Final Evaluation Report

Your Details	
Full Name	Erika Avril Manrique Ascencio
Project Title	Anticipating conservation priority areas: predicting climate warming reconfiguration of the diversity of the seasonally dry tropical forests
Application ID	32898-1
Date of this Report	May 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
Collect functional traits of plants associated with the Neotropical seasonally dry forest			x	We measured plant functional traits of more than 30 species. Functional traits measured for each species included: leaf area, leaf thickness, leaf dry mass, leaf toughness, and chlorophyll content. Then, we derived water content per dry mass unit and specific leaf area. With this functional data, we proposed a multi-trait resource use scores index to relate species drought sensitivity with changes in range size.
Identify the impacts on the taxonomic, phylogenetic, and functional diversity of the plants of the dry forest			x	For this objective, we evaluated the impacts of GGC on taxonomic and phylogenetic diversity. Unfortunately, despite the effort done to increase the number of species with functional information, the reduced number of species did not allow us to include this dimension of the diversity in the analysis. Nonetheless, in the manuscript that is currently considered for publication by the prestigious journal Plant Biology (impact factor = 3.9), we combined functional information from different species and traits to show that drought tolerance may be a key factor driving the redistribution of species of the NSDF.

Evaluation of the effectiveness of the current Protected Areas system across the SDTF			x	We evaluated the effectiveness of the PAs in the current scenario and three future climate change scenarios. The main results of this study were published in the high-impact factor (11) journal Global Climate Change.
Workshop for children focused on the recognition of the flora of the Neotropical dry forest and its conservation.			x	We developed a workshop with 60 children from Santa María Tecomavaca, Oaxaca. From this, we produced a book for the community, which is in the final editing stage.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

a) The COVID-19 pandemic resulted in multiple rescheduling of the fieldwork date until the institutions allowed us to enter the communities. Furthermore, due to security concerns, work with the communities was severely limited for at least 18 months. However, we used our vehicles to travel to nearby locations without interacting with the communities, and sample processing took place outside the institution.

b) Given the current violence and insecurity in Venezuela, it was determined that conducting the expedition in that country was not viable. Moreover, the costs had substantially increased, making it unfeasible to visit multiple sites. However, with this budget, more field trips were conducted in Mexico.

3. Briefly describe the three most important outcomes of your project.
We found that:

a) This project enhanced our understanding of functional leaf attributes of plants within one of the most vulnerable ecosystems, the Neotropical Seasonally Dry Forest, encompassing endemic species from Mexico and Colombia. Utilising this information, an index was developed to assess the susceptibility of species to drought induced by climate change.

b) We demonstrated that global climate change poses a significant threat to the conservation of plant richness across the Neotropical Seasonally Dry Forest biome. Ecologically, our results indicate that plant distribution could decrease by an average of 8.88 to 20.89% of their

original range if species can move. However, if species do not migrate as rapidly as climate change progresses, their range reduction could reach 79.36 to 89.25% compared to their current distribution. Additionally, the modification in the structure and composition of plant communities is linked to increases in warmer temperatures (+ 4,45 to 9.4°C), lower annual precipitation (-0.33 to 0.2 mm), and higher precipitation seasonality (+ 1.95). Also, we found that the impact of climate change is expected to be less severe only for those Fabaceae species that exhibit greater drought tolerance, resulting in minimal changes to their species range in the future. Overall, climate change is anticipated to homogenise the Neotropical Seasonally Dry Forest plant communities, although there may be exceptions where heterogenization occurs.

c) In a spatio-temporal context, global climate change is projected to result in losses in plant diversity, encompassing both taxonomic and phylogenetic aspects, across the biome's distribution. Consequently, novel species assemblages may emerge through local responses. Notably, regions exhibiting the highest taxonomic decreases include the Antillean islands, Yucatan, and Caatinga. Conversely, the most significant changes in phylogenetic diversity were observed in South American dry forests.

Upon assessing whether protected areas adequately safeguard and represent plant diversity, we found that current protected areas encompass samples of taxonomic and phylogenetic diversity in most biomes. However, in climate change scenarios, it became evident that the existing protected area network would need to be improved for future protection. This inadequacy is particularly noticeable in regions with higher phylogenetic richness and diversity, such as Caatinga. Therefore, urgent evaluation is needed to reconfigure protected areas to preserve plant communities.

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

During the workshop, we discovered that the children did not recognise the presence of a dry forest in their locality, and most had never experienced direct contact with the forest despite its proximity. The workshop comprised the following activities:

A sensory exercise aimed at identifying what the children perceived as a dry forest. They expressed their ideas through drawings.

- An informative session on the characteristics of a dry forest and its conservation significance.

- An introduction to the main tree species found in the area, highlighting their distinctive features.
- A guided forest walk to identify various tree species, allowing the children to capture images of the trees' characteristics. During the walk, discussions covered multiple topics, including the significance of soil, local wildlife, agricultural effects, and forest conservation importance.
- There was a reflective session after the tour, during which participants shared their experiences and insights on what they enjoyed and what impacted them the most.
- By engaging the children in these interactive and educational activities, we aimed to foster a deeper understanding and appreciation of the dry forest ecosystem among the younger generation and, by extension, within the broader community.

5. Are there any plans to continue this work?

Yes, since we know that little information exists about conserving these forests in Mexico, we would like to replicate the workshop held in Santa María Tecomavaca in other parts of the country, such as Veracruz, Michoacán, Sonora, etc. Working with children and their families is fundamental to achieving conservation goals.

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

We plan to publish three articles reporting all the results.

- Climate-driven shifts in the diversity of plants in the Neotropical seasonally dry forest: Evaluating the effectiveness of protected areas. Published in *Global Change Biology* (impact factor:11) DOI: 10.1111/gcb.17282
- Limited drought tolerance in the neotropical seasonally dry forest plants impairs species richness in the future second round of peer review in the *Journal Plant Biology*.
- The goal is not as far away as we thought: Identifying the priority areas for the conservation of plant communities in the NSDF in global change scenarios, tentatively to be submitted in June 2024.

In addition, we have already presented our results at:

Mexican Congress of Ecology (2022) with the presentation titled "Impactos del cambio climático global en la riqueza de plantas del bosque seco neotropical " in Oaxaca, Mexico.

- Annual meeting of the Association of Tropical Biology and Conservation (2022). The presentation titled "Climate warming impacts the taxonomic and phylogenetic diversity patterns of plants associated

with neotropical seasonally dry forests" in Cartagena de Indias, Colombia.
- We also participated in a radio broadcast programme that informed the public about the importance of dry forests and the impact of climate change on plants.

7. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?

Due to the pandemic, all pre-established timelines were delayed up to 8 months. We received the grant in September 2021 and used the money for the first time in November 2021 to buy the first computer. Later, in January 2022, we purchased a second computer to speed up the modeling process. Also, in January 2022, we made the first field trip to Mexico, and in August 2022, we went to Montes de María, Colombia. In January 2023, we went to Santa María, Tecomavaca, to collect more functional traits and to work with the community.

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

We recognise the importance of ongoing data collection on functional traits, particularly for endemic species or those with limited distribution. By doing so, we aim to address information gaps and gain a comprehensive understanding of how these functions will be affected in various global climate change scenarios.

Furthermore, we are committed to continuing our collaboration with communities to raise awareness about the significance of dry forests. Through these efforts, we aim to promote traditional knowledge and advocate for good practices to prevent the degradation of these vital ecosystems. Simultaneously, we plan to forge partnerships with other organisations and universities to expand our outreach and engage with a broader audience. Together, we can work towards the conservation and sustainable management of dry forests for both present and future generations.

9. 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 Rufford Foundation logo was used in each of the public presentations of the project's results, as well as in the posters referring to the project and the t-shirt used by the personnel during the fieldwork.

We added the logo in:

- Mexican Congress of Ecology (2022) with the presentation titled "Impactos del cambio climático global en la riqueza de plantas del bosque seco neotropical " in Oaxaca, Mexico.
- Annual meeting of the Association of Tropical Biology and Conservation (2022). The presentation titled "Climate warming impacts the taxonomic and phylogenetic diversity patterns of plants associated with neotropical seasonally dry forests" in Cartagena de Indias, Colombia.
- The children's book resulted from the workshop with children of the community of Santa María Tecomavaca.

Also, the logo will be set as the acknowledgment of the final document of my Ph.D thesis.

10. Please provide a full list of all your team members and briefly describe their roles in the project.

- Erika Avril Manrique Ascencio: Participated in field trips, data collection, species niche modeling, spatial analysis, and writing of papers, workshops, book editing
- Roger Guevara: Participated in field trips, data collection, analysis, and writing of articles, as well as in the workshop and book editing
- David Prieto-Torres: Participated in species niche modeling, spatial analysis, and writing of the articles
- -Fabricio Villalobos: Participated in the spatial analysis and writing of the papers
- Jorge Mercado: Participated in field data collection and article writing.
- Mauricio Arturo Juárez Fragoso: Participated in field data collection, workshop, and book editing

11. Any other comments?

Many thanks to the Rufford Foundation for its support. With them, most of the proposed activities were developed. I hope to receive the foundation's support for developing the following projects. We want to point out that as soon as the book finishes the editing process by the Instituto de Ecología, A.C., we will send it to you.

Also, I want to thank all the people who helped with this project, including the field trips, the processing of the samples in the laboratory, and the edition of the book for the children of the community of Santa María Tecomavaca. Special thanks to Santiago Sinica, Gregorio Mendoza, Edwin Ariza, and the students of the tropical systematics laboratory of the University of Sucre.

I would also like to extend my gratitude to local people, the teachers, directors, and children's tutors for opening the doors of their community to exchange knowledge and allow us to work with them.

Figure 1. Landscapes of Neotropical Seasonally dry forest in Mexico and Colombia

Figure

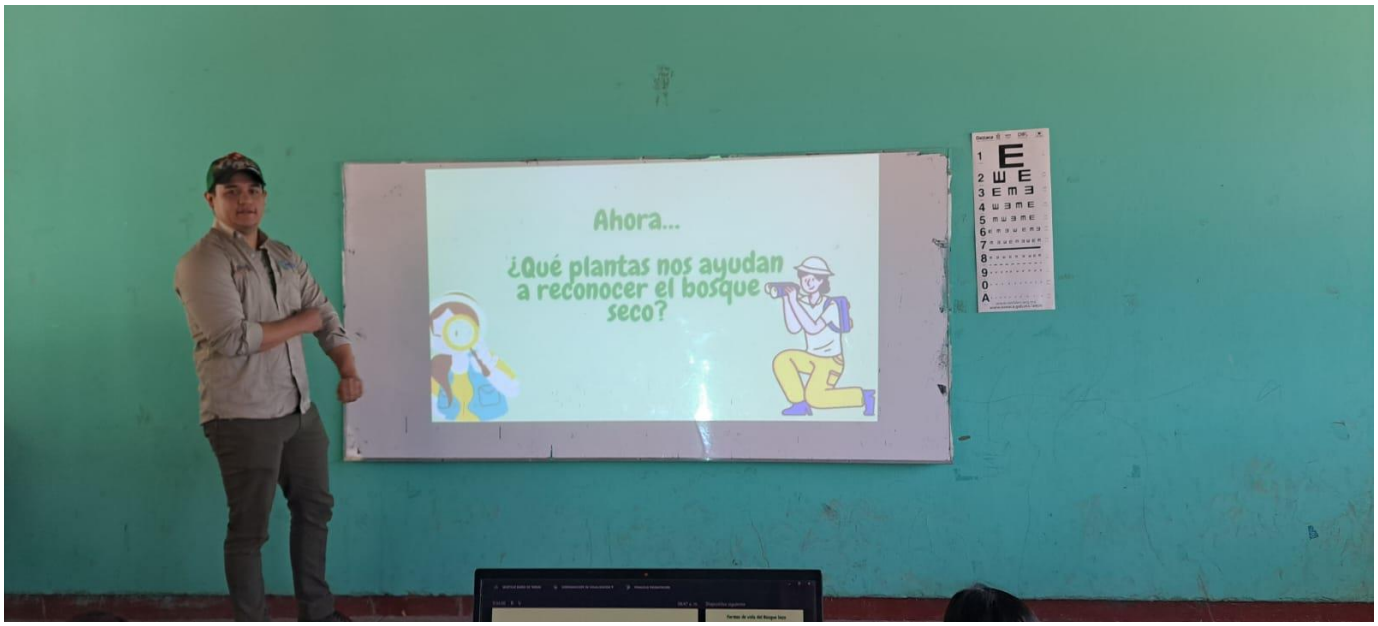

Figure 2. Workshop and reflection about the Dry Forest with the children from Santa María Tecomavaca

Figure 3. Workshop with the children from Santa María Tecomavaca at the forest

Figure 4. Field trips in the dry forest of Mexico measuring the plant functional traits

Figure 5. Measuring and teaching functional traits in Montes de María, Sucre, Colombia.

Figure 6. Presenting results of the impact of climate change in the taxonomic and phylogenetic diversity of plants associated with the Neotropical dry forest in the reunion of the Association for Tropical Biology and Conservation in Cartagena, Colombia