

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
Project title	Conserving top benthic predators in the Lakshadweep reefs: Identifying priority areas for grouper conservation and ecosystem functioning
RSG reference	12245-2
Reporting period	September 2012 to September 2013
Amount of grant	£5742
Your email address	ruchakarkarey@gmail.com
Date of this report	22/10/2013

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
Monitoring grouper community across reefs: species abundance, population size-structure, benthic structure, and prey-densities.				
To study the behavioural ecology of the peacock hind (<i>Cephalopholis argus</i>) in relation to habitat decline.				While this objective was not explicitly stated in our proposal, this approach was used to assess the impacts of habitat decline on groupers. We chose the peacock hind as it is a commonly found species of grouper across all reefs in the Lakshadweep. Studying the behavioural ecology (predation, territory size, social interactions etc.) of this grouper along a gradient of habitat decline, gave us valuable insights into the effects of bleaching-driven habitat decline on structure dependent top predators like groupers.
Ecosystem function: To study predation pressure on reefs along a gradient of grouper abundance and reef structure.				We were able to standardise a measure of relative predation rates between reefs using baited prey and video monitoring. However, we were unable to replicate these assays across our monitoring sites mainly due to difficulties in experimental design and logistics.
Fisher interviews to characterise the proliferating reef fishery				Because of gender bias, fishermen were not entirely comfortable in interviews. This along with language barriers and difficulties in translation limited sample size of interviews for quantitative analysis.
Documenting historical practices of traditional reef management				We managed to conduct these interview surveys only in Kadmat atoll. These surveys have yet to be extended to the other atolls, where fishing practices may have differed much more in the past, due to connectivity to the mainland and socio-economic status of

				the atoll. Gender bias and difficulties in finding and training a translator limited the study.
Prioritising areas for grouper conservation: spawning aggregations areas				This is an additional objective to the original proposal. However, one priority area has been identified for conservation. However, the lack of fisher knowledge of aggregations made it difficult to identify more areas in Lakshadweep.

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

Delay in permit process:

One major difficulty we faced this season was procuring permits for the season from the administration on time. We were delayed by 2 months, while we earlier wanted to start out work by October, we could only start by mid-December. This was a major setback in terms of time. To overcome this, we extended our field season to April, but changing weather conditions made it difficult to continue working. The backlog of proposed work could not be effectively handled even with a slight extension of the field season.

Predation assays

One major difficulty I faced was in replicating predation assays (to measure relative predation rates in reefs) across the resilience monitoring sites. This was one of my main objectives, was to study predation function on reefs along a gradient of reef degradation, using groupers as keystone species. However, a major setback was logistic difficulties in terms of availability of field/ dive assistants. Since Lakshadweep is a restricted entry zone, it is difficult to get permits to bring dive assistants from the mainland and at the same time, very few trained divers (not working full-time with the tourism department) are available for support. I therefore focussed the standardisation of my assays in Kadmat atoll, where I could hire a part-time dive assistant. The bulk of the monitoring work of this study, which was carried out across the atolls was conducted in 1 month (February- March) when the NCF team visited the field site. At this time, it was not possible to conduct the predation assays at each site, due to time constraints.

Fisher interviews for monitoring grouper catch and traditional management practices-

Because of gender bias, fishermen were not entirely comfortable in interviews. This, along with language barriers and difficulties in translation limited the number of interviews I could conduct. I hired a local field assistant and over the course of the study trained him in interview survey techniques. As a result, we could only interview few key informants and fishermen (n=12) and conduct two small meetings with the fisher community in Kadmat and Bitra atolls to discuss issues regarding changing fishing practices and inter-island fishing conflict.

Further, I was unable to effectively monitor fish landings in the three proposed atolls. As the reef fishery is still of subsistence type. We could only opportunistically monitor reef catch in Kadmat and Bitra atolls, especially when certain commercial fishing operations were conducted. We are in the process of setting up an informer-network to monitor daily reef catch in the atolls. Training

appropriate translators for conducting interviews will enable us to effectively conduct this portion of the study in the next season.

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

I faced difficulties in completing two major components of my study

- Quantifying reef fishing pressures and
- Studying functional processes like predation function along a gradient of reef degradation.
I therefore conducted a behavioural study on the foraging ecology of a common grouper (peacock hind, *Cephalopholis argus*) and behavioural study on mating strategies of a squaretail grouper (*Plectropomus areolatus*).

1. Behavioural plasticity in the peacock hind (*Cephalopholis argus*):

The peacock hind shows flexibility in foraging ecology and is therefore commonly found in degraded as well as high structured reef sites. Our behavioural study found that the peacock hind is able to switch its diet by feeding primarily on benthic invertebrates in degraded reefs and on fish prey in stable reefs, with high structural complexity. This species also shows flexible foraging behaviours, preferring ambush strategies in high structured reefs and a less structure-dependent roving strategy in degraded and low structured reefs. Our findings suggest that such differences of adaptability in foraging strategies and diet in different species of grouper may limit their survival in degraded coral reefs.

2. Alternative mating tactics in a grouper spawning aggregation (*Plectropomus areolatus*):

One of the most interesting finding of our work is that we were able to document novel alternative reproductive behaviours in a spawning aggregation of the squaretail grouper.

Our study documents inverse size assortment (large female fish found to associate with small males and large males with smaller females) as well as unique male and female lekking behaviours in an unfished spawning aggregation of the squaretail grouper.

While spawning aggregations of these species have been studied in other regions, few studies have looked at reproductive behaviour of individuals in spawning aggregations. Exploitative fishing is a necessary confounding factor in these studies that may strongly influence reproductive behaviours of these fish. Our study focuses on a nearly unfished spawning aggregation of *Plectropomus areolatus* and thus gives valuable insights into the reproductive behaviour of this species.

3. Traditional fisheries management practices:

Although pelagic tuna fishing has significantly overshadowed reef fishing in the past 30 years, interviews with the elderly fishermen suggest that loose forms of reef management had been practiced in the olden days. These traditional controls seem to have been practiced by using:

- **Species specific gears and nets** (a target driven fishery as opposed to the recent practices and generic gears).

- **Cooperative fishing:** where the community fished cooperatively, i.e., locations of fish catches etc. were shared between social groups. Thus, the fishing benefits were diffused across the community.
- **Atoll specificity:** Fishermen fished in an around their islands and therefore were better able to regulate fishing pressure on reefs. Currently, there is an increasing inter-island conflict between fishermen due to ease of accessing and fishing off other islands. Further documentation of such traditional practices will help inform fishing management and regulation plans in the Lakshadweep as this fishery develops a commercial market.

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

Our project did not directly engage with the local community. However, we had a few interactions with fisher folk and school children to discuss and explain our work. Discussions were held with the fisher folk in Bitra and Kadmat atolls to discuss changing patterns in fishing practices in the past 4 years. We also made presentations at Bitra and Agatti atolls to the fisher community regarding our work on grouper spawning aggregations and reef resilience. A documentary session, along with discussions was held at a school in Kadmat, where we broadly discussed coral reef ecology and fishing with the children.

5. Are there any plans to continue this work?

I plan to continue this work as part of my PhD, which I am currently in the process of registering for. The broad conceptual framework of my PhD is to predict how different grouper species respond to environmental and anthropogenic disturbances in the Lakshadweep by building an understanding of life-history characteristics and species-specific potentials for adaptability. In particular I am interested in studying the behavioral ecology of groupers in terms of their feeding and mating behaviors. I also plan to monitor and quantify fishing pressures on groupers in Lakshadweep as part of my PhD.

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

The results of our work have been shared in the form of field reports with the concerned departments. We have also made presentations of our work in a meeting with the fisher community in Bitra and Agatti. I am currently working on a manuscript for the spawning aggregation and behavioural study. Similarly, another manuscript that describes grouper distributional patterns in the archipelago is currently under peer review.

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

The project funds were used for the requested period since December 2012.

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
Accommodation: Field station	780	560	220	The difference in amount was used towards accommodation while travelling to other islands.
Boat hire/ fuel	1464	730	734	The balance amount was diverted towards living expenses and hiring dive assistants
2 Boat assistant + 1 Dive assistant	1080	1300	-220	We had to hire one part-time dive assistant. The remaining amount was adjusted from the boat budget.
Travel	730	520	210	The balance amount was adjusted with living allowance
Living allowance- 2 team members	1440	2300	-860	We overshot living expenditure as we had to invest in setting up a permanent field station
Dive equipment and maintenance	320	600	-280	Unfortunate breakdown of our dive compressor lead to over expenditure of the equipment budget.
TOTAL	5742	6010	268	

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

- Documenting the rising reef fishery in a systematic way**
 Our interviews suggest that reef fishing is rapidly increasing once again in the Lakshadweep as tuna catches have declined in the past years. As the fisheries department is incentivising reef fishery by providing storage-boxes and markets, it is crucial to monitor fish landings at its inception. Reefs are very prone to overfishing and our work shows that certain reefs are more susceptible to bleaching degradation than others. To be able to regulate reef fishing, at this stage it is necessary to monitor daily fish landings, and fishing locations, local and mainland markets etc. Looking forward I feel that monitoring and quantifying fishing pressure is one of the most important steps that needs to be taken.
- Understanding the functional importance of stable reef areas**
 Our first Rufford study has been able to identify a gradient of stable and unstable reefs (with respect to repeated bleaching disturbance impacts). However, it is necessary to understand the role and functional importance of these possible refugia to coral reefs. Future studies need to look at connectivity and migration to inform whether these stable reefs could serve as potential source areas for populations of fish and corals. From the perspective of conservation and management these stable locations could be very important.
- Monitoring and conserving grouper spawning aggregations**
 Several species of reef fish that are known to form spawning aggregations are found in the Lakshadweep. As fishing practices are moving from pelagic tuna back towards the reefs, spawning aggregations of fish will be highly vulnerable targets, unless they are identified and given protection right from the start. Identifying and monitoring spawning aggregations in

Lakshadweep through interviews and monitoring of fish catches is a necessary important step.

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 Rufford work?

Yes. The RSGF Logo was used in presentations and field reports. We have also fully acknowledged RSGF in our manuscripts.

11. Any other comments?

I would sincerely like to thank RSGF for being so flexible and supportive towards our work in the Lakshadweep in the past 3 years.