Passerine bird communities of Iberian dehesas: a review

J. L. Tellería

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Abstract

Passerine bird communities of Iberian dehesas: a review.— The Iberian dehesas are a man–made habitat composed of scattered oaks (*Quercus* spp.) and extensive grass cover occupying three million ha in south–western Iberia. This paper compares the structure of the passerine bird communities in this region with other bird assemblages of Iberian woodlands. Although forest bird numbers in the southern half of the Iberian peninsula are decreasing, the dehesas show the highest richness in breeding birds, seemingly as the result of the increased presence of border and open–habitat birds. A low intra–habitat turnover of species was observed in the dehesas, with birds recorded at a sampling point accounting for a high percentage of the total richness of the community. This can be related to the low spatial patchiness of this habitat. In winter, the dehesas continued to maintain many bird species, but showed bird densities similar to other woodlands. This pattern, as well as the scarcity of some common forest passerines during the breeding period, could result from the removal of the shrub layer typical of Mediterranean woodlands.

Key words: Dehesas, Forest bird communities, Iberian peninsula, Passerines, Seasonal changes, Species richness.

Resumen

Las comunidades de pájaros de las dehesas ibéricas: una revisión.— En este trabajo se revisa la composición y la estructura de las comunidades de aves de las dehesas ibéricas. Estos pastizales arbolados, cubiertos de encinas dispersas, ocupan unos tres millones de hectáreas del cuadrante suroccidental ibérico. Pese a la disminución de las aves forestales hacia el sur ibérico, las dehesas presentan un número elevado de especies si se las compara con otros bosques del área. Este rasgo parece ser consecuencia de la abundancia de aves típicas de medios abiertos o ecotónicos. La homogeneidad espacial de la estructura de las dehesas da lugar, además, a una baja tasa de cambio en la riqueza de especies dentro de este hábitat, de forma que las aves vistas en una estación de censo son un porcentaje elevado del total de la comunidad. En invierno, las dehesas siguen siendo un hábitat diverso, aunque presentan densidades similares a otros bosques del suroeste ibérico. Esta relativa escasez de aves pudiera deberse a la falta de arbustos fruticosos típicos del Mediterráneo sobre los que se alimentan muchas aves migradoras.

Palabras clave: Dehesas, Comunidades de aves forestales, Península ibérica, Paserinos, Cambios estacionales, Riqueza específica.

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Introduction

The Spanish dehesa, and its Portuguese counterpart the "montado", is an extensive agro-ecosystem situated in the south–western quarter of the Iberian peninsula and occupying around three millions ha (DÍAZ et al., 1997). It is composed of scattered oaks (e.g. holm oaks *Quercus ilex* and cork oaks *Quercus suber*) resulting from the clearing of former forests and the subsequent grazing and ploughing to prevent bush development and to maintain extensive grass cover. Grasses and acorns produced by these wooded pastures thereby sustain herds of cattle, sheep and pigs on large private estates (mean size approx. 500 ha; CAMPOS,1993). The landscape resulting from such forest management resembles an African savannah dotted with small pools that provide water for livestock during summer.

The dehesas are important for wildlife conservation because, despite their own biodiversity resources (DÍAZ et al., 1997; TUCKER & EVANS, 1997), they form a wooded matrix interspersed with hills and undisturbed patches of Mediterranean forests and shrublands. These habitat patches maintain several endangered species (Iberian Lynx *Lynx pardina*, Imperial Eagle *Aquila adalberti*, Black Stork *Ciconia nigra,* etc.) which, like other animals (raptors, carnivores, wild boars, deer, etc.), move between forests and dehesas (RODRIGUEZ & DELIBES, 1990; GONZÁLEZ, 1991). In addition, dehesas are a main wintering habitat for several migratory birds, some of concern for conservation (e.g. wood pigeons *Columba palumbus,* cranes *Grus grus*; PURROY, 1988; ALONSO & ALONSO, 1990). As the dehesas prove compatible with birds and other wildlife, a significant percentage of this habitat has been included in areas of national and international conservation strategies (TUCKER & EVANS, 1997; VIADA, 1999).

The bird fauna of Iberian dehesas has been studied from different perspectives. The study of HERRERA (1978a, 1980) on the structure and seasonal evolution of bird communities in two dehesas was the first and most complete approach to this issue to date. Other approaches have been focussed on describing the composition of bird communities (PERIS, 1991; SÁNCHEZ 1991), the effects of management strategies on birds (PASCUAL et al., 1991; CABELLO DE ALBA, 1992; DÍAZ & PULIDO, 1995, PULIDO & DÍAZ, 1992, 1997; DÍAZ et al., 2002), or different issues on the biology of individual bird species (e.g. LÓPEZ–GORDO et al., 1976, HERRERA, 1977, 1978b; ALONSO et al., 1991; DÍAZ & PULIDO, 1993; DÍAZ et al., 1996; DÍAZ & MARTÍN, 1998). However, bird communities in the dehesas have not been compared with those of other Iberian woodlands even though such an approach is adequate to disclose the specific features of bird assemblages (WIENS, 1989). This paper reviews the available information on the structure of dehesa bird communities to interpret their traits in the light of current hypotheses on the factors affecting the distribution of Iberian forest birds. To do so, specific traits of the dehesa bird assemblages are compared with the bird communities of other Iberian woodlands. More specifically, the study analyses: (i) the main features of the Iberian pool of forest birds from which the dehesa bird communities have been assembled; (ii) the effects of habitat structure of these wooded pastures on their species richness; and (iii) the way seasonal changes affect the structure of their bird assemblages.

Material and methods

Two data sets resulting from former studies on the structure of Iberian bird communities have been used to evaluate some relevant features of the dehesa bird assemblages (fig. 1). They refer to forest passerines (crows excluded) provided that these species are abundant and potentially ubiquitous along the Iberian gradient and homogeneous from a methodological point of view (censuses). The first data set records the results of point counts used to assess the effects of geographical location, climate and tree density on the structure of breeding bird communities (see TELLERÍA et al., 1992, 1999; TELLERÍA & SANTOS, 1993 for further details). Point counts were used to record the number of species observed over 10–minute long periods in the early morning at 20 sampling stations randomly distributed across each study woodland. These data are useful to obtain richness scores per sampling point (point diversity or internal alpha diversity) and the accumulative total richness (alpha or within–habitat diversity) of the studied woodlands (WHITTAKER, 1977 for further details). In addition, the mean point richness / total richness ratio can be used as an index of the intra–habitat turnover of species (internal beta or pattern diversity). A second data set refers to line transect counts where birds were recorded within a 50 m wide band (25 m at either side from the observer). They are useful to evaluate inter–habitat distribution and seasonal changes of bird abundance. These data were obtained from a review on the abundance distribution of Iberian passerines (see TELLERÍA et al., 1999 for details).

The statistical analyses were designed for specifically testing the relationships between the parameters of bird communities and some environmental effects, as well as the differences of dehesa bird communities with bird assemblages of conifer and broad–leaved woodlands, the two main groups of trees according to habitat preferences of Iberian forest birds (TELLERÍA & SANTOS, 1994). Regression analyses on log–transformed data were performed and ANOVA / ANCOVA comparisons in which dehesas were compared to the other woodlands were planned. All analyses were performed using the Multiple Regression and ANOVA / ANCOVA modules implemented in STATISTICA 5.5 (STATSOFT, 1999).

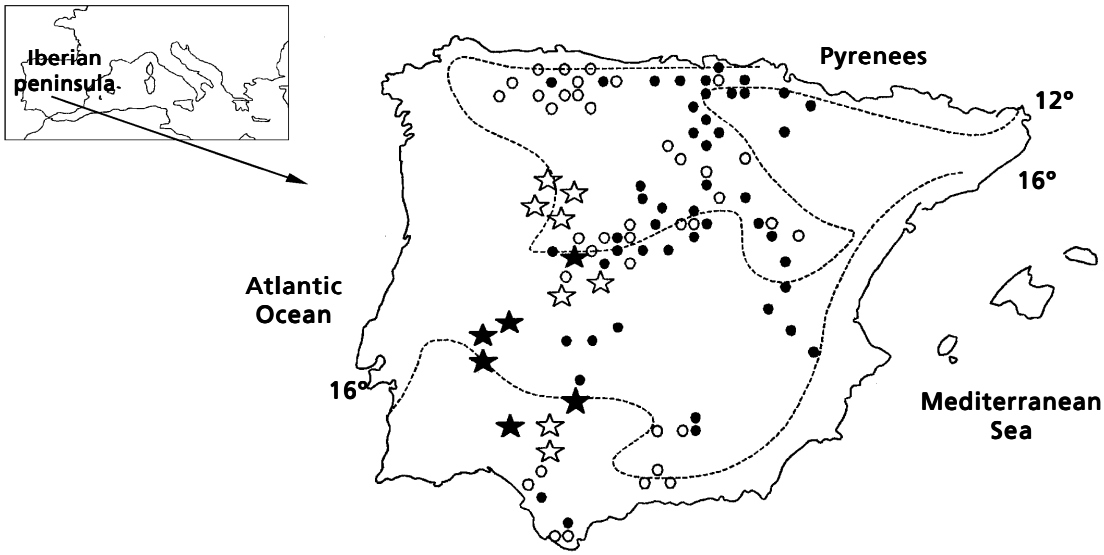

Fig. 1. Distribution of woodlands sampled to evaluate the structure of Iberian forest bird communities. The isotherm of 12ºC approximately delimits the distribution of Northern Iberian Plateau and mountains. White dots represent those woodlands where bird richness was evaluated by point counts during the spring. Black dots are sites where the structure of bird communities was evaluated by line transects during spring and winter. White and black stars show the situation of the dehesas sampled in both cases (see text for further details).

Fig. 1. Distribución de los bosques muestreados para estudiar la estructura de las comunidades de aves forestales ibéricas. La isoterma de 12ºC delimita, aproximadamente, la distribución de la Meseta y montañas del norte ibérico. Los puntos blancos sitúan los bosques censados en primavera mediante estaciones de escucha. Los puntos negros son bosques censados en primavera e invierno mediante transectos. Las estrellas blancas y negras representan la ubicación de las dehesas en ambos casos (ver el texto para más detalles).

Results

Tree density of Iberian woodlands decreased southwards along the Iberian peninsula, a pattern associated to a concomitant increase of bird richness (figs. 2, 3A). This was related to the changing composition of bird assemblages provided that arboreal and open–habitat birds decreased and increased respectively in the more open woodlands (fig. 3B). The high species richness of dehesa bird assemblages in relation to other Iberian woodlands could thus be related to the presence of large numbers of border birds (figs. 4A, 4B; table 1). Dehesas showed higher point and internal beta diversities during the breeding period (fig. 4C, 4D; see however the marginal statistical significance for internal beta diversity in table 1) but did not differ in spring and winter densities (fig. 4F; table 1). However, they showed higher species richness than other bird assemblages, even after controlling for the effects of altitude (an index of winter hardness along the Iberian gradient; fig. 5; table 2).

Discussion

Putting dehesas in a biogeographical context

Processes operating on larger spatial and temporal scales are important determinants of the structure of bird communities as they determine, for instance, the characteristics of the species pool from which local communities can be assembled (CALEY & SCHLUTER, 1997). This claim is particularly important when analysing the structure of bird communities in the Iberian peninsula given that many forest birds are adapted to environmental conditions of central Europe and become increasingly scarce in the Mediterranean (BLONDEL, 1990; MÖNKKÖNEN, 1994; TELLERÍA & SANTOS, 1993; HAGEMEIJER & BLAIR, 1997). From a historical perspective, this pattern of decreasing bird richness can be interpreted as the outcome of paleo–environmental fluctuations experienced by the Western Palearctic from the Quaternary (BLONDEL & MOUVER–CHAUVIRÉ, 1998). Throughout the late Pleistocene period, forests

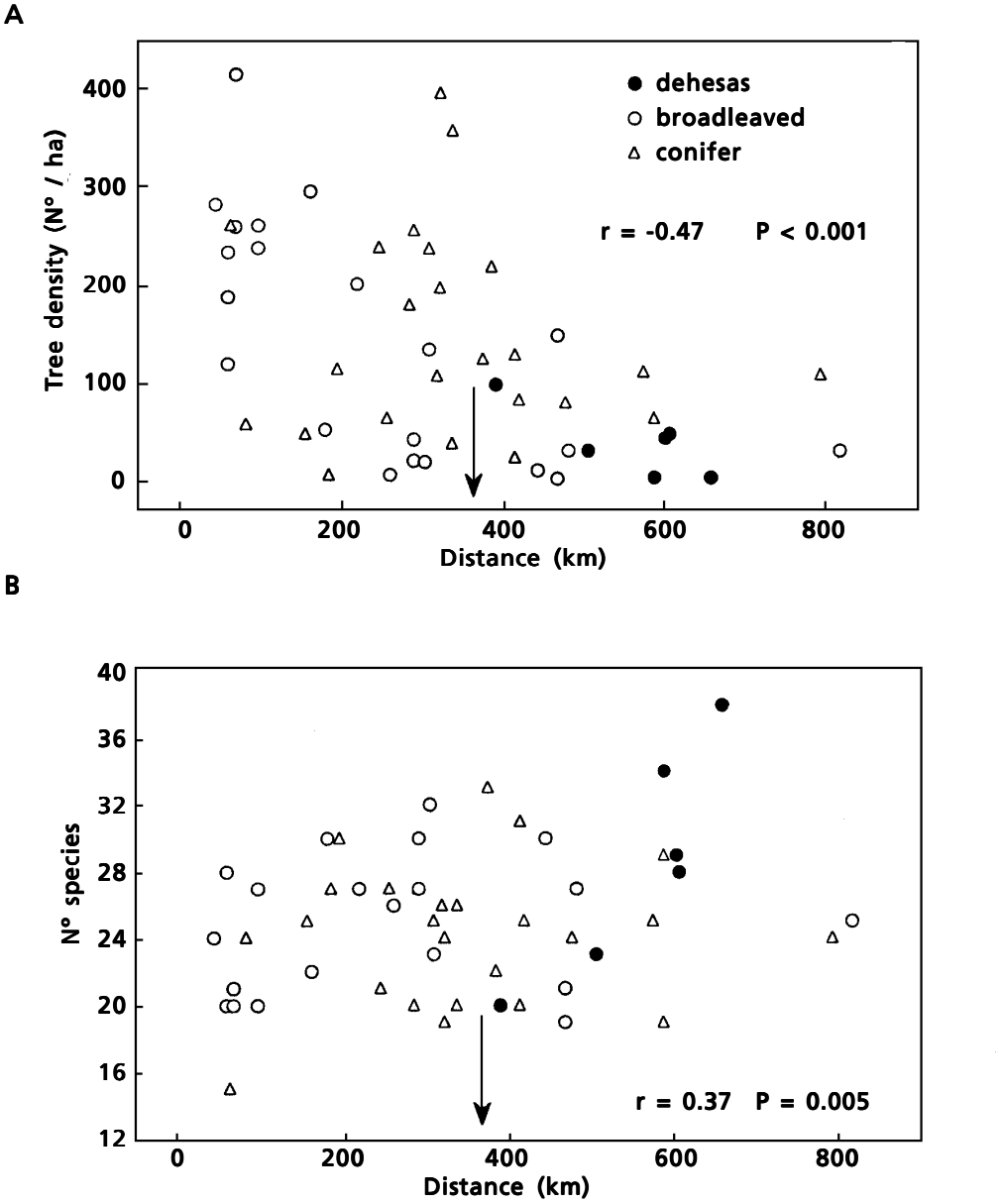

Fig. 2. Geographical distribution of tree density and bird richness in some Iberian woodlands. These patterns have been obtained by recording the mean density of trees (mean number of trunks > 20 cm dbh per ha) and the total richness of forest passerines recorded in the study woodlands (white dots in fig. 1). Distance refers to the number of km from each study area to the western side of the Pyrenees at the Spanish–French frontier. It describes a rough geographical and environmental gradient in which the arrow shows the transition between the northern plateaus and the southern half of Iberia (southern border of the 12°C isotherm in fig. 1). Dehesas are represented by black dots.

Fig. 2. Distribución de la densidad del arbolado y de la riqueza de aves forestales en algunos bosques ibéricos. Estos patrones han sido obtenidos registrando la densidad media del arbolado (número medio de troncos de más de 20 cm de diámetro por ha) y el número total de especies de pájaros en los bosques estudiados (puntos blancos en fig. 1). La distancia se refiere al número de km desde cada bosque a la frontera franco–española. Describe un gradiente geográfico y ambiental en el que la flecha marca el límite meridional de la meseta norte (borde sur de la isoterma de los 12°C en la fig. 1). Las dehesas están representadas por puntos negros.

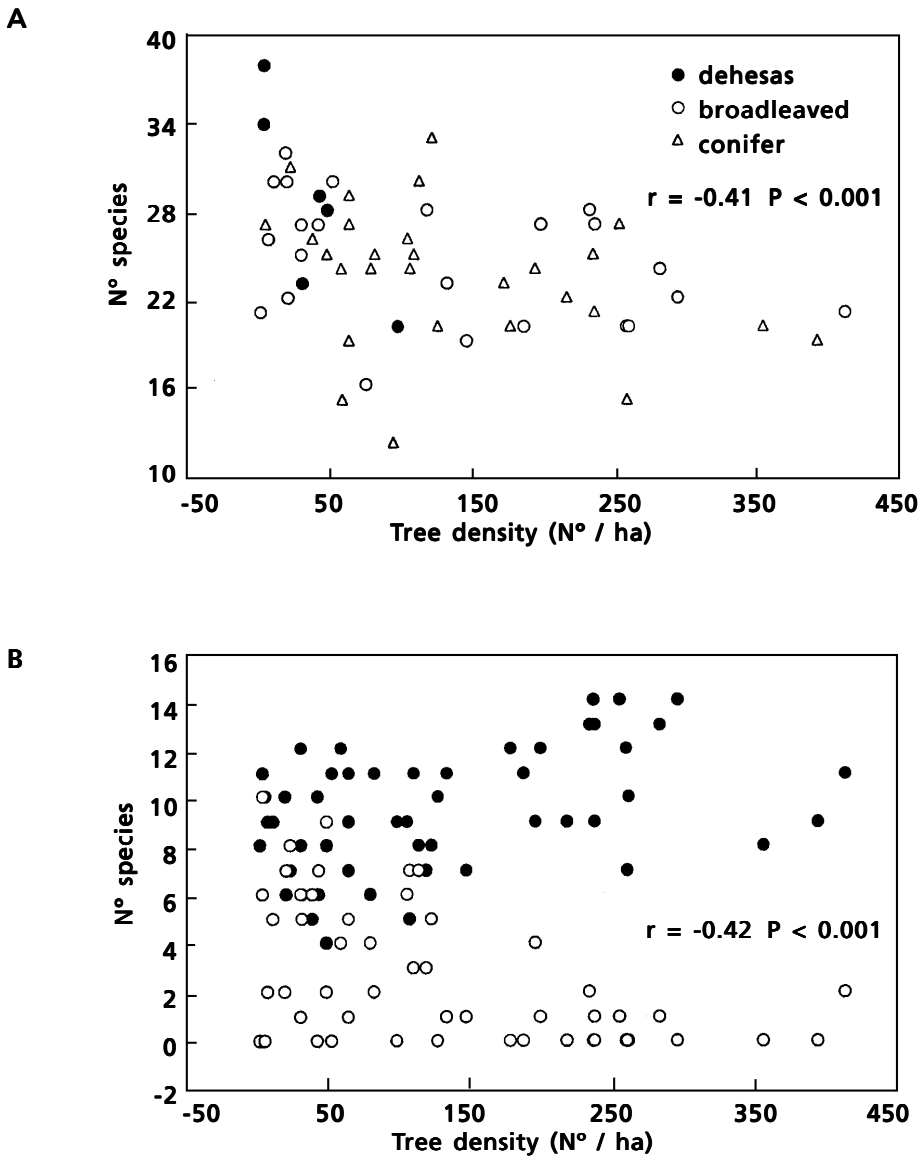

Fig. 3. Effects of tree density on bird richness of Iberian woodlands. A. Relationship between tree density and the total richness of passerines. B. Relationship between tree density and the richness of arboreal and border passerines (black and white dots respectively). Arboreal species are those that feed and nest in trees (e.g. tits *Parus*, treecreepers *Certhia*, nuthatches *Sitta*, etc.) while border species are those which usually breed in open habitats or woodlands with very scarce tree cover (larks *Galerida*, waigtails *Mortacilla*, wheathears *Oenanthe*, stonechats *Saxicola*, some *Sylvia* warblers, shrikes *Lanius*, buntings *Miliaria*, etc.).

Fig. 3. Efectos de la densidad del arbolado sobre la riqueza de pájaros en los bosques ibéricos. A. Relación entre la densidad de árboles y la riqueza total de pájaros. B. Relación entre la densidad de árboles y la riqueza de pájaros arborícolas y ecotónicos (puntos negros y blancos, respectivamente). Las especies arborícolas son aquellas que crían y se alimentan en el arbolado (carboneros Parus *spp., agateadores* Certhia*, trepadores* Sitta*, etc.) mientras que las ecotónicas son aquellas que crían en medios abiertos o muy aclarados (cogujadas* Galerida*, lavanderas* Motacilla*, collalbas* Oenanthe*, tarabillas* Saxicola*, alcaudones* Lanius*, escribanos* Miliaria*, etc.).*

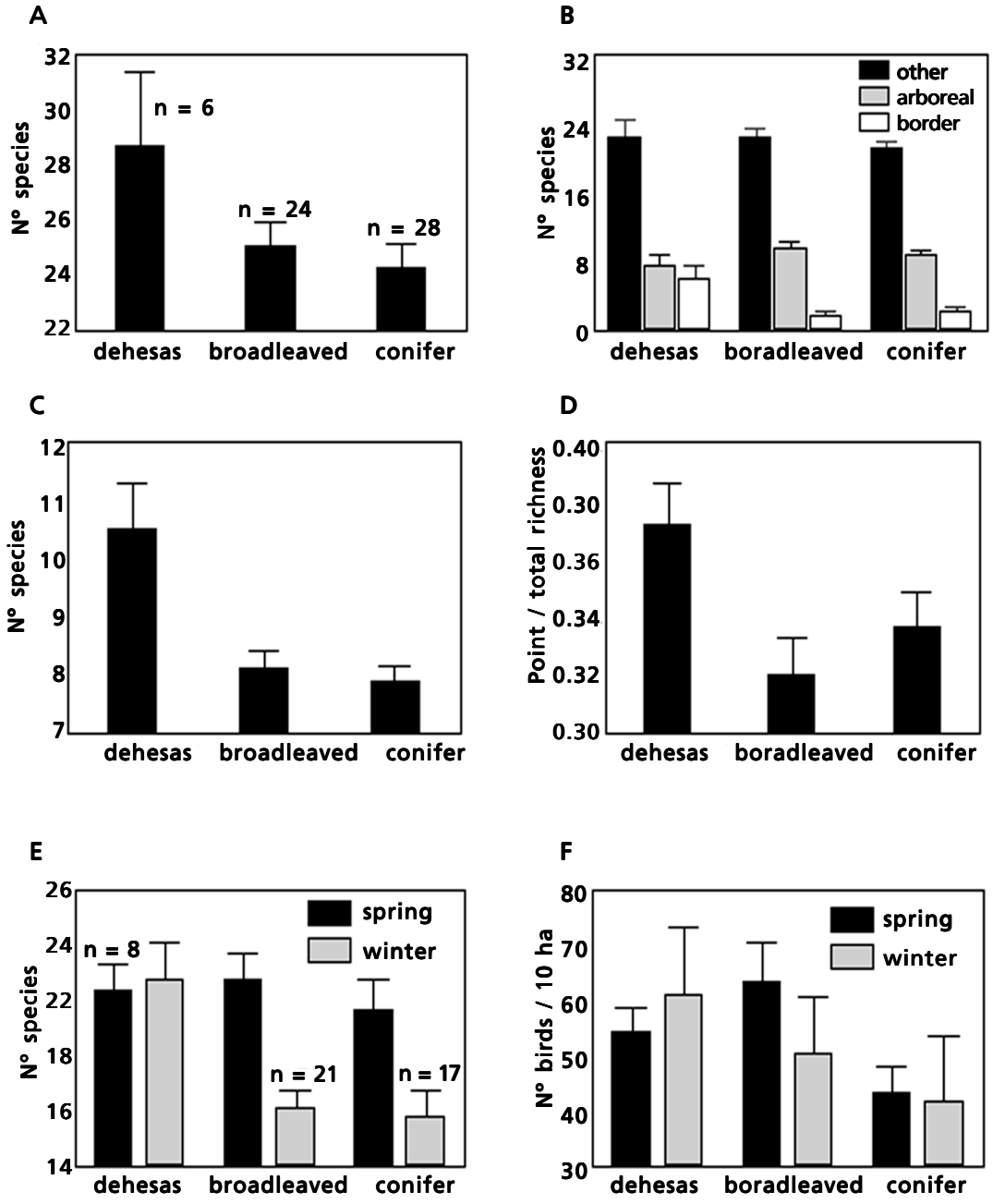

Fig. 4. Structure of forest bird communities in the Iberian peninsula. Patterns of bird richness during the breeding period as reflected by sampling point censuses: A. The mean total richness (± s.e.); B. Mean richness of arboreal and border passerines; C. Mean point richness; D. The relationship between the point and the total richness (an index of the internal turnover of species are represented). Other species in B refer to birds that are neither arboreal nor border passerines (see fig. 2). Seasonal changes of Iberian forest bird communities: E. The mean scores (± s.e.) of the number of species; F. Densities recorded by line transects are shown. Border species were originally excluded from these censuses. Broad–leaved woodlands are mainly composed of oaks (*Quercus*) and conifer woodlands by pines (*Pinus*).

concentrated in the mild Mediterranean peninsulas but, as global warming progressed, they shifted northwards producing the drawback of forest optimum to central Europe (MOREAU, 1954; HUNTLEY, 1993; TABERLET et al., 1998). In the Mediterranean, these changes were coupled with severe human pressure (forest fragmentation, clearings, etc.) since ancient times, reinforcing the effects of summer drought. The structure of mature forests was thus replaced by a predominantly shrubby vegetation or clearings to favour pasture growth. This structural modification changed the original microclimatic conditions favouring the propagation of heliophytic, schlerophyllous or pyrophytic trees, such as the holm oaks (*Quercus ilex*) and cork oaks (*Quercus suber*) of the Iberian dehesas (COSTA et al., 1990). These environmental changes produced a concomitant expansion of Mediterranean birds adapted to xeric conditions and open habitats (e.g. several Mediterranean *Sylvia* warblers) and the retreat to moist habitats or sectors (river banks, rainy mountains, etc.) of birds adapted to more mesic conditions (e.g. *Erithacus rubecula*, *Sylvia atricapilla, Phylloscopus collybita*, *Prunella modularis*, *Sylvia borin*, *Troglodytes troglodytes*, *Turdus philomelos,* etc; see TELLERÍA & SANTOS, 1994; PURROY, 1997 for the Iberian peninsula). This depletion of forest conditions was particularly strong in the southern half of Iberia, warmer and drier than northern mountains and plateaux (FONT, 1983) where woodlands are today composed of central European trees (*Fagus sylvatica, Quercus robur, Pinus sylvestris*) or by trees adapted to Mediterranean mountains (e.g. *Quercus pyrenaica, Juniperus thurifera*; BLANCO et al., 1997). In addition, as many of these northern forests have been managed for wood production, they presently show higher tree development and density (fig. 2). Consequently, forest birds are more abundant and widespread in the north as compared to southern Iberia where several species common to European woodlands are lacking (e.g. *Anthus trivialis, Prunella modularis, Regulus regulus, Sylvia borin, Parus palustris, Turdus philomelos*, etc.; PURROY, 1997; TELLERÍA et al., 1999). However, and despite this contrasting suitability of northern and southern Iberia for forest avifauna, the study showed that total bird richness in woodlands increased southwards along the Iberian gradient with dehesas showing the highest scores (figs. 2, 4). These noteworthy results can be explained, however, as an outcome of the particular structure of dehesas.

Table 1. Results of ANOVA planned comparisons testing for differences between "dehesas" and other woodlands (broadleaved and conifer) in the community traits described in figure 4 (contrast vector: dehesas -2, broadleaved 1, conifer 1).

Tabla 1. Resultados de las comparaciones con ANOVA para analizar las diferencias entre dehesas y otros bosques (de hoja ancha y coníferas) en los rasgos de la comunidad descritos en la figura 4 (vectores de contraste: dehesas –2, hoja ancha 1, coníferas 1).

	d.f.	*F*	*P*
Total richness	1,55	3.77	0.057
Arboreal species	1,55	2.07	0.156
Border species	1,55	6.85	0.011
Other species	1,55	0.14	0.708
Point richness	1,55	11.33	0.001
Point / total richness	1,55	2.93	0.093
Spring density	1,43	0.45	0.504
Winter density	1,43	3.07	0.087
Spring richness	1,43	0.09	0.761
Winter richness	1,43	10.16	0.003

*Fig. 4. Estructura de las comunidades de aves de los bosques ibéricos. Patrones de riqueza de pájaros durante el periodo reproductor reflejados por las estaciones de censo: A. Riqueza total media (± error estándar); B. Riqueza media de especies arborícolas y ecotónicas; C. Riqueza puntual media; D. Media de la relación entre la riqueza puntual y la riqueza total de cada comunidad (un índice del recambio interno de especies). Otras especies en B se refiere a las que no son ni arborícolas ni ecotónicas según los criterios explicados en la fig. 2. Cambios estacionales de las comunidades de aves forestales: E. Valores medios (± error estándar) del número de especies; F. Densidades registradas mediante taxiados. Las especies ecotónicas han sido eliminadas por no haber sido incluídas en muchos de los estudios revisados. Los bosques caducifolios están principalmente compuestos de robles y encinas (*Quercus*) y los de coníferas, de pinos (*Pinus*).*

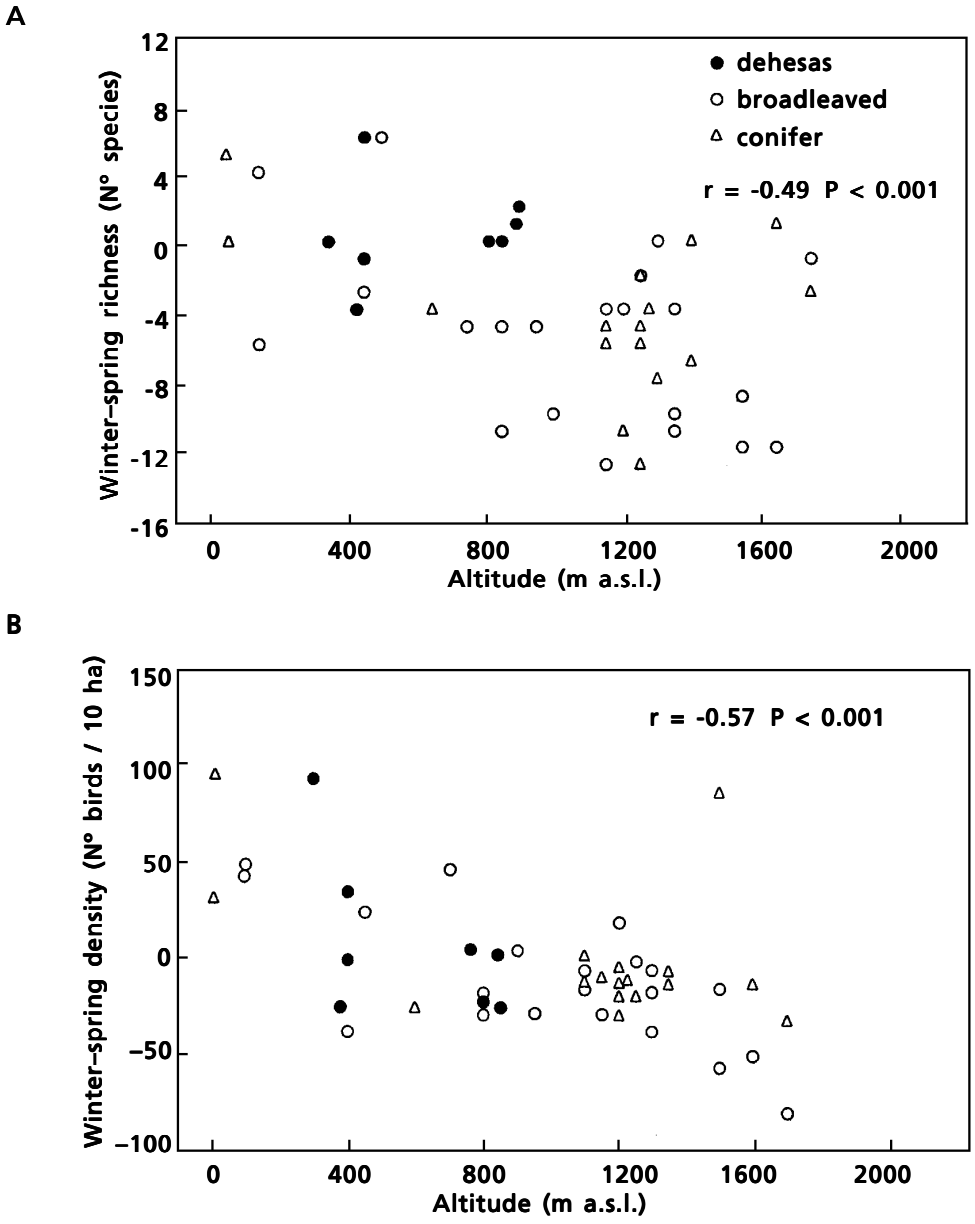

Fig. 5. Relationship between altitude and the seasonal change of Iberian forest bird communities as determined by subtracting spring scores from winter scores: A. Richness; B. Densities. Declined in winter as altitude increased (data from line transects in fig. 1).

Fig. 5. Relación entre la altitud y la evolución estacional de las comunidades de pájaros forestales caracterizada por la resta de los valores invernales a los primaverales: A. Riqueza; B. Densidad. Disminuyen en invierno al aumentar la altitud (datos de los transectos en la fig. 1).

Breeding bird communities of Iberian dehesas: the role of habitat structure

In addition to the effects of the regional pool of species, the structure of bird communities is determined by processes operating at local scales, such as the floristic and physiognomic structure of habitats (WIENS, 1989). As a rule, "the greater the habitat variety, the greater the species diversity" (ROSENZWEIG, 1995). Consequently, bird communities finally result from a balance between the available regional pool of species and the

local structure of habitats. The observed high total species richness of the dehesas is an unexpected result (see above) that can be explained because, despite their decreasing tree density and diversity and the concomitant reduction of some arboreal birds (fig. 4), their open physiognomy favours the presence of many birds from open and border habitats (fig. 3). The dehesas can therefore be viewed as an ecotonic habitat where a mixture of forest and non-forest passerines occurs (figs. 3, 4; see also DÍAZ et al., 2002). This may explain why despite the strong role of climate (e.g. rainfall), floristic composition (conifer vs. broadleaved woodlands) and geographical location (distance to northern core areas for many forest birds) on the distribution of individual forest passerines (TELLERÍA & SANTOS, 1994), forest physiognomy (tree density) has been described as the main correlate of woodland bird diversity in the Iberian Peninsula (TELLERÍA et al., 1992).

An additional, distinctive feature of dehesas is the high point richness (internal alpha diversity) and the low intra–habitat turnover of species (internal beta diversity) as reflected by the elevated percentage of the total bird richness observed in each sampling point (fig. 4; table 1). This feature can be related to the diverse structure of each sampling point, where grasslands and scattered oaks occur, and the strong spatial constancy of this physiognomy across a habitat where internal patchiness has been eliminated to produce a homogeneous cover of trees and grasses (BLONDEL & ARONSON, 1999). As management of dehesas decreases and bushes occupy the understorey, an internal turnover of species occurs in which birds from open habitats retreat (larks *Galerida*, *Lullula*, starlings *Sturnus*, sparrows *Passer, Petronia,* and some finches *Carduelis* and buntings *Emberiza*) while other birds from shrubby habitats expand (e.g. Mediterranean *Sylvia* warblers; PULIDO & DÍAZ, 1992). Unfortunately, unmanaged dehesas do not recover the floristic diversity of former Mediterranean forests and shrublands given that are usually colonised by oak ramets and gum cistus (*Cistus ladanifer*). It has been suggested that this lack of a diverse cohort of trees and shrubs typical of more undisturbed Mediterranean woodlands (other *Quercus* spp, *Olea, Pistacia, Phyllirea, Rhamnus,*... BLANCO et al., 1997), together the low tree density that could impair the ability of some arboreal birds to feed (PULIDO & DÍAZ, 1997), strongly affect the ability of this habitat to maintain some forest passerines common to European forests. Some of these birds (e.g. robins *Erithacus rubecula*, blackcaps *Sylvia atricapilla*) have sedentary populations in some undisturbed forests of Southern Iberia which show biological and morphological differences with their migratory counterparts (TELLERÍA & CARBONELL, 1999; PÉREZ–TRIS et al., 2000; TELLERÍA et al., 2001). These endemic populations, scarcer than the migratory ones, may become extremely scarce in areas covered by these extensive wooded pastures (PURROY, 1997).

Table 2. Results of ANCOVA planned comparisons testing for differences between dehesas and other woodlands (broadleaved and conifer) in the seasonal changes of density and richness observed in fig. 6 (effect: habitat; contrast vector: dehesas -2, broadleaved 1, conifer 1; covariate: altitude).

Tabla 2. Resultados de las comparaciones con ANCOVA para evaluar las diferencias entre dehesas y otros bosques (de hoja ancha y coníferas) en los cambios estacionales de densidad y riqueza observada en la figura 6 (efecto: hábitat; vector de contraste: dehesas –2, hoja ancha 1; coníferas 1; covariante: altitud).

		d.f.	*F*	*P*
Density				
	Habitat	1,42	0.49	0.489
	Altitude	1,42	20.21	<0.001
Richness				
	Habitat	1,42	9.13	0.004
	Altitude	1,42	10.71	0.002

Seasonal changes of bird communities

Migratory behaviour is a dynamic response of birds to environmental opportunities so that many populations and species track seasonal productive outputs moving across environmental gradients. Latitudinal trends in productivity are considered responsible for latitudinal migrations, while changing productivity with elevation also shapes similar selective pressures on birds inhabiting at middle and low latitudes (ALERSTAM, 1990). The contrasting climatic patterns between northern Iberian highlands and southern lowlands are strongly related to seasonal changes in abundance and distribution of some forest passerines (TELLERÍA et al., 1999, 2001). While mountains and plateaux of northern Iberia are better for breeding because of their productive spring output, the southern half is a more suitable region for wintering. In addition to mild temperatures, the arrival of autumn rains in these southern lowlands produces a concomitant sprouting of primary productivity and the ripening of fruit on many shrubs and trees which

local and migratory birds rely on (HERRERA, 1984; FUENTES, 1992). Because of these environmental conditions, south–western Iberia is one of the best wintering grounds for European migratory birds (TELLERÍA, 1988).

The dehesas seem a suitable place for wintering given that bird communities in this habitat maintain density and richness at the spring levels (fig. 4). This pattern can be related, however, to the location of dehesas at the south–western quarter of the Iberian peninsula and not to any particular ability to lodge large numbers of wintering passerines. After controlling for the effects of altitude —a surrogate of winter hardness— on the seasonal changes of Iberian bird communities, dehesas continued to have higher richness than other habitats but did not show any particular ability to maintain densities of wintering birds if compared to other woodlands located at the same altitudinal levels (fig. 5; table 2). This lack of seasonal differences can be related to the relatively low degree of seasonality in food supply to paserines (HERRERA, 1978a). It can be suggested that the lack of fruit–bearing shrubs in dehesas (e.g. *Olea, Pistacia, Phyllirea, Rhamnus*) as the result of bush removal may prevent the occupation of this habitat by the huge number of frugivorous passerines that winter in adequate forests and shrublands of the Mediterranean region (e.g. thrushes *Turdus*, blackcaps *Sylvia* atricapilla, robins *Erithacus rubecula*; HERRERA, 1998).

Conclusions

A first conclusion resulting from this review concerns the high number of bird species recorded in the Iberian dehesas despite their location at a considerable distance from the core area of European forest birds. This feature results from the particular physiognomy of dehesas, where border and open–habitat bird species compensate for the loss of forest birds. As this increased richness has been described by comparing dehesas with a large sample of Iberian woodlands, and woodlands usually show the highest richness scores of land bird communities (WIENS, 1989), it can be presumed that dehesas preserve one of the most diverse bird assemblages of Iberian habitats. It is interesting to point out that this increased richness, as well as the observed high point richness (another distinctive feature of this habitat), has been recorded in other organisms. Dehesa pastures, for instance, may possess 120–180 plant species, and some grass plots hold one of the highest plant diversities ever measured (DÍAZ–PINEDA et al., 1981; FERNÁNDEZ–ALÉS et al., 1993). These features, which enlarge the conservation value of dehesas (see Introduction), are the result of the traditional management of this habitat. From here it follows that misuse of these wooded grasslands (e.g. overgrazing, scrub invasion, degradation of tree cover, etc.) may lead to the depletion of these biodiversity resources (DÍAZ & PULIDO, 1995; BEAUFOY, 1998). A second conclusion refers to some evident shortcomings related to the open physiognomy of dehesas. A lack of developed tree and shrub covers have relegated some forest birds to remnants of Mediterranean forests so that the preservation of these patches inside the wooded matrix of dehesas benefits these birds in this extensive agro–ecosystem. Finally, it should be emphasised that the seasonal changes of bird abundance on dehesas are quite similar to those observed in other woodlands of the Iberian peninsula, a region where climatic harshness (and its productive correlates) strongly affects the seasonal distribution of birds. This feature contrasts with the spectacular numbers of woodpigeons (millions) and cranes (many thousands) which winter in dehesas (PURROY, 1988; ALONSO & ALONSO, 1990) relying on acorns and grasses (the two main resources produced by this farming system).

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