

Southernmost records of *Dromiciops gliroides*: extending its distribution beyond the Valdivian rainforest

Los registros más australes de *Dromiciops gliroides*: extendiendo su distribución más allá del bosque lluvioso valdiviano

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ABSTRACT

The geographic range of a species is often limited by sampling approaches, underestimating the actual distribution. This is likely the case of *Dromiciops gliroides* (Microbiotheria), an endemic marsupial from southern South America. We used camera-traps to record *D. gliroides* for the first time in Chaitén and Futaleufú (southern Chile), expanding its known distribution 100 km to the south. Climate and forest composition in this area differs from the typical Valdivian rainforest. Activity assessments show a narrow activity patterns compared to northern populations.

Keywords: activity patterns, camera traps, geography, Microbiotheria, temperate rainforest.

RESUMEN

El rango geográfico de una especie usualmente está limitado por el muestreo, subestimando su distribución. Este sería el caso de *Dromiciops gliroides* (Microbiotheria), un marsupial endémico de Sudamérica austral. Usamos cámaras-trampa para registrar a *D. gliroides* por primera vez en Chaitén y Futaleufú (al sur de Chile), expandiendo su distribución 100 km al sur. El clima y la composición del bosque de esta área difieren del bosque valdiviano. Los patrones de actividad encontrados son más estrechos que los de las poblaciones más al norte.

Palabras clave: bosque templado lluvioso, cámaras-trampa, geografía, Microbiotheria, patrones de actividad.

The geographic range of a species is a representation of the spatial arrangement of a given taxon, which defines the biological limits for its existence: it is the basic unit of biogeography (Brown et al. 1996). However, defining a distribution area could be challenging, as this inevitably depends on occurrence records and collecting methods, a requirement that could result in underestimations of the distribution areas due to lack of sampling effort and misconceptions about the species habits. Moreover,

distribution limits dynamic boundaries that depend on resource availability and climate change (Anderson et al. 2009; Riquelme et al. 2018). This may be the case of *Dromiciops gliroides* (Thomas 1894, Microbiotheria), a relict marsupial that inhabits the temperate forests of Chile and Argentina in southern South America. This marsupial is considered a “living fossil” as it is the only living representative of Microbiotheria, the sister group of Australasian marsupials (Hershkovitz 1999; Mitchell et al. 2014). Several historical records of *Dromiciops*

suggested relatively low population densities (Meserve et al. 1999; Kelt 2000), until the development of appropriate capturing methods that allowed a more frequent detection of this arboreal, nocturnal, and highly seasonal mammal (Muñoz-Pedrerros et al. 2005; Fontúrbel & Jiménez 2009; Fontúrbel 2010), which makes it a cryptic species. Most of the actual knowledge about *D. gliroides* comes from a few well-known sites, located in a small area at the center-south of the distributional range (Martin 2010).

Here we report the southernmost records of *D. gliroides*, which is beyond the limits of the Valdivian rainforest ecoregion in Chile. We set eight camera-traps (Bushnell Trophy Cam) from December 2018 to April 2019 along the Palena Province (43° 24'S, 72° 05'W; 43° 25'S, 72° 12'W and 43° 00'S, 72° 28'S), southern Chile. We found 43 photographic records at Chaitén and Futaleufú (Fig. 1), extending *D. gliroides* distribution 100 km to the south (Fig. 2). The current distribution area of *D. gliroides* is based on 20 locations (Patterson et al. 2003), but in more recent reports, Martin (2010) of and (Gurovich et al. 2015) provided 69 additional occurrence locations, which fall within NatureServe's distribution map (except for one location

at the north). Our study provides six new points, from which three are located southwards of the known distribution. By extending *D. gliroides* distribution based on this new data, it has increased 4969 km². In sympatry with *D. gliroides*, we detected nocturnal activity of two rodents species (*Oligoryzomys longicaudatus* and *Rattus* spp.) along with several birds species (*Pterotochos tarnii*, *Scelorchilus rubecula* and *Campephilus magellanicus* as the most frequent ones).

We also examined *D. gliroides* activity patterns at the new locations (Fig. 3a), using the *activity* package (Rowcliffe 2019) in R 3.5.3 (R Development Core Team 2019). Activity starts at 19 h and ends at 7 h, being similar to the activity patterns previously reported for the Valdivian rainforest (Fontúrbel et al. 2014) but showing a narrower activity peak (Fig. 3b). We contrasted the activity patterns of Fontúrbel et al. (2014) against the pattern obtained here using the *compareCkern* function of the *activity* package, with 1000 permutations. We found an overlap of 82.45 ± 0.04 % between both activity patterns, but the differences were marginally significant ($P = 0.053$).



FIGURE 1. Camera trap records of *Dromiciops gliroides* at Chaitén and Futaleufú. / Registros de *Dromiciops gliroides* en cámaras trampa de Chaitén y Futaleufú.

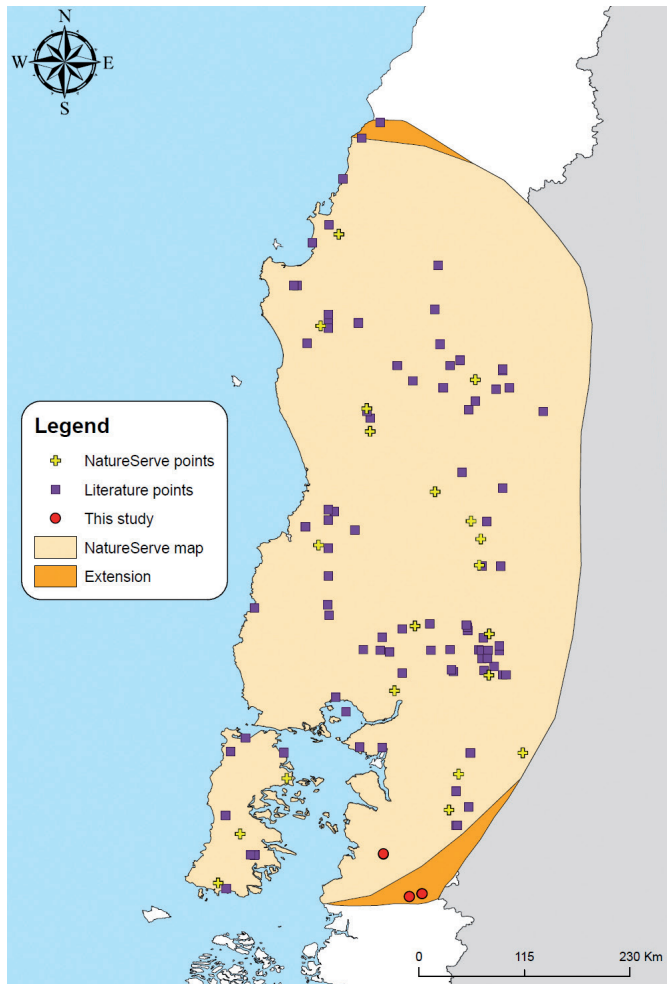


FIGURE 2. Distribution map of *Dromiciops gliroides*, comparing the current and proposed extension areas. / Mapa de distribución de *Dromiciops gliroides*, comparando la distribución actual y la extensión propuesta.

The ecological patterns of *D. gliroides* are quite consistent across the Valdivian rainforest, showing similar home ranges, body condition and population densities among sites of Argentina and Chile (Fontúrbel et al. 2012). However, we do not know how *D. gliroides* may respond to environmental conditions southwards of the Valdivian temperate rainforest, where there are larger daily and seasonal temperature fluctuations, lower rainfall, and colder nights that may trigger hibernation responses (Nespolo et al. 2018), narrowing their activity patterns. Also, we found differences in the forest composition. Some plant species that are typically associated with *D. gliroides* are less frequent or inexistent at this southernmost latitude. Such is the case of the bamboo *Chusquea* spp., one of the main components of *D. gliroides* nests and an important

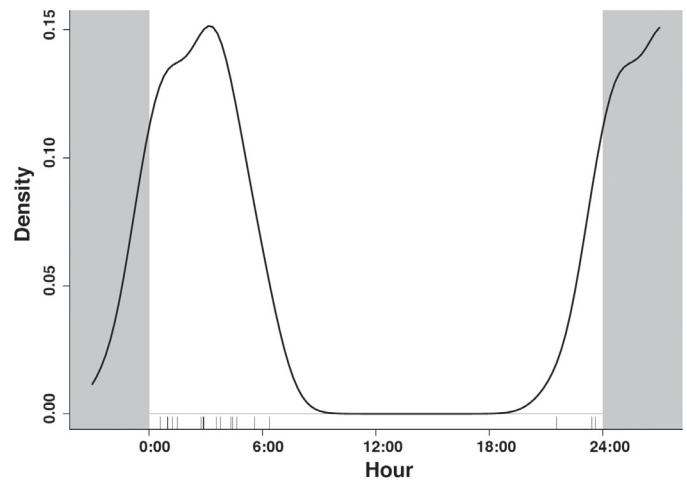


FIGURE 3. Kernel density functions of *Dromiciops gliroides* activity for (a) Chaitén-Futaleufú, and (b) the comparison of the Valdivian temperate rainforest and the Chaitén-Futaleufú. / Función de densidad de kernel de la actividad de *Dromiciops gliroides* en: (a) Chaitén-Futaleufú, y (b) la comparación de la selva lluviosa Valdiviana y Chaitén-Futaleufú.

predictor of its presence (Rodríguez-Cabal & Branch 2011), which is considerably less frequent in the newly discovered sites than in the Valdivian ecoregion (González & Donoso 1999). Another example is the hemiparasitic mistletoe *Tristerix corymbosus*, which constitutes a substantial part of *D. gliroides* diet (Amico & Aizen 2000; Amico et al. 2009), is not present in the Chaitén-Futaleufú region. Those individuals may be feeding on the fleshy-fruited shrub *Ugni molinae*, which is highly abundant in these new locations (Mora & Soto-Gamboa 2011), and might be explaining its persistence below *T. corymbosus*' distribution. These differences may alter resource availability for *D. gliroides*, consequently changing its diet and metabolic requirements (Cortés et al. 2011) in ways that are yet to be explored.

Except for the disturbance events of volcanic eruptions of the Chaitén volcano, the overall environmental conditions of the forest area surrounding the newly found *D. gliroides* locations have been stable at least since the Holocene (Heusser et al. 1992; Amico et al. 2009; Swanson et al. 2013). Therefore, the presence of *D. gliroides* in this area may not be recent, and the lack of other reports would be a consequence of insufficient sampling efforts. We strongly encourage further assessments of this iconic species of the Chilean fauna beyond the southern limit reported here, which is highly likely. In this sense, camera traps are a powerful approach to expand our knowledge of cryptic species.

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