

## 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](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

Grant Recipient Details	
<b>Your name</b>	Anand M Osuri
<b>Project title</b>	Understanding the drivers of losses in carbon storage ecosystem services provided by tropical forest fragments in India's Western Ghats
<b>RSG reference</b>	11086-2
<b>Reporting period</b>	1 April 2012 to 31 December 2013
<b>Amount of grant</b>	£5977
<b>Your email address</b>	moanand@gmail.com
<b>Date of this report</b>	16 <sup>th</sup> January 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
<p>To understand the mechanisms driving tree community change and aboveground carbon storage in fragmented tropical evergreen forests through an analysis of plant functional traits.</p>			Y	<p>Plant functional traits data were collected from over 620 trees representing 94 tree species occurring within natural forests in the study site. These data were linked to vegetation plot data from contiguous and fragmented forests (collected during an earlier RSG project) for two analyses:</p> <ul style="list-style-type: none"> <li>(a) To evaluate differences between contiguous and fragmented forests in terms of species composition, forest structure and carbon storage, and</li> <li>(b) To develop statistical models that explain variation in species abundance patterns between contiguous and fragmented forests, based on plant functional traits.</li> </ul> <p>Both analyses have been completed and are in the process of being translated to scientific manuscripts in international peer-reviewed scientific journals in the field of ecology and conservation – one in preparation and another provisionally accepted pending revisions. Once published, these results will be presented as reports to local administrators and other relevant stakeholders.</p>
<p>To investigate the effects of changes in forest structure and tree species composition on soil carbon storage.</p>			Y	<p>Over 450 leaf litter samples representing at least 67 tree species and 200 soil samples were collected from contiguous and fragmented forests sites to evaluate linkages between tree community composition, leaf litter quality and soil carbon storage. The laboratory processing of these samples was completed in December 2013 and the findings will be compiled as a scientific manuscript</p>

				for an international peer-reviewed scientific journal in the field of ecology and biogeochemistry. Once published, these results will be presented as reports to local administrators and other relevant stakeholders.
To explore prospects and mechanisms for forest conservation and management within the human-dominated landscape through interactions with local communities, conservationists and decision-makers.		Y		<p>The forest fragments in this study belong to a much larger network of forest remnants, which are protected by local communities and the state as sacred groves for their religious and cultural importance. Through the study and analysis of old forest records, current forest cover maps and satellite imagery, we evaluated recent trends in the extent and forest biomass of over 200 sacred groves across 70 villages in the study area, in order to evaluate their conservation status. We interacted with over 70 members of the local community involved in sacred grove protection and management, and interviewed them about the uses, values, threats and conservation prospects associated with these groves. During these interviews, we specifically discussed cultural values and how they were changing over time.</p> <p>The analysis of these data has been completed and a manuscript is in preparation for an international peer-reviewed journal in the field of conservation biology. Once published, these results will be presented as reports to local administrators and other relevant stakeholders.</p> <p>In December 2013, we presented these findings at the annual meeting of the Coorg Wildlife Society (a leading conservation organisation in the study area) which was attended by local conservationists and forest administrators. Our presentation generated much interest and a number of the attendees with direct interest or involvement in sacred groves conservation have requested our final</p>

			<p>report. In turn, the contacts we acquired with members of the local community involved with conservation and forest management the meeting will strengthen our planned outreach and future work in the landscape.</p> <p>This objective is scored as ‘partially achieved’ because some originally proposed work on exploring conservation opportunities through payment for ecosystem services schemes was not carried out. Based on comments raised by reviewers of the original project proposal and on discussions and learnings during this project, the overall focus of this objective was aligned more towards assessing cultural values, perceptions, and conservation values, rather than monetary values.</p>
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**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).**

There were unforeseen delays in implementation of certain project components, resulting from: (1) delays in obtaining research permits from the State forest department to for fieldwork within sacred forest fragments; and (2) delays due to technical problems with elemental analysis equipment. We were requested and granted no-cost project extensions by the donors to overcome these setbacks. Further, while awaiting permits to work on state-administered forests, we commenced our project work on privately-owned forests with permission from landowners.

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

The major outcomes of the project are

- (1) Scientific insights into the processes affecting forest carbon storage in fragmented forests:
  - a. Forest carbon storage is about 40% lower per unit area in fragmented forests compared to contiguous forests. Tree stands in fragments differ substantially from contiguous forests in terms of stand structure, tree allometry and species composition.
  - b. Plant functional traits related to seed size and dispersal mode are important predictors of differences in species abundance patterns between contiguous and fragmented forests, suggesting the role of altered seed arrival patterns in structuring tree communities in fragments.
  
- (2) Insights into recent trends, habitat status and conservation prospects within the sacred grove network of south Kodagu:

- a. The network of sacred forests is greatly reduced from what is officially reported, with a declining trajectory of aboveground biomass based on satellite image analysis.
- b. Deforestation for agricultural expansion and illegal logging, possibly intensified by uncertain land tenure and evolving cultural beliefs are perceived by local communities to be important threats to the conservation of sacred groves.

(3) Functional traits database: We have assembled a database of foliar and stem functional traits for 94 dominant tree species in the study area. This database, which is the first of its kind for the region, will soon be made freely and publicly available. Additionally, a free and open source software application called Black Spot, which is a rapid and automated tool for leaf area estimation, was developed and launched during the course of the project (<http://www.ncbs.res.in/blackspot.html>). Since its launch in April 2013, Black Spot has been downloaded nearly 300 times across 45 countries.

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

One component of the project explores the perceptions of members of the local Kodava community regarding the uses, values, threats and conservation prospects associated with sacred forest fragments. Along with our assessments of the ecological drivers of tree community change and carbon losses in fragments, these results provide important insights into the challenges and opportunities for conservation and management of these groves. We have commenced efforts to communicate our findings to local conservationists and forest managers, and plan to continue these efforts.

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

Yes. Our work indicates that a combination of ecological and anthropogenic drivers acts to alter species communities and forest biomass over time in sacred forest fragments. A variety of interventions are required to ensure the conservation of these forests, requiring coordinated and sustained efforts from diverse stakeholders. Towards this end, we are exploring ideas to engage with administrators, local communities and conservation practitioners to spread awareness, garner support and instigate action for better conservation and management of sacred forest fragments.

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

(1) Scientific manuscripts published in reputed, international, peer-reviewed journals in the fields of ecology and conservation: A total of four such manuscripts are planned – (a) an assessment of the impacts of fragmentation on aboveground carbon storage, (b) identifying the functional traits that predict tree community response to fragmentation, (c) relating shifts in the functional traits of tree communities in response to fragmentation to soil carbon storage and (d) evaluating recent trends, current status and conservation prospects the sacred grove network of southern Kodagu. Of these four, one has been provisionally accepted for publication pending a revision, another is being finalised for submission, and two are in preparation.

A manuscript on the Black Spot Leaf Area Calculator was published in the international journal *Plant Ecology* in November 2013. The final version of this paper can be downloaded from

<http://link.springer.com/article/10.1007/s11258-013-0273-z>. A free, author-generated version of this manuscript may be obtained from <http://www.ncbs.res.in/node/910>.

(2) Project report: A project report synthesising all the results in a non-technical and accessible style will be prepared and published, and distributed to the State Forest Department, local temple committees, local conservation organisations and interested citizens.

(3) Meetings and presentations: We have shared our findings with local conservationists and conservation organisations through meetings and presentations and are discussing other strategies for widespread and effective dissemination of the results.

**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 grant was used over a 20 month period from April 2012 to December 2013. This included an 8 month no-cost project extension to overcome delays in obtaining research permits and technical problems with laboratory equipment.

**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
Project assistant fellowship	1892	1892	0	
Temporary field staff	262	241	21	The used amount was lower than expected because some of the tasks were carried out by volunteers or by staff employed at the PI's host institution, to whom no payments were made from the project.
Field station rent and upkeep	388	387	1	
Food during fieldwork	275	279	-4	
Domestic travel for fieldwork and meetings	131	101	30	The used amount was lower than expected because (1) the project assistant spent longer durations of time at the study site and made fewer trips between the study site and office at Bangalore, and (2) there were a wide range of bus types and fares and we often travelled on buses with lower fares than had been budgeted for.
Vehicle hiring charges	1264	1264	0	
Office supplies and stationery	36	24	12	The used amount was lower than expected because quite a few of

				these resources were left over in working condition at the end of the PI's first RSG project, and were hence carried over
Field and office equipment	262	206	56	The used amount was lower than expected because quite a few of these resources were left over in working condition at the end of the PI's first RSG project, and were hence carried over
Meetings and conferences	131	66	65	The used amount was lower than expected because the organisations with whom we had planned for our meetings and outreach bore many of the related costs.
Telecommunications; Voice and data	124	125	-1	
Printing services	13	10	3	
Publications	65	0	65	There have been no publications yet but are planned and in preparation. At present, all the project findings are being prepared as scientific manuscripts for publication in international peer-reviewed journals, after which they will be translated as reports and non-technical material for forest officials and local communities.
Plant and soil elemental analysis and soil respiration	1134	1133	1	
<b>Total</b>	<b>5977</b>	<b>5728</b>	<b>249</b>	

**Exchange rate used: 1 £ sterling = 76.35 Indian Rupees**

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

The most important next step is to maximise the dissemination of our findings. Our project has generated a number of insights into ecological and anthropogenic correlates of biomass decline in forest fragments, many of which can contribute to the wider discussions on the ecological impacts of fragmentation, forest disturbance and the global carbon cycle, and community-based conservation models. We believe that it is important that these findings be published in reputed international journals that are widely read by scientists, conservationists and policy makers, and efforts are underway to achieve this. Equally important is to utilise these results to improve the conservation of the sacred groves in the study area. This would require close collaboration with forest administrators, local communities and conservationists to plan possible conservation interventions in the light of our findings and insights. These efforts, which were initiated in December 2013, will be expanded once some pending laboratory work on leaf litter traits and soil carbon are completed and the project results are validated through the academic peer-review process.

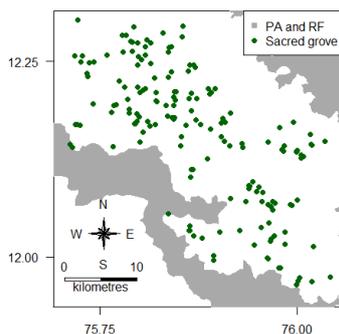
**10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?**

- The Rufford logo was used on the title slide of a presentation “Conservation of Kodagu’s Devarkadus: An ecological and social perspective”, at the annual meeting of the Coorg Wildlife Society on 6th December 2013 at Madikeri, Coorg.
- The Rufford logo was used on a poster titled “Understanding the drivers of carbon storage ecosystem services provided by tropical forest fragments in India’s Western Ghats” presented at the Rufford India Conference, 14th and 15th November 2013 at Bangalore.
- The Rufford logo was used on a poster titled “Black Spot Leaf Area Calculator” presented at the Student Conference in Conservation Science, 25th – 28th September 2013 at Bangalore. Additionally, funding support from the Rufford Small Grants programme is acknowledged on the Black Spot website (<http://www.ncbs.res.in/blackspot.html>).
- The Rufford Small Grants programme will be/is acknowledged on all scientific publications which emerge as an outcome of this project (e.g. <http://link.springer.com/article/10.1007/s11258-013-0273-z>).
- The project report for conservationists, managers and interested citizens will carry the Rufford logo and acknowledgement.

**11. Any other comments?**

1. Thank you! I have had a wonderful experience implementing my Rufford Small Grants project. I deeply appreciate the patience of the RSGF in extending my project when we were faced with unforeseen delays, and the freedom and flexibility given to me to manage the grant the way I thought best.

2. Some photographs:



*Map showing the sacred grove network of southern Kodagu*

*Anand M Osuri collecting leaf samples for functional traits analysis*



*Collection of leaf litter and soil samples for soil carbon analysis*



*Chengappa S.K. processing leaf samples for elemental composition at laboratory at National Centre for Biological Sciences, Bangalore.*



*Praveen N (right) talks to a village temple committee member about sacred groves*



*Anand M Osuri makes a presentation about conservation of sacred groves at the annual meeting of the Coorg Wildlife Society on 6th December 2013*