Original Investigation

Activity patterns of the vulnerable guiña (*Leopardus guigna*) and its main prey in the Valdivian rainforest of southern Chile

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ABSTRACT

The guiña (*Leopardus guigna*) is a small felid found primarily in temperate mixed forests of southern Andean and coastal ranges in Chile and Argentina. It is considered a vulnerable species, and is one of the least studied felids in the world. In this study our main aim was to document the relationship between the activity pattern of the guiña and that of its main prey in the Valdivian rainforest (Comau Fjord, southern Chile) using a camera-trap survey. We documented the activity patterns of small mammals and two ground-foraging bird species, as these have been previously cited as the main prey of this felid. Guiñas showed two nocturnal activity peaks, at the beginning and the end of the night, and a weak peak of activity at midday. Small mammals consistently revealed nocturnal activity, whereas both birds were strongly diurnal. Our results revealed a high overlap between the activity patterns of guiñas and small mammals, whereas this was negligible for the bird species. These findings support the idea that small mammals are guiñas' preferred prey in the Valdivian rainforest. Our study contributes to the understanding of the temporal relationships between the guiña and its prey, and may help to design effective management strategies to conserve this vulnerable felid.

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Introduction

Camera-trapping surveys have been recently used to assess the relationship between the activity patterns of predators and their prey in several regions worldwide through robust statistical analyses (*e.g.* Monterroso et al., 2013). This is especially useful for species that are cryptic, rare, and live in remotes areas (Linkie and Ridout, 2011; Foster et al., 2013). One such species is the guiña, kodkod, or Chilean cat (*Leopardus guigna*), the smallest of the neotropical wild cats (1.2–2.2 kg; Nowell and Jackson, 1996). This is a buffy to brownish felid heavily patterned with small black spots on the back and flanks, although dark individuals are also common (Redford and Eisenberg, 1992; Freer, 2004). As in other felids, the spot pattern of the guiña can vary between individuals (Freer, 2004). The guiña is found primarily in central and southern Chile and adjoining areas of Argentina (Redford and Eisenberg, 1992; Quintana et al., 2000). The species is strongly associated with the moist temperate mixed forests of southern Andean and coastal ranges (Acosta and Simonneti, 2004; Gálvez et al., 2013). The guiña is categorized as

Vulnerable by the International Union for Conservation of Nature, with a decreasing population trend, mainly as a consequence of habitat loss and human persecution, because it occasionally predates on poultry (Silva-Rodríguez et al., 2007; Acosta and Lucherini, 2008). The guiña is one of the least studied felids in the world. As a consequence, very little is known about its natural history, particularly about guiña–prey interactions. The few studies have suggested that small mammals form the major part of the guiña's diet (58–72% of prey remains; Freer, 2004; Correa and Roa, 2005; Zúñiga et al., 2005), of which rodents and a Microbiotherid marsupial *Dromiciops gliroides* predominate (Freer, 2004). The guiña also frequently takes avian prey (16–20% of prey remains; Freer, 2004; Zúñiga et al., 2005), mostly insectivorous birds that predominantly forage on the ground (Sanderson et al., 2002).

In this study, we aimed to document the relation between the activity pattern of the guiña and that of its main prey. To achieve this goal, we surveyed the activity of guiñas, small mammals, and birds in the Valdivian rainforest of southern Chile using camera-trapping.

Material and methods

Study area

Field work was carried out in the Huinay Biological Reserve in the Los Lagos Region of southern Chile, 42°22′ S, 72°24′ W (Fig. 1).

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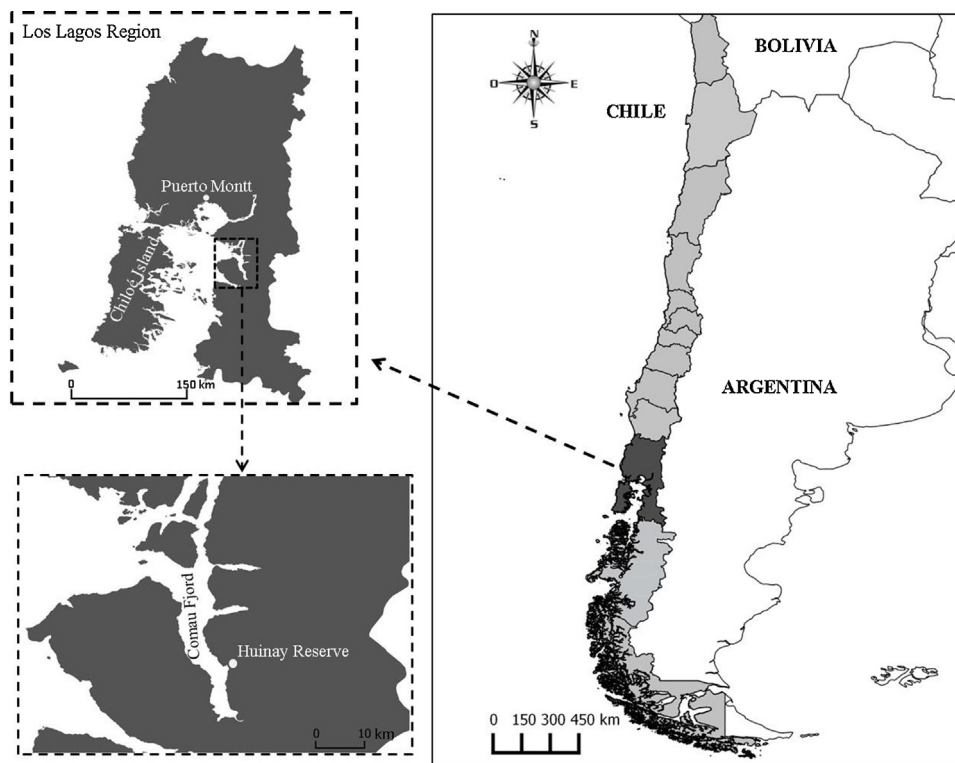Pablo.Ferreras@uclm.es (P. Ferreras).

Fig. 1. Location of the Huinay Biological Reserve and Comau Fjord within the Los Lagos Region, southern Chile.

The reserve lies in a representative area of the continental fjords of the northern end of Chilean Patagonia. The climate is temperate and humid, with an annual average temperature of 10.5 °C and average annual rainfall greater than 6000 mm (Huinay Scientific Research Foundation; www.fundacionhuinay.cl). The landscape is dominated by the Valdivian temperate rainforest, characterized by evergreen trees like ulmo (*Eucryphia cordifolia*) and tineo (*Weinmannia trichosperma*), deciduous *Nothofagus* sp. trees, and conifers, including the alerce (*Fitzroya cupressoides*) in higher elevations (Di Castri and Hajek, 1976). A dense understory of bamboo (*Chusquea quila*) and several species of ferns (*e.g. Lophosoria quadripinnata* and *Blechnum chilense*) is common. This area is within the distribution range of several mammalian terrestrial carnivores, including *Leopardus guigna*, *Lycalopex griseus*, *Galictis cuja* and *Puma concolor* (Iriarte, 2008).

Field sampling

Field sampling was based on camera-trapping of both guiñas and their main prey and was carried out in early spring 2013 (September–October). We set 18 camera-traps in an area of approximately 2000 ha in a nonuniformly layout due to field conditions (*i.e.* very steep slopes, dense vegetation, snow, etc.), and the scarcity of footpaths within the study area. The average distance between neighboring cameras was ∼600 m. We used 3 camera-trap models: (HCO ScoutGuard Model: SG550V, $n = 13$; Ltl Acorn Model: Ltl-5210, $n = 3$; Wildview Model X8IR, $n = 2$). We mounted camera-traps on trees approximately 0.5–1.0 m off the ground along pathways or trails. We used a mixture of canned sardines and vegetable oil as attractant to increase the animals' curiosity (Freer, 2004), and thus detection probability. Each camera-trap was maintained in the field at the same site for a minimum of 31 days (32.7 ± 1.5 days per camera) and we inspected them at least once to replace the battery or card and to add more attractant. We considered consecutive images of the same species taken by the same camera within 30 min to be detections of the same animal, unless they were clearly individually distinguishable (Kelly and Holub, 2008; Davis et al., 2011; Monterroso et al., 2013). In principle, different guiñas could be distinguished because they present frequently different fur patterns (see above). However, during our study when the same camera took several images within 30 min ($n = 6$), similar fur patterns between images indicated that these corresponded to the same individual. Images separated by a longer interval were considered to be independent detections, although they could be of the same individual (Kelly and Holub, 2008; Davis et al., 2011; Monterroso et al., 2013).

Prey species

To compare the activity patterns of the guiña and its prey species, we selected the most common prey, small mammals and ground-foraging birds (Freer, 2004; Correa and Roa, 2005; Zúñiga et al., 2005). Our study area is within the distribution area of at least 12 native and 3 invasive small mammal species (Iriarte, 2008). Among them, *Abrothrix longipilis* (30–50 g), *Abrothrix olivaceus* (24–42 g), *Irenomys tarsalis* (30–60 g), and *Oligoryzomys longicaudatus* (22–35 g) seem to be common (R. Fitzek personal communication). Because it is difficult to accurately identify small-mammal species from pictures taken by camera-traps, we pooled all the independent detections of these species into a category of 'small mammals'. In addition, we selected two bird species, the chucao tapaculos (*Scelorchilus rubecula*; average weight 38 g; Correa and Figueroa, 2001; hereafter chucao) and the black-throated huet–huet (*Pteroptochos tarnii*; average weight 154 g; Correa and Figueroa, 2001; hereafter huet–huet). These may constitute an important food source for the guiña, not only because they are terrestrial (Correa et al., 1990; Amico et al., 2008), but also because they are abundant in Chilean rainforests (Jiménez, 2000), and particularly in the study area (J. Martínez-Padilla personal communication).