

# New distribution and breeding location of the Stock Dove *Columba oenas* in Algeria

Mayssara El BOUHISSI <sup>1,2</sup>, Habib Allah BENHAMOU <sup>2</sup>, Abdelkader BEKKOUCHE <sup>3</sup>, Yassine BOULENOUAR <sup>4</sup>, Zouaoui KHACHEB <sup>5</sup> & Abdelwahab CHEDAD <sup>6,7\*</sup>



Received: November 20, 2023 – Revised: January 13, 2024 – Accepted: January 20, 2024

El Bouhissi, M., Benhamou, H. A., Bekkouche, A., Boulenouar, Y., Khacheb, Z. & Chedad, A. 2024. New distribution and breeding location of the Stock Dove *Columba oenas* in Algeria. – Ornis Hungarica 32(1): 209–221. DOI: 10.2478/orhu-2024-0015

**Abstract** Algeria hosts seven species of the Columbidae family, including pigeons and doves, the majority of which have been the subject of numerous studies, but none have been conducted on the Stock Dove (*Columba oenas*). Data on this species are still scarce, and its distribution is limited only to Kabylie in northern Algeria. Species occurrence data were collected from September 2022 to August 2023 using the point count method. However, the species was recently recorded in several new localities (20 stations) in West Algeria, at Sidi Bel Abbès and Tlemcen. All our observations were made in a semi-arid bioclimatic area at an altitude ranging between 750 and 1,216 m. Nesting sites were located on woodland and forest edges, not far from water sources, and feeding sites were located in open, natural, or agricultural environments where cereal seeds, grasses, flower buds, and young green shoots were consumed. It could also cohabit with other species of pigeons and doves.

**Keywords:** Columbidae, *Columba oenas*, breeding, range distribution, avifauna, Algeria

**Összefoglalás** Algériában hét különböző galambfaj él, amelyek többségével számos tanulmány foglalkozott korábban. Kivételt képez ez alól a kék galamb (*Columba oenas*). Ennek a fajnak szórványos adatai vannak az országból, elterjedési területe az északi országgrészben található Kabylie területére korlátozódik. Adatgyűjtés céljából 2022 szeptembere és 2023 augusztusa között végeztünk pontszámlálásokat. A közelmúltban a fajt több új helyen, összesen 20 állomáson észlelték Algéria nyugati részén, Sidi Bel Abbès és Tlemcen környékén. Minden megfigyelésünk fűszáraz bioklimatikus területen történt, 750 és 1216 m közötti tengerszint feletti magasságban. A fészkelőhelyek erdőszéleken és erdőkben találhatók, nem messze a vízforrásoktól, a táplálkozóhelyek pedig nyílt, természetes vagy mezőgazdasági környezetben helyezkednek el, ahol a kék galambok gabonamagvakat, füveket, virágrügyeket és fiatal zöld hajtásokat fogyasztanak. Más galambfajokkal is együtt élhet.

**Kulcsszavak:** Columbidae, *Columba oenas*, fészkelés, elterjedési terület, madárvilág, Algéria

<sup>1</sup> Laboratory Ecodevelopment of Spaces, University of Djillali Liabes Sidi Bel Abbès, 22000 Sidi Bel Abbès, Algeria

<sup>2</sup> Directorate of Forest Conservation of Sidi Bel Abbès (General Directorate of Forestry), 22000 Sidi Bel Abbès, Algeria

<sup>3</sup> Independent Naturalist, El Hamadna, 48000 Relizane, Algeria

<sup>4</sup> Directorate of Forest Conservation of Relizane (General Directorate of Forestry), 48000 Relizane, Algeria

<sup>5</sup> Independent Naturalist, Sidi Bel Abbès, 22000 Sidi Bel Abbès, Algeria

<sup>6</sup> Laboratory of Saharan Bio-Resources: Preservation and Valorisation, Ouargla University, 30000, Algeria

<sup>7</sup> Directorate of Forest Conservation of Ghardaïa (General Directorate of Forestry), 47000, Algeria

\* corresponding author; e-mail: agrochedad@yahoo.fr

## Introduction

In the course of evolution, species' ranges have repeatedly contracted and expanded in response to varying environmental conditions (Van der Jeugd *et al.* 2009). The dispersal of birds is linked to major natural phenomena on a geological scale, such as the last glaciation (Blondel 1995), but also to phenomena more limited in time, such as global climate warming in arid environments (Wolf 2000). In spite of this, animals are increasingly being transported beyond their native ranges by human activities and into places where they are alien (Clavero & Garcia-Berthou 2005, Simberloff *et al.* 2013, Blackburn *et al.* 2014). As a result, changes in species distributions are predicted to cause range contractions, alterations in community composition, and increased extinction risk (Thomas *et al.* 2006, Bellard *et al.* 2012).

The movement of organisms is a central process in ecology and evolution, and understanding the selective forces shaping the spatial structure of populations is essential to conservation (Samraoui *et al.* 2023), so that the distribution of species is affected, both in space and time, by environmental, biological, historical, and anthropogenic factors (Lomolino *et al.* 2006). There are two forms of movement in nature: (i) Migration is a form of evolutionary adaptation that allows organisms to undertake a directional and synchronized seasonal movement, either to hunt down fluctuating resources or to escape temporarily unfavorable conditions (Dingle & Drake 2007); (ii) Dispersal is the unidirectional movement of an individual from its native or breeding site; it is also a complex and multidimensional process influencing community structure, population dynamics, and connectivity (Greenwood & Harvey 1982, Levin *et al.* 2003).

The vast area of Algeria, with its diversity of ecosystems, has contributed to plant diversity, which in turn has affected animal biodiversity. In addition to the expansion of scientific research activity, all this has recently led to the addition of many species to the list of Algerian birds, and the announcement of the expansion of the distribution area and also new breeding sites (Chedad *et al.* 2020a, Boulaouad *et al.* 2022, Belakhdar & Chedad 2023). Birds are regarded as bioindicators due to the fact that variations in their population size, behavior, and capacity to reproduce reflect the health of the ecosystem (Harisha & Hosetti 2009, Schrag *et al.* 2009, Zhang & Ma 2011, Egwumah *et al.* 2017, Kurniawan & Arifianto 2017).

There are 352 species of the family Columbidae (regrouped pigeons and doves) that are distributed across most continents (Gill *et al.* 2023). Algeria has recorded seven nesting species, with a distribution between sedentary and migratory: (i) the Rock Dove (*Columba livia*) is considered one of the most commonly distributed species, with several subspecies (Isenmann & Moali 2000); (ii) the Eurasian Collared Dove (*Streptopelia decaocto*) was first observed in northeast Annaba in 1994, and it is considered a very common invasive species (Benyacoub 1998, Isenmann & Moali 2000); (iii) the Laughing Dove (*Spilopelia senegalensis*) has long been confined to the oases of the northeast and east of the country; subsequently, the species extended its range to the west and south in the mid-1960s (Isenmann & Moali 2000); (iv) the European Turtle Dove (*Streptopelia turtur*) is a summer nesting bird throughout the northern gate of the country and is resident practically

everywhere in the Sahara region at Hoggar, Tassili, Ménéa, Tindouf, Timimoun and Adrar (Isenmann & Moali 2000, Chedad *et al.* 2020b, Mansouri *et al.* 2022); (v) the Common Wood Pigeon (*Columba palumbus*) is a common resident in Algerian forests, and its populations have increased significantly in previous years (Isenmann & Moali 2000); (vi) the Namaqua Dove (*Oena capensis*) is a sedentary breeding species in the extreme south at Tamanrasset, In Guezzam and Bordj Badji Mokhtar (Isenmann & Moali 2000, Haddad *et al.* 2023); (vii) lastly, the distribution of Stock Dove (*Columba oenas*) is restricted to a specific region in Kabylie in northern Algeria (Isenmann & Moali 2000).

Globally, the Stock Dove is a wild species once found throughout Eurasia and North Africa, while their number of individuals has increased recently (1,400,000–2,600,000) (BirdLife International 2016, Anselin 2020). It is rarely observed in urban areas (Floigl *et al.* 2022), and typically inhabits deciduous forests, farmland, and woodland margins, particularly in the Western Palearctic (BirdLife International 2016, Donegan 2016, Richardson *et al.* 2023). It is capable of breeding in holes excavated by the Black Woodpecker (*Dryocopus martius*) (Kozhova *et al.* 2014), and it is categorized as a species of least concern (LC) on the IUCN Red List of threatened species (BirdLife International 2016, Donegan 2016). But nationally, the latter is protected by Algerian fiat (12-235) in relation to executive fiat 12-235 of 24 May 2012, establishing the list of protected non-domestic animal species. Their distribution is limited only to North Algeria in Kabylie at Djebel Babor, Tigzirt, and Tikjda, with a dubious observation in the south at Tilremt Daïas in Laghouat (probably confusion with Rock Dove) (Isenmann & Moali 2000).

In Algeria, several species of the Columbidae family have taken part in numerous studies, notably on reproduction, distribution, expansion, parasites, and others, but it should be remembered that there have been no studies on the Stock Dove except for a few mentions in Heim de Balsac and Mayaud (1962), Ledant *et al.* (1981), Isenmann and Moali (2000). The current study aimed to fill scientific gaps, document the presence of Stock Doves in new localities with new breeding sites in western Algeria and locations outside the known range, update the map of the national range area and provide an overview of this species' ecology.

## Materials and Methods

### Study areas

This study was carried out in two departments (Sidi Bel Abbès and Tlemcen), located in West Algeria. The arid bioclimate of these areas is characterized by an annual precipitation of below 50–250 mm. These regions are ecologically significant due to the diversity of ecosystems and their presence on migration routes, which has resulted in important avifaunistic biodiversity. More precisely, they are host to several species of migratory waterbirds and land birds, which makes them an important nesting and wintering area (El Bouhissi *et al.* 2021, 2023).

## Data collection

In order to make an updated distribution map of the Stock Dove in Algeria, with a focus on Sidi Bel Abbès and Tlemcen, species occurrence data were collected from September 2022 to August 2023 using the Progressive Frequency Sampling (*Echantillonnage Fréquentielle Progressif “EFP”*) method, which is a point count technique (see details in Blondel 1975, Bendjoudi *et al.* 2013, Chedad *et al.* 2021a). Species occurrence data from the current study was supplemented by additional occurrence data from GBIF 2023 ([www.gbif.org](http://www.gbif.org)), as well as from previous studies (Heim de Balsac & Mayaud 1962, Ledant *et al.* 1981, Isenmann & Moali 2000). Counts were undertaken by direct observation using a Nikon Coolpix P600 on a regular basis, with monthly surveys reinforced with additional surveys, especially during the main postnuptial (September and October) and prenuptial (March and April) bird migration seasons in various biotopes (Chedad *et al.* 2021b). ArcGIS (version 10.4 for Desktop: Esri®) was used to produce species distribution maps.

## Results

Throughout the various seasons from September 2022 to August 2023, the Stock Dove has been spotted multiple times in Sidi Bel Abbès and Tlemcen; all our observations were reported on a semi-arid bioclimatic at an altitude ranging between 750 and 1,216 m (*Table 1, Figure 1*).

*Table 1.* Range distribution of the Stock Dove in Algeria  
1. táblázat A kék galamb állományának eloszlása Algériában

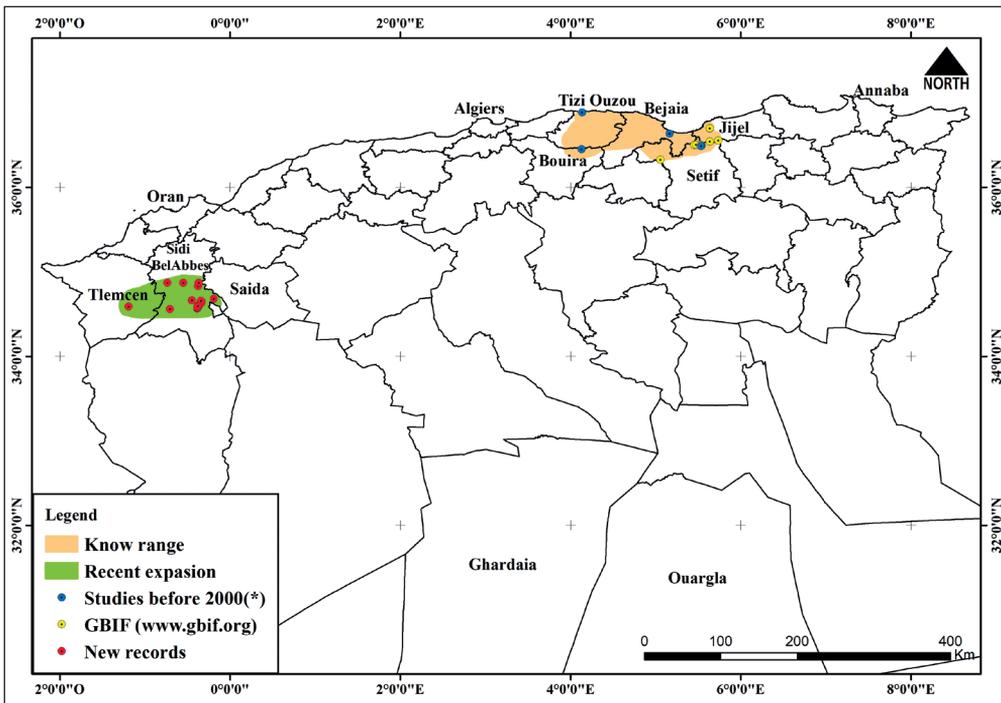
References	Department	Sectors	Number of stations	Altitude (m)	Bioclimatic stage	Max. Obs.	Date	Ph. St.
Current study	Sidi Bel Abbès	Merine, Dhaya, Oued Taourira, Bir El Hammam, Tafissour, Telagh and Mezaourou	19	750–1216	Semi-arid	19	27/01/2023	RB
	Tlemcen	El Gor	1	1150	Semi-arid	37	21/01/2022	U
GBIF	Sétif	Serdj El Ghoul, Djbel Babor, Oued El Bared, Ain Sebt, Hammam Guergour	10	685–1996	Subhumid/ Semi-arid	4	08/07/2021	RB
	Jijel	Selma Ben Ziada	1	614	Humid	NI	08/07/2021	U
Isenmann & Moali 2000	Sétif	Djbel Babor	1	939	Subhumid	NI	NI	RB
	Béjaïa	NI	1	48	Humid	NI	NI	RB
	Tizi Ouzou	Tigzirt	1	471	Subhumid	NI	13/4/1962	W
	Bouira	El Asnam	1	1435	Subhumid	10	25-26/10/1981	W

Max. Obs.: Maximum observed; Ph. St.: Phenological status (RB: resident breeder, W: wintering, U: status uncertain); NI: unidentified

In Sidi Bel Abbès, this species has been spotted at 20 stations in seven distinct sectors: Merine, Dhaya, Oued Taourira, Bir El Hammam, Tafissour, Telagh, and Mezaourou (*Figure 2b, 4*). All observations were recorded at different seasons, and the number of individuals ranged from 1 to 19; the highest number was recorded on 27 January 2023. Individuals were typically observed in groups of 2–4, and occasionally in flocks of 12–19. It preferred woodland and forest edges (Aleppo pine *Pinus halepensis*, evergreen oak *Quercus ilex*, barberry thuja *Tetraclinis articulata*, Mediterranean cypress *Cupressus sempervirens* and silver poplar *Populus alba*) and was often observed feeding on open areas such as farmlands (*Figure 2b, 3a*).

Additionally, there have been reports of a propensity for the species to reproduce; at the start of April, we observed the formation of couples and multiple males that were singing. Additionally, we discovered a number of holes in old evergreen oak trees, which are supposed to have nests, especially since every time we found several individuals near them. Following this, we obtained photographic evidence of the species' reproduction, specifically capturing an immature specimen at the late of August (*Figure 3b*).

In Tlemcen, we have only observed the species at one site in the El Gor in all seasons, but there was no evidence of nesting (*Figure 2a*). It often existed in colonies of 20 to 37



*Figure 1.* Map showing previous and updated distributions of the Stock Dove (*Columba oenas*) in Algeria. \*: previous studies before 2000 included Heim de Balsac & Mayaud (1962), Ledant *et al.* (1981) and Isenmann and Moali (2000)

1. ábra A kék galamb (*Columba oenas*) elterjedése Algériában korábbi és újabb adatok alapján \*: korábbi tanulmányok 2000 előtt: Heim de Balsac & Mayaud (1962), Ledant *et al.* (1981) és Isenmann and Moali (2000)

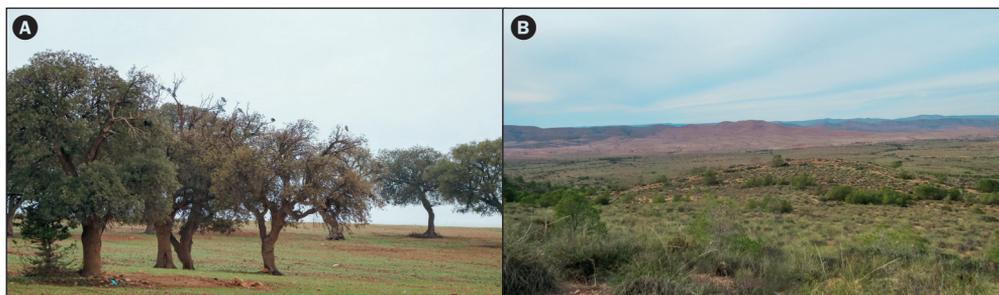


Figure 2. General view of the biotope preferable for the Stock Dove (*Columba oenas*); a: El-Gor (Tlemcen, Algeria); b: Bir El Hammam (Sidi Bel Abbès, Algeria)

2. ábra A kék galamb (*Columba oenas*) által preferált élőhely; a: El-Gor (Tlemcen, Algéria); b: Bir El Hammam (Sidi Bel Abbès ons, Algéria)

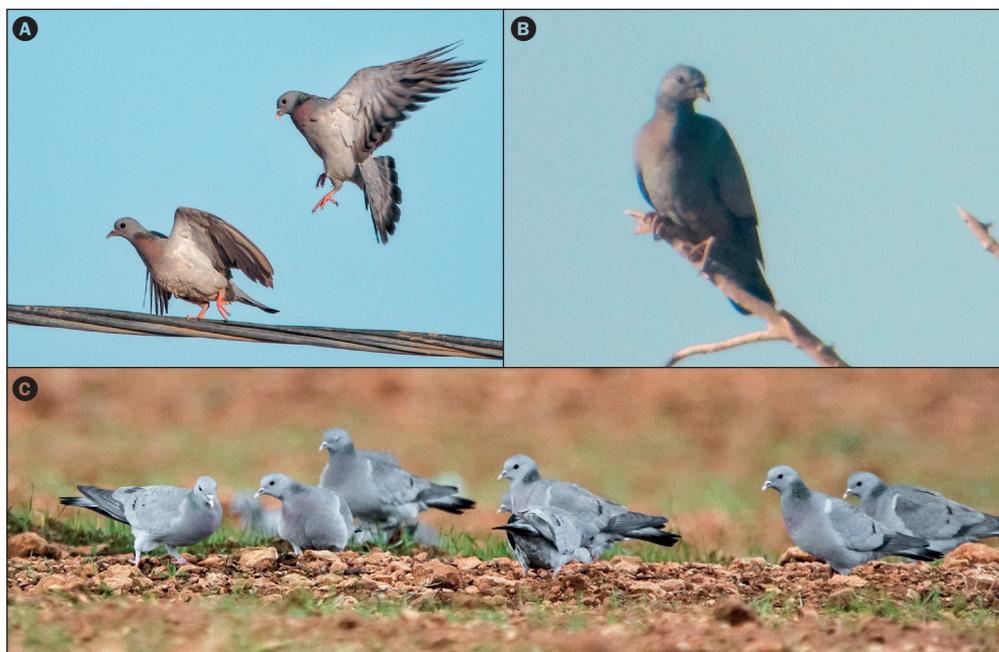


Figure 3. Stock Doves (*Columba oenas*) in their natural environment; a: a couple; b: an immature individual; c: a flock feeding in a ploughed field

3. ábra Kék galambok (*Columba oenas*) természetes környezetükben; a: egy pár; b: immatur példány; c: mezőgazdasági területen táplálkozó csapat

individuals; the highest number was recorded on 21 January 2023 (Figure 3c). It frequented an agricultural area adjacent to a sparse evergreen oak forest.

Generally, the species fed in mixed colonies with Common Wood Pigeons, Eurasian Collared Doves, and occasionally Rock Dove and European Turtle Doves.

It fed on the ground in open environments, whether natural, such as meadows and fallows, or artificial, like agricultural fields. It consumed seeds of cereals and grasses, flower buds, young green shoots, etc., according to the seasons, and was also interested in the lost parts

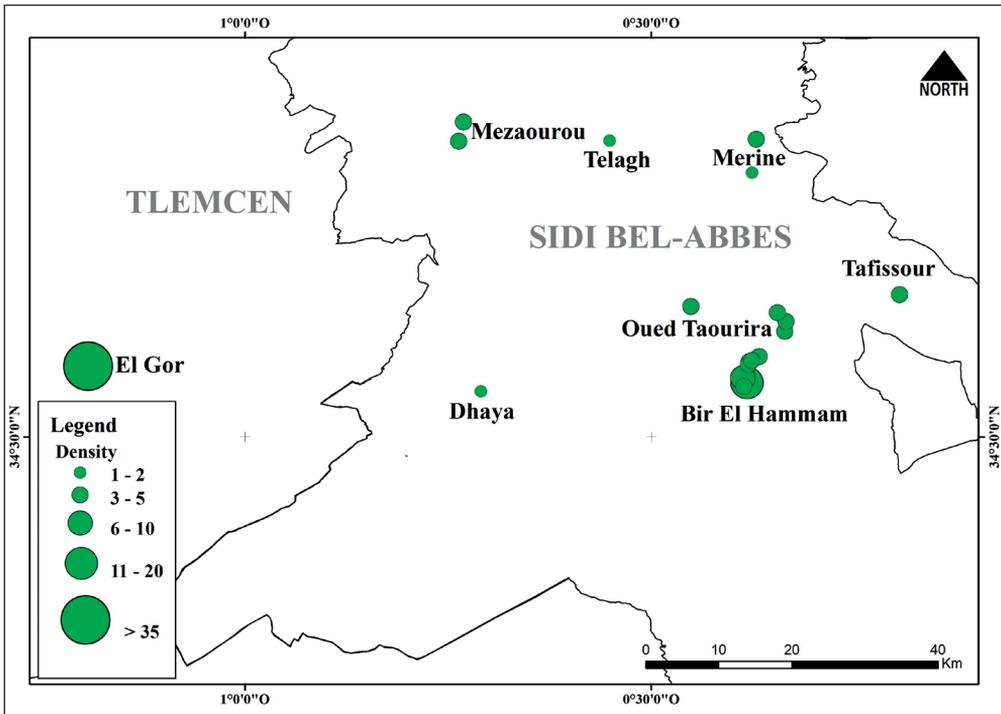


Figure 4. Geographic location of sites where the Stock Dove (*Columba oenas*) was newly recorded in Algeria

4. ábra Azon területek földrajzi elhelyezkedése Algérián belül, ahol újonnan észleltük a kék galambot (*Columba oenas*)

of harvests (wheat, barley, alfalfa, and legumes in general). During periods of repose, they congregated primarily atop old trees and over medium-voltage cables, and in all areas of their presence, they were in close proximity to water sources.

Although most of the Stock Dove sightings in both Sidi Bel Abbès and Tlemcen have been recorded in state forests, which fall under the authority of the Directorate of Forest Conservation (General Directorate of Forestry) of the Ministry of Agriculture and Rural Development, they were exposed to many natural and anthropogenic threats, including fires, overgrazing, logging, diseases, and the scarcity of rains. In addition to all the above, nomads and military barracks are distributed on the edge of the forest, which prevents access to extended areas.

## Discussion

### Species distribution and phenological status

Our results show new information about the distribution of the Stock Dove in western Algeria in Tlemcen and Sidi Bel Abbès, which is spread out over 20 stations in a semi-arid bioclimatic stage at an altitude of 750 to 1,216 m. This distribution has not been talked

about in these areas before, but nomads have said that this species has been there since the 1980s at Oued Taourira. Moreover, it was only found in Kabylie at Tizi Ouzou, Béjaïa, Jijel, Bouira, and Sétif, at 15 stations with different bioclimatic stages ranging from humid to subhumid and altitudes from 48 to 1,996 m (Isenmann & Moali 2000, GBIF 2023). We conclude that the distribution of this species is limited only to two distinct areas; the distance between them is more than 400 km, the first to the north in Kabylie and the other to the west at Tlemcen and Sidi Bel Abbès. It should also be noted that all the regions adjacent to the new distribution locations have been the subject of periodic surveys (Oran, Saida, Relizane, Tiaret, and Tissemsilt), but we have not recorded the presence of this species.

The number of individuals differs from region to region and season to season, with the greatest number recorded during the wintering period: 19 individuals in Sidi Bel Abbès and 37 in Tlemcen in January 2023. In the study area, the phenological status is resident breeder because we found several nesting clues, such as the formation of pairs, singing males, several holes in the trees, and a young. Isenmann and Moali (2000) also reported the species and likely nesting in northern Algeria in June 1977, July 1982, and, between 1989 and 1991, in Djbel Babor (Sétif) and elsewhere in little Kabylie (Béjaïa).

The winter increase in the number of birds can be attributed to the presence of resident populations that are supplemented by migrant birds for the duration of the season. This is particularly significant given that this area is considered an essential stopover site for migrating birds and an important wintering and breeding ground (El Bouhissi *et al.* 2021, 2023). As is the case with the Kabylie region, where its population increases significantly during the winter months (Isenmann & Moali 2000). Alternatively, it could be due to the fact that this species congregates during the winter and then disperses to neighboring regions during the breeding season (partial migration). Numerous avian species, such as the Trumpeter Finch (*Bucanetes githagineus*) and House Bunting (*Emberiza sahari*), use this behavior as a balancing mechanism for searching for other food and water sources as well as nesting areas (Chedad 2021, Chedad *et al.* 2021a).

### **Living environment**

We have found that the life of the Stock Dove is divided between two areas that can be adjacent to each other or separated and distant from each other: (I) nesting and roosting sites, often in woodland and forest edges (Aleppo pine, evergreen oak, barberry thuja, Mediterranean cypress, and Silver poplar); and (ii) earnings sites that form open areas such as farmlands and clearings. But this species is not registered in urban and peri-urban areas. Perrins (1998) reported that the activity radius during the breeding season reached 15–20 km.

These data correspond to what was previously concluded: Stock Dove is listed as a forest-dwelling species, is mainly present in deciduous and mixed forests, and depends on old beech trees for nesting (Gibbs *et al.* 2010, Koleček *et al.* 2010, Koschová *et al.* 2014, Floigl *et al.* 2022). Others believe that it is a bird of agricultural lands and forest edges and is rarely encountered in urban areas. However, in London, Stock Doves appear to be maintaining a healthy population in some parks because these large mature areas could provide more suitable habitat with more natural cavities in older trees (Richardson *et al.* 2023).

In the breeding sites at Sidi Bel Abbès, we found several holes, especially in old holm oak trees; the majority are natural holes but are also probably dug by the Levaillant's Woodpecker (*Picus vaillantii*), because the latter is considered a nesting species in these regions. Nesting holes dug by woodpeckers are frequently used by species nesting in secondary holes (Wesołowski 2001, Martin *et al.* 2004, Remm *et al.* 2006, Badis *et al.* 2023). According to Kosiński *et al.* (2011), Stock Dove prefers to breed in holes excavated by the Black Woodpecker, and it avoids dead trees, preferring those with multiple cavities and holes located higher up. Recent research suggests that holes in living wood are better insulated than those in dead wood. They have more consistent temperatures (smaller daily fluctuations) and are warmer during the night (Wiebe 2001, Coombs *et al.* 2010).

Generally, we have noted overlap between the ranges of five species of Columbidae, especially on the earnings site: the Common Wood Pigeon, the Eurasian Collared Dove, and sometimes the Rock Dove and the European Turtle Dove. This is because they are competing for the same resources. If their habitats overlap, this competition can lead to the local extinction of a less effective competitor (Reif *et al.* 2018) and/or niche partitioning (Finke & Snyder 2008). This process also allows competing species to use the same resources in different ways, and thus, promotes the co-existence of species (Vacher *et al.* 2016). Moreover, Floigl *et al.* (2022) confirmed the hypothesis of a high overlap of habitat between the five species of Columbia in agricultural areas in the Czech Republic. The same situation was found in Hungary between the European Turtle Dove and the Eurasian Collared Dove in the early 20<sup>th</sup> century, and this is the situation recently in the case of the Eurasian Collared Dove and the Wood Pigeon (Csathó & Bozó 2022). Also in terms of habitat overlap, Stock Dove overlapped with European Turtle Dove, the second highest habitat overlap of all other species after Common Wood Pigeon, which is not surprising since these species feed on agricultural land.

## Feeding ecology

The method of direct visual observation is used to examine trophic behavior and provides a swift qualitative assessment of the diet of the observed species (Blagosklonov 1987). Compared to other diet analysis techniques, such as the analysis of fecal sacs, droppings, and/or regurgitate pellets, this technique makes it easier to identify ingested species, matter, or items when investigating diet composition (Chedad *et al.* 2021a). Stock Doves are primarily granivorous species, feeding mainly on the seeds of cereals and grasses, flower buds, young green shoots, etc., on the ground in open environments according to the seasons, and they are also interested in the lost portions of the harvests. Previous studies have discussed this information and how it can be consumed by many species of the Araliaceae family, including Asteraceae, Boraginaceae, Brassicaceae, Amaranthaceae, Fabaceae, and others (Murton *et al.* 1965, Möckel 1988, Schumm *et al.* 2023). Additionally, certain insects, including Cecidomyiidae larvae and earthworm cocoons, can be consumed (Schumm *et al.* 2023). This is particularly true during the feeding period of the young or even during the critical period when plant-based food resources are scarce, as is the case with many birds, including the House Bunting (Chedad 2021, Chedad *et al.* 2021a).

The expansion of distribution areas for certain bird species in Algeria can be attributed to various factors, such as climate change, overexploitation of natural resources, fires, urban development, agricultural expansion, pollution of different types, the establishment of green spaces, and the emergence of new wetlands, particularly artificial wetlands (Chedad *et al.* 2020a, 2020c). In addition, the vastness of Algeria, with its rugged terrain and the impossibility of reaching others due to private or military properties, prevented researchers from investigating and following certain species.

In conclusion, the world, including Algeria, has experienced several enlargements or shrinkages of the range of species and breeding sites, following several factors both natural and artificial. This study documents the presence of Stock Doves in new localities with new breeding sites located outside the known range, in western Algeria, and also on the national distribution map, and we have given a contribution on behavior, distribution, and food.

Twenty new distributions and breeding points have been reported in western Algeria, in Sidi Bel Abbès and Tlemcen. Roosting and nesting sites are in forests and wooded edges, not far from water sources, and feeding sites are in open environments, natural or agricultural, where it consumes seeds of cereals and herbs, flower buds, and young green shoots. It cohabits with other species of pigeons and doves.

More research is necessary to compare the species' origin, distribution, and abundance in Algeria's north at Kabylie and west in this study, using phylogenetic analysis. Also, we expand the monitoring to find new sites, begin monitoring reproduction to better comprehend the life cycle of the species, and estimate the classification of certain areas as national reserves in order to preserve this species.

## Acknowledgements

We are most grateful to an anonymous reviewer for helpful comments and suggestions. We would like to thank the General Directorate of Forests and the members of the National Network of Algerian Ornithologist Watchers "R.N.O.O.A.". We also thank the Algerian Ministry of Higher Education.

## References

- Anselin, A. 2020. Northern Lapwing. *Columba oenas*. – In: Keller, V., Herrando, S., Vorišek, P., Franch, M., Kipson, M., Milanese, P., Martí, D., Anton, M., Klvanová, A., Kalyakin, M. V., Bauer, H-G. & Foppen, R. P. B. (eds.) European Breeding Bird Atlas 2. Distribution, Abundance and Change. European Bird Census Council & Lynx Edicions, Barcelona, pp. 182–183.
- Badis, M., Benchana, I. & Hamdi, N. 2023. Nest-site selection by Levaillant's Woodpecker *Picus vaillantii* in the Aurès Mountains of northeastern Algeria. – *Ostrich* 94(1): 60–64. DOI: 10.2989/00306525.2023.2185827
- Belakhdar, T. & Chedad, A. 2023. First record of the Dusky Warbler *Phylloscopus fuscatus* (Blyth, 1842) in Algeria. – *Biharean Biologist* 17(1): 45–46.
- Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W. & Courchamp, F. 2012. Impacts of climate change on the future of biodiversity. – *Ecology Letters* 15(4): 365–377. DOI: 10.1111/j.1461-0248.2011.01736.x
- Bendjoudi, D., Chenchouni, H., Doumandji, S. & Voisin, J. F. 2013. Bird species diversity of the Mitidja Plain (Northern Algeria) with emphasis on the dynamics of invasive and expanding species. – *Acrocephalus* 34(156–157): 13–26. DOI: 10.2478/acro-2013-0002

- Benyacoub, S. 1998. La Tourterelle turque *Streptopelia decaocto* en Algérie [Eurasian Collared Dove *Streptopelia decaocto* in Algeria]. – *Alauda* 66: 251–253. (in French)
- BirdLife International 2016. *Columba oenas*. – The IUCN Red List of Threatened Species 2016: e.T22690088A86074207. DOI: 10.2305/IUCN.UK.2016-3.RLTS.T22690088A86074207.en
- Blackburn, T. M., Essl, F., Evans, T., Hulme, P. E., Jeschke, J. M., Kühn, I., Kumschick, S., Marková, Z., Mrugała, A., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Ricciardi, A., Richardson, D. M., Sendek, A., Vilà, M., Wilson, J. R. U., Winter, M., Genovesi, P. & Bacher, S. 2014. A unified classification of alien species based on the magnitude of their environmental impacts. – *PLOS Biology* 12: e1001850. DOI: 10.1371/journal.pbio.1001850
- Blagosklonov, K. 1987. Guide de la protection des oiseaux [Guide to Bird Protection]. – Mir, Moscow (in French)
- Blondel, J. 1975. L'analyse des peuplements d'oiseaux, éléments d'un diagnostic écologique. I – La méthode des échantillonnages fréquentiels progressifs (E.F.P.) [Analysis of bird populations, elements of an ecological diagnosis I. The progressive frequency sampling (E.F.P.) method]. – *Revue Ecologie (Terre et Vie)* 29(4): 533–589. (in French with English Summary)
- Blondel, J. 1995. Biogéographie. Approche éco-logique et évolutive [Biogeography. Eco-logical and Evolutionary Approach]. – Masson, Paris (in French)
- Boulaouad, B. A., Harzallah, B., Ayyach, K., Attouche, W., Soukkou, W., Aissa, D. H., Faidi, H. & Missoum, M. 2022. A new species for Algeria, White-throated Bee-eater (*Merops albicollis*), observations of probably escaped individuals of Cut-throat Finch (*Amadina fasciata*) and Village Indigobird (*Vidua chalybeata*) and a checklist of southern Sahara birds. – *Ornis Hungarica* 30(2): 195–207. DOI: 10.2478/orhu-2022-0030
- Chedad, A. 2021. Bio-écologie des espèces aviennes dans quelques écosystèmes sahariens (Ghardaïa): Cas du Bruant du Sahara [Bio-ecology of avian species in some Saharan ecosystems (Ghardaïa): Case of the House Bunting]. – PhD Thesis Univ. Ouargla, Algérie DOI: 10.13140/RG.2.2.32728.21768 (in French with English Summary)
- Chedad, A., Bendjoudi, D. & Guezoul, O. 2020a Expansion of some species of the Fringillidae family in the Algerian Northern Sahara. – *Current Trends in Natural Sciences* 9(18): 92–99. DOI: 10.47068/ctns.2020.v9i18.013
- Chedad, A., Bendjoudi, D. & Guezoul, O. 2020b New data on the wintering and sedentary life of the European Turtle Dove *Streptopelia turtur* in the Algerian Northern Sahara. – *Current Trends in Natural Sciences* 9(17): 65–73. DOI: 10.47068/ctns.2020.v9i17.007
- Chedad, A., Bendjoudi, D. & Guezoul, O. 2020c Biodiversité de l'avifaune aquatique d'une zone humide artificielle à Kef Doukhane (Ghardaïa, Sahara Algérien) [Biodiversity of waterbirds in the artificial wetland of Kef Doukhane (Ghardaïa, Algerian Sahara)]. – *Bulletin De La Societe Zoologique De France* 145(4): 383–400. (in French with English Summary)
- Chedad, A., Bendjoudi, D., Beladis, B., Guezoul, O. & Chenchouni, H. 2021a A comprehensive monograph on the ecology and distribution of the House Bunting (*Emberiza sahari*) in Algeria. – *Frontiers of Biogeography* 13(1): e47727:1–19. DOI: 10.21425/F5FBG47727
- Chedad, A., Bouzid, A., Bendjoudi, D. & Guezoul, O. 2021b New observations of four waterbird species in Algerian Sahara. African. – *Journal of Ecology* 60(3): 516–522. DOI: 10.1111/aje.12934
- Clavero, M. & Garcia-Berthou, E. 2005. Invasive species area leading cause of animal extinctions. – *Trends in Ecology and Evolution* 20(3): 110. DOI: 10.1016/j.tree.2005.01.003
- Coombs, A. B., Bowman, J. & Garroway, C. J. 2010. Thermal properties of tree cavities during winter in a northern hardwood forest. – *Journal of Wildlife Management* 74(8): 1875–1881. DOI: 10.2193/2009-560
- Csathó, A. I. & Bozó, L. 2022. Urbanisation of the Common Wood Pigeon (*Columba palumbus*) in Southeast Hungary and its impact on the population of Eurasian Collared Dove (*Streptopelia decaocto*). – *Ornis Hungarica* 30(2): 135–150. DOI: 10.2478/orhu-2022-0025
- Dingle, H. & Drake, V. A. 2007. What is migration? – *Bioscience* 57(2): 113–121. DOI: 10.1641/B570206
- Donegan, T. M. 2016. The pigeon names *Columba livia*, '*C. domestica*' and *C. oenas* and their type specimens. – *Bulletin of the British Ornithologists' Club* 136(1): 14–27.
- Egwumah, F. A., Egwumah, P. O. & Edet, D. I. 2017. Paramount roles of wild birds as bioindicators of contamination. – *International Journal of Avian and Wildlife Biology* 2(6): 00041.
- El Bouhissi, M., Chedad, A., Sadine, S. E., Dahmani, W. & Hammou, M. A. 2021. Avifaunistic diversity of Merine forest, North-West Algeria. – *Current Trends in Natural Sciences* 10(20): 61–71. DOI: 10.47068/ctns.2021.v10i20.009

- El Bouhissi, M., Chedad, A. & Benhamou, H. A. 2023. New locality reported in winter for the Alpine Accentor *Prunella collaris* (Scopoli, 1769) in Algeria (Aves: Prunellidae). – *Algerian Journal of Biosciences* 4(1): 17–20.
- Finke, D. L. & Snyder, W. E. 2008. Niche partitioning increases resource exploitation by diverse communities. – *Science* 321: 1488–1490. DOI: 10.1126/science.1160854
- Floigl, K., Benedetti, Y., Reif, J. & Morelli, F. J. A. 2022. Spatial distribution and habitat overlap of five Columbidae species in the Czech Republic. – *Animals* 12: 743. DOI: 10.3390/ani12060743
- GBIF 2023. GBIF Occurrence. – DOI: 10.15468/dl.zm9fdp
- Gibbs, D., Barnes, E. & Cox, J. 2010. Pigeons and Doves – A Guide to the Pigeons and Doves of the World, 2<sup>nd</sup> ed. – Christopher Helm, London, UK.
- Gill, F., Donsker, D. & Rasmussen, P. (eds.) 2023. IOC World Bird List (v 13.2). DOI: 10.14344/IOC.ML.13.2
- Greenwood, P. J. & Harvey, P. H. 1982. The natal and breeding dispersal of birds. – *Annual Review of Ecology and Systematics* 13: 1–21. DOI: 10.1146/annurev.es.13.110182.000245
- Haddad, K., Chetibi, M., Afoutni, L. & Mauras, D. 2023. Status of Namaqua Dove in Algeria and recent observations in 2022. – *Dutch Birding* 45: 123–126.
- Harisha, M. N. & Hosetti, B. B. 2009. Diversity and distribution of avifauna of Lakkavalli Range Forest, Bhadra Wildlife Sanctuary, Western Ghat, India. – *ECOPRINT, Ecological Society (ECOS), Nepal* 16: 21–27.
- Heim de Balsac, H. & Mayaud, N. 1962. Les Oiseaux du Nord-Ouest de l’Afrique [The Birds of North-West Africa]. – Éd. Paul Lechevalier, Paris (in French)
- Isemann, P. & Moali, A. 2000. Oiseaux d’Algérie [Birds of Algeria]. – Ed. Société d’études ornithologiques de France, MNHN, Paris (in French)
- Koleček, J., Reif, J., Štátný, K. & Bejček, V. 2010. Changes in bird distribution in a Central European country between 1985–1989 and 2001–2003. – *Journal of Ornithology* 51: 923–932. DOI: 10.1007/s10336-010-0532-x
- Koschová, M. & Reif, J. 2014. Potential range shifts predict long-term population trends in common breeding birds of the Czech Republic. – *Acta Ornithologica* 49(2): 183–192. DOI: 10.3161/173484714X687064
- Kosiński, Z., Bilińska, E., Dereziński, J. & Kempa, M. 2011. Nest-sites used by Stock Doves *Columba oenas*: what determines their occupancy? – *Acta Ornithologica* 46(2): 155–163. DOI: 10.3161/000164511X625928
- Kurniawan, N. & Arifianto, A. 2017. Ornitologi: Sejarah, Biologi dan Konservasi [Ornithology: History, Biology and Conservation]. – Malang: UB Press (in Indonesian)
- Ledat, J. P., Jacob, J. P., Jacobs, P., Malher, F., Ochando, B. & Roche, J. 1981. Mise à jour de l’avifaune Algérienne [Update of the Algerian avifauna]. – *Gerfaut* 71 : 295–394 (in French)
- Levin, S. A., Muller-Landau, H. C., Nathan, R. & Chave, J. 2003. The ecology and evolution of seed dispersal: a theoretical perspective. – *Annual Review of Ecology and Systematics* 34: 575–604. DOI: 10.1146/annurev.ecolsys.34.011802.132428
- Lomolino, M. V., Riddle, R. B. & Brown, J. H. 2006. Biogeography. – Sinauer, Sunderland. Standard Lehrbuch der Biogeografie und Makroökologie
- Mansouri, I., Squalli, W., Nefla, A., Mounir, M., Achiban, H., Chedad, A., Hmidani, M., El Ghadraoui, L. & Dakki, M. 2023. Timing of migration dates and detection of first wintering sites for the Turtle Dove in Northwest Africa. – *African Journal of Ecology* 61(1): 153–162. DOI:10.1111/aje.13096
- Martin, K., Aitken, K. E. H. & Wiebe, K. L. 2004. Nest sites and nest webs for cavity-nesting communities in interior British Columbia, Canada: nest characteristics and niche partitioning. – *Condor* 106(1): 5–19. DOI: 10.1093/condor/106.1.5
- Möckel, R. 1988. Die Hohltaube: *Columba oenas* [Stock Dove]. – Die neue Brehm-Bücherei, Wittenberg Lutherstadt, Ziemsen, Germany (in German)
- Murton, R. K., Westwood, N. J. & Isaacson, A. J. 1965. Russian observations by G. N. Likhachev on the diet of the Stock Dove *Columba oenas* and Turtle Dove *Streptopelia turtur*. – *Ibis* 107(2): 254–256. DOI: 10.1111/j.1474-919X.1965.tb07303.x
- Perrins, C. H. (ed.) 1998. Birds of the Western Palearctic. – Oxford University Press
- Reif, J., Reifová, R., Skoracka, A. & Kuczyński, L. 2018. Competition-driven niche segregation on a landscape scale: Evidence for escaping from syntopy towards allotopy in two coexisting sibling passerine species. – *Journal of Animal Ecology* 87(3): 774–789. DOI: 10.1111/1365-2656.12808
- Remm, J., Löhmus, A. & Remm, K. 2006. Tree cavities in riverine forests: What determines their occurrence and use by holenesting passerines? – *Forest Ecology and Management* 221(1–3): 267–277. DOI: 10.1016/j.foreco.2005.10.015

- Richardson, J., Alexander, L. & Marsden, S. 2023. Landscape-scale predictors of persistence of an urban Stock Dove *Columba oenas* population. – *Urban Ecosystems* 26: 1–11. DOI: 10.1007/s11252-022-01283-y
- Samraoui, B., Nedjah, R., Boucheker, A., Bouzid, A., El-Serehy, H. A. & Samraoui, F. 2023. Blowin' in the wind: Dispersal of Glossy Ibis *Plegadis falcinellus* in the West Mediterranean basin. – *Ecology and Evolution* 13: e9756. DOI: 10.1002/ece3.9756
- Schrag, A. M., Zaccagnini, M. E., Calamari, N. & Canavelli, S. 2009. Climate and land-use influences on avifauna in central Argentina: Broad-scale patterns and implications of agricultural conversion for biodiversity Agriculture. – *Ecosystems and Environment* 132: 135–142. DOI: 10.1016/j.revmed.2009.03.009
- Schumm, Y., Masello, J., Vreugdenhil-Rowlands, J., Fischer, D., Hillerich, K. & Quillfeldt, P. 2023. Diet composition of wild columbiform birds: next-generation sequencing of plant and metazoan DNA in faecal samples. – *The Science of Nature* 110: 28. DOI: 10.1007/s00114-023-01863-8
- Simberloff, D., Martin, J. L., Genovesi, P., Maris, V., Wardle, D. A. & Aronson, J. 2013. Impacts of biological invasions: what's what and the way forward. – *Trends in Ecology and Evolution* 28: 58–66. DOI: 10.1016/j.tree.2012.07.013
- Thomas, C. D., Franco, A. M. A. & Hill, J. K. 2006. Range retractions and extinction in the face of climate warming. – *Trends in Ecology and Evolution* 21: 415–416. DOI: 10.1016/j.tree.2006.05.012
- Vacher, C. A., Tamaddoni-Nezhad, S., Kamenova, N., Peyrard, Y., Moalic, R., Sabbadin, L., Schwaller, J., Chiquet, M., IlexSmith, J., Vallance, J., Fievet, V., Jakuschkin, B. & Bohan, D. A. 2016. Learning Ecological Networks from Next Generation Sequencing Data. – In *Advances in Ecological Research* 54: 1–39.
- Van der Jeugd, H. P., Eichhorn, G., Litvin, K. E., Stahl, J., Larsson, K., Van der Graaf, A. J. & Drent, R. H. 2009. Keeping up with early springs: rapid range expansion in an avian herbivore incurs a mismatch between reproductive timing and food supply. – *Global Change Biology* 15(5): 1057–1071. DOI: 10.1111/j.1365-2486.2008.01804.x
- Wesołowski, T. 2001. Ground checks – an efficient and reliable method to monitor holes' fate. – *Ornis Fennica* 78: 193–197.
- Wiebe, K. L. 2001. Microclimate of tree cavity nests: Is it important for reproductive success in Northern Flickers? – *Auk* 118: 412–421.
- Wolf, B. 2000. Global warming and avian occupancy of hot deserts; a physiological and behavioral perspective. – *Revista Chilena Historia Natural* 73: 395–400.
- Zhang, W. W. & Ma, J. Z. 2011. Waterbirds as bioindicators of wetland heavy metal pollution. – *Proceedings of Environmental Sciences, 3<sup>rd</sup> International Conference on Environmental Science and Information Application Technology ESIA* 10: 2769–74. *Procedia Environmental Sciences* 10: 2769–2774. DOI: 10.1016/j.proenv.2011.09.429

