great benefit to green turtle conservation programmes in order to adapt best methods for nest protection from attacks by canids in a limited period within the nesting season. Studies to identify the cues that canids use to discover green turtle nest should be carried out in order to better understand their behaviour and to protect nests.

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HOMING, MIGRATION, AND NAVIGATION IN JUVENILE SEA TURTLES *

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Although the orientation cues used by hatchling sea turtles have been studied extensively, little is known about the mechanisms of orientation and navigation that guide older turtles. Experiments were conducted to investigate (1) whether juvenile loggerhead and green sea turtles would exhibit homing and migratory orientation in a laboratory setting and (2) whether homing might be accomplished using map-based navigation. Turtles were captured in inshore waters and displaced to a testing location, where they were allowed to swim while tethered in an experimental arena. Loggerhead and green turtles captured to the northeast of the testing site from May through September oriented in a direction that corresponded closely with the most direct path back to their capture site. Loggerheads captured to the southwest of the testing site at the same time of year also oriented in the direction of their respective capture location. Both loggerhead and green turtles tested during October and November oriented southward, a direction consistent with the migratory orientation observed in juvenile turtles in the wild at that time of year. These results indicate that the orientation behavior of loggerhead and green turtles in the arena setting accurately reflects that of wild turtles, thus setting the stage for future study of the factors underlying homing and migration in sea turtles. In addition, the results show that loggerheads are capable of homing after displacement to an unfamiliar location. Assessment of the navigational cues available to the turtles during transport and testing suggests that juvenile loggerheads are capable of map-based navigation.

OCCURRENCE, GROWTH AND OVERALL BODY CONDITION OF JUVENILE GREEN TURTLES (*CHELONIA MYDAS*) IN THE EFFLUENT DISCHARGE CHANNEL OF COMPANHIA SIDERÚRGICA DE TUBARÃO (TUBARÃO STEEL COMPANY), VITÓRIA, STATE OF ESPÍRITO SANTO, BRAZIL, 2000-2002

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Introduction
Juvenile and adult green sea turtles (*Chelonia mydas*) are found in feeding areas along most of the Brazilian coast. However, there is scant information about this species in the State of Espírito Santo. This study was undertaken by Projeto TAMAR, the

Brazilian sea turtle conservation program, in partnership with Companhia Siderúrgica de Tubarão (CST, Tubarão Steel Company), after a significant number of green turtles were found to inhabit the effluent discharge channel of the steel plant. The objective was to analyze, through mark and recapture, movement patterns and growth rates, and also to assess the overall body condition of the turtles in that area.

Methods

The study area is located 14 km north of Vitória, the State of Espírito Santo capital (20°16'S, 40°13'W). The effluent discharge channel is 500 m long, 33 m wide and averages 2 m in depth. Domestic and industrial effluents, after being treated and then mixed with the sea water used in the steel plant cooling, are discharged into the sea. Between February 2000 and February 2001, monthly average sea water temperature at intake was between 19°C (September) and 26°C (April-May). Monthly average water temperatures at discharge were 7-10^{o}C higher than those at intake. The increase in temperature and the availability of organic matter in the water make possible a noticeable growth of algae, on which green turtles feed. Fieldwork was carried out weekly, from 11 August 2000 to 10 August 2002, but none was carried out in May 2001. Turtles were captured by means of cast nests or by hand. They were then measured (curved carapace length (CCL) and width), weighed and double tagged on the front flippers (monel tags, National Band and Tag Co., USA, style 681). Overall body condition and presence or absence of tumors were determined visually, through physical examination of the turtle. Overall body condition was classified as 'Normal', 'Underweight", or 'Emaciated' following Walsh (1999).

Results and Discussion

Temporal distribution of the captures: In July 2002, fieldwork amounted to 8.5 h, but no turtle was captured in that month. A seasonal pattern in the captures was apparent, with a peak occurrence around the late winter or early spring (Fig. 1).

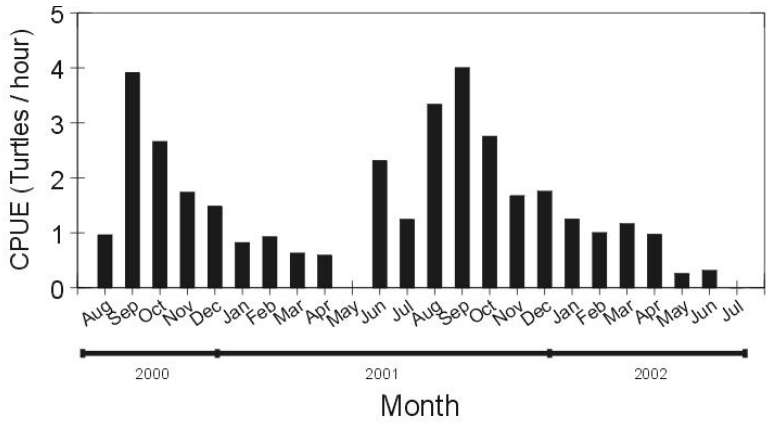

Figure 1. Temporal distribution of the captures: CPUE (individual turtles / hours of fieldwork) by month (n = 294). Multiple captures of one same turtle in each month were not considered in the construction of the graph.

Turtle size: Average CCL was 39.8 cm, SD = 5.3 cm, maximum = 56.7 cm, minimum = 28.0 cm (n = 157), which correspond with juvenile turtles, having a CCL well below that of nesting females in the Western Atlantic, which is generally in the range of 87-108 cm (Hirth 1997, converting straight carapace lengths (SCLs) into CCLs by means of the equation CCL = (1.0672 x SCL)-0.3138 (Teas 1993)). The CCL distribution was not significantly different form a normal one (Kolmogorov-Smirnov one sample test, n = 157, p = 0.786). There was no significant difference in CCL among months (Kruskal-Wallis Test, p = 0.746), so no seasonal pattern regarding turtle size was apparent.

Overall body condition: Most of the turtles (93.5%) were classified as "Normal", 3.6% as "Underweight" and 2.8% as "Emaciated". CCL was not significantly different among the three categories (Kruskal-Wallis test, n = 139, p = 0.332).

Presence or absence of tumors: Most turtles (80.6%) were without any tumors, and 19.4% had some tumor present. CCL was significantly different between the two categories (Mann-Whitney test, n = 139, p < 0.001); turtles with tumors had a higher average CCL (43.2 cm, SD = 4.3 cm, n = 27) than those without tumors (38.7 cm, SD = 5.4 cm, n = 112).

Displacements from the study area: Two green turtles tagged at the study area were found about 100 km north of that area. One turtle, tagged on 4 October 2000 (CCL = 44 cm), was found dead 13 days later, incidentally captured in a gill net. The other turtle, tagged on 14 September 2001 (CCL = 46 cm), was found dead about 10 months later – apparently from a gunshot wound to the carapace.

Maximum recapture interval (time between the first and last captures of one same turtle: Fig. 2 indicates that many turtles stay in the study area for at least two years. More fieldwork will be needed to determine a maximum period of stay for green turtles in the study area, and the relationship between length of stay and environmental conditions.

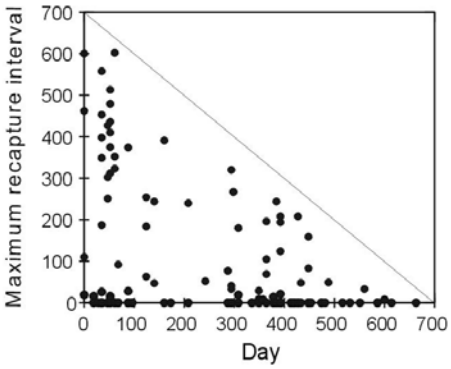

Figure 2. Distribution on the maximum recapture interval (time between the first and last captures, in days) of each turtle by the day when the first capture occurred. Each point represents one individual (n = 157). Days are counted from the first day when fieldwork was carried out (which is day = 0). A total of 68 turtles were captured two or more times, and 89 were captured just once (they are indicated by interval = 0). The diagonal line shows the maximum possible recapture interval for each day.

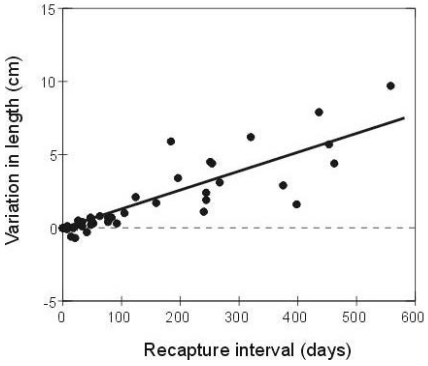

Figure 3. Variation in curved carapace length (CCL, cm) by maximum recapture interval (days) of each turtle, only for turtles that never had any record of tumors (n = 101). The horizontal dashed line indicates no variation in CCL. The solid line is a linear regression through the origin: Y = 0.01298X.

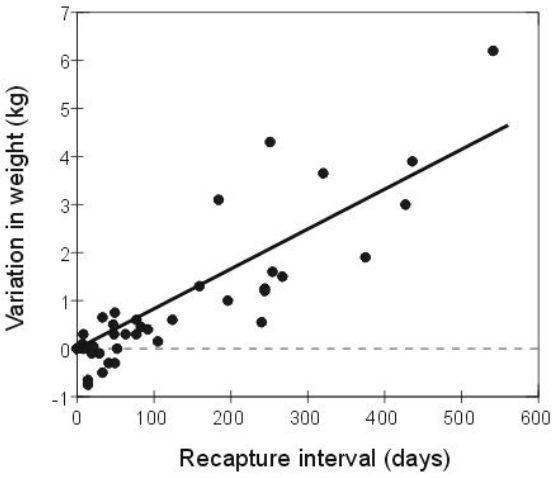

Figure 4. Variation in weight (kg) by maximum recapture interval (days) of each turtle, only for turtles that never had any record of tumors (n = 89). The horizontal dashed line indicates no variation in weight. The solid line is a linear regression through the origin: Y = 0.008299X.

Variation in CCL and weight: The average CCL growth rate was 4.7 cm / year (Fig. 3), and the average weight gain was 3.03 kg / year (Fig. 4).

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POPULATION SIZE AND DISTRIBUTION OF *CHELONIA MYDAS* AND *ERETMOCHELYS IMBRICATA* IN THE LAGOONS OF LAKSHADWEEP ARCHIPELAGO, INDIA

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Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles were studied in the offshore waters of Lakshadweep Islands from July 2001 to February 2002. Both species were present in the lagoons throughout the year. Of the 35 green turtles captured, 69% were immature (CCL range 40 - 60 cm) and of the 17 hawksbill turtles captured, 77% were between the CCL size range of 35 cm and 60 cm, which is considered to juvenile to sub-adult size class. Nocturnal activities for juvenile were apparent in both species. The lagoons of the Lakshadweep islands were found to be a developmental habitat for both species of sea turtles. The study found significant correlation between occurrence of green turtle and abundance of seagrass. The role of developmental habitats in the life history of both species is also discussed.

GREEN TURTLE (*CHELONIA MYDAS*) HATCHLING EMERGENCE FROM NATURAL NESTS IN CHAGAR HUTANG, REDANG ISLAND, TERENGGANU

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A total of 24 nests were monitored from July to October 2002 on Chagar Hutang beach in Redang Island, Terengganu, to determine the emergence time of green turtle (*Chelonia mydas*) hatchlings. Time of each emergence event was recorded and the sand temperature at 15 cm below sand surface was monitored from 1800 to 0800 hours the following morning. Generally emergence events were nocturnal. 57.14% of all emergence events occurred between 2000 - 2300 h. Nocturnal emergence is believed to be one of the strategies to avoid hyperthermia and daytime active predators. Hourly mean temperature was observed to decline steadily throughout the study. A steep decrease was observed between 2100-2200 h which coincided with the peak emergence activities. Emergence of green turtle hatchlings appeared to occur at a threshold temperature of 27.1^{o}C and ceased at temperatures higher than 33.8^{o}C. Some 96.4% of all emergence events occurred below 33^{o}C. Temperature decreased between initial and final emergence therefore sand temperature may not be the only cue to trigger emergence. Further investigations are needed to identify the specific thermal information or other possible cues used by hatchling to emerge. This study also found that size of hatchlings did not affect the time of hatchling emergence.