

# Population demise and extinction threat of the Angel de la Guarda deer mouse (*Peromyscus guardia*)

Eric Mellink<sup>a,\*</sup>, Gerardo Ceballos<sup>b</sup>, Jaime Luévano<sup>a</sup>

<sup>a</sup>CICESE, Apdo. Postal 2732, Ensenada, B.C. Mexico, Int'l. mailing address: PO Box 434844, San Diego, CA 92143-4844, USA

<sup>b</sup>Instituto de Ecología, UNAM, CU, Apdo. Postal 70-275, Mexico D.F. 04510, Mexico

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## Abstract

We analyze the status of the Angel de la Guarda deer mouse (*Peromyscus guardia*), a species endemic to Mexico, based on our own fieldwork, bibliographic records and information from colleagues. This species, with different subspecies on three islands and a population of an undetermined subspecies on a fourth, was apparently common until the mid-1960s. Currently the species is critically endangered, if not already extinct. One of the subspecies and the undetermined population are presumed extinct. Of the two other subspecies, one is at least in critical condition, and the other at least reduced. The demise of the species can be attributed to the introduction of domestic cats. The case of *P. guardia* is a good example of the vulnerability of other taxa of endemic rodents on islands in the Gulf of California. © 2002 Elsevier Science Ltd. All rights reserved.

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## 1. Introduction

Human activities have caused severe global environmental problems that are leading to a major population and species extinction crises in plants and animals. Hundreds of populations and species have become extinct in recent decades and many more, including thousands of populations, are on the verge of extinction (Hughes et al., 1997; Pimm et al., 1995; Wilson, 1992). The extinction crisis in mammals is particularly severe, and at least 83 species have become extinct in historic times, while about 30% are considered threatened or endangered (Hilton-Taylor, 2000; MacPhee and Fleming, 1999).

Mammal populations on islands are particularly prone to extinction, mainly because of small population sizes, reduced competitive ability, and the lack of biological mechanisms (i.e. naiveté) to avoid predators (Brown and Lomolino, 1998; Ceballos and Brown, 1995; Williamson, 1981). Among insular mammals, most extinctions have been caused by the introduction

of exotic species that act as competitors or predators (MacPhee and Fleming, 1999).

Insular mammals of Mexico fit this pattern of vulnerability. At least two insular species of wood rats (*Neotoma anthony* and *N. bunkerii*), one deer mouse (*Peromyscus pembertonii*), and one rice rat (*Oryzomys nelsoni*) have become extinct in recent decades (Ceballos, 1993; Mellink, 1992, in press; Smith et al., 1993). Indeed, insular species represent 40% of all mammal extinctions and eradications in Mexico (Ehrlich and Ceballos, 1997; Ceballos et al., in press). The islands of the Gulf of California, although considered relatively pristine, have long been used by fishermen and guano extraction workers, which have accidentally and intentionally introduced alien species (Mellink, in press).

The Angel de la Guarda deer mouse (*Peromyscus guardia*, Fig. 1) is endemic to the islands of the Angel de la Guarda archipelago, in the Midriff islands region of the Gulf of California (Hall, 1981; Lawlor, 1971). There are several additional species of *Peromyscus* on other islands in the region (Hall, 1981; Riddle et al., 2000). Different subspecies of *Peromyscus guardia* were known to occur on three islands of the Gulf of California: *P. g. guardia* (Ángel de la Guarda island), *P. g. mejiae* (Mejía island), and *P. g. harbisoni* (Granito

\* Corresponding author. Present address: PMP 1079 482 W. San Ysidro Blvd. #2, 92173 San Ysidro, CA, USA. Tel.: +1-52-6-174-5050; fax: +1-52-6-175-0545.



Fig. 1. Last known individual of *Peromyscus guardia* from Estanque island, maintained in captivity until 1998 (Photo: G. Ceballos).

island). An additional population, which may represent an undescribed subspecies, was found on Estanque island (Fig. 2).

This deer mouse was quite common on Ángel de la Guarda, Mejía, and Granito until the mid-1960s (Richard C. Banks, personal communication; Timothy Lawlor, personal communication). After that period it began to decline for unknown causes. In the winter of 1971, Avise et al. (1974) had little success trapping this species and others on Gulf of California islands. By 1973, the species was still extant on Mejía and Ángel de la Guarda, but trapping success was consistently low (Gill, 1981). In the early 1980s, Jesús Ramírez failed to capture it on Ángel de la Guarda (personal communication). Its apparent decline led to its classification as either fragile or threatened (Ceballos and Navarro, 1991; IUCN, 1996). However, there is no detailed information about its population decline and conservation status. Such information is critical to determine a strategy for its conservation. The purpose of this paper is to evaluate its current status.

## 2. Methods

This work was based on three sources of information: bibliography, field work, and interviews with colleagues. We review the published information for the four islands (Álvarez-Castañeda and Cortés-Calva, 1999; Banks, 1967; Brand and Ryckman, 1969; Burt, 1932; Lindsay, 1962, 1966; Townsend, 1912). Most of these sources describe rodent trapping results obtained on general natural history expeditions, although some derived from rodent-specific surveys.

Field work was used to assess the presence of *Peromyscus guardia* on each of the islands on which it occurred. We used Sherman life traps, baited with rolled oats, either alone or mixed with peanut butter or vanilla. Sampling consisted of 2287 trap-nights, as follows:

*Ángel de la Guarda*: 1–5 October 1990 (418 trap-nights), 26–30 June 1991 (897), 7–8 November 1999 (57), 17–21 April 2001 (360). Trapping included locations in the southern, middle, and northern part of the island. *Mejía*: 1–5 October 1990 (195), 7–8 November 1999 (40). *Granito*: 1–5 October 1990 (69), 7–8 November 1999 (22). *Estanque*: October 1995 (120), 16–17 November 1998 (29), 9–10 November 1999 (40), 17–18 April 2001 (40).

Finally, we corresponded or talked with R.C. Banks (15 May 1990), L.L. Grismer (30 June 1991), T.E. Lawlor (25 April 1990), J. Ramírez (18 May 1990) and B. Tershy (18 November 1999) on their work on these islands and their observations of rodents.

## 3. Results and discussion

Our results indicate that the populations on at least two of the four islands (Granito and Estanque) are probably extinct, and that there is a lack of evidence of its current presence on the two remaining islands (Table 1). The apparent demise of the species on the four islands is remarkably similar, although the islands strongly differ in size. *P. g. guardia* from Ángel de la Guarda Island was described as a species in 1912 (Townsend, 1912). Additional specimens were collected until 1962 and 1963 (Banks, 1967; Lindsay, 1962). At that time the species was very common at the northern end of Ángel de la Guarda (R.C. Banks, personal communication). This population was recorded again in 1965 (Brand and Ryckman, 1969) but by the late 1960s it was already rare and apparently confined to sandy beaches (T.E. Lawlor, personal communication). In 1971 and 1973 it was still extant (Avise et al., 1974; Gill, 1981), but observations in 1985 and 1987 suggested that this population was facing severe conservation problems, because no animals were found at two sites surveyed (J. Ramírez, personal communication). We did not capture any deer mice in 1990 and 1991, but in 1991 two deer mice, as well as one pocket mouse, were seen on northern Ángel de la Guarda (L. Grismer, personal communication). Since then, the species has not been found on any of the surveys carried out by us or by others (Álvarez-Castañeda and Cortés-Calva, 1999). Instead, domestic cats and house mouse (*Mus musculus*) have been recorded. Brown rats (*Rattus norvegicus*) have also been reported from this island (López-Forment et al., 1996).

The fate of other subspecies of rodents endemic to this island is contrasting. The Ángel de la Guarda pocket mouse (*Chaetodipus spinatus guardia*) was still abundant on a sandy plain in April 2001. Sandy plains seemed to be little suited to cats on Isla Cedros (Mellink, 1993). In contrast, the Ángel de la Guarda packrat (*Neotoma lepida insularis*) is apparently critically endangered, because neither we nor others

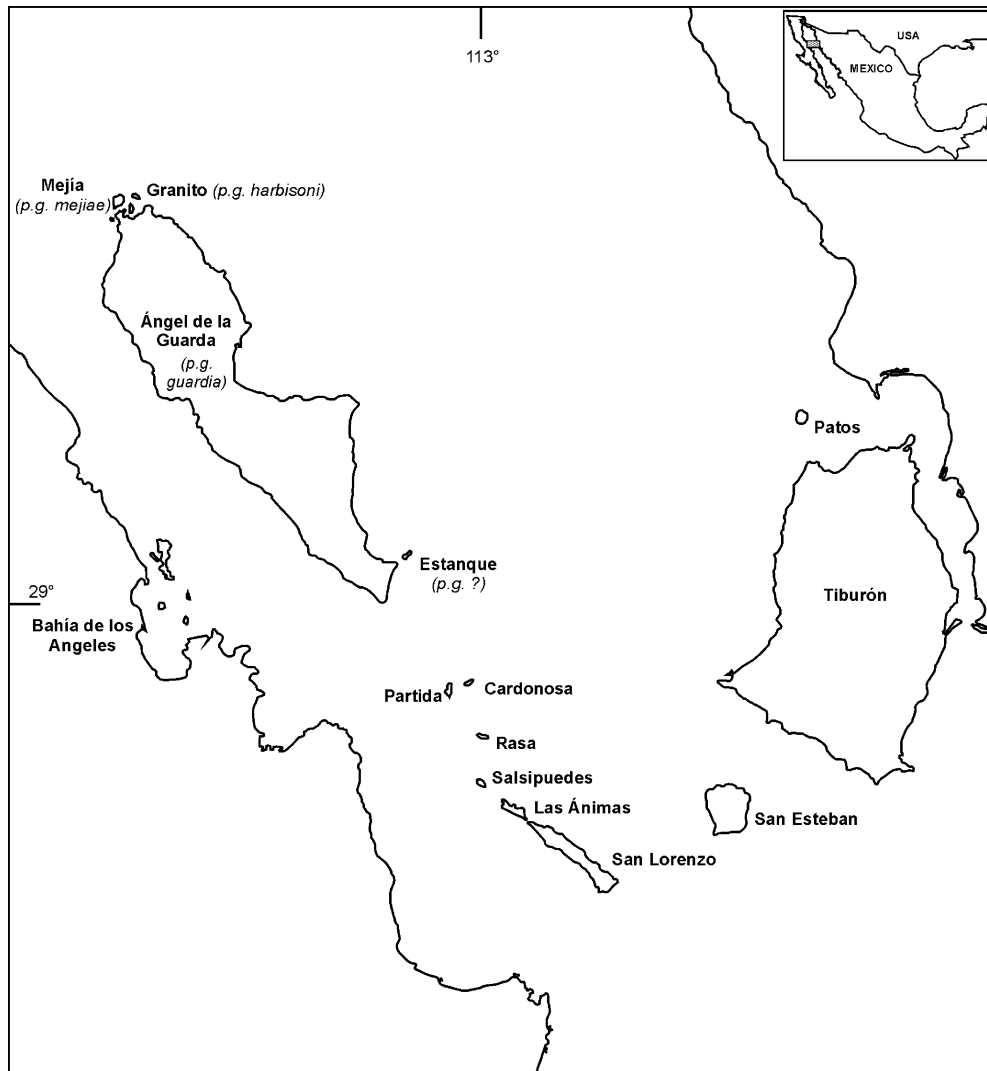


Fig. 2. Geographic range of *Peromyscus guardia*. The populations of Granito and Estanque islands are already extinct. The population on Mejía Island is at critical condition, and the population on Angel de la Guardia Island is at least endangered.

(Alvarez-Castañeda and Cortés-Calva, 1999) have been able to either capture it or see any dens. Although none of our surveys has been successful, a large part of the Angel de la Guardia island remains unstudied, and we cannot conclude more than that *P. g. guardia* is now much rarer at the sites where it was found to be common prior to the 1970s. The large size of the island (Table 1) and the likely habitat catholicism of the deer mouse, make it possible that a population of this subspecies still persist on unsurveyed parts of the island.

*P. g. mejiae* from Mejía Island was collected for the first time in 1931 (Burt, 1932). Between 1962 and 1965 several additional individuals were collected (Banks, 1967; Brand and Ryckman, 1969), and the subspecies was common in 1969 (T. Lawlor, personal communication). In 1973 it was still extant, but rare (Gill, 1981). We know of no additional surveys until the 1990s, when we and other researchers (Alvarez-Castañeda and Cortés-Calva, 1999) carried out surveys in which no

deer mice were captured, suggesting that it might have disappeared. In those surveys the only mammals captured or recorded were house mice and domestic cats. The pocket mouse of this smaller island (*Chaetodipus spinatus evermanni*) was also not captured (see also Patton and Álvarez-Castañeda, 1999).

The first specimens of *P. g. harbisoni* from Granito Island were collected in 1963 (Banks, 1967). At that time this subspecies was common (R.C. Banks, personal communication; T. Lawlor, personal communication). We did not find any individuals in 1990 and 1999, but captured instead black rats (*Rattus rattus*) and recorded signs of domestic cats. Similar negative results were reported in other surveys, when only house mice were captured (Alvarez-Castañeda and Cortés-Calva, 1999). Based on this evidence we consider that the local subspecies of deer mouse is probably extinct.

Finally, the *P. guardia* population of Estanque Island, which may represent an undescribed subspecies, was

Table 1

Current status of *Peromyscus guardia* and other sympatric species on the four islands off Baja California where the species was historically distributed (the size and location of the islands is given, as well as the introduced mammal species)

Angel de la Guarda (29°15' N 113°30' W; 895 sq km). Introduced species: <i>Mus musculus</i> , <i>Rattus norvegicus</i> , and <i>Felis catus</i> .	
<i>Peromyscus guardia guardia</i>	At least endangered
<i>Chaetodipus spinatus guardiae</i>	Common at specific locations
<i>Neotoma lepida insularis</i>	At least endangered
Mejía (29°35' N 113°34' W; 3 sq km). Introduced species: <i>Mus musculus</i> and <i>Felis catus</i> .	
<i>Peromyscus guardia harbisoni</i>	At least critically endangered
<i>Chaetodipus spinatus evermanni</i>	At least endangered
Granito (29°34' N 113°33' W; 0.4 sq km). Introduced species: <i>Mus musculus</i> , <i>Rattus rattus</i> , and <i>Felis catus</i> .	
<i>Peromyscus guardia harbisoni</i>	Probably extinct
Estanque (29°04' N 113°09' W; 0.3 sq km). Introduced species: <i>Felis catus</i> .	
<i>Peromyscus guardia ssp</i>	Probably extinct

first recorded in 1966 (Banks, in Lindsay, 1966). In 1995, Jesús Ramírez found that it was abundant and very tame; some mice came to feed from his hand. Four individuals were captured and maintained in captivity until 1998, when the last one died. In 1998 and 1999, we found no trace of this population, but we recorded a cat and collected about 25 cat scats, containing deer mouse hair and bones. A female cat, believed to have been the only one at the time, was removed in 1999, and all cat scats collected at that time contained exclusively insect and lizard remains (B. Tershy, personal communication), suggesting that the deer mouse population was already extinct.

We conclude that *P. guardia* is, at least, critically endangered. The demise of its four populations is likely to have been caused by the introduction of domestic cats and, probably, some negative interactions with introduced rats. Although the date of such introduction is uncertain, it is symptomatic that previous to the 1960s the deer mice were common. In the late 1960s and early 1970s outboard motors became more accessible and powerful, allowing for more and farther mobility of fishermen. At the same time the Mexican Federal Government launched an ambitious program promoting the creation of fishermen cooperatives in the region (Mellink, in press; Sierra and Sierra-Zepeda, 1977). As a result, the islands began receiving a large influx of fishermen, some of which intentionally introduced domestic cats to their seasonal camps. Regrettably, *P. guardia* has followed the same fate of other species such as *Neotoma anthony* and *N. bunkerii* that have become recently extinct (Mellink, 1992, 1993; Smith et al., 1993).

There are two general conservation lessons from this case. On the one hand, other insular populations of mammals (and also reptiles) that are already threatened by introduced species can disappear in a few years unless alien species are eradicated. The threat is particularly severe for endemic species such as *Ammodipus insularis* from Espiritu Santo Island,

*Neotoma varia* and *Peromyscus collatus* from Turner Island, and *Peromyscus pseudocrinitus* from Coronados Island. On the other, insular populations and species in the region, that presently are not threatened by alien species should be considered vulnerable, because of the high chances that alien species could be actively or inadvertently introduced. Active conservation of these endemic species should be a priority in Mexico (see also Valdez and Ceballos, 1997; Ceballos et al., 1998). It is imperative that decision makers take a hands-on approach to prevent the introduction of alien species and eradicate those already present.

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