

POPULATION INCREASE AND HABITAT USE
OF THE MIDDLE SPOTTED WOODPECKER
DENDROCOPOS MEDIUS IN THE ARAN VALLEY,
SPANISH PYRENEES

INCREMENTO POBLACIONAL Y HÁBITAT DEL PICO MEDIANO
DENDROCOPOS MEDIUS EN EL VALLE DE ARÁN,
PIRINEOS ESPAÑOLES

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SUMMARY.—The middle spotted woodpecker *Dendrocopos medius* is a scarce species in northern Spain and is listed as endangered in Catalonia. We show a marked increase over a 24-year period in a population of the middle spotted woodpecker in the Aran Valley in the eastern Pyrenees in Catalonia. The population increased from two pairs in 1990 to 27 pairs in 2010, expanding south and east into two arms of the valley. The estimated breeding density in 2010 was 0.22 pairs/10 ha. Out of 26 surveyed forests, 54% were occupied by the woodpecker. There was no difference in occupancy rates between small, medium-sized or large forest areas. Breeding territories in mixed-deciduous forest were characterised by the presence of large-diameter pedunculate oaks *Quercus robur*. We conclude that the middle spotted woodpecker is expanding its range in the Pyrenees, probably due to an increasing presence of mature oak forests. The as-yet-small population size of the middle spotted woodpecker in northeastern Spain, combined with its relatively low density, suggests that forest protection measures should remain in place for this regionally vulnerable species.

Key words: habitat use, mixed deciduous forests, population density, population size.

RESUMEN.—El pico mediano *Dendrocopos medius* es una especie escasa clasificada “en peligro” en Cataluña. En este trabajo presentamos evidencia de un marcado incremento en una población de esta especie durante un periodo de 24 años en el Valle de Arán, en los Pirineos orientales, en Cataluña. La población aumentó de 2 parejas en 1990 a 27 parejas en 2010, expandiéndose hacia el sur y el este en dos brazos del valle. La densidad de cría en 2010 fue 0,22 parejas/10 ha. De los 26 bosques inventariados, el 54% estaban ocupados por el carpintero. No hubo diferencia en las tasas de ocupación en

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áreas de bosque de tamaño pequeño, mediano o grande. Los territorios de cría en bosques mixtos caducifolios se caracterizaron por la presencia de robles carvallos *Quercus robur* de gran diámetro. El pico mediano está expandiendo su distribución en los Pirineos, probablemente debido a una creciente presencia de bosques maduros de roble. El tamaño aún pequeño de la población de pico mediano en el noreste de España combinado con una densidad relativamente baja desaconseja relajar las medidas de conservación para esta especie regionalmente vulnerable.

Palabras clave: bosques mixtos caducifolios, densidad de población, tamaño poblacional, uso del hábitat.

INTRODUCTION

The middle spotted woodpecker (MSW) *Dendrocopos medius* is a medium-sized woodpecker breeding across the Western Palearctic, from the Zagros Mountains (Iran) in the east to the Cantabrian Mountains (Spain) in the west, and from Latvia in the north to southeastern Turkey (Winkler and Christie, 2002; Pasinelli, 2003). Europe holds more than 75% of the world population (Onrubia *et al.*, 2003). The Spanish population is fragmented into five subpopulations, mainly occupying the oak forests of the northern third of the Iberian Peninsula (Purroy *et al.*, 1984; Romero, 1990). The Spanish population is estimated at 1,045-1,205 breeding pairs (Onrubia *et al.*, 2003).

In Catalonia, the single known population today is confined to the Aran Valley in the province of Lérida, forming the easternmost population in the Pyrenees (Romero, 1990). However, the past Pyrenean distribution is thought to have been broader (Grangé *et al.*, 2004; Salas *et al.*, 2005). In Catalonia the MSW has recently been catalogued as an endangered species (Romero *et al.*, 2004), due to its reduced distribution, threats from possible habitat modification and low population density.

Onrubia *et al.* (2003, 2004) identified the Iberian Pyrenean population as consisting of several small subpopulations (less than ten pairs each) and noted that, according to recent surveys, those fragmented populations

had either disappeared or suffered a marked decline. Robles and Olea (2003) outlined that the lack of information regarding the distribution, size and population trend of the MSW hampers recommendations for habitat management. We present the results of surveys over a 24-year period in a valley in the eastern Pyrenees, showing a marked increase in a population of the MSW. We also examine the composition and structure of the forest habitat used by the MSW.

STUDY AREA, MATERIAL AND METHODS

The study area comprised the lower part of the Aran Valley (Lérida, Spain) on the north slope of the Pyrenees (42° 35' - 42° 52' N, 0° 38' - 1° 02' W) (fig. 1). The study area has a surface of *c.* 200 km² and is at elevations between 600 and 1600 m. For surveys we selected 26 forest areas that were thought to be probably suitable for the MSW on the basis of unpublished observations of this species and the habitat requirements described for the woodpecker (Pettersson, 1985; Pasinelli, 2000; Robles and Olea, 2003). The MSW throughout its distribution range is largely associated with mature oak forests (Pettersson, 1985; Pasinelli, 2000; Robles and Olea, 2003). Consequently, we did not consider mixed coniferous forests and young mixed deciduous patches as potential habitat in spring (Robles and Olea, 2003; pers. obs.). Among the mixed oak

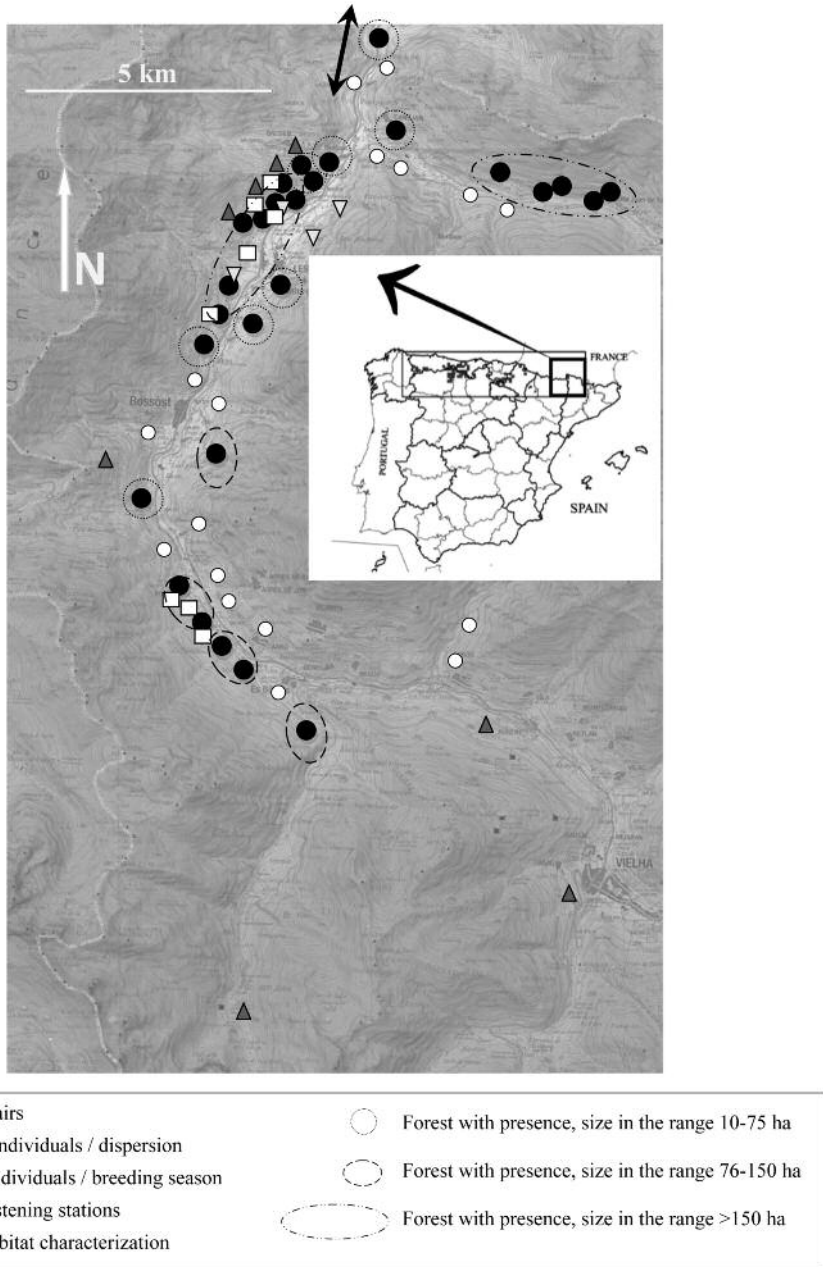


FIG. 1.—Distribution of the middle spotted woodpecker *Dendrocopos medius* in 2010 in Aran Valley (Lérida province, NE Spain). A potential path of interchange with the French population is indicated by a black double arrow.

[Distribución del pico mediano *Dendrocopos medius* en 2010 en el Valle de Arán (provincia de Lérida, NE España). Se indica con una flecha doble negra la vía potencial de intercambio de individuos con la población francesa.]

forest associations that dominate the valley bottom, we surveyed during spring those that included trees with a diameter at breast height (dbh) > 25 cm (Robles and Olea, 2003). One transect was surveyed on foot in each of the 26 forests. Between two and 10 listening stations were assigned along transects of 200-2,000 m length, depending on the size of the forest patch. Transects were surveyed in the first two hours after sunrise. Playback was used to stimulate the response of the woodpeckers (Purroy *et al.*, 1984; Resources Inventory Committee, 1998; Robles

and Olea, 2003; Kosinski *et al.*, 2004), but only from February until the first half of April, when the woodpeckers start to excavate nests. We played the “rattle-call”, rendered “tshick tscheck...” (Pasinelli, 2003) from our own recordings from the Aran Valley. We spent 15-25 minutes at each listening station. Playback and listening were alternated, with emitted playbacks of *c.* 15 seconds and listening periods of 10 minutes.

The field study was performed between 1986 and 2010, although on average the surveys were complete only once every two

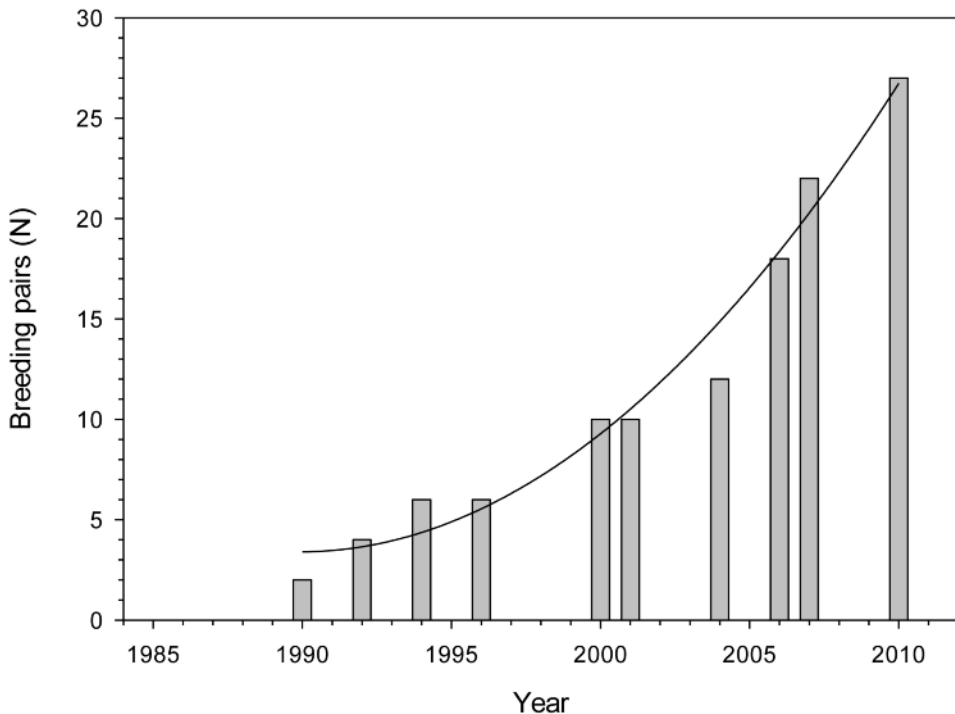


FIG. 2.—Number of breeding pairs of the middle spotted woodpecker *Dendrocopos medius* during the study period in the Aran Valley (Lérida province, NE Spain). The surveyed area was 1,520 ha, except during 1984-1990, when only *c.* 1,000 ha were surveyed. Regression: $y = 228983,862 - 230,141100x + 0,057826906x^2$ ($R^2 = 0,97$, $P < 0,001$).

[Número de parejas reproductoras de pico mediano *Dendrocopos medius* durante el periodo de estudio en el Valle de Arán (provincia de Lérida, NE España). El área prospectada fue de 1.520 ha, excepto en el periodo 1984-1990, cuando sólo se prospectaron aproximadamente 1.000 ha. Regresión: $y = 228983,862 - 230,141100x + 0,057826906x^2$, $R^2 = 0,97$, $P < 0,001$.]

years (fig. 2). The surveys were divided into three periods: (I) winter: from 21 November until 20 February; (II) spring: from 21 February until early June and (III) autumn: from 1 September until 20 November. The winter and autumn surveys were aimed at determining the dispersion areas and settlement in new territories, whereas the spring surveys aimed to identify the location of breeding pairs. We assumed absence of the species in a forest area after at least three surveys gave negative results (Robles and Olea, 2003; Kosinski *et al.*, 2004).

To confirm the existence of established breeding territories at occupied sites detected from transects, we followed up with ten visits per territory, spread between February and the end of April, corresponding to the period of maximum territorial activity. We considered a territory established when a pair was observed, recent nests were found or a positive response to playback was received on several occasions in periods I and II by both sexes. To calculate density, the total number of pairs in the study area during the breeding period (period II), excluding unpaired individuals, was divided by the total surveyed surface.

In order to describe the local habitat of the MSW, nine circular plots of ten m radius (314 m²) were selected in spring 2007. The plot locations were chosen to represent the range of variation in the composition and the structure of the forest canopy layer. All nine plots had presence of MSW (fig.1). The dbh, height, and species for each tree in the plots were recorded, and the canopy height and basal area were assessed. The number of trees with common ivy *Hedera helix* was also counted, based on the importance of the fruits of this climbing plant as supplementary food for the woodpecker (Arambarri *et al.*, 1997; Pasinelli, 2003; Fombellida *et al.*, 2009).

We calculated the best fitted function for the population trend of the MSW in the study area using Sigma Plot (v11, Systat Software

Inc.). Occupancy rates in forest fragments of different size were tested with a χ^2 test (at <http://www.vassarstats.net>) and detection rates in different forest types were tested with a Fisher Exact Test using R (v2.15.3, The R Foundation for Statistical Computing).

RESULTS

Population size and density estimates

The MSW population in the study area increased markedly from two pairs in 1990 to 27 pairs in 2010 (fig. 2). Sequential distribution maps (figs. 1 and 3) show that the species was first found in 1990 in the northern Aran Valley and from there expanded southwards in this valley. From 2001 onwards it continued to expand southwards into the main valley, and also expanded eastwards into an arm of the valley. The birds detected in 2010 during the breeding period comprised 27 males, 27 females and two of unidentified sex: a total of 56 individuals. The average distance between breeding territories was 1.1 km (range 0.3-3.5 km, n = 27).

Over the study period we detected the MSW in 14 out of the 26 deciduous forests that we surveyed (54%) (table 1). There was no difference in occupancy rates between forest areas that were small (10-75 ha), medium sized (76-150 ha) or large (> 150 ha) (table 1, $\chi^2_2 = 1.84$, P = 0.40). Analysing only the forests with presence of the MSW in spring 2010, we estimated an average density of 0.22 pairs/10 ha (range = 0.1-0.46; n = 14 forests).

Habitat characterisation and use of forest type

The MSW was detected in two types of forested environments during the breeding period (table 2): mixed deciduous forest and

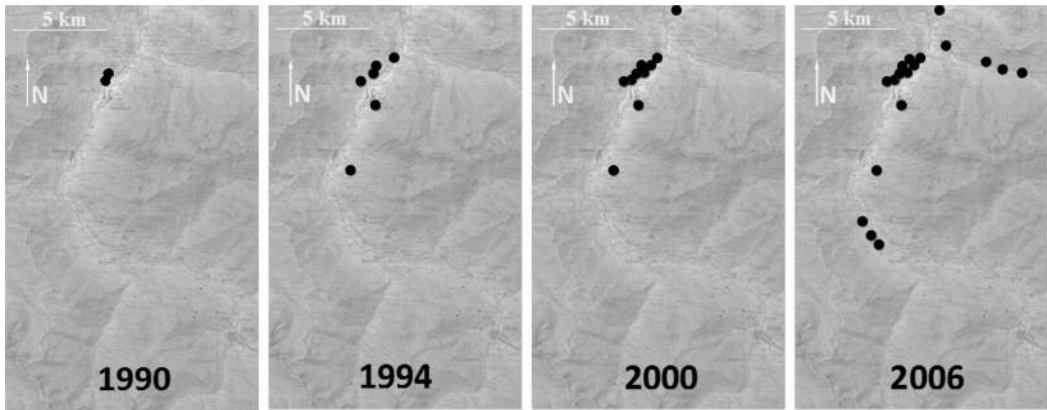


FIG. 3.—Distribution of middle spotted woodpecker *Dendrocopos medius* territories during 1990-2006 in the Aran Valley (Lérida province, NE Spain). The distribution in 2010 is given in figure 1. [Distribución de los territorios de pico mediano *Dendrocopos medius* durante 1990-2006 en el Valle de Arán (provincia de Lérida, NE España). La distribución en 2010 se da en la figura 1.]

sessile oak *Quercus petraea* forest. Outside the breeding season in addition to these two forest types we obtained sporadic contacts in pure beech forest and in mixed evergreen forest dominated by silver fir *Abies alba*, with scattered presence of beeches *Fagus sylvatica*. Although detection rates in several forest types average higher or lower than expected from an even distribution (table 2), these differences were not significant (Fisher Exact Test, $P > 0.09$ for breeding, non-breeding, and combined seasons), suggesting that the probability of recording was related to sampling effort rather than to forest type.

Average values of habitat characteristics for the mixed deciduous forest based on the nine plots in which the species was reported are presented in table 3. The mixed deciduous forest occurs in the lower parts of the valley, at elevations of 600-900 m.a.s.l. In contrast, the sessile oak forest is almost entirely monospecific, locally with a very scarce presence of wild cherry *Prunus avium*, beech or field maple *Acer campestre*. It has a lesser extent and is located at higher altitude (950-1,200 m) than the mixed de-

ciduous forest, and occurs just below the mixed coniferous and beech forests, at times interspersed by alpine meadows, depending on exposure.

In altitude, the 2010 range covers montane forests between 600-1,200 m.a.s.l. The mean altitude of the known breeding territories was 864 ± 139 m ($n = 27$). Twenty-four breeding pairs out of 27 (89%) had territories on east-facing slopes, whereas three pairs used west-facing slopes (11%) (fig. 1).

DISCUSSION

Population size trend, expansion and dispersion

We found a strong population increase of the MSW in the Aran Valley during 1990-2010 in combination with a range expansion into the southern and eastern arms of the valley. The source population for Aran Valley expansion is probably France, where at least ten adjacent territories with breeding pairs exist (pers. obs.), and those in turn, are con-

TABLE 1

The number of forest areas surveyed for presence of the middle spotted woodpecker (MSW) *Dendrocopos medius* and number of forests with presence, grouped into three forest-size categories. The total surveyed area was c. 1,520 ha.

[Número de áreas forestales prospectadas para el censo de presencia de pico mediano (MSW) *Dendrocopos medius* y número de bosques con presencia, agrupados en tres categorías según el tamaño del bosque. El área total prospectada fue de aproximadamente 1.520 ha.]

| Forest size | No. of forests surveyed | Forests with MSW presence |
|--------------|-------------------------|---------------------------|
| 10-75 ha | 19 | 8 |
| 76-150 ha | 5 | 4 |
| > 150 ha | 2 | 2 |
| Total | 26 | 14 |

nected with small populations towards the west, on the Pyrenean north face in the departments of Ariège and Haute-Garonne (Auria and André, 2003; Grangé *et al.*, 2004). The MSW is not known to occur in adjacent valleys in Spain and we consider an expansion from a Spanish source population unlikely. Further expansion south from the Aran Valley will probably be blocked by a barrier of alpine mountains with summits around 3,000 m.a.s.l. and a mountain pass at c. 2,000 m.a.s.l. to the south of the valley.

The range expansion of the MSW in the Aran Valley may be mainly due to the maturation of forests in recent decades as a result of protection from logging, improving conditions for the MSW that have resulted in population growth. Also, tree diseases and insect outbreaks in chestnut *Castanea sativa* and birch *Betula pendula* in the valley during the 1990s may have increased food availabili-

TABLE 2

The number of listening stations and mean number of positive contacts for each forest type surveyed in the census of the middle spotted woodpecker *Dendrocopos medius* in the Aran Valley during autumn/winter 2006 and spring 2007. In spring up to six repeat counts at listening stations were made and averaged. During autumn and winter one count per point was made.

[Número de estaciones de escucha y número promedio de contactos positivos para cada tipo de bosque prospectado en el censo del pico mediano *Dendrocopos medius* en el Valle de Arán durante otoño-invierno de 2006 y primavera de 2007. En primavera se realizaron y promediaron hasta seis recuentos repetidos por estación de escucha. Durante otoño e invierno se realizó un único recuento por estación.]

| Forest type | No. of listening stations | | Mean no. of positive contacts | |
|---|---------------------------|---------------------|-------------------------------|---------------------|
| | breeding period | non-breeding period | breeding period | non-breeding period |
| Mixed deciduous forest | 68 | 4 | 14.5 | 4 |
| Evergreen mixed forest | 22 | 1 | 0 | 1 |
| Sessile oak <i>Quercus petraea</i> forest | 5 | 5 | 0.5 | 1 |
| Beech <i>Fagus sylvatica</i> forest | 6 | 6 | 0 | 1 |
| Riparian forest | 4 | 4 | 0 | 0 |
| Total | 105 | 20 | 15 | 7 |

ty for the MSW, again resulting in population growth, as has been observed in other regions (Dejaegere, 1993; Dejaegere and Vandevenne, 1993; pers. obs.). The deciduous forest cover in the Aran Valley increased by 38% between 1992 and 2002 (DMAH, 2002). As these expanded forests mature, the local MSW population may increase further. The as-yet-small population size of the MSW in Catalonia, combined with its relatively low density, mean that current habitat protection measures should remain in place for this regionally vulnerable species.

The expansion of the MSW in the Aran Valley is a recent phenomenon that stands in contrast to the assessment a decade earlier by Onrubia *et al.* (2003, 2004) of the Spanish Pyrenean population as consisting of small, declining, fragmented subpopulations. MSW expansion has been observed recently also in the Irati Forest (Navarra, Spain), where in previous decades the species was not known to exist but where a pair was observed during 2011 and 2012 in pure beech forest (own data). The MSW has expanded its range in other regions of Europe, for instance in Belgium (Pasinelli, 2003) and The Netherlands (van Dijk *et al.*, 2010). In Flanders (Belgium), the MSW started to breed in 1998, with two known breeding pairs in 1999, 15 in 2003, and 50 pairs in 2005 (Vandekerkhove *et al.*, 2011). This recolonisation was related to the reappearance of old growth elements in lowland woodlands in northern Belgium (Vandekerkhove *et al.*, 2011), and the recent population growth trend there is similar to that found in the Aran Valley.

Density

Overall, 54% of the sampled forests were occupied by territorial individuals of the MSW (table 1). This pattern is in agreement with that observed in other studies, where not all of the available forest had a presence of the MSW (Robles and Olea, 2003). Our den-

sity estimates (average value 0.22 pairs/10 ha) are similar to those estimated in forests of the Cantabrian Mountains (Purroy *et al.*, 1984; Robles and Olea, 2003), but lower than those found in the forests of Izki (province of Álava) and in León (Arambarri and Rodríguez, 1996; Fombellida, 1999; García-Fernández *et al.*, 2002; Fombellida *et al.*, 2009). Some of these studies may have overestimated densities because of the census technique that was used (see discussion in Robles and Olea, 2003). For the Aran Valley also, density estimates partly obtained through extrapolation have been recently published: 0.36-0.68 territories/10 ha, corresponding to a population size of 50-104 individuals (Anton, 2009; Domínguez, 2010). We believe these are overestimates, because the censuses did not cover the deciduous forests completely and an extrapolation was applied to estimate the total population size. Our estimates are based on a repeated, complete census of a standardised survey area in forests with a high probability of MSW occurrence.

The average density estimated in our study is within the overall range reported in the global distribution of the MSW, i.e. 0.01-3.9 pairs/10 ha (Pasinelli, 2003). However, the densities presented in our study are lower than those reported for the centre and north of the Palearctic distribution of the MSW: 0.52 pairs/10 ha in Switzerland (Müller, 1982); 0.50 pairs/10 ha in Sweden (Pettersson, 1985); and 0.73-0.75 pairs/10 ha in Russia (Kossenko and Kaygorodova, 2007). These differences may be related to the differences in the structure and type of forest. The relatively low height of the trees in our study area limits the surface of rough bark available for foraging.

Our finding of no difference in occupancy by the MSW between small, medium-sized or large forest areas may seem counterintuitive, as small fragments can be expected to be less frequently occupied due to edge effects and rapid local extinctions in small patches

TABLE 3

The main characteristics of the mixed deciduous forest habitat occupied by the middle spotted woodpecker *Dendrocopos medius*: distribution of diameter classes per tree species (pedunculate oak *Quercus robur*, small-leaved lime *Tilia cordata*, European ash *Fraxinus excelsior*, beech *Fagus sylvatica* and silver birch *Betula pendula*); trees with ivy *Hedera helix*, tree heights, height above sea level. "Other tree species" include wild cherry *Prunus avium*, field maple *Acer campestre* and holly *Ilex aquifolium*. [Características principales del hábitat en bosques mixtos caducifolios ocupados por el pico mediano *Dendrocopos medius*: distribución de clases diametrales por especie arbórea (roble carvallo *Quercus robur*, tilo *Tilia cordata*, fresno *Fraxinus excelsior*, haya *Fagus sylvatica* y abedul *Betula pendula*); árboles con hiedra *Hedera helix*, alturas de árbol, altura sobre el nivel del mar. "Otras especies" incluye cerezo *Prunus avium*, arce *Acer campestre* y acebo *Ilex aquifolium*.]

| Mean tree density mean (N trees / ha) | | | | | | |
|---------------------------------------|-----------------|-------------------------|--------------|-----------------------|--------------|--------|
| Diameter (cm) | Pedunculate oak | Small-leaved lime | European ash | Beech | Silver birch | Others |
| 5-25 | 96.4 | 241.2 | 105.0 | 22.4 | 5.6 | 90.4 |
| 25-45 | 247.0 | 56.2 | 38.1 | 24.4 | 2.8 | 28.1 |
| 45-65 | 118.0 | 5.6 | 2.8 | 2.8 | 2.8 | |
| 65-85 | 16.1 | | | | | |
| 85-105 | 7.1 | | | | | |
| 105-125 | 10.7 | | | | | |
| Tree density (ind/ha) | | Trees with ivy (ind/ha) | | Tree height (m) | | |
| Mean 935 | | Mean 229 | | 4-7 (19.6 % n = 71) | | |
| Min. 300 | | Min. 32 | | 7-11 (17.1% n = 62) | | |
| Max. 2323 | | Max. 382 | | > 11 (63.3 % n = 229) | | |

(Villard *et al.*, 1999). However, the forest areas we studied are separated by only 1-3 km, allowing for movements and dispersal between fragments.

Habitat characterisation

The class distribution of the diameter at breast height (dbh) of trees in our plots show that *Tilia* and *Fraxinus* are found in two phases, young and adult, where small diameter classes dominate. In contrast, in *Quercus* young trees are present but the large-diameter classes predominate (table 3). The

presence of oaks with dbh up to 115-125 cm, corresponding to an age of 80-120 years, are characteristic of quality habitat for the MSW (Pettersson, 1985; Pasinelli, 2003; Kosinski and Winiecki, 2004).

The mixed deciduous forest characteristics of the study area are unique among the MSW breeding habitats in Spain. Elsewhere in the country, breeding MSWs occupy Pyrenean oak *Quercus pyrenaica* forests, where oaks predominate to a greater extent (Arambarri, *et al.*, 1997; Onrubia *et al.*, 2003; Robles *et al.*, 2007). The habitat in our study area is reminiscent of European mainland forests with its presence of oak, ash, beech and lime.

The MSW breeds in a rather broad altitudinal range in Spain, between 380-1600 m.a.s.l. Elevations of the MSW breeding territories in our study area at 600-1200 m are higher than those reported for central and east Europe, where the woodpecker prefers lowland breeding sites at 200-400 (-600) m (Pasinelli, 2003). Rather than an altitude preference, this trend may be because the favoured oaks occur at progressively higher altitudes towards the south of their ranges.

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