

AN INVESTIGATION OF THE GROWTH  
AND MIGRATIONS OF IMMATURE  
GREEN TURTLES UNDER NATURAL CONDITIONS

A Research Proposal Submitted  
to the World Wildlife Fund  
by  
George H. Balazs  
Hawaii Institute of Marine Biology  
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## BACKGROUND AND JUSTIFICATION

Knowledge of an animal's growth rate and age at sexual maturity is basic to understanding the dynamics of a population. With respect to marine turtles, Schmidt (1916) first focused attention on this point, stating "The most important facts to be determined are the rate of growth of turtles and their migrations." Furthermore, it was emphasized that "Almost nothing is known of the rate of growth, age or migrations of turtles."

Since Schmidt (1916) made these statements, several workers have accumulated valuable information on the migratory aspects of *adult* marine turtles, particularly for certain populations of green turtles (*Chelonia*). In addition, Carr and Carr (1970) have shown that the growth rate of *adult* green turtles nesting in Costa Rica is exceedingly slow, averaging 0.25 cm per year. However, except for some attempts to permanently mark hatchlings at natal beaches (Carr, 1967; Bustard, 1972; Hughes, 1974) and for preliminary in-sea capture work started in Hawaii, no systematic efforts have been made over the past 60 years to determine the growth rate and migrations of naturally occurring *immature* turtles. Hirth (1971) has pointed out the 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 principally on:



- (1) captive 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;
- (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 and migration data for immature turtles. These are:

- (1) the absence of an acceptable method of marking hatchlings that will remain clearly identifiable in subsequent years;
- (2) difficulties involved in locating, capturing, tagging and recapturing sufficient numbers of immature turtles directly in the sea.

Factor number (1) involves inherent problems which may never be satisfactorily resolved, and therefore is not a consideration in this research proposal. However, factor number (2) warrants careful evaluation.

Capturing immature turtles in the sea admittedly does impose difficulties and restraints, but preliminary work indicates that problems can be reduced substantially by careful selection of capturing sites and techniques used (Balazs, 1976). 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 ocean environment. This is undoubtedly due to convenience, and to the high level of efficiency

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

## SPECIFIC OBJECTIVES

- (1) To obtain accurate and comprehensive data on the rate of growth of immature Hawaiian green turtles under natural conditions;
- (2) To formulate a growth curve which will permit the reliable prediction of minimum and maximum ages at sexual maturity;
- (3) To determine the developmental migrations undertaken by immature Hawaiian green turtles;
- (4) To utilize the resulting information for the wise management and long term conservation of Hawaiian and other green turtle populations.

## PROPOSED RESEARCH

In the Hawaiian Archipelago (Figure 1) several sites have been identified as being particularly suited for capturing immature green turtles. At one of these locations, French Frigate Shoals, I have initiated such work incidental to studies of the seasonal breeding assemblage. A pool of 128 immature turtles has now been established and recoveries to date indicate that many individuals are resident to the area. Carapace measurements of the recaptured turtles thus far suggest that very slow growth occurs (approximately 1.5 cm in length per year). However, greater emphasis needs to be placed on this aspect of the work at French Frigate Shoals in order to further increase the size of 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 Kings Dive Club at the U. S. Naval Station, Midway, has recently been reconstituted. Earlier taggings at this location (totaling 189 turtles) proved to be less than adequate due to the size of tag used and serious corrosion problems. Corrections for these problems have now been made (see METHODS). 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 during the course of recreational SCUBA diving. Efforts at Midway should therefore be encouraged to the fullest extent. However, in order to insure proper capture and tagging techniques, as well as retain cooperation, goodwill, and enthusiasm, it is essential that I regularly travel to Midway, meet



with Koral Kings Dive Club members and involve myself directly in the work.

In February 1977, a 10-day underwater survey of Kure Atoll which I conducted indicated that this site also has excellent potential for the capture of immature turtles. Personnel of the U. S. Coast Guard LORAN Station have agreed to assist in this work, provided the appropriate guidance can be given at regular intervals.

Preliminary work on the capture of immature turtles in waters adjacent to the Islands of Lanai and Hawaii has resulted in the tagging of 93 individuals. An immature turtle originally tagged at Midway has been recovered in Hilo Bay, Island of Hawaii, a distance of approximately 2240 kilometers (Table 1). In order to properly organize and carry out more intensive capture work over an adequate time period, it will be necessary to regularly travel to these sites and employ resident research assistants at periodic intervals.

An immature turtle originally tagged at Midway has been recovered at Wake Island ( $19^{\circ}18'N$ ;  $166^{\circ}36'E$ ), a distance of approximately 1540 kilometers (Table 1). This recovery represents the first evidence for possible intentional movement of Hawaiian green turtles outside of the Hawaiian chain. Preliminary reports from personnel at Wake indicate the regular presence of immature green turtles. Survey visits to this site are therefore needed in order to gather further information and, if warranted and feasible, initiate cooperative capture and tagging studies.

## METHODS

### 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;
- (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 (No. 681) tags made from the highly corrosion resistant alloy, Inconel 625. Three thousand tags made from this material have been produced and paid for through special arrangements I have made with National Band and Tag Company (721 York St., Newport, KY 41072). The production of such tags is the first concerted action undertaken to solve the corrosion problems that have plagued many researchers using Monel alloy tags on marine turtles.

### Determinations of Growth

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.

#### Migrations

Captures that are made at the various study areas will make it possible to document the migrations of immature green turtles.



## EXISTING FINANCIAL SUPPORT

In July 1976 I was commissioned by the State of Hawaii, Office of the Marine Affairs Coordinator, to conduct a green turtle management study in the Hawaiian Archipelago. However, fiscal constraints in the State government have resulted in a low level of funds being made available for this purpose. Supplementary outside financial support is therefore being requested in order to give special emphasis to the aspects of growth and migrations of immature turtles.

A separate research proposal has been submitted to the Office of Sea Grant, National Oceanic and Atmospheric Administration, requesting financial support for a field research assistant and a portable SCUBA air compressor. This does not represent a duplication of the funds that are presently being requested from the World Wildlife Fund.

## FINANCIAL SUPPORT REQUESTED

## Travel (round trip from Honolulu)

Midway (2)	\$ 440
Kure	NC*
French Frigate Shoals	NC*
Island of Hawaii (2)	120
Island of Lanai (2)	60
Wake (1)	310

## Partial Living Expenses at Study Areas

Midway	140
Kure	140
French Frigate Shoals	140
Island of Hawaii	250
Island of Lanai	200
Wake	100

## Salaries

Part time research assistants on Lanai and Hawaii (2 months each at \$800 month)	3,200
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## Supplies

Nets, additional tag applicators, calipers and scales	325
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## Administration

10% overhead charge by the Research Corporation of the University of Hawaii	545
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Total costs per year	\$5,970
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Total costs for three year duration	\$17,910
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\*NC - no costs involved due to transportation being provided as a public service to my research project by the U.S. Coast Guard.

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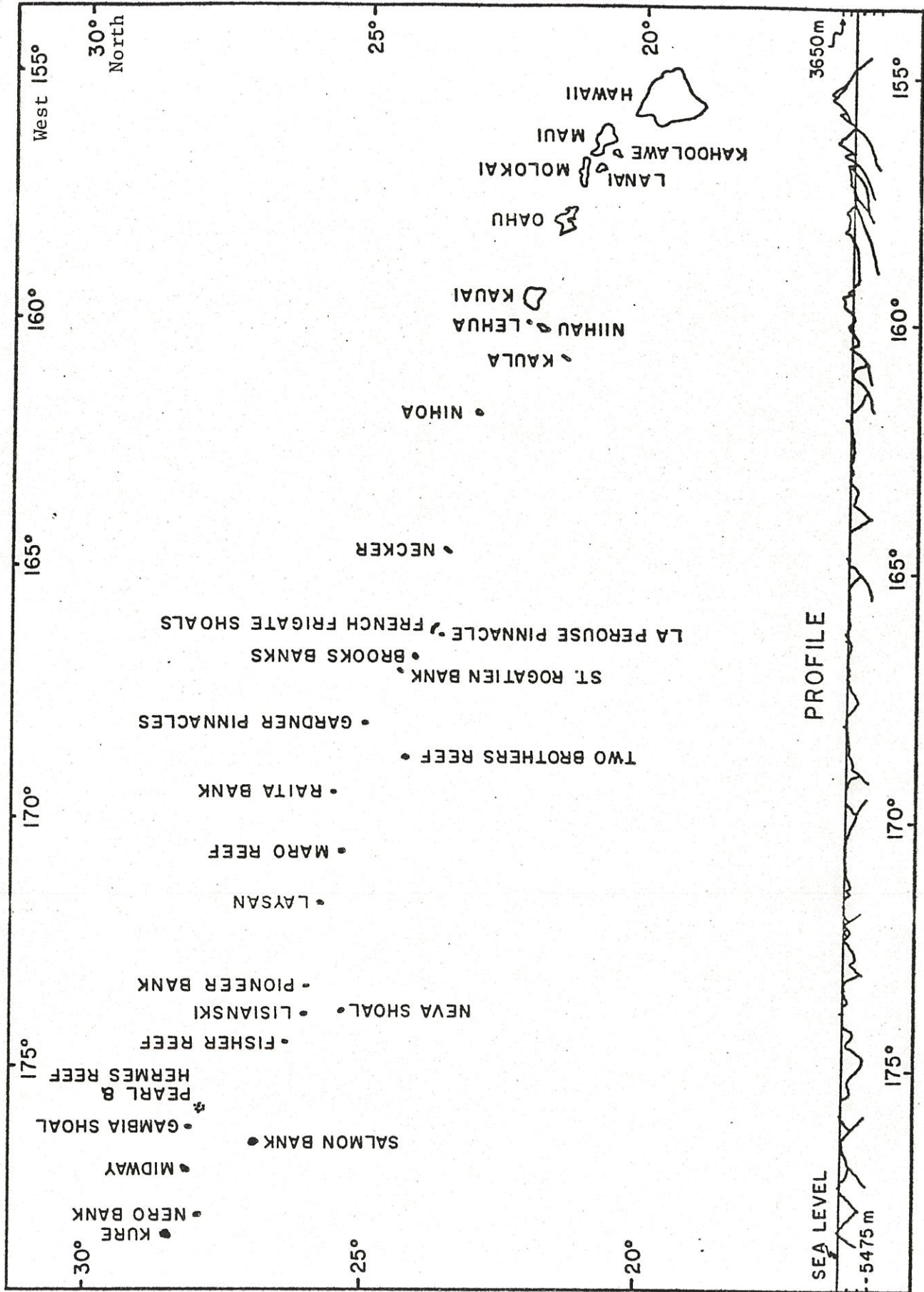


Figure 1. HAWAIIAN ARCHIPELAGO

Table 1

MOVEMENTS OF IMMATURE GREEN TURTLES  
(preliminary findings)

Tag No.	Date Tagged	Location Tagged	Carapace length (cm)	Location recovered	Interval in months	Distance (km)	Date recovered
1485	8 Nov. 1975	Midway	40.5	Hilo, Hawaii	7	2240	31 May 1976
1529	4 Jan. 1976	Midway	38.5	Wake	6	1540	12 July 1976