THE BREEDING BIRD COMMUNITY IN THE CORK OAK WOODLAND OF CÁDIZ AND ITS SIGNIFICANCE IN THE CONTEXT OF THE SOUTH AND WEST OF THE IBERIAN PENINSULA

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Introduction

The Cork Oak *Quercus suber* woodland that extends from the shores of the Strait of Gibraltar north and east to the area of Grazalema is among the world's largest and best preserved mass of vegetation of this type (Acosta Bono, 1984). It is also situated in the southernmost part of Europe and close to the Strait of Gibraltar. It is therefore a major area for stopping over of migrant birds (Finlayson, 1992). The purpose of this paper is to examine the breeding bird community at the landscape level and to consider its significance within the regional context of southern and western Iberia. The breeding bird community will be compared to that of a proximate offshore volcanic island, Madeira (Portugal), to consider to what extent the island bird community is a biogeographic product of the peninsular broad-leaved forests.

Methods

Here we present the results of a study of the breeding birds of Cork Oak woodland in the provinces of Cádiz and Málaga (Fig.1). We compare the study area with similar areas in the Sierra de Aracena (Huelva) and Sierra de Cazorla (Jaen) that are sufficiently distant but within a similar bioclimatic range to permit meaningful comparisons (Fig.1). Finally, we compare these data with those collected from the island of Madeira (Fig.1).

In the period 1997-2001 we have sampled a total of 1080 localities across the Iberian Peninsula from the Alentejo (Portugal) to Almería, including the 60 sampling localities on the island of Madeira. We have used a system of stratified random sampling of 20 1-ha sites within grid squares of 10 km x 10 km. These 10 x 10 km sampling grids were themselves embedded into 100 x 100 km grids, the aim being to study breeding bird patterns at the habitat, landscape and regional levels (Finlayson,

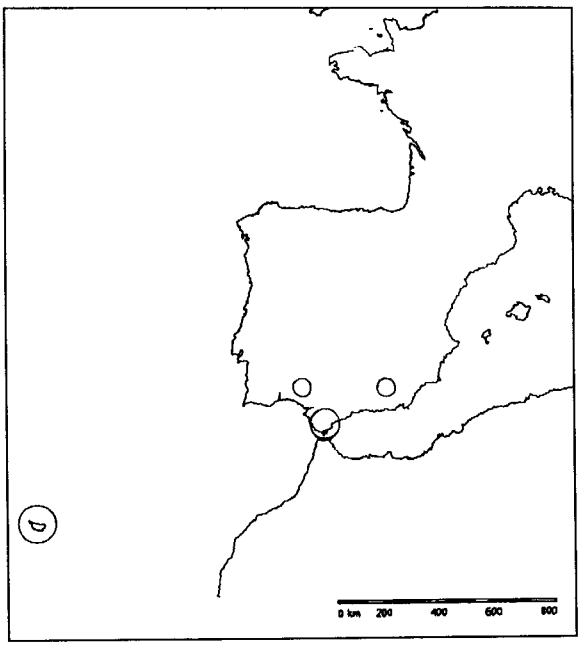

Figure 1. Map of the study areas.

1999). In each 1-ha site we measured 33 variables that measured vegetation structure and anthropic impact (presence of roads, farming activity, etc.) in four samplings per site, giving a data base of 142,560 data points. To these are added data on vegetation taxon composition and breeding bird densities. For the purpose of this paper we have used a data subset that includes the provinces of Cádiz and Málaga (Reference GIB – 200 1-ha sites), Aracena in Huelva (Reference ARA – 80 1-ha sites), Cazorla in Jaen (Reference CAZ – 60 1-ha sites) and Madeira in Portugal (Reference MAD – 60 1-ha sites).

Results

Fig.2 reveals the results of a Principal Components Analysis (PCA) based on the structural vegetation features of the ten landscape sites that comprised the 200 1-ha samples. The site situated within the main Cork Oak woodland mass between Jimena and La Sauceda (GIB 08) separates out from the other sites and identifies this landscape square which consists of virtually uninterrupted Cork Oak woodland. Site GIB 04 is closest to this site in vegetation terms. It is a landscape square that includes areas of Cork Oak woodland but is significantly more disturbed with areas of open farmland. It is situated between La Sauceda and Llanos del Valle.

Fig. 3 shows the results of a PCA of the breeding bird data. GIB 08, once again, separates out from all other sites revealing its uniqueness at the regional level, not just in terms of vegetation but also of bird communities. As with vegetation GIB 04, though distant, is the closest landscape square.

In Fig. 4 we present the results of a PCA that compares the two Cork Oak woodland landscape squares (GIB 08 and 04) with the remaining Gibraltar squares and the Aracena, Cazorla and Madeira squares in terms of vegetation structure. The GIB 08 square shows close structural affinities with the three Cazorla sites and slightly less so with the Aracena and Madeira sites which are nevertheless closer to it than all the other Gibraltar sites. Square GIB 04 adopts an intermediate position.

In Fig. 5 we present the results of a PCA using the breeding bird data. Here we observe a very close relationship between GIB 08 and the Cazorla and Madeira sites with the Aracena sites being more distant.

In Fig. 6 we present a comparison of total bird species abundance against diversity (Simpson Index). The Madeiran sites stand out as lowest in diversity and total abundance as would be expected from island populations (MacArthur & Wilson, 1967). The GIB sites show high diversity levels and are sandwiched between the montane samples of Cazorla and Aracena in abundance terms.

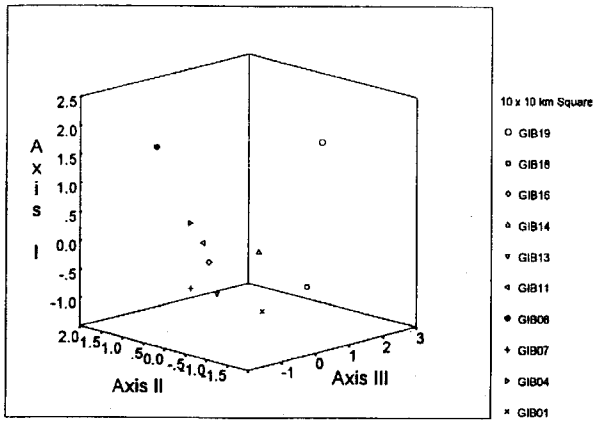

Figure 2 Principal Components Analysis of GIB sites by vegetation structure. The first three components explain 76.484% of the variance.

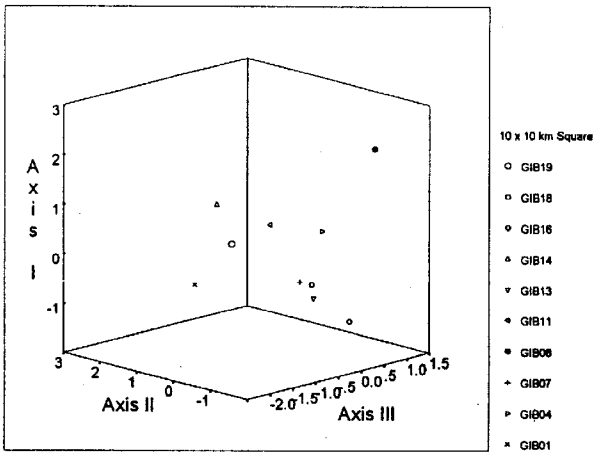

Figure 3. Principal Components Analysis of GIB sites by breeding bird community composition. The first three components explain 54.891% of the variance.

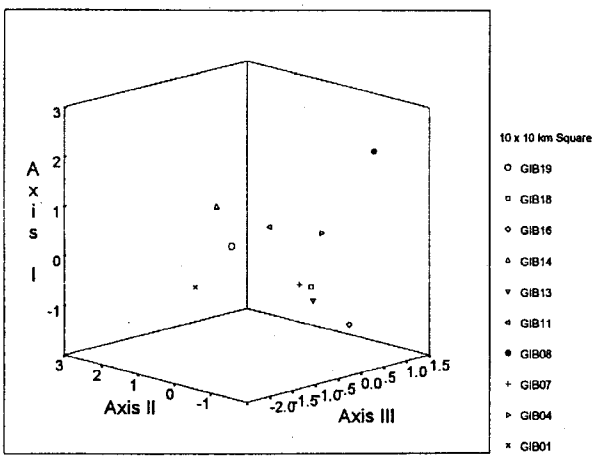

Figure 4. Principal Components Analysis of all sites by vegetation structure. The first three components explain 61.435% of the variance.

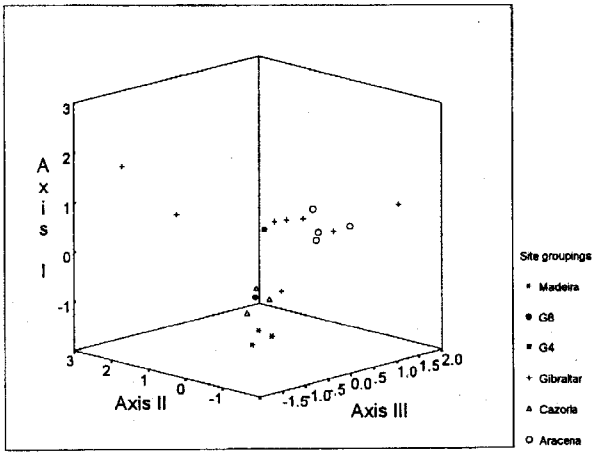

Figure 5. Principal Components Analysis of all sites by breeding bird community composition. The first three components explain 39.739% of the variance.

Discussion

These results indicate that the Cork Oak woodlands are within the region under study unique in terms of vegetation structure and bird communities. Between regions they have affinities with montane woodland and show an intermediate position between the north-eastern, more arid, woodlands of Cazorla and the more humid woodlands of Aracena in vegetation structural terms. In bird community terms these woods are closer to the Cazorla than the Aracena woods. This is because a number of Atlantic woodland species reach their southern limits in Aracena (Purroy, 1997). In our samples they included such species as Pied Flycatcher *Ficedula hypoleuca* and Garden Warbler *Sylvia borin*.

The relationship with the Madeiran avifauna is of particular interest. Of the 8 Madeiran non-endemic woodland species (Oliveira, 1999), 7 reached highest abundance levels in the GIB 08 square and the eighth (Sparrowhawk – *Accipiter nisus*)

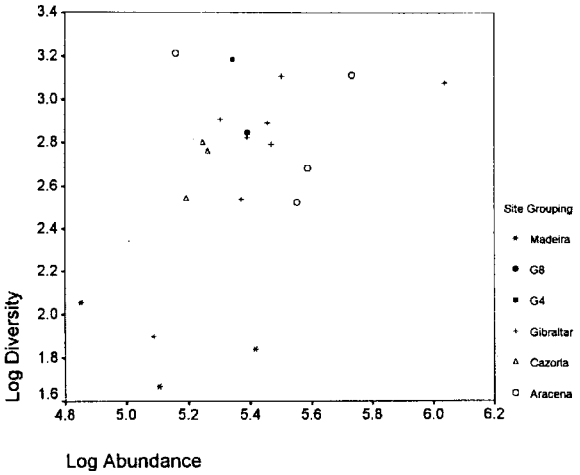

Figure 6. Relationship between bird species diversity and total abundance for all sites.

may also have done so but is secretive and difficult to sample (Table 1). We next compared those species absent as breeding birds but present in the mainland GIB region and the GIB 08 woodland landscape square. Fourteen woodland species were missing in Madeira (Table 2) which we assume have not colonised for reasons other than unsuitable habitat (e.g. low dispersal ability, chance, etc.). These we regard as potential colonisers. There were another 29 species that were present in the GIB region but not in GIB 08 and we consider that habitat considerations may preclude their colonisation of offshore islands, especially as a number of them are migrants and potentially good dispersers (Table 2). Overall, the woodland bird communities of southern and western Iberia appear homogenous with a well-defined species group. The main differences appear in the west, as we have seen, due to the presence of Atlantic species on the edge of their range. The island woodland bird community is composed of a subset of this mainland woodland group. In this respect the influence appears to be greatly from the GIB woodland group. Thus regressions between breeding bird densities of woodland birds in Madeira against the Cazorla, Aracena and GIB regions were not statistically significant. Regression with the GIB 08 woodland landscape square was, on the other hand, highly significant (R^2=0.303, p=0.015).

We conclude that the bird communities of southern and western Iberian woodlands have common affinities with the main differences being with the wetter western sites. Island communities have been established from such communities and are closest in structure to those of proximal mainland areas. The Madeiran woodland communities appear as subsets of the southern Cork Oak wood communities and appear to have been formed from those species that have the highest abundances on the mainland.

GIB08	GIB	CAZ	ARA
BUTEO BUTEO	*ACCIPITER NISUS*	*Carduelis carduelis*	*Petronia petronia*
MOTACILLA CINEREA	*Falco tinnunculus*		*Serinus canaria**
ERITHACUS RUBECULA	*Columba trocaz**		*Acanthis cannabina*
TURDUS MERULA	*Apus unicolor*		
SYLVIA ATRICAPILLA			
REGULUS IGNICAPILLUS			
FRINGILLA COELEBS			

* endemic species that have been compared to mainland equivalents
NB *Anthus berthelotti, Sylvia conspicillata* present but insufficient data to be included in the analysis

Table 1. Madeiran breeding bird species in relation to mainland regions/landscapes in which hey achieved highest abundances. Woodland species in capitals.

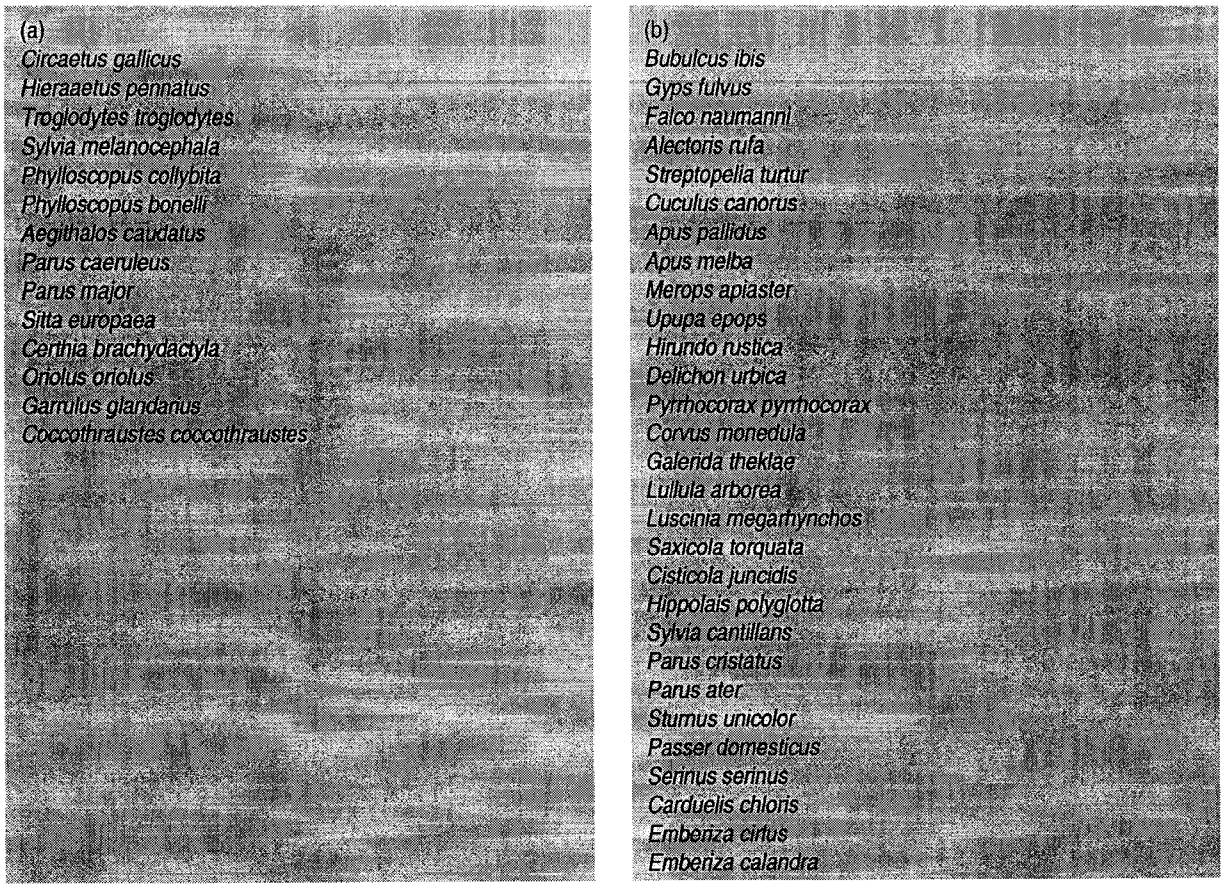

Table 2. (a) Mainland woodland species missing from Madeira; and (b) Mainland non-woodland species missing from Madeira

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