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USING WOODPECKERS TO INFORM SUSTAINABLE FORESTRY IN THE PIEDMONT FORESTS OF ARGENTINA

Natalia Politi – natalia.politi@fulbrightmail.org

Sebastián Albanesi – sebastianalbanesi@gmail.com

Luis Rivera – luosvriv@yahoo.com

Fundación CEBIO www.cebio.org.ar

Introduction

In forest ecosystems, woodpeckers provide nesting and roosting habitat for many species and therefore woodpeckers play an important role (Winkler y Christie 2002, Ojeda 2004, Bednarz *et al.* 2004). Some woodpecker species are considered keystone or engineer species since they create and modify essential habitat for other species (Jones *et al.* 1994). Most woodpeckers are sensitive to human activities since woodpeckers have specific habitat requirements, such as, large, old trees and dead wood. The decline in the distribution and number of woodpeckers is attributed to unsustainable timber operations and land transformation to other land uses (Mikusinski y Angelstam 1997). Moreover in undisturbed forests there are a greater number of woodpeckers than in harvested forests (Conner *et al*. 1975) and therefore woodpeckers have been used as reliable indicators of avian species richness, forest health, and the degree of forest exploitation (Drever *et al.* 2008). A recent study in the piedmont forest of northwestern Argentina has shown that cavities excavated by *Campephilus leucopogon* had a greater probability of being used by secondary avian cavity nesters (Politi et al. 2009). Such study supports the concept that woodpeckers are keystone species (Martin et al. 2004, Cornelius et al. 2008).

Most of the piedmont forest of Northwestern Argentina (estimates range from 50-90%) has already been transformed to agricultural fields. Protected areas are an essential tool for conservation, but because only a small fraction of lands can be set aside as reserves, it is essential to maintain biodiversity in areas subject to economic activities. Forests managed sustainably are likely to maintain their economic and ecological value. Currently, remnants piedmont forests are subject to unsustainable logging operations that do not consider biodiversity and the important role of biodiversity. Therefore, we have been undertaking research to increase our understanding of how to sustainably manage piedmont forests.

The management of tree cavities is challenging because of their dynamic nature. Moreover, cavity development is a relatively uncommon process. Trees with softer, rotten wood are often selected over healthier trees for excavation, but probably do not remain available for long. To better refine our guidelines for maintaining cavity trees we need to understand which trees are selected for excavation, the spatial distribution of potential cavity trees, the rate of creation of cavities, and which cavities are likely to persist longer. By delineating management guidelines based on the requirements of woodpeckers, we hope to mitigate the negative effects of selective logging. A capacity-building workshop and booklets will inform natural resources agency staff and local people of our recommendations for implementation in environmental impact assessments and new legislation for sustainable forest management. We also need to make our information available to the forest stewardship council (FSC) to assure that certification processes have the best available information.

Results

We found a total density of 41 decayed cavities/ha and 6 excavated cavities/ha, while only 0.41 cavities/ha were excavated by *Campephilus leucopogon*. DBH of excavated cavities trees was significantly greater than the DBH of decayed cavities (Table 1). Excavated cavities were located significantly higher from the ground than decayed cavities (Table 1). Decayed cavities were approximately equally distributed among trunks and branches (44% vs. 56%, respectively). However, excavated cavities were less likely to occur in trunks than in branches (33% vs. 67%, respectively). One fourth of the total excavated cavities occurred in dead trees (snags), but half of the excavated cavities that occurred in branches were located in dead branches. 99% of decayed cavities occurred in live trees and 20% of decayed cavities located in branches were on dead branches. *Calycophyllum multiflorum* and snags were selected for excavation by woodpeckers.

Cavities excavated by *Campephilus leucopogon* were found in trees with a mean DBH of 63±12 cm and at a height of 15±3 m from the ground. *Calycophyllum multiflorum* live trees had most of the cavities (39%) with mean DBH of 63±13 cm (Fig. 2) and at 14.99±3.82 m from the ground (Fig. 3). The second most used tree for excavation of cavities by *Campephilus leucopogon* was *Amburana cearensis* (17%) with a mean DBH of 69±17 cm (Fig. 2) at 16.63±6.73 m from the ground (Fig. 3).

During our year of study 0.05 new cavities/ha were created by woodpeckers, but we did not detect new decayed cavities. None of the cavities marked were lost during the year of study. We found that the home range of a pair of *Campephilus leucopogon* to be approximately 20 ha. Cavities excavated by woodpeckers have a clumped distribution.

Management recommendations

With the support of RSG we have shown that current forest practices in the piedmont forest of northwestern Argentina have a profound negative effect on tree cavity quantity and quality and affect the richness and abundance of cavity-nesting birds. We determined that suitable tree cavities are a rare resource in piedmont forests. We have established that there is a high rate of cavity loss but there is a high rate of cavity creation by woodpeckers, we still do not have information on the rate of creation by fungus but it seems to be rather slow. Cavities excavated by woodpeckers are preferred by nesting-birds, highlighting the key role of woodpeckers. Therefore we recommend that timber exploitation consider retaining at least 20 large trees (i.e., >60 cm of DBH)/ha especially of *Calycophyllum multiflorum* and *Amburana cearensis*. Furthermore, considering the high rate of decomposition of snags they should be retained since they are prone for excavation and also provide a food resource for woodpeckers. Until we can validate our results that assure that this recommendations are suitable to reach a sustainable timber management and because we have only considered only one component of biodiversity we suggest 10% of the area should be retained unlogged in a single block, preferably connecting with other unlogged patches.

Table 1. Comparison of excavated and decayed cavities characteristics.

	Cavities				
	Excavated	Decayed	t-test	df	p-value
Tree DBH (cm)	48.27±22.16	38.35±17.27	-1.80	91.00	0.077
Cavity height (m)	12.84±5.02	7.71±3.75	-4.23	91.00	0.00

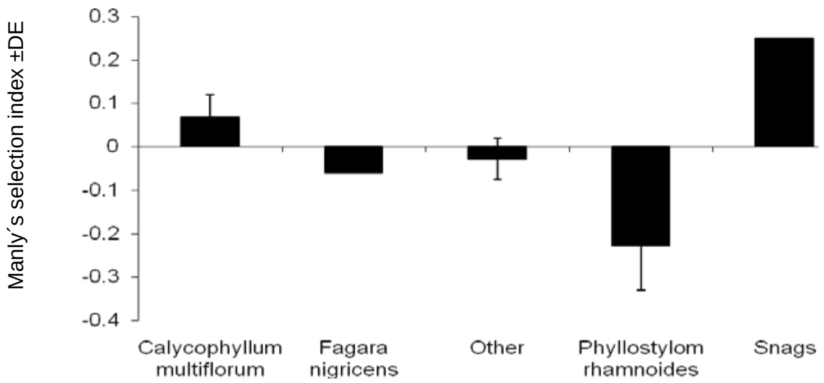

Figure 1. Tree species selection by woodpeckers to excavate cavities according to Manly´s selection index.

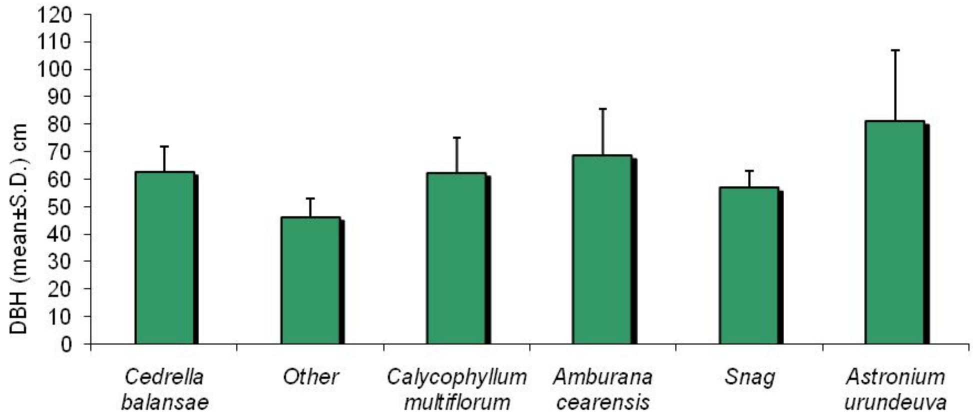

Figure 2. DBH of trees that a cavity excavated by *Campephilus leucopogon* in the piedmont of Northwestern Argentina.

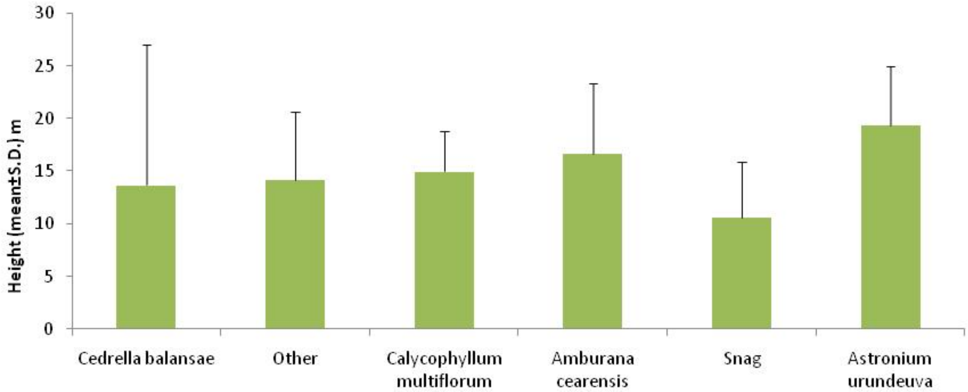

Figure 3. Height of cavities excavated by *Campephilus leucopogon* in the piedmont of Northwestern Argentina, according to tree species.