Exploring the status of the vulnerable guiña (*Leopardus guigna*) in Patagonia, Argentina

Ilaria Agostini[1], Florencia Frola Mendizabal[1], Laura Alvarez Borla[1], Verónica A. Quiroga[2], Sergio A. Lambertucci[3], M. Paula Cruz[4], Sebastián A. Ballari[1], Facundo Robino[5], Esteban Pizzio[6], Agustín Paviolo[4], Mario S. Di Bitetti[4]

[1]Consejo de Investigaciones Científicas y Técnicas (CONICET), CENAC - Parque Nacional Nahuel Huapi, Argentina
[2]b Universidad Nacional de Córdoba, FCEFyN, Centro de Zoología Aplicada y Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Instituto de Diversidad y Ecología Animal (IDEA), Córdoba, Argentina
[3]Grupo de Investigaciones en Biología de la Conservación, INIBIOMA, CONICET-Universidad Nacional del Comahue, Bariloche, Río Negro, Argentina.
[4]Instituto de Biología Subtropical, CONICET-Universidad Nacional de Misiones, Puerto Iguazú, Misiones, Argentina.
[5]Dirección Regional Patagonia Norte – Administración de Parques Nacionales, Bariloche, Argentina.
[6]Instituto de Investigaciones Forestales y Agropecuarias de Bariloche (IFAB), CONICET-Instituto Nacional de Tecnología Agropecuaria (INTA), San Carlos de Bariloche, Río Negro, Argentina.

Ilaria Agostini - 0000-0002-3136-0872

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Corresponding author
Ilaria Agostini
Consejo de Investigaciones Científicas y Técnicas (CONICET), CENAC - Parque Nacional Nahuel Huapi, Argentina; email: agostini.ilaria@gmail.com
Phone: 0054-9-294-4802116

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Abstract

The guiña (*Leopardus guigna*), the smallest felid in the Neotropics, is distributed along a narrow strip of Valdivian and Andean Patagonian forests of Chile and Argentina. Most of the information about the guiña comes from studies carried out in Chile, but very little is known about this rare and threatened species in Argentina, except for a few scattered records. To assess the status of a population of guiñas, we carried out the first large-scale camera-trap survey, locating 80 camera-trap stations over an area of 590 km^2 in the second largest protected area of Argentina, the Nahuel Huapi National Park, in northwestern Patagonia. From November 2022 to April 2023, over 3395 camera-trap days, we detected guiñas at four sites. The species was recorded in lenga beech, coihue beech and Valdivian forests, and in proximity to vehicular dirt roads or along a hiking trail. These few records suggest that the guiña is rare in this area. Large protected areas of northwestern Patagonia may play an important role in protecting small populations of this felid in Argentina.

Keywords: Andean Patagonian forest, camera trap, felid, Valdivian forest.

The guiña (*Leopardus guigna*) is the smallest felid in the Neotropics (<2 kg in weight; Nowell and Jackson 1996). It is a rare and elusive species, with primarily crepuscular-nocturnal activity (Delibes-Mateos et al. 2014, Sanderson et al. 2002). Although its habits are mainly terrestrial, the guiña may climb trees to rest, hunt, or escape predators (Altamirano et al. 2013, Sanderson et al. 2002); its diet is composed of rodents, birds, lizards, and insects (Figueroa et al. 2018). The guiña distribution spans over a narrow strip of 300,000 km^2 in central and southern Chile and southwestern Argentina (Napolitano et al. 2015). It is considered a forest specialist, preferring the dense bamboo forest understorey (Monteverde et al. 2019) in the Valdivian temperate forest ecoregion (Olson et al. 2001) of Chile and Argentina. The guiña is considered one of the most threatened felid species in South America, categorised as Vulnerable at a global scale (Napolitano et al. 2015), and also in Argentina (Monteverde et al. 2019). Globally, among the most threatened felids, the guiña has been listed as one of the 14 most understudied species, and is thus considered a high priority for research (Brodie 2009). Currently, all the information about the ecology and conservation of the guiña comes from studies conducted in Chile, while data from the Argentinian side are limited to 10 published records of species presence over the last two decades (Berrondo and Bravo 2022, Guerisoli et al. 2020, Monteverde and D'Oliveira 2010, Lucherini and Luengos Vidal 2003). The acknowledged gap of information about guiña populations in Argentina (Gálvez et al. 2023) is an important limitation to develop conservation actions in this country (Monteverde et al. 2019). This is why population surveys are strongly needed in Argentina.

Although the potential distribution of the guiña in Argentina has been estimated to be approximately 68,000 km^2 (Cuyckens et al. 2015), the species actual distribution probably spans less than 20,000 km^2 and the population density might be naturally low in this country. The species is potentially affected by threats

similar to those reported in Chile, including habitat fragmentation and degradation, retaliatory killing due to poultry predation, roadkill, predation by domestic and feral dogs, as well as diseases transmitted by domestic cats (Monteverde et al. 2019). Species current range in Argentina is thought to be limited to four protected areas: from north to south, the Lanín, Nahuel Huapi, Lago Puelo and Los Alerces national parks, which together cover a total area of 13,837 km^2 (SIB 2023). Nearly ¾ of the estimated distribution of the guiña in Argentina overlaps with protected areas (Monteverde et al. 2019), suggesting a pivotal role of these areas for the conservation of this population. So far, there is still little conservation effort on this felid in Argentina (Lucherini et al. 2018).

In 2001, a first record of guiña was obtained by live-trapping in Los Alerces National Park in an effort aimed at updating its distribution in Argentina (Lucherini and Luengos Vidal 2003). Then, in 2009, the first camera-trap record of the species was obtained in Lanín National Park (Monteverde and D'Oliveira 2010). More recently, six new records were opportunistically collected in Los Alerces National Park, four of which were from camera traps (Berrondo and Bravo 2022), one from an individual found dead and another one from a guiña casually captured in an American mink (*Neovison vison*) cage (Guerisoli et al. 2020). However, so far, the largest protected area with presence of guiña in Argentina, the Nahuel Huapi National Park (NHNP), has been relatively understudied. This is outstanding, given that this area is characterised by a wide heterogeneity of environmental features and anthropogenic impacts, which may represent conservation determinants for the species. Here, the only previous camera-trap survey carried out in the Andean Patagonian temperate forests found no evidence of guiña presence (Gantchoff and Belant 2016). With only a few anecdotal observational records of presence scattered across three decades (SIB 2023), and a lack of studies focused on evaluating the species presence and abundance, there is no current information about the conservation status of guiñas in the area. This knowledge gap has prompted us to undertake a camera-trap survey to assess the population status of this felid in NHNP.

Between November 2022 and April 2023, we conducted a camera-trap survey in NHNP (40°08'18" – 41°35'19" S and 71°50'52" – 71°04'45"W). NHNP is a 7,173 km^2 protected area lying mostly in the Valdivian ecoregion in the Patagonian Andes of Argentina (Mermoz et al. 2009). The climate of this area is cold and relatively humid. Likewise, it is characterised by sharp elevation (700-3,400 m a.s.l.) and annual precipitation (550-4,000 mm) gradients (APN 2019). We focused our effort on humid forests, which are thought to provide the most suitable habitat for the species (Monteverde et al. 2019). Humid forests in NHNP spans an area between the western border with Chile (at 71° 50' W longitude) to 71°26' of W longitude, below 1,600 m a.s.l., representing 60% of the park surface (Mermoz et al. 2009). Following elevation and precipitation gradients, the humid forests change from subalpine lenga (*Nothofagus pumilio*) forests, shrublands of the deciduous ñire (*Nothofagus antarctica*) on midslopes and valley bottoms, evergreen forests dominated by coihue (*Nothofagus dombeyi*), and relatively small areas of Valdivian temperate rain forests with the presence of the endemic conifers alerce (*Fitzroya cupressoides*) and the Guaytecas cypress (*Pilgerodendron uviferum*) (APN 2019).

We deployed 80 camera-trap stations throughout the central and southern area of NHNP (Fig. 1), along an altitudinal gradient (604-1,158 m a.s.l.), covering an area of approximately 590 km^2 (estimated as the Minimum Convex Polygon encompassed by all camera-trap stations excluding areas not covered by humid forests). On average, stations were located at 1,485 m (range: 746-7,338 m) from the nearest one. Thirteen stations were set in Valdivian forests, 10 in lenga beech, 28 in coihue beech and 25 in ñire beech forests. Forty-five stations were located along or in proximity to hiking or wildlife trails, 26 near vehicular dirt roads and five along the lake shore (only accessible by boat).Each station consisted of a single camera trap (Browning Strike Force Max HD Plus), active during 24 h, attached to a tree trunk at about 30–50 cm above ground level or to a fallen tree. Since we only had 40 camera traps available, we first allocated 40 camera traps and, after approximately 45 continuous days, we switched them to other adjoining selected locations, maintaining approximately the same proportions of camera traps among the different forest types. This camera-trap rotation allowed us to total 80 stations and sample a larger area of the park. At

each station, we placed two olfactory attractants: the Hawbakers Wildcat Lure #2 located in a cotton swab within a perforated plastic tube hanging from a tree branch and essence of catnip (*Napeta cataria*) sprayed upon the substratum. Of the 80 camera-trap stations, 76 worked properly while four provided no data due to malfunctioning or theft. The 76 camera-trap stations operated continuously during an average (±SD) of 44.67 ± 10.99 days (range = 37-83) reaching a realized effort of 3395 camera-trap days.

We obtained 807 independent (i.e., separated by at least 60 min) records of mammal species at 73 of the 76 operating stations (three stations did not provide any mammal record). Of these, four were of guiñas, resulting in a capture rate of 0.12 independent records/100 camera-trap days. The species was detected at four different stations (5.48% of the stations) with only one independent record each (Fig. 1). The first record was obtained on January 2, 2023, at 10:28 PM, at < 50 m from a vehicular dirt road along the Manso river, in a coihue beech forest (41.35793° S, 71.71081° W; Fig. 2a). The second record, of an individual crossing upon a large fallen tree trunk, was taken on January 4, 2023, at 6:37 AM, in Valdivian forest, at 36.1 km from the first record (41.04048° S, 71.80281° W; Fig. 2b) and at < 50 m from another dirt road. The third record was gathered on January 23, 2023, at 2:54 AM, along a hiking trail in a lenga beech forest, 16.04 km away from the first and 21.7 km away from the second record (41.23586° S, 71.81316° W; Fig. 2c). Finally, the fourth record corresponded to a guiña photographed on January 31, 2023, at 8:02 AM, along the same hiking trail in the lenga beech forest, only 1.2 km northwest of the previous record (41.23127° S, 71.82632° W; Fig. 2d). It is possible that these last two records belonged to the same individual, due to the relative proximity of the two camera-trap stations.

Because of our very limited sample size, we were not able to obtain an estimate of population abundance and thus failed in our initial aim of assessing the local population of guiñas. Yet, this is the first time that guiñas are recorded in a large-scale camera-trap study in the Argentinian Patagonia, and our findings could lay the foundation for future surveys of this species in the region. During our survey we obtained two records of Geoffroy's cat (*Leopardus geoffroyi*) and one of these was taken at a camera-trap station located only 4.49 km from the nearest station with a guiña record. The Geoffroy's cat is the most closely related species to the guiña (sister species; Gómez Fernández et al. 2020). The distribution ranges of these two felids are mostly parapatric but there are some contact zones where the two species are sympatric, specifically on the Argentinian side of guiña distribution, including our study area (Monteverde et al. 2019, Napolitano et al. 2015, Lucherini and Luengos Vidal 2003). It has been hypothesised that, when co-occurring, the guiña could be maintained to relatively low densities due to competition with the larger Geoffroy's cat (Lucherini and Luengos Vidal 2003). This competitive effect could be strengthened and be potentially detrimental to guiña populations wherever human activities transform forests into open landscapes that may promote the presence of the generalist Geoffroy's cat.

Furthermore, in two of the four sites where guiñas were recorded (the third and fourth records described above), we detected the presence of culpeo foxes (*Lycalopex culpaeus;* minimum-maximum number of independent records: 3-6), the most common native mesocarnivore in this area (Agostini unpublished data). Besides, exotic mammal species such as American minks (0-1 records), wild boars (*Sus scrofa;* 0-1 records) and domestic dogs (*Canis lupus familiaris*; 18-19 records) were also recorded. Dogs are known to exert a negative impact on native mesocarnivores in Chile (Gálvez et al. 2021) and Argentina (Zamora-Nasca et al. 2021). Particularly, they can predate on small felids (Silva-Rodriguez and Sieving 2011; Zamora-Nasca et al. 2021) and may transmit lethal diseases such as canine distemper (Uhart et al. 2012). Finally, the puma (*Puma concolor*) was detected at three stations, although not at any of the four with records of guiñas, being overall a rare carnivore species across all the study area (Agostini unpublished data).

These new guiña records confirm that the species can inhabit eastern Andean Patagonian forests, such as the lenga and coihue beech forests. Although it has been suggested that in its southern range the species prefers moister Valdivian forests (Napolitano et al. 2015, Nowell and Jackson 1996), it also inhabits

sclerophyllous forest-shrublands in the Mediterranean region of central Chile (Beltrami et al. 2021, García et al. 2021). Our preliminary data thus confirm some degree of ecological plasticity.

Our camera-trap records reveal the presence of guiña in different forest types and areas with some degree of human impact and other potential threats (e.g., invasive exotic species) in NHNP. This protected area, due to its large extension and ecological connectivity to other important national parks with guiña presence in both Chile and Argentina, may be playing an important role in protecting this felid in the latter. Given the overall paucity of records of guiña and the lack of information about the most important threats affecting the species in this part of its range (Gálvez et al. 2023, Monteverde et al. 2019), we recommend further camera-trap surveys covering additional areas of NHNP and other protected areas not yet surveyed (e.g., the nearby Lago Puelo National Park), as well as the surrounding non-protected areas. To increase the chance of detecting the species in this part of its range, where low densities represent a challenge for population assessments, we recommend increasing the sampling effort per camera-trap station (Rovero et al. 2013). In this regard, it is worth noting that, after completing our systematic camera-trap survey, two camera-trap stations were kept working during the fall and winter seasons. One of them, which was located in the Valdivian forest station where we previously obtained the second photographic record of guiña (described above), obtained two video records of guiña, on May 14 and August 24, 2023 (the first video-records of this species in Argentina; see Supplementary material: Video-1 and Video-2). This suggest that, in this area, deploying cameras for longer periods of time would result in higher chances of detecting the species. Finally, we recommend locating camera traps along wildlife trails but farther away from large trails and paths, areas that may be perceived as risky and avoided by guiñas because they are frequently used by people and dogs.

The knowledge about guiña population status, landscape use, and susceptibility to different threats will enable the identification of key areas for the conservation of this felid. It will also provide critical information for guiding future mitigation actions aimed at addressing the major threats to the species. All this will contribute to build a solid science-based action plan for the conservation of guiñas in Argentinian humid Patagonian forests.

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Statements and Declarations

The authors have no competing interests to declare that are relevant to the content of this article.

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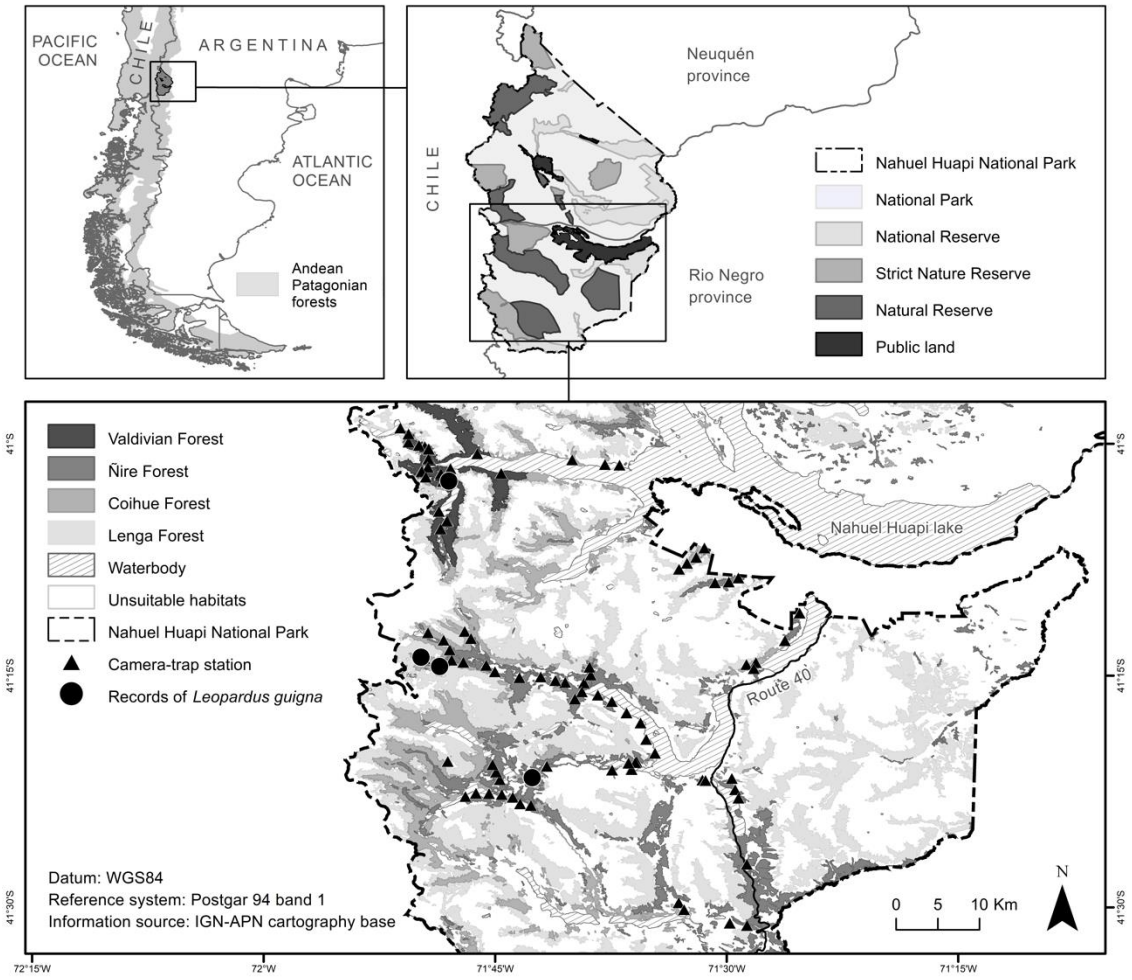
252 **Figure legends**

253 **Fig. 1** Study area and location of the camera-traps stations in the Nahuel Huapi National Park (November
254 2022-April 2023). The localizations of guiña records are represented by black circles

255 **Fig. 2** The four records of guiña (a, b, c, d) obtained from the camera-trap survey in the Nahuel Huapi
256 National Park from November 2022 to April 2023

258 **Fig. 1**



259

Fig. 2


a
GECCaP-CENAC-CONICET
10C 01/02/2023 10:28PM TRAMPA3
b
GECCaP-CENAC-CONICET
7C 01/04/2023 06:37AM ROMI
c
GECCaP-CENAC-CONICET
10C 01/23/2023 02:54AM CAUQUENES
d
GECCaP-CENAC-CONICET
5C 01/31/2023 08:02AM REFUVIEJO