The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Yasuní Chiriboga
Project title	Spatial Ecology and Conservation of neonate and juvenile blacktip reef sharks (*C. limbatus*) at San Cristobal Island, Galapagos Marine Reserve.
RSG reference	19794-1
Reporting period	May 2016 – July 2017
Amount of grant	£5000
Your email address	yasuni.chiriboga@hotmail.com
Date of this report	28th August 2017

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Compare the current shark abundance against the one found in the pilot survey in 2010-2011.				
Evaluate connectivity between all sampled mangrove areas.				
Start a long term monitoring program for juvenile sharks in San Cristobal.				We need more talks with the GNP Directorate to establish how this long - term monitoring plan could work in the future. For now, we were able to secure internal funding to continue through the 2017 season.
Evaluate the effectiveness of the new zonation scheme under development.				
Integrate side-fidelity and inter – nursery movement data into management proposals for San Cristobal.				We need more talks with the DGNP so they can evaluate if include our data as a parameter for future management proposals in the island.
Analyse how climate change (El Niño Current) may affect shark nurseries, and compare against pilot survey in 2010-2011.				More time in the field is necessary to understand how shark's behaviour change during the whole year, and compare with available data.
Involve GNP Directorate, local community and students from the local campus of USFQ, in the project.				

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

At first, we were planning to monitor offshore aggregation site activities in Kicker Rock islet. Monitoring activities included SCUBA diver surveys to count abundance of

sharks and using a laser photographic system we were planning to estimate shark size. Also, it was planned to use barbless hooks on handlines to bring sharks alongside the vessel and then measure, sex, and tag them. These activities were not accomplished because we could not adjust an accurate support for lasers, which was really important to get exact measurements from sharks. The methodology which included barbless hooks failed because in every tried we made, we just caught sharks from other species that were not the one that we were looking for. Because of all these inconvenient situations we decided not to monitor in this site, even though, we installed one VR2W receiver in this location.

We proposed to start a long term project to increase our knowledge in ontogenetic spatial ecology of sharks in conjunction with a current study about ontogenetic dietary changes. This plan was not achieved because the researcher in charge of the ontogenetic dietary changes, left the research aside for personal reasons. Even though we hope that in the future this objective will be accomplished.

3. Briefly describe the three most important outcomes of your project.

To compare the abundance of juvenile and neonate blacktip reef sharks from 2010 to 2016, in four coastal mangrove areas in San Cristobal – Galapagos Marine Reserve. Differences in abundance between these 2 years, give us important data about what is happening with the population of this shark species around the island. We found consistent differences in the number of sharks captured per effort unit on each place. Results from 2010 showed 71 captures in six fieldtrips of 1 hour each one, carried out from January until April. Males and females from different sizes were captured and presented a mean total length of 70 and 72.5 cm, respectively, and an average weight of 4 pounds. In contrast, under comparable conditions in our 2016-2017 research, we found 546 blacktip sharks in four coastal mangrove lagoons: Manglecito, La Seca, Puerto Grande (having the most abundance of sharks) and La Tortuga, in 14 fieldtrips of 90 minutes, as an average of effort unit. Captured sharks had a mean total length of 67.5 cm, and an average of weight of 2008.15 grams, equivalent to 4.43 pounds. These results may suggest that population of blacktips are increasing from 2010 to 2017.

To look for the movements of juvenile sharks in between the four nursery grounds. By using acoustic telemetry was another important outcome of our project. We have tagged 12 blacktip sharks and downloaded data from the array of receptors every six months since May 2016 until June 2017. We found a high degree of site fidelity in each location. We found connectivity between: La Seca, Manglecito and Puerto Grande, but not in La Tortuga. Connectivity was found between mangroves that were really closed to each other, differently from La Tortuga, which is the farthest. More activity was found at night than at the day, and exploratory movements outside their original nursery ground, were confirmed.

With all data that we have until today, we can suggest to the Galapagos National Park Directorate that these four mangrove areas are really important for the development of blacktip sharks, and they are not isolated, rather, they have a connection between each other. The importance to include these areas as one big

protected zone, and regulating fishing arts, could be the solution to avoid neonate and juvenile blacktip shark by catch by fishermen that catch bait at these places.

My undergraduate thesis will explore and analyse these themes in depth. I will send you a copy of my thesis upon completion.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Local community was able to participate actively in the project, involving people from San Cristobal, and students from the campus of Universidad San Francisco de Quito. The advantage of having the help from local people in the project let us reach our objectives rapidly and efficiently, as well, we shared all our scientific knowledge with them. Exchanging knowledge was the key to make this project work. On the other hand, environmental education was carried out by giving didactical talks to children and young people from San Cristobal´s schools. Hiring fishermen from the zone as boat captains was important to make them conscious about juvenile sharks and the risk of by-catch in these zones.

5. Are there any plans to continue this work?

Since we already started with this project, we thought that it is important to keep monitoring constantly the abundance of juvenile sharks in mangrove areas, that´s how we are going to have enough data for decision-making and for planning long-term management and conservation programs. We were able to secure funding for the 2017 season, and for the future we are exploring several options, which include more funding from foundations such as Rufford, and incorporating some of the monitoring into an undergraduate teaching course to cover some of the field expenses. We hope to apply to a second Rufford grant to develop this project further. Finally, we intend to use genetic analysis of fin samples taken in 2016 and 2017 to establish kinship patterns, both intra- and inter- annually.

6. How do you plan to share the results of your work with others?

Results are going to be shared with students and professors from Universidad San Francisco in Quito on December of 2017, and on January of 2018 they are going to be shared with the local community from Galapagos Islands, by planned talks and by the annual Symposium of Science that the Galapagos Science Centre organises every year since 2016. Also, we are planning to publish the research with others that are taking place at the same time.

Our project was featured in Episode 3 on the recent BBC Galapagos documentary, which aired in April 2017 and highlighted the importance of protecting key shark nursery locations in Galapagos.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The Rufford Small Grant was used on the first season of sampling, from May- October 2016. This grant was so important for the initial phase of our project because it let us buy the most important and expensive materials to start the research. For the second season, December until June 2017, other funding was used to complete two seasons of sampling.

This project is the baseline to start a long-term conservation and monitoring programme that requires of other grants or funding to keep fulfilling the objectives that were established for the long term.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Boat time	£1400	£2357	£957	We did an extra monitoring field trip in July and December.
Fisherman Hire	£750	£314	£436	Fisherman hiring was less expensive than budgeted.
V13 tags	£1400	£1178.57	£221.43	We found a better price for internal tags than budgeted
Office supplies	£210	£114	£96	We did not use too many office supplies as budgeted.
Per diem in field	£0	£756.43	£756.43	Per diem in field was not budgeted at first, but at the end an amount of Rufford's grant was used to cover these costs.
GNP Capacitation Course	0	£170	£170	A previous capacitation course given by the Galapagos National Park of Santa Cruz Island was mandatory to start with the sharks project in San Cristobal *(Certification is attached in PDF document)*
Introductory "R" course	0	£110	£110	There was an introductory course of "R" programming in Quito, and it was important to attend because data will be analysed by using this program *(Certification is attached in PDF*

				document)
Lithium Batteries for VR2Ws (12@40 each)	£240	£0	£0	Additional funding from Galapagos Science Centre to Dr Hearn, helped us with the lithium battery cost.
VR2W receivers (6@1000 each)	£1000	£0	£0	Additional funding from Galapagos Science Centre to Dr Hearn, helped us with the VR2W receivers cost.
Total	£5000	£5000		***Notes to Budget** We assume an exchange rate of 1.4 pounds sterling to the dollar.

9. Looking ahead, what do you feel are the important next steps?

Now that we already finished and reached the short term goals of our project, we think that the more important next steps are to keep monitoring how population abundance is in the long-term. This will let us involve more people from the community making this project something it belongs to them. Empowering people and making them part of an active project will let us introduce more agents of change to the problem that sharks face. Environmental education for kids and adults is a key step in this process because it is the only way that we can make people conscious and start making a real change in favour of sharks.

Additionally, during our work we discovered the first putative nursery grounds for the endangered scalloped hammerhead shark. We believe that there may be considerable spatial overlap between the two species and will continue to develop this theme by tracking the movements, growth, and survival of neonate hammerhead and blacktip sharks in the coming years to establish the extent of niche overlap and explore the suitability of neonate blacktips as proxies for hammerheads in the development of conservation measures.

Given that the apparent abundance of juvenile sharks decline over a season, we need to determine whether this is as a result of ontogenetic migration or whether there us high mortality of juveniles – in hammerhead nursery grounds in Hawaii, competition for resources were high, leading to starvation as a main cause of high juvenile mortality. We intend to partner with marine physiologists over the coming years to establish health parameters for both blacktip and hammerhead sharks.

Finally, we intend to incorporate an aerial survey component using drones, to carry out rapid mapping of the extent of nursery grounds in San Cristobal and then model and ground truth potential nursery grounds throughout the rest of the archipelago. Early pilot studies carried out in April and June 2017 showed promising results with this emerging technology.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

The Rufford Foundation logo was used in the presentation of our project at the first Symposium of Research and Science organized by the Galapagos Science Centre in 2016. Rufford Foundation was included in the thanks of all the presentations that we used for environmental education in the schools of San Cristobal. In the future, the logo will be used in the presentation of my dissertation project at Universidad San Francisco in Quito, and on 2018 that I will present results at San Cristobal´s community. We expect a peer-reviewed article to result from my analyses – this will also provide appropriate acknowledgement to Rufford.

11. Any other comments?

I am very grateful to the Rufford Foundation to have enabled me to pursue a career in Marine Conservation Biology. After graduation, I intend to continue and build upon this research with the support from my supervisor. I also hope that Rufford Foundation will continue to found this exciting and important project in the Galapagos Islands.

Please contact me if further information about my activities is required.