An Assessment of Maui Hawksbill Sea Turtle (*Eretmochelys imbricata*) Characteristics and Habitat Utilizations from In-Water Surveys and Incidental Observations (1998-2013)

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INTRODUCTION

As recognized in sea turtle recovery plans, certain research priorities are highlighted: "determine population size, status, and trends through long-term regular nesting beach and in-water censuses, and identify and protect primary nesting and foraging areas for the species…" (NMFS and USFWS 1998).

Hawksbills (*Eretmochelys imbricata*) worldwide and Hawaiian hawksbills are categorized as a "critically endangered" species (IUCN 2010). Despite being protected for 35 years, it is still relatively rare to see a hawksbill while snorkeling or SCUBA diving the coral reefs in Hawai'i. It is not well known that hawksbills are even found in Hawai'i, especially since they resemble Hawaiian green sea turtles (*Chelonia mydas*) that frequent the same coral reef habitats. Both greens and hawksbills have the same number of scutes, so that cannot be used to distinguish species (Figure 1). Besides the pointed beak that gives the hawksbill its name, species-specific features include four pre-frontal scales (greens have two), two claws per flipper (greens have one), and jagged serrations and overlapping scutes on the carapace, especially when young (Lutz and Musick 1997; Pritchard and Mortimer, 1999).

Population estimates and trend determination of the Hawaiian hawksbill population are unavailable due to their scarcity and lack of research. Hendrickson (1969) stated that hawksbills were only encountered sporadically, with no known nesting, and ongoing green sea turtle studies by NOAA-NMFS have not encountered a notable number of hawksbills. Of 313 turtles caught for tagging purposes at Kiholo Bay on Hawai'i Island, only three were hawksbills (Balazs et al. 2000). Nesting information is becoming available from the only two Hawaiian islands with hawksbill monitoring projects: Hawai'i Island and Maui, but there is a paucity of information about the foraging/resting life stages. This is a crucial component to characterizing the population of Hawaiian hawksbills. This report significantly builds on the author's first focused effort to quantify the numerous unanswered questions about hawksbills (1998-2011) by collating an additional two years of observations of a metapopulation of the Hawaiian hawksbills on Maui.

METHODOLOGY

I. Opportunistic Sightings

Due to the limited resources available for this type of research, underwater sightings of hawksbills were obtained in a variety of ways. The author has been actively seeking out hawksbills while snorkeling/diving and collecting incidental sightings from recreational users since 2000. The author created a hawksbill identification flyer that

provided information on where to send sightings, and co-created a general Hawaiian hawksbill brochure (Figures 2 and 3). These primary materials were utilized in educational outreach opportunities to different user groups in casual settings, during public presentations and events, and while visiting Maui snorkel/dive shops and governmental and educational locations in hopes that posting flyers would increase sightings. Online sources used for this same purpose included the Hawai'i Wildlife Fund website (www.wildhawaii.org), Facebook, www.iNaturalist.org, The Coral Reef Monitoring Portal (www.monitoring.coral.org/other_sites), and a YouTube video about this project. YouTube and Facebook are great resources for seeing what others are seeing during their underwater explorations, and the author occasionally browsed them with limited success of finding hawksbills on other islands, but no new Maui sites. Ursula and Peter Bennett's hawksbill observations at Honokowai, West Maui were included in this report (www.turtles.org) as well as some early photos from www.whalematch.com. Most notably, Don McLeish contributed the most sightings, high quality photographs and valuable behavior observations in the West Maui area (www.dmcleish.com) and Anita Wintner in the South Maui area.

Once located and identified, individual turtles were named as well as given unique numbers. Volunteers helped name the turtle, if it's a new individual to this collection, which encouraged further project involvement and connection to the research subject. The majority of these sightings came from individuals who have kindly committed their resources to regularly report their sightings, and this information is invaluable. Each report varied in accompanying details, but as much information as possible was gleaned from the accounts and photographs and added to the sightings data for each individual. Although additional accounts without pictures have been gathered, only sightings with pictures were included in these analyses for accuracy purposes.

2. Line-transect Surveys at Select Locations

Transect survey methodologies were proven during the author's Masters of Science research and only slightly modified for this project (King 2007). Each in-water snorkel transect was ~60 minutes long, with the start and end locations and times being recorded. Each survey involved 2-10 snorkelers swimming together at the surface in a single row perpendicular to and contouring the shoreline, focusing on the depth range of 1-45 ft (Leon and Diez 1999). The observers were arranged according to bathymetry, with the person closest to shore remaining at ~10 ft depth making sure that the inshore area was visible. The seaward observer remained at ~30 ft while covering this area and seaward to ~45 ft whenever possible. The other observers were spaced out between these two to complete the coverage. The purpose was to make a thorough "sweep" of

the area, detecting the turtles that were in the region. While everyone swam at a constant speed (which varied according to currents and conditions), ledges and crevices that might have qualified as turtle resting areas were checked briefly by freediving.

Green turtles were counted and sometimes photographed for particular features of interest (large fibropapilloma tumors, injuries, fishing gear interactions, etc). Once a hawksbill was found, photographs were taken whenever possible (both profiles, front flippers, tail region, carapace, and any unique features) for individual identification purposes. Turtles have unique arrangements of scales on both sides of their faces and flippers, and photographing them is a very nonobtrusive way of tracking them across time (Richardson et al. 1999, Bennett et al. 2000). Photographs have very effectively been used as a mark-recapture method in the place of tagging (Gerrodette and Taylor 1999).

Whenever possible, the following information was recorded for each turtle: time, location, depth, habitat (coral reef estimating whether the majority of the composition was *Porites compressa* (finger coral) or mixed species, sandy, rocky, or *halimeda spp*), and size in carapace length (small= <2 ft, medium= 2 ft – 3 ft, large= >3 ft; Parker 1991). When unsure about size categories, overlapping categories such as "small-medium" or "medium-large" were recorded. Large, mature turtles can be sexed by viewing the tails. Adult males have elongated and thick tails that grow well beyond their carapace and hind flippers while females have short tails that don't extend past their flippers. Tags, injuries or other notable characteristics, as well as each turtle's initial behavior (swimming which included breathing but not actively searching for food, foraging which included the act of searching for food, resting motionless on the sea floor, and cleaning being noted during resting and foraging) were recorded. Forage species were noted if discernable, along with any associated fish species monopolizing on foraging behaviors that tended to expose food items for them. Fish species that were observed cleaning the hawksbills were recorded.

Each turtle's behavioral reaction to human presence was also documented: tolerance (approaches or doesn't swim away), slow departure (swims slowly away and keeps its distance), or flight (rapid departure). When a turtle brushes one of its front flippers across its face in a sweeping motion this is termed "flipper swiping", and could possibly be a display of displeasure (Davidson 2001). This behavior has not been documented in hawksbills like it has for greens, so this was watched for.

Photographs (2,641) were organized in dated electronic files by location and turtle, and printed out and matched by individual. Each turtle has a binder of all sightings organized by date. Accompanying data were entered into Excel spreadsheets and analyzed using Excel. Caution should be used when interpreting statistical results

due to the non-normal data and irregular collection techniques by numerous different observers and quality of photographs. Some behaviors, such as cleaning, may go undocumented in photographs, so are likely underestimates of occurrences. Recognizing the difficulties in analyzing these types of data, the information is still valid and is the largest collection of Hawaiian hawksbill data known to exist.

RESULTS

These data build upon the collection of 368 (July 1998-May 2011) in-water hawksbill sightings collected during surveys by the author and incidentally from recreational snorkelers/divers through June 2013. These new 155 sightings contribute seven new hawksbills to the previous thirty-three known individuals for a total of forty Maui hawksbills.

One hundred and five different observers witnessed these hawksbills, with snorkelers contributing 73.4% (SCUBA divers, 26.6%) of the sightings in which that information was included (361 out of 492). Thirty-one people make up our Turtle Transect Team, and they are some of the best contributors to this project. The flyer distributions to six government and educational sites and thirteen dive/snorkel shops (with mixed responses about where they would be displayed), weren't as effective as we'd hoped in obtaining sightings (Table 1). Besides talking with snorkelers/divers who we've met while conducting transect activities and at outreach events, perusing Facebook and YouTube seems to be the most fruitful way of learning about hawksbill sightings since pictures and vidoes are posted. Requests for sightings are also made in every one of our "Hawaiian Hawksbill Happenings" newsletters that get sent to ~1,200 people approximately bi-monthly. This project is included on our website and periodically posted on our Facebook page. The majority of the sightings came from HWF's contacts. Don McLeish, for example, found the section of the HWF website that requested hawksbill sightings and emailed us when he found "Melinda" with a hook/line in her mouth in 2008.

All locations, besides Molokini, were classified similarly as nearshore fringing reef systems. Although no benthic-focused research transects were undertaken as a part of this project, more detailed data have been collected at some sites by the University of Hawai'i and State of Hawai'i's Department of Land and Natural Resources Division of Aquatic Resources. Further investigations can be made in the future to more accurately classify hawksbill habitats. Simply estimating the coral coverage in the hawksbill photographs showed that of the 463 sightings recorded amongst coral, the dominant (>90%) benthic composition of the reef was *Porites compressa* in 90 of those sightings (19.4%), and mixed in the other 80.6%.

Besides Molokini, which is unique in that it is a tiny islet off of Maui, all fifteen sighting locations were on the leeward facing shores of Maui in areas that tended to be easily accessible and therefore frequented by recreational users (Figure 4). The full range of sightings occurred in Hawaiian Islands Humpback Whale National Marine Sanctuary waters. Figures 5 and 6 are maps of the West and South Maui coastlines, showing the total number of individuals and sightings per location. West Maui, from Mala to Honokowai, had 73.6% of all of the Maui and Molokini sightings, and 31 of the 40 individuals (although one of these individuals "Kamalaole Male" was also photographed at Kamaole on the South Maui side). The majority of these forty individual hawksbills were seen at four distinct locations, with most being observed in multiple locations: Honokowai= 11, Embassy= 10, Kahekili= 18 and Mala= 11 individuals. The Honua Kai had four different individuals and the Ka'anapali area (near the Hyatt, Marriott and to the south of the Sheraton) had five individuals (Table 2). South Maui, from Kamaole to Maonakala, had seven individuals (including "Kamalaole"), three of which were found at multiple sites. There have been three individuals documented at Molokini, none of which have been identified anywhere else, for a total of twenty-five sightings.

The Kahekili area had the most sightings (and, although not quantified, probably the most effort by Don McLeish and other regulars) of individuals and total number of sightings: 18 and 266. For more detailed analysis of the eighteen individuals who have been sighted there, the Kahekili location was further divided into distinct habitat sections: nearshore coral reef, deeper reef ("The Burbs": ~25-40 ft depths) and the halimeda beds (*Halimeda kanaloana*) (Figure 7). Similarly, Mala's 43 sightings of 11 individuals were sorted into two easily discernible locations: Mala (Baby Beach=BB) and Mala Pier (the north end of Baby Beach) to show habitat use. Only four of the eleven Mala hawksbills were seen at the Pier.

A total of 92 dedicated in-water transect survey hours were completed from 2010-2013. Figure 8 shows that some new and expanded sites were explored. Taking into account the variable ocean conditions and range of the numbers of surveyors and distance covered, interpretation of sighting results were still useful, but no density by distance estimates were made. A total of 34 hawksbills and 503 greens were recorded on these transects, with a hawksbill sighting frequency of 0.37 turtles/transect, which essentially equates to a catch per unit effort (CPUE) of 0.37 hawksbills/hr and 5.47 greens/hr (Bjorndal and Eckert 2000; Scales et al. 2011). The sightings ranged from 0 to 3 hawksbills and 1 to 60 (at Honokeana, West Maui) greens per survey, with zero hawksbills found during 61 (66.3%) of the transects. The four transects with three hawksbills sighted per transect occurred at Mala and from the Embassy to Kahekili area, when and after we discovered "The Burbs". One new hawksbill was discovered: "Sooty" off of the Honua Kai. Fourteen already known individuals were sighted, many

multiple times, adding valuable behavior information to the database: “1D67=Pohue”, “‘OLI”, “Batwoman”, “Hope”, “Lady Grunge”, “Leftie”, “Lilia”, “Melinda”, “Misty”, “Nani”, “Pueo”, “Rocket Girl”, “Squiggles”, and “Twinkles”.

All transect data were pooled with the incidental sighting information. All sightings included in this report were confirmed by photographs, and only a few weren’t of high enough quality to discern individuals. Using the photo-ID method, forty different individual hawksbill turtles were sighted between 1-80 times in a total of fifteen different locations over <1-13 year spans (Figures 9, Table 2). The number of individual turtles and number of sightings are illustrated in Figures 5-7. Eleven hawksbills were only sighted one time (two at Honokowai, four at Kahekili, and one each at Ka‘anapali, Maonakala, Mala, Molokini, and Oneuli). When grouped in blocks of ten sightings from 1-80, twenty-five turtles were seen from 1-10 times, five from 11-20 times, five from 21-30 times, three from 31-40 times, and one from 61-70 and 71-80 times each (Figure 10).

Two hawksbills had the longest sighting histories of thirteen years (Kiniana and 83M=Ake). The majority of the hawksbills have been documented for less than half that duration. The forty individual turtles were sighted in 1 to 7 different locations each, with three turtles, 9.1%, being sighted in four locations (Figure 11, Tables 3-6). Of the eighteen seen in one location, eleven were only sighted one time total. Ten turtles were documented more than once in only one location, showing high site fidelity at the Embassy, Molokini, Mala (BB), Mala Pier, Maluaka, Kahekili-Reef, and Honokowai. As shown in Tables 3-6, hawksbills were seen in the same general regions of their sites for long time spans.

“Kiniana” and “Rocket Girl” traveled the farthest distances between sites: Mala (BB) to Honokowai, which are approximately 5.7 miles apart. The one exception to this was “Kamalaole Male” who was sighted foraging at Mala (BB) on 7/14/2008 and swimming offshore of Kamaole on 10/10/2010, with no sightings in between. Interestingly, his tail grew significantly in between sightings, confirming his male status in 2010. This is by far the longest re-sighting distance (~22 miles) suggesting he might have been undertaking a post-mating migration when he was sighted off of Kamaole in October. Only one other male has been documented: “Scar Boy” was swimming through Kahekili-Burbs on 4/30/2011, but hasn’t been seen since. It is a possibility that he was on his way to a mating area. Mating Hawaiian hawksbills have not been documented; therefore the locations of the mating areas are completely unknown. All known Maui hawksbill nesting beaches are along the South Maui and Hana coast (King et al. 2007 and 2012).

Sixteen of the forty turtles were large (40.0%) so were sexed and as mentioned above: only two were males and fourteen were females (Table 6). Eight turtles grew

enough during the course of this project to be placed into higher size classes (illustrated by ">>" between sizes in Tables 4-6). The twelve medium sized turtles (30.0%) all have very small tails and may actually be big enough to assume that they are females, but they were still listed as unknowns. It is unknown at what age or size range hawksbills reach sexual maturity, begin to show their sexual dimorphism, or how fast the males' tails grow once this begins. Using "Kamalaole Male" as an example, his tail was already longer than the other turtles his size (medium) that we've photographed in 2008, but obviously large in 2010. Therefore, since none of the medium sized turtles photographed showed any indication that they might be males since they had very small tails, the sex ratio is very female-biased even if the twelve small hawksbills (30.0%) turn out to be males. Molokini was the only site that had multiple turtles of only one size (small), and more diverse size classes were found at other locations.

Initial turtle behaviors upon discovery were recorded 536 times (when cleaning and foraging or cleaning and resting were happening, they were both counted, which is why there were more than 523 behaviors): cleaning (6.3%), resting (24.6%), swimming (28.2%), and foraging (40.9%) (Figure 12). Table 2 organizes individual hawksbill behaviors by locations. Twelve different hawksbills of all size classes were witnessed being cleaned. Cleaning took place the most in the Kahekili-Burbs (n=19) while the hawksbills were resting, as well as at the Kahekili-Reef area. "Squiggles" was getting cleaned twice at the Mala Pier while "hovering" above the reef, but the hawksbills were resting in the other instances at the Embassy, Honokowai, Ka'anapali, and Oneuli.

The initial behaviors by location and by sixteen individual hawksbills (chosen because they had ≥10 recorded behaviors, providing better insight) were graphed to identify any patterns (Figure 13 and 14). Foraging was shown to be the most common behavior overall, and all of these sixteen turtles were seen foraging with seven of them doing that more than other behaviors. All sixteen turtles were observed swimming and resting. Seven of these were not seen being cleaned.

The 276 sightings that had accompanying time data were categorized into 4, 3-hr and 1, 5-hr time bins (to include night time sightings). The percentage of sightings were: 06:00-09:00, 6.2%; 9:01-12:00, 30.8%; 12:01-15:00, 42.0%; 15:01-18:00, 19.2%; and 18:01-22:00, 1.8%) (Figure 15). Three night time observations were made: one at Mala ("Molo-mini") and two at Kahekili-Reef ("Skirts" was seen twice resting under a coral ledge just offshore, and another unidentified hawksbill was nearby). More night time observations are planned on being conducted in the future.

Particular fish species were occasionally associated with certain behaviors: foraging and cleaning. Saddleback wrasses (*Thalossoma duperrey*) were observed in the vicinity of hawksbills 79 times, and all but three of these sightings occurred while the hawksbills were foraging. They seemed to be benefitting from the byproducts of what

the hawksbills were stirring up as they foraged. Surgeonfish species, particularly the goldring (*Ctenochaetus strigosus*), cleaned the hawksbills' carapaces during 20 of the 23 occasions they were witnessed nearby the hawksbills. Six Hawaiian cleaner wrasses (*Labroides phthirophagus*) were recorded cleaning resting and foraging hawksbills.

Depth observations were made (or discerned from photographs) for 343 out of the 523 sightings and grouped into five categories of ten from 1 to >40 (Figure 16). Only thirteen (3.8%) turtle sightings occurred deeper than 40 ft at Molokini, Kamaole, Kahekili-Burbs, and Kahekili-Halimeda. The majority of the turtles were observed while at a depth range of 11-20 ft (53.6%), but that also may simply reflect that depth being the most common recreational snorkeling area.

Although often difficult to discern from photographs, turtle reactions to human presence were obtained from the sighting data in 415 incidences, with the category of tolerance being the most common reaction (84.3%). One small hawksbill who has only been seen once at Oneuli ("Akamai") exhibited true flight behavior that the photographer could only take one picture of it. It may have been seen there another two other times as well, but the photographs didn't come out due to it fleeing so fast. Three flight reactions from three different turtles: "Leftie" and "Lilia" at Mala and "Melinda" at Kahekili-Reef occurred, which may have been triggered by the observers towing surfskis tethered to them. This "tameness" allows for quality observations, especially while they are foraging, but subjects them to harassment.

Unfortunately, the hawksbills were most commonly foraging in crevices in the *Porites compressa* and other species of coral so seeing exactly what they find was challenging. Forage species were very difficult to identify, so these results may not be 100% correct, but based on knowledgeable observers and quality pictures, six species of algae (*Amansia glomerata, Codium spp, Halimeda kanaloana, Hypnea musciformis, Sargassum spp, and Turbinaria ornata*), unidentified sponges, fireworms (*Eurythoe spp*.), "mystery eggs", and an urchin were identified (Table 7). Also noteworthy but without photographic confirmation, a hawksbill that was presumed to be "Molo-mini" was witnessed catching and eating an octopus at Molokini (J. Svendson and D. Bromwell, pers. comm. 2004). Two different adult females have been documented eating turf algae(?) growing on the calcified pavement nearshore of the Embassy ("Melinda" four times and "1D67=Pohue" once) in 2012 and 2013. "Melinda" was seen delicately scraping the coral polyps from lobe coral at Kehekili-Reef on four different occasions. We are awaiting the results of scat samples we've sent for analysis to hopefully elucidate more species-specific identification.

DISCUSSION

This study has provided the first long-term assessment of a previously unknown aspect of Hawaiian hawksbills, their foraging and resting habitat. Monitoring hawksbills in these habitats, where they spend the majority of their lives, is the only way to truly assess threats to this life stage (Bjorndal 1999; Bjorndal and Eckert 2000). Below are brief descriptions of known threats to hawksbill survival related to identified hawksbill habitats. Table 8 applies a basic, relative rating system from 1-4 for each location (red 1= serious threat, orange 2= threat present but not serious, yellow 3= potential but no cases, green 4= no perceived threat):

Threats

1) New coastal development
2) Pollution
3) Algae blooms
4) Disease and injuries
5) Interaction with recreational fishers
6) Harassment by snorkelers/divers
7) Vessel strikes
8) Marine debris entanglement and ingestion
9) Poaching
10) Subsistence hunting (*Chelonia mydas*)
11) Climate change

1) New coastal development: There is very little undeveloped beachfront land left on Maui. The coastal strip along Kahekili has been developed in the last ten years, and resorts have already been approved along the last remaining open stretch near the Honua Kai. A timeshare development is underway between Maluaka and Oneuli, a previously wild coastal area. Impacts can be mitigated if green development is practiced, but regulations and recommendations need to be followed. Green building and regulations are development driven. Planners and community involvement in the planning process can lead to conservation practices which is the only way to truly mitigate the impacts.

2) Pollution: Two non-point sources can be identified as threats: land-based pollutant runoff from multiple sources and uncontrolled sedimentation run-off from storm events; and two point sources: influx of nutrients and other pollutants from wastewater injection wells and boat-based pollution from head pumping and

chemical cleaners. All have the potential to threaten the nearshore areas of all of the hawksbill sites, but the direct impacts, if any, are not well understood.

3) Algae blooms: Harmful algae blooms occur (due to multiple factors) in the Kahekili and Kihei areas. Short and long-term effects on hawksbills and their habitats have not been quantified.

4) Disease and injuries: A series of injuries were recorded, but none seemed to hinder the turtles' movements. "Stubby" at Molokini was missing most of its right front flipper from what appears to be a shark bite, or it may be the same individual that was rescued from entanglement in 1996 (identity information is not available). "Leftie" has a minor, old left rear flipper injury (the edge is shaved off). We noticed that "'OLI" developed a large abscess on its neck, so it was rescued, treated on Oʻahu, then returned to Maluaka for release. No evidence of fibropapillomatosis was observed in any hawksbills, but Ursula and Peter Bennett and George Balazs documented "Wai?", potentially a hawksbill/green hybrid, developing the tumors (Bennett and Keuper-Bennett 2008).

5) Interaction with recreational fishers: It seems that all of the hawksbill sites are targeted by spearfishermen, and shore-based recreational fishing is quite common all along Maui's coast. Interactions are occurring seemingly more often with green turtles especially, and may be more of a serious problem than what is being managed for (C.King, unpublished data). Seven fishing gear entanglements have been recorded: one at Molokini in 1996 (removal by DLNR-DAR), "TTFKAP" at Maluaka in 2007 (small fishing hook embedded in left front flipper with ~6 inches of trailing line), "1D67=Pohue" at Kahekili in 2008 (small fishing hook embedded in left shoulder with <6 inches of trailing line), "Squiggles" at Mala Pier in 2009 (line cut by University of Hawai'i Marine Option Program Director), "Melinda" at Kehekili-Reef in 2008 (line cut at the mouth by good Samaritans), and a bycatch incident using a fishing pole from shore at Olowalu in 2011 (no pictures of them cutting the line at the mouth exist for proof, but the fishermen were well aware of the difference between hawksbills and greens).

A small hawksbill with fishing line extending from its mouth was reported to HWF on 10/7/12, and Don McLeish was in the area. He found "Squiggles" with ~8" of line extending out of the mouth. He was able to cut the line with no injury to himself or the turtle. Squiggles was seen again three more times after that, still around the Mala Pier (where people actively fish). The NOAA turtle strandings program picked up Squiggles at Mala (BB) on 4/11/13. The necropsy showed two hooks embedded in its throat, which caused an infection, but the

official cause of death was drowning. This definitely highlights the important need for removing the hook, not just the line, in these cases.

6) Harassment by snorkelers/divers: None of the hawksbill sites are "safe" from recreational snorkelers and divers. We have witnessed countless harassment cases. Much more education needs to be promoted about proper sea turtle viewing etiquette, as this also seems to be increasing.

7) Vessel strikes: "Scar Boy" at Kahekili-Burbs had a large gash out of his carapace, which appeared to be from a boat strike. The Lahaina to Ka'anapali area and Oneuli-Maluaka area are high boat traffic areas with tour boats, local recreational boats and jet skis frequenting these sites. The hawksbills that forage and rest deeper are even more at risk when they surface to breathe, since they are farther offshore.

8) Marine and land-based debris: Marine debris is an increasing problem that potentially creates entanglement and ingestion issues for hawksbills, but the majority of it generally washes ashore on Maui's windward facing shores. A large net that was floating off of Oneuli was retrieved by boaters in 2011, so none of our study sites are safe. One Maui hawksbill stranding was off Lipoa Street in Kihei in 1994 ("injured by possible net entanglement" treated by Dr. Robert Morris and the NOAA Marine Turtle Research Program on O'ahu). A <2" carapace hawksbill was found entangled in a marine debris net by a tour boat going to Molokini on 4/20/13. It was cut free and released. Windblown, shore-based rubbish seems to be a bigger threat on the leeward coasts, but no interactions have been reported.

9) Poaching: Poaching happens despite regulations against it, and due to the lack of effective enforcement, this will likely continue. Although poachers may be targeting green turtles for their meat, a hawksbill's shell can still be valuable if recognized as such. It is not known if Hawaiian hawksbills are poisonous like in some areas of the world. A green turtle was found drowned, tied to a spear in the sand off of Mala (BB) in ~2003. A green carapace was found onshore at Maluaka in 2005 and two green plastrons were found in the water, just off a fishing point in between Maluaka and Oneuli in 2010. In a similar situation in that same location, we found the plastron in the water and the carapace in the bushes in 2012, so poaching is definitely a problem in that area. Another carapace was found half-buried in the sand at Kealia in 2010. There are probably many more incidences than these, so an investigation into these activities may lead to a pattern of behavior and should be quantified.

10) Subsistence hunting: A movement has been building to allow the cultural subsistence take of green sea turtles since the population is noticeably increasing. This will be particularly threatening to the hawksbills since they may be caught, by accident or intentionally, as well. Allowing this just opens up the door to non-subsistence take and will be very difficult to regulate, so hawksbill-related protections need to be in place before that happens.

11) Climate change: Issues from increased temperatures and storm events to ocean acidification are very complicated, but since hawksbills depend on our nearshore coral reef ecosystem to survive, it appears they will be affected on multiple levels. More research and forethought need to be undertaken and included in management plans.

Hawksbills worldwide are predominantly spongivores, but algae and invertebrates have been found in stomach contents (Witzell 1983; Meylan 1988; Limpus 1992; Lutz and Musick 1997; Diez and VanDam 2002; Spotila 2004). Little is known about the foraging habits of juvenile or adult Hawaiian hawksbills but their diets were thought to consist primarily of sponges (Balazs 1978a; NMFS and USFWS 1998). Dr. Ralph C. DeFelice identified a forage species as *Chondrosia chucalla*, a possibly endemic sponge (U. Keuper-Bennett, pers. comm. email 2005). Stable isotope analysis seems to be a promising new technology, but remarkably, there is still little known about the dietary preferences of Hawaiian hawksbills (Graham 2010; Graham et al. 2012). It is interesting that they are interacting with fishing gear, as typical bait (fish or squid) represents a whole different dietary category that they are attracted to. "Squiggles" was seen nibbling on a discarded mahi mahi head carcass, and his interactions with fishing gear likely led to his death. The observations from this study broaden the foraging species base considerably and future in-water research should focus on this aspect due to the accessibility of foragers and frequency of foraging activity.

Only nineteen interactions with green turtles were recorded. Fourteen different hawksbills were involved in thirteen occurrences of two hawksbills interacting: once at Mala (BB) and at the Embassy, tow times at Oneuli, three times at Kahekili-Burbs, and six times at Kahekili-Reef. None of these interactions seemed malicious, as they typically swam up to each other and "sniffed" each other for generally under one minute, then moved away from each other. This happened with all different size ranges. One occurrence of them "nipping" at each other was recorded.

The Kahekili to Embassy area is by far the best location to attempt a tagging study due to it not only having the highest abundance of sightings and individuals along with the highest chance of seeing more than one per day. Also, the typically "tolerant"

behaviors of the resident hawksbills that reside there make approaching them for capturing possible. A hawksbill capture attempt was made for tagging purposes in collaboration with NOAA in May, 2013, but unfortunately, injuries sustained by one NOAA member cancelled the mission. We hope to reschedule this valuable aspect of our research. There are multiple coral reef-related research projects being undertaken there (University of Hawai‘i, Scripps Institute, and the Division of Aquatic Resources), so tying the results of the study into those efforts may be extra useful (Figure 17).

Mala is the second tagging site choice due to its accessibility, low numbers of tourists, and high number of hawksbill individuals sighted there. Unfortunately, they tended to be noticeably more cautious (possibly due to how surveyors tend to be towing surfskis behind them, so they perceive us as a bigger threat than without) so will be more difficult to capture. More time was spent there, without the surfskis, to assess these hawksbills and this location, but hawksbills were not reliably found.

Oneuli became the first hawksbill-focused tagging site in 2008 when “Hope”, “TTFKAP” and “‘OLI” were tagged all on one day. Only Hope semi-regularly remains in the area, as ‘OLI and TTFKAP haven’t been seen since 2010 and 2011 respectively. Two new small hawksbills have been located there though: a very tame one named “Nani” who can be seen regularly in the same area, and “Akamai” whose skittish behavior was described above. This area seems to be significant enough for these small hawksbills to recruit to, so remains the third choice for satellite transmitter deployment.

Two post-nesting hawksbills have been tracked from Hawai‘i Island to Maui: one off the North Shore spanning from Waiehu to Spreckelsville (1996) and one in Ma‘alaea Bay (2008) (Figures 18 and 19). Due to technological limitations of the satellite transmitters, their locations weren’t more specific. This information should be included when quantifying hawksbill foraging/resting habitat and considering future research locations. Anecdotal sightings (no photographs though) from these locations have been received: MacGregor Point, Nakahele Pt, Maliko, Honolua Bay, Olowalu, Coral Gardens, Keawakapu, and Keone‘o‘io. The Turtle Transect Team surveyed five out of these eight locations (with more easily accessible and safer ocean conditions), with no hawksbill discoveries. An effort to continue to expand beyond the places we’ve searched so far is crucial to attain an accurate representation of hawksbill habitats.

Ligon and Bernard (2000) assessed the habitats of two inter-nesting and one post-nesting hawksbills on Maui (the North Shore hawksbill mentioned above) and 72 feet was the mean depth of the triangulated positions obtained from vhf radio transmitters. This depth is deeper than the habitats we’ve assessed in this study, therefore indicating a need to search additional nearshore and offshore areas even

though the majority of the known individuals tend to utilize a variety of depth ranges. We still may be missing many individuals due to this depth factor.

With the help of satellite tracking, most post-nesting females have been shown to stay within the Main Hawaiian Islands for foraging/resting purposes (Ellis et al. 1998; Parker et al. 2009). Two of the fourteen large females from this study were tagged after they nested at Pohue, Hawai'i Island: "83-M=Ake" (2005) and "1D67=Pohue" (2007). These incidences support the use of external metal flipper tags, since without them we wouldn't have been able to trace them to their nesting beach. Both of these hawksbills have only been seen in the Honokowai and Kahekili areas over thirteen and ten-year sighting histories respectively, showcasing the importance of this habitat for reproductive adult survival.

Twelve other untagged adult females have been documented in this study, all but one in the West Maui region (Table 6). Photos of some of the adult females that interacted at Kahekili were compared and it could be determined that their sizes ranged from largest to smallest: "Pueo", "Misty", "Rocket Girl", "1D67=Pohue", then "Melinda". If at least three of these hawksbills are bigger than at least one of the tagged females, then it raises the question, "where are these adult females nesting?" Putting things in perspective, there are approximately 100 nesting females on Hawai'i Island and ten on Maui, so assuming that they all don't nest in the same areas, this equates to up to twelve new nesting beach locations that aren't identified, which would be a considerable addition to the known nesting habitats and population. Satellite tracking females prior to nesting season could provide especially useful insight into this subject, if they happen to undertake a nesting migration, so special efforts should be taken to try to achieve this.

The low number of sightings for over ten years of data collection, albeit haphazard and non-quantifiable, illustrates the Hawaiian hawksbill's rarity and that there is still much to learn. The long-term nature of these data and repetitious site visits provide valuable insight into previously unknown aspects of hawksbill behavior and habitat use. It is recognized that the sites surrounding the areas where hawksbills have been seen need to be searched further to truly quantify individuals' home ranges, especially since years go by without seeing them (which also relates to search efforts). These forty hawksbills certainly aren't the only hawksbills that utilize Maui for foraging and resting, so admittedly this study needs to be expanded greatly, but it's a solid start to quantifying their habitat use, activity patterns, distribution, abundance, and population characteristics. Dedicated resources are still needed. This study can also be a model for expansion to other Hawaiian Islands (which the author has started), which is critical for truly assessing this population's status. These valuable Maui hawksbill habitats, especially West Maui, support the largest known population of Hawaiian hawksbills and should be the target of continued research and protection.

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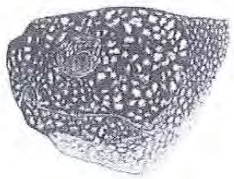
SEATURTLE.ORG

Sea Turtle Identification Key

Leathery, no scutes; 5 long ridges



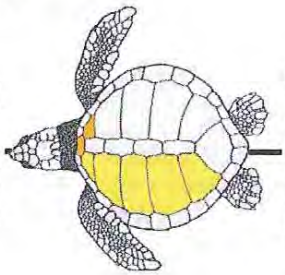
Leatherback
Dermochelys coriacea

Hard carapace (shell) with large scutes (shell plates)

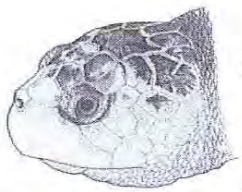
5 or more costal (lateral) scutes; First costal scute touches nuchal

Carapace wide and almost circular

5 costal scutes; Nearly circular

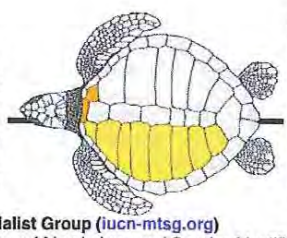


Restricted primarily to the Gulf of Mexico and Atlantic coast of the USA

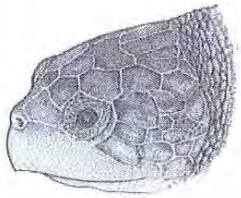


Kemp's Ridley
Lepidochelys kempii

usu. 6 or more costal scutes

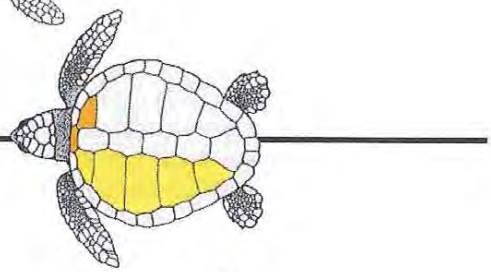


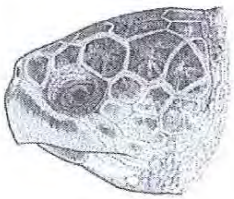
Found in tropical waters of the Pacific, Indian and South Atlantic Oceans



Olive Ridley
Lepidochelys olivacea

5 or 6 costal scutes; Carapace not circular

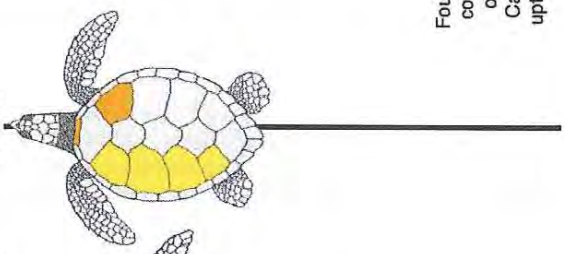


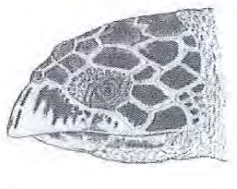


Loggerhead
Caretta caretta

4 costal (lateral) scutes; First costal scute does not touch nuchal

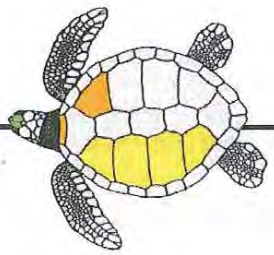
Two pairs prefrontal scales; overlapping scutes



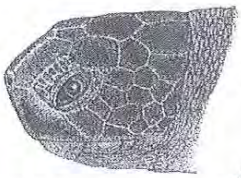


Hawksbill
Eretmochelys imbricata

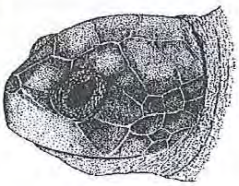
One pair prefrontal scales



Restricted primarily to the eastern Pacific Ocean; Dark pigmentation



Black*



Green
Chelonia mydas

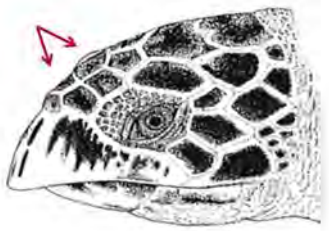
Found in tropical coastal waters of Australia; Carapace has upturned edges

Flatback
Natator Depressus

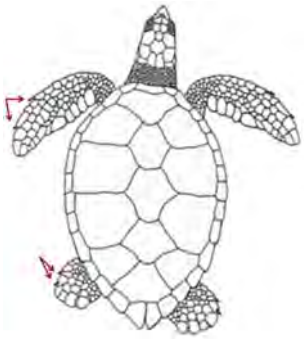
Sea turtle figures used by permission of the Marine Turtle Specialist Group (iucn-mtsg.org)
Source: Pritchard, P. C. H. and Mortimer, J. A. (1999) Taxonomy, External Morphology, and Species Identification. pp. 21-38. In: Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. (for further details see http://www.iucn-mtsg.org/publications/) Illustrations by Tom McFarland

~HAWAIIAN SEA TURTLES~

"honu'ea or 'ea"
HAWKSBILL TURTLE
(*Eretmochelys imbricata*)



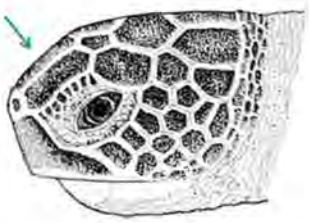

*Narrow head & pointed beak
*4 prefrontal scales (between eyes)



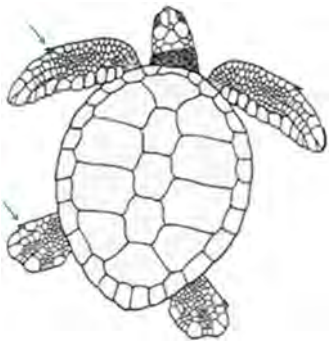

*Overlapping, like shingles, scutes (plates) on carapace
*Serrated edges when young (worn down on adults)
*2 claws per flipper


*Hatchlings are brown

"honu"
GREEN TURTLE
(*Chelonia mydas*)

*Rounded head
*2 prefrontal scales (between eyes)

*Adjoining, like tiles, scutes on carapace (shell)
*Carapace has smoother edges & is rounder
*1 claw per flipper

*Adult female sea turtles have short tails & adult males have long tails


*Hatchlings are gray & white

PLEASE HELP THIS CRITICALLY ENDANGERED SPECIES BY SENDING HAWKSBILL SIGHTINGS &/OR PHOTOS TO mauihawksbills@gmail.com. *Mahalo!*

Drawings: Thomas McFarland courtesy of WIDECAST / Photos: Cheryl King & Don McLeish / www.wildhawaii.org / ©2010 C.King

Hawaiian

Hawksbill Sea Turtles

Sea Turtles in Hawaiian Culture

As indigenous species in Hawai`i, sea turtles have historically played an important role in Hawaiian culture. Honu (green turtle) and `ea (hawksbill turtle) are mentioned in the Kumulipo, the Hawaiian creation chant. Hawksbills are also called honu`ea in some parts of Hawai`i.

Sea turtles were utilized in traditional ceremonies, and their use was controlled by the kapu ('taboo' or prohibition) system.

Honu meat and eggs were consumed and oils were used for skin treatments. `Ea meat was also consumed, although it is sometimes poisonous because a hawksbill's diet can include toxic sponges. `Ea shells were prized for the making of fish hooks, tools, medicine, and jewelry ("tortoiseshell").

Sea turtles appear throughout Hawaiian lore and legend in hula, petroglyphs, chants, and tattoos. Some families highly revere sea turtles as their `aumākua, or personal gods.

Hawksbill Trivia

- Hawksbill sea turtles are listed as "Endangered" under the 1973 Endangered Species Act.
- Adults can be ~3 feet in carapace (shell) length and weigh ~250 lbs.
- Hawksbills feed on sponges, invertebrates, and algae in the crevices of coral reefs.
- Adult hawksbills can hold their breath for up to three hours while resting.
- Between 1989 and 2007, 86 individual nesting females have been tagged on the islands of Hawai`i and Maui through limited monitoring activities.
- Results from satellite tracking show that hawksbill foraging grounds are within the Main Hawaiian Islands, primarily off the northeastern side of the island of Hawai`i along the Hāmākua coast.

Hawksbill Nesting

- It may take anywhere from 15 to 40 years for a hawksbill to begin reproducing.
- Regular nesting occurs on Maui, Moloka`i, and Hawai`i. Over 90% of documented nests have occurred along the Ka`ū coast on the island of Hawai`i.
- Between 5 and 15 individuals nest each year in Hawai`i.
- Adult females return (to the same region where they hatched) to nest every 2 to 8 years.
- Each female can lay 1 to 6 nests in a season, approximately 18 to 22 days apart.
- Each clutch (group of eggs) contains an average of 180 eggs that will incubate for approximately two months.

Hatchlings (Keiki)

- Sex determination is temperature-related; cooler temperatures within the nest chamber produce males and warmer ones produce females.
- Hatchlings emerge from the nest when the sand is cool, usually at night.
- Hatchlings find the ocean by crawling toward the brighter, open horizon.
- Hatchlings face a variety of predators on their way to the sea like crabs, birds, mongooses, cats, dogs, pigs and others. Once they reach the ocean, sea creatures like fish and sharks also eat them.
- Although unknown, it is assumed that a very small percentage of hatchlings survive to adulthood.

"The Lost Years"

The first few years of a Hawaiian hawksbill's life are a mystery. Once they leave the nesting beach, their movement patterns, growth rates, and diet are unknown. Eventually, they navigate back to Hawaiian nearshore coral reef habitats as juveniles and continue to mature.

Threats to Survival

Because hawksbills and humans share the Hawaiian Islands, our actions affect their survival.

Coastal development and beach walls damage or reduce nesting habitat.

Fires and artificial lights visible from the beach or shoreline may scare away nesting females and disorient hatchlings.

Non-native predators like mongooses, cats, pigs, and rats are a threat to eggs and hatchlings.

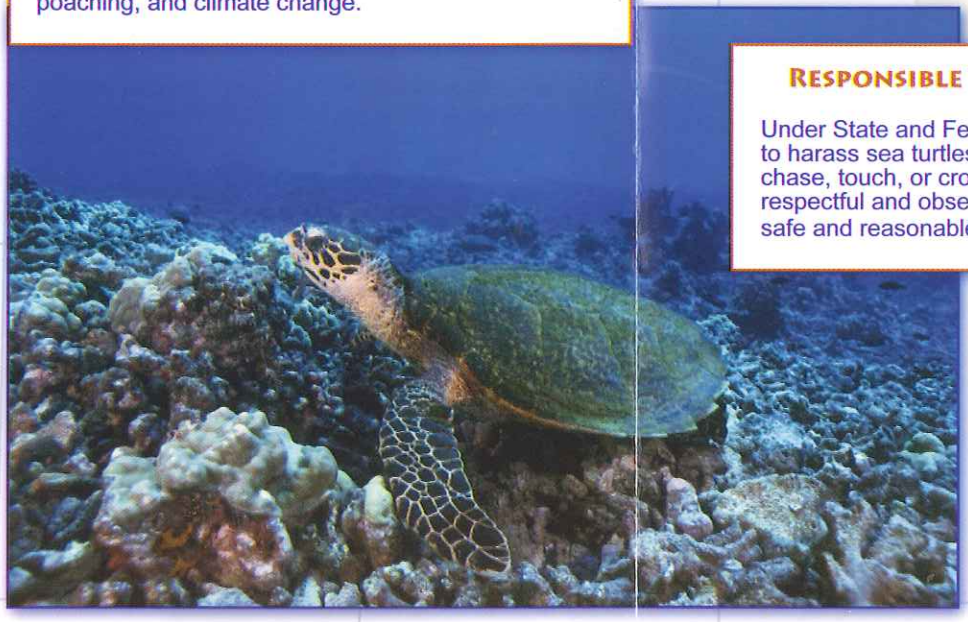
Some dune plants and grasses have thick roots that make nesting difficult. They also trap and entangle hatchlings.

Nighttime activity on nesting beaches can discourage nesting.

Beach driving can crush nests and creates tire ruts that trap hatchlings.

Trash or debris left on the beach can block hatchlings from reaching the sea.

Other threats include boat strikes, marine debris, urban run-off, invasive algae, fisheries interactions, poaching, and climate change.



Responsible Turtle Viewing

Under State and Federal law, it is illegal to harass sea turtles. Please do not feed, chase, touch, or crowd them. Be respectful and observe sea turtles from a safe and reasonable distance.

Photo Credits: Hawaii Island Hawksbill Project, C. King, A. Hebard, D. Bramwell, J. Baker, S. Eckert. Sea turtle illustrations by Tim Gunther, www.gunthergraphics.biz. Sea turtle diagnostic drawings by T. McFarland, courtesy of WIDECAST. Used with permission.

Hawaiian Hawksbills Need Your Kōkua!

Several agencies and organizations are collaborating in the on-going Hawaiian hawksbill research and recovery effort. Residents and visitors of all ages can get involved by volunteering or contributing in other ways. Mālama (protect) Hawaiian sea turtles by reporting tagged turtles, nesting activity, and in-water hawksbill sightings to the following.

Hawksbill Information Island Contacts:

O`ahu: NOAA's Pacific Islands Regional Office
808-944-2278, www.fpir.noaa.gov

Maui: Hawai`i State Division of Aquatic Resources
808-243-5294,
http://www.hawaii.gov/dlnr/dar/index.html or
Hawai`i Wildlife Fund
808-385-5464, http://wildhawaii.org

Hawai`i: Hawai`i Hawksbill Turtle Recovery Project 808-985-6090

To report stranded sea turtles please call the sea turtle stranding hotline: 808-983-5730

Report illegal or suspicious activity involving sea turtles to:

DOCARE: 808-643-3567 or

NOAA OLE: 1-800-853-1964

HAWAI'I WILDLIFE FUND

U.S. FISH & WILDLIFE SERVICE

NATIONAL PARK SERVICE

NOAA

HAWAI'I HAWKSBILL TURTLE RECOVERY PROJECT

DAR

Hawksbill or Green?

How to tell the difference

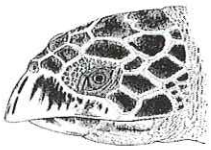
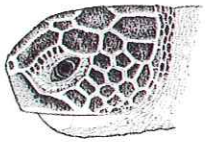
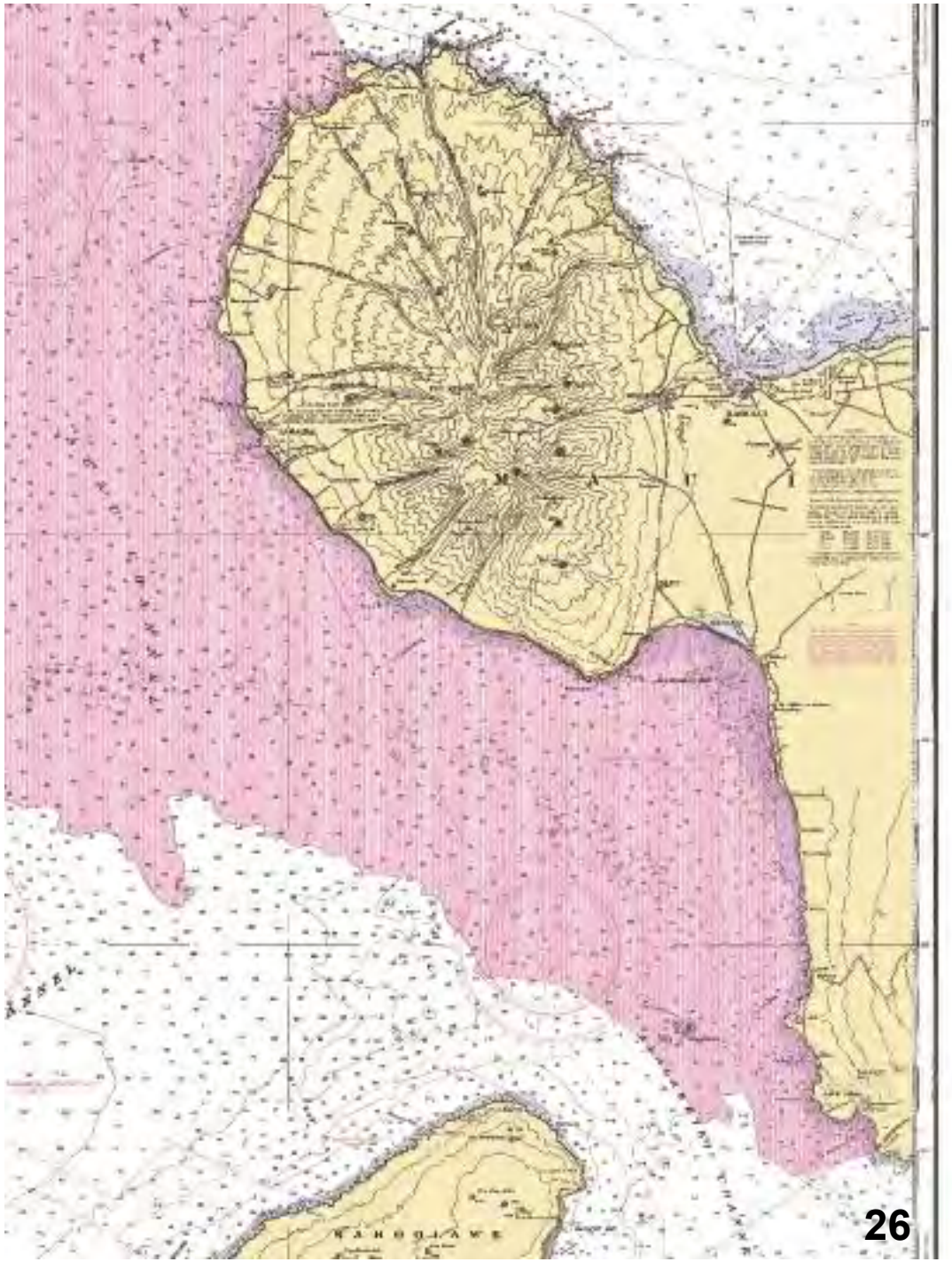
Hawksbill / `Ea / Honu`ea (*Eretmochelys imbricata*)	Green / Honu (*Chelonia mydas*)
	
• Narrow head and pointed beak • 4 pre-frontal scales (between eyes)	• Rounded head • 2 Pre-frontal scales (between eyes)
	
• Overlapping scutes on carapace (like shingles) • Carapace has serrated edges (juveniles) • Two claws per flipper	• Adjoining scutes on carapace (like tiles) • Carapace has smooth edges • One claw per flipper
	
• Hatchlings are all brown	• Hatchlings are dark gray with a white trim and underside.

Figure 4. Main Hawaiian Islands and Maui Island maps, showing Hawaiian Islands Humpback Whale National Marine Sanctuary waters (purple).



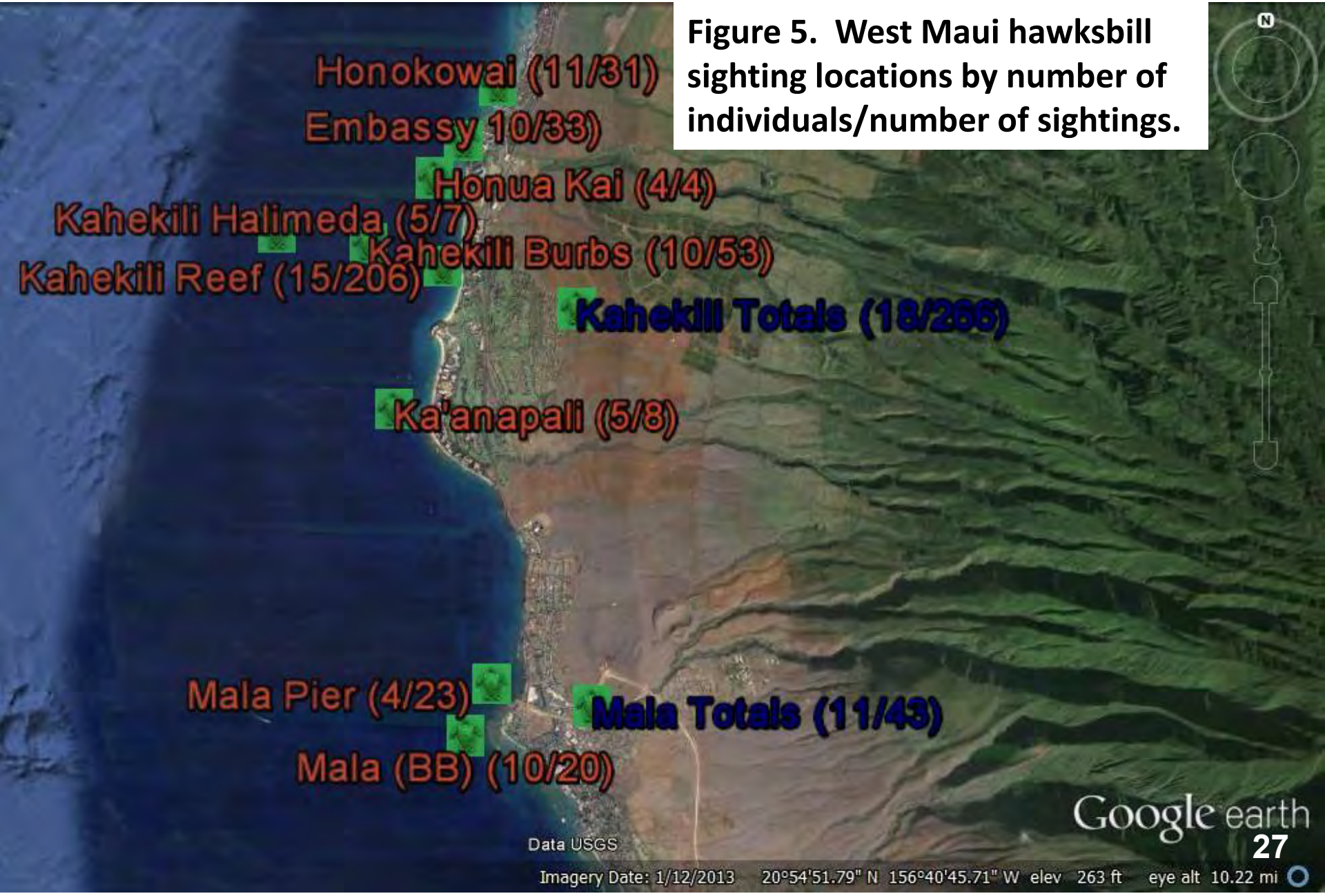


Figure 5. West Maui hawksbill sighting locations by number of individuals/number of sightings.

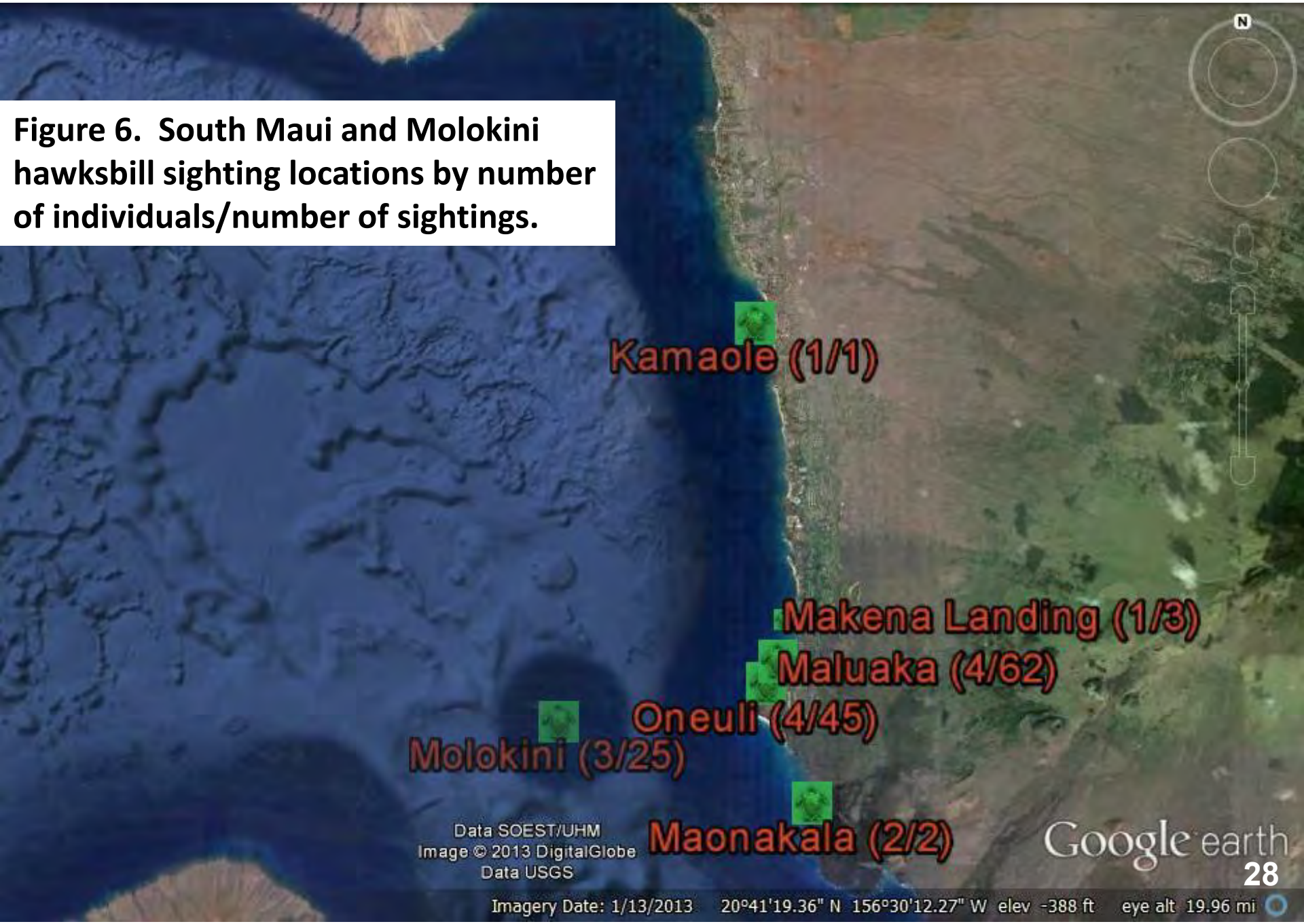


Figure 6. South Maui and Molokini hawksbill sighting locations by number of individuals/number of sightings.

Figure 7. West Maui's Kahekili (divided into 3 zones: Reef, Burbs and Halimeda) hawksbill sightings by number of individuals/number of sightings.

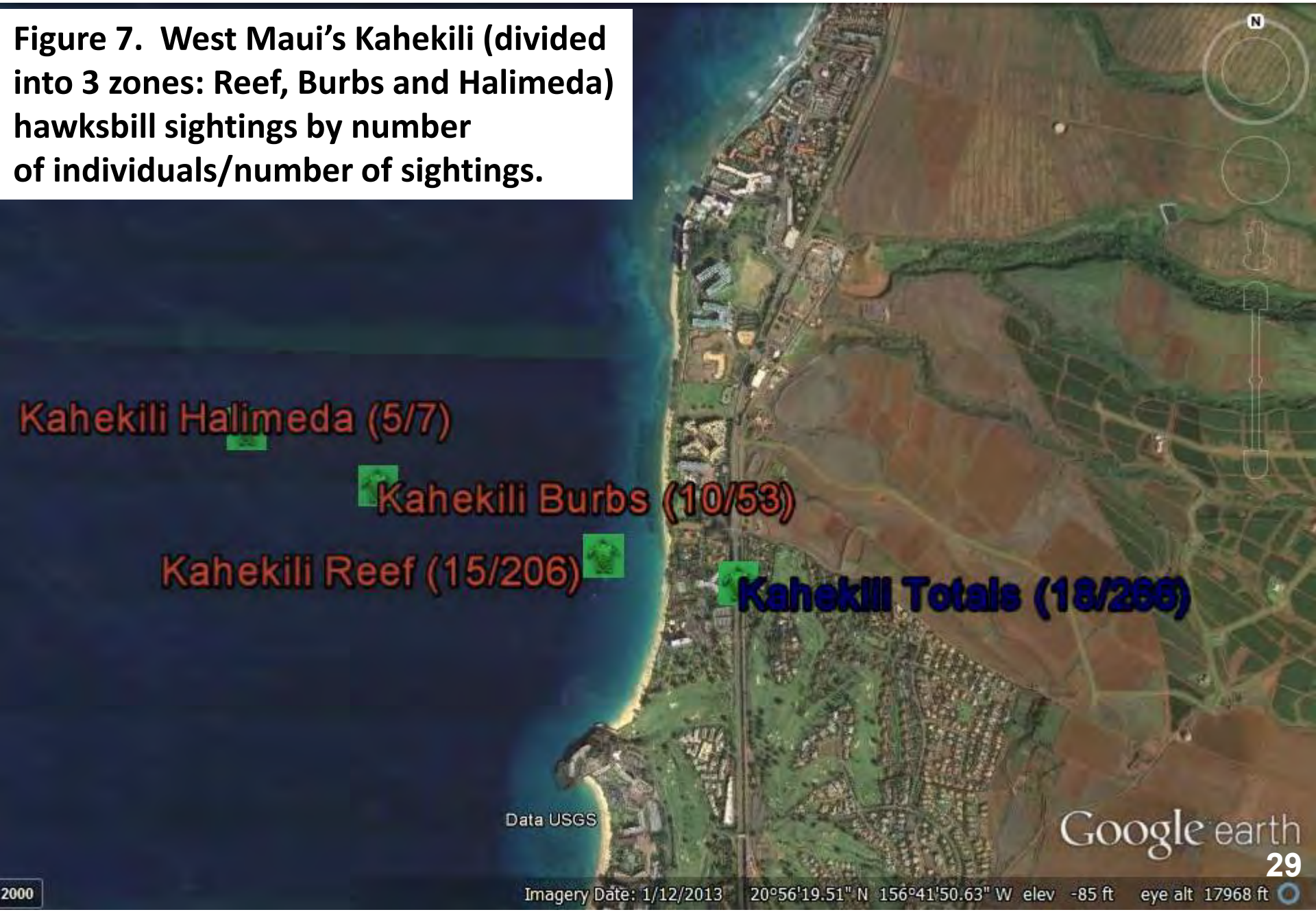
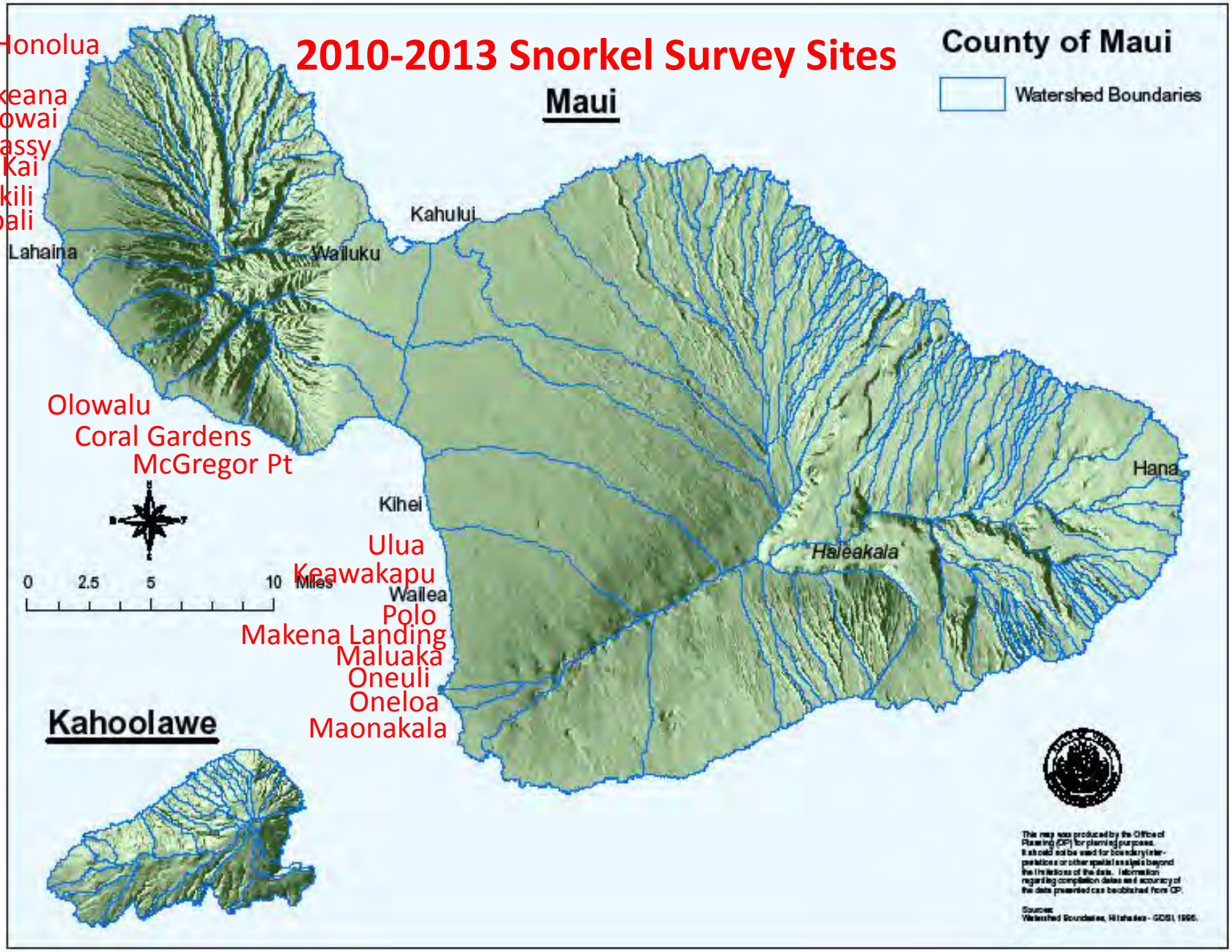


Figure 8. Maui snorkel transect locations (2010-2013).



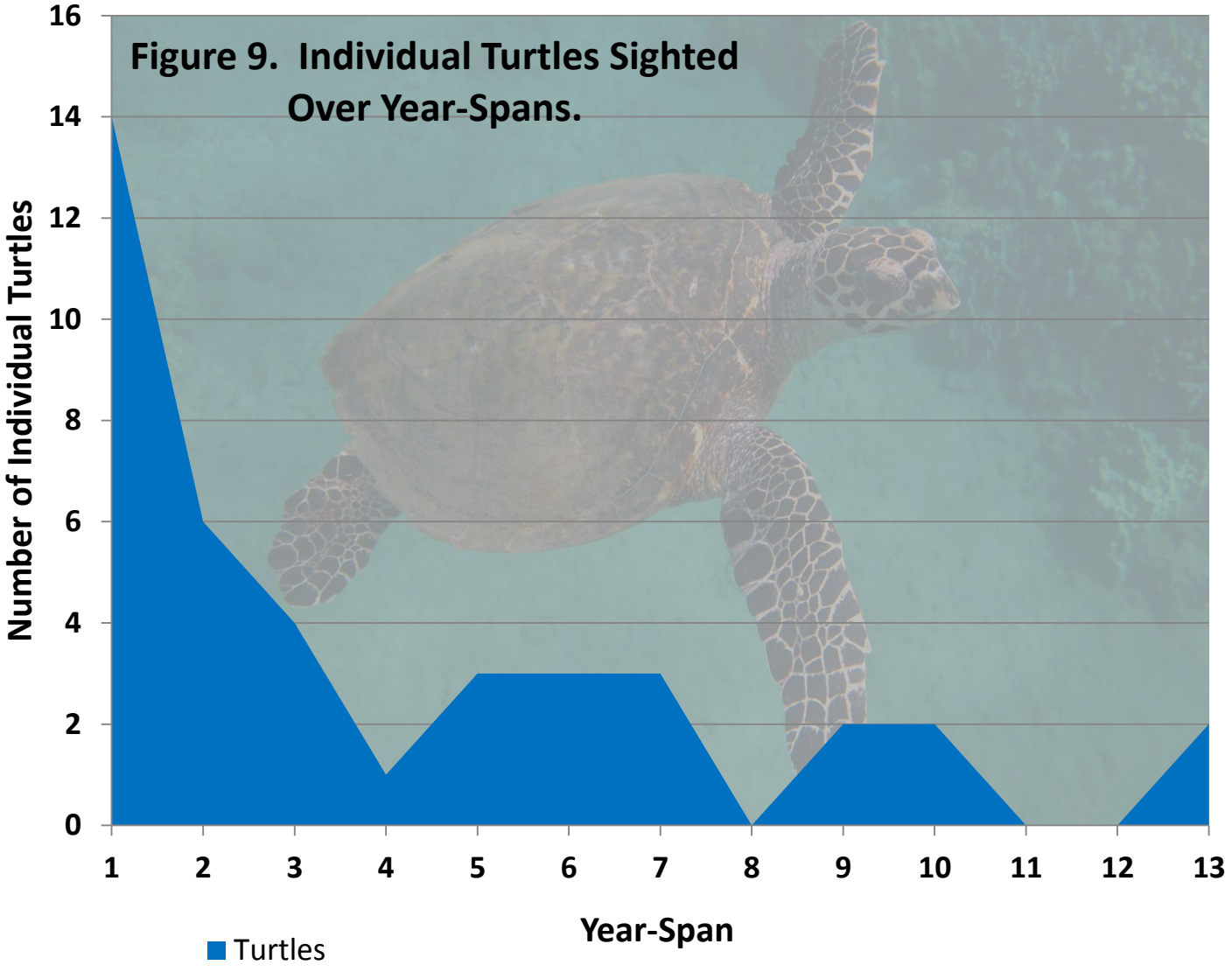


Figure 9. Individual Turtles Sighted Over Year-Spans.
Number of Individual Turtles
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Year-Span
Turtles

Figure 10. Total Sightings per Turtle (n=40).

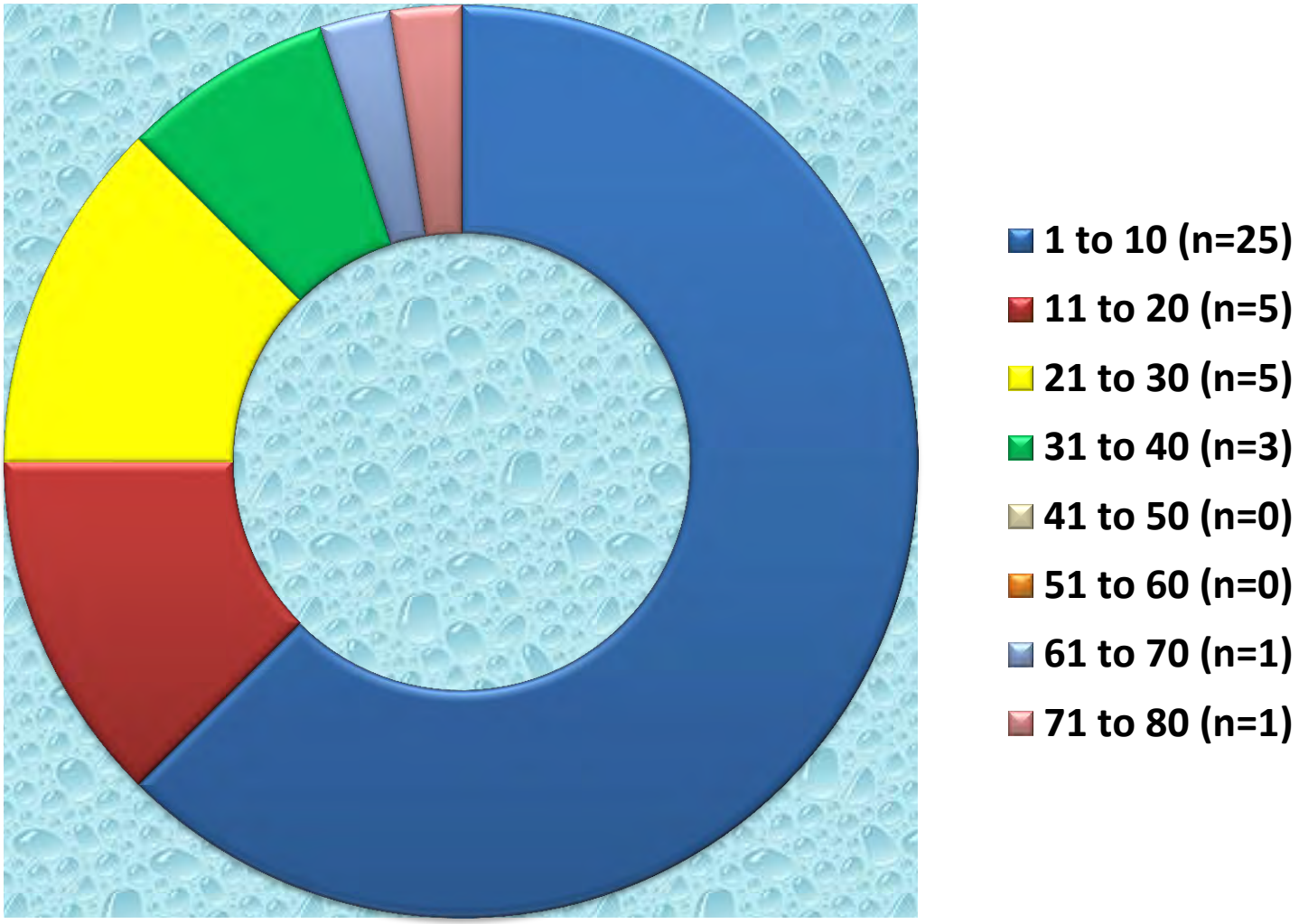


Figure 11. Individual Turtles Sighted in Different Locations.

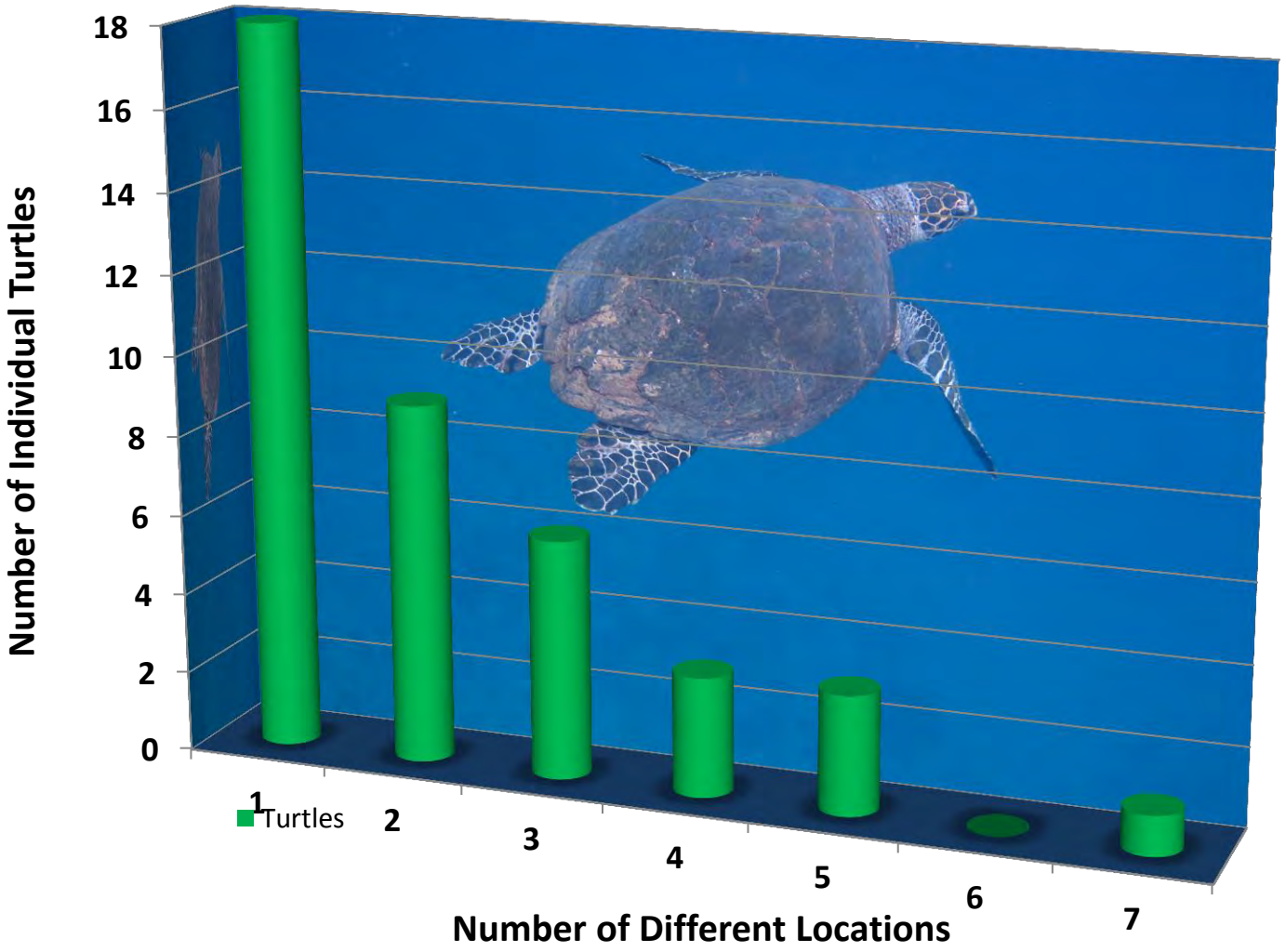


Figure 12. Observations of All Initial Hawksbill Behaviors (n=536).

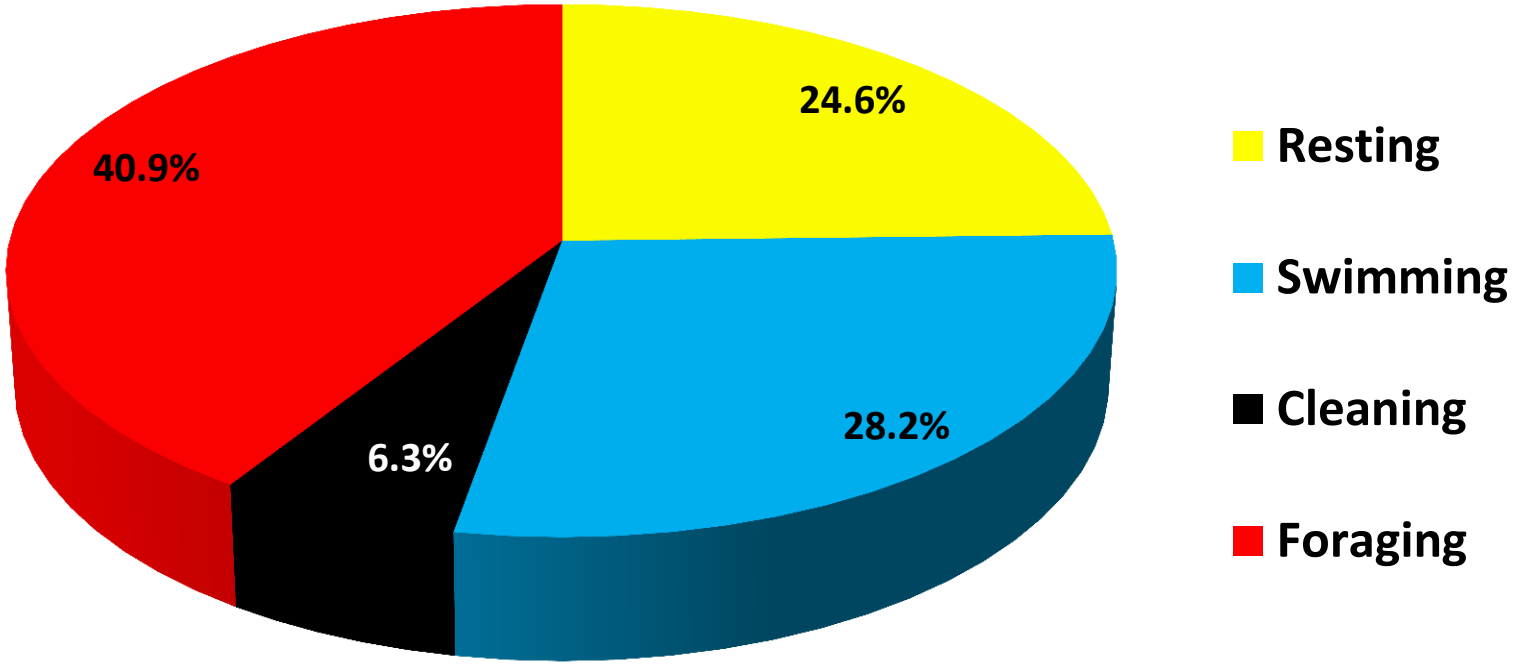


Figure 13. All Initial Hawksbill Behaviors by Location (N=536).

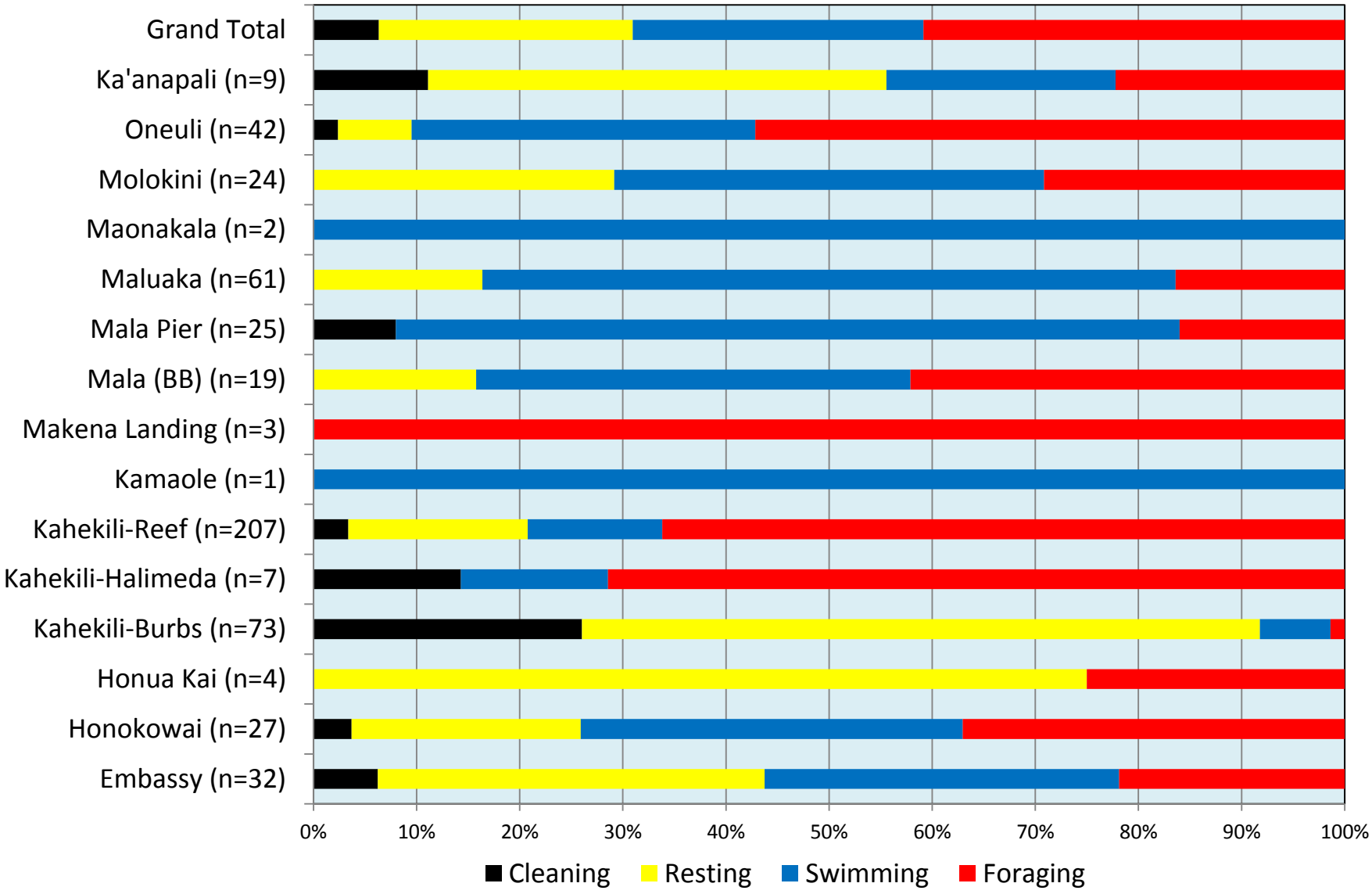


Figure 14. Frequency of Initial Behaviors by Individual Hawksbill (n=476).

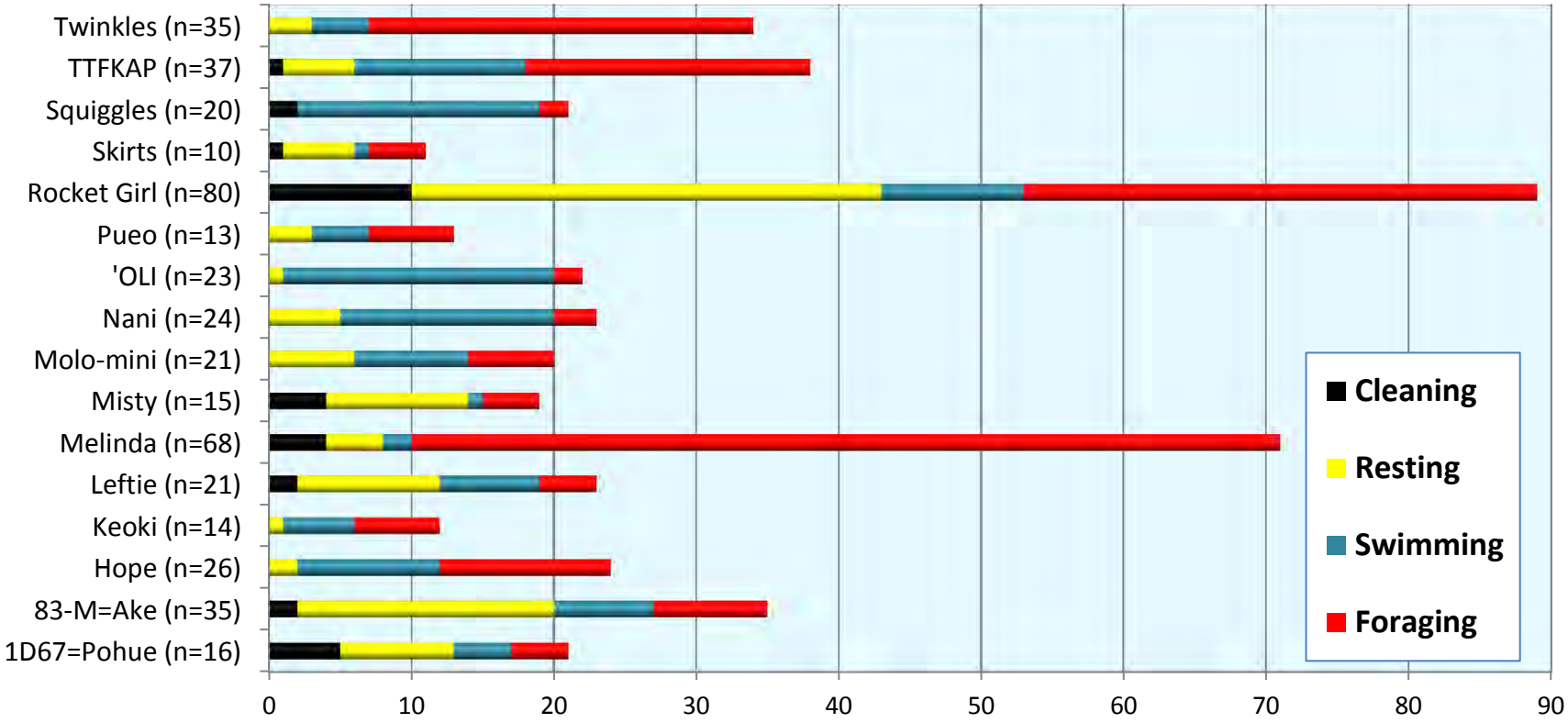


Figure 15. Time Blocks of All Hawksbill Sightings (n=276).

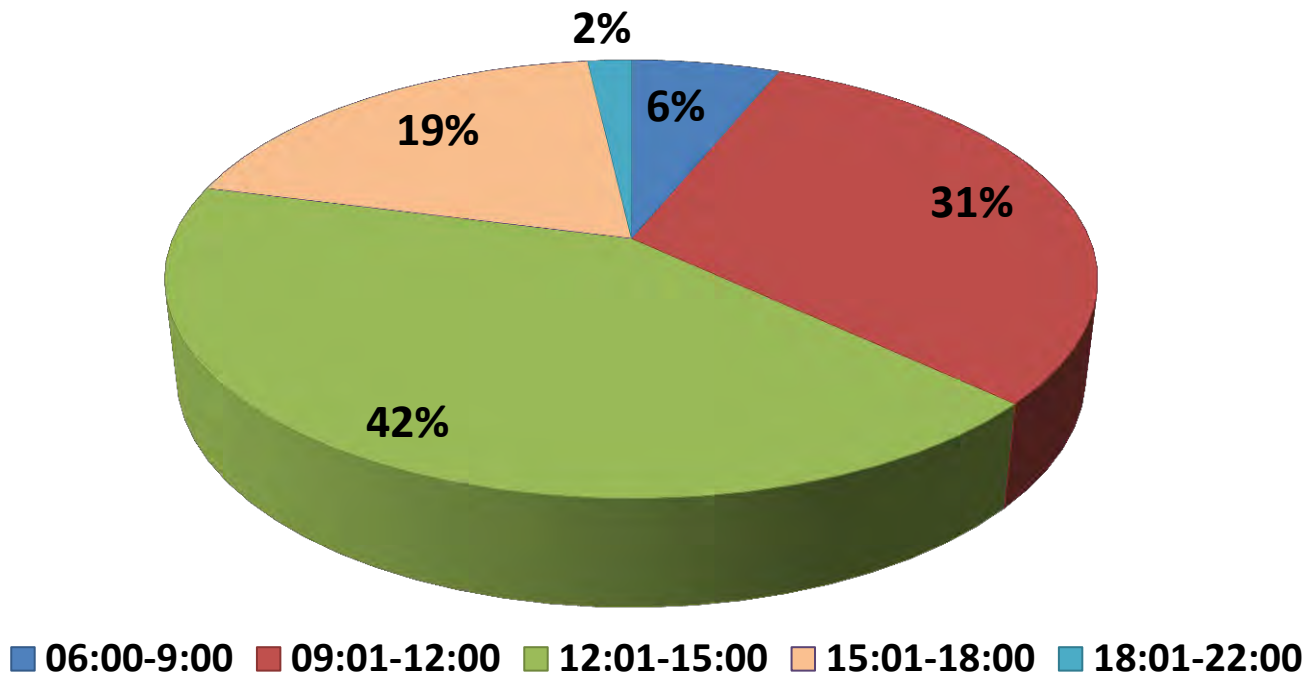


Figure 16. Hawksbill Sightings by Depth (n=343).

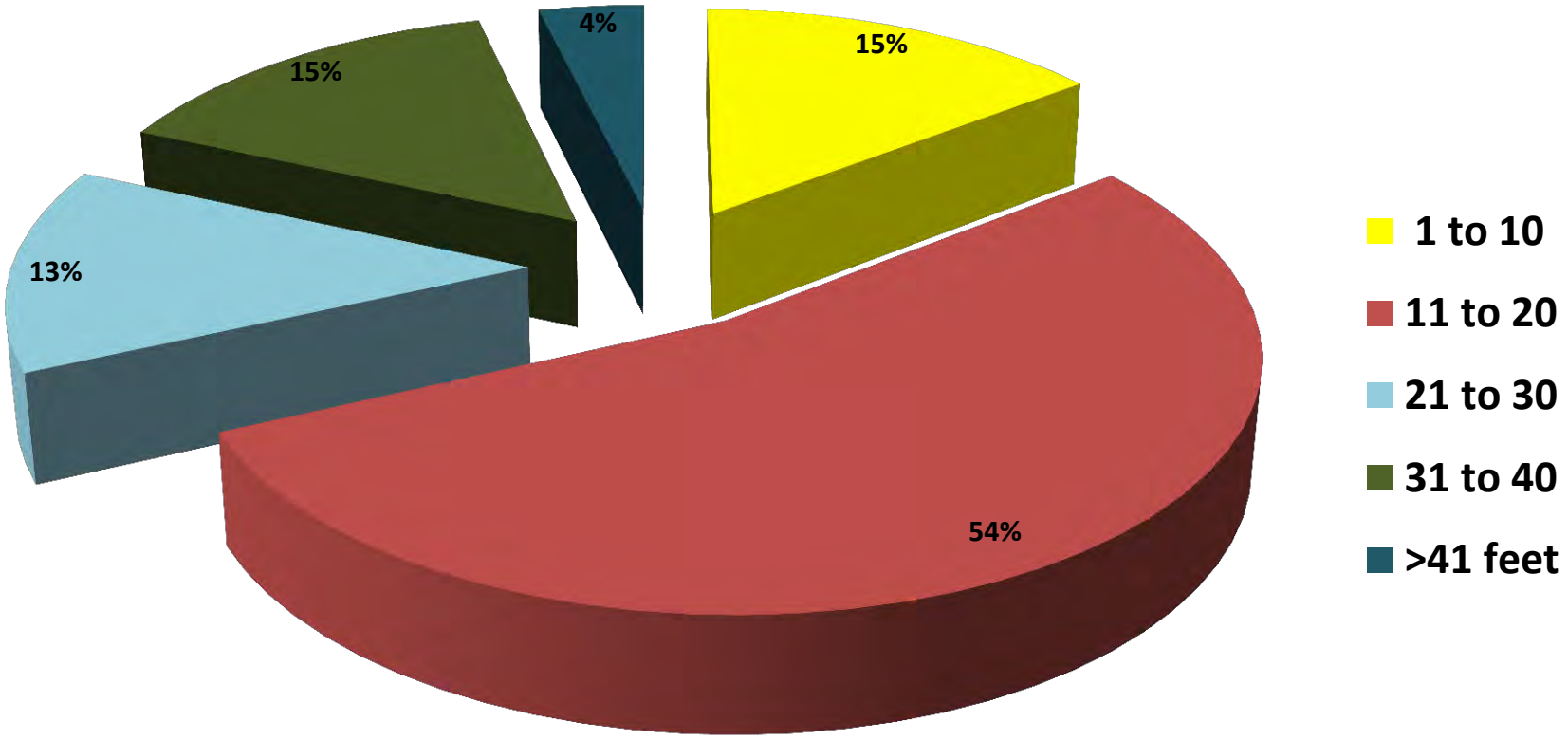
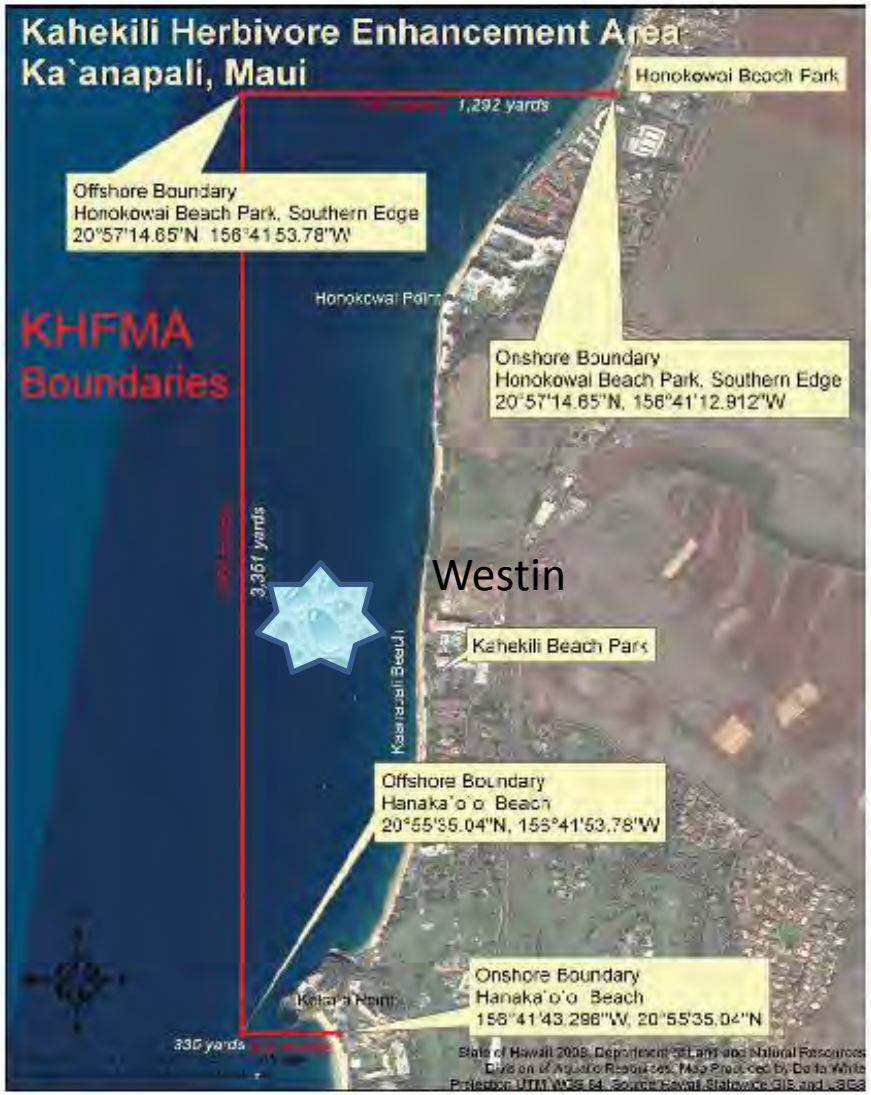


Figure 17. Kahekili Herbivore Fisheries Management Area (KHFMA).



Kahekili Herbivore Fisheries Management Area (KHFMA)

Permitted: To fish for, injure, kill, possess, or remove any finfish or invertebrate, except prohibited species indicated below. To use bait or other attractants while fishing for permitted marine life.

Prohibited: To injure, kill, possess, or remove any of the following:

rudderfishes (nenue)

parrotfishes (uhu)

surgeonfishes

sea urchins

Also Prohibited: To feed or deliberately introduce any attractant, directly to or in the vicinity of any marine life, except while fishing for permitted marine life.

Figure 18. 1996 post-nesting migration from Hawai‘i Island to Maui’s North Shore.

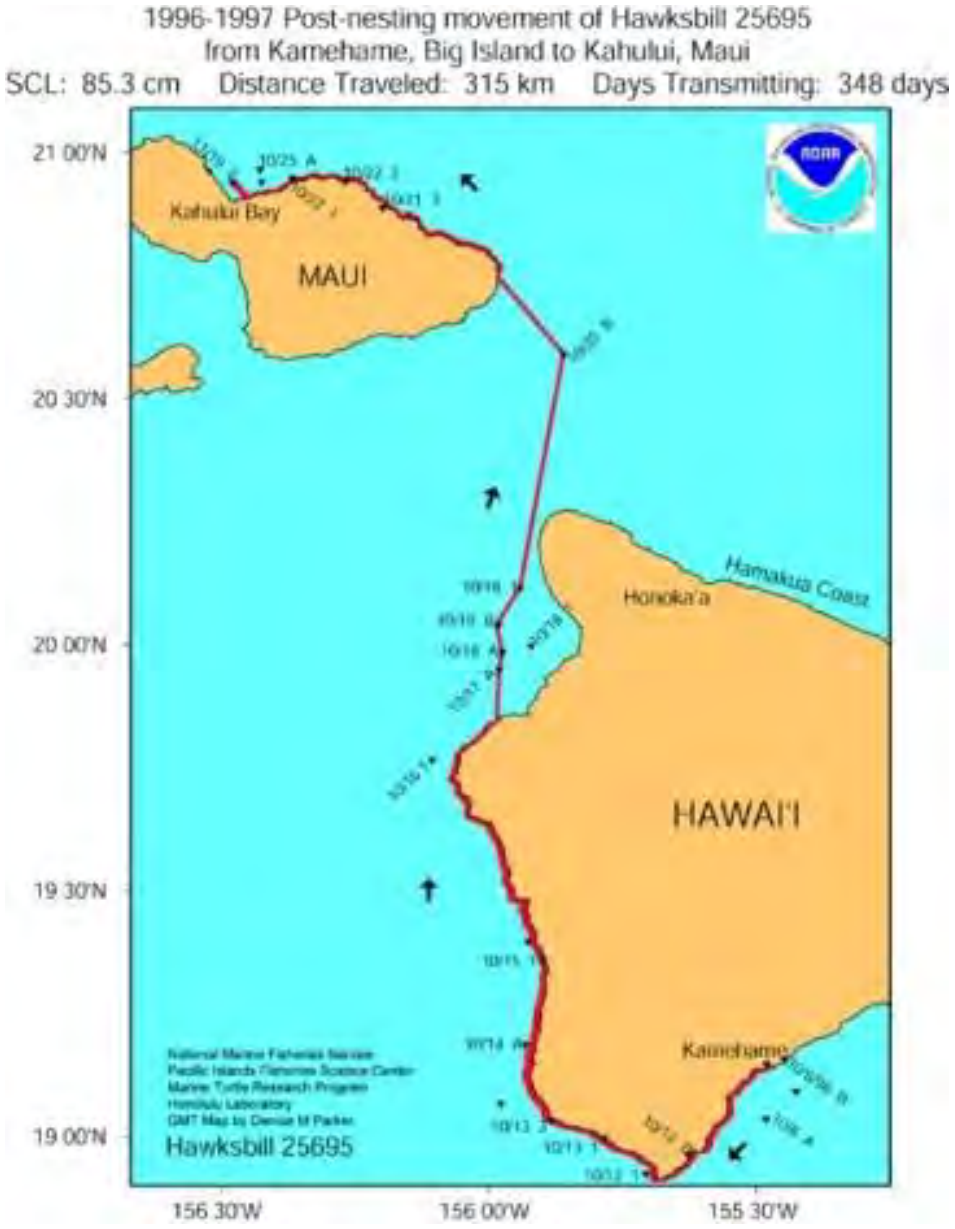


Figure 19. 2008 post-nesting migration from Hawai‘i Island to Maui’s South Shore.

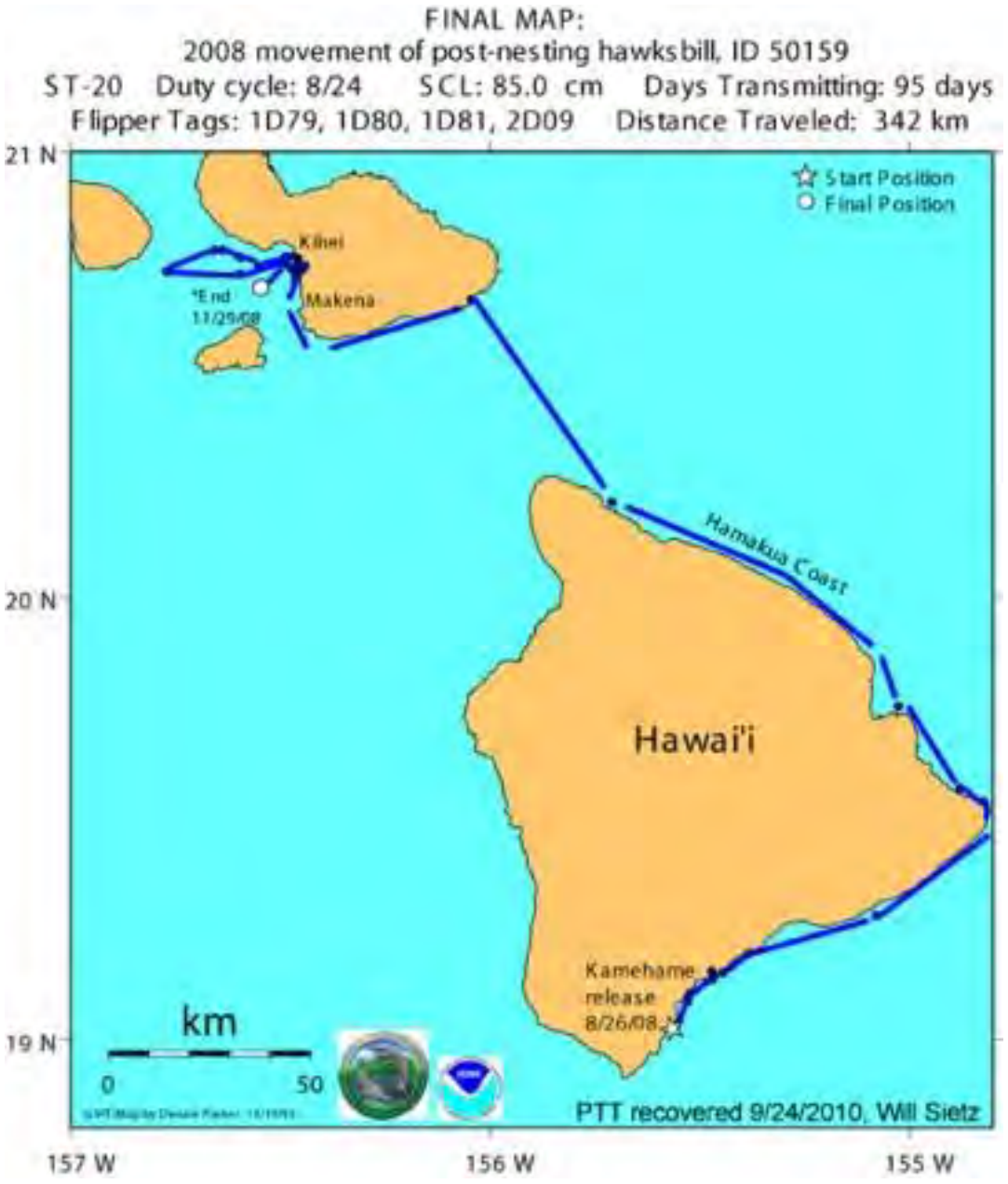


Table 1. Maui locations where hawksbill ID flyers were distributed.

Government & Educational Sites	Address	City
DLNR-Division of Aquatic Recources	130 Mahalani St.	Wailuku
Hawaiian Islands Humback Whale Nat'l Marine Sanct.	726 S. Kihei Rd.	Kihei
Kaho'olawe Island Reserve Commission	811 Kolu St. Suite 201	Wailuku
Kealia Pond National Wildlife Refuge	Milepost 6 Mokulele Highway (Hwy 311)	Kihei
Maui Ocean Center	192 Ma'alaea Rd.	Ma'alaea
UH Maui Community College Marine Option Program	310 Ka'ahumanu Ave.	Kahului
Reputable Dive Shops:		
B&B SCUBA	Azeka's Marketplace	Kihei
Boss Frogs	Lahaina Cannery Mall	Lahaina
Boss Frogs	4310 Lower Honapiilani Rd.	Kahana
Boss Frogs	5059 Napilihau St.	Napili
Boss Frogs	3636 Lower Honoapiilani Rd.	Ka'anapali
Ed Robinson's	Rainbow Shopping Center	Kihei
Maui Diving & Snorkel Center	Anchor Square	Lahaina
Maui Dive Shop	Kahana Gateway	Kahana
Maui Dive Shop	Lahaina Gateway Mall	Lahaina
Maui Dive Shop	Shops at Ma'alaea	Ma'alaea
Maui Dreams Dive Co	1993 S. Kihei Rd.	Kihei
Lahaina Divers	143 Dickenson St.	Lahaina
Turtle Town	61 S. Kihei Rd.	Kihei
Online:		
http://www.wildhawaii.org	Hawai'i Wildlife Fund Hawksbill Recovery Project	
http://www.facebook.com/hawaiiwildlifefund	HWF's Facebook page	
http://monitoring.coral.org/other_sites	Coral Reef Monitoring Portal	
http://mauihuliaufoundation.org	Maui Huliau Foundation video (direct link below)	
http://www.youtube.com/watch?v=hwWqNi8UURQ&list=PLAeCjZ5w3evmh2kie2wwFoxcLRX_kESsv&index=1		
http://www.youtube.com/watch?v=LkjPgrimvYU	C.King's video	
http://www.youtube.com/watch?v=Kh-z8z4MSVg	C.King's video (plus others on SandyCMaui channel)	

Table 2. Individual hawksbill behaviors by location.

Location	Hawksbill	# of Sightings	Resting	Swimming	Cleaning	Foraging
Embassy	1D67=Pohue	1				1
	Kiniana	1			1	
	Lady Grunge	5	2	1	1	
	Leftie	16	9	1	4	3
	Melinda	3				3
	Rocket Girl	1			1	
	Selma	2			2	
	Skeeter	1	1			
	Sooty	1				
	Twinkles	2			2	
Embassy Total	**10 individuals**	**33**	**12**	**2**	**11**	**7**
Honokowai	1D67=Pohue	2			1	1
	83-M=Ake	4			2	1
	Keoki	7	1		3	2
	Kiniana	3	2			
	Kuamo'o	1			1	
	Lady Grunge	1			1	
	Likeke	4				4
	Melinda	1		1		1
	Rocket Girl	1				1
	U&P	1	1			
	Wai?	6	2		2	
Honokowai Total	**11 individuals**	**31**	**6**	**1**	**10**	**10**
Honua Kai	Melinda	1				1
	Misty	1	1			
	Rocket Girl	1	1			
	Sooty	1	1			
Honua Kai Total	**4 individuals**	**4**	**3**			**1**

(Continued)

Table 2. (Continued) Individual hawksbill behaviors by location.

Location	Hawksbill	# of Sightings	Resting	Swimming	Cleaning	Foraging
Kahekili-Burbs	1D67=Pohue	8	8	5		
	83-M=Ake	1	1	1		
	Kiniana	1			1	
	Misty	7	7	3	1	
	Pueo	2	1		1	
	Rocket Girl	29	27	8	1	1
	Scar Boy	1			1	
	Skeeter	1	1	1		
	Skirts	2	2	1		
	Sooty	1	1			
Kahekili-Burbs Total	**10 individuals**	**53**	**48**	**19**	**5**	**1**
Kahekili-Halimeda	1D67=Pohue	1				1
	83-M=Ake	3				3
	Keoki	1				1
	Misty	1		1		
	Rocket Girl	1			1	
Kahekili-Halimeda Total	**5 individuals**	**7**		**1**	**1**	**5**
Kahekili-Reef	'Akahi	1			1	
	1D67=Pohue	4			3	1
	83-M=Ake	26	17	1	5	3
	AJC	1				1
	Keoki	6			2	3
	Lady Grunge	1			1	
	Melinda	63	4	3	2	56
	Misty	5	2			3
	Mustache	1	1	1		
	Pueo	10	1		2	6
	Rocket Girl	45	4	2	7	33
	Skinny	2	1		1	
	Skirts	8	3		1	4
	Twinkles	33	3		2	27
Kahekili-Reef Total	**15 individuals**	**206**	**36**	**7**	**27**	**137**
Kamaole	Kamalaole Male	1			1	
Kamaole Total	**1 individual**	**1**			**1**	
Makena Landing	Hope	3				3
Makena Landing Total	**1 individual**	**3**				**3**

(Continued)

Table 2. (Continued) Individual hawksbill behaviors by location.

Location	Hawksbill	# of Sightings	Resting	Swimming	Cleaning	Foraging
Mala (BB)	'Ikena	1				1
	Batwoman	6	1		5	
	Kamalaole Male	1				1
	Leftie	2			2	
	Lilia	3			1	2
	Misty	1				1
	Rocket Girl	2	1			1
	Roxy	2				2
	Skinny	1	1			
	Squiggles (death)	1				
Mala (BB) Total	**10 individuals**	**20**	**3**		**8**	**8**
Mala Pier	83-M=Ake	1				1
	Lilia	2			1	1
	Roxy	1			1	
	Squiggles	19		2	17	2
Mala Pier Total	**4 individuals**	**23**		**2**	**19**	**4**
Maluaka	'OLI	21	1		18	2
	Hope	9	1		4	4
	Nani	24	5		15	3
	TTFKAP	8	3		4	1
Maluaka Total	**4 individuals**	**62**	**10**		**41**	**10**
Maonakala	'OLI	1			1	
	Scott	1			1	
Maonakala Total	**2 individuals**	**2**			**2**	
Molokini	Molo1	3	1		1	1
	Molo-mini	21	6		8	6
	Stubby	1			1	
Molokini Total	**3 individuals**	**25**	**7**		**10**	**7**
Oneuli	'OLI	1				
	Akamai	1				
	Hope	14	1		6	5
	TTFKAP	29	2	1	8	19
Oneuli Total	**4 individuals**	**45**	**3**	**1**	**14**	**24**
Ka'anapali	Kamali'i Wahine	1				1
	Kiniana	2	2			
	Lady Grunge	1				
	Leftie	3	1	1	1	1
	Pueo	1	1		1	
Ka'anapali Total	**5 individuals**	**8**	**4**	**1**	**2**	**2**
Grand Total		**523**	**132**	**34**	**151**	**219**

Table 3. Small-sized individual turtle's sighting numbers and history by location.

Name {size}	Location	Total	Years
'Akahi {S}	Kahekili-Reef	1	2000
'Akahi Total		**1**	**1 yr**
Akamai {S}	Oneuli	1	2012
Akamai Total		**1**	**1 yr**
Kuamo'o {S}	Honokowai	1	2004
Kuamo'o Total		**1**	**1 yr**
Molo1 {S}	Molokini	3	1999-2000
Molo1 Total		**3**	**2-yr span**
Molo-mini {S}	Molokini	21	2003-2005, 2007
Molo-mini Total		**21**	**5-yr span**
Nani {S}	Maluaka	24	2012-2013
Nani Total		**24**	**2-yr span**
'OLI {S}	Maluaka	21	2009-2010
	Maonakala	1	2010
	Oneuli	1	2010
'OLI Total		**23**	**2-yr span**
Skeeter {S}	Embassy	1	2011
	Kahekili-Burbs	1	2010
Skeeter Total		**2**	**2-yr span**
Skinny {S}	Kahekili-Reef	2	2007
	Mala (BB)	1	≤2009
Skinny Total		**3**	**3-yr span**
Squiggles {S}	Mala (BB)	1	2013 (death)
	Mala Pier	19	2009-2013
Squiggles Total		**20**	**5-yr span**
Stubby {S}	Molokini	1	≤2002
Stubby Total		**1**	**1 yr**
Twinkles {S}	Embassy	2	2010
	Kahekili-Reef	33	2010-2011
Twinkles Total		**35**	**2-yr span**
Total: 12 smalls turtles		**135**	**<1 to 5-yr span**

{S}= small size (<2' carapace length)

Table 4. Medium-sized individual turtle's sighting numbers and history by location.

Name {size}	Location	Total	Years
Batwoman {S>>M}	Mala (BB)	6	2007-2008, 2010
Batwoman Total		**6**	**4-yr span**
Kamali'i Wahine {M}	Ka'anapali	1	2001
Kamali'i Wahine Total		**1**	**1 yr**
Likeke {S>>M}	Honokowai	4	2006, 2008
Likeke Total		**4**	**3-yr span**
Lilia {S>>M}	Mala (BB)	3	2010
	Mala Pier	2	2005, 2007
Lilia Total		**5**	**6-yr span**
Mustache {M}	Kahekili-Reef	1	2010
Mustache Total		**1**	**1 yr**
Roxy {M}	Mala (BB)	2	2007
	Mala Pier	1	2007
Roxy Total		**3**	**1 yr**
Scott {M}	Maonakala	1	≤2002
Scott Total		**1**	**1 yr**
Selma {M}	Embassy	2	2012
Selma Total		**2**	**1 yr**
Skirts {M}	Kahekili-Burbs	2	2012
	Kahekili-Reef	8	2012
Skirts Total		**10**	**1 yr**
Sooty {M}	Embassy	1	2013
	Honua Kai	1	2012
	Kahekili-Burbs	1	2012
Sooty Total		**3**	**2-yr span**
TTFKAP {S>>M}	Maluaka	8	2004-2007
	Oneuli	29	2004-2009
TTFKAP Total		**37**	**6-yr span**
Wai? {M}	Honokowai	6	2004, 2006-2008
Wai? Total		**6**	**5-yr span**
Total: 12 Mediums		**79**	**1 to 6-yr span**

{S}= small size (<2' carapace length)
{M}= medium size (2-3' carapace length)
>>= growth into higher size class

Table 5. Medium grown to large-sized individual turtle's sighting numbers and history by location.

Name {size} ♀♂	Location	Total	Years
Hope {M>>L} ♀	Makena Landing	3	2010, 2012
	Maluaka	9	2004-2007, 2010-2011
	Oneuli	14	2005, 2009-2011, 2013
Hope Total		**26**	**10-yr span**
Kamalaole Male {M>>L} ♂	Kamaole	1	2010
	Mala (BB)	1	2008
Kamalaole Male Total		**2**	**3-yr span**
Kiniana {M>>L} ♀	Embassy	1	2012
	Honokowai	3	2000, 2001, 2008
	Kahekili-Burbs	1	2009
	Ka'anapali	2	2012
Kiniana Total		**7**	**13-yr span**
Leftie {M>>L} ♀	Embassy	16	2010-2013
	Mala (BB)	2	2007, 2010
	Ka'anapali	3	2013
Leftie Total		**21**	**7-yr span**
Total: 4 Larges: 3 ♀ & 1 ♂		**56**	**3 to 13-yr span**

(Continued)

{M}= medium size (2-3' carapace length)
{L}= large size (>3' carapace length)
>>= growth into higher size class

Table 6. Large-sized individual turtle's sighting numbers and history by location.

Name {size} ♀♂	Location	Total	Years
1D67=Pohue {L} ♀	Embassy	1	2013
	Honokowai	2	2005, 2008
	Kahekili-Burbs	8	2010
	Kahekili-Halimeda	1	≤2004
	Kahekili-Reef	4	2007, 2008, 2010
1D67=Pohue Total		**16**	**10-yr span**
83-M=Ake {L} ♀	Honokowai	4	1999
	Kahekili-Burbs	1	2012
	Kahekili-Halimeda	3	2000, 2002, 2010
	Kahekili-Reef	26	1999-2001, 2005, 2007, 2009-2012
	Mala Pier	1	2011
83-M=Ake Total		**35**	**13-yr span**
AJC {L} ♀	Kahekili-Reef	1	2006
AJC Total		**1**	**1 yr**
'Ikena {L} ♀	Mala (BB)	1	2000
'Ikena Total		**1**	**1 yr**
Keoki {L} ♀	Honokowai	7	1998-2001
	Kahekili-Halimeda	1	2006
	Kahekili-Reef	6	2002-2004
Keoki Total		**14**	**9-yr span**
Lady Grunge {L} ♀	Embassy	5	2011-2013
	Honokowai	1	2012
	Kahekili-Reef	1	2011
	Ka'anapali	1	2013
Lady Grunge Total		**8**	**3-yr span**
Melinda {L} ♀	Embassy	3	2012-2013
	Honokowai	1	2009
	Honua Kai	1	2012
	Kahekili-Reef	63	2007-2013
Melinda Total		**68**	**7-yr span**
Total: 7 Larges: 7 ♀		**143**	**1 to 13-yr span**

(Continued)

{L}= large size (>3' carapace length)

Table 6. (Continued) Large-sized individual turtle's sighting numbers and history by location.

Name {size} ♀♂	Location	Total	Years
Misty {L} ♀	Honua Kai	1	2013
	Kahekili-Burbs	7	2010-2011
	Kahekili-Halimeda	1	2010
	Kahekili-Reef	5	2009-2010, 2012
	Mala (BB)	1	2007
Misty Total		**15**	**7-yr span**
Pueo {L} ♀	Kahekili-Burbs	2	2010
	Kahekili-Reef	10	2005, 2009, 2012
	Ka'anapali	1	2013
Pueo Total		**13**	**9-yr span**
Rocket Girl {L} ♀	Embassy	1	2011
	Honokowai	1	2008
	Honua Kai	1	2012
	Kahekili-Burbs	29	2010-2012
	Kahekili-Halimeda	1	2011
	Kahekili-Reef	45	2008-2012
	Mala (BB)	2	2007
Rocket Girl Total		**80**	**6-yr span**
U&P {L} ♀	Honokowai	1	2009
U&P Total		**1**	**1 yr**
Scar Boy {L} ♂	Kahekili-Burbs	1	2011
Scar Boy Total		**1**	**1 yr**
Total: 5 Larges: 4 ♀ & 1 ♂		**110**	**1 to 9-yr span**

GRAND TOTAL: 40 hawksbills	**12 Smalls**
523 sightings	**12 Mediums**
	16 Larges: 14 ♀ & 2 ♂

Table 7. Forage species chosen by individual hawksbills.

Species observed	#	'Ikena	1D67=Pohue	83-M=Ake	Hope	Keoki	Melinda	Molo-mini	Pueo	Rocket Girl	Squiggles	Skirts	TTFKAP	Twinkles
Melanamansia glomerata	18					1	4			3		4		6
Codium on *halimeda*	1			1										
Halimeda kanaloana	2		1	1										
Hypnea musciformis	1					1								
Sargassum spp.	1												1	
Turbinaria ornata	19									19				
Unidentified algae	15		2				6	1	2	2				2
Unidentified Sponge	7	1					1		1	1				3
Fireworm in *halimeda*	2			1		1								
"Mystery eggs"	1										1			
Lobe coral polyps	4						4							
Fish carcass	1										1			
Short-spined urchin	1				1									
	73													

Table 8. Threats on Maui's Nearshore Reefs and Hawksbill Habitats.

	Honokowai	Embassy	Honua Kai	Kahekili	Ka'anapali	Mala	Kamaole	Makena Landing	Oneuli	Maluaka	Maonakala	Molokini
1)	3	4	1	1	4	3	4	2	1	1	4	4
2)	1	1	1	1	1	1	2	2	2	2	4	3
3)	1	1	1	1	1	3	3	3	3	3	4	3
4)	2	3	3	3	3	3	3	3	3	3	3	3
5)	2	3	1	3	3	1	1	1	1	1	4	1
6)	3	2	2	2	2	2	2	2	2	2	2	1
7)	2	2	2	2	2	2	2	2	2	2	2	2
8)	3	3	3	3	3	3	3	3	3	3	3	2
9)	3	3	3	3	3	3	3	3	1	1	3	3
10)	1	1	1	1	1	1	1	1	1	1	1	1
11)	3	3	3	3	3	3	3	3	3	3	3	3

1= serious threat / 2= threat present but not serious / 3= potential but no cases / 4= no threat

1) New Coastal development
2) Pollution
3) Algae blooms
4) Disease and injuries
5) Interaction with recreational fishers
6) Harassment by snorkelers/divers
7) Vessel strikes
8) Marine debris entanglement and ingestion
9) Poaching
10) Subsistence hunting (*Chelonia mydas*)
11) Climate change