Using citizen science to monitor sea turtle populations in real-time around two Maldivian islands

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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.
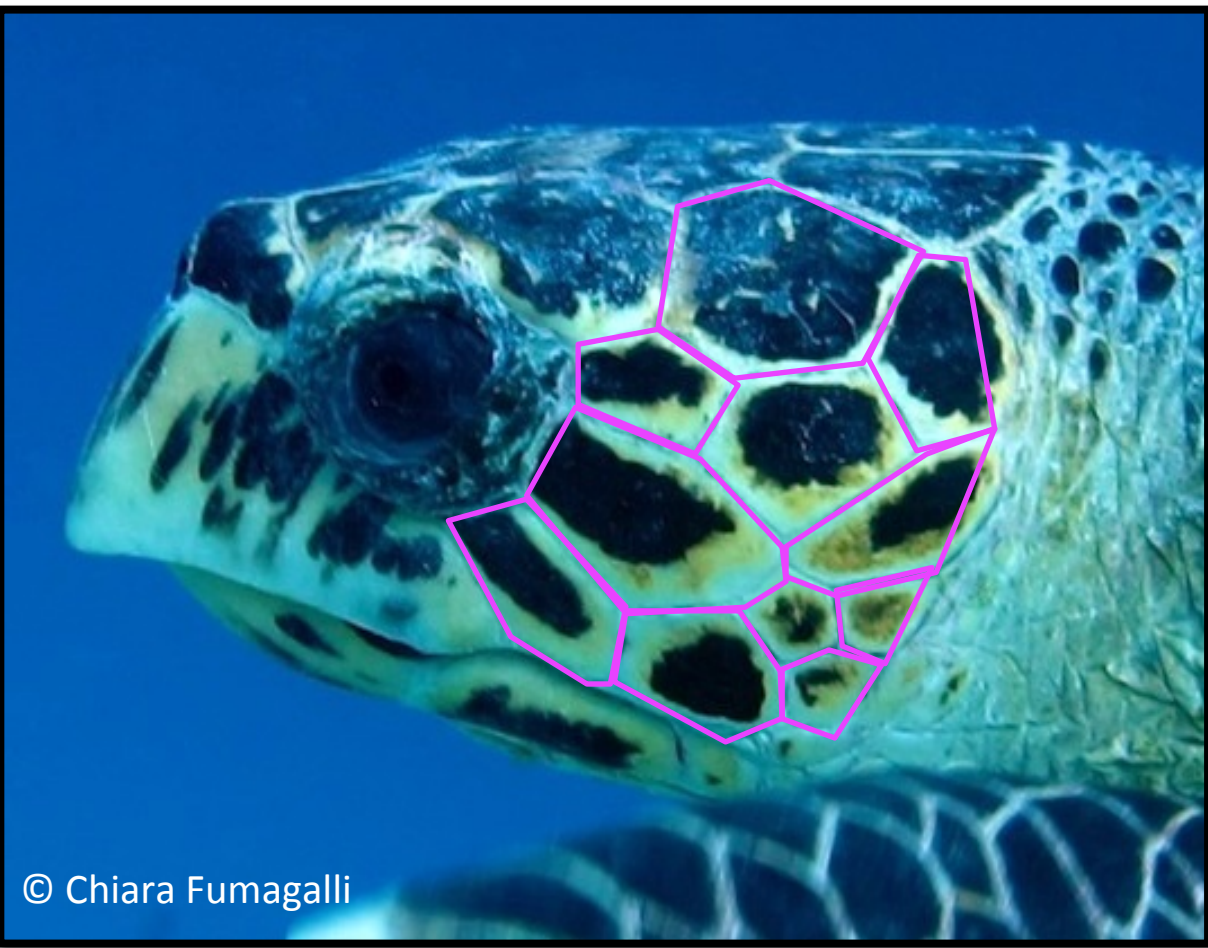

Fig. 1. Turtles have a unique pattern of facial scutes. L & R sides are asymmetrical. Area used for ID based on Jean et al. (2010)

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.
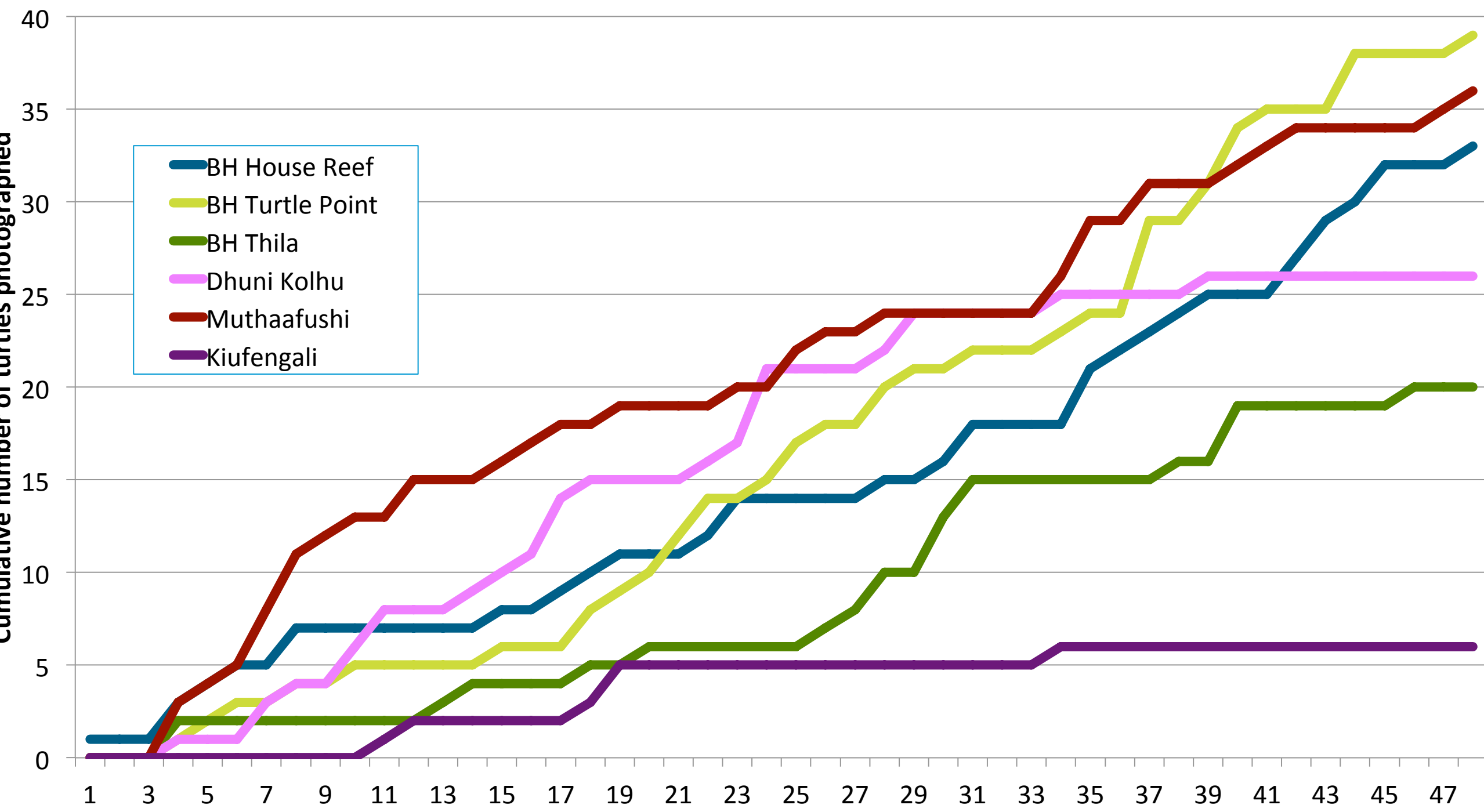
Results

Fig. 2. Plotting cumulative number of hawksbill turtles versus sampling occasion (1 month) creates discovery curves. Curve flattens when the current pop. has been photographed & increases when new turtles are photographed (2013-2016 data).

Table 1. Number & size of turtles photographed at Coco Bodu Hithi & Coco Palm Dhuni Kolhu resorts by guests and staff (2013-2016).

Resort / Atoll	Photographed Turtles	Population estimate [from RCapture]	Avg. SCL Hawksbill	Avg. SCL Green
Coco Palm Dhuni Kolhu (Baa)	70 Hawksbill 21 Green 5 Olive Ridley	DKHR: 30.3 +/- 1.8 Muthaafushi: 42.3 +/-3.4 Kiufengali: 6.6 +/- 1.0	44.9±8.6 cm	61.3±20.2 cm
Coco Bodu Hithi (North Male)	94 Hawksbill 4 Green	BHHR: 34.2 +/-1.2 BHTP: 42.1 +/- 1.6 BH Thila: 27.9 +/- 5.8	43.6±6.8	67.8±25.1

Why the Maldives?

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

- **No baseline dataset**, little data sharing, logistically difficult
- Millions of tourists visit to view marine wildlife, many with cameras
- Potential large volunteer workforce…
- **Put the tourists to work!**

Case study

✧ Program has collected over **10,000** of sightings from **17** atolls, **>300** unique submitters
✧ **1,651** *E.imbricata*, **281** *C.mydas*, & **22** *L.olivacea* identified
✧ 2 resorts chosen for case study (Coco Palm Dhuni Kolhu & Coco Bodu Hithi)
✧ Participants since 2013 & high guest involvement = consistent dataset
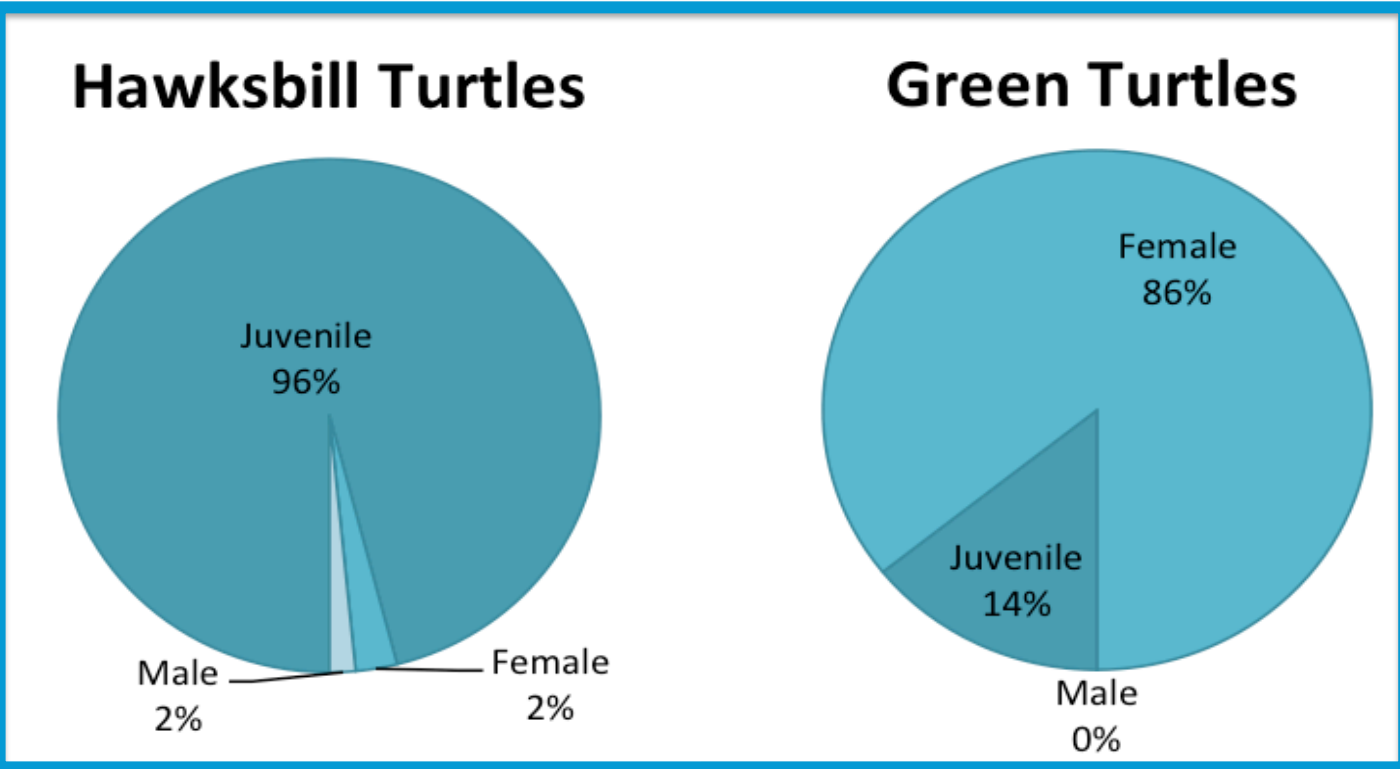✧ Observe trends, document population change

Fig. 4. Age & sex distribution from sightings (2 case study resorts combined).

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.
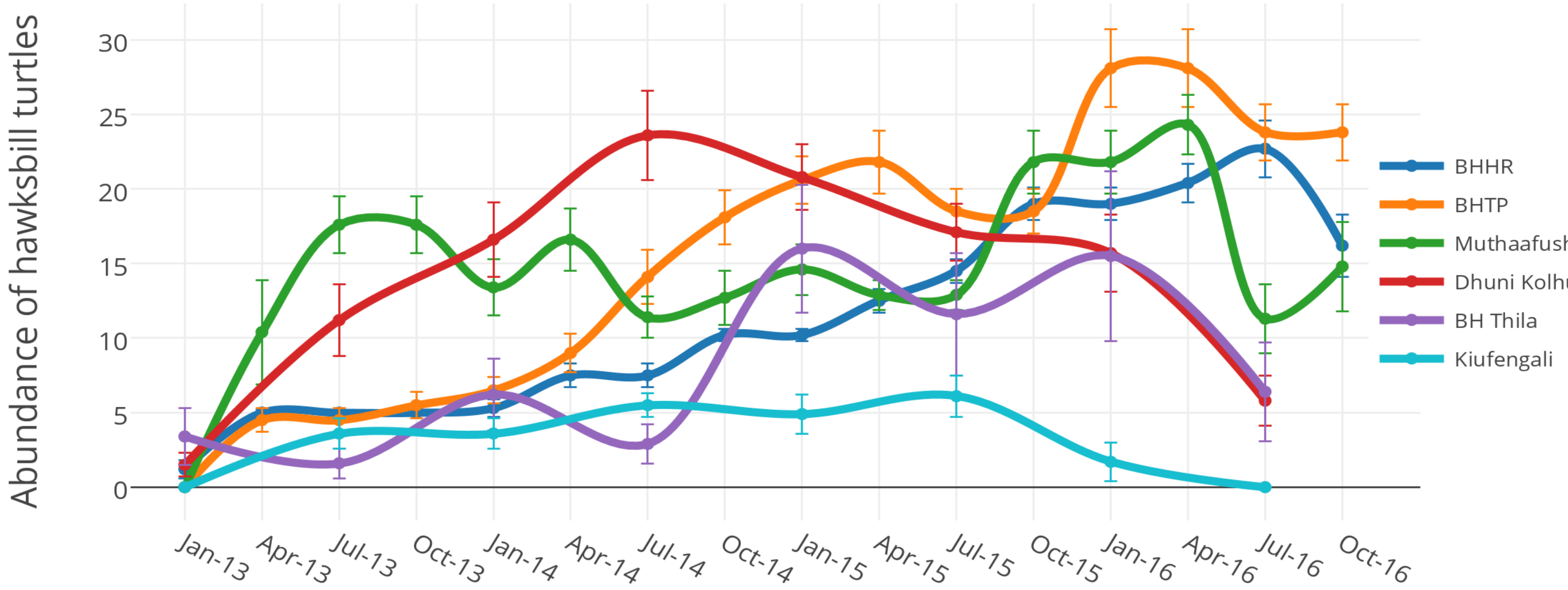
Population change over time

Fig. 7. Variation in resident turtle populations at 6 sites over 3 or 6 month intervals. Based on results from Rcapture open population models. There does not appear to be any seasonal variation.

Conclusions

- The Maldives is an ideal place to involve tourists in PID, as shown by Coco Collection Resorts
- A CS PID program can monitor turtle populations with minimal time & resource investment —fill gaps in scientific knowledge & increase value of species studied
- Opportunities for education & outreach → powerful awareness tool!
- Ability to survey remote areas, long-term consistent dataset that would otherwise be difficult
- Key to success is a network of engaged citizen scientists & developing a personal connection between them & animals studied