Mexican Small Mammal Assessment, Prioritization and Conservation Planning Workshop

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INTRODUCTION

Purpose

The workshop focused exclusively on conservation action planning for small mammals in the orders Rodentia and Eulipotyphla with native ranges in Mexico. On the IUCN Red List there are a total of 262 species in Mexico, 63 of which are globally threatened (Table 1). This workshop brought together experts on small mammals to agree on the status, research needs and priorities for this group of mammals.

Peromyscus schmidlyi by Luis Darcy Verde Arregoitia

Table 1. Extant small mammal species in Mexico					
Order	**Families**	**Genera**	**Species**	**Endemic**	**Globally Threatened***
Rodentia	8	50	225	98	54
Eulipotyphla	2	6	37	23	9

*Defined as Critically Endangered, Endangered, and Vulnerable

Goals of the workshop

- To improve understanding of the IUCN Red List process & Small Mammal Specialist Group's role
  - To provide details on the Red List process and how people can interact with the process more fully and efficiently
  - To raise awareness of SMSG's role, including its conservation priorities & strategic plan
- To provide an overview of the conservation status of species for the country
  - To collate details of species where Red List assessments need updating
  - To identify species where urgent field surveys are required
  - To identify, for each priority species, the conservation actions required- field conservation delivery/support, surveys, captive-breeding programmes, reintroductions, translocations and other relevant conservation actions
- To develop mechanisms for the implementation of conservation actions
  - To identify collaborations and funding opportunities for priority species
  - To identify training needs amongst small mammal biologists in the region
  - To recruit new members
- To agree on roles and next steps for the conservation of Mexican small mammals

Presentations on the roles of the IUCN and participating specialist groups

IUCN Small Mammal Specialist Group: responsibility and strategy

The mission is to serve as the "*global authority on the world's small mammals through developing a greater scientific understanding of their diversity, status and threats, and by promoting effective conservation action to secure their future*".

Volunteer members conduct fieldwork and lab research and donate their time and knowledge to improve the world's scientific understanding of the taxonomy, ecology and conservation status of over 2900 species. The SMSG promotes conservation actions on the ground for species of conservation concern, and develops strategies to enable more effective small mammal conservation.

Formed in 2011, the SMSG is an expanding global network of scientists and conservationists who share a passion for the world's rodents, shrews, moles, solenodons, hedgehogs and tree-shrews

The SMSG has teams in the United Kingdom at Durrell Wildlife Conservation Trust and in the United States at Texas A&M University. Global Wildlife Conservation (Austin, TX, USA based NGO) is involved primarily in a strategic role, helping with the design and decisions associated with these various programs of work.

The SMSG is responsible for three orders of small mammals – the rodents, tree shrews and the eulipotyphlans. These three orders contain more than 2900 species, of which well over 400 are considered threatened with extinction on the IUCN Red List. Small mammals are generally very poorly studied – many hundreds of species have never been photographed in the wild and even their basic ecology is unknown. For the most part they are under-represented in terms of both conservation funding and actions.

SMSG strategy: The group implements 3 programs of work to conserve small mammals:

1: Promoting small mammal conservation within the world's leading zoos

Zoos could play a much greater role in captive breeding for conservation purposes and provide greater funding and expertise to in-situ conservation efforts in the field.

2: Developing champions for key small mammal species

Individuals and small organisations can play a huge role in championing species conservation efforts, and ultimately this can lead to site-level protection programmes. We will identify key species and building the capacity needed for people to conserve them. This includes assistance with funding and training, support for research activities, providing networking opportunities and facilitating action planning.

3: Building conservation capacity in key small mammal regions

By identifying key geographical regions to begin conservation efforts, the SMSG can have maximum benefits to a whole suite of species. The SMSG, alongside many other important partners, has been working hard to complete the IUCN Red List reassessments for small mammals. Key regions have now been identified.

IUCN Conservation Planning Specialist Group

The Conservation Planning Specialist Group (CPSG) is a global network of conservation professionals helping to create success stories. CPSG provides species conservation planning expertise to governments, Specialist Groups, zoos and aquariums, and other wildlife organizations. Our ties to the IUCN are essential to the strength of CPSG and our position as a vital link between governments, conservation organizations, and others in the conservation community.

CPSG's mission is to save threatened species by increasing the effectiveness of conservation efforts worldwide. For over 30 years, CPSG has accomplished this by using **scientifically sound, consensus-based methods, collaborative processes, and neutral facilitation** that bring together people with diverse perspectives and knowledge to catalyze positive conservation change. CPSG transforms passion for wildlife into effective conservation.

Since its inception in 1979, CPSG has assisted in the development of conservation plans involving over 250 species through more than 600 workshops held in 71 countries. The tagline *"Changing the Future for Wildlife"* highlights its ongoing commitment to species conservation planning.

This collaborative effort with the SMSG is one of the first, but hopefully not the last, of collaborations amongst Specialist Groups to together develop a thorough assessment, prioritization and conservation action planning for endangered species, in this case, the threatened Rodentia and Eulipotyphla species of Mexico.

OVERVIEW OF THE ASSESSMENT PROCESS AND AGREEMENT ON SPECIES LIST TO USE

Shelby McCay provided a review of Red List terms, categories and criteria and explanations of the process, including who is involved with the Red List process (TAMU, Durrell, GMA, RL Unit), to ensure that everyone understood the correct terminology and procedures. The presentation also covered data quality types that are acceptable for assessments. A number of important points and considerations emerged from group discussions:

- There were several species that will need to be reassessed due to new information or insights provided by the participants.
- There are a number of taxonomic changes that need to be made to the Red List database, due to recent revisions and discoveries.
- The necessary time frames for completing these changes given the impending deadlines for the new Global Mammal Assessment were discussed.
- Possible improvements to the Red List process and ideas for increasing input from experts to facilitate the process in the future were considered.

There was also a valuable discussion of training needs for Red List assessments, conservation planning, and prioritization. One possibility discussed was that of a Red List Training workshop to be held in Mexico City sometime in the spring, to be conducted by Shelby McCay. This also relates to the capacity requirements for achieving the conservation objectives developed in the workshop. The Mexican participants strongly advised that we need to re-examine the assessments of 33 species. These species will not be updated until 2019, at the earliest, due to time constraints and capabilities of the SMSG team at TAMU and the need for the GMA to complete all reassessments by the summer of 2018. The species requiring taxonomic changes once the Red List database is open are listed in Table 1 in the Appendix.

Table 2 in the Appendix provides details of those species which need to be considered for reassessment on the Red List as a result of new information gathered during the workshop. An important result will be a full update on the list of Mexican small mammal species based upon the IUCN 2018 assessment and the input from the panel participants. In addition, this allowed us to finalize the full list of Mexican small mammal species to be considered in the prioritization exercise.

PRIORITIZATION SETTING

The group reviewed previously used methods for priority setting and collectively agreed on the information and data required on each small mammal species to begin ranking and prioritizing them. To do this, the data gathering process recently employed by the Antelope Specialist Group was reviewed and adapted. Table 2 shows the different data that was collated for each species. Ideally, Extent of Occurrence (EOO) and Area of Occupancy (AOO) would have been included, however, this was not possible to calculate during the workshop. These data sets should be considered for a Mexican participant lead, peer-reviewed publication on small mammal conservation priorities in Mexico. This is one of the proposed deliverables from the workshop. Dr. Lázaro Guevara, in the

laboratory of Dr. Victor Sanchez-Cordero, was named by the group as the Mexican coordinator for the SMSG and will assist in the development of this manuscript with Dr. Francisco Botello and the other participants.

Table 2. Data collected to inform subsequent prioritization exercise.

Data type	Details
Red List category	In most cases the published category, except in a couple of cases where crucial new information was presented by workshop participants leading to proposed relisting
Evolutionary Distinctiveness (ED)	A method of quantifying the uniqueness of a species. Calculated using a phylogeny, with more unique species receiving a higher score (Collen et al. 2011)
Population Size	An estimate of population size and an associated data quality score (high, medium, low)
Population trend	Trend (increasing, decreasing, stable and unknown) and an associated data quality score (high, medium, low)
Number of locations	Approximate number of locations, using the Red List definition of location
Protected Area coverage	Approximate percentage of species' range that is protected. We decided not to include a measure of Protected Area enforcement, because this is in general not an issue for Mexican conservation units
Captivity information	A record of whether the species is currently in captivity; whether it has been historically; and if there is a strong motive for initiating an ex situ captive breeding program
Population management	A record of whether there are any ongoing population management activities
Threats	An evaluation of 1-3 main threats. For each threat a record of the trend (increasing, decreasing, stable) and whether it was reversible (high, medium, low)
Comments	Any other information deemed relevant to understanding the conservation status

Based on the full species list developed earlier in the workshop, Globally Threatened species were divided up in to groups for teams with the relevant experience and expertise to assemble the data into the template. Only Globally Threatened species were considered, due to the large number of them (76 species in total were reviewed during the workshop). Groups then reconvened to report back and refine the information.

Habromys schimdyli by Pablo Colunga

Once the data for the Globally Threatened species was gathered, the prioritization process was defined. Only Critically Endangered species were ranked, due to time restrictions. For each species an 'Urgency' score and 'Feasibility' score was assigned, with a score of 1-3 with 3 being high. Additionally, it was recorded if the conservation actions for the target species would also benefit other Globally Threatened small mammals in the habitat or region.

Species were then ranked first on highest feasibility, then subsequently on the highest urgency, and finally using the number of other species which could benefit to rank them (Table 3). Having applied this ranking system, we selected the top six priority species for the development of comprehensive conservation action plans with budgets.

Table 3. Ranking of Critically Endangered species and the scoring system used to determine this. Species in bold were selected for full plans.

Rank	Species	Feasibility score	Urgency score	Number of other GT species that would benefit
1	***Xenomys nelsoni***	**3**	**3**	**3**
2	***Peromyscus guardia***	**3**	**3**	**2**
3	***Reithrodontomys spectabilis***	**3**	**3**	**2**
4	***Peromyscus slevini***	**3**	**3**	**1**
5	***Habromys schmidlyi***	**3**	**2**	**1**
6	***Habromys ixtlani***	**3**	**1**	**1**
7	*Sorex sclateri*	2	3	3
8	*Geomys tropicalis*	2	3	1
9	*Orthogeomys lanius*	2	3	1
10	*Habromys chinanteco*	2	3	1
11	*Habromys delicatulus*	2	3	1
12	*Habromys lepturus*	2	3	1
13	*Habromys simulatus*	2	3	1
14	*Tylomys bullaris*	2	3	1
15	*Neotoma nelsoni*	2	2	1
16	*Peromyscus bullatus*	2	2	1
17	*Tylomys tumbalensis*	1	3	3
18	*Sorex stizodon*	1	3	2
19	*Heteromys nelsoni*	1	3	1

SPECIES CONSERVATION ACTION PLANS

The breakout groups developed appropriate objectives, timeframes, primary opportunities, challenges, and potential collaborators and funding sources. See Table 3 in the Appendix for full details. All of these species are considered strong candidates for recovery and the targets of funding proposals.

Habromys lepturus by Gerardo Ceballos

ADDITIONAL FUNDING OPPORTUNITY

National Geographic recently launched a new grant scheme called RECOVERY OF SPECIES ON THE BRINK OF EXTINCTION. This RFP specifically targets IUCN Globally Threatened Species, given certain criteria are met (for further details see

https://www.nationalgeographic.org/grants/grant-opportunities/species-recovery/). There are several important considerations:

- Typical proposal requests should be less than US $30,000, of which <20% can be used as stipends.
- The funding goal is to halt further biodiversity decline by implementing species conservation plans.
- Applications must explicitly address priorities defined in published action plans. If no plan exists, the proposal must include an IUCN SSC Species Specialist Group endorsement letter.
- All applications should explicitly state the plan for evaluating the impact of the work.
- Preference will be given to proposals that include feasible plans to demonstrate change in key, quantifiable indicators of, for example, reduction in drivers of population decline (e.g. unsustainable hunting, fishing or logging), or increase in numbers, degree of protection or connectivity of populations of the target species.

CONSERVATION ACTION PLANS AND PROPOSAL DEVELOPMENT

We conducted a rapid review of the long list of Critically Endangered species in Mexico to identify species with suitable project opportunities for this specific funding opportunity. We selected three species and in teams developed short summaries, which will be pitched to SMSG contacts involved with the funding process. These applications will be SMSG endorsed and supported but led a Mexican Primary Investigator (PI). Each presents different opportunities and challenges. One of the species, *Tylomys bullaris*, was not in our top six, but in the top 10, and considered a strong candidate for an NGS proposal because it closely met the criteria.

Cozumel Harvest Mouse *Reithrodontomys spectabilis*

1. Population monitoring and follow up of distribution and abundance.
2. Exotic species control in the distribution range of the species.
3. Environmental education about *R. spectabilis* and its link with forest and fresh water on the island.
4. Captive reproduction for conservation at Africam Safari, Puebla.
Note: the habitat protection scheme is complete on the island via state and federal protected areas and in addition the entire island is recognised under the UNESCO Man and Biosphere Program.

Chiapan Climbing Rat *Tylomys bullaris*

1. Identification of remnant suitable habitat and where existing populations are located.
2. Identification of potential areas for improving habitat connectivity and conservation of the species.
3. Environmental education promoting positive attitudes and perceptions towards rodents and their links with forests and water conservation.
4. Captive reproduction for conservation at Zoológico Miguél Álvarez del Toro (ZooMAT), Chiapas, where there is past experience in captive breeding of the species.

Magdelena Wood Rat *Xenomys nelsoni*

1. This is a monotypic species within a genus endemic to the deciduous forests in Colima and Jalisco. Its distribution overlaps with a number of other endemic threatened Mexican species.
2. Identification of habitat and populations which are key for habitat connectivity outside its protected distribution.
3. Promotion of the establishment of protected areas on the identified priority regions for the conservation of this and codistributed species.

Xenomys nelsoni by Gerardo Ceballos

OUTCOMES

There were several important outcomes of the workshop.

- List of highest priority species projects, with key conservation actions required and potential implementers/those to be responsible for championing the species
- Selection of highest priority areas for initiating surveys
- Training needs assessment
- Research needs
- Plan for easing the Red List process and improving communication between assessors, contributors and the SMSG

DELEGATE LIST

The SMSG was extremely grateful for the time and effort of all those who were able to attend the workshop.

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Frank Carlos Camacho	Director General. Africam Safari
Luis Martínez	AfriCam Safari
Luis Carrillo	CPSG Mexico
Rosalind Kennerley	SMSG team based at Durrell (UK)
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Appendix

Table 1. The species requiring taxonomic changes or addition to the Species Information Service (SIS) once the Red List database is open.

Current Species Name	Taxonomic Change
Orthogeomys lanius	New genus: *Heterogeomys*
Handleyomys chapmani	New genus: *Oryzomys*
Peromyscus mekisturus	Potential change
Peromyscus avius	Needs to be added to SIS
Peromyscus carletoni	Needs to be added to SIS
Oryzomys peninsulae	Needs to be added to SIS
Thomomys nayarensis	Needs to be added to SIS
Heteromys goldmani	Needs to be added to SIS
Tamias solivagus	Needs to be added to SIS
Tamias dorsalis	Needs to be added to SIS
Cryptotis lacandonensis	Needs to be added to SIS

Table 2. Species Red List accounts to be reviewed, as a result of new information gathered during the workshop.

Species Name	Current Red List Category and Criteria	Species Name	Current Red List Category and Criteria
Cryptotis nelsoni	CR B1ab(i,ii,iii)	*Peromyscus ochraventer*	VU B1ab(iii)
Dasyprocta mexicana	CR A2c	*Reithrodontomys hirsutus*	VU B1ab (iii)
Dipodomys gravipes	CR D	*Sigmodon alleni*	VU A2c+3c+4c
Habromys simulatus	CR C2a(i,ii)	*Sorex macrodon*	VU B1ab(iii)
Neotoma nelsoni	CR B1ab(iii)	*Sorex milleri*	VU B1ab (iii)
Peromyscus caniceps	CR B1ab(v)	*Microtus quasiater*	NT
Peromyscus dickeyi	CR B1ac(iv)+2ac(iv)	*Neotoma phenax*	NT
Peromysucs guardia	CR(PE) B2ab(iv,v)	*Peromyscus polius*	NT
Peromysucs interparietalis	CR B1ab(v)	*Rheomys thomasi*	NT
Peromyscus pseudocrinitus	CR B1ab	*Chaetodipus lineatus*	DD
Peromyscus slevini	CR B1ab(v)	*Cryptotis alticola*	DD
Peromyscus pseudocrinitus	CR B1ab	*Cryptotis peregrina*	DD
Tylomys tumbalensis	CR B1ab(iii,v)	*Cryptotis tropicalis*	DD
Cryptotis griseoventris	EN B1ab(i,iii)	*Neotoma insularis*	DD
Cynomys mexicanus	EN B1ab(i,ii,iii,iv)	*Orthogeomys cuniculus*	DD
Habromys delicatulus	EN B1ab(i,ii,iii)+2ab(i,ii,iii)	*Peromyscus furvus*	DD
Heteromys nelsoni	EN B1ab(I,ii,iii,v)	*Peromyscus sagax*	DD
Megadontomys nelsoni	EN B2ab(iii)	*Reithrodontomys burti*	DD
Microtus umbrosus	EN B1ab(i,ii,iii)+2ab(i,ii,iii)	*Chaetodipus pernix*	LC
Nelsonia goldmani	EN B1ab(iii)	*Chaetodipos siccus*	LC
Peromyscus melanocarpus	EN B1ab(iii)	*Neotomodon alstoni*	LC
Reithrodontomys tenuirostris	EN B1ab(i,iii)	*Peromyscus gymnotis*	LC
Rheomys mexicanus	EN B1ab(iii)	*Peromyscus hooperi*	LC
Xenomys nelsoni	EN B1ab(iii)	*Peromyscus schmidlyi*	LC
Xerospermophilus perotensis	EN B1ab(iii)	*Tamias durangae*	LC
Zygogeomys trichopus	EN B1ab(iii,v)		
Handleyomys chapmani	VU B2ab(ii,iii)		
Handleyomys rhabdops	VU B1ab(iii)		

Table 3. The objectives for research and conservation activities for six priority species. The opportunities section is designed to capture information on connections, data, knowledge, institutions etc. that could be useful. Where possible costs were estimated, or High (H), Medium (M), or Low (L) were used.

Angel Island Mouse *Peromyscus guardia*

	Opportunities	Responsible persons*	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	10000	6 months
1.2 Characterize the genetics of the populations	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	3000	6 months
Objective 2: Captive breeding and reintroductions to islands where the species is currently extinct from						
2.1 Eradicate House Mouse *(Mus musculus)* from Mejia and Granito	GESI, CIB, CONAMP, Mexican Navy	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Repeated processes to control rodents when birds are not nesting. Confirming absence of rodents	21000	1 year
2.2 Confirm absence of cats *(Felis catus)* on Estanque Island	GESI, CIB, CONAMP, Mexican Navy	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Confirm absence of cats using camera traps	1500	3 months

Action						
2.3 Reintroduction of *P. guardia* to Mejia, Granito, and Estanque	GESI, CIB, CONAMP, Mexican Navy	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Select individuals for reintroductions to the three islands	4000	Long term
2.4 Find collaborating institution for the captive breeding program	Africam Safari	Africam Safari	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Obtain collaboration of Africam Safari. Facilities and infrastructure	50000 - 80000	2 months
2.5 Removing of individuals	Africam Safari	Africam Safari	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Africam Safari, Mexican Navy	4500	several months
2.6 Monitoring of genetic diversity	Africam Safari	TAC	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM		3000-6000	Short term

Objective 3: Monitor reintroduction success

Action						
3.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	7000	Long term process
3.2 Characterize the genetics of the populations	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	500	Long term process

Slevin's Mouse *Peromyscus slevini*

	Opportunities	Responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	16000	6 months
1.2 Characterize the genetics of the populations	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Very remote, difficult access, poor services near areas, huge island	3000	6 months
Objective 2: Remove the invasive species of *Peromyscus* from the island						
Option 1. Remove *P. sleveni*, poison the invasive species, and replace with *P. slevini* from captive bred population	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Large island, difficult to be effective. Captive breeding needs to be effective. Invasive species monitoring program needs to be effective prior to reintroduction.	30000	2 to 3 years
Option 2. Develop a size specific trap for the small invasive Peromyscus and trap individuals out while leaving *P. slevini*	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS	TAC	CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Design and effectiveness of the trapping and monitoring.	40000	Long-term (Years).

Objective 3: Captive breeding for insurance

3.1 Find collaborating institution for captive breeding program	Africam Safari	Africam Safari	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Obtaining necessary collaborations	50000 - 80000	2 months
3.2 Removal of individuals	Africam Safari	Africam Safari	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM	Obtaining necessary collaborations	4500	several months
3.3 Monitoring of genetic diversity	Africam Safari	TAC	Africam Safari, CONAMP, NGO GESI, SEMARNAT, Mirina Mexicana, CIB, Global Wildlife Conservation Species Recovery, NGS, UNAM		3000 - 6000	Short term

Magdelena Wood Rat *Xenomys nelsoni*

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	Detailed knowledge of Chamela-Cuixmala region already exists	GC / AC	UNAM Colima, UNAM Ecología, Fundación Cuixmala, SACBÉ	Financial resources	85000 /year	Short-term
1.2 Characterize the genetics of the populations	The population is conserved in Chamela		UNAM Colima, UNAM Ecología, Fundación Cuixmala, SACBÉ	Financial resources	3000 - 7000	Short-term

Objective 2: Increase habitat protection coverage and connectivity

2.1 Enlarge protected area network - develop detailed steps	There is interest in creating private reserves	GC / AC	UNAM Colima, Chamela-Cuixmala, CONANP, Government of Jalisco and Colima, SACBÉ	Mining & development interests in some areas, so potential land-use changes; only a few environmental groups present in region; security issues	25000	Short-term
2.2 Expand watershed management in the region - develop detailed steps (including restoration)	There already exists the perception among agriculturists of the need for these activities.	GC / AC	UNAM Colima, Chamela-Cuixmala, farmers, CONAGUA, SACBÉ	Security issues	100000 /year	Short-term

Objective 3: Create assurance ex situ populations

3.1 Infrastructure, biosecurity, land purchase	AZCARM	LM	Africam Safari	Lack of interest from other zoos in AZCARM	30000 - 60000	Short-term
3.2 Permits	There are several universities that can be engaged in the activities			Streamlining administrative processes	50	
3.3 Develop management protocols		LM	Africam Safari	Lack of biological requirements in captivity information	0	Short-term
3.4 Ex situ management of the species			Africam Safari		20000	

Objective 4: Create public awareness and positive perception and attitudes

4.1 Strengthen education actions at the local level	Outreach activities at the Chamela Station	CG	CONABIO, Fundación Cuixmala, IBUNAM	Negative perception towards rodents	M	Short-term

Cozumel harvest mouse *Reithrodontomys spectabilis*

	Opportunities	Responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	Detailed knowledge on Cozumel Island flora and fauna already exists	AC, EV, DVG, MMM, LBV	CONANP, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations	Financial resources	85000 /year	Short-term
1.2 Characterize the genetics of the populations		AC, EV, DVG, MMM, LBV	CONANP, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations	Financial resources	3000 - 7000	Short-term
Objective 2: Consolidate habitat protection coverage and connectivity						
2.1 Improve management of protected areas - develop detailed steps that will be required for proposals to CONANP	Detailed knowledge of Cozumel Island. 3 protected areas decreed and within the framework of the Biosphere Reserve	AC, EV, DVG, MMM, LBV	CONANP, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations	Appropriate implementation of the Local Ecological Management Program	L	Short-term
2.2 Evaluation and protection of water sources (cenotes and springs and associated watering holes)		AC, EV, DVG, MMM, LBV	CONANP, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations	Appropriate implementation of the Local Ecological Management Program	15000 /year	Short-term

Objective 3: Prevention of introduction of exotic species

3.1 Maintain insular biosecurity	National Strategy for Invasive Species already exists	AC, EV, DVG, MMM, LBV, IG	CONABIO, CONANP, GEICI, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations, PROFEPA	There is no control of incoming goods and services (4 million visitors/year, large number of boats and daily planes)	35000	Short-term
3.2 Control of exotic species	National Strategy for Invasive Species already exists	AC, EV, DVG, MMM, LBV, IG	CONABIO, CONANP, GEICI, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations, PROFEPA	There is no control of incoming goods and services (4 million visitors/year, large number of boats and daily planes)	140000 /year	Short-term

Objective 4: Create assurance ex situ populations

4.1 Infrastructure, biosecurity, land purchase	Opportunity to involve the wider Mexican zoo community (AZCARM)	LM	Africam Safari	Lack of interest from other AZCARM zoos	30000 - 60000	Short-term
4.2 Permits	Several universities are already engaged in activities			Streamlining administrative processes	50	
4.3 Develop management protocols		LM	Africam Safari	Lack of information on biological requirements in captivity	0	Short-term
4.4 Ex situ management of the species					20000	

Objective 5: Create public awareness and positive perception and attitudes

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
5.1 Strengthen education actions at the local level	Track activities on the island. Cozumeleño Pride	AC	CONABIO, CONANP, SACBÉ, ECOSUR, IEUNAM, UAEMor, UQROO, Municipality of Cozumel and local organizations, Africam Safari	Negative perception towards rodents (rats/mice)	30000 /year	Short-term

Schmidly's Deer Mouse *Habromys schmidlyi*

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	There has been relatively recent research and knowledge about the species	LLP, PCS, TAC	FCiencias UNAM	Financial resources	M	Short-term
1.2 Characterize the genetics of the populations	There has been relatively recent research and knowledge about the species	LLP, PCS, TAC	FCiencias UNAM	Financial resources	M	Short-term
Objective 2: Increase habitat protection coverage						
2.1 Increase protected area network - develop detailed steps	Existence of state parks		CONANP, Gobierno Estatal	Land use change	M	Short-term
2.2 Prevention of deforestation	Existence of state parks		CONANP, Gobierno Estatal	Security	H	Short-term

Objective 3: Create assurance ex situ populations

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
3.1 Infrastructure, biosecurity, land purchase	Opportunity to involve the wider Mexican zoo community (AZCARM)	LM	Africam Safari	Lack of interest from other AZCARM zoos	30000 - 60000	Short-term
3.2 Permits	Engagement of several local/regional universities			Streamlining administrative processes	50	
3.3 Develop management protocols		LM	Africam Safari	Lack of information on biological requirements in captivity	0	Short-term

Objective 4: Create public awareness and positive perception and attitudes

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
4.1 Strengthen education actions at the local level		CG	CONABIO			

Ixtlán Deer Mouse *Habromys ixtlani*

	Opportunities	Suggested responsible persons	Potential collaborators	Main challenges	Cost (US$)	Approximate timeframe
Objective 1: Determine the status of the populations						
1.1 Monitor the distribution and abundance of populations - need to develop the detailed steps to be implemented for the monitoring protocol	Relatively recent knowledge exists on this species	LLP, PCS, TAC	FCiencias UNAM	Financial resources	55000 /year	Short-term

1.2 Characterize the genetics of the populations	Relatively recent knowledge exists on this species	LLP, PCS, TAC	FCiencias UNAM	Financial resources	3000 - 7000	Short-term

Objective 2: Increase habitat protection coverage

2.1 Community conservation through participatory processes	There is already a presence of community conservation efforts		State governments and communities, IBUNAM	Habitat transformation	50000 /year	Mid-term
2.2 Prevention of deforestation	There is already a presence of community conservation efforts		CONANP, State governments, IBUNAM	Security	50000 /year	Long-term

Objective 3: Create assurance ex situ populations

3.1 Infrastructure, biosecurity, land purchase	Opportunity to involve the wider Mexican zoo community (AZCARM)	LM	Africam Safari	Lack of interest from other AZCARM zoos	30000 - 60000	Short-term
3.2 Permits	Engagement of several local/regional universities			Streamlining administrative processes	50	
3.3 Develop management protocols		LM	Africam Safari	Lack of information on biological requirements in captivity	0	Short-term
3.4 Ex situ management of the species		LM	Africam Safari		20000	

Objective 4: Create public awareness and positive perception and attitudes

4.1 Strengthen education actions at the local level	CG	CONABIO	Negative perception towards rodents (rats/mice)	n/a

* Responsible persons are suggestions. Names are as follows: Alfredo Cuarón (AC); Carlos Galindo (CG); David Valenzuela-Galván (DVG); Ella Vázquez-Domínguez (EV); Gerardo Ceballos (GC); Isabel González (IG); Luis Bernardo Vázquez (LBV); Luis Martínez (LM); Livia León-Paniagua (LLP); Miguel Martínez Morales (MMM); Pablo Colunga-Salas (PCS); Sergio Ticul Álvarez-Castañeda (TAC)