

NEW DATA ON THE NESTING OF THE ORTOLAN BUNTING *EMBERIZA HORTULANA* LINNAEUS, 1758 IN THE ALGERIAN AURES MOUNTAINS

Abdelhakim Bouzid^{a, b, c}, Nedjla Adamou^{d, e}, Abdelwahab Chedad^{b, f*}, Moulahcene Lazhar^g, Toufik Mouafek^g

^aDepartment of Biology Sciences, University of Ouargla, Algeria;

^bLaboratory of Saharan Bio-resources: Preservation and Valorisation, University of Ouargla, Algeria;

^cWetlands Conservation Laboratory (LCZH), University of Guelma, Algeria;

^dDirectorate of Forest Conservation of Laghouat (General Directorate of Forestry), 03000, Algeria;

^eLaboratory of Biology, Environment and Health (LBEH), Faculty of Natural and Life Sciences, University of El Oued, PO Box 789, El Oued 39000, Algeria;

^fDirectorate of Forest Conservation of Ghardaïa (General Directorate of Forestry), 47000, Algeria;

^gAlgerian wildlife watching association, Algeria

*Corresponding author. Email: agrochedad@yahoo.fr

 Nedjla Adamou: <https://orcid.org/0000-0003-1500-2319>

 Abdelhakim Bouzid: <https://orcid.org/0000-0002-3793-3432>

 Abdelwahab Chedad: <https://orcid.org/0000-0001-8098-1803>

Bouzid, A., Adamou, N., Chedad, A., Lazhar, M., Mouafek, T. 2024. New data on the nesting of the ortolan bunting *Emberiza hortulana* Linnaeus, 1758 in the Algerian Aures mountains. *Zoology and Ecology* 34(1), 71–77.
<https://doi.org/10.35513/21658005.2024.1.9>

Article history

Received: 6 March 2024;
accepted 13 May 2024

Keywords:

Algeria; Aures Mountains;
Ortolan Bunting; breeding;
umbrella species; nidology

Abstract. The Ortolan Bunting *Emberiza hortulana* is a rare and protected species in Algeria, with very rare nesting reports. It might be regarded as a possible umbrella species in the region. In this study, we report a new nesting site at Djebel Refaa woods, in the eastern part of the Atlas Mountains of Algeria, at 1830 m above sea level. Over an area of 125 hectares, we found three singing males, or 0.24 singing males/10 hectares. Three nests were located on the ground in an open environment in a steppic area and inserted in the bushes. The average diameter of the nests was 7.5 ± 0.53 cm, with a cup depth of 5.5 ± 0.67 cm. The approximate distance between the nest and its neighbour was 350 meters. Hatching commenced around 23 May, and flight training commenced on 15 June.

INTRODUCTION

Habitat selection is the methodical progression of behavioural responses through which an organism determines which available resources to utilize from various options (Johnson 1980). The availability of dietary resources has been designated as the most influential factor on survival and population growth in most species (Sinclair and Krebs 2003; Ruf et al. 2006).

Birds are considered effective bioindicators because changes in their population size, behaviour, and capacity to procreate reflect the health of the environment (Schrag et al. 2009; Harisha and Hosetti 2009; Zhang and Ma 2011; Kurniawan and Ontarian 2017; Egwumah et al. 2017). Also, climate change has important consequences on avian species and significantly affects their breeding phenology, particularly influencing the distribution of endemic species with restricted ranges (Badis et al. 2024).

The expansive and diverse ecosystems in Algeria have played a significant role in fostering plant diversity,

which subsequently impacts animal biodiversity. Furthermore, the burgeoning research endeavours in the country have recently contributed to the discovery of numerous species that were previously considered absent from the list of Algerian birds, as well as the disclosure of new breeding grounds and expansion ranges (Chedad et al. 2020; Belakhdar and Chedad 2023).

Buntings belong to the family Emberizidae, which is a large family of passerine birds that has a single genus, “*Emberiza*,” with 44 species (Cai et al. 2021; Gill et al. 2024; HBW and BirdLife International 2024), distributed throughout the Old World (Europe, Asia, Middle East, and Africa), including Algeria, which counted 11 species of buntings, including migrants and residents (Isenmann and Moali 2000; Djemadi et al. 2018; Chedad 2021; Chedad et al. 2021a; Adamou 2020).

As a long-distance migrant, the Ortolan Bunting (*Emberiza hortulana* Linnaeus, 1758) is highly dependent on a heterogeneous habitat structure primarily composed of semi-open agricultural land (Berg 2008; Kosicki and Chylarecki 2012). It has undergone a major de-

mographic decline around the world, particularly in Europe, Finland, Sweden, Estonia, Switzerland, etc. (Vepsäläinen et al. 2005; Berg 2008; Elts et al. 2015; Menz et al. 2009) and also in Algeria (Isenmann and Moali 2000).

Due to its rarity and its threatened habitats, *Emberiza hortulana* is the only species among the Emberizidae that is protected by the Algerian Executive Fiat (12-235) of 24 May 2012, establishing the list of protected non-domestic animal species. However, no study has been conducted specifically on this species except for records made by Heim de Balsac and Mayaud (1962), Ledant et al. (1981), and Isenmann and Moali (2000). In this context, the present study aims to fill in the gaps, first by providing preliminary data on the breeding status in Algeria in a new region at Djebel Refaa (Batna, eastern Algeria), especially since most of the previous observations were based only on singing males in order to prove the nesting status. Secondly, updating the distribution area and including confirmed and unconfirmed nesting areas are necessary to provide a better understanding of the phenological status of this species in Algeria.

MATERIALS AND METHODS

Study area

Pre-forest formations on the rocks of Djebel Refaa (1830 m) in the Aures massif, which is a component of the Atlas Mountains in eastern Algeria (Figure 1), consist primarily of the following plant species: Atlas pistachio *Pistacia atlantica*, Aleppo pine *Pinus halepensis*, Atlas cedar *Cedrus atlantica*, prickly juniper *Juniperus oxycedrus*, rosemary *Salvia rosmarinus*, esparto grass *Lygeum spartum*, and rushes *Juncus* spp. It is situated in a semi-arid bioclimate with irregular precipitation ranging from 200 to 400 millimetres annually.

Bird survey

We collected information on the occurrence of *Emberiza hortulana* across 125 hectares in Djebel Refaa, using the method of progressive frequency sampling (*Echantillonnage Fréquentielle Progressif*, or “EFP”), which is a point count technique (for further details, refer to Blondel 1975; Bendjoudi et al. 2013; Chedad et al. 2021a). Based on the number of singing males, we calculated the number of Ortolan Bunting male territories (de Groot et al. 2010). Supplementary species occurrence data were incorporated into the present analysis from GBIF 2024 (www.gbif.org) and prior research (Ledant et al. 1981; Isenmann and Moali 2000). Counts were conducted regularly through direct observation using the Nikon

Coolpix P900. Esri® ArcGIS 10.4 for Desktop was utilized to generate a map of species distribution.

RESULTS

Mapping species distribution in Algeria

Drawing from a comprehensive dataset comprising both historical sources predating the year 2000 and more recent post-2000 records sourced from GBIF (www.gbif.org), we have found that the range of Ortolan bunting covers 11 provinces (Algiers, Blida, Bouira, Tizi Ouzou, Bejaia, Bordj Bou Arreridj, M’sila, Sétif, Batna, Khenchla, and Jijel), which can be grouped into three main regions (Kabylie, Aures, and Algiers), where the climate varies between humid, subhumid, and semiarid, at an altitude ranging between 850 m (Jijel) and 1920 m (Batna). However, potential nesting cases are confirmed only by singing males in Djebel Mahmel and Chélia in the Aures in Batna and in the Kabyliein Tikijda (Bouira), and also by the feeding juveniles near the MerdjEz-Erragène dam in Jijel (Isenmann and Moali 2000), with a new site in Djebel Refaa (Batna), on the basis of our data in this study (Figure 1).

Breeding

During April, we observed the singing males in Djebel Refaa, located in the Aures mountainous region in eastern Algeria. Each male occupied a virtual circle that extended beyond 300 metres from the others. These males were perched on the tallest tree in the area, which was typically *Juniperus oxycedrus* or *Cedrus atlantica*, and sometimes at the top of a high rock, singing during the day (Figure 2A, B).

We conducted a nest-searching campaign during a month and a few days (May and June). Unfortunately, we encountered difficulties in identifying the exact location of the nests due to the vastness of the breeding region and the dense vegetation cover. In mid-June 2022, two fledglings were found being fed by their parents near one of the nests (Figure 2F). Then, we found two more nests by the end of the breeding season, but they were empty.

The three nests were built on the ground at the foot of a tuft of *Ephedra* spp. with a height of 50 cm, and the average nest diameter was equal to 7.5 ± 0.5 cm with a depth of 5.5 ± 0.7 cm (Figure 2C). It can be estimated that hatching begins around 23 May, and flight training begins around 15 June.

The breeding site is located at 1830 m above sea level, far from the urban agglomeration. It is situated in a low, open, bushy habitat with steppe characteristics. It

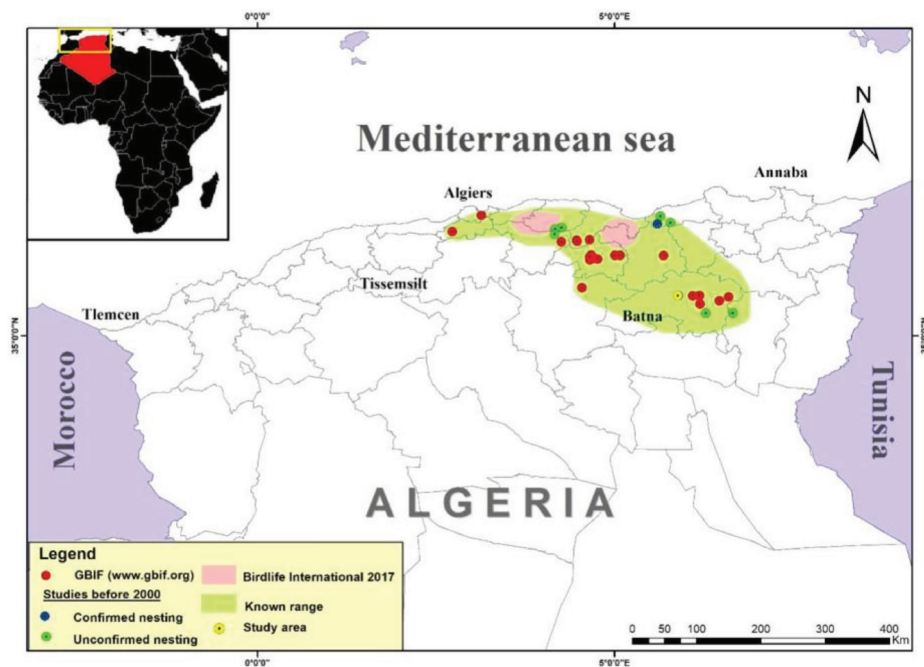


Figure 1. Map showing previous and updated distributions of the Ortolan Bunting (*Emberiza hortulana*) in Algeria.

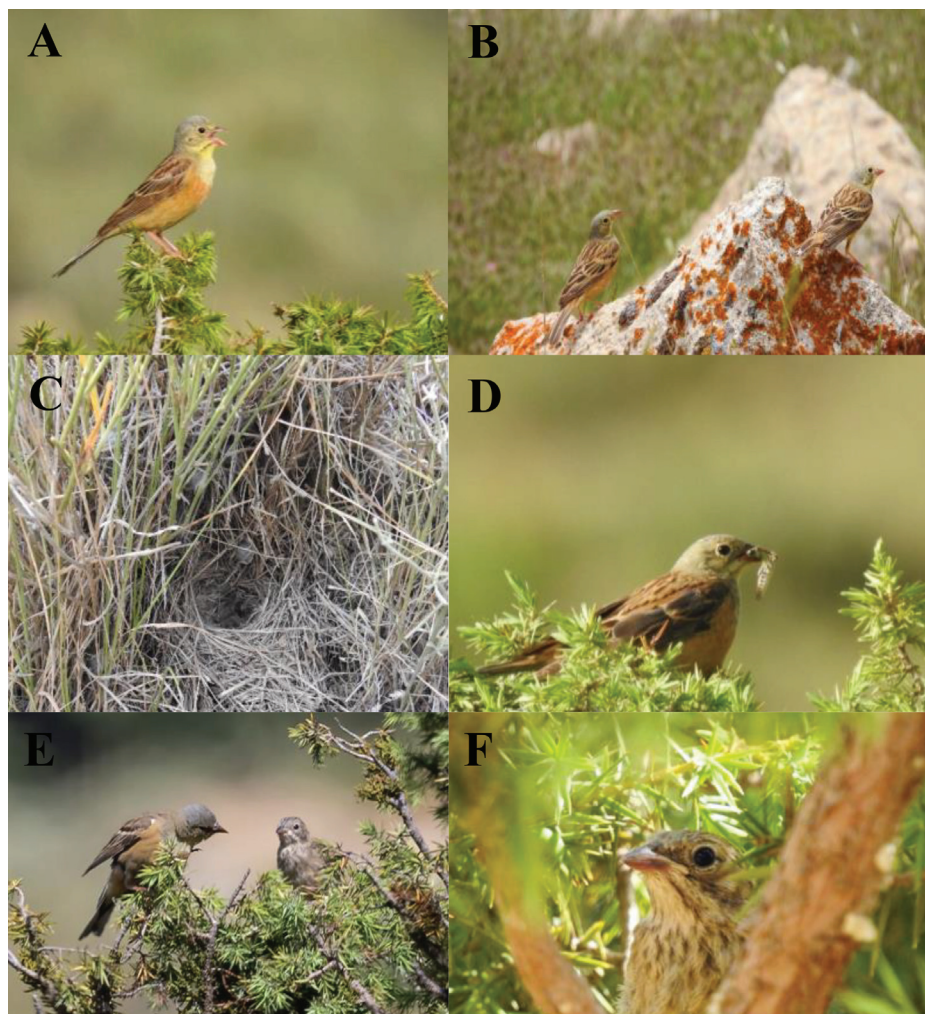


Figure 2. (A) Male Ortolan Bunting singing. (B) Ortolan Bunting pair. (C) Ortolan Bunting nest. (D, E) Feeding of a juvenile and flight training. (F) Juvenile Ortolan Bunting.

comprises a high tree diversity (*Juniperus oxycedrus* and *Cedrus atlantica*) associated with plants such as *Ephedra* spp., *Stipa* spp., *Avena* spp., and others. Both parents were feeding the juveniles with locusts, bees, butterflies, and dragonflies (Figure 2D, E).

In the same nesting site, we found three bunting species (*E. calandra*, *E. circlus*, and *E. cia*) and several farmland birds, such as *Alauda arvensis*, *Galerida cristata*, *Oenanthe leucura*, *Curruca hortensis*, *Turdus viscivorus*, etc.

DISCUSSION

The range area of the *Emberiza hortulana* is mainly located in the north-eastern part of Algeria in Kabylia, Aures, and also in Algiers (Ledant et al. 1981; Isenmann and Moali 2000; GBIF 2024; BirdLife International 2024). Regarding the nesting areas, prior research indicated that they were confined to three specific regions in Algeria: Batna, Jijel, and Bouira. However, recent observations have shown that they are now breeding only to Aures (Djebel Refaa).

This bunting species is mostly seen during migration: autumn passage (September) is less marked than in spring, at least in the Sahara (April to mid-May) (Isenmann and Moali 2000).

The numbers of steppe and farmland birds are rapidly declining globally due to intensive agriculture and changes in land use (Onrubia and Andrés 2005; Donald et al. 2006; Vorisek et al. 2010). The Ortolan Bunting can be considered a rare umbrella species, especially since its numbers are constantly decreasing, and the protection of this species and its habitat can protect many farmland species. The range of the species underwent many contractions and expansions throughout evolutionary history in response to changing environmental circumstances (Van der Jeugd et al. 2009). In recent years in Algeria, the range of some avian species has expanded, such as the Desert Sparrow (*Passer simplex*), House Bunting (*Emberiza sahari*), House Sparrow (*Passer domesticus*), Rufous-Tailed Scrub Robin (*Cercotrichas galactote*), Common Starling (*Sturnus vulgaris*), Maghreb Magpie (*Pica mauritanica*), Dupont's Lark (*Chersophilus duponti*), Greater Hoopoe-lark (*Alaemon alaudipes*), etc. (Bouzid et al. 2021a, b; Chedad et al. 2021a, 2022a; Haddad et al. 2021; Bouletif et al. 2022; Dahmani et al. 2022, 2023), and several Fringillidae species and wheatears (Chedad et al. 2020, 2021b). Also, the breeding sites are expansive for some species, such as: *Egretta garzetta*, *Anas platyrhynchos*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Plegadis falcinellus*, etc. (Chedad et al. 2022b, 2023a, b; Bouzid et al. 2023; Ould Amara et al. 2023), while other species are

declining, such as the Ortolan Bunting (Isenmann and Moali 2000).

In the study area of 125 hectares, we found three singing males, i.e., 0.24 singing males/10 hectares. This density seemed small but slightly larger compared to what was found in Poland by Kuzniak (1994) (0.11 to 0.15 singing males/10 hectares) and by Fonderflick and Thévenot (2002) in Causse Méjean (Lozère, France) (0.13 to 0.14 singing males/10 ha). A high proportion of unpaired males has been observed in declining Ortolan Bunting populations elsewhere in Norway (Dale 2001; Dale et al. 2005; Steifetten and Dale 2006), as well as in other passerine species (Donald 2007). According to Dale (2001), such a low rate of paired males would characterize small and isolated populations of species with a fragmented distribution, as is the case of the Ortolan Bunting.

The breeding site in Djebel Refaa provides food and shelter from predators and unfavourable climatic conditions. Bare grounds are known to be an important habitat characteristic of Ortolan Buntings as well as many other terrestrially foraging bird species (Nævra 2002; Moorcroft et al. 2002; Butler and Gillings 2004; Maurer 2006; Weisshaupt 2007; Berg 2008; Menz et al. 2009). Based on a 500-meter radius scale, the presence of the Ortolan Bunting was found to be adversely impacted by urban areas and their infrastructure, as well as forests. In contrast, de Groot et al. (2010) found that it had a positive correlation with permanent meadows and partially overgrown meadows, whether they had big trees or not. In general, birds select their habitat on different scales, ranging from the home range to the nest site scale, reflecting decisions on critical parameters such as nest safety and proximity to food resources (López-López et al. 2006). The trees on permanent meadows might also be used as breeding sites because, although the Ortolan Bunting is a ground breeder, it also breeds occasionally in trees (Glutz von Blotzheim and Bauer 1997).

In Switzerland, the species requires the availability of patchy, structurally diverse habitats, with solitary trees, bushes and rocks, which are used as song posts (Lang et al. 1990; Vepsäläinen et al. 2005). A possible explanation why all these habitats are chosen could be a general rule that the Ortolan Bunting prefers mosaic habitats with low vegetation as a foraging area and nesting site (Nævra 2002; Vepsäläinen et al. 2005).

In conclusion, the Ortolan Bunting is a threatened bird, and its nesting in Algeria is rare. Protecting its habitat is crucial as it safeguards not only this species but also a significant number of others, particularly farmland birds. Moving forward, it is essential to increase field surveys and research efforts to pinpoint nesting areas and migration timings and to conduct thorough studies on its reproduction and diet.

ACKNOWLEDGEMENTS

We would like to thank the Ministry of Higher Education and Scientific Research and the reviewers.

Conflict of interests

The co-authors report no conflicts of interest.

Funding

This research did not receive any financial support.

Data availability

The data used to support the findings of this study are included within the article.

REFERENCES

- Adamou, N. 2020. Little bunting *Emberiza pusilla*. *Dutch Briding* 42(6), 442.
- Badis, M., Elverici, C., & Hamdi, N. 2024. Climate-driven range shifts of Levaillant's Woodpecker *Picus vaillantii* in the Western Mediterranean. *Reg Environ Change* 24, 29. <https://doi.org/10.1007/s10113-024-02185-9>
- Belakhdar, T., & Chedad, A. 2023. First record of the Dusky Warbler *Phylloscopus fuscatus* (Blyth, 1842) in Algeria (French). *Biharean Biologist* 17(1), 45–46.
- 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, 13–26.
- Berg, A. 2008. Habitat selection and reproductive success of ortolan buntings *Emberiza hortulana* on farmland in central Sweden – the importance of habitat heterogeneity. *Ibis* 150, 565–573.
- Blondel, J. 1975. L'analyse des peuplements d'oiseaux – éléments d'un diagnostic écologique. La méthode des échantillonnages fréquentiels progressifs (E.F.P) [Analysis of bird populations – elements of an ecological diagnosis. The method of progressive frequency sampling (E.F.P)]. *Revue d'Ecologie (Terre et Vie)* 29, 533–589.
- Bouletif, H., Chedad, A., & Bendjedidi, A. 2022. Maghreb Magpie *Pica mauritanica* Malherbe, 1845 winters in two oases at Aurès Mountains, Algeria (Aves: Corvidae). *Algerian Journal biosciences* 03(01), 001–004.
- Bouزيد, A., Chedad, A., Guetaa, I., & Boulez, O. 2021a. Desert sparrow *Passer simplex* nesting in the Algerian Northern Sahara. *African Journal of Ecology*. <https://doi.org/10.1111/aje.12852>
- Bouزيد, A., Benammar, H., & Adamou, A. 2021b. Expansion de l'Agrobate roux *Cercotrichas galactotes* vers le sahara central algérien [Expansion of the Rufous-tailed Scrub Robin *Cercotrichas galactotes* in the Algerian Central Sahara]. *Alauda* 89(3), 57–60.
- Bouزيد, A., Chedad, A., Samraoui, F., & Samraoui, B. 2023. Range expansion of nesting Squacco Heron *Ardeola ralloides* and Black-crowned Night Heron *Nycticorax nycticorax* in the Sahara. *Wetlands Ecological Management* 31, 467–478. <https://doi.org/10.1007/s11273-023-09928-1>
- Butler, S.J., & Gillings, S., 2004. Quantifying the effects of habitat structure on prey detectability and accessibility to farmland birds. *Ibis* 146(Suppl. 2), 123–130.
- Cai, T., Wu, G., Sun, L., Zhang, Y., Peng, Z., Guo, Y., Liu, X., Pan, T., Chang, J., Sun, Z., & Zhang, B. 2021. Biogeography and diversification of Old World buntings (Aves: Emberizidae): radiation in open habitats. *Journal of Avian Biology* 52(6), e02672. <https://doi.org/10.1111/jav.02672>
- 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. <https://doi.org/10.13140/RG.2.2.32728.21768>
- Chedad, A., Bendjoudi, D., & Boulez, O. 2020. Expansion of some species of the Fringillidae family in the Algerian Northern Sahara. *Current Trends in Natural Sciences* 9(18), 92–99. <https://doi.org/10.47068/ctns.2020.v9i18.013>
- Chedad, A., Bendjoudi, D., Beladis, B., Boulez, 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. <http://dx.doi.org/10.21425/F5FBG47727>. Retrieved from <https://escholarship.org/uc/item/5hs9q97m>
- Chedad, A., Bendjoudi, D., & Boulez, O. 2021b. Place of Wheatear species within the avifauna of Ghardaïa (Algerian Sahara). *Current Trends in Natural Sciences* 10(19), 25–35. <https://doi.org/10.47068/ctns.2021.v10i19.003>
- Chedad, A., Adamou, N., Bouzid, A., Bendjoudi, D., & Guezou, O. 2022a. The Common starling *Sturnus vulgaris* L., 1758 regular wintering species in the Algerian Sahara. *Natural Resources and Sustainable Development* 12(1), 189–197. <https://doi.org/10.31924/nrsd.v12i1.099>
- Chedad, A., Bouzid, A., & Samraoui, B. 2022b. First successful nesting of the Little Egret *Egretta garzetta* in Ghardaïa (Algerian Sahara). *Zoology and Ecology* 32(1), 68–73. <https://doi.org/10.35513/21658005.2022.1.8>
- Chedad, A., Bouzid, A., Bendjoudi, D., & Boulez, O. 2023a. Avifauna of M'Zab region (Ghardaïa, Algerian Sahara): checklist and overview of the current status. *Zoology and Ecology* 33(1), 22–35. <https://doi.org/10.35513/21658005.2023.1.4>
- Chedad, A., Bouzid, A., Samraoui, F., & Samraoui, B. 2023b. Surviving amid the Saharan sands: first breeding record and nesting

- ecology of the Mallard in the Algerian Sahara. *Wetlands Ecology and Management*. <https://doi.org/10.1007/s11273-023-09970-z>
- Dahmani, W., Chedad, A., & Ait Hammou, M. 2022. A new locality of Dupont's Lark *Chersophilus duponti* in Algeria. *Zoology and Ecology* 33(1), 1–4. <https://doi.org/10.35513/21658005.2023.1.1>
- Dahmani, W., El Bouhissi, M., Chedad, A., & Ait Hammou, M. 2023. Données nouvelles sur l'aire de répartition du Sirli du Désert – *Alaemona laudipes* en Algérie [New data on the range of the Greater Hoopoe-lark *Alaemona laudipes* in Algeria]. *Alauda* 91, 129–132.
- Dale, S. 2001. Female-biased dispersal, low female recruitment, unpaired males, and the extinction of small and isolated bird populations. *Oikos* 92, 344–356.
- Dale, S., Lunde, A., & Steifetten, Ø. 2005. Longer breeding dispersal than natal dispersal in the ortolan bunting. *Behavioral Ecology* 16, 20–24.
- de Groot, M., Kmecl, P., Figelj, A., Figelj, J., Mihelič, T., & Rubinić, B. 2010. Multi-scale habitat association of the ortolan bunting *Emberiza hortulana* in a sub-Mediterranean area in Slovenia. *Ardeola* 57, 55–68.
- Djemadi, I., Draïdi, K., & Bouslama, Z. 2018. First record of Rustic bunting for Algeria. *Bulletin ABC* 25, 211–212.
- Donald, P.F. 2007. Adult sex ratios in wild bird populations. *Ibis* 149, 671–692.
- Donald, P.F., Sanderson, F.J., Burfield, I., & van Bommel, F.P.J. 2006. Further evidence of continent-wide impacts of agricultural intensification on European farmland birds, 1990–2000. *Agriculture, Ecosystems and Environment* 116, 189–196. <https://doi.org/10.1016/j.agee.2006.02.007>
- Egwumah, F.A., Egwumah, P.O., & Edet, D.I. 2017. Paramount roles of wild birds as bioindicators of contamination. *International journal of avian & wildlife biology* 2(6), 00041.
- Eltis, J., Tätte, K., & Marja, R. 2015. What are the important landscape components for habitat selection of the ortolan bunting *Emberiza hortulana* in northern limit of range? *European Journal of Ecology* 1, 13–25.
- Fonderflick, J., & Thévenot, M. 2002. Effectifs et variations de densité du Bruant ortolan *Emberiza hortulana* sur le Causse Méjean (Lozère, France) [Numbers and density variations of the Ortolan bunting *Emberiza hortulana* on the Méjean Causse (Lozère, France)]. *Alauda* 70(3), 399–412.
- GBIF.org (20 February 2024). GBIF Occurrence Download <https://doi.org/10.15468/dl.r4n9s5>
- Gill, F., Donsker, D., & Rasmussen, P. (eds) 2024. *IOC World Bird List* (v 14.1)_red. <https://doi.org/10.14344/IOC.ML.14.1>. <http://www.worldbirdnames.org/>, accessed at: 2023.03.20
- Glutz Von Blotzheim, U.N., & Bauer, K.M. 1997. *Handbuch der Vögel Mitteleuropas [Handbook of the Birds of Central Europe]*. Wiesbaden: AULA Verlag.
- Haddad, K., Bellatreche, M., Afoutni, L., & Mebarki, M.T. 2021. Données nouvelles sur l'aire de répartition du Moineau domestique – *Passer domesticus* en Algérie [New data on the range of the House Sparrow *Passer domesticus* in Algeria]. *Alauda* 89(4), 297–300.
- Harisha, M.N., & Hosetti, B.B. 2009. Diversity and Distribution of Avifauna of Lakkavalli Range Forest, Bhadra Wildlife Sanctuary, Western Ghat, India. *Ecological Society (ECOS), Nepal* 16, 21–27.
- HBW and BirdLife International. 2024. *Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world*. Version 8.1. Available at: http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBWBirdLife_Checklist_v81_Jan24.zip
- Heim de Balzac, H., & Mayaud, N. 1962. *Les Oiseaux du Nord-Ouest de l'Afrique [Birds of North West Africa]*. Paris, France: Paul Chevalier.
- Isenmann, P., & Moali, A. 2000. *Oiseaux d'Algérie [Birds of Algeria]*. Paris: Ed. Société d'études ornithologiques de France, MNHN. .
- Johnson, D.H. 1980. The comparison of usage and availability measurements for evaluating resource preference. *Ecology* 61, 65–71.
- Kosicki, J.Z., & Chylarecki, P. 2012. Habitat selection of the ortolan bunting *Emberiza hortulana* in Poland: predictions from large-scale habitat elements. *Ecological Research* 27, 347–355.
- Kurniawan, N., & Ontarian, A. 2017. *Ornitologi: Sejarah, Biologi dan Konservasi*. Malang: UB Press.
- Kuzniak, S. (Von). 1994. Vorkommen und Bestand des ortolans (*Emberiza hortulana*) in Polen, insbesondere in Westpolen [Occurrence and existence of the ortolan (*Emberiza hortulana*) in Poland, especially in western Poland]. In *Ortolan-Symposium, Wien 1992*, edited by Steiner, H.M. (Von) 65–72. 1. Wien: Institut für Zoologie, Universität für Bodenkultur, 188 pp.
- Lang, M., Bandorf, H., Dornberger, W., Klein, H., & Matern, U. 1990. Verbreitung, Bestandsentwicklung und Ökologie des Ortolans (*Emberiza hortulana*) in Franken [Distribution, population development and ecology of the Ortolan (*Emberiza hortulana*) in Franconia]. *Ökol. Vögel* 12, 97–126.
- Ledant, 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.
- López-López, P., García-Ripollés, C., Aguilar, J.M., García-López, F. & Verde, J. 2006. Modelling breeding habitat preferences of Bonelli's eagle (*Hieraetus fasciatus*) in relation to topography, disturbance, climate and land use at different spatial scales. *Journal of Ornithology* 147, 97–106.
- Maurer, M.L. 2006. Emergence of new cultivation practices

- in vineyards: any benefit for the endangered Woodlark *Lullula arborea*. Diploma thesis. University of Bern.
- Menz, M.H.M., Mosimann-Kampe, P., & Arlettaz, R. 2009. Foraging habitat selection in the last Ortolan bunting *Emberiza hortulana* population in Switzerland: final lessons before extinction. *Ardea* 97, 323–333.
- Moorcroft, D., Whittingham, M.J., Bradbury, R.B., & Wilson, J.D. 2002. The selection of stubble fields by wintering granivorous birds reflects vegetation cover and food abundance. *Journal of Applied Ecology* 39, 535–547.
- Nævra, A. 2002. Hortulanens skjebnetime [Ortolan bunting]. *Vår Fuglefauna* 25, 62–81.
- Ould Amara, O., Sibachir, A., Massif, T., Redouane, A., & Chedad, A. 2023. The first reproductive attempt of the Glossy Ibis *Plegadis falcinellus* in western Algeria. *Biharean Biologist* 17(2), 00–00.
- Onrubia, A., & Andrés, T. 2005. Impact of human activities on steppic-land birds: a review in the context of the Western Palearctic. In *Ecology and conservation of steppe-land birds*, edited by Bota, G., Morales, M.B., Manosa, S., Camprodon, J.. Barcelona: Lynx Edicions.
- Ruf, T., Fietz, J., Schlund, W., & Bieberm, C. 2006. High survival in poor years: life history tactics adapted to mast seeding in the edible dormouse. *Ecology* 87, 372–381.
- 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 & Environment* 132, 135–142. <https://doi.org/10.1016/j.revmed.2009.03.009>
- Sinclair, A.R.E., & Krebs, C.J. 2003. Complex numerical responses to top down and bottom-up processes in vertebrate populations. In *Wildlife Population Growth Rates*, edited by Sibly, R.M., Hone, J., & Clutton-Brock, T.H., 127–147. Cambridge: The Royal Society, Cambridge University Press.
- Steifetten, Ø., & Dale, S. 2006. Viability of an endangered population of ortolan buntings: The effect of a skewed operational sex ratio. *Biological Conservation* 132, 88–97.
- 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. <https://doi.org/10.1111/j.1365-2486.2008.01804.x>
- Vepsäläinen, V., Pakkala, T., Piha, M., & Tiainen, J. 2005. Population crash of the Ortolan bunting *Emberiza hortulana* in agricultural landscapes of southern Finland. *Annales Zoologici Fennici* 42, 91–107.
- Vorisek, P., Jiguet, F., van Strien, A., Skorpilova, J., Klvanova, A., & Gregory, R.D. 2010. Trends in abundance and biomass of widespread European farmland birds: how much have we lost? In *British Ornithologist's Union (Eds), Lowland Farmland Birds III: delivering Solutions in an uncertain World, Online Conference Proceedings*. <http://www.bou.org.uk/bouproc-net/lfb3/vorisek-et-al.pdf>
- Weisshaupt, N. 2007. Habitat selection by foraging wry-necks *Jynx torquilla* during the breeding season: identifying optimal species habitat. Diploma thesis. University of Bern.
- Zhang, W.W., & Ma, J.Z. 2011. Waterbirds as Bioindicators of Wetland Heavy Metal Pollution. *Proceedings of Environmental Sciences, 3rd International Conference on Environmental Science and Information Application Technology ESIA* 10, 2769–74.