

New host/parasite record for very rare chewing louse *Cuculotogaster arabicus* (Clay, 1938) (Phthiraptera: Ischnocera) on endemic mountain partridges of Arabian Peninsula

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Abstract The endemic avifauna of Arabia is unique and characteristic through the whole region. Little is known about these birds and their ectoparasites. The Arabian partridge *Alectoris melanocephala* (Rüppell, 1835) and Philby's partridge *Alectoris philbyi* Lowe, 1934 are two endemic species which are distributed through the Sarawat Mountains in Saudi Arabia and Yemen. Captive breeding population of these birds were examined for chewing lice at the National Wildlife Research Center (NWRC) near Ta'if. Only one rare species of louse, *Cuculotogaster arabicus* (Clay 1938), was found to infest these birds. The occurrence of such species is considered a first record of the genus *Cuculotogaster* from Saudi Arabia, and the association of *C. arabicus* with Philby's partridge is considered a new host/parasite association. The clear diagnostic characters, high definition photos, and drawing of male genitalia are available through this paper.

Keywords Arabian partridge · Philby's partridge · Endemics · *Cuculotogaster* spp. · Saudi Arabia

Introduction

Mountains tend to be more cold and windy so in tropical and sub-tropical habitat they support formation of large forests and wood lands if a good source of water present. The main key of the biodiversity of this ecosystem is the presence of different elevations which support a variety of plant communities from the bottom of the wadis to the top of the mountains (Mahmoud & Alazba 2015). Through this ecosystem, woods and forests usually provide a rich habitat for birds with plenty of foods and nesting places (Alderton 2008). In Saudi Arabia, the Sarawat Mountains and its forests form the main example of this habitat. It supports the life for many characteristic species of avifauna not only for the Arabian Peninsula but also for the whole world. Eleven endemic avian species are known to inhabit this mountain range and its forests: Arabian partridge *Alectoris melanocephala* (Rüppell, 1835), Arabian serin *Crithagra rothschildi* (Ogilvie-Grant, 1902), Arabian waxbill *Estrilda rufibarba* (Cabanis, 1851), Arabian wheatear *Oenanthe lugentoides* (Seeborn, 1881), Arabian woodpecker *Dendropicos dora* (Bates & Kinnear, 1935), Asir magpie *Pica asirensis* (L., 1758), Philby's partridge *Alectoris philbyi* Lowe, 1934, Yemen linnnet *Linaria yemenensis* (Ogilvie-Grant, 1913), Yemen serin *Crithagra menachensis* (Ogilvie-Grant, 1913), Yemen thrush *Turdus menachensis* Ogilvie-Grant, 1913, and Yemen Warbler *Sylvia buryi* Ogilvie-Grant, 1913 (Jennings 2010).

Little is known about the biology and ecology of the endemic partridges of Arabia, either for the Arabian or Philby's partridge. The Arabian partridge is endemic to some mountains of southern Saudi Arabia, Yemen, and western Oman. It usually prefers stony and sloppy

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grounds with a good vegetation cover (McGowan & Kirwan 2013), while Philby's partridge is only endemic to southwestern Saudi Arabia and northern Yemen. The two birds share the same habitat of their overlapping distributions, but Philby's partridge prefers lower altitudes (Cowell 2014).

As with all other members of the order Galliformes, the partridge/chewing lice interaction is a very complicated evolutionary relation. There are 13 genera of chewing lice recorded from the 45 species of partridges where some of these bird species are still never examined for chewing lice before: *Amysidea* spp., *Chelopistes* spp., *Colpocephalum* spp., *Cuclotogaster* spp., *Galliphilopterus* spp., *Goniocotes* spp., *Goniodes* spp., *Lagopoecus* spp., *Lipeurus* spp., *Menacanthus* spp., *Menopon* spp., *Oxylipeurus* spp., and *Somaphantus* spp. (Price et al. 2003). The chewing lice species of the Arabian Peninsula endemic partridge is only known from four samples representing only one species collected from a dead mummified Arabian partridge from Yemen in 1937 and preserved on the British Museum with Holotype slide No. 428 (Clay 1938). So, the aims of this work is to update the knowledge about the chewing lice of endemic partridges, collecting new materials, and examine Philby's partridge for chewing lice for the first time.

Material and methods

Captive breeding population of Arabian partridge and Philby's partridge (Supplementary file 1) were investigated for chewing lice in the National Wildlife Research Center (NWRC) near Ta'if. The visual inspection of host feathers was used as the main method for chewing lice collection. The collected samples were preserved in 95 % alcohol. Specimens were cleared using concentrated lactic acid for 2 days and then mounted on the slides using Puri's Media. Species identifications were made according to Clay 1938 and Price et al. 2003. Lice were photographed using a Panasonic FT2 14 Mp fixed on Nikon microscope eclipse 80i. The materials were deposited in the King Saud University Museum of Arthropods, Riyadh (KSMA).

Results

A total number of nine birds were investigated: six individuals of Arabian partridges and three individuals of Philby's partridge. All of these species were infected by one species of chewing lice, *C. arabicus* (Clay 1938).

Suborder: Ischnocera

Family: Philopteridae

Genus: *Cuclotogaster* Carriker, 1936:67

Gallipeurus Clay 1938b:135

C. arabicus (Clay 1938) (Fig. 1)

Gallipeurus arabicus Clay 1938b

Known host: *A. melanocephala* (Rüppell), Arabian partridge (Type host) (Galliformes: Phasianidae).

Local host: *A. melanocephala* Arabian partridge and new record host *A. philbyi* Philby's partridge.

Remarks: this species is collected from body feathers, especially the back feathers.

Head circumfasciata, marginal carina faint from the middle with lateral chitinization, clypeal suture absent, conus reduced, the preantennal region wide, antenna with sexual dimorphism, male with enlarged first antennal segment and characteristic third segment (Fig. 1c), temporal region wider than preantennal region, temple rectangular swollen with long marginal temporal seta I and II, gula with triangle chitinization, occipital bands present; prothorax short without lateral seta or spines, meso-metathorax junction visible on the lateral margin, posterior lateral hairs long, legs gradually elongated in length; abdomen with clear sexual dimorphism, oval in female, elongated in male, lateral margin of abdomen highly chitinized in both sexes, tip of abdomen in female with shallowly concave invagination, the tip of male abdomen bifid (Fig. 1d); genitalia of male very characteristic, parameres with two notch and small medium pit, endomeres flatten, sac clear.

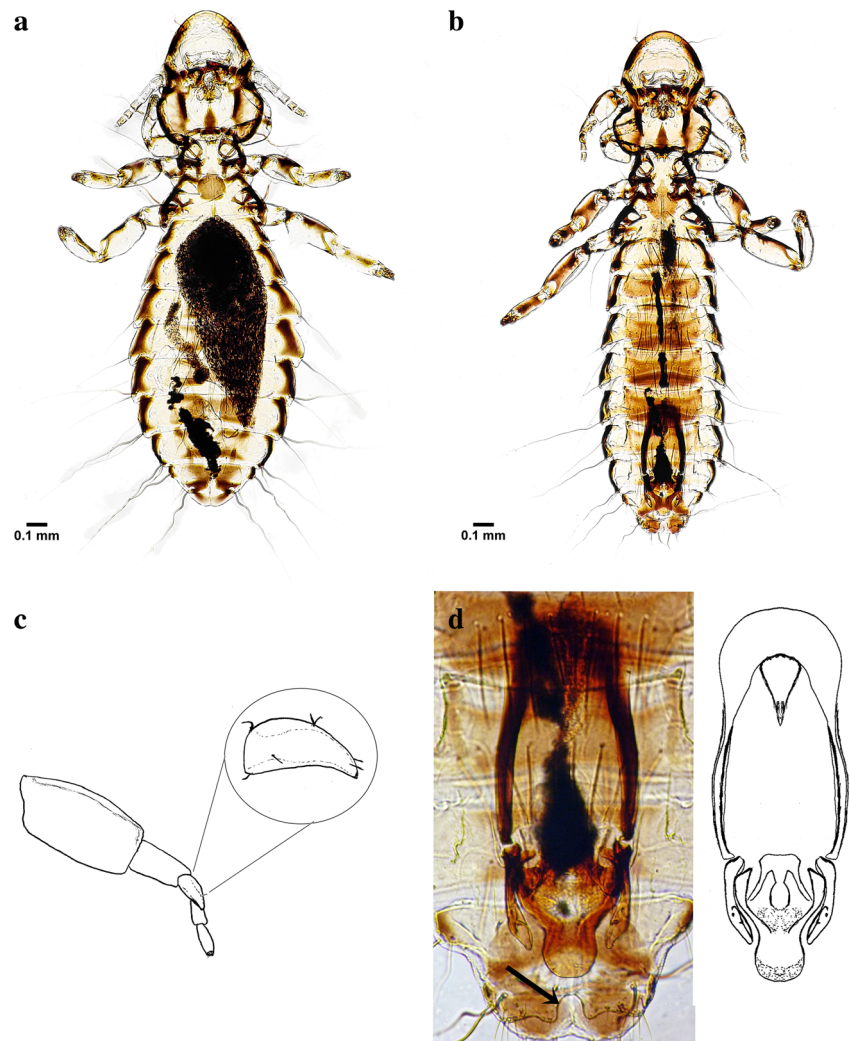
Material examined (28): *A. melanocephala* (Rüppell, 1835): 6(M), 12(F), 3(N), (NWRC), 1 Apr. 2012; *A. philbyi* Lowe, 1934: 1(M), 3(F), 3(N) (NWRC), 2 Apr. 2012.

	Measurements in mm for female	Measurements in mm for male
H.L.	0.61	0.55
H.W.	0.52	0.46
H.I.	1.17	1.19
T.L.	0.39	0.45
A.L.	1.39	1.42
Total length	2.39 ± 0.2	2.42 ± 0.2

Discussion

The studies concerning endemic avian fauna of Saudi Arabia are very scarce and consequently almost all of their chewing lice parasites are rarely known. The present work forms the first investigation of Saudi Arabian endemic birds' ectoparasites. During the survey work concerning the chewing lice of wild birds of Saudi Arabia, the authors had a chance to catch some endemic bird species including the Arabian serin (Ta'if), Yemen serin, and Yemen thrush (Asir mountains), but all of them were free of lice.

Fig. 1 *Cuculotogaster arabicus* (Clay 1938): **a** Female, **b** Male, **c** Male antenna showing the shape of characteristic third segment, and **d** Male genitalia, *black arrow* refers to invagination of the tip of the abdomen



The collection of *C. arabicus* (Clay 1938) from Arabian and Philby's partridge is considered a rediscovery of this species since 1937 because there is no data available about it except the four samples that were collected by Meinertzhagen and identified by Clay. High-quality photos and some drawings available in this study are the only representation of this species through all previous chewing lice works even on the original description (Clay 1938). From a taxonomic point of view, this is the first record of the genus *Cuculotogaster* from Saudi Arabia, and the association of *C. arabicus* with Philby's partridge is considered a new host/parasite association.

The distribution of the genus *Cuculotogaster* among *Perdicinae* is very characteristic, where most of the species is restricted only to one host (Price et al. 2003). Sympatric speciation of this genus is completely absent in the case of partridges and appears clearly in their closely related group *Francolin*. African species such as Clapperton's francolin *Pternistis clappertoni* Children,

1826 are parasitized by three species of *Cuculotogaster* spp. while in almost all partridges species there is only one species of *Cuculotogaster* present (Clay 1938; Tendeiro 1958). These facts induced us to reconsider our record of *C. arabicus* from Philby's partridge because it was collected from captive birds. The struggling could be a good explanation of such occurrence until new materials are available from free living birds.

Although there is great diversity of chewing lice on partridges around the world, the occurrence of only one species on Saudi Arabian endemics could be questionable. So, more work is needed to collect new samples from these birds especially from their wild habitat. Also, the threat that faces the habitats of partridges either on Saudi Arabia or around the globe puts a unique stress on their ectoparasites including chewing lice as well. This leads us to ask if such kinds of ectoparasites that infesting rare or endemic birds should be protected and incorporated into conservation programs or not.

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