Final Evaluation Report

Your Details	
Full Name	Subham Banerjee
Project Title	The maintenance of vegetation complexity in a prime wildlife habitat in the eastern Terai in India
Application ID	21980-1
Date of this Report	May 7, 2024

1. 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
Detailed sampling of vegetation using sample plots in each of the major vegetation formations.			✓	Did sampling in 70 plots in grasslands (swamp and dry), savannas and woodland.
Collection of plant voucher specimen for identification in the laboratory/herbarium.		✓		Identified most species in field. Brought samples to Lab. No Herbarium though.
Soil (top-soil) sample collection at 50 locations.			✓	Soil sampling was also done for 70 plots.
Mapping plant diversity and vegetation formations using a combination of ground data and remotely sensed data		✓		Detailed vegetation map generated via satellite data; plant diversity mapping inadequate.
Assessing habitats for important bird and mammal species that are the focus of wildlife conservation.		✓		Major habitats were mapped and assessed for fire risks and invasive plant diversity.

2. Describe the three most important outcomes of your project.

a) Detailed mapping of major vegetation formations and landcovers in Manas National Park was achieved by integrating ground-truthing vegetation surveys with satellite data. Historical landcover maps spanning 30 years were generated to assess habitat dynamics, crucial for understanding the status of grassland-specific threatened animal species.

b) Plant diversity assessments facilitated the mapping of two significant invasive species, *Chromolaena odorata* and *Mikania micrantha*, across Manas National Park. These invasives pose a threat to Terai habitat biodiversity. The up-to-date distribution data will inform management strategies for invasive plant control.

c) Soil sampling and subsequent mapping of major soil nutrients were conducted for Manas National Park. Given the pivotal role of soil nutrients in vegetation formations, these values were utilised as primary predictors to model the distribution of native and invasive plants. This study marks the first availability of soil nutrient maps for the park.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

After transporting the soil samples to IISER Kolkata for nutrient analysis, we encountered an unexpected hurdle: the CHN analyzer was non-operational. To address this setback, we swiftly rerouted the samples to NCBS Bengaluru, situated in the southern part of India in Karnataka state. There, leveraging a combination of CHN analyzer and mass spectrometer, we successfully measured crucial nutrients, including nitrogen and phosphorus.

4. Describe the involvement of local communities and how they have benefitted from the project.

I utilised the assistance of a field assistant from the local community, who supported logistics and fieldwork throughout the project. Although direct engagement with local communities was not the project's primary focus, numerous interactions occurred during its duration. These interactions involved discussions on grassland maintenance and biodiversity conservation, fostering awareness among locals. While the project itself does not directly benefit local communities, its findings are crucial for the forest department in formulating strategies for invasive plant control and fire management planning, essential for overall habitat maintenance. This indirectly benefits the livelihoods of local communities reliant on grasslands, highlighting the project's broader impact on the region.

5. Are there any plans to continue this work?

I'm planning to expand the habitat assessment work for grassland-specific animals, including the endangered pygmy hog and Bengal florican, within the Terai habitat of Manas National Park. My strategy involves leveraging an eco-acoustic approach to analyse the current distribution and density of these species. Moreover, as part of the pygmy hog conservation programme, the forest department releases pygmy hogs in new areas at various times. A critical aspect of this initiative is conducting health assessments of these potential release zones. I aim to utilise soundscape information to evaluate habitat health, thus enhancing the effectiveness of the pygmy hog release programme.

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

I have disseminated the results of my work through presentations and posters at various national and international conferences, notably including two Rufford India Conferences. Additionally, the findings, along with those from my ongoing research in Manas National Park, have been published in esteemed journals such as Forest Ecology and Management and Environmental Conservation. In these publications, I have duly acknowledged the support received from the Rufford Small Grant. Consequently, the results are readily accessible in the public domain.

Furthermore, I have communicated the findings and management implications to the Assam Forest Department through informal presentations.

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

Given the alarming 40% decline in grassland habitats crucial for the conservation of species like the pygmy hog, Indian rhinoceros, hispid hare, Bengal florican, and swamp deer over the last three decades, it's imperative to halt further degradation through effective management interventions. While our study underscores the pivotal role of fire in grassland maintenance, it's essential to strategise management fire practices to mitigate negative impacts on grassland-specific animal species.

To address this, I've already developed spatio-temporal fire patterns and a potential fire risk map for Manas National Park (Banerjee et al., 2021). Moving forward, I plan to install passive acoustic recorders to accurately inventory the habitat uses of grassland animals. By integrating the fire risk map with habitat occupancy information, we can develop a precise fire management plan for Manas National Park and other Terai habitats. This holistic approach will be instrumental in safeguarding these vital ecosystems and the species they support.

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

Yes, the Rufford Foundation logo was prominently featured in all conference posters and presentations related to this project. Additionally, in the two research articles stemming from the project's findings, I diligently acknowledged the support received from the Rufford Grant, including the specific grant application ID (21980-1). Here are the two articles:

1) Banerjee, S., Das, A., Rahman, M., Bhowal, S., Das, D., John, R., 2023. Grass fires and road structure influence plant invasions in a critical wildlife habitat in north-eastern India. Envir. Conserv. 1–9. https://doi.org/10.1017/S0376892923000024

2) Banerjee, S., Das, D., Zhang, H., John, R., 2023. Grassland-woodland transitions over decadal timescales in the Terai-Duar savanna and grasslands of the Indian subcontinent. Forest Ecology and Management 530, 120764. https://doi.org/10.1016/j.foreco.2022.120764

9. Provide a full list of all the members of your team and their role in the project.

1. Dr. Robert John Chandran - Provided invaluable guidance to ensure the project objectives were achieved scientifically. Assisted in determining appropriate statistical modelling methods for deriving significant ecological inferences from

plant survey data, soil nutrient data, and satellite data. Also contributed complementary project funds crucial for completing the project's findings.

2. Dr. Sarala Khaling - Facilitated logistical support and coordinated fieldwork activities. Contributed to plant species identification from collected samples and provided timely inputs through discussions.

3. Dwipendra Dev - Played a key role in conducting fieldwork, particularly in vegetation surveys and soil sample collection, alongside the project's Principal Investigator (PI).

4. Subham Banerjee – As Principal Investigator (PI), supervised the project thoroughly, overseeing fieldwork, soil sample analysis, satellite data analysis, and statistical modeling. Presented research findings at conferences and authored manuscripts for scientific journals, serving as the lead author and handling communication for the research articles.

10. Any other comments?

This project's findings indeed establish a solid foundation for future habitat management endeavours in Manas National Park and the broader Terai ecosystems of the Indian Subcontinent. The up-to-date land cover mapping, invasive plant distribution mapping, and soil nutrient maps generated through the project will serve as invaluable resources for subsequent work in this landscape. This comprehensive dataset will not only aid in the conservation efforts of threatened species but also contribute to the sustainable management of these critical ecosystems.