The potential for a citizen science Photo ID program to better protect marine turtles in the Maldives

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What is citizen science (CS)?

Involving untrained members of the public in research.

PROS: Large amounts of data collected over vast areas & time scales, cost-effective
CONS: Over-estimating abundance & diversity, incorrect ID, recording effort is difficult, how can we train the crowd to collect good quality data?

What is Photo ID (PID)?

A cost-effective, non-invasive monitoring technique that can be used by people with little training. A series of photos can reveal residency patterns, seasonal abundances, population structure, nesting intervals, etc.

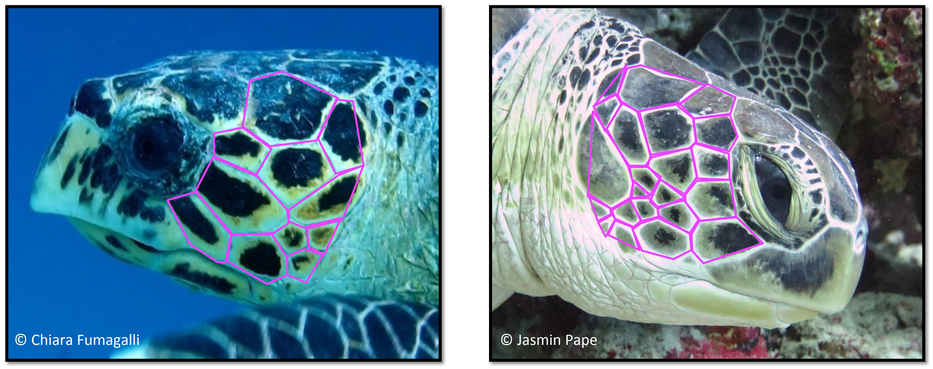

Fig. 1. Turtles have a unique pattern of facial scutes. L & R sides are asymmetrical. Area used for ID based on Jean et al. (2010)

Methods

Photos of both sides of a turtle's face collected from biologists & tourists. Turtles ID'd by eye only. Photos quality checked & capture histories for selected reefs created & analyzed using open & closed population models in R (Rcapture package). Capture occasions = 1 month.

Results

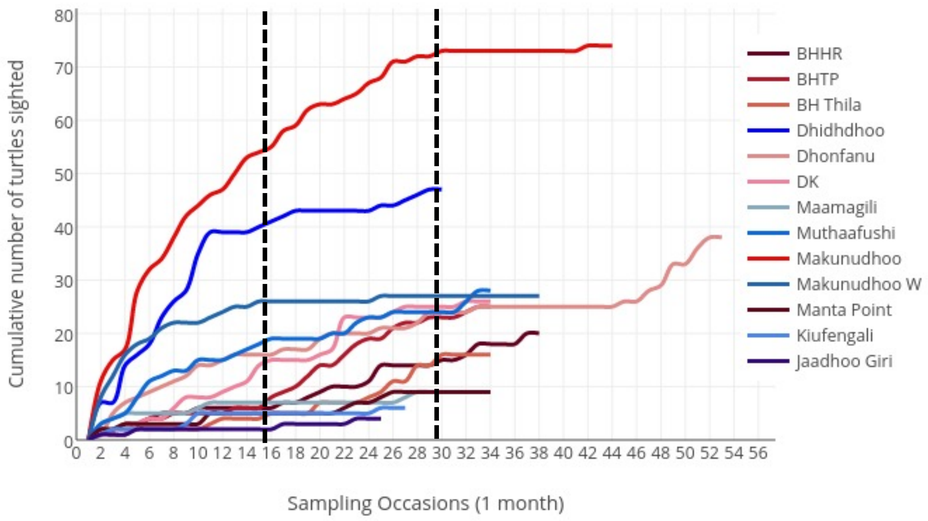

Fig. 2. Plotting cumulative number of turtles versus sampling occasion (1 month) creates discovery curves. Curve flattens when the current pop. has been photographed & increases when new turtles are photographed.

Table 1. Actual number of turtles photographed compared to model predictions from RCapture for 4 example reefs with weekly surveys.

Reef	Captured Turtles	Open Pop. Model	Closed Pop. Model	Within Error?
BHHR	20	21.2±1.3	22.7±2.2	Yes/No
BHTP	25	26.8±1.7	27.3±2.2	No/No
DK	26	28.9±2.1	35.5±5.9	No/No
Muthaafushi	28	36.9±4.6	38.1±6.2	No/No

Why the Maldives?

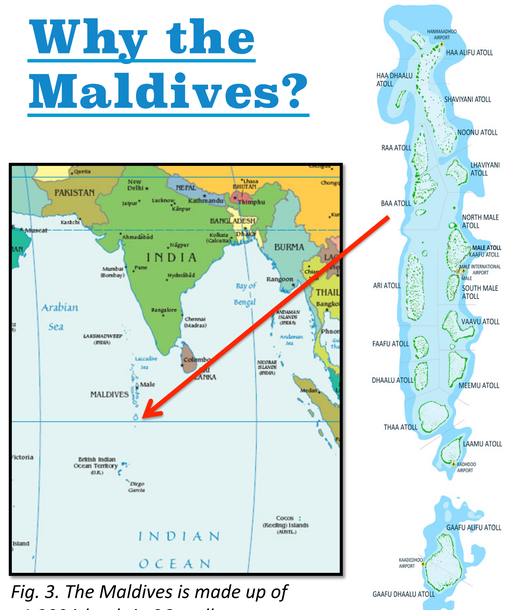

Fig. 3. The Maldives is made up of ~1,200 islands in 26 atolls.

- **No baseline dataset**, little data sharing
- Millions of tourists visit specifically to view marine wildlife, many with cameras
- Sea turtles are easily identifiable….
- **Put the tourists to work!**

Summary

✧ **961** *E.imbricata*, **123** *C.mydas*, **1** *C.caretta*, & **12** *L.olivacea* identified,

✧ Average 48.1±10.7 cm SCL for *E.imbricata* & 68.4±23.7 cm SCL for *C.mydas,*

✧ Extremely high foraging site fidelity,

✧ Discovery curves level off (all turtles photographed) after 15 – 30 months.

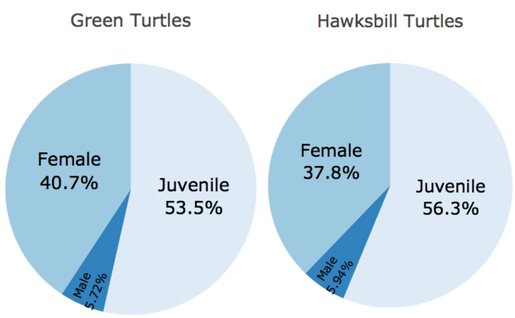

Fig. 4. Age & sex distribution from sightings.

Acknowledgements:
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Determining nesting interval

A series of photos has identified the same green turtle returning to nest 5 times on Baa Dhuni Kolhu. From photos, nesting interval was determined to be **15.25±2.66 days**. This is the first determination of green turtle nesting interval in Maldives.

Fig. 5. GR362 photographed nesting 5 times in the same season. Photos © Chiara Fumagalli.

Determining size at maturity

A hawksbill turtle was photographed over 3 years as it matured. At 60 cm SCL, it had a small tail, at 62 cm, it had a more noticeable tail. This has helped us narrow down size at maturity, now assumed to be **>60 cm for male hawksbills** in the Maldives.

Fig. 6. HK307 photographed over 3 years. <60 cm SCL in left photo & small tail, 62 cm SCL in right photo & larger tail. Photos © Chiara Fumagalli.

Population change over time

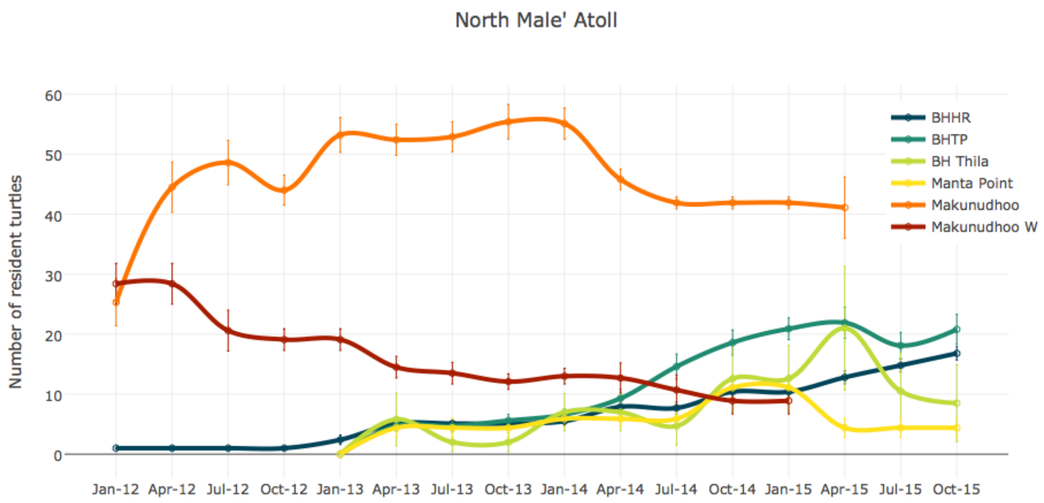

Fig. 7. Variation in resident turtle populations in North Male Atoll over 3 month intervals. Based on results from Rcapture open population models. There does not appear to be any seasonal variation.

Conclusions

- The Maldives, due to popular dive tourism, is an ideal place to involve tourists in PID.
- A CS PID program could be used to monitor turtle populations with minimal time & resource investment & fair accuracy according to model.
- Large number of juveniles → population is recovering from exploitation.
- Recommend ≥1 PID survey/week for number of captured turtles to be within error of model's prediction for total number of inhabitants.
- PID can be used to determine nesting interval, track maturity of individuals, & look at pop. change on a reef over time.