Habitat Use of Green Sea Turtles (*Chelonia mydas*) at the Hilton Waikoloa Lagoon

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Abstract

The Waikoloa Hilton lagoon on the Big Island of Hawaii is a four-acre habitat with a waterfall on the north side that provides a steady supply of algae, *Caulerpa racemose* originating from its canal system. Green sea turtles, *Chelonia mydas,* along with several fishes, have been observed feeding on the algae. Little is known about the number of turtles accessing this food source or unique habitat. Through facial photo documentation of sea turtles in the area and the use of I3S Pattern recognition software, 48 turtles were observed within the Hilton lagoon, with 18 of them being seen multiple times, one as many as 6 different occasions. These results demonstrate there is a high density of sea turtles frequenting the lagoon and further research in the area is needed to gain a better understanding of the total quantity of individuals using the area, recruitment, and length of time spent in the lagoon.

Introduction

Green sea turtles, *Chelonia mydas*, have been flourishing in Hawaiian waters in recent years (Glick, 2005). Recent surveys done by Alden Mazo, in Puako Hawaii, have shown approximately 120 turtles utilizing a 0.2 km^2 area of the shoreline (Mazo, 2022). Due to the threats connected to climate change, near shore Hawaiian sea turtles (greens and hawksbill) are listed as threatened and endangered under the Endangered Species Act, and Hawaii federal and state law. Understanding this species is critical to its continuation locally and globally.

Identifying individual turtles allows for a better understanding of growth patterns and habitat use. Facial recognition is confirmed as an efficient way to recognize sea turtles (Calmanovici et al, 2018), as the scales on the side of the turtle's face are unique, and taking photos is a much easier and less invasive identification technique than capturing and scanning for tags.

The Hilton Waikoloa resort is a 62-acre hotel on the Kohala Coast of the Big Island of Hawaii. The main attraction of the resort is a four-acre lagoon with connection to the ocean on its north side that is known to be populated with turtles. A waterfall (Figure 2) on the southwest side of the lagoon is fed by water from boat canals above which has a high abundance of *Caulerpa sp.* algae (Figure 3). A large and regular amount of *Caulerpa* comes down off the waterfall and is eaten by green sea turtles and various fish species. It was determined, by our observations and reports from workers, that the most populated area for turtles was around the waterfall, and it was more populated in the early morning and late afternoon.

Second, comparing regular measurements from field research of turtles at different sites from the past nine months, the body condition index, an objective assessment of body condition using a standard formula that considers mass and body length, of turtles in the Hilton lagoon is considerably higher than turtles in other habitats (Figure 5). As the Hilton is a unique habitat, and there is limited research done here, this information will help to define the habitat usage of the area, and the population size and characteristics of the area.

Figure 1. A facial shot analyzed by I3s where the turtle is reaching to snack on some *Caulerpa*

Figure 2. An aerial view of the waterfall where turtles are feeding

Methodology

6 snorkel surveys and 2 research trips were conducted from October 2022 to December 2022, to collect facial images from turtles found within the Hilton lagoon. Photos taken in water were collected using an Olympus TG-6 with underwater Olympus housing, usually in macro mode, to ensure clear outlines of turtle facial scales. When possible, the right and left of turtles were taken in succession to generate a full image set for each turtle. Photos taken on land were collected using an iPhone. These images were then stored in folders.

The survey method (Figure 4) was to start at the lagoon's beach and swim to the waterfall then to the bridge on the east side of the lagoon and then back to the waterfall, to collect photos any newly arrived individuals. Turtles were extremely acclimated to humans as they swim with and approach visitors regularly. In conjunction with regular field research, photos were taken of the left and right sides of the turtles collected prior to release.

These images were then used to create an I3S Hilton Database from which turtles could be identified using this facial recognition software.
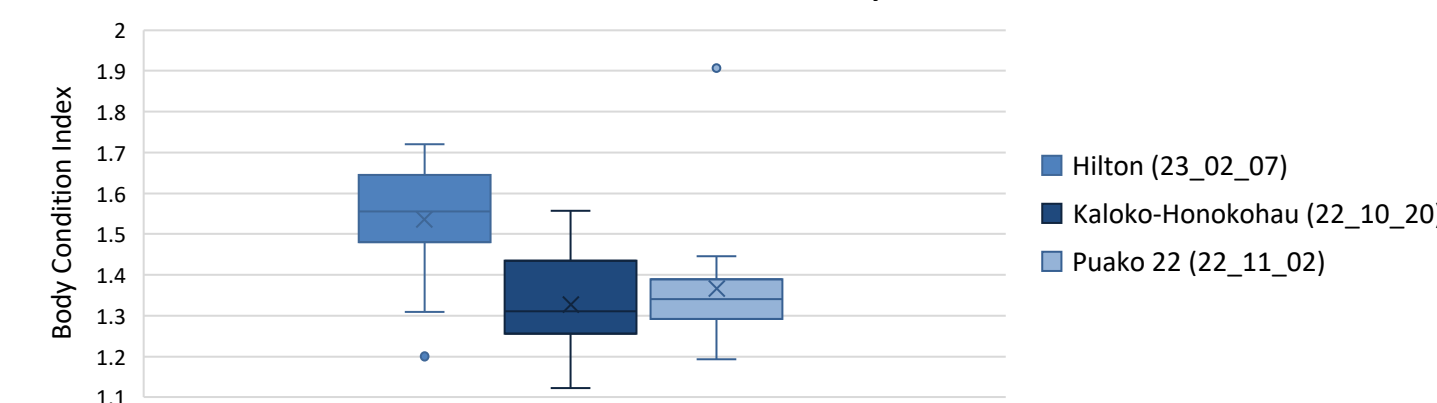

Figure 3. *Caulerpa* collected from the canal above the lagoon

Figure 4. Snorkeling survey route

Figure 5. Green sea turtle (*Chelonia mydas*) body condition index assessed at 3 study sites

- Hilton (23_02_07)
- Kaloko-Honokohau (22_10_20)
- Puako 22 (22_11_02)

Results

A total of 48 turtles have been identified within the Hilton lagoon, with 18 of them being seen multiple times. 30 turtles were observed one time, 10 turtles two times, two turtles three times, three turtles four times, two turtles five times, and one turtle was observed six times (Figure 6). While it is estimated that 48 individuals were identified, it is possible that there are five fewer because 11 turtles do not have confirmed left and right face shots (so a total of 48). There are six individuals who only have the right sides of their face in the database, and five individuals that only have photos of the left sides of their face.

Figure 6. Habitat Use of the Hilton Lagoon

(y-axis: Number of Turtles; x-axis: How Many Times Seen)

Discussion

It is now known that between 43-48 green turtles, *Chelonia mydas,* and 1 hawksbill turtle visit the lagoon habitat diurnally, and many turtles frequent that area near the waterfall, feeding on *Caulerpa*. Through this work, it is evident that there is potential for much more research to be done at this site, as the surveys done were limited, and more surveys and assessments would be needed to get a better understanding of the total quantity of individuals using the area, recruitment, and length of time spent in the lagoon. The nutritive content of *Caulerpa* compared to other commonly eaten algae in West Hawaii could also be analyzed to determine if it is related to higher body condition index. This work also validates the use of facial recognition along with the I3S Pattern software as a valuable resource for future research on turtle habitats and will serve as a foundation for facial recognition at the Hilton.

22/11/03 22/11/16 22/11/27 22/12/15 22/12/22 23/02/03
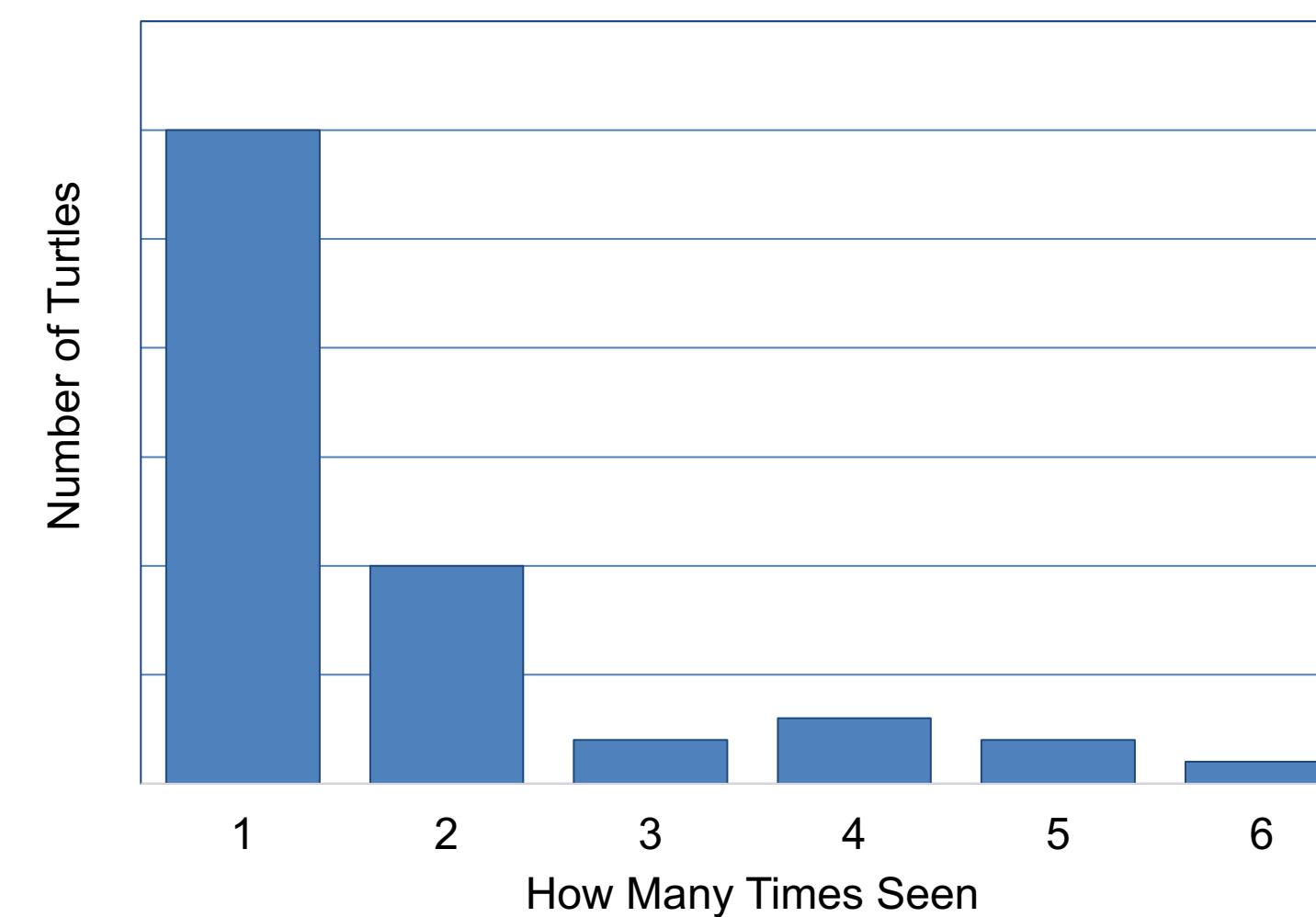
Figure 7. HA 166 seen six separate times (photos dated by yy/mm/dd)

A Significant Discovery

We were also fortunate enough to witness a critically endangered Hawksbill, with an amputated right front flipper, in the lagoon that was not previously recorded in the statewide photo-ID catalog for Hawaiian Hawksbills (Figure 8). This was the 71st Hawksbill with facial shots discovered on Hawaii Island.

Figure 8. Facial and aerial shots of the Hawksbill