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Distribution of the White-backed Woodpecker *Dendrocopos leucotos lilfordi* in the southern Pyrenees.

Distribución del pico dorsiblanco *Dendrocopos leucotos lilfordi* en el sur de los Pirineos.

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Abstract

We have compiled the information available for the White-Backed Woodpecker (*Dendrocopos leucotos lilfordi*) on the south-facing slopes of the Pyrenees since its detection in 1968 until 2016 and we have added the results of specific censuses carried out between 2017 and 2021 and the results of the GPS marking of reproductive specimens, both within the known range, as in other beech forests beyond its borders. An expansion towards the West and North has been verified. The nests are always located in *F. sylvatica*, except in the extreme western territories where they use *Q. rubra* too. The breeders in the traditional range are always individuals of more than two years old (euring 6), although a number of breeding juveniles have appeared in the extreme west (euring 5). Beech occupies more than 70% of the surface of all the territories, but this percentage is significantly lower in the newly detected territories than in those within the traditional distribution area. These latest results suggest that the expansion process is relatively recent and that it may still be

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in progress. The role of forest management in efforts to enable the expansion of this species to other beech forests in which it has not yet been detected is discussed.

Key words: census, fagus, forest management, GPS, lilfordi.

Resumen

Recopilamos la información disponible para el pico dorsiblanco (*Dendrocopos leucotos lilfordi*) en la cara sur del Pirineo desde su detección en 1968 hasta el año 2016 y añadimos los resultados de censos específicos llevados a cabo entre 2017 y 2021 y los resultados del marcaje de ejemplares reproductores, tanto en el área de distribución conocida, como en otros hayedos fuera de ésta. Se comprueba una expansión del mismo hacia el oeste y norte. Los nidos se ubican siempre en hayas, salvo en los territorios del extremo oeste donde también utilizan *Q. rubra*. Los reproductores en la zona de distribución tradicional son siempre individuos de más de dos años (euring 6), mientras que en las zonas de reciente detección aparecen reproduciéndose ejemplares juveniles (euring 5). El haya ocupa más de un 70% de la superfice de todos los territorios, pero este porcetaje es significativamente menor en los territorios de nueva detección que en los del área de distribución tradicional. Estos últimos resultados inducen a pensar que el proceso de expansión es relativamente reciente y que todavía continúa. Se discute el papel de la gestión forestal para posibilitar la expansión de esta especie hacia otros hayedos en los que todavía no ha sido detectado.

Palabras clave: censos, fagus, gestión forestal, GPS, lilfordi.

Laburpena

Honako artikuluan, Piriniotako hego isurialdean okil gibelnabarrari (*Dendrocopos leucotos lilfordi*) buruz, 1968an lehen aldiz antzeman zenetik 2016ra dagoen informazioaren bilketa egiten da. 2017tik 2021era egindako errolda espezifikoetako emaitzak ere eransten dira, baita ale ugaltzaileen markaketetan lortutako datuak ere, bai ezagututako banaketa-eremuaren barrukoak, nola ezagututako banaketa-eremuaren kanpokaldean kokatutako beste pagadi batzuetakoak. Mendebalderantz aurkitzen diren pagadi gehiengoetarako hedapen egiaztatzen da. Kabiak beti pagoetan kokatzen dira, mendebaldeko muturreko lurraldeetan izan ezik, non *Q. rubra* ere erabiltzen duten. Ohiko banaketa-eremuko ale ugaltzaileak beti bi urte baino gehiagokoak izan ziren (euring 6). Mendebaldeko muturreko lurraldeetako ale ugaltzaileak, ostera, gazteak izan ziren (euring 5). Pagoak lurralde guztien azaleraren 70% baino gehiago hartzen du, baina ehuneko hori nabarmen txikiagoa da detektatu berri diren lurraldeetan ohiko banaketa-eremuan baino. Azken emaitza hauek, hedapen prozesua berriki gertatu dela eta oraindik ere momentu honetan gertzatzen ari dela pentsarazten dute. Basoen kudeaketaren rola eztabaidatzen da, oraindik espeziea aurkitu ez den beste pagadietarako hedapena ahalbidetzeko.

Gako hitzak: basoen kudeaketa, erroldak, fagus, GPS, lilfordi.

Introduction

The White-Backed Woodpecker (*Dendrocopos leucotos*) is the largest of the European Spotted woodpeckers and one of the most threatened (Campión *et al*., 2020a). Despite showing a wide area of distribution, ranging from the Iberian Peninsula to Japan (Winkler & Christie, 2019; Grangé, 2022), more of its populations are composed of few specimens and are very isolated from the rest, which makes them very vulnerable (Grangé, 2022).

This would be the case of the existing one in the Pyrenees, which is estimated at just over 100-110 pairs on the south face (Campión *et al*., 2022) and 350-400 pairs on the north (Grangé, 2022), separated by more than 1000 km of unfavorable habitat of the nearest population, located in the Alps (Winkler & Christie 2019; Grangé, 2022). In addition, the latest published studies suggest that this population, belonging to the subspecies *D. leucotos lilfordi*, could be genetically separated enough from the nominal *D. leucotos leucotos* to be considered a differentiated species (Pons *et al*., 2021), which would make it one of the rarest bird species in Europe.

It is located in mature deciduous forests (Aulén, 1988; Melletti & Penteriani 2003; Gerdzhikov *et al*. 2018) with abundant dead wood (Hogstad & Stenberg, 1997; Carlson, 2000; Melletti & Penteriani 2003; Ettwein *et al*., 2020). In the Pyrenees, this habitat is found in beech forests (Fernández *et al*., 1994; Garmendia *et al*., 2006; Grangé, 2022) where it occupies territories of around 300 hectares (Campión *et al*., 2020a), much larger than those recorded in other populations such as the Alps (Ettwein *et al*., 2019). This larger size could be due to a lower quality of habitat in the Pyrenees (Campión *et al*., 2020a), perhaps related to the traditional intensive management of these forests or simply caused by being located on the edge of the global distribution of the species and the beech forests it inhabits. However, the extraction of wood from beech forests has fallen drastically since the 1950s due to the rural abandonment, the appearance of fossil fuels and the import of quality wood from other EU countries (Paletto *et al*., 2008). In addition, forest management has evolved towards a more conservationist model, which currently tries to achieve more heterogeneous forests, with trees of different ages and diameters and with a greater presence of dead wood (Muñoz & Schendtner, 2005). In this scenario, most forest bird species, including woodpeckers, are showing a positive trend, increasing both their abundance (Escandell & Escudero, 2020) and their area of distribution in recent decades (Galarza *et al*., 2020).

The common birds monitoring protocols, based on the listening points homogeneously distributed in a 10x10 km utm grid (Escandell & Escudero, 2020), are not adequate for the White-Backed Woodpecker, which requires a systematic search for the territories paying special attention to food marks and even the use of playback (Ettwein *et al*., 2020). Therefore, to study the trend of this species, it is necessary to carry out specific censuses.

To fill this knowledge gap, in this study, we compile the different citations and censuses of this species existing for the southern face of the Pyrenees since its detection in the early 1970s until 2016 and we add the results of the specific censuses and the GPS radio tracking program carried out between 2017 and 2021.

Material and methods

Study area and specific census

The fieldwork was carried out in the beech forests of the north of Navarra, either within the known distribution area of the White-Backed Woodpecker, as well as in other nearby forest masses with adequate structural characteristics to host the species (Fernández & Azkona, 1996; Garmendia *et al*., 2006). The specific censuses were carried out during the spring, starting the fieldwork in the month of March, when the species shows a greater territorial behavior which facilitates its detection (Aulén 1988, Grangé, 2015). These censuses were undertaken by Environmental Guards and professional ornithologists. In each stand to be surveyed, a walking tour was made with stops every 300 m to make a listening point. In case of not detecting individuals in apparently favorable habitat we started a short stimulation with digital playbacks of songs and drumming of the species (Melletti & Penteriani 2003), although the use of sound lures was avoided whenever possible, due to the potential nuisance that it can cause and also because of the possibility of attracting birds from distant territories or even predators (Campión & Elósegui, 2021). If the presence of the species was confirmed, a systematic search for the possible nest was carried out following the movements of the bird at a certain distance (Grange, 2015). In the search for the nest, a maximum of 4 hours were invested on 3 alternative days without rain or wind. If after this time the nest had not been located, the search was abandoned. No sound lures were ever used in this process.

Capture and study of reproductive specimens and habitat characterization

In those territories where it was possible to locate the nest, breeders were captured with mist nets installed at a high altitude (9-13 m) (see Campión *et al*., 2020 b). Once captured, birds were sexed and aged according to Villanúa *et al*., (2021) and ringed with an official metal ring and three colored ones that allow the identification of the specimens without the need to recapture them. In addition, the specimens were fitted with a miniaturized GPS tag (PinPoint GPS-VHF-75; Biotrack Ltd) fixed to the bird with a pelvic harness (Campión *et al.* 2020 b). These devices collected 5 locations per day on alternate days and stored them until they were downloaded remotely (Campión *et al*. 2020 a). With the precise GPS locations obtained, the territory (kernel 95%) of

each specimen was drawn as described in Campión *et al.* (2020a). For each territory, the percentage of surface occupied by coniferous forest, beech forest, other deciduous forest, prairies and pastures and humanized environments was calculated, using the layers provided by Corine Land Cover from 2018. All geospatial analyses were performed in QGIS free software (QGIS.org 2021).

Statistical analysis

To analyze the differences in the proportion of adults and second-year individuals between the traditional distribution area (until 2003) and that of recent detection, we performed a Chi^2 test applying Yate's correction due to the small sample size (Hammer *et al*., 2001).

Prior to the analysis of the differences in the habitat composition of the territories included within the traditional distribution area (until 2003) and those located in the area of recent detection, the distribution of habitat composition data was tested according to the test Kolmogorov-Smirnof goodness-of-fit for normality (p" 0.05) (Hammer *et al*., 2001). As they did not follow a normal data distribution ($p<0.05$), we used the Mann-Whithney U test non-parametric test.

Calculations and statistics were performed using the Past software version 4.03 (Hammer *et al*., 2001).

Compilation of bibliography, historical censuses and citations

All oficial bird atlas (Elósegui, 1985; Woutersen & Platteeuw, 1998; Sampietro, 2000; Campión & Senosiain, 2003; Campión *et al*., 2022), published scientific articles (Bernis & Iribarren, 1968; Purroy, 1972; Iribarren, 1973, Purroy, 1978; Senosiain, 1978; Fernández *et al*., 1994; Fernández & Azkona, 1996; Cárcamo, 2016; Cárcamo *et al*., 2019) and conference reports (Campión *et al.*, 2014) about the species in the southern Pyrenees were reviewed, looking for any information about its range or relative abundance.

Unpublished studies referring to specific censuses ordered by the Governments of Navarra or Aragon or included in different environmental impact assessment studies carried out in areas with potential habitat for the species (Fernández, 1991; Campión, 1998; Lorente *et al*., 2002; Campión *et al*., 2010; Basartea, 2012) were also reviewed.

Finally, all the citations for the species on the southern Pyrenees registered in the ornithological yearbooks (Arratibel *et al*., 1998, 2007; Bueno *et al*., 2013; Rivas *et al*., 2021), as well as in the two main online platforms (eBird and Observation), were compiled. In those cases in which the citations were outside the areas of known distribution, the observer was contacted to ensure that it was not an error in the identification or location of the observation point.

Results

Specific censuses carried out between 2017 and 2021 confirmed the presence of the species in 19 utm 10x10 km squares (Fig. 1), always occupying forests in which beech was the predominant species.

The nests were always located in beech, with the exception of the new territories of the extreme west, where the chosen species was *Q. rubra* (Elósegui, 2020).

A total of 18 reproductive specimens were captured, studied and marked; 14 of them in territories located within the distribution area described up to 2003 and 4 in newly detected areas. The proportion of adults and second year individuals varied signifi-

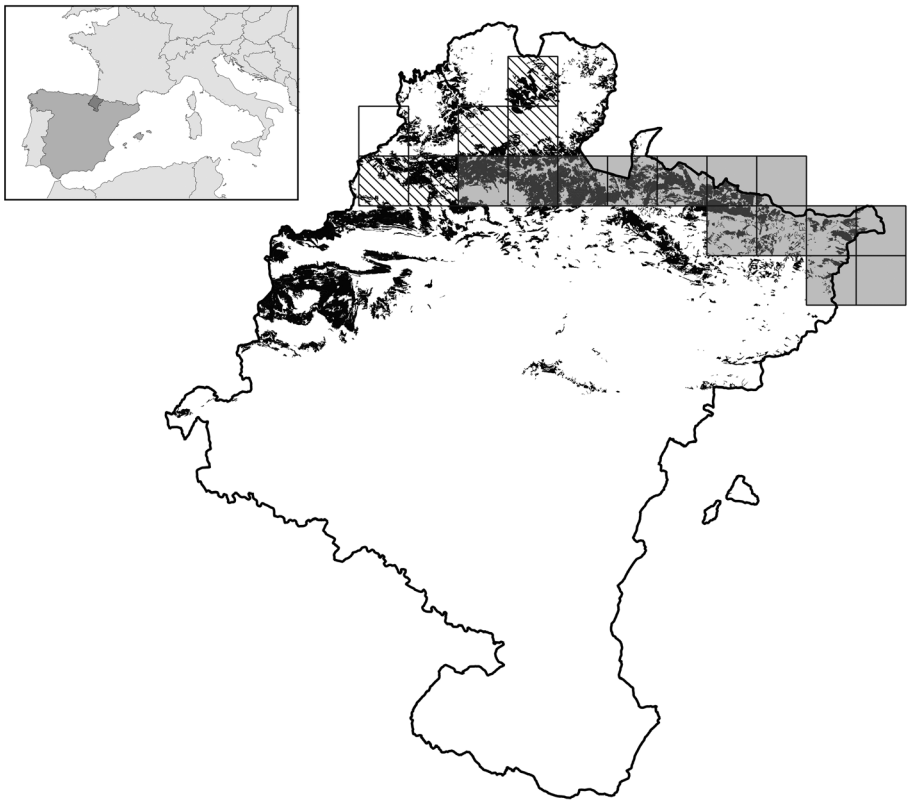

Fig. 1.- Distribution of beech forests (black shading) and UTM 10x10 grids with the presence of the White-backed Woodpecker confirmed until 2003 (grey grids), detected until 2018 (hatched grids) and until 2021 (unfilled grid).

Fig. 1.- Distribución de los hayedos (sombreado negro) y cuadrículas UTM 10x10 con presencia de pico dorsiblanco comprobada hasta 2003 (cuadriculas grises), detectada hasta 2018 (cuadrículas ralladas) y hasta 2021 (cuadrícula sin relleno).

cantly between the traditional range (all birds ≥ 2 years) and the recently detected range (1 bird ≥ 2 years and 3 second-year birds) (Chi^2=7,78; P=0.005).

Beech forests were the main land use in all territories, always occupying more than 70% of its surface. However, this percentage was significantly lower (Z=2.17, p<0.05) in the territories located in the areas of recent detection of the distribution (77.15 % ± 13.55 SD) than in those located in the areas of distribution known until 2003 (83.41 % ± 5.89 SD). This lower proportion of the area occupied by beech forests in the new territories was associated with an increase in the percentage of land occupied by oaks and conifers forest, grasslands and anthropized areas (Fig. 2), although these differences were not significant.

The review of the information available prior to the censuses of this work confirmed a constant distribution between 1968 and 1994 with a confirmed presence in 11 10x10 km utm squares, which was increased in 2003 when its presence was confirmed in another two 10x10 km utm squares located further west (Fig. 1).

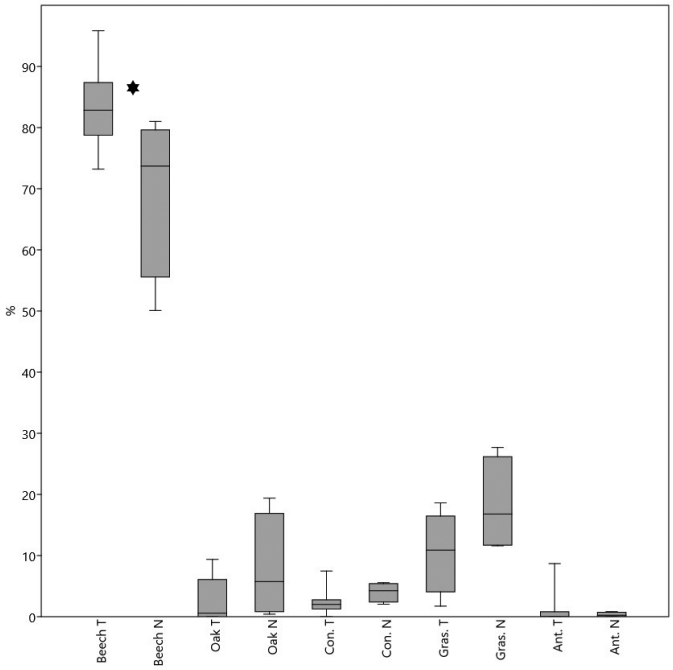

Fig. 2.- Mean percentage (± standard error) of each type of land use in the White-backed Woodpecker´s territories on the south of the Pyrenees within the traditional range (T)(n=14) and the recently detected range (N)(n=4)(* p<0.05).

Fig. 2.- Porcentaje medio (± error estándar) de cada tipo de uso de suelo en los territorios de pico dorsiblanco en el sur de los Pirineos dentro del área de distribución tradicional (T)(n=14) y de la de reciente deteción (N)(n=4)(* p<0.05).

The Observation platform collected 59 citations for the species, all within the traditional range known until 2003. The eBird platform collected 359 records, 26 of which appeared outside the area of distribution known until 2003, but in areas where the reproduction of the species was confirmed through our specific censuses. The only citation of the species outside of the 19 utm 10x10 km squares studied in the present work that had been recorded by these web platforms, was due to a location error and was removed from the platform after consultation with the author of the observation.

Discussion

The results obtained in this study confirm the progressive expansion of the species to the north and west, which perhaps began at the beginning of the century, as suggested by Campión & Senosiain in 2003. The positive trend is common to most forest bird species (Escandell & Escudero, 2020), including the woodpeckers (Galarza *et al.,* 2020), and may be related to changes in forest structure that have occurred in recent decades (Gil-Tena *et al.,* 2007). The reduced dependence on wood as fuel, the abandonment of harvesting practices such as charcoal (Paletto *et al*., 2008) and the introduction of conservation criteria in forest management (Garmendia *et al.,* 2006; Paletto *et al*., 2008; Kraus & Krumm, 2013), may have progressively achieved a greater age and heterogeneity of the forests, which in turn may improve the hosting capacity for forest species (Bollmann & Braunisch, 2013). This new situation may increase the amount of dead wood, both standing (snags) and fallen, and of trees of different ages, including extra-mature specimens (Muñoz & Schendtner, 2005; Garmendia *et al.,* 2006), basic requirements for the presence of White-Backed Woodpecker (Grangé, 2022). Faced with this new availability of suitable habitat, the dispersing juveniles seem to be colonizing the forests adjacent to the limit of the distribution area. These recently occupied forests have a slightly different habitat composition than where the White-Backed Woodpecker traditionally appeared in the Pyrenees (Fernández *et al*., 1994; Garmendia *et al*., 2006; Urkijo-Letona *et al.,* 2020; Grange , 2022). Although the beech continues to be by far the predominant species (>70%), the percentage of land occupied by this tree species is lower in the new territories that also include other types of forests, graslands and even anthropized environments. The ability to occupy non-beech deciduous tree forests is widely described in northern and eastern European populations (Aulén, 1988; Czeszczewik & Walankiewicz, 2006; Gerdzhikov *et al.,* 2018; Hämäläinen *et al.,* 2020). If this ability becomes established in our region, it could enable the "jump" of this species to other existing beech forest masses in the Pyrenees in which it has not yet been detected. In fact, the expansion towards the West would extend the distribution of *D. leucotos lilfordi* towards the Cantabrian mountain range, where beech forests are also expanding in the last thousands of years (Costa *et al.*, 1998).

A more detailed analysis of habitat selection by specimens equipped with GPS transmitters will allow a more precise definition of the requirements of this species. Once this information is obtained, the beech forests located on the periphery of the current distribution area could be characterized based on their potential for the species and possible expansion routes defined (Gil-Tena *et al.*, 2012). In these areas, a monitoring methodology should be established for the species, sensitive enough to ensure the detection of the species at low densities but cheap enough to be implemented in large areas of land. To achieve these objectives, various sources of information could be used. The main and most reliable would be the specific censuses carried out by professional ornithologists with the methodology used in this work. This option has the disadvantage of also being the most expensive, especially considering the large area of beech forest available near the current distribution area. Another option would be the compilation of the observations resulting from citizen science and recorded through web portals. These data can be very useful, especially in areas very frequented by amateur ornithologists. This has been the case in the present study, with detection of the species by amateur ornithologists in 2 of the 6 recently colonized utm grids that correspond to the Bertiz Natural Park, a place that is visited by thousands of ornithologists every year. Outside these areas with a large influx of naturalists, the observations provided by citizen science are much less frequent and their usefulness becomes merely anecdotal within a monitoring plan. In order to make the contributions of amateur ornithologists more useful, their field journeys should be coordinated by a monitoring plan designed specifically for the species and provide them with basic training on the census methodology of the species, as has been done for the case of the Middle Spotted Woodpecker *Dendrocoptes medius* with good results (Fernández-García & Robles, 2020). Finally, the use of passive recording systems should also be assessed, since there is already some experience recording the drummings of different species of woodpeckers like monitoring system (Brazaitis *et al.,* 2022).

Regarding forest management in the beech forests of the peripheral zone, taking into account the apparent tendency to expansion that the species is showing, all the beech forests located on the periphery of the known distribution area should be managed with the same criteria used in the areas where their presence has already been confirmed and that are aimed at maintaining a minimum of 8 snags and 20m^3/ha (Campión & Elósegi (2021).

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