

ECOLOGY AND CULTURAL SIGNIFICANCE OF SEA TURTLES AT PUNALU'U, HAWAII

George H. Balazs¹
Walter C. Dudley²
Leon E. Hallacher²
John P. Coney²
Shawn K. Koga¹

¹ National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole Street, Honolulu, Hawaii 96822-2396 USA

² University of Hawaii at Hilo, Marine Option Program, 200 West Kawili Street, Hilo, Hawaii 96720-4091 USA

Long-term tagging studies of sea turtles in nearshore waters of the Hawaiian Islands have been underway to gather comprehensive data on growth rates, food sources, movements, health status, habitat requirements, and population trends (Balazs 1980a, 1982, 1991; Balazs et al. 1987, 1994). The isolated Hawaiian Archipelago contains 132 islands and reefs extending for 2400 km across the North Pacific, from Kure Atoll at the northwestern end (28°N, 178°W) to the volcanically active island of Hawaii at the southeastern extremity (19°N, 154°W). The eight large (or main) populated islands in the southeastern portion account for 96% of the coastal benthic habitats suitable for post-pelagic Hawaiian green (honu), *Chelonia mydas*, and hawksbill (honu-'ea), *Eretmochelys imbricata*, turtles. Green turtles throughout the chain migrate to breed at French Frigate Shoals at the mid-point of the archipelago (Balazs 1976, 1983). A gradual increase in the number of nesting turtles has been recorded at this site since protection was afforded in 1978 under the U.S. Endangered Species Act. About 350 green turtles nested at French Frigate Shoals during the 1993 breeding season. In contrast, nesting by hawksbills (also protected under the Act) is confined to a few remote beaches exclusively in the main islands, where only small numbers continue to come ashore to lay eggs (Balazs 1978, Balazs et al. 1992).

Discrete foraging areas under systematic investigation in the Hawaiian Islands have been selected on the basis of (1) sufficient numbers of turtles residing in an area, and (2) the accessibility of the area for safely and successfully capturing the turtles for tagging. Punalu'u, a small sheltered bay and black sand beach in the Ka'u District on the east coast of the island of Hawaii, fully meets these requirements. This study site has been periodically visited to tag turtles since 1976. Students from the University of Hawaii at Hilo have served as field assistants to the senior author, thereby playing an essential role in all work accomplished. In addition to sea turtles, the sparsely populated and rural region of Ka'u is characterized by a rich Hawaiian cultural heritage.

METHODS

Turtles were captured by hand while snorkeling and scuba diving. Prior to 1988, large-mesh nets were set at night and monitored using a spotlight from shore and by swimming along the bottom to check for entangled turtles. Since 1988, turtles have been commonly found feeding in the daytime inside the bay, rather than at night. Consequently, during recent years nets have been effectively used by quickly surrounding turtles seen foraging close to shore. Turtles were measured, weighed, identified with two or more Inconel size 681 flipper tags, and carefully examined for health problems before being released. Food sources were determined by direct observations of foraging turtles, oral inspections, examining the butchered remains of illegally taken turtles, and by harmless esophageal flushing (Balazs 1980b, in press). Twenty-six expeditions have been made to Punalu'u ranging in duration from 1 to 4 days. For the past 4 years (1990-93) during April, July, and November study visits have been made three times a year for 2 days each.

RESULTS AND DISCUSSION

Since 1976, 183 green turtles ranging from 35.1-95.1 cm in straight carapace length (SCL) and weights of 6.8-115.0 kg have been captured at Punalu'u. Sixty-three turtles (34%) have been recaptured one or more times after 0.2-16.0 years in the wild, resulting in 121 carapace growth increments. Three turtles tagged at Punalu'u were later resighted nesting at French Frigate Shoals, a distance of 1200 km. In addition, two males and a female originally tagged at French Frigate Shoals were recaptured at Punalu'u. Except for these six distant migrations of adults, no turtles tagged at Punalu'u have been captured elsewhere, and none of the turtles tagged at other study sites have been found at Punalu'u.

No hawksbills were captured at Punalu'u, although on rare occasions immature individuals were seen outside the bay in nearshore waters of the adjacent coastline. In 1989 a hawksbill nested at Punalu'u, and the hatchlings were disoriented by lights from the nearby beach park. A documented hawksbill nesting also occurred at Punalu'u in 1975, but the eggs were destroyed by a tsunami. The only other known nesting at Punalu'u within historical times happened in 1974, and again involved a hawksbill. Balazs (1978, 1991) and Katahira et al. (this volume) summarize the status of hawksbill nesting at several small isolated beaches in Ka'u and other coastal areas of the main Hawaiian Islands.

Food sources-- The exclusive food source selected by green turtles foraging at Punalu'u is the red alga, *Pterocladia capillacea*. The distribution of this species is limited to shallow rocky areas close to shore, often in the lower portion of the intertidal zone where freshwater springs discharge into the sea. The thermal influence of these springs within the bay results in temperatures ranging from 19°-26°C. Ocean temperatures immediately outside the bay, where turtles rest on the bottom at depths of 5-25 m when not feeding, range from 24°-28°C. *P. capillacea* occurs at certain other coastal areas adjacent to Punalu'u where turtles are also known to forage.

Growth rates-- The 121 growth increments recorded at Punalu'u yielded a mean growth rate of 1.9 ± 1.4 cm/yr. Similar results were obtained (2.1 ± 1.2 cm/yr) when only one growth increment was used from each of the 63 turtles recaptured (i.e., growth between initial capture and the most recent recapture). Growth rates decreased considerably with increasing size after about 50 cm SCL. For example, turtles 50-55 cm had a mean growth rate of 3.7 cm/yr, turtles 70-75 cm grew 1.1 cm/yr, and turtles 75-80 cm only 0.5 cm/yr. The smallest size class (35-40 cm) also displayed slower growth

(1.0 cm/yr), although a larger sample size is needed to confirm these data. The initial slower growth may be due to dietary adjustments to herbivory when small turtles (35-40 cm) first arrive at Punalu'u from pelagic habitats where carnivory prevails. Studies of immature green turtles in the Southern Bahamas (21°N) also revealed decreasing growth rates with increasing size (Bjorndal and Bolten 1988). However, depressed growth was not seen in the smaller size classes.

Population trends-- More turtles have been captured during recent visits to Punalu'u than in past years, thereby suggesting an increase in the resident population. However, this tentative conclusion is complicated by the shift to predominantly daytime foraging and the increasing tameness to humans exhibited by the turtles. Presently the turtles are far more visible and easier to catch when feeding in the bay. In addition, difficulties exist in standardizing units of capture effort due to modifications in netting and hand-capture techniques. On any given day, 20 or more foraging turtles can usually be seen by observers standing along the shoreline or snorkeling 200 m from one side of the bay to the other. Somewhat comparable capture techniques and efforts have been used for the past 12 visits (1990-93). The annual number of turtles caught for these four years was 41, 59, 61 and 53, respectively. The number captured per visit ranged from 12-26. Recaptures of previously tagged turtles on each trip during this same time period ranged from 33-88% (mean 65%).

Disease-- Only two of the 183 turtles examined and tagged at Punalu'u have had tumors indicative of fibropapillomatosis. One was captured in 1984 and the other in 1990. Both turtles had a single

0.5-1.0 cm growth associated with an eye. One of these turtles also had a few leeches, *Ozobranchus branchiatus*, and patches of leech eggs. Small numbers of leeches have also been found in the mouths of two turtles without tumors at Punalu'u. All other turtles captured at Punalu'u have been judged healthy. The prevalence of tumors on turtles is exceedingly high at some study sites in Hawaii, such as Kaneohe Bay on Oahu (Balazs 1991).

Mortality-- Before protection under the U.S. Endangered Species Act, turtles at Punalu'u were regularly hunted and killed by nets, spearguns, firearms, and grappling hooks attached to bamboo poles. During the 1960s and early 1970s turtles taken at Punalu'u (and other prime foraging/resting sites throughout Hawaii) were sold to restaurants catering to the growing tourist trade. Heavy hunting mortality continued at Punalu'u until the mid-1980s, when enforcement agents of the National Marine Fisheries Service apprehended four persons identified by a witness as having caught and killed a turtle. The successful prosecution of this case, along with several others, and the resulting publicity especially in the rural Ka'u District, helped to considerably reduce turtle mortality. The current tameness of turtles at Punalu'u along with the shift to daytime foraging are believed to be the direct result of reduced hunting pressures. It should be noted that non-human predators of turtles, such as large sharks, have never been documented at Punalu'u.

Cultural significance-- Punalu'u is bordered on both sides of the coastline by religious stone structures and other archeological remains. Punalu'u is also the setting for probably the most significant legend relating to sea turtles in the ancient Hawaiian culture. The story, as documented by Hawaiian historian Mary Kawena Pukui, tells of two kinds of supernatural sea turtles (honu-po'o-kea and honu-ʻea) that came to Punalu'u where the mother gave birth to an egg she buried in the sand. A freshwater spring was then formed by digging into the earth. Later, when the egg hatched, a turtle emerged the color of polished kauila wood (*Alphitonia ponderosa*). This "turtle girl" was named Kauila. At will, she was able to assume human form and play with the children, but would change into a turtle again before going back into the water. "Children used to catch fish and shrimp in the spring, and Kauila watched lest the little ones fall in. The people loved Kauila for this and because her spring gave them drinking water" (Handy et al. 1972). Despite so many turtles being killed at Punalu'u during past decades, there are people who believe that Kauila's presence can still be felt there today and that she is, indeed, the "mystical mother" of all Hawaiian sea turtles. Plans are now underway to construct an educational sign and monument at Punalu'u telling about Kauila and the turtles using the bay.

Ecotourism-- Turtle-watching by tourists and residents alike is becoming an increasingly popular activity at Punalu'u and elsewhere throughout Hawaii. Each day several bus loads of tourists stop at Punalu'u for a short time to enjoy the beauty and tranquility of this secluded Hawaiian setting. Visitors clearly enjoy the experience of seeing turtles undisturbed in their natural environment. The careful use of turtles in ecotourism in this manner should be encouraged whenever possible. Sea turtles have considerable potential for economically benefiting Hawaii through ecotourism. In addition, tourists often serve to protect the turtles by reporting illegal activities.

ACKNOWLEDGMENTS

The on-going research program at Punalu'u would not have been possible without the generous cooperation and valuable assistance of A. & J. Howard, C. Bangay, D. Mazarakis, P. Hanoa, W. Dana, B. Tissot, T. Hammond, M. Childers, and M. Clapper. Many other people, too numerous to name here, have contributed time and talent to this work over the years. We sincerely thank them for their involvement. We also thank J. Beasley for editorial assistance in the preparation of this paper.

LITERATURE CITED

- Balazs, G.H. 1976. Green turtle migrations in the Hawaiian archipelago. *Biol. Conserv.* 9:125-140.
- Balazs, G.H. 1978. Terrestrial critical habitat for sea turtles under United States jurisdiction in the Pacific region. *'Elepaio* 39(4):37-41.

Balazs, G.H. 1980a. 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. 1980b. Field methods for sampling the dietary components of green turtles, *Chelonia mydas*. Herpetol. Rev. 11(1):5-6.

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, pp. 117-125, Smithsonian Inst. Press.

Balazs, G.H. 1983. Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, Northwestern Hawaiian Islands. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-36, 42p.

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, pp. 47-57.

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 Biology and Conservation.

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. Hirth, P. Kawamoto, E. Nitta, L. Ogren, R. Wass, and J. Wetherall. 1992. Interim recovery plan for Hawaiian sea turtles. Honolulu Lab., Southwest Fish. Sci. Cent. Admin. Rep. H-92-01, 76p.

Balazs, G.H., R.K. Miya, and M.A. Finn. 1994. Aspects of green turtles in their feeding, resting, and cleaning areas off Waikiki Beach. Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SEFSC-341, pp. 15-18.

Bjorndal, K.A. and A.B. Bolten. 1988. Growth rates of immature green turtles, *Chelonia mydas*, on feeding grounds in the Southern Bahamas. Copeia, 1988(3):555-564.

Handy, E.S.C., E.G. Handy, and M.K. Pukui. 1972. Native planters in old Hawaii: their life, lore, and environment. B.P. Bishop Mus. Bull. 233.

Katahira, L.K., C.M. Forbes, A.H. Kikuta, G.H. Balazs, and M. Bingham. this volume. Recent findings and management of hawksbill turtle nesting beaches in Hawaii. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.



NOAA Technical Memorandum NMFS-SEFSC-351

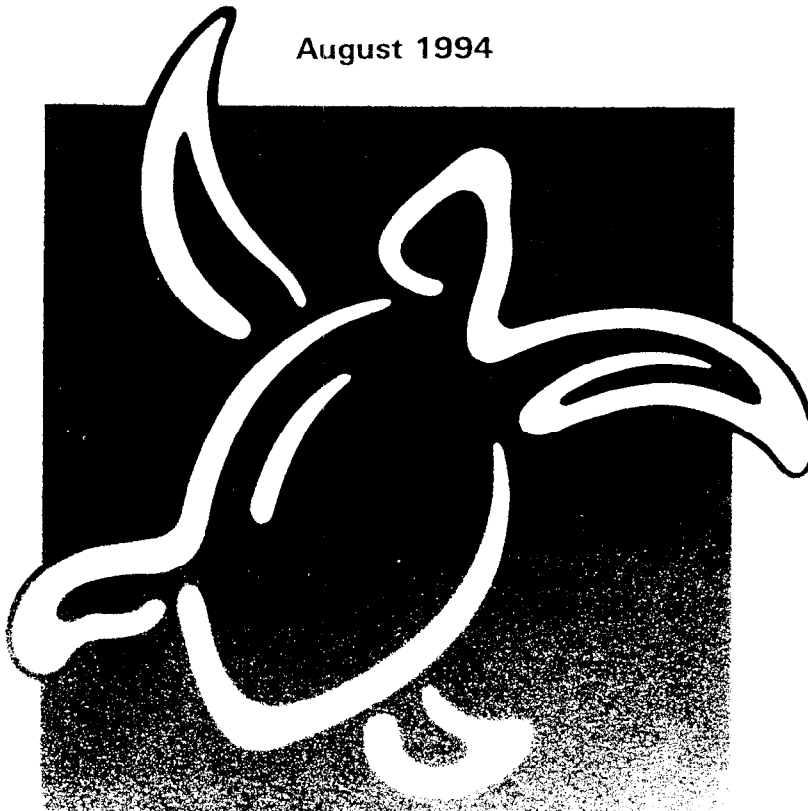
**PROCEEDINGS OF THE FOURTEENTH ANNUAL SYMPOSIUM
ON SEA TURTLE BIOLOGY AND CONSERVATION**

**1 - 5 March 1994
Hilton Head, South Carolina**

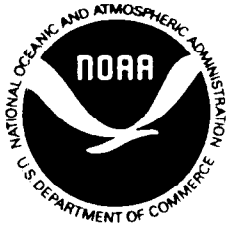
Compilers:

**Karen A. Bjorndal
Alan B. Bolten
Dale A. Johnson
Peter J. Eliazar**

August 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-351

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

**1 - 5 March 1994
Hilton Head, South Carolina**

Compilers:

**Karen A. Bjorndal
Alan B. Bolten
Dale A. Johnson
Peter J. Eliazar**

August 1994

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

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
D. James Baker, 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.

NOTICE

The National Marine Fisheries Service (NMFS) does not approve, recommend, or endorse any proprietary product or proprietary material in this publication. No reference shall be made to NMFS, nor to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends, or endorses any product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

This publication should be cited as follows:

Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar (Compilers). 1994. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.

Cover Artwork: Dawn Russell © 1994

Copies may be obtained by writing:

National Marine Fisheries Service
Miami Laboratory
Sea Turtle Program
75 Virginia Beach Drive
Miami, FL 33149

or

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161