

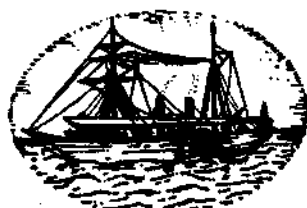
PROCEEDINGS OF THE SYMPOSIUM ON COASTAL AQUACULTURE

Held at Cochin

From January 12 to 18, 1980

**PART 4: CULTURE OF OTHER ORGANISMS, ENVIRONMENTAL
STUDIES, TRAINING, EXTENSION AND LEGAL ASPECTS**

(Issued in December 1986)



The Investigator

MARINE BIOLOGICAL ASSOCIATION OF INDIA

POST BOX NO. 1023, COCHIN-682 031, INDIA

Price : Rs. 400.00

EDITORIAL BOARD

DR. E. G. SILAS

DR. P. V. RAO

DR. P. V. RAMACHANDRAN NAIR

DR. K. RENGARAJAN

MR. T. JACOB

DR. K. J. MATHEW

DR. R. PAUL RAJ

DR. S. KULASEKHARAPANDIAN

DR. A. G. PONNIAH



MARINE BIOLOGICAL ASSOCIATION OF INDIA
COCHIN-682 031, INDIA

SYMPOSIUM SERIES 6

Abbreviation

Proc. Symp. Coastal Aquaculture, Pt. 4.

PRINTED IN INDIA BY A. D. THOMAS STEPHEN AT THE DIOCESAN PRESS, MADRAS 7 AND PUBLISHED BY
E. G. SILAS ON BEHALF OF THE MARINE BIOLOGICAL ASSOCIATION OF INDIA, COCHIN-682 031

OBSERVATIONS ON THE OLIVE RIDLEY TURTLE *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ) (FAMILY CHELONIIDAE) HATCHED AND REARED UNDER LABORATORY CONDITIONS

A. AGASTHEESAPILLAI

Central Marine Fisheries Research Institute, Cochin 682 031

ABSTRACT

One hundred and thirty four eggs of Olive Ridley turtle *Lepidochelys olivacea* (Eschscholtz) were incubated at an average temperature of 30.5°C under laboratory conditions. Thirty baby turtles emerged in three consecutive nights after 53 days of incubation. Of the remaining eggs, 69 did not hatch out and 35 failed to complete the development. Out of the 30 turtles that emerged, 28 died during the first 4 months, probably due to overcrowding and adverse conditions of the aquarium. The two turtles which survived, were reared in the aquarium for 1½ years, feeding with the meat of *Donax* sp., *Sepia* sp. and *Sardinella* sp. The morphological changes undergone and behaviour pattern of the turtles during the period of rearing were presented.

INTRODUCTION

LUTHER (1959) conducted an experiment at Mandapam Camp on incubation of eggs of Olive Ridley turtle and a few hatchlings emerged, had died. Mawson (1921) incubated eggs of Green Turtle *Chelonia mydas*; the incubation was a success, but she had not stated anything about the fate of the hatchlings. Bustard and Greenham (1968) and Bustard *et al.* (1969) had made reports on successful incubation of Green turtle and Loggerhead (*Caretta caretta*) turtles; but they had not made any report on rearing. Hornell's (1927) rearing of babies of Hawksbill (*Eretmochelys imbricata*) and Green turtles was not successful. Moorhouse (1933) reported 10-24% success in incubation of Green turtle eggs removed from oviducts and 41-86% success in twelve natural nests. Hendrickson (1958) had given an account on incubation of Green turtle eggs in hatchery and some accounts on growth. Jones (1959) made an attempt to incubate Leatherback turtle *Dermochelys coriacea* eggs, but did not

hatch out. Hirth (1971) had given a brief account on culture of turtle and Milne (1972) had given a short note on turtle culture in British West Indies and Australia. Boonlert Phasuk and Sayan Rongmuangsart (1973) had given an account on the Ridley turtle *Lepidochelys olivacea olivacea* Eschscholtz in captivity and the effect of food preference.

The author is greatly indebted to Dr. C. S. Gopinadha Pillai, CMFRI for helpful suggestions for improvement of the manuscript.

MATERIAL AND METHODS

One hundred and thirty four eggs laid at 0030 hrs, on 31st January, 1973 on the coast of Mulli Island in the Gulf of Mannar, about six metres above spring high tide level were collected at 0600 hrs. and placed softly one by one in an empty biscuit tin above a layer of coral sand of 4 cm height. The lateral space 3 cm left in the tin was filled with the same

type of sand. The eggs in the tin stood for a height of 13 cm and the sand was placed over the eggs for a height of 4 cm. The tin had a height of 35.4 cm and sides 24 cm (square). This semi-natural nest was brought to the laboratory by a canoe and placed on a wooden table in the laboratory.

A thermometer was placed vertically on the sand at the centre of the nest. The temperature was recorded daily at four consecutive periods : 0600, 1230, 1800 and 2400 hrs.

Once in four days 300 ml distilled water was sprinkled over the sand to keep the nest moist.

The hatchlings were measured, tagged and kept in a glass tank (121.5 × 60.5 × 33.0 cm) with sea water open circulation in the Aquarium. They were initially fed with the meat of *Donax* sp. for a week and thereafter with the meat of *Sepia* sp., *Sardinella* sp., *Pseudoscaena* sp., *Pellona* sp., *Cynoglossus* sp., *Hemirhamphus* sp., *Selaroides leptolepis*, *Dussumieria* sp., *Thrissoles* sp., *Anchoviella* sp., *Upeneus* sp., *Sillago sihama* and *Penaeus* sp. at 1030 hrs. and the unconsumed meat was removed at 1600 hrs. every day.

The nest was opened on the 8th day after the first emergence of the hatchlings to see the fate of the remaining eggs.

While cleaning the tank in the morning and evening the baby turtles were allowed to bask. The two babies survived were put together in one tank till the sixth month and put thereafter in separate tanks.

Water depth was lowered when the babies found difficult to swim and raised when they were active.

The per cent conversion efficiency was determined by the equation (Robert, 1971) :

$$\frac{\text{Grain}}{\text{Total food consumed}} \times 100$$

RESULTS

On the 54th day (25 March, 1973) of incubation at the average temperature of 30.5°C seventeen baby turtles (56.7%) emerged between 2015 hrs. and 2400 hrs. Six babies (20%) emerged between 0000 hr. and 0100 hr. on the 55th day (26 March, 1973). Five babies (16.7%) emerged between 2300 hrs. and 2350 hrs. on the same day and two babies (6.6%) emerged at 1200 hrs. on the 56th day (27 March, 1973). Thus in total thirty hatchlings (22.39%) emerged. Thirty five hatchlings (26.12%) failed to emerge. Sixty nine eggs (51.5%) failed to hatch out. Two babies (6.7%) survived and the other 28 babies died within four months.

The two survived babies No. 5451 and 5452 thrived well on carnivorous diet. The baby turtle No. 5451 weighed 16 gm and measured 41 mm carapace length at emergence ; at the end of one year it weighed 3016.9 gm and had a carapace length of 267 mm; at the end of 1½ years it weighed 5600 gm and its carapace measured 345 mm. The baby turtle No. 5452 weighed 17 gm and measured 40 mm carapace length at the time of emergence ; at the end of one year it weighed 2012.6 gm and had a carapace length of 237 mm at the end of 1½ years it weighed 4087 gm and the carapace measured 307 mm. The average monthly weight and length increments are given in Table 2.

OBSERVATIONS

Eleven different characters observed are recorded here.

Positive heliotropism

The newly hatched baby turtles were placed in a white plastic tray and photographed at about 1000 hrs. on a verandah. When they were in the tray they were very active and the direction of their movement was towards the position of the sunlight.

TABLE 1. Details of food consumed by the baby Olive Ridley turtle *Lepidochelys olivacea* (Eschscholtz) No. 5451 and 5452

Months	Baby turtle No. 5451		Baby turtle No. 5452	
	Food consumed per month (gm)	% of food consumed per body weight per day	Food consumed per month (gm)	% of food consumed per body weight per day
October 1973	1808	5.74	829	4.25
November	1954	4.61	1001	4.39
December	2093	3.71	1315	4.04
January 1974	2196	3.29	1215	2.89
February	2922	1.29	1473	3.10
March	3265	3.95	1917	3.42
April	4110	4.24	1391	2.33
May	3789	3.53	1731	2.84
June	5271	4.54	2673	3.97
July	3676	2.97	2581	3.32
August	4352	2.83	3423	3.50
September	4238	2.65	4033	3.53
Total	37674		23582	

Vigour by basking

Whenever the baby turtles in the rearing tanks were found too weak to swim and appeared to be drowned they were at once taken out, washed in fresh sea water and placed on dry floor for basking. After half-an-hour the babies were replaced in the water. The babies began to swim with vigour and to breathe; they had lost their weakness by means of basking.

Duration of submergence in water

The baby turtles were able to remain under the water motionless from three to five minutes from the third month to one year old and from five minutes to half-an-hour from one year to 1½ year old.

Anxiety for food at the feeding time

When the feeding time approached and the feeding actually delayed the babies used to raise their heads very often towards the direction from where the food was supplied.

Fear for seaweed

The seaweeds *Gracilaria edulis* and *Sargassum* sp. were supplied on different occasions to the baby turtles; they became terrified at the very sight of the seaweeds and did not eat even a bit from those; perhaps it might be due to that they were habituated to feed on carnivorous diet. Boonlert Phasuk and Sayan Rongmuangsart (1973) had fed the hatchlings with the Green alga *Enteromorpha intestinalis*, the shore plant *Ipomoea pes-caprae* and the turtle grass *Thalassia testudinum* and the hatchlings showed the best preference for the turtle grass.

Movements in the water

The movements of the baby turtles during the first two months after the emergence were mainly on the surface of the water in the rearing tank. For feeding only they would dive to the bottom. The two survived babies exhibited anticlockwise movement along the sides of the tank from the third month to one year old.

After one year they showed clockwise movements. The reason for the initial surface movements, second anticlockwise and the third clockwise movements is not known.

Mutual behaviour

The two survived baby turtles were put in separate tanks to study the per cent conversion efficiency. Whenever they were put together unexpectedly they showed immense restlessness by flapping their flippers and swimming hither and thither vigorously in terror as if a stranger had intruded to disturb. After about half-an-hour of restlessness they used to become calm. When they were together in the restful stage in the rearing tank, the No. 5452 baby would first become active and bite the flipper of the baby No. 5451 which to its best would not allow itself to be bitten by maintaining certain calm and subtle movements; if by chance its flipper was bitten, it, all of a sudden, lost its restfulness and swam from the surface to bottom, from bottom to surface, slantingly and sometimes perpendicularly. They had no contention for the food supplied.

Reaction to noise

When there would be perfect silence in the rearing room and some sudden noise was made unexpectedly or with intention either by bolting or putting some material the baby turtles struck with fear made loud noise by flapping their flippers, swimming violently and spraying the water throughout the rearing room.

Taming

The baby turtles were tamable. They became tame to the author as they were acquainted by feeding, washing, basking and taking measurements. When any stranger tried to touch them they used to dive to the bottom of the tank and disappear from their vicinity.

Moulting

The moulting was not uniform for all the laminae; it was just casting off bits of laminae from carapace, plastron and head. The frequency of moulting was more till one year old and some bits of laminae could be seen on the bottom of the tank on almost all mornings. When the babies were removed from water and kept in a bucket for basking moulting took place rapidly; on getting dry the surface portions of laminae would rise up and fell down on wiping. The moulting locations in the body in the order of predominance were laterals, centrals, plastron laminae and head laminae.

Body colour change during growth

The babies newly emerged from the nest had a sooty black colour and a thin white margin around the carapace and posterior edge of each flipper. The gapes were grey, throat dark and the base of the neck lighter. There were three white spots on the femoral laminae, one in the middle and the other two at the upper part of the laminae, one on each of the pair. The middle white spot is the point of attachment of the yolk with the developing embryo for supply of nutrients (Pl. I B, C).

By the time of growth the intensity of the body colour was diminishing; the carapace margin became light yellow.

Six months old baby turtles

Dorsal view: In turtle No. 5451 the grey margin in the fore flippers were dominant and seams became grey. In turtle No. 5452 the intensity of the sooty black colour slightly disappeared and margins appeared slightly grey.

Ventral view: In turtle No. 5451 the margin of the proximal part of fore flippers and neck became grey. The black patches on the plastron were not so intense. In turtle No. 5452 the margin of the proximal part of fore flippers

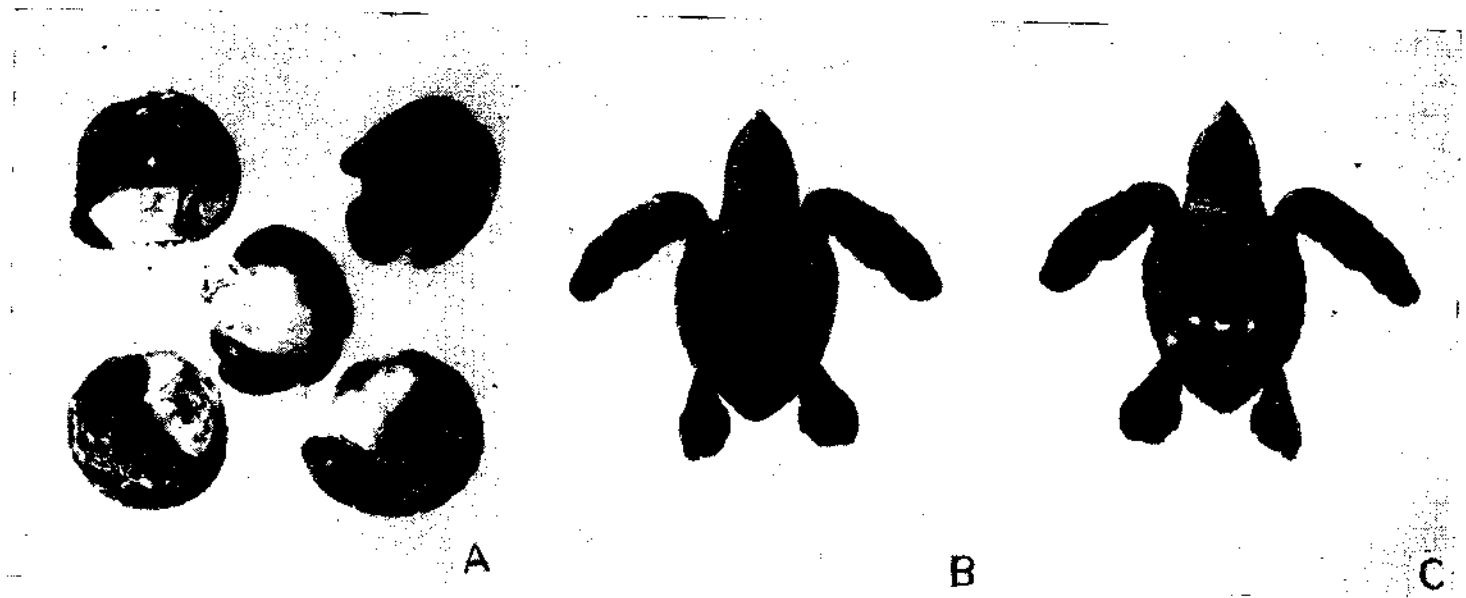


PLATE I. Emerged and nonemerged baby Ridley turtles *Lepidochelys olivacea* (Eschscholtz) by incubation of eggs in the laboratory : A. A few of the under-developed babies nonemerged ; B. One of the newly hatched babies—dorsal view and C. The same hatched baby—ventral view.

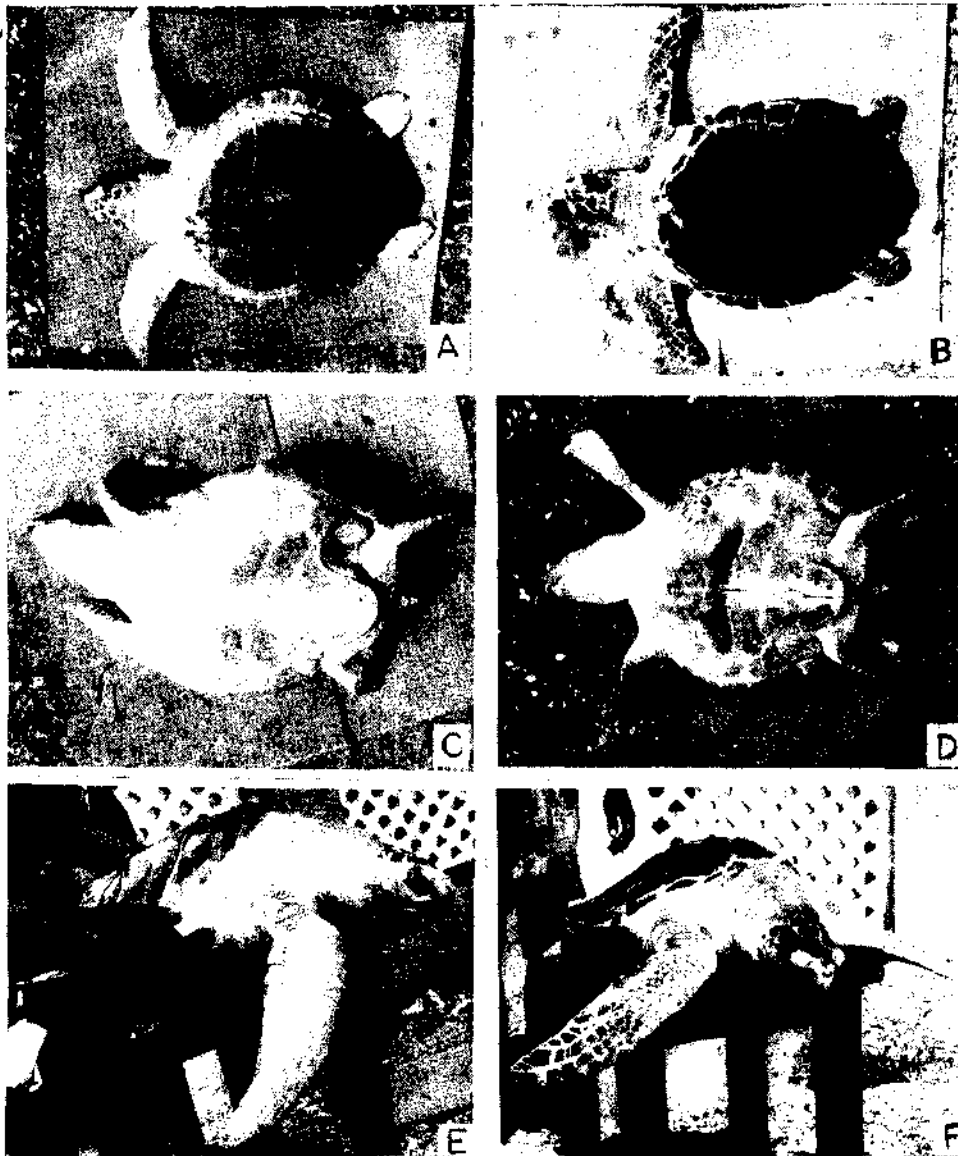


PLATE II. One and-a-half year old baby Ridley turtles *Lepidochelys olivacea* (Eschscholtz) No. 5451 and 5452 : A. Dorsal view of baby No. 5451 ; B. Dorsal view of baby No. 5452 ; C. Ventral view of baby No. 5451 ; D. Ventral view of baby No. 5452; E. Frontolateral view of baby No. 5451 and F. Frontolateral view of baby No. 5452.

and the neck contained black colour. The black patches on the plastron were intense.

Lateral view : In turtle No. 5451 the dorsal ridges were visible. The rostral and the lateral margins of fore flippers became grey and there were grey patches in front of each eye. In turtle No. 5452 the dorsal ridges were visible. The rostral was grey. The lateral margins of the fore flippers were not so grey as in the other baby. The grey patch in front of each eye was as that in the other baby.

Front view : In turtle No. 5451 the grey colour along the front margin of fore flippers appeared dominantly. The central ridge was clearly visible. The grey colour in front of the eyes, on the rostral and surrounding the nasals were very clear. In turtle No. 5452 the grey colour along the front margin of the fore flippers was not dominant. The central ridge was clearly visible. The grey colour in front of the eyes, on the rostral and surrounding the nasal was clearly visible.

One year old baby turtles

Dorsal View : In turtle No. 5451 the grey colour was dominant on fore flippers, head seams, laterals, marginals and hind flippers. The anterior half of the carapace was showing shades of grey colour. In turtle No. 5452 the grey colour was not so dominant on fore flippers, head seams, laterals, marginals and on hind flippers.

Ventral view : In turtle No. 5451 the black colour almost vanished in flippers and the proximal parts of the flippers had changed into grey. The plastron was yellowish grey. In turtle No. 5452 the flippers retained black colour in more areas than in the other baby. The proximal parts of the flippers were grey. The plastron was light yellow grey.

Lateral view : In turtle No. 5451 the fore flippers had become almost grey. In turtle No. 5452 the grey colour was only in seams.

Front view : In turtle No. 5451 the front margins of fore flippers were grey. The head and neck had become much more grey. In turtle No. 5452 the front margins of fore flippers were slightly grey. The head and neck retained more black colour.

One-and-a-half year old baby turtles

Dorsal view : In turtle No. 5451 almost all parts except some laminae on head and hind parts of carapace had become grey. The precentral and the succeeding three centrals had become almost grey. The four pairs of anterior laterals had almost become grey. The marginals except the hind three had become grey. In turtle No. 5452 the carapace retained black colour. The fore flippers retained the black colour in the laminae of the middle and hind portions. The head was almost black. The hind flippers retained black laminae but grey colour had occupied more parts (Pl. IIA, B).

Ventral view : In turtle No. 5451 the plastron was yellowish grey. The flippers had become grey. In turtle No. 5452 the plastron was yellowish grey. The flippers retained uniform very light shades of black colour (Pl. II C, D).

Fronto-lateral view : In turtle No. 5451 it had become almost grey except slight black patches on laminae of head and carapace. The hind part of the plastron remained slightly black. In turtle No. 5452 almost half of the area on head, neck and flippers had become grey, but many laminae partially retained black colour. The carapace remained black except anterior seams (Pl. II E, F).

The No. 5451 turtle underwent prominent colour change from 11½ month onwards. The middle portion of the second, third and fourth centrals (ridges) and the lateral periphery of the three anterior pairs of laterals exhibited dark grey radiating streaks; gradually the

change of colour spread to the surrounding areas. After 14th month the remaining centrals began to appear grey. The central portion of laterals remained black. From 16th month onwards the central portions of the anterior three centrals also began to appear grey. When it attained the age of $1\frac{1}{2}$ years the original black colour remained in light shades in the central portion of laterals and nearly one half of the carapace at the hind end retained the black. The No. 5452 turtle remained without any considerable colour change except that the intensity of the black colour slightly diminished and underwent some minor changes as explained before.

DISCUSSION

The egg laying season of the Olive Ridley turtles *Lepidochelys olivacea* (Eschscholtz) is from September to January. Hare Island, Valai Island, Mulli Island and Dhanushkodi Coast are the main nesting sites in the Gulf of Mannar. Carr (1952) had reported that the egg laying season of Ridley turtles on Indian Coast is from September to December. Luther (1959) had reported an incident of egg laying of a Ridley turtle in October. The author had observed egg laying in December and January.

The range of eggs per clutch is 50-138 from the observation of the author. Deraniyagala (1939) had reported the range as 90-135 eggs.

The eggs hatched out after 53 days of incubation in the laboratory conditions; the incubation period was counted from the time of egg laying in the natural nest. Deraniyagala (1939) in Sri Lanka recorded the incubation period as 50 to 60 days.

The author moistened the nest with distilled water as mentioned under Material and Methods by Busard and Greenham (1968). The mean temperature during the 53 days of the incubation period at 0600 hr was 29.3°C, at 1230 hr 30.5°C, at 1800 hr 31.8°C and at

2400 hr 30.5°C. The average of these four is 30.5°C.

All the thirty baby turtles emerged in three nights. In natural nests also the babies emerge in nights (Handrickson, 1958); that instinctive character is a natural protective device to safeguard themselves from lethal temperatures of the strongly irradiated beaches and from predators like dogs, foxes, pigs, crows, etc. (Hirth, 1971).

The hatchlings exhibited variation in central and lateral counts. The central laminae varied from 7 to 9; five babies had 7 centrals, twelve babies had 8 centrals and thirteen babies had 9 centrals. The laterals varied from 4 to 9; one baby had 9 left laterals, two babies had 5 left laterals, ten babies had 7 left laterals and seventeen babies had 6 left laterals; as regards right laterals, one baby had 4, two babies had 8, four babies had 7, five babies had 5 and eighteen babies had 6. Coming to marginals one baby had 14 on the left and 12 on the right, another had 12 on the left and 11 on the right, another had 13 on the left and 12 on the right, four babies had 13 on the left and 13 on the right and 23 babies had 12 on the left and 12 on the right. From this data when the majority counts are considered normal, a baby having 8 centrals, 6 pairs of laterals and 12 pairs of marginals is normal. Deraniyagala (1939) had recorded 5 to 8 laterals (coatales) on each side as range; but from the author's observations of the thirty babies the range may be modified as 4 to 9.

Boonlert Phasuk and Sayan Rongmuangsart (1973) found that the hatchlings preferred oyster meat to all other types of meat diet. *Sardinella* sp. meat was also supplied.

The average daily food consumption per body weight was 3.61% (range: 1.29%-5.7%) and 3.47% (range: 2.33%-4.39%) for the No. 5451 and 5452 baby turtles respectively (Table 1). The per cent conversion efficiency

TABLE 2. Length and weight increments of the baby Olive Ridley turtles *Lepidochelys olivacea* (Eschscholtz) No. 5451 and 5452

Period of age	Weight increment (gm)		Average monthly weight increment (gm)		Length increment (mm)		Average monthly length increment (mm)	
	Turtle No. 5451	Turtle No. 5452	Turtle No. 5451	Turtle No. 5452	Turtle No. 5451	Turtle No. 5452	Turtle No. 5451	Turtle No. 5452
First 6 months (March 1973 to Sept. 1973)	868.0	477.0	144.67	79.5	135.0	101.0	22.50	16.83
Second 6 months (Sept. 1973 to March 1974)	2132.9	1518.6	355.48	253.1	91.0	96.0	15.17	16.00
Third 6 months (March 1974 to Sept. 1974)	2583.1	2074.4	430.52	345.7	78.0	70.0	13.00	11.67
First one year (March 1973 to March 1974)	3000.9	1995.6	250.08	166.3	226.0	197.0	18.83	16.42
1½ Years (March 1973 to September 1974)	5584.0	4070.0	310.22	226.1	304.0	267.0	16.89	14.83

in the two babies was not uniform; it was high during September to January, slightly came down in February and March, further declined in April, May and June and inclined in July, August and September. The great reduction in per cent conversion efficiency in April, May and June might be due to the rise in temperature. The average monthly per cent conversion efficiency was 14.37 (range: 6.01-26.60) and 15.76 (range: 3.02-24.64) for the No. 5451 and 5452 turtles respectively.

The mortality during the first month was 33.3%, during the second month 53.3%, no mortality in the third month and 6.7% during the fourth month. Boonlert Phasuk and Sayan Rongmuangsart (1973) reported that the mortality was 33% during the first six months and according to them the aquarium conditions also seemed to influence the mortality rate of baby turtles. The overcrowding of the turtles in the rearing tank may also be a reason for the mortality.

REFERENCES

- BOONLERT PHASUK AND SAYAN RONGMUANGSART 1973. Growth studies on the Ridley turtle *Lepidochelys olivacea* Eschscholtz, in captivity and the effect of food preference on growth. Phuket Marine Biological Centre, Phuket, Thailand, *Research Bulletin*, 1: 14.
- BUSTARD, H. R. AND P. GREENHAM 1968. Physical and chemical factors affecting hatching in the Green sea turtle *Chelonia mydas* L. *Ecology*, 49 (2): 269-276.
- K. SIMKISS AND N. K. JENKINS 1969. Some analysis of artificially incubated eggs and hatchlings of Green and Loggerhead sea-turtles. *J. Zool. Lond.*, 158 (3): 311-315.

- CARR, A. 1952. *Handbook of turtles*. Cornell University Press, Ithaca, N. Y. 542 p.
- DERANIYAGALA, P. E. P. 1939. *The tetrapod reptiles of Ceylon*. Colombo, 412 p.
- HENDRICKSON, J. R. 1958. The Green sea turtle [*Chelonia mydas* (Linn.)] in Malaya and Sarawak. *Proc. Zool. Soc. Lond.*, 130 : 455-535.
- HIRTH, H. F. 1971. Synopsis of biological data on the Green turtle *Chelonia mydas* (Linnaeus) 1758. *FAO Fish. Synop.*, 85, U.N. Rome, 1971.
- HORNELL, J. 1927. *The turtle fisheries of the Seychelles islands*. H. M. Stationary Office.
- JONES, S. 1959. A Leathery turtle *Dermochelys coriacea* (L.) coming ashore for laying eggs during the day. *J. Bombay nat. Hist. Soc.*, 56 (1) : 137-139.
- LUTHER, G. 1959. On an abnormal egg of the turtle, *Lepidochelys olivacea* (Eschscholtz) with observations on hatching of the eggs. *J. Mar. biol. Ass. India*, 1 (2) : 261.
- MAWSON, N. 1921. Breeding habits of the Green turtle (*Chelonia mydas*). *J. Bombay nat. Hist. Soc.*, 27 (4) : 956-957.
- MILNE, P. H. 1972. *Fish and shellfish farming in coastal waters*. London. 208 p.
- MOORHOUS, F. W. 1933. Notes on the Green turtle (*Chelonia mydas*) *Rep. Great Barrier Reef Comm.*, 4 (1) : 22 p.
- ROBERT, C. 1971. Effects of delayed initial feeding on larvae of the Grunion *Leuresthes tenuis* (Ayres). *Fish. Bull.*, 69 (2) : 411-425.