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Sky-island microendemism of a Chilean coastal mountain lizard: a new record for *Liolaemus frassinettii* Núñez, 2007 broadens its range in three dimensions

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Species with restricted ranges are at greater risk of extinction than those with broad ones and, for this reason, endemism has led scientists to focus conservation efforts on such species (e.g., Kraus et al., 2023). Species' ranges represent geographical expressions of their ecological niches. Microendemic species occupy the most restricted niches, defined as those with a very limited geographic distribution, usually < 20 km^2 (Wamelink et al., 2014; Araujo et al., 2024), which are often located on islands or isolated high-elevation plateaus (Laspiur et al., 2021). These restrictions increase their vulnerability to disturbances and make them highly dependent on habitat integrity for their survival (Wulff et al., 2013; Araujo et al., 2024).

Liolaemus is a genus endemic to southern South America that includes the lizards with the southernmost distribution in the world (Jaksic, 2022; Moya et al., 2025). Approximately 72% of reptiles in Chile are members of this genus (Ruiz de Gamboa, 2020), and there is a high degree of endemism (about 64% of *Liolaemus* species in Chile; Ruiz de Gamboa, 2020; Moya et al., 2025). Some of these species, such as *L. carezzae* Campos-Soto et al., 2023 and *L. frassinettii* Núñez, 2007, can be considered microendemic. In fact, *L. frassinettii* is known only from its type locality, the summit of Cerro Cantillana at an elevation of 2281 m (Fig. 1; Núñez, 2007; Troncoso-Palacios, 2021). It is the only species among the so-called "leopard lizards" (including *L. frassinettii*, *L. leopardinus*, *L. ramonensis*, *L. valdesianus*, and *L. ubaghsi*) that inhabits the Coastal Mountains and not the Andes, where the four other species are found (Esquerré et al., 2019). Some authors have listed a second locality, Cerro Horcón de Piedra (ASPAM, 2014; Esquerré and Núñez, 2017), but there is some uncertainty associated with this record and other authors do not include it (e.g., Mella, 2017; Troncoso-Palacios, 2021).

As a lizard isolated on a high-elevation plateau with an area of only a few square kilometres (Díaz and Núñez, 2017), *L. frassinettii* meets the criteria to be considered one of the most microendemic lizard species in the world (see Glaw et al., 2012; Laspiur et al., 2021). Furthermore, *L. frassinettii* is a very poorly known sky island species for which there are no ecological studies. In this context, we here document an additional confirmed record for *L. frassinettii* within the Altos de Cantillana plateau and show that the species occupies a broader elevational and habitat spectrum across the plateau than previously documented.

On 5 February 2023, two adults (Fig. 2A, B) and one juvenile of *L. frassinettii* were found on large, cracked rocks, surrounded by high-elevation steppe and Santiago Oaks (*Nothofagus macrocarpa*; Fig. 2C). The record was obtained during a survey conducted by the second author during wildlife prospecting duties near the Las Launas Sector of Altos de Cantillana (33.9168°S, 70.9763°W, elevation 2022 m; Fig. 1). The lizards were photographed to allow identification but were not collected. They were identified using the diagnostic features provided in the original description (Núñez, 2007): dorsal scales small and slightly triangular, inconspicuously keeled, imbricate or juxtaposed; colouration mottled with patches of deep black scales, particularly on posterior flanks. The adults were distinguished from the juvenile primarily by their size difference, with the former being large and robust (the species can reach an SVL of up to 91.1 mm; Troncoso-Palacios, 2021) and the juvenile considerably smaller but still exhibiting the distinctive leopard-like colour pattern characteristic of the species (Núñez, 2007).

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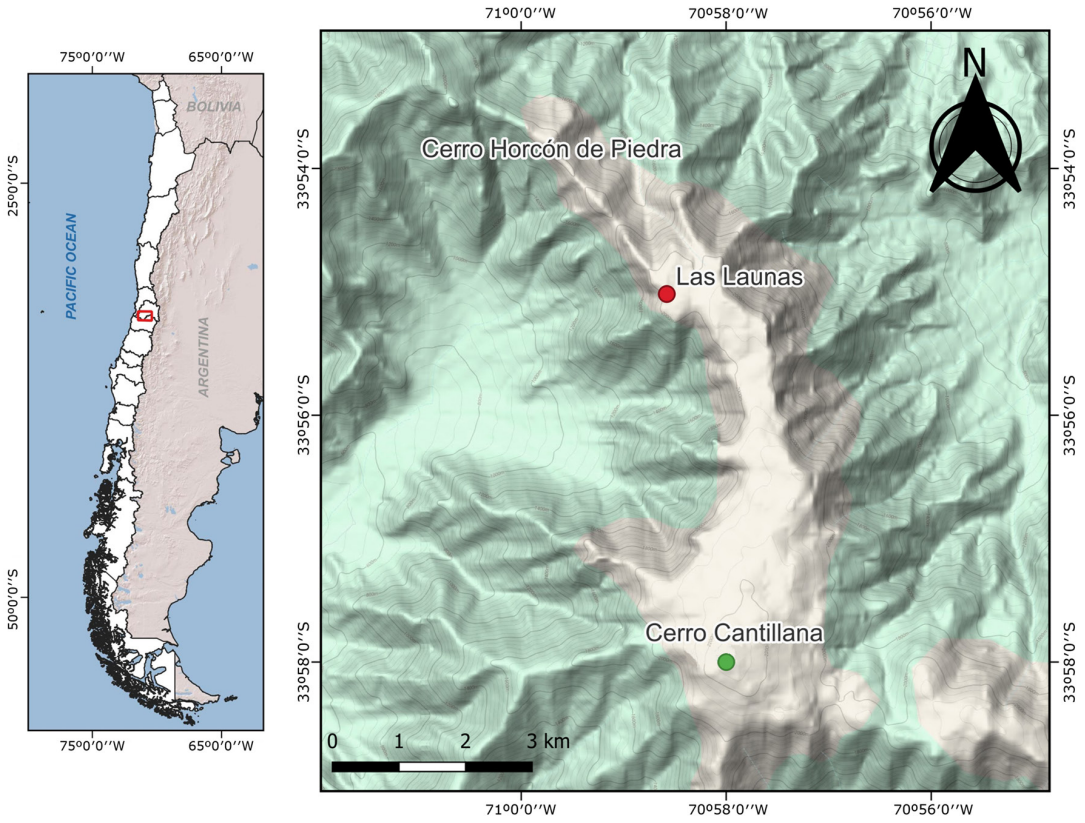

Figure 1. Range of *Liolaemus frassinettii*. The green circle indicates the only historical record of Cerro Cantillana, the type locality. The red circle indicates the new record at Las Launas. Greyish colouration indicates elevations > 2000 m.

The landscape is dominated by Santiago Oaks, native shrubland, and high-elevation steppe, characteristic of the Chilean Coastal Mountain range (Luebert and Pliscoff, 2017). The new record is located a straight-line distance of 6 km to the north from the summit of Cerro Cantillana (the type locality) and lies more than 200 m below the rocky summit environment where the species had previously been reported (Fig. 1). One week after the initial sighting, four adults were observed at the same locality, confirming the existence of a population in the area. Rather than merely showing that the species inhabits more northerly sectors of Altos de Cantillana, our observations show that *L. frassinettii* also occupies areas of the plateau associated with montane oak vegetation, thus extending its confirmed occurrence in three dimensions within Altos de Cantillana.

There is a questionable record in the technical datasheet for *L. frassinettii* issued by the Chilean Ministry of the Environment (ASPAM, 2014). In this document, the summit of Cerro Horcón de Piedra is listed (dated to 2014), but the report does not provide supporting photographs or geographic coordinates. Furthermore, there are inconsistencies in the document: (1) In Table 1, the record is dated to 2012 instead of 2014; (2) In this table, the record is assigned to an elevation of 1480 m, which does not correspond to the summit of Cerro Horcón de Piedra (2070 m). This record has rarely been acknowledged (e.g., Esquerré and Núñez, 2017) and is generally omitted (e.g., Demangel, 2016; Mella, 2017; Troncoso-Palacios, 2021). We recently reported on a study of *L. nigroviridis* (Mella-Romero et al., 2025) on the eastern slopes of Cerro Horcón de Piedra up to an elevation of 1849 m and recorded the presence of *L. monticola*, *L. nigroviridis*, and *L. nitidus* but not *L. frassinettii*. Given these inconsistencies, the presence of *L. frassinettii* at the summit of Cerro Horcón de Piedra needs to be confirmed before it is included in any assessments.

In the IUCN Red List, *L. frassinettii* is listed as Vulnerable based on criterion D2 (Díaz and Núñez, 2017).

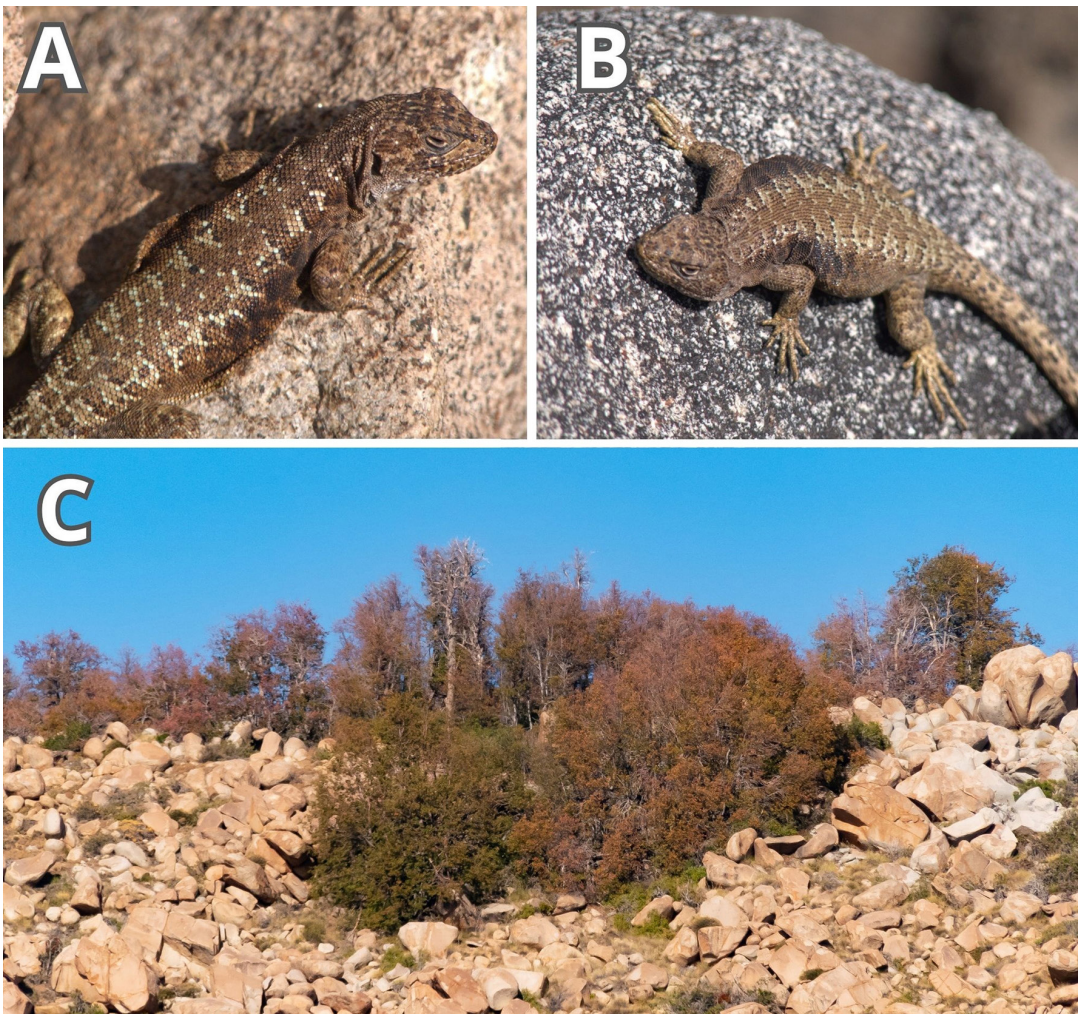

Figure 2. Individuals and environment recorded for *Liolaemus frassinettii* at Las Launas. (A, B) Adults of *L. frassinettii*. Note the colouration, mottled with patches of deep black scales, particularly on the posterior flanks, which is characteristic of this species. (C) Habitat of *L. frassinettii* at Las Launas. Note the presence of several Santiago Oak trees. Photos by C. Rivera.

This criterion applies to species with a range of < 20 km^2 or a minimal number of locations (five or fewer). Due to the estimated area of occupancy of 4 km^2 for *L. frassinettii* it can be considered a microendemic species (Díaz and Núñez, 2017; Laspiur et al., 2021; Araujo et al., 2024). However, it is unclear why the species was assigned this assessment category, given that it had only been confirmed on the summit of Cerro Cantillana. Perhaps it was assumed that the species could be found continuously on the hills surrounding Cerro Cantillana at similar elevations, but this was never confirmed. Our record of *L. frassinettii* at Las Launas shows that the species is not restricted to the rocky summit itself but also occupies rocky outcrops embedded within, or immediately adjacent to, montane oak patches and high-elevation steppe. With the available data, it is not possible to confirm the species' range or its continuity between the two known localities, and the estimated 4 km^2 may overstate the species' actual area of occupancy. Thus, further information on the range and abundance of *L. frassinettii* is urgently needed for an accurate assessment of its conservation status.

The record at Las Launas does suggest that the species may use a more heterogeneous habitat mosaic than previously assumed. For an ectothermic lizard inhabiting a high-elevation sky island, rocky

outcrops near Santiago Oak may provide a desirable combination of basking surfaces, shaded refuges, and buffered microclimatic conditions. In this context, the proximity of montane oak woodland could increase thermal and structural heterogeneity at the microsite scale, potentially broadening the range of suitable activity sites and prey availability available to the species throughout the day and under changing weather conditions (Laspiur et al., 2021; Vera et al., 2023; Mella et al., 2025).

Although the localities described for the species are within a private reserve (Altos de Cantillana), this does not imply the absence of threats to the species. Fires, which have been recorded more frequently in the area in recent years (Sarricolea et al., 2020), and climate change could significantly impact populations of this highland species (see Mella-Romero et al., 2024; Moya et al., 2024). If *L. frassinettii* depends on a fine-scale mosaic of exposed rocks and neighbouring woody cover, then changes in fire regime, vegetation structure, and local microclimate may affect not only habitat availability, but also the thermal quality of occupied microsites. Currently, there is only one study addressing biogeographical and genetic aspects of the species that analysed the differentiation of *L. frassinettii* with respect to the other four species of leopard lizards (Esquerré et al., 2019). Hence, another important avenue we propose to explore is a genetic study between both populations (Las Launas and summit of Cerro Cantillana) using nuclear markers, to obtain information about gene flow and population connectivity.

This record, along with other recent studies on the geographic expansion of high-elevation species in Chile, such as the frog *Alsodes igneus* Cuevas & Formas, 2005 (Alveal et al., 2021) and the lizard *Pristidactylus volcanensis* Lamborot & Diaz, 1987 (Mella-Romero and Mella, 2023), emphasise the necessity for more extensive surveys. For *L. frassinettii*, this will be essential not only to determine its actual distribution across the plateau, but also to understand how elevational variation and habitat heterogeneity may shape its ecology and conservation requirements.

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