

Final Evaluation Report

Your Details	
Full Name	Susma Giri
Project Title	Parasite prevalence and loads across elevations in <i>Apis laboriosa</i> in Annapurna Conservation Area, Nepal
Application ID	b05e55-1
Date of this Report	7/26/2022

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
1. Distribution of <i>A. laboriosa</i> along the trail from New Bridge to Annapurna Base Camp.				Data on distribution of <i>A. laboriosa</i> hives were collected based on self-observation (GPS points) and/or questionnaire interview with the local people or honey hunters as well as focus group discussion.
2. Parasitism across elevations and seasons in <i>A. laboriosa</i> .				Among the proposed testing of five parasites viz.: <i>Nosema ceranae</i> , <i>Crithidia</i> sp., <i>Varroa</i> mite, conopid fly larva, and <i>Acarapis woodii</i> in <i>A. laboriosa</i> (N = 79) between 1265 and 1898 m asl elevations during three field trips (two seasons: Spring and Summer), we detected <i>Varroa</i> mite in one bee from high-elevation in May 2019 and <i>Crithidia</i> sp. in four bees from low-elevation in April 2021. Given the lack of comparable data, we were unable to compare parasitism across elevations and seasons in <i>A. laboriosa</i> .
3. Increasing awareness on <i>A. laboriosa</i> among the local people and other stakeholders.				By conducting the symposium (see objective 6) and focus group discussion with the local people, and by presenting the output of this work at various conferences and meetings, we believe this study has helped to increase awareness on <i>A. laboriosa</i> among the stakeholders. We are currently preparing a few flyers to share information on <i>A. laboriosa</i> and brochures for distribution to the park visitors and add information on the websites as we had proposed.
4. Training undergraduate/graduate students				This study has supported/trained one undergraduate student and one graduate student to complete their theses. Likewise, a few undergraduate and graduate students were trained in field work and laboratory

				procedures for the detection of aforementioned parasites.
5. Training a group of high-school and undergraduate students in identifying some bee parasites using microscopes.				Given Covid-19 restrictions, we couldn't train any high-school student in identifying bee parasites using microscopes. However, a few undergraduate students were trained.
6. A symposium on pollinators targeting students, researchers and policy makers.				A symposium on "Pollinators for sustainable livelihoods" was successfully organised (on 19 th October 2019) as part of the 4 th International Conference on Mountains in the Changing World (18 th -19 th October 2019). A total of five talks (one invited and four research works) presenting information about pollinators were delivered to an audience of >25 from different institutions/organisations and countries and included students, researchers and influencers.

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

- a) For the first time, we report the infestation with *Crithia* sp. and *Varroa* mites in *A. laboriosa* of Nepal. We show that the wild *A. laboriosa*, that are considered to be comparatively less affected by various anthropogenic activities, are infested with parasites, even though at lower rates. This indicates an increased risk to *A. laboriosa* populations at the study site given the possibility for infestation spill over to other populations, ultimately leading to higher infestation rates in future.
- b) Using the Landsat images and calculating Normalized Difference Vegetation Index (NDVI) for 1990, 2000, 2010, and 2020, we found that the water bodies have shrunk by more than half in 2020 compared to 1990 (See Fig. 1 below). Considered an important resource for the bees, this decrease in water resources, along with a drastic increase in built-up area may be among the important causes of decline in *A. laboriosa* populations as the respondents/local people had expressed.
- c) Local people are mostly aware of the decreasing *A. laboriosa* populations and consider land conversion along with the loss of native forests, unplanned and haphazard constructions, and overexploitation/honey hunting to be among the major threats to these bees in the study area. While many local people have increased plantations of bee-favoured crops/plants in the past 5 years to help wild bee conservation, they do believe that the intervention by other stakeholders including the Government of Nepal is a must for the desired conservation output.

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

The project began in January 2019. As proposed, first field trip was completed in April, second was a little late in August 2019 considering weather conditions of the field site and to include seasonal effects in our study. The third field visit was delayed until March 2020 due to various technical and weather issues. As we were ready for the third and last field trip, Covid-19 hit the world and Nepal was highly affected too. Due to the risks and uncertainties caused by COVID-19 and multiple lockdowns in Nepal, our last field trip was finally completed in April 2021. We faced challenges in the lab work too. Although dissection was easily completed, PCR analysis of samples took us almost 1 year to complete. PCR analysis in our bees were performed in collaboration with another institution. Because this study is the first of its kind in Nepal, figuring the appropriate method based on those applied in other countries and in other bees, was a challenge. While the analysis should have been completed within a few weeks if everything worked out, various issues such as: having to order primers from abroad, lack of positive samples in Nepal and as such, having to request DNA extract from the infected samples from abroad, and several other technical issues led to a prolonged time in figuring out the appropriate lab procedures. Later, we also decided to compare parasitism in wild *A. laboriosa* with domesticated *A. cerana* and *A. mellifera* which added a week or two to the research period.

However, our hard work has paid off and we have finally completed the project successfully. We are thankful to The Rufford Foundation team for being understanding with our requests for multiple extensions of the project period.

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

The members of the local community had actively participated during the course of the field work from informing about and guiding us to the beehives to questionnaire survey and key informant interview. The local people were very welcoming and helped us with other logistics as well. Through focus group discussion with over 40 households from four villages: Chhomrong, Tualung, Kyumi, and Bhrujungkhola/Sardikhola, we exchanged our knowledge about *A. laboriosa* and threats to them. The communities were concerned about the decrease in bee populations and the total amount of honey harvested and are hopeful towards the better management of both domesticated and wild honeybees in the future.

5. Are there any plans to continue this work?

Definitely. In the light of early stage of infestation by microsporidian *Crithidia* sp. and an external mite in the wild *A. laboriosa*, I believe that a large-scale study with larger sample size (79 wild bees in this study) and broader range of species (including commercial bees), at greater temporal and spatial scale is necessary. Further, we are working on getting some help from researcher abroad who are working on PCR analysis of parasitism in bees. Once finalised, I expect the lab procedure to be short and to-the-point. As such, we should be able to perform more analyses in shorter time.

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

The results obtained from this research are (and will be) shared through various means including article publications, thesis reports, reports to the conservation area and Department of National Park and Wildlife Conservation, symposia, conference presentations and social media.

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

Some important next steps are:

- i. Sequencing of the samples that are found to be infested with *Crithidia* sp. for confirmation.
- ii. Preparing and publishing an article on the parasitism in *A. laboriosa* of the Annapurna Conservation Area.
- iii. Planning for future research to continue and understand parasite infestation in *A. laboriosa* as we see infestation at an early stage that might expand in future.

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 logo of The Rufford Foundation was used and acknowledged in all of the oral and poster presentations, banners prepared for the symposium and in the thesis report of the student supported by this grant. The Rufford Foundation logo will be used in the brochures produced and in the websites with information on *A. laboriosa*. Likewise, the foundation will also be acknowledged in any article publications that we envision. As such, I believe that the Foundation received good publicity during the course of this project.

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

Name	Description	Role
Susma Giri	Principal Investigator	Project design, implementation, supervision, analysis, & report writing
Bhumika Acharya	Graduate student (working on her MSc thesis)	Field work, lab work, questionnaire design, and analysis
Mitesh Shrestha	Research coordinator at Research Institute for Bioscience and Biotechnology	Supervising PCR analysis of the samples.
Arjun Limbu	Undergraduate student (working on his BSc thesis)	First field work and data compilation

Meena Saru, Sagar Giri, Sagar Chaudhary, Suresh Kunwar	Field Assistants	Assisting Bhumika Acharya in her field work
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10. Any other comments?

I take this opportunity to thank The Rufford Foundation for supporting research like this in pursue of nature conservation. This grant is among the first two grants I received as I began my career in 2016 and has been crucial to advance my research work in Nepal. As such, the foundation has been very helpful to early-career researchers like me. While ideally, it would have been wonderful to complete the project as proposed, various unforeseen circumstances led to a prolonged project-period. I highly appreciate the flexibility exercised by the foundation.

I am also thankful to the local people of the study area for sharing their valuable knowledge and time.

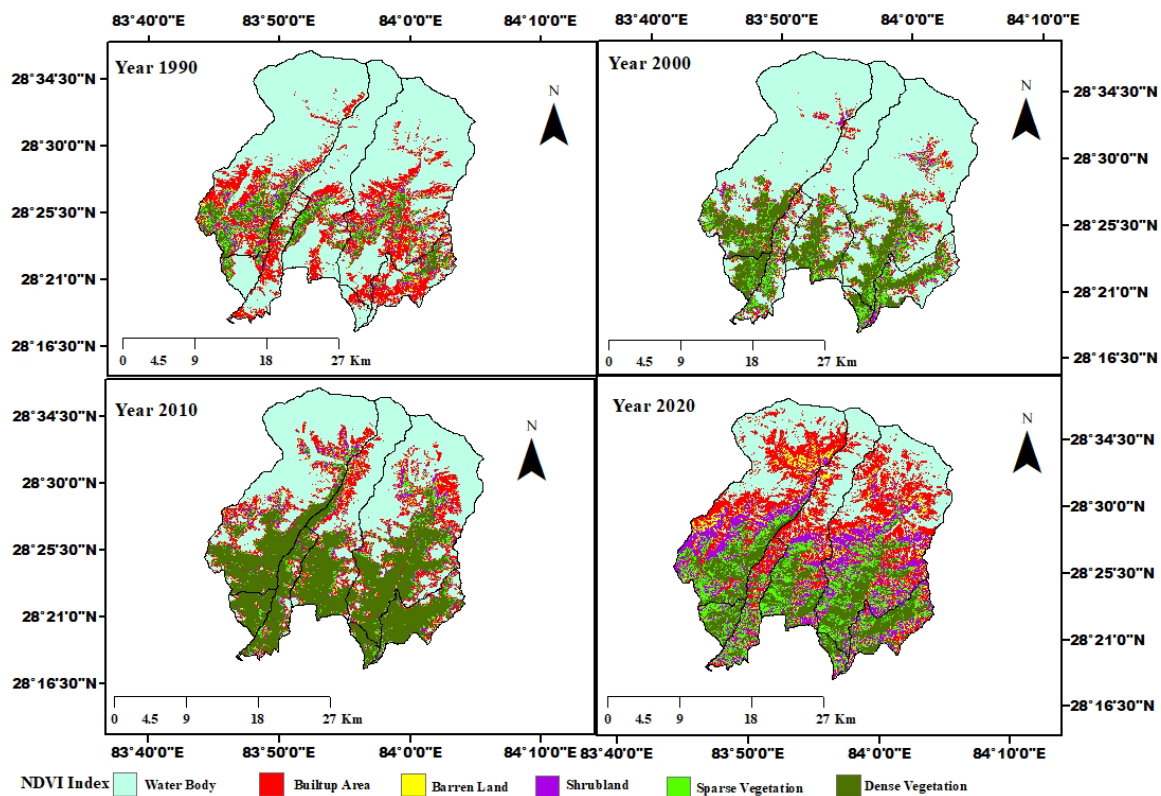


Figure 1: NDVI map of the study area from 1990 to 2020 AD.