

# The Middle-spotted Woodpecker *Leiopicus medius* in the Basque Country, Northern Spain: review of current ecological status

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**Abstract** Despite previous inventories and atlas of the avifauna in the Basque Country, Northern Spain, the dense population of the Middle-spotted Woodpecker *Leiopicus medius* in the Izki forest was not discovered until the 1990's. This population mainly occupies a 3,700 ha *Quercus pyrenaica* forest, showing an average density of 0.89 territories/10 ha. The occurrence and abundance of territories is positively associated to the density of large caducifolious *Quercus* trees (>35 cm diameter). While nesting trees are apparently easily available, large trees for foraging could be a more limiting resource, given the historical exploitation regime of the forest. There are several other massifs in the region with smaller populations, but the functional connectivity, demographic and dispersal dynamics relating the core Izki and the peripheral areas have not been investigated. The conservation relevance of the Izki population in the Spanish context is high and given the need to understand the effects of forest management, future research should include spatial ecology, breeding performance as well as population monitoring.

Keywords: Picidae, *Quercus pyrenaica*, forest, Iberian Peninsula, conservation

**Összefoglalás** A korábbi madárfaunisztikai felmérések és a Baszkföldről (Észak-Spanyolország) készült madártani atlasz ellenére csupán az 1990-es években írták le az Izki-i erdőben található, népes közep fakopáncs (*Leiopicus medius*) populációt. Ez a populáció egy 3700 hektáros, főleg pireneusi tölgyekből (*Quercus pyrenaica*) álló erdőben található, 0,89 territórium/ha sűrűséggel. A territóriumok megoszlása pozitív összefüggést mutat a vastag törzsű, lombhullató tölgyek (>35 cm átmérő) jelenlétével. Míg a fészkelésre alkalmas fák könnyen elérhetőek, addig a táplálkozásra szolgáló vastagabbak limitáló forrást jelenthetnek a sokéves erdőgazdálkodásnak tulajdoníthatóan. A térségben számos kisebb költőállomány is megtalálható, azonban az Izki-i populációval fennálló kapcsolatokat, demográfiai és terjedési dinamikájukat még nem vizsgálták. Az Izki-i populáció természetvédelmi jelentősége igen magas, és szükségessé teszi az erdőgazdálkodás hatásának feltérképezését. A jövőbeli kutatásoknak egyaránt tartalmaznia kell a faj ökológiájának, költésbiológiájának és populációdinamikájának felmérését.

Kulcsszavak: Picidae, pireneusi tölgy, erdőgazdálkodás, Ibériai-félsziget, természetvédelem

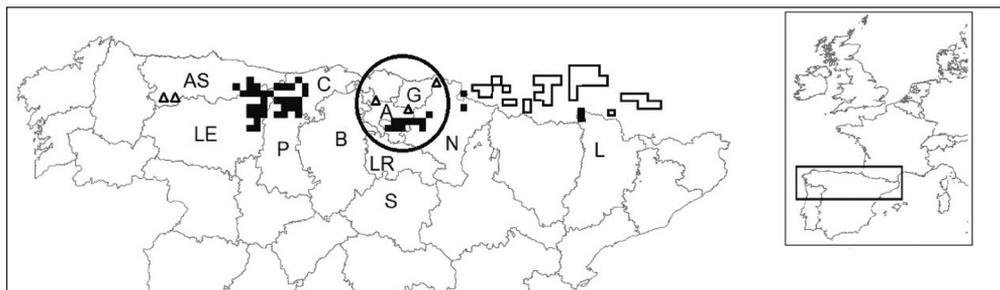
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## Introduction

The Middle-spotted Woodpecker *Leiopicus medius* is nearly endemic in the Western Palearctic, from European Russia and the Caucasus, to France and the Iberian Peninsula (Gorman 2014). The nominate race is distributed across continental Europe, as the formerly described Iberian race *liliana* is not currently recognized (Gorman 2004). This woodpecker is a resident of temperate forests, strongly preferring mature oak woodlands. It also inhabits mixed deciduous and riparian forests, parklands, wooded pastures and even beech stands, provided

the availability of standing large, decaying and rough-barked trees (Pasinelli 2003). The oak volume and the number of suitable trees for foraging (>35 cm girth) and nesting (>20 cm girth) have been related to patch occupancy, colonization and persistence. The overall long-term trend is declining, because the species is sensitive to the general fragmentation of the original lowland oak forests in Europe (Lammertink 2014). More recently, various trends and moderate increases have been reported for core Central European countries, and the conservation status proposed by the IUCN Red List is “least concern”, both globally (BirdLife International 2012) and regionally in the European Union (BirdLife International 2015). In spite of this, small, isolated and peripheral populations face an increased risk of extinction (Pasinelli 2003).

Northern Spain holds the westernmost population of the species. It encompasses the main mountain ranges, namely the Cantabrians, the Basque and the Pyrenees. These form an 800 km long, W-E oriented corridor. Although traditionally exploited, degraded and reduced in their original surface, oak (*Quercus pyrenaica*, *Q. faginea*, *Q. robur* and *Q. petraea*) forests remain mainly at altitudes between 700 and 1300 m, with lowland forests showing a much more relict and patchy occurrence. Three separate populations of the Middle-spotted Woodpecker are known in Northern Spain. The Cantabrian is located in the provinces of Asturias, Cantabria, León and Palencia, and its extent of occurrence (*sensu* IUCN 2014) covers



**Figure 1.** Current distribution of the Middle-spotted Woodpecker *Leiopicus medius* in Spain, during breeding period. Presence recorded in UTM 100 km<sup>2</sup> squares, updated from Onrubia *et al.* (2003). Black squares indicate confirmed presence; triangles, old, possible or unconfirmed presence. The area of the population in the Basque Country and neighbouring districts is circled. Borders of Spanish provinces are delineated. Those mentioned in the text are signalled: AS – Asturias, LE – León, P – Palencia, C – Cantabria, B – Burgos, A – Álava, G – Gipuzkoa, N – Navarre, LR – La Rioja, S – Soria and L – Lérida. The UTM 100 km<sup>2</sup> squares in the northern (French) section of the Pyrenees closer to the Spanish border, with confirmed presence during breeding periods 2009–2012 (Issa & Muller 2015), are also shown (empty squares)

**1. ábra** A közép fakopáncs (*Leiopicus medius*) jelenlegi spanyolországi költési elterjedése. Az előfordulás feltérképezése 100 km<sup>2</sup>-es UTM négyzetekben készült, Onrubia *et al.* (2003) nyomán. A fekete négyzetek jelentik a megerősített előkerülést, míg a háromszögek a lehetséges régi vagy nem megerősített előkerülést mutatják. A körön belül találhatóak a baszkföldi és az azt körülvevő populációk. A határvonalak a spanyol tartományokat jelölik. A szövegben említett és az ábrán jelölt tartományok a következők: AS – Asturias, LE – León, P – Palencia, C – Cantabria, B – Burgos, A – Álava, G – Gipuzkoa, N – Navarre, LR – La Rioja, S – Soria and L – Lérida. A Pireneusok Franciaország-felőli részére eső UTM négyzetek (közel a spanyol határhoz) a 2009–2012 közötti költési időszaki megkerülések adatait mutatják (üres négyzetek, Issa & Muller 2015)

around 35 squares of 100 km<sup>2</sup>. A subpopulation in the western section of the Cantabrians has probably gone extinct in the last decade (Sánchez *et al.* 2009). As for the Pyrenees, two subpopulations are known from the provinces of Lérida and Navarre respectively, with a joint extent of occurrence of just 5 squares of 100 km<sup>2</sup> (Onrubia *et al.* 2003). In fact, these Pyrenean subpopulations are possibly connected to the population of the Northern (French) slope of the range, where the species is more widely distributed (Issa & Muller 2015).

Finally, the Basque population lays at an intermediate geographic position between the above mentioned, c. 125 km distant to the closest limits depicted for the Cantabrian and 60 km for the Pyrenean. It is found in the province of Álava and the adjacent fringes of Navarre and Burgos (González *et al.* 2006), and covers an extent of occurrence of 10 squares of 100 km<sup>2</sup> (Onrubia *et al.* 2003) (*Figure 1*). This population is highly relevant from a conservation perspective. In the Spanish context, because it contains the densest population thriving in a continuous, unfragmented forest block (the Izki forest) and it holds at least one third of the country's numbers, even though figures available for the Cantabrian are partial and not completely comparable (García-Fernández *et al.* 2002, Robles & Olea 2003, Fernández & Lozano 2009, Fombellida *et al.* 2009); and globally, because populations at the edge of the distribution may represent local adaptations, distinct evolutionary potential and ability to persist under rapidly changing climatic scenarios (Hampe & Petit 2005, Fuller *et al.* 2011, Rehm *et al.* 2015). In this paper, I review and synthesize the discovery, inventory, research and current state of knowledge about this population.

## Historical background and discovery

Apparently, there is no specifically attributable mention of the Middle-spotted Woodpecker in the classical Spanish literature (Bernis 1995). Popular, vernacular names have not been described either, the species presence being covered by the much more common and abundant Great-spotted Woodpecker *Dendrocopos major* (Bernis 1995, García-Fernández 2008) The scientific inventory of the avifauna in Spain is quite recent in historical terms, if compared to central and northern European countries. The first systematic approaches date back to the late 19<sup>th</sup> century, when the catalogues by Ventura Reyes and José Arévalo were published. Ornithological contributions at this stage were highly influenced by visiting naturalists and ornithologists, like Alfred Brehm, Howard Saunders and Howard Irby (Tellería 2004).

Reig (2004) and Salas *et al.* (2005) have compiled and reviewed critically the existing historical records on the occurrence of the Middle-spotted Woodpecker in the Iberian Peninsula. The reliable data – detailed observations or descriptions of museum specimens – are referred to the Catalan Pyrenees (1879, 1913) and the Cantabrians (1876, 1921), apart from northern Portugal (1896) and other Spanish regions where the records are considered doubtful (central Spain) or simply erroneous (southern Spain). Among historical authors, Witherby (1922) provided certain information on the Cantabrian population, and captured eight specimens, that based the already mentioned proposal of the subspecies *Dryobates medius liliana*. The question whether the Middle-spotted Woodpecker had a wider distribution in the 19<sup>th</sup> century than today remains open, given the evidences from northern Portugal.

Regarding the Basque-Navarre mountain range, the Middle-spotted Woodpecker was not mentioned by foreign ornithologists visiting the region, although this part of the country did not attract as much interest as southern Spain. Saunders (1884), Chapman and Buck (1893), Gadow (1897), Blasius (1907) and Ticehurst and Whistler (1925) explored several forested areas, especially in Navarre, but found no record on this species, unlike other less cryptic woodpeckers (e.g. Black Woodpecker *Dryocopus martius*). The first mention is credited to Aldaz (1918), who just noted the “rare” occurrence of the species. Despite vague, it may be reliable because his catalogue and descriptions are well founded, based on collections (although apparently this was not the case for the Middle-spotted Woodpecker) (Sansinenea 1908). None of the Spanish populations of the species produced new substantial information until the pioneer study by Purroy *et al.* (1984) in the Cantabrians. As for the Basque region, the only worthwhile was Noval (1967) who stated “few observations and not completely reliable”. In Navarre, Purroy (1974) knew an only occupied locality, but better ascribed to the Pyrenean range than to the Basque.

During 1975–1977, field efforts to map the distribution of breeding bird populations in the southern third of the Basque Country – and neighboring regions, namely La Rioja, Burgos and Soria – were undertaken by De Juana (1980). He authored a pioneering atlas, but obtained no records for the Middle-spotted Woodpecker.

The first systematic mapping of the breeding bird populations in the Basque Country and Navarre were performed in years 1982–1984, using conventional atlas methodology and the 100 km<sup>2</sup> squares of the Universal Transverse Mercator (UTM) grid as sampling units. The entire region was covered, but the Middle-spotted Woodpecker was recorded in just two locations. Although no specific census was made, regional population size was estimated less than 10 pairs on account of the scarcity of observations, and distance from the known areas for the Cantabrian and the Pyrenean (French) populations suggested isolation and an endangered status (Elósegui 1985, Faus 1985).

In the early 1990's, Arambarri and Rodríguez (1994) communicated the presence of the species in a new location in the province of Álava. In this case, records were regular and suggested a well-established population. After their discovery, in May-June 1994 and 1995, these authors performed a more systematic census, sampling *Q. pyrenaica* and *Q. faginea* forest patches over a total area of 17 UTM 100 km<sup>2</sup> squares, by means of 387 point counts along pre-fixed itineraries, where play-back was used (Arambarri & Rodríguez 1996). Occurrence of the Middle-spotted Woodpecker was demonstrated in five of those squares, concentrated in and around the so-called Izki forest. This is a vast woodland of nearly 7,000 ha, dominated by *Q. pyrenaica* (3,700 ha), *Q. faginea* (900 ha) and beech *Fagus sylvatica* (1,800 ha). Density in the Izki forest was  $1.29 \pm 0.12$  pairs/10 ha, assuming that birds responded to the tape from a maximum distance of 150 m. The population size was estimated  $451 \pm 42$  pairs, including birds from the close Sabando forest, a patch of nearly 450 ha dominated by *Q. pyrenaica*.

The fact that this population had gone previously unnoticed, contrasts sharply with its shown local abundance, the conspicuousness of the birds at occupied sites and the relatively good knowledge about the regional avifauna. The participants in the 1982–1984 atlas probably mistook observations of the unexpected Middle-spotted Woodpecker for the

Great-spotted, which was frequent in all sorts of forest landscapes and also inhabited the Izki forest at that time (Faus 1985). Gainzarain (2006) pointed out that, decades ago, under a more intensified forest exploitation regime, the Middle-spotted Woodpecker density could be lower, thus preventing detection. But this idea is hard to apply, because the systematic approaches to the description of the regional avifauna began in the late 1970's and deepened in the 1980's, as seen above. This period is not that far from the discovery of the population, and encroachment of the forest as a consequence of rural emigration to cities had already begun in the 1950's (Michel & Gil 2013).

## Distribution

Since the discovery of the Izki population, two systematic studies on the distribution, covering the whole Basque region, were performed. The first one took place in 1995 and was focused on the Picidae assemblage (Lanius Ornithological Society *et al.* 1995). The Middle-spotted Woodpecker was searched for in 27 UTM 100 km<sup>2</sup> squares that held a significant surface of caducifolious *Quercus* patches. Occurrence was only noted for seven squares, spread over the already known Izki population and the western tip of Gipuzkoa province, bordering Navarre. Nevertheless, in this latter sector, records of the species were not definitely confirmed.

The second systematic survey was performed in the framework of the Spanish atlas of breeding birds during 1998–2001, and again every UTM 100 km<sup>2</sup> square was surveyed using non-specific atlas methodology. Ten squares were found occupied by the Middle-spotted Woodpecker, six of them in Álava – the Izki forest being the core – and four in neighboring areas of Navarre (Onrubia *et al.* 2003). The species went unrecorded from the squares in Gipuzkoa province where the 1982–1984 atlas and the 1995 survey had signaled it.

While the study by Onrubia *et al.* (2003) is the most recent systematic, extensive approach to the breeding distribution of the population, the picture was still not complete. Two additional populations have been reported in the last decade, from locations where the occurrence of the species was previously unknown. The first one (Montes de Vitoria range) was surveyed in detail, by means of 58 point counts over a total surface of 610 ha of oak patches, interspersed among a forest matrix of beech stands and coniferous plantations (Unanue *et al.* 2010). The number of occupied patches was small (14% of positive point counts). The second population (Sierra de Entzia range) has not been investigated yet, but the presence of territorial individuals has been well established over the years 2013–2015 (J. M. Fernández-García, own data). These two populations are not contiguous to the Izki core population, but in fact functional connectivity among them is probable, because despite the fragmentation of the oak patches, the forest matrix is continuous and distances to the closest boundaries are less than 15 km. This length is within reach for a short-distance natal disperser like the Middle-spotted Woodpecker (Pasinelli 2003).

Even with such intensity of sampling at regional scale, there are three distinct forest massifs where the occurrence of the species has been cited in the past, but which lack reliable evidences about the presence of a permanent breeding population. The first one is the

eastern tip of Gipuzkoa province: surveys in 1982–1984 and 1995 communicated few and unconfirmed records (see above); the one in 1998–2001 did not. During March–May 2015, the best oak habitat patches remaining in six wider areas of Gipuzkoa have been sampled by means of point counts. Just one territory (i.e. a locality where individuals were detected on two visits) was assessed, apart from other two unrepeated records. Therefore, current distribution and population size in Gipuzkoa province appears to be certainly small or even anecdotic (Itsas Enara Ornithological Society 2015).

The other two massifs with previous records lay both in Álava. Opportunistic observations (Elguea-Urkillara range, 1994, Gorbea range, 2006 and 2007) by skilled observers were communicated, and more ambitious surveys have taken place thereafter. However, occupied territories or even isolated birds have not been recorded again (J. M. Fernández-García own data, Unanue *et al.* 2014), in spite of the availability of suitable and large patches of oak habitat. Structural connectivity could play a role in explaining the absence, because these forest patches are either too far from the closest known population (40 km) or separated by broad (5–7 km) cultivated areas that could act as barriers, thus preventing dispersal. Temporal occupancy, inter-annual variability as well as local colonization and extinction processes have been documented for the Cantabrian population of the Middle-spotted Woodpecker (Robles & Ciudad 2012), and tentatively could explain out-of-range records.

Post-breeding (wintering) distribution of bird populations in Álava province was assessed in 2002–2005. Linear transects were performed in every UTM 100 km<sup>2</sup> squares during December–January, applying non-specific methodology. As for the Middle-spotted Woodpecker, a map of occurrence and relative abundance was built, which showed a similar range than the breeding period and absence over areas other than the Izki forest and its surroundings (Gainzarain 2006). Therefore, at the mentioned sampling scale, the resident status of the population was evident.

## Density and population size

The census by Arambarri and Rodríguez (1996) was the first to quantify the abundance of the Izki population. In 2000, breeding bird assemblages were investigated at Izki, counting individuals along transects totalizing 2.02 km across *Q. pyrenaica* patches and 1.36 km across *Q. faginea* patches (Onrubia *et al.* 2001). The average Middle-spotted Woodpecker densities were estimated at 1.7 birds/10 ha (*Q. pyrenaica* woodland) and 0.3 birds/10 ha (*Q. faginea* woodland). For comparison, this same study measured abundance of sympatric Great-spotted Woodpecker at 0.2–0.3 birds/10 ha. But the Middle-spotted Woodpecker numbers were later criticized by Robles and Olea (2003), based on invalid methodological assumptions, which probably led to overestimate the population density. Authors of previous censuses had used long emissions of tape vocals, considered 150 m as the maximum attracting range, concentrated their fieldwork in May and June during the incubation and chick-rearing periods, did not separate territorial males and females, and did not acknowledge floaters or dispersing birds. These aspects have been highlighted by Berndt (2009) as potential sources of overestimation of local Middle-spotted Woodpecker population size.

No other attempts to census the Izki population have been made until 2012, when Ciudad and Robles (2014) estimated population size by mapping territories in 37 parcels (30 ha each), selected randomly. Surveyed area was around 16% of the forested surface of Izki, and nearly 25% of the oak woodland, therefore meaning a robust sample. Parcels were visited 3–5 times during pre-breeding period (March–April), when birds showed a peak in territorial behavior. Each parcel was sampled in detail by one skilled observer, at a rate of 20 ha/hour. Every 100 m, vocalizations were emitted during 30 seconds. If Middle-spotted Woodpeckers were detected, the position, activity and movement of the birds were mapped. Territories per parcel were delimited based on repeated detections and interactions among birds, rejecting cases of vagrancy and territories with a minor surface inside the parcel. Average woodpecker density in the Pyrenean oak forest was 0.89 territories/10 ha (95% CI: 0.74–1.04), which yielded a global estimation of 338 territories (280–396) for the entire study area. Densities of 0.2–0.6 territories/10 ha have been measured in the Cantabrian range (Robles & Olea 2003, Fombellida *et al.* 2009), and 0.3–0.6 territories/10 ha in the Pyrenees (Camprodon *et al.* 2009). Therefore, densities at Izki forest outnumber those reported for other Spanish populations, and approach those for Central Europe (Pasinelli 2003), but we must take into account that differences in methodology may prevent reliable comparisons.

## Habitat use and selection

The breeding habitat of the Izki population was described for the first time by Arambarri and Rodríguez (1997). They parameterized forestry variables (dominance, coverage, number and dimension of trees, regeneration) in four plots of 50 m diameter, centered in trees with known nests. *Q. pyrenaica* was the dominant tree species (80–90%) in three plots, and *F. sylvatica* (62%) in the remaining. Main accompanying shrubs were *Ilex aquifolium*, *Crataegus monogyna* and *Malus sylvestris*. Average volume of wood was 189 m<sup>3</sup>/ha (167–207).

A more focused research was performed by Maldonado *et al.* (2009). The forest structure was characterized along nine transects 200 × 8 m, ascribed to patches occupied and unoccupied by Middle-spotted Woodpeckers, where species of trees, diameter, height, sanitary state, age and dead wood were measured. Transects “with” woodpeckers showed less density of trees, higher numbers of trees > 50 cm diameter (12–50/ha vs. none) and snags > 20 cm (6–90 vs. none), higher average diameters (31 cm vs. 21), older age (>130 years vs. < 100), higher diversity of tree sizes tending to irregular structure, and a marginally higher volume of logs and dead wood on the ground. Statistical tests were not applied in this study, and the Middle-spotted Woodpecker presence-absence patch classification was questionable, based on old (year 1994), indirect or non-systematic information. However, the use of mature to intermediate forest structures – or at least harbouring big caducifolious trees – was evident.

Ciudad and Robles (2014) described habitat selection during breeding, searching for correlations between presence and abundance of territories in 37 parcels (30 ha each; see above) and a number of structural variables (number, height, health condition and holes regarding trees > 9,5 cm diameter), parameterized in 330 circular plots (0,04 ha each) regularly distributed inside the parcels. Generalized linear models (GLM) and multiple linear

regressions (LM) were applied. The occurrence and density of Middle-spotted Woodpecker territories were positively associated to density of large caducifolious *Quercus* trees (> 35 cm diameter); on average there were 65 such trees inside occupied parcels vs. 15 in unoccupied ones. But this influence was not detected for potential nesting trees (>17 cm and decaying). Authors suggested that foraging trees acted as a limiting resource for the population, unlike nesting trees which seemed much more available. This feature was possibly a consequence of the history of coppice exploitation of the forest, which originated stands with high competence among regenerating trees.

Apart from the landscape and parcel scales, habitat selection has been investigated at the nesting-tree scale. Arambarri and Rodríguez (1997) described six trees that had been used for breeding. Five of them were *Q. pyrenaica* and just one *F. sylvatica*, but all were damaged or presented dead parts. Holes had been excavated at 1.1–5.4 m height. No orientation preference was observed. Maldonado *et al.* (2009) characterized in detail 26 nesting trees and plots 15 m diameter around each one of them, although the unambiguous attribution of such holes to Middle-spotted Woodpecker was not verified in the field. They found that the density of trees within the plot was lower than the average in the patch, and that frequency of holes excavated on damaged or dead trees was seven times higher than those on apparently healthy trees ( $\chi^2$ ,  $p < 0.01$ ). Also, a clear preference for trees colonized by the fungus *Fomes fomentarius* was reported: nearly half of the trees in the forest with fungi had been excavated ( $\chi^2$ ,  $p < 0.01$ ). Diameter range for nesting trees was 20–50 cm, but the average diameter (33.7 cm) was larger (t test,  $p < 0.01$ ) than the average tree within the patch. Nest height above ground varied between 1 and 14 m. Finally, there was a trend to increase the number of holes with the intensity of damage in the trees, from healthy to decaying and dead.

In turn, Ciudad and Robles (2014) described physical characteristics of 28 trees (all *Q. pyrenaica*) with holes known to have been used by Middle-spotted Woodpeckers for nesting. Mean height of the hole was 4.5 m (range 1.5–10.5), and entrance was biased towards S-SE. Average diameter of the nesting tree was 33.8 cm (range 18.5–53.2). These parameters were compared for each nesting tree with the three closer trees, by means of generalized linear mixed models (GLMM). Best model associated nesting to tree condition (i.e. health), presence of fungus and of previous holes, either natural or excavated.

Post-breeding habitat use has received little attention. But basically, no relevant differences compared to the breeding period have been reported. Domínguez and Onrubia (2004) found a positive selection for patches with high *Q. pyrenaica* coverage and mature stands, also exhibiting a rich substrate of fruiting shrubs (*I. aquifolium* and *C. monogyna*). Gainzarain (2006) confirmed the extensive use of the *Q. pyrenaica* woodland, and much weaker abundance in certain open *Q. faginea* patches.

## Breeding biology

Six breeding attempts monitored by Arambarri and Rodríguez (1997) rendered estimated laying dates between April 27–28 and May 10–11. One adult stayed with the chicks inside the hole until they were 12 days old. From day 16, chicks were generally fed at the entrance of the hole.

Ciudad and Robles (2014) calculated laying date for two broods at Izki forest: May 9 and 12. Breeding success (proportion of nests with at least one fledgling) was 70% (N=10), with losses from predation by carnivorous mammals and *D. major*. Mean fledging date was June 9 (range May 31-June 22, N=7) and average number of fledglings per nest was 2.2 (range 1–3, N=5). This parameter does not depart from the Cantabrian population (H. Robles & C. Ciudad, *in litt.*), but is low if compared to the core of the European distribution ( $4.1 \pm 1.4$  from four studies) (Pasinelli 2006).

## Diet

Information on this topic is rather anecdotic. Only Arambarri and Rodríguez (1997) recorded feeding activities (N=204) from two nests. They observed an increase in feeding frequency with age of chicks (Kruskal-Wallis test,  $p < 0.01$ ). The most important preys were Hymenoptera (32% of feedings) and Coleoptera (22%). A high relevance of common ivy *Hedera helix* berries was noted in one of the nests (42%), with lower in the other (4%). The presence of ivy in Middle-spotted Woodpecker diet has generally been undervalued (Pasinelli 2003, Spülher *et al.* 2015), but could compensate low availability of insects during energetically demanding periods, like brood-rearing (Froehlich-Schmitt 2015).

## Concluding remarks

It is surprising that the dense population of Izki was not discovered until the 1990's, given the relatively good knowledge about the regional avifauna. Possibly, ornithologists focused their attention on more attractive or fashionable groups, such as waterbirds, raptors and migrants, which were already subject to monitoring programs. Forest birds in general and woodpeckers in particular could be overlooked, despite the fact that they are a dominant component of most bird assemblages in the Basque Country (Galarza 1996). Again, unknown smaller populations have been described in the 2000's, although in these cases it is not clear whether the reason could be a recent colonization of new forest massifs by the core Izki population. On the contrary, we've witnessed recent and inconclusive efforts to confirm the situation in other areas where the species was recorded in the past.

Interpretation of this picture should take into account spatial ecology, functional connectivity and demography. In the Cantabrian range, persistence of the species on forest patches was related to habitat structure and fragmentation, but also to the size of the local population (Robles & Ciudad 2012). Unluckily, research on Izki has only focused on topics that are essential to estimate the conservation status (census and monitoring) and to design compatible forest exploitation practices (habitat selection). But clearly, understanding the dynamics in the core Izki population and the peripheral forest massifs requires new research priorities. For instance, survival, dispersal and habitat preference of juveniles are important to estimate colonization-extinction rates in suboptimal habitat patches and genetic exchange among subpopulations (Robles *et al.* 2008).

Knowing the reproductive output is key to estimate the impact of forest management on habitat quality and population fitness, because density indicators maybe buffered by demography. Compared to Central European populations, breeding parameters in Spanish Middle-spotted Woodpecker populations show lower values, and that could also apply to the Basque Country (Ciudad & Robles 2014), but sample sizes reported are too small. From a global perspective, the marginal position of the Spanish populations is important to determine genetic conservation units and to decide their relevance for the species conservation in a context of environmental change.

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