

Final Evaluation Report

Your Details	
Full Name	Lorena Bueno Valadão Mendes
Project Title	Conservation of native bees and plant species from the endangered Campos Rupestres, with emphasis on specialized buzz-pollination
Application ID	30327-1
Date of this Report	March 03, 2022

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

The aim of the study was to describe the relationship between pollinators and *Chamaecrista* plant species in the Campo Rupestre. Therefore, our study was intended to achieve the following objectives:

Objective	Not achieved	Partially achieved	Fully achieved	Comments
(i) investigate the diversity of <i>Chamaecrista</i> plants that occur in the campo rupestre and their specialized bee pollinators				Throughout my fieldwork, which lasted from February 2020 to March 2022, I was able to record 19 species of <i>Chamaecrista</i> , some of them endemic to Minas Gerais state (<i>Chamaecrista distichoclada</i> , <i>C. monticola</i> , <i>C. rotundata</i> , <i>C. hedysaroides</i> and <i>C. debilis</i>) and endangered in the Campo Rupestre (<i>C. bracteolata</i>). I was able to record 33 bee species visiting and collecting the pollen of flowers. With these results, we will be able to contribute to the conservation of these species.
(ii) evaluate the importance of species (generalists and specialists) in the dynamics and maintenance of the pollination network				The objective was achieved. The results have already been analysed. I finished the analysis and building of the plant-pollination network to help me better understand the functional role of native bee species in the community of Diamantina's Campo Rupestre and pollination service. And then, the manuscript is in the writing process.

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

a). There is a large diversity of plant species – until now, I found about 20 *Chamaecrista* species in the area. The plant species are visited by a great diversity of bees. These bee species are essential to the maintenance of pollination of many other plant species, including crops. So, the conservation of these *Chamaecrista* species is critical to the maintenance of Campo Rupestre vegetation and ecosystem services.

b). There is a diversity of bees visiting *Chamaecrista* flowers – I discovered 33 different species of bees visiting the flowers. It is a good result and shows that *Chamaecrista* is an important pollen resource for the bees.

c). The difference in the efficiency of visiting bees in the pollination of *Chamaecrista* plants – during this fieldwork I investigated the efficiency of each bee in removing and depositing pollen grains in the flowers. With these results, I noticed a difference in the pollination efficiency of the bees that visit the plants. This difference can have an impact on the maintenance of these plant species if there is a sudden reduction or extinction in some bee species.

These results can help to fill essential gaps in knowledge of the Campo Rupestre biodiversity and will help to effectively implement conservation or restoration programmes, considering that knowledge of the biodiversity of ecosystems and interactions is an important basis for conservation. Understanding the processes that modulate community dynamics is relevant for the maintenance and conservation of plant and pollinator species as well as the ecological processes in which they are involved. Furthermore, these results can help to improve our ability to predict the impacts of changes in natural environments (such as loss of native vegetation and introduction of exotic species) on the functioning of communities and consequently on ecosystem services.

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

The Coronavirus pandemic created many logistical difficulties, which delayed the schedule of the project, especially as I was myself infected, precluding going to the field according to the plan on one occasion. I had to reorganise the field schedule, but it did not affect the development or the results of my project. Moreover, in another occasion, very strong rains that destructed the road we take to get to the field also contributed to slightly delay our schedule. Besides that, I did not have any unforeseen difficulties during the development of the project.

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

A small part of the grant was directed to NGO Biotropicos its' located in Diamatinas' city. Biotrópicos disseminates the importance of biodiversity and conservation of Campo Rupestre through art, science, and socio-educational actions and this project will help it continue with this amazing job with the local community in Diamantina as well. Through this collaboration, I believe that we made an impact on how the local people see the importance of plants and pollinators in maintaining the environment of Campo Rupestre. Besides that, during the fieldwork I always had contact with local communities, considering the Campo Rupestre area is inside of Diamantina's city. In this contact, the community had a lot of curiosity about what I was doing, and I always explained the importance of bees, native plants, and conservation of biodiversity and Campo Rupestre. Finally, I also proposed to show the results to the local community through short talks for students at the local schools. I conducted short talks for students of the local community, and I

constructed a game that I attached to the email, that I played with the students after the talks. This game was also shared on social media. I showed them the importance of Campo Rupestre preservation for the maintenance of ecosystem services, throughout the talks and the game.

5. Are there any plans to continue this work?

Yes, this project is part of a PhD thesis research and I have one year to finish it yet. I still have a lot of data to analyse the results using different software, like R, for statistical analysis and construction of the graphics. It will help me to understand and describe the pattern of pollination interactions that I investigated this year in Campo Rupestre area. I have been conducting research on plant-pollination interactions since my masters' degree and I pretend to continue. Furthermore, I want to continue disseminating the acquired knowledge about plants, bees, pollination, and their importance for biodiversity maintenance for local communities.

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

To the local communities, in addition to the game that was created and continues to be constantly promoted through social networks, I intend to create an educational video that will be shown in short talks for students in the region, and also on my social media. My main objective is to reinforce the importance of pollination, plants, and bees for the maintenance of ecosystem services. Additionally, I created an Instagram account where I post frequently pictures and informative texts about Campo Rupestre biodiversity. I pretend to continue this activity to reach different kinds of people. Finally, I pretend to prepare interactive material about plant and bee diversity in the Campo Rupestre. These materials will be disseminated through social media.

To the scientific community, I will write and prepare papers to publish in good journals about ecology and conservation. I pretend to submit papers in: Ecology, Ecology letters and Biological Conservation.

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

I believe that the important step is to disseminate the results, both scientific and local community. For Scientific communities, writing and published papers. I hope my results about this type of interaction may support further studies at Campo Rupestre. Besides that, with these results published in scientific journals, I hope to fill some gaps that have in the literature about plant species, and this restricted pollination system that I studied. For the local community, keep sharing on social media the game, video, and photos with information about Campo Rupestre.

I think that these results are important to make conservation measures more effective.

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, during 2020 and 2021, I presented two talks at the Federal University of Uberlândia about the interactions between the flowers of the *Chamaecrista* species and visiting bees. In November 2021, an article was published in the journal Plant Biology involving the investigation on the evolution of morphology and function of the flowers and interaction networks including plants and buzzing bees (<https://doi.org/10.1111/plb.13359>). In October of 2022, I submitted and presented one abstract for Simpósio Brasileiro de Polinização. As I mentioned before, I created an Instagram account where I have frequently posted photos and informative texts about the biodiversity of the Campo Rupestre, including plants of *Chamaecrista* and bee species (<https://www.instagram.com/campo.rupestre>).

In all these activities, I emphasised the participation of The Rufford Foundation and published the Rufford Foundation's logo when possible.

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

Pietro Kiyoshi Maruyama Mendonça (professor at the Federal University of Minas Gerais) and **Vinicius Lourenço Garcia de Brito** (professor at the Federal University of Uberlândia) are my Ph.D. thesis advisers. They participated in all the implementation of this project. We had monthly meetings to discuss better methods to apply in the field stages and advances in data collection. Besides that, they always helped me with the theory that I needed to develop all the stages of the project. They gave me all the support that I needed to develop this project and for my Ph.D. research.

André Rodrigo Rech (professor at the Federal University of Vales do Jequitinhonha e Mucuri) is our collaborator and provided all the logistical and structural support of the laboratory to carry out the research. During these months, I always used André's laboratory for processing the field material. Besides that, I had support from some of his students in some stages of the field.

NGO Biotrópicos (a non-governmental organization located in Diamantina) received the grant directed by Rufford to me and did all the bank transmits to transfer the money to my account. So, this was an important collaborator, and I am so thankful to Alexander and his NGO.

10. Any other comments?

I am so thankful to The Rufford Foundation. This grant provided to me was essential to the development of my project. With these results, I can understand better how this specific buzz-pollination behaviour modulates the interaction with natural *Chamaecrista* plant species considering that this study system from the Campo Rupestre includes many endemic bees and other pollinator species. Furthermore, now I can publish the results of interactions in scientific journals and disseminate the information gathered to the local public, indicating the importance of conserving native species for maintaining pollination and ecosystem services. To finish, I want to

share some pictures that I could take during this year collecting data that I attached in the email.

Plant species	IUCN category	Obs.
<i>Chamaecrista bracteolata</i>	Endangered	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista monticola</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista ramosa</i>	Not Evaluated	Large distribution.
<i>Chamaecrista rotundifolia</i>	Not Evaluated	Large distribution.
<i>Chamaecrista flexuosa</i>	Not Evaluated	Large distribution.
<i>Chamaecrista debilis</i>	Not Evaluated	Until now, is endemic of Cerrado and Campo Rupestre.
<i>Chamaecrista hedysaroides</i>	Least Concern	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista nictitans</i>	Not Evaluated	Large distribution.
<i>Chamaecrista desvauxii</i>	Not Evaluated	Large distribution.
<i>Chamaecrista rotundata</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista distichoclada</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista olesiphylla</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista rossicorum</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista tragacanthoides</i>	Not Evaluated	Until now, is endemic of Minas Gerais and Campo Rupestre.
<i>Chamaecrista nictitans</i> var.2	NA	Species still in the process of identification by specialists.
<i>Chamaecrista ramosa</i> var.2	NA	Species still in the process of identification by specialists.
Ch. sp.9	NA	Species still in the process of identification by specialists.
Ch. sp.20	NA	Species still in the process of identification by specialists.

Bee species	Obs.
<i>Acampopoeum prinii</i> (Holmberg, 1884)	
<i>Apis mellifera</i> Linnaeus, 1758	
<i>Augochlora (Oxystoglossella)</i> sp.05	Species still in the process of identification by specialists.

<i>Augochloropsis</i> sp.49	Species still in the process of identification by specialists.
<i>Augochloropsis</i> sp.50	Species still in the process of identification by specialists.
<i>Augochloropsis</i> sp.51	Species still in the process of identification by specialists.
<i>Augochloropsis</i> sp.52	Species still in the process of identification by specialists.
<i>Augochloropsis</i> sp.53	Species still in the process of identification by specialists.
<i>Bombus</i> (<i>Thoracobombus</i>) <i>morio</i> (Swederus, 1787)	
<i>Bombus</i> (<i>Thoracobombus</i>) <i>pauloensis</i> Friese, 1913	
<i>Caenohalictus</i> sp.01	Species still in the process of identification by specialists.
<i>Centris</i> (<i>Hemisiella</i>) <i>tarsata</i> Smith, 1874	
<i>Centris</i> (<i>Hemisiella</i>) <i>trigonoides</i> Lepeletier, 1841	
<i>Centris</i> (<i>Ptilotopus</i>) <i>scopipes</i> Friese, 1899	
<i>Centris</i> (<i>Trachina</i>) <i>fuscata</i> Lepeletier, 1841	
<i>Centris</i> (<i>Trachina</i>) <i>rupestris</i> Azevedo & Silveira, 2005	
<i>Ceratina</i> (<i>Ceratinula</i>) <i>minima</i> Friese, 1908	
<i>Dialictus</i> sp.13	Species still in the process of identification by specialists.
<i>Exomalopsis</i> (<i>Exomalopsis</i>) <i>nalis</i> Spinola, 1853	
<i>Exomalopsis</i> (<i>Exomalopsis</i>) <i>fulvofasciata</i> Smith, 1879	
<i>Exomalopsis</i> (<i>Exomalopsis</i>) <i>tomentosa</i> Friese, 1899	
<i>Melipona</i> (<i>Melikerria</i>) <i>quinguefasciata</i> Lepeletier, 1836	
<i>Oxaea flavescens</i> Klug, 1807	
<i>Paratetrapedia lineata</i> (Spinola, 1853)	
<i>Paratrigona subnuda</i> Moure, 1947	
<i>Pseudaugochlora flammula</i> Almeida, 2008	
<i>Pseudaugochlora graminea</i> (Fabricius, 1804)	
<i>Ptiloglossa</i> sp.05	Species still in the process of identification by specialists.
<i>Thectochlora alaris</i> (Vachal, 1904)	
<i>Trigona braueri</i> Friese, 1900	

<i>Trigona spinipes</i> (Fabricius, 1793)	
<i>Xylocopa</i> (<i>Dasyxylocopa</i>) <i>fortuita</i> Melo, 2017	
<i>Xylocopa</i> (<i>Diaxylocopa</i>) <i>truxali</i> Hurd & Moure, 1963	
<i>Xylocopa</i> (<i>Neoxylocopa</i>) <i>hirsutissima</i> Maidl, 1912	
<i>Xylocopa</i> (<i>Schonherria</i>) <i>subcyanea</i> Pérez, 1901	