DIAGNOSIS AND REPORT OF *Coccus moestus* DE LOTTO, 1959 (HEMIPTERA: COCCOMORPHA: COCCIDAE), A NEW RECORD FROM CUBA

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RESUMEN

La escama blanda *Coccus moestus* De Lotto, 1959 (Hemiptera: Coccidae) se registra por primera vez para Cuba. Los ejemplares fueron recolectados en la Ciénaga de Majaguillar, al noreste de la provincia de Matanzas, Cuba, sobre *Calophyllum antillanum* Britton (Calophyllaceae). La especie se diagnostica e ilustra con base en material colectado en este estudio. Se provee una clave taxonómica para separar las especies del género *Coccus* Linnaeus registradas en Cuba.
Palabras clave: Cóccido, Coccoidea, escama blanda, especie invasora, nuevo registro.

SUMMARY

The soft scale, *Coccus moestus* De Lotto, 1959 (Hemiptera: Coccidae), is newly recorded for Cuba. The species was collected at Majaguillar swamp in the northeastern part of Matanzas province on *Calophyllum antillanum* Britton (Calophyllaceae). The coccid is diagnosed and illustrated based on material collected in this study. A taxonomic key to separate the recorded species of the genus *Coccus* Linnaeus in Cuba is provided.
Keywords: Coccid, Coccoidea, new record, invasive species, soft scale.

INTRODUCTION

Scale insects (Coccomorpha) are considered among the world's major crop pests, being found in most ecosystems (Kondo *et al.* 2008). Their introduction to and establishment in new regions is a real threat to agricultural, natural and urban ecosystems. New invasive species are continuously being identified causing a negative impact in different biogeographical regions (Evans & Dooley 2013, Kondo *et al.* 2015, 2016, Mazzeo *et al.* 2014, Pellizzari & Germain 2010, Stocks 2013, 2015, Wyckhuys *et al.* 2013). The scale insect fauna (Hemiptera: Coccoidea) of Cuba consists of 177 species (176 spp. listed by Mestre *et al.* (2015) plus a newly recorded invasive species *Crypticerya genistae* (Hempel) (Mestre *et al.*, in press). In Cuba, the Coccidae, with 31 recorded species, represents the third most species-rich family of scale insects after the Diaspididae with 75 spp. and Pseudococcidae with 39 spp. (Mestre *et al.* 2015).

Recently, a soft scale insect, later identified as *Coccus moestus* De Lotto was collected in the localities of Guarina and San Mateo (the latter one takes the name of the Channel) at Majaguillar marsh which waters drains towards the sea (Caña 2010). In both localities there is a swamp forest (Capote & Berazaín 1984), with predominance of ornamental plants, young royal palms *Roystonea regia* (Kunth) O.F. Cook (Arecaceae) and a species of tree locally known as "ocuje", *Calophyllum antillanum* (Caña 2010). The Majaguillar marsh extends along the northern sector of the municipality of Martí, in the northeast of Matanzas province. It includes a

strip with a total area of 46.2 km^2 that has boundaries with Corralillo, Villa Clara province (east), up to the Roque channel (west) and has the largest water reserve in the territory (Caña 2010).

The genus *Coccus* Linnaeus, 1758 (Hemiptera: Coccomorpha: Coccidae) is represented in Cuba by four invasive species, namely, *Coccus capparidis* (Green), *Coccus hesperidum* Linnaeus, *Coccus longulus* (Douglas) and *Coccus viridis* (Green) (Mestre *et al.* 2015). All of these *Coccus* species are polyphagous and occur in all tropical and subtropical regions of the world, with the exception of *C. capparidis* that has hitherto not been recorded from the Afrotropical Region (García Morales *et al.* 2016). Herein we report an additional species, *Coccus moestus* De Lotto, for the first time for Cuba. A taxonomic key is provided to separate *C. moestus* from other species of *Coccus* reported in Cuba, based on the adult females. With the addition of this coccid, the list of Coccomorpha in Cuba is increased to 178 species.

METHODS

Samples were collected at two localities of Majaguillar Ciénaga, i.e., Guarina and San Mateo, located in the municipality of Martí, northeast of Matanzas province. The scale insect specimens were collected manually on the host and put into 70 % ethanol. Scale insect specimens were taken to the laboratory and slide-mounted according to the following procedure. Specimens were placed in 10 % KOH at room temperature for 24 hours; then they were placed under a stereomicroscope and body contents were removed by making a small incision with an insect pin and pressing the contents out with a small spatula and then rinsing the insect cuticle with distilled water until the body contents were completely removed. Next, the specimens were put into increasing concentrations of ethanol (75 % to 90 %) for dehydration of the insect cuticle and then transferred to triple Essig's solution for staining. Once stained, the cuticle was transferred to 90 % ethanol for 30 minutes and then into clove oil for another 30 minutes and finally placed in Canada balsam with a cover slip on the glass slide. Each slide was labeled soon after with its corresponding collecting data.

The species was diagnosed based on specimens collected in Cuba. Observations of the dermal structures were performed with a phase-contrast light microscope (Carl Zeiss-Axioskop 2) and digital images were taken with a digital camera coupled to the microscope (Axiocam). Measurements of the insect length and width were made on the images taken with a stereomicroscope (Carl Zeiss-Stemi SV6) using AxioVision software (see 3.1 software at 1300 $\times$ 1030 dpi.) and are given as a range.

For the insect drawing, the outline was drawn based on the images taken under the stereomicroscope and the details of the dermal structures were made based on the images taken under a phase contrast microscope, using the computer program Adobe Illustrator and a digital-drawing Wacom Tablet. Illustrations of the adult females show the dorsum on the left side and the venter on the right side following the traditional format used by scale insect taxonomists. The body length (measured at the longest point) and width (measured at the widest point) of the adult female are given in millimeters (mm) as mounted on the slide; all other measurements are given in microns (μm).

The soft scale insects (Coccidae) were identified using the taxonomic keys of Gill *et al.* (1977), Hamon & Williams (1984), and Williams & Watson (1990).

RESULTS AND DISCUSSION

Genus *Coccus* Linnaeus

Type species. *Coccus hesperidum* Linnaeus 1758: 455.

Key to the adult females of *Coccus* Linnaeus recorded in Cuba [adapted from Gill *et al.* (1977) and Williams & Watson (1990)].

1. Dorsal setae tapering, flagellate or with sharply-pointed apices . . . . . 2.
1' Dorsal setae cylindrical, not tapering, with apices rounded or clavate . . . . . 3.

2(1). Dorsal setae distinctly flagellate and curved. Ventral tubular ducts absent ..... *Coccus longulus* (Douglas).
2'. Dorsal setae spine-like, straight, with sharply-pointed apices. Ventral tubular ducts present *Coccus hesperidum* Linnaeus.
3(1'). Ventral tubular ducts absent from thorax, but with 4–13 present submarginally on areas of posterior abdominal segments on each side. Tibio-tarsal articulatory scleroses absent *Coccus capparidis* (Green.)
3'. Ventral thoracic tubular ducts present, absent from abdominal region. Tibio-tarsal articulatory scleroses present ..... 4.
4(3'). Dorsal tubular ducts present submarginally, numbering 24–30 around body; each dorsal tubular duct larger in size than ventral thoracic tubular ducts. Dorsal setae and minute discoidal pores distributed in a definite pattern leaving many bare areas, giving the dorsum an areolated pattern. Ventral tubular ducts each with a thin filament, much narrower than the duct. Antennae usually 8 segmented, sometimes 7 segmented with segment four partially articulated ..... *Coccus moestus* De Lotto.
4'. Dorsal submarginal tubular ducts absent. Dorsal setae and minute discoidal pores scattered evenly throughout, not forming an areolated pattern on dorsum. Ventral tubular ducts each with a thick filament, almost as wide as the duct. Antennae 7 segmented..... *Coccus viridis* (Green).

Notes. The above key should be used with caution since it will not work for *Coccus* species that have not been hitherto recorded from Cuba. The genus *Coccus* is distributed worldwide, especially in tropical regions, and currently contains 112 described species (García Morales *et al.* 2016). According to Williams & Watson (1990), much research is needed on species from southern Asia and the Neotropical region.

***Coccus moestus* De Lotto, 1959**

Material examined. Cuba. Matanzas. Majaguillar swamp: Guarina, 8.X.2011, coll. D. Reyes, ex *Calophyllum antillanum*, 8 adult ♀♀ (CZACC); San Mateo, 19.XI.2011, coll. D. Reyes, ex *Calophyllum antillanum*, 4 adult ♀♀ (CZACC).

Diagnosis. Adult female.

Field recognition. Insect body oval, slightly convex, yellowish-brown in color, covered with a thin layer of semitransparent wax.
Mounted material. (Fig. 1). Body outline oval; body 1.66–2.78 mm long, 0.90–1.67 mm wide.

Dorsum.
Derm entirely membranous or slightly sclerotized. Dorsal setae (dset) clavate, with rounded apices. Dorsal microducts (dmic) small, each with a long terminal filament. Setae and microducts present in a reticulated pattern, giving the dorsum an areolated pattern, less pronounced near body margins. Simple pores not detected. Dorsal tubular ducts (dtbd) present, each larger in size than ventral tubular ducts, totaling 22 to 24 around submargins, located on the limits of the dorsal reticulated pattern and lined in a perpendicular direction to body margin. Preopercular pores (prop) scarse, present in a midline on mid-dorsum anterior to anal plates. Dorsal tubercles (dtub) present, totaling 10 to 12 around body margins. Pocket-like sclerotizations absent. Anal plates (aplt) together quadrate, located at about 1/5 of body length from posterior margin, anterior margin slightly concave and shorter than posterior margin, each plate with 4 setae on dorsal surface of posterior end, anogenital fold with 2 setae. Anal ring with 10 setae (not illustrated).

Margin.
Marginal setae (mset) rather short, with fimbriate apices, straight to slightly bent, arranged in a single row, with 10–20 on each side between anterior and posterior stigmatic areas. Stigmatic clefts well developed, fairly deep, each with 3 robust spinose stigmatic setae (stgset), each straight to slightly bent, median seta longest, about 5 times longer than lateral setae. Eyes not detected.

Venter.
Derm entirely membranous. Pregenital discpores (pdp) each with 6–10 (mostly 10) loculi, present around vulvar area and across median

areas of posterior abdominal segments (segments VI–VIII). Spiracular disc-pores (spdp) each with 5 loculi, rarely a few pores with fewer or more loculi, present in a single irregular row extending laterally from each spiracle to body margin. Ventral microducts (vmic) more or less scattered evenly throughout. Ventral tubular ducts (vtbd) present, with a slender inner ductile (terminal filament), similar in length to outer ductule, each tubular duct with a well-developed gland present on area around mesothoracic and metathoracic coxae. Ventral setae (vset) slender, straight or slightly bent, short, sparse on a submarginal band; with 2 pairs of long interantennal setae and 3 pairs of long prevulvar setae. Spiracles rather small, with posterior peritremes relatively larger than anterior spiracular peritremes. Legs well-developed, with tibio-tarsal articulatory sclerosis, metathoracic legs usually largest; claws without a denticle; claw digitules, slender, knobbed; tarsal digitules knobbed, slightly longer than claw digitules. Antennae (ant) well developed, each 8 segmented, sometimes 7 segmented. Mouthparts well developed, with 4 pairs of labial setae.

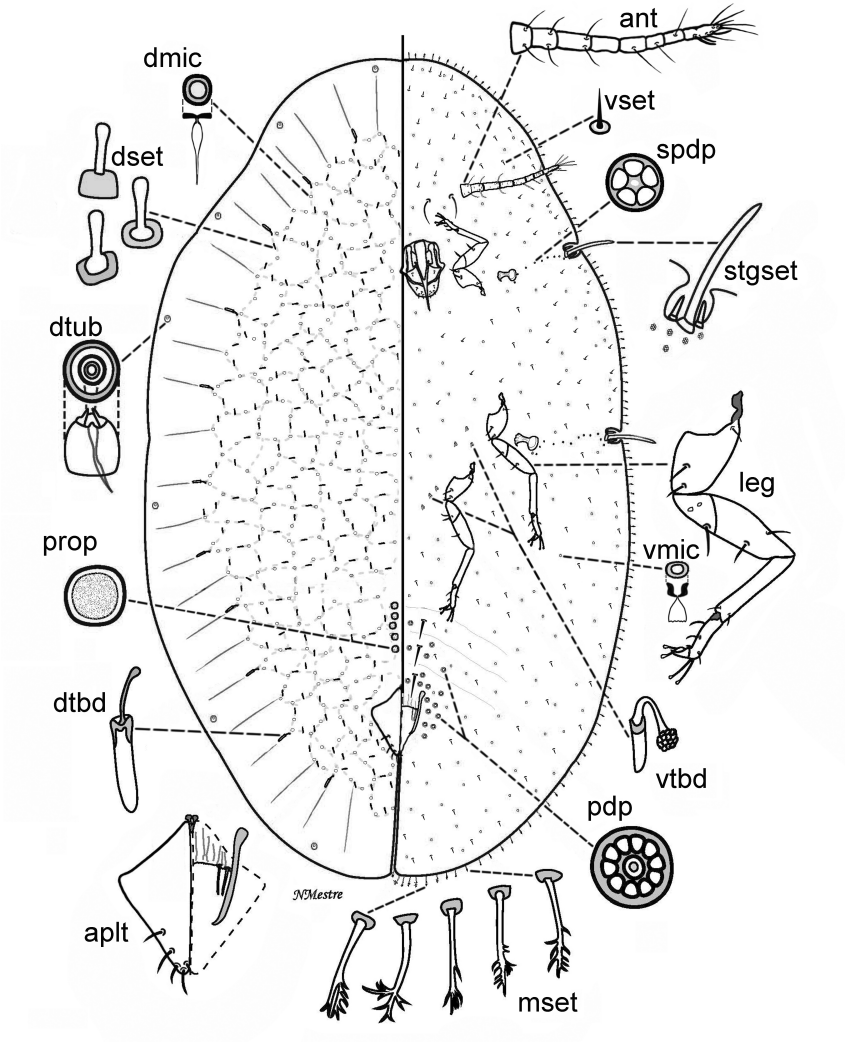

Figure 1. *Coccus moestus* De Lotto, adult female. Abbreviations as follows: ant = antenna; aplt = anal plate; dmic = dorsal microduct; dset = dorsal setae; dtbd = dorsal tubular duct; dtub =dorsal tubercle; mset = marginal setae; pdp = pregenital disc pore; prop = preopercular pore; spdp = spiracular disc pore; stgset = stigmatic setae; vmic = ventral microduct; vset = ventral seta; vtbd = ventral tubular duct.

Biogeographical distribution.
Afrotropical: Kenya, Tanzania, Zanzibar. **Oriental:** Bonin Islands (=Ogasawara-Gunto). **Oceania:** Federated States of Micronesia (Caroline Islands, Truk Islands), Guam, Palau, Vanuatu (=New Hebrides). **Neotropical:** Barbados, Costa Rica, *Cuba, Dominican Republic, Ecuador, Guadeloupe, Guyana, Haiti, Honduras, Jamaica, Puerto Rico & Vieques Island (Puerto Rico), Trinidad and Tobago (Trinidad). **Palearctic:** China; Japan (Beardsley 1966, 1975; De Lotto 1959; García Morales *et al.* 2016; Gill *et al.* 1977; Miller *et al.* 2014; *Present study).

Host plants.
Anacardium occidentale L., *Mangifera indica* L. (Anacardiaceae), *Artocarpus altilis* (Parkinson) Fosberg, *Artocarpus* sp. (Moraceae), *Asplenium nidus* L. (Aspleniaceae), *Bactris* sp. (Arecaceae), **Calophyllum antillanum* Britton, *C. inophyluum* L. (Calophyllaceae), *Drypetes integerrima* (Koidz.) Hosok. (Putranjivaceae), *Hibiscus* sp. (Malvaceae), *Syzygium* sp. (Myrtaceae), *Nephelium* sp. (Sapindaceae), *Persea americana* Mill. (Lauraceae), *Scaevola* sp. (Goodeniaceae) (Beardsey 1975, García Morales *et al.* 2016, Miller *et al.* 2014, *Present study).

Remarks.
Coccus moestus is a newly introduced species to Cuba. The species is likely of African origin (De Lotto 1959, Beardsley 1966, 1975). De Lotto (1959) listed as a host of *C. moestus* the "clove tree (*Eugenia* sp.)" as a plant host; however, this has been changed above to *Sysygium* sp., because the clove tree "*Syzygium aromaticum*" used to be classified in the plant genus *Eugenia*. In Peru it is considered a plant quarantine pest (SENASA 2016). *Calophyllum antillanum* is a new host species for *C. moestus*, but this coccid was recorded from *C. inophyllum* in Pohnpei Island (Federated States of Micronesia) by Beardsley (1975). The adult female of this species has been described and well-illustrated by De Lotto (1959), Beardsley (1966), Gill *et al.* (1977) and Williams & Watson (1990).

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LITERATURE CITED

Beardsley, J.W. 1966. Insects of Micronesia. Homoptera: Coccoidea. *Insects of Micronesia* 6: 377-562.

Beardsley, J.W. 1975. Insects of Micronesia. Homoptera: Coccoidea. Supplement. *Insects of Micronesia* 6: 657-662.

Capote, R & R. Berazaín. 1984. Clasificación de las formaciones vegetales de Cuba. *Revista del Jardín Botánico Nacional, Cuba* 5: 27-75.

Caña, D. 2010. Planificación estratégica para la sostenibilidad del desarrollo local en el municipio de Martí. *M.Sc. Thesis. Facultad de Ingeniería Química y Mecánica. Universidad de Matanzas "Camilo Cienfuegos", Cuba.*

De Lotto, G. 1959. Further notes on Ethiopian species of the genus *Coccus* (Homoptera: Coccoidea: Coccidae). *Journal of the Entomological Society of Southern Africa* 22: 150-173.

Evans G. & J. Dooley. 2013. Potential Invasive Species of Scale Insects for the USA and Caribbean Basin. Pp. 320-341, in *Potential Invasive Pests of Agricultural Crops* (J. Peña, ed.). CAB International, Wallingford, UK.

García Morales, M., B. D. Denno, D. R. Miller, G. L. Miller, Y. Ben-Dov & N. B. Hardy. 2016. ScaleNet: A literature-based model of scale insect biology and systematics. Database. doi: 10.1093/database/bav118. http://scalenet.info. (checked 02/01/2017).

Gill, R. J. 1988. The scales insects of California. Part 1. The soft scales (Homoptera: Coccoidea: Coccidae). California Department of Food and Agriculture. Sacramento, California, USA.

Gill, R. J., S. Nakahara & M. L. Williams. 1977. A review of the genus *Coccus* Linnaeus in America North of Panama (Homoptera: Coccoidea: Coccidae). *Occasional Papers in Entomology* No. 24. California Department of Food and Agriculture. Sacramento, California, USA.

Hamon, A. B. & M. L. Williams. 1984. The soft scale insects of Florida (Homoptera: Coccoidea: Coccidae). *Arthropods of Florida and Neighboring Lands Areas*. Florida Department of Agriculture & Consumer Service, Division of Plant Industries, Gainesville, FL, USA.

Kondo, T., P. J. Gullan & D. J. Williams. 2008. Coccidology. The study of scale insects (Hemiptera: Sternorrhyncha: Coccoidea). *Corpoica – Ciencia y Tecnología Agropecuaria* 9: 55-61.

Kondo, T., P. J. Gullan, G. W. Watson, A. E. Bustillo & L. G. Montes. 2015. New distribution and host records for white coconut scale, *Parlagena bennetti* Williams (Hemiptera: Diaspididae). *Insecta Mundi* 0422: 1-6.

Kondo, T., P. J. Gullan, A. L. Peronti, A. A. Ramos-Portilla, A. Caballero & N. Villarreal-Pretelt. 2016. First records of the iceryine scale insects *Crypticerya brasiliensis* (Hempel) and *Crypticerya genistae* (Hempel) (Hemiptera: Monophlebidae) for Colombia. *Insecta Mundi* 0480: 1-9.

Mazzeo, G., S. Longo, G. Pellizzari, F. Porcelli, P. Suma & A. Russo. 2014. Exotic scale insects (Coccoidea) on ornamental plants in Italy: a never-ending story. *Acta Zoologica Bulgarica* Suppl. 6: 55-61.

Mestre, N., A. B. Hamon, G. Hodges & T. Kondo. 2015. Lista de insectos escama (Hemiptera: Sternorrhyncha: Coccoidea) de Cuba. *Poeyana* 500: 33-54.

Mestre, N., J. L. Fontenla, T. Kondo & A. Álvarez. 2017. *Crypticerya genistae* (Hempel) (Hemiptera: Monophlebidae) nuevo registro de insecto escama invasor para Cuba. *Fitosanidad* (in press).

Miller, G. L. & D. R. Miller. 2003. Invasive soft scales (Hemiptera: Coccidae) and their threat to U.S. Agriculture. *Proceedings of the Entomological Society of Washington* 105: 832-846.

Miller, D. R., G. L. Miller, G. S. Hodges & J. A. Davidson. 2005. Introduced scale insects (Hemiptera: Coccoidea) of the United States and their impact on U.S. Agriculture. *Proceedings of the Entomological Society of Washington* 107: 123-158.

Miller, D., A. Rung, G. Parikh, G. Venable, A. J. Redford, G. A. Evans, & R. J. Gill. 2014. Scale Insects, Edition 2. USDA APHIS Identification Technology Program (ITP). Fort Collins, CO. http://idtools.org/id/scales/ (checked 02/01/2017).

Pellizzari, G. & J. F. Germain. 2010. Scales (Hemiptera, Superfamily Coccoidea). Chapter 9.3. Pp. 475-510, in *Alien terrestrial arthropods of Europe. BioRisk* (A. Roques, M. Kenis, D. Lees, C. Lopez-Vaamonde, W. Rabitsch, J-Y. Rasplus & D. B. Roy, eds.). Pensoft, Sophia, Bulgaria.

SENASA (Servicio Nacional de Sanidad Agraria). 2016. Lista de plagas cuarentenarias no presentes en el Perú. Ministerio de Agricultura y riesgo. La Molina, Lima, Perú. 40 p. http://www.senasa.gob.pe/senasa/wp-content/uploads/2014/12/Lista-de-plagas-cuarentenarias-agosto-2016.pdf. (checked 02/01/2017).

Stocks, I. 2013. Recent Adventive Scale Insects in Florida and the Caribbean Region. Pp. 342-362, in *Potential Invasive Pests of Agricultural Crops* (J. Peña, ed.). CAB International, Wallingford, UK.

Stocks, I. 2015. *Fiorinia proboscidaria* Green (Hemiptera: Diaspididae), a new armored scale pest of citrus in Florida. Pest Alert. FDACS-P-02033. http://www.freshfromflorida.com/content/download/51395/1116140/PEST_ALERT_fiorinia_proboscidaria.pdf. (checked 02/01/2017).

Williams, D. J. & G. W. Watson. 1990. The Scale Insects of the Tropical South Pacific Region. Pt. 3: The soft scales (Coccidae) and other families. CAB International, Wallingford, UK.

Wyckhuys, K.A.G., T. Kondo, B. V. Herrera, D.R. Miller, N. Naranjo & G. Hyman. 2013. Chapter 21. Invasion of exotic arthropods in South America's biodiversity hotspots and agro-production systems. Pp. 373-400, in *Potential Invasive Pests of Agricultural Crops* (J. Peña ed.). CAB International, Wallingford, UK.

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