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Growth Rates of Juvenile Green Turtles (*Chelonia mydas*) from the Atlantic Coastal Waters of St. Lucie County, Florida, USA

Michael Bresette & Jonathan Gorham
Quantum Resources Inc. P.O. Box 30008 Palm Beach Gardens, FL 33410 USA (E-Mail: michael_bresette@fpl.com)

The St. Lucie Nuclear Power Plant is located on Hutchinson Island, a 36 km long barrier island on the east coast of Florida. The power plant draws cooling water from the Atlantic ocean through three large diameter pipes. Since March 1976, when the first power generating unit began operation, sea turtles have become entrained by cooling water into the plant's intake canal system (see Bresette et al.1998). A database of all turtles captured at the power plant has been maintained since 1976 and includes multiple captures of juvenile green turtles (*Chelonia mydas*).

In this study, green turtles were captured from the power plant's intake canal by tangle nets, dipnets and divers. Captured turtles were tagged with Inconel # 681 metal tags on the trailing edge of both front flippers. Forestry calipers were used for straight carapace measurements and a flexible tape was used for over the curve carapace measurements. All measurements were taken to the nearest 0.1 cm and recorded on a standardized data sheet. General health, distinguishing marks and recapture events were noted and the turtles were released back to the ocean. Based on recapture data for 80 green turtles captured at the power plant between July 1994 and December of 1999, we calculated growth rates for different size classes of juvenile green turtles utilizing the near shore reefs of an area on Central Florida's Atlantic coast.

When calculating growth rates in this study straight carapace lengths (SCL) were used. Carapace length measurements were taken from the nuchal notch to the distal tip of the posterior marginals. Only turtles with at large intervals of greater than 1 year were included in this study. This parameter produced growth data for 80 juvenile green turtles. SCL at original capture was subtracted from measurement at recapture to produce centimeters of growth. This figure was then used to calculate a mean growth rate per year. Negative and zero growth values were not excluded when calculating (Mendonca 1981) and Broward County, Florida (Wershoven & Wershoven 1990). However they appear to grow at a slower rate than reported for areas of the Caribbean Basin such as Great Inagua (Bjorndal & Bolten 1988), Puerto Rico (Collazo et al. 1988) and growth rates. In the case of multiple recaptures of an individual, only the initial capture and last recapture were used in our calculations. Thus, each turtle contributed equally and independently to the overall mean growth rate.

Turtles were assigned a size class category based on the mean of the initial capture and recapture SCL. Mean growth rates were calculated for 3 size classes in 10 cm increments from 30-60 cm (Table 1). Comparison of mean growth rate among size classes showed no significant differences (ANOVA, $F=0.929$, $P<0.05$).

Size class	n	Mean Growth Rate (cm) ±SD
30 - 40 cm	48	2.3 ± 1.1
40 - 50 cm	25	2.6 ± 0.9
50 - 60 cm	7	2.7 ± 0.7

Table 1. Mean growth rates for juvenile green turtles.

In order to quantify the influence of measurement error on growth rates, we examined all recapture events (536) occurring during the time period of this study. Turtles that had recapture intervals of 14 days or less were included for measurement error comparisons. Data from 44 such short term recaptures were used to calculate an absolute mean value for measurement error of both straight and curved carapace measurements. A matched pairs t - test was used to assess differences between the two measurement methods. Measurements were collected by any one of six different observers. These observers were unaware that the data would be used for measurement error calculation. This eliminated the otherwise inevitable bias to minimize error in a testing situation and included the variation in the way multiple subjects measure turtles.

Straight carapace length measurement error was calculated at an absolute mean of 0.20 cm + 0.17 SD. Over the curve measurement error was also calculated and resulted in an absolute mean of 0.43 cm + 0.43 SD. Error rates for curved measurements were found to be significantly greater than those for straight measurements (matched pairs t-test, $t=3.72$, $P<0.05$). All statistical calculations were made using Prism 3.0 software (Graphpad 1999).

Green turtles in this study grew at a similar rate to green turtles reported in the Mosquito Lagoon, Florida the U.S Virgin Islands (Boulon & Frazer 1990). Our growth rates appear faster than those for green turtles found in areas of the Pacific such as Hawaii (Balazs et al. 1998a), Australia (Limpus & Chaloupka 1997) and the Galapagos Islands (Green 1993). Due to small sample sizes and large standard deviations, statistical comparisons between our study and the ones mentioned above were not performed.

Growth rate differences among geographic groups can be attributed to any number of factors. Ehrhardt and Witham (1992) point out that sea turtles are exposed to varying conditions that may affect growth rate, such as habitat differences, changes in feeding behavior with age, and population mixing. In addition, sex specific growth patterns were found in green turtles in Australia (Limpus & Chaloupka 1997) and other variables such as water temperature (Stickney et al. 1973) and disease (Balazs et al. 1998b) also play roles in the growth of sea turtles.

Determining how much of the measured growth increment is attributable to measurement error is critical when working with slow growing animals (Bjorndal & Bolten 1988). Since actual growth in our study over a 14 day period was considered negligible (<0.1 cm), differences can be attributed to measurement error. Based on our results it appears that the precision of calipers in linear measurements affords the observer less opportunity for measurement error. It is apparent that straight carapace measurements are considerably more accurate and should be used, when available, in growth rate calculations.

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