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	Camila Carvalho de Carvalho
Project title	Exploring the use of side-scan sonar to provide population estimates of Amazonian manatees in the Amanã Sustainable Development Reserve, Amazonia, Brazil
RSG reference	Ana Carolina Meirelles, João Carlos Gomes Borges and Daniel Gonzalez-Socoloske
Reporting period	August 2016 – February 2018
Amount of grant	£5000
Your email address	camila.carvalho@mamiraua.org.br
Date of this report	February 19 2018

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
Test configurations of SSS				
Create a reference SSS image bank				We were able to identify and confirm pink river dolphin images very well and some images of arapaima fish and tucuxi dolphin, but it would be helpful to obtain more images of these species for proper identification; it would also be valuable to confirm caiman images, in order to distinguish from manatee images. Clear identification of Amazonian manatee images has not yet been possible in our area due to environmental conditions and the animals' behaviour, requiring further efforts.
Partnership with SSS researchers				We established a partnership with Dr Daniel Gonzalez-Socoloske, an expert at using SSS for viewing manatees, which proved of paramount importance to the development of this project. We have also collaborated with Dr Nataly Castelblanco, who provided some images of manatees in Guianas. We are planning to establish a new partnership with MSc Diogo Souza at INPA (National Institute for Amazonian Research, in Manaus) to conduct sonar surveys in a site harbouring several semi-captive manatees, improving our capacity to identify their shape in the sonar image and document their behaviour towards the sonar and survey boat.
Bottom survey of Amanã and Castanho channels				
				After surveying the bottom, we decided to focus our efforts primarily

Survey at Amanã and Castanho channels				on Amanã lake, where manatees aggregate during the dry season, because the depth in this location was more appropriate to sonar surveys. Therefore, we did not survey Castanho channels.
Population estimates				Because we had to dedicate so much time to perfecting the experimental design, confirming manatee images and estimating an appropriate detection rate, we were unable to achieve this goal.

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

The main difficulty was to confirm manatee images in the dark waters of the Amazon. We were expecting to confirm the images during the dry season through direct observations, but it was not possible due to the cryptic nature of the species. Though we found signs of the presence of manatees (feeding vestiges and faeces), we did not observe any directly during the sonar surveys. We also tried to a detect radio tagged manatee with the sonar, but the marked animal appeared to flee from the approaching boat, potentially indicating to us that manatee behaviour in this area could also be a challenge to sonar research. Therefore, we feel the need to continue improving the methodology.

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

(i) Optimising sonar configurations and surveys: This project was instrumental to let us understand the optimal characteristics of the environment, which are required to conduct successful sonar surveys, and to optimise side-scan sonar configurations and installation for this area. With these requirements attended, it will be possible to continue side-scan surveys and apply the methodology systematically after the estimate of the detection rate and the confirmation of manatee images have been resolved.

(ii) Identifying pink river dolphin (*Inia geoffrensis*) and large vertebrate images: It was possible to identify the pink river dolphin images in the sonar and see how they differentiate from the images observed for Antillean and Florida manatees (as well as Amazonian manatees). It was also important to identify, confirm and differentiate tucuxi dolphins (*Sotalia fluviatilis*) and arapaima fish (*Arapaima gigas*) images, as they can also be of the same size as Amazonian manatees. All the images are very different from what we expect a manatee image based on studies from other areas.

(iii) Establishing new partnerships: The growing partnership with Dr Daniel Gonzalez-Socoloske was a critical outcome of this project. Daniel's experience in sonar surveys in different locations and in manatee image identification contributed a great deal to our work, and we could learn with and from him and plan new future steps.

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

Our field assistants came from local communities in Amanã Sustainable Development Reserve (ASDR) and they received a daily stipend during the fieldtrips, while they also received training in the technique. Their involvement in this project was very important because we could learn from them many characteristics of the environment that were essential to planning the experimental design in sonar research. The local people know where manatees aggregate in the dry season and where the deepest areas in the region are. It was also gratifying to see their interest in observing sonar images and many times confirm their knowledge about the lake. In addition, we tried to engage former manatee hunters in the process. The methodology consisted in a former hunter observing manatees in the deepest areas of the lake and then us passing with the sonar to confirm; unfortunately, the conditions of the lake were not appropriate to this approach at the time of the effort (*e.g.* choppy conditions), so we are planning to do in the future again.

5. Are there any plans to continue this work?

Yes, there are plans to continue this work. The use of side-scan sonar in the Amazonian waters is in its infancy, so in this project we had to start from zero in many aspects, including sonar configurations, experimental design and image recognition in a site where many other large aquatic vertebrates are present. So, after concluding these first steps (many goals were reached with this project), we plan to design a systematic survey to be applied every year and give us the possibility of monitoring the population and provide a population estimate, which is the final aim of the sonar research. By using the sonar in the semi-captivity area with the known number of manatees present near Manaus, we hope to zero in the capacity to detect manatees more accurately.

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

We plan to share our results publishing a paper on pink river dolphin sonar images, with detailed descriptions and explaining how those images differentiate from manatee images. We shall also complete bottom surveys of the Amanã Lake to share the information with Mamirauá Institute researchers from diverse areas of interest. We also plan to present results in the Sirenian Symposium at the Workshop on Aquatic Mammals in Latin America (Lima, Peru, 5th-8th November 2018) so we can discuss with other sonar researchers about the images we get and about our surveys.

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 grant was executed from August 2016 until December 2017, 6 months beyond we had originally planned. We chose to extend it because in 2016 the water level did not drop as much as expected, whereas the best period to conduct sonar research in ASDR is the dry season (end of the year). Therefore, we decided to make another trial in 2017. In addition, we established a partnership with Dr Daniel

Gonzalez-Socoloske, after contacting him to be our reference, and he proposed to (and did) help us in our sonar field seasons in Brazil in July and December 2017.

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
Side scan sonar Hummingbird Helix number 9	1,000	769	231	We were able to purchase the equipment in the US and bring it to Brazil, therefore avoiding shipping and import taxes.
Fuel (gasoline for 15 and 60 HP boats, transportation in field)	1,534	2,014	-480	As we added an extra season in our project, it was necessary to buy more fuel than originally planned.
Maintenance (repair of boats)	396		396	The boat repairs were paid for by another grant, which allowed us to save money for another fieldtrip in December.
Food for team in the field	990	576	-414	The field time was reduced in relation to the estimate in the project and it was possible to join the field efforts of this project with other projects of our research group, thus sharing the food.
Supplies(12 V batteries, ropes, field material)	300	96	-204	Some supplies were paid for by another grant.
Large boat daily taxes	780		780	We did not need the large boat to do our experimental design in this step of the project.
Field assistant		1,169	-1,169	Due to the country´s economic crisis, our research group lost hired field assistants, but that help was necessary to operate the speed boat and help with sonar surveys.
Bank taxes		91	-91	These had not been taken into account at the beginning.
Sonar Viewer and Reefmaster software		191	-191	We realized that these software were better than Humviewer to

				sonar image analysis.
Accommodation for Dr Daniel Gonzalez-Socoloske		80	80	As Dr Daniel Gonzalez-Socoloske came to Brazil with his own resources, we helped with the accommodation in the city of Tefé the day before and after we went to the field.
100 GB on Google Drive		16	-16	It was required to share the sonar images with other researchers, especially Dr Daniel Gonzalez-Socoloske.
Total	5,000	5,000		

Budget was estimated in Real (Brazilian currency) and calculated in Sterling pounds at the rate of 1 S = R$ 4,42, according to the exchange rate of the date that the grant was received.

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

The crucial next step is to confirm Amazonian manatee images. We intend to do side-scan sonar surveys in an area of semi-captivity that contains a known number of rehabilitated manatees near Manaus, which is under the responsibility of INPA (National Institute of Amazonian Research). We are currently in touch with MSc Diogo Souza, the principal researcher in that project, to discuss this possibility.

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?

No, we did not produce any material but we publicized the project in:
Mamirauá Institute website (https://www.mamiraua.org.br/pt-br/comunicacao/noticias/2018/2/6/instituto-mamiraua-utiliza-sonar-para-estimar-abundancia-de-peixes-boi-amazonico/), which was replicated in

Brasilien Portal http://www.brasilienportal.ch/news/brasilien-news/71695-brasilianische-forscher-mit-echolot-amazonas-manatis-auf-der-spur/

Espaço Ecológico no Ar http://espacoecologiconoar.com.br/pesquisadores-testam-sonar-na-amazonia-para-encontrar-peixes-bois/

Revista Ecológico http://www.revistaecologico.com.br/noticia.php?id=5261

Rádio Web News http://radiowebcoopnews.com.br/variedades/instituto-mamiraua-utiliza-sonar-para-estimar-abundancia-de-peixes-boi-amazonico/

Mundo Geo http://mundogeo.com/blog/2018/02/06/pesquisadores-usam-sonar-para-estimar-numero-de-peixes-boi-na-amazonia/

O Eco http://www.oeco.org.br/noticias/pesquisadores-testam-sonar-na-amazonia-para-encontrar-peixes-bois/

Portal MCTIC
http://www.mctic.gov.br/mctic/opencms/salaImprensa/noticias/arquivos/2018/02/Mamiraua_utiliza_sonar_para_estimar_abundancia_de_peixesboi_amazonico.html and we publicised in a local radio Rádio Rural de Tefé, which went on the air on February 12th 2018.

11. Any other comments?

Estimating manatee abundance is one of the main questions in manatee research and conservation, and given the animal's reclusive and shy nature, this may be one of our best shots at approaching some population estimate, at least for some specific sites (which might then be replicated in other areas in Amazonia). We have been working with the idea and taking some baby steps towards that goal and the use of SSS for several years now, and Rufford´s support has been fundamental helping us make some significant advances and plan practical future steps that can bring us closer to our goal, so we extend our warmest thanks to your support.