

Project Update: February 2023

This update reports on the results obtained from May 2021 to March 2022. We carried out nine field trips, four in San Cristobal de Las Casas and five in Ocuilapa, in Chiapas, Mexico (Figure 1).



Figure 1. Location of study sites in Chiapas, Mexico

Results

A. San Cristóbal de Las Casas (SCLC)

The Landscape

San Cristóbal de Las Casas (SCLC) is a medium-sized city in southeastern Mexico with a population of 250,000. We established a study area of 15,143 ha. It was classified in four cover classes: built up, forests, croplands and mountain wetlands (Figure 2) with QGIS software. Sixty-six percent of the total area was covered by forests and the smallest cover class was mountain wetlands (<2%). The city of SCLC constituted 14% of the total studied area. Between 1990 and 2020, the city has doubled its size. According to this study the mountain wetlands were the most threatened ecosystems in SCLC. The principal threat to this ecosystem was the urban sprawl driven by irregular settlements caused by social problems.

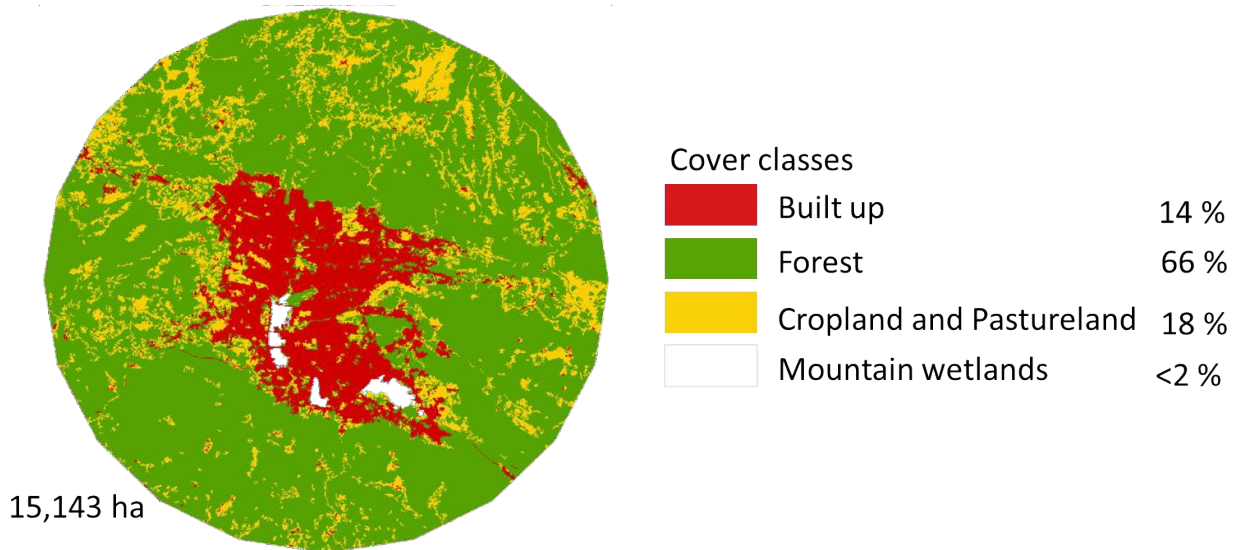


Figure 2. Study area and cover classes in San Cristobal de Las Casas, Chiapas, Mexico

Rodents and Landscape

We sampled rodents in this landscape through an urban gradient from downtown to a point 5 km from the centre. Along this gradient we chose contrasting sites: urban areas, forested areas, cropland areas, pastureland areas and mountain wetlands (Figure 3).

We sampled 10 species of rodents (Figure 5); the most abundant was the Toltec cotton rat (*Sigmodon toltecus*), a medium-sized rodent common in grasslands, such as croplands and pasturelands. Another abundant rodent was the Mexican deer mouse (*Peromyscus mexicanus*) a very typical small rodent of the southeastern Mexico in forests and in disturbed areas (secondary forests, coffee plantations). We also sampled synanthropic rodents (those which live near people): *Mus musculus*, *Rattus rattus* and *Rattus norvegicus*. Fortunately, these rodents were found in urban contexts or in people contexts. We subdivided the landscape into four types: urban, transition, mosaic and conserved according to their configuration characteristics. The transition and mosaic were the most abundant and diverse types of landscapes in SCLC.



Figure 3. Contrasting sites for rodent sampling: a) forested areas, b) mountain wetlands, c) pastureland areas, d) cropland areas and, e) urban areas; f) panoramic view of the city.



Figure 4. Sampling rodents in a small portion of forest in San Cristóbal de Las Casas, Chiapas, Mexico.

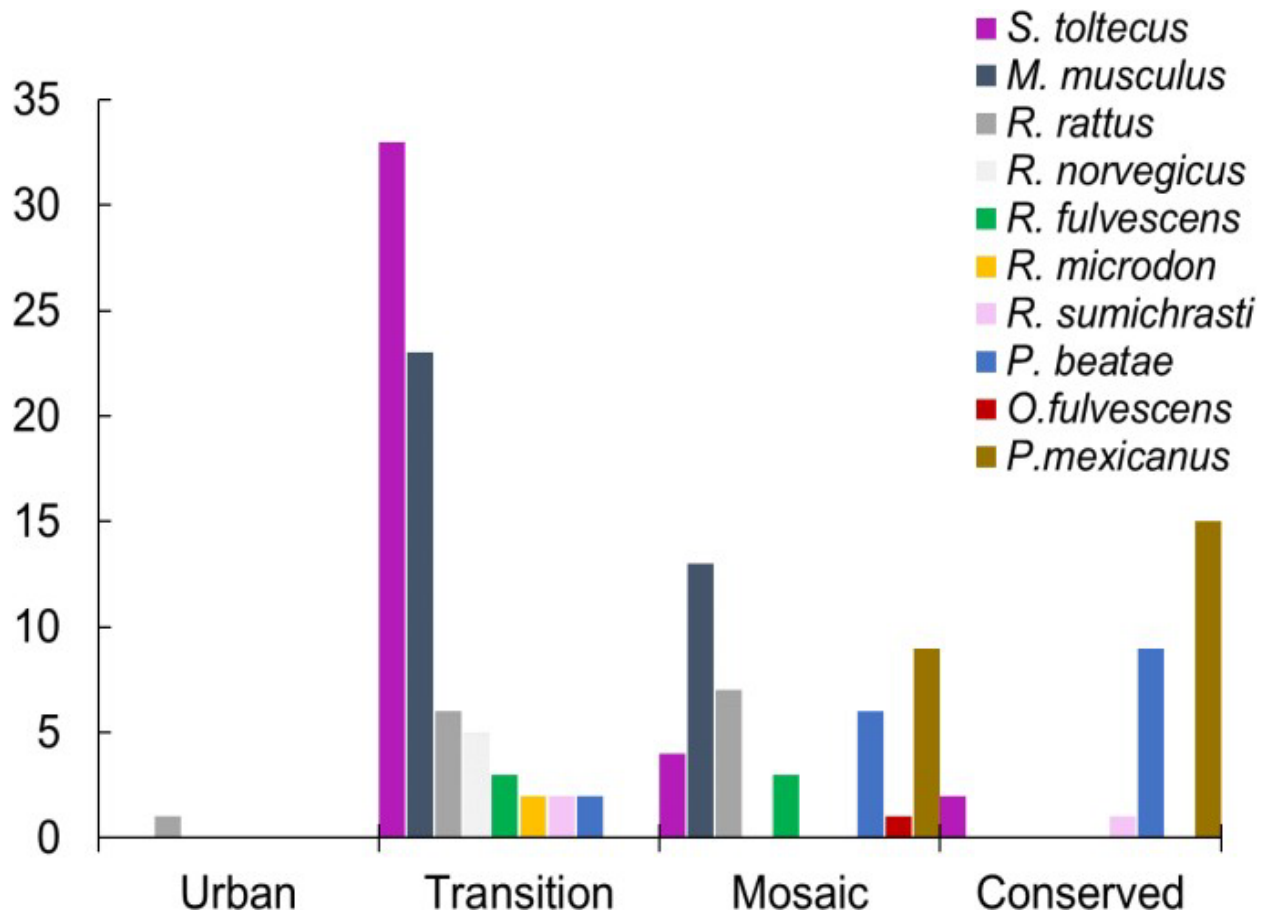


Figure 5. Species of rodents sampled in San Cristobal de Las Casas, Chiapas, México (Left: *Peromyscus mexicanus*. Right: *Sigmodon toltecus*).

B. Ocuilapa

The Landscape

Ocuilapa is a rural locality with a population of 4,000 in southeastern Mexico. Here, the principal activities were agriculture and cattle ranching. We established a study area of 15,143 ha. It was classified in four cover classes: built up (soil covered by concrete, devoid of vegetation, houses, and roads), tropical forest, burned secondary tropical forest and secondary tropical forest (acahual), pastures, and crops (Figure 6) with QGIS

software. Forty-six percent of the total area was covered by forests and the least covered class was built up (<1%). The study area is characterised by patches of remnant tropical forest (sub-deciduous and deciduous), secondary tropical forest, oak forest, cultivated pasture, and rain-fed agriculture. Other land uses are the crops of maize (*Zea mays*), beans (*Phaseolus vulgaris*), and coffee (*Coffea arabica*). The latter is cultivated under the shade of forest trees, thus allowing the growth of native trees that otherwise would be cut for grazing, favoring areas of acahual. Other common plantations are citrus fruits such as lemon (*Citrus aurantium*) and orange (*C. medica*), banana (*Musa paradisiaca*), and pineapple (*Ananas comosus*).

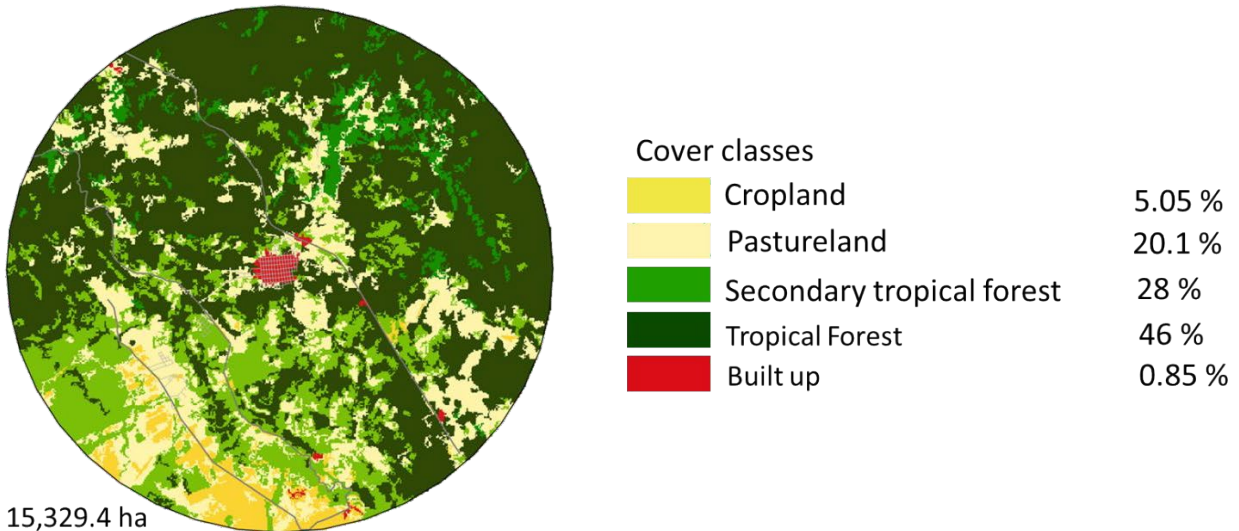


Figure 6. Study area and cover classes in Ocuilapa, Chiapas, Mexico

Rodents and Landscape

We sampled rodents in this landscape through an urban gradient from downtown to a point 5 km from the centre. Along this gradient we chose contrasting sites: urban areas, forested areas, cropland areas, pastureland areas and secondary tropical forest (Figure 7).

We sampled 10 species of rodents (Figure 8), the most abundant were the Mexican deer mouse (*Peromyscus mexicanus*) and Aztec mouse (*Peromyscus aztecus*), two very typical small rodents of southeastern Mexico, found in forests and disturbed areas (secondary forests, coffee plantations).

We subdivided the landscape into four types: rural, tropical forest, pastureland and cropland according to their configuration characteristics. The tropical forest and pastureland were the most abundant and diverse types of landscapes in Ocuilapa.



Figure 7. Contrasting sites for rodent sampling: a) tropical forest, b) pastures, c) urban areas, d) secondary tropical forest

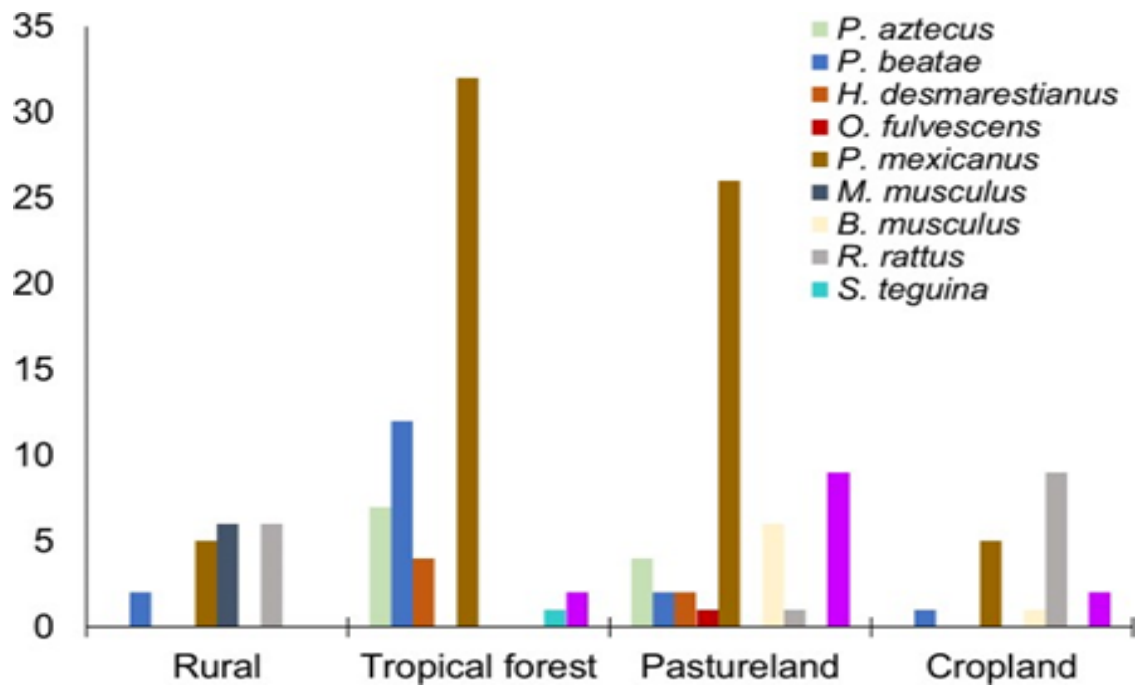


Figure 8. Species of rodents sampled in Ocuilapa, Chiapas, Mexico (Left: *Peromyscus mexicanus*. Right: *Peromyscus aztecus*).

Diversity per site is measured by alpha and beta indexes.

Beta index (β_{SOR}) = 0.63

Turnover (β_{SIM}) = 53 %

Nestedness (β_{SNE}) = 47%



	Urban	Transition	Mosaic	Conserved
Richness (⁰ D)	1	7	8	4
Shannon index (¹ D)	1	5.77	4.56	5.12
Simpson index (² D)	1	5.12	3.39	2.34
Abundance	1	43	76	27

Beta index (β_{SOR}) = 0.509

Turnover (β_{SIM}) = 69 %

Nestedness (β_{SNE}) = 31 %



	Rural	Cropland	Pastureland	Tropical forest
Richness (⁰ D)	4	5	8	6
Shannon index (¹ D)	3.73	3.55	4.52	3.6
Simpson index (² D)	3.58	2.90	3.17	2.71
Abundance	19	18	51	58

Up to now, we can conclude that San Cristobal de Las Casas is the most impoverished site because the landscape is highly fragmented. The turnover of species is poor which implies that the rodents remain in limited and small areas and they do not have a chance to move between fragments of the same cover class. This could be explained because SCLC is a city where the roads break up the portions of forest and even the mountain wetlands, isolating the fragments. Unfortunately, this is the situation which is

mirrored in Ocuilapa. Even when the landscape preserves bigger and better conserved portions of tropical forest, the cattle ranching activity is diminishing space in the forest. Indeed, in Ocuilapa, the pastures are the type of landscape where the diversity is higher than in the tropical forests.

One of the objectives of this project was to prove that in preserved areas the rodent species have lower prevalence of zoonotic viruses. Disappointingly, we faced too many difficulties performing the lab analyses necessary to confirm this premise. The main obstacle was the tedious bureaucracy behind the purchase of the lab reagents. We request them for the last year, but just recently in March 2023 (hopefully) we would be concluding the process and we could get all the material. In this way, we are estimating to conclude analyses in April 2023. All analyses will be performing at the Center of Research in Infectious Diseases (CIENI).