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A REPORT ON THE OLIVE RIDLEY, *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ) [TESTUDINES : CHELONIIDAE] OF BAY OF BENGAL

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(With 4 Text-figures, 4 Plates and 5 Tables)

INTRODUCTION

No definite data and information are available on the present status of marine turtles of Indian Coast. Hirth & Carr (1970) have expressed their disappointment on the inadequacy of knowledge on the ecological geography of marine turtles of the Western Indian Ocean which is also true for the entire Sea Coast of India. Smith (1931), while mentioning the distribution and range of sea turtles in the Indian Coast, gave some general information ; Valliappan and Pushparaj (1973), Valliappan and Whitaker (1974) and Murthy and Menon (1976) gave some preliminary reports on sea turtles.

From Zoological Survey of India two turtles surveys were carried out by the author in 1975 and 1976 in the Orissa Coast and he visited some turtle breeding areas in that region. These surveys revealed that the most common and commercially important turtle occurring in the Bay of Bengal is the *Lepidochelys olivacea* (Eschscholtz) and it is the most exploited species of sea turtles in its breeding or nest laying season in the Bay of Bengal.

The work of Schulz (1975) on the ecology and biology of Olive Ridley in Surinam is very important and extensively deals with the nesting aggregation of *L. olivacea* along with some other sea turtles in the Atlantic coast of America. In this context the works of Pritchard (1969), Carr (1952) and Zwinenberg (1976) are also valuable and helpful for studying the Olive Ridleys.

So far no important earlier report on the nesting ground of Pacific Ridley in the coast of Bay of Bengal is available. In the present paper the author summarises results of his preliminary survey of such grounds and has also tried to ascertain the status of this turtle and their colonies

in some of the areas surveyed. The systematic account and general information on this species, with a key to other species of sea turtles will be helpful to the workers on the sea turtles of the Indian Coast.

Systematic Account

1843. *Lepidochelys* Fitzinger, *Syst. Rept.*, p. 30.
(Type : *Chelonea olivacea* Eschscholtz)

The family Chelonidae, which includes the Pacific Ridley or the Olive Ridley, contains four genera, namely *Chelonia* Latreille, *Lepidochelys* Fitzinger, *Careita* Rafinesque and *Eretmochelys* Fitzinger. The genus *Chelonia* can at once be separated from the rest of the genera in the family by the presence of one pair of prefrontal scales. The genera *Lepidochelys* and *Caretta*, likewise, can be distinguished from *Eretmochelys* in having five or more laterals and also in the precentrals being in contact with the laterals. The remaining two genera, however, continued to be confused with each other for a long time even after the publication by Deraniyagala (1933). This was caused by the broad similarity in characters, and the apparent similarity leading to the resultant taxonomic confusion and for a long time the two were identified as *Caretta*, commonly known as Loggerhead.

Generic characters : Laterals from five to nine ; four enlarged inframarginals, some of which perforated by a pore near the hind margin ; precentral and lateral laminae usually in contact ; pterygoid bones markedly broadened anteriorly, with strong ectopterygoid processes ; in the lower jaw a strong median elevation at the posterior edge of the bony alveolar surface ; nural bones eleven to fifteen in number.

A key to all the genera, species and subspecies of the family Cheloniidae is given below with the help of which *Lepidochelys* could be easily identified even to the subspecies level.

Key to the genera, species and subspecies of the family Chelonidae

1 (4) One pair of prefrontal scales. Lateral laminae 4. ... Genus *Chelonia* Latreille

2 (3) Colouration above predominantly brownish ; shell margin not markedly indented above hind limb ; shell less chunky and deep, especially from the middle of the laterals towards periphery ... *Chelonia mydas mydas* (Linné)

(Atlantic and Caribbean)

3 (2) Colouration above predominantly greenish or olive brown ; shell often markedly indented above hind limb ; chunky and often with the laterals completely straight from the margin of centrals ... *Chelonia mydas agassizii* Bolourt.

(Pacific Coast of America, throughout Indian and Indo-chinese water including Andaman and Nicobar groups of Islands).

4 (1) Two pairs of prefrontals. Laterals 4-9.

5 (6) Laterals in 4 pairs ; precentral not in contact with the lateral ; laminae of the carapace usually conspicuously imbricated ... Genus *Eretmochelys* Fitzinger

Eretmochelys imbricata (Linné)

(In all the tropical waters widely seattered along the Atlantic Ocean, Indian and Indochinese waters).

6 (5) Laterals in 5 or more pairs ; precentral in contact with 1st lateral ; snout relatively short and broad.

7 (10) Inframarginal bridge with 4 enlarged scales ; colour gray or olive green. ... Genus *Lepidochelys* Fitzinger

8 (9) Colour dorsally olive ; laterals usually in more than five pairs ; each inframarginal with a pore ; limbs with one or two claws. ... *Lepidochelys olivacea olivacea* (Eschscholtz)

(Indian and Pacific Oceans ; West coast of Africa, West coast of America, Pacific coast or Mexico and Costa Rica).

9 (8) Colour dorsally dark grey ; laterals usually in five pairs ; inframarginal poreless ; limbs three clawed. ... *Lepidochelys olivacea kempii* (Garman)

(Waters of Massachusetts, England, Ireland and Azores).

10 (9) Colour brown or reddish brown ; bridge with three enlarged inframarginals. Genus *Caretta* Rafinesque

11 (10) Marginal laminae averaging 12 on each side; limbs two or one clawed ... *Caretta caretta caretta* (Linné)

(Atlantic and Mediterranean).

12 (11) Marginal laminae averaging 13 on each side ; limbs two clawed ... *Caretta caretta gigas* Deraniyagala

(Indian and Pacific Oceans).

Lepidochelys olivacea olivacea (Eschscholtz)

1829. *Chelonia olivacea* Eschscholtz, *Zool. Atlas* pt. 1, p. 2, pl. 11.
(Type locality : Manila Bay, Philippine Islands)
1931. *Caretta caretta olivacea*, Smith, *Fauna Bri. Ind.*, **1** : 71 & 72.
1933. *Lepidochelys olivacea*, Deraniyagala, *Ceylon J. Sci.* (B) **XVII** : 62-72.
1951. *Lepidochelys olivacea olivacea* Carr, *Hand Book of Turtle*, pp. 341-410.
1976. *Lepidochelys olivacea*, Zwinenberg, *Bull. Maryland Herpt. Soc.* **12** (3) : 75-95.

Description : The carapace in adult is more depressed than in other chelonians and slightly longer than broad. In dorsal view it looks almost circular or rather broadly heart-shaped which is expansively coradate in both the sexes without any trace of carina. The carapace is fairly high, highest point being anterior to the middle but it is flattened or even dished in along the centrals. The margin is more or less serrated posteriorly, formed of 27, rarely 25 shields. The variation of marginals are from 12 to 14 in each side. The nucal or precentral is generally in contact with the first costal. The vertebrals or centrals range from five to nine and also the costal or the laterals display a corresponding number of pairs of asymmetrical arrangement. The costals vary in number 6 to 8, occasionally 5 to 9. The numerical arrangement of centrals and costals are variable but the plastral scutes are more or less constant. The plastron distinguishes this turtle from all the other chelonians in possessing a distinct pore on the posterior edge of each of the four enlarged inframarginal scutes or laminae. A similar pore may also occur on the axial lamina.

The head is large and broad, with convex sides to the wide beaks. Due to the characteristic parrot like beak of these turtles they are popularly known as Parrot Beaked Turtles. Each beak possesses edges and these in the adult form an anterior point which blurts with edge. The margin of each beak is nearly V-shaped and the horny upper beak extends to the choanae. The alveolar surfaces of the upper jaw bone smooth and symphysis of lower jaw is very long. There is one enlarged scale on the middle of outer surface of lower jaw. The cephalic scales comprise of two pairs of frontals, the posterior one of which is larger than anterior, a hexagonal frontal usually forming an emargination in the fronto-parietal which is narrower anteriorly and posteriorly, two or three pairs of parietals, interparietal usually wanting, supraocular one to three on each side, the lst in contact with fronto-parietal, preocular 3 or 4, supraocular ten.

In young specimens the carapace is strongly tricarinate and plastron bicarinate. Usually each flipper is furnished with two claws but many adults possess only one upon the anterior limb. The scales are juxtaposed and margins are subimbricate in adolescent.

The tail of the mature male is much longer than that of the female, extending at least as far as the tips of the posterior stretched flippers and not exceeding the hind rim of carapace in the latter. In the male the single claw on each anterior limb is much stronger and more curved. The middle part of plastron in the male is more concave and the lateral profile slopes more gradually from the highest point of back and down to the hind shell margin.

Colour : The carapace colour is uniform olive without mottling or veriegation found in other species. Due to its colouration it is popularly known as Olive Ridley. The plastron is light greenish yellow or greenish white. The legs and neck are olive above, lighter below.

The young are of more or less uniform black with a faint white margin to the limbs and carapace. The adolescent is dark grey dorsally, pale yellow ventrally and cheeks and beaks pale green.

Remarks : The Olive Ridley, *Lepidochelys olivacea olivacea* of the Indian Coast is often confused with the Atlantic Ridley, *L. olivacea kempii* or even with the Atlantic Loggerhead, *Caretta caretta caretta* (Linnè) and Pacific Loggerhead, *C. caretta gigas* Deraniyagala. Many considered this species conspecific with the Atlantic *C. c. caretta* which they considered to be more variable in the Indo-Pacific region than the Atlantic. It was not until 1933 that the skeletal anatomy, vomer separating the maxillaries and by the lateral processes on the pterygoids, of the two genera were shown to be very different from one another although externally they appear very similar.

Distinction between *L. olivacea kempii* and *L. olivacea olivacea* is also very narrow. In the adult *L. o. kempi* the carapace colour is greyish and the enlarged inframarginal scutes are at times three on one or both the sides (Carr. 1952). In the typical subspecies the carapace is greenish olive, there are almost invariably four pairs of enlarged inframarginals and presence of a single inframandibular scale. Otherwise the two subspecies agree in other respects including bony alveolar ridge upon the palate, skeleton, subcircular outline of carapace, the bluish green dorsal pigmentation of head and limbs and the pale greenish yellow plastron. The pigmentation of the young of these two forms are almost black and differs feebly from one another. According to Deraniyagala (1961) the colouration of the first recorded young by Lourence (1951) and of four hatchlings from Vera Cruz kept in the Kansas University Museum of Zoology were as dark as the young ones of the forma *typica* but differed from them in lacking the white margin to the carapace.

The geographic continuity of ranges of these two subspecies has not been demonstrated within the Atlantic and Indo-Pacific forms though there may be potentiality of breeding contact around South America but certainly not around Cape Horn. According of Schmidt and Inger (1957) this potentiality does not seem to be realised with present zonation of sea in temperate turtles as the Atlantic forms are clearly distinguishable even by their minor characters.

Distribution : This species is distributed widely in the warmer parts of tropical and subtropical East and West Atlantic, Indian and Pacific Oceans. The northern limit of it in the Western Pacific is southern Japan and in the Eastern Pacific (W coast of America) it is from Baja California to Chile. According to Carr (1961) the Ridleys occur regularly in the 650 miles long coast from Kino to San Blas including much of the eastern shore of Gulf of California and to the coast south of the mouth of the gulf. Deraniyagala (1939) mentioned its distribution from the East Atlantic and west coast of Africa. This species not only nests on the west coast of Africa from Senegal to Congo but Schulz (1975) has reported it in the northern and north eastern coast of S. America, in the coast of Guyana, Surinam and French Guiana. This species shows a remarkable distribution in the Atlantic being virtually absent in the Caribbean region. According to Smith (1931) it is generally distributed in the Indian waters and abundant in the vicinity of Andaman Islands and near the coast of Sri Lanka but rare in the Gulf of Siam. In the East Indies the species appears to be more abundant than the Loggerhead and it seems this species reach remote islands of the midway chains in the Pacific. In short Pacific Ridley ranges from the west coast of Africa, Ceylon and the East Indies to the Pacific coast of America.

Range and status : In this section I have tried to mention the nesting localities of the species and its present status if it was available with special interest in the Indian and Pacific Oceans regions from the available literature in my hand. Pritchard's (1969) work in this respect will further improve our knowledge but due to its absence I have mostly depended on the work of Frazier (1975). Detailed information from China, South Japan, East Indies and Australia is not available to me for its detail study of distribution and present status.

East-Atlantic and west coast of Africa—Banana (East Atlantic) ; Ivory coast, Gabon and Congo one specimen from each of the place was examined by Babcock (1930).

Western Indian Ocean Region : Frazier (1975) has grouped this region in two territories, the islands and the mainland : *Ethiopia*—recorded in

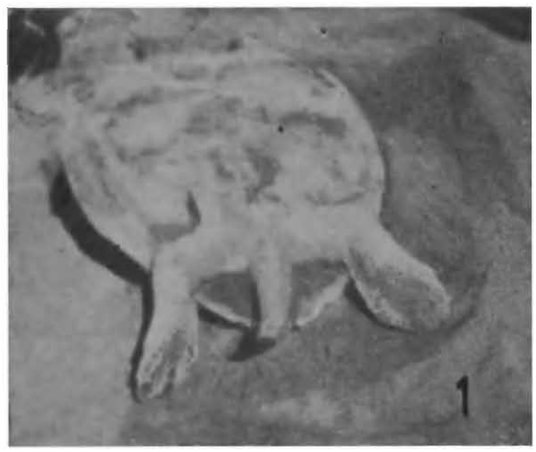
the last century. *United Republic of Tanzania*—may not be uncommon, at least nest on Maziwi. *Mozambique*—a substantial population, notably in the north where they nest. *Kenya*—may nest and there may be a fair sized breeding population in Ungwana Bay.

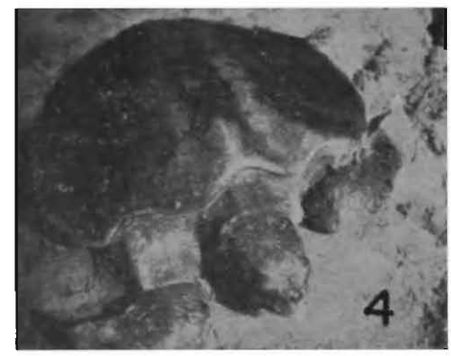
Republic of South Africa—nest very rarely. *Sultanate of Oman*—nest on Masirah. *Iran*—common specially in the Persian Gulf and nest on Lavan Island. *Pakistan*—Ridleys continue to use their traditional nesting sites around Karachi beaches and from all available evidence the egg laying females are more numerous than available beach areas so that some earlier egg clutches often being partly excavated or disturbed by subsequent nesting females which in turn encourages predatory dogs (Roberts, 1977). *Malagasy Republic*—there is substantial population in the south west, but they do not nest. The estimated recent catch is 2,400. *Sri Lanka*—The most common species and several thousand may nest yearly. Deraniyagala (1939) has mentioned several nesting grounds.

Indian Coast : In the Zoological Survey of India record only of two specimens have been mentioned which were collected from the Kerala beach by Furguson in 1891 and about another collection of Asiatic Society of Bengal, the collection locality generally mentioned as Bay of Bengal. In the Western Coast, Greaves (1933) recorded this species nesting in the Malad-Merve beach of Maharashtra. It also nests in the Konkan and Trivandum beach, Kerala Coast. Ridleys have been reported from some small Islands of Gulf of Mannar. The east coast of India (Bay of Bengal) is a very important nesting ground for this species. There are mass nesting places in the Madras beach, West Bengal and Orissa Coast [Satbhya, Gahirmatha, Konarak (Chandrabhaga)]. According to Bhaskar (1978) waters off India's coast, Lakshadeep islands, situated 120-200 miles off Kerala's Coast (in five islands of Amindivi) this species is predominantly common. According to him (Bhaskar 1979) some islands in the Gulf of Kutch in Western India are nesting ground of Olive Ridley.

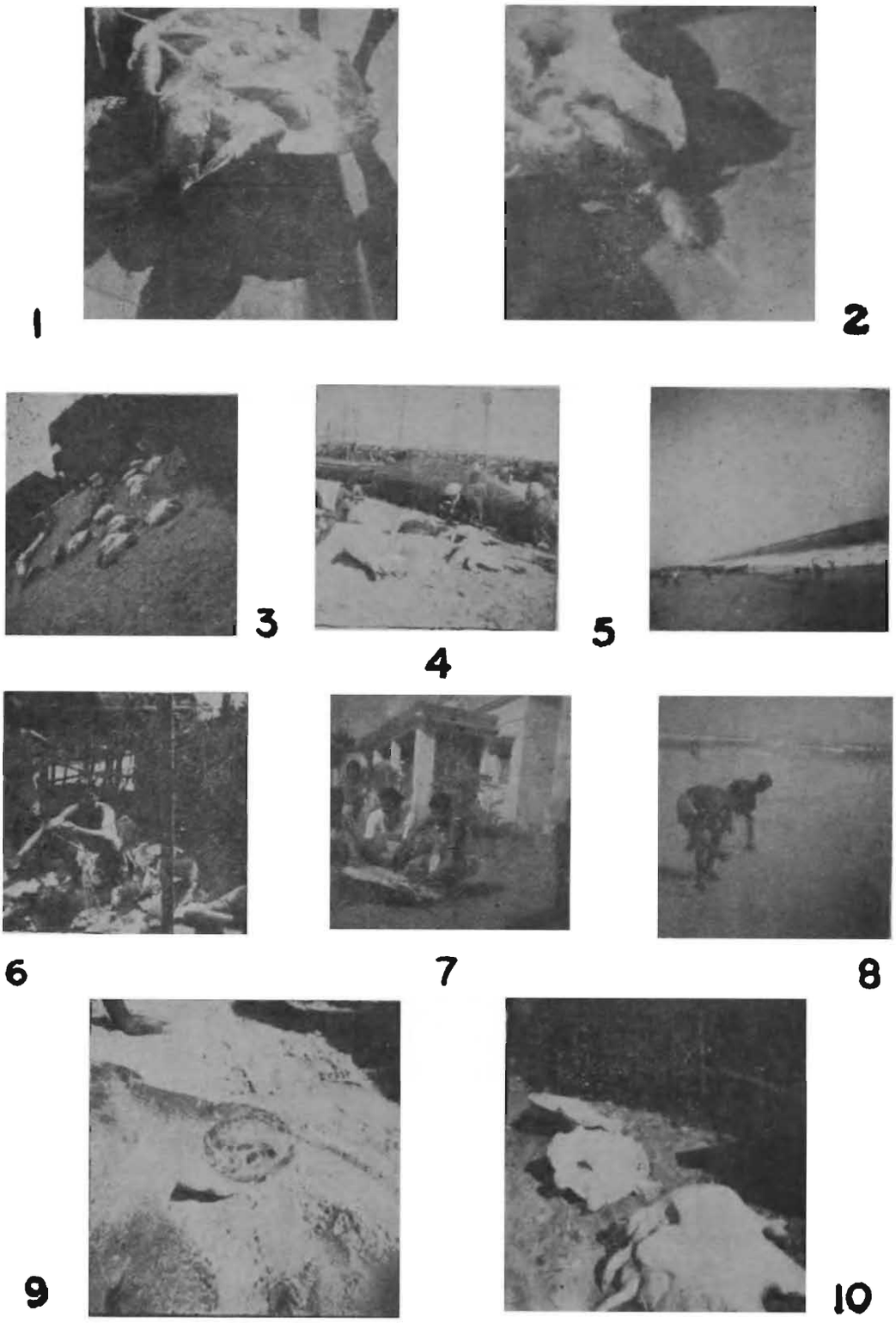
Pacific Coast of North and South America : Mass nesting sites are there in this coast from Baja California to Chile, particularly in the coast of Mexico and Costa Rica (Pritchard, 1969). Hondurus nesting occurs but in Colombia there may be possibility. *West Malaysia* : All the fiive genera of sea turtles occur along the coast of west Malaysia but *L. olivacea* nests in number. Its eggs are in good demand which sells 8.10 cents each (Moll, 1976).

Western Atlantic, northern and eastern South America : In Surinam mass nesting occurs at Eilanti, Galibi and Bigisanti beach. Another





Lepidochelys olivacea (Eschscholtz). Fig. 1. ♂, Ventral view. Fig. 2. ♀ Ventral view (Note Comparative tail length). Fig. 3. A stacking of turtles at Puri where turtles are stacked before despatching to the Railway Station. Fig. 4. Dorsal view of a freshly caught turtle. Fig. 5. Author and an Assistant taking measurement of a ♂ and a ♀ turtle. Fig. 6. Author and the local Veterinary Surgeon examining and consulting over a turtle.



Lepidochelys olivacea (Eschscholtz). Figs. 1 and 2. Two stages of extended penis of two ♂♂ ; (1) fully extended, (2) partially extended with wart like tubercles at the end portion. Fig. 3. Entire view of a stacking yard. Fig. 4. Author is examining freshly landed turtles at Puri beach. Fisherwomen are waiting to carry them to the stacking yard. Fig. 5. A part of the typical beach where the species lay its eggs. Fig. 6. A fish seller at Chandbali fish-market selling turtle meat. (Chandbali inland port on the Baitarani river). Fig. 7. Assistants are busy dissecting one specimen. Fig. 8. A part of the beach at Astrang. The beach is less sloping comparatively from the Puri beach. Fig. 9. Head shield of a specimen. Fig. 10. Plastron depression of ♂.

nesting place is east of Marowijne river of French Guiana (Schulz, 1975). It was recorded earlier from Caracas, Venezuela.

Philippines : The type specimen was collected from Manila Bay. *New Britain* : Some broods of eggs had been collected many years ago.

Nesting grounds of Olive Ridley in the Bay of Bengal

Tamilnadu—(1) Valiappan and Pushparaj (1973) made a preliminary survey in the Tuticorin area of Tamilnadu which is an area important for the turtle industry in South India. The stretch of beach between Tiruchendur and Idinthakaral is an important nesting area of Ridley and some years ago great numbers of nests could be seen along beaches near Manappod. (2) *Madras to Kalpakkam area*—Valliappan and Whitekar (1974) undertook a survey of Olive Ridleys in the 50 kms coastline of the above mentioned area. In the Madras coast the fishermen consider the turtle a god or "Sami". The turtles are mostly released into the sea when cauget in a fishing net. But the "Kattukarans" such as Harijans, Villis, Irulas, Kurvikars and some villagers living along the coast collect eggs for personal consumption and sale. The Ridleys are known as "Kadalaamai" in this area. Though the present status of the species in the Madras coast is not known, it is certain that Ridleys are the most common nesting turtles.

It is also reported that Ridleys also nest in the coasts of Porto Novo, South Arcot Dist. and Point Calimere, Thanjavur Dist.

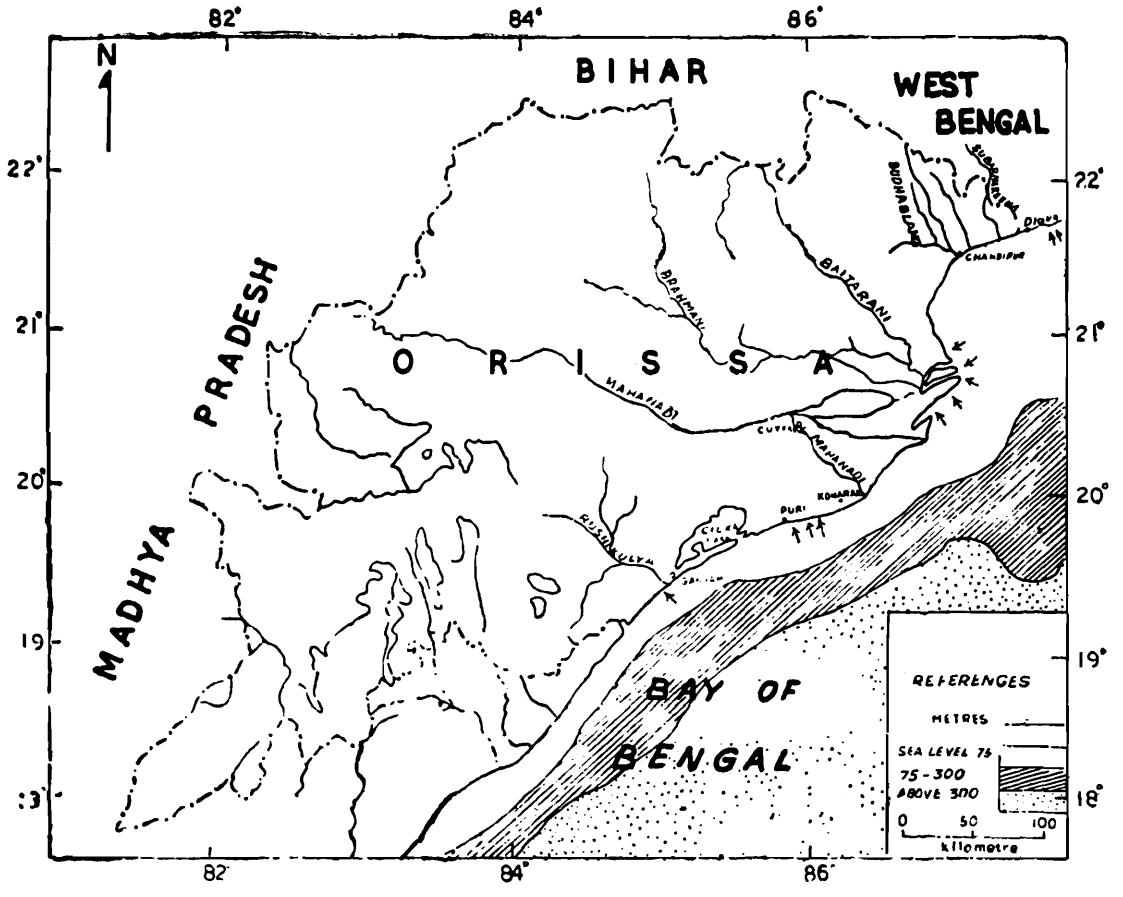
It is estimated that during 1975-76 (December-March) nesting season roughly 4,500 eggs were collected from 42 nests of Madras Coast.

Orissa Coast : Surveys conducted by the Zoological Survey of India in the Orissa Coast have revealed four areas as the major nesting ground of Ridleys, in the Orissa Coast, such as sea side deltoid area of Brahamani and Baitarani rivers, Puri-Balukhand, Konarak-Chandrabhaga and Chandipur-Burablang estuary (Text-fig. 1).

(1) *Sea side Delta of Brahamani-Baitarani*—Two sea side places within the Cuttack Dist. of this area known as *Gahirmatha* and *Satbhyia* are very good nesting grounds of Ridleys. *Gahirmatha*—This place is nearly 35 km. east of Chandbali, Balasore Dist. at the mouth of Dhamara river where it meets the sea. There are also some islets at the mouth of the river which are also good nesting grounds. During the nesting season in 1975 it is reported that 33,000 Olive Ridleys were marked in three nights on 8 km. stretch of the sea coast near Wheelers Islands in this area (Kar 1980). Experiment on a clutch of eggs of this species has been carried out at this place (Biswas *et al.* 1977). The tagging

and marking operation is now being carried out here by the Forest Dept. of the State Government.

(2) *Satbhyia*—This sea coast place of Cuttack Dist. is nearly 35 km. south east of Chandbali and it is only approachable from here upto Dangmal (Vitorkonika) by boat or launch and from there after crossing



Text-fig. 1. Map showing the coast line of Orissa and part of West Bengal. Arrow marks indicate the nesting ground of the species.

the branch of Brahamani river one has to walk down the sea coast. Due to the difficulty of communication the Satbhyia coast is most undisturbed nesting ground of Ridley in the Orissa Coast.

In the nesting season the egg laying density may be so intensive in this place that even it may reach one nest per square meter.

(3) *Puri-Balukhand*—This area is the most important turtle fishing center of the Orissa Coast. The southern part of Puri after Chakrathistha is known as Balukhand and the sea side Casurina Reserve Forest of this area is reported as a nesting ground of Ridleys.

(4) *Konarak-Chandrabhaga*—Chandrabhaga, 22 miles east of Puri is nesting ground and some clutches of eggs were collected at this place in 1975 (Biswas *et al.* 1977) where a small stream known as Kushabhadra meets the sea. Ridleys are nesting all along the coast from Chandrabhaga to Astharang, one fishing centre between Konarak and Puri,

Practically the entire Puri to Konarak sea coast is nesting ground of this species excepting some short distances to this area due to fishing and human disturbances.

After Puri, Konarak is next important turtle catching center of the Orissa Coast.

(5) *Chandipur*—This sea side fishing centre of Balasore Dist. situated on the mouth of Burhabalang river is another important turtle fishing center of the Orissa Coast. The sea is very shallow here and during low tide nearly 2 to 3 km. beach becomes exposed and may be for this reason turtles are not able to utilize this beach as a nesting ground though good turtle fishing is carried out in the near about sea of Chandipur. I once came across a dead Ridley upside down in a pit of a beach which may be the result of an unsuccessful attempt of nesting.

West Bengal :

(1) Digha—This is the sea coast place of Midnapore Dist., West Bengal which is well known for turtle fishing (Text-fig. 1).

(2) Sunderban—The seaface islands of Sunderban estuary such as Lothian and Sagar islands are nesting ground of this species. Hatchlings and eggs have been collected from these islands.

Remarks on the weather and physiography of the nesting beaches in the Bay of Bengal

The study of weather and physiography of nesting beaches and the adjacent sea of the Bay of Bengal is very important and essential to understand and explain the seasonal migration, nesting, incubation etc. of the Olive Ridley coming for nesting in the coast of Bay of Bengal.

The present investigation shows that *Lipidochelys olivacea* is the only dominant extensively occurring sea turtle of the Indian subcontinent. Therefore, it is presumed that weather condition and physiography of Indian coast is suitable for the purpose of their nesting. In this chapter I have tried to compile some data on weather condition and physiography of the region keeping in view that it will be useful to the workers if investigations are carried on in relation to these data. Though I was not able to work in detail the species in relation to the data presented but it has been suggested in the preceeding chapters that there is a relation of starting the breeding season with the on set of the north east monsoon from the last week of November and continuing the same till last week of January. Incubation period of eggs ends with the on set of south west monsoon in the middle or 3rd week of

June. Further, prevailing temperature of the beach directly dependent on the atmospheric temperature is one main factor of controlling the duration of incubation period of eggs.

The beach condition is another important factor to induce the Olive Ridley for selecting their nesting ground in the Bay. During my surveys I have found the surface condition of the Chandipur beach in the Orissa coast and Digha beach in the West Bengal are most unsuitable for their nesting though these two places are good turtle fishing centres. The sea is very shallow in these two places and long distances in the sea bed from the coast become exposed during the low tide. The beach becomes harder after the exposure due to muddy soil mixed with sand. Sandy beach is most suitable for digging out their nest holes.

Table 1. Annual Rainfall in Orissa coast according to Ray and Ray (1974)
1964-1971

Month	1964	1965	1966	1967	1968	1969	1970	1971
				YEARS				
				(In Millimetres)				
January	—	0.5	63.6	—	2.77	—	8.32	15
February	—	63.8	27.1	27.43	53.84	5.70	45.61	15
March	—	22.6	1.8	34.35	5.21	13.71	75.43	3
April	—	30.5	64.5	16.55	24.54	51.36	7.82	376
May	38.2	25.5	26.7	8.88	23.66	99.13	131.66	459
June	592.7	25.9	249.4	67.42	202.00	138.37	478.25	575
July	437.0	417.0	201.2	140.10	253.00	296.16	238.20	812
August	425.5	206.8	144.1	130.35	247.00	380.83	175.65	650
September	219.6	210.7	138.5	273.10	177.45	245.90	325.23	991
October	135.6	79.4	112.6	88.42	172.41	35.86	85.46	656
November	25.8	—	104.6	7.70	59.07	62.38	30.70	501
December	—	—	0.3	—	—	—	—	—
Total	1874.7	1082.7	1134.4	794.30	1368.80	1329.40	1600.33	5362

Table 2. Average monthly air temperature (C°)
at Chandipur Base

Month	*Average Range C°*	
	Minimum	*Maximum*
September	23.8	35.5
October	21	33
November	21	31
December	17	29
January	15	27
February	17	30
March	21	33
April	22	35
May	25.5	35.5

Ocean currents originating from the Indian Ocean flow along this coast principally in two directions ; from north to south during December to May and from south to north from June to November, but according to Sewell (1929) the flow of the surface current during March to May is from south to north and according to Wyrtkis (1961) the flow of surface current in February is from south to north which agrees with the observation of Sewell. The general circulation of surface water in August is from north to south along this coast. During the December-January period, there is a shift in current direction along the coast of the Bay upto December, there is northerly flow of warm water, which originates from the Indian Ocean. From December there is a northerly flow reversal of the current, with the direction shifting from north to south. Consequently, there is gradual overlapping by the cold current from the north of the warm, but strong current from the south. Perhaps, due to this reason the upper strata of water remains cold and the lower one is warm during December-January period.

Salinity : The general salinity of water recorded (Chandipur Base) from December 1971 showed a slow increase from 22.8°/00 in December 1971 to 34.6°/00 in May, 1972.

Table 3. Salinity Fluctuation in Coastal Waters

Month	*Average Salinity* (°/00)
December	22.8
January	25.0
February	26.9
March	30.6
April	31.5
May	33.6

Some Notes on the Natural History, Ecology and Biology of the Ridley

Common name : The generic name *Lepidochelys* means "scale turtle". Unlike the other sea turtles the Olive Ridley or the Pacific Ridley has more than five costal scales or shields along the sides of the carapace which may go up to a dozen, arranged irregularly.

In the East African coast the Olive Ridley is called "Kigemge" by the Bajun people. According to Carr (1961) the Pacific form which ranges from Sri Lanka and the East Indian to the Pacific coast of America is known in southern Mexico and central America generally by the word "Couama" but actually the term is an old carribean name used for

Loggerhead. In Mexico the light coloured variety of Ridley is known as "Mestiza" but actually "Golfina" is the name applied for the *L. olivacea*. In the Madras coast of India it is known as "Kadalaamai" (sea turtle).

Catching method of the turtle in Bay of Bengal

The main catching method of this turtle mentioned by Valliappan and Pushparaj (1973) in its feeding ground is by means of nets. In the Tuticorin coast the fishermen place their heavy large hole nets of a bottom set type across the channels between islands and reefs or parallel to the reefs. The turtles use high tide to go over the reefs to feed and while coming back during the receding tide turtles are caught in the net but it is not clear from their description what species of turtles are being caught in this method. In the Orissa coast no doubt accidentally turtles are being caught in fishing nets but fishermen usually try to avoid nets for catching turtles because nets are damaged by turtles. I have seen such damaged nets being repaired by fishermen. During the mating season of this species the males remain floating hooked above the female in copulation so indifferently in the sea that the pairs allow the fishermen in boats to approach very near them. The fishermen upturn the pair suddenly and drag up the pair on the boat and in this operation a piece of wood and a small strong net is also used or even if a plank is placed in front of the couple the paired turtle may crawl out of water into the boat for better copulation facilities. No doubt sometimes nesting females may be also being caught but this catch is negligible. The method of catching the Ridley floating in copulation is indicated further by the maximum number of catch in Orissa coast during their mating season and of 50% male and female ratio in the total number of catch per day.

The food and feeding ground : No adequate information of its feeding ground is available but it is presumed that coral reef areas near the Andaman and Nicobar islands are the feeding grounds of the nesting population that come to nest in the Orissa and West Bengal coast. One report by Biswas and Sanyal (1977) of one juvenile green turtle being collected from the sea near the Nicobar coast indicated that a population of sea turtles spends a period of its life near about Andaman and Nicobar Islands.

According to Valliappan and Pushparaj (1973) the 160 km. distance between Tuticorin to Rameswaram where there is a chain of 20 islands of atolls, is the feeding ground of turtles. Here the average depth of water between shore and island is 2 fathoms and the channel between

islands is 3 fathoms. The island reef of this area is known as "Paarai" to the fishermen where they place their nets to catch the turtles that come to feed here.

In the opinion of Dernaniyagala (1939) this species is probably more of a bottom dweller and less of the habit of floating the sea surface excepting during its breeding season. This point is substantiated when some nesting turtles are found with settlements of *Balanus* on their carapace. It inhabits shallow water between the reef and shore and by no means uncommon in larger bays and lagoons.

This species is mainly herbivorous, at least in its adult stage. I have found gut full of algae in the dissected adult Ridley specimens but Daraniyanagala (*loc. cit.*) has mentioned that it also takes sea urchin, *Clypeaster humilis*, as well as young pearl oysters.

There is possibility of change of food habit from carnivorous tendencies in the young stage to mainly herbivorous feeding habit in the adult stage like that of *Chelonia mydas*. In cases of some Ridley population great distance separates their feeding and nesting grounds unlike green turtles. But in respect of Bay of Bengal population possibility of a great distance separating between feeding and nesting grounds is unlikely having feeding grounds in the Bay itself. Carr and Caldwell (1956) were getting regularly in Florida in the same net green turtles as well as *Lepidochelys olivacea kempii* (Garman) which are supposed with different feeding habits. Green turtles are available in pastures of grass flats (Turtle grass, *Thalassea* and Manatee grass, *Cymodocea*) but for the presence of Atlantic Ridley it was surmised that they were on the flats with the green turtles to feed there on crabs and invertebrates. But in the case of Pacific Ridley as it also turns to vegetarian diet in its adult stage it can be also expected to be available in association with the green turtles in the Bay of Bengal wherever the turtle pasture will be available. This possibility of change of feeding habits is further strengthened by the report of Zwinenberg (1976) on the food and feeding habits of Olive Ridley.

Range in size and weight : The Ridley is the smallest sea turtle and seldom weighs more than 40 kgs. According to Schulz (*loc. cit.*) it seldom weighs more than 50 kgs. Pritchard (1969) gave the average weight of 14 turtles as 35.7 kgs. The average weight of turtle from the Orissa coast is 30 kgs. which may vary between 30 to 35 kgs. but it will seldom exceed 35 kg.

The Ridley is the smallest of the sea turtle reaching maturity at a length of shell about two feet (61-68 cm.). The measurements given (Table 4) below of 10 specimens each of male and female are more

than the measurements quoted above. The average carapace length and breadth of 500 females of Surinam Ridleys given by Schulz (1975) is 68.5×60.4 cm. but in the ten samples of adult females of Puri Coast it is 57.8×50.2 cm. The difference of the two averages may be due to less number of measurements in the Puri population and the range of variation in the length into breadth is 63 to 75×53 to 66 cm. in the Surinam specimens and 64 to 72×55 to 63 in the same number of females of the Puri Coast.

The plastron breadth is slightly more than its length.

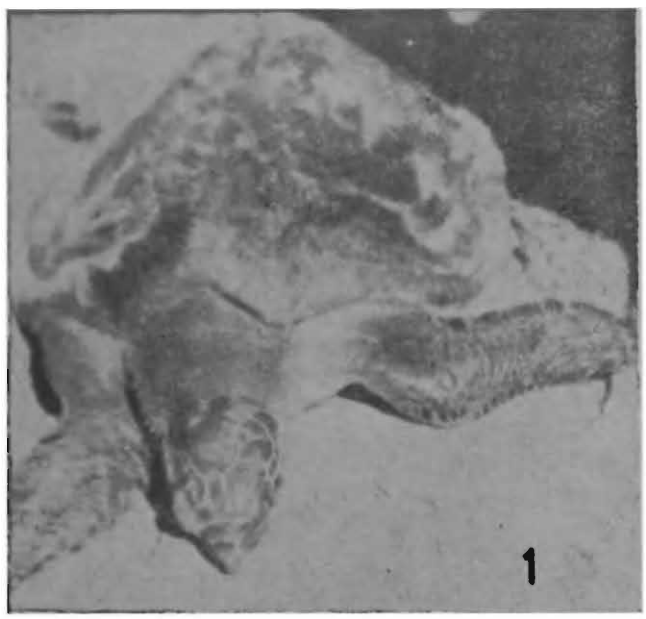
Table 4. *Measurements of mating males and females of Puri Coast*
(Measurements in cm.)

Female				Male			
Carapace		Plastron		Carapace		Plastron	
Length	Breadth	Breadth	Length	Length	Breadth	Breadth	Length
70	60	55	52	68	61	51	49
69	61	50	49	70	57	49	48
67	55	50	49	67	59	50	48
72	59	53	52	64	56	48	47
69	62	53	52	68	65	52	48
67	65	53	51	78	60	50	49
67	63	54	54	70	59	51	49
66	57	51	50	79	64	53	51
67	61	51	50	73	60	51	50
64	59	53	52	70	61	50	48

Breeding season of the Ridley in the Bay of Bengal

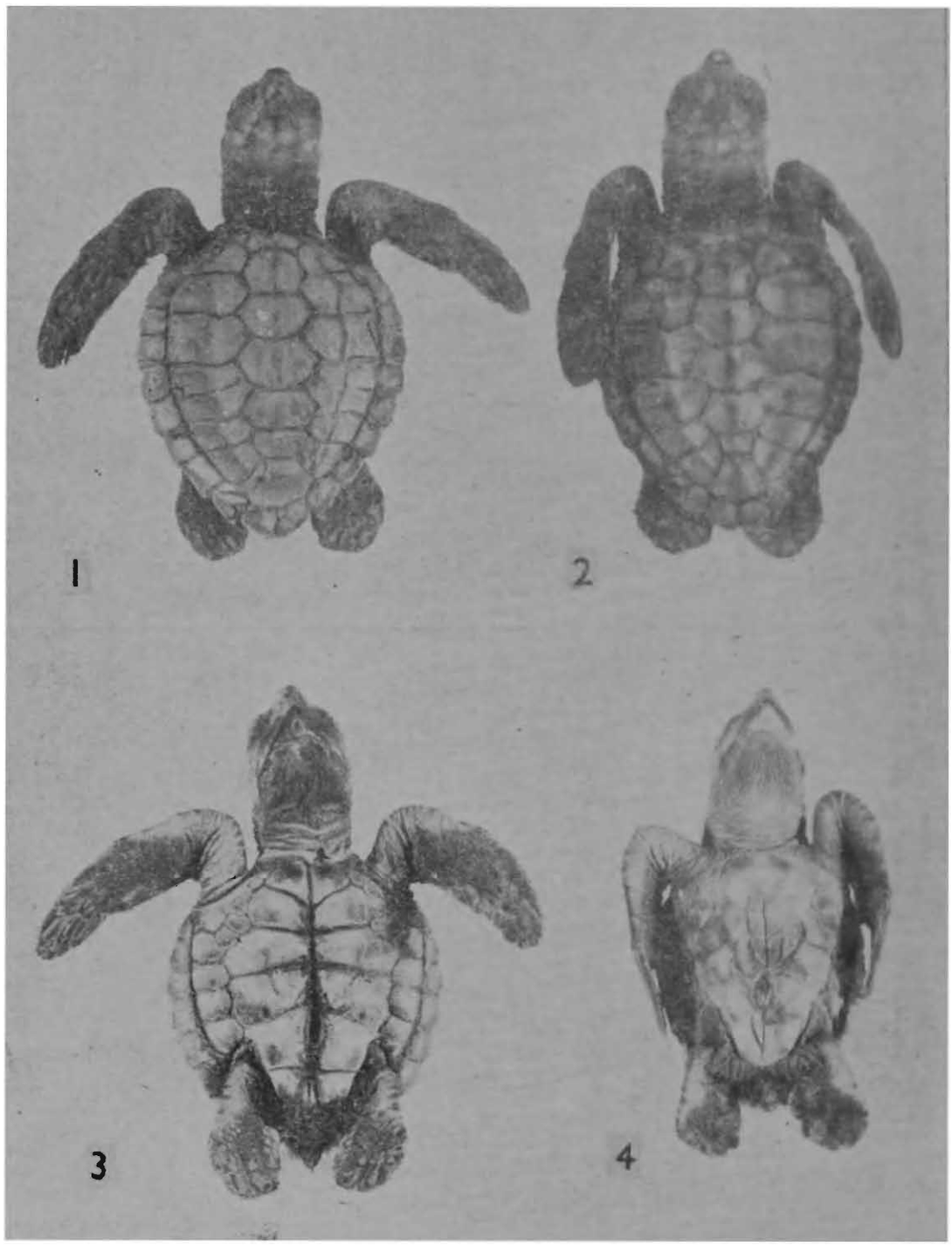
Mating season : For the Ridley the season generally starts in the Bay of Bengal from the 3rd week of November and ends in the end of January. The actual peak of the mating season may be taken as the period of the breeding season which is from the middle of December to the middle of January. The mating season almost coincides with the north-east monsoon or the trade wind that sets in usually in the last week of November and lasts till the last week of January. This is the most suitable period of the year when the sea condition for the copulating pairs can remain in undisturbed condition in a calm, quite and cool sea. During the December-January period due to the shift in current direction along the coast of Bay, the northward flow of warm water originating from the Indian Ocean is very helpful to the breeding pairs. The concentration of turtle population occurs during this period just before the nesting season in the Bay of Bengal and this congregation is particularly observable off the mouth of rivers

BISWAS PLATE IX



Lepidochelys olivacea (Eschscholtz), Fig. 1. Head shield and the expansion of the front flipper. Fig. 2. Side view of head from the ventral side. Fig. 3. Wavy marking on the carapace of a freshly caught specimen. Fig. 4. Fishermen children playing with a turtle lying the flipper. Fig. 5. The beach condition of Chandipur.

BISWAS PLATE X

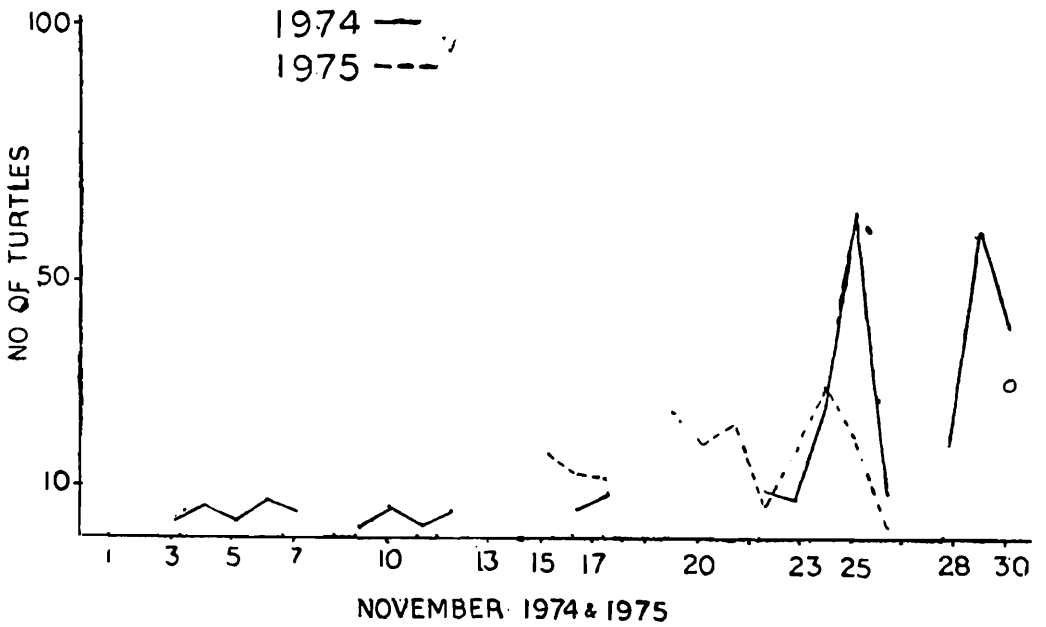


Lepidochelys olivacea (Eschscholtz). Figs. (1 & 2) dorsal and (3 & 4) ventral views of four hatchlings. Fig. 4. Specimen is underdeveloped, hatched in an artificial condition.

of Orissa approximately 6 km. coast line starting from the mouth of Chilka to Chandrabhaga (Konarak Coast) to the mouth of Mahanadi Baitarani estuary (Sea faces of Bhitorkonika estuary) and Budhabalang river mouth of Balasore district and also in the coast of West Bengal at the sea faces of Digha to Sunderban estuary. During this time the combined pairs of turtles are found floating scattered in these areas and become the victims of easy catch to the fisherman.

An approximate idea of a part of the mating turtle population and its peak periods can be gathered from a catch of an area of sea adjacent to Puri coast by the number of turtles booked from the Puri Railway Station for the consumption of Calcutta market where it is sold profitably. The local consumption of turtle meat is very negligible due to religious taboo and also nonprofitable market price. Therefore the number of turtles booked per day may be taken as the approximate average per day catch of this area.

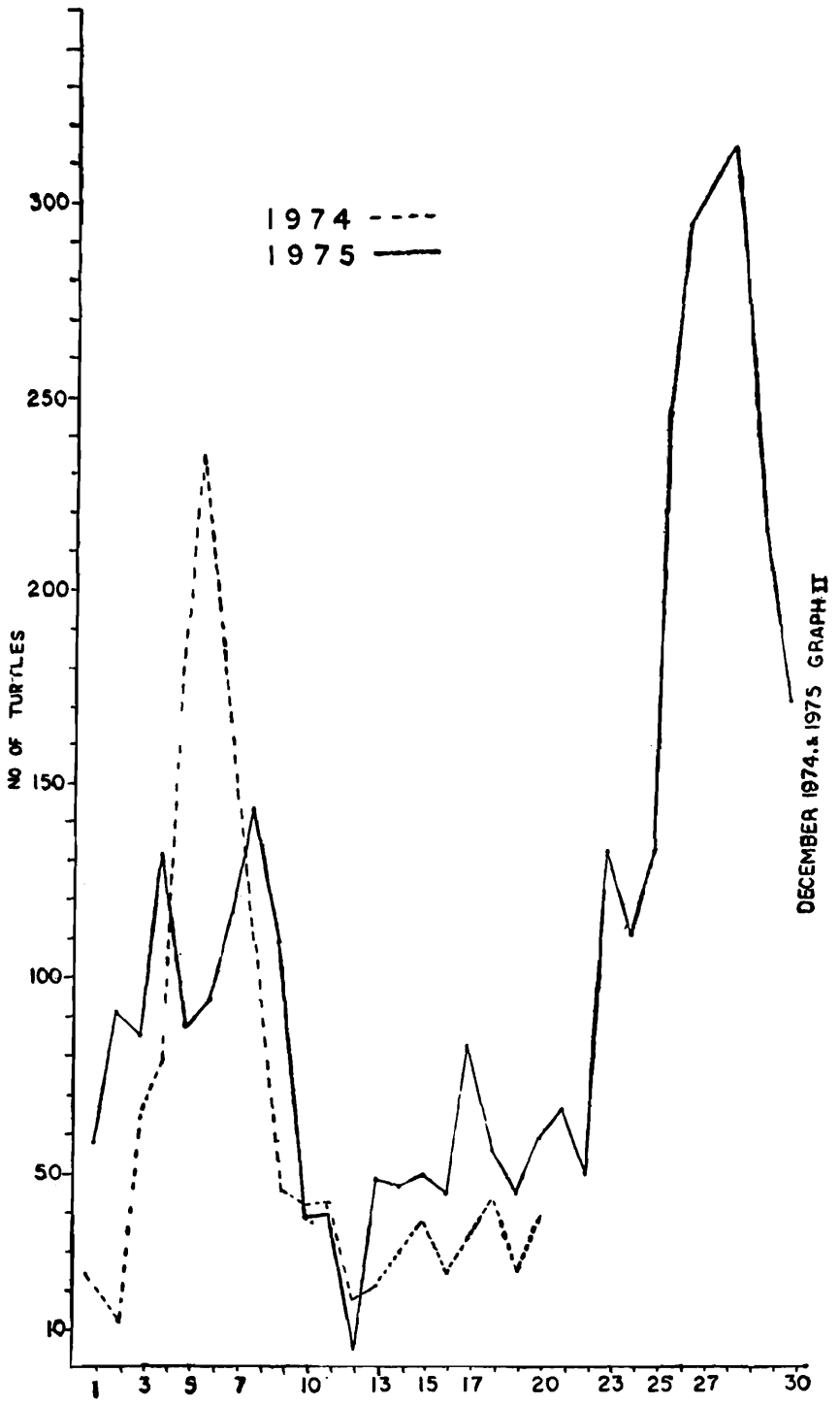
Like the nesting periodicities of Ridleys and Green turtles they have also the mating or pairing periodicities which can be seen from the daily catches of these turtles from the sea of Puri coast during their mating season. The comparative study of turtle catch in the month



Text-fig. 2. Graph showing the turtle catch of November 1974 & 1975.

of November, the beginning of the turtle fishing season and in December, the peak period of the season of two consecutive years 1974 and 1975 will give an approximate idea of this periodicity or rhythm. The first picking up of the catch in the season is on 24th and 25th November of the years 1974 and 1975 respectively (Text-fig. 2). In both these two years the peak collection period was from 1st to 10th

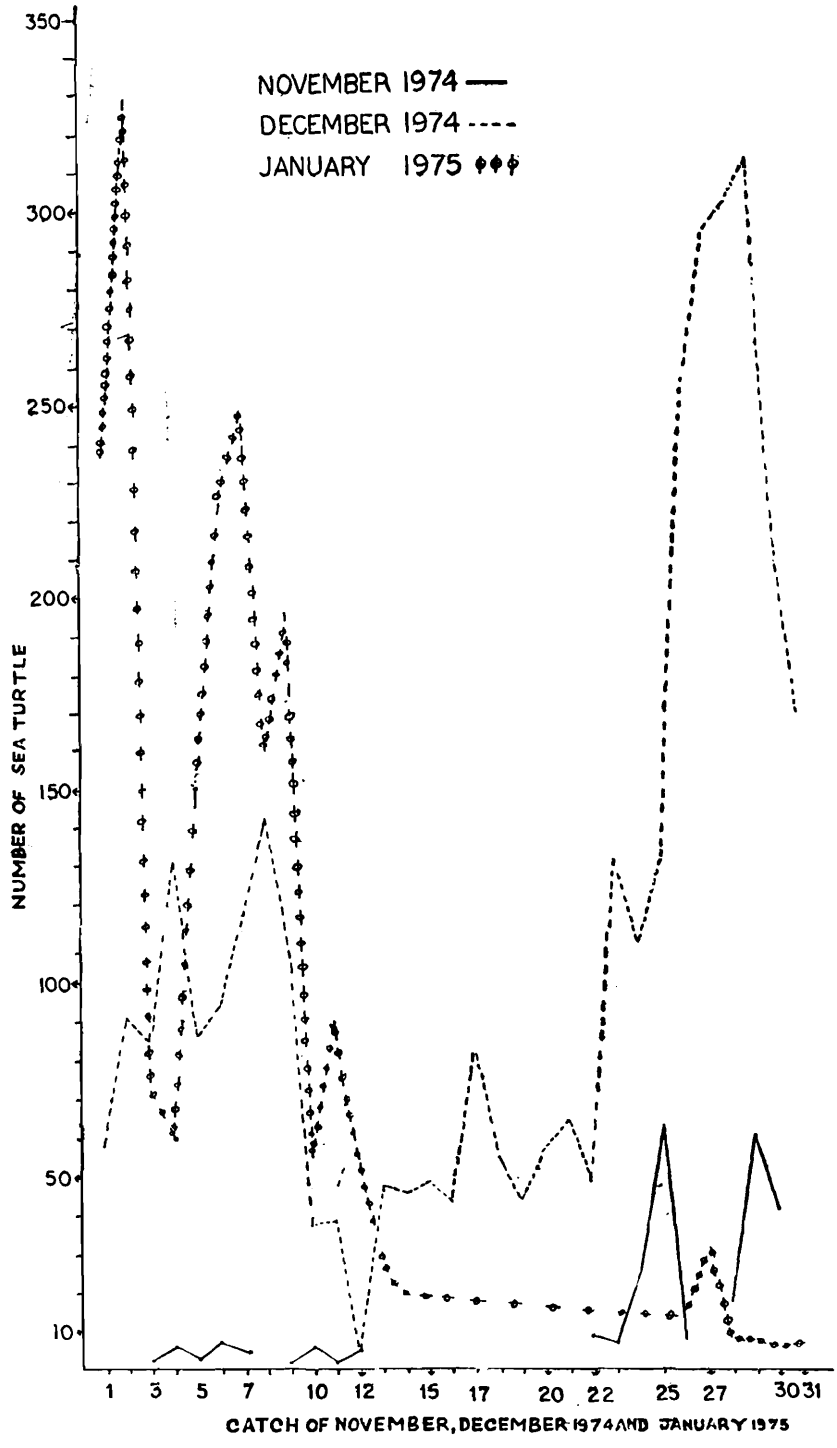
December which fell down abruptly on 12th but continued in a higher lavel (Text-figs. 3 & 4).



Text-fig. 3. Graph showing the turtle catch of December 1974 & 1975.

Comparative study of daily turtle catches from the sea of Puri coast in the three months of the turtle season 1974-'75 (Text-fig. 4) shows that from 22nd November the catch started to rise and reached to two peaks on 25th and 29th and the trend continued and the catches increased further in December reaching peaks on 2nd, 4th, 8th, 11th, 17th, 21st, 23rd, 26th and 29th. In January the trend continued and reached peaks on 2nd, 7th, 9th, 11th after which the catch went

down abruptly but remained steady from 15th to 25th. The catch again rose on 27th and ended in February. 29th December and 2nd January were the two days of highest catch of the season. One peculiarity is observed in this detailed study of daily catch that it is not continuous



Text-fig. 4. Graph showing the turtle catch of November, December 1974 & January 1975.

rise or fall of catches but always with 2 to 5 days of intervening low catches between peak collections.

In the chapter on the commercial importance of the species it has been noted on the basis of information of two collecting agents of Digha

coast, West Bengal that the actual turtle fishing season started in West Bengal coast in 1978-'79 from middle of October. The collection increased throughout November, reached maximum in December and ended in middle of January. When compared with the breeding season of turtles of Puri coast we find that in West Bengal it bad started and ended earlier in 1978-'79 which may be due to early start of the trade wind.

Nesting season : Since mating brings about fertilization of eggs that will be laid two or three years later and has nothing to do with the eggs of the season, it seems likely that copulation could take place equally well before or after nesting and that it may also occur at both times. Observation along the Coast of Sinaloa, Mexico (Carr 1961) seems to indicate that the same is ture of *Lepidochelys olivacea*.

The mating as well as nesting period of this species overlaps. The nesting time starts near about middle of December which is also the peak mating time and continues upto the middle of February and consequently hatching period lasts near about upto the end of May. The laying of eggs and hatching duration has been adjusted in such a timely requlority in the Ridley population of Bay of Bengal that the hatching will be completed in the end of May or just before onset of rainy season which usually starts in the coast of Bay of Bengal in the middle of June. We may have an idea of the period from the date of egg collections (Table 5) and its hatching out dates.

During this period turtles begin to come up in number for laying eggs along practically entire coast of Bay of Bengal wherever they get suitable beach condition. The author has come across during his survey of Orissa coast such suitable nesting grounds at Satbhya, Gahirmatha, Chandrabhaga, Balukhanda etc. out of which Satbhya was found most suitable for their nesting where the density of eggs laying reaches even one clutch in a square meter.

A phenomenon is seen in *L. O. olivacea* coming for nesting in a mass as if in waves having a clear periodicity which is comparable with similar mass nesting of *L. o. kempii* known as 'arribada'. This 'arribada' also takes place in the Ridleys of Orissa coast in the peak time of its nesting season but the author missed to observe the incident when he was at Talichua on 17. 1. 76 a place in the Bhitorkonika. It has been reported by the local fishermen that usually it takes place at Gahirmatha and Satbhya in the month of January in the period after spring tide with decreasing high water, *i. e.*, between newmoon and first quarter, and between fullmoon and last quarter. [Just after

Purnima (full moon) Kotal (Spring tide) or Amabasya (new moon) Kotal]. Following are the nesting seasons in different coasts of Bay of Bengal and East Pacific :

Regions		Months	
East Pacific Ocean	—	August to November	—4
Sri Lanka	—	September to January	—5
Burma	—	March to April	—2
India	—	January to April	—4

Table 5. Data of collections of eggs and hatching period of 13 clutches from Madras and Orissa coast.

Nos.	Date of collection	Date of hatching	Total nos. of eggs	Days to hatch	Locality
1.	22. 12. 73	21. 2. 74	135	60	Madras coast
2.	25. 12. 73	26. 2. 74	43	63	,,
3.	28. 12. 73	26. 2. 74	143	60	,,
4.	5. 1. 74	2. 3. 74	139	57	,,
5.	9. 1. 74	5. 3. 74	128	55	,,
6.	9. 1. 74	7. 3. 74	120	57	,,
7.	20. 1. 74	28. 3. 74	105	66	Orissa coast
8.	25. 1. 74	17. 3. 74	105	50	Madras coast
9.	25. 1. 74	19. 3. 74	85	52	,,
10.	29. 1. 74	21. 3. 74	127	51	,,
11.	29. 1. 74	21. 3. 74	116	51	,,
12.	29. 1. 74	21. 3. 74	140	51	,,
13.	12. 2. 75	10. 4. 74	119	54	Orissa coast

So far collected clutch size of this area are found to vary from 43 to 145 number of eggs and days of hatching 51 to 66 days.

Some notes on nesting behaviour, incubation and hatchlings

Nesting behaviour : Carr (1948) has observed in detail the nesting behaviour of a number of Pacific Ridleys on the beach of Isler de Ratones in Hunduras in the Gulf of Forseca (Pacific Ocean) and Werler (1951) recorded an egg laying incident of this species at Padre Island off the Texas coast. In Bay of Bengal nesting behaviour and incidences have been observed by Biswas *et al.* (1977), Valliappan and Whitaker (1974) and Greaves (1933).

Incubation : In natural condition the incubation success of eggs varies from clutch to clutch from 50% to 80% of the laid eggs due to presence of a good number of nonfertile eggs and also due to obstruc-

tion or overcrowding of fully formed hatchlings not being able to get out of their nests. In an experiment conducted at Gahirmatha beach, Orissa Biswas *et al.* (*loc. cit.*) got 66.66% incubation success.

The above mentioned paper also suggests that the incubation period depends on the average air temperature during that period. Usually 60 days are recognised for incubation of eggs in natural condition at the beginning of the season when air temperature remains comparatively low but in the end of the season when temperature rises it takes less time for incubation.

Size and weight of eggs and hatchlings : Following are measurements of two samples of eggs and hatchling from two nesting areas of Orissa coast according to Biswas *et al.* (1977).

Gahirmatha	*Konarak*
5 eggs on 1. 4. 75	*20 eggs*
Diameter—34 to 38 mm.	Diameter—35 to 37 mm.
Weight —33 to 33 gms.	Weight —25.5 to 27.2 gms.
10 hatchlings	*10 hatchlings*
Length of carapace 35 to 40 mm.	Length of carapace 34 to 42 mm.
Weight — 12.2 to 15.5 gms.	Weight — 13.5 to 16 gms.

ECONOMIC IMPORTANCE OF THE SPECIES IN THE COASTAL AREAS OF BAY OF BENGAL

This species has a commercial importance in the economy of eastern and southern coastal areas of India. One of the main occupations of many fishermen in the coastal belt of Bay of Bengal and Orissa for three months of a year is the turtle fishing and *Lepidochelys olivacea* is the only main catch of this season.

A major portion of the turtle catch from the Orissa coast comes from Puri coast which also includes the catch of the Konarak coast. This catch is mainly exported out of the state from Puri Railway Station. The majority of the fishermen community engaged in turtle catching operation in this area are the Christian community of coastal Andhra temporarily settled in the sea side bustees (hutments) known as Luniasahi in the Puri coast of Balukhand area. Most of them come by their sailing boats from the Andhra coast in the beginning of September and leave this place in March and April after the closure of the important fishing season of this area. At present some of them have permanently settled in the Balukhand area of Puri. Usually the Hindu Andhra fishermen or local fishermen are not engaged in the turtle catching operation due to the religious taboo.

Calcutta is the main market of consumption of this species. From the Puri Rly. Station most turtles are booked to the Howrah Rly. Station. Recently developed anothar minor center of consumption is Raipur, Madhya Pradesh. Konarak is another centre for turtle catch in the Orissa coast. The turtles caught from the sea are carried from the Chandrabhaga seashore to the stocking centre of Konarak near the northern side of the Sun-Temple. The turtles are loaded on the bus top at this place for transporting them either to Bhubaneswar or Puri Rly. Station. At Puri fishermen sell turtle to the middleman at the price of Rs. 20 to 25 each and it is sold to the wholeseller of Howrah Chandni market, a market of fish wholesale at Rs. 57 to 60 per turtle. The retailers or fish-sellers purchase in the Chandni wholesale market to sell the turtle meat at Rs. 5/- or 6/- per kg. The fishermen of Chandrabhaga get less price per turtle than the fishermen of Puri may be due to the more transporting cost of this place than Puri. The turtles are despatched by train upside down, both pairs of fore and hind limb tied up together with an identification mark and a number inked on the plastron. The Puri municipality charges 25 paise on each turtle as octroi duty.

Following is the month-wise despatch of turtle from the Puri Rly. Station in the year 1974-75 which can be taken as the approximate month-wise turtle catch of this area in that season.

Despatch from Puri Rly. Station :	November, 1974	—	282
,, ,, ,,	December, ,,	—	3448
,, ,, ,,	January, 1975	—	2460
Despatch from Malatipatpur Rly. Stn., the Rly. Stn. after Puri from 3.11.74 to 23. 11. 74.			149
	Total		6339

The turtles that used to be caught at Gahrrmatha, at the mouth of the Dhamara river and the seaface places of Vitorkonika estuary used to be brought to Chandbali by boat and from here it again used to be carried on bus stop or by truck to the Bhadrak Rly. Station, finally for despatching to Howrah Rly. Station. This area was wellknown for the collection of turtle eggs. It was reported by the Range Officer Konika, Forest Dept., Govt. of Orissa that seven boat loads of turtle eggs were collected in 1974 from this area and despatched to the Calcutta market. But turtle catching and collection of its eggs in the nesting season of this area has been stopped since 1975 with the declaration of the area of Vitorkonika as the turtle and crocodile sanc-

tuary. The eggs are usually sent to the Calcutta market. Though turtle meat is not popular it is also used by the local low caste people. I have seen turtle meat being sold in the Chandbali market of Orissa and Namkhana (Sundarban), West Bengal.

November is also the month when the season of turtle catch starts from Chandipur, an important fishing center in mouth of Burdhabalaug river. On an average 4 quintals of sea turtles numbering nearly 30 specimens are usually caught at this place daily during the peak period of the turtle season and despatched to the Calcutta market.

From the Digha and Sunderban coast of West Bengal this species is also being caught and marketed in the Calcutta market. Though I have also data of annual catch of this area but which can be presumed to be no less than twenty thousand in the season.

Information about the Madras coast will be available from the reports of Pusparaj, Whitaker and Valliappan (*loc. cit.*).

An account of turtle catch at Digha coast of West Bengal in 1978-'79 has been gathered from two agents, one stationed at Digha proper and another at Junput. Turtles are collected at Digha from 6 seaside depots. and at Junput from 2 and sent by truck to the Kharagpur Railway Station for the Calcutta market.

Turtle catch at Digha coast of West Bengal in 1978-79.

15th October, 1978 to 30th October, 78	858	161
1st November, 78 to 15th November, 78	1661	284
16th November, 78 to 30th November, 78	3880	889
1st December, 78 to 15th December, 78	4644	1080
16th December, 78 to 31st December, 78	5081	1412
1st January, 79 to 15th January, 79	1201	210
	17,325	4,036
	4,036	
Total catch	21,361	

PROTECTION AND CONSERVATION

It is regretable that very little attention has been paid to the sea turtles that are nesting in the coast of India. To find out a rational plan of protection for the turtles of Indian coast and sea, the nesting areas or grounds of the species concerned are to be first searched out. The key to the future of turtle resources lies in the preservation of these nesting grounds of beaches. The next important step is ascertaining the number of nests that are being laid in these different nesting grounds in every year. In this respect the steps taken in Surinam for

the conservation of Olive Ridley will be very relevant to state here (Schulz, 1975) :

In 1963 for the protecting of nesting turtles Bigisanti nesting beach Wia-Wia Nature Reserve had been set up. In 1966 the boundaries of the Nature Reserve was further expanded. In April 1964 poachers started poaching turtles. The Forest Deptt. took firm action against it. The Nature Reserve authority is gathering quantitative data about laying in approximately 10 km. long beach which is being patrolled daily from April to August and all nests laid during the previous night are being counted. In this Reserve tagging, weighing and taking measurements of turtles are also regularly carried on and more data were collected about incubation periods and hatching percentage for eggs including of those replanted in nests. The World Wild Life Fund is also financing in this work of the Nature Reserve which paid in 1964 for buying up and rebuying of 30,000 eggs and in 1968 most of the Ridley nests of Eilanti were bought with the financial aid from the W. W. F. In this respect it can be mentioned that the W. W. F. is also helping the Madras Snake Park for its plan of rebuying turtle eggs of Madras coast.

Lastly for the conservation of the Ridleys of the Indian coast, information on population dynamics, such as sex ratio, annual recruitment and mortality, age distribution are important for the proper management of a conservation programme in the Indian coast.

The following proposals are therefore proposed to the Government and to the people concerned for the protection and conservation of the Olive Ridley of Bay of Bengal which are also equally applicable for other sea turtles.

1. Annual quotas of turtle catch and collection of its eggs should be fixed for each demarcated area only. The total ban for exploitation of this species at present is not necessary as the species is predominantly the most numerous marine turtle today in the Bay of Bengal. This fact has been well experienced by the author in his present survey as well as by the reports of Zwinenberg (1977), Valliappan and Whitaker (*loc. cit.*).

2. Fishery and Forest Depts of the concerning States should be entrusted to supervise that the exploitation beyond the fixed quota does not exceed.

There is a Government ban for turtle catching which is not strictly enforced in India.

3. Selected areas and beaches where mass nesting is now taking place are to be declared turtle sanctuaries where total ban should be enforced and the immediate off shore areas should be closed for trawling.

The Bhitorkonika estuary of Brahamani and Mahanadi rivers has been declared such a sanctuary by the Orissa Government and the Forest Dept. at present is engaged there for marking turtles.

4. Buying and rebuying scheme of turtles eggs in the entire coast should be started under the Fishery and Forest Depts. If the financial help from the Govt. is limited for such a scheme, the help of W. W. Fund and other societies interested in the conservation should be sought for. The eggs thus procured should be buried for iucubation.

The Madras Snake Park has already been receiving financial help in this scheme from the W. W. Fund.

5. Nesting areas should be protected by the Coastal, Forest and Lighthouse guards and it should be incorporated in their duties to protect the nesting beaches from the poachers and predators by regularly patrolling these areas.

6. To increase conservation awareness in the coastal people and fishermen a programme of conservation education should be carried out.

7. Lastly a pilot project of a Turtle Ranch as is in operation at the Field Station of the Surinam Forest Service to raise newly hatched Green sea turtle in captivity should be started at a suitable place in the coast of Bay of Bengal (*Marine Turtle Newsletter No. 7. April 1975*). The specific goals of the Surinam project should be also the objectives for our project. There is a scope in India for establishing such a project in Waltair coast at the Waltair Zoogarden.

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