# The Rufford Small Grants Foundation

# Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants 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** | Maximilian Hirschfeld |
| **Project title** | Biotelemetry of juvenile blacktip sharks and the conservation of key nursery habitats in the Galápagos Archipelago |
| **RSG reference** | 11344-1 |
| **Reporting period** | April 2012 – April 2013 |
| **Amount of grant** | £6,000 |
| **Your email address** | maximilian.hirschfeld@estud.usfq.edu.ec |
| **Date of this report** | May 2013 |

**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 |
|---|---|---|---|---|
| Confirmation of blacktip shark nursery areas | | | X | The use of formerly proposed nursery areas by blacktip sharks was confirmed during this study. A high abundance of blacktip pups in these areas, a strong site attachment of the animals and the use of the same areas across years were revealed. |
| Active tracking of 8 juvenile sharks | | | X | Throughout the study eight individual sharks were continuously tracked over 2 nights and 2 days. |
| Investigation of the movement patterns and home ranges of juvenile blacktip sharks | | | X | Based on the tracks of eight sharks we analysed swimming speed, site attachment, distance travelled and estimated the home range of the young predators. |
| Analysis of habitat preference | | | X | Sea floor mapping was not accomplished using sonar techniques due to elevated costs. High-resolution satellite images and in-situ depth measurements were used instead to render sea floor maps using Geographic Information Systems (GIS). Based on these maps, the preference of juvenile blacktip sharks for certain habitats within their nursery area was successfully investigated. The results underline the importance of shallow water refuges to the survival of juvenile sharks. |
| Delineation of key areas for conservation | | | X | The analysis of the distribution of the sharks' movements allowed us to determine relatively small core areas that are crucial to the sharks within their first life stage. These areas lie within shallow water of sheltered bays that serve as nurseries and can be defined precisely with our data. These results can be used to determine the location and spatial extend of no-take zones. |
| Community participation and involvement | | | X | Many local students and volunteers have participated actively in this research and even fishermen have collaborated in the project (see figure 2 in section 4.). |
| Diffusion of results and organisation of | | X | | Objectives and results have been diffused by oral presentations to local |

| | | | | |
|---|---|---|---|---|
| workshops for the fisheries sector | | | | and international students on the Galapagos Islands as well as at the University of San Francisco de Quito on mainland Ecuador. Further oral and poster presentations are planned to inform the local and scientific community in the Galapagos. Workshops with the local fisheries and tourism sector and the Galapagos National Park Services (GNPS) still have to be organised with the GNPS. |
| Use of results to aid the design of a new zoning scheme for the Galapagos Marine Reserve | | X | | The data obtained from this study show the importance of the shark nurseries and provide a spatial scale for the implementation of their conservation. These results will have to be combined with information of long-term monitoring and movement behaviour of other shark species as part of the Shark Conservation Plan of the GNPS. The design and implementation of a new zoning scheme of the marine reserve is a multi-institutional effort that will take form throughout this and next year. |

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

Due to extended periods of maintenance on vessels of the Galapagos National Park Services (GNPS) that were of suitable size for the field research, a small private fishing vessel was hired at a low cost to conduct the field research. Additionally, several times a second fishing boat was rented for transportation, whenever the larger vessels of the GNPS were being maintained or were needed in other monitoring or patrolling activities in the extensive marine reserve. Since the beginning of 2012, the Galapagos National Park was undergoing a change in the structure and organization of the institution, which was unforeseen at the time the research permit was granted in October 2011. Some of the telemetry equipment (VR100 acoustic receiver, originally provided through the GNPS) was found to have a technical failure at the beginning of the study. Within 1 month the Galapagos Science Center provided another receiver.

These unexpected developments resulted in a delay in the field trips and less frequent shark tracking sessions as well as higher expanses for the field research as had been estimated. In order to accomplish the objectives of this project and provide sufficient data for the management of shark nurseries the Galapagos National Park Services extended the research permits until February 2013. To cope with the elevated costs for the field research, additional funding of $5,000 was obtained from the Project Aware Foundation in September 2012. Therefore we were able to conduct several field trips throughout a second phase between November 2012 and January 2013 completing the movement data of 8 sharks and cover possible variance of the behaviour throughout the year.

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

This study is the first ever to actively track juvenile blacktips sharks to shed light on the movement behaviour associated to their nursery areas. Additionally, it is the first study on sharks that focuses on the small-scale movements of juveniles of any shark species within the Galapagos Marine Reserve.

1. The data recollected during this research include the movement patterns of juvenile blacktip sharks at different times of the day and around the year. At the same time we investigated how much the sharks are attached to their nursery areas and which habitat types they prefer the most. Our findings do not only confirm the long-term use of the same nursery areas identified by the Galapagos National Park in 2009, but also clearly underline the severe dependence of the young blacktips on these habitats to seek shelter from predation at a critical early life stage. The sharks were found to spend most of their time within the protected bays with few explorations mostly during the night. Movements outside the nursery were much faster than within the bay and in random directions. The strong attachment to the same protected bays was confirmed for all sharks and throughout the year. The young sharks all preferred rocky to mixed substrates at very shallow water depths in the most protected corner of the bay, indicating the importance of the nursery as a refuge.
2. One of the mayor objectives was provide a precise location and spatial extend of the areas which are essential to the survival of juvenile blacktip sharks within their first life stage. Therefore we analysed the geographical distribution of movements and determined core areas where the movements of all sharks were highly concentrated. These core areas are found within shallow water of the shark nurseries and are of a similar small size for all individuals (mean= 0.03km$^2$ sd ±0.03km$^2$) and therefore we can distinguish these as key areas for the conservation of blacktip sharks (Figure 1).

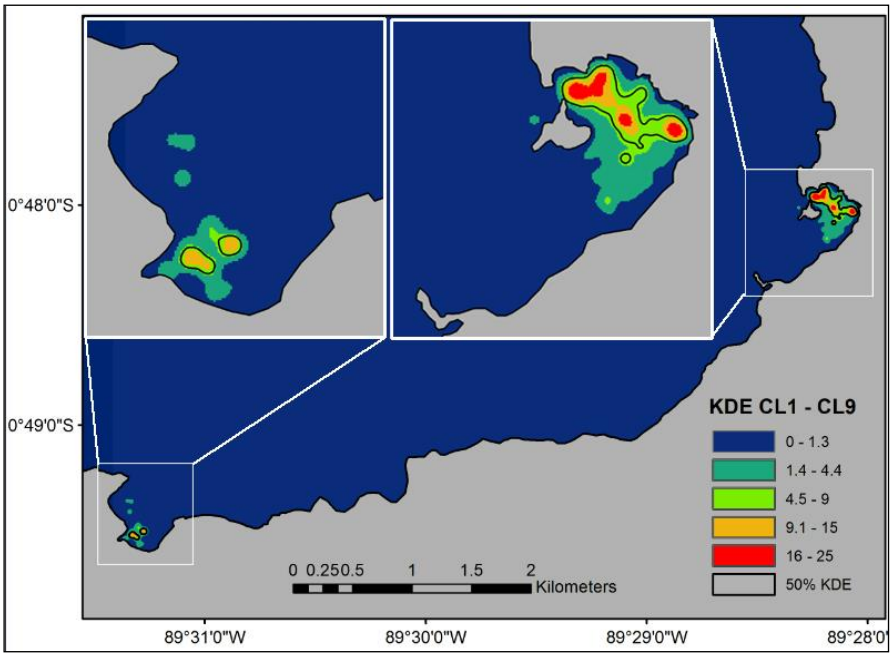


**Fig.1.** Map showing the primary study site, Puerto Grande on the right and another shark nursery on the left. The boxes on the top show a magnification of the two bays. The colour scale reveals the intensity of use by the juvenile blacktip sharks and the black line encircles core areas of high use, calculated using a 50% Kernel Density Estimator (KDE) typically used in conservation focused telemetry studies.

3. Another pillar of our conservation effort was to build capacity among the local community. Throughout this study many local students volunteered during the preparation and execution of the scientific fieldwork as well as other educational events. Many became an essential part of our research team and supported the project during all activities. Likewise Park Rangers of the marine investigation department of the Galapagos National Park gained the know-how of using acoustic telemetry equipment and to use the technique for marine conservation research.

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

Local volunteers that actively participated in the investigation clearly gained the highest direct benefit from our project. They were familiarised and capacitated in almost the entire aspects of this hands-on conservation project on their home island. This included the planning of research activities, working under harsh conditions in the field in a team of scientists, volunteers and national park staff. Besides gaining valuable knowledge of how to use sophisticated research equipment and work hand in hand with the local authorities they organised events to involve the rest of the community. The inclusion of the fisheries sector into scientific research is another invaluable part of our conservation effort. Only if the local fishermen are involved directly into the work of scientists and the local authorities they may understand the nature and importance of investigation and habitat protection to the conservation of their own natural resources. The table below shows the amount of individuals of different social sectors and the Galápagos National Park Services that actively participated in research activities.

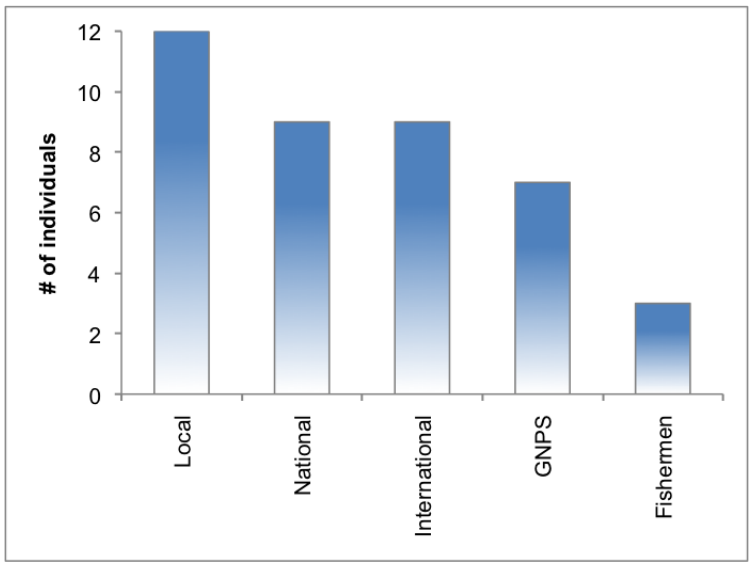


**Fig. 2.** Project participation: Local, national and international volunteers, park rangers and scientists of the Galapagos National Park (GNPS) and local fishermen.

Finally, several talks about the project and the importance of shark conservation in the Galapagos Marine Reserve were given to local undergraduate level students. Younger children participating in an educational camp of the Galapagos National Park were invited to the marine ecology laboratory of the Galapagos Science Centre, were they were taught about the project in a more hands on fashion.

In February 2013, the projects team of local and national volunteers organised the Island's first "Shark Day" as a public educational event. Mostly aimed at a younger audience, the event included

activities such as giant cardboard games, the construction of sharks with plastic recovered from local beaches and a shark-jeopardy on a large screen. All activities had the objective to make the kids embrace the importance of sharks for the health of marine ecosystems, anthropogenic threads to shark populations and what they, as Galapagos residents can do to protect their heritage.

**5. Are there any plans to continue this work?**

Both, the Galapagos National Park Services and the Charles Darwin Foundation have expressed their interest in continuing to collaborate to investigate key areas for shark conservation. Besides the valuable results we obtained through this project, there still exists a great lack of baseline knowledge about the ecology and population status of several shark species inhabiting the Galapagos Islands. So far only nursery areas of blacktip sharks could be identified, while habitats used by other species within their first life stage are still uncertain. Therefore the scientific and regulating institutions are seeking to emphasise research focussing on the population status, movements and habitat use of the most important shark species in the Galapagos. The Galapagos National Park is explicitly interested in continuing to investigate the movements of juvenile blacktip sharks on other potential nursery areas on the other islands in order to increase efficiency of a new zoning scheme in protecting the species throughout the entire Archipelago.

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

First of all, the results will be presented in an internal workshop for the Galapagos National Park Services (GNPS) in order to provide a feedback to the heads of the institution and to develop conservation strategies. As part of the Shark Conservation Plan of the GNPS the results the projects results will be incorporated into workshops for the scientific, public and fisheries sector of the Galapagos Islands throughout 2013/14.

In order to provide information to the scientific community I applied to present the results in form of a poster presentation during the III World Summit on Evolution, held on San Cristóbal Island in June 2013. Furthermore, an oral or poster presentation at the XV Latin American Congress of Marine Sciences - Colacmar is planned. Most importantly, I am currently working on a manuscript to submit for publication in the international journal *Environmental Biology of Fishes*.

Finally, the results shall continue to be presented to local students of the Galapagos Islands as part of their curriculum and in permanent posters at the local university.

**7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?**

The RSG was used over the entire study period between April 2012 and January 2013. Originally, the fieldwork was planned to last only until August 2012. Nevertheless, through the extension of research permits we were able to meet the objectives of this project and even study the movement of blacktip sharks throughout an entire year. Additionally, this permitted us to increase local participation and frequency of educational events. As a consequence, the distribution of our results through oral and poster presentations, workshops and scientific publication will be delayed by this period.

**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 |
|---|---|---|---|---|
| Material for field research (Gillnets, snorkelling gear, gloves, storage boxes, Ichtyometer, tents) | 650 | 900 | + 250 | Generally, costs for the working material was similar. Extra costs were caused by equipment maintenance and 3 small tents, which were purchased to lodge volunteers during the field trips. |
| Compact Digital Camera | 225 | 225 | 0 | |
| Digital Scale | 275 | 0 | - 275 | Provided by the Galapagos National Park. |
| Acoustic Transmitters | 2200 | 2200 | 0 | |
| Field computer for data management | 300 | 350 | +50 | |
| Interisland boat trips for equipment transportation and organisational meetings | 350 | 500 | +150 | Three additional trips to the National Park headquarters were necessary for strategic meetings and to establish a time line for the extension of research permits. |
| Seabed mapping | 2000 | 550 | - 1450 | Mapping of the seabed was accomplished based on depth measurements and substrate verification during two field trips (cost £225 each for boat rental, fuel and motor oil) combined with high resolution satellite images. Therefore I could avoid paying a specialised geographer to use sonar techniques to map seafloor and water depth. |
| Rental of small boat to track sharks | 0 | 1200 | + 1200 | |
| **Total** | | | - 75 | Some field material, several boat rentals as well as food supplies during field trips were covered by and additional smaller fund obtained from the Project Aware Foundation. |

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

To meet the projects objectives, first of all we need to communicate the results to the Galapagos authorities and scientific community to establish a conservation strategy. The results need to be included into the new zoning scheme of the Galapagos Marine Reserve with the approval of the local community. Therefore, we need to give a feedback to the supporters of the project as well as hold workshops with tourism and fisheries sectors.

Secondly, I aim at collaborating in the multi-institutional effort to investigate shark populations and key shark habitats, such as nursery areas in order to further improve conservation management in the marine reserve. Knowledge on the ecology of many species of sharks that are resident to the Galapagos still needs mayor investigation.

Finally, this effort will need to include the education of the local community through direct participation of local volunteers or through educational events.

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

Up to date, the RSGF logo has been used in presentations for local and international students, tourists and at the University Of San Francisco De Quito. In the future I am planning on using the logo on poster presentations at international symposiums and at educational facilities on the Galapagos. Furthermore, I will continue to mention the RSG as the mayor source of funding of this project and incorporate the logo in oral scientific presentations and workshops and especially written publications in scientific journals.

**11. Any other comments?**

I appreciate the focus of the Rufford Small Grants Foundation on smaller conservation projects and especially the short reviewing periods. Your funding has enabled us to even exceed our initial goals and establish a base for future conservation research. We are confident that our outcomes also meet your expectations. Thank you.