Winter distribution and population size of the Red Kite *Milvus milvus* population in the Basque Eurosiberian region

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Spain hosts a large part of the central/western-European Red Kite population in winter and so plays a major role in its conservation. As a breeding bird, the Red Kite is declining across much of Spain, although in the Basque Eurosiberian region it has of late experienced relatively rapid population growth, especially in the province of Gipuzkoa. As a consequence, the distribution and size of its population in this region is presumed to have increased. To update population data, a winter Red Kite census was conducted in 2020–21, which coincided with an international appeal (LIFE EuroKite) to monitor this raptor in winter. This paper analyses and discusses the results of this census, furthers knowledge of Red Kite distribution and population size in the Basque Eurosiberian region in winter, and evaluates its role as a wintering area for this species in Europe. We detected ca. 50 roosts used by a total population of up to 700 individuals. During a simultaneous census, the number of roosts used at the same time was ca. 30. The size of the roosts ranged from 1-2 to 145 birds. Overall, the contribution of the surveyed region to the Spanish wintering Red Kite population is small in absolute numbers (less than 1.5%). However, these numbers are important regionally and indicate a remarkable increase over the 373 birds detected during the previous national census (2013–2014). Some of these birds (roughly 10%) belong to local breeding stock, which is thus confirmed to be resident.

Key words: Red kite, *Milvus milvus*, bird conservation, species of concern, wintering, raptors.

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The Red Kite *Milvus milvus* breeds in forest patches and forages over open countryside (Carter 2007). Although its conservation status is favourable in some northern European countries (Staneva & Burfield 2017), its southern (Mediterranean) populations in countries such as Portugal, Spain and Italy have been reported to have suffered severe declines in recent years (Viñuela *et al.* 1999, Madroño *et al.* 2004, Zuberogoitia & Martínez 2011, Staneva & Burfield 2017). Recent data reveals an increase or greater stability in most European populations, the main exception being Spain, where a negative trend still prevails (see population status and trends at EU and Member State levels, available at https://nature-art12.eionet.europa.eu), above all in the south (Sergio *et al.* 2019). The Red Kite is today one of the most threatened raptors in Spain and is classified as 'Endangered' on the updated Red List of Birds of Spain (López-Jiménez 2021), the same classification as on the previous list dating from the beginning of the twentieth century (Madroño *et al.* 2004). Legally, however, it is in fact listed as 'Critically Endangered' (Royal Decree 139/2011, 4 February, and subsequent updates). Part of this decline is thought to have been caused by human-induced factors such as poisoning (Berny & Gaillet 2008, Coeurdassier *et al.* 2012, Tavecchia *et al.* 2012, Mateo-Tomás *et al.* 2020).

Migratory bird populations occupy very large geographical areas during their annual cycles and hence their conservation is dependent not only on conditions at their breeding sites but also along their migration routes and in their winter quarters (Newton 2004). Spain hosts a large share of the central/western-European wintering Red Kite population and so its role in its conservation is vital (Molina 2015). In light of this, knowledge of the spatial distribution and number of wintering Red Kites is essential for its conservation, as is information on key areas, which require dedicated monitoring and conservation measures and are of particular value given the large-scale distribution changes observed in Red Kite breeding areas. Study of this raptor in the Eurosiberian region of the Basque country is of additional interest as it is precisely here that the recovery of the Red Kite is taking place (Nägeli *et al.* 2021).

Concurrent with the recovery of its European breeding population, the Red Kite in the Basque Eurosiberian region has also recently experienced relatively rapid population growth, especially in the province of Gipuzkoa (Olano *et al.* 2016a), where the breeding population in 2020 was estimated at 32 pairs (Olano *et al.* in prep.). Given these two trends, the distribution and size of the wintering Red Kite population in this province is presumed also to have increased. The last winter census of the Red Kite in this province dates from 2013–2014, when 141 kites were counted (Molina 2015). In the neighbouring province of Bizkaia (which, together with Gipuzkoa, covers most of the Basque Eurosiberian region), the population was assessed at 232 birds (Molina 2015). To bring this information up to date, a Red Kite census was conducted in winter 2020–21 coinciding with an international appeal (LIFE EuroKite: LIFE18 NAT/AT/000048) to monitor this kite's winter population, in which the Iberian Peninsula plays a crucial role (Staneva & Burfield 2017). This paper analyses and discusses the results of the 2020–21 census, updates knowledge of Red Kite distribution and population size in the Basque Eurosiberian region in winter, and provides insights into this raptor's habitat requirements. Finally, we also compare the situation of the Red Kite in these two provinces from a standpoint of management requirements.

Methods

Study area and data collection

This study was carried out in the provinces of Gipuzkoa and Bizkaia, which together constitute most of the Basque Eurosiberian region (Fig. 1). They occupy an area of ca. 4,200 km^2 each and both boast rugged relief covered by mosaics of woodland (either of native Atlantic forest or exotic plantations of Monterey pine and eucalyptus), open grassland (pastures and meadows), and urban and industrial areas. Winters are mild and very humid, with mean temperatures of ca. 8°C and an annual precipitation of 1,000–1,500 mm, a significant part of which falls in winter.

Fieldwork consisted of a search for roosts throughout virtually the whole region. The territory was divided into several subzones, which were shared out among the rangers taking part in this project (for details, see Acknowledgements). From December 2020 to the end of January of 2021, each ranger looked for both single-bird or communal Red Kite roosts in their assigned areas. In all, the sampling effort was over 350 h.

To search for roosts, rangers took up positions before dusk at good vantage points and actively searched for kites. Once located, birds were followed visually to their roosts (around dusk kites fly directly to their roosting sites). If visual contact was lost, the next day observers chose a point within the zone where the contact had been lost and waited until the birds reappeared to track them visually to the roost. This protocol was repeated on as many days as was necessary to find all the roosts. As a methodology, it was not infallible and it is likely that some roosts were not detected, especially if they were single-bird roosts or held only a few birds. Both Gipuzkoa and Bizkaia are characterized by their highly rugged topography and detecting red kites as they move to their roosting sites is a challenge. Overall, however, we consider that our method was sufficiently robust to detect most kite concentrations.

Additionally, a simultaneous census was carried out on 8 January in the evening or, alternatively, on 9 January in the morning (i.e. assuming that the kites that left a roost in the morning were the same as those that would have been counted the previous evening). This census coincided with an international kite count.

Not all counts were carried out on 8 January because the weather was extremely bad, with snow storms, and so logistically it was easier for some rangers to conduct the survey on 9 January.

Once a roost was found, its position and main characteristics were recorded: type of substrate (tree), as well as the size of the woodland patch in which the roost was situated (4 categories: <1 ha, 1–5 ha, 5–10 ha, >10 ha). To assess patch size, we used the mapping tools in Google Earth to draw polygons. As well, the number of birds using the roost was annotated and for every roost, counts were performed on every visit.

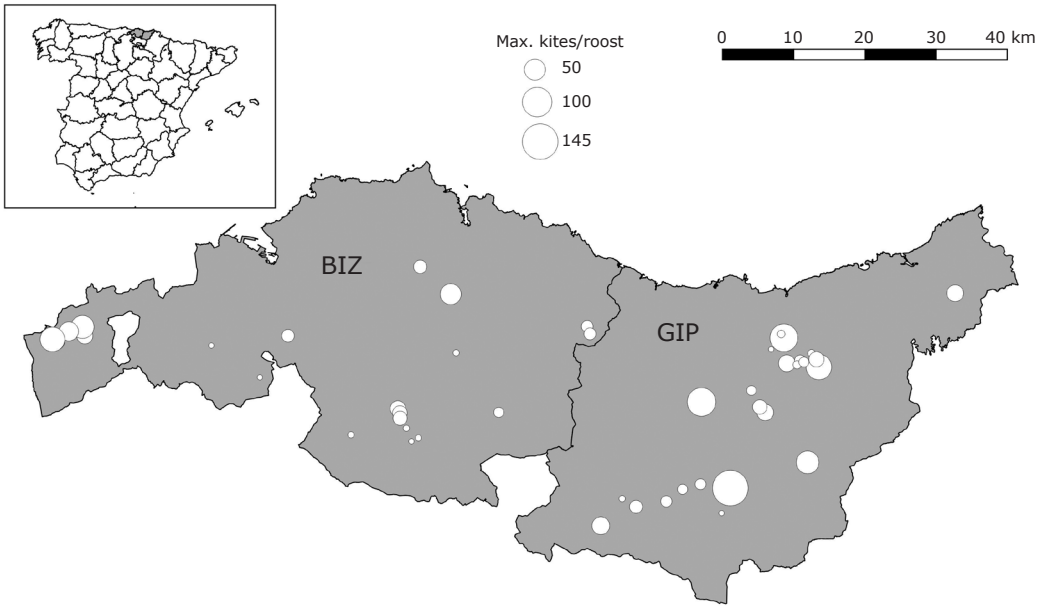
Statistical analyses

We used chi-square tests on $N \times 2$ contingency tables to compare the populations in the two provinces; N was the number of variable categories (e.g. type of substrate = tree species; woodland patch area pooled into semi-quantitative categories). To examine the relationship between the density or location of winter roosts and the distribution of breeding Red Kites in Gipuzkoa (Bizkaia has no confirmed breeding pairs), we used a correlation test using UTM 5×5 km cells. For each cell, we obtained both the number of wintering kites and number of pairs detected during the breeding season (source: Gipuzkoa Administration; sample: 32 pairs in 2020). Additionally, we ran a chi-square test for a two-way contingency table to test whether or not the occupancy of a UTM cell in winter was independent of its occupancy during the breeding season. Finally, to test whether or not single- or two-bird roosts were situated in or close to the woods used during the breeding season, we conducted a *U*-test (sample size for the 1–2 bird roosts was less than ten cases) to compare the average shortest distance to a nest between single or two-bird roosts and roosts with more than two birds. Cartographic analyses were performed using QGIS (QGIS Development Team 2009), whilst the other analyses were run with R (R Core Team 2020).

Results

Overall, 48 different roost sites were detected during the winter (Fig. 1), most (64.6%) in stands of Monterey pine (*Pinus radiata*), followed

Figure 1. Spatial distribution of the Red Kite roosts and their maximum sizes detected during winter 2021 in the provinces of Bizkaia (BIZ) and Gipuzkoa (GIP), a region referred to in this work as the Basque Eurosiberian region. *Distribució espacial dels dormidors de milà reial i les seves mides màximes detectades durant l'hivern de 2021 dins les províncies de Biscaia (BIZ) i Guipúscoa (GIP), que en aquest treball anomenem la regió eurosiberiana basca.*



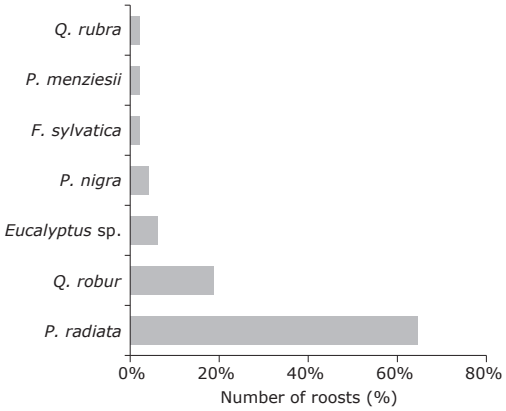


Figure 2. Substrate of the Red Kite roost sites detected in the Basque Eurosiberian region in winter 2021 (*n* = 48 roosts).
Substrat dels dormidors de milans reials detectats a la regió eurosiberiana basca durant l'hivern de 2021 (n = 48 dormidors).

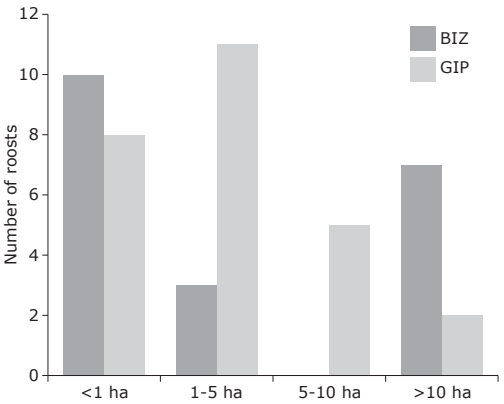


Figure 3. Frequency distribution of Red Kite roosts in the Basque Eurosiberian region (BIZ, Bizkaia; GIP, Gipuzkoa) in terms of the size of the woodland patch in which roosts were detected.
Distribució de les freqüències dels dormidors de milà reial a la regió eurosiberiana basca (BIZ, Biscaia; GIP, Guipúscoa) en relació a la mida de la zona boscosa on es va trobar el dormidor.

by those in stands of native oaks *Quercus robur* and, much more marginally, other tree species including both native (beech *Fagus sylvatica* and poplar *Populus nigra*) and exotic (black pine *Pinus nigra*, Douglas fir *Pseudotsuga menziesii*, eucalyptus *Eucalyptus* spp., and northern red oak *Quercus rubra*) species (Fig. 2). The proportion of roosts in each substrate did not vary between the two provinces ($\chi^2 = 3.6$; $df = 6$; $P = 0.854$). The size of the woodland patch in which roosts were found ranged from <1 ha to >10 ha, with most roosts being located in patches of <1 ha (37.5%) or 1–5 ha (29.2%) (Fig. 3). The size of such patches varied between the two regions ($\chi^2 = 12.0$; $df = 3$; $P = 0.005$), with Gipuzkoa having a proportionally higher number of roosts in smaller forest patches (Fig. 3).

Although the maximum number of kites per roost varied substantially from single-bird roosts ($n = 5$) to one with 145 birds (Fig. 4), the proportion of roosts in the population size categories did not vary between the two provinces ($\chi^2 = 0.8$; $df = 3$; $P = 0.842$). Roosts of over 50 birds were more frequent in Gipuzkoa ($n = 5$ vs. $n = 2$). During the simultaneous count, 676 kites were counted at 27 roosts (Gipuzkoa: 434 kites, 13 roosts; Bizkaia: 242 kites, 14 roosts). On the census day, only two one-single bird roosts (both in Bizkaia) were detected and the largest detected roost was one of 94 birds in Gipuzkoa (Fig. 5).

In Gipuzkoa, a province with a confirmed breeding population of 32 pairs of Red Kite (Olano *et al*. in prep.), 12 5×5 UTM cells out of the total of 108 cells had at least one roost (Table 1). Of these, six cells host breeding kites and six had winter roosts with no breeding kites (Table 1). There was no significant correlation between breeding numbers and numbers found in winter ($r = 0.024$, $P = 0.218$; Fig. 6). The occupancy

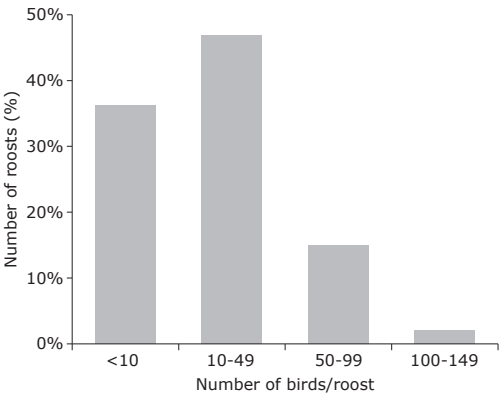


Figure 4. Frequency distribution (in percentage) of the Red Kite roosts in the Basque Eurosiberian region in terms of the maximum number of bird counts at each site.
Distribució de la freqüència (en percentatge) dels dormidors de milà reial a la regió eurosiberiana basca en relació amb el nombre màxim de recomptes a cada dormidor.

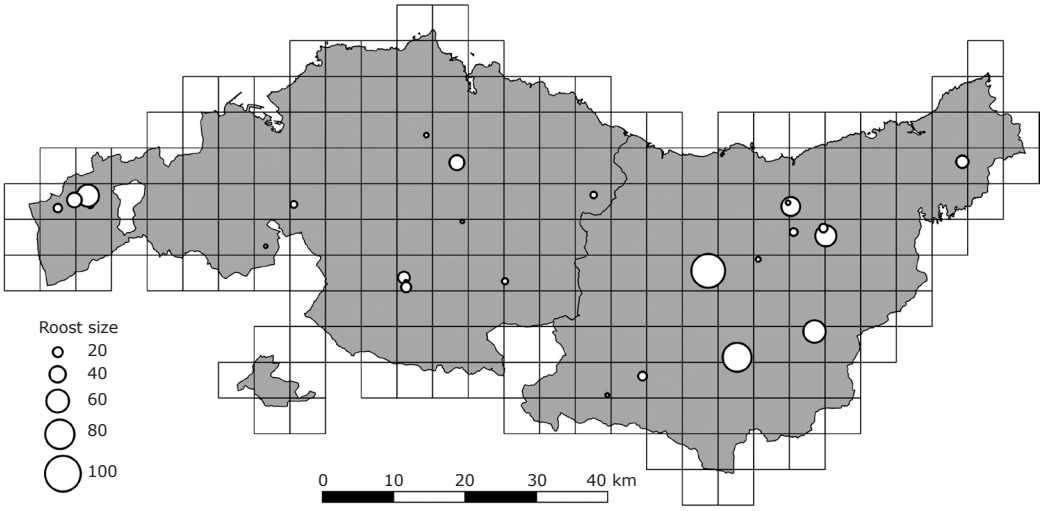


Figure 5. Spatial distribution of the Red Kite roosts and their sizes detected during a simultaneous census conducted in January 2021 (BIZ, Bizkaia; GIP, Gipuzkoa). Grid: UTM 5×5 cells. Nest sites in Gipuzkoa are not shown for reasons of conservation security.
Distribució espacial dels dormidors de milà reial i les seves mides detectats durant un cens simultani realitzat el gener de 2021 (BIZ, Bizkaia; GIP, Gipuzkoa). Quadrícula: UTM 5×5 cel·les. La localització dels nius a Guipúscoa no es mostra per criteris de conservació.

(i.e. presence of roosts) of UTM cells in winter was not independent of the occupancy during breeding season ($\chi^2 = 6.02$, $df = 1$, $P = 0.024$) as proportionally there was a higher number of cells in which occupancy was detected in both periods (Table 1). Single- or two-bird roosts in Gipuzkoa tended to be closer to known existing nest sites (mean ± SE: 1.0 ± 0.7 km, $n = 4$; range: 0.0-3.0 km) than larger roosts (2.6 ± 0.4 km, $n = 23$; range: 0.0-9.8 km), albeit not significantly ($Z = 1.54$, $P = 0.125$).

Discussion

In the Basque Eurosiberian region ca. 50 Red Kite roosts used by a population of almost 700 birds were identified during the winter surveying period. During the simultaneous census, the number of roosts detected was ca. 30. The size of the roosts ranged from 1–2 to 145 birds. Overall, the contribution of the surveyed region to the wintering Spanish Red Kite population – estimated at ca. 50,000 birds (Molina 2015) – is small in absolute numbers (roughly less than 1.5%), although it should be noted that the surface area of the surveyed provinces represents just 0.85% of the area of peninsular Spain. These numbers are important at regional level since (1) they show a clear increase over the 373 birds found in the previous national census in 2013–2014 (Molina 2015); (2) part of these birds belong to the local breeding stock, which can be confirmed as resident (SEO BirdLife & Gipuzkoa Administration, unpubl. data from GPS-tracking). Two adults equipped with GPS tracking devices remained in a radius of no more than a few hundreds of meters of their nest for the whole of the year. Thus, if breeding birds are sedentary and we exclude locally born birds due to their tendency to disperse outside breeding areas, we can conservatively estimate that roughly 20% of the birds using the winter

Table 1. Table showing the number 5×5 UTM grid cells in Gipuzkoa with breeding or/and winter roosts of Red Kites in the 2021 breeding season and the following winter.
Taula creuada amb les cel·les de quadrícula UTM 5×5 de Guipúscoa incloent tant els dormidors de cria i/o hivernada de milans reials per a la temporada de reproducció de 2021 i l'hivern següent.

Number of grid cells with:	Winter roost(s)	No winter roost(s)
Breeding pair(s)	6	18
No breeding pair(s)	6	78

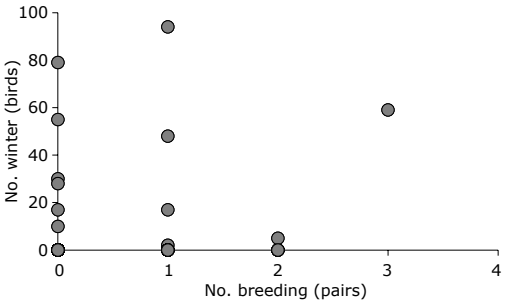


Figure 6. Red Kite counts in UTM 5×5 cells during the breeding and winter periods. Counts from the winter are taken from the simultaneous census performed in January 2021.
Recompte de milans en cel·les UTM 5×5 durant el període de cria i d'hivernada. Els recomptes d'hivern provenen del cens simultani de gener de 2021.

roosts correspond to the local breeding stock. The protection of these roosting sites, therefore, is vital for the conservation of not only kites from abroad (i.e. 'purely' wintering birds) but also of the increasing local breeding population (Olano *et al.* 2016a).

The size of the winter roosts within the survey region was small in relation to other Spanish regions. In the nearby region of Navarra, roosts with over 250 birds have been found (Gorosti, unpubl. data; for details see http://milano-real.blogspot.com). The largest roosts, which can host over 800 birds (Viñuela *et al.* 1999), are mainly found on the northern Castilian plateau, which hosts about 50% of all the Red Kites wintering in Spain (Molina 2015).

Single- or two-bird roosts were not unusual and many were situated in or close to the woodland patches used during the breeding season (Olano, pers. obs.). Previous studies carried out in the Guadalquivir marshes have revealed that local adult kites tend to roost in or close to their nests, while local immature birds and birds from abroad use communal roosts located further away from nest sites (Heredia *et al.* 1991). Something similar seems to occur in Gipuzkoa and, even though the underlying causes of this behavior remain unknown, some hypotheses can be proposed. It could reflect a strategy aimed at (1) defending the territories to be used in the next breeding season from possible future competitors, behaviour that, theoretically, will mostly occur in males (Potti & Montalvo 1991, Kokko 1999, Morbey & Ydenberg 2001, Rotics *et al.* 2018); and/or (2) maximizing the exploitation of already known (i.e. familiar) foraging places and/or occupying the best places before migrants arrive in the non-breeding season (Tellería & Pérez-Tris 2004).

Wintering Red Kite numbers in the Basque Eurosiberian region tended to decline east-to-west, a finding that concurs with the fact that this species breeds in Gipuzkoa (32 territories in 2020; Olano *et al.*, in prep.) but not in Bizkaia. The location of roosts, however, did not match particularly well the location of nest sites, which suggests that ecological requirements during the non-breeding period and/or of non-local birds vary seasonally (Heredia *et al.* 1991), although the causes of this pattern remain unknown.

Most roosts (>60%) were situated in plantations of the exotic Monterey pine. We believe that – at least in part – this is because these pines represent the dominant woodland type over much of the region (Olano *et al.* 2016b). That said, we have noted that birds tend to roost in pine patches even if patches of broad-leaved woodland composed of trees such as oaks (genus *Quercus*) are available nearby (M. Olano, obs. pers.). This behaviour could be attributable to the fact that pines, unlike native deciduous trees, do not shed their leaves in winter and so offer better shelter against possible predators and disturbances, or heavy rain and wind.

Currently, a very high proportion of these trees are affected by the brown-spot needle blight (BSNB), a fungal disease caused by the pathogen *Lecanosticta acicola* (formerly *Mycosphaerella dearnessii*) (Anonymous 2015). Originally from North America, in Europe BSNB has become a serious emerging invasive disease in pines and is currently spreading very fast from southern to northern Europe (Jankovsky *et al.* 2009, Adamson *et al.* 2015, Ortíz de Urbina *et al.* 2017). Until recently, BSNB had only had a marginal impact on both native and exotic pine woodland in northern Spain; however, over the past few years it has started to spread rapidly and has caused severe defoliation and mortality in places that hitherto had not been affected (Ortíz de Urbina *et al.* 2017). The spread of this disease has provoked serious habitat changes as many trees in many woodland areas are dying and forest-dwelling raptors including the Red Kite are losing their nesting habitats. Studies carried out during the breeding season show

that only ca. 10% of pine plantations in Gipuzkoa in 2008 were unaffected by BSNB (source: Gipuzkoa Administration), thereby indicating that almost all of the nesting habitat of the Red Kite in Gipuzkoa (and, therefore, the substrate of most winter roosts) have suffered infection by BSNB. The proportion of winter roosts affected by BSNB was not measured, although it can be roughly estimated to be over 80%.

In conclusion, the Basque Eurosiberian region (provinces of Gipuzkoa and Bizkaia) harbours ca. 50 Red Kite roosts (some of them alternative sites) during the winter, which are used by a population of somewhat less than 700 birds. This population is approximately double the size of the population detected in previous censuses (conducted in 2013–2014), in part due to the increase in local breeding stock, especially in Gipuzkoa. Most roosts were located in Monterey pine plantations, which could become a conservation problem given that most of these plantations are currently suffering from brown-spot needle blight, a fungal disease that can kill branches or even the whole tree.

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Resum

Distribució hivernal i mida de la població del milà reial *Milvus milvus* a la regió eurosiberiana del país Basc

Espanya acull una part important de la població de milà reial d'Europa central/occidental durant l'hivern, per tant, té un paper important per a la seva conservació. Paral·lelament, la població reproductora local resident està disminuint en vastes àrees d'Espanya, però a la regió eurosiberiana basca, el milà reial ha experimentat últimament un creixement demogràfic relativament ràpid, especialment a la província de Guipúscoa. Com a conseqüència, se suposa que la distribució i la mida de la població hivernant ha augmentat. Per actualitzar aquesta informació, es va realitzar un nou cens durant l'hivern 2020/21. Aquest cens també va coincidir amb una convocatòria internacional (LIFE EuroKite) per fer el seguiment de l'espècie a l'hivern. L'objectiu d'aquest treball és analitzar i discutir els resultats d'aquest cens per actualitzar els nostres coneixements sobre la distribució de milans reials i la mida de la població a la regió eurosiberiana basca a l'hivern i avaluar el seu paper com a zona d'hivernada de l'espècie a Europa. Es van detectar ca. 50 dormidors, utilitzats per una població d'uns 700 individus. Durant un cens simultani, el nombre de dormidors utilitzats a la vegada era de ca. 30. La mida dels dormidors oscil·lava d'entre un o dos ocells fins a 145. En conjunt, la contribució de la regió de l'enquesta a la població de milans hivernants a Espanya és petita en xifres absolutes (aproximadament menys de l'1,5%). No obstant això, aquestes xifres encara tenen importància a nivell regional, ja que mostren un augment notable respecte als 373 exemplars trobats en l'anterior cens nacional fet el 2013–2014, i una part d'aquests (aproximadament un 10%) pertanyen a la població nidificant local, la qual es confirma que és resident.

Resumen

Distribución invernal y tamaño poblacional del milano real *Milvus milvus* en la región eurosiberiana del País Vasco

España alberga una fracción importante de la población de milano real de Europa central/occidental durante el invierno, por lo que juega un papel importante para su conservación. Paralelamente, el stock reproductor local residente está disminuyendo en vastas áreas de España, pero en la región vasca eurosiberiana, el milano real ha experimentado últimamente un crecimiento poblacional relativamente rápido, especialmente en la provincia de Gipuzkoa. Como consecuencia, se supone que ha aumentado la distribución y el tamaño de la población invernante. Para actualizar esta información, se realizó un nuevo censo durante el invierno 2020/21. Este censo también coincidió con una convocatoria internacional (LIFE EuroKite) para el seguimiento de la especie en invierno. El objetivo de este trabajo es analizar y discutir los resultados de dicho censo, con el fin de actualizar nuestro conocimiento sobre la distribución y el tamaño poblacional del milano real en la región eurosiberiana del País Vasco en invierno y evaluar su papel como zona de invernada de la especie en

Europa. Detectamos ca. 50 dormideros, utilizados por una población de unos 700 individuos. Durante un censo simultáneo, el número de dormideros utilizados a la vez fue ca. 30. El tamaño de los dormideros varió desde una o dos aves hasta 145. En general, la contribución de la región de estudio a la población invernal de milanos reales en España es pequeña en números absolutos (aproximadamente menos del 1,5%). Sin embargo, esta cifra aún tiene importancia a nivel regional, ya que muestran un aumento notable en comparación con las 373 aves encontradas en el censo nacional anterior realizado en 2013–2014, y parte de estas aves (alrededor del 10%) pertenecen a la población local nidificante, que se confirma como residente.

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