INSECTA MUNDI

A Journal of World Insect Systematics

0268

First report of *Delphastus quinculus* Gordon and *Diomus seminulus* (Mulsant) (Coleoptera: Coccinellidae) feeding on eggs and first-instar nymphs of *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae)

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Date of Issue: December 7, 2012

CENTER FOR SYSTEMATIC ENTOMOLOGY, INC., Gainesville, FL

G. González F., R. L. Bermudez and T. Kondo.
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Insecta Mundi 0268: 1–6

ZooBank registered urn:lsid:zoobank.org:pub:7A36CC95-71CD-42F0-A746-F1AC883A9E08

Published in 2012 by
Center for Systematic Entomology, Inc.
P. O. Box 141874
Gainesville, FL 32614-1874 USA
http://www.centerforsystematicentomology.org/

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INSECTA MUNDI 0268: 1-6 2012

First report of *Delphastus quinculus* Gordon and *Diomus seminulus* (Mulsant) (Coleoptera: Coccinellidae) feeding on eggs and first-instar nymphs of *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae)

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Abstract. *Delphastus quinculus* Gordon and *Diomus seminulus* (Mulsant) (Coleoptera: Coccinellidae) are reported for the first time feeding on eggs and first-instar nymphs of *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae). Diagnosis and illustrations are provided for both species. Updated information on their biology, hosts and geographical distribution is also provided.

Resumen. Se reportan a *Delphastus quinculus* Gordon y *Diomus seminulus* (Mulsant) (Coleoptera: Coccinellidae) por primera vez como depredadores de huevos y ninfas del primer instar de *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae). Las dos especies de coccinélidos se diagnostican y se ilustran en detalle. Se provee también información actualizada sobre sus biologías, hospederos y distribución geográfica.

Introduction

The invasive multicicatrices fluted scale (MFS), *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae), has become a serious pest on the Colombian islands of Providencia and San Andres (ICA 2010). The scale was first reported on the Colombian mainland from specimens collected in the departments of Antioquia, Tolima and Valle del Cauca, from which they appeared to have reached the San Andres Island on infested ornamental plants (Kondo et al. 2012). This highly polyphagous scale has been reported on 95 host plants including palms, leguminous trees, many ornamental plants and tropical fruit trees, such as avocado, citrus, coconut, guava, jackfruit, mango, and soursop (Kondo et al. 2012). On mainland Colombia, it has been reported as a pest of mango in the department of Tolima (Kondo 2001, as *Icerya brasiliensis*; Kondo and Unruh 2009), and causing stunted growth on soursop in the department of Valle del Cauca (Kondo 2008, as *Crypticerya* sp.). On San Andres Island, high infestations of the MFS are common on palm trees, which leaves are usually covered by sooty mold which grows on the insects' excreted honeydew (Kondo et al. 2012). Defoliation and dieback of urban trees, particularly *Erythrina variegata* L. and *Pithecellobium dulce* (Roxb.) Benth.), have been also observed on that island (Kondo et al. 2012). The natural enemies that help keeping the MFS populations under control in the mainland have not been observed on Providencia and San Andres islands. Only two natural enemies have been reported from San Andres Island, namely a fungus *Paecilomyces* sp. (Eurotiales: Trichocomaceae) (Quiroga et al. 2011) and one unidentified chrysopid lacewing (Kondo et al. 2012). In contrast, numerous natural enemies of the MFS have been reported in mainland Colombia, including at least two hymenopteran parasitoids, a phorid fly, a lacewing, and two small partially identified coccinel-

lids from the genera *Delphastus* Casey (Microweiseinae: Serangiini) and *Diomus* Mulsant (Scymninae: Diomini) (Kondo et al. 2012). Herein we identify these two coccinellids as *Delphastus quinculus* Gordon and *Diomus seminulus* (Mulsant). For a better recognition of these species, illustrations and general features are provided. Information on their hosts and distribution are also provided. Finally, we briefly discuss the potential use of these ladybird beetles as biological control agents for the control of the MFS on the islands of Providencia and San Andres.

Materials and Methods

A natural occurring infestation of the MFS on leaves of an unidentified palm tree planted within Corpoica, Palmira Research Station, was monitored for natural enemies. MFS infested leaves were marked with yellow plastic tape, and examined periodically. When the coccinellids were detected in the field, the leaves with the MFS and the coccinellids were cut with garden scissors and taken to the laboratory for observation under a Nikon SMZ-445 stereo-microscope. Some of the ovisacs of the MFS were cut open with the aid of sharp forceps. The coccinellids were collected using small brushes and put into 70% alcohol.

The extraction of genitalia and species identification of the two coccinellids was carried out by the first author. The genitalia of the coccinellids were extracted by macerating the abdomens in 10% KOH solution inside a glass tube submerged in hot water for 20–30 minutes, and later washed with distilled water. Components of the genitalia were separated under the microscope using insect pins and slide-mounted in glycerin on glass slides in order to photograph the important morphological features. For subsequent storage, the genitalia were put into micro vials filled with glycerin and attached to the insect pin of the specimen from which they were extracted. Both male and female specimens were dissected.

Depository. Specimens are deposited at the insect collections of Guillermo González, Santiago, Chile (CPGG) and Corpoica, Palmira Research Station (ECCP).

Results and Discussion

Delphastus quinculus Gordon (Fig. 1–2)

Delphastus quinculus Gordon 1994: 120.

Material studied. (N=8). **Colombia:** Valle del Cauca, Palmira, Corpoica, Palmira Research Station, 03°30'34"N, 76°19'02"W, 1004 m a.s.l., 28.vii.2010, coll. Rodrigo López B., ex. feeding on eggs and nymphs inside ovisac of *Crypticerya multicicatrices*, on undetermined palm, 3 dissected specimens (1 adult male + 2 adult females); and 3 not dissected specimens (CPGG). 2 male voucher specimens in alcohol (ECCP).

General Features. Length 1.3 to 1.4 mm. Oval, shiny, dark brown to black in color. Prosternum, legs and abdomen reddish brown. Pronotal punctuation large and conspicuous, elytral punctuation very hard to see. Examination of the genitalia (of males and/or females) is needed for a correct identification, since in Colombia there are 5 species in this genus, all with very similar external morphology. In females, apex of spermatheca with a row of 5 to 8 spicules. In males, genitalia are characterized by a long, slender, basal lobe and short parameres, which are narrow in lateral view (Gordon 1994).

Known hosts. *Aleurocanthus woglumi* Ashby (Gordon 1994) (Hemiptera: Aleyrodidae); *Pinnaspis aspidistrae* (Signoret) and *Pinnaspis strachani* (Cooley) (Hemiptera: Diaspididae) at a lemon orchard (Miró and Castillo 2010); and *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae) (present study).

Note. According to Reyes et al. (2010), studies conducted on *D. pusillus* (LeConte) on *T. vaporariorum* by Garcia et al. (2005) and Perez et al. (2008) are misidentifications of *D. quinculus*. Until the work by Gordon (1994), species with glabrous, shiny elytra and an elongate tegmen were commonly misidentified as the North American species, *D. pusillus*, which does not occur in Colombia, and this trend continued

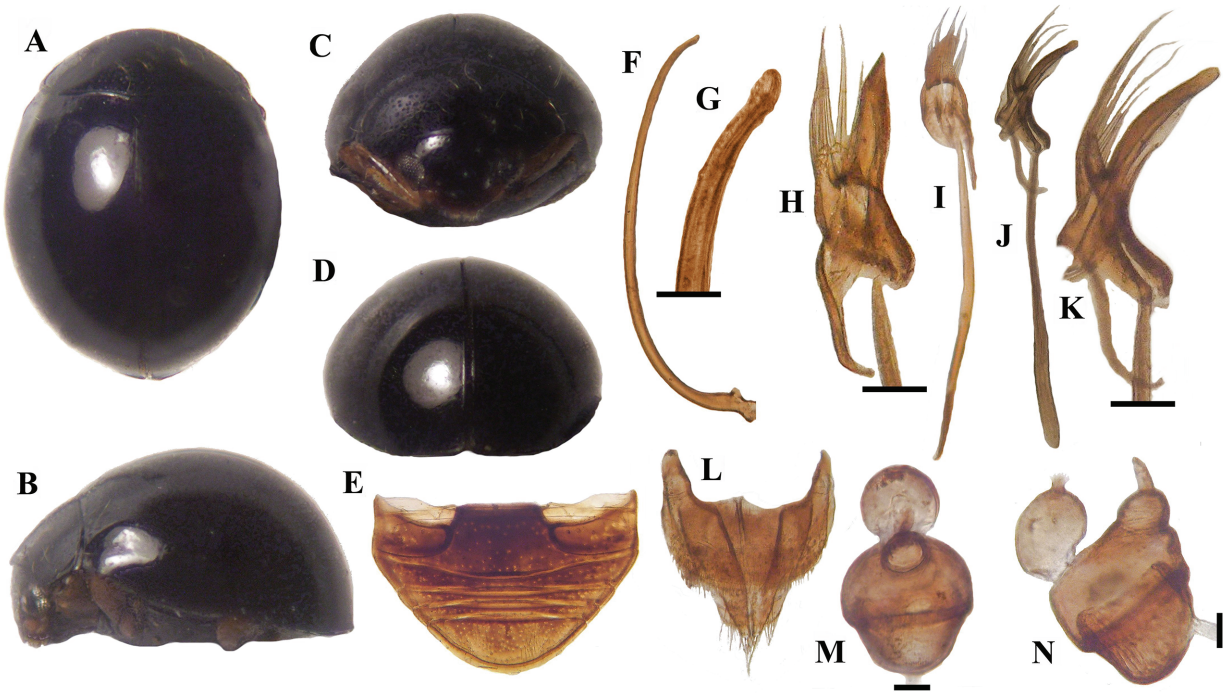

Figure 1. D*elphastus quinculus* Gordon. **A–D:** habitus; **E:** abdomen (ventral view); **F–G:** male sipho; **H–K:** male tegmen; **L:** female coxites; **M–N:** female spermatheca. Photos by G. González.

because of unfamiliarity with Gordon's work. Through the examination of female genitalia, Gordon (1994) discovered the presence of multiple species with similar morphology, including *D. quinculus*. Thus, the species identified as *D. pusillus* in Colombia could correspond either to *D. quinculus* or *D. argentinicus* Nunenmacher, which are species that are very hard to distinguish by external morphology or on the male genitalia alone.

Distribution. Colombia, Cuba, Ecuador, Peru, Trinidad, Venezuela (Gordon 1994).

Biology. Members of the genus *Delphastus* are known to prey upon whiteflies (Aleyrodidae) and armored scales (Diaspididae) (Gordon 1985). In the present study, we found individuals of *D. quinculus* preying upon eggs and first-instar nymphs of the MFS (Monophlebidae). In order to reach the eggs and newly hatched first-instar nymphs of the MFS, the adult beetles eat through the ovisac of the adult female (Fig. 2). Sometimes several beetles were found within one ovisac. A second species of coccinellid also was found within the ovisacs of the MFS (see below).

***Diomus seminulus* (Mulsant) (Fig. 3)**
Scymnus (*Diomus*) *seminulus* Mulsant 1850: 954.
Diomus seminulus: Gordon 1999: 151.
For a complete synonym list see Gordon (1999).

Material studied. (N=2). **Colombia:** Valle del Cauca, Palmira, Corpoica, Palmira Research Station, 03°30'34"N, 76°19'02"W, 1004 m a.s.l., 28.vii.2010, coll. Rodrigo López B., ex. Feeding on eggs and nymphs inside ovisac of *Crypticerya multicicatrices*, on undetermined palm, 1 adult male specimen (CPGG). 1 male voucher specimen in alcohol (ECCP).

General features. Length: 1.5 to 2.2 mm. Body oval in shape, opaque in color, with thick and conspicuous punctuation, especially on elytra. Pilosity decumbent, abundant. Coloration variable, light brown, reddish brown or dark brown, but any of these colors may be combined on pronotum and elytra; some specimens with dark pronotum with margins of a lighter color; elytra may have longitudinal bands of a

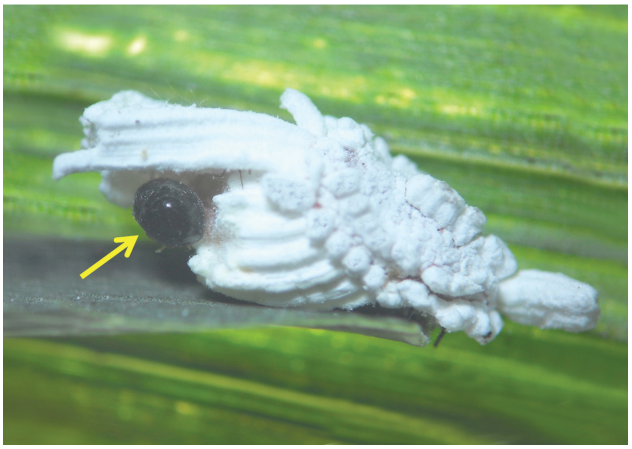

Figure 2. *Delphastus quinculus* Gordon (see arrow) feeding on eggs inside ovisac of *Crypticerya multicicatrices* Kondo and Unruh. Notice that the coccinellid has eaten part of the wax of the ovisac in order to get access to the eggs that are held inside it. Photo by R. López Bermúdez.

lighter color compared to margins. Completely jet black specimens are often female. Male genitalia are characterized by having a siphonal apex with a short filament about 1/5 length of sipho, and female genitalia are characterized by having a robust, c-shaped tubular infundibulum (Gordon 1999).

Note. Examination of the genitalia is crucial for correct identification of the species, since in Colombia there are 45 species known in this genus, many of which could be confused with some of the color morphs of *D. seminulus*.

Known hosts. *Tetranychus* sp. (Acari: Tetranychidae) and *Aleurodicus cocois* (Curtis) (Hemiptera: Aleyrodidae) on banana and plantain; *Lepidosaphes beckii* (Newman) (Hemiptera: Diaspididae), *Aphis spiraecola* Patch and *Toxoptera aurantii* (Boyer de Fonscolombe) (Hemiptera: Aphididae) on cherry (Miró and Castillo 2010); "Aphididae" (Gordon 1999); *Sipha flava* (Forbes) (Hemiptera: Aphididae) (Monteiro et al. 2011a,b,c); and *Crypticerya multicicatrices* Kondo and Unruh (Hemiptera: Monophlebidae) (present study).

Distribution: South America (Gordon 1999; González 2008).

Biology. *Diomus seminulus* is quite polyphagous, and is known to feed on mites, aphids, armored scales, whiteflies and now the MFS. Two specimens of *D. seminulus* were found inside ovisacs of the MFS, feeding on eggs and first-instar nymphs. Monteiro et al. (2011a) studied the longevity and oviposition rate of *D. seminulus* reared on the yellow sugarcane aphid, *Sipha flava*, at 24°C, 70 ± 10% relative humidity and 12h photophase. Adult males of *D. seminulus* were shown to live on average 110.8 days, with a range of 56 to 145 days, whereas adult females lived on average 106.4 days, with a range of 67 to 135 days. The preoviposition period of female beetles was 11 days. On average, each adult female of *D. seminulus* laid 70.7 eggs during its oviposition period. Peak oviposition occurred between the 20th and 50th day after adult emergence, and during this period 60% of all eggs were laid. Although 25% of the beetle pairs remained laying eggs after this peak, Monteiro et al. (2011a) did not recommend insect rearing at this stage because of the low egg production. Monteiro et al. (2011b) studied the longevity of the larval stages of *D. seminulus* fed with *S. flava* in glass containers (1.4 cm diameter and 2.4 cm high), kept in climate chambers at 16, 20, 24 and 28°C, 70 ± 10% relative humidity and 12h photophase. The average total duration of the larval stage decreased as temperatures increased, i.e., 46, 24.4, 16.2 and 14 days at 16, 20, 24 and 28°C respectively; the survival rate of the immature stages was 11, 32, 46 and 28%, at 16, 20, 24 and 28°C respectively; the best rearing temperatures for *D. seminulus* were 20 and 24°C. At 12 and 16°C, the eggs dried and darkened in color, with a viability of 0% and 29% respectively; egg viability at 20, 24 and 28°C was 67, 98 and 43% respectively; temperatures of 20 and 24°C were the most suitable for egg development (Monteiro et al. 2011c).

Conclusions

Both of these coccinellids, *D. quinculus* and *D. seminulus*, were found feeding on eggs and first-instar nymphs inside the ovisacs of *C. multicicatrices*. Of the two species, *D. quinculus* was the most common at the collection site. Because of their importance as predators of economically important pests, i.e., *D. quinculus* to control *T. vaporariorum* (Aleyrodidae) and *D. seminulus* to control *S. flava* (Aphididae), further studies on their biology should be carried out, which may help to mass rear these coccinellid

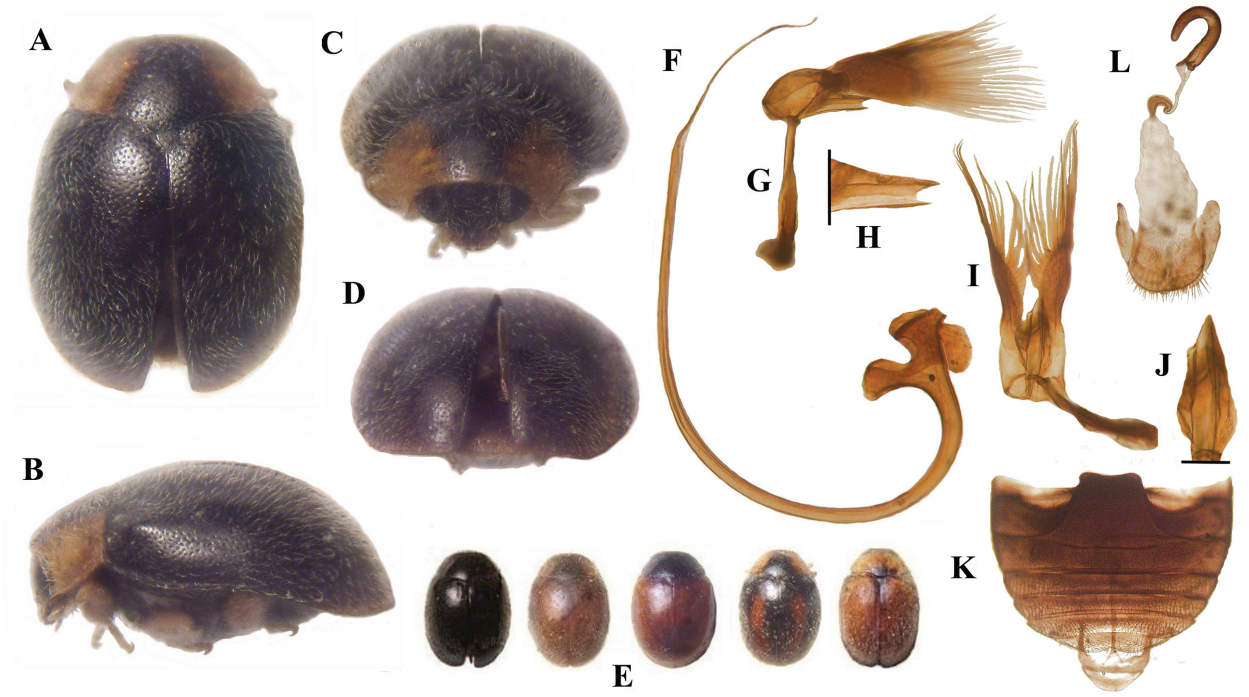

Figure 3. *Diomus seminulus* (Mulsant). **A–D:** habitus; **E:** Habitus variation; **F:** male sipho; **G–J:** male tegmen; **K:** abdomen; **L:** female genitalia. Photos by G. González.

species in the future. As suggested by Kondo et al. (2012), these coccinellids have a potential use within an integrated pest management program to target eggs and first-instar nymphs of *C. multicicatrices*.

Acknowledgment

We thank Dr. José Adriano Giorgi (Universidade Federal Rural de Pernambuco) for reviewing the text; and to Dr. Penny Gullan (Australian National University, Canberra) for reviewing earlier versions of the manuscript and for checking the English text.

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Received September 16, 2012; Accepted November 6, 2012.