# SEX RATIOS OF HATCHLINGS OF THE GREEN TURTLE, *Chelonia mydas*, IN NATURAL NESTING GROUNDS, IN OPEN BEACH HATCHERY, AND IN SHELTERED BEACH HATCHERY IN GULISAAN ISLAND, SABAH

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# ABSTRACT

The sex of the green turtle, *Chelonia mydas*, is determined by temperature during egg incubation. Temperatures higher than 30.0 $^0$C generally produce female while below 30.0 $^0$C produce male hatchlings, but the actual temperatures were dependent on where the investigations had been carried out. Gulisaan Island, one of three islands in the Turtle Islands Park, is one of the important turtle hatchery sites for the green and hawksbill turtles, *Eretmochelys imbricata*, in Sabah, Malaysia. A preliminary study by the present investigator in 1996 in Gulisaan Island concluded that feminisation of these turtles was temperature dependent during the dry period of April to July. The present investigation was planned as an extension to the previous study to coincide with the wet season from November 1997 to January 1998, but coincided with the El Niño dry period. In addition, an experiment was carried out to investigate the feasibility of lowering the incubation temperature of eggs by using different roofing materials in the open-beach hatchery. The materials used for shading were non-porous plastic canvas, black netting, green netting, and coconut fronds. Fifteen hatchlings were haphazardly selected from each clutch and sacrificed for histological examination of their gonads.

Results showed that the natural nesting grounds have slight variations ranging 30.1 ± 0.1 $^0$C (± S.E.) for vegetated locations and 31.3 ± 0.3 $^0$C for sandy locations. The sex ratio of hatchlings from natural nesting grounds was 7 females to 3 males. However, it was clear that female hatchlings were only produced from the exposed sandy locations, while the shady vegetated locations produced balance female to male sex ratio. The open-beach hatchery however, had consistently high incubation temperatures (31.3 ± 0.1 $^0$C), producing 100 % female hatchlings. The shading of the open-beach hatchery resulted in lower incubating temperatures and significantly different sex ratios. The plastic canvas treatment recorded lower temperature (30.7 ± 0.1 $^0$C), but was not significant in producing males, as 100 % females were produced. The green netting treatment lowered the temperature to 30.2 ± 0.1 $^0$C, producing female to male sex ratio of 7:3. The black netting treatment lowered the temperature to 29.6 ± 0.1 $^0$C, producing female to male sex ratio of 2:8. However, at 29.6 ± 0.2 $^0$C, the coconut frond treatment produced female to male sex ratio of 7:3, contrary to the generalisation that at this temperature more males will be hatched. This seen an anomalous result since the incubation temperature, on the average, did not surpass the estimated pivotal temperature range of 30.16 $^0$C to 30.19 $^0$C, but may just be within natural variation.

These findings are significant to enable hatchery manipulation to produce the desired sex ratios in green turtle hatcheries. Providing shade to the open-beach hatcheries is recommended during periods of high temperature and dry weather to keep natural ratios of female to male hatchling. In addition, the observed correlation of sex ratios with incubation temperature and incubation duration from the three incubation conditions can be used as a simplified method in estimating the sex ratios produced in the open-beach hatchery. This study has provided a rare empirical

estimate of the sex ratios in the wild under the impact of elevated global temperature such as the El Niño phenomenon. These findings and its applications are relevant to the conservation of green turtles in the Gulisaan Island and most probably throughout the Indo-Pacific region.