



## **Shark and Ray Conservation in Belize**

Lead Scientist: Dr. Demian Chapman, Florida International University

Co-PIs: Dr. Yannis Papastamatiou, Florida International University & Dr. Elizabeth Babcock, University of Miami

Team Leaders: Kathryn Flowers & Megan Kelley

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## LETTER TO VOLUNTEERS

Dear shark and ray volunteers,

On behalf of our team I would like to sincerely thank all of you for your work in 2018. As an Associate Professor at Florida International University and the Lead Scientist of the Earthwatch Project Shark and Ray Conservation in Belize, I have been working on a wide variety of conservation-related research topics for the past two decades, but of all of my projects, I feel most at home when studying in Belize with students and a new crew of Earthwatch volunteers. This stems from the deep connection I have with this tiny nation and the strong sense of family I have developed with the Belizean people, especially with our boat crew Captain Buck Nunez and First Mate Bert Miranda. The enthusiasm and interest of the Earthwatch volunteers never fails to encourage our team to work even harder to help Belize and other nations forge sensible and effective conservation strategies for sharks and rays.

I first came to Belize in July 2000. Now, after nearly two decades and more than 20 expeditions later, I have fallen in love with this country, its barrier reef ecosystem, and its people. Since I was a small boy in New Zealand, sharks have been my passion. When I arrived in Belize, one would only occasionally see sharks in the fish market, and the prices paid for them were modest. This has changed. Today, fishers are exploiting sharks in Belize with very little regulation. My team has deployed baited remote underwater videos (BRUVs)—underwater video traps to count sharks and other fish—on reefs where gillnets and fishing are allowed, and found that sharks are nearly absent on these reefs.

Thankfully, there is still hope for the sharks and rays of Belize. Your curiosity, desire to learn, and dedication have contributed to several firsts, and not just for this project but national and internationally as well. The official updated National Plan of Action for Sharks was presented in June by the National Shark Working Group (NSWG) and the Belize Fisheries Department (BFD), which includes the world's first ray sanctuary and the first ever shark species-specific assessments in Belize. In September, we will be presenting the shark anal fin work from the fisheries monitoring program in collaboration with the BFD, allowing us to identify and address potential overfishing. We're also poised to buy out fishers who may be targeting sharks at Glover's Reef and Lighthouse Reef and reel them in to scientific research on sharks, which will also help us monitor the fishery.

Our BRUV deployments have found robust and thriving shark populations on reefs where gillnets and/or fishing are banned—marine reserves. It is our goal to monitor these no-fishing zones and to investigate how and why they are working for shark conservation. We also aim to elucidate the ecological role of sharks and rays through behavioral and tissue analyses. To these ends, we have thrown on our work gloves to deploy BRUVs and catch sharks and rays on some of the most beautiful reefs in the Caribbean. Collecting these valuable data and building innovative conservation strategies would not have been possible without the help of our volunteers. Thank you for sharing this incredible journey with us!

Sincerely,

Demian Chapman on behalf of the team Yannis Papastamatiou, Elizabeth Babcock, Kathryn Flowers, Megan Kelley, Buck Nunez, Ashbert Miranda

## SUMMARY

We have continued our long-term baited remote underwater video sampling at Glover's Reef Atoll (GRA), and conducted environmental DNA sampling alongside this work. The fisheries monitoring program with the BFD has been successful, with over 1000 shark anal fins collected, identified, and measured. The 5-year National Plan of Action for sharks was finalized in June with the NSWG. Data have been successfully collected for our shark and ray tracking project, nurse shark habitat connectivity project, and seascape of fear project. Through stable isotope analysis we have found that Caribbean reef sharks are not top predators as they are feeding at the same level as grouper and barracuda (Bond *et al.* 2018).

## Goals, Objectives, and Results

**Objective 1: Monitor the relative abundance of sharks in one established marine reserve (Glover's Reef Atoll), one new marine reserve (South Water Caye), and one fished site (Belize City) to quantify reserve effectiveness.**

BRUV monitoring has continued at GRA, with 40 camera deployments completed in the lagoon and 40 camera deployments completed on the forereef. In addition, 20 eDNA samples were collected in the lagoon, and 20 eDNA samples were collected on the forereef. The inclusion of this work will contribute to a larger global project to test if it is possible to identify the same shark and ray species in the water samples and on the videos. Moving forward, BRUV data will also be used to assess southern stingray habitat use.

**Objective 2: Determine the extent to which Caribbean reef shark populations in marine reserves are self-sustaining.**

In 2018, two juvenile Caribbean reef sharks were tagged with coded transmitters that have a 10-year battery life span ("V16s"). Newly captured individuals were tagged with a passive integrated transponder (PIT tag), whenever possible, in order to identify them if recaptured. A total of 15 juvenile Caribbean reef sharks (<120 cm total length, "TL") have been tagged with V16s for this portion of our project. DNA samples were collected from all individuals whenever possible.

**Objective 3: Assess the species composition of the Belizean shark fishery.**

More than 1000 shark anal fins have been collected from local fishers. Volunteers assisted with species identification and measurements of the fins, which will help us determine if overfishing is occurring on a species-specific basis. Results from this work will be available in September. Dr. Chapman attended four meetings with the NSWG and the BFD this year to keep this project on track.

**Objective 4: Assess the effects of sharks on the behavior (depth range, foraging rate, refuging time) of stingrays.**

Thirteen female southern stingrays were caught and tagged with V16s in 2018. Newly captured individuals were tagged with a PIT tags whenever possible in order to identify them if recaptured. To date, 23 southern stingrays have been tagged to track their movements around GRA. Additionally, three white spotted eagle rays and one Atlantic Chupare have been tagged with V16s to compare their movements with those of the southern stingrays. DNA samples were collected whenever possible.

This year, three large sharks (>120cm TL) were captured and tagged with V16s (one Caribbean reef shark and two lemon sharks). To date, nine large sharks have been tagged to assess potential spatial overlap with southern stingrays.

A full receiver download occurred in April 2018. All 22 receivers (“listening stations”) were retrieved, data extracted, and replaced two tri-axial accelerometer deployments on southern stingrays occurred at GRA, resulting in one dataset of 12 hours and one of 24 hours. This will help us identify daily activity patterns. Future work will include deployments on large Caribbean reef sharks. To date, six accelerometer datasets have been collected - four at GRA and two at South Water Caye (SWC).

Kathryn has continued to work with the BFD to ensure the ray sanctuary comes into legislation smoothly by the end of 2018. Educational workshops for fishers and tourists are being planned for 2019.

#### **Objective 5: Assess nutrient dynamics and habitat connectivity by nurse sharks.**

In total, 30 nurse sharks have been tagged with V16s. 29 of those individuals have been transmitting data. 74 blood, 73 muscle, and 77 fin samples have been collected for stable isotope analysis. All newly captured individuals were fitted with external dart tags whenever possible, in order to identify recaptured individuals. Since 2017, 86 individual nurse sharks have been fitted with dart tags and seven have been recaptured.

Five nurse sharks have been fitted with tri-axial accelerometers. One of those deployments was on an individual already fitted with a V16, and one of those deployments included an active acoustic track.

## **PROJECT IMPACTS**

### **1. Increasing Scientific Knowledge**

#### **a) Total citizen science research hours**

Approximately 250

#### **b) Peer-reviewed publications**

**Bond ME, Valentin-Albanese J, Babcock EA, Hussey NE, Heithaus MR, Chapman DD.** 2018. The trophic ecology of Caribbean reef sharks (*Carcharhinus perezi*) relative to other large teleost predators on an isolated coral atoll. *Marine Biology* 165.

\*Earthwatch and volunteers acknowledged

#### **c) Non-peer reviewed publications:**

National Shark Working Group (includes **Dr. Demian Chapman**). National Plan of Action for Sharks. 2018. Belize Fisheries Department.

\*Earthwatch acknowledged

## 2. Mentoring

### a) Graduate students

Student Name	Graduate Degree	Project Title	Anticipated Year of Completion
Megan Kelley <i>Major advisor: Yannis Papastamatiou</i>	Ph.D. Biological Sciences	Predator mediated nutrient cycling and habitat connectivity on a Caribbean atoll	2020
Kathryn Flowers <i>Major advisor: Yannis Papastamatiou</i>	Ph.D. Biological Sciences	The role of dynamic fear seascapes in driving stingray behavior and habitat use	2021
Jessica Quinlan <i>Major advisor: Demian Chapman</i>	Ph.D. Biological Sciences	From boat to bowl: CITES implementation for hammerhead sharks in Belize and China	2021

### b) Community outreach

Name of school, organization, or group	Education level	Participants local or non-local	Details on contributions/ activities
Belize Fisheries Department (BFD)	Various	Local governmental organization	Meetings and presentations; continuation of fishery monitoring program with the BFD staff and local fishers

## 3. Partnerships

Partner	Support Type(s) <sup>1</sup>	Years of Association (e.g. 2006-present)
Paul G. Allen Philanthropies	Funding	2015-present
The Roe Foundation	Funding	2002-present
Mays Family Foundation	Funding	2016-present
Belize Fisheries Department	Permits	2000-present
Florida International University	Academic support, funding	2016-present
University of Miami	Collaboration, academic support	2000-present
Wildlife Conservation Society	Accommodations, logistics	2000-present

<sup>1</sup> Support type options: funding, data, logistics, permits, technical support, collaboration, academic support, cultural support, other (define)

#### 4. Contributions to management plans or policies

List the management plans/policies to which your project contributed this year

Plan/Policy Name	Type <sup>2</sup>	Level of Impact <sup>3</sup>	New or Existing?	Primary goal of plan/policy <sup>4</sup>	Stage of plan/policy <sup>5</sup>	Description of Contribution
National Plan of Action for the Conservation and Management of Sharks	Management plan	National (Belize)	Existing	Species conservation	Adopted June 2018	Dr. Demian Chapman is an active member of the Shark Working Group and data from this project directly contributed to the plan. Dr. Chapman also organized the in-country meetings with the Belize Fisheries Department for the development and local dissemination of this updated plan.
Ray Sanctuary	Law	National (Belize)	New	Species conservation	To be adopted by end of 2018	Proposed by Kathryn Flowers and Demian Chapman.

<sup>2</sup>. Type options: agenda, convention, development plan, management plan, policy, or other (define)

<sup>3</sup>. Level of impact options: local, regional, national, international

<sup>4</sup>. Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other

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

## 5. 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
n/a				

- 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 <sup>6</sup>
n/a					

<sup>6</sup> Resulting effect options: decreased competition, improved habitat for species, range increased, population increase, improved population structure, increased breeding success, maintained/enhanced genetic diversity, other

### 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 <sup>7</sup>	Description of contribution	Resulting effect <sup>8</sup>
n/a			

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

<sup>8</sup> 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.

- Food and water
- Flood and disease control
- Spiritual, recreational, and cultural benefits
- Nutrient cycling

Details:

**By studying the effectiveness of marine protected areas for sharks and rays, we were able to communicate our findings to the Belize Fisheries Department. Our work has directly contributed to an improved management plan for sharks that will include the protection of all ray species in Belize. These conservation actions will benefit Belize's fishery and tourism industries. Additionally, our work is examining the extent to which nurse sharks connect different habitats through nutrient transfer.**

#### 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 <sup>9</sup>	Description of contribution	Resulting effect
n/a		

<sup>9</sup> 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

## 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?  Yes  No
- 2) Has the protected area status of your research site changed?  Yes  No
- 3) Has the conservation status of a species you study changed?  Yes  No
- 4) Have there been any changes in project scientists or field crew?  Yes  No

Details - provide more information for any 'yes' answers

**The entire exclusive economic zone (200 nautical miles offshore) in Belize will become a ray sanctuary. No commercial ray fishing activities will be able to occur without penalty in Belize waters. Expected TBA December 2018.**

- 5) Provide details on any changes to your objectives, volunteer tasks, or methods, include reason for the change.  
 Capture methods for all rays have improved to reduce the amount of bait required. Although rays will still be caught as by-catch on shark longlines, we will be focusing on catching rays using cast nets on the sandflats and hand lines in the deeper lagoon and forereef. Caribbean reef sharks will also be tagged with tri-axial accelerometers to assess their diel activity patterns in relation to those of southern stingrays.

## ACKNOWLEDGEMENTS

PLEASE REFER TO THE FUNDING AND COLLABORATOR SHEET ABOVE.