

The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants 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 <u>jane@rufford.org</u>.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Rohan Arthur
Drojoct titlo	Assessing resilience in coral reef seascape: bleaching
Floject due	responses and recovery in the Lakshadweep Archipelago
RSG reference	9101-1
Reporting period	November 2010-November 2011 (final report)
Amount of grant	£ 5,990
Your email address	<u>rohan@ncf-india.org</u>
Date of this report	3 December 2011



1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not	Partially	Fully	Comments
	achieved	achieved	achieved	
1. Resilience			Fully	We surveyed all inhabited coral atolls in
Assessments across			Achieved	the Lakshadweep and were able to
the Lakshadweep				conduct survey two sunken atolls in the
Atolls				chain – perhaps the first-time reef
				surveys have been conducted at many of
				these locations. In total we collected
				reef data on 42 reef locations on 12
				atolls across the archipelago
2. Assessing the			Fully	This was done by analysing
relative resilience			Achieved	environmental, benthic, fish and
potential across				anthropogenic data across the entire
reef sites				archipelago using an IUCN protocol for
				bleaching-related resilience
3. Identify factors			Fully	We used a 13-year benthic dataset from
that contribute to			Achieved	a subset of these reefs in order to
resilience and				determine which parameters measured
resistance across				during our survey were most sensitive to
the archipelago				resilience and resistance.
4. Establish long-		Partially		We identified sites along a predicted
term monitoring		achieved		resilience gradient to establish long-term
locations along a				monitoring based on identified
predicted gradient				resilience-sensitive indicators. We have
of resilience				begun basic monitoring at three of these
				locations and will require another
				season to establish sites along the entire
				gradient with detailed monitoring.

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

Because of a change in the bureaucratic machinery in the Lakshadweep, our post-monsoon research permits were delayed by several months and we have not been able to get back into the field to finish the establishment of the long-term monitoring locations. I have worked personally with the concerned departments to expedite this process and make our access to the islands more sustainable. As a result of this, we have been now been granted longer term research permits to conduct our field research on the Lakshadweep reefs, and we will be restarting our programme from the middle of December 2011.

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

1. Determining bleaching-related mortality and status across the archipelago

Our study surveyed 42 reef locations on 12 of Lakshadweep's atolls, including two sunken atolls, covering the entire archipelago. This survey was among the first of its kind specifically designed to



comprehensively establish the ecological status of the reefs after a major bleaching episode. We documented more than 500 species of fish during our survey, many of them new records for the Lakshadweep. The Lakshadweep atolls are particularly susceptible to El Niño-related mass bleaching events and have suffered catastrophic mortality in the past. However, very little is known of how these reefs respond to these repeated events, and our survey will provide a valuable baseline from which we can determine future responses. What is clear is that the 2010 El Niño event, while severe, left behind a much patchier picture of disturbance than the last large bleaching event that impacted these reefs in 1998. Post-bleaching mortality was not as severe and varied considerably between reefs While it is still too early to identify the factors that drove this location-specific response, it appears to be influenced highly by local oceanographic patterns, depth, and exposure to monsoonal waves. The results of this study will contribute to ongoing long-term monitoring of the Lakshadweep atolls and in helping understand how these atolls will respond to future climate change.

2. Identifying factors contributing to resilience and resistance

I addition to providing an archipelago-wide perspective on current reef status and post-bleaching responses, our study was specifically geared to determining which combination of factors contributed to the overall resilience seen at these reefs. For every location we surveyed, we estimated a range of potential resilience/resistance variables related to oceanography, connectivity, benthic composition, fish community composition, anthropogenic influences among others. For a subset of the locations surveyed, we have been collecting data on benthic change over the last 13 years, and we used trends from these long-term data sites to identify which of these measured variables best explain a locations' relative ability to withstand and/or recover from a disturbance event. Our analysis indicates that the resilience of the Lakshadweep reefs may be driven by a small set of potentially interacting factors including exposure to monsoonal storms, depth, physical shading of the reef location, benthic composition and the health of a few fish guilds. This analysis gives us a clear set of variables that we will need to integrate into a comprehensive monitoring programme. Additionally, this will help in designing a management system for these reefs that is centred on principles of resilience in the face of increasing climate uncertainty.

3. Identifying sites of high and low potential resilience in the Lakshadweep

Based on our surveys, we estimated an overall resilience score for every reef location we sampled. This allows us to identify locations within the Lakshadweep complex with relatively high resilience and sites, which are particularly susceptible to disturbance effects. We are attempting to test this relative resilience assessment with long-term monitoring sites established at sites along the gradient of putative resilience. Over the next few years, our research efforts will be geared to determining the specific mechanisms and drivers of this relative resilience across this gradient. This will give us a much better understanding of what processes and functions we need to focus our management efforts on in order to protect and enhance the inherent buffer capacity of these reefs. In addition, this assessment on its own provides a means of prioritising management efforts. While resilient reefs may require some level of protection to ensure that their resilience is not compromised by future anthropogenic influences, susceptible reefs may require additional management interventions to ensure that these reefs are given the best chance to recover from disturbance events when they do occur.



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

All our field staff are drawn from the local community and several of them have been working with my programme for the last decade or more. We also periodically engage with the local self-governance agencies in the islands where we work in order to discuss our research and its implications for the local communities, particularly fishers. In addition, we liaise closely with local environmental and volunteer organisations including the Lakshadweep Coral Reef Monitoring Network, the LMRCC, and others to communicate our findings and assist with their programmes where possible.

5. Are there any plans to continue this work?

One of the ongoing outcomes of this work is the establishment of permanent reef monitoring sites where we will be monitoring long-term trends in benthic and fish communities to track ecosystem health across the archipelago. We have already been working on these reefs for more than a decade and plan to continue research here. In particular, I am keen to understand the ecological mechanisms underlying the proposed resilience we have identified at these reefs with an eye to their long-term rational management based on resilience principles.

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

- 1. We have already submitted a detailed report of our initial results to the Lakshadweep Administration, the Department of Environment and Forests and the Department of Fisheries in the Lakshadweep.
- 2. We are currently preparing two manuscripts that directly relate to the resilience surveys and three additional manuscripts that use parts of this survey together with other work to submit to peer-reviewed journals
- 3. We have submitted abstracts to present our work as oral presentations at the upcoming International Coral Reef Symposium in Cairns, 2012. We are awaiting their acceptance and will make the presentations if we are able to raise funds to attend the conference.

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

The RSG funds were used for a period of 1 year as proposed

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 (UK £)	Actual Amount (UK £)	Difference (UK £)	Comments
Air travel	750	750.59	-0.59	
Local Travel	270	288	-18	
Boat Hire	820	815	5	
Dive Compressor and Tanks	650	513	137	



Living Expenses	1300	1564	-264	Field campaign was more expensive than planned
Field Assistance	310	310	0	
Field Equipment (Temperature Gauges, camera, another field equipment)	1620	1663	-43	
Report Writing and other Administrative Expenses	270	86	184	NCF underwrote these expenses to compensate for overspending elsewhere
Total	5,990	5,990	0	

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

- 1. Establishing the baseline monitoring along the gradient of identified resilience is the most important first step that we will need to take the work forward. We plan to do this in the coming season
- 2. Identifying the mechanisms and drivers of reef resilience and susceptibility in the face of repeated disturbance events is a vital conservation science goal since this will help provide very directed inputs to managers on the specific functions they need to protect and enhance to maximize resilience.

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

All our reports to the Lakshadweep Administration, Forest Department and other departments in the Lakshadweep featured the Rufford Small Grants Fund prominently. We recently presented initial parts of our results at the Estuarine Research Foundation conference in Florida and acknowledged the RSGF prominently in our presentations. In addition, all peer reviewed manuscripts will clearly indicate that RSGF provided partial support for this work.