

ASPECTS OF GREEN TURTLES IN THEIR FEEDING, RESTING, AND CLEANING AREAS OFF WAIKIKI BEACH

George H. Balazs
Russell K. Miya
Michele A. Finn

National Marine Fisheries Service, Southwest Fisheries Science Center Honolulu Laboratory, 2570 Dole Street, Honolulu, Hawaii 96822-2396 USA

BACKGROUND

Long-term tagging studies of green turtles (*Chelonia mydas*) in near shore waters of the Hawaiian Islands have been underway to gather comprehensive data on growth rates, movements, food sources, health status, and habitat requirements (Balazs 1980, 1982, 1991; Balazs et al. 1987). The isolated Hawaiian archipelago extends for 2400 km across the North Pacific. However, the large and inhabited volcanic islands of Kauai, Niihau, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii, located at the southeastern end of the chain account for 96% or 1165 km of the existing coastline. The majority of post-pelagic Hawaiian green turtles, ranging from 35 cm juveniles to adults >82 cm, reside in the shallow benthic habitats bordering these eight islands.

Green turtles in the Hawaiian Islands have been listed and protected since 1978 under the U.S. Endangered Species Act. The population presently contains an estimated 1400 adult females. Reproductive migrations take place over considerable distances to French Frigate Shoals, located at the mid-point of the archipelago (Balazs 1976). A gradual increase in the number of nesting turtles at this site has been recorded since systematic monitoring started in 1973.

Discrete foraging and resting areas being intensively studied have been selected on the basis of 1) sufficient numbers of turtles residing in an area, and 2) the accessibility of the area to safely and successfully capture the turtles for tagging. The increased sightings of turtles during recent years in waters along world-famous Waikiki Beach have resulted in the inclusion of this site for investigation.

Located on the south shore of Oahu a short distance from downtown Honolulu, Waikiki extends for 3 km from Diamond Head to the Ala Wai Yacht Harbor. Turtles foraging along the shallow Waikiki reef, particularly in front of the Sheraton Waikiki Hotel, can regularly be seen by beachgoers and occupants of oceanfront hotel rooms. It is not unusual for turtles to briefly surface right next to tourists swimming, wading, or floating on air mattresses. In addition, scuba divers just 500 m from shore commonly encounter turtles resting on the bottom at depths of 5-15 m. Greater numbers of turtles along Waikiki offer special opportunities for research. The potential also exists to expand the role of sea turtles in ecotourism and conservation education programs. Both avenues are presently being pursued. Results of a preliminary study of the turtles along Waikiki have recently been presented in Miya and Balazs (1993).

METHODS

All capture efforts were conducted during daylight hours. Turtles resting on the bottom were caught by hand during the course of skin and scuba diving. Numerous underwater observations of the behavior of turtles were also made during these activities.

Large-mesh nets were rapidly deployed from the beach to capture turtles foraging close to shore. Netting was facilitated by stationing an observer on an upper floor of the Waikiki Sheraton Hotel. The location and

movements of turtles underwater could be readily seen from this vantage point. Information was relayed by hand-held radio to the capture team waiting on the beach. Extended observations on the diving behavior of turtles were also possible from the hotel.

Turtles were measured, weighed, identified with Inconel 681 alloy flipper tags, and carefully examined for health problems before being released. An oral inspection using a speculum was also conducted on each turtle. Food sources were determined by harmless esophageal flushing, following the procedures described by Balazs (in press). Fibropapillomas present on turtles were counted and ranked on the basis of tumor size and location (severity scores ranging from 1-4, with 4 being the most severe).

During the 30-month study period reported upon in this paper (Oct. 90 - Apr. 93), four turtles, two of which were tagged, were found dead or dying along Waikiki Beach. Necropsies conducted on these animals also contributed useful information.

RESULTS AND DISCUSSION

Forty-six turtles were captured and tagged ranging from 37.6 to 80.8 cm in straight carapace length and weights of 7.7 to 81.8 kg. An 80.7 cm turtle showed evidence of being an adolescent male, based on tail length. The sex of all other turtles captured could not be discerned due to their immature size. Nine (20%) of the 46 turtles were recaptured one or more times, all within the Waikiki study area. No turtles tagged at other study sites in Hawaii were among those captured off Waikiki. Thus far, none of the turtles tagged at Waikiki have been captured elsewhere.

Although only green turtles were captured, an adult female loggerhead (*Caretta caretta*) was regularly seen and videotaped by scuba divers off Waikiki starting in October 1991. This is an exceedingly rare species in the Hawaiian Islands. Attempts to capture and tag the turtle, which probably originated from Japan, have not yet been successful.

Cleaning symbiosis- Many of the turtles captured were in the vicinity of a site called "Canyons" where cleaning by several species of fish commonly occurs. Turtles were seen here posing in unusual positions while fish grazed on algae and small barnacles growing on their skin and carapace. The presence of cleaning stations like this in the Hawaiian Islands has been reported by scuba divers with increasing frequency during recent years. A specialized cleaning behavior between a wrasse (*Thalassoma duperrey*) and the green turtle in Hawaiian waters has recently been demonstrated by Losey et al. (in review).

Growth rates- Recapture intervals greater than a year existed for only 3 of the 9 turtles recaptured. The growth rates of these three turtles were: 3.7 cm/yr for a 57.6 cm turtle; 3.0 cm/yr for a 69.3 cm turtle; and 0.3 cm/yr for the largest (80.8 cm) turtle captured. Growth exhibited by two of these turtles was higher than the overall average of 2.5 cm/yr computed for green turtles residing at the various other Hawaiian coastal areas under investigation.

As research off Waikiki progresses, growth rates of turtles in this area will have to be carefully interpreted. The practice by some divers of attracting and "taming" fish, eels, and turtles by hand feeding them squid and other proteinaceous food could alter natural growth. Two turtles that fall into this category have thus far been tagged for comparative purposes. It should be noted, however, that not all of the turtles that show little or no fear of humans diving off Waikiki are the result of hand feeding. During recent years turtles at several sites throughout the Hawaiian Islands have demonstrated a surprising tameness to swimmers, divers, and people walking along the shoreline. The reason for this phenomenon is unknown, but could be due to protective regulations and their generally effective enforcement.

Food sources- The food sources of turtles residing along Waikiki were found to consist of benthic algae, including *Ulva fasciata*, *U. reticulata*, *Spyridia filamentosa*, *Pterocladia capillacea*, *Gelidium pusillum*, and *Hypnea musciformis*. The latter red alga is now widespread along the coastline of Oahu, as well as Maui,

following its introduction from Florida into Kaneohe Bay on Oahu in 1974. Green turtles have been found to forage heavily on *H. musciformis* at a number of these locations (Russell and Balazs in review).

Tumors and ectoparasites- Four (9%) of the 46 turtles captured were found to have fibropapillomas. The carapace lengths of these turtles ranged from 52.6 to 70.3 cm. Two of the cases were serious (score = 3), and two were considered moderate (score = 2). The largest turtle, which was also the most severely tumored in addition to being emaciated, was found dead on Waikiki Beach five months after being tagged. The cause of fibropapillomas is unknown, but investigations both in Hawaii and Florida are in progress (see Balazs and Pooley 1991). It should be noted that the 9% affliction rate off Waikiki is relatively mild when compared to other coastal areas studied on Oahu, Molokai and Maui. For example, the prevalence of tumors on turtles at Palaau, Molokai, is estimated to now be 50%. Virtually no tumors were present on turtles sampled at this location up until 1985.

The presence of small numbers of leeches, *Ozobranchus branchiatus*, and/or their eggs was found on 5 (11%) of the turtles captured. In three of these cases, leeches were present in the mouth. Only one turtle with leeches had fibropapillomas.

Mortality and injury- Two of the four turtles found dead or dying along Waikiki Beach had severe propeller wounds to their carapace. Another turtle was found swimming in a weakened condition with the same kind of injury. The wound was treated and sealed with dental adhesive by a consulting veterinarian. Since its release the turtle has been seen on several occasions in good condition.

Two turtles were documented as having been entangled in gill nets. One was found dead washed ashore, and the other was rescued alive from a net. It is not uncommon for gill nets to be set in the near shore waters of Waikiki.

Other significant findings included two turtles with small fishhooks, one in the mouth and one in a front flipper; two turtles with healed puncture wounds resulting from a three-prong spear; one turtle with partly missing but healed hind flippers likely resulting from shark attack; and two turtles entangled in monofilament fishing line. One of the entanglements had resulted in the amputation of a front flipper that had completely healed. Monofilament line protruding from the esophagus was wrapped tightly around the base of the other front flipper. The line was cut as close as possible in the mouth. It was expelled in a fecal pellet 34 days later and found to be 2 m long.

ACKNOWLEDGMENTS

This on-going research program off Waikiki Beach would not be possible without the generous cooperation of Atlantis Reef Divers and the Sheraton Waikiki Hotel. We appreciate the continuing assistance and advice of John Wilson, who dives daily with turtles and videotapes their behavior. We also express our gratitude to Dr. Robert Morris for his special efforts in the veterinary care of turtles in trouble. Many other people, too numerous to name here, have contributed their time and talent to this work. We sincerely thank them all and look forward to their future involvement.

LITERATURE CITED

- Balazs, G.H. in press. Innovative techniques to facilitate field studies of the green turtle, *Chelonia mydas*. Proceedings of the Twelfth Annual Symposium on Sea Turtle Conservation and Biology.
- Balazs, G.H. 1976. Green turtle migrations in the Hawaiian archipelago. *Biol. Conserv.* 9:125-140.
- Balazs, G.H. 1980. Synopsis of biological data on the green turtle in the Hawaiian Islands. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-7, 141p.

- Balazs, G.H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago. In: K.A. Bjorndal (editor), *Biology and conservation of sea turtles*, p.117-125, Smithsonian Inst. Press.
- Balazs, G.H. 1991. Current status of fibropapillomas in the Hawaiian green turtle, *Chelonia mydas*. In: G.H. Balazs and S.G. Pooley (editors), *Research plan for marine turtle fibropapilloma*. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-SWFSC-156, p.47-57.
- Balazs, G.H., R.G. Forsyth, and A.K.H. Kam. 1987. Preliminary assessment of habitat utilization by Hawaiian green turtles in their resident foraging pastures. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-71, 107p.
- Balazs, G.H. and S.G. Pooley (editors). 1991. *Research plan for marine turtle fibropapilloma*. U.S. Dep. Commer. NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-156, 113p.
- Losey, G.S., G.H. Balazs, and L. Privitera. in review. A cleaning symbiosis between the wrasse, *Thalassoma duperry*, and the green turtle, *Chelonia mydas*. *Copeia*.
- Miya, R.K. and G.H. Balazs. 1993. Ecology and conservation of green turtles in the nearshore waters of Waikiki Beach. *'Elepaio* 53(2):9-13.
- Russell, D.J. and G.H. Balazs. in review. Colonization by the alien marine alga *Hypnea musciformis* (Wulfen) J. Ag. (Rhodophyta: Gigartinales) in the Hawaiian Islands and its utilization by the green turtle, *Chelonia mydas*. *Aquatic Botany*.



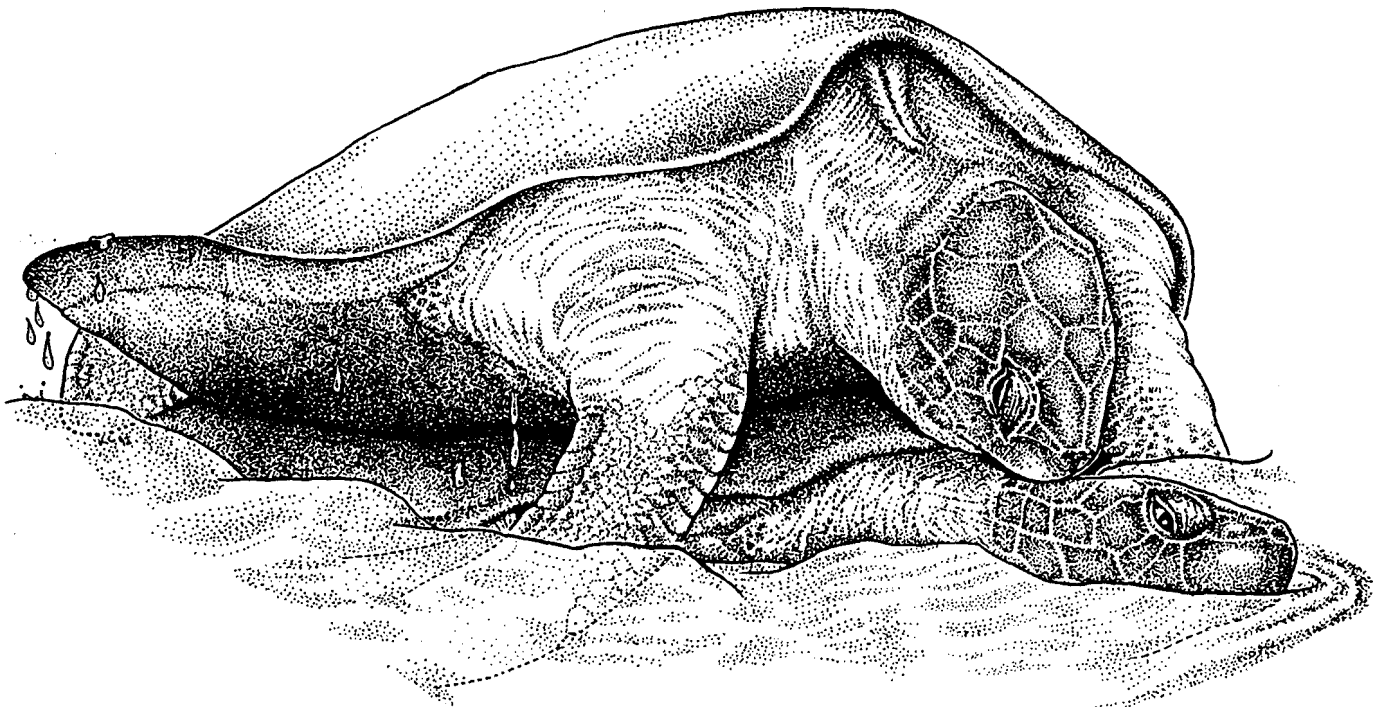
NOAA Technical Memorandum NMFS-SEFSC-341

**PROCEEDINGS OF THE THIRTEENTH ANNUAL SYMPOSIUM
ON SEA TURTLE BIOLOGY AND CONSERVATION**

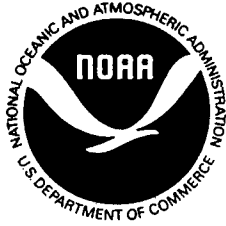
**23-27 February 1993
Jekyll Island, Georgia**

**Compilers:
Barbara A. Schroeder
Blair E. Witherington**

January 1994



**U.S. Department of Commerce
National Oceanographic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149**



NOAA Technical Memorandum NMFS-SEFSC-341

**PROCEEDINGS OF THE THIRTEENTH ANNUAL SYMPOSIUM
ON SEA TURTLE BIOLOGY AND CONSERVATION**

23-27 February 1993
Jekyll Island, Georgia

Compilers:

Barbara A. Schroeder
Blair E. Witherington

JANUARY 1994

U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
D. James Baker, Ph.D., Administrator

NATIONAL MARINE FISHERIES SERVICE
Rolland A. Schmitten, Assistant Administrator for Fisheries

The Technical Memorandum Series is used for documentation and timely communication of preliminary results, interim reports, or special-purpose information. Although the memoranda are not subject to complete formal review, editorial control, or detailed editing, they are expected to reflect sound professional work.