

# Status and distribution of diurnal raptors in Central North Algeria, the case of Great Kabylia

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## Abstract

*Status and distribution of diurnal raptors in Central North Algeria, the case of Great Kabylia.* In 2018 and 2019 thirteen species of raptors, with 407 individuals, were found nesting in Great Kabylia in Algeria. During this period, 196 raptor nest sites were located (*Falco tinnunculus* is not included as it thrives in many biotopes and tolerates anthropization). We noted a decrease in specific richness and abundance of raptors in the region compared to data for 1992. Some raptors were not seen during our study: *Gypaetus barbatus*, *Pandion haliaetus*, *Falco biarmicus*, *Circaetus aeruginosus*, and *Falco eleonora*. We classified nesting diurnal raptors into three classes according to their relative abundance: (1) widespread species (10–26%): *F. tinnunculus*, *Hieraaetus pennatus*, and *Buteo rufinus cirtensis*; (2) common species (5–10%): *Elanus caeruleus*, *Falco peregrinus*, *Circaetus gallicus*, *Falco naumanni*, *Gyps fulvus*, and *Milvus migrans*; and (3) uncommon species (1–5%): *Neophron percnopterus*, *Accipiter nisus*, *Aquila fasciata*, and *Aquila chrysaetos*. With the exception of *N. percnopterus*, which is classified as an endangered species, the raptors of Great Kabylia are mainly classified in the category of species of least concern (IUCN, 2020).

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Key words: Raptors, Nest sites, Great Kabylia, Algeria

## Resumen

*Estado y distribución de las rapaces diurnas en la Gran Cabília (norte de Argelia Central).* En la Gran Cabília (Argelia) nidifican 13 especies de rapaces, de las que observamos 407 individuos durante los años 2018 y 2019. En este periodo localizamos 196 puntos de nidificación de rapaces, excluyendo a *Falco tinnunculus* puesto que prospera en diferentes biotopos y tolera la antropización. Observamos una disminución de la riqueza y abundancia de especies de rapaces en la región con relación a los datos de 1992. Durante nuestro estudio no observamos algunas rapaces como *Gypaetus barbatus*, *Pandion haliaetus*, *Falco biarmicus*, *Circaetus aeruginosus* y *Falco eleonora*. Las rapaces diurnas nidificantes se clasifican en tres clases según su abundancia relativa: (1) especies muy difundidas (10–26%): *F. tinnunculus*, *Hieraaetus pennatus* y *Buteo rufinus cirtensis*; (2) especies comunes

(5–10%): *Elanus caeruleus*, *Falco peregrinus*, *Circaetus gallicus*, *Falco naumanni*, *Gyps fulvus* y *Milvus migrans*; y (3) especies poco comunes (1–5%): *Neophron percnopterus*, *Accipiter nisus*, *Aquila fasciata* y *Aquila chrysaetos*. Las rapaces de la Gran Cabília están incluidas, en su mayor parte, en la categoría de especies de preocupación menor (UICN, 2020), excepto *N. percnopterus*, que está clasificada como especie en peligro de extinción.

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Palabras clave: Aves rapaces, Lugares de nidificación, Gran Cabília, Argelia

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## Resum

*Estat i distribució dels rapinyaires diürns a la Gran Cabília (nord d'Algèria Central)*. A la Gran Cabília (Algèria) nidifiquen 13 espècies de rapinyaires, de les quals vam observar 407 individus durant els anys 2018 i 2019. En aquest període vam localitzar 196 punts de nidificació de rapinyaires, excloent-ne *Falco tinnunculus* atès que prospera en diferents biòtops i tolera l'antropització. Vam observar una disminució de la riquesa i abundància d'espècies de rapinyaires a la regió respecte a les dades de 1992. Durant el nostre estudi no vam observar alguns rapinyaires com *Gypaetus barbatus*, *Pandion haliaetus*, *Falco biarmicus*, *Circaetus aeruginosus* i *Falco eleonora*. Els rapinyaires diürns nidificants es classifiquen en tres classes segons l'abundància relativa: (1) espècies molt difoses (10–26%): *F. tinnunculus*, *Hieraaetus pennatus* i *Buteo rufinus cirtensis*; (2) espècies comunes (5–10%): *Elanus caeruleus*, *Falco peregrinus*, *Circaetus gallicus*, *Falco naumanni*, *Gyps fulvus* i *Milvus migrans*; i (3) espècies poc comunes (1–5%): *Neophron percnopterus*, *Accipiter nisus*, *Aquila fasciata* i *Aquila chrysaetos*. La major part de rapinyaires de la Gran Cabília estan inclosos en la categoria d'espècies de preocupació menor (UICN, 2020), excepte *N. percnopterus*, que està classificada com a espècie en perill d'extinció.

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Paraules clau: Ocells rapinyaires, Llocs de nidificació, Gran Cabília, Algèria

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## Introduction

Diurnal raptors often attract much attention from ornithologists due to their size, fierce behavior, rarity, the symbolism often associated with them, and the identification problems they sometimes pose (Dubois and Duquet, 2009). Raptors play an important role in maintaining the balance of rodents, grain–eating birds, and insects harmful to crops. When they hunt diseased prey, it limits the spread of animal epidemics. Some raptors are nature's garbage collectors because they feed on the corpses of wild and domestic animals (Franchimont, 2001). Studies performed on diurnal raptors in Algeria to date have mainly focused on the trophic ecology of a few species, such as *Falco tinnunculus* (Baziz et al., 2001; Souttou

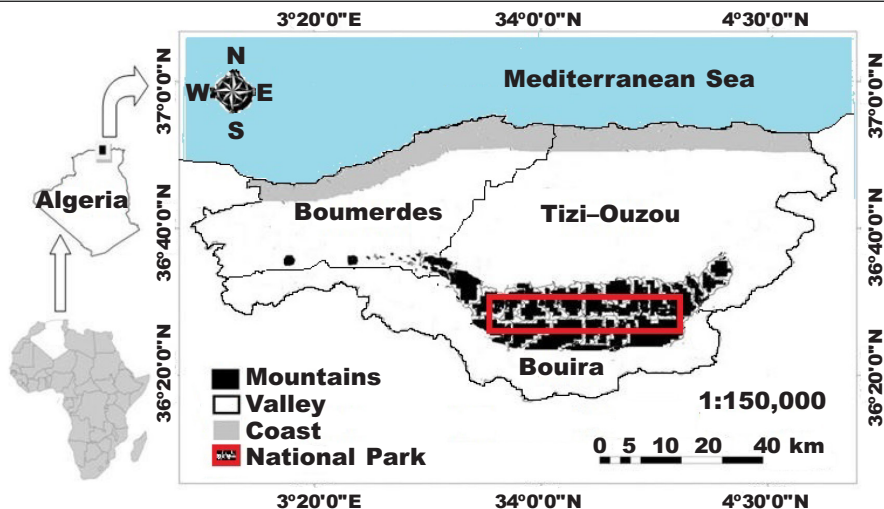


Fig. 1. Study region in Great Kabylia (Algeria).

Fig. 1. Área de estudio en la región de la Gran Cabília (Argelia).

et al., 2005, 2006, 2007, 2008, 2012, 2018), *Elanus caeruleus* (Manaa et al., 2013), *Falco eleonora* (Bakour and Moulai, 2019), *Buteo rufinus cirtensis* and *Falco biarmicus* (Djilali, 2019). Among the research of note on the distribution of diurnal raptors carried out in Algeria it is worth mentioning that of Heim de Balsac and Mayaud (1962), Kerautret (1967), Ledant et al. (1981), Moali and Gaci (1992) in Great Kabylia; Moulai and Mostefai (2015) in Béjaïa; Benmammam–Hasnaoui and Bounaceur (2019) in the extreme northwest of the country; Messabhia (2019) in the region of Oum El Bouaghi; Djilali (2019) in Ghardaïa and Béchar; and Elafri et al. (2020) in northeastern Algeria. The most recent update of nesting diurnal raptors in Great Kabylia in northern Algeria was the work of Moali and Gaci (1992). The aim of the present study was to update the status and distribution of the diurnal raptors of Great Kabylia, 30 years later.

## Material and methods

### Study area

The study was conducted in Great Kabylia. The observations were mainly made in the departments of Tizi–Ouzou and Boumerdes, and in part of the north of the department of Bouira. The study region has a Mediterranean climate. It is bound to the north by the Mediterranean Sea, to the east by the department of Béjaïa, to the west by the capital Algiers and the Blida department, and to the south by the M'sila department. Three main ecological zones characterize the study region; the mountain, the valley, and the coast (fig. 1).

The mountain range of Djurdjura mainly represents the mountainous relief. It is characterized by a cedar forest with an area of 2,940 ha, in which there are two types of stands: cedar stands (*Cedrus atlantica*) occupying 80% of the total area, with a few scattered plants of Holm oak (*Quercus rotundifolia*), maple (*Acer obtusatum* and *Acer monspessulanum*), aleppo pine (*Pinus halepensis*), zean oak (*Quercus canariensis*) and yew (*Taxus baccata*).

The remaining 20% of the area is populated by mixed cedar (cedar and holm oak) (Moussouni and Boubaker, 2015). The shrub layer comprises *Quercus rotundifolia*, *Berberis hispanica*, *Crataegus laciniata*, *Rosa sicula*, *Rosa canina*, *Lonicera kabylica*, *Daphne laureola* subsp. *latifolia*, *Ruscus aculeatus* (Meddour, 2010). The rocky mountain cliffs with cavities and caves favor the settlement of raptors. The scree below forms their hunting grounds. In the middle of the mountain range is the Djurdjura National Park, between the departments of Tizi-Ouzou and that of Bouira, covering an area of 18,550 ha. The valley makes up a larger area than the mountain and coast areas. It is characterized by the presence of a set of human agglomerations (towns and villages), and agricultural land, and on the neighboring hills we find mixed forests of holm oak and cork oak. The coastal strip has a humid climate and is characterized by cork oak forests, areas with shrubland, dune ridges, ponds, and sea cliffs.

### Methodology

The census of diurnal raptor nesting pairs and the geolocation of raptor nest sites were carried out for two consecutive years; 2018 and 2019. Counts were carried out during the breeding season from March to July. The total area surveyed on the ground was 552,400 ha. The method adopted for the census of breeding pairs was the systematic search for raptor nest sites in favorable habitats, namely, rocky mountain cliffs (mainly in the Djurdjura National Park), seaside cliffs, tall trees, and rocky peaks in the valley. The investigation was sometimes carried out by car (road transect method) at valley level, or on foot (hiking) in places inaccessible to vehicles, especially in the mountains and seaside cliffs. The observations were carried out on a total of 46 roads and routes. The conservation status of the species was assessed with reference to the IUCN Red List (IUCN, 2020).

We calculated the total number of the breeding raptor pairs detected in all surveys. Moreover, the species' totals and the relative abundance (%) ( $n/N \times 100$ ) were also counted: where (n) is the count of pairs of a particular bird species and (N) is the total number of the pairs counted for all species during each count session. For frequency occurrence (%) ( $N_i/N_t \times 100$ ), where ( $N_i$ ): number of roads and routes where breeding pairs of one species have been observed, ( $N_t$ ): total number of roads and routes visited.

On the maps, in addition to the number of the breeding pairs observed we added the number of juveniles of colonial species to gather more data concerning the size of the colonies. The colonies mentioned in the maps are those of *Falco naumanni* and *Gyps fulvus*.

Principal component analysis (PCA) was used to show the correlation between diurnal raptor species and the main habitats of Great Kabylia. The distribution of the raptor species according to the three habitat types on the graphic allowed us to separate the raptor species into groups.

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## Results

Thirteen species of diurnal raptors nest in Great Kabylia in Algeria. During the study period, 196 breeding pairs and 407 individuals were identified (table 1, see also the dataset published through GBIF (Doi: [10.15470/wt5dgi](https://doi.org/10.15470/wt5dgi)), including 13 juveniles of *Falco naumanni* and two juveniles of *Gyps fulvus* (colonial species).

Among the raptors inventoried, Falconidae were represented by three species; the common kestrel *F. tinnunculus*, the lesser kestrel *F. naumanni*, and the peregrine falcon *F. peregrinus*. There were ten species of Accipitridae: black-winged kite *E. caeruleus*, *A. nisus*, short-toed snake eagle *C. gallicus*, booted eagle *H. pennatus*, Bonelli's eagle *A. fasciata*, golden eagle *A. chrysaetos*, black kite *M. migrans*, griffon vulture *G. fulvus*, Egyptian vulture *N. percnopterus*, and North African long-legged buzzard *B. rufinus cirtensis* (table 1).

According to their relative abundance (table 1), the raptors were categorized into three classes; very common: 10–26%, common 5–10%, uncommon: 1–5%. The species *F. tinnunculus*

Table 1. Number and status of diurnal raptors nesting in Great Kabylia (Algeria). N, total number of raptors pairs; OF, occurrence frequency (in %); RA, relative abundance; BS, breeding status (NS, sedentary breeder; NM, migratory breeder); IUCN, IUCN status in 2020 (LC, least concern; EN, endangered; D, decreasing; S, stable; U, unknown; I, increasing).

Tabla 1. Número y estado de las rapaces diurnas nidificantes en la Gran Cabilia (Argelia): N, número total de parejas de rapaces; OF, Frecuencia de ocurrencia (en %); RA, abundancia relativa; BS, tipo de reproductor (NS, nidificante sedentario; NM, nidificante migrador); IUCN, estado en la UICN en 2020 (LC, preocupación menor; EN, en peligro; D, en descenso; S, estable; U, no común; I, en aumento).

Raptor species	N	FO	RA	BS	IUCN
Falconidae					
<i>Falco tinnunculus</i>	49	84.78	25.00	NS	LC–D
<i>Falco naumanni</i>	11	5.56	5.61	NM	LC–S
<i>Falco peregrinus</i>	12	26.09	6.12	NS	LC–S
Accipitridae					
<i>Elanus caeruleus</i>	18	21.74	9.18	NS	LC–S
<i>Accipiter nisus</i>	6	13.04	3.06	NS	LC–S
<i>Circaetus gallicus</i>	10	19.57	5.10	NM	LC–S
<i>Hieraaetus pennatus</i>	26	30.43	13.27	NM	LC–U
<i>Aquila fasciata</i>	6	13.04	3.06	NS	LC–D
<i>Aquila chrysaetos</i>	4	8.7	2.04	NS	LC–S
<i>Milvus migrans</i>	10	15.22	5.10	NM	LC–S
<i>Gyps fulvus</i>	11	8.7	5.61	NS	LC–I
<i>Neophron percnopterus</i>	8	13.04	4.08	NM	EN–D
<i>Buteo rufinus cirtensis</i>	25	28.26	12.76	NS	LC–S

(25%), *H. pennatus* (13.27%) and *B. rufinus cirtensis* (12.76%) belong to the class of very common species; *E. caeruleus* (9.18%), *F. peregrinus* 6.12%, *F. naumanni* and *G. fulvus* with the same frequency (5.61%); *M. migrans* and *C. gallicus* with the same frequency (5.10%) belong to the class of common species; *N. percnopterus* 4.08%, *A. nisus* and *A. fasciata* with the same frequency (3.06%) and *A. chrysaetos* 2.04% belong to the class of uncommon species.

Diurnal raptors nesting in Great Kabylia are distributed according to the three latitudinal zones of the study area (coast, valley and mountain) (fig. 1).

Figure 2A shows the nine species and the coastal zone with six species. The valley zone hosted the highest number of pairs with 53.57% (105 pairs), the mountain zone hosted the second largest number with 29.59% (58 pairs), followed by the coastal zone with 16.84% (33 pairs) (fig. 2B).

The PCA (fig. 3) results revealed a total variance of 90.95%. This rate of information was retrieved by the two axes (F1 and F2). However, the F1 axis (54.81%) conveyed more information than the F2 axis (36.14%). Coast and valley environmental variables were strongly and positively linked to the 1st dimension (F1), with the respective values: 0.85 and 0.92. Both these variables contributed strongly to the formation of the F1 axis. The

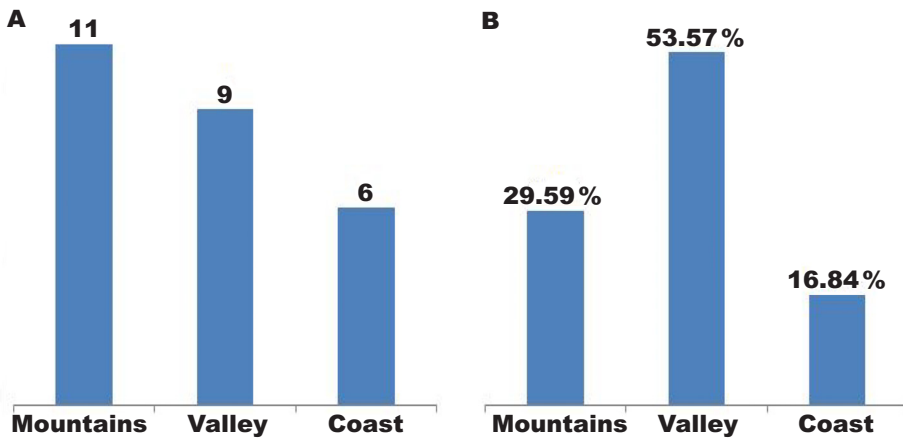


Fig. 2. Distribution of diurnal raptors in the three latitudinal zones of Great Kabylia: A, specific richness; B, relative abundance.

Fig. 2. Distribución de rapaces diurnas en las tres zonas latitudinales de la Gran Cabilia: A, riqueza de especies; B, abundancia relativa.

mountain variable was strongly and positively correlated to the 2nd dimension (F2), with a value of 0.95. This is a strong contribution to the formation of the F2 axis. The significance of the level of the correlation matrix was 0.95 (5% risk of error). This correlation matrix between the environmental variables indicates that the variables coast and valley were moderately high (0.62), meaning an average similarity in species richness and number of raptor breeding pairs in these two habitat types. The coast and mountain variables were weakly correlated (0.11), indicating a low degree of similarity in species richness and number of raptor breeding pairs in these two habitat types.

The valley and mountain variables showed a negative correlation ( $-0.27$ ), meaning a weak and negative relation between the two variables. The species richness and number of raptor breeding pairs differed greatly in the two habitat types.

Regarding the species assemblages according to the three habitat types (mountain, valley and coast), we identified four groups. Group G1 (fig. 3) consisted of the most dominant species on the coast, and also the most abundant species in the study area: *F. tinnunculus* (FT) and *H. pennatus* (HP). The 2nd group, G2, consisted of *B. rufinus cirtensis* (BRC), *E. caeruleus* (EC), and *M. migrans* (MM). These species are characteristic of the valley habitat. The 3rd group, G3, consisted of the following species: *G. fulvus* (GF), *F. naumanni* (FN), *N. percnopterus* (NP), and *A. chrysaetos* (AC). They are species of mountain habitat. *A. chrysaetos* (AC) is found at an extreme position in the PCA graph because of the low number of individuals, with only 4 pairs. The 4th group, G4, consisted of the following species: *A. fasciata* (AF), *A. nisus* (AN), *C. gallicus* (CG), and *F. peregrinus* (FP). These are placed in the center of the PCA graph, i.e., they are not well represented as their presence was low (number of pairs  $\leq 8$  pairs).

Figure 4 shows the distribution of raptor nest sites in Great Kabylia in 2018 and 2019. The results of the distribution of diurnal raptor species in Great Kabylia (fig. 4), as seen in Map 1, show that the 10 identified pairs of *M. migrans* were mainly observed in the valley. These pairs were mostly within a minimum distance of 500 meters from each other. For the species *N. percnopterus*, all eight pairs were located in the Djurdjura Mountain, mainly in the



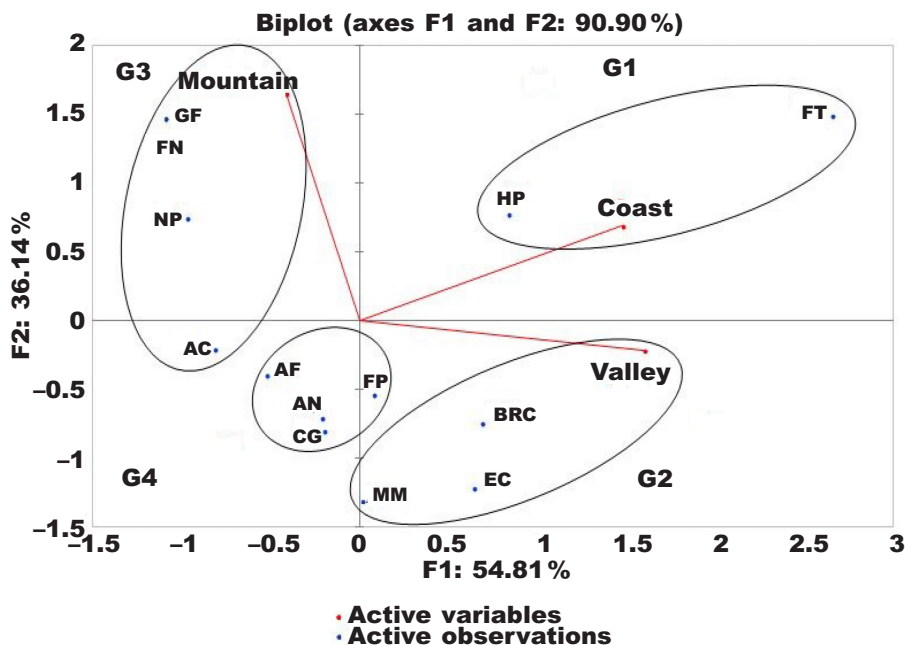


Fig. 3. Principal component analysis (PCA) of diurnal raptor species according to their main habitats in Great Kabylia. (For abbreviations see the text).

Fig. 3. Análisis de componentes principales (PCA) de las especies de rapaces diurnas en los principales hábitats de la Gran Cabília. (Para las abreviaturas, véase el texto).

national park, at distances of at least around 5 km. Map 2 shows the four identified pairs of *A. chrysaetos* were mainly found in the mountains, at least 25 km apart. The six pairs of *A. fasciata* were observed in all three types of habitat (mountain, valley, and coast). Map 3 shows the 18 pairs of the species *E. caeruleus* were mainly in the valley area (16 pairs), although two pairs were recorded on the coast. In Map 4, the 49 pairs identified of the species *F. tinnunculus* are distributed in the three types of habitat (mountain, valley, and coast) with predominance for the valley (26 pairs), seven pairs in the mountain, 16 pairs in the coastal area. Map 5 shows 22 of the 25 pairs of *B. rufinus cirtensis* were in the valley (22 pairs) and three pairs were in the mountains. For the species, *F. naumanni*, the 11 pairs identified in two colonies were exclusively found in the mountains. The two settlements are far apart (about 70 km). Map 6 shows the four colonies of *G. fulvus*, with 11 pairs. These colonies are all approximately about 5 km apart, and the distance between the closest pairs within the colonies was about 10 m. The 12 identified pairs of *F. peregrinus* were distributed over the three habitat types: three pairs on the coast, seven pairs in the valley, and two pairs in the mountains. Map 7 shows the 26 identified pairs of the species *H. pennatus*, distributed over the three habitat types, with 12 pairs in the valley ( ), eight pairs on the coast, and six pairs in the mountains. Map 8 shows the 10 identified pairs of *C. gallicus*, eight in the valley and two in the mountains. The six pairs of *A. nisus* were distributed over the three habitat types: three pairs on the coast, two pairs in the valley, and one pair in the mountains.

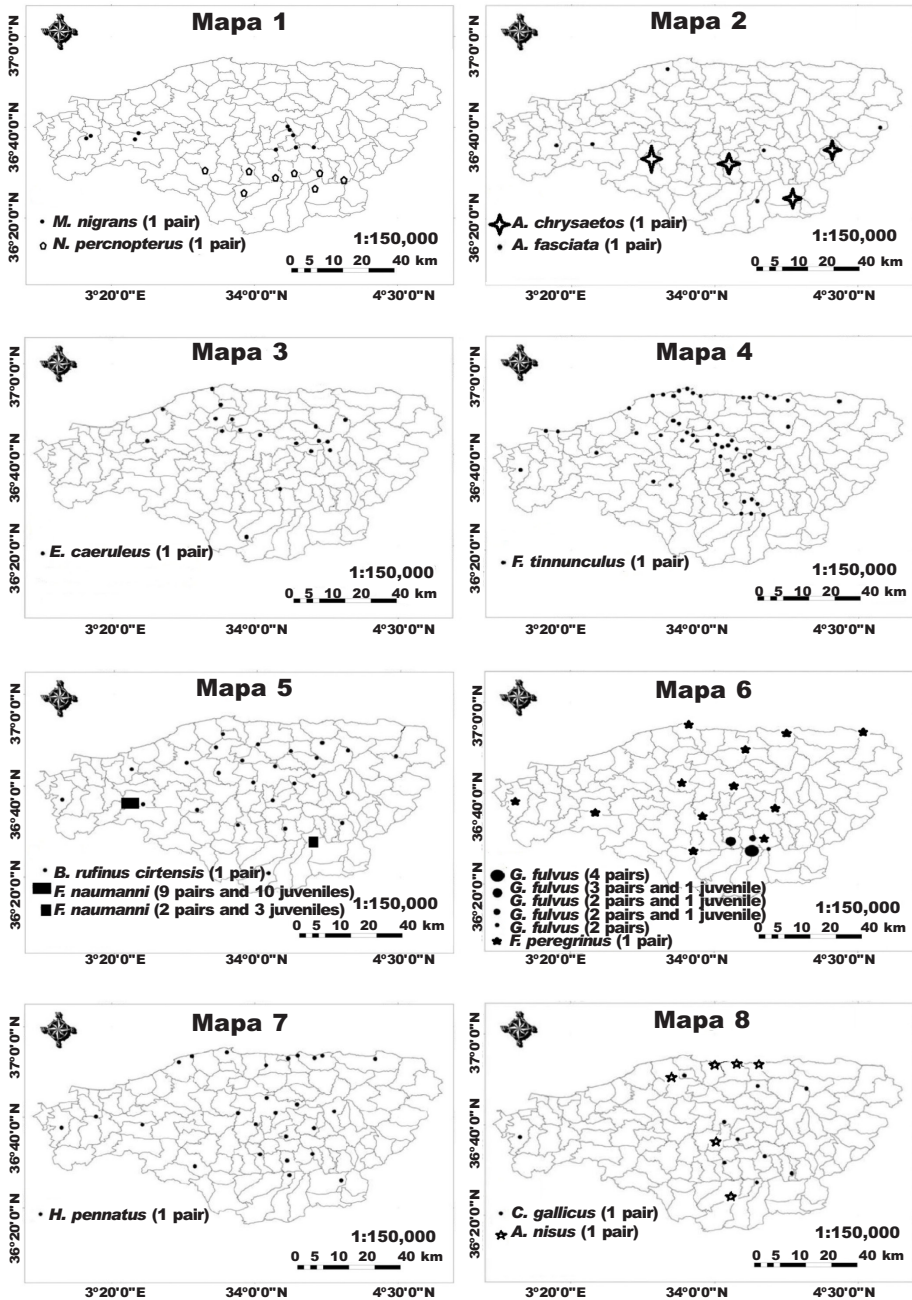


Fig. 4. Distribution of nesting pairs of diurnal raptors in Great Kabylia.

Fig. 4. Distribución de parejas nidificantes de rapaces diurnas en la Gran Cabília.



Table 2. Number of pairs of nesting diurnal raptors observed in the region of Great Kabylia between 1992 and 2019.

Tabla 2. Número de parejas de rapaces diurnas nidificantes entre 1992 y 2019 en la región de la Gran Cabília.

Raptor species	Number of pairs in 1992 (Moali and Gaci, 1992)	Number of pairs (present study, 2018-2019)
Falconidae		
<i>Falco tinnunculus</i>	More than 40	49
<i>Falco naumanni</i>	2 colonies (size not specified)	2 colonies (11 pairs)
<i>Falco peregrinus</i>	19	12
<i>Falco eleonora</i>	7 individuals	0
<i>Falco biarmicus</i>	2	0
Accipitridae		
<i>Elanus caeruleus</i>	4	18
<i>Accipiter nisus</i>	Number not specified	6
<i>Circaetus gallicus</i>	9	10
<i>Circaetus aeruginosus</i>	2	0
<i>Hieraaetus pennatus</i>	Very common (number not specified)	26
<i>Aquila fasciata</i>	13	6
<i>Aquila chrysaetos</i>	3	4
<i>Milvus migrans</i>	19	10
<i>Gyps fulvus</i>	42	11
<i>Neophron percnopterus</i>	32	8
<i>Gypaetus barbatus</i>	1	0
<i>Buteo rufinus cirtensis</i>	Number not specified	25
Pandionidae		
<i>Pandion haliaetus</i>	1	0

## Discussion

In Great Kabylia in Algeria, 13 species of diurnal raptors were found nesting during 2018 and 2019. Some years earlier, in the same region, Moali and Gaci (1992) identified 18 nesting species. We did not observe five species reported by previous authors, namely *F. eleonora*, *F. biarmicus*, *C. aeruginosus*, *G. barbatus*, and *P. haliaetus*. The colony of seven pairs of Eleonore's falcon observed at Tizirt no longer seems to exist. The emblematic species of Djurdjura National Park, *Gypaetus barbatus*, was not found breeding during our study period. Neither was *Pandion haliaetus*, which seems to breed only in coastal areas in Algeria, especially on cliffs and coastal islets (Moulaï et al., 2015).

Table 2 presents the comparison of the number of diurnal raptor nesting pairs between 1992 and 2019 in the region of Great Kabylia.

On a specific scale, *F. tinnunculus* is the most common raptor species in the region. We counted 49 pairs counted in the present study. This is similar to data from Moali and Gaci (1992) in the same region, with 40 pairs in 1989. Numbers of this species seems to remain high. The species *F. naumanni* is rarely encountered in the study area. Only two colonies were recorded, and both were in different areas; one colony of 28 individuals (nine pairs and 10 juveniles) and another colony of seven individuals (two pairs and three juveniles). Moali and Gaci (1992) also recorded two colonies in 1989, but did not specify numbers. The same finding (two colonies) was reported by Desmond, as cited by Ledant et al. (1981). Moali and Gaci (1992) reported 19 pairs of the species *F. peregrinus*. However, in the present study, only 12 pairs were recorded (table 2). The species *F. biarmicus* was rarely observed by Kérautret (1967) and Moali and Gaci (1992), and no evidence of nesting was described. However, Moali (1999) estimated the presence of two pairs. In the present study, we did not observe any individuals of this species. The species *E. caeruleus* is reported with 18 pairs distributed essentially in the open environments of the valleys. Moali and Gaci (1992) reported the nesting of the black-winged kite on May 15th 1987, but did not specify the number of pairs (table 2). However, in 1999, Moali estimated the presence of four pairs. The species *A. nisus* was reported by Moali and Gaci (1992) as a frequent species in the cedar forest of Djurdjura. In the present study we it is rather a discrete forest species, hence the rarity of observations, with only six pairs recorded. Moali and Gaci (1992) reported nine pairs of *C. gallicus* in 1989. In the present study, we observed 10 pairs. The species *H. pennatus* was reported by Kérautret (1967) and Moali and Gaci (1992) as the most common and abundant eagle. The same finding is reported in the present study, with 26 pairs (table 2). The species *A. fasciata* was reported by Moali and Gaci (1992) with 13 pairs in 1989. In the present study, only six pairs were recorded. Concerning the species *A. chrysaetos*, four pairs are noted during our study. Moali and Gaci (1992) reported only three pairs in Great Kabylia. The species *M. migrans* was reported by Kérautret (1967) as being very common, without specifying the number of pairs, and Moali (1999) reported the presence of 19 pairs. In the present study, only 10 pairs were recorded. The species *G. fulvus* was observed by Desmond cited by Ledant et al. (1981) with a population organized in two groups. Moali and Gaci (1992) reported 42 pairs between 1988 and 1991. In the present study (2018–2019), we estimated a population of 11 pairs and two juveniles in the Djurdjura Mountains. This decline is probably due to the poisoning in 1997 that caused the death of a dozen individuals of *G. fulvus* (pers. comm. by residents). We also note the decline of *N. percnopterus*, with 32 pairs recorded in 1989 by Moali and Gaci (1992), and only eight pairs and three juveniles for the present study (2018–2019) in Djurdjura (table 2). Concerning the species *G. barbatus*, no observations are reported in the present study. However, the population of this species has previously been described but in low numbers. In 1989, Moali and Gaci (1992) observed a single pair in the northeast of Great Kabylia, in the coastal zone. Desmond, quoted by Ledant et al. (1981), reported in Djurdjura the existence of two breeding areas for this species and regular observations of adults and two juveniles. In Tunisia, *G. barbatus* is considered an extinct species, according to Isenmann et al. (2005). The species *B. rufinus cirtensis*, is quite common in our region with the presence of 25 pairs. Moali and Gaci (1992) did not specify the number of pairs estimated in 1989. The species *C. aeruginosus* was described by Moali and Gaci (1992) as widespread in winter along the Sebaou and one of its tributaries. Both authors assumed that a few individuals remain to nest there, and Moali (1999) estimated the presence of two pairs. In the present study, we recorded a single observation of a male individual in winter in a reed pond in the coastal zone, but the species was not seen again during the breeding season. The species *P. haliaetus* was reported by Moali and Gaci (1992) who observed a pair and their juvenile east of Tigzirt in July 1990. In the present study, the species *P. haliaetus* was observed (table 2).

Concerning the conservation status of the species studied (IUCN, 2020), the diurnal raptors of the study area are in the rank of species of least concern (LC) for the majority of species, except for *N. percnopterus*, which is classified as endangered (EN).

The most abundant species in the present study in Great Kabylia are *F. tinnunculus* (25%), *H. pennatus* (13.27%) and *B. rufinus cirtensis* (12.76%). These three species alone represent more than 50% of the breeding raptors in Great Kabylia. In comparison, in Europe, and more precisely in France, the most common nesting raptors are *F. tinnunculus* and *B. rufinus cirtensis*, representing respectively 43% and 25% (Hauchecorne and Beaudoin, 2006). In Algeria, 41 diurnal raptors can be observed, 23 of which are nesting (Isenmann and Moali, 2000). Depending on the habitats and regions surveyed in Algeria, an average of 5–14 breeding raptors can be noted in any region at a time (Bougaham and Moulai, 2013; Moulai and Mostefai, 2015; Benmammar–Hasnaoui and Bounaceur, 2019; Messabha, 2019; Djilali, 2019; Elafri et al., 2020).

To better protect diurnal raptors, protective measures are essential in all three habitat types in Great Kabylia (mountains, valley and coast). It is essential to prohibit the hunting of raptors, whatever the species, and authorized game hunters must not use pellet guns that can cause lead poisoning of raptors that feed on carrion. Farmers in the valley should reduce the use of pesticides to limit the phenomenon of bioaccumulation and thus avoid the poisoning of raptors. Forest fires are another great danger for diurnal birds of prey in Great Kabylia, especially for juveniles that cannot yet leave their nests.

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