

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	Chetana Babburjung Purushotham
Project title	Evaluating the effects of terrestrial sediments on coral community structure in a post-bleaching scenario in the Andaman Islands, India.
RSG reference	17024-1
Reporting period	February 2015 to November 2016
Amount of grant	£5000
Your email address	chetana.puru11@gmail.com
Date of this report	13-3-17

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
Measurement of sediment stress				We intended to use multiple measures of sediment load to arrive at the degree of sediment stress experienced by reefs located at varying distances from islands and therefore, sources of runoff. We were able to measure four different measures: 1) rate of sediment input; 2) light intensity; 3) % sediment deposition; and 4) % terrestrial input in deposited sediment. This provided us with a comprehensive understanding of the breadth of effects sediments have on these reefs and which sediment load factors may be more important at different spatial and time scales.
Identifying indicator-species and – patterns				We are now able to identify benthic (bottom dwelling) reef organisms including certain coral taxa and types of algae, the presence and absence of which could potentially be used as indicators of sediment stress when studying coral reefs around the Andaman Islands. Known coral behaviours such as secretion of mucous sheets by corals experiencing sediment stress were found in sites with high sediment load here as well. We also observed interesting behaviours that occurred only in sites of high sediment load, which could also be used as indicators of sediment stress. This included the occurrence of daytime polyp activity (typically night time) of sediment sensitive <i>Acroporid</i> corals, however further research on the indicative ability of this particular behaviour would be required.
Long term monitoring				At the end of this project we intended to initiate long term monitoring of reef sites with a locally based organisation that

			<p>could utilise replicable and cost-effective methods that were tested during this study. Reef sites have been identified, methods have been tested and competent personnel from DIVEIndia (our local dive operator collaborator) have been chosen to carry out the monitoring. We have not been able to launch the monitoring yet, partly due to the delay in completing the fieldwork component of this project as well as December-February being in their busiest months of the year for the dive centre. We are hoping to launch the monitoring once the tourist season slows down in April and May 2017. Details and progress of the project will be constantly updated on the DIVEIndia website and blog once launched.</p>
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2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

We did face a few unforeseen circumstances during the course of the project. The Department of Environment and Forests (DoEF, <http://s1.and.nic.in/doef/index.php#&panel1-1&panel2-1>) asked us to revisit our choice of study sites from what we initially proposed. We were asked to conduct our research around the reef areas around Havelock in the Ritchie's Archipelago instead of the Mahatma Gandhi Marine National Park. Adhering to their recommendations, while ultimately working out very well for the project objectives, did delay us by 7 months. Further delays came with strong monsoons in 2015 and 2016 during which time we were unable to enter the sites to retrieve our data, setting us back by a month and a half each year. We have had to extend the project timeline by nearly 3-4 months in order to complete the fieldwork. However, that



having been said, the data collection process has been smooth and the delay has not compromised the quality of information we had set out to collect.

Figure 1: Sediment runoff from island creeks into coral reefs in Havelock.

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

- **Establishing baseline data:** Through this project we have been able to assess the extent of terrestrial sediment influences on the recovery of reef areas in Ritchie's archipelago. During the field season of 2016 we also encountered mass bleaching in all our study sites and took the opportunity to examine the extent of bleaching, even though it was not one of our objectives. One of the main limitations for research and conservation initiatives to take place in the Andamans is the absence of baseline data to work with. Presently, we have very limited publically accessible data available for researchers and managers. Through this one project we have been able to generate baseline data on
 - A) The structure and composition of recovering corals in sites that are representative of shallow coral reefs in the Andamans. Overall, *Acroporid* or staghorn coral which used to be dominant in these reef sites (as known from anecdotes and is evident from coral rubble) have recovered very poorly. However, being sediment sensitive, their recovery seems to be least in sites experiencing high sediment load.



Figure 2: Measuring growth in young *Acroporid* coral colonies.

- B) Fine-scale data on the seasonal dynamics of sediments. Sediment input is maximum during the monsoon and post monsoon season and least in the summer season. Sediment deposition does not appear to be as important a factor as the sediment suspended in the water column which reduces light intensity penetrating the water. Sediment deposited on the reef is similar in all sites, however in sites closer to the islands, this deposited sediment is composed more of clay particles (island origin), while sites further away are composed of calcium (reef origin)

C) Onset of a mass summer bleaching episode as well as post bleaching status of the reefs. Significant levels of mass bleaching were observed in reefs around Havelock Island. Bleaching began in Havelock around 10th to 12th May. ONSET data loggers deployed in these sites indicate that water temperature reached 33 to 34 degrees Celsius at the water surface and up to 32 degrees at 10 m depth around the time that bleaching was observed to begin. Cool localised deep water currents in March and April 2016 may have played an important role in keeping water temperatures down until May and delaying the onset of bleaching (as indicated by the data loggers as well as observations while diving. This requires further investigation).

We can now begin to examine the potential role of sediments in influencing the progress of bleaching and mortality, an opportunity that was missed during past bleaching events and is therefore a critical assessment for the reefs of the Andamans. With this kind of easily accessible baseline information in place, we will also be able to scale up the process of future recovery assessments, and subsequent management initiatives for the reefs in these islands.

- **Initiating an integration of multiple stakeholders: Authorities and Dive operators:**

In order to link the outcomes of this research with management, we wanted to work with the Department of Environment and Forests (DoEF) of the Andaman and Nicobar Islands, the main custodians of the islands' reefs. Based on discussions with the DoEF, reefs around Havelock Island were chosen for this project and future monitoring. Havelock Island has been rapidly developing in the past 10 years in order to accommodate the growing dive tourism industry, and the DoEF has been keen to know how this may affect sediment loads from islands and any consequences of this on reef health. With support from the DoEF, we have based our research out of Havelock where we have, and continue to receive complete field support from a well reputed local dive centre DIVEIndia (www.diveindia.com) - providing us boats, local staff and dive gear for fieldwork.

DIVEIndia has been actively working for the past 14 years towards protecting the reefs they dive at and educating divers about reefs and conservation. By having the DoEF and DIVEIndia on-board with this project, we were able to bring two organisations which otherwise seem to have conflicting interests over coral reefs as resources. Dive schools like DIVEIndia are teaching and sensitising hundreds of tourists each year. For their operation they are able to access several reef sites, sometimes more often than researchers and authorities. DoEF is now starting to see dive centres in a positive light and not merely as a disturbance or threat to reef health. As a positive first step, there have been discussions of having dive centres such as DIVEIndia to survey reef health in these reef sites that they visit them regularly and have logistics required, in place. The DoEF of Havelock along with DIVEIndia has conducted beach clean-ups on remote islands and we hope

this will be a regular collaboration in the future (April 2016 <https://www.instagram.com/p/BEirUYKrmYG/?taken-by=diveindia>).

- **Initiating long term monitoring with DIVEIndia- a local dive school**

Initiating a long term program to monitor reef recovery and threats including terrestrial sediments has been one of the intended outcomes of this project. We have not been successful in launching the program as yet due to reasons mentioned earlier. Yet, what we have been able to achieve is forge a partnership with an organisation that is extremely motivated to run this program in-house. DIVEIndia already has the field logistics in place and skilled personnel required to carry out the long term monitoring project. With the funds remaining in this project meant for the long term monitoring programme, we will launch the programme in April and May, which are the lean months for DIVEIndia. Reef sites have been identified (10 sites frequented by DIVEIndia including the four sites included in the current study), dive staff from the DIVEIndia for this programme have also been identified and are currently being trained by us. Chetana is currently based in DIVEIndia and will continue to be for at least another 12 -15 months to ensure that the project takes off, as well as adapt the programme at any stage if required. Details and progress of the project will be constantly updated on the DIVEIndia website and blog once launched.

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

All fieldwork support was provided for this project by DIVEIndia. DIVEIndia staff - boat crew and dive professionals who assisted on this project are all local islanders belonging to the Karen community (Figure 1). Karens are originally farmers and fishermen, many of whom have now made their way into the dive tourism industry. During this project, there was a natural and mutual exchange of knowledge throughout. Their understanding of seasonality, conditions of the seas and the marine life is incredible. However, they were not as aware of ocean warming, coral bleaching and the reasons behind the current status of these coral reefs. Many of them have shown a keen interest in learning more and continuing to be involved in efforts such as this project. The long term monitoring program at DIVEIndia will be carried out with the help of the Karen dive professionals, who are already skilled in working underwater and a few of them with desk work as well. Most important to a long term programme, these people think, live and work as a community and their involvement and support for this project in the long run is feasible as the Andaman Islands are their home.



Figure 3: Team DIVEIndia with all dive staff from the Karen community who assisted with the fieldwork on this project. Upper L-R: Saw Harrel, Saw Franklin, Saw Andrew, Saw Ezikel, Saw Darrick, Shaheb, Saw Stephen. Lower L-R: Saw Ajay Kumar, Saw Latha, Saw Shwejuja, Saw Nathaniel, Saw Mevi-Charleston and Chetana Babburjung Purushotham (Principal investigator)



Figure 4: Saw Darrick placing a marker buoy at one of study sites in Havelock

5. Are there any plans to continue this work?

This project was focussed on looking at the effect of terrestrial sediments on coral communities in reefs affected by bleaching. We will grow this into a larger monitoring programme which will now be the focus for the team which will be based in Havelock Island. The programme, while remaining simple in its design and in the data collection component, will include more reef sites around Havelock that will be studied all year around. We will be measuring not just the recovery of coral, but other reef invertebrates as well, reef fish and environmental parameters especially in anticipation of more frequent mass bleaching episodes.

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

We will be sharing the results of our work in the following ways:

For the DoEF:

A final report will be submitted to the authorities, alongside discussions with the department officials who were involved in the initial stages of the project and who provided our project with permission and support. We have already submitted a mid-term progress report in May 2016.

We will provide them with a long term monitoring manual after it has been test run at DIVEIndia in April-May 2017.

For the scientific community:

We are writing two research papers which will be sent to peer-reviewed journals:

1. Purushotham et al. How does sediment load differ across patch reefs, over time? *In prep*
2. Purushotham et al. How does sediment load influence extent of coral reef bleaching? *In prep*.

For the general public:

We will be writing popular articles in Indian magazines for the awareness among the general public in mainland India. We will also be providing visiting tourists at Havelock with information about the project through regular presentations and talks that are conducted at DIVEIndia.

We have already been conducting discussions with visiting children about coral reef conservation and importance of terrestrial influences such as deforestation, erosion and sedimentation onto reefs.



Figure 5: Talking about coral reefs and the importance of terrestrial factors, addressing a gathering of school students from Mumbai visiting the Andaman and Nicobar Environmental Team (ANET) in October 2017.

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 time period initially proposed to RSGF was 18 months starting February 2015. The actual timeline over which the grant has been used is 21 months. £548 is still remaining, (details mentioned below), which we would like to use to launch the long term monitoring project in April and May 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.

Assumed exchange rate: 80 Indian Rupees to £1

Item	Budgeted Amount	Actual Amount	Difference	Comments
Air travel	227	217	10	
Local travel	28	27	1	
Boat hire + dive costs+field team wages	2050	1604	446	Three separate items in the proposed budget were then combined into one as DIVEIndia charged us for all three items under a unified item of 'dive costs'. We spent lesser on our diving fieldwork than we initially budgeted as DIVEIndia subsidised the diving costs to facilitate our research work.
Living expenses (food, stay and personal expenses for the principal investigator)	1701	2760*	1059	The expenses towards living expenses in Havelock Island, which is an upcoming tourist island, surpassed our planned budget (actual expenses amounted to £ 6.1/ day). Further, time spent in field was also extended by an additional 3-4 months. The additional £ 1059 was taken from the budget for purchasing data loggers which was not used.
Equipment- data loggers	1086	1059*	27	We applied and received an equipment grant from IDEAWILD which covered the entire cost for the data loggers needed in the study. We instead utilised the money under this item to meet the living expenses of the team leader of the project for 4 months starting February-May in the Andamans in 2016.
Equipment –sediment traps	103	103	0	Purchase and assembly of sediment traps fit well in the amount budgeted.

Sediment analysis	206	148	58	We were able to conduct the sediment analysis ourselves at a lower cost without having to approach a laboratory.
Consumables	21	21	0	This item was used to purchase stationary, cable/zip ties, batteries and carry out printing work
Contingency	21	15	6	This item was used to purchase medical supplies while in field.
Total	5443	4895	548	

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

Some important next steps:

1. Launch the long term monitoring programme at DIVEIndia in the next 2 months and ensure smooth running for at least 12 months under our supervision. We will utilise the £548 towards the fieldwork in setting up the long term monitoring programme, designing, printing and distributing the monitoring booklets. The costs for fieldwork required for the regular monitoring of sites after the initial implementation will be borne by DIVEIndia.
2. Continued research on understanding coral reef recovery in the Andamans integrating other important factors that are becoming more relevant each year- overharvesting reef fish for export and tourism related island development.
3. To maintain the momentum we have gathered, working with a dive centre that sees value in contributing to ongoing research and conservation. We will be working with DIVEIndia trying to build an education wing within the dive school.
https://m.facebook.com/story.php?story_fbid=1779303695428870&id=159583344067588&ft=top_level_post.id.1779303695428870%3A%26objid.1779303695428870%3Athrowback_story_fbid.1779303695428870&tn=%2C%3B

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?

We used The Rufford Foundation logo on a leaflet kept on the DIVEIndia boat and was used to talk about this project to dive guests who were diving at the study sites. The logo was also used in a presentation about the project that was made to school children visiting the Andaman and Nicobar Environmental Team (ANET) in October 2017

We will acknowledge RSGF in all material related to this work that is produced in the future (e.g., peer-reviewed papers, booklets, popular articles and conferences).