Final Evaluation Report

Your Details	
Full Name	Jorge Alberto Andrade Sánchez
Project Title	Ecology and Conservation of the San Quintin Kangaroo Rat (*Dipodomys gravipes*)
Application ID	32712
Date of this Report	22/08/2023

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
Determine habitat use and home range		X		The accomplishment of this objective was affected by unforeseen difficulties related to COVID-19 pandemic. However, I overcome the difficulties and determined the habitat use and its characteristics within 19 localities thorough and beyond the historical distribution range.
Identify the specie's diet			X	This objective was fully accomplished.

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

a) Morphometric and molecular verification of the specie's rediscovery.

Considering that the species' rediscovery was questioned at the beginning of the project, I contemplated to provide a formal verification of the specimen's identity. Even though this was not originally proposed, we took advantage of permits to collect handle and to collect tissues and specimens and of the fieldwork conducted on the project. Any associated expenses of this outcome were covered by internal funding (Details on financial report)

As a team we, aimed to provide a morphometric and molecular verification of the specie's presence. In order to achieve this, I collected seven skulls and seven tissue samples. To evaluate morphometric features, I took 13 external measurements with a manual caliper and compared to those of sympatric species (*D. simulans* and *D. merriami*) based on one way ANOVA's and MDS analysis.

For molecular analysis, we extracted total genomic DNA of seven specimens of five localities using a DNeasy kit (Qiagen), sequenced a Cox3 (mtDNA) fragment of 680bp with the primers L8618 and H9323 (Riddle, 1995). Amplifications were performed in Perkins-Elmer GeneAmp PCR system 9600 (Applied Biosystem, Foster City, CA) following standardized protocols. We aligned the Cox3 sequences with 11 sequences from GeneBank of 11 *Dipodomys* species (including *D. gravipes*) using ClustalW (Thompson et al. 1997) in Bioedit 7.0.5 (Hall 1999). We used Akaike Information Criteria in jModelTest (Posada 2008) to determine that GTR+G was the best fit evolution model for the phylogenetic analysis. We inferred a phylogenetic tree using maximum-likelihood analysis using Mega 6 (Tamura et al. 2013. Five thousand bootstrap replicates evaluated the nodal support of the branches. We estimated the polymorphic sites and the nucleotide diversity using DnaSP 5.0 (Librado and Rosas 2009). To further details see Andrade et al (2022).

In all morphometric traits the specimens classified as *D. gravipes* were significantly bigger than of those of *D. simulans*. Figure 1 show the MDS analysis based on the cranium measurements compared with the congeneric species.

Regarding the molecular analysis, the genetic data provided a strong support (bootstrap = 100) for a species group including my seven samples and the *D. gravipes* sequence available at the geneBnak repository, clearly separated from other kangaroo rats, including its sympatric species (Figure 2). We identified one polymorphic site in the seven sequences, resulting in two haplotypes and a nucleotide diversity of 0.0008.

The results endorse the rediscovery of the species in 2017 (Tremor et al. 2019) and more important, is a cornerstone for its future conservation, as well future research. Although, this can be viewed as a secondary outcome is highly important result that derived from the project and that could not be achieved without the support of The Rufford Foundation.

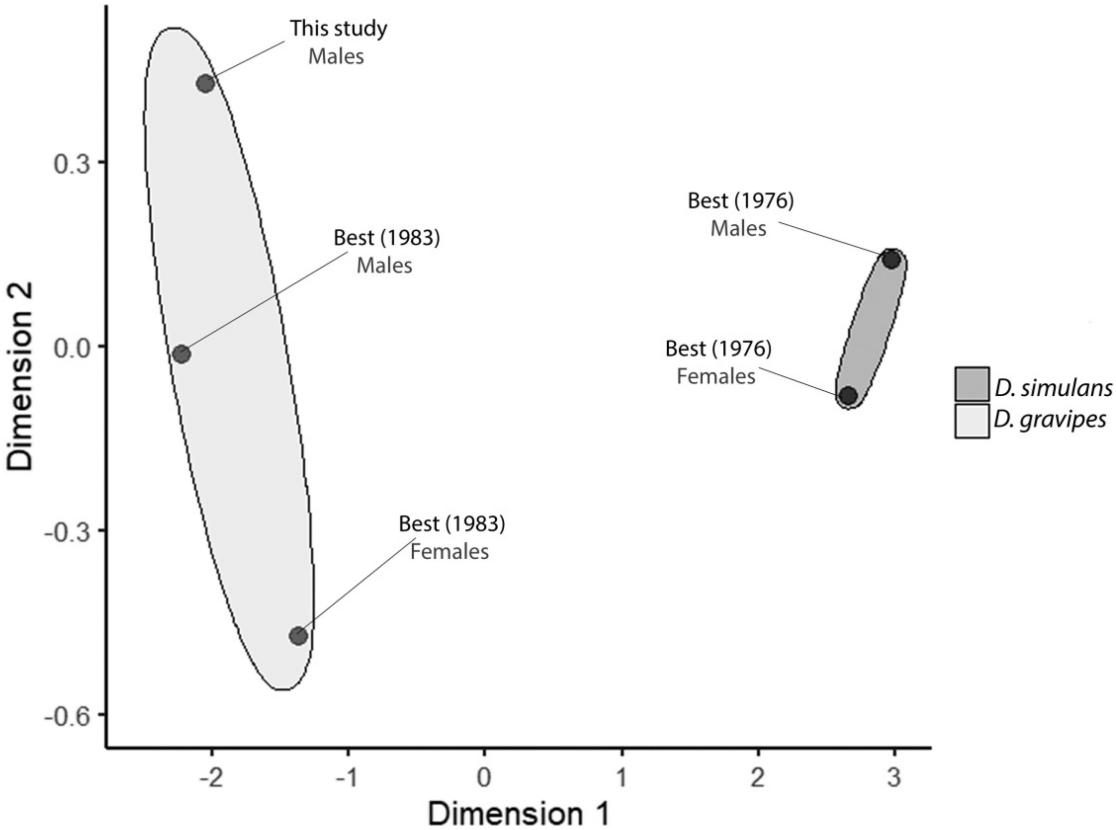

Figure 1. MDS grouping according to cranial measurements. *Dipodomys gravipes* measurements correspond to the measurements provided by Best (1983) and this study, and *Dipodomys simulans* measurements correspond to the measurements provided by Best (1976).

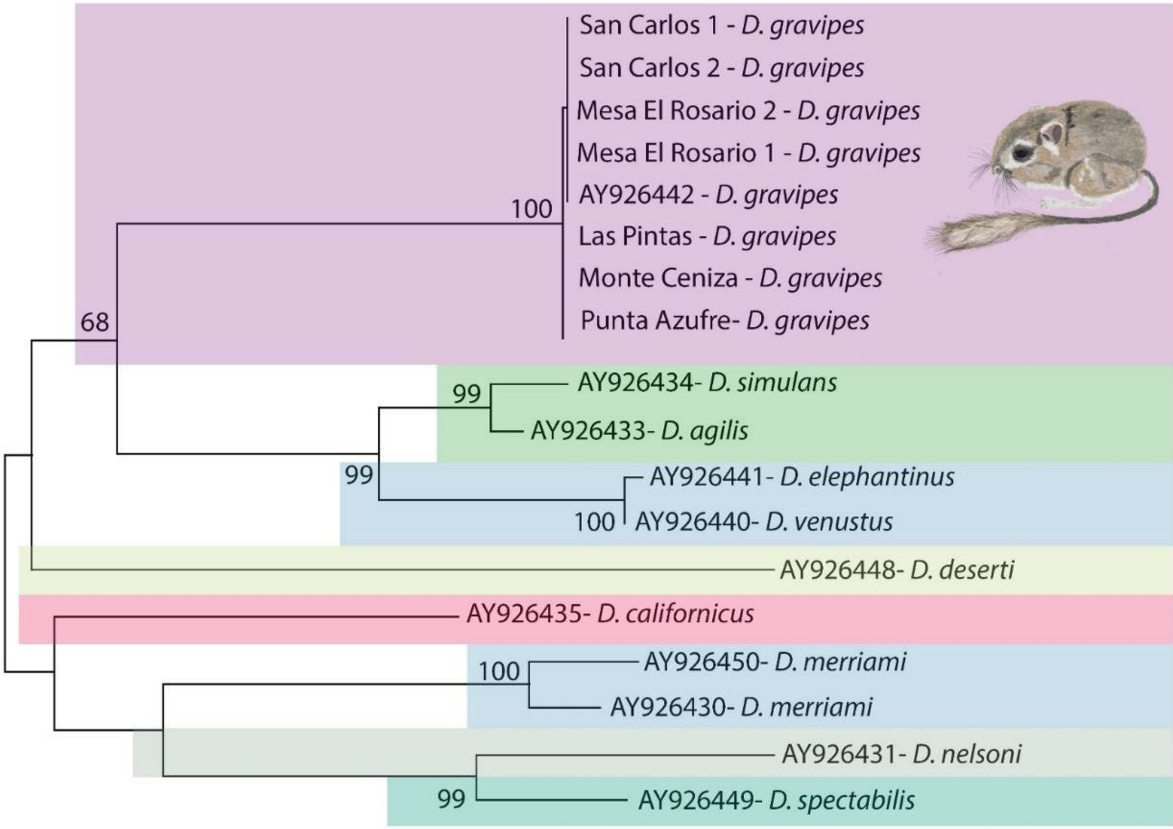

Figure 2. Maximum-likelihood phylogenetic tree of *D. gravipes* based on 680 bp of Cox3. Sequences per species are as follows: *Dipodomys gravipes*: AY926442; *Dipodomys simulans*: AY926434; *Dipodomys nelsoni*: AY926431; *Dipodomys spectabilis*: AY924649; *Dipodomys deserti*: AY926448; *Dipodomys agilis*: AY926433; *Dipodomys venustus*: AY926440; *Dipodomys venustus elephantinus*: AY926441; *Dipodomys californicus*: AY926435; and two sequences from *Dipodomys merriami*: AY926430, AY926450 (Alexander and Riddle 2005). This figure is differs on the colors from published version.

b) Habitat use and range expansion.

To evaluate habitat use we searched for the San Quintín kangaroo rat through its known historic range, as well as ~ 60 km to the north and ~ 50 km to the south of it. We surveyed 19 confirmed *D. gravipe's* localities all historical localities that were not actively farmed or urbanized, based on the San Diego Natural History Museum database, Lawrence M. Huey´s field notes, Vertnet (www.vernet.org), and the Global Biodiversity Information Facility (GBIF; www.gbif.org). We scouted for potentially occupied sites within and beyond its known distribution range based on the species' habitat according to Best and Lackey (1985). At each promising site, both historical and potential, we looked for active tracks, and round burrow entrances ≥8.4 cm high and ≥7.6 cm wide (Best 1976). If we found signs of the apparent presence of the species, we placed three long Sherman traps (30.5 cm long) baited with rolled oats at the entrance of every active burrow and left them open from dusk to dawn. We identified all kangaroo rats captured to species level based on external characteristics. Although the species is similar to the Dulzura kangaroo rat (*Dipodomys simulans*), body measurements are highly reliable to separate the adults of both species (Andrade-Sánchez et al. 2023). We obtained body weight, as well as total, tail, hindfoot, and ear length.

The extent of survey sites was defined by the surface occupied by active burrows. At each survey site we recorded the most abundant plant species, identifying them according to our knowledge of the regional flora and using Rebman and Roberts' (2012) field guide. Additionally, we qualitatively estimated the proportion of soil covered by herbs and shrubs across each entire colony. Sites were assigned on of the following land use categories no evidence of previous farming, abandoned farmland, urban, and garbage dump. We considered a site as "abandoned farmland" if the original vegetation had been removed and old furrows were visible. We also noted land use around each colony.

We obtained elevation (m asl), slope (°) and terrain ruggedness values (*sensu* Riley et al. 1999) from the 30 x 30 m ASTER Global Digital Elevation Model Ver. 3 (Abrams et al. 2020), at NASA's Land Processes (https://asterweb.jpl.nasa.gov/gdem.asp). For all calculations, we used the Raster Terrain Analysis tools and the raster calculator of Quantum GIS (QGIS; Version 3.8.0; Zanzibar). Additionally, soil classification of all sites was extracted from Mexico's national continuum soil spatial layer at a scale of 1:250 000 (INEGI 2007), using the Point Sampling tool of QGIS.

Proportion of cases which did not have evidence of previous farming and those being abandoned farmland were compared between sites currently occupied by the San Quintín kangaroo rat and those not occupied by the species through a Chi^2 test. A Chi^2 test was used also to determine if there was an effect of type of habitat adjacent to the sites surveyed on the presence or not of the species. We used an alpha level of 0.10 for all statistical tests.

Our trapping effort totaled ~ 2400 trap nights on 42 sites, 34 within the known historical distribution, and eight outside it. We captured a total of 83 San Quintin kangaroo rats at 13 sites within the known distribution, and at six beyond it (Figure 3). The species was not captured at 23 of the sites surveyed. Of the 13 localities on which the species was captured within its historical distribution, five were localities at which it had been captured before the 1970-1980s decline, and eight were localities at which it was recorded for the first time in our study. No signs of activity nor individuals of the species were captured at three localities where it had been trapped before its population collapse. Locations where we captured the species beyond its known geographic distribution were two north of it and four south of it.

Locations at which the species was present either historically and, or currently (n=22) had an elevation of 6-251 m asl, a slope of 0.7-8.5° and a ruggedness value of 0.37-3.12. Soil type was fluvisol at five locations, planosol at three, regosol at four, solonchak at one, and xerosol at 10. Sites that we considered potential and explored for the species presence but were we did not find signs of it (n=19) had values of 7-128 m asl, 0.5-9.7°, and 0.5-5.12. Their soil type was fluvisol at three locations, planosol at one, regosol at three, solonchak at five, and xerosol at seven. Eighty-four percent of the sites where we captured the species were abandoned farmland plots, including the sites within the historic range as well as those in the expanded range, and 83% of the historical locations where we captured the species were now abandoned farmland (Figure 3 and Table 1). The San Quintín kangaroo rat tended to occupy abandoned farmland more commonly than sites without evidence of previous farming (Chi^2=3.11, p= 0.08). There was no effect of adjacent habitat type on the presence or absence of the species (Table 1; Chi^2=5.01 p= 0.41).

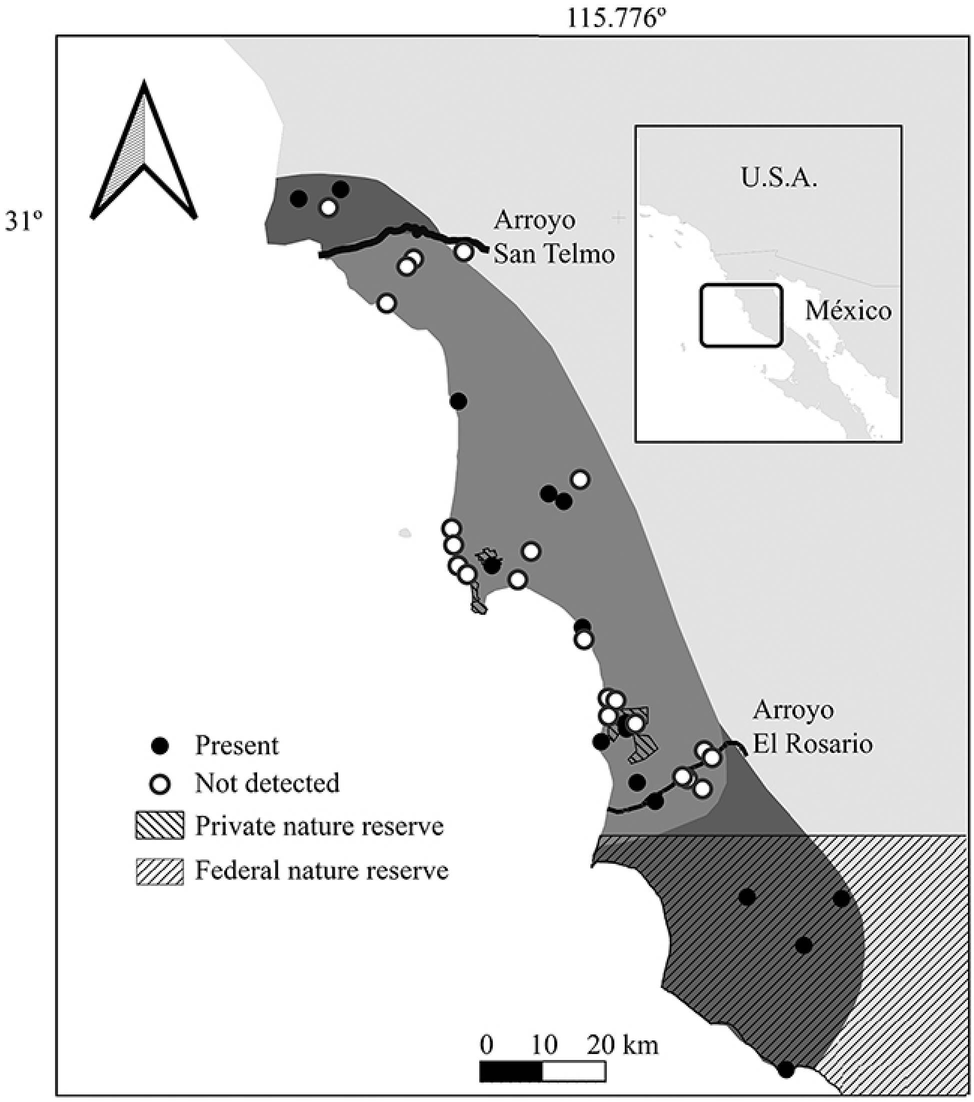

Figure 3. The San Quintín-Rosario area, Baja California, displaying the sites where the San Quintín kangaroo rat was captured, and sites with no captures of the species. Closeness of some sites where the species was captured resulted in overlapping circles.

Table 1. Current condition and adjacent habitat of sites on which San Quintín kangaroo rats were capture and of sites at which they were not. Numbers in columns are the number of sites in each category. Baja California, Mexico.

Case	**Total**	**Current condition: % (Number)**				**Adjacent habitat: % (Number)**					
		No farming evidence	**Abandoned farmland**	**Garbage dump**		**Shrub patch**	**Coastal sage scrub**	**Dune vegetation**	**Marsh vegetation**	**Cropland**	**Crops & Urban**
Absent in historic range	23	75 (9)	45 (13)	100 (1)		73 (8)	25 (2)	50 (2)	75 (3)	54 (7)	4 (1)
Historic site	4	8 (1)	7 (2)	100 (1)		27 (3)	0	0	0	0	100 (1)
Potential site	19	67 (8)	38 (11)	0		46 (5)	25 (2)	50 (2)	75 (3)	54 (7)	0
Present	19	25 (3)	55 (16)	0		27 (3)	75 (6)	50 (2)	25 (1)	46 (6)	5 (1)
In historic range	6	8 (1)	17 (5)	0		9 (1)	0	50 (2)	25 (1)	8 (1)	100 (1)
New in historic range	7	8 (1)	21 (6)	0		0	50 (4)	0	0	23 (3)	0
New in north expansion	2	0	7 (2)	0		0	0	0	0	15 (2)	0
New in south expansion	4	8 (1)	10 (3)	0		18 (2)	25 (2)	0	0	0	0

Table 2. Vegetation of sites on which San Quintín kangaroo rats were capture and of sites at which they were not. Numbers in columns are the number of sites in each category. Baja California, Mexico.

Case	**Total**	**Soil cover by plants: % (Number)**			**Herbs: % (Number)**			**Shrubs >0.05m: % (Number)**	
		<10%	**>10%**		**No or few**	**Yes**		**No or few**	**Yes**
Absent in historic range	23	44 (15)	100 (8)		100 (8)	44 (15)		49 (18)	100 (5)
Historic site	4	9 (3)	12 (1)		37 (3)	3 (1)		8 (3)	20 (1)
Potential site	19	35 (12)	88 (7)		63 (5)	41 (14)		40 (15)	80 (4)
Present	19	56 (19)	0		0	56 (19)		51 (19)	0
In historic range	6	18 (6)	0		0	18 (6)		16 (6)	0
New in historic range	7	20 (7)	0		0	20 (7)		19 (7)	0
New in north expansion	2	6 (2)	0		0	6 (2)		5 (2)	0
New in south expansion	4	12 (4)	0		0	12 (4)		11 (4)	0

The most common plant species found in survey sites, whether occupied or not by the species, were Vizcaíno saltbush (*Atriplex julacea*), Menzie´s goldenbush (*Isocoma menziesii*), broom baccharis (*Baccharis sarathoides*), and crystalline iceplant (*Mesembryanthemum crystallinum*). The last species, an invasive exotic, was present at all sites, whether they were or not occupied by the species. The San Quintín kangaroo rat only used sites with <10% ground cover by plants, regardless of whether it was by herbaceous plants and that lacked shrubs; Table 2), except at three sites which had a few of the latter.

Our results document the presence of the San Quintín kangaroo rat throughout its known historical distribution, but also extend it ~10 km to the north and ~50 km to the south, surpassing the two historically active watercourses that might have been barriers to the species' dispersal: Arroyo San Telmo and Arroyo El Rosario, respectively. Moreover, allows for a description of habitat characteristics of the sites colonised and, or recolonised by the species.

All locations at which we captured the species had <10% cover by herbs and few or no shrubs. This suggests that, in abandoned farmlands, the species uses sites in early successional stages. Those stages that had more than a few shrubs were not used by the species. In the region, sites in the later stages include shrubs like ragweed (*Ambrosia chenopodifolia*), spiny rush (*Juncus acutus*), Baja desert-thorn (*Lycium brevipes*) and California desert-thorn (*Lycium californicum*).

Our results confirm that the San Quintín kangaroo rat occupies flatland with scarce vegetation, as also described by other researchers (Best 1983; Best and Lackey 1985). However, in addition to the avoidance of sites with >10% plant cover and sites with shrubs taller than 0.5 m, finer habitat characteristics remain to be investigated.

The six sites beyond the traditionally accepted distribution range where we documented the San Quintin kangaroo rat (Fig. 2) represent an important range expansion. The northern limit accepted in the literature was that defined by Huey (1964) and neither he nor other mammologists seem to have carried out collecting immediately north of the San Telmo River according to GBIF, Vernet and Huey´s field note. But, given Huey's experience and insight it is highly unlikely confident that he would have explored any evidence suggesting that the species was in the area.

About the southern limit, Huey wrote in his field notes on 5 May 1925 "… I am satisfied that the large kangaroo rat - *D. gravipes* - found farther north does not occur this far south." The collecting of specimens of this species in 1966 by T. Best in the El Rosario riverbed (Vertnet), after Arroyo El Rosario had ceased to be a perennial stream, and water flows were greatly reduced, could indicate the colonisation of this area by the species between those two dates. Like at the northern limit, there are no known small mammal surveys on the coastal plain between Arroyo El Rosario and Punta San Carlos (Fig. 2) earlier than ours, or their results were not made public, either as publications or as specimens. Although the species could have occurred in this area unnoticed at the time of Huey or Best, the fact that all colonies south of Arroyo El Rosario are on abandoned farmland allow us to believe that a more recent colonisation is more likely. As our reconnaissance of the road to Puerto Santa

Catarina revealed, Punta San Carlos is currently the southernmost location of the species.

Our data allows us to conclude that:

- The San Quintín kangaroo rat is highly resilient in spite of the severe decline of its population caused by agricultural expansion in the 1970s and 1980s.
- Both agriculturally driven processes, suppression of dispersal barriers and the abandonment of farmed patches, favored dispersal and the establishment of the species in unoccupied patches beyond the previous limits of its distribution.
- Based on our data, we hypothesise that abandoned farmland in early ecological succession allows colonisation by the species. However, as shrubs encroach upon colonies the species ceases to use those patches.
- The current patchy spatial distribution of the specie's population is largely due to anthropogenic activities. Hence, further research and conservation actions must be framed within the context of agricultural development, as well as under a metapopulation approach.

c) The specie's diet.

The diet's species was determined based on the analysis of faecal samples. We conducted a total of ine surveys at each locality. At each survey period we placed 100 Sherman traps on a grid arrangement of 10 x 10 traps at equal intervals of 10 m, baited with rolled oats, and left from dusk to dawn for two nights. Considering the total number of traps deployed per locality, nights and number of surveys, trapping efforts was 1200 trap nights per locality and 3600 overall. We obtained individual's standard external measurements: body weight, total, tail, hindfoot, and ear lengths. We placed an alphanumerical ear tag at each individual. We determine individuals' reproductive status considering descended testes in males as reproductively active or inactive if testes were not fully descended. For females, we considered enlarged nipples as indicatory of lactating; copulatory plug as indicative of recent matting; pubic symphysis aperture as indicative of recent birth and palpating the belly for foetuses to assess pregnancy status. We collected faecal samples when these were present on Sherman traps and the bag to handle the individuals. We cleaned all Sherman traps between nights and sampling periods to make sure of collecting samples of the handled individual. All faecal samples were stored on small plastic bags until stored in lab. Figure 4 show some of the field-work activities.

Figure 4. Photographs of fieldwork. A) *Dipodomys gravipes*. B) Measuring ground cover. C) Handling a specimen of *Dipodomys gravipes.* D) Typical habitat of the species. E) Grid of Sherman traps. E) Taking field notes on one study locality.

Plant materials were crushed and cleared with a sodium hypochlorite at 5.1% of concentration on a blender (Habib and Peña, 1980). A selection of 40 mg to 100 mg per plant samples were mounted onto a slide and observed at microscope at 10, 60 and 100x to typify each plant according to its vegetative diagnostic characteristics: cell size, cell shape, cell arrangement, stomata, trichomes and glands (Habib and Peña, 1980). We took photos with a camera mounted on the microscope and create a digital reference database of the structures of each plant. Based on these diagnostic characteristics, created a dichotomous key for the plants from each site.
To determine the partially digested item in faeces of each sample, we selected a minimum of three faecal pellets per individual, cleared with sodium hypochlorite at 5.1% and washed with distilled water through x-mm sieve to clean debris. A selection of 40 mg of faecal material were mounted onto five slides on series using a metallic plate with 5 holes of 7 mm to spread faecal material evenly (*sensu* Habib and Peña,

1980). To quantify vegetative content on each sample, we used 20 fields of view per slide for a total of 100 fields of view per individual sample. Field of view was separated by pre-marked distances on the microscope stage. We used a magnification of 40x for all samples. We identified vegetative content to species level on each field of view by comparing with the digital reference data base based on the plant's diagnostic characteristics (Baumgartner and Martin, 1939; Sparks and Malchek, 1968; Habib and Peña, 1980; Litvaitis et al., 1996), and by following our dichotomous key. Figure 5 show key elements to identify the plants.

We identified several plant species at different proportions. It is important to highlight that the methods tend of sub-estimate the presence of seed on the rodent's diet and considering that the genus *Dipodomys* is primarily granivorous, is likely our results are diminishing the presence of seeds on its diet. However, our results suggest that the species is generalist and consume a wide variety of plants, including green parts of these. Moreover, our data shows that the species is able to consume invasive plants such as *Mesembryanthemum crystallinum*. The latter is important as it show a high capacity of resilience on this endangered rodent.

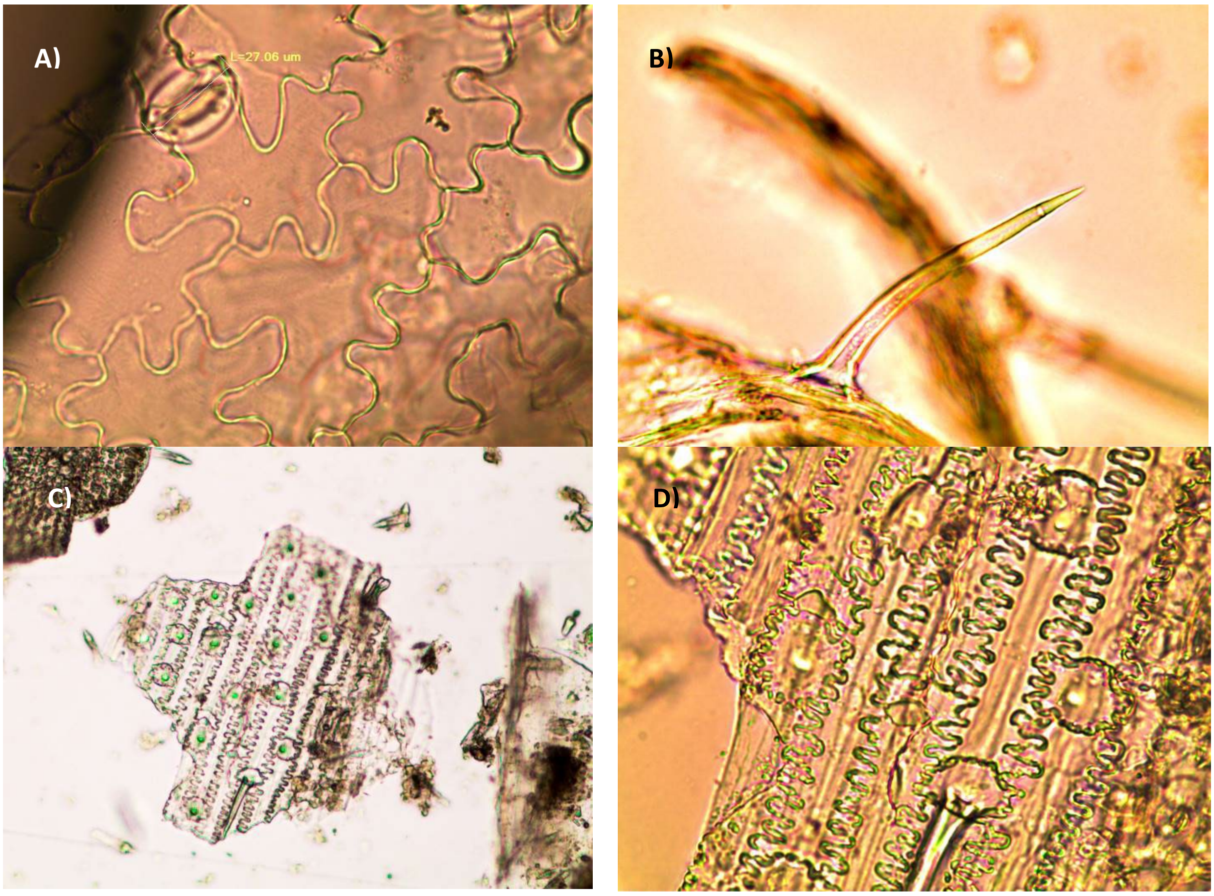

Figure 5. Examples of partially digested plants in the fecal samples of kangaroo rats, A) corresponds to a typical "puzzle" arrangement of a dicot, B) show a trichome which is key to identify dicots, C) show the particular arrangement of the cell of a grass and D) is a closer look (40x) of the grass.

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

Covid-19 pandemic affected the project. The biggest issued was the time span on which the project was executed. The project heavily relied on field work and México and my academic institution banned fieldwork and travels. Therefore, fieldwork started a year and a half before the grant approval. Other big issue was the fact that Mexico and US border closed. This limited the importation of radio-tracking devices to México. In consequence, we were forced to modify the first objective. However, the modification allowed to evaluate habitat use on a broader spatial scale than originally planned. Our examination of the habitat's localities within and beyond the former distribution range of the species lead to the documentation of 19 localities with the presence of the species. Besides tackling the obstacles that arose, I was able to obtain crucial data regarding habitat use of the species and to document a range expansion. Altogether, the outcomes of this modified objective are considered key for the conservation of the species. In consideration of this, we prepared and submitted a scientific paper to a peer-review journal.

The limitation to go to the study localities, allowed to invest time in a different way. We were able to obtain tissues and skulls from previous surveys and to collect few more samples from an additional short field trip. Therefore, we spend time on the genetic lab and data analysis to address the first of three main outcomes. These main results were published on a peer-review scientific journal.

The objective 2, diet of the species, was also delayed by Covid19-related problems. However, we managed to collect faecal samples from several localities and at a different season of the year. Therefore, I successfully overcome the limitations and finished the objective 2.

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

Fieldwork of the project occurred on remote localities and close to local communities. As an outreach strategy I directly involved local participants in the field-work activities. All of them actively participated as fieldwork assistants. We used a participatory approach to include the local and as consequence they learned and reinforced the capacities to survey small mammals (rodent in particular) within their communities (Figure 6).

Figure 6. Local field assistants from the localities of El Rosario and San Quintin. A) Placing Sherman trap. B) Measurements to create the grid of Sherman traps

Moreover, one study locality belongs to a local conservation non-profit. The non-profit is a key stakeholder on the study region. The project allowed to create an alliance with this crucial actor. Summary of the outcomes of the project, as well the papers published were delivered to the organisation with the objective to aid its management and conservation decision process on its areas.

5. Are there any plans to continue this work?

The overall project is part of my PhD dissertation and thus remains active. There are several next steps to be addressed in the near future. This are further detailed in the next steps section of this report. These will the main objectives of the continuation of the work during and after the PhD dissertation. It should be highlighted that the species remains under the category of critically endangered by the International Union of Conservation of Nature (IUCN) and potentially extinct in the wild by the environmental agencies in México. Therefore, the continuation of the project goes beyond research and includes work with local stakeholders.

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

To date we have published an article in a peer-reviewed scientific journal specialised in zoology regarding the first main outcome. This paper was published on the Canadian Journal of Zoology (Journal Impact Factor: 1.4) and it is titled **"Was the San Quintin kangaroo rat really rediscovered?** (Figure 7).

Canadian Journal of **Zoology**

Was the San Quintín kangaroo rat really rediscovered?

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Figure 7. Screenshot of the tittle, authors and affiliation of the article published on the Canadian Journal of Zoology (https://cdnsciencepub.com/journal/cjz).

A second paper with the tittle **"**Site occupation and range expansion by the highly endangered, Mexican micro endemic San Quintín kangaroo rat" is currently under review by the Journal of Mammalogy (Journal Impact Factor: 1.7). This article corresponds to the outcomes of the first objective.

Regarding the outcomes of the second objective, the specie's diet, I plan to analyse the data into more detail in order to elucidate spatio-temporal patterns on the diet and to publish the results on a scientific journal.

Outreach is crucial for my purposes. Throughout the course the project, I gave talks about the species and the project with the correct publicity to Rufford foundation. List of the talks below:

6.1 Outreach talk to middle-school "Xochicalco" with the tittle "The San Quintin kangaroo rat: a threatened species".
6.2 Keynote speaker in Ecology Symposium at the University of Guadalajara with the tittle "Chronicle of an officially extinct species: Challenges for the conservation of the San Quintin kangaroo rat".
6.3 Outreach talk in the life science Symposium at CICESE.

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

Considering the major outcomes, there is several subsequent research and conservation objectives to be addressed. The first major outcome of this project, the molecular and morphometric analysis, showed a low genetic diversity among the samples and thus within the current populations. There are several ecological and evolutionary implications of the latter. Therefore, one important step to be addressed is the analysis of the genetic and genomic diversity. This data is crucial to create management and conservation strategies as can inform about the distribution of the genetic/genomic diversity and highlight isolated populations (and the opposite) and illuminate regarding the evolutionary potential of the species.

Habitat assessment though the species' range, showed that the San Quintin kangaroo rat is highly resilient. However, poorly is known about the influence of the habitat traits on the demography of the species and its variation over space and time. Therefore, I feel, or I know that a next important step is to evaluate the changes on demographic patterns though time and space.

The second outcome also highlighted that there are several localities without protection of any kind that are within private properties and as an abandoned croplands can be transformed to active farmland again in the near future. This possesses a serious threat to the conservation of the species. In consequence, it is urgent to create a strategy to prevent the destruction of the remaining colonies. However, a proper conservation strategy should include more actions to be carried out. Considering this, the next crucial step is to create a robust long-term conservation plan. I am aware that in order to achieve this step is necessary to work with local stakeholders (e.g., local non-profits, academic institutions, farmers and government institutions). Thus, the conservation plan should be multi-actors.

In summary, there are two steps which include necessary research to inform management a conservation actions and a following crucial step: a long-term conservation multi-institutional plan for the San Quintin kangaroo rat.

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?

Rufford grant was recognized on several occasions. Besides the acknowledgment in the research articles, recognition has given in the outreach talks. In the figure 8 there is an example of opening slide with the logos of the foundation.

Figure 8. First slide of an outreach talk with the logo of Rufford Foundation aknowleging the financial suppot.

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

Eric Mellink: Co-Supervisor – Was involved in all stages of the project as a supervisor.

Mónica E. Riojas-López: Co-Supervisor – Was involved in all stages of the project as a supervisor.

Scott Tremor: Researcher – Was involved in field-work activities and also supervised parts of the project.

María Clara Arteaga: Researcher – Was involved in genetic objective as a supervisor.

Carlos González: Field assistant – Was involved in the field data collection.

Bertha Macias: Field assistant – Was involved in the field data collection and data processing.

Jaime Luevano: Field assistant – Was involved in the field data collection.

Alejandra Castañeda-González: Field assistant – Was involved in the field data collection.

Jaqueline Chavira: Field assistant – Was involved in the field data collection and data processing.

Diego Andrade: Field assistant – Was involved in the field data collection.

Armando Martínez: Field assistant – Was involved in the field data collection.

Enrique Alfaro: Local Field assistant – Was involved in the field data collection.

Alberto Sánchez: Local Field assistant – Was involved in the field data collection.

Kaliman Sánchez: Local Field assistant – Was involved in the field data collection.

Jorge Alejandro: Local Field assistant – Was involved in the field data collection.

Ariel Peralta: Local Field assistant – Was involved in the field data collection.

10. Any other comments?

A biology Bachelor's student took the role of field assistant and data processing during part of the project. This was part of her research stay that I and Eric Mellink and Mónica Riojas-López co-supervised. She successfully finished the research stay. In consideration of this, The Rufford Foundation though the stipend granted aid on the formation a biologist.

All work was conducted the Mexican environmental law (permits SGPA/DGVX/3150/19 and SGPA/DGVX/3150/22) and ascribing to the guidelines of the American Society of Mammologists (ASM) for the use of wild mammals in research (Sikes and Animal Care and Use Committee of the American Society of Mammalogists 2016). All fieldwork at each study locality was carried out with the landowner permission.