Final Evaluation Report

Your Details	
Full Name	Justin H Baumann
Project Title	Continuing research on coral acclimatization on the Belize Mesoamerican Barrier Reef System
Application ID	24771-D
Grant Amount	£10,000
Email Address	j.baumann3@gmail.com
Date of this Report	Nov 5, 2018

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
Begin reciprocal transplant experiment				Successfully completed in partnership with Fragments of Hope LTD (completed with previous Rufford funding)
Collect coral buoyant weights, surface area, energy reserves, and symbiont density at beginning of experiment				Successfully completed in partnership with Fragments of Hope LTD (completed with previous Rufford funding).
Repeat all measurements after 3 months (March)				Successfully completed in partnership with Fragments of Hope LTD
Repeat all measurements after 6-9 months (June-October)				Successfully completed in partnership with Fragments of Hope LTD in October 2018
Repeat all measurements after 1 year				We will not be able to go back in December 2018 for the 1-year time point due to lack of funding but hope to collect this last time point in early 2019.
Coral Heat Ramps to track thermal tolerance				This side experiment was removed from the project plan as we lacked the resources to fund the required instruments

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

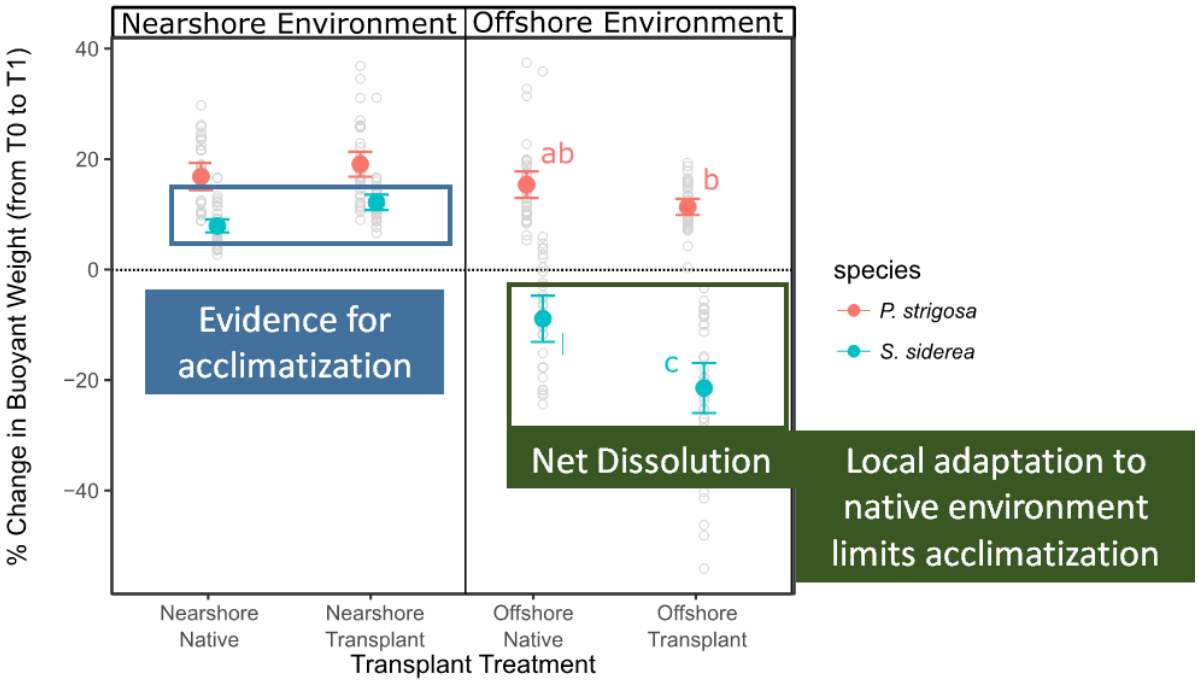
Overall the project was a huge success! We were able to establish a strong collaboration with Fragments of Hope LTD, a coral restoration NGO based in Placencia, Belize. Storms limited our diving and work days on more than one trip but we were able to get all of our sampling and monitoring done in spite of poor conditions. Our only setbacks were not being able to complete our stretch goal of doing thermal tolerance incubations (we couldn't afford the equipment as other grant applications fell through) and we have not yet recorded our 1-year time point data yet (the experiment has not been running for a year yet and we are still seeking funding to sample in early 2019)

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

1. Established a working partnership with Fragments of Hope LTD to ensure future collaborative research and knowledge sharing that will benefit both parties and the country of Belize through science based coral restoration techniques

2. We found that corals living in nearshore areas, which are more impacted by land-based stress and are not protected areas actually grow faster than offshore corals of the same species. We are currently investigating causes for this, but our results, coupled with results from our previous work (funded by Rufford) indicate strongly that nearshore coral reefs warrant protective status.

3. We have found evidence that both species of coral exhibit a degree of thermal acclimatisation, meaning that when conditions change (to get hotter, for example) these corals have at least some genetic capacity to become accustomed to this change over their lifetime. This indicates that these two species may be able to alter their physiological response to their environment in order to keep up with warming, at least in the short term. This may buy these corals time for us to reduce global emissions, preventing these species from being lost.



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

Every step of this research has been carried out through direct partnership of local community members and organisations. Our transport was arranged with locally owned transfer service Roam Belize. We stayed in local Maya operated lodging (Sea View Suites) and purchased food or meals from local grocers and independent

restaurants. In addition to this, our work was approved and permitted by the Belize Fisheries Department, who worked with me to produce CITES international export permits and local research permits. Most importantly, we partnered with Fragments of Hope LTD, a local coral restoration NGO to complete our work. Corals were harvested, fragmented, and transplanted using techniques that we had learned from our previous work as well as techniques perfected for Fragments of Hope in the field. Fragments of Hope provides alternative labour and careers to locals in Placenica Belize who would otherwise be fishers or tour guides, thereby educating locals on the benefits of sustainability and conservation and helping to transition the local economy to a more sustainable model. Fragments of Hope has helped get several important local reefs protected status and has restored hectares of endangered coral, bringing back thriving fish and shellfish communities that will help the local economy for years to come. Each day of our research we hired a boat captain and a community researcher trained through Fragments of Hope to aide us in our work. We also purchased diving gear (tanks, weights) through a locally owned dive shop. Lastly, we partnered with Southern Environmental Association (SEA) to work in a marine protected area that they are in charge of enforcing. We were able to stay overnight at their ranger station in the cayes (30 km offshore). During our time there, we demonstrated our methods to the rangers, guides, and guests on the island. We have fully embraced the collaborative nature of this type of fieldwork and it would not have been possible without our local counterparts. We look forward to growing our collaborative relationship for years to come.

5. Are there any plans to continue this work?

I am very interested in continuing this work and so are my collaborators at Fragments of Hope. We have learned important lessons about how to fragment and farm mounding corals from this project and we are still learning more about how each coral species responds to the stress of being moved to a novel environment. In order to safeguard the biodiversity of Belize's reefs, we hope to continue this work with additional coral species in order to protect and restore a standing stock of coral biodiversity.

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

Thanks to previous Rufford funding, this work has been ongoing since 2014. As a result, two peer-reviewed publications have already been published and a third is in review as I write.

The direct results of this Second Booster Grant have been shared with the general public at my dissertation in North Carolina in August 2018. I have also shared these results with ~100 local high school students in North Carolina since August. I will be presenting these same results to the Earth, Atmospheric, and Marine Science Department at North Carolina State University in November 2018 as well as to the local community at a Science Cage event in Chapel Hill, North Carolina in November 2018.

Next calendar year I will share the results of this project with the international scientific community at the Association for the Science of Limnology and Oceanography (ASLO) Aquatic Sciences meeting in San Juan, Puerto Rico (February 2019). These results are currently being synthesised and once the final time point is collected they will be written into an article that will be submitted to a peer-reviewed scientific journal. Lastly, I will share these results with the government of Belize in my required annual report to the Belize Fisheries Department.

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 from February-October 2018 and covered the costs of two field trips to Belize (March 2018, October 2018).

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.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Transport to and from airport	0	764	+764	External funding to cover these costs was not granted
Dry Ice	0	557	+557	External funding to cover these costs was not granted
Zip ties, scissors, and other field equipment	0	1225	+1225	External funding fell through. Needed to replace broken SCUBA gear, annual service of gear, and additional tools purchased to complete work
Food	2000	998	-1002	Used remaining budget on food. Spent less than anticipated due to cutting trips to fewer days.
Community Researchers	1554	1200	-354	Fewer days than planned, but community researcher salary was increased to meet current market rates set by Fragments of Hope.
Boats	3885	2675	-1210	Again, fewer days used than planned (to meet budget restrictions due to lack of other external funding).
Flights	930	1315	+385	Flights were more expensive

				than anticipated due to travel during peak season
Lodging	1631	1265	-366	Fewer days and shortened trips to meet budget restrictions
Total	10,000	10,000		

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

The final steps of this project are to return to Placencia in 2019 to collect samples and measurements after 1+ years of transplant. This will give us a final idea of the ability of the corals in the experiment to acclimatize to new environments. We are presently analysing results of the 9-month time point and see evidence of acclimatisation in both species! We are currently chasing down physiological mechanisms for this. We suspect that some environmental condition associated with nearshore reefs allows corals to grow faster there (we suspect nutrient loading, but more experiments are needed to confirm).

In any case, we have seen clear evidence that the two species of Caribbean coral we studied here show signs of acclimatization, indicating that they may survive SOME degree of climate change. We are interested in trying to get protective status for nearshore reefs that are dominated by these corals and, thanks to our collaboration with Fragments of Hope, we are also interested in expanding our transplant work to several more species in order to attempt to restore a standing stock of Caribbean coral biodiversity to heavily impacted reefs around Belize.

We aim to work directly with Fragments of Hope to make this expanding coral nursey and out plant restoration system a reality. We hope that a final Rufford Foundation Completion Grant will help us do that.

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?

I use the Rufford Foundation logo in all of my public talks including:

1.) My public dissertation defence at UNC in August 2018.
2.) High school outreach in September 2018.
3.) High School outreach in October 2018.
4.) (Future) Carolina Science Café, November 2018.
5.) (Future) Invited seminar at NCSU, November 2018.
6.) (Future) ASLO Aquatic Sciences talk, February 2019.

In addition to these specific events, the Rufford logo features on my professional website. I also include some examples of application materials to help others apply for Rufford funding. My website has had 811 visitors and ~ 1600 views in 2018 alone, many of whom have likely been exposed to the Rufford logo.

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

Justin Baumann	Team leader	Grant writer, designed the experiments, did the research, analysed the data, built the collaborations
Colleen Bove		Dive master, research technician, did the research, consulted on all decisions
Mary Lide Parker		Videographer and photographer
Lisa Carne	Founder of Fragments of Hope LTD	Helped with all in country logistics, provided local expertise and local research assistance, fostered collaboration with Belize government and local NGOs

12. Any other comments?

I was fortunate enough to graduate with a PhD in Marine Sciences from UNC in 2018. My field research work was funded every step of the way by the Rufford Foundation. I am so very grateful the opportunities provided to me by this funding. I have met so many new people and learned much about the coral reefs of Belize as well as the culture and the people. These grants afforded me the freedom to pursue my own interests in research and conservation and search for my unique place in the academic research sphere. I am happy to say that I think I have found it and I could not have done it without your support! Thanks so much.