

Identification key for chewing lice (Phthiraptera: Amblycera, Ischnocera) infesting the Indian Peafowl (*Pavo cristatus*) with one new country record and new host record for Saudi Arabia

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Abstract: The amblyceran and ischnoceran lice removed from the Indian Peafowl (*Pavo cristatus* L.) collected at the Riyadh bird market, and other specimens available in the King Saud University Museum of Arthropods, Kingdom of Saudi Arabia, were identified. *Amyrsidea minuta* Emerson, a new country record, and *Goniodes dissimilis* Denny were found infesting the Indian Peafowl in Saudi Arabia. *Goniodes dissimilis* is recorded for the first time from this bird species, along with *Menacanthus stramineus* (Nitzsch), the well-known chicken body louse. All previous records of the 12 species of chewing louse reported from the Indian Peafowl are reviewed. An identification key for the 13 species is given with taxonomic notes. Additionally, a new photo-editing technique for chewing louse images is noted.

Key words: Indian Peafowl, Amblycera, Ischnocera, Saudi Arabia, photo-editing

1. Introduction

Chewing lice (Phthiraptera: Amblycera and Ischnocera) are wingless paraneopterans that are mostly ectoparasites of birds (Aves), but also of mammals (Clayton et al., 2008). There are about 4000 species of chewing louse worldwide (Price et al., 2003; Dik et al., 2011). Many species of chewing louse exhibit a high degree of host specificity and are important models of host-parasite evolution (Clayton et al., 2003).

Relatively few studies regarding either the taxonomy or the biology of chewing lice are available for the Middle East. For the Kingdom of Saudi Arabia, currently 19 chewing louse species and 2 subspecies have been recorded (Abu Yaman, 1978; Aldryhim, 1991; Taula and Hussain, 1999; El-Ahmed et al., 2012; Al-Ahmed et al., 2014). At least 500 species of birds are known from Saudi Arabia (Silsby, 1980; Porter and Aspinall, 2010). Additionally, taking into account the number of migratory birds passing through Saudi Arabia and the large number of exotic and domesticated bird species, the low number of known species of chewing louse is not reflective of the probable true diversity of this group of ectoparasites in the Kingdom.

The Indian Peafowl or Blue Peafowl (*Pavo cristatus* L.) is a bird species recognized for its beauty, especially the male, in particular for the long train made up of elongated upper-tail covert feathers with colorful eyespots. The Indian Peafowl has been introduced widely from its original Indian subcontinental range by legal and illegal bird trading (Ramesh and McGowan, 2009). In Saudi Arabia, the Indian Peafowl is an exotic species brought to the Kingdom many years ago as an ornamental bird (Alyousef, 2006).

The chewing lice known to infest the Indian Peafowl have been previously treated in scattered papers describing new taxa, or in revisions of genera that include species known to infest this bird (Kellogg and Paine, 1914; Clay, 1938, 1940; Emerson, 1961; Price and Beer, 1963; Lakshminarayana and Emerson, 1971; Eichler and Mey, 1978; Scharf and Price, 1983). There is no identification key available that specifically addresses the chewing lice of the Indian Peafowl. The objective of this paper is to review the Amblycera and Ischnocera species known to infest this bird species, including providing their biological notes, a direct identification key, and a new photo-editing technique for microscopic slide presentation.

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2. Materials and methods

As part of a larger study of chewing lice in Saudi Arabia, the authors had an opportunity to examine lice taken from Indian Peafowl by Y Aldryhim during a study of domestic fowl in the central region of Saudi Arabia (Aldryhim, 1991). This material was deposited in the King Saud University Museum of Arthropods, Riyadh (KSMA). Specimens of chewing lice were also collected from Indian Peafowl during a survey of birds being sold at the Riyadh bird market. Only male birds were examined from both samples previously collected by Aldryhim in 1991 and from the bird market. The total number of birds examined for lice was 3 individuals: 2 birds from the central region of Saudi Arabia and 1 from the Riyadh bird market.

Lice were collected by visual inspection of Indian Peafowl feathers and preserved in 70% alcohol. In the laboratory, specimens were cleared using potassium hydroxide for the specimens collected by Aldryhim (1991) and lactic acid for specimens newly collected from the Riyadh bird market. The specimens were then mounted onto slides using Puri's medium. Species identifications were accomplished using the works of Ewing (1929), Clay (1940), Bienko (1964), and Scharf and Price (1983). Other references that discuss chewing louse species that are known to infest the Indian Peafowl were used to aid in the development of the identification key (Kellogg and Paine, 1914; Clay, 1938, 1940; Emerson, 1961; Price and Beer, 1963; Lakshminarayana and Emerson, 1971; Eichler and Mey, 1978; Scharf and Price, 1983).

Slide-mounted lice were photographed using a Panasonic FT2 14Mp fixed onto a Nikon Eclipse 80i microscope. The photos were edited using PhotoScape (3.6.5) and Picasa 3 free software. They were enhanced using the "sharpen" tool of the editor interface of PhotoScape, opened using Picasa 3, and the photos were then manipulated using the "more fun and useful image processing" interface. Invert colors were chosen and the Orton-ish effect was applied. Using the Orton-ish effect allowed options for more effective editing. Through using these options, "blooming" was reduced, brightness was increased, and fade was set at zero. The final image could then be saved and used for further editing.

All lice specimens are preserved in the King Saud University Museum of Arthropods (KSMA). Symbols used are F for female, M for male, and N for nymph.

3. Results

Thirteen species of chewing louse, 6 species in 3 genera of Amblycera and 7 species in 3 genera of Ischnocera, are known to parasitize Indian Peafowl, including a new host record found during this study.

Suborder: Amblycera

3.1. *Amyrsidea minuta* Emerson, 1961 (Figure 1)

Type host: *Pavo cristatus* L.

Specimens examined (13): (8) El-Hair 23/XII/1994 4(F), 3(M), and 1(N); (5) Riyadh 8/III/2013 3(F), 2(M).

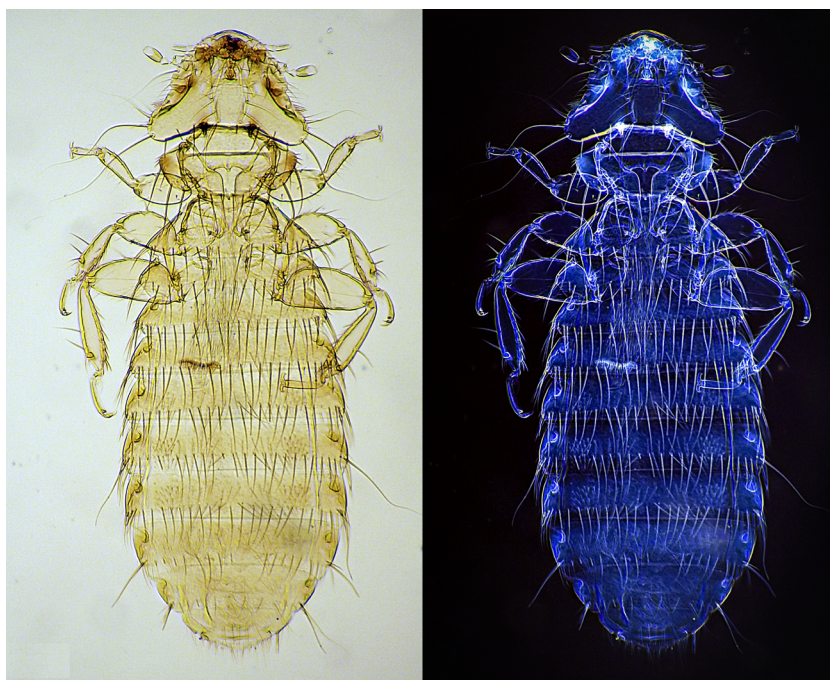


Figure 1. Female *Amyrsidea minuta*. Normal image on the left and modified image on the right. The modified photo shows the effectiveness of the editing technique, showing small structures and textures of the lice more clearly than the normal one.

This species is a new country record for Saudi Arabia. *Amyrsidea minuta* is the smallest species of the genus and is characterized by distinctive male genitalia (Figure 2). This species is similar to *A. afropavo* Benoit, 1962 (Scharf and Price, 1983), which parasitizes the Congo Peafowl, *Afropavo congensis* Chapin, but it can be distinguished from it by the highly developed hypopharyngeal sclerite and the smaller number of sternal setae on both sexes (17–22). Additionally, the male genitalia of *A. afropavo* have wider epimeres.

3.2. *Amyrsidea phaeostoma* (Nitzsch, 1866)

Menopon phaeostoma Nitzsch, 1866

Type host: *Pavo cristatus* L.

This species is one of the largest species of the genus. It is characterized by 5 medioanterior metanotal and abdominal tergal setae in both sexes.

3.3. *Colpocephalum tausi* (Ansari, 1951)

Galliferrisia tausi Ansari, 1951

Type host: *Pavo cristatus* L.

3.4. *Colpocephalum thoracicum* Kellogg & Paine, 1914

Colpocephalum echinatus Ewing, 1930

Type host: Green Peafowl *Pavo muticus* L.

This species was described originally from nymphs collected from the Green Peafowl, *Pavo muticus* L., by Kellogg and Paine (1914). Ewing (1930) proposed *C. echinatus* as a new species from the same bird species, but from adult males and females. Price and Beer (1963) revised the species of *Colpocephalum* that are associated with Galliformes and considered *C. thoracicum* as the valid name, with *C. echinatus* as a synonym.

3.5. *Menacanthus kaddoui* (Eichler and Mey, 1978)

Gallacanthus kaddoui Eichler and Mey, 1978

Type host: *Pavo cristatus* L.

This species was first described in the genus *Gallacanthus* from specimens collected from Indian Peafowl from Baghdad, Iraq (Eichler and Mey, 1978).

3.6. *Menacanthus stramineus* (Nitzsch, 1818) (Figure 3)

Eomenacanthus stramineus (Nitzsch, 1818)

Specimens examined (2): El-Hair 23/XII/1994 1(F); Riyadh bird market 8/III/2013 1(F).

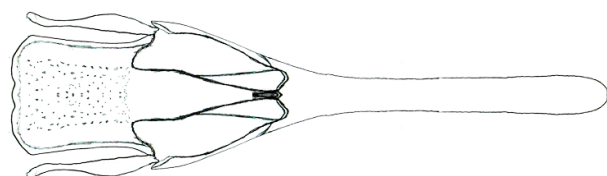


Figure 2. The illustrated drawing of *Amyrsidea minuta* male genitalia.

Type host: Wild Turkey *Meleagris gallopavo* L.

The chicken body louse is a well-known pest and a widespread species of chewing louse occurring on numerous Galliformes hosts. It is characterized by a pair of spine-like processes on the ventral side of the head and a pointed mesosternum. This species was first recorded from Saudi Arabia by Aldryhim (1991) from domesticated chickens. One female specimen was collected from an Indian Peafowl being sold at the Riyadh bird market in 2013.

Suborder: Ischnocera

3.7. *Goniocotes mayuri* Lakshminarayana & Emerson, 1971

Type host: *Pavo cristatus* L.

This species is closely related to *G. parviceps*; it was collected from Indian Peafowl occurring in India, Nepal, and the United Kingdom (Lakshminarayana and Emerson, 1971).

3.8. *Goniocotes parviceps* (Piaget, 1880)

Goniodes parviceps Piaget, 1880

Goniocotes yngarejsuf Eichler, 1950

Type host: *Pavo cristatus* L.

3.9. *Goniocotes rectangulatus* Nitzsch, 1866

Type host: *Pavo cristatus* L.

The type specimen of this species is apparently lost. Kéler (1939) redescribed this species from 2 specimens in the Halle Museum, Germany. *Goniocotes rectangulatus* has been recorded from *P. cristatus* and *P. muticus* from various areas of the world (Lakshminarayana and Emerson, 1971).

3.10. *Goniodes dissimilis* Denny, 1842 (Figure 4)

Type host: *Gallus gallus* L.

Specimens examined (1): Riyadh bird market 8/III/2013 1(M).

This species is recorded for the first time from *P. cristatus* based on a male specimen found on a bird from the Riyadh bird market in 2013. This occurrence could be doubtful; this will be reviewed later in Section 4.

3.11. *Goniodes meinertzhageni* Clay, 1940

Type host: *Gallus gallus* L.

3.12. *Goniodes pavonis* (L., 1758)

Pediculus pavonis L. 1758

Nirmus tetragonocephalus Olfers 1816

Goniodes falcicornis Nitzsch 1818

Type Host: *Pavo cristatus* L.

This species was the first chewing louse described from the Indian Peafowl by Linnaeus (1758).

3.13. *Lipeurus pavo* Clay, 1938

Type Host: *Pavo cristatus* L.

This species can be easily distinguished from other *Lipeurus* species by an elongated head and occipital bands (Clay, 1938).

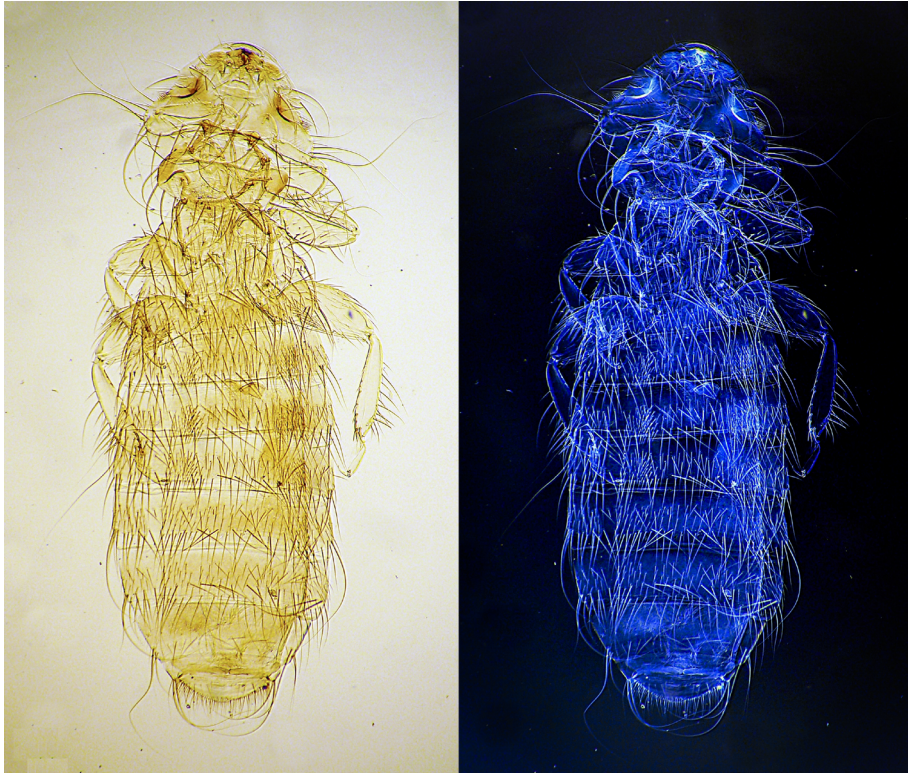


Figure 3. Female *Menacanthus stramineus*. Normal image on the left and modified image on the right.

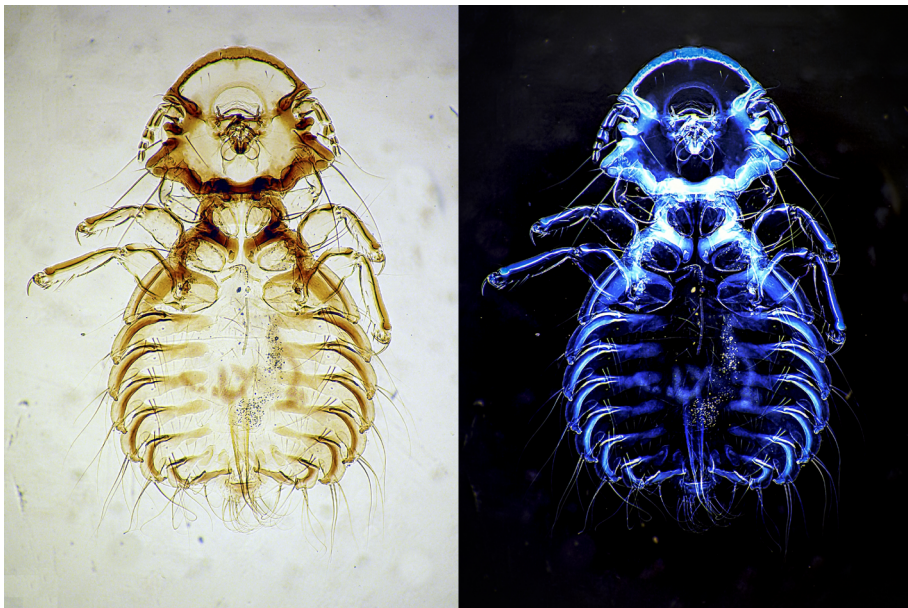


Figure 4. Male *Goniodes dissimilis*. Normal image on the left and modified image on the right.

Key to species of chewing lice parasitizing Indian Peacock

1. Antennae clavate, concealed at rest in antennal fossae, maxillary palps present *Amblyceria* 2
 Antennae usually filiform, appear on the side of the head, maxillary palps absent *Ischnocera* 7
2. Head with ventral processes and pair of postpalpal processes *Menacanthus* 3
 Head with no ventral processes or palpal processes 4
3. Mesosternum entirely curved anteriorly (Figure 5a) *Menacanthus kaddoui*
 Mesosternum pointed medially (Figure 5b) *Menacanthus stramineus*
4. Head temporal lobe subrectangular, body elongated; hind femur with ventral rows of short thick spines (Figure 5c) *Colpocephalum* 5
 Head temporal lobe rounded, body stout; hind femur without such ventral rows of short thick spines *Amyrsidea* 6
5. Lateral tergite IX has a comb of 2–5 spiniform setae (Figure 5d) *Colpocephalum tausi*
 Without such combs on tergite IX *Colpocephalum thoracicum*
6. Abdomen with 2 rows of tergal setae *Amyrsidea phaeostoma*

- Abdomen with only posterior row of tergal setae (Figure 1) *Amyrsidea minuta*
7. Abdomen elongated, the first antennal segment of male slightly slim (Figure 5e) *Lipeurus pavo*
 Abdomen oval or almost rounded, the first antennal segment of male enlarged (Figures 5f–5h) 8
8. First antennal segment of male without appendage, and if present it is not sharply pointed (Figure 5f); pleurites of abdominal segment VIII of female with well-developed pulvilliform setose processes *Goniodes* 9
 First antennal segment of male with sharp pointed appendage (Figures 5g and 5h); pleurites of abdominal segment VIII of female without such processes *Goniocotes* 11
9. Antennal base is not lobed *Goniodes dissimilis*
 Antennal base is enlarged and lobed 10
10. Large, thickened overhanging clavi and terminal segments of the abdomen in both sexes; anterior margin of male genital opening prolonged posteriorly and bilobed *Goniodes pavonis*
 Normal clavi and terminal segment of abdomen; male genitalia not prolonged posteriorly *Goniodes meinertzhageni*

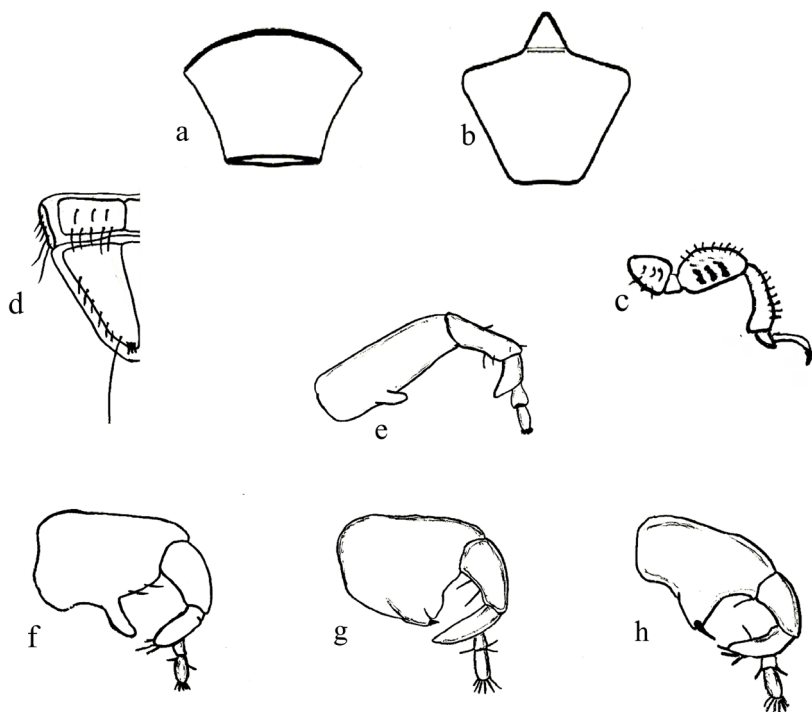


Figure 5. a) Mesosternum of *Menacanthus kaddoui*; b) mesosternum of *Menacanthus stramineus*; c) hind leg of *Colpocephalum* spp.; d) dorsal view of VIII and IX segment of *Colpocephalum tausi*; e) male antenna of *Lipeurus pavo*; f) male antenna of *Goniodes meinertzhageni*; g) male antenna of *Goniocotes mayuri*; h) male antenna of *Goniocotes parviceps*.

11. The preantennal region of head slightly wider than the postantennal part *Goniocotes parviceps*

The preantennal region of head is shorter or equal to postantennal part 12

12. Anterior margin of carina narrow; antenna of male very large, especially the first antennal segment, which has a triangular appendage with a thick spine-like appendage ...

..... *Goniocotes mayuri*

Anterior margin of carina wide; antenna slim showing slightly significant difference between male and female ..

..... *Goniocotes rectangulatus*

4. Discussion

The Indian Peafowl is a conspicuous bird species worldwide, and for centuries captive individuals have been introduced into Africa, Europe, the Middle East, and North America (Ramesh and McGowan, 2009). This bird species is often associated with other Galliformes, exposing it to a wide range of ectoparasites of worldwide origin, no doubt resulting in the relatively large number of different chewing louse species being identified. The number of chewing lice associated with specific bird species is variable, ranging from a single species to as high as 20 louse species from Tinamiformes hosts (Ward, 1957). There has been no consensus on what factors control the relative diversity of lice found on specific bird hosts (Clayton et al., 2008). It would be informative to study the lice of the Indian Peafowl from its original Indian subcontinental range in order to determine the number of endemic louse species. Additionally, it is noted that no single bird was host to 13 species of louse. The sympatric occurrence of 2 species of 1 genus from the same bird host—for example, in the Indian Peafowl, *G. mayuri* and *G. parviceps* (Lakshminarayana and Emerson, 1971)—is also of interest, requiring further study regarding models of host–parasite evolution (Clayton et al., 2003).

Thirteen species of 2 suborders of Phthiraptera are known to infest Indian Peafowl. Six are known only from *P. cristatus*: *C. tausi*, *G. mayuri*, *G. rectangulatus*, *G. meinertzhageni*, *L. pavo*, and *M. kaddoui*. *P. muticus*, *A. minuta*, *A. phaeostoma*, *C. thoracicum*, *G. parviceps*, and *G. pavonis* are also shared with its close relative, the Green Peafowl, while *G. dissimilis* and *M. stramineus* have a wide range of galliform hosts.

This paper reports the first study of the chewing lice infesting an exotic bird in Saudi Arabia. One new louse record, *A. minuta*, is reported for the first time for Saudi Arabia. The ischnoceran *G. dissimilis* is reported for the first time from the Indian Peafowl.

The occurrence of *G. dissimilis* on Indian Peafowl could be due to fighting with or contamination from domestic fowl. This record can easily indicate how the spread of certain bird species exposes them to a wider

variety of ectoparasites, which may adapt to the new host and create stable populations on this bird through succeeding generations; we think the same thing occurred with *M. stramineus*. Kellogg and Paine (1914) reported the occurrence of this species on captive-bred Common Pheasant *Phasianus torquata* Gmelin, 1789; this record may also indicate the ability of this species to transfer to a wide range of Galliformes hosts, especially those bred in captivity. Male *G. dissimilis* was collected from the male Indian Peafowl from Riyadh bird market, but considering this record as evidence of a stable complete relationship between Indian Peafowl and this species of louse is dubious, and to confirm it would require more studies and records from different parts of the world.

The new photo-editing technique described using PhotoScape (3.6.5) and Picasa 3 free software is part of a larger work on producing new software for microscopic organism photo presentation that will be published elsewhere. The photos produced by this technique look like X-ray photos of human body parts. The advantages of this method appear in the clarity of hairs and highly chitinized body parts, especially on the head region, which appear against a black background. In addition, the visibility of very small structures and textures found on the louse body, such as the very small hairs on the upper part of the *G. dissimilis* head (Figure 4) or the group of small spines on the dorsal side of the *A. minuta* abdomen (Figure 1), is enhanced. Furthermore, this technique uses free software and does not require specialized skills like those needed for fluorescent dye photography, for example, which produces similar images. Overall, the photos produced are more detailed and clearer than normal photos, especially at a small publication size.

Ecological and molecular studies are needed to achieve comprehensive understanding of peafowl/lice interaction, especially in its native habitat. Additional studies are also required to document the chewing lice occurring on various hosts in Saudi Arabia, one of the largest countries in the Middle East.

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