Nesting Hawksbill Turtles (*Eretmochelys imbricata*) on the Island of Maui, Hawai‘i from 1996-2003

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Introduction

The Hawaiian archipelago is one of the most isolated island chains in the world. In the Pacific, little is known about the abundance and distribution of critically endangered hawksbill sea turtles (*Eretmochelys imbricata*). Hawaiian hawksbill turtles, *‘ea*, inhabit nearshore reefs but are rarely seen compared to the threatened Hawaiian green sea turtle (*Chelonia mydas*), known as *honu*. The majority of the greens migrate up to the Northwestern Hawaiian Islands to nest, while hawksbills utilize the Main Hawaiian islands for both nesting and foraging. This has been shown through the satellite tracking of post-nesting hawksbills which remained within the southern archipelago, sometimes only traveling to different coasts on the same island (Ellis *et al.* 2000). This behavior, coupled with geographical isolation, indicates that recruitment of hawksbills from outside the archipelago to aid in recovery is not likely to occur. Hawksbills nest predominately on Hawai‘i Island, but lower numbers also nest on the islands of Maui, Molokai and Oahu with a statewide estimate probably not exceeding fifty reproductive females with only 6-20 of these nesting each year (Pers. com. Gilmartin, W. 2004). These low numbers accentuate the need for thorough monitoring for the turtles’ immediate protection and to gather information to aid in population recovery efforts.

Figure 1. Returning to the sea from Oneloa beach.

Monitoring approach

Hawksbill nesting activities were first documented on Maui in 1991 at Kealia beach, and an organized community-based effort to systematically monitor these occurrences began in 1996 (Mangel *et al.* 2000). A multi-agency collaboration has been essential for protecting this small population from dangers caused by human disturbance, coastal lighting, non-native vegetation, predators, and vehicular collisions. Nesting season begins in mid-May with hatching events stretching into December. During these months the Dawn Patrol, a community group of approximately 30 dedicated volunteers, walks the three known primary nesting beaches (*Kealia, Kawililipoa and Oneloa*) each morning looking for evidence of nesting (Figure 2). Once nesting is discovered, a phone tree is activated to advise the Department of Land and Natural Resources Division of Aquatic Resources (DLNR DAR), U.S. Fish and Wildlife Service (USFWS) and Hawai‘i Wildlife Fund (HWF). HWF is a public, non-profit, 501(c)3 research, education and conservation organization formed in 1996 to assist in the recovery of the hawksbill, other protected species and their environments in Hawai‘i. This joint effort between government agencies, non-government agencies and community volunteers pools available resources to intensely survey and monitor each nesting and hatching event. This typically entails ~12 hour nightly vigils waiting for the females to nest and guarding the nests during hatching. Adult females are measured and tagged using metal flipper tags, while some have been outfitted with satellite and radio tracking equipment (results not reported here).

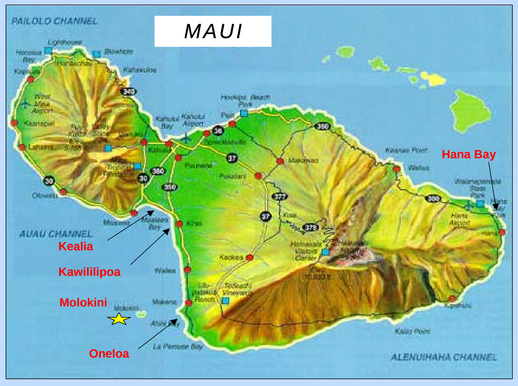

Figure 2. Maui with the four nesting beaches and Molokini

Nesting beaches

Kealia

From 1991 through 1996, Kealia was the first and only recorded hawksbill nesting beach on Maui. This 3 mile stretch of coastline borders the Kealia Pond National Wildlife Refuge with condominiums along its northwestern and southeastern ends. Bustling North Kihei Road connecting Ma‘alaea and Kihei (Figures 2 & 3) runs parallel to the coastline, reaching within ten feet of the high tide line in some areas. At least three gravid females seeking suitable nesting habitat or misoriented by headlights have wandered onto the road. Two were killed by passing vehicles (1993, 1996). Dead hatchlings have been found both on the road and entangled in non-native vegetation. These plants have also restrained two adults which were released when found. These events drew community attention to the area and solutions were sought. The most significant improvement included the installation of a wooden drift fence to prevent turtles from crawling onto the road while rebuilding the eroding sand dunes and blocking vehicles from driving on the beach. Turtle crossing signs were erected near the accident sites and suggestions were made to reroute the road around the Refuge.

There have not been any more turtle fatalities along Kealia since the commencement of active monitoring, but the fence is in desperate need of replacement and will no longer deter a determined turtle. The turtle crossing signs have been stolen repeatedly and can’t be replaced until funding is secured. Plans for a permanent fence have not been finalized and the road has not been rerouted due to landowner issues and other complications. Sand dunes near the road have continued to degrade, leaving very little suitable nesting area. The quality of the sand for incubation is in question since none of the nests since 1996 have been successful (see Results section). Sand analysis is planned, pending funding for lab tests. A permit has been obtained to relocate the second and subsequent nests, by the same female within a season, to nearby Kawililipoa beach to compare nest successes in hopes of shedding some light on this problem.

Oneloa

This popular 2/3 mile long by 30 meter wide white sand beach is the heart of Makena State Park and, by our assessments, the best overall habitat for future nesting (Figures 1 & 4). The beach is rather free of non-native dune vegetation and the comparatively large dune area appears healthy. Being located within a State Park allows for more protection and care without the threat of development and the associated lighting problems. But development is encroaching quickly on this once remote and wild area, with plans for building that will inevitably surround this region. Consistent with the other beaches, threats to nesting and hatching ‘ea include various predators (crabs, mongooses, rats, cats, and dogs) and human traffic resulting in deep holes, footprints, and campfires.

Figure 4. Oneloa beach

Figure 3. Kealia beach

Hana Bay

This beach, being located on the northeastern windward coast, is quite different from the other three in its location on Maui (Figures 2 & 5). A report of hatchlings in 2001 prompted an investigation of the beach but no nest cavity was found. Interviews with the witnesses determined that the hatchlings were most likely hawksbills. Due to Hana’s distant location, resource limitations and this being an isolated incident, this beach is not regularly monitored by this project. Although it is not currently considered primary hawksbill nesting habitat, the community has become more aware of the possibility and has been provided with contact instructions on what to do if there are any future indications of nesting.

Figure 5. Hana Bay

Kawililipoa

The first nest at Kawililipoa was reported in 1997. This ~150 meter stretch of beach is in a residential neighborhood, and the houses are set back from the duneline by ~50 meters (Figure 6). This parcel has been saved from construction because it is State land, although unrecognizable due to adjacent property owners having pruned and manicured the area out from their houses to the dunes, without being contested. The dune system is overrun with non-native vegetation which hinders nesting and entangles hatchlings. An effort to replace these with native plants has been ongoing.

The Leilani Kai Resort, which was the most significant source of light trespass, lies on the southern end of the habitat which the turtles have utilized. A 2001 USFWS grant afforded HWF biologists the opportunity to resolve the problem of beachfront lighting in this neighborhood by retrofitting, redirecting and replacing fixtures. This project was successful in part because of two educational aids: an ‘ea video *Red Turtle Rising* (April and DeLiberto 1999) and a 1997 HWF brochure *A Guide To “Turtle Friendly” Coastal Lighting* (Figure 6). A lighting ordinance is being proposed for Maui County with nesting sea turtles, migratory birds and the *Haleakala* Observatory in mind.

1996 - 2003 Hawksbill Nesting Summary

Season	Location	# of females	# of nests	Mean # of eggs/nest	Mean success
1996	Kealia	2	5	170	16%
1997	Kealia	2	2	206.5	0.5%
1997	Kawililipoa	1	3	152	43%
1997	Oneloa	1	1	141	23%
1998	Kawililipoa	1	5	154	68.9%
1999	Kawililipoa	1	5	190.2	60%
2000	Kealia	1	4	232.3	0.1%
2001	Oneloa	1	5	169.6	68.7%
2001	Hana Bay	1	1	^	^
2002	Kealia	1	1	191	0%
2003	Ø	0	0	^	^
			(32 total)		
Total mean		1.5/season	4/season	181/nest	38%

Table 1. Nesting summary data

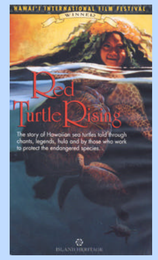

Figure 6. Kawililipoa beach with lighting educational tools

Results

From 1996-2002 the previously described four beaches were found to support hawksbill nesting activities, but not during every season, averaging 1.5 nesting females/year island-wide (Table 1). There were no known hawksbill nests on Maui in 2003. These activities were documented at Kealia in 1991, 1993 and 1994 (prior to organized surveys), and in 1996, 1997, 2000, and 2002. There were 12 known nests during these 7 seasons by at least 5 different females, of which two were killed by vehicular collisions and three were identified by tagging. Kawililipoa was utilized for three consecutive years (1997, 1998 and 1999), yielding 13 nests from at least 2 different tagged females. Oneloa was added to the Dawn Patrol’s schedule in 1997 when hatchlings were found and was closely monitored in 2001 when 5 nests were laid by one tagged female. Also in 2001, hatchlings that were identified as hawksbills were found at Hana Bay, but the nest chamber was never located.

The tagging that began in 1997 has resulted in the identification of six different females (one/year), with size ranges from 84.5-93.4 cm CCL (89.1 cm mean) and 78.2-87.0 cm CCW (83.4 cm mean). No recaptures have occurred, raising the potential remigration interval to two to seven years if these turtles are site-specific. It is certainly possible that these turtles are nesting on other beaches and they have gone undetected or unreported, or tracks on surveyed beaches have been erased by high tides or heavy winds. These scenarios seem practical, especially when a low number of nests are found within a season. The number of clutches/female/season has ranged between one and five with a mean of 4.0. The total ratio of nests to aborted attempts was 32:25, or 1.3 nests for every “false crawl”. Eighty percent of these false crawls occurred on narrow, eroded Kealia beach (1 nest to every 1.7 false crawls). Mean internesting interval was 20.1 days (n=17). Of the 23 recorded times that a hawksbill was seen emerging from the sea, 7 of these emergences (30%) occurred between 22:00 and 23:00 with the earliest and latest known emergences occurring at 18:58 and 03:42 hours.

The twenty-four excavated nests averaged only 38% hatching success (defined as the number of hatchlings/number of eggs/nest, with percentages converted to arcsin values). Six out of seven clutches (from three different females and seasons) that have been monitored after deposition at Kealia since 1997 have had ~0% hatching success. One nest in 1997 had a 1% success rate. In years prior to 1997, nests had been productive (73% and 16% estimated average hatching success from 1993 and 1996 respectively; Mangel *et al.* 2000). Kawililipoa and Oneloa nests have been successful (62.5% and 61.1%), with incubation periods averaging 57.5 and 60.5 days respectively. Nest success evaluations to determine development stages of unhatched eggs are not done during the excavations, as the clutch remains are sent to NOAA/NMFS for analysis. These development-specific data will be presented at a later date.

Hatchling dispersion

Four hatchlings, presumably from Maui, have been found in the waters surrounding Molokini crater. This 1.5 hectare crescent shaped cinder cone is a marine reserve and popular SCUBA diving and snorkeling destination (Figures 2 & 7). Deciphering how the hatchlings arrived here is difficult when considering oceanographic conditions and being able to only assume which beach the hatchlings came from. Localized information on currents is unavailable. The prevailing northeast tradewinds may create ocean conditions that could assist in the dispersion of hatchlings towards Molokini from either Kealia, Kawililipoa or any other beach on the southeastern coast of Maui. The prevailing strong southeasterly winds along the southern coast of Maui could allow similar dispersion from Oneloa towards Molokini.

Another possibility for why these hatchlings reached Molokini is that the Coast Guard navigation light atop the crater warning mariners to steer clear actually attracted the hatchlings. This white light (3 amp bulb) is on a 2.5 second on/off cycle and can be seen from 7 nautical miles away. Molokini is located off the southern shore of Maui approximately 10 nautical miles (nm) from Kealia, 7.8 nm from Kawililipoa and 2.8 nm from Oneloa. This light can be directly seen from Oneloa, and one live ‘ea hatchling was found by a snorkeler on 10/23/01, presumably from this beach as this was the only beach that had any known nest activity for the season. Interestingly, the excavation for the nest closest to this date occurred on 10/12/01, so this turtle would have emerged from the nest = 11 days earlier. On 9/4/01, another live hatchling was found by a snorkeler just north of Pu‘u O‘lai, which is approximately one mile northwest of Oneloa. It was found within a day(s) after an assumed emergence from Oneloa. The first recorded dead hatchling to have been found by a diver at Molokini was on 11/6/95, a year that no nesting was thought to have occurred on Maui so its origin is unknown. On 9/22/96 another dead hatchling was found by a boat at Molokini. The excavation for the nest closest to this date occurred at Kealia on 9/19/95, 3 days earlier. In October of 1998 a live hatchling was found which seemingly originated from Kawililipoa, but the dates are unavailable to determine the length of time between emergence and the sighting (10/7/98 excavation). These five hatchlings are the only ones that have been reported anywhere offshore of Maui. This anomaly of sightings could simply be due to the large number of reef viewers in this particular area, increasing the odds of witnessing the hatchlings which may or may not have randomly arrived there. Regardless, more thorough research on ‘ea hatchling dispersion is needed and being planned for in the future.

Figure 7. Oneloa and Molokini with light

Discussion

A tremendous effort is ongoing to understand and protect Maui’s few nesting ‘ea, and without it the survivorship of these turtles would certainly be jeopardized. This project has saved adults and hatchlings from a gauntlet of threats, from being run over by cars to being overturned in footprints in the sand. Although the increase in monitoring has greatly improved the dataset for each nesting and hatching occurrence, the actual numbers of nesting ‘ea are not increasing. The lack of recaptures brings up short and long-term viability questions. Although some nesting could be occurring that is going undetected or unreported, one or two nesting females per year are dangerously small numbers. The question cannot be ignored, “Are these conservation efforts all in vain?” It seems unlikely that Maui’s population is sustainable with such a low level of reproduction and low hatching success coupled with habitat degradation and the other previously mentioned threats. Alternatively, are these numbers and behaviors consistent with historic times or are they species-specific? A state-wide modeling and overall assessment of this species and its habitats needs to be undertaken to prioritize and implement research and conservation measures. In the interim, the increase of survey coverage with heightened community awareness and involvement will continue to broaden our understanding of nesting trends on Maui.

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