Tree–cavity Nesting of Austral Pygmy–Owls (*Glaucidium nana*) in Andean Temperate Forests of Southern Chile

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Letters

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Key Words: *Austral Pygmy-Owl*; Glaucidium nana; *biological legacies*; *breeding*; *cavity-nesting*; *Chile*; *habitat*; *nesting*; *Patagonia*; *temperate rainforests.*

Tree cavities are key habitat components that structure the diversity of cavity-nesting communities (Martin and Eadie 1999). Most cavity users cannot create their own cavities (i.e., secondary cavity nesters [SCN]). Therefore, their populations can be limited by the production and availability of both excavated and natural cavities (Aitken and Martin 2008, Newton 1998).

Knowledge about the breeding biology of most neotropical cavity-nesting *Glaucidium* species varies from ''unknown'' to ''poorly known'' (Deville and Ingels 2012). The Austral Pygmy-Owl (*Glaucidium nana*), the southernmost *Glaucidium* species, is widely distributed in Chile, inhabiting forests, forest-steppe ecotones, shrublands, and sometimes urban parks (Jiménez and Jaksic 1989, Figueroa et al. 2013). Ibarra et al. (2012) suggested that in Andean temperate forests the Austral Pygmy-Owl selects stands with large living trees, which provide thermally suitable roosting and breeding sites. However, breeding records of this owl are mostly anecdotal (Housse 1945, Barros 1950, Goodall et al. 1957), with limited breeding ecology described for individuals using nest boxes (Santillán et al. 2010). Here we provide information on Austral Pygmy-Owl breeding activity and descriptions of nesting sites used in natural forest stands.

During the 2011–2012 and 2012–2013 breeding seasons we searched for nests at 15 sites (each with an area of at least 20 ha) in Andean temperate forests of the Araucanía Region, Chile (see Ibarra et al. 2012, for a full description of the study area). We spent about 6 hr daily, 5 d/wk, from October to January looking for nests of avian cavity-nesting species (n = 28 species, T.A. Altamirano, and J.T. Ibarra unpubl. data). We specifically searched for Pygmy-Owl nests by watching for cavities and breeding behavior (carrying nesting material or prey in the bill). Searching was conducted during daylight, as Austral Pygmy-Owls are known to be diurnal (Norambuena and Muñoz-Pedreros 2012).

We monitored nests we found every 4–7 d using a video camera cavity-monitoring system, until fate was determined. Furthermore, a total of 10 camera traps (Reconyx RC55, RECONYX Inc., Holmen, Wisconsin, U.S.A.) were deployed in front of active nests of Austral Pygmy-Owls and other cavity-nesting species for monitoring interspecific interactions, breeding activity, and nest fate. After the nesting season, we quantified site characteristics at three levels: (a) *cavity-level*: origin (excavated or naturally formed by tree decay processes), height, entrance orientation, cavity entrance width and height, vertical and horizontal depth; (b) *tree-level*: tree species, diameter at breast height (DBH), diameter at cavity height (DCH), vine and epiphyte cover, decay stage of nest tree (decay classes: 1: live, healthy tree; 2a: live tree with sign of boring arthropods and/or fungal decay; 2b: nearly dead tree with broken top and advanced levels of decay, with <20% live branches; 3: standing dead tree in progressive states of decay; adapted from Thomas et al. 1979); (c) *habitat-level*: forest successional stage within 50-m radius (early = 4-20 yr old, mid = 35–70 yr old, late = >100 yr old), slope, canopy cover, understory cover, tree density (only trees with DBH >12.5 cm were counted), signs of recent human activity (logging, grazing, or fire).

We found three Austral Pygmy-Owl nests (one in 2011–2012 and two in 2012–2013) in tree cavities (Table 1). Pygmy-owls started laying during October (nests #1 and #3) and November (nest #2). As in nest boxes (mean clutch = 4.8 eggs, Santillán et al. 2010), clutch size in tree cavities ranged from four to five eggs. Camera trap records for nest #3 indicated that eggs were incubated by one adult, likely the female (Housse 1945), but we often recorded a second adult calling from the surrounding area while we monitored the nest. The incubation period of 15–17 d was only recorded for nest #1. All nesting attempts were successful, resulting in three fledglings for nests #1 and #2, and three or more for nest #3. Fledging occurred between 21–22 December (nest#1), 19–20 December (nest #2), and 30 December–01 January (nest #3).

Nests #1 and #2 were located in the same natural cavity generated by decay where a branch had fallen from the tree trunk. The hole was used in consecutive seasons confirming that this owl species will reuse cavities in subsequent years (Housse 1945), although we do not know whether the same adults nested in both years, because adults were unmarked. The nest tree was located in a suburban early successional forest dominated by coihue (*Nothofagus dombeyi*) and lingue (*Persea lingue*), where numerous large trees and snags remained. Nest #3 (Fig. 1a) was located in a cavity apparently excavated by a Chilean

Table 1. Characteristics of nesting cavities and habitat used by Austral Pygmy-Owls in Andean temperate forests, Chile.

NEST OR HABITAT VARIABLE	NESTS 1/2[a]	NEST 3
Cavity		
Origin	Natural	Excavated
Cavity height (m)	8.2	7.2
Entrance orientation (°)	70	254
Entrance width (cm)	9.5	6.8
Entrance height (cm)	12.0	6.0
Vertical cavity depth (cm)	28.5	124.8
Horizontal cavity depth (cm)	22.2	36.2
Nest Tree		
Species	*Nothofagus dombeyi*	*Nothofagus obliqua*[b]
Diameter at cavity height (cm)	45.9	55.5
Diameter at breast height (cm)	113.2	83.3
Vine and epiphyte cover (%)	7	5
Decay class	3	2b
Habitat		
Forest successional stage	Early	Mid
Slope (%)	0	23
Canopy cover (%)	1	95
Understory cover (%)	55	85
Tree density (no./ha)	253.8	583.9
Average DBH (cm)	28.85	39.9
Signs of recent human disturbance	Logging-grazing	Fire

[a] The same cavity was used in consecutive breeding seasons.
[b] Burned tree.

Flicker (*Colaptes pitius*) based on its entrance characteristics (width, height, shape). The nest tree was also a remnant or residual large tree situated in a mid-successional stand, burned 50–60 years ago, dominated by roble (*N. obliqua*) and laurel (*Laurelia sempervirens*). Both nesting trees were among the largest remaining in their respective stands (Table 1).

Our camera traps recorded pygmy-owls attempting to prey on active cavity nests of Thorn-tailed Rayaditos (*Aphrastura spinicauda*) and Chilean Swallows (*Tachycineta meyeni*) (Figure 1b). Both attempts were unsuccessful. However, we recorded adult pygmy-owls of nest #3 feeding nestlings with Austral Thrushes (*Turdus falcklandii*), Chucao Tapaculos (*Scelorchilus rubecula*), White–crested Elaenias (*Elaenia albiceps*), Black-chinned Siskins (*Carduelis barbata*), austral opossums (*Dromiciops gliroides*), exotic black rats (*Rattus rattus*), and other unidentified small mammals.

Our nesting and feeding observations expand our understanding of the natural history of Austral Pygmy-Owls and confirm that this species uses both natural and excavated cavities for nesting, as suggested by early naturalists in Chile (Barros 1950, Goodall et al. 1957, Housse 1945). Natural cavities are created over decades by fungal decay and insects, as well as by physical damage due to fire and wind (Cockle et al. 2012). Pygmy-owls also occupy cavities excavated by Chilean Flickers, an excavator that frequents disrupted secondary stands and forest edges, where lower numbers of natural cavities are available. This excavator species also provides suitable cavities earlier in succession than those formed by decay processes. Chilean Flickers create cavities that are subsequently occupied by several SCN species that may compete for this limited resource (T. Altamirano, and J.T. Ibarra unpubl. data). Either natural or excavated, cavities used by Austral Pygmy-Owls tend to be in large decaying and dead trees, based on our small sample. These habitat structural components constitute critical ''biological legacies'' (Perry and Amaranth 1997), that are occasionally left behind after anthropogenic disturbance in Andean forests.

Nest webs (i.e., production and use of tree-cavity resources) and food webs (i.e., production and use of feeding resources) frequently become intertwined (Martin and Eadie 1999, Purcell and Verner 1999). Austral Pygmy-Owls were recorded entering the cavities of other species with active nests and they fed their nestlings with avian and mammalian prey species. Cavity-nesting birds often have lower nest-predation rates than birds that construct open cup nests (Martin and Li 1992). Interestingly, both attempts by pygmy-owls to prey on cavity nests of songbirds were unsuccessful, illustrating the relative security of cavities for SCN (Purcell and Verner 1999). With the exception of Chucao Tapaculos, avian prey recorded in this study were

Figure 1. Nesting activity of Austral Pygmy-Owls in Andean temperate forests recorded by means of camera traps: (a) Adult on cavity nest #3; the cavity was excavated by a Chilean Flicker in a broken branch node. (b) Sequence of a pygmy-owl attempting to prey on an active cavity nest of Chilean Swallows.

open-cup nesters, although we note that these are relatively more abundant and thus more available than cavity-nesters in South American temperate forests (Rozzi et al. 1996, Ibarra et al. 2010). We recommend additional studies on the competitive and predatory role of Austral Pygmy-Owls in structuring nest webs and food webs in South American temperate forests.

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