

## Final Evaluation Report

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Your Details	
<b>Full Name</b>	Tshering Dendup
<b>Project Title</b>	Patterns of Foraging Activity of Insectivorous Bats in Remnant Forest in the Sub-tropical Zone of Bhutan.
<b>Application ID</b>	25753-1
<b>Grant Amount</b>	£4994
<b>Email Address</b>	<a href="mailto:tsedup605@gmail.com">tsedup605@gmail.com</a>
<b>Date of this Report</b>	22 <sup>nd</sup> August 2018 – 22 <sup>nd</sup> August 2019

**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
Monitor bat activity acoustically and identify the most preferred habitats by insectivorous bats.				We determined bat activity by using Pettersson D240x from different habitats (forest, agriculture and remnant) and statistically revealed that the forest and agriculture were preferred more as foraging habitats than the remnant. However, species richness in the remnant is almost equal to the forest which suggest that the remnant is important for bats as the remnant might have provided shelter or might have used as navigational routes by the foragers in the time of feeding activity.
Study prey composition (Insects defined into order level) in different habitats.				Collected insects from different habitats and calculated biomass from eight different orders. We found Coleoptera, Hymenoptera, Lepidoptera and Diptera as the most dominant insect prey.
Identify the most vulnerable species to the fragmentation of forest habitats.				Out of 15 known, <i>Rhinolophus</i> spp. was one of the most abundant species recorded acoustically. However, their presence restricted to the forested habitat only which we can assume that if the fragmented habitats are further disturbed, the species are more vulnerable as compare to other ubiquities species.

**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.**

During our survey, we encountered two limitations in our field work. Firstly, inaccessibility of the study sites caused by geographical barriers such as hills and mountains and the rivers that stopped us reaching certain places for sampling. However, we followed block design methods to overcome the bias in our acoustic sampling to monitor bat activity. Secondly, due to lack of library calls from this region we faced challenges in the identification of species acoustically. However,

we used different reliable resources of established call references for the identification besides our own recorded call references.

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

1. Remnant as important habitat for bat species.

Although it was found statistically less in terms of bat activity in the fragmented forest which was monitored acoustically, the fragmented forest in the agricultural landscapes were found important to insectivorous bat as the species richness was almost equal to that of undisturbed forest habitat. Therefore, presence of fragmented forest and given the protection to those patchily distributed in the farmland may help to protect and sustain bat population.

2. Establishment of library calls from the study sites.

We used trapping methods (mist nets and harp traps) and identified the species, measured morphological characteristics of every captured species. We recorded their calls and analysed at least of five call parameters (FmaxE, end frequency, middle frequency, call duration and Inter-pulse interval) and maintained our own library calls of at least of eight different species. This would definitely help to future researcher to monitor bat population acoustically (library call will be available in the publication).

3. Conservation Implications.

In our study, we found *Rhinolophus luctus* as one of the most abundantly recorded but only from forested habitats. During our trappings, we captured *Kerivoula hardwickii* (by harp trap) from the forested area but found no single record from acoustic surveys from other classified habitats. These would mean that those species are habitat specialists and restricted to cluttered habitats. The degradation of forest or fragmented forest from the agricultural landscapes may increase the risk of local extinction of those species. Therefore, protection of forest elsewhere would directly have positive impact on the conservation of bat populations.

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

During our field surveys, we covered more than 120 sampling sites within two districts (Dagana and Tsirang). We met farm owners (maize field, rice field, orange orchard) to carry our acoustic samplings from their properties. During our meeting, we advocated the importance of insectivorous bats in the field of agriculture. We also did cave surveys to study roosting habitats (ca 20 caves within two districts, Tsirang and Dagana) with the involvement of local community. They were convinced that the conservation of bat population would benefit in terms of biological pest control which would increase the yield from their farmland. We also hired local people (Mr. Jigme Wangchuk and Mr. Bikash) as our field assistants throughout our field survey where they have learnt some skills and knowledge in the field of bat conservation. Most importantly, we involved local government in our field work whenever we have our survey falls under their jurisdiction. Thus, directly or indirectly created awareness on the importance of the conservation of bats to the community through local government involvement.

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

I do plan to investigate further in this field focusing on the seasonal variations on the feeding activity of insectivorous bats in different landscapes. It is hoped that this future research will reveal the effects of seasons on bat activity in different habitats. Furthermore, acoustic survey has proven the most effective way of monitoring bat activity, it is very important to have basis of call library from this region. Therefore, I would continue to establish call references which would enhance to work on the conservation of bat of Bhutan.

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

I have disseminated almost all our findings during my seminars (first seminar on 5<sup>th</sup> March 2019, second seminar on 2<sup>nd</sup> May 2019; at PSU, Thailand). I also made a presentation to Ministry of Education, Royal Government of Bhutan about our research work on 5<sup>th</sup> August 2019 and shared our scientific findings. I have submitted my thesis booklet to my graduate school (PSU) for the future references and soon I will submit to Ugyen Wangchuk Institute of Conservation and Environmental Research, Bhutan, to the Ministry of Education, Royal Government of Bhutan and to other relevant institutions in the country. We have submitted our findings to international peer-reviewed journals (*Journal of Mammalian Biology*) to reach the information to the scientific community of Chiroptera.

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

The duration of this project was from August 2018 to August 2019.

**8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.**

Item	Budgeted Amount	Actual Amount	Difference	Comments
Used to buy research equipment (Bat detector, harp traps, mist net, camera, alkaline batteries of 9v for Petterson D240x, AAA batteries of 1.5 for recorders, binocular, printing of thesis booklets.	2844	2844		

Payment for field assistants	1200	1340	+140	Adjusted from accommodation expenditure and from self-income.
Accommodation and transport costs for fieldwork/gasoline	950	900	-50	Used for the payment of field assistants.
<b>Total</b>	<b>4994</b>	<b>5084</b>	<b>+90</b>	Managed from self-income

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

1. Determining the checklist of insectivorous bats nationwide will be useful for the future researchers to work towards conservation and management of the bat population.
2. Dietary analysis of bats will be helpful to understand the pest control management in the agricultural landscapes so as to incorporate in the traditional organic farming system in Bhutan.
3. Study on seasonal variation may help in the management and protection of the foraging habitats of bats.
4. Study on roosts (caves) will be useful to protect their roosting habitats and the species of bats.

**10. 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?**

We acknowledged and used the Rufford Foundation logo during all the seminars and presentation with the gratitude to make ahead to the foundation in elsewhere working towards conservation projects.

**11. Please provide a full list of all the members of your team and briefly what was their role in the project.**

**Mr. Tshering Dendup**

I am the principal investigator of this research project and responsible person for all research planning and executing all research work.

**Assist. Prof. (Dr.) Sara Bumrungsri**

He was my advisors who guided my work and supported all the way from the beginning and till the completion of my research work. He also visited to my study sites during preliminary survey and guided in the execution of this scientific research project.

**Dr. Pipat Soisook, Researcher, Curator of mammals.**

I am very much indebted to him for his support and guidance, especially in the species identification and call analysis by using Bat Sound Pro 4.2.1 (Petterson Electronics and Acoustic AB).

**Mr. Lhakpa Kalden Tamang (Forest Ranger).**

He genuinely helped and taught me in the field of study mapping with regard to land use and forest coverage in my sites (Dagana and Tsirang).

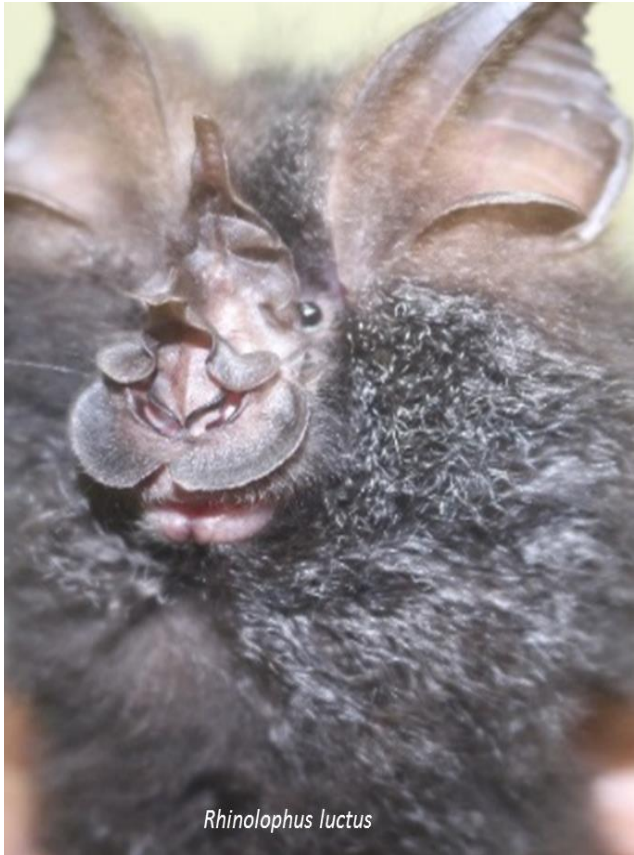
**Mr. Jigme Wangchuck and Mr. Bikash.**

Provided their support as my field assistants in my fieldworks to carry out my acoustic samplings and during cave surveys right from the beginning till the completion of my project.

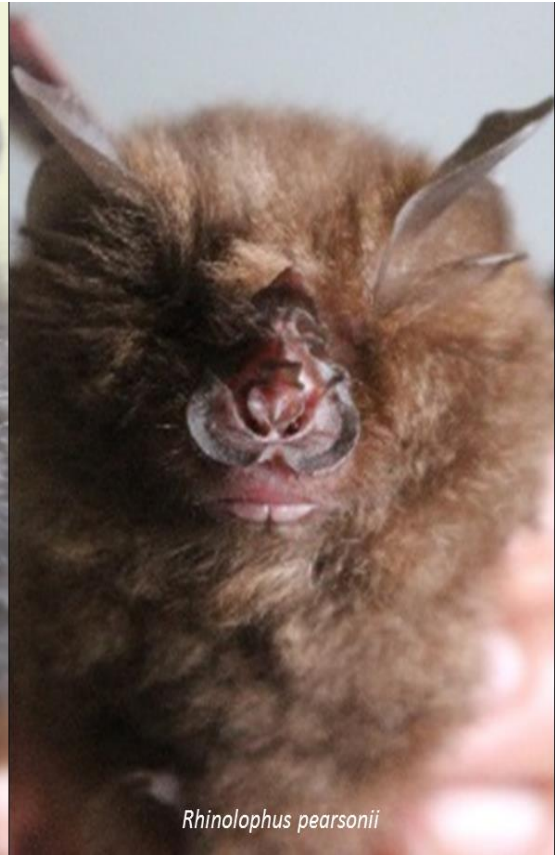
**12. Any other comments?**

We are very much indebted to the Rufford Foundation for providing financial support in this project without which our research wouldn't have completed the way it is of now. The funding support enabled us to execute our research work effectively and successfully completed on stipulated timeframe of our project. With great hopes and confident, our findings may help to work towards in better conservation and management in the field of chiropteran studies.

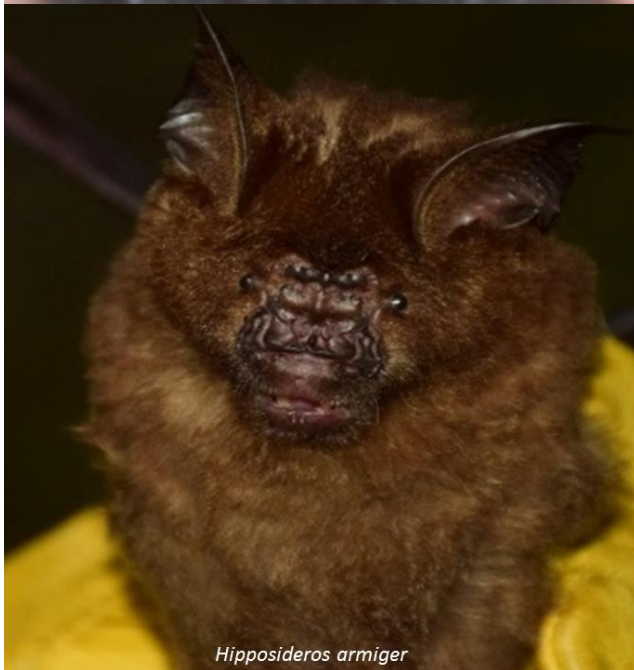




*Rhinolophus luctus*



*Rhinolophus pearsonii*



*Hipposideros armiger*



*Hipposideros cineraceus*



Mosaics of Habitats





