Chapter V

DISCUSSION
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Of the seven species of turtles found in the world, four are found in the Indian coastal waters and all of them are categorized as endangered by the IUCN and are protected under the Indian Wild Life Act 1972.

The varied species are found to nest and forage along diverse habitats along the mainland and islands of India. In recent times these unique nesting habitats have been subjected to a lot of stress from the growing human population and subsequent increase of developmental activities. In view of this and towards the conservation of nesting habitats, which determines the survival of the species, the study "Environmental factors influencing turtle nesting along the Indian coast" was taken up.

Many of the Environmental parameters, particularly beach topography including beach type, island or mainland, breadth, slope, sand dunes, soil types proximity of rivers in relation to their influence on nesting habitats have been studied only with particular coastal states, such as Orissa, Andhra Pradesh, and
Lakshwadeep islands. (Dash and Kar 1990) (Shanker et.al., 2006). The occurrence of vegetation and its influence on nesting habitats has only been briefly mentioned or not mentioned at all in previous studies like the recent UNDP Sea turtle project published as the Marine turtles of the Indian subcontinent 2006. But a more detailed listing can be found for the Orissa coast (Dash and Kar, 1990) and (Pandav, 2006).

However even these studies have enlisted vegetation as overall, from a larger area or district, and are not site specific. The current study focuses on short listed areas of high nesting intensity along all coastal states and attempts to compare flora based on their availability, intensity and possible influence on the nesting habitats.

Threats to turtles in the current study, has been examined or compared more from a human impact point of view than from natural causes. The latter has been extensively studied and documented in World and Indian contexts which can be found, as early as in studies from Carr (1956) and Salm (1976), Murthy and Menon (1976). The causes are numerous, and largely cannot be helped.
Records of tides and currents have been maintained by various departments, including Climatology and Meteorology. Tidal influences with regard to nesting beaches and particularly the high nesting ones, have not been compared or studied in detail, except for indications of monthly wise tidal variations, or just levels with particular states such as Orissa, Gujarat and West Bengal (Dash and Kar, 1990; Sunderraj et al., 2006). These, if have been recorded, is only seen for a maximum of five years, and has not been analysed with regard to nesting seasons or its peak.

The current study compares tidal variations for every month in every state for over a period of ten years and attempts to compare its relationship with nesting seasons and its peak, if any. It also takes into account the moon phases linked with the particular high tides influencing high intensity nesting. Though this is a much argued subject, where many find no correlation, studies like those of Subramaneum (1999) has found links between the lunar cycle and nesting peaks. The current study investigates further.

The results of this comparative study are given state wise, from the places surveyed along the Indian coast. They are in the
order of surveyed dates. The final comparison of the results has been provided towards the end of the chapter. To help a better understanding of the work, previous studies have also been discussed herewith.

**Karnataka**

Karnataka has a coastline of 260kms. It is in the western side of India facing the Arabian Sea. Coastal Karnataka extends to three districts such as the Dakshina Kannada, Udupi and Uttara Kannada. The Dakshina Kannada and Udupi districts lie between 12° 27' and 13° 58' North latitude and 74° 9' to 75° 10' East Longitude and 13° 55'' to 15° 31' North latitude (Anand Rao and Sherieff, 2002).

Karnataka coast has only nesting of Olive ridley turtles (Kar and Bhaskar, 1982). The nesting of Olive ridleys is sporadic along the Karnataka coast (Madhyastha *et. al.*, 1986; Kurian and Nayak, 2003 and Sharath, 2006). This is comparatively unstudied with the rest of coastal states of India and works have been restricted to those of, Appayya (1985, 1986), Kar and Bhaskar (1982), Rajgopalan *et. al.*, (1996), Kurian and Nayak (2002), Nayak *et.al.*, (2003) and Forest Departments.
There has been very little knowledge on the nesting season of the state. A recent study by McCann (2007) in the Udupi district records nesting between September and February. The current investigation from beach and market surveys and has found a season ranging from October-April for the Uttara Kannada district. Many areas of Karnataka however still remain to be recorded for occurrence of nesting.

The selection of survey sites was largely based on the knowledge of local communities and resource people and little from earlier works, as much of the coastline is unexplored with regard to nesting information.

**Beach topography**

The topography of the coastal beaches of Karnataka with regard to the nesting scenario has hardly been studied. And the nesting densities that were reported by Sharath were only in 2006, along the Dakshina Kannada and Uttara Kannada districts. However the survey areas listed were quite small to include all Uttara Kannada beaches to estimate nesting densities that are linked to topographical aspects. But other records like those from Nayak (1982), Anand Rao and Sherieff (2002), Andrade and Nayak (2004) have studied the coastal ecosystems.
of Karnataka giving some accounts into the topographical aspects.

Study beach areas were selected from the three coastal districts of Uttara Kannada, Udupi, and Dakshina Kannada, and were surveyed between the years 2002 and 2004. The places are listed below:


Beach Vegetation

Several studies including those mentioned above have documented the flora of Karnataka beaches, but none in particular relating to the nesting beaches. However the current study examines some dominant flora along the beaches:

Ipomea pescaprae found throughout except on rocky shores; Spinifex littoreus mostly along the same beaches where Ipomeas are distributed. Plantations like Casuarina and Coconuts were also found. Other vegetation growing in lesser
intensity are the Pandanus which is commonly found, but in small patches particularly around the Dhareshwar coast. Mangroves mostly found near riverine outlets and some beaches with silt formation.

Cultural aspects and threats

The development along the beaches, such as erection of erosion preventive structures continues to progress through out the coast. And this has also been confirmed by Sharath (2006). The current investigation has found that nest predations are pretty high especially from humans as some communities were found to harvest adults and eggs both for consumption and traditional beliefs, and some other are also found to worship the turtles. Until the year 2004, Karwar fish market openly sold turtle eggs and meat and the consumers were mostly from the Christian community. After the ban was imposed this trend has now come to an end. Some communities like those of the Gowdas in the Gokarna areas, who are basically vegetarian, would harvest adult turtles and eggs for their religious rituals. However and strangely enough the Kharvi or the fishermen community do not harm the turtle but instead revere, them a situation comparable to the coastal fisher folk in Orissa. It is also tradition among the Gowdas, to leave one egg back in the nest pit as a
mark of respect for the turtle, which suggests a natural conservation sense among the community. There is also a Masai temple in Kumta where turtles are worshiped.

Sand mining continues to be rampant along the coast, which is resulting in shallowness of the sand layers, thereby eroding the nesting spaces of turtles.

Tidal Heights and Moon phase

Tidal heights and corresponding moon phase in relation to nesting season and its peak in Karnataka has not been studied before. High tides have been found favourable for nesting and studies like Kurian and Nayak, (2002) and Subramanuem (2004) has indicated a correlation. The current study which has compared data of tidal heights for the last 10 year for Karnataka state has found that high tides ranging from 2.04 mtrs to 2.21 mtrs were prevalent in the months from October to April which coincides with the nesting season particularly in Uttara Kannada. Also the peak season November and December record higher tidal values between 2.17mtrs and 2.21mtrs. the months after the nesting season appear nowhere in the 2.0 metre range. And interestingly these high tides have occurred at night, the time turtles prefer to nest. The Moon phase prevailing during these
months is 1-2 days prior to full moon and new moon and exactly on full moon and new moon.

Goa

The state of Goa is at the northwestern tip of Karnataka and has a coastline of 160 kms. It is bordered by Maharashtra in the north, Karnataka in the south, the Western Ghats in the east, and the Arabian Sea in the west separated by the Terekhol River. Its geographical position is between the latitudes 15°48'00" North to 14°53'54" North and longitudes 74° 20'13" East to 73° 40'33" East.

Three species of turtles are known to nest in Goa, the Olive ridleys, Green turtles and Leatherbacks. (Kar, 1982, Bhaskar, 1984, Das, 1985), but studies from Giri and Chaturvedi (2006) indicate the nesting of only olive ridleys.

However the history of turtle conservation activities dates back to one by Captain Gerald Feranandes who initiated sea turtle conservation movement in (1996) involving local villagers (Kutty, 2002, Giri, 2006). Another by a church priest was initiated in Galgibaga (1999) involving local people, school and
college students, and later the activity was taken over by the forest department (Giri, 2006).

**Beach Topography**

The nesting sites of turtle along beaches of Goa are along the beaches of Morjim, Agonda and Galgibag, which fall into the north and south divisions of Goa respectively. The rivers Chapora and Galgibaga empty into the Arabian Sea and are also in close proximity to these nesting sites. This was also observed by Giri (2006). Earlier studies have not been able to generate much data on the nesting densities along these beaches, but here there has been some mentions of protected nests and beach topography. The presence of undisturbed sand dunes, coconut and casuarina plantations and adjoining rivers along nesting beaches have been mentioned by Giri (2006).

The current study bases itself on this report, which was submitted in brief to the UNDP project in 2002. The list of study sites were identified from the report and further investigation carried out. However an addition of another sporadic nesting site bordering Karnataka was also surveyed.
Beach vegetation

Plantations of Casuarinas and coconuts have been reported in previous studies (Giri, 2006), the observation also shared in the current investigation and has found it to be quite ubiquitous in distribution. However, small patches of \textit{Ipomoea pescaprae} have been observed along the Morjim and Agonda Stretches in the present study.

Threats

Poaching of eggs is a major hazard in the non-protected beaches of Goa and harvesting of adults and selling of their meat, capture in trawl fisheries has been found in Goa. Developmental activities from tourism are also posing a serious threat (Giri, 2000). While these continue to be threats the current study also observes that beaches like Agonda are in the process of being eroded and a large part of the beach has already undergone erosion. Also the sighting of a dolphin entrapped in a gill net, in the low nesting area of Poleam, suggests possible threats to turtles also. Fishing related mortalities have been reported by Rajagopalan (1999).
Tidal heights and Moon phase:

The months of October to March are reported to be the breeding season in Goa (Giri 2006) and September to April as reported by the Goa Forest Department (2006).

The monthly tidal analysis for the last 10 years in Goa shows that the high tides dominant in particular months, particularly at night were prevalent between the months of October to March ranging from 2.25 mtrs to 2.38mtrs. This is exactly coinciding with the nesting season. Moreover after March the tidal cycle is seen to reverse with all highest tides falling during day, which is an unlikely time for turtle nesting as has been documented by (Shanker, 2003).

The dominant moon phase recorded is one day prior/after Full moon or new moon and exactly on full moon and new moon.

Orissa

The State of Orissa is on the eastern coast of India with a coastline of 480 km, extending from 17° 49' N to 22° 34' N Latitude and from 81° 27'E to 87° 29'E longitude. It is one of three places in the world which witnesses the mass nesting of Olive ridley turtles called the 'Arribada' Spanish term meaning mass
arrival. On the mass nesting beaches such as the Gahiramtha coast 100,000 turtles come at once to nest crowding the beach, where every bit of space available is occupied by nesting turtles (Shanker, 2003). The current investigation also witnessed this event. Despite human presence, turtles are just not deterred from nesting. A Mass activity probably makes them feel more secure.

Of the four species of turtles reported from this place only the nesting of Olive ridleys has been confirmed (Dash and Kar, 1990). The mass nesting of turtles occur in three places along the Orissa coast-Gahirmatha known to the scientific world since 1973, the Devi river mouth discovered in 1981 (Kar, 1982) and the recently discovered Rushikulya river mouth (Pandav, 1994). From the point of view of the current study this area is of high importance as the mass nesting events here was what triggered my curiosity into taking up this wide area of investigation.

The coast of Orissa particularly along the Ganjam district and Gahirmatha shows significant amount of differences from the other coasts of India. Conservation genetic study (Shanker et. al., 2003) suggests similarity in genetic pattern in the mass nesting population which makes them site specific returning to the beaches of their birth. Moreover tag studies on the east coast
also confirmed it. However since genetic or tag studies has been limited from the west coast of India these results cannot be confirmed. In addition two particular incidents along the Orissa coast such as the super cyclone in 1998, which broke up one of the mass nesting patches Ekakulanasi (also previously broken up by cyclone in 1989) into Nasi 1 and Nasi 2 (Pandav, 1998), and the planting of casurina trees by the forest department as a preventive measure on one such mass nesting site, led to the mass nesting turtles look for alternate sites. This event questions the hypothesis of site fidelity for turtles and suggests other factors such as the environment to have a crucial role in nesting. This is indicative of the need for space, irrespective of the genetic factors that controls site selection. Thus the current study found the need to compare beach breadths and other topographical factors important for the species survival.

**Beach topography**

Nesting ecology and beach topography of the mass nesting beaches have been studied in great length from 1973 (Daniel and Hussain, 1973; Bustard, 1974; 1976; Kar, 1980; Kar and Bhaskar, 1982; Biswas, 1982; Silas et. al., 1984). While all of these have been specific to Orissa, a comparative study of habitats across India using the same parameter format has not
been carried out. The current study brings out these topographical factors and some peculiar observations on vegetation and tides.

The study areas in this place, was however not selected on the basis of the UNDP report, but from earlier publications such as Dash and Kar (1990), Pandav (1994) etc.

**Beach vegetation**

The most prominent beach vegetation found all along the Orissa coast, are sand binders such as *Ipomoea pes caprae, Launea sarmentosa, Gisekia pharancoides* and *Spinifex littoreus* (Pandav, 2006). Mangrove vegetation at the background of the Ekakula beach has been discussed by Dash and Kar (1990). Mangrove vegetation along with the common sand binders has been observed by the current study and a mangrove patch is also seen in the adjacent Baubali beach another probable mass nesting area which has not been mentioned in the latest UNDP Sea turtle survey which was carried out in the years 2001-2002.

The Rushikulya beach in the Ganjam district is 6kms long and has scanty growth of *Ipomoea pes caprae* and no presence of Casurina plantations (Pandav, 2006). In addition to this
observation current study has recorded patches of the *Pandanus* species towards the Rushikulya rivers direction, which has not been mentioned in the above studies. In fact this is the only species dominantly found in the east coast of India when compared with other states.

**Threats and cultural perspectives**

The mass nesting beaches are marked as protected sanctuaries and are uninhabited by humans. They do not face threat from development activities. Rushikulya however has a small village close by, but not in the immediate vicinity. Besides these are protected and highly patrolled beaches. The only threat is from the mechanized trawl fishing activities where turtles get entrapped in the nets, suffocate and die. In fact the mortality is so great, at least 10,000 turtles are landed dead in a year (Shanker, 2003). Dead turtles on the beach are common sight on these beaches and have been recorded by the present investigation. In fact the study has also noticed turtles being trapped in the inundated places on the Nasi 2 islands. Heavy erosion to nesting beaches has also been documented by Rajagopalan (1984). Another interesting fact here is that the trawl fishermen catch fish but do not consume turtles, a situation
comparable to some of the fishing communities like the Kharvis on the Karnataka coast. Turtles are worshipped in these places.

**Tidal heights and Moon Phase**

The months of January to March are reported to be the breeding season in Orissa (Pandav, 2006). The monthly tidal analysis for the last 10 years in Orissa shows that the high tides dominant particular months at night were between the months of January to March, ranging from 2.55 mtrs to 2.75 mtrs. This is found to be exactly coinciding with the nesting season. Moreover after march the tidal cycle is seen to reverse with all higher tides falling during day, which is an unlikely time for turtle nesting as has been documented by previous studies. There has however been nesting during the day in the Rushikulya river mouth. The dominant moon phase recorded is one day after full moon or new moon, and exactly on full moon and new moon.

**Gujarat**

The state of Gujarat has a coastline of 1600kms and is the longest in the country. It lies in the north western region of India at 20°01' -24°N Latitude and 68°10' 74° 28' E Longitude. It is has been documented as the only mainland state that witnesses a
high intensity nesting of green turtles while the other major nesting grounds are in the Andaman and Nicobar islands and to a lesser extent in the Lakshwadeep islands (Bhaskar, 1984). The surveyed areas were in the districts of Porbandhar and Junagadh (Kar and Bhaskar, 1982) reported the nesting of four species of sea turtles - Olive ridleys, Greens, Leather backs and Hawksbills, but studies from the recent UNDP sea turtle survey (Sunderraj et al, 2002) recorded nesting of only Olive ridleys and Greens. The surveyed areas were in the districts of Jamnagar and Junagadh as these witnessed higher nesting intensities as indicated in the UNDP survey. But on suggestions from Dr Sunderraj in 2005, nesting had considerably reduced at Jamnagar while the coast of Porbandhar recorded increase of nesting. This observation however has been confirmed in the recent UNEP-CMS Sea turtle project report (Sunderraj et. al, 2006). There was high nesting of two species, olive ridley and green turtles at Porbandhar and Junagadh coasts. The nesting season occurred between June to January (Bhaskar, 1984) and the current survey was carried out between September 2005 and October 2005.

Beach topography

The topography of the Gujarat coast has been studied across four major divisions such as Kachchh, Saurashtra,
Mainland and Gujarat, where length width and soil types have been mentioned (Patel, 1997) but not in relation with high intensity sea turtle nesting beaches, as has been focused in the current study. Further this investigation also includes other parameters such as occurrence and intensity of sand dunes and beach vegetation.

**Beach Vegetation:**

The dominant Beach vegetation in relation to these high intensity nesting sites has not been recorded before, and if any, there has been only a brief mention as to the occurrence of coastal plantations (Sunderraj et. al., 2006).

The current study has identified some dominant vegetation found. The dominant types of beach vegetation found along the study sites are:

1. Sand dune grasses related to the American beach grass, *Ammophyla brevigulata* found abundantly distributed.
2. Abundance of green algae, Ulva species spread through out several shoreline stretches.
3. Plantations such as *Casuarina equicetifolia* Among the less dominant varieties are several cactus species found towards the rocky areas, and *Ipomea pescaprae*
Threats

The coastal districts of Porbandhar and Junagadh have fewer dangers to nesting turtles or its nests, as has been documented in the latest survey by Sunderraj et. al., (2006) compared to Jamnagar coast which has high levels of nest predation. Harvest of eggs by local communities is low. Dogs, jackals, monitor lizards, crabs, crows are observed to prey on nests (Bhaskar, 1984). Sand mining however, has been documented as one of the frequently occurring threats along the Gujarat coast (Bhaskar, 1984, Jayakumar, 2000, Andrew, 2000 and Sunderraj, 2006) and is a shared observation by the current study.

Tidal heights and Moon Phase

The only records of some indications of tides in the Gujarat coast is about the level of tides witnessed in the areas (Sunderraj et.al., 2006) which is an extract from Patel (1999). The current study has analysed tidal data for Gujarat coast for the last 10 years and has found a tidal height of 2.40 to 2.43 mtrs prevailing in the months from December to January, which apparently coincides with the peak nesting time of Olive ridleys and Green turtles. The moon phase is also found to be the same during
these months, and is found to be exactly on one day prior full
moon or new moon and exactly on full moon and new moon.

Andaman & Nicobar Islands

Beach Topography

The status, flora and fauna of the islands and profiles of all
the protected areas for both the islands groups have been
documented to an extent (Pande et al., 1991; Mathew and Gardi,
2000; Andrews and Sankaran, 2002).

The current study will discuss this flora in with regard to
the high intensity nesting sites and for comparison with other
coastal states.

The first records of turtles from these islands comes from
Blyth (1863) where three species of turtles were reported from the
Andaman islands, including green turtle, Olive ridley and
hawksbill turtle.

The Andaman & Nicobars is particularly interesting for
habitat study as three species of marine turtles, Leatherbacks,
hawksbills, and green turtles have been documented for their
good nesting numbers (Bhaskar, 1979 and 1993 a, Andrews,


Moreover the Hawksbill and leather back populations in the Andaman Nicobar islands is the highest that has been recorded (Andrews, 2000a).

For the purpose of study, beaches of high intensity were selected from the Andamans, Little Andamans and Great Nicobar Islands.

The study sites are cut bent Bay in Middle Andamans, West Bay, South Bay in little Andamans, and the Galathea Beach in Great Nicobar islands and these sites were mostly selected for their leather back, hawksbill nesting intensity and were based on the following reports.

Surveys from Bhaskar and Tiwari (1992) and Bhaskar (1994) has indicated good nesting of Leatherbacks at the Galathea river North South Bay, in Great Nicobar and surveys from Andrews (2000) has reported high intensity of Leatherbacks on West Bay, little Andaman and low intensity of nesting at the adjacent beach south bay. The survey also reported a good number of nesting in Cutbert Bay.
The habitats were surveyed during day and night as it was the peak nesting season for Leatherbacks mid January to February (Andrews, 2000). Fresh nests and tracks of leatherbacks & Hawksbills were encountered; however no nesting leather backs were seen. But n nesting Olive ridley that came to nest was observed in Cutbert Bay. The turtle returned without nesting as the patch it entered was quite eroded, leaving just about 1 mtr space from water line, which has indicate that space was an important factor for nesting.

Field observations on beaches of Andaman & Nicobar

At Great Nicobar, Galathea River point was not accessible, as much of the beach was eroded by the Tsunami making difficult for boats or ships to land. However an offshore survey from a distance of a 500 mtrs was made from a small ship. The beach was found considerably reduced, discussing data with other researchers who had visited the place before Tsunami of 2004.

Beach Vegetation

Studies from (Pandey et. al., 1991; Mathew and Gardi, 2000), Andrews and Sankaran (2002) have documented the flora
and fauna. The current study, in relation and comparison with other nesting beaches, observes the dominant fauna to be, sea mahuas. While secondary to this are the Pandanus vegetation and *Ipomea pescaprae*, found bordering shore about 20-30 mtrs from the water line.

**Threats**

Threats to turtles have been reported for all four species in the Andaman Islands (Bhaskar, 1979, 1993; Whitaker, 1985; Andrews 2000 & 2006).

There is a practice of harvesting turtle eggs & meat by the tribals. The current study observes beach erosion have to be a major threat after the Tsunami. Legal permission in India and with threats from Global warming, and sea level rise, it could be grave situation for turtles, despite the threats they already face.

**Tidal heights and moon phases**

The nesting season is found varying with different species (Ref) for Hawksbill, Leatherbacks, Green, Olive ridley. On analyzing monthly tides for the last 10 years, a favorable tide level is found to coincide with:
1) Green turtle nesting season March to September with peak in June & July.
Tidal range the season highest tides fall during day; and green turtle also nest in day. Tidal range for season: 2.26 mtrs – 2.49 mtrs. Tidal range during peak time is 2.37 – 2.39 mtrs. Transition: In the month of July tidal values increase during night time from the previous month’s value 1.94 mtrs to 2.02 mtrs.

2) Hawksbill nesting season: is from July to September is the peak in August. Tidal range for the season is 2.02-2.37 mtrs for peak month – 2.23 mtrs. Transition: From November high tides are found shifting to night. Leather Beach Nesting Season: Commences November – to February with peak nesting in Mid Jan. Tidal range – for season: 2.33 – 2.42 mtrs and for the peak month is Jan & Feb is exactly 2.33 trs.

**Lakshwadeep Islands**

Four species of turtles have been reported from the Lakshwadeep islands (Bhaskar, 1978, 1979; Silas, 1984; Lal Mohan, 1989). Green and Hawksbill turtles are reported to be the most common in the island groups of the western Indian Ocean (Frazier, 1982).
There has been few studies in these island on sea turtles starting from Bhaskar (1978, 1979), Silas (1984), Frazier (1980) and the latest Tripathy et al., (2001). The studies of Tripathy et al., (2001) are also reported in the publication Marine turtles of the Indian subcontinent (August 2006). The current investigation was carried out in between (Jan 2007 and Feb 2007).

The surveyed areas falls in the Laccadive, Minicoy islands, of which three islands fall in the inhabited group and 4 in the uninhabited group.

**Beach Topography and Vegetation**

The Topography of the islands and vegetation has been studied quite in detail by the latest survey of Tripathy et al., (2001) and on its ecofloristics (Radhakrishnan et al., 1998).

The former has discussed beach several aspects of the current investigation with the exception of slope, presence of dunes and other threat finding and social perspectives, which are discussed in this study.
Among the flora listed along the beaches the dominating types, such as Clerodendrum, inerme, Ipomea pescaprae, Launea sarmentosa, Spinifex littoreus and Suriana maritina and shrubs such as Pemphis acidula, Scapeola sericea (Radhekrishnan et. al., 1998). Mangroves are only seen in the Minicoy island consisting of two species, Ceriops candolleana and Bruguiera cylindrica, Tripathy et. al., (2006) and the dominant sea grasses are Thalassia hemprictice and Cymodocea isoetifolia (Jagtap, 1987).

But the Lakshwadeep Biodiversity action plan report (2002) mentions a third species of mangroves in the Minicoy island and extensive occurrence of Pandanus odorattissimus. The current study also confirms the occurrence of Pandanus odorattissimus in Minicoy and in other islands like Tinnakara.

**Threats and cultural perspectives**

The greatest threats to the islands are from erosion, erection of tetrapods, which is reducing the nesting space for turtles. Tripathy et. al., (2003, 2006) also discuss these in detail along with the practice of killing green and hawksbill turtle for their fat to grease boats, and stuffing them for sale as curios. Green and Hawksbills carcasses were found on the beach. The
current study in addition to this has also discovered skeletal remains of Hawksbills, located deep in the scaveola bushes; where the turtles have been killed while laying eggs. Developmental threats are also discussed as houses and building and resorts close to beaches.

However this study identifies, that the threats are mainly from outsiders with their development plans of building and the island people have a tradition, where men are sent to the households of woman they are married to. Thereby the problem of expanding and constructing houses is not there. This is an eco-friendly practice of the Islanders.

**Tidal heights and moon phase.**

The nesting season of turtles is between October and March (Tripathy et. al., 2003). The tidal range operating in the season is from 1.26 mtr - 1.5 mtrs.

All higher tides for this season are observed during night, ideal conditions for Hawksbill and ridley turtles. After March the high tides reverse to the day time, where its values are higher. But green turtles also nest during day and in higher intensities in
the months of June, July since the tidal values for these months
during day are higher and ranges between 1.51 to 1.57 mtrs.

**Tamil Nadu**

Tamil Nadu has a coastline of 980 km and lies in the
geographical position of 13° 04’ N latitude and 80°17’ E longitude
facing the Bay of Bengal.

This place is of particular importance in that the first
records to marine turtles comes from this region in a poem of the
Tamil Sangam (C 400 AD) reported by Sanjeevraj (1958). Next to
Orissa, Tamil nadu has initiated the highest number of
conservation programs in the country. The first research and
conservation program in India was initiated by the Madras Snake
Park Trust (Valliapan and Whitaker, 1974).

Five species of marine turtles have been found in Indian
waters – olive ridley turtle, green turtle, leatherback, hawksbill
and loggerheads. Barring loggerheads all the other 4 are found
nesting along the Tamil Nadu coast (Kar and Bhaskar, 1982)
Beach Topography and vegetation

Bhupathy and Saravanan survey the Tamil nadu stretch in the UNDP survey (2001) and reported that sandy beaches were suitable for nesting and rocky beaches, swamp and areas of development are unsuitable.

Andhra Pradesh

Andhra Pradesh has a coastline of 980 kms and is one of the largest maritime states in India. Its geographical position falls at (13°34' – 19°6' N and 80°16'-84°47 E). It comprises of nine coastal districts all facing the Bay of Bengal.

Five species of turtles – leather backs, hawks bills, logger heads were reported from Andhra Pradesh (Dutt, 1976, 1979; Biswas, 1982; Kar and Bhaskar, 1982). But only olive ridleys were confirmed to nesting here (Kar, 1983; Subbarao et. al., 1987).

Olive ridleys were reported from the northern Andhra Pradesh coast (Rajasekhar and Subba Rao, 1993; Priyadarshini, 1998) and large numbers have been reported to travel through the offshore waters of Tamil Nadu and Andhra Pradesh to and from the mass nesting features in Orissa.
**Beach Topography & Vegetation**

Andhra Pradesh is an important nesting site of Olive ridleys. There has been no particular studies that concentrated on coastal vegetation types of beach profiles, as detailed as those carried out for Andaman & Nicobar islands and Karnataka (Pandey *et. al.*, 1991, Mathew and Gardi, 2000, Andrews and Sankaran, 2002 Anand Rao and Sherif, 2002). However Tripathy *et. al.*, (2003) has discussed, the dominant Palmyra (*Borassus flabellier*) and Casuarina (*Casurina litorea*) plantation on the beach, along with cashew and coconuts. But the current study observes and emphasizes on the sand dune grass and a rich distribution *Pandanus sp.* in the northern Andhra Pradesh bordering the mass nesting sites of Olive ridleys. The distribution is so intense, that people even use them as fences for bordering properties.

Tripathy *et. al.*, (2003) also has mentioned sand dunes between 10-20 feet and the occurrence of Psammophytes on sand dunes.

The current study in addition to the previous observations made by others, records beach dimensions and sand quality.
Threats and cultural perspectives

Beaches in the northern coast of Andhra Pradesh are subject to high erosion and fishery related mortalities, as seen from several carcasses of turtles on a same stretch of beach. Mechanized trawl fishing is rapidly replacing traditional methods, and lack of turtle excluder devices in the trawl nets, makes it a severe threat. These are potential threats identified by the current study. Fishery related mortalities have been reported before from the AP coast (Rao, 1984; Subba Rao et. al., 1987; Raj Sekhar and Subba Rao, 1993; Priyadarshini, 1998 and Tripathy et. al., 2006).

Other threats reported were from lighting on the beaches from various sources and jackals which shelter within casurina plantation (Tripathy et. al., 2006).

Like Orissa, people do not exploit turtles for its eggs for consumption in this region. Turtles are in fact worshiped and a temple for which particularly exists. However some fishing communities collect turtle eggs and sell them (Tripathy et. al., 2006).
This context is comparable to the Kumta coast of Karnataka, where some fishing communities have constructed a temple called Masai for turtle worship.

**Tidal Heights and Moon Phase**

The nesting season for turtles is between January to May (Kar, 1883, 1990) and recent studies from Tripathy et. al., (2006) reports November to March, which is based on turtle mortalities.

The tidal height prevalent in the season is 1.41 mtrs to 1.71 mtrs, which is a drastic contrast with the Orissa coast. This tidal range coincides with the nesting season exactly with Tripathy et. al., (2003) observation, as from April-September, all the higher tides are found to fall within the day. The olive ridley is largely known to nest at night or during darkness. This may be high intensity nesting time and the other report from Kar (1883-1990) may have included even the time of low nesting, which accounts for April and May.

**West Bengal**

Among the four sea turtles: - Olive ridleys, green turtles, hawksbills and loggerheads, Olive ridley is found to be the most common and abundant, in the Digha and Sunderban coasts of
West Bengal (Biswas, 1982; Saha, 1986; Das, 2001; Chowdhary, 2001). The latest UNDP survey by Choudhary et al. (2001) also confirms this.

With regard to studies on the influenced beach and topography and vegetation on turtle nesting intensities, there has not been any focused study. But there has been some observations on few nests where the depth, humidity, pH and clutch size were determined (Chowdhary et al., 2001) while this could yield more knowledge on preference of nesting sites, of compared with more places and nests, the compared with more places and nests, the observation on the location as one being located 30 mtrs from high tide line, adds value to the current study.

Vegetation was mainly mangroves of various kinds and the list is too large to list. However the presence of these forests indicate the high content of silt in the soil, which perhaps indicates, the moisture absorbing capacity of the soil, a requirement for turtle nests to absorb moisture from its surroundings. Hejmadi and Sahoo (1994) have indicated the development of eggs with its surrounding environment.
Threats

Incident mortality through fishing operation has been accounted for large scale deaths in West Bengal (Raut and Nandi, 1986) and Chowdhary et al., (2001). Besides West Bengal also accounts for large scale turtle trade, where 21,361 turtles were collected and sent by truck to Kharagpur railway station to Kolkata market (Biswas, 1982).

Predators such as tigers and water monitor lizards have been identified to be threats to nesting females or their eggs (Saha 1984, 1986; Gani 2001). But the report has no records of conclusive attacks of tigers on turtles. The report has also indicated egg shell fragments and tiger pug marks close to each other implying predation by tigers.

The current study confirms the observations of tiger pug marks and egg shell proximity along with the erection of sea walls along the Bokkhali Island. It also notices that wall has been fracture by the waves beating on it, indicating that wall is not helpful against erosion and reduces space for nesting turtles.
**Tidal heights and moon phase**

The nesting season for turtles is between December to March and the peak during February. The tidal range and time is quite peculiar to the state with respect to nesting seasons.

December is noticed to be the only month where some higher tides of all during night. For all other months higher tides are seen during day.

The Tidal range at night for the nesting season is between 3.71 mtrs and 4.54 mtrs. And after these seasons all tides are on an increasing level reaching upto 6.0mtrs. The moon phase is 2 to 4 days prior full moon or new moon.

**Kerala**

Three species of sea turtles nest along the Kerala coast, Olive ridleys, Green turtles and Leatherbacks (Kar and Bhaskar, 1982; Shanmugasunderam, 1968; James, 1959 and Pillai et al, 2003). The UNDP survey in Kerala has reported nesting of Hawksbill as seen by fishermen. The study however gave no indication or data on the intensities of turtle nesting along the Kerala coast.
The study sites for the research study were selected based on indications from previous literature (Kutty, 2001) and discussions with resource personnel.

**Beach Topography and Vegetation**

From the current studies it is evident that the beaches in Kerala are subject to a lot of erosion and is quite high in the Perumathura beaches in Trivandrum. The topography on vegetation of the beaches has not been studied in relation to the nesting beaches and the current study therefore cannot interpret or compare results. Vegetation along most beaches are the coconut trees, planted and unplanted. Patches of *Ipomea pes caprae* found in Perumathura and Ezhimala beaches.

The beach at Ezhimala is at the base of a group of hills, where the navy is setting up a large base.

**Threats and conservation programmes**

The major threat here is from sea erosion and the beaches are being walled extensively. This is also seen on the Perumathura beach, where work is in progress. Such threats also reported by Jaya Kumar (2001). Moreover there is the practice of
consuming turtles largely by the Christian community as noted by the same study.

But on the other hand there have also been efforts by a group of fishermen who initiated Sea Turtle Conservation on the Kalavipalam beach in 1992. One of them, supposed to be the initiator of the program, Mr. Surendrababu, said what began as sheer curiosity, with relation to the hatching of eggs spread out into a community based turtle conservation activity. However they were first motivated by reading an article in the newspaper.

The current study observes that even Kannur district can take up this as a part of the Navy's programme. The people there have reported obtaining tags attached to turtles, after they were captured. Tagging programs and creation of a data base can be carried out here as this beach is secluded and has very little disturbance at present.