MS THESIS RESEARCH PROPOSAL

DEPARTMENT OF OCEANOGRAPHY
UNIVERSITY OF HAWAII

Title

THE GROWTH RATE AND FEEDING EFFICIENCY OF THE GREEN SEA TURTLE (*CHELONIA MYDAS*)

Degree Candidate

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The Growth Rate and Feeding Efficiency of the Green Sea Turtle (Chelonia mydas)

INTRODUCTION

The green sea turtle (Chelonia mydas) has been the subject of much concern throughout the world. The animals' breeding habits once brought thousands of turtles to many beaches surrounding the tropical and subtropical oceans. However, because of heavy fishing by turtle industries, most breeding stocks have now been depleted and many no longer exist. Although strict laws have been enacted to combat this depletion, they cannot be universally enforced (Parsons 1962 and Ingle 1949).

Attempts at conservation and restocking former nesting beaches are now underway. Dr. Archie Carr, with the support of the Caribbean Conservation Corporation and the aid of the US Navy, has flown tens of thousands of turtle hatchlings to concerned people to be released in these no longer used nesting areas (Schroeder 1966). When the turtles mature it is hoped that these selective adults will return to the foster beaches rather than the beaches frequented by their parental stock (Carr 1967 and Parsons 1962). Nevertheless, there is no documented evidence of such behaviour and the favorable response can only be hoped for.

The "ranching" of sea turtles has been suggested as a means of obtaining high-protein productivity without the depletion of breeding stocks. Due to the high fecundity of the turtle--approximately 600 eggs per breeding season (Hendrickson 1958)--

it is theoretically a resilient species to heavy fishing pressure. Other characteristics of the life cycly of the turtle present him as a perfect candidate for sea-ranching (Mitsukuri 1904, Seale 1917, Hidebrand 1929, Moorehouse 1937, Ingle 1949, Harrisson 1955, Hendrickson 1958, Carr and Hirth 1961, Parsons 1962, Carr 1967). Such a project is now being undertaken co-operatively in the Caribbean by the Caribbean Conservation Corporation, the Bahamas National Trust, the Lerner Marine Laboratory, and The National Audubon Society (Carr 1967).

After thoroughly pursuing articles appearing in Biological Abstracts of the past ten years and all references cited in each of these articles, as well as personal communication with Dr. J. Hendrickson--Hawaii's foremost authority on sea turtles, all pertinent information has been accumulated. From this data it seems that both the conservation and ranching efforts are based solely on descriptive information concerning only the repreductive processes of the adult and the life of the very young. Out of all this information there is none describing growth rate of the sea turtle past the age of three. Our lack of knowledge in this area is made quite evident in the 1962 work by Caldwell in which, because of the inability to cite a specific age of maturity, he estimates this age to be in the range of from 5 to 13 years.

In order for conservation or ranching efforts to ever be successful, it is necessary that the growth rate of the sea turtle, at least up to maturity, be established. A detailed study of such growth information would be a significant contribution to our knowledge of this most valuable and promising food source.

RESEARCH OBJECTIVES

The objectives of the proposed study are twofold: (1) the determination of long-term growth rates, and (2) an indication of the advisability of raising Chelonia mydas in captivity. This will be approached using three methods: (1) oxygen uptake, (2) energetics of food ingestion and egestion, and (3) general short-term optimal growth rates under captive conditions for a wide weight range of turtles.

MATERIALS AND METHODS

Source of Animals

There are many feeding areas of Chelonia mydas off the Hawaiian Islands. Many methods of capture have been described in the literature and can be used to provide the basic population of research animals. Turtles needed to fill size gaps can be obtained from private stocks on the islands or be imported from the Palau and the Caribbean areas. Fifty to one hundred turtles would provide an optimal research stock.

Food

Young turtles are carnivorous for the first few years of life and are mainly herbivorous thereafter. Foods for both groups will be utilized. To determine the foods utilized by animals not in captivity, stomach contents of the varying sized turtles will be obtained, and that information coupled with direct observation in the field. Food preference will be tested as far as possible

to permit a final choice of food for each age group of turtles. The foods presented will be those naturally available off the island of Oahu or commercially packaged. Substitution for meat diets will be made only if such a practice would be advantageous on a larger scale and the substitutes are as acceptable to the animal as its original food.

Facilities

The facilities needed for this experiment consist of: a large natural holding pond similar to the western-most pond on Coconut Island; an artificial pond approximately 20 feet in diameter and 4 to 5 feet deep; water circulation pumps; 5 small solid holding tanks of 10, 20, 50, 150, and 250 gallon capacities; a thermostat and temperature regulating device readily convertible between the tanks; an oxygen or carbon dioxide gas analyzer; a bomb calorimeter; a desiccator; and a single-beam balance.

General Comments

All of the animals will be kept in their respective holding ponds--the younger carnivores in the rapidly flushing artificial pool, the older herbivores in the large natural pond. A selected two-thirds of the animals will be withdrawn for their respective experiments, each placed individually into a small holding tank proportional to its size and given the required time to adjust to its new environment before the experiment is begun. Each turtle will be identified by a tag attached to its shell and all data will be listed according to the identifying number.

Collection of Data

Oxygen uptake: Oxygen uptake will be determined at varying

times of day on one-third of the experimental turtles representing the entire weight range. This will be done at 20°, 25°, and 30° C as well as any other temperatures indicated as necessary. Each experiment will be done in duplicate.

The magnitude of oxygen uptake will be determined by placing each test animal in an appropriately sized holding tank with known volume of water and air. Samples of water and air will be taken for determination of initial oxygen content. The animal will be left in the sealed tank a length of time determined suitable for their respective sizes. At the end of this period, samples of air and water will again be extracted for oxygen determination.

The use of a respirometer could be investigated, although there is some indication that the sea turtle can extract oxygen from sea water through its cloaca (Berkson 1966).

Food Conversion Efficiency: After the determination of the suitable food source, as previously mentioned, caloric content of the foods will be obtained by use of the bomb calorimeter. Weighted amounts of food will be presented periodically to each of a second group of test animals. Excess food left by individuals will be collected and the caloric content determined. Receptacles will be fitted to the excretory organs of each turtle, the device anchored to the turtle's shell. Caloric content of the excrement thus collected will also be determined. From this we are able to tabulate the metabolic energetics.

Growth Rate Under Optimal Conditions: The last group of one-third of the experimental population, also representing the entire weight range, will be kept in their respective holding

ponds. Where the other two groups will be periodically interchanged in their experimental utilizations, this group will have a continuous experimental regimen. This will entail maintaining optimum conditions as indicated by the other experiments. Growth rates of these undisturbed animals will be observed through regular weighting of each animal.

Analysis and Presentation of Data

The semi-instantaneous growth rates of the different sized animals used in this study should be applicable to a Von Bertalanffy growth curve. From this, an overall growth rate should be obtainable. In conjunction with growth rate, food conversion efficiencies should permit estimations of the advisability of controlled ranching of Chelonia mydas.

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