Short Communication

Extirpation of an insular subspecies by a single introduced cat: the case of the endemic deer mouse Peromyscus guardia on Estanque Island, Mexico

Ella Vázquez-Domínguez, Gerardo Ceballos and Juan Cruzado

Abstract The Angel de la Guarda deer mouse Peromyscus guardia on Estanque Island, in the Angel de la Guarda archipelago of the Gulf of California, was probably driven to extinction by a single introduced domestic cat. P. guardia was trapped on the island in October 1995, at which time the species was still relatively abundant. In 1998 a domestic cat was spotted on the island; no deer mice were found at that time nor during subsequent field work in 1999 and 2001. In 1998, c. 100 cat scats were collected, 2% of which contained P. guardia bone remains and 90% P. guardia hair. The cat, which was eradicated in 1999, was the only introduced predator on the island. Our results confirm the extreme vulnerability of island rodent populations to the introduction of alien mammalian predators. To our knowledge, apart from the extermination of Stephens Island wren Xenicus lyalli in New Zealand in 1894 by the lighthouse keeper’s cat, this is the first report of the destruction of the total population of an insular species by a single cat. With two of the three subspecies of P. guardia now extinct, the only potentially extant population is on the larger Angel de la Guarda Island, where the species was last seen in 1991. A comprehensive survey of the island is required, with subsequent action for the species recovery and conservation if it is found to be extant.

Keywords Alien species, Angel de la Guarda deer mouse, Estanque Island, extinctions, island mammals, Mexico, Peromyscus guardia.
mouse was ‘relatively abundant and easily trapped’ (pers. comm.). However, later surveys indicated that *P. guardia* was extinct (Mellink *et al.*, 2002). From the animals trapped in 1995, two females and two males were subsequently kept in captivity until they died in 1998, after which they were deposited as voucher specimens in the Mammal Collection at the Instituto de Ecología, UNAM. Additional fieldwork was carried out on the island in November 1998 (29 trap nights), November 1999 (40) and April 2001 (40; Mellink *et al.*, 2002), but no individuals were trapped. Given the island’s small size and scarce vegetation, the trapping effort over a 4-year period is adequate and comparable with other studies on the California islands (Mellink 1992; Case *et al.*, 2002; Mellink *et al.*, 2002). During the 1998 field trip we collected *c.* 100 cat scats and saw one cat. We analysed the contents of the scats to determine the cat’s prey, including *c.* 25 scats analysed by Mellink *et al.* (2002) and *c.* 75 that had been stored. In 1999 eradication specialists removed the cat, which was a female, and confirmed there were no other cats on the island (B. Tershy, pers. comm.). No other cat was seen or cat scats found during the subsequent field trip in 2001.

The fact that no individuals could be captured in the visits of 1998, 1999 or 2001 indicates that the *P. guardia* population on Estanque Island is now extinct, and all available evidence suggests that the single cat, accidentally introduced to the island, was probably responsible. Our analysis of the cat’s scats revealed that 2% contained *P. guardia* bone remains and 93% *P. guardia* hair, and that the cat also consumed endemic Baja California fishing bats *Myotis vivesi*, birds and lizards (Table 1, Plate 1).

There are several general conservation lessons from Estanque Island. Firstly, *P. guardia* is another addition to the long list of island species that have become extinct or are Critically Endangered (Smith & Quin, 1996; Alcover *et al.*, 1998; MacPhee, 1999). At a global scale 83% of all mammal extinctions are of island species, such as the Coronados Island packrat *Neotoma bunkerii* in Mexico, the Falkland Islands fox *Dusicyon australis*, and the Sardinian pika *Prolagus sardus* (Smith *et al.*, 1993; MacPhee, 1999). Considering the mammals exclusively inhabiting islands, at least 27% of species on the world’s islands have gone extinct (Alcover *et al.*, 1998). Trends in Mexico are similar, with 40% of all extinct mammals being island species (Ceballos & Navarro, 1991). Secondly, this example further demonstrates the impacts that alien species have on island animals. Other threatened vertebrates on the Gulf of California islands include Bryant’s woodrat *Neotoma bryanti*, San Lorenzo mouse *Peromyscus interparietalis*, black chuckwalla *Sauromalus hispidus*, Catalina rattlesnake *Crotalus catalinensis*, and elegant tern *Sterna elegans* (Mellink, 1992; McChesney & Tershy, 1998; Case *et al.*, 2002). Thirdly, this is one of the most extreme examples of the susceptibility of island rodent populations to introduced mammals. To our knowledge there are no other examples in which the total population of an

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Table 1: Material found in the *c.* 100 cat scats collected on Estanque island during 1998, including species identification (where possible), percentage of the total scat weight, and description of the corresponding material.

<table>
<thead>
<tr>
<th>Species or group</th>
<th>% of scat weight</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angel de la Guarda deer mouse <em>Peromyscus guardia</em></td>
<td>1.87</td>
<td>16 right inferior mandibles, 13 left inferior, 24 superior, 115 molar teeth (pieces)</td>
</tr>
<tr>
<td>Baja California fishing bat <em>Myotis vivesi</em></td>
<td>2.50</td>
<td>16 right inferior mandibles, 7 left inferior, 3 complete, 26 superior maxillary teeth hair (with some pieces of stone)</td>
</tr>
<tr>
<td>Mammal</td>
<td>93.12</td>
<td>feathers and bones</td>
</tr>
<tr>
<td>Bird</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Reptile</td>
<td>insignificant</td>
<td>2 mandibles</td>
</tr>
</tbody>
</table>

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Fig. 1 Angel de la Guarda Archipelago, in Baja California, Mexico, with the location of Estanque Island.
Extirpation of a population of *Peromyscus guardia*

A limited amount of information indicates that the genetic differences between *P. guardia* on Estanque and the Angel de la Guarda subspecies were not large. In an early study with six individuals from Angel de la Guarda Island (Avise et al., 1974) *P. guardia* was found to have low levels of genetic variability. We carried out an allozyme analysis of the four individuals captured on Estanque in 1995 and found that the heterozygosity ($H = 0.010$, data available upon request from the authors) was similar to that reported for the species 22 years earlier ($H = 0.014$; Avise et al., 1974).

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**References**


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**Biographical sketches**

Ella Vázquez Domínguez is interested in the link between genetic variability and fitness components in rodents in tropical systems, particularly as applied to the evaluation of population structure and conservation strategies. She is also carrying out research in molecular genetics, population ecology and phylogeography of rodents and fish, and on the macroecology of North American mammals.

Gerardo Ceballos has studied population dynamics, community ecology and conservation issues in small mammals from a tropical dry forest in western Mexico. He has extensive research experience on the conservation of threatened mammals.

Juan Cruzado is carrying out research on the small mammal community associated with prairie dogs on the prairies of northern Mexico.