

NESTING BEHAVIOUR AND SOME BIOLOGICAL ASPECTS OF OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) IN CAPTIVITY

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ABSTRACT

In 1992, the Phuket Marine Biological Center began studies on the breeding behaviour and biology of olive ridley turtles (*Lepidochelys olivacea*) reared in captivity. A large pond was built with an artificial sand beach on one side. Six males and 14 females were released into the pond after having been in captivity at the Center for 16 years. In December 1992, a female laid a clutch of 122 eggs. The average egg diameter was 38.5 mm. Incubation lasted 56 days. On an average, carapace length of the hatch was 43.0 mm, carapace width 36.5 mm, and the weight 19.0 g. Hatch success was 89.6%. The behaviour and characteristics of turtles reared and born in captivity were similar to that of turtles observed in nature.

INTRODUCTION

Reichert (1979) proposed to raise hatchlings as a means to protect and increase the population, especially in areas where turtle habitat has been degraded. The Sea Turtle Conservation Project of the Phuket Marine Biological Center (PMBC) began two years before Reichert launched the proposal. In the first years of the project, hatchlings were collected from hatcheries in areas granted sea turtle egg concessions. The hatchlings were raised until they had grown substantially, and then released to the sea. Some were tagged before release. Some individuals were kept for growth studies and a nursery project. In recent years, concessionaires were asked to sell their eggs to the conservation project rather than on the market for consumption. At the same time, hired help and volunteers collected eggs from various beaches for the conservation project. Still, the number of eggs and hatchlings have continued to decline.

Along west coast of Thailand, the number of sea turtles has declined so quickly that there soon may be none left for the future. In consequence, the concession status of many nesting beaches has been cancelled. The concessions were lifted because the number of turtles was too small. In an attempt to remedy the lack of sea turtles, the PMBC began studying the behaviour and biology of sea turtles in captivity in the hope that the offspring from raised males and females might be used to increase the natural population.

Subsequently, a pond was constructed with an artificial sand beach at one end. The slope in front of the beach has a steep angle to allow the turtles easy access for nesting. Upon completion six males and 14 females were released into the pond and studies on their breeding and nesting began.

The purpose of the studies at PMBC was to learn more about the biology and behaviour of *Lepidochelys olivacea* raised to adulthood in captivity. Studies were done on the nesting behaviour, the females, and the artificial beach to determine if the behaviour deviated from that of turtles in natural conditions. It was hoped that the turtles would breed and their offspring could be released to the sea to build up the falling natural population.

MATERIALS AND METHODS

The rearing tanks and breeding pond

The rearing tanks were constructed when the PMBC was established. They were made of concrete: 3 x 4 m and 1 m deep. They were filled with sea water. The breeding pond was completed in October 1992. It was also made of concrete: 10 m wide, 15 m long, and 1.5 m depth of sea water. The floor slopes up at one end and terminates in an artificial sand beach, 10 m long, and 6 m wide. The depth of sand varies from 0.5 to 1 m. Sand from Laem Panwa Bay was used. Water was sprinkled on the sand daily to maintain proper moisture.

The breeding stock & measurements

Fourteen females and six males were selected for the breeding pond. They were measured and weighed (carapace length from 55-69 cm and weight from 32-43 kg, Table 1). Each turtle was marked by carving a number on the back scales. Egg size was measured for comparison with *in situ* eggs. Hatch success rate, size, weight, and strength of the turtles were measured for comparison with *in situ* nests and hatch. Daily nest temperatures were recorded throughout the incubation period.

Turtles and nests found on the beaches at Thataeng and Taimuang in Taimuang District, Phangnga Province and on Toongdab Beach of Phrathong Island in Kuraburi District, Phangnga Province between December 1992 and January 1993 provided data for comparison.

Table 1. Characteristics of turtles in breeding pond.

Number	Carapace width (cm)	Carapace length (cm)	Weight (kg)	Sex
4	53	57	35	female
10	51	55	32	female
17	51	63	36	female
30	55	60	32.5	female
37	67	64	38	female
39	65	66	39	female
41	62	65	39.5	female
42	62	69	43	female
43	65	65	41	female
45	62	64	34	female
47	65	63.5	40	female
49	62	65	38	female
50	62	66	33.5	female
51	63	63	37.5	female
37	63	61	35	male
38	59	62	30.5	male
40	62.5	62.5	32	male
44	65	63	36.5	male
46	63	62	35	male
48	58	58	38	male

RESULTS

Egg laying of turtles in rearing tanks

Turtles were first observed mating in the rearing tanks in August 1986. They continued through February 1987, mating almost every day. Males were able to mate with two to three females. The first female released a clutch on December 27, 1986. Deposition took place in the water since there

was no breeding pond or artificial beach at that time at the Center. Most females deposited eggs at night but the clutches were eaten by other turtles. From 1987 to 1992, more females deposited clutches in the water of the rearing tanks, and eggs were repeatedly eaten by other turtles. However, staff collected some eggs that were released during daytime, but no eggs produced viable hatch. The eggs contained partially formed fetuses, indicating that the eggs were fertilized (Chantrapornsyl, 1992).

Nesting on the beach at the breeding pond

The turtles mated almost every day. After the mating period, but before deposition of eggs, many females made false crawls on the beach, coming out of the water to dig tentatively in many places. They used their noses and mouths to explore the sandy environment. They would then return to the water without nesting.

On December 2, 1992 at about 14:00 turtle # 39 emerged and dug two holes on the beach, but returned to the water without laying a clutch. The following day at 07.30, the same turtle emerged again and dug a deep hole. She was observed to alternate with her right and left hind legs in scooping out a hole as deep as she could (about 30 cm). She then used her hind legs to scoop out the sides of the bottom, making the hole wider at the bottom than at the top. When she had excavated as much as possible, she rested for a minute, then began depositing her clutch, one to three eggs at a time, interspersed with mucous. She laid 122 eggs in about 30 minutes. When the female had finished laying, she began to cover the eggs with sand, alternatively using her right and left hind legs until the hole was covered completely. Then she piled more sand on top and began to beat it down with her hind legs and chest, throwing her whole weight down upon the sand. This produced a loud noise. She did this seven or eight times, rested for about 30 seconds, and beat the sand down some more in a similar fashion. After many more repetitions, she slowly began to crawl forward, kicking sand behind her as she went, covering her tracks. Finally she returned to the water, having spent about 30 minutes covering up her nest. The exact location of the nest would have been difficult to ascertain due to her concealment efforts. This nesting behaviour is

similar to reports in the literature on turtle nesting in nature.

On December 17, 1992, 14 days after her first clutch, #39 emerged again to lay a second clutch, numbering 116 eggs. All aspects of her behaviour were similar to those of her first nesting effort.

The incubation and hatching

The 87 eggs were left on the beach to hatch in "natural" conditions. Water was sprinkled on the sand daily since a humidity of 2-8% is required to produce viable eggs (Schulz, 1975). On January 28, 1993, 56 days after the first nest was made, the sand above it began to cave in at about 18:00. By 21:00, the first hatchlings had begun to emerge. The first turtles made it to the water and others soon followed. Seventy-eight of the 87 eggs produced viable hatchlings (90% hatch success). During the incubation period, the average daily high temperature was 32.3°C and the average daily low was 26.8°C (Table 2).

Table 2. Comparison of eggs and hatchlings in captivity and from natural nesting sites. E.C. = Egg circumference (mm); W = Weight (g); No. E. = Number of eggs; F.H.C.L. = First hatchling carapace length (cm); F.H.C.W. = First hatchling carapace width (cm); F.H.W. = First hatchling weight (g); H.S.R. = Hatch success rate (%); I.P. = Incubation period (days); H.T. = High temperature (°C); L.T. = Low temperature (°C).

	Breeding pond		Natural nesting sites	
	average	range	average	range
E.C.	38.5	37.0-40.5	39.5	37.0-39.5
W	-	-	33.0	30.3-37.0
No. E.	122	-	117	95-145
F.H.C.L.	36.5	34.0-39.0	35.0	33.0-37.0
F.H.C.W.	43.0	41.0-44.5	43.0	40.0-45.0
F.H.W.	19.0	17.0-22.0	19.1	18.0-20.0
H.S.R.	89.6	-	73.7	58.0-83.9
I.P.	56	-	52	48-57
H.T.	32.3	-	-	-
L.T.	26.8	-	-	-

The eggs and the first hatchling

Nesting female #39 had a carapace length of 66 cm, carapace width of 65 cm, and weighed 39 kg. Her eggs had diameters from 37-40.5 mm, with an average of 38.5 mm. This is similar to egg dimensions found in *in situ* nests at Thaimuang beach on November 16, 1992 (average 38.5 mm, range from 37 to 39.9 mm). Incubation time on the

artificial beach was 56 days. Emergent hatchling carapace length averaged 43 mm (41-44.5 mm) and an average weight of 19 g (17-22 g).

This does not differ significantly from dimensions of hatchlings emerging from nests at Taimuang Beach. Their average carapace width was 35 mm (33-37 mm); average carapace length was 43 mm (40-45 mm); and an average weight of 19.1 g (range from 18 to 20 g) (Table 2). The hatchlings were taken to the rearing tanks to study their growth, the ability to reproduce, and the possibility of rearing them commercially in the future.

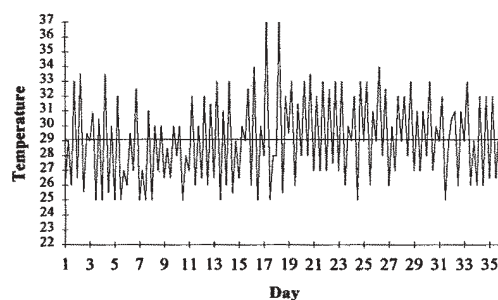


Figure 1. Temperature fluctuation during incubation period (average 29.1°C).

DISCUSSION

The carapace length of olive ridley turtles in the breeding pond at Phuket Marine Biological Center was 55-69 cm, or slightly smaller than breeding olive ridley at Surinam, South America, where Schulz (1975) found an average carapace length of 68.5 cm (63-75 cm).

From our observation of mating and nesting behaviour in the breeding pond, it is apparent that turtles raised in captivity can reach sexual maturity. Turtles reared in captivity reached maturity between the age of eight and ten years. On the Cayman Turtle Farm, it was found that *Chelonia mydas* reached sexual maturity faster in captivity than turtles in the sea. This could be related to the plentiful and nutritious food given to captive turtles. One turtle in Grand Cayman began breeding at the age of eight years, but usually they were two to three years older. In naturally occurring sea turtles, the age at sexual maturity was estimated at about 30

years (Balazs, 1977a; Limpus and Walter, 1980 in Morosovsky, 1983). Our findings compare well with Simon *et al.* (1975) who found that 37 days after mating, the first turtle made a nest. Each female was able to lay four to eight nests per season. Incubation lasted 56 days. Hatching success was 78%. At Devel's Hole Sink in Bermuda, an artificial beach was constructed at one end of a bay. The mouth of the bay was closed off by a concrete bar. Two pairs of *Caretta caretta* and *Chelonia mydas* were released into the bay. From 1975 to 1979, the turtles nested, indicating that turtles can nest on beaches other than their natal beaches.

In accordance with Wingate (1980), the breeding instincts of sea turtles remained intact in confined areas. The number and size of eggs produced by the turtles reared in captivity did not differ significantly from findings in nature. Further, egg sizes of olive ridley along the Andaman coast of Thailand did not differ significantly from those of olive ridley in Australia, e.g. Bustard (1972) found an average egg size of 38.8 mm (38.5-41.0 mm).

It has been a matter of concern that sea turtle eggs incubated under artificial conditions can yield

much distorted sex ratio of the hatch as a result of temperature variation. Dutton *et al.* (1985) recorded that sex of leatherback hatchlings varied seasonally in nature with an average of 30% of females for clutches laid in May and 100% female for the clutches laid in June. Morosovsky *et al.* (1984) studied the green turtle and leather-back turtle nesting in Surinam. For both species there were seasonal changes in the sex ratios of the hatchlings with more males being produced during the cooler months of nesting season and more females during the warmer months (estimates of overall sex of green turtle was 53.9% female, and 49% female for the leatherback). Bass *et al.* (1992) estimated the temperature which resulted in a sex ration of 1:1 (the pivotal temperature) to be 29.2°C in hawksbill turtle incubated at constant temperature. However, the within-season changes of temperatures are small in southern Thailand, so temperature related changes cannot distort sex ratios to a large extent. In the present study, temperatures fluctuated from about 25°C to 36°C with an average of 29.1°C (Fig. 1). But It has not been shown directly how sex ratio of hatchlings would be affected.

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