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Effect of Salinity on Food Utilisation of the Olive Ridley, *Lepidochelys olivacea*

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Abstract

To determine the effect of salinity on survival and food utilization of the olive ridley *Lepidochelys olivacea*, the hatchlings of the sea turtle were exposed to salinity ranging from 0 to 100% seawater. Mortality of the hatchlings was maximum in the groups exposed to freshwater. The hatchlings have the capacity to tolerate dilution of salinity upto 25% SW. The feeding rates of hatchlings exposed to 0 and 25% SW were higher (1228.2 and 1190.3 $J.g^{-1}$ day^{-1}) than those (803.6 - 879.6 J.g-1 day^{-1}) of the 50,75 and 100% SW groups. The conversion rate was the highest in the group exposed to 25% SW (238.7 J.g-1day^{-1}) and the lowest (109.3 $J.g^{-1}day^{-1}$) in the group exposed to 0% SW.

Introduction

The hatchlings of the olive ridley *Lepidochelys olivacea* often enter the nearby estuary after emergence from their natural nests in the mass nesting ground at Gahirmatha (Orissa). They were observed to migrate into the estuary away from the sea and were sighted up to about 8 km from the river mouth where the salinity undergoes wide fluctuations from 0 to 30 ppt. It is not known whether the hatchlings could feed and grow under severe euryhaline conditions. The effects of salinity on osmoregulation (Dunson, 1979, 1981; Dunson and Moll, 1980) and sodium electrolyte movement (Dunson, 1979; Kooistra and Evans, 1976; Robinson and Dunson (1976) have been studied in turtles. Surprisingly, there is no study so far on the salinity induced changes on food utilisation of sea turtles. To find out the effects of salinity on survival and food utilisation of *L. olivacea*, an experiment was conducted by exposing the hatchlings to salinity ranging from 0 to 100% sea water.

Materials and Methods

To study the effect of different salinity levels, *L. olivacea* hatchlings which emerged from a single nest in the hatchery at Kovalam (near Chennai) were reared in seawater and acclimated to laboratory conditions for one month. For the experiment, 25 healthy individuals (live body weight : 32±3.2 g; carapace length : 53.7 ± 1.50 mm) were selected. The selected individuals were divided into 5 groups of 5 individuals each and acclimated at 0, 25, 50, 75 and 100% seawater (SW). The test individuals were reared separately in circular plastic aquaria of equal size (diameter : 32 cm) and capacity (10 1). The mean salinity of 100% SW was 33.5±2.40 ppt and the salinity of 0, 25,50 and 75% SW were 0.4, 8.0, 16.5 and 24.7 ppt, respectively.

The experiment was conducted for 40 days. The test individuals were fed *ad libitum* on cut pieces of the flesh of the clam *Meretrix casta* for 2 hr/day. The mean water temperature during the experiment was 28 ± 2.0 C and the mean dissolved oxygen concentration was 4.5 ± 0.40 ml/l. Dead turtles were removed immediately. Rates of feeding, assimilation, conversion and metabolism of each test individual were calculated by restricting to the number of days of survival. The live weight of the test individuals was determined on every 10th day. The calorimetric estimations on the turtle food and faeces were made using a Parr semi-micro bomb calorimeter. The procedures followed for estimation and calculation of food utilisation parameters are described elsewhere (Rajagopalan, 1988).

Results and Discussion

During the 40 day experimental period, mortality was maximum in the group exposed to freshwater. Of the 5 hatchlings exposed to freshwater, only one hatchling survived for 40 days and the other 4 individuals died between 10 and 21 days of exposure. All the individuals exposed to 25% SW survived and it may be concluded that *L. olivacea* hatchlings have the capacity to tolerate dilution of salinity upto 25% SW.

During the first 10 days of the experiment, the feeding rate of the individuals exposed to 0% SW was remarkably higher (1142 J.g initial live $turtle^{-1}$ day^{-1}) than that of all the other groups (686 to 830 $J.g^{-1}$ day^{-1}). However, the feeding rate in 0% SW reduced to 794 $J.g^{-1}$ day^{-1} during 11-20 days of the experiment and further declined to 460 $J.g^{-1}$ day^{-1} during 31-40 days (for calculating the feeding rate for every 10 day period the average food consumed $J.g^{-1}$ day^{-1} during the 10 day period was divided by the average initial live weight of the turtle at the commencement of the corresponding 10 day period). It is evident that exposure to freshwater induces abnormally high feeding rate during the first 10 days. As 80% of the turtles could not sustain in freshwater, these individuals either succumb

Table 1: Effect of salinity on food utilisation parameters in *L.olivacea*; rates are expressed as J.g initial live turtle-1 day-1 and efficiencies as %; values of 25,50,75 and 100% SW group are mean of 4 or 5 individuals; ± represents SD.

Parameter	0% SW	25% SW	50% SW	75% SW	100% SW
Feeding rate	1228.2±204.00	1190.3±149.66	803.6±101.59	879.6±60.58	868.9±72.19
Assimilation rate	1196.0±197.20	1155.5±140.91	793.0±107.36	853.7±58.72	845.9±68.07
Conversion rate	109.3±43.85	238.7±28.13	169.1±26.69	189.3±38.39	153.2±27.94
Metabolic rate	1086.7±224.42	916.8±125.27	623.9±101.84	664±72.79	692.7±65.74
Assimilation efficiency	97.3±2.11	97.1±1.84	98.7±1.28	97.1±0.81	97.4±1.39
Conversion efficiency					
	(K_1) 8.9 ± 4.77	20.1±2.15	21.0±4.49	21.5±4.88	17.6±3.37
	(K_2) 9.1±4.80	20.7±2.00	21.3±3.95	22.2±4.85	18.1±3.36

within 20 days of exposure or drastically reduce the feeding rate by about 60% on prolonged exposure. The feeding rate of other groups also decreased by about 30 to 50% during the course of the experiment due to increase in live weight of the test individuals.

The overall feeding rate during the 40 day experimental period was higher in 0% (1228.2 $J.g^{-1}$ day^{-1}) and 25% SW (1190.3 $J.g^{-1}$ day^{-1}) than that of the higher salinity groups (803.6 to 879.6 $J.g^{-1}$ day^{-1}) (Table 1). The t values in the former two groups were significantly higher than those of the latter three groups. Considering the highest (1228.2 $J.g^{-1}$ day^{-1}) and the lowest feeding rates (803.6 $J.g^{-1}$ day^{-1}), it is clear that L. olivacea, when fed ad libitum, has the capacity to decrease/increase food consumption by more than 50% depending on the environmental conditions.

During the 40 day period, the live weight of the turtle exposed to 0% SW increased from 29.2 g to 46.5 g. The increase in live weight of the turtle exposed to all other salinity levels were higher than that of the 0% SW group. For instance, the live weight of the hatchlings exposed to 100% SW increased from 31.8 g at the beginning of the experiment to 90.0 g on the 40th day.

Though the feeding rate (1228.2 $J.g^{-1}$ day^{-1}) was substantially higher in the group exposed to 0% SW, very low conversion efficiency (K_2 = 9.1%) has resulted in the lowest conversion rate (109.3 $J.g^{-1}$ day^{-1}) (Table 1). Also, this group has expended considerably higher percent of assimilated energy (90.9%) towards metabolism (Table 2). The group exposed to 25% SW consumed almost an equally high quantity of food (1190.3 $J.g^{-1}$ day^{-1}) but (i) spent less energy on metabolism (79.3%) and (ii) exhibited high conversion efficiency (K_2 = 20.7%), resulting in higher conversion rate (238.7 $J.g^{-1}$ day^{-1}) among all the groups. From this experiment, it appears that 25% salinity may be the optimum level for *L. olivacea* hatchlings to exhibit maximum survival and conversion rate. Exposing the freshwater emydid turtle *Callagus borneoensis* to different salinity conditions, Dunson and Moll (1980) reported that all the turtles survived upto 100% SW for the entire experimental duration of 16 days. However, the individuals exposed to salinities above 25% SW lost weight equivalent to about 1% body weight day^{-1}. *L. olivacea* not only survived 0 to 100% SW but also exhibited growth in all the salinities. It appears that the marine *L. olivacea* is physiologically specialised to tolerate wide range of salinities than the freshwater *C. borneoensis*. It has been reported that the marine turtles have large salt glands (about 67 mg/100 g body weight) and are able to control electrolyte balance effectively (Dantzler and Holmes, 1974).

The experiment has provided the following clues for laboratory rearing of the hatchlings: (i) the hatchlings have the capacity to increase the feeding rate by 50% depending on the salinity conditions; (ii) high feeding rate does not necessarily result in high conversion rate and excess feeding may result in diversion of more energy for expenditure on metabolism; and (iii) the hatchlings are able to survive and exhibit maximum conversion rates in 25% SW, which may be considered as the suitable salinity level for laboratory rearing.

Bhasker (1981) and Biswas (1982) reported that maximum nesting of the marine turtles normally occurs in sandy beaches close to bar mouth of a river (see also Hughes, 1972). They concluded that the marine turtles selected beaches near estuaries for mass nesting so that the hatchlings are exposed to ideal conditions. Frazier (1980) reported considerable number of immature loggerheads and Kemps ridleys in the Chesapeake Bay, hundreds of km from the sea in Oklahoma (Carr, 1952). The observations on the migration of a few newly emerged olive ridley hatchlings towards low saline waters in the estuary at Gahirmatha and the capacity of the hatchlings to exhibit maximum survival and growth rates at 25% SW confirm that the hatchlings are advantageously placed if they have a chance of encountering low saline waters.

Table 2: Percentage of assimilated energy allotted by L.olivacea for metabolism and growth under different salinities.

Salinity (% SW)	Growth	Metabolism
0	90.9	9.1
25	79.3	20.7
50	78.7	21.3
75	77.8	22.2
100	81.9	18.1

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