

Final Evaluation Report

Your Details	
Full Name	Maiara Vissoto
Project Title	Conservation of frugivorous birds and native plants in a tropical urban area
Application ID	34977-1
Date of this Report	January 25th, 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
Recording the plant species and the birds that consume their fruits in greenspaces (such as fragments of native vegetation and managed spaces) across the urban area of Campo Grande throughout two years.				We have finished data collection, organised the material and now I am in the stage of disseminating these results to the local community, specialists, and decision makers.
Measure functional traits of plants in the field and of birds in museums				We have finished data collection and organised the material.
Measure characteristics of the urban landscape				We have finished the characterisation of the landscape in the urban area of Campo Grande. However, given the difficulties to adjust the method for detecting green and impervious coverages, it took longer (6 months) than we first expected.
Identify birds and plants				All plant species and birds that consumed their fruits were identified. However, we would like to highlight that plant identification took longer (6 months) than we expected, as species in some plant families were more challenging.
Assemble multiple networks of interactions for each sample unit (24 in total)				After identifying all plants and frugivorous birds, we also completed the assembly of multiple interaction networks (n=24), one for each sampling unit.
Take a course on analysis of functional and phylogenetic diversity				Due to the Covid-19 pandemic, the course on analysis of functional and phylogenetic diversity was postponed and it was not possible to participate.
Analysis				I have recently completed the statistical analyses of the collected data and am now finalising the writing

			of my PhD thesis, which is related to this project.
How the functional and phylogenetic diversities of frugivorous birds and plants vary in these locations			We have examined the effects of the urban land use gradient on the functional diversity of plants and birds. Now I'm writing a manuscript about how the urban landscape influences these parameters, and if they, in turn, play a role in structuring interaction networks. In general, functional diversity corresponds to greater variation in morphological attributes that is desirable for the performance of ecosystem functions.
How the availability of fruits throughout the year can affect the conservation of animal-plant interactions in these locations			Our data showed that some green spaces present temporal gaps in fruit availability. Plants with fleshy fruits are food for many birds in the rainy season, whereas dry fruits (such as legumes) provide food items in the dry season. Therefore, planting species that fill these temporal gaps in fruit availability is important for the conservation of frugivorous birds.
Provide insight into the landscape-scale processes that influence bird in highly modified ecosystems			We identified that some measures of diversity of food resources of frugivorous birds (such as Shannon diversity and Pielou equitability of plants) are positively influenced by tree and shrub cover. Furthermore, Pielou equitability of plants decreases with increasing impervious surface coverage in the landscape surrounding the studied green spaces.
Start writing articles, reports, abstracts for meetings			We have already started the writing of the manuscript reporting the results related to this project. We also aim to present these results in an international symposium ("8th Frugivores and Seed Dispersal Symposium") that will take place in August.
Disseminate results to the local populations, to decision-making agents and other that are concerned with the conservation of birds and			We finished the preparation of the pocket guide presenting the main species of attractive native plants offering fruit resources for the avifauna occurring in the urban area of Campo Grande. We are now waiting for the

management of remnants of native vegetation			printed copies to start its dissemination. We intend to distribute it at IMASUL and SEMADUR (entities in charge of the administration of green spaces in the municipality). Also, we will distribute it to the population participating in a local birding event which will occur between February and March 2024, as well as other events like this throughout the year. Furthermore, we are planning to disseminate the results and explain the importance of conserving native fruit plants to children in conservation units, where fieldwork was carried out.
Disseminate the acquired knowledge in plant-animal mutualisms and their implications for the conservation in urbanized areas by presenting talks in different scientific and outreach events.			We intend to present results of this research at the "Frugivores and Seed Dispersal Symposium", an international scientific event that will take place in August 2024. Registration in the event have already been completed.

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

Probably due to the connectivity of green spaces and conservation units within the urban area, Campo Grande is home to a great diversity of plants (n = 84 species) and frugivorous birds (n = 70 species). I believe that the most important result of the project was to have carried out a survey of plants that are attractive to birds over a long period of time. Therefore, through the analysis of interaction networks we can observe that there are very important plants for the frugivorous birds community, representing key plant species for cultivation in private gardens or public green spaces.

Furthermore, through the analysis of functional and phylogenetic diversity measures, we were able to recognise some facets of diversity that are important for maintaining interactions in urban areas. For example, the functional richness of plants can provide us with information about missing morphological traits, which allows us to suggest some management strategies in favour of conserving interactions between species in the green infrastructure of urban areas.

Among plant species, *Cecropia pachystachya*, *Trema micrantha*, *Myrsine guianensis*, *Miconia albicans*, *Inga laurina* and *Schefflera morototoni* were the most important species for the maintenance of frugivorous birds in the community. This is because these species fructified for longer periods of time and/or produced large amounts of fruit (resources) for the birds.

I think this study will highlight the importance of fruits for conservation of high diversity of birds (including threatened species) in tropical urban landscapes.

In a personal aspect, learned to use tools that I had never used before, such as those related to the landscape analysis as the QGIS, which was enriching for me. I also learned a lot about plant identification. It was very challenging for me, since I was more familiar with birds. Finally, I had contact and strengthen collaboration and friendship with wonderful people that took part in different phases during this project.

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

During data collection, one of the difficulties was the personal security in some of the sampled locations. Sometimes even when accompanied, I had to cancel the data collection and reschedule for another day, due to potential insecurity. Another negative aspect is in relation to time management. I often planned to complete some activities right after the field, such as measuring fruits in the laboratory, organising the data, and carrying out the procedure to dry plant branches and assemble exsiccates. But it wasn't always possible, and I had to postpone some activities that I thought would be faster. Another difficulty during field work was collecting fruits from high trees (> 20 m tall). Sometimes I managed to find the fruits in the litter or lawn, other times, I photographed the fruits and their branches. These actions made it possible to reach the species level of most of the species.

One obstacle we faced was the time to identify the plants. We recorded more than 80 plant species being consumed by frugivorous birds, some of which are present in the pocket guide. Some of these species belong to families (such as Myrtaceae) or genus (such as *Ficus* spp.) that are difficult to identify. With the help from experts, we reached the species level for most species, but this took an unexpected amount of time.

Another difficulty was characterising the urban landscape in terms of land use at a fine scale. The first two methods tested presented some problems: in the first we tried a manual procedure, which was very time consuming, and it would be difficult to reach the established deadlines to deliver the results. The second method provided a classification of the landscape on a very "coarse" scale, and for our purpose it would not serve. We continue to search for alternative ways to extract these measurements and found the called "supervised classification". In this method, the landscape classification is made by extracting pixel samples for each class of land use (such as trees, streets, water bodies and others). However, the pixel size did not allow us to detect landscape details (such as the paved streets). The alternative that worked was to use the NDVI (Normalized Difference Vegetation Index) and NDBI (Normalized Difference Built-Up Index), which were the most promising for characterizing the landscape according to our objectives.

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

As I worked in public green spaces, people who walked through the green areas interacted with me, interested in my project. It was gratifying to hear them talk about the birds that visit their gardens, other green areas near their homes, and other fruits that they were saw feeding on. It was also very interesting the appreciation of the population with the macaws that pass through the streets or even in their gardens. Indeed, in cities people are often involved in their work routine, but when a macaw flies by, it takes the Campo Grande people's eyes away to glimpse such beauty. We are looking forward to sharing the results and talking about birds with the community, we hope that this sparks their interest in cultivating native plants in their yards. It will be a great step forward. Planting trees not only involves offering resources and shelter for diversity, but associates with numerous ecosystem services (such as temperature reduction) that benefit the human population and minimise environmental impacts. The distribution of the pocket guide is scheduled to take place from February 2024 onwards. We believe it will be very useful to provide guidelines for the local population interested in attracting frugivorous birds to their yards, and also for the decision makers, in planning urban green spaces more attractive for the fauna inhabiting the city.

5. Are there any plans to continue this work?

Yes, this year we intend to present our results to experts, in an international symposium, and incorporate their suggestions/criticisms into the articles we will submit for publication. We also intend to present these results in birdwatching events and continue the dialogue with the local community.

After the previous step, we intend to use the data set, which is large, to answer new questions we asked along the way of this project.

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

We will distribute pocket guides to the local population interested in attracting diversity to their homes, to people interested in birdwatching, and also to managers of urban green areas in the city of Campo Grande. Furthermore, even when we run out of copies of the pocket guide, we will make it available for download via the internet. The dissemination will begin between February and March 2024 in a birdwatching event, where we will talk about the importance of the conservation of green areas providing food resources for birds. Furthermore, we intend to expose the importance of the results for management in favour of the conservation of frugivores and actions to optimize ecosystem services. Finally, we will present partial data from the work at a symposium (Frugivores & Seed Dispersal Symposium <https://www.fsd2024.com.br/evento/fsd2024/home>) and disseminate the achieved results to the scientific community through the publication of papers in specialised journals.

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

Now I am focusing on writing the articles for my PhD thesis, to disseminate the results of this project for the scientific community. Regarding the dissemination of the work to the local community, we consider that the birdwatching activities can reach the population interested in the conservation of native plants, as they represent the food resources for preserving frugivorous birds inhabiting the city. We strongly believe that this birdwatching activity aimed at children can trigger awareness of nature. Finally, communicating our results for managers will support actions enhancing the attractiveness of green spaces for the fauna inhabiting the cities.

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, we use the logo on: (i) the pocket guide we are producing and that will be distributed to the community and to the people in charge of the management of green areas in the city of Campo Grande, (ii) in the abstract and on the slides/banner presenting the preliminary results of this project in the Frugivores & Seed Dispersal Symposium <https://www.fsd2024.com.br/evento/fsd2024/home>; (iii) in the presentation of my PhD thesis, and (iv) and in the acknowledgements of the resulting manuscripts we included explicit mention to the grant reference number. In addition, we expect that the data set can result in other articles, and The Rufford Foundation will be acknowledged in every scientific publication stemming from this project.

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

M.Sc. Maiara Vissoto – Involved in conceptualisation of the study, designing the study, conducting field data collection, data analyses and report writing.

Dra. Andrea Cardoso de Araujo – Ecologist and the project's guiding supervisor. Her expertise is on plant-animal network interactions. She supervised me in this project, providing guidance on defining the study questions and experimental design, overseeing the data collection process, guiding the statistical analysis, and interpreting obtained results.

Dr Pietro K. Maruyama - His expertise is on network interactions between plants and pollinators. He is my co supervisor in the PhD and helped me providing guidance on defining the study questions and experimental design.

Field Assistant:

Tainá Boschi

Nayara Morais

Beatriz Carneiro

Gabriel Tirintan

Carlos Alberto Castro

Aléxia Murgi
Hugo Cabral
Evaldo Benedito de Souza
Maristela Benintes
Simone Mamede

These people are some of those who accompanied me, in doing so they provided security and spared no effort to help.

Laboratory assistant:

Pablo Pinheiro Dutra
Fabio Bolzan

These people contributed, giving instructions and tips for using the QGIS tool, as there are some steps that are not learned in courses.

Rafael Antunes Dias

My supervisor in the master's degree, even from a distance, helped me extract the phylogenetic diversity index.

Flávio Macedo Alves

Professor and doctor in the botany department, he helped me a lot in being able to successfully identify plants.

Assistance in publishing results:

Instituto Mamede: Pesquisa Ambiental e ecoturismo

10. Any other comments?

I would like to thank The Rufford Foundation for the opportunity, I am very grateful for the financial support and for believing in the potential of this project. Thank you very much! I hope to do my best in publicising this work so that it can result in actions in favour of conservation.



Photo of a copy of the pocket guide created by the publisher.