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TEMPERATURE DEPENDENT SEX DIFFERENTIATION IN THE OLIVE RIDLEY LEPIDOCHELYS OLIVACEA AND ITS IMPLICATIONS FOR CONSERVATION

ABSTRACT

Temperature is a controlling factor that has important effects on sex differentiation in embryos of most turtle species. In general, females are produced at the higher end of the range, and males, at the lower. The sex is determined by their temperature during the middle third of development. The effect of three temperatures, 26-28°C, 29-30°C and 31-32°C showed that females only were produced at the high incubation and males only, at the low, with both sexes developing at the intermediate temperature. Both Studies on a transplanted beach nest showed that only females were produced in the nest. Both laboratory and field studies have important implications for the conservation of the endangered sea turtles in general.

INTRODUCTION

Most turtle species that have been tested are without recognisable sex chromosomes. Furthermore, they are temperaturelabile as to sex differentiation. The temperature of incubation during the middle third of embryonic development is apparently critical as to whether an embryo differentiates as male or female. Males are produced at the low and females, at high, with both sexes developing at an intermediate temperature, termed as the pivotal temperature. So far three of the eight species of sea turtle have been found to confirm to the same general pattern: the loggerhead Caretta caretta (Yntema and Mrosovsky, 1980); the green turtle Chelonia mydas (Miller and Limpus, 1981; Morreale et al., 1982); and the olive ridley Lepidochelys olivacea (Dimond and Mohanty-Hejmadi, 1983; McCoy et al., 1983).

Furthermore, a common practice for conservation of sea turtles has been to move eggs from natural nests to beach hatcheries or styroform box incubators and then the release of hatchlings into the sea as they emerge. This exercise is an attempt to improve the hatching success and thereby incraase the chances of survival of the population. This method is popular and is practiced in many parts of the world. At present, in India thousands of hatchlings from beach hatcheries are being released into the sea (Silas and Rajagopalan, 1984). But this practice has increasingly been criticised because of the temperature-labile sex differentiation. It is opined that many eggs at a single temperature may lead to distortion of sex ratios and instead of survival may destroy a population (Pritchard, 1980; Spotila et al., 1983; Mrosovsky, 1983). What is even more distressing is that we donot have much idea regarding the sex ratio under natural conditions to evaluate this method especially for olive ridley.

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MATERIALS AND METHODS

For laboratory studies, clutches of eggs were removed from nests in 1983 and 1984 at Gahirmatha, Bhitar Kanika Sanctuary, Orissa; a few hours after laying and transported to the laboratory at Utkal University within two to three days. The eggs were placed either between two layers of moist cotton or buried in sand in enamel pans. Eggs were incubated at three temperature levels: cool (26-28°C); "room" (Fluctuating from 1 to 5.5°C per day, withmean ranging from 28.1 to 31.7 which was recorded with a dualcontrol thermistor (Fig.1); and warm (31-32°C).

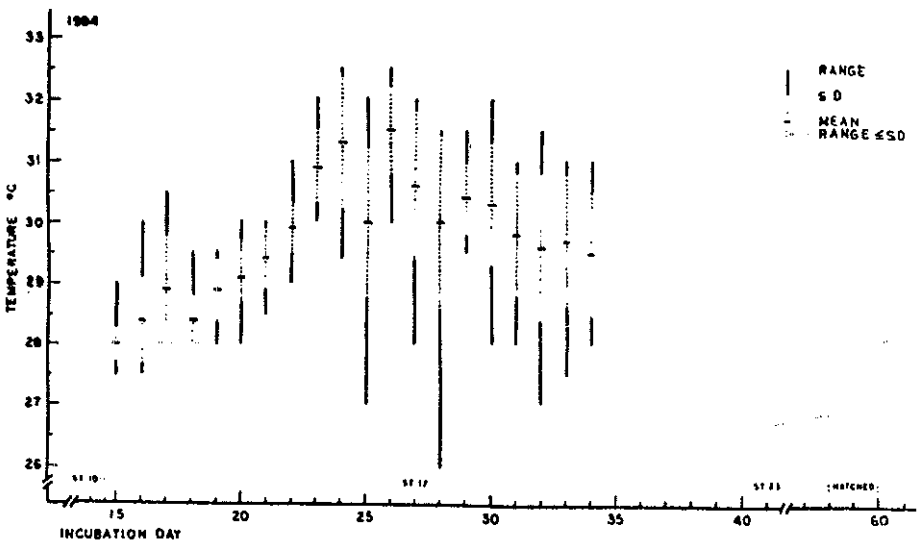

Fig. 1. Daily temperature record, with mean, standard deviation and range based on continuous recording for eggs of *Lepidochelys olivacea* at "room" temperature. Day 1 of incubation was 12 February 1984. At day 14, the day previous to the start of continuous monitoring, the embryos were at Yntema's stage 10+. Temperature recording was discontinued after day 34. Hatching occurred between days 58 and 60.

Eggs were candled at regular intervals and dead embryos were removed from the clutch. At certain times normal embryos were removed and fixed for staging and histological studies.

In order to study the sex ratio in transplanted beach nests, a clutch of 104 eggs were taken from a nest in the hatchery at Gahirmatha on day 24 of transplantation, coded as to their position in the nest and brought to complete development at room temperature in the laboratory at Utkal University. By day 24 of development i.e. before transport to the laboratory, the embryos had passed Yntema's stage 22 when sex is probably determined (Yntema, 1968; 1979). After hatching, the hatchlings were sacrificed, their gonads were examined morphologically and then processed for histology.

RESULTS AND DISCUSSION

The temperature of incubation affected the rate of development (Table 1). By 1[illegible] days of incubation, the warm temperature embryos had reached stage 19; the room temperature ones stage 16 and the cool temperature ones stage 12. Hatching occured accordingly: at a shorter period at warm, at an intermediate period at room and at a longer period at cool temperatures.

An examination of gonads by gross examination followed by histological examination revealed that females only were produced at 30°C or above and males only were produced at a temperature of 28°C and below (Table 1). Both males and females were prdduced at 29.5°C indicating that this probably represents the pivotal temperature at which both sexes can develop. These results confirm the observations of McCoy et al. (1983) that at the higher range of temperature only females and at lower range only males were produc[illegible] although there is a difference between the critical temperatures in t[illegible] work and ours. This is probably due to the fact that we have us[illegible]ggs from a different population than theirs.

TABLE 1. Effect of temperature on development and sex ratio of Lepidochelys olivacea

Temperature (°C)	Number of days for hatching	Sex (%)
26.5	76 (75-78)	Males (100)
28.0	75 (72-75)	Males (100)
29.5	58 (58-60)	Males (40) Females (60)
30.0	55 (54-55)	Females (100)
31.0	51	Females (100)
31.5	45 (45-46)	Females (100)

As said earlier, it is advantageous to produce as many males and females according to the need, in any conservation efforts. Therefore, this work has far reaching implications for the conservation of the olive ridley.

The results of the beach nest showed that transportation of 24 day embryos with a well developed circulation, did not adversely affect the survival. The hatching success was 69% (72 out of 104 eggs) which is within the range of hatching percentage under laboratory and natural clutches. The time of hatching was remarkably synchronous, all hatching between 48 to 50 days. All the hatchlings were females indicating that the temperature in the beach hatchery was above the pivotal temperature. This result indicates that the concern expressed by several workers that beach hatcheries may produce hatchlings of predominantly one sex may be justified. Therefore, it is planned to examine more nests in the beach hatcheries at Gahirmatha in the coming nesting season to determine if the sex ratio of the particular nest studied holds good for others. In the meantime, it is necessary to examine the sex ratio of hatchlings in other areas in India where transplantation of nests to other hatcheries is being practiced for improving hatching success.

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