Acta Oecologica 35 (2009) 685–690

Contents lists available at ScienceDirect

Acta Oecologica

journal homepage: www.elsevier.com/locate/actoec

Original article

Intra-annual variation in habitat choice by an endemic woodpecker: Implications for forest management and conservation

Eduardo Garcia-del-Rey [a,*], José María Fernández-Palacios [a], Pascual Gil Muñoz [b]

[a] Departamento de Ecología, Facultad de Biología, Universidad de La Laguna, 38206 La Laguna, Tenerife, Canary Islands, Spain
[b] Sección de Montes, Medio Ambiente, Cabildo Insular de Tenerife, Santa Cruz de Tenerife 38200, Canary Islands, Spain

ARTICLE INFO

Article history:
Received 21 July 2008
Accepted 18 June 2009
Published online 17 July 2009

Keywords:
Forest ecology
Tenerife
Canary Islands
Habitat selection
Dendrocopos major canariensis
Conservation
Management
Pinus canariensis

ABSTRACT

The Canary Islands great spotted woodpecker *Dendrocopos major canariensis* is an endemic bird restricted to the *Pinus canariensis* forests of Tenerife and Gran Canaria. Classification tree models were applied to explore the relationship of the occurrence of this picid and habitat variables between two contrasting periods (breeding vs. non-breeding seasons) and for the entire annual cycle. During the reproductive period the availability of mature trees (DBH > 60 cm), and snags (dead trees), for nesting and roosting, characterize the breeding territory. Outside the breeding season the choice of locations was driven by a tree cover larger than 28.5% and the presence of trees taller than 8.5 m on average, a pattern explained by the availability of pine seeds in the cones of well-developed canopies, and less so by predation risk. Overall, during the annual cycle, well-developed canopy sites influenced the presence of this picidae (tree cover > 38%) and on more open sites (<38%) the presence of mature trees (DBH> 60 cm) became the second most important predictor of occurrence. We suggest that food abundance and availability could be the ultimate factor explaining the intra-annual variation observed, with the availability of snags being an important factor during nesting. In the range of this endemic, we recommend selective cuts in pine plantations, to allow the trees to set seed and improve their crops, minimizing the elimination of snags, and killing some large pine trees if the priority is to expand the distributional range of the woodpecker.

1. Introduction

The great spotted woodpecker *Dendrocopos major* is widely distributed across Eurasia and occupies continental islands (e.g. Great Britain), continental fragments (Corsica, Sardinia and Sicily), but also oceanic islands such as Japan and the Canary Islands (del Hoyo et al., 2002). On the Canary Islands, the south-western limit of its range, the great spotted is the only woodpecker present and has differentiated, based on mitochondrial DNA, into an endemic race (*D.m. canariensis*) (Garcia-del-Rey et al., 2007). Originally, two different races, *D.m. thanneri* on Gran Canaria and *D.m. canariensis* on Tenerife, have been described based on plumage colour differences (Cramp, 1985).

Woodpeckers became residents in the Canaries between 150,000 and 50,000 years ago (Garcia-del-Rey et al., 2007) and today they inhabit only the forests of Canary Islands pine *Pinus canariensis* on Gran Canaria and Tenerife. This tree is adapted to live near sea level up to 2400 m (Jimenez et al., 2005), but today is restricted to 500–2400 m in the south and 1000-2000 in the north. This pine tree is well adapted to volcanism (Climent et al., 2004), its needles exhibit morphological drought adaptations (Grill et al., 2004) and its cones and seeds vary in size with altitude (Gil et al., 2002). A Canary pine tree can grow 40–50 m in height and live for more than 700 years (Ceballos and Ortuño, 1951).

Despite the taxonomic uniqueness of this ecological system, very little is known about the ecology of this picidae in the Canaries. Habitat selection has been a major topic in ecology (Cody, 1981) and is widely considered as a primary research tool to develop effective forest management policies. The pine forests on the Canary Islands are currently protected by law and can not be exploited for timber (Martín-Esquivel et al., 1995). However, some forest management actions are taking place, particularly on the island of Tenerife, mainly with the aim of achieving the naturalization of the high density pine plantations.

The main objective of this study was to identify which environmental factors influence the choice of sites by the Canary Islands great spotted woodpecker during the entire annual cycle, as well as the choice of territory occupancy (breeding period) and the selection of winter foraging sites (non-breeding period) by this species. We use our findings to recommend forest management actions that will benefit the conservation of this species.

* Correspondence author. Tel.: +34 661213731; fax: +32 922 318311.
E-mail address: edugdr@ull.es (E. Garcia-del-Rey).

1146-609X/$ – see front matter © 2009 Elsevier Masson SAS. All rights reserved.
doi:10.1016/j.actao.2009.06.009

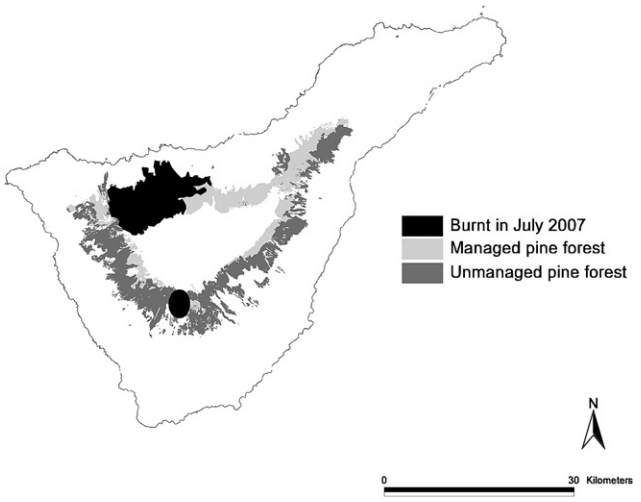

Fig. 1. Distribution of different types of pine forest areas on the island of Tenerife (Canary Islands, Spain). The black circle indicates the location of the study site during the non-breeding period.

2. Material and methods

This study was undertaken on the island of Tenerife (28°20′N–16°20′W), Canary Islands, during two contrasting periods in the annual cycle of this woodpecker. The pine forest on this island ranges from 700 to 2400 m above sea level, with special variations according to the exposition. The adult pine trees can reach normally 15–25 m height, and exceptionally 40–50 m height, with a diameter at breast height (hereafter DBH) larger than 2.5 m (Blanco et al., 1989), but nowadays this is very rare. Today, three main pine forest zones can be identified, in the island (del Arco et al., 2006) (see Fig. 1), from which for this comparative study, the "typical pine forest" stratum was chosen. This stratum, comprises an unmanaged total pine forest area of c. 20 000 hectares (i.e. 62% of today's total pine forest area) and an understorey dominated by two endemic leguminous shrubs: *Chamaecytisus proliferus* and *Adenocarpus viscosus*. Hence, recently burnt areas and currently managed plantations, with different intensity of selective cuts, have been excluded from the analyses.

2.1. Breeding period

As part of a long term breeding bird survey by Sociedad Ornitológica Canaria (SOC) (i.e. Programa de Seguimiento de Aves Canarias), 45 great spotted woodpecker territories were identified during the breeding seasons of 2005–2007, along 370 point counts, distributed systematically on randomly selected plots, around the entire pine forest area of Tenerife (see Fig. 1 in Garcia-del-Rey and Cresswell, 2005). All territories within the stratum under study were surveyed during the reproductive period of 2008 (April–May) to look for active nests. The microhabitat around 30 active nests (within the typical pine forest stratum under study) was characterized, within a 25 m radius plot, by measuring nine variables (Table 1): the percentage of tree cover was measured with a spherical convex densitometer (Lemmon, 1956, 1957), the percentage of shrub cover, the number of trees of different thickness and the number of dead trees (snags) were measured visually. The average heights of trees, the mean shrub height and the terrain slope were estimated with a dendrometer (Haglöf Vertex IV). A rangefinder (±1 m error) was used to delimit the 25 m radius area around the observer. All nine variables were also measured, within a 25 m radius plot, at random points ($n = 30$) from each nest site. The UTM coordinate of the centre of every nest/random point was measured with a Global Positioning System reader. These explanatory variables (Table 1) were selected based on the most important ecological requirements of the woodpecker genus (*Dendrocopos*) (Snow and Perrins, 1998).

2.2. Non-breeding period

A plot (2.5 × 2.5 km) was randomly selected (UTM coordinates of the SW corner: 336000-3118000), 2225 m asl, on the stratum under study. The plot was divided (with the aid of Arcview maps) by a 500 × 500 m grid and cells were visited systematically (one visit/cell only), to record birds actively foraging during the winter of 2008 (1 December–1 February). Birds were identified with binoculars (Zeiss 10 × 40). Special care was taken to avoid pseudo-replication through mapping of movements of previously observed individuals on 1:5000 maps. The sampling effort was also standardised to 1 h per cell and a single observer (EGDR) collected all the data. No surveys were done during rain or strong wind and bird detection field work was only conducted between 7.30 (dawn) to 10.30 h. The microhabitat around each bird foraging was characterized, within a 25 m radius plot, by measuring the same 9 variables (see Table 1).

The microhabitat structure representative of this study site (hereafter, available) was also characterized by measuring the same 9 variables (Table 1), within a 25 m radius plot, located at the intersections (nodes) ($n = 30$) of the gridlines (500 × 500 m cell), (see Sutherland et al., 2004 for the robustness of this method).

2.3. Statistical analysis

Two analytical approaches were used to study the habitat preferences of the woodpecker: 1) Habitat selection: the explanatory habitat variables for occupied and random/available sites were compared using Mann–Whitney *U*-test. 2) Modelling of habitat preferences: potential intercorrelations between variables were examined using Spearman's rank correlation tests. Occupied and random/available places were scored as a binary dependent variable and the habitat measures as independent explanatory variables (Manly et al., 1993).

Table 1
Explanatory variables used to characterize, within a 25 m radius circular plot, the vegetation architecture of the microhabitat of the Canary Islands great spotted woodpecker *D. major canariensis* during the breeding (nest-site selection) and the non-breeding (foraging site selection) period. Mean values (±SD) of the habitat variables measured in nest-sites and random points also included.

Predictor	Description	Nest-sites ($n = 60$)	Random points ($n = 60$)
TC	Cover of pine trees (%)	42.72 ± 22.95	10.61 ± 9.16
T1	Number of trees with a diameter at breast height (DBH) > 60 cm	1.50 ± 1.37	0.93 ± 1.36
T2	Number of tress with a DBH between 35 and 60 cm	1.57 ± 2.43	2.29 ± 2.26
T3	Number of tress with a diameter (DBH) < 35 cm	14.19 ± 12.84	15.56 ± 15.39
MTH	Mean tree height of the six closest trees (m)	12.93 ± 3.68	9.86 ± 2.76
SC	Cover of shrubs (%)	20.05 ± 22.09	23.84 ± 20.41
MSH	Mean shrub height (m)	1.02 ± 0.61	0.84 ± 0.50
SL	Slope (degrees)	19.82 ± 13.98	12.32 ± 6.08
DT	Number of dead trees (snags)	0.82 ± 0.74	0.79 ± 1.40