

Understanding the Drivers of Losses in Carbon Storage Ecosystem Services Provided by Tropical Forest Fragments in India's Western Ghats (RSG 11086-2)

Progress Report II

I have now completed 18 months of my project which commenced on 1st April 2012. I have received a three-month no-cost extension of the project to complete a few pending tasks by December 2013. In the following paragraphs, I summarise my main activities during the period from 1st May 2013 to 15th October 2013.

1. Plant functional traits data collection

12 month update (April 2013): We carried out intensive fieldwork in forest sites between October and December 2012 to collect data on seed, wood and leaf traits of native tree species. We now have data on 90 species from 720 individual trees. The plant traits dataset is nearly complete, with respect to the targets set at the beginning of the project.

18 month update (October 2013): All fieldwork components for species functional traits analysis were completed by April 2013. There are no fresh updates for this project component.

2. Laboratory work to characterize biophysical traits of leaves and wood

12 month update: Between January 2013 and March 2013 all plant material that was collected during field campaign were processed and data on wood density, specific leaf area (SLA), leaf carbon and leaf nitrogen were obtained. The sample extraction procedure for leaf phosphorus content and other leaf nutrients is currently underway.

18 month update: The time- and labour-intensive step of pre-processing samples for measuring leaf phosphorus and other leaf nutrients is complete and all samples are ready for analysis. We were unable to run the instrument to analyse the samples because of some technical problems, which have recently been resolved. Sample analysis will be completed by November 15th 2013.

3. Field work for soil carbon pools and fluxes

12 month update: During November-December 2012 we installed 20 leaf litter-fall traps across two forest fragment sites to monitor seasonal patterns in leaf litter quantity and quality in the study system. We also collected samples of freshly fallen leaf litter from 130 trees spanning 61 species. In the likely event of research permits being available to us from April 15th 2013, a field campaign to collect leaf litter and soil samples from across our study sites is planned for April-May 2013.

18 month update: Leaf litter and soil samples (190 samples each) were collected during April-May 2013 from across 13 sites. These samples are presently being processed in the laboratory to measure microbial composition and respiration rates of soils, and leaf litter and soil carbon and nutrients. Here too, there have been a few

delays due to some technical problems with instruments. The work is now slated for completion between November 15th and December 15th 2013.



Team members collect samples of forest floor leaf litter (top) and 10cm soil cores (top right) for analysis relating soil carbon storage and efflux to leaf litter quality. At right, team members at the project field station at Hudikeri, south Kodagu, prepare the soil and leaf litter for storage and transport to the laboratory.



4. Interview surveys to characterize local peoples' impact on tree species composition in forest fragments

12 month update: We have been preparing background material and complementary analyses to accompany the interview data collected in the field. The fieldwork for this is slated to coincide with the upcoming soils/litter fieldwork described above.

18 month update: During May-September 2013, we interviewed members of village temple committees across our study site. Village temple committees play an important role in managing and protecting sacred groves, many of which were sites where we conducted our ecological research. We used semi-structured interviews to ask temple committee members about the uses of and values associated with sacred groves, changes in the quality of habitat over time and current and future challenges for management and conservation. In all, we interviewed around 70 temple committee members. The interview recordings data are presently being transcribed and processed.



A team member conducts interviews about the management and conservation of sacred groves with members of sacred grove temple committees from different villages.

5. Change analysis using satellite imagery

12 month update: None

18 month update: Using forest biomass data from the vegetation surveys conducted between 2011 and present, we identified indexes based on freely available remotely-sensed data from the Landsat Program that are closely correlated with aboveground biomass. We then evaluated change in these indexes over the last decade to detect change in forest biomass of sacred forest fragments in comparison with more strictly protected areas.

6. Project outcomes

Preparation of scientific manuscripts

12 month update: Three scientific manuscripts based on data collected during this and our previous RSG are in preparation, with two nearing completion. The first, titled “Altered stand density and tree allometry reduce carbon storage in evergreen forest fragments in India’s Western Ghats” will shortly be submitted to an international peer-reviewed scientific journal specializing in issues of forest management and conservation science. This manuscript not only documents 40% less carbon stored per area in fragmented forests compared to contiguous forests, but also explores the changes in habitat structure and species composition that drive these carbon losses.

18 month update: We are working on a revision to this manuscript based on comments and suggestions received following peer review by an international scientific journal. The results will be shared once the manuscript is finalized and published in a scientific journal.

12 month update: A second manuscript on the ecological processes that filter tree communities in fragmented forests and the resultant impacts on carbon storage is in preparation and likely to be ready for submission by May 2013. This manuscript will be submitted to an international peer-reviewed ecology journal that deals with conservation topics.

18 month update: Work on this manuscript has been delayed as we await a few more results from the laboratory analysis. The revised timeframe for finalizing this manuscript is December 2013.

12 month update: A third manuscript which presents a method and a software tool to rapidly estimate leaf area is nearing completion and will shortly be submitted to an international peer-reviewed journal specializing in ecological methods. The software tool, which will be made freely available on the internet shortly, is likely to be quite useful to people researchers collecting data on plant functional traits.

18 month update: This manuscript has been accepted for publication will and appear shortly in the journal Plant Ecology. The software, called Black Spot, provides a tool and method to rapidly estimate leaf area from scanned images in a standardized and consistent manner. The free Black Spot download and other documentation can be accessed at <http://www.ncbs.res.in/blackspot.html>. Black Spot is likely to have diverse users among ecologists and conservationists working on plant science, and has already been downloaded over 160 times across 30 countries.

Features
A software and method for automated leaf area estimation from scanned leaf images

- Free
- Use off-the-shelf flat bed scanners
- Process multi-species image datasets
- Batch process
- Rapid and accurate
- No calibration required
- Output to CSV

Accuracy & Performance

100 leaf images
51 Species

Accuracy: 99.6 %

Processing time:
Manual: 220 minutes
Black Spot: 20 minutes

How it works

Automated work flow:
Calculate leaf area

Input: scanned image

Output: leaf area, leaf area percentage, leaf area ratio

Download & Install

Free to download at:
<http://www.ncbs.res.in/blackspot.html>

Download contains:
Software, users manual, original source code

Installation:
No installation required. Black Spot runs as an executable file after download

Operating system:
Designed for Windows. Run on Linux and Mac OS X with windows emulators

Support:
blackspot@ncbs.res.in
blackspot.ncbs@gmail.com

Developed by: Hema Sharma & Anand K. Das, *Ecology and Conservation Institute, Government of Karnataka, NCBS, Bangalore*

Supported by:

The Black Spot software was showcased at the 'Who's who in Conservation Science' at the Student's Conference in Conservation Science, Bangalore, India, during September 2013

12 month update: In addition, we plan to prepare at least one-two more manuscripts from the data collected during this project, the details of which will be provided shortly. We will keep RSG informed and share copies of manuscripts as and when they're published.

18 month update: We are currently preparing a scientific manuscript built around temporal change in sacred forest biomass (Section 5) and local forest managers' perceptions of past change and future threats (Section 4). This manuscript will provide a fresh perspective on the prospects for conservation in sacred groves, and we intend to publish it in a reputed international journal that covers conservation topics.

7. Future directions

12 month update: Of the remaining six months of this grant, April, May and June will be devoted to completing all field- and laboratory-related components of the project. The remaining time will be dedicated to finalizing project deliverables, including technical and non-technical material for dissemination of project findings to key stakeholders. Our plans for the same are in the process of being developed and I will provide more information on this shortly.

18 month update: Important targets for the coming three months include the completion of laboratory work and finalizing project deliverables, including the publication of scientific papers and preparation of technical and non-technical material for dissemination of project findings to key stakeholders.