Final Evaluation Report

Your Details	
Full Name	Maria Alejandra Camargo Vargas
Project Title	Understanding the impact of tropical cyclones on mangrove forests, adjacent seagrass beds and the nutrition of green turtles: the case of two Fijian islands.
Application ID	28712-1
Grant Amount	£6000
Email Address	maacamargova@unal.edu.co
Date of this Report	January 30th 2022

1. 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
To assess how the content of nutrients and organic matter in soils of terrestrial forests in the hinterland of mangroves and sediments from mangroves and seagrass beds, is related to the loss of mangrove forest in Makogai Island due to tropical cyclone Winston in 2016				Given the unexpected circumstances found at the one of the study sites, this objective was shifted to the following: -To assess how the mangrove extent influences the physico-chemical conditions of the water column (i.e., dissolved inorganic nutrients) and the sediments (i.e., dissolved inorganic nutrients, organic matter content and grain size distribution) of adjacent seagrass beds. -To assess to what extent those conditions affect the development of seagrass communities (i.e., seagrass coverage). These objectives were fully achieved having as study site only one of the two initially planned islands (Yadua Island).
To assess how the influence of mangrove loss on seagrass beds in Makogai Island is translated into the nutrition of the endangered green turtle (Chelonia mydas) foraging on such seagrass blades.				This objective was also shifted to the following: -To evaluate potential site fidelities of green turtles based on discrepancies in the conditions of their main dietary source (seagrass blades). Unfortunately, this objective was not achieved, given that it was not possible to export animal material from Fiji to Germany. This was due to several temporal restrictions and long-processing permit requirements at that time as a consequence of the pandemic situation.

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

The major unforeseen difficulty was the occurrence of a natural phenomenon (underwater volcano eruption) nearby one of the study sites, which completely hampered the original project objectives. However, the 'new' project maintained the initial purpose of evaluating the interconnectedness of mangrove and seagrass

ecosystems. The project was successfully developed having as study site only Yadua Island. It specifically addressed the question: Does the mangrove extent have an effect on the physico-chemical (i.e., sediments and water column nutrient content, and sediment organic matter and grain size distribution) and biological (i.e., seagrass coverage) conditions of adjacent seagrass beds?

On the other hand, the worldwide sanitary emergency due to the Covid-19 pandemic, significantly delayed the last steps of the project (i.e., samples exportation and analysis). This also did not make possible the exportation of animal material from Fiji to Germany, which did not allow the analysis of the green turtle faecal samples.

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

This work represents – to our knowledge – the first comprehensive study on the biogeochemical interactions among terrestrial, mangrove and adjacent seagrass ecosystems, under natural conditions.

- The mangrove extent was proved to play a significant direct role in maintaining low water column nutrient concentrations (i.e., nitrate and ammonia), which is one of the essential habitat conditions that adjacent seagrass communities require to thrive. This is of particular interest given that showcases the filter function of mangroves from carbonate-dominated environments, which has mostly been acknowledged from terrigenous and especially deltaic mangrove systems.

- Seagrass communities beneficiate indirectly from the extent of mangrove patches when they occur in close proximity, as they take advantage of the water column chemical characteristics that are directly influenced by the mangrove extent. In this sense, mangrove ecosystems should be taken into consideration when designing conservation strategies in favour of seagrass beds occurring nearby them.

- Seagrass sediments were predominantly dominated by sand, which was the main driver for the differences between seagrass and both terrestrial and mangrove habitat sediments. Moreover, terrestrial forest sediments were mostly composed by sand in sites where mangroves were naturally absent. This pattern suggests that there is some sediment input coming from the sea landwards that would otherwise remain in the mangroves. Therefore, mangroves were found not to act as coastal buffers from terrestrial sediment loads, instead, they seemed to be playing a role in shoreline protection by means of effective sediment deposition processes, which also may help them to cope with the sea-level rise on this oceanic island.

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

Yadua Island is inhabited by ~200 indigenous people, who exclusively rely on fishing and small-scale farming to sustain themselves. Besides a green turtle and seagrass

monitoring project, which is being carried out in Yadua since 2014, this project was the very first to study mangrove ecosystems on this island. This project was initially introduced to the village chief and the community members. Moreover, two community members who are students at the University of the South Pacific were chosen as fieldwork assistants, and other islanders were eager to support project activities and data collection throughout the fieldwork campaigns. In fact, the fieldwork would have not been successfully accomplished without the help of the local community from Yadua Island. On one hand, the budget allocated to the fieldwork assistants' allowance certainly contributed to local capacity building. On the other hand, I would dare to say that this experience and all what I could teach them about mangroves and their importance for adjacent ecosystems and marine species has encouraged them to protect and sustainably use the mangrove timber resources they usually extract.

5. Are there any plans to continue this work?

As I mentioned above, the green turtles' faecal samples were not exported to Germany, due to pandemic-related restrictions. This is certainly a potential opportunity to continue this work, which is being discussed. The idea is to analyse those samples by means of stable isotopes or GC/MS techniques, to explore the green turtles' trophic dynamics and how this species is interlinked to mangroves as mediators of food resources, and how this affects the food choice based on seagrass chemical characteristics.

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

This project led to the production of the M.Sc. Thesis entitled: The role of the mangrove extent in the conditions of adjacent seagrass beds: The case of a remote Fijian island. The thesis was successfully defended last 16th December 2021 in front of an academic auditorium, including some project-local members. Throughout 2022, I will participate and present it at some academic conferences (ICYMARE in Germany, and SENALMAR in Colombia). Additionally, I am currently preparing two manuscripts to submit for publication in indexed scientific journals.

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

The grant was used according to the anticipated length of the project (fieldwork phase in Fiji from November 2019 to April 2020). The project, however, was extended until December 2021, due to some pandemic-related circumstances that delayed the sample analyses which were performed in Germany.

8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion. Local exchange rates used: 1 EUR = 0.869 GBP, 1 EUR = 2.420 FJD

Item	Budgeted Amount	Actual Amount	Difference	Comments
Local travel (Suva, Fiji)	74	74		
Local travel to Yadua Island	178	210	+32	Sub-estimated in budgeted amount.
Boat expenditures on Yadua Island	666	700	+34	Sub-estimated in budgeted amount.
Travel expenditures Makogai Island	973	200	-773	Makogai island was taken out from the sampling design, thus only one fieldwork campaign expenses were required.
Food expenditures	888	600	-288	Over-estimated in budgeted amount.
Lodging	444	345	-99	Due to change in number of fieldwork campaigns per island.
Subsistence payment for local team at Yadua Island	800	600	-200	Over-estimated in budgeted amount.
Subsistence payment for local team at Makogai Island	800	400	-400	Due to change in number of fieldwork campaigns per island. Only one fieldtrip was carried out to Makogai island.
Traditional protocol (sevusevu)	52	52		
Materials and supplies 1 (green turtle faeces sampling)	111	64	-47	Over-estimated in budgeted amount.
Materials and supplies 2 (sediment, water and leaf sampling)	214	1240	+1026	Increased due to water samples analyses (nutrient content) carried out in Fiji. Water samples were supposed to be exported to Germany to be analysed within a month after collection. This was not possible due to the pandemic, so that such analyses were done in Fiji.
Management overhead costs	800	876	+76	Due to extra fees when withdrawing funds from ATMs in Fiji.

TOTAL	**6000**	**5361**	**-639**	Remaining funds returned to The Rufford Foundation

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

Having proved the imperative role of mangroves in maintaining suitable conditions for seagrass species (e.g., water quality), it is urgent to call for the rehabilitation of mangrove stands as an active restoration strategy for tropical seagrasses that occur in close proximity to mangrove ecosystems. Particularly, mangroves that have been lost due to natural phenomena such as tropical cyclones, which brings detrimental effects to seagrass beds that sustain the green turtle population foraging in Fijian waters. Considering the very few studies that have actually evaluated the influence of mangroves on seagrass communities on oceanic islands, the next important step is to disseminate these results as much as possible to the academic as well as non-academic community (especially in Fiji) for this information to be used in the local conservation agenda.

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

The logo was used on the project proposal presentation done at the University of the South Pacific previous to the outset of fieldwork activities. Additionally, all subsequent presentations (i.e., thesis progress seminar at the University of Bremen and thesis defence at the Leibniz Centre for Tropical Marine Research) also displayed the Foundation logo in the acknowledgements section.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Martin Zimmer & Véronique Helfer: Project supervisors. They provided valuable scientific and academic support throughout all phases of the project.

Susanna Piovano: Local supervisor. She supported the fieldwork and laboratory phase in Fiji, from logistics to scientific advice.

Shritika Prakash: Project assistant. She helped with all kinds of project-related tasks including logistics and fieldwork activities. She provided significant help to coordinate fieldwork campaigns.

Malakai Tuiono: Fieldwork assistant. He tirelessly helped with all kinds of project-related activities. His support in the field was fundamental for this project to having been successfully accomplished.

Pita Qarau: Local assistant. He was in charge of the boat transfers to and from sites, as well as on the island during fieldwork. He provided valuable geographical knowledge to identify and select the appropriate study sites.

12. Any other comments?

Despite all the ups and downs throughout the project execution, this was undoubtedly quite an enriching experience for me to learn how things work in the real world, and how to face and overcome difficulties when you are the one responsible for making all decisions. I am profoundly grateful to The Rufford Foundation for making this all possible. It certainly plays an imperative role in building up essential attributes and values for early career scientists and conservationists wishing to contribute to the understanding and protection of nature.