Part 1

INTRODUCTION
India has a coastline of ~8,000 km, including the mainland coast and the coasts of the offshore islands of Andaman and Nicobar and Lakshadweep. Four species of marine turtles, including the olive ridley turtle (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*) and hawksbill turtle (*Eretmochelys imbricata*), nest on Indian coasts and are found in Indian territorial waters (for an early review, see Kar and Bhaskar 1982, Bhaskar 1981, 1984). There are a few reports of loggerhead turtles (*Caretta caretta*) from Indian waters, though no known nesting beaches have been discovered; loggerheads, however, do nest in small numbers in Sri Lanka (Tripathy 2005).

Olive ridleys nest on both east and west coasts of the Indian mainland (including the offshore islands), as well as on the coasts of Sri Lanka, Bangladesh and Pakistan (Biswas 1982, Kar and Bhaskar 1982). The olive ridley population in Orissa is of obvious global significance—it is one the major mass-nesting rookeries in the world, the others being La Escobilla in Mexico, and Playa Ostional and Playa Nancite in Costa Rica (Pritchard 1997). Furthermore, recent studies have indicated the uniqueness of the Indian olive ridley population in comparison to other global populations (Shanker et al 2004a). These turtles may have served as an evolutionary source for the re-colonisation of ridleys in the Pacific and Atlantic oceans, after the extirpation of populations in those basins (Shanker et al 2004a). Several thousand ridleys may also nest in Andhra Pradesh (Tripathy et al 2003), Tamil Nadu (Bhupathy and Saravanan 2002) and the Andaman and Nicobar Islands (Andrews et al 2001).

Large leatherback populations are currently restricted to the islands of Great Nicobar and Little Nicobar; a few turtles nest in the Andamans (Andrews et al 2001) and in
Sri Lanka (Ekanayake et al 2001). Given the recent decline of Pacific leatherbacks, the Indian Ocean populations assume greater significance, especially the ones in the Nicobars (Andrews and Shanker 2002) and Sri Lanka (Ekanayake et al 2002).

Green turtles nest in Pakistan and Gujarat on the west coast, and also in the Lakshadweep archipelago, the Andaman and Nicobar Islands, and in Sri Lanka (Kar and Bhaskar 1982). Hawksbills nest in large numbers only in the Andamans, but some nesting occurs in the Nicobars, Lakshadweep and Sri Lanka (Kar and Bhaskar 1982). In the subcontinent, the only nesting grounds for loggerheads are in Sri Lanka. Major marine 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, and in the Andaman and Nicobar Islands.

The subcontinent is clearly an important region for marine turtles. However, these turtles are under severe threat from fishery-related mortality, depredation of eggs and other threats related to development. Despite decades of research at some sites, the data is not standardised and is difficult to interpret (Shanker et al 2004b). For many other sites, information derives from surveys done more than twenty years ago, or there is no information at all. Most of these early surveys were carried out by Satish Bhaskar for the Madras Crocodile Bank Trust (see Kar and Bhaskar 1982, Bhaskar 1984, Whitaker, this volume, Chapter 2). The GOI–UNDP surveys during 2000–02 were carried out to bridge this gap in information and to provide an update on the status and threats to marine turtles in the Indian subcontinent (see Sharma, this volume, Chapter 3).

In this book, the chapters in Parts 2 and 3 examine the status and threats to marine turtles in India—in the coastal states of the Indian mainland and the offshore islands of Lakshadweep and Andaman and Nicobar. To provide a complete picture for South Asia, the following section reviews the marine turtles of Pakistan, Bangladesh and Sri Lanka. This is followed by a closer examination of fishery-related issues, including causes and effects, and potential solutions such as turtle excluder devices. We then examine conservation programmes and legal issues; reviews of community-based conservation and legislation that were carried out under the GOI–UNDP project, followed by a chapter on international instruments for marine turtle conservation. In the final section, we present some recent research that serves to enhance our understanding of the biology and conservation of these species.

Before Research and Conservation

There are relatively few historic records of any interaction between humans and turtles in the subcontinent, though there are some pre-Christian accounts of trade in tortoiseshell from India and Sri Lanka (Frazier 2003, de Silva, this volume, chapter 15). A Tamil poem from the fourth century AD describes the nesting of a marine turtle (Sanjeeva Raj 1958). In the eighteenth century, the captain of a ship writes of thousands of turtles on the Balasore coast of Orissa (Hamilton 1727, c.f. Mohanty-Hejmadi 2000). There are also nineteenth-century records from the Andaman and Nicobar Islands, of the harvesting of turtles by the indigenous people of the islands and the British administrators (see Andrews et al, this volume, Chapter 4).
Adult marine turtles were not harmed in most parts of the Indian subcontinent. For Hindus, a religious belief states that turtles are an incarnation (the *kurma avatar*) of Vishnu, one of the gods of the Hindu trinity. There is a temple (*Sri Kurmanadha Devasthanam*) at Srikurman in Andhra Pradesh, on the east coast of India, where the idol of a turtle is worshipped (see Chapter 6). Muslims in the subcontinent generally do not eat turtles; Islamic custom forbids the consumption of certain animals, considered *haram* or unclean. While turtles are not strictly *haram*, they may fall into one or another of the interim categories (e.g. *makrooh* – religiously disliked but not forbidden). This ambiguity in the classification of marine turtles may have resulted in a certain degree of protection amongst local Muslims. Christians and ethnic tribal communities do eat turtle meat and eggs. However, in many areas where turtles eggs were exploited, a few eggs (between 2–5) would be left in the nest to ensure the perpetuation of the species (Madhyastha 1986, Pandav et al 1994, Giri 2001, pers. obs.).

Despite the absence of records, marine turtles were well known along the coast of India. Reports have been kept of their occurrence by early maritime visitors, particularly along the Kerala, Gujarat and Orissa coasts (Hamilton 1727, Mannadiar 1977). There are also species records in ZSI and CMFRI archives, and the district gazettes of various states along the west and east coasts, with special reference to trade in hawksbill, green and olive ridley turtles (Annandale 1915, Gardiner 1903 and 1906, Greaves 1933, Chari 1964, Shanmugasundaram 1968, Santharam 1975, Mannadiar 1977, Dutt 1979, Das 1984, Anon 1991).

Most early accounts deal with chelonians in the context of their consumptive value (Acharji 1950, Murthy and Menon 1976, Murthy 1981). In Orissa, the locals exploited turtle eggs, which were collected in boatloads (Dash and Kar 1987). Though marine turtles were killed at many sites, the two main centres of the turtle trade were the Gulf of Mannar (*Kuriyan 1950*) and Orissa (Dash and Kar 1990). In the Gulf of Mannar, green turtles were taken in large numbers on both sides—the Sri Lankan as well as the Tamil coasts (Jones and Fernando 1968). The estimate is that four to six thousand turtles were taken annually in the late 1960s in southern Tamil Nadu, with about three quarter of these being green turtles.

In Orissa, *Kanika* was under a zamindari during the British period, which levied a revenue (called *andakara*) for the collection of eggs from the Gahirnatha mass-nesting beaches. In 1957, the management was transferred to *Anchal Sasan* of the state’s revenue department. The forest department of Orissa then issued licenses for the collection of eggs, at the rate of Rs. 15 per boatload of eggs, each boat containing roughly between 35,000 to 100,000 eggs (Dash and Kar 1987, Kar 1988). Eggs were sold in all the riverside villages where they were either consumed by poorer communities or transported to Kolkata (formerly Calcutta). Locally, turtle eggs were preserved in large quantities by sun-drying and also used as cattle-feed. The estimated legal take in the 1973 season was 150,000 eggs (FAO 1974), but the actual illegal take was probably much more (Dash and Kar 1987). The Orissa forest department stopped issuing licenses after the 1974–75 nesting season; in 1976, marine turtles were placed in Schedule 1 of the Indian Wildlife (Protection) Act, 1972.
Prior to the 1970s, there was no organised turtle fishery in Orissa. But whenever adult marine turtles were found alive in fishing nets, they were collected and transported to nearby railway stations, from where they were booked to Kolkata. Live turtles were booked almost everyday to Kolkata from Puri, Bhubaneswar, Maltipatpur and almost all the coastal railway stations of Orissa. Turtles were often booked as fishery products, so the magnitude of this trade is difficult to assess (Kar 1988, Dash and Kar 1990). Biswas (1982) reports that over 6,000 turtles were dispatched from Puri during three months in 1974–75. He also reports that 21,000 turtles were despatched to Kolkata from Digha, in three months in 1978–79. Many accounts report an annual catch of ~50,000 turtles from the Orissa and West Bengal coasts, till about 1980 (see Silas et al 1983a and b, Kar and Dash 1984, Das 1985). Obviously, the increase in adult take was due to the introduction of mechanised fishing in the ’70s. The launch of a massive protection programme in Orissa—involving the navy and coast guard, and state law-enforcing agencies like the forest, fisheries and police departments—led to the collapse of this illegal trade in marine turtles in 1984–85 (Kar and Dash 1984).

**Marine Turtle Surveys and Research**

**INITIAL SURVEYS**

Surveys and documentation of marine turtles in India began at two sites, namely Gahirmatha in Orissa, and Chennai (formerly Madras) in Tamil Nadu. The mass-nesting of turtles in Orissa was first reported in 1973, by J C Daniel and S A Hussain of the Bombay Natural History Society, but was confirmed and announced to the scientific world at large by H R Bustard, an FAO consultant, following a survey on crocodiles in the region (Bustard 1974, FAO 1976). Following this, a research programme was established and monitoring was initiated (see Dash and Kar 1984, Dash and Kar 1990). This led to the discovery of other mass-nesting sites in Devi river mouth (Kar 1982) and in Rushikulya (Pandav et al 1994). Subsequently, the Orissa coast was monitored by the Orissa forest department and the Wildlife Institute of India (Pandav 2000).

In Chennai, monitoring of status and threats (and hatchery programmes for conservation) were initiated by the Madras Snake Park Trust (Valliapan and Whitaker 1974). Satish Bhaskar, who was a part of this group, would survey much of the Indian coast over the next few years—including Gujarat (Bhaskar 1978, 1984), Lakshadweep (Bhaskar 1979a, 1984), the Andaman and Nicobar Islands (Bhaskar 1979b), Goa, Andhra Pradesh and Kerala (Bhaskar 1984) (see also Whitaker, Chapter 2). His extensive surveys in the Andaman and Nicobar Islands provide a wealth of information for the region (see Andrews et al, Chapter 4). Marine turtle monitoring in Chennai has been nearly continuous over the last thirty years, thanks to the efforts of the Madras Snake Park Trust (1973–76), Central Marine Fisheries Research Institute (1977–81), the Tamil Nadu forest department (1982–87) and the Students’ Sea Turtle Conservation Network (1988–present) (Shanker 1995, 2003). Surveys were also carried out in Andhra Pradesh (Raja Sekhar and Subba Rao 1987, Priyadarshini 1998), Karnataka (Madyastha et al 1985), Gujarat and Karnataka (Frazier 1989a, 1989b).

A picture emerges here of extensive surveys of the entire coastline by Bhaskar in the late
’70s and ’80s, followed by his detailed surveys in the Andaman and Nicobar Islands in the ’90s. After this, efforts are fragmented, barring the long-term monitoring programmes in Orissa and Chennai on the east coast. This serves as the backdrop for the detailed surveys carried out under the GOI–UNDP project between 2000–03. Currently, monitoring is continuing in many states—under the auspices of a project funded by the Convention on the Conservation of Migratory Species—including Gujarat (Gujarat Institute of Desert Ecology), Maharashtra and Goa (Bombay Natural History Society) and Tamil Nadu and Kerala (Salim Ali Centre for Ornithology and Natural History). The Andaman and Nicobar Environmental Team has been monitoring the nesting beach at Galathea in Great Nicobar Island from 2001. Thus the GOI–UNDP project provided a significant fillip to marine turtle monitoring throughout the country.

AN OVERVIEW OF RESEARCH

H R Bustard initiated research programmes in Orissa with several forest officers, most notably C S Kar, who worked for his PhD thesis on the olive ridleys of Gahirmatha (Kar 1988). Kar tagged more than 10,000 nesting turtles between 1975–80 and carried out extensive research, summarised in Dash and Kar (1990). The Orissa forest department continued its research and monitoring programme at Gahirmatha. Rajasekhar (1987) also submitted a doctoral thesis on marine turtles in Andhra Pradesh. Several research programmes were initiated during the ’90s, notably the Wildlife Institute of India’s programme in Orissa, which led to the discovery of the mass-nesting site at Rushikulya (Pandav et al 1994). The programme carried out extensive tagging of mating pairs (for the first time in India) and nesting turtles on the coast of India (Pandav 2000). Pandav (2000) conducted research in Orissa, on offshore distributions, nesting and other aspects of reproductive biology, tagging over 1,500 mating pairs and 10,000 nesting turtles. The programme also documented a rapid increase in fishery-related mortality of ridleys in Orissa (Pandav et al 1998, Pandav and Choudhury 1999), leading to a number of NGO campaigns and increase in media interest in olive ridleys. Ram (2000) and Tripathy (2004) studied offshore distributions of mating turtles in Gahirmatha and Rushikulya, respectively.

In the ’80s, research was initiated at Utkal University, Orissa on temperature sex determination in olive ridley turtles and on other aspects of their biology (Dimond and Mohanty–Hejmadi 1983, Mohanty–Hejmadi et al 1984, 1989, Sahoo et al 1996, 1998). At around the same, the Central Marine Fisheries Research Institute initiated studies in Orissa and Chennai (Silas et al 1983a, 1983b, 1985, see papers in Silas 1984). Rajagopalan (1989) completed his PhD thesis on eco-physiological studies on marine turtles, and his students have recently completed their PhD theses on marine turtles as well (Kannan 2004, Venkatesan 2004).

Little is also known about the migratory paths followed by the marine turtles that nest in Orissa, though anecdotal accounts (Oliver 1946, Deraniyagala 1953, Whitaker and Kar 1984) suggest that large numbers of turtles have been seen migrating together along the east coast of India. As an activity of the GOI–UNDP Sea Turtle Project, the Wildlife Institute of India, the Orissa forest department and the Smithsonian Institution, Washington DC collaborated to attach satellite transmitters on four female olive ridleys
in Orissa in April 2001. One of these turtles migrated to Sri Lanka over the course of the next four months, while the others remained in the offshore waters of Orissa (for a map, see http://www.wii.gov.in/webs/satindex.html).

Most recently, studies have been initiated on the molecular genetics of marine turtles along the mainland coast and islands of India. Olive ridleys on the east coast of India appear to be genetically distinct from other global populations, and even differ significantly from the adjacent population in Sri Lanka (Shanker et al 2004a). Shanker et al (2004a) also propose that the Indian olive ridley and the Kemp’s ridley (*Lepidochelys kempi*) could be remnants of a global population which was otherwise extirpated following climatic changes prior to and after the closure of the Isthmus of Panama. Thus, the Indian Ocean region, and in particular the distinct Indian population, may have served as a source for ridley re-colonisations following the extirpation of populations in other ocean basins.

**Marine Turtle Conservation in India**

Along with the monitoring programmes, marine turtle conservation was also initiated in Orissa and Chennai in the early ’70s. While the Orissa programme was coordinated by the forest department, the turtle hatcheries in Chennai were at first operated by the Madras Snake Park, and later by the CMFRI and the 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. Many programmes like THEERAM in Kolavipaalam (Kerala), the Students’ Sea Turtle Conservation Network, Chennai and Green Mercy and Dolphin Nature Club, Visakhapatnam have beach protection programmes as well as hatcheries for the protection of marine turtles. More importantly, these programmes have served as powerful tools of education, spreading awareness about marine turtles and coastal conservation. In Chennai, 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 group of young fisher folk (Kutty 2002).

Similar programmes have sprung up all along the coast, including Goa, where 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). TREE organises youth from fishing villages into turtle protection units for *in situ* protection of nests near their villages (Dharini 2003). The Madras Crocodile Bank Trust conducts mobile exhibitions into fishing villages on weekends.

Marine turtle conservation in Orissa has a storied past, beginning in the early ’70s when the large-scale legal / incidental take of turtles from Gahirmatha was widely reported (Davis and Bedi 1978, see also Frazier 1980). In the early ’80s, numerous petitions and letter-writing campaigns were supported and endorsed through the *Marine Turtle*
Newsletter, an international newsletter (Mrosovsky et al 1982); several hundred letters were written to then prime minister, Indira Gandhi (Mrosovsky 1983).

J Vijaya, a young and adventurous field biologist, conducted field surveys in the early ’80s and reported large numbers of turtles being sold in fish markets near Kolkata (Vijaya 1982, Moll et al 1983). This, along with her photographs of hundreds of turtle carcasses (published in India Today, see Bobb 1982), brought even more attention to the extraordinary numbers of turtles being killed in Orissa. Prime Minister Gandhi’s support and her initiative to involve the coast guard in protecting the marine area at Gahirmatha helped drastically reduce direct take to a point where it was thought to be negligible.

However, even then, incidental mortality was considered a major threat by E G Silas, then director of the Central Marine Fisheries Research Institute (Silas 1984). Incidental mortality was reported through the ’80s (James et al 1989), and in the 1990s, Bivash Pandav of the Wildlife Institute of India, Dehradun reported thousands of stranded carcasses in Gahirmatha and other neighbouring beaches, which he attributed to high incidental mortality in offshore trawling. He advised immediate remedial action (Pandav and Choudhury 1999, Pandav 2000).

Other conservation programmes were launched during this period, most notably Operation Kachhapa in Orissa, which is a collaboration between government and non-government organisations to protect marine turtles on the Orissa coast, particularly with a view to reducing trawler-related mortality (Shanker and Mohanty 1999, Wright and Mohanty, Chapter 23). In 2000, the Annual Symposium of Sea Turtle Biology and Conservation in Orissa passed two resolutions on this issue: the ‘urgent need to review coastal development plans in order to conserve olive ridley marine turtles as well as critical nesting habitat [sic] for the turtles and other endangered species on the Orissa coast, India,’ and the ‘urgent need to reduce trawling-related mortality of olive ridley marine turtles on the Orissa coast, India.’ (Anon. 2000).

All told, there has been a tremendous amount of attention focussed on the olive ridleys in Orissa, both nationally and internationally. Towards the end of 2004, traditional fishworkers, local conservation groups and national conservation agencies came together at the Orissa Marine Resources Conservation Consortium to pursue common objectives for the conservation of marine resources, including marine turtles, while promoting the livelihoods of the fishing communities (Aleya 2004).

ON THE SUBCONTINENT

By sheer size, India tends to dominate the subcontinent, but there are significant marine turtle populations in the other countries, and the contribution of these conservation programmes has made a great impact. In Pakistan, the Sindh wildlife department has been monitoring green turtles and olive ridleys for over two decades at Hawksbay and Sandspit (on the Karachi coast), a 20-km stretch of beach (Kabraji and Firdous 1984). There is believed to be a decline in nesting, particularly of olive ridley turtles (Asrar 1999). Surveys have provided some information of the Balochistan coast (Groombridge et al 1998, Groombridge 1989) and more information has been forthcoming in recent years (see Qureshi, Chapter 17)
The majority of Sri Lanka’s population are Sinhalese Buddhists who neither eat turtles nor their eggs. However, the Sinhalese Christians and Tamils in northern Sri Lanka have been involved in the exploitation of turtles for generations; the Tamils in Jaffna are accomplished turtle-catchers and use(d) a variety of nets to capture marine turtles (Frazier 1980, Hewavisenthi 1990). Recently, many marine turtle hatcheries have been set up all over Sri Lanka, mainly for tourism. Poor management practices (such as retention of hatchlings in tanks) and low hatching success of translocated eggs, means that these hatcheries may also be detrimental to marine turtle populations (Amarasooriya 1996, Hewavisenthi 1993). Dattari and Samarajiva (1982) carried out early surveys in the region. More recently, the Turtle Conservation Project (TCP) has been active in conducting surveys of nesting and incidental catch, and has also initiated conservation programmes at many sites (See Kapurusinghe, Chapter 14). TCP strongly promotes community-based conservation, involving local communities as nest protectors.

In Bangladesh, data indicates far higher nesting densities in the past, which is consistent with the high levels of exploitation reported in this region (Islam 2001, Islam 2002). While most Bangladeshis (90 per cent) are Muslim and will not consume turtles or turtle products, they will trade in meat, eggs and turtle carapaces to other communities in Bangladesh, India and Myanmar (Islam 2001). Das (1989) reports that the Bangladeshis traded meat for rice with the Burmese. In Bangladesh, marine turtle conservation has centred around St. Martin’s Island (see Rashid and Islam, Chapter 16)

**Conclusion**

The degree of similarity between the threats to marine turtles discussed at the CMFRI workshop in 1984 and major threats to marine turtles today is not an encouraging sign. Fishery-related mortality, predation of eggs, beach erosion, development and *Casuarina* plantations were all emphasised then, and remain threats even today, some more so than before. Despite twenty years of research and conservation efforts, none of these threats has been mitigated. On the other hand, the number of agencies, individuals and government sectors that are currently interested and involved in marine turtle conservation is greatly encouraging. There are small conservation programmes all around the country. Within the government, the Ministries of Commerce and Agriculture have become involved in marine turtle conservation. Organisations such as the Central Institute of Fisheries Technology and Marine Products Export Development Authority and several state fisheries agencies are involved in developing and promoting turtle excluder devices. Nearly all state forest departments run marine turtle hatcheries or support small non government organisations. The coast guard has been interested and involved in turtle conservation in many states, particularly in Orissa, where they have been active since the early ’80s. The GOI–UNDP project involved numerous partners in coastal states around the country who continue to be active participants in marine turtle monitoring and conservation.

There is, however, still a clear gap between intent and success. Despite the interest and involvement of diverse stakeholders, things have not improved for marine turtles. There is clearly a need for dialogue, cooperation and coordination between agencies, both within the government, and between government and non government agencies. The
participatory approach to management has been greatly stressed in recent times and this includes networking and involvement of multiple stakeholders. Another important issue would be the economic concerns of stakeholders, particularly local communities. Responsible marine fisheries are required, and not merely from the point of view of marine turtle conservation.

We hope that after the decades that witnessed the birth of research, conservation and NGO participation, this will be the decade of partnership and collaboration, of consensual action between diverse stakeholders, towards the common objective of marine turtle conservation on the Indian subcontinent.

**Literature Cited**


Hamilton, A. 1727. *A new account of the East Indies (Volume I).* Edinburgh: printed by John Mosman (One of His Majesty’s Printers) and sold at the King’s Printing House in Craig’s Clof MDCCXXVII.


