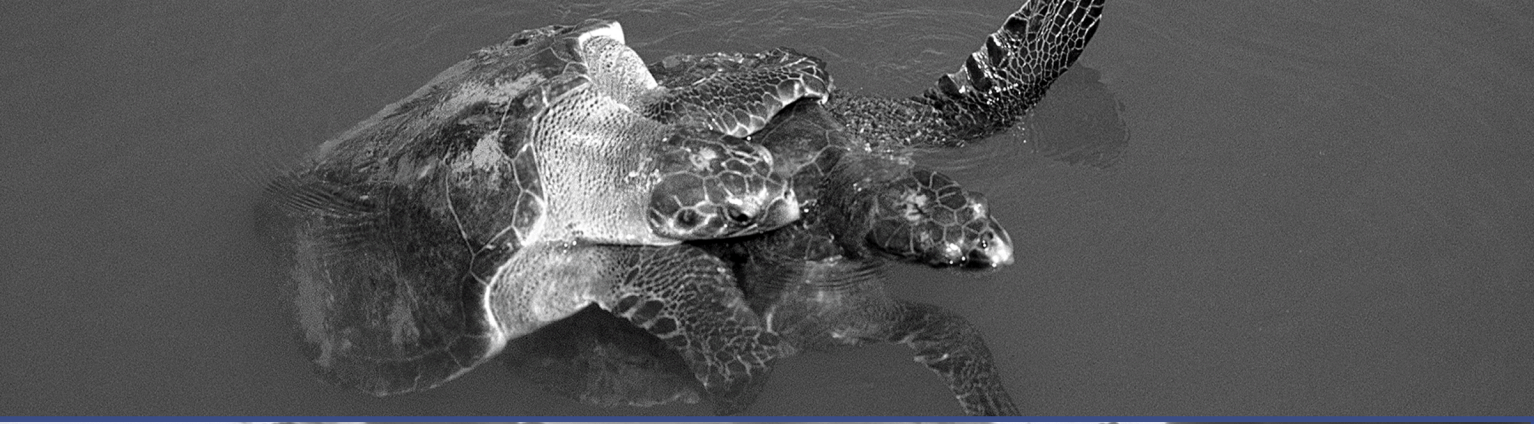


Towards an Integrated and Collaborative Sea Turtle Conservation Programme in India

Centre for Herpetology
Madras Crocodile Bank Trust
Tamil Nadu, India

CMS

A UNEP/CMS-IOSEA Project

IOSEA
Marine Turtle MoU

CITATIONS

Any reference that concerns the execution of the project or the overview of the project (chapter 1) may be cited as:

> Shanker, K. and H.V. Andrews (2006) *Towards an integrated and collaborative sea turtle conservation programme in India: a UNEP/CMS-IOSEA Project Report*. Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, 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. Brahmbhatt, A. Saravanakumar, B. Muthuraman and S.K. Das (2006) The status of sea turtle populations on the Gujarat coast. In: *Towards an integrated and collaborative sea turtle conservation programme in India: a UNEP/CMS-IOSEA Project Report* (eds. K. Shanker and H.V. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, Tamil Nadu.
>
> Giri, V., V. Katdare, D. Fernandes and A. Rahmani (2006) The status of sea turtles on the Maharashtra and Goa coasts. In: *Towards an integrated and collaborative sea turtle conservation programme in India: a UNEP/CMS-IOSEA Project Report* (eds. K. Shanker and H.V. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, 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: *Towards an integrated and collaborative sea turtle conservation programme in India: a UNEP/CMS-IOSEA Project Report* (eds. K. Shanker and H.V. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, 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: *Towards an integrated and collaborative sea turtle conservation programme in India: a UNEP/CMS-IOSEA Project Report* (eds. K. Shanker and H.V. Andrews). Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, Tamil Nadu.

Published by:

Centre for Herpetology/Madras Crocodile Bank Trust,
Postbag 4, Mamallapuram,
Tamil Nadu 603104. India
Email: mcbtindia@vsnl.net

Acknowledgements:

The Centre for Herpetology/Madras Crocodile Bank Trust would like to thank Marco Barbieri (CMS) and Douglas Hykle (CMS/IOSEA Marine Turtle MoU) for their support, the Ministry of Environment and Forests, Government of India for endorsing this p roject, and concerned state Forest Departments for their cooperation in the execution of the project. We would also like to thank all our project collaborators and partners. The project was administered and coordinated by Seema Mundoli at MCBT.

Photo Credits:

Front cover: Mating olive ridleys in Orissa (Bivash Pandav); Galathea, Great Nicobar Island (Kartik Shanker); Leatherback hatchling (Kartik Shanker)

Back cover: Leatherback tracks, Great Nicobar Island (Kartik Shanker)

Towards an Integrated and Collaborative Sea Turtle Conservation Programme in India

Project Partners

Bombay Natural History Society

Centre For Herpetology/Madras Crocodile Bank Trust

Gujarat Institute of Desert Ecology

Sálim Ali Centre for Ornithology and Natural History

Project Coordinator

Centre For Herpetology/Madras Crocodile Bank Trust

Funded By

Convention On The Conservation Of Migratory Species Of Wild Animals (CMS)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Five of the seven species of sea turtles are found in Indian coastal waters and at least four have significant nesting beaches and/or feeding areas. Sea turtles in Indian coastal waters are severely affected by incidental catch in fisheries, coastal development, habitat loss and depredation of eggs. To address these issues, a collaborative sea turtle project was initiated with funding from the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Coordinated by the Centre for Herpetology/Madras Crocodile Bank Trust (MCBT), monitoring programmes and networking were conducted during February, 2004 to May, 2005 in Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu on the mainland coast of India and in the Andaman and Nicobar Islands. These programmes were carried out by four partners including the Andaman and Nicobar Island Environmental Team(ANET), a division of the Centre for Herpetology/Madras Crocodile Bank Trust, Bombay Natural History Society (BNHS), Gujarat Institute of Desert Ecology (GuIDE) and the Salim Ali Centre for Ornithology and Natural History (SACON). We provide a brief overview of the project activities.

Project Activities

Monitoring: Selected beaches were monitored during the nesting season in Gujarat, Maharashtra, Goa, Kerala, Tamil Nadu, and the Andaman and Nicobar Islands. Following the GOI – UNDP sea turtle project, this exercise focused on a few selected sites on the mainland coast. Intensive monitoring was carried out on the Jamnagar, Junagadh and Porbandhar coasts in Gujarat, Raigad and Ratnagiri districts in Maharashtra, and Mammallapuram-Pondicherry and Nagapattinam coasts of Tamil Nadu. In the islands, Cuthbert Bay Turtle Sanctuary in Middle Andaman, Jahaji Beach on Rutland Island, South Andaman Island and the Galathea National Park in Great Nicobar Island were intensively monitored. Further, in the Andaman and Nicobar islands, nesting sites were confirmed, previously unsurveyed beaches and islands were surveyed, and post tsunami surveys were conducted to assess damage. The December 2004 tsunami destroyed many nesting beaches including Galathea, where the main monitoring and tagging programme was being carried out. Other beaches in Gujarat, Kerala and Goa were monitored by the Forest Department. These surveys form an important part of long term data for the assessments of these nesting beaches and populations.

Networking: The project teams worked with local partners in all the states covered in this project. Monitoring at several sites mentioned above was carried out by non government organizations (NGO) and by state Forest Departments. The project team interacted with both sets of stakeholders and provided informal and formal training during the project period. Capacity building and training workshops were conducted for state Forest Departments and non-government organisations that work on sea turtles in each of the five states involved. In Gujarat, hatchery programmes were initiated by the Forest Department as a result of the workshops conducted by this project. Gujarat does not have a long history of sea turtle conservation by NGOs; 6 conservation NGOs and a few individuals were contacted during this project, and could form the basis of future networking. In Maharastra, Sahyadri Nisarga Mitra, a rapidly growing NGO, was supported and assisted in monitoring during the project, as was Green Cross in Goa. Several NGOs in Kerala and Tamil Nadu were contacted during the project and students were provided with training and support for monitoring. There are only a few local NGOs in the Andaman and Nicobar Islands currently involved in conservation, and this may be a big lacuna. In addition, the partners professed difficulty in working with NGOs since these are mostly small voluntary groups with little or no funds or infrastructure and no administrative support.

Identification of migratory routes: Tags were purchased to reinitiate PIT tagging of leatherback turtles in Great Nicobar Island and metal flipper tagging of other species in the islands and on the mainland coast of India. However, tagging could not be initiated due to lack of permits from the respective state governments despite considerable effort on the part of project partners. Permits were not received for tissue sample collection, but results of an ongoing genetics project on marine turtles of India should be available by the end of 2006. Plans for launching telemetry studies in Orissa and Andaman and Nicobar Islands have not materialized yet, but are still under consideration. It is expected that progress will be made in these areas, but given logistic and other constraints, may take time.

Regional management plan: The project was initiated on the assumption that regional collaboration and integration may be promoted in the context of the IOSEA Marine Turtle Memorandum of Understanding. The project was supposed to set in place tagging and telemetry programmes that would catalyse such collaboration. Unfortunately, this has not yet happened, though project authorities are hopeful that they will do so in the near future. Projects were also to be initiated in other states in India by other institutions, which also have not materialized. Though the absence of this hampers the formulation of a regional management plan, we do provide recommendations to achieve these objectives.

In addition to the above, two issues of the Indian Ocean Turtle Newsletter were partially supported by the project. The IOTN was initiated to provide a forum for exchange of information on sea turtle biology and conservation, management and education and awareness activities in the in the Indian subcontinent, Indian Ocean region, and South/Southeast Asia.

Recommendations

The activities carried out in this project need to be continued, or in some cases, initiated. There is little dispute over the need for research (tagging, telemetry and genetics), continous monitoring at selected sites, and conservation education. Specifically, the following tasks and activities need to be carried out:

Training of government staff: The state Forest Departments are the main government stakeholders for the conservation of sea turtles. These agencies have been involved in sea turtle conservation programmes, particularly hatcheries, in states like the Andaman and Nicobar Islands, Tamil Nadu, Gujarat, Goa and Kerala. Therefore, it is essential to train frontline staff of the Forest Department in ongoing activities such as hatchery programmes and monitoring. These were initiated in several states during this project, but need to be reinforced and extended to other sites and states.

National and regional networking of NGOs: During this project, NGOs were networked at the state level. We recommend that NGOs from different states and countries be brought together to share experiences and learning and to introduce them to national and regional level networks.

Building capacity of NGOs: NGOs were involved in the project at different levels depending on their size and capability. Their interactions indicate that they have a variety of needs, including funding and infrastructure. NGOs need be provided medium term support to enable them to participate in such a network, and continue their key activities. A national training programme in monitoring and hatchery management is also urgently required.

Working with local communities: Local community groups are active in a few areas in Tamil Nadu, Goa, Kerala, and Maharashtra. In areas where community groups are present, we need to engage with these groups and integrate them into the network. In numerous areas, community groups need to be initiated to involve the local communities in conservation.

Regional and national coordination: Until networks attain a critical mass or momentum beyond which they can operate on their own, external inputs will be required to initiate, coordinate and sustain the interactions of stakeholders, including organizations of various types, sizes and capacities. It is recommended that future programmes invest in a dedicated individual for this task.

Conclusions

The project specifically 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 local networks of non-government organisations. We recommend that these organisations be supported as a follow-up to this project to further sustain and expand sea turtle monitoring and conservation along the coast. Further efforts are required to fully integrate the respective state government organisations as they must be full, active and supporting partners if the programme is to be truly integrative and collaborative.

Chapter 1

Towards an integrated and collaborative sea turtle conservation programme in India

Kartik Shanker and Harry V. Andrews

INTRODUCTION

Five of the seven species of sea turtles are found in Indian coastal waters. Sea turtles have received considerable attention in recent years, as many populations have declined (Pritchard, 1997). All five species that occur in Indian waters are listed on Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), and on Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Olive ridley turtles (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*) are listed as Endangered in the IUCN Red List, while leatherback (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) are listed as Critically Endangered. All these species are listed as endangered under Schedule 1 of the Indian Wild Life (Protection) Act, 1972 – the single most important law for species protection in India. Though the importance of these sea turtles is acknowledged in state, union and international legislation and policies, they are under severe threat from fishery-related mortality, depredation of eggs and developmental activities. Incidental catch in fisheries is a particularly serious problem (Rajagopalan *et al.*, 1996), especially in Orissa, where over 100,000 dead olive ridley turtles have washed ashore in the last ten years (Shanker *et al.*, 2004a).

India has a coastline of approximately 8000 km, including the mainland coastline and the offshore islands of Andaman and Nicobar, and Lakshwadeep. Four species of turtles including the olive ridley, green turtle, leatherback and hawksbill nest on Indian coasts (for an early review, see Kar and Bhaskar, 1982; Bhaskar, 1984). There are a few reports of loggerheads from Indian waters, but no known records of nesting (Tripathy, 2005). Olive ridleys nest on both east and west coasts of the Indian mainland, as well as on the beaches of Sri Lanka, Bangladesh and Pakistan, and on India's offshore islands (Biswas, 1982; Kar and Bhaskar, 1982). The olive ridley rookeries in Orissa are of obvious global significance since they constitute one of the major mass nesting sites in the world (Pritchard, 1997). Several thousand ridleys may also nest annually outside of Orissa, particularly in Andhra Pradesh (Tripathy *et al*., 2003), Tamil Nadu (Bhupathy and Saravanan, 2002) and the Andaman and Nicobar Islands (Andrews *et al*., 2001). Furthermore, recent genetic studies have indicated the distinctiveness of the Indian olive ridley population in comparison to other global populations (Shanker *et al.*, 2004b). These turtles may have served as an evolutionary source for the recolonisation of ridleys in the Pacific and Atlantic oceans after the extirpation of populations in those basins (Shanker *et al*., 2004b).

Large nesting leatherback populations in India are restricted to Great and Little Nicobar Islands, but a few turtles nest in the Andamans (Andrews *et al*., 2001). Given the recent decline of Pacific leatherbacks (Spotila *et al.*, 2000), the Indian Ocean populations assume even greater significance, especially the ones in Nicobars (Andrews and Shanker, 2002) and Sri Lanka (Ekanayake *et al.*, 2002). Green turtles nest in Gujarat on the west coast of India, in Lakshadweep, and the Andaman and Nicobar Islands, as well as in Pakistan and Sri Lanka (Kar and Bhaskar, 1982). Hawksbills nest in relatively large numbers only in the Andamans, but some nesting occurs in Nicobar, Lakshadweep and Sri Lanka (Kar and Bhaskar, 1982). In the region, the only nesting grounds for loggerheads are in Sri Lanka, although some of the information is questionable. Major green turtle feeding areas occur off the west coast of India in the Gulf of Kachchh, in the lagoons of the Lakshadweep islands, off the coasts of Sri Lanka and Tamil Nadu to the south and in the Andaman and Nicobar Islands. Hawksbill feeding areas occur in the offshore islands. Olive ridleys are known to feed off the coast of southern Tamil Nadu and Sri Lanka.

Monitoring

Surveys and documentation of sea turtles in India began in the early 1970s at two sites, namely Gahirmatha in Orissa, and Madras in Tamil Nadu (Kar and Bhaskar, 1982; Shanker, 2003). Between the late 1970s and mid 1990s, Satish Bhaskar surveyed much of the Indian coast including Gujarat (Bhaskar, 1978; 1984), Lakshadweep (Bhaskar, 1979a; 1984), Andaman and Nicobar Islands (Bhaskar, 1979b; 1984; 1993), Goa, Andhra Pradesh and Kerala (Bhaskar, 1984). Surveys were also carried out in Andhra Pradesh (Raja Sekhar and Subba Rao, 1993; Priyadarshini, 1998) and Karnataka (Madyastha *et al*., 1986; Frazier, 1989), Gujarat and Karnataka (Frazier, 1987). Unfortunately, decades of research at some sites has not helped understand or manage populations as the data is not standardised and is difficult to interpret (Shanker *et al.*, 2004b).

A major lacuna was that most information was from surveys done more than twenty years ago by Satish Bhaskar for the Madras Crocodile Bank Trust (see Kar and Bhaskar, 1982; Bhaskar, 1984). This gap was partly addressed when the Wildlife Institute of India (WII) implemented a Government of India – UNDP –sea turtle conservation project between 2000 and 2002. One of the main aims of the GOI – UNDP national sea turtle project was to evaluate the status of, and threats to, sea turtles along the entire coastline of India, carried out by multiple agencies in different maritime states (see individual papers in Shanker & Choudhury, 2006). 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 were required. Additional surveys were expected to serve the multiple purposes of confirming status, densities and threats, as well as carrying out the tagging of animals in key areas, and the collection of samples for genetic analysis; of particular importance is the building of networks for conservation. It was in this context that the CMS project was initiated to promote the monitoring of sea turtles on the coast of India.

Conservation and community based initiatives

Along with the monitoring programmes, sea turtle conservation was also initiated in Orissa and Madras in the early 1970s. While the Orissa programme was coordinated by the Forest Department, the turtle hatcheries in Madras were operated by first the Madras Snake Park Trust, followed by the Central Marine Fisheries Research Institute and Tamil Nadu Forest Department. Since 1988, it has been operated by a non government organisation, the Students Sea Turtle Conservation Network (SSTCN) (see Shanker, 2003 for a review). Student and NGO programmes were initiated at a number of other sites in India. Many programmes like THEERAM in Kolaavipalam, Kerala, the Students Sea Turtle Conservation Network, Madras and Green Mercy and Dolphin Nature Club in Visakhapatnam have beach protection programmes as well as hatcheries for the protection of sea turtles. More importantly, these programmes have served as powerful tools of public education, spreading awareness about sea turtles and coastal conservation. In Madras, the Trust for Environmental Education (TREE) has recently mobilised youth groups in several fishing villages to protect turtles and nests in the vicinity of their villages. THEERAM in Kerala is of particular interest since it was initiated by a young group of fishermen (Kutty, 2002). Other similar programmes have sprung up all along the coast, including Goa, where the local communities have worked with the Forest Department to try and combine turtle protection and eco tourism (Kutty, 2002). The Sahyadri Nisarga Mitra in Maharashtra has been working with numerous villages along the coast of Maharashtra (Katdare and Mone, 2003). The Trust for Environmental Education in Madras organizes fishing village youth into turtle protection units for in situ protection of nests near their villages (Dharini, 2003).

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 geographical range and diverse habitats of each population. While the knowledge of this biology is critical to identify appropriate alliances, it is the formation and management of these alliances that will ensure sea turtle conservation in the region. Creating and supporting these networks and alliances formed the second key objective of the CMS project on sea turtle conservation in India.

PROJECT ACTIVITIES

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 specifically aimed at consolidating coastal surveys of populations of and threats to sea turtles, and establishing mechanisms to 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 sea turtles at key sites along the Indian mainland coast and islands
2. To use research and monitoring programmes to build a network with local institutions and agencies and to promote public education and awareness programmes amongst local communities and diverse sectors of society
3. To identify the origins of sea 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

Table 1.1: Agencies and states where project was implemented

Agency	State	Importance of site
GuIDE	Gujarat	Mainland nesting beach for green turtles
BNHS	Maharashtra, Goa	West coast nesting sites of ridleys, community based conservation of olive ridleys
SACON	Tamil Nadu, Kerala	Olive ridley nesting, green turtle feeding grounds
ANET	Andaman & Nicobars	Nesting of green, hawksbill, leatherback and olive ridley turtles, feeding of green turtles and hawksbills

Each of the following four chapters provides details about project activities, status of sea turtle populations and recommendations for each of these states. The first objective was to monitor the status of nesting populations in the above states. Details of year-round nesting activity, index beaches, and relative intensity of nesting are now available for these areas (see Annexure 1 for list of Index beaches). There is also updated information on threats and recommendations for conservation.

The second objective, networking, has been effective. A number of NGOs, government departments, and community based organisations were contacted in each of the states. It is hoped that these organisations will form the basis of future work for sea turtle conservation along the coast. The project collaborated with and supported NGOs to assist with the monitoring programmes and provided training and capacity building. These NGOs are expected to continue monitoring, and increase awareness and improve conservation of sea turtles along the entire coast (see Annexure 2 for list of NGOs).

While the first two objectives met with success in the project, the third objective was not achieved at most field sites. Permits were not received for tagging in most states, barring Gujarat and the Andaman and Nicobar Islands. In Great Nicobar Island, however, the beach where tagging was carried out as part of this project (and has been ongoing since 2001) was destroyed by the tsunami. The researcher working on the project, Ambika Tripathy, was a victim of the tsunami of 26th December, 2004. Funding was not received during this project to carry out molecular genetics and satellite telemetry. However, with ongoing monitoring by local groups, it is expected that tagging can be initiated at some sites, with satellite telemetry in specific areas such as the Andaman and Nicobar Islands and Orissa.

Finally, the project planned to formulate a regional management plan and to use its results to foster regional and sub-regional cooperation. The project partially supported the production of the Indian Ocean Turtle Newsletter which is distributed throughout the region. A regional plan, which includes steps to increase regional cooperation, is discussed below.

Monitoring

Selected beaches were monitored during the nesting season in Gujarat, Maharashtra, Goa, Kerala, Tamil Nadu and the Andaman and Nicobar Islands. Following the GOI – UNDP sea turtle project, this exercise focused on a few selected sites on the mainland coast. The details of monitoring for each state are provided below.

Gujarat

Monitoring of 14 index beaches round the year in Jamnagar, Porbandhar, and Junagadh coasts (all on the Saurashtra coast) and two additional beaches for nine months by the project personnel, recorded a total of 1902 nests. 945 nests were recorded in Jamnagar (361 olive ridley and 584 green turtle), 449 in Porbandhar (143 olive ridley and 306 green turtle) and 508 in Junagadh (164 olive ridley and 344 green turtle). Partial surveys of Kachchh and Porbandhar by the Gujarat State Forest Department yielded a total of 193 nests. Bhaskar (1984) estimated a total of 2109 of both olive ridley and green turtle nests along the Saurashtra coast surveyed during August to October 1981. A recent one time survey reported 603 nests on the Saurashtra coast (Jamnagar, Porbandhar and Junagadh) out of the total 676 nests estimated for the entire Gujarat coast (including Kachchh, Amreli and Bhavnagar) (Sunderraj *et al.*, 2002). Even though the present survey recorded a higher number of nests, these estimates cannot be compared as this survey was carried out in selected beaches for whole year, while the earlier estimates were based on surveys restricted to specific time period.

This study reported a total of 1363 green turtle and 732 olive ridley nests with an overall species composition of 65% and 35% respectively. Major threats were sand mining and nest predation – 44 % of nests were predated by humans and animals. Stranding was relatively low, given the large number of fishing vessels on the Gujarat coast.

Maharashtra and Goa

As the nesting frequency is very low on the entire coast of Maharashtra, monitoring efforts were concentrated on beaches where sea turtle conservation activities were taking place, mostly by Sahyadri Nisarga Mitra. During 2004-05, maximum nesting was reported from Velas; 14 olive ridley nests were reported and protected on this beach. A total of 1468 eggs were relocated in the hatchery and 744 hatchlings were released. A few nests were also reported and protected in Dabhol, Kolthare and Kelashi in Ratnagiri district and Harihareshwar in Raigad district. In Morjim, Goa, only nine nests were protected during 2003-04, down from 30 nests in 2000-01. In Galgibaga, 14 nests were protected during 2003-2004.

The major threats are incidental catch in fishing nets, and consumption of eggs and adults by humans in some localities. Developmental activities like construction of hotels and resorts, sand mining and beach illumination also affect the nesting of sea turtles in some localities, especially in Goa.

Tamil Nadu and 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 coastline 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. According to NGOs, on an average, about three nests were found per kilometer in the area.

In Tamil Nadu, 36 olive ridley nests were recorded during January to March 2004 in the Mamallapuram - Pondicherry beach (50 km). The Chennai beach has been monitored by the Students' Sea Turtle Conservation Network (SSTCN) since 1988; a total of 50 nests were collected for their hatchery during January - April 2004, and 62 nests during 2005. 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 December to April 2004 and 2005 respectively.

No sea turtle carcasses were observed along the west coast (north Kerala) during both years (i.e. 2003 - 04 and 2004 - 05). Along the east coast, 231 turtle carcasses, mostly olive ridleys were recorded during 2003 – 04.. Only 21 carcasses were observed during 2004–05, and all of them prior to the 26th December 2004 Indian Ocean Tsunami that seriously impacted 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/ rumours of another tsunami in the area. Hence, it may be reasonably concluded that mortality of turtles in the area was largely due to fishing activities. Sea turtle exploitation is also high in southern Kerala. Depredation of eggs by animals and humans was high in northern Tamil Nadu in areas not patrolled by NGOs, where it ranged from 64 % to 100 %.

Andaman and Nicobar Islands

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.

A total of 711 olive ridley nests were recorded for the beaches in Cuthbert Bay during 2003-04. Monitoring was interrupted by the tsunami during the 2004-05 season. In Ramnagar Beach on the southeast coast of North Andaman Island, the wildlife wing of the forest department reported 207 olive ridleys nests during 2003-04. At Galathea, Great Nicobar Island, a total of 255 nests were recorded during this season.

During the 2003–04 season, a total of 23 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. At Galathea, results of monitoring during the 2003–04 season show that some of the leatherbacks tagged during the 2000–01 and 2001–02 seasons at Galathea re-migrated. A total of 575 nests were recorded during this sesason.

Following the December 2004 tsunami., an ecological impact assessment was conducted from January - April 2005. On the whole, beaches in the Andamans had undergone minimal changes. Some of the beaches had become inaccessible for turtles to nest due to reef flat upheaval. In Little Andamans, all three major sea turtle nesting beaches were affected. These beaches were partially washed away and submerged during high tide. No evidence of turtle nesting on these beaches was found. But observations and indications are that these beaches are reforming.

The islands of the central Nicobar group and Great and Little Nicobar were severely affected by the tsunami. The entire coast and habitat were completely destroyed impacting all coastal flora and fauna and affecting some of the mega species. In the Galathea area of Great Nicobar, the wave, at a height of 30 m, had gone inland almost 1.5 km, destroying all the beaches, mangroves and the entire coastal habitat of the South Bay, including the areas around the light house at the southern tip of the island. 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 are 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. Beaches in Little Nicobar and Katchal Islands were also prime sea turtle nesting beaches and these have been washed away. The beaches on the west and north eastern coast of Little Nicobar Islands were impacted; however leatherback nesting was noticed up to March 2005.

Conclusion

Beaches were selected on the basis of earlier surveys for intensive monitoring. Some of these sites can serve as index beaches and need to be monitored on a long term basis, since baseline data is now available for them (see Annexure 1). Other beaches are monitored by conservation groups and should continue to be monitored with periodic technical inputs from sea turtle biologists.

Networking

The project teams worked with local groups in all the mainland states included in this project. The monitoring at several sites mentioned above was carried out by non government organizations (NGO) and by state Forest Departments. The project team interacted with both sets of stakeholders and provided informal and formal training during the project period. Capacity building and training workshops were conducted for state Forest Departments and non-government organisations that work on sea turtles in each of the five states involved.

Gujarat

A total of 32 stretches/villages were rapidly surveyed in four coastal districts and five types of stakeholders were identified, including representatives of NGO groups, GSFD staff, coastal villagers, fisherfolk and others (naturalists). Before initiation of this turtle project, concerned state and district level forest department authorities were contacted and requested for logistic and other support. The Conservators of Kachchh and Junagadh took necessary action and provided support from their concerned field level staff to carryout training workshops for Kachchh and Porbandhar districts respectively. Two training workshops were conducted in these districts for the state forest staff. A field guide was prepared in the local language (Gujarati) with pictorial representation and distributed to the participants. As a result of these workshops, the forest here initiated two sea turtle hatchery programmes each. GSFD staff surveyed Kachchh and part of the Porbandhar coast under their sea turtle hatchery programme for a period of four months covering a coastal distance of around 50 and 70 km respectively. Two new turtle hatcheries were established on the Porbandhar coast, in addition to the one at Madavpur, while one new hatchery was established in Kachchh coast at Pingleshwar, in addition to the one at Mandvi, which was shifted to a new site closer to the beach. All hatcheries continue to be operated by the Forest Department.

In addition, 6 conservation NGOs and a few individuals were contacted during this project, and form the basis of future networking. The Panchjany Pariyavaran Trust, Amateur Rangers Nature Club, Okha-Mandal Pariyavaran Vikas Trust, Kachba Unchar Kendra, Gir Nature Youth Club and Kachchh Environment and Ecological Cell, expressed great interest in participating in the network.

Maharashtra and Goa

The project interacted primarily with the Sahyadri Nisarga Mitra (SNM) in Maharashtra and Green Cross in Goa. SNM is an NGO based in Chiplun, Ratnagiri district, Maharashtra that became involved in sea turtle conservation while documenting avian diversity, especially nesting of the white-bellied sea eagle, along the coast of Maharashtra. SNM started sea turtle conservation in Ratnagiri district in 2002 and have increased their coverage to several districts in the state. A one-day workshop at Chiplun, the first on sea turtles in Maharashtra, was organised with the help of SNM in February 2005. The participants were mostly from the forest department, local NGOs, villagers, fishermen, trawler owners and workers, school teachers and students. At this workshop, SNM was unanimously chosen as the nodal agency to gather and disseminate information related to sea turtle conservation activities in Maharashtra. To promote individual efforts towards sea turtle conservation, SNM initiated an award, "Kasav Mitra" (Turtle Friend), to be awarded for significant work in sea turtle conservation in Maharashtra.

Data was collected on the outlook of the local community towards sea turtle conservation. Villages like Ashwem, Morjim, Betul, Agonda, Talpona and Galgibaga showed a high degree of support towards conservation. Green Cross, a well known NGO in Goa, is actively involved in the rescue and relocation of injured animals, especially reptiles. They also conduct lectures and slide shows on snakes in different areas in Goa. Their active involvement in sea turtle conservation started from the breeding season of 2003-04. Though sea turtle conservation in Goa started in 1999, it was confined to only a few beaches and most people were not aware of it. Hence, Green Cross is initially concentrating on an awareness programme. This includes illustrated lectures and meetings with target groups like fishermen, locals living in the vicinity of nesting beaches, trawler owners and workers.

Tamil Nadu and Kerala

During the project period, the team members interacted with members of various institutions working on coastal areas, especially on sea turtle conservation in Kerala and Tamil Nadu. Technical support was given to government agencies and NGOs when required. Thanal, Theeram and Naythal are important NGOs actively involved in sea turtle conservation along the Kerala coast. The latter two NGOs conduct hatchery programmes with public participation. These NGOs are also supported by the Kerala Forest Department. Apart from them, the Central Marine Fisheries Institute (CMFRI) at Cochin and Vizhingam conducts research on sea turtles along the Kerala coast.

Along the Tamil Nadu coast, several government agencies and NGOs are involved in sea turtle conservation. Project personnel interacted with the Student's Sea Turtle Conservation Network in Chennai, which has been active since 1988, and the recently initiated Students' Sea Turtle Network, Nagapattinam. 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; Sálim Ali School of Ecology, Pondicherry; AVC College, Mayiladuthurai and Marine Biological Station, Zoological Survey of India, Chennai.

As a part of community participation in the project, local students were encouraged to undertake short-term field based research on sea turtle ecology and conservation. Financial and technical support was provided to students of the Sálim 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. A workshop on sea turtle conservation was planned for the stakeholders of Kerala and Tamil Nadu duing January 2005 and preliminary arrangements were made. However, subsequent to the 26th December 2004 Indian Ocean Tsunami, the response was understandably poor and hence the workshop could not be held.

Andaman and Nicobar Islands

There are few local NGOs in the Andaman and Nicobar Islands currently involved in conservation, and this may be a big lacuna. Workshops for training Forest Department staff in monitoring and hatchery programmes were planned, but could not be conducted because of the December 2004 Indian Ocean Tsunami

Indian Ocean Turtle Newsletter

In addition to the above, two issues of the Indian Ocean Turtle Newsletter were partially supported by the project. The Indian Ocean Turtle Newsletter was initiated to provide a forum for exchange of information on sea turtle biology and conservation, management and education and awareness activities in the in the Indian subcontinent, Indian Ocean region, and South/Southeast Asia. The newsletter also intends to cover related aspects such as coastal zone management fisheries and marine biology. The newsletter is distributed free of cost to a network of government and non-government organisations and individuals in the region. All articles are also freely available in PDF and HTML formats on the website. The two issues include a special section on Orissa, and bibliographies of literature on Orissa and the mainland coast of India.

Conclusion

In general, all the partners professed difficulty in working with local NGOs since these are mostly small voluntary groups with little or no funds or infrastructure and no administrative support. This is itself a challenge that needs to be addressed in future projects. It must also be recognized that, while the project partners are the premier institutions working in each of the regions, their own capacities for conservation and networking has evolved during the last two projects. These organizations and individuals had not worked on sea turtles prior to 2000 and are now a major part of the sea turtle conservation scene in the country. This in itself is a significant contribution.

Identifications of migratory routes

Tagging

Tags were purchased to reinitiate PIT tagging of leatherback turtles in Great Nicobar Island and metal flipper 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 from the respective state governments despite considerable effort on the part of project partners. Tagging programmes could not be reinitiated in Andaman and Nicobar Islands, as the only accessible nesting beach, Galathea on Great Nicobar Island, where tagging had been carried out from 2000, was washed away during the tsunami of December, 2004.

Metal tags were purchased from the Kentucky Band Tag Company, USA. Two thousand tags (Type – INCONEL 1005-681 Conservation Tag) with the numbers CG 1001 – 3000 were purchased. The number sequence follows the sequence CG 0001 – 1000 purchased during an earlier project on 'Conservation Genetics' and used throughout India. The tags were inscribed with the message "RETURN TO: MCBT, POSTBAG 4, MAMALLAPURAM, TN 603104. INDIA"

The tags were distributed to project partners and remain in their custody till tagging programmes can be initiated by them or other partners in various states.

250 PIT tags (Passive Integrated Transponders) were purchased for use on leatherbacks at the Galathea beach, along the south-eastern coast of Great Nicobar Island. The tags and the Power Tracker 11 multi mode scanner were purchased from AVID (American Veterinary Identification Devices. Inc.). The tags are in the custody of the Madras Crocodile Bank Trust till tagging programmes can be initiated in the Andaman and Nicobar Islands.

Genetics

A project was initiated in 2001 on the molecular genetics of marine turtles on the mainland coast and islands of India by the Wildlife Institute of India, Dehradun and Centre for Cellular and Molecular Biology, Hyderabad. This project was supposed to provide additional samples, and funds for analysis not included in the earlier project. This project was unable interact with the earlier project as it could not supply samples, as permits were not received, and did not generate funds for analysis. The genetics project is expected to be completed later this year, and results will be published by 2007.

Telemetry

When the project was initiated in 2003, proposals were under consideration for the initiation of telemetry studies in the Lakshadweep Islands, Andaman and Nicobar Islands and Orissa. The Lakshadweep Island proposal, from the Wildlife Institute of India, included field studies and telemetry. Only field studies have received funding, and will be initiated later in 2006. Several agencies expressed interest in leatherback telemetry in the Andaman and Nicobar Islands. A collaborative proposal including the Project Coordinator's organization (Ashoka Trust for Research in Ecology and the Environment, Bangalore), Wildlife Institute of India, Madras Crocodile Bank Trust and Andaman and Nicobar Forest Department, was prepared and circulated after meetings with the Chief Wildlife Warden of the Islands. However, plans had to be shelved after the tsunami of December, 2004. The most accessible nesting beach at Galathea, on Great Nicobar Island was washed away and infrastructure has still not been fully restored. Other sites are being explored. In Orissa, telemetry may be initiated by the Wildlife Institute of India, with funds from the Ministry of Petroleum and Natural Gas.

Recommendations for the states

Each of the states require specific actions depending on the history of conservation, people's involvement and current status of sea turtles and threat. Some of the key recommendations are listed below.

Gujarat

1. During this project, several NGOs and a few individuals were contacted and could form the basis of future conservation efforts. These NGOs must be encouraged to participate in hatchery programmes and monitoring.

2. Hatchery programmes of the Forest Department need to be supported with technical inputs to the staff on monitoring, hatchery management practices and maintenance of data records.

3. Continuous and long term monitoring of nesting populations for a period of at least five years covering 20-25 index beaches along the coastal districts of Kachchh, Jamnagar, Porbandhar and Junagadh is essential to establish nesting population status for the Gujarat coast.

4. Coastal development is a major problem on the Gujarat coast. Conservation efforts must attempt to mitigate the impacts of industries on coastal habitats.

Maharashtra and Goa

1. Sea turtle conservation should be extended to other coastal districts of Maharashtra through support to the Sahyadri Nisarga Mitra and other sea turtle conservation groups.

2. Currently, nests are protected in hatcheries in all the localities, which results in a reduction in hatching success (around 50%). Thus, there is a need to promote *in-situ* protection of nests.

3. Locals at turtle nesting sites in Goa should be trained towards viable ecotourism, and though there have been some problems with this, it may prove to be a useful strategy for conservation.

Tamil Nadu and Kerala

1. As over 50% of the adult turtle mortality occurred during January, a closed period for gill net (set net) fishing is suggested. During this period, alternate fishing techniques should be explored.

2. Enhanced beach patrolling by the forest department and other agencies during the peak turtle nesting season may save as many as 65 to 90% of the nests from poachers in Tamil Nadu

3. Hatchery programmes involving the public may increase the success of sea turtle conservation initiatives. Supporting the efforts of local NGOs with both technical and financial inputs is essential. An ideal location for starting a hatchery programme is on the Nagapattinam coast.

4. The data on turtle nesting along the east coast during 2000–01, 2003–04 and 2004–05 showed high fluctuation in nesting density, emphasizing the need for long term datasets. It is necessary to continue monitoring along important areas such as Chennai and Nagapattinam.

Andaman and Nicobar Islands

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 sea 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.

Recommendations at the national level

The project was initiated on the assumption that regional collaboration and integration would be good for sea turtle conservation. The project was supposed to set in place tagging and telemetry programmes that would catalyse such collaboration. Unfortunately, this has not yet happened, though project authorities are hopeful that they will do so in the near future. Projects were also to be simultaneously initiated in other states in India by other institutions, which also have not materialized. Though the absence of this hampers the formulation of a management plan, we do provide recommendations below based on lessons learned within this project.

The activities carried out in this project need to be continued, or in some cases, initiated. There is little dispute over the need for some research (tagging, telemetry and genetics), continous monitoring at a few sites, and conservation education. The challenges are in working with the various stakeholders and bringing them together for the conservation of sea turtles. We divide our recommendations into 3 sections, based on stakeholders:

Working with the government

The state Forest Departments are the main stakeholders for the conservation of sea turtles. These agencies have been involved in sea turtle conservation programmes, particularly hatcheries, in states like Tamil Nadu, Gujarat, Goa and Kerala. Though they participated in the training programmes, and were favourable to the objectives of the project, permits for work involving handling of animals (tagging, sampling) were not easy to obtain. Therefore, two key recommendations would be to:

1. Train frontline staff of the Forest Department in ongoing activities such as hatchery programmes and monitoring

2. Obtain long term permits for tagging and research programmes

Working with NGOs

NGOs were involved in the project at different levels depending on their size and capacity. Their activities indicate that they have a variety of capacity and infrastructure needs. We recommend that:

3. NGOs be brought together to share experiences and learning and to introduce them to national and regional level networks

4. NGOs be provided medium term support to enable them to participate in such a network, and continue their key activities

Working with communities

Community groups are active in a few areas in Tamil Nadu, Goa, Kerala, and Maharashtra. This project was unable to engage with them to any great extent, for a variety of reasons peculiar to each area and group.

5. In areas where community groups are present, we need to engage with these groups and integrate them into the network

6. In numerous areas, community groups need to be initiated to involve the local communities in conservation.

Towards regional collaboration and integration

The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia is already being used to promote regional cooperation for sea turtle conservation in the region. As this report goes to print, the Government of India is about to become a signatory to the MoU. The activities outlined in the Conservation and Management Plan of the IOSEA MoU are comprehensive and guide sea turtle conservation in the region. Sub-regional implementation priorities need to be agreed and strategically financed. The MoU's dynamic website (www.ioseaturtles.org) – containing hundreds of current news stories, features and in-depth articles -- is the most comprehensive and up-to-date source of information on marine turtle activities across the region. Non-governmental organizations have been encouraged to provide information on their activities, which are increasingly in evidence in the Online Project Database and as part of a special region-wide Year of the Turtle campaign conducted in 2006.

Efforts such as the Indian Ocean Turtle Newsletter, the Marine Turtle Specialist Group and the recently published "Marine Turtles of the Indian subcontinent" (Shanker and Choudhury, 2006) have played a role in increasing regional communication and interaction. The third issue of IOTN contained a bibliography on sea turtles of Sri Lanka. The newsletter has also carried reports of the Intenational Sea Turtle Society, Marine Turtle Specialist Group and IOSEA Marine Turtle Memorandum of Understanding. The marine turtle book, published under the GOI UNDP Sea Turtle Project, includes surveys done in all the coastal states, and reviews of sea turtle status in Pakistan, Bangladesh and Sri Lanka. It also includes reviews of fishing related issues, law and policy (national and international), conservation and research.

However, these interactions have been confined to a few conservationists and biologists from the region. Thus there is a need for much greater interaction and participation both at the national and at the regional levels. We therefore recommend the following, not in any particular order of priority:

Meetings and workshops

1. A regional workshop on sea turtle conservation involving multiple stakeholders (government, non-government and researchers) from all the countries in south Asia

2. Multi-country sub-regional workshops from border regions such as Gujarat (India) and Pakistan, West Bengal (India) and Bangladesh, and Tamil Nadu (India) and Sri Lanka.

3. A training programme on hatchery management practices and beach monitoring that may be conducted as part of the above workshop(s)

4. Inter-governmental meetings in the context of the IOSEA MOU on marine turtle conservation

Projects

5. Multi-country collaborative projects on genetics, telemetry and tagging

Publications

6. Increasing the profile and impact of publications such as the Indian Ocean Turtle Newsletter which can reach a wide audience with regionally relevant messages and information

7. Translation of accessible technical material such as sea turtle manuals produced by MCBT into local languages within and outside India

Regional forums

8. Promoting and strengthening regional forums (including the Marine Turtle Specialist Group) to promote sea turtle conservation at a regional level

THE FUTURE OF SEA TURTLE CONSERVATION IN INDIA

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. This has resulted in a variety of conflicts which remain unresolved today. This exclusionist approach in terrestrial area management has been in stark contrast to the flexible case-specific methods applied for the management of marine resources by government and non-government agencies thus far. Whether this is intentional or accidental is not entirely clear, but perhaps there is recognition that marine ecosystems require management measures that are distinctly different from those currently practiced in terrestrial areas.

The coastline of India is densely inhabited and used by numerous fishing communities concurrently. There are community-based systems of fisheries management including 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, the introduction of modern fishing methods threatened the livelihoods of these communities and coastal ecosystems: mechanised craft and gear, principally trawlers with bottom trawling methods severely impacted fish stocks, destroyed the gear of small-scale fishermen, and established economic situations in which the small-scale fishers were greatly disadvantaged. 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 kilometres (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 high 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 nets. National and international efforts to introduce Turtle Excluder Devices (TEDs) and/or 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 to the turtles. 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 by focusing on a single endangered species. For example, protecting the interests of the traditional, small-scale 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 (OMRCC) (Aleya, 2005). The OMRCC includes community based groups at Rushikulya and Devi River mouth, local groups such as Project Swarajya, fishworker groups like the United Artists Association (UAA) and Orissa Traditional Fish Workers Union (OTFWU), national groups including Ashoka Trust for Research in Ecology and Environment (ATREE) and Action for Food Production (AFPRO), and interntional agencies like Greenpeace and Worldwide Fund for Nature (WWF). 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. Through the

necessary collaboration between fishers and conservationists, the scope of the conservation programme expanded from sea turtles to marine conservation in a broader sense, which has a positive impact on the effective conservation of marine and coastal resources and ecosystems.

Building a network for monitoring and conservation

Sea turtle conservation, whether nationally or regionally, must build on this paradigm rather than follow the terrestrial exclusionary approach. This can only be achieved with the cooperation of a wide-ranging network of individuals, communities and groups. The mainland coast of India extends over 6000 km including nine states and four union territories, with as many or more different linguistic and cultural groups. To achieve a common objective requires collaboration and integration of efforts, not to mention a large list of other complex social actions. The range of different civil society and community groups that have independently evolved along the coast provides an excellent basis to begin such integration. Sharing of experiences and application of common methods and best practices can lead to synergies that will provide a significant impetus to sea turtle conservation. This project has helped to identify and build bridges with those agencies that will form a part of this network, which is the first and critical step. An integrated and collaborative programme would require the following:

- Building consensus on objectives, which would involve widening the focus on marine and coastal conservation to include a wider group of stakeholders
- Adopting a participatory approach to decision making and action
- Using standardized methods for monitoring and research, which allows effective evaluation of conservation actions and impacts

These objectives can be achieved through an extension of the main elements of the current project. While most of the activities were state centric in this project, the integration needs to be at the national and regional levels. Towards this, national workshops, along with local training and capacity building, are planned as a follow up to this project. Field visits by the groups who participated in this project to other field sites in the country to share experiences and learn from others are also planned. Tagging programmes and satellite telemetry at select sites are expected to highlight the migratory nature of the species, which necessitates such collaborative action for conservation. These networks can be extended to other countries in the region such as Sri Lanka, Bangladesh, Pakistan and Maldives. A regional network for sea turtle monitoring and conservation which follows best practice methods and provides a coordinated effort is the ideal. This project has taken several steps in this direction, but future efforts will have to build intensively to attain the ideal.

Future Plans

It is believed that the monitoring and networking programmes must continue for a few more 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. Until networks attain a critical mass or momentum beyond which they can operate on their own, external inputs will be required to initiate, coordinate and sustain the interactions of stakeholders, including organizations of various types, sizes and capacities. It is recommended that future programmes invest in a dedicated individual for this task. Thus, the project is seeking funding support to continue monitoring and support local communities and NGOs for the next few years. It is essential for long term monitoring programmes to be continuous and not lapse in between. This is especially true for beach monitoring, whose value is substantially diminished if constant effort is not maintained over a minimal period. 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, funded by the Ford Foundation and implemented by the Covenant Centre for Development, Madurai.

REFERENCES

Aleya, K. 2005. Initiatives towards consensus – the Orissa Marine Resources Conservation Consortium. *Indian Ocean Turtle Newsletter* 1: 12-13.

Andrews, H.V., S. Krishnan & P. Biswas. 2001. *The status and distribution of marine turtles around the Andaman and Nicobar archipelago*. GOI UNDP sea turtle project Report. Madras Crocodile Bank Trust, Tamil Nadu, India.

Andrews, H.V. & K. Shanker. 2002. A significant population of Leatherback turtles in the Indian Ocean. *Kachhapa* 6:17.

Bhaskar, S. 1978. Note from the Gulf of Kutch. *Hamadryad* 3(3): 9-11.

Bhaskar, S. 1979a. Notes from Lakshadweep. *Hamadryad* 4(1): 7-9.

Bhaskar, S. 1979b. Sea turtle survey in the Andaman & Nicobars. *Hamadryad* 4(3): 2-19.

Bhaskar, S. 1984. The distribution and status of sea turtles in India. In: *Proceedings of the workshop on sea turtle conservation* (Ed. E.G. Silas), pp. 21-35. CMFRI Special Publication 18.

Bhaskar, S. 1993. *The status and ecology of sea turtles in the Andaman and Nicobar Islands*. ST 1/93. Centre for Herpetology, Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, Tamil Nadu- 603104, India.

Bhupathy, S. & S. Saravanan. 2002. *Status survey of sea turtles along the Tamilnadu coast*. A GOI-UNDP Sea Turtle Project Report. Salim Ali Centre for Ornithology and Natural History, Coimbatore. India.

Biswas, S. 1982. A report on the olive ridley *Lepidochelys olivacea* (Eschscholtz)(Testudines: Chelonidae) of Bay of Bengal. *Record of Zoological Survey of India* 79: 275-302.

Dharini, S. 2003. Turtle conservation by local communities in Madras. *Kachhapa* 8: 22

Ekanayake, E.M.L., T. Kapurasinghe, M.M. Saman & M.G.C. Premakumara. 2002. Estimation of the number of leatherbacks (*Dermochelys coriacea*) nesting at the Godavaya rookery in southern Sri Lanka during the nesting season in 2001. *Kachhapa* 6:11-12.

Frazier, J.G. 1987. *A report on a trip to Mangrol, Gujarat*. Unpublished Report.

Frazier, J.G. 1989. Survey of the marine turtle hatcheries of Karnataka. *Hamadryad* 14(2): 8-18.

Kar, C.S. & S. Bhaskar. 1982. The status of sea turtles in the eastern Indian Ocean. In: *The Biology and Conservation of sea turtles* (Ed. K.A. Bjorndal), pp. 365-372. Smithsonian Institution Press, Washington D.C., USA.

Katdare, V. and R. Mone. 2003. Turtle conservation in Konkan, Maharashtra, India. *Kachhapa* 9: 7-8.

Kutty, R. 2002. *Community based conservation of sea turtle nesting sites in Goa, Kerala and Orissa*. A GOI - UNDP Sea Turtle Project Report. Kalpavriksh, Pune, India.

Madhyastha, M.N, B.K. Sharath & I.J. Rao. 1986. Preliminary studies on marine turtle hatchery at Bengre beach, Mangalore. *Mahasagar Bulletin of the National Institute of Oceanography* 19(2): 137-140.

Pritchard, P.C.H. 1997. Evolution, phylogeny and current status. In: *The Biology of Sea Turtles* (Eds. P.L. Lutz and J.A. Musick), pp. 1-28. CRC Press, Boca Raton, USA.

Priyadarshini, K.V.R. 1998. *Status, ecology and management of olive ridley sea turtles and their nesting habitats along north coastal Andhra Pradesh*. Annual Report (Jan 1997to Jun 1998) WWF-India.

Raja Sekhar, P.S. & M.V. Subba Rao. 1993. Conservation and management of the endangered olive ridley sea turtle *Lepidochelys olivacea* (Eschscholtz) along the northern Andhra Pradesh coastline, India. *B.C.G. Testudo* 3(5): 35 – 53.

Rajagopalan M, E. Vivekanandan, S.K. Pillai, M. Srinath & A.B. Fernando. 1996. Incidental catch of sea turtles in India. *Marine Fisheries Information Services T & E Series* 143: 8-16.

Shanker, K. 2003. Thirty years of sea turtle conservation on the Madras coast: a review. *Kachhapa* 8: 16-19

Shanker, K., B. Pandav & B.C. Choudhury. 2004a. An assessment of olive ridley (*Lepidochelys olivacea*) nesting population in Orissa on the east coast of India. *Biological Conservation* 115: 149-160

Shanker, K., J. Ramadevi, B.C. Choudhury, L. Singh & R.K. Aggarwal. 2004b. Phylogeography of olive ridley turtles (*Lepidochelys olivacea*) on the east coast of India: implications for conservation theory. *Molecular Ecology* 13: 1899-1909.

Shanker, K. & B.C. Choudhury (Eds.). 2006. *Marine turtles of the Indian subcontinent*. Universities Press, Hyderabad, India.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin & F.V. Paladino. 2000. Pacific leatherback turtles face extinction. *Nature* 405: 529–530.

Sunderraj, S.F.W., J. Joshua, V. Vijayakumar, J.S. Serebiah, I.L Patal, A. Saravanakumar & N.M. Joshi. 2002. *Status of the Breeding Population of Sea Turtle along the Gujarat Coast*. Gujarat Institute of Desert Ecology, Bhuj-Kachchh, Gujarat. 44p.

Tripathy, B. 2005. Status of the loggerhead turtle in India. *Current Science* Vol. 88, 4: 535-536.

Tripathy, B., K. Shanker & B.C. Choudhury. 2003. A survey of olive ridley turtles and their nesting habitats in Andhra Pradesh on the east coast of India *Oryx* 37: 454-463.

Chapter 2

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

S.F. Wesley Sunderraj, J. Joshua, L. Brahmbhatt, A. Saravanakumar, B. Muthuraman and S.K. Das

INTRODUCTION

The state of Gujarat on the west coast of India has 92 species of reptiles from 63 genera belonging to 20 families (Vyas, 1998), which includes four species of sea turtles, namely olive ridley, green, leatherback and hawksbill turtles. However, nesting of only olive ridley and green turtles has been documented on the Gujarat coast (Bhaskar, 1978, 1984; Kar and Bhaskar, 1982), while the other two species are occasionally sighted by local fishermen. Though sea turtle research activities started in late 70's in Gujarat coast, most of them were short term and rapid surveys. Frazier (1980) has discussed the threats to the sea turtles of Gujarat in terms of egg and animal poaching, and there is information on an international tag return (Firdous, 1991) and a necropsy of a stranded animal (Frazier, 1989). Except for these notes and a few sketchy and old survey reports, there is no other information on these nesting populations and potential nesting habitats. A recent study by Sunderraj *et al.* (2002), based on one time survey, discussed nesting density, egg predation and provided qualitative information on threats like mining and beach contamination due to spread of oil particles and sea garbage. Though the Gujarat coast supports the only signficant nesting of green turtles along the mainland coast of India, no long term data is available for this region.

Threat to coastal and marine environments

The Gujarat coast and marine environment faces threats from rapid industrial and urban development. Since Gujarat is one of the industrial states of the country, many large scale industries are located along the coast. It is estimated that, out of 1.7 million registered small scale industries in the state, one third 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. It is mentioned that, Tapi estuary discharges 26.3 Mm^3 waste water every year. The eastern shore of Gulf of Khambhat receives 174 mm^3 effluents annually from the large and medium sized industries (Sen Gupta and Deshmukhe, 2000).

Gujarat also has the highest number of ports (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 a direct threat to marine ecosystems. 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. Four Single Buoy Moorings (SBM) have been placed in the Gulf of Kachchh to handle 40-80 MT of crude oil per year, which is expected to increase to 100 MT (Desai, 1997). Overall it is estimated that the coastal waters of Gujarat can expect to receive 606 mm^3 domestic sewage and 215 mm^3 of industrial effluents every year.

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

detrimental to the sea turtle population in terms of an increase in the incidental catch of turtles in fishing nets.

Threats to sea turtles

There are a few studies which have discussed the direct and indirect threats to sea turtles and their habitats 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). Incidental catch in fishing gear like trawl 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 2001; Tripathy *et al.*, 2003). Coastal plantations (Pandav *et al.*, 1998) and sand mining along the nesting beaches have been documented as major threats to turtle habitat (Bhaskar, 1984; Andrews, 2000). All these threats have been reported along the Gujarat coast (Bhaskar, 1984; Sunderraj *et al.*, 2002). However, the magnitude of their impacts need to be studied with long term monitoring programmes.

Rationale of the project

The absence of recent baseline data on sea turtle nesting populations and the impacts of above mentioned developmental activities on the marine ecosystem suggests the need for long term surveys along Gujarat coast. Even though the GOI-UNDP sea turtle project (2000-01) came up with baseline status for many coastal districts, full breeding season surveys were not carried out at all the sites. Considering the necessity of more extensive surveys and intensive long term data collection, the Centre for Herpetology/Madras Crocodile Bank Trust (MCBT), Tamil Nadu launched this project in January 2004. 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 turtles along the Indian coast. The Gujarat Institute of Desert Ecology (GUIDE) – Bhuj, Gujarat is one of the collaborative agencies involved in the project to coordinate and implement this project along the Gujarat coast.

STUDY AREA

The state of Gujarat, situated in the northwestern frontier of India (20°01' – 24°07' N and 68°10' – 74°28' E) encompasses a total land area of 196,024 km^2 constituting 6.0% of the total land area of the country. The total population of the state was estimated to be 505 million in July 2001. Gujarat has the longest coastline in India, covering more than 1600 km which is around 22% of the total coastline (7100 km) of the country. The coastline of the state stretches from Lakhpat in the northwest, in Kachchh district to Umargaon in the south, in Valsad district. Out of 184 talukas of 25 districts, 40 talukas of 13 districts are on the coast. Among the coastal talukas, 19 were totally marshy in nature and not suitable for sea turtle nesting (Fig. 2.1). The coastal area, up to 20 km from the shoreline, covers 30,022.25 km^2 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 Khambat 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 Khambat is aligned in a north-south direction and the 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. There are four major, five medium, 25 minor and five desert rivers in the state.

The coastal zone can be broadly divided into three geographical parts and five sub-regions based on specific inter-tidal characteristics (Table 2.1). 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 the Bhavnagar-Bharuch segment in the Gulf of Khambhat area. These currents develop a

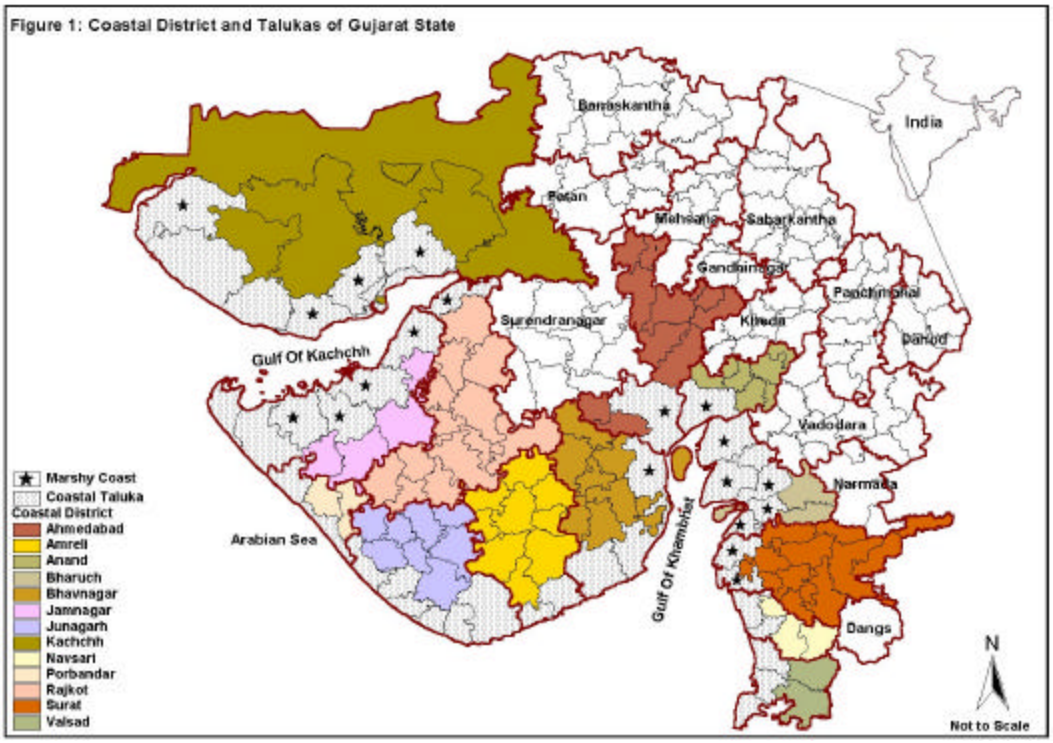


Figure 2.1: Coastal District and talukas of Gujarat

shoreward component during the SW monsoon. The soil types in the inter-tidal area are predominately sandy, silty and muddy in nature (Table 2.1) 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 500 m and no marshy coast.

Table 2.1: 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

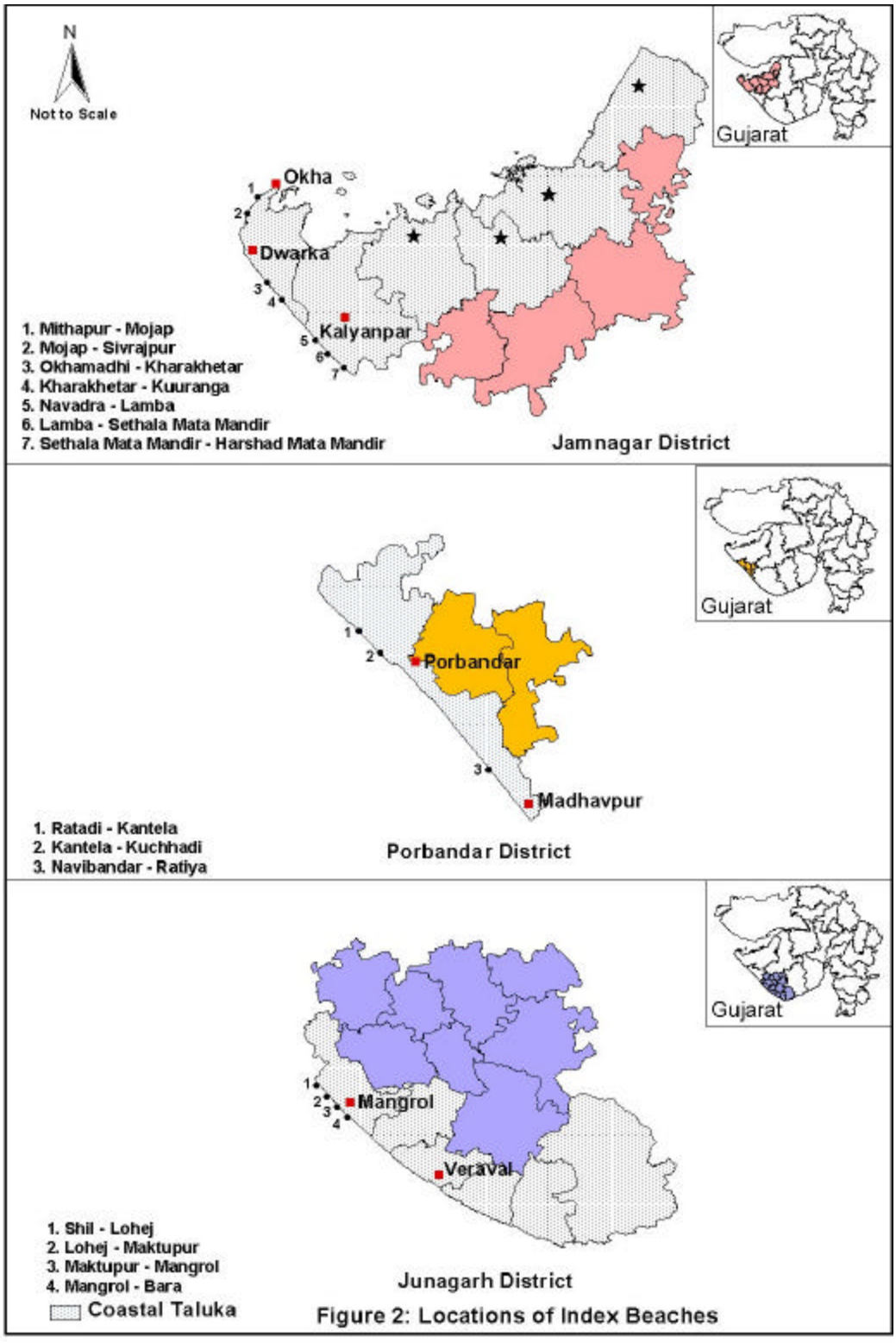


Figure 2.2: Locations of the index beaches

PROJECT APPROACH

Networking of stakeholders

One of the aims of the project was to enhance the knowledge of different stakeholders (government and non-government) by providing training towards the conservation and management of sea turtles 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 of the importance of sea turtle conservation along Gujarat coast. These stretches were selected based on the following criteria: sites with higher nesting records, based on data from GOI-UNDP project (2000-01), adequate coverage of the potential coast, villages located closer to nesting beach and involvement of local communities or residents during the GOI-UNDP project.

Gujarat State Forest Department

Co-coordinating the project with the Gujarat State Forest Department (GSFD) was another objective of the project. Therefore, implementation of project was informed to State and concerned district level authorities such as the Chief Conservator of Forest (state), Conservators and Deputy Conservators of forest of Kachchh, Jamnagar, Porbandhar and Junagadh districts. Forest department field staff at the level of foresters, forest guards, and watchers were involved in nest monitoring with the guidance of their senior officers. Further, the trained staff of Kachchh and Porbandhar districts were actively involved in nest monitoring, which provided nesting data to the project.

Training workshop

Under this project, two training workshops were conducted in Kachchh and Porbandhar districts for the state forest department staff and a few interested local villagers. These workshops had lectures in *Gujarati* (the local language) to introduce the participants to the basic sea turtle biology, nesting biology, threats, and sea turtle conservation and management. A field visit was included in the afternoon session and training was imparted on sea turtle survey and nest monitoring techniques. A field guide was prepared in Gujarati with pictures and distributed to the participants.

NESTING SURVEY AND MONITORING

Selection of coastal districts

Based on the Survey of India topo sheets, four major shore types were identified along the Gujarat coast, which were pure sandy beaches, rocky shore with sandy patches, pure marshy shores, and marshy shore with sandy patches. 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). Though the state has the longest coastline of the country with 13 coastal districts, five districts – namely Rajkot, Ahmedabad, Kheda, Anand, Bharuch and Surat – did not have suitable nesting habitats. The remaining seven districts formed 82.06% of the coastline, of which only Kachchh, Jamnagar, Porbandhar and Junagadh had significant nesting, while Amreli, Bhavnagar and Surat coasts had very low nesting density (Table 2.2). Thus, only Jamnagar, Porbandhar and Junagadh were selected for intensive monitoring in this study.

Field survey

In Gujarat, the nesting season of the olive ridley begins in June and ends in early November, while green turtles nest between July and January (Bhaskar, 1984). However, since the hatchery programme of the Gujarat State Forest Department at Madhavpur village of Porbandhar district in 2002 showed sporadic nesting of both olive ridley and green turtles till March, it was decided to carry out nest monitoring for one full year covering all the months. Monitoring of nesting was carried out using the following methods:

1. Intensive monitoring of index beaches by the project personnel
2. Co-ordination of nesting surveys and hatchery programmes by the state forest department
3. Involvement of a few interested individuals from NGOs in index beach monitoring.

Selected index beaches were monitored from February 2004 to March 2005. All the index beaches were monitored once every week during the nesting season from June – January (including the nesting season of both olive ridley and green turtles), and only once a month outside the nesting season (rest of the months). An additional three beaches were monitored once a month for a period of nine months, while state forest department personnel also surveyed some stretches for selected periods.

Table 2.2: Status of suitable nesting habitat and its density in different districts

District	Coastal length (km)	Potential coast (km)	Total nests	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

Nest survey

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

Threat assessment

Threats to sea turtles were evaluated at two levels: 1. Direct threat to sea turtle populations in terms of nest predation and sea turtle mortality due to incidental catch in fishing nets 2. Threats 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 at the index beaches.

Nest predation

Nests predated by animals were enumerated; they were easily differentiated from human predation by the presence of scattered eggshells and partially consumed eggs around 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 incidences/1 km), medium = (3-4 incidences /1 km) and high = 3 (> 4 incidences/1 km). Sand mining location was rated as: low = (landward side of the coast), Medium = (on the coast) and high = (on 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 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 factors: (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, and (3) Index Beach specific density was estimated by extrapolation for each month. Nesting survey carried out by the GSFD under sea turtle hatchery development has been discussed separately.

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 NGO groups, GSFD staff, coastal villagers, fisherfolk 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 briefed about their role in the project and the work involved. In total 79 people of different stakeholder groups were contacted. These included 18 forest department staff (FD), 24 fisherfolk (FF), 20 coastal villagers (CV), and 12 representatives of six NGOs (Table 2.3). In addition five naturalists from the area also showed interest in being part of the sea turtle conservation network (Annexure 1).

Table 2.3: Details of Stakeholders involved in networking

Coastal district	No of villages surveyed	Types of stakeholders				
		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 Staff, FF – Fisherfolk, CV-Coastal Villagers, NGO – Non Government Organisation, O – Others

NGO involvement

During the stakeholder identification survey, a few NGOs 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 showed great interest in participating in the 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 the sea turtle conservation network are given in Annexure 2.

Capacity building of GSFD staff

Project coordination

Before initiation of this project, concerned state and district level forest department authorities were contacted and requested for logistic and other support. Conservators of the concerned regions were also approached to carry out capacity building and training workshop for field level department staff. Numerous officers of the forest department were informed about the project (Table 2.4). The Conservators of Kachchh and Junagadh took necessary action and provided support from their concerned field level staff to carryout training workshops for Kachchh and Porbandhar districts respectively (Table 2.4).

Table 2.4: Coordination of project with GSFD authorities

District	**GSFD – Authorities**	
Gandhinagar	Chief Conservator of Forest – Wildlife	
	Conservator of Forest	**Deputy/ Asst Conservator of Forest**
Kachchh Jamnagar	1 1 Director Marine National Park	1, DCF, 2 ACF 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 in Kachchh and Porbandhar districts for the state forest staff. In total, 58 participants took part in the workshops, which included two Deputy Conservators of Forest (DCF) of Kachchh and Porbandhar districts who inaugurated the workshop in their respective areas. The other officer who participated included two Assistant Conservators of Forest (ACF) and six Range Forest Officers (RFO). The field level staff trained in this workshop were nine foresters, 30 forest guards and eight watchers (Table 2.5). In addition six representatives from NGOs also attended the workshop. As a result of these workshops and concern of the existing high nest predation pressure, the forest department in Kachchh and Porbandhar coasts initiated two sea turtle hatchery programmes each.

Table 2.5: 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 Staff			
Foresters	3	6	9
Forest Guards	17	13	30
Forest watchers	4	4	8
Total	32	26	58

These workshops had three lectures in Hindi and Gujarati and a field demonstration. In the first session the participants were introduced to basic facts about sea turtles. The second was on techniques to identify turtle species and monitoring of nesting beaches. The third lecture was on sea turtle egg collection, translocation and hatchery management. They were also taught about the advantages and disadvantages

of sea turtle hatchery programmes and the need for proper management. Details of different themes covered in the workshop are given in the Table 2.6.

Table 2.6: Details of themes covered in the training workshop

Major themes	Details
Sea turtles – General	Number of species and their distribution (International, National and State); size, range, longevity, diving, long distance migration, food habits, natal homing. Temperature – sex determination etc.
Sea turtle biology	Species specific morphology, nesting activity, clutch size, egg size, crawl pattern, etc.
Sea turtle conservation	General threats - pollution, coastal development, coastal plantation, artificial illumination, beach armoring, egg 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 relocation, nest record maintenance, hatchling monitoring and release. Advantages and disadvantages of hatcheries.

In the afternoon participants were taken to the nearest beach and data collection was demonstrated in the field. Model turtle nests were constructed on the beach with dummy eggs. The participants 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 along with differentiation of predators based on the field tracks and signs present in and around the model nests.

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 relocation in the hatchery were also given in the guide. Sea turtle hatchery management was also covered, with information starting from selection of hatchery sites, materials (cheap and locally available), regular maintenance of nest record, collection and release of hatchlings.

GSFD activity

GSFD staff surveyed Kachchh and part of the Porbandhar coast under their sea turtle hatchery programme for a period of four months covering a coastal distance of around 50 and 70 km respectively. Two new turtle hatcheries were established on the Porbandhar coast, in addition to the one at Madavpur, while one new hatchery was established in Kachchh coast at Pingleshwar, in addition to the one 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 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 2.7). Under this project, a total of 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 a week, while additional beaches wer monitored once in a month during early morning and late evenings.

Table 2.7: Details of index beaches and their monitoring schedule

Coastal districts	No. of beaches	MP (months)	MF	Total days	Beach length	Total distance (km)
JMC - IB	7	14	Weekly	56	4 – 5 km	32
PBC - IB	3	13	Weekly	52	4 – 5 km	13.5
JUC	4	13	Weekly	52	3 – 4.5 km	15
JMC-AB	2	9	Monthly	9	3 – 4 km	8
PBC-AB	1	7	Monthly	7	5 km	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, 1902 very fresh nests were recorded on the 14 index beaches. Along the Jamnagar coast, a total of 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 449 nests. In the case of Junagadh, three index beaches were monitored for 14 months recording 508 nests (Table 2.8).

Table 2.8: Status of nesting population along the index beaches

Coast	Nature of data	CDM (km)	NDM	Olive ridley	Green turtle	Overall
Jamnagar	7 index beaches			338	521	859
	2- additional beaches			23	63	86
Sub total		32	37	361	584	945
Porbandhar	3 index beaches			121	242	363
	1- additional beaches			22	64	86
Sub total		13.5	38	143	306	449
Junagadh	4 index beaches	15	38	164	344	508
Grand total		60.5	37.67	668	1234	1902

CDM – Coastal dstance monitored, NDM – Number of Days Monitored, IB- Index Beaches, AB- Additional Beaches

Nesting population - GSFD Survey

Under sea turtle hatchery programme, GSFD staff recorded a total of 195 nests. Of that, 176 nests were reported from the Porbandhar coast and 19 from the Kachchh coast. Out of 19 nests recorded in Kachchh coast, 17 were olive ridley and two were green turtle nests. In Porbandhar, a total of 176 nests were reported from two hatcheries (Tukda Miyani – 70 and Rangbai Odadar - 106 nests). Of these, 47 were olive ridley and 127 were green turtle nests (Table 2.9). Two nests were reported as hawksbill nests based on egg size (reportedly smaller than olive ridley eggs), but this identification was not confirmed. These nests were located dose to the Tukda miyani hatchery 27 km west of Porbandhar and close to Gosa village 19 km east of Porbandhar. The nests had 164 and 114 eggs respectively. There is no additional data to confirm species identification.

Table 2.9: 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)

Species composition

Species composition - index beaches

Out of 1902 nests reported, 1234 were green turtle nests (65%), while the rest (35%) were olive ridley nests. Coast specific species composition showed the same trend with more green turtle nests, the Jamnagar coast had a comparatively lower proportion of green turtles (62%) than the Porbandhar and Junagadh coasts (68%) (Table 2.10).

Table 2.10: Species composition of different coasts

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- GSFD Survey

Species composition was estimated excluding the two reported hawksbill nests from Porbandhar coast. In Kachchh, out of the 19 nests, a majority were olive ridley nests (17), which formed 89% of the total. Green turtles dominated the Porbandhar coast with 73% (127 nests) out of the total 174 nests reported (Table 2.11).

Table 2.11: Status of species composition – GSFD

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 GSFD resulted in a total record of 2095 nests along the Gujarat coast. Out of 2095 nests reported, 732 were olive ridley and 1363 were green turtle nests. (Table 2.12).

Nest Density

Monthly beach specific nest density

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 on the Jamnagar coast. Green turtle nest density showed a maximum of 17.60 nests/km and minimum of 7.60 nests/km at Navadra-Lamba and Okhamadhi-Kharakhetar beaches respectively. Similar variations in beach specific density of the two species was observed along the Junagadh and Porbandhar coasts (Table 2.12).

Table 2.12: Monthly nesting density for index beach along different coats

Index beach	**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 - Kharakhetar	5.0	32	26	5.2	47	38	7.6	79	64	12.8
4. Kharakhetar - 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
Sub Total	*32*	*338*	*274*	*8.6*	*521*	*422*	*13.2*	*859*	*696*	*21.8*
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
Sub Total	*13.5*	*121*	*96*	*7.1*	*242*	*191*	*14.2*	*363*	*287*	*21.3*
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
Sub Total	*15*	*164*	*129*	*8.6*	*344*	*271*	*18.1*	*508*	*401*	*26.7*
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

For example, in Porbandhar, Ratadi– Kantela and Kantela-Kuchhadi were the two beaches which recorded higher density of 8 and 10 olive ridley nests/km and 15 and 20 green turtle nests/km than the coastal average (7 olive ridley and 14 green turtle nests/km) respectively. In Junagadh, beach specific olive ridley density varied from a minimum of 633 nests to a 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 the coastal average (8.60 nests/km). In the case of green turtle nest density, only two beaches, Shil–Lohej with 24 nest/km and Mangrol–Bara with 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).

Nesting activity

Monitoring of nesting activity along the index beaches showed 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 ridleys showed peak nesting in July and second peak was observed in November whereas in case of green turtles, the peak was between November and January (Fig. 2.3). Sporadic nesting was observed throughout the year.

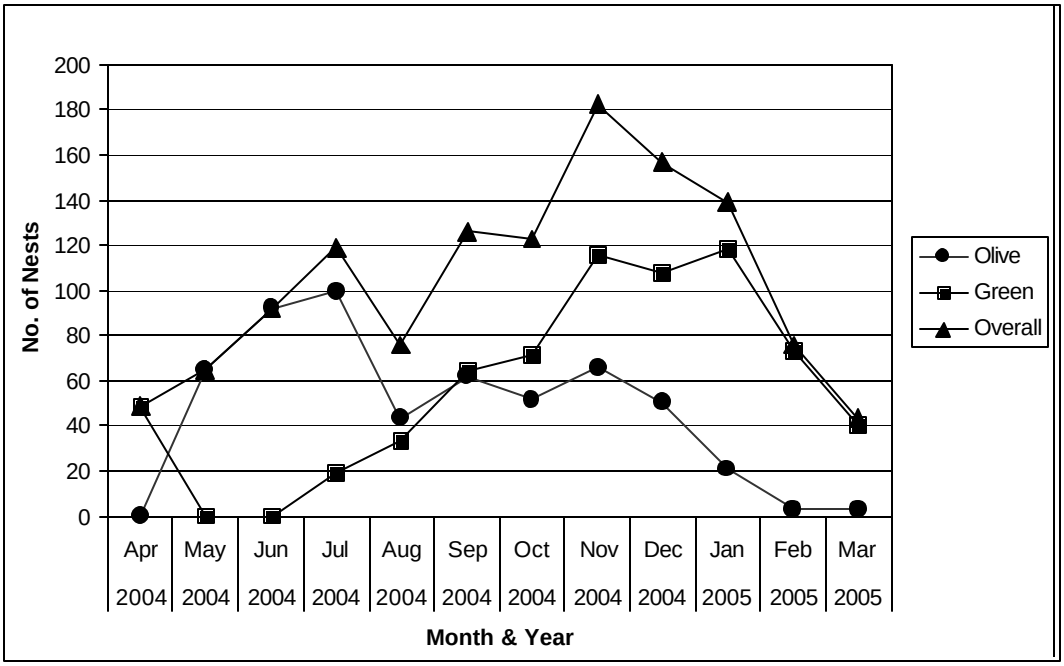


Figure 2.3: Monthly nesting activity on the Gujarat coast

THREATS

Nest predation

Nest predation and source

The rate of nest predation estimated from 14 index beaches showed that, out of 1730 nests, 755 were predated, which constituted 44% of the total. A comparison of predation pressure among the coasts revealed that Jamnagar coast was under more predation pressure (47%) than Junagadh (42%), and Porbandhar (37%) (Table 2.15). Out of the 1730 nests reported along the index beaches, 469 were

predated by animals (27%) and 286 by local people (17%). There was not much difference in animal predation among the coasts, as it varied from maximum of 28% at Jamnagar to minimum of 26% at Junagadh. Human predation also showed a little variation among the coasts with high human predation recorded at Jamnagar (19%) followed by Junagadh (16%) and Porbandhar (11%) (Table 2.13).

Table 2.13: 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 2.16). Among the different coasts, Jamnagar showed more predation of green turtle nests (42%) than Junagadh (37%) and Porbandhar (35%). Porbandhar coast recorded the lowest predation pressure on olive ridley nests (37%) compared to other coasts (Table 2.14).

Table 2.14: 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

Sources of nest predation

Olive ridley nests were comparatively under more predation by animals (36%) than human being (16%). Even though, the same trend was observed in green turtles, predation by animals was comparatively lower (22%) than olive ridleys. Comparison of predation types between the coasts showed that there was not much difference in animal predation. In olive ridleys, animal predation ranged from 35% at Junagadh to 37% at Jamnagar. This ranged from 23% at Porbandhar to 22% at Junagadh for green turtles. In case of human predation, Porbandhar had the lowest predation of 8% and 12% in olive ridley and green turtles respectively. A maximum of 21% and 18% of human predation was estimated at Jamnagar and Junagadh coasts respectively (Table 2.15).

Table 2.15: 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,

Beach specific nest predation

The magnitude of predation pressure was derived by comparing the percent of predation at index beaches with the overall coastal predation pressure. Olive ridley nest predation pressure on the Jamnagar coast ranged from a maximum of 73% at SMM -HMM beach to a minimum of 36% at Mithapur -Mojap beach. A 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 turtles ranged between 54% in SMM-HMM and 35% in Okhamadhi-Kharakhetar beach. Higher predation pressure compared to coastal predation pressure (42%) was reported only from two beaches (SMM-HMM 54% and Lamba-SMM 46%) (Table 2.16). Since olive ridley nests were subjected to very high predation, Mojap-Sivrajpur, Lamba-SMM, and SMM-HMM were also found to have high overall predation of 50, 52 and 61% respectively (Table 2.16).

Table 2.16: Status of beach specific nest predation in different coasts

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. Mojap – 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
Sub Total	*338*	*185*	*54.7*	*521*	*220*	*42.2*	*859*	*405*	*47.2*
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
Sub Total	*121*	*51*	*42.3*	*242*	*85*	*35.1*	*363*	*136*	*37.5*
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
Sub Total	*164*	*87*	*53.1*	*344*	*127*	*36.9*	*508*	*214*	*42.1*
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

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%.

On the Junagadh coast, beach specific nest predation on olive ridley 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 ridleys (67% and 63%) and green turtles (43% and 47%) (Table 2.16). Since these two beaches had higher predation on both the species, they reported higher overall predation pressure of 51 and 52% respectively.

Stranding

Turtle mortality and density

A total of 22 dead turtles were reported along the index beaches of Jamnagar coast. Of these, 16 were green turtles and rest were olive ridleys. Eight were male and fourteen were females. Along the Porbandhar, coast a total of 10 dead turtles were recorded, of which six were green turtles and four were olive ridleys. On the Junagadh coast, out of 20 dead turtles reported, 14 were green and six were olive ridleys. There were more dead green turtles (36) than olive ridleys (16) and more females (33) than males (19) (Table 2.17).

Table 2.17: 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 dead turtle density varied from a minimum of 0.19 to a maximum of 0.40 turtle / km for olive ridley in Jamnagar and Junagadh coasts respectively. The same for green turtles was a minimum of 0.44 at Porbandhar and a maximum of 0.93 turtle / km in Junagadh. Combined, a 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 2.18).

Table 2.18: Density (turtle/km) of dead sea turtles on the index beaches

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 on the index beaches, a further 13 were reported from the three additional beaches and other areas visited. Size class measurements were made and assessed for a total of 65 animals. The size class of olive ridleys varied from minimum of 47 cm to maximum of 68 cm with the mean of 59.8 cm. Minimum, maximum and mean size class in green turtle was 31, 106 and 88.1 cm respectively (Table 2.19). Green turtles showed more variation in size class than olive ridleys. Out 16 olive ridley measured, only one was < 50cm CCL, whereas in the case green turtles, six animals were <70cm CCL, which showed that sub adult turtles also occur in these areas.

Table 2.19: Species specific size class of stranded turtles

Species	No of Turtles	Curved carapace length (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. The highest mining activity (55%) was recorded along the Jamnagar coast followed by Junagadh (24%). Further, based on the encounter rate of sand mining, al the coasts reported just little more than one incidence of mining per kilometer with a range of 1.16 incidence /km in Jamnagar coast to 1.04/km in Porbandhar coast. All three coasts scored low mining impact values. The overall encounter rate of mining was 1.11 incidences/km (Table 2.20).

Table 2.20: 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	Low
Porbandhar	13.5	14	20.90	1.04	Low
Junagadh	15	16	23.88	1.07	Low
Total	60.5	67	100.00	1.11	Low

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

Out of 37 sand mining events recorded on the Jamnagar coast, 46% were located on the coast and fall under medium impact zone. On the Porbandhar coast, 50% of the mining was reported on landward side and only 21% (three incidences) was on nesting beaches. In Junagadh, a 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 zones are included, Junagadh was considered to be the most threatened (81.25%) followed by Jamnagar (73%). Overall, 27% of mining activities were located in the high impact zone or on the nesting beach (Table 2.21).

Table 2.21: 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)

HATCHERY PROGRAMME

Hatching success

In Kachchh, a total of 1446 eggs from 19 nests were placed in the hatchery. Of that 750 eggs hatched with a hatching rate of 52%. Species specific hatching success showed a hatching rate of 55% in olive ridleys and 39% in green turtles. Excluding the reported hawksbill nests, a total of 6970 eggs collected from 69 nests were kept in Tukda-Miyani hatchery. Overall, this hatchery had 71% hatching success and

the species specific hatching success showed a slightly higher rate for green turtles (72%) than for olive ridleys (69%) (Table 2.22). 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 for olive ridley nests (77%) than green turtles (73%).

Table 2.22: Rate of hatching success in GSFD turtle hatcheries

Area	Kachchh			P- Tukda Miyani			P- Rangbaj-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

Tagging and tissue sample collection

Permits were received 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 project, a total of 300 Inconel tags 1005-681 have been supplied by the Madras Crocodile Bank Trust- Chennai, Tamil Nadu. However, due to delay in permission, the peak nesting period was missed. 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.

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 on the Saurashtra coast) and two additional beaches for nine months by the project personnel, recorded a total of 1902 nests and partial surveys of Kachchh and Porbandhar by the Gujarat State Forest Department yielded a total of 193 nests (excluding two hawksbill nests). Bhaskar (1984) estimated a total of 2109 of both olive ridley and green turtle nests along the Saurashtra coast surveyed during August to October 1981. A recent one time survey reported 603 nests on the Saurashtra coast (Jamnagar, Porbandhar and Junagadh) out of the total 676 nests estimated for the entire Gujarat coast (including Kachchh, Amreli and Bhavnagar) (Sunderraj *et al.*, 2002). Even though the present survey recorded a higher number of nests, these estimates cannot be compared as this survey was carried out in selected beaches for whole year, while the earlier estimates were based on surveys restricted to specific time period.

Inter-annual fluctuations in nesting populations, adaptation of different survey techniques by researchers and beach specific variation, and duration of surveys makes it difficult to compare results (Schroeder and Murphy, 1999). Further, it takes many years to determine accurate population trends on nesting beaches, thus emphasising the value of long-term standardised surveys. Even though monitoring of nesting beaches is the easiest and least expensive, short-term surveys (<10 years) are inadequate to assess green turtle population due to several reasons (Chaloupka and Limpus, 2001). 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 an important nesting habitat for green turtles, long term monitoring is essential to ascertain population status.

Species composition

Though four turtle species are believed to occur in the state, only the breeding of olive ridleys and green turtle has been established (Bhaskar, 1978; Kar and Bhaskar, 1982; Bhaskar, 1984; Sunderraj *et al*., 2002), while hawksbill and leatherback turtles have been occasionally sighted by local fishermen. Even though GSFD survey on the Porbandhar coast claimed the record of two hawksbill nests based on the egg size and a clutch size of 164 eggs, it needs further verification.

Although both green turtles and olive ridleys were reported to nest on the Kachchh coast (Bhaskar, 1984), no green turtle nests were reported in the year 2000 due to loss of nesting habitats because of beach erosion (Sunderraj *et al.*, 2002). Under this project, out of 19 nests reported by the department staff, two were green turtle nests while 17 were olive ridley nests. This study reported a total of 1363 green turtle and 732 olive ridley nests with an overall species composition of 65% and 35% respectively. This is similar to the previous survey where 68% of recorded nests were green turtles (Sunderraj *et al*., 2002).

Potential nesting beaches

The extrapolated overall monthly density for olive ridley and green turtles was 8 nests/km and 14 nests/km respectively, which was 23 nests/km for the Gujarat coast. Beach specific monthly density showed that Mojap-Sivrajpur (26 nests), Navadra-Lamba (28 nests), Lamba-SMM (25 nests) and SMMT-HMM (27) were high nesting density beaches compared to the overall coastal density of 22 nests/km reported on the Jamnagar coast. Ratadi– Kantela (23 nests) and Kantela-Kuchhadi (29 nests) reported more nests than the coastal density of Porbandhar coast (21 nests /km). Shil –Lohej and Mangrol – Bara had 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 a daily basis of these eight high density beaches can indicate actual nesting on the coast.

Nesting season

Olive ridleys were reported to nest between June and early November on the Gujarat coast, while green turtle nesting starts in July and ends in January (Bhaskar, 1984). However, the present observation showed that both species nest till March. However, olive ridley peak nesting occurred between July and November. Sporadic nesting takes place throughout the year along the Gujarat coast. Since this is the first survey that covers the entire year and many factors influence nesting, long term observations will provide a better picture of nesting seasonality.

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. 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) mentions Waghiris and Kolis as 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 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). The continuous monitoring of the index beaches and egg collection by the forest department for ex situ conservation might have restricted local people from 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. Overall nest predation by humans is lower (16.5%), than the previous estimate of 21% (Sunderraj *et al*., 2002). Further, since the Porbandhar coast was frequently under surveillance for egg collection by the forest department staff it had a comparatively lower overall nest predation (37%) and human predation (11%) compared to the Jamnagar and Junagadh coasts.

Species-specific nest predation

Olive ridley nests were comparatively under more predation (52%) than green turtles (39%). Within species, olive ridleys showed a considerable difference between human (16%) and animal predation (36%). In the case of green turtles, there was not much difference between human (17%) and animal (22%) predation. 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 higher animal predation on olive ridleys than green turtle nests on the Kachchh coast and reasoned that green turtle nests escape predation by animals more frequently than olive ridleys for the reason stated above.

Stranding

During the survey, 52 dead turtles were encountered along the index beaches of the Gujarat coast. The rate was comparatively high along the Junagadh coast (1.33 turtle/km) compared to the other two coasts which were monitored. Incidental catch in fishing gear like trawl nets and gill nets is believed to be the major threat (Rajagopalan *et al.*, 1996). Even though 12,648 mechanized and 8370 non-mechanized fishing vessels operating on the Gujarat coast (Anon., 1995), record of only 52 dead turtles appears to be a fairly low level of mortality. The number of dead turtles reported (52) and overall density (0.86) was higher than the earlier report of 37 dead turtles, (Sunderraj *et al.*, 2002); however this survey was based on the entire year of monitoring. However, onshore surveys of turtle mortality do not provide a true picture of at-sea mortality (Epperly *et al.*, 1996).

Sand mining

Sand mining in the nesting beaches is one of the threats affecting nesting activity in terms of habitat loss and has been reported in many states on the mainland coast (Bhaskar, 1984; Abraham, 1990; Jayakumar, 2000) and in Andaman and Nicobar Islands (Andrews 2000). The mining of calcareous sandy beaches for construction and cement industries was reported in Gujarat, especially on the Saurashtra coast (Bhaskar, 1982, 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 per kilometer and is assessed as low impact based on the frequency of occurrence. Nevertheless, since 27% of mining takes place on the nesting beaches, it may affect the nesting activity. During the monitoring survey, false crawls were reported in the mined area in four locations. Witherington (1999) suggests that persistent removal of the beach sand disrupt stabilizing vegetation exacerbates erosion and eliminates nesting habitat. Sand mining need to be studied very intensively considering its frequency of occurrence, extent of area under mining and distance to nesting sites, etc.

Hatchery programme

Overall nest predation along Gujarat coast was reported to be 57%, while it was 100% on the Kachchh coast; other threats like sand mining on nesting beaches, spread of oil particles, sea debris and sewage pollution were also reported (Sunderraj *et al.*, 2002). 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 high predation pressure and other threats to the nesting habitat, in addition to existing sea turtle hatchery at Madhavpur, the Gujarat State Forest Department established three hatcheries. These hatcheries were managed by department staff who were trained as part of the capacity building of government stakeholders under this project. In addition to protecting the eggs through translocation into hatcheries, regular surveying of the nesting beaches for egg collection may have reduced egg poaching by local people. The decline in overall nest predation from 57% to 44% and the decline in predation by humans on the Porbandhar coast could be attributed to increased surveillance.

CONSERVATION AND MANAGEMENT STRATEGIES

Research activities

Sea turtle surveys started in Gujarat coast in late 1970s, but most of the surveys were one time surveys and discussed possible nesting sites and threats. Two nation wide projects have been conducted to monitor nesting populations (GOI-UNDP in 2002 and present projects), but need to continue in order to provide long term datasets. Lack of basic data on feeding and nesting populations and rapid coastal and maritime developments and threats to nesting populations and their habitats necessitate long term in depth study on the Gujarat coast, as data procured through short term studies 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 conservation of sea turtles in these areas. Continuous and long term monitoring of nesting populations for a period of at least five years covering 20-25 index beaches along the coastal districts of Kachchh, Jamnagar, Porbandhar and Junagadh is essential to establish nesting population status for the Gujarat coast. In addition, the following activities and studies are recommended:

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

Public awareness and training

The best approach to reducing the impact of coastal development and human impacts to nests and nesting beaches is the creation of public awareness among different stakeholders. Awareness must be created at various levels to reduce the different types and magnitude of threats. Sea turtle research and conservation activities are intensive, and therefore an integrated sea turtle conservation approach would need well trained stakeholders at different levels in order to have significant impacts on conservation. The following stakeholders need to be involved in sea turtle conservation:

- Fisherfolk and coastal residents – educating these groups regarding the conservation significance of sea turtles can help to reduce egg poaching, sewage pollution, sand mining, etc. Fisherfolk need to be trained to survey offshore feeding populations and recovery of turtles in their fishing nests.
- NGOs and students: NGOs and students of the coastal villages, talukas and districts form a massive human force that can be utilised for conducting nature education in coastal villages, nest surveys, hatchery programmes, beach cleaning etc.
- Government departments: Awareness among Port Authority, Maritime Board, Pollution Control Board, and Fisheries Department authorities can facilitate control of industrial development in 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.

- 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 can be utilised for monitoring of offshore turtle populations, identification of feeding and breeding habitats and also for offshore tagging programmes which requires manpower, infrastructure and financial support.

Thus an intensive sea turtle conservation campaign should be carried out along the Gujarat coast. These awareness programmes need to be carried out for stakeholders at five levels. 1. Coastal communities (fisherfolk, coastal villagers, NGOs), 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 GSFDstaff

Most sea turtles take over a decade to mature and year –to year fluctuations occur in nesting activities. The importance of nesting beaches can only be determined from standard, repeatable long-term data on nesting activity. In general, it is not possible to find researchers and experts for long term monitoring of the entire coast of the state. Therefore, the best option is to enhance the knowledge of forest department field staff. The importance and significance of capacity building workshops is given below:

- Even though two workshops were carried out under this project, only 58 candidates were trained in two coastal districts, which forms very small fraction when considering that 13 districts share the coastline of the state.
- The advantage of extensive training programmes is that, since all the staff can be trained in standard techniques, the services of any staff can be availed in any area.
- The trained staffs can generate quality data that can be reliable and comparable with different time periods and areas.

Considering the necessity of long term monitoring, it may be useful to carry out intensive capacity building and training workshops on sea turtle conservation and management for the field level forest department staff which would include Range Officers, Foresters, Forest Guards and Watchers. Since, department staff are frequently transferred it may be necessary to carry out workshops involving initially all the field level staff of coastal districts and later extend it to the entire state.

Acknowledgements

This project was possible due to the valuable support 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 Convention on the Conservation of Migratory Species of Wild Animals (CMS) for financial support. Madras Crocodile Bank Trust (MCBT), Chennai, and Wildlife Institute of India (WII) – Dehradun for identifying GUIDE as a research organisation 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 guards 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.

REFERENCES

Abraham, C. 1990. Preliminary observation on the nesting of the Olive ridley sea turtle (*Lepidochelys olivacea*) on the Madras coast, South India. *Hamadryad* 15: 10-12.

Andrews, H. 2000. Current marine turtle situation in the Andaman and Nicobar Islands – An urgent need for conservation. *Kachhapa* 3: 19-23.

Anon. 1995. Perspective planning of the fishery harbour development – 1996-2021. Commissionarate of fisheries, Government of Gujarat, Gujarat.

Anon. 1999. Commissionarate of Fisheries, Gujarat Fisheries Statistic – 1998-99, Government of Gujarat, Gujarat.

Bhaskar, S., 1978. Note from the Gulf of Kutch. *Hamadryad* 3(3): 9-11.

Bhaskar, S. 1984. The distribution and status of sea turtles in India. In: *Proceedings of the workshop on sea turtle conservation (Ed. E.G. Silas)*. CMFRI Special Publication 18: 21-35.

Bhaskar, S. 1993. *The status and ecology of sea turtles in the Andaman and Nicobar Islands*. Center for Herpetology. Publication: ST/93. Madras Crocodile Bank Trust, Tamil Nadu, India.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. In. *The Biology of Sea Turtles* (Ed. P.L. Lutz and J.A. Musick), pp. 199-231. CRC Marine Science Serice. CRC Press Inc , Boca Raton.

Boulon, Jr, R.H. 1999. Reducing Threats to eggs and Hatchlings: In Situ Protection. In: *Research and Management Techniques for the Conservation of Sea Turtles*. (Eds. K.L. Eckert., K.A. Bjorndal, F.A. Abreu- Grobois, M. Donnelly), pp. 175-178. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Chaloupka, M & C. Limpus. 2001. Trends in the abundance of sea turtles resident in southern Great Barrier Reef waters. *Biological Conservation.* 102: 235-249.

Desai, P.N. 1997. Coastal *Marine Environment of Gujarat: A Benchmark Survey Report. Gulf of Kachchh*. Gujarat Ecological Society. Vadodara. pp. 169.

Epperly, S.P., J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner, P.A. Tester & J.H. Churchill. 1996. Beach stranding as an indicator of at-sea mortality of sea turtles. *Bulletin of Marine Science* 59: 289-297.

Firdous, F. 1991. A turtle's journey from Pakistan (Karachi) to India (Gujarat). *Marine Turtle Newsletter* 53: 18 – 19.

Frazier, J. 1980. Exploitation of marine turtles in the Indian Ocean. *Human Ecology* 4: 329-368.

Frazier, J. 1989. Observations of stranded green turtles, (*Chelonia mydas*), in the Gulf of Kutch. *Journal of the Bombay Natural History Society* 86: 250-252.

Harry, J.L. & C.J. Limpus. 1989. Low-temperature protection of marine turtles eggs during long-distance relocation. Australian Wildlife Research. 16: 317-320.

Jayakumar, C., 2000. An update on Turtle conservation activities in Keralam. *Kachhapa* 2:13.

Kar, C.S. & S. Bhaskar. 1982. The status of sea turtles in the eastern Indian Ocean. In: *The Biology and Conservation of sea turtles* (Ed. K.A. Bjorndal), pp. 365-372. Smithsonian Institution Press, Washington D.C., USA.

Limpus, C.J. & M. Chaloupka. 1997. Nonparametric regression modeling of green turtles growth rate (southern Great Barrier Reef). *Marine Ecology Progress Series* 149: 23-43.

Pandav, B. 2001. Conservation and management of Olive ridley sea turtles on the Orissa coast. Ph.D thesis, Utkal University, Bhubaneshwar, India.

Pandav, B., B.C. Choudhury & K. Shanker, 1998. The olive ridley (*Lepidochelys olivacea*) in Orissa: An urgent call for an intensive and integrated conservation programme. *Current Science* 75: 1323-1328.

Pandav, B. & B.C. Choudhury. 1999. An update on the mortality of olive ridley sea turtles in Orissa, India. *Marine Turtle Newsletter* 83: 10-12.

Pandav, B., B.C. Choudhury & C.S. Kar. 1997. Mortality of Olive ridley (*Lepidochelys olivacea*) due to incidental capture in fishing nets along the Orissa coast, India. *Oryx* 31: 32-36.

Pandav, B., B.C. Choudhury & K. Shanker, 1998. The olive ridley (*Lepidochelys olivacea*) in Orissa: An urgent call for an intensive and integrated conservation programme. *Current Science* 75: 1323-1328.

Parmenter, C.J. 1980. Incubation of eggs of the green sea turtle, *Chelonia mydas*, in Torres Strait, Australia: the effect of movement on hatchability. *Australian Wildlife Research* 7: 487-491.

Patel, P.P., 1997. *Eco-regions of Gujarat*. Gujarat Ecology Commission, Vadodara. 146 p.

Pritchard, P.C. H. 1992. Why nest relocation programs may be harmful to sea turtles. In. *Proceedings of 5th Annual Nat. Conf on Beach Preservation Technology* (Ed. L.S. Tait). Florida Shore and Beach Preservation association, Tallahassee, FL. 408 p.

Pritchard, P.C.H. & J.A. Mortimer, 1999. Taxonomy, external morphology and species identification. In: *Research and Management Techniques for the Conservation of Sea Turtles*. (Eds. K.L. Eckert., K.A. Bjorndal, F.A. Abreu- Grobois, M. Donnelly), pp. 21-38. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Rajagopalan, M., E. Vivekanandan, S.K. Pillai, M. Srinath & A.B. Fernando, 1996. Incidental catches of sea turtles in India. *Marine Fisheries Information Service, T&E Series* 143: 8–15.

Schroeder, B. and S. Murphy. 1999. Population Surveys (Ground and Ariel) on Nesting beaches. In: *Research and Management Techniques for the Conservation of Sea Turtles*. (Eds. K.L. Eckert., K.A. Bjorndal, F.A. Abreu- Grobois, M. Donnelly), pp. 45-53. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Sen-Gupta, R. & G. Deshmukhe. 2000. *Coastal and Marine Environments of Gujarat: Ecology and Economy*. Gujarat Ecological Society, Vadodara, Gujarat.

Sunderraj, S.F.W., J. Joshua, V. Vijayakumar, J.S. Serebiah, I.L Patal, A. Saravanakumar & N.M. Joshi. 2002. *Status of the Breeding Population of Sea Turtle along the Gujarat Coast*. Gujarat Institute of Desert Ecology, Bhuj-Kachchh, Gujarat. 44p.

Tripathy, B., K. Shanker & B.C. Choudhury. 2003. Important nesting habitats of Olive ridley turtles (*Lepidochelys olivacea*) along the Andhra Pradesh coast of eastern India. *Oryx* 37: 454-463.

Vyas, J. 1998. The reptiles of Gujarat State: updated distribution. *Tigerpaper* 25(1): 8-14.

Witherington, B.E. 1999. Reducing Threat to Nesting Habitat. Pp: 21-38. In: *Research and management techniques for the conservation of sea turtles*. K.L. Eckert, K.A. Bjorndal, F.A. Abreu-Grobois & M. Donnelly(eds.). IUCN/SSC Marine Turtle Specialist Group Publication No.4.

Wyneken, J., T.J. Burke, M. Salmon & D.K. Pedersen. 1988. Egg failure in natural and relocated sea turtle nests. *Journal of Herpetology* 22:88.

Zug, G.R., G.H. Balazs, J.A. Wetherall, D.M. Parker, S.K.K. Murakawa. 2002. Age and growth in Hawaiian green sea turtles (*Chelonia mydas*): an analysis based on skelotochronology. *Fishery Bulletin* 100: 117-127.

Annexure 1: Details of villages surveyed for stakeholder networking

Coastal district	Details of stakeholders approached and informed about the project	
	Area	**Type of stakeholder**
Kachchh		
1	Pingleshwer	Fisherfolk 1, Forest Dept 2
2	Suthri	Forest Dept 2, Coastal villager 1
3	Chhachhi	Fisherfolk 1
4	Bada village	Fisherfolk 1
5	Nanalayja	Fisherfolk1 , 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	Fisherfolk -4
5	Sivrajpur	NGO 1
6	Varwala	NGO 1, Coastal villager -1
7	Dwarka	Forest Dept -1, NGO 1
8	Okha – Madhi	Fisherfolk -2
9	Kuranga	Coastal villagers 2
10	Navadra	Coastal villagers 1
11	Lamba	Fisherfolk -1
12	Miyani	Fisherfolk -1
Porbandhar		
1	Visavada	Forest Dept 2,
2	Kanttela	Coastal villagers 3, Fisherfolk 1
3	Kuchhadi	Fisherfolk 1, Coastal villagers 2
4	Birla sagar	Forest Dept 1, NGO Coastal villagers 3
5	Navibandar	Forest Dept 1
6	Balej	Fisherfolk -1
7	Chingariya	Fisherfolk -1
8	Madhavpur	Coastal villagers 2, NGO -3, Fisherfolk 2
Junagadh		
1	Shil	Fisherfolk 1, Forest Dept 1
2	Rahij	Fisherfolk 1,
3	Mangrol	Coastal villagers 1, Forest Dept 2
4	Bara	Fisherfolk 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 programmes. 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. Satish 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 is involved in conducting environment awareness and nature education programmes for villagers, school and college students. They are involved in bird and marine animal watching and also monitoring of wetlands. They do monitor turtle nesting activity along Mithapur, Mojap beaches.
Okha-Mandal Pariyavaran Vikas Trust - NGO	Mr. Shivbha K. Subhaniya (Programme 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.
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 involved in turtle hatchery programme 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: amitjethava@rediffmail.com	This nature club is actively involved in sea turtle nest monitoring and also conduct 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 is involved 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 Clinic 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 conducts turtle walks along the Mandvi beach of Kachchh coast.
Fakirmohmed A. Turk	Fakirmohmed A. Turk Jamadar Wadi Village. Dharab, Mundra Taluka ,Kachchh District	He is an 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, V. Katdare, D. Fernandes and A. Rahmani

INTRODUCTION

Maharashtra and Goa, on the west coast of India, are also rich in the diversity of sea turtles. Daniel (1983) listed three species viz., hawksbill, green turtle and loggerhead in Maharashtra's waters. Later Bhaskar (1984) and Das (1985) reported the olive ridley turtle. But recent survey showed that except the loggerhead, all the other four species are reported from Maharashtra (Giri and Chaturvedi, 2003). Goa, Maharashtra's southern neighbouring state, is also rich in the diversity of sea turtles, where 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 reports of nesting of green turtle also (Shaikh, 1983; Gole, 1997; Giri and Chaturvedi, 2003). There are also records of the nesting of olive ridley and leatherback turtles in Goa (Das, 1985; Bhaskar, 1984), but recent nesting records are only of olive ridleys (Giri and Chaturvedi, 2001). In Goa, the Forest Department has been protecting some sea turtle nesting beaches with the help of local people from 1997 (Giri and Chaturvedi, 2001). In Maharashtra, a sea turtle conservation movement was started by an NGO, Sahyadri Nisarga Mitra (SNM) in 2002. In the first year, the SNM started their work in one village and have now spread to 13 villages from three coastal districts of Maharashtra (Katdare and Mone, 2003).

Most studies on sea turtles in India have mainly focused on the east coast and little information is available on the population on the west coast. During this survey, monitoring was carried out on some of the potential beaches in Maharashtra. The major threats to sea turtles in Maharashtra are from poaching of eggs and incidental catch 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 of the Forest Department in Goa and SNM in Maharashtra, there is a change in the attitude of local people towards the sea turtles. In some localities, they are helping to protect sea turtles and their nests. Apart from this, locals are also collecting data related to nesting on their beaches. This information will be essential for long term monitoring. Today these activities are restricted to few sites, but they are fast spreading to other localities which will surely help conserve 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 by using traditional methods. Apart from this, mechanised fishing is also intensively carried out along the entire coast. There is sporadic nesting of olive ridleys along the entire coast with a few good nesting beaches in Sindhudurg and Ratnagiri districts (Giri and Chaturvedi, 2003). Most of these beaches are sparsely populated and low in fishing activity.

Goa

Goa is a small state on the west coast of India with a coastline of 160 km, bounded by Maharashtra to the north and Karnataka to the south. Of the 160 km of coastline, about 65 km are sandy beaches, which are suitable for nesting. 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 carried out intensively 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. A few beaches, with low 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.

METHODOLOGY

Monitoring

One of the objectives of this project was to monitor nesting sites to assess the conservation status of different species of sea turtles. There are confirmed reports of nesting of olive ridleys in Malwan in Sindhudurg district (Giri and Chaturvedi, 2003). Hence, during the first phase, a 50 km stretch of sparsely populated beaches near Malwan in Sindhudurg district (Fig. 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, the entire beach was surveyed two times. Early morning surveys were carried out to check for signs of nesting. Night surveys were carried out to check for fresh nesting. Information regarding beach profile and mortality was also collected. Interactions with locals, especially fishermen, were used to collect information on incidental catch in fishing nets and offshore sightings of dead or live sea turtles. Along with these interviews and discussions, slide shows were arranged to increase general awareness towards conservation of nature, focusing on sea turtles as flagship species. These shows were mainly arranged for local communities in coastal villages.

In the second phase, from October 2004 to March 2005, monitoring was restricted to the beaches where sea turtle conservation is being carried out. These beaches were mostly in the Ratnagiri and Raigad districts; all sites were selected by Sahyadri Nisrga Mitra (SNM). 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 highly populated. Olive ridleys are known to nest on some of the sparsely populated beaches (Fig. 3.2). There are a few sites where Forest Department with the help of locals is protecting the nests of olive ridley. Information on sea turtle nesting was collected by the Forest Department and locals at these sites. Data was also collected 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, points were attributed to each beach and the data is graphically represented.

Networking

The major threats to sea turtles in Maharashtra are from the poaching of eggs and incidental catch in fishing nets. The threats in Goa are from incidental catch in fishing nets, developmental activities along the beach and poaching of eggs. We interacted with different NGOs, village leaders and villagers, schools and colleges to make them aware about sea turtles and encouraged them to participate in sea turtle conservation, which is slowly spreading on the coast of Maharashtra.

The local NGOs involved in this activities were Sahyadri Nisarg Mitra (SNM), Chiplun in Maharashtra and Green Cross in Goa. Both these NGOs actively carried out awareness campaigns in both the states. To promote the sea turtle conservation activities of SNM in Maharashtra, BNHS provided a small grant through the Salim Ali Nature Conservation Fund during the breeding season of 2004. A one day workshop was also conducted in Maharashtra and was attended by 62 stakeholders. These were mostly local NGOs, Forest Department officials, local villagers, teachers and students.

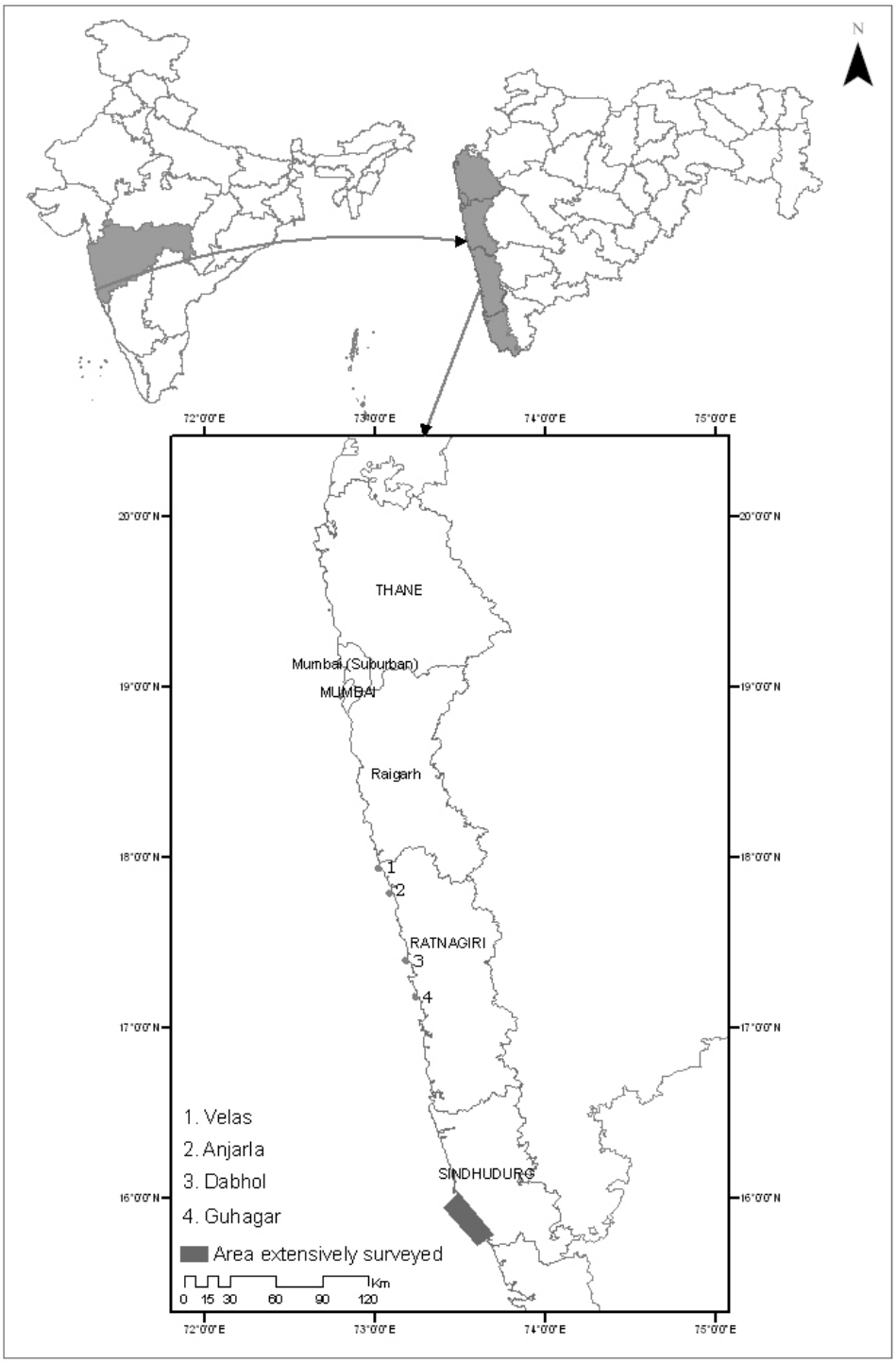


Fig: 3.1 Some Important nesting sites of sea turtles in Maharashtra

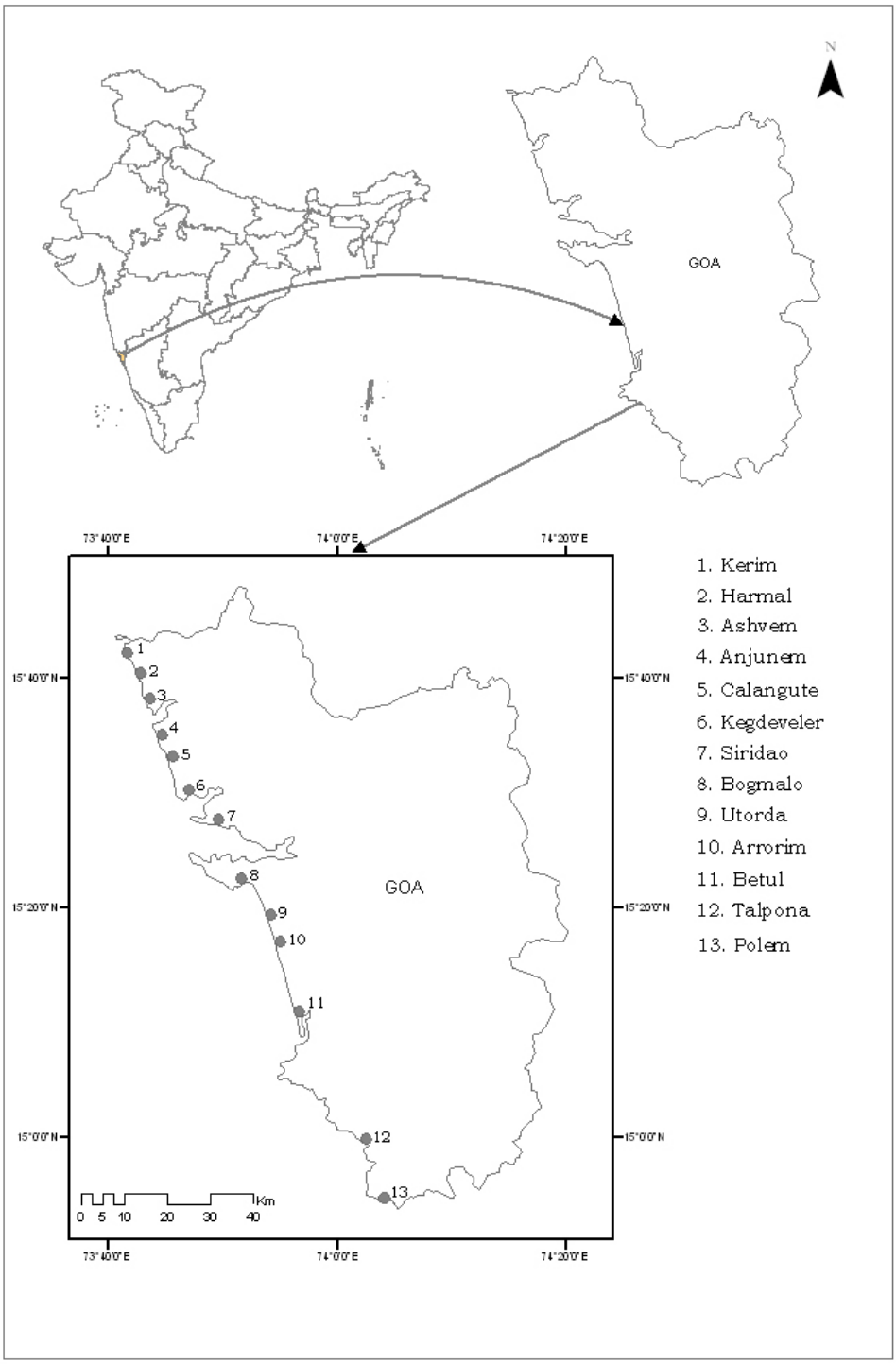


Fig: 3.2 Some Important nesting sites of sea turtles in Goa

RESULTS AND DISCUSSION

Monitoring in Maharashtra

In Maharashtra, the nesting season is from October to March and there are reports of sporadic nesting of olive ridleys from the entire coast. The potential areas for the nesting of olive ridleys in Maharashtra are mostly in Sindhudurg and Ratnagiri districts (Giri and Chaturvedi, 2003). Hence sites were selected for intensive monitoring in these two districts.

Phase I – Nesting

For the first phase, monitoring was carried out from January to April 2004. We selected a 50 km stretch of sparsely populated beaches near Malwan, the southernmost part of Sindhudurg district (Table 3.1). Apart from a large fish landing centre like Malwan, most of the beaches are sparsely populated. There are 21 villages / beaches in this stretch. The longest of all these beaches was Vengurla (6 km) and shortest was Kille Niwati (0.5 km). Apart from this, six potential sparsely populated beaches in Ratnagiri district were also surveyed. There were fresh nesting reports from these beaches in the recent past. About two visits were made to each of these sites during the survey. We recorded only two fresh nests from the entire stretch of 50 km during this survey. On February 2, 2004, we saw fresh track marks and one exposed nest at Achara, likely poached by local people. There are also reports of sand mining from this beach. At Tambaldeg, we saw one more fresh mark and an undisturbed nest on February 1, 2004. This is one of the villages where the Forest Department protects nests with the participation of local people. This is a small village with a 3 km long beach. The beach is about 500 m from the village and is backed by *Casuarina* plantations and sand dunes. Traditional fishing is carried out in this village and locals consume turtle eggs. On January 23, 2004 we saw one predated nest, probably by stray dogs at Guhagar in Ratnagiri district.

The maximum number of nests was recorded at Velas. This beach is about 2 km in length, and is backed by *Casuarina* plantations. The village is about 1 km away from the beach. The main occupation of the people of this village is agriculture. The people of this village do not eat sea turtle meat but collect and eat turtle eggs. There is a small stream between the village and the beach which gets flooded during high tide. The village is separated from the beach during this period. Thus it is largely a secluded and undisturbed beach. The main threat to the sea turtle nests on this beach is from predation by jackals. On January 22, 2004, we recorded three predated and one partly predated nest. Sahyadri Nisarga Mitra (SNM) started sea turtle conservation on this beach in 2002 with the help of the local community. In 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% (Katdare, 2003). In 2003-2004, a total of 30 nests were protected on this beach by SNM. Of 3028 eggs, 1500 hatchlings were released. During 2003-2004, SNM also protected five nests in Murud, Saldure and Anjarla, all in Ratnagiri district.

Mortality

The main threat to adult sea turtles is from incidental catch in the fishing nets. During this survey period of four months, we recorded 39 dead turtles from the stretch of 50 km. Of these, there were 28 olive ridleys and 11 green turtles (Table 3.1). We checked for external injuries, but apart from small cuts on the flippers in a few turtles, there was no evidence of injury, suggesting that most died due to asphyxiation. The locals also believe that the cause of the death could be incidental catch in fishing nets. Compared to other parts of the Maharashtra coast, there are very few villages in the Sindhudurg district where sea turtle meat is consumed by some people. Most fishermen release the turtle immediately if they get caught in their fishing nets. And if the turtle is already dead, they are thrown into the sea. The fishermen also reported the sighting of many dead turtles at sea.

Table 3.1: 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 Morve	2 olive ridleys Green turtle -	SCL 25.00 & 28.00 SCL 26.00
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 Kille Niwati	2 olive ridleys Green turtle -	SCL 31.00 & 25.00 SCL 27.00
District: Ratnagiri		
Gavkhadi	-	
Ganeshgule	-	
Guhagar	One nest	Damaged
Hedavi	-	
Velaneshwar	-	
Velas	4 nests	3 predated and 1 partly predated

SCL - Straight Carapace Length

Phase II Nesting

As the nesting frequency is very low on the entire coast of Maharashtra, as indicated by phase I of monitoring, we employed a different monitoring technique for the second phase from October 2004 to March 2005. In this phase, monitoring efforts were concentrated on beaches where sea turtle conservation activities were taking place. All these sites were selected by Sahyadri Nisarga Mitra (SNM). The selection of these site was based mainly on the number of recent nesting reports and the response of 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 3.2).

The main threat to the sea turtle nests is from humans in most of these localities. Apart from this, the nests are also predated by jackals and stray dogs. To protect these nests, SNM has initiated hatchery programmes. Before starting sea turtle conservation programmes, SNM meets with the local people and makes then aware about sea turtles and the need for conservation. Then SNM selects two or three interested volunteers from each village. These volunteers are given some remuneration for their work. Then SNM provides basic training with regard to collection and relocation of nests and maintenance of the hatchery. During the breeding season, these volunteers patrol the beach daily and relocate eggs to the hatchery. The hatchery is located 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 from the mesh, the bottom half of the hatchery is covered with cardboard sheets from all the sides during the hatching period. The eggs are incubated under natural conditions. After hatching, the hatchlings are immediately released. The volunteers maintain data including date and time of nesting, number of eggs, date of hatching and number of hatchlings released.

Table 3.2: Village wise nesting data in the breeding season of 2003-04

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

During 2004- 05, SNM started sea turtle conservation at Harihareshwar in Raigad district. Here four nests were protected; out of 455 eggs, 255 hatchlings were released successfully. This beach is about 4 km long and is divided in two by a small rocky hillock. This is also a sparsely 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, four nests of olive ridley were protected on this beach. During 2004-05, Sahyadri Mitra, a local NGO from Mahad started sea turtle conservation at Diveagar in Raigad district. They are working in collaboration with SNM. This beach is also a sparsely populated beach with low fishing activity. The main reasons for the selection of this site were recent nesting reports and the willingness of some local people to participate in sea turtle conservation. They reported and protected four nests and 237 hatchlings were released.

The maximum nesting was reported from Velas during 2004-05; 14 olive ridley nests were reported and protected on this beach. A total of 1468 eggs were relocated in the hatchery and 744 hatchlings were released. Four olive ridley nests reported and protected in Dabhol in Ratnagiri district. This is small 2 km long beach backed by *Casuarina* plantations. This is the first attempt at sea turtle conservation on this beach; out of 410 eggs, 233 hatchlings were released. Four nests were protected in Kolthare in Ratnagiri district, a sparsely populated beach. Again , this was the first year of sea turtle conservation activity; only 82 hatchlings were released out of 322 eggs. In Kelashi, only one nest was reported. This beach is 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. Despite 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 ridleys 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 at each site. The forest guards and volunteers patrol the beach to prevent the poaching of eggs. Their duty also involves noting the location of nests and protecting them from stray dogs and jackals. These nests are protected *in-situ*. These sites are Morjim and Agonda in north Goa and Galgibaga in south Goa. Compared to other beaches in Goa, these are less disturbed and unpopulated beaches.

Morjim was the first site in Goa where sea turtle conservation was started by the Forest Department in 1997. During 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 an increase in the number of nests protected, more areas of the beach came under protection and during 2000-01, 30 nests were located and protected. In the subsequent years the number of nests declined and during 2003-04 only nine nests were protected (Table 3.3).

Galgibaga is another well known sea turtle nesting site in south Goa where eggs of sea turtles were popular as food among locals. Then in 1999, with the initiative of a local priest and help from the Forest Department, a sea turtle conservation movement was started in this village. In the first year, 10 nests were protected. In the next breeding season (2000-01) 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 3.3)

Table 3.3: 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	9	-
2002-03	11	19	15
2003-04	9	14	6
2004-05	6	5	9

Agonda is a locality in North Goa where sea turtle conservation was initiated in 2000-2001. This is also a sparsely populated beach with minimal tourist activities. Compared to the other two beaches, the number of nests on this beach is low. In 2003-04, six nests were protected here.

Apart from the above nesting sites, there are a few other nesting beaches in Goa where there were recent reports of sea turtle nesting. Although the Forest Department of Goa has taken initiatives to protect the sea turtle nesting sites, this is likely to be successful only if the local community supports the endeavour. Most of the potential sea turtle nesting sites are undisturbed and less populated. But now, due to sea turtle nesting, these beaches are on the tourist map of Goa and many tourists are visiting these beaches to see the nests. With the influx of tourists, the tourism industry is also taking interest in these sites. Thus, there is a direct or indirect benefit to local communities. We collected information on the outlook of local people towards sea turtle conservation, the benefits they are getting from this activity and the views of the tourists. These are important aspects that are essential to formulate a conservation action plan for sea turtles in Goa.

Potential nesting sites

To rank the beaches according to their suitability for turtle nesting, we took into consideration beach profile, disturbance and fresh nesting reports (Table 3.4). 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 a few other beaches such as Velsao, Betalbatim, Colva, Benaulim and Betul with potential for nesting, but there is very little information from these sites. Similarly beaches scoring two points represent moderate nesting beach potential. These are mostly disturbed beaches. Beaches scoring one point are not suitable for sea turtle nesting as most of these beaches are either highly developed or rocky.

Table 3.4: Potential nesting sites in Goa

Category	**Name of Beach**
High	Querim, Morjim, Velsao, Betalbatim, Colva, Benaulim, Betul, Agonda, Talpona, Galgibaga
Medimum	Arambol, Manderem, Ashwem, Siridao, Agassaim, Arossim, Utorda, Majorda, Varca, Cavelosim, Mobor, Palolem
Low	Calangute, Candolim, Sinquerim, Canaguinim

Local support

We collected data on the outlook of the local community towards sea turtle conservation and the beaches where people were willing to support this activity were given more points (Table 3.5). Villages like Ashwem, Morjim, Betul, Agonda, Talpona and Galgibaga showed a 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 the importance given to sea turtles, they will not get enough space on the beach for running temporary hotels for tourists.

Table 3.5: Degree of local support from the villagers in Goa

Category	**Name of Beach**
High	Ashwem, Morjim, Betul, Agonda, Talpona, Galgibaga
Medimum	Querim, Arambol, Manderem, Calangute, Candolim, Majorda, Betalbatim, Colva, Benaulim, Varca, Cavelosim, Mobor, Canaguinim, Palolem
Low	Vagator, Anjuna, Baga, Sinquerim, Bambolim, Siridao, Agassaim, Arossim

Benefits to coastal villages from turtle nesting

Most coastal villages derive either direct or indirect benefits from sea turtles. Villages like Querim, Mandrem, Ashwem and Morjim in the north Goa and Benaulim, Betul, Agonda, Talpona and Galgibaga in South Goa derive more benefit from sea turtle nesting (Table 3.6). Most of these beaches are secluded compared to the other populated beaches in Goa, and very few tourists visit these beaches. But during the breeding season of sea turtles, which coincides with the tourist season in Goa, many interested local and overseas tourists visit these beaches. Those engaged in the tourism industry like taxi drivers, shack owners, local guesthouses and hotels benefit during this period.

Table 3.6: Benefit to coastal villages from turtle nesting

Category	**Name of Beach**
High	Querim, Manderem, Ashwem, Morjim, Benaulim, Betul, Agonda, Talpona, Galgibaga
Medimum	Arambol, Calangute, Candolim, Vaingunim, Bambolim, Agassaim, Velsao, Majorda, Betalbatim, Colva, Varca, Cavelosim, Mobor
Low	Vagator, Anjuna, Baga, Coco, Miramar, Arossim, Canaguinim, Palolem

Shack owner perspectives on sea turtles

A shack is a temporary shelter / hotel built on the beach to attract tourists. As these shacks are on the beach, they may sometimes pose hurdles for nesting sea turtles. However, in 2003, we saw two nests very close to one of the shacks in Morjim. The role of shack owners is also important in sea turtle conservation as they can help in reporting and protecting turtle nests. Most shack owners from turtle nesting sites are aware of their beach being a potential nesting site of sea turtles. They also believe that the number of tourists is increasing in recent years due to sea turtle nesting. They are supportive to the Forest Department's initiatives to conserve turtle nests. Some 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 a unique species. We interviewed five shack owners near different sea turtle nesting sites. When asked about their views on turtle nesting on their beach, 45% responded positively. They are happy that sea turtles nest on their beaches and are willing to support sea turtle conservation activities. Interestingly, 25% of shack owners responded negatively. They felt that once the beach is declared a sea turtle nesting site, then many restrictions will follow.

Apart from the above, we also collected information on other aspects related to sea turtle conservation. One of the aspects was awareness of sea turtle nesting sites among tourists. We found that 46% of overseas tourists are aware of these sites as they are made popular by the local media and the tourism department. Interestingly, the awareness level of Indian tourists is low and is only 21%. Goa is known for its beautiful beaches and most tourists visit Goa to enjoy its scenic beauty (34% overseas and 17% Indian). Yet, 19% of overseas tourists visit Goa to see the turtle nesting sites whereas only 4 % of Indian tourists visit Goa to see these sites. When questioned on the endangered status of sea turtles, 49% of overseas tourists said that they were aware of this, while only 18% were unaware. However only 9% of Indian tourists were aware about the status of sea turtles and 24% were unaware.

We also collected information on the frequency of sea turtle sightings by fishermen. For this, we interviewed 50 fishermen from different areas. Eighteen responded positively and told us that they see turtles regularly. But they admitted that the frequency was very low compared to 10 years ago. Thirteen fishermen responded negatively and told us that they had not seen sea turtles at all in the last few years. The remaining 19 said that they had seen sea turtles occasionally. When 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 programmes on the use and function of the TED needs to be conducted for fishermen. But as there are very few reports of incidental catch in fishing nets, this may not be a priority. There appears to be a slow decline in the number of sea turtle nests on different beaches in Goa (Table 3.3). The locals believe that the number of nesting sea turtles has declined in the last 10 years. The fishermen, who practice deep-sea fishing, also supported this view.

Networking

Most of the less populated beaches, where sea turtles nest, are difficult to reach for monitoring during the breeding season. Also, lack of awareness is the main cause of threats to sea turtles. Thus, the conservation of sea turtles and their nests on these beaches requires the involvement of local communities. We interacted with two local NGOs, Sahyadri Nisarga Mitra in Maharashtra and Green Cross in Goa. Both these NGOs actively carry out awareness campaigns in their respective states.

Sahyadri Nisarga Mitra (SNM)

Sahyadri Nisarga Mitra (SNM) is an NGO based in Chiplun, Ratnagiri district, Maharashtra. While documenting avian diversity, especially nesting of the white-bellied sea eagle, along the coast of Maharashtra, they came across some dead sea turtles and their exposed nests at Velas, in Mandangad taluka, Ratnagiri district. On enquiry, the locals informed them that these were sea turtle nests and were predated by jackals and stray dogs. SNM thus started sea turtle conservation in Ratnagiri district from October 1, 2002. They arranged awareness campaigns in 45 villages of this district. They met with local

people in different coastal villages and distributed information sheets about sea turtles. Posters giving information on sea turtles and their importance were also displayed on some important beaches.

In the breeding season of 2003-04, SNM organised a sea turtle conservation programme at Velas. This activity was extended to three more beaches, Anjarla, Saldure and Murud, all in Ratnagiri district, in 2004-05. Hatcheries were established and one or two locals were appointed on these beaches to locate sea turtle nests for the hatchery. They were given an honorarium by SNM. Apart from this, some locals helped voluntarily to locate and protect sea turtle nests. The SNM also arranged awareness campaigns through meetings with villagers, lectures and exhibitions. This campaigning has strengthened the turtle conservation movement in Maharashtra.

During the breeding season of 2004-05, people of several new localities started conserving sea turtle nests on their respective beaches. During this season, sea turtle conservation was started at 10 different villages covering three coastal districts in Maharashtra. Of these, two villages were from Raigad district, seven from Ratnagiri and one from Sindhudurg district (Table 3.2). In all these villages, the local villagers supported this activity. Some local NGOs, which had taken initiatives to start conservation activities, were also supported by the SNM to carry out the sea turtle monitoring at certain localities. This resulted in the protection of 31 nests from the above mentioned sites.

We organised a one-day workshop at Chiplun with the help of SNM in February 2005. This was attended by 62 participants from different fields. This was the first workshop on sea turtles in Maharashtra. The participants were mostly from the forest department, local NGOs, villagers, fishermen, trawler owners and workers, school teachers and students. The main objective of this workshop was to develop and strengthen sea turtle conservation along the coast of Maharashtra. The efforts of the SNM were appreciated by all the participants. In this workshop, we covered issues related to sea turtles and their conservation in Maharashtra. The introductory session on sea turtles and their life history made the participants aware of different aspects of sea turtle biology, their role in nature, their present status and threats. The second session, conducted by the members of SNM, focussed on the sea turtles of Maharashtra and the efforts of SNM towards the conservation of sea turtles at different localities. Information on how to translocate eggs from nests, development of hatcheries and their management was also given. In one session, conducted by Forest Department officials, participants were made aware of the legal status of sea turtles and other legal issues related to their protection. Information was also given on the activities of the Forest Department.

The last session was interactive and the participants were given an opportunity to express their views regarding sea turtle conservation. Most of the participants showed interest in conservation of sea turtles and were keen to extend it to their villages, but one of the major hurdles was funding for the establishment and management of hatcheries. In this session, we also selected some potential turtle nesting sites and local NGOs or individuals who would carry out awareness campaigns in these sites. It was also decided to nominate one nodal agency which would gather and disseminate information related to sea turtle conservation activities in Maharashtra. SNM was unanimously chosen as the nodal agency. To promote individual efforts towards sea turtle conservation, the SNM initiated an award, "*Kasav Mitra*" (Turtle Friend). This award is to be given to a person doing significant work in sea turtle conservation in Maharashtra. In the first year the award was given to Mr. Nandkumar Patil, the village leader of Velas. This was the first village in Maharashtra where the sea turtle conservation was started by SNM, and the role of Mr. Patil was vital. His personal interest led the SNM to develop a hatchery and other activities related to sea turtle conservation in this village.

Green Cross

Green Cross is a well known NGO based in Goa and is actively involved in the rescue and relocation of injured animals, especially reptiles. They also conduct lectures and slide shows on snakes in different areas in Goa. Their active involvement in sea turtle conservation started from the breeding season of 2003-04. Though sea turtle conservation in Goa started in 1999, it was confined to only a few beaches and most people were not aware about it. Hence, Green Cross is initially concentrating on an awareness programme. This includes illustrated lectures and meetings with target groups like fishermen, locals living

in the vicinity of nesting beaches, trawler owners and workers. We also networked with individuals who are involved in sea turtle conservation, including one of the authors (D.F.).

Tagging and tissue collection

This is essential for the long-term conservation of sea turtles, as tagging has not been carried out in Maharashtra and Goa uptil now. We had already applied for tagging and tissue sample collection for genetic analysis to the Ministry of Environment and Forests, Government of India. But permits were not received. We had informed the NGOs 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.

CONCLUSION AND RECOMMENDATIONS

Our study indicates that there is a decline in sea turtle populations in Maharashtra and Goa. This is mostly due to incidental catch in fishing nets, and consumption of eggs and adults by humans in some localities. Developmental activities like construction of hotels and resorts, sand mining and beach illumination also affect the nesting of sea turtles in some localities, especially in Goa. Most of thes threats are due to lack of awareness about sea turtles. Most coastal villagers are aware of sea turtles, but they are ignorant about their importance, their legal status and protection given to them. Though efforts taken by some NGOs and people are showing promising results, there is a need to intensify this awareness campaign. The best results were seen in Maharashtra. Here due to meticulous efforts taken by the SNM, the sea turtle conservation movement, which was initiated in one village, has spread to 13 villages covering three coastal districts. All these localities are monitored with the help of local villagers. Every year new localities are being added to this list.

Currently, nests are protected in hatcheries in all the localities, which results in a reduction in hatching success (around 50%). To solve this problem, there is a need of *in-situ* protection of nests. This is practised in Goa where hatching success is higher than Maharashtra. The following recommendations may improve the conservation of sea turtles in Maharashtra and Goa:

1. Sea turtle conservation should be extended to other coastal districts of Maharashtra
2. There should be a control or ban on development activities causing disturbances to sea turtle nesting beaches in both the states.
3. Tagging studies should be carried out using local resources.
4. Locals at turtle nesting sites in Goa should be trained towards viable ecotourism.
5. The efforts of individuals or NGOs towards sea turtle conservation should be appreciated and encouraged

Acknowledgements

The project was made possible by funding through the MCBT-CMS Sea Turtle Project, implemented by the Madras Crocodile Bank Trust (MCBT), Chennai. We are grateful to Dr. Kartik Shanker Principal Investigator and Project Co-ordinator; Mr. Harry Andrews and Dr. B.C. Choudhury Principal Investigators for measures taken to sanction the project to the Society. We thank Chief Conservators of Forests (Wildlife) of Maharashtra and Goa for permissions and support to carry out the surveys in their states. During the surveys in the two states, we received excellent cooperation from all the Forest Department staff in all the areas visited. We are grateful for their help and cooperation extended to us, without which the survey would not have been a success. Our special thanks to Mr. Paresh Porob of Goa Forest Department for his valuable support, suggestions and hospitality.

The first survey was possible with the efforts from Mr. Vinay Kolte. His meticulous efforts helped us to plan our field visits precisely. We are thankful for him. We are thankful to Ram Mone, Sachin Palkar who regularly visited the sites in Maharashtra for monitoring. We are also thankful to Vijay Mahabal, Vishwas Joshi, Sanjay Godbole, Jayant Kanade, Pramod Joshi and Babar sir for their kind co-operation. We are also thankful to Mr. J.C. Daniel for his comments on the drafts of our report. At the BNHS, we are grateful to Dr. Rachael Reuben, Honorary Secretary and Mr. Naresh Chaturvedi, Curator for their encouragement. Mr. Vithoba Hegde and Mr. Vinod Patil, Field Assistant, Collections

Department, accompanied us during the surveys and was a great help and companion. Mr. Gopi Naidu, Computer Assistant helped in doing the formatting of the report. We are also thankful to Ms. Divya Fernandes and Ms. Vibhuti Dedhia for editorial inputs. We are thankful to Mr. Girish Jathar for his valuable suggestions. We are grateful to the staff of Accounts Department for their valuable support. Thanks are also due to Mr. Sachin Kulkarni, Project Manager for taking care of the administrative matters of the project respectively. We are also thankful to Mr. Mohit Kalara for preparing the maps. Many people, individuals or those attached to various departments or institutions, helped us during the surveys by providing us information or sometimes even accompanying us during the surveys. We are unable to name them here individually since there were so many of them, but we are indebted to them for their help and cooperation.

REFERENCES

Bhaskar, S. 1984. The distribution and status of sea turtles in India. In: *Proceedings of the workshop on sea turtle conservation* (Ed. E.G. Silas), pp. 21-35. CMFRI Special Publication 18.

Daniel, J. C. 1983. *The Book of Indian Reptiles*. Bombay Natural History Society. Bombay.

Das, I. 1985. *Indian Turtles - A Field Guide*. WWF - India, Calcutta.

Giri, V. & N. Chaturvedi. 2001. Survey of Marine Turtles along the coast of Maharashtra and Goa (2002). *Proceedings of the National Workshop for the development of a National Sea Turtle Conservation Action Plan, Bhubaneshwar, Orissa*. Ed. Kartik Shanker and B. C. Choudhury. Wildlife Institute of India, Dehradun.

Giri, V. & N. Chaturvedi. 2003. Status of Marine Turtles of Maharashtra. *Kachhapa* 8: 11-15.

Gole, P. 1997. *Conservation of biodiversity of the west coast between Mumbai and Goa.* Ecological Society, Pune.

Katdare V. & R. Mone. 2003. Turtle Conservation in Konkan, Maharashtra. *Kachhapa* 9: 7-8.

Shaikh, K.A. 1983. Distribution of nesting sites of sea turtles in Maharashtra. In: *Proceedings of the workshop on sea turtle conservation* (Ed. E.G. Silas). CMFRI Special Publication 18.

Chapter 4

The status of sea turtle populations on the Tamil Nadu and Kerala coasts 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 Indian limits (Kar and Bhaskar, 1982). All of these species are distributed in Tamil Nadu (Bhupathy and Saravanan, 2002) and at least four species are found within the coastal areas of Kerala. The Wildlife Institute of India (WII) recently implemented a Government of India – UNDP sea turtle conservation Project (see Shanker and Choudhury, 2006). This project (2000 - 01) evaluated the status of sea turtles and their nesting habitats in all maritime states of India, which included an assessment of threats 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 the population trend of a species is critical for the preparation and implementation of conservation programmes. As a part of the present CMS - MCBT project on the sea turtles, the Sálim Ali Centre for Ornithology and Natural History (SACON), Coimbatore undertook studies along the Kerala and Tamil Nadu coasts during the 2003 - 05 turtle nesting seasons.

METHODOLOGY

Study area

The all India coordinated GOI–UNDP–WII sea turtle project (2000–2001) suggested that the Nagapattinam and Chennai coasts (Fig. 4.1 & 4.2) along the Tamil Nadu and the beaches of North Kerala (Fig. 4.3) were important sea turtle nesting areas. Hence, the present study monitored turtle nesting and mortality along these beaches. These beaches are largely sandy and provide suitable nesting habitats. The south Chennai (12°31'– 12°08' N and 80°10'–79°56'E) and Nagapattinam coasts (11°51' – 11°30' N and 79°51' – 79°46' E) are part of the Palar and Cauveri deltas respectively. The north Kerala coast (~ Kozhikode - Kannur; 11°41'–12°38' N and 74°55'–75°38'E) has many west flowing rivers and remnants of mangrove vegetations at the river mouths. Important ground vegetations along the sandy beaches are ground glory, *Ipomoea pescaprae* and Ravanan's moustache, *Spinifex littoreus*. Coconut plantations and sea walls 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 found on the beach. As surveys were done at fortnightly intervals, tracks found during each survey were considered as new. Nest predation by animals or exploitation by locals was based on tracks and signs found near exploited nests. Number of carcasses found on the shore indicated the turtle mortality. Carcasses of turtles were marked with paint to avoid counting them again. Project personnel surveyed the Mamallapuam - 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 a daily basis. Details of the monitoring in various sectors during this study are given in Table 4.1.

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 their participation requested in project activities. During 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).

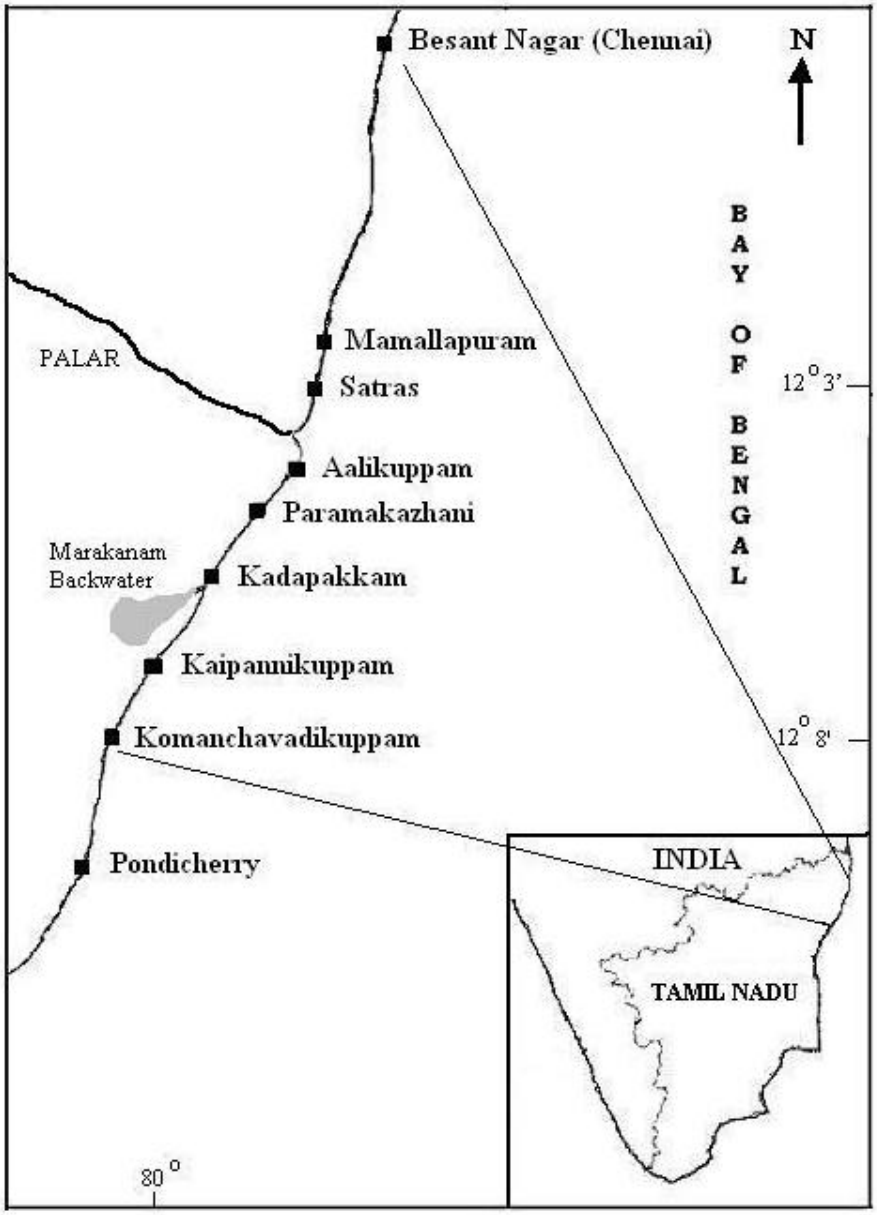


Figure 4.1: Map showing the Chennai - Pondicherry coast and prominent villages.

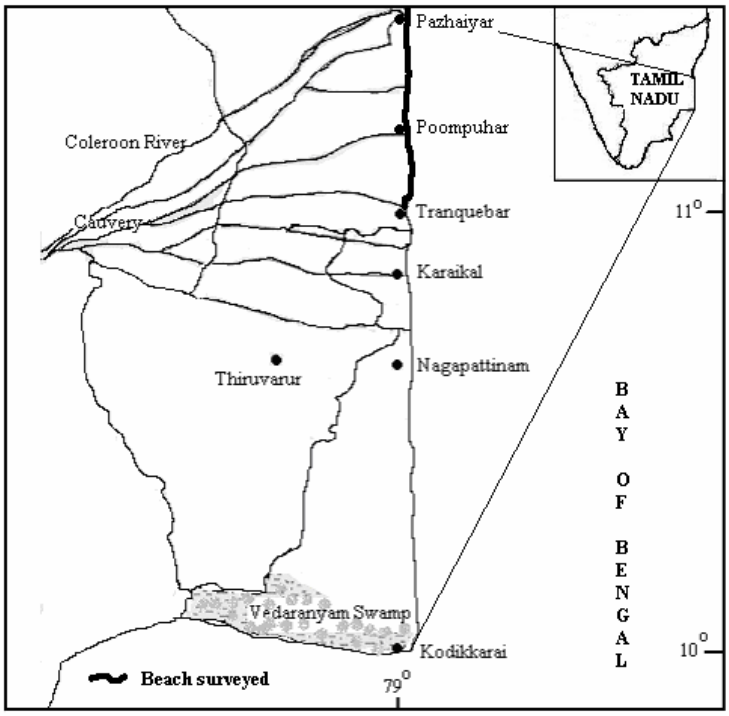


Figure 4.2: Map showing the study area along the Nagapattinam coast.

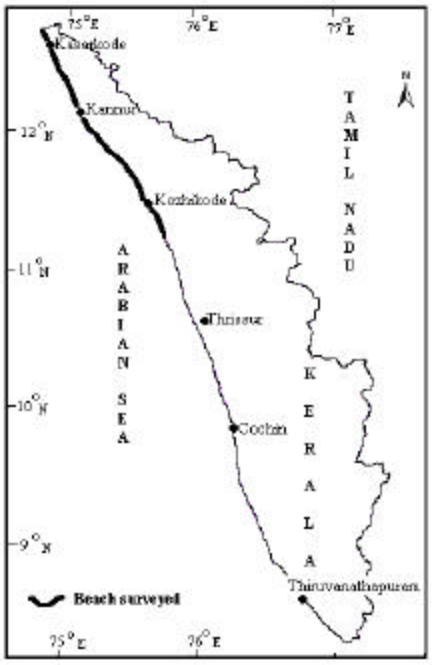


Figure 4.3: Map of Kerala showing the study area.

Table 4.1: 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

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 morality along the 60 km coastline 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. The hatchlings are released into the sea. Apart from collecting ecological information, these hatcheries are used for nature education and awareness programmes.

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 4.2).

Table 4.2: 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 a daily basis during the nesting season) by the Students' Sea Turtle Conservation Network (SSTCN) since 1988 and this continued during this study as well. A total of 50 nests (8.3 /km) were collected for their hatchery during January - April 2004. During 2005, 62 nests were collected (10.3 / km; SSTCN data). The average nesting intensity for 16 years was 9.4 nests / km (Table 4.3). A hatchery is being maintained by the SSTCN on an annual basis. The SSTCN also provides training and awareness programmes to students.

Table 4.3: Nesting of ridleys along the Chennai coast during 1989 – 2005; - data not available; Source: SSTCN, Shanker 2003

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 2004 and 2005 respectively (Table 4.4). This works out to be about 7.5 and 15 nests /km. Nesting along this beach was about 20-nests/km during 2000-01 (Bhupathy and Karunakaran, 2003)

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. Hence, sea turtles nested subsequent to the major monsoon season of the areas ie the northeast and southwest monsoons respectively. Peak nesting along the east and west coasts were during February and October respectively. The 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.

The reasons for the difference in the number of nests observed along the Chennai and Nagapattinam coasts during 2003 - 04 and 2004 - 05 are unclear. Most likely, these differences could be due to certain annual or cyclic changes in the nesting of turtles. Further studies may throw provide better insights in this regard.

Table 4.4: Nesting of ridleys along the Nagapattinam coast during December – April, 2003 – 04 and 2004 – 05; 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.

Turtle Mortality

Mortality

No sea turtle carcasses were 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 (Table 4.5). 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 impacted 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 another tsunami the area. Hence, it may be reasonably 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 4.6). Prior to and during January, turtles aggregate in the shallow waters near the beach for breeding. These areas are also important gill net fishing grounds. Fishermen in the area largely use small mechanised boats and catamarans for fishing. The density of fishing vessels (both mechanised and non-mechanised) was 26 and 28/km on the Mamallapuram and Nagapattinam coasts respectively. In these areas, gill nets were mostly used for fishing. Gill nets are set in shallow waters and left for about 8 - 10 hours. Entangled turtles in the net die due to asphyxiation. This is evident 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 the fishermen themselves. In all, 70% of the fresh carcasses found on the shore had one or two missing flippers and shell or head injuries. Fishing communities of these areas (Chennai, Nagapattinam) largely do not consume turtles, while inhabitants of south Tamil Nadu (Gulf of Mannar) do.

Table 4.5: Olive ridley mortality along select beaches of Tamil Nadu and Kerala during 2003 - 04; based on carcasses; number in parenthesis indicate number of green turtles, * total count.

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

Table 4.6: Mortality of olive ridleys along the Chennai and Nagapattinam coasts during 2003 – 05 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 Chennai, Nagapattinam and North Kerala do not consume turtles, but they do 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 was negligible. These groups (NGOs) 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 the night for collecting eggs.

Of the 36 nests observed during January - April 2004 along the Mamallapuram –Pondicherry coast, 25 (69.4%) were found predated (Table 4.7). 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 4.7: Exploitation of turtle eggs along select beaches of Kerala and Tamil Nadu; * - based on questionnaire survey

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 took the eggs of almost all nests along the Nagapattinam coast, whereas inhabitants took only 12.5% along the Mamallapuram coast, indicating that the latter is relatively less disturbed. High mortality of adult turtles was observed in both these areas along the east coast 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 areas, especially sea turtle conservation pertaining to Kerala and Tamil Nadu (Appendix I). Technical support was given to government agencies and NGOs when required. A brief profile of important NGOs that are involved in sea turtle conservation in the area is given below (Table 4.8).

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

Table 4.8: 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 and Information Network, Thiruvananthapuram 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 NGO 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 sea 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 programme of Theeram was initiated in 1996. Eggs

of about 40 - 60 nests are collected annually (largely) from the beach (10 km) around Kolavipalam and hatchlings released into the sea. Theeram activities are partially supported by the Kerala Forest Department.

Naythal: Naythal - coastal information conservation and action samithi is a NGO registered as a society. This society is the realisation of the aspiration of a team of youth at Thaikadappuram village, who believed that they should help address environmental problems. The main objective of the organisation is coastal information and conservation with a special emphasis on environmental problems. The activities of the Naythal are aimed at the 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 India.

Motivated by the activities of the youth in Kolavipalam (Theeram), Naythal members have been attempting to collect and hatch the turtle eggs and release hatchlings since 2002 - 03. Activities of Naythal extend over a 10 km stretch of 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 groups and individuals. Naythal also collaborates with other environmental organisations like SEEK (Society for Environmental Education in Kerala), Kasaragod on conservation related issues.

Along the Tamil Nadu coast, especially on the Chennai and Nagapattinam areas, several government agencies and NGOs are involved in sea turtle conservation. A brief description of 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 till 1977. A total of 197 nests were collected during this period. Details on the nesting behavior and biology of olive ridleys were recorded for the first time in India. A large number of students and general public participated in the turtle walks. Further to this, a countrywide sea turtle status survey was organized by the MSPT during 1981, and this provided the first information on many important turtle areas such as the Gujarat and Tamil Nadu coasts.

Madras Crocodile Bank Trust: The Madras Crocodile Bank Trust (MCBT) has been active in providing guidance to NGOs and researchers in the region since 1988. Long term monitoring of sea turtles in the Andaman and Nicobar Islands is being undertaken by MCBT. Students of the Centre for Herpetology in MCBT have been monitoring turtle nesting on the 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 programme. The SSTCN is likely one of the longest running students' conservation programmes in the world. Students from schools, colleges and other educational institutes are members of this network. The activities of SSTCN include 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 an 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 helped form active groups interested in sea turtle conservation in the area. Two 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 beaches near Tranquebar and Poompuhar respectively. The National Service Scheme (NSS) volunteers from the colleges were used to popularise the importance of sea turtles among the inhabitants of the area. The students' group at Poompuhar has committed to actively monitor sea turtle nesting and mortality along the Nagapattinam coast in forthcoming years as 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; Sálim Ali School of Ecology, Pondicherry; AVC College, Mayiladuthurai and Marine Biological Station, Zoological Survey of India, Chennai. The project also exchanged information and interacted with the forest department officials, especially at Chennai, Nagapattinam, Ramanathapuram and Tirunelveli.

Training

Efforts were made to involve local communities, students and government officials in the project. Seminars, slide shows and hands on training were organised to motivate students and members of NGOs in both states. As a part of community participation in the project, local students were encouraged to undertake short-term field based research on sea turtle ecology and conservation. Financial and technical support was provided to students of the Sálim 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 the involvement in sea turtle conservation programmes in the area in forthcoming years as well.

It was planned to conduct a workshop on sea 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.

Tagging and tissue collection

Tagging programmes can be carried out in selected areas of the Tamil Nadu coast, particularly Chennai where a students programme patrols the beach every year. Additionally, tagging in feeding areas such as Gulf of Mannar may provide clues about the migration of individuals. Permits, however,were not received for tagging and tissue sample collection for genetic analysis from the Ministry of Environment and Forests, Government of India.

SUGGESTIONS FOR CONSERVATION

- Annual Closed Season for Fishing - As over 50% of the adult turtle mortality occurred during January, a closed period for gill net (set net) fishing is suggested. This may be implemented for one month (January) along the east coast. During this period, the use of alternate fishing techniques should be explored. Discussions with the concerned departments (forest and fisheries) and stakeholders are needed for active participation and effective implementation.

- Control of egg poaching– Poaching of turtle eggs is widespread along the entire olive ridley nesting range, and in some areas it is very severe. Egg poaching is more prominent where no protected areas or NGO activities are found, and is negligible 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.

- Enhanced beach patrolling by the forest department and other interested parties during the peak turtle nesting season is crucial. Intensive beach patrolling for two months (February-March) on 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 programmes and community participation in conservation efforts is important for getting positive results. Hatchery programme involving the public, and incentives and alternate livelihoods for fishermen may increase the success of sea turtle conservation initiatives. Supporting the efforts of 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 programme is on the Tranquebar - Poompuhar (Nagapattinam) coast. With the involvement of the forest department and local community, this could act as a model nature education and conservation initiative. A hatchery programme is particularly necessary for the Nagapattinam coast, as local people pilfer the eggs of almost all nests.

- Training– Workshops and training programme may be organized for field staff of the forest and fisheries departments and researchers, providing information on the status of sea turtles, research techniques and problems in conservation. Hands on training programmes to the fishermen of Chennai and Nagapattinam coasts by expert institutions such us CMFRI on how to release entangled sea turtles in the nets without damage may be very useful. Both government and non-government organisations may organise training programmes at regular intervals. Allocation of funds for these activities from government and NGO sectors is important.

- Research- The data on turtle nesting along the east coast during 2000 - 01, 2003 - 04 and 2004 - 05 showed high fluctuation in 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). The reason for these fluctuations needs 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 check if the same population nests along these coasts. Tagging programmes and genetic studies along both these coasts 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 ensure the long-term survival of sea turtles.

Acknowledgements

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). We 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 Sálim Ali Centre for Ornithology and Natural History (SACON), Coimbatore. We thank Dr. V. S. Vijayan for providing facilities at SACON to undertake this work. We are 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. We 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 we are 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); Sálim 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.

REFERENCES

Bhupathy, S & S.Saravanan. 2002. Status of sea turtles along the Tamil Nadu coast, India. Kachhapa. 7: 7-13.

Bhupathy, S. & R. Karunakaran. 2003. Conservation of olive ridley sea turtle *Lepidochelys olivacea* (Reptilia/Chelonia) along the Nagapattinam coast, southeast coast of India. Indian Journal of Marine Science. 32 (2): 168-171.

Kar, C. S. & S. Bhaskar. 1982. Status of sea turtles in the Eastern Indian Ocean. Revised edition. *In*: Biology and conservation of sea turtles. pp: 365-372. Bjorndal K A (Ed). Smithsonian Institution Press, Washington DC.

Shanker, K. 2003. Thirty years of sea turtle conservation on the Madras coast: a review. Kachhapa. 8: 16-19.

Shanker, K. & B.C. Choudhury (Eds.). 2006. Marine turtles of the Indian subcontinent. Universities Press, Hyderabad, India.

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

- Ashoka Trust for Research in Ecology and the Environment, 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.
- Poompuhar College, Poompuhar.
- Sálim Ali School of Ecology, Pondicherry University.
- Students' Sea Turtle Conservation Network, Adayar, Chennai.
- Students' Sea Turtle Network, Poompuhar, 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, A. Tripathy, Saw Aghue, Saw Glen, Saw John and K. Naveen

INTRODUCTION

Four species of sea turtles occur around the Andaman and Nicobar Islands. These include, the leatherback turtle (*Dermochelys coriacea*), the hawksbill turtle (*Eretmochelys imbricata*), the green turtle (*Chelonia mydas*) and the olive ridley (*Lepidochelys olivacea*). Although there are several historical citations of sea turtles in the islands dating from the early 1800s, there are no historical status and distributional records. Surveys were started during 1978 by Bhaskar and most of the leatherback rookeries in the Nicobars were found only in the early 1990s (Bhaskar and Tiwari, 1992; Bhaskar, 1993). A complete review of literature and surveys is provided in Andrews *et al.* 2006.

Previous surveys and studies in these islands have recorded India's best nesting beaches for three species , namely leatherbacks, green turtles and hawksbills. Extensive feeding grounds for hawksbill and green turtles 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 and 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 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 Wild Life (Protection) Act (1972). However, indigenous groups of people, the original inhabitants of the Andaman and Nicobar Islands, are still exempt from the Indian Wild Life (Protection) Act.

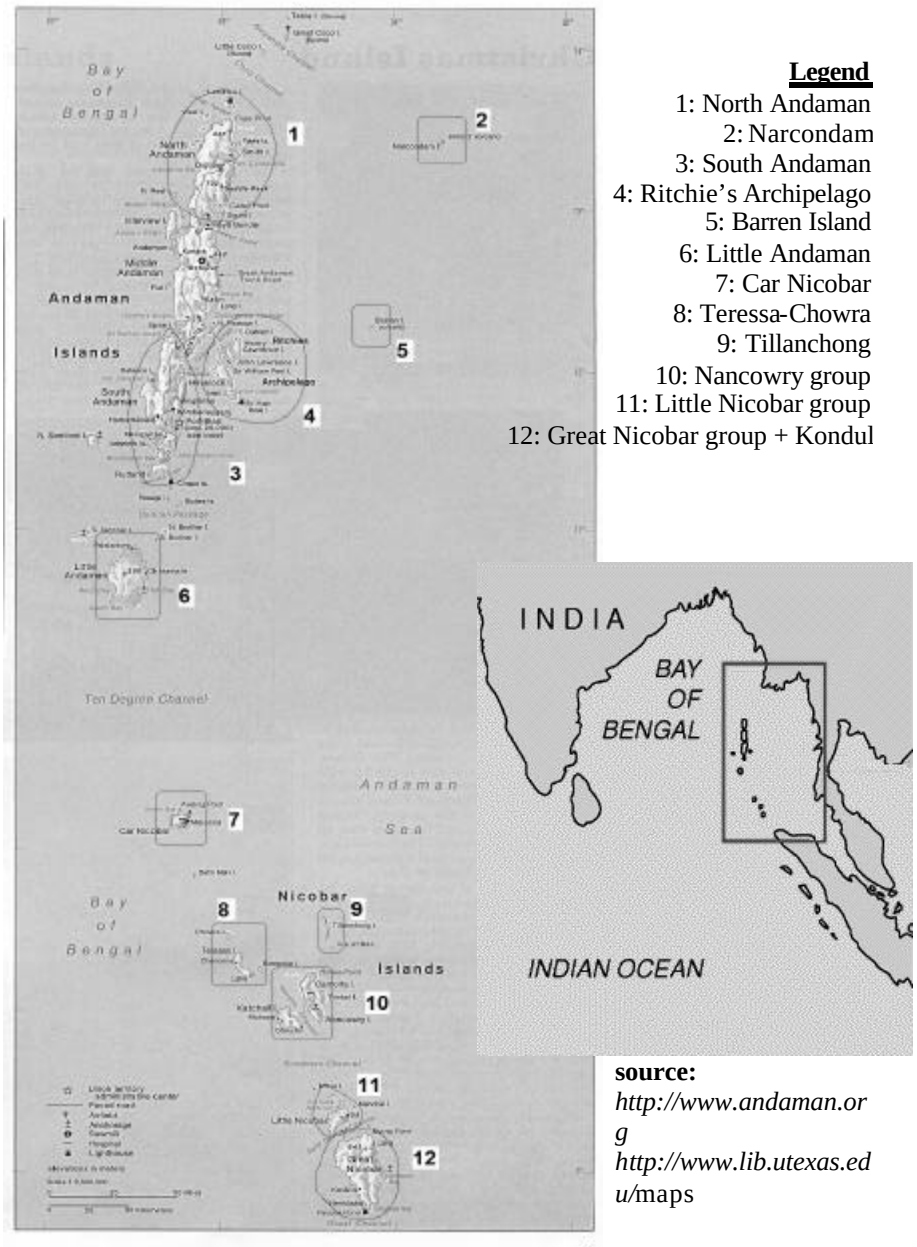
STUDY AREA AND METHODS

The Andaman and Nicobar Archipelago consists of over 345 islands, islets and rocky outcrops, with land area extending up to 8,249 km^2 and a coastline stretch of 1,962 km; the Andaman Islands constitute 6408 km^2 and the Nicobars 1841 km^2. 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. 5.1).

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 have a forest cover of 94%. The entire Nicobar group is a tribal reserve, 12 of the 23 islands are inhabited, and there are 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 and 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. 5.2). In November 2000 a field station was set up at the Galathea beach in South Bay on the southeast coast of Great Nicobar Island (Fig. 5.3). 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).



Legend
1: North Andaman
2: Narcondam
3: South Andaman
4: Ritchie's Archipelago
5: Barren Island
6: Little Andaman
7: Car Nicobar
8: Teressa-Chowra
9: Tillanchong
10: Nancowry group
11: Little Nicobar group
12: Great Nicobar group + Kondul

source:
http://www.andaman.org
*http://www.lib.utexas.edu/*maps

Figure 5.1: The Andaman and Nicobar Islands

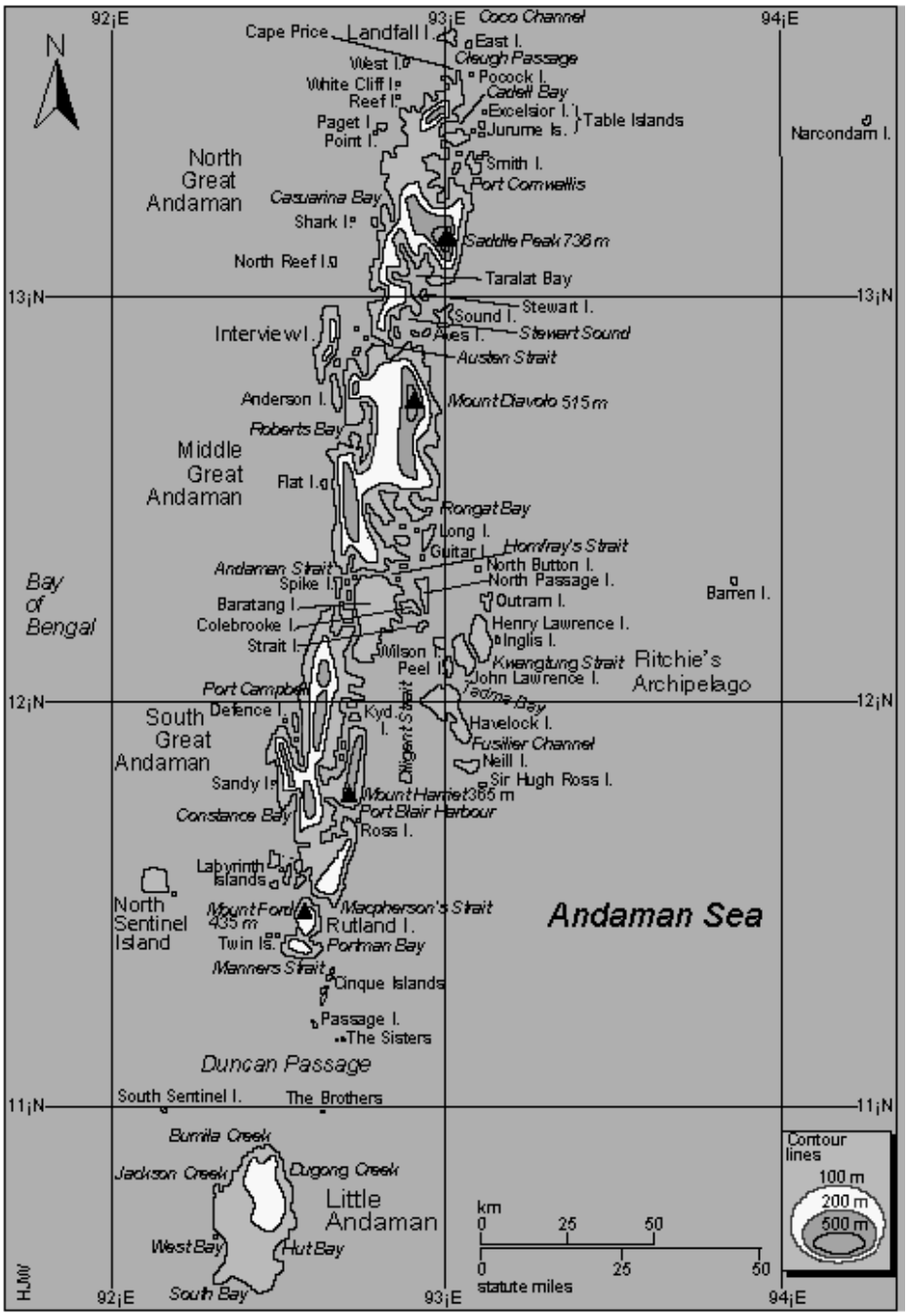


Figure 5.2: The Andaman Islands

Monitoring of re-nesting by individual turtles, frequency of nesting and assessment of nesting populations were carried out by notching and tagging individual turtles. At Cuthbert Bay, Rutland Island and at Galathea in Great Nicobar Island, green turtles, olive ridleys and hawksbills were notched on the edge of the carapace 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 and McDonald, 1994; Andrews *et al.*, 2001). During the 2000–01 and 2001–02 nesting seasons 297 leatherbacks were tagged. During 2001–02, olive ridleys and leatherbacks were also tagged using metal tags as part of another study on conservation genetics (K. Shanker, pers. comm.). 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). Carapace lengths and widths were measured for all turtle species that were 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 2003–04 and 2004–05 season due to lack of permits, 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. 5.2 and Fig. 5.3).

Olive ridleys

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 (Fig. 5.4). During this season 16 dead olive ridleys were 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 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, mainly 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 it is estimated that 296 individuals nested, based on previous studies on renesting intervals which show that olive ridleys nest 2.24 times in a season in the Andamans (Andrews *et al*., 2001).

Monitoring for the 2004- 2005 started during November 2004 and concluded 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. 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 2003–04 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.

At Galathea Beach, Great Nicobar Island, nesting commenced during November 2003 with 18 turtle encounters and 13 nesting, and during December 38 were encountered and 28 nested. Nesting peaked in January 2004 with 106 encounters and 82 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. 5.4a). A total of 255 nests were monitored on Galathea Beach and is estimated that 114 individuals nested during the season.

For the 2004–05 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.

Leatherback turtles

During the 2003–04 season, a total of 23 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 5.4b shows the nesting trend for leatherback turtles at three localities. For the 2004–05 season two leatherbacks were encountered at Cuthbert Bay beach and both nested, one 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. 5.4b). 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, 137 leatherbacks were encountered with 84 nesting.

Green turtles

Figure 5.4c shows low intensity nesting of green turtles at the two monitoring sites during the 2003–04 season. During the 2004–05 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, Inglish Island in the Ritchie's Archipelago was visited and three green turtle hatched nests were found. Two hawksbill turtles 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).

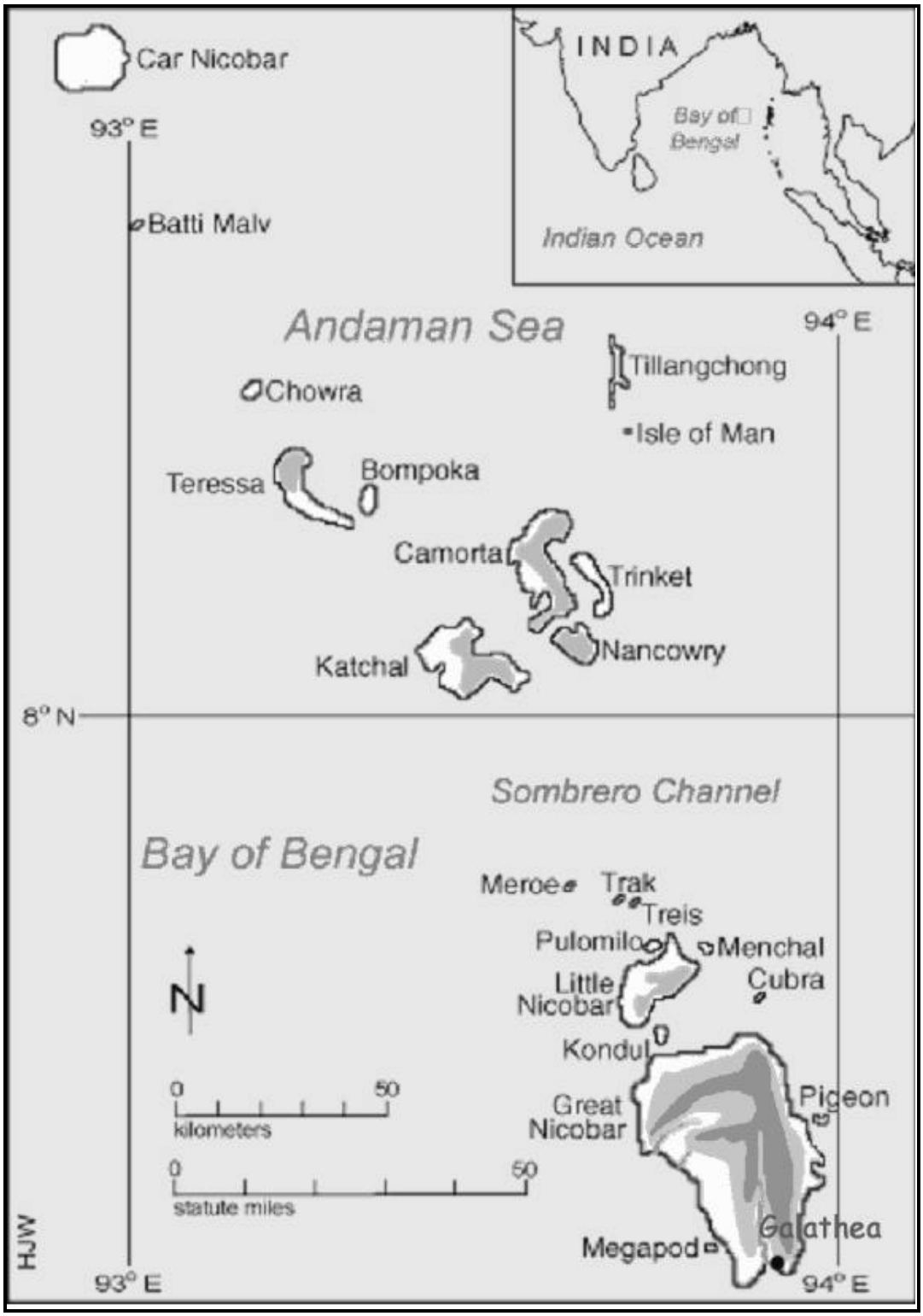
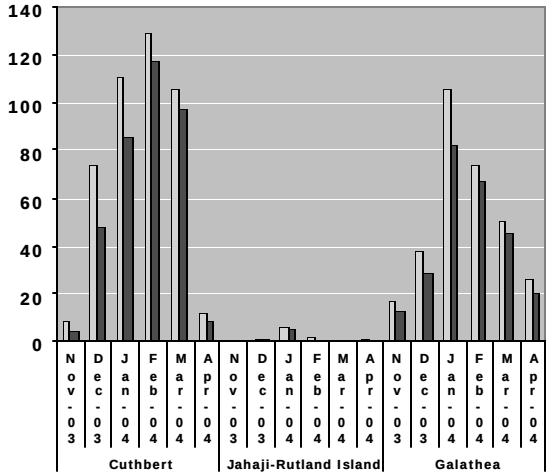
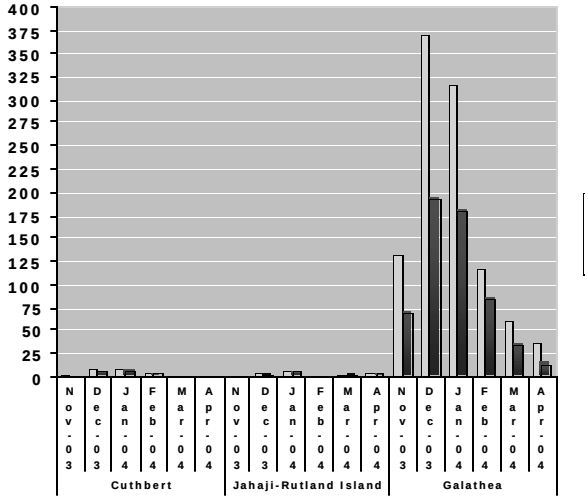


Figure 5.3: The Nicobar Islands

a) Lepidochelys olivacea



b) Dermochelys coriacea



c) Chelonia mydas

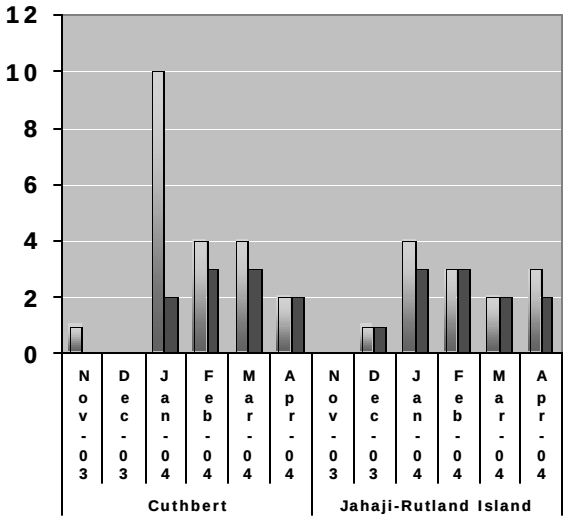


Figure 5.4: Nesting of 3 species at index beaches (light grey – number of turtles encountered; dark grey - number of turtles which nested)

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

Andaman Islands

Following the December 2004 tsunami., an ecological impact assessment was conducted from January 2005- April 2005. Beaches on South Reef, Interview, Snark, Point, Paget, Reef, West, Landfall and East Islands had changed very little. Due to the upheaval of reef flats, turtles could not access the beaches on the islands. The reef flats on the western, southern and eastern side of Lotouche Island had also been 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, were observed on the eastern and southern sides of Snark and West Island. Beaches on the eastern and southern sides of Snark Island had changed very little. Six green turtle nests were found on Snark Island, besides tracks and nest of a hawksbill turtle. Due to the upheaval of reef flats, turtles did 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, had undergone minimal changes; however the beach on the southeastern side had built up. Due to islands and reef flats upheaval sea turtles did not have access to these beaches for nesting and this was evident as no tracks or nests were found on these beaches. Two plastrons of green turtle were found on the west coast and no evidence was available to determine the cause of death. However, there were 22 sightings of green turtles around the island.

Very minor changes occurred to beaches along the western and eastern coasts. Most beaches were swept away partially and high tide reached the forest line; however these beaches are reforming. These beaches include, from the south western side, Foul Bay, Tammi, Yadita and Robert Bay, and 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 were swept away partially as was observed on Flat, Hump and Tuft Islands.

The beaches on the southwest coast and northeastern side of Interview Island had 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 was swept away; however regeneration of small tufts, 3- 4 cms high, was observed, and over 10 green turtles and three hawksbills 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, were also reported. Our observations around South Button suggested intact reefs. Eight green turtle and three olive ridley nests were counted on Middle Button Island. Eleven green turtle and six olive ridley nests were observed on Inglish 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 were all affected. These beaches were all washed away partially and now get submerged during high tide. No evidence of turtle nesting on these beaches was found. But observations and indications are that these beaches are reforming. Two other new beaches formed after the tsunami, one starting at the northern mouth side of Jackson Creek to a length of 5 km; turtle tracks and nests of three species of sea turtles were recorded from this beach, including four green turtle nests, three olive ridley nests and two leatherback nests. Another 2 km long beach has formed and is situated 4 km south of Jackson Creek and nests and track of four nests of green turtles and two olive ridley nests were found on this beach.

Great Nicobar and areas in the central and northern Nicobars

The entire coast and habitat have been completely 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 30 m, had gone inland almost 1.5 km. This has destroyed all the beaches, mangroves and the entire coastal habitat of the South Bay, including the areas around the light house at the southern tip of the island. Currently, debris 10 m high, consisting of fallen trees, plastics, timber and other materials from the sea, drift on to the land area at each high tide. The high tide line reaches the slope forests and 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 are 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. Beaches in 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 along the southeastern coast (at 43 km and at 45.5 km points along the north south road); hawksbill and olive ridley turtles were observed nesting in these two beaches. However these nests would have been 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 leatherback 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 sea 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.

Acknowledgements

We very much appreciate and thank the Convention on the Conservation of Migratory Species of Wild Animals (CMS) for their interest in supporting and funding this all India project. The Andaman and Nicobar Department of Environment and Forests is acknowledged for its support and endorsement. We are grateful to Mr. S. K. Chowdhury, Chief Wildlife Wardens, Mr. Graham Durai, D. C. F., Mr. Thomas, A.C.F HQ, A.C.F., Campbell Bay and Range Officer Saw Robert Pee. Much credit goes to our ANET and the MCBT 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.

REFERENCES

Abraham, C. 1990. Preliminary observation on the nesting of the Olive ridley sea turtle (*Lepidochelys olivacea*) on the Madras coast, South India. Hamadryad. 15: 10-12.

Acharji, M.N. 1950. Edible chelonians and their products. J. Bombay Nat. His. Soc. 49 (3): 529- 532.
Ackerman, R.A. 1980. Physiological and ecological aspects of gas exchange by sea turtle eggs. Am. Zool. 20:575.

Alcock, A. 1902. A Naturalist in Indian Seas. John Murray, Albemarle Street, London.

Ali, R., H.V. Andrews & I. Das. (Eds). 2002. Ecology, Floristics and Socio economics of three National Parks in the Andaman Islands. ANET/ Technical Report- 2002. Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram- 603 104. Tamil Nadu.

Alvarado, J. & T.M. Murphy. 1999. Nesting Periodicity and Internesting Behavior In: *Research and Management Techniques for the Conservation of Sea Turtles*. (Eds. K.L. Eckert., K.A. Bjorndal, F.A. Abreu- Grobois, M. Donnelly), pp. 115-118. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Andrews, H. 2000. Current marine turtle situation in the Andaman and Nicobar Islands – An urgent need for conservation. *Kachhapa* 3: 19-23.

Andrews, H.V. & A.P. Tripathy. 2004. *Status and population dynamics of leatherback sea turtle (Dermochelys coriacea), with observations on other species, around the Andaman and Nicobar Archipelago, India.* Report to Marine Conservation Society, U. K. Centre for Herpetology/Madras Crocodile Bank Trust, Post Bag- 4, Mamallapuram- 603 104, Tamil Nadu, S. India.

Andrews, H.V., S. Krishnan & P. Biswas. 2001. *The status and distribution of marine turtles around the Andaman and Nicobar Archipelago.* GOI-UNDP- National sea turtle project Report. IND/97/964.

Andrews, H.V., S. Krishnan & P. Biswas. 2002. Leatherback nesting in the Andaman and Nicobar Islands. *Kachhapa* 6: 13- 16.

Andrews, H.V., S. Krishnan & P. Biswas. 2006. Distribution and status of marine turtles in the Andaman and Nicobar Islands. In: *K. Shanker and B.C. Choudhury (eds.) Marine turtles of the Indian subcontinent,* pp. 33-57. Universities Press, India.

Andrews, H.V. & K. Shanker. 2002. A significant population of leatherback turtles in the Indian Ocean. *Kachhapa* 6: 19.

Bhaskar, S. & M. Tiwari. 1992. *Andaman and Nicobar Sea Turtle Project. Phase-I. Great Nicobar Island*. Centre for Herpetology, Madras Crocodile Bank Trust, Post bag 4, Mamallapuram, Tamil Nadu- 603 104, India.

Bhaskar, S. 1984. The distribution and status of sea turtles in India. In: *Proceedings of the workshop on sea turtle conservation* (Ed. E.G. Silas), pp. 21-35. CMFRI Special Publication 18.

Bhaskar, S. 1993. *The status and ecology of sea turtles in the Andaman and Nicobar Islands*. ST 1/93. Centre for Herpetology, Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, Tamil Nadu- 603104, India.

Khan, I. H. 1983. Wildlife. In: *Hundred years of forestry in the Andamans, 1883-1983.* pp. 53- 60. Issued on the occasion of the Centenary celebration of the Forest Department, Andaman and Nicobar Islands. Port Blair.

Pande, P., A. Kothari & S. Singh. 1991. *Directory of National Parks and Sanctuaries in the Andaman and Nicobar Islands. Management Status and Profiles.* Indian Institute of Public Administration, New Delhi.

Parmenter, C.J. 1980. Incubation of eggs of the green sea turtle, *Chelonia mydas*, in Torres Strait, Australia: the effect of movement on hatchability. *Australian Wildlife Research* 7: 487-491.

Smith, M.A. 1941. The herpetology of the Andaman and Nicobar Islands. *Proceedings of the Linnean Society of London* 153(1): 150- 158.

Whitaker, R. 1978. Herpetological survey in the Andamans. *Hamadryad* 3(1): 9- 16.

Plate 1. East coast Great Nicobar, South Bay where the Galathea beach used to be.

Plate 2. East coast Great Nicobar, South Bay where the Galathea beach used to be.

Plate 3. West coast Great Nicobar Island

Plate 4. West coast Great Nicobar Island.

ANNEXURE 1

LIST OF POTENTIAL INDEX BEACHES

Name of the Beach	Distance	Primary Monitoring Agency (first year monitored)
GUJARAT		Green turtles and olive ridleys
Mithapur – Sivrajpur, Jamnagar	8	Gujarat Institute of Desert Ecology[1] (2000)
Okhamadhi - Kuranga, Jamnagar	10	Gujarat Institute of Desert Ecology[1](2000)
Navadra-HMM, Jamnagar	14	Gujarat Institute of Desert Ecology[1](2000)
Ratadi– Kuchhadi, Porbandhar	8	Gujarat Institute of Desert Ecology[1](2000)
Navibandar- Ratiya, Porbandhar	5	Gujarat Institute of Desert Ecology[1](2000)
Madavpur, Porbandhar	Unknown	Gujarat State Forest Department (Hatchery)
Shil – Bara, Jundagadh	15	Gujarat Institute of Desert Ecology[1](2000)
Mandvi, Kachchh	Unknown	Gujarat State Forest Department (Hatchery)
MAHARASHTRA		Olive ridleys
Harihareshwar, Raigad	4	Sahyadri Nisarga Mitra[2](2004)
Diveagar, Raigad	3	Sahyadri Mitra(2004)
Velas, Ratnagiri	4	Sahyadri Nisarga Mitra[2](2003)
Kelashi, Ratnagiri	3	Sahyadri Nisarga Mitra[2](2004)
Kolthare, Ratnagiri	2	Sahyadri Nisarga Mitra[2](2004)
Dabhol, Ratnagiri	2	Sahyadri Nisarga Mitra[2](2004)
GOA		Olive ridleys
Morjim	Unknown	Goa State Forest Department (Hatchery) (1997)
Agonda	Unknown	Goa State Forest Department (Hatchery) (1999)
Galgibaga	Unknown	Goa State Forest Department (Hatchery) (2000)
KERALA		Olive ridleys
Kolavippalam, Kozhikode	6	Theeram Nature Conservation Society (1996)
Thaikadappuram, Kasargode	10	Naythal (2002)
TAMIL NADU		Olive ridleys
Chennai (Adyar – Nilankarai)	7	Students' Sea Turtle Conservation Network (1974)[4]
Chennai (Nilankarai – Uthandi)	10	TREE Foundation (2001)
Pondicherry	10	Salim Ali Centre for Ornithology and Natural History[1]
Nagapattinam	10	Salim Ali Centre for Ornithology and Natural History[1]
ANDAMAN AND NICOBAR ISLANDS		Olive ridleys, Green turtles, Leatherback turtles
Cuthbert Bay, Andamans	6	ANET + A&N Forest Department[3] (2000)
Ramnagar beach, Andamans		A&N Forest Department (1988)
Jahaji, Rutland Island, Andamans	4.5	Andaman and Nicobar Environmental Team[1] (2000)
West Bay, Little Andamans	6	Andaman and Nicobar Environmental Team[1] (2000)

1 – as part of GOI-UNDP and UNEP-CMS-IOSEA sea turtle projects in 2000-01 and 2003-05
2 – with inputs from Bombay Natural History Society in 2000-01 and 2003-05.
3 – with inputs from Andaman and Nicobar Environmental Team
4 – monitoring by various agencies till SSTCN started programme in 1988

ANNEXURE 2

LIST OF NON GOVERNMENT ORGANISATIONS IN GUJARAT, MAHARASHTRA, GOA, KERALA AND TAMIL NADU

Name of the Group	Contact person and details	Involvement in sea turtle conservation
GUJARAT		
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.	Involved in UNEP/CMS-IOSEA project in 2004
Amateur Rangers Nature Club Mithapur – Okha.	Mr. Satish H. Trivedi E-1, New Merchant Colony Mithapur 361 345 Dist: Jamnagar, Phone: 02892-223489, MB: 9824169937 E-mail: mcafuser@tatachemicals.com	Involved in UNEP/CMS-IOSEA project in 2004
Okha-Mandal Pariyavaran Vikas Trust - NGO	Mr. Shivbha K. Subhaniya Mr. Devisingh. S. Manek P.O Varwala – 361 335 Taluka- Dwarka Okhamandal District Jamnagar	Involved in UNEP/CMS-IOSEA project in 2004
Kachba Unchar Kendra – Madhavpur	Mr. Praveen M. Solanki Kachba Unchar Kendra, Madhavpur village, Post - Sheel, Porbandar. Phone: (0286) 2272560	Involved in UNEP/CMS-IOSEA project in 2004
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: amitjethava@rediffmail.com	Involved in UNEP/CMS-IOSEA project in 2004
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 Email: rajnipatwa@yahoo.com	Involved in UNEP/CMS-IOSEA project in 2004
MAHARASHTRA		
Sahyadri Nisarga Mitra (SNM)	Mr. Bhau Katdare Near Lakshminarayan Temple Chiplun, District Ratnagiri Maharashtra 415605. Email: sahyadricpn@rediffmail.com	Involved in sea turtle conservation from 2002
GOA		
Green Cross	Miss Dearlyn Fernandes "Alleluia"	Involved in sea turtle conservation from 2003

	26/ 7 Viegas Vaddo, Opp. Sukha's Garage Arpora, Bardez, Goa 403518	
KERALA		
Thanal Conservation Action and Information Network	C. Jayakumar Post Box No. 815, Kawdiar, Thiruvananthapuram – 695 003.	Involved in GOI UNDP Sea turtle project in 2000-01
Theeram Nature Conservation Society	M.T. Suresh Babu, President Kolavippalam, Payyoli Gram Panchayat, Quilandi Taluka, Kozhikode, Kerala.	Involved in sea turtle conservation from 1996
Naythal	P. V. Sudheer Kumar/ K Radhakrishnan Nair Naythal, Thaikadappuram (Po), Nileshwar (Via), Kasaragod – 671 314, Kerala.	Involved in sea turtle conservation from 2002
TAMIL NADU		
Students' Sea Turtle Conservation Network (SSTCN), Chennai	V. Arun/ B. Maheshwaran, Co-ordinators Adyar, Chennai, Tamil Nadu.	Involved in sea turtle conservation from 1988
Trust for Environmental Education (TREE) Foundation, Chennai	Supraja Dharini No. 63, First Avenue, Vetuvankeni, Chennai, Tamil Nadu 600041. Email: treefoundation2002@yahoo.com	Involved in sea turtle conservation from 2001
Madras Crocodile Bank Trust (MCBT)	Harry V. Andrews Postbag 4, Mamallapuram Tamil Nadu 603104. India. Email: mcbtindia@vsnl.net	Involved in sea turtle conservation from 1978
Students' Sea Turtle Network (SSTN), Tranquebar	A.S. Paul Ravindran Zoology Department TBML College, Poraiyar, Nagapattinam District, Tamil Nadu- 609 307.	Involved in UNEP/CMS-IOSEA project in 2004
Students' Sea Turtle Network (SSTN), Poompuhar	J. Gokulakrishnan, Co-ordinator Poompuhar Vanagiri (PO), Poompuhar, Nagapattinam - Tamil Nadu.	Involved in UNEP/CMS-IOSEA project in 2004

AFFILIATIONS

Harry V. Andrews
Centre for Herpetology/Madras Crocodile Bank Trust
Postbag 4, Mamallapuram
Tamil Nadu 603104. India.
Email: mcbtindia@vsnl.net

Kartik Shanker
Ashoka Trust for Research in Ecology and the Environment
659, 5th A Main Road, Hebbal
Bangalore 560024. India

Currently:
Centre for Ecological Sciences
Indian Institute of Science
Bangalore 560012. India.
Email: kshanker@ces.iisc.ernet.in

S. Bhupathy, M. Vijay, A.M.A. Nixon, R. Karunakaran and J. Gokulakrishnan
Salim Ali Centre for Ornithology and Natural History
Anaikatty P.O.
Coimbatore 641008. India.
Email: sb62in@yahoo.co.uk

J. Subramanean
Pondicherry University,
R.Venkataraman Nagar, Kalapet
Pondicherry 605014. India.
Email: subbu_97@sify.com

Sunderraj S.F.W., J. Joshua, L. Brahmbhatt, A. Saravanakumar, B. Muthuraman and S.K. Das
Gujarat Institute of Desert Ecology
P.O.Box: 83, Oppt Changleshwar Temple
Mundra Road,
Bhuj 370001. Kachchh, Gujarat. India.
Email: wesley.s@rediffmail.com

Varad Giri
Bombay Natural History Society
Hornbill House
Dr. Sálim Ali Chowk
Shaheed Bhagat Singh Road
Mumbai 400023. Maharashtra. India.
Email: varadgiri@gmail.com

A. Tripathy, S. Aghue, S. Glen, S. John and K. Naveen
Andaman and Nicobar Islands Environmental Team
Centre for Herpetology/Madras Crocodile Bank Trust
Postbag 4, Mamallapuram
Tamil Nadu 603104. India.

PROJECT PARTNERS

Bombay Natural History Society (BNHS)
Hornbill House
Dr. Sálim Ali Chowk
Shaheed Bhagat Singh Road
Mumbai 400023
Maharashtra. India.

Phone: +91 22 22821811
Fax: +91 22 22837615
Email: bnhs@bom4.vsnl.net.in
Website: www.bnhs.org

Centre for Herpetology/Madras Crocodile Bank Trust (MCBT)
Postbag 4, Mamallapuram
Tamil Nadu 603104. India.

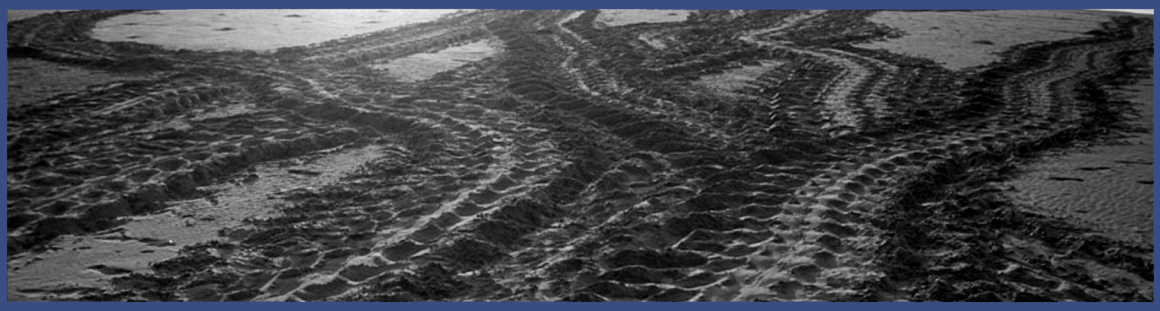
Phone: +91 44 27472447
Fax: +91 44 27472958
Email: mcbtindia@vsnl.net
Website: www.madrascrocodilebank.org

Gujarat Institute of Desert Ecology (GUIDE)
P.O.Box: 83, Oppt Changleshwar Temple
Mundra Road, Bhuj 370001
Kachchh, Gujarat. India.

Phone: +91 2832 232160/232161/232162
Fax: +91 832 232162
Email: desert_ecology@yahoo.com

Salim Ali Centre for Ornithology and Natural History (SACON)
Anaikatty Post
Coimbatore 641108
Tamil Nadu. India.

Phone: +91 422 2657101-105
Fax: +91 422 2657088
Email: salimali@vsnl.com
Website: www.saconindia.org



Project Partners

Bombay Natural History Society, Mumbai

Centre for Herpetology
Madras Crocodile Bank Trust, Tamil Nadu

Gujarat Institute of Desert Ecology, Bhuj

Salim Ali Centre for Ornithology
and Natural History, Coimbatore

Project Coordinator

Centre for Herpetology/Madras Crocodile Bank Trust, Tamil Nadu

Funded by

Convention On The Conservation Of Migratory Species Of Wild Animals (CMS)