BENAKI PHYTOPATHOLOGICAL INSTITUTE

Hellenic Plant Protection Journal **19:** 5-14, 2026
DOI 10.2478/hppj-2026-0002

First record of Dermestid and Ptinid beetles as insect pests of stored silkworm products in Egypt – Description of morphological features

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Summary *Attagenus fasciatus* (Thunberg, 1795) and *Anthrenus coloratus* Reitter 1881 (both Coleoptera: Dermestidae), and the spider beetle *Gibbium psylloides* (Czempinski, 1778) (Coleoptera: Ptinidae), were recorded for the first time in stored silkworm products such as cocoons and feaces in Egypt. Notes on the detailed morphological descriptions for all species are presented. The impact on national sericulture industry should be considered. *Attagenus fasciatus* and *A. coloratus* are serious pests of silkworm cocoons which are damaged by their larvae boring into them to feed on pupae. *Gibbium psylloides* is a minor pest of the silkworm industry feeding on dry debris plant, and feaces.

Additional keywords: Anthrenus coloratus, Attagenus fasciatus, Dermestidae, *Gibbium psylloides,* Ptinidae, Sericulture

Introduction

One of the most significant industries in many parts of the world, sericulture, contributes significantly to the national economies of several countries (Elsaffany *et al.,* 2019; Fathy and Gad, 2022; Saha *et al.,* 2022). The mulberry silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae) provides several commercial industrial products, including degummed silk and feaces, used for the textile industry or some incipient biomedical applications. In Asia, a number of potentially useful medical products include silk proteins (fibroin and sericin) and powder from dehydrated silkworm pupae (Ryu, 2014; Huang *et al*., 2017; Aznar-Cervantes *et al*., 2021).

The silkworm industry has to contend with a number of insect pests destroying silkworm cocoons, raw silk, and stocked silk textiles in stores, amongst these the dermestid beetles which are of particular importance in Egypt, India and other countries. Dermestids cause harm to living cocoons retained for formation of next moths' generation, silkworm eggs, and live larvae in grain age (silkworm culture) (Veer and Rao, 1995; Lawrence and Ślipiński, 2013). The main source of the loss is due to the larvae's feeding activity, which drill the silken cocoons to feed on pupae, rendering cocoons unusable for reeling (Thiagarajan and Govindaiah, 1987; Veer *et al.,* 1996; Taha *et al.,* 2017; Elsaffany *et al.,* 2024; Fouad *et al.,* 2025). Furthermore, larvae of spider beetles of the family Ptinidae feed on dry plant material for silkworms and their feaces (Alfieri, 1976; El Sawaf and El-Sayes, 2009; Abied, 2011; Elsaffany *et al.,* 2024).

This study focuses on three Coleoptera recorded for the first time as pest of silkworm products in Egypt: *Attagenus fasciatus* (Thunberg, 1795) (Coleoptera: Dermestidae) (Löbl and Smetana, 2007) on silkworm cocoons; *Anthrenus* (*Anthrenops*) *coloratus* Reitter 1881 (Coleoptera: Dermestidae) (Nardi and Háva, 2019) on silkworm pupae within cocoons; spider beetle *Gibbium psylloides* (Czempinski, 1778) (Coleoptera: Ptinidae) on silkworm feaces and waste. The morphological and ecology notes on three insect species were studied and damage effects of these pests on silkworm products were recorded.

Materials and Methods

Insect collection

The tested insect samples were collect-

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ed from silkworm material in the Sericulture Research Unit, Plant Protection Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt, as follows: *A. fasciatus* was collected from stored cocoons of the silkworm for one year which was found infested at larval and adult stage. *A. coloratus* was collected from silkworm pupae within stored cocoons; *G. psylloides* was collected from silkworm wastes (dry plant materials and feaces). The samples were preserved in Eppendorf containing 70% Ethyl alcohol and deposited at -4ºC until used in the morphological investigation.

Identification and morphological studies

Identification of the species was based on the study of morphological characters, which was carried out within Alfieri collection, Plant Protection Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. The morphological features included antennae, abdomen and male genitalia (the most valuable and preferable character, usually accepted as being the final criteria (Wilson, 1927; Dobzhansky, 1931).

The whole specimens were boiled for 5-15 minutes in 10% KOH, and placed in distilled water to rinse and then immediately to ethyl alcohol for dehydration. All structures were transferred to glycerin mounts. Morphological structures were examined with Olympus SZ61 steromicroscope. All drawings (male genital structure and other parts) were made by a camera lucida attached with Olympus SZ61 steromicroscope. The ocular micrometer was used in making measurements (presented in millimeters) as follows: BL- body length (from anterior margin of the head to apex of the elytra); SL - sternites length (from the anterior margin to the apex of posterior margin). The specimens were photographed by Tucsen USB2.0 H series attached with Olympus SZ61 (Olympus Corp., Tokyo, Japan). The terminology used in species descriptions, nomenclature and systematic adopted are according to Háva (2004); Löbl and Smetana (2007) and Lawrence and Ślipiński (2013).

Results and Discussion

Attagenus fasciatus (Thunberg, 1795)

Family Dermestidae; Subfamily Attageninae Laporte, 1840; Tribe Attagenini Laporte, 1840; Genus *Attagenus* Latreille,1802. Adult species of the genus *Attagenus* are distinguished from other genera of Dermestidae by free mouthparts; antennae with 3-jointed clubbed; hypomeron without distinct antennal cavity, and the first segment of metatarsi at most, as long as the second.

Synonyms: *Anthrenus gloriosae* Fabricius, 1798:76; *A. annulifer* Laporte, 1840b:36; *A. cinnamomeus* Roth, 1851:122; *A. unifasciatus* Fairmaire, 1860:168 *Trogoderma subfasciatum* Chevrolat, 1864:617; *A. plebeius* Sharp, 1885b:147.

Diagnosis of adult stage: Body from 4-5.5 mm in length, elongate oval, dark brown to brownish yellow or black with white to whitish yellow, densely semi-recumbent hairs, and a sinuate fascia at both elytra; head withdrawn into pronotum, anterior clypeal margin slightly straight, eye finely faceted with sparsely short setae; antennae 11-segments, with 3-segmented club-shaped, brownish yellow, segments of antennal club is broader in male than in female; pronotum strongly inclined, convex with rounded anterior margin, postero-lateral margins making right angles, lateral margin with distinct ridge, posterior margin as long as or slightly longer than elytral base; elytra with one fascia or band of whitish hairs at basal third of elytra, and distinct lateral margin, and indistinct elytral suture, elytral apex rounded, scutellum distinctly triangular; legs stout, reddish brown. Abdomen with five visible sternites, with densely recumbent short hairs (Figs 1, 2 and 3 a).

Male genitalia (Figs 3 b, c, and d): aedeagus with paramere distinctly longer than phallobase or penis with slightly and densely subequal setae at apical half, slightly pointed apically, and distinctly curved inward. Phallobase or penis is broader at basal third,

Figure 1. *Attagenus fasciatus*: a) adult and b) larva (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

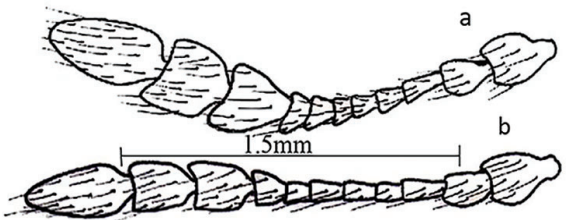

Figure 2. *Attagenus fasciatus:* Antennae of a) male and b) female (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

cone-shaped, bifurcated at base.

Diagnosis of larval stage: body length in late instar larvae nearly 5.5-6.5 mm; body elongated, carrot-shaped, cylindrical and strongly sclerotized, black to dark brown, with densely recumbent black and white backward hairs and long setae; median longitudinal line indistinct; ventral side whitish with greyish densely hairs; abdomen with long caudal brush (Fig. 1).

Damage effects: Damage by *A. fasciatus* larvae was recorded on silken cocoons (Fig. 4). *Attagenus fasciatus* is a well-known pest of silkworm cocoons (Rajashekhargouda and Devaiah, 1986; Ansari and Basalingappa, 1989; Veer *et al.,* 1991, 1996). Nevertheless, *A. fasciatus* is a pest of stored products such as grains, cotton and leather goods, dried milk, flour and many other animal and plant products (Armes, 1990; Ali, 1992; Ali *et al.,* 2011).

***Anthrenus (Anthrenops) coloratus* Reitter, 1881**

Discretion (Figs 5-8)

Family Dermestidae; Subfamily Megatominae Leach, 1815; Tribe Anthrenini Casey, 1900; Genus *Anthrenus* includes nine subgenera, between of these is *Anthrenops* which distinguished by the following characters: antennae 9-segments with terminal antennomere of male is longer than the penultimate one, whereas the terminal antennomere in female as long as the penultimate one.

Synonyms: *A.* (*Anthrenops*) *coloratus* Reitter, 1881; *A. rufescens* Pic, 1923a.

Diagnosis of adult stage: Body length 2-2.7 mm elongate oval, brown to dark brown with whitish to yellowish scales on head, pronotum, and elytra; female much longer

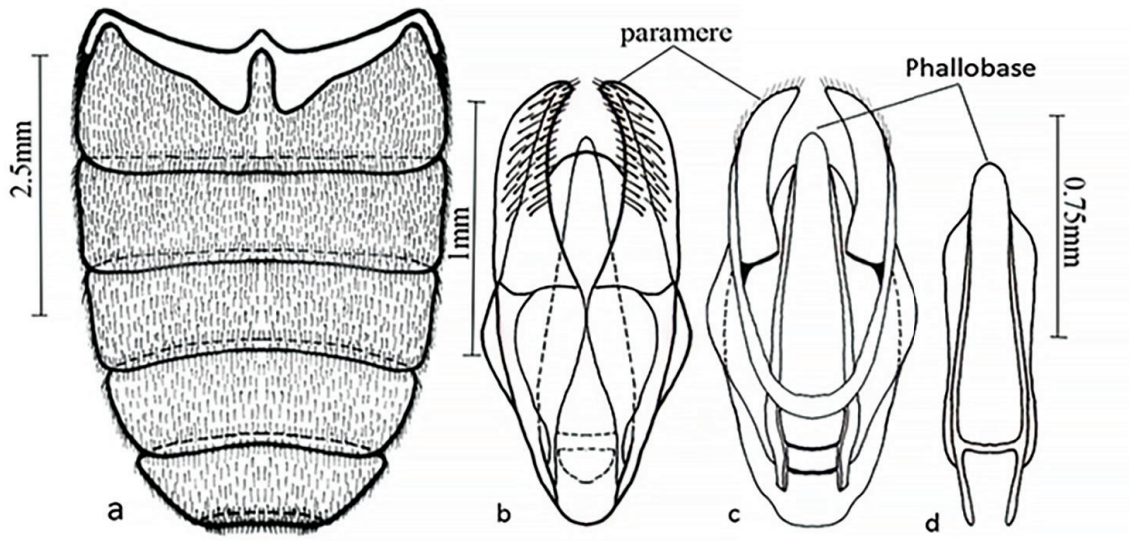

Figure 3. *Attagenus fasciatus*: a) abdominal sternites; b) aedaegus of male dorsal; c) ventral and d) phallobase or penis (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

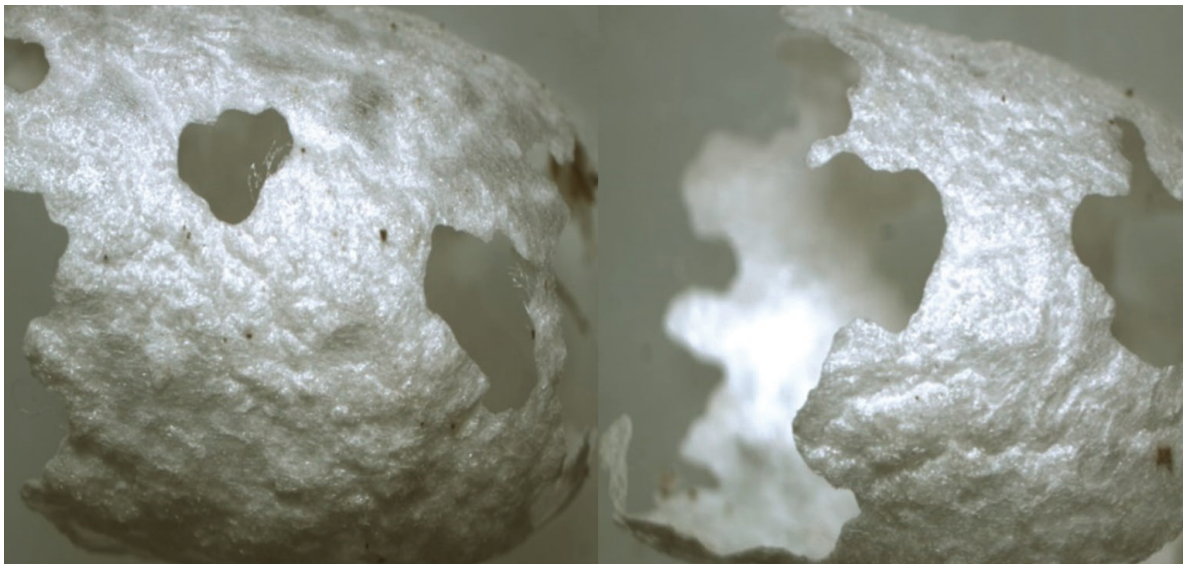

Figure 4. Damage of silkworm cocoons caused by larvae of *Attagenus fasciatus* (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

and broader than male (Fig. 5).

Antennae: 9-segments covered by short hairs, with three segmented club-shaped, the terminal antennomere in female as long as the seventh segment and penultimate ones, while in male the terminal antennomere is much broader at apical portion, and distinctly longer than the seventh and penultimate ones (Fig. 6).

Abdomen: five segments with densely short hairs, the first sternite is the longest (Fig. 7 a).

Male genitalia: aedeagus with parameres wider at basal half to nearly apex, slightly rounded terminally, distinctly longer than phallobase with densely short setae viewed from ventral and dorsal aspects. Phallobase or penis broader at basal half tapered toward apex upturned inward (Figs 7 b and c).

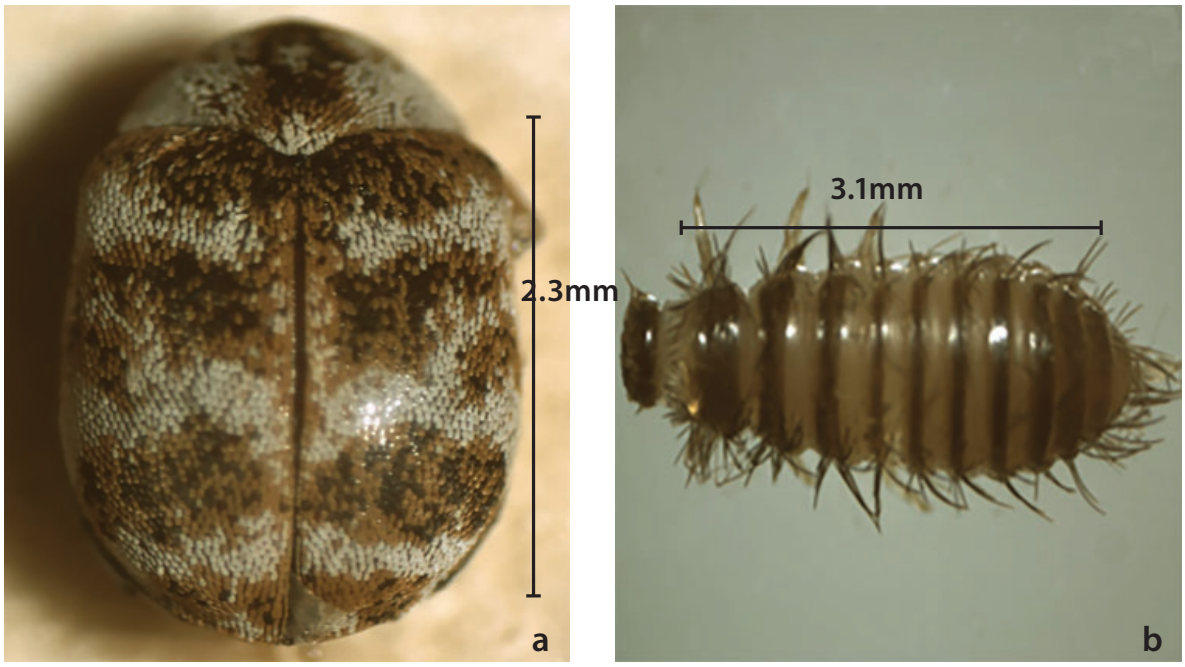

Figure 5. *Anthrenus* (*Anthrenops*) *coloratus*: a) adult and b) larva (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

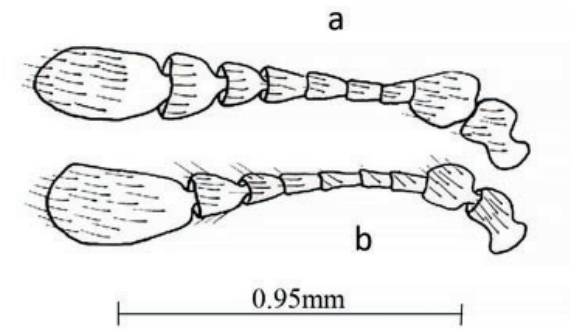

Figure 6. *Anthrenus* (*Anthrenops*) *coloratus*: Antennae of a) female and b) male (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

Diagnosis of larval stage: body length in late instar larvae nearly 3-4 mm; body cylindrical, slightly sclerotized, brown to beige in color in dorsal view, with ring of disperse long and slightly longer brown setae; head brown with golden recumbent hairs; median longitudinal line distinct particularly on the abdominal tergites; end of abdomen with short caudal brush; ventral side yellowish white dispersal setae and slightly denser hairs especially on abdominal sternites (Fig. 5).

Damage effects: Individuals collected from April to August caused serious damage to preserved insects and silkworm pupae (Fig. 8), primarily infested by the black carpet beetle *A. fasciatus*. Since May and June, infestation could be detected at preserved insects in wooden boxes, as exuviae of larvae, larvae and adult stages. Our observation is consistent with several reports indicating that *A. coloratus* has a very wide distribution and is recorded from the Mediterranean subregion, Africa, Asia and North America (Halstead, 1974). It is reported as a pest of insect collections in museums in Sudan (Hinton, 1945) and stuffed animals in India, e.g., leopard, civet cat, loris and bat (Ansari and Basalingappa, 1986), birds and mammals in zoological museums (Ansari, 2021). The total time required to complete its life cycle varies depending on the type of material it infests. It takes 140-159 days on dried silkworm pupae, 145-163 days on dried silk moths, 145-175 days on feathers, and 159-192 days on fur (Ansari, 2021). It is frequently collected from stores and houses, on wool clothes, blankets, brushes, etc (Veer *et al.,* 1991).

Gibbium psylloides (Czenpinski) Discretion (Figs 9-11)

Family Ptinidae Latreille, 1802; Subfamily

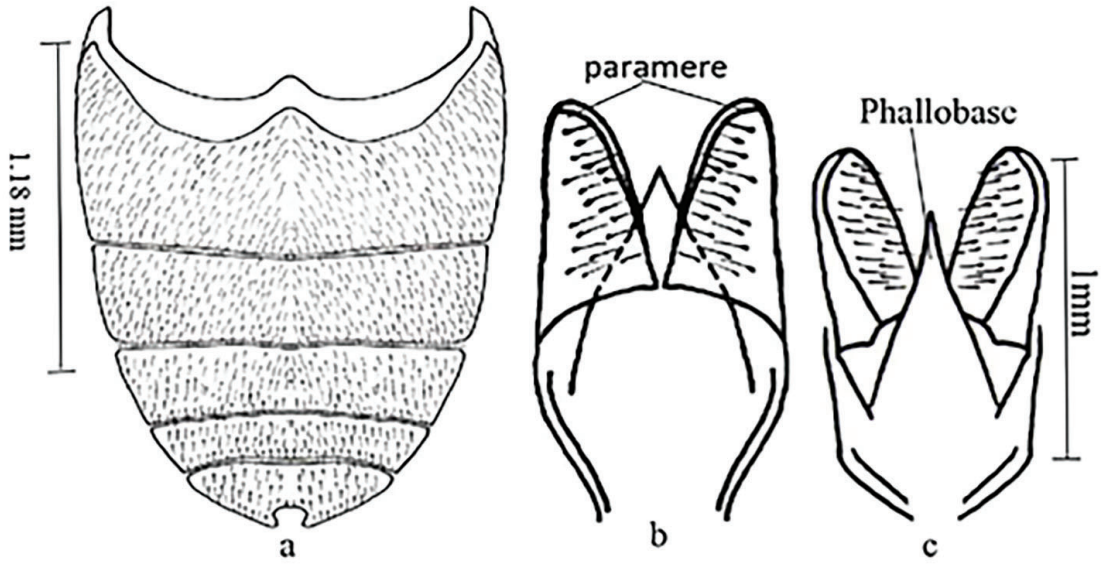

Figure 7. Abdominal sternites (a); dorsal (b), and ventral aspects (c) of aedaegus, of *Anthrenus* (*Anthrenops*) *coloratus* (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

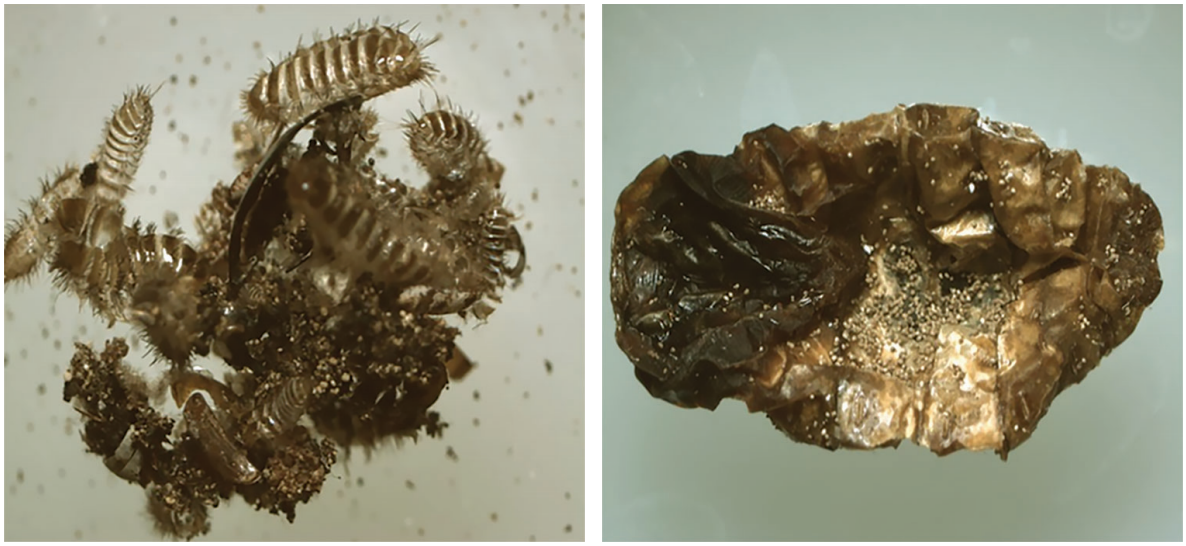

Figure 8. Damage of silkworm pupae within cocoons caused by larvae of *Anthrenus* (*Anthrenops*) *coloratus* (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

Gibbiinae Mulsant and Rey, 1868; Tribe Gibbiini Mulsant and Rey, 1868; Genus *Gibbium* Scopoli, 1777; *Gibbium psylloides* (Czenpinski), 1778 or shiny spider beetle is closely related to *G. aequinoctiale* Boieldieu (Bellés, 1985; Bellés and Halstead, 1985).

Synonyms: *Scotias psylloides* Czenpinski, 1778:51; *Ptinus scotias* Fabricius, 1781:74; *Ptinus seminulum* Schrank, 1781a:36; *Gibbium longicorne* Reitter, 1884h:296; *Bruchus apterus* Geoffroy, 1785:57.

Diagnosis of adult stage: Adult pear-shaped to globular, pronotum and elytra strongly convex, smooth, reddish to orangish in color, slightly darker than ventral surface; body from 1.8-2.75 mm in length; antennae 11-segmented filiform, with densely short recumbent hairs, the terminal antennomere

is longer than penultimate one, distinctly tapered apically; antennal fossa strongly produced laterally at posterior margin, lateral third sloping to middle, median confluence of margins forming an acute angles; ridges beneath more prominent, eyes are slightly closer to the posterior margin of antennal fossae; legs and ventral surface clothed with densely, golden- yellowish pubescence making an obscure surface, femorae stout apically, tibiae of all legs with two apical spurs, tarsi 5-segmented. Elytra sealed concealing scutellum, strongly convex. Abdomen with four segments, distinctly narrower than elytra when viewed from ventral side, with an obscured pubescence, the first two segments are equal in length, the third segment is slightly shorter than the second one, the fourth segment as long as or slightly shorter than the first three segments (Figs 9, 10 and 11 a).

Male genitalia: aedeagus with paramere slightly longer than phallobase or penis provided with sparsely short setae at apical third, apical portion of penis not chitinized, the sclerotized portion with narrow and long dorsal carina (Figs 11 b, c, and d).

Diagnosis of larval stage: body length in the late instar 4 mm or slightly longer, scrab-like, stout, slightly chitinized, with densely semi-erect whitish yellow setae; head brown, with distinct chewing mouthparts (Fig. 9).

Damage effects: This species is present all over Egypt, all year round. Many individuals were obtained from an alabaster jar, hermetically closed in Tut Ank Amoun tomb 3500 years old, present on silkworm wastes (dry plant materials and feaces). Our observation is consistent with several reports indicating that *G. psylloides* is a small flightless detritus feeder, sometimes found in damp, mouldy grain residues, but also in vegetable leather and other animal products. The larvae bore holes in the host to pupate and cause damage to packaging or the commodities them-

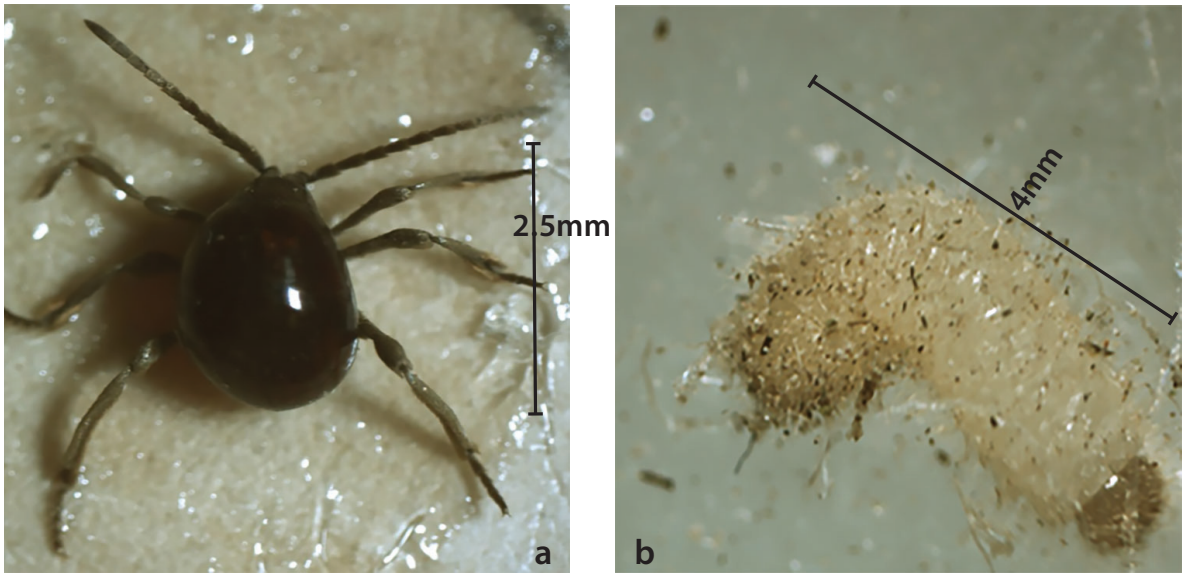

Figure 9. a) Adult and b) larva of *Gibbium psylloides* (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A)

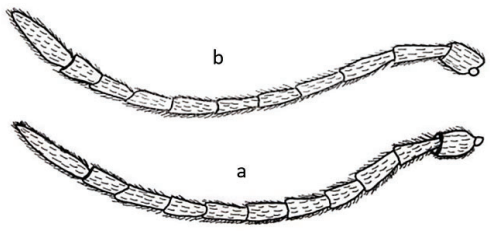

Figure 10. Antennae of *Gibbium psylloides*: a) ventral and b) dorsal view (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

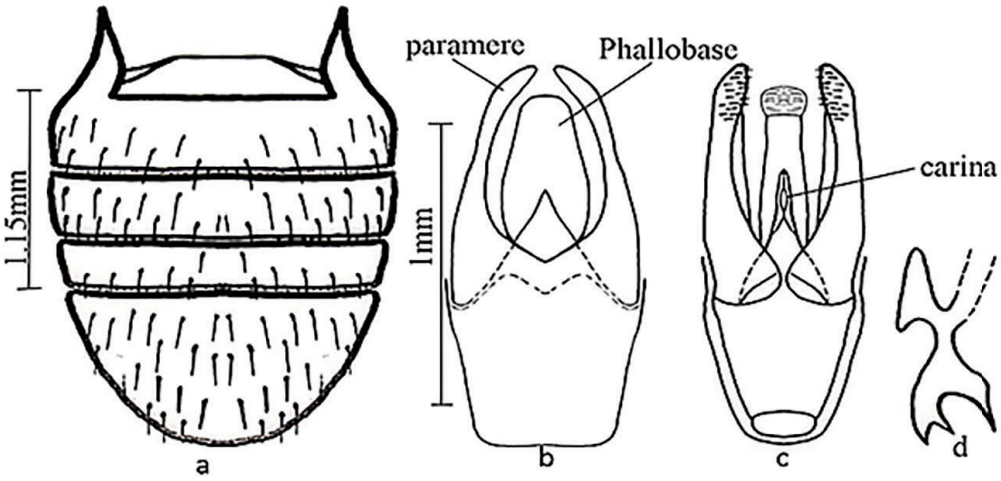

Figure 11. *Gibbium psylloides*: a) abdominal sternites, aedeagus; b), c) dorsal ventral aspect; d) chitinized carina (by Bedewy, M.M.M., Elsaffany, A.H., Gad, H.A.).

selves. In addition to furniture and dried plants in herbaria collections, larvae of *G. psylloides* can harm fabrics, mummies, animal mounts and silkworm wastes (dry plant materials and feaces) (Querner, 2015; Elsaffany *et al.,* 2024).

Conclusion

Based on our results, *A. fasciatus*, *A. coloratus* and *G. psylloides* are insect pests on stored silkworm products such as cocoons, pupae and feaces in Egypt, causing damage which could affect the national sericulture industry.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Received: 3 April 2025; Accepted: 3 January 2026

Πρώτη καταγραφή σκαθαριών Dermestidae και Ptinidae ως εχθρών αποθηκευμένων προϊόντων μεταξοσκώληκα στην Αίγυπτο – Περιγραφή μορφολογικών χαρακτηριστικών

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Περίληψη Η παρουσία των εντόμων *Attagenus fasciatus* (Thunberg, 1795), *Anthrenus coloratus* Reitter 1881 (και τα δύο Coleoptera: Dermestidae), και *Gibbium psylloides* (Czempinski, 1778) (Coleoptera: Ptinidae), καταγράφηκε για πρώτη φορά σε αποθηκευμένα προϊόντα μεταξοσκώληκα, όπως κουκούλια και περιττώματα, στην Αίγυπτο. Παρουσιάζονται λεπτομερείς μορφολογικές περιγραφές για όλα τα είδη. Θα πρέπει να γίνει εκτίμηση για τις πιθανές επιπτώσεις στην εθνική βιομηχανία σηροτροφίας. Τα είδη *A. fasciatus* και *A. coloratus* είναι σοβαροί εχθροί των κουκουλιών του μεταξοσκώληκα, τα οποία καταστρέφονται από τις προνύμφες τους που εισχωρούν σε αυτά για να τραφούν στις νύμφες. Το *G. psylloides* είναι ένας ήσσονος σημασίας εχθρός στη βιομηχανία της σηροτροφίας, το οποίο τρέφεται με ξηρά υπολείμματα φυτών και περιττώματα.

Hellenic Plant Protection Journal **19:** 5-14, 2026