

MONITORING AND NETWORKING FOR SEA TURTLE CONSERVATION IN INDIA

Centre For Herpetology/Madras Crocodile Bank Trust

Bombay Natural History Society

Gujarat Institute of Desert Ecology

Sálim Ali Centre For Ornithology And Natural History

A UNEP CMS PROJECT



CITATIONS

Any reference that concerns the execution of the project or the overview of the project may be cited as:

Shanker, K. and H. Andrews (2006) *Monitoring and networking for sea turtle conservation in India: a UNEP CMS project report*. Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu.

All material contained in chapters 2 to 5 referring to data or results from the projects conducted in the states must be cited as follows:

Sunderraj S.F.W., J. Joshua, L. Brahmabhatt, A. Saravanakumar, B. Muthuraman and S.K. Das (2006) The status of sea turtle populations on the Gujarat coast. In: *Monitoring and networking for sea turtle conservation in India: a UNEP CMS project report* (eds. K. Shanker and H. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu.

Giri, V. (2006) The status of sea turtles on the Maharashtra and Goa coasts. In: *Monitoring and networking for sea turtle conservation in India: a UNEP CMS project report* (eds. K. Shanker and H. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu.

Bhupathy, S. M. Vijay, A.M.A. Nixon, J. Subramanean, R. Karunakaran and J. Gokulakrishnan (2006) The status of sea turtle populations on the Tamil Nadu and Kerala coasts. In: *Monitoring and networking for sea turtle conservation in India: a UNEP CMS project report* (eds. K. Shanker and H. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu.

Andrews, H.V., A. Tripathy, S. Aghue, S. Glen, S. John and K. Naveen (2006) The status of sea turtle populations in the Andaman and Nicobar Islands. In: *Monitoring and networking for sea turtle conservation in India: a UNEP CMS project report* (eds. K. Shanker and H. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu.

Published by:

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EXECUTIVE SUMMARY

Five of the seven species of marine turtles are found in Indian coastal waters and at least four have significant nesting beaches and/or feeding areas. Many turtle populations in Indian coastal waters are seriously affected by incidental catch in fisheries, coastal development, habitat loss and depredation of eggs. As a part of this collaborative project, monitoring programs and networking were initiated in Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu on the mainland coast of India and in the Andaman and Nicobar Islands. These programs were carried out by four partners including the Andaman and Nicobar Environmental Team, Bombay Natural History Society, Gujarat Institute of Desert Ecology and the Salim Ali Centre for Ornithology and Natural History. Index beaches were monitored during the nesting season in Gujarat, Maharashtra, Goa, Kerala, Tamil Nadu and the Andaman and Nicobar Islands. Forest Departments in each of the states and non-government organisations that work on sea turtles were contacted in each of the states, and workshops were conducted for capacity building and training. Tags were purchased to reinitiate PIT tagging of leatherback turtles in Great Nicobar Island and metal tagging of other species in the islands and on the mainland coast of India. However, tagging could not be initiated at some sites due to lack of permits. In the Andaman and Nicobar islands, the December 2004 tsunami destroyed many nesting beaches including Galathea, where the main monitoring program was being carried out. The project especially aimed at consolidating coastal surveys of populations and assessment of threats to sea turtles, and establishing mechanisms that will enable long term monitoring and conservation actions, by building capacity and networking with local institutions. This has been achieved to some extent, with the formation of a network of local non-government organisations. These organisations will be supported as a follow-up to this project to further sustain sea turtle monitoring and conservation along the coast.

Chapter 1

An overview of the UNEP – CMS project in India – 2003 to 2005

Kartik Shanker and Harry Andrews

INTRODUCTION

Five of the seven species of marine turtles are found in Indian coastal waters and at least four have significant nesting beaches and/or feeding areas. All these species are listed as endangered under Schedule 1 of the Indian Wildlife Act (1972) and in Appendix 1 of CITES. All sea turtles have declined in recent times (Ross, 1982), but Leatherbacks (*Dermochelys coriacea*) and Hawksbills (*Eretmochelys imbricata*) are considered to be globally endangered species (Spotila *et al.*, 1996; Meylan & Donnelly, 1999). Many turtle populations in Indian coastal waters are seriously threatened due to incidental catch in fisheries (Rajagopalan *et al.*, 2001), particularly the olive ridley (*Lepidochelys olivacea*) population in Orissa, where over 100,000 turtles have drowned as incidental catch in the last five years (Shanker *et al.*, 2004). Many factors need to come together for the conservation of these species, but none more than cooperation between agencies in different states and sectors within the country AND between governmental and non-governmental agencies in the region. A key component to this cooperation is the elucidation of the migrations of different populations in order to identify the complete habitat of each species. The Wildlife Institute of India (WII) recently implemented a UNDP – Government of India sea turtle conservation project. One of the main aims of the GOI – UNDP national sea turtle project was to evaluate the status of and threats to marine turtles along the entire coastline of India (see papers in Shanker & Choudhury, 2002). This was carried out by multiple agencies in different maritime states. While the survey revealed much valuable information (especially for many parts of the coast for which there was little prior information), full season surveys were not carried out at all sites. Hence, more extensive surveys and intensive data collection at key sites need to be carried out. Additional surveys would serve the multiple purposes of confirming status, densities and threats, tagging of animals in key areas, collection of samples for genetic analysis and building of networks for conservation.

The CMS project on ‘Monitoring the migrations of Indian Marine Turtles: towards an integrated and collaborative conservation programme’ was conceived to build on the platform created by the GOI UNDP project. Many of the partners from the earlier project, especially those involved in coastal surveys and networking were also partners in this project. The project especially aims at consolidating coastal surveys of populations of and threats to sea turtles, and establishing mechanisms that will enable long term monitoring and conservation actions, by capacity building and networking with local institutions.

The overall objectives of the project were:

1. To monitor the status of marine turtles at key sites along the Indian mainland coast and islands
2. To use research and monitoring programs to build a network with local institutions and agencies and to promote education and awareness programs amongst local communities
3. To identify the origins of marine turtles nesting on the Indian coast and to elucidate their migratory routes using conventional tagging, molecular genetics and satellite telemetry
4. To use research results to formulate a regional management plan and to foster sub-regional and regional collaborations that are necessary for the conservation of migratory species

PROJECT ACTIVITIES

Four agencies have been subcontracted to carry out the monitoring and networking activities on the coast of India. The agencies have initiated work at each of these sites, including surveys of nesting beaches, and networking with local organisations .

Agency	State	Importance of site
GuIDE	Gujarat	Mainland nesting beach for Green turtles
BNHS	Maharashtra - Karnataka	West coast nesting sites of ridleys, community based conservation of olive ridleys
SACON	Tamil Nadu, Kerala	Ridley nesting, Green turtle feeding grounds
ANET	Andaman & Nicobars	Nesting of 4 species, Feeding of Green turtles and Hawksbills

Each of the following chapters provides details about project activities, status of sea turtle populations and recommendations for each of these states.

RECONCILIATION AND MARINE CONSERVATION IN INDIA

In general, the Government of India has protected terrestrial species' habitats by declaring them as national parks and sanctuaries from which people are excluded entirely. The resulting conflicts persist unabated and unresolved today on the streets and in courtrooms. The rigidity of this exclusionist approach in terrestrial area management is in stark contrast to the flexible case-specific methods applied for the management of marine resources by government and non-government agencies. Marine ecosystems require management measures that are distinctly different from those currently practiced in terrestrial areas.

Much more densely inhabited than most forests, the coasts are necessarily used by numerous fishing communities concurrently. Community-based systems of fisheries management include fishing gear restrictions or closed seasons in specific areas, or bans on particular forms of fishing such as night fishing or dynamite fishing. In the late 1970s, modern fishing methods threatened the livelihoods of these communities and coastal ecosystems: mechanised craft and gear, principally trawlers with bottom trawling methods severely impacted fishing stocks. By the early 1980s, many coastal states in India had responded by introducing legislation and formalized some of the existing management measures in the form of Marine Fisheries (Regulation) Acts. For example, the Orissa Marine Fisheries (Regulation) Act (OMFRA), introduced in 1982, prohibits all trawlers from fishing within 5 kilometre (km) of the shore. Through this law, the state has also regulated the use of certain fishing gears and permits only certain fishing practices in areas of turtle congregation. These laws are not designed to exclude people from their marine environments. It appears that these kinds of conservation measures also recognise that humans have historically 'used' or consumed marine species, including those now classified as 'endangered'. Therefore, fisheries management prescribes conservation options that allow for the presence of humans and human activity, but calls for modifications in the range, intensity and nature of these activities.

For example, in Orissa, conservationists have been trying for the last few years to prevent olive ridley turtles from being trapped in trawl fishing nets. National and international efforts to introduce Turtle Excluder Devices and to keep trawlers out of the Gahirmatha Marine Sanctuary have failed, due to the strong resistance from the trawling community. Already there was considerable discontent among various fishing communities, since the 1997 declaration of the Gahirmatha Marine Sanctuary, which denied them all of their fishing rights within a delineated core zone. Conservationists now recognise that a more effective strategy would be to focus efforts on the protection of offshore congregation patches. They also recognise that within the congregation areas, certain forms of fishing might be benign. Since most major turtle congregations occur within 5-6 km of the shore, merely enforcing the fishing regulations of the OMFRA, which bans all mechanised fishing within 5 km of the coast, would effectively help in conserving these turtle populations. In contrast to laws governing protected areas, the OMFRA also has the flexibility to formulate creative rules that are area, activity and time specific.

Many believe that wildlife conservation can succeed if it is done through means that protect people's livelihood rights rather than those of a single endangered species. For example, protecting the interests of the traditional fisherfolk through the implementation of the OMFRA, the turtle congregations within the near-shore areas would have been protected, albeit inadvertently. Today, conservationists and fisherfolk have rallied under the banner of the Orissa Marine Resources Conservation Consortium. This alliance is possible because the fisheries laws only exclude certain activities rather than people. Not only can this practical, context-specific model form the basis for marine conservation in future, it could also serve as a powerful tool in refining terrestrial conservation methods.

FUTURE PLANS

It is believed that the monitoring and networking programmes must continue for a period of about 5 years at least, in order to build adequate capacity to enable these programmes to sustain themselves. The coastal networks must receive support in the form of training, information and funding. Thus, the project is seeking funding support to continue the monitoring and support of local communities and NGOs for the next 3 –5 years. The project also seeks to incorporate sites such as Andhra Pradesh and Orissa which were not included in the current project for logistic reasons. It is essential for long term monitoring programmes to be continuous and not lapse in between. This is especially true for tagging programmes, whose value is substantially diminished if tagging is not carried out during intervening years. Thus the project is seeking permits and funding to allow it to carry out these programmes continuously over the next 3 – 5 years.

It is currently expected that funding for such an enterprise will be received as part of a larger network for Coastal Enterprise Livelihoods and Conservation programme on the coast of India, implemented by the Covenant Centre for Development, Madurai.

Chapter 2

The status of sea turtle populations on the Gujarat coast of India

Sunderraj S.F.W., J. Joshua, L. Brahmhatt, A. Saravanakumar, B. Muthuraman and S.K. Das

INTRODUCTION

Gujarat state is bestowed with 92 species of reptiles from 63 genera belonging to 20 families (Vyas, 1998a), which includes four species of sea turtles, Olive ridley (*Lepidochelys olivacea*), Green turtle (*Chelonia mydas*), Leatherback Sea turtle (*Dermochelys coriacea*) and Hawksbill turtle (*Eromochelys imbricate*). However four turtle species are believed to occur in the state, only the breeding of Olive ridley and Green turtle has been established in Gujarat coast (Bhaskar 1978; Kar and Bhaskar 1982 and Bhaskar 1984), while other two were occasionally sighted by local fishermen. Frazier (1980) discussed about the threats to marine turtles of Gujarat in terms of egg and animal poaching, in addition to information available on an international tag return (Firdous 1991), and necropsies from stranded animal (Frazier 1989). Except for these sketchy and old survey reports, there is no detailed and recent information available on nesting population and potential nesting habitats.

Though sea turtle research activities started in late 70's in Gujarat coast, most of them were short term and rapid surveys. A recent study by Sunderraj et al. (2002), based on one time survey discussed about nesting density, egg predation and qualitative information on threats like mining and beach contamination due to spread of oil particles and sea garbage etc. In spite of Gujarat coast supporting comparatively more nesting population of green turtles among other maritime states of the country and providing nesting beaches for Olive ridley, no long term data is available.

Threat to coastal and marine environments

Gujarat coast and marine environments faces threats from rapid industrial and urban development. Gujarat being one of the industrial states of the country, many large scale industries are housed in the coastal districts. It is estimated that, out of 1.7 million registered small scale industries in the state, one third of them are located in the coastal districts. Cements, petrochemicals, pharmaceutical, textile pulp and paper, pesticides and insecticides and salt are the water polluting industries of the state. A total of 563 large and medium industries are listed as water polluting units in the state. It is mentioned that, Tapi estuary discharges 26.3 Mm³ wastes water every year. The eastern shore of Gulf of Khambhat, receives 174 Mm³ effluents annually from the large and medium industries (Sen Gupta and Deshmukhe 2000).

Gujarat also has the highest number of ports in the country (41), handling 9% of total cargo of the country, which is expected to increase to 25% of India's total cargo. Increase in vessel traffic with its associated problems of oil spill, garbage and ballast water disposal and spillage of other transport materials are direct threat to marine ecosystem. Presence of oil storage terminals and refineries are the main threats to Gulf of Kachchh. Currently the petroleum product consumption of the state is 78 MT and likely to exceed 270 MT by 2020. The Gulf of Kachchh has been placed with four Single Buoy Mooring (SBM) to handle 40-80 MT of crude oil per year and targeted to increase to 100 MT (Desai 1997). Overall it is estimated that, coastal water of Gujarat can be expected to receive 606 Mm³ domestic sewage and 215 Mm³ of industrial effluents every year.

Gujarat ranks first among the littoral states of India in marine fish production accounting for 23% of the national total. The revenue generated through, fish export was 637.85 corers, which formed 13.6% of the national share (Anon 1999). The average annual growth rate of number of fishing centers and villages showed a 5.27% increase and with an active fishermen population of 13.76% in the state (Sunderraj et al. 2002). In addition to urban and industrial related problems, rapid increase in fishery related activity will also be detrimental to the sea turtle population in terms of increase in incidental catch of turtles in the fishing nets.

Threats to sea turtles

There are some studies which has discussed about the direct and indirect threats to sea turtles and their habitat in India. Nest predation by animals and local people for consumption of eggs is a common threat to sea turtles along the Indian coast (Frazier 1980; Kar and Bhaskar 1982; Bhaskar 1984, 1993; Rajagopalan et al. 1996; Pandav et al. 1998 and Roychowdhury 2002). Incidental catch in fishing gears like trawl net and gill net has been reported as the major threat in different coastal districts (Rajagopalan et al. 1996; Pandav and Choudhary 1999; Pandav et al. 1997., Pandav 2000; Roychowdhury 2002; Tripathy and Choudhury 2002). Coastal plantation (Pandav et al. 1998) and sand mining along the nesting beaches have been documented as the main threats to turtle habitat (Bhaskar 1984; Abraham 1999; Jayakumar 2000; Andrews 2000)

All the above mentioned threats like turtle nest predation by man and animals for egg consumption, turtle mortality due to incidental catch, sand mining and spread of oil particles has also been reported along the Gujarat coast (Bhaskar 1984; Sunderraj et al 2002). However, quantitative assessment and their magnitude of impacts need to be studied with long term monitoring.

Rationale of the project

Absence of recent baseline data on sea turtle nesting population and the above discussed impacts of developmental activities on the marine ecosystem vouches the need for a long term survey along Gujarat coast. Even though GOI-UNDP nation wide sea turtle project (2000-01) came up with baseline status for many coastal districts, full breeding season surveys were not carried out in all the sites. Considering the necessity of more extensive survey and intensive long term data collection, Centre for Herpetology – Madras Crocodile Bank Trust (MCBT), Tamil Nadu and Wildlife Institute of India, Dehra Dun launched this UNEP – CMS sea turtle project in January 2004 with the financial support from Convention on the Conservation of Migratory Species of Wild Animals –CMS. This project aims to assess the nesting population status through long term intensive monitoring and capacity building of different stakeholders towards the conservation of sea turtle along the Indian coast. This project also involves the elucidation of their migratory routes using conventional tagging, molecular genetics and genetics and satellite telemetry techniques. Gujarat Institute of Desert Ecology (GUIDE) – Bhuj, Gujarat, is one of the collaborative agencies involved in the project to coordinate and implement this nation wide project along Gujarat coast.

STUDY AREA

The state of Gujarat, situated in the Northwestern frontier of India (200 01' – 240 07' N and 680 10' – 740 28' E) encompasses a total land area of 1, 96,024 km² constituting 6.0% of the total land area of the country. The total population of the state was estimated to be 5.05 million in July 2001. Gujarat has the longest coastline in India, covering more than 1600 km forming around 22% of the total coastline (7100 km) of the country. The coastline of the state stretches from Lakhpat in the northwest, of Kachchh district to Umargaon in the south, of Valsad district. Out of 184 talukas of 25 districts, 40 talukas of 13 districts share the coastline. Among the coastal talukas, 19 were totally marshy in nature and not suitable for nesting (Figure 1). The coastal area, up to 20 km from the shoreline covers 30,022.25 km² encompassing 59 towns and 2802 villages. The human population of this coastal limit is 9 million, and contributes 21.8% of the total population of the state.

The Arabian Sea and Gulfs of Kachchh and Khambhat border the coast of the Gujarat. The Gulf of Kachchh, aligned in an east-west direction, has depth from less than 20m at the head to about 60m at the mouth. The Gulf of Khambhat is aligned in a north-south direction and depth ranges from 5 – 27m. The continental shelf off the west coast of Saurashtra slopes very gently to a depth of 60m up to a distance of 350 km. Four major, five medium, 25 minor and five desert rivers around the state, annually drain 71,000 mm³ water into the seas.

The coastal zone can be broadly divided into three geographical parts and five sub-regions based on area specific inter-tidal characteristics (Table 1). The coastal tract of the sub-regions vary in length from 200 to 300 km and in width from 5 – 40 km. The tide on the Gujarat coast is semi-diurnal with large diurnal inequality and varying amplitudes leading to remarkable variation in different sub-regions with the minimum range of 2-3 m in the open sea stretch between Dwarka-Div segments to a maximum of 10 m in Bhavnagar-Bharuch segments in the Gulf of Khambhat area. These currents develop a shoreward component during the SW monsoon. The soil types in the inter-tidal area are predominately sandy, silty and muddy in nature (Table 1) and with no contiguous rocky shore along the coast. Shallow depths, medium to high tidal amplitudes, moderately strong tidal currents with associated turbulence create a perennially homogenous one-layer water mass all along the coast.

The present monitoring was carried out along the Saurashtra coast covering three coastal districts namely; Jamnagar, Porbandhar and part of Junagadh. The coast is mostly sandy in nature with discontinuous rocky shore varying in length from 100 to 500m and no marshy coast.

Table 1: Coastal Zone of Gujarat Coast

Regions	Sub-region	Coastal – Km		Rainfall (mm)	Tide (m)	Soil type
		Length	Width			
Kachchh coast		300	10	250-400	3-8	Silty/Sandy
Saurashtra coast	Navalakhi – Dwarka	250	10-15	350-400	3-5	Muddy
	Dwarka–Div	300	15-25	350-550	2-3	Sandy
	Div – Bhavnagar	250	20-25	500-600	6	Sandy/Muddy
Mainland Gujarat coast	Bhavnagar–Bharuch	250	20-40	600-800	10	Silty/Muddy
	Hansot – Umbergaon	200	5-20	800-1800	8-9	Sandy/Silty

Source: Patel, 1997

AIMS & OBJECTIVES

Aims

- To monitor important nesting sites in Gujarat coast to assess the conservation status of different species of marine turtles
- To Network and provide training to government officers and non government organization in the state to enhance conservation actions

Objectives

- To monitor index beaches to assess nesting densities and threats to marine turtles
- To initiate tagging program at sites with a potential for long term monitoring.
- To collect tissue samples of marine turtles for genetic analysis
- To identify non government organizations and establish a network for the conservation of marine turtles in the state.
- To support non government organization in their conservation work.

- To conduct training workshop for the non government organization and government officers in marine turtle conservation and management
- Prepare conservation and monitoring strategies for the survival of the threatened marine turtles

PROJECT APPROACH

Networking of stakeholders

One of the aims of the project is to enhance the knowledge of different stakeholders (Government and Non-Government) by providing training towards the conservation and management of marine turtle in the state. Under this scope of work some of the coastal stretches were selected for making the coastal populace aware of the project and importance of the marine turtles' conservation along Gujarat coast. These stretches were selected based on the following criteria like: sites with record of comparatively more number of nests documented during the GOI-UNDP project period (2000-01), adequate coverage of the potential coast, village located closer to nesting beach and villagers involved and gained experienced during the GOI-UNDP project.

GSFD – involvement

Co-coordinating the project with the Gujarat State Forest Department (GSFD) was another objective of the project. Therefore, implementation of project was properly informed to the State and concerned district level authorities like Chief Conservator of Forest (state), Conservators and Deputy Conservators of forest of Kachchh, Jamnagar, Porbandhar (recently designated and covers portion of western part of the Junagadh) and Junagadh districts. Forest department field staffs at the level of foresters, forest guard, and watchers were involved in nest monitoring using proper approach with the guidance of their higher authorities. Further, the trained staffs of Kachchh and Porbandhar districts were actively involved in nest monitoring, which has provided nesting data to the project.

Training workshop

Under this project, two training workshops were conducted one each in Kachchh and Porbandhar districts especially for the State Forest Department staffs and few interested local villagers. These workshops had three in house lectures in Gujarati (local language) to introduce the participants to the sea turtle basic biology and more about nesting biology, threats and sea turtle conservation management. Field visit was included in the afternoon section and training was imparted on sea turtle survey and nest monitoring techniques. A field guide was prepared in the local language (Gujarati) with pictorial representation, and distributed to the participants.

NESTING SURVEY AND MONITORING

Selection of coastal districts

Out of 50 talukas falling within 20 km distances from the coastline, only 40 talukas were actually sharing the coast. Based on the Survey of India topo sheet study, four major shore types were identified along the Gujarat coast, which were pure sandy, rocky shore with sandy patches, pure marshy and marshy shore with sandy patches. In spite of the state having the longest coast line, constituted by 13 coastal districts, five districts namely Rajkot, Ahmedabad, Kheda, Anand, Bharuch and Surat were not having suitable nesting habitats. Even though rest of the seven districts form 82.06% of the total coastal length, based on the 2000-01 sea turtle nesting survey it was found that only 520 km of coast was suitable for nesting (Sunderraj et al. 2002). Further, among these seven districts only Kachchh, Jamnagar, Porbandhar and Junagadh were reported with comparatively more nesting, while Amerli, Bhavnagar and Surat coasts had very low nesting density (Table 2). In the present study only Jamnagar, Porbandhar and Junagadh were selected for intensive monitoring.

Table 2: Status of suitable nesting habitat and its density in different districts

District	Coastal length (Km)	Potential Coast (km)	Total Nest	Density /km
1. Kachchh	406	83.50	61	0.73
2. Jamnagar	342	111.5	324	2.91
3. Rajkot	No potential nesting habitat			
4. Junagadh/5.Porbandhar	261	170.50	279	1.64
6. Amreli	62	25.0	5	0.20
7. Bhavnagar	152	100.75	7	0.07
8. Ahmedabad	No potential nesting habitat			
9. Kheda /10 Anand	No potential nesting habitat			
11. Bharuch	No potential nesting habitat			
12.Surat	No potential nesting habitat			
13.Valsad *	90	28.50	21*	0.23*
Overall Total	1313	519.75	676	1.38

*Very old nesting locations. Source: Sunderraj et al. 2002

Field survey

Nesting season of Olive Ridley starts in June and ends in about early November while Green turtle nest between July to January (Bhaskar 1984). However, the recent (2002) turtle egg collection for hatchery program by the Gujarat State Forest Department at Madhavpur village of Porbandhar district showed sporadic nesting of both Olive and Green turtles till March, it was decided to carry out nest monitoring for one full year covering also the months out of their normal nesting seasons.

Monitoring of nesting was carried out in three ways; 1. Intensive monitoring of index beaches by the project personnel. 2. Co-ordination of nesting survey and hatchery program by the State Forest Department staffs. 3. Involvement of few interested representatives of NGOs in index beach monitoring. Selected index beaches were monitored from February 2004 to March 2005. All the index beaches were monitored once in every week during the nesting season from June – January (including nesting season of both Olive ridley and Green turtles), and only once a month outside the nesting season (rest of the months). Further three beaches were monitored once in a month for a period of nine months, while the State Forest Department personal had also surveyed some stretches for a selective period.

Nest survey

During field survey, data related to nesting activities like nests with eggs, false crawl, crawl distance, crawl pattern and width were recorded. Nest monitoring was carried out once in a week during nesting season and once in 30 days out of nesting season. Since monitoring interval varied from 7 -30 days, nests were categorized into three types: very fresh nests (clear crawl marks and wet in nature), moderately fresh nests (faint crawl marks and dry), and old nest (no crawl marks).

Threat assessment

Threats to sea turtles were at two levels. 1. Direct threat to sea turtle population in terms of nest predation and sea turtle mortality due to incidental catch in the fishing net. 2. Threat to nesting beaches mainly sand mining, spread of oil particles and beach pollution due to domestic garbage and sea debris. Among these, only nest predation, sea turtle mortality, and mining were studied quantitatively along the index beaches.

Nest predation

Nests predated by animals were enumerated; they were easily differentiated from the human predation by the presence of scattered eggshells and partially consumed eggs around the dugout nests. Human predated nests were differentiated from hatched nests by relatively deep excavations in the former case and presence of other signs like foot and hand marks around the nests. Size of unhatched eggs, depth of excavated nests, crawl width and crawl patterns were checked with care (Pritchard and Mortimer 1999) to identify the species of turtle. Predation rate was estimated by calculating relative percent of the total nests recorded with the eggs (excluding false crawls) and that showed signs of predation.

Stranding

Stranded dead turtles in different stretches were enumerated along the coast. Sex was identified by the presence of a long tail and curved claws on the fore flippers in males. Curved carapace length was measured from the anterior tip at the point of the nuchal scute to the posterior tip of the supra-caudal. Curved carapace width was measured at the widest part of the carapace.

Sand mining

Incidence of sand mining was recorded along the index beaches and magnitude of this impact was assessed in two ways 1. based on the frequency of occurrence (i.e encounter rate/km) and 2. location of mining closer to the nesting beaches. Subjective rating was given to sand mining based on the frequency of occurrence: low = 1 (two incidence/1 km), medium = (3-4 incidences /1 km) and high = 3 (> 4 incidence/1 km). Sand mining location was rated as: low = (landward side of the coast), Medium = (on the coast) and high = (in the nesting beach). Overall impact was assessed based on the relative percent of frequency of occurrence in different impact zones

Data Analysis

All the analyses were carried out based on only very fresh nests recorded from 14 index beaches. Since monitoring frequency varied from seven days to 30 days gap, the estimated nesting density was found to be very low. Therefore nesting density was calculated based on the following consideration. 1. Even though moderately fresh nests were also recorded, only very fresh nests were used for density estimation, 2. Relative density was estimated based on only the number of very fresh nests and number of monitoring days for overall coastal density, 3. Index Beach specific density was estimated by extrapolation for month. Nesting survey carried out by the Gujarat State Forest Department under sea turtle hatchery development has been discussed separately. Hatchling success for the GSFD ex situ program was estimated only based on number of eggs placed and number of hatchlings that came out.

RESULTS

NETWORKING OF STAKEHOLDERS

A total of 32 stretches/villages were rapidly surveyed in four coastal districts and five types of stakeholders were identified. They were representatives of NOG group, GSFD staff, Coastal Villagers, Fishery Folks and others (naturalists). These different groups of people were briefed about the importance of the project and conservation of sea turtles along the Gujarat coast. They were also explained about their role in the project and the work involved, through informal dialogue. In total 79 people of different stakeholder groups were met and discussed. These include 18 forest department staffs (FDS), 24 fishery folks (FF), 20 coastal villagers (CV), and 12 representatives of six NGOs (Table 3). In addition five naturalists of the local area also showed interest in part of sea turtle conservation network. Coastal district wise name of the villages surveyed and types of stakeholders with whom formal discussion were made, is given in the annexure (Annexure 1).

Table 3: Details of Stakeholders involved in networking

Coastal district	No of villages surveyed	Types of stake holders				
		FDS	FF	CV	NGO	O
Kachchh	6	8	4	4	3	4
Jamnagar	12	2	8	4	6	
Porbandhar	8	4	6	10	3	
Junagadh	6	4	6	2		1
Total	32	18	24	20	12	5

FDS- Forest Department Staffs, FF – Fisher folk, CV-Coastal Villagers, NGO – Non Government Organization, O – Others

NGO Involvement

During the stakeholder identification survey few NGO's like Panchjany Pariyavaran Trust - Bet Dwarka, Amateur Rangers Nature Club, Mithapur – Okha, Okha-Mandal Pariyavaran Vikas Trust in Jamnagar district, Kachba Unchar Kendra – Madhavpur, of Porbandhar district were very much interested in participating in sea turtle conservation network. In addition Gir Youth Nature Club of Amreli district also showed interest in joining the sea turtle conservation network. Details of NGOs and other individuals identified for sea turtle conservation network given in Annexure 2

Capacity building of GSFD staffs

Project coordination

Before initiation of the UNEP – CMS sea turtle project, concerned state and district level forest department authorities were contacted and requested for their logistic and other necessary support. Conservators of the concerned circles were also approached to carry out capacity building and training workshop for the field level department staffs. A total of four Conservators of forests, four DCFs and three ACFs were well aware of the project activities. Conservators of Kachchh and Junagadh circles took necessary action and provided support from their concerned field level staffs to carryout training workshops for Kachchh and Porbandhar districts respectively (Table 4).

Table 4: Coordination of Project with GSFD Authorities

District	GSFD – Authorities	
Gandhinagar	Chief Conservator of Forest – Wildlife	
	Conservator of Forest	Deputy/ Asst Conservator of Forest
Kachchh	1	1, DCF, 2 ACF
Jamnagar	1 Director Marine National Park	1. DCF
Porbandhar	1	1 DCF, 1 ACF
Junagadh	1 – Wildlife , 1- Territorial	1. DCF

Training Workshop

In this project two training workshops were conducted one each in Kachchh and Porbandhar districts especially for the state forest staffs. In total 58 participants took part in the workshop, which included two Deputy Conservators of Forest (DCF) of Kachchh and Porbandhar districts who inaugurated the workshop in their respective areas. The other officer level participants were two Assistance Conservators of Forest (ACF) and six Range Forest officers (RFO). The field level staffs trained under this workshop were nine foresters, 30 forest guards and eight watchers (Table 5). In addition six representatives from NGOs also attended the workshop (Plate 1). As a result of these workshops and concern of the existing high nest predation pressure, the forest department in Kachchh and Porbandhar coast, initiated two sea turtle hatchery programs each.

Table 5: Details of workshop participants

Participants	Kachchh coast	Porbandhar coast	Total
No. of Officers			
DCF	1	1	2
ACF	2		2
RFO	5	2	7
No. of Field Staffs			
Foresters	3	6	9
Forest Guards	17	13	30
Forest watchers	4	4	8
Total	32	26	58

These workshops had three in house lectures in Hindi and Gujarati and a field demonstration. In the first session the participants were introduced to the basic facts about the Sea Turtles. The second was on techniques to identify turtle species and monitoring of nesting beaches. Third was on the sea turtle egg collection, translocation and sea turtle hatchery management. They were also taught about the advantages and disadvantages in sea turtle hatchery programs and need for proper approach and management. Details of different themes covered in the workshop are given in the table (Table 6).

Table 6: Details of themes covered in the training workshop

Major thrust area	Topics
Sea Turtle -Interesting fact	Number of species and their distribution (International, National and State) Size range, longevity, Deep sea diver, long distance migration, food habits, nesting on natal beach. Temperature – sex determination etc.
Sea turtle Biology	Species specific Morphology, nesting activity, clutch size, egg size, crawl pattern, species identification, etc.
Sea turtle conservation	General threats - pollution, coastal development, coastal plantation, artificial illumination, Beach armoring, egg predation, animal predation, incidental catch, survival rate, conservation activities needed, etc.
Nest survey and Monitoring	Identification of nests, morphometric measurement, identification of species and sex and predation types. Egg collection, transportation.
Hatchery management	Site selection, Hatchery construction, Nest Placing, Nest record maintenance, Hatchling monitoring and releasing. Advantages and disadvantages in hatchery management.

In the afternoon participants were taken to the nearest beach and explained how to collect data in the field. Model turtle nests were constructed on the beach with dummy eggs. They were trained to locate and identify the nests of different species based mainly on the nest size and crawl pattern and size. Further they were shown how to differentiate nests that were predated and unpredated along with differentiation of predators based on the field tracks and signs present in and around the model nests (Plate 2).

A field guide was prepared in the local language (Gujarati) with pictorial representation and distributed to the participants. This Guide carried information on the basic biology of the sea turtles, pictorial representation of five species of sea turtles found in Indian coastal waters with their, size, weight, crawl pattern and width, clutch size, egg size, nesting season and major distributional range. It also explained the techniques involved in species identification with key characters and morphometric measurements. Further details about the nest survey, egg collection, transportation and placing in the

nursery were also given in the guide. Sea turtle hatchery management was also covered, with the information starting from selection of hatchery location, materials (cheap and locally available) need to be used, regular maintenance of nest record, collection and releasing of hatchlings in different place and time.

GSFD – activity

GSFD staffs surveyed Kachchh and part of Porbandhar coast under their sea turtle hatchery program for a period of four months (period to be mentioned) covering the coastal distance of around 50 and 70 km respectively. In Porbandhar coast two new turtle hatcheries were established in addition to the one at Madavpur, while one new hatchery was established in Kachchh coast at Pingleshwar, in addition to the one existing at Mandvi, which was shifted to a new site closer to the beach.

MONITORING OF INDEX BEACHES

A total of 14 index beaches were surveyed from February 2004 to till March 2005, which includes seven, three and four beaches on Jamnagar (Feb 2004 – Mar 05), Porbandhar and Junagadh coasts (Mar 2004 – Mar 05) respectively. In addition, three beaches, two in Jamnagar and one in Porbandhar were monitored for a period of seven and nine months respectively (**Table 7**). Under this project, overall 17 beaches with the varying length of 3-5 km covering a total distance of 73.5 km were monitored. All these index beaches were surveyed once in a week, while additional beaches once in a month during early morning and late evening.

Table 7: Details of index beaches and their monitoring schedule

Coastal Districts	No. of Beaches	MP (Month)	MF	Total Days	Beach Length		Total Distance (km)
JMC - IB	7	14	Weekly	56	4	5	32
PBC - IB	3	13	Weekly	52	4	5	13.5
JUC	4	13	Weekly	52	3	4.5	15
JMC-AB	2	9	Monthly	9	3	4	8
PBC-AB	1	7	Monthly	7		5	5
Total	17						73.5
KUC -GSFD		4					Ca. 40
PBC - GSFD		4					Ca. 80

JMC – Jamnagar Coast, PBC – Porbandhar Coast, JUC – Junagadh coast, AB – Additional Beach, KUC – Kachchh Coast. IB-Index Beach, MP- Monitoring Period, MF- Monitoring Frequency

Nesting Population

Nesting population - Index beach

During the study period monitoring of 14 index beaches resulted in recording a total of 1902 very fresh nests. Along Jamnagar coast in total 946 nests were recorded, of which 859 nests were documented from seven index beaches monitored for 13 months and 86 nests from two additional beaches monitored for only nine months. Porbandhar coast accounted for 363 nests from three index beaches monitored for 14 months and 86 nests from one additional beach surveyed for nine months, totaling to 449 nests. In the case of Junagadh coast, three index beaches which were monitored for 14 months resulted in recording of 508 nests (Table 8 & Plate 3).

Table 8: Status of Nesting Population along the Index beaches

Coast	Nature of data	Olive ridley	Green turtle	Overall
Jamnagar	7 index beaches	338	521	859
	2- additional beaches	23	63	86
Sub total		361	584	945
Porbandhar	3 index beaches	121	242	363
	1- additional beaches	22	64	86
Sub total		143	306	449
Junagadh	4 index beaches	164	344	508
Grand total		668	1234	1902

IB- Index Beaches, AB- Additional Beaches

Nesting population - GSFD Survey

Under sea turtle hatchery program, GSFD staffs recorded a total of 195 nests. Of that, 176 nests were reported from Porbandhar coasts and 19 from Kachchh coast. Out of 19 nests recorded in Kachchh coast, 17 were Olive ridley and rest (two) green turtle. In Porbandhar coast a total of 176 nests were reported from two hatcheries (Tukda Miyani – 70 and Rangbai Odadar - 106 nests. Of that 47 were Olive ridley, 127 Green and two nests of Hawksbill (Table 9). Even though, two nests were reported as Hawksbill based on their egg size (it has been stated that, the eggs were smaller than Olive eggs), identification of other key characters of hatchlings was not attempted to confirm the species.

Table 9: Status of nesting reported by the Gujarat State Forest Department

Species	Coastal districts			Overall	
	Kachchh	Porbandhar-Tukda Miyani	Porbandhar – Rangbai Odadar	Porbandhar	All coasts
Olive ridley	17	24	23	47	64
Green turtle	2	45	82	127	129
Hawksbill		1	1	2*	2
Total	19	70	106	176	195

*Reported as Hawksbill (see Box 1)

Box 1. Report of Hawksbill Nesting

However four species of sea turtles are believed to occur in the coastal waters of Gujarat state, only the breeding of Olive ridley and Green turtle has been established (Bhaskar, 1978; Kar and Bhaskar, 1982 and Bhaskar 1984), while Hawksbill and Leatherback were occasionally sighted by local fishermen. Under Hatchery development program, two hatcheries, one at the beach closer to Tukda miyani village 27 km west and another at Odadar village 10 km east of Porbandhar were established along Porbandhar coast. During turtle egg collection for the hatchery development, two nests were reported as Hawksbill's nests, one from close to Tukda miyani nursery and one in beach close to Gosa village which is 19 km east of Porbandhar. It has been stated by the persons involved in egg collection that, all the eggs collected from these two nests were smaller than Olive eggs and measured less than 4 cm diameter. Number of eggs collected was 164 and 114, while the nest depth was 60 and 75 cm respectively. Crawl width measured for the second nest was 90 cm. Even though, they were not able to look for other key characters like two pairs of prefrontal scales, variegated carapace, coloration – brown, and strongly serrated posterior margin (Sanker et al. 2003), with the help of hatchlings, record of 164 eggs collected from the Tukda Miyani area, and size of all the eggs (278 including both the nests) less than 4cm, which gives some clue that there is fair chances of record of Hawksbill nesting along the coast. However, further detailed observation on some more records, with all other possible key characters of nest and hatchlings can give strong possibilities of nesting of Hawksbill along Gujarat coast.

*Species composition*Species composition - Index beach

Overall species composition of nests showed that, out of 1902 nests reported, 1234 nests belonged to green turtle, which contributed 65% of the total nests, while rest (35%) were of Olive ridley. Even though coast specific species composition also showed the same trend with more nests in favour of green turtles, Jamnagar coast reported comparatively low proportion of Green turtles (62%) than other coasts. There was no variation in species composition between Porbandhar and Junagadh coasts as both recorded the same percent of (68%) of Green turtles and (32%) Olive ridley (Table 10).

Table 10: Species composition of different coasts (MO)

Coast	Overall	Olive ridley		Green turtle	
		Total Nests	R%	Total Nests	R%
Jamnagar	945	361	(38.20%)	584	(61.80%)
Porbandhar	449	143	(31.85%)	306	(68.15%)
Junagadh	508	164	(32.28%)	344	(67.72%)
Grand total	1902	668	(35.12%)	1234	(64.89)

R% - Relative per cent

Species composition- GSF D Survey

Species composition was estimated excluding two nests Hawksbill reported from Porbandhar coast. In Kachchh coast, out of the reported 19 nests, majority of them were Olive ridley (17 nests), which formed 89% of the total. Green turtles dominated the Porbandhar coast with 73 % (127 nests) out of the total 174 nests reported. Overall trend was also in favour of Green turtles, which contributed 67% with a record of 129 nests of the total 193 nests reported (Table 11).

Table 11: Status of Species composition – GSF D

Species	Kachchh		Porbandhar		Overall	
	TN	R%	TN	R%	TN	R%
Olive ridley	17	89.47	47	27.01	64	33.16%
Green turtle	2	10.53	127	72.99	129	66.84%
Total	19	100.00	174	100.00	193	100.00

TN – Total Nests, R% - Relative per cent

Overall population and species composition

During the project period monitoring of 14 index beaches and three additional beaches and survey of Kachchh and Porbandhar coast by the GSF D resulted in a total estimation of 2095 nests along the Gujarat coast. Out of 2095 nests reported, 732 were of Olive ridley and 1363 Green turtle nests. Even though, the data collection was done by two groups of people, no much difference was observed in species composition. Species composition based on GSF D survey was marginally on the higher side for green turtle (67%) than index beach monitoring (65%). The overall estimated species composition was 65% Green turtle and 35% Olive ridley (Table 12).

Table 12: Overall nesting population and Species composition

Species	GSFD Survey		Index beach		Overall	
	TN	R%	TN	R%	TN	R%
Olive ridley	64	33.16%	668	35.12	732	34.94
Green turtle	129	66.84%	1234	64.89	1363	65.06
Total	193	100.00	1902	100.00	2095	100.00

TN – Total Nests, R% - Relative per cent

Nest Density

Coast Specific Nest Density

Nesting density was estimated only for the 14 index beaches. Overall estimated nesting density for Gujarat coast was 0.76 nests/km. This cost was found to support more Green turtle (0.49 nests/km) than Olive ridley (0.27 nests/km). Coast specific density showed that Junagadh reported more density (0.89 nests/km) than Jamnagar (0.73) and Porbandhar (0.71) (Table 13). Species specific density across coasts showed that density of Olive ridley was high in Junagadh (0.29) followed by Jamnagar (0.28) and Porbandhar (0.24 nests/km). In case of Green turtles also Junagadh coast supported more (0.60 nests/km), while the lowest density (0.44 nests/km) was estimated in Jamnagar (Table 13).

Table 13. Nesting Density of different coasts

Coast	CDM (km)	NDM	Olive ridley		Green turtle		Overall	
			TN	D/Km	TN	D/Km	TN	D/Km
Jamnagar	32	37	338	0.28	521	0.44	859	0.73
Porbandhar	13.5	38	121	0.24	242	0.47	363	0.71
Junagadh	15	38	164	0.29	344	0.60	508	0.89
Grand Total	60.5	37.67	623	0.27	1107	0.49	1730	0.76

CDM – Coastal distance monitored, NDM – Number of Days monitored, TN – Total nests, D – Density/km

Monthly Beach Specific Nest Density

In Jamnagar coast, beach specific Olive ridley density varied from maximum of 10.75 nests/km at Mojap-Sivrajpur beach to minimum of 5.20 nests/km at Okhamadhi-Kharakhetar beach. Mithapur – Mojap (9 nests/km), Mojap-Sivrajpur (10.75 nests/km), Navadra-Lamba (10 nests/km), Lamba-SMM (10 nests/km) and SMMT-HMM (9.75 nests/km) were the beaches which had higher nest density compared to the overall coastal density of 8.56 nests/km. Estimated Green turtle nest density showed maximum of 17.60 nests/km and minimum of 7.60 nests/km at Navadra-Lamba and Okhamadhi-Kharakhetar beaches respectively. Even though, the same beaches reported higher density of Green nests compared to the overall coastal density (14.15 green nests/km), Navadra-Lamba showed highest density of 17.60 nests/km followed by 16.75 nests/km at SMM-HMM beach. Irrespective of species, the same beaches showed high nest density, which was more than the overall coastal density of 21.75 nests/km (Table 14).

In Porbandhar coast, Ratadi– Kantela and Kantela-Kuchhadi were the two beaches which recorded higher density of 8 and 10 Olive nests/km and 15 and 20 Green nests/km than the coastal density (7 Olive and 14 Green nests/km) respectively. The same beaches dominated in overall nest density (Ratadi– Kantela 23 nests/km and Kantela-Kuchhadi 29 nests/km), which was more than the density recorded (21 nests /km) for that coast (Table 14).

Beach specific Olive ridley density varied from minimum of 6.33 nests and maximum of 9.33 nests/km at Maktupur–Mangrol and Shil–Lohej beaches respectively. Shil–Lohej, Lohej–Maktupur and Mangrol–Bara were the three beaches that recorded a marginally higher density of Olive ridley

nests (9 nests/km) than coastal density (8.60 nests/km). In the case of Green turtle nest density, only two beaches, Shil–Lohej with 24 nest/km and Mangrol–Bara 20 nests/km, showed a higher density than the coastal estimate (18 nests/km). The overall nesting density was also high in these two beaches with 33 nests/km in Shil–Lohej and 30 nests/km in Mangrol–Bara compared to total coastal density (27 nests/km) (Table 14). Irrespective of coast the estimated Olive nesting density for Gujarat coast was 8 nests/km and that of Green was 15 nests/km with the overall density of 23 nests/km (Table 14).

Table 14: Monthly Nesting Density for Index beach along different coasts

Index Beach Code	BD	Olive Ridley			Green Turtle			Overall		
		TN	EN	MD/Km	TN	EN	MD/km	TN	EN	Total /km
Jamnagar N= 37 Days										
1. Mithapur – Mojap	4.0	45	36	9.0	51	48	12.0	96	78	19.5
2. Mojap-Sivrajpur	4.0	53	43	10.8	74	60	15.0	127	103	25.8
3. Okhamadhi - Kharakhatar	5.0	32	26	5.2	47	38	7.6	79	64	12.8
4. Kharakhatar - Kuranga	5.0	36	29	5.8	66	54	10.8	102	82	16.4
5. Navadra-Lamba	5.0	62	50	10.0	109	88	17.6	171	139	27.8
6. Lamba-SMM	5.0	62	50	10.0	91	74	14.8	153	124	24.8
7. SMM- HMM	4.0	48	39	9.8	83	67	16.8	131	106	26.5
<i>Sub Total</i>	<i>32</i>	<i>338</i>	<i>274</i>	<i>8.6</i>	<i>521</i>	<i>422</i>	<i>13.2</i>	<i>859</i>	<i>696</i>	<i>21.8</i>
Porbandhar N=38 Days										
1. Ratadi–Kantela	4.0	42	33	8.3	76	60	15.0	118	93	23.3
2. Kantela-Kuchhadi	4.5	55	45	10.0	114	90	20.0	169	133	29.6
3. Navibandar-Ratiya	5.0	24	19	3.8	52	41	8.2	76	58	11.6
<i>Sub Total</i>	<i>13.5</i>	<i>121</i>	<i>96</i>	<i>7.1</i>	<i>242</i>	<i>191</i>	<i>14.2</i>	<i>363</i>	<i>287</i>	<i>21.3</i>
Junagadh N= 38 Days										
1. Shil –Lohej	3.0	36	28	9.3	91	72	24.0	127	100	33.3
2. Lohej – Maktupur	4.5	52	41	9.1	85	67	14.9	137	108	24.0
3. Maktupur – Mangrol	3.0	24	19	6.3	51	40	13.3	75	59	19.7
4. Mangrol – Bara	4.5	52	41	9.1	117	92	20.4	169	133	29.6
<i>Sub Total</i>	<i>15</i>	<i>164</i>	<i>129</i>	<i>8.6</i>	<i>344</i>	<i>271</i>	<i>18.1</i>	<i>508</i>	<i>401</i>	<i>26.7</i>
Overall (37.67 Days & total distance 60.50 km)		623	496	8.2	1107	881	14.6	1730	1378	22.8

IB – Index Beaches, BD-Beach Distance, TN – Total Nests, EN-Estimated nests/month, MD – Monthly density, SMM Sethala mata Mandir , HMM, Harshad Mata Mandir

Nesting activity

However, monitoring of nesting activity along the index beaches showed report of nesting of Olive ridley in all the months except in the month of April 2004. Green nesting was reported in all the months except in May and June (2004). Olive ridley showed peak nesting in July and second peak was observed in November where as in case of Green it was between November and January (**Figure3**). Irrespective species, sporadic nesting was observed throughout the year.

THREATS*Nest predation*Nest Predation and Source

Rate of nest predation estimated from 14 index beaches showed that, out of 1730 nests, 755 were under predation, which constituted 44 % of predation pressure. Comparison of predation pressure among the coasts revealed that, Jamnagar coast was under more nest predation (47 %) followed by Junagadh (42 %). Porbandhar reported the least with only 37 % of nests being predated (Table 15). Out of the 1730 nests reported along the index beaches, 469 were predated by animals and 286 by local people, which vouched for 27 % and 17 % of predation pressure of the total nest recorded respectively. There was not much difference in animal predation among the coast, as it varied from maximum of 28% at Jamnagar to minimum of 26.38% at Junagadh. Human predation showed little variation among the coasts with high human predation recorded at Jamnagar (19 %) followed by Junagadh (16%) and Porbandhar (11 %) (Table 15).

Table: 15: Status of nest predation sources along the index beaches

Coasts	Overall			Human predation		Animal predation	
	TN	PN	%	PN	%	PN	%
Jamnagar	859	405	47.15	166	19.32	239	27.82h
Porbandhar	363	136	37.47	40	11.02	96	26.45
Junagadh	508	214	42.13	80	15.75	134	26.38
Total	1730	755	43.64	286	16.53	469	27.11

TN – Total Nests, PN – Predated Nests

Species Specific Nest Predation

Comparison of nest predation between species showed that, Olive ridley nests were under higher predation (52 %) than Green turtle nests (39 %) (Table 16). Among the different coasts, Jamnagar showed more nest predation on Green turtle (42 %) than Junagadh (37 %) and Porbandhar (35 %) coasts. Porbandhar coast recorded the lowest predation pressure on Olive ridley (37%) compared to other coasts (Table 16).

Table 16: Species specific nest predation status along the index beaches

Coasts	Olive ridley			Green Turtle		
	TN	PN	%	TN	PN	%
Jamnagar	338	185	54.73	521	220	42.22
Porbandhar	121	51	42.15	242	85	35.12
Junagadh	164	87	53.05	344	127	36.92
Total	623	323	51.85	1107	432	39.02

TN – Total Nests, PN – Predated Nests

Species specific and sources of nest predation

Olive ridley nests were comparatively under more predation by animal 36% than human being 16%. Even though, the same trend was observed in Green turtles, predation by animal was comparatively lower (22%) than Olive ridley. Coast specific predation types also showed the same trend. Comparison of predation types among the coasts showed that there was not much difference in animal predation. In Olive ridley, animal predation ranged from 35% at Junagadh to 37% at Jamnagar. The same for Green was 23 % at Porbandhar to 22.38% at Junagadh. In case of human predation, Porbandhar coast estimated the lowest predation of 8.26% and 12.40% in olive and green turtles respectively. Maximum of 20.60% and 18% of human predation was estimated at Jamnagar and Junagadh coasts respectively (Table 17 & Plate 4).

Table 17: Species Specific and Sources of Nest Predation

Districts	Olive ridley			Green turtle		
	TN	HPN (%)	APN (%)	TN	HPN (%)	APN (%)
Jamnagar	338	60 (17.75)	125 (36.98)	521	106 (20.35)	114 (21.88)
Porbandhar	121	10 (8.26)	41 (33.88)	242	30 (12.40)	55 (22.73)
Junagadh	164	30 (18.29)	57 (34.76)	344	50 (14.53)	77 (22.38)
Total	623	100	223	1107	186	246
Overall		16.05	35.79		16.80	22.22

TPN – Total Nests, HPN – Human Predated nests, APN – Animal Predated Nests,

Difference in Predation Sources

Comparison of difference in percent of predation types between the species clearly indicates that, Olive nests were more prone to animal predation than the Green nests. The estimated difference between animal and human predation in Olive was 20%, while the same for green turtles was only 5%. Among the coasts, Olive nests of Porbandhar coast were more prone to animal predation and the difference was 26% followed by Jamnagar (19%) and Junagadh (16%). In case of Green turtles, only Porbandhar showed a difference of 10% between animal and human predation followed by 8% difference in Junagadh coast (Table 18).

Table 18: Percent difference of Species Specific and Sources of Nest Predation

Districts	Olive ridley			Green turtle		
	APN	HPN	%D	APN	HPN	%D
Jamnagar	36.98	17.75	19.23	21.88	20.35	1.53
Porbandhar	33.88	8.26	25.62	22.73	12.40	10.33
Junagadh	34.76	18.29	16.48	22.38	14.53	7.85
Total	223	100		246	186	
Overall	35.79	16.05	19.74	22.22	16.80	5.42

TN – Total Nests, HPN – Human Predated nests, APN – Animal Predated Nests,

Beach specific nest predation

The magnitude of predation pressure was derived by comparing the percent of predation at index beach level with the overall coastal predation pressure. Olive ridley nest predation pressure in Jamnagar coast ranged from maximum of 73% at SMM-HMM beach to minimum of 36% at Mithapur -Mojap beach. Comparison of predation pressure of index beaches with the nest predation pressure (55%) of that coast showed that among the seven beaches monitored, three beaches namely Mojap-Sivrajpur, Lamba-SMM, and SMM-HMM were under high predation with a report of 66%, 61% and 73% respectively. Nest predation on Green turtle ranged between 54% in SMM-HMM to 35% in Okhamadhi-Kharakheta beach. Higher predation pressure compared to coastal predation pressure (42%) was reported only from two beaches (SMM-HMM 54% and Lamba-SMM 46%) (Table 19).

Since the Olive ridley nests were subjected to very high predation, irrespective of species, Mojab-Sivrajpur, Lamba-SMM, and SMM-HMM were the beaches found to have high overall predation of 50, 52 and 61% respectively (Table 19).

Out of three beaches monitored along Porbandhar coast, only Ratadi–Kantela estimated more predation (48%) on Olive ridley nests compared to 42% along the entire coast. Ratadi–Kantela and Navibandar-Ratiya were the two beaches that recorded higher predation (37 and 38% respectively) on Green turtle nests compared to coastal pressure (35%). These two beaches reported overall higher predation pressure of 41% and 38% irrespective of species.

In Junagadh coast, beach specific nest predation on Olive and Green turtles varied from, 67-39% and 47-27% respectively, while overall pressure was between 52 and 31%. Maktupur–Mangrol and Mangrol–Bara were the two beaches, which showed higher nest predation on Olive (67% and 63%) and Green (43% and 47%) (Table 19). Since these two beaches had higher predation on both the species, they reported an overall predation pressure of 51 and 52% respectively.

Table 19: Status of Beach Specific Nest Predation in different Coasts – (MO)

Index Beaches	Olive Ridley			Green Turtle			Overall		
	TN	PN	%	TN	PN	%	TN	PN	%
Jamnagar									
1. Mithapur –Mojap	45	16	35.6	51	20	39.2	96	36	37.5
2. Mojab-Sivrajpur	53	35	66.1	74	29	39.2	127	64	50.4
3. Okhamadhi-Kharakhetar	32	14	43.8	47	16	34.0	79	30	37.9
4. Kharakhetar – Kuranga	36	16	44.4	66	23	34.9	102	39	38.2
5. Navadra-Lamba	62	31	50.0	109	45	41.3	171	76	44.4
6. Lamba-SMM	62	38	61.3	91	42	46.2	153	80	52.3
7. SMM- HMM	48	35	72.9	83	45	54.2	131	80	61.1
<i>Sub Total</i>	<i>338</i>	<i>185</i>	<i>54.7</i>	<i>521</i>	<i>220</i>	<i>42.2</i>	<i>859</i>	<i>405</i>	<i>47.2</i>
Porbandhar									
1. Ratadi– Kantela	42	20	47.6	76	28	36.8	118	48	40.7
2. Kantela-Kuchhadi	55	22	40.0	114	37	32.5	169	59	34.9
3. Navibandar- Ratiya	24	9	37.5	52	20	38.5	76	29	38.2
<i>Sub Total</i>	<i>121</i>	<i>51</i>	<i>42.3</i>	<i>242</i>	<i>85</i>	<i>35.1</i>	<i>363</i>	<i>136</i>	<i>37.5</i>
Junagadh									
1. Shil –Lohej	36	14	38.9	91	25	27.5	127	39	30.7
2. Lohej – Maktupur	52	24	46.2	85	25	29.4	137	49	35.8
3. Maktupur – Mangrol	24	16	66.7	51	22	43.1	75	38	50.7
4. Mangrol – Bara	52	33	63.5	117	55	47.0	169	88	52.1
<i>Sub Total</i>	<i>164</i>	<i>87</i>	<i>53.1</i>	<i>344</i>	<i>127</i>	<i>36.9</i>	<i>508</i>	<i>214</i>	<i>42.1</i>
Total	623	323	51.9	1107	432	39.0	1730	755	43.6

TN – Total Nests, PN – Predated Nests, SMM Sethala mata Mandir , HMM, Harshad Mata Mandir

Stranding

Turtle mortality and density

A total of 22 dead turtles were reported along the index beaches of Jamnagar coast. Of that, 16 were Green turtles and rest of the six was Olive ridley. The contribution of male and female was eight and

14 turtles respectively. Along Porbandhar coast a total of 10 dead turtles were recorded, of which six were Green turtles and four were Olive ridley. In Junagadh coasts, out of 20 dead turtles reported, 14 were Green and rest six were Olive ridley. Among these, irrespective of species the number of male and female dead was 19 and 33 respectively. Overall status of dead turtles showed more Green (36) and more females (33) than Olive (16) and males (19) (Table 20 & Plate 4).

Table 20: Status of Dead Turtles reported along the Index Beaches

Coasts	Olive Ridley			Green Turtle			Overall		
	M	F	T	M	F	T	M	F	T
Jamnagar	2	4	6	6	10	16	8	14	22
Porbandhar	2	2	4	2	4	6	4	6	10
Junagadh	3	3	6	4	10	14	7	13	20
Total	7	9	16	12	24	36	19	33	52

M=Male, F-Female, T- Total

The estimated dead turtle density varied from minimum of 0.19 to maximum of 0.40 turtle / km for Olive ridley in Jamnagar and Junagadh coasts respectively. The same for Green turtle was minimum of 0.44 at Porbandhar and maximum of 0.93 turtle / km in Junagadh. Irrespective of species, maximum density of 1.33 dead turtles / km was encountered in Junagadh followed by Porbandhar coast (0.74 turtle / km). The estimated overall density for the entire coast was 0.86 turtles/km (Table 21).

Table 21: Density (turtle/km) of dead Sea Turtles along the Index Beach

Coasts	TDM	Olive Ridley		Green Turtle		Overall	
		NDT	TD	NDT	TD	NDT	TD
Jamnagar	32	6	0.19	16	0.50	22	0.69
Porbandhar	13.5	4	0.29	6	0.44	10	0.74
Junagadh	15	6	0.40	14	0.93	20	1.33
Total	60.5	16	0.26	36	0.59	52	0.86

NDT-No. of Dead Turtles, TD-Total Density

Size class of Stranded turtles

In addition to 52 dead turtles reported in index beaches, further 13 were reported from the three additional beaches and other area visited. So size class measurements were made and assessed for a total of 65 animals. The size class of Olive ridley varied from minimum of 47cm to maximum of 68 cm with the mean of 59.75cm. Minimum, maximum and mean size class reported in Green turtle was 31, 106 and 88.08cm respectively (Table 22). Estimated standard deviation of 16.71 in Green turtle showed more variation in size class than in Olive ridley (5.89). Out 16 Olive ridley measured only one was reported to be < 50cm CCL, whereas in the case Green turtle, six animals were <70cm CCL, which showed that sub adult turtles also occur of in these areas.

Table 22: Species Specific size class of Stranded Turtles

Species	No of Turtles	Curved Carapace length in CM			SD
		Minimum	Maximum	Average	
Olive ridley	16	47	68	59.75	5.89
Green turtle	49	31	106	88.08	16.71

Sand Mining

In total 67 locations with sand mining were recorded along the 14 index beaches. Of that highest of mining activities of 55% (37 incidences) was recorded along the Jamnagar coast followed by Junagadh

(24%). Further, based on the encounter rate of sand mining, all the coasts reported just little more than one incidence of mining per kilometer with the range of 1.16 incidence /km in Jamnagar coast to 1.04/km in Porbandhar coast. All three coasts scored a mining impact value low. The estimated overall encounter rate of mining was 1.11 incidences/km and which resulted in a score low impact value (Table 23).

Table 23: Impact status assessment of sand mining activity along the index beaches based on frequency of occurrence

Coasts	DS-Km	Frequency of mining	R%	ER/Km	Impact scale & value
Jamnagar	32	37	55.22	1.16	1-Low
Porbandhar	13.5	14	20.90	1.04	1- Low
Junagadh	15	16	23.88	1.07	1- Low
Total	60.5	67	100.00	1.11	1- Low

DS-Distance, R%- Relative %, ER-Encounter Rate

Out of 37 sand mining activities recorded in Jamnagar coast, 46% of mining activities were located on the coast and fall under medium impact zone. In case of Porbandhar coast 50% of the mining were reported on landward side and only 21% (three incidences) were reported in the nesting beaches. In Junagadh, maximum of eight and five mining locations were reported in medium and high impact zones, which formed 50 and 31 % of the total mining locations respectively. When both medium and high impact zone areas are included, Junagadh coast was considered to be more threatened (81.25%) followed by Jamnagar coast (73%). Overall 27 % of mining activities were located in high impact zone or in the nesting beach (Table 24 & Plate 4).

Table 24: Assessment of Sand Mining Activity Impact Status along the Index Beaches based on occurrence at different Impact Zones

Coasts	No of mining locations	Frequency & Relative % of occurrence at different impact zones		
		Low	Medium	High
Jamnagar	37	10(27.03)	17 (45.95)	10 (27.03)
Porbandhar	14	7 (50.00)	4 (28.57)	3 (21.43)
Junagadh	16	3 (18.75)	8 (50.00)	5 (31.25)
Total	67	20 (29.85)	29 (43.28)	18 (26.87)

TAGGING AND TISSUE SAMPLE COLLECTION

Gujarat Sate Forest Department – (Wildlife) facilitated in acquiring permission to tag and collect tissue sample of both Olive ridley and Green turtles from the Ministry of Environment and Forest –New Delhi, Government of India. Under this UNEP-CMS Sea Turtle Project, a total of 300 Kentucky-USA-Incinel tags 1005-681 have been supplied from the Nodal agency – Madras Crocodile Bank Trust- Chennai, Tamil Nadu. However, due to delay in permission and procuring of tags and applicator, the peak nesting period was missed out. Further as Gujarat coast has low intensity of nesting activity, even our few attempts during the tail end of the nesting season were not successful. Added, due to lack of financial support the tagging activity was not able to continue. Nevertheless, tagging and tissue sample collection will be done whenever funding is available.

HATCHERY PROGRAM

Hatching success

In Kachchh coast a total of 1446 eggs from 19 nests were placed in the hatchery. Of that 750 eggs hatched with the hatching rate of 52%. Species specific hatchlings success showed maximum hatching

rate of 55% in Olive ridley and 39% in Green turtle. Excluding Hawksbill nests, a total of 6970 eggs collected from 69 nests were kept in Tukda-Miyani hatchery. Overall, this hatchery estimated 71% hatching success and the species specific hatching success showed a slightly higher rate for Green turtle (72%) than Olive ridley (69%) (Table 25). A total of 10,702 eggs were collected from 105 nests for Rangbai - Odadar hatchery, which had a overall estimated hatching rate of 74%. This hatchery reported slightly higher hatching rate of 77% of Olive ridley compared to Green turtles (73%).

Table 25: Rate of hatching success in GSFDF Turtle Hatcheries

Area	Kachchh			P- Tukda Miyani			P- Rangbai-Odadar		
	Eggs	H	H %	Eggs	H	H %	Eggs	H	H %
Olive ridley	1175 (17)	643	54.72	2425 (24)	1677	69.15	2514 (23)	1925	76.57
Green turtle	271 (2)	107	39.48	4545 (45)	3250	71.51	8188 (82)	5956	72.74
Overall	1446 (19)	750	51.86	6970 (69)	4927	70.69	10702 (105)	7881	73.64

Eggs - No.of Eggs relocated (nests in parenthesis), H - Hatchlings, H % - Hatching success

Coast and species specific hatching success

Coast specific hatching success showed that Kachchh coast reported an overall success of only 52% that of Porbandhar coast was 72%. Overall species specific hatching success showed very little difference between Olive ridley (69%) and Green (72%). Irrespective of species and coast, the ex situ conservation effort of GSFDF resulted in 71% hatching success (Table 26).

Table 26: Coast specific hatching success in GSFDF Turtle Hatcheries

Area	Kachchh			Porbandhar			Overall		
	Eggs	H	H %	Eggs	H	H %	Eggs	H	H %
Olive ridley	1175 (17)	643	54.72	4939 (47)	3602	72.93	6114	4245	69.43
Green turtle	271 (2)	107	39.48	12733 (127)	9206	72.30	13004	9313	71.62
Overall	1446 (19)	750	51.86	17672 (174)	12808	72.48	19118	13558	70.91

Eggs - No.of Eggs relocated (nests in parenthesis), H - Hatchlings, H % - Hatching success

DISCUSSION

Nesting population

Under this project only potential nesting beaches were monitored in selected coastal districts. Monitoring of 14 index beaches round the year in Jamnagar, Porbandhar, and Junagadh coasts (all these form Saurashtra coast) and two additional beaches for nine months by the project personnel, estimated a total nesting population of 1902 nests and partial survey of Kachchh and Porbandhar by the Gujarat State Forest Department yielded a total nesting population of 193 (excluding two Hawksbill nests). During the study period a total of 2095 nests were reported in the selective area of Gujarat coast. Bhaskar (1984) estimated a total of 2109 of both Olive ridley and Green turtle along the Saurashtra coast surveyed during August to October 1981. A recent one time survey carried out reported 603 nests in Saurashtra coast (Jamnagar, Porbandhar and Junagadh) out of the total 676 nests estimated for the entire Gujarat coast (including Kachchh, Amreli and Bhavnagar). Even though, the present estimate showed a higher population, these estimates cannot be compared as this was carried out in selected beaches for whole year, while the earlier estimates were based on surveys restricted to specific time period.

According to Schroeder and Murphy (1999), year –to- year fluctuation in nesting population, adaptation of different survey techniques by researchers and beach specific variation and short term survey cannot be compared or extrapolated. Further, it takes many years to know the accurate population trends of the nesting beaches, thus insisting the value of long-term standardized surveys. Even though monitoring of nesting beaches is the easiest and least expensive, according to Chaloupka and Limpus (2001) short-term survey (<10 years) are inadequate to assess Green turtle population due to several reasons, and green turtles are long-lived (Limpus and Chaloupka, 1997; Zug et al. 2002), and females skip several nesting seasons because of nutritional constrain (Bjorndal 1997). Since Gujarat coast provides nesting habitat for Green turtles, long term monitoring is very essential to ascertain population status.

Species composition

However four turtle species are believed to occur in the state, only the breeding of Olive ridley and Green turtle has been established in Gujarat coast (Bhaskar, 1978; Kar and Bhaskar, 1982 and Bhaskar 1984), while Hawksbill and Leatherback have been occasionally sighted by local fishermen. Even though GSFD survey in Porbandhar coast claims record of two Hawksbill nests just based on the egg size (<4cm diameter), and clutch size of 164 eggs, it needs further checking by verifying the other key characters pertaining to the hatchlings before confirming the report of nesting of Hawksbill along Gujarat coast.

Although, both Green and Olive ridley reported to nest in Kachchh coast (Bashkar, 1984), no Green turtle nests were reported in the year 2000 the reason for which has been mentioned as loss of nesting habitats due beach erosion (Sunderraj et al. 2002). Under this project, out of 19 nests reported by the department staffs, two nests were of green while 17 were Olive nests. However, comparison of nesting population with previous survey (61 nests in 2000) showed a very low nesting in Kachchh coast. This study reported a total of 1363 Green turtle and 732 Olive nests with the overall species composition of 65% and 35% respectively (Table 12). Contribution of Green turtle nesting to the overall population is slightly lower than the previous record which is 68% (Sunderraj et. al., 2002). Since the present monitoring survey covered the entire nesting season of both the species, one can safely say that, Gujarat coast support more Green turtles than Olive ridley with the ratio of 1.86 Green turtle : 1 Olive ridley nest.

Nesting density

Based on the index beach monitoring, the estimated overall relative density/km was less than one turtle (0.76 nests/km) and maximum density was reported in Junagadh coast (0.89 nests/km). Species specific density was 0.27 and 0.49 for Olive ridley and Green turtles respectively (Table 13). The estimated nesting density is found to be very low, which may be due to consideration of only very fresh nest and missing of nests that had taken place between the monitoring surveys which extend to a minimum of seven days during nesting season and more than 20-25 days out of nesting season. The other biological reasons could be that, literature values for remigration intervals range from 2-3 years for most species (Alvarado 1999). Further, according to Bjorndal (1997) females Green turtles skip several nesting seasons because of nutritional constrain.

Potential nesting beaches

Extrapolated overall monthly density for Olive ridley and Green turtle was 8 nests/km and 14 nests/km respectively, which was 23 nests/km for the Gujarat coast (Table 14). Irrespective of species, beach specific monthly density showed that, Mojap-Sivrajpur (26 nests), Navadra-Lamba (28 nests), Lamba-SMM (25 nests) and SMMT-HMM (27) were found to be higher nesting density beaches compared to the overall coastal density of 22 nests/km reported in Jamnagar coast (Table 14). Ratadi– Kantela (23 nests) and Kantela-Kuchhadi (29 nests) reported more nest than the coastal density of Porbandhar coast (21 nests /km). Shil –Lohej and Mangrol – Bara estimated higher density of 33 and 30 nests/km than the coastal estimate of 27 nests/km in Junagadh. Out of 14 beaches

monitored for a full year, intensive monitoring on daily basis of the above mentioned eight high density beaches can indicate the actual nesting potential of the concerned coast.

Nesting season

Olive Ridley nests between June and early November, while Green turtle nesting starts in July and ends in January (Bhaskar 1984). However, the present observation showed nesting beyond their nesting season. Olive extends the nesting activity from November to till March and green from January to March (2005) with few nesting. However, more nesting of Olive was observed between July and November (**Figure 3**). Comparison of nesting activity of Olive ridley showed that in the eastern coast, nesting further delayed and starts in December and usually peaks after January in Orissa and Tamil Nadu coasts (Shankar, 1995 and Pandav, 2001). In Andhra Pradesh active nesting takes place between January and March (Tripathy, *et.al.* 2003). Though, both the species reported nesting beyond their normal nesting period leaving few month gaps, irrespective of species very sporadic nesting takes place throughout the year along the Gujarat coast. Since it was the first full year observation and many other factors influence the nesting activities, only long term observation can give an actual picture.

Threats

Nest predation

The overall estimated rate of egg predation was 44 % of which 17% were by animals and 20.8% were by local people (Table 12). Nest predation by animals and local people is a common threat to sea turtles along the Indian coast (Frazier 1980; Kar and Bhaskar 1982; Bhaskar 1984, 1993; Rajagopalan et al. 1996, Pandav et al. 1998). Bhaskar (1984) mentioned Waghiris and Kolis are the two communities mainly involved in egg collection for consumption and also listed dogs, jackals, monitor lizards, crabs, crows and perhaps wild pigs and hyenas as the predators of turtle eggs and hatchlings on Gujarat coast. However, the estimated nest predation pressure of 44% is lower than the previous estimate of 57% (Sunderraj et al. 2002). Continuous monitoring of the index beaches and egg collection by the forest department for ex situ conservation might have cautioned and restricted the local people indulged in egg poaching. Boulon jr (1999) states that, the presence of researchers or surveillance personnel (department staffs and community activities) on nesting beaches can reduce or even eliminate egg poaching and nest predation. It is also evident that, overall nest predation by human is lower (16.53%) (Table 15), than the previous estimate of 21% (Sunderraj et al 2002), further, since Porbandhar coast was frequently under surveillance for egg collection by the forest department staff it exhibited a comparatively lower overall nest predation (37%) and also human predation (11%) compared to Jamnagar and Junagadh coasts (Table 12 & 15).

Species-Specific Nest Predation

Olive ridley nests were comparatively under more predation (52%) than green turtles (39) (Table 13). Within species, Olive ridley showed a considerable difference between human (16 %) and animal predation (36%). In the case of Green turtle there was not much difference between human (17%) and animal (22 %) predation (Table 14). The difference in animal predation between the species was mainly due to the nest depth. The olive ridley makes a shallower nest than green turtles, which is easier for animals to locate and dig. Bhaskar (1984) reported high animal predation on Olive ridley than Green turtle nests in Kachchh coast and reasoned that Green turtle nests escape predation by animals more frequently than Olive ridley due to their nest excavation area being deeper and more extensive.

Stranding

During the survey, 52 dead turtles were encountered along the index beaches of Gujarat coast. The rate was comparatively high along Junagadh coast (1.33 turtle/km) than the other two coasts, which were monitored. The incidental catch in fishing gears like trawl net and gill net is the major threat (Rajagopalan et al., 1996). Even though 12,648 mechanized and 8370 non-mechanized fishing vessels are operating in Gujarat coast (Anon, 1995), record of only 52 dead turtles showed fairly low level of

mortality. Even though, number of dead turtles reported (52) and overall density (0.86) was higher than the earlier report of 37 turtle and density of 0.07 turtle/km, (Sunderraj et al. 2002), considering that this estimate was based on one year monitoring, still mortality due incidental catch in fishing net seems to be very low in Gujarat coast. Five months survey in Orissa coast reported 806 dead Olive ridley in Andhra Pradesh (Tripathy et al., 2003) and a total of 5282 dead Olive ridley were counted in 480 km of Orissa coast (Pandav et al., 1997). Since onshore survey of turtle mortality do not provide a true picture of at-sea mortality due to many coastal characters (Epperly et al. 1996) only off shore survey of fishing vessels may give a better picture and this estimate is only a partial account of mortality.

Sand Mining

Sand mining in the nesting beaches is one of the threats affecting nesting activity in terms of habitat loss and it has been reported in many coastal states in India (Bhasker 1984; Abraham 1990; Jayakumar 2000) and in Andaman and Nicobar Islands (Andrews 2000). Gujarat coast reported mining of calcareous sandy beaches for construction and for cement industries especially in Saurashtra coast (Bhaskar 1982 and 1984). However, no attempts were made to quantify the impact of sand mining on nesting activity. Under this study an attempt was made to qualitatively assess this impact on nesting beaches. This study reported one mining activity at every one kilometer and is assessed as low impact based on the frequency of occurrence. Nevertheless considering the location of mining, since 27% of mining takes place just in the nesting beaches, it falls under high impact zone (Table 24), and it may affect the nesting activity. During the monitoring survey in four locations, false crawls were reported just in the mined area. It clearly indicates that, the animal might have changed the nesting location due to shallowness of the site. Witherington (1999) discussed that, persistent removal of the beach sand disrupt stabilizing vegetation exacerbates erosion and eliminate nesting habitat. Sand mining, need to be studied very intensively considering its frequency occurrence, extent of area under mining and distance to nesting sites, etc.

Hatchery development

Waghiris and Kolis are the two communities mainly involved in egg collection for consumption and animals like feral dogs, jackals, monitor lizards, crabs, crows and wild pigs and hyenas predate turtle eggs and hatchlings in Gujarat coast (Bhaskar 1984). Overall nest predation along Gujarat coast was reported to be 57%, while it was 100% in Kachchh coast. Added, the threats like sand mining on nesting beaches, spread of oil particles, sea debris and sewage pollution were also reported (Sunderraj et al. 2002). The beaches facing high level of egg poaching, predation, erosion, artificial lighting, beach nourishment, and other vehicular and foot traffic have been justified for nest translocation (Lutcavage et al. 1977). Though, there are many inherent problems in moving sea turtle eggs and incubating them under artificial conditions, which also results in lower hatchling rates than undisturbed natural nests (Pritchard 1992), under certain conditions translocated nests may do better (Wyneken et al. 1988).

In order to overcome the high predation pressure other threats to nesting habitat, in addition to existing sea turtle hatchery at Madhavpur, GSF established three hatcheries, where an overall hatching success of 52% (Mandvi-Kachchh coast), 71% (Tukda-Miyani) and 74 % (Rabgbai-Odadar – Porbandhar coasts) have been obtained. These hatcheries have been well managed by the department staffs who have been trained under the capacity building of government stakeholders under this UNEP – CMS Sea Turtle Project. Even an old estimate of hatching success at Bhavnagar showed a rate of 74% and 71% during 1988-89 and 1989-90 respectively (Sunderraj et al. 2002). In addition to protecting the eggs through translocation into hatcheries, regular surveying of the nesting beaches for egg collection also reduced the egg poaching by the local people. It has been estimated that, the overall nest predation had reduced to 44% from 57% reported earlier and human predation has comparatively decreased in Porbandhar coast (11%) than in other coasts (Jamnagar 19% and Junagadh 15%).

CONSERVATION AND MANAGEMENT STRATEGIES

Research activities

Sea turtle survey activities started in Gujarat coast in late 70's, and most of the surveys were one time and discussed about possible nesting sites and existing threats. Even though, two nation wide projects were initiated on long term monitoring of nesting population (GOI-UNDP in 2002 and present UNEP-CMS Sea turtle Projects) they were not able to continue due to lack of financial supports. Lack of basic data like feeding and nesting population and rapid coastal and maritime developments and existing threats to nesting population and their habitats, necessitate long term in depth study for the Gujarat coast, as data procured through short term or poor data can be detrimental to the conservation of these species. Hence, the following long term research activities need to be initiated to promote more quality data collection over a longer period with conservation objectives for these areas. Continuous and long term monitoring of nesting population at least for a period of five years covering 20-25 index beaches along the potential coastal districts (Kachchh, Jamnagar, Porbandhar and Junagadh) is very essential to establish nesting population status for the Gujarat coast.

- In addition annual survey of nesting population covering the entire Gujarat coast during the peak nesting season of both Olive ridley and Green turtles is also suggested to understand the nesting potential of rest of the coasts.
- Monitoring of feeding population status and their distribution and impact of incidental catch through off shore surveys is very essential
- Monitoring of migration through tagging of more number of turtles of nesting and feeding population for longer period is suggested, which would also help to study the population structure (age and size class) and sex ratio of both the species.
- Monitoring and quantitative assessment of threats related to coastal and fishery development like coastal industries, ports, cargo movements and increase in fishing vessels and fishery population is essential to understand the sea turtle mortality
- Study on quantitative assessment of threats to nesting population and habitats like animal and egg predation, status of predatory species, sand mining and spread of invasive species, oil particles and domestic sewage pollution along the coast are very important.
- Basic research need to be carried out to understand nesting biology like nesting season, re-nesting intervals, nesting behavior, clutch size, egg morphology, incubation period, hatching success and aging of nests etc.
- In addition the existing sea turtle hatcheries can act as a laboratory to study the above aspects as well as to understand pivotal temperature for both Olive and Green turtle species.
- Impact of sand mining on nesting beaches need to be studied quantitatively using Global Positioning System and correlating mining and nesting locations. In addition sand mining should be quantified in terms of extent of area, frequency of mining and distance to nesting locations to understand the magnitude of this impact on habitat loss.

Public awareness and training

The best option to reduce the impact of coastal development and human impacts to nest and nesting beaches is creation of public awareness among the different stake holders. Awareness must be created at various levels to reduce the different types and magnitude of threats. Sea turtle research and conservation activities are man and coast intensive, therefore integrated sea turtle conservation

approach would need well trained stakeholders at different levels in order to have significant impact towards conservation

- Fisher folk and coastal residents – educating these groups regarding the conservation significance of sea turtles can help to reduce egg poaching, sewage pollution, sand mining activities, etc. Fishery folk need to be trained to survey offshore feeding population and recovery of stranded turtles in their fishing nests.
- NGOs and Students: NGOs and students of the Coastal villages, talukas and districts form massive human force that can be utilized for conducting nature education in coastal villages, nest survey, hatchery program and beach cleaning etc.
- Government departments: Awareness among Port Authority, Maritime Board, Pollution Control Board, Fisheries Department authorities can facilitate in many ways like, control of developments in active sea turtle nesting and feeding habitats along the coasts, regulation of vessel movements and fishing activities, control and monitoring of pollution, etc.
- Coastal Industrial sectors: They can help in control of further expansions and developments along the coast and reduce coastal pollution. In addition they can also provide infrastructural facilities and financial support for research and conservation activities.
- Defense force: Awareness and training of Coast Guard, Naval Force and Border Security Force (water wing) will help in coastal and nesting beach protection. They are the best educated man power, who can be utilized for long term monitoring of offshore turtle population, identification of feeding and breeding habitats and also for offshore tagging programs which requires lots of man power, infrastructure and financial supports.

Keeping the above advantages and uses of awareness and training program, it is suggested to carry out an intensive sea turtle conservation campaign along the Gujarat coast. These awareness program need to be carried out for stakeholders at five levels. 1. Coastal community (fisher folk, coastal villagers, NGO's), 2. Education institutions (college and school staff and students), 3. Government departments, 4.Coastal Industrial sectors and 5. Coastal Protection Forces.

Training and capacity building of gsfld staffs

Most of the sea turtle species take well over a decade to mature and year –to year fluctuation do occur in nesting activity. The real value of nesting beach survey depends on establishing a standard, repeatable long-term data on nesting activity to monitor population status. In general, it is not possible to avail many researchers and experts for long term monitoring of the entire coast of the state. Therefore, the best option is, to enhance the knowledge of the State Forest Departmental field staffs towards Sea turtle conservation and Management. The importance and significance of capacity building workshop is given below:

- Even though, two works shops were carried out under this project's scope of work, only 58 candidates were trained in two coastal districts, which forms very small fraction when considering that 13 districts are sharing the coastline of the state.
- The advantage of this training program is that, since all the staffs will be trained in similar way with standard technique, the services of any staff can be avail in any given area and time.
- The trained staffs can generate quality data that can be reliable and comparable with different time periods and areas.
- It is also an added advantage to carry out annual nesting survey covering the entire coast in a specific time period

Considering the necessity of long term monitoring, it is suggested to carry out intensive capacity building and training workshops on Sea turtle conservation and Management for the Field level State Forest Department which would include Range officers, Foresters, Forest Guard and Watchers. Since, department staffs are subjected to transfer it is suggested to carryout workshops involving initially all the field level staffs of coastal districts and then extend it to the entire state in the later stage.

Hatchery management

There are many inherent problems in moving sea turtle eggs and incubating them under artificial conditions like lower hatchling rates (Pichard,1992), skewed sex ratio (Miller and Limpus, 1981 and Morreale et al. 1982) low vigor and survivorship of hatchlings (Ackerman 1980). Even though, the on going sea turtle hatchery program showed, encouraging hatching success rate, proper precaution and care taken in following the egg translocation procedures will improve further. In order to maintain and manage a hatchery the best possible manner and to achieve better hatching success and sex ratio, the following instructions are suggested (Limpus et al. 1979; Parmenter 1980; Harry and Limpus 1989; Boulon Jr. 1999; and Mortimer. 1999)

Collection and Transportation

- Eggs should be translocated from the beaches where very severe predation, poaching, erosion and other beach developments take places.
- Hatchlings sex ratio is often skewed towards any one sex, depending on conditions in the hatchery. Therefore to help and ensure proper sex ratio, eggs destined for the hatchery need to be obtained throughout the nesting season.
- Number of eggs (nests) transferred to the hatchery should be proportionate to the amount of nesting that occurs each month for each species
- Only very fresh eggs less than 2- 4 hours should be translocated to hatcheries
- Eggs collected within 4 to 8 hours of deposition generally have good chance of survival, if handled carefully
- Eggs can be collected in a very clean plastic or cloth bag
- More than 10 - 12 hours old nests should be allowed to remain in situ (in the beach) for at least 21-25 days to reduce the impact of movement-induced mortality
- If eggs are collected 10 hours after laying, great care should be taken by collecting them in a bucket or tray (not in a bag) with some moist sand from the nest to avoid shake and jerks to the eggs.
- It is suggested to record the nest depth (in the beach) while collecting the eggs, so that, the original dimension can be replicated while constructing nest in the hatchery

Relocation

- Eggs should be relocated as early as possible and avoid transporting into longer distances
- Eggs should be buried at the same depth as the natural nests - which is species specific
- Nest should be constructed in a similar shape of natural nest ie. With a narrow neck and flask shaped bottom

- Eggs should be carefully placed in the nest and covered first with moist and then dry sand on very top.
- Nest should be placed with enough space between each other (at least 1 m gap) so that, they do not affect each other during development and also provide enough space for the hatchery workers to move.
- Each nest should be numbered and the associated data such as clutch size, species, nest location and date of collection can be recorded in a data book

Hatchling release

- Hatchlings should be released into sea as soon after emergence as possible at the earliest possible after emergence
- Hatchlings should be released in groups, but at different times of the night and at different points to prevent the creation of fish feeding station.
- Hatchling should be allowed to crawl across the beach to allow imprinting
- Do not release the hatchlings during bright sun or on hot sand
- Do not retain the hatchlings in a container with water.
- If immediate release of hatchlings is not possible, for time being, they should be kept in soft, moist cloth or sack in a cool and dark place.

Beach management

The newly initiated ex situ conservation (hatchery development and management) program showed encouraging result and help in protect some amount of eggs from the existing threats like poaching, predation and sand mining. However, following beach management need to be followed protecting some eggs in the natural conditions and thereby maintains the natural sex ratio.

- Avoid translocation of eggs from the undisturbed area – away from the coastal villages and development activities.
- Egg collection for hatchery need to be obtained throughout the nesting season
- Number of eggs need to be translocated should be proportional to the amount of nesting that occurs each month for each species
- In addition, regular beach patrolling should be carried out to protect the nest left in the beaches.
- Coastal villagers, fisher folk and local student can be involved in beach patrolling

Tagging and tissue sample collection

Sea turtle tagging program has been widely used and proved to be a valuable source of information on reproductive biology, growth, population and migration. In India, intensive tagging program was carried out only along Orissa coast, where 15,000 Olive ridleys were tagged. This study provided some evidence that the turtles nesting along Orissa coast migrate to the coastal waters of Sri Lanka and

southern Tamil Nadu (Pandav 2001). Even though, Gujarat State Forest Department sanctioned and permitted the tagging and tissue sample collection under this project, this scope of work could not be covered due to some technical delay and lack of financial support.

Even though, large number of tags have to be applied over many years before any useful results can be obtained, it is also very important to start and continue the tagging program, which can provide some information. Since Gujarat coast support comparatively more Green turtles than other maritime states of the country, any sort of information acquired through tagging and tissue sample collection - genetic study, will be more valuable and first time for the state and Green turtles. Therefore, Gujarat State Forest Department should prioritize Sea turtle as a special case with other wildlife research and conservation activities. In fact a separate fund allocation needs to be considered for long term research, conservation and management of Olive ridley and Green turtles of this state.

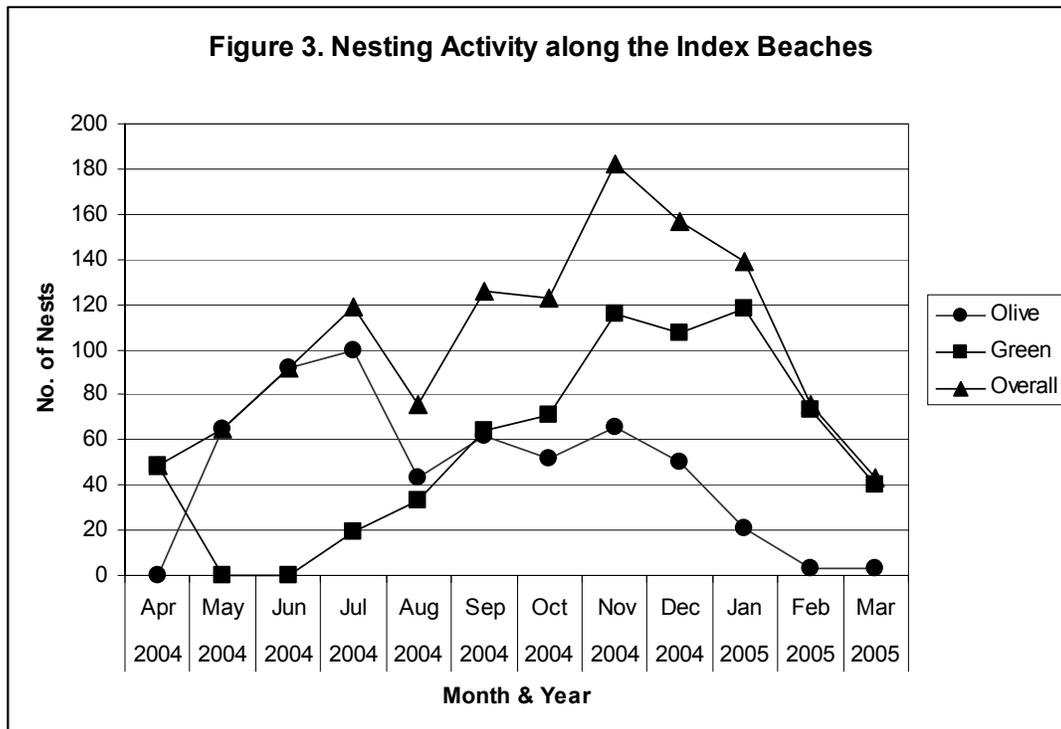
Annexure 1: Details of villages surveyed for stakeholder networking

Coastal district	Details of stake holders approached and informed about the Project	
	Area	Type of Stakeholder
Kachchh		
1	Pingleshwer	Fishery folk 1, Forest Dept 2
2	Suthri	Forest Dept 2, Coastal villager 1
3	Chhachhi	Fishery folk 1
4	Bada village	Fishery folk 1
5	Nanalayja	Fishery folk1 , Coastal villager 2
6	Mandvi,	Forest Dept 4, NGO 1, Coastal villager 1, Others 1
7	Bhuj	NGO 2. Others 3
Jamnagar		
1	Bet Shankodher	NGO 1
2	Okha	NGO 1
3	Mithapur	NGO 1, Forest Dept-1,
4	Mojap	Fishery folk -4
5	Sivrajpur	NGO 1
6	Varwala	NGO 1, Coastal villager -1
7	Dwarka	Forest dept -1, NGO 1
8	Okha – Madhi	Fishery folk -2
9	Kuranga	Coastal villagers 2
10	Navadra	Coastal villagers 1
11	Lamba	Fishery folk -1
12	Miyani	Fishery folk -1
Porbandhar		
1	Visavada	Forest dept 2,
2	Kanttela	Coastal villagers 3, Fishery folk 1
3	Kuchhadi	Fishery folk 1, Coastal villagers 2
4	Birla sagar	Forest Dept 1, NGO Coastal villagers 3
5	Navibandar	Forest Dept 1
6	Balej	Fishery folk -1
7	Chingariya	Fishery folk -1
8	Madhavpur	Coastal villagers 2, NGO -3, Fishery folk 2
Junagadh		
1	Shil	Fishery folk 1, Forest dept 1
2	Rahij	Fishery folk 1,
3	Mangrol	Coastal villagers 1, Forest dept 2
4	Bara	Fishery folk 4
5	Khambaliya	Coastal villagers 1
6	Chorwad	Forest dept 1, Others 1

Annexure 2: Details of stakeholders - Sea turtle conservation network

Name of the Group	Contact person	Nature of activity
Panchjany Pariyavaran Trust - Bet Dwarka – NGO	Mr. Himatsinghji. M. Vadher, Mr, Dhanshyam. H. Vadher (Chairman) Bet Dwarka, Okhamandal, Dist: Jamnagar - 361 330, Phone: (02892) 23824 & 62338.	They do nature education and awareness programs. They also coordinate with Center for Environmental Education (CEE) and WWF (Ahmedabad) for nature education and conservation activities.
Amateur Rangers Nature Club Mithapur – Okha.	Mr. Satiah H. Trivedi E-1, New Merchant Colony Mithapur 361 345 Dist: Jamnagar, Phone: 02892- 223489, MB: 9824169937 E-mail: MCAFUSER@tatachemicals.com	This Nature club involves in conducting environment awareness and nature education programs for villagers, school and college students. They do involve in bird and marine animal watching and also monitoring of wetlands. They do monitor turtle nesting activity along Mithapur, Mojar beaches.
Okha-Mandal Pariyavaran Vikas Trust - NGO	Mr. Shivbha K. Subhaniya (Program Offiver) Mr. Devisingh. S. Manek P.O Varwala – 361 335 Taluka- Dwarka Okhamandal District Jamnagar	Community based Development activities like water resource development and soil conservation activities. Mr. Shivbhai is capable of writing poems and slogans on environment. He is potential candidate who can be involved in public awareness programs.
Kachba Unchar Kendra – Madhavpur	Mr. Praveen M. Solanki Mr. Santhi bhai Solanki Mr. Vinubhai Solanki Kachba Unchar Kendra, Madhavpur village, Post- Sheel, Porbandar. Phone: (0286) 2272560	A small group of 4-6 people involve in turtle hatchery program in Madhavpur village. This hatchery is under the control of Director, Marine National Park – Jamnagar. They have more than five years of experience in turtle egg collection and hatchery management.
Gir Nature Youth Club	Amit B. Jethava President Gir Office – Main Bazar, Khambha, Amreli, District –Amreli, Gujarat 365 650 Ph: 02797-260181, Tele Fax: 02797-260121 Email: amijethava@rediffmail.com	This nature club actively involve in sea turtle nest monitoring and also do public awareness campaign on wildlife conservation
Kachchh Environment and Ecological Cell – KEE Cell	Mr. Rajni Patwa President KEE-Cell Akshyaraj Appartment Bankers Colony, Bhuj – 370 001 Ph: 02832-254600®, 230232(o) Fax: 02832-252516 Mobile: 098252 25932 Rajnipatwa@yahoo.com	This NGO group involve in environment and community related development works. Very keen to take part in sea turtle conservation activities

Interested Individuals		
Dr. Prashant Vasa	Dr. Prashant Vasa Kutch Netramani Cilinic Sea Face, Near Court' Kachchh, - Mandvi – 370 465 E-Mail vasa_prashanth@yahoo.com	He is ophthalmologist by profession; very much interested in sea turtle conservation. He dose turtle walk along the Mandvi beach of Kachchh coast.
Fakirmohmed A. Turk	Fakirmohmed A. Turk Jamadar Wadi Village. Dharab, Mundra Taluka ,Kachchh District Phone: 02838 -	He is a amateur bird watcher and wildlife lover and interested in sea turtle conservation activities
Arpit N. Devmurari	Arpit N. Devmurari 1-Navneet Society, Opp. Pankaj Scociety , Jamnagar – 361 008 Phone: (R) 0288 – 2676457, Mobile: 9426442243 E-mail: deomurari@gmail.com	BE Computer Engineer by profession: Naturalist and bird watcher.



Chapter 3

The status of sea turtle populations on the Maharashtra and Goa coasts of India

Varad Giri

INTRODUCTION

Maharashtra and Goa, the states on the west coast of India are also rich in the diversity of the sea turtles. Daniel (1983) listed 3 species viz., Hawksbill, Green Turtle and Loggerhead in Maharashtra's waters. Later Bhaskar (1984) and Das (1985) reported the Olive Ridley. But as per the recent survey, except Loggerhead all the other four species are reported from Maharashtra (Giri et al. 2003). Goa, Maharashtra's southern neighbouring state, is also rich in the diversity of marine turtles, where the Olive Ridley, Leatherback and Green turtles are reported. The Olive Ridley is known to nest sporadically along the entire coast of Maharashtra. There are some stray reports of nesting of Green Turtle also (Shaikh 1983, Gole 1997 and Giri et al. 2003). There were records of the nesting of Olive Ridley and Leatherback in Goa (Das, 1985, Bhaskar, 1984), but recent nesting records are only of the Olive Ridley (Giri et al. 2001)

In Goa, the Forest Department with the help of local people is protecting some sea turtle nesting beaches from 1997 (Giri et al. 2001). In Maharashtra also sea turtle conservation movement is started by a NGO, Sahyadri Nisarga Mitra (SNM) from 2000. In the first year this activity was started in one village and now it is spread in 13 villages from three coastal districts of Maharashtra (Katdare & Mone, 2003 and Katdare pers.comm.).

Studies on sea turtles in India have been mainly focused on the east coast and little information is available on the population of the west coast. The studies related to monitoring with the help of tagging and molecular genetics have not been carried out on the west coast of India. These studies are essential for proper conservation practices. During this survey monitoring was carried out on some of the potential beaches in Maharashtra. The major threats to the sea turtles in Maharashtra are from poaching of eggs and incidental catches in fishing nets. The threats in Goa are mostly from incidental catches in fishing nets and developmental activities along the beach. Recently due to the efforts taken by Forest Department in Goa and SNM in Maharashtra, there is change in the attitude of local people towards the sea turtles. In some localities they are helping in protecting the sea turtles and their nests. Apart from this the locals are also collecting the data related to nesting on the respective beaches. This information will be essential for long term monitoring. Today these activities are restricted to few sites, but it spreading other localities also which will surely help in the conservation of sea turtles in Maharashtra and Goa.

STUDY AREA

Maharashtra

From the border of Gujarat on the north, to the border of Goa on the south, the coastline of Maharashtra covers about 720 km. This region has five coastal districts, Sindhudurg, Ratnagiri, Raigad, Thane and the urban area of Mumbai. The main occupation of the people on the coast is fishing and agriculture. In small villages fishing is mostly carried out using by traditional methods. Apart from this, mechanised fishing is also intensively carried out along the entire coast.

There is sporadic nesting of Olive Ridley along the entire coast with few potential beaches in Sindhudurg and Ratnagiri district (Giri et al. 2003). Sahyadri Nisarga Mitra started sea turtle

conservation movement in Maharashtra from 2002. Though this activity was started in two villages in the first year, now it is in 13 villages. Most of these beaches are less populated and with minimum fishing activities.

Goa

Goa is a small state on the west coast of India with the coastline of 160 km. bounded by the coastline of Maharashtra on the north and Karnataka on the south. Of the 160 km of coastline, about 65 km are sandy beaches, which are suitable for the nesting of sea turtles. The state is divided into two districts, South Goa and North Goa. The main occupation of the people on the coast is fishing. Mechanised fishing is intensively carried out along the entire coast of Goa. Most of the beaches of Goa are highly populated as they are the important destinations for Indian and foreign tourists. The tourist season in Goa is from October to May, which coincides with the breeding season of sea turtles. There are few less populated beaches, with less influx of tourists, are known for sea turtle nesting. Of these three beaches Morjim, Galgibag and Agonda are protected by Forest Department, especially during the breeding season for sea turtle conservation.

METHODOLOGY

Monitoring

One of the objectives of this project was to monitor nesting sites to assess the conservation status of different species of marine turtles. There are confirmed reports of nesting of Olive Ridley from the coast near Malwan in Sindhudurg district (Giri et al 2003). So for the first phase, a 50 km stretch of less populated beaches near Malwan in Sindhudurg district (Map 3.1) was monitored from February to April 2004. There are 21 villages / beaches in this stretch and on an average three visits were made to each site during the survey period. During each visit, we use to survey the entire beach for two times. The early morning survey was mainly to check nesting signs like track marks. As the sea turtles are known to nest during the night, we use to survey the beach in the night for any checking fresh nesting.

We had also collected the information regarding beach profile and mortality (Datasheet attached). In the free time we interacted with the locals, especially fishermen to collect more information on incidental catch in fishing nets and offshore sightings of dead or live sea turtles. Along with these interviews and discussions we arranged slide shows for general awareness towards conservation of nature focusing marine turtles as flagship species. Mainly these shows were arranged for the local communities in the villages.

In the second phase, which was from October 2004 to March 2005, monitoring was restricted to the beaches where sea turtle conservation activities are taking place. These beaches were mostly in the Ratnagiri and Raigad district. All these sites were selected by Sahyadri Nisarga Mitra (SNM), a networking NGO for this project and monitoring was done with the help of local community.

According to some locals, there were reports of sporadic nesting of sea turtles in the monsoon on some of the beaches in Sindhudurg district. These localities were surveyed during the monsoon of 2005 but no nesting was reported.

In Goa the coastline is comparatively small and most of the beaches are populated as this is one of the famous tourist destinations in India. Thus sea turtles, mostly Olive Ridley are known to nest on some of the less populated beaches (Map 3.2). There are few sites where Forest Department with the help of locals protecting the nests of Olive Ridley. We are using the information regarding nesting of sea turtles collected by the Forest Department and locals in these sites.

Apart from this we have collected data on threats, effect of tourism on nesting sites and local people's perspectives towards sea turtles from 32 beaches in Goa. This information was mainly based on the interviews with local coastal villagers, trawler owners and workers, officials of Forest Department, Indian and Non-Indian tourists and people linked to the tourism business. Based on the information

collected during these interviews, we had given points to each beach and the data is graphically represented.

Tagging and tissue collection

This is essential for long-term conservation of sea turtles, as tagging has not been carried out in Maharashtra and Goa upto now. We had already applied for tagging and tissue sample collection for genetic analysis to Ministry of Environment and Forests, Government of India. But we are still waiting for the permission. We had informed the NGO's and locals involved in sea turtle conservation about tagging and tissue collection and they are willing to take up this work. Thus this work is to be initiated just after we get the permission from MoEF.

Networking

The major threats to the sea turtles in Maharashtra are from the poaching of eggs and incidental catches in fishing nets. The threats in Goa are from incidental catches in fishing nets, developmental activities along the beach and poaching of eggs. This is mainly happening due to the lack of awareness regarding sea turtles. We interacted with different NGO's, village leaders and villagers, schools and colleges and made them aware about the sea turtles and encouraged them to participate in the sea turtle conservation movement, which is slowly spreading on the coast of Maharashtra.

The local NGO's involved in these activities were Sahyadri Nisarg Mitra (SNM), Chiplun in Maharashtra and Green Cross in Goa. Both these NGO's were actively carrying out awareness campaigns in both the states. To promote sea turtle conservation work of SNM in Maharashtra, BNHS has provided a small funding through Salim Ali Nature Conservation Fund during the breeding season of 2004-2005.

A one day workshop was also conducted in Maharashtra and was attended by 62 stakeholders. These were mostly the local NGO's, Forest Department officials, local villagers, teachers and students.

RESULTS AND DISCUSSION

Monitoring in Maharashtra

In Maharashtra nesting season is from October to March and there are reports of sporadic nesting of Olive Ridley from the entire coast. According to Giri et al. 2003 the potential areas for the nesting of Olive Ridley in Maharashtra are mostly in Sindhudurg and Ratnagiri districts. So for intensive monitoring we selected sites from these two districts. Monitoring was done in two phases.

Phase I – Nesting

For the first phase, monitoring was carried out from January to April 2004. We selected a 50 km stretch of less populated beaches near Malwan, the southernmost part of Sindhudurg district (Table 4.1). Apart from a large fish landing centre like Malwan, most of the beaches are less populated. There are 21 villages / beaches in this stretch. The longest of all these beaches was Vengurla which was about 6 km. and shortest was Kille Niwati, it was about 0.5 km.

Apart from this we surveyed six potential less populated beaches in Ratnagiri district. There were fresh nesting reports from these beaches in the recent past. Though these visits were not regular, but on an average 2 visits were made to each of these sites during the survey period.

Table 1: Sites visited during first phase

Name of the beach	Sightings / nesting	Remarks
District: Sindhudurg		
Kolam- Chivala	2 olive ridleys	SCL 13.50 & 27.00
Dandi / Nishankathi	Olive ridley	SCL 28.00
Devbag-Tarkarli	Olive ridley Green turtle	SCL 26.00 SCL 25.00
Bhogave	3 olive ridleys	SCL 50.00, 32.00 & 35.00
Achara	Olive ridley Green turtle	SCL 29.00 SCL 26.00
Tondavali	2 green turtles	SCL 25.00 & 27.00
Talashil	Olive ridley Green turtle	SCL 40.00 SCL 29.00
Tambaldeg	2 olive ridleys Green turtle	SCL 25.00 & 28.00 SCL 26.00
Morve	-	
Kemundale	Olive ridley 2 green turtles	SCL 28.00 SCL 32.00 & 26.00
Vengurla	3 olive ridleys Green turtle	SCL 28.00, 30.00 & 24.00 SCL 37.00
Velaghar-Arawali	2 olive ridleys	SCL 33.00 & 27.00
Mochemad	-	
Taank	Olive ridley	SCL 35.00
Vayangani / Dabholi	Olive ridley Green turtle	SCL 24.00 SCL 31.00
Khavane	2 olive ridleys Green turtle	SCL 27.00 & 29.00 SCL 28.00
Faliyefonde	Olive ridley	SCL 29.00
Kondur	Olive ridley	SCL 26.00
Kelus	Olive ridley	SCL 30.00
Neevati	2 olive ridleys Green turtle	SCL 31.00 & 25.00 SCL 27.00
Kille Niwati	-	
District: Ratnagiri		
Gavkhadi	-	
Ganeshgule	-	
Guhagar	One nest	Damaged
Hedavi	-	
Velaneshwar	-	
Velas	4 nests	3 predated and 1 partly predated

SCL Straight Carapace Length

We reported only two fresh nests from the entire stretch of 50 km during this survey. On one of the visits on 2 February 2004, we saw a fresh track marks and one exposed nest at Achara. The local person who accompanied us during this survey informed us that the eggs from this nest were stolen by the people. This beach is about three and half km. in length and is mostly backed by Casuarina plantations. The village is close to the beach. One of the major threats for the sea turtles nesting is poaching of eggs by humans. Though there is some fishing activity near the village, rest of the beach is undisturbed. The informed us that the nest are also predation by Jackals and stray dogs. Recently there are reports of sand mining from this beach. Though this is not on large scale but is happening on regular basis.

At Tambaldeg, we saw one more fresh mark and an undisturbed nest on 1 February 2004. To protect this nest from human predation, we cleared track marks. We haven't informed the local about this nest. Subsequently we visited this beach on 16th and 28th February and the nest was still undisturbed. Thus this nest was successfully protected in situ. This is one of the villages where with the participation of local people and Forest Department few nests of the sea turtles are successfully protected. This is a small village and the beach is about 3 km. long. The beach is about 500 meters from the village and is backed by Casuarina plantation and sand dunes. Traditional fishing is carried out in this village and the people consume turtle eggs.

On 23 January 2004 we saw one predated nest, probably by stray dogs at Guhagar in Ratnagiri district. This is one of the populated beaches and is very close to the village.

Maximum number of nests was reported at Velas. This beach is about two km in length, and is backed by the Casuarina plantation. The village is about one km away from the beach. The main occupation of the people of this village is agriculture. The people of this village don't eat meat of sea turtles but few collect and eat the eggs. There is a small stream which runs in between the village and the beach and gets flooded during the high tide. The village is virtually separated from the beach during this period. Thus this is a secluded and undisturbed beach. The stream joins the sea on the northern side of the beach. The southern tip of the beach is rocky. The main threat to the sea turtle nests on this beach is from predation by jackals. On 22nd January 2004 during our morning search on this beach, we reported 3 predated and one partly predated nest.

This is the beach where Sahyadri Nisarga Mitra, with the help of local community started sea turtle conservation from 2002. In the breeding season of 2002-2003 they reported 50 nests on this beach. All the nests were relocated into a hatchery. Out of 5372 eggs from 50 nests, 2734 hatchlings were released with the hatching success 50.89 % (Kadare, 2003). In the breeding season of 2003-2004 a total of 30 nests were protected on this beach by SNM. Of the 3028 eggs, 1500 hatchlings were released. During the breeding season of 2003-2004 SNM also protected 5 nests in Murud, Saldure and Anjarla also. All these villages are in Ratnagiri district.

Mortality

The main treats to the adult sea turtles is from incidental drowning into the fishing nets. During this survey period of four months we reported 39 dead turtles from the stretch of 50 km. Of these 28 were Olive Ridley and 11 Green Turtles (Table 4.1). We checked for external injuries, apart from small cuts on the flippers in few turtles, no evidences were reported. Mostly they would have died due to suffocation. The locals also believe that the cause of the death could be incidental catch in fishing nets. Compared to other parts along the coast of Maharashtra, there are very few villages in the Sindhudurg district where sea turtle meat is consumed by some people. Mostly fishermen release the turtle immediately if they get in their fishing nets. And if it is dead then they throw it in the sea. The fishermen also reported many dead turtles in the sea.

Phase II Nesting

As the nesting frequency is very less on the entire coast of Maharashtra, which was confirmed from the data collected during phase I, we had changed the monitoring technique for Phase II. It was from October 2004 to March 2005. In this phase we concentrated our monitoring efforts on the beaches where sea turtle conservation activity is taking place. All these sites were selected by Sahyadri Nisarga Mitra (SNM), a networking NGO for this project. The selection of the site was mainly based on the number of recent nesting reports and response of the local people towards sea turtle conservation. A total of 10 villages, two from Raigad, seven from Ratnagiri and one from Sindhudurg district were selected for monitoring (Table 4.2).

The main threat to the sea turtle nests is from humans in most of these localities. Apart from this the nests are also predated upon by Jackals and stray dogs. To avoid this danger and also due to limited

resources SNM is protecting sea turtle nests in hatcheries. Before starting sea turtle conservation program, SNM meet with the local people and makes them aware about the sea turtles and the need of their conservation. Then SNM selects two or three interested people from each village as volunteers for this activity. These volunteers are given some remuneration for their work. Then SNM gives basic training regarding relocation of nest and its care to these volunteers. During the breeding season these volunteers patrol the beach daily. On locating the nest, they carefully remove eggs and relocate them in hatchery. The hatchery is always on the same beach, just above high tide line. It is mostly rectangular and is prepared by using G.I. Mesh and wooden poles. To avoid injury to hatchlings by G.I. mesh, bottom half of the hatchery is covered with cardboard sheet from all the sides during hatching period. Each nest is given a number. The eggs are incubated in the natural condition. After hatching the juveniles are immediately released in the sea. The volunteers maintain data like date and time of nesting, number of eggs, date of hatching and number of hatchlings released. Thus for this phase we are using the data collected by local from above mentioned villages.

During this phase of monitoring we haven't collected the information on mortality.

Table 2: Village wise nesting data in the breeding season of 2003-04

Sr.	Locality	# of nests
District: Raigad		
1	Diveagar	4
2	Harihreshwar	4
District: Ratnagiri		
3	Velas	14
4	Kelashi	1
5	Karde	0
6	Kolthare	4
7	Dabhol	4
8	Ambolga	0
9	Madban	0
District: Sindhudurg		
10	Tondoli	0

During the breeding season of 2004- 05 SNM started sea turtle conservation activity at Harihreshwar in Raigad district. Here four nests were protected. Out of 455 eggs, 255 hatchlings were released successfully. This beach is about four km in length and is divided in two parts. There is a small rocky hillock, which divides this beach in two parts. This is also a less populated beach with minimum fishing activity. Here the major threat to the sea turtle nests is from humans and stray dogs. Though this is the first year of sea turtle conservation activity, four nests of Olive Ridley were protected on this beach.

During the breeding season of 2004-05, Sahyadri Mitra, a local NGO from Mahad started sea turtle conservation activity at Diveagar in Raigad district. They are working in collaboration with SNM. This beach is also a less populated beach with minimum fishing activity. One of the main reasons to select this site was the recent nesting reports and willingness of some local people towards the sea turtle conservation. They reported and protected four nests of Olive ridley and 237 hatchlings were released. Maximum nesting was reported from Velas during the breeding season of 2004-05 and 14 nests of Olive Ridley were reported and protected on this beach. A total of 1468 eggs were relocated from these 14 nests in a hatchery and of them 744 hatchlings were released.

Dabhol is in Ratnagiri district and on this beach four nests of Olive Ridley were reported and protected. This is small beach and is about 2 km in length. It is backed by Casuarina plantation. Though this is the first attempt of sea turtle conservation on this beach, four nests were protected and out of 410 eggs 233 hatchlings were released.

Kolthare was another beach in Ratnagiri district where four nests were protected. This is also a less populated beach and was the first year of sea turtle conservation activity. Here the hatching rate was very low and only 82 hatchlings were released out of 322 eggs.

In Kelashi, only one nest was reported. This beach about 3 km long and is undisturbed. A total of 14 hatchlings were released from 51 eggs.

Other sites were Karde, Ambolgad, Madban and Tondoli in Ratnagiri district. Apart from intensive monitoring during the breeding season, no nesting was reported from these sites.

Monitoring in Goa

In Goa the nesting season of sea turtles is from October to March. Like Maharashtra, there is sporadic nesting of Olive Ridley along the entire coast of Goa. From the nesting season of 1997 the Forest Department started protecting turtles and their nests. Prior to this turtle eggs were regularly poached by the locals for consumption. The Forest Department deploys two forest guards and a couple of local volunteers on each site. The forest guards and volunteers patrol the beach to prevent poaching of eggs. Their duty also involves location of the nests and protecting them from stray dogs and jackals. These nests are protected in-situ. They also keep records of nesting data. These sites are Morjim and Agonda in North Goa and Galgibaga in South Goa. Compared to other populated beaches these are less disturbed and unpopulated beaches in Goa.

Morjim was first site in Goa where sea turtle conservation was started in 1997. During the breeding season of 1997-98, only five nests were protected on a small part of this beach. In the next year (1998-99), eight nests were protected. Along with increase in the number of nests protected, more areas of the beach came under protection and during the breeding season of 2000-2001, 30 nests were located and protected. In the subsequent years the number of nests was declined and during the breeding season of 2003-04 only nine nests were protected (Table 4.3).

Galgibaga is another well known sea turtle nesting site in South Goa. Here the sea turtle conservation started in the breeding season of 1999-2000. Earlier the eggs of sea turtles were consumed by the locals for food. Then with the initiative by a local priest and help of the Forest Department, sea turtle conservation movement was started in this village. In the first year i.e. 1999, 10 nests were protected, in the next breeding season (2000-2001) protection was given to 33 nests, subsequently 19 nests were protected in 2002-03 and in the breeding of 2003-04, 14 nests were protected (Table 4.3)

Table 3: Nesting data in Goa

Year	Number of nests		
	Morjim	Galgibaga	Agonda
1997-98	5	-	
1998-99	8	-	
1999-2000	14	10	
2000-01	31	33	9
2001-02	20	-	-
2002-03	11	19	15
2003-04	9	14	6
2004-05			

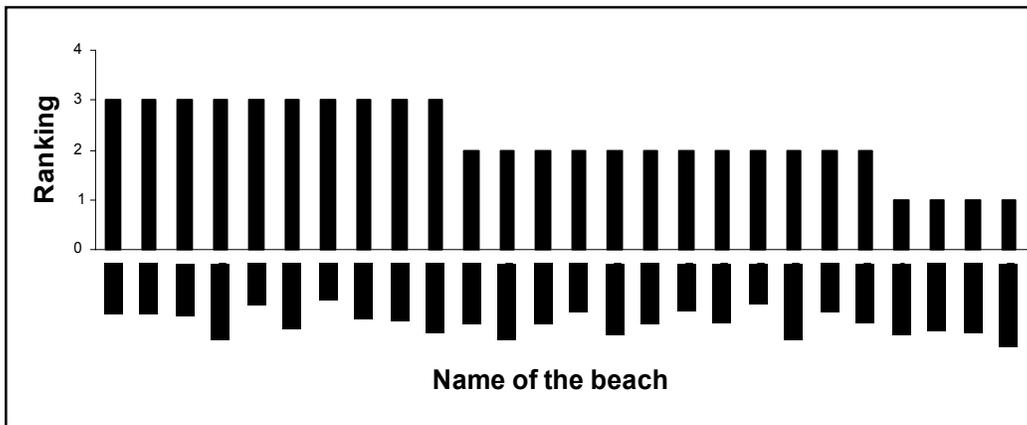
Agonda is another locality in North Goa where sea turtle conservation movement is started from the breeding season of 2000-2001. This is also a less populated beach and with minimum tourist activities. Compared to other two beaches, the number of nests is less on this beach. In the breeding season of 2003-04 six nests were protected on this beach.

We had also collected information on different aspects related to sea turtles from Goa. Apart from the above mentioned turtles nesting sites, there are few other potential beaches in Goa where there are recent reports of sea turtle nesting. Although the Forest Department of Goa had taken initiatives to protect the sea turtle nesting sites, this will only possible if the local community is supporting this endeavor. Thus the role of local community is equally important in sea turtle conservation. Most of the potential sea turtle nesting sites are undisturbed and less populated due to fewer tourists. But now days due to sea turtle nesting, these are on the tourist map of Goa and many tourists are visiting these beaches. With the influx of tourists, the tourism industry is also taking shape in these sites. Thus there is direct or indirect benefit to the local community of these villages. We had also collected information of the outlook of local people towards sea turtle conservation, the benefits they are getting from this activity and the views of tourists. These are some of the important aspects and will be essential to formulate conservation action for sea turtles in Goa.

Potential nesting sites

Apart from the above sites, there are few potential turtle nesting beaches in Goa (Fig. 4.1). To rank these beaches, we had taken into consideration the beach profile, disturbance and fresh nesting reports. The beaches with three points are potential nesting sites and these are Querim and Morjim in North Goa and Agonda, Talpona and Galgibaga in South Goa. These are less populated beaches with moderate tourist activity. Apart from this there are few other potential beaches like Velsao, Betalbatim, Colva, Benaulim and Betul. But there is information from these sites. Similarly beaches scoring two points represent moderate potential. These are mostly the disturbed beaches. Beaches scoring one point are not suitable for sea turtle nesting as most of these beaches are highly developed or they are rocky.

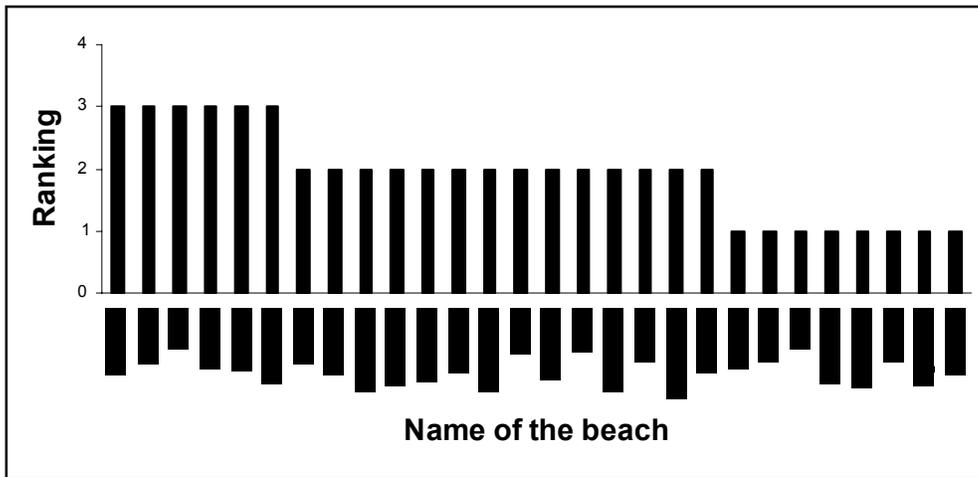
Figure 1: Potential nesting sites



Local support

In Goa one of the key factors of sea turtle conservation is the involvement of the local community. We had collected data on the outlook of the local community towards sea turtle conservation from all the beaches. Thus the beaches where maximum of the people are willing to support this activity are given more points (Fig. 4.2). Villages like Ashwem, Morjim, Betul, Agonda, Talpona and Galgibaga show high degree of support towards conservation. Beaches scoring two points, one point and zero point represent moderate support low support and no support respectively. In most of the villages the locals feel that due to sea turtles they will not be getting enough space on the beach for running temporary hotels for tourists.

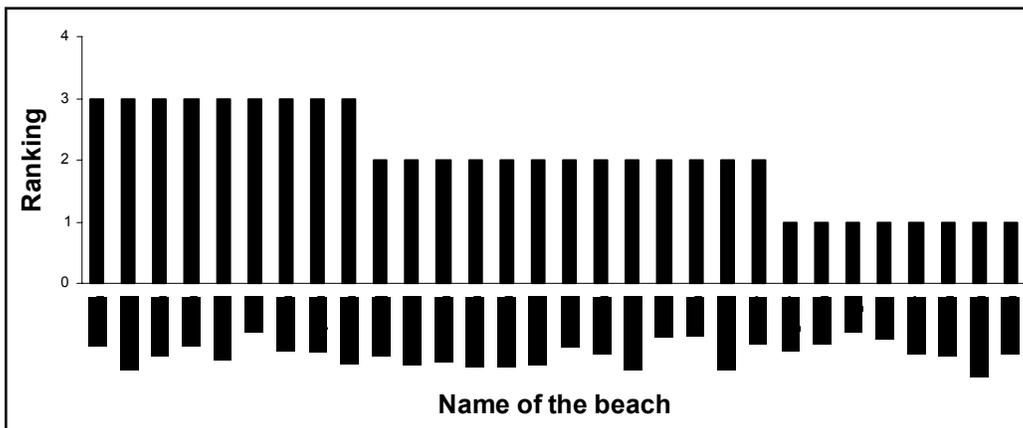
Figure 2: Local support



Benefits to coastal villages from Turtle nesting

Most of the coastal villages derive either direct or indirect benefits from sea turtles. Villages like Querim, Mandrem, Ashwem, Morjim in the North Goa and Benaulim, Betul, Agonda, Talpona and Galgibaga in South Goa get more benefit from sea turtle nesting. Most of these beaches are secluded and compared to other populated beaches in Goa very few tourists visit these beaches. But during the breeding season of sea turtles, which coincides with tourist season in Goa, many interested Indian and overseas tourists visit these beaches. People engaged in the tourism business like taxi drivers, shack owners, local guesthouses and hotels get benefit during this period.

Figure 3: Benefit to villages from nesting



Shack owner perspectives on Sea Turtles

Shack is a temporary shelter / hotel built on the beach to attract the tourists. Though this is not a permanent construction but they are generally erected on the beach during the tourist season. As these shacks are on the beach, sometimes they become the hurdle for nesting sea turtles. But in 2003 we had seen two nests very close to one of the shacks in Morjim. The role of shack owners is also important as they can help in reporting and protecting turtle nests. Most of the shack owners from the turtle nesting sites are aware of their beach being potential nesting site of sea turtles. They also believe that the number of tourists is increasing in the recent years due to sea turtle nesting. They are supportive to the Forest Department’s initiatives to conserve sea turtle nests. Some of the shack owners do report sea turtle nesting to the Forest Department. According to them it is more profitable to promote

ecotourism than poaching of eggs for consumption. Most of them also feel that conservation of sea turtles is important, as it is the unique and rare species. We had interviewed shack owners of different sea turtle nesting sites. While asked about their views on turtle nesting on their beach, 45% responded positively. They are happy that sea turtles are coming to nest on their beaches and are willing to support sea turtle conservation activities. Interestingly 25% of shack owners have given negative response. They feel that once the beach is declared as sea turtle nesting site, then there are many restrictions.

Apart from the above main points we had also collected information on different aspects related to sea turtle conservation. This information was collected in a short period, mostly during the breeding season of sea turtles. One of them was awareness of sea turtle nesting sites among tourists. As per our information 46% of overseas tourists are aware of these sites. These sites are made popular by local media and Tourism Department. Interestingly awareness level of Indian tourists is low and it is 21% only. Goa is known for its beautiful beaches and most the tourists visit Goa to enjoy the scenic beauty (34 % overseas and 17 % Indian). Interestingly 19 % of overseas tourists are visiting Goa to see the turtle nesting sites. Only 4 % of Indian tourists are coming to Goa to visit turtle nesting sites. While asked about the endangered status of sea turtles, 49% of overseas tourists said that they are aware about this and only 18% are unaware. But only 9% of Indian tourists are aware about the status of sea turtles and 24% are unaware.

We had also collected information on frequency of sea turtle sightings by the fishermen. For this we interviewed 50 fishermen from different areas. Out of this 18 responded positively and told us that they have seen the sea turtles regularly. But they admitted that the frequency is very less compared to what they have seen before 10 years. 13 fishermen responded negatively and told us that they haven't seen the sea turtles in the last few years. While the rest 19 said that they have seen the sea turtles very occasionally.

While asked about the TED (Turtle Excluder Device), 94% of fishermen told us that they did not have any knowledge about this device. This indicates that awareness programs on the use and functioning of TED needs to be conducted only for the fishermen. But as there are very few reports of incidental catch in the fishing net, this can be done in the later stage.

There is slow decline in the number of sea turtle nests on different beaches in Goa (Table 4.3). The noticeable decline is seen in the number of nests at Morjim. This trend is also seen in Galgibaga and Agonda. The locals believe that the number of nesting sea turtles is declining in the last 10 years. The fishermen, who go for deep sea fishing, also supported this view.

Networking

The major threats to the sea turtles in Maharashtra are from the poaching of eggs and incidental catches in fishing nets. The threats in Goa are from incidental catches in fishing nets, developmental activities along the beach and poaching of eggs. This is mainly happening due to the lack of awareness regarding sea turtles. We interacted with different NGO's, village leaders and villagers, schools and colleges and made them aware about the sea turtles and encouraged them to participate in the sea turtle conservation movement, which is slowly spreading on the coast of Maharashtra.

The local NGO's involved in this activities were Sahyadri Nisarga Mitra (SNM), Chiplun in Maharashtra and Green Cross in Goa. Both these NGO's were actively carried out awareness campaign in both the states. To promote sea turtle conservation work of SNM in Maharashtra, BNHS has provided a small funding through Salim Ali Nature Conservation Fund during the breeding season of 2004-2005.

A one day workshop was also conducted in Chiplun, Maharashtra. It was a state level workshop and was organised in collaboration with the Sahyadri Nisarga Mitra. This was the first workshop on sea turtle conservation in Maharashtra. and was attended by 62 stakeholders. These were mostly the local NGO's, Forest Department officials, local villagers, teachers and students.

Chapter 4

The status of sea turtle populations on the Tamil Nadu and Kerala coast of India

S. Bhupathy, M. Vijay, A.M.A. Nixon, J. Subramanean, R. Karunakaran and J. Gokulakrishnan

INTRODUCTION

Among the five species of sea turtles distributed in the Indian region, four of them, the Olive ridley (*Lepidochelys olivacea*), Green turtle (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) nest within the Indian limits. All of these species are distributed in Tamil Nadu and at least four species are found within the coastal areas of Kerala. The Wildlife Institute of India (WII) recently implemented a UNDP - Government of India sea turtle conservation Project. This project (2000 - 01) evaluated the status of marine turtles and their nesting habitats in all maritime states of India, which included an assessment of threat to the survival of turtles. Data on important nesting beaches were generated, which formed the benchmark for future assessments and monitoring. Among many aspects, monitoring population trend of a species is critical for the preparation and implementation programs for any species. As a part of the present CMS - MCBT project on the marine turtles, the Sálim Ali Centre for Ornithology and Natural History (SACON), Coimbatore has undertaken studies along the Kerala and Tamil Nadu coasts during 2003 - 05 turtle nesting seasons.

Objectives

Major objectives of the present study were to, monitor important nesting sites in Tamil Nadu and Kerala to assess the conservation status of different species of marine turtles, and to network with and provide training to government officers and non-government organizations in both states to enhance conservation actions.

METHODOLOGY

Study Area

The all India coordinated UNDP – GOI - WII Olive ridley project (2000 - 2001) suggested that the Nagapattinam and Chennai coasts (Fig. 1 & 2) along the Tamil Nadu and the beaches of North Kerala (Fig. 3) as important marine turtle nesting areas. Hence, the present study monitored turtle nesting and mortality along these beaches. These beaches are largely sandy (Fig. 4) and provide suitable nesting habitats. The south Chennai (12o 31' – 12o 8' N and 80° 10' – 79° 56"E) and Nagapattinam coasts (11o 51' – 11o 30' N and 79° 51' – 79° 46' E) are part of the Palar and Cauveri delta respectively. The north Kerala coast (~ Kozhikode - Kannur; 11o 41' -12o 38' N and 74° 55' – 75° 38"E) has many west flowing rivers and remnants of mangrove vegetations on these river mouth. Important ground vegetations along the sandy beaches are Ground glory, *Ipomoea pescaprae* (Fig. 5) and Ravanan moustache, *Spinifex littoreus* (Fig. 6). Coconut plantations and sea walls (Fig. 7) have heavily impacted the west coast. The sea walls were built mainly for preventing sea intrusion into land. The west and east coasts receive major rainfall from the Southwest (May - July) and Northeast (October - November) monsoons respectively.

Field Methods

Each study sector was divided into 10 km unit and fortnightly surveyed (during 0600 -0830 hrs) for recording turtle nesting and mortality. Data on nesting intensity was based on tracks (Fig. 8) found on the beach. As surveys were done at fortnightly interval, tracks found during each surveys were considered as new. Nest predation by animals or exploitation by locals was based on tracks and signs found nearby exploited nests. Number of carcasses (Fig. 9) found on the shore indicated the turtle mortality. Carcasses of turtles were marked with paint to avoid repeat count. Project personnel surveyed the Mamallapam - Pondicherry (50 km) and Nagapattinam (30 km) beaches fortnightly on foot. The Chennai (6 km) and North Kerala (20 km) beaches were monitored by NGOs on daily basis. Details of the monitoring in various sectors during this study are given in Table 1.

Various stakeholders with respect to coastal area conservation especially, the Forest and Fisheries departments, NGOs, educational institutions, subject experts and fishermen were contacted for information and requested for their participation in the project activities. During the fieldwork, the project staff also interacted with above groups. Available past data on turtle nesting, mortality and exploitation are compared with the present data.

Nesting intensity for the locality studied was calculated based on average nesting during this study. Number of nesting during the season was estimated as

$$N = n * d * t,$$

where N = total nesting, n = average nesting (1.2), d = number of sectors (5), and t = duration (90 days).

Table 1: Sea turtle monitoring schedules along the Kerala and Tamil Nadu coasts during 2003 - 05.

Beach Sector	Distance (km)	Duration	Monitored by
Kerala			
Kozhikode	6	September - December 2003	Theeram
Kasarakod	10	September - December 2003	Naythal
Tamil Nadu			
Chennai	6	January - April 2004 January - April 2005	SSTCN
Mamallapuram- Pondicherry	50	January - April 2004	MCBT - CMS Project
Nagapattinam	30	January – April 2004 December 2004 – May 2005	MCBT - CMS Project

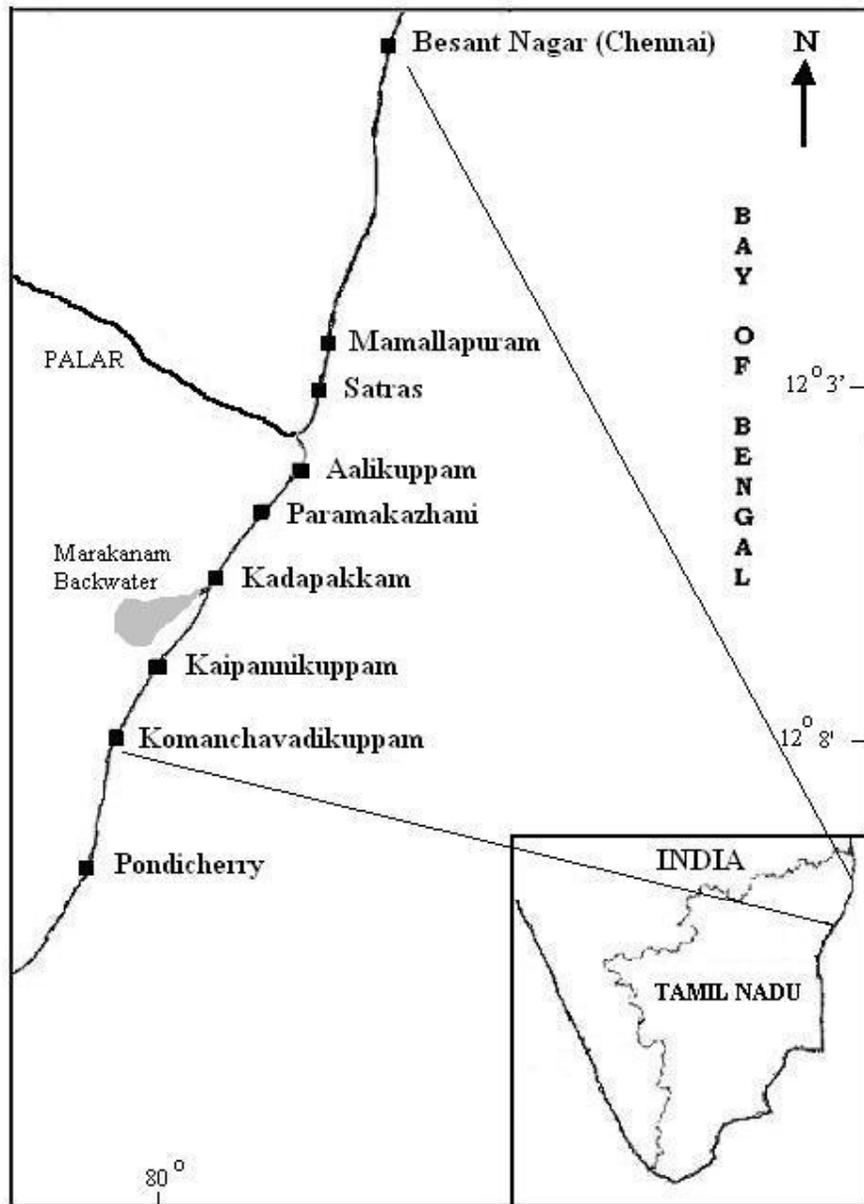


Figure 1: Map showing the Chennai - Pondicherry coast and prominent villages.

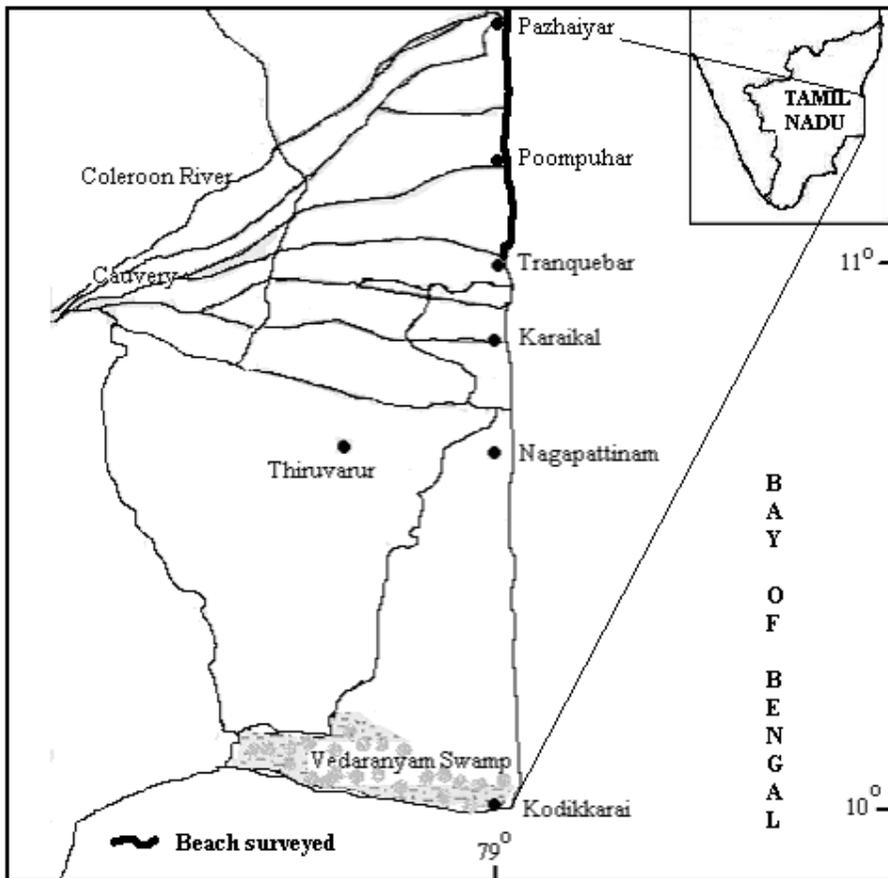


Figure 2: Map showing the study area along the Nagapattinam coast.

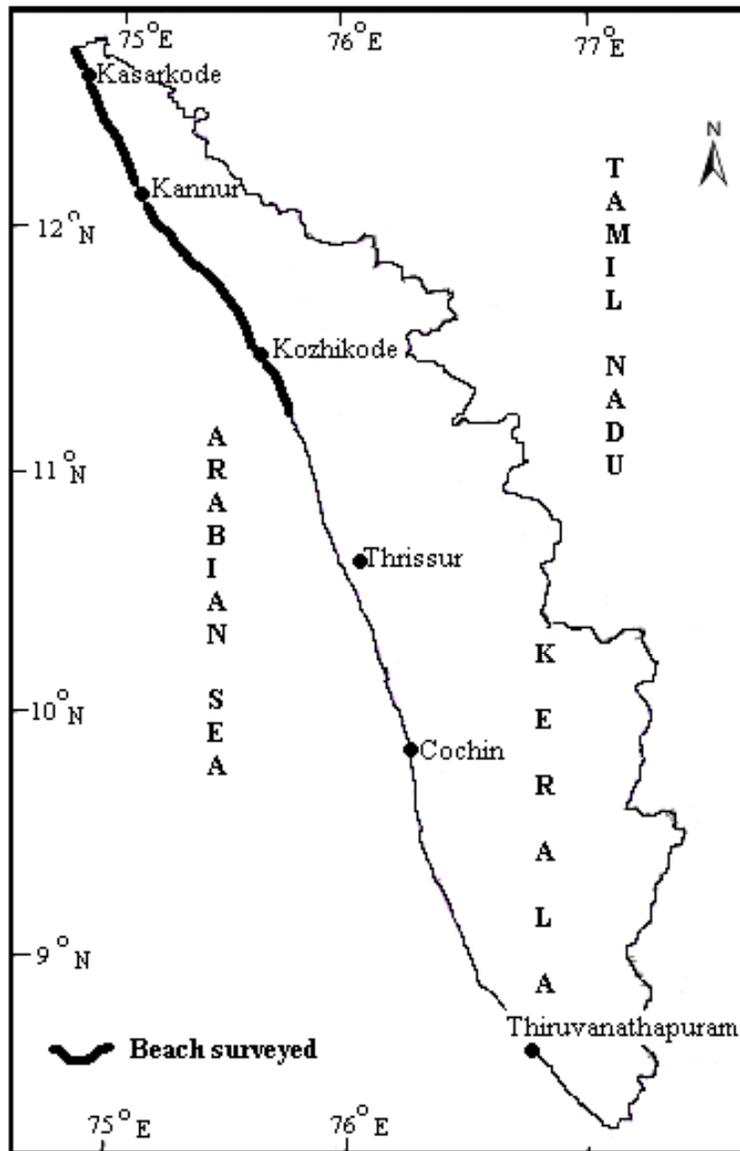


Figure 3: Map of Kerala showing the study area.

RESULTS AND DISCUSSION

NESTING

Kerala

Sandy beaches suitable for sea turtle nesting were found on the North Kerala (i.e. Kannur and Kasarkod) coast. A survey conducted for documenting the nesting and mortality along the 60 km coasts during February - March 2003 yielded no nests. Interviews with fishermen of the area revealed that turtles nest along the west coast largely during September - November with the peak during October. Data with the NGOs, namely Theeram and Naythal also support this view. According to them, on an average, about three nests were found per kilometer in the area. These NGOs in collaboration with the Kerala Forest Department and local communities, especially the fisherman, collect turtle eggs and maintain hatcheries (Fig. 10). The hatchlings are being released into the sea. Apart from collecting ecological information, these hatcheries are used for nature education and awareness programs.

Tamil Nadu

Mamallapuram- Pondicherry

The Mamallapuram - Pondicherry beach (50 km) was surveyed for only one year (2003 - 04). In all, 36 Olive ridley nests were recorded during the fortnightly sampling from January to March 2004. Peak nesting was observed in the first fortnight of March. Estimated nesting density along this area is about 11 nests / km during January - April 2004 (Table 2).

Table 2: Nesting of ridleys along the Mamallapuram- Pondicherry coast (50 km), Tamil Nadu during January – March 2004.

Fortnight	Number of nest	Average nesting/ day/10km
January I	3	0.6
January II	6	1.2
February I	7	1.4
February II	7	1.4
March I	13	2.6
March II	0	0
Total	36	7.2
Average nesting/ day/10km		1.2
Estimated nests		540
Nest/km		10.8

Chennai

The Chennai beach has been monitored (on daily basis) by the Students' Sea Turtle Conservation Network (SSTCN) since 1988 and was continued during this study as well. A total of 50 nests (8.3 /km) were recorded during January - April 2004. During 2005, it was 62 nests (10.3 / km; SSTCN data). Average nesting intensity for 16 years was 9.4 nests / km (Table 3). A hatchery is being maintained by the SSTCN on annual basis. The SSTCN also provides training and awareness programs to students (Fig. 11).

Table 3: Nesting of ridleys along the Chennai coast during 1989 – 2005; - data not available; Source: SSTCN.

Year	Survey distance (km)	No. of nests	Nest /km
1989	6-15	68	4.5 – 11.3 (~8)
1990	15	55	3.7
1991	15	206	13.7
1992	15	175	11.7
1993	6	60	10
1994	6	86	14.3
1995	6	67	11.2
1996	6	40	6.7
1997	6	17	2.8
1998	6	15	2.5
1999	6	47	7.8
2000	6	67	11.2
2001	6	105	17.5
2002	6	67	11.2
2003	6	-	-
2004	6	50	8.3
2005	6	62	10.3

Nagapattinam

The Nagapattinam beach was monitored for turtle nesting during 2003 -04 and 2004 - 05. On the 30 km beach monitored, a total of 17 and 30 nests were recorded during the fortnightly sampling from December to April 2003 and 2005 respectively (Table 4). This works out to be about 7.5 and 15 nests /km. Nesting along this beach was about 20-nests/km during 2000-01.

Turtle nesting along the east coast of Tamil Nadu (Chennai and Nagapattinam) occurred during January - March, whereas it was between September and December along the North Kerala coasts. In other words, turtle nested subsequent to the major monsoon season of the respective area, northeast and southwest monsoons. Peak nesting along the east and west coasts were during February and October respectively. Intensity of the sea turtle nesting on the Kerala and Tamil Nadu coasts is sporadic, and its density varied from 3 to 15 nests / km.

Table 4: Nesting of ridleys along the Nagapattinam coast during 2003 - 2004 and 2004 - 2005; Fortnightly sampling during December to April 2003 - 05.

Fortnightly survey	2003-04	2004-05
December II	0	0
January I	3	*
January II	3	*
February I	6	8
February II	2	9
March I	3	9
March II	0	2
April I	0	2
April II	0	0
Total	17	30
Estimated nest/ km	7.5	15

*Not surveyed due to disturbance in the area caused by the 26th December Indian Ocean Tsunami.

Reasons for the difference in the number of nests observed along the Chennai and Nagapattinam coasts during 2003 - 04 and 2004 - 05 are unclear. One of the reasons could be high mortality due to incidental catch (see below) in fishing gears during the previous year. However, these differences could be due to certain annual or cyclic changes in the nesting of turtles as well. Further studies may throw better insights in this regard.

Turtle Mortality

Mortality

No carcass of sea turtle was observed along the west coast (north Kerala) during both years (i.e. 2003 - 04 and 2004 - 05). Interviews with fishermen in the area also revealed that dead turtles get stranded along these beaches only occasionally.

Along the east coast, 139 turtle carcasses (~3 / km) including 134 Olive ridleys and five Green turtles were recorded on the Mamallapuram - Pondicherry coast during 2003 - 04. During the same period, 92 carcasses including 90 Olive ridleys and two Green turtles were observed along the Nagapattinam coast. The turtle mortality of this area also worked out to be about three turtles / km. Only 21 carcasses (20 Olive ridleys and one Green turtle) were observed during 2004 - 05, and all of them prior to the 26th December 2004 Indian Ocean Tsunami that seriously hit the coastal areas of the Indian region. No new carcasses were observed during January – April 2005. Fishing activities were halted during this period due to the fear/ rumors of fresh Tsunami in the area. Hence, it may reasonably be concluded that mortality of turtles in the area was largely due to fishing activities.

Turtle mortality was highest during January on the east coast (Table 6). Prior to/during January turtles aggregate in the shallow waters nearby beach for breeding activities such as selection of mate, courtship and finding appropriate nesting beach. These areas are also important gill net fishing grounds. As mortality data showed that most of the turtles die prior to nesting, and adults are wiped before breeding, this would have serious implications on the survival of the species.

Fishermen in the area largely used small mechanized boats and catamarans for fishing. Density of fishing vessels (both mechanised and non-mechanised) was 26 and 28/km on the Mamallapuram and Nagapattinam coasts respectively. In these areas mostly gill nets were for fishing. Gill nets are set in shallow waters and left for about 8 - 10 hours. Entangled turtles in the net die due to drowning. This is evidenced from the everted internal organs through body openings such as cloaca. The fishermen in the area also chop off the flippers or club the head of live turtles found entangled in the net. This is done for removing turtles without much damage to the nets and fishermen themselves. In all, 70% of the fresh carcasses found on the shore had one or two missing flippers and shell or head injuries. Locals of these areas (Chennai, Nagapattinam) do not consume turtles. Inhabitants of south Tamil Nadu (Gulf of Mannar) consume sea turtles.

Table 5: Olive ridley mortality along select beaches of Tamil Nadu and Kerala during 2003 - 04; Number in parenthesis indicate number of Green turtles, * total count.

Location	Beach monitored (km)	Turtle Mortality*	Nest predation (%)	Remark
North Kerala	60	Low	Unknown	Single survey
Nagapattinam	30	90 (2)	100	Fortnightly survey
Mamallapuram - Pondicherry	50	139 (5)	69.4	Fortnightly survey
Chennai	6	Low	Low	Daily survey

Table 6: Mortality of Olive ridleys along the Chennai and Nagapattinam coasts during 2003 - 2005 based carcasses found along on the beach; * Green turtles.

Fortnightly survey	Mamallapuram- Pondicherry	Nagapattinam
December II	0	0
January I	29	26
January II	61	22
February I	19	9
February II	20	14
March I	2	6
March II	3	9
April I	0	4
April II	0	0
Total	134+5*	90+2*

Exploitation

Inhabitants of the present study areas (Chennai, Nagapattinam, North Kerala) do not consume turtles, but they consume turtle eggs. Locals on both Nagapattinam and Mamallapuram- Pondicherry coasts pilfered eggs of a large number of nests. As the beaches were monitored on daily basis by the SSTCN and NGOs along the Chennai and North Kerala coast, exploitation of eggs by Humans in these areas were negligible. These groups (NGOs) have also collected turtle eggs to maintain hatcheries with the involvement of students and local communities.

Along the Nagapattinam coast, all the nests found during 2003 - 04 were predated; 14 (82.5%) by Humans and 2 (17.5%) by domestic dogs. Professional poachers traversed the beach extensively on foot during night for collecting eggs.

Of the 36 nests observed during January - April 2004 along the Mamallapuram –Pondicherry coast, 25 (69.4%) were found predated. Among the predated nests, jackal and domestic dog contributed 54.2% and 33.3% respectively. Inhabitants of the area pilfered about 12.5 % of the total nests observed in the area. Native communities such as Irulas consume turtle eggs occasionally.

Table 7: Exploitation of turtle eggs along select beaches of Kerala and Tamil Nadu.

Location	Beach monitored (km)	Nest predation / exploitation (%)	Predated by		
			Humans	Domestic dog	Jackal
North Kerala*	20	Low	Unknown	-	-
Nagapattinam	30	100	82.5	17.5	-
Mamallapuram – Pondicherry	50	69.4	12.5	33.3	54.2
Chennai	6	Low/ Unknown	-	-	-

Locals have taken away eggs of almost all nests along the Nagapattinam coast, whereas inhabitants took only 12.5% of them along the Mamallapuram coast. This indicates that the later one is relatively less disturbed. High mortality of adult turtles was observed in both these areas along the east coast (Table 5) due to fishing activities. This shows the existence of high anthropogenic pressure on both adult and eggs of Olive ridley sea turtles.

NETWORKING AND TRAINING

Networking

During the project period, the team members interacted with members of various institutions working on coastal area, especially the marine turtle conservation pertaining to Kerala and Tamil Nadu (Appendix I). Technical support was given to Government and Non Government Organisations when required. Brief profile of important NGOs that involve in marine turtle conservation in the area is given below (Table 5).

Thanal, Theeram and Naythal are important NGOs actively involved in marine turtle conservation along the Kerala coast. The later two NGOs with the help of public participation conduct hatchery programs. These NGOs are also supported by the Kerala Forest Department. Apart from them, Central Marine Fisheries Institute (CMFRI) at Cochin and Vizhingam conduct research on marine turtles along the Kerala coast.

Table 8: Prominent NGOs involved in sea turtle conservation along the coasts of Kerala and Tamil Nadu.

S.No.	NGO	Contact Address
Kerala		
1	Thanal	C. Jayakumar Thanal Conservation Action and Information Network Post Box No. 815, Kawdiar, Thiruvananthapuram – 695 003.
2	Theeram	M.T. Suresh Babu, President Theeram Nature Conservation Society, Kolavippalam, Payyoli Gram Panchayat, Quilandi Taluka, Kozhikode, Kerala.
3	Naythal	P. V. Sudheer Kumar/ K Radhakrishnan Nair Naythal, Thaikadappuram (Po), Nileshwar (Via), Kasaragod – 671 314, Kerala.
Tamil Nadu		
4	SSTCN, Chennai	V. Arun/ B. Maheshwaran, Co-ordinators Students' Sea Turtle Conservation Network (SSTCN) Adayar, Chennai, Tamil Nadu.
5	SSTN, Tranquebar	A.S. Paul Ravindran Students' Sea Turtle Network (SSTN), Tranquebar Zoology Department TBML College, Poraiyar, Nagapattinam District, Tamil Nadu- 609 307.
6	SSTN, Poompuhar	J. Gokulakrishnan, Co-ordinator Students' Sea Turtle Network (SSTN), Poompuhar Vanagiri (PO), Poompuhar, Nagapattinam - Tamil Nadu.

Thanal: Thanal Conservation Action & Information Network, Tiruvananthapuram is a source of inspiration for NGOs such as Theeram and Naythal. Thanal executed the sea turtle work along the Kerala coast for the GOI – UNDP - WII Olive ridley project during 2000-01.

Theeram: Theeram Nature Conservation Society, a local Non Government Organization at Kolavipalam, Kozhikode was started by fishermen and local people in 1996. The effort was prompted by a news clipping in the 'The Hindu' on the marine turtle conservation, and also curiosity to know whether they could hatch turtle eggs normally consumed by locals. The result was good and the whole village supported the efforts. The local youths organized themselves into a group known as "Theeram

Prakruti Sarakshana Samiti”, a committee to protect the coastal environment. The turtle hatchery program of Theeram is continued since 1996. Eggs of about 40 - 60 nests are collected annually (largely) from beach (10 km) around Kolavipalam and hatchlings released in the sea. Theeram activities are partially supported by the Forestry projects of the Kerala Forest Department on annual basis.

Naythal: Naythal - coastal information conservation and action samithi, is a Non Government Organization registered society. This Society is a realization of the aspiration of a team of youths at Thaikadappuram village, who thought that it is high time that they also offer their humble service to interfere with the environmental problems. The main objective of the organization is coastal information and conservation with special emphasis to environmental problems. The activities of the Naythal are aimed at study and propagation of biological thought, education and conservation. Naythal believes that participatory biodiversity conservation is the only viable long-term solution in a country like ours.

Motivated by the activities of the youths in Kolavipalam (Theeram), Naythal members have been attempting to collect and hatch the turtle eggs and release the hatchlings in the sea since 2002 - 2003. Activities of Naythal extend for about 10 km stretch of the beach (covering Kanhangad municipality and Nileshwar Grama Panchayat of Kasaragod District). Efforts are on to cover the entire coastal belt of Kasaragod district with the help of the likeminded. Naythal also collaborates with other environmental organizations like SEEK (Society for Environmental Education in Kerala), Kasaragod in conservation related issues.

Along the Tamil Nadu coast, especially on the Chennai and Nagapattinam areas, several Government and Non Government Organisations involve in marine turtle conservation. A brief description on a few important NGOs is given below.

Madras Snake Park Trust: The Madras Snake Park Trust (MSPT) maintained the first sea turtle hatchery in 1974 and continued it till 1977. A total of 197 nests were collected during this period. Details on nesting behavior and biology of Olive ridleys were recorded for the first time in India. A large number of students and general public have participated in the turtle walks. Further to this, a countrywide marine turtle status survey was organized by the MSPT during 1981, and this provided the first information on many important turtle areas such as Gujarat and Tamil Nadu coasts.

Madras Crocodile Bank Trust: The Madras Crocodile Bank Trust (MCBT) has been active in providing guidance to NGOs such as SSTCN and TREE and researchers in the region since 1988. Long term monitoring of marine turtles in Andaman and Nicobar islands is being undertaken by MCBT. Students of the Centre for Herpetology in MCBT have been monitoring turtle nesting in Kovalam coast. The present all India (CMS - MCBT) project is being executed by the MCBT involving various Government and Non Government Organisations.

Student’s Sea Turtle Conservation Network: The Students’ Sea Turtle Conservation Network (SSTCN) established its first hatchery in December 1988 when the Tamil Nadu Forest Department decided to close down its sea turtle program. The SSTCN is perhaps the oldest students’ network involved in sea turtle conservation in India. Students from schools, colleges and other educational institutes are members of this network. The activity of SSTCN includes beach monitoring, hatchery management, and protection of wild nests, education and awareness. Members of the SSTCN monitor the beach between Besant Nagar and Neelankarai (~6 km) on annual basis.

Students’ Sea Turtle Network, Nagapattinam: The project team interacted with the locals of the Nagapattinam coast, one of the most important sea turtle nesting beaches of Tamil Nadu and could help forming active groups interested in sea turtle conservation in the area. Two active students’ groups were formed during this study; one based at TBML College, Poraiyar and the other at Poompuhar. Both of them monitored turtle nesting on 10 km beach near Tranquebar and Poompuhar respectively. The National Service Scheme (NSS) volunteers from the colleges have been used to popularize the importance of sea turtles among the inhabitants of the area. The students’ group at

Poompuhar has committed to actively monitor the sea turtle nesting and mortality along the Nagapattinam coast in forthcoming years well.

Apart from the above, the project team interacted with research institutes such as Suganthi Devadason Marine Research Institute (SDMRI), Tuticorin; CAS Marine Biology, Annamalai University; CMFRI, Tuticorin, Mandapam and Chennai; Sálím Ali School of Ecology, Pondicherry; AVC College, Mayiladuthurai and Marine Biological Station, Zoological Survey of India, Chennai. The project is also exchanged information and interacted with the Forest Department officials, especially at Chennai, Nagapattinam, Ramanathapuram and Tirunelveli.

Training

Efforts were made to involve the local communities, students and government officials in the project. Seminars, slide shows and hands on training were organized to motivate the students and members of NGOs in both states.

As a part of the community participation in the project, local students were encouraged to undertake short-term field based research work on sea turtle ecology and conservation. Financial and technical support was provided to the students of the Sálím Ali School of Ecology, Pondicherry University and AVC College, Mayiladuthurai. These students monitored turtle nesting and mortality during 2003-04 along the Mamallapuram- Pondicherry and Nagapattinam coast respectively. Further to the training to the students along the Nagapattinam coast, the students have committed to involve in sea turtle conservation programs in the area in the forthcoming years as well.

It was planned to conduct a workshop on marine turtle conservation for the stakeholders of Kerala and Tamil Nadu during January 2005. Preliminary arrangements were made contacting various groups. However, subsequent to the 26th December 2004 Indian Ocean Tsunami, the response for such an effort was poor and hence, the workshop could not be held.

SUGGESTIONS FOR CONSERVATION

- Annual Close Season for Fishing - As over 50% of the adult turtle mortality occurred during January, closed period for gill net (set net) fishing is suggested. This may be implemented for a month (January) along the east coast. During this period alternate fishing techniques to be used by the fisherman should be explored. Discussions with the concern departments (Forest and Fisheries) and stakeholders need to be done for active participation and effective implementation.
- Control of Egg Poaching– Poaching of turtle eggs is wide spread along the entire Olive ridley nesting ranges, and in some areas it is very severe. Egg poaching is more prominent where no protected areas or NGO activities are found, and is almost stopped in select sectors of North Kerala, where NGOs such as Naythal and Theeram are active. These NGOs use the local fishermen to collect eggs for hatcheries, as nests are located.
- Enhanced beach patrolling by the Forest Department and other interested parties during the peak turtle nesting season is crucial for their long - term survival. Intensive beach patrolling for two months (February-March) on the turtle nesting beaches of the east coast of Tamil Nadu may save as many as 65 to 90% of the nests from poachers. Beach patrolling during September - October may be ideal along the west coast for the conservation of turtles.
- Community Participation- Awareness program and community participation in the conservation efforts made is important for getting desired results. Hatchery program involving public with incentives and alternate livelihood may increase the success of the sea turtle conservation initiatives many folds. Supporting the efforts made in this direction by SSTCN (Chennai), SSTN (Nagapattinam), Theram (Kozhikode) and Naythal (Kasaragod) with both technical and financial inputs are essential.

- An ideal location among the present study areas for starting a sea turtle hatchery program is on the Tranquebar - Poompuhar (Nagapattinam) coast. This program with networking currently in place in the area with the involvement of Forest Department and local community, would act as a model nature education and conservation initiative. Hatchery program is particularly necessary for the Nagapattinam coast, as local people pilfer the eggs of almost all nests.
- Training– Workshops and training program may be organized for field staff of the Forest and Fisheries departments and researchers providing information on the status of marine turtles, research techniques and problems in conservation, etc. Hands on training programmes to the fishermen of Chennai and Nagapattinam coasts by expert institutions such as CMFRI on how to release the entangled sea turtles in the nets without damage may be very useful. Both Government and Non Government Organisations may organize training programs at regular intervals. Allocation of funds from Government and NGO sectors are also important.
- Research- The data on turtle nesting along the east coast during 2000 - 01, 2003 - 04 and 2004 - 05 showed high fluctuation in the nesting density. For instance, along the Nagapattinam coast, it was from 7.5 (2003 - 04) to 20 (2000 - 01) nests/ km. Data generated for about two decades by the SSTCN on the Chennai coast also showed similar variations (2.8 to 17.5 nests/km). Reasons for these fluctuations need to be investigated. It is necessary to continue the monitoring of turtle nesting and mortality along important areas such as Chennai and Nagapattinam.
- The nesting season of sea turtles along the east and west coasts was different, and it would be interesting to find if the same population is involved in the nesting along these coasts. Tagging program along both these coasts simultaneously may provide information on the breeding stock, movement pattern of turtles, etc.
- Co-ordination among Government and Non Government Organisations and local communities needs to be strengthened to insure long-term survival of marine turtles.

Appendix 1: List of Institutions and authorities participated or consulted during this project.

ATREE, Bangalore.
AVC College, Mayiladuthurai.
CAS Marine Biology, Annamalai University.
Central Marine Fisheries Research Institute (CMFRI), Chennai.
Central Marine Fisheries Research Institute (CMFRI), Mandapam.
Chennai Snake Park Trust (CSPT), Chennai.
Chief Wildlife Warden, Kerala.
Chief Wildlife Warden, Tamil Nadu.
Covenant Centre for Development (CCD), Madurai.
District Forest Officer, Tirunelveli.
Marine Biological Station, Zoological Survey of India, Chennai.
M. S. Swaminathan Research Foundation, Chennai.
Naythal, Kasaragod, Kerala.
Pooppuhar College, Pooppuhar.
Sálim Ali School of Ecology, Pondicherry University.
Students' Sea Turtle Conservation Network, Adayar, Chennai.
Students' Sea Turtle Network, Pooppuhar, Vanagiri, Nagapattinam.
Students' Sea Turtle Network, TBML College, Poraiyar, Nagapattinam.
Suganthi Devadason Marine Research Institute (SDMRI), Tuticorin.
Theeram Nature Conservation Society, Kozhikode, Kerala.
Wildlife Warden, Point Calimere Wildlife Sanctuary, Nagapattinam.

Chapter 4

The status of sea turtle populations in the Andaman and Nicobar Islands of India

Harry V. Andrews, Ambika Tripathy, Saw Aghue, Saw Glen, Saw John and K. Naveen

INTRODUCTION

Four species of marine turtles occur around the Andaman and Nicobar Islands, These include *Dermochelys coriacea*, the leatherback turtle, *Eretmochelys imbricata*, the hawksbill turtle, *Chelonia mydas*, green sea turtle and *Lepidochelys olivacea*, olive ridley. Although there are several historical citations, since the early 1800s, there are no historical status and distributional records. Survey, by Bhaskar, was started during 1978 and most of the leatherback rookeries in the Nicobars were found only in the early 1990s (Bhaskar & Tiwari, 1992; Bhaskar, 1993).

Previous surveys and studies in these islands have recorded India's best nesting beaches for three species *Dermochelys coriacea*, *Eretmochelys imbricata* and *Chelonia mydas*. Extensive feeding grounds for *Eretmochelys imbricata* and *Chelonia mydas* have also been confirmed (Bhaskar, 1993; Andrews, et. al., 2001). The hawksbill population in the Andamans and Nicobars are the largest for India and most important for the Northern Indian Ocean region. The leatherback nesting population in the Nicobar is one of the four colonies that exceeds 1000 individuals in the Indo-Pacific, and hence of global significance (Andrews 2000a; Andrews, et. al., 2001; Andrews & Shanker, 2002). The green turtle is the most common and widespread species throughout both island groups. During the early 1940s and up to early 1990s, authors reported loggerheads (*Caretta caretta*) to occur around the islands (Smith, 1941; Whitaker 1978; Khan 1983; Pande et. al., 1991), probably confusing it with the ridleys or the green turtles.

In the Andaman Islands, the ban on hunting and harvesting of turtles came into force in 1977; sea turtles were protected under Schedule 1 of the Indian Wildlife (Protection) Act (1972). However, indigenous groups of people, the original inhabitants of the Andaman and Nicobar Islands, are still exempted from the Indian Wildlife (Protection) Act.

STUDY AREA AND METHODS

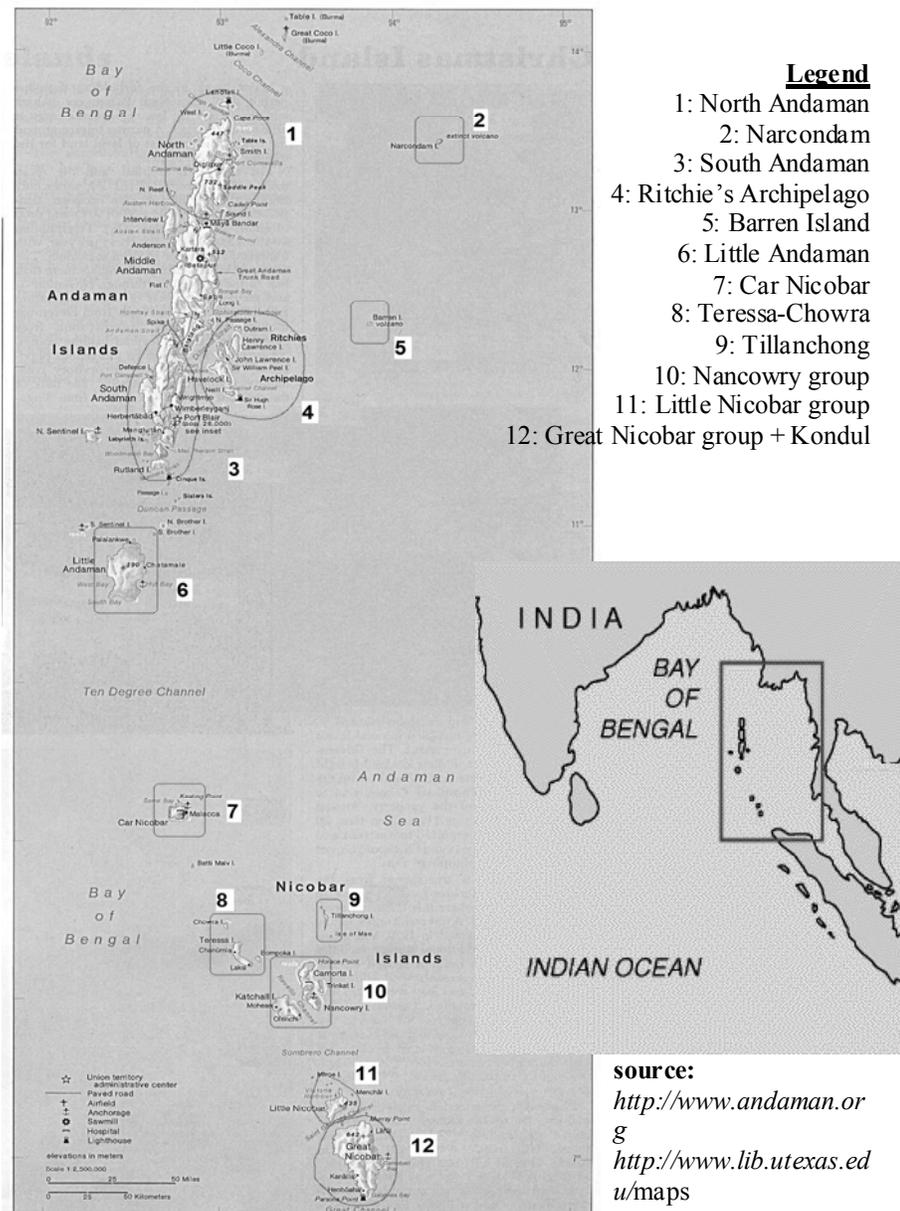
The Andaman and Nicobar Archipelago consists of over 345 islands, islets and rocky outcrops, with land area extending up to 8,249 km² and a coastline stretch of 1,962 km; the Andaman Islands constitute 6408 km² and the Nicobars 1841 km². The Andaman Islands are the extension of the submerged Rakhine (Arakan Yomas) range of Myanmar and the Nicobars are the continuation of the Mentawai Islands to the south and southeast of Sumatra. These two island groups situated in the Bay of Bengal span 6°45' N to 13°41' N (740 km) and 92°12' E to 93°57' E (190 km). The nearest land mass south of Great Nicobar Island is Sumatra, 145 km southeast; and the Myanmar coast is roughly 280 km north of Landfall Island, the northern-most island in the Great Andaman group (Fig.1).

Of the 306 islands in the Andamans and Nicobars, 23 are inhabited, 94 are designated as wildlife sanctuaries, including six areas as national parks, two of which are marine national parks, two areas and two islands as tribal reserves in the Andamans. The land area of 6408 km² in the Andamans constitutes 69% as reserves and protected areas of which 36% is tribal reserves. The Andaman and Nicobar Islands has a forest cover of 94%. The entire Nicobar group is a tribal reserve, 12 of the 23 islands are inhabited, and has four wildlife sanctuaries, three of which are islands. The Great Nicobar Island has two national parks, a wildlife sanctuary and an area of 885 km² as the Great Nicobar

Biosphere Reserve. The status, flora, fauna and profiles of all the protected areas for both island groups have been previously discussed (Pande, et al. 1991; Andrews & Sankaran 2002). Settlers from mainland India, numbering over 450, 000, inhabit 11 of the Andaman Islands and the three original inhabitants; inhabit two small areas and two islands in the Andaman group.

Surveys and monitoring were started during July 2000 by setting up two field stations, one at Cuthbert Bay on the east coast of Middle Andaman Island and another at Jahaji beach, Woodmason Bay, on the south coast of Rutland Island in South Andaman (Fig. 2). In November 2000 a field station was set up at the Galathea beach in South Bay on the south east coast of Great Nicobar Island (Fig. 3). Out-lying islands and remote beaches in the Andamans and Nicobars were surveyed with the help of a dugout canoe and an inflatable rubber boat as previously reported (Andrews et. al. 2001).

Figure 1: The Andaman and Nicobar Islands



the edge of carapaces with the help of small hacksaws; three different combinations were used for the three field stations. At Cuthbert Bay and Rutland Island in the Andamans, barnacles on the carapaces of leatherback were counted and mapped for individual identification and other obvious external marks and injuries were also recorded.

At the Galathea beach, along the south-eastern coast of Great Nicobar Island, leatherbacks were implanted with PIT tags (Passive Integrated Transponders). The tags and the Tracker 11 multi mode scanner used were manufactured by AVID (American Veterinary Identification Devices, Inc.) (for a review of the method, see Dutton & McDonald 1994; Andrews et al., 2001). During the 2000- 2001 and 2001- 2002 nesting seasons 297 leatherbacks were tagged. On beaches and islands where only nests and excavations of leatherbacks were counted and actual nesting could not be monitored, 10% were excluded as false nests from the total number of nests counted (Andrews et al., 2001; Andrews et al., in press). Carapace lengths and widths are measured for all turtle species that are encountered while nesting. Nests laid below the high tide line were translocated to a hatchery as previously reported by Andrews, et al., (2001). Although no tagging was carried out during the 2003- 2004 and 2004- 2005 season, all turtles that emerged at the Galathea beach were scanned for the presence of tags that were implanted during the previous seasons.

RESULTS

The current study and monitoring was started during November 2003 and was carried out at the Cuthbert Bay Turtle Sanctuary in Middle Andaman, Jahaji Beach on Rutland Island, south of South Andaman Island and at the Galathea National Park in Great Nicobar Island (Fig. 1 & Fig. 3).

Lepidochelys olivacea

Monitoring at Cuthbert Bay Turtle Sanctuary started during November 2003 and nine olive ridleys were encountered during the month and only five nested. The following month, during December, 74 were encountered and 48 of these nested. Nesting started peaking during January 2004 when 111 were encountered and 86 nested and peaked during February with 129 encounters and 117 nesting. During March 2004 nesting started tapering with 106 encounters and 97 nesting. By early April only 14 turtles were encountered and 11 nested and nesting ceased by mid April. Figure 4 shows the nesting trend for this species in relation to other two monitoring sites. During this season 16 dead olive ridleys were found washed ashore on the sanctuary beach.

Two other beaches north of the turtle sanctuary were monitored twice every month during the 2003-2004 season, on Arguna Beach 262 predated nests were counted and 78 intact nests were counted; besides two dead turtles. Most of the nests were predated by feral dogs and a few nests by natural predators, water monitor lizards (*Varanus salvator*). Large scale predation by feral dogs on eggs, nesting turtles and hatchlings has been reported (Bhaskar, 1993; Andrews, et al., 2001). On Chotabalu Beach seven predated nests and one intact nest was recorded. A total of 711 nests were recorded for the beaches in Cuthbert Bay and is estimated that 296 individuals nested, this estimation is derived from previous studies on re-nesting intervals and that olive ridley nests on an average 2.24 times in a season (Andrews et al., 2001).

Monitoring for the 2004- 2005 started during November 2004 and concluded end April 2005, no monitoring was conducted between 23 December 2004 and 12 January 2005. During the monitoring period 116 olive ridleys were encountered and 75 of these nested. Interestingly of these 94 olive ridleys were encountered after the tsunami of which 64 nested. During the same season three olive ridleys were disturbed by feral dogs and did not nest, nine were bitten by dogs and killed, seven nests were predated by dogs and turtles were washed and found dead due net entanglement.

At the Jahaji beach on Rutland Island monitoring started during the same period in November 2003 and only sparse nesting of olive ridleys occurred during the whole season. During November no turtles nested or were encountered, during December only one turtle nested and six were encountered

during January 2004 and of these five nested. The last three turtles were encountered during February and April and these did not nest.

In Ramnagar Beach on the southeast coast of North Andaman Island, the Wildlife Wing of the Forest Department conducts monitoring each year. During the 2003- 2004 season, 207 olive ridleys nests were reported here and it is estimated that 92 individuals nested on this beach. Nesting at this beach commenced during December 2003 and peaked during January 2004 with 107 nests, 55 in February and two in March when nesting ceased.

In Great Nicobar Island at the Galathea Beach nesting commenced during November 2003 with 18 turtle encounters and 13 of these nesting, and during December 38 were encountered and 28 of these nested. Nesting peaked in January 2004 with 106 encounters and 82 of these turtles nested. In February 74 olive ridleys were encountered 67 nested, nesting then started tapering off by March with 51 encounters and 45 nesting and during April 25 were encountered and 20 nested and nesting ceased by third week of April (Fig. 4a). A total of 255 nests were monitored on Galathea Beach and is estimated that 114 individuals nested during the season.

For the 2004- 2005 season monitoring at the Galathea Beach was started in November and during this month 16 olive ridleys were encountered and of these 11 nested. Due to the 26th December 2004 tsunami all records and data was lost.

Derموchelys coriacea

During the 2003- 2004 a total of 23 *Derموchelys coriacea* leatherbacks were encountered on the Cuthbert Bay beach, in Middle Andaman, of which 15 nested. In Jahaji Beach, Rutland Island, 13 were encountered and 12 nested, where nesting commenced only during November and five individuals nested and nesting ceased during February 2004. Figure 5 shows the nesting trend for leatherback turtles at three localities. For the 2004- 2005 season two leatherbacks were encountered at Cuthbert Bay beach and both nested, one nesting was after the tsunami.

At the Galathea National Park in Great Nicobar Island, results of monitoring during the 2003- 2004 season show that some of the leatherbacks tagged during the 2000-2001 and 2001-2002, at the Galathea beach re migrated. Nesting commenced during late September 2003, with 46 encounters and 20 nests by October, nesting started peaking during November with 123 encounters and 70 nests. By December, nesting peaked with 369 encounters and 193 nests. During January 2004, 316 turtles were encountered and of these 180 nested. Nesting started tapering off during February with 116 encounters and 84 nesting; during March there were 60 encounters of which 35 nested. By April 2004 nesting slowed down with 36 turtle encounters and 13 nests and by the third week nesting ceased (Fig. 4b). The total number of encounters at the Galathea Beach was 1030 resulting in 575 nests and the estimated number of individual females nested is 145. During November 2004, of the 137 leatherbacks encountered resulted in 84 nesting.

Chelonia mydas

Figure 4c shows low intensity nesting of *Chelonia mydas* at the two monitoring sites during the 2003-2004 season. During the 2004 - 2005 of the eight green turtles encountered only three nested at the Cuthbert Bay beach, in Middle Andaman.

Other areas, islands and observations

During late April 2004, Middle Button Island was visited, and 19 hatched green turtle nests were found, besides 24 other nests where the species could not be identified. On the same day, English Island in the Ritchie's Archipelago was visited and three green turtle hatched nests were found. Two hawksbill turtles, *Eretموchelys imbricata*, were also sighted along the shores of a narrow beach north of Cuthbert Bay Turtle Sanctuary and south of Arguna beach and it is known that hawksbills nest on this beach (Andrews, et. al., 2001).

Figure 3: The Nicobar Islands

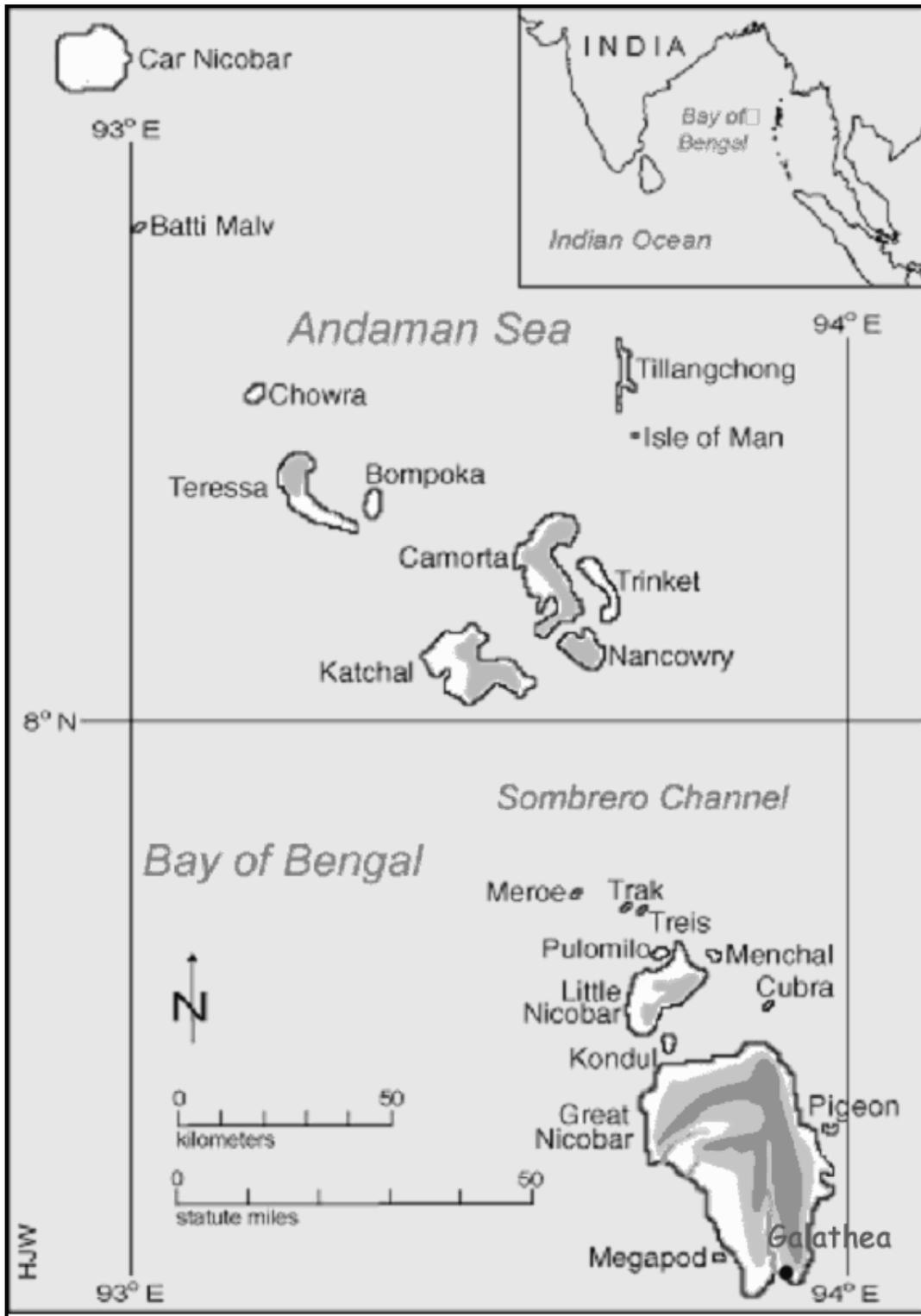
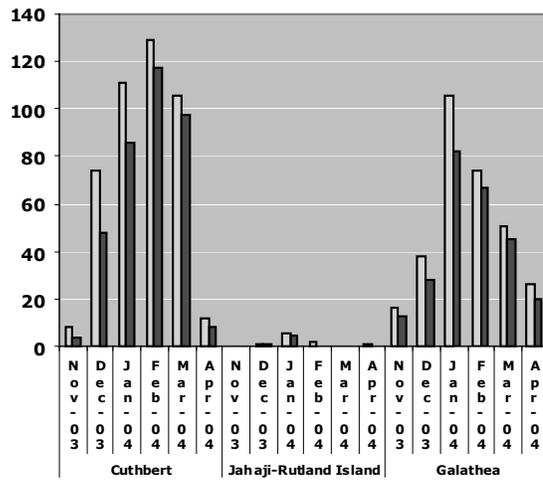
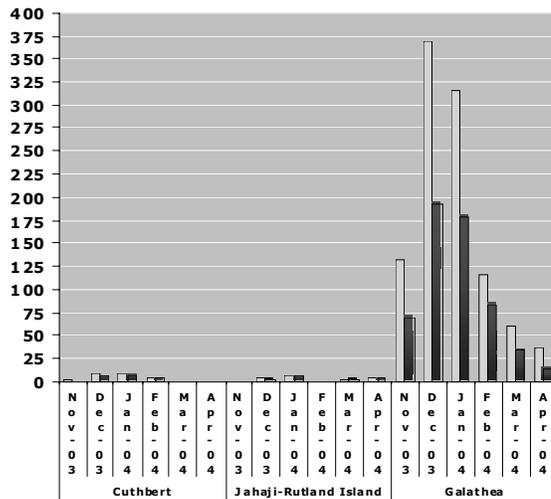


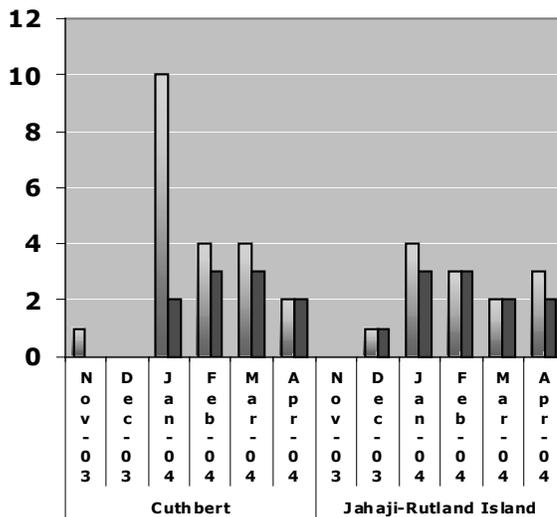
Figure 4: Nesting of 3 species at index beaches (light grey – number of turtles encountered; number of turtles which nested)



a) *Lepidochelys olivacea*



b) *Dermochelys coriacea*



c) *Chelonia mydas*

IMPACTS OF THE 26TH DECEMBER 2004 TSUNAMI ON MARINE TURTLE NESTING HABITATS

Andaman Islands

An ecological impact assessment was conducted, starting January 2005- April 2005. Beaches on South Reef, Interview, Snark, Point, Paget, Reef, West, Landfall and East islands have changed very little. Due to the upheaval of reef flats turtles do not have access to the beaches on the islands (Fig: 7, 8 & 9). The reef flats on the western, southern and eastern side of Lotouche Island are also exposed. Eight green sea turtles (*Chelonia mydas*) and three hawksbill turtles (*Eretmochelys imbricata*) were sighted along Lotouche Island. The exposed reef flats along northeastern side, the Northern, eastern and the southern sides of West Island, is estimated to be 4.5 km². Reefs, 2- 4 m deep, was observed on the eastern and southern sides of Snark and West Island. Beaches on the eastern and southern sides of Snark Island have changed very little. Six green sea turtle (*Chelonia mydas*) nests were found on Snark Island, besides tracks and nest of a hawksbill turtle (*Eretmochelys imbricata*). Due to the upheaval of reef flats, turtles do not have access to the beaches on the eastern and western sides of Point, Paget, Reef, West, Landfall and East Islands.

Beaches on North Reef Island, on the north western and eastern sides, have minimal changes, however the beach on the south eastern side has built up. Due to islands and reef flats upheaval marine turtles do not have access to these beaches for nesting and this was evident as no tracks or nests were found on these beaches (Fig: 10). Two plastrons of green sea turtle (*Chelonia mydas*) was found on the west coast and no evidences were available to conclude the cause of death. However, there were 22 sightings of *Chelonia mydas* around the island.

Very minor changes have occurred to beaches along the western and eastern coasts. Most beaches have been swept away partially and high tide reaches the forest line, however these beaches are reforming. These beaches include, from the south western side, Foul Bay, Tammi, Yadita and Robert Bay. On the eastern coast; Cape Vestal, Paikat Bay, Woteng and Cuthbert Bay. Turtles were nesting up to April 2005, at Paikat Bay, Woteng and Cuthbert Bay. Some of the island beaches too have been swept away partially and was observed on Flat, hump and Tuft.

The beaches on the south west coast and northeastern side of Interview Island have become inaccessible for turtles to nest, due to reef flat upheaval. The status of these beaches can be only concluded after this year's monsoon. The sea grass bed on the north of Interview Island at Branne Point has been swept away, however regeneration of small tufts, 3- 4 cms high, was observed, beside over 10 *Chelonia mydas* and three *Eretmochelys imbricata* of different size classes were sighted in this bay.

No noticeable impacts were observed around the Ritchie's Archipelago islands. Resort owners, divers and sail boat people from Havelock reported that the reefs around Havelock and Neil Islands were in good condition and not impacted, regular sightings of dugongs, south of Havelock Island, was also reported. Our observations around South Button resulted in intact reefs. Eight *Chelonia mydas* and three *Lepidochelys olivacea* nests was counted on Middle Button Island. Eleven *Chelonia mydas* and six *Lepidochelys olivacea* nests were observed on English Island.

Little Andaman Island

The three major sea turtle nesting beaches, West Bay, South Bay on the west coast and Butler Bay on the eastern coast, for four species of sea turtles including the leatherback sea turtle have been all affected. These beaches have been all washed away partially and now submerge during the high tide. No evidence of turtles nesting on these beaches was found. But observations and indications are that these beaches are reforming and will come back to their original landscape after this year's monsoon (Fig: 11 & 12). Two other new beaches have currently formed after the tsunami, one starting at northern mouth side of Jackson Creek to a length of 5 km, turtle tracks and nests of three species of marine turtles, *Chelonia mydas*, four nests, *Lepidochelys olivacea*, three nests and *Dermochelys coriacea*, two nests, were recorded from this beach (Fig: 13). Another 2 km long beach has formed and is situated 4

km south of Jackson Creek and nests and tracts of four nests of *Chelonia mydas* and two *Lepidochelys olivacea* nests were found on this beach (Fig: 14).

Great Nicobar and areas in the central and northern Nicobars

The entire coastal areas and habitats have been completely affected and destroyed impacting all coastal flora and fauna and affecting some of the mega species. In the Galathea area and the entire South Bay, the wave, at a height of 30m, had gone inland almost 1.5 km (Fig: 15 & 16). This has destroyed all the beaches, mangroves and the entire coastal habitat of the South Bay, including the areas around the light house at 51 km (Fig: 17 & 18). Currently debris, 10 m high, consist of fallen trees, plastics, timber and other materials from the sea that drift on to the land area at each high tide. The high tide line reaches the slope forests and existing mangrove species and other coastal flora are drying up. The same effect was observed for the west coast of Great Nicobar Island and islands in the central group and on Car Nicobar Island.

The most affected is the sea turtle beaches along the east coast of Great Nicobar, mainly the Galathea beach and along the west coast of Great Nicobar up to the areas along the Alexandria and Dagmar Rivers. Including beaches along Little Nicobar and Katchal Islands and these areas were prime sea turtle nesting beaches and these have been washed away. Currently in Great Nicobar Island in South Bay, two beaches are forming, one at 43 km and at 45.5 km, hawksbill and olive ridley sea turtles were observed nesting in these two beaches. However these nests will be destroyed as these beaches flood at high tide. The beaches on the west coast of and North eastern coast of Little Nicobar Islands has been impacted, however *Dermochelys coriacea* nesting was noticed up to March 2005 (Chandi, 2005. Unpublished).

Currently no major management or conservation effort is required for the Andaman and Nicobar Islands. The sea turtle beaches that have been affected will re-form after this year's monsoons and other new beaches will form in the next two to three years and this will require monitoring as marine turtles will find new nesting beaches. However, the next two to three years will be crucial and intensive surveys and monitoring will be required to quantify nesting trends, populations and the nesting beaches and islands.

NOTE: Figures 5 – 18 are not included in this document

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ACKNOWLEDGEMENTS

Gujarat

The project on “Tracing the migration of Indian marine turtles: towards an integrated and collaborative conservation program” was possible due to the valuable supports received from various departments of Government of India and Government of Gujarat and many individuals. Gujarat Institute of Desert Ecology (GUIDE) is thankful to the Government of India (GOI) – Ministry of Environment and Forest (MoEF) and United Nations Environment Program (UNDP) and Convention on the Conservation of Migratory Species of Wild Animals (CMS) for the financial support. Madras Crocodile Bank Trust (MCBT), Chennai, and Wildlife Institute of India (WII) – Dehradun for identifying GUIDE as a research organization to carry out the project for Gujarat State. We greatly acknowledge the Chief Conservator of Forest (Wildlife) Gujarat State, for providing permission to carryout this project. All the Conservators of Forest (Kachchh, Jamnagar, Porbandhar and Junagadh divisions), Deputy Conservators of Forest, Assistant Conservators of Forest and Forest Range Officers of coastal districts are thanked for their logistic supports and suggestions rendered during the monitoring survey along the respective coastal areas. We specially thank the foresters, Forest guard and watchers of Kachchh and Porbandhar divisions who helped in survey and monitoring of nesting beaches and also providing valuable data. We sincerely acknowledge all the field assistances from different coastal villages and voluntaries of NGOs for their involvement and help during our field survey. We thank Mr. Naresh Maheshwari, Computer Assistant of GUIDE for preparing the maps, plates and formatting the text.

Tamil Nadu

The present report is a part of the project, “Tracing the Migration of Indian Marine Turtles: Towards an Integrated and Collaborative Conservation Program” funded by the Convention of Migratory Species (CMS), being executed by the Madras Crocodile Bank Trust (MCBT). I thank Mr. Harry Andrews and Dr. Kartik Shanker of the MCBT for supporting this work. As a part of this project, monitoring of sea turtles along the Kerala and Tamil Nadu coasts have been coordinated by the Sálím Ali Centre for Ornithology and Natural History (SACON), Coimbatore. I thank Dr. V. S. Vijayan for providing facilities at SACON to undertake this work. I am grateful to the Chief Wildlife Wardens, Tamil Nadu and Kerala for issuing permits to undertake surveys along the coastal areas of the respective states. District Forest Officers of both states were supportive and provided logistics when required. I thank Mr. A. D. Baruah, Wildlife Warden, Point Calimere Wildlife Sanctuary for his valuable suggestions and support extended to this project. Several Government and Non Government Organisations took part in the project, and I am thankful to all of them. Among the NGOs, Students’ Sea Turtle Conservation Network (SSTCN), Chennai; Students’ Sea Turtle Network, Nagapattinam (SSTN Tranquebar, Poompuhar); Theeram, Kozhikode and Naythal, Kasaragod provided valuable input and participated in the project. Among the research and educational institutions, Central Marine Fisheries Research Institute (CMFRI); Sálím Ali School of Ecology and Environmental Sciences, Pondicherry University; AVC college, Mayiladuthurai; TBML college, Poraiyar and Poompuhar college, Poompuhar provided significant input to the project.

Andaman and Nicobar Islands

We very much appreciate and thank the Convention on the Conservation of Migratory Species of Wild Animals (CMS) & United Nations Environment Programme (UNEP) for their interest in supporting and funding this all India project. The Andaman and Nicobar Department of Environment & Forests is acknowledged for its support and endorsement. We are grateful to Mr. S. K. Chowdhury, Chief Wildlife Wardens, Mr. Garaham Duari, D. C. F., Mr. Thomas the A. C. F HQ, the A. C. F., Campbell Bay and Range Officer Saw Robert Pee. Much credit goes to our ANET and the Croc Bank Team for all their help and efforts mainly, Saw John, Johnny, Saw Pambay, Saw Pawang, Edwin Pooba and Saw Nelson. Seema Mundoli is acknowledged for all her help and patience, while in the Nicobars, in compiling monthly financial and field reports and, for her editorial help. We thank the Trustees of the Centre for Herpetology/ Madras Crocodile Bank Trust, as always for all their encouragement and support. Finally we would like to thank and acknowledge Pankaj and Lalto for their help with photography.

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