



CONSERVATION AND MANAGEMENT OF THE ENDANGERED  
OLIVE RIDLEY SEA TURTLE  
*LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ)  
ALONG THE NORTHERN ANDHRA PRADESH COASTLINE, INDIA

P.S. RAJA SEKHAR AND M.V. SUBBA RAO  
Department of Environmental Sciences  
Andhra University, Visakhapatnam, India

### Introduction

India with its 6,100 km of shoreline attracts five species of sea turtles: The Leatherback, *Dermochelys coriacea* L; the Loggerhead, *Caretta caretta* L; the Green Sea Turtle, *Chelonia mydas* L; the Hawksbill, *Eretmochelys imbricata* L; and the Olive Ridley, *Lepidochelys olivacea* (Eschscholtz). All the five species of sea turtles face depletion of their population mainly due to poaching of the breeding turtles and their eggs. Now most of the nesting colonies of these turtles have disappeared from India's mainland beaches, Olive Ridley turtles being the main exception (Raja Sekhar, 1987).

The Olive (Pacific) Ridley Turtle, *Lepidochelys olivacea* is the most common Indian sea turtle and worst victim of human depredation. Huge numbers of Olive Ridleys - estimates reach 30,000 individuals annually - reach markets in Calcutta where they are sold for their meat and several boatloads of turtle eggs were recently being transported from mainland beaches and Gahirmatha Island of Orissa state (Das and Kar, 1986). At Gahirmatha in Orissa, the Olive Ridleys have the worlds largest rookery, where an 'Arribada' occurs every year around February after turtles migrate from the Indian Ocean along the coasts of Tamilnadu and Andhra Pradesh (Bhaskar, 1983).

A good number of these migratory turtles nest, sporadically on the Northern Andhra Pradesh coastline (16°50' - 18°25' latitudes, 82°10' - 84°10' longitudes). This region is densely populated by tribes of fishermen who often poach the breeding sea turtles and rob their eggs which are an easy catch and provide a livelihood. As Frazier (1980) describes, sea turtles are an ancient group of reptiles which have been swimming the oceans for over a hundred million years. These ancient reptiles are a valuable resource to many people of the Indian Ocean having contributed to the nutritional, economic and cultural fabric of the region.

However, despite the long standing value of this resource its future is in jeopardy and many sea turtle populations have declined to the point where they are no longer significant resources either materially or culturally. This is mainly due to indiscriminate exploitation largely at breeding stages, for their meat, eggs, shell and calipee which has reached such enormous proportions that all the species of sea turtles are in critical condition. If the sea turtles are properly conserved and managed they could be an invaluable resource for the coastal people of the Indian Ocean, both nutritionally and economically (Frazier, 1982).

## Study Area

The coastline between Kalingapatnam in the north and Hope Island in the south has been selected for the present studies, which is an important nesting place for the Olive Ridley. This area has a coastline of 280 km that runs through Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts of Andhra Pradesh in between: 16°50' - 18°25' latitudes; 82°25' - 84°10' longitudes (fig. 1.)

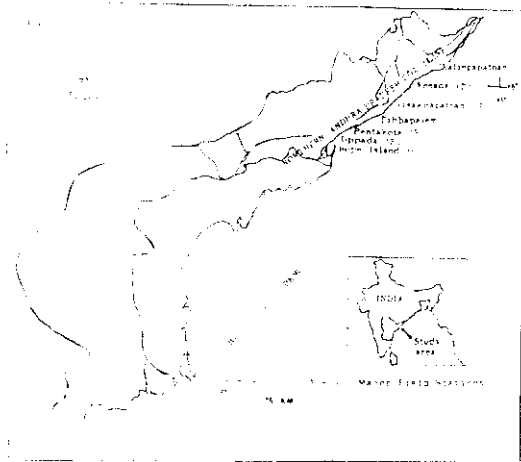


Fig. 1. Study area of Northern Andhra Pradesh coastline for Olive Ridley Sea Turtle conservation and management.

This area has varied shore conditions ranging from rocky to shallow sandy shores with several extensions of hill ranges projecting into the sea. Seven rivers with creeks, back waters and streams also enter the sea.

There are 53 villages most of which belong to fishing tribes with a population around 63,000. A total of 300 to 350 trawlers operate along the coastline and a large number of mechanised boats and catamarans. Visakhapatnam is a major port and the headquarters of the Eastern Naval Command of India. For the convenience of executing the present investigation the entire study area was divided into seven major zones.

Of these, Zone A (Visakhapatnam) harbors many industries along its coast including the largest steel plant in Asia. Zone B (Konada) has a shoreline of 48 km, Zone C (Kalingapatnam) is between the rivers of Nagavali and Vamsadhra with a coastline of 28 km. Zone D (Dibbapalem) consists of 36 km rocky shoreline with rockpools. Zone E (Pentakota) is the largest rocky shoreline with rockpools. Zone F (Uppada) has a shoreline of 38 km and Zone G (Hope Island) in the southern part has a shoreline of 25 km parallel to the mainland, varying in width from 200 to 1500 metres.

## Status of the Olive Ridleys

Field studies have been conducted along the Northern Andhra Pradesh coastline from 1983 to 1987 and the major part of the survey was made on foot and, when required, with the assistance of natives of the region or fishermen of the local villages. The principle method used in the present study was 'Syndrome approach' which refers to a group of signs and symptoms which, when considered together, indicate the present status of the area on the basis of which predictions for the future may be made (Riney, 1967). For this, the data obtained from several sources, i.e., information on turtle trade, turtle hunting, exploitation of nests, nesting turtles and their arrival for nesting.

The status of the Olive Ridleys, *Lepidochelys olivacea* along this coastline as was evident from the exploitation pattern reveals their future is alarming. The exploitation concentrates so heavily on reproducing animals and their nests, beginning from egg laying until hatchlings return back to the sea, either by human or subject to heavy predation (Raja Sekhar, 1987). Live turtles captured either incidentally in the fishing gear or when they are sighted especially during courtship and on shore during the nesting activity, were kept upside-down to avoid movement and escape (plates 1 & 2).



Plate 1. An Olive Ridley Sea Turtle, *Lepidochelys olivacea*, coming to shore for nesting during night time.

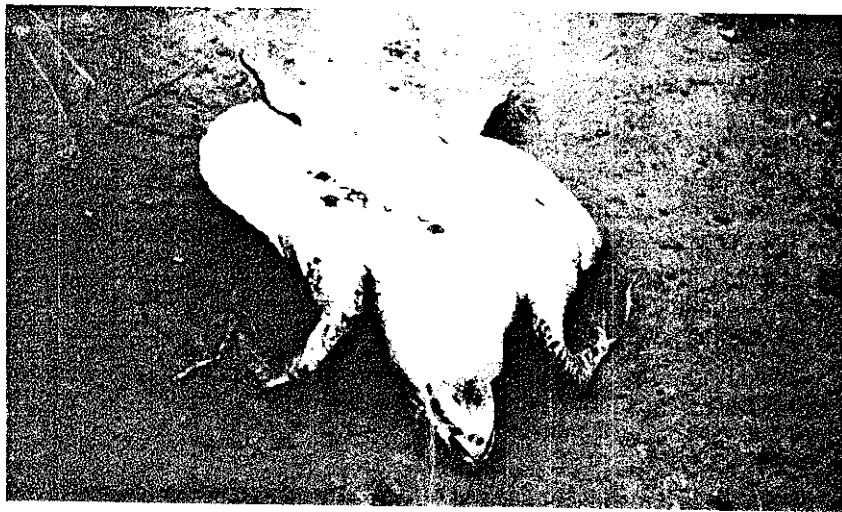


Plate 2. Olive Ridley Sea Turtle, *Lepidochelys olivacea*, on its dorsal side (tilted position) for trade.

During the study period 648 Olive Ridelys were caught while they were in courtship and 170 were captured on shore during their nesting and brought for trade at different markets. Apart from human captures, 15 were accidentally trapped in fishing nets on shore and 9 were killed by predators while they were nesting. Besides the capture of live turtles, 577 carcasses of Olive Ridelys were found washed ashore due to mechanised shrimp trawlers (Table 1.).

Zone	No. of carca's found on shore	No. of crawis tracks	Freshley laid nests	Human distured nests	Turtle for trade	Caught while fishing	Trapped in dry nets	Caught while nesting	Turtles killed by the pred'rs	Nests distured by pred'rs
A	53	47	27	78	25	128	3	32	0	49
B	57	32	12	54	32	68	2	23	1	42
C	82	40	14	51	30	92	1	20	1	56
D	83	51	18	75	78	101	4	36	1	28
E	102	51	16	53	37	99	2	18	1	65
F	79	78	12	52	53	55	1	25	1	58
G	116	68	25	79	63	111	2	16	4	65
Total	577	367	124	442	318	648	15	170	9	363

Table 1. Factors threatening the survival of Olive Ridley Sea Turtles, *Lepidochelys olivacea* at different zones and divisions of the study area during the period 1984 -1987

The status of Olive Ridelys along this coastline was also evident from disturbed nests, eggs and hatchlings by human and other predators. In the study period 804 were recorded of which 442 had been excavated by humans for eggs and 363 nests were destroyed by predators, i.e., jackals, hyenas, foxes and dogs etc., (Table 1). At the present study zones, A and D have higher percentages of turtle trade and nests disturbed, while B and F recorded the minimum trade and disturbances. The number of turtles caught in the fishing gear at all zones was ranged between 100 - 125.

### Breeding Ecology

During the breeding season of the Olive Ridelys systematic surveys on foot (turtle walks) were conducted along the coastline of each zone and data collected pertaining to the sea turtles. The Olive Ridelys are oviparous animals and breed every two to three years, and the breeding seasons synchronised with the non-monsoon season (winter and early summer) of this region. The breeding season as described here covered the period from courtship activity to the emergence of the hatchlings and were conveniently divided into three periods:

- 1) Mating (courtship activity)
- 2) Nesting (egg-laying period)
- 3) Hatching (emergence of hatchlings)

**Mating (courtship):** Courtship activity was observed from mid-November and lasted for nearly three months until mid-February. Mating of the Olive Ridelys takes place offshore at the surface and both participants remain with little movement for several hours. Mating was observed for longer periods (2 to 8 hours) during which time the Olive Ridelys were found to be most susceptible to capture by poachers as the turtles could not separate easily enough to escape quickly.

**Nesting (egg laying):** Nesting was observed between early January and late March though greater part of the season was during winter, but the air temperature began to gradually increase: peak nesting was observed during February. Olive Ridley sea turtles lay their eggs on the sandy beaches in the nest pits dug by themselves. Fresh nests were identified by examining the shoreline at regular intervals at night with the assistance of fishermen, often following the tracks of the turtles in the sand. During the survey a total of 124 freshly laid nests of Olive Ridelys were located, of which 7 nests were brought for artificial hatching while 23 nests were protected *in situ* until hatching.

**Nesting habitat:** The nesting beaches selected by the Olive Ridelys were with fine sandy areas with gradual slopes and often edges with small patches of ground vegetation at the high beach platform. The nesting places were mainly dominated by grass species, *Spinifex littoreus*; a creeper *Ipomea pescaprae*; a mangrove plant, *Pandanus fascicularis*. Shore fauna consist mainly of ghost crabs, *Ocypoda* sp. *Uca* sp. and several types of insect larvae (maggots) and ants. Birds like cranes, *Grus communis*; seagulls, *Larus*

*brunnicephalus*; cattle egrets, *Bubulicus ibis coromandus*; pond herons, *Ardeola grayii* and domestic crows, *Corvus splendans* were most dominant. Of mammals like jackals, *Canis aureus*; foxes, *Vulpus bengalensis*; and hyenas, *Hyena striata* were common in most of the areas edged with dense vegetation, while domestic dogs and pigs were common in the areas near human habitation.

**Nesting times:** The time of nesting was arbitrarily determined based on the tracks of the Olive Ridleys in the sand. Olive Ridleys usually nest at night, mostly on moon-lit nights between dusk and dawn. With the evidence of the fresh tracks most nesting occurred during 1900-2100 hrs. Nests were usually sited on beaches at a distance ranging from 10 to 60 metres from the high tide water mark. Most of the nests were located at a distance ranging from 16 to 45 metres.

**Tracks of Olive Ridleys:** the arrivals and departures of the Olive Ridleys left tracks on the sandy beaches in undisturbed conditions. The track width ranged from 70 to 80 cm with alternately arranged fore-flippers marks and in most cases indicated the route and direction taken by the nesting turtle. During the study, three types of tracks were identified: a) Crescent, b) Conical, and c) Rectangular. The crescent and conical types indicate routes taken by a disturbed nesting turtle wandering on shore without nesting and returning back to the sea. But the Rectangular crawls made by an undisturbed nesting turtle, usually made one or two false nests (without eggs) below hightide to mislead the predators and a successful nest (with eggs) above hightide mark (Fig 2). Of the 367 crawls recorded 183 were crescent types, 146 conical and the remaining 38 were rectangular.

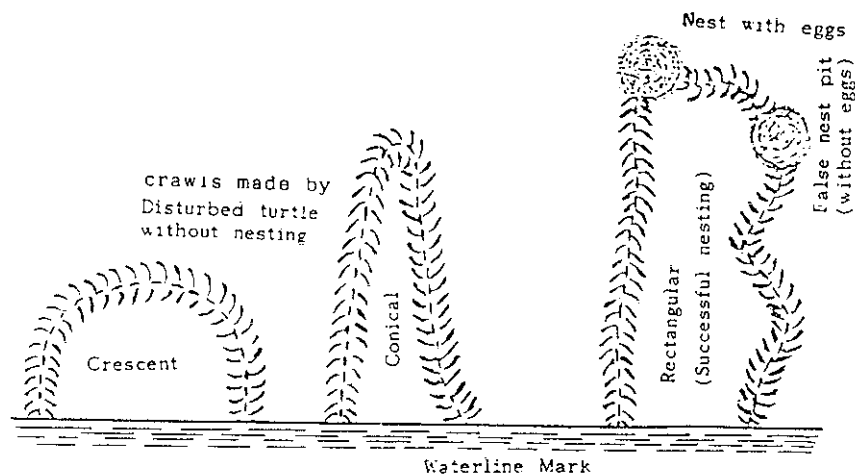


Fig 2. Types of crawls made by nesting Olive Ridleys *Lepidochelys olivacea* on the sandy beaches.

**Nest and clutch size:** The depth of the Olive Ridleys nests ranged from 40 to 90cm, while the majority of nests have a depth range between 50 to 60cm. The clutch size of the Olive Ridleys has a range from 80 to 145 per nest, and the monthly means of clutch size varied slightly.

**Eggs:** Olive Ridleys turtle eggs were arranged 3 to 4 layers in the nest, white in colour, round in shape with a diameter ranging from 37 to 46mm and a weight range from 25 to 37g. The shell was porous, delicate and slightly flexible (Plate 3).

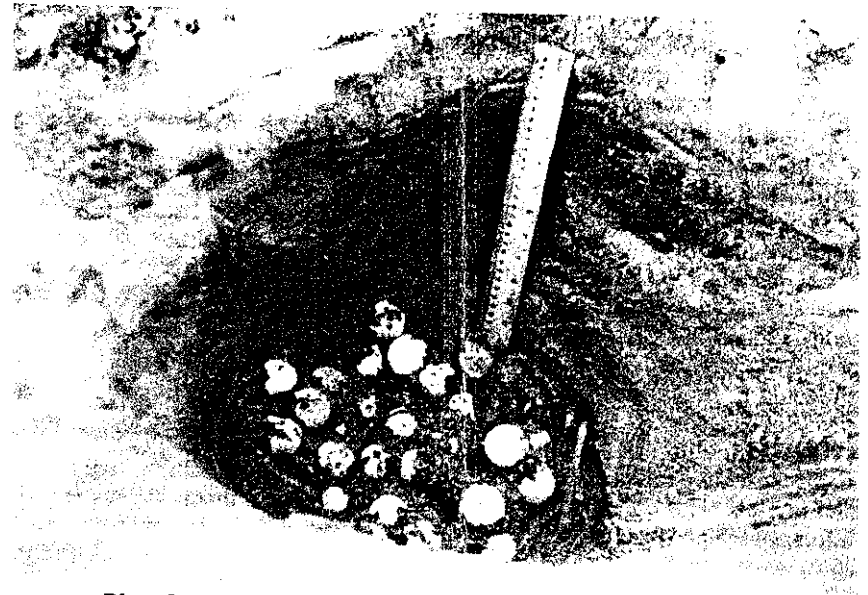


Plate 3. An Olive Ridleys Sea Turtle nest on shore showing its eggs, nest diameter and depth.

**Hatching (Emergence of new hatchlings):** After two months of incubation (55 to 58 days) hatchlings from the nests beginning in early March up to June before the rainy season starts, during time air temperatures rapidly increases.

**Hatchlings:** Immediately after hatching from eggs, the hatchlings are black in colour and weigh between 15 to 18g. They had a size range of 36 to 41mm in carapace length and 34 to 40mm carapace in width. The hatchlings have a single claw on each flipper which were very active after they entered the sea.

#### Captive Breeding Programmes

Captive breeding is an important aspect in the conservation programme for obtaining

higher percentages of hatchling success in both well protected natural (*in situ*) conditions and in artificial incubation. After the nests were identified the top layer of sand was removed by hand until the eggs were exposed. The eggs were placed in well ventilated wooden boxes with sand. The eggs were arranged in the boxes without changing their axial orientation in the nest. Then the eggs were transported by road to the central hatchery as quickly as possible, but no longer than 12 hours. Soon after the eggs were brought to the central hatchery, they were placed in a sterile Petridish between moistened cotton layers, then the Petridishes were arranged in the BOD incubators in which the required temperatures were maintained, constantly in between 27° to 30° ± 1°C and some of the nests left in nature (*in situ*) with protection wire meshes.

**Maintenance of incubation temperatures:** Incubation temperatures played a crucial role in determining the sex of the sea turtle hatchlings. In natural conditions (*in situ*) temperatures fluctuate, below or above the range without harm to the embryos but are lethal if held constantly above the 32° and below 27°C in artificial incubation (Dimond and Hejmadi, 1983). Hence a narrow range of temperatures were maintained constantly in the present experiments i.e., 27° to 30°C ± 1°C. In artificial hatching, temperature maintenance and moistening of the cotton layers are essential precautions. After hatching, the sex of the hatchlings was determined by post mortem examination of dead hatchlings and was compared with gross morphology of the gonads as described by Hejmadi and Dimond, 1986. In our captive experiments most of the eggs were kept at higher temperatures, 30°C and 31°C constantly for obtaining more females rather than males which would be helpful in better conservation and the hatchlings examined were 80% females (Subba Rao et. al., 1987).

**Artificial hatchling:** A total of seven clutches were hatched under laboratory conditions. Of these, two clutches belong to 1984 - 1985 and the remaining five nests were hatched in 1985 - 1986: altogether a total of 891 eggs were incubated under artificial conditions, of which 127 eggs were infertile. Out of 764 fertile eggs kept for hatching 86 (11.26%) were found with dead embryos (pipped eggs) occurred during the period between 20 and 45 days of incubation. Fifty two (6.8%) eggs did not hatch but contained discernible embryos - they were seen after the sixth week of incubation. Most of these unhatched eggs with discernible embryos were found during the stage of the seventh and eighth weeks of incubation. Overall, 626 fertile eggs from 764 eggs of seven clutches were successfully hatched. The hatching time was varied between 56 to 60 days and the average hatching success was obtained 82% (Table 2).

Year	Total eggs hatched	Infertile eggs	Fertile eggs	Spoiled eggs	Eggs developed and unhatched	Hatched eggs	Hatched dead	Hatching success
	(n)	(n)	(n)	(n)	(n)	(n)	(n)	(n)
1984-5	128	18	110	12	6	92	6	83.6
1984-5	100	14	86	8	7	71	7	82.5
1985-86	112	19	93	10	6	77	4	82.7
1985-86	132	16	116	13	8	95	6	81.8
1985-86	136	18	118	14	7	97	7	82.2
1985-86	141	20	121	15	8	98	8	81.0
1985-86	142	22	120	14	10	96	9	80.0

(n) = Number

Table 2. Details of the hatching and hatching success of seven nests incubated in the Central Hatchery during 1984 - 1986

**In situ (Natural) Hatching:** A total of 23 nests were protected individually with wire meshes and guarded by the local fishermen and clutch size of these nests range from 80 to 145 eggs (mean 118 eggs/clutch). Of these, 10.5% of the eggs were found to be infertile or met with embryonic death and spoiled before the first week of incubation. These eggs omitted a foul smell and attracted soil insects if left unchecked and damaged the whole nest. Another 34.4% of eggs were spoiled before 45 days while 10.2% of the eggs did not hatch but contained discernible embryos. The remaining 44.9% of the eggs hatched and 10.6% hatchlings did not emerge out of the nest and were found to be infected with ants and dead in the pit. Overall, the hatchling success rate was 34.2% of the total eggs and the hatching period was between 57 to 62 days (table 3).

Details	Minimum	Maximum	Average
Clutch size (No of eggs)	80	145	118
Egg diameter (mm)	37	46	40.08
Weight of eggs (g)	22.4	37.0	32.28
Infertile eggs (%)	7.50	15.15	10.54
Ferile eggs (%)	84.86	92.50	89.46
Eggs spoiled before:			
Day 15 (n/clutch)	2	18	9
Day 30 (n/clutch)	12	34	24
Day 45 (n/clutch)	0	12	7
Unhatched eggs with discernible embryos (n/clutch)	3	27	12
Hatched eggs and dead in nest (n/clutch)	5	24	13
Hatching period (d)	51	62	57
Hatched eggs and escaped from nest (%)	28.81	47.31	34.24

Table 3. Details of the hatching and hatching success in the Olive Ridleys clutches *in situ*.

#### Management Studies for the Conservation of Olive Ridleys

For the conservation and management of the Olive Ridleys, and their protection along the coastline, success depends mostly upon control of the human factor and predatory disturbances.

**Human interference:** Along the defined coastline of the study area a population of around 63,000 inhabit 53 villages. The literacy rate is 3 to 7%. Activities of the shore inhabitants being mainly fishing, crab hunting, shell collection for lime and ornaments; fishing is the main activity.

The fishing activity was intensive all along the coast. Deep sea fishing with modern trawlers was extensive in zones A and G with as many as 350 trawlers operating. In addition to these, around 3,400 small boats and mechanised craft were in operation. Maximum numbers of craft were operating in zone D (Hope Island) followed by zones A and E. While fishing, a few turtles get accidentally trapped in the gear and are brought to shore for several purposes including trade (plates 4,5, & 6).



Plate 4. An adult Olive Ridleys Sea Turtle *Lepidochelys olivacea*, being carried for slaughter



Plate 5. Preparation for indiscriminate killing, Olive Ridleys Sea Turtle beginning from ventral side, for turtle meat, shell and calipee.



Plate 6. Olive Ridleys Sea Turtle meat cut into minor pieces for selling in the market, the same turtle carapace being used as a carrier for turtle meat.

Olive Ridleys are being used by the fisherman tribes for many purposes. The carapace is used for carrying fish (Plate 7) or other materials, while the meat was either consumed or sold and used as a bait material on the hooks of the fishing nets to trap large fish. The price of the Olive Ridleys at various markets varied from time to time. Live animals were sold at any prices between Rs.30 to 75 while the meat was sold up to Rs.4/kg. The carapace of the Olive Ridleys were most sought after and were sold at prices ranging from Rs.10 to 50 depending upon their size.

Very often the fishermen knit their nets or spread them for drying on the shores and at times, nesting turtles happen to get trapped. these were killed by them for trade or personal consumption. During the study period, 15 were accidentally trapped in the nets, brought to the markets at various zones for selling (table 1). Beachcombers capture the nesting turtles or disturb the nests, collect eggs for trade or personal consumption. A total of 442 nests identified as disturbed by humans was recorded during the study period. Besides fishing, other human activities altered the nesting grounds of the sea turtles, such as agricultural purposes (plantations and social forestry), quarry mining and sand collection for building.



Plate 7. Carapace of the Olive Ridley Sea Turtle, being used for carrying sand, dried fish and mud for construction purposes.

**Predatory disturbances:** Consequent to the human inhabitation, the presence of predators and their destruction to nests, eggs and hatchlings were considered to be major disturbances on the coastline. The predatory disturbances was evident from the destroyed nests with partly eaten eggs and hatchlings. Once the nests were disturbed, this arrested further incubation due to lack of moisture content and it dried out gradually with dead embryos. In the study area predation by domestic dogs and pigs was very high near villages and also in some area where the human activity is less, wild predators like foxes, jackals and hyenas were noticed, and all of these preyed upon the eggs, hatchlings and

nesting turtles (plate 8). In nature Olive Ridley hatchlings emerge from the nest in groups and usually spend some time on the nest surface, and very often fall prey to domestic crows, seagulls and ghost crabs.



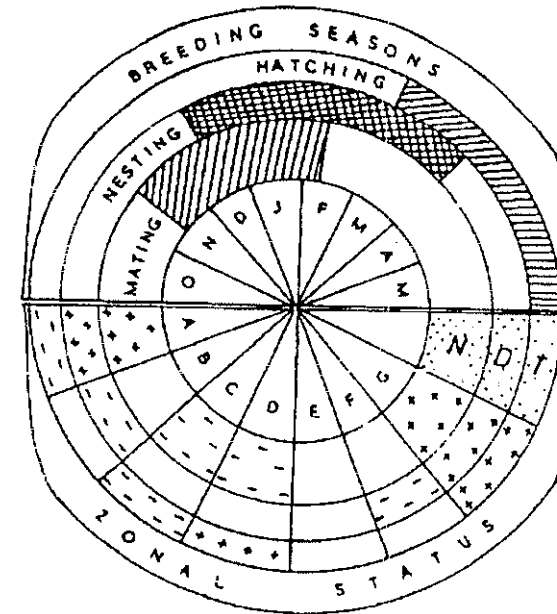
Plate 8. Predatory disturbance by a domestic dog to the Olive Ridley freshly laid nest on the shoreline. Observe the damaged eggs and egg shells around the nest.

Predation on the Olive Ridley turtle eggs was very high both in freshly laid eggs and at the time of hatching. As many as 363 nests were recorded as disturbed by predators. Sometimes these major predators (hyenas) attacked the nesting turtles and killed them on the shore and 9 of such carcasses killed by predators were identified (Table, 1).

**Zonal importance:** Surprise raids were made on 23 fish markets within the zones where turtle trade was observed. The number of surprise raids made at each fish market ranged from 2 to 7 for year. The turtle trade indicates that the sea turtles are being exploited indiscriminately. Most of the trade was carried out where illiterate and most backward classes of society were involved. Zone D and G have maximum records in sea turtle trade while, zones A and C have minimum trade recorded.

In all zones sea turtle trade has been decreased remarkably from year to year of the study area due to awareness created among the fishermen communities. Zone G had maximum predatory and human disturbances to the nests and nesting turtles followed by zones, A, E, D, C, F and B. With individual zones the arbitrary divisions which recorded maximum number of arrivals of turtles was considered very significant in providing

adequate protection to the nesting grounds, nesting turtles and also for better conservation (Fig. 3).



Upper half: O,N,D,J,F,M,A,M = Months from October to May.  
Lower half: A,B,C,D,E,F,G = Different zones marked for the Management Studies.

N = Nesting, D = Disturbances, (Human & Predators) T = Trade

+++ = Maximum --- = Minimum  
++ = Maximum -- = Minimum  
+ = Minimum - = Minimum

Fig 3. Schematic diagram showing the breeding seasons and status at different zones of the Olive Ridley *Lepidochelys olivacea* turtles of the Northern Andhra Coast.

**Extension programmes:** Since the major threat to the survival of the Olive Ridelys and other species of sea turtles is due to the ignorance as well as the 'subsistence pattern of fishermen' it is proposed to educate them on the importance of sea turtles and also involve them in the conservation movement. A pilot extension programme was organised to bring out awareness of the importance of sea turtles so as to avoid or reduce the decimating factor of humans and help protect the sea turtles (Subba Rao et al., 1987).

Extension programmes were conducted at each village and the people were educated through audio-visual aides on the importance of sea turtles, conservation and their role in nature. The co-operation of the state forest department (wildlife wing) was sought and they also displayed several boards of posters on sea turtle conservation and relevant legislation - Wildlife (Protection) Act, 1972. As the first step several extension lectures on the subject have been delivered in local 'Telugu' language at 28 fishermen villages.

This programme has enabled us to find more information about the sea turtles and also create awareness among the fishermen tribes. Secondly a few selected persons were put in charge to guard the defined coastline and the nests laid in that area during the breeding season of the sea turtles. (November-April) and incentives were given to them for their efforts. They were educated on the various stages of hatching sea turtle eggs and nests, these were shown to them through audio-visual instruction and monitoring techniques.

### Discussion and Recommendations

The Andhra Pradesh coastline provides a major migratory route or pathway for the Olive Ridleys to approach 'Gahirmatha Island' in Orissa state where the largest 'Arribada' was reported by Bustard (1976) and it is most likely that a good number of turtles sporadically nest along the Northern Andhra Pradesh coastline between Hope Island (near Kakinada) and Kalingapatnam. In view of this the Northern Andhra Pradesh coastline is an important region in the conservation of the Olive Ridleys but like other parts, exploitation of sea turtles exists in this area.

As was evident from the present study, the Olive Ridley Turtles *Lepidochelys olivacea* have been subjected to severe exploitation and their nesting grounds are fast deteriorating at the Northern Andhra Pradesh coast and here active management for conservation of these turtles is highly essential. Frazier (1980) described various conditions of exploitation ranging from the hunter who eats, to the hunter who sells the catch. In most of the cases, the immediate benefit for hunters was money and food, only for their 'subsistence' but the most intensive exploitation is for export.

The subsistence pattern of hunting for the Olive Ridleys was reported along the coasts of Orissa and West Bengal to cater for the Calcutta market by Das and Kar (1986). However such large scale commercial exploitation was not intensified in the Northern Andhra Pradesh coast but incidental catches of turtles in the trawler nets, poaching of nesting turtles and destruction of nests was intensive as was evident from the present study. The increase trend of the turtle trade not only removes the turtles but severely limits their reproduction, and future turtle trade obviously depend upon the breeding stock and the eggs which regulate their populations (Kuriyan, 1950).

The 'subsistence pattern' of hunting cannot be ruled out suddenly as they have been dependant on sea turtle fishing in the Indian Ocean for centuries (Frazier, 1982). The people normally consume turtle meat and eggs, use the shell for carriage purposes and also obtain cash from the sea turtle products which adds considerably to their income.

Unfortunately the majority of the hunters along the coastline were illiterate and were not aware of the present state of turtles and its impact on their very subsistence.

For the conservation and management programmes of the Olive Ridleys captive breeding or headstarting is an important and vital aspect. The newly emerged young are usually buoyant and appear to be unable to dive effectively so are easy prey to the sea fish (Hendrickson, 1958). Thus captive rearing of the newly emerged hatchlings for 9 to 12 months until the hatchlings were tough enough to protect themselves helps to avoid heavy mortality during their early life in the sea. Theoretically it ought to be possible to reduce the natural predation on young sea turtles by artificial incubation of eggs and rearing the hatchlings to a size too big for the predators (Carr, 1968).

The World Conference on sea turtle conservation held in Washington, D.C., USA in November, 1979 developed a sea turtle conservation strategy of World wide scope (Bjorndal, 1982) and suggested priorities for sea turtle conservation. This emphasised the protection of nesting beaches, nests, control of predation by man and predators, protection from beach erosion, nesting turtles, avoidance of incidental catches and resuscitation of partly drowned turtles and finally legislation.

Since the present study reveals that a little less than a half of the nests are being destroyed or disturbed by humans, it is clear that a management programme without the co-operation and involvement of the local people responsible would be of little use in the protection and effective management of the Olive Ridley turtles along the coastline of Northern Andhra Pradesh. It was in this context that an extension programme 'save sea turtles' was launched (Subba Rao et al., 1987) and as evidence from the results of the present study, the turtle trade, turtle hunting and the destruction has been reduced considerably from the first year to the last year of the study. The decrease however, was not only due to the increased awareness of the people but also several other factors including greater protection and involvement of the local people mostly the fishermen tribes.

Based on the present study, the following recommendations are considered of very great importance in the management and conservation of the Olive Ridleys along this coastline in India.

(i) **Subsistence hunting:** It can be avoided through intensive extension programmes of education in all the 53 villages of the study area and to bring out awareness of the status and importance of sea turtles.

(ii) **Starting of beach hatcheries:** In all the zones with technically trained personnel supported with several poor fishing tribes who after due training could be employed to supply the hatcheries with eggs, providing information of nesting turtles and protecting the nesting habitats as wardens. This type of tribal involvement reduce the factor of human interference and on the other hand provides needed employment to several poor tribes.

(iii) **A central sea turtle farm:** Central sea turtle farm has to be organised which will receive the new hatchlings from various beach hatcheries of different zones to rear

successfully until they are one year old and cross the crucial period of their life circle.

(iv) **Starting sea turtle farming and management training institute:** The centre may also serve as a research centre to develop sea turtle farming as one of the cottage industries in the fishing villages to utilize the turtle resources in a rational way.

(v) **Strict implementation of the Indian Wildlife (Protection) Act, 1972:** Strict implementation and severe punishment for the commercial exploiters of the sea turtles and eggs. Declare Hope Island near Kakinada as a sea turtles sanctuary and ban all fishing and other activities that are harmful.

#### Acknowledgements

The authors duly acknowledge the University Grants Commission (UGC), New Delhi for financial assistance, and the State Forest Department (A.P) for giving permission to collect the eggs and rearing the hatchlings in captivity. One of the author (PSRS) duly acknowledges the Council of Scientific and Industrial Research (CSIR), New Delhi for awarding the Research Associateship.

#### References

- Bhaskar, S., 1983. Surveying sea turtles. *World Wildlife Fund India*, 47(4):5.
- Bjorndal, K.A., 1983. Manual of sea turtle research and conservation techniques. K.A., Bjorndal (ed), *Centre for Environmental Education*, Washington, D.C., 1-107.
- Bustard, H.R., 1976. World's largest sea turtle rookery. *Tiger paper*, 3:3.
- Carr, A.F., 1968., So excellent a fish: A natural history of sea turtles. *Cox & Wyman Ltd.*, Cassel, London.
- Das, M.C., and Kar, C.S., 1986. Conservation and Management of sea turtle Resources in Orissa coast. *Proc: Int., Symp., Environ. & Ecotoxicology*. The Academy of Environmental Biology, India, 303-316.
- Dimond, M.T., and Hejmadi, P.M., 1983. Incubation temperature and sex differentiation in a sea turtle. *American zoologist*, 23:1017.
- Frazier, J., 1980. Exploitation of Marine turtles in the Indian Ocean. *Human Ecology*, 8(4): 329-370.
- Bjorndal, K.A., 1982. Subsistence hunting in the Indian Ocean. *Proc: World conference on sea turtle conservation*. K.A. Bjorndal (ed), *Smithsonian Institution press*, Washington, D.C., 391-396.
- Hejmadi, P.M., and Dimond, M.T., 1986. Temperature dependent sex determination in the Olive Ridley turtle. *Progress in Dev. Biology*, Part-A, Alan R. Liss. Inc. U.S.A., 159-162.
- Hendrickson, J.R., 1958. The green sea turtle, *Chelonia mydas* (Linn.) in Malaya and Sarawak. *Proceedings of the Zoological Society of London.*, 130: 455-535
- Kuriyan, G.H., 1950. Turtle fishing in the sea around Kurusadai Island. *Journal of the Bombay Natural History Society.*, 49(3): 509-512.

- Raja Sekhar, P.S., 1987. Captive Propagation and Management of an endangered sea turtle, *Lepidochelys olivacea* (Eschscholtz) of the Northern Andhra Coast, *Doctoral thesis*, Andhra University Visakhapatnam, India: 1-93.
- Riney, 1967. Conservation and Management of African wildlife. *F.A.O. publication*, Rome.
- Subba Rao, M.V., Raja Sekhar, P.S., and Subba Rao, V.V., 1987. Ecology and Management of the Indian sea turtles. U.G.C., *Final technical report*, 1-25.