

A Research Proposal Submitted  
to the New York Zoological Society

for

AN INVESTIGATION OF GROWTH IN THE  
IMMATURE GREEN TURTLE UNDER NATURAL CONDITIONS

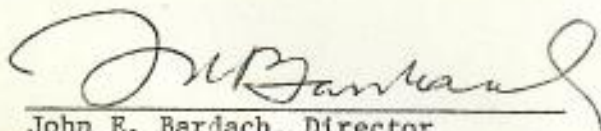
by

George H. Balazs  
Hawaii Institute of Marine Biology  
P. O. Box 1346  
Kaneohe, Hawaii 96744

Duration: Two years (January 1977 - January 1979)

Amount Requested: \$9,875

Institutional Endorsement:



John E. Bardach, Director  
Hawaii Institute of Marine Biology

ABSTRACT

Supplemental support is requested to enable intensive growth studies to be conducted in immature Hawaiian green turtles under natural conditions. This research will yield basic biological information that has long been recognized to be of major importance, but nevertheless continues to be virtually nonexistent for all populations of marine turtles.

### Research Objectives

1. To obtain accurate and comprehensive data on the rate of growth in immature Hawaiian green turtles (*Chelonia* sp.) under natural conditions.
2. To formulate a growth curve which will permit the reliable prediction of age at sexual maturity in Hawaiian green turtles under natural conditions.
3. To utilize the resulting information for the long-term conservation of Hawaiian and other *Chelonia* populations.

### Background and Justification

Knowledge of an organism's growth rate and age at maturity is basic to understanding the dynamics of a population. With respect to marine turtles, Schmidt (1916) first focused attention on this fact, stating "The most important facts to be determined are the rate of growth of turtles and their migrations." Further, he pointed out "Almost nothing is known of the rate of growth, age or migrations of turtles." Since that time, several workers have accumulated valuable information on the migratory aspects of adult marine turtles, particularly in populations of *Chelonia*. In addition, Carr and Carr (1970) have shown that growth in sexually mature *Chelonia* nesting in Costa Rica is exceedingly slow (.25 cm per year). However, except for preliminary work started in Hawaii, virtually no efforts have been made over the past 60 years to accurately determine growth in immature turtles and age at maturity under natural conditions. Hirth (1971) has pointed out this continuing dearth of empirical growth data and reiterated Schmidt's (1916) earlier sentiments.



With the exception of Schmidt's (1916) own pioneering short-term growth study, and a single estimate presented by Carr and Caldwell (1956), growth and maturation data appearing in the literature have been based on either (1) turtles raised for varying periods of time in an artificial environment where they received atypical diets; (2) turtles recovered from the wild that had previously been raised for varying periods of time in an artificial environment where they received atypical diets; or (3) speculation supported by little, if any, factual information. None of these three methods of determination can be considered acceptable in terms of application to naturally occurring marine turtles.

Two factors can be attributed to the scarcity of relevant growth data on immature turtles. These are (1) absence of an acceptable method of marking newly emerged hatchlings that will remain clearly identifiable in subsequent years; and (2) difficulties involved in locating, capturing, tagging and recapturing sufficient numbers of immature turtles directly in the sea. Factor number one involves inherent problems which may never be satisfactorily resolved, and therefore is not a consideration in this research proposal. Factor number two, however, warrants careful evaluation. Capturing immature turtles in the sea admittedly does impose difficulties and restraints, but preliminary work (Balazs, 1976) indicates that problems can be reduced substantially by careful selection of capturing sites and techniques used. Nearly all researchers of marine turtles have thus far chosen to conduct tagging studies on the nesting beaches, rather than carry their work directly into the marine environment. This is undoubtedly due to convenience and the high level of efficiency that can be achieved at

such aggregate sites where comparatively large numbers of adult females are easily available for tagging. Although such research continues to be essential, it is now absolutely imperative that attention be focused on less than adult size turtles in the sea if significant advances are to be made to our knowledge of these endangered animals.

#### Proposed Research and Needs

In the Hawaiian Archipelago, several sites have been identified as being particularly suited for capturing immature *Chelonia*. At one of these locations, French Frigate Shoals, I have initiated such work incidental to studies of the seasonal *Chelonia* breeding assemblage. A pool of tagged immature turtles has now been established and recoveries indicate that many animals are resident to the area for extended periods of time. Carapace measurements and body weights of turtles recaptured to date suggest that very slow growth occurs (approx. 1.5 cm per year). However, special emphasis urgently needs to be placed on this aspect of work at French Frigate Shoals in order to increase the tag pool and accumulate a significant number of recoveries over an extended time period.

On a cooperative basis, and under my guidance, the capture and tagging of immature turtles by members of the Koral King Dive Club at Midway Atoll (Northwestern Hawaiian Islands) is being reestablished. Previous taggings originally started at this location by U. S. Fish and Wildlife Service personnel proved to be less than adequate due to the size of tag used and serious corrosion problems. Corrections for these problems have been



formulated and will be implemented at the earliest possible time (see Research Techniques). It should be emphasized that cooperative arrangements, such as at Midway, are highly advantageous in terms of financial costs. No expenditures are necessary for labor, as the capture and tagging of immature turtles takes place routinely during the course of recreational SCUBA diving. Efforts at Midway should therefore be encouraged to the fullest possible extent. In order to retain cooperation, goodwill, and enthusiasm, as well as ensure proper capture and tagging techniques, it is essential that I regularly meet with Koral King Dive Club members and involve myself directly in the work.

In addition to French Frigate Shoals and Midway, other locations in the Hawaiian Archipelago offer unique opportunities for conducting intensive growth studies of immature turtles. Of particular interest are select sites off the Islands of Hawaii and Lanai, as well as at Kure Atoll. However, in order to properly organize and carry out such work over an adequate time period, it is necessary to periodically travel to these sites.

Of significant related importance to the proposed intensive growth studies of immature turtles is the recent recovery of an eight kilogram turtle at Wake Island on July 12, 1976 which was originally tagged at Midway on January 4, 1976. Wake is situated approximately 1,000 miles to the southwest of Midway, considerably removed from the Hawaiian Archipelago. This recovery is the first evidence for possible intentional movement of Hawaiian *Chelonia* to waters outside of the Hawaiian chain. A reconnaissance survey of Wake is therefore needed in order to gain further information on this subject and investigate the feasibility of initiating cooperative growth studies.

## Research Techniques

### Capture

Three basic methods have thus far been successfully used in the Hawaiian Archipelago to capture immature turtles in the sea. These non-injurious techniques consist of (1) capture by hand, both while free diving and through the use of SCUBA; (2) capture with specially designed long-handled scoop nets used both from shore and from a small outboard powered boat; and (3) capture with specially modified mesh nets set vertically in shallow coastal waters. The particular method of capture used at each of the study areas will vary according to applicability and labor and equipment resources available.

### Identification

All turtles captured will be identified by affixing intermediate size tags made from the highly corrosion resistant alloy INCONEL 625. Two thousand tags made from this material are presently being produced by special order through arrangements I have made with National Band and Tag Company, Newport, Kentucky. The production of such tags is the first concerted action undertaken to solve corrosion problems that have plagued many researchers using MONEL alloy tags on marine turtles. Although INCONEL 625 tags are costing approximately three times more than the standard MONEL tags traditionally used, the benefits derived from longer tag life will be well worth this added expenditure.



#### Determinations of growth

Rate of growth will be determined through measurements of straight carapace length and width, curved carapace length and width, and body weight. All of these criteria are deemed necessary for accurate detection. Carapace measurements will be made with calipers and flexible tape, and body weight will be taken with a portable spring scale.

Suitable numbers of tag and measurement "kits" will be distributed to cooperating organizations (e.g., Koral Kings Dive Club) in order to simplify and promote the collection of data.

#### Financial Support from Other Sources

I have recently been commissioned by the State of Hawaii, Office of the Marine Affairs Coordinator, to conduct a green turtle management study throughout the Hawaiian Archipelago. However, fiscal constraints in the State government have resulted in a very low level of funds for this purpose. Financial support will be provided for only 50% of my research time and for only a minimum of necessities in the way of equipment, supplies (includes INCONEL tags) and travel. In view of the State's prevailing fiscal situation, it is indeed fortunate and praiseworthy that even these base funds have been made available.

Under such conditions, without additional support the study will be restricted principally to locating and censusing feeding aggregations of turtles.



Financial Support Requested

In order to carry out the intensive growth studies proposed, the following support is needed as a supplement to funds which I have been provided by the State of Hawaii.

Partial Salary for Principal Investigator:

Two months per year for two years (\$1,575 per month including fringe benefits). \$ 6,300

Travel (round trip from Honolulu)

Midway Atoll (4)	880
Island of Hawaii (4)	280
Island of Lanai (4)	100
Wake (1)	310

Partial Living Expenses at Study Areas:

Midway Atoll (20 days)	240
Island of Hawaii (20 days)	500
Island of Lanai (20 days)	400
Wake (5 days)	100

Equipment: 295

Tag applicators, calipers, tapes and scales necessary to assemble 14 tag and measurement kits

Administration: 470

5% overhead charge by the Research Corporation of the University of Hawaii

TOTAL \$ 9,875

Literature Cited

- Balazs, G. H. (1976) Green turtle migrations in the Hawaiian Archipelago. *Biological Conservation*, 9,125-40.
- Carr, A. and Carr, M. H. (1970) Recruitment and remigration in a green turtle nesting colony. *Biological Conservation*, 2,282-4.
- Carr, A. and Caldwell, D. K. (1956) The ecology and migrations of sea turtles, 1. Results of field work in Florida, 1955. *American Museum Novitates*, 7-23.
- Hirth, H. F. (1971) Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). FAO Fisheries Synopsis No. 85.
- Schmidt, J. (1916) Marking experiments with turtles in the Danish West Indies. *Meddelelsen Fra Kommissionen For Havundersogelser*, 5,1-26.



KURE

MIDWAY

PEARL AND  
HERMES REEF

LISIANSKI

LAYSAN

MARO  
REEF

GARDNER  
PINNACLES

FRENCH  
FRIGATE  
SHOALS

NECKER

NIHOA

LEHUA  
KAUAI

OAHU

HONOLULU  
KAULA

MOLOKAI

LANAI

MAUI

KAHOOLAWE

HAWAII



# HAWAIIAN ISLANDS

## NORTH PACIFIC OCEAN

