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The spatial dynamics of sea turtles within foraging grounds on Eleuthera, The Bahamas

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Photo credit: Ryley Parent

LETTER TO VOLUNTEERS

Dear volunteers, Thank you so much for all your support in 2019, our 6th year! We had a great time and appreciated being able to establish in a new site on Eleuthera as well as return to Abaco. In particular, we learnt so much about the fibropapilloma disease on Eleuthera and Abaco, and collected critical data in Half Sound, an area slated for development on Eleuthera. Due to the devastating category 5+ hurricane Dorian that hit Abaco and Grand Bahama on Sept 1 - 3, our friends and partners at Friends of the Environment, Bahamas Underground, the Natural History Museum, as well as vendors who supplied our vehicles and boats, all suffered major damages. We have been keeping them in our thoughts and ask you to do the same and also consider making a [donation](#) that will help towards their recovery. Sadly we will not be able to return in 2020 but hope to in 2021. Know that the rest of the Bahamas is still open for business!

Thank you again for supporting our important work.

Sincerely, Annabelle Brooks & Beth Whitman

SUMMARY

We completed a 6th year in our long-term monitoring of the creeks around South Eleuthera, and expanded to a new site in Central Eleuthera, Savannah Sound. We documented the spread and severity of fibropapilloma disease in Eleuthera and Abaco, plus made a significant stride in tagging over 180 turtles in Abaco. For our social survey we conducted over 70 social interviews in Abaco to gauge the public perception of the status of local turtle populations and their legal protection. We conducted marine debris surveys on 5 beaches around Eleuthera, followed by clean ups. We also collaborated on several studies with the Cape Eleuthera Institute.

GOALS, OBJECTIVES, AND RESULTS

Long term monitoring

Volunteers helped capture both new and tagged turtles this year in 12 sites on Eleuthera and Abaco. The majority of captures were of green turtles, but loggerheads were present in Abaco as well as hawksbill in Eleuthera and Abaco. In addition to the regular body condition assessments that we perform on all captured turtles, we also documented fresh injuries observed on several turtles including lacerations from boat strikes, deep wounds from entanglement in monofilament fishing line, and shark bite wounds.

Assessing the knowledge, attitudes, and perceptions of Bahamians concerning sea turtles and sea turtle conservation in Abaco

Earthwatch volunteers conducted 146 social surveys this summer in Marsh Harbour. Out of 146 surveys, 134 (92%) people responded that they had seen a sea turtle in the Bahamas. When asked what they thought the recent trends in sea turtles were nearly 49% of respondents believe they are increasing in number and 21% believe they are decreasing, 22% being unsure, and 7% saying there has been no change. When asked if they were aware that in 2009, there was a Bahamas-wide ban on the harvesting of sea turtles, 76% responded yes and 85% either agreed or strongly agreed that the ban was important for sea turtle conservation in The Bahamas. 85% also believed that the ban was necessary to promote healthy ecosystems and environments around Abaco. 94% of respondents believed it is important to protect sea turtle in The Bahamas, yet when asked if the ban should only apply to non-Bahamians, only 75% of respondents strongly disagreed but 15% agreed or strongly agreed and the remaining few were unsure. Some respondents were aware of basic biology and that turtles nest on beaches, mangroves provide nursery habitat and that they eat seagrass, but there was also misinformation for example, when asked what turtles eat conch, shrimp and fish were among the answers as well as just not knowing. The majority of respondents knew that green, hawksbill

and loggerhead turtles were found in The Bahamas, and were also aware that people ate them and still did despite the ban on harvest. The responses are currently being analyzed in further detail.



Volunteers interviewing local citizens outside the supermarket in Marsh Harbour. Photo credit: Ava Thompson

Assessing fibropapilloma disease

We dedicated a week of field work to a new site on Eleuthera in Savannah sound. Out of 32 turtles captured, 7 (22%) had fibropapilloma tumors (Fig.1), and scored moderate to severe on the score system of Rossi et al. (2016). On average, sea turtles affected with FP were larger ($45.7\text{cm} \pm 2.1\text{cm SE}$) than healthy turtles ($41.8\text{cm} \pm 1.1\text{cm SE}$), and heavier ($12.3\text{kg} \pm 1.5\text{kg}$) than healthy turtles ($9.8\text{kg} \pm 0.6\text{kg}$). Body condition Index was calculated using length and weight and 26 (81%) of turtles captured were in very good condition, 3 (9.3%) were in robust condition, 2 (6.2%) were normal, and 1 (3.1%) emaciated. This emaciated ($\text{BCI} = <1.00$) turtle did not have FP and all FP afflicted turtles were in very good condition ($\text{BCI} = >1.2$), except one which was normal ($\text{BCI} = 1.0 - 1.1$). Tumor location was fairly evenly spread around all four flippers, and less ocular tumors were seen (Fig.?) and the majority of tumors were in size class B (1-4cm) (Tab 1.).

We continued tagging efforts for a second year in Abaco and captured 186 green turtles, 4 loggerheads, and a hawksbill across 6 sites. Out of 137 green turtles included in this analysis, 43 (31%) had fibropapilloma tumors, and scored moderate to severe on the score system. There was very little difference in size between infected and health turtles (48.4cm and 47.7cm respectively) or weight (16.3kg and 16.0kg respectively). Body condition index was also very similar between infected and healthy turtles. The majority were in very good condition (84% of infected, 90% of healthy), 9.3% of infected and 8.5% of healthy were in robust condition, 2.3% of infected and 1.0% of healthy were normal, and 4.6% of infected turtles were emaciated. However, tumor location was quite different to the infected turtles in Eleuthera, with the majority found on the front two flippers and head (Fig. 2). The majority of tumors were also in size class B (1-4cm) with fewer larger tumors compared to Eleuthera (Tab 1.).



Figure 1. Turtle caught in Savannah Sound with significant tumor formation around tail and rear flippers.

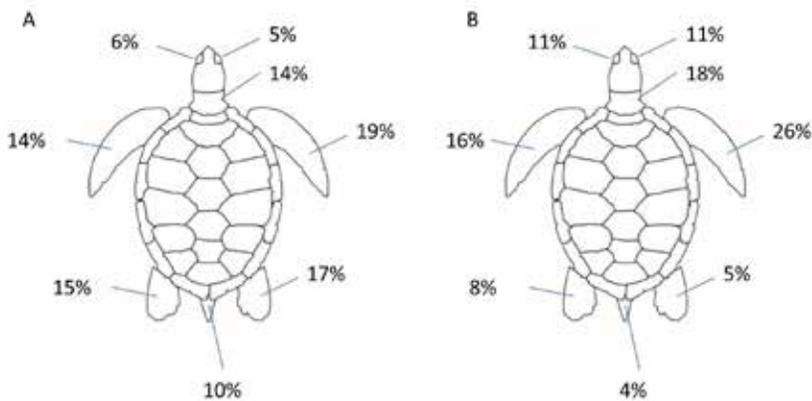


Figure 2. The proportion of tumors found on various parts of the body, for 105 tumors in Savannah Sound (A), and 185 in Abaco (B).

Table 1. Proportion of tumors in the various size classes.

Tumor Size class	Savannah Sound	Proportion %	Abaco	Proportion %
A = < 1 cm	22	21.0	63	34.1
B = 1-4 cm	59	56.2	100	54.1
C = 4-10 cm	21	20.0	19	10.3
D = >10 cm	3	2.9	3	1.6
Total number of tumors:	105		185	
Average number of tumors/turtle	15		4.3	



Determining Fine-Scale Behavior

This year, in collaboration with Dr. Nathan Robinson of Cape Eleuthera Institute, we were able to deploy several animal-borne cameras (called TurtleCams) on juvenile green turtles in southern Eleuthera. Animal-borne cameras provide a unique first-person perspective into the activities of these animals. The footage can be used to answer many valuable questions about turtles, including: what do they feed on, in which habitats do they spend the majority of their time, and how do they interact with other turtles as well as potential predators. Animal-borne cameras also simultaneously record both temperature and depth, providing environmental data that can influence the behaviours recorded on the TurtleCam. An example of the footage that we have been able to collect so far can be found at the following link: <https://youtu.be/ZRqPXDtwTc>

PROJECT IMPACTS

1. Increasing Scientific Knowledge

a) Total citizen science research hours

8 hours per day, for 7 days, for 81 people = 4536

b) Peer-reviewed publications

Gary, M & Brooks, A. Juvenile green turtles (*Chelonia mydas*) restrict home ranges in a shallow tidal foraging area (*In review*) Earthwatch acknowledged.

Brooks, A et al. A review of Fibropapillomatosis in The Bahamas. (In prep) Earthwatch will be acknowledged.

Multi-level habitat selection by a large marine herbivore (*Chelonia mydas*) in a shallow coastal ecosystem: the influence of predation risk, food abundance, and forage nutrient content (In prep) Earthwatch will be acknowledged.

c) Non-peer reviewed publications:

d) Books and book chapters

e) Presentations:

2. Outreach and Mentoring

a) Graduate students

Student Name	Graduate Degree	Project Title	Anticipated Year of Completion

b) Community outreach

Provide details on how you have supported the development of environmental leaders in the community in which you work.

Name of school, organization, or group	Education level	Participants local or non-local	Estimated number of participants	Details on contributions/activities

3. Partnerships

Partner	Support Type(s) ¹	Years of Association (e.g. 2006-present)
Cape Eleuthera Institute	Permit, field work support, collaboration	2014 - present
Friends of the Environment	Logistics	2018 - present
Family Island Research and Education	Field work support, collaboration	2012 - present
Archie Carr Center for Sea Turtle Research	Collaboration	2012- present

Contributions to management plans or policies

Plan/Policy Name	Type ²	Level of Impact ³	New or Existing?	Primary goal of plan/policy ⁴	Stage of plan/policy ⁵	Description of Contribution

² Type options: agenda, convention, development plan, management plan, policy, or other (define)

³ Level of impact options: local, regional, national, international

⁴ Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other (define)

⁵ Stage of plan/policy options: proposed, in progress, adopted, other (define)

4. Conserving natural and sociocultural capital

a) Conservation of taxa

i. *List any focal study species that you did not list in your most recent proposal*

Species	Common name	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source

ii. *In the past year, has your project helped conserve or restore populations of species of conservation significance? If so, please describe below.*

Species	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source	Description of contribution	Resulting effect ⁶

b) Conservation of ecosystems

In the past year, has your project helped conserve or restore habitats? If so, please describe below.

Habitat type	Habitat significance ⁷	Description of contribution	Resulting effect ⁸

⁷. Habitat significance options: nursery, breeding ground, feeding site, corridor, migration path, refuge, winter range, summer range, spring range, fall range or other (define)

⁸. Resulting effect options: extent maintained, condition achieved, restored, expanded, improved connectivity or resilience

c) Ecosystem services

Indicate which ecosystem service categories you are **directly studying** in your Earthwatch research and provide further details in the box below as needed.

Provisioning Services

- Fisheries (Fresh & Marine)
- Energy (Fuelwood/hydropower)
- Livestock grazing
- Material extraction (e.g. resin, grass)
- Timber
- Water supply
- Other food (crops, wild foods, spices)
- Pharmaceuticals

Regulating & Support Services

- Carbon sequestration/storage/ "blue"
- Coastal protection
- Erosion control
- Flood regulation/protection
- Pest and disease control
- Pollination
- Seed dispersal
- Water purification/quality
- Nutrient cycling

Cultural Services

- Cultural/historical values
- Health (mental & physical)
- Research & knowledge
- Recreational
- Spiritual/aesthetic values

Other Services

- Biodiversity
- Employment/Livelihoods

Details:

Social surveys in local community recording knowledge, perceptions, cultural values etc. of sea turtles and their conservation

d) Conservation of cultural heritage

Provide details on intangible or tangible cultural heritage components that your project has conserved or restored in the past year.

Cultural heritage component ⁹	Description of contribution	Resulting effect

⁹. Cultural heritage component options: traditional agriculture, artifacts, building(s), hunting ground or kill site, traditional ecological knowledge and practices, monument(s), oral traditions and history, spiritual site, traditional subsistence living

e) Impacting local livelihoods

Provide details on how livelihoods were impacted by your project. This includes persons hired to assist Earthwatch teams (field assistants, guides, cooks, drivers, etc.) and any economically applicable training provided to local community stakeholders.

Local livelihood impact(s)	Description of contribution	Number of people impacted
Car rental	Rental fees	1 company (Abaco)
Boat rental	Rental fees	2 companies (one in Abaco, one in Eleuthera)
Fuel purchase	For vehicles/boats from local gas stations	
Dining in local restaurant	Meal out for whole team	5 different restaurants between Abaco and Eleuthera

f) Please provide any other measurable actions that you conducted within the local community(s) where your research takes place.

RESEARCH PLAN UPDATES

Report any changes in your research since your last proposal/annual report. For any 'yes' answers, provide details on the change in the 'Details' box. This section will not be published online.

- | | | |
|-----------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------|
| 1) Have you added a new research site or has your research site location changed? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 2) Has the protected area status of your research site changed? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 3) Has the conservation status of a species you study changed? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 4) Have there been any changes in project scientists or field crew? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

Details - provide more information for any 'yes' answers

New Co-PI, usual changes in field staff

- 5) Provide details on any changes to your objectives, volunteer tasks, or methods, include reason for the change.

ACKNOWLEDGEMENTS

We would like to thank all the field staff and interns that assisted us in 2019, particularly Ryley Parent, Liberty Boyd, Alex Smith, Savannah Ryburn, and Jack Bliss. We thank Stephen Connett especially for his support in the field in Abaco. We thank CNN for documenting our research. We thank Friends of the Environment and Cape Eleuthera Institute for hosting us. We thank the facilitators of the teen teams and school groups.

LITERATURE CITED

Rossi S, Sanchez-Sarmiento AM, Vanstreels RET, dos Santos RG, Prioste FES, Gattamorta MA, et al. (2016) Challenges in Evaluating the Severity of Fibropapillomatosis: A Proposal for Objective Index and Score System for Green Sea Turtles (*Cheloniemydas*) in Brazil. PLoS ONE 11(12): e0167632. doi:10.1371/journal.pone.0167632