

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	Justin Baumann
Project title	Continuing research on coral acclimation on the Belize Mesoamerican Barrier Reef System
RSG reference	20837
Reporting period	Nov 2016- Dec 2017 (weather related extension granted)
Amount of grant	£10,000
Your email address	baumannj@live.unc.edu, j.baumann3@gmail.com
Date of this report	Dec 21, 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
<p>Collect 6 colonies of 2 species of coral from 3 sites with different thermal regimes (as defined by previous Rufford funded research)</p>				<p>My Rufford Booster Grant proposal was submitted to collect whole coral colonies and transport them back to my lab to conduct controlled tank experiments. This is a natural follow-up to my previous work that would have allowed me to test acclimation ability under given conditions by isolating certain variables.</p> <p>However, Belize has recently restructured its Fisheries Department and thus the regulations have changed. The export of live coral is no longer permitted.</p> <p>However, the Belize Fisheries Department proposed that I work with a local NGO and do a transplant experiment in-situ instead of taking corals out of the country. I agreed and have built a strong collaboration as a result. The following objectives are modified to demonstrate the successes resulting from this change of plans.</p>
<p>Collect and fragments 6 colonies of 2 species of coral from nearshore and offshore reefs</p>				<p>We have been working with two species of coral for several years now. The massive starlet coral (<i>Siderea siderea</i>) and the symmetrical brain coral (<i>Pseudodiploria strigosa</i>). These two species of coral are abundant and important reef-builders and are also relatively stress tolerant. Previous work has shown that they can tolerate warmer and more variable near shore reefs and that this tolerance is likely not attributed to the changing symbiont communities. Follow up work has shown us that the growth rates of these species at near shore reefs are elevated relative to those at offshore</p>

			<p>reefs, but that the growth rates on near shore reefs are declining while growth rates are stable on offshore reefs.</p> <p>We became curious as to what the mechanisms for these trends are and if it is possible that near shore corals have acclimatized or adapted to local conditions. It appears that local conditions have recently worsened on near shore reefs leading to a decline in growth rate. We are interested in understanding if corals from the near shore can: a.) grow faster; and b.) show a stable growth trend on offshore reefs than corals from offshore reefs. As such, we collected six colonies of <i>S. siderea</i> and <i>P. strigosa</i> from on offshore and one nearshore reef. We then fragmented each colony into 13 pieces. Six of these pieces were transplanted to the home reef (either inshore or offshore) and six were transplanted to the other reef site (either offshore or inshore). One piece of each colony was flash frozen for further physiological analysis in the lab. These pieces will serve as time 0 controls.</p> <p>I will need to go back after 3, 6, and 12 months to weigh and collect additional corals for time point measurements.</p>
<p>Establish a collaboration with a local NGO</p>			<p>Thanks to a restructuring of fisheries regulations, I began a collaboration with a Belize based coral restoration NGO called <i>Fragments of Hope</i> (FoH). FoH trains local guides and fisherfolk in coral restoration work. Offering them new jobs and skills that are aimed at protecting and preserving the reef instead of exploiting it. Recently, FoH won a UN Climate Change Secretariats Women4Results Lighthouse award and were recognised at the COP23 meeting in Fiji. FoH focuses on protecting and replanting endangered Acroporid</p>

			<p>corals (elkhorn and staghorn). They build restoration tables at various sites throughout Belize and garden corals on the tables until they are large enough to plant out. These tables were perfect for our transplant experiment as we needed a substrate to attach our transplants to. FoH allowed us to use a few of their tables and even built a new one for our purposes at a new site. This build was funded by this Rufford grant and will allow FoH to expand their restoration work. We were able to work together on this project and some of my materials, including a large and reliable tile saw, the likes of which is generally hard to come by in Belize, were donated to FoH upon completion of the transplants so that they can expand their restoration work to include new species that they previously could not section. Through this collaboration we have been able to learn a lot about local knowledge of the Belize barrier reef system and work with dedicated conservationists who have spent their entire lives relying on and trying to preserve this ecosystem. The lessons have been invaluable and the collaboration is a strong one that we hope to continue into the future.</p>
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2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Our biggest difficulties were 1.) New regulations preventing export of live coral from Belize and 2.) Weather.

New regulations prevented us from exporting live coral to conduct tank experiments. However, after talking with authorities at Belize Fisheries Department I was able to make contact with a *Fragments of Hope*, a local NGO. I proposed an alternative project to FoH and they agreed to collaborate on it. As a result, instead of doing tank experiments we began a reciprocal transplant experiment. Corals were moved from offshore to nearshore and from nearshore to offshore to assess how they respond to new or different environmental conditions. If responses are similar between home and new reefs then we may have data to suggest

adaptation has occurred. If response are plastic across space we have evidence of plasticity or acclimatisation. This project is set to continue for the next 12 months, with collection time points at 3, 6, and 12 months from now.

Weather delayed our trip on two occasions. First, the Caribbean hurricane season was very tough this year, so we decided to move our trip from October to November. Following discussions with FoH we learned that hurricane conditions were probable in November, so the trip was delayed until December. A gracious extension was granted by Rufford allowing us to continue our work. Our December project was successful and we are excited to continue our work into the New Year.

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

- 1.) Established a new collaboration with a local conservation NGO
 - a. *Fragments of Hope* (FoH) agreed to collaborate with me on a reciprocal transplant experiment designed to understand differences in growth and physiological responses in two species of thermally tolerant corals. This collaboration made our work possible and also sets the stage for future collaboration with FoH all aimed at understanding coral resilience to stress, how future reefs may function, and how to best preserve and protect coral reef resources into the future.
- 2.) Successfully began a reciprocal transplant experiment
 - a. See above for additional details. We collected six colonies of two species of coral from two sites (near shore and offshore). Each colony was fragmented into 13 pieces. One piece was frozen as a time 0 control, six pieces stayed on the home reef, and six were transplanted to the opposite reef (either offshore or near shore).
- 3.) Collected time 0 control samples for comparison to future time point collections.
 - a. One piece of each collected colony was frozen and transported back to UNC for further analysis. I will analyse the chl-a, concentration of symbionts, protein, lipid, and carbohydrates concentrations of these fragments. All of these analyses will serve as time 0 baselines for comparison to future time point collections. This will allow us to track the responses of these corals over time.

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

Part of our research goal is to work directly with local communities. Collaborating with *Fragments of Hope* allowed us to do just that. We worked with a local boat operator and captain during our research and we also worked with two community researchers trained in diving and coral restoration. All of these folks were integral parts of our research team. We learned a lot about local reefs that we had never been to and about how coral restoration is working in Belize. We also discussed local

and national level conservation issues such as rising tourism and increased cruise traffic.

Additionally, we bought all of our food and gear that we did not bring with us from small, locally owned businesses and stayed in a locally owned guest house. We also spent some time in the morning or evening each day talking with locals about our work and the work of *Fragments of Hope*. In the past our trips have been a bit of a whirlwind as we needed to go to 10+ sites all across the country in 2 weeks. However, this time we spent 10 days in the same guest house and in the same town so we were able to get to know some locals and really talk with them about what we were doing. We are confident that awareness of coral restoration and of the status of the Belize barrier reef was communicated. We are also hopeful that we provided some economic stimulus to the town during our trip.

5. Are there any plans to continue this work?

There are concrete plans to continue this work. Based on availability of funding we are planning to go back to our sites to weigh all of our corals and collect one piece of each colony in March/April 2018, July 2018, and November/December 2018.

These three time points are essential in understanding the response and rate of responses of our coral species to new environmental conditions.

I am applying for a second booster grant through the Rufford Foundation and will seek complementary funding from the PADI foundation and others.

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

A professional photographer and videographer joined me on this research trip to document it and to help with the field work. She is employed by my university (UNC Chapel Hill) and has committed to writing a news story and editing a video about this work for UNC. She is also planning to pitch a story on this work to *Hakai Magazine*. Additionally, this work has already been shared on social media through UNC Research, *Fragments of Hope*, Mary Lide Paker, and myself (Facebook, Twitter, and Instagram). We live blogged about our trip and some of our experiences. I have also committed to writing a story for the online magazine *Got Science?*

Additionally, I plan to write a blog post on my own marine science blog, UNdertheCblog about this experiment. I am also collaborating with *Science Over Everything* to produce a short instructional video on coral reefs for use in K-12 classrooms. The video was partially filmed during this experiment in the field. I am also planning to present this work during my PhD defence in Spring 2018 which will be a public lecture. I will be presenting this research at one or two conferences in 2018 and have already shared my Rufford funded work 10+ times in academic setting, including two published papers. A publication will result from this work after its completion, expected date Spring 2019.

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

I received the Rufford Booster Grant in November 2016. From November 2016-October 2017 I used the grant to purchase some necessary equipment and to book flights and lodging. The bulk of the grant (about 2/3) was used in November and December 2017 to pay for lodging, food, boats, tanks, and local research assistants.

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. 1 £ sterling = \$1.34 USD - \$1 USD= \$1 Belize Dollars

Item	Budgeted Amount	Actual Amount	Difference	Comments
Flights for 3	1700	1700	0	
Lodging	1100	1100	0	
Salary for 2 community researchers	200	447	247	We actually had 2 or 3 community researchers each day depending on need. We increased the rate for our researchers based on experience.
Annual dive gear servicing	150	200	50	Had a broken SCUBA regulator that needed a part
In-country transport	200	329	129	Rates were higher than anticipated
Tank rental	150	75	-75	Needed fewer tanks than planned
Boat Rental+ captain+ gas	8000	3250	-4750	Needed fewer research days and travelled shorter distances than originally planned
Purchased Gear (tile saw, zip ties, super glue)	0	899	899	We had a tile saw and super glue in the lab before this trip but the saw was not suitable for the work and the glue did not dry fast enough when wet. As a result, we had to buy a more powerful saw and new glue that was more specific to our needs.
Food (for my team and our local assistants, captains, and collaborators)	800	2000	1200	Food costs were higher because we agreed to cover food for our assistants while they were on the job.

Total	12,300	10000	-2300	*NOTE: original budget included funds from a different grant that I applied for. I did not receive this grant so everything was funded directly by The Rufford Foundation.
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9. Looking ahead, what do you feel are the important next steps?

The next step of this project is to return to the sites in 3, 6, and 12 months to weigh all of the corals and collect one piece of each colony for further analysis. Concurrently, I will be analysing all of the Time 0 control fragments that were just collected.

After each time point the collected fragments will be analysed and growth rates, symbiont density, chlorophyll a, and a suite of other physiological parameters will be compared between time points to determine the responses of each colony to environmental change.

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?

I attended an RSG conference in November 2017 during which I presented my previous RSG funded work and used the RSG logo. I also presented at an educator conference in Raleigh, NC in October to a room of ~500 conference attendees. During this presentation I talked about non-governmental funding including RSG and used the logo. I often email with perspective RSG applicants and I use the RSG logo on the acknowledgments slide of every talk I give. Lastly, I mention RSG as a funding source in all of my publications of which there are currently two from this project. A third publication is under review at this time.

11. Any other comments?

I enjoyed the November RSG conference in Belize and would love to attend future conferences. As always, my team and I are grateful for your continued support and your flexibility regarding travel dates and weather delays. We are looking forward to applying for a second booster grant.

