

Final Evaluation Report

Your Details	
Full Name	Matheus de Oliveira Neves
Project Title	Revealing amphibian diversity of Upper Paraguay River Basin and assessing Protection Areas to shelter them under land-use and changing climate
Application ID	33582-1
Date of this Report	23/08/2022

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
Synonymization of <i>Pristimantis ventrigranulosus</i> and distribution of <i>P. dundeei</i> .				The article is practically ready. There was only one error in the molecular analyses that we are redoing. We will submit this article quickly.
Description of a new species of the genus <i>Pristimantis</i> for the Serra da Bodoquena National Park.				We can't find individuals of the new species in every fieldwork performed. We collected only two adult individuals in the last fieldwork in February 2022 (details in the section below). However, we have already done the acoustic and molecular analyses.
Understand the patterns of amphibian species richness for the Upper Paraguay River Basin (UPRB) currently and in the future (2080) under climate change.				Through the species distribution models with climatic and topographic data, we show which are the areas with the greatest richness, as well as important localities for future extinction and colonisation due to climate changes. Article submitted.
Evaluate Protected Areas (PAs) of the UPRB according to amphibian diversity currently and in the future (2080).				We verified among the 74 PAs belonging to UPRB which have greater richness than random areas in the present and future, showing the importance of these PAs.
Indicate important new areas for the conservation of amphibians that are not yet preserved.				Through a prioritisation analysis made by Zonation, we indicate areas that need attention, taking into account the occurrence of endemic, rare and/or threatened species in not preserved areas.
To carry out environmental education on the preservation of amphibians of the Pantanal in public schools, Protected Areas and through the Internet.				We met 250 students from the Pantanal schools Escola Municipal Vitória Regea and Escola Municipal Buriti in the municipality of Cáceres, Pantanal of Mato Grosso State. In the SESC Serra Azul Protection Area, we also met about 40 students of the Inocência Rachid Jaudy State School of the municipality of Nobres

			and Benedita de Almeida State School of the Municipality of Rosário Oeste, both in Mato Grosso State. All students attended lectures, received informative material, and saw specimens of amphibians to demystify these animals.
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2. Describe the three most important outcomes of your project.

a). An important outcome of our project was the evaluation of the protected areas (PAs) of the Upper Paraguay River Basin (UPRB) and the indication of new important areas that are not yet protected. Our models considered future climate change (2080) with two scenarios of greenhouse gas emissions (intermediate and severe) evidencing the PAs that will perform better in harbouring the diversity of amphibians today and in the future. Through an analysis of prioritisation of areas by the zonation that takes into account rare and/or threatened species and species underrepresented in existing PAs, we found which regions within the UPRB need protection and are not yet protected (see figure 2).

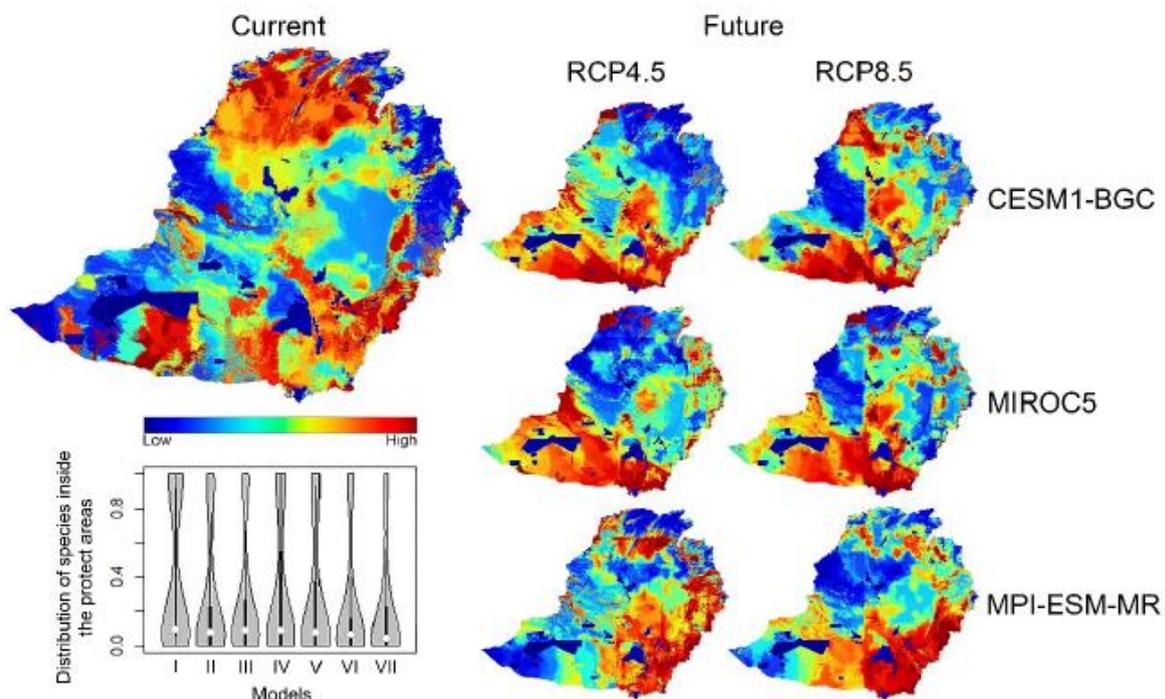


Figure 2. Spatial conservation prioritization procedure from Zonation indicating the conservation value of cells in current time and in the future under three different models (CESM1-BGC, MIROC5, and MPIESM- MR) and two greenhouse gas emission (RCP4.5 and RCP8.5). In the left bottom, Violin plot graphic of the results generated by the analysis. Numbers are different projections: I) Current, II) CESM1 – RCP4.5, III) CESM1 – RCP8.5, IV) MIROC5 – RCP4.5, V) MIROC5 – RCP8.5, VI) MPI-ESM-MR – RCP4.5, and VII) MPI-ESM-MR – RCP8.5. White circles are the medians, thick black

bars are the interquartile and thinner black bars are the standard deviations of the interquartile.

b). Through species distribution models using climatic (present and future 2080) and topographic data, we have revealed the amphibian richness patterns for UPRB (Figure 3). In addition, comparing the current and future distributions of each species, we found the main areas of local extinction, turnover and colonisation within our study area (Figure 4). These are important results for conservation planning in the UPRB region indicating which areas will be most affected by climate change (high turnover and local extinction) and where the areas that will serve as a shelter for local diversity in the future are located (colonisation - see Figure 4).

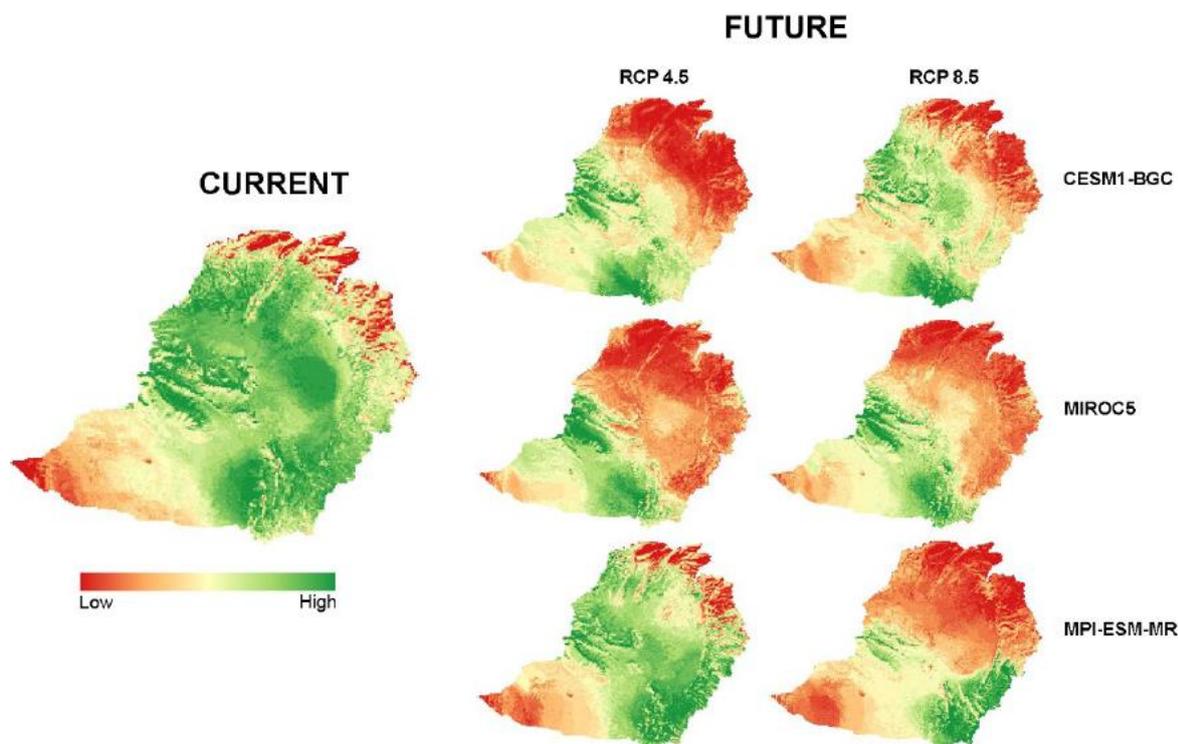


Figure 3. Predicted richness of amphibian species in the study area under current and future environmental conditions. The maps present current and future in three climate models (CESM1-BGC, MIROC5, and MPIESM- MR) under two different scenarios (RCP4.5 and RCP8.5).

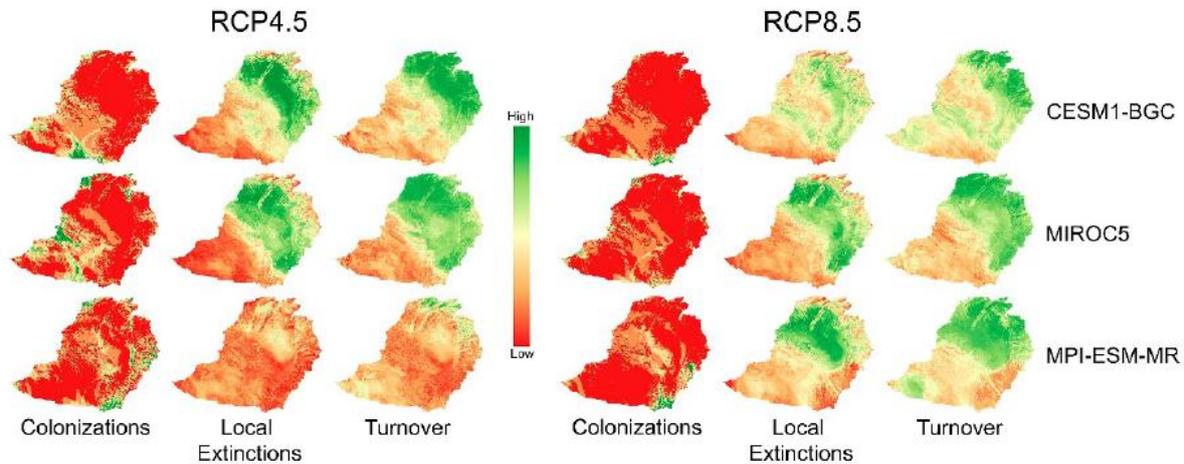


Figure 4. Predicted future colorizations, local extinctions and species turnover in amphibians' community throughout the study area. The map colours vary between the lowest score in red and the highest in green with different proportions among the maps, the Colonization value is up to 15, Local Extinction up to 24 and Turnover up to 100%.

c). The elucidation of the populations of the genus *Pristimantis* in Mato Grosso do Sul was also an important result for two main reasons: I) We found that *P. ventrigranulosus* is not a valid species and is synonymous with *P. dundeei* which has a larger distribution than we previously knew. Thus, we expanded the distribution of *P. dundeei* to two states, Mato Grosso do Sul and Goiás. Until then, *P. dundeei* was restricted to Chapada dos Guimarães and is classified as "Critically Threatened" in the national list. II) We found that the population of *Pristimantis* from the Serra da Bodoquena National Park (SBNP) is a new species, and we are describing it. Through the field work done inside and outside the SBNP, we discovered important information about the ecological requirements of the species that helps us to classify its conservation status in the future. *Pristimantis* sp. nov. does not depend on water bodies (like pools, ponds, streams, etc.) for reproduction, but they are highly sensitive to desiccation, making them dependent on forest areas with high environmental humidity. In the Serra da Bodoquena, where the species is endemic, it is found in the last large remnants of primary forest in the region, covered mainly by the SBNP, immersed in a strongly anthropised matrix (Figure 5). This fact demonstrates the high importance of forest remnants protected by the SBNP for biodiversity and the need to generate more knowledge about environmental requirements (local and landscape), geographical distribution and conservation status of the new species which may be threatened or in population decline.

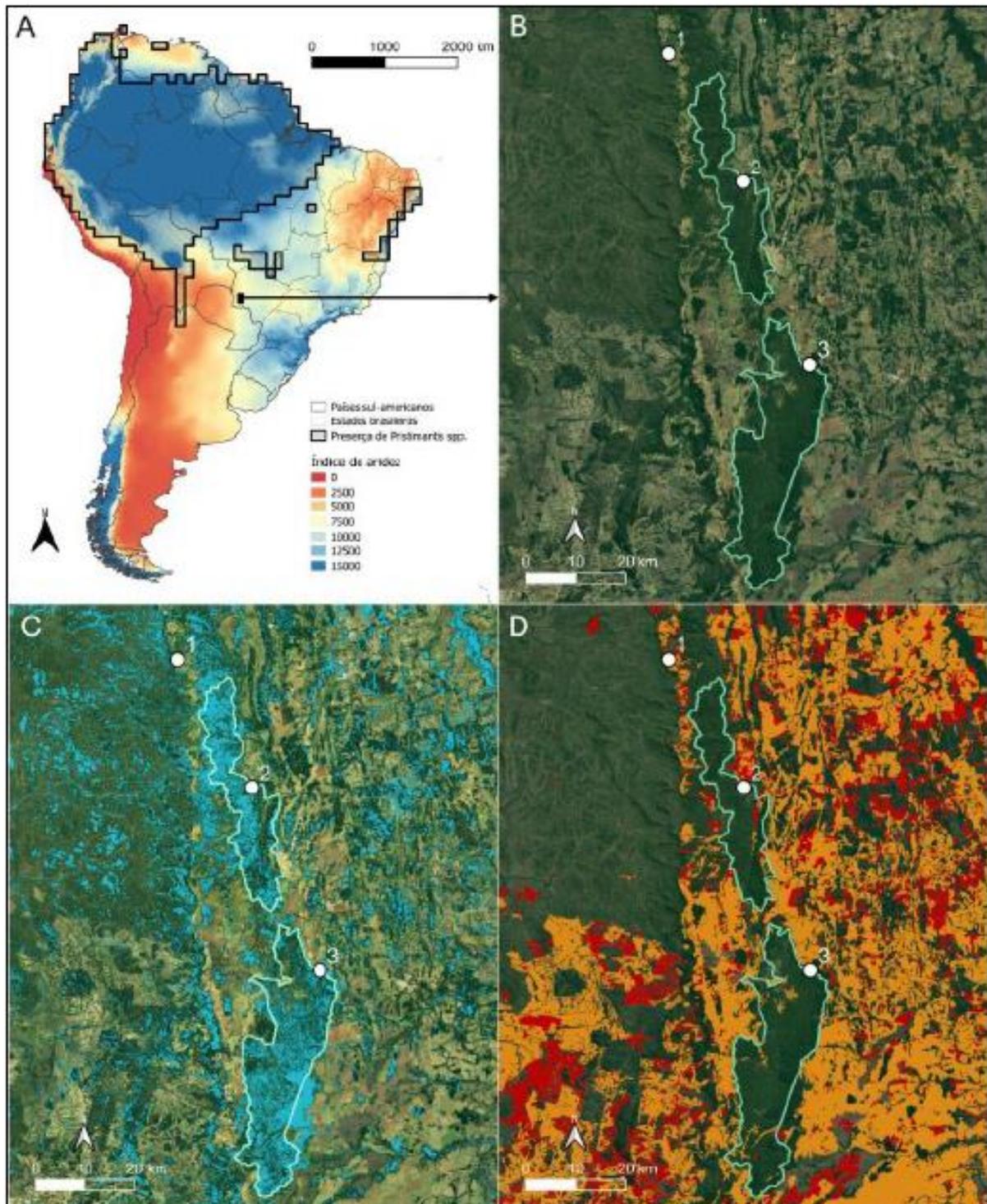


Figure 5. A) Area of occurrence of known species of the genus *Pristimantis* (shaded area) superimposed with a map of aridity intensity (Tabuco & Zomer 2019) along South America. The new species of *Pristimantis* occurs in the most arid region of the genus. The black rectangle represents the region where the new species was found. B) Enlargement of the area represented by the black rectangle, showing in detail the limits of the Serra da Bodoquena National Park (green line) and the occurrence points of the new species: 1) Morraria do Sul; 2) Poço do Córrego Azul; 3) Córrego Taquaral (type locality). C) Remnants of primary forest (Turubanova et al. 2018)

along the Bodoquena plateau. D) Deforestation in the region of Serra da Bodoquena (INPE 2019) before the year 2000 (orange areas) and between 2001-2018 (reddish areas) with emphasis on the large fragments that make up the park.

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

The Covid-19 pandemic was a major obstacle to the development of our project. One of our goals is to promote environmental awareness about Pantanal amphibians in Pantanal public schools to help preserve local species. In-person classes were suspended during 2021 and, due to that, we carry out online interventions in online classes. Just in July and August 2022, we could meet students in two public schools in the municipality of Cáceres, in the Pantanal of the Mato Grosso State, and also, we met students from more two public schools in the SESC Serra Azul Protected Area. All students attended lectures, received informative material, and saw specimens of amphibians to demystify these animals.

We conducted fieldwork in different locations along the Nascentes do Rio Taquari State Park (NRTSP), Serra de Maracaju, Brazilian Chaco, Pantanal and the Serra da Bodoquena National Park (SBNP) and surrounding areas (Figure 1). Among these localities, we can easily find specimens of *P. dundeei* in the NRTSP (for the synonymisation article), but we can't find specimens of the new species in the SBNP. After exploring six areas in and out SBNP, we found just two adult individuals and four juveniles, all in the last fieldwork held in February 2022, which is not enough for a type series. However, we are still going to do some more fieldwork to try to find more examples. In these fieldworks already done, we were able to record the advertisement call of the species and analyse its characteristics in addition to obtaining relevant information about the natural history, distribution, and conservation of the new species. Anyway, the work to describe this new species will continue until we get all the information necessary for this.

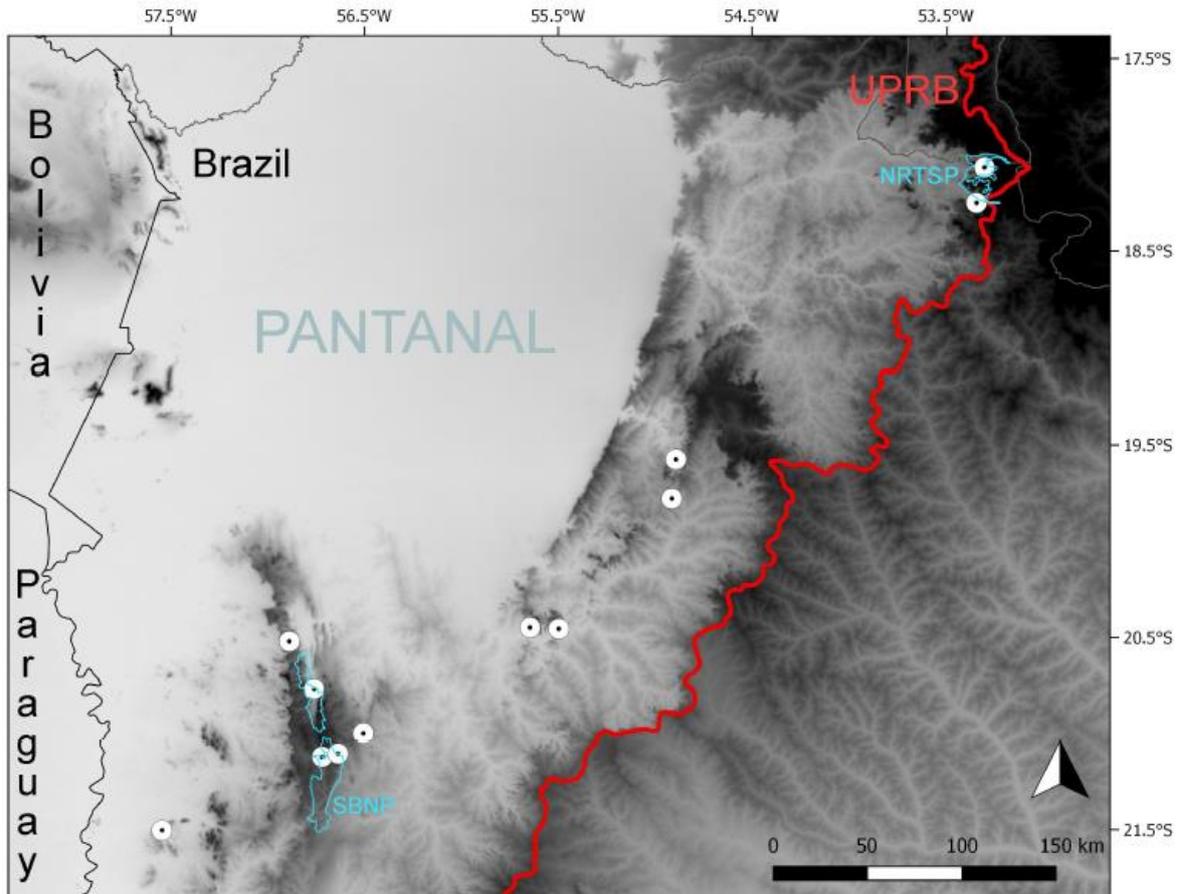


Figure 1. Sampled area. Dotted Circle: localities sampled by the project in the period of this report in the Upper Paraguay River Basin (UPRB), including in the Nascentes do Rio Taquari State Park (NRTSP) and Serra da Bodoquena National Park (SBNP).

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

The part with greater involvement of the local communities is our environmental awareness in Pantanal public schools. We met 250 students from the Pantanal schools Escola Municipal Vitória Regea and Escola Municipal Buriti in the municipality of Cáceres, Pantanal of Mato Grosso State (Blog news: "Researchers bring environmental education to more than 250 public school students in Cáceres" <https://www.caceresnoticias.com.br/cidade/pesquisadoreslevam-educacao-ambiental-para-mais-de-250-alunos-de-escola-publicas-decaceres/658851>). In the SESC Serra Azul Protection Area, we also met about 40 students of the Inocência Rachid Jaudy State School of the municipality of Nobres and Benedita de Almeida State School of the municipality of Rosário Oeste, both in Mato Grosso State. All students attended lectures, received informative material, and saw specimens of amphibians to demystify these animals. Through the internet, we reach society by highlighting the importance of amphibians, addressing climate change and other conservation topics on different platforms and events on YouTube (Echoing Science

Channel: "The Pantanal and its amphibians" - https://www.youtube.com/watch?v=h_KNUa87o_g&t=1827s; Santa Marcelina

College: Biology Week: "Upper Paraguay basin: the Pantanal and their surroundings plateaus" - <https://www.youtube.com/watch?v=Sb8uE0MH6oQ&t=11s>.

"Amphibians from flooded environments - V Week Save the Frogs" - <https://www.youtube.com/watch?v=nlysmJxpzio&t=2511s>), live on Instagram

(National Parks Project: Research in Protected Areas - <https://www.youtube.com/watch?v=RYWdGKjhaew>), radio station (<https://educativa.ufms.br/06-10-2020-anfibios-matheus-oliveira-neves/>) and online classes (<https://www.youtube.com/watch?v=rniFqjbTOLA&t=4s>).

5. Are there any plans to continue this work?

Yes, there are. We will continue the research not yet finalised but which are in the final processes for submission (one already submitted and two more scientific articles in process). We will also continue the project with interventions for environmental awareness in public schools in the Pantanal and through the internet. This is an important goal of our project that we want to expand to other cities in the Pantanal region, contributing to the environmental awareness of amphibians. In addition, we are starting new taxonomic works with problematic species to the north of the Pantanal (this past year, we focused on the southern region of the Pantanal). We have already found two likely new species that need an investigation with tools of integrative taxonomy (molecular, bioacoustics, morphology, among others) for the correct determination of these species. We also need to try new areas not yet sampled, or little sampled as in the Serra do Amolar, Pantanal do Paiaguás, Santa Bárbara State Park, among other places. For these objectives, we count on a renewal of the partnership between our Sapo Pantaneiro Project and The Rufford Foundation.

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

For society, we are communicating our results through Lives on Instagram, lectures on YouTube channels, texts on blogs and news sites, interviews on radio stations, participating in weeks and conferences, and other ways to reach the general public (Figure 6). We believe that social networks are an essential tool to achieve this goal.



Figure 6. Material for the dissemination of some actions to share our results with society through social networks.

For the scientific community, we will publish three scientific papers in renowned international journals containing the results of our project. After that, we will publish on news sites throughout Brazil, since the Pantanal is in high visibility due to the environmental impacts caused in recent years, mainly by the fire. Also, we participated in the Rufford Foundation Brazil Conference - 2022, in Recife, State of Pernambuco, where we presented the results that we have achieved in this one-year project. We also presented lectures on the subject at the Science and Technology Week of the Federal Institute of Mato Grosso do Sul, Biology Week of the Faculdade Santa Marcelina, HERPETORAMA – Herpetology Conference, and the V Save the frog Week (Figure 6).

We want our results on the evaluation of the PAs and indications of new areas to reach decision makers and be part of the planning of future environmental conservation for the region. The patterns found for amphibians are correlated with the other groups of vertebrates, so these results can assist in the installation of new PAs and subsidise new studies and field work in the Pantanal region and surrounding plateaux. Thus, the next step is to submit our article and then we will summarise the results found in an accessible language and send them to decision-makers (NGOs for nature conservation, congressmen and councillors, government agencies, among others). In this letter, we will make ourselves available for consultation and help in developing new strategies for the conservation of the region.

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

The next steps are to keep applying the interventions in schools and finalise and submit the scientific articles of this first year of the Sapo Pantaneiro Project. Afterwards, we will promote our results through social networks, take them to scientific events and write a letter with the main results to reach decision makers so that our study serves as a basis for conservation future planning. Thus, we will finalise the first stage of our project.

We are already starting new objectives and new research with the amphibians of the Upper Paraguay River Basin to promote their knowledge and conservation. Following the same line of the first project, our three main future objectives will be: 1) to carry out fieldwork for recording and collecting materials (specimens, tissues, vocalisation, among others) of two new species already registered in the surrounding plateaux of the Pantanal (one of the genus *Ameerega* and the other of *Boana* gr. *semilineata*); 2) through species distribution models, we want to quantify the population losses for each amphibian species of the UPRB due to the impacts of future climate change (2080) by classifying the species in different degrees of risk of extinction and population decline; and 3) promote environmental awareness about amphibians in public schools in the Pantanal in other Pantanal municipalities and through the internet.

I, coordinator of the Sapo Pantaneiro Project, was linked to the Federal University of Mato Grosso do Sul, municipality of Campo Grande, last year and the focus of our project was on the southern region of the Pantanal. Now, I am linked to the Federal University of Mato Grosso, municipality of Cuiabá, and the focus of this new stage will be in the northern region of the Pantanal and surrounding plateaux.

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 the Rufford logo in all the presentations we have made at events and in our dissemination through social networks. The Rufford logo is also present on our website, social networks and in the informative material that was distributed to students. In all our speeches (radio station, lectures, blogs, among others) we add that the work we are doing is supported by The Rufford Foundation.

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

Dr. Matheus de Oliveira Neves

Coordinator of the Sapo Pantaneiro Project. He carried out the field work, the analysis and writing of the articles, dissemination on social networks and events and will make the interventions in public schools.

Professor Diego José Santana

He carried out field work, molecular analysis and correction and suggestion of scientific articles.

Professor Christine Strüssmann

She helped in the elaboration of the project; she obtained tissue of species from outside the study area that was necessary to complement the analyses and correction and suggestion of the scientific articles.

Dr. José Luiz Massao Moreira Sugai

He carried out field work and helped in writing and correcting the article on the new species of *Pristimantis*.

Professor Dr. Mario Ribeiro Moura

Helped in the preparation and correction of the article on the evaluation of Protected Areas.

Sandro Roberto da Silva Pereira

Manager of Serra da Bodoquena National Park. He helped in the logistics of the field work to meet the new species and helped in the application for a collection permit.

Luzia Nunes Mamoré

Teacher at Escola Pantaneira Cyriaco da Costa Rondon. She helped in the elaboration of the information material and in the elaboration of the activities that was passed on to public school students.

10. Any other comments?

Dear members of The Rufford Foundation,

I come through this cover letter to thank for the grant provided to me to enable the Sapo Pantaneiro Project. I have been working with research related to the taxonomy and conservation of amphibians in the Pantanal for more than 6 years, during my doctorate and postdoctoral studies. Throughout this time, I have encountered unknown species and elaborated data to base decision-making on their conservation. However, Brazil's current policy does not provide us sufficient support to develop our research. With this grant provided by Rufford, we carry out important fieldwork in regions little or no explored in the Pantanal and in the surrounding plateaux, we buy fundamental materials for the realisation of the research, we made molecular analyses, we visit scientific collections and prepare environmental education materials for amphibians in the region.

The work of The Rufford Foundation for the Pantanal region is very important, as well as for global science with the support of research and environmental conservation for countries that need this support. Thus, in addition to scientific gain, the foundation contributes to the preservation of species and to the dignity and sovereignty of these countries.

