

# THE BREEDING DISTRIBUTION OF CHIFFCHAFF 'PHYLLOSCOPUS COLLYBITA BREHMII' AND BONELLI'S WARBLER 'PHYLLOSCOPUS BONELLI' IN SOUTHERN SPAIN

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## Introduction

Two species of *Phylloscopus* warbler breed in southern Iberia, the Bonelli's Warbler *P. bonelli* and the Iberian sub-species of the Chiffchaff *P. collybita brehmii* (Lack, 1971; Finlayson, 1992). The Bonelli's Warbler is a trans-Saharan migrant which arrives in the area to breed in March (Finlayson, 1992). It breeds in broadleaved woodland and in some pine woods and regenerating broadleaved woods where it can be numerically dominant, contributing up to 13.6% of all passerine individuals (Finlayson, 1992). The Iberian Chiffchaff is thought to be largely resident and establishes breeding territories ahead of the arrival of the Bonelli's Warbler (pers. obs.). Its breeding distribution is restricted to the most mature broadleaved woods and is never a numerically dominant species (Finlayson, 1992).

The two breeding strategies may therefore be contrasted as follows (after Finlayson, 1992):

**Bonelli's Warbler** A widely distributed and abundant breeding species which reaches highest densities in broadleaved woodland. It is a species which is widely dispersed within the main habitats it occupies.

**Chiffchaff.** A scarce species with a restricted habitat distribution. Within the habitats in which it breeds it is well dispersed, though less so than Bonelli's, and is not as abundant.

## Methods

In order to determine more precisely the habitat occupation patterns of the two species a sample of 71 1-ha plots within an area of rich broadleaved woodland within the Alcornocales Natural Park, Cadiz, Spain (Fig.1) were examined during the period 12 April to 2 May, 1993. The plots were selected by driving along tracks which intersected the woods and stopping

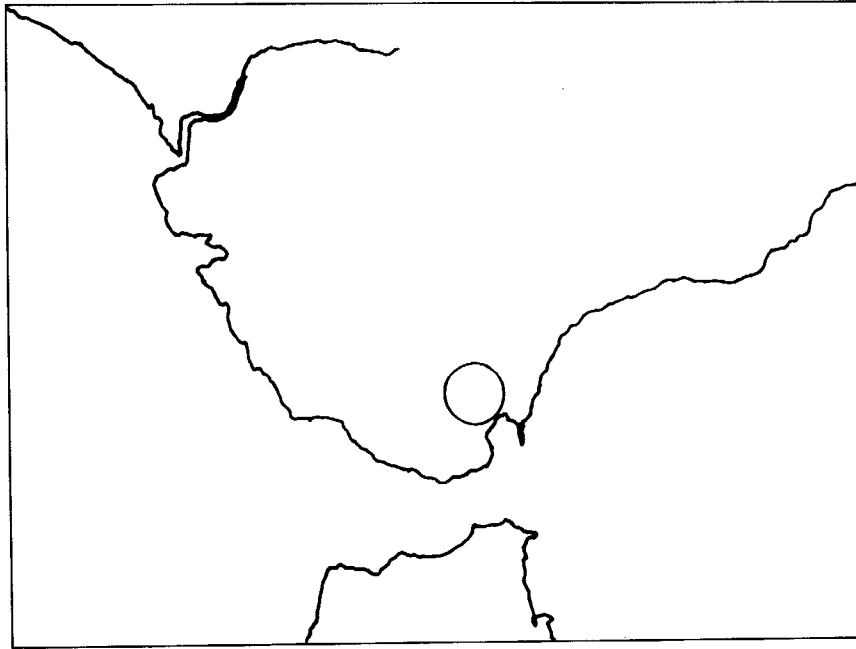


Figure 1.

at intervals of 1 km; the plots were not selected therefore using prejudged criteria and so are considered representative of the different types of vegetation in these woods. The study period coincided with the breeding of the two species ahead of fledging and a narrow time frame was chosen to reduce risk of underrecording territories once song activity declined. All observations were taken from sunrise to a maximum of five hours after sunrise in order to minimize bias due to diurnal variation in activity. At each sampling point a series of biotic and abiotic variables were recorded including the number of Bonelli's Warbler and Chiffchaff singing males within fifty metres of the observation point in an imaginary square with the observer at the centre; each sample therefore recorded number of breeding territories (equated to singing males) in 1-ha units. No sampling points were repeated and sampling was conducted on days with similar meteorological characteristics.

## Results

### The Habitat

The site spanned the altitudinal range 100-700 metres (median 400 metres) and, being in an area where Atlantic depressions discharge a great volume of water, was rich in streams (occurring in 56.3% of all sampling points). The area was well-wooded and 10 different tree species were recorded; the main tree species in 77.5% of the sampling points was the Cork Oak *Quercus suber*, followed by Maritime Pine *Pinus pinaster* (11.3%); Algerian Oak *Q. canariensis* and Olive *Olea europaea* var. *sylvestris* (each 4.2%) and Alder *Alnus glutinosa* (2.8%). The frequency distributions of the second, third and fourth commonest trees in each sampling point are at Appendix 2. In 19.7% of the plots there was no second dominant tree and in all cases the single species was Cork Oak. In 45.1% of the plots there were only two dominant trees: Cork Oak 93.8%; Algerian Oak 43.8%; Maritime Pine 31.25%; Alder 12.5%; and Narrow-leaved Ash *Fraxinus angustifolia*, Olive and Hawthorn *Crataegus monogyna* each 6.3%. The woodland was characterised by a rich shrub layer with 39 different species

being recorded. Bracken (though not a shrub included as a shrub layer component) was the main species in 31% of the sampling points, followed by Green Heather (12.7%), Thorny Broom *Callicotome villosa* (9.9%) and Bramble *Rubus ulmifolia* (8.5%). Bramble occurred most frequently as the second shrub (16.9%), followed by Bracken (12.7%); Thorny Broom (8.5%); Tree Heather (8.5%); and Green Heather (7%). The shrub community, although containing a wide range of species, was therefore dominated by a small number of very abundant species.

### Species distribution Patterns

Chiffchaffs were less widely distributed and less abundant than Bonelli's Warblers within the study area (Chiffchaff mean=0.49 s.d.=0.84 n=71; Bonelli's mean=0.61 s.d.=0.76 n=71). Principal Components Analysis of the variables recorded including Bonelli's Warbler and Chiffchaff numbers was inconclusive requiring fourteen factors to explain 92.2% of the variation and the highest factor only accounting for 16.2% of the variation. Multiple regression of Chiffchaff against all other variables, however, indicated a statistically significant negative correlation with Bonelli's Warbler ( $B=-0.4082$ ;  $P=0.01$ ) and Cuckoo ( $B=-.7927$ ;  $P=0.02$ ) and positive relationships with Bird Species Richness (BSR) ( $B=0.3474$ ;  $P=0.01$ ) and presence of streams ( $B=0.1657$ ;  $P<0.05$ ). Multiple regression of Bonelli's Warbler against all other variables produced an equivalent negative relationship against Chiffchaff and highly significant positive relationships with altitude ( $B=0.002$ ;  $P=0.01$ ) and Warbler Species Richness (WSR) ( $B=0.3123$ ;  $P=0.01$ ) and a strong negative relationship with Maximum Shrub Height (SHRUBMAX) ( $B=-.2793$ ;  $P=0.01$ ).

## Discussion

### Habitat Occupation Patterns

The results indicate that there is a separation in habitat occupation between Chiffchaff and Bonelli's Warbler. This could be the result of direct competition between the two species, of differential habitat selection or a combination of the two. Since Chiffchaffs set up breeding territories ahead of the arrival of Bonelli's Warblers it is unlikely that territory selection in that species is influenced by direct competition from Bonelli's Warblers. The results suggest that the main factor determining the distribution of Chiffchaff breeding territories is the presence of fresh water. Many of the other variables measured may be related to the presence of streams and may interact with each other; this could explain why no single variable explained alone the overall variation. The positive relationship with Bird Species Richness indicates that Chiffchaffs breed in areas of broadleaved woodland which have a rich breeding passerine community. The negative relationship with presence of Cuckoo need not indicate an avoidance of Cuckoos, especially as these birds arrive after territories have been set up and Chiffchaff is unlikely to be a preferred Cuckoo host species; the relationship may therefore be due to association with other variables (e.g. habitat factors). Telleria (1981) found Chiffchaffs in the damper woods close to the Strait of Gibraltar in August. In a study of the woodland communities in the same study area as the present, Fernandez-Pasquier (1982) commented that the Chiffchaff showed a clear preference for humid woods with a rich shrub layer, nesting in wild Olive, Cork and Algerian Oaks, and even in Alders. He found Chiffchaffs in greatest abundance in stations with mixed woodland although he did not include streams as a habitat variable; his analyses only showed convincingly a clear relationship between Chiffchaff numbers and vegetation height in the winter, this being a time when many nominate Chiffchaffs arrive from the north (Finlayson, 1977; Telleria, 1981). Fernandez-Pasquier's (1982) results showed more Chiffchaffs than Bonelli's Warblers in his study plots suggesting that his sample of eleven was too limited to present a broad picture of the distribution of these two species.

The Bonelli's Warbler distribution suggests that there may be an element of exclusion by Chiffchaffs especially as Bonelli's shows no direct tendency to avoid areas with streams. This interpretation would be consistent with other similar patterns of

species pairs in which the resident species establishes itself ahead of and excludes the migratory species (Finlayson, 1992). If this is so then it would explain the greater presence of Bonelli's Warblers on higher ground where there were fewer streams and where residents might be unable to remain in the winter months. The negative relationship between Bonelli's and shrub height, indicating a disproportionate concentration of Bonelli's Warblers in areas with a low shrub layer, is especially significant as a negative relationship existed between shrub height and altitude ( $B=0.0027$ ;  $P=0.01$ ).

There is apparent confusion in the literature on the Bonelli's Warbler's preferred type of undergrowth in the breeding season (Cramp & Brooks, 1992); in the broadleaved woods of southern Spain, at least, it does appear that Bonelli's Warbler avoids areas with a high shrub layer. According to Lack (1971) Bonelli's Warbler and Chiffchaff coexist in southern Spain in lowland woods of evergreen and deciduous oak with a rich bush layer and suggests that the two species may be separated by feeding stations. The present study shows that there is a habitat distinction between the two species which may be maintained by interspecific territoriality. The Chiffchaff's preference for wet woodland has also been reported for southern breeding areas in the former USSR (Cramp & Brooks, 1992) and may be a feature of southern breeding populations of this species.

### Habitat Conservation

When examined on a broad, regional, scale Chiffchaff and Bonelli's Warbler are species which, in southern Spain breed typically in broadleaved woodland. The Chiffchaff exhibits a narrower habitat range than the Bonelli's Warbler which also breeds, although in lower density, in pine woods and late matorral successional stages (Finlayson, 1992). The Chiffchaff would appear to be, at this regional level of organization a species which is more likely to be affected by habitat loss and fragmentation than the Bonelli's Warbler. At the broadleaved forest level the Chiffchaff is also confined to a narrow habitat patch sequence, specifically close to fresh, running, water whereas the Bonelli's Warbler is more widely distributed. Any conservation scheme aiming at the protection of these two species would have to take into account these specific requirements. In the case of the Chiffchaff it would seem that the population is structured along a system of "corridors" following the hydrological characteristics of the area and selection of areas would have to ensure the existence of an interconnecting network of streams and brooks. The Bonelli's Warbler would seem easier in that its habitat requirements are broader. We have no knowledge, however, of the relative fitnesses of individuals breeding in different patches within the broadleaved woodland mosaic or indeed of those breeding in other habitats.

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