Annual Report of Hawai‘i Wildlife Fund
Hawksbill Nest Monitoring and Research
2010

Federal Fish and Wildlife Permit No. TE829250-7

Hawai‘i Wildlife Fund
P.O. Box 70
Volcano, HI 96785

2010 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 monitoring and research are to identify individual nesting hawksbill turtles, take biopsy samples for analysis, 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 predators, human disturbance, coastal lighting, non-native vegetation, and vehicular traffic.

Methods

Project Activities

Ongoing actions during the nesting season included email announcements/updates to our >500 contacts, public outreach events (lectures at The Hawaiian Islands Humpback Whale National Marine Sanctuary and the Pacific Whale Foundation, educational booths at “Mālama Kanahā” at Kanaha Beach Park, “Festivals of Aloha” at Manele Bay Resort, and “The Limu Festival” in Hana, and school visits to Makawao Montessory and Kihei Charter School), multiple turtle fence mending project days, and marine debris and rubbish cleanups partnering with Kanu Hawai‘i, Community Work Day, Na Kai ‘Ewalu Canoe and Cultural Club, Surfrider Foundation, and South Maui Sustainability Group.

Nesting Turtle and Nest Monitoring

Nesting season can begin as early as mid-May, with hatching events stretching into December. During these months, the Maui Dawn Patrol, a community group of approximately 40 volunteers, walks Maui’s four known South Maui nesting beaches (Kealia, Kalepolepo, Kawililipoa, and Oneloa) early each morning looking for evidence of nesting. Although we have had nesting events in Hana, we have not organized Dawn

Patrols there yet. Once nesting actvity is 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.

Tagging, Transmitter Attachment, & Tissue Sampling

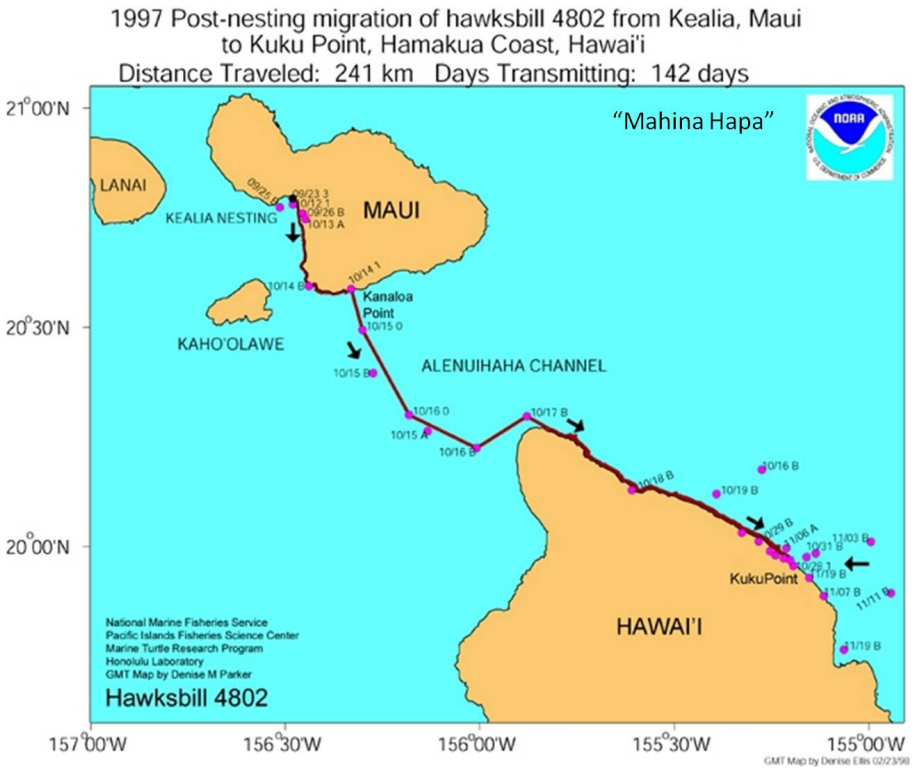
None in 2010 due to the non-processing of State permit renewals…

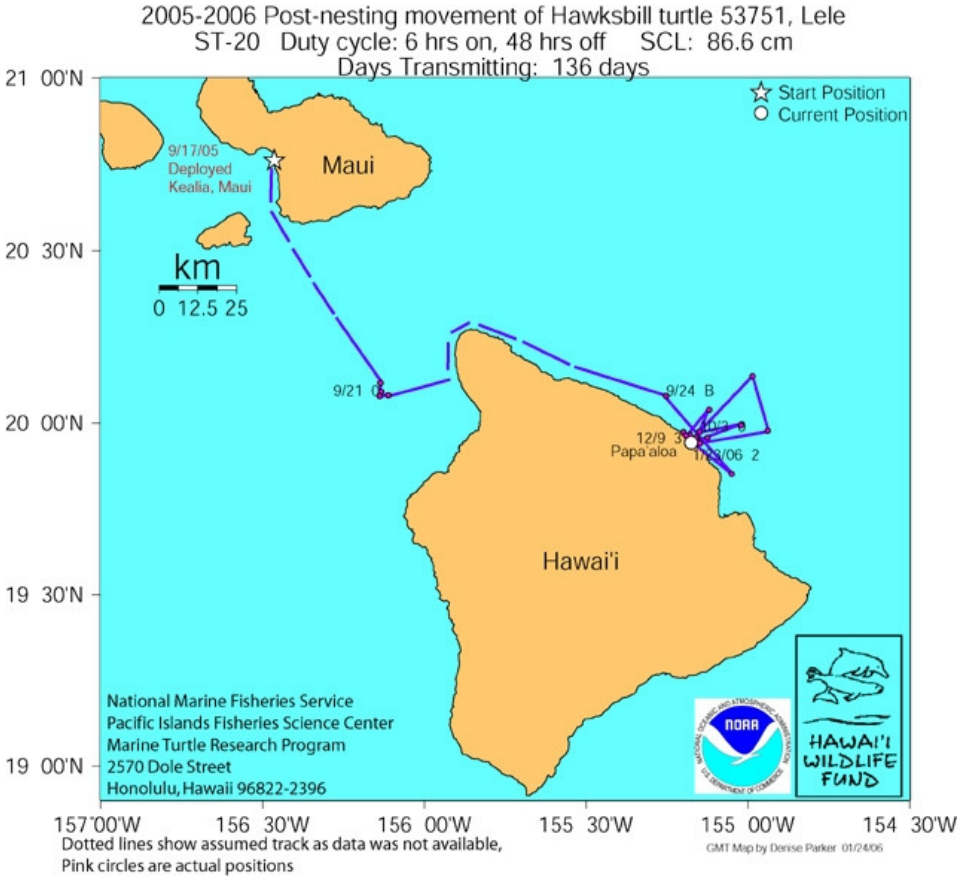
Results

Maui Nesting Research

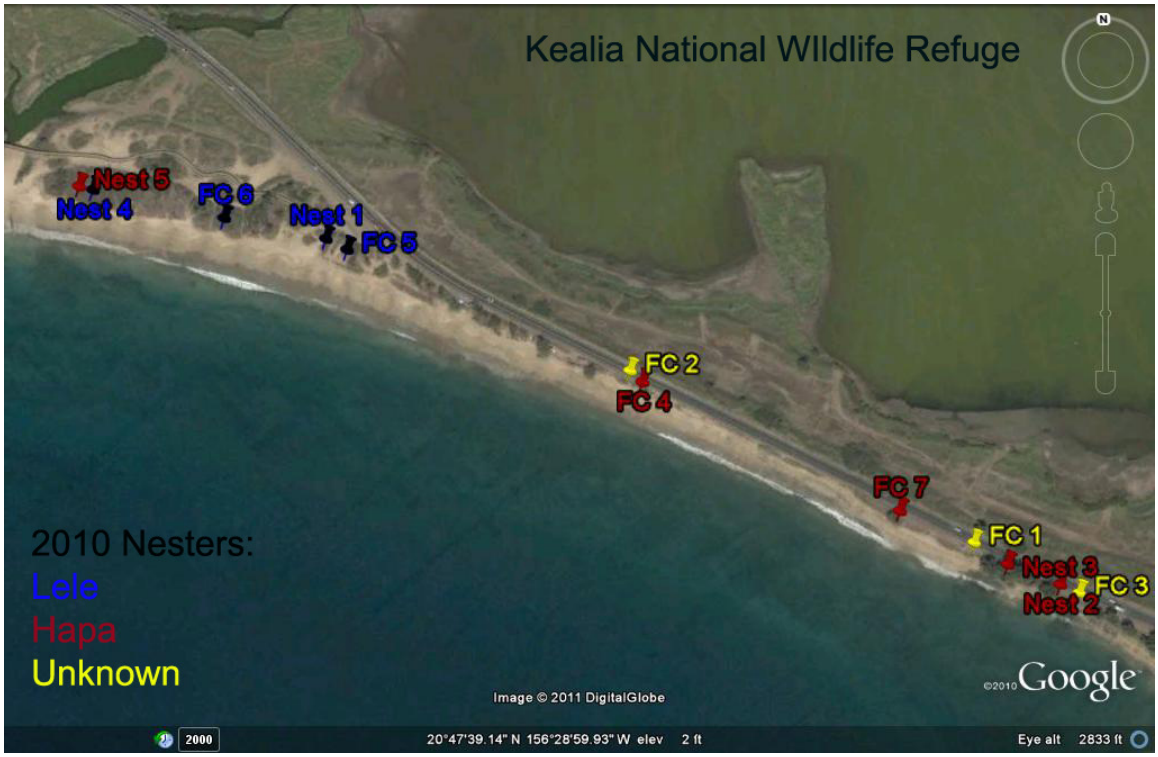
No nests were laid on the Dawn Patrolled Kawililipoa, Kalepolepo or Oneloa beaches this season. We documented five nests and seven false crawls on Maui this season, all at Kealia. For the second time since 1996 and similar to the 2009 season, there were two nesting hawksbills at Kealia in the same season. One of the nesters was “Lele” (translated as to fly, jump, leap, hop, burst forth, to sail through the air as a meteor; to get out of, to land, to disembark as from a canoe; to move as stars in the sky), who laid two nests in 2000 and one nest in 2005. The other female was also a remigrant. “Mahina Hapa” (translated as half moon) laid three nests in 1997 and was the first hawksbill that HWF tagged, but hadn’t been sighted since. Her return thirteen seasons later definitely gives her the longest remigration interval of the five turtles who have returned to nest out of the seven total tagged Maui nesters. Both of these nesters had been flipper tagged (one tag per front flipper) in previous seasons and it is noteworthy that each tag was still in place this season. Tag loss has not been an issue with any Maui remigrant nesters to date. Hapa LFF: H326/ RFF: H327 & Lele LFF: H332 / RFF: H333

During past seasons, both Hapa and Lele have been tracked, using VHF radio and satellite telemetry, to their foraging sites along the Hāmākua Coast of the island of Hawai‘i (*see maps below*). Although satellite telemetry data have its accuracy shortfalls, data collected from both turtles showed that their foraging areas were similar in location. Hapa’s data showed the Kuku Pt area as her preferred habitat in 1997 and Lele traveled to nearby Papa‘aloa and Maulua Bay in 2005. Lele’s old tranmsitter was still attached to her shell (the box, not the antennae), but we could not remove it since the State permit was not in place. Hapa’s carapace showed no indication of having had a transmitter affixed to it.


1997 Post-nesting migration of hawksbill 4802 from Kealia, Maui
to Kuku Point, Hamakua Coast, Hawai'i
Distance Traveled: 241 km Days Transmitting: 142 days
"Mahina Hapa"
LANAI
KEALIA NESTING
MAUI
Kanaloa Point
KAHO'OLAWE
ALENUIHAHA CHANNEL
KukuPoint
HAWAI'I
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
Marine Turtle Research Program
Honolulu Laboratory
GMT Map by Denise M Parker
Hawksbill 4802
21°00'N
20°30'N
20°00'N
157°00'W
156°30'W
156°00'W
155°30'W
155°00'W


2005-2006 Post-nesting movement of Hawksbill turtle 53751, Lele
ST-20 Duty cycle: 6 hrs on, 48 hrs off SCL: 86.6 cm
Days Transmitting: 136 days
Start Position
Current Position
9/17/05
Deployed
Kealia, Maui
Maui
km
0 12.5 25
Papa'aloa
Hawai'i
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
Marine Turtle Research Program
2570 Dole Street
Honolulu, Hawaii 96822-2396
HAWAI'I WILDLIFE FUND
21 00'N
20 30'N
20 00'N
19 30'N
19 00'N
157 00'W
156 30'W
156 00'W
155 30'W
155 00'W
154 30'W
Dotted lines show assumed track as data was not available,
Pink circles are actual positions
GMT Map by Denise Parker 01/24/06

The five nests and seven false crawls (labeled FC) are labeled in succession below. Hapa's three nests and two false crawls are in maroon and Lele's two nests and two false crawls are labeled in blue, with unknown nesters labeled in yellow.



Date	Nest or False Crawl	Nester	Internest-Interval	Nest Excavation	Clutch Size	% Success	LatLong	
6/27/10	FC 1	?	^	^	^	^	20^0 47'33.80"N	156^0 28'48.40"W
8/27/10	FC 2	?	^	^	^	^	20^0 47'39.04	156^0 28'58.48
8/28/10	Nest 1	Lele	^	11/6/2010	176	0.0%	20^0 47'43.15	156^0 28'07.35
8/29/10	Nest 2	Hapa	^	11/6/2010	191	0.0%	20^0 47'32.52	156^0 28'45.83
<8/31/10?	FC 3	?	^	^	^	^	20^0 47'32.34	156^0 28'45.36
9/15/10	FC 4	Hapa	17	^	^	^	20^0 47'38.84	156^0 28'58.16
9/15/10	FC 5	Lele	18	^	^	^	20^0 47'42.75	156^0 28'06.80
9/15/10	FC 6	Lele	18	^	^	^	20^0 47'43.79	156^0 28'10.42
9/15/10	Nest 3	Hapa	17	11/26/2010	212	0.0%	20^0 47'33.16	156^0 28'47.42
9/17/10	Nest 4	Lele	20	11/26/2010	200	0.0%	20^0 47'44.82	156^0 28'14.34
10/1/10	FC 7	Hapa	16	^	^	^	20^0 47'34.79	156^0 28'50.68
10/2/10	Nest 5	Hapa	17	12/12/2010	208	0.0%	20^0 47'44.86	156^0 28'14.71

To begin the season, an unknown hawksbill left tracks with signs of digging including an unconfirmed nest on 6/27/10. HWF patrolled Kealia for 3 subsequent nights but did not detect her return so this area was assumed to be a nest. Upon 70 days of

incubation the area was excavated but no eggs were found (*labeled FC 1*). Night and dawn patrols were also made 16-22 days after this first nesting attempt but again, no signs of nesting were found.

Exactly two months passed without any sign of nesting activity. Then on 8/28/10 a hawksbill made another nesting attempt that was clearly unsuccessful (due to thick pickleweed and dry sand atop a high dune; *labeled FC 2*) so HWF patrolled that next evening. We found Lele while she was just starting to dig her egg chamber at 00:45. She laid her eggs from 1:12-1:46, covered the egg chamber from 1:47-2:18, and was back in the ocean at 2:29 (*labeled Nest 1*).

We assumed that it was Lele who had false crawled that night before we found her nesting on 8/28/10, but the Dawn Patrol reported another set of tracks two mornings later (after Lele's successful nest) so it looked like we had two nesters all of a sudden. Therefore we can't be certain which turtle false crawled on 8/27/10. We patrolled the next three nights but the turtle did not return. Upon inspecting the new nesting area closer we found a site atop a nearby dune where it looked like a turtle had dug and thrown sand around. We treated both of these new areas as potential nests and watched over them accordingly (*labeled as Nest 2 and FC 3 respectively*).

Expecting the nester(s) to return, our organized patrols were fortunate enough to see them both on the same night, which has never happened on Maui during the course of this project. We found Hapa at 21:30 atop a tall dune but the sand appeared too dry to dig an egg chamber even though she tried many times, but we found her again at 02:45 to the south as she was covering her nest (*labeled as FC 4 and Nest 3 respectively*). This was 17 nights after her first nest was found.

While some of us were watching Hapa during her first nesting attempt, another team patrolled further down the beach and found Lele at 22:20 but she didn't nest successfully (*labeled FC 5*). It didn't take her long to re-emerge from the ocean because we found her at 01:29 trying to find a good spot (<100 yds away from her first attempt), but the dune vegetation was too thick for her to dig through so she gave up and went back to the ocean at 02:07 (*labeled FC 6*). This was night #18 of her internesting interval. We walked, watched, and waited for her to return the next night but she didn't.

It wasn't until two nights after her first attempts at her second nest, night #20 after her first nest of the season, that Lele emerged farther north of her other attempts and finally dug through the ʻakiʻaki grasses and nested (*labeled Nest 4*). With the help of our night vision scope and a bright moon, we observed and filmed the whole process. She was digging her egg chamber when we first came across her at 20:45, and she laid her eggs from 21:24-22:03. She covered up her nest for 18 minutes and it took her 6 minutes to crawl back to the ocean at 22:46. We patrolled 16-23 nights later, but we never saw her again. Her last nests of previous seasons have been laid on 10/13/00 and 9/16/05.

On night #16 of her internesting interval, which is the earliest and rather uncommon interval we've recorded for all Maui hawksbill nesters, Hapa emerged and

crawled around in an area where the pickleweed had grown very densely, so she couldn't dig through it (*labeled FC 7*). We spotted Hapa on Oct 2nd (night #17 of her inter-nesting interval) at 22:39 as she crawled up the dune near the pond outlet, and we got to watch the whole nesting process after she was finally able to dig through the 'aki'aki grass at 23:22. She laid her eggs for 21 minutes and was done covering her nest and back in the ocean at 1:01 (*labeled Nest 5*). As shown on the map, Hapa went beyond the range of her previous attempts and laid this nest very close to Lele's last nest. We patrolled 16-23 nights later, but this was Hapa's last nest. Her last nest in 1997 was laid on 10/11/97.

Nest Monitoring

Both tragic incidences that occurred last season in which the two unknown nests' hatchlings crawled onto the road instead of towards the ocean shows the importance of intensive monitoring of each nest so that this can be prevented. Due to what ended up being false crawl #3 and nest #3's close proximities to the road and the disorientation effects that vehicle lights have on hatchlings, we erected black silt fences that shielded the lights and eliminated the possibility of them crawling onto the road. No major dune restoration events were planned, but invasive vegetation species were removed around each nest so that the hatchlings' wouldn't get entangled. Nests #4 and #5 were laid in the native 'aki'aki grasses, so the grasses in the hatchlings' paths were temporarily covered with sand during the hatching window and then uncovered after the excavations (with no harm to the 'aki'aki). Nest watching is also needed when the hatchlings emerge during the day because they are more susceptible to dehydration/sand burns and are more visible to predators or human disturbance. Unfortunately, all of our efforts were for nothing, as no hatchlings emerged from these five nests.

Nest Success

None of the 987 eggs laid this season produced any live hatchlings and after waiting until approximately 72 days of development for each nest, they were excavated (*see photo on cover*). Hapa's average clutch size from her three nests was 203.7 and Lele's two nests averaged 188 eggs, for a 197.4 overall average clutch size for the five nests. All of the eggs, none of which were opened on Maui, were sent to George Balazs (NOAA-NMFS). Upon opening each egg from the first two nests, no obvious signs of developing embryos were seen. Some samples of egg matter were sent to Dr. Peter Dutton for PCR analysis, and he found mtDNA in both clutches, meaning they had been fertilized. No results from the other 3 nests have been reported by these teams as of 1/29/11 but similar results are expected. It is important to note that besides Kealia, none of Maui's beaches' nests have had development issues and all have overall high hatching success rates.

Sand Temperature Analysis

Information obtained from temperature data loggers during incubation coupled with dead hatchling necropsies can approximate the sex ratio of hatchlings produced. Sex-determination is temperature dependent so if the egg's temperature is over a certain degree the hatchling will be female, but if it's below it will develop to be male. 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.

We buried small temperature loggers in nest #1, #4 and #5 and near the other two known nests, all at ~10-20" depth. The data from the temperature loggers have been assessed by NOAA-NMFS and the findings were that none of the data indicated extreme, out of the ordinary temperatures that would cause early embryo fatalities in all of the nests. We are collaborating with NOAA to solve this Kealia egg development mystery.

Prey Species Identification

While the final biopsies to complete the initial phase of this research were collected in 2009, the biopsy tissue has been stored at the University of Hawai'i – Hilo Marine Sciences Dept. Stable isotope analyses on the biopsies were not initiated until the 2009-2010 winter/Christmas break and were still being analyzed at the end of 2010 by Dr. Jason Turner. Results will be available in 2011 and a manuscript summarizing the findings for publication will be drafted in 2011.

Discussion

HWF has now tagged seven nesting hawksbills since 1997 and most have returned to nest again. Orion (Oneloa 2001, 2004 and 2008) was the first, Lele (Kealia 2000 and 2005) was the second, Hōkūlele (Kawililipoa 1999 and 2006) was the third, Kolohe (Kealia 2002 and 2009) was the fourth, and now Hapa (Kealia 1997 and 2010) is the fifth known tagged hawksbill to remigrate to Maui for another nesting season after being tagged. The survivorship of one tagged nester from 1998 (Sasha at Kawililipoa) is particularly in question since she has not returned to nest that we know of. Now, Hapa's return after 13 seasons gives hope that Sasha will come back as well.

There are barely enough Dawn Patrol volunteers to reliably search the four known nesting beaches in the mornings, and despite our public outreach efforts nests could be going undetected and/or unreported on other beaches as well. It was odd that two months went by between the first and second crawl activities this season. It's a possibility that nests were missed due to the common difficulty in finding nesting evidence since high winds can obliterate tracks and high tides can wash away tracks along some portions of Kealia. HWF has found that if the nesting process isn't directly witnessed then the nest is very difficult to find, as the disturbed areas are very subtle and don't appear to be true nests when in fact they are. False crawls and nests tend to look very similar when laid amongst vegetation since the amount of thrown sand is limited (*see photo on cover*).

Over the course of this project there have been multiple incidences (including false crawl #1 this season) at Kealia when crawls had to be assumed to be nests if the turtles didn't return to the monitored Kealia areas to lay their actual nests. It has been concluded that the turtles must have traveled elsewhere to nest.

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 and Will Seitz of the National Park Service have reported Big Island hawksbills that have switched nesting beaches within and among seasons, to beaches that are sometimes 11 miles apart. Kealia nesters consistently have the highest number of false crawls and the lowest nesting totals per season (1-3) compared to Kawililipoa (4-5) and Oneloa (4-5) nests. One crawl was detected at Kealia in 2004, but it wasn't a nest and the hawksbill didn't return to Kealia all season, leaving the questions unanswered as to who it was and if she ended up nesting successfully anywhere else. It seems probable that Kealia turtles have a larger nesting range and their other nests are going undetected if they aren't laid along patrolled beaches.

This season, the Dawn Patrol expanded coverage so the whole stretch of "Sugar Beach" was walked, from Ma'alaea to Kolepolepo by the Hawaiian Islands Humpback Whale National Marine Sanctuary. This is a positive step, as these areas would be likely choices for Kealia nesters since they are the closest surrounding beaches. There are other beaches along the south shore that should be prioritized for the expansion of patrols due to the proximity to the other nesting beaches: Kawililipoa and Oneloa.

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 by passing vehicles on North Kihei Road. Only half of the permanent recycled plastic fence was installed in 2008 and even though funding for the rest of the fence was secured through the County of Maui, it expired before being used by The Kealia National Wildlife Refuge. Sections of the new fence are inadequate at stopping the turtles (they can crawl under or over it) so until the special posts are pounded in, extensions are built, and the rest of the fence is ordered and installed, HWF will have to continue to fix a large part of the dilapidated fenceline. This has unnecessarily cost HWF thousands of dollars and valuable time.

Not only does the whole fenceline need to be fully replaced with the recycled plastic fence material, it ideally should be relocated mauka of the existing location of the sand fence, which is too close to the high tide line in some 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 can only presume the negotiations by The Kealia Pond National Wildlife Refuge will continue. The idea of rerouting the road around the Kealia Refuge, obviously the best solution, should be proposed again.

The newly formed Maui Canoe Club has signed a contract with A&B and taken up residency along the southernmost stretch of Kealia, towards the Kealia Condominium. They have erected fences that are reasonably acceptable (saving us money and time) and

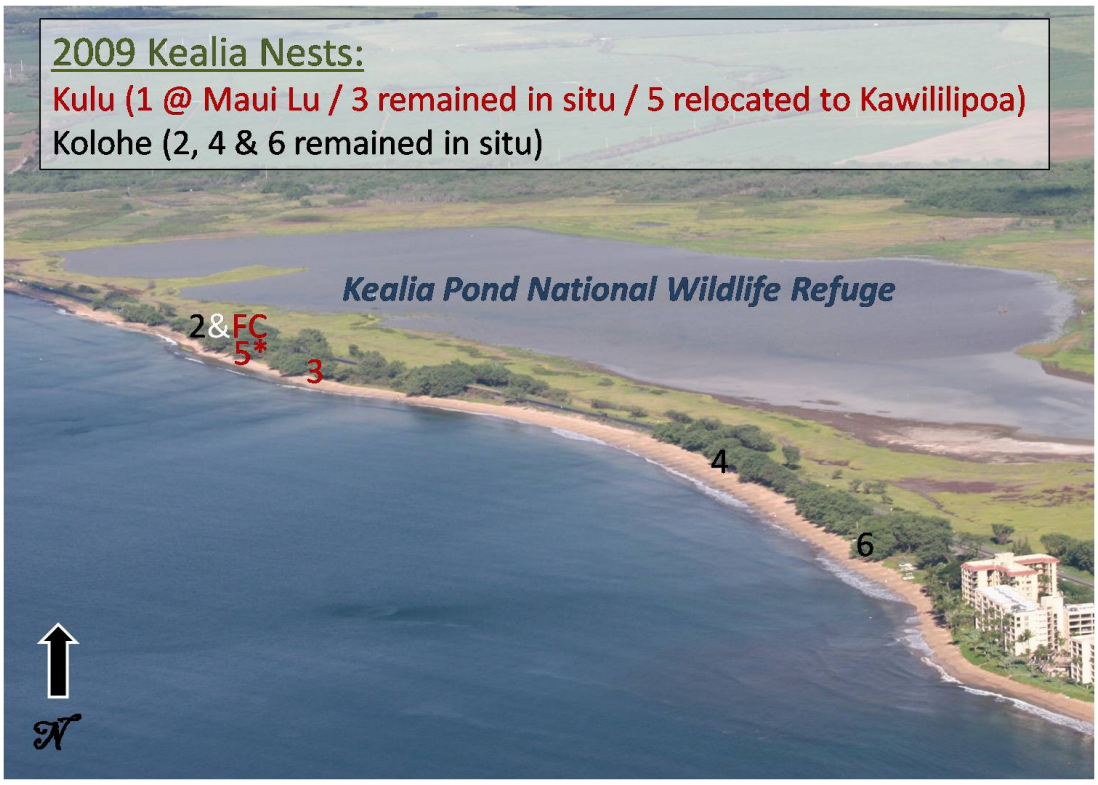
cleaned up the area by displacing many of the homeless who had been abusing the area. They hopefully will become valuable partners next season.

Getting the report of the Maui Lu Resort neighbors having to redirect 2009 nester "Kulu" back across the road to the beach after she got disoriented was very disturbing. Unfortunately, there are many well-lit roads that run very close to much of Maui's coastline, so if hawksbills (or any other turtle species) choose these areas to nest there is a real concern for their safety, their hatchlings' safety, as well as that of passing motorists. Although erecting turtle fences along every roadside beach is recommended, it is obviously impractical due to the resources involved. It's impossible to darken vehicle headlights, so solutions to these problems on a beach by beach basis should be considered before another valuable nesting turtle is killed.

The high success of the Kealia nests during the 2009 season was a welcome surprise. Why this was the case after a total failure of all nests since 1997, and again this season, remains a mystery. Reproductive problems with either or both hawksbill males and females may be an explanation for the failure of some nests. These are complicated issues that are currently beyond our scope of detection and understanding. Why were "Kolohe's" 2009 nests successful but none of her 2002 eggs developed? The easy explanation would be that she simply wasn't able to find a suitable mate in 2002 but she found one in 2009- problem solved. However, that can't be stated due to our lack of fertility information. None of Hapa's 3 nests hatched in 1997 either, but no clutch development information is available and fertility tests were not conducted. This is also the case for Lele's 2000 nests. Lele's 2005 eggs in the one nest she laid appeared to be in a similar state of undevelopment as this season's eggs, but we relocated it to Kawililipoa immediately after it was laid, and unfortunately fertility tests were inconclusive. "Kulu" was a new nester to Kealia in 2009 so maybe her seemingly younger reproductive age was a factor in her successful nests.

Of the four Kealia tagged nesters, only Hapa and Lele have been tracked post-nesting, and they both swam to nearby locations along the Hāmākua coast. Not ruling anything out, it's possible that something in their foraging environment has affected their reproductive abilities. The other Maui nester who was shown to forage along the Waipio Valley area (north of where Hapa and Lele reside) was the 1998 Kawililipoa nester, "Sasha", who laid five successful nests that season. None of the four Big Island nesters who have been tracked to the Hāmākua coast have laid failed nests either, so this doesn't seem to be the answer.

The only obvious difference between the 2009 successful nests and the unfruitful ones of the past are their general locations (*see map*). The 2009 season's nests were laid southeast of all the other unproductive ones that have been found at Kealia. Nest #6 was laid close to where the 1996 nester was killed on the road (pre-fence). Also that year and very near nest #6, dead hatchlings were found on the road so it had been a good incubation environment back then.



The location of 2009's nest #3 allowed some direct sunlight, but the other three were laid in extremely shady locations. This noticeably slowed nest incubation, and likely contributed more males to the population than females, but we have no way of knowing whether it affected incubation success. Most past Kealia nests have been laid in areas that received direct sunlight, such as all 2010 nests except #3 (which was very shaded). Coupling the heat with the possible lack of moisture (if that's shown to be the case in pending sand sample analyses) in the sand may have negatively affected hatchling development.

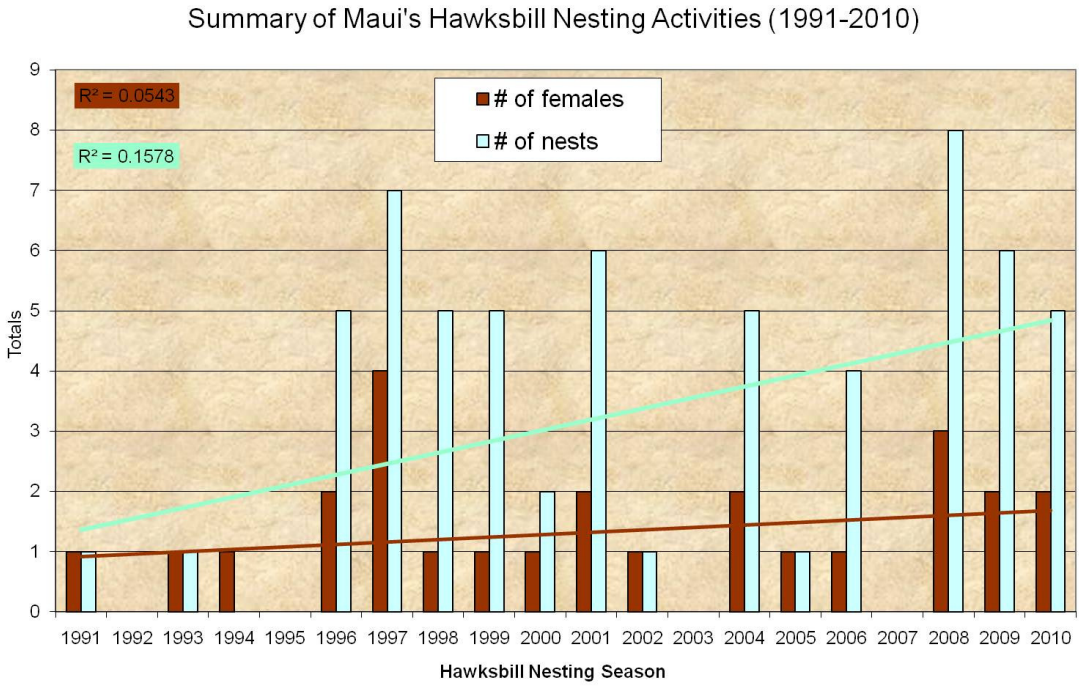
Two of the four 2009 nests (#2 and #4) were laid in a dirt/sand/kiawe mix, resembling the substrate of unsuccessful Kealia nests from the past. This didn't seem to affect development as was suspected; as these nests had remarkable incubation results similar to the other two laid in predominately sand (2009's #3 and #6). The sandy dirt mixture of all five 2010 nests may have played a negative role in allowing the eggs to receive the oxygen they needed for respiration. A network of thin roots were present in the 2010 nest chambers, which also may have affected oxygen or moisture content.

The previously explained theories about habitat factors that may be contributory to the lack of clutch success at Kealia are based on what's known about a turtle egg's basic incubation environment needs: moisture, oxygen and heat. Whatever factors that are contributing to the very early, nearly immediate halt of embryonic development at Kealia must be extreme, because nests around the world are subject to a wide combination of environmental factors and most seem to incubate normally. Are toxic doses of pollutants entering the sand from the nearby road, pond, sugar cane fields,

electric company, etc? Conspiracy theories abound and the fact that this has been happening for so long involving so many turtles, but only at Kealia, makes it quite the mystery…

Knowing that there are development issues at Kealia, a highly degraded habitat to begin with, demands that we become proactive in ensuring that no more clutches are lost. Therefore, the future relocation of nests from Kealia warrants further discussion. As we stated after the successful 2009 season, our recommendations are that if nests are laid at Kealia where egg development has been unsuccessful (all northwestern sites) then they should be relocated to the 2009 southeastern, successful Kealia nest spots. It's unfortunate that the lack of a State permit and the removal of this possibility from our Federal permit didn't allow us to practice this management solution this season, as the perfect opportunities were there. Another idea is to test at least one clutch (after leaving a control in situ) in a controlled incubator environment, which can in theory eliminate Kealia sand issues altogether. More research and strategizing will be done concerning this topic before next season.

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. As of yet, the actual numbers of nesting hawksbills on Maui are not increasing significantly (*see figure below*). 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 report fully and accurately represents our work. Excavation nest numbers still must be verified by NOAA-NMFS, so the ones used here are unofficial.

William Gilmartin

Cheryl King