


Shark and Ray Conservation Belize

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January 2019 – August 2019

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Photo credits from top left to bottom: Megan Kelley, Katie Flowers, Emma Fowler

LETTER TO VOLUNTEERS

Dear shark and stingray teams,

We had another fantastic year working in Belize, with a new research site added on the mainland - Riversdale. There, we are funding shark fishers to help us tag sharks in exchange for reducing their shark catch. From 2018 - 2019, our support helped cut the national shark catch in Belize in half!

At Glover's Reef Atoll, we have continued our BRUV surveys and telemetry projects. We are tracking 105 sharks and rays within our listening station array for the next 10 years. The nurse shark data collection phase has been completed – congratulations Megan! The stingray accelerometry project will continue at South Water Caye in order to compare activity levels of the stingrays at Glover's Reef to those in an area with fewer sharks.

Speaking of fewer sharks, we do have some disappointing news from Glover's Reef - the Caribbean reef shark sightings on our baited remote underwater video cameras have decreased since 2016, corresponding to shark fishing off the edge of the marine protected area. Early detection of this decline would not have been possible without your help. The fishers are within their legal right to fish there, so we proposed a buffer zone of 2.5 miles around the three atolls (Lighthouse, Turneffe, and Glover's Reef) to the Belize Fisheries Department. The fisheries department agreed with this plan and extended this regulation to include a 2.5 mile buffer zone off the entire barrier reef as well. This means shark fishing would be prohibited in those areas. This piece of legislation, along with the ray sanctuary, are currently still waiting to be approved by the Fisheries Minister. Finalizing new laws requires a lot of patience, good communication with local stakeholders, and persistence. Thanks to your support, we will continue to fight for shark and ray protections in Belize. This summer we were able to discuss the ray sanctuary with the shark fishing community in Riversdale, local non-governmental organizations, the fisheries department, the coast guard, marine protected area coordinators, and rangers. From this, we were able to gather valuable information about where endangered Ticon cownose rays and critically endangered smalltooth sawfish may still be found in Belize.

Thanks again for all your efforts that led to these results. We look forward to continuing our work and publishing results in the coming years. And maybe we'll even be lucky enough to see a few familiar faces in the 2020 field season!

Demian Chapman, principal investigator

SUMMARY

The data collection phase for the nurse shark project at Glover's Reef Atoll (GRA) was completed in January 2019, and for the stingray project in June 2019. The movements of 105 sharks and rays are being monitored within our acoustic array at GRA. BRUV surveys were continued on the forereef and in the lagoon at GRA, as well as conducted across several reefs near Riversdale, our new research site off the mainland. Collection of morphometric data with Earthwatch volunteers and local fishers continues to contribute to an ongoing analysis in collaboration with the Belize Fisheries Department (BFD). This analysis will enable scientists and BFD to determine the status of fished shark species and provide BFD with the information they need to make informed management decisions.

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 surveys continued on the forereef (22 deployments) and in the lagoon (40 deployments) at GRA. Past data

have contributed to the Global FinPrint project, a global analysis of the status of reef shark populations (MacNeil *et al*. in review).

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

In 2019, three juvenile Caribbean reef sharks (≤120 cm total length, "TL") 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. One juvenile shark tagged in June 2018 was recaptured in April 2019. A total of 18 juvenile Caribbean reef sharks 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.

All shark fishers are required to remove and submit all anal fins from sharks landed during the fishing season. It was determined that each species, except hammerheads, blacktips, and blacknose sharks, has a unique anal fin allowing for positive species identification. In collaboration with the BFD, these fins are being identified and used to reconstruct the species composition of each fishing season. Furthermore, body length measurements and anal fin width measurements have been collected to create a regression that can be applied to collected anal fins, allowing us to estimate shark size at capture. Understanding the species and size composition of the fishery is critical for making informed management decisions for sharks.

Objective 4: Assess the effects of sharks on the behavior of stingrays.

Seven female southern stingrays were caught and tagged with V16s in 2019. Newly captured individuals were tagged with a PIT tag whenever possible in order to identify them if recaptured. To date, 30 southern stingrays have been tagged to track their movements around GRA. Additionally, seven whitespotted eagle rays and two Atlantic chupare stingrays have been tagged with V16s to compare their movements with those of southern stingrays. DNA samples were collected whenever possible.

This year, ten large sharks (>120cm TL) were captured and tagged with V16s (seven Caribbean reef sharks and three lemon sharks). To date, 19 large sharks have been tagged to assess spatial overlap with southern stingrays.

Seven tri-axial accelerometers deployments on southern stingrays occurred at GRA. Cumulatively, 13 accelerometer datasets have been collected – 11 at GRA and two at South Water Caye (SWC). At least eight more deployments will occur at SWC to test for activity differences across a gradient of reef shark presence (high abundance at GRA, low abundance at SWC).

Ray sanctuary outreach was conducted with the Belize Fisheries Department, marine protected area coordinators, marine protected area rangers, members of the Belize Coast Guard, several local non-governmental organization managers, tourists from Off The Wall Dive Center and Resort, and six of the 75 licensed shark fishers in Belize including the chairperson of the Shark Fishing Association and recent recipient of Belize's Outstanding Fisher Award. Pamphlets outlining the new law and requesting sighting information on threatened species (smalltooth sawfish, Ticon cownose rays, and oceanic manta rays) were given to each organization to disseminate widely.

Strategies to enforce the law were discussed with these groups. The law is pending the signature of the Fisheries Minister.

Objective 5: Assess nutrient dynamic and habitat connectivity by nurse sharks.

The data collection phase of this project is complete. In total, 30 nurse sharks have been tagged with V16s. Twenty-nine of those individuals have transmitted data, while some are detected across multiple receivers. 81 blood, 80 muscle, and 80 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, 92 individual nurse sharks have been fitted with dart tags and seven have been recaptured. Five nurse sharks have been successfully 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. Megan Kelley has advanced to candidacy, successfully defended her research proposal, and is on track to graduate Fall 2022. Publications can be expected following graduation.

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, Heithaus MR, Grubbs RD, Cerrato R, Peterson BJ, Pikitch EK, **Chapman DD** (2019) Top predators induce habitat shifts in prey within marine protected areas. *Oecologia*, 190(2): 375-385. Earthwatch acknowledged.

Flowers KI, Kelley MC (in press) Resting whitespotted eagle ray (*Aetobatus narinari*, Aetobatidae). *Journal of Ichthyology*. Earthwatch acknowledged.

MacNeil *et al*. (in review*) Global status and conservation potential of reef sharks. *Nature*. Earthwatch not acknowledged due to collaborative nature of paper (>100 authors) and funding primarily from Paul G. Allen Philanthropies. Authors who are current or past Earthwatch staff include D Chapman, Y Papastamatiou, M Bond, K Flowers, G Clementi, J Valentin-Albanese, J Quinlan.

***Please note this publication is under peer review. The addition of the manuscript here does not confirm publication will occur in the journal it was submitted to and rejection is still possible.**

c) Presentations:

Chapman D. Global FinPrint and shark conservation. Frost Science Museum. October 2019.

Kelley M. Using movement and activity to infer predator mediated nutrient transfer. FIU Biosymposium, department talk. Febraury 2019.

2. Outreach and Mentoring

a) Graduate students

Student Name	Graduate Degree	Project Title	Anticipated Year of Completion
Megan Kelley *Major advisor: Yannis Papastamatiou*	Ph.D. Biological Sciences	Predator mediated nutrient cycling and habitat connectivity on a Caribbean atoll	2022
Kathryn Flowers *Major advisor: Yannis Papastamatiou*	Ph.D. Biological Sciences	The role fear in driving stingray behavior and habitat use	2021
Jessica Quinlan *Major advisor: Demian Chapman*	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	Estimated number of participants	Details on contributions/ activities
Belize Fisheries Department	Various	Local	4	Meetings and presentations; continuation of fishery monitoring program with the BFD staff and local fishers
Hosted by the Wildlife Conservation Society	Various	Local coast guard, marine protected area coordinators, rangers, and NGO leaders	20	Overview of Earthwatch project and forthcoming ray protections
Off the Wall Dive Center & Resort	Various	Local & foreign tourists	15	Overview of Earthwatch project and forthcoming ray protections
Riversdale Shark Fishers	Various	Local	6	Overview of Earthwatch project and forthcoming ray protections

3. Partnerships

Partner	Support Type(s)[1]	Years of Association (e.g. 2006-present)
Paul G. Allen Philanthropies	Funding	2015-2018
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
Riversdale Boat Rental	Accommodations, logistics	2018-present

4. 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
Ray sanctuary	Law	Local	New	Species Conservation	In Progress	Proposed by Kathryn Flowers & Demian Chapman
Shark buffer zones around existing MPAs	Law	Local	New	Species Conservation	In Progress	Proposed by Demian Chapman

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[6]
n/a					

[6.] 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[7]	Description of contribution	Resulting effect[8]
n/a			

c) Ecosystem services

Provisioning Services

☒Fisheries (Fresh & Marine)
☐Energy (Fuelwood/hydropower)
☐Livestock grazing
☐Material extraction (e.g. resin, grass)
☐Timber
☐Water supply

Regulating & Support Services

☐Carbon sequestration/storage/"blue"
☒Coastal protection
☐Erosion control
☐Flood regulation/protection
☐Pest and disease control
☐Pollination

Cultural Services

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

☐Other food (crops, wild foods, spices)
☐Pharmaceuticals

☐Seed dispersal
☐ Water purification/quality
☒ Nutrient cycling

Other Services
☒Biodiversity
☐Employment/Livelihoods

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
n/a		

e) Impacting local livelihoods

Local livelihood impact(s)	Description of contribution	Number of people impacted
Shark fishers	Employed to do science instead of fish sharks	11
Riversdale cooks	Employed to cook for staff & volunteers	2
GRA boat captains	Employed	2
GRA first mate	Employed	1

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

Between 2018 – 2019, Belize shark catch was reduced by approximately 50% due to the employment we provided the shark fishers.

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

Riversdale has been added as one of our primary research sites. Local shark fishers are now a part of our field team there.

ACKNOWLEDGEMENTS

SEE "PARTNERSHIPS" ABOVE