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New records of chewing lice (Phthiraptera: Amblycera, Ischnocera) from Egyptian pigeons and doves (Columbiformes), with description of one new species

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ABSTRACT

Little information is available about the chewing lice of wild birds of Egypt, including common groups such as pigeons and doves (Columbiformes). Through this work, parasitic chewing lice of common columbiformes of Egypt were revised including new data. Three species of pigeons and doves (*Streptopelia decaocto* Frivaldszky 1838, *Spilopelia senegalensis* Linnaeus 1766 and *Columba livia* Gmelin 1789) were examined for chewing lice at three different localities. A total of 124 specimens of lice were collected. Nine species were identified from these samples; one species (*Columbicola joudiae* n. sp.) was considered a new species to science, six species were recorded from Egypt for the first time, and two species have been identified in Egypt before. Taxonomic and ecological remarks for all identified chewing lice samples are provided along with known and local hosts, measurements and material examined. Description and images of the new species are also provided.

1. Introduction

The study of chewing lice has been neglected for many years in the Middle East including Egypt (Nasser et al., 2015). The country located on the main bird migration route between Europe and Africa. Its' territory includes a wide range of habitats generated by the Nile and the high altitudes of Sinai Mountains, making Egypt a hot spot area for the birds in the region (Elliott et al., 1999). Despite the large number of migratory and resident birds of the country, the knowledge of the Egyptian chewing lice fauna is fragmentary and incomplete. The only previous studies on the Egyptian chewing louse fauna are those of Hafez and Madbouly (1966a, 1966b, 1968a, 1968b). Up till now, only 61 chewing lice species belonging to 31 genera have been recorded from the avifauna of Egypt. This number is very small, compared to the number of potential host species in the country (Hafez and Madbouly, 1966b).

Pigeons and doves form a cosmopolitan bird group found on all continent except Antarctica (Shelley, 1872). They are classified in the family Columbidae in the order Columbiformes. This family are divided into three subfamilies, Columbinae, Claravinae, Raphinae (Cabot et al., 1996). There are around 43 genera and 319 species of doves and pigeons around the world. Among the many species of Columbiformes, the Rock Dove is the most widely domesticated by humans for hundreds of years and have become feral in cities around the world (Beletsky, 2007). It has been bred into several diversities kept by hobbyists. Also, several species of Columbiformes are used as food which reflects their economical and biological importance (Blechman, 2006).

Chewing lice of Columbiformes have long been at the center of research into host/parasite interactions (Pilgrim, 1976; Toro et al., 1999; Clayton et al., 2003; Johnson et al., 2005). In total, twelve genera of chewing lice are known to infest pigeons and doves including *Auricotes* Kéler, 1939; *Bonomiella* Conci, 1942; *Campanulotes* Kéler, 1939; *Cavifera* Clay & Price, 1970; *Coloceras* Taschenberg, 1882; *Colpocephalum* Nitzsch, 1818; *Columbicola* Ewing, 1929; *Hohorstiella* Eichler, 1940; *Kodocephalon* Kéler, 1939; *Physconelloides* Ewing, 1927; *Quateia* Price & Emerson, 1975 and *Turturicola* Clay & Meinertzhagen, 1938. Collectively, these genera include around 450 species (Price et al., 2003). Despite the ubiquity of publications on pigeon and dove lice, none of them deal with this group in the Middle East (Eichler, 1952; Ansari, 1955a, 1955b; Lakshminarayana, 1979; Tendeiro, 1973, 1974, 1984; Adams et al., 2005; Naz et al., 2012).

Exploration of ectoparasites, especially chewing lice, of Columbiformes from Egypt is essential, not only for the local interest but also for the entire region. Eleven species of pigeons and doves have

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been recorded in the country which are Rock Dove *Columba livia* Gmelin, 1789; Stock Dove *C. oenas* Linnaeus, 1758; Common Wood Pigeon *C. palumbus* Linnaeus, 1758; Namaqua Dove *Oena capensis* Linnaeus, 1766; Laughing Dove *Spilopelia senegalensis* (Linnaeus, 1766); Eurasian Collared Dove *Streptopelia decaocto* (Frivaldszky, 1838); Mourning Collared Dove *S. decipiens* (Hartlaub & Finsch, 1870); Oriental Turtle Dove *S. orientalis* (Latham, 1790); African Collared Dove *S. risoria* (Linnaeus, 1758); European Turtle Dove *S. turtur* (Linnaeus, 1758); and Bruce's Green Pigeon *Treron waalia* Meyer, 1793 (Meininger and Mullié, 1981; Birds of Egypt, 2018). Hafez and Madbouly (1966b) reported only two species of chewing lice from Egypt: *Columbicola columbae* and *Cb. bacillus* from *Columba livia* and *Spilopelia senegalensis*, respectively. Therefore, this work aimed to update the knowledge about the chewing lice infesting the pigeon and dove fauna of Egypt, and describe *Columbicola joudiae* n. sp. as a new species to science.

2. Materials and methods

Between February and June 2018, bird were caught at several localities in Egypt, selected to maximise the number of resident and migratory species encountered: Ain Shams University Botanical Garden at central Cairo 30°04′40.3″N 31°16′56.7″E, Ras Seder, South Sinai 29°26′34.4″N 32°45′31.5″E and Sidi Kirayr, north coast 31°00′27.9″N 29°38′30.8″E. Bird through February to June 2018. The birds were collected using standard mist nets (mesh: 1.8 cm × 0.12 mm & size: 2 m × 15 m). The nets were placed between trees and palms in the previous sites (Supplementary materials 1). Birds were identified according to Porter and Aspinall, 2013. Here, we focus on the lice collected from pigeons and doves, and lice collected from other hosts will be addressed in a separate publication.

Live caught birds were placed in a fumigation chamber (Clayton and Drown, 2001), using chloroform as a fumigant. Following fumigation, lice were removed by ruffling over a white surface, and by careful visual examination (Supplementary materials 1). All examined birds were released at the capturing location.

The collected lice were divided into two parts. One part was kept in 90% ethyl alcohol for future studies, the other part was processed for slide mounting. Briefly, lice were placed in 95% ethyl alcohol then transferred to lactic acid for about two days for clearing and then mounted using Canada-balsam. Chewing lice were identified according to Eichler, 1952; Ansari, 1955a, 1955b; Lakshminarayana, 1979; Tendeiro, 1973, 1974, 1984; Adams et al., 2005; Naz et al., 2012. The distribution pattern of parasitic chewing lice among hosts were also revised from several sources including Price et al. (2003). All specimens photographed using S-EYE YW500 camera5mp fixed on BOECO BM-120 microscope. The measurements of samples were taken using the previous camera software for Head Width (HW) of Ischnocera and Amblycera through the temporal region. Photoshop lightroom 5 was used to prepare final images. All specimens are kept in Ain Shams University Collection (ASUC), as indicated. To avoid confusion, the generic names of pigeon lice were abbreviated as follows: *Colpocephalum* = *Cc.*; *Campanulotes* = *Cu.*; *Coloceras* = *Co.*; *Columbicola* = *Cb.* Measurements are abbreviated as follows: Head Length = HL; Head Width = HW; Head Index = HI; Thorax Length = TL; Abdomen Length = AL; Total Length = TOL.

3. Results

A total of 124 specimens of chewing lice were collected from 23 captured individuals of Columbiformes [*Columba livia* (13 birds), *Streptopelia decaocto* (3 birds) and *Spilopelia senegalensis* (7 birds)]. Nine species of chewing lice were recovered (Table 1), including six new records for Egypt. One recovered species of *Columbicola* did not correspond to any of the species in this genus according to the key of Adams et al. (2005), and is here described as a new species, *Columbicola joudiae* n. sp. The species collected are summarized in Table 1.

Suborder Amblycera Kellogg, 1896
Family Menoponidae Mjöberg, 1910
Colpocephalum Nitzsch, 1818
Colpocephalum turbinatum Denny, 1842:198
Colpocephalum ailurum Nitzsch in Giebel, 1861a:522
Colpocephalum bicinctum Nitzsch in Giebel, 1861a:524
Colpocephalum caudatum Giebel, 1874:261
Colpocephalum dissimile Piaget, 1880:520
Colpocephalum intermedium Piaget, 1880:521
Colpocephalum costaricense Carriker, 1903:172
Colpocephalum abruptofasciatum Mjöberg, 1910b:36
Neocolpocephalum wetzeli Eichler, 1941b:374
Colpocephalum wernecki Orfila, 1959:477

Type host: *Columba livia* Gmelin, 1789, Rock Dove.

Other hosts: *Ducula bicolor* (Scopoli, 1786), Pied Imperial-Pigeon; *Zenaida asiatica* (L., 1758), White-winged Dove; *Elanus leucurus* (Vieillot, 1818), White-tailed Kite; *Haliastur indus* (Boddaert, 1783), Brahminy Kite; *Haliastur sphenurus* (Vieillot, 1818), Whistling Kite; *Milvus migrans* (Boddaert, 1783), Black Kite; *Milvus milvus* (L., 1758), Red Kite; *Terathopius ecaudatus* (Daudin, 1800), Bateleur; *Circus aeruginosus* (L., 1758), Western Marsh Harrier; *Circus assimilis* Jardine & Selby, 1828, Spotted Harrier; *Circus approximans* Peale, 1848, Swamp Harrier; *Circus cyaneus* (L., 1758), Northern Harrier/Hen Harrier; *Accipiter fasciatus* (Vigors & Horsfield, 1827) Brown Goshawk; *Accipiter tachiro* (Daudin, 1800), African Goshawk; *Melierax metabates* Heuglin, 1861, Dark Chanting Goshawk; *Buteo galapagoensis* (Gould, 1837), Galapagos Hawk; *Buteo jamaicensis* (Gmelin, 1788), Red-tailed Hawk; *Buteo magnirostris* (Gmelin, 1788), Roadside Hawk; *Buteo swainsoni* Bonaparte, 1838, Swainson´s Hawk; *Falco mexicanus* Schlegel, 1850, Prairie Falcon; *Aquila audax* (Latham, 1801), Wedge-tailed Eagle; *Haliaeetus leucocephalus* (L., 1766), Bald Eagle; *Haliaeetus leucogaster* Gmelin, 1788, White-bellied Sea Eagle; *Haliaeetus leucoryphus* (Pallas, 1771), Pallas´s Fish Eagle; *Haliaeetus vocifer* (Daudin, 1800), African Fish Eagle; *Hieraaetus morphnoides* (Gould, 1841), Little Eagle; *Hieraaetus pennatus* (Gmelin, 1788), Booted Eagle; *Lophaetus occipitalis* (Daudin, 1800), Long-crested Eagle; *Polemaetus bellicosus* (Daudin, 1800), Martial eagle; *Spizaetus nipalensis* Hodgson, 1836, Mountain Hawk-eagle; *Buteo buteo* (L., 1758), Eurasian Buzzard; *Buteo rufofuscus* (Forster, 1798), Jackal Buzzard; *Henicopernis longicauda* (Garnot, 1828), Long-tailed Buzzard; *Herpetotheres cachinnans* (L., 1758), Laughing Falcon; *Pandion haliaetus* (L., 1758), Osprey; *Pernis apivorus* (L., 1758), European Honey Buzzard; *Pernis ptilorhyncus* (Temminck, 1821), Oriental Honey Buzzard; *Bubo sumatranus* (Raffles, 1822), Barred Eagle-Owl; *Ketupa zeylonensis* (Gmelin, 1788), Brown Fish-Owl; *Ninox connivens* (Latham, 1801), Barking Owl; *Tyto alba* (Scopoli, 1769), Barn Owl; *Aegypius monachus* (L., 1766), Cinereous Vulture; *Gyps africanus* Salvadori, 1865, African White-backed Vulture; *Gyps bengalensis* (Gmelin, 1788), Indian White-backed Vulture; *Gyps coprotheres* (Forster, 1798), Cape Griffon; *Gyps fulvus* (Hablizl, 1783), Griffon Vulture; *Gyps indicus* (Scopoli, 1786) - Indian Vulture; *Gyps rueppellii* (Brehm, 1852), Ruppell´s Griffon; *Necrosyrtes monachus* (Temminck, 1823), Hooded Vulture; *Neophron percnopterus* (L., 1758), Egyptian Vulture.

Local host: *Columba livia* Gmelin 1789, Rock Dove.

Remarks: This is the first record of *Colpocephalum turbinatum* from Egypt. The *Cc. turbinatum* found during this study were all located on the abdomen of the host, near the skin.

Material examined: 2 males from Ain Shams University Botanical Garden at central Cairo (30°04′40.3″N 31°16′56.7″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.25 (0.23–0.28); HW: 0.36 (0.33–0.39); HI: 0.69 (0.67–0.71); TL: 0.26 (0.22–0.29); AL: 0.50 (0.47–0.54); TOL: 1.01 (1.00–1.03).

Suborder Ischnocera Kellogg, 1896
Family Philopteridae Burmeister, 1838
Campanulotes Kéler, 1939
Campanulotes bidentatus (Scopoli, 1763):385

Table 1
Summary of species of chewing lice collected in Egypt in 2018.

Host species	Louse species	Comment
Columba livia Gmelin, 1789	*Campanulotes bidentatus* (Scopoli, 1763)	New record
	Campanulotes compar (Burmeister, 1838)	New record
	Colpocephalum turbinatum Denny, 1842	New record
	Columbicola columbae (Linnaeus, 1758)	Hafez and Madbouly (1968a, 1968b)
	Columbicola tschulyschman Eichler, 1942	New record
Streptopelia decaocto (Frivaldszky, 1838)	*Coloceras piageti* (Johnston & Harrison, 1912)	New record
	Columbicola bacillus (Giebel, 1866)	Hafez and Madbouly (1968a, 1968b)
Spilopelia senegalensis Linnaeus, 1766	*Coloceras chinense* (Kellogg & Chapman, 1902)	New record
	Columbicola joudi n. sp.	

Pediculus bidentatus Scopoli, 1763

Type host: *Columba palumbus* L. 1758, Common Wood Pigeon.

Other hosts: *Columba livia* Gmelin 1789, Rock Dove.

Local host: *Columba livia* Gmelin 1789, Rock Dove.

Remarks: This is the first record of *Campanulotes bidentatus* from Egypt. All specimens of *Cu. bidentatus* were located on head and neck feathers of host.

Material examined: 7 males and 4 females from Ain Shams University Botanical Garden at central Cairo (30°04′40.3″N 31°16′56.7″E) and Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.30 (0.28–0.32); HW: 0.37 (0.34–0.40); HI: 0.81 (0.79–0.83); TL: 0.26 (0.22–0.30); AL: 0.47 (0.47–0.48); TOL: 1.03 (1.00–1.07). Female HL: 0.36 (0.35–0.37); HW: 0.38 (0.33–0.42); HI: 0.95 (0.93–0.97); TL: 0.27 (0.23–0.31); AL: 0.66 (0.63–0.69); TOL: 1.29 (1.24–1.34).

Campanulotes compar (Burmeister, 1838):431.

Goniocotes compar Burmeister, 1838

Goniocotes formosanus Sugimoto, 1929:25

Type host: *Columba livia* Gmelin 1789, Rock Dove.

Local host: *Columba livia* Gmelin 1789, Rock Dove.

Remarks: This report constitutes a new geographical record of *Campanulotes compar* from Egypt.

Material examined: 11 males and 8 females from Ain Shams University Botanical Garden at central Cairo (30°04′40.3″N 31°16′56.7″E) and Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.27 (0.25–0.29); HW: 0.57 (0.54–0.60); HI: 0.47 (0.45–0.49); TL: 0.24 (0.20–0.29); AL: 0.48 (0.43–0.53); TOL: 0.99 (0.95–1.03), female HL: 0.42 (0.39–0.45); HW: 0.43 (0.40–0.46); HI: 0.98 (0.95–1.01); TL: 0.33 (0.30–0.37); AL: 0.76 (0.72–0.80); TOL: 1.51 (1.47–1.55).

Coloceras Taschenberg, 1882

Coloceras chinense (Kellogg & Chapman, 1902b):160.

Goniocotes chinense Kellogg & Chapman, 1902b

Type host: *Spilopelia chinensis* (Scopoli, 1768), Spotted Dove.

Other hosts: *Gallicolumba luzonica* (Scopoli, 1786), Luzon Bleeding-heart; *Leptotila rufaxilla* (Richard & Bernard, 1792), Grey-fronted Dove; *Macropygia unchall* (Wagler, 1827), Barred Cuckoo-dove; *Streptopelia bitorquata* (Temminck, 1809), Sunda Collared Dove; *S. capicola capicola* (Sundevall, 1857), Ring-necked Dove; *S. capicola damarensis* (Hartlaub & Finsch, 1870), Cape Turtle Dove; *S. capicola electa* (Madarász, 1913), Cape Turtle Dove; *S. decipiens* (Hartlaub & Finsch, 1870), Mourning Collared Dove; *S. orientalis* (Latham, 1790), Oriental Turtle Dove; *S. roseogrisea* (Sundevall, 1857), African Collared Dove; *S. semitorquata* (Rüppell, 1837), Red-eyed Dove; *S. tranquebarica* (Hermann, 1804), Red Turtle Dove; *S. turtur isabellina* (Bonaparte, 1838), European Turtle Dove; *S. turtur turtur* (L., 1758), European Turtle Dove; *S. vinacea* (Gmelin, 1789), Vinaceous Dove; *Spilopelia senegalensis* (L., 1766), Laughing Dove; *Turtur abyssinicus* (Sharpe, 1902), Black-billed Wood-dove; *T. afer* (L., 1766), Blue-spotted Wood-dove; *T. brehmeri* (Hartlaub, 1865), Blue-headed Wood-dove; *T. chalcospilos* (Wagler, 1827) Emerald-spotted Wood-dove; *T. tympanistria* (Temminck, 1809), Tambourine Dove.

Local host: *Spilopelia senegalensis* (Linnaeus, 1766) Laughing Dove.

Remarks: This is the first record of *Coloceras chinense* from Egypt.

Material examined: 14 females from Ain Shams University Botanical Garden at central Cairo (30°04′40.3″N 31°16′56.7″E) and Sidi Kirayr, north coast (31°00′27.9″N 29°38′30.8″E), February & June 2018, collector: Eslam Adly.

Measurements: Female HL: 0.50 (0.47–0.53); HW: 0.63 (0.61–0.65); HI: 0.79 (0.76–0.82); TL: 0.45 (0.43–0.47); AL: 0.81 (0.78–0.84); TOL: 1.76 (1.73–1.79).

Coloceras piageti (Johnston & Harrison, 1912b):19.

Goniodes piageti Johnston & Harrison, 1912b

Goniodes minus Piaget, 1880:256

Coloceras sofioticus Eichler, 1950e:3

Type host: *Streptopelia chinensis* (Scopoli, 1768), Spotted Dove.

Other hosts: *Streptopelia bitorquata* (Temminck, 1809), Sunda Collared Dove; *S. decaocto* (Frivaldszky, 1838), Eurasian Collared-Dove.

Local host: *Streptopelia decaocto* (Frivaldszky, 1838), Eurasian Collared-Dove.

Remarks: This report constitutes the first record of *Coloceras piageti* in Egypt.

Material examined: 8 females from Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Female HL: 0.53 (0.51–0.55); HW: 0.66 (0.63–0.69); HI: 0.80 (0.77–0.83); TL: 0.47 (0.44–0.50); AL: 1.13 (1.11–1.15); TOL: 2.13 (2.07–2.19).

Columbicola Ewing, 1929

Columbicola confusissimus (Giebel, 1866):379

Lipeurus bacillus Giebel, 1866

Lipeurus baculus Burmeister, 1838:434

Columbicola confusissimus Eichler, 1947e:264

Columbicola hopkinsi Ansari, 1955b:47

Type host: *Streptopelia turtur turtur* (L., 1758) European Turtle Dove.

Other hosts: *Streptopelia decaocto* (Frivaldszky, 1838), Eurasian Collared Dove; *S. decipiens* (Hartlaub & Finsch, 1870), Mourning Collared Dove; *S. roseogrisea* (Sundevall, 1857), African Collared Dove; *S. semitorquata* (Rüppell, 1837), Red-eyed Dove; *S. tranquebarica* (Hermann, 1804) Red Turtle Dove; *Spilopelia senegalensis* (L., 1766), Laughing Dove.

Local host: *Streptopelia decaocto* (Frivaldszky, 1838), Eurasian Collared Dove.

Remarks: *Columbicola bacillus* was previously recorded in Egypt by Hafez and Madbouly (1968a, 1968b). All specimens of *Cb. bacillus* were located on feathers of wing and tail.

Material examined: 7 males and 2 females from Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.50 (0.49–0.51); HW: 0.23 (0.20–0.26); HI: 2.17 (2.14–2.20); TL: 0.40 (0.38–0.42); AL: 1.23 (1.18–1.28); TOL:

2.13 (2.04–2.21). Female HL: 0.53 (0.52–0.54); HW: 0.20 (0.20–0.20); HI: 2.65 (2.64–2.66); TL: 0.45 (0.43–0.47); AL: 1.52 (1.51–1.52); TOL: 2.50 (2.49–2.51).

Columbicola columbae (Linnaeus, 1758):614.

Pediculus columbae Linnaeus, 1758

Lipeurus antennatus Giebel, 1874:213

Philopterus baculus Nitzsch, 1818:293

Phagopterus columbae Freire & Duarte, 1944:14

Nirmus filiformis Olfers, 1816:90

Columbicola juan-fernandez Eichler, 1952b:349

Type host: *Columba livia* Gmelin 1789, Rock Dove.

Other hosts: *Columba eversmanni* Bonaparte, 1856, Yellow-eyed Pigeon; *C. guinea* L., 1758, Speckled Pigeon; *C. oenas* L., 1758, Stock Dove.

Local host: *Columba livia* Gmelin 1789, Rock Dove.

Remarks: This species was previously recorded in Egypt by Hafez and Madbouly (1968a, 1968b).

Material examined: 26 males, 19 females and 8 nymphs from Ain Shams University Botanical Garden at central Cairo (30°04′40.3″N 31°16′56.7″E) and Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.51 (0.44–0.58); HW: 0.24 (0.18–0.30); HI: 2.13 (2.08–2.18); TL: 0.40 (0.31–0.49); AL: 1.25 (1.19–1.31); TOL: 2.16 (2.07–2.25). Female HL: 0.57 (0.52–0.62); HW: 0.35 (0.31–0.39); HI: 1.63 (1.57–1.69); TL: 0.42 (0.36–0.48); AL: 1.54 (1.50–1.58); TOL: 2.53 (2.44–2.62).

Columbicola joudiae n. sp.

Type host: *Spilopelia senegalensis* (Linnaeus, 1766), Laughing Dove (Fig. 1a).

Type locality: Ain Shams University Botanical Garden in central Cairo, Egypt (30°04′40.3″N 31°16′56.7″E).

Holotype: 1 Male; Ain Shams University Botanical Garden at central Cairo, Egypt, 8 Mar. 2018, E. Adly, from *Spilopelia senegalensis*.

Paratypes: 8 male, 4 female and 2 nymphs of the same locality of the holotype (ASUC).

Etymology: The specific epithet refers to the first author's nine-year-old sister, Joudi Saad Adly, who is very interested in entomology and ornithology. By naming a species after her, I hope to make her proud and to inspire her to deep in love with this great field.

Description: Body elongated (Fig. 1b&c). Head similar in both sexes, elongated with narrow temples (Fig. 1d). Posterior marginal head setae (PMHS) and anterior marginal head setae (AMHS) spike like, PMHS shorter than AMHS. Antennae sexually dimorphic, with male scape enlarged. Thorax slightly wider than head, pronotum rounded trapezoidal, metanotum with two relatively short marginal metanotal setae on each side. Abdomen nearly similar in both sexes but slightly wider in female, tergal and sternal plates similar to that of all *Cb. theresae* group, tergites with characteristic soft texture appear clearly in male than female, with row of two lateral pleural setae elongated posteriorly. Segment VIII with hair like trichobothrium. Genitalia of male as in Fig. 1e: male mesosome much longer than wide, distal section reaching almost to distal end of parameres. Proximal section with dark serrations on lateral margins and paired anterior bulges. The dark serrations do not converge medially. Three large pores visible on each side of proximal part of mesosoma (Fig. 2). Distal margin of mesosome with dark, crescent-shaped thickening. Parameres convergent, blunt. Female poorly differentiated from *Cb. carrikeri* and *Cb. theresae*: subgenital plate without lateral setae, genital groove rounded anteriorly and expanding posteriorly with indistinct lateral indentations (Fig. 1f).

Diagnosis: *Columbicola joudiae* n. sp. is a member of the *Cb. theresae* group, and keys to *Cb. theresae* group in the key of Adams et al (2005). We separate it from all known species in the *Cb. theresae* species group

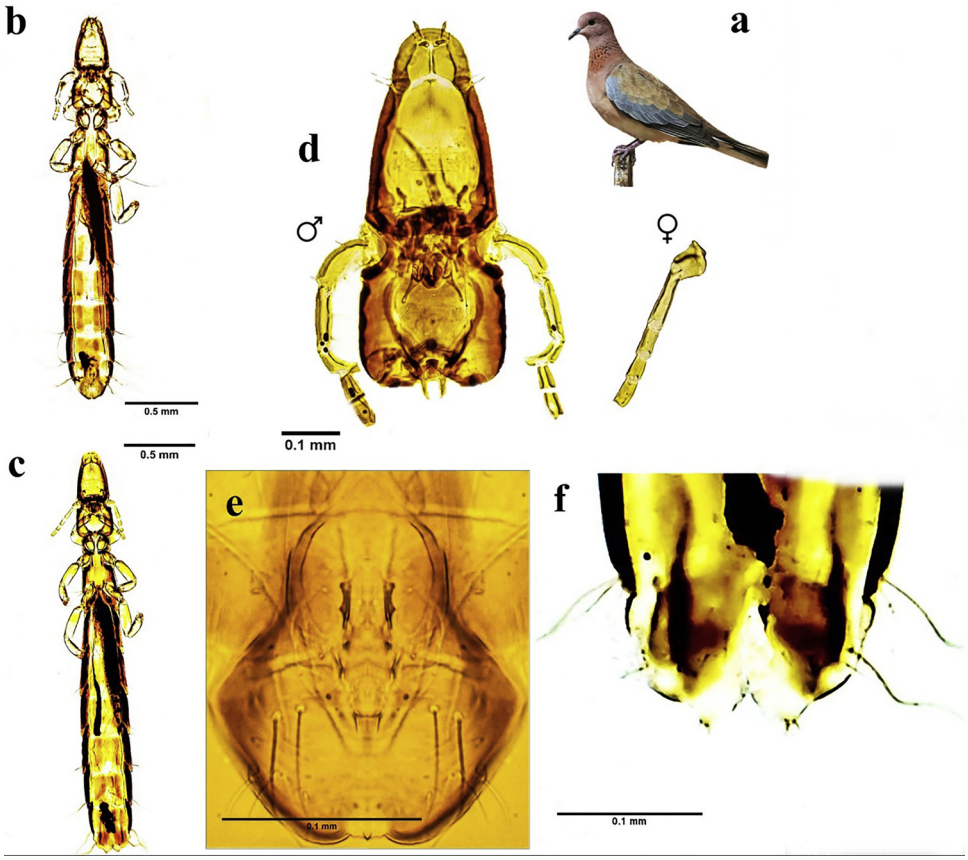

Fig. 1. a. Type host: Laughing Dove; b. Male *Columbicola joudiae*; c. Female *Cb. joudiae*; d. Head of male *Cb. joudiae* and female antennae; e. Genitalia of male *Cb. joudiae*; f. Sub genital of female *Cb. joudiae*.

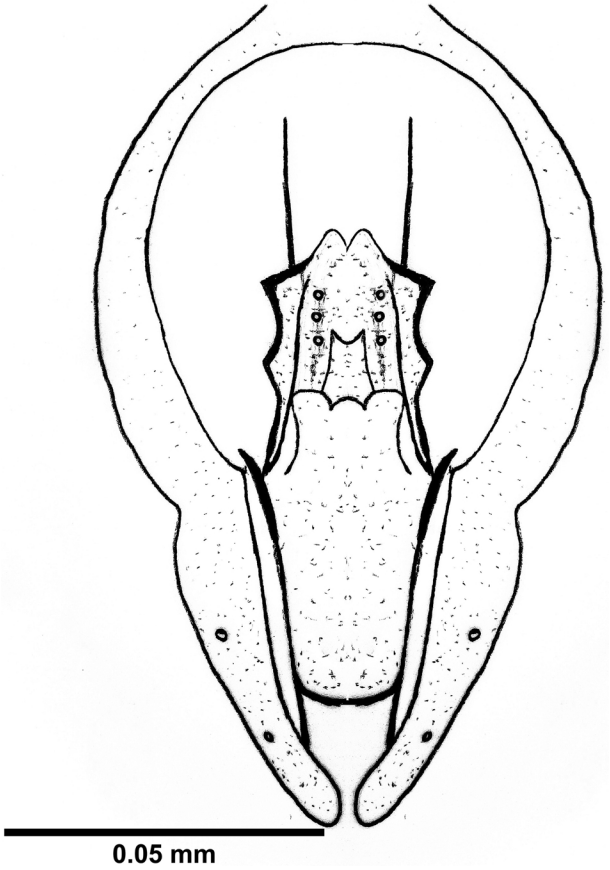

Fig. 2. Illustration of Genitalia of male *Columbicola joudiae*.

by characters of the male genitalia, particularly the mesosome. The mesosome is most similar to that of *Cb. deboomi* and *Cb. carrikeri*, with which it shares the prominent serrations of the lateral margins in the anterior end, the presence of the crescent-shaped sclerite in the distal mesosome, and the overall elongated shape of the mesosome.

Columbicola joudiae can be separated from *Cb. deboomi* by the following characters: distal end of mesosome flattened in *Cb. deboomi* but elongated to reach near distal end of parameres in *Cb. joudiae*; 4 pores present on each side of mesosome in *Cb. deboomi*, but only 3 pores on each side in *Cb. joudiae*; distal mesosome with lateral extensions that seem to articulate with parameres in *Cb. deboomi*, but no such extensions in *Cb. joudiae*. Female of *Cb. deboomi* is unknown, and no comparison can be made.

Columbicola joudiae can be separated from *Cb. carrikeri* by the following characters: proximal margin mesosome flat in *Cb. carrikeri*, but with paired anterior extensions in *Cb. joudiae*; lateral thickenings of distal mesosome divergent in *Cb. carrikeri*, but convergent in *Cb. joudiae*; mesosome with only 1 prominent pore on each side near anterior end in *Cb. carrikeri*, but with 3 pores on each side in mid-part of proximal half of mesosome in *Cb. joudiae*. Female genitalia largely as in *Cb. carrikeri*, but distal section wider and whole genital groove longer.

Remarks: With the description of *Cb. joudiae*, a total of four species of *Columbicola* are known from *Spilopelia senegalensis*. Of these, both *Cb. theresae* and *Cb. joudiae* belong to the *Cb. theresae* species group. The material of *Cb. theresae* examined by Tendeiro (1967; material not examined by us), Adams et al. (2005; material not examined by us) originated from all extremes of the host's range (India, Nepal, Thailand, Ghana, Botswana, South Africa), suggesting that this species occurs throughout the range of the host. By contrast, *Cb. joudiae* is presently known only from Egypt, which lies more or less in the center of the host's range. Possibly, *Columbicola* from African hosts was erroneously identified as *Cb. theresae* by Tendeiro (1967) and Adams et al. (2005), and this material may in fact constitute more specimens of *Cb. joudiae*. The type material of *Cb. theresae* is from India. A critical reexamination of all *Cb. theresae* group species is needed to investigate whether the species in this group, many of which occur on multiple hosts, harbor further unrecognized species, and to establish the geographical limits of *Cb. theresae* and *Cb. joudiae.*

Note that Tendeiro (1967) reported *Cb. theresae* from Egypt. In light of the discussion above, we do not presently include this species on the Egyptian list, until the specimens can be examined, and it can be established that Tendeiro's specimens are not misidentified *Cb. joudiae*.

Measurements: Male HL: 0.62 (0.60–0.64); HW: 0.26 (0.23–0.29); HI: 2.38 (2.35–2.41); TL: 0.46 (0.44–0.48); AL: 1.53 (1.50–1.56); TOL: 2.61 (2.58–2.64), female HL: 0.60 (0.57–0.63); HW: 0.27 (0.24–0.30); HI: 2.22 (2.18–2.26); TL: 0.49 (0.48–0.49); AL: 1.71 (1.69–1.73); TOL: 2.80 (2.78–2.82); GL: 0.13 (0.12–0.14); GW: 0.10 (0.09–0.10).

Columbicola tschulyschman Eichler, 1942e:28.

Columbicola montschadskyi Blagoveshtchensky, 1951:308

Type host: *Columba rupestris turkestanica* Buturlin, 1908, Hill Pigeon.

Other hosts: *Columba leuconota* Vigors, 1831, Snow Pigeon; *C. livia intermedia* Strickland, 1844, Rock Dove; *C. livia neglecta* (Hume, 1873) Rock Dove.

Local host: *Columba livia* Gmelin, 1789, Rock Dove.

Remarks: This report constitutes the first record of *Columbicola tschulyschman* in Egypt.

Material examined: 1 males from Ras Seder, South Sinai (29°26′34.4″N 32°45′31.5″E), February & March 2018, collector: Eslam Adly.

Measurements: Male HL: 0.52 (0.52–0.52); HW: 0.34 (0.34–0.34); HI: 1.53 (1.53–1.53); TL: 0.43 (0.43–0.43); AL: 1.22 (1.22–1.22); TOL: 2.17 (2.17–2.17).

4. Discussion

This study presents the first efforts in exploration of Egyptian chewing lice fauna since Hafez and Madbouly (1966a, 1966b, 1968a, 1968b). Six new records of chewing lice were added to the Egyptian chewing lice fauna from three common hosts (*Columba livia, Spilopelia senegalensis* and *Streptopelia decaocto*). In addition, one new species of chewing lice from Laughing Dove (*Spilopelia senegalensis*), thereby increasing the total number of chewing louse species on Egyptian columbiform to nine. Recently, several new species of chewing lice were described from columbiform host in different parts of the world (e.g. Bush et al., 2009; Naz et al., 2012; Gustafsson et al., 2015). Together, these descriptions and ours highlight indicate the fact that there is more louse species to be found not only in rare or seldom caught groups of birds, but even in such relatively well studied groups as pigeons and doves.

Despite examining only three species of columbiform hosts in this study, we were able to record six new species of chewing lice for Egypt and find one new species for science. Four of these new records were from the common Rock Dove, indicating that even common birds in Egypt may be hosts to previously unrecorded species of chewing lice. However, both identification of known species and discovery of new species is made harder by the lack of recent critical revisions of many chewing louse genera, including many genera presumably found in the country. Such researches not only encourage more local contributors to join the study of this interesting group of insect but also has its impact on its research on the middle east and consequently the whole world.

Most, but not all, chewing lice are host specific (Clayton et al., 2008). This suggests that the geographical range of a louse species is similar to that of its host species, in particular in cases where the louse species is very common on its host. If the host is cosmopolitan, like the domestic pigeon, the louse is likely also cosmopolitan. Many of these new records from Egyptian pigeons are therefore not surprising, as the

hosts are common in Egypt. However, only one of the four species of *Columbicola* found on *S. senegalensis* were recovered in our study. Unless this is an effect of the relatively low number of pigeons examined, this may suggest that the different species of *Columbicola* from this host have more limited geographical ranges than their host. Very little is known about what factors limit the geographical distribution of chewing lice, and more research in to this topic is needed. Tools like Geographical Information System (GIS), DNA sequencing, and bioinformatics may be instrumental in addressing some of these questions.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.actatropica.2018.10.016.

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