

**MARINE TURTLE RESEARCH
HONOLULU LABORATORY
SOUTHWEST FISHERIES SCIENCE CENTER
NATIONAL MARINE FISHERIES SERVICE**

Background Information

Sea turtles are designated worldwide as threatened and endangered species. Population declines have been prominent in the Pacific Islands as the result of nesting habitat loss and excessive and widespread harvesting for commercial and subsistence purposes. The principal species of concern to Pacific islanders are the green turtle (*Chelonia mydas*) and the hawksbill (*Eretmochelys imbricata*). Both turtles are the focus of considerable conservation efforts by the Regional Marine Turtle Conservation Programme (RMTCP) of the South Pacific Regional Environment Programme (SPREP) based in Apia, Western Samoa. The SPREP is a non-governmental organization providing assistance to the environmental needs of 22 Pacific island nations. The SWFSC Honolulu Laboratory plays an important role in assisting SPREP in the conduction of the RMTCP. There is presently the strong desire by native inhabitants of many Pacific islands to reverse declining trends of sea turtles so as not to lose an acknowledged important part of their cultural and nutritional way of life. This task will not be easy due to inherent biological constraints of most sea turtles, which include extensive oceanic migrations for reproduction, vulnerability to predation, unknown pelagic life stages, and slow growth resulting in delayed sexual maturity of 25 or more years.

There are only two populations of loggerheads (*Caretta caretta*) in the Pacific, one originating in Australia where serious declines are occurring, and the other in southern Japan where numbers of nesting females appear to be stable. Leatherbacks (*Dermochelys coriacea*) inhabiting the Pacific mainly originate from nesting beaches in Mexico and Costa Rica where significant declines have been documented, in Indonesia where their status is uncertain but possibly stable, and Malaysia where the nesting colony is nearly extinct despite 30 years of conservation measures. Both leatherbacks and loggerheads are the species of principal concern with regard to incidental take in pelagic longline and other commercial fisheries of the Pacific conducted mainly by Japan, Taiwan, Korea and, to a lesser extent, the United States.

Green turtles in the Hawaiian Islands are genetically discrete and geographically isolated. Under the protection of the U.S. Endangered Species Act, this population has responded favorably to 21 years of recovery and research efforts by the SWFSC Honolulu Laboratory working in cooperation with the U.S. Fish and Wildlife Service, the State of Hawaii, and several private conservation organizations (Figure 1). The greater numbers of green turtles in waters around the main Hawaiian Islands have resulted in more opportunities for tourists and local people to view turtles in the water, in the same manner that humpback whales are an ecotourism

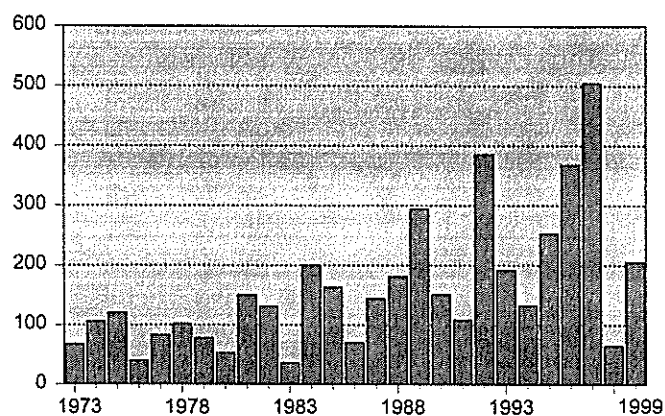


Figure 1. The number of green turtles nesting at the index study site of East Island has tripled since system monitoring started in 1973. 1997 was the highest year on record followed by a very low year in 1998. Interannual variations in green turtle nesting such as this are known to occur worldwide.

has rapidly emerged in the past decade as a potentially serious threat to populations worldwide (Figure 2). This sickness has emerged as a significant issue regarding sea turtles and their habitats at certain sites worldwide including Hawaii, Florida, Barbados, Australia, and the Pacific (coasts of Mexico and Costa Rica). The disease is manifested by the formation of multiple fibrous masses of tissue 1 mm to 30 cm in diameter growing from the eyes, flippers, neck, tail, seams of scutes, and in the mouth.

The tumors also form in the internal organs (Figure 3). Although most FP tumors are histologically classified as benign (noncancerous), they can significantly disrupt and destroy the vital life functions of breathing, feeding, vision, and swimming. In advanced stages of the disease, turtles will often be lethargic, emaciated with soft and sunken plastrons, and prone to stranding ashore. Abnormal serum chemistry and hematology frequently are present. In addition, the pathology of FP is often associated with heavy burdens of internal parasites consisting of spirorhynchid cardiovascular flukes. FP has been shown to be transmissible in laboratory studies using injected cell-free tumor extracts.

Strandings of dead or even live turtles offer an array of special research opportunities that are impossible or difficult to pursue by other avenues. In the Hawaiian Islands, an integral component of this research includes a stranding and salvage research program started in 1982. This activity is carried out in partnership with the State of Hawaii's Department of Land and Natural Resources, the Southwest Region Pacific Islands Area Office, and the University of Hawaii-JIMAR and Marine Option Program. Reports of strandings from the public, as well as from county, state,

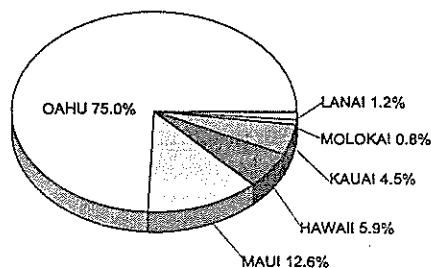


Figure 4. Green turtle strandings in the Hawaiian Islands by island, 1982-98 (N=2377).

and federal personnel on six major inhabited Hawaiian Islands, form the basis for initiating a response to collect data or acquire the turtle. The primary objective of the stranding research program in the Hawaiian Islands at present is to obtain information relevant to the epidemiology of FP. Strandings have increased annually over 17 years, from 10-20 cases in the early 1980s to 200-300 cases in the late 1990s. Most occur on Oahu (Figure 4). Strandings have decreased on Maui since a record high of 46 in 1996, but tumor prevalence here remains the highest of any island (Figure 5). Strandings occur evenly

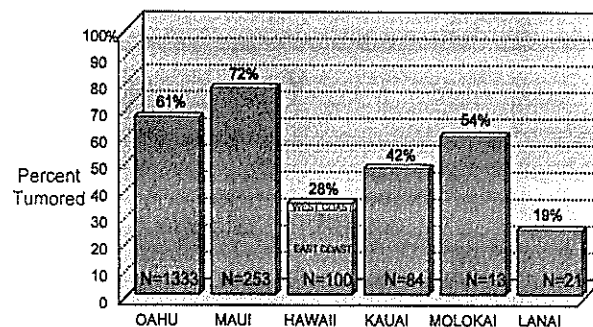


Figure 5. Data area based upon 1804 turtles examined for tumors over 17 years (1982-1998). Only two turtles with tumors have ever stranded along the West coast of the island of Hawaii, one in 1986 and the other in 1992.

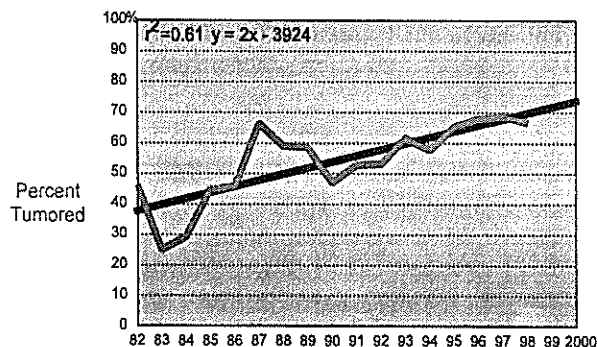


Figure 6. The percent tumored green turtles in strandings recorded throughout the Hawaiian islands has fluctuated over the past 17 years, but remained high at 65-70% since 1995 (N=2377).

studies by the USGS National Wildlife Health Center (NWHC). Representational Difference Analysis (RDA) screening for viruses is underway in collaboration with the Institute for Virology in Mainz, Germany. Laboratory techniques have been developed in collaboration with the Honolulu Field Station of NWHC to measure the humoral (antibody) and cellular (cell mediated) immune responses of clinically healthy green turtles held in captivity at the Kewalo Research Facility. Research has recently been completed to measure the immuno-competence of turtles in the wild at FP and non-FP habitat locations.

Benthic dinoflagellates, *Prorocentrum* spp., have been identified and quantified on algae and seagrass consumed by Hawaii's green turtles in a field study conducted in collaboration with the Florida Department of Environmental Protection. Nearshore coastal foraging habitats at high-risk for FP have a high prevalence and abundance of *Prorocentrum* spp. Non-FP foraging areas (the entire west coast of the Island of Hawaii) have very low *Prorocentrum* spp. These dinoflagellates are known to produce okadaic acid, a biotoxin shown to promote tumors in mice. Preliminary analysis of green turtle tissues has confirmed the presence of okadaic acid.

The University of Hawaii is analyzing remote videotape of the cleaning relationships between Hawaiian reef fishes and green turtles to provide baseline data on the potential role of carnivores transmitting FP between turtles. Turtles with FP may also be deterred from visiting cleaning sites due to painful bites to tumors by fishes. Tissues from cleaner fishes are being tested for oncogenic viruses.

Mexus Pacifico FP collaborative research of Eastern Tropical Pacific Mexican sea turtles has continued to be a highly successful cooperative study, involving information exchange and research training. This project is conducted with Dr. Javier Vasconcelos (Director) and his staff of the Centro Mexicano de la Tortuga INP sea turtle research station in Oaxaca, Mexico. A 14-day collaborative investigation was recently accomplished to assess histopathological characteristics and viral presence in tumors occurring on nesting olive ridleys. This specialized disease work is being conducted in part under contract by the Honolulu Laboratory to Drs. Alonso Aguirre and Terry Spraker, with veterinary technical assistance by Ms. Beth Zimmerman and others. There is an exceedingly high level of cooperation and mutual professional respect among all parties involved in the international effort to resolve a disease problem shared by Hawaii and the Pacific coast of Mexico.

The FP research currently in progress as noted in the above sections will be continued in FY 2000. In addition, as certain studies come to their appropriate conclusion, research will be expanded, fine-tuned, and enhanced in the areas of the Mexus Pacifico FP collaboration and the identification of the role of coastal ecosystem stresses and biotoxin-producing dinoflagellates in promoting FP.

Population Monitoring

The number of green turtles nesting in Hawaii each year has substantially increased at the index nesting site of East (Hikina) Island, French Frigate Shoals (FFS) in the Northwestern Hawaiian Islands (NWHI), from less than 100 in the early 1970s, to 200-500 in the 1990s (Figure 1). However, the total number of nesting females in the population is still well below historical levels and the fibropapilloma tumor disease continues to be a threat. The number of green turtles observed in waters around the main Hawaiian Islands has also increased significantly. Turtles in these foraging pastures are mostly immature turtles resulting from the increased nesting success.

Satellite Tracking to Estimate Post-Hooking Survival

This research was initiated in June 1997 by the Honolulu Laboratory working in partnership with the SWR Observer Management Program. To date, small satellite transmitters have been deployed from Hawaii-based commercial longliners on 31 hooked loggerheads, 6 olive ridleys, and 1 green turtle (e.g., Figure 10). Twenty-seven of the deployments resulted in pelagic trackings ranging from 0.2 to 8.2 months duration covering distances of 13-7,282 km (Figure 11). The remaining 11 deployments produced no tracking data, and all of these involved turtles that were classified as “deeply hooked” (hook lodged in the esophagus and impossible to remove). Of the 27 tracked turtles, 14 were deeply hooked and 13 “lightly hooked” (the hook was in the mouth or elsewhere allowing easy removal). There were no significant differences between these two groups for the duration of transmissions in months (3.4 ± 2.1 deep versus 3.5 ± 2.7 light) or the distance the turtles traveled ($2,354 \pm 1,927$ km deep versus $1,843 \pm 1,385$ km light). The full analyses of these data are in progress.

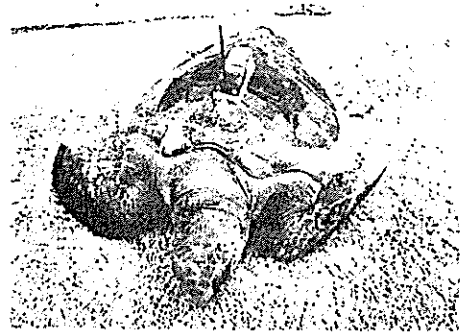


Figure 10. Incidentally captured pelagic loggerhead turtle fitted with a satellite transmitter to study longline fishery interactions.

The results of satellite tracking research relevant to loggerhead pelagic foraging habitat is presented in the Fisheries Oceanography section of this Program Review document.

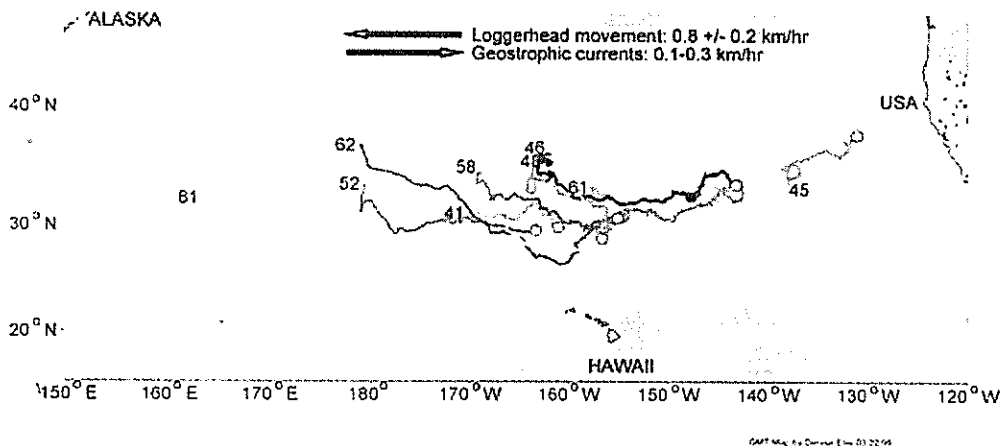


Figure 11. East-to-west movement of nine pelagic loggerhead turtles in the North Pacific Ocean as determined by satellite telemetry. The straight carapace length of the turtles are shown as the endpoint of each tracking line.

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