

Table 1. Fate of nests in harvested and non-harvested sectors of the beach.

| | October (%) | | November (%) | | December (%) | |
|------------------|-------------|-----------|--------------|-----------|--------------|-----------|
| | Harv | Non-harv. | Harv. | Non-harv. | Harv. | Non-harv. |
| Fresh Nests | 21.2 | 49.9 | 29.9 | 20 | 14.2 | 24.5 |
| Rotten Nests | <1 | 50.1 | 25.1 | 67.8 | 68 | 45.5 |
| Cooked Nests | 78.8 | <1 | 20.1 | 6.1 | 10.7 | <1 |
| Developing nests | - | - | 24.9 | 6.1 | 7.1 | 30 |

Ostional. Poaching activity is also higher during the beginning and the end of the season, when fewer rangers are hired for control. Even though this pattern proves that protection by community hired rangers does have a positive effect, a considerable amount of poaching is also recorded directly in front of the community (Pueblo).

In both Nancite and Ostional, Cornelius *et al.* (1991) had found a higher proportion of hatched nests in areas that were frequently washed by incoming tides. We also found this in our experimental harvesting regime sectors. One of the areas, in which no harvesting was allowed, had an estuary behind it that broke into the ocean during the wet season. This area produced a higher number of hatchlings/m² than all the other experimental areas. The non-harvested areas also had a greater density of fresh nests per square meter (0.8) compared to that of harvested areas (0.7).

Management Options. Harvesting must be confined to the arribada areas of the beach during the first 36 hours, and stronger measures taken against poaching. Guards should be posted strategically at the south end of the beach where a large number of solitary nests are laid and poaching is greatest. Educational programs in the community against poaching should be implemented, and stronger sanctions must be imposed by the Ostional Development Association.

Nest fate and hatchling production is obviously greatly influenced by environmental and physical factors. Unfortunately because of our small sample size and short duration of study, we could not come to any definitive conclusion on a comparison of the results for hatchling production in

harvested and non-harvested areas. Methods must be developed to collect data over a long time span.

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**Can the Olive Ridley Turtles in Orissa, India Be Saved -
A Review of the Scientific Facts Available**

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Olive ridley turtles, *Lepidochelys olivacea*, nest in low densities all along the eastern coast of India. However, the most important nesting beaches lie in Orissa, where the mass nesting occurs. The olive ridley turtle is well known for its annual mass nesting or arribada, when several thousand turtles migrate to the breeding ground to mate and nest simultaneously. The 480 km Orissa coast harbors three such mass nesting beaches. These are the Gahirmatha rookery near the mouth of rivers Brahmani and Baitarani along the northern Orissa coast, the rookery near the mouth of river

Devi located 100 km south of Gahirmatha, and the Rushikulya rookery located 320 km south of Gahirmatha near the mouth of river Rushikulya along the southern Orissa coast. A significant portion of world's olive ridley population that migrates every winter to the Indian coastal waters nests at these three rookeries.

The Gahirmatha beach was the first of Orissa's nesting beaches to be made known to the scientific community during the mid-1970s by the FAO/UNDP crocodile project (Bustard 1976). Substantial nesting has been recorded at

this site with over 100,000 turtles in most years and over 600,000 turtles in peak years (Dash and Kar 1990). Due to a cyclonic storm and beach erosion, the Gahirmatha beach was considerably reduced in size when a 3 km long spit broke away from the mainland in 1989, reducing the 10 km nesting beach to a 3 km island. From 1990 the arribada continued in this island and the last arribada recorded here was in 1996. Since 1997 this 3 km long island has further been fragmented into two parts and has been greatly reduced in length, width and height. Where as the average beach width was 140 m in 1996, it was reduced to only 60 m in 1997. Reduction in beach height also resulted in frequent inundation of nesting ground. While 83% of the tracks monitored (n=800) in 1996 resulted in nests, only 23% (n=1990) monitored during 1997 and 1998 resulted in nests, thus indicating unsuitability of beach conditions for the turtles to nest.

The rookery near the mouth of river Devi was discovered in 1981 (Kar 1982) and was then completely forgotten by the scientific and conservation community. Since then much of the nesting area at this rookery has been altered by a *Casuarina* (tree) plantation and the nesting population has shown a considerable reduction in number (Pandav *et al.* 1994). The Rushikulya rookery was discovered in March 1994 (Pandav *et al.* 1994 a & b). Since 1994, olive ridleys have been nesting en-masse at this rookery with considerable fluctuations in the number of nesting females from 60,000 in 1995 to 8,000 in 1998.

All five species of sea turtles that occur in India (including the olive ridley) are legally protected. They are included in Schedule I of the Indian Wildlife Protection Act (1972), as well as in Appendix I of Convention of International Trade in Endangered Species of Wild Flora and Fauna (CITES) that prohibits trade in turtle products by signatory countries. The mass nesting beach at Gahirmatha is a part of the Bhitarkanika Wildlife Sanctuary. The coastal waters off Gahirmatha were declared a marine sanctuary in 1997. The coastal waters off Devi and Rushikulya rookeries have been declared a no-fishing zone during the turtle breeding season.

Despite the legal protection given to the sea turtles, the sea turtle population migrating to the coastal waters off Orissa has been declining in recent years. The death of several thousand adult breeding individuals in Orissa each year has become a major concern of the national and international community. The biggest cause of mortality is the incidental capture of adult turtles in trawling nets. Uncontrolled shrimp trawling in areas of high sea turtle concentration has resulted in heavy mortality of adult sea turtles during the last decade. Dash and Kar (1990) reported the stranding of 4,682 adult olive ridleys at Gahirmatha rookery between September 1978 and May 1983. In 1993, during a six-month survey by Wildlife Institute of India (WII), 5,400 dead olive ridleys were found washed ashore along the 480 km Orissa coast (Pandav *et al.* 1997). Since then more than 30,000 dead adult olive ridleys have been documented in Orissa (Pandav and Choudhury 1999). Mortality due to illegal near shore trawling and gill netting

has been increasing each year. It reached a record high in 1998 with 13,500 turtles found along 282 of the 480 km coastline (Pandav and Choudhury 1999), hence, the actual number of dead turtles washed ashore the Orissa coast could have been much higher.

A second major cause of disturbance is artificial lighting along the coastline. Developmental activities such as establishment of a missile test range and construction of a major port near Gahirmatha and mushrooming growth of aquaculture farms and chemical industries near Rushikulya rookery have resulted in increased lighting near the nesting beaches. Human consumption of sea turtle eggs and meat is minimal in Orissa. However, heavy predation on sea turtle nests by feral dogs and jackals take place at Rushikulya rookery after mass nesting. Estimates show that almost 25-30% of the eggs laid during an arribada are predated at Rushikulya rookery. The planting of *Casuarina* trees in some of the prime nesting grounds has further restricted the nesting space available. In addition, *Casuarina* trees with their thick litter renders the beach unsuitable for nesting turtles.

The first step towards solving these problems is strict enforcement of the ban on mechanized fishing in near shore areas and in areas of high sea turtle concentrations. The Government of Orissa has declared the coastal waters off Gahirmatha a marine sanctuary and the coastal waters off the other two rookeries as closed areas. Besides this, the Orissa Marine Fishing Regulation Act of 1983 prevents any kind of mechanized fishing within 5 km of the shoreline. However, the enforcing agencies, the Forest Department and State Fisheries Department, lack the infrastructural facilities to enforce the ban on fishing in these areas. The concerned agencies should be provided with adequate sea going vessels and personnel for strict enforcement of these bans. The use of turtle excluder devices (TEDs) should be made mandatory for trawlers operating in the coastal waters beyond 5 km from the shoreline. However, use of TEDs alone will not bring down the turtle mortality because turtles are also caught and killed in gill nets and TEDs can not be used in gill nets. Therefore, strict enforcement of the existing law on no fishing zones along with TEDs in other fishing zones seems to be the best answer to reduce turtle mortality.

A major step towards saving this population would be giving protected area status to the sea turtle nesting beaches as well as the coastal waters having high sea turtle concentration. Of the three nesting beaches in Orissa, only Gahirmatha and its coastal waters are legally protected. The nesting beaches at Devi and Rushikulya rookeries lack any kind of protected area status, thus making them vulnerable to anthropogenic disturbances. The tagging studies by WII (Pandav and Choudhury, unpublished data) have revealed the movement of turtles between these three rookeries and have demonstrated that turtles use more than one rookery for nesting during a season. This implies that turtles nesting off the coast of Orissa may be part of a single population, meaning that turtles at all three rookeries are equally important. Further, if the nesting beach at Gahirmatha continues to decline due to geographical factors, these

turtles may nest at other rookeries and it is important that these alternate nesting beaches are 'turtle friendly'. Thus protection of all three rookeries is extremely crucial for the survival of turtles in Orissa.

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Possible Threats to and Conservation Measures for the Nesting Olive Ridley Populations, *Lepidochelys olivacea*, at Andhra Pradesh Coastline, India

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Abstract

Olive ridley sea turtles, *Lepidochelys olivacea*, found in the Indian Ocean and its bay islands are highly vulnerable from various threats. At Gahirmatha in Orissa state, India, the olive ridleys have their largest rookery (mass nesting). Every year around February, the breeding populations migrate from the Indian Ocean to the mass nesting sites after travelling from the coastal waters of Tamilnadu and Andhra Pradesh. Even though these migratory populations are protected under Schedule I of the Indian Wildlife (Protection) Act, 1972, their exploitation is continuing in the coastal villages of Andhra Pradesh. Live turtles are captured incidentally in courtship activity or subjected to strandings of nesting turtles for meat, shell and calipee. Other possible threats identified in the region are human interference to their nesting habitats, nests and hatchlings, due to major construction works and artificial illumination on the beaches.

In every breeding season (November to March) it was estimated that from 2000 to 3000 live turtles of breeding stock are subjected to indiscriminate exploitation and as many carcasses (dead turtles > 2 per km) on coastline due to trawl fishing and instant mortality. Besides live turtles, freshly laid nests are predated by jackals, foxes and domestic dogs and are also excavated by beachcombers, resulting in 90% losses. To prevent these possible threats, conservation programs were initiated to reduce the mortality of nesting turtles, and to protect the nests, eggs and hatchlings. Also a management plan was formulated for the development of important nesting habitats and feeding grounds of olive ridleys in this region.

Introduction

Of the world's seven species of sea turtles, five species: the green turtle (*Chelonia mydas*); loggerhead (*Caretta caretta*); hawksbill (*Eretmochelys imbricata*); leatherback (*Dermochelys coriacea*) and the olive ridley (*Lepidochelys olivacea*) are distributed in the Indian Ocean and placed in Schedule I of the Indian Wildlife (Protection) Act, 1972. These species are also listed in Appendix I of the Convention on International Trade in Endangered species of wild fauna and flora (CITES, 1975). All the five species nest on the coasts of the Indian Ocean and its Bay Islands, while the olive ridleys have their largest (mass) nesting site at Gahirmatha of Orissa state in Northern Indian Ocean (Kar, 1980).

In winter months (January to March) olive ridleys migrating from the Indian Ocean to the coasts of Orissa for mass nesting (arribada) pass through the coastal waters of Tamilnadu and Andhra Pradesh. During migration these breeding populations are utilizing the nearby suitable habitats to lay their nests sporadically, along the coastline of Andhra Pradesh (Raja Sekhar, 1987). These migratory turtles are exploited by the local people for meat, shell and calipee, also the nests, eggs, and hatchlings subject to over predation by canine predators. Apart from biotic interferences, the developmental activities and intensive shrimp fishing along the coastline cause threats to the survival of olive ridleys in the region.

Study Area

The coastline between Kalingapatnam (Vamsadhara River) in the north and Kakinada (Godavari River) in the south is an important area. As a migratory corridor for olive