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	Julia K. Baum
Project title	New Insights about Coral Reef Resilience from the Heart of the 2015-2016 El Niño
RSG reference	21032-B
Reporting period	April 2017 – December 2018
Amount of grant	£10,000
Your email address	juliakbaum@gmail.com baum@uvic.ca
Date of this report	February 5th, 2019

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
1. Socioeconomic Monitoring				
		■		We mostly achieved this objective: although we conducted interviews in only 120 households, we had aimed to survey ~10% of the atoll's households, and we did so (as it turns out there are only ~1015 homes on the atoll). We also re-focused our questions away from the El Niño (because people were not reporting any long-term effects of it) and toward an interesting increase in the government copra subsidy on the island, and its impacts on fishing effort, livelihood diversity and household wellbeing.
2. Coral Reef Ecosystem Monitoring				
a) quantify fish and invertebrate abundances			■	We exceeded expectations for fish surveys – conducting them at 34 sites (instead of 25) because many of them had not been surveyed for several years due to time constraints or poor weather. We also conducted two surveys at different times of day at each of five strategically important sites. We did not, therefore, have time to do the invertebrate surveys. We also completed a new acoustic survey of the fish community using hydrophones at multiple sites.
b) quantify herbivory rates			■	We completed a large number of herbivory rate dives but decided to concentrate these at a smaller number of sites, spread across the disturbance gradient, to minimise inter-site variation in our analyses.
c) quantify benthic community composition / coral recruitment			■	We exceeded expectations, completing these surveys at 28 sites.

d) quantify reef structural complexity				We fully achieved this objective, photographing all of our permanent mega-photo quadrats.
e) sample tagged coral colonies				We exceeded expectations, re-sampling 165 tagged coral colonies and tagging and sampling 149 new ones.
f) coral recruitment tiles				We exceeded expectations, retrieving and redeploying tiles at all 12 sites and deploying tiles at two new sites.
3. Conservation Education and Outreach				
a) participatory research				We fully achieved this objective, conducting our socio-economic surveys with our partners at the Ministry of Environment.
b) conservation education activities				We focused our activities on school groups, and successfully conducted our proposed presentations, interactive activities (crafts, games, etc.) on coral reefs, climate change, sharks and reef fishes.
c) reports				We prepared and disseminated the report last year. We have also submitted data to NOAA Coral Reef Watch's forthcoming paper on the impacts of the 2015-2016 El Niño on coral reefs.
d) global communications				We shared our project on our websites and via social media. We have also spent considerable time over the past year – including a week of on-island filming – with a Canadian film crew who are making a documentary about the impacts of climate change on coral reefs.

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

None. Apart from the usual challenges of working in such a remote field location, we had a fantastic team, who worked incredibly hard, such that we had a highly successful expedition.

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

Our 2017 expedition was a success, and I have worked very hard over the past year and a half to build a team of students at the University of Victoria to process and analyse data, and write manuscripts based on our field data. We have made considerable progress, notably the following three outcomes, which relate to the four 'monitoring success' components of my application:

i) Discoveries about the Impacts of the 2015-2016 El Niño: Based on data collected during the 2017 expedition supported in this grant (as well as our 2015-2016 expeditions), we have documented significant ecological impacts of the El Niño including:

- Mass coral mortality (~90% coral cover loss around the atoll; Baum, Claar, Lund, Tietjen, McDevitt-Irwin. In advanced preparation for *Nature Climate Change*);
- Significant loss of reef habitat structure and volume (Magel, Burns, Gates, Baum. 2019. Effects of bleaching-associated mass coral mortality on reef structural complexity across a gradient of local disturbance. In press: *Scientific Reports*);
- Heat stress induced changes to the coral microbiome, including increases in alpha and beta diversity (indicative of invasions by pathogenic bacteria (McDevitt-Irwin, Garren, Vega Thurber, McMinds, Baum, 2019. Variable interaction outcomes of local disturbance and El Niño-induced heat stress on coral microbiome alpha and beta diversity. In press: *Coral Reefs*);
- We have also published a timely critique of coral bleaching survey methods (Claar and Baum 2019. Timing matters: Survey timing during extended heat stress influences perceptions of coral susceptibility to bleaching. *Coral Reefs*);

Six other manuscripts based on our 2017 Rufford-supported expedition will be submitted this year. These include:

- Evidence of how heat stress directly impacts reef fish communities (Magel, Dimoff, Baum in prep);
- Description of a novel mechanism of coral resistance to heat stress (Claar and Baum in prep);
- Examination of how the coral microbiome responded to heat stress, across the entire coral community and disturbance gradient (Epstein and Baum in prep);
- An examination of how herbivory changed as a result of the mass coral mortality (Smith, Dimoff, Baum in prep.);
- Quantification of acoustic signals from coral reef fish communities (Dimoff and Baum in prep);

As well as:

- Description of socioeconomic changes on Kiritimati, based upon our long-term household survey (Romeo and Baum, in prep);

ii) Discoveries about short-term recovery from the 2015-2016 El Niño: We have closely monitored coral recruitment (new corals ~0.5mm) around the island using settlement tiles, and have documented almost total recruitment failure thus far. We are preparing this work for publication (Tietjen and Baum in prep).

- Additionally, we are quantifying the abundance of juvenile and sub-adult corals for signs of recovery. Our work shows significant losses, but also that there are still corals of these life history stages around the atoll (Tietjen and Baum in prep).
- We have also tagged and sampled new corals, and continued to sample coral colonies that were tagged before/during the El Niño. These are providing important new information about how coral symbionts change with heat stress.

iii) Conservation Education and Outreach: In both 2017 and 2018, we made multiple presentations to, and conducted interactive activities with, the local schoolchildren to teach them about coral reef biology and conservation. These were well received. Additionally, in 2018, I worked for a week on-island with a documentary film crew who interviewed me and filmed me and my team working. The documentary is anticipated to be released later this year. These measures should increase awareness locally and globally, respectively.

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

At this stage, having conducted 14 expeditions to Kiritimati over the past decade, my team and I have strong connections with local communities, businesses, and government (Ministry of Fisheries, Ministry of Wildlife). We will continue to build on these connections and on community involvement in our future trips. In particular, during our 2018 expedition one of the Ministry of Fisheries technicians started working with us on our boat. We are teaching him our protocols, and will continue to work with him this coming year. The local community benefits through knowledge about the status of their coral reef ecosystem, as our monitoring program is the only one conducted on Kiritimati.

5. Are there any plans to continue this work?

Yes. I feel deeply committed to Kiritimati (both the people and the environment) and I plan on continuing my work there for the foreseeable future. Since this 2017 Rufford-supported expedition, my team and I already returned and completed a 3-week expedition in June-July 2018. I plan on returning to Kiritimati in July 2019, and would like to apply for a 2nd Booster Grant that would support our coupled socio-economic/ecological monitoring program, and focal studies on coral reef recovery dynamics.

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

We shared the results of our 2017 expedition with the local government on Kiritimati (Ministry of Fisheries, Ministry of the Environment) through in person meetings during our 2018 expedition. We also wrote a 2017 Research Report that we sent to them and the federal Government of Kiribati in Tarawa (prior to our 2018 expedition); we send copies of our publications to both as well, as they come out.

I have presented research from this expedition in ten invited talks: University of Ottawa (September 2017), Dalhousie University (October 2017), Royal Society of Canada (November 2017), Cambridge University (December 2017), University of Queensland, Brisbane, Australia (March 2018), James Cook University (March 2018), University of New South Wales, Sydney, Australia (April 2018), Stanford University (May 2018), University of Guelph (July 2018), University of Victoria (February 2019).

We have published three papers from this work, and are preparing eight more.

This work will also be highlighted in a forthcoming documentary (Aaron Floresco, Producer; Su Rynard, Director) on coral reefs and climate change.

Lastly, we share our work via social media on Twitter and Facebook: @BaumLab, which now has >3500 followers and on our websites.

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 period of the work for this Rufford Foundation grant was April 2017 – December 2018, with funds all spent in the summer of 2017 to support our 4-week expedition to Kiritimati. This is the same as the anticipated timeline. Note: some work remains to analyse and write-up the data, and my students and I will continue working hard on this this year.

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
Flights (to/from Kiritimati via Honolulu) for J. Baum & 5 team members (£1397.55 X 6 people = £8385.30 total)	2795	2622	173	The budgeted amount paid for my and team member K. Tietjen's flights from Victoria – Honolulu–Kiritimati (rtn). Flights were less than anticipated.
Salary for MELAD/Fish	1118	1034	84	Ended up only requiring 37 days'

Dept. Enumerators				work total.
Transportation for enumerators	1118	1079	39	Cost was pretty much as anticipated.
Household survey supplies	128	68	60	Materials were less than anticipated.
Outreach materials	319	183	137	Materials were more cost-effective than anticipated.
Boat rental	3504	3504		The total boat rental bill was £5805, and I charged the budgeted amount to Rufford.
Shipping/excess luggage charges	819	1179	-361	Luggage fees had gone up, and we had more gear to ship as well.
Research permit	200	343	-143	The Kiritimati government charged us a new 'diving permit' in addition to our research permit.
TOTAL	10,000	10,012	-12	

Exchange rates for expenses before trip (e.g. plan tickets, materials): US$ to £ = 0.799; CDN$ to £=0.5999.
Exchange rates for expenses during trip (e.g. salary, transportation, boat rental, shipping): US$ to £ = 0.7708; CDN$ to £=0.6125.

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

The most important next step ecologically is to assess recovery of Kiritimati's coral reefs from the incredible heat stress and coral mortality they experienced during the 2015-2016 El Niño. We are also closely monitoring climate models (from the U.S. and Australian governments) for signs that there may be another heat stress on event later this year.

I will use our 2019 expedition to continue strengthening my ties with the local government and communities, to encourage them to think about and take initial steps toward coral conservation in light of fishing pressure and climate change. To do so, I will build on my relationships with local community leaders and government. I would like to travel to the capital of Kiribati (Tarawa) within the next year to meet with government there to discuss conservation options for Kiritimati. Important next steps are to determine what conservation policies might be feasible on Kiritimati, both in terms of fisheries resource management and climate change adaptation.

I have started to reach out to NGOs (WWF) with the goal of engaging them to start work on Kiritimati. There is a great need for sustained and focused conservation effort on Kiritimati, and the additional help of an e-NGO could be highly beneficial. I will continue to work on this this year.

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

Yes. The RF logo is posted on my lab website, has been shown (as an acknowledgement to our RF funding) on all talks about this research, and is included in my students' theses. We also acknowledged The Rufford Foundation in tweets last year, and we acknowledge the foundation in each of our Kiritimati publications.

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

Canadian/U.K. Team:

Kristina Tietjen: Kiritimati Project Manager, Coral field team member, MSc student (conducting analyses on coral recruits, juveniles, sub-adults)

Sean Dimoff: Fish team lead and dive safety specialist

Jenn Magel: Coral field team member, MSc student (conducted analyses on coral reef habitat complexity and impacts of heat stress on reef fish);

Laurence Romeo: Masters Student (Imperial College London), Socioeconomic surveys

Tyler Phelps: Fish field team member

Kevin Bruce: Coral field team member

Kiritimati Team:

Kauaata Irata Baibuke: Socioeconomic surveys

Aana Berenti: Socioeconomic surveys, Wildlife Office, Ministry of Wildlife

Taratau Kirata: Senior Fisheries Officer

Ratita Bebe: (Head of MELAD, Ministry of Wildlife)

Alfred Smith: Dive team support

12. Any other comments?

I am grateful for Rufford's continued support of my project on Kiritimati, and look forward to continuing this work.