SATELLITE TRACKING OF HAWKSBILL TURTLES NESTING IN THE HAWAIIAN ISLANDS

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Few studies have been undertaken using satellite telemetry to determine post-nesting migrations of hawksbill turtles, Eretmochelys imbricata. Additionally, none of the work reported to date has taken place in the Pacific region (Byles and Swimmer, 1994, Groshens and Vaughn, 1994). In the Hawaiian Islands the hawksbill, known as honu'ea, is a rare and endangered species (Balazs, 1978; Balazs *et al.* 1992; 1994). An estimated total of not more than 30 females nest in the best of years at 10 beach sites found exclusively on the islands of Hawaii, Maui, Molokai and Oahu. Hawksbills are not known to reside or nest in the Northwestern Hawaiian Islands, where green turtles, *Chelonia mydas* (honu), seasonally migrate to breed from throughout the archipelago (Balazs, 1976).

Kamehame, a small remote beach at 19° 8.8'N, 155° 28.2'W on the southeastern coast of the island of Hawaii, hosts a major portion of all hawksbill nesting in the Hawaiian Islands. Since 1989, females arriving here have been monitored, tagged, and protected by biologists from the nearby Hawaii Volcanoes National Park (Katahira *et al.*, 1994). However, no tagged turtles have been recorded away from the nesting beach. In addition, there are almost no reports of adult hawksbills being sighted by divers anywhere in coastal waters. Knowledge of the whereabouts of marine foraging habitats occupied by Hawaiian hawksbills is essential to adequately understand, protect, and manage this local population. The principal objective of the ongoing study reported here is to locate the resident feeding areas of hawksbills. Satellite telemetry using the Argos system was initiated at Kamehame in 1995 to accomplish this goal.

METHODS

Telonics ST-3 transmitters were attached to two nesting hawksbills during late August 1995. Deployment was scheduled to coincide with the latter part of the nesting season. Transmitters were programmed with a duty cycle of six hours on, six hours off. The units were turned on at a time computed for the latitude and longitude of Hawaii to synchronize with optimum satellite overpasses. Each 765 g transmitter was safely and securely attached to the carapace using Silicone Elastomer and thin layers of fiberglass cloth soaked with polyester resin. The turtles were harmlessly confined in a prone position inside a portable plywood pen during the attachment process. The same procedure successfully used to satellite-track the reproductive migrations of green turtles

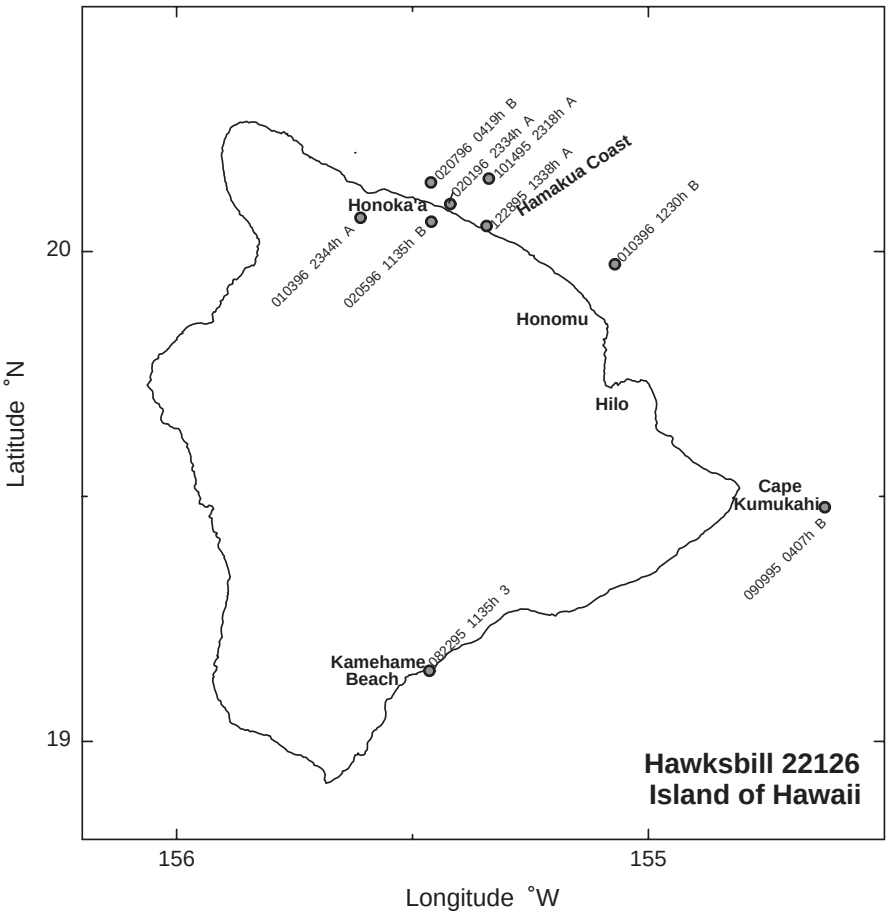

Figure 1. Post-nesting migration of hawksbill 22126 from Kamehame Beach to the Honoka'a region of the Hamakua Coast, Island of Hawaii. A minimum distance of 200 km was traveled. The month, day, year, time, and LC designation as supplied by Argos are listed for each position.

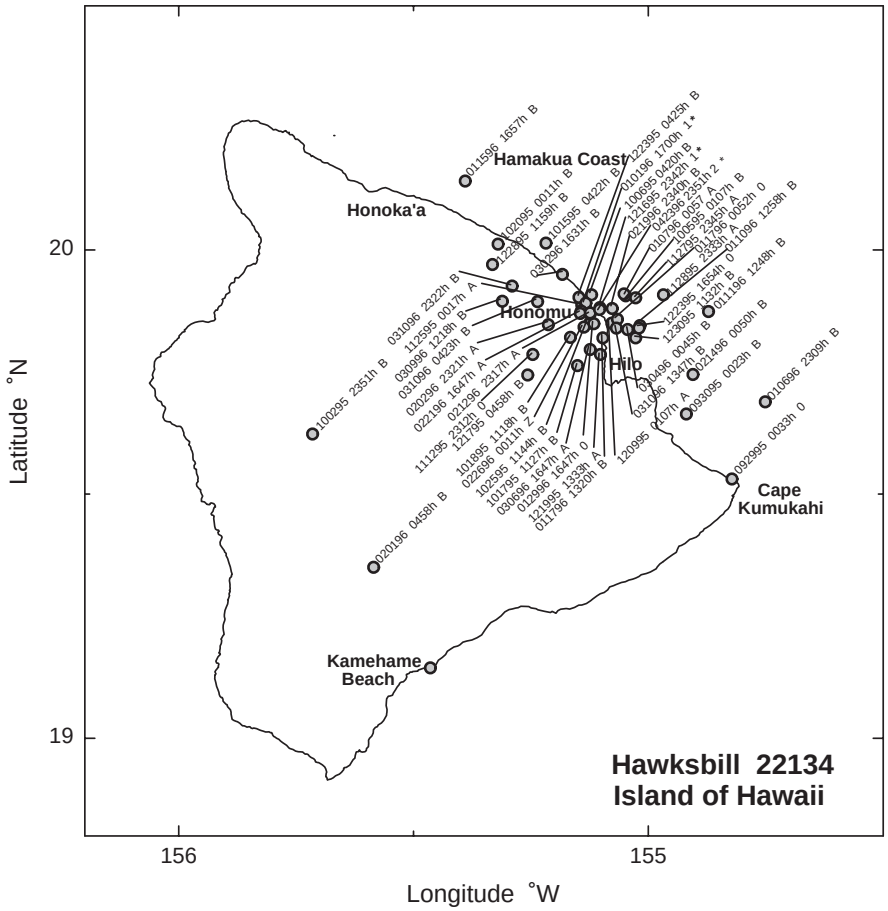

Figure 2. Post-nesting migration of hawksbill 22134 from Kamehame Beach to Honomu on the Hamakua Coast, Island of Hawaii. A minimum coastal distance of 135 km was traveled. The month, day, year, time, and LC designation as supplied by Argos are listed for each position.

in the Hawaiian Islands was carried out with hawksbills in the present study (Balazs *et al.*, in press).

RESULTS

Hawksbill 22126- This turtle was equipped with a transmitter on 8/22/95 after an unsuccessful nesting attempt. She measured 88 cm in straightline carapace length (SCL). Earlier in the season she had been recorded at Kamehame on four occasions. Flipper tags (N439/N440) showed that she had originally nested at this same site in September 1991 and was resighted nesting there again in 1993. On 8/24/95, two days after being released with the transmitter, she came back ashore at Kamehame and successfully nested.

During the following seven months 90 transmissions were relayed by Argos from hawksbill 22126; however, only eight supplied location data of latitude and longitude (Fig. 1). The remaining reports were limited to diving data showing that the turtle was usually surfacing only 9-12 times during each 12-hour period computed by Argos. Individual dives frequently lasted more than 50 minutes. The eight positions were minimally sufficient to show that the turtle had traveled to the windswept northeastern side of the island known as the Hamakua Coast. A position on 9/9/95 off the eastern point of Cape Kumukahi indicated that the turtle had taken the shortest route around the island. This post-nesting migration involved a coastal distance of about 180 km. Two of the eight positions were during February 1996, thereby demonstrating an extended residency by the turtle along the Hamakua Coast.

Hawksbill 22134- A transmitter was deployed on hawksbill 22134 on 8/24/95 after an unsuccessful nesting attempt. During the previous month this 83 cm SCL female had been flipper-tagged (B773/B774) at Kamehame when encountered there for the first time. On 8/29/95, five days after transmitter attachment, the turtle emerged again to successfully nest at this same site. During the next eight months, over 100 transmissions were relayed by Argos, 50 of which included positions of varying levels of usefulness (Fig. 2). Three of the reports were locations of high accuracy (LC 1 or LC 2) occurring during December 1995 and January and April of 1996. These data, used in combination with many of the other positions, conclusively demonstrated that the turtle had also traveled to the Hamakua Coast and, like the other hawksbill, had taken the shortest route around the island. The LC 1 and LC 2 positions placed the turtle in the nearshore waters of Honomu, a minimum coastal distance of about 135 km from Kamehame. The infrequent surfacing intervals revealed by Argos for this turtle were similar to those recorded for hawksbill 22126.

Positions shown in Figures 1 and 2 illustrate that Argos data must be carefully interpreted when tracking sea turtles,

especially in studies where only short movements result. Positions received from Argos designed as LC 1, 2, and 3 are defined as quite accurate. However, no definitions of accuracy are given by Argos for LC 0, A, B, and Z positions. For these data the responsibility rests with the researcher to judge reliability and usefulness. Positions supplied may be reasonable and acceptable in one transmission, and totally unacceptable for the same LC designation when received at other times. The positions shown in the interior of the island in the accompanying figures are clearly inaccurate, hence serve to emphasize this important point.

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SATELLITE TELEMETRY OF MIGRANT MALE AND FEMALE GREEN TURTLES BREEDING IN THE HAWAIIAN ISLANDS

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Satellite telemetry using the Argos system was conducted during 1995 for the first time on adult male green turtles, *Chelonia mydas* (honu), breeding in the Hawaiian Islands at French Frigate Shoals (24°N, 166°W). In addition, a nesting green turtle was satellite-tagged in 1995 to expand upon data obtained during 1992 and 1993 when five other migrant females were successfully tracked by satellite to their resident foraging pastures (Balazs, 1994; Balazs *et al*,. 1994).

The goal of this work is to develop detailed maps of the specific routes taken by males and females between breeding and foraging areas and to determine swimming and diving behaviors during the migrations. When viewed in conjunction with environmental, geomagnetic, and other factors, these data will provide insight into the navigational mechanisms of green turtles in the Hawaiian Islands. The satellite telemetry studies of green turtles by Liew *et al*. (1995) and Papi *et al*. (1995) in Malaysia, and Schroeder *et al*. (in press) in Florida, constitute parallel lines of important research.

METHODS

Telonics ST-3 backpack transmitters were placed on two adult males during early June 1995 and on a nesting female in late September 1995. The deployment schedules were planned to coincide with estimated departure times from French Frigate Shoals for periods of mating and nesting. The transmitters were programmed with a duty cycle of six hours on, six hours off. The units were turned on at a time of day computed to synchronize with optimum satellite overpasses for the region of deployment.

The transmitters were safely and securely attached to the carapace using thin layers of fiberglass cloth and polyester resin. The transmitters measured 17 x 10 x 3.5 cm with the antenna extending 13 cm from the top. At special request to the manufacturer, the full length of the antenna was sheathed in tubing to provide added protection against damage. Silicone Elastomer, a two-part quick curing-rubber product, was also incorporated to properly mount the transmitter