

INSECT ECTOPARASITES ON THE WHITE STORK, *Ciconia ciconia* (L.) (CICONIIFORMES: CICONIIDAE), DURING THE BREEDING PERIOD IN THE EXTREME EAST OF ALGERIA

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Abstract. Avian and other migratory fauna are strongly exposed to different forms of parasites in their feeding and breeding areas; the white stork is a good model for the study of this phenomenon. This study was carried out in the region of Tebessa, which is located in the extreme east of Algeria, at an altitude of 896 m and which belongs to the semi-arid bioclimatic stage. Two colonies of white stork are chosen for this study, one nesting in urban areas and the other in a natural environment. The results obtained revealed the presence of ten ectoparasite species found on the feathers of the white stork. They belong to 4 orders: Phthiraptera, Heteroptera, Hymenoptera and Diptera, 4 suborders and 5 families. A total of 246 specimens were collected: 67 specimens of *Ardeicola* sp., 63 specimens of *Colpocephalum* sp. and 46 specimens of *C. zebra*. On the storks from the urban area, 50 specimens were collected; they belong to 7 different species. *Ardeicola ciconiae* is the most abundant species, accounting for 38% of the total fauna, followed by *Ciconiphilus quadripululatus* (Burmeister, 1838) with 28%, *Ardeicola* sp., with 14%. On the storks from the natural area, 117 specimens were collected; they belong to 4 different species. *Ardeicola* sp. is the most abundant species, accounting for 38% of the total ectoparasitic fauna, followed by *Colpocephalum* sp., with 36% and *C. zebra* with 26%.

Keywords: ectoparasites, feathers, *Ciconia ciconia*, urban environment, natural environment.

Rezumat. Insectele ectoparazite ale berzei albe, *Ciconia ciconia* (L.) (Ciconiiformes: Ciconiidae), în timpul perioadei de reproducere, în estul extrem al Algeriei. Păsările și alte specii migratoare sunt puternic expuse diferitelor forme de paraziți în zonele de hrănire și reproducere; barza albă reprezintă un bun model pentru studiul acestui fenomen. Acest studiu a fost realizat în regiunea Tebessa, situată în extremitatea estică a Algeriei, la o altitudine de 896 m, care aparține zonei bioclimatice semi-aride. Două colonii de barză albă au fost alese pentru acest studiu, una care a cuibărit în zona urbană și cealaltă într-un mediu natural. Rezultatele obținute au evidențiat prezența a 10 specii ectoparazite găsite pe pene la barza albă. Acestea aparțin la 4 ordine: Phthiraptera, Heteroptera, Hymenoptera și Diptera, 4 subordine și 5 familii. Au fost colectate 246 de exemplare: 67 de exemplare de *Ardeicola* sp., 63 de exemplare de *Colpocephalum* sp. și 46 de exemplare de *Colpocephalum zebra*. Pe berzele din zona urbană au fost colectate 50 de exemplare; acestea aparțin la 7 specii diferite. *Ardeicola ciconiae* este cea mai abundentă specie, reprezentând 38% din fauna totală, urmată de *Ciconiphilus quadripululatus* (Burmeister, 1838) cu 28%, *Ardeicola* sp., cu 14%. Pe berzele din mediul natural, au fost colectate 117 exemplare care aparțin la 4 specii diferite. *Ardeicola* sp. este cea mai abundentă specie, reprezentând 38% din fauna ectoparazică totală, urmată de *Colpocephalum* sp. cu 36% și *C. zebra* cu 26%.

Cuvinte cheie: ectoparaziți, pene, *Ciconia ciconia*, mediu urban, mediu natural.

INTRODUCTION

Birds as parasite hosts provide a large mosaic of habitats for several groups of parasitic arthropods adapted to life in specific types of such microhabitats. Two basic groups of organisms can be distinguished: one group includes ectoparasites of the bird hosts, the second includes members of an accompanying fauna, which is associated with the microenvironment of the nest (BAJERLEIN et al., 2006), in wild animals that are pathogenic vectors responsible for important zoonosis (COLEBROOK & WALL, 2004).

The parasitic arthropods of birds are an extremely varied group showing both taxonomic and ecological diversity. There are fleas (Insecta: Siphonaptera), bugs (Insecta: Hemiptera), and flies (Insecta: Diptera), but the chewing lice (Insecta: Phthiraptera), which are specific to birds and mammals, are probably the most important insects; they are stationary on birds and mammals, live on feathers or hairs, on the surface of the skin or inside, in body cavities or internal organs (FRYDERYK & IZDEBSKA, 2009). In the world, the works that treat birds-ectoparasites relationships are numerous; however, the number of studies related to chewing louse species among the white stork have been carried out in certain regions like Turkey (DIK & USLU, 2006), Romania (ADAM, 2007) and Poland (FRYDERYK & IZDEBSKA, 2009). In Algeria, this type of study is limited to BACIR & BOUSICIMO (2006) on *Turdus merula mauritanicus*, ROUAG-ZIANE et al. (2007) on *Fulica atra*, ROUAG-ZIANE & CHABI (2008) on *Cyanistes caeruleus ultramarinus*, and MAMMERIA et al. (2014) on *Ciconia ciconia* in the north east of Algeria.

MATERIALS AND METHODS

Presentation of the study area: the study is conducted in Tebessa region, located in the far east of Algeria, which covers 13,878 km² and belongs naturally to the immense steppe expanse of the country; geographically, it is limited: at the north by the wilaya of Souk-Ahras, at the west by the wilayas of Oum El-Bouaghi and Khenchela, at the south by the wilaya of El-Oued and at the east by the Tunisia (Fig. 1).

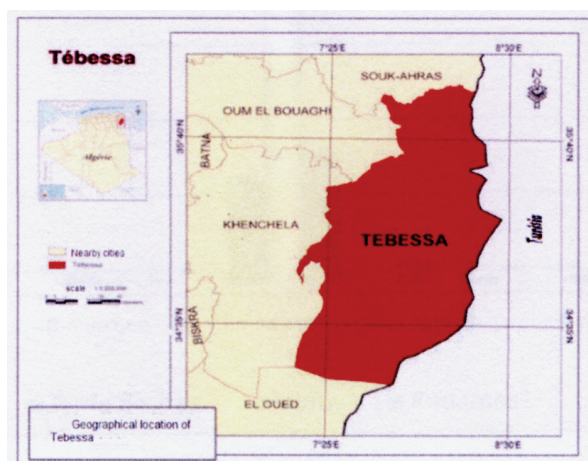


Figure 1. Geographical location of the study area - Lambert coordinates: 35° 29'N, 08° 08'E (NEFFAR, 2012).

Two populations of white storks were selected for this study; the first nested in an urban area (El Merdja Station) northeast of Tébessa (35° 29'N, 08° 08'E), and the second population nested in a rural area (Ain Zaroug Station).

Sampling techniques

The sampling lasted for 3 months, from April to July, coinciding with the breeding period of the chicks.

Specimens were collected from young and adults by either enclosing only their bodies (not the head) in a bag by shaking them, rubbing the feathers, or spraying the body on white cloth with a suitable insecticide.

The obtained individuals were stored in ethyl alcohol (70%) and transported to the laboratory with labels indicating the collecting data and the study station and then, they were identified and confirmed at the National School of Veterinary Sciences in El Harrach (Algiers, Algeria).

Methods of exploitation of the results

After the identification of the samples, we used ecological indices for calculating the relative abundance (AR%), which is defined by the percentage of individuals of a species (ni) to the total number of individuals (Ni) (DAJOZ, 1971) Equation: $AR\% = (ni / Ni) \times 100$.

RESULTS

The faunal community of ectoparasites found on white stork *Ciconia ciconia* (Linnaeus, 1758) in the region of Tébessa (Algeria) and sampled during the breeding period of chicks consists of nine (09) species, which belong to the order Phthiraptera, family Menoponidae, suborder Amblycera as *Colpocephalum zebra* Burmeister, 1838, *Colpocephalum* sp., *Ciconiphilus quadripustulatus*; family Philopteridae, suborder Ischnocera like *Neophilopterus incompletus* (Denny, 1842), *Ardeicola ciconiae*, *Ardeicola* sp.; and other insects: Rhopalidae sp. Ind., *Protocalliphora* sp. Ind.

The study of the richness of white stork ectoparasites revealed that the urban station (El Merdja) presents a higher number of species (seven species) than the rural one (Ain Zaroug), which contains only four species (Table 1).

Table 1. Richness, abundance, and relative abundance of the faunal ectoparasites in the study stations.

Taxa	Study stations					
	El Merdja			Ain Zaroug		
	R	A	R.A. %	R	A	R.A. %
Menoponidae	01	09	22.89	02	119	60.71
<i>Colpocephalum zebra</i>	-	00	00	+	51	26.02
<i>Colpocephalum</i> , sp.	-	00	00	+	68	35.59
<i>Ciconiphilus quadripustulatus</i>	+	09	22.89	-	00	00
Philopteridae	03	45	54.20	01	72	36.73
<i>Ardeicola ciconiae</i>	+	24	28.91	-	00	00
<i>Ardeicola</i> sp.	+	11	13.25	+	72	36.73
<i>Neophilopterus incompletus</i>	+	10	12.04	-	00	00
Rhopalidae	01	06	7.22	-	00	00
<i>Rhopalidae</i> sp. ind.	+	06	7.22	-	00	00
Hymenoptera	01	08	9.63	01	05	2.55
<i>Apocrita</i> sp. ind.	+	08	9.63	+	05	2.55
Calliphoridae	01	05	6.02	-	00	00
<i>Protocalliphora</i> sp.	+	05	6.02	-	00	00
Total	07	83	99.97	04	196	99.99

Legend: + Presence, - absence; R - richness, A - abundance, R.A. % - relative abundance.

Total Abundance was higher at Ain Zaroug station where 196 individuals were counted; however 83 specimens were captured at El Merdja station (Table1). With a relative abundance of 54.20%, Philopteridae was more abundant than Menoponidae (22.89%) at El Merdja, in Ain Zaroug the relative abundance of Menoponidae was more important (60.71%) followed by Philopteridae 36.73%. Other taxa are very low or absent (Fig. 2).

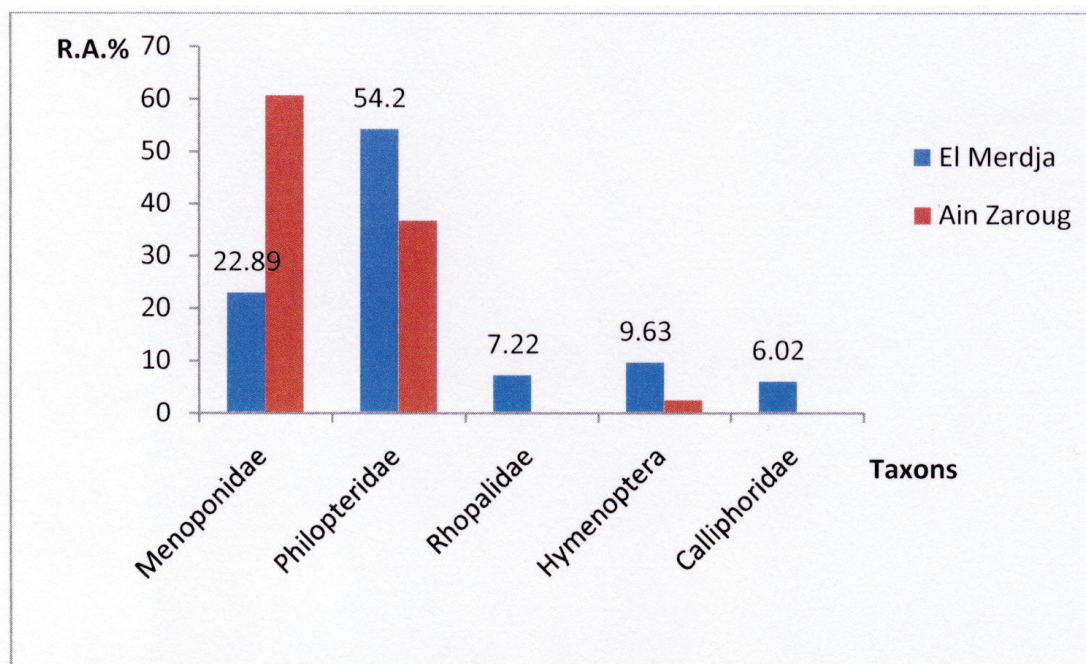


Figure 2. Relative abundance of ectoparasites in the study stations.

Ardeicola ciconiae was the most abundant ectoparasite on white stork at El Merdja representing 32.88% of the total number of fauna ectoparasite, followed by *Ardeicola* sp. 15.06%, then *Neophilopterus incompletes*, *Ciconiphilus quadripustulatus* and *Apocrita* sp. ind. With respectively 13.69%, 12.34%, 10.97%. *Rhopalidae* sp. ind. and *Protocalliphora* sp. were the least important ectoparasites on white stork in this station (Fig. 3).

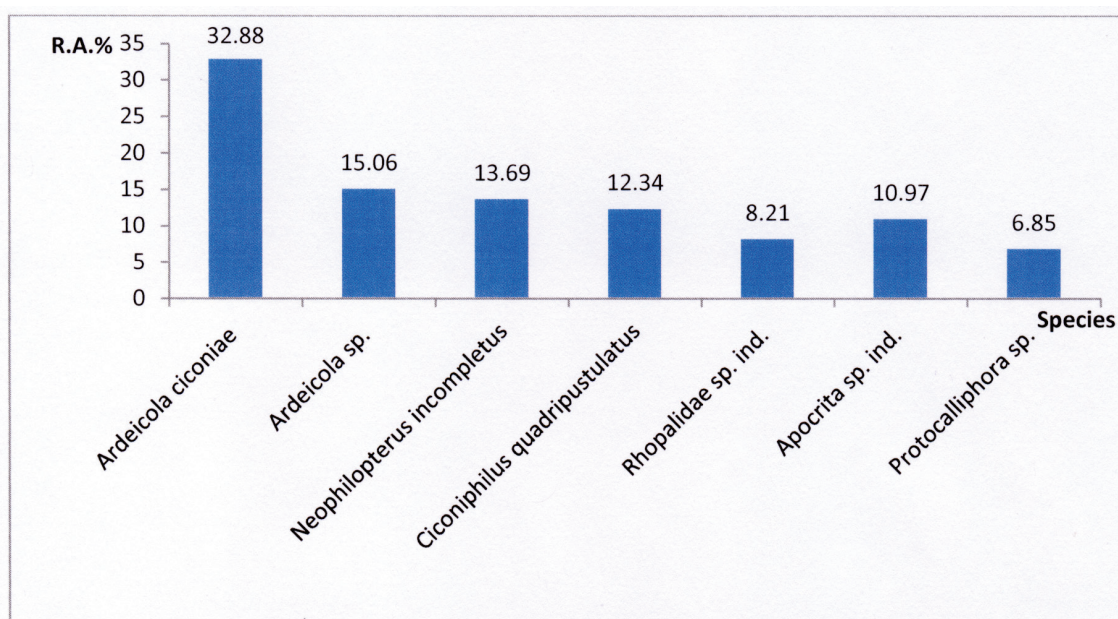


Figure 3. Relative abundance of ectoparasite species on white stork at El Merdja station.

The most abundant species at Ain Zaroug were *Ardeicola* sp., which represented 36.74 % followed by *Colpocephalum* sp. (34.69%) and *C. zebra* with 26.02%. *Apocrita* sp. ind. were weakly represented (Fig. 4).

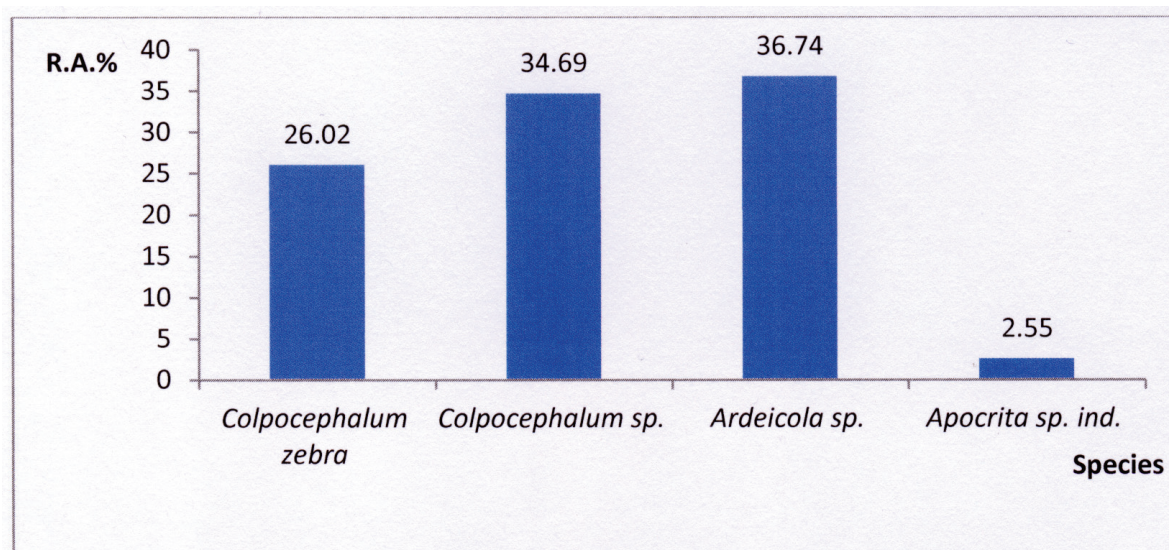


Figure 4. Relative abundance of ectoparasite species on white stork at Ain Zaroug station.

Ectoparasites on white stork from El Merdja station were abundant in May as in June; *Ardeicola ciconiae* was more dominant in May with 47.37% followed by *Ardeicola* sp. with 18.42%, while *Neophilotheus incompletus* was only present in June (27.77%) and *Ciconiphilus quadripustulatus* was more abundant in June (19.45%) than in May (Fig. 5).

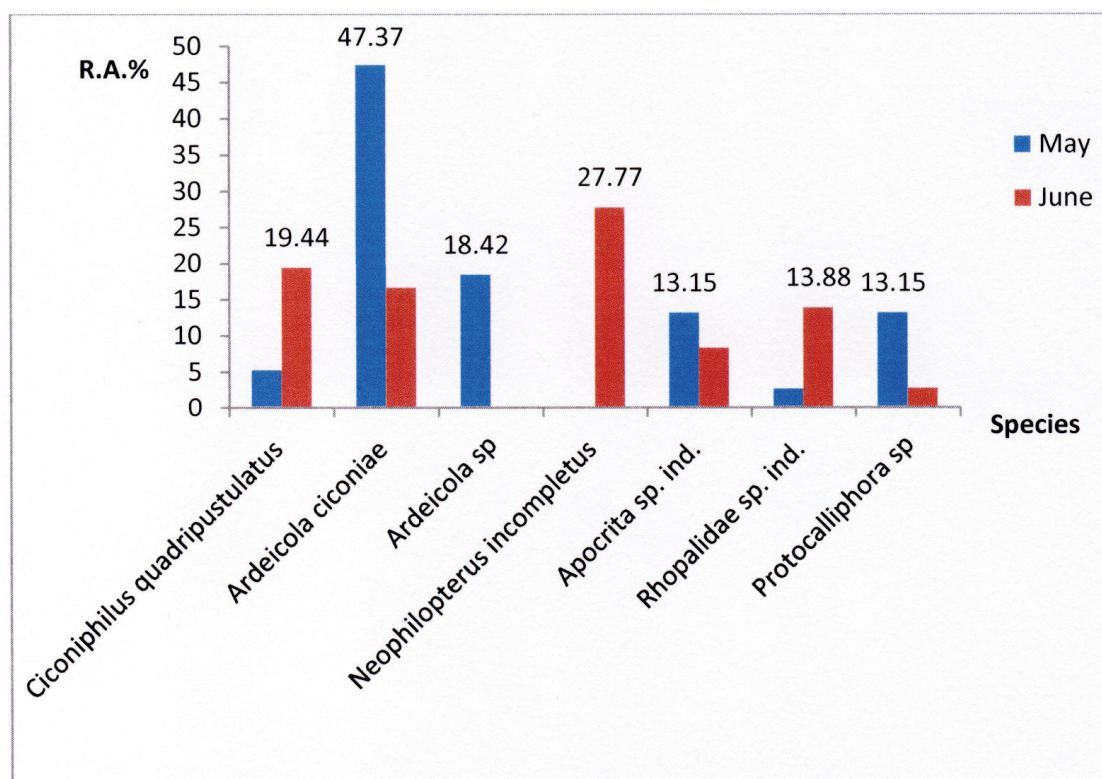


Figure 5. Phenology of ectoparasites on white stork at El Merdja station.

The ectoparasites on the white stork at Ain Zaroug station were more abundant in June (92 specimens), followed by May 79 specimens, then April 25 specimens. *Colpocephalum zebra* was predominant in May (39,24%) whereas *Ardeicola* sp. and *Colpocephalum* sp. with 44.56%, respectively 39.13% were more abundant in June (Fig. 6).

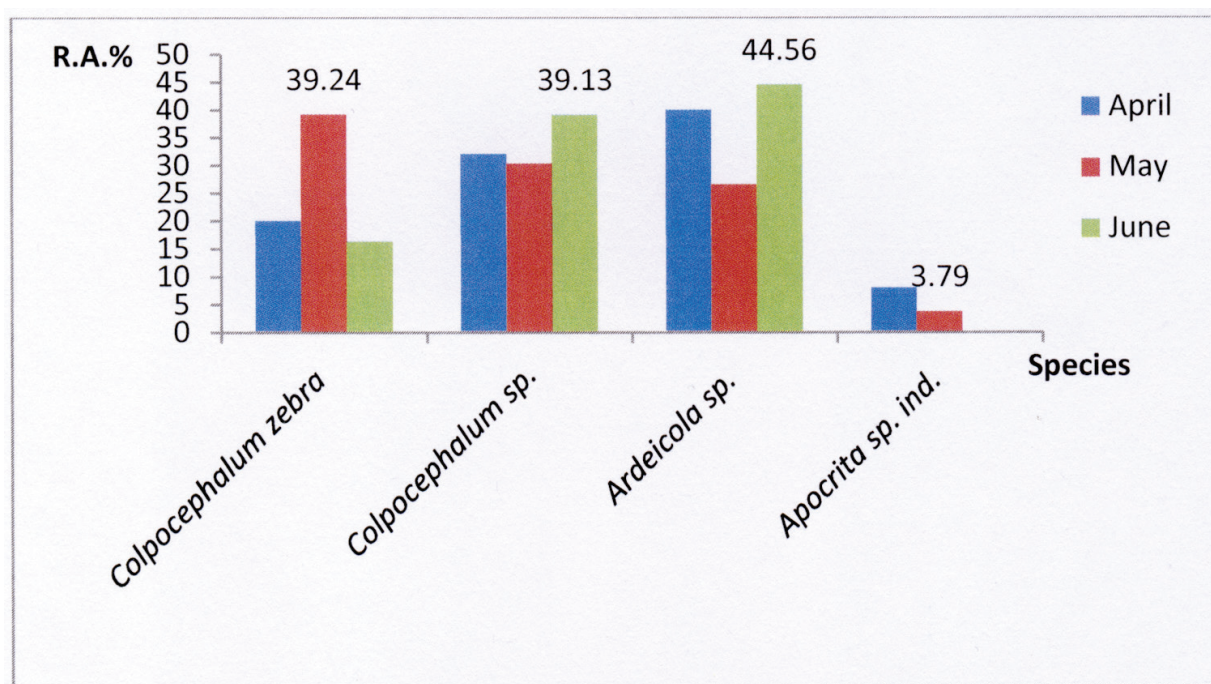


Figure 6. Phenology of ectoparasites on white stork at Ain Zaroug station.

DISCUSSION

The chewing lice from the white stork identified in the Tebessa region are *Colpocephalum zebra*, *Colpocephalum* sp., *Ciconiphilus quadripustulatus*, *Ardeicola ciconiae*, *Neophiloaterus incompletus*, and *Ardeicola* sp. In many regions in the Algerian littoral, two species were found on different avian hosts: *Menacathus stramineus* on *Luscinia megarhynchos*, *Columba livia* and *Columbicola columbae* on *Alectoris chukar* (BAZIZ-NEFFAH et al., 2015).

In north-east of Algeria, MAMMERIA et al. (2014) found only one species belonging to Laemobothriidae in the nest of a White stork.

In his first study on chewing louse insect pests of white storks in Turkey, DIK & USLU (2006) reported the presence of four species: *Colpocephalum zebra*, *Neophiloaterus incompletus*, *Ardeicola ciconiae* and *Ciconiphilus quadripustulatus*, which is confirmed later by DIK et al. (2011). Similar result is obtained by GIRISGIN et al. (2013) in the north-west of Turkey.

In Hungary, species reported on *Ciconia ciconia* are: *Ardeicola ciconiae*, *Ciconiphilus quadripustulatus*, *Colpocephalum zebra*, *Neophiloaterus incompletus* and *N. tricolor* (REKASI, 1993), while in Belgium HELLENTAL et al. (2004) found only two species on *Ciconia ciconia*, which are: *Ciconiphilus quadripustulatus* and *Neophiloaterus incompletus* and in Bulgaria, ILIEVA (2005) notes the presence of a single species *N. incompletus*. On the other hand, *N. incompletus*, *Colpocephalum zebra*, *Ciconiphilus quadripustulatus* and *Ardeicola ciconiae* are found on *Ciconia ciconia* in Romania (ADAM, 2007).

According to PRICE & BEER (1965), the genus *Colpocephalum* includes 43 species specific to Ciconiiformes, including 19 newly described with their hosts, and some species of *Colpocephalum* that are morphologically divergent from *C. zebra* that is specific to *Ciconia ciconia ciconia*.

FRYDERYK & IZDEBSKA (2009) show that parasites have preference to sites on their host *Ciconia ciconia*: most specimens (91%) of *C. zebra* were found on the wings, while *N. incompletus* and the rest of *C. zebra* were observed on other parts of the body (neck, breast, flanks, back).

The abundance of chewing louse fauna is more important on the white storks at Ain Zaroug than on those of El Merdja. The most abundant species at Ain Zaroug is *Ardeicola* sp. followed by *Colpocephalum* sp. and *C. zebra*; at El Merdja, the most abundant species is *Ardeicola ciconiae* followed by *Ardeicola* sp., and *Neophiloaterus incompletus*.

In the north western of Turkey, the most abundant species is *Ciconiphilus quadripustulatus* with 441 individuals, followed distantly by *Ardeicola ciconiae* with 11 individuals, *Neophiloaterus incompletus* with 6 individuals and *Colpocephalum zebra* with 3 individuals (GIRISGIN et al., 2013). FRYDERYK & IZDEBSKA (2009) also reported

the presence of a large number of lice on white storks in Poland, dominated by *C. zebra* with 237 specimens, while *N. incompletus* is less numerous.

Monthly fluctuations in the abundance of the ectoparasites species on *Ciconia ciconia* at El Merdja and Ain Zaroug stations show a variation in the abundance of species over the months.

The peak of infestation of the white stork at Ain Zaroug occurred in June by *Ardeicola* sp.; *Colpocephalum* sp. is very abundant in June and *C. zebra* in May. At El Merdja *Ardeicola ciconiae*, *Ardeicola* sp. are very abundant mainly in May; however, *Ciconiphilus quadripustulatus* and *Neophilopterus incompletus* are very recorded.

ASH (1960) reported that chewing lice appear on young birds from 1-15 days and Menoponids are the first to be present on birds as they are able to find food before feathers appear. In the Danube Delta in Romania, *Neophilopterus incompletus* and *Colpocephalum zebra* are more abundant on *Ciconia ciconia* in August (REKASI et al., 1996).

REFERENCES

- ADAM C. 2007. Data on the chewing louse fauna (PHTHIRAPTERA: AMBLYCERA, ISCHNOCERA) from some Romanian autochthonous and exotic birds. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»*. Bucharest. **50**: 145-210.
- ASH J. S. 1960. A study of the Mallophaga of birds with particular reference to their Ecology. *Ibis*. British Ornithologist's Union. Oxford. **102**: 93-110.
- BACIR A. & BOUSICIMO Z. 2006. Impact of the ectoparasites sure the biology of the reproduction of the blackbird (*Turdus merula mauritanicus*) nesting at low altitude in the North-east Algeria. Second seminar Euro Mediterranean of biology Environmental. Mesogea, flight. 62. *Bulletin du Museum d'Histoire Naturelle de Marseille*.
- BAJERLEIN D., BLOSZYK J., GWIAZDOWICZ DJ., PTASZYK J., HALLIDAY B. 2006. Community structure and dispersal of Mites (Acari, Mesostigmata) in nests of tea white stork (*Ciconia ciconia*). *Biologia*. Bratislava **61**(5): 525-530.
- BAZIZ-NEFFAH F., BITAM I., KERNIF F., BENELDJOUI A., BOUTELLIS A., BERENGER J. M. ZENIA S. DOUMANDJI S. 2015. Contribution à la connaissance des ectoparasites d'oiseaux en Algerie. *Bulletin de la Société Zoologique de France*. Paris. **140**(2): 81-98.
- COLEBROOK E. & WALL R. 2004. Ectoparasites of livestock in Europe and the Mediterranean region. *Veterinary Parasitology*. **120**(4): 251-274. (Accessible to www.researchgate.net/publication/8637570).
- DAJOZ R. 1971. *Precis of ecology*. Edit. Dunod. Paris. 434 pp.
- DIK B. & USLU U. 2006. Beyaz Leyleklerde (*Ciconia ciconia* Linnaeus, 1758) Görülen Mallophaga (Insecta) Türleri. Türkiye Parazitoloji Dergisi. *Official Journal of The Turkish Society for Parasitology*. **30**(3): 220-225.
- DIK B., ERDOĞDU YAMAÇ E., USLU U. 2011. Chewing lice (Phthiraptera) Found on Wild Birds in Turkey. *Journal of the Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. **17**(5): 787-794.
- FRYDERYK S. & IZDEBSKA J. N. 2009. Chewing lice (Insecta- Phthiraptera) of the white stork (*Ciconia ciconia* L.) in Poland. *Annales Universitatis Mariae Curie-Sklodowska*. Lublin. **64**(2) sectio C: 83-88.
- GIRISGIN AO., DIK B., GIRISGIN O. 2013. Chewing lice (Phthiraptera) species of wild birds in northwestern Turkey with a new host record. *International Journal for Parasitology: Parasites and Wildlife*. Elsevier. **2**: 217-221.
- HELLENTAL RA., PRICE RD., PALMA RL. 2004. *Chewing Lice of Belgium*. <http://bch-cbd.naturalsciences.be/Belgium/biodiversity/fauna flora habitats/belchewinglice>. Pdf (Accessed: 14.06.2005).
- ILIEVA MN. 2005. New data on chewing lice (Insecta: Phthiraptera) from wild birds in Bulgaria. *Acta Zoologica Bulgarica*. Bulgarian Academy of Sciences. Sofia. **57**(1): 37-48.
- MAMMERIA AB., BITAM I., BOUTELIS A., KERNIF T. 2014. First account of Arthropods in the nest of the white stork, *Ciconia ciconia* in Algeria Including the flea *Ctenocephalides felis*. *Bulletin de la Société Zoologique de France*. Paris. **139**(1-4): 199-213.
- NEFFAR S. 2012: Etude de l'effet de l'âge des plantations de figuier de Barbarie (*Opuntia ficus indica* L. Miller) sur la variation des ressources naturelles (sol et végétation) des steppes algériennes de l'Est. Cas de Souk-ahras et Tébessa. *These de Doctorat*. L'Université d'Annaba-Algerie. 236 pp.
- PRICE R. & BEER J. 1965. The *Colpocephalum*. (Mallophaga: Menoponidae) of the Ciconiiformes. *Annals of entomological Society of America*. Scientific Journal series. Minnesota Agricultural Experiment Station. **58**: 111-131.
- REKASI J. 1993. Bird lice (Mallophaga) parasiting the birds of Hungary. *Aquila*. **100**. 71-93. Accessible to Aquila_EPA-01603_1993_071-093.pdf.
- REKASI J., KISS J. B., TÖRÖK ZS. 1996. Data on the bird lices (Mallophaga) parasiting the bird species of the Danube Delta (Romania). *Analele Științifice ale Institutului „Delta Dunării” Tulcea*: 41-46.
- ROUAG-ZIANE N., BOULAHBAL A., GAUTHIER-CLERC M., THOMAS F., CHABI Y. 2007. Inventory and quantification of the ectoparasites of the Coot Coot *Fulica atra* (Gruiformes: Rallidae) in the northeast of Algeria. *Parasite*. **14**: 253-256. Accessible to <http://www.parasite-journal.org>. (doi.org/10.1051/parasite/2007143253).

ROUAG-ZIANE N. & CHABI Y. 2008. Ecology of the reproduction of the Tit blue (*Cyanistes caeruleus ultramarinus*) in a deciduous habitat. Characterization of diet and inventory of the ectoparasites. *Review Synthesis of the science and of the Technology*. L'Université d'Annaba-Algerie. **17**: 14-24.

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