THE CONSERVATION-RELATED BIOLOGY AND ECOLOGY OF THE LEATHERBACK TURTLE, *DERMOCHELYS CORIACEA*, IN RANTAU ABANG, TERENGGANU, MALAYSIA

（マレーシアのオサガメ保護に関する生理生態学的研究）

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by

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Dedicated to the recovery of the gentle giants

ABSTRACT

This dissertation provides an analysis of the temporal and spatial trends exhibited in the Malaysian leatherback nesting population in Terengganu, addresses the most serious threats to the survival of the population, and through conservation-oriented research, formulates measures to counteract the declining trend observed in the population. Conservation measures which have been formulated and proposed have been translated into action by the appropriate federal and state agencies responsible for the conservation and management of sea turtles.

Temporal analysis of annual leatherback landings in Malaysia for the period 1967-1992 indicate a dramatically declining trend described by the quadratic equation $Y = 98.93 - 3.85T + 0.04T^2$ where $Y = \sqrt{\text{landings}}$ and T = (year -1966). If current trends persist, the model predicts population extinction by the year 2003. However, it is anticipated that with the intensification of conservation efforts at both the local and international level, the decline will be arrested to enable population stabilisation and eventual restoration.

Spatial analysis of landing trends throughout the coastline of Terengganu between 1984 and 1992 indicate that landings within the Sanctuary in Rantau Abang have declined significantly while landings south of the Sanctuary have been sustained over the same period. Because the Sanctuary is subjected to intense tourism and hence human pertubations, it is suggested that turtles there have strayed south to nest.

Conservation-oriented research is focussed on two major areas, i.e. protection of eggs and hatchlings; and the offshore protection of gravid turtles. Since almost 100% of the eggs deposited are incubated in beach hatcheries (a small percentage is hatched in "in-situ" nests and in styrofoam boxes), careful egg handling techniques are important to ensure optimal hatch rates. It is found that leatherback eggs can tolerate rough handling only up to five hours after oviposition. Beyond this threshold, careful handling to prevent rolling, bumping, rotation and disorientation of the vertical axis will enhance hatch rates. As a management technique, it is recommended that eggs should reach hatcheries and replanted within three hours of oviposition.

Further investigations on factors affecting hatchability of leatherback eggs revealed the unique problem of egg infertility. Of the clutches of eggs presently deposited in Rantau Abang, about 18.8% of them are totally infertile clutches. Furthermore, within fertile clutches, an average of 30.5% of the eggs are infertile. Because of this high incidence of infertility, a method is developed for selecting only fertile eggs for incubation, while the infertile ones can be marketed, thus resulting in considerable savings. This method is based on the development of the white spot on fertile eggs after 4-5 days of incubation, and thus requires further handling. Under experimental conditions, it is found that extreme care in egg handling and selection after five days of incubation does not impair hatch rates. While proven to be highly viable under experimental conditions, this technique of egg selection would be disastrous under minimally supervised field conditions. With the subsequent ban on the commercial sale and consumption of leatherback eggs in Terengganu, the method was not put into practice.

It is postulated that the phenomenon of egg infertility is caused by a male-impoverished mature population which has resulted from decades of producing female-biased hatchlings. Sex-ratio studies and temperature profiling of the nesting beaches and hatcheries in Rantau Abang have provided sufficient evidence for this. Hatchlings produced from the beach hatchery in Rantau Abang were predominantly females while those incubated in styrofoam boxes with mean incubation temperatures not exceeding 29.2^{o}C were predominantly males. Eggs incubated at mean incubation temperatures of 30.4^{o}C produced 100% female hatchlings. The pivotal temperature for the Rantau Abang population therefore lies between 29.2 to 30.4^{o}C. Sand temperatures at nest depth in the three beach hatcheries and throughout the Rantau Abang Sanctuary in 1990 exhibited temperatures which exceeded the threshold for production of 100% female hatchlings. In order to combat the continuing production of a strongly female-biased population, a management technique is proposed whereby eggs located distantly from hatcheries are to be transported and incubated in styrofoam boxes maintained at temperatures below 29.2^{o}C. This practice reduces the effects of mishandling, thereby enhances hatchability of eggs, as well as ensures the introduction of some male hatchlings into the population. This technique has been practised for the last two seasons and found to produce hatch rates similar to full-term "in-situ" nests.

The safety of leatherbacks and other sea turtles in the coastal seas of Terengganu was investigated by interviewing a sample of 52 local fishermen on incidences of turtles captured in their fishing gear. A total of 128 real cases of incidental captures were recorded for 1984 and 1985. Of these, 47 were leatherbacks, 40 were olive ridleys while green turtles accounted for 41 of the cases. Trawl nets accounted for 95 captures, drift/gill nets 29 and

bottom longlines accounted for four of the captures. Out of the 47 leatherback captures recorded, 42 were from trawl nets, 4 were from drift/gill nets, while longlines accounted for one case. Upon extrapolation, it was found that the total number of trawl nets operational in Terengganu in 1984 and 1985 had the potential of killing about 321 leatherbacks per year.

Leatherbacks are most susceptible to Malaysian fishing gear during the nesting season (April to September). In order to understand their behaviour at sea and the habitats utilised during the internesting intervals, a radio-tracking study was conducted. Data obtained from 12 female turtles showed that they travelled over an extensive range, covering a longshore distance of more than 100 km and extending 40 km off the coastline. However, the area where turtle traffic appeared concentrated occured within 10 km of the coastline, spanning a longshore distance of approximately 30 km., with the nesting sanctuary located within. Based on these findings, an offshore sanctuary, called the "Rantau Abang Fisheries Prohibited Area" has now been legally established for the protection of gravid leatherbacks. The offshore sanctuary extends 10 nautical miles (18.5 km) offshore and is bounded by Kuala Merchang in the north and Tanjung Jara in the south. Trawl nets, drift nets and fish traps are banned during the nesting season.

Although the studies conducted have made significant contributions towards the conservation of the Malaysian leatherbacks, further areas of research are identified and deemed crucial for the fine-tuning and development of more intensive conservation techniques. With both local and international inputs, the rate of decline observed in the Malaysian leatherback population is expected to drop, and subsequently stabilise. Optimism remains that the depleted population will be slowly restored to a viable level.