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The scale insect (Hemiptera: Coccomorpha) collection of the entomological museum "Universidad Nacional Agronomía Bogotá", and its impact on Colombian coccidology

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Abstract. Acquisition of local and global biodiversity knowledge demands immediate and long-term efforts, both tutoring new generations of taxonomists and establishing, maintaining and improving research collections. Through biodiversity studies, the entomological museum "Universidad Nacional Agronomía Bogotá" (Bogotá, Colombia) has been developed and has built up a substantial collection of scale insects (Hemiptera: Coccomorpha), with 7,052 slide-mounted specimens and close to 800 alcohol-preserved samples representing 115 species belonging to 59 genera and nine families. This insect group is exclusively phytophagous, and many species are pests on economically important crops in Colombia. Curation of scale insect specimens includes slide mounting, identification, cataloging and databasing. Ecological and geospatial analyses of field data have identified insect-host interactions, and areas of the country where new field collections should be made. Host-insect interaction analysis has shown that coffee is the host-plant with the largest number of associated scales, *Rhizoecus cacticans* (Hambleton, 1946) and *Rh. colombiensis* Ramos & Caballero, 2016 are the scale species with the largest host-plant range; and *Geococcus coffeae* Green, 1933 and *Puto barberi* (Cockerell, 1895) are the commonest scale species. Altitudinal and geographic distribution analysis have shown that sampling efforts have been concentrated in the central region, while the northern and southeastern regions of Colombia have been poorly collected. These analyses provide a guideline for future studies, such as which zones should be sampled and which host-plant species have information gaps in their documented distributions and scale insect-host interactions. The museum's large number of specimens, species diversity representation and rich associated biological data indicate that the scale insect collection of the "Universidad Nacional Agronomía Bogotá" entomological museum is the most important in Colombia.

Key words. Alpha taxonomy, biodiversity conservation, Neotropical, South America, Sternorrhyncha.

INTRODUCTION

The scale insects (Hemiptera: Sternorrhyncha: Coccomorpha) are comprised of 55 families (20 of them extinct) and more than 8,000 extant species worldwide (García Morales et al. 2016). In Colombia, 252 species have been recorded, representing 13 families, with hosts in more than 40 plant families. The scale insect families with the greatest diversity are Diaspididae (with 32% of recorded species), followed by Pseudococcidae (26%), Coccidae (17%) and Rhizoecidae (10%) (García Morales et al. 2016).

The Coccomorpha is an important group due to its economic impact on agriculture worldwide (Kondo 2001; Gullan & Martin 2003). In Colombia, over 100 species have been recorded attacking crops such as avocado (*Persea americana* Mill., 1768), banana (*Musa paradisiaca* L., 1753), cacao (*Theobroma cacao* L., 1753), coffee (*Coffea arabica* L., 1753), sugarcane (*Saccharum officinarum* L., 1753), citrus (*Citrus* sp..), oil palm (*Elaeis guineensis* Jacq., 1763), mango (*Mangifera indica* L.,

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1753) and cassava (*Manihot esculenta* Crantz, 1766) (Figueroa 1977; Castillo & Bellotti 1990; Gallego & Vélez 1992; Kondo 2001; Kondo et al. 2008; Caballero et al. 2017, 2019; Ramos-Portilla & Caballero 2017). At the international level, several scale insect species are considered to be quarantine pest risks by the Colombian phytosanitary protection organization, Instituto Colombiano Agropecuario (ICA). Its Resolution 3593 (Instituto Colombiano Agropecuario 2015) includes scale insects such as *Aonidiella aurantii* (Maskell, 1879), *Comstockaspis perniciosa* (Comstock, 1881) and *Aulacaspis rosae* (Bouché, 1833) (Diaspididae), *Eulecanium tiliae* (L., 1758) (Coccidae), *Icerya aegyptiaca* (Douglas, 1890) and *I. seychellarum* (Westwood, 1855) (Monophlebidae), and *Maconellicoccus hirsutus* (Green, 1908) and *Pseudococcus calceolariae* (Maskell, 1879) (Pseudococcidae). As endemic quarantine pest risks, the following scale insects were mentioned: *Coccus hesperidum* L., 1758, *Saissetia coffeae* (Walker, 1852), *Icerya purchasi* Maskell, 1879 and *Selenaspidus articulatus* (Morgan, 1889) (Instituto Colombiano Agropecuario 2015).

The chronology of coccidology in Colombia

The first scale insect species described from Colombia was *Coccus caudatus* by F. Walker in 1852, based on a male specimen. It came from a personal collection without information on its host or locality and is conserved in the British Museum (Natural History) in London, U.K. (Walker 1852). Coccomorpha studies in Colombia began in 1929, when F. Laing described *Crenulaspidiotus maurellae* and *Acanthococcus tucurincae* from samples collected in Magdalena department (Laing 1929). The entomologist L. Murillo was the first Colombian to describe a scale insect species, *Puto antioquensis* from samples taken on roots of *Coffea arabica* in the department of Antioquia (Murillo 1931). Over the next two decades, 23 new species from various departments of Colombia were described by F. Laing, E. Hambleton, N. S. Borchsenius, R. Mamet and A. S. Balachowsky (Laing 1929; Hambleton 1946; Mamet 1954; Balachowsky 1957, 1959a, b; Beardsley 1986; Williams & Granara de Willink 1992; Gimpel & Miller 1996;).

The Russian-born French entomologist A. S. Balachowsky was one of the most important contributors to the coccidology of Colombia. He published descriptions of 16 species of Diaspididae, Eriococcidae, Pseudococcidae and Rhizoecidae. He also provided information from samples he collected when visiting Colombia in the 1950s and his slide-mounted specimens are conserved in the Muséum National d'Histoire Naturelle in France (Balachowsky 1957, 1959a, b). The first Colombian entomologist to conduct pioneering scale insect inventories for the country was A. Figueroa: he listed five families, 34 genera and 53 species, including new records and lists of host plants (Figueroa 1946, 1952, 1977). So far, there is no information regarding the whereabouts of his collection (Caballero et al. 2017). Figueroa was followed by F. Mosquera, who published two important papers about the genus *Ceroplastes* (Coccidae) in Colombia, in which he listed seven species, six of them presented as new (Mosquera 1979, 1984). Slide-mounted specimens representing those species are currently preserved in the Colección Taxonómica Nacional de Insectos "Luis Maria Murillo" (Colombia).

The last part of the 20th century was characterized by important efforts on the recognition of species in Colombia, carried out by several national and international researchers. Castillo & Bellotti (1990) listed mealybugs (Pseudococcidae) associated with cassava, from which slide-mounted specimens are preserved in the International Center of Tropical Agricultural (CIAT) collection. Likewise, Gallego & Vélez (1992) increased the number of families, genera and species of Coccoidea recorded, particularly for the families Diaspididae, Pseudococcidae and Coccidae. In the same year, Williams & Granara de Willink (1992) listed and described eight species of mealybugs (Pseudococcidae, Putoidae and Rhizoecidae) from Colombia. Posada (1989), in his treatise on insects in agriculture, updated the species list of Coccoidea for Colombia to 114 taxa (93 of them to species level), associated with more than 60 economically important crops.

In the 21st century, Colombian coccidology has been characterized by a new insight. Through reviewing previous contributions, the coccidologist Dr. Takumasa Kondo has led the investigation in Colombia and in the world, publishing more than 120 peer-reviewed papers. He has been working constantly to update the list of scale insects in the country, and has described more than 50 new species, 14 of them from specimens collected in Colombia: *Akermes colombiensis* Kondo & Williams, 2004, *Austrotachardiella colombiana* Kondo & Gullan, 2005, *Leptococcus rodmani* Kondo, 2008, *Neotoumeyella caliensis* Kondo & Williams, 2009, *Crypticerya multicicatrices* Kondo & Unruh, 2009, *Bombacoccus aguacatae* Kondo, 2010, *Cryptostigma philwardi* Kondo, 2010, *Foldilecanium multisetosum* Kondo, 2011, *Hemilecanium guanabana* Kondo & Hodgson, 2013, *Toumeyella coffeae* Kondo, 2013, *Pulvinaria caballeroramosae* Tanaka & Kondo, 2015, *Capulinia linarosae* Kondo & Gullan, 2016, *Cryptinglisia corpoica* Kondo & Montes, 2018, *Cryptinglisia ica* Montes & Kondo, 2018 (Kondo & Williams 2004, 2009; Kondo & Gullan 2005, 2008; Kondo & Unruh 2009; Kondo 2010a, b, 2011, 2013; Kondo & Hodgson 2013; Tanaka & Kondo 2015; Kondo et al. 2016a, 2018).

The Entomological Museum UNAB and its scale insect collection

The northernmost region of South America, the so-called Tropical Andes Hotspot, is considered to be the most

biodiverse region on Earth (Conservation International 2005), and this richly biodiverse realm is under persistent threat from human activities such as mining, timber extraction, oil exploration, extensive monocrop cultivation, and illegal trafficking of fauna and flora (FAO 2019). In order to preserve and study that biodiversity, specialized insect collections in universities play an essential role in training new generations of entomologists. In 2001, the Faculty of Agronomy (FA) at the Universidad Nacional de Colombia, Bogotá, designated the "Universidad Nacional Agronomía Bogotá" (UNAB) museum as a "*Scientific Center for research and student learning of Insect Systematics*" related to agriculture (Sistema de Patrimonio Cultural y Museos 2008). One of the greatest achievements at the UNAB museum is the collection and curation of close to 180,000 dry-mounted specimens, 18,400 larvae and adults preserved in alcohol, and 10,430 slide-mounted specimens as follows (rounded numbers): Coccomorpha (7000 slides), Collembola (1700), Aphidomorpha (1400), Aleyrodomorpha (500), Thysanoptera (90), Acari (90) and Psyllomorpha (50 slides). Overall, the museum's collections represent 4,000 species, 150 families, and 19 insect orders (Serna et al. 2017).

In the last five years there has been a notable effort to build the Scale Insect Collection at UNAB (hereafter referred SIC-UNAB) to become the most important collection of this insect group in the country and one of the most important in South America. This development is derived from undergraduate and graduate theses and studies and has contributed to the knowledge of Colombian scale insect biodiversity with descriptions of new species and new collection records. Moreover, the SIC-UNAB has received contributions by recognized coccidologists like Douglass Miller (USDA Animal and Plant Health Inspection Service, U.S.A.), Pennelope Gullan (Australian National University, Australia), Takumasa Kondo (Corporación Colombiana de Investigación Agropecuaria, Colombia), Lucía Claps and Patricia Gonzalez (Universidad Nacional de Tucumán, Argentina), Bora Kaydan (Çukurova University, Turkey) and Ana Lucia Peronti (São Paulo State University, Brazil).

In view of the economic impact of scale insects and the lack of knowledge about their diversity in Colombia, our aim is to present the status of the SIC-UNAB and acquaint the coccidologist community with the most important scale insect collection in Colombia and one of the most important in South America. Furthermore, our intention is to encourage coccidologists to consider the SIC-UNAB as a partner to develop new taxonomic studies and specimen exchanges.

MATERIALS AND METHODS

The specimens deposited in the SIC-UNAB are composed mainly of insect samples collected by students and specialists from the Universidad Nacional de Colombia. The two most significant sources of samples are from (1) Dr. Andrea Ramos working in partnership with Instituto Colombiano Agropecuario (ICA), and (2) the sampling conducted by the Centro de Investigación del Café (Cenicafé). The first covered 12 departments of Colombia focused on the main economically important crops (i.e., *Musa* sp., *Theobroma cacao*, *Coffea* sp., *Citrus* sp. and *Saccharum officinarum*). The second was carried out in seven departments and aimed to record the scale insects associated with coffee roots. Other sources of samples include the Corporación Colombiana de Investigación Agropecuaria (Agrosavia), the Banana Association of Colombia (AUGURA), Bogotá Botanical Garden "Jose Celestino Mutis", and exchanges with national and international entomological museums.

The first scale insect slides were made using different protocols, such as those standardized by Williams & Granara de Willink (1992) and the Systematic Entomology Laboratory (2015), U.S. Department of Agriculture, Beltsville, MD, U.S.A. Since 2016, SIC-UNAB has switched to a modification of the method established by Sirisena et al. (2013), as the process is faster and avoids the use of some carcinogenic compounds (xylene and phenol). All samples are preserved as permanent slide-mounts in Canada balsam.

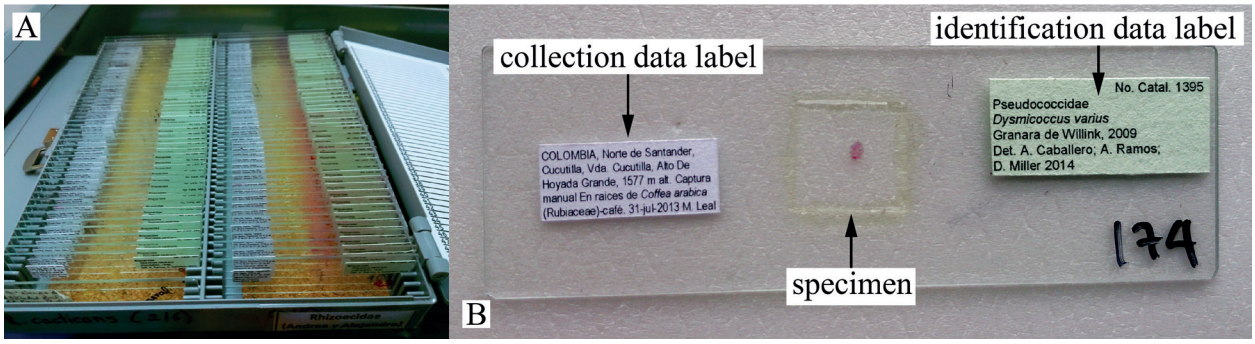

Fig. 1. A. Slide holder with samples curated. **B**. Slide of a curated sample, showing the arrangement of collection and identification data labels and specimen.

Identifications and imaging have been carried out using a Nikon Eclipse E600 and Zeiss Axio Lab.A1 phase contrast compound microscopes, a Lumenera Infinity 1-5C and Axiocam ERc 5s microscope cameras, and the photograph editing software Image-Pro Insight version 8.0. Taxonomic determinations are supported by publications, comparisons with voucher specimens and specialist corroborations. The data systematization is made using Microsoft Excel 2017® software.

Curatorship is based on the protocol given by Martínez-Alava & Serna (2015). The scale insect database is composed of field data and taxonomic information, i.e., genus, family, order, identifier, identifier institution, identification date (dd-mmm-yyyy), curator observations, number of specimens, sex, development stage of specimens, and voucher specimens conserved in ethanol. The liquid voucher specimens are preserved in 75% ethanol with the same labels inside the vials (Fig. 1).

A simple scale insect-host interaction network analysis was performed with the information available in the collection. The matrix used for the analyses comprised quantitative data of the number of associations recorded in the SIC-UNAB database between scale insect species (rows) and plant hosts (columns). Network metrics were calculated as follows: i) number of nodes or total number of species of the network as the sum of the number of scale insect species with host record and the number of host-plant species, ii) linkage density as total number of interactions divided by the total number of plant and insects species in the network, iii) connectance as the proportion of actually observed interactions to all possible interactions, being 0 when there are no interactions and 1 when all species interact, and iv) H_2 as the network-level specialization measure, based on the deviation of the number of interactions of a species and the expected number of interactions of each species (Blüthgen et al. 2006; Dormann et al. 2009; Delmas et al. 2019). Also, bipartite graphs representing the linkage between species were constructed. Interaction analysis and figures were performed with a *bipartite* package (Dormann et al. 2008) in the open-license software R version 3.5.2 (R Development Core Team 2019).

Available data about altitude (m a.s.l.) and location (decimal degree coordinates) were used to plot the pattern of altitudinal and geographical distribution. The altimetry graphic was built in the console RWizard (Guisande et al. 2014), based on the free statistical software R version 3.5.2 (R Development Core Team 2019).The geographic distribution map was developed with the software DIVA-GIS version 7.5.0, with a physical map layer designed by Milenioscuro, CC BY-SA 3.0 (Milenioscuro 2009).

RESULTS AND DISCUSSION

To date, the SIC-UNAB preserves 7,052 curated specimens, resulting from more than 1,000 samples. The collection has records of 131 taxa, of which 115 are identified to species level, 3 are identified as species complexes and 13 identified to genus level (see Appendix I: Table 1). The 115 species belong to 57 genera and nine families. The highest diversity is represented by species of Pseudococcidae (34.1%), followed by Rhizoecidae (23.2%). The remainder of the species are divided between Diaspididae (18.8%), Coccidae (10.9%), Ortheziidae (2.9%), Monophlebidae (2.9%), Asterolecaniidae (2.2%), Putoidae (2.2%), Eriococcidae (1.4%), Dactylopiidae (0.7%) and Margarodidae (0.7%). Worldwide, the most diverse scale insects families are Diaspididae (> 2,600 spp.), Pseudococcidae (> 2,000 spp.) and Coccidae (> 1,100 spp.), but SIC-UNAB conserves a rich on representation of Pseudococcidae and Rhizoecidae because the research projects that have provided samples to the collection were focused on the diversity of mealybugs in the broad sense, i.e., Pseudococcidae, Rhizoecidae and Putoidae.

The scale insects-host interaction network based on samples deposited in the SIC-UNAB is shown in Figure 2. The interaction network based on the information available at the SIC-UNAB consisted of 222 nodes, corresponding to a total of the scale insect species and their host-plant species. Of the 131 taxa, 120 have host data, with 102 plant species. In the network, 227 interactions or links were recorded, with a density of 1.023 links per species. Around 70% of the scale insect species are recorded with only one host-plant species.

The network metrics of the data were low, with a connectance value of 0.019 and H_2 of 0.604. Connectance values close to zero indicate little interaction between the species, and the low H_2 index indicates a high level of specialization of the species in the network. These metrics provide preliminary knowledge of the association between scale insects and their hosts in Colombia.

The scale insect species with the highest number of interaction records (grade) with host plants are *Rhizoecus cacticans* (Hambleton, 1946) and *Rhizoecus colombiensis* Ramos & Caballero, 2016. The polyphagous habit of *R. cacticans* is confirmed and its range of host records is increased. The SIC-UNAB conserves samples of this species associated with 34 hosts, of which 23 are new records (Appendix I: Table 1). This new information broadens its host-range from 32 to 53 plant species. *Rhizoecus colombiensis* was described from specimens collected and preserved in SIC-UNAB, hence most of the hosts that have been recorded for this species are the same as are presented in this paper, except for four plant species recorded here for the first time (see underlined names of hosts in Appendix I: Table 1).

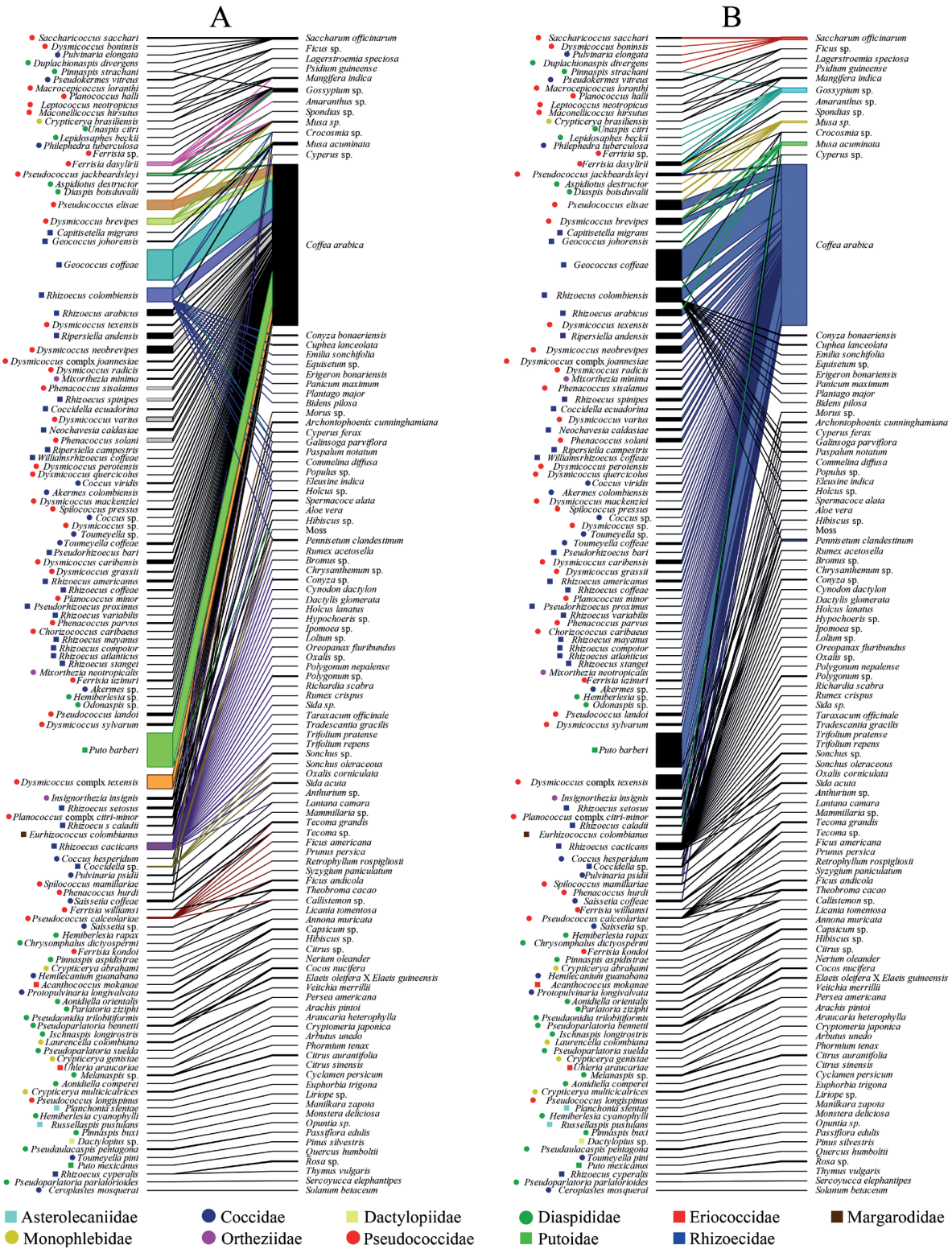

Fig. 2. Interaction network of association between scale insects and hosts based on storage samples in the scale insect collection of the entomological museum "Universidad Nacional Agronomía Bogotá" (SIC–UNAB). **A**. The bipartite graph on the left emphasizes scale insect species with the same color indicating the rectangle of the species and the line of the link. **B**. The graph on the right emphasizes plant hosts and their links. The width of the rectangle next to each species name is proportional to the sum of interactions involving this species, while the width of the lines linking scale insect species and plant species is again proportional to the number of interactions between the connected species.

Fig. 3. Altimetry graphic with range by species given in meters about sea level (m a.s.l.). Each point indicates one sample. Color and shape indicate taxonomic family.

Puto barberi (Cockerell, 1895) and *Geococcus coffeae* (Green, 1933) are the species most recurrent in the collection samples (Fig. 2 A), but this contrasts with their host associations. Both species have several samples on *Coffea arabica* (Rubiaceae), due to the large sampling effort on coffee in one of the most important projects that built the collection (Caballero et al. 2018, 2019). *Puto barberi* is recorded in association with *Hibiscus* sp. (Malvaceae), however, this species is polyphagous and has been recorded from more than 50 plant species (Williams et al. 2011; García Morales et al. 2016). *Geococcus coffeae* is also polyphagous, associated with 63 plant species (Williams 1968; García Morales et al. 2016), however, in the collection it is recorded on only four hosts, one of them corresponding to an earlier record (*C. arabica*) and three new records, i.e., *Crocosmia* sp. (Iridiaceae), *Galinsoga parviflora* (Asteraceae) and *Musa acuminata* (Musaceae).

The plant species with the highest number of interactions with scale insect species (63) was *C. arabica*, which is also an indicator of the large sampling effort in coffee cultivation. The remaining plant species are recorded in association with no more than seven species of scale insects (Fig. 2B).

The focus of the UNAB museum is agricultural entomological diversity, which means the study of arthropods associated with plant species of agricultural importance. As a result of different studies, the SIC-UNAB preserves samples that represent 45% (63 species) of the worldwide scale insect diversity recorded on *C. arabica*, which is 141 species (García Morales et al. 2016; Caballero et al. 2019). Other plants of agricultural importance for Colombia are cotton (*Gossypium* sp.) and plantain (*Musa acuminata* Colla, 1820), both with seven scale insect species recorded, banana (*Musa paradisiaca*) with six; sugarcane (*Saccharum officinarum*) with five; mango (*Mangifera indica*) with four; and soursop (*Annona muricata* L., 1753) with three. The number of associations are indicated in Figure 2B**.**

Altitudinal and geographic distribution

The analysis showed that *Rhizoecus colombiensis* is the species with the widest altitude range, being present from 6 m a.s.l. on *M. acuminata* to 2,792 m a.s.l. on *Holcus* sp. (Poacaeae) (Fig. 3). The species is polyphagous (Ramos-Portilla & Caballero 2016) and its hosts include banana and plantains (*Musa* sp.), which can grow from sea level up 2,000 m a.s.l., *Coffea arabica*, which can grow between 1,000 and 2,300 m a.s.l. (Federación Nacional de Cafeteros 2013), and *Holcus* sp. which is able to grow up to 3,300 m a.s.l. (Apráez et al. 2019). Other species with wider altitude range are *R. arabicus*, *R. cacticans* and *G. coffeae* (Rhizoecidae) which cover around 2,000 meter. *Rhizoecus arabicus* and *G. coffeae* were found from sea level to 2,200 m a.s.l., and *R. cacticans* from 1,200 m a.s.l. to 3,100 m a.s.l.

Pseudokermes vitreus (Cockerell, 1894) and *Crypticerya brasiliensis* (Hempel, 1900) both present a special situation. For each of these species there are only two samples, and in each case, the samples are from extreme altitude points with more to 2,000 meters between them (Fig. 3). The altitude points for *P. vitreus* are 244 and 2,694 m a.s.l. in Caquetá and Boyacá departments, respectively. *Crypticerya brasiliensis* was found at 24 and 2,357 m a.s.l., in Providencia Island and Boyacá, respectively. These data agree with previously recorded information on both species, which are polyphagous and associated with plants from warm and temperate regions (Kondo & Hardy 2008; García Morales et al. 2016; Kondo et al. 2016b).

Regarding the geographic distribution, the SIC-UNAB has an important representation of the Colombian Coccomorpha fauna from the Andean and Caribbean biogeographic regions (Fig. 4). This bias is due to UNAB projects that have been focused on coffee crops, which are mostly cultivated in the Andean region.

A sanctuary for scale insects in Colombia

Research on SIC-UNAB has provided new records of species and hosts for Colombia and Mexico, taxonomic keys and descriptions of new scale insect species found on crops such as citrus, sugarcane and coffee (Kondo et al. 2016b; Ramos-Portilla & Caballero 2016, 2017; Caballero et al. 2017, 2018; Caballero & Ramos-Portilla 2018). In addition, the collection has authoritative taxonomic determinations and stores type material of *Acanthococcus mokanae* González, Ramos & Caballero, 2019, *Ferrisia williamsi* Kaydan & Gullan, 2012, *Rhizoecus colombiensis* Ramos & Caballero, 2016, *Pseudorhizoecus bari* Caballero & Ramos, 2018, *Tillancoccus koreguajae* Caballero & Ramos, 2018 and *Williamsrhizoecus coffeae* Caballero & Ramos, 2018 (see Appendix I: Table 1).

Compared to the main scale insect collections of Colombia, the SIC-UNAB conserves the most significant collection, as we show below:

Instituto Alexander Von Humbolt (IAVH): No scale insect specimens (J.C. Neita, Bogotá, pers. comm. 2020).

International Center for Tropical Agriculture Arthropod Reference Collection (CIATARC): 259 slide-mounted scale insect specimens, 84 voucher liquid samples, representing six families, 21 genera, and 29 species (data of genera and species no provided) (M.I. Gómez, Valle del Cauca, pers. Comm. 2019).

Colección Taxonómica Nacional de Insectos Luis Maria Murillo (CTNI): 631 slide-mounted specimens of two families: Coccidae with six genera and 14 species, Rhizoecidae one genus and one species. This collection conserves type material of *Bombacoccus aguacatae* Kondo, 2010 (holotype), *Ceroplastes boyacensis* Mosquera, 1979

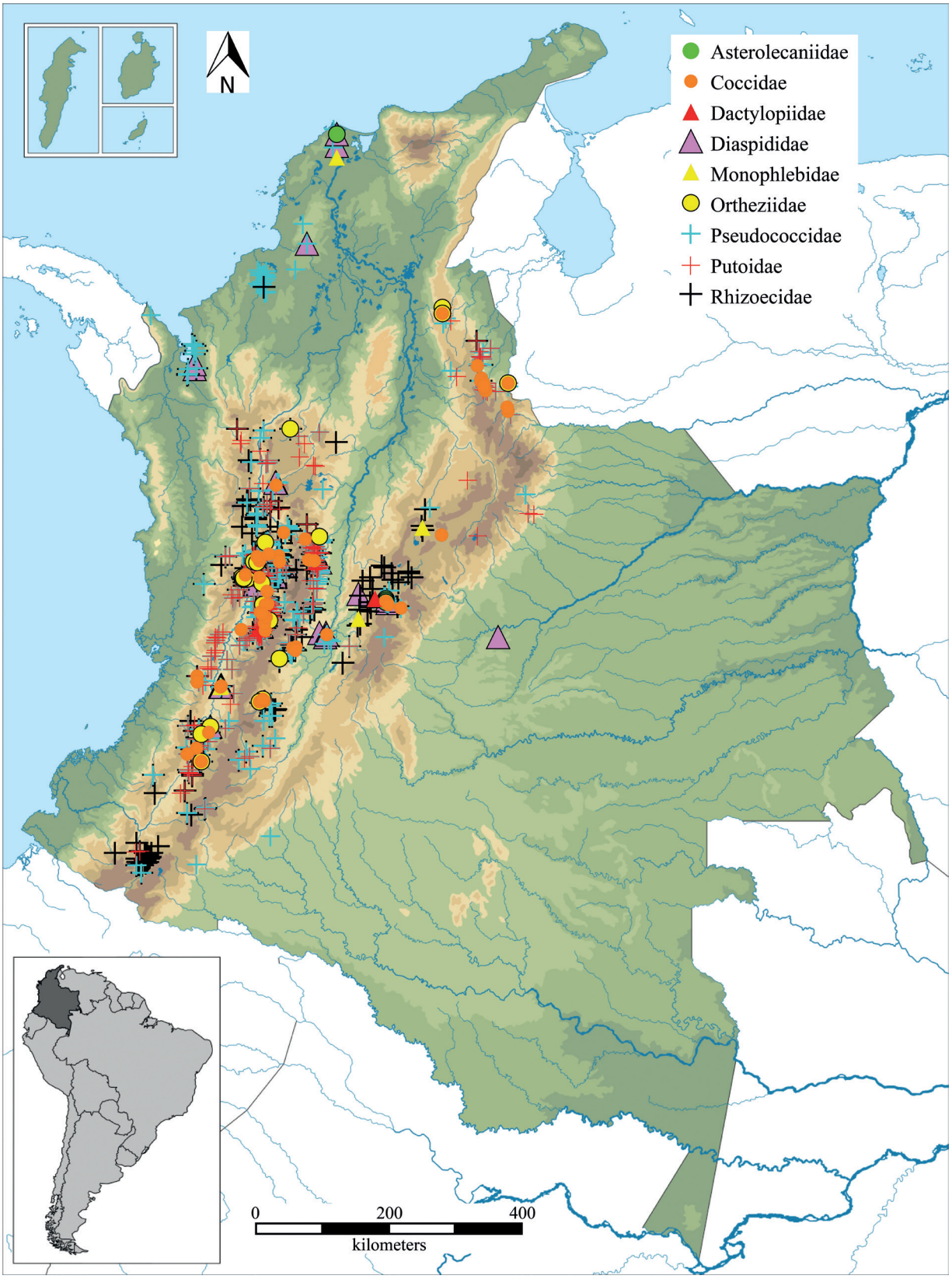

Fig. 4. Map of Colombia with distribution of Coccomorpha samples under conservation in Scale Insect Collection of entomological museum "Universidad Nacional Agronomía Bogotá" (SIC–UNAB). Samples discriminated by families with symbols and colors.

(holotype and paratypes), *Ceroplastes cundinamarcensis* Mosquera, 1979 (holotype and paratypes), *Ceroplastes martinae* Mosquera, 1979 (holotype and paratypes), *Ceroplastes mosquerai* Ben-Dov, 1993 (holotype and paratypes), *Ceroplastes ocreus* Mosquera, 1984 (holotype and paratypes), *Ceroplastes trochezi* Mosquera, 1979 (holotype and paratypes), *Cryptinglisia corpoica* Kondo & Montes (holotype and paratypes), *Cryptinglisia ica* Montes & Kondo (holotype and paratypes), *Pulvinaria caballeroramosae* Tanaka & Kondo, 2015 (paratypes), and *Rhizoecus colombiensis* Ramos-Portilla & Caballero, 2016 (paratype) (E. Vergara, Bogotá, pers. Comm. 2020)

Museo Entomológico Francisco Luis Gallego (MEFLG): 52 slide-mounted scale insect specimens. Pseudococcidae: 13 genera, 24 species. Diaspididae: 15 genera, 22 species. Margarodidae: seven genera, eight species. Coccidae: 13 genera, 19 species. (J. Quiroz, Medellín, pers. Comm. 2019)

Museo de Historia Natural del Instituto de Ciencias Naturales (ICN): 15 slide-mounted scale insect specimen of families Pseudococcidae and Coccidae (data of genera and species no provided). This collection conserves material Type of *Leptococcus rodmani* Kondo, 2008 (paratype) and *Akermes colombiensis* Kondo & Williams, 2004 (paratype). (F. Fernandez, Bogotá, pers. Comm. 2019)

Universidad Nacional Agronomía Bogotá (UNAB): 7,052 slides-mounted scale insects specimens (details in Appendix I: Table 1).

New records for Colombia

***Geococcus johorensis* Williams, 1969** [UNAB N° cat. 1861]* COLOMBIA: Antioquia, Apartadó, Vda. Churidó, Fca. Villa Nancy, 7°47'38.72" N, 76°38'56.94" W, 27 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector N. Herrera, 6 ♀♀ adults; Antioquia, Carepa, Vda. Las Trecientas, Fca. Villa Adis, 7°46'56.93" N, 76°46'6.56" W, 17 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector O. Giraldo, 7 ♀♀ adults; Antioquia, Chigorodó, Vda. Saden Guacamaya, Fca. Las Anitas, 7°42'45.86" N, 76°46'23.09" W, 6 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector N. Herrera, 3 ♀♀ adults; Antioquia, Chigorodó, Vda. Saden Candelaria, Fca. Doña Mayo, 7°42'50.26"N, 76°46'6.56" W, 6 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector O. Giraldo, 6 ♀♀ adults; Antioquia, Chigorodó, Vda. Saden Colorada, Fca. San Ignacio, 7°42'18.72" N, 76°46'23.09" W, 6 m a.s.l., ex *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector L. Escobar, 5 ♀♀ adults; Antioquia, Turbo, Vda. Barro Colorado, Fca. Villa Arelis, 8°1'43.18" N, 76°39'26.89" W, 26 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector N. Herrera, 4 ♀♀ adults; Antioquia, Turbo, Vda. Barro Colorado, Fca. La Mejor Esquina N° 2, 8°1'55.45" N, 76°39'56.52" W, 25 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector O. Giraldo, 2 ♀♀ adults; Antioquia, Turbo, Vda. La Esperanza, Fca. La Esperanza, 8°5'43.76" N, 76°40'16.68" W, 21 m a.s.l., ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector L. Escobar, 2 ♀♀ adults; Antioquia, Turbo, Vda. Villa María, Fca. Los Tres Hermanos, 8°6'41.98" N, 76°42'24.52" W, 5 m. a.s.l. ex roots *Musa acuminata* (AAB) (Musaceae), Feb-2015, collector L. Escobar, 5 ♀♀ adults.

*All samples with the same catalogue number.

***Phenacoccus hurdi* McKenzie, 1964** [UNAB N° cat. 1861] COLOMBIA: Cundinamarca, Bogotá D.C., Localidad Teusaquillo, Universidad Nacional de Colombia., 4°38'9.49" N, 74°5'20.22" W, 2564 m a.s.l., ex leaves, stems, and flowers of *Lantana camara* (Vervenaceae). 2-Abr-2012, collector A. Caballero, 10 ♀♀ adults.

***Puto mexicanus* (Cockerell, 1893)** [UNAB N° cat. 5538] COLOMBIA, Boyacá, Arcabuco, 5°44'17.00" N, 74°24'52.00" W, 2742 m a.s.l., ex leaves of *Quercus humboldtii* (Fagaceae). 10-Abr-2019, collector P. Rodríguez, 3 ♀♀ adults and 4 ♀♀ 3rd instars.

CONCLUSIONS

In a megadiverse country like Colombia, research to increase awareness of diversity, with taxonomy as the main tool, should be a priority. The entomological museum UNAB contributes to this crucial task through curation and conservation of specimens as vouchers of species richness. Its collection of scale insects has become the most important in Colombia due to the number of specimens, diversity of species and associated information on their geographical distribution. The information stored in this collection has contributed to the knowledge of Coccomorpha taxonomy and Colombian phytosanitary status, providing a list of 115 species, new records of three scale insects and 61 host plants and distribution information. Of the 252 species recorded so far for Colombia, the SIC–UNAB has 115 species i.e., 41% of total of the current Colombian Coccomorpha diversity. This collection provides new information about associations of scale insects with host plants of economic importance to Colombia, their locations, and confirmation of previous records. This information will be useful to phytosanitary authorities and will enable research centers to plan regulation and investigation activities.

The ecological analysis allowed us to infer the sampling frequency by species, and to identify association networks between scale insects and their hosts, and geospatial distributions. The analysis presented here gives an insight into how to direct and structure new research. Based on the geographic analysis, the SIC-UNAB should

redirect its field collecting to northern, west, and southeastern Colombia, which coincides with biodiversity hotspots such as the Caribbean, Pacific and Amazonas regions. New analyses of species richness and host associations should be directed towards economically important crops to evaluate their impact in ecosystems of the country. Good examples might be banana and avocado crops, whose cultivated areas are substantial in Colombia and their production systems influence other associated plant species. Regarding identification methodology, so far the UNAB museum had used a morphological approach but in the future, it should include molecular techniques and ecological analysis as new information sources, trying to get closer to integrative taxonomy.

The mission of the entomological museum UNAB, as part of a public institution and as an element of the most important university in Colombia, is to provide information about Colombian insect diversity and related issues. In that sense, we encourage the coccidology community to consider the SIC-UNAB as a collaborating institution in future studies and for housing samples.

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APPENDIX I:

Table 1. List of species represented in the Scale Insect Collection at the UNAB entomological museum "Universidad Nacional Agronomía Bogotá" (SIC-UNAB), with information on location, host, catalogue number, material type, number of mounted specimens and liquid vouchers.

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Asterolecaniidae							
Planchonia stentae (Brain,1920)	Cun	*Euphorbia trigona* (Euphorbiaceae)	4949			27	X
Russellaspis pustulans (Cockerell, 1892)	Atl	*Manilkara zapota* (Sapotaceae)	4973			15	X
Coccidae							
Akermes colombiensis Kondo & Williams, 2004	Ant, Cal, Cau, Qui	*Coffea arabica* (Rubiaceae)	3494			41	X
Akermes sp.	Qui	*Coffea arabica* (Rubiaceae)	4771			1	X
Ceroplastes mosquerai Ben-Dov, 1993 [2]	Nar	*Solanum betaceum* (Solanaceae)	4931			10	X
Coccus hesperidum (Linnaeus, 1758)	Ant	*Hibiscus* sp. (Malvaceae),	4848			4	X
Coccus sp.	Cal, Tol	*Coffea arabica* (Rubiaceae)	3498 4888			7	X
Coccus viridis (Green, 1889)	Ant, Cal, Cau, Ris, Tol	*Coffea arabica*, *Faramea* sp., *Ixora coccinea* (Rubiaceae); *Cestrum nocturnum* (Solanaceae)	3497			33	X
Hemilecanium guanabana Kondo & Hodgson, 2013	VdC	*Annona muricata* (Annonaceae)	4939			1	X
Philephedra tuberculosa Nakahara & Gill, 1985	Tol	*Gossypium* sp. (Malvaceae)	4948			9	X
Protopulvinaria longivalvata Green, 1909 [2]	Caq	*Capsicum* sp. (Solanaceae)	4962			10	X
Protopulvinaria pyriformis (Cockerell, 1894)	VdC	Euphorbiaceae	4958			3	X
Pseudokermes vitreus (Cockerell, 1894) [2]	Boy, Caq	*Ficus* sp. (Moraceae)	4965			34	X
Pulvinaria elongata Newstead, 1917	Cal, VdC	*Saccharum officinarum* (Poaceae)	1507 1836			17	X
Pulvinaria psidii Maskell, 1893	Cun	*Coffea arabica* (Rubiaceae)	1854			33	X
Saissetia coffeae (Walker, 1852)	Cal, Cun, Qui, Ris	*Schinus molle* (Anacardeaceae); *Tecoma grandis* (Bignonaceae); *Coffea arabica* (Rubiaceae)	873 3524			66	X

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Saissetia sp.	Cun	*Ficus andicola* (Moraceae)	824			1	
Tillancoccus koreguaje Caballero & Ramos, 2017	Caq	*Saccharum officinarum* (Poaceae)	836	X	X	3	
Toumeyella coffeae Kondo, 2013	Cau, NdS, VdC	*Coffea arabica* (Rubiaceae)	1412 4641			45	X
Toumeyella pini King, 1901	Ind (USA)	*Pinus silvestris* (Pinaceae)	1510			5	X
Dactylopiidae							
Dactylopius sp.	Cun	*Opuntia* sp. (Cactaceae)	5537			2	X
Diaspididae							
Aonidiella comperei McKenzie, 1937	Tol	*Citrus aurantifolia* (Rutaceae)	1837			42	X
Aonidiella orientalis (Newstead, 1894)	Atl, Cau	*Nerium oleander* (Apocynaceae); *Citrus limon* (Rutaceae)	4845			8	X
Aspidiotus destructor Signoret, 1869	Ant	*Musa* sp. (Musaceae)	4846			19	X
Chrysomphalus dictyospermi (Morgan, 1889) [2]	Cun	*Callistemon* sp. (Myrtaceae)	4847			7	X
Diaspis boisduvalii (Signoret, 1869)	Ant, VdC	*Musa* sp. (Musaceae)	4849 4932			20	X
Duplachionaspis divergens (Green, 1899)	Met, Ris	*Saccharum officinarum* (Poaceae)	667 4852			11	X
Hemiberlesia cyanophylli (Signoret, 1869) [2]	Cun	*Liriope* sp. (Liliaceae)	4861			15	X
Hemiberlesia rapax (Comstock, 1881)	Cun	*Callistemon* sp. (Myrtaceae)	4938			3	X
Hemiberlesia sp.	Cal	*Coffea arabica* (Rubiaceae)	4573			1	
Ischnaspis longirostris (Signoret, 1882)	Ant	*Cocos nucifera* (Arecaceae)	1010 4940			11	X
Lepidosaphes beckii (Newman, 1869) [2]	VdC	*Gossypium* sp. (Malvaceae)	4942			7	X
Melanaspis sp.	Ant, Cun	*Arbutus unedo* (Ericaceae); *Phormium tenax* (Asphodelaceae)	1501 1502			13	X
Odonaspis sp.	Ant	*Coffea arabica* (Rubiaceae)	4629			3	X
Pseudoparlatoria bennetti (Williams, 1969)	VdC	*Veitchia merrillii*, *Cocos nucifera*, *Elaeis oleifera* x *Elaeis guineensis* (Arecaceae)	1504			32	X
Parlatoria ziziphi (Lucas, 1853)	Atl	*Citrus* sp. (Rutaceae)	1885			15	X
Pinnaspis aspidistrae (Signoret, 1869)	Tol	*Annona muricata* (Annonaceae)	1863			15	X
Pinnaspis buxi (Bouché, 1851)	Ant	*Monstera deliciosa* (Araceae)	1864			3	X

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Pinnaspis strachani (Cooley, 1898)	Cal, Suc, Tol	*Gossypium* sp. (Malvaceae); *Saccharum officinarum* (Poaceae)	676 4947			25	X
Pseudaonidia trilobitiformis (Green, 1896)	Atl, Bol	*Nerium oleander* (Apocynaceae)	4960			18	X
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886)	NdS	*Passiflora edulis* (Passifloraceae)	4956			8	X
Pseudoparlatoria parlatorioides (Comstock, 1883) [2]	Cun	*Yucca elephantipes* (Asparagaceae)	1506			9	X
Pseudoparlatoria suelda Wolff, 2001 [2]	Ris	*Persea americana* (Lauraceae)	4964			4	X
Unaspis citri (Comstock, 1883) [2]	VdC	*Gossypium* sp. (Malvaceae)	4971			2	X
Eriococcidae							
Acanthococcus mokanae González, Ramos & Caballero, 2019	Atl	*Hibiscus* sp. (Malvaceae); *Capsicum* sp. (Solanaceae)	4928	X	X	41	X
Uhleria araucariae (Maskell, 1879)	Cun	*Araucaria heterophylla* (Araucariaceae); *Cryptomeria japonica* (Cupressaceae)	1876			16	X
Margarodidae							
Eurhizococcus colombianus Jakubski, 1965 [2]	Cun	*Aloe vera* (Asphodelaceae); *Coffea arabica* (Rubiaceae)	890 4629			2	X
Monophlebidae							
Crypticerya abrahami (Newstead, 1917)	VdC	*Annona muricata* (Annonaceae)	1858			2	X
Crypticerya brasiliensis (Hempel, 1900)[2]	Boy, ASP	*Mangifera indica* (Anacardeaceae); *Psidium guineense* (Myrtaceae)	819 1857			12	X
Crypticerya genistae (Hempel, 1912)	Atl, VdC	*Arachis pintoi* (Fabaceae)	1856			6	X
Crypticerya multicicatrices (Kondo & Unruh, 2009) [2]	Cun	*Citrus sinensis* (Rutaceae)	1859			3	X
Laurencella colombiana Foldi & Watson, 2001	Cun	*Persea americana* (Lauraceae)	4941			8	
Ortheziidae							
Insignorthezia insignis (Browne, 1887)	Chi (Mex); Ant, Cau, Qui, Ris	*Coffea arabica* (Rubiacea)	1499 4574			52	X
Mixorthezia minima Konczné Benedicty & Kozár, 2004	Chi (Mex); NdS	*Coffea arabica* (Rubiacea)	1806 1862			6	X
Mixorthezia neotropicalis (Silvestri, 1924)	Tol	*Coffea arabica* (Rubiacea)	4774			1	
Pseudococcidae							
Antonina graminis (Maskell, 1897)	Cor, Met	Poaceae	4929			25	X
Chorizococcus caribaeus Williams & Granara de Willink, 1992	Cal	*Coffea arabica* (Rubiaceae)	3495			4	

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Dysmicoccus boninsis (Kuwana, 1909)	Ant, Boy, Cho, Tol	*Saccharum officinarum* (Poaceae)	843			57	X
Dysmicoccus brevipes (Cockerell, 1893)	Ant, Cal, Cau, NdS, Qui, Ris, Tol, VdC	*Cyperus* sp. (Cyperaceae); *Musa acuminata* (Musaceae); *Coffea arabica* (Rubiaceae);	830 1390 3500 4622 4853			269	X
Dysmicoccus caribensis Granara de Willink, 2009	Cal, Hui. NdS, Qui, Tol, VdC	*Coffea arabica* (Rubiaceae)	1391			166	X
Dysmicoccus complex *joannesi-ae-neobrevipes*	Cau, Tol	*Coffea arabica* (Rubiaceae)	4643 4854			9	X
Dysmicoccus complex *texensis-neobrevipes*	Ant, Cal, Cau, Hui, Qui, Ris, Tol, VdC	*Coffea arabica* (Rubiaceae)	1398 3785 4934			510	X
Dysmicoccus grassii (Leonardi, 1913)	Cau, NdS, Qui, Tol	*Coffea arabica* (Rubiaceae)	4626 4777			13	X
Dysmicoccus mackenziei Beardsley, 1965	Cal, Hui	*Coffea arabica* (Rubiaceae)	3787 4933			4	X
Dysmicoccus neobrevipes Beardsley, 1959	Ant, Cal, Cau, Qui, Ris, VdC	*Coffea arabica* (Rubiaceae)	1394 3786 4570			233	X
Dysmicoccus perotensis Granara de Willink, 2009	Cal, Cau	*Coffea arabica* (Rubiaceae)	4769			4	X
Dysmicoccus quercicolus (Ferris, 1918)	Cal, Cau	*Coffea arabica* (Rubiaceae)	4624			5	X
Dysmicoccus radicis (Green, 1933)	Qui, Ris	*Coffea arabica* (Rubiaceae)	4572			13	X
Dysmicoccus sp.	Cun, NdS, Ris	*Coffea arabica* (Rubiaceae)	1398 4628			6	X
Dysmicoccus sylvarum Williams & Granara de Willink, 1992	Cal, Cau, Tol	*Coffea arabica* (Rubiaceae)	3787 4627			32	X
Dysmicoccus texensis (Tinsley, 1900)	Chi (Mex); VdC	*Coffea arabica* (Rubiaceae)	1397 1496			23	X
Dysmicoccus varius Granara de Willink, 2009	Ant, Cal, Cau, NdS, Tol	*Coffea arabica* (Rubiaceae)	1393 1395 4571			158	X
Ferrisia dasylirii Kaydan & Gullan, 2012 [2]	Ant, Atl, Cor, Suc, Tol, VdC	*Mangifera indica*, *Spondias* sp. (Anacardiaceae); *Amaranthus* sp. (Amaranthaceae); *Gossypium* sp. (Malvaceae); *Musa* sp. (Musaceae)	1860			161	X
Ferrisia kondoi Kaydan & Gullan, 2012 [2]	Caq, Hui	*Licania tomentosa* (Chrysobalanaceae); *Theobroma cacao* (Malvaceae)	1834			5	X
Ferrisia sp.	Cor	*Gossypium* sp. (Malvaceae)	4936			3	
Ferrisia uzinuri Kaydan & Gullan, 2012	Tol	*Coffea arabica* (Rubiaceae)	4776			1	

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Ferrisia williamsi Kaydan & Gullan, 2012 [2]	Ant, Cun, Caq	*Tecoma* sp. (Bignoniaceae); *Theobroma cacao* (Malvaceae)	4935		X	25	X
Leptococcus neotropicus (Williams & Granara de Willink, 1992)	Caq, Mag	*Mangifera indica* (Anacardiaceae); *Ficus* sp. (Moraceae)	1500 4945			19	X
Maconellicoccus hirsutus (Green, 1908)	Ant, Atl	*Mangifera indica* (Anacardiaceae); *Lagerstroemia speciosa* (Lythraceae)	4943			11	X
Macrocepicoccus loranthi Morrison, 1919	VdC	¿?	4944			15	X
Paraputo sp.	Cau	*Coffea arabica* (Rubiaceae)	4631			13	
Phenacoccus dearnessi King, 1901	Ind (USA)	¿?	1503			5	
Phenacoccus hurdi McKenzie, 1964 [1,2]	Cun	*Lantana camara* (Verbenaceae)	1505			10	X
Phenacoccus madeirensis Green, 1923	San	Myrtaceae	4952			8	X
Phenacoccus parvus Morrison, 1924	Ant	*Coffea arabica* (Rubiaceae)	4632			2	
Phenacoccus sisalanus Granara de Willink, 2007	Ant, Cal, Qui, Ris, VdC	*Coffea arabica* (Rubiaceae)	1402 3508			99	X
Phenacoccus solani Ferris, 1918	Ant, Cal, Cau, Qui, Ris, Tol, VdC	*Coffea arabica* (Rubiaceae)	1404 3507			71	X
Planococcus complex *citri-minor*	Cal; Rom (ITA)	*Coffea arabica* (Rubiaceae); *Populus* sp. (Salicaceae)	3788 4955			10	X
Planococcus halli Ezzat & McConnell, 1956 [2]	Ant	*Lagerstroemia speciosa* (Lythraceae)	4959			6	X
Planococcus minor (Maskell, 1897)	VdC	*Coffea arabica* (Rubiaceae)	1403			1	X
Planococcus sp.	Cas	*Coffea arabica* (Rubiaceae)	4954			5	X
Pseudococcus calceolariae (Lidgett, 1898)[2]	Cun	*Tecoma* sp. (Bignonaceae); *Ficus americana* (Moraceae); *Callistemon* sp., *Syzygium paniculatum,* (Myrtaceae); *Retrophyllum rospigliosii* (Podocarpaceae); *Prunus persica* (Rosaceae)	1877			38	X
Pseudococcus elisae Borchsenius, 1947	Ant, Cal, Cau, NdS Qui, Ris, Tol, VdC	*Musa* sp. (Musaceae); *Coffea arabica* (Rubiaceae)	1405 3512			404	X
Pseudococcus jackbeardsleyi Gimpel & Miller, 1996	Ant, Cal, Cau, Cor, Qui, Ris, Suc	*Spondias* sp. (Anacardiaceae); *Gossypium* sp. (Malvaceae); *Musa* sp. (Musaceae); *Coffea arabica* (Rubiaceae),	3513			53	X

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Pseudococcus landoi (Balachowsky, 1959)	Ant, Cal, Qui, Ris, Tol, VdC	*Coffea arabica* (Rubiaceae)	1406 3510			100	X
Pseudococcus longispinus (Targioni Tozzetti, 1867) [2]	Cun	*Cyclamen persicum* (Primulaceae)	825 4961			13	X
Pseudococcus sp.	Cau, Cor, Tol	*Ocimum basilicum* (Lamiaceae); *Gossypium* sp. (Malvaceae); *Coffea arabica* (Rubiaceae)	4634 4635 4775 4953 4957			23	X
Saccharicoccus sacchari (Cockerell, 1895)	Cau, Put, Tol	*Saccharum officinarum* (Poaceae)	835			112	X
Spillococcus mamillariae (Bouche, 1844)	Cun, Qui	*Mammillaria* sp. (Cactaceae), *Coffea arabica* (Rubiaceae)	1509 4772			36	X
Spilococcus pressus Ferris, 1950	Cau, Ris	*Coffea arabica* (Rubiaceae)	4640			1	X
Putoidae							
Puto barberi (Cockerell, 1895)	Ant, Cal, Cas, Cau, Hui, Nar, NdS, Qui, Ris, San, Tol, VdC	*Hibiscus* sp. (Malvaceae); *Coffea arabica* (Rubiaceae)	838 1408			1046	X
Puto antioquensis (Murillo, 1931)	Nar	¿?	4963			1	X
Puto mexicanus (Cockerell, 1893) [1,2]	Boy	*Quercus humboldtii* (Fagaceae)	5538			3	X
Rhizoecidae							
Capitisetella migrans (Green, 1933) [2]	Ant	*Musa acuminata* (Musaceae)	1855			1	X
Coccidella ecuadorina Konczné Benedicty y Foldi, 2004	Cau, Cun, Nar	*Coffea arabica* (Rubiaceae)	4620			3	X
Coccidella sp.	Ant, Cun, Nar	Bryophyta; *Sonchus oleraceous*, *Sonchus* sp. (Asteraceae); *Sida acuta* (Malvaceae); *Oxalis corniculata* (Oxalidaceae), *Pennisetum clandestinum* (Poaceae), *Rumex acetosella* (Polygonaceae); *Coffea arabica* (Rubiaceae)	3496			36	X
Geococcus coffeae Green, 1933 [2]	Ant, Cal, Cau, Cun, Nar, NdS, Qui, Ris, Tol, VdC	*Galinsoga parviflora* (Asteraceae); *Crocosmia* sp. (Iridaceae); *Musa acuminata* (Musaceae); Poaceae; *Coffeae arabica* (Rubiaceae),	1400 1498 3504 4937			966	X
Geococcus johorensis Williams, 1969 [1,2]	Ant	*Musa acuminata* (Musaceae)	1861			44	X
Neochavesia caldasiae (Balachowsky, 1957)	Ant, Cal, Ris, VdC	*Coffeae arabica* (Rubiaceae)	1401 3505			65	X
Neochavesia eversi (Beardsley, 1970)	Cun, Tol	Cyperaceae, Poaceae	831			18	X

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Pseudorhizoecus bari Caballero & Ramos, 2018	NdS	*Coffeae arabica* (Rubiaceae)	1807	X	X	6	X
Pseudorhizoecus proximus Green, 1933	Chi (MEX)	*Coffeae arabica* (Rubiaceae)	1875			7	X
Rhizoecus americanus (Hambleton, 1946)	Ant, Cau, NdS, Qui, Ris, VdC	*Coffeae arabica* (Rubiaceae)	1326 4576 4637			34	X
Rhizoecus arabicus Hambleton, 1976	Ant, Cal, Cau, Cun, Qui, Ris, Tol	*Musa acuminata* (Musaceae); *Coffeae arabica* (Rubiaceae)	484			129	X
Rhizoecus atlanticus (Hamleton, 1946)	Ris	*Coffeae arabica* (Rubiaceae)	4638			3	
Rhizoecus cacticans (Hambleton, 1946) [2]	Ant, Boy, Cal, Cau, Cun, Nar, Ris, Tol	Bryophyta; *Oreopanax floribundus* (Araliaceae); *Conyza* sp., *Chrysanthemum* sp., *Galinsoga parviflora*, *Hypochaeris* sp., *Sonchus oleraceous*, *Taraxacum officinale* (Asteraceae); *Tradescantia gracilis* (Commelinaceae); *Ipomoea* sp. (Convolvulaceae); *Cyperus* sp. (Cyperaceae); *Trifolium pratense*, *Trifolium repens* (Fabaceae); *Crocosmia* sp. (Iridaceae); *Sida acuta* (Malvaceae); *Oxalis corniculata*, *Oxalis* sp. (Oxalidaceae); *Bromus* sp., *Cynodon dactylon*, *Dactylis glomerate*, *Eleusine indica*, *Holcus lanatus*, *Lolium* sp., *Pennisetum clandestinum* (Poaceae); *Polygonum nepalense*, *Rumex acetosella*, *Rumex crispus* (Polygonaceae); *Coffea arabica*, *Richardia scabra* (Rubiaceae); *Lantana camara* (Verbenaceae),	483 3518			220	X
Rhizoecus caladii Green, 1933	Ant, Cal, Cun	*Commelina diffusa* (Commelinaceae); *Cyperus ferax* (Cyperaceae); *Musa acuminata* (Musaceae); *Paspalum notatum* (Poaceae); *Coffea arabica*, *Spermacoce alata* (Rubiaceae)	1495 4577 4966			9	X
Rhizoecus coffeae Laing, 1925	NdS	*Coffea arabica* (Rubiaceae)	1409				

SPECIES	LOCALITY	HOST	CAT	HTY	PTY	SPCM (♀♀ adults)	LV
Rhizoecus colombiensis Ramos & Caballero, 2016	Ant, Cal, Cau, Nar, Qui, Ris, Tol, VdC	*Bidens pilosa*, *Emilia sonchifolia*, *Erigeron bonariensis*, *Galinsoga parviflora* (Asteraceae); *Cyperus ferax* (Cyperaceae); *Equisetum* sp. (Equisetaseae); *Crocosmia* sp. (Iridaceae); *Cuphea lanceolata* (Lythraceae); *Musa acuminata* (Musaceae); *Eleusine indica*, *Holcus* sp., *Panicum maximum*, *Paspalum notatum*, *Pennisetum clandestinum* (Poaceae); *Plantago major* (Plantaginaceae)	678 3519	X	X	494	X
Rhizoecus compotor Williams & Granara de Willink, 1992	Ris	*Coffea arabica* (Rubiaceae)	4578			6	
Rhizoecus cyperalis (Hambleton, 1946)[2]	Cun	*Thymus vulgaris* (Lamiaceae); *Rosa* sp. (Rosaceae)	488			23	X
Rhizoecus mayanus (Hambleton, 1946)	Cal	*Coffea arabica* (Rubiaceae)	3522			1	
Rhizoecus neostangei Miller & McKenzie, 1971	Chi (MEX)	Poaceae	1508			1	
Rhizoecus setosus (Hambleton, 1946)	Cau, Cun, Ris, Tol	*Archontophoenix cunninghamiana* (Arecaceae); *Coffea arabica* (Rubiaceae)	4579			75	X
Rhizoecus spenipes (Hambleton, 1946)	Ant, Cal, Qui, Ris, Tol	*Coffea arabica* (Rubiaceae)	3521			58	X
Rhizoecus stangei McKenzie, 1962	Tol	*Coffea arabica* (Rubiaceae)	4773			2	X
Rhizoecus variabilis Hambleton, 1978	Ant, Cal, Cun, Qui, Tol	*Cuphea lanceolata* (Lythraceae); *Coffea arabica* (Rubiaceae)	4580			34	X
Ripersiella andensis (Hambleton, 1946)	Ant, Cal, Qui, Ris, Tol, VdC	*Coffea arabica* (Rubiaceae)	1411 3523 4636			145	X
Ripersiella campestris Hambleton, 1946	Chi (MEX)	Poaceae, *Coffea arabica* (Rubiaceae)	1497			10	X
Ripersiella kelloggi Ehrohrn & Cockerell, 1901	Cun	¿?	489			6	X
Williamsrhizoecus coffeae Caballero & Ramos, 2018	Ant; Chi (MEX)	*Coffea arabica* (Rubiaceae)	4642 4639	X		18	X

Abbreviations: Cat. N° (catalogue number); Ant (Antioquia), ASP (The San Andres, Providencia and Santa Catalina Archipielago), Atl (Atlantico), Boy (Boyacá), Cal (Caldas), Caq (Caquetá), Cas (Casanare), Cau (Cauca), Cho (Chocó), Cor, (Córdoba), Cun (Cundinamarca), Hui (Huila), Mag (Magdalena), Met (Meta), Nar (Nariño), NdS (Norte de Santander), Put (Putumayo), Qui (Quindio), Ris (Risaralda), San (Santander) Suc (Sucre), Tol (Tolima), VdC (Valle del Cauca); ITA (Italy), Rom (Roma); MEX (Mexico), Chi (Chiapas); USA (United States of America), Ind (Indiana); ¿? (No information); [1] New country record, [2] New host record (scientific names underline); HTY holotype; PTY paratype; N° SPCM number of mounting-slide specimens; LV Liquid voucher available.