PHOTO-IDENTIFICATION OF JUVENILE HAWKSBILLS USING FACIAL SCALES

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Introduction

- The ability to identify individuals within a population is a key issue for most behavioral, ecological and conservation studies.
- Most sea turtle mark-recapture studies use external flipper tags (metal or plastic) previously attached to identify individual.
- However, considerable tag loss can occur due to: 1) time after tag attachment, incorrect attachment, being knocked/bite off, tagger, study area, target species, size, piercing site, tag material, color and design.[1-5]
- Considering the long duration of sea turtle life cycles, flipper tag loss can be a major issue for conducting long term studies.
- Studies using photo-ID techniques in sea turtles include: head coloration patterns of leatherback turtles [6,7] and facial profiles of green turtles,[8] greens and hawksbills,[9] hawksbills,[10] and loggerheads.[11,12]
- Assessments of hawksbill facial profiles for photo-ID have been attempted before,9,10 but have been limited by small sample sizes (13 and one individual)
- Here, we assessed the potential of using natural facial markings to reliably identify individuals in a juvenile aggregation of hawksbill sea turtles.

Figure 1. Map of study area. Pablo Féliz is shown here taking measurements.

Methods

- Juvenile hawksbills were manually caught during free diving at Jaragua National Park and the adjacent Cabo Rojo area (Dominican Republic; Figure 1). The saturation tagging project in place there since 1996 has tagged over 1200 individual green and hawksbill sea turtles.
- All captured turtles were brought to a vessel for tag application (inconel, plastic and/or PIT) and data collection prior to release in their capture site. Since 1998, we have taken digital photographs of the left facial profile of each turtle captured.
- All recaptures with good quality photographs were selected for this study (n = 78 , or 39 individuals). These were colorized to back and white to reduce for differences in color hues.
- Mean size of turtles was 32.5 cm SCL (SD=7.0, range 19.6 -50.1). Mean recapture interval was 300.5 days (SD = 564.5, range 63–2035, see Fig. 2).
- The complete photo dataset was analyzed by experienced observers (authors and three additional collaborators) to determine the utility for photo-ID of several facial characteristics.
- The reliability and wider utility of photo-ID was assessed by testing the ability of 20 naïve observers to correctly match known individuals. For this, one of two sets of 24 photographs (=12 individuals) captured at different times were presented to observers for matching. The sets only included images that clearly showed the tympanic scales. Prior to the matching tests, naïve observers were briefed on the objectives of the study and the most useful characteristics for photo-ID found by expert observers.

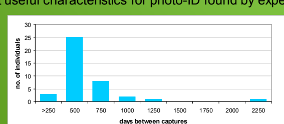

Figure 2. Capture interval for turtles used in photo-ID.

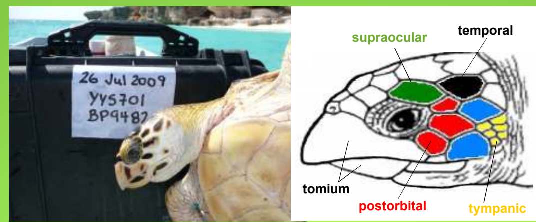

Figure 3. Photograph taking and diagram showing names of facial scales and other characteristics evaluated.

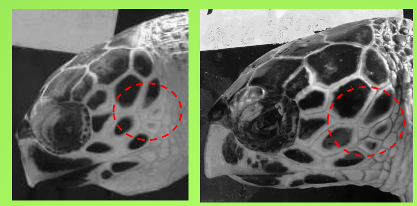

Figure 4. Two views of turtle 2008-009 showing persistence of tympanic and postorbital scale patterns despite color change in the scales and bill.

Figure 5. Evolution of facial characteristics for turtle 2002-043 (2002, 2003, 2006). Notice change in tomium markings.

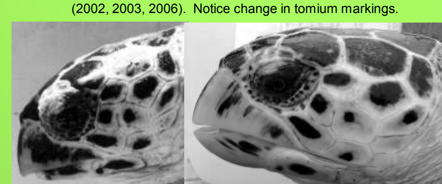

Figure 6. Two views of turtle 2000-047, the longest interval recapture we have facial profiles for (2000-2006). Notice stability of tympanic scales while color markings changed.

Facial characteristic	*Individual variation*	*Stability over time*	*Visibility in photos*	*General utility for Photo-ID*
tomium color markings	high	low	high	low
scale color markings	moderate	low	high	low
Postorbital scale #	low	high	high	low
Postorbital scale shape	low	high	high	low
Postorbital scale arrangement	low	high	high	low
2nd postorbital scale #	low	high	high	moderate
2nd postorbital scale shape	moderate	high	high	moderate
2nd postorbital scale arrangement	moderate	high	high	moderate
Supraocular scale shape	low	high	moderate	low
Temporal scale shape	low	high	moderate	low
Tympanic scale #	high	high	high	high
Tympanic scale shape	high	high	high	high
Tympanic scale arrangement	high	high	high	high

Table 1. Evaluation of characteristics for photo-ID in hawksbill by expert panel.

Results

- Tympanic scales were considered the most useful facial characteristic for individual recognition (see Table 1) in terms of their number, shape and arrangement.
- Post orbital scales and those posterior to them (whether subtemporal or central) were stable in number, shape and arrangement through time, but did not show enough individual variation for easy recognition (for example, only one individual had 4 PO scales instead of 3).
- Even though color markings on facial scales and tomium can be very distinctive, they proved to be very unstable through time (by both increasing and decreasing in size, number and changing shape).
- The mean success rate in photographic sorting and matching by experts was 100% and by naïve observers, 89% (range 58-100%).
- Our recommendation for matching individuals is to look closely and fix an image of the tympanic scales, go through possible photos and once a similar one is detected, proceed to compare the shape and arrangement of the postorbital scales and those posterior to them.

Discussion

- The high success rate in matching tests by both experts and naïve observers indicates that facial scales can be a reliable method for individually recognizing individual hawksbill sea turtles.
- However, given the serious effect incorrect matches or failed detection can have on various studies (specially mark-recapture estimates), it is recommended that observer ability is tested prior to conducting photo-ID exercises, and that photo-ID is only used as a back-up method when physical tags are not available or are known to be lost.
- In contrast with the work on loggerheads by Schofield et al 2008, we could not establish an identification tree to group turtles prior to matching. This is possibly due to our limited sample size, but also because many of the suggested grouping characteristics (for example number and relative size of postorbital scales) showed very little variability in hawksbills examined.
- Also, here we present results from photos selected for their quality and visibility. Sometimes on a moving boat under varying light conditions and with moving animals, such photos are difficult to obtain and may limit the application of the method. Similar limitations can be said for underwater photographs. For these reasons, many of our recapture photos had to be excluded from the matching exercise, reducing the sample size for our analyses.
- Also, knowing in advance the importance of capturing clearly the tympanic scales can be of use to prospective hawksbill photo-ID projects. Even in some blurry photographs, if the tympanic area could be seen reasonably well, its match was usually found.
- Given the increasing resolution of digital cameras available today, as well as photo-editing possibilities to enhance contrast, color, and sharpness, we think it is worthwhile for turtle research projects to include facial profiles in their hawksbill databases, as they can help retrieve very valuable and irreplaceable information.

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