



Photo Courtesy Ryan Tabata

MAUNALUA BAY HONU SURVEY

Biology 499 Directed Research Report:
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Abstract

This project was a three month study on the turtles that inhabit Maunalua Bay and the surrounding area of Oahu, Hawaii. An attempt was made to determine foraging sites of green turtles within the bay through the use of terrestrial, snorkeling, kayaking, and SCUBA surveys; however those sites were unable to be located with this study. Photographs of turtles taken during SCUBA surveys were used to test a photo identification software that may be manipulated to accommodate turtle identification purposes. The use of the software seems promising and should be considered to begin a database of turtles and data on individual turtles around Hawaii, and hopefully soon, around the world. Community outreach was achieved through gathering volunteers to conduct surveys and through the creation of a webpage on turtles of Maunalua Bay.

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A. INTRODUCTION

I. *Maunalua Bay, Oahu, Hawaii*

Maunalua Bay is enjoyed by a number of user types, both extractive and non-extractive. Many residents and visitors derive recreational, commercial, educational, and cultural benefit from the bay. However, while the bay may be well loved, it is certainly not well cared for. Estimates from commercial catch data, as well as input from local kupuna and fishermen depict a steep decline in the marine resources within the bay over the past several decades (A. Miller, pers. comm.).

This decline is a result of a multitude of problems facing the bay, from land-based sediments and pollutants entering the bay to invasive species displacing native habitat and species, to irresponsible fishing practices. With a confluence of so many threats, a comprehensive solution is necessary. This includes addressing all of these threats in a holistic way that includes restoration, education, and changes in policy. Just as importantly, a comprehensive approach must include all stakeholders, including fishers and their valuable insights (A. Miller, pers. comm.).

II. *Green Sea Turtles*

The Hawaiian green sea turtle (*Chelonia mydas*) is culturally significant to the Hawaiian people. Known as *honu*, turtles were featured in a number of traditional practices. Thirty years ago the populations were critically low. Thankfully, protection was granted to threatened *honu* under the Endangered Species Act on July 28, 1978 (“Green Turtle”). This designation makes it illegal to harm, harass or kill any sea turtles, hatchlings or their eggs. It is also illegal to

import, sell, or transport turtles or their products (“Sea Turtle Conservation Strategies”). The green turtles population in Hawaii has been increasing since the mid-1980s (Balazs and Chaloupka 2006, Chaloupka and Balazs 2007, Chaloupka et al. 2008) however, the turtles are still vulnerable to threats such as habitat loss, destructive fishing techniques, and tumors caused by the fibropapilloma virus. Specific threats to Maunalua Bay’s turtles include fast moving boats, harassment by humans, loss of foraging habitat, and entanglement in fishing nets and hooks. Maunalua Bay is a feeding and resting area for many *honu*. They are commonly seen in the nearshore areas and two particular locations: Turtles Surf Site and Turtle Canyon, both of which are named for the *honu* that can be seen there (Balazs et al. 1987).

III. *Project Rationale*

Determining foraging and resting sites of green sea turtles is crucial for the conservation, monitoring and management of this threatened species. Threats to sea turtles cannot be properly understood or assessed without first knowing where the turtles are located. Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on seagrasses and algae. For this reason it is important to understand the algal communities in the turtles’ habitat. Facial profiles of scale patterns on individual turtles have been shown to be a viable way to identify an individual turtle within a population (Bennett et al. 2000, Schofield et al. 2008) (Figure 1).

Photographing the facial profiles of the *honu* may be used to track the occurrence of fibropapilloma and other conditions. Currently, there are no monitoring programs,

ocean captures or assessments of *honu* in the bay (Hargrove 2008) and the population size is not known. The only information gathered on *honu* in the bay is collected when the turtles are stranded or entangled; however, rehabilitated turtles are released into the bay and based on records of turtle strandings, it is evident that turtles are frequenting the bay (Figure 2) (Hargrove 2008). Basking and nesting of green turtles has not been documented in Maunalua Bay, but, the 173 strandings of turtles since 1982 suggests that the bay must be used as foraging and resting habitat (Hargrove 2008). There have been a few studies of *honu* populations in Maunalua Bay but, these covered small sections of the bay and were short-term (Balazs et al. 1987, Brock 1989).

IV. *Overview of Project/ Hypothesis*

The research project attempted to determine foraging sites of honu (Chelonia mydas) in Maunalua Bay, Oahu, Hawaii through recording the presence and abundance of sea turtles at various locations in the bay using GPS. Facial profiles were photographed of turtles observed and various types of data were collected in an attempt to identify individual turtles occupying the bay. Community outreach and awareness of honu in Maunalua Bay was attempted through the use of a webpage addition to Malama Maunalua's website.

B. MATERIALS AND METHODS

I. *Location*

Located on the island of Oahu, Maunalua Bay encompasses a large area of the southeastern coastline (Figure 3). Situated between Waikiki and Diamondhead to the

west, and Hanauma Bay to the east, the area stretches from Kawaihoa (Koko Head) to Kūpikipiki‘ō (Black Point) to the Ko‘olau ridgeline. This area’s seven miles of coastline and six-and-a-half square miles of nearshore marine environment are comprised of extensive beaches, rich native algae beds, and expansive coral reefs; all of which provide habitat for the full compliment of unique reef species in Hawai‘i, including *honu* and Hawaiian monk seals (“Kai-Sea”). The confluence of these conditions also serves to attract tens of thousands of residents and visitors alike each year (A. Miller, pers. comm.).

Although green sea turtles are most likely found in all areas of Maunalua Bay, the east end of the bay is easily accessed by the community and is known to be frequented by turtles on a daily basis. The best known area to see turtles has been named Turtle Canyon. Turtle Canyon is located approximately 950m west of the Hawaii Kai Entrance Channel (Brock 1989). In 1989, Brock completed an environmental impact report for the development of a proposed ferry system into Hawaii Kai. In his analysis, Brock assessed the green turtle population in the bay. He concentrated his search at four locations (Turtle Canyon plus three additional sites) in the east end of the bay that he determined were used as “resting habitat”, (Figure 4 and 5). These four sites are seaward of the spur and groove zone of the fringing reef. As this study allowed mostly for surveys to be conducted while snorkeling, most study sites were concentrated in shallower water, shoreward of the spur and groove zone. Likewise, it seemed that foraging habitat for turtles would be more common in these shallower waters where algal beds are probably more abundant. The community-based aspect of this study included surveys conducted by

volunteers from Island Divers using SCUBA, which focused on areas in deeper water. Thus, both shallow-water and deep-water sites were surveyed.

II. *Survey Methods*

Surveys were conducted from 9/1/2008 to 11/16/2008. Most days began with terrestrial surveys along the shore of the bay beginning at dawn twilight, a time of the day that turtles have been observed actively foraging (Balazs et al. 1987). During the five days of terrestrial surveys, the project leader walked along the water's edge stopping and looking out over the water for at least ten minutes each at multiple locations, each roughly 70 m apart. The number of times turtles were seen surfacing for air was recorded and the corresponding GPS coordinates also recorded on the "Sea Turtle Sightings" form (Figure 5). The forms were printed on waterproof paper, and were brought along on surveys with a clipboard and pencil. Other data collected included the start time for each point recorded, the sky, wind, and surf conditions, and any relevant comments about each location (i.e. the presence of fisherman or lots of dogs in the water which could scare off foraging turtles in shallow water). An Olympus 7.1 Megapixel digital camera and housing, binoculars, and Garmin GPSmap 76csx were used during surveys, all borrowed from the University of Hawaii at Manoa Marine Option Program. It was believed that several turtles would be seen foraging/ surfacing for air in the shallow water close to shore and that terrestrial surveys would only be underway for two days. However, after several days of terrestrial surveys and not seeing a single individual, the three sites where turtles appeared to be most abundant were chosen for the snorkeling surveys.

The three sites chosen for snorkeling surveys were investigated, beginning in the morning of each day. The project leader and one other volunteer snorkeled around each

site and covered as much area as possible within a two hour time frame. GPS coordinates of the snorkel site perimeters were not recorded due to fears of flooding the GPS systems. A brief qualitative assessment of the surrounding habitat was also conducted and included substrate type, estimates of rugosity, and any other notable features of each survey site.

After unsuccessful terrestrial and snorkeling surveys, one day of kayak surveys was incorporated into the study. It was thought that kayaking would disturb the turtles less and would also allow to survey further from shore in deeper water, thus seeing more turtles. The project leader and one volunteered kayaked moving from the center of the bay, east towards Portlock and then circled around to move west towards Black Point. Paddling stopped and the kayak set still for ten minute intervals to watch for turtles at fifteen different sites. However, after several hours of kayaking in and around Maunalua Bay Beach Park, no turtles were observed.

Volunteers from Island Divers aided in data collection by conducting SCUBA surveys in deeper water where snorkeling was not feasible (Figure 6). These surveys occurred over two days and five locations in and near Maunalua Bay were visited: Koko Craters, Turtle Canyon, Skimmin's Wall, Lana'i Lookout, and Sea Cave. Five divers volunteered their time. The project leader informed each diver of the goals of the project, how to fill out data collection logs and how to go about photographing the turtles encountered. Attempts were made to consistently photograph the right facial profile of each turtle encountered, however, as many photographs as possible were taken in order to facilitate the photo identification process. Because each turtle has a unique scale pattern on its head, these photos may help in tracking these turtles and monitoring them in future

studies. Each photographed turtle was assigned a number and as much data as possible was collected for each turtle observed. This information included an estimate of size, presence of fibropapilloma tumors, and the presence of fishing hooks or nets. The “Sea Turtle Sightings” form distributed by the Marine Turtle Research Lab of Honolulu, HI was slightly modified, with their permission, to be more relevant to this study and was used to collect and record all data (Appendix 1-A).

III. *Data Analysis & Photo Identification*

All raw data recorded on the waterproof paper during surveys was transferred to Excel spreadsheets. The GPS coordinates recorded at each survey site, along with turtle abundance, were plotted on multibeam bathymetry and a land satellite image of Maunalua Bay (Figure 6) in ArcMap Version 9.3 (software used provided by the Pacific Islands Benthic Habitat Mapping Center) to produce a map showing the locations of the turtles. The photographs of each turtle were compiled and the corresponding data and turtle identification number were also entered into Excel spreadsheets. Several attempts to use photo recognition software were conducted using the “Interactive Individual Identification System” (I^3S). This free software uses an algorithm of spot patterns to match a new photograph to a photograph already in the database and has been used with manta rays, raggedtooth sharks, and whale sharks. A few sample photographs of the turtles, showing the right profile, encountered during the SCUBA dives were uploaded to the software’s database, following the directions in the I^3S Manual. Once an image, in .jpg format, is uploaded to the database, a “fingerprint” file is made from the image by selecting a series of reference points on the image. Because this software is meant for use

on fish, it asks for the certain fins to be selected, to be used as reference points, and then “dots” on the animals’ skin. To be consistent and to use this software for the turtle images, these fin reference points were selected as follows: “Top 5th gill”= edge of turtle beak, “Edge pectoral” = farthest point back on top of head, “Bottom 5th gill”= farthest point back on bottom of head. Next, instead of selecting “dots”, the junctions between scales were marked as points. Also, a point halfway between two junctions was made, if possible. This process creates an outline of each scale (Figure 7). The highest quality image available for a particular individual is used and this image, with the red “dots”, is then saved as the fingerprint file in the database and used to match other photos to it. The process for matching new photos to those already in the database is done similarly to creating the fingerprint file. A new image is uploaded to the software, and the fin and scale reference points are chosen. Once the points are chosen, a search is conducted to find matches to this image in the database. A small window pops up after the search, and a list of matching images is populated, along with the number of matched points between images. This new, matched image can be compared side-by-side with the existing database image. The “spot-cloud” of matched pairs is also made available, showing dots of both animals and the dot pairs that were matched (Figure 8). This new image can then be inserted into the database, if desired.

C. RESULTS

I. Surveys

Terrestrial surveys were initially planned to only encompass two days of research.

However, after those first two days, only two turtles were observed. These turtles did not

appear to be foraging, just simply surfacing for air. It was decided that terrestrial surveys would continue for a few more days until a number of turtles were observed in a single area, thus being indicative of a common foraging ground. After five days of terrestrial surveys, eight turtles were seen surfacing for air, but there was no sign of turtles foraging. Thus, snorkeling surveys in the areas where the most turtles were seen: East Portlock (off the beach park), West Portlock (from residents' back-yards), and Waialae Beach Park commenced in the hopes that turtles would be encountered (Raw data in Appendix 1-B). Three days of snorkeling surveys were conducted. One day of snorkeling at Portlock, two turtles were observed swimming in the distance, but they were too far to collect data and photographs of them. The other snorkeling surveys did not encounter any turtles.

Kayak surveys were not originally planned for this project, however, after terrestrial and snorkeling surveys did not lead to turtle observations, one day of kayak surveys were conducted. This survey lasted a little more than two hours and allowed the search to go into deeper water than terrestrial and snorkeling surveys allowed, but still, there were no turtles observed.

Lastly, in an attempt to get the local Hawaii Kai community involved and informed on sea turtle biology in Maunalua Bay, "turtle-id" SCUBA dives were advertised to Island Divers' club members. The two days of diving conducted by volunteer divers, which included a total of five sites and five dives, provided all the photographs and data used in this project (Table 1). Two green and one hawksbill turtle were seen at Turtle Canyon and three green turtles at Koko Craters were observed and photographed. Three green turtles were seen at Skimmin's Wall, two at Lana'i Lookout, and five at Sea Cave (Table 1). Every turtle seen was either resting under reef ledges and

overhangs or between rocks, or swimming. Of all the surveys, not a single turtle was observed foraging. In total, fifteen turtles were observed during SCUBA surveys and photographs and data were collected on each individual turtle (Table 1, Appendix 1-C).

With all the surveys combined, thirty turtles were seen in Maunalua Bay surfacing for air, swimming, or resting (Figure 9).

II. Photo Identification

The photo-identification software was used to match sample photos of two turtles observed during the SCUBA dives: one green turtle and the only hawksbill turtle seen. The number of matched dot pairs between the fingerprint image stored in the database and the “unknown” image was quite high. For the green turtle example, 60 dots were chosen in the fingerprint file to outline the scales on the right profile (Figure 6). The image used for comparison had 39 dots selected (the second image was of much poorer quality and at a different angle than the fingerprint image). When the comparison was made, 26 pairs of dots were matched between images (Figure 7). For the hawksbill turtle example, 32 dots were selected for the fingerprint image and 23 for the comparison image. Between these two, 19 dot pairs were made.

III. Community Outreach

Malama Maunalua is a community-based organization that is focused on cleaning up and taking care of Maunalua Bay. For this reason, it was important to incorporate a community-based portion into the project. The volunteer divers for SCUBA surveys were one way

this was accomplished, along with the creation of a webpage (which is still being created as of this writing) to inform the community of the turtles in the bay and how they can help. The webpage will be an addition to the Malama Maunalua website. Also, all data and corresponding photographs of the turtles observed during the SCUBA surveys will be made available to local turtle authorities, including the Marine Turtle Research Program.

D. DISCUSSION

This project is one of very few studies of turtles in Maunalua Bay, Oahu, Hawaii. Although the main goal of the project- to find foraging sites of the turtles in the bay- was not fulfilled, the data collected can aid in future studies. Above-water surveys have been used in the past to observe turtles foraging and surfacing in near-shore waters (Brock 1989). However, above-water surveys were not successful during this project, possibly for a number of reasons. Firstly, the terrestrial surveys were conducted beginning in the early morning hours, however, it may be possible that the surveys should begin even earlier. However, this method makes it difficult to see turtles surfacing under low light conditions. Secondly, previous above-water surveys (Brock 1989) were conducted from boats in deeper water, the turtles observed during those surveys were most likely surfacing from resting or swimming. It is much easier to see turtles from a boat than from land due to height restrictions and field of view. Also, terrestrial surveys are restricted to the land available on the coastline. On several occasions during this project, the shoreline and beaches were not accessible due to residential developments. Likewise, anthropogenic activity was quite high in the mornings when surveys were taking place. This activity included multiple fisherman, surfers, dogs and swimmers (Appendix 1-B).

Unfortunately, snorkeling surveys did not produce useful data either. The three days of snorkel surveys seemed promising, but even after venturing far from shore into deeper water, turtles were not observed. It was hoped that the terrestrial surveys would show the active foraging sites of the turtles and that snorkeling surveys would just be conducted to give truth to that hypothesis, however, after several days of terrestrial surveys with few turtles observed, the timeframe would not allow to continue that type of survey.

After discussion of finding few turtles during terrestrial and snorkeling surveys, it was suggested that kayaking be used as it may cause less disturbance to the turtles, resulting in more encounters. The project leader and a volunteer kayaked from the Hawaii Kai boat channel first east towards Portlock and then circled around and moved west towards Black Point. After stopping at fifteen different sites, no turtles were observed. Perhaps future studies could start kayaking earlier in the morning and multiple days because this method should be a promising way to find turtles throughout the bay.

One goal of this project was to involve the local community and to inform them about the turtles that inhabit the bay. This task was completed with the help of several volunteer SCUBA divers from Island Divers scuba shop. The dives proved successful in finding turtles in bay; however, the turtles encountered were swimming or resting, not foraging. Also, three of the dives were conducted *outside* of Maunalua Bay. Although it is probably true that the turtles seen at those three sites do enter the bay, it was unfortunate that more sites could not have been explored within the bay given the time constraints of the project.

Previously, photo identification of sea turtles has been completed through the tedious task of manual matching photographs (Bennett et al. 2000, Schofield et al. 2008). As of this writing, there has yet to be a survey completed that utilizes software in the process of sea turtle photo identification. The software used for photo identification, “Interactive Individual Identification System,” (I^3S) is not ideal for sea turtle scale pattern identification because it was designed to be used with sharks and rays. However, slight modifications to the software such as changing the reference points of pectoral fins and gills slits to ones similar such as those this project chose, can make this software more suitable for turtle photographic identification. The process of “outlining” the scale pattern with spots is a task simple enough for almost anyone to complete. Manual matching of photographs is a labor-intensive task, and the ability to have a database of “fingerprint” images to which new ones can easily be compared is an exciting thought. Likewise, a software similar to I^3S would still allow photographs to be compared side-by-side to be sure the individuals match. If a software can be created to create a database of turtle images and corresponding data on each individual, this data can be shared to turtle biologists worldwide to aid in turtle research and to understand problems still facing turtles such as the fibropapilloma tumors.

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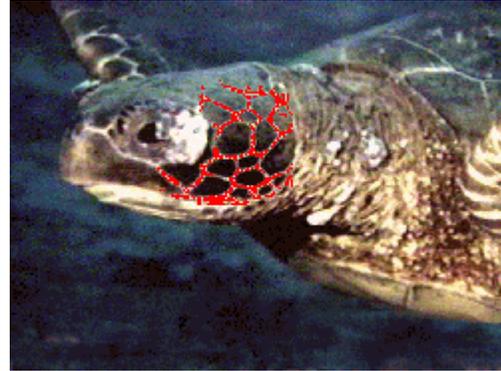
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Clothahump, 1988



Clothahump, 1993

Diagram formed by removing everything except the red mask:

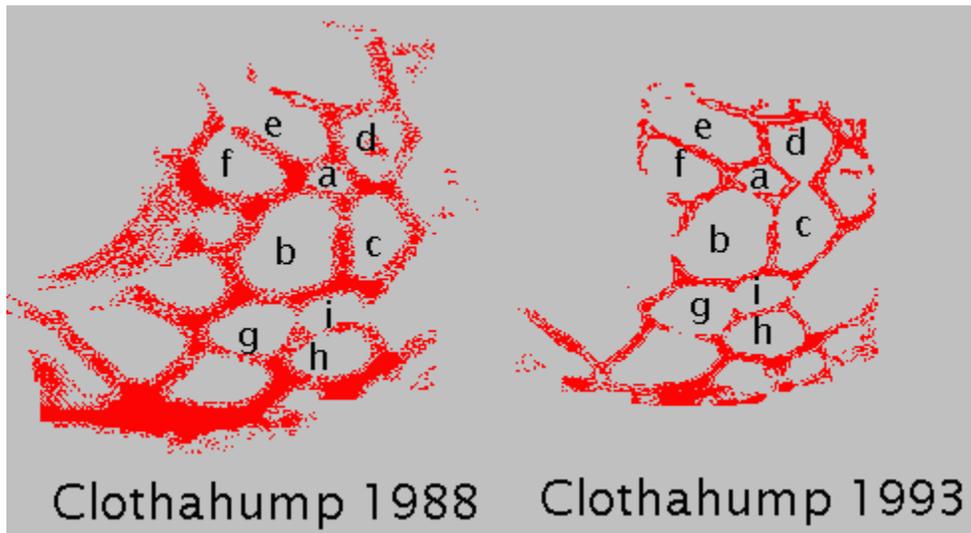


Figure 1: Excerpt from <http://www.turtles.org>: “We [The Bennett’s] have eight summers of observations in the waters of Honokowai, West Maui. Over that time, we have done nearly 1000 dives averaging about 75 minutes each, with 35-40 of those minutes spent actually watching turtles. We have made over 90 hours of videotape and taken over 2500 photographs. We have paid close attention to watching and documenting the changes in the environment. We have developed a reliable method of identifying individual turtles--over 100 of them so far--allowing us to track the changes in their condition from year to year.” The above images show how photo identification in sea turtle facial profiles works: “The two portraits from the Dedication (above) provide an excellent example of how this works. Clothahump was the first turtle we met, back in 1988. The image on the left is a portrait from that year. The image on the right was taken the last time we saw her, in 1993. The facial pattern in each picture has been highlighted in red for emphasis (“Recognizing Individual Turtles”).

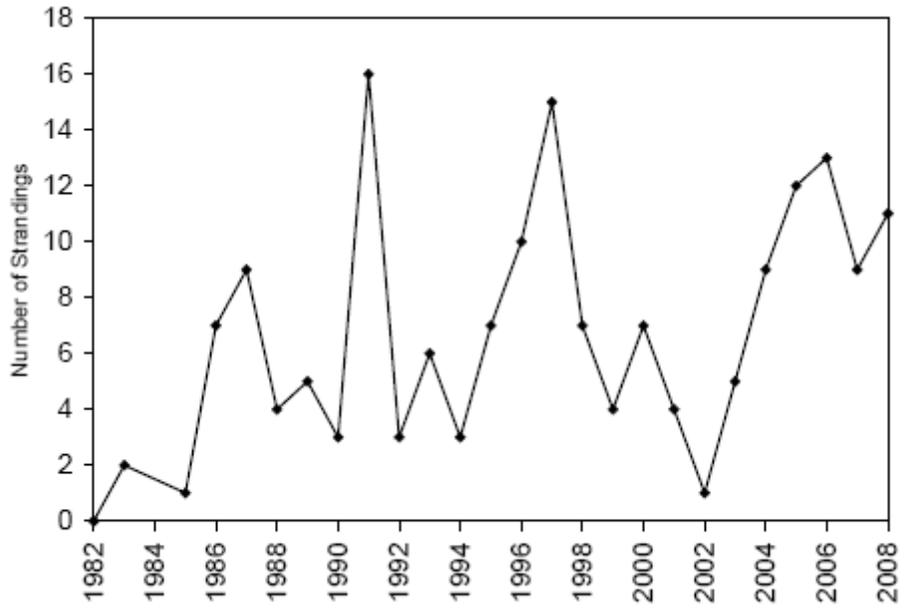


Figure 2: Green turtle strandings by year in Maunalua Bay area (1982-2008) (Hargrove 2008).

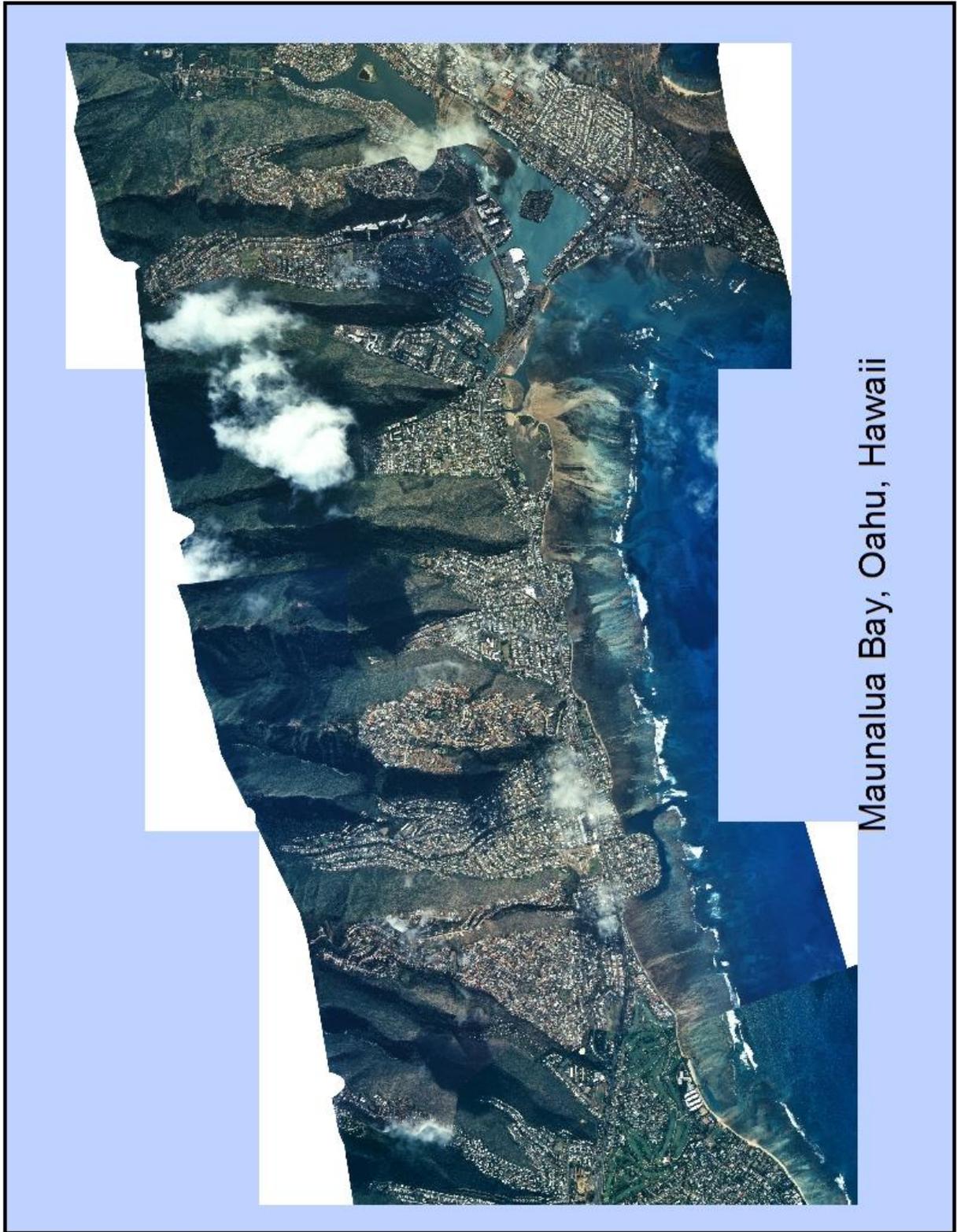


Figure 3: Georeferenced NOAA/ NOS Aerial Photography by Pacific Disaster Center (PDC) of Maunaloa Bay in 2000, compiled and projected in ArcMap Version 9.2 (“Shoreline Imagery for Oahu”).

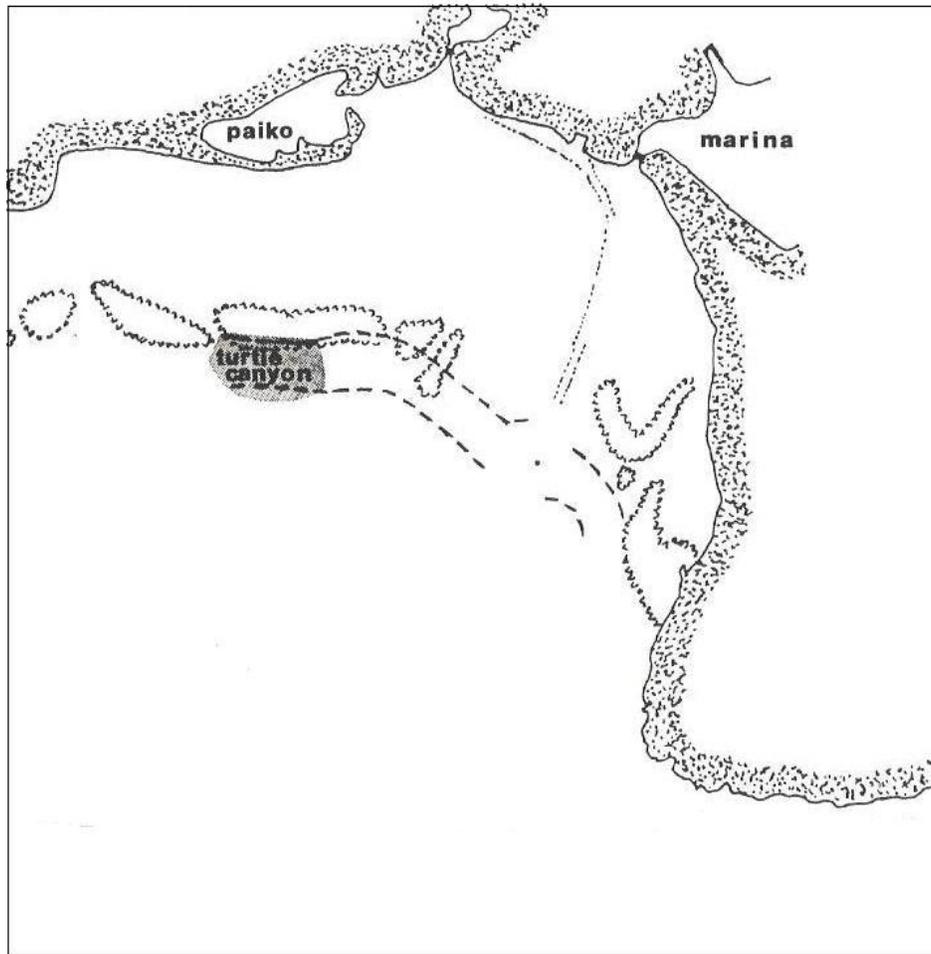


Figure 4: Map of the east end of Maunalua Bay showing the band of resting habitat covered by Brock (1989) to determine the population size of green sea turtles (*Chelonia mydas*). Notice the Hawaii Kai Entrance Channel (the dotted lines from northeast to southwest near the marina) which was a reference point for the four locations that were studied.

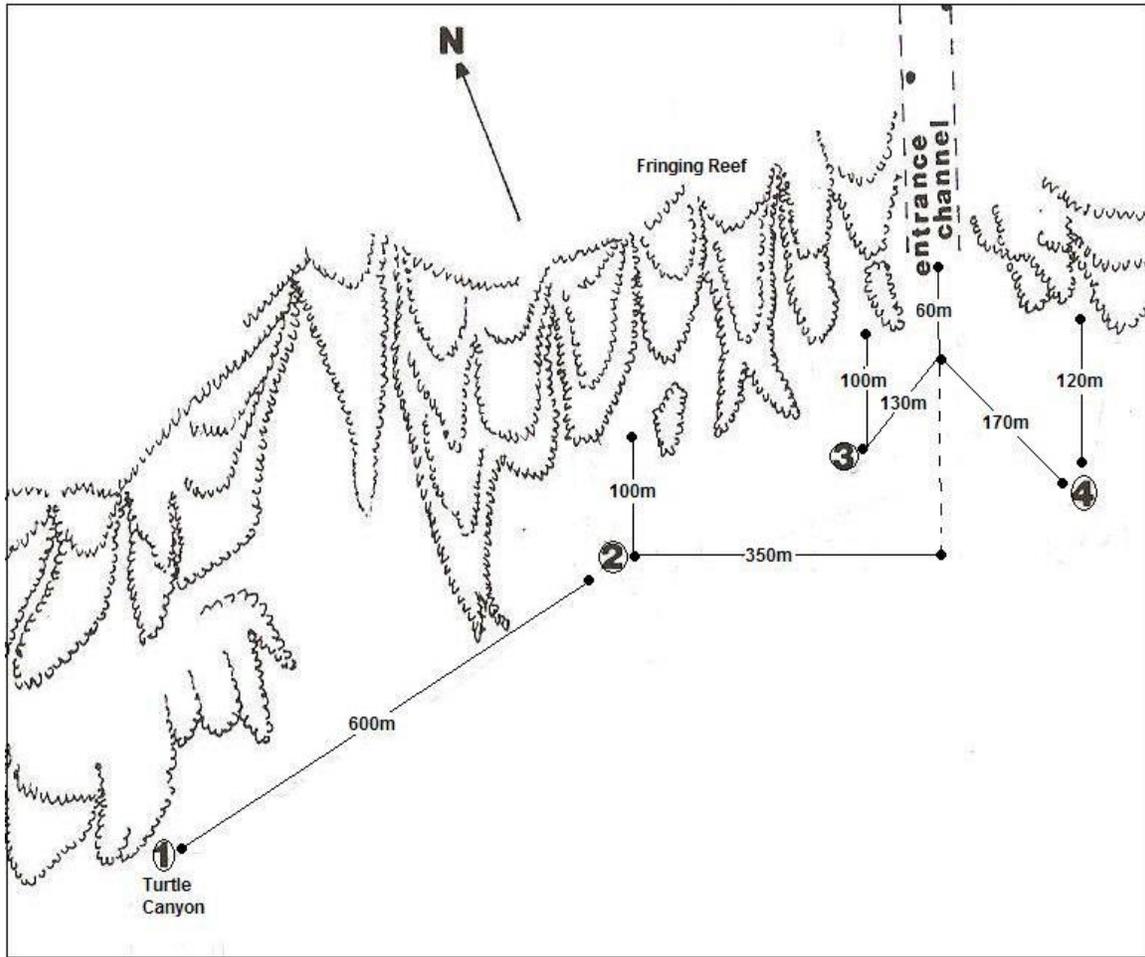


Figure 5: The four sites studied by Brock (1989) to determine the population size of green sea turtles (*Chelonia mydas*) in Maunalua Bay. All sites were just seaward of the “spur and grove” zone of the fringing reef. The approximate locations of each site are relative to a point 60m seaward of the Hawaii Kai Entrance Channel.



Figure 6: Island Divers volunteer divers taking photographs and collecting data on turtle 5 at Koko Craters dive site on 11/16/2008. Photo by Alisha Bare.

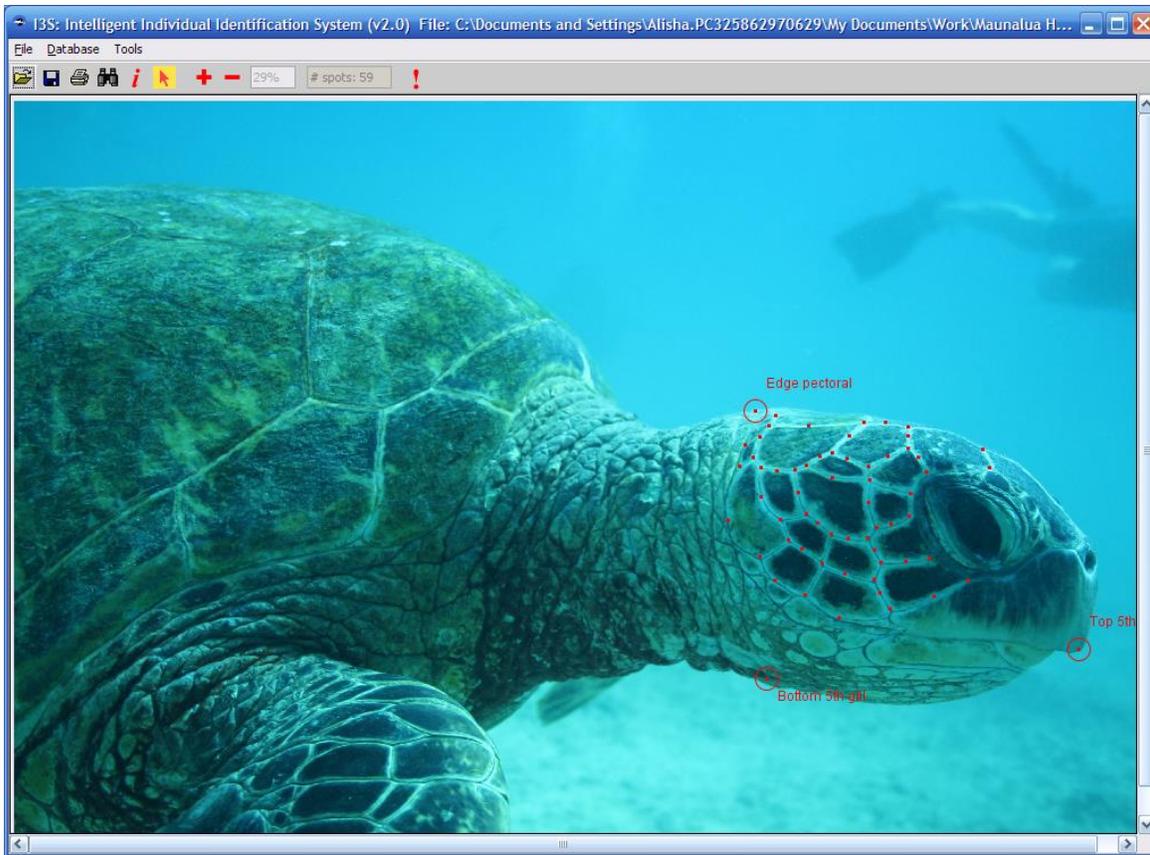


Figure 7: Fingerprint file of “Turtle 3” showing the placement of reference points outlining the scale pattern of the turtle’s right profile, created using “Interactive Individual Identification System” (I^3S) (Hartog and Reijns 2007). This image is then stored in a database and used to match other photos to it.

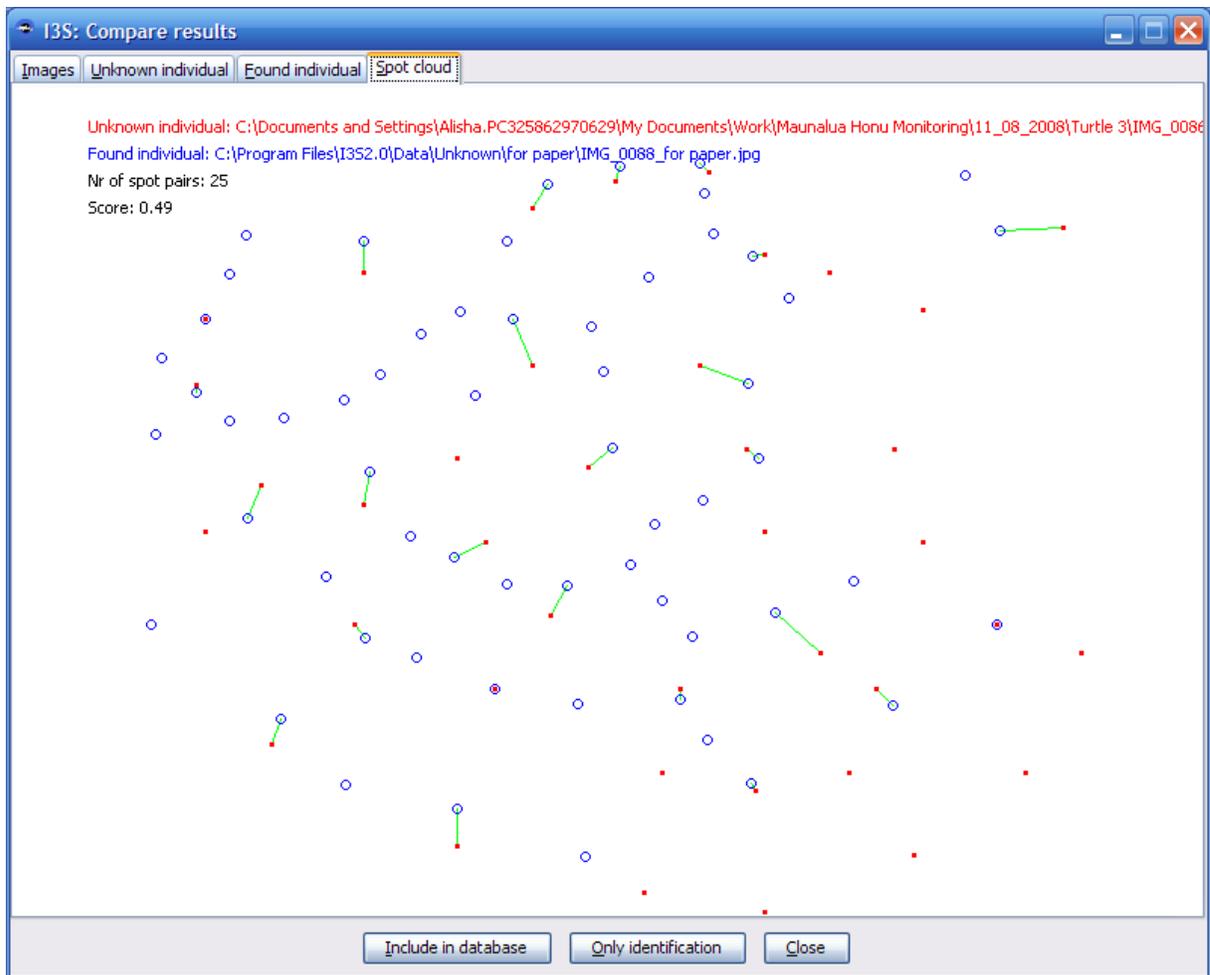


Figure 8: “Spot cloud” of matched pairs between turtle images of right profiles. The open blue circles represent dots chosen on the fingerprint image, already existing in the database. The red spots are the dots chosen on the new, unknown individual. Green lines connect dot pairs.

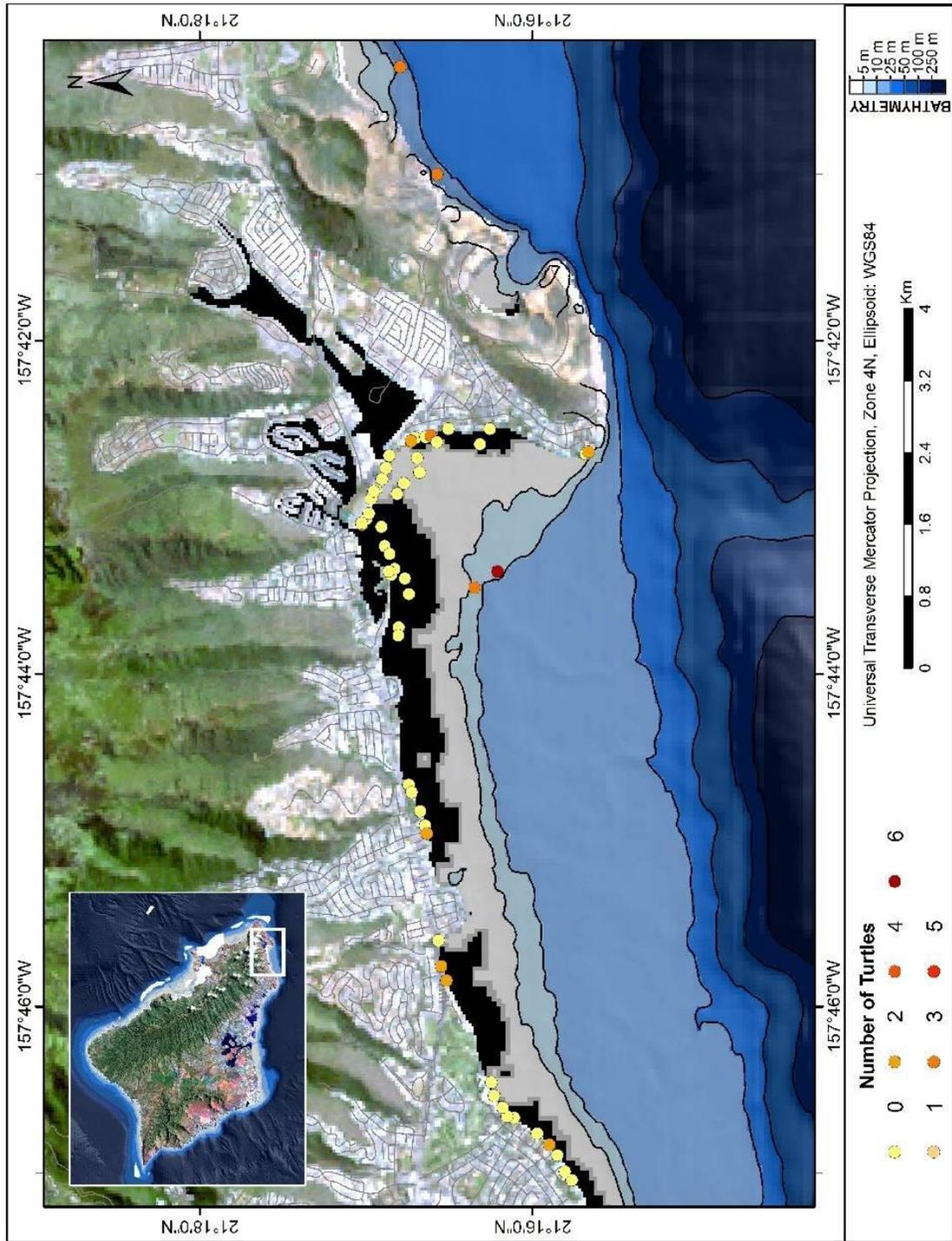


Figure 9: Total number of turtles observed in and near Maunalua Bay during terrestrial, snorkeling, kayaking and SCUBA surveys from 9/1/2008 to 11/16/2008. Turtle abundance is plotted on Land Satellite imagery and bathymetric data of O’ahu provided by the Pacific Islands Fisheries Science Center Coral Reef Ecosystem Division Pacific Islands Benthic Habitat Mapping Center.

Table 1: Turtles encountered, observed, and photographed during SCUBA surveys. Turtle numbers correspond to each individual's photographs available in Appendix 1.

Turtle ID	Size	Behavior	Tumor Severity (1-3)	Date	Time	Location	Latitude	Longitude	Depth (ft)	Visibility (ft)	Rugosity (1-5)	Comments
Hawksbill	M	Swimming	n/a	11/8/2008	10:00	Turtle Canyon	21.2724167	-157.7246833	30	50	2	Lots algal growth on carapace.
1	M	Swimming	1	11/8/2008	10:00	Turtle Canyon	21.2724167	-157.7246833	30	50	2	Small tumor in corner of right eye and right shoulder.
2	M	Swimming	1	11/8/2008	10:20	Turtle Canyon	21.2724167	-157.7246833	22	50	2	Small tumor in corner of right eye.
3	L	Posing for Cleaning/Swimming	n/a	11/8/2008	12:15	Koko Craters	21.2701333	-157.7230833	30	50	2	Lots of algae/coralline algae on carapace. Very large tail, probably male.
4	L	Resting/ Swimming	2	11/8/2008	12:15	Koko Craters	21.2701333	-157.7230833	32	50	2	Tumors around corners of both eyes and both shoulders
5	M	Swimming	3	11/8/2008	12:20	Koko Craters	21.2701333	-157.7230833	30	50	2	Lots of tumors, especially on left side. Heavy algal growth on carapace and plastron, scar on carapace, plastron 2 appeared sunken in.
6	M	Swimming	n/a	11/16/2008	9:30	Skimmin's Wall	21.2799000	-157.6725667	72	75	3	Hook in left side of neck
7	M	Resting	n/a	11/16/2008	9:30	Skimmin's Wall	21.2799000	-157.6725667	72	75	3	Scar on carapace
8	S	Swimming	n/a	11/16/2008	9:45	Skimmin's Wall	21.2799000	-157.6725667	72	75	3	
9	S	Resting	n/a	11/16/2008	11:00	Lanai Lookout	21.2761667	-157.6833333	65	75	4	X-1 on both sides of carapace. Extra center scute. Release from SLP.
10	M	Resting/ Swimming	n/a	11/16/2008	11:00	Lanai Lookout	21.2761667	-157.6833333	65	75	4	
11	M	Swimming	n/a	11/16/2008	12:15	Sea Cave	-	-	50	100	5	
12	M	Swimming	n/a	11/16/2008	12:15	Sea Cave	-	-	50	100	5	Coralline algae on carapace.
13	M	Resting/ Swimming	n/a	11/16/2008	12:15	Sea Cave	-	-	50	100	5	Resting, covered with sand
14	M	Swimming	n/a	11/16/2008	12:15	Sea Cave	-	-	50	100	5	Missing left back flipper. Coralline/ high algal growth on carapace.
15	S	Resting	n/a	11/16/2008	12:15	Sea Cave	-	-	50	100	5	Very small, very clean carapace.

Appendices:

Appendix 1-A: A slightly modified version of the “Sea Turtle Sightings” form distributed by the National Marine Fisheries Service, Honolulu Lab, Marine Turtle Research Group. This form will be used for data collection.

Sea Turtle Sightings

Maunaloa Bay Honu Survey: UH Biology 499 Directed Research Project
Please complete one form per turtle for Photo ID use

Date	Time of Sighting		Distance and Route covered	Sky, Wind, and Surf Conditions	Underwater Visibility	Substrate/Rugosity/Algae	Size of turtle ^A	Severity of tumors ^B	Behaviors seen	Turtle #
	START	STOP								
GPS Coord:										
LOCATION and DEPTH:										
Other Comments and Descriptions: (Injuries, Hooks/Fishing line, Tags, etc.)										
Sightings by (Name, address, phone number):										
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>1 = Lightly afflicted with tumors</p> </div> <div style="text-align: center;">  <p>2 = Moderately afflicted with tumors</p> </div> <div style="text-align: center;">  <p>3 = Heavily afflicted with tumors</p> </div> </div> <p style="text-align: right; margin-top: 10px;">Use reverse side if more space needed</p>										

^A Shell size; **S** = small, < 24 inches (2 ft.); **M** = medium, 24 – 33 inches (2 – approx. 3 ft); **L** = Large, > 33 inches (3 ft or greater)

^B **1** = Lightly afflicted, **2** = moderately afflicted, **3** = heavily afflicted

Note: HARASSMENT AND DISTURBANCE ARE STRICTLY PROHIBITED. All sea turtles in Hawaii are protected by State and Federal regulations. The distribution of this sighting form by the National Marine Fisheries Service is NOT a solicitation to conduct surveys or research. The objective is to record and obtain information from individuals who are normally encountering turtles during the course of their regular activities (recreational or visitor diving, hiking the shoreline, etc.)

Form design: Denise Parker 1/00
Photos: Ursula Keuper-Bennett, www.turtles.org
Form modified, with permission: Alisha Bare 7/08

Through 10/31/2008 Please Send Copy Of This Form To: Alisha Bare PO Box 11862 Honolulu, HI 96828
Email: abare@hawaii.edu Phone: 808-348-7120

After 10/31/2008
SEND COPY TO:
NMFS, Honolulu Lab
Marine Turtle Research
2570 Dole Street
Honolulu, Hawaii 96822
Phone: 808-983-5733
Fax: 808-983-2902

Appendix 1-B: Raw data. Data from collection sheets used during all terrestrial, snorkeling, kayaking, and SCUBA surveys.

Date	Location	Waypoint	Start Time	Survey Type	Latitude	Longitude	# Turtles	Sky, wind, surf conditions	Visibility	Depth	Comments
9/1/2008	West Portlock	100	6:58	Terrestrial	21.2817200	-157.7138100	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	Just right of entrance channel. Person fishing.
9/1/2008	West Portlock	101	7:07	Terrestrial	21.2813100	-157.7126900	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	Approx. 500 yds. Left of channel, off Portlock Dr.
9/1/2008	West Portlock	102	7:24	Terrestrial	21.2783900	-157.7097200	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	Dogs in water
9/1/2008	West Portlock	103	7:32	Terrestrial	21.2773600	-157.7096300	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	Water very murky/dirty
9/1/2008	West Portlock	104	7:51	Terrestrial	21.2750700	-157.7088000	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	
9/1/2008	West Portlock	105	8:27	Terrestrial	21.2709200	-157.7088200	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	
9/1/2008	East Portlock	106	9:06	Terrestrial	21.2613400	-157.7112900	0	Overcast, tide going out, 0 surf <1 ft	n/a	n/a	Portlock beach park
9/1/2008	Maunlua Bay Beach Park	107	10:11	Terrestrial	21.2633000	-157.7178200	0	Partly cloudy, low tide	n/a	n/a	Lots of jet skis, dogs in water
9/1/2008	Maunlua Bay Beach Park	108	10:28	Terrestrial	21.2637000	-157.7183800	1	Partly cloudy, low tide	n/a	n/a	Turtle surfaced.
9/1/2008	Maunlua Bay Beach Park	109	10:33	Terrestrial	21.2630400	-157.7172700	0	Partly cloudy, low tide	n/a	n/a	
9/1/2008	Maunlua Bay Beach Park	110	10:46	Terrestrial	21.2627900	-157.7158100	0	Partly cloudy, low tide	n/a	n/a	Long W
9/1/2008	Maunlua Bay Beach Park	111	10:54	Terrestrial	21.2623000	-157.7149400	0	Partly cloudy, low tide	n/a	n/a	
9/13/2008	Waialae Beach Park	001	10:56:04	Terrestrial	21.2626833	-157.7840000	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	Few small boats offshore, few people on beach, dogs
9/13/2008	Waialae Beach Park	002	11:08:46	Terrestrial	21.2633633	157.7831333	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	
9/13/2008	Waialae Beach Park	003	11:23:24	Terrestrial	21.2641500	-157.7815000	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	
9/13/2008	Waialae Beach Park	004	11:34:08	Terrestrial	21.2649333	-157.7804500	1	Mostly sunny, low tide, 1 surf 1-2 ft	n/a	n/a	Turtle surfaced twice.
9/13/2008	Waialae Beach Park	005	11:45:44	Terrestrial	21.2661667	-157.7793333	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	
9/13/2008	Waialae Beach Park	006	12:05:50	Terrestrial	21.2684833	-157.7777667	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	
9/13/2008	Waialae Beach Park	007	12:25:17	Terrestrial	21.2691667	-157.7776000	0	Mostly sunny, low tide, 0 surf 1-2 ft	n/a	n/a	
9/14/2008	Waialae Beach Park/ Kahala	008	14:07:41	Terrestrial	21.2696333	-157.7767167	0	Overcast, high tide	n/a	n/a	
9/14/2008	Waialae Beach Park/ Kahala	009	14:22:40	Terrestrial	21.2704833	-157.7756667	0	Overcast, high tide	n/a	n/a	
9/14/2008	Waialae Beach Park/ Kahala	010	14:41:15	Terrestrial	21.2707667	-157.7742000	0	Overcast, high tide	n/a	n/a	
9/20/2008	Waialae Beach Park	n/a	9:30	Snorkel	n/a	n/a	0	Sunny, high tide	30 ft	4-20 ft	First snorkel survey, sand and mud bottom close to shore with algal patches. Further offshore substrate became rocky, very rugose with lots of fish. Algal genera seen: Padina, Halimeda, Halophila, Caulerpa, Liagora, Asparagopsis, Acanthophora, Gracilaria, Hydroclathrus, Avrainvillea, Dictyota, Galaxaura
9/28/2008	Maunlua Bay Beach Park	011	6:12:06	Terrestrial	21.2760500	-157.7600000	0	Clear skies, low tide	n/a	n/a	Small beach park. 3 fisherman, lots of Acanthophora and Boodlea on beach.
9/28/2008	Maunlua Bay Beach Park	012	6:30:53	Terrestrial	21.2757833	-157.7625833	1	Clear skies, low tide	n/a	n/a	
9/28/2008	Maunlua Bay Beach Park	013	6:45:30	Terrestrial	21.2752500	-157.7640167	1	Sunny, low tide	n/a	n/a	
9/28/2008	Maunlua Bay Beach Park	014	7:21:01	Terrestrial	21.2837500	-157.7182500	0	Sunny, low tide	n/a	n/a	
9/28/2008	Maunlua Bay Beach Park	015	7:41:24	Terrestrial	21.2825500	-157.7150500	0	Sunny, low tide	n/a	n/a	

Date	Location	Waypoint	Start Time	Survey Type	Latitude	Longitude	# Turtles	Sky, wind, surf conditions	Visibility	Depth	Comments
9/28/2008	Portlock	016	8:19:03	Terrestrial	21.2610167	-157.7111000	1	Sunny, low tide	n/a	n/a	
10/4/2008	East Portlock	017	6:25:36	Terrestrial	21.2809833	-157.7114667	0	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	018	6:45:36	Terrestrial	21.2787833	-157.7100000	1	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	019	7:01:56	Terrestrial	21.2768167	-157.7094500	2	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	020	7:38:05	Terrestrial	21.2790167	-157.7444167	0	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	021	7:50:31	Terrestrial	21.2787333	-157.7461833	0	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	022	8:05:17	Terrestrial	21.2778667	-157.7470500	0	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	023	8:13:59	Terrestrial	21.2773833	-157.7485167	0	Overcast, raining, tide coming up	n/a	n/a	
10/4/2008	East Portlock	024	8:24:21	Terrestrial	21.2772000	-157.7493000	1	Overcast, raining, tide coming up	n/a	n/a	Saw two turtles in distance, but not close enough to get photos before they swam off. Sand bottom towards shore shifted to rocky, very rugose bottom with few corals as moved seaward.
10/5/2008	East Portlock	n/a	7:00	Snorkel	n/a	n/a	2	Overcast, high tide	60 ft	10-50 ft	
10/5/2008	West Portlock	n/a	9:00	Snorkel	n/a	n/a	0	Overcast, high tide	30 ft	5-20 ft	Horrible vis, no turtles observed, although saw some here during terrestrial surveys. Sand/ mud/ silt bottom. Algal cover ~ 20%.
11/8/2008	Turtle Canyon	025	9:53:57	Scuba/Snorkel	21.2724167	-157.7246833	3	Slightly overcast, very windy	85 ft	35 ft	3 trained divers collecting data, I did snorkel surveys, off Island Diver's dive barge w/ 20+ divers in water. Lots of black trigger fish at surface, little rugosity. Hawksbill.
11/8/2008	Koko Craters	026	12:05:15	Scuba/Snorkel	21.2701333	-157.7230833	6	Mostly sunny, windy	85 ft	35 ft	3 trained divers collecting data, I did snorkel surveys, off Island Diver's dive barge w/ 20+ divers in water. More turtles here, mostly resting under ledges of craters. Diver's saw 5, I saw one.
11/9/2008	Maunilua Bay Beach Park	027	8:59:23	Kayak	21.2781667	-157.7117167	0	Overcast, rainy	n/a	n/a	Kayak survey leaving from Eastern channel, towards Portlock, back to western Maunilua Bay.
11/9/2008	Maunilua Bay Beach Park	028	9:13:51	Kayak	21.2762167	-157.7101167	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	029	9:20:42	Kayak	21.2719000	-157.7103333	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	030	9:41:39	Kayak	21.2779333	-157.7131333	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	031	9:44:50	Kayak	21.2795167	-157.7142500	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	032	9:48:06	Kayak	21.2801833	-157.7153000	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	033	9:54:58	Kayak	21.2817667	-157.7185333	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	034	9:57:44	Kayak	21.2814667	-157.7205333	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	035	9:58:57	Kayak	21.2809500	-157.7213167	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	036	10:03:52	Kayak	21.2804667	-157.7228000	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	037	10:08:15	Kayak	21.2794333	-157.7237667	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	038	10:21:38	Kayak	21.2790167	-157.7253333	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunilua Bay Beach Park	039	10:25:30	Kayak	21.2800500	-157.7266667	0	Overcast, rainy	n/a	n/a	

Date	Location	Waypoint	Start Time	Survey Type	Latitude	Longitude	# Turtles	Sky, wind, surf conditions	Visibility	Depth	Comments
11/9/2008	Maunlua Bay Beach Park	040	10:45:53	Kayak	21.2800667	-157.7294833	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunlua Bay Beach Park	041	10:55:57	Kayak	21.2807833	-157.7234000	0	Overcast, rainy	n/a	n/a	
11/9/2008	Maunlua Bay Beach Park	042	10:59:36	Kayak	21.2810000	-157.7230500	0	Overcast, rainy	n/a	n/a	
11/16/2008	Skimmin's Wall	n/a	9:15	Scuba	21.2799000	-157.67256667	3	Overcast, sprinkling.		75	2 trained divers from Island Divers off "Sea Fox."
11/16/2008	Lanai Lookout	n/a	11:00	Scuba	21.27616667	-157.68333333	2	Overcast		75	2 trained divers from Island Divers off "Sea Fox."
11/16/2008	Sea Cave	n/a	12:30	Scuba	-	-	5	Clear skies		100	2 trained divers from Island Divers off "Sea Fox."

Appendix 1-C: A sampling of photographs of individual turtles encountered during SCUBA dives, some of which were used to test photo identification software. The corresponding data for each turtle is found in Table 1.



Hawksbill



Turtle 1



Turtle 2



Turtle 3



Turtle 4



Turtle 5



Turtle 6



Turtle 7



Turtle 8



Turtle 9



Turtle 10



Turtle 11



Turtle 12



Turtle 13



Turtle 14



Turtle 15