

Final Evaluation Report

Your Details	
Full Name	Cíntia Fernanda da Costa
Project Title	Bats of the neglected Brazilian-Uruguayan savanna: occupancy, diversity and conservation
Application ID	28810-1
Date of this Report	May 23, 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. To Uncovering the hidden bat diversity of the Brazilian-Uruguayan savanna through acoustic detection				We monitored 68 sites located at least 1.5 km apart, for 5 nights at each site, during the spring and summer of 2019 and 2020 in five areas in the Brazilian Pampa. We recognised the occurrence of at least 23 taxa in the studied areas - this number is much higher than previously described for each sampled region.
2. To Identify and evaluate a set of bat species with basic, non-existent, incomplete or unsatisfactory information occurring in the study areas				Most detected species are categorized as Least Concern, although Eptesicus brasiliensis, Histiotus cf. velatus and Promops centralis are also still lacking basic ecological information, including distribution ranges, population sizes and regional threats to their conservation, which is certainly preventing an adequate assessment of their conservation status; Myotis ruber, also occurring in the area is categorised as Vulnerable in the Rio Grande do Sul and Near Threatened worldwide. Molossus cf. currentium is classified as Data Deficient in Brazil.
3. To investigate the influence of landscape structure on the occupancy of aerial insectivores in the Brazilian Pampa in multiple scales				The response to landscape structure was species-specific: the occupancy probability of Eptesicus brasiliensis and Molossus cf. currentium increased with landscape connectivity at the 500 m scale while Eptesicus furinalis and Histiotus cf. velatus were negatively affected by landscape connectivity at the 5.0 km scale. Molossus occupancy probability responded negatively to landscape heterogeneity at the 3.0 km scale, while Promops centralis responded positively to landscape heterogeneity at the 5.0 km scale. Molossus rufus responded negatively to native vegetation cover and positively to landscape heterogeneity at the 5.0



		km scale. Myotis albescens and Molossops temminckii did not respond significantly to any of the evaluated landscape metrics.
4. To investigate the influence of microclimate on the detection of aerial insectivores in the Brazilian Pampa		Mean temperature and mean relative humidity positively affected the detection probability of the edge- space forager Eptesicus brasiliensis, the open-space forager Molossus cf. currentium and of the edge-space forager Histiotus cf. velatus. The detection probability of the edge- space forager Molossops temminckii increased with mean temperature, the open-space forager Molossus responded positively to temperature, the edge-space forager Eptesicus furinalis and the open-space forager Molossus rufus had similar response. The detection of Myotis albescens and Promops centralis did not respond to any of the microclimatic variables.
5. To model the spatial extrapolation of the occupancy bat species in the Brazilian- Uruguayan savanna in multiple scales		Species showing highest estimated occupancy probabilities (values ranging from $\beta\psi$ 0.55 to 1.00) in the two main phytophysiognomies – shallow soil fields and mixed stands of andropogon grass – present in the Brazilian and Uruguayan portion of the Brazilian- Uruguayan Savanna, were Eptesicus furinalis and Histiotus cf. velatus. Those were followed by Molossus rufus and Promops centralis (values ranging from $\beta\psi$ 0.34 to 0.99), and finally, Eptesicus brasiliensis, Molossus cf. currentium and Molossus with moderate occupancy probabilities (values ranging from $\beta\psi$ 0.04 to 0.89
6. To reduce the Wallacean deficit through acoustic monitoring		Our work has shown that the distribution of <i>Promops centralis</i> goes even further south in the Neotropics and that its occupation is far from low in pampas landscapes. Furthermore, if confirmed, the detection of <i>Molossus</i> cf. <i>currentium</i> , would represent the southernmost record of the species in Brazil, and the first for the Brazilian portion of the Brazilian-Uruguayan savannah; this species also has a high



		probability of occupation in the region.
7. To estimate changes in bat taxonomic, functional and phylogenetic diversity according to changes in land-use		Work on this objective is still in progress. We are currently working on analysing the various facets of bat diversity in the Pampa and writing the paper that we hope to submit soon to share our results.
8. To collaborate with relevant stakeholders on the ground		We strengthened links with the Brazilian Bat Research Society (https://www.sbeq.net/), of which my supervisor, Maria João Pereira, became Vice-President and I act in the coordination of the communication secretariat and in the bioacoustics and education committees. We approached the NGO IGRÉ (http://www.igre.org.br), which aims to promote the sustainable use of land and water resources in the Pampa region, and we have collaborated with the Secretary of State for the Environment and Sustainable Development (SEMA – RS), sharing some results of our project to support decision-making in the rapid expansion of wind turbine installation in the region. In addition, we strengthened links with rural landowners in the sampled areas, including the Cerro dos Porongos farm, which participates in the Alianza del Pastizal Program and develops sustainable meat production in the Pampas; The Maronna Foundation, through support for research and rural outreach projects, contributes to sustainable rural development and the Santa Rita do Jarau Farm, which promotes ecotourism activities in the cerro do Jarau region, in the municipality of Quaraí. However, we were unable to work in schools and traditional communities in the region, due to the covid-19 pandemic.
9. To promote actions to popularize science for the conservation of bats that occur in the		We developed the Morcegos do Pampa Outreach Project, through social networks – Facebook, Instagram, Twitter, YouTube and Website: https://linktr.ee/morcegosdopampa.



Pampa	We developed illustrated promotional materials that were disseminated through weekly posts, showing the bat diversity that occur in the Pampa. All material is available on our social media, in Portuguese and English. We also developed an animation in video format to illustrate ecological aspects of the Pampa biome, its biodiversity and main threats https://youtu.be/cK1HiUFtXJI. Additionally, we produced videos to visualise and hear the echolocation calls and the social calls emitted by bats and recorded by us during the work developed in Pampa. All videos are available on our YouTube channel. As an example, we provide the direct
	As an example, we provide the direct
	link to the video 'Have you heard a bat
	loadys
	https://youtu.be/9dDbCtDOvDM



Objective 1. Sonograms and Spectrograms of the sounds of the nine bat species identified in the Pampa biome.





Objective 3 e 4. An illustrated summary of the results of the occupancy models for the nine acoustically identified bat species in the Pampa biome.

MORCEGOS GO PAMPA					Ø		E	¢	
Rufford	Myotis albescens	Molossops temminckii	Eptesicus brasiliensis	Molossus cf. currentium	Molossus molossus	Eptesicus furinalis	Histiotus cf. velatus	Molossus rufus	Promops centralis
Detection	Null	Temperature	Temperature + Humidity	Temperature + Humidity	Temperature	Temperature	Temperature + Humidity	Temperature	Null
Occupancy	Null	Null	Connectivity	Connectivity	Heterogeneity	Connectivity	Connectivity	Native cover	Heterogeneity
Landscape scale	Null	Null	500 m	500 m	3.0 km	5.0 km	5.0 km	6.0 km	5.0 km

Objective 5. Results of Spatial Extrapolation of Occupancy bat Species in the Brazilian-Uruguayan Savanna at Multiple Scales.





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

a). We present the first comprehensive study of aerial insectivorous bats in the Brazilian Pampa using acoustic monitoring, contributing to the reduction of the Wallacean deficit in the region: We added records for two new species – Promops centralis and Molossus cf. currentium and for at least six species from the genera Cynomops, Eumops, Nyctinomops, Eptesicus, Histiotus and Molossus. Our results suggest that the bat fauna of the Brazilian Pampa can easily exceed 40 species.



b). The occupancy estimates projected for the regions neighbouring those sampled suggest that the landscape is reasonably favourable for the overall assemblage of aerial insectivorous bats, particularly areas with native elements including the *espinilho* tree, Acacia caven Mol., wetlands, water, and riparian forests. This remains to be validated by further field data and for the remaining regions of the Brazilian-Uruguayan Savanna, but sites with those landscape elements are potentially the ones with higher probabilities of detection of aerial insectivore bats.

c). Through the Morcegos do Pampa Outreach Project, we significantly contributed with quality information aimed at changing the general population's perception of the importance of bats and the need to protect them. The use of social medias in a period of isolation resulting from the COVID-19 pandemic seems to have been a winning bet, given the more than 1500 followers and 4000 positive interactions, in just under a year after the profiles were created.

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

We believe that the greatest unforeseen difficulties were those related to the emergence of the COVID-19 pandemic, which made it difficult to hold workshops, courses, and lectures in schools and other communities in the cities near to the sampling sites. However, we overcame these problems with alternative solutions, publicising our results such as the development of the Morcegos do Pampa Outreach Project on social media and by organising virtual events.

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

During the fieldwork, the owners of the sampled areas were receptive and collaborative. Some of these owners accompanied us to the sites where the detectors were set and often offered logistical support for the field campaigns, being essential to guide us to the places of more difficult access. Some sampling areas belonged to different landowners, and some acted as mediators to gain access to areas of others avoiding any unforeseen conflict; we used these moments to discuss about the importance of studying and protecting bats, as well as the environments where they live. During this period, we held an online lecture for students of the Biological Sciences Course of the Centro Universitário da Região da Campanha and the Universidade Federal do Rio Grande, where we talked about bioacoustics, ecology, and conservation of bats in the Pampa. In addition, we interact frequently with followers of the Morcegos do Pampa Outreach Project, who seek us out to clarify doubts about bat ecology and other frequent questions about possible interactions between humans and these animals.





Figure 1. A, B and C) Farm owners accompanying and guiding us to the sound recorders installation points and D) online lecture for students of the Biological Sciences Course in the Pampa region.

5. Are there any plans to continue this work?

Yes, we are very interested in continuing this project by undertaking additional expeditions to capture and record potential bat species that could not have their echolocation calls fully distinguished during the present project. In addition, a new bat species was recently described - *Myotis pampa*, whose type locality is Artigas (Uruguay), on the border with Quaraí (Brazil) and Entre Ríos (Argentina), is probably endemic to the Brazilian-Uruguayan savanna, occurring in the grasslands of these three countries. We obtained acoustic records that could belong to this bat, and we aim to validate this theory in new field campaigns; this species is probably under some level of threat due to its restricted distribution in a region under increasing anthropogenic pressure. In parallel, during my Ph.D., which has just started, we intend to evaluate the effects of fire on patterns of occupancy and diversity of bats in Brazilian savannas, including the understanding of patterns and processes of functional diversity of bats and how anthropogenic disturbances, such as intense, large, and persistent fires, alter the occupation and diversity of species in these environments.

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

a). As mentioned above, we have already shared our results and other pertinent information about Pampa bats on social media through the Morcegos do Pampa Outreach Project. We intend to continue with this form of dissemination and expand



our niche of activity, developing educational materials, aimed at different age groups, to be used by educators and articles aimed at newspapers and magazines in the region.

b). This project was developed during the master's degree of the author of this project, which at the end of this period, generated an academic document that will soon be available to the community in the university library.

c). To complement and access the results by the scientific community, scientific papers and book chapters are being prepared and will be progressively submitted for publication in high-impact journals:

- Article "Modelling the occupancy through acoustic detection of aerial insectivorous bats in the Brazilian-Uruguayan savannah", submitted to Landscape Ecology journal in May 2022 (corresponding author).
- Article focusing on the estimate of changes in taxonomic, functional, and phylogenetic diversity of bats according to changes in land use, in preparation (corresponding author).
- Review paper on the diversity of species that occur in the Brazilian Pampa, in preparation (co-author).
- Book chapter about hierarchical analyses of occupancy, abundance and, density of mammals in southernmost Brazil, in preparation (co-author).
- Book chapter about mammals of the Campos Sulinos: diversity and conservation, in preparation (co-author)

d). In October 2019 we participated in the XIII Encuentro de Ganaderos de Pastizales Naturales del Cono Sur - Alianza del Pastizal BR. We presented our work to the conference attendees, who were mostly people interested in maintaining sustainable meat production in the Pampa biome. As a result, many of the producers present joined the projects developed in our laboratory and made their rural areas available for us to expand our sampling sites.

e). We gave an online lecture to students of the Biological Sciences Course at the Centro Universitário da Região da Campanha (URCAMP, Bagé/RS) in September 2020 and participated in the XXIII Biological Journey of the Universidade Federal do Rio Grande (FURG, Rio Grande/RS), where we talked to students of the Biological Sciences Course about bioacoustics, ecology, and conservation of bats in the Pampa.

f). We also participated in two scientific events on Twitter: (i) the first conference on Brazilian bats on Twitter (#CMBT1), organised by the Brazilian Society for the Study of Bats (SBEQ) in October 2020 and (ii) the second world conference on bats on Twitter (World Bat Twitter Conference #WBTC2), organised by the Bat Conservation Research Laboratory at the University of the West of England in Bristol, May 2021.



g). We presented the main results of this work in two online scientific events: (i) national event - I SBEQ Online - Bats of the Global South, organised by the Brazilian Society for the Study of Bats (SBEQ) in October 2021 and (ii) international event - Ecoacoustics Congress, organized by the International Society of Ecoacoustics (ISE), in June 2021. In addition, we will attend the national event XI Brazilian Congress of Mammalogy and the XI Brazilian Meeting for the Study of Bats, which will take place in October 2022.

h). Recently, in partnership with an artist from the region, we developed a watercolour poster with bats occurring in the Pampa. this material will be digitised and from it, we will prepare copies to be distributed to the general public, as well as other informative and educational materials such as books and educational games.



Figure 2. Records from attendance in events A) Team attending the XIII Encuentro de Ganaderos de Pastizales Naturales del Cono Sur - Alianza del Pastizal BR, in October 2019; B) Slide presented at the World Bat Twitter Conference #WBTC2, in May 2021. C) Watercolour poster with illustrations of the 34 species of bats that occur in the Pampa biome, made by @letintas, local artist.

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

a). Continue to improve integration with the local community, with information on the diversity of bats that occur in the Pampa, emphasising the value of ecosystem services provided by bats.

b). Increase our partnership network in Brazil and in other countries, especially those harbouring the Brazilian-Uruguayan savannah.



c). Field-validation of the occurrence of some species of bats at a larger scale, mainly those that are rare or endemic, and of some of the acoustic records that have not yet been identified to the species level.

d). Visit local schools and develop educational materials and, if possible, integrate children and teenagers in some parts of the field expeditions.

e). Provide information to support environmental licensing companies and government authorities in the preparation of technical reports on good practices for acoustic monitoring of bats in open environments.

f). Finally, train students, protected areas staff, and landowners of small proprieties by integrating different disciplines related to the environment and biodiversity conservation in the Pampa biome.

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 used and will continue to use the logo on all publicity materials we prepare and lectures we participate. In addition, we mention in all the academic publications that the project was partially financed by the grant received from the Rufford Foundation.

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

Cíntia Fernanda da Costa: Project coordinator, responsible for programming and executing all stages of this project, from its submission, field trips for data collection, screening, analysis, to the final report and the various products that were and are being prepared for the dissemination of our results.

Maria João Ramos Pereira: Advisor of this project, coordinated and participated in all the activities listed above.

Flávia Pereira Tirelli: Field assistant and responsible for contacting the owners of the lands we sampled, participated in all field campaigns.

Adriana Arias-Aguilar: Field assistant, participated in some field campaigns and provided support in the identification of records obtained.

Erika Sant' Anna Petzhold: Field assistant, participated in most field trips.

Patricia Paludo: Field assistant, participated in some field trips.

Danielle Franco: Field assistant, participated in some field trips.

Dênis Sana: Field assistant, participated in some field trips

Marcelo Gehlen de Oliveira: Field assistant, participated in some field trips.



10. Any other comments?

We are deeply grateful to The Rufford Foundation for the financial support, without which most part of this project would have not been possible to fulfil. This support was particularly relevant under the present political scenario in Brazil, with continuing financial cuts to science and education, and even governmental attacks on the findings (and even researchers) of the scientific community. Therefore, we highlight the importance of these grants for researchers at the beginning of their careers in countries of the Global South.





Figure 3. A, B and C) Fieldwork teams; D) Sound recorder and datalogger installed at the sampling site; E, F, G and H) Different types of vegetation and soil cover in the sampling areas.





Figure 4. Some examples of the biodiversity present in the sampled areas in the pampa biome; I) Pyrocephalus rubinus; J) Molothrus bonariensis; K) Athene cunicularia; L) Lycalopex gymnocercus; M) Rhea americana; N) Colaptes melanochloros; O) Cereus hildmannianus and P) Cypella fucata.