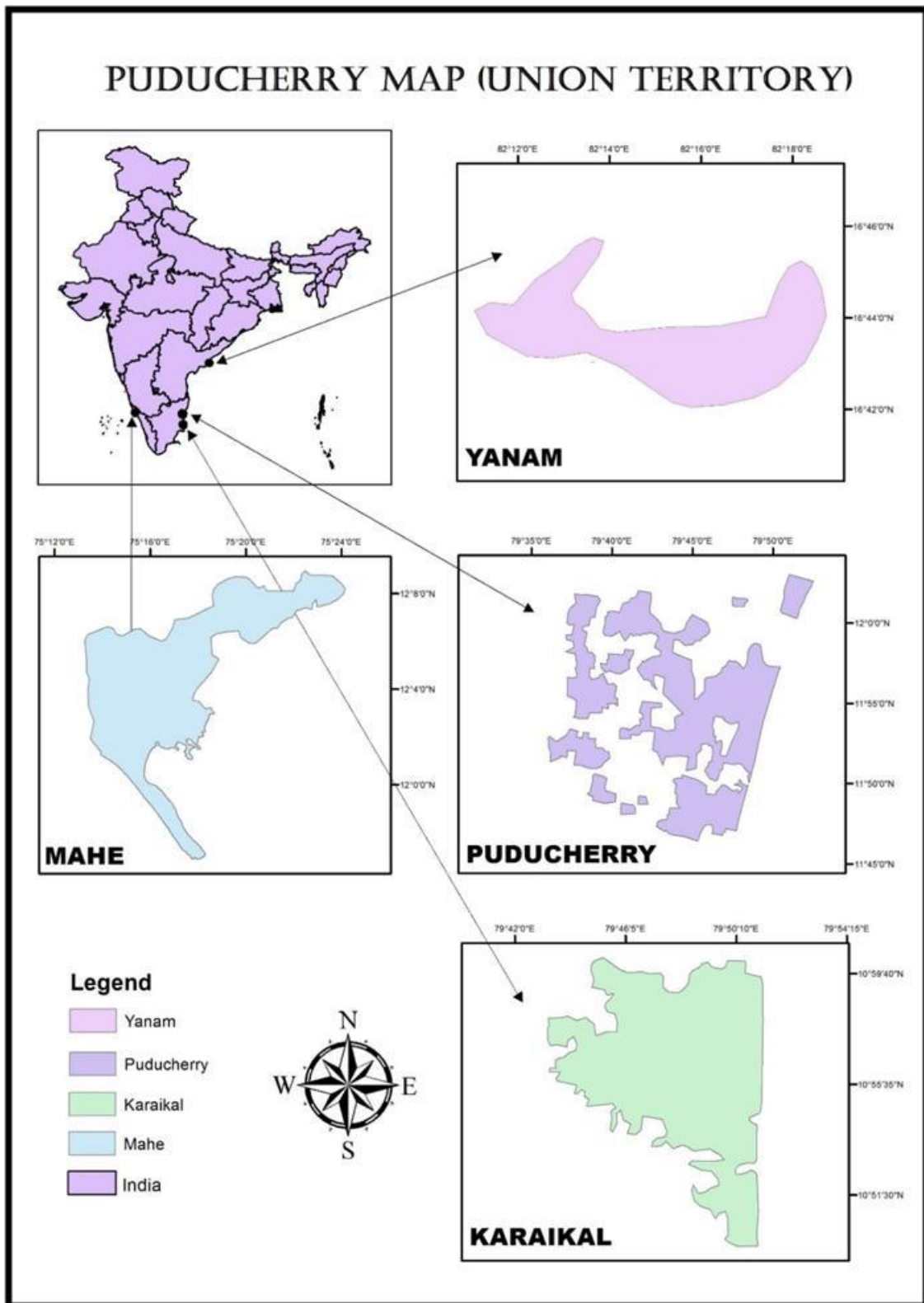
2. Puducherry Union Territory

Puducherry is situated on the Coromandal coast of Peninsular India, and is considered as the "The Window of French Culture". Historians say that the Puducherry in olden days was merely a "Fishing Village". It was an erstwhile French colony and merged with the Indian Union on the 1st November 1954 (*Fish Economy of the Union Territory of Puducherry - An Overview*). The Union Territory of Puducherry, an important maritime state in the Country is unique in several aspects. Unlike the rest of the states, it does not have a contiguous area, it consists of four dispersed parts: Puducherry, Karaikal, Yanam on the Bay of Bengal and Mahe on the Arabian Sea. Puducherry and Karaikal are by far the larger ones, and both enclaves of Tamil Nadu. Yanam and Mahe are enclaves of Andhra Pradesh and Kerala, respectively (Figure 2.1).



Figure 3 Undisturbed beaches of Puducherry before independence

Figure 2.1. Map showing the different territories of Pondicherry Union Territory



2.1. Puducherry Region

The Puducherry region is the largest of all four, and lies on the East coast, between 11°45' and 12°00' N latitudes and 79°35' and 79°50' E longitudes with an area of 293 km² bound by Bay of Bengal on the East (Figure 2.2). It has a 23.25 km long coastline and a continental shelf of 1000 sq.km enriched with marine fisheries potential. It has a fishermen population of about 25,892 of which 5,481 nos. of fishermen are actively engaged in fishing from 17 fishing villages in four different communes (Table 2.1 & 2.2). Of the 17 fishing villages in Puducherry region 16 villages has fish landing centre which includes Puducherry fishing harbour.



Puducherry is known for sporadic but solitary nesting of sea turtles especially Olive ridley and Green sea turtles along entire coasts of this Union Territory. However, due to changes in the beach profile along most parts of Puducherry coasts the turtles nesting are now restricted to few stretches of Pudcherry (Banugopan and Davidar 1999). High number of sporadic nesting of sea turtles observed on the beaches of Kanaga Chettikulam, Chinnakalapet, Periyakalapet, Veerampattinam, Chinnaveerampattinam, Nallavadu, Pannithittu, Narambai and Moorthykuppam in Puducherry. Of these, beach between Nallavadu and Moorthykuppam

is an important sea turtle nesting beach in Puducherry. Aside from the striking natural beauty that plants provide, they are crucial parts of beach ecosystems. Plants such as *Ipomoea pes-caprae*, *Spinifex littoreus* and *Cyperus arenarius* are the coastal flora found in abundance here and serve as the natural nesting sites for sea turtles (Pradheep et al., 2013).

2.2. Karaikal Region

Karaikal region lies at 10° 51' and 10° 59' N latitudes and between 79° 42'E and 79° 54' E longitudes with an area of 160 km² and is about 150 km further south of Puducherry, isolated within the Thanjavur District bounded on the east by the Bay of Bengal (Figure 2.2). The fishing villages of Karaikal are spread over a coastline length of 15 km along the south east coast of India, between Mandapathur fishing village on the north and North Vanjiur on the south. It has a fishermen population of about 11,294 of which 2,594 nos. of fishermen are actively engaged in fishing from 10 fishing villages in three different communes (Table 2.1 & 2.2).

Table 2.1. List of the fishermen population and information of fishing activity in Puducherry

| District | Coastal Communes | Fisher folk population | Total Population | FISHING CRAFT | | |
|------------|------------------------|------------------------|------------------|---------------|-----------|---------------|
| | | | | Mechanised | Motorised | Non-motorised |
| Puducherry | Puducherry | 20,131 | 25,892 | 244 | 1139 | 531 |
| | Bahour | 3703 | | | | |
| | Ariyankuppam | 2058 | | | | |
| Karaikal | Karaikal | 8588 | 11,294 | 115 | 376 | 121 |
| | Kottucherry | 858 | | | | |
| | Tirumalarajan-pattinam | 1848 | | | | |

Figure 2.1. Map of the Pondicherry Union Territory showing the turtle nesting beaches in the Puducherry and Karaikal Region

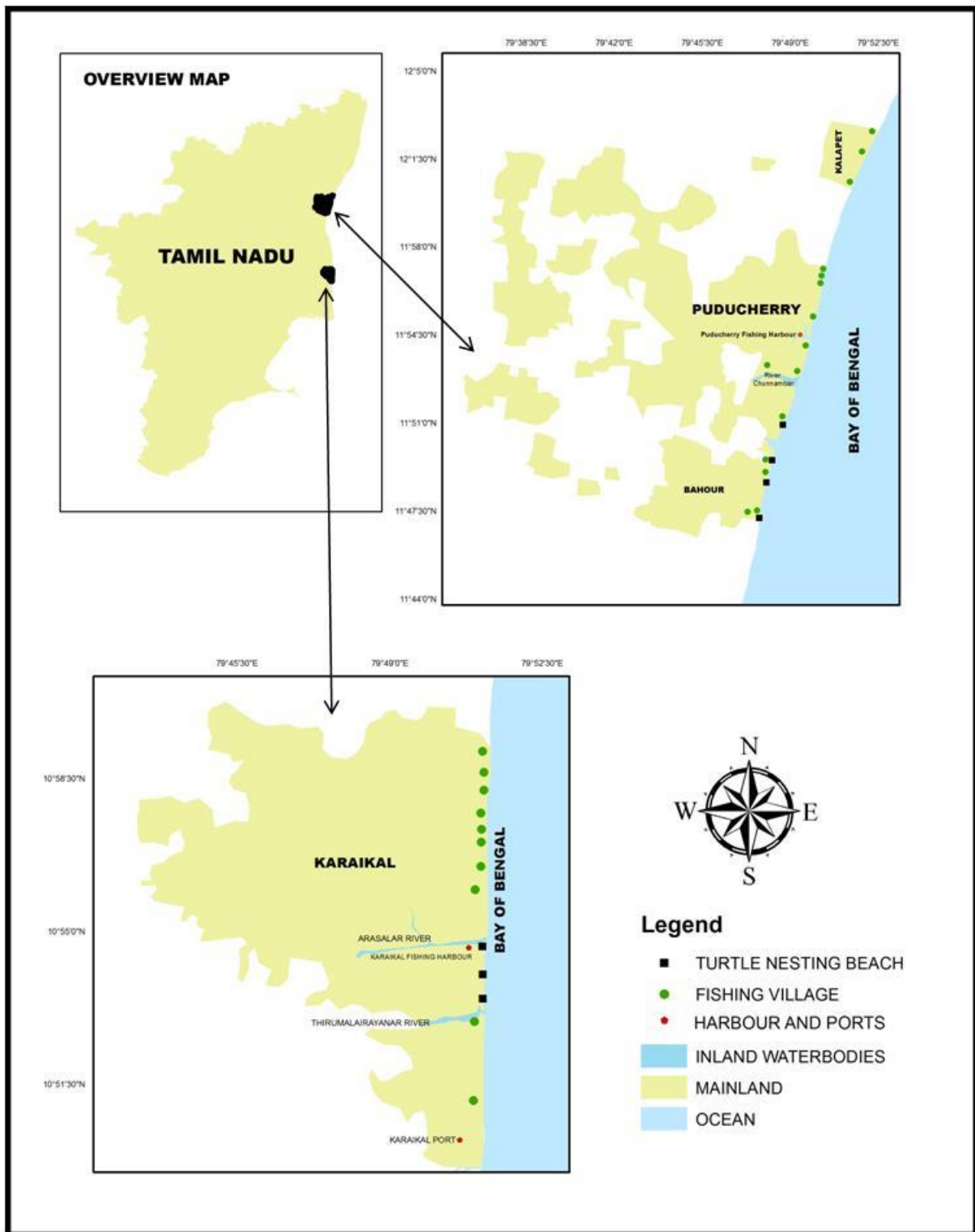
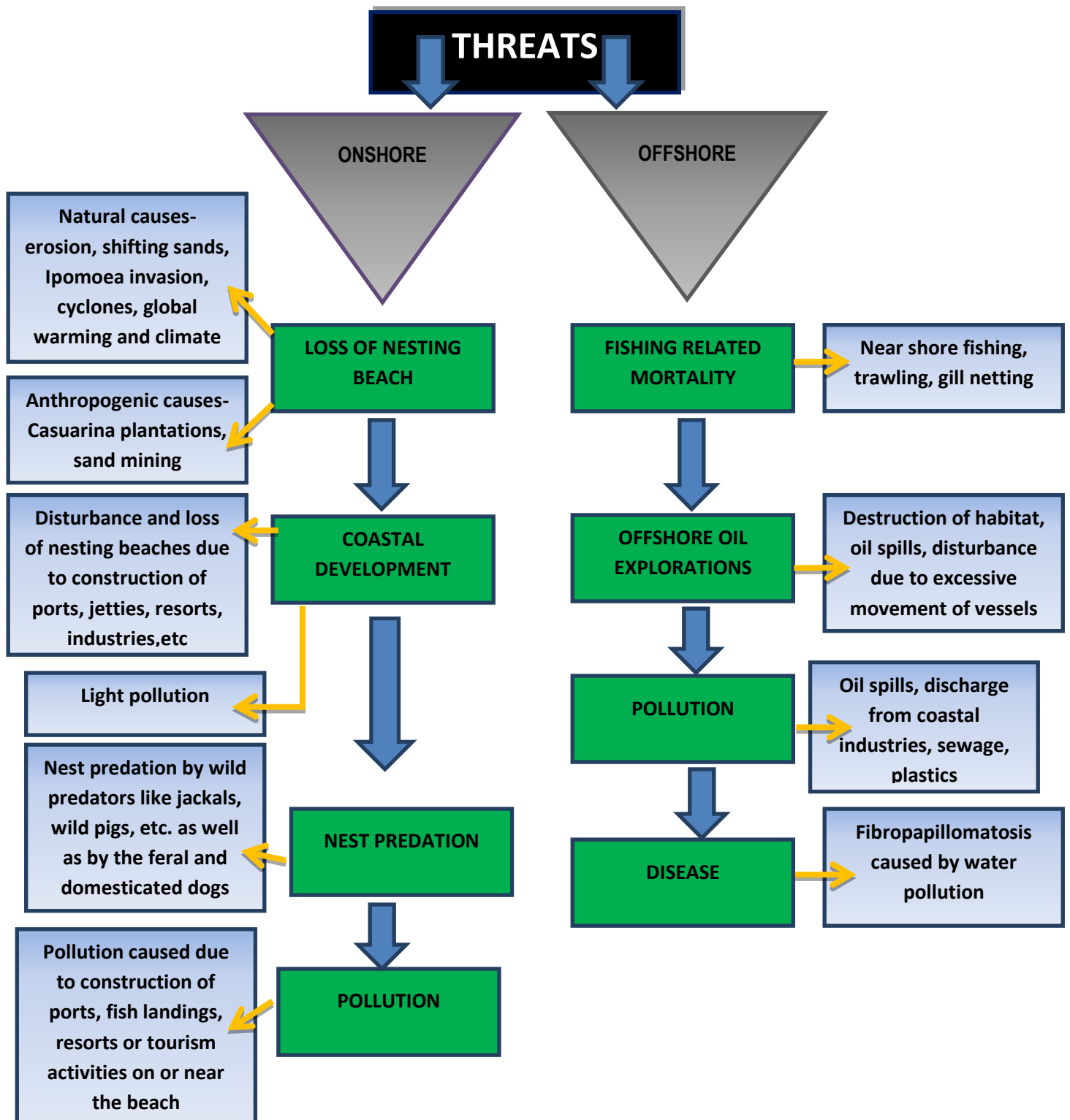


Table 2.2. List of marine Fishing villages and fish landing centres on the Puducherry and Karaikal coastline

| PUDUCHERRY | | KARAIKAL | |
|--------------------------------------|---------------------------------------|---------------------------|--------------------------------|
| Fishing Villages | Landing Center | Fishing Villages | Landing Center |
| 1. Kurusukuppam | 1. Peria Kalapet | 1. Akkampettai | 1. Mandapathoor |
| 2. Solai Thandavan Kuppam | 2. Pillai Chavadi | 2. Kalikuppam | 2. Akkam Pettai |
| 3. Periyakalapet | 3. Vaithi | 3. Karaikal Medu | 3. Kottucherry Medu |
| 4. Veeram Pattinam | 4. Peria Veeram Pattinam | 4. Karukkala Cherry | 4. Kasakudi Medu |
| 5. Pillaichavady | 5. Nallavadu | 5. Keezhakasaku dimudu | 5. Kilinjal Medu |
| 6. Pudukuppam | 6. Kanagachetti kulam | 6. Kilinjal Medu | 6. Karaikkal Medu |
| 7. Solai Thandavan Kuppam (North) | 7. Chinna Kalapet | 7. Kottucherry Medu | 7. Karukalancher y |
| 8. Vaithikuppam | 8. Solaithandav an Kuppam | 8. Mandapathur | 8. Thirumalaraya n Pattinam |
| 9. Vambakeerapala yam (North) | 9. Kuruchi Kuppam | 9. North Vanjore | |
| 10. Vambakeerapala yam (South) | 10. Vembakeerap alayam | 10. J.R. Pattinam | |
| 11. Chinnakalapet | 11. Pudukuppam | | |
| 12. Chinnaveerampa ttinam | 12. Panithittu | | |
| 13. Kanaga Chettikulam | 13. Narambai | | |
| 14. Narambai | 14. Moorthi Kuppam | | |
| 15. Pannittittu | 15. Pondicherry Fishing Harbour | | |
| 16. Moorthykuppam | 16. Kalikuppam | | |
| 17. Nallavadu | | | |

3. Onshore and offshore threats faced by the sea turtles



3.1. Onshore threats to sea turtles

Turtles nest on a variety of beach types. The mechanisms by which nesting females choose a beach or site on a beach are poorly understood (Mortimer 1995). Turtle species share broad nesting requirements. They nest on exposed marine beaches in deep, relatively loose sand above high-tide level (Hendrickson 1995). There is, however, a great deal of inter and intraspecific variation in preference regarding more specific beach characteristics. These include some physical features, such as beach length, width, height, slope, orientation, and vegetation (Horrocks & Scott 1991; Mortimer 1995; Salmon et al. 1995; Kikukawa et al. 1999).

The onshore habitats of marine turtles are under threat because of natural as well as anthropogenic pressures. The natural threats include loss of nesting beaches due to erosion, as well as sea level rise due to global warming. A major reason why marine turtles throughout the world are in danger is the growing interference of human on their onshore habitats which may be either through the direct influence or due to developmental activities taking place on the coastline. Some of the existing natural threats like predation of the turtle eggs get intensified when the human movement brings along associated predators like dogs. Other anthropogenic threats include pollution on the shoreline, casuarina plantations, light pollution on the beaches, etc.

A. Loss of turtle nesting beach: Beach erosion: This is the loss of beach or dune sediments by natural phenomena like wave action, tidal currents, wave currents, and drainage or high winds. Coastal erosion is a problem common to shorelines around the world, impacting about 70% of the Earth's sandy beach environments (Zhang et al, 2004). Beach erosion most commonly occurs during coastal storms. These storms are accompanied by a temporary increase of local sea level (the storm-generated surge above the normal astronomical tide) so that energetic storm waves are able to attack higher elevations of the beach and dune. Sediments there are extracted and put into suspension by the waves and carried offshore. Much of the sand is returned to the beach after the storm by long-period swell waves during normal water level. However, the major effect of the beach erosion is the loss of the sea turtle nesting habitats.



Figure 4 Exotic plantation along Karaikal coasts sheltering turtle nest predators such as dogs etc and also encroaching the nesting habitat

B. Sea level rise: The coastal areas are vulnerable to the sea level rise due to global warming. Loss of beach habitat occurring due to the sea level rise has both economic and environmental consequences. Beaches provide valuable ecological services in the form of natural protection for adjacent habitats such as lagoons and wetlands, and essential nesting habitat for endangered species such as marine turtles (Hendry 1993). The physical characteristics of beaches determined their vulnerability to sea-level rise. Narrower beaches with lower elevation are predicted, perhaps inevitably, to lose a larger proportion of their area under all scenarios of a rise in sea level.

Female sea turtles prefer to nest within specific elevational ranges above mean sea level, and this may affect nest success (Horrocks & Scott 1991; Maktav et al. 2000). In cases where landward beach movement in response to sea-level rise is constrained, inundation of currently preferred nesting areas could result in female turtles shifting their nest sites up the beach. As the sea levels rise and beaches are squeezed between development and an advancing sea,

female turtles are forced to nest in a relatively narrower band, exposing them not only to the impacts of development but also to a greater risk of nest overlap and saltwater inundation of their nests.

C. Dune vegetation growth: Very little is known about the effect of the natural dune vegetation like *Ipomoea pes-caprae* on the sea-finding abilities of the sea turtle hatchlings. Natural beach vegetation is commonly found at several places on the Puducherry coast. According to Pradheeps *et al*, (2013), plants such as *Ipomoea pes-caprae*, *Spinifex littoreus* and *Cyperus arenarius* are the coastal flora found in abundance here and serve as the natural nesting sites for sea turtles, such as the Olive Ridley (*Lepidochelys olivacea*, Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricate*) turtles.

According to a study by Rivas and Marco (2016), dune vegetation had a negative effect on hatchling speed, which led to an increased exposure time to predators and dehydration and it could potentially entail extreme physiological stress affecting hatchling mortality. Beach vegetation can affect sea turtle nesting productivity by obstructing nest construction (Chen *et al.* 2007) and potentially drying the sand, which can result in egg chamber collapse during nest excavation (Bustard & Greenham 1968).

Vegetation can also affect developing embryos. Roots can pierce, penetrate, and desiccate eggs, erode eggshells, and encase eggs in mats of vegetation (Leslie *et al.* 1996). Roots can also absorb nutrients and moisture from eggs (Hannan *et al.* 2007). Root invasion may reduce pore spacing (air volume between sand grains), impeding gas exchange between the eggs and surrounding sand that is vital for embryonic development and survival (Ackerman *et al.* 1985). Roots can also affect hatchlings, as they may become entrapped in mats of roots and fail to emerge from the nest (Caldwell 1959). Those hatchlings that do emerge may become entangled or disoriented by vegetation on the beach and fail to locate the ocean (Godfrey and Barreto 1995). The presence of vegetation might negatively influence the suitability of nesting habitats if beach erosion processes increase on nesting grounds in the future (Rivas and Macro 2016)



Figure 5 *Ipomoea pes-caprae* on the nesting beaches of sea turtles along Nallavadu coasts

D. Anthropogenic threats: Puducherry coast has been facing threats of erosion owing to natural disasters, pollution, exploitation and anthropogenic activities. The beaches near Nallavadu-Pannithittu- Narambi villages in Puducherry had been reported with an average of 100 nests of olive ridley every year before 2004 (as per Fishermen Comm.). However, this nesting number has now reduced to 30 to 40 in last three seasons i.e. from 2015 to 2017. Local communities believe that the land use changes along the coast are not conducive for more nesting. The man made threats on nesting beaches including 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.

Most of the Puducherry coasts have been modified in last 50 years due to various developmental activities except few stretches, and this appear to be the primary reason for the preference of sea turtle to nest on the beaches of Nallavaadu and Pannithittu villages, were there is minimal disturbance (Banugopan and Davidar, 1999). Similarly, beaches near

Arasalar River in Karaikal. These critical nesting beaches of the sea turtle are also highly threatened due to erosion caused by the nearby developmental activities.

The coastal satellite images of Puducherry have been analysed based on visual interpretation keys and analysed the land use and land cover changes from 2004 to 2015. During the last eleven years the prominent changes have occurred in land use and land cover of Puducherry coasts. A considerable increase in built-up land and aquaculture has taken place as well as a huge decrease in agricultural land between these periods. Agricultural land and beaches were converted into built up and aquaculture areas. About 24% of agricultural area in Nallavadu and 27.4% in Vanjur (Karaikal) were compromised for aquaculture and built up areas. Built up areas rose by 78% in Vanjur and 34% in Nallavadu. Percent rise for aquaculture in Vanjur could not be calculated as there was no land under aquaculture in 2004, while in Nallavadu, percent rise of aquaculture was 500%. As the coastal population continues to grow, there is remarkable increase in built up land and decrease in agricultural land.

E. Beach armouring : The deliberate ‘armouring’ of the coast with the sole purpose of protection of upland structures was rapidly degraded sea turtle nesting habitats in many parts of the Puducherry. Coastal armouring (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, and geotextile tubes) can impede turtle's access to upper regions of the beach/dune system, thereby limiting the amount of available nesting habitat. Impacts also can occur if structures are installed during the nesting season. For example, unmarked nests can be crushed or uncovered by heavy equipment, nesting turtles and hatchlings can get caught in construction debris or excavations, and hatchlings can get trapped in holes or crevices of exposed riprap and geotextile tubes. Important sea turtle nesting beaches of Puducherry should be free from beach armouring as sea turtles normally prefer gentle sloping seaward sand dunes rather than beaches which are subject to regular erosion.



Figure 6 Beach armoring to protect coastal infrastructure along Puducherry coast

F. Exotic plantations and over growth of vegetation on nesting beaches: While the beach itself is devoid of any vegetation due to the constant action of waves, the dune zone above the high tide line has various types of natural vegetation despite being subject to wind action in Puducherry coasts. Dune grass and other spiny vegetation trap blowing sand and help stabilise, maintain and elevate dune structures. There are also other salt tolerant creepers that help bind the sand.

Most sea turtles prefer open sandy beaches for nesting. Coastal sand dunes with natural vegetation such as *Ipomoea pes-caprae* and *Spinifex littoreus* are ideal nesting sites for sea turtles in India. The natural dune vegetation and dune structures are closely interrelated and have coevolved to support floral, and faunal communities obligate to the coastal dune habitat. Dense vegetation of exotic plants such as casuarinas provides shelter for both natural (jackals, monitor lizards, etc.) and subsidised predators (dogs, pigs, etc.) to breed and add additional predation pressure on nesting females, eggs and hatchlings, especially in Arasalar beach. In addition to that, exotic vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings.



Figure 7 Arasalar beach, Karaikal with casuarinas plantation

G. Artificial illumination: With increase in developmental activities along the coast, the nesting sites are often abandoned by the turtles due to human induced activities such as coastal illumination. Turtle hatchlings use visual cues to find the sea when they emerge. Both nesting adults and hatchlings therefore, are susceptible to changes brought on by the use of artificial lighting on the beach. The best strategy is to put off all artificial lights visible on the sea turtle nesting beaches during the breeding season. The number of lights near sporadic and secondary nesting beaches must be reduced to the minimum necessity and switched off during peak nesting nights.



Figure 8 Illumination along coast can deter sea turtles arrival to beach for nesting

H. Impact of Coastal development: In the process of coastal development (construction of highways, Hotels, Ports) coastal geomorphology is considerably altered. Engineering actions are often geared towards the development rather than towards the natural coastal geomorphology and ecological processes. Deltaic drainages, coastal vegetation, and the shore sand dunes often get impacted irreversibly. Apart from reducing natural coastal habitat, a highway, ports, and buildings also bring in new impact factors not present in the area before the construction of the highway. In the context of marine turtles, coastal highways on sand dunes have invaded sea turtle nesting sites, and highway illumination and vehicular traffic illumination have impacted marine turtles directly. In many areas, the quality of nesting beaches has already been compromised by beachside construction, exposing sea turtles to lights, activity, noise and altered physical characteristics, all of which can affect nesting success. With increasing access to the coast, human settlements crop up on the coast and along with humans, accompanying livestock, and pets (dogs) cause considerable damage to the coastal ecosystem. Predation on adults and hatchlings gets enhanced significantly as the presence of subsidised predator increases. Tourist activities on the beach like dirt bike riding, jeep parasailing, horse riding, etc. may impact the nests of the turtles directly. The sewage disposal by the human settlements near the coast pollutes the sea water and causes health problems in the sea turtles.

Construction on the dune and/or very close to the high tide line of the sea, directly impact sea turtles by:

- Reducing the space available for them to nest
- Disturbing their egg laying activities (due vehicular traffic)
- Increasing human and other biotic disturbance on the nesting beach. Increase in the garbage and waste material on the beach.
- Removing beach sand for constructions, thereby eliminating significant amounts of nesting habitat.
- Altering the geomorphology of the sand dunes and reducing the natural nesting beach over a period

I. Tourism: The pristine beaches of Puducherry are a heaven of tranquillity and can captivate visitors with their ethereal natural beauty. The beach and its immediate adjacent land, backwaters and offshore waters are preferred locations for coastal tourism. The greatest ecological threats that mass tourism poses, undoubtedly lie in the infrastructure and transport arrangements required to support it, particularly in situations where the numbers of tourists are subject to little control. Physical development of resorts, consumption of fuel by buildings, aircraft, trains, buses, taxis and cars, overuse of water resources, pollution by vehicle emissions, sewage and litter all contribute to substantial, often irreversible, environmental degradation, as well as to dramatic social consequences. The development of extensive road networks throughout the area increases habitat loss and creates habitat fragmentation. The natural landscape gets subsequently altered, interfering or stopping the natural ecological processes completely.



Figure 9 Tourism activities near Nallavadu beach need to be eco-friendly.

Impact of Coastal Tourism on sea turtles

- Construction of physical structures like restaurants, hotels causes physical alteration of the habitat and loss of nesting beaches
- Removal of vegetation, sand, corals, etc. from the habitat leads to increase in erosion of sand from the nesting beaches making the habitat less suitable to turtle nesting.
- Installation of beach chairs, tables, shops, etc on the beach acts as a barrier for nesting females in finding a suitable nesting spot.
- Joy rides on beach using animals like horses may result into nest destruction by trampling as well as compaction of sand which makes the beach a less suitable nesting habitat.
- Speedboat movement and anchoring in the shallow habitats lead to destruction of the habitat. The boat movement also results into collision with turtles giving them fatal injuries.
- Littering of beach by tourists result into increase in garbage and trash on the beach which threatens the health of the tourists as well as the turtles nesting on the beach.

The turtles as well as the hatchlings may get entangled in the trash and their movement gets restricted.

- Snorkelling, SCUBA diving, etc. can disturb the foraging and breeding activities of the turtles. These activities may be causing damage to the habitat like seagrasses, corals, etc. unintentionally which results into the loss of sea turtle habitat.



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Figure 10 Beach vehicle needs to be avoided on the nesting beaches such as Nallavadu

J. Nest predation: Turtle eggs are particularly vulnerable to predators. Eggs are predated by natural and subsidised predators, and in many instance by humans. Many animals seem to be aware of the nesting cycle of marine turtles, and eagerly gather to ravish nests once the turtles have made them. The hatchlings must also escape the clutches of these animals when they try to reach the water, and even when they reach the ocean, predators such as sharks await them. The very presence of monitoring and surveillance personnel or even just researchers is often enough to deter egg collectors to some extent. This, of course, is if the collectors know that the collection of eggs is illegal, which is not the case in many areas. In this case, it is first necessary to acquaint them with the wildlife laws. Predators such as semi-domestic, feral dogs, introduced and widespread plants are also nuisance to sea turtle nests. It is important to monitor and manage the dogs on the nesting beaches of sea turtles along Puducherry coasts.



Figure 11 Nest predation

Figure 3.1. Time stamp images from Google earth of the Puducherry coastline showing the loss of turtle nesting beach south of the river mouth near Thengaithittu and rapid urbanisation to the north from 2005 to 2016.

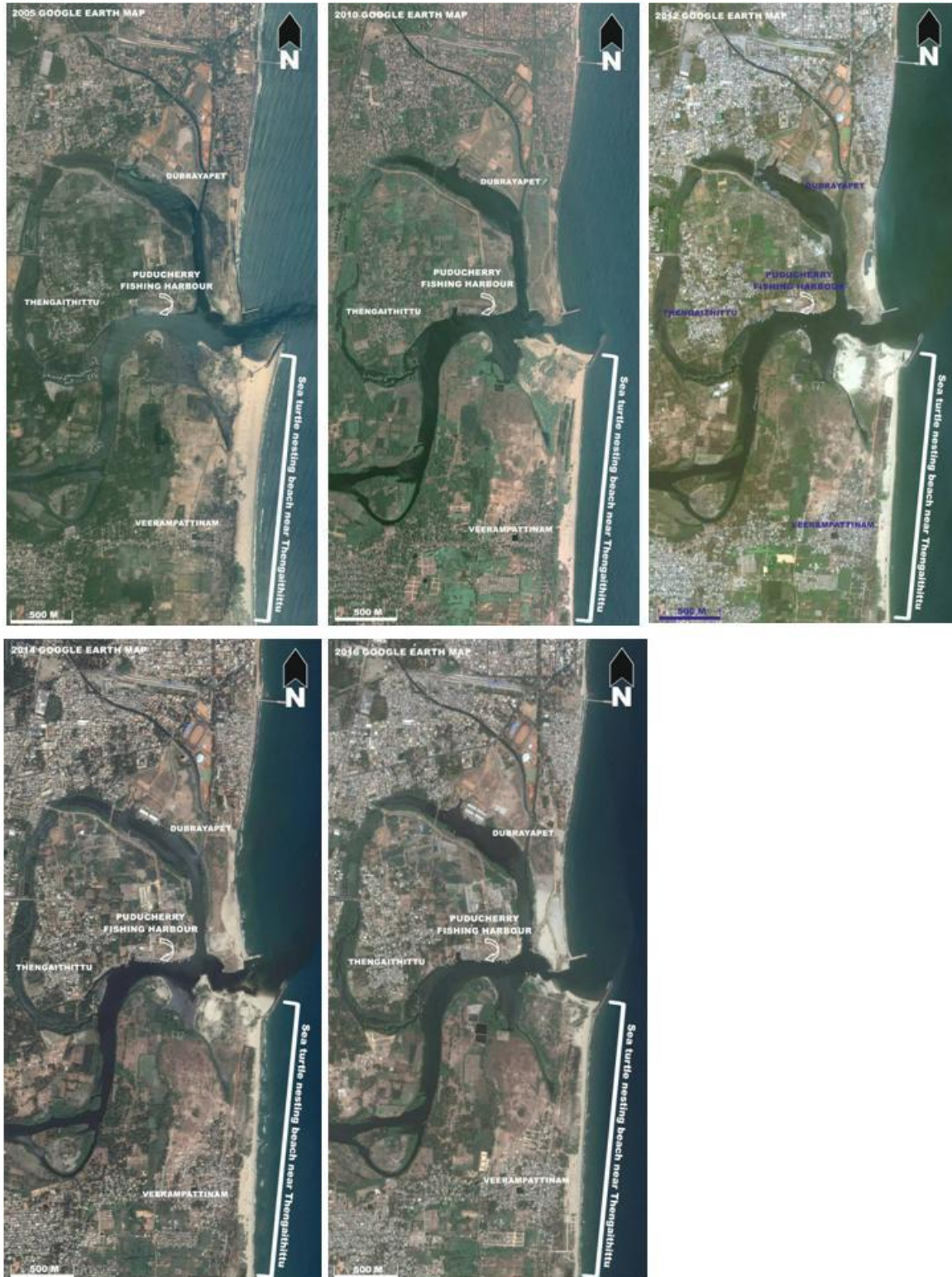


Figure 3.2. Time stamp images from Google earth of the Puducherry coastline showing the loss of turtle nesting near Nallavadu and Narambi between 2005 to 2010. Narambai and Nallavadu approximately 6 -10 km from Puducherry fishing harbour and Puducherry port.

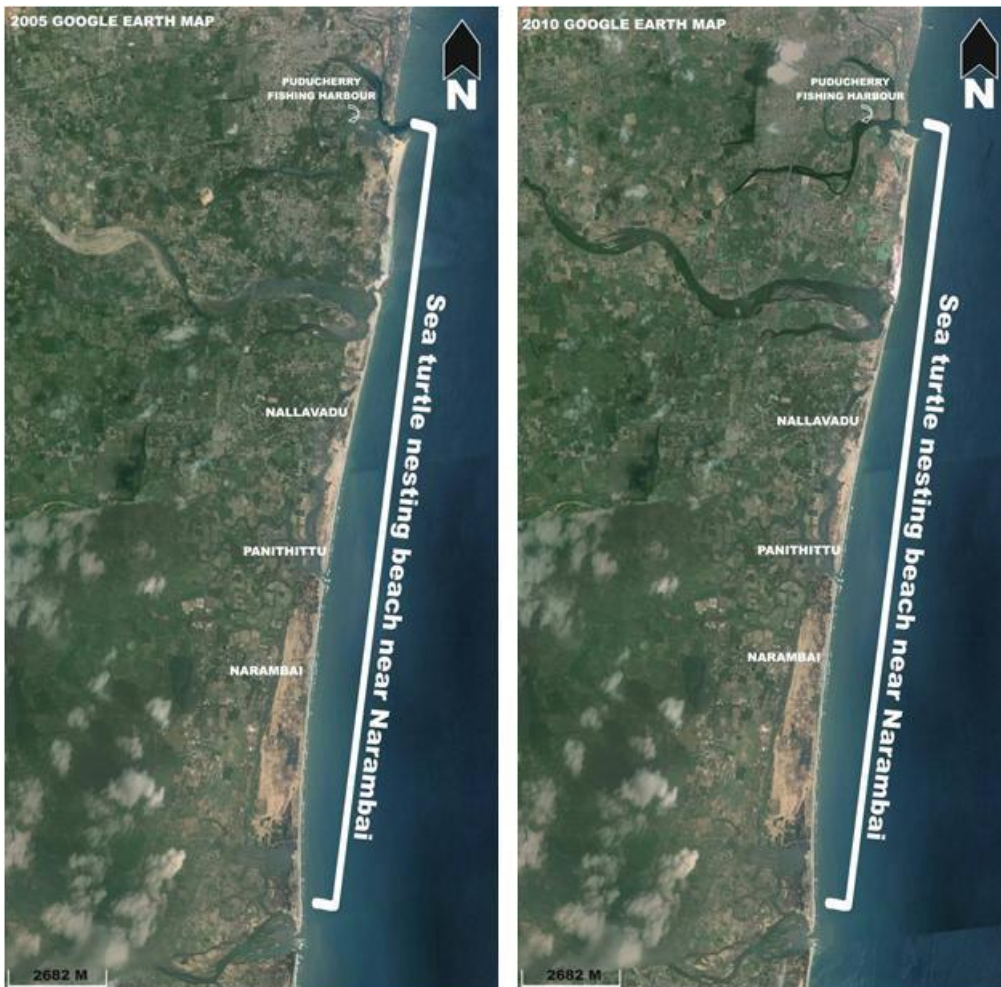


Figure 12 Proposed Sea Turtle Community Reserve

Figure 3.3. Time stamp images from Google earth of the Karaikal coastline showing changes in the beach morphology along this coast before and after Karaikal port construction. The port is located near to the Vanjur beach.



3.2. Offshore threats to sea turtles

Coastal offshore habitats also have great significance for the survival of marine and coastal flora and fauna. Marine turtles, whose lifecycles are intricately linked to both onshore and offshore coastal habitats, can be important indicators of impacts, since their survival is dependent on the wellbeing of these two habitats. Offshore waters are most important habitat for sea turtles, males and females begin the reproductive cycle by migrating from their feeding grounds to breeding grounds. Feeding and breeding grounds may be separated by several thousand kilometers. Courtship and mating occur primarily in the offshore waters of the breeding ground; 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.

The Olive ridley turtle is capable of foraging at great depth (up to 150 m or even more) in tropical neritic waters and undertake long journeys in search of suitable feeding grounds. They swim over considerable distances offshore and float calmly over deep sea waters, waiting for certain crustaceans which emerge to the surface of water only during the night (Eckert et al., 1999; Tikader and Sharma, 1997). This largely carnivorous turtle feeds on dead fish, crabs and other crustacean, jellyfishes and molluscs (Daniel, 1984; Das, 1985; CNMA, 2002). Large number of olive ridley turtles travel through the offshore waters of Tamil Nadu, Puducherry and Andhra Pradesh when traversing to and from the mass-nesting beaches of Odisha (Kar, 1983; Raja Sekhar and Subba Rao, 1993; Tripathy et al. 2003; Tripathy et al. 2006). It was reported that some of the turtles that nest in Odisha may be feeding off the coast of Sri Lanka and Tamil Nadu (Pandav, 2000; Bhupathy and Saravanan, 2006).

Sea turtles are vulnerable to offshore threats at all stages of life, from hatchlings to juveniles to adults. They are several offshore threats to sea turtle population in and around Puducherry waters viz., fishing related threats, pollution, disease and offshore oil explorations.

- A. Fishing related mortality:** Puducherry and Karaikal regions support 2,526 fishing crafts of which 399 are mechanized, 1,515 are motorized and 652 are traditional crafts. Trawler, Gillnetter and Ring seiner are foremost in mechanized fishing crafts, Fibre glass boat and Dugout Canoe are foremost in Motorized fishing crafts and

Catamaran is the only fishing crafts predominantly used as traditional fishing methods (Marine Fisheries Census 2010, CMFRI).

As per the traditional ecological knowledge of the fishermen in the Puducherry fishing village, there was a drastic decline in the turtle nesting on their beaches but the same time the number of dead turtles stranded on the beach increased that might be due to intensive fishing nearby area. December, January and February is the important mating season of Olive Ridley along east coast of India including Puducherry. Turtles congregate near offshore of nesting beaches before nesting and these breeding turtles are more vulnerable to fishing especially for trawlers. This might be reason the more number of dead turtles stranded near Narambi beaches during December, January and February. This observation further strengthen that both beach and nearby offshore water of Narambi fishing village are important turtle habitat of Puducherry.

Operation of different types fishing gears and boat traffic are the major threats during breeding season to the sea turtles, near offshore of Puducherry especially near Narambi (Puducherry) and Arasalar River Beach (Karaikal). It was observed that the breeding season of sea turtles coincides with the peak fishing season. Turtles get entangled in gillnets, pound nets, and the lines associated with long line and trap/pot fishing gear. Turtles entangled in these types of fishing gear may drown and often suffer serious injuries to their flippers from constriction by the lines or ropes. In addition to entangling turtles, long line gear can also hook turtles in the jaw, oesophagus, or flippers. Trawlers that are not outfitted with turtle excluder devices (TEDs) do not allow turtles to escape from their fishing nets, which may result in mortality through drowning.

One of the study by WII on the olive ridley turtles in Odisha waters suggests that, mechanized trawl fishing is responsible for much of the turtle mortality in the offshore waters of Odisha, there is however no information on the impact of gill net fishing on the incidental capture and mortality of turtles in these waters. This is even more important as gill net fishing is practiced around the river mouths, which is where the turtles congregate. Therefore, a study on sea turtle-fisheries interface should look into the monofilament or multifilament, and any other gill net fishing practices in Puducherry is required. Based on which, measures to reduce turtle by-catch in these fisheries can be devised (*Compilation of research information on Olive ridley turtles, May 2009*).



Figure 13 Sea turtles killed while fishing but incidentally along Odisha coasts during 1990s

B. Offshore oil explorations: Although, there is no ongoing oil exploration activities nearby off coast of Puducherry but this area has also been identified as potential source of hydrocarbons that could possibly be explored in the future. The extraction of oil, gas, and minerals from the Earth's crust provides most of the energy and resources our society needs. However, prospecting, drilling, and transport associated with offshore mining can seriously damage sensitive marine areas and disturb marine species in a number of ways. Pollutants include things like toxic metals, pcb's, petroleum products, and agricultural and industrial runoff of contaminants such as fertilizers, chemicals, nutrients, and untreated waste. Pollutants may cause immediate harm to sea turtles through direct contact or can build up in tissues over time and lead to immune suppression resulting in disease and death. Sea turtle habitat overlaps with areas most likely to be affected by offshore oil exploration and production. Petroleum pollution occurs from intentional discharge from vessels, vessel groundings, offshore oil exploration and production, transport of oil products, spills, and runoff of oil from land based sources. Oil from spills far offshore concentrate along convergence zones (where currents meet) which is are important areas for young turtle development. Oil from spills offshore also washes up on beaches where it degrades nesting habitat, and can impact nests, nesting females, and hatchlings making their way to the water. Sea turtles are also affected by ingesting food contaminated by oil or tar balls. Tar balls form

when crude oil floating in the water degrades. A large percentage of dead hatchlings whose stomach contents have been examined have ingested tar balls (Oil and Sea Turtle NOAA, 2003)

Possible likely impact of exploratory drilling and other related work in the area as below.

- Disorientation of migrating adult and hatchling of sea turtles due to illuminations from drilling rigs.
- Oil pollution during exploratory drilling and accidental oil spills and blow outs during exploratory and production phase.
- Damage to marine environment & benthic fauna due to large scale dumping of drilling cuttings.
- Additional impact on displacement of fishing community and fishing ground.
- Specific recommendation and additional mitigatory measures were suggested by the MEG for safe environmental practices.



C. Pollution in offshore waters: Coastal waters and beaches are under constant threat from pollution originating from landward activities as well as from the sea. Such pollutants have often proved to be the primary cause of death of marine animals. Impacts of pollution on sea turtles have been less severe, although accidental ingestion of plastics has been documented to indirectly cause death due to poisoning or starvation because of the inability to swallow

food due to the blockage of the food passage by these materials. Further, changes in water temperature and quality results in changes in their offshore breeding congregation locations. Changes in salinity profile and levels of organic and inorganic pollutants in the vicinity of mass nesting sites will impact adults and hatchlings.

Therefore, it is important to continuously monitor levels of pollution both onshore and offshore of Puducherry. Prohibiting discharge of crude oil, pesticides, heavy waters, heavy metals and other poisonous effluents to estuaries and coastal areas and near turtle nesting beaches would help save the turtle habitats. Prohibition should be imposed on discarding of fishing lines, nets, plastic bags and other trash into the water or on the beach leading to ghost fishing and incidental mortality of sea turtles.



Figure 14 Marine Pollution

D. Disease: One of the most common disease and threat to sea turtle populations in worldwide is fibropapillomatosis. Also known as "FP", this disease causes cauliflower-shaped tumours on external soft parts and internal organs of a sea turtle. This skin disease causes the turtles to develop tumours on their skin. Though it most commonly affects greens, it has also been documented in loggerheads, Kemp's ridleys, olive ridleys and leatherbacks. This disease can be fatal if it invades the turtle's internal system, but will often heal if the tumours are superficial. down making them more vulnerable to predation and collisions with boats. Tumours around the eyes can obscure vision and eventually cause blindness, and tumours around the mouth can impair breathing and feeding. In some areas, many stranded and dead turtles have FP tumours. Research is still being done to determine the exact cause and transmission of this disease.



Figure 15 Disease affected sea turtle

4. Conservation Actions

4.1. Suggested measures to manage onshore threats

A. Guidelines to control erosion of turtle nesting beaches

- Periodic artificial nourishment is widely regarded as an environmentally acceptable method of beach and dune protection and restoration for short-term urgencies (viz. storm-induced erosion) as well as long-term issues (i.e. structural erosion and relative sea-level rise) (Hanson et al, 2002). Nourishment includes deliberately placing an amount of sand on an eroding beach or creating a beach where no beach or only a narrow beach was present before (Speybroeck et al, 2006).
- While beach nourishment often seems preferable, it can negatively impact sea turtles if the sand is too compacted for turtles to nest in or if the sand imported is drastically different from native beach sediments, thereby potentially affecting nest-site selection, digging behaviour, incubation temperature and the moisture content of nests. Colour, density and grain shape can change the heat retention capacity of the sand and thus alter the temperature of the beach sand. Therefore the preferred time of nourishment entirely depends on the nature and location of the beach and the species inhabiting or exploiting it (Speybroeck et al, 2006).
- However, when done correctly and in accordance with all laws, nourishment may create suitable habitats for rare or threatened organisms like sea turtles (Speybroeck et al, 2006). It is worth noting that a very wide beach resulting from nourishment is generally only beneficial to sea turtles only in those areas where less degraded nesting habitat had previously existed.

B. Guidelines for management of turtle nesting beach guarding against sea level rise

- Whilst a number of management options can preserve beach area, the best option is that beaches remain in a natural state, maintaining vegetation, sand characteristics and morphology.
- The goals of coastal management in response to sea-level rise should ideally be to ensure that development does not occur in areas vulnerable to flooding, that ecological systems can function naturally and that economic activities are protected

- 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.

C. Guidelines for management of natural vegetation growth on turtle nesting beach

Tropical seaward 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. The following are the suggestions for manually managing the natural vegetation on the turtle nesting beaches.

- 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 (excavation and sifting) 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.

D. Guidelines for eco-friendly beach armouring:

- All important nesting beaches of moderate intensity must be identified and should be free from beach armouring as sea turtle normally prefer gentle sloping seaward sand dunes rather than eroded beaches.
- Beach changes must be measured and monitored on a regular basis; this may be mandatory information for planning agencies and others to reduce the problems caused by coastal erosion and effective management.
- Construction of temporary sand trapping fences: A typical sand fence consists of vertical planks joined with wire/rope or supported with sand posts. Such structures have proved to be more effective in controlling beach erosion and are relatively as sea turtle friendly. The placement of these fences should not impact nesting females. In general, a section of the fence should be less than 3 m in length with 45° angle about the high tide line. The section of the fence should all be parallel to each other.
- Sand trapping fences perhaps constructed in destroyed, eroded beaches during the non-nesting season and once the sand is trapped sufficiently to create a dune, it should be planted with appropriate vegetation. This will further reduce erosion and remove the need for armouring. Depending on the availability, the fence can be constructed with discarded coconut branches, dry wood and logs, and other materials.
- Coastal vegetation promotes the large-scale trapping of sand. The stems of beach grasses reduce the wind velocity near the surface resulting in deposition of sand. The plant roots also serve to bind and consolidate the sand. Therefore, re-vegetation is a suitable option for eroded beaches instead of armouring. However, this should be area specific and depend on the characteristic of a particular site. For example, olive ridley prefers wide sandy beaches with no vegetation up to a distance of 50-100 m from the high tide line.

E. Guidelines for eco-friendly coastal vegetation

The biological and ecological significance of the beach are often overlooked while undertaking developmental activities or afforestation programmes. The following guidelines are therefore suggested for eco-friendly re-vegetation of the coastal sand dunes.

- As a policy, no exotic species should be planted in CRZ areas so as to prevent unknown/unforeseen ecological impacts
- Environmental and ecological impact assessment studies must be conducted before taking up any afforestation programmes along the coast, with provisions set up to evaluate any post-project impacts on sea turtles
- Plantation of exotic vegetation should be clearly avoided on beaches that are known to be sea turtle nesting grounds
- Apart from the high prioritised 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 historically known sea turtle nesting sites, alien and exotic plantations should be gradually removed to restore the nesting beaches to their former state

F. Guidelines for managing coastal illumination

Any light that is visible to the human eye at turtle level on a beach affects the nesting turtles and/or hatchlings. The most direct and complete way to resolve the problem of lights near sea turtle nesting beaches is to put off all artificial lights visible on the nesting beaches during the breeding season. Unfortunately eliminating all the beachfront lighting is not always possible. There is a definite need for a Coastal Illumination Act to define appropriate beachfront lighting, to set standards, apply regulations, and deal with offenders. Compared to other kinds of coastal development, light pollution is probably

one of the problems that can be solved with relative ease, if the government and residents are committed to conserving sea turtles. The following illustrations (adapted from Witherington & Martin 2003, see bibliography) depict factors to be considered for suitable lighting near sea turtle nesting beaches, including mounting position, light distribution, and overall suitability.

Under such circumstances, following a few simple measures can help mitigate impacts.

- Artificial illumination along important sea turtle nesting beaches during the nesting season must be turned off (depending on the species, the peak nesting season at any particular location usually does not exceed three months of the year).
- The number of lights near sporadic and secondary nesting beaches must be reduced to the minimum necessary and switched off during peak nesting nights.
- Illumination reaching the nesting beach can be reduced by lowering, shielding, and redirecting light sources onto immediate land rather than towards the sea. Even the glow on the horizon can affect sea turtles. Low mounted lights are better than lights that shine upwards from a high pole.
- An easy means to reduce the influence of light on turtle beaches is to screen them on the seaward side. This can be done by applying dark tinting to windows visible on the beach and by drawing curtains after dark to shield lights.
- Care in placement and orientation of light fittings on coastal buildings and infrastructure will considerably reduce the impact of direct and scattered lighting on turtle nesting beaches. Orienting light towards land or by directing lights downwards and by using lamp shades is an easy and effective solution.
- Studies have shown that fluorescent, mercury vapour, high-pressure sodium vapour, metal halide and white incandescent lighting disorient sea turtles the most. Further studies need to test which lights affect sea turtles the least (and this may be species specific). For loggerheads, low-pressure sodium vapour lights (not to be confused with high-pressure

sodium vapour lights) that emit a pure yellow light seem to work best. Similar studies need to be carried out for olive ridleys which nest along much of the Indian coast and are most affected by artificial lighting.

- Security lighting can be placed on motion sensitive switches that keep lighting off when it is not needed. Lights that come on only when approached can be quite effective for security purposes.
- Vegetation can suitably “block” artificial lighting from reaching the beach. This might not be applicable in all situations but may work in specific cases (see Karnad *et al.* 2009).

G. Guidelines for managing coastal development on and around turtle nesting beaches

- Locating the construction of Ports sites far away from the coastal dune habitat, construction of roads and other building may be preferably done on the landward slope of the sand dunes rather than the seaward slope
- Environmental Impact Assessment studies and alternate site locations to eliminate such impacts should be mandatory regulation for the establishment of ports, harbours and jetties.
- Plantation of indigenous species on the seaward side of the highway to reduce lights on the beach from vehicular traffic and marine drives and also to safeguard the highway from sand deposition
- Closure of vessel traffic at night, at least during nesting season at prime sea turtle nesting areas
- Creation and restoration of degraded dune habitats caused by highway construction
- Creation and enforcement of rules and regulations, which prohibit construction within a certain distance from the sea and making a buffer area which can simultaneously accommodate the dynamic nature of beaches

- In areas that are already extensively developed, coastal realignment is an alternative, or complementary, approach to the enforcement of setbacks. Hotels have an economic life of ca. 25e30 years before they need to be extensively renovated, converted or demolished (Cambers et al, 2003). At the end of this life span there is scope for rebuilding further back from the water.

H. Guidelines for eco (turtle) friendly tourism

- Regulated coastal tourism activities on the turtle nesting beaches especially Nallavadu cluster in Puducherry and Arasalar cluster in Karaikal.
- Turtle friendly coastal illumination must be lit up on the beaches.
- Beach levelling and removal of natural vegetation should be permitted after consulting the conservationists or coastal zone management authorities
- Foot traffic on turtle nesting beaches should be controlled to avoid disturbance to the turtle nests. Nests should be marked so that the tourists don't accidentally end up disturbing them.
- A ban on using heavy animals for joy rides or vehicles for tourism activities on the beaches should be enforced.
- Tourism infrastructure development should be well beyond the high tide line or on the landward slope of the beach rather than the seaward slope.

4.2. Suggested measures to manage offshore threats

The main objectives of this action plan are to control the offshore threats of marine turtles that occur in Puducherry, and to restore and manage all species of marine turtle migrating from their feeding grounds to breeding grounds to Puducherry. This Action Plan of Marine Turtles focuses on reducing threats, conserving critical habitat, exchanging scientific data, increasing community awareness and participation, promoting regional cooperation, seeking resources for implementation and enforcing the present fishing law. There are a number of gaps in our knowledge about the marine turtle population in Puducherry waters. These gaps occur in areas of biology and ecology, habitat requirements, and potential threats. The following is a list of efforts that are required in order to fill the knowledge gaps.

A. Guidelines Fishing Related Mortality

- In coastal shrimp trawl fisheries, promote the use of turtle excluder devices (TEDs) to reduce sea turtle by-catch or incidental catch and mortality.
- Avoid purse seine encirclement of sea turtles to the extent practical.
- Requirements for appropriate handling, including resuscitation or prompt release of all bycatch or incidentally caught (hooked or entangled) sea turtles.
- If encircled or entangled, take all possible measures to safely release sea turtles.
- For fish aggregating devices (FADs) that may entangle sea turtles, take necessary measures to monitor FADs and release entangled sea turtles, and recover these FADs when not in use.
- Development and implementation of appropriate combinations of hook design, type of bait, depth, gear specifications and fishing practices in order to minimize by-catch or incidental catch and mortality of sea turtles.
- In long line gear, use of large circle hooks with no greater than a 10 degree offset, combined with whole fish bait. These measures have shown to be effective in reducing sea turtle interactions and mortality;
- Arrangement of gear configuration and setting so that hooks remain active only at depths beyond the range of sea turtle interaction; and
- Retrieval of long line gear earlier in the day and reduce soak time.
- Avoid loss and discarding of fishing gear and other debris; and retrieving derelict fishing gear and other debris at sea.
- Setting gill nets perpendicular to the shore to reduce interactions with nesting females.

- Regulations on the movement route of fishing boats near the Arasalar River estuarine are required. Entry and exist route of fishing boats to the landing centre should be at a vertical line instead of sailing along coastal waters of nesting beach where turtles use the water for breeding. This would prevent the killing of mating turtles.

B. Guidelines for offshore oil explorations

Considering the extreme sensitivity of the conservation of olive ridley turtles both globally as well as nationally and in the light of news facts on the behavioural pattern of turtles brought out by Wildlife Institute of India, Dehradun, the proposal of exploratory drilling operations for oil and gas in off-shore exploratory block MN-DWN-98/2(MD-10) and NEC-OSN-97/2(NEC 25) in the Bay of Bengal of Oishaa coast needs in-depth examination from environmental angle. Assuming that the exploratory work would eventually lead to further developmental activities, a Multi-Disciplinary Expert Group (MEG) was required to assess the likely impacts of exploratory drilling and to suggest possible mitigation measures additionally for protection the natural life cycle of the turtles. The MEG reviewed identified possible likely impact of exploratory drilling and other related work in the area as below.

- Disorientation of migrating adult and hatchling of sea turtles due to illuminations from drilling rigs.
- Oil pollution during exploratory drilling and accidental oil spills and blow outs during exploratory and production phase.
- Damage to marine environment & benthic fauna due to large scale dumping of drilling cuttings.
- Additional impact on displacement of fishing community and fishing ground.
- Specific recommendation and additional mitigatory measures were suggested by the MEG for safe environmental practices.

C. Guidelines for management of pollution

- Prohibit discharge of crude oil, pesticides, heavy waters, heavy metals and other poisonous effluents to estuaries and coastal areas and near turtle nesting beaches.
- Prohibit discarding of fishing lines, nets, plastic bags and other trash into the water or on the beach which results in ghost fishing and incidental mortality of sea turtles.

- Introduce organised clean-up of beaches and near shore waters by local forest and fisheries departments and other governmental agencies in collaboration with nongovernmental organisations, coastal communities, and school and college students.

4.3. Guidelines to control nest predation and manage through hatchery program

Sea turtles do not have parental care. The female turtle deposits the eggs on the beach and leaves the rest to nature. Nature worked pretty well for millions of years, but human related threats such as harvest of adults and eggs, and predation by feral animals has had severe negative impacts on most turtle populations including in Puducherry.

Since most nesting beaches in Puducherry are affected by factors that endanger nesting turtles, eggs and hatchlings, it is often necessary to have an appropriate conservation programme to safeguard the sea turtle populations. Management to maximize hatchling production while maintaining the natural ecosystem processes still remains a priority. In this section offsetting nest loss due to nest predation through hatchery management is detailed.

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 labor intensive, and makes it possible to transplant eggs into hatcheries relatively quickly. One alternative that combines aspects of *in situ* and *ex situ* practices is to simply translocate 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 very high humus/organic soil content.



Figure 16 A model hatchery to protect eggs from predators and safely hatch them.

Buried mesh and caging: 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.

Eggs need to be protected immediately after laying when they are most susceptible to predation. Again, after about 30 days, when the nest temperature reaches a certain level (due to the metabolic heat generated by the developing embryos), the predated eggs start to rot and

smell. Predators (like dogs) which rely on smell will learn quickly to locate these nests. Fresh nests are also susceptible to these predators. Hatchlings are again susceptible to predation during emergence. In such cases, the nests need to be protected throughout the incubation and emergence period. The placement of mesh or caging surrounding each individual nest is possible on beaches where the main threat is from predators such as dogs and pigs. The mesh should be buried deep enough to protect the egg from burrowing by predators. Mesh size should be big enough to allow hatchlings to crawl through after emergence, if the nests are not going to be monitored during that period.

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 go 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 of egg deposition. Eggs collected within 8 - 10 hours (i.e. 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 laying eggs, 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 a nesting turtle is found, it is best to collect the eggs during or immediately after 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 completed 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, i.e. 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 metre between nests (and up to 2 metres 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. A sample hatchery data sheet is provided on page 127. 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.

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. Unless 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 a 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 behaviour and exhaust their yolk reserves. They need both the yolk reserves and swim frenzy behaviour to help them to swim past the breakers. Hatchlings should not be retained in containers with water; they should be released as soon after emergence as possible.

4.4. Sea turtle monitoring program for effective management

Sea turtle monitoring program is an important component as it provides information on turtle population, nesting and habitat status, offshore distribution and threats. It is expected that a reduction in the mortality will increase the current survival rate of marine turtles across their range. Details of the different activities as part of the monitoring program that are required to be taken up along the coast is given in Table 4.1. Organizing such programs should be made mandatory within the jurisdiction of Puducherry, which will help in reductions in mortality, and evaluate the effectiveness of management measures adopted.

The monitoring programs should always include gathering and collating information through

- Assessment of marine turtle mortality related to fishery
- Assessment of marine turtle distribution at sea from information provided by fishers and
- Assess sea turtles nesting along the coastline
- Beach monitoring to assess the status of the nesting beach
- Assessment of the feasibility of tracking entangled turtles after release to determine survivorship and migratory paths.

Setting out beach transects is a good way to determine which area has the highest density of nests. This activity can decide the place of the hatchery as well as areas in need of higher vigilance. Every 200 meters a marker post is to be placed to facilitate quick recording of location when gathering data. Starting at 0.2 km on the stretch of beach, marker posts from 1 to 10 indicate distance or as far as monitoring is manageable. Patrol groups should never be larger than two people. Whereas large groups are harder to control working with a turtle, and there is a much higher risk of disturbing the animal.

Nesting is the most accessible and vulnerable stage of sea turtle life history. If there is a possibility of encountering egg-bearing females or newborn hatchlings on the beach, then certain rules of behavior must apply. If these rules are not enforced, the encounters may result in sea turtle harassment, changing patterns of nest site selection, lowered reproductive success, and environmental degradation (e.g., shoreline erosion, litter, beach fires, trampling of vegetation). Without a trained guide or another expert in attendance, onlookers can easily

frighten the turtle or alter her natural behavior, collect or restrain hatchlings, or damage the nest cavity.

The aim of Sea turtle monitoring program is to determine an increase or decrease of sea turtle population size in the nesting species, while at the same time increase the hatchling success through nest protection and hatchery management. The very presence of monitoring and surveillance personnel or even just researchers is often enough to deter egg collectors to some extent. This, of course, is if the collectors know that the collection of eggs is illegal, which is not the case in many areas. In this case, it is first necessary to acquaint them with the wildlife laws. All five species of sea turtles found in Indian waters are classified in Schedule 1 of the Indian Wild Life (Protection) Act, 1972, which affords complete protection for the turtles and their eggs. Offenders can be sentenced to imprisonment for a maximum of seven years.

Marine debris defined by NOAA as any “persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally disposed or abandoned into the marine environment”. Trash in the near-shore waters and coastal areas of Puducherry are a growing problem. Most often the trash observed at sea are those discarded on land, and either get carried into the ocean by wind or during high tide. Sea turtles are known to accidentally ingest certain kinds of trash especially plastic transparent polythene bags, and have resulted in death. Thus, regular monitoring and cleaning the beaches by involving local community and schools and college would help in maintaining the beach and the nearshore waters relatively clean. This effort will also create sea turtle conservation awareness among local populace.

Refer the ‘Sea turtles of India (2011) A comprehensive field guide to research, monitoring and conservation (Compilers. S. Shenoy, T. Berlie and K. Shanker). Dakshin Foundation, Bangalore and Madras Crocodile Bank Trust, Mamallapuram, India. 148 pages’ for further details.

Establishment of Research cum Rescue and Rehabilitation Centre for Marine Animals in Puducherry

Background

Stranding of marine animals such as whales, dolphins, turtles, etc have been observed frequently along east coast of India including Puducherry. Mostly, due to lack of adequate facilities and capacity, those stranded animals either let die or released back without any first aid but with injuries. However, stranded marine animals (turtles) have long attracted public attention. Those that wash up dead are, for all their value to science, seldom seen by the public as more than curiosities. Animals that are sick, injured, orphaned or abandoned ignite a different response. Generally, public sentiment supports any effort to rescue, treat and return them to sea.

Losing their way from their deep sea migratory paths due to natural or manmade ocean disturbances is believed to be among the probable causes of marine mammals beaching. However, not much scientific study has so far been done to assess the behaviour, habitat and adaptability of these giant marine mammals.

The National Park authority unable to successfully rescue and release the stranded marine mammals largely due to lack of capacity and logistics. The whales and dolphins are social animals, moving in groups. They have poor visibility and communicate with each other through echolocation or sound made by them to stay in touch with each other during migration.

Due to disturbances in the sea water created by the movement of warships, thundering, cyclone etc., echolocation of certain individual whale may get disrupted, turning it haywire. In the process, such individuals tend to get washed ashore. Other factors — including climate change, tectonic movements of sea beds caused by sub oceanic volcanoes or earthquakes — also impact the overlying ocean water, which in turn can influence the whales as well.

Further, disturbances in the form of Active SONAR (sound navigation and ranging) may also affect certain species of whales. SONAR emits varying frequencies of sound vibrations under water and used to detect marine vehicles. The immense pressure of such waves may cause internal bleeding in the ear and brain tissues, killing or disorienting whales, including infants from their mothers.

Moreover, injured whales, dolphins and dugongs due to fishing or navigating boats are also strand including sea turtles. Rescuing, treating and rehabilitate them required unique capacity and facilities. Therefore, it is recommended to establish a 'Marine Animals Rescue and Rehabilitation Facility' at Gulf of Kutch .

Roles of Authority

The Forest Department is legally responsible for enforcing the Wildlife (Protection) Act , 1972. This means that PFD is in charge at marine mammal stranding events. As the lead decision maker, PFD's responsibilities include:

- Protecting the welfare of stranded animals
- Disposing of any dead marine mammals
- Ensuring the health and safety of staff, volunteers, and the public
- Enabling cultural protocols – this involves consulting with local s through every step of the stranding, including rescue, euthanasia, sampling and disposal
- Enabling research, e.g. through the collection of scientific samples.

Major actions required to rescue and rehabilitate certain marine animals in the Puducherry .

▪ Immediate care

Aim: To prevent more animals dying, reduce stress, and increase chances of survival

Any animals found stranded the stay clear of the tail as this can cause injury. In suitable conditions (i.e. not too windy), cover animals with wet sheets and begin gently bucketing water onto them. Do not cover the blow hole or pour water into the opening (to prevent this, wait until the animal has taken a breath before pouring). Concentrate on flippers and flukes (tail). If an animal is on its side: try to get the whale upright by digging a shallow trench parallel to the belly, remove sheets, and gently roll the animal into the trench. Ideally use at least 4–6 people. Keep flippers tucked downwards into sides, and once the whale is upright, dig small holes for the flippers to hang freely into. If the whale is too big or suctioned into wet sand, do not over-exert or cause injury to yourself or others.

▪ Moving

Aim: To move animals to deeper water, and to bring scattered animals together

Ensure all people are aware to avoid the tail and the mouth over the next stages, as these are powerful and can cause injury. Moving the animals generally begins when water is about knee deep or more around the animals. Only people with wetsuits should be involved from this stage on. Coincide your re-floating efforts with waves for increased buoyancy. Tarpaulins, slings or pontoons may be used to shift smaller animals, under the guidance of DOC. Avoid moving

animals over rough surfaces when not fully buoyant. Do not tow animals by fins, flippers or tails.

- **Reorientation**

Aim: To prepare the animals for release and decrease the chance of re-stranding

Once in waist-deep water begin gently rocking the animal from side to side. Have at least 2 people per animal. This should be carried out for as long as possible to allow the animal to familiarise itself with movement in water. Bring all animals together so the pod can be released together. Wait until the last animal is ready for release. Reorientation time will vary depending on the condition of the animals but can take an hour or more. Subject to conditions, each animal should have had at least 30 minutes. Assess whether the animal can: Surface to breathe unassisted f Orientate and stay upright in the water Self-right if rolled onto its side

- **Release**

Aim: To release all of the animals in one group

Release animals in water deep enough for them to swim but shallow enough for helpers to walk. Do not release until given the go ahead from rescue crew. A co-ordinated release will greatly increase the chances of a successful re-float. Any whales showing aggressive behaviour are to be avoided and identified to the person coordinating the release.

- **Monitoring**

Aim: To prevent re-strandings

You may be asked to form a human chain parallel to the shore, creating a barrier between the animals and the beach. If you are, ensure you remain in a comfortable depth of water, and not above shoulder height when standing. Stay in line in the human chain. At this stage, animals may become defensive of the pod and may become agitated or aggressive if approached. This may be displayed as tail slapping, swimming close by, or open-mouthed lunging. Striking metal objects or slapping the water's surface can deter animals from returning to shallow water. DOC boats may be used to help herd

animals offshore. Be aware that animals can be groggy, disoriented, and can be very determined to return to shore. Do not jeopardise your own safety to stop the animals returning.

Establishment of a Mobile Marine Animal Rescue and Rehabilitation Facility (MMRRF)

A mobile Marine Animal Rescue and Rehabilitation Facility (MMRRF) needs to be established in collaboration with WII and CMFRI. All marine animals stranded alive are required to be rescued by this facility. Treated animals need to be released back safely to the sea. A van with inflated boat, with all necessary rescue materials, medicine etc is required for this facility. Further, a Rapid Response Team consisting of atleast five members who have been trained in the marine mammals rescue and release need to be associated with this facility. A trained veterinarian should be part of the Rapid Response Team.

Turtle Scholarships and Turtle Ambassadors

As part of outreach and awareness component, a unique participatory program, the Turtle Scholarship Scheme needs to be initiated to engage local fisherfolk communities at grassroot level. This program should target school-going children of local communities (mostly of fisherfolk) and provide them with a scholarship of Rs. 500 / month for a period of two years to support their education. The students selected through the process should be identified as Turtle Ambassadors and will become part of an extensive Turtle Volunteer Network, alternatively known as Friends of Turtles Network. This multi-pronged strategy involves school children in turtles conservation awareness activities and integrates their families as part of the wider network of forest department frontline staff, divers, tourist boat operators and coastal village communities. This network will provide us with information on turtles nesting, sightings/stranding as well as participates in outreach events for generating awareness in the areas of turtles occurrence.

Establishment of First Sea Turtle Conservation Reserves of India at Karaikal and Puducherry

Puducherry, is a small but beautiful Union Territory of India, located along the southern east coast of India with coastline of 45 km. This coastline is being used for nesting of sea turtles, especially Olive Ridley and Green Sea turtles. Their sporadic nesting is at peak during November to February along Puducherry and Karaikal coasts. High sporadic nesting of sea turtles were observed on the beaches along Nallavadu/Moorthikuppam villages (Puducherry) and beaches around Arasalar River (Karaikal), therefore, these two beaches have been identified as 'Important Sea turtle Habitats of Puducherry' and recommended to be declared as the 'Community or Conservation Reserves' as per the Wildlife (Protection) Act, 1972. Further, it is recommended to manage these two beaches with active participation of local communities by promoting the turtle conservation as well as eco-tourism.



Figure 17 Time stamp images from Google earth of the Karaikal coastline showing changes in the beach morphology along this coast before and after Karaikal port construction. The port is located near to the Vanjur beach

4.5. Budget: The cost for monitoring and the conservation actions that can be done for sea turtles in Puducherry.

| S. No. | Activity | Time Frame | Institutional Representation | Budget* |
|---------------|---|-------------------|---|----------------|
| 1 | Beach monitoring | Once a month | Forest Department | 2.0 |
| 2 | Control and removal of excess natural vegetation | Every October | Forest Department | 2.0 |
| 3 | Nest counting & Protection | Seasonal | Forest Department | 10.0 |
| 5 | Hatchery Development | Permanent | Forest Department | 10.0 |
| 6 | Turtle Friendly coastal illumination | Permanent | Municipality | 20.0 |
| 7 | Tree Plantation along the coastal highway | Permanent | Forest Department | 10.0 |
| 8 | Beach Cleaning | Once a month | Municipality | 5.0 |
| 9 | Enforcement of TED's | Permanent | Fisheries Department | 10.0 |
| 10 | Fishermen Awareness Campaigns | Once a month | Forest Department | 5.0 |
| 11 | Turtle by-catch reduction by enforcement of a turtle by-catch management plan | Permanent | Forest & Fisheries Department | 2.0 |
| 12 | Sea turtle Research (tracking, offshore population monitoring, nesting biology) | Three years | Research institutions & Forest Department | 20 |
| 13. | Establishment of Research cum Turtle Rescue and Rehabilitation Centre | Permanent | Forest Department & MoEFCC | 200 |
| 14 | Establishment and management of of Sea turtle Conservation Reserves at Nallavadu and Karaikal | Permanent | Forest Department, MoEFCC and WII | 100 |
| 15 | Turtle Scholarships and Turtle Ambassadors | 10 years | Forest Department | 10 |

* Rupees in lakhs per year

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