

The coexistence of *Desmodus rotundus* with the human population in San Luis Potosí, México

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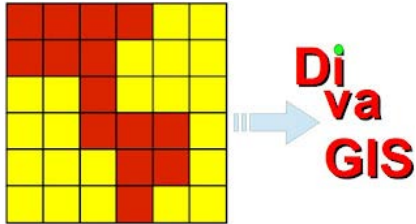
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Article aim and Journal Information



Analyze the close relationship between *D. rotundus* and humans, through the development of a probable MaxEnt dispersal model of *D. rotundus* based on known shelters and different environmental variables.



Analyze the relationship between the shelters found and their proximity to human settlements, as a process of coexistence with the use of Diva Gis.

Its goal is to share research findings from scientific institutions in Mexico and worldwide related to animal sciences.

The journal is bilingual and publishes full articles in Spanish or English.



Introduction

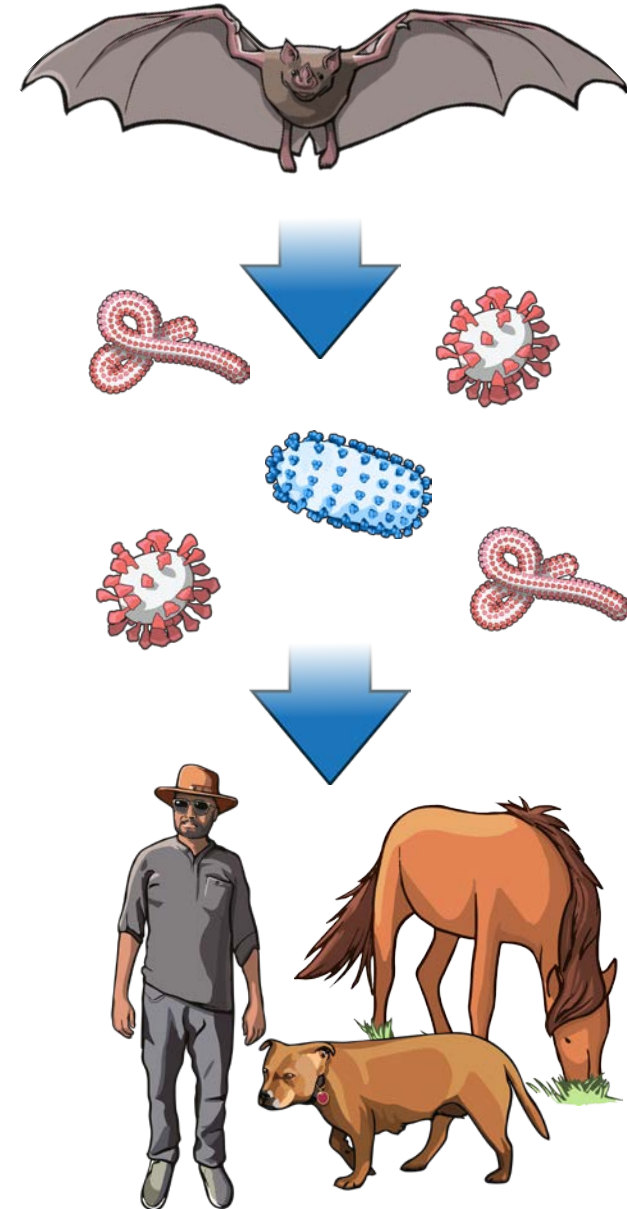
Bats are the mammals recognized as reservoirs of potentially zoonotic viruses.

Have been associated with:

- Ebola
- Marburg
- SARS
- Rabies
- Influenza A

These emerging diseases have the potential to cause epidemics by the interaction between infected bats, the infectious agent and the host.

Sometimes there is an intermediate host, these come into contact and infect humans even amplifying the virus.



Introduction

Changes in the environment, mainly those caused by temperature, rainfall and humidity as well as the height above sea level and those given by interaction influence the frequency and duration of contact between humans and bats.

Rabies is the most widely studied viral disease from bats.

There are three species of hematophagous bats in Latin America:

- *Diaemus youngi*
- *Diphylla ecaudata*
- *Desmodus rotundus*



Desmodus rotundus belongs to the Phyllostomatidae family.

The main transmitter of rabies in humans and bovine paralytic rabies (BPR).

Introduction

They weaken cattle through blood loss, lead to secondary infections, reduce milk and meat production and lead to death if cattle develop BPR.

Of the 255 cases of BPR reported during 2019, 30 (11.76%) were reported in San Luis Potosí.

Until 2017 Nuevo León was considered free of BPR, however, in 2018 three cases were reported, demonstrating an increase in the dispersal of the vector.



Shelter information

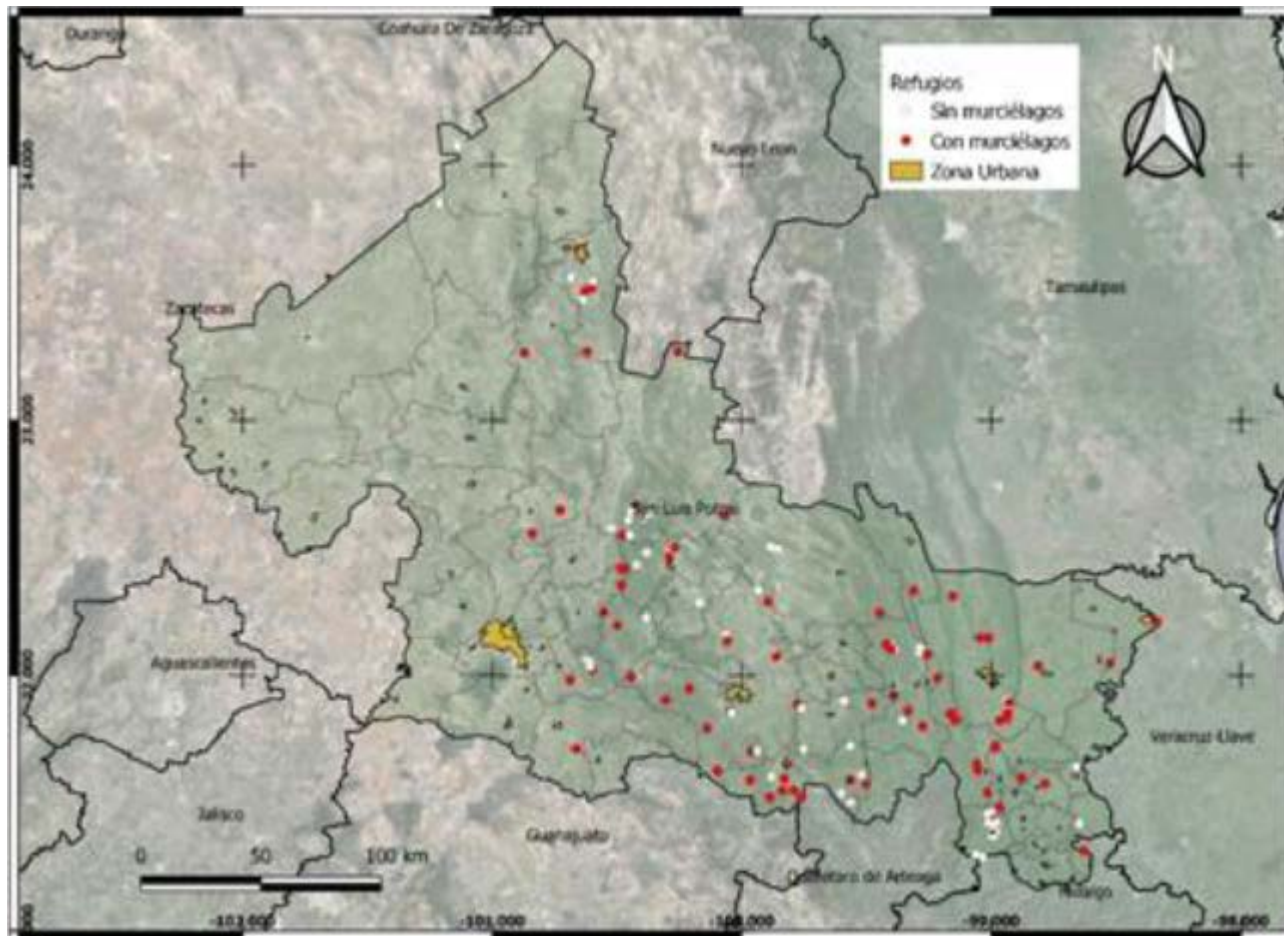


Figure 1. Geographical location of the empty shelters and shelters occupied by *Desmodus rotundus* from 2014 to 2016 by the State Committee for the Promotion and Protection of Livestock of San Luis Potosí (CEFPPSLP).



Shelter information

A total of 180 shelters were identified.

- 80% were artificial (3 abandoned houses, 1 school, 1 warehouse, a bus station and a bridge stand out).
- 20% are natural shelters such as caves.

The distribution is greater towards the Huasteca region.

D. rotundus presence?

In 102 shelters (56.7%) between 6 and 18 individuals were captured.

The rest were found empty.

Analysis of potential contact or coexistence

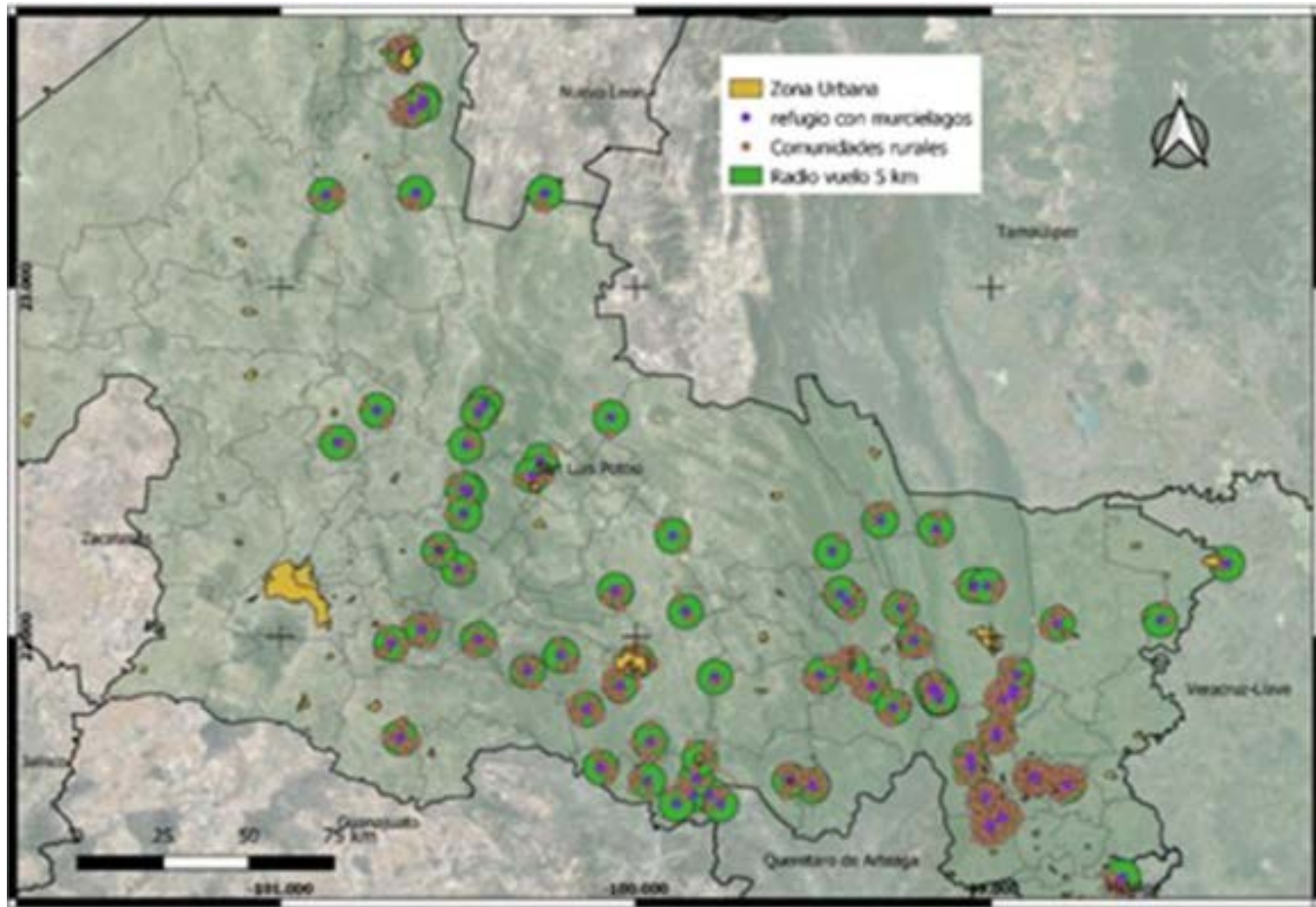


Figure 2. Rural and urban localities within a radius of 5 km from the shelters inhabited in San Luis Potosí during 2014-2016.



Analysis of potential contact or coexistence

An average flight radius of 5 km from the location of each shelter was considered, and buffers were made.

A total of 976 rural communities, which were inhabited from 1 or up to 3,124 inhabitants, making a total of 124,884 inhabitants.

15 cities representing a total of 337,836 inhabitants.

The average distance from the shelters to the first settlement with a human population was 518 ± 11.33 m.

There is an interaction at different levels and frequency of contact with humans, who could be potentially exposed to the rabies virus.

Desmodus rotundus dispersal prediction model

Environmental conditions have changed moderately, generating more sites of environmental suitability towards the northern region.

Is in the southwestern region where there is a greater probability of development of colonies.

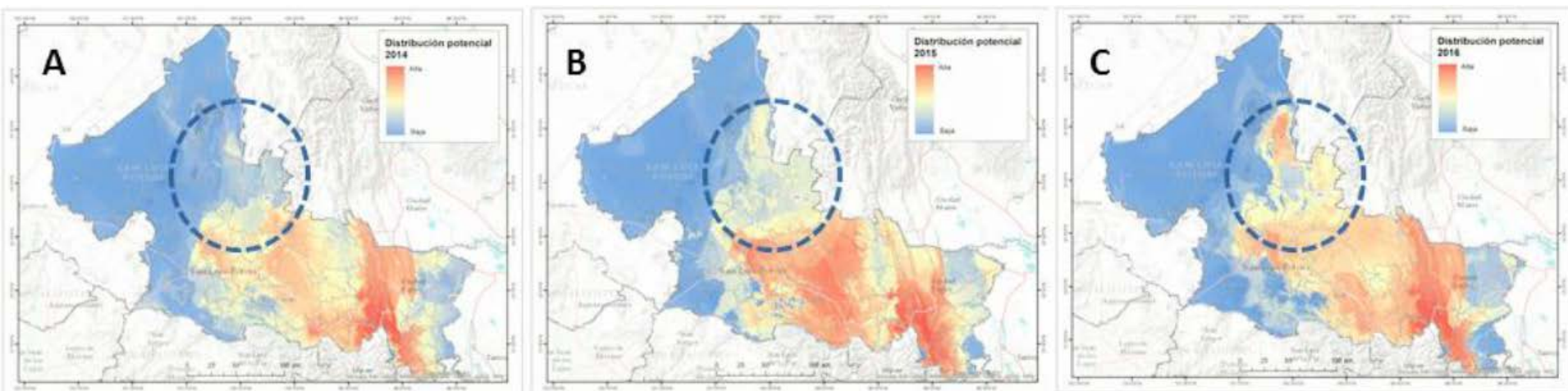


Figure 3. The prediction model with MaxEnt for the presence of *Desmodus rotundus*, for 2014 (A), 2015 (B), 2016 (C).

Desmodus rotundus dispersal prediction model

The overall Area Under the Curve was 0.992 over the entire period under study.

These results allow making a robust prediction model regarding the dispersal of *D. rotundus*.

Year	Variable	Contribution (%)
2014	Temperature seasonality	30.0
	Precipitation of the driest quarter	16.1
	Annual temperature oscillation	14.9
	Precipitation seasonality	14.3
2015	Annual temperature oscillation	26.8
	Precipitation of the driest quarter	16.7
	Precipitation seasonality	11.8
	Temperature seasonality	11.5
2016	Annual temperature oscillation	22.8
	Temperature seasonality	20.0
	Precipitation of the driest quarter	14.9
	Diurnal temperature oscillation	12.5

In conclusion...

It is common to identify shelters in sites near human populations of San Luis Potosí.

A higher frequency of aggressions by *Chirotera* could be expected; however, that does not happen.



Is necessary to study the role that urbanization plays in the distribution of *D. rotundus*, as well as the presence of wild and domestic animals as a buffer against attacks on humans.

It is important to be able to predict the sites of environmental suitability for the location of possible shelters associating them with human settlements.



Materials and Methods

The study was carried out in the state of San Luis Potosí.

Climate that predominates is the dry and semi-dry, present in 71% of the state.

Average annual temperature is 21°C.

Average minimum temperature is 8.4°C in January and the average maximum is around 32°C in May.

Rainfall occurs during the summer from June to September.

Average rainfall of the state is around 950 mm per year.

Dispersal model using MaxEnt

It was carried out through the records of location of shelters notified and visited during the years 2014 – 2016.

24 environmental variables (EV) were used for the dispersal model, 19 of them were downloaded from the Worldclim database at a 1 km².

5 variables of climate obtained from the National Institute of Statistics, Geography and Informatics (INEGI).

Environmental variable
Average annual temperature (°C)
Diurnal temperature oscillation (°C)
Isothermality (quotient between parameters EV2 and EV7)
Temperature seasonality (coefficient of variation, %)
Average maximum temperature of the warmest period (°C)
Average minimum temperature of the coldest period (°C)
Annual temperature oscillation (difference between parameters EV5 and EV6)
Average temperature of the rainiest quarter (°C)
Average temperature of the driest quarter (°C),
Average temperature of the warmest quarter (°C)
Average temperature of the coldest quarter (°C)
Annual precipitation (mm)
Precipitation of the rainiest period (mm)
Precipitation of the driest period (mm)
Precipitation seasonality (coefficient of variation, %)
Precipitation of the rainiest quarter (mm)
Precipitation of the driest quarter (mm)
Precipitation of the warmest quarter (mm)
Precipitation of the coldest quarter (mm)
Climate map (types of climate)
Land use (types)
Soils (type of soil)
Geology (type of rocks)
Altitude (m.a.s.l)



Dispersal model using MaxEnt

MaxEnt created pseudo-absence points and divided the base into 2 groups randomly:

- Data for training: 80% of the location records of the shelters.
- Data for validation: Remaining 20% and measures predictive capacity.

The result of the model then expresses the value of the suitability of the habitat as a function of environmental variables, through a statistical validation test called Area Under the Curve (AUC).

The software calculated the percentage of contribution to the model of each of the EV.

This analysis marks the climatic similarity between the sites where the shelters are and where the species possibly lives.



Analysis of potential contact or coexistence

With the coordinates of the shelters inhabited by *D. rotundus*, a buffer layer with a radius of 5 km was generated, through the Qgis program.

Additionally, with the information of the location of rural communities, of which only those that were within the created buffer were selected, and another with urban áreas, selecting those that touched the same buffer.

The number of human settlements (rural localities and urban areas) was counted, as well as their population, which are potentially within the buffer and therefore maintain interactions with colonies of *D. rotundus*.

The average distance from the shelter to the nearest dwelling was calculated.



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