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# ***Ecology and Management of Indian Sea Turtles***

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Dedicated to:



Dr. M.V. SUBBA RAO(Author) & Dr.H.R. BUSTARD

**Dr. H.R.BUSTARD,** Ph.D

Formerly FAO Expert on Crocodiles and Sea turtles and instrumental in involving the Author in the Conservation and Management of Indian Crocodiles & Sea Turtles

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## PREFACE

The present investigations on the Olive ridley sea turtles, *Lepidochelys olivacea* (Eschscholtz) is an important study of their Breeding Ecology, Captive Propagation and Management. The sea turtles has received attentions from all parts of the World, including countries, large and small, rich and poor and many states around the Indian Ocean. On the list of projects occupying the attention of the World Wildlife Fund and the Species Survival Commission, sea turtles are top priority.

If the turtles are properly conserved and husbanded could be an invaluable source of food for the growing population in a hungry World. Now a days the demand for turtles meat, oil, skin, calippee and shell has reached enormous proportion, resulting threatening these valuable species of sea turtles. The investigation present here for the Olive ridleys given valuable information for the researchers and conservators who are interesting on the sea turtles.

The University Grants Commission, New Delhi is duely acknowledged for supporting the project, financially to study on the "Ecology and Management of the Indian Sea Turtles". It is in this project, the present study has been made and it may be first of its kind completely based on ground survey and covered a distance of about 280 km runs through the districts of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari of the Northern Andhra Pradesh. Many natives, fishermen tribes provided valuable information and helped in many ways at the field works. The author is thankful to them without whose co-operation this work would not have been successful.

Finally, my sincere thanks to the Government of Andhra Pradesh Forest Department, especially to the Chief Conservator of forest (Wildlife wing) whose unremitting co-operation and assistance and also the staff of Indira Gandhi Zoological Park, Visakhapatnam helped in many ways for successful completion of this project work.

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## **INTRODUCTION**

Sea turtles are ancient group of Reptiles which have been swimming the oceans for over a hundred millions years. These oldest reptiles are valuable resources to many people of the Indian Ocean having contributed to the nutritional, economic and cultural fabric of the region (Frazier, 1980).

However, despite the long standing values of this resources, its future is in jeopardy and many turtles population have been declined to the point where they no longer significant resources, either materially or culturally. This is mainly due to indiscriminate exploitation largely at breeding stages (Frazier, 1982).

Preservation and wise exploitation of marine turtles in Washington, D.C., U.S.A. in November 1979, emphasized the need in conserving these valuable resources and developed a conservation strategy of World Wide Scope (Bjorndal, 1982 and Pritchard et.al., 1983).

India, with its 7,500 km of shoreline draw five species of sea turtles; the leather back, *Dermochelys coriacea* Linn; the logger head, *Caretta caretta* Linn; the Hawk's bill turtles, *Erettmochelys imbricata* Linn; and the Olive ridley, *Lepidochelys olivacea* ( Eschoschoitz).

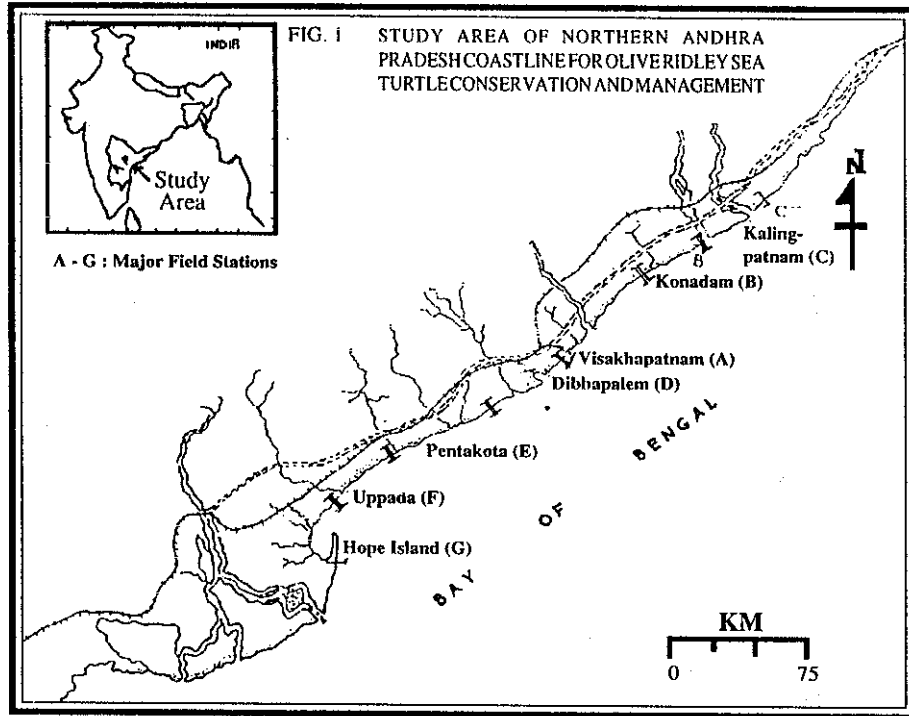
All the five species of Sea turtles in the Indian Ocean facing depletion of their population mainly due to poaching of the breeding turtles and their eggs. Now most of the nesting colonies of these turtles have been disappeared from the main land, beaches, Olive ridleys being the main exception. Olive ridley sea turtles, *Lepidochelys olivacea* (Eschoschoitz) is most common in Indian Ocean and worst victim of human depredation.

The Present study along the Northern Andhra Pradesh coastline and a result of four successive years (1983 - 1987) studied of marine turtles especially the Olive ridleys, *Lepidochelys olivacea*.

### **STUDY AREA:**

The coastline between Kalingapatnam in the North and Hope Island in the

South has been selected for the present investigation. This area has a coastline of 280km that runs through Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts of Andhra Pradesh situated between 16° 50' and 18° 25' latitudes and 82° 10' and 84° 10' longitude (Fig.1)



This area has diversified shore conditions ranging from rocky to shallow sandy shores with several extensions of hill ranges projecting into the sea. Seven rivers with their major tributaries have their estuary in this area and a number of creeks, backwaters and streams also merge into the sea.

A total of 53 villages, most of which belong to fishermen tribes and their population is around 63,000. A total of 300 to 350 fishing trawl operating along this coast line and a large number of mechanized boats and catamarans (Table 1), Visakhapatnam is a major port and the Head Quarters of the Eastern Naval Command of India.

**Table 1: Physiographical and Social information of the demarcated zones for the sea turtle, *Lepidochelys olivacea* Management**

Zone	Main Station	Longitude	Latitude	Boundaries		Shoreline (Km)/ Condition	Rivers, Backwaters Perennial streams creeks & salt pans	Plantations	No. of Villages	Population			No. of boats	Other activities/ importance
				North	South					Male	Female	% literacy		
A	Visakhapatnam	83° 30' 83° 35'	17° 40' 18° 00'	Champavathi (R)	Dolphin's nose	52 rocky deep Creeks:4	Goshani (R) Champavathi (R) Perennial streams:2	Casuarina Banana Coconut	10	4936	4973	6.8	751	Port operations, Naval operations, Shipyard and its docks, Recreation, Sanddigging
B	Konada	83° 35' 84° 00'	18° 00' 18° 15'	Nagaravathi (R)	Champavathi (R)	48 Shallow sandy	Perennial streams:2 Back waters:1 Creeks:6	Casuarina Coconut Cashew-nut	7	3144	3117	3.3	308	Agriculture, Cattle farming, Fresh water fishing, etc.
C	Kalingapatnam	84° 00' 84° 10'	18° 15' 18° 25'	Vamsachara (R)	Nagaravathi (R)	28 Shallow sandy	Nagaravathi (R) Vamsachara (R) Backwaters:1 Creeks:3, Salt Pans:2	Coconut Casuarina Banana	7	2598	2562	4.0	369	Quarry mining, Fresh water fishing/Temple for 'Kumarabara'
D	Dibhapalem	83° 20' 83° 00'	17° 40' 17° 30'	Dolphin's nose	Padmadaka (V)	36 Backwaters:1 rocky deep	Backwaters:1 Creeks:5 Salt pans:2	Casuarina Coconut Banana	8	8066	8033	3.9	903	Upcoming Steel Plant & shifting of industrial labour Quarry mining
E	Pentakota	83° 00' 83° 30'	17° 30' 17° 15'	Lovapalem (V)	Pentakota (V)	59 shallow sandy	Sarada (R) Tandava (R) Back waters:1 Creeks:3, Salt Pan:1	Cashew-nut Coconut Casuarina	7	6666	6548	4.5	624	Agriculture, Sand digging, & Fresh Water fishing
F	Uppada	82° 30' 83° 15'	17° 15' 17° 00'	Chiripeta (V)	Valakapudi (V)	38 shallow Sandy	Yakeru (R) Backwater:1 Creeks:3	Casuarina Coconut Cashew-nut	9	4002	4009	4.0	435	Cattle farming, Piggery & Fresh water fishing
G	Hope Island	82° 15' 82° 10'	17° 00' 16° 50'	Valakapudi (V)	Coringa (R)	25* Shallow sandy	Gareru (R) Coringa (R) Creeks:1 Backwaters:1	Casuarina Coconut	5**	2430	1962	5.2	302	Fresh water fishing, Brackish water fishery

R : River,

V : Village

\* : 4 Kms shoreline of mainland,

\*\* : 2 Villages of mainland

For the convenience of executing the present investigation, the entire study area was divided into seven major zones (Fig1).

Zone:	Main Station:
A	Visakhapatnam
B	Konada
C	Kalingapatnam
D	Dibbapalem
E	Pentakota
F	Uppada
G	Hope Island

Zone A (Visakhapatnam) harbors and many industries along its coastline including the largest Steel Plant in Asia. At zone B (konada) is the main station has a shoreline of 48km. Zone C (kalingapatnam) situated between the rivers of Nagavali and Vamsadhara with a coastline of 28km. Zone D (Dibbapalem) is the 36 km shoreline of rocks and rocky pools. Zone E (Pentakota) is the largest rocky shoreline of 59km. Zone F (Uppada) has a shoreline of 38km and Zone G (Hope Island) is the Southern Zone has a shoreline of 25km, parallel to the main land varying in width ranging from 200 to 1500 meters ( $P_1 - P_6$ ).

### STATUS OF THE OLIVE RIDLEY TURTLES:

Field studies has been conducted along the Northern Andhra Pradesh coastline for a total period of four years during 1983-1987. A major part of the survey was made on foot and when required with the assistance of some natives of the region or fishermen of the local villages. The 'Syndrome approach' (Subba Rao et al, 1987) is the principal method used in the present study to assess the status of hunting, exploitation of nests, nesting turtles and its arrivals for nesting.

Status of Olive ridleys, *Lepidochelys olivacea* along this coastline is alarming and their breeding turtles. Olive ridleys occur commonly in this region from the

onset of monsoon and appears until the end of winter, the peak season being during December-February. Most of the fishermen interviewed have expressed that turtles fishing is not in large scale commercial exploitation of this region, it was only a substream hunting for their livelihood.

Live turtles were captured either incidentally in the gear or when they are sighted especially during the courtship activity and on shore during the nesting activity. Captured turtles were kept in tilted position to avoid their movements and escape. During the period, a total of 648 Olive ridleys caught in gear, 170 captured on the shore during the nesting activities. At the present study, zones A and D have shown higher percentage while B and F recorded the minimum. The difference between the successive years was minimal and negligible, while the number of turtles caught in the gear in all the zones ranged between 200 and 225 (Table 2). Besides the live turtles captured by the man as many as 577 carcasses of *Lepidochelys olivacea* found washed shore or killed by predators (Table 3).

**Table 2:** Olive ridley sea turtles, *Lepidochelys olivacea* alive in fishing gear and while nesting during 1983-86:

Zone	Turtles caught in gear				Turtles caught while nesting			
	1983 -84 I Year	1984-85 II Year	1985-86 III Year	(%)	1983-84 I Year	1984-85 II Year	1985-86 III Year	(%)
A	52	41	35	19.75	12	9	11	18.82
B	23	24	21	10.50	9	6	8	13.53
C	27	30	35	14.20	7	6	7	11.76
D	28	41	32	15.59	15	9	12	21.18
E	26	29	38	14.35	8	4	6	10.59
F	13	15	27	08.49	10	7	8	14.71
G	42	32	37	17.12	7	4	5	09.41
<b>Total :</b>	<b>211</b>	<b>212</b>	<b>225</b>		<b>68</b>	<b>45</b>	<b>57</b>	

**Table 3:** Carcasses of Olive ridley sea turtles (*Lepidochelys olivacea*) found at different zones during 1983 - 86.

Zone	I Year 1983-84	II Year 1984-85	III Year 1985-86	(%)
A	28	16	9	9.18
B	24	19	14	9.88
C	31	27	24	14.22
D	29	32	22	14.38
E	37	44	26	18.54
F	36	21	22	13.70
G	42	41	33	20.10
<b>Total:</b>	<b>227</b>	<b>200</b>	<b>150</b>	

The status of the Olive ridleys along the defined coastline was also evident from the destruction or disturbances to the nests and nesting habitats. A total of 929 nests were recorded of which 805 were disturbed by the human or subjected to the predation.

**Table 4:** Status of the Olive ridley sea turtle nests along the Northern Coast of Andhra Pradesh during 1983-1986.

Status of Nests	I Year 1983-84		II Year 1984-85		III Year 1985-86	
	(n)	(%)	(n)	(%)	(n)	(%)
Undisturbed	22	(17.74)	36	(29.03)	66	(53.23)
Human disturbed	204	(46.15)	151	(34.16)	87	(19.69)
Predators disturbed	147	(40.15)	113	(31.13)	103	(28.37)
<b>Total</b>	<b>373</b>	<b>(40.15)</b>	<b>300</b>	<b>(32.29)</b>	<b>256</b>	<b>(27.56)</b>

## BREEDING ECOLOGY:

During the breeding season of the olive ridleys, the systematic surveys on foot were made along the entire coastline of each zone and data pertaining to the sea turtles. Breeding seasons were determined basing on the personal observation recorded during the surveys which the author compared with the data of the 'Syndrome approach'.

The Olive ridley Sea turtles, *Lepidochelys olivacea* are oviparous animals and nest by annually. The breeding season synchronized with the non - monsoon seasons (Winter and early Summer) of this region.

## BREEDING SEASONS:

The breeding seasons as referred here covered the period from courtship activity to the emergence of the hatchlings and was conveniently divided into three periods.

1. Courtship season
2. Nesting season
3. Hatching season.

### 1. COURTSHIP SEASON:

Mating was observed from mid November and lasted for nearly three months until mid February and occurred during the winter season.

### 2. NESTING SEASON:

Nesting was observed between early January to late March through a greater part of the season was during winter, but the air temperature began to gradually increase, Peak nesting was observed during February.

### 3. HATCHING SEASON:

Hatchlings emerged from the nests in early March to late May, before pre Monsoon. During the time, the temperature rapidly increases.

### COURT SHIP:

Courtship of the Olive ridleys takes place off - shore on the surface and both the participants remain with little movement for several hours. Courtship was observed for longer periods ( 2 to 8 hours). During the time, the Olive ridleys were found to be most susceptible to capture by poachers as the turtles could not disassociate easily to escape.

### NESTING:

Olive ridley sea turtles laying their eggs on the sandy beaches in the nest pits dug by themselves ( $P_7 - P_9$ ). Nest and Nesting habitat of the Olive ridleys recorded by examining the shoreline at regular intervals during nights with the assistance of a few fishermen tribes often basing on the crawl tracks of the turtles ( $P_{10}$ ). A total of 124 nests of Olive ridleys were located in the study period.

**Table 5:** Monthly distribution of identified nests of Olive ridley sea turtles during 1983 - 86.

Month	Years							
	1983-84		1984-85		1985-86		Total	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
December	2	9.1	2	5.6	6	9.1	10	8.06
January	4	18.2	6	16.7	7	10.6	17	13.71
February	14	63.6	18	50.0	28	42.4	60	48.39
March	2	9.1	10	27.7	25	37.9	37	29.84
Total: (n)	22		36		66		124	

### NESTING HABITAT:

The beaches selected by the nesting Olive ridleys were fine sandy areas with a gradual slope and often edged with small patches of ground vegetation at the high beaches platform. The nesting region were mainly dominated by grass species, *Spinifex littoreus* ( $P_6$ ); a creeper, *Ipomea pescaprae*; a mangrove plant, *Pandanus fascicularis*. Shore fauna consists of mainly ghost crabs, *Ocypoda species*, *Uca species*, several insect larvae, maggots. Birds like cranes, *Grus communis*; sea gulls, *Larus brunnicephalus*, cattle egrets, *Bubulcus ibis coromandus*; pond herons, *Ardeola grayii*; and domestic crows, *Corvus splendis* were most dominant.

Of mammals, jackels, *Canis aureus*; foxes, *Vulpus bengalensis*; and hyacnas, *Hyaena striata* were common in most of the areas where the areas edged with dense vegetation, while domestic dogs and pigs were common in the areas where human habitation is more.

### NESTING TIMES:

Time of the nesting was arbitrarily determined basing on the crawl tracks of the Olive ridleys. Crawls were mapped as stylized drawings. With the help of these drawings, the tracks were identified ( $P_{10}$ ).

Olive ridleys usually nest during nights, mostly on the Moon - lit nights between dusk and dawn. With the evidence of the fresh crawls, the successful nesting occurred during 2200 - 2400 hrs while, minimum nesting occurred during 1900 - 2100 hrs (Table 6). Location of the Olive ridley nests usually sited on typical beaches at a distance ranging from 10 to 60 meters from the high - tide water mark. Most of the nests were located at a distance ranging from 16 to 45 meters ( $P_{11} - P_{12}$ ).

**Table 6:** Frequency of Olive ridleys nesting at 1st hour and 3rd hour intervals during 1984 -85

Time (h)	(% nesting)	
	1st hour	3rd hour
1900	3.23	
2000	4.03	12.10
2100	4.84	
2200	14.52	
2300	16.13	43.55
2400	12.90	
0100	4.84	
0200	6.45	19.35
0300	8.06	
0400	17.74	
0500	5.65	25.00
0600	1.51	

### NESTING BEHAVIOR:

The time lapsed between the nesting, (the nesting turtle arrivals to its return) after nesting was from 127 to 232 minutes: (i) the nesting turtle hurriedly crawled at right angle to the shoreline and slowly reached the high platform of the beach. (ii) with all the fore flippers, it began to throw the sand changing the orientation of its body to all direction and made a body pit as depth as its height or a little more ( $P_7$ ). (iii) latter with hind flippers alternatively driven the sand to sides and a rectangular round cornered hole was made which was further widened and deepened by slightly forward movements followed by digging with hind flippers. (iv) after the nest hole was dug, eggs were laid one after another and at times 2 or 3 together. (v) soon after the eggs laying, the nest movements of the hind flippers and latter the body pit was also covered using all the four limbs and left no trace of the

activity( $P_8$ ). After successful nesting, the Olive ridley retreats into the sea ( $P_9$ ).

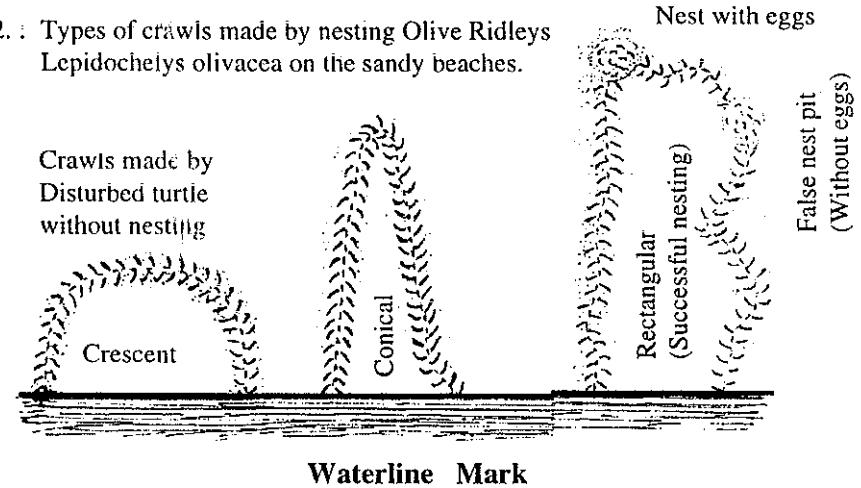
Several Olive ridleys visited the shore, moved for some time and returned back into the sea. Some of the turtles have attempted to nest but failed, these were evident from the crawls identified during the turtle walks at night times.

### CRAWL TRACKS:

The arrival and retreat of Olive ridleys formed crawl tracks ( $P_{10}$ ) on the sandy beaches and these were more clear on the sand in undisturbed conditions. The crawl width ranged between 70 and 80cm with alternatively arranged fore - flippers marks and in the most cases indicated the route taken by the turtle. Three types of crawl tracks were observed (Fig.2) These are:

- Crescent shaped
- Conical shaped
- False - nesting - crawls

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



Of the crawl tracks, 367 recorded during the study period, 183 were crescent shaped and 46 conical shaped, while the remaining were false nesting crawls (Table 7) ( $P_{11}$ ).

**Table 7:** Frequency of different types of crawl tracks of the Olive ridleys during 1983 -86.

Crawl type Nesting	I Year	II Year	III Year	Total	
	1983-84 (n)	1984-85 (n)	1985-86 (n)	(n)	(%)
Crescent	49	62	72	183	49.87
Conial	51	46	49	146	39.78
False	8	16	14	38	10.35
Total	108	124	135	367	--

### NEST AND CLUTCH SIZE:

The depth of the nest of the Olive ridleys ranged from 40 to 90 cm while the maximum number of nests have a depth range between 50 and 60 cm irrespective of its depth ( $P_{12}$  -  $P_{14}$ ). The clutch size of the Olive ridleys has a range from 80 to 145 eggs ( $P_{13}$ ). The monthly means of clutch size varied slightly. However the range was long during the latter part of the nesting season. Eggs were arranged in 3 to 4 rows.

### EGGS:

The identified nests were opened and noted the nest location, clutch size, egg morphology, weight etc. Size of the eggs ( $P_{14}$ ) was measured with a Vernier callipers while the eggs were weighed on a simple monopan balance in the laboratory. Eggs that have spoiled before the first week of incubation were opened and examined for the embryonic development were referred to as infertile eggs. Eggs with unusual size and shape without any embryonic development were recorded as abnormal eggs.

The eggs of the Olive ridley sea turtles were white in colour and round in shape with a diameter of ranging from 37 to 46 cm and a weight range from 22.4 to 37 g. The shell was porous, delicate and slightly flexible ( $P_{14}$ ).

### INFERTILE AND ABNORMAL EGGS:

On average, 10.54% eggs were recorded as infertile eggs without any symptoms of embryonic development or with early embryonic deaths. Infertile eggs in individual clutches ranges from 16 to 19.

In three instances, abnormal eggs of Olive ridleys were found and this constituted 1.65% of the infertile eggs. The abnormal eggs were odd in shape, size and weight. One egg was very much elongated and probably fusion of two eggs and measured 65mm in length and 42mm in breadth while the weight of the egg was 55.9g. In a different clutch, a couple of very small eggs round in shape 24mm in diameter and 5.7g weight were noticed.

### CAPTIVE PROPAGATION:

After the nests were identified and opened carefully by hand until the top layer of eggs exposed. Well ventilated wooden boxes were used to carry the eggs in which the nest sand was used to cover the inter spaces between the eggs and egg layers. The eggs were arranged in the boxes without changing their axial orientation as they were same in the nest. Then the eggs were transported by road to the Central Hatchery as quickly as possible but not later than 12 hours.

Soon after, the eggs were brought to the Central Hatchery and were placed in a sterile petridishes in between moistened cotton layers, then the petridishes were arranged in the BOD

Incubators in which the required temperatures were maintained ( $27^{\circ}$  to  $30^{\circ} \pm 1^{\circ}$  c). Some of the nests were hatched as it is in the natural conditions (*in situ*) with protection of wire meshes. Hatching experiments were conducted both '*in situ*' and in laboratory conditions.

## 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 27°C or above 30°C range without harm to the embryos but are lethal if held constantly above 32°C and below 27°C in artificial incubation. Hence a narrow range of temperatures were maintained constantly in the present experiments i.e., 27° to 30° ± 1°C. In artificial hatching, temperature maintenance and moistening of the cotton layers are essential precautions.

### 'IN SITU' HATCHING :

A total of 23 nests were protected individually with wire meshes and guarded with local fishermen youth. The clutch size of these nests had a range of 80-145 eggs with the average size of 118 eggs/clutch.

Of these, 10.54% of the egg were found to be infertile or met with early embryonic death and spoiled before the first week of the hatching. These eggs emitted foul smell and attracted soil insects which damaged the whole nest if unchecked.

Another 34.36% of eggs have spoiled before 45 days, while 10.21% of the eggs did not hatch but contained discernible embryos. 44.89% of the eggs hatched but they could emerge out of the nest. These hatchlings were infected with ants, insect larvae and other soil insects. On the whole the hatching success was 34.24% of the total eggs. Hatching period was between 57 and 62 days, while most of the nests hatched by 57th day (Table 8).

**Table 8 :** Details of the hatching and hatching success in the Olive ridley clutches 'in situ'.

Parameters	Minimum	Maximum	Average
Clutch size (No. of eggs)	80	145	118
Egg diameter (mm)	37	46	40.08
Weight of the egg (g)	22.4	37.0	32.28
Infertile eggs (%)	7.50	15.15	10.54
Fertile 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 discernable embryos (n/clutch)	3	27	12
Hatched eggs and dead in nest ( n / clutch)	5	24	13
Hatched eggs and escaped from nest (%)	23.81	47.31	34.24
Hatching period (days)	51	62	57

### ARTIFICIAL HATCHING :

A total of seven clutches were hatched under laboratory conditions (P<sub>15</sub> - P<sub>20</sub>). Of these two clutches belonged to 1984-1985 and remaining five

clutches were of 1985-1986. Altogether a total of 891 eggs were incubated under artificial conditions. Of which 127 were infertile and rest of the fertile eggs were kept for artificial incubation. Out of 764 fertile eggs were kept for hatching, 86 (11.26%) dead as pipped eggs. This occurred during the period between 20 and 45 days of incubation. Most of these turtles embryos dead in pipped eggs have been recorded during 3rd, 4th and 5th weeks of incubation. Out of 764 eggs (fertile for hatching), 52 (6.80%) eggs were unhatched but contained discernable embryos. These unhatched eggs with discernable embryos were found during the seventh and eighth weeks of incubation.

On the whole, 626 fertile eggs from 764 eggs of seven clutches have been successfully hatched under complete captive conditions. The hatching time varies between 56 and 60 days. The overall hatching success was 81.94% (Table 9). ( $P_{15} - P_{20}$ ).

### EGGS DURING INCUBATION :

During the period of incubation, the eggs of Olive ridleys have showed several variations in the size, weight, colour etc. These have been well recorded in the hatching experiments under artificial incubation.

The eggs increased gradually for the first two weeks by the size and weight. The total increase by weight during the period was 2.1g. Between the 3rd and 5th weeks of the incubation, the weight increase was very minimal (0.5g). After the 5th week, the eggs lost their weight until they were hatched, the mean weight reduction was 3.7g. A similar trend was observed with the size of the eggs by the end of the 2nd week was 1.2mm, between 3rd and 5th weeks, the increase was 0.4mm and their after decreased till hatching. The mean decrease was 2.6mm. As the eggs incubation progressed, the eggs shell showed gradually deposition of calcium on its surface.

**Table 9:** Details of the hatching and hatching success of seven nests incubated in the Central Hatchery during 1984-86.

Year	Total eggs hatched	Infertile eggs	Fertile eggs	Spoiled eggs	Eggs developed & unhatched	Hatched eggs	Hatched & dead	Hatching success
	(n)	(n)	(n)	(n)	(n)	(n)	(n)	(n)
1984-85	128	18	110	12	6	92	6	83.6
1984-85	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
Total:	891	127	764	86	52	626	47	81.94

### HATCHLINGS:

Immediately after the emergence from the eggs, the hatchlings were dark black in colour and weighed between 15 and 18g and had a size range of 36-41mm in carapace length and 34-40mm of carapace width ( Table 10 ).

**Table 10:** Morphometry of the one day old hatchling of the Olive ridley sea turtles.

Parameters	Range	Mean
Carapace length (mm)	36 - 41	39.46
Carapace width (mm)	34 - 40	38.62
Plastron length (mm)	25 - 29	27.43
Plastron width (mm)	22 - 26	24.14
Head length (mm)	16 - 19	17.66
Tail length (mm)	3 - 4	3.27
Weight (g)	15 - 18	16.72

## ABNORMAL HATCHLINGS:

Out of 579 turtle eggs hatched in captivity, eight were found to be having abnormalities such as short flippers, ill developed snout and carapace of abnormal shapes etc. These occurred in negligible percentages.

## INCUBATION TEMPERATURES AND SEX-RATIOS:

Incubation temperatures seemed to have played a crucial role in determining the sex of the sea turtles. Incubation temperatures below 29°C hatch to males and above 29°C hatch to females. An examination of the external features of the hatchlings revealed that most of the males have longer tails with a narrow cloacal slit and oval shape body, while the females have shorter tails with oval shaped cloacal apertures and slightly wide rounded body.

## CAPTIVE REARING:

During the study period a total of 579 hatchlings of the Olive ridleys were reared in complete captive conditions for 9 to 12 months during 1984-85 and 1985-86 respectively. After which, they are released into the sea. The hatchlings were reared in artificial tanks of different sizes, some independently, some in pairs, and some in groups depending upon the size of the tank 50cm x 100cm and hatchlings subjected to acclimatization of 50:50 sea water to fresh water, for reducing the monitor costs ( $P_{21} - P_{22}$ ).

## ACCLIMATIZATION:

During the study period, two types of water acclimatization experiments were conducted.

- 1) Direct acclimatization (DA)
- 2) Gradual acclimatization (GA)

Hatchlings acclimatized under GA conditions were relatively more active than those acclimatized under DA conditions. Mortality was high in DA when compared with GA stock.

At concentrations below 50% sea water hatchlings were more susceptible to the fungal and bacterial infections, which often made the hatchlings inactive, loss of appetite and resulted in death.

## FOOD AND FEEDING:

In captivity, different varieties of food items were offered considering the age, size and response of the hatchlings. The newly born hatchlings of Olive ridleys did not feed on any of the food items provided until they are 5-6 days old and later attempted feeding on marine algae, *Gracillaria sp.*

However, a few hatchlings which appeared to be weak and inactive were forced fed with vitamin drops and glucose water. On the whole, food types belonging to the following five kinds are provided to the hatchlings during the captive rearing.

These are:

- a) Marine algae
- b) Polychaets
- c) Crustaceans
- d) Molluscs
- e) Marine fish

During the first two months, the hatchlings fed mainly on marine algae and molluscs. They rarely attempted on other varieties of which, artificial food types such as boiled eggs and meat pieces. From the fifth month, they feeding on marine algae gradually decreased, while feeding on marine fish was increased. However, feeding on molluscan varieties ranked high throughout the rearing experiments. Olive ridley hatchlings preference to various types of food were shown in Table 11.

**Table 11:** Food types offered to the Olive ridley hatchling in captive and its food preference.

Food Types offered	Food Preference
<b>A. Marine Algae</b>	
a. <i>Gracillaria sp.</i>	+++
b. <i>Ulva sp.</i>	++
c. <i>Spongomorpha sp.</i>	+
d. <i>Chaetomorpha sp.</i>	0
<b>B. Polychaeta</b>	
a. <i>Nereis sp.</i>	++
b. <i>Sebella sp.</i>	+
<b>C. Crustacea</b>	
a. <i>Metapenaeus monoceros</i>	+++
b. <i>Penaeus indicus</i>	++
c. <i>Scylla sp.</i>	+
<b>D. Mollusca</b>	
a. <i>Cellana radiata (Limpets)</i>	+++
b. <i>Nerita albicella</i>	++
c. <i>Sepia sp.</i>	++
<b>E. Marine Fishes</b>	
a. <i>Stolephorus sp (white bait)</i>	+++
b. <i>Sardinella longiceps (white bait)</i>	++
c. <i>S.gibbosa (white bait)</i>	++
d. <i>Dussumeria sp.(white bait)</i>	+

+++ : High preference ; ++ : Common Food; +: Low preference; 0: Rejected.

The food consumed by an individual hatchling increased with the increasing age, and the consumption of a 19.5g on day 7th was 0.75g has been increased to 103g at the end of one year, when the body weight of the hatchling was 712.5g. The increase in the food consumption with the increase in the age and weight of the hatchling was observed during the study period.

## GROWTH:

Growth of the hatchlings of sea turtle was studied for 12 months under captive conditions. Growth in term of size (carapace length), weight of the body before feeding. At the end of one year, the hatchlings had an average increase of 712.5g by weight, 145.5mm in carapace length and 142mm in carapace width. Growth in the initial phases was rapid and gradually declined at the latter phases (Table 12).

**Table 12:** Mean growth and growth rate in the hatchlings of the Olive ridley sea turtles in captive rearing.

Age (Days)	Weight (g)	Increase (%)	Carapace			
			Length (mm)	Increase (%)	Width (mm)	Increase (%)
60	46.0	296.8	30.0	93.8	30.0	96.8
120	50.5	82.1	30.0	48.4	31.0	21.1
180	70.5	62.9	18.5	20.1	19.0	21.1
240	127.0	69.6	12.5	11.3	15.0	13.8
300	204.0	65.9	9.5	7.7	5.5	4.4
360	198.0	38.6	5.5	3.8	3.5	2.7

As the hatchlings grown, several changes occurred in their physical appearance, markings on the soft parts and structure of the carapace. The piastron region and the soft parts gradually turned pale and the shell toughened, the outer edge of the shell to form angular ledges. Growth of the second claw was observed on the flippers from the fifth month onwards ( $P_{21} - P_{22}$ ).

## MORTALITY IN CAPTIVITY:

Mortality of the hatchlings reared in captivity was recorded as and when it occurred and the dead hatchlings were thoroughly examined to identify the reason for

mortality. From the time of hatching to the end of one year, altogether 135 were dead of 626 hatched in captivity, 95% (47) of hatchlings were dead after hatching. Remaining 23.84% (36) in 1984 - 85 and 12.15% (52) in 1985 - 86 were due to mortality factors, responsible given in Table 13.

**Table 13:** Mortality factors in captive rearing of the Olive ridleys hatchlings during 1984 - 85 and 1985 - 86

Reasons for Mortality	1984 - 85		1985 - 86	
	(n)	(%)	(n)	(%)
Bacterial and Fungal infections	16	44.44	24	46.15
Digestive problems	8	22.22	13	25.00
External injuries	6	16.67	8	15.38
Excretory problems	2	5.56	3	5.77
Obstruction of food in throat	3	2.78	2	3.85
Undiagnosed	1	2.78	2	3.85

A total of 579 hatchlings reared in captivity and of these 84.80% hatchlings reached one year old. Five major factors caused severe mortality during the captive rearing of the Olive ridley hatchlings.

- a) Infection from Bacteria and Fungi
- b) Digestive problems
- c) External injuries
- d) Excretory problems
- e) Obstructions of food in the throat.

Bacterial and Fungal infections appeared when the hatchlings rearing in more fresh water and less sea water and unhygienic conditions. First attacked the soft parts

especially eyelids, nostrils, neck region, tips and joints of flippers and cloacal region. When infections caught on the eyelids, and resulted in blinding and ultimately turtles exhibited loss of weight and reduced movements. Digestive problems including indigestion due to over feeding, gas formation, malnutrition etc., such individuals refused to feed, reducing activity and floated for longer periods seeking corners of the tank. In group rearing, hatchlings bite one another causing injuries on the soft parts which very often infected with bacteria and fungi. The infected parts appeared white to dirty yellow in colour and when unchecked lead to death. Some of the hatchlings of the total mortality in the hatchlings was due to excretory problems. Such hatchlings exhibited swollen abdominal region, accumulation of urine in the urinary bladder and could not dive into the water.

While feeding larger pieces of food items more often than not got struck in the throat region, obstructing the air passage, such individuals faced spontaneous death after continuous spattering on the water surface with fore flippers for 5 to 10 mts. In captive rearing, mortality gradually decreased from the first month to the last month. The first five months recorded more than 70 % of mortality.

### EPEDEMIC, DIAGNOSIS AND TREATMENT:

Different types of treatments were tested to each of the mortality factors and the treatments that were found to be effective. For fungal and bacterial infection caused due to maximum mortality. For this infection, 5ppm of Potassium permanganate (KMNO<sub>4</sub>) bath for 5 to 10 mts., later they were kept in shade dry conditions for 3 to 4 hrs after they released in individual plastic pools with 100% sea water. The treatment was repeated until the infection was controlled. If the infection was served, such individuals separated cleanse with medical Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and turked with sterile cotton. Later, they were treated with the mixture of vaseline with antibacterial, Garamycin and antifungal, Daktarine gel ointment.

Hatchlings suffering from digestive problems were separated and released into individual plastic tubs containing pure sea water and they were kept for few days without food and forcey fed with liquid food mixture of multivitamin syrup,

glucose with Digene syrup. Obstruction of food particles in the throat region was found, then the mouth was opened with a blunt forceps with which the food particles were removed physically if it is visible. When the obstruction particles was not visible the pharynx region was spot flushed with glucose plus sea water for two to three times until the obstruction cleared.

### **BEHAVIOUR OF THE HATCHLINGS:**

Some behavioural aspects were recorded on the basis of continuous observation as by simple tests to the hatchlings were seven days old. They were very active with continuous movements in the tubs, always faced towards the light source. Under captive conditions, the activity of the hatchlings including mainly for:

- a) Feeding
- b) Movements
- c) Resting
- d) Combats

### **FEEDING:**

While the hatchlings were in feeding, they picked up food materials or particles by mouth, however when the food material was very small, they disturbed with fore flippers and catch the food after it was raised from the bottom. In case of large meat pieces, they bite the piece and tied to cut them holding with the fore flippers and sharp nails on the flippers.

### **MOVEMENTS:**

Healthy hatchlings stay at a few centimeters above the bottom of the tank. Depending upon the age, size and state of the health of the hatchlings, they remained under water for considerable periods. One year old hatchlings have an interval of about 18 mtrs between two breaths.

### **RESTING:**

Olive ridley hatchlings usually rest very frequently for shorter periods ranging from a few minutes during day time to several hours in nights. Three types of resting behaviour were observed. (i) Resting on the bottom (ii) Resting on the surface of the water (iii) Resting on the support. Most of the resting period was longer. They selected dark corners of the bottom of the tank and remaining without any movements. The hatchlings are resting on the rocks or corals which provided in the tank with the support of the tank wall.

### **COMBATS:**

In group rearing, hatchlings bite with one another especially on the soft parts, such as flippers, nostrils and neck region and some time edges of the carapace. Rarely they fought directly facing each other. Most of the combats lasted for few seconds ranging from five to twenty seconds.

### **MANAGEMENT STUDIES:**

Protection and Management of the Olive ridleys of the Northern Andhra coast mainly depending upon the control of human interference and predatory disturbances to the breeding turtles, breeding grounds and the nests. Human interference on the turtles trade and other aspects required for the management have been collected through Syndrome approach as mentioned earlier. Predatory disturbances were recorded on the basis of field observations and careful examination of the disturbed nests. Post-paid self addressed cards were distributed to the Village Head and other literates who provided several types of information on the Olive ridleys and other sea turtles.

### **HUMAN INTERFERANCE:**

Along the defined coastline of the study area around 63,000 population inhabited in 53 villages. The literacy people are 3 to 7 % activities of the shore inhabitants including mainly fishing, crab hunting, shell collection for lime, ornamental, knitting, drying of fish and nets on the shore. Of these, fishing is the major activity.

The fishing activity was intensive all along the coast. Deep sea fishing with modern trawls was extensive in Zones A and G as many as 350 trawlers were found to be operating here. In addition to these, around 3,400 small boats and mechanized crafts were in operation. Maximum number of the crafts were operating in zone D, followed by zones A and E. While fishing, few turtles accidentally get trapped in the gear which are brought to shore for several purposes including trade. During the study period, 648 turtles were brought for trade ( $P_{23} - P_{26}$ ). Olive ridley are being used by the fishermen tribes for many purposes. The Caapace is being used carrying the fish, salt and other materials ( $P_{27} - P_{28}$ ). While the meat was either consumed or sold or used as bait material ( $P_{26}$ ) on the hooks of the nests to trap large fish.

The price of Olive ridleys at various markets varied from time to time. Live meat of Turtles were sold at any price between Rs.2 to 4 per kg. ( $P_{25}$ ). Carapace of the Olive ridleys were brought and were sold at prices ranging from Rs. 10 to 50 depending upon their size. Market prices at different zones during 1983 - 87 were delineated in Table 14.

**Table 14:** The price of Olive ridley sea turtle carapace, meat, live animal and eggs sold at different Zones in the markets during 1983-86.

Zone	No. Of Markets	Live animals each (Rs.)	Meat per Kg (Rs)	Carapace each (Rs)	Eggs each (Ps).**
A	4	45 - 50	2 - 3	30 - 40	25 - 45
B	2	30 - 40	1 - 2	15 - 20	15 - 20
C	3	30 - 45	1 - 2	15 - 25	15 - 25
D	4	50 - 75	3 - 4	40 - 50	35 - 50
E	5	40 - 45	1 - 2	10 - 15	20 - 30
F	2	40 - 45	1 - 3	15 - 20	20 - 30
G	3	45 - 50	2 - 3	25 - 35	25 - 40

\*\* 1 Rupee = 100 Ps.

Very often the fishermen knit the nets or spread them for drying on the shore and at times, some nesting turtles happen to get trapped. These were killed by them for trade or personal consumption. A total of 15 such accidentally trapped in the nets during the study period.

Beach combers capture the nesting turtles or disturbed the nests, collect the eggs for trade or personal consumption. A total of 2 nests identified as disturbed by the human was recorded during the study period. Besides the fishing activities, other activities of the human that altered the nesting grounds of were sea turtles, include mainly agriculture, social forestry, quarry mining and sand collection for masonry purposes.

### PREDATOR DISTURBANCES:

Consequent to the human inhabitation, the presence of domestic dogs, pigs etc., was very high ( $P_{29} - P_{30}$ ). Beside these in some areas where the human activity is meagre, wild predators like foxes, jackals and hyaenas were noticed. All these more often preyed upon the Olive ridleys eggs and the nesting hatchling turtles. In nature, Olive ridley hatchlings emerge from the nest in groups and usually spend some time on the nests surfaces encircling it or moving here and there were very often fall prey to domestic crows and sea gulls as well as Ghost crabs.

Predation on the Olive ridleys turtles eggs was very high in the freshly laid eggs or at the time of hatching ( $P_{29}$ ). As many as 363 nests were identified as disturbed by the predator ( $P_{29} - P_{30}$ ). Some times, these major predators attack the nests and killed them on the shore and nine off such carcasses killed by predators were identified.

### ZONAL IMPORTANCE:

All these zones were made surprise radius on 23 fish markets where turtles trade was observed. The number of surprise raids made at each fish market ranged from 2 to 7 / market / year.

The data on the turtles trade indicated that the sea turtles are being exploited indiscriminately. Most of this trade carried out in the market where illiterates and most backward classes of the society are involved. Zones D and G have maximum records in sea turtles trade while, zones A and C have minimum trade records (Table 15).

**Table 15 :** Olive ridleys turtles brought for trade at different zones during 1983 - 86.

Zone	I Year 1983 - 84	II Year 1984 - 85	III Year 1985 - 86	%
A	17	6	2	7.86
B	23	8	1	10.06
C	16	10	4	9.44
D	48	22	8	24.53
E	22	12	3	11.63
F	29	22	2	16.66
G	36	25	2	19.82
Total (n)	191	105	22	-
(%)	60.06	33.02	6.92	-

In all the zones, sea turtles trade has decreased remarkably from year to year of the study area due to awareness, creation among the fishermen communities. Comparative study of arrivals of the *Lepidochelys olivacea* as revealed from the fresh crawls and identified nests indicates that zone G, attracted a large number of sea turtles, nest in a graded order i.e. zones, F,A,D,E,C and B.

Zone G had maximum predatory and human disturbances to the nest and nesting turtles followed by zones A, E, D, C, F and B (Table 16).

**Table 16 :** Factors threatening the survival of Olive ridley Sea Turtles at different zones and divisions of the study area.

Zone	No of Zones divided	False Crawls	Identified Nests	Human Disturbed nests	Turtle trade	Caught in fishing gear	Trapped in Drying nets	Turtles released in to the Bay of Bengal	Caught while nesting	Turtles killed by predators	Nests disturbed by Predators
A	5	47	27	78	25	128	3	19	32	0	49
B	4	32	12	54	32	68	2	12	23	1	42
C	3	40	14	51	30	92	1	10	20	1	56
D	3	51	18	75	78	101	4	23	36	1	28
E	5	51	16	53	37	93	2	11	18	1	65
F	3	78	12	52	53	55	1	17	25	1	58
G	2	68	25	79	63	111	2	11	16	4	65
TOTAL : 25		367	124	442	318	648	15	103	170	9	363



the turtles but severely limits the reproduction. Further turtles trade obviously depends upon the breeding stock and the eggs which regulate their populations.

The subsistence fishing for the Olive ridleys was reported along the coast of Orissa and West Bengal to cater to Calcutta market (Silas et al., 1984). However, if such large scale of commercial exploitation was not intensified in the Northern Andhra Pradesh coast but intensified in the catches of turtles in the gill nets in trawl operations. Poaching on the nesting turtles and destruction of nests was intensive as was evident from the present study. This type of hunting can be referred to 'Subsistence hunting' as described by Frazier (1980) which cannot be ruled out along the Northern Andhra Pradesh coastline, where people consume turtle meat and eggs, use the shell for carriage purposes (P<sub>27</sub> - P<sub>28</sub>), also cash the product which add considerably to their income.

Frazier (1980a) illustrated various conditions of exploitations ranging from the hunter who eats and sells the catch. In this, in most of the cases, the immediate benefits for hunters action were not aware of the present state of turtles and its impact on their very subsistence. It was in this context, an extension programme 'Save Sea Turtles' was launched (Subba Rao et al., 1987) and was as evident from the results of the present study. On 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 hired people mostly the fishermen tribes. This programme proved to be very successful in protecting the sea turtle resources.

To a greater extent through the extension programme, poaching of Olive ridley sea turtle could be reduced, however, the main threat was at the nesting beaches, where the nests, nesting hatchlings are exposed to several dangers as described earlier. Main threats came from beach combers and predators both wild (foxes, jackles, hyaenas, mangoose) and domestic (dogs and pigs) (P<sub>29</sub> - P<sub>30</sub>).

Hendrickson (1958) made an hypothetical estimation. According to him 77% of loss to the turtles must occur during the period before the nests are hatched

and he states that "in a hypothetical population of animals with the breeding potential that the turtles have, the population size would remain stable if only slightly more than 0.1% of the eggs laid resulted in adult turtles which hired out complete lives". He is also estimated that the rates of loss to various factors during the early stages of life cycle of sea turtles and concluded that 14% would be the hatching success while 1.7% would survive after the first week of life at Sea. Under complete protected conditions, the percentage hatchlings obtained in the wild nests of Olive ridleys in the present study was 34.24%. Under laboratory conditions, the hatchlings success obtained was between 80 and 83.6% with a mean of 81.94%.

The newly emerged young ones are usually buoyant and appear to be unable to dive effectively (Hendrickson, 1958), and he assumed due to the specific gravity, the quantity of the yolk sac, the ability to dive by the newly emerged young increased with the age and it is most likely that the young hatchlings appears the surface for a considerable period in their early stages. The hatchlings are exposed to several dangers like easy predation. Thus captive rearing of the newly emerged hatchlings for six to twelve months until the hatchlings are tough enough to protect themselves is essential to avoid heavy mortality during their early life in the Sea. Hence, captive propagation programme have assumed a position of increasing importance in the conservation of sea turtles. 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 enemies to eat (Carr, 1968).

Information on the nesting grounds of Olive ridleys was wanting. The present study to a large extent delineates the nesting grounds, in terms of distance from the high tide zone vegetation associated with the dominant species of both plants and animals. Bhaskar (1983) in his survey of the Northern Andhra Pradesh coast reported the density of Olive ridleys nests was 1.64 /km, for the same region, in the present study it was 1.08 / km.

Since the present study reveals that a little less than a half of the nests are being destroyed or disturbed by human. It is imperative that a involvement of the 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.

The World conference on Sea turtles conservation held in Washington, D.C., USA in strategy of Worldwide scope (Bjorndal, 1982). Pritchard et al., (1983) suggested that priorities should be for Sea turtles conservation. These emphasizes the protection of the nesting beaches nests, control of predations by man and predators protection, beach erosion protection. Later nesting turtles were avoidance of incidental catches and resuscitation of drowned turtles and finally the legislation, which helps the conservation of Sea turtles.

### RECOMMENDATIONS:

Basing on the present study, the following recommendations are considered of very importance in the Conservation and Management of the Olive ridley Sea turtles.

- (1) **Subsistence Hunting:** It can be avoided through intensive extension programme in all the 53 villages of the study area and to bringout an awareness of the status and importance of sea turtles.
- (2) **Starting of Beach Hatcharies:** In all the zones with the technically trained personnel supported with several poor fishermen tribes who after due training could feed the hatcharies with eggs providing information of nesting turtles of their jurisdictions protecting type nesting habitat as guards. This type of tribal involvement reduce the factor of Human interference and on the other hand providing employment to several poor tribes.
- (3) **A Central Sea Turtles Farm:** It has to be organised which will be fed with the newly born hatchlings from various beaches. Hatcheries of different zones to rear the hatchlings until they are one year old and cross the most crucial period of their life cycle.
- (4) **Starting of Sea Turtles Farming and Management Training Institute:** It may also serve as a Research centre to develop sea turtles farming as one of the cottage industries in the fishermen villages so as to utilize the turtles

resources in rational way.

- (5) **Strict implementation of the Indian Wildlife (Protection) Act, 1972:** Impose severe punishment to the commercial exploitation of the sea turtles. Declare the Hope Island near Kakinada as Sea Turtles Sanctuary and ban all fishing and other maritime activities which are harmful to the sea turtles.

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## RESEARCH PUBLICATIONS ON SEA TURTLES

(by M.V. Subba Rao et al.)

### I. FOREIGN JOURNALS / INTERNATIONAL SYMPOSIA:

1. Captive Propagation of an endangered sea turtle, *Lepidochelys olivacea* (Eschscholtz). In Proc: World Conference on Endangered species in captivity, Cincinnati, Ohio, U.S.A., 292 - 306 (1990).
2. Conservation and Management of an endangered Olive ridley sea turtle, *Lepidochelys olivacea* (Eschscholtz) North Andhra Pradesh coastline, India. *TESTUDO* (UK), 3 (5) : 35 - 53 (1993).
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4. Captive rearing of an endangered Olive ridleys sea turtles hatchlings for the conservation purpose. *Ibid*, Adelaide, Australia, (Abstract) (1994).
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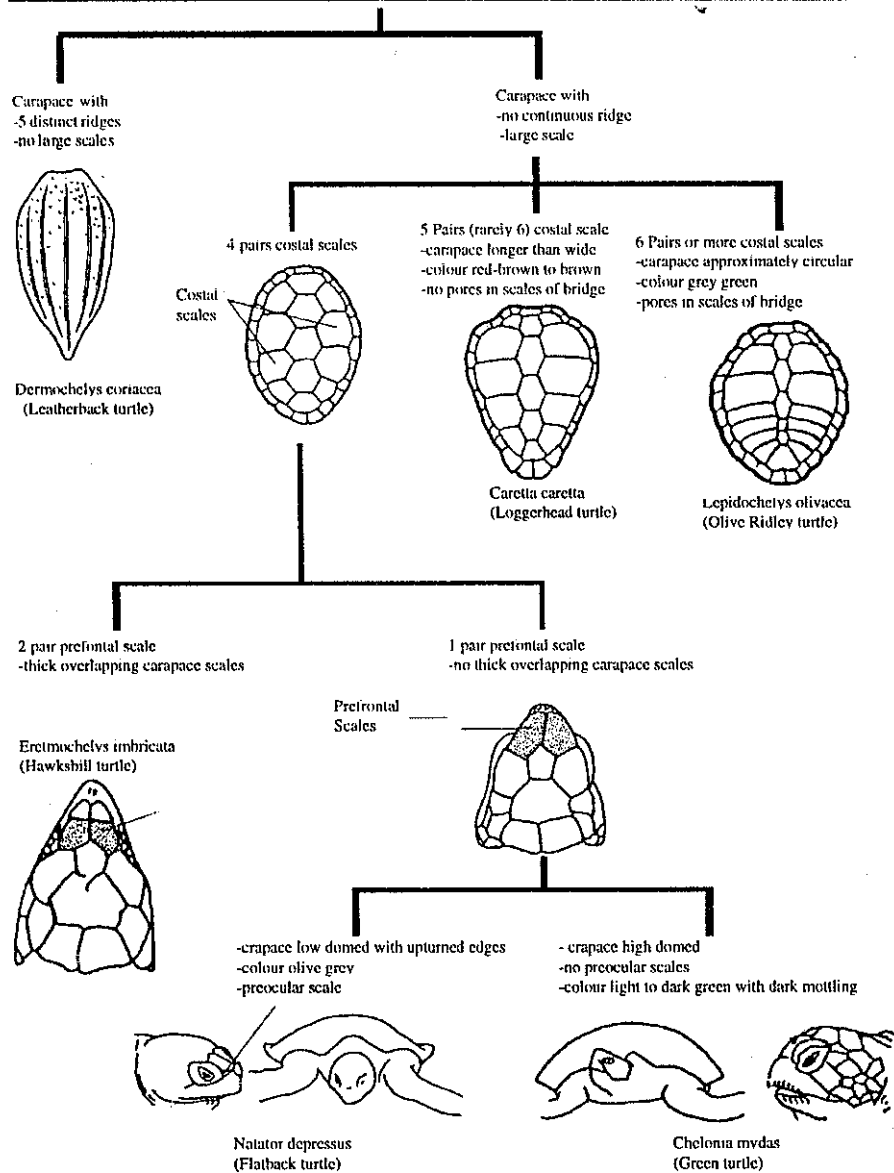
1. Extension Programme in Conserving the Wildlife resources. In Proc: *Science Development and Environment*, 141 -145 (1978).
2. Captive propagation techniques for the Olive ridley sea turtles. In Proc: *Bioresources Conservation and Management*, 93 - 102 (1991).
3. A note on the eggs and hatchlings of the Olive ridley sea turtles, *Lepidochelys olivacea* (Eschscholtz). *Cobra, News Letter*, (4): 6 - 7 (1991).
4. Note on the eggs and hatchlings of the endangered Olive (Pacific) ridley turtle, *Lepidochelys olivacea* (Eschscholtz). *J Nat. Conser*, 4 (1) : 31 - 34 (1992).
5. Status of the Olive ridley sea turtles along the Northern Andhra Pradesh coast. In Proc: *Forests, Wildlife & Environment* : 100 - 107 (1993).
6. A note on Food and Feeding of the Olive ridley sea turtles hatchlings, *Lepidochelys olivacea* (Eschscholtz) in captivity. *J. Bombay Nat. Hist. Soc.*, (1996) (in press).

### **SAVE MARINE TURTLES !**

- ⊛ Public awareness and Education campaigns about the threats to marine turtles should be established in all countries with marine turtle populations.
- ⊛ Important nesting beaches can be protected by limiting man-made disturbances such as artificial lighting.
- ⊛ Important feeding habitats, like sea-grass beds and coral reefs should be protected.
- ⊛ Fishing gear and methods can be improved to reduce the number of turtles drowned in fishing nets each year.
- ⊛ Marine pollution must be minimised.
- ⊛ Research and monitoring projects can be established in countries that are not currently studying their marine turtle populations. The greater our understanding of the lives of marine turtles, the easier it will be for us to protect them.
- ⊛ Countries have to work together to end the illegal trade in turtle products worldwide.

## **IDENTIFICATION KEY MARINE TURTLES PHOTOS DO YOU KNOW ? ECONOMIC IMPORTANCE OF SEA TURTLES**

# IDENTIFICATION KEY

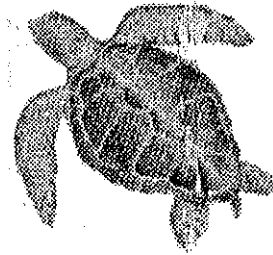


# MARINE TURTLES

Marine Turtles have inhabited the earth for over 100 million years. They are a successful group of animals, that have witnessed the rise and fall of the dinosaurs and, until relatively recently, have survived in great numbers.

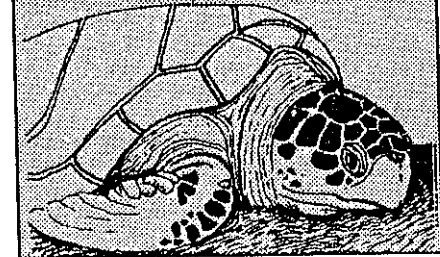
Today eight species of these ocean dwelling reptiles remain. All of them are now threatened with extinction due to man's destructive activities.

## LOGGERHEAD TURTLE (*Caretta caretta*)



Logger heads grow to 1 metre in length and weigh up to 180 kilograms.

Loggerheads are primarily carnivorous and feed on molluscs, jellyfish and crustaceans. The name "Loggerhead" refers to the large head which accommodates a large, muscular set of jaws, ideal for crushing molluscs and crustaceans.



This species nests on tropical beaches and also on beaches in some temperate locations such as the Mediterranean and the South-East of the U.S.A.

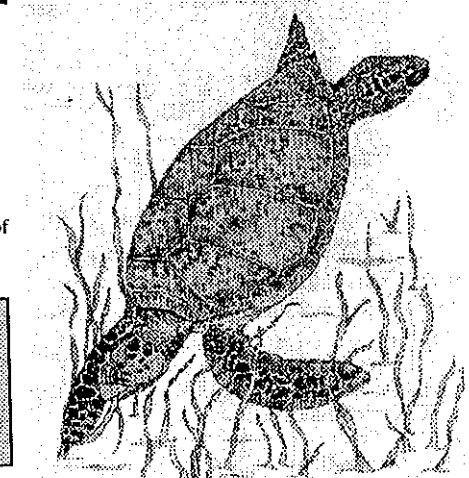
## GREEN TURTLE (*Chelonia mydas*)

Green turtles have an average length of 1 metre and can weigh up to 230 kilograms.

They are migratory and can be found in the tropical Indian, Atlantic and Pacific Oceans.

Green turtles are caught and killed to make "turtle soup" which is a delicacy in many parts of the world. Their English name refers to the colour of the fat found under their shells which is used to make the soup.

Young green turtles are mainly carnivorous. The adults however are herbivorous, feeding only on marine vegetation.



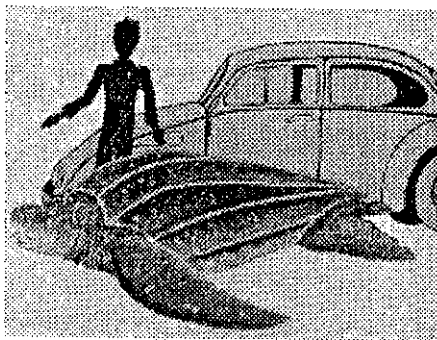
### LEATHERBACK TURTLE (*Dermochelys coriacea*)

Leatherbacks feed exclusively on jellyfish and will travel long distances in search of their prey. Leatherbacks have been seen feeding on jellyfish in the waters of Arctic circle, some 4345 kms from their tropical nesting beaches.

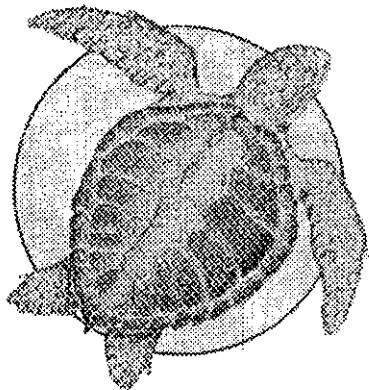
Leatherbacks can survive in the extreme cold because, unlike other turtles, they can regulate their own body temperature. Their bodies are also insulated by layers of fatty tissue.

The English name "Leatherback" refers to their unique carapace. The other marine turtle species have rigid shells comprised of a few large, flattened bones covered in large horny scales. The Leatherback's carapace is comprised of thousands of tiny, star-shaped bones which are covered in a tough, leathery skin, a structure which gives the Leatherback's shell a great deal of flexibility. Leatherback turtles can dive to depths of 1500 metres in search of deep sea jellyfish. At these depths the Leatherback's body is subjected to tremendous water pressure, but its flexible shell does not break and so the turtle can feed safely. The Sinhala name "dhara kesbawa" refers to the distinctive ridges on the carapace.

The Leatherback turtle is the **L A R G E S T** of all the marine turtles. They can grow upto 3 metres in length and usually weigh about 600 kilograms. The largest Leatherback ever found weighed 916 kilograms !



### OLIVE RIDLEY TURTLE (*Leptochelys olivacea*)



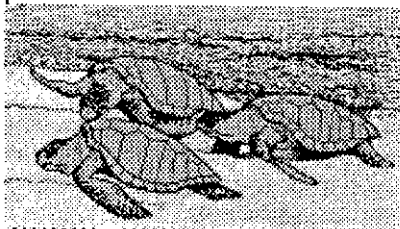
The Olive Ridley turtle is the **SMALLEST** of the marine turtles. The adults weigh less than 40 kilograms and measure up to 65 cm in length.

They are found mostly in the tropical Indian and Pacific Oceans.

They are omnivorous, eating crustaceans and some marine vegetation.

### ARRIBADA !!

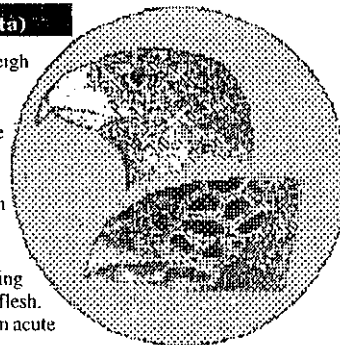
In a few countries, Olive Ridley turtles will nest on a beach in a huge congregation known as an "arribada". This Spanish word means "the arrival". For example, in India, 600,000 Olive Ridley turtles have been recorded nesting on the same beach over a period of a few weeks. Gahamnatha, Orissa State. Despite the apparently large populations Olive Ridley turtles are endangered. This is because so many individuals of this species depend on the security of a small number of important beaches for nesting.



### HAWKBILL TURTLE (*Eretmochelys imbricata*)

Hawksbills are also relatively small turtles, adults commonly weigh about 50 kilograms and measure up to 90 cm.

They inhabit tropical coastal waters around coral reefs and are mostly carnivorous. They prey on a large variety of animals including jellyfish, sponges and crustaceans. The Hawksbill turtle gets its English name from its narrow bird like beak, which it uses to catch animals hiding in small crevices.



Hawksbill turtles sometimes eat toxic sponges. Instead of being poisoned, Hawksbills can actually store the toxins in their own flesh. If a person eats the flesh of a Hawksbill turtle they may die from acute food poisoning.

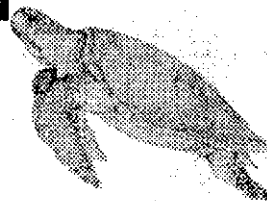
The Sinhala name "Potu kesbawa" describes its beautifully patterned shell. The Hawksbill turtle is now highly endangered because for centuries, people around the world have killed them for their shell. Once cleaned and polished, the shell is crafted into "tortoiseshell" ornaments.

**The trade in "tortoiseshell" products must stop if we are to save the Hawksbill turtle from extinction.**

### FLATBACK TURTLE (*Naturfor leprosus*)

Flatback turtles grow to a length of 90 cm and weigh as much as 70 kilograms.

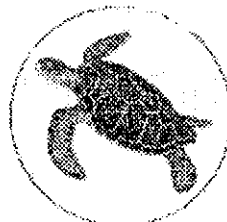
They nest only in Australia and although they are fairly common in the Torres Strait and off Queensland, they are regarded as rare because of their limited distribution. There are some reports of Flatback sightings in the waters around Sri Lanka.



Little is known of the diet of the Flatback turtle although seaweed and cuttlefish have been found in their stomachs.

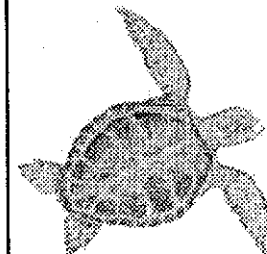
### BLACK TURTLE

For many years scientists have disagreed about whether the Black turtle was simply a colour variation of the Green turtle or a separate species. Today the black turtle is recognised by many scientists as a separate species. The Black turtle inhabits the Pacific Ocean.

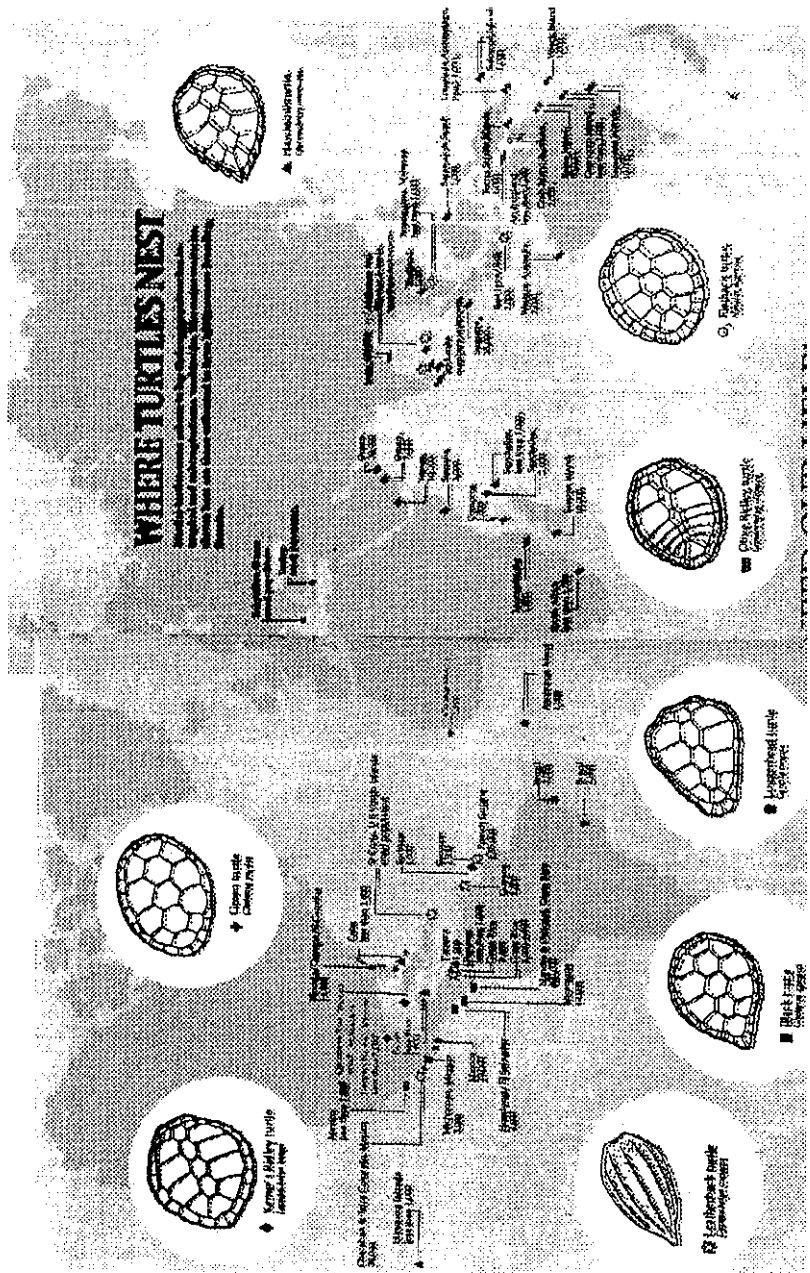


### KEMP'S RIDLEY TURTLE (*Leptochelys kempi*)

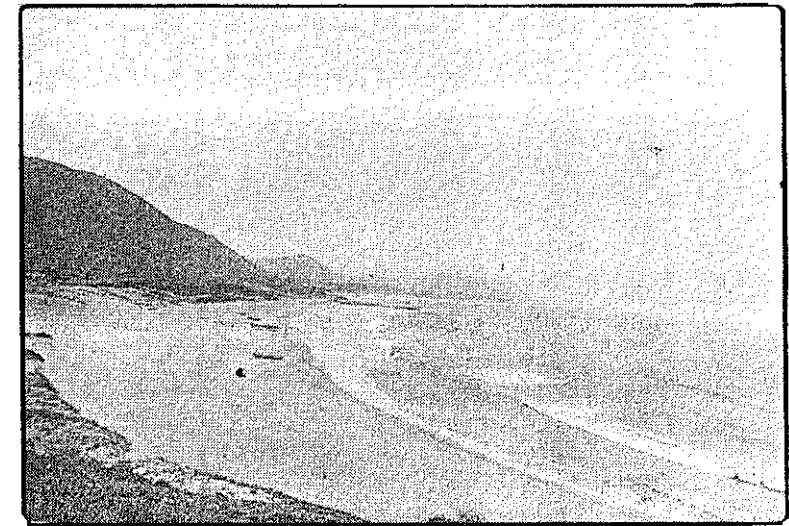
Like the Olive Ridley turtle, Kemp's Ridley turtles nest simultaneously in large numbers. In 1947, 60,000 Kemp's Ridley turtles nested on a beach in the Gulf of Mexico. Today there are less than 2,000 of this species left. All the remaining females nest only on this one beach in Mexico. They are the rarest of all the marine turtles.



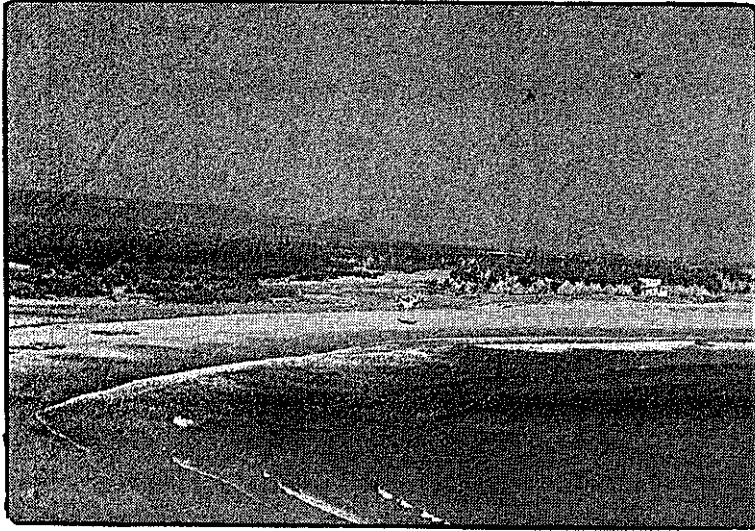
Conservation efforts have allowed the numbers of this species to gradually increase. Nevertheless their precarious situation is a constant reminder of how easily fragile marine turtle populations can be pushed close to extinction.



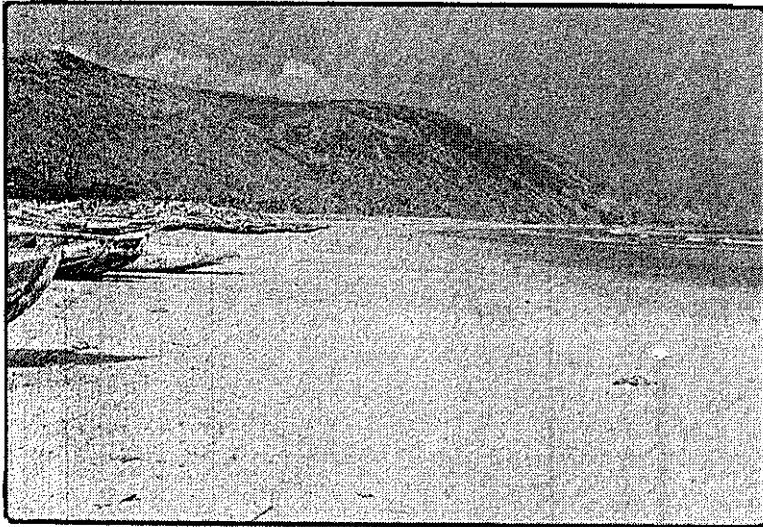
P<sub>1</sub> : Beach Vegetation with *Casuarina* wind-belts (Plantations) near Bhimilipatnam near Visakhapatnam (Zone A)



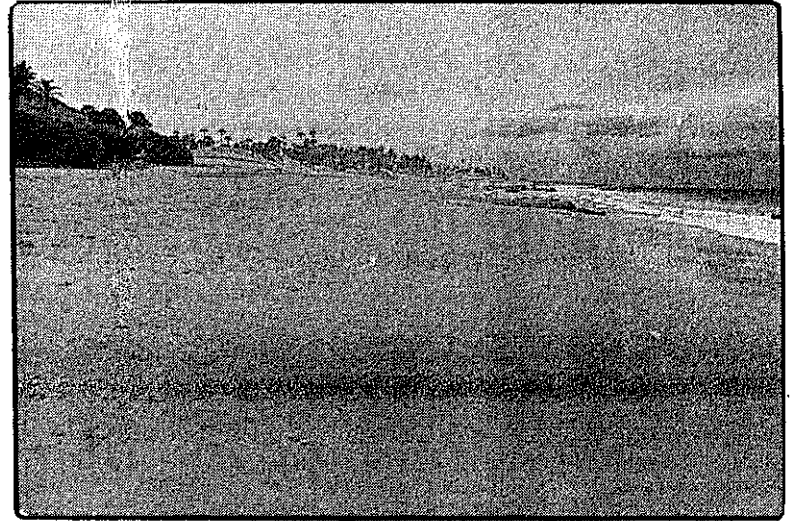
P<sub>2</sub> : Beach Vegetation at Rishikonda, near Visakhapatnam (Zone A) Spread with *Lacunae sarmentosa* and *Ipomoea per caprea*.



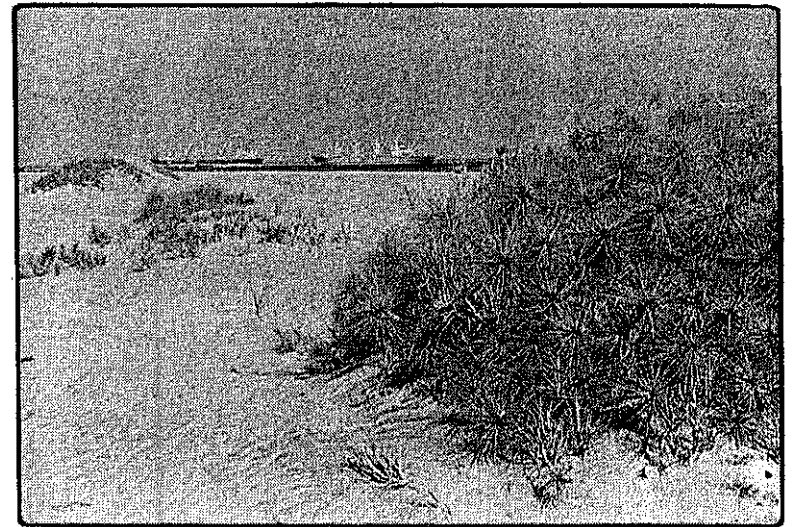
P<sub>3</sub> : A panoramic view of a typical fishermen village at Appikonda, near Dibbapalem (Zone D)



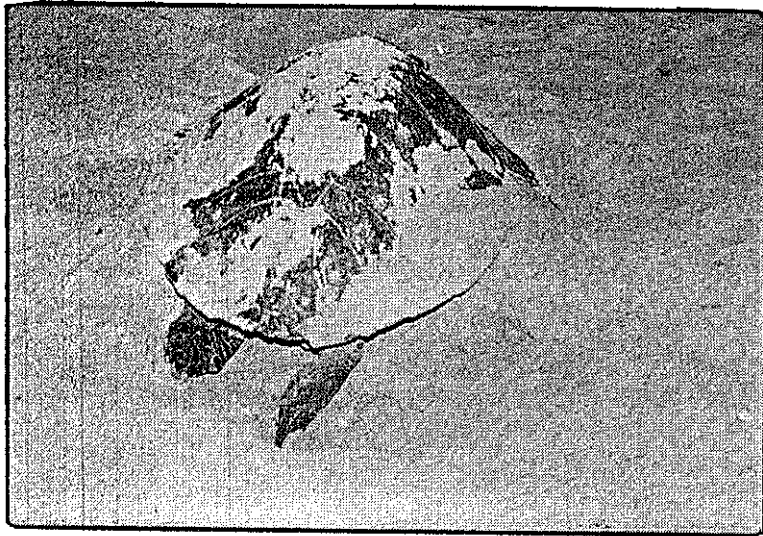
P<sub>4</sub> : Fishing harbour at Dibbapalem (Zone D)



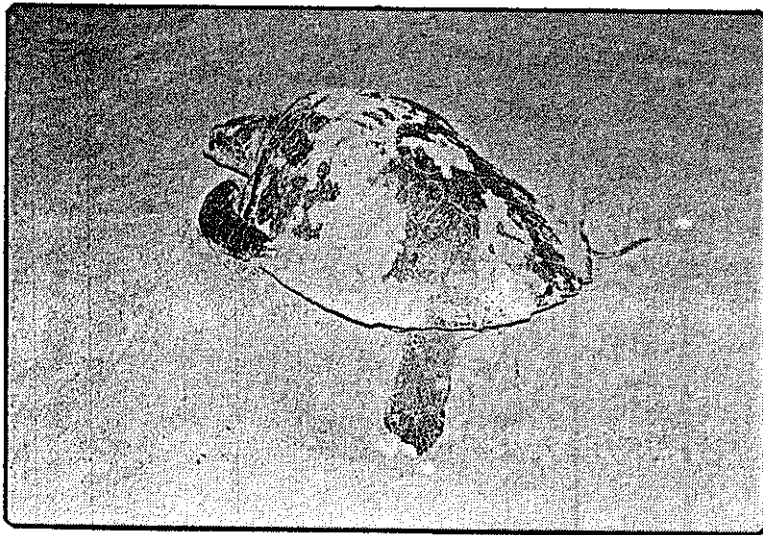
P<sub>5</sub> : Cashew orchards and several varieties of palms edging the shoreline near Pentakota (Zone E)



P<sub>6</sub> : Beach Vegetation at Hope Island (Zone G) : Dominant by *Spinifex littoris*, a grass species



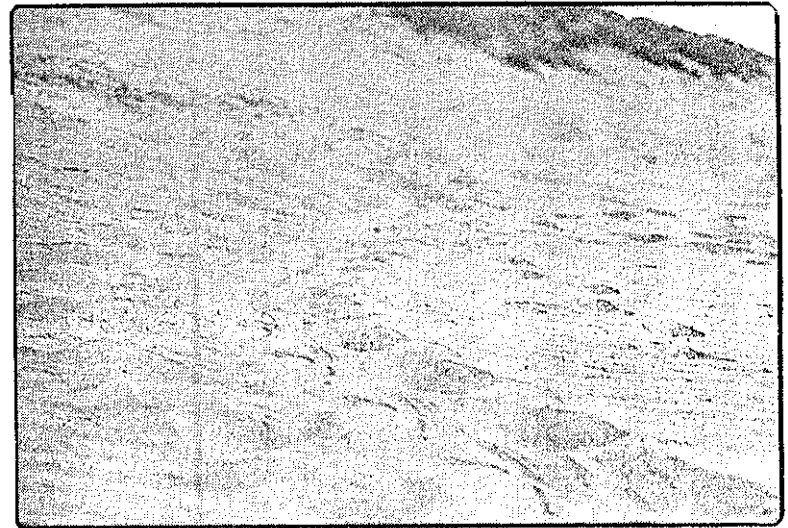
P<sub>7</sub> : An Olive ridley digging the nest hole with the hind flippers



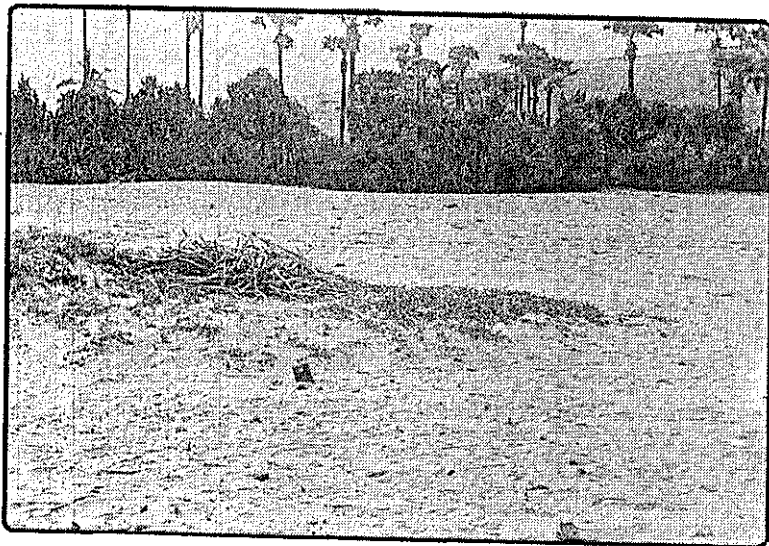
P<sub>8</sub> : After the egg laying, the nest hole was being covered.  
Top layer of the eggs can be seen.



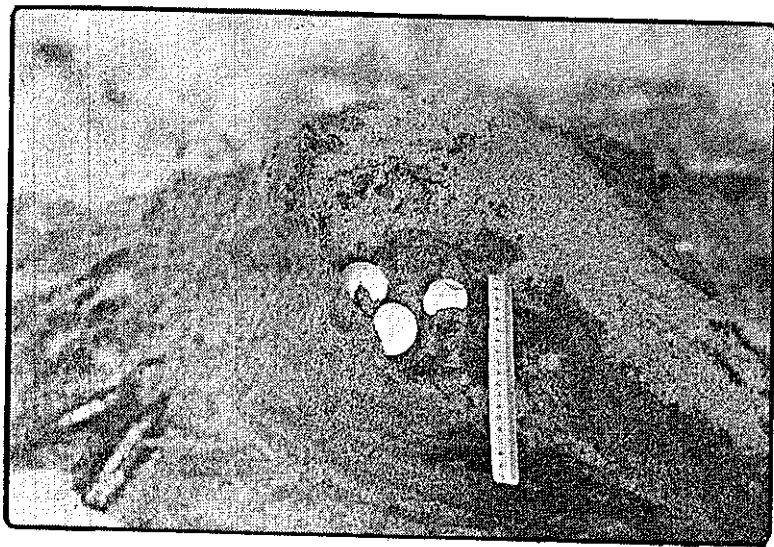
P<sub>9</sub> : After successful nesting, the Olive ridley retreats into the Sea.



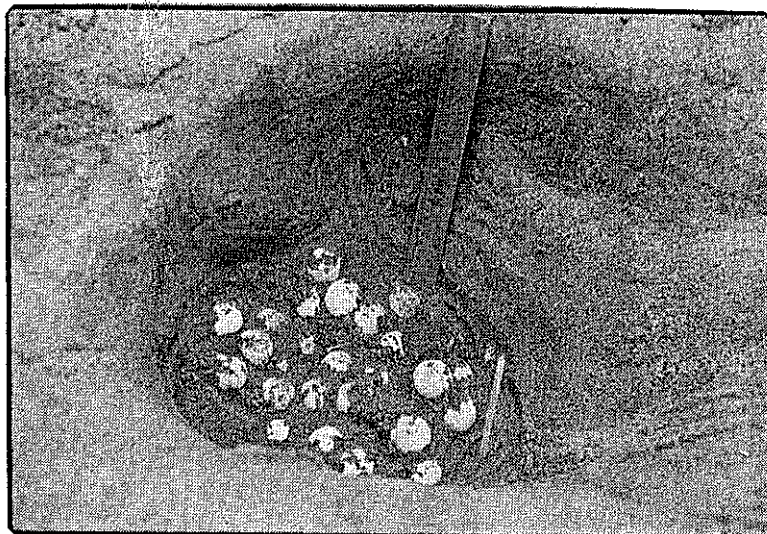
P<sub>10</sub> : A crawl track of an Olive ridley turtle



P<sub>11</sub> : A typical nesting area of Olive ridleys-often close to shore vegetation. The Palm tree are seen. flag marks the polition of the nest. Behind, the



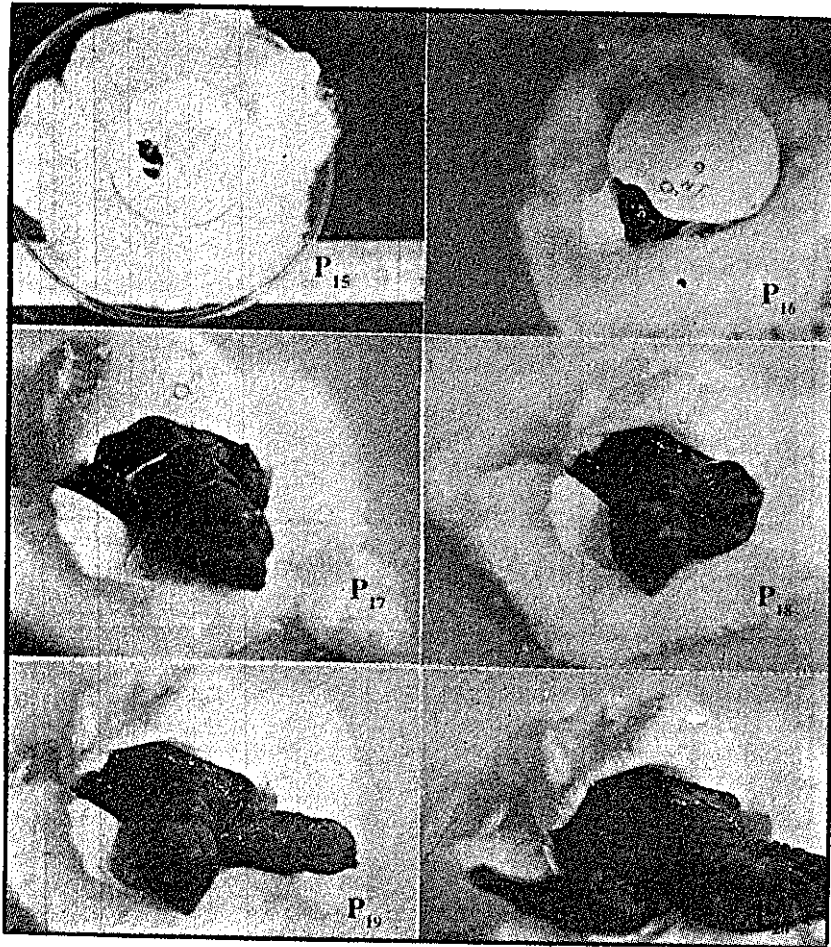
P<sub>12</sub> : Just opened fresh nest of an Olive ridley showing the depth to the top layer eggs.



P<sub>13</sub> : An Olive ridley nest .



P<sub>14</sub> : One day old Olive ridley turtle eggs.

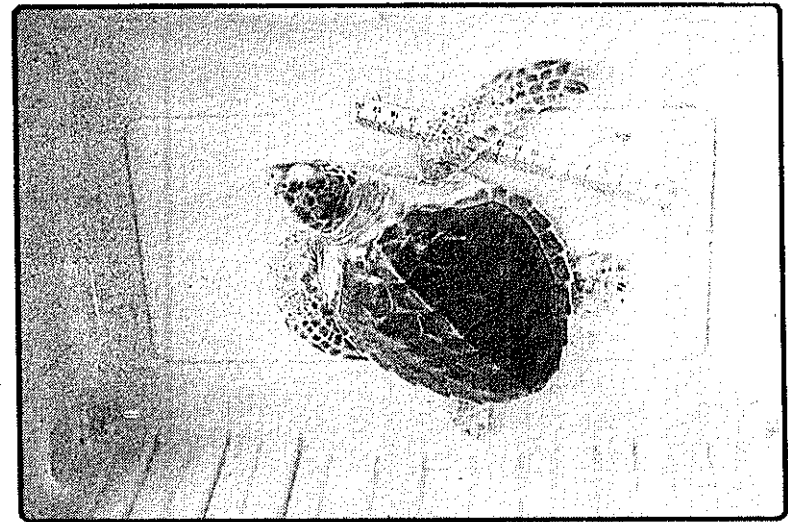


P<sub>15</sub> - P<sub>20</sub> : Sequence of photographs of the emergence of the Olive ridley turtle from the egg. (Laboratory incubation)

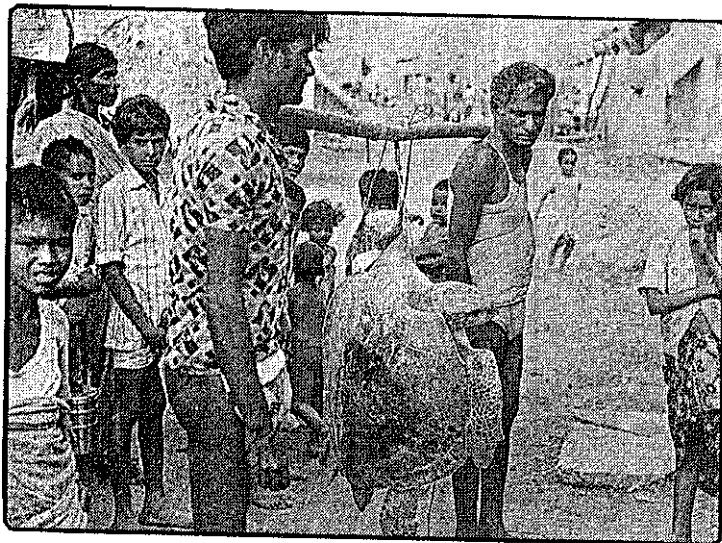
- P<sub>15</sub> : Egg-slit was made internally
- P<sub>16</sub> : Snout protruded.
- P<sub>17</sub> : Head emerged
- P<sub>18</sub> : Emergence of force - flippers.
- P<sub>19</sub> : Half emerged carapace.
- P<sub>20</sub> : Carapace emerged completely



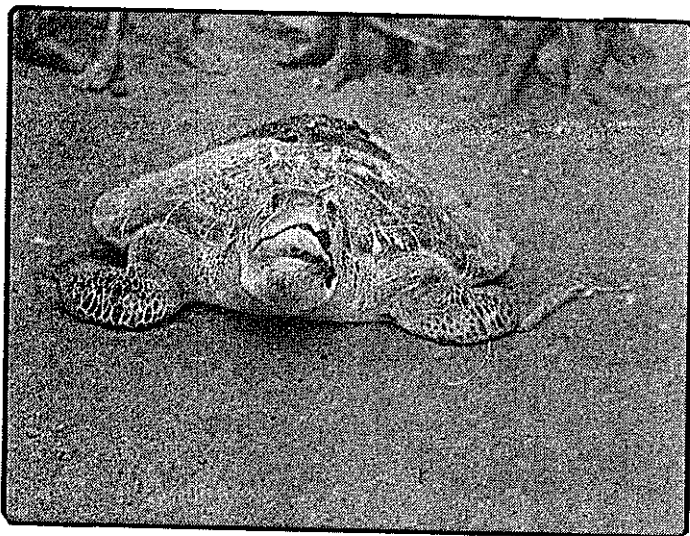
P<sub>21</sub> : Nine months old Olive ridley hatchling reared in captivity : All scutes of the carapace and sculation on the soft parts are well developed.



P<sub>22</sub> : One year old Olive ridley hatchling reared in captivity : All soft parts-flippers, neck, and head became light in colour and sculation is distinct.



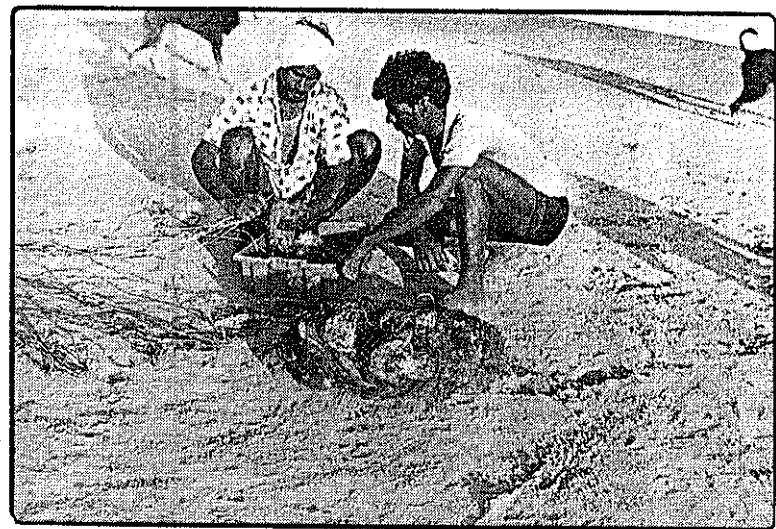
P<sub>23</sub> : Subsistence hunters (Fishermen) carrying a 40Kg adult Olive ridley turtle tightly tied to a fore flipper and hung brutally.



P<sub>24</sub> : Adult Olive ridley turtle caught in gear and was half dead before it was brought to shore



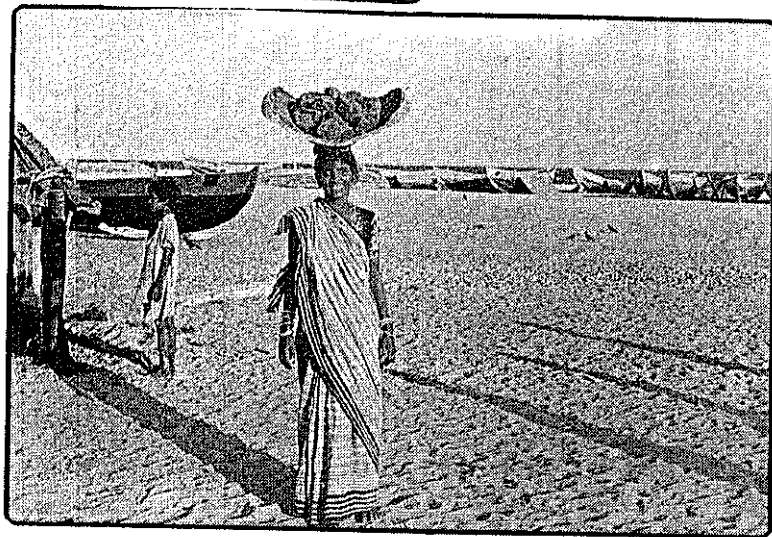
P<sub>25</sub> : A heap of flesh of Olive ridley turtle : Ready for sale at a fish market at Gangavaram (Zone D)



P<sub>26</sub> : Olive ridley meat being used as bait material to trap fish.



P<sub>27</sub> : A fisher woman using the carapace of Olive ridley as fish carriage.



P<sub>28</sub> : Carapace of Olive ridley turtle being used as soil carrier for house construction



P<sub>29</sub> : A domestic dog robbing the Olive ridley eggs.



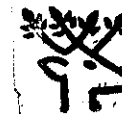
P<sub>30</sub> : A domestic dog feeding on caracasses of an Olive ridley.

## DO YOU KNOW ?

1. Rookery : Sea Turtle lay eggs in groups.
2. Arribada : Mass nesting of sea turtles- Best place in India. Gabarimata, Bhitarkanika of Orissa State.
3. Mexico :Famous for sea turtle cottage Industry.
4. Caribbean Island of U.S.A: First Sea turtle farm in the world.
5. Galapagos Island: Extremely very large size sea turtles.
6. In Eastern Region of India : Tribal and Girijan people, the Turtle is a God.
7. In Ethics, 'Kurmavatara' is a second avatar our of 10 avatars of incarnation of Lord Vishnu.
8. Srikurmam (Turtle), a Village in Srikakulam district of A.P. have Sun temple.
9. Turtles are aquatic and mainly carnivorous and Tortoises are terrestrial and mainly Herbivorous animals.
10. No teeth for Turtles, Tortoises and Terrapins or Interaps belongs to a group, is known as Chelonia of class Reptilia.
11. Life span of turtles are more than 100 years, longest living creatures in the world. Longest recorded turtle is 300 years, still living in Congo Island.

## ECONOMIC IMPORTANCE OF SEA TURTLES

1. Calipee (Turtle soup) used for TB, Asthama, Bronchitis.
2. Green sea turtle (*Chelonia mydas*) - Meat is very tasty when compare to other Sea turtles.
3. Carapace (Turtle outer shell) is used for ornamentation, tea table as like 'pamale' for carrying purpose.
4. Sea turtle watches



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