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FIRST NESTING RECORDS OF THE ENDEMIC SLENDER-BILLED PARAKEET (*ENICOGNATHUS LEPTORHYNCHUS*) IN SOUTHERN CHILE

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Resumen. – Primeros registros de nidos de Choroy (*Enicognathus leptorhynchus*) en el sur de Chile. – Documentamos los primeros antecedentes sobre la nidificación del loro Choroy (*Enicognathus leptorhynchus*) obtenidos a partir de dos nidos naturales ubicados en el bosque templado del sur de Chile. Los nidos se encontraron en cavidades naturales a 19 m de altura en árboles emergentes del dosel. La postura alcanzó hasta 10 huevos y eclosionaron 4 y 5 pichones, respectivamente. El período de incubación duró aproximadamente 30 días, y los polluelos permanecieron en el nido alrededor de otros 40 días. Los pichones tuvieron una pérdida de peso previo a abandonar el nido y siguieron creciendo una vez fuera. Los pichones desarrollaron dos plumones distintos antes de la aparición de las plumas, un patrón previamente descrito para un loro endémico de la alta cordillera de Colombia. Esto podría ser una estrategia de los psitácidos habitantes de zonas frías para combatir las bajas temperaturas mientras permanecen en el nido. Nuestro trabajo confirma la necesidad de seguir estudiando la biología reproductiva de los psitácidos que habitan las zonas templadas, en particular de Sudamérica.

Abstract. – We report the first data on nesting ecology of the Slender-billed Parakeet (*Enicognathus leptorhynchus*) from two wild nests in native temperate rainforests of southern Chile. Nests were located in natural cavities 19 m up in emergent trees. Posture reached up to ten eggs and clutched four and five nestlings, respectively. Incubation period extended around 30 days, and nestling period around 40 days. Nestlings presented mass recession before fledging and finished their development once out of the nest. They exhibited two successive downs before feather emergence, a similar pattern shared with species from high-elevated mountains in tropical Andes. This may be a strategy, for psittacines inhabiting cooler regions, to overcome low temperatures while in the nest. Our study points out the necessity to collect additional information on breeding biology in the wild for this and other southern temperate psittacines. *Accepted 12 February 2011.*

Key words: Slender-billed Parakeet, *Enicognathus leptorhynchus*, Psittacidae, *Nothofagus* forest, temperate rainforest, Chiloé Island.

INTRODUCTION

The ecology of psittacines inhabiting temperate ecosystems is barely known compared to species present in tropical and subtropical ecosystems. Species living in temperate or high-elevated ecosystems show differences in nesting biology with other psittacines. For

instance, high-mountain living species, such as the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*) from Mexico and the Azure-winged Parrot (*Hapalopsittaca fuertesi*) from Colombia, have respectively higher nest success and lower growth rate than counterpart lowland psittacines (Monterrubio *et al.* 2002, Tovar-Martínez 2009). In Argentina, nestlings of the Patagonian Burrowing Parrot (*Cyanoliseus patagonus*) remain longer in the nest than other psittacines of similar weight (Masello & Quillfeldt 2002). The growth of two consecutive downs during nestling's stage in high-mountain psittacines species has also been highlighted (Collar 1997, Tovar-Martínez 2009). Despite these evidences, so far studies have been insufficient among psittacines living in cooler environment, e.g., concerning the question if their nesting biology stands out from tropical species. Even less data are available to indicate whether characteristics presented by high-mountain living psittacines can be applied to species inhabiting temperate latitudes.

The Slender-billed Parakeet (*Enicognathus leptorhynchus*) is one of the two psittacids inhabiting the temperate rainforests of southern South America (Fjeldså & Krabbe 1990, Juniper & Parr 2003). The species is endemic to Chile and ranges from Santiago (33°S) to Aisén (45°S). Its populations have declined since the 1950's due to habitat loss, shooting, and disease (Fjeldså & Krabbe 1990, Juniper & Parr 2003, Forshaw 2006) although it is not currently considered globally endangered (IUCN 2010). Little is known about the ecology and reproductive biology of this parakeet, particularly in respect to its nesting requirements and breeding success. Herein, we describe aspects of the breeding biology of the Slender-billed Parakeet from two natural nests discovered in a temperate rain forest of southern Chile. We expect that this study will contribute to the better understanding of the ecology of southern temperate psittacines.

METHODS

This study was conducted in the north-east of the Chiloé Island (41°S, 73°W). The landscape is a mosaic of old-growth and secondary native forest fragments in an anthropogenic matrix of agricultural fields (Willson & Armesto 1996, Hoffmann *et al.* 1999, Willson *et al.* 2005). In the area, vegetation belongs to the North-Patagonian forest type with a canopy dominated by *Tepualia stipularis*, *Drymis winterii*, *Podocarpus nubigena*, *Nothofagus nitida*, and several species of Myrtaceae. Emergent *N. nitida* trees over 20 m height were sparsely distributed (Aravena *et al.* 2002). The climate is temperate with a mean annual temperature of 10.0 °C and a mean annual rainfall over 2097 mm, falling almost all year round (Carmona *et al.* 2010).

Nests were located in two forest fragments > 100 ha, one in the Senda Darwin Biological Station (SDBS) and the other in the locality of Caulín, 6 km east of SDBS, both at sea level. At each site we accessed a nest of the Slender-billed Parakeet using tree climbing techniques (Perry 1978, Dial & Tobin 1994). Nesting trees were characterized by their height (using a 50 m tape) and diameter at breast height (DBH). For each nest, we measured its height from the forest floor, horizontal and vertical diameter of entrance, cavity depth from the base of the nest lip, minimum internal diameter, and cavity orientation (Saunders *et al.* 1982).

Nests were visited almost once a week after their discovery and until the last nestling left the nest. Egg size as well as bill, wing, and tarsus length of each nestling were measured to the nearest 0.1 mm using digital callipers and at each nest inspection following hatching (Moreno *et al.* 2005). For comparative purposes, we obtained similar morphometric data from 26 adult skins in the Ornithology Collection of the National Museum of Natural History of Chile. We

limited the measurements taken depending on the quality of individual museum skins sampled. Body mass of nestlings was also recorded using 1.0 g precision *Pesola* balances. Morphometric data are given as mean ± one standard deviation.

RESULTS

Nests were found in two large living *N. nitida* emergent trees, both 23 m high. Nest tree DBH was 82 cm and 98.5 cm in SDBS and Caulín, respectively. Trees were similar in shape; long and straight trunk without branches until at 19 m, height where several limbs constituted an emergent crown. Nest cavities were located just below the crown at 19 m. Entrance holes were almost rounded shape and measured 16 cm high by 12 cm width for SDBS and 12 cm high by 9 cm width for Caulín. Nest deeps from bottom of entrance were 43 cm and 26 cm in SDBS and Caulín nest respectively, and the narrowest inner diameters were 20 cm for SDBS and 23 cm for Caulín. The nest cavity bottom was garnished with finely chopped pieces of wood. No other added materials were present, with the exception of few sparse feathers from the belly. Entrance orientation faced southwest for SDBS and northeast for Caulín.

The SDBS nest was monitored 13 times. The first visit (22 November 2006) took place when only two eggs were present. By 21 December, the first hatchling was present (Fig. 1), and by the last visit (14 February 2007) all fledglings had left the nest. On the first visit to the Caulín nest (11 January 2007), five nestlings were present. This nest was visited five times and by the last one (4 February) the two last fledglings were still present at the nest. Based on this information, the incubation period extended for 26–28 days and the nestling period for 42–45 days.

The SDBS nest had up to 10 eggs, seven of which were laid in a seven-day interval, representing a rate of one egg per day. Mean length and width of these 10 eggs plus one unhatched egg from the Caulín nest were 35.0 ± 1.7 mm and 26.4 ± 0.6 mm, respectively. Four nestlings (40 %) hatched asynchronically in the SDBS nest. Five of six eggs from the SDBS nest that failed to hatch presented signs of cracks or were destroyed. The shells of hatched eggs were not removed by adults but they disappeared with time. At hatching, chicks had a white thin hair-like down which was replaced progressively by a shorter, denser, and grey down (Fig. 1) around day 10. The Caulín nest was discovered containing five nestlings with feathers already emerged from wings and one unhatched egg, suggesting a minimum clutch of six eggs. Pre-fledging data of bill and wing length and body mass come from Caulín as last visits were realized much closer to fledging day (4 days gap between last and second last visit) than in SDBS nest (9 days gap), giving a better approximation of prefledging data.

Bill growth showed a linear increase (Fig. 2), reaching 26.4 ± 1.2 mm (N = 5) at fledging. Wing growth also showed a linear increase in length during all the nestling period, reaching 186.0 ± 7.2 mm (N = 5) at fledging. Tarsus growth showed strong increase during the first days until stabilizing around day 25 in 27.0 ± 0.8 mm (N = 9, Fig. 2). Average bill length of adult skins from museum collection was 33.8 ± 1.4 mm (N = 25) while wing length was 212.3 ± 6.2 mm (N = 26) and tarsus length 26.3 ± 1.1 mm (N = 23).

The body mass of the SDBS nestlings progressively increased to a mean of 298.2 ± 3.6 g around day 35, then decreased to 269.7 ± 6.4 g (N = 3, Fig. 2) on the last visit. Thus nestlings lost a minimum of 10 % (28.5 g in SDBS) of their mass during the last 7 to 10 days in the nest. Weight previous to fledge recorded by the last inspection in Caulín was 248.4 ± 5.3 g (N = 5).

FIG. 1. A twenty days nestling of Slender-billed Parakeet with a short grey and dense down. Lower left insert shows a one day hatchling with a white thin hair-like down, both from the nest at Senda Darwin Biological Station.

DISCUSSION

This study provides the first records of nest characteristics and breeding aspects for the Chilean Slender-billed Parakeet in the wild. Nest cavities and trees were very similar in both cases: same tree species, similar tree shape, nest at the same height, similar entrance and depth. In addition, as both nests were situated just below the tree crown, they presented easy access and gave a large view across the surrounding forest, since these emergent trees were above the forest canopy. The breeding period on Chiloé Island lasts from November to mid-February and agrees with data provided by Fjeldså & Krabbe (1990). However, our results indicate that it is considerably longer than previously reported (Johnson 1967).

The Slender-billed Parakeet and the Colombian high-mountain Azure-winged Parrot hatchlings exhibit the same two successive downs previous to the development of feathers (Tovar-Martínez 2009). These downs, in particular the second denser one, are likely to be an adaptation of psittacine chicks to the relatively low temperatures at high altitudes (Collar 1997). Climatic rainy and cold conditions on Chiloé Island at sea level present similarities compared to 3000 m high Andean forest of Colombia (Tovar-Martínez 2009). Thus the two consecutive downs may be a strategy of psittacines living in cold environments to have better thermal insulation while in the nest.

The body-mass recession observed before fledging has already been reported for some others psittacines (Aramburú 1997, Masello &

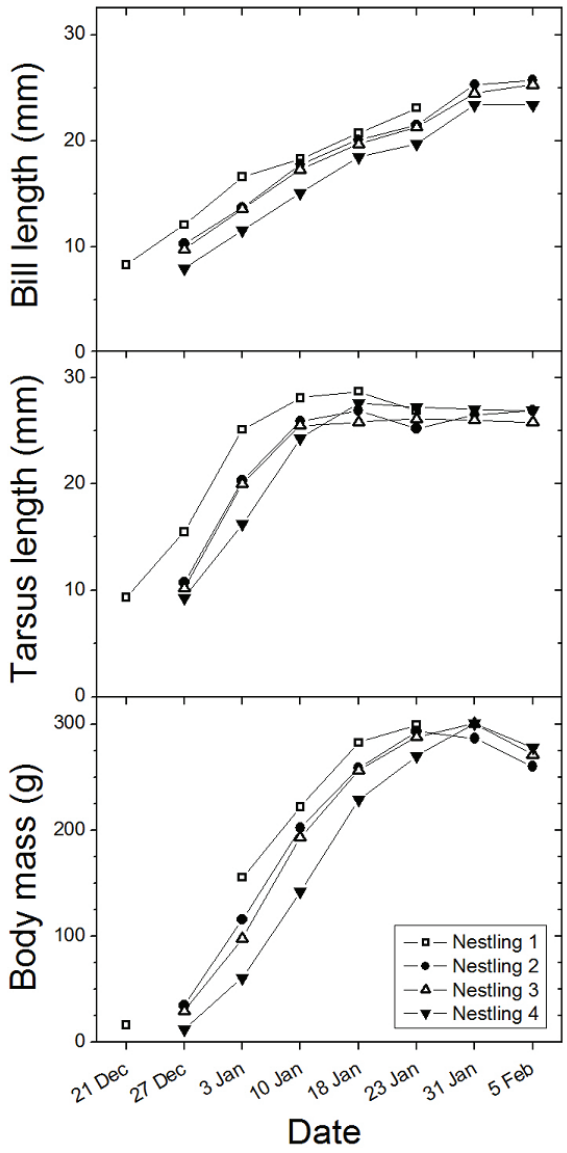

FIG. 2. Morphometric measures and body mass of the four nestlings in the nest at Senda Darwin Biological Station during the breeding period.

Quillfeldt 2002, Renton 2002, Tovar-Martínez 2009). The weight at fledging (248 g for Caulín) was close to the weight reported by Forshaw (2006) for adults (240 g). In contrast, bill and wing lengths did not reach their maximum size by the time birds left the nest. Bill length of adult specimens was 22 % longer than those of pre-fledging in the Caulín nest. Similarly, pre-fledging wing length represented 88 % of the average wing length mea-

sured in adult museums specimens. At contrary, tarsus length was similar between wild nestlings before fledging and museum specimens. Thus, young birds continue their development after leaving the nest.

The SDBS nest revealed an extraordinary clutch size for the Slender-billed Parakeet, outnumbering a previous report of three to six eggs (Goodall *et al.* 1946). Based on the allometric curve of Masello & Quillfeldt's study (2002), an adult parrot of 240 g, such as the Slender-billed Parakeet (Forshaw 2006), should have a clutch size of 3.5 eggs. A similar clutch size of 10 eggs has only been reported previously for the Green-rumped Parrotlet (*Forpus passerinus*), a small psittacid of 30 g (Beissinger & Waltman 1991). However, in general tropical birds exhibit smaller clutch sizes than counterparts of temperate latitudes (Skutch 1953, Young 1994, Martin *et al.* 2000, but see Yom-Tov *et al.* 1994), and as Masello & Quillfeldt's allometric curve is based on many parrot species of tropical and subtropical latitudes it might explain our observation.

Nevertheless, the possibility of a second female laying eggs in the same nest can not be neglected as the laying average rate of one egg per day for a 7-day period is uncommonly high for the family Psittacidae (Collar 1997) and also because two eggs presented severe damages on their shelves. Even if nests were not monitored during long-term session in this study and so any evidence of a third bird visiting the nest cavity is unproven, the phenomenon of multiple females sharing the same nest exists and has been reported for another psittacine, the Horned Parakeet (*Eunymphicus cornutus*, Theuerkauf *et al.* 2009). As well, evidence of egg destruction and/or infanticide due to conspecific intruders in Green-rumped Parrotlet, Palm Cockatoo (*Probosciger aterrimus*), Crimson Rosella (*Platycercus elegans*), and Eclectus Parrot (*Eclectus roratus*) nesting attempts have been observed or suggested by authors (Beissinger & Waltman 1991, Waltman & Beissinger 1992, Krebs 1998, Heinsohn & Legge 2003, Juniper & Parr 2003, Murphy *et al.* 2003) who mainly attributed this behavior to the lack of nesting sites. The island of Chiloé, especially the north, has been highly deforested for agricultural purposes (Carmona *et al.* 2009) and, together with selective logging, this reduces the number of available cavities for secondary cavity nesting birds (Díaz *et al.* 2005, Cornelius *et al.* 2008) and thus might increase competition among psittacines.

Much remains to be learned on the Slender-billed Parakeet and other parrots of the temperate Neotropics. Our results provide information, albeit the small sample size, on nesting phenology and nest site characteristics and describe a clutch size extraordinarily large for the size of this species (which must be confirmed by further studies). Additional data on the biology, ecology, and distributional local movements of this parakeet are necessary to plan and develop successful strategies to enhance its conservation and also to comprehend better its relationship to man, as the species is considered in some places as a pest to crops (Juniper & Parr 2003). Future forest management should consider the critical nesting period to enhance the conservation not only of the Slender-billed Parakeet but also of the highly endemic and endangered avifauna of this region (Stattersfield *et al.* 1998). Similarly, selective logging recreating natural disturbance regimes and keeping old and large *N. nitida* trees (alive or dead) will provide appropriate nesting sites for the numerous cavity nesting community (Franklin & Armesto 1996, Willson & Armesto 1996, Díaz *et al.* 2005, Ojeda *et al.* 2007, Cornelius 2008). As this study contributes to the knowledge on Slender-billed Parakeet nesting biology but arises new interrogations, we hope the information reported herein will encourage additional studies to be done on temperate Neotropical psittacines.

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