

### 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. 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. 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	Rucha Karkarey
	Coping mechanisms and the vulnerability of a keystone reef
Project title	predator (peacock hind, Cephalopholis argus) to climate change
	in Lakshadweep
RSG reference	16133-В
Reporting period	February 2016
Amount of grant	8440
Your email address	rucha@ncf-india.org
Date of this report	25 <sup>th</sup> March 2016



# **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
Coping mechanisms: foraging flexibility along a habitat gradient (diet, foraging mode and territory size)				
Physiological consequences of habitat degradation – (growth rates and body condition)			_	
consequences of habitat degradation				
Public outreach and engagement				This objective is ongoing and part of a larger project which is studying the resilience of the Lakshadweep to climate change. Outreach activities will be conducted through the months of March and April 2016 and December 2016 – March 2017. Reference materials have been produced for public outreach: A booklet of the most common marine species in Lakshadweep has been designed and will be circulated. The booklet highlights interesting behaviours of functionally important marine species and their vulnerability to climate change. An outreach program is planned with schools in <i>Kadmat</i> and the local dive and water sports staff at the tourist resort, in April 2016.
Fisheries Management				Talks with the Lakshadweep Administration have been initiated to formulate an integrative fisheries management plan for the archipelago. This project is part of a larger project that NCF is conducting in the Lakshadweep, and information about coping mechanism, vulnerable species and habitat thresholds is being compiled from multiple projects in the program to inform a comprehensive coral reef management plan for the islands.



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

We had issues with travel logistics due to unforeseen weather conditions and sudden changes to conveyance schedules between the islands and the mainland. We suffered some delays in starting the work.

We were unable to collect adequate samples of the peacock grouper (in terms of size classes and number) from the local markets, as was originally proposed. Similarly, samples had to be bagged underwater soon after being caught, because they tended to regurgitate their stomachs while being reeled in. Collecting gut contents was an integral part of our diet analysis and hence we had to rethink our sampling methodology. We had to thus procure our own fishing equipment and collect samples while diving, thus further delaying sampling. Despite these setbacks, we were able to finish our ecological study within the given timeframe.

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

1. As the architectural complexity of reefs declines beyond a particular threshold (a mean height of 60 cm) several long-lived species of groupers are unable to survive and drop out of the species assemblage. Out of the eight most abundant groupers in *Kadmat*, four species were not found in reefs in which the structure had declined to more than 60 cm height. Very few species of groupers like the peacock grouper (*Cephalopholis argus*) not only survived but increased in abundance in these degraded habitats.

2. The peacock grouper modifies its foraging mode when reefs decline beyond the 60 cm threshold of structure. In low structured reefs, the peacock grouper predominantly uses the structure-independent 'widely-foraging' mode to catch prey. Conversely, in high structured reefs it predominantly uses the structure-dependent 'ambush' mode.

3. Despite differences in prey availability in reefs with high and low structure, the peacock grouper is able to maintain a specialized, high-trophic diet by switching between foraging modes.

4. Declining habitat conditions and behavioural switches, did not appear to impact the physiology (growth rates) of the peacock groupers between reefs.

5. Interestingly, peacock groupers varied in their morphometry between reefs – the peacock grouper was found to be heavier for a given size in low structured sites – indicative of good health.

6. Our work indicates that despite a decline in prey and structural resources on degraded reefs, the peacock grouper is able to maintain its high trophic diet through the mechanism of foraging flexibility. It is likely that other species of groupers are more limited in their foraging behaviours and are therefore unable to adapt to rapidly degrading reefs. Together with a competitive release in low structured reefs and flexible foraging modes, species like the peacock grouper appear to be winners and will dominate fish assemblage on reefs in the future.



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

As this study was largely an ecological study, the local community was not directly involved in the project. However, the peacock grouper and other similar species of groupers are an important food fish for local communities. Non-local commercial fisheries in Lakshadweep are now increasingly targeting groupers. Understanding the vulnerability of such critical food-fish species to rapid climate-change disturbances in Lakshadweep, is an important aspect of coral reef and sustainable fisheries management. The results of this study are being communicated to the Lakshadweep administration.

#### 5. Are there any plans to continue this work?

Yes. We plan to extend this work to several other fish species of ecological and commercial importance in Lakshadweep.

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

The results of the work will be shared via: 1. Peer-reviewed publications in international journals; 2. Reports that can be shared with policy makers – local Lakshadweep administration; 3. International conference presentations (International Coral Reef Symposium, Hawaii 2016); and 4. Discussions with local fisher groups, a short educational programme with school children and local dive and water-sports staff at the island tourist resorts.

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

The RSG was used for 1 year (January 2015 – March 2016).

The timeframe of the project was sufficient for us to complete the ecological data collection and laboratory work.

However, because we only work in the islands for 2-3 months during the fair season (December-April), we were not able to conduct the outreach programme together with data collection. We anticipated conducting the latter between December 2015 and February 2016, however because of some setbacks in ecological data collection in the previous season we were unable to do so.

A part of the outreach component of the study will be carried out in April 2016 and is also proposed for next season.

### 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.

ltem	Budgeted	Actual	Difference	Comments
	Amount	Amount		
Otolith processing	1200	1350	- 150	Otolith processing was carried out at
				the Centre for Advanced studies in
				Blanes, Spain (
				http://www.ceab.csic.es/). Change in



				exchange rate at the time of payment lead to increase in cost.
Stable Isotope Analysis	1800	1700	100	Fewer samples collected, than those that were budgeted for.
Field Assistant food	420	400	20	
Lab assistant accommodation and	420	0	420	Used towards accommodation and travel of the principal researcher to
food				the Stable Isotope facility in Ahmedabad (www.prl.res.in)
				Advanced studies in Blanes, Spain( http://www.ceab.csic.es/
Local translator	600	600	0	
Travel	800	800	0	
Field station	900	900	0	
Equipment	1000	1000	0	
Sample collections	300	900	-600	Market collections were abandoned because of sampling inconsistency, fishing equioment was purchased to collected our own samples.
Printing outreach materials	800	600	200	Ongoing expense
Misc	200	100	100	Medical expenses for team
TOTAL	8440	8470	-90	

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

1. Filling gaps in the story: In this study, we were able to understand coping mechanisms of the peacock grouper in response to reef degradation, limits and physiological consequences of the same. A next step would be to get a direct measure of fecundity/ reproductive output in individuals along the reef gradient. This can help us in predicting population growth rates of the peacock groupers under various scenarios of disturbance. In this study, we were unable to incorporate breeding periods of the peacock grouper in our sampling strategy, because of lack of data on reproductive seasonality of this species in the region. But in the course of this study, we have gained an understanding of the reproductive periods of the peacock grouper in Lakshadweep and future studies can address these questions.

2. Understanding plasticity and adaptation: An interesting future direction would be to understand how adaptable and plastic these behavioural responses are to environmental change. Translocation experiments on peacock grouper individuals between reefs of different structures could be designed to understand the plasticity of these behavioural shifts within individuals. Another future direction would be to use gene regulatory frameworks to investigate the molecular triggers of this environmentally induced behavioural divergence that results in two types of foraging modes in this species.

3. Extending to other species and guilds: Understanding the vulnerability of keystone species to climate change disturbances is critical to evaluate the amount of fishing pressure they can sustain.



Similarly, understanding coping mechanisms is critical to understand how functional roles of species change in degraded reefs, impacting the overall resilience of a reef to climate-change. It will be very useful to extend this study to other species and guilds of ecological and commercial importance in Lakshadweep.

## 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?

The RSGF funding will be acknowledged in: 1) reports provided to the Lakshadweep administration; 2) peer-reviewed papers submitted to international journals; 3) Outreach materials - booklets and posters; and 4) Conference presentation (ICRS 2016). Information about Rufford Grants was also provided to other researchers working in the islands and we recommended that they submit applications for funding to the Rufford Small Grants Programme.

#### 11. Any other comments?

We would really like to thank the RSG for being an extremely supportive grant with the management being very understanding, appreciative and flexible.