

Final Evaluation Report

Your Details	
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Project Title	The Role of Natural Areas in Maintenance of High Rodent Species Diversity and Low Prevalence of Zoonotic Viruses in Chiapas, Mexico
Application ID	34742-1
Date of this Report	08/18/2023

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
Evaluate the land use change in both localities between 1990 and 2020.				We assessed the change in vegetation cover at the sites of interest over two time periods. We found that the vegetation types have undergone the most changes are forests, mountain wetlands, and tropical forests. The main changes have been attributed to urbanisation (in San Cristóbal) and pasture (in Ocuilapa).
Assess diversity of rodent species in an urban gradient in San Cristóbal de Las Casas and Ocuilapa.				In each locality of interest, we discovered 10 species of rodents. Contrary to what was expected, the highest species diversities of rodents were not found in the better-preserved natural areas, but rather in those with intermediate conservation status, which are actually heterogeneous (containing fragments of forests, tropical forests, mountain wetlands, and cultivated areas).
Identify potential epidemiologic risk areas according to suitability conditions for rodent species				Unfortunately, due to the lengthy process involved in gathering the necessary inputs for molecular analyses in search of <i>Mammarenavirus</i> , this objective could not be carried out
Verify the prevalence of <i>Mammarenavirus</i> in the sample of species collected in the localities.				In the original proposal, it had been suggested to conduct these analyses at the Faculty of Veterinary Medicine of the UNAM. However, it was ultimately not possible to carry them out there. As a result, the analyses were conducted at the Research Center for Infectious Diseases (CIENI) of the National Institute of Respiratory Diseases (INER). The analyses were performed by Dr. Maribel Soto Nava (maribel.soto@cieni.org.mx), a specialist in Immunology and Virology. After analysing 300 samples, only 1 positive case for <i>Mammarenavirus</i> was found. The positive case was found and

			collected in a public park.
Workshops (two by locality) aimed at students of Elementary and High schools.			One workshop by locality was conducted with students and adults from the communities in question.

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

a). Regarding the preservation of a rich diversity of rodent species: Contrary to expectations, in this project, we found that natural areas with intermediate conservation status, meaning those containing a combination of original forest or tropical forest fragments or mountain wetlands, along with areas of cultivated land and pasture exhibit greater diversity in rodent species than better preserved natural areas like natural parks or reserves. Nevertheless, we found that these fragments of well preserved natural areas serve as suitable habitats for species not found elsewhere. An example are *Scotinomys teguina* and *Heteromys desmarestianus* found exclusively in tropical forest fragments. Similarly, in the case of *Peromyscus beatae*, which is found in pine forests and pine-oak forests, it is absent from areas of intermediate conservation as well as urban environments.

Even though the results were contrary to expectations, they offer us a broader perspective regarding the need to conserve natural areas, even when their sizes have diminished. Likewise, the results emphasise the importance of preserving heterogeneous natural areas, as these indeed maintain higher levels of diversity.

b). Regarding the vegetation changes: In San Cristóbal de Las Casas, the pressure exerted on natural areas with any conservation status (and even on natural areas without status) is primarily due to urbanisation encroaching upon the small fragments of mountain wetlands (the most threatened) and also the pine and pine-oak forests. Urbanisation is what generates the convergence of vegetation patches, resulting in an increase in rodent species, including rodent species typical of urban environments that could act as reservoirs for zoonotic pathogens, potentially representing a risk to human health.

In Ocuilapa, a similar phenomenon of original vegetation loss occurs, even within protected natural areas, due to the establishment of pastures and urbanisation. However, the process of urbanisation in this locality has resulted in the preserved sections of tropical forest being quite large, although they are surrounded by small communities, pastures, and agricultural areas. This landscape arrangement facilitates species turnover and the movement of rodent species between portions of tropical forest, increasing their abundance.



Photos of rodents were found in this project. Rodents from San Cristóbal de Las Casas: a) *Peromyscus beatae*, b) *Sigmodon toltecus*, c) *Peromyscus mexicanus*, d) *Reithrodontomys sumichrasti*, e) *Peromyscus beatae*; rodents from Ocuilapa: f) *Peromyscus aztecus*, g) *Baiomys musculus*, h) *Heteromys desmarestianus*, i) *Peromyscus mexicanus*.



Left: San Cristóbal de Las Casas. Right: Ocuilapa.

c). Finally, molecular analyses were conducted to detect *Mammarenavirus* in 300 samples. Our interest in these viruses stems from the previous detection of one of these viruses in a native rodent species from southeastern Mexico, which is abundant in the natural areas of the region. Additionally, it has been shown that some of these viruses have the potential to cause infectious diseases in humans living in contexts similar to those described in previous paragraphs. We found a single positive result, originating from a public park. At this point, the specific species of *Mammarenavirus* is unknown, but ongoing analyses are being conducted to determine it. This result highlights, on one hand, the circulation of the virus in wild populations of mammals widely distributed in the southern-southeastern of the country, and on the other hand, the necessity of having numerous samples to effectively analyse the prevalence of potentially zoonotic viruses in mammal species inhabiting areas close to human populations.

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

This project faced several challenges that kept delaying its completion. The first issue was the limited willingness we encountered from the residents of the localities to participate in workshops about rodent appreciation, and the importance of preserving natural spaces. We believe this was due to the fact that the talks addressed information about the highly stigmatised rodents. Nevertheless, we managed to approach the topic from the perspective of human health and the significance of preserving clean spaces where humans live (their homes, parks, coops). This idea could be extended to the natural areas surrounding the cities and towns where we worked. The second problem was the procurement of supplies for the molecular analyses. Between institutional bureaucracy for procurement and the scarcity of some items from suppliers, the delivery of these supplies to the laboratory responsible for the analyses kept getting delayed and extended. In this case, we were left with no choice but to wait, as there is only one supplier in the country for one of the required inputs. We patiently awaited that supply for a year.

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

The participation of the people in this project was crucial, as we needed to enter their homes to set up traps. Even though there was some initial hesitation, once people understood the purpose of the project, they became very engaged. We hope to have planted the seed of the importance of preserving the natural areas that surround them.



Landowners in Ocuilapa.

5. Are there any plans to continue this work?

Certainly, there are plans to continue with this project, as the obtained results provide a basis for considering the implementation of long-term monitoring of the natural areas surrounding the cities of interest and the mammal species acting as virus reservoirs.

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

We share the preliminary results with the communities during our workshop. So far, we have written two articles where we share the results obtained in this project, regarding the results of land use and diversity of rodents. One is a scientific article (<https://doi.org/10.12933/theya-22-2100>), and the other is a communication science article (<http://doi.org/10.22201/cuaieed.16076079e.2022.23.2.5>). We also participated in two international conferences where we presented progress from the research. One was at the Student Conference on Conservation Science-New York in 2021, with the poster titled "The role of urbanization in rodent diversity in a small city in Chiapas, Mexico," and the other was at the 101st Annual Meeting of the American Society of Mammalogists (ASM) with the poster titled "Rodent diversity and distribution in a highly human-modified tropical landscape." Additionally, a virtual lecture was given to doctoral students at the University of Sciences and Arts of Chiapas (UNICAH).

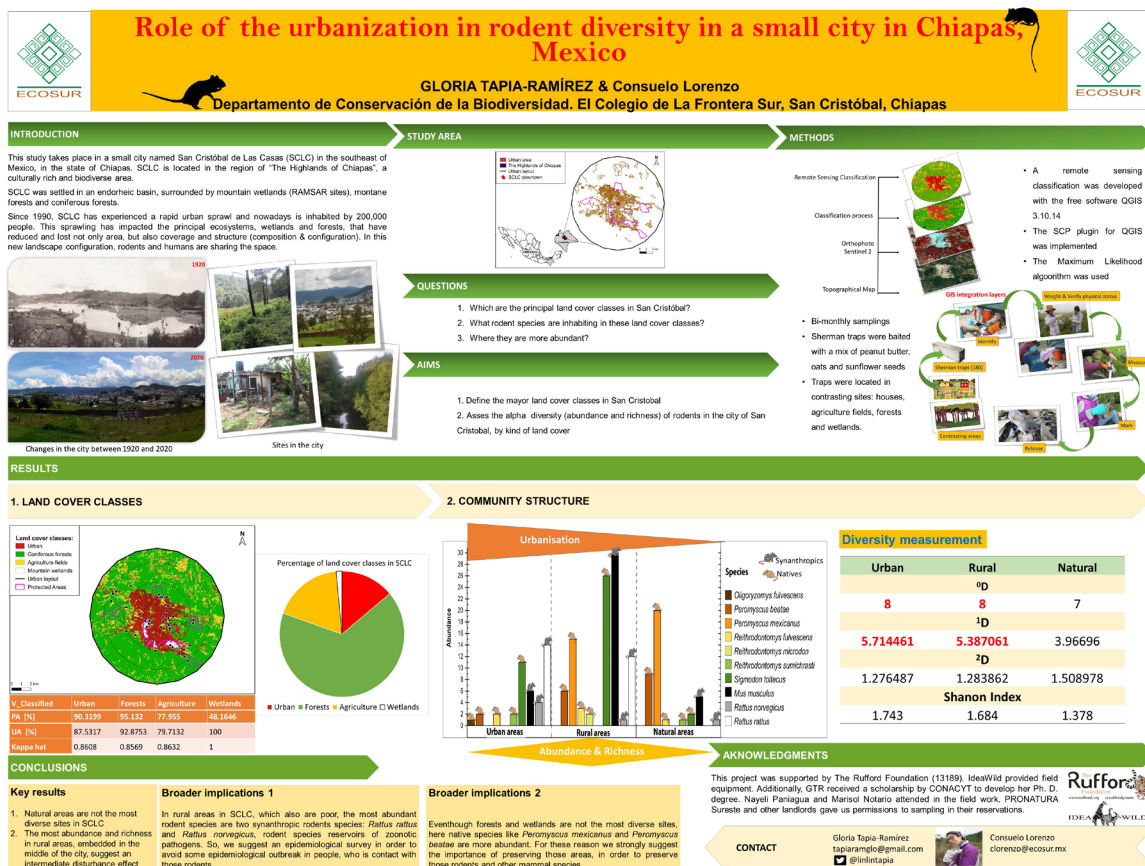
7. Looking ahead, what do you feel are the important next steps?

The next important steps will be:

- Publishing the results where we report the presence of positive outcomes, in which we are currently working on.
- Presenting these results, explained to the health authorities of the localities worked.

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?

We included the logo in the PowerPoint presentations created for workshops and talks, as well as in the posters presented at conferences. Here are some examples.



Poster presented in Student Conference on Conservation Science-New York in 2021,



Cover for talk performed at the University of Sciences and Arts of Chiapas (UNICAH).

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

Gloria Tapia-Ramírez. Team Leader: Responsible for project development and fieldwork. Managed laboratory supply procurement. Conducted workshops and presented project results in conferences and talks.

Consuelo Lorenzo. Supervisor: Guided and supervised project activity implementation.

Maribel Soto Nava. Specialist in Immunology and Virology: Conducted molecular detection analyses for *Mammarenavirus* in the collected samples.

Aaron Hernández Núñez. Field Assistant: Assisted in site transportation for sampling and collaborated in rodent sampling.

Nayeli Paniagua Gutiérrez. Field Assistant: Assisted in rodent sampling activities in both localities.

Margarito Gómez. Local guide in Ocuilapa: Assisted in locating houses for trap placement in the Ocuilapa locality and introduced us to the locals and authorities.

Rodrigo López Pérez. Local guide in San Cristóbal de Las Casas: Assisted in locating houses for trap placement in the Ocuilapa locality and facilitated communication with the locals in their native language (Tsotsil).

10. Any other comments?

I am very grateful to The Rufford Foundation for the provided funds. Without this grant, the project wouldn't have been possible. The results obtained, although at first glance, may seem modest with only one positive record, are the first ones obtained in the country. These reinforce our main hypothesis that emphasised the necessity to conserve natural areas where mammal species can persist, thereby reducing, at least partially, the potential risk of infections resulting from human-wildlife contact.