Hawai'i Wildlife Fund's Hawksbill Recovery Project
Initial Report of Nesting Beaches Throughout Greater Maui and Historical Nesting Records
(1991-2014)

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Hawksbill Recovery Project

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Introduction

Little is known about the abundance and distribution of critically endangered Hawaiian hawksbill sea turtles (*Eretmochelys imbricata*) in the Pacific, since encountering them in their foraging and nesting habitats is very rare. Both of these habitats exist in geographically isolated Hawai'i, and hawksbills, known as "honu'ea" or "'ea", face a variety of anthropogenic threats. Their nesting habitat is particularly vulnerable due to the burgeoning human population and increasing coastal development. Understanding hawksbill nesting population characteristics includes monitoring efforts, identification of potential and current threats and mitigation of these threats. Active research and cooperative, community-driven conservation actions that promote the understanding and protection of nesting and foraging habitats in Hawai'i are the keys to this species' survival.

Within the Hawaiian Archipelago, green sea turtles (*Chelonia mydas*, known as "honu") predominately nest in the Northwestern Hawaiian Islands with an increasing number nesting in the Main Hawaiian Islands, but hawksbills only nest in the Main Hawaiian Islands (Figure 1). The majority of Hawaiian hawksbills nest on Hawai'i Island, where they have been monitored for over twenty years. Smaller numbers are also known to nest on the islands of Maui, Moloka'i and O'ahu, with a statewide estimate thought to be likely fewer than one hundred reproductive females with fewer than twenty nesting each year.

Hawksbill nesting activities were first documented on Maui in 1991 at Kealia (Figure 2). Hawai'i Wildlife Fund (HWF) organized a community-based effort to systematically monitor and mitigate these occurrences in 1996 after a passing car killed a second gravid female when she wandered onto North Kihei Road, either seeking suitable nesting habitat or disoriented by headlights (1993 was the first documented road fatality). HWF was formed specifically to focus on the conservation of the Hawaiian hawksbill turtle (and other protected native marine life) and was incorporated as a 501(c)3 non-profit organization in 1996. For the last 19 years, HWF has conducted monitoring, research and conservation efforts on Hawaiian hawksbills and obtained necessary Federal (U.S. Fish and Wildlife Service) and State of Hawai'i (Department of Land and Natural Resources) endangered species research permits. This project and the Hawai'i Island project are the only hawksbill nest monitoring programs in Hawai'i.

The primary objectives of HWF's Hawksbill Recovery Project are to identify individual nesting hawksbill turtles, take biopsy samples for genetic and stable isotope analysis, determine sizes of these females, the sites they use for nesting, the inter-nesting intervals and locations, the number of nests laid in a season by each female, individual nesting behavior patterns, nest success, to relocate nests that may be threatened by tidal flooding or excessive trampling, and to attach transmitters to post-nesting females to track them to their long-term

foraging/resting areas. During the course of this research, nesting females, nests and hatchlings are protected against dangers caused by predators, human disturbance, coastal lighting, non-native vegetation, and vehicular traffic.

Methods

A Hawaiian hawksbill-specific brochure was developed by NOAA and HWF for educational purposes (Figure 3). Since this is a community-based project, volunteer recruitment and spreading accurate information about what to look for during nesting season, and who to call if nesting females, tracks or hatchlings are found, has shown this brochure to be effective. Nesting season can begin as early as mid-May, with hatching events from July and continuing as late as early January. From June through September, the Maui Dawn Patrol, a community group of approximately 35 volunteers organized by United States Fish and Wildlife Service volunteers, walked Maui's four known South Maui nesting beaches (Kealia, Kalepolepo, Kawililipoa, and Oneloa) early each morning looking for evidence of nesting (Figure 4). Although there have been sporadic nesting events in Hana, the Dawn Patrol has not organized patrols there yet (Figure 5). HWF initiated patrols at potential hawksbill nesting beaches on Maui's South Shore (Oneuli and Little Beach), and on Maui's North Shore where green sea turtles are known to nest. Due to the increase in Maui green nesting events, HWF similarly monitors those but with a greater emphasis on hawksbills.

Once nesting activity was discovered, a phone tree was activated to advise the Department of Land and Natural Resources Division of Aquatic Resources (DLNR DAR), the United States Fish and Wildlife Service (USFWS), and HWF. Each subsequent nesting and hatching event was intensely monitored by HWF. This typically entailed all-night vigils searching for the females (walking the beach multiple times each night) to identify them and their nest sites, and then guarding the nests 24/7 during the course of hatching to ensure each hatchling reached the ocean safely.

Three days after the first major emergence from each nest, the nests were excavated by USFWS, DLNR-DAR and HWF to release any trapped hatchlings and to determine overall nest success. Nest remains were frozen and shipped to the Marine Turtle Research Program of the National Oceanic and Atmospheric Administration, National Marine Fisheries Service in Honolulu.

Basic analytical tests were run on the data using Microsoft Excel, with standard deviations represented with the mean calculations. Some data were missing or incomplete for the nests in the 1990s, so different analyses were conducted with different seasons and categories, depending on what data were available.

Results

Nesting Activity

Since 1991 when hawksbill nesting was first scientifically recorded, Maui hawksbill nesting activity was documented in every season except 1992, 1995, 2003, 2007, and 2013 (Figure 6). Prior to 1996, only two nests were confirmed. Hatchlings were found from one nest in 1991 (no excavation data available, as nest wasn't found), and one nest was laid at Kealia in 1993 (73.0% successful) prior to this female getting fatally struck on North Kihei Road. No nests were found in 1994, but multiple rescues occurred at Kealia (an unknown number of individuals, but likely just one): a nester got stuck in the mud, entangled in pickleweed, and crossed North Kihei Road twice. Five nests were found in 1996 by at least two different females, but one got fatally struck on North Kihei Road. This sparked the creation of HWF, and the subsequent data collected are summarized below.

The earliest recorded nesting activity of all seasons occurred on 5/18/98 and the last nest was excavated on 1/2/12, for a nearly 8-month nesting activity window (Table 1). A total of 78 nests and 63 false crawls were recorded on eight different beaches from 1991-2014: Kealia, Kalepolepo, Kawililipoa, Oneloa, Little Beach, Hana Bay, Koki, and Hamoa (Figures 4 and 5). The mean number of nests/year for this twenty-four year period was 3.3 ± 2.7SD and the mean number of nesting females/year was 1.4 ± 1.1. Since monitoring was not consistent until 1996 when HWF was formed, earlier seasons were dropped from analysis, increasing the mean number of nests/year to 4.0 ± 2.7 with the number of nesting females to 1.3 ± 1.0 during these nineteen seasons (1996-2014). The mean number of nests laid per female per season was 2.6 ± 1.5 (range from 1-5 nests; n=29).

Nine nesting females have been tagged by HWF, with unknown hawksbills still nesting mainly in Hana (Figures 7 and 8). Each tagged hawksbill is referred to by their left front flipper (LFF) tag number and name chosen by HWF project participants (Table 1):

1) 1997: H-326 "Hapa" at Kealia
2) 1998: H-329 "Sasha" at Kawililipoa
3) 1999: H-330 "Hokulele" at Kawililipoa
4) 2000: H-332 "Lele" at Kealia
5) 2001: H-334 "Orion" at Oneloa
6) 2002: H-340 "Kolohe" at Kealia
7) 2009: H-343 "Kulu" at Kealia
8) 2011: H-336 "Uhane Niniu" at Oneloa
9) 2014: H-338 "Ali'i Li'i" at Kawililipoa

Nesting Beach Identification

Since hawksbill nesting activity was first documented at Kealia in 1991, it has remained the most frequently utilized beach on Maui, with 28 nests by 4+ turtles over 13 seasons ("Hapa", "Lele", "Kolohe", "Kulu", plus at least one unidentified turtle) (Figure 9). There has been nesting activity from one untagged turtle "Kawili '97" and three known turtles ("Sasha", "Hokulele" and "Ali'i Li'i) at Kawililipoa for a total of 20 nests in four seasons. Oneloa has had 24 known nests by 2+ females over 6 seasons ("Orion", an unknown who is referred to as turtle "Oneloa X" and "Uhane Niniu", which may have been "Oneloa X"). The two nests that were laid at Little Beach, which is adjacent to Oneloa but separated by a steep rock groin, were done so by "Orion". There was a false crawl (FC) at Kalepolepo in 2008 by an unknown female then a nest by a turtle that was later tagged at Kealia ("Kulu" in 2009). Hana nesting is more enigmatic since patrols are lacking, but Hana Bay has had activity for two seasons (hatchlings were found in 2001 and there were two false crawls in 2008). One nest has been documented at Koki and one at Hamoa beaches in 2008. Only one nesting beach was identified before this project started in 1996, and only two nesting beaches were identified for the first 4 years of this project (1996-2000). Since 2001, three Hana beaches and three additional South Maui beaches have been identified.

Threats to Nesting Habitats

All-night vigils to identify nest locations and protect nesting females and emerging hatchlings have been conducted by HWF for the last 19 years. These actions mitigate the threats identified below and are crucial for nesting female and hatchling survival. There are different and analogous threats at each of Maui's nesting beaches. Table 3 categorizes 17 threats in the following categories:

1= serious threat (red)
2= threat present but not serious (orange)
3= potential but no cases (yellow)
4= no threat (green)

1) New/increased coastal development (directly impacting beach characteristics)
2) Light pollution (causing adult and hatchling misorientation events)
3) Vehicular beach traffic (smashing nests or striking nesters)
4) Human trampling (impacting nests)
5) Misorientation onto roadway (adult and hatchling mortalities)
6) Impacts by recreational users (camping, fishing, parties, etc)

7) Predation by feral or domestic animals (mongoose, rodents, cats, dogs)
8) Beach vegetation (limits available nesting areas, roots within the chamber potentially affecting development and entanglement upon hatchling emergence)
9) Invasive algae piles (blocks hatchlings' access to the ocean)
10) Deep holes (sand type conducive to create deep footprints that hatchlings get stuck in and holes dug by beachgoers that both nesters and hatchlings get trapped in)
11) Egg development issues (failed nests)
12) Egg poaching (digging up eggs)
13) Nesting female poaching (killing nesting turtles)
14) Land-based and marine debris (buried in the sand)
15) Erosion (limiting sufficient nesting habitat)
16) Flooding (tidal, large waves or stream mouth)
17) Climate change (limiting available habitat due to sea level rise)

The achievements of HWF's Hawksbill Recovery Project, a long-term research and conservation program, have been possible due to the overwhelming volunteer efforts and the collaborative nature of the resource management agencies charged with responsibility for this species: USFWS, NOAA/NMFS and DLNR. A tremendous effort is ongoing to understand and protect Maui's nesting hawksbills, and without it the survivorship of these turtles would certainly be jeopardized further. This community-based project has saved adults and hatchlings from a gauntlet of threats. The intensified monitoring of each nesting and hatching event has also greatly improved the dataset for these occurrences. As of yet, the actual numbers of nests on Maui are not increasing significantly. With a critically endangered species at such risk, more resources need to be funneled in this direction as there are many ways to increase survival. And, innovative research methodologies should be explored to further our knowledge of all aspects of this specie's life history to aid in its protection.

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Figure 1. Hawaiian Island Chain with Maui inset.

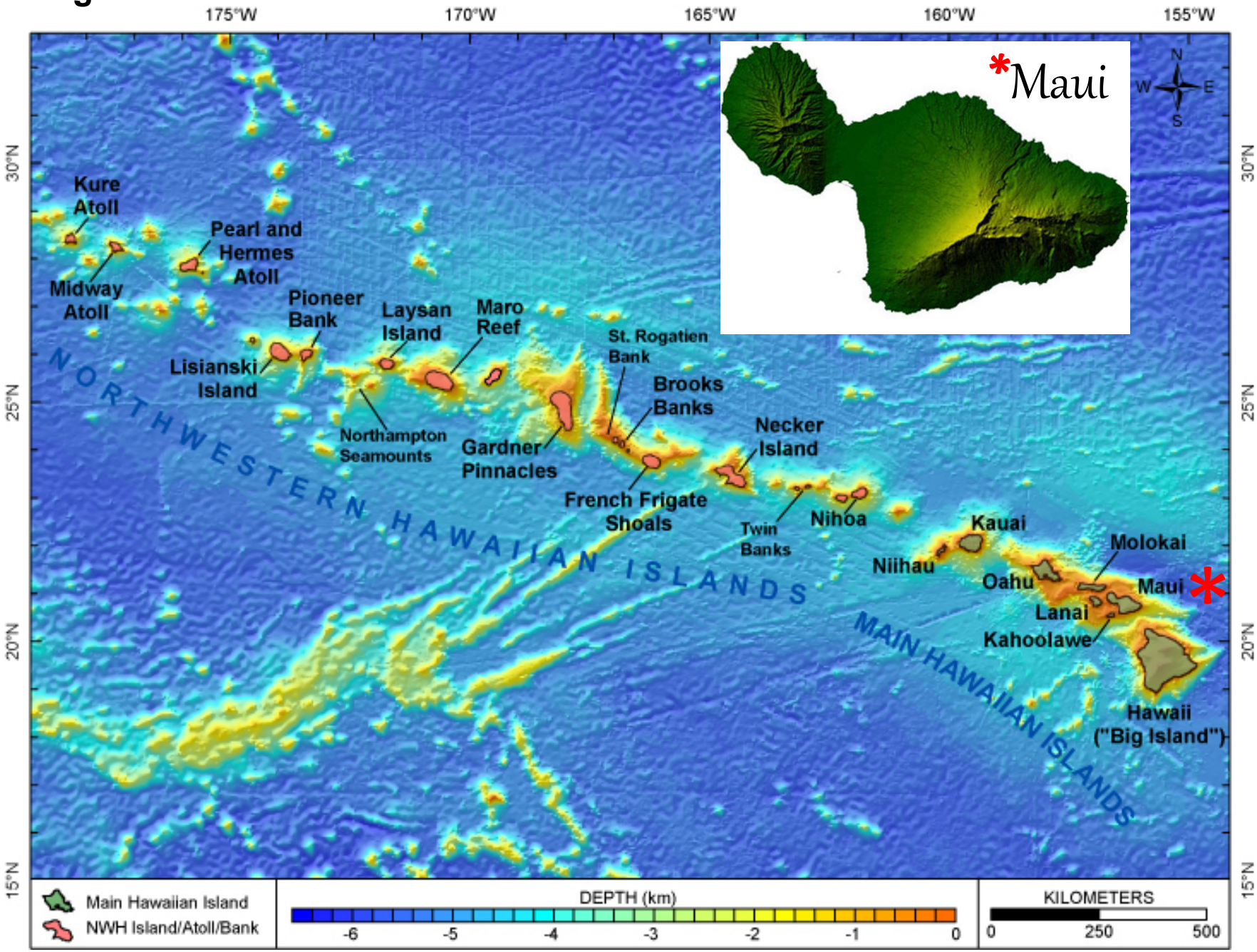
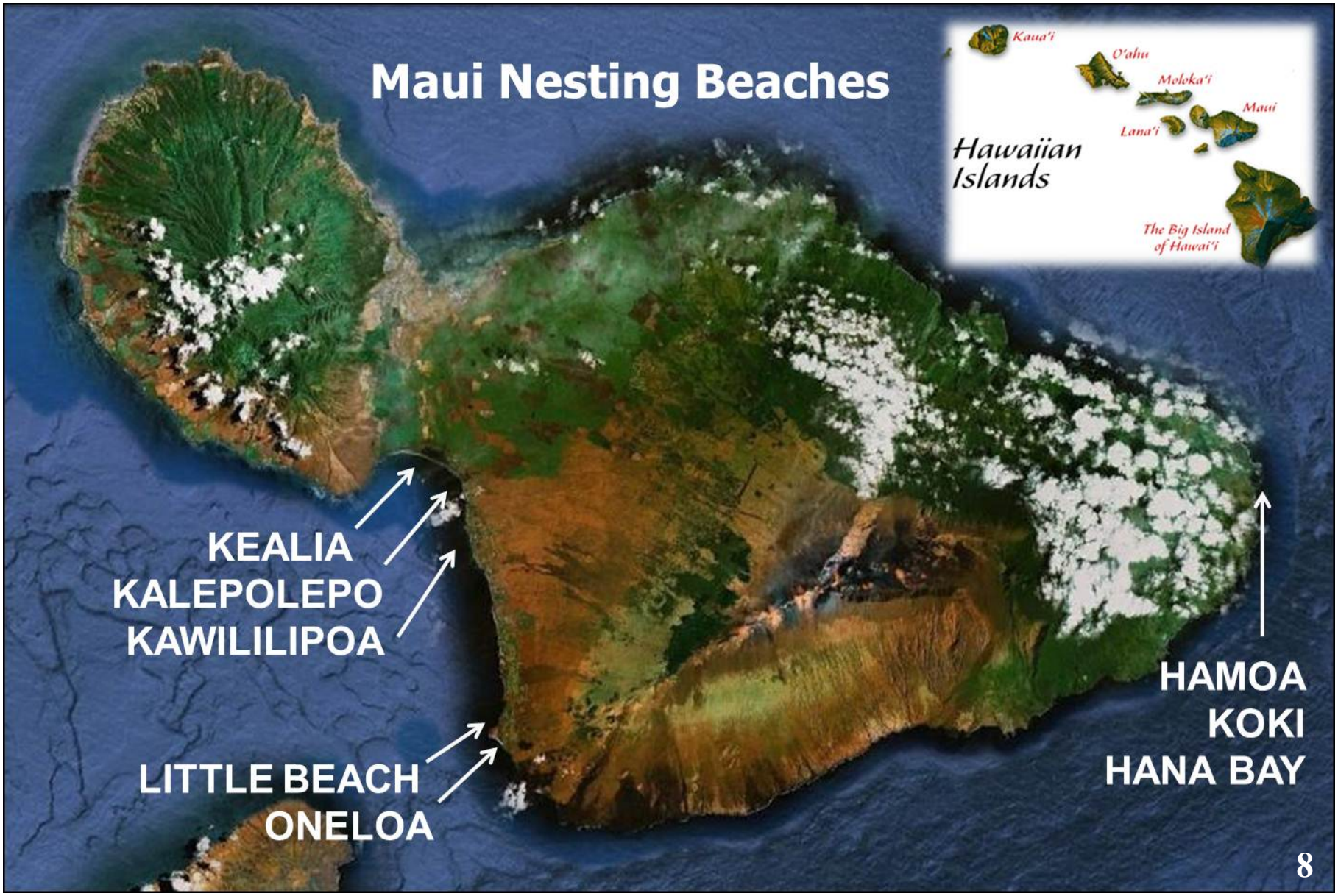
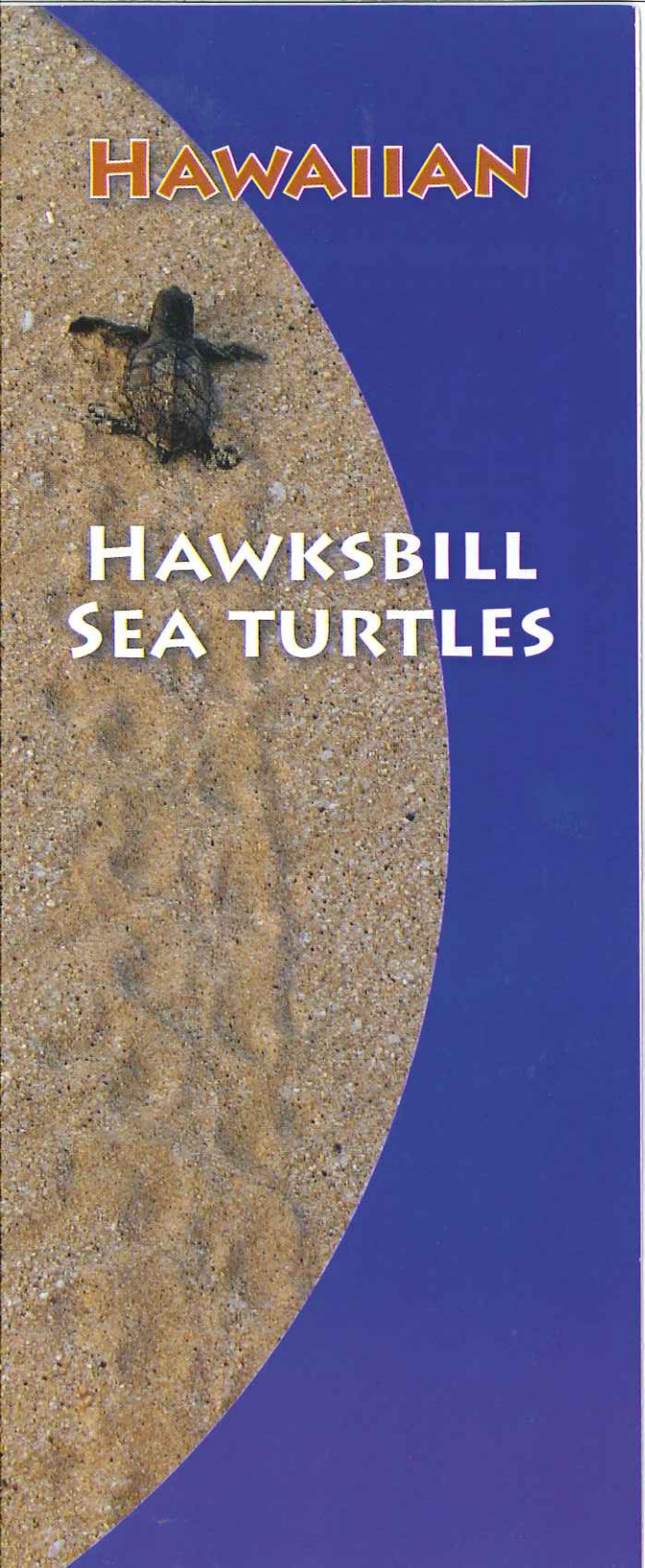


Figure 2. Hawksbill Nesting Beaches.



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.

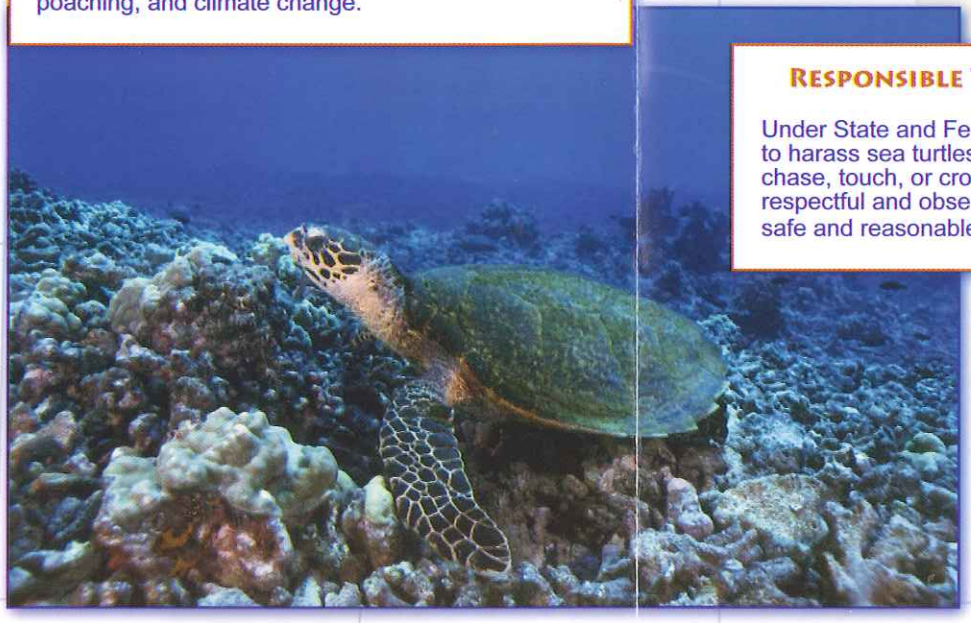
Some dune plants and grasses have thick roots that make nesting difficult. They also trap and entangle hatchlings.

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.

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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

Hawksbill or Green?

How to tell the difference

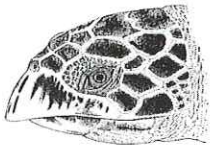
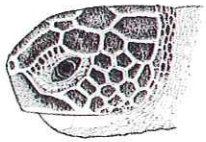
Hawksbill / `Ea / Honu`ea (*Eretmochelys imbricata*)	Green / Honu (*Chelonia mydas*)
	
• Narrow head and pointed beak • 4 pre-frontal scales (between eyes)	• Rounded head • 2 Pre-frontal scales (between eyes)
	
• Overlapping scutes on carapace (like shingles) • Carapace has serrated edges (juveniles) • 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. South Maui nests by location with (the # of individual nesters/# of nests/ # of seasons).

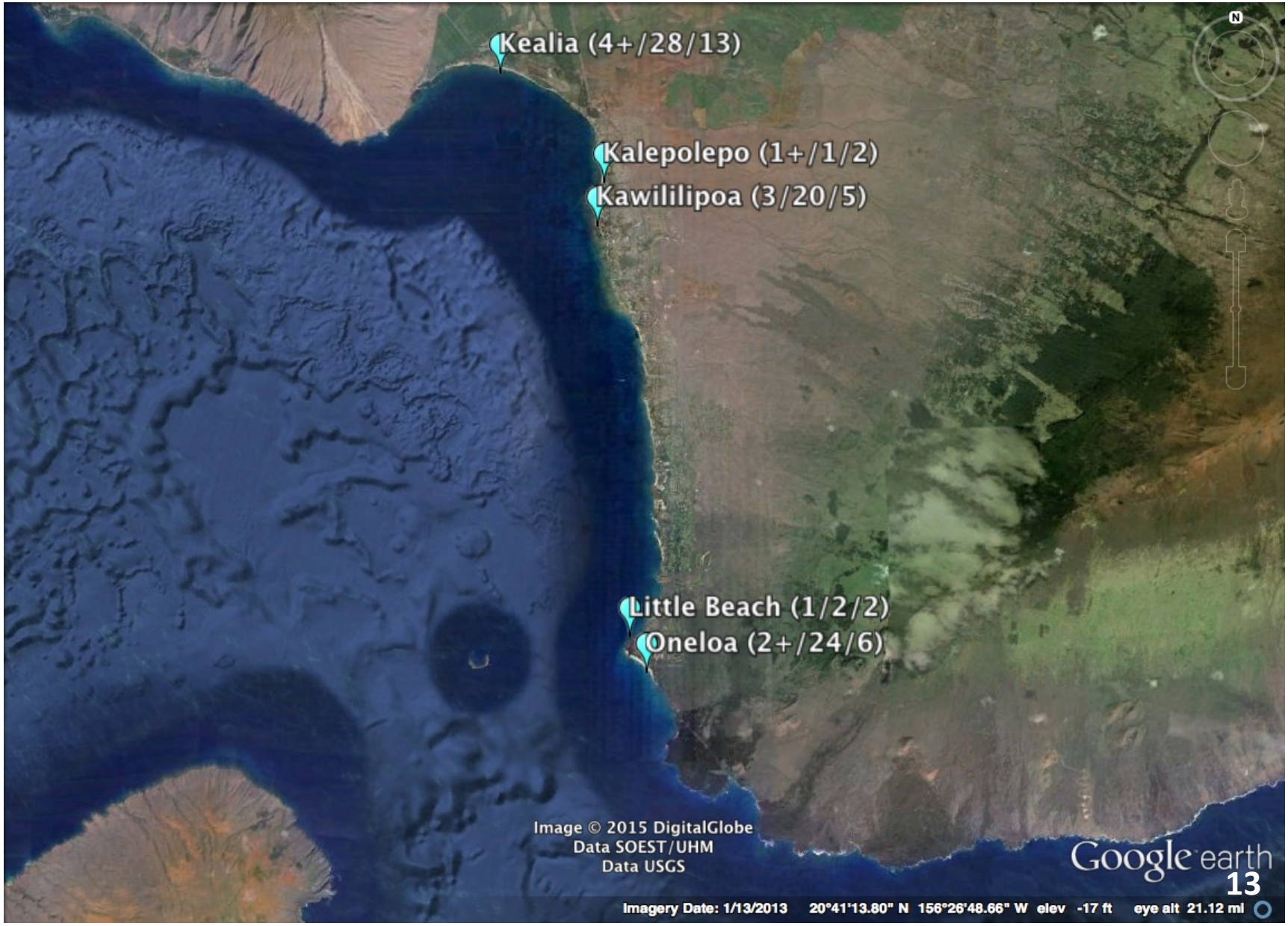


Figure 5. East Maui nests by location with (the # of individual nesters/# of nests/ # of seasons).

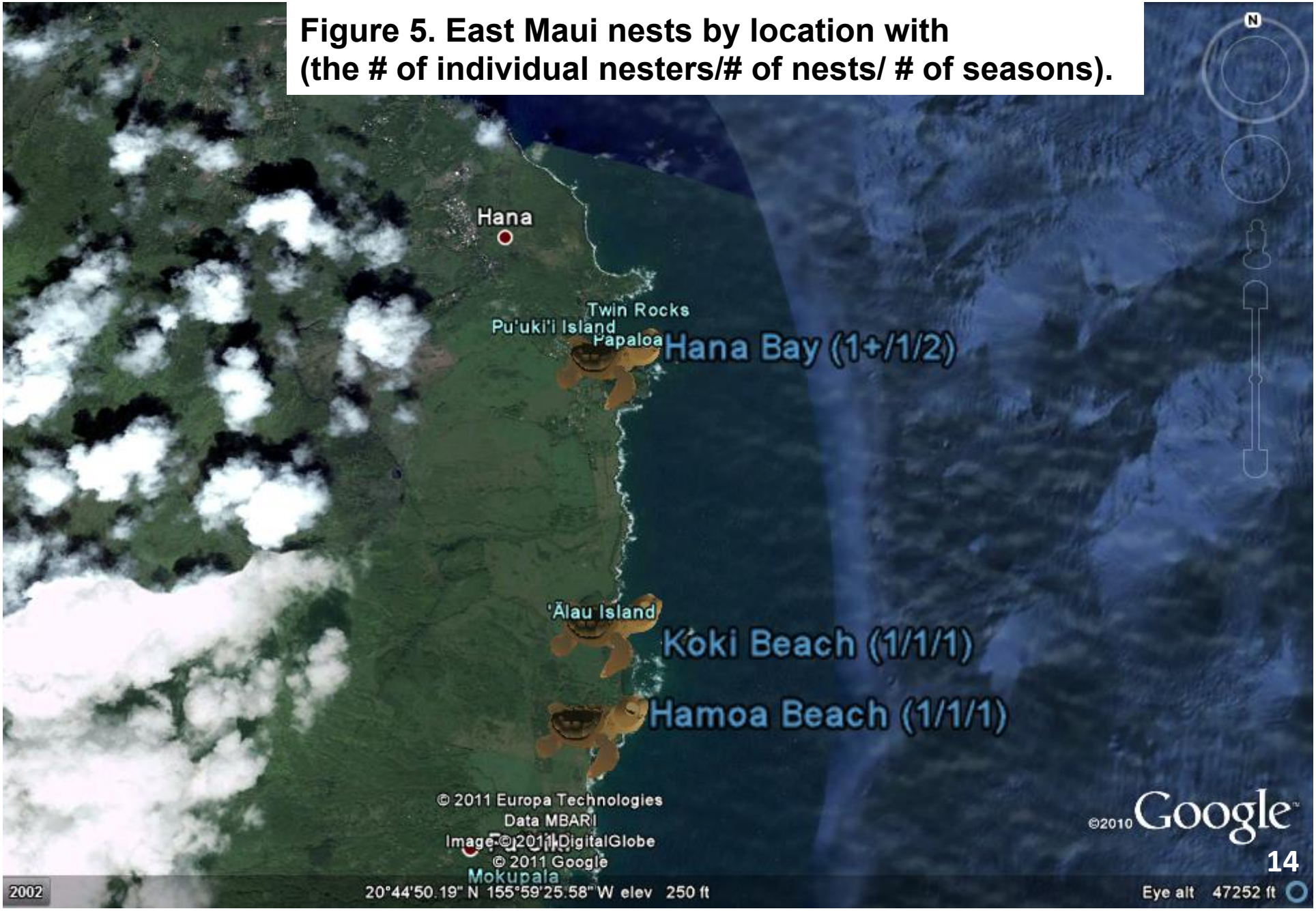


Figure 6. Summary of Maui's Hawksbill Nesting Activities (1991-2014)

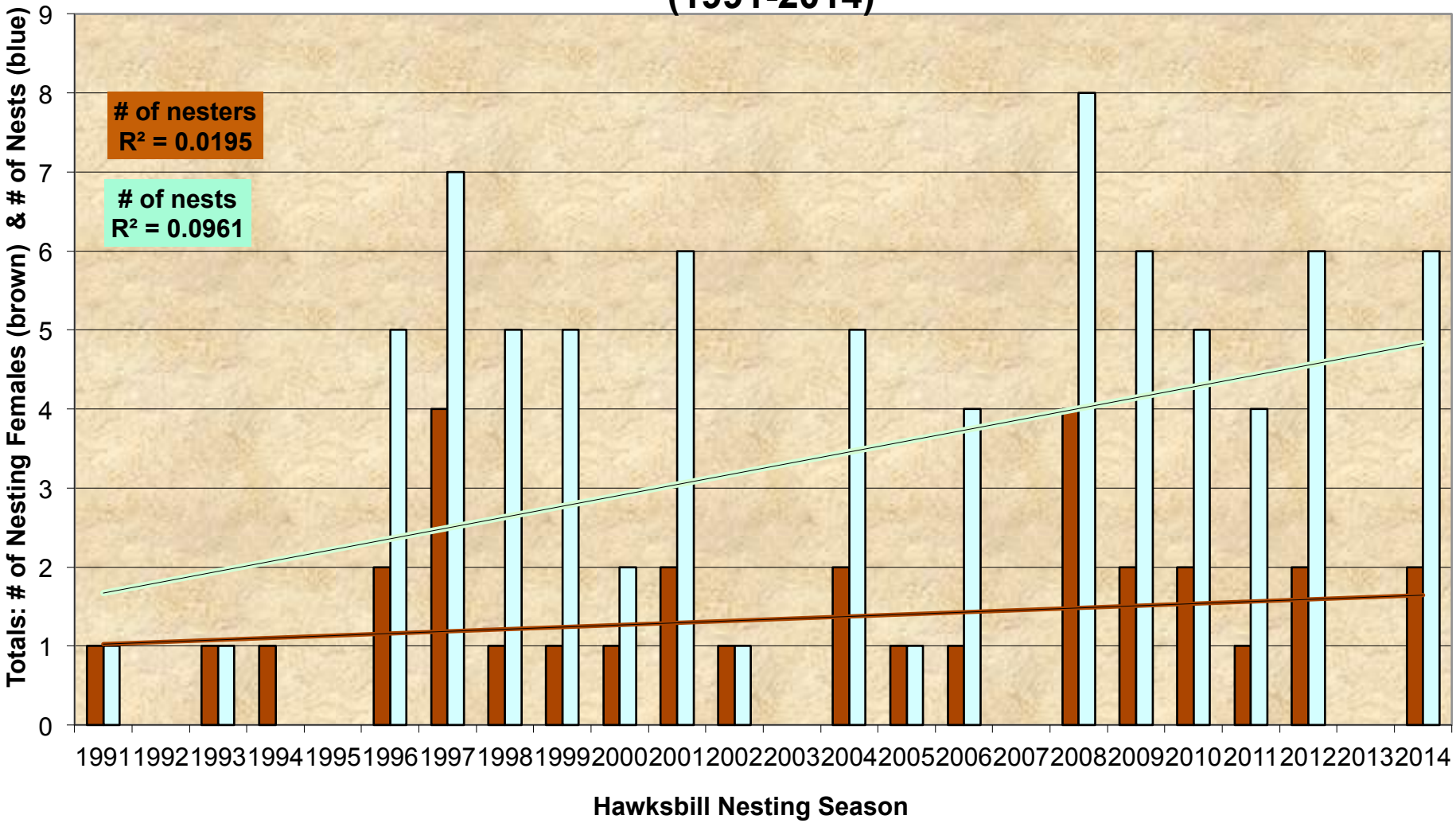


Figure 7. Annual Tagging Totals.

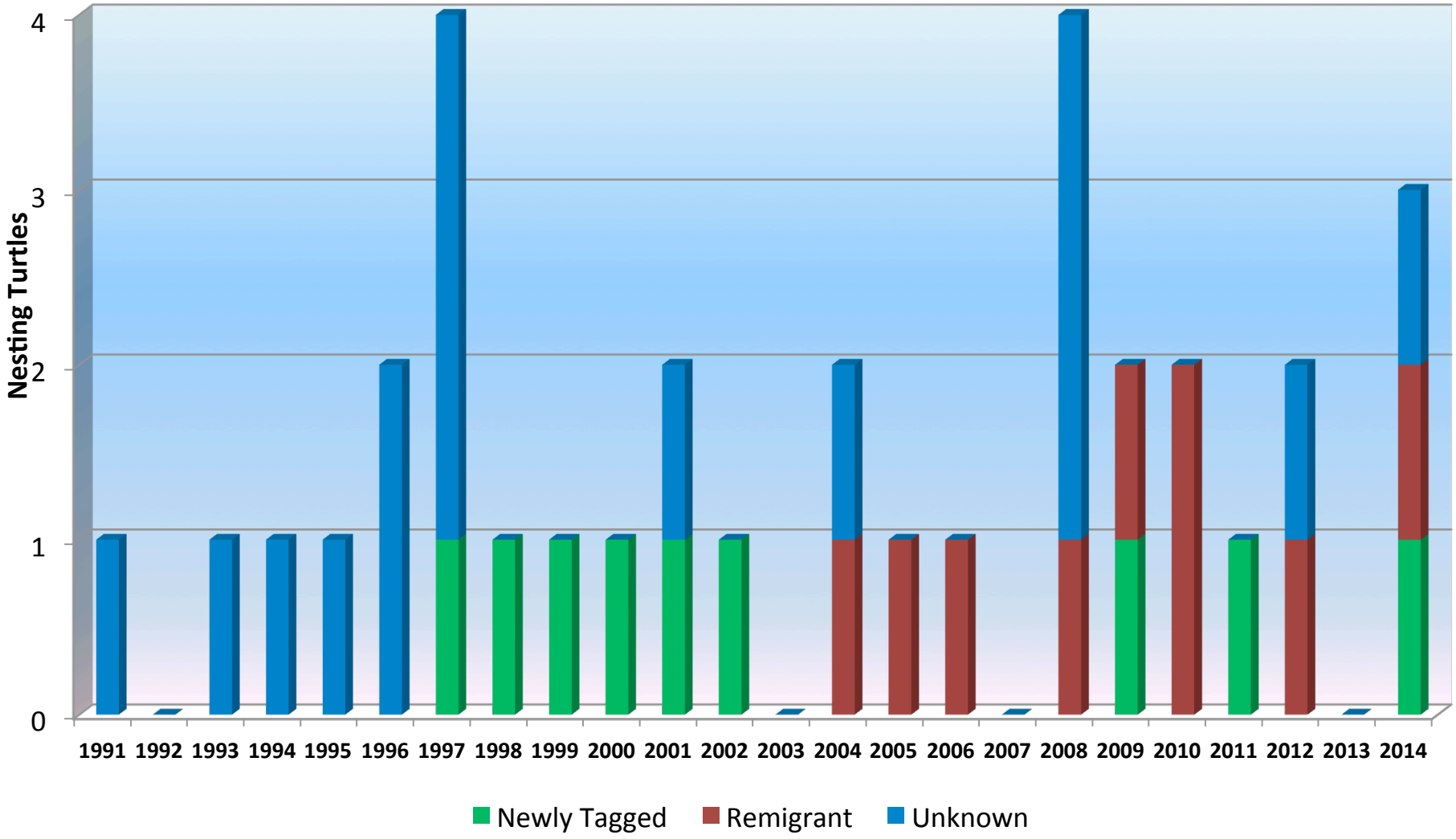
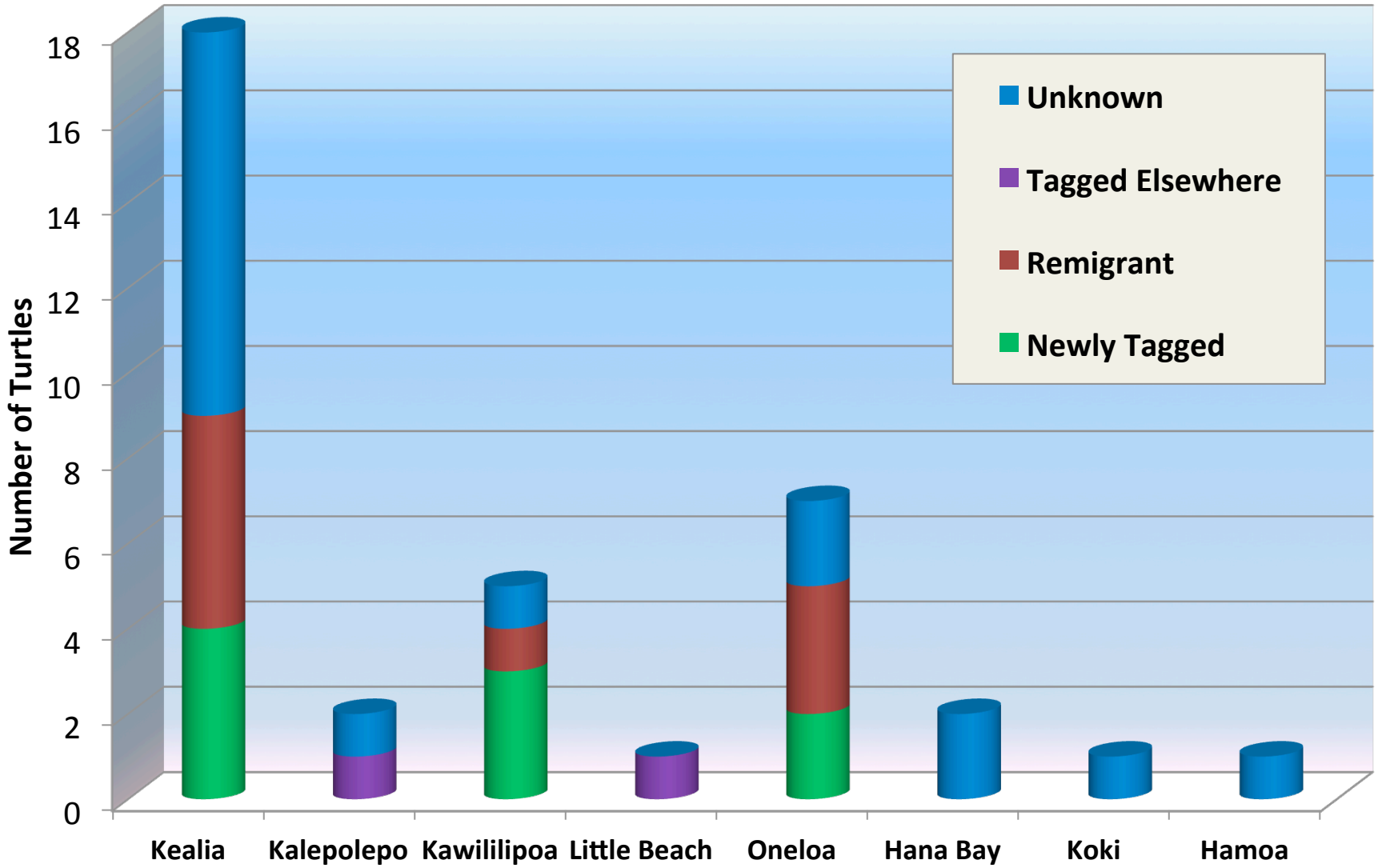


Figure 8. Tagging by Location (1997-2014).



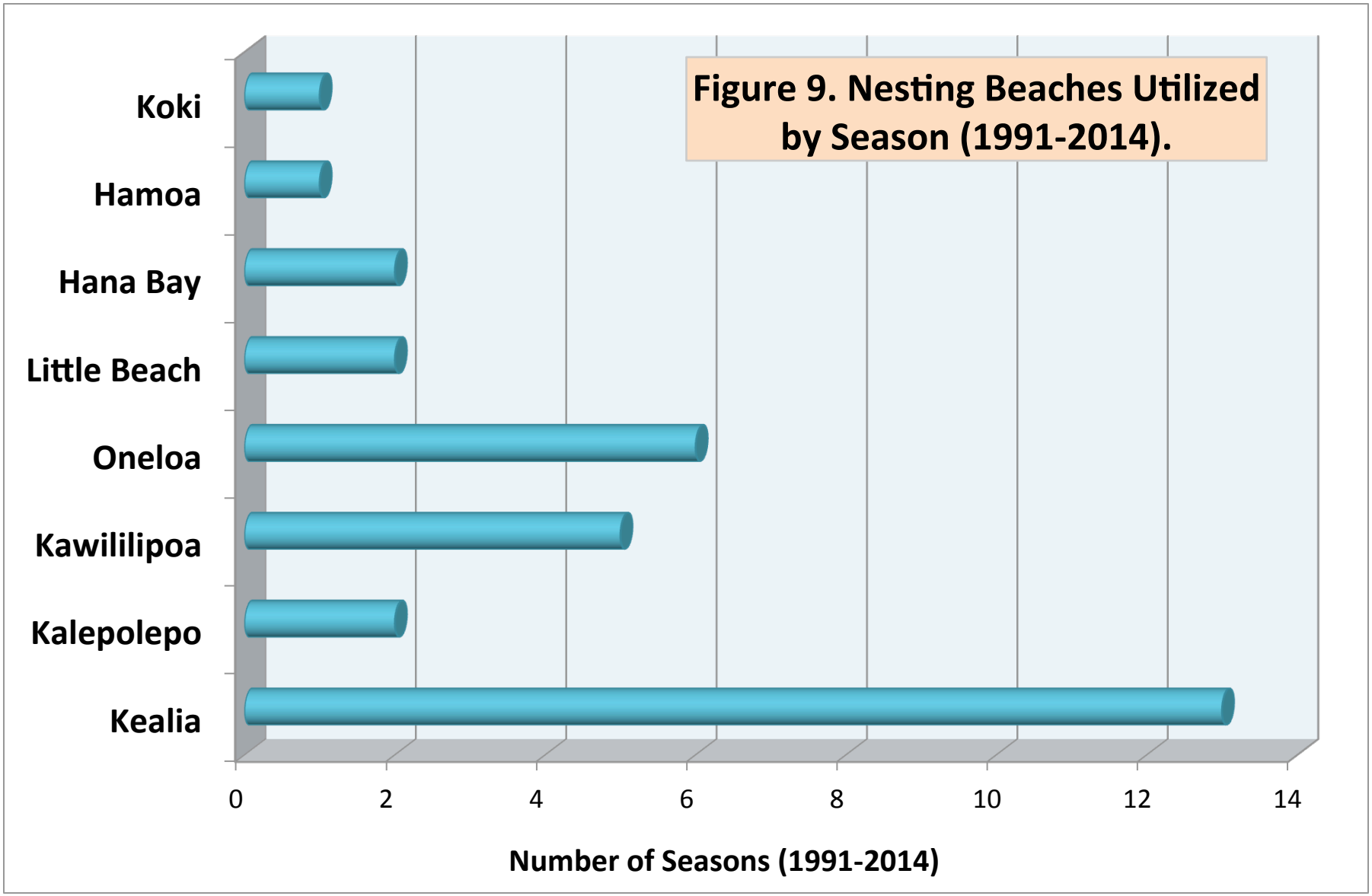


Figure 9. Nesting Beaches Utilized by Season (1991-2014).

Table 1. Annual seasonal start and end dates by turtle since HWF monitoring began (1996-2014).

Season	Location	Turtle	# Nests	False Crawls	1st activity	Last Activity	Last Excavation
1996	**Kealia**	Kealia '96 Struck	5	n/a	7/24/96	8/30/96	10/20/96
1997	**Kealia**	Hapa	3	16	~7/31/97	10/11/97	n/a
1997	**Kawililipoa**	Unknown	3	0	n/a	n/a	n/a
1997	**Oneloa**	Unknown	1	0	n/a	n/a	n/a
1998	**Kawililipoa**	Sasha	5	1	**5/18/98**	8/8/98	10/7/98
1999	**Kawililipoa**	Hokulele	5	1	6/29/99	9/19/99	11/29/99
2000	**Kealia**	Lele	2	2	8/18/00	10/13/00	12/22/00
2001	**Oneloa**	Orion	5	3	~7/1/01	9/22/01	11/27/01
2001	**Hana Bay**	Unknown	1	0	n/a	n/a	n/a
2002	**Kealia**	Kolohe	1	2	9/14/02	9/14/02	11/23/02
2003	**none**						
2004	**Oneloa & Little Beach**	Orion	5	4	6/17/04	9/4/04	11/20/04
2004	**Kealia**	Unknown	0	1	9/23/04	9/23/04	12/4/04
2005	**Kealia**	Lele	1	5	8/8/05	9/16/05	11/27/05
2006	**Kawililipoa**	Hokulele	4	1	6/21/06	8/16/06	10/25/06
2007	**none**						
2008	**Oneloa**	Oneloa X	2	0	6/7/08	6/23/08	8/8/08
2008	**Oneloa**	Orion	4	1	6/30/08	9/1/08	11/12/08
2008	**Kalepolepo**	Unknown	0	1	7/17/08	7/17/08	n/a
2008	**Hana Bay**	Unknown	0	2	6/29/08	6/29/08	n/a
2008	**Koki**	Unknown	1	0	8/3/08	8/3/08	10/20/08
2008	**Hamoa**	Unknown	1	0	n/a	n/a	n/a
2009	**Kalepolepo & Kealia**	Kulu	3	1	7/9/09	8/27/09	10/24/09
2009	**Kealia**	Kolohe	3	0	7/27/09	9/3/09	11/13/09
2010	**Kealia**	Unknown	0	3	6/27/10	6/27/10	9/7/10
2010	**Kealia**	Lele	2	2	8/28/10	9/17/10	11/26/10
2010	**Kealia**	Hapa	3	2	8/29/10	10/2/10	12/12/10
2011	**Oneloa**	Uhane Niniu	4	0	8/27/11	**10/21/11**	**1/2/12**
2012	**Oneloa & Little Beach**	Orion	5	5	6/17/12	9/17/12	11/23/12
2012	**Kealia**	Unknown	0	1+?	9/15/12	n/a	n/a
2013	**none**						
2014	**Kealia**	Unknown	0	1+?	6/12/14	n/a	n/a
2014	**Kealia**	Hapa	3	3	8/17/14	9/19/14	12/2/14
2014	**Kawililipoa**	Ali'i Li'i	3	4	7/23/14	10/3/14	11/7/14

Table 2. Maui Hawksbill Nesting Summary (1991 – 2014; n=78 nests).

Season	Location	# of Females	# of Nests	Mean # of eggs/ nest	Mean Hatchling Emergence	Mean Hatchling Success
1991	Kealia	1?	1	n/a	n/a	n/a
1993	Kealia	1 killed	0	*	*	*
1994	Kealia	1 crossed road	1	n/a	n/a	n/a
1996	Kealia	2? (1 killed)	5	157.7	n/a	16.0%
1997	Kealia	Hapa + 1?	3	206.5	n/a	0.0%
1997	Kawililipoa	1?	3	152	n/a	43.0%
1997	Oneloa	1?	1	141	n/a	23.0%
1998	Kawililipoa	Sasha	5	154	n/a	68.9%
1999	Kawililipoa	Hokulele	5	190.2	n/a	60.0%
2000	Kealia	Lele	2	232.3	0.1%	0.0%
2001	Oneloa	Orion	5	169.6	71.3%	63.0%
2001	Hana Bay	1?	1	n/a	n/a	n/a
2002	Kealia	Kolohe	1	191	0.0%	0.0%
2003	Ø	0	0	*	*	*
2004	Kealia	1?	0	false crawl	*	*
2004	Oneloa	Orion	4	166.8	83.4%	70.8%
2004	Little Beach	Orion	1	160	93.8%	42.5%
2005	Kealia»Kawili	Lele	1	224	0.0%	0.0%
2006	Kawililipoa	Hokulele	4	216.3	19.8%	11.9%
2007	Ø	0	0	*	*	*
2008	Oneloa	Orion	4	182	79.6%	74.8%
2008	Oneloa	1?	2	163.5	82.9%	82.9%
2008	Kalepolepo	1?	0	false crawl	*	*
2008	Koki	1?	1	116	71.6%	71.6%
2008	Hana Bay	1?	0	crawls	*	*
2008	Hamoa	1?	1	washed out	0.0%	0.0%
2009	Kalepolepo	Kulu	1	151	82.1%	23.2%
2009	Kealia	Kolohe	3	177	93.6%	75.0%
2009	Kealia	Kulu	1	183	83.6%	80.9%
2009	Kealia»Kawili	Kulu	1	180	50.0%	47.8%
2010	Kealia	Lele	2	187.5	0.0%	0.0%
2010	Kealia	Hapa	3	201.7	0.0%	0.0%
2011	Oneloa	Uhane Niniu	4	169.0	97.2%	95.3%
2012	Oneloa	Orion	4	177.8	85.4%	79.7%
2012	Little Beach	Orion	1	205	45.9%	23.9%
2012	Kealia	1?	1	not found	*	*
2013	Ø	0	0	*	*	*
2014	Kealia	Hapa + 1?	1	208	0.0%	0.0%
2014	Kealia»Kawili	Hapa	2	188	0.0%	0.0%
2014	Kawililipoa	Ali'i Li'i	3	176	47.0%	45.8%
	8 beaches	9 tagged	78	177.3 ± (n=70)	56.1% (n=50)	20

Table 3. Threats on Maui's Nesting Beaches.

	Kealia	Kalepolepo	Kawililipoa	Little Beach	Oneloa	Hana Bay	Koki	Hamoa
1) New/increased development	2	2	3	4	4	4	4	4
2) Light pollution	1	1	1	4	3	1	4	4
3) Vehicular beach traffic	1	1	4	4	2	3	4	4
4) Human trampling	2	2	3	1	1	1	1	1
5) Misorientation onto roadway	1	1	4	4	4	2	4	4
6) Impacts by recreational users	1	1	2	1	1	1	1	1
7) Predation by feral or domestic animals	2	2	2	2	1	2	2	2
8) Beach vegetation	1	2	1	3	2	4	4	4
9) Invasive algae piles	4	4	2	4	4	4	4	4
10) Deep holes	3	3	3	3	2	3	3	3
11) Egg development issues	1	3	2	3	3	3	3	3
12) Egg poaching	3	3	3	3	3	3	3	3
13) Nesting female poaching	3	3	3	3	3	3	3	3
14) Land-based and marine debris	2	2	3	4	4	4	4	4
15) Erosion	1	2	3	4	4	4	4	4
16) Flooding	1	2	3	3	2	3	3	3
17) Climate change	3	3	3	3	3	3	3	3

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