# 2008 Report on Hawksbill Sea Turtle Foraging
# &
# Nest Monitoring Research

## State of Hawai‘i Special Activity Permit 2009-12

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# Report on 2008 Hawksbill Sea Turtle Foraging Permit Research

## Introduction

Within the Hawaiian Archipelago, hawksbills predominately nest on Hawai‘i Island and lower numbers are also known to nest on the islands of Maui, Moloka‘i and O‘ahu. A statewide estimate is thought to be at least fifty reproductive females with only up to 20 of these nesting each year.

Little is known about the foraging ecology of critically endangered hawksbill sea turtles (*Eretmochelys imbricata*) in Hawaii. In 2007, HWF partnered with Shannon Graham in the Conservation Biology Masters Degree Program at the University of Hawaii Hilo to conduct foraging ecology research on the hawksbill turtle. The primary objectives of the foraging research are to identify foraging depth and preferred prey species of post-nesting females. Earlier tracking studies had shown that the majority of adult females migrate to the Hamakua Coast of Hawaii Island after nesting, however prey species of Hawaii hawksbills are only known from stomach contents of one dead animal as reported in Balazs (1978). From the latter study, only three sponges were specified but not identified to species.

This research was performed in collaboration with George Balazs (NMFS, Honolulu) and supported by volunteer assistance from the community.

## Methods

*Transmitter Attachment*

On August 1, 2008, one VHF transmitter was instrumented on a post-nesting female at Kamehame. Attachment methods of transmitter conformed to procedures elucidated by Balazs et al (1995). On August 25, 2008, a satellite transmitter (Telonics model ST-20 A-1025), equipped with pressure sensor capabilities, was deployed on the same female after oviposition. This was likely her 3rd nesting event. Data retrieved from the ARGOS system included transmission date and position coordinates.

*Tissue Sampling*

During the time of the VHF transmitter deployment on August 1, 2008 at Kamehame, tissue from the posterior edge of the hind flipper was collected by biopsy. On August 9, 2008, tissue was retrieved from a post-nesting female on Maui and mailed to Hawai`i Island by fed ex for further analysis. George Balazs sent additional epidermal samples from 2 dead hawksbill turtles from Kauai found on March 2, 2008 and Oahu found on September 4, 2008. In October, Mr. Balazs sent 100+ hatchlings from various nesting sites on Hawai`i Island. Approximately 40 hatchling samples were in suitable condition to be utilized for analysis.

Procedures for tissue sampling from live hawksbill turtles:
The skin sampling region was deadened with 2% lidocaine hydrochloride and cleaned with betadine prior to sampling. A few mg of tissue were removed with a 6 mm biopsy punch. Samples placed in a sealed cryotube were stored on ice in the field, and frozen at -20°C in the lab until subsequent analysis. Straight carapace length, width, and tag information, if present, from each turtle were recorded.

*Stable Isotope Analysis*

Thawed tissue samples were rinsed in distilled water and desiccated at 60°C for 48 hours. Dried samples were granulated to fine powder with a scissor. Approximately 1.0 mg of dried homogenous tissue was placed in sterilized tin capsules. Samples were analyzed at the EPSCOR Analytical Lab by a DeltaV Isotopic Ratio Mass Spectrometer with a Costech Elemental Analyzer. Denoted as parts per thousand (‰), $\delta^{13}C$ and $\delta^{15}N$ values will be further investigated relative to the diet.

*Animals and Locations of Activities for the Foraging Research*

| Turtle ID | Site | Activity | Date |
|---|---|---|---|
| N/A | Kauai | Tissue collected from dead hawksbill | March 2, 2008 |
| 1D79, 1D80, 1D81, 2D09 | Kamehame, Hawai`i | Instrument deployed & tissue collected from post-nesting hawksbill | August 1 & 25, 2008 |
| H334, H335 | Oneloa, Maui | Tissue collected from post-nesting hawksbill | August 9, 2008 |
| N/A | Oahu | Tissue collected from dead hawksbill | September 4, 2008 |

## Results to Date

The hawksbill turtle from Kamehame (transmitter ser.#51059) traveled northeast on the windward side of the Hawai`i Island to the south end of Maui (exact location undetermined due to low accuracy levels). The instrument stopped transmitting on November 29, 2008. Radio tracking information was unsuccessful due to loss of transmitter antennae between inter-nesting events.

Potential prey species were collected from the Hamakua Coast at depths we believe the females are feeding at. The potential prey stable isotope composition will be compared with the turtle tissue values in attempt to identify hawksbill prey preferences. In addition, stable isotope values from hatchlings will be compared with results from adult tissues to determine if dead hatchlings could be utilized for future foraging studies. Our goal is to have this work completed and a report drafted by summer of 2009.

## Conclusions & Future Conservation Recommendations

Hawksbill turtles from other geographical locations feed primarily on sponges and average depth of feeding is <18m. Based on the two turtle movement patterns in this study, diving is limited to <30m. Shallow water environments are impacted directly and indirectly by anthropogenic activities. Sedimentation and run-off from coastal development can alter the ecology of coral reefs. As recommended by NMFS (1998), foraging habitats of sea turtles need to be elucidated to strengthen management programs. This foraging assessment will help decipher the foraging ecology of these endangered sea turtles and pinpoint hotspots and prey species that may need future conservation efforts.

We certify that the information in this survey report and attached exhibits fully and accurately represent our work.

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|---|---|
| _____ | _____ |
| William Gilmartin | Date |
| _____ | _____ |
| Shannon Graham | Date |

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# 2008 Maui Hawksbill Sea Turtle Activities

## Introduction

In the Pacific, little is known about the abundance and distribution of critically endangered hawksbill sea turtles (*Eretmochelys imbricata*). Within the Hawaiian Archipelago, hawksbills predominately nest on Hawai‘i Island. Lower numbers are also known to nest on the islands of Maui, Moloka‘i and O‘ahu, with a statewide estimate thought to be at least fifty reproductive females with only 6-20 of these nesting each year. Hawksbill nesting activities were first documented on Maui in 1991 at Kealia. Hawai‘i Wildlife Fund organized a community-based effort to systematically monitor these occurrences in 1996 after a passing car killed a second gravid female when she wandered onto North Kihei Road, either seeking suitable nesting habitat or disoriented by headlights.

The primary objectives of this research are to identify individual nesting hawksbill turtles, determine sizes of these females, the sites they use for nesting, the internesting intervals, the number of nests laid in a season by each female, to relocate nests that may be threatened by tidal flooding, and to attach transmitters to post-nesting females to track them to their long-term foraging/resting areas. During the course of this research, nesting females, nests and hatchlings are protected against dangers caused by human disturbance, coastal lighting, non-native vegetation, predators, and vehicular traffic.

## Methods

Nesting season can begin as early as mid-May, with hatching events stretching into December. During these months, the Dawn Patrol, a community group of approximately 30 volunteers, walks Maui’s three known nesting beaches (Kealia, Kawililipoa and Oneloa) early each morning looking for evidence of nesting. Once this has been discovered, a phone tree is activated to advise the Department of Land and Natural Resources Division of Aquatic Resources (DLNR DAR), the United States Fish and Wildlife Service (USFWS), and the Hawai‘i Wildlife Fund (HWF). Each subsequent nesting and hatching event is intensely monitored by HWF. This typically entails all-night vigils waiting for the females to nest successfully, and guarding the nests during the course of hatching to ensure each hatchling reaches the ocean safely. Three days after the first major emergence of each nest, the nest is excavated to release any trapped hatchlings and to determine overall nest success.

The real concern, as it has been every season, was that hawksbill turtles would crawl onto North Kihei Road and get run over again by passing vehicles. The dune fence that is supposed to keep turtles off the road was not completely replaced (as it still desperately needs to be), and the newest areas already had large missing pieces in which a turtle could easily have crawled through and reached the road. Since this land is Alexander and Baldwin’s, the only action that HWF could take was to try to repair the

fence as much as possible. We are still awaiting an agreement with USFWS Kealia National Wildlife Refuge and A&B to erect a permanent fence made from recycled plastic. Half of it was installed in 2008 and funding for the rest of the fence was secured through the County of Maui but hasn't been implemented. Sections of the new fence are inadequate at stopping the turtles (they can crawl under it) so until the special posts are pounded in and the rest of the fence is ordered, HWF will have to continue to fix the dilapidated fenceline.

Activities under this section of the report were conducted on the island of Maui. For the first time since nesting was discovered at Makena State Park, Oneloa (1997), we documented 2 nesting hawksbills here in the same season. One of the nesters was "Orion", who laid 5 nests in 2001 and 2004 (left and right front flipper tags: H334 / H335). The other nester wasn't identified due to her irregular nesting interval, but it's thought that she laid 2 of the 6 Oneloa nests. There was also a July nesting attempt near Ohukai Rd in Kihei, which could have been this mystery nester or a completely different hawksbill altogether. No nests were laid on the Dawn Patrolled Kawililipoa or Kealia beaches, but two hawksbill nests were found in Hana (Koki and Hamoa). A turtle was disturbed twice in one night while trying to nest at Hana Bay, but it's unkown whether it was a hawksbill or a green.

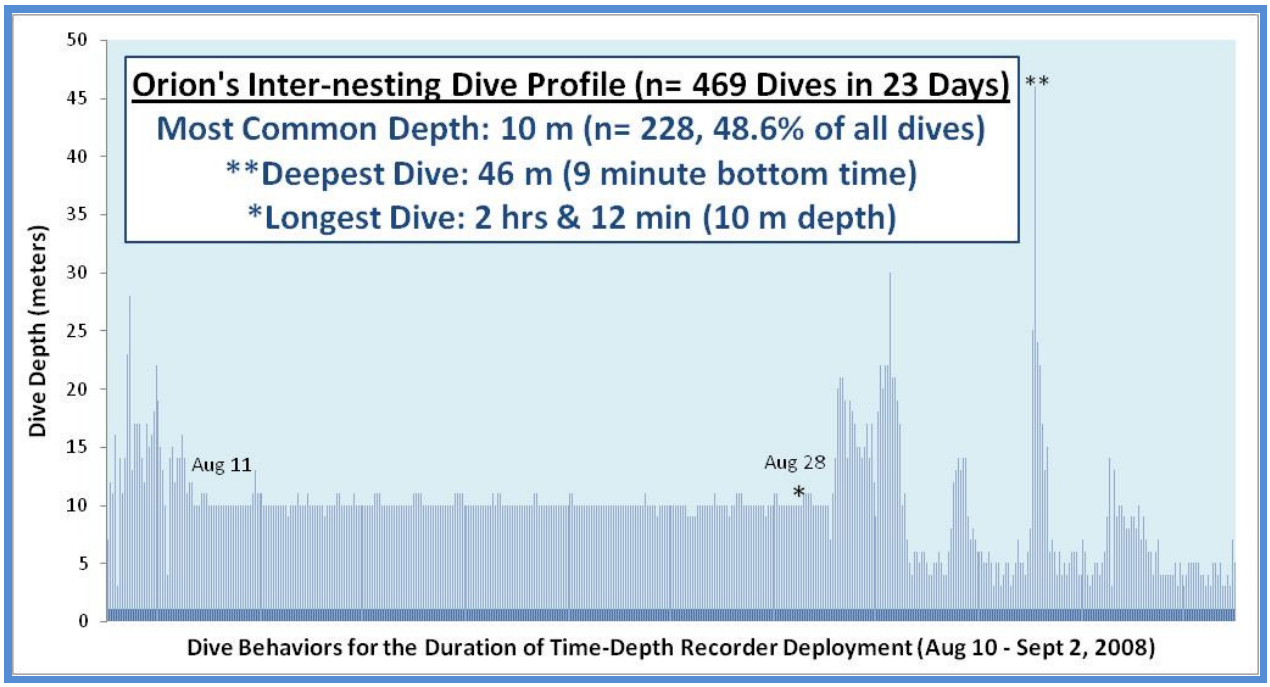
## Results & Discussion

The first Oneloa nest of the season was laid on June 7th, compared to Orion's June 17th, 2004 and approximately July 1st, 2001 nests. Since there was some confusion as to who the other nester was, we cannot say which turtle laid the first nest. We watched Orion lay nests 4-6, which took approximately two hours each. Egg laying itself takes ~30 mins, and was occurring at 00:40, 01:40 and 03:20 at each nest. The six nests laid are labeled in succession below. There were also two "false crawls" at Oneloa, in which the unknown nester (FC-1) and Orion (FC-2) crawled up the beach but didn't find adequate nest sites.

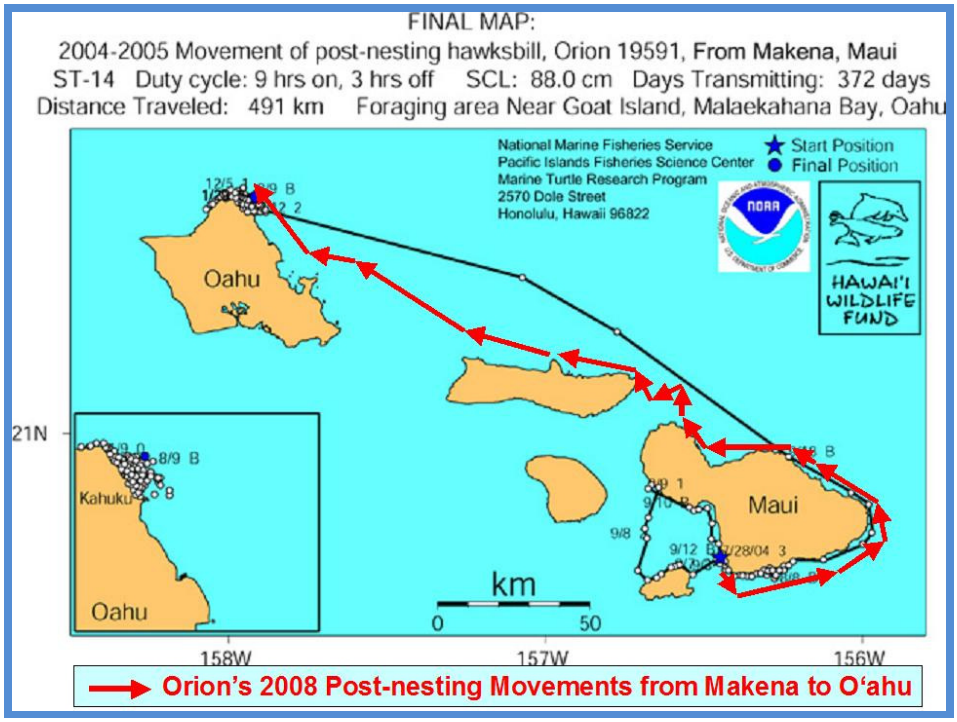
Orion's metal flipper tags were secure and in good condition. Her old satellite/VHF transmitters (from 2004) were removed on 8/10/08. No signs of fibropapillomatosis or external injuries were detected. Orion's shell is damaged, so length measurements aren't reliable but the width of her shell has only grown 1.5 cm since 2001 (CCW: 84.5 to 86.0 cm).
Measurements taken on 8/10/08:
SCL= 86.5, SCW= 68.6, SCLmin= 84.5, SCLmax= 86.5
CCL= 91.5, CCW= 86.0, CCLmin= 90.0, CCLmax= 93.5

*Movements*

We documented Orion's dive behavior with a 3" data logger called a Time-Depth recorder (TDR) that we epoxied onto her shell after she laid nest #5 (8/10/08). The graph below is a depiction of the depth of each dive she made during the 23 days before she returned to Oneloa to lay nest #6. As you can see, for the majority of her inter-nesting time (Aug 11-Aug 28) she made regular dives to the same 10 meter depth location in what appears to be a resting state (as opposed to foraging or actively swimming around). These regular dives typically lasted around 1.5 hrs. The dives before and after that timeframe reflect her swimming to and from that location. Unfortunately we don't know where this location was as we didn't attach the satellite tracking device until after she laid nest #6 (9/2/08). When we tracked her in 2004 (black route on map on next page), we showed her inter-nesting location to be Nakaohu (near Nu'u), a ~24 km swim from Oneloa.



After Orion laid nest #6 (likely her 4th nest of the season), she swam around East Maui, crossed the channel to Moloka‘i, then continued to swim towards O‘ahu (red arrows overlaid on 2004 map on next page). Her ~280 km journey lasted around 2 weeks, ending in the same foraging waters off O‘ahu where we found her to reside in 2004.

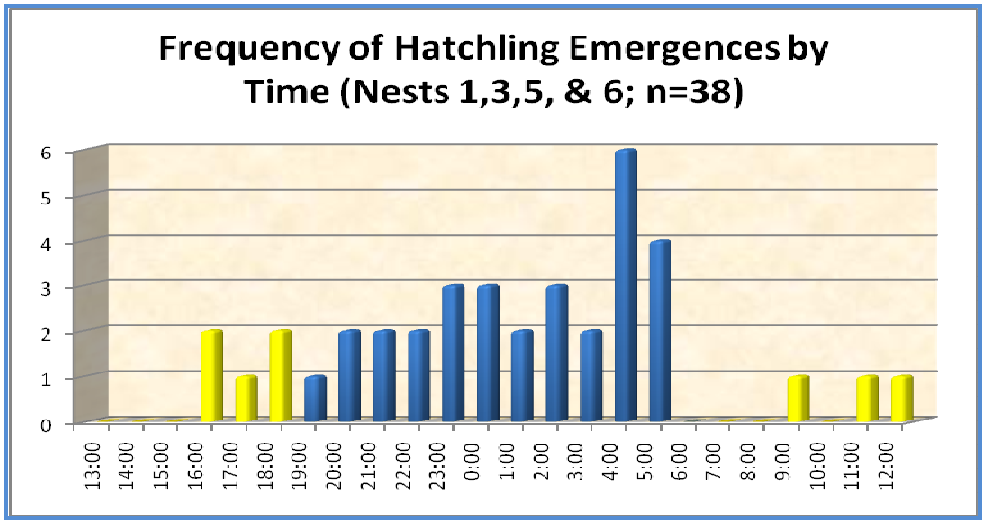



*Nest Success*

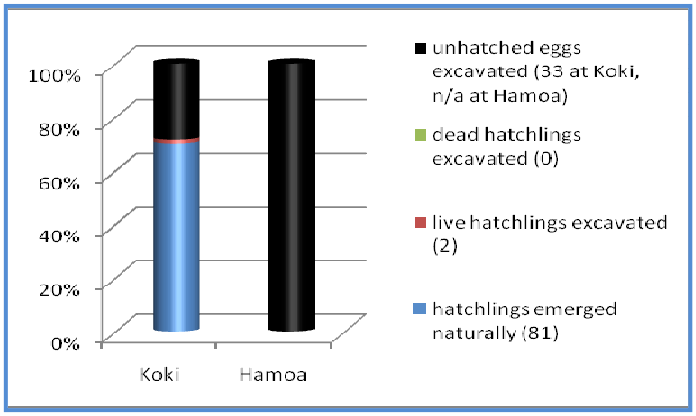
Nest watch coverage was nearly 24/7 once we discovered mongoose digging into a nest. This was very important, not only to keep the mongoose away but we also assisted their journey when necessary through entangling dune vegetation, down steep sand drop-offs and out of deep footprints, all the while dodging ghost crabs. Just as Oneloa’s name is translated, it is a big beach! The turtles took from 11 to 60 minutes to enter the ocean depending on nest location, wave conditions and individual hatchling fitness. Over 164 different volunteers held these vigils as well as helped search for Orion.

One of the most frequently asked questions is always, “When do the hatchlings crawl out of the nest?”. Well, this is a sand temperature-dependent event which typically occurs at night, but we usually record daylight emergences as well. See graph below for how many times hatchlings emerged (38 total events) during each hour of the day this season. This does not cover the amount of hatchlings, just the hour that they emerged from the nest. The highest number of hatchlings that emerged at once was at 00:45 (70 from nest #5), but as you can see, they really can appear at any time. This year, the

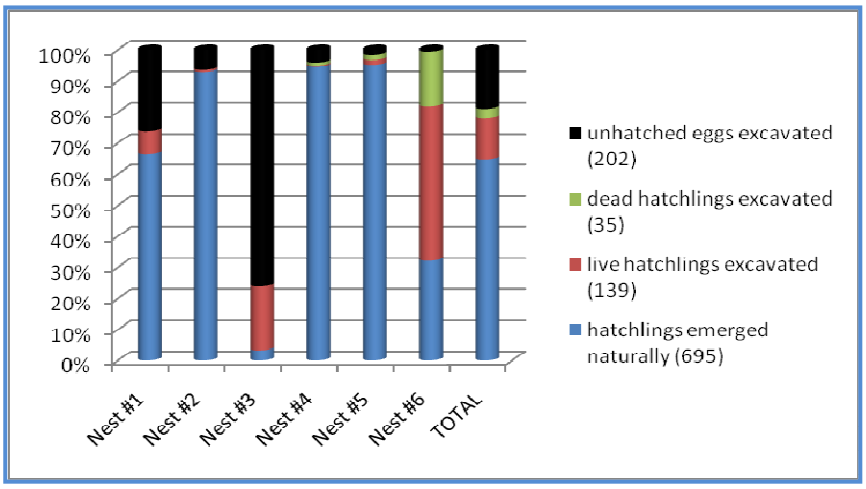
luckiest nest watchers had the 4:00 AM shift, as six different emergences happened between 04:00-04:59.



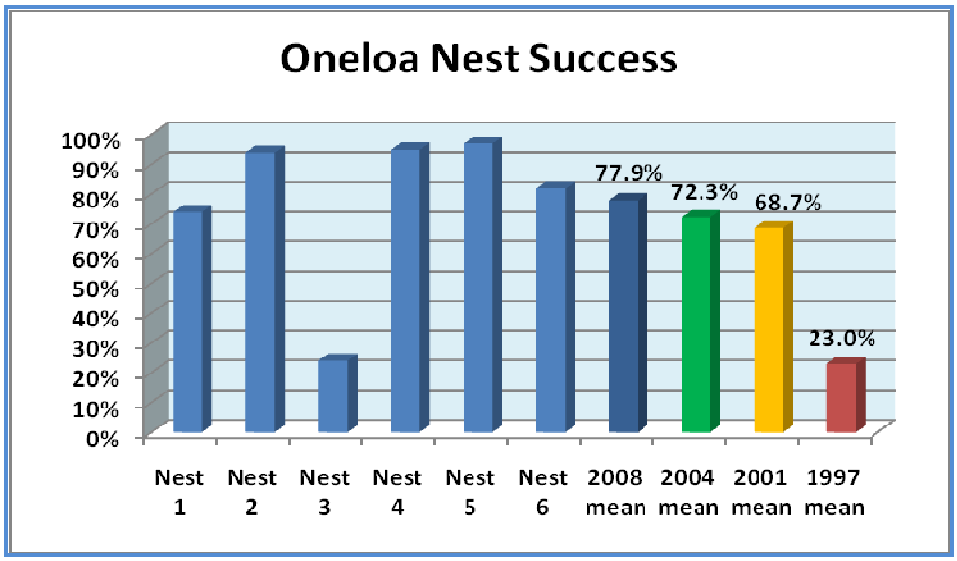

The two Hana hawksbill nests faired very differently from one another. Approximately 81 hatchlings emerged naturally (and 2 live ones were rescued during the excavation) from the Koki Beach nest of 116 eggs, for a 72% success rate. The Hamoa nest got washed out by high surf and although some of the eggs were retrieved and reburied, none hatched.




The six Oneloa nests had a significantly higher egg count from the Koki nest, ranging from 155-202 with an average of 178.5 eggs per nest. Most of the hatchlings emerged naturally from the Oneloa nests, and we rescued an additional 139 live ones during the nest excavations for a total of 834 live Oneloa hatchlings reaching the ocean.



The 2008 Oneloa nest successes ranged from 24-97%, averaging 77.9%. This has been the most successful season since monitoring began at Oneloa in 1997.
Oneloa nest excavations:
#1: 8/8/08
#2: 9/1/08
#3: 9/1/08
#4: 9/19/08
#5: 10/15/08
#6: 11/12/08




Since none of the eggs were opened during the excavation, it is unclear what stage of development the hatchlings reached before dying. These unopened eggs were sent to NOAA/NMFS for analysis. Until verified, all nest numbers stated above are preliminary.

## Conclusions & Future Conservation Recommendations

Orion (Oneloa 2001, 2004 and 2008) was the first, Lele (Kealia 2000 and 2005) was the second, and Hōkūlele (Kawililipoa 2006) is the third known tagged hawksbill to return to Maui for another nesting cycle since 1997 when tagging began. Three tagged nesters, from 1997, 1998 and 2002 have not returned that we know of. This could be partly due to the fact that there are barely enough people to reliably patrol the three known nesting beaches in the mornings, and nests are going undetected and/or unreported on other beaches. Hawksbills have been known to nest in sporadic locations elsewhere in the world, which seems to be the case for some Hawaiian hawksbills as well. Larry Katahira of the National Park Service has reported that a handful of Big Island hawksbills have switched nesting beaches within and among seasons, to beaches that are sometimes 11 miles apart. The south shore from Kihei to Makena should be prioritized for the

expansion of these patrols due to the proximity to the other nesting beaches: Kealia and Oneloa.

Determining the sand incubation temperature of each nest laid on Maui would be an important project to undertake. Placing a number of small temperature data loggers into the sand surrounding each nest can accomplish this. Information obtained from these loggers throughout the duration of incubation coupled with genetic analysis can determine the sex ratio, which is temperature-dependent, of hatchlings produced. This pivotal temperature has not been determined for Hawaiian hawksbills. Predicting whether the majority of hatchlings are males or females would provide insight into the reproductive potential for the future population.

Again, the urgent and critical priority for the upcoming nesting season must be the completion of the Kealia fence replacement or repair to keep nesting hawksbills from being run over on North Kihei Road. Not only does it need to be fully replaced with the recycled plastic fence (that Kealia National Wildlife Refuge has had since the late 1990s), it ideally should be relocated mauka of the existing location of the sand fence, which is too close to the high tide line in many areas. This will increase the available nesting habitat as much as possible on this highly eroded beach. Unfortunately, this is Alexander and Baldwin land, and we presume the negotiations by USFWS Kealia Pond National Wildlife Refuge continue. The idea of rerouting the road around the Kealia Refuge, obviously the best solution, should be proposed again.

A tremendous effort is ongoing to understand and protect Maui's few nesting hawksbills, and without it the survivorship of these turtles would certainly be jeopardized further. This community-based project has saved adults and hatchlings from a gauntlet of threats. The intensified monitoring of each nesting and hatching event has also greatly improved the dataset for these occurrences. But, the actual numbers of nesting hawksbills on Maui are not increasing. And the annual mean hatching success for Maui's nesting beaches remains low with a range of 0% to 77.9%. With a critically endangered species at such risk, more resources need to be funneled in this direction. And innovative research methodologies should be explored to further our knowledge of all aspects of this species' life history to aid in its protection.

We certify that the information in this survey report and attached exhibits fully and accurately represent our work.

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| William Gilmartin | Date |
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| Cheryl King | Date |

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