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	Carla Roberta Gonçalves Reis
Project title	Impacts of anthropogenic fertilization on nitrogen dynamics in fringe and basin mangrove forests in the Estuarine-Lagunar Complex of Cananeia-Iguape, Brazil
RSG reference	20243-1
Reporting period	30th August 2016 – 30th August 2017
Amount of grant	£3282
Your email address	carlargreis@hotmail.com
Date of this report	30th 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
Evaluate biological nitrogen fixation rates in sediment and leaf litter in conserved mangroves and those mangroves subjected to anthropogenic fertilization in the ELC of Cananeia-Iguape, Brazil				
Evaluate net rates of nitrogen mineralization and nitrification in sediment of conserved mangroves and those mangroves subjected to anthropogenic fertilization in the ELC of Cananeia-Iguape, Brazil				
Evaluate the natural abundance of nitrogen stable isotopes ($\delta^{15}N$) in the sediment-plant-leaf litter system in conserved mangroves and those mangroves subjected to anthropogenic fertilization in the ELC of Cananeia-Iguape, Brazil				
Evaluate impacts of anthropogenic fertilization on nitrogen dynamics in mangroves of the ELC of Cananeia-Iguape, Brazil				During the study, we realised that another measurement – the natural abundance of nitrogen stable isotopes ($\delta^{15}N$) of ammonium and nitrate in estuarine water (i.e., the $\delta^{15}N$ signature of nitrogen sources for the studied mangroves) would be essential to achieve this goal. These analyses are currently being carried out.
Evaluate the use of the natural abundance of nitrogen stable isotopes ($\delta^{15}N$) in leaf samples as a monitoring tool to indicate impacts on nitrogen dynamics in mangroves				During the study, we realised that another measurement – the natural abundance of nitrogen stable isotopes ($\delta^{15}N$) of ammonium and nitrate in

				estuarine water (i.e., the $\delta^{15}N$ signature of nitrogen sources for the studied mangroves) would be essential to achieve this goal. These analyses are currently being carried out.

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

During the study, we realized that an unforeseen analysis – the $\delta^{15}N$ of ammonium and nitrate in estuarine water – would be central for the adequate interpretation of the $\delta^{15}N$ in the sediment-plant-litter system results. These analyses are not trivial, of high cost, and are carried out only in few laboratories worldwide. We established a new collaboration with the researcher Sasha Carey Reed (U.S. Geological Survey), who is partially funding these analyses. We managed to run the $\delta^{15}N$ of nitrate in the Stable Isotope Ratio Facility for Environmental Research of the University of Utah, and these analyses are currently being carried out. We are also in negotiation to run the $\delta^{15}N$ of ammonium in the Reston Stable Isotope Laboratory of the U.S. Geological Survey.

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

1) We concluded that nitrogen fertilisation is not affecting the biological nitrogen fixation rates in sediment and leaf litter in mangroves in the ELC of Cananeia-Iguape. We are still evaluating the results, but our current interpretation indicates that the excess of nitrogen that reaches mangroves via pollution is quickly lost to the atmosphere. This has important implications regarding the role of mangroves on local air quality and global warming because intensified nitrogen losses to the atmosphere usually result in higher losses of NO, which is an air pollutant, and of N_2O, one of the main greenhouse gases.

2) Measurements of nitrogen concentrations in estuarine water, sediment, and vegetation were not good indicators of nitrogen availability and dynamics in the studied mangroves. This is an important result since most of the decisions on environmental management regarding eutrophication of aquatic/marine systems rely on this type of measurement.

3) Instead, the $\delta^{15}N$ in the sediment-plant system proved to be closely related to anthropogenic nitrogen fertilization, suggesting this is a much better indicator in this system. However, the detailed interpretation of how nitrogen fertilisation affects nitrogen dynamics in mangroves, and of how leaf $\delta^{15}N$ can be used as a monitoring tool of N fertilisation in mangroves are yet to be done, once we receive the $\delta^{15}N$ in estuarine water results.

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

There were no specific immediate benefits for local communities from this project. However, a collective effort that has been carried out for more than 10 years by researchers and other actors in society to promote the recovery of mangrove areas in the Iguape region, in which we include the present study, has led to a judicial decision on 14th August of 2017 wherein the Sao Paulo State Government has 180 days to close the Valo Grande and also to deal with all environmental damage caused by the Valo Grande in the Iguape region. This ruling has important implications for local communities in the Iguape region because mangrove recovery can improve fisheries and tourism in the region, which are their main livelihood.

5. Are there any plans to continue this work?

Yes, after this study is concluded, we will identify the main questions that need to be addressed and delineate a new research proposal to move forward with increasing our knowledge of mangrove functioning for their conservation and management. We are also looking forward to the possibility of studying the recovery of mangrove ecosystems in the Iguape region.

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

We are currently working on a manuscript which we intend to submit this year to an international peer-reviewed scientific journal with an impact factor that suggests many will access the research results. We also intend to present this study in the upcoming Mangrove and Macrobenthos Meeting to be held in Singapore in 2018. Technical reports will also be provided for environmental agencies in Brazil.

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

All resources from the grant were used for fieldwork from October 2016 to April 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
Car fuel	107	181	74	Difference due to the difference in the exchange rate at the time of application (1.00 £ = 5.03 R$) and at the time the grant was received (1.00£ = 3.93 R$). Also,

				we expected to use only one car to transport people and materials to the field, but two cars were required, which increased the car fuel expenses
Toll roads fees	19	45	25	Difference due to the difference in the exchange rate at the time of application (1.00 £ = 5.03 R$) and at the time the grant was received (1.00 £ = 3.93 R$). Also, we expected to use only one car to transport people and materials to the field, but two cars were required, which increased the toll fees expenses
Accommodation in Cananeia municipality, Sao Paulo State, Brazil	572	697	125	Difference due to the difference in the exchange rate at the time of application (1.00 £ = 5.03 R$) and at the time the grant was received (1.00 £ = 3.93 R$)
Accommodation in Iguape municipality, Sao Paulo State, Brazil	667	813	145	Difference due to the difference in the exchange rate at the time of application (1.00 £ = 5.03 R$) and at the time the grant was received (1.00 £ = 3.93 R$)
Food during fieldwork	1,430	1,343	87	-
Boat rental	135	204	68	Difference due to the difference in the exchange rate at the time of application (1.00 £ = 5.03 R$) and at the time the grant was received (1.00 £ = 3.93 R$). Also, given adverse climate conditions during fieldwork, we had to rent a boat for an extra half day to accomplish fieldwork
11 Polyethylene bottles of 2,000 ml	53	0	53	We opted not to purchase this item to cover the extra fieldwork expenses
12 high-density polyethylene bottles of 1,000 ml	19	0	19	We opted not to purchase this item to cover the extra fieldwork expenses
12 high-density polyethylene bottles of 125 ml	10	0	10	We opted not to purchase this item to cover the extra fieldwork expenses
Whatman GF\F 150 mm filters	268	0	268	We opted not to purchase this item to cover the extra fieldwork expenses
Total	3,282	3,282	0	

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

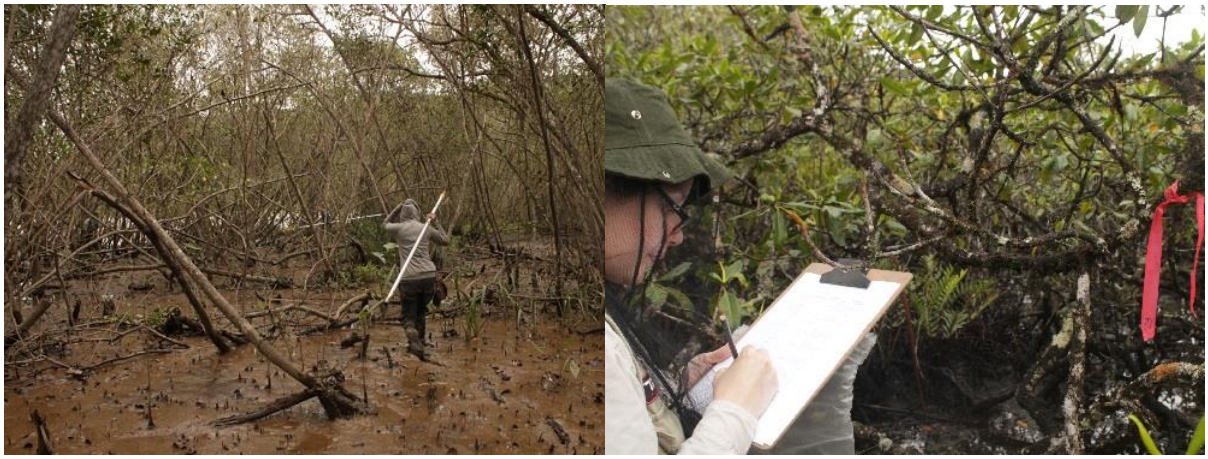
We feel that it is important to expand the spatial and temporal scales of our study to increase our knowledge about mangroves functioning and our capacity to make generalisations that will apply for larger mangrove areas. Once we gain sufficient knowledge regarding the consequences of nitrogen fertilisation on mangroves, we also feel that we should start exploring the interactions between nitrogen, phosphorous, and carbon cycles in mangroves in the contexts of global warming and nutrient enrichment. In particular, assessing how these drivers of change will affect carbon fluxes and stocks in mangrove sediment. Mangrove areas in the Iguape region are also subjected to the invasion of aquatic macrophytes and the African grass *Brachiaria*. Because biological invasions can potentially affect nutrient and carbon cycling in ecosystems, we feel that this is also an important subject to be investigated.

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?

Not yet, but the financial support by The Rufford Foundation will be properly described in the published paper, as well as in any future presentations, technical reports, and any other kind of communication.

11. Any other comments?

We would be more than happy to keep The Rufford Foundation apprised of any publications and presentations in the near future that result from this study. We also would like to thank The Rufford Foundation for the opportunity and for their trust. We hope that in the not too distant future we will be able to work in collaboration on new research for the benefit of mangroves and society.



Left: Fieldwork at conserved basin mangrove in Cananéia Island. Right: Fieldwork at impacted fringe mangrove in Iguape region.