

Article

First Records of Feather Mites and Haemosporidian Parasites in the Isabelline Wheatear (*Oenanthe isabellina*) from the Westernmost Part of the Species Breeding Range

Nevena Kolarova ¹, Aneliya Bobeva ², Mihaela Ilieva ² , Christoffer Sjöholm ³ and Dimitar Dimitrov ^{2,*} 

¹ Faculty of Biology, Sofia University “St. Kliment Ohridski”, 8 Dragan Tzankov Blvd., 1164 Sofia, Bulgaria; nkolarova@uni-sofia.bg

² Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Str., 1113 Sofia, Bulgaria; aneliabobeva@gmail.com (A.B.); mihaela.ilieva@gmail.com (M.I.)

³ Independent Researcher, Äspinge 5069, 242 95 Hörby, Sweden; christoffer.sjoholm@email.com

* Correspondence: dimitar.dimitrov@iber.bas.bg

Abstract: Host range expansions are an important factor for shaping the community of associated symbiotic organisms. Birds, as a highly mobile group of animals, are of particular interest to study with respect to the diversity and the distribution of the organisms using them as hosts during such large-scale movements. The Isabelline wheatear (*Oenanthe isabellina*) is a species with a main breeding area in Asia, which has expanded west, towards the Balkans, since the middle of the last century. We collected feather mites and blood samples for haemosporidian parasites screening from adult and juvenile Isabelline wheatears from the westernmost edge of the species breeding area in western Bulgaria. The feather mite species *Alaudicola rosickyi* (Černý, 1963), previously found on other wheatear species, was found for the first time on Isabelline wheatears. One species of avian malaria parasites—*Plasmodium relictum* (Grassi and Feletti, 1891) (lineage SGS1)—represented the first record of a malaria parasite in this host species in Europe. Increasing the sampling in the South European populations of the species will shed light on blood parasite species diversity and will reveal if other feather mite species have followed their host during its breeding range expansion.

Keywords: Analgoidea; avian malaria; passerine; *Plasmodium*; new host records; Bulgaria



Citation: Kolarova, N.; Bobeva, A.; Ilieva, M.; Sjöholm, C.; Dimitrov, D. First Records of Feather Mites and Haemosporidian Parasites in the Isabelline Wheatear (*Oenanthe isabellina*) from the Westernmost Part of the Species Breeding Range. *Diversity* **2024**, *16*, 436. <https://doi.org/10.3390/d16080436>

Academic Editors: Gary Voelker and Luc Legal

Received: 22 June 2024

Revised: 18 July 2024

Accepted: 21 July 2024

Published: 23 July 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

In nature, symbionts are the most diverse and abundant group of organisms, which comprise a major part of the food webs [1–3]. Birds are hosts of a variety of symbiont organisms with which they may have parasitic, commensal, and mutualistic relationships. One group of parasites, avian haemosporidians (Apicomplexa, Haemosporida), unicellular parasites transmitted by dipteran vectors, which include parasites from the genus *Plasmodium* (known as causative agents of malaria), have gained a lot of interest in recent years [4–6]. Feather mites (Acariformes, Astigmata, Analgoidea and Pterolichoidea) are another group of commensal or parasitic organisms associated with birds [7,8]. Despite the long history of research on these two groups of organisms, a lot of avian hosts are insufficiently studied.

The Isabelline wheatear (*Oenanthe isabellina*) is a migratory bird species that breeds in Asia and some parts of Eastern Europe, and winters in a wide area spreading from West Africa to South Asia [9,10] (Figure 1). From the main breeding areas in the Central parts of Asia, this species has spread westwards and currently, small populations of Isabelline wheatears can be found at the westernmost edge of the species range in Western Bulgaria, even though it is more abundant in south-eastern parts of the country [11]. Isabelline wheatears prefer open habitats and commonly nest in abandoned rodent or lagomorph burrows [9,10,12]. In Bulgaria, the species presence is associated primarily with colonies

of European souslik (*Spermophilus citellus*) [11]. This close association with burrowing rodents and lagomorphs was in the foundation of a number of parasitological studies on the transmission of pathogens, such as plague, between mammals and birds, including studies on the diversity of the possible vectors like fleas and ticks [13–15]. However, data on feather mites and haemosporidian parasites on the Isabelline wheatear are scarce. So far, the species was reported as a host of feather mites from Eastern Europe and Asia [16–18]. In the Lower Don area, Mironov et al. [8] studied eleven Isabelline wheatears in total, but feather mites were not found.

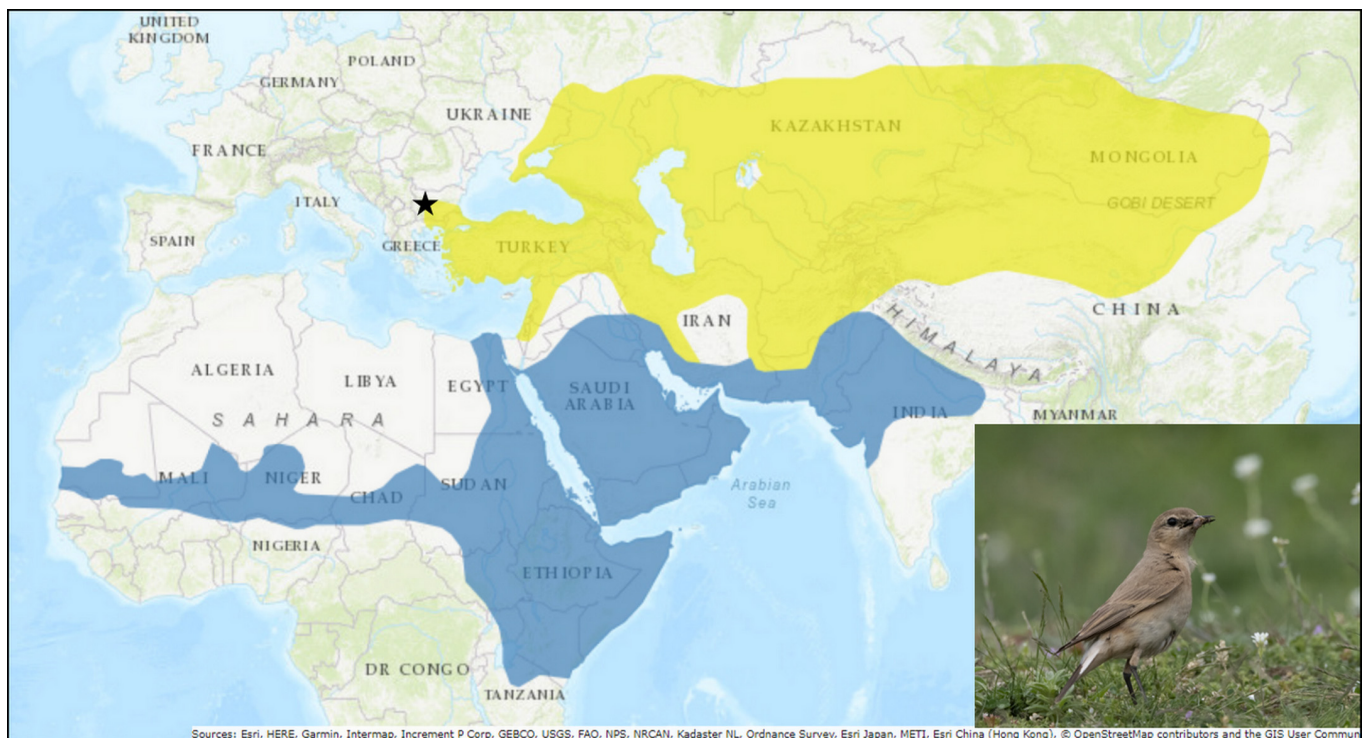


Figure 1. Breeding range (yellow) and wintering distribution (blue) of the Isabelline wheatear *Oenanthe isabellina* according to BirdLife International [19]. The sampling site is marked with an asterisk. Picture of the bird—taken by Violeta Dimitrova.

To our knowledge, only three studies have examined Isabelline wheatears for haemosporidian parasites. Paperna et al. [20] found a low prevalence of *Leucocytozoon* and *Haemoproteus* in migrating Isabelline wheatears passing through Israel in spring. Birds with avian malaria parasites (genus *Plasmodium*) were not recorded. Ciloglu et al. [21] did not find haemosporidian parasites in five examined birds, and Hussein et al. [22] found *Plasmodium* sp. in one of the three examined Isabelline wheatears in Iraq.

This study is the first to examine this species for feather mites and haemosporidian parasites in Bulgaria, and aims to increase the knowledge about the diversity and distribution of these two groups of organisms.

2. Materials and Methods

Isabelline wheatears were observed during a study of a European souslik colony in May 2022, in the northwest of Kremikovtsi District, Sofia Valley, Bulgaria (42°47.526' N, 23°29.513' E; 690 m a.s.l.). As a pilot study on their parasites, three adult and four juvenile birds were captured using mist nets and were ringed under permit No. 934/19.04.2022 issued by the Bulgarian Ministry of the Environment and Waters (MOEW). The wheatears were ringed, and standard measurements were taken. All birds were examined for feather mites, and blood samples for morphological and molecular identification of haemosporidian parasites were collected.

2.1. Feather Mites' Collection and Identification

All feather mites observed were removed, stored in 70% ethanol, and were mounted on microscope slides in Euparal mounting medium. Feather mite species identification was performed according to Černý [23] and Mironov [24]. The pictures of collected mites were taken using a combination of a Canon EOS 2000D digital camera, PRO-CA Camera Adapter, and a microscope Olympus SZ61. The collected mite specimens are deposited in the Zoological Collection of Sofia University, Faculty of Biology, Department of Zoology and Anthropology (BFUS).

2.2. Collection of Blood Samples and Preparation of Blood Smears

Blood samples were collected from each bird after puncture of the brachial vein with a sterile syringe needle (size 27G × 3/4). A heparinized capillary was used to collect approximately 30–50 µL of the blood drops at the place of puncture. Several blood drops were immediately used to prepare three thin blood smears on ready-to-use clean glass slides. Blood smears were air dried by a battery-operated fan right after smearing and fixated in 100% methanol for 5 min. Fixated blood smears were air dried and stained in 10% Giemsa solution prepared with phosphate-buffered dH₂O (pH 7.2) for one hour at room temperature. The rest of the collected blood was placed in a 1.5 mL plastic tube with 0.5 mL of SET buffer (0.015 M NaCl, 0.05 M Tris, 0.001 M EDTA, pH 8.0) for further molecular investigation.

2.3. Microscopic Examination of the Blood Smears

Microscopic examination was carried out on a Zeiss Axio Imager M2 light microscope (Oberkochen, Germany) equipped with a ProgRes c10 plus digital camera and ProgRes CapturePro v2.8.0 imaging software. Blood films were examined for 15–20 min at low magnification (immersion oil 630×), and then at least 100 microscopic fields were screened at high magnification (immersion oil 1000×). Parasitaemia values were calculated in percentage as number of infected erythrocytes per 10,000 erythrocytes. The identification of parasite blood stages and morphological species was conducted according to Valkiūnas [4].

2.4. Molecular Identification of Haemosporidian Parasites

Whole DNA extraction of blood samples stored in SET buffer was performed via the proteinase K and ammonium acetate extraction method. Obtained DNA was quantified using a NanoDrop 2000 spectrophotometer (Thermo Scientific, Wilmington, DE, USA), and it was subsequently diluted to an approximate concentration of 25–50 ng/µL. A nested PCR protocol was used to amplify a 479 bp fragment of the *cyt b* gene of the haemosporidian genera *Haemoproteus*, *Plasmodium*, and *Leucocytozoon*, as described by Hellgren et al. [25]. All reactions were carried out using DreamTaq Green PCR Master Mix (2×) (Thermo Fisher Scientific Inc.). Two percent agarose gel stained with GelRed (Biotium Inc., Fremont, CA, USA) was used to visualize the presence or absence of amplified signals. The positive samples were sequenced at Macrogen Ltd. (Amsterdam, The Netherlands) from the 5' and 3' ends with the primers HaemF (ATGGTGCTTTCGATATATGCATG) and Haem R2 (GCATTATCTGGATGTGATAATGGT), respectively. Obtained sequences were then edited, assembled and aligned using CodonCode Aligner version 8.0.2 (CodonCode, Dedham, MA, USA), and compared to the available sequences in the MalAvi database [5].

3. Results

3.1. Feather Mites

Feather mites were collected from the wing feathers of the three adult birds; in total, 5 male and 15 female mites were found (Figure 2), while no mites were found on the juvenile birds. All collected mites were morphologically identified as *Alaudicola rosickyi* (Černý, 1963).



Figure 2. *Alaudicola rosickyi* (Černý, 1963) found on an Isabelline wheatear; male (**Left**), female (**Right**). Scale bars 100 μ m.

3.2. Haemosporidian Parasites

Three birds were found to be infected with haemosporidian parasites. Mature gametocytes of *Plasmodium relictum* (cyt b lineage SGS1) were found in one of the adult wheatears with parasitaemia of 0.01% (Figure 3). Characteristic morphological features of *P. relictum* mature gametocytes, such as oval shape and marked displacement of the erythrocyte nucleus, were observed. Pigment granules are roundish and randomly scattered in the cytoplasm, which is also a typical feature for this parasite (Figure 3). Low parasitaemia and the lack of young stages in the smears preclude a detailed morphological description and presentation of different stages of growth. In two other birds, an adult and a juvenile, we observed single young forms of haemosporidian parasites, which we failed to amplify molecularly perhaps due to low DNA quantity (under 2 ng/ μ L).

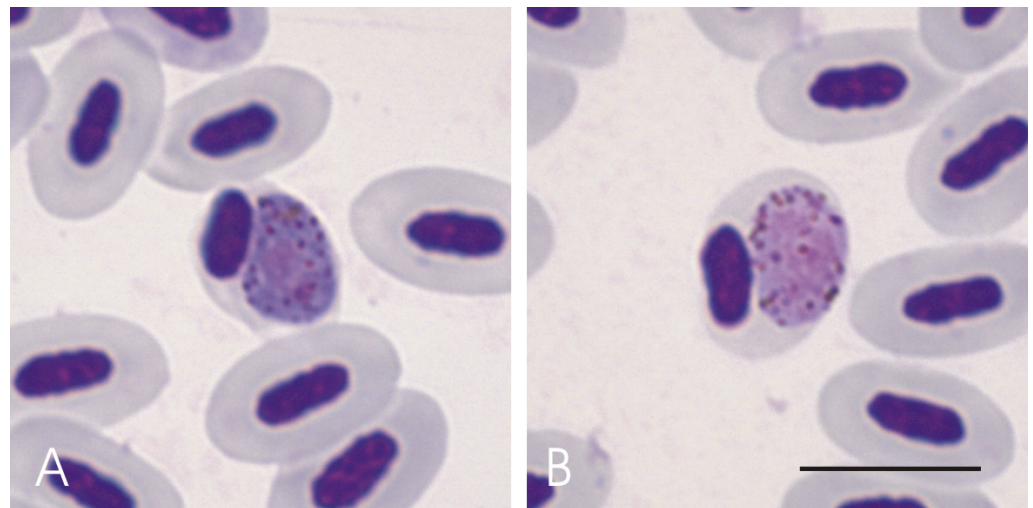


Figure 3. *Plasmodium relictum* macrogametocyte (A) and microgametocyte (B) found in the blood of an adult Isabelline wheatear. Scale bar 10 μ m.

4. Discussion

In our study, we found a species of feather mite, *Alaudicola rosickyi*, for which the Isabelline wheatear represents a new host species. The feather mite genus *Alaudicola* Mironov, 1996 includes six species, of which five are associated with larks (Alaudidae), and only *A. rosickyi* is known from birds of the genus *Oenanthe* [8]. This feather mite species was first described from the eastern black-eared wheatear (*Oenanthe melanoleuca*; previously *O. hispanica*) from Albania [23], and it was recently reported from the pied wheatear (*Oenanthe pleschanka*) from Russia [8]. *Alaudicola rosickyi*, together with *Proctophyllodes hipposideros* Gaud, 1953, were found by Ivan Vasilev on northern wheatears (*Oenanthe oenanthe*) in Bulgaria in 1964 (unpubl.). In the 1950s, Dubinin [16] reported the Isabelline wheatear and the northern wheatears as hosts of *Pterodectes bilobatus* (Robin, 1877). At that time, only this species was known and other species currently included in the genus *Alaudicola* Mironov, 1996 had not yet been established. It is highly probable that Dubinin (1951) actually dealt with *Alaudicola rosickyi*, but did not recognize that this species from wheatears differs from *P. bilobatus* (now *A. bilobatus*) associated with larks. We did not find other species of feather mites, but the Isabelline wheatear was reported as a host of *Proctophyllodes leptocaulus* Gaud, 1953 and *Pterodectes* sp. from Kyrgyzstan [17], and *Proctophyllodes hipposideros* from Ukraine [18]. The last one, *P. hipposideros*, is the most commonly found species on wheatears; it has been reported so far on the western black-eared wheatear (*Oenanthe hispanica*) and the red-rumped wheatear (*O. moesta*) from Morocco [26]; the northern wheatear from Sweden, Bulgaria, and Russia [8,27,28]; and the pied wheatear from Armenia, Ukraine, and Russia [8,18,29]. *Strelkoviacarus integer* (Trouessart et Neumann, 1888) is another feather mite species that was collected from the northern wheatear from Russia [30]. Doña et al. [31] reported some unexpected feather mite species for wheatears, like *Proctophyllodes cetti* Badek, Mironov et Dabert, 2008 and *P. schwerinensis* (Černý, 1982) on the northern wheatear, and *Proctophyllodes mesocaulus* Mack-Fira et Cristea-Nastasescu, 1968 on the western black-eared wheatear and the black wheatear (*Oenanthe leucura*), using DNA metabarcoding. However, this study was focused on detecting accidental, but natural, transfers of feather mites between passerines. Thus, finding these feather mite species does not mean that they have established stable intra-populations on wheatears. Further studies involving more specimens of the Isabelline wheatear examined might be expected to find other species of feather mites such as the *P. hipposideros*, which is widely distributed in wheatears.

Wheatears are rarely studied for haemosporidian parasites. So far, there are no published records of haemosporidian parasites found on wheatears in Europe. In our

study on Isabelline wheatears, we found *Plasmodium relictum* (lineage SGS1)—a widespread generalist parasite (lineage) registered on all continents except Antarctica, which is found in 148 avian host species from 37 families, 12 orders, and 9 vector species (mostly mosquitoes from genus *Culex*) (MalAvi database; accessed April 2024). Recently, *Plasmodium* sp. was found in an Isabelline wheatear in Iraq [22]. However, this record was only based on morphological examination of blood slides, and the parasites were only identified to a genus level with no molecular data provided. In Eilat, Israel, Paperna et al. [20] found a very low prevalence of genera *Leucocytozoon* and *Haemoproteus* in 19 studied Isabelline wheatears, also based on examination of blood smears and without identification of the parasites to a species level.

Data on haemosporidian parasites in other species of wheatears are also scarce. Haiba [32] first reported *Plasmodium praecox* (currently *Plasmodium relictum*) in the northern wheatear and the mourning wheatear (*Oenanthe lugens*) (Lichtenstein, MHC 1823) in Egypt. Valkiūnas et al. [33] found parasites from the three genera, *Haemoproteus*, *Leucocytozoon*, and *Plasmodium*, in pied wheatears in Turkmenistan, and Nourani et al. [34] reported *Haemoproteus* sp. in the same host species from Iran; however, both studies were based just on morphological identification of the parasites to the genus level. In the MalAvi database, where the records are based on the *cyt b* gene of the parasites, only two records of haemosporidian parasite lineages in wheatears can be found, both in northern wheatears—lineage SGS1 (*Plasmodium relictum*) from Morocco [35] and lineage OEOEN01 (*Haemoproteus* sp.) from Iran [36]. Recently, Ghaemitalab et al. [37] reported lineage LK05 (*Plasmodium* sp.) from variable wheatear (*Oenanthe picata*), also from Iran. In the study by Valkiūnas et al. [38], the authors mention lineage GRW6 (*Plasmodium elongatum* Huff, 1930) as infecting northern wheatears; however, details on this record are not published yet.

The above-mentioned studies on feather mites and haemosporidian parasites were broadly oriented towards their diversity and prevalence in various bird species, and in most cases, the number of screened wheatears was low. Increasing the sampling efforts in terms of better species coverage, more sampling locations, and higher sample sizes is crucial for expanding our knowledge of the blood parasites and feather mites in this comparatively rarely caught group of passerines. In the case of the Isabelline wheatear, gathering more data on other groups of ectoparasites and endoparasites (e.g., ticks, fleas, and parasitic worms) will be of interest, in the light of their co-existence with ground squirrels and other burrowing rodents and the possibility of cross-infections.

Author Contributions: D.D., M.I. and N.K. designed the study; C.S., D.D., M.I. and N.K. performed the fieldwork; N.K. collected and identified the material of feather mites; D.D. carried out the microscopic examination of the blood slides for haemosporidian parasites; A.B. organized and performed the molecular lab work. All authors have read and agreed to the published version of the manuscript.

Funding: This work has been carried out in the framework of the National Science Program “Environmental Protection and Reduction of Risks of Adverse Events and Natural Disasters”, approved by the Resolution of the Council of Ministers No. 577/17.08.2018 and supported by the Ministry of Education and Science (MES) of Bulgaria (Agreement No. D01-27/06.02.2024). This study was supported by COST Action WIMANET (Wildlife Malaria Network), CA22108, supported by COST (European Cooperation in Science and Technology) and by the Bulgarian National Science Fund (project DN 01/6).

Institutional Review Board Statement: We have permit No. 934/19.04.2022 issued by the Bulgarian Ministry of the Environment and Waters (MOEW) for capture, ringing and sampling the wild birds, mentioned in the M&M section.

Data Availability Statement: The new data created and all preparations of feather mites and blood smears were deposited in the collections of the Faculty of Biology, Sofia University “St. Kliment Ohridski” and the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, and are available upon request.

Acknowledgments: The authors are grateful to Denis Gradinarov (Faculty of Biology, Sofia University) for taking the images of the feather mites, to Vladimir Stefanov for his help with the fieldwork planning and to the three reviewers for their valuable suggestions on the earlier version of the manuscript.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- Lafferty, K.D.; Dobson, A.P.; Kuris, A.M. Parasites Dominate Food Web Links. *Proc. Natl. Acad. Sci. USA* **2006**, *103*, 11211–11216. [CrossRef] [PubMed]
- Morand, S. (Macro-) Evolutionary Ecology of Parasite Diversity: From Determinants of Parasite Species Richness to Host Diversification. *Int. J. Parasitol. Parasites Wildl.* **2015**, *4*, 80–87. [CrossRef] [PubMed]
- Larsen, B.B.; Miller, E.C.; Rhodes, M.K.; Wiens, J.J. Inordinate Fondness Multiplied and Redistributed: The Number of Species on Earth and the New Pie of Life. *Q. Rev. Biol.* **2017**, *92*, 229–265. [CrossRef]
- Valkiūnas, G. *Avian Malaria Parasites and Other Haemosporidia*; CRC Press: Boca Raton, FL, USA; London, UK; New York, NY, USA; Washington, DC, USA, 2005; ISBN 0415300975.
- Bensch, S.; Hellgren, O.; Pérez-Tris, J. MalAvi: A Public Database of Malaria Parasites and Related Haemosporidians in Avian Hosts Based on Mitochondrial Cytochrome b Lineages. *Mol. Ecol. Resour.* **2009**, *9*, 1353–1358. [CrossRef] [PubMed]
- Pigeault, R.; Vézilier, J.; Cornet, S.; Zélé, F.; Nicot, A.; Perret, P.; Gandon, S.; Rivero, A. Avian Malaria: A New Lease of Life for an Old Experimental Model to Study the Evolutionary Ecology of *Plasmodium*. *Philos. Trans. R. Soc. B Biol. Sci.* **2015**, *370*, 20140300. [CrossRef] [PubMed]
- Doña, J.; Proctor, H.; Serrano, D.; Johnson, K.P.; Oploo, A.O.; Huguet-Tapia, J.C.; Ascunce, M.S.; Jovani, R. Feather Mites Play a Role in Cleaning Host Feathers: New Insights from DNA Metabarcoding and Microscopy. *Mol. Ecol.* **2019**, *28*, 203–218. [CrossRef] [PubMed]
- Mironov, S.V.; Zabashta, A.V.; Malyshev, L.L. Biodiversity of Feather Mites Parasitizing Passerines of the Lower Don Area and Quantitative Characteristics of Their Invasion. *Entomol. Rev.* **2023**, *103*, 573–599. [CrossRef]
- BWPi. *The Birds of the Western Palearctic Interactive*; 2006 Upgra.; DVD Birdguides: Shrewsbury, UK, 2006.
- Collar, N. Isabelline Wheatear (*Oenanthe isabellina*). In *Birds of the World*; del Hoyo, J., Elliott, A., Sargatal, J., Christie, D., de Juana, E., Eds.; Cornell Lab of Ornithology: Ithaca, NY, USA, 2020.
- Shurulinkov, P.S.; Nikolov, I.P.; Daskalova, G.N.; Nikolov, B.P.; Stoyanov, G.P. Further Range Expansion of the Isabelline Wheatear *Oenanthe isabellina* in Bulgaria. *Ciconia* **2008**, *16*, 49–56.
- Li, S.; Peng, W. Nest-Site Selection by Isabelline Wheatears *Oenanthe isabellina* on the Tibet Plateau. *Forktail* **2014**, *30*, 132–133.
- Lipaev, V.M.; Kozlovskaya, O.L.; Surkov, V.S.; Derevich, S.M.; Busoedova, N.M.; Antipeva, O.A. Wheatears of North-Western Mongolia (a Contribution to Their Distribution, Ecology and Epizootological Importance). In Proceedings of the International and National Aspects of the Epidemiological Surveillance of Plague, Scientific Conference, Irkutsk, Russia, 10–13 October 1978; Safonova, A.D., Ed.; Ministerstvo Zdravookhraneniya SSSR: Irkutsk, Russia, 1977; pp. 78–82.
- Martynov, G.A.; Shevchenko, V.L.; Stepanov, V.M.; Martynova, N.V.; Grazhdanov, A.K.; Zharinova, L.K. Experimental Infection of Isabelline Wheatears, *Oenanthe isabellina* Temm., 1829, with the Plague Agent. *Meditinskaya Parazitol. Parazit. Bolezn.* **1983**, *52*, 37–41.
- Shevchenko, V.L. Fleas and Mites of the Isabelline Wheatear (*Oenanthe isabellina* Temm., 1829) and Its Nests in Northern Cis-Caspia. *Meditinskaya Parazitol. Parazit. Bolezn.* **1983**, *52*, 41–46.
- Dubinin, V. Feather Mites (Analgoidea). Part I. In *Introduction in Their Study*. In *Fauna USSR, Paukoobraznye*; Akademia Nauk SSSR: Moscow, Russia; Leningrad, Russia, 1951; pp. 1–363.
- Chirov, P.A. Mites of the Superfamily Analgoidea Which Live on Birds in Kirgizia. *Entomol. Issled. Kirg. Akad. Kirg. SSR* **1979**, *13*, 49–54.
- Burdejnaja, S.J.; Kivganov, D.A. Taxonomic Characteristic of Mites of the Family Proctophyllodidae from Birds Migrating via Zmeiny Island. *Zapovidna Sprav. Ukr.* **2009**, *15*, 71–75.
- BirdLife International Species Factsheet: Isabelline Wheatear *Oenanthe isabellina*. Available online: <https://datazone.birdlife.org/species/factsheet/isabelline-wheatear-oenanthe-isabellina> (accessed on 27 March 2024).
- Paperna, I.; Rózsa, L.; Yosef, R. Avian Haemosporidian Blood Parasite Infections at a Migration Hotspot in Eilat, Israel. *Eur. J. Ecol.* **2016**, *2*, 47–52. [CrossRef]
- Ciloglu, A.; Ergen, A.G.; Inci, A.; Dik, B.; Duzlu, O.; Onder, Z.; Yetismis, G.; Bensch, S.; Valkiūnas, G.; Yildirim, A. Prevalence and Genetic Diversity of Avian Haemosporidian Parasites at an Intersection Point of Bird Migration Routes: Sultan Marshes National Park, Turkey. *Acta Trop.* **2020**, *210*, 105465. [CrossRef]
- Hussein, I.O.; Mirshamsi, O.; Mohammadiankalat, T.; Aliabadian, M. Prevalence of Avian Haemosporidian Parasites: A Comparative Study between Resident and Migratory Birds of Iraq. *Iran. J. Anim. Biosyst.* **2023**, *19*, 115–126. [CrossRef]
- Černý, V. Deux Espèces Nouvelles d'Acariens Plumicoles. *Acarologia* **1963**, *5*, 649–652.
- Mironov, S.V. A New Genus of the Feather Mite Subfamily Pterodectinae (Analgoidea; Proctophyllodidae). *Parazitologiya* **1996**, *30*, 398–403.

25. Hellgren, O.; Waldenström, J.; Bensch, S. A New PCR Assay for Simultaneous Studies of *Leucocytozoon*, *Plasmodium* and *Haemoproteus* from Avian Blood. *J. Parasitol.* **2004**, *90*, 797–802. [[CrossRef](#)]
26. Gaud, J. Acariens Plumicoles (Analgesoidea) Parasites Des Oiseaux Du Maroc. I. Proctophyllodidae. *Bull. Société Sci. Nat. Phys. Maroc* **1957**, *37*, 105–136.
27. Černý, V. Feather Mites (Analgesoidea) from Birds Trapped at the Falsterbo Bird Station, Southern Sweden. *Acta Univ. Lund. Sect. II Medica Math. Sci. Rerum Nat.* **1965**, *8*, 1–8.
28. Kolarova, N.T.; Mitov, P.G. Feather Mites of the Superfamily Analgoidea (Acari: Astigmata) from Passerines (Aves: Passeriformes) in South Dobrudzha, Bulgaria. *Acta Zool. Bulg.* **2008**, *2*, 91–102.
29. Arutunjan, E.S.; Mironov, S.V. New and Little Known Species of Analgoid-Mites from the USSR. *Acad. Sci. Armen. SSR Inst. Zool. Zool. Pap.* **1983**, *19*, 319–336.
30. Mironov, S.V. Feather Mites from Passerines of the North-West of Russia. *Parazitologiya* **1996**, *30*, 521–539.
31. Doña, J.; Serrano, D.; Mironov, S.; Montesinos-Navarro, A.; Jovani, R. Unexpected Bird–Feather Mite Associations Revealed by DNA Metabarcoding Uncovers a Dynamic Ecoevolutionary Scenario. *Mol. Ecol.* **2019**, *28*, 379–390. [[CrossRef](#)] [[PubMed](#)]
32. Haiba, M.H. Plasmodia of Common Egyptian Birds. *J. Comp. Pathol. Ther.* **1948**, *58*, 81–93, IN7–IN8. [[CrossRef](#)]
33. Valkiūnas, G.; Iezhova, T.A.; Mironov, S.V. High Prevalence and Diversity of Blood Parasites of Passerine Birds in Southern Turkmenistan. *Parazitologiya* **2001**, *35*, 135–141.
34. Nourani, L.; Aliabadian, M.; Dinparast Djadid, N.; Mirshamsi, O. Occurrence of *Haemoproteus* spp. (Haemosporida: Haemoproteidae) in New Host Records of Passerine Birds from the East of Iran. *Iran. J. Parasitol.* **2018**, *13*, 267–274. [[PubMed](#)]
35. Drovetski, S.V.; Aghayan, S.A.; Mata, V.A.; Lopes, R.J.; Mode, N.A.; Harvey, J.A.; Voelker, G. Does the Niche Breadth or Trade-off Hypothesis Explain the Abundance–Occupancy Relationship in Avian Haemosporidia? *Mol. Ecol.* **2014**, *23*, 3322–3329. [[CrossRef](#)]
36. Nourani, L.; Aliabadian, M.; Mirshamsi, O.; Djadid, N.D. Molecular Detection and Genetic Diversity of Avian Haemosporidian Parasites in Iran. *PLoS ONE* **2018**, *13*, e0206638. [[CrossRef](#)]
37. Ghaemitalab, V.; Mirshamsi, O.; Valkiūnas, G.; Aliabadian, M. Prevalence and Genetic Diversity of Avian Haemosporidian Parasites in Southern Iran. *Pathogens* **2021**, *10*, 645. [[CrossRef](#)] [[PubMed](#)]
38. Valkiūnas, G.; Zehtindjiev, P.; Dimitrov, D.; Križanauskienė, A.; Iezhova, T.A.; Bensch, S. Polymerase Chain Reaction-Based Identification of *Plasmodium (Huffia) elongatum*, with Remarks on Species Identity of Haemosporidian Lineages Deposited in GenBank. *Parasitol. Res.* **2008**, *102*, 1185–1193. [[CrossRef](#)] [[PubMed](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.