Hawai‘i Island Hawksbill Turtle Recovery Project
2010 Annual Report

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Introduction

Hawksbill turtles (*Eretmochelys imbricata*, honu‘ea or ‘ea) are the rarest sea turtle in the Pacific Ocean and are classified as critically endangered on the International Union for Conservation of Nature and Natural Resources Red List (Ballie and Groombridge 1996). Due to predation, alterations to nesting habitat, coastal development, and numerous other limiting factors, the recovery and survival of this species requires immediate management, monitoring, and research actions (National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (FWS), 1998).

The objectives of the 2010 Hawai‘i Island Hawksbill Turtle Recovery Project (HIHTRP) based at Hawai‘i Volcanoes National Park (HAVO) were: 1) To manage and protect hawksbill sea turtle nesting habitat on the island of Hawai‘i by monitoring nesting beaches and ensuring hatchlings safely reach the ocean; 2) To collect baseline data on Hawai‘i’s nesting hawksbill population and facilitate informed management decisions; 3) To protect, restore, and manage coastal and ocean resources by controlling non-native predators and vegetation; 4) To implement several of the actions needed to achieve recovery for the hawksbill sea turtle as identified by the FWS and the NMFS 1998 Recovery Plan; 5) To assist recovery and maintenance of healthy and productive coastal and marine ecosystems that benefit society; 6) To promote public stewardship of coastal and marine ecosystems through outreach and interpretation efforts; 7) To survey coastline to identify undocumented nesting habitat;

Funding for the 2010 effort was provided in part by National Park Service - (NPS) HAVO, FWS Pacific Islands Office, NMFS Pacific Islands Regional Office (PIRO), Hawai‘i Natural History Association (HNHA), and a donation from The World Turtle Trust (WTT). Youth in Park (YIP), Americorps, Youth Conservation Corps Program (YCC) and Department of Defense (DOD) sponsored YCC also contributed to the project in various capacities.

At various times throughout 2010, project personnel consisted of one University of Hawai‘i (UH)-Pacific Cooperative Studies Unit (PCSU) project coordinator, one PCSU project technician, three UH interns, three Youth Internship Program (YIP) hires who were also UH-Hawaiian Internship Program interns, two Recovery Act Americorps interns, and over 30 full-time NPS Volunteers-In-Park (VIPs), and numerous other part-time volunteers. These personnel contributed various amounts of time to the project, anywhere from two to ten months. From late-April till early January, project personnel provided nearly continuous nightly coverage, recorded field data, controlled non-native predators and plants, and performed on-site interpretation at up to six hawksbill nesting sites while frequently monitoring eight other sites for nesting activities by performing day checks. This report summarizes field activities from April 20, 2010 through February 5, 2011.

Methods

Site monitoring: Nearly continuous nightly monitoring throughout the 2010 nesting season was provided at the following sites: ʻĀpua Point, Halapē, Kamehame, Kōloa-Nīnole, Pōhue Bay, and ʻĀwili Point. In addition to the sites previously mentioned, day checks were regularly performed at Keauhou, Punaluʻu, Horseshoe, Kahakahakea, Hāliʻipalala, and Humuhumu Point. Sporadic checks were conducted at Waimanu, Pololū, and Manukā.

Nesting turtles: Each time a nesting turtle was observed, the times and types of nesting activities were documented. Weather, tide, moon phase, and moon presence were recorded at the time of emergence from the surf. Times of crawls, digs, egg laying, covering, and returning to the ocean were also recorded. Upon heading back to the ocean, field personnel briefly restrained the turtle to check its tags and ensure that there was a readable tag on each flipper. If the turtle was previously tagged, tag numbers were recorded and if necessary, tags were adjusted. If the turtle had not been previously tagged or if the tag(s) had come off, size 681 inconnel style tags (National Band and Tag Co., Newport, KY) were applied proximal of and adjacent to the first large scale on the posterior edge of the flipper. These tags were supplied by NMFS – Marine Turtle Research Program (MTRP) in Honolulu. Furthermore, if the turtle was untagged, personnel scanned her rear flippers for PIT tags (Passive Integrated Transponder) with a Biomark Pocket Reader. Standard carapace measurements were taken using calipers. All turtles were checked for external injuries and abnormalities. Data collected was used to calculate individual remigration interval, nest-to-attempt inter-nesting interval, nest-to-nest inter-nesting interval, and carapace size. Maps were sketched to show each crawl pattern, false nest location, and nest location.

Nests and hatchlings: Nest sites were marked and identified by date, turtle ID number, turtle tag numbers, observers, and GPS coordinates. In rare situations when a nest was laid in an area characteristically inundated by high tidal cycles, the nest was relocated to an area above the high tidal line immediately after the nesting female returned to the water. Personnel cautiously placed each egg into a container, the dimensions of the original nest chamber were carefully replicated, the eggs returned to the ground, and then covered with damp subsurface sand; the orientation of each egg was carefully maintained throughout the entire process. All dates of hatchling activity were recorded. During the hatchling emergence phase, nests were continuously monitored for signs of activity. During the hatchling emergence, personnel counted hatchlings and ensured their safety to the ocean. Personnel rescued stranded hatchlings led astray by artificial light as well as found in vegetation and cobblestones. Approximately 48 to 72 hours after the main hatchling emergence, all nests were excavated to inventory nest contents and rescue trapped hatchlings within the nest cavity. Data collected was used to calculate incubation period, nest contents, clutch size, and nest hatch success. In addition, as part of a continued collaborative effort, hatchlings and/or embryo sample from each nest excavation were collected and sent to scientists at NMFS for DNA and genetic analysis. As part of another continued collaborative effort with NMFS-MTRP, 12 Hobo Pendant Temperature Light Data Loggers (Part # UA-002-08) were deployed at four beaches. These were used to record both ambient beach temperature and inside incubating nests to research temperature sex determination.

Predator management and nest protection: As in past years, nests were closely guarded throughout the season by field personnel. Small mammal live traps were baited, set, and checked

several times daily at ʻĀpua Point, Halapē, Kamehame, Kōloa, and Pōhue Bay to control mongooses (*Herpestes auropunctatus*), rats (*Rattus* sp.), and feral cats (*Felis catus*) throughout the nesting season. Captured animals were euthanized humanely using carbon dioxide. This method was recommended by the American Veterinary Association's (AMVA) Panel on Euthanasia (AMVA 2001). The species and sex of each predator was recorded. Wire mesh nest enclosures (screens) were constructed over most of the nests observed at Halapē, Kōloa, Pōhue Bay, and ʻĀwili Point to provide further protection from predators, vehicles, and humans. After 45 days of incubation, nest enclosures were cut open or removed to prevent trapping any hatchlings. At Kamehame, we maintained an ungulate fence that protects the nesting habitat from feral pigs (*Sus scrofa*) and cattle (*Bos taurus*).

Basking green turtle monitoring: If a green turtle was observed with fibropapillomatosis or if a stranded individual was found, it was to be removed from the beach and given to the UH-Hilo/NMFS-MTRP Strandings Team.

Education and public outreach: Project personnel provided extensive on-site and off-site interpretation to community members in both formal and informal settings. Personnel, volunteers and students from UH-Hilo, The Nature Conservancy of Hawaiʻi (TNC), and ʻImi Pono no ka ʻAina, participated in overnight camp trips at Kamehame, where they learned about marine turtle conservation and helped with beach monitoring and habitat restoration. Extensive outreach was performed at all the beaches, especially at Punaluʻu, Kōloa, and Halapē for community members, school groups, and visitors. In addition, elementary through college level students participated in rubbish and debris clean ups and received educational presentations. Thousands of turtle brochures were distributed to local residents and visitors by project personnel, and Punaluʻu vendors.

All HAVO coastal backcountry visitors were given hawksbill educational brochures with a sighting report form along with their wilderness camping permit by NPS interpretive rangers. They also received aid and interpretation from project personnel about backcountry protocols, proper leave-no-trace ethics, and sea turtle viewing etiquette. Coastal debris clean-ups were done at each field site. Interpretive signs were replaced or maintained at the various nesting beaches. Project staff provided educational displays at numerous community events including UH Career Fair, UH Earth Day, UH Ocean Day, HAVO Cultural Festival, HAVO Kilauea Visitor Center, and performed presentations at some area schools.

Results of 2010 Season

The first signs of nesting activity were found on April 20, 2010. This is one of the earliest documented nestings in project history. Field coverage extended until the final nest was excavated on January 12, 2011 (with some remaining eggs excavated on February 4, 2011). Similar to 2009, the 2010 season was the longest season on record. The nesting season from first egg laying to final nest excavation was approximately 267 days.

A total of 12 tagged adult female hawksbills were observed: one at ʻĀpua Point, two at Halapē, four at Kamehame, two at Kōloa-Nīnole, two at Pōhue Bay, and one at ʻĀwili Point. Five of these individual hawksbills were newly tagged (Table 1), while the remaining seven individuals were returnees from previous seasons (Table 2). These new recruits bring the number of adult

female hawksbills tagged on Hawai‘i Island to 105. In addition one adult female olive ridley (*Lepidochelys olivacea*) was observed and newly tagged at ‘Āwili Point (Table 3). A total of 39 confirmed hawksbill nests and 1 olive ridley nest were documented on Hawai‘i: four at ‘Āpua Point, 10 at Halapē, 10 at Kamehame, three at Kōloa, nine at Pōhue Bay and three hawksbill and one olive ridley at‘Āwili Point. In addition, there was evidence indicating two additional possible nests at both Kamehame and ‘Āwili Point. Adult hawksbill tracks were also documented at Keauhou. Of the 40 confirmed sea turtle nests documented, 39 were excavated. Three of the nests (including the olive ridley) were translocated immediately after oviposition to save them from tidal inundation. 19 of the nests were screened with wire mesh enclosures to protect them from predators and recreational beach users.

The cumulative results for hawksbills for the 2010 season are as follows: Nest-to-attempt inter-nesting interval ranged from 18 to 24 days with a mean of 19.8 ± 0.9 days (n=24). Nest-to-nest inter-nesting interval ranged from 19 to 29 days with a mean of 21.7 ± 1.0 days (n=23). Incubation period ranged from 50 to 75 days with a mean of 58.4 ± 2.3 days (n=29). Clutch size ranged from 89 to 287 eggs with a mean of 172.2 ± 8.3 eggs (n=38). Nest hatch success ranged from 0 to 97.6% with a mean of 54 ± 5.1% (n=38). From the 38 excavated hawksbill nests, approximately 3,666 hatchlings are estimated to have reached the ocean. The results for the olive ridley nest are discussed in the ‘Āwili Point (Road to the Sea) section below.

As in previous seasons, effort to document and protect sea turtles was extensive. From mid-April till mid-January project personnel spent a total of 882 monitoring nights covering four to eight nesting sites for a total of 2,212 worker nights (# of monitoring nights X # of personnel). In addition to nightly monitoring duties, project personnel performed 930 day checks for a total of 1,916 worker days at these and additional sites.

Cumulative non-native predator trapping effort consisted of 43 traps baited at five sites on 650 days for a total of 6,699 trap days. This effort resulted in the removal of 227 predators (one animal per 29.5 trap days) across all sites. A total of 141 mongooses (98 male and 43 female), 72 rats (59 male and 13 female), and 14 feral cats (seven male and seven female) were caught at ‘Āpua Point, Halapē, Kamehame, Kōloa, and Pōhue Bay. As a result of predator control efforts, there was minimal nest depredation documented at these sites.

Table 1.
Identification information of newly tagged adult female hawksbills on Hawai‘i Island, HI in 2010.

Project ID#	LFF	RFF	LRF	RRF	Date Tagged	Location
101	2D20	2D21	2D22	2D23	07-17-10	‘Āpua Point
102	3D23	3D19	3D22	3D21	07-20-10	Kamehame
103	3D66	3D25	3D26	3D67	07-23-10	Kamehame
104	3D55	3D59	3D56	3D57	07-28-10	Nīnole
105	3D74	3D76	3D77	3D75	10-31-10	‘Āwili Point

Table 2.
Identification information of returning adult female hawksbills on Hawai‘i Island, HI in 2010.
[ ] = previous tag either fallen off or removed.

Project ID#	LFF	RFF	LRF	RRF	Year Last Observed	Location
30	B565	B566	3D28	3D29	1999	Kamehame
48	304Z	[305Z],100M	98M	99M	2004	Kōloa*
58	3D07	481X	3D09	3D08	2004	Halapē
64	85M	88M	[84M],2D15	83M	2005	Pōhue
75	1D18	1D17	1D20	1D19	2007	Halapē
77	1D64	1D65	1D66	1D67	2007	Pōhue
86	1D79	1D80	2D09	1D81	2008	Kamehame

*Turtle was tagged at Kamehame in 1999, nested at Kōloa in 2004, false nested at Kōloa in 2010 and disappeared.

Table 3.
Identification information of newly tagged adult female olive ridley on Hawai‘i Island, HI in 2010.

Project ID#	LFF	RFF	LRF	RRF	Date Tagged	Location
OR 1	3D78	3D79	none	none	11-09-10	‘Āwili Point

Site Summaries:

***‘Āpua Point*:**
This was the site of the first hawksbill tagged by the project in 1991 and this summer, 19 years later, the 101st. One newly tagged hawksbill (Turtle ID #101) laid a total of four nests at this beach in the backcountry of HAVO. As part of our continued outreach efforts, families from the Kalapana Fishing Council community group were able to witness one of the nesting events. This community group assisted in removing invasive maunaloa vine (*Carnivalia cathartica*) from the nesting beach just hours before the turtle nested in the same spot the weeds had previously been.

Turtle ID #101’s standard carapace length (SCL) was 81 centimeters (cm). Her mean nest to crawl inter-nesting interval was 19 ± 0.6 days (n=3) with a range of 18-20 days. While her nest to nest interesting interval was 19.7 ± 0.3 days (n=3) with a range of 19-20 days. She laid her first nest on July 17 and her fourth nest on September 14. The first nest was excavated on September 22 and the fourth nest on November 12. Approximately 223 hatchlings safely reached the ocean from the four nests, including 77 that were rescued by personnel during excavations. Two hatchlings were found dead on the rocky beach. The average incubation time was 55 ± 0 (n=4) days. All four nests had trickle emergences. The mean clutch size was 139.8 ±

9.9 (n=4) eggs with a range of 110 to 151 eggs. The mean nest hatch success was 41.2 ± 5.3% (n=4) with a range of 31.1 to 54.5%.

None of the four nests were screened. Non-native predator control efforts resulted in the removal of 52 animals from the nesting area: seven mongooses, 41 rats, and four feral cats were captured and euthanized. Trapping effort consisted of seven traps baited and set on 159 days for a total of 1,113 trapping days. This is an average of one animal per 21.4 trap days. There was no predation documented on the nests. Personnel spent 161 monitoring nights (384 worker nights) and 9 daychecks (19 worker days) at this site between May 11 and November 12, 2010.

Keauhou

Adult female hawksbill tracks were found on a daycheck here on August 13. The tracks were found on the eastern side (ʻĀpua Point side) of Keauhou We followed up with night monitoring for nine monitoring nights (17 worker nights) and then continued regular daychecks but were unable to document any additional activity this season. Although it is unknown, it is possible that the turtle that crawled here was Turtle ID #75 who nested 2.6 km west at Halapē three nights later. Non-native predator control effort was seven traps baited for two days for a total of 14 trap days. This resulted in the removal of 16 mongooses (13 male and three female) from the nesting site. Project personnel performed 115 daychecks between May 24 and November 3, 2010 for a total of 229 worker days.

***Halapē*:**

Two adult female turtles – both returnees (ID #58 and #75) were observed crawling at this beach. 2010 was Turtle ID #58's second observed nesting season. She had a six year remigration interval, having been tagged in 2004. Her SCL was 85 cm. This was also Turtle ID #75's second nesting season, returning on a three year remigration interval after having been tagged in 2007. Her SCL was 82 cm. A total of ten nests were documented, protected, and excavated. This number tied with Kamehame for most documented nests at any beach on Hawai'i in 2010. Both turtles laid four confirmed nests each, and it is suspected that each turtle laid one of the additional two "unobserved" nests for a total of five nests each. Between the two nesters, the mean nest to attempt interesting interval was 21.1 ± 1.0 days (n=7) with a range of 18 to 24 days. The mean nest to nest interesting interval was 22.1 ± 0.7 days (n=8) with a range of 20 to 25 days.

The mean incubation time was 53.1 ± 0.6 days (n=9) with a range of 50 to 57 days. As in pasts seasons, most of the nests had trickle emergences. The mean clutch size was 151 ± 5.2 eggs (n=10) with a range of 130 to 175 eggs. The mean nest hatch success was 37.1 ± 6.3% (n=10) with a range of 7.4 to 64.7%. An estimated 540 hatchlings safely reached the ocean from the ten nests. Of the 540 hatchlings to sea, 169 (31%) of them were rescued by personnel during excavation. Seven hatchlings were found dead on the beach.

Volunteers educated backcountry campers on ways to minimize their impact on turtles and maximize their wildlife viewing experiences. This was especially needed since most of the nests were located directly in front of the campsites. Several different groups of visitors including children were able to witness adult females, hatchling emergences and nest excavations (Figures 1 and 2). However, due to drought and lack of rain catchment water for visitors, nighttime camping permits were not issued for Halapē after July 30 by HAVO. This was done as a safety

precaution for visitors. A side effect was that it helped to minimize human activity at this popular backcountry campground.


Figures 1 and 2: Volunteers and campers witness a rare daytime hatchling emergence at Halapē, HI.

Other endangered and threatened species observed here include an untagged dead juvenile green sea turtle (*Chelonia mydas*) found on the rocks at Halapē iki on June 27 (Figures 3 and 4). Also, a Hawaiian monk seal (*Monachus schauinslandi*) was also observed at Halapē iki on July 27.


Figures 3 and 4: Stranded green turtle (*Chelonia mydas*) found on the rocks at Halapē iki, HI.

The first documented nest was laid on May 3 and the last nest on September 6. The first nest was excavated on June 28 and the last nest on October 15. Project personnel spent 184 monitoring nights (459 worker nights) and 13 day checks (29 worker days) here between January 29, 2010 and November 27, 2010. Eight of the ten nests were screened. The exact location of the other two nests was unknown until time of hatching. Non-native predator control resulted in the removal of 41 non-native mammals: 25 mongooses (14 male and 11 female), 14 rats (13 male and one female), and two female feral cats. Trapping effort was seven traps baited on 147 days for a total of 1,029 trap days. This is an average of one animal per 25 trap days. No nests were predated due to trapping, the deployment of fence enclosures over the nests, and the presence of onsite personnel.

In addition, project personnel along with a non-native vegetation specialist from HAVO Resources Management Division, trail crew from HAVO Maintenance Division, and the Wilderness Volunteers worked together to remove koa haole (*Leucaena leucocephala*) and other

non-native vegetation for eight field days (88 workers days) in March. This effort greatly reduced the amount of this highly invasive plant at the nesting habitat (Figures 4 and 5).

Figures 4 and 5: Alien plants encroaching on hawksbill nesting habitat (left). Personnel worked to remove alien plants to open up more nesting habitat (right). The sign informs campers about the presence of nesting hawksbills. Halapē, HI.

***Kamehame*:**
Four turtles – two newly tagged (ID #s 102 and 103) and two returnees (ID #s 30 and 86) - laid a total of 10 documented nests and at least two "possible" nests. This is the largest number of both nesting turtles and nests documented at any site in 2010. Newly tagged turtles ID #s 102 and 103 each laid two confirmed nests. Their SCLs were 82 and 76 cm respectively.

Turtle ID# 30 was the earliest turtle tagged in project history for this season. Turtle ID# 30 (NOAA ID: 25695) was originally tagged at Kamehame and outfitted with a satellite transmitter in 1996 at Kamehame (G. Balazs-NMFS). Subsequent tracking data revealed that she travelled clockwise around South Point, along Kona Coast to Kahului Bay, Maui (Parker et al. 2009). She returned to nest at Kamehame in 1999. Turtle ID# 30 was not seen again for 10 seasons. She is the second turtle in the last two seasons to have a 10 year remigration interval. However, it is possible that she nested undetected at an unknown beach during the 10 year absence. Turtle ID #30 laid at least three confirmed nests. Her SCL was 84 cm.

This was Turtle ID# 86's second nesting season, having been tagged two years earlier in 2008 (Figure 6). Turtle ID #86 had also been outfitted with a satellite transmitter (supplied by G. Balazs NMFS-PIFSC) and attached by S. Graham (UH-HWF) in 2008. According to Argos data, Turtle ID #86 (NOAA ID: 50159) traveled counter clockwise around the island's eastern most point, Cape Kumukahi, then northwest along the Hāmākua Coast before crossing the ʻAlenuihāhā Channel to Maui (G. Balazs, pers.com.). Her final tracking destination was on the leeward coast of Maui. Project personnel removed the transmitter and returned it to NMFS-PIFSC (Figure 7). Turtle ID #86 laid three confirmed nests and had an SCL of 85.5 cm.


Figure 6: Turtle ID #86 returned to nest at Kamehame, HI after having been tracked to Maui. Figure 7: Personnel remove transmitters.

Between these four nesters, the mean nest to attempt interesting interval was 18.6 ± 0.2 days (n=8) with a range of 18 to 19 days. The mean nest to nest interesting interval was 22 ± 1.2 days (n=7) with a range of 20 to 29 days.

There were two nest translocations performed at Kamehame during the 2010 nesting season. These nests were originally laid in front of the cliff face on the southwest side of the beach, an area that is frequently inundated by high tide (Figure 8). Both nests were relocated to more suitable substrate in the naupaka (*Scaevola taccada*) vegetation region above the high tidal line (Figure 9). The translocations were conducted immediately after the post-nesting turtle returned to the ocean. The first translocated nest was on July 23 and contained 164 eggs. This nest had an above average hatch success rate of 86%. The second translocated nest was on August 16 had a 42% hatch success rate. No eggs or hatchlings from either nest would have survived without these emergency translocation measures.


Figure 8: Personnel collecting eggs laid in tidal inundation zone, Kamehame, HI. Figure 9: Eggs are carefully reburied in higher ground.

The mean incubation time was 64.4 ± 2.5 days (n=8) with a range of 57 to 75 days. The mean clutch size was 185 ± 17.6 eggs (n=10) with a range of 121 to 287 eggs. The mean nest hatch

success was 69.8 ± 6.1% (n=10) with a range of 33.1 to 96.2%. An estimated 1,345 hatchlings safely reached the ocean from the ten nests. Two hatchlings were found dead on the beach. A total of 1,850 eggs were counted from the 10 excavated nests.

Project personnel spent 171 monitoring nights (475 worker nights) and 15 day checks (48 worker days) here between February 26, 2010 and December 13, 2010. The first documented nest was not observed until July 23. The last observed nesting crawl was on October 14. The first nest excavation was on September 26 and the last was December 12. None of the 10 confirmed nests were screened due to high density of nests in a small area. Nest predation was observed on at least one occasion. Feral cat tracks were observed on top of two of the nests, a small hole was dug and about 12 eggs were found. Non-native predator control resulted in the removal of 97 non-native mammals: 84 mongooses (66 male and 18 female), six rats (four male and two female), and seven feral cats (three male and four female). Trapping effort was 20 traps baited on 173 days for a total of 3,460 trap days. This is an average of one animal per 39 trap days. However, despite an extensive trapping effort, nest predation was documented on one occasion by rats and/or a feral cat.

We also continued with habitat restoration again this season. Volunteers worked to remove non-native vegetation, koa haole (*Leucaena leucocephala*) and Christmas berry (*Schinus terebinthifolius*) from the nesting habitat in preparation for sea level rise and to help relieve nest overcrowding. We also cut four openings into the naupaka vegetation to make room above the high tide line for nests. These corridors into the naupaka were utilized on multiple occasions and allowed nesting females access to higher ground.

***Punalu‘u*:**
A Punaluʻu resident reported seeing hatchlings in the water near a small pocket beach near the pavilion. We were unable to locate the nest. However, we did document two adult females using similar habitat a short distance (< 1 mile) away at Kōloa (next section). Project personnel performed 168 daychecks (358 worker days) monitoring this site between May 22, 2010 and December 9, 2010. As in past seasons, personnel interacted with and performed outreach with numerous beach users.

Kōloa:
Nesting was documented here for the first time since 2004. One newly tagged adult female (Turtle ID #104) and one remigrant (Turtle ID #48) were observed at this site. Despite the relatively high nesting site fidelity of hawksbills, Turtle ID #48 is another individual that demonstrates the use of multiple beaches. She was originally tagged at Kamehame, approximately five kilometers northeast, in 1999. She was then observed nesting five years later at Kōloa in 2004. She was not seen again for six years until this summer. However, she was only observed false nesting on two occasions and then was not seen again. While unknown, it is possible she may have nested at an unmonitored site nearby such as Kāwā or Kaʻiliʻili.

Based on observations and internesting interval data, the three confirmed nests were most likely from Turtle ID #104. Her SCL was 88.5 cm. Her nest to attempt interesting interval was 21 days. Her nest to nest interesting interval was 22 days. The first nest was laid on August 16 and the third nest was laid on September 29. All three nests were screened to protect them from

high densities of non-native predators and recreational beach users (Figure 10). The results from these nests were bleak. Nest 1 had only a 3.9% hatch success, while the other two both had 0% hatch success. In all three cases, the majority of eggs were completely undeveloped and contained only yolks. The nests at this site were subjected occasionally to water from high tides. It seems that this was fatal to the eggs. The incubation time for the few hatchlings that emerged from the first nest was 68 days. A total of only eight hatchlings made it to sea. The other two nests did not have any hatchlings. The mean clutch size was 196.7 ± 4.1 (n=3) with a range of 190 to 204 eggs. The mean hatch success was 1.3 ± 0 % (n=3) with a range of 0 to 3.9%.

Figure 10: The three nests at Kōloa were protected with nest enclosures. Exposure to high tides likely contributed to nest failure.

Predator control resulted in the removal of 24 non-native mammals: 22 mongooses (10 male and 12 female), one male rat, and one female feral cat. Trapping effort was 2 traps baited on 20 days for a total of 40 trap days. This is an average of one animal per 1.8 trap days. In addition, personnel performed considerable outreach at this site talking with residents, tourists, and school groups and cleaned up rubbish and debris. Project personnel spent 97 monitoring nights (209 worker nights) and performed 73 daychecks (161 worker days) monitoring this site between May 23, 2010 and December 14, 2010.

Nīnole:

Nīnole is a rocky, cobblestone beach located on the same private property as Punaluʻu in close proximity to Kōloa. Personnel tagged Turtle ID #104 at Nīnole where she false crawled on several occasions before nesting at Kōloa. In addition, personnel also observed a Hawaiian monk seal (Tag #: R4DF) utilizing this beach to haul out. This female seal was outfitted with satellite transmitter on Oahu and migrated to the Kaū Coast (T. Wurth, pers.comm.). When she was first observed her transmitter was still present. Subsequent observations revealed that the transmitter was no longer attached. Project personnel performed 138 daychecks (197 worker days) and spent 24 nights (54 worker nights) monitoring this site between May 23, 2010 and

December 1, 2010. In addition, this site was also monitored on the nights personnel camped at Kōloa.

Kāwā Bay and Ka'ili'ili:
As in 2009, it is unknown if any hawksbills nested at these sites in 2010. Due to a conflict over legal ownership of these sites, personnel did not monitor these sites for the second season in a row. It is suspected that Turtle ID# 48 may have utilized one of these sites. She disappeared from nearby (~5 km) Kōloa after having only false nested on two nights. She also has a history of utilizing multiple beaches.

***Pōhue Bay*:**
The first nest documented here in 2010 was laid on April 20. Although hatchlings were observed in June of 2007 indicating nesting in late March/early April, this is the earliest observed nesting activity in project history. Two remigrant turtles (Turtle ID #s 64 and 77) and nine nests were monitored and protected at this beach. Turtle ID #64 (Figures 11 and 12) was on a five year remigration interval, having been tagged in 2005. She laid four confirmed nests. Her SCL was 87 cm. Turtle ID #77 was on the more common three year remigration interval having been tagged in 2007. She laid two confirmed nests and likely two more as there were three additional unobserved nests. Both of these nesters were observed and identified by divers foraging off of west Maui (see discussion).

Figures 11 and 12: Turtle ID #64 observed swimming in Pohue Bay (left) and resting in 20 feet of water (right).

Between these two nesters, the mean nest to attempt interesting interval was 20 ± 0 days (n=5). The mean nest to nest interesting interval was 21.5 ± 0.9 days (n=4) with a range of 20 to 23 days. The mean incubation time was 59.9 ± 1.0 days (n=7) with a range of 56 to 62 days. The mean clutch size was 213.4 ± 4.4 eggs (n=8) with a range of 196 to 229 eggs. The mean nest hatch success was 77.2 ± 7.1% (n=8) with a range of 44.5 to 93.4%. Over 1,300 hatchlings safely reached the ocean from the nine nests. Thirteen hatchlings were found dead on the beach. In addition, a Hawaiian monk seal was observed on the beach here in June.

Project personnel spent 154 monitoring nights (425 worker nights) and 20 day checks (55 worker days) here between April 20, 2010 and January 6, 2011. Six of the nine nests were screened. The other three nests were not because their exact location was not known until time of hatching.

Predator control resulted in the removal of 13 non-native mammals: three male mongooses and 10 rats (eight male and two female). Trapping effort was seven traps baited on 151 days for a total of 1,057 trap days. This is an average of one animal per 81 trap days.

ʻĀwili Point (Road to the Sea)

One newly tagged female (Turtle ID #105) laid three confirmed nests and two additional possible nests. Two of the nests were unobserved and exact location of the eggs was unknown until time of hatch. Therefore, they were not screened. The third nest was screened. In addition, an adult female olive ridley (*Lepidochelys olivacea*) nested and was tagged here on November 9. This was only the fourth time that an olive ridley has been documented nesting in State of Hawaiʻi (G. Balazs, per. comm). She nested in the tidal inundation zone (Figure 13) and project personnel performed an emergency translocation (Figure 14) to relocate her eggs to a safer spot near the vegetation (Figures 15 and 16). This nest hatched out successfully on 56 days incubation in January 2011 with 80 hatchlings out of 88 eggs making it safely to the ocean (Figure 17) for a 90% nest success upon excavation upon excavation (Figure 18). This nest was not screened due to permit issues. However, it was closely guarded by onsite personnel.

The first nesting activity was found here on August 23. The last nesting event was the olive ridley on November 9. This is one of the latest egg-laying events in project history. The only incubation data was 62 days (n=1). The mean clutch size from the three hawksbill nests was 115 ± 13.3 eggs (n=3) with a range of 89 to 133 eggs. The mean hatch success was 64.9 ± 32.1% (n=3) with a range of 0 to 97.6%. From the three excavated hawksbill nests, it is estimated that 249 hatchlings safely reached the sea.

Figure 13: Olive ridley turtle (*Lepidochelys olivacea*) nesting in the tidal inundation zone, ʻĀwili Point, HI. (left) Figure 14: Eggs were saved from the rising tide. (right)


Figures 15 and 16: Eggs were translocated to suitable habitat at the *Ipomea* morning glory-sand interface.


Figure 17: Olive ridley hatchling main emergence. Figure 18: Personnel excavate to release the remaining hatchlings and collect data and samples.

Project personnel spent 75 monitoring nights (189 worker nights) and 62 day checks (136 worker days) here between June 3, 2010 and February 5, 2011. While there was no predator control at this site, one feral cat was taken away from the beach and adopted to a farm.

Horseshoe, Kahakahakea, Hāli'ipalala, Humuhumu Point, Manukā, Waimanu:
Although these beaches were monitored frequently by day-checks, night monitoring was insufficient and evidence of turtle activity could have been erased by foot or vehicular traffic, waves, and/or high winds by the time personnel arrived. Project personnel spent 321 monitoring days (555 worker days) and seven nights (20 worker nights) monitoring these sites.

Kahalu'u Bay, Kailua-Kona

In April, residents Heloise and Chris Lochman reported to us frequently observing an untagged juvenile hawksbill (Figures 19, 20, and 21) approximately two to three feet long in Kahaluʻu Bay. They saw it almost daily from late December 2009 to mid-February 2010 and after that every several weeks. They also reported observing an adult hawksbill feeding on collector urchins six or seven years ago.

Figures 19, 20, and 21: A juvenile hawksbill was observed by snorkelers in Kahaluʻu Bay. Photos by Tom Clarke.

Other Endangered Species Activities:
In addition to the olive ridley sea turtle at ʻAwili Point, personnel also observed a Hawaiian monk seal (*Monachus schauinslandi*) on several occasions hauled out at Halapē, Punaluʻu, Nīnole, Pōhue and Humuhumu Point (Figures 22 and 23). The seal seen at Punaluʻu and Nīnole was identified as Tag #: R4DF. The Hawaiian hoary bat, ʻŌpeʻapeʻa (*Lasiurus cinereus semotus*) was observed at Kamehame and Pōhue. No green turtles with fibropapillomatosis were removed this season. One juvenile green turtle was found stranded dead near Halapē in HAVO (Figures 3 and 4).

Figures 22 and 23: Hawaiian monk seal (*Monachus schauinslandi*) R4DF hauled out on Nīnole beach with transmitter still attached (left). Unidentified seal hauled on beach near Humuhumu Point (right).

Other Collaborations:
As in previous seasons, HIHTRP collected 224 samples from 39 excavated nests (including the olive ridley) and will be depositing them with the NMFS-PIFSC and SWFSC to be used for genetic analysis to establish the stock structure of the population. An inventory with the number and description of all samples collected and deposited is included in Appendix A. In addition, NMFS-PIFSC provided 12 Hobo Pendant Temperature Light Data Loggers (Part # UA-002-08) that were deployed in nests and as controls at nesting sites for temperature dependent sex ratio research.

Discussion

***Newly Tagged Turtles*:**
While the upward trend in new recruits the last five years went down this year, five new recruits were tagged in 2010, which is still a respectable amount (Figure 24). This brings the total number of adult females tagged on the Island of Hawaiʻi since 1991 to 105. Of the 105 nesting turtles that HIHTRP has tagged in 19 years, 46 individuals (or 44%) have been tagged in the past six years. Although there is not enough data yet to confirm, this upward trend may be an early indication that the numbers of nesting Hawaiian hawksbills could be increasing.

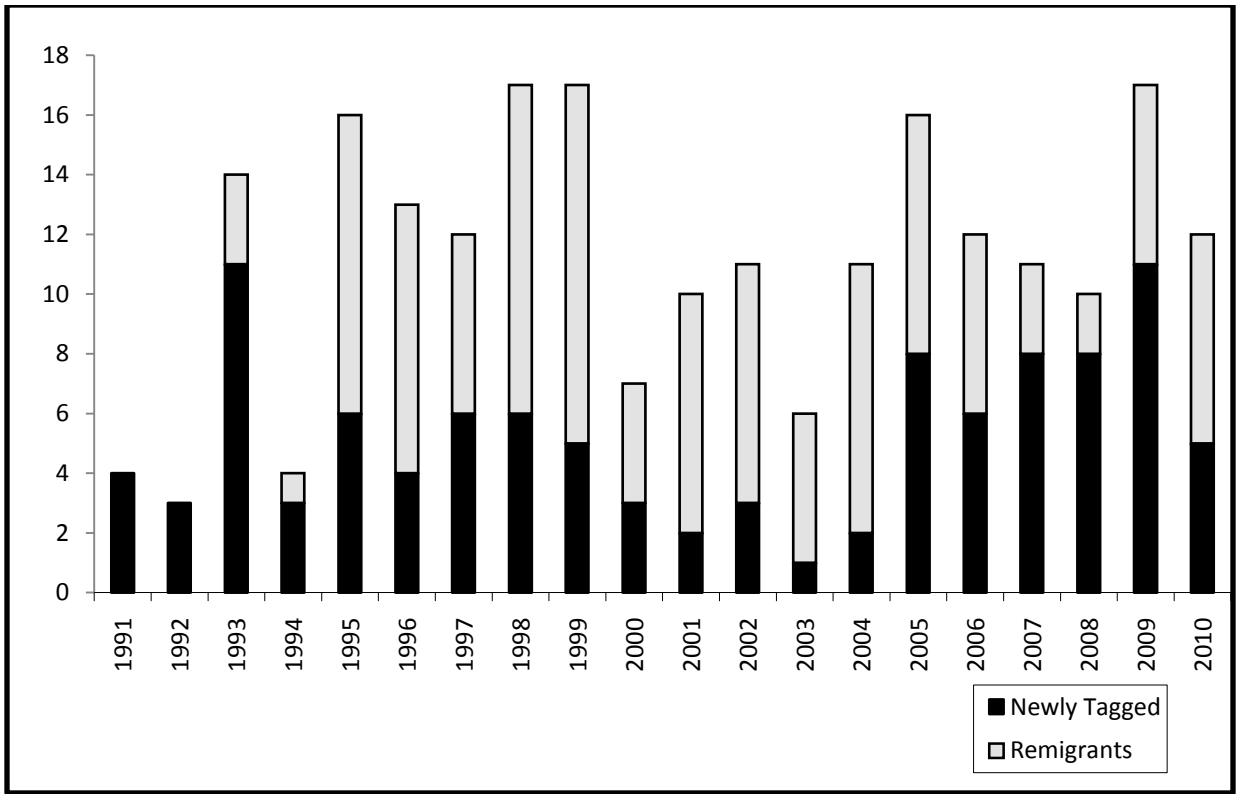


Figure 24: Number of newly tagged compared to remigrant hawksbills by year, 1991-2010, Hawai‘i Island, HI.

***Remigrant Turtles*:**

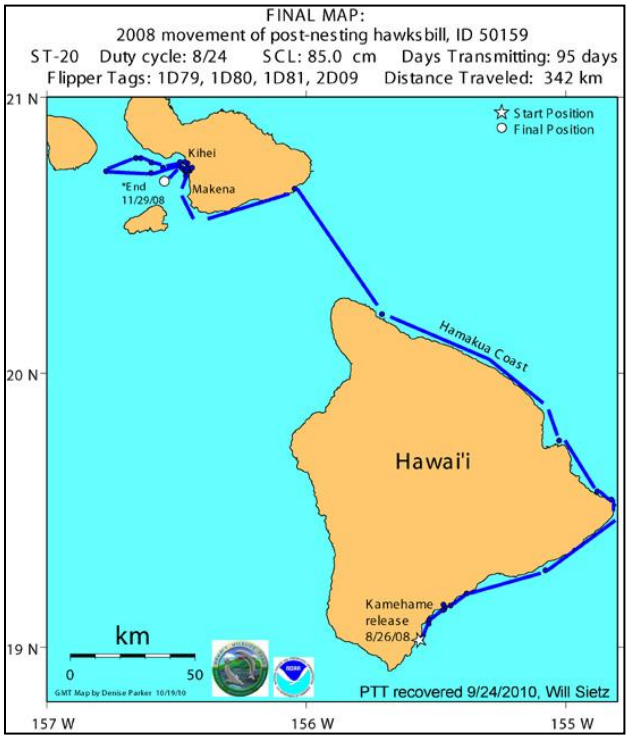
During the four seasons between 2005 and 2008, the number of remigrant turtles was declining (Figure 24). During the 2009 season, six remigrants were observed. The 2010 season had seven observed remigrants, the most since 2005. One of these turtles (ID #30) was originally tagged in 1996. This was the first time she was seen in 10 years. Our data suggests that the average remigration interval is 3.5 ± 0.2 years (n=113) with a range of two to 10 years. This is the second year in a row that we observed a 10 year remigration interval. Previous to 2009, the longest remigration interval recorded was eight years. However, it is possible that she was missed in a previous season at an unknown beach or nested without being identified.

Interisland Migration (Maui-Hawai‘i):

Four hawksbills during the 2010 season came to nest in Ka‘ū were previously tracked to or observed in Maui waters. Two were at Kamehame and the other two were at Pōhue. Turtle ID #64 was reported to have been first observed at Honokōwai in 1999 (Keuper-Bennett and Bennett 2002). She was tagged at Pōhue in summer 2005 and observed by divers in November off Kahekili, Maui. Turtle ID #77 was tagged in 2007 also at Pōhue. She was observed by divers in off shore reef habitat in west Maui in 2008. A third hawksbill that came from Maui was ID # 86 (NOAA ID: 50159). She was tagged and outfitted with a transmitter at Kamehame in 2008 (S. Graham, UH-HWF). Satellite tracking data revealed that after leaving Kamehame, she traveled counter-clockwise around Cape Kumukahi and up the Hāmākua Coast before travelling to the leeward waters of Maui, a distance of 342 km (G. Balazs and D. Parker pers. comm.) (Figure 25). Finally, Turtle ID #30 (NOAA ID: 25695) was tracked in 1996 from

Kamehame, around South Point and up the Kona Coast on her way to Kahului Bay, Maui, a distance of 315 km (Parker et al. 2009) (Figure 26).

While the Hāmākua Coast has been identified as a primary foraging ground (Parker et al. 2009), these sightings and data add to the information of post-nesting hawksbills regarding interisland migration between Hawai‘i and Maui resident foraging grounds.



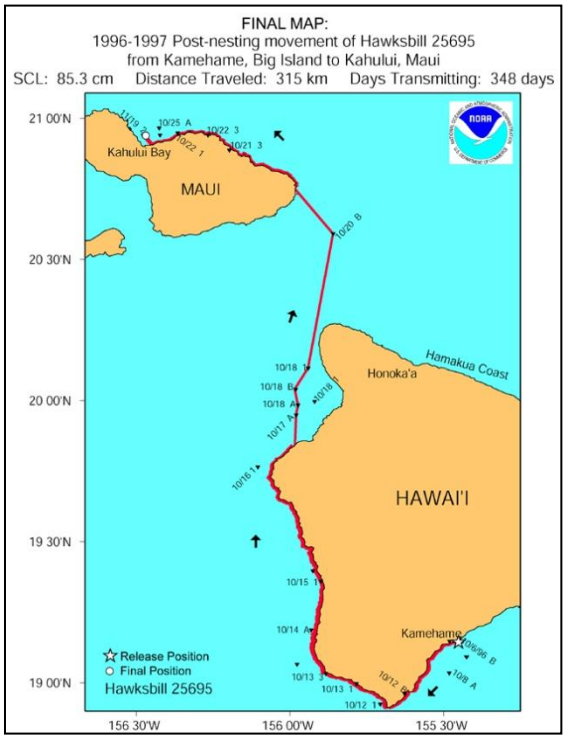


Figure 25 and 26: The satellite track of Turtle ID #86 (left) and Turtle ID #30 (right) from Kamehame to Maui. (maps courtesy of G. Balazs and D. Parker, NMFS).

Individual Turtles Use of Multiple Beaches:

As in previous seasons, at least one individual adult female was documented utilizing a different beach from where she was originally tagged in a previous year (ID # 48). This individual was originally tagged and nested at Kamehame in 1999. She was then observed nesting at Kōloa, 4.5 km southwest, in 2004. In 2010, she returned to Kōloa to false crawl on two occasions.. She was not observed again. It is possible that she moved southwest down the coast and nested at Kāwā and/or Ka‘ili‘ili. It is also a possibility that she laid an unobserved nest near the pavilion at Punalu‘u, as residents reported seeing hatchlings there. These sites mentioned (Kamehame, Punalu‘u, Kōloa, Kāwā, and Ka‘ili‘ili) are located along approximately six kilometers of coast (Appendix B). Another individual (ID # 105) was tagged on the cobblestone beach at Nīnole. She then came up and nested nearby at Kōloa. These repeated findings each season continue to emphasize that the entire coastline, not strictly individual beaches, needs to be managed with consideration for nesting turtles.

***Nest Translocations*:**
Project protocol is to only translocate a nest if it is in imminent danger. This situation occurred three times in 2010. All three times the nests were laid in the tidal inundation zone. Having onsite project personnel saved two hawksbill nests at Kamehame and the olive ridley nest at ʻĀwili. The eggs were relocated immediately after oviposition. Hatch success was 86% and 42% for the hawksbills and 92% for the olive ridley. None of these eggs would have survived without the immediate actions of field personnel.

***Beach access to Kāwā and Kaʻiliʻili*:**
As mentioned in previous reports, the State received funding from the Section 6 Recovery Land Acquisition Program (FWS) for the County of Hawaiʻi to acquire and protect approximately 3.2 km of coastline located at and around Kāwā Bay including Kaʻiliʻili Beach. Protecting these beaches and coastal wetlands was identified as the primary land protection priority by the County of Hawaiʻi Public Access, Open Space and Natural Resources Preservation Commission, the Mayor, and the County Council. This property provides habitat for four federally listed species including the hawksbill turtle, green turtle, Hawaiian monk seal, Hawaiian coot (*Fulica alai*), and a candidate for listing, the orange-black Hawaiian damselfly (*Megalagrion xanthomelas*). A survey conducted by the NPS to evaluate the area's resources and suitability for National Shoreline designation, concluded that this area merited protection because its resources were of national significance.

Among Hawaiʻi County objectives for protecting this site and it's turtle nesting areas include the following: fostering partnerships with local community organizations and federal and state agencies to help limit vehicular access, performing non-native predator control around nesting areas, and restoring native vegetation. Monitoring and protecting hawksbills by HIHTRP at this site has occurred since the early 1990's. A dispute over legal ownership of the property between local beach residents and the county resulted in the project withdrawing monitoring coverage during the 2008 nesting season. There was no coverage the last two seasons. It is uncertain at this time what the status of the land acquisition is.

Conclusion/Recommendations

This year marks the 21st anniversary season of HIHTRP. Project success this season was measured by: 1) Project personnel provided nearly continuous nightly coverage at six beaches and consistently checked nine others while documenting nesting activity at eight beaches. 2010 was the longest field season ever recorded, with the first nest documented in April and the last nest excavated in January; 2) A total of 12 nesting hawksbill turtles were observed; 3) We continued to see new recruits entering into the nesting population with five newly tagged individuals. These new recruits bring the total tagged since 1991 to 105; 4) 39 hawksbill nests were documented and protected. This brings the total number of documented nests since 1989 to over 739; 5) Over 3,666 hatchlings are estimated to have safely reached the ocean, bringing the estimated total since 1989 to over 83,000; 6) Minimal eggs were documented as depredated on by predators this season at beaches with continuous coverage and minimal hatchlings were found dead on the beach; 7) An olive ridley turtle was tagged and nest saved from inundation. This is only the fourth documented olive ridley nesting in Hawaiʻi State history; 8) Educational outreach efforts continued to generate support for sea turtle and coastal conservation from local

community members and project partners; 9) We added to over 10 years of hawksbill genetic samples by collecting 224 samples; 10) We made 13 temperature data logger recordings to further aid temperature sex determination research. 11) Over 40 volunteers and interns gained field experience that will aid in them in future careers in conservation.

Based on our findings during the 2010 and previous seasons, we make the following recommendations:

1) ***Monitor and protect all potential nesting sites.***
Our priority remains on intensively monitoring and managing beaches that have the most documented activity and the greatest threats to hatchling survival. However, given the overall small number of nesting events in any given season (e.g. <60) all known nesting beaches need to be monitored and managed, regardless of their activity levels so as to maximize nest success. Long term monitoring of annual nesting is crucial for determining the status of the population. Because of ongoing threats by predators, invasive non-native plants and human activities, beaches that have been identified as nesting habitat need to be consistently managed every year.

2) ***Continue to survey for and identify new nesting beaches.***
There are many potential nesting beaches on the island of Hawai‘i for which no nesting activity has been documented. These include beaches where unconfirmed nesting activity has been reported by a community member. Systematic follow-up monitoring to revisit sites or confirm nesting reports is often challenging because of a lack of access, personnel, or resources. In addition, the time between nesting remigration intervals for a female (two to ten seasons) requires that beaches be surveyed continuously for several years before nesting can be documented. We need to continue to work with landowners to gain access to these sites. For example, we had hoped to monitor and manage Wai‘ahukini and Kā‘iliki‘i since 2008. However, all access to Wai‘ahukini or anywhere in the ahupua'a of Pākini Nui West is currently off-limits. The Army found a significant number of live ordinance and is continuing to inventory and eventually dis-arm the ordinance. In addition to the landowners and lessees, we will have to wait for the Army’s approval to re-enter the area.

3) ***Explore ways to improve nest success at particular sites.***
The threats caused by non-native vegetation, predators, and human activities need to be addressed at each site. For example:

***‘Āpua Point*:**
Having onsite personnel continuously monitoring this site during nesting season continues to be essential to save the lives of hatchlings that would otherwise become stranded and die on the cobblestone beach. Non-native plants, particularly mauna loa vine (*Carnavalia cathartica*) need to be regularly controlled to protect the nesting habitat and prevent roots from trapping hatchlings.

Halapē:
Nest hatch success is typically below average in comparison to other beaches. Nests at Halapē often incubate for shorter durations (<55 days) and produce trickles of hatchlings that occasionally emerge during hot daylight hours instead of during lower temperatures such as at night or in early morning. Day time emergence increases hatchling exposure to dehydration and

desiccation. Incubation time may or may not be a factor in trickle emergences and low hatch successes. We have worked in collaboration with NMFS and Dr. Thane Wibbels deploying temperature data loggers in order to better understand the relationship between temperature, incubation time, and hatch success. Shading and/or watering the nests at Halapē should be considered to possibly increase hatch success. Continued management to control invasive plants, predators, and human activity is strongly recommended. The popularity of this site for backcountry campers requires careful onsite management to protect turtles while educating campers. To prevent overcrowding of nest sites, the park should consider the possibility of reducing the amount of campers during heavy nesting seasons.

Kamehame

Throughout much of our monitoring history, nest overcrowding has been an issue because there is only a small area of suitable nesting substrate. The foremost problem with nest overcrowding results in nesting females digging up an existing nest and destroying viable eggs. Overcrowding was not as much of a problem during the 2010 season because of the lower number of nests in comparison to previous seasons. On several occasions this season, nesting females were pulled away from locations where they were digging up an existing nest. Pulling a nesting female off an existing nest could discourage turtles from nesting, but is necessary to protect viable eggs. As mentioned in the 2009 report, it is possible that nest overcrowding could possibly be improved by cutting additional "turtle nesting trails" into the naupaka. The naupaka-sand interface habitat becomes crowded with nests, especially towards the end of the season. We cut four openings into the naupaka that provided nesting habitat above the high tide line. The turtles responded by nesting in these openings. We also improved habitat by removing alien plants that take over and form impenetrable roots making successful nesting difficult. We are also considering moving the ungulate fence further back to make more room for nesting turtles and in preparation for sea level rise. This fence proved to be critical in protecting the nests and habitat during the severe drought in 2010. Without the fence, the cattle would have eaten all the naupaka and trampled all the nests.

Punalu'u:

Light pollution at Punaluʻu could be reduced in three simple ways: education, changing light fixtures, and shielding existing light from the beach. Educational measures could include installing a large interpretive sign possibly at the south end of the beach (along an outside wall of the pavilion for example) that contained information not only about light pollution, but also about the history of the beach, the biology of sea turtles, the differences between greens and hawksbills, as well as threats and mitigations. With this conglomerate of information, the interpretive sign (and brochures) would hopefully not only help visitors realize the importance that Punaluʻu plays in the Kaʻū community, but also evoke a sense of concern, awareness and knowledge from residents and visitors alike. Other educational opportunities could include holding informational sessions or lectures that would teach homeowners, community members, and anyone else in attendance specifically how to reduce light pollution. Also, installing other basic signs or stickers with a simple slogan (i.e., "Keep Sea Turtles In The Dark") near the light switch in the pavilion for example, could influence the general public to turn off the lights. Finally, having onsite interpretive staff could serve to educate people and reduce conflicts between wildlife and humans.

The presently utilized white to yellow light could be changed to light visible to the human eye, but undetectable to hawksbills. Witherington and Martin (2000) noted that most turtles cannot detect red light (620-750nm), and thus recommended changes could include installing light of this wavelength in order to make the beach safe for both humans and turtles. Floodlights on the vacation rental house should be replaced with shielded downlights, illuminating only the stairs as needed for safety. The existing artificial light at the county beach park pavilion could be shielded with a screen or window that would block the light from polluting the beach. The shields could be installed so that pavilion users, for example, could open them during the day, thus enabling a beach view, but be able to close them at night, thus preventing turtles from being drawn southward along the beach.

It is important to note that reducing light pollution at Punaluʻu must be considered a shared effort not only because the beach is heavily used by the local public, but also because it is a main tourist attraction along the Kaʻū coast. Implementing and maintaining changes that reduce light pollution will require regular cooperation and communication between multiple groups including: HIHTRP, private landowners, state, federal and county agencies, community groups, and tourists. In 2010 HIHTRP met with beach residents and FWS and NMFS personnel to begin discussions on ways to work together to improve the light pollution problem. It is recommended that FWS continue to work with the County of Hawaii and beach residents to apply for funding that will help facilitate a project to retrofit existing lights at Punaluʻu, especially in the pavilion and the parking lot at the south end of the beach park and at residences.

Kōloa

All three nests were failures in 2010, most likely due to repeated exposure to salt water during high tides. In 2003, personnel translocated all four nests because of their proximity to the high tideline. In 2004, three nests were left *in situ* and had above average hatch successes. Based on these three seasons of observations, any nest that is not laid in the vegetation should be translocated to higher ground. The beach here experiences dramatic tidal fluctuations that over the course of the two month incubation exposes nests to immersion in salt water. In addition, heavy recreational use and high density of predators requires onsite personnel to protect all nests here.

Kāwā Bay and Kaʻiliʻili:

As mentioned in last year's report, access and management of hawksbill habitat at these sites is extremely challenging due to sensitive cultural and political issues. In addition to marginal habitat and high density of non-native predators, human activities pose significant threats to nesting hawksbills. Management practices need to be implemented immediately to reflect the ecological significance of the site. Therefore, signs should be posted to thoroughly educate visitors and promote stewardship. Limiting vehicular access on the nesting habitat is high priority for conservation. Non-native predator control needs to be regularly performed during the nesting season. Reducing the impacts from artificial lighting also needs to be implemented during the season. The State and the County of Hawaiʻi will need to work with beach residents and implement the necessary measures to protect this valuable nesting habitat.

Humuhumu Point, (Road to the Sea)ʻĀwili Point and Manukā

To manage the recreational impact, we determined that at these sites it would be very difficult to keep the current road alignment while permanently blocking off vehicular access to the nesting habitat and still allowing access to fishing grounds along the coast. However, some simple steps could be taken to protect some of the nesting habitat and nests at ʻĀwili Point without closing the road. Boulders or some similar barricades could prevent trucks from driving on most of the beach where the turtles nest. Future work needs to be done with the landowner, the State of Hawaiʻi, to change the course of the roads to solve this problem and install permanent barriers if we are to protect the nesting habitat from vehicular traffic.

4) ***Secure long-term funding for the project.***

From 1989 to 1992, the project was initiated by HAVO Resources Management Division with minimal funds and coverage, usually incidental to other HAVO backcountry programs. Since then the project has slowly grown into a partnership between government agencies, private landowners, educational institutions, non-profit organizations, and community members. Over recent years funding has been through several FWS competitive grants that assist private landowners, NPS, HNHA, NMFS-PIRO, FWS grants, and donations from WTT. Securing adequate funding in the face of rising operating costs continues to be a challenge each season. We are working to adapt so that we can continue our efforts with less resources without having to reduce our monitoring efforts. However, if we cannot continuously secure adequate funding, we may be forced to reduce our efforts.

5) ***Strengthen partnerships.***

We need to further strengthen our partnerships with private landowners, state, federal, and county agencies, educational institutions, non-profits, and community groups to find funding and to better manage coastal ecosystem integrity and promote responsible stewardship of coastal resources. For example, the beach at Humuhumu Point (Kahuku) is for sale and on the Hawaiʻi County Open Space List. We need to continue partnering and planning to apply for the funds to purchase this site at the federal and state level.

6) ***Continue with education and outreach efforts.*** Building support among the community is imperative for the long-term success of the project. In particular, increasing public awareness on the harmful impacts of off-road vehicles, trash, artificial lights and predators is needed to reduce incompatible human actions during critical nesting periods.

7) ***Additional analysis of long-term data sets.*** A technical report in review now is the first step in documenting 20 years of monitoring at nesting beaches on Hawaiʻi Island. Additional research and analysis of the data is planned over the next few years to evaluate differences in nesting occurrence and nest success among sites and years, including the influence of local environmental factors on hatchling nest success.

Most of our management actions and recommendations are high priority actions as identified in the 1998 Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle by the NMFS and the USFWS. According to the Plan, "…The recent discovery of significant numbers of nesting hawksbills on the Hilo coast of Hawaiʻi is perhaps the only positive sign in an otherwise bleak picture. With virtual protection and an aggressive management plan in place, the Hawaiian hawksbills stand the best chance for recovery…".

Acknowledgements

Special mahalo to Lauren Kurpita, Elizabeth Ransom and all the 2010 Turtle Volunteers and Interns for their help with the data collection for the creation of this report. Extra special mahalo and aloha to Minky Markiewicz for two decades of volunteer service. We would also like to acknowledge the following project supporters, partners and cooperators: National Park Service-Hawai‘i Volcanoes National Park, U.S. Fish and Wildlife Service, Hawai‘i Natural History Association, National Marine Fisheries Service, University of Hawai‘i at Mānoa - Pacific Cooperative Studies Unit, World Turtle Trust, Three Mountain Alliance and ‘Imi Pono no ka ‘Āina, Yamanaka Enterprises Inc., Nani Kahuku ‘Āina LLC, Hawai‘i State Department of Land and Natural Resources, The Nature Conservancy of Hawai‘i, University of Hawai‘i at Hilo, Hawai‘i Wildlife Fund, Ka‘ū High School, The Trust for Public Land, Hawai‘i County, Kupu and Americorps, and the Big Island ohana.

Hawai‘i Volcanoes National Park, Resources Management Division, Thanksgiving 2010

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Appendix A. Specimens (n=224) collected by HIHTRP on Hawai‘i Island 2010-2011.

Hawaii Island Hawksbill Turtle Recovery Project: Contact Will Seitz (808) 985-6090
Eretmochelys imbricata and *Lepidochelys olivacea* specimens
collected under permits USFWS TE-739923-6 and Hawai‘i DLNR SAP-2011-32
Island of Hawaii, 2010 Season
Submitted to NOAA-NMFS Pacific Islands Fisheries Science Center, Honolulu, HI. March 2011

Specimen #	Location	Tag #s LFF/RFF	Turtle ID	#Hatchlings	#Partially Developed	#Pipped	#Unopened Eggs	Total Specimens
1	‘Āpua Point	2D20/2D21	101	5				5
2	‘Āpua Point	2D20/2D21	101	3				3
3	‘Āpua Point	2D20/2D21	101	2		1		3
4	‘Āpua Point	2D20/2D21	101		4			4
5	Halapē	3D07/481X?	58?	1	2			3
6	Halapē	3D07/481X	58	3				3
7	Halapē	3D07/481X	58	0	1	1		2
8	Halapē	3D07/481X	58	4				4
9	Halapē	1D18/1D17	75	4				4
10	Halapē	1D18/1D17	75	13				13
11	Halapē	1D18/1D17	75	3				3
12	Halapē	1D18/1D17	75	16	49	17		82
13	Halapē	1D18/1D17	75	3				3
14	Kamehame	B565/B566	30	3				3
15	Kamehame	B565/B566	30	3				3
16	Kamehame	1D79/1D80	86	3				3
17	Kamehame	1D79/1D80	86	2				2
18	Kamehame	1D79/1D80	86	3				3
19	Kamehame	3D23/3D19	102	1		3		4
20	Kamehame	3D23/3D19	102	1	3			4
21	Kamehame	3D66/3D25	103			3		3
22	Kamehame	3D66/3D25	103	1	1	1		3
23	Kamehame	UNK	UNK				2*	2
24	Kōloa	3D55/3D59?	104?		10			10
25	Kōloa	3D55/3D59?	104?		12			12
26	Kōloa	3D55/3D59	104	3				3
27	Pōhue	1D64/1D65?	77?	4				4
28	Pōhue	1D64/1D65?	77?	4				4
29	Pōhue	1D64/1D65	77	1				1
30	Pōhue	1D64/1D65	77	1		2		3
31	Pōhue	85M/88M?	64?	3	2	1		6
32	Pōhue	85M/88M	64	3				3
33	Pōhue	85M/88M	64	2				2
34	Pōhue	85M/88M	64	3				3
35	Pōhue	85M/88M	64	1	2			3
36	‘Āwili Point	3D74/3D76?	105?		1			1
37	‘Āwili Point	3D74/3D76?	105?	1				1
38	‘Āwili Point	3D74/3D76	105		3			3
39	‘Āwili Point	3D79/3D78	OR 1	3**				3
			TOTALS:	**103**	**90**	**29**	**2**	**224**

* = 2 unopened eggs found washed up on beach. ** = *Lepidochelys olivacea*
? = unobserved nest, educated guess as to nesting female's identity

Appendix B: Map of confirmed hawksbill nesting habitat on Hawai‘i Island.