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Notes and Comments

Hexacladia smithii Ashmead, 1891 (Hymenoptera: Encyrtidae) in Panama: first record and new association with *Berecynthus hastator* (Fabricius, 1798) (Hemiptera: Pentatomidae)

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Berecynthus hastator (Fabricius, 1798) is synonym of *Berecynthus delirator* (Fabricius, 1787) (Grazia and Hildebrant, 1982; Rider and Rolston, 1995), whose geographical distribution is limited to the neotropics. Currently, there are records of this species in Bolivia, Brazil, Costa Rica, Colombia, French Guyana, Mexico, Nicaragua, Peru, Puerto Rico, Suriname, Venezuela and Panama (Grazia et al., 2015; Segarra-Carmona et al., 2015; Cazorla and Moreno, 2020; Rider, 2021; Dellapé, 2021; GBIF, 2022). In Panama *B. hastator* was reported in Coco Solo, Province of Colon (09º 22' 21.43" N, 79º 52' 52.32" W), Puerto Armuelles (08° 39' 09" N, 82° 07' 24" W), Bayano (09° 06' 58" N, 78° 46' 24" W), Kobe (08º 55' N, 79º 34' W), Chorrera (08º 52' 49" N, 79º 47' W), Santiago (08º 07' N, 80º 59' W), Las Cumbres (09º 06' N, 79º 32' W) (Grazia and Hildebrant, 1982; GBIF, 2022). Adults of *B. hastator* were collected in Panama with light traps and its association with agricultural crops and uncultivated plants was not confirmed (GBIF, 2022); the voucher specimens were deposited in the collection of Texas A&M University, College Station, Texas, USA; Illinois Natural History Survey Insect Collection, Illinois, USA, and Smithsonian Tropical Research Institute, Panama (GBIF, 2022). The adults of *B. hastator* collected in Panama with of light traps and its association with agricultural crops and uncultivated plants were not confirmed (GBIF, 2022). The impact of *B. hastator* on crops of economic importance is limited; this insect is mentioned as a possible vector of *Phytomonas staheli* McGhee and McGhee, 1979 (Trypanosomatidae), a possible etiological agent of the "Marchitez Sorpresiva" in species of Arecaceae, among these *Cocos nucifera* L., *Elaeis guineensis* Jack (Segeren, 1982). In addition, the associations between *B. hastator* and *Gossypium hirsutum* L. and *Phaseolus* sp. (Tellez and Maes, 1991), *Oryza sativa* L. (Krinski, 2014; Rider, 2021), *Rottboellia cochinchinensis* (Lour.) Clayton (Haywood et al., 1994) and *Sabal mexicana* Mart. (Brailovsky et al., 1992) were confirmed.

Hexacladia smithii Ashmead, 1891 is a gregarious endoparasitoid present in the neotropics which develops in nymphs and adults of some species of Coreidae (Baldin et al., 2010), Pentatomidae (Santis, 1979; Corrêa-Ferreira et al., 1998) and Scutelleridae (Santis,1980). Records of *H. smithii* were confirmed in Brazil (Ashmead, 1891), Costa Rica (Noyes, 2010), Nicaragua (Noyes, 2010), Puerto Rico (Noyes, 2010), and Trinidad and Tobago (Burks, 1972; Noyes, 2010). Some species of economic importance such as *Arvellius albopunctatus* (DeGeer, 1773) (Panizzi and Silva, 2010), *Edessa meditabunda* (Fabricius, 1794) (Cuezzo and Fidalgo, 1997), *Euschistus heros* (Fabricius, 1798) (Corrêa-Ferreira et al., 1998) and *Diceraeus furcatus* (Fabricius, 1775) (cited as *Dichelops furcatus*, Panizzi and Silva, 2010), were parasitized by *H. smithii*, in the soybean crops (*Glycine max* L.) and tomato (*Solanum lycopersicum* L.) (Panizzi and Silva, 2010), among others. In Panama, there is limited information on new records of parasitoids and insects-pest of economic importance and the trophic associations they may present. Therefore, the confirmation of the biotic relationship between *H. smithii* and *B. hastator* is considered a relevant contribution to strengthening biological control and integrated pest management programs in emerging insects-pest.

Adults of *B. hastator* were randomly collected in 25 tomato plants (*S. lycopersicum* - Cultivar "IDIAP T-7") by means of insect aspirators adapted for the capture of parasitoids, during the periods of February 2017, March 2018 and February 2019. The experimental tomato plots of 50 m^2 were cultivated in a family farming system located in Cabra, Pacora, Panama (09º 07´ N, 79º 19´ W). Dr. Jocelia Grazia (Universidade Federal do Rio Grande do Sul) made the identification and confirmation of *B. hastator*. The diagnosis of this species indicates that the genus *Berecynthus* is close to *Dichelops* Spinola, *Padaeus* Stål, *Euschistus* Dallas (Grazia, 1978) and more recently to *Diceraeus* Dallas (Barão et al., 2020). *Berecynthus hastator* (Fabricius, 1798) is the only valid species of the genus, characterized by the clypeus

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longer than mandibular plates, differing from the other closer genera, except *Euschistus*, that includes some species with clypeus longer. The main differences of *Berecynthus* are found in the morphology of genitalia for both sexes (Figure 1). Voucher specimens collected in 2017 (3♀, 2♂) and 2018 (2♀, 1♂), were deposited in the collections of the Museum of Invertebrates G.B. Fairchild of University of Panama, Panama and the Laboratory of Entomological Systematics (LES) of the Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil (1♀, 2♂).

Adults of *B. hasator* collected in the experimental plots were separated and transferred to transparent plastic containers (7 cm x 5 cm x 5 cm) with a moistened paper towel at the base of the container and covered with a tulle fabric mesh. Individuals were separated into groups of approximately 10 adults of *B. hastator* per container, where they were fed peanuts, bean pods and a 90% honey solution, offered in small swabs of cotton. In order to maintain temperature, relative humidity, and constant photoperiod, the insects were transferred to regulated chambers at 28+2 ºC, 80% of relative humidity and 12 hours of photophase, located in the laboratory of Biological Pest Control of the Instituto de Innovación Agropecuaria de Panamá (IDIAP), in Chepo, Panama. Adults of *H. smithii* emerged from *B. hastator* were identified by Dr. Valmir Costa (Instituto Biológico, Campinas, SP, Brazil) following the key of Noyes (2010). This endoparasitoid presents reddish-brown color (Figure 2a) and the basitarsus of mid legs, in both sexes, a line of about 10 stout pegs ventrally. The male´s fore wing, post marginal vein at least 1.5 x as long as stigmal vein (Figure 2b), and the female's fore wing is characterized by the subapical infuscate area broadly connected to median infuscate band, costal cell with less than 10 setae dorsally and at least 2 or 3 setae ventrally, and postmarginal vein clearly longer than stigmal vein (Figure 2 c). Voucher specimens (5♀, 3♂) were deposited in the collections of the Museum of Invertebrates G.B. Fairchild of the University of Panama, Panama, and the Oscar Monte Collection of Entomophagous Insects (3♀, 4♂) (IBCBE-007229-007235) of the Instituto Biológico, Campinas, São Paulo, Brazil.

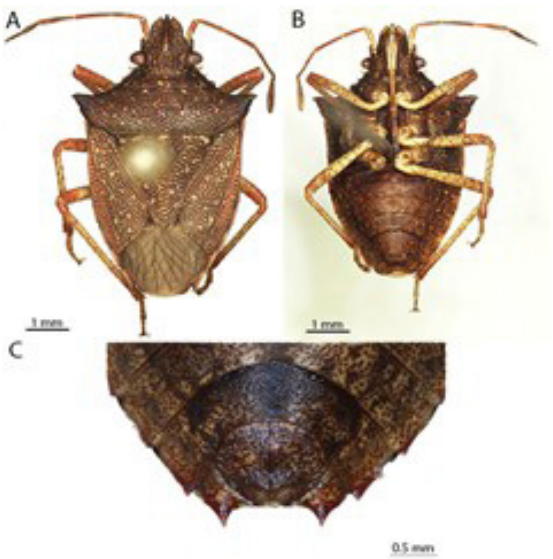

Figure 1. *Berecynthus hastator* (Fabricius, 1798) (Hemiptera: Pentatomidae). (a) body, dorsal view; (b) body, ventral view; (c) female genital plate. Photo: Dr. Lurdiana D. Barros.

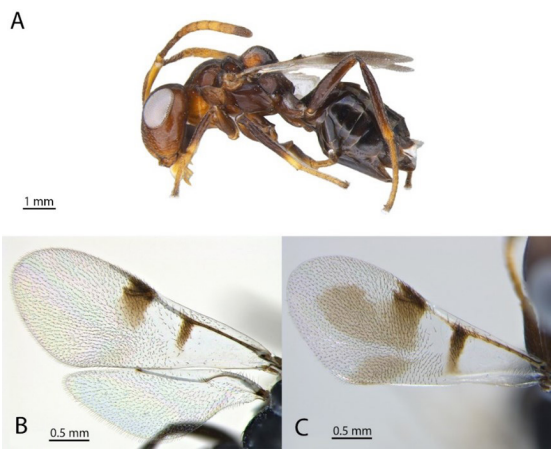

Figure 2. *Hexacladia smithii* (Ashmead, 1891) (Hymenoptera: Encyrtidae. (a) body, lateral view; (b) male fore wing; (c) female fore wing. Photo: Dr. Valmir A. Costa.

The circular holes caused by the emergence of adults of *H. smithii* in the abdomen of adults of *B. hastator* and the quantification of emerged adults of *H. smithii* allowed to calculate the rate of (%) natural parasitism.

% Parasitism = [(Total Parasitized Adults / Total Collected Adults) 100]

The natural parasitism of *H. smithii* in adults of *B. hastator*, over the years 2017, 2018 and 2019, was 39.13% (9/23), 56.25% (9/16), 38.09% (8/21), respectively. Therefore, the first report of *H. smithii* is considered a new trophic association between this endoparasitoid and *B. hastator*, for Panama. No damage caused by adults of *B. hastator* were observed on tomato plants. The data submitted by GBIF (2022) indicated that in Panama the collection of *B. hastator* were made by means of light traps, thus the trophic association "*S. lycopersicum* - *B. hastator*" was not confirmed. Noyes (2019) confirmed that there were no previous records of *H. smithii* in Panama, information that was validated by GBIF (2022). The relevance of the information presented strengthens the Pentatomidae species management programs, based on the adaptation and colonization of *H. smithii*, in the agroecological zones of Panama.

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