

Parasitologie

FIRST ACCOUNT OF ARTHROPODS IN THE NEST OF THE WHITE STORK, *CICONIA CICONIA*, IN ALGERIA, INCLUDING THE FLEA *CTENOCEPHALIDES FELIS*

par

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We collected twelve nests of the white stork *Ciconia ciconia* from the wetland of El-Tarf in the extreme northeast of Algeria during 2008 and 2009, between September and November. The nests were carefully dislocated to collect the different arthropod species contained either at the surface of the nest or in the material used to build the nest.

We found 159 mites, belonging to Mesostigmata, Uropodina (150) and Sejidae, Sejina (9). We also found 2 pseudoscorpions, 1 chewing louse (Mallophaga, Laemobothriidae) and, for the first time in nests of white storks, the flea *Ctenocephalides felis* (4 specimens). The remainder were ant heads, beetle heads of Carabidae and Histeridae, immature *Anthocoris* bugs (Heteroptera) and woodlice (Isopoda).

Keywords: White Stork, *Ctenocephalides*, mites, wetlands, Algeria.

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Bulletin de la Société zoologique de France 139 (1-4)

Première description d'arthropodes trouvés dans les nids de la cigogne blanche *Ciconia ciconia* en Algérie ; présence de la puce *Ctenocephalides felis*

Entre 2008 et 2009, douze nids de cigogne blanche *Ciconia ciconia* ont été récupérés, entre septembre et novembre, dans la zone humide d'El Tarf à l'extrême nord-est de l'Algérie.

Nous avons identifié 159 acariens appartenant aux Mesostigmata, Uropodina (150 spécimens) et Sejidae, Sejina (9 spécimens). Pour la première fois dans les nids de cigognes blanches, nous avons trouvé des puces de l'espèce *Ctenocephalides felis* (4 spécimens), 2 Pseudoscorpions, et 1 pou d'oiseaux (Mallophaga, Laemobothriidae). Nous avons également trouvé des têtes de fourmis, des Coléoptères Carabidae et Histeridae, une punaise immature du genre *Anthocoris* (Heteroptera) et des Isopodes (Cloportes).

Mots-clés : Cigogne blanche, *Ctenocephalides*, acariens, zones humides, Algérie.

Introduction

Bird parasites have been extensively studied around the world (CLAYTON & WALTHER, 1997). Those that feed on the blood of their host can slow the development of chicks or even kill them (PROCTOR & OWENS, 2000).

Bird nests are crucial for the spreading of mites and their direct diffusion by birds, via either the nest building material or feathers, promoting diversity and gene flow in many species of Uropodina (BŁOSZYK *et al.*, 2006).

Uropodina are typical elements of the soil fauna, preferring substrates rich in organic substances (ATHIAS-BINCHE, 1977), and their diet is very diverse (CONSTANTINESCU & CRISTESCU, 2007). The presence of these mites in bird nests is accidental and they are either directly conveyed with building material, or transported phoretically by insects (Table 1). However, their role in the community structure is still unknown (BŁOSZYK *et al.*, 2004). Uropodina deutonymphs attach to arthropods (AINSCOUGH, 1981) by their anal apparatus (pedicel) (ATHIAS-BINCHE, 1984; BŁOSZYK *et al.*, 2006). Phoresy is an effective dispersal strategy, which can lead to parasitism.

Materials and methods

Between 2008 and 2009, twelve nests of 10 kg were recovered after the departure of white storks (between early August and mid-September at the wilaya (province) of El Tarf (far northeast of Algeria) when locating nests with GPS. Nests were taken from various supports near human habitations (MAMMERIA *et al.*, 2012).

Our choice of this region was based on three conditions:

– a significant number of white storks are found in this area (MAMMERIA *et al.*, 2012);

***Ctenocephalides* fleas in nests of white stork in Algeria**

- this bird species occurs in close vicinity to human homes, making it important to identify the arthropods that it carries during migration (MAMMERIA *et al.*, 2012);
- the damp climate of the region of El-Tarf is favourable for the proliferation of parasites.

This area could therefore be a favourable habitat for vectors and a reservoir of infectious agents.

This is the first contribution to the study of arthropods in white stork nests in Algeria, where the migration and ecology of this species are poorly documented.

Sampling

With the help of volunteers in each region, we were able to record the date of departure of migrating birds and collect nests within a short time frame (no more than two days) in order to ensure optimal representation of parasites, which can have short life-cycles (JANOVY *et al.*, 1992).

Some accessible nests facilitated the collection of the first surface layer (CLAYTON & WALTHER, 1997). Those in less accessible positions were recovered by causing their downfall.

The nests were placed in large plastic bags and treated on site for preliminary sorting. The base and the nest contours are made of a pile of branches, to which the species adds manure, grass, vine shoots, paper, rags, school bags and anything else available. The bottom is lined with twigs, moss and leaves to support eggs. After sorting, the first layer was sieved to obtain arthropods.

Preparation of laboratory samples

1. Fixation and storage: nests were sent to the Pasteur Institute in Algiers to recover small arthropods, which were then preserved in 70% ethanol (FURMAN & CATTS, 1982). Ectoparasites were collected and identified using tweezers under a binocular microscope equipped with a camera.

2. Quantitative evaluation: mites that were visible to the naked eye were counted directly. Smaller species were much more difficult to enumerate (CLAYTON & WALTHER, 1997), and their counts will be discussed later.

3. Morphological identification: the samples were photographed using a Zeiss Stemi 2000-C stereomicroscope with a fixed camera (Zeiss, Jena, Germany), in the Research Unit on Infectious and Tropical Emergent Diseases (URMITE), Faculty of Medicine, Aix-Marseille University, Marseille, France, in 2013. In order to identify mites, we used the keys of KARG (1989, 1993), SONENSHINE (1993) and BELL & RHODES (1994). Identifications were confirmed in 2013 by the URMITE.

The supports were selected from the wet area of El-Tarf near human habitations, according to their accessibility:

- Ruins-house near urban area, in front of the airport: N36°46.650' E8°06.238', N36°46.855' E8°08.119', N36°47.495' E8°12.199' and N36°39.507' E7°35.638';

Bulletin de la Société zoologique de France 139 (1-4)

- Trees (date palms) in front of the airport: N36°46.338' E8°17.346' (2 nests), N36°46.440' E7°53.567' and N36°45.518' E7°56.786';
- Eucalyptus in Bouteldjar area: N36°35.661' E8°11.880', N36°35.533' E8°11.895', N36°48.923' E7°48.690' and N36°43.496' E7°38.522'.

Results and discussion

A total of 159 mites was collected, the majority (90 %) of which was represented by the suborder Uropodina (Acari: Mesostigmata), characterized by the form of the gnathosoma (BAL, 2006). Several authors have reported the presence of Uropodina in bird nests in the world, as summarized in table 1.

Trichouropoda ovalis (C.L. Koch, 1839) (Figure 1) represents the majority (ca. 80%) of collected mites. This species is observed throughout Europe, associated with several species of migratory birds (WIŚNIEWSKI, 1996) (Table 2). However *T. ovalis* is the only species of the genus that is fungivorous, having a preference for *Sphaeronema mycelium*.

A species of *Uropoda*, presumably *U. orbicularis* (O.F. Müller, 1776) (Figure 2), represents nearly 20% of all collected mites. This species is found on some mam-

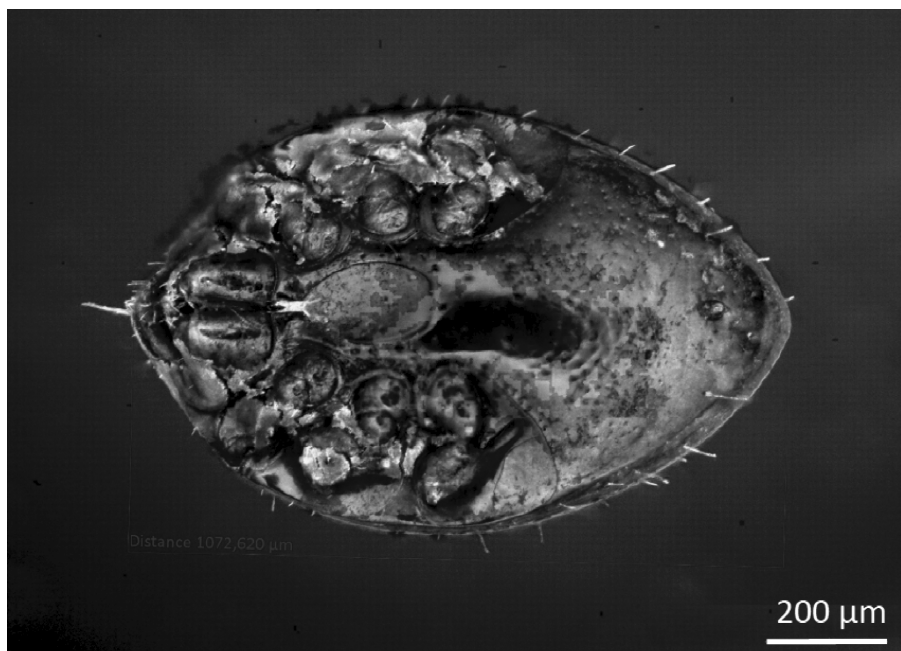


Figure 1

Trichouropoda ovalis (C.L. Koch, 1839), ventral view.

Trichouropoda ovalis (C.L. Koch, 1839), face ventrale.

***Ctenocephalides* fleas in nests of white stork in Algeria**

Table 1

Previous records of Uropodina from bird's nests.
Signalisations antérieures d'*Uropodina* dans les nids d'oiseaux.

Authors / region	Nest / Feathers	Taxa
NORDBERG, 1936 in Scandinavia	Nests of 12 species of different birds (at the first time).	Uropodina.
PHILIPS, 1981 in Norway.	Nest of hawks <i>Accipiter gentiles</i> .	Two species of Trachytidae.
BŁOSZYK & OLSZANOWSKI, 1985, 1986 in Poland.	Nesting boxes/nests of 8 species of passerine birds.	Nine species of Uropodina.
BŁOSZYK, 1990 in Poland	White stork <i>Ciconia ciconia</i> .	<i>Uroobovella pyriformis</i>
MAŠAN & KRISTOFIK, 1993, 1995 in Slovakia.	Nests of swallow <i>Riparia riparia</i> Nest and feathers of <i>Remiz pendulinus</i> .	Eight species of Uropodina.
KRISTOFIK <i>et al.</i> , 2001 in Slovakia.	Reed warbler <i>Acrocephalus arundinaceus</i> and <i>A. scirpaceus</i> .	Four species of Uropodina.
GWIAZDOWICZ <i>et al.</i> , 1999, 2000; GWIAZDOWICZ, 2003 in Poland.	Raptor nests.	Eleven species of Uropodina.
TRYJANOWSKI <i>et al.</i> , 2001 in Poland.	Red-backed shrike nests <i>Lanius collurio</i> .	Six species of Uropodina.
BŁOSZYK <i>et al.</i> , 2005 in Turkey	White stork <i>Ciconia ciconia</i> .	<i>Macrocheles merdarius</i> , <i>Macrocheles robustulus</i> , <i>Uroobovella pyriformis</i> , <i>Trichouropoda orbicularis</i> .
BŁOSZYK <i>et al.</i> , 2006 in Turkey	<i>Turdus merula</i> nests (bird builds its nest with soil).	<i>Trichouropoda orbicularis</i> , <i>Trichouropoda ovalis</i> .
BŁOSZYK <i>et al.</i> , 2009 in Poland.	The black stork <i>Ciconia nigra</i> ,	<i>Dendrolaelaps strenzkei</i> , <i>Apionoseius infirmus</i> , <i>Macrocheles merdarius</i> , <i>Macrocheles ancyleus</i> .

mals, in animal faeces (WIŚNIEWSKI & HIRSCHMANN, 1993) and in bird nests (HALLIDAY *et al.*, 2005) (Table 2). It is a phoretic species that disperses by flies (Diptera) and dung beetles of the families Geotrupidae and Scarabaeidae (KOFER & SCHMÖLZER, 2000; BŁOSZYK *et al.*, 2002; BAJERLEIN & BŁOSZYK, 2003, 2004). It was previously observed in Slovakia and Poland in the nests of different birds (Table 2). Uropodina were found sucking the body fluids of dead animals (KARG, 1989). This form of saprophagous nutrition may be a precursor of parasitism (ATHIAS-BINCHE, 1991; KARG, 1993; KARG & SCHORLEMMER, 2008).

Sejida (Figure 3) represent a small percentage (5.3%) of collected mites. The Sejida comprise three families (Sejidae, Ichthyostomatogasteridae, and

Bulletin de la Société zoologique de France 139 (1-4)

Table 2

Distribution in Europe of *Trichouropoda ovalis* (C.L. Koch, 1839)
and *Uropoda orbicularis* (O.F. Müller, 1776).

Distribution en Europe de Trichouropoda ovalis (C.L. Koch, 1839)
et de *Uropoda orbicularis* (O.F. Müller, 1776).

	Region	Reference	Pays
<i>Trichouropoda ovalis</i> (C.L. Koch, 1839)	Pecs	KARPELLES, 1893	Hungary
	National park Hortobágy	HIRSCHMANN, 1981	
	Hêtre National Park	WIŚNIEWSKI, 1996	
	Fertig- Hanság National Park	KONTSCHAN, 2002a	
	Green Mountains (Hungary)	KONTSCHAN, 2002b	
	Aggtelek National	KONTSCHAN, 2003a	
	Velvet (Hungary)	KONTSCHAN, 2003b	
	Bird Species (KONTSCHÁN, 2005, 2007)		
	European pied flycatcher (<i>Ficedula hypoleuca</i>)	NORDBERG, 1936	Scandinavia
	Blackbird (<i>Turdus merula</i>)	BŁOSZYK & OLSZANOWSKI, 1985	Poland
	Penduline tit (<i>Remiz pendulinus</i>)	MAŠAN & KRIŠTOFIK, 1995	Slovakia
	Great reed warbler (<i>Acrocephalus arundinaceus</i>)	KRIŠTOFIK <i>et al.</i> , 2001	
	Sparrow (<i>Passer</i> sp.)	FENDA <i>et al.</i> , 1998	
	Mallard (<i>Anas platyrhynchos</i>)	FENDA & PINOWSKI, 1997	Poland
	Great spotted eagle (<i>Aquila clanga</i>), White-tailed Sea Eagle (<i>Haliaeetus albicilla</i>), Osprey (<i>Pandion haliaetus</i>)	GWIAZDOWICZ <i>et al.</i> , 1999, 2000	
	Red-backed shrike (<i>Lanius collurio</i>)	TRYJANOWSKI <i>et al.</i> , 2001	
<i>Uropoda orbicularis</i> (O.F. Müller, 1776)	Bird Species		
	Penduline tit (<i>Remiz pendulinus</i>)	MAŠAN & KRIŠTOFIK, 1995	Slovakia
	Mallard (<i>Anas platyrhynchos</i>)	FENDA <i>et al.</i> , 1998	
	White-tailed Sea Eagle (<i>Haliaeetus albicilla</i>)	GWIAZDOWICZ <i>et al.</i> , 2000	Poland
	Red-backed shrike (<i>Lanius collurio</i>)	TRYJANOWSKI <i>et al.</i> , 2001	

Ctenocephalides fleas in nests of white stork in Algeria

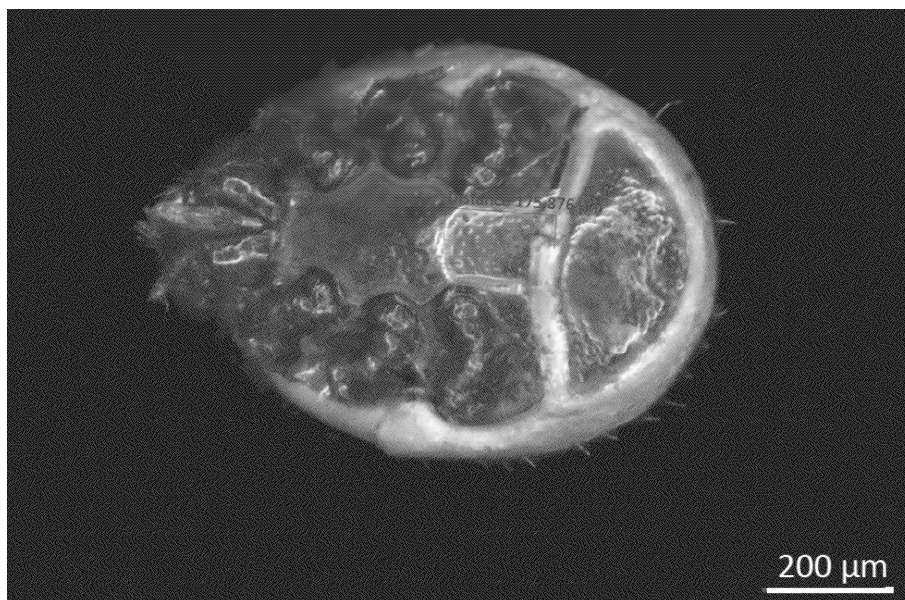


Figure 2

Uropoda orbicularis (O.F. Müller, 1776), ventral view.

Uropoda orbicularis (O.F. Müller, 1776), face ventrale.

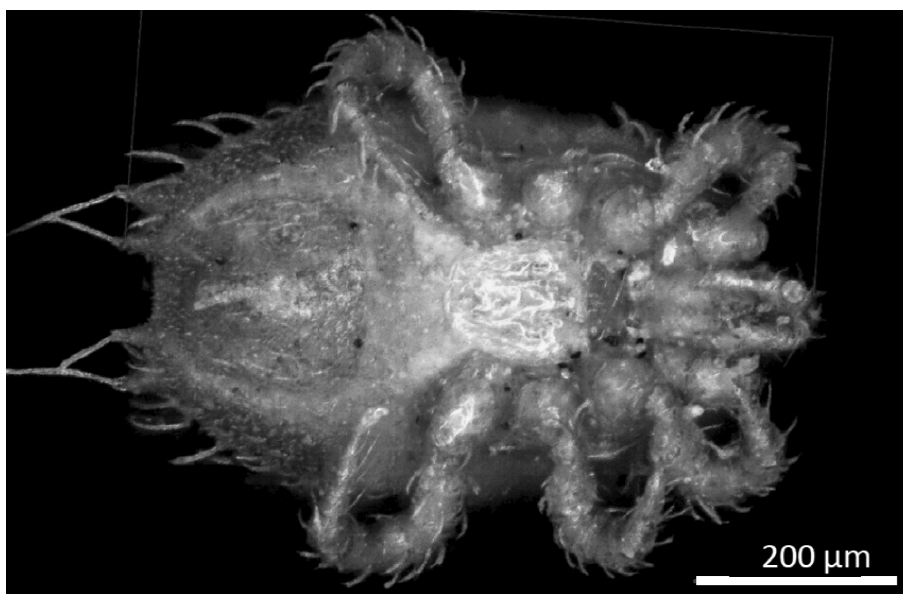


Figure 3

Unidentified mite species belonging to the family Sejidae (Sejina), ventral view.

Espèce non-identifiée appartenant à la famille des Sejidae (Sejina), face ventrale.

Bulletin de la Société zoologique de France 139 (1-4)

Uropodellidae) of enigmatic mesostigmatic mites with a mixture of characters within Parasitiformes (WALTER, 2013). Sejida is an unusual infraorder, showing a combination of a cosmopolitan distribution and a relatively small number of species (LEKVEISHVILI & KLOMPEN, 2004, 2006). Sejida are poorly known to date. They have been recovered from tree holes, under bark, in termite nests, litter, a bat cave, and rat and bird nests (GILYAROV & BREGETOVA, 1977). Sejida are free living, although deutonymphs of Sejidae and Uropodellidae are phoretic on beetles, especially on Cerambycidae (LEKVEISHVILI & KLOMPEN, 2004).

We found four adult fleas, identified as *Ctenocephalides felis* (Bouché, 1835) (Siphonaptera: Pulicidae) (Figure 4). This is the first report of *Ctenocephalides* in the nests of the white stork. These bloodsucking ectoparasites could be present in the empty nests because of their proximity with cats present in the part of the town where

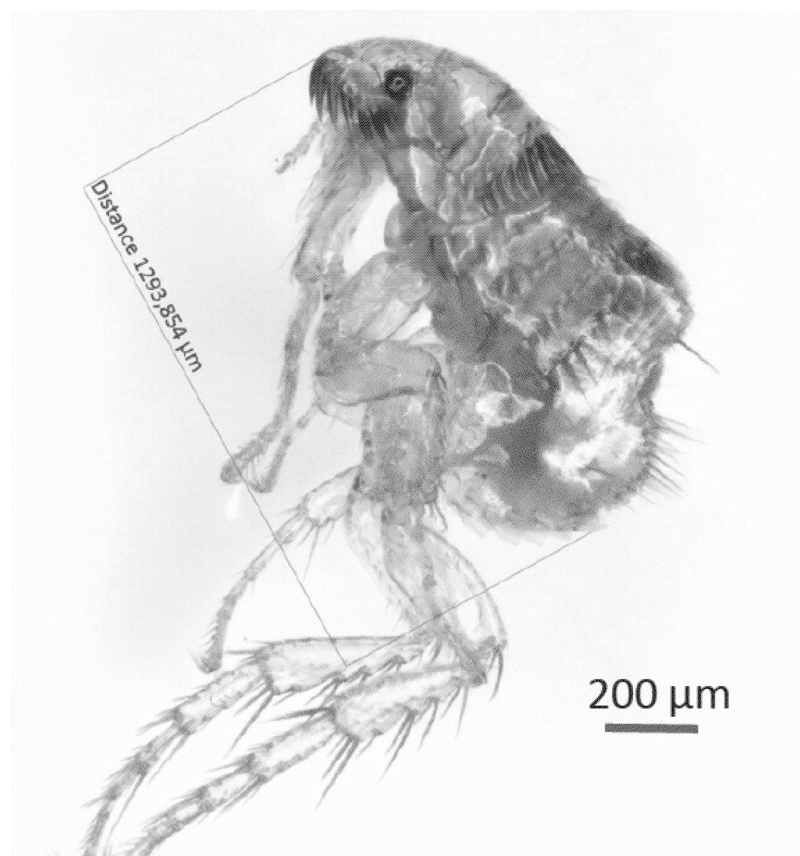


Figure 4

Ctenocephalides felis (Bouché, 1835).
Ctenocephalides felis (Bouché, 1835).

Ctenocephalides fleas in nests of white stork in Algeria

they were collected. Many parasites perform successive passages through hosts belonging to different species. Such transfers are an essential key to the ecology and evolution of parasites (THOMAS *et al.*, 1997).

Cat fleas present two recognized subspecies: *C. felis strongylus* (Jordan, 1925), observed in the African continent and *C. felis felis* (Bouché, 1835) in the other regions (North Africa, Europe and America) (YAO *et al.*, 2010). Among the fleas of medico-veterinary interest, a small number are important pests in humans. About 94 % of known species bite mammals and birds (SERVICE, 2008). Fleas have a cosmopolitan distribution and are vectors of several important zoonoses, including plague and murine typhus (PERRY & FETHERSTON, 1997). *C. felis* is an important vector of the human diseases Bartonella, Rickettsia and Wolbachia (ROLAIN *et al.*, 2003).

We found two Pseudoscorpiones (Figure 5). Pseudoscorpions feed on the larvae of moths and beetles, lice, ants and mites (HODGSON *et al.*, 2008). These arachnids are sometimes phoretic, clinging to the legs of flies, beetles and other insects.

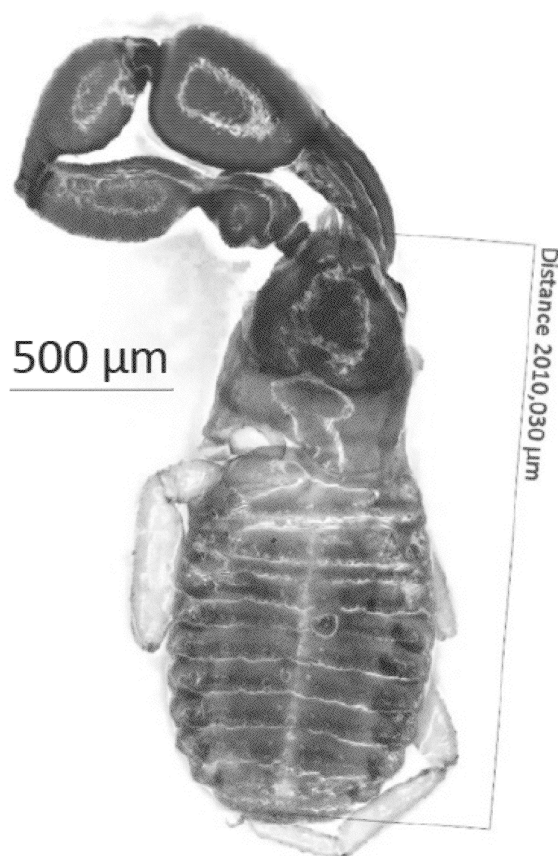
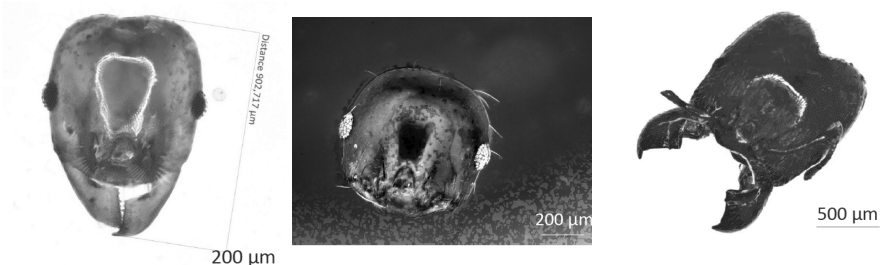


Figure 5
Pseudoscorpion.
Pseudoscorpion.

Bulletin de la Société zoologique de France 139 (1-4)

A mallophagan louse, belonging to Laemobothriidae, was also discovered in one of the nests. Mallophaga are specific parasites of their host, and they can spread by phoresis on flies (GIRISGINA *et al.*, 2013). *Colpocephalum zebra* (Burmeister, 1848), *Neophilopterus incompletus* (Denny, 1842) and *Ardeicola ciconia* (Linnaeus) have been found in nests of the white stork in Poland (SŁAWOMIRA & IZDEBSKA, 2009) and in Turkey (İNCI *et al.*, 2010; DIK *et al.*, 2011).

Insecta. The remains found are heads of ants (Figures 6-8), heads of beetles of the subfamily Carabidae (Coleoptera) (Figure 9). Histeridae (Coleoptera), immature *Anthocoris* bugs (Heteroptera) are also present in nests, probably in close correlation with stork diet. We did not calculate the total number of fragment by nest, because we were not interested in dietary preferences.



Figures 6-7-8

Ant heads.
Têtes de fourmis.

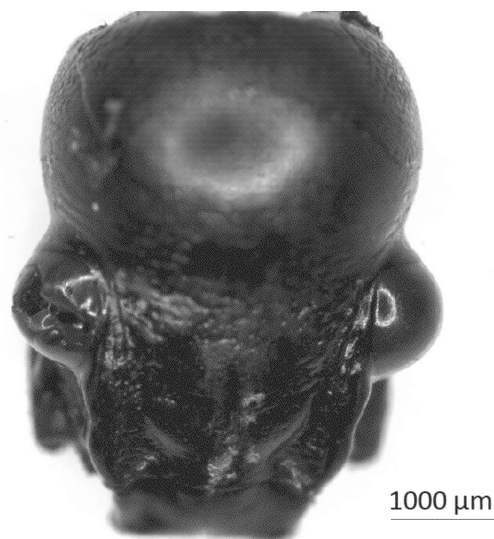


Figure 9

Coleoptera, Carabidae.
Coleoptera Carabidae.

***Ctenocephalides* fleas in nests of white stork in Algeria**

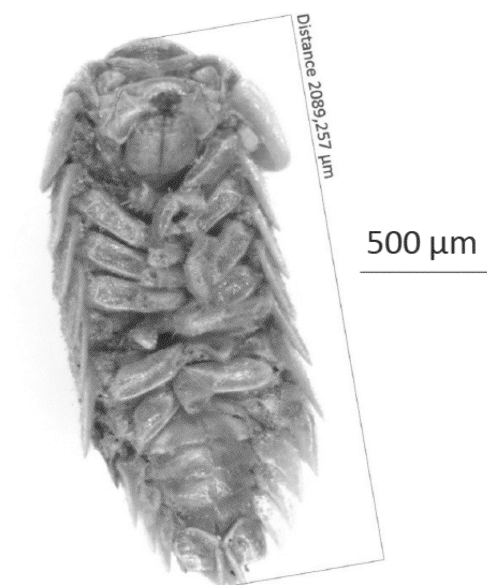


Figure 10

Woodlouse (Isopoda), ventral view.
Cloporte (Isopoda), face ventrale.

Isopoda (woodlice) (Figure 10). Terrestrial isopods were collected in all nests. Woodlice are crustaceans of the suborder Oniscoidea, which are usually found in soil and trees (TAJOVSKÝ *et al.*, 2012).

Conclusions

Out of all the arthropods collected, we found a Uropodina mite to be dominant, accidentally transmitted to the white stork nests by phoresy. Its overall impact is not clearly determined; it could play a role in the elimination of pests, or else have a negative effect on chicks (BAJERLEIN *et al.*, 2006).

In addition, we recorded one species of *Ctenocephalides*, which illustrates the diversity of host-parasite relationships with adaptive strategies for all environments. It should be noted that the nests were collected near human habitations.

For the first time, we collected *Ctenocephalides* from the nests of the white stork *Ciconia ciconia*, represented by the species *C. felis* (Bouché, 1835) (Siphonaptera: Pulicidae). These bloodsucking ectoparasites, found in empty nests, would have been in proximity with cats, which are present in the part of the town where they were collected. Many parasites make successive passages through hosts belonging to different species. Such transfers are an essential key to the ecology and evolution of parasites (THOMAS *et al.*, 1997).

Bulletin de la Société zoologique de France 139 (1-4)

The great majority (90%) of the collected mites belong to Uropodina (Acari: Mesostigmata), which are phoretically dispersed by flies (Diptera) and dung beetles of the families Geotrupidae and Scarabaeidae. We found *Trichouropoda ovalis* (C.L. Koch, 1839) (ca. 80%), *U. orbicularis* (O.F. Müller, 1776) (20%) and Sejida (5.3%). Many woodlice (Isopoda), Pseudoscorpiones, a mallophagan louse (Laemobothriidae), the heads of ants, heads of beetles (Coleoptera) of the family Carabidae (Coleoptera), Histeridae (Coleoptera) and immature *Anthocoris* bugs (Heteroptera) are also present in nests, probably in correlation with the stork's diet.

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***Ctenocephalides* fleas in nests of white stork in Algeria**

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Bulletin de la Société zoologique de France 139 (1-4)

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***Ctenocephalides* fleas in nests of white stork in Algeria**

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