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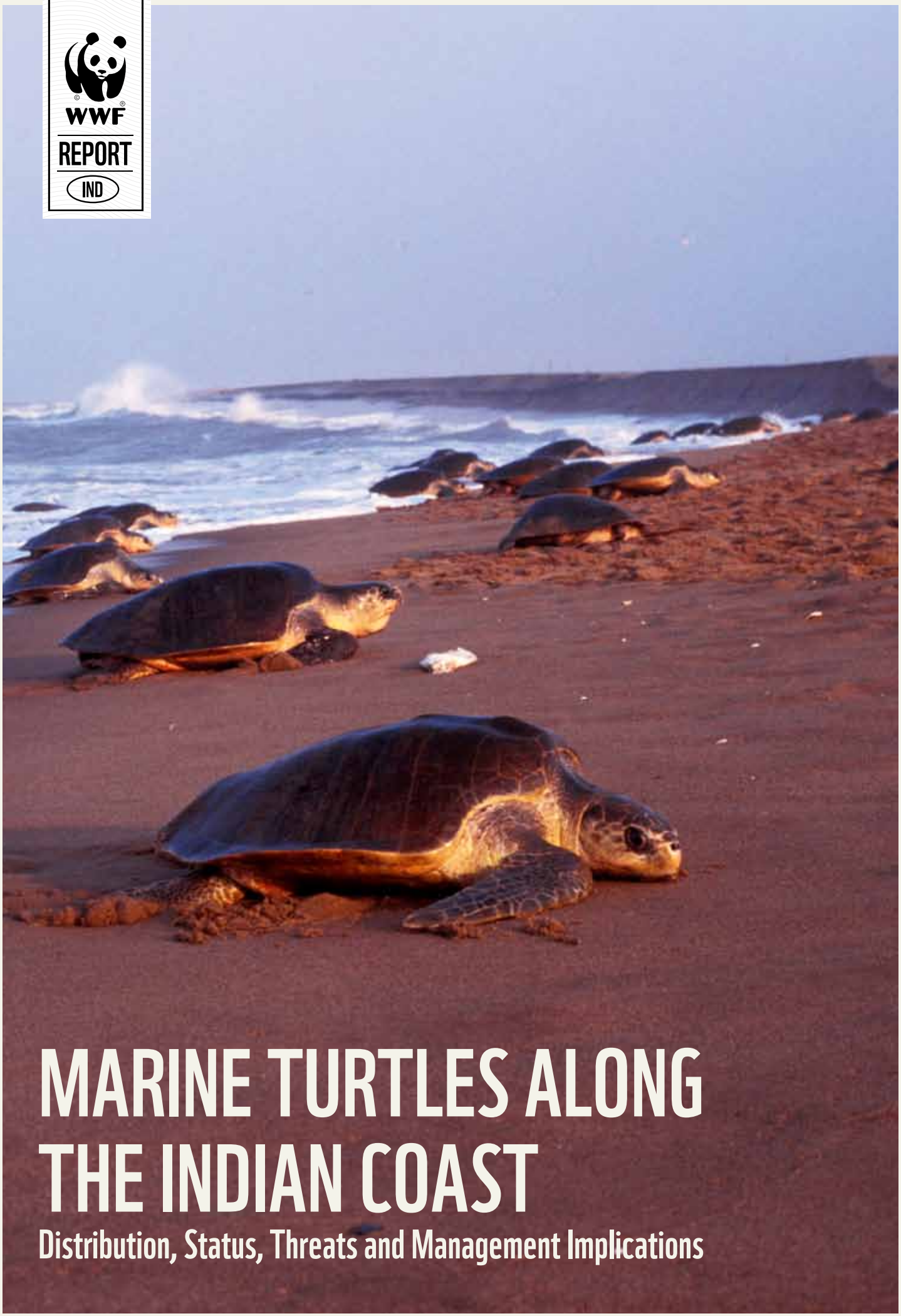

MARINE TURTLES ALONG THE INDIAN COAST

Distribution, Status, Threats and Management Implications

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CONTENTS

PREFACE

India has a coastline of more than 8000 km which is rich in biodiversity. Apart from sustaining fishing grounds, India's coastal waters and beaches provide foraging and nesting sites for a variety of marine species, including sea turtles. Five species of sea turtles are known to inhabit Indian coastal waters and islands. These are the Olive Ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*) and the Leatherback (*Dermochelys coriacea*) turtles. Except the Loggerhead, the remaining four species nest along the Indian coast.

Though many of the ecological interconnections influencing sea turtle behavior and biology remain unclear, it is known that sea turtles occupy a unique position within the food web. They consume an assortment of prey, including puffer fish, crustaceans, sponges, tunicates, sea grasses, and algae. The unusual life cycle of the animal plays a vital role in transportation of nutrients from the highly productive marine habitats such as sea-grass beds to energy-poor habitats like sandy beaches. This helps reverse the usual flow of nutrients from land to sea.

Threats to marine turtles in India are many, and varied. Some of the major threats include unplanned beach development (including ports, lighting, tourism and plantations), by-catch mortality (in trawl nets and gill nets), weak enforcement of fisheries and Protected Area regulations and, to a limited extent, killing of turtles for meat and the poaching of eggs.

The coastal state of Odisha on the eastern coast of India experiences one of the world's largest mass nestings or *arribada* of the Olive Ridley turtle during the months of October to April. Three of the world's major mass nesting beaches for this species are located in Odisha, supporting a nesting population of probably more than half a million Olive Ridleys, making this one of the most critical conservation areas for this species globally.

However, there are other significant turtle populations in India, which also need to be protected and which are less known. This initiative, which builds on earlier surveys is an attempt to understand the current status, distribution and threats to sea turtles in India. It covers the coastal states of India, but due to limitations of resources, leaves out the islands of Andaman and Nicobar and Lakshadweep. We hope that this report helps to provide an understanding of the current status and trends in turtle distribution along the Indian coast. It also assesses the threats to turtle populations in each state and provides recommendations for their conservation.

NESTING LOCATIONS ALONG THE EAST AND WEST COASTS OF INDIA

Map: Annie Kurian

Gujarat is the northern most location on the west coast of India, and is an important nesting and foraging ground of green sea turtles on the mainland. Olive Ridleys used to be found in good numbers, but current surveys record only green turtles.

Maharashtra is mostly a sporadic olive ridley nesting site, but has few occurrences of green turtles as well. Most of its beaches are well monitored for turtle nesting.

Goa is the smallest state in India and borders Maharashtra and Karnataka. Increase in developmental activities on the beaches here has drastically reduced the nesting numbers of olive ridleys.

Karnataka has a sporadic turtle nesting coast, and the species commonly reported is the olive ridley. However, much of its coastline needs to be thoroughly assessed for the distribution and density of nesting turtles.

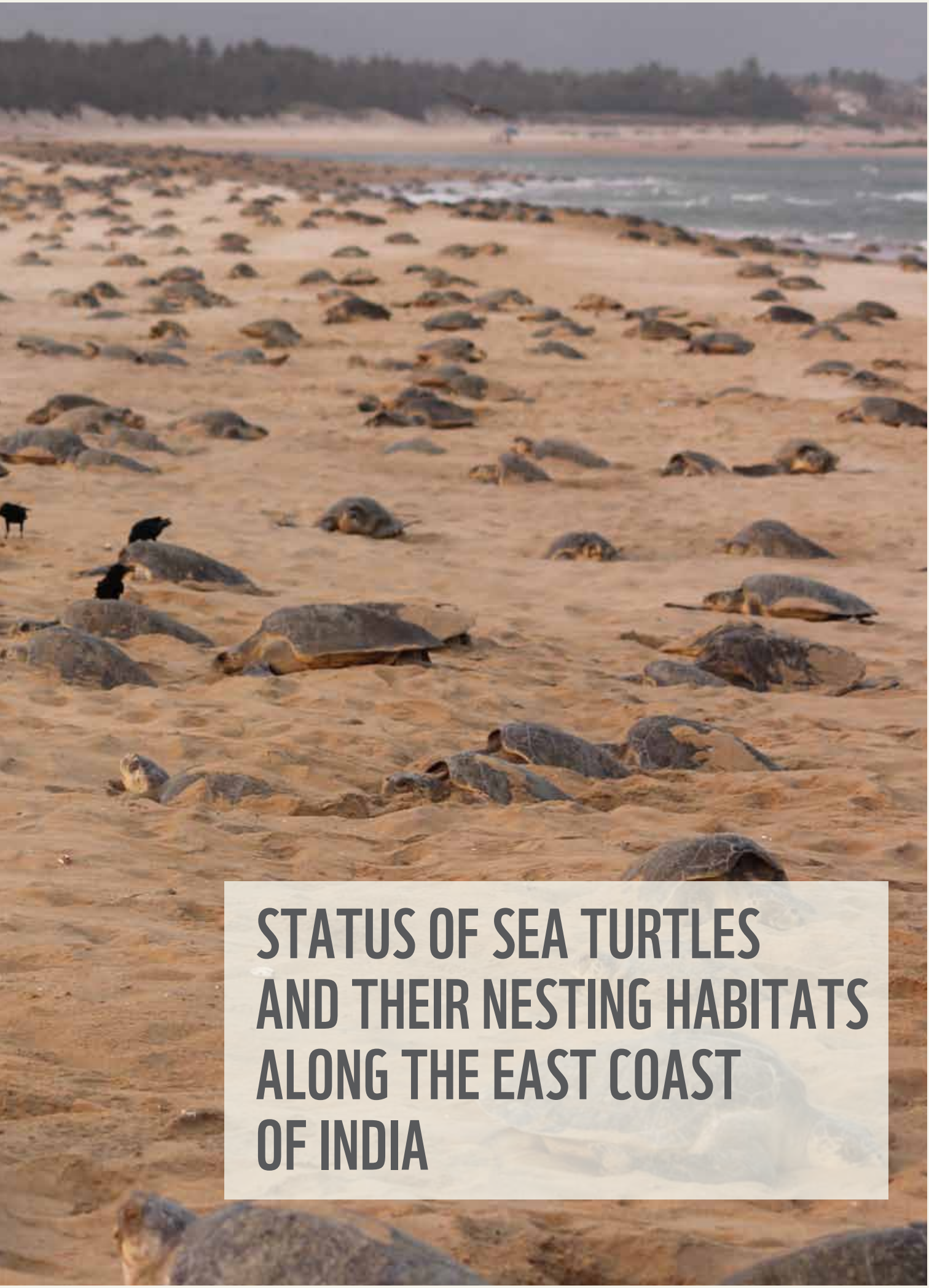
Kerala is the southern most location on the west coast of India with 70% of its coastline sea walled. Olive Ridley nesting numbers have dropped considerably.

Tamil Nadu is located in the southern end of the east coast of India and forms the migratory corridor for olive ridleys that mass nest in Odisha. It has both nesting and foraging grounds and reports the occurrence of five species of sea turtles.

Andhra Pradesh borders Tamil Nadu in the south and the mass nesting beaches of Odisha in the north. After Odisha, it is considered to be the second most important nesting habitat for olive ridleys on the mainland.

Odisha supports the largest congregation of nesting olive ridleys in the world. It also has sporadic nesting beaches. Developmental activities pose a huge threat to these nesting habitats.

West Bengal located to Odisha's north, supports the world's largest mangrove habitat, the Sunderbans, which is also a turtle nesting ground. East Midnapore is the other, but records very low nesting.



STATUS OF SEA TURTLES AND THEIR NESTING HABITATS ALONG THE EAST COAST OF INDIA

MARINE TURTLE HABITATS AND NESTING STATUS IN TAMIL NADU

S. Saravanan, J.Gokulakrishnan, Arun.V, Akila Balu, Murugan Annapan and Annie Kurian

BACKGROUND

The State of Tamil Nadu plays an important role in the research and conservation of sea turtles in India. It is among the two mainland states reporting occurrence of all five species of turtles in India (Kar and Bhaskar 1982, Bhupathy and Saravanan 2006) and forms a part of the migratory corridor for olive ridleys that mass nest in Odisha (Pandav 2000). The oldest known reference-poem of the Tamil Sangam (c.400AD) which describes the nesting habit of a sea turtle (Sanjeev Raj 1958), and references from the pre-independence period such as Chacko (1942), where the nesting of a loggerhead turtle in the Gulf of Mannar has been described, show the long history of sea turtles here. Along the Indian coast, the state pioneers in research and conservation efforts of marine turtles (Valliapan and Whitaker 1974, Whitaker 1977, Bhaskar 1981), and hosts one of the earliest community based marine turtle conservation programmes- The Students' Sea Turtle Conservation Network (SSTCN), which has continuously been monitoring olive ridley nesting on an annual basis since 1988 (Shanker 1995, 2003).

Although Kar and Bhaskar (1982) had reported the nesting of four species of sea turtles-olive ridley, hawksbill, green and leatherback; latest records indicate the nesting of only olive ridleys along the Tamil Nadu coast (Bhupathy and Saravanan 2006). Research and conservation of sea turtles along the coast of Tamil Nadu has been carried out by several government and non government organisations. The Central Marine Fisheries Research Institute (CMFRI) had studied aspects of marine turtle biology and fishery related mortality (Agastheesapillai and Thiagarajan 1979, Silas and Rajgopalan 1984, Rajgopalan et al 1996). Since 1974, the Madras Snake Park Trust (MSPT), Tamil Nadu Forest Department, and CMFRI have monitored the coast (Shanker 1995, 2003). A community based sea turtle conservation programme initiated by Trust for Environmental Education (TREE) Foundation along the Tamil Nadu coast has also been in existence since 2002 (Dharini, S. 2011). Exploitation of marine turtles in the Gulf of Mannar, Tamil Nadu, has also been recorded as early as the 1940's and 50's (Chacko 1942 and Kuriyan 1950) and Frazier (1980). Information on the status of marine turtles along the Pondicherry and Point Calimere coasts is also available (Banugopan and Davidar 1998).

Extensive surveys were carried out in 2000-2001 to assess the nesting status of the entire coast of Tamil Nadu, as part of the National- GOI-UNDP Sea Turtle Project implemented by the Wildlife Institute of India (WII). In the survey, all five species of sea turtles were found distributed in Tamil Nadu, but with records of nesting of only olive ridleys (Bhupathy and Saravanan, 2002) as reported in Marine Turtles of the Indian subcontinent (Shanker and Choudhury, 2006). Data on important nesting beaches was generated which form the benchmark for future assessments and monitoring (Bhupathy et al 2007). As part of the UNEP/CMS – IOSEA project (2003-05), Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, undertook surveys along the Chennai and Nagapattinam coasts, places previously identified to be important nesting areas during the GOI-UNDP survey. This WWF-India initiative builds on the earlier studies to provide a status of turtle distribution in 2010-12.

STATUS AND LOCATION OF NESTING BEACHES

The coastline of Tamil Nadu extends from Pulicat Lake in the north to Cape Comorin in Kanyakumari district in the south. The coastline (1076 km) of the state spreads across 13 coastal districts along the Bay of Bengal, Indian Ocean and Arabian Sea. The coastline of Tamil Nadu has been divided into the Coromandal coast (extending from Chennai to Point Calimere about 357 km), Palk Bay (extending from Point Calimere to Pamban about 294 km), Gulf of Mannar (extending from Pamban to Kanyakumari about 365 km) and West Coast Arabian Sea (about 60 km). The coastline is characterized by sandy beaches, mudflats, rocky outcrops, spits, coastal dunes, estuaries, lagoons and mangrove vegetation across the state. Flora such as *Ipomoea pescaprae*, *Spinifex littoreus*, *Casuarina equisetifolia*, *Prosopis julifora and Borassus flabellifer* are found across the coastline.

Tamil Nadu has 591 marine fishing villages scattered across 13 coastal districts. These villages have a population of 1.05 million. Of this population, 0.20 million is actively engaged in fishing. In the offshore waters, the fisheries potential is exploited using about 45181 traditional crafts and 5596 mechanized boats. The infrastructure facilities include three major fishing harbors, three medium fishing harbors and 363 fish landing centers (Fisheries Department, Government of Tamil Nadu).

Turtle nesting beaches are spread across 12 coastal districts in the northern, central, and southern regions of the coast of Tamil Nadu. Twenty five sandy beaches were selected for nest monitoring, and are shown in Figures 1, 2 & 3. Co-ordinates of the beaches have been provided in table 1 below.

FIGURE 1. BEACHES SURVEYED ALONG THE NORTHERN COAST OF TAMIL NADU

FIGURE 2. BEACHES SURVEYED ALONG THE CENTRAL COAST OF TAMIL NADU

FIGURE 3. BEACHES SURVEYED ALONG THE SOUTHERN COAST OF TAMIL NADU

TABLE 1. CO-ORDINATES OF NESTING BEACHES MONITORED ACROSS TAMIL NADU COAST

Coast/District	Nesting Areas	Latitude(N)	Longitude(E)
I. Chennai			
	1. Marina	13°03'15"N	80°17'01"E.
	2. Besant Nagar	13°00' 01"N	80°16'00"E.
	3. Neelankarai	12°56'52"N	80°15'46"E.
	4. Uthandi	12°51' 30"N	80°15'03"E.
II. Mamallapuram – Pondicherry			
	1. Satras	12°31'23"N	80°10'03"E.
	2. Alikuppam	12°26'22"N	80°08'00"E.
	3. Paramakazhani	12°20'52"N	80°04'10"E.
	4. Kadapakkam	12°16'11"N	80°01'04"E.
	5. Kaipanikuppam	12°12'51"N	79°59'04"E.
	6. Komanachavadi	12°08'05"N	79°55'56"E.
III. Pondicherry		11°53'14"N	79°49'31"E.

IV. Cuddalore		11°44'36"N	79°47'15"E.
V. Nagapattinam			
	1. Pazhaiyar	11°20'53"N	79°50'35"E.
	2.. Poombhuhar	11°07'52"N	79°51'17"E.
	3. Tarangambadi	11°01'45"N	79°51'22"E.
VI. Karaikal		10°56'52"N	79°51'13"E.
VII. Vembar – Tuticorin			
	1. Vembar	09°04'29"N	80°10'03"E.
	2. Vaipar	08°59'39"N	78°15'21"E.
	3. Taravaikulam	08°53'22"N	78°10'34"E.
VIII. Tirunelveli			
	1. Uvari	08°16'41"N	77°53'44"E.
	2. Kootapuli	08°08'34"N	77°35'56"E.
IX. Kanyakumari			
	1. Kanyakumari	08°04'34"N	77°33'06"E.
	2. Kovalam	08°04'48"N	77°31'28"E.

METHODOLOGY

The last extensive survey of the Tamil Nadu Coast was carried out by Bhupathy and Saravanan (2006) as part of the GOI-UNDP 2000-2001 survey. About 530 km of coastline was identified to be suitable for olive ridley nesting. From this designated area, the present survey covered 205 km of coastline spreading over 8 districts.

PRE-NESTING SURVEY

The nesting season along the coast of Tamil Nadu lasts from December to April (Bhupathy and Saravanan 2006). A pre-nesting survey was carried out along the 530 km stretch during the first fortnight of December 2011 to re-identify suitable beach stretches for monitoring in view of recent developmental activities on beaches and shoreline changes that may have occurred during the Tsunami of 2004. Accordingly, 205 km of the coastline was selected for monitoring. Secondary data was collected through interviews with fishermen, Forest Department staff and NGOs during the survey. A total of 30 fishing villages were visited across the state, and information was collected on the status of sea turtles and current nesting. All literature available was reviewed, including the previous studies of GOI-UNDP and UNEP-CMS/IOSEA sea turtle conservation projects. The overall status of nesting in the state was assessed based on primary and secondary information collected during the survey.

Nesting crawls

© S. SARAVANAN / WWF-INDIA

NESTING SURVEY

Sea turtle nesting surveys were carried out from December 2011 to March 2012 along the coast of Tamil Nadu. The nesting beaches were divided into 10 km units and surveyed on a daily, fortnightly and monthly basis. Few areas were surveyed everyday while others on a monthly basis. Data on nesting of olive ridley turtles was collected by tracing the nests from the tracks made by turtles on the beach, during fortnightly and monthly surveys. On the Chennai coast, turtle nests observed during monitoring (14 km) by the Students Sea Turtle Conservation Network (SSTCN) team, were relocated into turtle hatcheries in Besant Nagar and Marina beach. Some details of the nesting survey are given in table 2.

TABLE 2. SURVEYED AREAS AND STAKEHOLDERS INVOLVED

S. No	Beach	Kms Surveyed	Survey Type	Monitored by:
1	Chennai	14	Daily	SSTCN
2	Neelankarai –Uthandi	10	Fortnightly	WWF-India
3	Mamallapuram - Pondicherry	50	Fortnightly	WWF & Resource Person
4	Pondicherry	10	Daily	NEST*
5	Cuddalore	6	Daily	NEST*
6	Nagapattinam	40	Fortnightly	Poombuzhar and TBML Colleges
7	Karaikkal	5	Daily	Trained Fishermen
8	Rameshwaram**	20	Single survey	WWF
9	Tuticorin – Vambar	30	Fortnightly	ANNMOO
10	Tirunelveli	10	Monthly	WWF & Resource Person
11	Kanyakumari	10	Monthly	WWF & Resource Person
	Total	**205**		

* Nethaji Snake Trust, Madurai
** Tranquebar Bishop Manickam Lutheran College
*** Only pre-nesting surveys were carried out to identify beaches for monitoring
**** Annapan and Mookamma Trust

TURTLE MORTALITY

Turtle mortality was estimated through direct observation of dead turtles washed ashore and from reports published in the newspapers. Curved Carapace Length (CCL) and Curved Carapace Width (CCW) were measured when the carapaces of dead turtles were found intact. This is particularly carried out on nesting beaches to relate body size to reproductive output, to determine minimum size at sexual maturity, and to monitor nesting female size for a particular rookery (Bolten 1999). Attempts were also made to determine the sex of the turtle based on the tail length. The turtle nesting intensity for the localities studied was calculated by: Number of nests recorded during the study period/Length of the beach surveyed.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

A distance of 205 km of the coast of Tamil Nadu was monitored by various stakeholders and the nesting population of olive ridley turtles was estimated. In the current nesting survey, observations show that nesting of olive ridleys has not changed much after the Tsunami in most fishing villages lying between Chennai and Pondicherry, and along Nagapattinam coast. But in few places such as Point Calimere, between March and April 2005, an increase in nesting was observed because of the increased beach space that resulted from the clearance of the invasive *Prosopis julifora* by the Tsunami. About 30 mts of beach space from the waterline was found cleared of vegetation (Kurian 2008). However, due to various development and intensive fishing activities in the southern coastal districts, fishermen have reported a decline of about 50% in nesting. A report of nesting activity on the Tamil Nadu coast is as follows:

NORTHERN TAMIL NADU COAST

The following beach stretches have been monitored for turtle nesting status along the Tamil Nadu coast:

i. Chennai coast (Neelankarai – Besant Nagar and, Marina Beach)

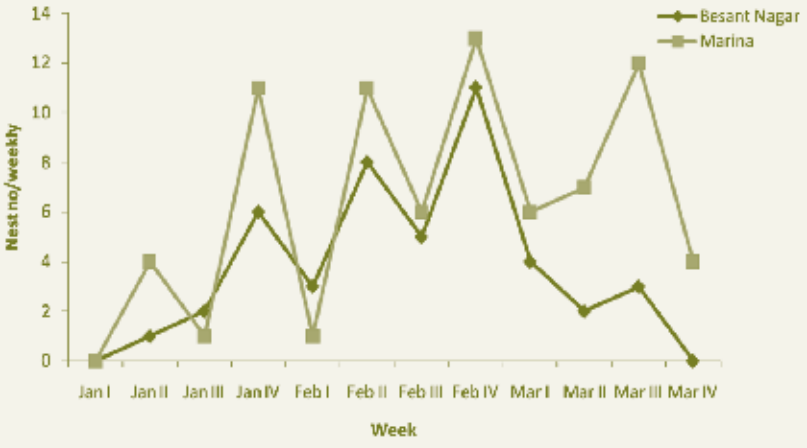
ii. Chennai coast (Neelankarai – Uthandi)

iii. Mamallapuram – Pondicherry

CHENNAI COAST (NEELANKARAI – BESANT NAGAR AND, MARINA BEACH)

Observations of the nesting of olive ridley turtles is carried out on a regular basis across two beach stretches by the SSTCN team. These observations are made from Neelankarai to Besant Nagar and Marina beach, which is a stretch of 14 km. Both these beach stretches were monitored for the current survey as well. As part of the conservation initiatives, the SSTCN team move turtle eggs from their natural nests into hatcheries situated at Besant Nagar and Marina beach where they are protected from the natural predators and human disturbances. The hatchlings that emerge are released safely into sea. In the current survey, overall 121 nests were identified in both the beach stretches; a total of 76 nests were sighted in Marina beach (7 km); and 45 nests were found between the Besant Nagar and Neelankarai beach area (7 km). Maximum numbers of nests were observed during February 2012 along both the

FIGURE 4. OLIVE RIDLEY TURTLE NESTS OBSERVED ALONG CHENNAI COAST



stretches. The nesting of olive ridley turtles was delayed this year and the first nest could only be noticed by the second week of January, 2012. The reason may be due to the Cyclone- "*Thane*".

Nesting of olive ridley turtles reached a peak during the 4th week of February 2012 in both Neelankarai – Besant Nagar and Marina stretches, and slowly reduced during the 3rd week of March 2012 in both the stretches. But the nesting activity prolonged in the Marina stretch till the 1st week of April 2012.

CHENNAI COAST (NEELANKARAI – UTHANDI)

Nesting survey was carried out fortnightly in this stretch by WWF-India personnel. The survey was conducted from January to March 2012 during the early morning hours. A 10 km stretch along the coast was surveyed and information on nesting was recorded. A total of 6 olive ridley nests were recorded during the survey and maximum numbers were seen during 2nd week of January 2012.

MAMALLAPURAM – PONDICHERRY

A beach stretch of 50 km from Mamallapuram to Pondicherry was monitored by WWF-India personnel and a resource person. The stretch was divided in to 10 km units and surveyed over 5 consecutive days. The nesting survey was carried out on a fortnightly basis during early morning hours and nesting information was recorded. The survey was conducted in February and March 2012. In all, 44 nests of olive ridley turtles were observed during the survey. The maximum number of nests was observed during 2nd week of February and March 2012 and some areas recorded higher nesting activity, ranging between 12 and 17 nests.

CENTRAL TAMIL NADU COAST

The surveyed nesting areas falling under the central Tami Nadu coast include:
i. Pondicherry and Cuddalore
ii. Nagapattinam Coast
iii. Karaikal Coast

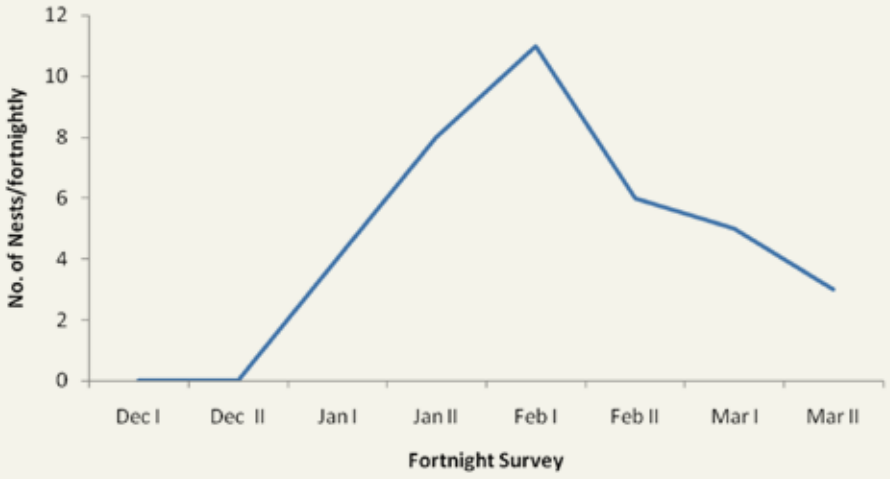
PONDICHERRY AND CUDDALORE

The nesting survey was carried out between January and March 2012 by Nethaji Snake Park Trust (NEST) volunteers. The volunteers walked daily along a 10 km stretch from Kanagachetikulam to Puranakuppam in Pondicherry, and 6 km along Devanampattinam stretch in Cuddalore district. A total of 6 nests were observed during the survey and relocated to a safe place to avoid predation. These nests were monitored day and night by NEST volunteers.

NAGAPATTINAM COAST

Nesting survey was carried out from December to March 2012 on a fortnightly basis. A 40 km stretch from Tranquebar to Pazhaiyar in Nagapattinam district was monitored by post graduate students from TBML and Poompuhar colleges. This stretch was further divided into units of 10 km each and surveyed on 4 consecutive days. From this survey, a total of 37 olive ridlye turtle nests were recorded. Maximum numbers of nests were observed during the 1st week of February 2012 (Fig.5).

FIGURE 5. OLIVE RIDLEY TURTLES NESTS OBSERVED ALONG NAGAPATTINAM COAST



KARAIKAL COAST

A 5 km stretch was surveyed along Karaikal beach. The nesting intensity of olive ridley turtles was monitored by trained fishermen. A total of 5 nests were recorded from this stretch.

SOUTHERN TAMIL NADU COAST

Along the southern Tamil Nadu coast, the following nesting areas were monitored:

i. Tuticorin – Vembar

ii. Tirunelveli and Kanyakumari

TUTICORIN – VAMBAR

A 30 km stretch was surveyed from December 2011 to March 2012 by the ANNMOO Trust. From the fortnightly surveys carried out, no direct evidence of nesting activities was observed. However, secondary information on nest predation was received from local fishermen. Foraging turtles were sighted in the offshore waters, and were also noticed by local fishermen.

TIRUNELVELI AND KANNIYAKUMARI

A stretch of 15 km including the southern tip of Tamil Nadu was monitored by WWF-India staff and a resource person. Fishing related and other developmental activities in the coastal areas have increased, although no evidence on their impact on nesting could be seen in the districts. A total of 6 nests were recorded during a fortnight of surveys.

TABLE 3. FORTNIGHTLY NESTING SURVEYS ALONG SELECTED LOCATIONS OF TAMIL NADU COAST

Fortnightly Period	Neelankarai - Uthandi (10 Km)	Mamal-lapuram-Pondicherry (50 Km)	Nagapatti-nam (40 Km)	Tuticorin (30 Km)	Tirunelveli & Kanyakumari (15 Km)
December I	NS	NS	0	NS	NS
December II	NS	NS	0	0	NS
January I	0	NS	4	0	0
January II	3	NS	8	0	4
February I	0	9	11	0	1
February II	1	14	6	0	0
March I	1	9	5	0	0
March II	1	12	3	0	1
Total nests	6	44	37	0	6

NS: No survey carried out

TABLE 4. NESTING SURVEYS ON A DAILY BASIS ACROSS TAMIL NADU COAST

Daily Survey Period	Chennai-Marina & Besant Nagar – Neelankarai (14 Km)	Pondicherry & Cud-dalore (16 Km)	Karaikal (5 Km)
December	NS	0	0
January	25	0	4
February	58	3	1
March	38	3	1
Total	121	6	6

NS: No survey carried out

DECADAL NESTING TREND AS SEEN FROM GOI-UNDP, UNEP AND WWF-INDIA SURVEYS

Three most important nesting locations of olive ridleys were identified by Bhupathy and Saravanan (2006) in the GOI-UNDP 2000-2001 survey along the Tamil Nadu coast. These areas were selectively monitored in the UNEP-CMS 2004-2005 survey by Bhupathy et al (2007). The current sea turtle survey conducted by WWF-India has also monitored these locations among several other important nesting areas. The nesting intensity of olive ridley turtles along these important and commonly surveyed areas has been compared in table 5.

TABLE 5. DECADAL TREND OF NESTING ALONG THE TAMIL NADU COAST (2000-2012)

S. No	Important Nesting Habitats	GOI-UNDP 2000 -01	UNEP/CMS – IO-SEA 2004-05	WWF-INDIA 2011 -12
1	Chennai	105	65	45
2	Mamallapuram - Pondicherry	7	36	44
3	Nagapattinam	18	30	37
	Total Nests	130	131	126
	Total distance surveyed	365	86	205
	Nests/Km	0.36	1.52	0.61

Since the area covered and methodology used in these surveys may be varied, these results should be seen as indicative.

Garbage discarded on Chennai beach

© ANNIE KURIAN

Stalls located on Chennai beach

© ANNIE KURIAN

CHENNAI

The Chennai coast has been monitored by the SSTCN over a period of 24 years since 1988. The nesting areas between Neelankarai – Besant Nagar beach are regularly monitored and a total of 105, 65 and 45 nests were recorded during 2001, 2005 and 2012 respectively. The nesting intensity has declined over a period of time as seen in Table 5. Increased fishing related activities in the past few years along the northern part of Tamil Nadu coast could perhaps be one of the reasons that has caused this decline.

MAMALLAPURAM - PONDICHERRY

A 50 km stretch has been monitored during 2001, 2004 and 2012. From these surveys, 7, 36 and 44 nests have been recorded. The nesting numbers in this stretch has increased slightly (Fig 5). The reasons may be due to increased conservation awareness efforts made by local NGOs, along with increased turtle protection hatcheries that have come up in these areas.

NAGAPATTINAM

Along the Nagapattinam coast, about 40 km of the beach was monitored in 2000-01, 2003-04, 2004-05 and 2011-12 in the nesting season between December and March. The nesting surveys recorded a total of 18, 17, 30 and 37 nests respectively. A slight increase in nesting numbers is also noticed here (Fig 5), which may be due to regular nest protection activities carried out by the local researchers from nearby colleges.

STATUS OF TURTLE MORTALITY

Marine turtle mortality surveys were carried out along with nesting surveys. During the present study, 174 dead turtles were encountered in the field. The turtles washed ashore were counted and measured for Curved Carapace Length (CCL) and Curved Carapace Width (CCW). Sex was determined by the length of tail. In most of the observations, turtle carapaces were seen without the tail or body flesh, so the determination of sex was difficult. These turtles were categorised as "sex unknown".

CHENNAI: The Chennai coast from Marina to Neelankarai recorded 29 dead turtles washed on the shore. Of these, 27 were olive ridley carcasses and the remaining 2 were hawksbill carcasses. However, only 16 olive ridley turtles were measured as the remaining 11 had considerably broken carapaces that could not be measured.

PONDICHERRY, CUDDALORE AND KARAIKAL: A total of 40 dead turtles were recorded from these areas. 4 were found from a 16 km stretch of Pondicherry, and 6 from a 6 km stretch from Cuddalore. The remaining 30 carcasses were from Karaikal, from the south of Tranquebar area.

NAGAPATTINAM: The coastal stretch from Pazhaiyar to Tranquebar recorded 109 turtle carcasses. The highest turtle mortality was observed during the second half of February 2012. This year, the mortality of juveniles was higher (as shown in table 6) compared to the previous years. The mortality of sea turtles was observed to be more severe in the Point Calimere Sanctuary after the cyclone '*Thane*'.

Measuring Curved Carapace Length and Curved Carapace Width

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TABLE 6. CARAPACE MEASUREMENTS (CCL AND CCW) OF TURTLE CARCASSES

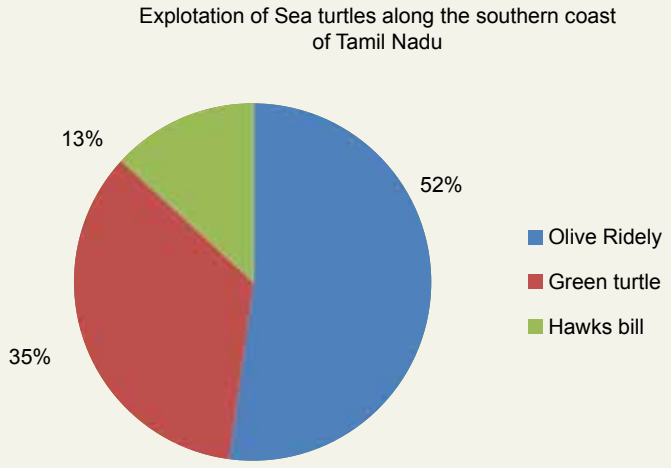
CCL category (cm)	Tranquebar		Poompuhar		Pazhaiyar	
CCL & CCW	CCL	CCW	CCL	CCW	CCL	CCW
20 – 30	2	4	4	6	1	3
30 – 40	5	9	9	11	8	12
40 – 50	8	5	12	8	15	12
50 – 60	7	6	11	12	9	8
60 – 70	5	3	7	5	6	4
Total	**27**		**43**		**39**	

* CCL- Curved Carapace Length, CCW- Curved Carapace Width

SOUTHERN COAST: Sea turtle mortality was also observed in the southern coast of Tamil Nadu from Rameshwaram to Kanyakumari. A total of 6 carcasses were observed during monthly surveys along this stretch. Among these, 2 carcasses had intact carapaces and hence could be measured.

EXPLOITATION OF SEA TURTLE ALONG THE SOUTHERN COAST

The exploitation of sea turtles along the southern coast was observed during the GOI–UNDP survey in 2000-2001. During the current season, 23 turtles were caught in fishing nets and all except Hawksbill turtles were consumed by local fishermen. In the total catch, 52% comprised olive ridleys, 35% green turtles, and the remaining 13% hawksbill turtles. Despite stringent laws enforced in the area, this practice continues unabated, but in a concealed manner. During interviews with the community, initially most people were hesitant to divulge any details regarding sea turtles. Persistent attempts and reassurance of the intent of visit helped draw out some information on the status of exploitation.



THREATS

Hatchlings emerging on Kalpakkam beach

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NESTING BEACHES

Natural calamities like the Tsunami of 2004, and cyclones have taken their toll on several areas of the Tamil Nadu coast, which is still evident in coastal areas of central Tamil Nadu. Global warming or climate change may also account for this, as fishermen have witnessed an increase in water level which has reduced nesting areas in the southern coast. Sand mining in the southern coastal districts has also reduced nesting beaches. Casuarina plantations, which reduce beach space for nesting, are quite prominent along the Kanyakumari coast.

Sand mining along Kanyakumari coast

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Green turtle stranded on Chennai beach

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INCIDENTAL CATCH

Turtle mortality from incidental catch in fishing gear, especially gill nets, is seen across the state. Trawling may also be prominent in the area as seen from the numerous fishing boats attached with trawls. But the extent of turtle mortalities from such practices could not be determined as fishermen were hesitant to divulge information. Interviews with people at the fish landing centres revealed that most of the remains of the exploited turtles are discarded at sea, and flesh and eggs (when found) get distributed amongst the boat crew, before they reach the shore. There is also an increase in fishing activity observed during the nesting season.

EXPLOITATION FOR MEAT AND EGGS

Carapace of an exploited olive ridley turtle

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The consumption of sea turtle eggs and meat is found to be on a declining trend along the Tamil Nadu coast. Strict enforcement of wildlife laws by the State Forest Department has played a key role in some of the areas. Moreover, awareness programmes and hatcheries operated by various NGOs have helped fishermen realize the value of conservation of turtles. Some fishermen engaged in nesting monitoring activities through these NGOs have found a means to employment which has helped improve their livelihood.

However, there is a general non co-operation noticed amidst fishermen with regard to interviews. The strict legal action taken against a youth of their community has made them hostile towards outsiders seeking interviews or involved in turtle conservation. This was revealed by some of the community members, after persistent queries. Most of the others interviewed, simply maintained that no nesting was observed there, or that it had not happened in recent years. This trend was seen in most places along the southern coast. Turtle eggs were also found to be predated on by the increasing number of feral dogs along the coastline.

IMPACTS OF COASTAL DEVELOPMENT

Increased coastal developmental activities such as building construction, and mast lighting on the beaches are noticed, as well as increase in industries and human

Left: Sea wall in Tirunelveli district

Right: NEST members being trained on sea turtle monitoring

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movements due to tourism on nesting beaches. Beach lighting deters turtle nesting and also disorients hatchlings from reaching the sea. In order to address this problem, some conservation groups like SSTCN and MCBT visit coastal villages around Chennai and Mamallapuram to ensure that beach/mast lights are switched off just before the nesting season and during the time of hatching. In the southern districts, nesting beaches were considerably disturbed by developmental activities such as sand mining, nuclear power plants, fishing harbors and intensified fishing activities. Similarly, in the central region, the Nagapattinam coast had disturbances from various thermal power plants, aquaculture and increase in fishing activities. In the northern coast of

Tamil Nadu, increasing residential plots, mast lights and fishing vessels were identified to be serious threats to turtle nesting.

RECOMMENDATIONS

Tamil Nadu's coastline has been subject to rapid industrialization over the past decade. Coast based developmental activities such as sand mining, nuclear power plants, fishing harbors, intensified fishing activities, thermal power plants, aquaculture, increasing residential plots, and mast lights are critically impacting the turtle nesting beaches along the coast. The declining trend of turtle nesting along the coast is one of the major impacts. Threats such as incidental catch and exploitation of turtles continue to persist in the southern districts, despite recommendations being made in the extensive survey of GOI –UNDP (2000-2001). Given rapidly intensifying threats to turtles and coastal biodiversity, the following conservation measures are recommended:

1. Sea turtle conservation will have importance only through addressing the livelihoods of the coastal fisher people. Existing turtle conservation efforts by local NGOs and Forest Department should take on a new paradigm of addressing livelihoods along with sea turtle conservation. Existing turtle conservation NGOs on the coast should merge their efforts with other coastal NGOs in conservation for strengthening advocacy against coastal developments that threathens conservation and livelihoods.

2. The coastal waters of Tamil Nadu form part of the migratory corridor of turtles that mass nest in Odisha (Pandav 2000). In view of this, fishing related activities should be monitored and controlled, particularly during the migratory time and turtle breeding period along the Tamil Nadu coast. It is absolutely necessary to control at least those fishing activities involving trawlers from operating in the waters during the designated period as offshore monitoring of fishing activities are extremely difficult. Turtle Excluder Devices (TED) should be made mandatory in all fishing trawlers/nets to reduce the incidental catches of sea turtles along the Tamil Nadu coast. Appropriate compensatory mechanisms for the period fishermen are restricted from fishing should be strategized and implemented.

3. Planting of Casuarinas should be carefully planned, taking into consideration the nesting space required for turtles. However, as a significant number of studies have shown the disadvantages of these plantations to turtles and other marine life, it would be most desirable to prevent these plantations along the coast. Other appropriate measures, such as restoring beaches and dunes should be explored and considered.

4. The need for coastal development activities such as thermal power plants, aquaculture, sand mining, construction of residential buildings, and lighting of the beaches that affect turtles and coastal livelihoods, should be critically relooked and coast friendly laws should be put in place accordingly. It may be helpful to raise awareness on CRZ rules across various coast based institutions and local fishing communities. Strict implementation of these laws across the state is critical for the sustenance of coastal biodiversity and turtles.

5. An educational and friendly approach to turtle conservation should be adopted in southern Tamil Nadu where turtle exploitation is high, and community displeasure to conservationists is intense, as is evidenced through the interviews.

In these parts, previous methods of law enforcement led to the fisher communities feeling humiliated, therefore causing a breach in relationships. As a result, illegal exploitation of turtles continues in a concealed manner. The community's trust and confidence has to be restored through the joint efforts of conservation groups and the Forest Department.

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STATUS OF SEA TURTLE HABITATS AND NESTING IN ANDHRA PRADESH

S. Saravanan, Kumari Swamy, Farida Tampal

BACKGROUND

The state of Andhra Pradesh has one of the largest coastlines in the country, and lies adjacent to the mass nesting grounds of olive ridley turtles in Odisha. Owing to its location, and considerably high sporadic nesting numbers, the coast of Andhra Pradesh is considered to be an important olive ridley nesting habitat.

Along with Tamil Nadu, it is the only other place on the Indian mainland where the occurrence of five species of sea turtles; leatherback, hawksbill, loggerhead, green and olive ridley turtles, have been reported by Kar and Bhaskar (1982) and Tripathy et al (2003). However, nesting of only olive ridleys has been recorded in the state (Kar 1983, Rajasekar et al 2000, Tripathy et al 2003). They have been reported to travel in large numbers through the offshore waters of Tamil Nadu and Andhra Pradesh when traveling to and from the mass nesting sites of Orissa (Kar 1983, Rajasekar and Subba Rao, 1993, Bhupathy and Saravanan 2006).

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Nesting beach of olive ridley turtle (ORT) in North AP

Olive ridley nesting was also recorded along the coast during the 1980s (Kar 1983, Subba Rao et al 1987). Southern most rookeries have been reported 50 kms from Orissa-Andhra border. Their sporadic and high intensity nesting was recorded in the north coastal region (Priyadarshini 1998, Rajasekar and Subba Rao 1993). Only sporadic nesting was reported across the Andhra Pradesh coast during intensive beach studies of GOI-UNDP 2000-2001 sea turtle project. Sporadic nesting was also documented in Sriharikota of southern coast (S. Sivakumar 2010). Records of turtle mortality along the Andhra Pradesh coast (Rao 1984, Tripathy et al 2003) and exploitation of sea turtle meat and eggs in northern Andhra Pradesh coast has been reported by Rajasekar and Subba Rao (1993), and Tripathy et al (2006).

This WWF-India initiative builds on the earlier studies to provide a status of turtle distribution in 2010-12.

STATUS AND LOCATION OF NESTING BEACHES

Andhra Pradesh is one of the largest maritime states in the country with a coastline of 980 km. Nine districts of the state fall into coastal Andhra Pradesh, with Nellore district bordering the state of Tamil Nadu (Figure 2) in the south, and Srikakulam district bordering the state of Odisha located to its north (Figure 1). The significant natural geographic features that mark these borders are the Pulicat lagoon and Bahuda river mouth respectively.

The maps below show the coastal districts and co-ordinates of the beaches (names provided in Table 1) with higher intensity of nesting turtles. Fishing villages along the nesting locations have also been listed.

FIGURE 1. BEACHES SURVEYED ALONG NORTHERN ANDHRA PRADESH

FIGURE 2. BEACHES SURVEYED ALONG CENTRAL ANDHRA PRADESH

FIGURE 3. BEACHES SURVEYED ALONG SOUTHERN ANDHRA PRADESH

TABLE 1. POTENTIAL NESTING LOCATIONS AND THEIR COORDINATES

Northern Andhra Pradesh	Jeedupalam	18°07'08"N	83°44'08"E.
	Muthiyavanipalem	17°32'10"N	83°05'35"E.
	Hope Island	16°58'16"N	82°20'47"E.
Central Andhra Pradesh	Sacremento Island	16°35'12"N	82°18'59"E.
	Lankavanidibba	15°42'58"N	80°49'21"E.
	Elichetladibba	15°43'25"N	80°54'03"E.
	Isakapalle	14°44'22"N	80°06'19"E.
Southern Andhra Pradesh	Ramachandrapuram	14°39' 25"N	80°09'35"E.
	Lakhsmipuram	14°41'44"N	80°08'59"E.
	Mypadu	14°30' 22"N	80°10'43"E.

METHODOLOGY

SECONDARY INFORMATION

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Nesting crawl of olive ridley turtles in northern Andhra Pradesh

Review of literature, collection of secondary data from fishermen, local Forest Department staff, NGO's and pre-nesting surveys helped plan the detailed turtle nesting and mortality surveys along Andhra Pradesh coast. A questionnaire based interview model was used to collect secondary data from various stakeholders during the pre-nesting survey. This survey was carried out between the months of November-December 2010, as nesting season in Andhra Pradesh commences sporadically from the month of December; extending till April.

NESTING SURVEY

The nesting survey along the Andhra Pradesh coast was patterned after the study method used by Tripathy et al (2003) in the GOI UNDP Sea Turtle Survey, where coastal districts were classified into three different zones and further into small sectors through coastal landmarks such as rivers, islands, lagoon etc. The nesting beaches were surveyed fortnightly in selected beaches, and on a daily basis in few other locations. The nesting population of olive ridley turtles was estimated in both the surveys. The nesting beaches were surveyed on foot and direct sightings of turtle nesting and indirect sighting such as fresh crawl marks on the beach were recorded. The beaches with intensive nesting were surveyed on foot twice a day and information recorded on number of nesting turtles, number of eggs laid and information on hatchlings.

In these nesting sites on most occasions, eggs were removed from the original nests and shifted to turtle hatcheries to reduce the hatchling mortality as an immediate conservation measure. The turtle nesting intensity for the localities studied was

calculated as: Total number of nests recorded in the season/Total number km surveyed.

MORTALITY SURVEY

Dead olive ridley turtle in northern Andhra Pradesh

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Mortality of sea turtles was estimated through direct observation of dead turtle washed on to the coast, and from secondary sources, such as reports published in newspapers. Curved Carapace Length (CCL) and Curved Carapace Width (CCW) of dead turtles encountered on beaches was measured. Attempts were made to determine the sex of the turtles based on the length of tail. Few turtle carcasses were noticed with only the carapace and therefore identifying the sex in these cases was a not possible.

NORTHERN ANDHRA PRADESH COAST

Olive ridley turtles caught in a fishing net in Muthiyavanipalem in northern Andhra Pradesh

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

Transects selected for fortnightly surveys:

1. Srikurmam to Ganagalapeta (13 km),
2. Peddanagayyapalem to Annavaram (5 km),
3. Kondarajupalem to Mukkam (2 km),
4. Uppada to Rishikonda (10 km) and
5. Rishikonda to RK beach (15 km)

Transects surveyed on a daily basis:

1. Muthiyavanipalem (3 km)
2. Hope Island (5 km).

The nesting information on olive ridley turtles in Jeerupalem village, Srikakulam district was also obtained from Divisional Forest Officer, Srikakulam from their in situ conservation programme.

CENTRAL ANDHRA PRADESH COAST

PCCF (Wildlife) & CWLW visiting turtle hatcheries at Sacramento

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

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

Transects surveyed on a daily basis:

1. Sacramento Island (3 km)
2. Elichetladibba (8 km) and
3. Lankavanidippa (6 km)

SOUTHERN ANDHRA PRADESH COAST

In-situ conservation at Sacramento

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The southern Andhra Pradesh coast extends from Krishna river mouth to Pulicat lagoon near the Tamil Nadu border and is 310 km in length. The rivers that flow into the Bay of Bengal are Pennaru, Gondlakamma, Musi, Palleru, Swarnamukhi and Kandaleru. Mangrove vegetation was observed

Ex-situ conservation at Sacramento

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in Krishna river mouth from Nizampatnam to Gondlakamma. Sand dunes, rising to about 20 to 50 mts were observed from Musi to Pennaru river mouths. Olive ridley turtle in-situ and ex-situ conservation has been initiated in Nellore district by Tree Foundation with the support of Andhra Pradesh Forest Department.

Transects surveyed on a daily basis:

1. Ramachandrapuram beach (16 km)
2. Lakshmipuram (6 km)
3. Mypadu (3 km)
4. Isakapalli (3 km)

CURRENT DISTRIBUTION AND STATUS OF NESTING

Marine turtle nesting survey was carried out from December 2010 to May 2011 in central Andhra Pradesh and south Andhra Pradesh coasts and from February 2011 to April 2011 in north Andhra Pradesh coast. Nesting survey was conducted in river mouth surrounding all the three zones (except few beaches in north Andhra Pradesh coast). The nesting beaches of Muthiyavanipalem in Visakhapatnam, Hope island near Kakinada, Sacramento Island near Coringa Wildlife Sanctuary and Elichetladibba, Lankavanidippa near Krishna mouths, Ramachandrapuram, Lakshmipuram, Isakapalli and Mypadu in Nellore Districts were studied intensively (daily) for estimating nesting population of olive ridley turtle. Similarly, nesting beaches from Visakhapatnam coast to Srikurmam (in few transects) were studied fortnightly (Table 1).

Hatchlings being released into the sea

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The major vegetation seen in the coast of AP is *Ipomea pescaprae, Spinifex littoreus* and *Launea sarmentosa* spread across the sand dunes. Apart from this, *Casuarina litorea* and *Palmyra Borassus flabellifer* are the dominant tree species that were planted by Andhra Pradesh Forest Department as barriers against cyclones and storms. (Tripathy et al. 2003) Few patches of cashew and coconut plantations are also observed on the AP coast.

NESTING STATUS OF OLIVE RIDLEY NEAR RIVER MOUTHS

The present study was carried out mainly on beaches located near river mouths as olive ridley turtle nesting intensity was reported to be high at these locations (Tripathy et. al. 2003). Along a length of 101 km of the Andhra Pradesh coast that was surveyed, a total of 1798 nests of olive ridleys were recorded. Among this, 236 nests of olive ridleys were recorded in north AP; 1456 in central AP; and 106 nests were recorded in south AP. Nesting intensity of 2.13 nest/km/season was estimated in northern AP, in fortnightly surveyed beaches (total 45 kms). Similarly during intensive/daily surveys, nesting intensity of 13 nests/km (total length 11 km) were recorded in northern AP; 86 nests/km/season (17 km length in 3 beaches) in central AP; and 4 nests/km/season in southern AP coasts (total of 28 km covered in 4 intensively surveyed beaches) were estimated. The nesting begins in the month of December sporadically and ends in April. Nesting was found to be very high in February (987) and March (656).

Zone wise analysis

NORTHERN ANDHRA PRADESH COAST

In the northern coastal zone, 45 km was surveyed fortnightly. Along this length three nesting beaches, 11 km each were surveyed intensively (Table 2). The fortnightly surveys were carried out in Bahuda, Vamsadhara, Nagavalli and Gostani rivers mouths (Table 1). The transect length varied from 2 km (minimum) to 10 km (maximum). A total of 96 nests were recorded in fortnightly survey and about 140 nests were recorded in intensive surveys (daily). The nesting beach of Muthiyavanipalem was studied during February to April, whereas Hope Island was studied since December 2010. Nesting of olive ridley turtles was observed to peak in February in Hope Island, but was observed to peak in March and April in Muthiyavanipalem. The fortnightly surveys also revealed that maximum nesting occurred during March.

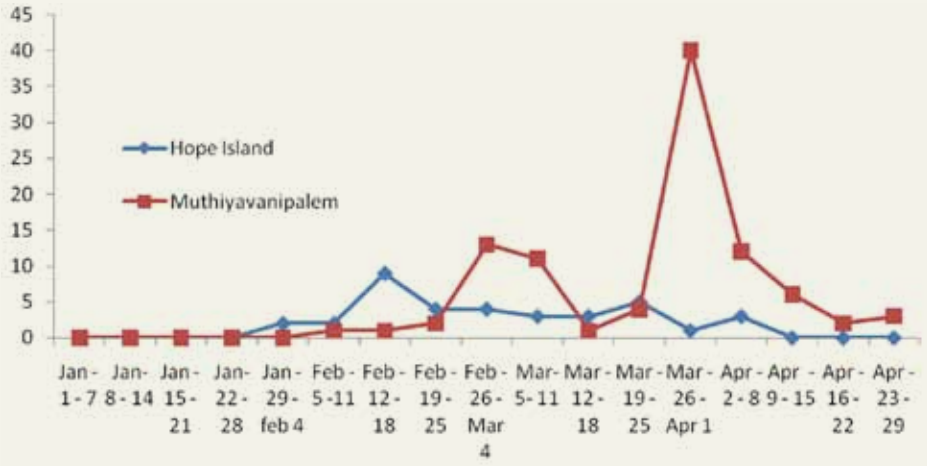
TABLE 2. OLIVE RIDLEY TURTLE NESTING IN NORTH ANDHRA PRADESH COAST (BEACHES SURVEYED FORTNIGHTLY FOR 2 MONTHS)

S. No	Transect*	Kms	February	March	Total Nests
1	Peddavalteru to R.K. beach	5	0	2	2
2	Appugaru to Rishikonda	10	6	9	15
3	Rishikonda to Uppada	10	1	2	3
4	Kondarajupalem to Mukkam	2	0	3	3
5	Peddanagayyapalem to Annavaram	5	0	5	5
6	Ganagalapeta to Srikurmam	13	0	68	68
7	Total	45	7	89	96
	Nest per Km	**2.13 nests**			

TABLE 3. OLIVE RIDLEY TURTLE NESTING IN NORTH AP COAST (INTENSIVE BEACHES/BEACHES SURVEYED ON DAILY BASIS)

S. No	Nesting Beach	Kms	February	March	April	Total Nests
1	Hope Island	5	20	13	3	36
2	Muthiyavanipalem	3	7	55	34	96
3	Jeerupalem	3	3	5	0	8
	Total	**11**	**27**	**68**	**37**	**140**
	Nest per Km	**13 nests**				

FIGURE 4. WEEKLY NESTING OF OLIVE RIDLEY TURTLE IN INTENSIVELY STUDIED BEACHES IN NORTH ANDHRA PRADESH COAST



The nesting of olive ridley turtle varies weekly in different intensive study areas. In the three (intensive) beaches, nesting started during the last week of January; nesting was prolonged in Muthiyavanipalem near Visakhapatnam. The peak nesting was observed in Hope Island in mid February, where as in Muthiyavanipalem the peak was observed in the last week of March and first week of April.

CENTRAL ANDHRA PRADESH COAST

Along the central Andhra Pradesh coast, the study was restricted to few island patches near the Godavari and Krishna river mouths. A total of 1456 nests with nesting intensity of 86 nests/km/season were recorded during the study. The intensive study beaches vary in length; Elichetladibba (8 km), Lankavanidippa (6 km) and Sacramento Island (3 km). The nesting begins sporadically during December (only in Elichetladibba) and was observed to peak in February (Table. 3).

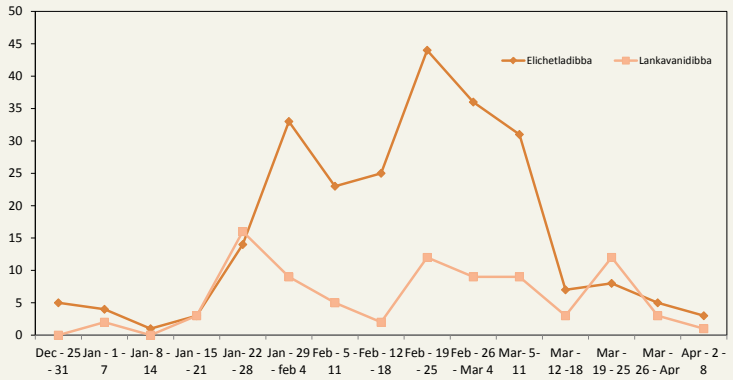
TABLE 4. OLIVE RIDLEY TURTLE NESTING IN INTENSIVE NESTING BEACHES OF CENTRAL ANDHRA PRADESH COAST

S. No	Nesting Beach	Kms	January	February	March	April	Total Nests
1	Sacramento Island	3	24	699	387	6	1119
2	Elichetladibba*	8	33	132	68	4	245
3	Lankavanidippa	6	24	30	31	1	92
	Total	**17**	**6**	**861**	**486**	**11**	**1456**
	Nest per Km	**86 nests**					

(Source: Forest Department)* 5 nests recorded during December 2010

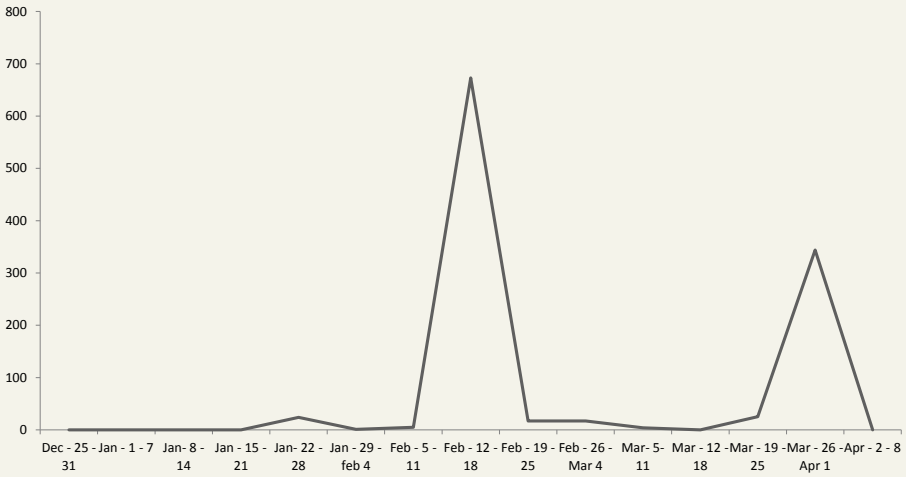
The nesting intensity of olive ridley turtle varied in both intensive beaches studied in central AP, but the peak nesting was observed in the last week of January and mid February. Maximum number of nests were observed in Elichetladibba compared to Lankavanidippa.

FIGURE 5. WEEKLY NESTING INTENSITY OF OLIVE RIDLEY TURTLE NEAR KRISHNA RIVER MOUTH



(Source: Forest Department)

FIGURE 6. NESTING INTENSITY OF OLIVE RIDLEY TURTLE IN SACRAMENTO (WEEKLY) NEAR GODAVARI RIVER MOUTH



The nesting intensity was very high in Sacramento Island near CWLS in Godavari river mouth (Fig 3). The nesting of olive ridley turtle was observed to be very high in mid February (673), and then in the last week of March (344).

SOUTHERN ANDHRA PRADESH COAST

The present study focused only on river mouths of Nellore district and a total of 28 kms was surveyed. The nesting intensity was very low when compared to the coastlines of central and northern Andhra Pradesh. The nesting of olive ridley turtle also begins during the month of January and ends in March. The maximum nesting was recorded in February (Table 4).

TABLE 5. OLIVE RIDLEY TURTLE NESTING IN INTENSIVE NESTING BEACHES OF SOUTH AP COAST

S. No	Nesting Beach	Kms	January	Febru-ary	March	Total Nests
1	Ramachandrapuram	16	3	39	5	47
2	Lakshmipuram	6	4	31	8	43
3	Isakapalli	3	0	16	0	16
4	Mypadu	3	0	6	0	6
	Total	**28**	7	**92**	**13**	**106**
	Nest per Km	**4 nests**				

(Source: Forest Department)

SEA TURTLE MORTALITY

Marine turtle mortality survey was carried out in few transects along northern and central Andhra Pradesh coasts. Nesting and mortality surveys were carried out simultaneously. The turtles washed ashore were counted and the Curved Carapace Length (CCL) and Curved Carapace Width (CCW) were measured. Sex was determined by the length of the tail. In most of the observations, turtle carapace was seen without the tail or body flesh, so determination of sex was difficult; these turtles were categorised as "sex unknown" and marked as 'U' (Table 6). A total of 50 turtle carapaces were encountered; among these, 30 were female, 1 was male and 19 were unknown. The average length and width of carapace encountered was 67 cm and 65 cm respectively.

TABLE 6. TURTLE MORTALITY OBSERVED (ON FIELD) ALONG ANDHRA PRADESH COAST (2010-2011)

No	Transect/Village	KM	Number	Sex	CCL*(cm)	CCL*(cm)
1	Appugaru to Rishikonda	10	5	F	69	65
2	Rishikonda to Bhimili	13	6	(F5, U 1)	67	64
3	RK Beach Vizag	1	1	U	65	62
4	Erada Beach	1	1	U	71	68
5	Muthiyavanipalem	1	1	U	51	47
6	Chintapalli	1	1	F	65	62
7	Kundavanipeta-Srikurmam	10	6	(F3, U 3)	70	68
8	Rajaramapuram	1	1	U	70	68
9	Interu – Pettapatnam	13	11	(F7, U 30, M 1)	66	65
10	Pallethumalapalem	2	9	(F1, U 8)	67	68
11	Palakantippa	3	5	F	69	67
12	Manginapudi	2	3	(F2, U 1)	69	66
	Total		**50**			

*Average Value; F: Female; M: Male; U: Unknown

Apart from field encounters of dead turtles, mortalities were also recorded from published information shared by NGOs. These include 154 turtles (9 male, 132

females and 13 unknown) which were found on shore along the Kottapeta coast near Bhavanapadu Fishing Harbour on the northern coast of Andhra Pradesh, on 17th March 2011 (K.L.N. Murthy & K.V.Ramana Murthy 2011).

THREATS

INCIDENTAL CATCH

On the Andhra Pradesh coast, the nesting season coincides with the fishing season. This results in high incidence of turtles being caught in fishing gear, particularly the gill nets. Most of the time, as seen from the current survey, such capture of turtles is incidental. This was observed throughout the state. From the 50 fishing villages visited across the state, fishermen have reported that nesting has declined across all the zones. Increasing number of mechanized boats in operation as well as increasing fisherfolk population in the nesting beaches and fishing activities seems to have caused the decline of turtle nesting.

EXPLOITATION FOR MEAT AND EGGS

In northern and central Andhra Pradesh, turtle meat and eggs are still consumed by the fishing community. But in a few villages near Srikurmam, where the turtle temple is located, villagers revere the turtle and therefore do not consume the meat.

TABLE 7. QUESTIONNAIRE USED FOR FISHERMEN IN COASTAL VILLAGES OF ANDHRA PRADESH

S. No	Date	Village	No of persons	Nesting	Status	Exploitation	Trawls (approximate nos)
1	4-Feb-11	Peddawalter	10	Yes	Decline	Yes - Eggs	500
2	4-Feb-11	Appugaru	15	Yes	Decline	Yes - Eggs	150
3	4-Feb-11	Judugulapalem	5	Yes	Decline	No	10
4	4-Feb-11	Rishikonda	15	Yes	Decline	No	100
5	5-Feb-11	Timmapuram	8	Yes	Decline	No	10
6	5-Feb-11	Chapala Timmapuram	6	Yes	Decline	No	10
7	5-Feb-11	Mangumarpeta	3	No	Not sure	Yes - Eggs	10
8	5-Feb-11	Uppada	8	Yes	Decline	Yes - Eggs	40
9	5-Feb-11	Bhimili	10	Yes	Decline	Yes - Eggs	100
10	6-Feb-11	Erada	10	Yes	Decline	Yes - Eggs/Meat	25
11	6-Feb-11	Appikonda	5	Yes	Decline	Yes - Eggs/Meat	20
12	6-Feb-11	Muthiyavanipalem	8	Yes	Decline	Yes - Eggs/Meat	30
13	6-Feb-11	Tantada	5	Yes	Decline	Yes - Eggs/Meat	10
14	7-Feb-11	Annavaram	5	Yes	Decline	Yes - Eggs/Meat	20
15	7-Feb-11	Gondarajpalem	6	Yes	Not sure	Yes - Eggs/Meat	15
16	7-Feb-11	Konnada	10	Yes	Decline	Yes	25
17	8-Feb-11	Peddanagayyapalem	8	Yes	Decline	Yes - Eggs/Meat	10
18	8-Feb-11	Chintapalli	10	No	Not sure	No	600
19	9-Feb-11	Kundavanipeta	11	Yes	Decline	Yes - Eggs/Meat	30
20	9-Feb-11	Ganagalapeta	9	Yes	Decline	Yes - Eggs/Meat	40

21	9-Feb-11	Bandarvanipeta	10	Yes	Decline	Yes - Eggs/Meat	15
22	10-Feb-11	Mogadalapadu	3	No	Not sure	No	150
23	10-Feb-11	Rajaramapuram	5	No	Not sure	No	100
24	10-Feb-11	Megavaram	8	Yes	Decline	Yes- Eggs	50
25	10-Feb-11	Vajrapukotturu	6	No	Not sure	No	40
26	10-Feb-11	Baruva	10	Yes	Decline	Yes - Eggs	50
27	10-Feb-11	Donkuru	12	Yes	Decline	Yes	100
28	10-Feb-11	Srkurmam	10	Yes	Decline	No	50
29	10-Feb-11	Balarampuram	3	Yes	Decline	No	10
30	1-Mar-11	Interu	10	Yes	Decline	No	20
31	1-Mar-11	Varlakunditippa	5	No	Not sure	Yes - Eggs	10
32	1-Mar-11	Pettapatnam	10	Yes	Decline	Yes - Eggs	25
33	1-Mar-11	Chandrapalem	20	Yes	Decline	Yes - Eggs/Meat	50
34	1-Mar-11	Karaagraharam	10	No	Not sure	No	10
35	2-Mar-11	Pallethumalapalem	5	Yes	Decline	No	-
36	2-Mar-11	Palakayatippa	5	No	Decline	No	-
37	3-Mar-11	Mangipudi	5	Yes	Decline	Yes	50
38	4-Mar-11	Nizampatnam Harbour	10	Yes	Decline	No	150
39	4-Mar-11	Suryalanka	5	Yes	Decline	Yes- Eggs	60
40	5-Mar-11	langavanidippa	10	Yes	Decline	Yes -Eggs	50
41	6-Mar-11	Vadevaru	10	Yes	Decline	-	200
42	7-Mar-11	Ramachadrapuram	2	Yes	Decline	-	25
43	8-Mar-11	Mypadu	10	Yes	Decline	Yes- Eggs	150
44	9-Mar-11	Kothapatnam	8	Yes	Decline	Yes- Eggs	150
45	27-Mar-11	Sacramento	10	Yes	Decline	Yes- Eggs	50

RECOMMENDATIONS

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

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

3. Incentives to fishing community have to be provided in order to follow sustainable fishing practices, particularly during turtle nesting seasons. So far, there have been no such efforts. We suggest employing the fishers as turtle watchers or protectors in their villages during nesting seasons.

4. Compulsary use of Turtle Excluder Devices (TED) has to be implemented through the Fisheries Department in mechanized boats to reduce the incidental catches during fishing. As per the personnel communication from Deputy Director Fisheries of Andhra Pradesh on TED, it is compulsory for all mechanized boats/

trawls, especially during turtle nesting season to use TED (The TED regulation under the Marine Fisheries Regulation Act of Andhra Pradesh). However, implementation is not effective so far. Nevertheless, it is positive to note that there is less resistance to TED from fishermen in Andhra Pradesh. Therefore, awareness on TEDS must be taken up on a continuous basis in major fishing harbors such as Nizampatnam, Vodareru, Kakinada and Visakhapatnam.

5. Coastal Regulation Zone (CRZ) has to be strengthened and enforced with the joint efforts of the State Government. Policies should be put in place for beach sand mining that are affecting turtle nesting ground as well as harming the coastal ecology A community based coastal zone conservation programme with special reference to sea turtle across the state should be implemented by the Forest Department with support of credible NGOs.
6. In addition to the existing efforts of turtle conservation organisations in Andhra Pradesh, research and monitoring study of olive ridley turtle population and migration should be initiated and furthered by institutions like CMFRI, WWF-India and Forest Department during nesting season in the state.
7. Few local NGOs such as VSPCA, Green Mercy, and Tree Foundation have been monitoring and protecting turtle nests through ex-situ and in-situ conservation. These efforts should be supported and extended throughout the Andhra Pradesh coast.

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MARINE TURTLES OF ODISHA: STATUS, ISSUES AND THREATS

Chandra Sekhar Kar and Michael Peters

BACKGROUND

The Odisha coast sustains the largest congregation of olive ridley turtles, and is among the only three mass nesting grounds of the world; this phenomenon of mass nesting is called the Arribada-a Spanish term for mass arrival. Turtles, such as the green (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) have also been sighted off the shores of Odisha. However, only olive ridley has been reported to nest on the coast of Odisha (Kar and Bhaskar, 1982; Kar, 1988, Dash and Kar 1990; Pandav, et al. 1994, 1997).

The mass nesting activity on Gahirmatha coast has been documented in various studies (Bustard 1974, 1976; Kar, 1980; Bustard and Kar, 1981; Kar and Bhaskar 1982, Silas et al., 1984; Pandav, et al. 1994, 1997). However, mass nesting at Gahirmatha was confirmed and made known to the scientific community by Dr. H. R. Bustard, an FAO consultant during his survey in the Bhitarkanika Mangroves for crocodiles (Bustard, 1974; FAO, 1976). During the 1970's and 80's, much of research and study was concentrated on Gahirmatha, Devi river mouth (Kar 1982) and southern end of Puri beach (Biswas, 1982). Later, subsequent studies have identified most parts of Odisha to be the sea turtle nesting beaches (Kar, C.S. 1980,1981,1982,1988,1992,1999, 2000, 2002 a, b, c, 2010 a, b, 2011; Kar and Bhaskar 1982; Silas et al. 1983; Kar and Dash 1984 a, b; Whitaker and Kar 1984; Chadha and Kar 1999; Dash and Kar 1990; Kar and Padhi 1992; Pandav et al. 1994 a, b, 1995, 1997; Kar and Satpathy 1996; Dani and Kar 1999; Pandav and Kar 2000; Patnaik and Kar 2000; Patnaik et.al. 2001; Prusty, et al. 2000, 2007; Tripathy, B. 2005; Singh et al.2007 Mohanty, S.C. et al. 2004, 2006; Kurian 2008; Muralidharan 2009; Anon, 2009). Mass nesting behavior was reported by Kar and Dash (1984).

Olive ridley turtles mating

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Olive ridleys are the smallest of the sea turtles and are generally found in tropical seas. The adults are about 65 cm long and weigh between 30 to 55 kg. It was found that a major segment of the olive ridley population visiting the Odisha coast are from south of Sri Lanka (Pandav and Choudhury, 2000). The Forest Department of Odisha flipper tagged ~15,000 nesting female turtles during 1980s, and the CMFRI have tagged nearly ~1,000 turtles. Further, the Wildlife Institute of India tagged ~22,000 nesting turtles and 1,670 mating pairs in the offshore waters of Odisha from 1995-2002. The results of all these studies showed that olive ridley turtles migrate between mass nesting beaches (Dash & Kar, 1990, Pandav & Choudhury, 2000; 2005, Tripathy & Pandav, 2008).

Genetic studies confirmed the results from tagging and satellite telemetry studies and showed that there is no genetic difference between nesting populations in each of the mass nesting beaches. More significantly, the results revealed the distinctiveness of the population on the east coast of India including Sri Lanka, and suggested that these are the ancestral source for contemporary global populations of olive ridley turtles (Shanker et al., 2004).

Beginning from November, olive ridley turtles start arriving on the Odisha coast and congregate in three major groups off Gahirmatha, Devi and Rushikulya coastal waters. Smaller congregation of the mating pairs are also seen particularly in all major river mouth areas of Odisha from Subarnarekha river in the north, bordering West Bengal to Bahuda river mouth in the south, bordering Andhra Pradesh – the two neighboring coastal states of Odisha. They are generally found at this time within about five to ten kilometers off shore. Here, they forage and mate. Till about end of December, turtle congregations are seen mostly as mating pairs on the surface of shallow coastal waters. The mating pairs are also seen in lesser concentrations some times till end of February. It has been seen that sea turtles tend to come back to the same nesting grounds almost every year (Kar, 1988 1992; Pandav and Choudhury, 2000). Eggs fertilize almost a month after mating. From the end of January, the male congregation separates from the females and the female turtles start approaching the coast. By mid February the gravid females are almost within one to two kilometers from the coast. Some of them start coming ashore to nest in solitary runs. This solitary nesting is a strategy adopted by them throughout their circumglobal range. This is noticed in quite a number of places along the Odisha coast, where the beach is sandy with gentle slopes which are approachable for the turtles. However, in some selected locations, the gravid olive ridley females emerge on the beach for nesting en mass in very large synchronized aggregations (Kar and Dash 1984). Such mass nesting behavior is referred to as arribada. The phenomenon of mass nesting of olive ridley sea turtles generally occurs sometimes between February and March, although in some years it has taken place as early as late December or even in early April.

Female olive ridley coming ashore to nest

It has been seen that some factors trigger the nesting impulse of the female congregation and they start coming ashore to nest in large numbers over a period of five to seven days. The common factors noticed during such mass nesting or arribadas are - the onset of the strong on-shore winds, increase in turbidity of the sea water, phase of the lunar cycle and sudden changes in weather conditions. A female on an average, lays 110 eggs but can lay up to about 180 eggs in one clutch (Kar, 1988, 1990; Dash and Kar 1990). The nesting numbers start with tens or hundreds or even thousands and peaks in a few days, and then starts to ebb out and may terminate entirely by the sixth or seventh day.

Olive ridley females generally have been seen climbing above the high tide mark to select a site to dig the body pit and nest hole to lay their eggs. Eggs are laid in dug up nest holes, resembling an earthen pot, with a narrow mouth and neck and a much wider rounded bottom. The body pit is dug up using all the four flippers while the nest hole is dug up by the hind legs. A completed nest measures about one and a half feet deep. Eggs are about the size of a table tennis ball and the shell is soft and leathery. The ridley females take about 14 to 18 minutes to lay the eggs. After laying the eggs, the female covers the nest hole with its flippers and thumps the nest with its underbelly. She then leaves for the sea, and does not return for the hatching.

The incubation period is temperature dependant and varies from about 50 to 70+ days. On an average, the eggs incubate in about fifty plus days. It has been seen that if the mean incubation temperature is above 30° Celsius, more females are produced from the eggs (Diamond and Mohanty-Hejmadi (1983), Mohanty Hejmadi et al (1984).

Mass nesting by gravid female olive ridleys

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When the eggs of a nest cluster hatch, the new born hatchlings move towards the surface collectively and this could take a day or more. Hence, during this hatching period it is advisable not to allow anyone to walk on the important nesting beaches. Such walking could result in trampling over the emerging hatchlings, making the sand more compact and more difficult to crawl through and even crushing hatchlings close to the surface. Generally, the turtle hatchlings prefer to emerge from the nest during the dark hours and move towards the sea. However, presence of artificial lights near the nesting beach disorients the hatchlings and instead of moving toward the sea they tend to move towards the source of artificial illumination (Dash and Kar, 1990; Kar 2010, 2011; Karnad et. al 2009; Pandav and Choudhury, 2000).

The olive ridleys are known to nest in very large numbers within a short span of five to seven days on suitable stretch of selected sandy beach over a length of about one to three kilometers or more. However, the species have also been known to emerge in individual sorties onto numerous suitable sandy beaches to lay eggs, which are considered as an alternate nesting strategy, the species has adopted for its survival. Dash and Kar (1990) and Kar (1988) have compiled and extensively reviewed such nesting sites of olive ridleys throughout the world.

Oliver ridley hatchlings emerging from a nest

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The last survey on nesting habitats along the Odisha coast was conducted in 1993. Thereafter, the Odisha coastline has undergone significant changes due to natural and man-made alterations in the coastal geomorphology. Therefore, revisiting the entire coast of Odisha to assess the status of sea turtle nesting is required (Tripathy et al 2008). The present study was undertaken to survey and document all the nesting sites of olive ridley sea turtles including both mass nesting as well as sporadic nesting sites distributed all along the Odisha coast.

STATUS AND LOCATION OF NESTING BEACHES

The general coastline where the olive ridleys have been recorded to nest lies to the south of the Dhamra river mouth between the Maipura river mouth - 24°45'11.32"N 87°05'29.81"E in the north and south of Bahuda river mouth up to little beyond Sonapur village - 19°04'31.42"N 84°45'48.39"E . The river mouths that fall in between these points and where good nesting sites of the olive ridleys have been found, are along the river mouths of Maipura, Baunsagarh, Hansua, Mahanadi, Devi, Kadua, Nuanai, Rushikulya and Bahuda. Of these sites, the phenomenon of nesting in large numbers over a few days or "arribada", generally occurs on the Gahirmatha coast (Nasi islands), and just north of the Rushikulya river mouth from Purunabandha to Kantiagada and extending further to the north. Some sporadic nesting also takes place in the sandy coastline between Chandipur north and Udaypur near West Bengal border.

In Odisha coastal waters, the continental shelf area is 23,830 kms. The continental shelf, north of Paradip is generally shallow and the depth is between 10 to 12 meters even up to 20 kilometers deep into the sea, while it becomes shallower along the Bhadrakh and Balasore coasts. To the south of Paradip, the continental shelf area is narrow and steep and the depth zone varies widely from 20 to 200 meters. Along Gahirmatha and Devi coast, good mangroves are located in Bhitarkanika which provides a food source for the adults and hatchlings. This could be a reason for the olive ridleys to favor the area for mass breeding and mass nesting (Kar, 1988; Dash and Kar, 1990; Kar, 2010, 2011, 2012; Kar and Satpathy, 1996).

The coast of Odisha, north of Dhamra along Bhadrakh district is generally muddy which is not conducive for nesting. However, the new born hatchlings after emergence period spend some time in the shallow waters of the coastal area before their final disappearance in to the deep sea. The river mouths, especially that of Maipura and Rushikulya provide good foraging grounds for the adult olive ridleys and thus there is a large congregation of them off these river mouths, resulting in the mass nesting at Gahirmatha and Rushikulya. These two coasts also have a wide beach which allows the turtles enough space to nest. However, the Nasi II Island along the Gahirmatha coast is seen to be shrinking and the length has come down to almost 800 mts and the width to almost 200 mts.

After digging of the ship channel of the Dhamra port, the Nasi I island had started eroding and was completely lost in 2 to 3 years. Thereafter, the Nasi II Island has also started eroding and the beach width is considerably reducing throughout its length. The beach at Rushikulya has been stable so far up to 2010 nesting season and there is a consistent length of about 6 kilometers and an average width of about 60 meters. In this area, mass nesting in any particular year, takes place in a length of 2-3 kms and heavy to moderate sporadic nesting takes place in the rest of the area.

FIGURE 1. MAJOR NESTING SITES OF OLIVE RIDLEYS ALONG THE ODISHA COAST

R=River mouths with higher nesting densities

TABLE 1. CO-ORDINATES OF IMPORTANT NESTING BEACHES OF ODISHA

S. No	Nesting Location	Co-ordinates
1	Dhamra River	20°46'29.70" N 86°59'9.65" E
2	Mahanadi River	20015'30.91" N 86 040'40.64" E
3	Devi River	19°57'54.15" N 86°22'46.34" E
4	Kushabhadra River	19°50'56.82" N 86° 1'48.05" E
5	Rushikulya River	19021'20.49" N 85002'48.62" E
6	Bahuda River	19007'38.36" N 84 047'48.15" E
7	Nuanai River	19°49'7.48" N 85°54'36.11" E
8	Wheeler Island	20°45'27.72" N 87° 5'10.14" E
9	Ekakula	20042'13.38" N 87 002'06.75" E
10	Habalikhati	20040'13.29" N 86 059'12.97" E
11	Chinchiri River Mouth	20035'11.59" N 86 051'18.43" E
12	Pentha	20033'47.82" N 86 049'08.01" E
13	Barunei River Mouth	20030'13.05" N 86 045'32.41" E
14	Agarnasi Island	20028'58.37" N 86 048'29.37" E
15	Paradeep	20°15'31.02" N 86°40'33.11" E
16	Jhatadri River Mouth	20011'00.07" N 86 032'05.28" E
17	Ramtara	20006'52.01" N 86 029'08.05" E
18	Hawa Khana	20005'57.85" N 86 028'34.49" E.

19	Sahana Nasi	19057’18.21 ” N 86 021’56.70” E.
20	Keluni River Mouth	19054’31.01” N 86014’20.02” E.
21	Bali Harchandi	19007’38.36” N 84 047’48.15” E.
22	Prayagi	19027’59.67” N 85 010’18.37” E.
23	Podampeta	19024’47.63” N 85 006’06.23” E.
24	Gokhurkuda Rookery	19°21’41.85” N 85° 3’ 21.40” E
25	Gopalpur Port	19018’21.58” N 84 058’02.11” E.
26	Markandi	19°57’15.97” N 19°57’15.97” E.
27	Sonapur	19°51’42.55” N 86° 4’13.33” E

The most prominent beach vegetation found all along the Odisha coast are sand binders – *Ipomea pescaprae*, *Launea sarmentosa, Gisekia pharnacoides* and *Spinifex littoreus*. (Pandav, Choudhury and Kar, 1994, 1997). These, sometimes, can be deterrents to nesting turtles, if they cover a larger portion of the nesting area, as it is difficult for the turtle to dig the nest through the creepers. Mangroves are found on the Mahanadi estuary, the Brahmani-Baitarani confluence, Devi estuary, and mouths of Dhamra, Budhabalanga and Subarnarekha rivers. Along with this, the other major prominent vegetation is Casuarinas, planted almost all along the coast. This was planted in the 1970s by the government with the view of mitigating beach erosion and providing protection against cyclonic storms (Pandav, Choudhury and Kar, 1994, 1997). Such plantations, very close to the high tide level, may be one of the factors which have stopped the mass nesting phenomenon at Devi in the past years, as turtles did not find the place to nest. Turtles generally nest above the high tide level, to prevent salt water seeping in to the eggs and damaging them.

Ipomea pescaprae growing on the beach

METHODOLOGY

LITERATURE REVIEW AND INTERVIEWS

The current survey of the Odisha coast has taken place after a gap of eighteen years, since the last extensive survey of 1993 (Pandav et al 2006). A thorough review of available literature on sea turtles was made to know the distribution of olive ridleys on a global, national and regional level, and in particular along the Odisha coast.

MASS NESTING AND SPORADIC NESTING SITES

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Casuarinas planted near the high tide line

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Turtle nesting among Casuarinas due to shortage of space

In Odisha, there is sufficient recorded information on the nesting figures at the two current mass nesting sites and many studies have been carried out by the researchers of State Forest Department and other researchers from universities as well as other Research and Development institutions. Though there is mention in some literatures on the sporadic nesting of sea turtles in many places along the coast of Odisha, other than the mass nesting sites, there are few published figures on the sporadic nesting sites. The documents were reviewed to list out the significant as well as lesser known nesting places along the different coastal districts and coastal forest divisions along the coast. The Divisional Forest Officers with jurisdiction over the relevant nesting beaches, local fishermen and villagers along the coast were interviewed to gather information on the relative nesting intensities. Literature on the state governments plans for developmental activities along the coasts was also reviewed. Published information on the mass nesting figures at Gahirmatha and Rushikulya was collected and has been quoted. Literature on olive ridleys by other sea turtle researchers was analyzed to have a better understanding of the species, their distribution along Odisha's coast, the threats to the species and habitats as well as various issues and problems.

FIELD SURVEYS

The general nesting period along the Odisha coast is between February and May, though sporadic nesting has also been sighted between November and January; and in Devi rookery, sporadic nesting has been reported by Forest Department field staff and fishermen, almost throughout the year. During the nesting season, field

visits were made to the known mass nesting beaches as well as the significant higher density sporadic nesting beaches, as inferred from recorded documents and referred publications. During the survey period, stretches of important nesting beaches were surveyed twice daily– once between six and nine at night and again between five and seven the next morning. Nesting and nesting tracks were documented.

DAILY SURVEYS: SIGNIFICANCE ALONG ODISHA COAST

Forest Department patrolling boats at Babubali

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Forest Department camps at Babubali

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Frequent surveys on a daily basis are of particular importance along the Odisha coast, due to the strong occurrence of southernly winds that tend to erase nesting tracks of turtles the same night, within a couple of hours. This is especially seen on the dry portion of the beach. Tracks on the wet portion (till the high tide mark) are visible as long as they are not wiped out by the next set of waves. The southerly winds generally start from the middle of February, after which the maximum numbers of sporadic nests are laid on windy nights. These winds are also one of the factors observed to trigger the mass nesting phenomenon - the onset of the strong on shore winds, increase in turbidity of the sea water and approach of the particular phase of the lunar cycle.

After the initial beach surveys, interactions were held with the local Forest Department officials to gather ground information on the intensity of nesting turtles at the sporadic nesting sites. There was interaction also with the local fishermen either living or operating near the beach to gather information on the nesting turtles and the beach. An attempt was made to interact with the maximum number of local forest officials and local community members from each listed sporadic nesting beach to get an average nesting intensity over the years in different beaches.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

The Odisha coast is 480.40 kms long comprising six coastal districts stretching from east of Subarnekha river mouth bordering West Bengal to the marshes of Ichchapuram

in Andhra Pradesh. The six coastal districts as indicated by the National Centre for Sustainable Coastal Development (NCSCM 2011) are, Ganjam (60.85 km), Puri (136.48 km), Jagatsinghpur (58.95 km) Kendrapada (83.95 km), Bhadrak (52.61 km) and Baleshwar (87.96 km) (NCSCM 2011). The major rivers including Subarnarekha, Budhabalanga, Baitarani, Mahanadi, Devi and Rushikulya and several smaller rivers such as Hansua, Kadua, Kushabhadra and Bahuda, drain into the Bay of Bengal (Pandav et al 2006). The mass nesting beaches where large congregations of olive ridley turtles come to nest are located along the districts of Kendrapara, Puri and Ganjam; and sporadic nesting occurs in all six, except Bhadrak which currently has no records of nesting owing to its muddy nature.

The 2010-2011 season recorded mass nesting only on Gahirmatha, Nasi II of the Kendrapada district and at Rushikulya river mouth in Ganjam district. The survey of the Odisha coast recorded the nesting of only olive ridley turtles. Observations on the current status of mass nesting and sporadic nesting sites of Odisha coast are listed below:

MASS NESTING SITES ALONG THE ODISHA COAST

Olive ridleys nest en masse along three districts of Odisha coast:

1. Gahirmatha Marine Sanctuary (Nasi Island) near Dhamra river mouth in Kendrapada district.
2. Rushikulya river mouth area (Purunabandha-Gokharkuda-Kantiagada beach strip) in Ganjam district.
3. Devi river mouth area (New Devi Nasi Island) and the beach strip between Sahana Nasi and Keluni Muhana in Puri district.

GAHIRMATHA MASS NESTING SITE

The first scientific publication of 'mass nesting' of olive ridley sea turtles along Gahirmatha coast of Odisha was in 1974, in the Kendrapara (former Cuttack) District (Bustard, 1974). During the above period it was taking place in the mainland, between the Maipura river mouth (20°43'25.51"N 87°04'01.86"E) and Satabhaya (20°36'48.97"N 86°53'13.22"E). Sporadic nesting was taking place further south up to Chinchiri mouth. This entire coastline of about 35 km length was, therefore, included under the Bhitarkanika Wildlife Sanctuary (Bustard, 1976; Kar, 1980) which happens to be the first designated Wildlife Sanctuary of the state of Odisha.

FIGURE 2. MASS NESTING LOCATIONS AT THE GAHIRMATHA ROOKERY

There were very high sand dunes from Kanhupur – Satabhaya up to Habalikhati - Akhifuta jora. The height of these sand dunes often exceeded hundred feet. The beach along its entire length was very wide. There was long sand spit beyond Ekakula at the mouth of the river. There was no Casuarinas plantation along this stretch which was later initiated by the coastal Shelter Belt Afforestation Division as a cyclone prevention measure. The plantation was initiated on the top of sand dunes and was also taken up on all barren sandy areas along the Gahirmatha coast resulting in a total change in the topography of the area. At that time, the olive ridley sea turtles used to climb on to those dunes with gentle slopes to lay eggs. Due to such plantation activities, shrinking of nesting habitat was observed on both, the dunes as well as adjoining beaches.

This part of the coastline experiences seasonal erosion and accretion cycle influenced by the seasonal changes in the north eastern as well as south western winds. Besides this natural phenomenon, anthropogenic influences such as construction of Paradip port has also triggered the erosion process all along the Gahirmatha coast in the last few decades. Due to construction of wave breakers to protect the coastline close to the port, erosion has occurred further north. This process has been further accelerated due to digging of ship channels to make the port functional. Due to removal of several million metric tons of sand from the ship channel and further removal of sand required for regular maintenance dredging, the Gahirmatha coastline has experienced erosion over the years. As a result of loss of suitable nesting habitat and its modification due to manmade activities, the mass nesting site has been shifted towards the north. In the last 3-4 decades, there has been a north ward shift of over 10 kms in last three to four decades and presently the mass nesting is taking place in the Nasi islands.

A portion of the sand spit was cut off from the mainland during a cyclone in 1989. Thereafter, the opening was widened and the separated portion of the sand spit again fragmented forming the Nasi islands. These sand spits moved further northwards to form the Nasi Islands in Bhadrak District. At present, mass nesting continues in the Nasi Islands and sporadic nesting in a reduced scale on the beaches from Ekakula to Chinchiri of Gahirmatha coast of the Bhitarkanika Sanctuary.

As the Nasi islands are a part of the Gahirmatha Marine Sanctuary, there is no anthropogenic pressure from villages or human habitations since there are none close to it. However, illegal mechanized fishing around the islands in the congregation zone is a constant threat which is being dealt with by the law enforcement agencies. Two major fish landing centers are located close by - Dhamra is just 13 km north west of the Gahirmatha mass nesting site, while Paradip is about 66 kilometers south. The coastline from Dhamra river mouth up to Mahanadi river mouth has been included in the Gahirmatha Marine Sanctuary notified in 1998, under the Indian Wildlife (Protection) Act, 1972. This Marine Sanctuary is seen by the trawlers and mechanized fishermen as a good source of fish, especially during October to March, which incidentally is also the turtle congregating period in these waters. There is also intrusion into the Sanctuary by mechanized fishing boats from adjoining states such as West Bengal and Andhra Pradesh as well as from adjoining countries like Bangladesh, Sri Lanka and Thailand. It is an unfortunate fact that despite legal measures made mandatory for all trawlers to install Turtle Excluder Devices at all times while fishing, not a single trawler is using it, even though it was initially distributed free of cost by the Marine Products Export Development Agency (MPEDA) through the Fisheries Department of the state government. It has been studied that more than 70% of turtle captures in shrimp trawl fisheries in Odisha occurs within 5 km from shore. Such fishing is done generally in shallow coastal waters, in less than 10 fathoms counter line. Stranding is higher in zones where there is heavy marine fishing and high sea turtle

abundance (Gopi, G.V. et. al., 2002). The State Forest and Fisheries Department along with the help of the Coast Guard and other associated law enforcement agencies put in a lot of effort to keep the trawlers out of the sanctuary, especially during the turtle congregation periods.

Erosion along Gahirmatha coast

© C. S. KAR

The Gahirmatha coastline and the mass nesting site has been subjected to long term erosion processes over the last many years due to human activities such as construction of Paradip Port in the 1960s. Of late, this has been accelerated further by the construction of Dhamra Port, where digging of a ship channel from the port to the sea has been done with a dimension of about 15 km length, 15 meter height and a width of about 250 meters. Due to such digging, several metric tons of sand was removed from the vicinity of the mass nesting beaches resulting in complete erosion of the Nasi island I and severe erosion in the Nasi II rookery which has impacted the sea turtles and their habitats. Even though there has been seasonal erosion cycle followed by the natural building back of beaches, the mass nesting sites have now been reduced to just about 900 meter in length and an average width of about 80 mts.

Artificial lights from the adjoining defense base and the major port of Dhamra are a real threat to the adult as well as the newly hatched turtles as they get disoriented.

DEVI (ASTARANG) ROOKERY

In the Devi rookery, on the mouth of the Devi river, in Puri District, (19°57'54.25"N 86°21'55.16"E), nesting was discovered in 1981 (Kar 1981), and 'mass nesting' was reported till about 1997 in an island off Petaphutei near the Devi river mouth. Eventually this island was submerged and lost due to the coastal processes and a new sand spit was formed in front of it, at the Devi river mouth, which became an ideal

FIGURE 3. MASS NESTING LOCATIONS AT DEVI RIVER MOUTH ROOKERY

ground for ‘sporadic nesting’. There has been no systematic documentation of the nesting of olive ridley sea turtles during the nesting seasons in the past. However, for the last several years, there is high density ‘sporadic nesting’ along the coast in the new Devi Nasi island as well as along the stretch of the main land between Sahana Nasi and Keluni Muhana.

One of the main nesting places in the south of Devi River mouth - N 19°57’02.64”, E 86°21’01.68” is Keluni Muhana. Sporadic nesting is reported roughly along an approximately 10 km stretch, south of Devi river mouth up to the Kadua river mouth or “Keluni Muhana”. It is a wide beach, with an average width of 80 meter. The Casuarina plantations have been cleared from the beach and there is very little vegetation on the beach. Though there are three fishing villages in this stretch, they are traditional and non-mechanized. However, their fishing nets are often a cause of concern as the multifilament nets which are a threat to turtles have also been seen with most fishermen. Threat of predation from feral dogs, jackals, hyenas and jungle cats exists all along the nesting area.

Predation on nests by feral dogs

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Nesting has also been seen on the New Devi Nasi Island - off Devi mouth - N 19°57’46.42”, E 86°23’02.59”. This is an island just off the Devi River mouth which was about 7 - 8 km long, but has now been fragmented in to three parts each of about 3 - 4 km with an average width of about 100 meters. There is no habitation here and also negligible wildlife predation pressure on olive ridley nests. In the five years, till about 2010 the average nesting (on the mainland and the island) per season can be pegged at below 5000, while in 2011 there was over 10,000 nesting. It is absolutely essential that immediate management measures are taken up to enable more nesting in the area. There is good potential to bring back the ‘mass nesting’ status to the Devi rookery.

Though there were reports of mass nesting from the Devi River mouth in the early 1980s, by mid 1990s the mass nesting had stopped. This may be attributed to sudden increase in the mechanized fishing activities in the last one or two decades in the turtle congregation zone. Even in recent years, almost in every season, sea turtle mating pairs are observed. But due to high unregulated fishing activities, mating pairs are continuously disturbed which could also be a reason for failure of arribadas to take place. There are no local mechanized gill netters in this area. However, trawlers and mechanized gill netters operating from Paradip base have come to this area after construction of Astaranga Fishing harbor. Due to collapse of Astaranga Fishing harbor, these trawlers are now taking shelter in a tidal creek in Nuagada area in a private jetty and are operating from there. Further, a number of trawlers from Andhra Pradesh as well as from Puri and Chandravaga also come to fish in this turtle congregation zone. As the turtle congregating area is yet to be notified as a Protected Area, even inspite of orders of the Hon’ble High Court of Odisha, it is difficult to control and curb the mechanized fishing activities in the congregating zones. Trawlers and mechanized fishing boats can be seen rampantly fishing in the turtle congregations zones and even as close as one to two kilometers from the beach, which is flouting all legal restrictions.

Besides, massive Casuarinas plantation by the Forest Department on the beach and on the top of sand dunes close to the high tide level has resulted in the shrinkage of the nesting habitat.

RUSHIKULYA ROOKERY

The third mass nesting site was discovered in mid 1990s north of the Rushikulya river mouth, in the Ganjam District (19°21'20.49"N 85°02'48.62"E) (Pandav et al., 1994, 1997). The rookery area is about 6 km long starting from the Purunabandha village, just north of the Rushikulya river mouth, crossing Gokharkuda village and extending up to the north of Kantiagada (Podampeta) village. The beach here is very conducive for nesting, being wide (varying between thirty to a hundred meters). In any particular year, mass nesting was occurring in 1-3 km stretch, while high to moderate density sporadic nesting was taking place further north. Though there is erosion of the beach almost every year during the onslaught of the southerly winds and the monsoon, it often builds itself back before the start of the nesting season.

FIGURE 4. MASS NESTING SITES AT RUSHIKULYA ROOKERY

Anthropogenic pressures from fishermen and wildlife depredation of nests by feral dogs, jackals, hyenas and jungle cats pose a large threat to this rookery. Here, the fishermen of the three villages are the main operators at sea, with some mechanized boats sneaking in from south from Arjyapalli fishing village and even trawlers from neighboring state (Andhra Pradesh) in the south. The local fishermen in this area do not possess trawlers. The fishing gears of the traditional fishermen, even the mechanized ones, were usually the turtle friendly ones, but these are changing fast in shape and sizes. However, they fish in the turtle congregation zones, when the gravid female turtles come close to shore before nesting. The local fishermen are being

Birds preying on nests

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constantly sensitized and urged to stay away from congregation zones of nesting olive ridleys.

Developmental activities also pose a threat to the rookery. Construction of Gopalpur Port in the north is just about 14 - 15 km south of the site. The results show that there has been a change in beach geomorphology and near shore sea current circulation pattern influencing the erosion and accretion processes; prevalent in the north side of the port due to construction of groyns (wave breakers) and are similar to the studies of Komer 1998, in Ennore along the east coast of India. There was a minimal change in the coastal geomorphology due to erosion and accretions before the groynes (north wave breakers) were constructed by Gopalpur port. However, it has been predicted that the erosion processes will be accelerated further north of the Gopalpur port, depending on further channel dredging and construction of more number of groynes.

Construction of groynes north of Gopalpur port

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There is also the threat of artificial lights from the nearby National Highway, the lights of the three coastal villages and the Jayashree chemical factory located about three kilometers away. The hatchlings are disoriented and thousands often head inland, guided by the glow of the factory lights. This has prompted WWF-India and the Berhampur Forest Division to install mesh fencing, starting from 2008, along the upper level of the rookery to protect hatchlings from heading inland, as well as minimize predation by wildlife on the nests and hatchlings. WWF-India has been associated with the State Forest Department in the protection of the Rushikulya rookery since 2005, by providing day and night patrolling as well as surveillance of the rookery site, sensitizing and involving coastal school children and fishermen community for the cause of sea turtle conservation.

It is worth noting that during the 2010-11 season, mass nesting of 7.24 lakhs olive ridley sea turtles has already taken place in Odisha coast in the above two sites, Nasi II Island and Rushikulya rookery, which is the highest ever mass nesting of sea-turtles recorded in Odisha coast in the last 10 years. Details of the nesting are given below:

1. Nasi II Island of Gahirmatha coast in Gahirmatha Marine Wildlife Sanctuary under Mangrove Forest Division (Wildlife), Rajnagar and
2. Rushikulya rookery under Berhampur Forest Division.

TABLE 2. MASS NESTING NUMBERS AT GAHIRMATHA AND RUSHIKULYA ROOKERIES (2011)

Nesting Location	Period of Mass Nesting	Nesting Olive Ridleys (estimate in lakhs)
Nasi II Island off	1) 26.02.2011 to 08.03.2011	3,60,663
Gahirmatha coast	2) 24.04.2011 to 27.04.2011	1,11,354
Rushikulya Rookery	1) 03.03.2011 to 08.03.2011	2,52,611
	Total	**7,24628**

(Source: Kar 2011)

TABLE 3. MASS NESTING FIGURES OF GAHIRMATHA AND RUSHIKULYA ROOKERIES (2001-2011)

Nesting Season	Nesting Numbers (in lakhs)		Total (in lakhs)
	Gahirmatha	Rushikulya	
2001-2002	0.00	0.35	0.35
2002-2003	0.73	2.08	2.81
2003-2004	2.43	2.01	4.44
2004-2005	2.34	0.89	3.23
2005-2006	2.67	1.98	4.65
2006-2007	1.46	-	1.46
2008-2009	1.67	2.61	4.28
2009-2010	3.57	1.56	5.13
2010-2011	4.72	2.52	7.24

(Source: Kar 2011)

SPORADIC NESTING SITES

Besides these three main nesting sites, sporadic nesting occurs in varying degrees on the five of the six coastal districts of Odisha. In Bhadrak district, since the coastline is muddy, nesting by olive ridleys does not take place, although hatchlings from the nearby Nasi rookery spend considerable time in the coastal waters off the shores of this district, before their final disappearance to the deep sea. In Baleshwar district, sporadic nesting takes place north of Chandipur particularly in the stretch between Budhabalanga – Panchupada and Subarnarekha rivers, but the number is comparatively insignificant.

The significant nesting beaches in the remaining four coastal districts are detailed below. It is to be mentioned here, that every year seasonal camps are established by the coastal Forest Divisions of the state during the months of October-November and continues till March-April. During this period, the sporadic nests are regularly monitored. However, since the camps are closed after April, the sporadic nesting in the remaining months is not monitored. Kar (1988); Dash and Kar, (1990) have mentioned sporadic nesting in almost every month during the eighties along the Gahirmatha coast. Similarly, along the Devi coast, sporadic nesting also takes place every month throughout the year and to date. But these nests are not counted and monitored during May to October.

KENDRAPARA DISTRICT

Kendrapara District has a coastline of 83.55 km in length. It extends from Maipura or Dhamra river mouth in the north to Mahanadi river mouth in the south. Much of the coastline is sandy in nature. As such it provides a good nesting habitat for the olive ridley sea turtles.

Ekakula – Habalikhati - Satabhaya - Chinchiri stretch

This stretch is about 35 km in length and holds some the earlier best nesting sites of the second millennium. It extends from about N 20°42'13.38", E 87°02'06.75" at Ekakula till about N 20°35'11.59", E 86°51'18.43" at Chinchiri river mouth.

FIGURE 5. SPORADIC NESTING SITES OF THE EKAKULA-CHINCHIRI STRETCH

EKAKULA BEACH - N 20°42'13.38", E 87°02'06.75": This is a sand spit near the river Maipura, about 3 km long and about 80 - 100 meters wide with a stretch of Casuarinas on the seaward side and mangrove on the landward side. It is a few km south of the Nasi Islands. Sporadic nesting has been reported on this beach, from which the Nasi islands broke off. About a thousand nests are laid each season. This being part of the National Park, there is no habitation within 3 km. However, there is threat of predation from wild boars.

HABALIKHATI BEACH - N 20°40'13.29", E 86°59'12.97": This is a small nesting stretch of beach south of Ekakula. The beach is not very wide as there is plantation close to the beach. This is also a part of the National Park. There are about two hundred nests laid in this stretch every season. There is threat of predation of nests by feral dogs, jackals, hyenas and wild boar.

CHINCHIRI RIVER MOUTH - N 20°35'11.59", E 86°51'18.43": This is a small stretch of beach, north of the Chinchiri river mouth. The beach is not very wide and Casuarinas are quite close to the high tide mark. Small hamlets of farmers are about 2 km away. Two to three hundred nests are laid every season and the threat of wildlife predation exists.

Chinchiri - Pentha - Barunei Stretch

This is about a 15 km in length and is also a good sporadic nesting stretch. It extends from about N 20°35'11.59", E 86°51'18.43" at the Chinchiri river mouth till the Barunei river mouth at N 20°30'13.05", E 86°45'32.41".

FIGURE 6. SPORADIC NESTING SITES BETWEEN CHINCHIRI AND BARUNEI STRETCH

PENTHA BEACH - N 20°33'47.82", E 86°49'08.01": This narrow stretch of beach is south of the Chinchiri River mouth and is often subjected to heavy erosion. About five hundred and more nests are laid here every season. In the season of, 2003-04 about 25,000 nests were laid on this stretch and on the nearby Agarnasi Island, during the nesting period from February till March. On this beach, there is threat of wildlife predation.

AGARNASI ISLAND - MADALI: N 20°28'58.37", E 86°48'29.37": This is a slightly concave shaped island east of the Barunei River mouth. It is about 4 km from north to south and about 300 meters wide in the middle and tapering off at both ends. The main vegetation here is Casuarinas and it is about three to four kilometers from the mainland. The average olive ridley sea turtle nesting per season here is about three to four hundred. Being an island, there is almost no threat from wildlife predation.

Hatchlings trapped in net abandoned on the beach by fishermen

Immediate threats to the nesting beaches include removal of huge amount of sand upstream by sand miners from rivers draining into the Bay of Bengal; erosion of the beach due to man made activities; damming in the upstream of rivers like Mahanadi, causing less silt to reach coastal waters for beach nourishment; construction of ports and harbors;

removal of huge quantities of sand for land filling in low lying areas, dredging of ship channels and removal of huge quantities of sand by Paradip Port in the south and Dhamra Port in the north, removal of sand for annual maintenance dredging of the ship channels, plantations on beach and sand dunes reduces nesting habitats, human habitation on beaches, dry docking of boats and vessels on beaches, construction of boats and vessels on beaches, net drying, repairing and stacking on beaches, fish drying on beaches and changes in beach profile due to erosion.

On these sporadic nesting beaches, the Forest Department sets up hatcheries during the nesting season to protect the eggs. They also conduct interaction programs, along with NGOs such as WWF-India, People For Animals and other local organizations to sensitize the traditional fisher folk of the nearby villages on sea turtle conservation. There has not been any significant change in the nesting status of these nesting beaches over the last ten years. As most of the sporadic nesting groups along the coast of this district occur in the Bhitarkanika National Park bordering the Gahirmatha Marine Sanctuary, there is strict control on the human activity on the nesting sites to mitigate the anthropogenic pressures. There is not much community involvement in direct conservation of the turtles as the area is part of the National Park, and there are restrictions on people's movement in the area. The Mangrove Forest Division (Wildlife), Rajnagar conducts regular intensive monitoring of the beach.

JAGATSINGHPUR DISTRICT

Jagatsinghpur district has a coastline of 58.95 km in length. It extends from Mahanadi river mouth in the north to Devi river mouth in the south. Much of the coastline is sandy in nature. As such it provides a good nesting habitat for the olive ridley sea turtles.

Paradip – Sandhakuda – Jatadhari Stretch

This is about a 20 km stretch from the mouth of the Mahanadi River, at N 20°15'30.91", E 86°40'40.64", till the north of the Jatadhari river mouth at N 20°11'00.07", E 86°32'05.28".

FIGURE 7. SPORADIC NESTING SITES BETWEEN THE PARADIP AND JATADHARI RIVER STRETCH

At Paradip and Sandhakuda, there is a lot of traditional fishermen activity. Fishermen park their boats on the beach and repair their nets, which results in a lot of net piece debris. The Jatadhari beach is about 50 to 60 feet wide and there is not much debris or vegetation. Human activity on the beach is almost negligible. Data gathered indicate that less than hundred nests are laid every season from April onwards, and most go unrecorded as the Forest Department seasonal camps are closed by that time. However, the nesting numbers is found to be gradually decreasing. There is threat from wildlife predators like jackals, hyenas and jungle cats.

Jatadhari - Devi river mouth stretch

This beach stretch is about 35 km long and extends from N 20°11'00.07", E 86 °32'05.28" at the Jatadhari river mouth till north of the Devi river mouth at 20°00'42.94", E 86 °25'25.15".

FIGURE 8. SPORADIC NESTING SITES BETWEEN JATADHARI AND DEVI RIVER MOUTHS

RAMTARA - N 20°06'52.01", E 86 °29'08.05": The beach is quite wide and clean, which could favour nesting. The villagers of nearby coastal habitation catch prawn fingerlings from the shore along this stretch, which acts as a deterrent for nesting turtles. There is also the presence of about fifteen or twenty traditional non-mechanized fishing boats, most of which have turtle friendly fishing gear. Ramtara village is about 1.5 km away. The average nesting in this place is about less than hundred per season from April onwards. Nests are mostly unrecorded as the Forest Department seasonal camps are closed by that time. The place also shows a gradual decrease in nesting numbers. There is threat from wildlife predators like jackals, hyenas and jungle cats.

HAWAKHANA - N 20°05'57.85", E 86 °28'34.49": The beach is south of Ramtara. There is little fishing activity on the beach, it is wide and clean and conducive for nesting. Padmapur village is about 1.5 km away. Here, the nesting figure averages about 200 per season April onwards which almost goes unrecorded as the Forest Department seasonal camps are closed by that time. Predation threat from feral dogs and jackals is ever present. The local fishermen have traditional non-mechanized fishing boats and most have turtle friendly fishing gears.

NEW DEVI NASI ISLAND: This was a 7-8 km long sandy island in front of Bandar village. This is located on the northern extreme end of the Mangrove Forest Division (Wildlife) Rajnagar. It also marks the northern extreme end of the Jagatsinghpur district. In recent years, the island has been fragmented in to three parts, each measuring about 2-3 kms. It has an average width of about seventy to hundred meters with very little beach vegetation. The average nesting per season here is about one to two hundred. There is the threat of predation from feral dogs, jackals and jungle cats.

Immediate threats to the nesting beaches include removal of huge amount of sand from rivers draining into the Bay of Bengal from upstream of rivers, erosion of the beach due to man made activities, damming in the upstream of rivers like Mahanadi causing less silt to reach coastal waters for beach nourishment, construction of ports and harbors, removal of huge quantities of sand for land filling in low lying areas, dredging of ship channels and removal of huge quantities of sand by Paradip Port in the north, removal of sand for annual maintenance dredging of the ship channels, plantations on beach and sand dunes reduces nesting habitats, human habitation on beaches, dry docking of boats and vessels on beaches, construction of boats and vessels on beaches, net drying, repairing and stacking on beaches, fish drying on beaches, change in beach profile due to erosion in past few years has been observed.

Nesting among parked fishing boats

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The state Forest Department has been active in these parts by setting up hatcheries, sometimes with WWF-India's association. The Forest Department also involves youth from the fishermen community of the local villages for setting up hatcheries and managing them. They conduct awareness programs in association with NGOs.

PURI DISTRICT

Puri district has a coastline of 136.48 km. It extends from south of Devi river mouth in the north to Prayagi in the south. Among all the coastal districts in Odisha, Puri district has the longest coastline which is predominantly sandy in nature.

Sahana - Ganga Devi - Gundalba Stretch

This beach stretch of about 8 km extends from Sahana Nasi at N 19°57'18.21", E 86 °21'56.70" – N 19°56'29.76", E 86 °18'50.27". This beach is south of the Devi river mouth, starting from the river mouth till the Gundalba village. Fishermen from Sahana village use the river and back waters for fishing activities and rarely go in to the sea. However, some fishermen from the neighboring state of Andhra Pradesh temporarily use the beach in front of this village to park their traditional non-mechanized boats. The people of Gundalba village are mainly farmers. There is a constant threat of predation by feral dogs and jackals to the nests. There has not been any major change on this beach due to erosion in the past five years.

FIGURE 9. SPORADIC NESTING SITES BETWEEN SAHANA AND GUNDALBA

Casuarinas plantations along this beach stretch were completely destroyed during the super cyclone of 1999. However, the entire area was again planted with Casuarinas after the super cyclone. It has an average width of 70-100 mts with very little beach vegetation. The average nesting per season is about one to two hundred.

Gundalba – Daluakani - Keluni Mouth Stretch

This beach stretch of about 9 km extends from N 19°56'29.76", E 86°18'50.27" to N 19°54'31.01", E 86°14'20.02" at the Keluni River mouth.

FIGURE 10. SPORADIC NESTING SITES AT GUNDALBA AND KELUNI RIVER MOUTH AREAS

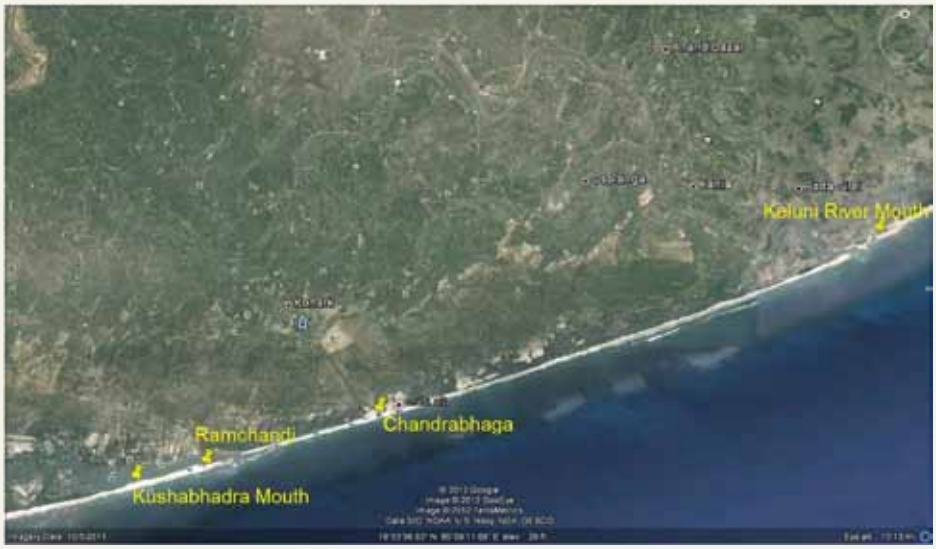
This sporadic nesting area stretches from the Gundalba village front till the mouth of the river Keluni in the south. It extends from the forest camp at Jahania, which is also a tourist spot and a fish landing centre for traditional non-mechanized fishing boats. The nesting beach has an average width of 70 mts. The average nesting in this place is about four hundred every season. The Casuarinas, which earlier were very close to the high tide mark, have now been pushed back. This has resulted in the gradual increase

in the nesting figures. However, there is predation from feral dogs, jackals and hyenas. It has an average width of 70-100 mts with very little beach vegetation. The average nesting per season here is about one to two hundred. There is the threat of predation from feral dogs, jackals and jungle cats.

Keluni mouth – Chandravaga - Ramachandi – Kushabhadra river mouth

This beach stretch extends from N 19°54'31.01", E 86°14'20.02" to N 19°51'14.41", E 86 °04'12.81" south of the mouth of the Keluni river to north of Kushabhadra river mouth. The stretch is about 22 kms long.

FIGURE 11. SPORADIC NESTING SITES BETWEEN KELUNI AND KUSHABHADRA RIVER MOUTHS

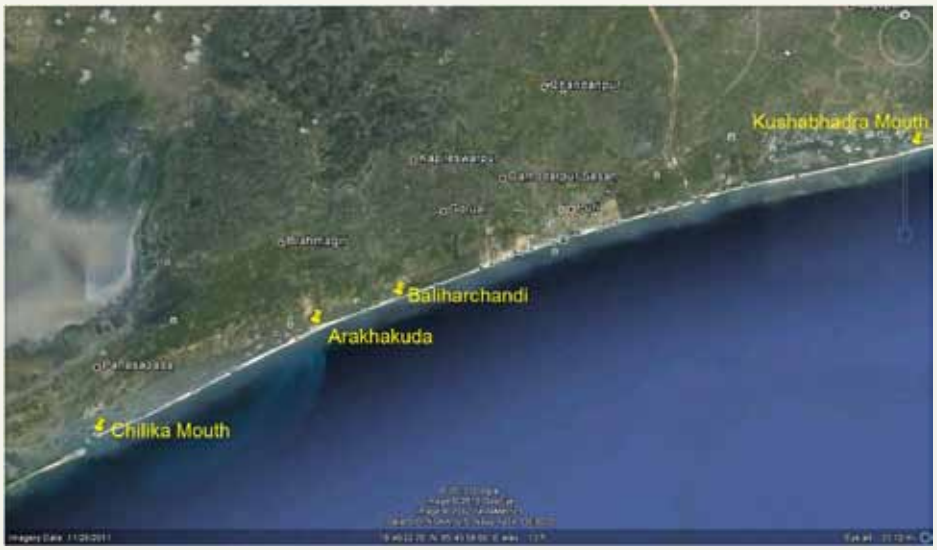


This beach extends from the Keluni river mouth till the Ramachandi temple near Kushabhadra river mouth. Chandravaga beach is located midway, and is about 3.5 kms from the Sun temple at Konark. There are very high sand dunes between Keluni mouth and Chandravaga extending about 30-35 meters. The beach at Ramachandi is a sand spit, about 2-3 km long, from south of the river Kushabhadra and just about 100 meters wide. About three hundred nests are laid here in each season. There is no presence of fishing boats along this stretch as the villagers near the beach are farmers. However, there is predation from feral dogs and jackals. From Chandravaga, the marine drive road runs almost parallel to the coastline and it is within 50-100 mts.

Kushabhadra - Bali Harachandi – Arakhakuda – Chilika New Mouth

This stretch is about 62 kms long. It extends from N 19°51'14.41", E 86 °04'12.81" till north of the Chilika mouth at N 19°40'34.53", E 85 °31'36.54". Bali Harachandi beach along this stretch is an important tourist attraction place. The beach stretches past the Bali Harachandi temple east of the river Harachandi (tributary of Bhargavi). The nesting area at Bali Harachandi is about 2 km long and about 50 mts wide. Fishing boats are present on the beach. The fishermen do not use fishing gear harmful to turtles. The average nesting is less than 100 per season. Arakhakuda is close to the old mouth of Chilika Lagoon. A small river flows between the beach and the mainland, keeping the nests safe from land predators.

FIGURE 12. SPORADIC NESTING SITES BETWEEN KUSHABHADRA-CHILIKA RIVER MOUTHS



Chilika New Mouth/Rambharatia – Rajhans – Prayagi Stretch

This stretch is 46 km long. It extends from N 19°39'56.83", E 85°31'04.87", south of the Chilika mouth till about N 19°27'59.67", E 85°10'18.37" covering the coastline of Chilika which is the largest brackish water lagoon of south east Asia. This has been designated as the first RAMSAR SITE in the state of Odisha. The State Forest Department has been active in these parts by setting up hatcheries and conducting awareness programs in association with NGOs. The Department also involves youth from the local community from these places for setting up hatcheries and managing them.

Threats to the sea turtle nesting habitats in Puri district include damming in the upstream of rivers causing less silt to reach coastal waters for beach nourishment, plantations on beach and sand dunes leading to reduced nesting habitats, human habitation on beaches, dry docking of boats and vessels on beaches, construction of boats and vessels on beaches, net drying, repairing and stacking on beaches, fish drying on beaches; change in beach profile due to erosion in past few years have been observed.

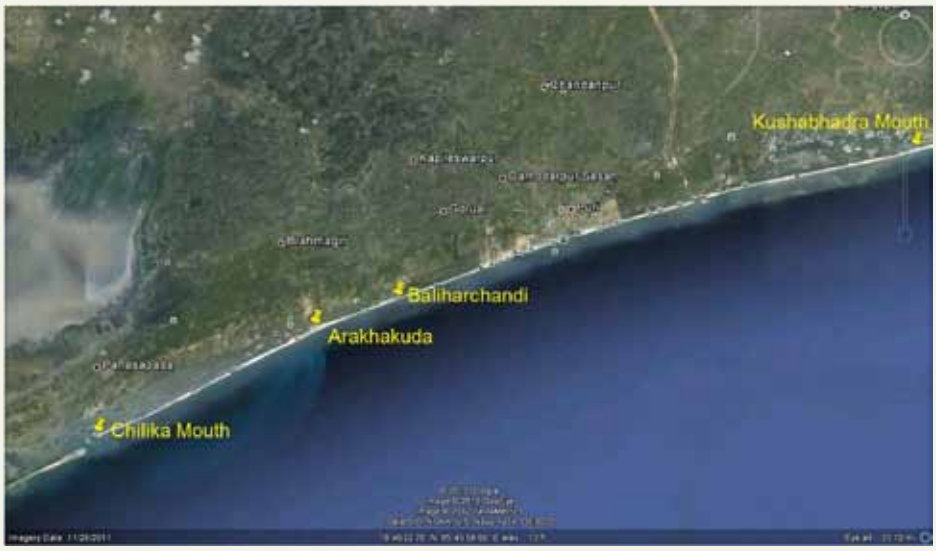
GANJAM DISTRICT

Ganjam District has a coastline of 60 km. It extends from Prayagi in the north to Andhra Pradesh border in the south. After Bahuda river mouth, the southern tip of the district, there is fishing jetty at Sonapur village. There is a ferry service at this site to reach the beach. At Sonapur, the beach is about 60-70 mts wide. Thereafter, the beach width gradually broadens, and close to the A.P. border, it is more than 150 metres wide. The mating pairs of olive ridleys are also seen during November – January in the coastal waters of these parts. This beach observes few hundred turtles nesting each year. About ten years back there was not much fishing by mechanized boats. Most of the fishing was being done by "Moha – jal", which is a turtle friendly method of fishing. However, in last decade, mechanized fishing has progressed in the area, with influx of fishermen from the neighboring state of Andhra Pradesh.

Prayagi – Aleswara – Bateswara – Podampeta

This stretch is 9 km long. It extends from N 19°27'59.67", E 85°10'18.37" to about N 19°24'47.63", E 85°06'06.23" at the Podampeta fishing village, north of the Rushikulya rookery.

FIGURE 13. SPORADIC NESTING SITES BETWEEN PRAYAGI AND PODAMPETA



Erosion along Podampeta coast

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The beach is wide but there are Casuarinas close to the beach. The nesting area is about a kilometre long and 50-60 metres wide. There are villages about a kilometre from the beach and there is little fishing activity from traditional fishermen in these parts, except at Podampeta. Near Prayagi, sand dunes are about 15-20 mts high. The maximum height is at Aleswar, which is about 30-35 mts. Gradually, it reduces towards Bateswar and Podampeta. There are about fifty nests laid in a season, most of which are predated upon by feral dogs, jackals and hyenas. Beach erosion observed to follow closely after nesting, washing away most of the nests.

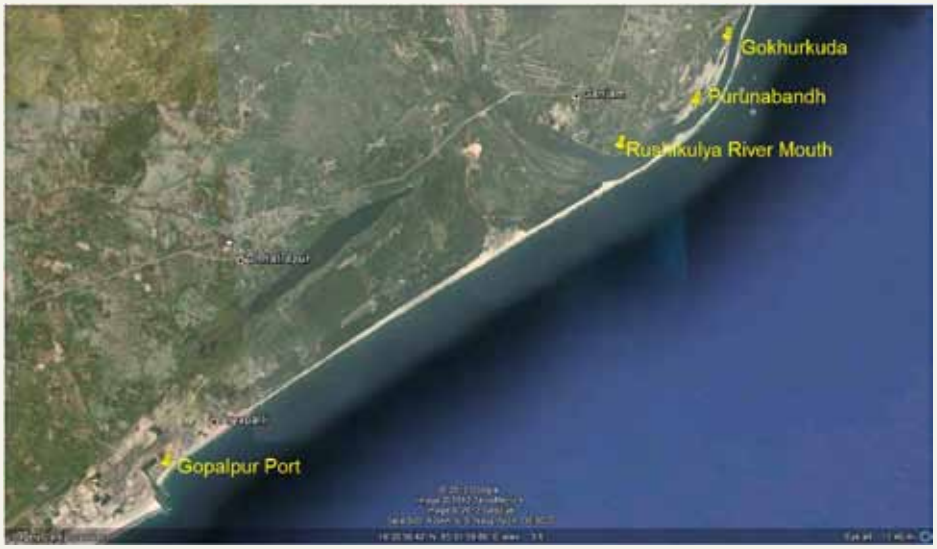
Podampeta – Gokharkuda- Purunabandha - Rushikulya mouth

This stretch is 6 km long. It extends N 19°24'47.63", E 85°06'06.23" to about N 19°22'22.04", E 85°03'54.85" at the mouth of the Rushikulya river. Generally, this is a mass nesting stretch.

Rushikulya mouth – North of Gopalpur Port

This stretch is 12 km long. It extends from N 19°21'54.75", E 85°03'45.28" south of the Rushikulya river till about N 19°18'21.58", E 84°58'02.11" north of the Gopalpur port. There are no sand dunes till north of Gopalpur. After Gopalpur, the sand dunes stand about 35 metres high. Gopalpur beach is a tourist site as well as a fishing village with about 100 boats. About 500 metres of stretch is a tourist site, with a number of hotels close to the high tide mark.

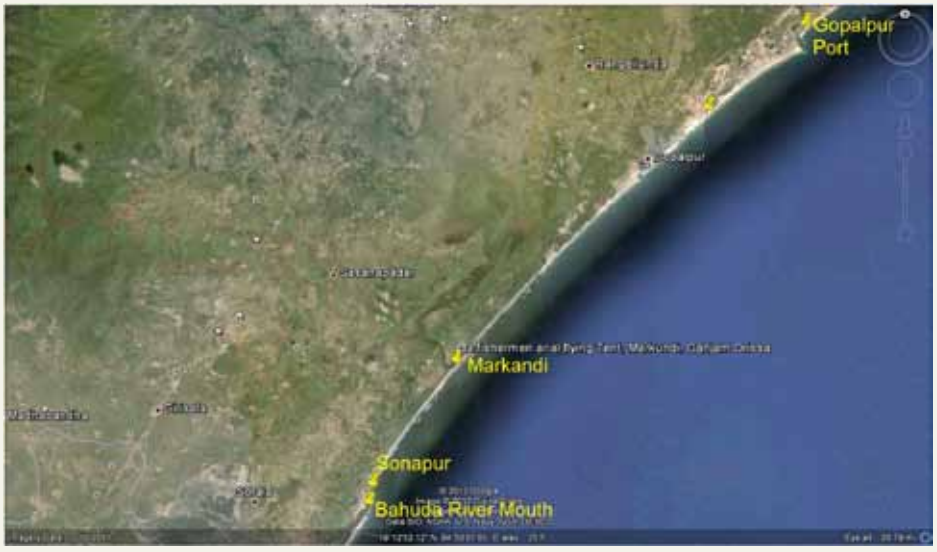
FIGURE 14. NESTING SITES BETWEEN RUSHIKULYA AND TOWARDS THE NORTH OF GOPALPUR PORT



South of Gopalpur Port – Markandi - Bahuda River mouth - Sonapur

This stretch is 26 km long. It extends from N 19°17'52.87", E 84°57'55.53" south of the Gopalpur Port till about N 19°07'38.36", E 84°47'48.15" at the Bahuda river mouth.

FIGURE 15. SPORADIC NESTING SITES BETWEEN GOPALPUR PORT AND BAHUDA RIVER MOUTH (ANDHRA BORDER)



The beach is south of Ramayapatna. It is not a very wide beach, and located close to the mouth of a small stream. The nesting area is about 1.5 km long and 50-60 metres wide. Markandi village is less than a kilometer from the beach. There are traditional fishermen in the village. Average nesting is about fifty per season. Threat to nests from wildlife and beach erosion also exists here. This beach lies on the border of Odisha and Andhra Pradesh. The nesting area is about 600 to 700 meters long and 30-40 metres wide. Sonapur village is about 200 meters from the beach. The average nesting here is also about fifty in a season and there is the threat of depredation from wildlife. From Markandi onwards, no sand dunes are seen. The Forest Department does not have much activity in these sporadic nesting places as the nesting figures are poor compared to the mass nesting site of Rushikulya. But turtle awareness programs are conducted in the villages along with leading NGO's like WWF-India and United Artists Association.

Threats to the sea turtle nesting habitats in Ganjam district include damming in the upstream of rivers like Rushikulya causing less silt to reach coastal waters for beach nourishment, construction of ports and harbours, removal of huge quantities for land filling in low lying areas, dredging of ship channels and removal of huge quantities of sand by Gopalpur Port in the north, removal of sand for annual maintenance dredging of the ship channels, sand mining for heavy metals exploitation by Indian Rare Earths (IRE), plantations on beach and sand dunes leading to reduced nesting habitats, human habitation on beaches, dry docking of boats and vessels on beaches, construction of boats and vessels on beaches, net drying, repairing and stacking on beaches, fish drying on beaches, change in beach profile due to erosion in past few years has been observed.

Gopalpur Port

THREATS

NESTING BEACHES

Global climatic change and the upcoming ports on the coast of Odisha pose a constant threat to the turtle nesting habitats. Odisha's coast has been prone to changes in physical profile in the last ten years. Beaches conducive for nesting have been eroded and nesting islands have shrunk. As the general tidal flow in the Bay of Bengal is north westward, any construction activity has been detrimental for the beach on its north. Dredging of ship channels by removal of huge quantities of sand and removal of sand for annual maintenance dredging results in erratic shifting of sand in the sea, causing some beaches and islands to deplete. There is also the issue of damming in the upstream of rivers causing less silt to reach coastal waters for beach nourishment. Sand mining in rivers upstream causes removal of huge amount of sand from rivers draining into the Bay of Bengal. In effect, there is very little silt transfer to the sea to rebuild the beaches and islands.

The most threatened rookery currently is the Nasi II Island at Gahirmatha and being a small island, the threat is ever so large. The coastline protection activities in the attached land mass of the Defense Department could also be responsible for the erratic physical changes. The Nasi II beach could be wiped out in the near future if the present trend of erosion continues. There is very little that can be done to prevent the erosion. The rest of the Gahirmatha coast, in the mainland, where currently sporadic nesting occurs, is comparatively less threatened from beach erosion. The beach of Devi has been subjected to changes in profile but has not greatly affected the nesting grounds in the mainland. A new island formed off the river mouth could be more favored by the turtles in the near future. However, there is not much threat of erosion currently to the Rushikulya rookery, though the upcoming Gopalpur port, in the south has raised some concern. As of now, though there is some erosion with the start of the Southerly winds, the beach builds itself back by the start of the next nesting season.

Casuarinas have been planted almost all along the coast. The Forest Department has begun to realize its effect on beach biodiversity and is moving back the patches wherever possible. Though Gahirmatha coast does not have much of these trees, their removal along the Devi coast could be credited for the gradual increase in the sporadic nesting. The beach has become wider and more conducive for nesting. At Rushikulya, the Casuarinas plantations allow a wide beach for nesting. Almost in all nesting places there is the threat of nest predation and threat to hatchlings from feral dogs, jackals, hyenas, wild boar and jungle cats.

COASTAL EROSION

Seawalls force waves back to the ocean. These waves take the sand in front of the seawall and deposit it far away from land. The water in front of the seawall gets deeper and makes for bigger waves next to the shoreline, so we always have to build bigger seawalls. The sea will always win this battle because the force of water will always be stronger than any seawall or wave breakers. Sand replenishment takes sand away from one place to deposit it elsewhere. Man made jetties, groynes or wave breakers help to catch sand which works well for that particular stretch of beach. But beaches down stream will erode away because they do not get any sand. Threat of beach erosion is also being attributed to the digging up of ship channels by the port. Being close to the rookery at Nasi Island, the Dhamra Port has generated a lot of concern among turtle conservationists. The proposed ports south of Paradeep are also seen as a threat to the

nearby Devi rookery. The upcoming Gopalpur port can also lead to large scale changes in the beach profile of Rushikulya rookery.

HUMAN SETTLEMENTS ON NESTING HABITATS

In the last few decades, human settlements on many important sea turtle nesting beaches particularly by fisher folk of neighboring coastal districts has increased alarmingly. Associated infrastructure and disturbances such as the number of huts, boats, nets, domesticated and feral dogs are also on the rise. Some examples of such settlements are in places like Chandanipal, Sandhakuda, Ganga Devi, Chandravaga, Penthakati, Podampeta (Kantiagada), Gokharkuda, Arjyapalli, Gopalpur, Sonapur. Nets discarded on beaches trap hatchlings from reaching the sea; eventually resulting in mortalities.

INCIDENTAL CATCH

Trawls are the largest threat to turtles congregating near beaches in the sea. Turtles need to surface for air every half hour. Trawlers drag their nets along the bottom of the sea for 2 to 3 hours at a stretch, and a turtle drowns to death when entrapped in it. Though the government has made it mandatory for all trawlers to use TEDs within their nets, it is never actually used. The trawl operators argue that using TEDs result in a huge loss of catch; as fish get released along with the turtles when it escapes through the device. However, a WWF-India study conducted in 2010 demonstrated that only about 2.5% of the catch is lost due to the use of TEDs.

Olive ridleys captured in trawl nets

© BIVASH PANDAV

There is a constant threat of trawlers along the Gahirmatha coast and to a greater extent along the Devi coast. The winter months are when the turtles start congregating off the nesting grounds and the same area of the sea is thought to be the best fishing grounds by trawler operators. Though there are clear laws on “no fishing zones” especially during the turtle congregation period, there is constant intrusion by the trawlers resulting in incidental catch and death of turtles. There is a constant cat and mouse game between the sea patrolling government agencies and the trawlers. There are occasional standoffs and casualties on both sides. Often, trawlers from Bangladesh are the frequent offenders at Gahirmatha. At Devi, there is very little patrolling and the trawlers fish very close to the coast. Andhra trawlers intrude into the “no fishing zone” catch “mother prawns”. The sea is almost like a mini township at night. This could be one of the reasons that turtles stopped mass nesting at Devi in the last ten years.

TABLE 4. FISHERY RELATED MORTALITIES OF TURTLES IN ODISHA (2001-2011)

S. No	Year	Dead Turtles
1.	2001-2002	12,977
2.	2002-2003	10,086
3.	2003-2004	04,981
4.	2004-2005	03,227
5.	2005-2006	03,242
6.	2006-2007	04,046
7.	2007-2008	05,763
8.	2008-2009	05,680
9.	2009-2010	05,003
10.	2010-2011	03,473

(Source: C.S Kar 2011)

At Devi and Jagatsinghpur district, there is a big threat from the multifilament gill netters also operating in these areas. Turtles often get entangled in the long hanging nets in the sea and drown. There is hardly any presence of trawlers along the Rushikulya rookery because the traditional fishermen there have always kept trawlers away from their fishing grounds, using force if necessary. However, traditional fishermen also pose a great threat to nesting habitats. Generally, good fishing grounds are linked to good turtle congregation grounds. In the months of January to March and April, when the female turtles start coming closer to the nesting beaches, fish congregation is often close to the turtle congregation. Rampant fishing by the traditional fishermen, most of whom have O.B.M. boats tend to break up the congregation which either delays nesting or forces turtles to shift to lesser conducive beaches. Sometimes this could result in no mass nesting.

Traditional fishermen park their boats over a large beach area, close to their habitation and sometimes build and repair boats on the beach close to the high tide mark. They use the beach to dry and repair their nets which results in net debris being left scattered on the beach. Adult turtles get entangled in the larger pieces and cannot move, but the bigger threat is to hatchlings which could get entangled in large numbers in a small piece of net. Often, fishermen also use the beach to dry their fish. These activities litter the beach and also act as a deterrent to turtles approaching the beach for nesting. Sometimes the fishermen build their huts close to the beach front and their artificial lights at night further add to the problem. This threat is prominent in Puri and Ganjam districts.

TABLE 5. DATA ON FISH LANDING CENTERS ON THE ODISHA COAST

1.	Harbor	4
2.	Jetty	8
3.	Landing Platform	15
4.	Other Landing Centre	36
	Total	**63**

(Source: Directorate of Fisheries, Govt. of Odisha, 2010)

TABLE 6. FISHING CRAFTS OF ODISHA COAST (2009-2010)

S. No	Fishing Craft	Numbers
I	**Mechanised**	
	Wooden Trawler	987
	Sona Trawler	559
	Gillnetter	608
	Total	**2154**
II	**Motorised**	
	IBM	1691
	OBM	2777
	BLC/FRP	165
	Total	**4633**
III	**Non-Motorised (total)**	**2973**

(Source: Directorate of Fisheries, Govt. of Odisha, 2010)

EXPLOITATION FOR MEAT AND EGGS

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Nets set for catching prawn fingerlings – Podampeta

Turtle meat was exported to West Bengal from Odisha till the late seventies (Kar, 1988, 1992; Dash and Kar, 1990). However, this has been completely stopped. There are no reports of local people along Odisha's coast consuming sea turtle eggs or meat. In most coastal villages, the sea turtle is considered as an avatar or second incarnation of lord Vishnu and worshipped. The Forest Department and NGOs promote this practice and belief as it favours sea turtle conservation initiatives.

IMPACTS OF COASTAL DEVELOPMENT

Though there is a lot of concern about the effects of developmental activities along the coast on the nesting habitats and beach profile, little scientific study has been taken up to document the coastal processes. The new port of Dhamra is seen as a direct threat to congregating turtles at Gahirmatha. This also leads to increased illumination around turtle habitats. The port lights disorient turtles and hatchlings. Ship traffic poses a threat to the sea turtles in their migratory routes.

There are plans to also set up major ports at Astaranga, Chudamani and Subarnarekha river mouth. The techno-feasibility is also being examined to setup minor ports at other potential port sites all along the coast in Odisha. Development of major and minor ports and fishery harbors requires construction of coastal structures like ship channels, breakwaters, jetties, groynes and reclamation bunds. These man made

coastal structures often interfere in the functioning of the coastal processes of the region. Modifications in the coastal processes have large impact on the coastline which happens to be the breeding or nesting habitats of sea turtles and other wildlife. The effects of dredging of ship channels and construction of groynes on the shoreline have earlier been studied by many researchers such as Komer (1998); Elmoustapha et al., (2007); Elsayed and Mahmoud, (2007); Kokpinar, Darama, and Guler, (2007); Ozolcer and Komurcu, (2007); Ozolcer et al., (2006); Kudale, (2010). Construction of breakwaters, jetties, groynes, and other structures, in general have adverse effects on the adjacent beaches and may even affect beaches some distance away (Kudale, 2010).

In some places, there is development of tourism infrastructure very close to the beach which has prevented turtles from nesting on those beaches. This is noticed in Gopalpur and some places of Chandravaga, Puri, and Paradip. The state government is chalking up plans for massive upgradation of tourism along the coast. As turtles nest almost all along the shores of Odisha wherever suitable sandy beaches are available, this could pose a real threat due to the presence of lighting along the coast which will deter nesting turtles and disorient hatchlings. Close to the coast, wherever there is a plan of a marine drive road it will definitely pose light issues from the night traffic flow. Such marine drive roads, therefore, have to be very carefully planned particularly when these are close to the rookery sites or high density sporadic nesting sites and other congregated zones in the coastal waters.

IMPACTS OF OIL SLICK/SPILL FROM VESSELS

Oil spills and sea pollution will inevitably occur if medium and large ports are being set up along the coast. Most oil spills within Odisha waters are likely to happen close to the coast or in harbors. This makes it extremely difficult for responders to prevent some oil from reaching the shoreline as, depending on local weather, currents and tides, spilt oil could reach the coast within hours.

Oil slick from MV Malavika, April 2010

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On 22nd September, 2009 newspapers in Odisha reported of some degree oil slick along the Paradip coast from the sunken ship “Black Rose” along with pictures of the oil spill. The sea current patterns had made the slick move to the south, and also some amount of oil spill moved from the Paradip Port area north towards the Gahirmatha nesting beach, thereby impacting both the Gahirmatha and the Devi Rookery located on either side of the Paradip Port. A thin layer of oil deposition from the oil spill was also recorded on a 500 mts stretch on the curved portion of the Chinchiri river mouth within the Gahirmatha Wildlife Sanctuary. The area affected by the uil slick was a 50-60 km stretch of the coastline. An oil slick in the off-shore waters and on-shore coast can be detrimental to the olive ridleys and other marine fauna which use the beach, the inter-tidal region, as well as coastal waters as their habitats. On 12th April 2010, a ship (MV Malavika) met with an accident near the Gopalpur port in the evening hour. Initial surveys conducted by the field assistants of the Forest Department, revealed that thick “oil cakes” had spread

Oil slick near Paradip, October 2009

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Oil slick at Jatadhari river mouth, October 2009

© MICHAEL PETERS / WWF-INDIA

unevenly across the mass nesting beach at Rushikulya, extending up to Prayagi (20 kms north) from the Rushikulya river mouth. Fisher folks of Gokharkuda and Kantiagada fishing villages intimated that the small fishes caught in their nets were stained with oil.

The port areas have been planned at identified strategic locations at Gopalpur, Bahuda muhan, Palur, Baliharchandi, Astaranga, Jatadhari muhan, Barunei muhan, Dhamra, Chudamani, Inchuri, Chandipur, Bahablpur and Kirtania. Along with ports, other mega projects like iron and steel companies, oil corporations, oil refinery units, fertilizer companies, ship yards and chemical industries are also coming up which shall generate large volumes of waste water. Water pollution is gradually emerging as an important issue in the state. Domestic waste, industrial waste, fertilizers and pesticide residues reach coastal and marine waters through rivers, creeks, bays and back waters, affecting wildlife in general and sea turtles in particular.

RECOMMENDATIONS

1. The most important positive step towards sea turtle conservation would be the serious and absolute implementation of the conservation laws of the country, already in place. Implementation of strict use of TEDs while trawling, which has already been made mandatory by Fisheries Department of the Government of Odisha, is absolutely necessary and will bring about a huge reduction in adult sea turtle mortality. Trawling in all the designated "No Fishing Zones" must be stopped completely. The Forest and Fisheries Department, along with the local District Administration's help, as well as support of the local community should jointly work together towards implementation of the laws. Stakeholders and possible violators should be made aware of the repercussions of offences.

2. Sea turtles could use different beaches for nesting in different seasons. Hence all the nesting sites need to be protected. Nasi II located at Gahirmatha has legal protection status. The other mass nesting site at Rushikulya and the good sporadic nesting sites of Devi and some parts of Jagatsinghpur need to be given some form of protected status to make turtle conservation easier. There have been directions from Hon'ble High Court of Odisha as well as Hon'ble CEC of Supreme court of India and proposals have also been submitted by the Wildlife Organization of Forest Department. These Marine Protected Area Notifications may be made by the government urgently for long term protection and conservation of sea turtles as well as other wildlife in these identified habitats. These notifications will not only help the sea turtles but also all other species in the coastal and marine ecosystems of Odisha.

3. Coastal erosion issues needs to be studied properly by identifying the possible natural and man made causes. Until the causes are properly studied and documented, the integrated coastal zone management planning will fail in suggesting and implementing remedial measures. With the ever increasing threat from erosion at Nasi, it becomes even more important to immediately start protection of the other more stable nesting beaches. Nasi nesting habitat being an island and a part of the Protected Area (part of Gahirmatha Marine Sanctuary zone) needs no further intervention on the rookery front. However, protection at the other mass nesting sites such as Devi and Rushikulya areas needs to be intensified.

4. Casuarina plantations along the beach could act as a buffer for coastal storms, but such plantations should be very carefully planned. In the nesting sites, plantation should be well above the possible nesting areas. Planned plantation can also be effective in screening and reducing the impact of artificial lights from traffic or habitation close to the nesting grounds. Pushing back the Casuarinas line at Pentha after the trees were completely damaged and lost during the super cyclone of 1999, possibly has brought about an increase in the nesting there. Similar action needs to be taken at the other sporadic nesting sites to try and increase the nesting of olive ridleys. All the plantations on the top of the existing high sand dunes should be removed and these may be planted behind the dunes, on the land ward side. Strict implementation of the circulars issued by the Chief Wildlife Warden of the state relating to Casuarina plantations along the beaches is required.

5. At present, with the fencing of the beach by WWF-India and the Forest Department to keep off wild predators, the next biggest threat to the rookery is from human population. They come in large numbers and walk all over the beach to watch nesting turtles and often directly disturb the gravid females as they toil up the beach or are digging or laying their eggs. During mass hatchling emergence periods, visitors walk all over the beach to look at emerging hatchlings. When the

eggs hatch it takes the hatchlings about a couple of days to climb over each other and emerge from the nest cavity on to the sand surface. People walking all over the rookery result in constant trampling on the sand over such nests. This exercise compacts the sand over the nest, making it difficult for the hatchlings to emerge. If they are not able to emerge within a couple of days they just manage to reach close to the surface of the sandy beach and eventually are smothered in the heat of sand during the blistering day and die of dehydration and physical trampling. Further people use torches at night which greatly disturbs and disorients the turtles especially the hatchlings. People in their enthusiasm to help the hatchlings reach the sea; pick them up with their bare hands. The magnetic impulse from their body could wipe off the geomagnetic imprint of the natal beach on the hatchling, which is presumed to help them in coming back to their natal beach, when they become adult. Small separate segments need to be earmarked (at the mass nesting sites in the unprotected areas) for visitors to look at nesting turtles and hatchlings without disturbing them. It is necessary to develop a crowd control mechanism at Rushikulya rookery particularly during the period of mass nesting and mass hatchling emergence periods.

6. The protection activity during nesting season needs to be upgraded, especially at the sporadic nesting sites. More efficiently operated hatcheries will ensure that more hatchlings get a safe passage to sea. It is presumed that only one in a thousand hatchlings survive to reach the deep sea after they enter the water. This makes it more important to ensure that there is more successful nesting and hatching. Only then will we be able to help their population survive and increase. This activity needs to be immediately implemented at the growing “sporadic nesting” sites such as Devi and Chilika coast. These sites need to be revived to give the sea turtles an alternate safe site to nest if the Nasi II island and present Rushikulya rookery sites are destroyed and completely wiped out due to manmade activities like coastal developments (dredging of ship channels and construction of wave breakers), which looks imminent.

7. Local fishermen should be sensitized on using turtle friendly fishing gears, especially during turtle congregation and breeding seasons. As this is generally a six month period, it should not be too difficult to implement. Traditional fishermen should be sensitized on better management of their boats and activities at their boat landing spots on the beach. They should be informed of the protection and conservation measures in the turtle congregation zones by patrolling government agencies and urged to fish away from these zones.

8. The recent oil spills from ship accidents at Paradip and Gopalpur Ports are glaring examples of the threats to this flagship species arriving to the state annually as well as all to other marine life forms of the region. The drainage of ballast waters can have a huge impact on the biodiversity of the coast. Monitoring of the environmental impact of the oil spill involves mobilization of adequate number of trained personnel along with vehicles, vessels, chemicals and equipments to be involved in the response and the completion of all study associated with the oil spill. The monitoring has to continue for some time by a multidisciplinary group of subject experts from various fields, ensuring the safety of marine and estuarine wildlife; measuring the toxicity of seafood and gathering information on the recovery from the site, both on the beaches as well as in the near shore and in the offshore coastal waters.

9. Oil spill response is a balance between removing all the oil while causing minimum harm to the environment in the area being cleaned and taking into account safety issues and the available resources. The cost of an oil spill response will depend on many factors, such as the quantity and type of oil spilled, the

weather conditions at the time of the spill and the area affected. Large spills a far away from shore can cost very little if they break up naturally, but relatively small spills in a coastal zone supporting fishing and tourism along with its rich and varied biodiversity can be very costly. The polluter should pay all the costs involved in an oil spill response and subsequent cleanup activities. However, if the spiller cannot be identified or when such identification is delayed due to various reasons including court cases and litigations, then it becomes more problematic. However, pending these controversies and legal issues, government may take a decision to put in place an emergency oil spill response plan to immediately combat any such incidences in future, both for the coast as well as near shore/ off shore coastal waters and the high seas. This should include multidisciplinary group of subject experts from various fields; adequate number of trained personnel along with vehicles, vessels, chemicals and equipments, as well as sufficient contingent funds ear marked for the purpose with designated agencies for mitigating the adverse impact of such disasters.

10. The government may immediately start long term scientific studies on the impacts of the developmental activities along the coast and coastal waters on the sea turtles and their habitats as well as migratory paths and provide for the required mitigation measures. Before approving any further developmental activities in any sphere along the coast and coastal waters, the government may conduct a detailed scientific study to assess the impacts on turtles and other coastal and marine life. If there are major adverse impacts, the projects should be scrapped. Utmost care should be taken with the proposals for ports – major or minor. Establishment of designated "No Go Areas" or "No Development Zones" in an area of 15-20 km radius of the known mass nesting areas which are critical wildlife habitats particularly relating to sea turtles would be most helpful in this regard.

11. All scientific studies on sea turtles as well as other coastal and marine biodiversity along with their diverse coastal and marine habitats should be taken up on a long term basis by institutionalizing them. This will be possible through establishment of an International Coastal and Marine Biodiversity Research Center/Institute in the state of Odisha at Bhubaneswar with field research centers along Gahirmatha coast, Devi and Rushikulya river mouth areas. The institute may take up short term, medium term, long term research activities as well as regular monitoring works in a routine manner such as:

    - Daily routine monitoring of the inland and offshore lighting at night at three major mass nesting/breeding sites by positioning of CCTV cameras during congregation, mass mating/nesting and mass hatching emergence periods.
    - Improving, standardizing and strengthening of daily routine monitoring of sea fishing activities by trawlers, gill netters and other mechanized boats activity in three major mass nesting sites by establishing radars on both ends of each rookery/breeding grounds during the breeding season. Daily routine monitoring of the movement of all mechanized fishing vessels and monitoring vessels on line through positioning of vessel tracking system in all fishing vessels as well as patrolling vessels during the breeding season.

12. The responsibilities of the State and Union Government should be towards creating Specific Budget Head and adequate budget in the annual budget of the Union and the State Government for sea turtles which may be designated as the "flag ship" species of our coastal and marine environment. The responsibilities of the International and National mother NGOs should also be to earmark and provide adequate funds for conservation, protection and research activities of this globally important species and population of marine turtles and other coastal and

marine biodiversity of Odisha.

13. The decision of the government of Odisha for establishment of an exclusive National Sea turtle Research Centre/National Sea Turtle Research Institute to give an identity to sea turtles of Odisha would be a most welcome step.

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NESTING STATUS OF SEA TURTLES IN WEST BENGAL -THE EAST MIDNAPORE SCENARIO

Punyasloke Bhadury, Amit Kumar and Manoj Maiti

BACKGROUND

The West Bengal coast stretches between two unique natural heritages; Sundarbans- the world's largest mangrove population located in the east, and the state of Odisha in the west, which harbours one of the world's largest nesting populations of olive ridley turtles. In West Bengal, the turtles were reported to be most common and abundant along the east Midnapore district coast and Sundarbans of South 24 Parganas district (Biswas 1982, Sanyal 1983, Tikader 1983 Raut and Nandi 1985, 1986, Das 2001, Roy Choudhury 2001, Roy Choudhury et al. 2006).

West Bengal also records nesting of four species of marine turtles namely- olive ridley, green, hawksbill and loggerhead turtles (Anon 2000). During the GOI-UNDP surveys of 2000-01 the presence of olive ridleys was confirmed along the coast of West Bengal, but except for a dead specimen of hawksbill, no sightings of green and loggerhead turtles were recorded. Olive ridley nests were recorded from the sea-facing sandy beaches of the deltaic islands of Mechua, Chaimari, Jambudwip, Kalash and Bijaera of the Sundarbans (Roy Choudhury et al. 2006). A nesting survey by Kurian involving the Forest Department of the Sundarbans division was carried out along the same islands, including Lothian in 2006, but only predated nests were recorded from Bijaera. Tiger pugmarks were also sighted about 10 meters away from the predated nests (Kurian 2008). Tigers, wild boars and water monitors have been identified as predators of nesting females or their eggs in the nesting beaches of Sundarbans (Saha 1984, 1986, Gani 2000). There are reports of nesting in two other islands namely Kedurdwip and Pirkhali in the Sundarbans (Roy Choudhury et al. 2006 and Mukherjee 2001). Sanyal (1983) reported nesting of olive ridleys in Kanak Island but the island could not be located during the survey of 2000-02.

Despite these studies, limited information exists on the migration, mating and nesting season and beaches of turtles, clutch size, incubation period, and incidental catch, threats, including trade in olive ridleys along the West Bengal coast (e.g. Saha 1986, Roy Choudhury 2001, and Rajgopalan et al. 2001). A pollution impact study along the coastal areas of West Bengal was carried out through the GOI UNDP project, the results of which emphasized the importance of evaluating and mitigating pollution in the region, considering its close proximity to the mass nesting beaches of Orissa (Mukherjee 2006) Roy Choudhury et al. (2006) also reported low nesting intensity during 2001-02 in comparison to 2000-01. However, no well coordinated studies were undertaken following 2001-2002 to assess the marine turtle population including nesting beaches along the east Midnapore coastal belt.

STATUS AND LOCATION OF NESTING BEACHES

The study areas of Junput, Dadanpatrabar, Shankarpur and Digha lie in the East Midnapore region of West Bengal. The coastal length of East Midnapore is 60 kms and is continuous with the Odisha state; the deltaic islands of the Sundarbans are separated by the Ganga estuary in the Bay of Bengal region.

FIGURE 1. STUDY AREAS OF EAST MIDNAPORE REGION

TABLE 1. CO-ORDINATES OF STUDY AREAS OF EAST MIDNAPORE, WEST BENGAL

Study area	Area covered (GPS coordinates)	Beach type
Junput	21°42'802"N;87°49'216"E to 21°4 1'900"N;87°46'280"E	Sandy
Shankarpur	21°38'45.5"N;87°37'28.0"E to 21°3 7'9.95"N;87°33'3.06"E	Mostly sandy, but rocky at some places
Dadanpatrabar	21°41'385"N;87°45'485"E to 21°33'202"N;87°38'410"E	Sandy
Digha	21°27'9.95"N;87°31'55.5"E to 21°36'26.8"N;87°28'27.5"E	Rocky and Sandy

METHODOLOGY

The present study was undertaken with a focus only on the East Midnapore district of West Bengal. Four locations namely Junput, Dadanpatrabar, Shankarpur and Digha in East Midnapore were surveyed as part of this study (see Fig. 1). Reports of olive ridley nests and carcasses were documented in a previous study across these locations (Choudhury et al. 2006). The field study was conducted during February- April 2011. The area covered during the study with GPS coordinates are detailed in Table 1. Field trips lasting for 3-4 days every week from February to April were conducted in different fishing villages, fish-landing centres and beaches. Occasional trips were undertaken in the fish markets to check on the sale of turtle eggs and meat across the study areas. Information on the occurrence of marine turtles including nesting sites if any were obtained through interviews with fisher folk, trawler operators and villagers. During the survey, the beaches of Dadanpatrabar, Shankarpur, Junput and Digha were searched on foot to enumerate dead turtles.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

In the current study of the east Midnapore region, nesting turtles or nests, including that of the common olive ridleys, were not observed. But some activity of sporadic nesting in Dadanpatrabar was revealed during conversations with local inhabitants. However, such claims warrant further scientific investigation (Choudhury et al. 2006).

TABLE 2. OLIVE RIDLEY CARCASSES FOUND IN EAST MIDNAPORE, WEST BENGAL

Beach	February 2011	March 2011	April 2011
Junput	8	3	4
Dadanpatrabar	-	13	1
Shankarpur	-	3	1
Digha	-	8	-
Total	**8**	**27**	**6**

However, dead carcasses of 41 olive ridleys (Table 2) were recorded from Junput, Shankarpur, Dadanpatrabar and Digha beaches between February-April 2011. Length and width of the intact carapaces of the turtles varied between 62-81 cm and 59-72 cm respectively. Carcass of other marine turtle species was not observed during the study period. Due to badly decomposed state of bodies, and broken carapaces, male and female of the species could not be distinguished. Most carcasses were found in close vicinity to the fishermen villages. In a previous study by Roy Choudhury et al (2006) there were reports of nests in Dadanpatrabar during the survey of 2000-01. However, in the current extensive survey, no nests could be recorded in Dadanpatrabar and adjoining areas. More detailed studies need to be undertaken to verify nesting in these places.

Air and sea surface temperature across the study sites ranged from 27°C to 29°C for both the cases. The pH of the water ranged from 8.0-8.2 while the salinity ranged from 14-23 ppt. The studied beaches were mostly sandy in nature except for rocky stretches in the Shankarpur sector.

THREATS

NESTING BEACHES

Dead olive ridley turtle encountered on the beach of Junput, East Midnapore coast

Beach erosion is a serious threat to occasional nesting populations of olive ridleys reported by local inhabitants, in the East Midnapore coastal areas. To counter beach erosion, several unplanned steps have been taken including Casuarina plantations along the Dadanpatrabar, Junput, Shankarpur and Digha coastlines. Casuarina

trees are known to affect the nesting beaches as reported previously (Saha, 1984). It is envisaged such plantations will also affect the sporadic nesting of turtles along these coastlines. Besides Casuarina, vegetation consists of halophytic creepers and herbs which were not part of the plantation activity. Feral dogs were encountered on all beaches, and these could also pose a threat to the nesting population of marine turtles. Incidentally, feral dog numbers were highest in Dadanpatrabar and were also found feeding on some decomposing carcasses.

A feral dog eating a carcass of an olive ridley in Dadanpatrabar coast of east Midnapore

INCIDENTAL CATCH

The olive ridley turtle carcasses encountered in the beaches of Junput, Dadanpatrabar, and Shankarpur during the study were found in close vicinity to fishing villages. The turtle shells encountered in Digha were adjacent to the fish landing centre (Digha Mohana). Interviews with the fishermen (10-15 fishermen from each village) revealed that a majority of these dead turtles were noticed during gill net trawling activities in the coastal and offshore waters in the Bay of Bengal. Many of the fisher folk at the landing centres in Shankarpur and Digha refused to divulge details about the incidental catch of olive ridleys during the months of January-April. There are unverified reports that some of the incidental catches are sold in the landing centres from time to time. Some of the fisher folks in the Digha landing centre informed that incidental turtle catches were released in the coastal waters because of fear of legal action.

EXPLOITATION FOR MEAT AND EGGS

Aquaculture is one of the serious threats to the marine turtle population along the East Midnapore coastal district of West Bengal. Fisher folk and local villagers revealed that olive ridley turtles caught in fishing nets were extracted for their meat, which was subsequently sold to the aquaculture farm owners for use as fish feeds. These activities are thought to be concentrated around aquaculture farms located close to Dadanpatrabar and Junput coastlines. However, such claims require further verification. In the study, it could not be ascertained whether ridley meat was consumed by the local people, partly due to their reluctance in sharing the information. But there are previous reports of the sale of turtle meat in East Midnapore district (e.g. Roy Choudhury et al. 2006; Vijaya, 1982).

Previous studies have reported that marine turtle eggs were collected for consumption by the fisher folks along the Midnapore coast. Although this practice continues to exist in some places as revealed from interviews with local fisher communities and villagers, presently nesting of marine turtles along the coast of East Midnapore is extremely sporadic, and further ground truthing on the practice would be required. During surveys, no evidence of sale in turtle meat or eggs could be obtained. But the prevalence of an age old practice, where local inhabitants consumed blood of marine turtles for medicinal reasons, including that of reducing blood pressure, was revealed by fishermen.

COASTAL DEVELOPMENT

BEACH TOURISM: Rampant tourism continues to be a serious threat to olive ridley turtles which may be nesting along the coastal areas of East Midnapore. In particular, developmental activities associated with tourism could be affecting the nesting population, if any, in Dadanpatrabar. In the study, it was observed that cars and other four wheelers were being driven along a popular beach known as Mandarmani, adjacent to Dadanpatrabar. Such activity may have resulted in rapid decline of nesting olive ridleys. In Digha intense tourism pressure has resulted in the decline of turtles and based on information revealed by local people, no nesting population of olive ridley turtles were observed in the area in the last five to six years.

Mast lights along the West Bengal Coast

© ANNIE KURIAN

SEA WALLS, DYKES AND EMBANKMENTS: Coastal development, another major threat to marine turtles, was observed along the East Midnapore coastal belts. To prevent coastal erosion sea walls were erected in the Junput, Shankarpur and Digha coastline of East Midnapore. In Shankarpur, the sea walls erected to prevent erosion stretched several kilometers along the coastline. Construction of dykes and embankments, as evident in the Junput coastal area, could adversely affect turtle migrations and nesting in the region.

RECOMMENDATIONS

1. Incidental catch of turtles happens during gill net and trawl net operations in the coastal and offshore waters of Bay of Bengal. It is important to introduce TEDs amongst the fishermen communities in the region, as such devices can decrease the chances of turtle being caught in the nets. Fishermen co-operatives are active in the region and workshops can be conducted to explain the use of TEDs. On a pilot scale, it would be good to provide some of the fishermen with TEDs through grants provided by the government and non-government agencies.
2. There is a need to enforce the wildlife laws in the region so as to protect the dwindling marine turtle population more actively by Forest, Fisheries and Agriculture Departments of the state. The enforcement of the wildlife laws could become more effective by involvement of local people, government representatives (panchayat members) and NGOs.
3. Additional efforts including constant monitoring during nesting season, as well as a strict vigilance on sale of marine turtle meat has to be initiated in the East Midnapore coastal district.
4. Field surveys involving Forest Department officials and wildlife volunteers should be done on a yearly basis to assess the status of the marine turtle population visiting the Midnapore coast.
5. It has also become imperative to cross check and collect evidence about the use of turtles as feeds in the aquaculture farms in the region. While in 2000-

01 survey some nests of olive ridleys were recorded in Dadanpatrabar area but none were recorded as part of this study. This indicates that the nesting may have become extremely sporadic in the region and one of the possible causes is coastal development. There is an urgent need to ensure that coastal development is well planned in the region and at the same time can sustain the marine turtle populations.

6. One of the most important things that require further attention is to create awareness about nesting turtles of the region, among the local people and visiting tourists. Incidentally, residents of East Midnapore district excluding the fishing community are not well aware about the presence of marine turtles in the coast. Therefore a mass awareness programme involving Forest Department and wildlife policy making organizations like WWF-India can be initiated in the region. Activities such as meetings and workshops, distribution of leaflets, brochures and handouts that explain the need to conserve marine turtles, can significantly aid in the process.

7. Tourists visiting the region should be sensitized more about the marine turtles and a possibility of introducing wildlife tourism, in particular turtle tourism, can be explored. Such an initiative could generate revenue for turtle conservation and at the same time create job opportunities for the local communities. To conclude the future of marine turtle visiting the East Midnapore coastal belt for nesting is bleak unless steps are being taken by government and non-government agencies as an utmost priority.

ACKNOWLEDGEMENTS

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Appendix

TABLE 3. MORPHOLOGICAL MEASUREMENTS AND SEXING OF TURTLE CARCASSES ENCOUNTERED ON JUNPUT, SHANKARPUR, DADANPATRABAR AND DIGHA AREAS (2011)

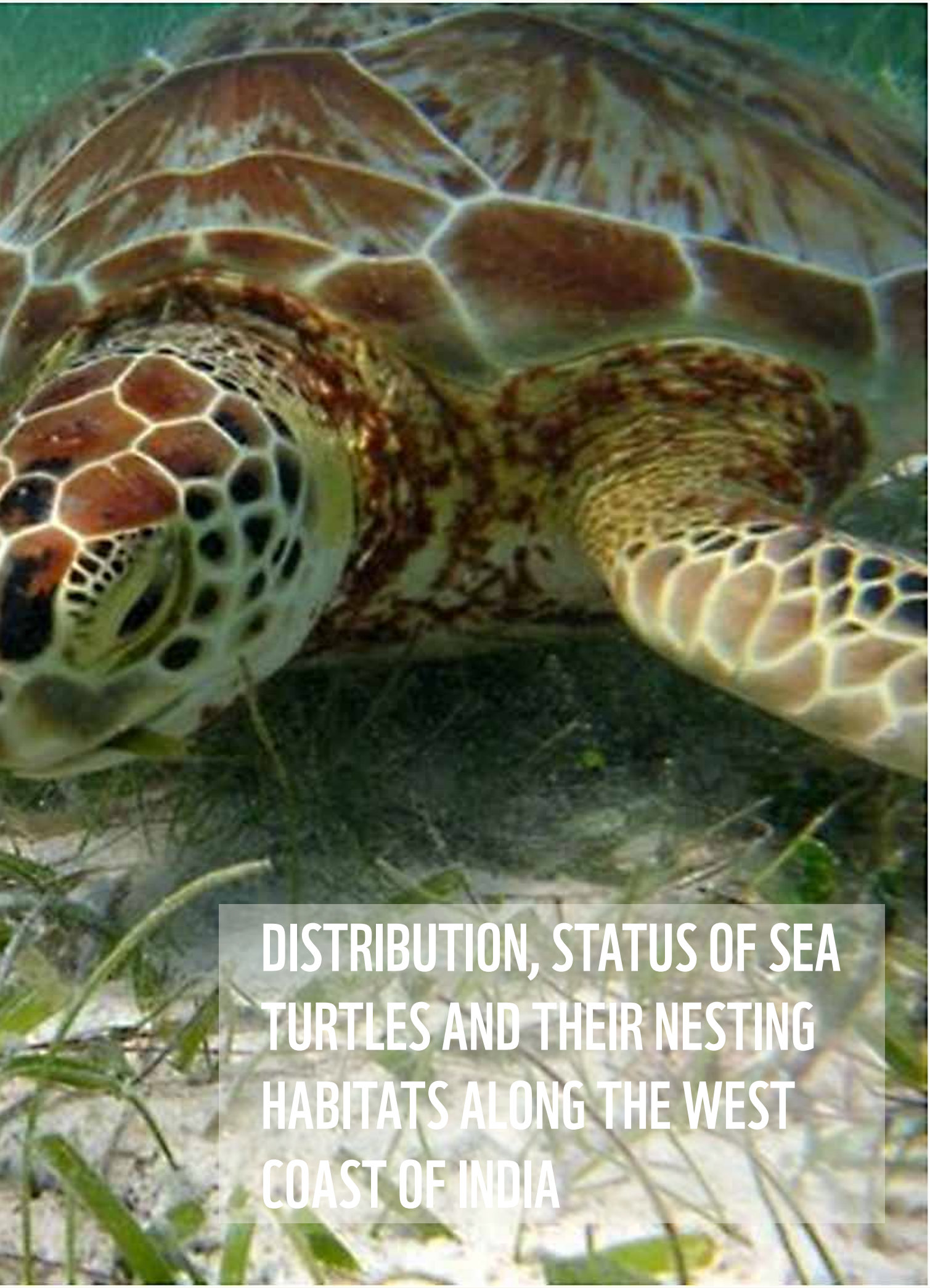
S. No.	Date	Area	Location	Shell Length (In cms)	Shell Width (In cms)	Condition of the dead carcass
JUNPUT						
1	19-02-11	Haripur -Bugudan	21°41'973"N 87°47'918" E	64	59	NA
2			21°41'877" N 87°47'709" E	66	60	Skeleton visible; Partially decomposed
3			21°41'750" N 87°47'523" E	69	64	Decomposed
4	22-02-11	Haripur Bugudan	21°41'565" N 87°46'691" E	81	66	Partially decomposed
5	23-02-11	Haripur Junput	21°42'110" N 87°48'092" E	62	59	Relatively fresh Carcass; Head and skins visible; Decomposition started
6			21°42'109" N 87°48'100" E	78	68	Completely degraded; Head and Skull visible
7			21°42'450" N 87°48'650" E	77	65	-
8			21°42'716" N 87°48'179" E	60	59	-
9	03-03-11	Haripur Junput	21°42'230" N 87°48'332" E	-	-	Broken shell
10	11-03-11	Junput	21°41'565" N 87°46'691" E	-	-	Broken shell
11	11-03-11	Haripur	21°41'897"N 87°47'791"E	60	60	Freshly landed turtle; no damage to shell; no clotting of blood
12	1-04-11	Haripur	21°42'07.5"N 87°48'00.1"E	69	68	Head was attached to shell and flippers were decomposed.
13	1-04-11	Haripur	21°42'16.5"N 87°48'20.2"E	75	72	Decomposed
14	1-04-11	Haripur- Junput	21°42'32.0"N 87°48'50.5"E	79	70	Only shell was present
15	1-04-11	Haripur	21°42'00.4"N 87°47'54.1"E	55	52	Intact shell; More humped and looked like eaten.
SHANKARPUR						
1	25-03-2011	Shankarpur	21°38'017"N 87°33'556"E	74	69	Broken shell
2			21°38'019"N 87°33'309"E	60	53	Shell present, Skull separated from the main shell
3			21°37'995"N 87°33'306"E	-	-	Completely broken shell, hard to measure
4	04-04-11		21°38'45.5"N 87°37'28.3"E	-	-	Only skull

Head to tail Length (In cms)	Flippers (In cms)	Sex	Surroundings	Nearest Fishing Village
DADANPATRABAR				
-	-	-	Mechanised Fishing trawlers; Casuarina plantation; Feral dog (1 no)	Haripur
-	Fore flipper 9	-	Casuarina plantation; Feral dog (1 no)	--do--
84	-	-	Casuarina plantation; Feral dog (1 no)	--do--
-	Claws Visible	Possibly Male	Casuarina plantation	Bugudan
79	Claws Visible and hind flipper 30	Possibly Female	Casuarina plantation	Haripur
-	-	-	Casuarina plantation	Haripur
-	-	-	Casuarina plantation; Feral dog (3 no)	Junput
-	-	-	Casuarina plantation; Feral dog (3 no)	Junput
-	-	-	-	-
-	-	-	Sandy beach	Bugudan
86	Front flipper- 34 Hind flippers-20	Female	Haripur fishing village, huge Casuarina plantation	Haripur
90	-	-	Casuarina plantation	Haripur
-	-	-	Casuarina plantation	Haripur
-	-	-	At the level of high tide	Junput
-	-	-	Away from shore, close to fishing village	Haripur
-	-	-	Casuarina plantation; Feral dogs (3 no)	-
-	-	-	Bycatch dumping area	-
-	-	-	-	-
-	-	-	-	-

1	04-03-11	Sonamui	21°39’530”N 87°41’494”E	60	60	Decomposing, Neck absent
2			21°39’530”N 87°41’494”E	-	-	Shell broken
3		Dadanpatra-bar	21°39’818”N 87°42’346”E	62	59	Decomposed; Possibly eaten up
4			21°39’890”N 87°42’516”E	60	56	Decomposed; Shell broken
5			21°39’947”N 87°42’622”E	-	-	Only Skull visible
6			21°40’096”N 87°43’008”E	-	-	Only broken shell
7			21°40’163”N 87°43’103”E	70	62	Completely Removed Flesh and only Shell
8			21°40’266”N 87°43’470”E	-	-	One broken frag ment. Could not measure.
9	13-03-11	Dadanpatra-bar	21°40’490”N 87°43’937”E	75	69	Broken shell
10	13-03-11	Dadanpatra-bar	21°40’279”N 87°43’495”E	67	57	Fresh carcass; Injuries in hind flipper; No blood clot
11	13-03-11	Dadanpatra-bar	21°39’895”N 87°42’561”E	68	61	Front flippers damaged ; De-composing
12	26/03/11	Showli (Junput and Dadanpatra-bar)	21°41’385”N 87°45’485”E	62	50	Shell present
13	27-03-11	Mandarmani	21°39’202”N 87°38’410”E	-	-	Shell broken; hard to measure
14	03-04-11	Dadanpatra-bar	21°40’15.9”N 87°43’24.3”E	--	-	Only Skull is present
DIGHA						
1	05-03-11	Digha	21°37’808”N 87°32’829”E	--	--	Shell broken
2			21°37’808”N 87°32’829”E	-	-	Shell broken
3			21°37’808”N 87°32’829”E	-	-	Shell broken
4			21°37’808”N 87°32’829”E	-	-	Shell broken
5			21°37’808”N 87°32’829”E	-	-	Carcass badly decomposed
6			21°37’808”N 87°32’829”E	-	-	Shell broken
7			21°37’808”N 87°32’829”E	-	-	Completely degraded Shell, Fragmented Carcass found
8	12-03-11	Digha Mohana	21°37’808”N 87°32’829”E	-	-	Partially broken shell

-	-	-	Near Beach Resort; Human intervention; Vehicle movement, Feral dogs (6 No)	No fishing village; Hotels and Resorts only.
-	-	-	Near Beach Resort; Human intervention; Vehicle Movement Feral dogs (6 No).	No fishing village; Hotels and Resorts only.
-	-	-	Lots of bycatch thrown in the area.	Khothi
-	-	-	Lots of bycatch thrown in the area.	Khothi
-	-	-	Lots of Bycatch thrown in the area; Non mechanized fishing boats and mechanized trawlers	Khothi
-	-	-	Lots of Bycatch thrown in the area; Non mechanized fishing boats and mechanized trawlers	Khothi
-	-	-	In the Casuarina forest; Sandy area	Khothi
-	-	-	-	Khothi however no fishing village nearby.
-	-	-	Fishing area for Khothi village,	Khothi
87	Front flippers- 34 Hind flippers-26	Possibly Female	Fishing area for Khothi village,	Khothi
77	-	-	Fishing area for khothi village,	Khothi
-	-	-	Muddy area close to Showli village	Showli
-	-	-	Mohana of Mandar moni; Feral dogs (2 no)	Mandarmani
-	-	-	-	-
-	-	-	Huge Landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Huge landing centre; Tourist spot; Barrier to beaches.	Digha Mohana
-	-	-	Fishing village	Digha Mohana

FORAGING GREEN SEA TURTLE © ROBERT VAN DAM



DISTRIBUTION, STATUS OF SEA TURTLES AND THEIR NESTING HABITATS ALONG THE WEST COAST OF INDIA

SEA TURTLES OF KERALA: STATUS, ISSUES AND THREATS

Murukan Pareparambil and Renjan Mathew

BACKGROUND

Sea turtles have been reported from Kerala waters as early as 1923, where Cameron was informed by fishermen about 40 leatherback turtles being caught annually when spotted at sea or travelling ashore to nest. Smith (1931) reported leatherbacks frequently occurring in the waters near Thangasherry reef. Green turtles were also reported along the Quilon coast (Shanmugasundaram 1968). Olive ridley turtles were reported to nest frequently along the Kerala coast (Kar and Bhaskar 1982, 1984).

While early scientific reports of turtles in Kerala exist from 1923, the state also pioneers one of the country's first community based initiative in turtle conservation- the Theeram Prakriti Samrakshana Samiti; it has been operational since 1992 and is led by a group of fishermen who were sensitized about turtle conservation in their youth through an article in the newspaper. Till date, a 10 km stretch of the Kolavipalam beach is monitored by the Theeram group.

Apart from reports of turtles occurring in water and land, the stranding and capture of turtles in fisheries have also been reported along the Kerala coast; stranding of leatherbacks and accidental catch of green turtles have been recorded from several areas in Kerala (Pillai et al 2003, 2004).

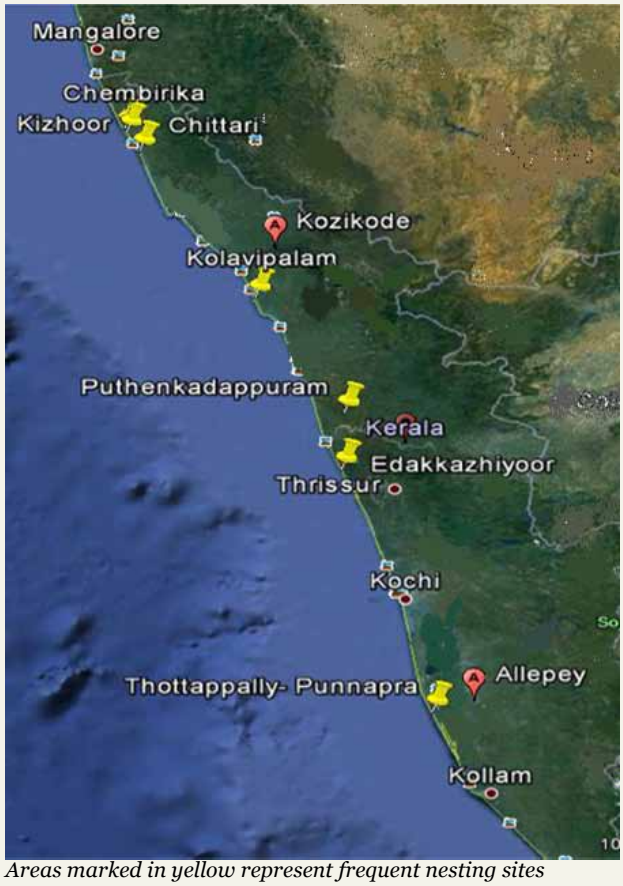
A survey and field study of the entire Kerala coastline (Kumar and Jaykumar 2002, 2006) has been covered in the GOI-UNDP2000-2001 sea turtle project. The secondary information gathered show nesting status across 9 coastal districts of Kerala, and the critical status of threats to turtles. The survey results indicate the nesting of only hawksbill species, and no other. A study in 2004 examined the traditional practices and rights of fishermen in the Kerala coast and development of education strategies for community based turtle conservation (Jaykumar 2004).

The UNEP-CMS carried out between 2003 and 2004, surveyed north Kerala along Kannur and Kasargod coast, previously reported to be important nesting habitats of sea turtles (Bhupathy 2007). The nesting season in Kerala was found to be between the months of September and October, through secondary sources of information. No turtle mortalities were recorded during the survey, and reports from fishermen revealed only occasional stranding. Nest depredation by humans and predation by dogs/wild animals was reported to be unknown. The 2010-11 WWF-India survey is an attempt to determine the current nesting status of turtles, nesting species, threats and conservation status along the Kerala coastline.

STATUS AND LOCATION OF NESTING BEACHES

Kerala has a coastline of about 590 km with nine coastal districts stretching between Karnataka and Tamil Nadu states located to its north and south respectively. Eight of these districts-Kasargod, Kannur, Kozikode, Malapuram, Thrissur, Alappuza, Kollam and Thiruvanthapuram have shown some nesting activity in the last three to six years. From the forty five locations surveyed around these districts, seven show higher nesting numbers between 2005-2011. These locations are Kizhoor, Chembirika and Chittari in the Kasargod district; Kolavipalam in Kozikode district; Puthenkadapuram and Edakkazhiyoor in Thrissur district; and the Thottappally and Punnapra stretch in Allepey district.

FIGURE 1. FREQUENT NESTING LOCATIONS OF TURTLES ALONG KERALA COAST



Areas marked in yellow represent frequent nesting sites

TABLE 1. CO-ORDINATES OF FREQUENT NESTING LOCATIONS ALONG KERALA COAST

S. No	Nesting Location	Co-ordinates
1.	Chembirika	12°28'11.08"N 74°59'54.30" E
2.	Kizhoor	12°28'11.08"N 74°59'25.34" E
3.	Chittari	12°20'28.45"N 75°03'45.62"E
4.	Kolavipalam	11°32'52.84"N 75°35'46".66" E
5.	Puthenkadapuram	10°35'38.04"N 75°59'48.28"E
6.	Edakkazhiyoor	10°37'20.65"N 75°59'05.76"E
7.	Thotapally-Punnapra	9°19'00.65"N 76°22'49.85"E

METHODOLOGY

The current survey was carried out across the nine coastal districts of Kerala; the list of beaches with some reports of turtle nesting in the last few years has been given in table 1. Although some research attempts have been made in the past, there has been no extensive information-primary or secondary- on the nesting habitats, numbers that nest, threats to turtles, and turtle landing centres along Kerala's coast. In the current survey, sea turtle status information has been documented based on extensive interviews conducted with various groups of coastal people-NGO, Forest Department,

Representatives of Fishermen/ Trawl operator's societies, Representatives of Local State Government Departments, Enforcement Personnel, Fisher communities and coastal youth groups. The work was carried out between March and June 2010. Nest monitoring activity of the historic sea turtle conservation organisation- Theeram Prakruthi Samrakshana Samithi, along the Kolavipalam beach has been documented here. Areas surveyed in the study include new locations and those from the previous surveys-Dileepkumar and Jaykumar (2006) and Bhupathy et al (2007). This includes 90% of the total coastal areas in Kerala. Places like Ernakulum and Cochin had very minimal surveys. The information gathered from the survey could help future efforts in monitoring nesting habitats for assessing a detailed nesting status.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

Marine turtles have been reported from all the 9 coastal districts of Kerala. In most locations local people confirm the nesting species as olive ridley, except in one - Puthenkadapuram in Thrissur- where occurrence of a green turtle has been observed. The beaches listed below (Table 2) have been reported by Dileep Kumar and Jaykumar (2006) and the places have been covered in the current survey. These locations are known to have some confirmed and unconfirmed reports of nesting. There are also areas included that have not been surveyed by Dileepkumar and Jaykumar (2006) and Bhupathy et al (2007):

TABLE 2. BEACHES REPORTED FOR THE OCCURANCE OF MARINE TURTLES IN KERALA

Thiruvananthapuram District	Pozhiyur, Poovar, Vizhinjam, Kovalam, Beemapalli-Poonthura, Veli - Shankhumukham, Perumathurai - Thazhampally, Anchuthengu and Edava - Odayam - Varkala beach
Kollam District	Kollam - Thangassery harbour, Kappil - Edava - Odayam and Mukkam – Pozhikkar
Aleppey District	Aleppey beach, Punnapra beach, Thottappally - Punnapra beach, Pallana beach, Thaikkal - Ottamasseri beach and Valiyazhikkal
Ernakulum District	Munambam and Cherai(Ernakulum); Azhikkode beach, Kothalam - Kaipamangalam beach, Nattika beach, Moothakunnam - Snehatheeram beach, Thalikulam - Nambikkadav beach, Vadanappilly beach, Blangad - Moonamkallu beach,
Thrissur District	Chavakkad - Puthenkadappuram beach, Edakkazhiyoor - Nalamkallu beach, Mannalamkunnu beach, Periyambalam beach(Thrissur)
Malapuram District	Kadalundi (Anangadi), Muthiyam (Vallikkunnu), Parappanangadi - Alungal, Kettungal - Tanur, Unniyal, Koottayi, Pandayi - Nair Thodu, Koottayi Azhimukham,
Kozhikode District	Ponnani - Marakkadavu, Puthuponnani - Munambam Jaram – Veliyancode Chaliyam beach, Beypore - Calicut - Puthiyappa beach, Kappad beach, Thikkodi - Kolavipalam beach
Kannur District	Ezhimala - Ettikkulam beach, Choottad - Mattool beach, Meenkunnu - Chal beach, Payyambalam beach, Thottada - Ezharakadappuram beach, Muzhuppilangad beach

Kasargod District	Mavila - Thrikkaripoor beach, Thaikkadappuram - Azhithala beach, Ajanur - Hosdurgbeach, Chittari beach, Pallikkara (Bakel) beach, Kottikulam beach, Odath - Kappil beach, Chembarikka beach, Kizhoor beach, Kasaba - Nellikunnu beach, Mogral - Kavugoly beach, Peruvad - Kumbala Beach, Shiriya - Ayila beach, Uppala - Benkkara beach, Manjeswaram beach, Talappadi - Kanwatheertha beach
Included	Unreported Nesting beaches and Reported Nesting Beaches from Dileep Kumar and Jayakumar(2006)

The number of turtles nesting along the Kerala coast is very less and records maintained are very few; they include the efforts of Theeram, Green Habitat and Naithal operating in Kozikode, Thrissur and Kasargod districts respectively. Theeram, an environmental organisation in Kozhikode district, has been maintaining consistent records since mid 1990 on nesting turtle numbers, eggs and hatchlings; the details of the last six years have been put together in table 3 with secondary data from other coastal districts.

NESTING STATUS OF KOLAVIPALAM BEACH

Kozikode district has a coastal length of 71 kms, out of which 8 kms is monitored for nesting activity along the Kolavipalam beach by the organisation, Theeram Prakruthi Samrakshana Samithi. Between 2005-2011, Theeram has recorded 78 nests along the beach stretch. In this period, the highest number of nests was recorded at 23 in the year 2007, which recorded a nesting density of 2.875 nests/km; the current year 2011 has recorded among the least, a nesting density of 0.875 nests/km.

TABLE 3. NESTING STATUS ALONG KERALA COAST 2005-2011 (INCLUDED: RECORDS OF THEERAM)

S. No	District	Nesting-species	05	06	07	08	09	10	11	Nests total	Eggs total
1	Thiruvanantha-Puram	OR	1	NI	2	2	4	2	1	12	NI
2.	Kollam	OR	1	NI	NI	1	NI	NI	1	3	NI
3	Allapuzha	OR	NI	1	3	1	5*	3	1	14	116
4	Thrissur	OR	NI	NI	NI	NI	18*	25*	9	52	2088
	Thrissur	GR	NI	NI	NI	NI	1	NI	NI	1	NI
5	Malapuram	OR	NI	NI	NI	NI	5	8*	6*	19	310
6	Kozhikode	OR	8*	8*	23*	9*	6*	17*	7*	78	6109
7	Kannur	OR	NI	NI	NI	1*	4*	3	NI	8	60
8	Kasargod	OR	NI	NI	NI	15*	20	34	17	86	2000
Total		**10**	**9**	**28**	**29**	**59**	**92**	**42**	**273**	**8883**	

NI: No Information; OR: olive ridley; GR: green turtle; *Eggs recovered from nests ; 05-11: years between 2005-2011

The figures in table 3 from monitored Kolavipalam beach by Theeram areas as well as those reported by coastal groups indicate a declining trend for turtle nesting along Kerala's coast. Reasons are perhaps due to the increase in threats listed below.

THREATS

NESTING BEACHES

Coastal afforestation with Casuarina plantations along the coastal stretches is still a major threat to the turtles. Fortunately these plantations have been raised years back by the Social Forestry Division of the Kerala Forests and Wildlife Department under the Kerala Forestry Project aided by the World Bank, and presently there is not much afforestation activity along the coast. There is a possibility that some of the historic nesting sites have been lost due to such inappropriate afforestation programmes along the coast. Nattika in Thrissur is one such area. The roots of the plantations prevent the turtles from digging their nests to lay the eggs. Sand mining is another of the most recent and threatening activities to a majority of the beaches in Kerala. The demand for sand for various construction purposes has almost exhausted all the sand reserves in the rivers of the state. This has led to a shift to beach sand mining for construction purposes. Salinity of the sand is got rid off by washing with freshwater. Even though this is illegal, beach sand mining is presently the biggest growing threat particularly for turtle nesting habitats in Kerala. The beach in Kolavipalam has shrunk to a great extent as a result of this. Even though local conservation groups have raised their concern to authorities, and despite filing cases in court, this illegal activity persists.

Sand mining pits and waste dumped on beaches

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INCIDENTAL CATCH

Trawl nets are one of the major threats to the turtles. For majority of other turtles caught in nets, like the gill nets, fishermen kill them and consume the meat themselves or sell it in the local market. This practice is common in Vizhinjam in Thiruvananthapuram district; Thangassery in Kollam district; Aleppey district and Azheekkal in Kannur District. Some of the fishermen claim that they deliberately kill turtles when caught as they cause financial loss by destroying the nets. This was revealed by fishermen, mainly from Calicut, Malapuram and parts of Thrissur district.

Landing of turtles is a regular phenomenon at the districts of Trivandrum (Tvm), Kollam(Klm), Allepey (Alp), Thrissur (Tsr), Malapuram (Mlp), Kozikode (Kzd), Kannur (Knr) and Kasargod (Kgd).(Source: Interviews with Various stakeholders 2011)

In Kottikulam area of Kasargod, fishermen try to rescue the turtles caught in the trawl nets and release them back into the waters because of their religious beliefs that turtles are considered as the reincarnation of Lord Vishnu. As per the general observation made by the fishermen, mechanised boats used in fishing create much disturbance in the coastal waters through noise and turbulence, and this scares away the turtles coming to nest. Many turtles get trapped in nets and die because the nets are not fitted with any TEDs. Fishermen are of the opinion that, more than other causes, fishing nets are the major threat to marine turtles.

EXPLOITATION FOR MEAT AND EGGS

This is the most traditional and common threat to the turtles, revealed by majority of the fishermen along the Kerala coast. Eggs are harvested by fishers by following the tracks left by the nesting turtles. The eggs are utilized mostly for household consumption, but in places like the northern regions of Kerala, they are sold illegally. But currently, with increased awareness programs conducted by conservation groups and partly due to strict enforcement of laws by the Kerala Forests and Wildlife Department, the collection and consumption of eggs is coming down. But still fishermen confess that collection of eggs is done opportunistically. Consumption of turtle meat is more common in the southern regions of Kerala. The eggs of the turtles are mainly consumed by the fishermen themselves. When sold illegally in markets, (Kattakada in Thiruvananthapuram), it is promoted on the label that it is very good for curing asthma.

Carapaces of turtles exploited for meat in southern Kerala

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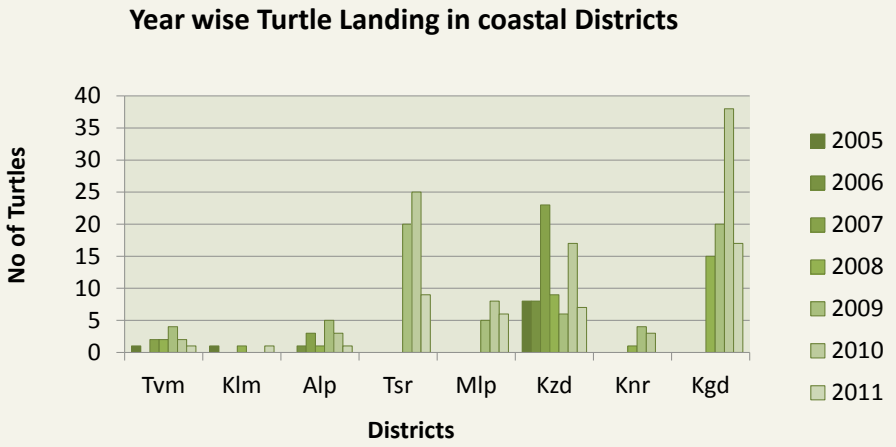
FIGURE 2 TURTLE LANDING LOCATIONS AND STATUS IN KERALA (2005-2011)



The nature of selling varies between areas. Kattakada is well known and an established illegal market for turtle meat. People from far off places are also reported to be buying turtle meat here. Whereas in Vizhinjam, turtles caught are kept alive in a drain running alongside the harbour, by securing one of the flippers with a rope tied to a pillar or heavy stone. When a buyer approaches, they are retrieved from the water body, slaughtered and sold. Sometimes the turtles are put upside down in the harbour area, and covered with dry banana leaves so that they are not easily seen. In majority of the other areas, it is done in a secretive manner. There is an established illegal network consisting of trawl operators and fish merchants who are very active in this trade. From the coastal districts, sometimes the turtle meat goes to other districts like Kottayam, where it is in high demand by the affluent Christian community, who consider it as a delicacy.

PREDATORS

In the beaches across the northern regions, predation by dogs, jackals and mongoose (which is rare) pose a serious problem to the nests of turtles, as they are dug out by these animals. Even though they devour only some eggs, the entire nest gets affected.

TABLE 4. BEACHES, CO-ORDINATES, AND RELATED THREATS ALONG KERALA COAST

District	Beach	Co-ordinates	Threats
Thiruvanan-thapuram	Pozhiyur	8°16'00.82"N 77°08'05.40"E	Consumption of meat Collection of eggs Disturbance from fishing boats
	Poovar	8°19'02.93"N 77°04'15.09"E	Consumption of meat Collection of eggs
	Thazhampally	8°37'51.63"N 76°47'15.02"E	Consumption of meat Collection of eggs Casuarina plantation Sea wall
	Anchuthengu	8°39'57.89"N 76°45'35.33"E	Consumption of meat Collection of eggs
	Varkala	8°43'57.90"N 76°42'21.17"E	Casuarina plantation Sea wall
Kollam	Thangassery	8°52'21.69"N 76°35'41.93"E	Consumption of meat Collection of eggs
Alappuzha	Thottappally Punnapra	9°19'00.65"N 76°22'49.85"E	Casuarina plantation Consumption of meat Collection of eggs Pollution by DDT Predation by dogs
	Punnapra	9°25'58.25"N 76°20'00.17"E	Collection of eggs
	Aleppey	9°29'37.60"N 76°19'04.55"E	Casuarina plantation Artificial lighting Sea wall Collection of eggs
	Thaikkal Ottamasseri	9°44'54.52"N 76°17'03.56"E	Sea wall Consumption of meat Sand mining
Thrissur	Nattika	10°24'51.31"N 76°05'03.74"E	Collection of eggs Predation by dogs
	Moothakun-nam	10°25'35.35"N 76°04'44.83"E	Human disturbance at night Collection of eggs
	Vadanappilly	10°28'00.49"N 76°03'38.74"E	Sea wall Collection of eggs
	Blangad	10°32'16.35"N 76°01'22.70"E	Sea wall Predation by dogs
	Puthenkadap-puram	10°35'38.04"N 75°59'48.28"E	Predation by dogs

	Edakkazhiyoor	10°37'20.65"N 75°59'05.76"E	Collection of eggs Predation by dogs
	Mannalam-kunnu	10°39'24.63"N 75°58'10.07"E	Human disturbance from tourism Collection of eggs
Malappuram	Muthiyam-Vallikkunnu	11° 05'37.47"N 75°50'19.67"E	Trawling nets Predation by dogs Sea wall Collection of eggs
	Parappanan-gadi	11°04'22.83"N 75°50'35.24"E	Trawling nets Anchoring of boats Sea wall Human presence on the beach Artificial lighting
	Kettungal – Tanur	10°58'41.98"N 75°52'14.91"E	Consumption of meat Trawling nets Collection of eggs Human presence on the beach Sea wall
	Koottayi	10°50'55.42"N 75°54'04.93"E	Trawling nets Collection of eggs Human presence on the beach Sea wall
	Nair Thodu – Pandai	10°50'55.42"N 75°54'04.93"E	Collection of eggs Predation by jackals or mongoose Sea wall
	Palapetty Veliancode	10°43'58.00"N 75°56'42.89"E	Sea wall Poaching Collection of eggs
	Marakkadavu	10°46'25.35"N 75°55'04.32"E	Sea wall
Kozhikode	Chaliyam	11°09'19".17N 75°48'11".70E	Sea wall Human presence on the beach Trawling nets Collection of eggs
	Calicut - Puthi-yapa	11°15'34".80N 75°46'11".70E	Human presence on the beach Trawling nets Collection of eggs
	Kolavipalam	11°32'52".84N 75°35'46".66E	Sea wall Sand mining
Kannur	Meenkunnu – Chal	11°53'05".17N 75°20'25".65E	Casuarina plantation Collection of eggs
	Payyambalam	11°52'17".12N 75°21'04".70E	Sea wall Human disturbance from tourism Trawling nets
	Thottada Ezharakadap-puram	11°49'11".39N 75°25'05".28E	Casuarina plantation Sea wall Collection of eggs Trawling nets
	Muzhuppilan-gad	11°47'44".71N 75°26'32".36E	Human and vehicular disturbance Collection of eggs
Kasargod	Thaikkadap-puram	12°13'01.07"N 75°06'49.53"E	Sand mining Trawling nets

	Chittari	12°20'28.45"N 75°03'45.62"E	Collection of eggs Poaching
	Pallikkara	12°22'44.46"N 75°02'40.80"E	Human disturbance due to tourism Predation by dogs and jackals
	Kottikulam	12°24'39.14"N 75°01'19.35"E	-------
	Odath	12°25'28.23"N 75°00'41.78"E	Casuarina plantation Collection of eggs Beach sand mining Predation by dogs
	Chembarikka	12°27'03.18"N 74°59'54.30"E	Casuarina plantation Beach sand mining Rocky uneven beach Collection of eggs Trawling nets
	Kizhoor	12°28'11.08"N 74°59'25.34"E	Human disturbance due to fishing Beach sand mining Waste dumping Collection of eggs Poaching
	Mogral	12°33'08.09"N 74°57'15.10"E	Sea wall Collection of eggs Poaching Trawling nets Predation by dogs Increased disturbance from mechanized boats
	Peruvad	12°35'00.82"N 74°56'27.19"E	Trawling nets Collection of eggs
	Kumbala	12°35'00.82"N 74°56'27.19"E	Human presence on the beach Collection of eggs
	Shiriya	12°36'43.79"N 74°55'42.25"E	Beach sand mining Collection of eggs Trawling nets
	Uppala	12°40'08.09"N 74°54'15.10"E	Human presence on the beach Collection of eggs Trawling nets
	Manjeswaram	12°42'31.28"N 74°53'09.44"E	Trawling nets Sea wall Collection of eggs
	Thalappady	12°47'08.87"N 74°51'13.41"E	Casuarina plantation Beach sand mining Predation by dogs Trawling nets Increased disturbance from mechanized boats

IMPACTS OF COASTAL DEVELOPMENT

Plantation of Casuarina along Kerala coast

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Sea wall along Chellanam beach-Allepey

© DR. ANOOP BALAN / CMFRI-KOCHI

Sea wall along Kolavipalam area

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Out of the total length of 590 km of coastline of Kerala about 260 km is under varying degrees of erosion (Sreekala et aI., 1998). In order to combat this erosion, shore protection measures have been taken for the last 100 years. These shore protection structures made along the coast are broadly classified into three: (1) seawalls, (2) seawall & groynes assembly and (3) groynes. Accreted beaches are being developed into tourist destinations. Even though the dams constructed on the rivers do not come under the coastal zone, they have considerable influence on the sediment budget of the coastal zone. Sea walls, covering a considerably good extent of the coast, prevent the turtles from entering the beach for nesting. An informal view shared by a government official estimates that about 60-70% of the Kerala coastline already has sea walls. The rest of the length will also be walled in a short time because of the heavy lobbying of construction contractors for their own profits and also on the wide propaganda that sea walls protect the coasts from erosion and natural calamities like Tsunamis.

PORTS AND FISHING HARBOURS

One major port at Cochin, 14 minor ports, and several fishing harbours are situated along this coastal zone. Utilizing the dredged material from the shipping channel, the land area in the vicinity of the Cochin port has been considerably enlarged as noticed in Willington Island, Candle Island, Marine Drive and Vallarpadam. In addition to the ports mentioned above, a series of fishing harbours and fish landing centres have been established along this coast. These areas contribute to the decline in turtle nesting

through increasing human and vehicular disturbances. Adjacent to the ports, beaches are used for anchoring fishing boats which decrease the nesting area, and at times are complete obstruction to nesting turtles. Most of the industries of Kerala are situated in and around the coastal zone. In addition to this, the bulk of the State's wood and clay based industries, fish processing plants, boat building yards, and coir industries are situated along these harbours.

TOURISM

Kerala holds very high tourism potential and the coasts and beaches contribute to the potencial. The places with such potential include, Poovar, Kovalam, Shankhumukham, Varkala, Kappil, Papanasham, Cherai, Snehatheeram, Periyambalam, Chavakkad, Vallikunnu, Calicut, Payyoli, Mahe, Kannur, Payyambalam, Bakel, Muzhupilangad and Manjeswaram. New tourism projects are coming up in many beaches across Kerala, which includes heavy construction activities, increased human presence even at night, and lighting from various inland sources known to be unfavorable for turtles.

HOUSING DEVELOPMENT

Kerala is the most densely populated state in India with a population of 318 lakhs recorded in 2001. In this, about 30% live in the coastal zone. Due to this high density of population compared to the other parts of the state, the coastal zone has undergone substantial development. Out of the total 14 districts of the state, 7 district headquarters are located in the coastal zone. They are Kasargod, Cannanore, Calicut, Ernakulum, Allepey, Kollam and Thiruvananthapuram. All four Municipal Corporations - Calicut, Cochin, Kollam and Thiruvananthapuram and 19 Municipal Towns (including the district headquarters) are situated in this zone. Easy water transport and shipping facilities and availability of abundant water resources also attracted the industrial and other related development projects to this zone. In addition to the major reclamation works undertaken at the Cochin Port with dredged material, there are major governmental schemes for reclamation at Kattampally, Kayamkulam, Paravoor, Trichur, Ponnani and Korappuzha. Besides this, private agencies and individuals also have undertaken this activity all along the coast of Kerala. The high density of population in this zone has necessitated large-scale housing development in the coastal zone. Near the urban centers, the density of housing has reached such an alarming proportion that the people of the lower strata (mainly fisherman) even encroach the newly accreted beaches.

RECOMMENDATIONS

Kerala's turtle nesting habitats are on a serious decline from rapidly increasing human induced threats. This is a critical situation considering that the number of nesting turtles have also declined over the years, as evidenced from our survey and earlier studies. We recommend an urgent conservation action for the coastline of Kerala based on the guidelines detailed below:

1. Foremost of all, the coastline of Kerala needs to be monitored thoroughly to determine sea turtle nesting status. The extensive secondary information gathered in the current survey can be used for proper planning and monitoring of nesting activity. Existing NGO operations need to be strengthened; particularly those initiated by fishermen such as Theeram. It can help give an impetus to turtle conservation, and strengthen the need among communities for preservation of coastal resources in Kerala.

2. More effective and efficient awareness programmes addressing issues of consumption of meat and collection of eggs should be conducted targeting the fishermen, coastal community, local youth and students. This should be organized at the grassroots level as a local initiative. Also enforcement should be strengthened by capacity building of the Forest Department personnel on such subjects, more vigilance through patrolling and raids wherever necessary, as well as initiation and strengthening of local informants.

3. Turtle Excluder Device (TEDs) should be installed in all trawling nets on a compulsory basis by taking into confidence the fishermen cooperative societies/ trawl operators societies. In case of loss to fishing gear, proper compensation mechanism should be put in place by the Forest/Fisheries Department.

4. To reduce predation, local conservation groups should be initiated, and strengthened by giving proper technical, infrastructure and financial support to encourage various protection activities like patrolling of the beaches at night, and putting up hatcheries wherever required.

5. Coastal afforestation, if necessary, should be done with proper selection of the site to ensure that the entry and exit paths of turtles are not blocked or encroached upon and that nesting grounds are not lost. For beach sand mining, enforcement agencies like the Police, Marine Enforcement, Department of Mining and Geology should be more vigilant and violators should be booked under adequate provisions of the law and other measures like confiscation of vehicles should be implemented.

6. Sea walls should only be constructed wherever absolutely required. Also developing alternate technologies like geo-textiling should be considered for known turtle nesting beaches (Geo-textiling materials can be laid along the shoreline and growth of local grass species promoted to improve shoreline protection. This will ensure smooth entry for the turtles from the coastal waters onto the land and will also check erosion). Tourism development projects should be implemented on a controlled basis with proper EIA studies to ensure that no damage is done to the habitat and other inhabiting species. Coastal lightings towards the inland, be it coastal settlement or tourism, should be kept to the minimum. For known turtle nesting sites, human disturbance should be avoided to the maximum possible extent, especially at night during the turtle nesting seasons.

7. Polluting activities like waste dumping, opening drains and effluent disposal from industries should be controlled at all cost. Kovalam and Calicut beaches are classic examples of pollution due to open drains. An extreme case is the application of DDT in Thottappally beach in Allepey. Waste dumping in coastal areas is very common and was very visible during the survey in areas such as Odath – Kappil in Kasargod, Payyambalam in Kannur, Calicut beach, Ponnani in Malapuram, Chavakkad in Thrissur and Andhakaranazhi in Allepey.

8. Coastal Eco Development Committees (EDCs) should be initiated and all the above activities should be brought under their banner to ensure participatory and bottom-top approach so that the local people develop a sense of belongingness and attachment to save the marine turtles.

9. The Kerala Forests and Wildlife Department being the custodians of the entire wildlife as per the WPA should have a separate division for wildlife outside forests including marine turtles.

10. Proper coordination should be ensured between the various enforcement agencies including the Kerala Forests and Wildlife Department, Police, Coast Guard, Marine Enforcement, Mining and Geology.

ACKNOWLEDGEMENTS

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We would like to thank all the people along the Kerala Coast with whom we had some level of formal or informal interaction – fishermen, trawl operators, coastal communities, youth clubs, representatives of fishermen/trawl operators societies, representatives of local self government departments, enforcement personnel etc. We particularly thank Mr. Surendra Babu (and family) of the Theeram Prakruthi Samrakshana Samithi who kick started the community based turtle conservation efforts in Kerala and for sharing valuable information on the nesting status at Kolavipalam beach.

We would also like to place on record our heartfelt thanks and gratitude to Salam Usman, Mohammed Shafeeq, Arunjith P.S., Nature Club Members from MES College, Ponnani, Arif P., Mohammed Faisal, Nidhish, Nature Club Members from PSMO College, Thirurangadi and Lekshmi Nambiath, Amrita College of Engineering, Kollam who were volunteers in the survey along the coast. A special thanks goes to Mr. Maqbool T.K., Lecturer, Department of Zoology, MES College, and Ponnani for taking the lead in arranging the volunteers.

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MARINE TURTLE HABITATS AND NESTING STATUS IN KARNATAKA

Ravi Pandit and Rakesh Soans

BACKGROUND

Karnataka coast is a sporadic turtle nesting area and has been the least studied for assessing a complete nesting status among the Indian coastal states. The only nesting species recorded is the olive ridley (Kar and Bhaskar 1982), also reported in other studies. Madhyastha et al (1986) have observed only the sporadic nesting of olive ridleys along the Karnataka coast, and assessed their nesting density between Mangalore and Mukka area to be 0.75/km. A hatchery was established at Bengre near Mangalore and 2560 hatchlings were released in 1984 (Madhyastha et.al. 1986).

Bengre beach which has had a hatchery since 1984

Hatcheries were also initiated by the Karnataka Forest Department, and some media reports indicate 40 such hatcheries established all along the Karnataka coast in 1894. A century after the first hatcheries were established, a study by Frazier (1989) could confirm only three located at Bengre, Trasi and Jali. From these, a total of 15,000 hatchlings were released into sea (Appayya 1985). Currently, hatcheries at Jali and Trasi are functional.

An old hatchery still in existence at Trasi.

Nearly two and half decades later, the Karnataka coast was surveyed under the GOI-UNDP sea turtle project (2000-2001), out of which 40 nesting locations were identified across three districts-Dakshina Kannada, Udupi and Uttara Kannada (B.K. Sharath, 2003). The overall nesting density for Dakshina Kannada and Udupi districts was assessed and found to be 0.25/km/survey. For Uttara Kannada district, it was 0.33 nests/km/survey. Another research study (2000-2002) identified four new nesting locations along the Karwar coast, and confirmed the nesting of olive ridley on the Devbag beach area (Kurian 2002). The study also recorded sale of turtle eggs in the Karwar market. 664 eggs were purchased and relocated into a hatchery set up on the Devbag beach, supported by the Forest Department. Studies on incubation, hatchling behavior and feeding patterns were thereby carried out (Kurian 2002, Kurian and Nayak 2003). Records of green turtles occurring in the Karnataka waters has been pointed out in a study by Richardson (2008), where Nethrani and Hog islands in the Uttara Kannada area were observed to be feeding grounds of green turtles that nested on Srilankan beaches.

Olive ridley nesting in Devbag beach-Karwar

© ANNIE KURIAN

Juvenile green turtle at the Gangavali Hatchery.

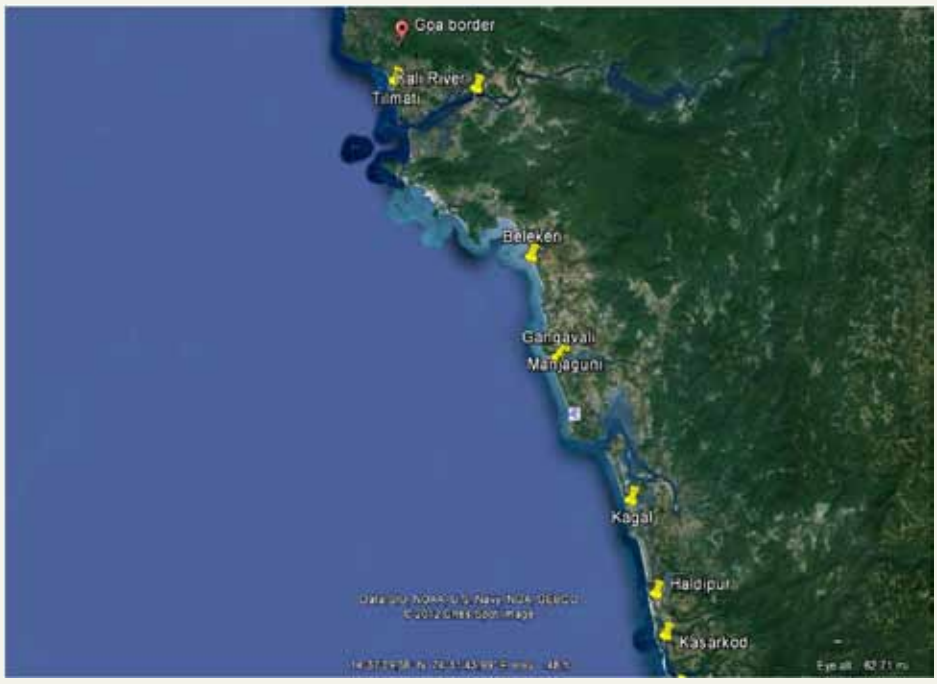
© RAVI PANDIT

On account of the prevailing threats to turtles, particularly from trade in markets and predation of eggs by the local communities, various other surveys and resultant hatchery programs have followed along the Karnataka coast. A hatchery was established in 2003 along Kodibag beach of Karwar (Kurian 2008), a hatchery established in 2004 near the Gangavali estuary by the Heereguthi forest division has released 2500 hatchlings till 2006 (Records of Udar 2006-Heeregutti Forest division and, Kurian 2008). FSL India (Field Services and Intercultural Learning)started turtle conservation efforts in 2005, and monitors certain beach stretches regularly, 60 km north of Coondapur in the Udupi district (McCann 2007)-a good number of hatchling released from these efforts continues to date. CGA (Canara Green Academy) also started their turtle conservation efforts in 2005 (Bhat 2007) in the Honnavar area and have established three hatcheries (the Heereguthi Forest hatchery is now part of CGA operations), which has released over 5000 hatchlings to date. (Records of Canara Green Academy 2011)

STATUS AND LOCATION OF NESTING BEACHES

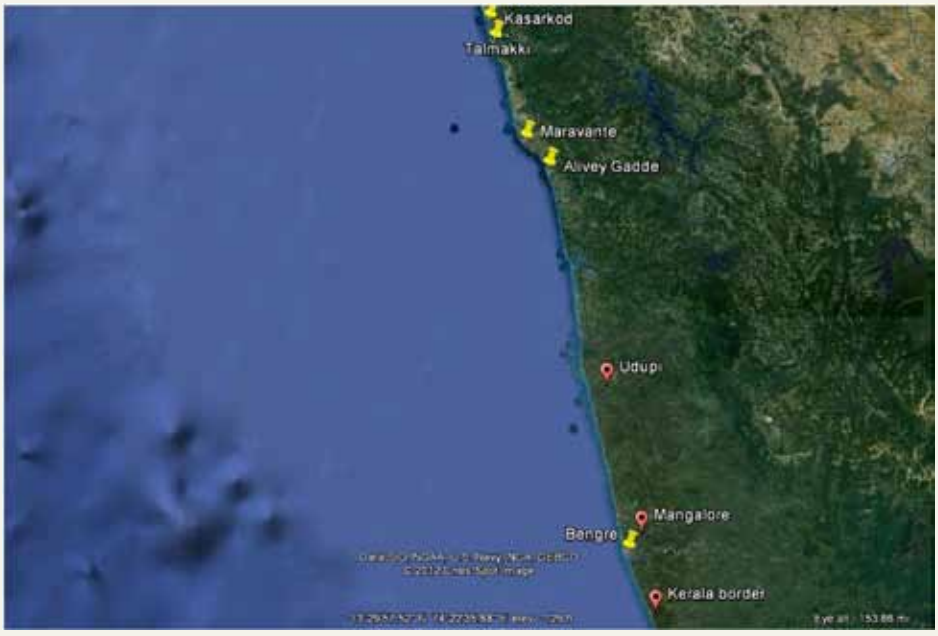
Karnataka has a coastal length of 260 km which falls under three districts, the Uttara Kannada district, which is the northern part of the stretch, sharing its boundary with Goa, the Dakshina Kannada district which is the southern part and borders Kerala, the Udupi district is the central part flanked by the Uttara Kannada and Dakshina Kannada districts. Surveys were carried out in all three districts, and based on primary and secondary sources of information, the following important nesting habitats have been marked in two sections of the map given.

**FIGURE 1.
NESTING HABITATS
ALONG THE UTTARA
KANNADA DISTRICT**



Areas marked in yellow are sites frequented by olive ridley turtles.

**FIGURE 2.
UDUPI AND
DAKSHINA
KANNADA DISTRICTS**



Areas marked in yellow are sites frequented by olive ridley turtles.

TABLE 1. POTENTIAL NESTING SITES WITH NEW NESTING AREAS LISTED

S. No	Name of nesting the beach	Beach Type	Co-ordinates
Uttara Kannada District			
1	Tilmati*	Small Black sand	N14.90019 E74.09111
2	Devbag	Long sandy beach.	N14.84525 E74.11454
3	Amdalli (S)	Sandy	N14.75938 E74.17922
4	Belekeri*	Long sandy beach	N14.70572 E74.26435
5	Kini*	Sandy	N14.70579 E74.26435
6	Manjaguni*	Sandy	N14.60259 E74.29021
7	Gangavali	Sandy	N14.59030 E74.29435
8	Kagal*	Sandy	N14.49140 E74.36355
9	Dhareshwara*	Sandy	N14.37469 E74.40492
10	Haldipur*	Sandy	N14.34576 E74.43485
11	Kasarkod*	Sandy	N14.26028 E74.43256
12	Talmakki*	Sandy	N14.12745 E74.48281
13	Bailoor*	Sandy	N14.05862 E74.49700
14	Bengre (Bhatkal)	Sandy	N14.05865 E74.49699
Udupi District			
15	Alivegadde*	Sandy	N13.92608 E74.58227
16	Someshwara (N)	Sandy	N13.87360 E74.60198
17	Alwekodi*	Sandy	N13.86451 E74.60812
18	Tarapati (paduvari)	Sandy	N13.84547 E74.61314
19	Kiremanjeshwara	Sandy	N13.76822 E74.63120
20	Navunda	Sandy	N13.75813 E74.63326
21	Maravante	Sandy	N13.72017 E74.64011
22	Trasi	Sandy, Narrow Beach	N13.69360 E74.64440

23	Belehitlu (Bijadi)	Sandy	N13.58609 E74.67594
24	Tekkatte	Sandy	N13.58592 E74.67626
25	Malpe	Northern part is sandy	N13.36510 E74.69731
26	Padubidre	Sandy	N13.11903 E74.76505
27	Hejmadi	Sandy	N13.11901 E74.76505
Dakshina Kannada District			
28	TannirBavi	Sandy	N12.89985 E74.81267
29	Bengre	Sandy	N12.88102 E74.81635
30	Bengre	Sandy	N12.88101 E74.81635
31	Bengre	Sandy	N12.84769 E74.82694
32	Someshwara	Sandy	N12.81474 E74.84004
33	Talappadi	Sandy	N12.76057 E74.86390

**New Nesting Areas*

Beaches in Table 1 show 32 suitable nesting sites identified from a survey of 44 sites located along the entire Karnataka coast. The remaining sites were under pressure from developmental activities such as cosntruction of sea walls and beach roads, or were rocky shores and narrow beaches, hence have not been listed here. In the suitable nesting sites listed, surveys showed that on the northern part of the Karnataka coast, Casuarina (*Casuarina littorea*), Coconut (*Cocos nucifera*), Pandanus, Calotrophis, Agnimantha (*Premna integrifolia*) were predominant. The southern part was dominated by Palmyra (*Borassus flabellifer)*, Casuarina, *Premna integrifolia* and *Cocos nucifera*. Mangrove species such as *Exocaria agallocha* and *Brugeria cylindrica* are seen at the river mouths in Udupi district.

METHODOLOGY

The current nesting survey was carried out by Canara Green Academy (CGA) and Field Services and Intercultural Learning (FSL India) at Uttara Kannada and Udupi districts respectively, CGA has been carrying out nest relocation activities in few locations of the Honavar area since 2005, and FSL-India has been monitoring nests along a 60 km stretch north of Coondapur. Nesting season along the Karnataka coast ranges between September to April.

NEST MONITORING

In Udupi district, FSL-India monitors turtle nesting along a 60 km stretch from Udupi to Bhatkal, located north of Coondapur. When nesting season is underway, volunteers set up 12 information centres, each located at a distance of 5 km, and hatcheries are simultaneously set up at strategic nesting locations. These temporary structures

provide all information on turtles, conservation practices, and a contact number of an FSL member in charge of the area. When nests are sighted by an informant of the area, the information is communicated to the FSL member, who then relocates the nest to the hatchery. Surveys are carried out on a fortnightly basis by the informants trained and assigned for the job. In the Honavar stretch of Uttara Kannada area, CGA supports three hatcheries and works with local community and Forest Department in monitoring and relocating nests.

BEACH SURVEY

As part of the current nesting status survey (2011-2012), CGA has visited most major beaches of Karnataka, and secondary information collected through interviews with various coastal people and groups. This was done to gain more information on nesting habitats, status and threats. Meetings for interviews were not arranged, but local gatherings in coastal villages and beaches were made use of. These interviews were conducted through pre-prepared questionnaires, the sample and results of which are provided in Table 2. These beach visits and interviews were conducted between April and June 2011. Beaches that have not been covered include Om and Kudle beaches near Gokarna, Belambara beach in Ankola, and beaches lying between Maravante and Coondapur areas.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

UTTARA KANNDA DISTRICT

Uttara Kannada district has a coastal length of 140 km stretching between the state of Goa in the north and Udupi district in the south. The nesting species here is the olive ridley. The areas from where nests are relocated lie between Ankola and Bhatkal taluks, which is a distance of 101 km. Three hatcheries have been set up along this stretch by CGA, which includes the hatchery once operated by the Heereguthi Forest Department. Nests retrieved from Manjaguni, Gangavali, Kagal, Baada, Kadle, Dhareshwara, Haldipur, Kasarkod, Apsarakonda, Talmakki, Bailoor, Bengre and Jali are relocated into these hatcheries; this activity is carried out with the help of local fishing communities and the Forest Department of Ankola and Honnavar divisions.

TABLE 2. NESTS RELOCATED INTO HATCHERIES FROM UTTARA KANNADA DISTRICT (2007-2011)

			No of Nests Recorded							
S. No	**District**	**Year**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mrch**	**Total**
1	Uttara Kannada	2007-08	-	-	5	16	25	9	9	64
2		2008-09	-	5	2	7	14	7	3	48
3		2009-10	2	3	8	6	4	1	1	25
4		2010-11	-	4	6	10	6	5	8	49

(Source: CGA, and Forest department of Honnavar)

The data given in table 3 are nesting records maintained from the years 2007 to 2011. The current nesting data for the years 2007-2011 in Uttara Kannada show a declining trend for turtle nesting in the region. The nesting density for the year 2007-2008 was 0.63 nests/km. For the year 2008-2009, it is 0.475, which is lower than the previous year. Nesting for the year 2009-2010 showed a density of 0.25 nests/km, and for the year 2010-2011 showed 0.485 nests/km stretch. However, since the places surveyed make a total length of 101 km only, do not cover the entire Uttara Kannada region; and as specific distances of nests recovery cannot be ascertained as seen in Sharath (2006), the data therefore cannot indicate the complete nesting status.

UDUPI DISTRICT

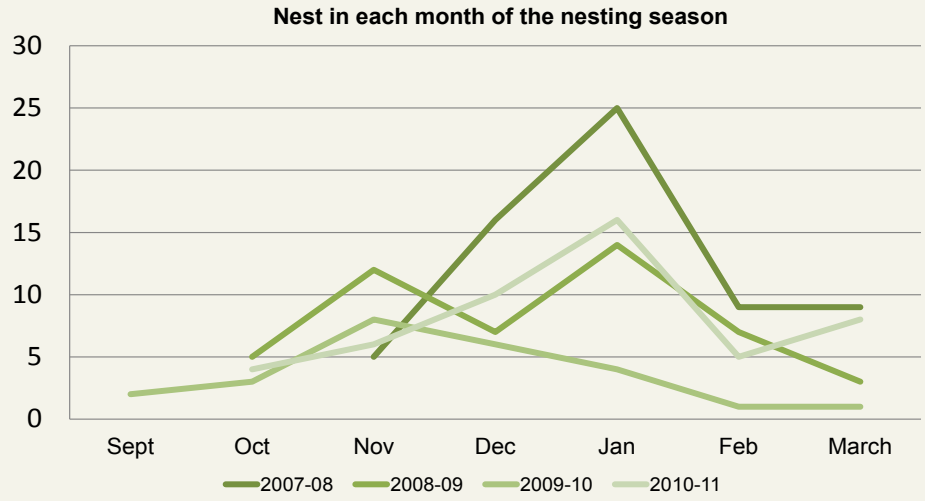
Udupi is located between the Uttara Kannada and Dakshina Kannada districts with a coastline of 98 km. The FSL-India team monitors 60 kms of this stretch lying north of Coondapur. The nesting species found here is the olive ridley. The nesting beaches falling under this stretch are Navunda, Maravante, Kanchugodu, Kodi, Bijadi, Kota and Malpe. Reports of McCann (2007) show nests also recorded by FSL from Koravadi, Maravanthe, and Navunda beaches of the Coondapur area, which at the time were observed to be most frequently visited nesting sites for the region.

TABLE 3. TURTLE NESTING STATUS IN UDUPI DISTRICT (FSL-INDIA: 2007-2012)

S. No	Area: Udupi-Bhatkal					
1.	Year	2007-2008	2008-2009	2009-2010	2010 - 2011	2011 - 2012
2	Distance Surveyed in Kms	60	60	60	60	60
3	Total Nests Recorded	13	12	16	12	8

The nesting trend from 2007 to 2012 shows a decline in nesting numbers, starting from a nesting density of 0.21 nests/km in 2007-2008 and reaching a low of 0.133 nests/km in the current year 2011-2012. However, as this does not include the remaining 38 kms of the coast, the figures here cannot represent the absolute nesting density in Udupi district. The 8 nests recovered in the current year had a total of 942 eggs, where the average clutch size was 117.7 eggs. Out of this, 720 hatchlings were successfully released the sea.

FIGURE 3. MONTHLY STATUS OF NESTS IN THE UTTARA KANNADA AND UDUPI HATCHERIES



Source: CGA, FSL-India, and Forest Department

Data collected indicates November-January as peak season of nesting, as maximum no of nests have been recovered during these months. The graph above also indicates a sample pattern for the nesting season in Karnataka, which commences from September (a period when the monsoons are coming to an end) and the season gradually coming to an end in March, a couple of months before the monsoon begins.

COMMUNITY OBSERVATIONS OF TURTLE NESTING

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A Hawksbill rescued from Alwekodi-Uttara Kannada

In the current survey, secondary information from interviews with fisher folk has confirmed the nesting of olive ridley turtles along the Karnataka coast. The decline of sea turtle nesting over the years has been indicated by majority of the interviewees. One of the major reasons is mechanized boating and use of gillnets in fishing. Most of them observe that traditional fishing practices are not the cause for turtle mortality offshore. During the entire survey, only one dead turtle was recorded from Alwekodi beach (N13.86308 E74.60809) of Udupi district.

On nesting and offshore occurrences of sea turtles, two individuals have revealed the nesting of a large sized turtle without carapace about three to four decades back. The description most likely indicates a leatherback turtle. Apart from olive ridley, fishermen have also encountered offshore, the hawksbill and green turtles. But many of the coastal inhabitants have never gone into sea and hence unaware about turtles offshore. The occurrence of both the species in water has been confirmed directly, in the current study by Canara Green Academy. Nesting density as observed by the fisher people, can range between 1 and 10 per season approximately, for a 3 km stretch of beach. But some beaches like the Manjaguni in Ankola taluk, Haldipur in Honavar, Tannirbavi and Bengre in Mangalore, have been observed to have more than 10 nestings per season.

TABLE 4. RESULTS OF INTERVIEW WITH FISHERS, FOREST DEPARTMENT AND NGOS

Questionnaire	UK (N-51) %	Udupi (N-38) %	M'lore (N-12) %	Total (N-101) %
Olive Ridley Nesting	94. 12	81. 58	75	87 .13
Beaches with less than 10 nesting/season	80	95	78	86. 37
Beaches with more than 10 nesting/season	20	5	22	13. 63
Decline in nesting over the years	64. 71	71. 05	91. 67	70. 30
Mortalities -Mechanized and Gill net fishing	98. 04	89. 47	100	95. 05
Traditional fishing	NA	NA	NA	-
Poaching for Eggs	82. 35	78.95	83. 33	81. 19
Poaching for Meat	50. 98	21. 05	66. 67	41. 58

Turtles seen Offshore				
Olive Ridley	98. 04	89. 47	100	95. 05
Green Turtle	41. 18	31. 58	41. 67	37. 62
Hawksbill	23. 53	7. 89	NA	14. 85
Leatherback	NA	5. 26	NA	1. 98
Don't Know	NA	10. 53	NA	-
Participation By Stake holders				
KFD	20	NA	NA	-6.82
NGO	NA	25	NA	11.6
Locals	NA	NA	NA	-
NGO and KFD	20	NA	NA	6.82
NGO, KFD and Locals together	33. 33	10	NA	15.91
None	26. 67	65	100	59.09

N = total no of people interviewed; % = percentage of responses for the particular question; NA= not aware or no information available

Noticeable turtle conservation efforts are mostly seen in parts of Uttara Kannada and Udupi districts. These efforts are mainly carried out with the involvement of NGOs, local communities and Forest Department. However, in Dakshina Kannada/ Mangalore district, no conservation activity has been reported. The involvement of the stake holders is found to be greater in Uttara Kannada district 33.33% and 10% for the beaches in Coondapur of Udupi district. Even with existing conservation activities in the area, interviewees have revealed poaching of eggs, as this is preferred to meat of turtle. This has been confirmed by NGOs including Canara Green Academy, who are involved in the purchase of eggs from sellers for relocation into hatcheries.

THREATS

NESTING BEACHES

Seawalls are built on most parts of the coast due to large scale erosion. Sea erosion is more commonly seen in southern part of Karnataka compared to Northern part. Southern part of the wall is more continuous than the northern part, and is ranging between few meters to few kilometers. Earlier studies by Sharath (2006) observe that sea walls along the coast do not leave much nesting habitat for turtles. Therefore, it is important to identify all sporadic nesting sites and develop a mechanism by which these nests can be saved from predation.

Olive ridley carcass on beach

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INCIDENTAL CATCH

Fishing is the main activity of most villages along the Karnataka coast except in Kiremanjeshwara and Navunda areas in Coondapur. The boats used for fishing comprises the traditional, purse seine and also medium range trawlers which are mostly used for deep sea fishing. Compared

Traditional boats (pati doni) in Amdalli-Northern Karnataka Coast

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to Dakshina Kannada and Udupi districts, traditional boats (locally called pati doni) are found more commonly in the Uttara Kannada region; fishing activity in the area is much less compared to Udupi and Dakshina Kannada areas. Hence, waters in this region are also found less disturbed. Many fishery related activities like ice plants, fish processing industries are seen all along the coast of Karnataka.

Sea turtle mortality

During the survey, majority of interviewees revealed that use of mechanized boat sand gill nets in fishing activities has increased the offshore mortality of sea turtles. Rajgopalan et al (1996) recorded fishery related mortality of sea turtles along the Karnataka coast which, though minimal, is still prevalent as indicated by the olive ridley and hawksbill carapaces. Sharath (2006) encountered carapaces and skulls of olive ridley turtles along the coast of Dakshina Kannada District. Hawksbill carapaces were also found in the houses of several fishers.

In the current year, along the Udupi Coast (2011-2012), eight dead turtles and six that were severely injured were found by the FSL team. The injured turtles were rescued, treated and later released back to sea. The cause of injuries was identified to be strangulation in nets, and contact with boat propellers. The Honavar Forest Division encountered 3 injured olive ridley turtles and two green turtles. They were treated in temporary rehabilitation centers at Kaikini village in Bhatkal of the Honavar division. Experiences of KFD (Karnataka Forest Department) officials and NGO volunteers reveal more number of injured turtles being received in rehabilitation centers during monsoon. Reasons are unknown as fishing is banned during the rainy season, which lasts for 3 months.

EXPLOITATION FOR MEAT AND EGGS

In the current study there were reports of poaching of turtles for meat and eggs by the coastal villagers. Egg Poaching is common in most villages except in Haldipur, Apsarakonda, Dhareshwara and Talmakki of the Uttara Kannada district, and Maravante and Trasi in Udupi district. Apart from consumption needs, eggs are not used for any other purpose. Poaching of eggs has however decreased in Coondapur and Honavar Forest Divisions, on account of conservation efforts by the forest department and non- governmental organisations. Other areas

Beach shacks with awareness posters in Maravante beach

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that were found lacking in conservation efforts, continued to report harvesting of eggs for supplementary income or food. On an average they profit Rs 5 per egg. Due to religious sentiments and awareness about the Indian Wild Life Laws, killing of sea turtles has reduced. However, poaching of eggs continues to be a threat to turtles.

IMPACTS FROM COASTAL DEVELOPMENT


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Sea wall along the coast: a feature seen increasingly along the Karnataka coast


© ANNIE KURIAN

Sand mining in the Kodibag estuary area, Karwar


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Increasing developmental activities along the Malpe coast


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Motorised boats in Alwekodi (Coondapur) towards southern Karnataka coast

Sea erosion, sea wall construction, sand mining, harboring of boats on the beaches, construction of village roads, encroachment of beach areas for habitation and development, development of tourism and illumination on the beaches are the major causes of habitat loss in Karnataka. The national highway NH17 runs all along the coast of Karnataka. However, this runs closer to the beaches in Karwar and between Maravante and Trasi in Coondapur, which can be a disturbance to nesting turtles. Village roads being constructed and developed on the beach side is also an alarming development. They are visible along Amdalli, Keni, Haldipur, Talmakki, Bailoor, Bengre, Jali in Uttara Kannada District, Alivegadde, Kelapete Shiroor, Alwekodi, Tarapati, Madikal, Maravante, Trasi, Kodikanya, Malpe in Udupi district and Tannir Bavi, Bengre and Talappadi in Dakshina Kannada district. Although the year of construction varies, from mere observation it implies that these roads could be around 10 years old. Increasing importance to tourism in Karnataka, and development of tourist spots on the beaches have led to the erection of sodium vapour and halogen lamps. This artificial illumination

with other development based disturbances from tourism could pose a greater threat to nesting turtles and emerging hatchlings in future.

CONSERVATION THROUGH COMMUNITY TRADITIONS AND NGO's

Turtles are considered sacred and are revered by local communities throughout Uttara Kannada district. Certain sects are even refrained from any physical contact with turtles. Fishermen who encounter them at sea, would damage their nets to release the trapped turtle. Reverence of turtles is also seen among people in Dakshina Kannada and Udupi districts.

Another interesting aspect shows that fishermen communities, such as the Kharvis of Apsarakonda (Uttara Kannada) area, have banned all activities found detrimental to sea turtles. A community court penalizes the guilty up to Rs. 5000. It includes people who harm turtles or poach its eggs. As a result of these actions and beliefs, majority of the coastal people do not poach turtles. Although this practice has been prevalent for the last 10 years, it was found ineffective, as the adjacent villages were engaged in poaching. It indicates that a mere ban or punishment cannot help conservation in the long term, but has to be accompanied with local involvement in turtle conservation.

At places like Honnavar and Coondapur areas, FSL-India and CGA are engaged in turtle conservation efforts. In the initial years of work, eggs were purchased from the sellers and relocated into hatcheries for conservation. Later CGA evolved a unique method of involving poachers in conservation. A meeting of poachers (now informants) and Forest Department was conducted to discuss the strategy for conservation. Honorariums for the informants were fixed by the people in the meeting. This strategy has helped to avoid the purchase of eggs and reducing its consumption by the local communities.

RECOMMENDATIONS

1. Karnataka coast remains poorly researched for complete nesting status, despite all studies carried out so far. However, future efforts can make use of the existing data pool of nesting status and habitat distribution for planning extensive and thorough nesting status surveys along Karnataka coast. A database on nesting details for Karnataka coast should be maintained jointly with local communities.
2. Moving of eggs from their initial location should be avoided to maintain the optimal natural sex-ratio and incubation success rate. But as most egg predation appears to occur as a result of human activity excavating turtle nests, for sale or personal consumption, protecting the eggs in situ for two weeks after deposition and then relocating would help embryonic development of eggs as well deter egg poaching.
3. Community involvement in turtle conservation ensures sustainability of conservation activity initiated. Hence, all efforts to involve local communities in turtle conservation must be emphasized and supported at the same time. One such avenue that can be considered is ecotourism which can enable active community participation and support long term conservation of turtles.
4. Sea walls and Casuarina plantations have not proved to be effective solutions to prevent erosion, but on the other hand, causes reduced productivity and bio-diversity as a by-product. At the least, a protocol which prescribes the planting of Casuarina at a minimum distance from the mean high water mark is necessary. Green wall concept for stabilization of beaches has been introduced from 2010-

11 in some parts of Karnataka by the Forest Department. This should be studied for its effectiveness, and only then replicated. Ideally, the progressive replanting of coastal areas with native plants that minimise natural states in succession should be adopted.

5. Integration of local bodies (panchayat), Port Authorities, CRZ authorities and the local territorial forest officials has to be established for planning coastal development activities. Conservation and protection of biodiversity is the main responsibility of the Forest Department, and they should be taken in to confidence in planning coastal development. Every department works in isolation, which does not help the conservation of sea turtles.
6. Beach management and biodiversity conservation needs to be prioritized by the local governing body and an action plan prepared accordingly. Equal importance has to be given to individual stretches of beaches as well as action plan for beach management, with equal importance to individual beach stretches. NGOs, Forest Department, local fishing communities have to be involved in the action plan process.
7. Karnataka Forest Department major stakeholder in turtle conservation should extend conservation efforts to other parts of the state as well. In view of the rising threats from development, hatcheries should be established at strategic locations on beaches and permanent rehabilitation centers are to be established to treat the injured turtles.
8. Long term conservation and management of turtles and its habitat in coastal Karnataka depends on the involvement of local fisher folk, volunteers from NGOs and KFD officials. Intensive education and awareness activity needs to be conducted. Beach patrolling by the KFD and NGOs is also required for monitoring of beaches during nesting season. This helps in reducing egg poaching, poaching of turtle form eat and encroachment of beaches.
9. Community awareness programs that incorporate local youth groups, school and college students are perhaps the most interactive and effective means of introducing conservation values into the forefront of social consciousness. Government should recognize the contribution of community and appropriate program and funding should be made available.
10. NGOs who work with local fishing communities, and conservation of turtles need to network and build concerted efforts to train and spread conservation awareness among local communities. A forum for such interactions needs to be promoted and strengthened at a regional level. Karnataka Forest Department should be part of the Village Forest Committees/Joint Forest Management committees already established in coastal regions.
11. Conferences and annual workshops can be conducted with the aim of sharing information and providing opportunities for participation and education. These meetings should also allow NGOs, governmental departments and stakeholder groups the opportunity to voice concerns and deliver progress reports concerning the state of conservation efforts in their local areas.

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SEA TURTLE NESTING STATUS IN GOA

Sujeeth Kumar Dongre

BACKGROUND

Goa has the smallest coastal length of just 120 kms, among all the coastal states in India. However, this state records one of the earliest community based initiatives in sea turtle conservation, next to Kerala. The main nesting species here is the olive ridley. Sporadic nesting of olive ridley and leatherback turtles has been recorded all along the coast of Goa (Bhaskar, 1984, Das, 1985) but recent nesting records are only of olive ridleys (Giri and Chaturvedi, 2001). Of the 120 km coastline, about 8 km in Goa have been identified as major nesting sites and are being protected by the Goa Forest Department. These sites are Morjim in north Goa, and Galgibaga and Agonda in south Goa. Nesting takes place between October and March each year (Dongre and Shambhu 2008, Giri. V, 2001).

In fact the coastal population has taken a suo moto cognisance of the turtles' annually recurring nesting behavior and hatching success, and had initiated small scale conservation efforts in areas such as Morjim, Mandrem in North Goa and Galgibaga and Agonda in South Goa districts. The first was initiated in Morjim in 1995-96 by retired army officer Captain Gerald Fernandes, when he began an informal awareness and education campaign (Kutty 2006). This was to help the unemployed fisher folk whose fish catch was seriously declining. Interestingly, a number of religious leaders also extended their full support by mobilising the support of their followers. Rev. Fr. Mariono of Galgibaga initiated education and awareness programme among the locals of Galgibaga and Agonda since the year 1998. He informed the local youth that whoever finds turtle nests and protects them will be rewarded. These initiatives created greater impact on the locals to start turtle conservation.

Realizing that community participation is important for the success of conservation efforts, the Goa Forest Department has involved local communities at these nesting sites, and has worked with them for the protection of sea turtles since 1997 (Dongre and Shambhu 2008). Locals are appointed as volunteers to protect turtle nests and tens of hundreds of hatchlings are released into the sea every year (Dongre and Shambhu 2008).

Morjim beach: An important nesting and conservation site

Beaches like Morjim in North Goa, Agonda and Galgibaga in South Goa are less disturbed and unpopulated (Giri et al 2003). Apart from these nesting sites, there are a few other nesting beaches in Goa where there were recent reports of sea turtle nesting. Giri and Chaturvedi (2002)as part of the turtle monitoring project of UNDP, categorised the beaches of Goa into three according to their suitability for turtle nesting, taking into consideration beach profile, disturbance and fresh nesting reports in the year 2001. Beaches like Querim (Keri), Morjim, Velsao, Betalbatim, Colva, Benaulim, Betul, Agonda, Talpona, Galgibaga are categorised as high potential areas whereas Arambol, Mandrem, Ashwem, Siridao, Agassaim, Arossim, Utorda, Majorda, Varca, Cavelosim,

Mobor, Palolem are medium potential areas and Calangute, Candolim, Sinquerim, Canaguinim are low potential nesting areas.

STATUS AND LOCATION OF NESTING BEACHES

A list of five beaches in Goa, identified to be the most potential nesting sites, is given in the map below. These are Mandrem, Ashvem, Morjim, Agonda and Galgibaga. The other potential beaches are Kerim, Harmal, Ashvem, Morjim Anjuna, Calangute, Kegdeveler, Siridao, Bogmalo, Utorda, Arrorim, Betul, Talpona and Polem. The listing is based on comparative studies from earlier survey information and the current one.

FIGURE 1. POTENTIAL NESTING BEACHES LOCATED ALONG NORTH AND SOUTH OF THE GOAN COAST

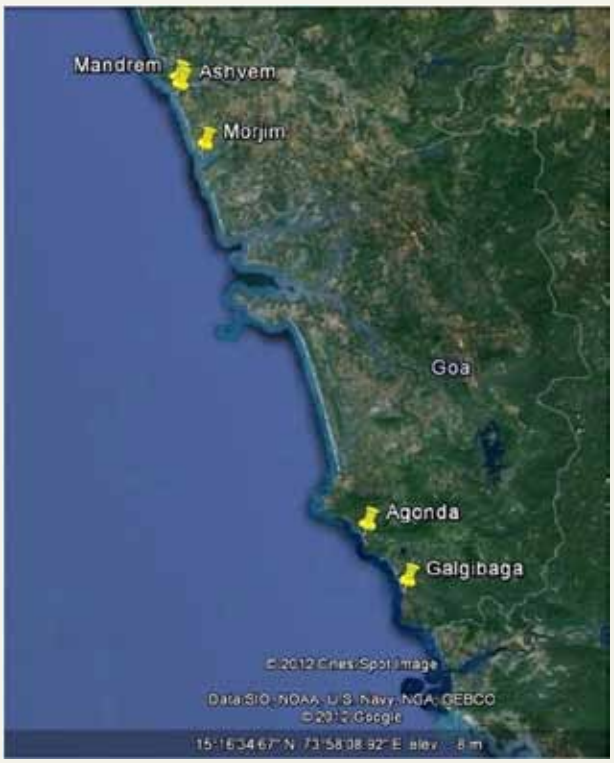

TABLE 1. CO-ORDINATES OF THE MAIN NESTING BEACHES OF GOA

Sr.No	Nesting beach	Co-ordinates
	Mandrem	N 15” 38’ 57. 25’ E 73° 42 55.0.4’
	Ashvem	N 15” 38’ 47. 39’ E 78° 43’ 00.17’
	Morjim	N 15” 36’ 53. 25’ E 73”44’ 9. 34’
	Agonda	N 15” 02’ 24. 04 E 73” 59’ 16. 66’
	Galgibaga	N 14” 57’ 32. 07 E 74” 02’ 56. 64’

METHODOLOGY

The coastline of Goa is characterized by continuous stretches of sandy beaches, occasionally interrupted by rocky promontories or headlands which protrude as far as 2 - 3 km into the sea (Mascarenhas. A 1998). Of the total 120 kms of the shore line, about 65 km are sandy beaches, which are suitable for turtle nesting (Giri.

V et al 2003). Taking this into consideration findings of beach characterization, and from personal observations, beaches like Keri, Arambol, Mandrem, Ashvem, Mandrem, Mobor, Kavellossim, Majorda, Colva, Varca, Betalbatim, Agonda, Talpona and Galgibaga were considered for the monitoring during the project period from December 2010 to March 2011

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

Interviews with local fishermen, turtle volunteers and other stakeholders revealed that beaches of Keri, Arambol, Ashvem in the north and Mobor, Kavellossim, Colva, Majorda, Varca, Betalbatim in south Goa were potential nesting habitats in the past. However, for the last decade, nesting numbers have reduced. Some of the reasons could be change in morphology and ecology of the beach due to unplanned tourism activities, and destruction of sand dune vegetation and light pollution along the shoreline. Most of the shoreline is under threat of erosive processes as evidenced by eroded berms and uprooted trees. The Cansaulim - Arossim part, consisted of very prominent 6 to 8 m high vegetated sand dunes, many of which have been levelled (Mascarenhas. A 1998). Last three years have been characterized by erratic precipitation of south west monsoon.

A decadal analysis of data collected from various stakeholders and personal observations show a drastic decline of sea turtle populations along these historic nesting sites in Goa.

TABLE 2. COMPARITIVE NESTING ACCOUNTS OF SIGNIFICANT NESTING LOCATIONS IN GOA

Name of the beach	Beach Distance (kms)	Year	No. of Nests	Nesting Density (nests/km)
Morjim	3	2000-01	31	10.33
		2010-11	3	1
Agonda	3	2002-03	15	5
		2010-11	6	2
Galgibaga	1.5	2000-01	33	22
		2010-11	10	6.66

(Source: Forest Department and stakeholders)

MORJIM

The beaches of Temb Vaddo and Vithal Das Vaddo of Morjim in north Goa stretching upto 3 kms is a sandy and porous substratum having a good fringe vegetation. The river Chapora shows a confluence with the Arabian Sea. While excessive and unplanned tourism activities need to be controlled, locals can earn their livelihoods while protecting sea turtle nesting habitats (Dongre and Shambhu 2008). The sea turtle conservation efforts of the local volunteers appointed by the Goa Forest Department are showing great interest. In order to come up with a suitable strategy, members of the local Panchayat were consulted and a meeting held with other stakeholders, the Centre for Environment Education (CEE) Goa, and forest officials (Dongre and Shambhu 2008). In the last three years, incidences of juvenile green turtles *(Chelonia mydas)* caught in the fishing nets and washed ashore were observed

and recorded. The volunteers on Morjim beach located these turtles, and reported to the Goa Forest Department. Records maintained by the Goa Forest Department have shown that for the years 2000-2011, there has been a decline in nestings of olive ridleys from 31 to 3 nests, and nesting density of 10.33 to 1 nest/km stretch respectively.

AGONDA

This beach in the southern coastal stretch of the state attracting turtles and tourists alike. The length of the beach is approximately 3 km comprising typical sandy substrate and vegetation. Talpona River empties into the Arabian Sea imparting an estuarine character to this water mass. Despite the fluctuating number of shoring turtles, there are nestlings recorded annually. The Goa Forest Department continuously monitors the nesting on these beaches and their data revealed that sea turtles nest on this beach every year. 2011 recorded 6 turtle nests on this beach where the nesting density is 2 nests/km stretch, which is a decline from 15 nests recorded in 2002-2003 with a nesting density of 5 nests/km stretch.

GALGIBAGA

Galgibaga sea turtle hatchery

This is the southernmost location of nesting range with a poor density. It is a fairly undulating shoreline with sparse vegetation and witnesses the nesting of turtles in the breeding season. The confluence of river Galgibaga with Arabian sea is witnessed here. The perusal of records show, though generally declining, nesting is fairly steady here. Besides the four locations mentioned above, the other coastal stretches also witness the sporadic nesting of sea turtles. They are Mobor, Kavellossim, Colva, Majorda, Varca and Betalbatim. These areas are predominantly fishing villages of south Goa and hence may invite inter sectoral conflicts with turtle nesting and conservation efforts. Nevertheless, monitoring and surveillance during the nesting season is regularly carried out. The year 2011 recorded 10 nests of olive ridley turtles and the nesting density is 6.66 nests/km stretch, whereas the years 2000-2001 showed 33 nests for 1.5 km beach stretch with a nesting density of 22 nests/km stretch.

MANDREM

Discussion with the turtle volunteers of Morjim revealed that a stretch of 2 km sandy beach of Mandrem offers a continuum of nesting habitat for the turtles, though sporadic. Mr. Rajan Halankar, a dedicated volunteer of the Goa Forest Department has observed, though data not maintained, that on an average, annually 2 or 3 gravid sea turtles visit the beach. The impediments to nesting and conservation are not very different from Morjim. Two more beaches in the extreme north namely Arambol and Keri are also sporadic nesting sites of olive ridleys.

TABLE 3. STAKE HOLDER INTERVIEW AND AWARENESS EFFORTS BY CEE ALONG THE COAST OF GOA

Beaches Morjim, Agonda and Galgibaga: These beaches are significant nesting sites of Goa. Morjim is located in the north; Agonda and Galgibaga in the south of Goa. They range from 2-3 kms in length. There were a total of 21 stakeholders interviewed from these beaches, and they included fishermen, shack owners and teachers. The nesting species of these places reported from the interviews was only the olive ridley. **Stakeholder views and awareness level:** Stakeholders report that nesting of turtles have declined over the period of last five years. The nesting species reported here is the olive ridley. The stakeholders are aware of the status of sea turtle conservation and feel the beach should be protected. The shack owners feel that turtle conservation should go in hand with the tourism activities and they are ready to support conservation initiatives. In the Agonda and Galgibaga beaches, records of nesting have been maintained by the Forest Department, who also carry out nest monitoring activities. There is high awareness of sea turtle conservation among the local communities, particularly along Agonda and Galgibaga beaches. **Education and awareness efforts by CEE:** In Morjim, Agonda and Galgibaga, CEE has organised various educational and awareness activities involving locals, school students and teachers. The Goa Forest Department has a small Information Centre where posters developed by CEE are displayed for public awareness.
Beaches Mandrem, Arambol, Keri, Mobor, Cavellosim, Majorda, Colva, Varca, and Betalbatim: The Mandrem, Arambol and Keri beaches are 2-3 km long and located in the north of Goa, Mobor, Cavellosim, Majorda, Colva and Varca are 3-4 km long and located in the central part of Goa, and Betalbatim which is 2 km long is located in the south of Goa. A total of 29 people comprising fishermen, life guards, shack owners and tourists were interviewed from these beaches. **Stakeholder views and awareness level:** There is general awareness about sea turtle conservation amongst the stakeholders interviewed from all the beaches. But the northern section – Mandrem, Arambol had a better awareness level. All of them confirm the nesting of olive ridleys, but mostly uncertain of recent occurrences. Many of them report seeing turtles occasionally and some 3-4 years back. Since no volunteers have been deployed to monitor these beaches, records have not been maintained. The tourists interviewed are not aware of turtles visiting these beaches. Despite this, some of the interviewees feel that the nesting numbers have gone down over the years. **Education and awareness efforts by CEE:** CEE had undertaken an Education and Awareness programme on Sea Turtle Conservation in Goa. The school teachers were trained in the northern section of beaches, hence the stakeholders showed better awareness of sea turtles. In the central section, beaches of Cavellosim, Majorda, Colva and Varca; and Betalbatim in the south, awareness levels were lower, as no CEE educational programs were conducted there. But the current survey served an opportunity to educate fishermen and tourists on the beaches.

THREATS

NESTING BEACHES

Eroding nesting beach at Keri

Erosion of beaches and dunes has been observed at several places along the open sea front and within estuaries. This phenomenon, although localised, is significant at Arambol, Anjuna, Majorda and Colva. There are reports and observed phenomenon

that the Sinquerim beach in north Goa has been completely eroded due to the stagnation of river Prices. Due to construction and other activities, the sand dune vegetations are razed, hence the erosion of sand is more prevalent along the shore line.

INCIDENTAL CATCH

Sea turtle mortality in fishing nets in Goa has reduced compared to the earlier years. Turtles caught incidentally are release back into water. The traditional fishing, which is called *rampon*, is carried out near the beach and hence this activity does not contribute much to turtle mortality. None of the mechanised trawlers are fitted with Turtle Excluder Devices in Goa. As a result, there is turtle mortality from this activity. Although it is not as high as in other places, considering the highly reduced nesting rates on Goan beaches, even a single turtle mortality could perhaps amount to a huge loss in conservation.

EXPLOITATION FOR MEAT AND EGGS

Turtle trade for meat and eggs was once highly prevalent in Goa. But due to high levels of awareness in view of the declining number of turtle nests, the situation has undergone a dramatic change. Poaching and demand for turtle eggs has presently reduced. But there is a menace of stray cattle and dogs, which results in the trampling and predation of nests.

IMPACTS OF COASTAL DEVELOPMENT

Nests protected in-situ near tourism shacks in Goa

For the last decade, the shoreline has witnessed drastic changes. The advent of tourism, population increase, coupled with building activities and modern societal demands, has resulted in large scale changes in the geological and ecological setup, and has indelibly altered ecosystems, land use patterns and the coastal zone landscape (Mascarenhas et al., 1997). In this context, of all the coastal landforms, sand dunes which are sensitive geomorphic features that act as nature's line of defense against the forces of the ocean, have suffered the greatest from anthropogenic pressures (Lobo, 1988; Mascarenhas, 1990, 1996, a; Narayan, 1997). Heavy construction activity and associated infrastructure requirements of the tourism industry have led to a chaotic and haphazard growth of many coastal stretches (Mascarenhas A, 1998).

The makeshift shacks which are permitted to be erected on the beaches of Goa from October to March every year sometimes are erected on the sand dune vegetation by clearing the same. Garbage is a major problem on the beaches. The president of the Shack Owners Welfare Association, during the interview, has reported that the contractors who collect garbage and bottles on the beach discard them on sand dune vegetation and mangrove areas.

LAXITY IN COMPLIANCE WITH STATUTORY REGULATIONS

Beaches such as Mandrem, Morjim in the north Agonda and Galgibaga in the south are classified as CRZ I areas. Haphazard construction activities have become rampant in areas like Morjim and Mandrem. Agonda and Galgibaga so far are not facing such pressure of tourism activities.

LIGHTING

Incidentally, Morjim and Agonda beaches of late have become major tourist attraction due to its pristine beaches and turtle nestings. Other beaches such as Arambol, Ashvem, Mobor, Kavellossim, Colva, Majorda, Varca and Betalbatim attract large number of tourist and to accommodate such high influx large hotels and other facilities are created, sometimes by destroying beach habitat. Erection of high mask lighting for security purpose on some of the prominent beaches have led to light pollution and thereby hindering turtle movement.

RECOMMENDATIONS

1. Most urgent intervention is to carry out stakeholder sensitization at all levels including concerned segment of bureaucracy.
2. Prosecution and follow up of wildlife offences concerning sea turtle conservation is required.
3. Cooperation from the shack owners in protecting the turtle nests on the beaches is needed. Goa Forest Department and other concerned government department and NGOs could take initiatives in organising stakeholder workshops and draw a strategy where the sea turtle conservation and turtle tourism go hand in hand.
4. Development of good way side signages and interpretation centres will help raise awareness. The volunteers can be trained in conducting educational activities for the general public during the nesting season.
5. Strong educational and awareness activities in schools, colleges and local villages.
6. Involvement of fishermen in monitoring the sea turtle congregation in the offshore waters.
7. Previous studies conducted by Dr. Satish Bhasker and Mr. Varad Giri have confirmed the presence of green and loggerhead turtles. But during the monitoring period, except for a few green turtles caught in the fishing net and washed ashore on Morjim and Galgibaga, there are no evidences of them nesting on the shoreline. Continuous monitoring of entire beach for all season could perhaps bring out fresh evidences of these species.
8. Turtle nesting beaches are also a major attraction for tourists and generate revenue for the locals during the tourist season. When compared to the other beaches, Morjim is relatively pristine and secluded and has only recently started attracting tourists. Sea turtles have become one of the major attractions for tourists here. While excessive and unplanned tourism activities need to be controlled, locals can earn their livelihoods while protecting sea turtle nesting habitats (Dongre and Shambhu 2008). It is important that an integrated management plan is evolved where both tourism and turtle conservation is achieved.

9. Increase of manpower, surveillance and monitoring is an urgent necessity. The departments who are supposed to monitor the nestings and other activities on the beaches are under staffed and there is dearth of trained manpower.

10. The Goa Forest Department has taken great initiatives in sea turtle conservation. However, to sustain the efforts, it lacks exclusive budgetary provision for long term turtle monitoring activities along the shore line. Volunteers, who monitor the nesting beaches, are appointed only for six months from October to March. It is important that an exclusive budgetary allocation is made for the turtle conservation for long term.

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MARINE TURTLE HABITATS IN MAHARASHTRA - DISTRIBUTION, STATUS AND THREATS

Vishwas. D. Katdare

BACKGROUND

Maharashtra state has the second largest coastline on the western side of India, and its coast is interspersed with unique sea turtle nesting habitats, most of which are substantially monitored by Sahyadri Nisarga Mitra (SNM), a non-governmental organisation in operation since 2002 (Katdare and Mone,2003). Its coastal waters also record green turtle occurrences, being located adjacent to Gujarat, which is the main green turtle nesting habitat on the mainland.

Velas – An important nesting beach along Maharashtra coast

Prior to this, the GOI UNDP project surveyed the Maharashtra coastline in 2000-2001 to assess the nesting status. In the nesting history of Maharashtra, initially only three species of marine turtles were reported – the hawksbill, green and loggerhead (Daniel 1983). Later, the nesting of olive ridley turtles was recorded by Shaikh (1983), Bhaskar (1984), and Das (1985). Green turtles were found to nest sporadically in Maharashtra (Gole 1997). The GOI UNDP sea turtle project 2000-2002 reported the occurrence of olive ridleys, leatherbacks, hawksbills, and green turtles after surveying 60 locations across 5 districts. It recorded 15 important nesting sites clustered in Ratnagiri and Sindhudurg districts (Giri and Chaturvedi 2006). SNM is currently operating in 39 villages across 4 districts and to date has not recorded any green turtle nests, but observes that although there are reports, the probability of its nesting on the Maharashtra coast is very less. However, nesting of olive ridleys was found to be frequent (Records of Katdare SNM 2002-10, Katdare and Mone 2005).

A survey in 2004-2005, UNEP-CMS IOSEA - a follow up to the UNDP project, surveyed Sindhudurg, Ratnagiri and Raigad district to assess and compare the conservation status at turtle nesting sites and at conservation sites. The study also recorded the sporadic nesting of olive ridleys along the Maharashtra coast (Giri et al 2006). Subsequent to this, a research study carried out by Kurian (2008) involving the Forest Department of Sindhudurg confirmed the occurrence of olive ridley turtles on the Nivti - Khavne stretch, among several beaches surveyed, and the occurrence of green turtles in the waters offshore, from the several carapaces of greens retrieved from fishermen households. Giri et al (2006), who also recorded the carapaces in the same locations, had discarded them as incidental catches.

STATUS AND LOCATION OF NESTING BEACHES

From the 118 sandy beaches surveyed across 4 districts in Maharashtra; Thane, Raigad, Ratnagiri and Sindhudurg, for the year 2010 (Katdare 2010), 13 beaches that had considerable nesting in the past few years, have been listed in the sections of the map below. The co-ordinates and some beach characteristics of these important nesting zones have also been included subsequently.

FIGURE 1. NESTING LOCATIONS BETWEEN RAIGAD AND RATNAGIRI DISTRICTS

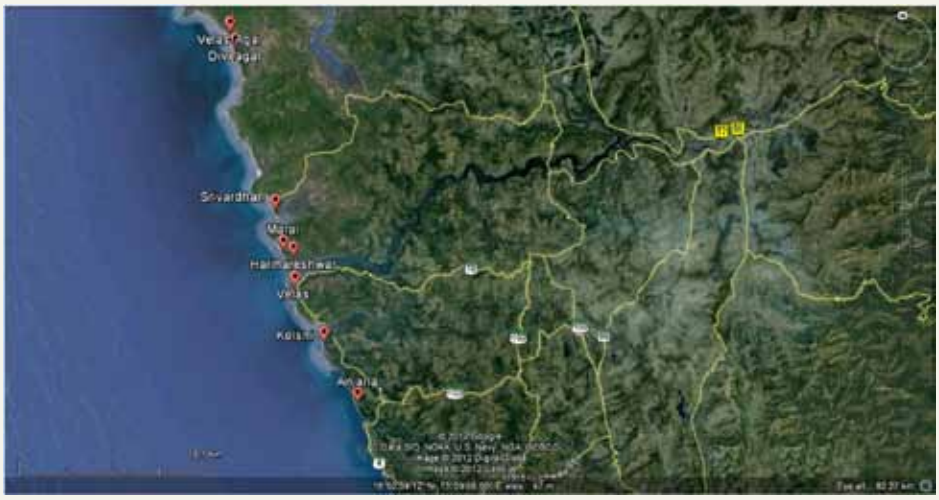

FIGURE 2. NESTING LOCATIONS ALONG RATNAGIRI DISTRICT

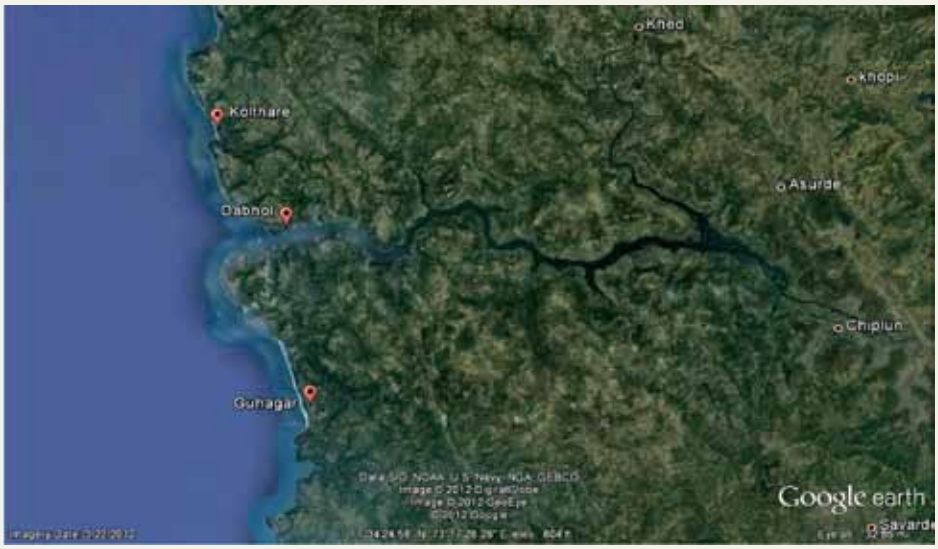

FIGURE 3. NESTING LOCATIONS ALONG SINDHUDURG DISTRICT

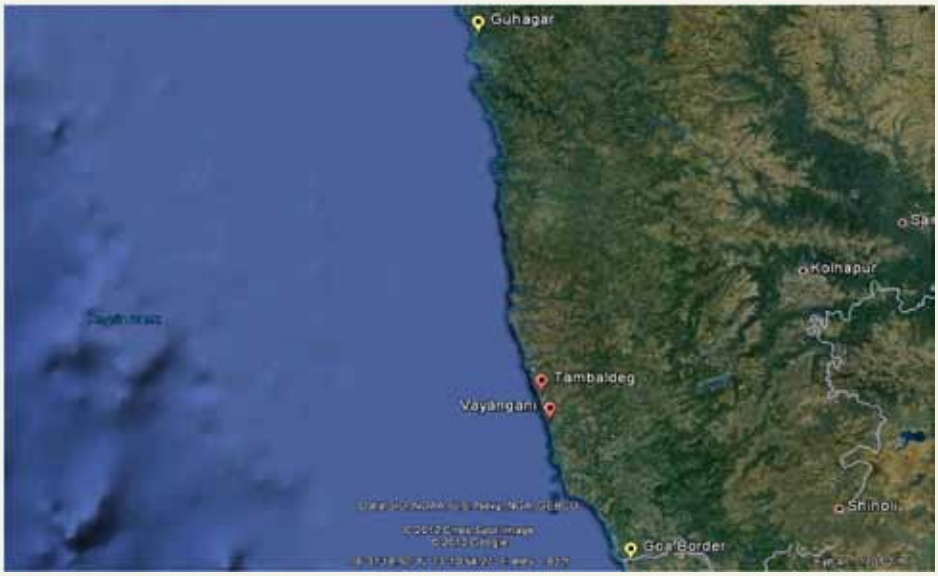

TABLE 1.BEACH CHARACTERISTICS AND CO-ORDINATES OF 13 FREQUENT NESTING SITES OF MAHARASHTRA

S. No	Nesting Beaches	Beach Length (mtrs)	Beach Type	Surround-ingVegetation	Co-ordinates
Ratnagiri District					
1	Velas	3000	Sandy	Casuarina	N7°57.875` E73°01.735
2	Kelshi	2000	Sandy	Casuarina, Screw pine	N17° 4.762' E73° 03.274'
3	Anjarla	1200	Sandy	Casuarina, Screw pine	N 17° 51.354' E73° 5.052'
4	Kolthare	1250	Sandy	Casuarina Screw pine	N19°39.096' E73° 8.019'
5	Dabhol	1500	Sandy	Casuarina, Co-conut	N17°35.148° E73°10.117°
6	Guhagar	5000	Sandy	Casuarina, Co-conut	N17° 28' 11" E73° 12' 0"
Raigad District					
7	Maral	2500	Sandy	Casuarina, Screw pine	N17°59.898" E 73° 01.161'
8	Hari-hareshwar	2000	Sandy	Mangroves	N 17° 9.511" E 73° 01.738'
9	Velas	4000	Sandy	Casuarina	N17°57'25.51" E °02'52.86'
10	Diveagar	4500	Sandy	Casuarina, Screw pine	N18°11.096" E72°58.884
11	Srivardhan	3000	Sandy	Coconut	N18° 1′ 59.88" E 73° 1′ 0.12″
Sindhudurg District					
12	Tambaldeg	2000	Sandy	Casuarina	N16°37'18.92" E 73°10'54.27
13	Vayangani	2500	Sandy	Casuarina, Coco-nut, Lady'sfinger, Vitex nigunda	N 15°52.692" E 73°36.317'

Beach width: 0-10 mtrs

METHODOLOGY

SNM has been monitoring turtle nesting since 2002 in 39 locations across 4 districts of Maharashtra, with the exception of Mumbai. For carrying out the current survey, a two-fold methodology was adopted for collection of data:

1. The known beaches where nesting has been recorded consistently for the past few years, from a minimum of three years to maximum of ten, were selected for intensive monitoring in the current status survey (Table 1).Thirteen such beaches were selected for intensive monitoring for assessing current nesting status. These beaches were monitored by village level volunteers for two consecutive years, including 2010-2011. In Maharashtra, the nesting season is between November to April.

2. A questionnaire was developed to collect secondary information on turtles, including physical and social factors linked to nesting beaches. A total of 160 villages were covered from the entire coastline (728kms) of Maharashtra [Annexure 1]. The districts of Thane, Raigad, Ratnagiri and Sindhudurg were surveyed. Mumbai coast was not focused in the current survey, due to disturbances from large-scale pollution, including beach based constructions and lights, which are factors known to affect turtle nesting. The survey team involved 7 coordinators and 19 volunteers. Interviewees comprised 627 individuals [Annexure 2]. Simple statistical methods like frequency distribution were used to analyze the data collected.

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

OLIVE RIDLEY

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An olive ridley captured during trawl fishing along the Sindhudurg coast

Olive ridley is the most common turtle found along Maharashtra coast, and its occurrence in the current survey has been reported from all 39 villages monitored by SNM. But there were no confirmed reports of nesting of green, leatherbacks and hawksbill turtles along the coast.

Of the 118 beaches surveyed, the 13 beaches intensively monitored had some considerable nesting; around 3-23 nests recorded in a span of 3 consecutive years at some places, and for 10 consecutive years at places like Velas in Ratnagiri district. The remaining 114 beaches had only one or two cases of nesting in the last ten years, and lacked data for most of the years. High level of poaching (100%) in these areas could be a reason for no nests being recorded. The survey carried out by Giri et al (2002), reported an average of 2-3 nests from information received from 60 localities along five coastal districts. Surveys were minimal in Mumbai, Thane and Raigad districts. Giri and Chaturvedi (2003) identified potential nesting areas in Maharashtra located mostly in Sindhudurg and Ratnagiri districts. The current survey shows a change in trends, with the potential nesting beaches occurring mostly in Raigad and Ratnagiri districts, with only a couple of places from Sindhudurg district. A small variation in nesting season is also observed, from October-March (Giri et al 2006) to November-April in the current survey.

TABLE 2 . NESTING IN THE 13 FREQUENT NESTING LOCATIONS OF MAHARASHTRA COAST (2010-2012)

Sr No.	Nesting Beach	Beach Distance	Total Nests		Total Eggs		Hatchlings Released	
	2010 - 2012	2010 - 2012	2010 - 2011	2011 - 2012	2010 - 2011	2011 - 2012	2010 - 2011	2011 - 2012
Ratnagiri District								
1	Velas	3	23	17	2737	1980	1316	736
2	Kelshi	2	7	5	819	502	297	276
3	Anjarla	1.2	2	3	208	296	34	7
4	Kolthare	1.25	11	6	INS	479	INS	73
5	Dabhol	1.5	7	1	754	128	364	87
6	Guhagar	5	3	7	238	ND	40	40
	Total	**13.95**	**53**	**39**	**756**	**3385**	**2051**	**1219**
Raigad District								
7	Maral	2.5	13	8	1246	981	414	981
8	Harihareshwar	2	3	6	342	749	188	749
9	Velas	4	23	0	561	0	250	0
10	Diveagar	4.5	9	9	1141	1132	462	531
11	Murud	3	8	0	140	0	100	0
	Total	**16**	**56**	**23**	**3430**	**2862**	**1414**	**3846**
Sindhudurg District								
12	Tambaldeg	2	20	2	332	213	200	172
13	Vayangani	2.5	7	5	650	515	334	194
	Total	**4.5**	**27**	**7**	**982**	**728**	**534**	**366**
	Overall	**34.45**	**136**	**69**	**9168**	**6 975**	**3816**	**3846**

Nesting Density (2010-2011) =3.95 nests/km stretch; Nesting Density (2011-2012) = 2.00 nests/km ND: No Data; M: Mean; INS: In-situ

A decadal analysis of nesting across Maharashtra (Appendix 1, Table 3) including the current year (2011-2012) shows that the year 2010-2011 (Table 2) had the highest nesting numbers. These nests were recovered from the districts of Raigad, Ratnagiri and Sindhudurg where the 13 beaches are distributed. The total distance surveyed across these beaches was 34.45 kms out of which 136 nests were obtained for the year 2010-11. The nesting density which is determined as the number of nests per kms surveyed was found to be 3.95 nests/km stretch for all three districts in total. The current year (2011-2012) recorded a total of 69 nests (34.45 kms) across the three districts, which is more or less half the nesting numbers of the previous year.

The nesting density accordingly is recorded to be 2.00 nests/km stretch. Velas and Murud in Raigad districts had no nesting for the current season. However, nesting was seen in Tawsal beach of Ratnagiri district which had no nesting in the 2010-11 season.

Nesting density was also assessed for the three districts of Ratnagiri, Raigad and Sindhudurg. The highest was recorded for Ratnagiri with a nesting density of 3.80 nests/km stretch in 2010-11, and 2.80 in 2012. Raigad recorded 3.5 nests/km stretch in 2010 and 1.43 nests/km. Sindhudurg recorded the highest density of 6 nests/km stretch in 2010-11 and 1.56 nests/km stretch in the current year (2011-12). Ratnagiri

Olive ridley hatchlings released into the sea

district also records the highest number of eggs and hatchlings released to sea than Raigad and Sindhudurg districts in both years.

In the year 2012, out of a total 68 nests recorded from Ratnagiri and Raigad districts, 6247 eggs were found, from which 3234 hatchlings were released to the sea.

GREEN TURTLE

Green turtle and olive ridley carapaces found in fishermen houses along the Maharashtra coast

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The occurrence of this species is reported from the entire coast of Maharashtra but sporadic nesting is reported from only a few localities (Gole 1997, Shaikh 1983). Carapaces of green turtles in fishermen households have been recorded in different studies by Giri and Chaturvedi (2003) and Kurian (2008). However, its relation to nesting on the coast, could not be ascertained. SNM, likewise, has not recorded nesting of green turtles since the year 2002. Moreover, the project areas covered by SNM are quite extensive and monitored regularly. The possibility of nesting by the species along the coast is probably very low. In many places, local fishermen have reported the presence of adult and juvenile green turtles near the coast. There are also records of dead green turtles on some beaches of Maharashtra.

LEATHERBACK TURTLE

Very little information exists about the species and reports of its occurrence on the coast are rare. Ten to fifteen years ago, one nest each was recorded in Sindhudurg and Raigad district (Giri V. 2001). However, no authentic record of its nesting is available.

HAWKSBILL TURTLE

This species is reported from many coastal villages in Maharashtra. Most of the records are of occurrence of juveniles in offshore waters. Juveniles of the species were reported from Nivti in Sindhudurg district, Ratnagiri and Velas in Ratnagiri district. No nests of this species have been found in the state by SNM.

NESTING BEACHES

Locals from 91% of coastal villages [Appendix 1, Table 4] have reported an annual increase in the high tide line. This has resulted into a decrease in available beach area for nesting. At many places, the nests got submerged under the high tide. Further, illegal sand mining is rampant on many beaches of Maharashtra. Locals collect sand for personal use and also for sale in the markets. Srivardhan and Diveagar are two of the important nesting sites where illegal mining occurs. Some people were also caught for carrying out such mining at the village of Anjarla.

Maharashtra State Forest Department had taken up the work of raising Casuarina plantations to act as a bio-shield on some of the coastal villages. The Casuarina saplings were planted right up to the high-tide line. In the process, it eliminated large stretches of sea turtle nesting habitat. At Velas, in Ratnagiri district, the Forest Department has taken positive steps to stop the plantation on the advice of SNM. Sustained follow-up with the Maharashtra Government has also resulted in this action being replicated across the entire coast of Maharashtra.

INCIDENTAL CATCH

Turtles get caught in fishing nets incidentally, and as a consequence get killed. Local fishermen often encounter the species at sea, trapped in their fishing nets. Those fishers, who regard the turtles sacred, release the turtle back to sea, or even those who consider it inauspicious do not harm it. But other local fishermen capture turtles for its meat and carapace. Often these turtles get sold illegally in local markets or within the community itself. Trade in carapaces occurs in some areas, where they are sold as show pieces.

Olive ridley turtle found dead on the beach

Often dead/injured turtles are reported from coastal villages. Turtles are injured by the boats' propellers and caught in fishing nets all over the coast. On comparing data from the 1997 and 2003 Fisheries Surveys of Maharashtra, it was found that mechanized fishing was on the rise. The traditional crafts in Maharashtra including canoes, catamarans and plank built boats are still used by some fishermen. (Maharashtra State Fisheries Department 1997, 2003)

TABLE 5. LOCATIONS WITH INTENSIVE MECHANISED FISHING IN MAHARASHTRA

Sr No.	District	Motorized+Mechanized Boats	Non-motorised boats
1	Thane	3321	1185
2	Mumbai	2366	813
3	Raigad	3202	1921
4	Ratnagiri	2800	1577
5	Sindhudurg	1416	2040
	Total	**13105**	**7536**

EXPLOITATION FOR MEAT AND EGGS

Direct poaching of turtles and eggs from nesting beaches occurs at some places which lack adequate patrolling or protection. On such beaches, 100% harvest of eggs is still observed. SNM has tried to bring down the poaching rate on the beaches it protects, and efforts are still ongoing to include more of the non-protected beaches under surveillance. In Maharashtra, fishermen are generally aware about the legal status of the olive ridley; and in the past 10 years with the conservation efforts made by SNM in the local fishing villages, the awareness level among fishers has greatly increased.

IMPACTS FROM COASTAL DEVELOPMENT

Construction on beaches for power projects in Konkan is a major threat to turtles. This threat will only intensify in the future as 16 coal base power projects are proposed to be constructed along the coast of Konkan, Maharashtra. Of these, the Jindal, Finolex and Enron projects are already functional. The Western Ghats Ecology Expert Panel headed by Dr. Madhav Gadgil has submitted a report to the Central Govt. regarding this issue. There has been social and political opposition to these projects, including large scale campaigns by the local communities. However, the power plants are still expected to be established in Konkan.

At Dabhol, a huge stone wall has been constructed for protection to GEL gas pipe line (which supplies gas to Enron power project) along the coast. This construction was observed by SNM during its regular monitoring in the nesting season. Due to this wall, half of the beach has been covered making it very difficult for turtles to find suitable nesting places.

SEA WALLS: In many villages, stone walls are constructed by the government to prevent erosion caused by increase in high tide. The walls are erected next to the high tide line, hence the high tide water reaches up to the wall leaving no dry patch for turtles to nest. This is found to be increasing as local people are demanding for it, in order to be protect their villages. [Appendix 1, Table 4].

TOURISM: Increase in tourism is one of the major threats to turtles. In Konkan the inflow of tourists is rising and a large majority of them visit beaches. Increase in garbage and debris from the sea are some of the problems arising out of tourism. The beaches remain crowded till late night which results in heavy and prolonged lighting of the beaches. Bright lighting not only deters turtles from nesting but also disorients hatchlings from reaching the sea.

The village of Murud in Ratnagiri district is a glaring example of how tourism has affected marine turtles. In the year 2008-09 six nests were reported on the coast which reduced to one and zero in the next two years. This is because of increase in human presence on beaches from tourism. While its a necessity for economic growth, tourism has to be regulated so as not to have any adverse effect on turtles and their nesting.

A CONSERVATION ACTIVITY BY SAHYADRI NISARGA MITRA

The Kasav Mitra Mandal is established at Velas in Mandangad taluk of Ratnagiri by SNM, with the involvement of local people who are willing to work for the conservation of marine turtles. The Mandal provides lodging and boarding facilities and guides film-shows on demand by the visitors/tourists arriving at Velas, particularly during the time of an event called Turtle Festival. The Mandal charges reasonably for those facilities and spares 10% of the total income during the festival towards the marine turtle conservation fund. This fund is utilized exclusively for conservation of marine turtles at Velas. The volunteers, local youth, SHGs, Mahila Bachat Gats, have joined the Mandal

Turtle Festival

as members. This combination of livelihoods and conservation can easily be replicated by the Maharashtra Tourism Department at other sites along the coast.

RECOMMENDATIONS

1. Forest Department should undertake wide scale awareness campaigns with the involvement of locals along the entire Maharashtra coast.
2. Destruction of turtle habitats should be banned throughout the Maharashtra coast. Forest and Revenue Departments should take initiatives and plan to execute the ban effectively.
3. A long-term systematic study of turtle breeding on Maharashtra coast has to be undertaken.
4. The Kasav Mitra Mandal, a livelihoods & conservation programme can be replicated by the Maharashtra Tourism Department at other sites along the coast.
5. Pollution and dumping of garbage on beaches should be prevented through strict enforcement of rules.
6. Coal based power projects should not be sanctioned along the Maharashtra coast.

ACKNOWLEDGEMENTS

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Appendix

TABLE 3. NESTING STATUS OF COASTAL VILLAGES MONITORED BY SAHYADRI NISARGA MITRA IN MAHARASHTRA (2002-2012)

S. No.	Place	2002 -03	2003-04	2004-05	Nests 2005-06	2006-07	2007-08	2008-09	2009 -10	2010-11	2011-12
1	Chikhala	ND	ND	ND	0	ND	0	ND	ND	ND	ND
2	Arnala	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
3	Navapur	ND	ND	ND	ND	ND	0	1	ND	ND	ND
4	Vasai	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
5	Akshi	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
6	Nandgaon	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
7	Murud Janjira	ND	ND	ND	1	1	3	1	ND	8	ND
8	Diveagar	ND	ND	4	3	4	24	35	19	9	9
9	Valvati	ND	ND	ND	ND	1	0	ND	ND	ND	ND
10	Maral	ND	ND	ND	1	1	8	11	9	13	8
11	Harihareshwar	ND	ND	4	4	4	2	9	ND	3	6
12	Velas	50	30	14	21	31	36	45	22	23	17
13	Kelshi	ND	ND	1	1	3	14	15	7	7	5
14	Anjarla	ND	4	ND	ND	ND	12	2	6	2	3
15	Saldure	ND	0	ND	ND	ND	ND	ND	ND	ND	ND
16	Karde	ND	ND	0	ND	ND	ND	1	ND	ND	ND
17	Murud Harnai	ND	1	ND	ND	ND	ND	6	1	0	ND
18	Kolthare	ND	ND	4	2	7	26	10	3	11	6
19	Dabhol	ND	ND	4	2	3	34	18	7	7	1
20	Guhagar	ND	ND	ND	ND	1	0	1	ND	3	7
21	Sandkhol	ND	ND	ND	1	ND	0	ND	ND	ND	ND
22	Ratnagiri	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
23	Ganesh gule	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
24	Vetye	ND	ND	ND	ND	0	0	ND	ND	ND	ND
25	Ambolgad	ND	ND	0	ND	2	0	ND	ND	ND	ND
26	Tondoli	ND	ND	0	ND	ND	ND	ND	ND	ND	ND
27	Tarkarli	ND	ND	ND	0	1	2	ND	ND	1	ND
28	Deobag	ND	ND	ND	0	1	1	ND	ND	ND	ND
29	Bhogave	ND	ND	ND	0	0	1	ND	ND	ND	ND
30	Kelus	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
31	Tambaldeg	ND	ND	ND	ND	ND	ND	ND	ND	20	7
32	Vayangani	ND	ND	ND	ND	ND	3	ND	ND	7	5
33	Ubhadanda	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
34	Mochemad	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
35	Shiroda	ND	ND	ND	ND	ND	0	ND	ND	ND	ND
36	Madban	ND	ND	0	ND	ND	ND	ND	ND	ND	ND
37	Vadrai	ND	ND	ND	0	ND	ND	ND	ND	ND	ND
38	Varawade	ND	ND	ND	0	ND	ND	ND	ND	ND	ND
39	Velas - Agar	ND	ND	ND	ND	ND	ND	ND	ND	23	ND
40	Srivardhan	ND	ND	ND	ND	ND	ND	ND	ND	2	ND
	Total	**50**	**35**	**31**	**36**	**62**	**167**	**155**	**74**	**139**	**69**

Nesting Turtle Species: Olive ridley
Nesting Season: November-March
Total no of nests recorded between November 2002- May 2012: 818 nests
Total no of hatchlings released (2002-2012): 33,080

Frequent nesting sites:

Ratnagiri district- Velas, Kelshi, Anjarla, Kolthare, Dabhol and Guhagar
Raigad district- Maral, Harihareshwar, Velas, Diveagar and Murud
Sindhudurg district- Tambaldeg, Vayangani

TABLE 4: STATUS OF 160 BEACHES ACROSS MAHARASHTRA WITH RELEVANCE TO TURTLE NESTING (KATDARE 2010)

Name of Village	Length of Sea Shore (In mtr)	Type of beach	Casuarina Plantation	Screw Pine Plantation	Distance between high tide line & Ipomea	Change in High tide
Sindhudurg District						
Devgad	250	S	Y	N	4 to 6 m	Y
Rameshwar- Kalvashi Beach	1000	S	N	Y	0 to 7m	Y
Padawane	2000	S	Y	N	4 to 9 m	Y
Fanase	3000	S	Y	N	5 to 10 m	Y
Mithmumbri	1500	S	Y	Y	2 to 5 m	Y
Taramumbri-Devgad	500	S	Y	N	0 to 2m	Y
Kunakeshwar	1500	S	Y	N	5 to15 m	Y
Kunkeshwar- Katwan	1000	S	N	Y	2 to 5 m	Y
Mithabav	1000	S	Y	N	5 to 10 m	Y
Hindle-Morwewadi	5000	S	N	Y	2 to 8 m	Y
Tambaldeg	2000	S	Y	N	3 to 7 m	Y
Munage	3000	S	Y	N	6 to 15 m	Y
Vayangani	3000	S	Y	N	5 to12 m	Y
Achara-Pirawadi, Hirlewadi	2000	S	Y	N	2 to 9 m	Y
Tondawali	7000	S	Y	N	0 to 10 m	Y
Tondawali-Talashil	7000	S	Y	N	3 to 11m	Y
Malvan-Dhuriwada	1000	S	N	N	3 to 10 m	Y
Kolam-Mirya Banda	1000	S	Y	N	1 to 7m	Y
Malvan	2500	S	N	N	0 to 4 m	Y
Malvan-Dandi	2500	S	N	N	5 to 10 m	Y
Wayari	3000	S	Y	N	7 to15 m	Y
Kondurawadi	200	S	N	N	0 to 5 m	Y
Medha-Niwati-Shriramwadi	2500	S	Y	Y	7 to 20 m	Y
Bhogave	2500	S	N	Y	5 to 6 m	Y
Kille-Niwati	300	S	N	N	2 to 8 m	Y
Tarkarli	3000	S	Y	N	5 to 10m	Y
Deobag	2000	S	N	N	0 to 2 m	Y
Rameshwar-Kolwadi	250	S	N	N	2 to 12 m	Y
Rameshwar-Ghariwadi	200	S	N	N	0 to 2 m	Y
Girye, Pural-Kotharwadi	600	S	Y	N	1 to 3 m	Y
Mochemad	1500	S	N	N	10 to 15 m	Y
Ubhadanda	2000	S	Y	N	3 to 10 m	Y
Ubhadanda-Kurle Muthwadi	2000	S	N	N	3 to 10 m	Y
Navabag – Ubhadanda	3000	S	Y	N	5 to 15 m	Y
Bagayatwadi-Ubhadanda	2000	S	Y	Y	5 to 15 m	Y
Vayangani	2500	S	Y	N	5 to 10 m	Y
Kalvi Bandar	1000	S	N	N	2 to 10 m	Y

Turtle Presence Y/N	Years of reporting in last 5 yrs/10 yrs/15 yrs	Nesting Y/N	No. of Nests	Poaching of Turtles	Egg Poaching	Fishing on beach H/M/L	Beach suitable for Nesting	Any house/ hotel on the beach (within 100m)
Y	10 yrs	N	0	N	N	M	Y	N
Y	15 yrs	Y	0	N	Y	N	Y	N
Y	5 yrs	Y	0	N	Y	M	Y	N
Y	5 yrs	Y	0	N	Y	N	Y	N
Y	5 yrs	Y	0	N	Y	M	Y	N
Y	5 yrs	N	0	N	N	M	Y	Y
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	5 yrs	Y	1	N	N	H	Y	Y
Y	5 yrs	Y	0	N	Y	M	Y	N
Y	5 yrs	Y	0	N	N	N	Y	N
Y	5 yrs	Y	20	N	N	H	Y	Y
Y	5 yrs	Y	IN	N	Y	H	Y	Y
Y	5 yrs	Y	3	N	Y	L	Y	N
Y	5 yrs	Y	0	N	Y	H	Y	Y
Y	5 yrs	Y	0	N	Y	M	Y	Y
Y	5 yrs	Y	1	N	Y	M	Y	Y
Y	10 yrs	N	0	N	N	M	N	Y
Y	10 yrs	N	0	N	Y	H	N	N
Y	15 yrs	N	0	N	N	M	N	Y
Y	10 yrs	N	0	N	N	H	N	Y
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	5 yrs	Y	0	N	N	M	Y	N
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	5 yrs	Y	1	N	Y	H	Y	Y
Y	5 yrs	Y	0	N	Y	H	Y	Y
Y	5 yrs	Y	3	N	N	H	Y	Y
Y	5 yrs	Y	2	N	N	H	N	Y
Y	5 yrs	Y	0	N	Y	L	Y	N
N	N	N	0	N	N	L	Y	N
Y	5 yrs	Y	0	N	Y	N	Y	N
Y	5 yrs	Y	1	N	Y	H	Y	N
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	5 yrs	Y	0	N	Y	H	Y	Y
Y	15 yrs	N	0	N	N	H	Y	Y
N	N	Y	0	N	N	N	Y	N
Y	5 yrs	Y	10	N	Y	H	Y	Y
Y	5 yrs	Y	0	N	N	H	Y	Y

Falye Fonda-Kalvi bandar	300	S	N	N	2 to 8 m	Y
Khavane	300	S	N	N	5 to 20 m	Y
Rameshwar-Damlemal Beach	250	S	N	N	5 to 7m	Y
Vijaydurga	200	S	N	N	0 to 5 m	Y
Redi	1000	S&R	N	N	0 to 3m	Y
Shiroda-Velagar, Kerwadi	2000	S	Y	N	7 to 10 m	Y
Arwali Tank	2000	S	Y	Y	5 to 10 m	Y
Ratnagiri District						
Bhatye	2000	S	Y	N	3 to 7m	Y
Ratnagiri-Mandvi	1500	S&R	N	Y	0 to 7m	Y
Ratnagiri-Murugwada	1000	S	N	N	0 to 5 m	Y
Mirya	3000	S	N	N	0 to 1m	Y
Vayangani-Golap	600	S&R	N	Y	1 to 3m	Y
Kurli	600	S	N	Y	0 to 2 m	Y
Ganesh Gule	1500	S	Y	N	2 to 5 m	Y
Tawasal-Padawe	2000	S	Y	N	3 to 10 m	Y
Ranpar-Golap	1250	S	Y	N	0 to 1 m	Y
Madban	2000	S	Y	N	3 to 6 m	Y
Pangere-Dande	1500	S&M	N	N	2 to 8 m	Y
Musa Kaji	300	S	N	N	0 to 3 m	Y
Bakale	150-200	S	Y	N	3 to 7m	Y
Kajarbhati-Dhokmale	1500	S	Y	N	10 to 15m	Y
Ware-Dhokmale	2000	S	Y	Y	8 to12 m	Y
Malgund	3500	S	Y	N	0 to 10 m	Y
Ganapatipule	3000	S	Y	Y	7 to 10 m	Y
Ril	2000	S	Y	Y	5 to 14 m	Y
Varvade-Padvane	2000	S	N	N	0 to 7 m	Y
Nandivade	1000	S	Y	Y	5 to 10 m	Y
Nandivade-Ambuwadi	600	C	N	N	1 to 8 m	Y
Tavsal-Agar-Rohile	1500	S&R	Y	N	0 to 5 m	Y
Bhandarpule	2000	S	Y	N	5 to10 m	Y
Kalabadevi	5000	S	Y	N	2 to 12 m	Y
Guhagar	6000	S	Y	N	5 to 10 m	Y
Chaferi	350	S&R	N	N	0	Y
Gavkhadi	2000	S	Y	N	2 to 6 m	Y
Purngad	1000	S&R	N	N	0	Y
Kasop	300	S&R	N	N	0 to 2 m	Y
Vetye	700	S&R	Y	N	0	Y
Ambolgad-(Uparche Bandar)-1	7000	S	Y	Y	2 to 7m	Y
Jaitapur	2000	S	Y	N	0 to 1m	Y
Ambolgad-2	2500	S	N	N	2 to 6 m	Y
Bandachawada	350	S	N	N	5 to 10 m	Y
Undi	1000	S&R	N	Y	0 to 5 m	Y
Sandhkhol	1500	S	Y	N	15 to 16 m	Y
Kachara	300	S	N	N	6 to 15 m	Y

Y	5 yrs	Y	IN	N	Y	H	Y	Y
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	10 yrs	Y	0	N	Y	L	Y	N
Y	10 yrs	N	0	N	N	M	N	Y
Y	5 yrs	Y	0	Y	Y	M	N	Y
Y	5 yrs	Y	0	N	N	L	Y	Y
Y	10 yrs	Y	0	N	Y	M	Y	Y
Y	10 yrs	Y	0	N	N	L	Y	Y
N	N	N	0	N	N	M	N	Y
Y	5 yrs	Y	0	Y	Y	M	Y	Y
Y	5 yrs	Y	0	Y	Y	H	N	Y
Y	5 yrs	Y	0	Y	Y	N	N	N
Y	5 yrs	Y	0	Y	Y	M	Y	Y
Y	5 yrs	Y	0	Y	Y	L	Y	Y
Y	5 yrs	Y	0	Y	N	M	Y	N
Y	5 yrs	Y	0	Y	Y	N	Y	Y
Y	5 yrs	Y	0	Y	Y	H	Y	Y
N	N	N	0	N	N	H	N	Y
N	N	N	0	Y	N	L	N	Y
N	N	Y	0	N	N	N	Y	N
Y	5 yrs	Y	0	Y	Y	L	Y	Y
N	N	Y	0	Y	Y	N	Y	Y
Y	5 yrs	Y	0	Y	Y	L	Y	Y
Y	5 yrs	N	0	Y	Y	N	Y	Y
Y	5 yrs	Y	0	Y	Y	N	Y	Y
Y	10 yrs	N	0	Y	Y	M	Y	Y
Y	10 yrs	N	0	Y	Y	M	Y	Y
Y	5 yrs	Y	0	Y	Y	L	Y	Y
N	N	Y	0	N	N	N	Y	N
Y	10 yrs	Y	0	Y	Y	M	Y	Y
Y	5 yrs	Y	0	Y	Y	N	Y	Y
Y	5 yrs	Y	2	Y	Y	N	Y	Y
N	15 yrs	Y	0	N	N	N	Y	N
Y	5 yrs	Y	0	Y	Y	L	Y	Y
N	N	N	0	N	N	H	N	Y
N	N	Y	0	N	Y	L	N	Y
Y	5 yrs	Y	0	N	Y	L	Y	Y
Y	5 yrs	Y	IN	Y	Y	H	Y	Y
N	N	Y	0	N	Y	N	Y	N
Y	5 yrs	Y	0	N	Y	H	Y	Y
Y	5 yrs	Y	0	Y	Y	L	Y	N
Y	5 yrs	Y	0	Y	Y	N	Y	Y
Y	5 yrs	Y	1	Y	Y	N	Y	Y
Y	10 yrs	N	0	N	N	H	Y	Y

Asgoli	2000	S	Y	Y	5 to 10 m	Y
Palshet	500	S	Y	N	2 to 9 m	Y
Budhal	500	S&R	N	N	0 to 5 m	Y
Anjanvel	2000	S&M	N	N	0 to 5 m	Y
Kondkarul	800	S	IN	IN	2 to 6 m	Y
Borya Karul	4000	S	N	N	2 to 7 m	Y
Naravan	4000	S	Y	N	15 to 17 m	Y
Hedavi	4500	S	Y	N	0 to 1m	Y
Velaneshwar	1500	S	N	N	10 to 15 m	Y
Sakhariagar-Hedavtad	1000	S&R	N	N	0 to 9 m	Y
Ganesh Gule- Beach-2	700	S&R	N	N	0 to 3 m	Y
Dabhol	5000	S	Y	N	0 to 1m	Y
Uttambar	1000	S	N	N	0 to 1 m	Y
Anjarle	1200	S	Y	Y	0 to 5 m	Y
Burondi	1500	S&M	Y	N	IN	Y
Kolthare	1250	S	N	Y	0 to 1m	Y
Harne	1500	S&R	N	N	1 to 2 m	Y
Ladghar	2000	S&Rg	N	N	0 to 2 m	Y
Karajgav	500	S	N	N	0m	Y
Vanavase	1500	R	N	N	0m	Y
Karde	5000	S	Y	N	0 to 5 m	Y
Murud	3000	S	Y	Y	0 to 2 m	Y
Velas	3000	S	Y	N	5 to 10 m	Y
Kelshi	2000	S	Y	Y	0 to 2 m	Y
Harihareshwar	500	S	Y	Y	1m	Y
Raigad District						
Kashid	3000	S	Y	N	0 to 3m	Y
Korlai	2000	S	N	N	N	Y
Murud - Janjira	3000	S	Y	N	2 to 4 m	Y
Revdanda	5000	S	Y	N	2 to 5 m	Y
Nagaon	4000	S	Y	N	0	Y
Varsoli	2000	S	Y	N	1m	Y
Akshi	3000	S	Y	N	0	Y
Alibag	4000	S&R	Y	N	0	Y
Thal	4000	S	Y	Y	IA	Y
Navgaon	2000	S&R	N	N	2m	N
Kihim	3000	S&R	Y	N	IA	Y
Moracha Pada	3000	S	Y	N	1 to 2 m	Y
Sasavane-Dighodi	2000	S&R	N	N	2m	Y
Maral	2500	S	Y	Y	5 to 15 m	N
Aravi Kondvil	5000	S	Y	Y	0m	Y
Shrivardhan, Jivana Koliwada	3000	S&C	Y	Y	2m	Y
Bhendkhol	2000	S&C	N	N	IN	N
Shekhadi	1500	S&R	N	N	IA	Y
Deveagar	4500	S	Y	Y	0 to 5 m	Y

Y	5 yrs	Y	0	N	N	H	Y	Y
Y	5 yrs	Y	0	N	N	M	Y	Y
Y	5 yrs	Y	0	N	N	H	Y	Y
Y	10 yrs	Y	0	Y	Y	M	N	Y
Y	15 yrs	N	0	N	N	H	Y	Y
Y	5 yrs	Y	0	Y	Y	L	Y	Y
Y	5 yrs	Y	0	Y	Y	N	Y	N
Y	5 yrs	Y	0	Y	Y	N	Y	Y
Y	5 yrs	Y	0	Y	Y	M	Y	Y
N	N	N	0	N	N	H	N	Y
Y	10 yrs	Y	0	Y	Y	N	Y	N
Y	5 yrs	Y	61	Y	Y	H	Y	N
Y	10 yrs	Y	0	Y	Y	M	Y	Y
Y	5 yrs	Y	18	N	N	M	Y	N
N	N	N	0	N	N	H	N	Y
Y	5 yrs	Y	49	N	N	L	Y	N
N	N	N	0	N	N	H	N	Y
Y	5 yrs	Y	0	Y	N	N	Y	N
N	N	N	0	N	N	N	N	Y
N	N	N	0	N	N	N	N	Y
Y	5 yrs	Y	1	Y	Y	L	Y	Y
Y	5 yrs	Y	IN	N	N	N	Y	Y
Y	5 yrs	Y	227	N	N	N	Y	N
Y	5 yrs	Y	34	N	N	N	Y	N
Y	5 yrs	Y	23	N	N	N	Y	N
Y	15yrs	N	0	N	N	N	Y	N
Y	N	N	0	Y	Y	H	N	Y
Y	5 yrs	Y	IN	N	Y	H	Y	Y
Y	5yrs	Y	0	Y	Y	M	Y	Y
Y	N	N	0	N	N	N	N	Y
N	N	N	0	N	N	H	N	N
Y	5 yrs	Y	0	N	Y	M	Y	Y
N	15 yrs	N	0	N	N	H	N	Y
N	15 yrs	N	0	N	N	L	N	Y
N	15 yrs	N	0	N	N	H	N	Y
N	15 yrs	N	0	N	N	Y	N	Y
Y	5yrs	Y	0	N	N	N	Y	Y
N	N	N	0	N	N	M	N	Y
Y	5 yrs	Y	21	N	N	L	Y	N
Y	N	Y	0	Y	Y	L	Y	N
Y	5 yrs	Y	0	Y	Y	H	Y	N
Y	IN	Y	0	N	Y	N	Y	N
N	10 yrs	Y	0	N	Y	L	Y	N
Y	5 yrs	Y	70	N	N	L	Y	N

Aadgaon, Bhandariwadi	1000	S&R	N	N	1 m	Y
Aagardanda	2000	S&R	N	N	IA	Y
Nandgaon	2000	S&R	Y	Y	IA	Y
Velas, Raigad	1000	S	Y	N	1 to 2 m	Y
Thane District						
Vasaigaon (Sherucha Beach)	5000	S	Y	N	1m	Y
Arnala, Nadapur	7000	S	Y	Y	3m	Y
Koliwada -Pachubunder, Vasai	?	S	Y	N	IN	Y
Rajodi Pada, Nala	2000	S	N	N	0m	Y
Kalam	4000	S&R	N	N	0m	Y
Bhuigaon Khurd	2000	S	Y	N	0m	IN
Ramali, Rangaon	3000	S	Y	N	IN	Y
Rangaon	3000	S	N	N	0m	Y
Navapur	2000	S	IN	IN	IN	IN
Dahanu (Par Naka)	5000	S&M	Y	N	0m	Y
Zai	1000	M	Y	Y	0m	Y
Chikhala	2000	S	Y	N	3m	Y
Bordi	2000	S	Y	N	15-20 feet	Y
Kolwad	2000	M	N	N	0m	Y
Narpad	2000	M	Y	N	2m	Y
Dhakati Dahanu	2000	S&R	Y	N	0m	Y
Gungapada	1500	S&R	Y	N	1 feet	Y
Wadhavan	1000	S&M	Y	N	5 m	Y
Varor	2000	S	Y	N	0m	Y
Badapokharan	NR	NR	NR	NR	NR	NA
Dandipada(Chinchani)	500	S&M	Y	N	0m	Y
Chinchani	1000	S	Y	Y	1 m	Y
Tarapur	300	S	N	N	0m	Y
Satpati	4000	S&M	Y	N	0m	Y
Shirgaon	3000	S	Y	N	10 m	Y
Ghorlipada (Mahim-Tembe)	2000	S&M	N	N	IA	Y
Jambhulpada (Mahim-Tembe)	1000	S&M	Y	N	0m	Y
Kelawa	2000	S	Y	N	1m	Y
Usarani	2000	S	N	N	5m	Y
Mathane	1000	S	Y	N	2m	Y
Mamachi Wadi (Arnala)	2000	S	Y	N	3m	Y

IN=Insufficient Data;
NR= Not Recorded;
S=Sandy; C=Cliff; R=Rocky; RG=Red Gravel; IA=Ipomea Absent

Y	5 yrs	Y	0	N	Y	M	Y	Y
N	IN	Y	0	N	N	M	Y	N
Y	5 yrs	Y	1	N	Y	N	Y	N
Y	5 yrs	Y	IN	N	N	N	Y	Y
Y	15yrs	N	0	Y	Y	L	N	Y
Y	5yrs	N	0	Y	N	H	Y	N
Y	20 yrs	IN	0	Y	Y	H	N	IN
Y	5 yrs	N	0	Y	Y	L	N	Y
Y	15yrs	N	0	Y	N	L	N	Y
Y	15yrs	IN	0	IN	IN	L	N	N
Y	15 yrs	IN	0	N	Y	L	IN	Y
Y	15 yrs	N	0	Y	N	L	N	Y
IN	IN	IN	1	IN	IN	IN	IN	Y
N	10 yrs	N	0	N	N	N	N	Y
N	5 yrs	N	0	N	N	L	N	Y
Y	5 yrs	N	0	N	N	N	Y	N
N	N	N	0	N	N	N	N	N
N	IN	N	0	N	N	L	N	N
N	15 yrs	N	0	N	N	L	N	N
N	5 yrs	N	0	N	N	L	N	N
N	10 Yrs	N	0	N	Y	L	N	Y
N	10 yrs	N	0	N	N	L	Y	N
N	N	N	0	N	Y	L	N	N
N	N	N	0	N	N	L	N	N
Y	5 yrs	N	0	N	Y	L	N	N
Y	5 yrs	N	0	N	Y	M	N	N
N	N	N	0	N	N	L	N	Y
Y	10 yrs	N	0	N	Y	H	N	N
Y	5 yrs	Y	0	N	Y	L	Y	N
N	N	N	0	N	N	H	N	N
N	N	N	0	N	N	N	N	N
Y	5 yrs	N	0	N	Y	N	N	N
Y	10 yrs	N	0	N	N	L	N	N
Y	10 yrs	N	0	N	Y	N	Y	N
Y	5yrs	N	0	N	Y	L	Y	N

SEA TURTLE HABITATS AND NESTING STATUS IN GUJARAT

Dinesh Goswamy, Jignesh Gohil, Sunny Shah and Annie Kurian

BACKGROUND

The Gujarat coast is characteristic for high density nesting of green turtles along the Indian mainland. The other nesting species is the olive ridley. The nesting of the two species and the occurrence of leatherback and hawksbill turtles in the waters offshore has been reported across various studies (Bhaskar 1978, 1979, 1981, 1984, Kar and Bhaskar 1982). Since the 70's there have been several successive studies on sea turtles of Gujarat. Uptil the 80's some of these studies have revealed possible nesting sites and status and threats to turtles, such as egg predation, sand mining and killing of turtles for oil and flippers (Frazier 1980).

However, in 1983, Siraimeetan (1985) made important offshore observations on the occurrence of green turtles in the waters of Okha and West Veraval. The study also revealed some aspects into the biology of green turtles, the frequency of capture of turtles in trawls, and its subsequent trade and exploitation in the Dwarka market. Subsequently, Frazier (1989) conducted necropsy studies on green turtles stranded in the Bet Dwarka region. Drowning in trawls was implied to be the cause, and the activity was also found prevalent in the Okha region. Notes on tag returns (Firdous 1991), and nesting activities along various locations of the Gujarat coast have also been reported (Patel 1991, Nareshwar 1994, 1998).

Green turtle nesting along Gujarat coast

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Almost a decade later, (Sunderraj et al 2006) the GOI- UNDP project carried out in 2000-2001, surveyed the entire Gujarat coast, and identified 6 coastal districts as potential nesting habitats. Nests of green and olive ridley turtles were recorded from Jamnagar, Junagadh, Amreli, Bhavnagar, Valsad districts with the exception of Kachchh, where only nests of olive ridley were recorded. Parallel to this study, Venkatesan et al (2004) surveyed the Saurashtra coast to study the nesting ecology of green sea turtles.

The UNEP-CMS sea turtle survey was carried out in 2004 along the Gujarat coast with the aim of assessing the nesting population status through long term intensive monitoring and capacity building of different stakeholders towards the conservation of sea turtles along the Indian coast (Sunderraj and Joshua 2006). A research survey was carried out in 2005 between Porbandar and Junagadh districts to compare and assess the nesting ecology of high intensity nesting beaches. A high concentration of green turtle nests about 50-100 were found in five different beach stretches lying between Porbandar and Junagadh districts. (Records of Kurian and Sunderraj 2005, Kurian 2008).

While there has been continual research study along the Gujarat Coast since the 70's, conservation efforts for sea turtles are far too minimal, particularly considering the great length of the coastline. There are just five hatcheries set up by the Forest Department, and the oldest of these functioning over the last two decades are located at Madhavpur and Kachchh. Details of the Kachchh hatchery from 1985-2006 has been reported by Meena et al (2007).

Nesting crawl at Santeshwar beach

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STATUS AND LOCATION OF NESTING BEACHES

Gujarat has the longest coastline in India, measuring 1650 km, out of which 520 km is found suitable for turtle nesting (Sunderraj 2002.) The coast is broadly divided into three different geographical parts, namely Kachchh, Saurashtra coast and main land coast and five sub-regions, based on specific inter-tidal characteristics (Patel 1997 and Sunderraj et al 2006).

The study area is situated in Saurashtra coast, from Jamnagar (Okha) to Bhavnagar, which includes the districts of Junagadh, Amreli and Porbandar, ranging more than 450 km. Based on observations from the current survey, the composition of Gujarat beaches is distinct from each other. 62 % of area covers sandy patches, 25% sandy and rocky, and 13 % beach type is muddy and rocky. The nesting beaches found along the Saurashtra stretch, were mostly sandy in nature, and were concentrated in the central part. Few rocky and sandy stretches were found occurring on the east and west of the peninsula, and muddy and sandy stretches located at the far end of the east and western sides. Of the 39 stretches surveyed in the Saurashtra region, 22 potential sea turtle nesting sites have been listed in the three sections of map – 1) Dwarka to Madhavpur 2) Madhavpur to Chorwad and 3) Adri to Santeshwar – given below:

Potential sea turtle nesting sites on the Saurashtra region of Gujarat Coast.

FIGURE 1. DWARKA TO MADHAVPUR

FIGURE 2. MADHAVPUR TO CHORWAD

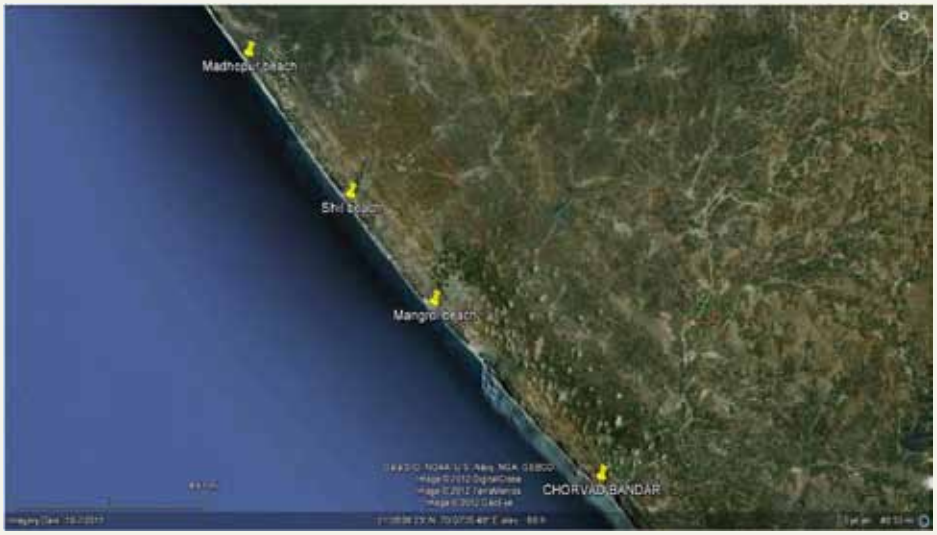

FIGURE 3. ADRI TO SANTESHWAR

METHODOLOGY

The nesting survey of the Gujarat coast was carried out primarily in the Saurashtra region, along the coastal districts of Jamnagar, Porbandar, and Junagadh. Amreli and Bhavnagar which are part of the mainland coast and Kachchh and Gulf of Khambhat regions of Gujarat were also included, but had less intensive surveys. The PNC (Prakruthi Nature Club) has been involved in sea turtle conservation for the last eight years along the Gujarat coast. As per their observations, in the last six years turtle nesting season occurs mainly between October to March. Pre-nesting surveys to identify suitable beaches for monitoring, was carried out between March 2011 and July 2011. This period did not record any nesting activity.

The beach identification process included field observations and collection of secondary information from Forest and Fisheries Departments, and fisher folk along the beaches. Based on this, 39 coastal stretches were selected for further monitoring,

from the districts of Jamnagar, Porbandar, Junagadh including Diu, an island located off the Junagadh coast. The total distance covered in the selected areas was 240 km. Nesting surveys were carried out between September 2011 and March 2012. The beaches were monitored on foot, averaging 10 km/day, on a monthly basis. Depending on feasibility, both day and night surveys were carried out.

The co-ordinates of 39 selected nesting stretches, including potential sea turtle nesting beaches identified, are tabulated as below:

TABLE 1. CO-ORDINATES OF THE 39 NESTING STRETCHES SURVEYED

S. No	Surveyed beach stretches	Surveyed distance (kms)	Co-ordinates
JAMNAGAR DISTRICT			
1	Jamnagar -Positra	60	N22°27'59.9466" E70°3'59.9256
2	Positra-Mithapur	6	N22° 25'.202 E 68 59'.545
3	Mithapur-Shivrajpur	5	N22° 19'.422 E 68 56'.452
4	Shivrajpur-Dalda*	7	N22 °16.332 E 68 57'.057
5	Dalda-Dwarka	15	N22 °14'.393 E 68 57'.637
6	Dwarka-Harshad Mata	11	N21° 52' 55.35 E 69 18' 00.15"
7	Harshad Mata-Miyani*	10	N21 °50'.249 E 69 22'.236
PORBANDAR DISTRICT			
8	Miyani-Porbandar	26	N 21° 50' 16 .18 E 69 23' 04.55"
9	Porbandar-Odadar	5	N21° 34' 26.74" E69 39'53.23"
10	Odadar-Gosabara	8	N21° 32'.406 E 69 42'.711
11	Gosabara-Narwai *	9	N21°28' 48.69" E 69 45' 29.37"
12	Narwai-Navibandar *	4	N21° 32' 05.26" E69 42' 29.57"
13	Navibandar-Ratia*	5	N21° 30' 07 87" E69 44' 18.02"
14	Ratia-Untda*	5	N21° 23' 45.62" E69 45' 49.02"
15	Untda-Balej *	5	N21° 23' 15.08" E69 50' 24.90"
16	Balej-Bhansara*	4	N21 °29' 58.98" E69 51' 31.87"
17	Bhansara-Gorser*	5	N21° 17' 58.81" E69 55' 03.33"
18	Gorser-Chingariya	3.5	N21° 17' 07.08" E69 55' 50.58"
19	Chingariya-Madhavpur	4	N21 °15'.513 E69 57'.976
JUNAGADH DISTRICT			
20	Madhavpur-Antroli	4	N 21° 15'.786 E 69 57'.061"
21	Sangwada-Shil*	3.5	N21°10'53.49" E 70.01' 32.60"
22	Shil -Lohej*	3	N21°10'18.13" E 70 02' 07.27"
23	Lohej-Maktupur	7	N21°09' 20.42" E 70 02' 58.37"
24	Maktupur-Mangrol	6	N21°07' 36.39" E 70.04' 40.25"
25	Mangrol-Mangrol Bara*	3	N21° 05' 42.68" E70.06' 54.88"
26	Mangrol Bara-Khodada	7	N21° 03' 25.99" E70.09' 24.94"
27	Chorwad-Adri	7	N20 °59'. 990 E 70 13'.761
28	Adri-Veraval*	7	N 20° 56' 24.60"E 7 18' 26.70"
29	Veraval-Sutrapada	6	N20 °51' 10.67"E70 26' 40.46"
30	Sutrapada- Zala-na-Vadodara*	5	N20 °53'.705 E70 27'. 233
31	Zala-na-Vadodara- Dhamlej*	6	N20 °46' 44.38"E 70.35'49.06"

32	Dhamlej-Barda	2	N20 °46' 17.92"E 70.36' 56.30"
33	Barda-Mul Dwarka	1	N20 °46' 06.60"E 70 38' 10.32"
34	Mul Dwarka-Chara	4	N20 °45'.796 E 70 39'. 614
35	Chara-Sarkhadi	3	N20° 44' 0.72" E 70 42' 41.90"
36	Sarkhadi-Santeshwar*	9	N20° 43' 21.13" E 70 45' 25.43"
37	Santeshwar-Madhada*	1	N20° 42' 08.22" E 70 48' 16.78"
38	Madhada-Kotda	1	N43°38'19.39" W116°14'28.86"
39	Diu-Vanakabra	3	N20°42'36.000" E 000°58'48.
	Total distance monitored	**226**	

**Potential Turtle Nesting Beaches*

CURRENT DISTRIBUTION AND STATUS OF MARINE TURTLES

NESTING SURVEY

Stranded green sea turtle in Gujarat

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In Gujarat, the nesting season previously recorded for both and green turtle was between the months of June and January. Olive ridley nesting began in June and ended in early November, while green turtles nest between July and January (Bhaskar, 1984). However, PNC has observed variations in the nesting season over the last six years and records the nesting activity to be commencing in October and ending in March. For the current season (2011), turtle nesting along the Gujarat coast began only by late December. Field surveys included collection of nest related information like crawl marks, nests with eggs, egg tills, nest distance from high tide line, live nesting, and documentation of threats to nesting areas and stranded turtles.

Secondary information collected from various stakeholders indicate a history of 10-15 years of turtle nesting along the Saurashtra coast. From the surveyed coastal stretches, nests were found to be located at a range of 12-25 mtrs from the high tide line. A total of 219 nests have been recorded from the region, where almost all were observed to be green turtle nests. Only one nest of olive ridley was recorded from the Madhavpur beach located in the Porbandar coast.

The Kachchh coast could not be extensively covered in the current survey. Of the 406 km of coastline, only 15 km could be surveyed. A total of 3 nests could be recorded from this stretch. The place has a hatchery where nests are relocated; hence the above observation may not be an absolute number. As per secondary information, nesting has declined over the years in Kachchh, particularly along the Narayan Sarovar-Koteshwar temple area near Kachchh and Pakistan border. Areas monitored were the

coastal districts of Jamnagar, Porbandar, and Junagadh. The following tables (2, 3 and 4) show the number of green turtle nests recorded from the districts. They include individual coastal stretches surveyed, and the overall nesting intensity of the various coastal districts. The beach stretches or its classification found within these districts are not always common to the GOI-UNDP survey (2000). There are new beach stretches; or wider stretches that include the places of earlier study, and sometimes do not include places previously surveyed.

JAMNAGAR COAST

The Jamnagar coast is 355 kms long, extending from Bedi Bunder in the Gulf of Kachchh region to Harshad in the Porbandar district. Along this stretch, 142 kms were monitored, and throughout, the only turtle species/nests found was of the green turtles. Data given in table 2 also corresponds to green turtle nesting. In the Jamnagar-Positra stretch only 10kms were monitored in the survey, and no nests were found. Since a hatchery located at Positra relocates nests from surrounding areas including Baidher Island, which is a total distance of 60 km, this stretch has been included in table 2, for determining nesting density. For the current nesting season, 13 nests were found relocated into the hatchery. All of them were green turtle nests, as confirmed by the hatchery maintainer.

Bhaider Island had no nesting for the current season, as seen from our field observations and secondary information collected. Earlier in 2000, Bhaider Island had recorded the highest nesting density for the Jamnagar coast; 33 olive ridleys and 3 green turtle nests from 2.5 km stretch of beach. Along the same stretch in 1984, Bhaskar had recorded 76 nests in a single night survey. The nesting history across 30 years in Bhaider Island ranges from a record of 76 nests in 1984 to 0 in the current season; indicative of a critical decline in nesting numbers for the area.

TABLE 2. NESTING STATUS ALONG THE JAMNAGAR COAST

Sr.No	Nesting Beach	Distance Surveyed (km)	Number of Nests (green turtle)
1	Jamnagar -Positra	60	13
2	Baidher Island	2	0
3	Positra-Mithapur	6	6
4	Mithapur-Shivrajpur	5	3
5	Shivrajpur-Dalda	7	11
6	Dalda-Dwarka	15	4
7	Dwarka-Harshad Mata	11	12
8	Harshad Mata-Miyani	10	4
	Total	**116**	**53**
NESTING DENSITY=0.46NESTS/KM			

Total nesting for Jamnagar coast was 53 nests, all of which were observed to be green turtles. Olive ridley nests were completely absent. The nesting intensity for the area was found to be 0.46 nests/ km for green turtles. In the GOI-UNDP sea turtle project carried out in the year 2000 (Sunderraj et al 2006), 234 green turtles and 90 olive ridley nests were recorded from 111.5 km of beach surveyed along the Jamnagar coast. The nesting intensity was found to be (2.10) and (0.81) respectively. The UNEP-CMS survey of 2004 recorded 324 nests from 111.5 km of beach surveyed and the nesting

intensity was found to be 2.91 nests/km stretch. The current survey, observes a drastic decline of green and olive ridley turtle populations, in the surveyed districts of Saurashtra coast. However, the results cannot indicate absolute densities considering the limited number of surveys and areas covered.

PORBANDAR COAST

The coastline of Porbandar is 106 km long, stretching between the Jamnagar and Junagadh coasts. Of the total stretch, 83.5 km was monitored and, the nesting species observed was mostly the green turtle, except for one olive ridley nest from the Madhavpur beach area. Between Jamnagar and Junagadh 12 stretches of beach were surveyed and recorded a total of 74 nests. The beach stretch between Navibandar and Ratia recorded 11 nests, which was highest for the area, and the stretch between Odadar and Gosabara recorded the lowest of just 2 nests. These may not be absolute numbers due to presence of hatcheries (three) located in area, where turtle nests' from the entire Porbandar are relocated. Surveys carried out in the year 2000 (Sunderraj et al 2006), along 84 kms of Porbandar stretch, from Miyani to Madhavpur recorded 127 nests of green turtles.

TABLE 3. NESTING STATUS ALONG THE PORBANDAR COAST

Sr. No	Nesting Beach	Distance Surveyed (km)	Number of Nests (green turtle)
1.	Miyani-Porbandar	26	6
2.	Porbandar-Odadar	5	5
3.	Odadar-Gosabara	8	2
4.	Gosabara-Narwai	9	6
5.	Narwai-Navibandar	4	9
6.	Navibandar-Ratia	5	11
7.	Ratia-Untda	5	7
8.	Untda-Balej	5	6
9.	Balej-Bhansara	4	8
10.	Bhansara-Gorser	5	7
11.	Gorser-Chingariya	3.5	3
12.	Chingariya-Madhavpur*	4	4
	Total	**83.5**	**74**
Nesting Density = 0.88 Nests/Km			

**Only one olive ridley nest found.*

The highest number of green turtle nests (38) were recorded in the Kantla-Kachhadi stretch. The Navibandar-Ratia stretch (in the current survey) had recorded 2 nests. Some of the other stretches between Gorser to Madhavpur had just 2 nests, but the current survey shows a slight increase in numbers to 7 nests. The nesting intensity for the year 2000 was 1.51 nests/km for the Porbandar coast; the current survey shows a density of 0.88 nests/km.

JUNAGADH COAST

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Garbage littered along the Junagadh coast

The Junagadh coast extends between the Porbandar and Amreli coasts and has an approximate length of 155 km. of which, 85.5 km was monitored. The only turtle species found nesting was the green turtle. In the study by Sunderraj et al 2006, the Junagadh coast included the Porbandar area as well. But as Porbandar is a separate coastal district, the current survey has tabulated observations for both Junagadh and Porbandar separately. Along the Junagadh stretch, 20 different beach areas were surveyed and the total number of nests found was 104, which shows a slight increase in green turtle nesting numbers, as the previous study (Sunderraj et al 2006) carried out along 86.5 km of Junagadh stretch recorded 98 green turtle nests. In the latter survey, the Mangrol-Bada stretch recorded 28 green turtle nests in a 5 km stretch. In the current survey, named as the Mangrol-Mangrol Bara stretch showed a decline in numbers to just 5 nests in a 3 km stretch surveyed.

TABLE 4. NESTING STATUS ALONG THE JUNAGADH COAST

Sr.No	Nesting Beach	Distance Surveyed (kms)	Number of Nests (green turtle)
1.	Madhavpur-Antroli*	4	5
2.	Sangwada-Shil*	3.5	7
3.	Shil -Lohej	3	8
4.	Lohej-Maktupur	7	4
5.	Maktupur-Mangrol*	6	3
6.	Mangrol-Mangrol Bara	3	5
7.	Mangrol Bara-Khodada	7	3
8.	Chorwad-Adri	7	2
9.	Adri-Veraval	7	9
10.	Veraval-Sutrapada	6	5
11.	Sutrapada- Jala-na-Vadodara	5	6
12.	Jala-na-Vadodara- Dhamlej*	6	10
13.	Dhamlej-Barda	2	2
14.	Barda-Mul Dwarka*	1	4
15.	Mul Dwarka-Chara	4	5
16.	Chara-Sarkhadi	3	6
17.	Sarkhadi-Santeshwar	9	8
18.	Santeshwar-Madhwada*	1	12
19.	Madhwada-Kotda	1	0

20.	Diu-Vanakabra	3	0
	Total	**85.5**	**104**
Nesting Density = 1.22 Nests/Km			

But nesting in the Jala-na-Vadodara (called Vadodarajala in, Sunderraj et al 2000) to Dhamlej, Antroli-Shill and Santeshwar-Madhwada (stretch not covered in the 2000 survey) stretches, showed a noticeable increase from no green and olive ridley turtle nests (Sunderraj et al 2000) to 12 green turtle nests in the current survey. A similar trend is noticed in the Dhamlej - Mul Dwaraka, and Maktupur-Mangrol beach stretches. A small decrease in green turtle nests in some of the beaches of the current survey is also evident. The beaches between Mul Dwaraka and Vanakabra are additional stretches surveyed, and not covered in the previous study (survey of Sunderraj et al 2000).

In the current survey, nesting density for green turtles along the Junagadh coast is 1.22 nests/km, which indicates a marginal increase in a decade's time from the last survey carried out (i.e. Sunderraj et al 2000) which showed a nesting density of 1.13 nests/km.

DECADAL STATUS OF TURTLE NESTING – UNDP, UNEP, AND WWF-INDIA SURVEYS

The coastal districts of Jamnagar, Porbandar and Junagadh are considered to be potential nesting locations along Gujarat coast, as seen from the GOI-UNDP and UNEP-CMS surveys. These districts have also been focused on in the current WWF-India Sea Turtle Survey (2011-2012). In table 5 the three potential nesting locations have been considered for comparing total nest counts and nesting densities between the years 2000, 2004, and 2012. These numbers are only indicative as seasons, area covered and months may have been different.

TABLE 5. DECADAL STATUS OF NESTING ALONG THE SAURASHTRA COAST (2000-2012).

Sr.No	Nesting Habitats	GOI-UNDP 2000-2001	UNEP-CMS 2004-2005	WWF-INDIA 2011-2012
1	Jamnagar	324	945	53
2	Porbandar	155	449	74
3	Junagadh	124	508	104
	Total Nests	**603**	**1902**	**231**
	Total Distance Surveyed	**282**	**73.5**	**285**
	Nests/km	**2.14**	**25.88**	**0.81**

Source:(GOI-UNDP)Sunderraj et al (2002); (UNEP-CMS) Sunderraj et al (2006)

The other areas such as Kachchh, Bhavnagar, Amreli, and Valsad have had very limited surveys for 2012 and hence have not been included. For the year 2000, the GOI-UNDP survey recorded a total nest count of 603 nests from Jamnagar, Porbandar and Junagadh districts; total distance surveyed was 282 km, and nests include that of olive ridley and green turtle. The total nesting density was estimated to be 2.14 nests/km. In the year 2004 the UNEP-CMS survey was launched, which was a more detailed survey compared to the previous one. The survey recorded a total nest count of 1902 nest from 73.5 km surveyed; and the nesting density was 25.88 nests/km stretch.

Almost a decade later (2011-2012), the same districts have been surveyed and records show 231 nests out of 285 km covered. The nesting density was recorded to be 0.81 nests/km, which is exactly half the figure of the year 2000. Besides only one olive ridley nest was found from the Porbandar coast for the entire Saurashtra region. Bhaider island which was previously abundant with turtle nests in the years 2000 and 1984, did not record any nesting activity in the current season(2011-2012). These observations suggest an overall decline of nesting numbers in the Saurashtra coast, and species wise decline of olive ridley numbers.

VERAVAL TO KODINAR STRETCH

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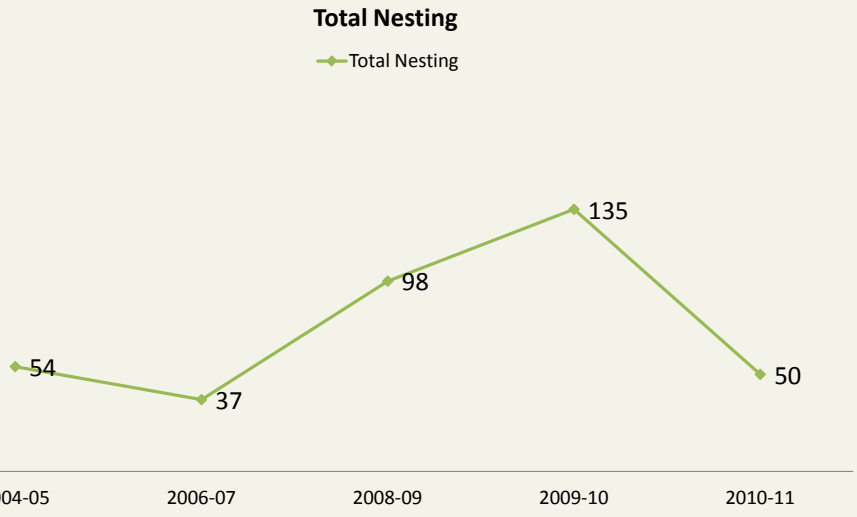
Hatchlings emerging from a nest near the Kodinar beach

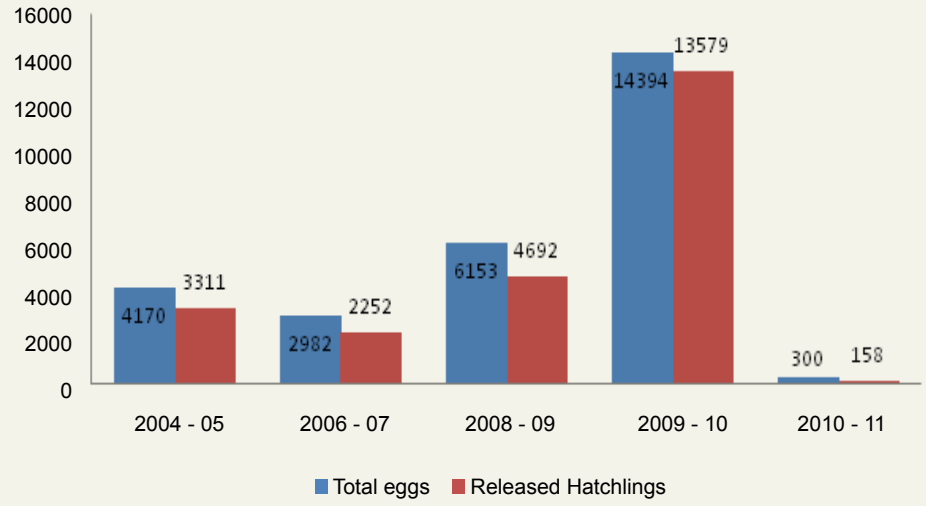
This stretch lies along the Junagadh coast and is approximately 40km long. The places between Veraval to Chara (as shown in Table 4) are found along this stretch. It has been regularly monitored since 2004 to date by the members of the Prakruthi Nature Club (PNC) and Forest Department. Although other parts of Gujarat coast lack consistent monitoring, a nesting pattern can be observed below (Fig 4) for this particular stretch. Starting from a total of 54 nests in 2004, increased gradually to a peak of 135 nests in 2009-2010, and then recorded a steep decline of 50 nests in 2010-2011 and subsequently receding to 41 nests for 2012

FIGURE 4 NESTING PATTERN (2004-2011) IN THE VERAVAL TO KODINAR STRETCH



Source: PNC and Forest Department

FIGURE 5 HATCHERY DETAILS (2004-2011) IN THE VERAVAL- KODINAR STRETCH



Source: PNC and Forest Department 2004-2011

MORTALITIES

A green turtle captured during fishing and mutilated of all 4 flippers. It was found stranded on the Kodinar coast on June 2012.

© DINESH GOSWAMY AND JIGNESH GOHIL

During the current nesting season a total of 41 dead turtles were found washed ashore. They were sighted between the months of October 2011 and June 2012. The Mangrol to Gosabara stretch in the Porbandar district recorded 13 dead green turtles between October and November 2011 and during December another 26 dead turtles were found along the same stretch. The mortalities were linked to a Cyclone at sea. Two dead green turtles were found in the Gulf of Kachchh during the month of December; one washed ashore and the other floating in sea. One green turtle was found stranded on the Kodinar shore in June 2012 with of all four flippers mutilated, thereby resulting in its mortality. Fishermen engage in such acts to prevent damage to their fishing nets.

THREATS

NESTING BEACHES

Sand mining, a detrimental activity to turtle nesting, persists unabated all along the Gujarat Coast. The effects and extent of the activity on nesting beaches of Gujarat has been documented since the 70's. Elevated sandy beaches on islands like Deeds and Muada have over the last decades been "mined" down to spring high water level making nesting by sea turtles on the exposed water-logged silt impossible. Between

sand and coral mining India stands to lose its two mainland reefs and associated marine life, including the turtles (Bhaskar 1979).

Beach sand erosion at Santeshwar

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Erosion of sand is a big issue on Chara and Santeshwar beach of Kodinar which is found to destroy nests and deter nesting turtles. Last year Chara had nesting of 26 turtles and in 2012 recorded only 4 nests, which indicates considerable decrease in turtle nesting for the area. With the exception of Jamnagar Marine National Park all other beaches surveyed in the districts of Jamnagar, Junagadh, Porbandhar, Amreli, Bhavnagar and Ahmedabad have been affected by beach erosion. The coast of Ahmedabad is marshy in nature with no potential sandy beaches for nesting.

INCIDENTAL CATCH

All coastal areas monitored in the three districts, including partially surveyed areas of Amreli, and Bhavnagar have revealed the incidental capture of turtles - leading to its mortalities. However, in many cases, even as turtles are caught alive in fishing nets, they are killed or injured by fishermen, to save nets from further damage. Turtles get captured in Trawl or Gill nets, which account for 48% and 52% of their mortalities respectively. The use of trawl nets during fishing is highly concentrated in the Jamnagar and Porbandar areas. Gill nets are found commonly used in Porbandar, Amreli and Bhavnagar. But some areas like Mangrol, Veraval, Diu, Rohisa and Jafrabad lying in the Porbandar and Amreli stretches have the use of both Trawl and Gill nets. The current survey has also observed incidental captures of turtles in the Marine National Park of the Jamnagar area.

EXPLOITATION FOR MEAT AND EGGS

None of the areas surveyed have recorded the exploitation of turtles in the current year or even in the last five years. In the past farmers used to hunt for turtle eggs, as consuming the liquid inside by their bullocks, was believed to prevent them from excessive drooling. However there are still unconfirmed reports of exploitation reported from the Mangrol and Chorwad areas of Junagadh coast. Previously, exploitation of turtle eggs was prevalent in the Veraval area. The Waghiris and Kolis were the two main communities involved in the consumption of turtle eggs in Gujarat (Sunderraj et al 2006). The involvement of PNC in exposing this activity and thereby strengthening legal protection has reduced the exploitation rates in the Veraval area.

IMPACTS OF COASTAL DEVELOPMENT

Development of ports, jetties and SEZs are the biggest issues in turtle conservation. There are over 50 ports along the Gujarat coast, and Saurashtra region has approximately 20 ports (source: Gujarat Maritime Board); new ports and SEZs are proposed at Jakhau, Porbandar, Kodinar, Veraval, and Shivrajpur. Shapurji Pallonji a major construction company of Gujarat is involved in the construction of a port coming up on Chara beach which is potential turtle nesting area as well. Additionally a cement plant is in the process of coming up on Shivrajpur-Kachigad beach, known to be another potential turtle nesting site.

Waste disposal at Alang Ship Breaking Yard

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Alang the largest ship breaking yard in the country (Sunderraj et al 2006) in the Gulf of Khambhat is another player that pollutes the coast line of Gujarat. Earlier waste from this yard sprawled over to the Gulf of Khambhat, but now this waste containing oil spillage has travelled up to the Veraval coast lying north-west to Alang. Abandoned plastic nets, oil spillage, and plastic waste from ship breaking yards is destroying turtle nesting sites. Throwing waste gill nets on the beach is found to be trapping turtle hatchlings on their way to the sea and, obstructing adult turtles during nesting. Very often, this action has also resulted in the death of hatchlings and adults.

TABLE 6. THREATS TO TURTLE NESTING ALONG THE SAURASHTRA COAST

Surveyed Area	District	Nesting Species	Threats, and Impacts on Nesting
Okha and Bet Dwarka	Jamnagar	Green	Nesting is high here. But there are impending threats from Mining and Jetty, Fishing Yard, Port etc.
Dwarka	Jamnagar	Green	Nesting is low due to tourism, development, hotels, and fishing areas.
Okhamadhi	Jamnagar	Green	Windmill development and lightnings.
Veraval	Junagadh	Green	Nesting numbers affected due to sand mining.
Sutrapada	Junagadh	Green	Nesting has reduced due to Industrial pollution in sea water and sand mining.
Diu	Junagadh	Green	Nesting numbers greatly affected due to tourism, Hotels, and lightings.
Rohisa	Amreli	Green	Nesting numbers greatly affected due to industrial pollution.

Jafrabad	Amreli	Green	Nesting numbers greatly affected in the last 2 years due to ports, power plants, cement industries, pollution in sea water and lighting.
Mahuva	Bhavnagar	Green	Nesting numbers greatly affected from shipping yards, sand mining and lightings and coastal development.

CONSERVATION EFFORTS

Hatchling release by Prakruthi Nature Club

Hatchling release at Madhavpur Hatchery

On the Gujarat coast, there are no major conservation activities for sea turtles. Only visible are the turtle hatcheries initiated by the Forest Department, and a hatchery in the Kodinar beach operated the Prakruthi Nature Club members. Hatcheries are found located at areas like Mangrol, Madhavpur-Ghed, Odadar, and Rangbai in Porbandar district, Positra in Jamnagar, Kodinar hatchery in Junagadh district, and Mandvi, Dwarka Nalliya in the Kachchh region. The only operational hatcheries or that are working on a regular basis are at Madhavpur which has been functioning for the last twenty years. The hatchery at Kodinar which has been monitoring the Veraval to Kodinar stretch since 2004 and the Positra hatchery.

RECOMMENDATIONS

The rapidly expanding industrialization along Gujarat coast is putting tremendous pressure on the coastal biodiversity. Sea turtle habitats along the coast and at sea face serious threat. Nesting numbers have already declined to alarming levels as evidenced by the current study and from our (PNC) observations of the coast over the years, particularly the Kodinar stretch. We advocate urgent conservation action along the Gujarat coast, through the following measures:

1. Sea turtles and its conservation is a majorly neglected area in the state of Gujarat. Media reports reveal the lack of interest by the Union and State governments in the research and conservation of turtles, as the opportunity for industrial development is immensely high in Gujarat. In the current state of affairs, a massive awareness programme has to be raised all along the coastline involving many stakeholders; wherein conservation of nesting habitats and all coastal

resources should be addressed. As pointed out in the UNEP-CMS survey the awareness programmes should span across- coastal communities involving fisher folk, coastal villagers and NGOs; educational institutions involving staff and students of both colleges and schools; coastal industrial sectors; and coastal protection forces involving Forest Department, Coast Guard and Marine Police; fisheries and Custom departments should be equally involved.

2. Sand mining poses a huge threat to nesting beaches along the Gujarat coast. This is especially gaining ground along the Jamnagar coast. Large pits created by the activity have been recently noticed along the Okha, Shivrajpur, Mithapur, Dwarka and Lamba areas. Apart from destroying nesting areas, turtles have also been found trapped in these pits. In the current status survey, Jamnagar has recorded the least number of nests (53) which is less than a fourth the figure obtained a decade ago. This is a critical situation for the survival of turtles, and requires governmental intervention. It would be helpful to arrange at the earliest, an open dialogue between sea turtle conservationists and the State Government of Gujarat

3. Sea turtles are least exploited for their eggs or meat in the state of Gujarat. However, their incidental catches and subsequent mortalities in gill and trawl fishing nets is of considerable concern, given that the current nesting activity along Gujarat coast has declined to an alarming level. Sometimes incidental catches also lead to fishermen brutally incapacitating the turtle, to prevent damage to nets. There are incidents of all flippers being severed, along the Saurashtra coast. These situations can be prevented by compulsorily installing Turtle Excluder Devices in trawl nets, and educating fishermen to disentangle trapped turtles in nets rather than injuring them. Compensating fishermen for any loss of catch due to TEDS installed, or damage to nets caused by turtles can motivate fishermen in adopting these conservation measures.

4. Due to increased industrial activities along the Gujarat coast, marine debris is noticed to be accumulating in sea water and on beaches; therefore polluting the habitats of sea turtles. Abandoned plastic, fishing nets, oil slicks and other waste discarded in water and on beaches pose a big threat to turtles while migrating or foraging in water, nesting on land, and to hatchlings emerging from the sand. A regular clean up is necessary, and can be done only with organised group efforts. Coast guards, schools, colleges, personnel from coast based industrial and tourism units, and interested public can be involved to carry out regular beach cleanup activities.

5. Turtle conservation activities along Gujarat coast are limited to those imitated by the Forest Department, and are only a few. Fishermen groups should be organised in every coastal district and these groups should be trained and supported with adequate funds by NGOs and Forest Department to engage in nest monitoring and coastal protection activities. To begin with, one fisher's group can be organised in every coastal district. NGOs and Forest Department personnel can team with the fishers to give impetus to the conservation activity. These groups can also be trained in carrying out basic research activities pertaining to turtles and the coast in general.

6. Stakeholders trained during awareness programs should ultimately join forces and dialogue with the Gujarat government for strategizing conservation measures and reviewing the need and extent to which coast based developmental activities can be carried out along the Gujarat coast. Guidelines for the operation of industries and tourism units on the coast should be addressed and designed during the process of the dialogue.

7. Long term recommendations for sea turtle research along Gujarat coast have been listed in detail in the UNEP-CMS survey by Sunderraj et al (2006); these are important, and as they are still relevant to the current context, we would like to reinstate them for the long term conservation of turtles along the coast:

    - Annual survey of nesting populations covering the entire Gujarat coast during the peak nesting season of both olive ridley and green turtles to understand the nesting potential of rest of the coast.
    - Monitoring of feeding populations, their distribution and the impact of incidental catch through off shore surveys.
    - Monitoring of migration through tagging of nesting and feeding populations which would also help to study the population structure (age and size class) and sex ratio of both species.
    - Monitoring and quantitative assessment of threats related to coastal development including.
    - coastal industries, ports, cargo movements and fisheries (increase in fishing vessels and fisher populations) to understand sea turtle mortality.
    - Study on quantitative assessment of threats to nesting population and habitats like animal and egg predation, status of predators, sand mining and spread of invasive species, oil particles and domestic sewage pollution along the coast are very important.
    - Basic research to understand nesting biology including nesting seasonality, re-nesting intervals, nesting behavior, clutch size, egg morphology, incubation period, hatching success etc.

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+1,520

Work days to complete the study

9

Coastal states surveyed

+10

Organizations worked together on this study

+3.7 Lacs

Olive ridleys mass nest in Orissa

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