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Effects of nest box size on the nesting and renesting pattern of *Aphrastura spinicauda* and *Troglodytes aedon*

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ABSTRACT. Using large and small nest boxes I determined the effect of the nest box size upon nesting and renesting probability, as well as the reproductive success of two secondary cavity nesters, the thorn-tailed rayadito (*Aphrastura spinicauda*) and the house wren (*Troglodytes aedon*) was determined comparing large and small boxes. In order to assess these effects nest boxes were monitored by two consecutive years. Results indicated that *Aphrastura* nested mainly in the large instead of the small nest boxes, and nesting *Troglodytes* used primarily small nest boxes. Nevertheless, the renesting pattern of both species, including renesting attempts after successful fledging and after nest failure, was not affected by nest box size and the probability of renesting was not influenced by the success of previous reproductive events. The size of the nest box did not affect the reproductive success of both species when they nested or re-nested, in spite of the weight of the nest was increased with the size of the nest box. These results apparently are not supported by limitation by space, costs of nest building or the presence and behavior of the nest predator and parasites. Nevertheless, since *Troglodytes* has the potential to usurp cavities used by other species of birds, I suggest implementing monitoring programs for *Aphrastura* using both large and small nest boxes in order to avoid the use of large nest boxes by *Troglodytes*.

[Keywords: nesting, renesting probability, nest box use]

RESUMEN. El efecto del tamaño de la caja nido sobre el patrón de anidación y reanidación de *Aphrastura spinicauda* y *Troglodytes aedon*: Utilizando cajas-nido de tamaño grande y pequeño se determinó el efecto del tamaño de las mismas sobre la probabilidad de anidar y re-anidar, así como sobre el éxito reproductivo de dos especies de aves habitantes de los bosques esclerófilos de Chile central que nidifican en cavidades secundarias: *Aphrastura spinicauda* y *Troglodytes aedon*. Para ello, se monitorearon cajas nido de dos tamaños durante dos años consecutivos. Los resultados indican que los *Aphrastura* tienden a anidar en cajas grandes y los *Troglodytes* en las pequeñas. Sin embargo, el patrón de renidificación de ambas especies, incluyendo tanto las puestas de reemplazo como las segundas puestas, no fue afectado por tamaño de la caja y la probabilidad de renidificación no fue influenciada por el éxito reproductivo anterior experimentado en las mismas cajas. El tamaño de las cajas-nido no afectó el éxito reproductivo de estas dos especies cuando ellas anidaron o re-anidaron a pesar de que el peso del nido se incrementó con el tamaño de las cajas-nido. Estos resultados no logran ser explicados como una respuesta a la limitación por espacio, costos energéticos en la construcción del nido o a la presencia y conducta de los depredadores y parásitos. Sin embargo, dado que los *Troglodytes* tienen el potencial de usurpar cavidades utilizadas por otras especies de aves, se sugiere utilizar cajas-nido grandes y pequeñas al implementar programas de monitoreo para favorecer a *Aphrastura*. De esta forma, se reduciría la presencia no deseada de los *Troglodytes* en las cajas-nido grandes.

[Palabras clave: anidación, re-anidación, uso de cajas-nido]

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INTRODUCTION

Cavity size is a key feature of nest sites that influences nest site selection and consequently the reproductive success of nesting birds (Karlsson & Nilsson 1977). Thus, secondary cavity-nester birds are expected to prefer the cavity size that maximizes reproductive success. Great cavities permit to lay large clutch sizes, reducing both competition for space among siblings and the brood mortality due to hyperthermia (Rendell & Robertson 1989, 1993; Slagsvold 1989; Alatalo *et al.* 1988). On the other hand, large cavities may experience higher predation, an excessive accumulation of nest residue and to demand larger energetic costs during the nest construction (Moed & Dawson 1979; Stephens *et al.* 1998; Wiebe & Swift 2001). Nevertheless, since birds can face a trade-off between benefits and reproductive costs of renesting in old nests (see Aitken *et al.* 2002), cavity size preference could be dependent on the previous nesting attempts. Renesting birds can be vulnerable to ectoparasites, predation risk and the reduction in the cavity size due to the accumulation of old nest material (Rendell & Verbeek 1996; Mazgajski 2003). Thus, the likelihood of nesting or renesting in a nest cavity could depend on its size, the size of other available nest sites and the influence of previous nesting success (Stanback & Dervan 2001; Aitken *et al.* 2002).

Nest boxes constitute a valuable tool to assess nest site selection and reproductive success of secondary cavity nesting birds (Newton 1998). In temperate sclerophilous forests of Central Chile two secondary cavity nesting species, the thorn-tailed rayadito (*Aphrastura spinicauda*) and the house wren (*Troglodytes aedon*), nest in tree holes and soil cavities (Vergara unpublished data). Of these two bird species, *A. spinicauda* seem vulnerable to loss and fragmentation of such sclerophilous forests (Vergara unpublished data), hence the use of nest boxes is a necessary conservation tool for this cavity-nesting bird (Newton 1998).

However, although previous studies in Chilean forests have evaluated the nesting pattern of *A. spinicauda* and *T. aedon* using nest boxes (e.g. Muñoz-Pedreros *et al.* 1996; Moreno *et al.* 2005; Tomasevic & Estades 2006; Vergara and Marquet 2007) they do not provide information to justify the nest box size used in such experiments. *Troglodytes aedon* have been reported nesting in sites previously used by other cavity nesters, constructing stick foundations on such abandoned nests hence reducing the cavity volume and availability (Thompson & Neill 1991; Alworth & Scheiber 2000). Thus, in sclerophilous forests *A. spinicauda* can potentially suffer a reduction in the number of available cavities and an increase in the probability of nest usurpation by *T. aedon* (Vergara unpublished). Nevertheless, in sclerophilous forests *A. spinicauda* also nest earlier than *T. aedon* which apparently reduces the strength of interference competition by cavities and increases cavity availability for nesting *A. spinicauda* (Vergara unpublished). Thus, in order to study nest box use by *A. spinicauda* and *T. aedon*, it is necessary to consider that nest boxes used by *T. aedon* are as a rule unavailable to rayaditos later on because wrens build a stick foundation.

Here, using large and small nest boxes I compare the use of different cavity sizes and the reproductive success of *A. spinicauda* and *T. aedon* considering the effect of *T. aedon* on nest box availability for *A. spinicauda*. I assessed differences in the use of different nest box sizes by *A. spinicauda* and *T. aedon* and determined if the reproductive success of these bird species was associated with it. Also, I determined if such nest box use is influenced by previous nesting success. Finally, I discussed how these results could be used in nest-boxes programs for favoring *A. spinicauda*.

METHODS

A total of 74 nest boxes were placed in two adjacent patches (5.3 and 13.1 ha, respectively) of homogeneous vegetation, composed by evergreen sclerophyllous forest (*Cryptocaria alba*) and located ca. 10 km north of downtown Santiago, Chile (33° 22' S, 70° 30' W). Of these nest boxes 39 were large sized and 35 small sized. The size of large and small nest boxes was chosen considering the entire size range of nest boxes available in Unión de Ornitólogos de Chile (UNORCH, http://www.unorch.cl), which are used for a variety of small passerines of Chilean forests, including *A. spinicauda* and *T. aedon* (hereafter only named by genus). Boxes were constructed from 1.2 cm thick particle boards and entrance was 3 cm in diameter, located 3 cm from the top of the box. Large boxes were 2.2 times greater in both bottom area and volume than the small ones. Large boxes had a base of 15.4 by 17.4 cm, a height of 16 cm at the front and 18 cm at the back (mean height: 17 cm), and the bottom area and volume was 268 cm^2 and 3315 cc, respectively. Small boxes had a base of 10 by 12.4 cm, a height of 14 cm at the front and 16 cm at the back (mean height: 15 cm), and the bottom area and volume was 124 cm^2 and 1500 cc, respectively. Each box was attached to a single tree (>30 dbh) at a height of 6-8 m and entrance faced northeast. To control for possible habitat effects, the small and large boxes were separated by the same distance (> 20 m) and their density was homogeneous across the study site (14 boxes/ha). Nest boxes were checked once a week during the reproductive season of 2003 and 2004, i.e. from mid-September to the start of January (18 weeks/year). In each visit I checked for: 1) the presence of a new nest; 2) the presence of a clutch of eggs or a brood; 3) the number of chicks. Using these data, I estimated the number of young fledged as the number of nestlings on brood-week 2 minus the number of missing or dead nestlings remaining in the nest after fledging (considering that nestling growth lasts up to 22 days in the nest, Moreno et al. 2005). Nesting and renesting attempts were recorded when a nest was completely built and at least one egg was laid (Stanback & Rockwell 2003). To determine if nest-building costs were different between species, at the end of the 2004' season I removed 15 nests of *Aphrastura* and 15 of *Troglodytes* to record their dry weight. From these nests, I additionally estimated the composition of nest materials by distinguishing visually the presence of different materials in the nest structure.

Differences in the use of different nest box sizes by *Aphrastura* and *Troglodytes* was assessed by testing if the nesting and renesting probability, i.e. the frequency of nesting and renesting attempts, in large nest boxes was similar to that of the small boxes. I determined the number of nest boxes occupied and the number of nest boxes available. The number of nest boxes occupied, i.e. with nesting and renesting attempts and those available was measured separately for each nest box size, bird species and year. To analyze renesting attempts I considered nests made and reoccupied during the same year (within a reproductive season) as well as those reoccupied the next year. Additionally I distinguished between renesting attempts after successful fledging and after nest failure. As I wanted to determine the effect of abandoned nests on renesting probability, the nests built were not removed. Renesting observations of colour-ringed *Aphrastura* (3 individuals) and *Troglodytes* (3 individuals) caught inside nest boxes, indicated that renesting attempts are made by the same pairs that nested at the beginning of the season (renesting probability was 1 for both species). Thus, the fact that nesting and renesting attempts were analyzed separately allows to control pseudoreplication in data (see below). Since renesting attempts could be also influenced by biological factors associated to previous nesting attempts, these effects were removed partially by including the previous reproductive success in the estimation of renesting probabilities (see above). Differences in the nesting probability were also tested in *Troglodytes* that nested in abandoned nests of *Aphrastura*. However, as *Troglodytes* built a stick foundation in the box, preventing later use of them by *Aphrastura*, nest boxes with presence of abandoned nests of *Troglodytes* were not considered as available for *Aphrastura*. Finally, nest boxes used by other bird species during the breeding season were not considered as available for neither species.

Differences in the nesting and renesting probabilities were determined using Nominal Logistic Regression (Dobson 1990), including nest box size and year as factors. In order to assess if the effect of nest box size on renesting attempts was different between renesting after successful fledging and after nest failure, the previous reproductive success was also included as a predictor variable into the models. In such analyses I determined the interaction between nest box size and year as well as between nest box size and previous reproductive success. A significant nest box size x year interaction indicates that there was a temporal change in the use of large and small nest boxes, and a significant box size x reproductive success interaction that selection of suitable sites depends on nest box size. Nest box was included as a random factor in the models to control pseudoreplication due to the inclusion of more than one nest attempt from each nest box. Reproductive success was estimated as the number of young fledged per clutch and it was normalized by a logarithmic transformation (Kolmogorov-Smirnov test $p > 0.05$ for both species). I compared the number of young fledged between large and small boxes using a t-test. To obtain a sufficiently large sample size, reproductive success data from the two years were pooled. To determine if nest-building cost was different between species, the dry weight of *Aphrastura* and *Troglodytes* nests was compared using a t-test. Additionally, using data from 2004 I determined, separately for large and small nest boxes, if the laying date, measured as the number of weeks since the nest initiation date (numbered from 1 to 18), was associated with the nest weight using parametric correlations.

RESULTS

During both 2003 and 2004, *Aphrastura* and *Troglodytes* had, respectively, a total of 30 and 22 nesting and renesting attemps (Table 1). Nest box size affected the nest selection behavior of *Aphrastura* and *Troglodytes*. *Aphrastura* nested mainly in large nest boxes (in 39% and 19% of the large and small boxes, respectively) and this selection behavior was not influenced by the year (Tables 1 and 2). *Troglodytes* nested mainly in small nest boxes (in 21% and 34% of the large and small boxes, respectively; Tables 1 and 2). Additionally, there was a significant nest box size x year interaction on nest box use of *Troglodytes* (Table 2), indicating that during year 2004 the frequency of nesting attempts was greater than during 2003 (Table 1). *Aphrastura* did not use primarily the large nest boxes than the small ones when they renested (they renested in 52% and 50% of the large and small boxes, respectively; Tables 1 and 2). Renesting attempts after failure by *Aphrastura* tended to occur in the same proportion as they were available and they were not affected by nest box size (Fisher exact test: $p= 0.68$ and $p= 0.65$ for years 2003 and 2004, respectively). In addition, there was a significant effect of year on the frequency of renesting attempts by *Aphrastura* since renesting frequency was greater during 2004 (Tables 1 and 2). In the same way, *Troglodytes* did not use primarily the small nest boxes than the large ones when they renested (Table 2), and the frequency of renesting attempts was greater during 2004 (they renested in 71% and 60% of the large and small boxes, respectively; Tables 1 and 2). Renesting attempts after failure by *Troglodytes* tended to occur in the same proportion as they were available and they were not affected by nest box size (Fisher exact test: $p= 0.66$ for the year 2004).

Reproductive success of *Aphrastura* and *Troglodytes* was not associated with nest box size (Table 3). For nesting and renesting *Aphrastura* the number of young fledged in large boxes was not different than the number of young fledged in the small ones (Table 3). The number of young fledged in large boxes used for *Troglodytes* nesting, renesting and nesting in abandoned *Aphrastura* nests was not different than the number of young fledged in the small ones (Table 3). For the 2004 breeding season, the weight of *Aphrastura* and *Troglodytes* nests in large boxes was greater than the weight of nests made in small nest boxes ($t_{13}= 2.75$, $p= 0.04$ and $t_{13}= 4.18$, $p= 0.008$, respectively). *Aphrastura* nests in large boxes have a weight of 36.5 g (SE= 1.7, n=8) and in small ones they weighted 25.7 g (SE=2.1, n=7). *Troglodytes* nests in large boxes have a weight of 97.7 g (SE=5.3, n=6) and in small ones they weighted 74.2 g (SE= 3.2, n=9). The weight of *Aphrastura* nests decreased with laying date in both large and small nest boxes (df = 8, r =-0.81, $p= 0.017$ and df = 7, r=-0.83, $p= 0.021$) (Figure 1). Nevertheless, there was not a significant correlation between nest weight and laying date for *Troglodytes* ($p> 0.1$). Composition of nest materials was similar between large and small nests in both species *Aphrastura* nests were made of small sticks, rhizomes, grasses, horse hairs, dry leaves and feather of *Aphrastura*, doves, California quails and domestic birds. *Troglodytes* nests consisted of a 2.8 mm diameter (SE= 0.4, n=7 nests) stick foundation with a nest core made of the same materials as of *Aphrastura* nests.

Table 1. Number of large and small nest boxes with nesting and renesting attempts of *Aphrastura and Troglodytes*. Number of nest boxes available during the breeding season is showed between brackets (see methods).

Tabla 1. Número de cajas-nido grandes y pequeñas que presentaron eventos de anidación y re-anidación de *Aphrastura* y *Troglodytes.* Entre paréntesis se indica el número de cajas nidos disponibles durante la estación (ver métodos).

	Troglodytes		*Aphrastura*	
Year	Large nest boxes	Small nest boxes	Large nest boxes	Small nest boxes
Nesting				
2003	7 (27)	6 (26)	13 (32)	8 (30)
2004	2 (15)	9 (18)	7 (19)	2 (22)
Renesting				
2003	2 (5)	0 (2)	4 (12)	2 (8)
2004	8 (9)	6 (8)	10 (15)	6 (8)
Renesting after failure				
2003	1 (2)	0 (0)	3 (7)	2 (5)
2004	3 (8)	2 (6)	4 (6)	3 (5)
Nesting in nests of *Aphrastura*				
2003	1 (9)	1 (6)		
2004	7 (11)	5 (7)		

DISCUSSION

Nesting pattern

Aphrastura and *Troglodytes* use primarily the large and the small nest boxes, respectively. However, this use pattern did not result in a greater reproductive success for these two bird species. Nevertheless, our data did not support an effect of nest box size on reproductive success possibly because of the sample size was too small. Furthermore, nesting *Aphrastura* and *Troglodytes* could have been attracted to large and small nest boxes, respectively, by mechanisms different to the following ones:

1) Limitation of space: large cavities may be valuable nest sites for breeding birds due to the potential reproductive benefits of laying greater clutch sizes, hence of having greater brood sizes (e.g. Rendell & Robertson 1989). The "limitation of space" hypothesis is not

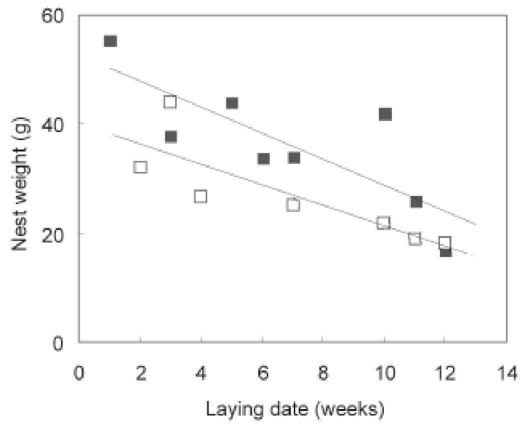

Figure 1. Relationship between the weight of *Aphrastura* nests and laying date in both large (filled squares) and small nest boxes (empty squares).

Figura 1. Relación entre el peso de los nidos del rayadito y la fecha de postura de huevos en cajas-nido grandes (cuadrados llenos) y pequeñas (cuadrados vacíos).

Table 2. Parameter coefficients of the logistic regressions including the effect of nest box size, year, previous reproductive success, and their interactions on the frequency of nesting and renesting attempts of *Aphrastura* and *Troglodytes* in nest boxes available.

Tabla 2. Parámetros de las regresiones logísticas que incluyen el efecto del tamaño de la, caja-nido, año, éxito reproductivo anterior, y sus interacciones sobre la frecuencia de los eventos de anidación y re-anidación de *Aphrastura* y *Troglodytes* en las cajas-nido disponibles.

	Troglodytes			*Aphrastura*		
Variable	Parameter	SE	p	Parameter	SE	p
Nesting						
Intercept	-1.79	0.76	0.019	-0.36	0.49	0.469
Nest box size	2.04	0.91	0.025	-1.84	0.87	0.003
Year	0.84	0.88	0.337	0.03	0.61	0.960
Size x year	-2.25	1.12	0.044	1.02	1.06	0.335
Degrees of freedom= 75						
Renesting						
Intercept	1.79	1.08	0.096	1.22	1.79	0.499
Nest box size	-1.29	1.59	0.417	-2.89	2.80	0.302
Year	-2.76	1.26	0.031	-3.33	1.41	0.018
Size x year	-7.37	451.9	0.996	1.04	1.74	0.554
R†	4.58	146.1	0.996	0.28	0.43	0.520
Size x R†	-4.28	134.5	0.995	0.11	0.6	0.854
Degrees of freedom= 35						
Nesting in nests of *Aphrastura*						
Intercept	2.17	1.44	0.132			
Nest box size	7.45	643.4	0.998			
Year	-3.69	1.59	0.020			
Size x year	-14.2	859.7	0.997			
R*	-0.48	0.56	0.384			
Size x R*	8.78	203.3	0.997			
Degrees of freedom= 17						

† previous reproductive success.
* previous reproductive success of *Aprhrastura* nests.

sustained since the number of young fledged of *Aphrastura* did not increase with nest box size. Additionally, in sclerophilous forests the clutch size of *Aphrastura* ranges from two to five eggs, similar to these ranges observed in relict forests of the north of Chile by Vergara and Marquet (2007), where the nest box volume is 1.85 times (6125 cc) larger. These backgrounds suggest that clutch size of *Aphrastura* is relatively independent of the nest box size. Furthermore, the clutch size range (3-6 eggs) and mean (4.1) reported by Moreno *et al.* (2005) in Chiloé Island, who used nest boxes with a relatively similar volume as the nest boxes used by Vergara and Marquet (2007) in a relict forest, are larger than these reported in both relict forest and sclerophilous forests, suggesting that clutch size pattern responds to large spatial scales rather nest site attributes. In addition, in sclerophilous forests the number of hatching eggs is positively associated with clutch size but is not associated with nest site attributes, as nest box size (Vergara unpublished).

2) Cost of nest building: the nest size for both species was greater in large nest boxes, which could be associated with an increase in the cost of nest building. However, since the nest weight of *Troglodytes* was about three times greater than the nest weight of *Aphrastura*, the primary use of small nest boxes by *Troglodytes*

Table 3. Reproductive success of *Aphrastura* and *Troglodytes* in large and small nest boxes. I indicated the number of young fledged (mean ± SE) with the result of t-test with unequal variances.

Tabla 3. Éxito reproductivo de *Aphrastura* y *Troglodytes* en cajas-nido grandes y pequeñas. Se indican los datos del número de volantones producidos (media ± error estándar) con su comparación estadística mediante una prueba t de varianzas desiguales.

Species	Large boxes	Small boxes	t-value	d.f.	p
Aphrastura					
Nesting in a empty box	1.55 ± 0.31	1.40 ± 0.49	-0.15	28	0.886
Renesting	2.00 ± 0.51	2.13 ± 0.69	0.27	20	0.792
Troglodytes					
Nesting in a empty box	1.02 ± 0.51	1.86 ± 0.48	-1.09	22	0.284
Renesting	2.87 ± 0.87	2.62 ± 0.33	0.22	14	0.822
Nesting in nests of rayaditos	3.25 ± 0.83	3.25 ± 0.29	0.00	12	1.000

could have been determined by energetic limitations. Nest construction by *Troglodytes* in empty boxes could demand a significant cost of nest building because their nests consist of a stick foundation (see Kennedy & White 1992). Thus, in order to reduce this cost *Troglodytes* could have nested mainly small nest boxes. In North America, *Troglodytes* are generalist in terms of their cavity preferences, since they nest in many types of cavities (Thompson & Neill 1991), and their reproductive success is not affected by cavity size (Purcell *et al.* 1997).

3) Parasite and predators: in sclerophilous forests of Central Chile the prevalence of ectoparasites, such as fleas (*Dasypsyllus (Neornipsyllus) aedon*), can become high in nests of both bird species (Beaucournu et al. 2006). Moreover, previous studies have showed a correlation between the number of flea larvae found in the nests of small cavity nesters and the duration of the breeding period because of it is associated to the number of flea generations in the nest (e.g. Tripet & Richner 2004). Laying and incubating *Aphrastura* spend longer periods of time in their nests than *Troglodytes*. Length of incubation period of rayaditos is about 16 days and the total nesting period ranges between 15 and 23 days (Moreno et al. 2005; Vergara and Marquet 2007). *Troglodytes* have shorter incubation periods (<15 days) and nesting periods (<20 days) than *Aphrastura* (Vergara and Marquet 2007). Thus, *Aphrastura* breeding in larger nest boxes could be more resilient to the detrimental effect of accumulation of nest materials such as parasites, dead nestlings, old food or feces. However, my results suggest that the accumulated old nest material in large nest boxes do not to reduce the reproductive success of *Aphrastura* and *Troglodytes*. Furthermore, the main nest predators in this forest are birds, such as the austral thrush (*Turdus falcklandii*), the austral blackbird (*Curaeus curaeus*) and the chimango caracara (*Milvago chimango*) as well as small mammals, like the elegant fat-tailed mouse opossum (*Thylamys elegans*). These nest predators have caused most of the nest failure and mortality experienced by *Troglodytes* and *Aphrastura* (Vergara unpublished data.) and their effect on nest success could be independent on the nest box size. Although I do not have any evidence to support this behavioral mechanism, I hypothesize that nest predators do not discriminate between nest box size. Thus, the nest box size may be not an important factor in determining nest predation risk. Additionally, although *Aphrastura* nests also are vulnerable to nest usurpation by house *Troglodytes*, this effect is associated mainly to distance from edge rather than nest site variables as the nest box size (Vergara unpublished data).

Renesting pattern

Renesting probability of *Aphrastura* and *Troglodytes* was not influenced by nest box size, contrasting with the nest box selection of nesting *Aphrastura* and *Troglodytes*. Birds may reuse cavities only when successful cavities are more valuable than untested sites or when construction of a new nest constitutes a significant time-energy cost (Conrad & Robertson 1993; Gauthier & Thomas 1993). Nevertheless, renesting behavior of *Aphrastura* and *Troglodytes* was not associated to previous reproductive success. Probably, the maintenance of nest sites during and between seasons would be a competitive advantage for *Aphrastura* and *Troglodytes* overcoming the effect of previous reproductive events. In addition, renesting *Aphrastura* and *Troglodytes* using large nest boxes could avoid the cost of nest building in such sites. However, previous studies in North America have showed that nesting and renesting *Troglodytes* spent equal amounts of time in nest preparation in nest boxes (Johnson 1996). Thus, renesting *Troglodytes* were not attracted to use large nest boxes in spite of the fact that the nest size in these sites was larger than the nest size in small nest boxes. For *Aphrastura*, the null effect of nest box size on renesting probability could have been influenced by the negative relation between nest weight and laying date. Thus, the nest size in a large nest box and a small one could be similar depending on the date when the nest was made.

Previous studies have pointed out that the abundance of *Aphrastura* and *Troglodytes* increase in sites with nest boxes indicating that both species are limited by nesting sites (e.g. Tomasevic and Estades 2006). Nevertheless, since nesting probability of *Aphrastura* and *Troglodytes* was not affected by nest box size, their respective selection behaviors may reduce inter-specific competition for cavities of the same size. However, exploitation competition for nest sites between both species could be increased because nesting *Aphrastura* did not nest in abandoned *Troglodytes* nests. Furthermore, usurpation of *Aphrastura* nest boxes by *Troglodytes* is a common phenomenon in this forest (Vergara unpublished data). *Aphrastura* is a forest specialist birds and the *Troglodytes* is a habitat generalist species (Kennedy & White 1992). Thus, the conservation of *Aphrastura* populations in fragmented landscapes like Central Chile could be an important issue. Moreno *et al.* (2005) used successfully large nest boxes (6353 cc) to assess the nesting pattern of *Aphrastura* in the Chiloé Island (41°85′ S, 73°39′ W), southern Chile. Similarly, Vergara and Marquet (2007) using nest boxes of 5900 cc had a total of 31% of nest box occupancy by nesting rayaditos *Aphrastura* in a fragmented forest in semiarid Chile (30°40′ S, 71°30′ W). In addition, in spite of Tomasevic and Estades (2006) did not report nest box use, they found a large abundance of *Aphrastura* in sites were 3861 cc nest boxes were installed than in sites without nest boxes.

Therefore, in order to implement a monitoring program intending to favoring *Aphrastura* I recommend to use both large-sized nest boxes (> 3500 cc) and small-sized nest boxes (<1500 cc), which could reduce the potential negative effect of *Troglodytes* on nesting *Aphrastura*, through of their nest usurpation behavior (Belles-Isles & Picman 1986). Providing both small and large nest boxes, is therefore a first step to segregate species-specific cavity characteristics, and consequently, to avoid nest competition and usurpation. Furthermore, I also suggest continual removal of nests or installing new empty nest boxes periodically to reduce parasite infection (Rendell & Verbeek 1996) and to favor renesting by *Aphrastura*.

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