A comparative study of the arthropod fauna in stork, barn swallow and common pigeon nests

R. Sadeddine*, S. Righi, K. Daghri, K. Saidani and A. Benakhla

Abstract

An analysis was conducted on the arthropod fauna collected from stork, swallow, and pigeon nests during summer 2018 in three regions of north-eastern Algeria (Guelma, El-Tarf, and Annaba). A total of 40 nests was examined, of which 58% were infested with arthropods. Arthropods were less abundant and species rich in swallow nests than in pigeon or stork nests, where a greater dominance of mesostigmatic mites (78.71% and 72.41%, respectively) was found. *Dermanyssus gallinae* was the most abundant (33.05%) and most frequent (73.33%) mesostigmatic mite in pigeon nests, while *Uropodina* mites were dominant (41.37%) in white stork nests with a frequency of 76.92% of the nests analysed. In swallow nests, the following arthropods were found: *Psocidea, Hemiptera, Hymenoptera* and *Coleoptera* belonging to the class *Insecta* and *Isopoda* belonging to the class *Malacostraca*. This is the first comparative survey of arthropods occupying the nests of these bird species in northern Algeria. It is anticipated that these data, that highlight the richness of the arthropod fauna in the nests of these bird species, will motivate further research aimed at characterising the arthropod community in different bird nests and determining the nature of the relationships between them.

Key words: arthropod fauna; bird nest; white stork; barn swallow; rock pigeon

Introduction

Bird nests are specialised structures with the primary function of accommodating eggs and fledglings by offering favourable conditions (Deeming and Mainwaring, 2015). They also represent an important habitat for several groups of parasitic arthropods where they find shelter and food. A micro-ecosystem is created in many bird nests, involving highly variable interactions between birds and nesting arthropods, and is characterised by a multitude of adaptive strategies that allow invertebrates to inhabit the microenvironments of different host species.

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Furthermore, several factors control the abundance and diversity of arthropods in bird nests such as nest-building materials, geographical location, nest size, and host species (Fryderyk and Izdebska, 2009; Mainwaring et al., 2014; Boyes and Lewis, 2018; Carvallo et al., 2020). Because information on nest arthropods is scarce, there are even fewer studies on the drivers of nest arthropod diversity. We characterized arthropod diversity in cup- and dome-shaped nests along a 130 km latitudinal gradient in the mediterranean-type region of Central Chile and, we assessed whether nest dimensions and climatic factors explain richness (alpha-diversity).

Parasitic arthropods of bird nests constitute an extremely varied group that exhibit different ecological functions. These arthropods can be detritivorous, saprophagous or predatory. Some are strictly confined to bird nests, taking advantage of the favorable habitat without affecting birds, while other species of external parasites can be highly pathogenic or vectors of severe pathogens, harming their hosts (Goodenough and Hart, 2012; Roy et al., 2013; Deeming and Mainwaring, 2015; López-Rull and García, 2015).

Most research on bird nests has been focused on ectoparasites and their impacts on avian fitness, productivity, and population dynamics (Goodenough and Hart, 2012). It is important to note that parasites represent only a small proportion of the arthropod community present in birds’ nests, whereas the whole arthropod fauna of birds’ nests is much more diverse. However, the diversity and ecological roles of nest arthropods have been neglected in many studies (Proctor, 2003; Mainwaring et al., 2014), especially as this fauna may exhibit large variations among different bird species. All these considerations led us to conduct this study by expanding our approach to arthropods in the bird’s nest ecosystem.

Figure 1. Map with tagged sampling locations
The aim of this study was to compare the abundance and species richness of arthropods in the nests of white stork (*Ciconia ciconia*: Pelecaniformes, *Ciconiidae*), barn swallow (*Hirundo rustica*: Passeriformes, *Hirundinidae*), and rock pigeon (*Columba livia*: Columbiforme, *Columbidae*).

**Material and methods**

**Study areas and arthropod collection**

In accordance with the national protection regulations (executive decree 12-235 of May 24, 2012) relating to the protection and conservation of avifauna, this study was conducted after obtaining authorisation from the environmental protection departments of all three regions of study.

During summer 2018, arthropods were collected from a total of 40 bird nests: 12 swallow, 15 pigeon, and 13 stork nests. These nest samples were collected from seven sites in three provinces: El Taref, Annaba and Guelma (Figure 1). All nests were taken from supports located near human dwellings, hence the importance of identifying the arthropods they contain. In the spring, some swallow nests present in rural buildings were monitored, and nests not occupied during the entire breeding period were collected. These nests were constructed of mud pellets containing grass stalks and feathers, they were fixed at the junction of two walls at an inner corner. Their interiors were filled with feathers, grasses and dead bird carcasses. Pigeon nests built more than three months ago on the roofs of the houses were shaken to recover part of the building materials before being re-installed.

For storks, we targeted easily accessible nests found in trees (at a height of about four meters). In addition, because of the very large size of the stork nests, much of the twigs, leaves and litter available at the bottom of the nest (about 7–8 kg per nest) were systematically removed.

None of the examined nests contained eggs. However, young birds were occasionally observed in pigeon and stork nests.

The nest material was transported in sealed plastic bags to the parasitology laboratory of the Chadli Benjedid University of El-Tarf, where it was placed in a Berlese funnel (De Lillo, 2001) for a minimum of 48 hours. Also, the plastic bags containing the nest material were stored in the refrigerator to decrease arthropod activity. Collected arthropods were stored in labelled tubes containing 70% ethanol.

All collected arthropods were identified (Leng and Mutchler, 1920; Snodgrass, 1935; Krantz, 1971; Herring, 1976; Hyatt, 1980; Smithers, 1990; Masan, 1999; Mackay, 2002; Kalúz and Fenda, 2005; Bal and Özkan, 2006; Moraza et al., 2009; Thyssen, 2010; Di Palma et al., 2012; Keum et al., 2016; Mackay and Shultz, 2018; Gomes-Almeida and Pepato, 2021). Mites were transferred to slides using Hoyer’s mounting medium (Faraji and Bakker, 2008) and examined under a light microscope (Leica microsystems). All insects were identified and photographed using a binocular zoom stereomicroscope (Zeiss Axio Zoom.v16).

The arthropod material was analysed using the following methods: dominance (ratio between the number of individuals of a given species compared to the number of all individuals in the study, as a percentage), frequency (percentage of nests in which the species occurred), and abundance (ratio between the number of arthropods and the number of examined nests) (Bloszyk et al., 2005).
Table 1. Parasites detected in the present study and their prevalence (D: Dominance; F: Frequency)

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Species</th>
<th>Swallow-nests D%</th>
<th>Swallow-nests F%</th>
<th>Pigeon-nests D%</th>
<th>Pigeon-nests F%</th>
<th>Stork-nests D%</th>
<th>Stork-nests F%</th>
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</thead>
<tbody>
<tr>
<td>Ixodida</td>
<td>Ixodidae</td>
<td>-</td>
<td>118 (33.05%) 11 (73.33%)</td>
<td>/</td>
<td>6 (1.68%) 2 (13.33%)</td>
<td>7 (2.68%) 2 (15.38%)</td>
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<tr>
<td>Mesostigmata</td>
<td>Dermanyssidae</td>
<td>-Dermanyssus gallinae</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>10 (3.83%) 2 (15.38%)</td>
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<tr>
<td></td>
<td>Macronyssidae</td>
<td>-Ophionussy sp.</td>
<td>/</td>
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<td>3 (1.40%) 7 (2.68%)</td>
<td>1 (7.69%)</td>
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<td></td>
<td>Laelapidae</td>
<td>-Hypopias aculeifer.</td>
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<td>3 (1.40%) 7 (2.68%)</td>
<td>1 (7.69%)</td>
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<td>Asciidae</td>
<td>-Asca sp.</td>
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<td>10 (9%) 9 (8.33%)</td>
<td>8 (7.20%)</td>
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<td></td>
<td>Parasitidae</td>
<td>-Parasitus beta</td>
<td>/</td>
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<td>1 (8.33%) 7 (6.30%)</td>
<td>1 (7.69%)</td>
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<tr>
<td></td>
<td>-Parasitus fucorum.</td>
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<td>1 (8.33%) 7 (6.30%)</td>
<td>1 (7.69%)</td>
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<td></td>
<td>-Pergamasus sp.</td>
<td>/</td>
<td>/</td>
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<td>/</td>
<td>1 (8.33%) 7 (6.30%)</td>
<td>1 (7.69%)</td>
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<tr>
<td>Uropodidae</td>
<td>-Uropoda orbicularis</td>
<td>/</td>
<td>/</td>
<td>(27.73%) 6 (40%)</td>
<td>/</td>
<td>(41.37%) 10 (76.92%)</td>
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<tr>
<td></td>
<td>-Uroobovella pyriformis</td>
<td>/</td>
<td>/</td>
<td>51 (14.28%) 6 (40%)</td>
<td>45 (17.24%) 8 (61.53%)</td>
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<td></td>
<td>Trematuridae</td>
<td>-Trichouropoda ovalis.</td>
<td>/</td>
<td>/</td>
<td>35 (9.80%) 4 (26.66%)</td>
<td>48 (18.39%) 5 (38.46%)</td>
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<tr>
<td>Prostigmata</td>
<td>Trombidiidae</td>
<td>/</td>
<td>/</td>
<td>5 (1.40%) 1 (6.66%)</td>
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<tr>
<td>Araneae</td>
<td>Segestriidae</td>
<td>1 (7.69%)</td>
<td>/</td>
<td>1 (8.33%) 8 (2.24%)</td>
<td>4 (2.66%)</td>
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<tr>
<td></td>
<td>Pseudoscorpiones</td>
<td>Chernetidae</td>
<td>6 (15.40%)</td>
<td>4 (33.33%) 9 (2.52%)</td>
<td>5 (33.33%) 5 (1.91%) 3 (23.07%)</td>
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<tr>
<td>Psocoptera</td>
<td>Trogiiidae</td>
<td>3 (2.70%)</td>
<td>/</td>
<td>1 (8.33%) 21 (15.88%)</td>
<td>5 (33.33%) 7 (2.68%) 2 (15.38%)</td>
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<tr>
<td></td>
<td>-Lepinotus reticulatus</td>
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<tr>
<td></td>
<td>-Trogium pulsatorium</td>
<td>3 (2.70%)</td>
<td>/</td>
<td>1 (8.33%) 17 (4.76%)</td>
<td>4 (26.66%) 7 (2.68%) 2 (15.38%)</td>
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<tr>
<td>Hemiptera</td>
<td>Lyctocoridae</td>
<td>11 (9.90%)</td>
<td>/</td>
<td>3 (25%) 13 (6.64%)</td>
<td>3 (20%) 9 (3.44%) 3 (23.07%)</td>
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<tr>
<td>Hymenoptera</td>
<td>Formicidae</td>
<td>3 (2.70%)</td>
<td>/</td>
<td>1 (8.33%) 5 (1.40%)</td>
<td>2 (13.33%) 7 (2.68%) 3 (23.07%)</td>
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<tr>
<td>Isopoda</td>
<td>Armadillidiidae</td>
<td>- Armadillidium vulgare.</td>
<td>7 (6.30%)</td>
<td>2 (16.66%)</td>
<td>5 (33.33%) 2 (13.33%) 8 (3.06%) 3 (23.07%)</td>
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<tr>
<td>Coleoptera</td>
<td>Scarabaeidae</td>
<td>- Aphodinae</td>
<td>/</td>
<td>/</td>
<td>2 (0.56%) 1 (6.66%)</td>
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<tr>
<td></td>
<td>Tenebrionidae</td>
<td>10 (9%)</td>
<td>/</td>
<td>3 (25%) 8 (2.24%)</td>
<td>2 (13.33%) 19 (7.27%) 5 (38.46%)</td>
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<td></td>
<td>-Nalassus dryadophilus</td>
<td>2 (1.80%)</td>
<td>/</td>
<td>1 (8.33%) 8 (2.24%)</td>
<td>2 (13.33%) 12 (4.59%) 5 (38.46%)</td>
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<td>Staphylinidae</td>
<td>Alphitobius diaperinus</td>
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<td>5 (1.91%) 2 (15.38%)</td>
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<td>Histeridae</td>
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<td>2 (0.76%) 1 (7.69%)</td>
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<td>Dermentidae</td>
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<td>10 (3.83%) 2 (15.38%)</td>
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<td></td>
<td>- Anthrenus amandae</td>
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<tr>
<td></td>
<td>- Larvae</td>
<td>68 (61.26%)</td>
<td>6 (50%)</td>
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**Total** | **111** | **12** | **357** | **15** | **261** | **13** |
Results

Of the 40 nests examined, 85% (34/40 = arthropod prevalence) contained arthropods. Only some of the swallow nests were without arthropods. A total of 729 specimens belonging to 10 taxonomic orders were collected (Table 1), representing an overall parasite load of around 18.2. Arthropod communities were more abundant and species rich in pigeon and stork nests than in swallow nests, with a parasite load of 23.8 (357 arthropods/15 pigeon nests) and 20.07 (261 arthropods/13 stork nests) vs 9.25 (111 arthropods/12 swallow nests).

Pigeon and stork nests were more frequently inhabited by mesostigmatic mites (78.71% and 72.41% respectively), which was also the highest species diversity. This group included hemato-

phagous, predatory, and phoretic mites belonging to the families: Dermanyssidae, Laelapidae, Ascidae, Parasitidae, Uropodidae, and Trematuridae.

The haematophagous mite Dermanyssus gallinae (De Geer, 1778) (Figure 2) was recurrently collected in pigeon nests and was the most abundant mesostigmatic mite at a rate of 33.05%. This mite was isolated from 73.33% of pigeon nests. Similarly, Uropodid mites (Figure 2) included two species: Uropoda orbicularis (O.F. Müllcr, 1776) and Uroobovella pyriformis (Berlese, 1920), with a dominance of 27.73% and 41.37% in pigeon and stork nests respectively.

More than 26% of pigeon nests and 38% of stork nests were inhabited by Trichouropoda ovalis (Koch, 1839), while the highest abundance was observed in the stork nests. The other identified mites

Figure 2. [a] Uroobovella pyriformis; [b] Uropoda orbicularis; [c] Ophionyssus sp.; [d] Dermanyssus gallinae
showed a low dominance and their occurrence was occasional (Table 1).

The arthropods present in the various examined bird nests belonged to the Insect (Psocodea Hemiptera, Hymenoptera, and Coleoptera) group and Malacostraca group (Isopoda). Most of these insects were identified at the species level. Lepinotus reticulatus (Enderlein, 1905) was isolated from a pigeon nest. Insect species i.e., Trogium pulsatorium (Linnaeus, 1758), Lyctocoris campestris (Fabricius, 1794) (Figure 3), Formicoidea, and Isopoda species, Armadillidium vulgare (Latreille, 1804) were found in all three host species.

The largest number of specimens belonged to the order of Coleoptera, with 120 specimens isolated, belonging to five families: Scarabaeidae (Aphodiinae), Tenebrionidae, Staphylinidae (Figure 3), Histeridae and Dermestidae. Unfortunately, the Dermestidae, representing 61.26% of the arthropod community colonizing swallow nests, were mainly Dermestidae larvae. These larvae had a frequency of 50%.

Also, we noted the presence of the orders Oribatida, Araneae and Pseudoscorpiones (Figure 3). In particular, these three orders of arthropods were recorded in pigeon nests. The total numbers of identified specimens per taxonomic group are summarised below (Table 1).

**Discussion**

This study aimed to compile a checklist of the arthropods present in the nests of three bird species from northeastern Algeria: rock pigeon (Columba livia), white stork (Ciconia ciconia) and barn swallow (Hirundo rustica) and to compare the diversity of the arthropod fauna among these bird species. Although sim-
ilar research has focused exclusively on arthropods in the stork nest ecosystem in the El Tarf province (Mammeria, 2014), this study highlights the diversity of the arthropod fauna in both stork nests and other bird nests, displaying the richness of this fauna in the three study regions in northeast Algeria. This is based on the assumption that abundance and species diversity are strongly influenced by several factors, e.g., nest building materials, nest size, and host behaviour. Therefore, the fauna colonising the nests of the three bird species studied would be expected to differ.

Through this study, we recorded the presence of arthropod-free/poor/rich nests. We determined 10 taxonomic orders; some specimens could not be identified to the species level due to alterations of the body or immature stage, and thus the diversity analysis of arthropods remains incomplete.

The low abundance and diversity in barn swallow nests were unexpected, as previous studies have reported contrasting results. Here, all swallow nests were absolutely free of mites, in contrast to Babbitt and Burtt (1991) who identified blood-sucking, predatory and detritivorous mites in tree swallow nests. Generally, barn swallows are faithful to their nesting sites throughout their lives. When they return in the spring, they reoccupy the nests used the previous year (Møller, 1990). However, heavy use of the nests each year increases their parasite abundance and the nest parasite pressure can be so strong that birds can abandon the nest or change locations. This is well documented by the studies on behaviour of brown pelicans and barn swallows, whose nests were infested with ticks or hemipterans (Fryderyk and Iżdebska, 2009). Also, Barclay, (1988) Møller (1993, 2000) found that barn swallows avoid using old nests containing haematophagous mites and in the same way, cliff swallows (Hirundo pyrrhonota), after their return, choose clean nests or build new ones (Brown and Brown, 1986).

Similarly, there are many reasons why barn swallows abandon their nests, including: death of birds during migration or in their wintering area, or due to a predator (cat, birds of prey) or if the area has become too poor in insects (increasing urbanisation, chemicals sprayed on crops) (Gorenzel and Salmon, 1994; Jenni-Eiermann et al., 2008), which may explain the presence of these unoccupied nests during the breeding season.

In the nests of rock pigeons, mites were very numerous and diversified, and included the presence of haematophagous, predatory, phoretic mites with a dominance of the species D. gallinae, a ubiquitous parasite of domestic fowl also commonly found on wild birds. When these hosts are not available, the red poultry mite (D. gallinae) bites mammals (Moroni et al., 2021). In addition, this mite is capable of transmitting viral, rickettsial and protozoan diseases to birds (Clayton and Tompkins, 1995). The species was recorded in 73.33% of the nests studied. In the study by Šustek et al. (1992), the blood-sucking species D. gallinae was reported as the most abundant mite in bird’s nests. This mite has a short generation time and can rapidly build huge populations. A very large number can be present in a single nest (Richner and Heeb, 1995). The presence of this mite in rock pigeon nests has been reported in several studies. Also, it has been recorded in the nests of several bird species, including barn swallow nests, contrary to our results (Mašán et al., 2014). On the other hand, we reported the absence of these haematophagous
parasites in stork’s nests (*Ciconia ciconia*) but we still recorded various mesostigmatic mites.

Mesostigmata from the family *Laelapidae* are known to be the most aggressive predators of arthropods in the soil (Walter and Proctor, 2013). We recorded the presence of killer mite (*Hypoaspis aculeifer*), (Canestrini, 1884). This predatory soil mite has already been identified in bird nests (Gwiazdowicz et al., 1999; Krištofík et al., 2003; Fenda and Lengyel, 2007), and even in starling nest boxes, it is considered to be a true predator of poultry red mites and its use in biological control seems to be one of the various control options (Lesna et al., 2009).

Other predatory Mesostigmata (*Ascidae, Parasitidae*) identified in this study were recurrently isolated from bird nests. Several species of the family *Ascidae* (a soil-dwelling mite) were found in the nests of Red-backed and Grey shrikes (Tryjanowski et al., 2001; Gwiazdowicz et al., 2006) and specimens of the genus *Parasitus* were frequently identified in stork nests (Šustek et al., 1992; Bajerlein et al., 2006). Most of the *Parasitidae* determined in our study are deutonymphs, which is similar to what was found by Bloszyk et al. (2005) and Roy et al. (2013) in stork nests.

We also report the presence of specimens belonging to the families *Uropodidae and Trematuridae*, these phoretic mites mainly associated with bird nests are either directly transported with building materials or transported phoretically by insects (Bloszyk et al., 2005). However, their role in community structure is still unknown (Bajerlein and Bloszyk, 2004). Phoresy is an efficient dispersal strategy, which can lead to parasitism. Several authors have reported the presence of Uropodina in bird nests worldwide (Mammeria, 2014).

Insects appeared in the nests of all three host species, with a total of 225 specimens belonging to 5 orders (Table 1). The highest number of individuals and species was Coleopterans (Figure 3). Several specimens of detritivorous Coleopterans have been noted in many nests by Babbitt and Burtt (1991) and Roy et al. (2013). These insects are not specific to bird nests, but have found a convenient habitat in the nest, probably due to the presence of animal substances, which are widely available in insectivorous bird nests (Tryjanowski et al., 2001; Sazhnev et al., 2022). Also the bug *Lycocoris campestris* (Fabricius, 1794) is present in bird nests, living as a predator of small invertebrates, such as moth larvae that feed on debris (Saulich and Musolin, 2009).

We found Pseudoscorpions in the nests of all the three host species. Pseudoscorpions are occasionally but regularly found in swallow nests (*Hirundo rustica*), feeding on moth larvae and mites, lice, beetles and ants (Krištofík et al., 2007; Hodgson et al., 2008). These arachnids are sometimes phoretic, clinging to the legs of flies, beetles and other insects (Mammeria, 2014).

The occurrence of some arthropods (specimens of the order *Isopoda, Psocoptera, Hymenoptera and Aranea*) in bird nests is incidental: specimens from the order Isopoda were collected in 17.5% of nests, terrestrial isopods belonging to the suborder *Oniscoidea* were generally found in soil and trees (Tajovsky et al., 2012). The order *Psocoptera* includes omnivorous insects that feed mainly on moulds, algae and fungi and grow on various substrates, *Trogium pulsatorium* (Linnaeus, 1758) species found in our results, lives in nature where it can be found in trees and dry litter. Finally, specimens of the orders *Hymenoptera and Araneae* found in the nests were probably brought in with the bird’s diet.
It is commonly known that many components of bird nest fauna are inadvertently introduced into the nest using construction material (Tryjanowski et al., 2001) which may partially explain the identification of certain arthropods found in this study.

Hard ticks (Ixodidae) are obligate temporary parasites of vertebrate animals, alternating between parasitic and free-living life cycles on one or more host animals. All species have three developmental stages: larva, nymph and adult. Coupling can take place on and off the host. The blood meal taken by the females is necessary for egg laying and once engorgement is over they drop to the ground, where over time they lay a batch of eggs. However, the life cycles of hard ticks are categorized by the number of times their stages feed and whether they moult on the host or leave their hosts for moulting in the environment. Accordingly, species are classified as one-host, two-host, or three-host ticks (Anderson and Magnarelli, 2008; Bonnet et al., 2017).

The majority of hard ticks feed on mammals and some of them are specific parasites of birds. Several species belonging to the genera: Ixodes, Haemaphysalis and Dermacentor have been identified in bird nests (Krumpál et al., 2016). In this study, collected ticks appear to belong to the genus Dermacentor, knowing that the immature stages of D. marginatum feed mainly on birds. Also, this tick is found in the cooler and more humid parts of the Mediterranean climate zone (Walker, 2003).

Conclusion

In conclusion, on the basis of our findings, we were able to identify the diversity of arthropod fauna colonizing the nests of these three bird species. Mites are the most abundant and frequent arthropods inhabiting the nests of rock pigeon and white stork. The mite fauna is dominated by D. gallinae that was recorded in 73.33% of pigeon nests and Uropodidae with are accidentally transmitted to bird nests by phoresis; these phoretic mites are present in 40% of pigeon nests and 76.92% of stork nests. Also, we noted the presence of insects belonging to five different taxonomic orders in the nests of the three avian species and one larvae Dermacentor sp. in a stork nest. Many parasites realize successive passages through hosts belonging to different species. These transfers are an essential key to the ecology and evolution of parasites. These results show the diversity of host-parasite relationships with adaptation strategies for all environments and provide essential data for other future fundamental ecological studies.

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A comparative study of the arthropod fauna in stork, barn swallow and common pigeon nests

Komparativna studija faune člankonožaca u gnijezdima roda, domaćih lastavica i običnih golubova

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Analiza faune člankonožaca prikupljenih iz gnijezda roda, lastavica i golubova provedena je tijekom ljeta 2018. godine u tri regije sjeveroistočnog Alžira, Guelma, El-Tarf i Annaba. Ukupan je broj ispitanih gnijezda bio 40, od čega je u 58 % otkrivena infestacija člankonožcima kojih je bilo manje u gnijezdima lastavica nego u gnijezdima golubova i roda. Zamijećena je veća dominacija grinja reda Mesostigmata (78,71 %, odnosno 72,41 %). Dermanyssus gallinae bila je najraširenija (33,05 %) i najčešća (73,33 %) grinja reda Mesostigmata u gnijezdima golubova, dok su u gnijezdima bijelih roda najdominantnije bile grinje kohorte uropodina (41,37 %) s učestalosću od 76,92 % broja analiziranih gnijezda. U gnijezdima lastavica pronađene su sljedeće grinje: Psocodea, Hemiptera, Hymenoptera i Coleoptera kojih pripadaju razredu Insecta i Isopoda koja pripada razredu Malacostraca. Ova je studija prva komparativna studija člankonožaca koji žive u gnijezdima triju vrsta ptica (bijela roda, domaća lastavica i divlji golub) u sjevernom Alžiru. Nadamo se da će ovi podaci koji su pokazali bogatstvo faune člankonožaca u gnijezdima ovih triju vrsta ptica motivirati dodatna istraživanja s ciljem karakterizacije zajednice člankonožaca prisutne u gnijezdima različitih ptica i određivanja naravi njihovog međusobnog odnosa.

Ključne riječi: fauna člankonožaca, gnijezda ptica, bijela roda, domaća lastavica, divlji golub