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A new host of a parasitoid wasp, and an illustrated key for the species of *Heteroschema* (Hymenoptera: Chalcidoidea: Pteromalidae)

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Abstract

We register the species *Heteroschema rugosopunctata* for the first time as a parasitoid of pupae of the fly of the pigeon pea *Melanagromyza obtusa* (March, 1914) (Diptera: Agromyzidae). In this study, we first offer the nomenclatural history of the genus *Heteroschema* Gahan and then provide our finds. In September 2014 and March 2016, we conducted two field trips to the Colombian Amazon region, South America, where we collected pods of *Flemingia macrophylla* (Willd.) Merrill. (Fabaceae) containing pupae of the fly, which, in turn, were parasitized. We took the samples to the lab and reared the individuals to the emergence of the wasps. Identification of the specimens was carried out using several morphological tools. Through employing macro-photographs of the type specimens from museums and those collected in this study, we also developed an illustrated key to distinguishing the species currently known in the genus.

Keywords: Taxonomy, new host, *Heteroschema rugosopunctata*, *Melanagromyza obtusa*.

Introduction

Heteroschema is a large genus of parasitoid wasps, with a few species described, and characterized by the following combination of features: propodeum short, with a distinct nucha and a strong costula, which separates the neck from the rest of the propodeum; petiole short; postmarginal vein twice length as stigmal vein; left mandible tridentate, right one quadridentate; antennae inserted high on the face, particularly in males; female with antenna of three anelli and five funicular segments; male antenna with two anelli and six funicular segments [1-3]

Gahan described *Heteroschema prima* Gahan (1919), a parasitoid reared from larvae of *Melanagromyza gibsoni* Malloch, 1915 (Diptera: Agromyzidae), and established it as the type species of the genus. Previously, Ashmead had described three species named *Sphegigaster aeneiventris*, from specimens collected in the Kansas State Agricultural College [4]; and *Pteromalus rugosopunctatus* and *Glyphe punctata*, collected in the islands of St. Vincent and Grenada [5]. Later on, Gahan studied those species and concluding that *H. prima* was a junior synonym of *P. rugosopunctatus*, thereby transferring the latter species and into *Heteroschema* [6]. In that study, Gahan found also that *Glyphe punctata* was very similar to *H. rugosopunctata*, from which it could be separated by the darker legs, strongly compressed “abdomen”, forming a triangular process that extends to the middle coxae, and hypopygium prominent but not attaining the apex of the “abdomen”. Consequently, *Glyphe punctata* was also transferred into *Heteroschema* [6]. Finally, Peck transferred *Sphegigaster aeneiventris* into *Heteroschema* [7]. Therefore, *Heteroschema* is currently composed of three species named *H. aeneiventris* (Ashmead, 1888), *H. punctata* (Ashmead, 1894), and *H. rugosopunctata* (Ashmead, 1894).

The aim of the present paper is to include a record of a new host for *H. rugosopunctata*, and use the opportunity to provide macrophotograph images of type material for all currently described species in the genus.

Material and Methods

Material studied of *Heteroschema rugosopunctata* was obtained through rearing of specimens in the laboratory, at the UNAB (Universidad Nacional Agronomía Bogotá) entomological

Museum. Pods of *Flemingia macrophylla* (Willd.) Kuntze ex Merr. (Fabaceae) infested with *Melanagromyza obtusa* were collected in the field in September 2015 and March 2016, while working on the project “Diversity of insects in agricultural ecosystems of cocoa, *Theobroma cacao* L. (1753) and “copoazú”, *T. grandiflorum* (Wild. Ex Spreng.) K. Schum., 1886 (Malvaceae), in the departments (provinces) of Caquetá and Putumayo, Colombia”, develop by the “Sistemática de Insectos Agronomía SIA” research group, at the entomological Museum UNAB (Universidad Nacional Agronomía Bogotá) (<http://hbs.bishopmuseum.org/codens/codens-inst.html>).

Adults were obtained by placing the plants inside breeding chambers, which consisted of plastic boxes sizing 20x10x5 cm, with a 5x5 cm cutout on the lid, covered with a cloth of muslin for ventilation; to avoid moisture excess, a piece of absorbent paper was inserted into the boxes. At the same time, 30 pupae of *M. obtusa* from each locality were extracted from the pods of *F. macrophylla* and grouped to place them into four petri dishes per locality. Parasitoids were collected as they emerged (from each pupa, one or two parasitoid emerged). Adults of *M. obtusa* and their parasitoids emerging from the boxes were captured, sacrificed, air-dried, cardboard-point mounted, labeled, and organized under the protocol suggested in Martinez and Serna [8]. The parasitoids were identified to the genus level employing the keys of Gahan [1], Boucek and Heydon [2], and Ashmead [4, 5].

To extract the larvae of the parasitoid and observe the mode of parasitism, ten pupae were dissected. Clearing of specimens was performed employing KOH (10% concentration for 24 hours, then neutralized with glacial acetic acid, and sequentially passed through four alcohol concentrations: 10, 40, 70 and 90%. Finally, mounting of specimens was made on slides, using Canada balsam, and dried at 60 °C for 12 hours.

Morphological features of specimens were studied under 60× magnifications on a NIKON SMZ 1 stereomicroscope, and a Nikon Eclipse E600 microscope with 100× magnification. Measurements were taken using the program Image-Pro Insight version 8, and photographs were taken with a Lumenera Infinity 1-5C camera mounted on the microscope, and a Canon 5D Mk II camera with EF 100mm f2.8 with macro lens, and extension tubes. Images of *H. rugosopunctata*, *H. punctata* and *H. aeneiventris* were provided by Dr. Michael Gates (USDA—United States Department of Agriculture), and are also available at <http://www.usnmhymtypes.com>.

Terms for morphological features follow Gibson [9] and Gibson *et al* [10]. Abbreviations are: mv, Marginal vein; pmv, Postmarginal vein; smv, Submarginal vein; stv, Stigmal vein line; man, mandible; mp, maxillary palpus; lp, labial palpus; anl, anellus; fun, funicle; fu₁, first funicular segment; and clv, clava.

Results and Discussion

Material Examined: Specimen entire; cardboard-point mounted, deposited in UNAB under catalogue No. 1437. Colombia, Caquetá, Florencia, CIMAZ (Centro de Investigaciones Amazónicas Macagual), N 1°29'58.70" W 75°39'46.44", 274 m (27 ♀). Sept 2014. Colombia, Putumayo, Villa Garzón, Vda, San Rafael, Fca. El Escondite, N 0°47'41" W 76°35'8" 317 m (15 ♀). Febr 2016.

In September 2014 and February 2016, specimens of *Heteroschema rugosopunctata* (Fig. 1-6) emerged from pupae of *Melanagromyza obtusa* (Malloch), which, in turn,

developed in fruits (pods) of *Flemingia macrophylla* (Fabaceae).

Heteroschema rugosopunctata is Nearctic and Neotropical distributed, being reported as primary parasitoids from pupae of different species of Agromyzidae (Diptera), including *Melanagromyza gibsoni* (Malloch, 1915), *M. socolena* Sanabria & Zenner, 1994, and *Amauromyza maculosa* Malloch, 1913 [11-15].

Fig. 1-6 *Heteroschema rugosopunctata* extracted from pupae of *Melanagromyza obtusa*, from Caquetá and Putumayo (Colombia); 1, lateral habitus(♀); 2, forewing (mv, Marginal vein, pmv, Postmarginal vein, smv, Submarginal vein, stv, Stigmal vein); 3, mouthparts (man, mandible, mp, maxillary palpus, lp, labial palpus); 4, antenna (anl, anellus, fun, funicle, fu₁, first funicular segment, clv, clava); 5, head, frontal view; 6, dorsal habitus.

On the contrary, *M. obtusa* had previously been found to be parasitized by the following parasitoids: *Bracon* sp., *B. fletcheri* Silvestri (Braconidae); *Trichopria* sp. (Diapriidae) [16-20] *Euderus* sp. [21-22], *E. agromyzae* Gangrade [23-26], *E. lividus* (Ashmead) [23, 24, 27-28], *Diglyphus funicularis* Khan, *D. mandibularis* Khan [24, 29], *Tetrastichus atomella* Khan (Eulophidae)[30]; *Eupelmus* sp. (Eupelmidae) [22]; *Eurytoma* sp. [31-33], *E. melanagromyzae* [34], *Plutarchia* sp. nr. *indefensa* (Walker) [22] (Eurytomidae); *Pseudotorymus* sp., *Microdontomerus* sp. and *Monodontomerus* sp. (Torymidae) [35]; *Ormyrus* (Ormyridae), *Callitula* sp. (Pteromalidae) [36]. And recently *Pediobius cajanus* (Eulophidae) was reported as parasitoid in the Dominican Republic [37]. Despite the aforementioned studies, there are no previous records on the parasitism of *M. obtusa* by *H. rugosopunctata*.

Key to females of the described species of *Heteroschema*

1. Head and mesosoma with distinct metallic green luster (Fig. 7-8); metasoma bright metallic green to bronze, under some angles of light (Fig 7)*H. aeneiventris* (Ashmead)

Fig. 7-8 *Heteroschema aeneiventris* (Ashmead, 1888) (holotype)(♂): 7, lateral habitus, 8, head, frontal view.

- Head and mesosoma black(Fig. 1,6, 9-12), or with a faint copper tinge, under some angles of light; metasoma bright metallic green to bluish, under some angles of light (Fig. 1,6,12).....2

2. Anterior most ventral region of metasoma produced forward into a compressed triangular process that extends to the middle coxae; hypopygium prominent, but not reaching the apex of the metasoma (Fig.10); darker legs.....*H. punctata* (Ashmead)

Fig. 9-10 *Heteroschema punctata* (Ashmead, 1894) (holotype)(♀): 9, dorsal habitus, 10, lateral habitus.

- Anterior most ventral region of metasoma with or without a compressed triangular process, if present, it does not extend to the middle coxae; hypopygium not as above; legs pale (Fig. 12)..... *H. rugosopunctata* (Ashmead)

Fig. 11-12. *Heteroschema rugosopunctata* (Ashmead, 1894) (holotype)(♀): 11, dorsal habitus, 12, lateral habitus.

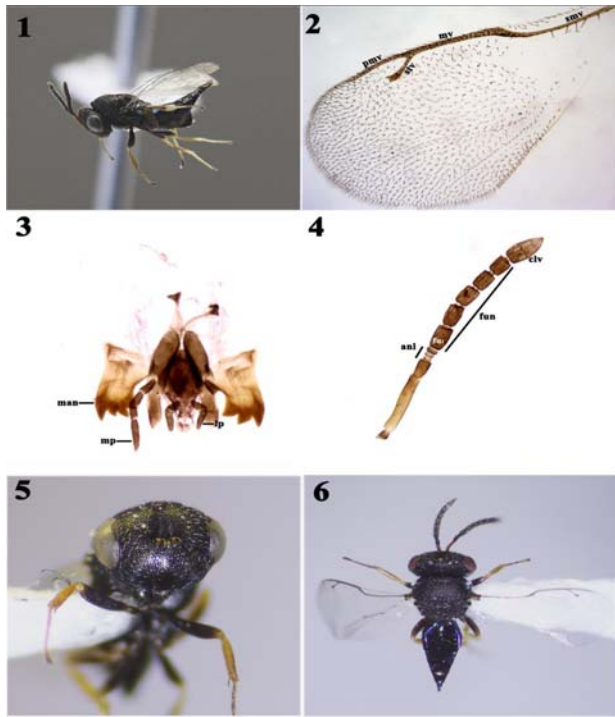


Fig 1-6: *Heteroschema rugosopunctata* extracted from pupae of *Melanagromyza obtusa*, from Caquetá and Putumayo (Colombia), lateral habitus(♀); 2, forewing (paratype) (mv Marginal vein; pmv, Postmarginal vein; smv, Submarginal vein; stv, Stigmal vein); 3, mouthparts (man, mandible; mp maxillary palpus; lp labial palpus); 4, antenna (anl anellus; fun funicle; ful first funicular segment; clv, clava); 5, head, frontal view 6, dorsal habitus



Fig 7-8: *Heteroschema aeneiventris* (Ashmead, 1888) (holotype)(♂): 7, lateral habitus; 8, head, frontal view.



Fig 9-10: *Heteroschema punctata* (Ashmead, 1894) (holotype)(♀): 9, dorsal habitus; 10, lateral habitus.

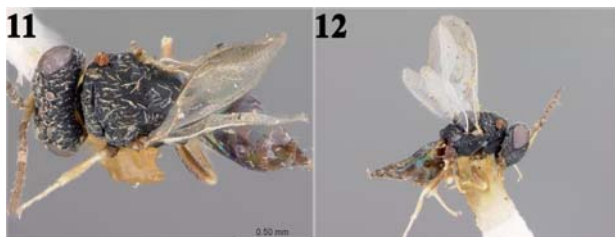


Fig 11-12: *Heteroschema rugosopunctata* (Ashmead, 1894) (holotype)(♀): 11, dorsal habitus; 12, lateral habitus.

Conclusions

At present, *Heteroschema rugosopunctata* is clearly taken apart from the current species in the genus, and we provide a straightforward illustrated key to doing so. However, this is a large genus in need of a taxonomic revision for the neotropics.

Melanagromyza obtusa and its host plant *Flemingia macrophylla* are exotic species for Colombia. Our report of a new parasitoid of the fly of the pigeon pea contributes to the knowledge of potential pest regulators which could be used in future programs of Integrated Pest Management.

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