Nature Watch

The Odyssey of the Olive Ridley

Kartik Shanker

Kartik Shanker was involved with the conservation of the olive ridley with the Students Sea Turtle Conservation Network (SSTCN) in Chennai. Thereafter, he spent two years in the Upper Nilgiris studying small mammal and herpetofaunal communities, a subject in which he hopes to acquire a PhD in the near future.

Ridleys are unique amongst sea turtles in exhibiting mass-nesting, when several thousand turtles migrate en masse to their nesting ground to mate and nest simultaneously. Gahirmatha, in Orissa, has the largest sea turtle rookery in the world, with 100,000 to 500,000 turtles nesting there in most years. Mass mortality and fragmentation of the beach led to the failure of the arribada in 1997 and 1998, but more than 200,000 turtles nested on the 2 km long island in Gahirmatha in March, 1999. Despite the occurrence of the arribada, the outlook for the turtles is bleak since 10000 turtles were drowned as incidental catch in shrimp trawling operations. Over 40,000 turtles have been washed ashore dead since 1994 as a result of drowning in trawl fishing nets. The implementation of existing laws preventing mechanised fishing in near-shore waters and the mandatory use of turtle excluder devices on trawlers would substantially reduce mortality. The consolidation of current conservation efforts is necessary to ensure that this species does not disappear from Indian waters in the near future.

Ten Thousand at a Glance

Marine turtles have fascinated scientists and naturalists for many years. Their extraordinary transoceanic migrations, their ability to instinctively locate their nesting grounds when they mature, the diving abilities of leatherbacks, the underwater hibernation of loggerheads, all these have riveted the attention of biologists. However, even amongst turtles, two species are unique in displaying one of the most spectacular reproductive phenomena, the mass nesting or arribada. Of the seven or eight species of sea turtles (depending on whether the East Pacific black turtle is considered a sub-species of green turtle), two

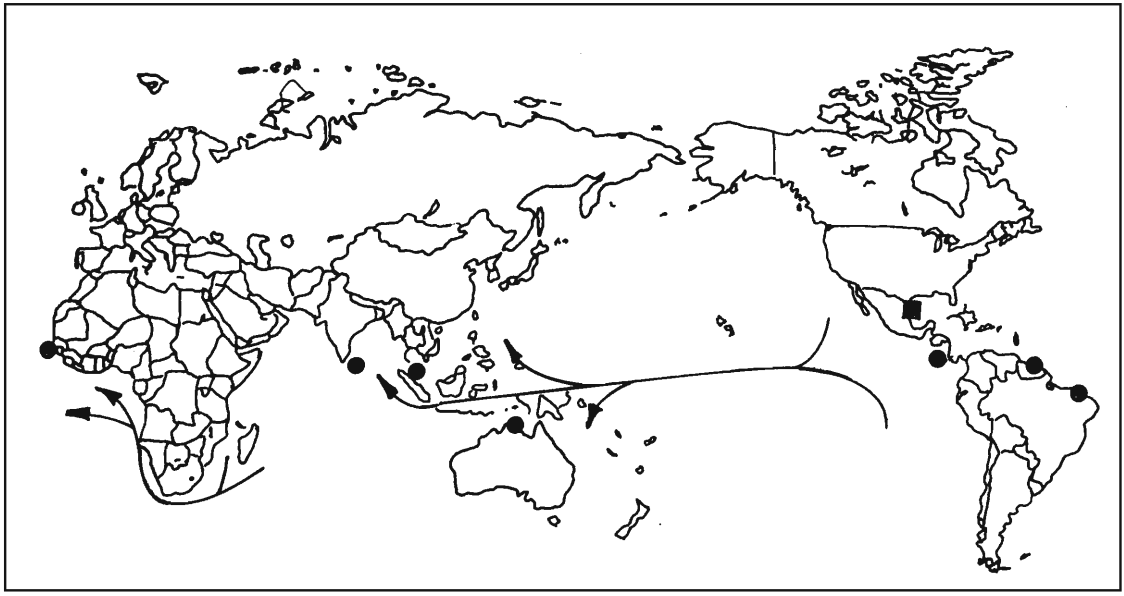


Figure 1. A map showing the nesting sites (circles) of the olive ridley in the world and the only nesting site of the Kemp's ridley (square). Apart from Orissa, there are two major mass nesting sites in Pacific Costa Rica and one in Pacific Mexico. The arrows indicate an evolutionary biogeographic model in which the olive ridley may have spread westward from the Eastern Pacific region through the Indian Pacific region and recently colonised the Atlantic ocean via southern Africa.

species display mass nesting while the rest nest solitarily. The two species of ridleys, the Kemp's ridley which is found only on the east coast of Mexico, and the olive ridley, found worldwide, exhibit the phenomenon of mass nesting (*Figure* 1). Of the two, the Kemp's ridley nests only in arribadas, the Rancho Nuevo in Mexico was and is the only known nesting site for this species. It is also unique amongst turtles in that it nests during the day as a rule.

The olive ridley (*Lepidochelys olivacea*) is one of the most numerous sea turtles thanks to the continued existence of a few mass nesting sites. There are two sites in Pacific Costa Rica and one in Pacific Mexico. In India, there are three major mass-nesting sites of the olive ridley all on the east coast, in Orissa (*Figure* 2). The nesting site at Gahirmatha (a part of Bhitarkanika sanctuary) at the mount of the river Maipura near Dhamra, was discovered by the scientific community in 1974, and is the largest sea turtle rookery in the world with 100,000 to 500,000 turtles nesting there each year. There are smaller rookeries at the mouth of the Devi River (north of Puri) and Rushikulya in Ganjam district in southern Orissa. This year, mass nesting has been recorded at

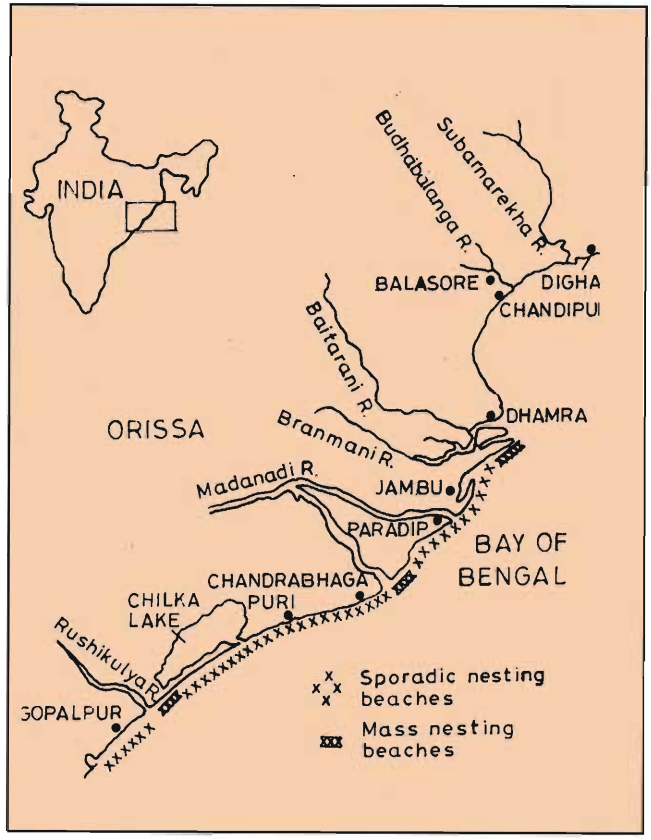


Figure 2. A map of the nesting beaches of the olive ridley in Orissa. The northern most site is Gahirmatha, with Devi River mouth in between and Rushikulya to the south.

Figure 3. The mass nesting (arribada) of olive ridleys at the Nasi island off the Gahirmatha coast. Though most sea turtles, with the exception of the Kemp's ridley, nest during the night, there was mass nesting during much of the day for the first three days during the arribada this year (Kartik Shanker).

another site at Barunei mouth, about 30 km south of Gahirmatha (*Figure* 3). At the beginning of the 1999 nesting season, local conservationists and researchers did not expect that the arribada would take place this year, especially at Gahirmatha. The arribada had failed two years in a row, which has not happened in the last twenty five years. Mass mortality had taken its toll of the population over the past five years and the nesting beach was unsuitable for nesting. The original nesting beach at Gahirmatha was a 10 km long beach which was part of the mainland. In 1989, a cyclone caused a 4 km sand spit to separate from the mainland and become an island. Since then the turtles have nested only on the

island. In 1997, the island further fragmented into two, both now only about 100 metres wide (*Figure* 4), and turtles nest predominantly on the northern fragment. The islands are very close to the Wheeler islands, which include the Outer Wheeler island, where the Defence Research and Development Organisation (DRDO) has its missile testing range in Long Wheeler island, where the Wildlife Institute of India has a sea turtle research station. Since the nesting islands (known as Ekakulanasi 1 and 2) have become narrower over the past few years, they are inundated by sea water during spring tide and this renders them unsuitable for nesting.

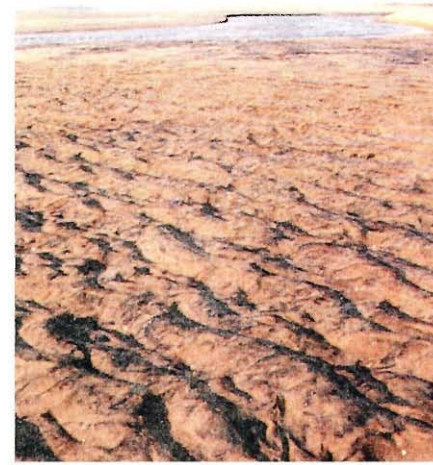
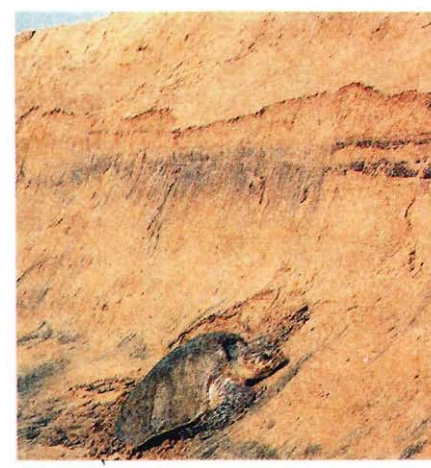


Figure 4. The nesting beach at Nasi 1, Gahirmatha. This is a fragment of the island which originally broke away from the mainland during a cyclonic storm in 1989. The beach is likely to get further fragmented as sea water has formed an inlet and a small water body within the island (Kartik Shanker).

In the last week of March, however, the turtles suddenly began to strand on the beach. About fifty thousand turtles nested on each of the first two days. Mass nesting occurred during the day and night over much of the next ten days. It is estimated that 210,000 to 250,000 turtles nested during this time. During the arribada, hundreds of turtles come ashore with every wave till there are thousands of turtles crawling around on the beach looking for a place to nest (*Figure* 5). Some will return to the water without nesting, not to come back later that night or after a few days. Other turtles begin to dig their nests, throwing sand over other turtles near them, and often they are almost fully buried themselves by the time they finish laying their eggs. Each turtle digs a flaskshaped nest about a foot and half deep, and lays 100 to 150 soft, ping pong ball sized eggs. More than thirty million eggs are laid on the 2 km long island at Gahirmatha (*Figure* 6).

Figure 5. Erosion of the beach creates various problems for turtles, including the formation of steep walls which the turtles struggle to climb when they come ashore to nest (Kartik Shanker).



Unfortunately, however, 80% of the eggs are lost over the next month due to flooding and erosion (*Figure* 7). Generally, the loss of eggs during an arribada is extremely high. A fair number are predated, though the proportion of eggs predated during an arribada

may be less than that of solitary nesters, a possible explanation for the phenomenon of mass nesting. Late nesting turtles destroy some proportion of the eggs of early nesting turtles (*Figure* 8). And of course, nests laid near the high tide line and shallow nests are exposed during spring tides. Scientists have long debated the causes of the arribada. Though the ultimate cause is not known, there are two theories for the proximate mechanism by which arribadas take place. One theory proposed that the turtles are triggered by an external stimulus or stimuli which causes them to come ashore en masse and nest. It is true that, in Gahirmatha, arribadas occur during the third quarter of the moon and when there is a strong wind. Another theory suggests that there is social facilitation in the phenomenon, perhaps by chemical communication, supported by the fact that ridleys alone amongst turtles have inframarginal pores. There is, however, no conclusive proof that they communicate with each other. In fact, satellite telemetry studies show that females are not spatially associated during internesting period and aggregate only during mass nesting. The fluctuation in the number of nesting turtles at the various nesting sites in Orissa, and nesting at new site this year implies that turtles may change sites if a particular beach becomes unsuitable for nesting. This contradicts the theory that sea turtles are very rigid about returning to nest on their natal beach.

A Transoceanic Life Cycle

Sea turtles have separate feeding and breeding grounds. These may be thousands of kilometres away from each other. During the breeding season, they migrate to the breeding ground, mate (*Figure* 9) and then the females come ashore to nest. When the eggs hatch after 7 to 8 weeks, (sex is determined by incubation temperature) the hatchlings emerge from the nest, usually at night to avoid predators, locate the sea using the brighter horizon (moon and star light reflecting off the water) and immediately head back to the sea. As they reach the sea, they head out into the open ocean by swimming perpendicularly to the wave direction. At this time, they are also oriented to the earth's

Figure 6(top left). Mass nesting at Nasi 2, Gahirmatha. Nesting was very heavy on the first two days with about 50,000 turtles nesting during the day and night (Bikash Pandav).

Figure 7 (top right). Some turtles start laying before they can dig their nests properly, laying their eggs in very shallow nests which are easily exposed or predated (Kartik Shanker).

Figure 8(bottom left). Late nesting turtles dig up the nests of earlier turtles (Bivash Pandav)

Figure 9(bottom right). Turtles mate in the off shore waters. The male mounts the female, holding her with the claws on his foreflippers, and the large claws on his hind flipper, the female may receive bites to the neck and flippers during this time, he then curls his long tail to bring their cloaca into contact and erects his penis into her cloaca (Kartik Shanker)

Figure 10. Two olive ridleys return to the sea after nesting (Kartik Shanker)

magnetic field. Recent experiments have shown that turtles can detect the magnetic inclination angle and the magnetic field intensity and use these to navigate in the open ocean. The hatchlings spend the next ten to fifteen years in seaweed rafts and FADs (Fish Aggregating Devices) being carried around by transoceanic currents. Juvenile loggerheads from the nesting beaches of Japan may traverse the North Pacific during their developmental migration, a distance of over 10,000 kms. When the turtles mature, they return to the feeding grounds to join the adult colonies and then undertake their first breeding migration. Olive ridleys (and leatherbacks) are open ocean feeders and do not have specific feeding grounds. Several olive ridley females, which nested in the arribada at Costa Rica, were tracked using satellite telemetry and were found to head in different directions into the Pacific after they had finished nesting (*Figure* 10). Tags from turtles that nested on the Orissa coast have been recovered from Sri Lanka and Kerala, implying that they move south along the east coast and then fan out into the southern Indian Ocean.

Turtles face many natural predators from the time the hatchling leaves its nest and makes a dash for the sea. It falls prey to dogs, jackals and birds on the beach and then a host of marine carnivores. In fact, only one in a thousand hatchlings survives to adulthood. Sea turtle populations grow very slowly, which means that populations that are severely depleted by human-related activities, may take a very long time to recover. Over the years, turtles have been heavily exploited for meat (mainly green turtles), tortoiseshell (hawksbills) and eggs. They are also adversely affected by loss of habitat due to developmental activities and increase in coastal habitation. Beach lighting poses a major problem because adults and hatchlings are disoriented by artificial light and hatchlings are unable to find the sea on emerging from the nest and so die of dessication or predation in the morning.

Travails of Turtles in Orissa

Figure 11. The mass mortality of ridleys off the coast of Orissa is mainly due to drowning in trawl fishing nets. More than 40,000 turtles have been killed in the past five years and 10,000 turtles were killed in 1999 (Kartik Shanker).

Worldwide, shrimp trawling has been identified as the biggest cause of turtle mortality. Since the trade in turtle meat and products is banned internationally, they cannot be hunted. However, they are accidentally caught and killed in shrimp fishing operations. In India, several thousand turtles were captured year after year off the coast of Orissa and shipped to Calcutta to meet the demand for meat till the 1970s. The olive ridley is classified in Schedule I of the Indian Wildlife Protection Act (1972), and the imposition of the ban on turtle meat substantially reduced poaching. However, in recent years, turtle mortalities have increased dramatically due to shrimp trawling (*Figure* 11). Frequently, ten or more sea turtles are caught during a single trawling operation. Since 1994, more than 40,000 turtles have died off the coast of Orissa due to trawling. Mortality reached a peak with 13,575 turtles washed ashore in 1998 and about 10,000 turtles have already been washed ashore dead this year. Olive ridleys can dive for about an hour under normal conditions, but trawl nets are operated for several hours and the stress of being trapped further decreases the turtle's chance of survival.

Even so, turtles drowned in trawl nets are usually in an anoxic state and comatose, and will revive if they are kept out of water in a cool place for a few hours. However, most trawler operators are unaware of this and even if they were aware, many might simply not be concerned enough to wait for turtles to revive before throwing them back into the water. The trawlers can also minimise turtle mortality by using turtle excluder devices (TEDs) which are trapdoors attached to the trawl net which allow the turtles to escape from the trawl nets. However, none of the trawlers operating in Orissa now use TEDs because the fishermen

Figure 12. Prawns are currently the big source of money and all mechanised fishing is largely directed towards commercial shrimp fishing. In fact, it is a genuine concern that the offshore waters of Orissa may soon be fished out of prawns, though ironically this may help the cause of sea turtles (Kartik Shanker).

believe that the TEDs cause loss of catch.

Sea turtles also face other problems along the Orissa coast. They are caught in gill nets and fishermen cut off their flippers or beat them to death to avoid damage to their fishing nets. Prawn seedling fishing nets along the coast prevent the turtles from coming ashore to nest. The proliferation of aquaculture farms and fishing jetties along the coast aggravates the problems of the turtles. Beach lighting is a major problem at Rushikulya which is located close to a town, and the glow from the town lights disorients hatchlings. Most of the solitary nests at Rushikulya are predated by dogs, which have increased due to human habitation on the beach. The planting of *Casuarina* has been a major cause of habitat degradation along the Orissa coast.

Figure 13. The lifestyle of the local fishing folk has been impacted by the trawlers and developmental activity along the coast. Their concerns must also be addressed while seeking a solution to the problem of sea turtle conservation of the east coast (Kartik Shanker)

Saving Sea Turtles

Due to numerous problems faced by olive ridley on the Orissa coast, it becomes necessary to take active steps to ensure their survival. Trawlers, with their unregulated fishing have depleted the fish stocks in the offshore waters of Orissa, severely affecting the local traditional fisherfolk (*Figure* 12). The banning of trawling in the near-shore waters would help both the traditional fisherfolk and the turtles. The Orissa Marine Fisheries Regulation (OMFR) Act 1982 and Rules 1983 already prohibits any kind of mechanised fishing within a distance of 5 km from the shore along the entire Orissa coast. However, due to the lack of monitoring, trawlers and other mechanised boats easily flout this law. The first step in the conservation of turtles would be the strict enforcement of this law.

Further, the use of TEDs must be made mandatory for all trawlers operating in the off-shore waters of Orissa.

Currently, only the nesting beach at Gahirmatha enjoys a protected status, since it is a part of the Bhitarkanika sanctuary. The offshore waters of Gahirmatha can also be protected by declaring it a marine sanctuary. The other nesting beaches at the Devi River Mouth, Rushikulya and now, Barunei need to be accorded some legal status so that the nesting turtles there can also be protected. Monitoring these areas would also help reduce hatchling mortality due to predation by dogs and jackals.

The reduction in beach front lighting and the introduction of controlled 'turtle friendly' lights would greatly reduce hatchling mortality. Over the past two years, organisations such as the Defence Research and Development Organisation (DRDO) and chemical factories, which have been a major source of artificial light near mass-nesting beaches, have been persuaded to turn off their lights during the nesting season. The cooperation of such organisations and the people living along the coast is essential for the success of the conservation programme (*Figure* 13). In 1999, various government, non-government and research organisations have come together to form a movement called Operation Kachhapa which aims to monitor nesting and mortality on the coast, prevent trawling through patrolling and promote turtle conservation amongst the local people through education and awareness programmes. This is a conservation scenario where the local people do not have to be driven out to protect the species; in fact, supporting the cause of the traditional fisherfolk would indirectly help the olive ridleys of the Orissa coast.

Current and Future Research in Support of Conservation

Research on these turtles also gives us valuable information which can help in formulating strategies for their conservation and management. Since sea turtles do not respect national boundaries, it often requires cooperation between several different governments and organisations working in different

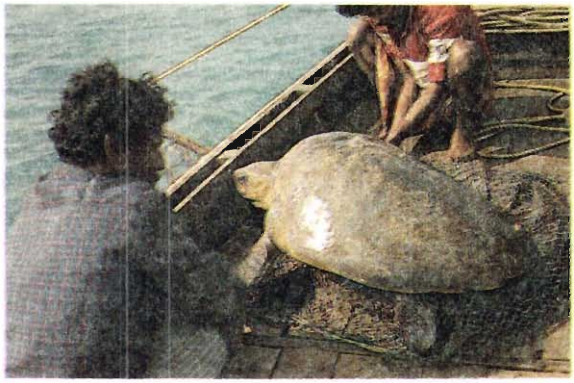


Figure 14. Bivash Pandav and a team of Wildlife Institute of India have been working on the sea turtles of Orissa since 1994. Research includes tagging and monitoring the turtles in offshore waters, studying the mating and nesting behaviour, and monitoring the nesting beaches on the Orissa coast (Kartik Shanker).

countries to effectively conserve and manage a sea turtle population. However, one must first identify the turtle's migration routes to determine which areas the turtles use and where they are being exploited or killed. Bivash Pandav of the Wildlife Institute of India has tagged several thousand turtles off the Orissa coast (*Figure* 14). His tagging study has shown that the turtles swim south to the tip of the peninsula. More studies using satellite telemetry may be needed further to trace their migration route. His study also showed that the same turtles use different mass nesting beaches for laying their eggs, and are not restricted to a single site as it was earlier suspected. His tagging work on mating pairs provides insights into the reproductive behaviour of the species.

Research on the population genetics of the species would give information on the distinctiveness of the different populations that nest on the east coast and possibly on the origin of the turtles. Studies on the coastal geomorphology, which are in progress, would be invaluable, considering the dynamic nature of the nesting beach. Conservation-oriented research would go a long way in supporting monitoring and education programmes to ensure the survival of the species.

Suggested Reading

[1] **Bivash Pandav, B C Choudhury and C S Kar, Olive ridley sea turtle (*Lepidochelys olivacea*) and its nesting habitats along the Orissa coast, India. A status survey, Wildlife Institute of India, Dehradun, India, 1997.**

[2] **L Peter, Lutz and A John, Musick (Eds), *The biology of sea turtles*, CRC Press, Florida, USA, 1997.**

[3] **Bivash Pandav, B C Choudhury and Kartik Shanker, The olive ridley sea turtle (*Lepidochelys olivacea*) in Orissa: An urgent call for an intensive and integrated conservation progra-mme, *Current Science*, 75 (12), 1323–1328, 1998.**

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