

ANALYSES OF TURTLE PARTS RECOVERED FROM SHARK STOMACHS SAMPLED  
AT PEARL AND HERMES REEF AND FRENCH FRIGATE SHOALS,  
NORTHWESTERN HAWAIIAN ISLANDS

Internal Summary Report  
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by

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### Introduction

During April and May 1977, shark fishing was conducted at Pearl and Hermes Reef and French Frigate Shoals in conjunction with investigations of shark predation on the Hawaiian monk seal, *Monachus schauinslandi*. Dr. Leighton Taylor and Mr. Skip Naftel are the co-investigators of this research project, with the vessel EASY RIDER being used for capture operations.

Preliminary examinations of stomach contents by the co-investigators revealed that eight of the sharks captured had been feeding on sea turtles. All of the sharks involved were identified as large tiger sharks (*Galeocerdo cuvieri*). Turtle parts were subsequently made available to me for evaluation with respect to species, numbers, and sizes of turtles represented. Information on the species and numbers of sharks caught as well as details of other items recovered from the stomachs will be presented elsewhere by Dr. Taylor and Mr. Naftel.

### Background

It is well-known that in Hawaii and other areas of the world sea turtles are a regular dietary component of tiger sharks (Sarangdhar, 1943; Gudger, 1948, 1949; Ikehara, 1960; Tester, 1969; Fujimoto and Sakuda, 1971). However, with the exception of several earlier examinations which I have made, no systematic

analyses have been conducted of recovered turtle parts in order to gain ecological data relevant to the turtle populations involved. Such analyses have considerable potential for providing information on natural mortality rates by size categories, incidence of turtles at particular locations, carapace colorations, food sources used by the turtles and other important factors. In essence, recovery and analyses of turtle parts from shark stomachs permits access to information that would otherwise be very difficult and in some cases impossible to obtain by other techniques.

#### Methods

The various turtle parts from each of the eight shark stomachs were visually examined and identified as to particular body structure. Intact parts, consisting principally of scutes (carapace and plastron) and the horny beaks covering the jaws, were measured and compared with specimens from turtles of a known size contained in my reference collection. Estimates were then made of the original sizes of the turtles represented. The number of turtles present in each shark's stomach was determined by the size and incidence of body parts, and variations in the pattern and coloration of scutes.

#### Findings

Results of the analyses are presented in Table 1. All of the parts were identifiable as having originated from green turtles (*Chelonia mydas*). A maximum of <sup>17</sup>15 different turtles was found to be present in the <sup>9 total - (congenitic)</sup>eight sharks. The four sharks captured at Pearl and Hermes Reef contained eight turtles, while the <sup>5</sup>four sharks captured at French Frigate Shoals contained <sup>9</sup>seven turtles. A single shark from Pearl and Hermes Reef accounted for five turtles.

The estimated straight carapace lengths ranged from 15 to 37 inches, with three turtles being greater than 32 inches and therefore large enough to have been sexually mature. All three of these individuals were from sharks captured at French Frigate Shoals, the colonial breeding site for Hawaiian green turtles during the months of April to September.

Most of the parts consisted of keratinized structures of epidermal origin, such as scutes and beaks. This suggests that such horny material is more resistant to the digestive processes of tiger sharks than bone and tissue. The length of time that a keratinized structure may be retained in a tiger shark's stomach is an important but unknown factor.

With the possible exception of the distal portion of a left front limb found in shark No. 16, it is logical to conclude that all of the recovered parts represented turtle fatalities. There is, however, the possibility that in some instances mortality may have been unrelated to shark attack and occurred prior to ingestion.

#### Literature Cited

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Table 1. Results of Analyses

Capture location and shark ID no.	Capture date	Turtle parts present	No. turtles represented	straight carapace length (inches)	Estimated sizes approximate weight (lbs)
Pearl and Hermes Reef					
4	20 April 1977	horny beaks covering jaws; scutes from carapace	5	21	45
				22	60
				22	60
				25	90
				25	90
16	20 April	distal portion of left front limb	1	15	15
20	21 April	portion of carapace and plastron; pelvic girdle	1	16	25
30	23 April	scutes from carapace; portion of rib	1	29	140
Total			8		

Table 1. Continued.

Capture location and shark ID no.	Capture date	Turtle parts present	No. turtles represented	Estimated sizes straight carapace length (inches)	Estimated sizes approximate weight (lbs)
French Frigate Shoals					
54	19 May	scutes from plastron; scale from tail	1	25	90
56	19 May	scutes from carapace	3	21 37 37	45 275 275
66	20 May	complete carapace (2); complete head (2)	2	15 16	15 25
71	20 May	scutes from plastron; rib and vertebrae	1	33	200
Total			7		

Addendum to Analyses of Turtle Parts Recovered  
from Shark Stomachs - 20 July 1977 by G. H. Balazs

In conjunction with telemetry studies, additional shark fishing was conducted at French Frigate Shoals during June 1977 by Messrs. Taylor, Naftel and a research associate, Tim Tricas. One of the tiger sharks captured (ID no. 9) was found to contain a juvenile green turtle measuring 16 1/8 inches in carapace length. Except for a severed right front limb, this specimen was recovered intact with little evidence of deterioration from digestive action. In addition, the same shark also contained carapace scutes and partially digested ribs and vertebrae of an adult green turtle estimated to measure 36 inches in carapace length.

Like other data presented in the body of this report, the recovery of only carapace scutes, ribs and vertebrae presents an enigma as to the whereabouts of the remainder of the turtle. Some of the more plausible explanations are listed as follows.

1. Only a portion of the turtle was ever ingested by the shark, with the remainder perhaps being consumed by other sharks.
2. The entire turtle was eaten by the shark, however, pieces were regurgitated either before being hooked or while struggling on the hook.
3. The entire turtle was eaten by the shark and all pieces but those recovered underwent digestive action and passed on along the intestinal tract in an unrecognizable form.

If the keratinized structures are in fact exceptionally resistant to digestion, the last explanation (no. 3) would seem to be the least likely in that only 13 of the 38 carapace scutes (present in *Chelonia*) were found in the shark's stomach. In addition, there were no scutes from the plastron or horny beaks from the jaws. The carapace scutes that were present showed no signs of deterioration from digestion. It is therefore unlikely that structures of the same chemical composition could have undergone such radically different rates of digestion.