

*A Third Species of Hemilecanium  
Newstead (Hemiptera: Coccoidea:  
Coccidae) from the New World, with Keys  
to Species in the Genus*

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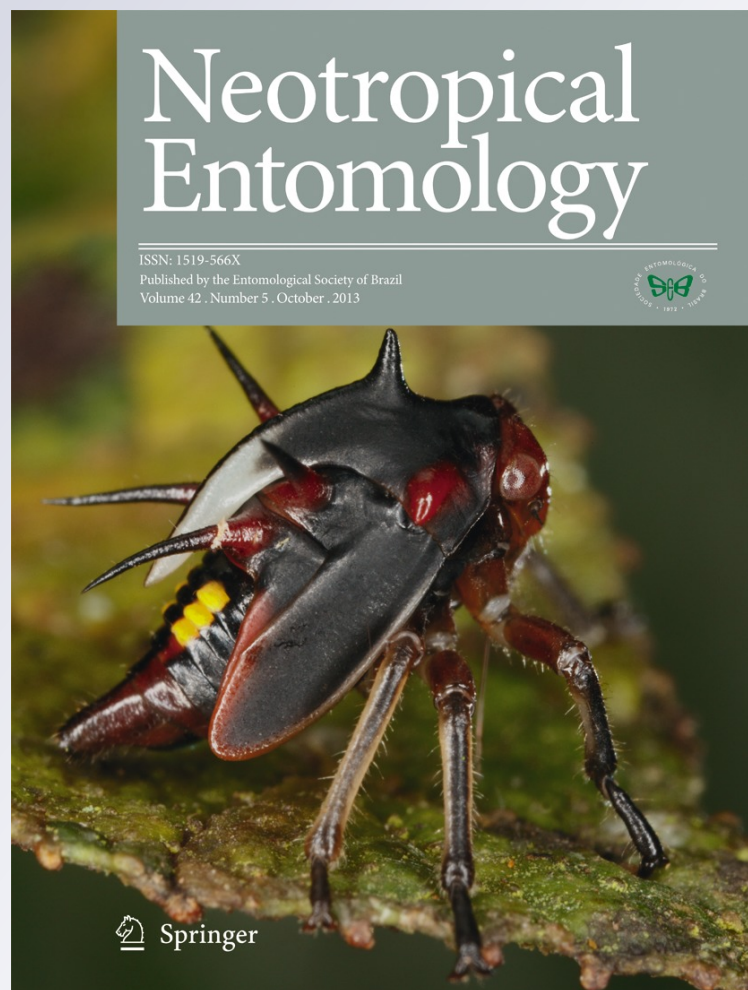
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# A Third Species of *Hemilecanium* Newstead (Hemiptera: Coccoidea: Coccidae) from the New World, with Keys to Species in the Genus

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## Keywords

Annonaceae, coccid, Colombia, soft scale insect, soursop, taxonomic keys

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## Introduction

Currently, there are 27 species of soft scale insects in the genus *Hemilecanium* Newstead (Hemiptera: Coccoidea: Coccidae), most of which occur in the Afrotropical region (22 spp.) (Hodgson 1991, 1993), with three species known from the Oriental region and two species from the New World (Kondo & Hardy 2008). The two New World species are *Hemilecanium montrichardiae* (Newstead) from Guyana and *Hemilecanium bursera* (Hodgson & Kondo) from Mexico (Newstead 1920, Hodgson & Kondo 2007, Kondo & Hardy 2008).

Until recently, most species of *Hemilecanium* were included in the genus *Etiennae* Matile-Ferrero. However, Kondo & Hardy (2008) synonymized *Etiennae* with *Hemilecanium* based on a comparative study of the morphology of the adult females, adult males and first instars (crawlers), including a phylogenetic analysis in which they recovered a sister-group relationship between the type species of the two genera, *Etiennae villiersi* Matile-Ferrero and *Hemilecanium theobromae* Newstead; that is, each of these species was more closely related to each other than either was to other species in their respective genera.

The genus *Hemilecanium* contains many pest species. For example, Campbell (1997) reported three species as pests of cocoa tree, *Theobroma cacao* (Malvaceae): *H. theobromae* in

## Abstract

A new species of *Hemilecanium* Newstead, *Hemilecanium guanabana* Kondo & Hodgson n. sp., is described and illustrated based on the adult female, adult male and first instar. The specimens were collected in the municipality of Palmira, state of Valle del Cauca, Colombia, on soursop, *Annona muricata* (Annonaceae). Updated identification keys are provided for the adult females of all 28 species of the genus *Hemilecanium*, and for known adult males and first instars. An updated list of the 23 species of soft scales (Coccidae) known from soursop worldwide is included.

Cameroon, *H. cacao* (Hodgson) in Nigeria and *Hemilecanium gouligouli* (Hodgson) in the Republic of the Congo. In India, Shafee *et al* (1989) reported *Hemilecanium imbricans* as a pest of tamarind, *Tamarindus indica* (Fabaceae). Hodgson (1991) reported *Hemilecanium petasus* (Hodgson) (as *Etiennae petasus*) on a leguminous tree in Nigeria causing dieback; it was found mainly on the underside of the lower shaded branches and was attended by ants. In Sukhothai Province, Sawankhalok District, Thailand, Kondo & Williams (2005) found *Hemilecanium mangiferae* Kondo & Williams causing serious infestations associated with sooty mold, especially on the native mango cultivar “Nam Dokmai”; on some trees, the surface of the twigs and branches was completely covered by these insects, and large amounts of sooty mold were growing on the honeydew on the trunk, branches and twigs, and also blackening the ground just below the infested canopy, while the leaves of the infested trees showed signs of yellowing. In another study, *Hemilecanium uesatoi* Kondo & Hardy was reported as a potential pest in the Ryukyu archipelago, Japan, where it was found on white sapote, *Casimiroa edulis* (Rutaceae), *Elaeocarpus sylvestris* (Elaeocarpaceae), *Ficus erecta* (Moraceae) and *Mallotus japonicus* (Euphorbiaceae) (Kondo & Hardy 2008).

On May 6, 2009, TK collected a soft scale insect in large numbers covering the branches and twigs of a soursop tree, *Annona muricata* (Annonaceae), planted in a research plot

at the Colombian Agriculture Research Corporation (Corpoica), in the municipality of Palmira, state of Valle del Cauca, Colombia. The insect was identified as an undescribed species of *Hemilecanium* Newstead and is described here based on the adult female, adult male and first-instar nymph. The new species of *Hemilecanium* can cause dieback of branches of heavily infested trees, and has the potential of becoming a pest if not properly managed. This is the third species of *Hemilecanium* recorded from the New World and brings the total worldwide to 28.

## Material and Methods

Specimens were slide-mounted according to the method given by Williams & Granara de Willink (1992), and were studied under an Olympus BX40 phase-contrast compound microscope. One specimen was mounted on each slide, unless otherwise stated. Illustrations of the insects followed the typical format adopted for scale insects, with the dorsal side drawn on the left side and the ventral side drawn on the right side. Enlargements of important structures are placed around the main illustration; however, these enlargements are not in direct proportion to each other. Measurements of slide-mounted specimens were made using an ocular micrometer. Measurements of total body length are presented in millimeters, whereas all other measurements are presented in micrometers as a range.

Descriptions were made based on multiple slide-mounted specimens. The terminology used to describe the adult female followed mostly that of Hodgson (1994), except that we have replaced the term “microductule” with “microduct” and “spiracular disc-pores” with “spiracular pores.” The term “pregenital disc-pores” has been avoided because in *Hemilecanium*, these multilocular pores are not restricted to the perivulvar (pregenital) region, and they can be present throughout the mid-areas of the venter, thus using the term “pregenital” is misleading. The term “multilocular pore” has been used for all the pores with multiple loculi, with the exception of spiracular pores. The terminology for the first instar followed that of Kondo & Williams (2005). Terminology and the system for measurement of the adult male (e.g. the length of the head is measured from the apex to the pronotal ridge) followed chiefly that of Giliomee (1967). Abbreviations used in the figures are as follows. Adult female: anal plate (anplt); antenna (ant); dorsal microduct (dm); dorsal setae (dset); dorsal tubercle (dtb); marginal seta (mset); multilocular pores (mp); preopercular pore (prp); simple pore (sp); spiracular pore (spp); ventral microduct (vm); ventral tubular duct (vtdct); ventral seta (vset). Adult male: antennal bristle (ab); anterior metasternal setae (amss); aedeagus (aed); anus (an); basal rod (bra); basisternum (stn2); capitate setae (caps); caudal extension (ce); claw (c); claw digitules (cdt); coxa (cx);

cranial apophysis (ca); dorsal abdominal setae (ads); dorsal simple eye (dse); femur (fm); fleshy setae (fs); furca (f); gena (g); genal setae (gs); hair-like setae (hs); lateral arm of midcranial ridge (lmcr); median crest (mc); mesepisternum (eps2); mesothoracic spiracle (sp2); metathoracic spiracle (sp3); ocelli (o); ocular sclerite (ocs); pedicel (pdc); penial sheath (ps); postocular ridge (pocr); precoxal ridges (pcr2); preocular ridge (procr); prescutal ridge (pscr); prescutum (prsc); pronotal ridge (prnr); proepisternum+cervical sclerite (pepcv); prosternum (stn1); scape (scp); scutum (sct); scutellum (scl); subepisternal ridge (ser); postalare (pa); postmetaspiracular setae (eps3s); posterior metasternal setae (pmss); tegular setae (tegs); trochanter (tr); ventral midcranial ridge (vmcr); ventral simple eye (vse). First-instar nymph: anal ring (ar); dorsal microduct (dm); dorsal seta (dset); marginal seta (mset); spiracular pore (spp); stigmatic setae (stgset); tarsal digitules (tdt); tarsi (ta); trilocular pore (trp); ventral cephalic seta (vcset); ventral microduct (vm); ventral submarginal setae (vsset).

Abbreviations for the depositories are as follows: The Natural History Museum, London, UK (BMNH), Colección Entomológica de la Universidad Nacional, sede Palmira, Palmira, Valle del Cauca, Colombia (CEUNP), Museo de Entomología, Corporación Colombiana de Investigación Agropecuaria, Centro de Investigación Palmira, Palmira, Valle del Cauca, Colombia (MECP), The United States National Museum of Natural History Coccoidea Collection, Beltsville, MD, USA (USNM), and Museo de Entomología, Universidad del Valle, Cali, Valle del Cauca, Colombia (UVCO).

## Results and Discussion

### Key to adult females of *Hemilecanium* Newstead

[Adapted from Kondo & Hardy (2008) and Hodgson (2008)]

1. Dorsal tubercles entirely absent .....2  
     Dorsal tubercles present, at least a few around body margin .....3
2. Anal plates together pyriform; eyespots present ..... *Hemilecanium recurvatum* Newstead  
     Anal plates together quadrate; eyespots absent ..... *Hemilecanium sinetuberculum* (Hodgson)
3. Cribriform plates present; dorsal tubercles restricted to submargins.....4  
     Cribriform plates absent; distribution of dorsal tubercles variable, normally restricted to submargins, but may be scattered over dorsum .....6

4. Dorsal tubular ducts present, each with a sclerotized funnel-shaped aperture .....*H. theobromae* Newstead  
Dorsal tubular ducts absent .....5
5. Derm sclerotization pronounced on mid-dorsum; submarginal dorsal tubercles numbering 41–66 ..... *H. imbricans* (Green)  
Derm sclerotization pronounced around anal plates; submarginal dorsal tubercles numbering 18–24 .....*H. mangiferae* Kondo & Williams
6. Stigmatic spines not differentiated from marginal setae .....7  
Stigmatic spines clearly differentiated from marginal setae .....10
7. Marginal setae setose, similar to ventral submarginal setae; prothoracic tibia and tarsus significantly narrower than those of other legs; dorsal tubercles without satellite tubular ducts .....*H. cacao* (Hodgson)  
Marginal setae sharply spinose, much thicker than ventral submarginal setae; prothoracic tibia and tarsus not significantly narrower than those of other legs; dorsal tubercles with satellite tubular ducts .....8
8. Pocket-like sclerotizations present; dorsal tubercles with satellite tubular ducts; posterior spiracular pore bands complete, extending in a line from area laterad to each spiracle to margin.....9  
Pocket-like sclerotizations absent; dorsal tubercles without satellite tubular ducts; posterior spiracular pore bands incomplete, composed of a small group of pores present next to each posterior spiracular peritreme ..... *Hemilecanium guanabana* Kondo & Hodgson sp. n.
9. Dorsal tubular ducts each with a funnel-like aperture; dorsal tubercles restricted to margins and submedial areas of dorsum, absent from mid-dorsum; ventral tubular ducts restricted to a fairly wide submarginal band, absent from mid-areas of venter ..... *H. villiersi* (Matile-Ferrero)  
Dorsal tubular ducts without a funnel-like aperture; dorsal tubercles scattered on dorsum; ventral tubular ducts present throughout venter ..... *Hemilecanium coriaceum* Hall
10. Dorsal tubercles with satellite tubular ducts; dorsum with long thin tubular ducts, each always with a funnel-like aperture .....11  
Dorsal tubercles without satellite tubular ducts; dorsum often without tubular ducts but when present, usually without a funnel-like aperture ..... 13
11. With fewer than 30 marginal setae between the stigmatic areas; dorsal tubular ducts restricted to a small group submedially in the abdomen; cell-like areolations of sclerotized dorsum in whorls ..... *Hemilecanium halli* (Hodgson)  
With more than 50 marginal setae between stigmatic areas; dorsal tubular ducts present or absent but when present, distributed throughout dorsum; cell-like areolations of sclerotized dorsum not in whorls .....12
12. With fewer than 70 preopercular pores; with eight-segmented antennae ..... *H. petasus* (Hodgson)  
With more than 200 preopercular pores, with nine-segmented antennae ..... *Hemilecanium kellyi* (Brain)
13. Antennae six-segmented ..... 14  
Antennae eight- or nine-segmented ..... 16
14. Dorsal tubercles scattered on dorsum; legs normally developed (tibia+tarsus generally longer than 200  $\mu\text{m}$ ); multilocular disc-pores abundant across all abdominal segments and across meso- and metathorax but scarce on prothorax and head; each posterior spiracular peritreme generally more than 1.7 times wider than basal width of metacoxa.....*Hemilecanium cedrelus* Hodgson  
Dorsal tubercles restricted to area around margins; legs reduced (tibia+tarsus less than 120  $\mu\text{m}$ ); multilocular disc-pores not abundant, only common immediately around genital opening and perhaps preceding segment, scarce on other abdominal segments, thorax and head; width of posterior spiracular peritremes smaller, usually less than basal width of metacoxa ..... 15
15. Dorsal tubular ducts with a funnel-like aperture; with more than 100 preopercular pores; ventral tubular ducts present in a fairly broad submarginal band .....*H. gouligouli* (Hodgson)  
Dorsal tubular ducts absent; with fewer than 50 preopercular pores; ventral tubular ducts present in a narrow submarginal band ..... *Hemilecanium ferox* (Newstead)
16. Pocket-like sclerotizations absent; dorsal setae near anal plates markedly longer than those near margins .....17

- Pocket-like sclerotizations present; dorsal setae near anal plates not usually markedly longer than those near margins .....19
17. Claw with a distinct denticle; with more than 18 dorsal tubercles per side; dorsal tubular ducts present ..... *Hemilecanium madagascariensis* (Hodgson)
- Claw without a denticle; with fewer than 12 dorsal tubercles per side; dorsal tubular ducts absent .....18
18. Multilocular pores abundant on head, thorax and abdomen ..... *Hemilecanium cephalomeatus* (Hodgson)
- Multilocular pores absent from head and thorax, restricted to abdominal segments VI and VII .....*Hemilecanium ulcusculum* (Hodgson)
19. Ventral tubular ducts present medially .....20
- Ventral tubular ducts absent medially .....22
20. Preopercular pores few, restricted to area immediately anterior to anal plates; dorsal tubercles almost flat ..... *Hemilecanium candelabra* (Hodgson)
- Preopercular pores abundant, extending well onto thorax; dorsal tubercles convex .....21
21. With fewer than 20 dorsal tubercles on each half of body; dorsal tubular ducts without a funnel-like aperture.....*Hemilecanium combreti* (Hodgson)
- With 25 or more dorsal tubercles on each half of body; dorsal tubular ducts with a well-developed funnel-like aperture ..... *Hemilecanium multituberculum* (Hodgson)
22. Multilocular pores usually restricted to 1–3 pregenital abdominal segments but occasionally found laterad to metacoxae, but always absent entirely on head and thorax ..... 23
- Multilocular pores found on all abdominal segments (at least medio-laterally) and also medially on thorax .....25
23. With fewer than 50 preopercular pores, rarely extending as far forward as prothorax; with more than 40 marginal setae between stigmatic areas ..... *Hemilecanium tafoensis* (Hodgson)
- With more than 100 preopercular pores, extending onto head region; with fewer than 30 marginal setae between stigmatic areas.....24
24. Antennae six-segmented; claw with a denticle; multilocular pores absent laterad to metacoxae .....*Hemilecanium carpenteri* (Newstead)
- Antennae eight-segmented; claw without a denticle; multilocular pores restricted to medio-lateral areas of abdomen and laterad to metacoxae .....*H. montrichardiae* (Newstead)
25. Antennae 6-segmented; multilocular pores rare or absent on mid-areas of anterior abdominal segments .....*H. bursera* (Hodgson & Kondo)
- Antennae eight-segmented; multilocular pores frequent to abundant on mid-areas of anterior abdominal segments .....26
26. Dorsal tubercles scattered on dorsum; stigmatic spines clavate ..... *H. uesatoi* Kondo & Hardy
- Dorsal tubercles restricted to area around margins; stigmatic spines sharply spinose .....27
27. Preopercular pores generally fewer than 70 and never extending onto head; antennae more than 400  $\mu\text{m}$  long; lateral stigmatic spines distinctly shorter than marginal spines .....*Hemilecanium ferina* (De Lotto)
- Preopercular pores generally more than 100, extending onto head region; antennae less than 300  $\mu\text{m}$  long; lateral stigmatic spines subequal in length to marginal spines ..... *Hemilecanium capensis* (Hodgson)

#### Key to known adult males of *Hemilecanium* Newstead

[Adapted from Kondo and Hardy (2008)]

1. Dorsospiracular setae present; ocular sclerite with two or three hs ventral head setae anterior to each ventral simple eye; with  $\geq 45$  anterior metasternal setae .....2
- Dorsospiracular setae absent; ocular sclerite with 0 or 1 ventral head setae anterior to each ventral simple eye; with  $\leq 40$  anterior metasternal setae .....3
2. Each side of body anterolateral to anus (abdominal segment VIII) with a cluster of four to six hs; dorsal surface of abdominal segment I with some fs; dorsal midcranial ridge with  $\leq 6$  fleshy setae (fs) +  $\leq 4$  hair-like setae (hs) ..... *H. uesatoi* Kondo & Hardy
- Each side of body anterolateral to anus (abdominal segment VIII) without setae; dorsal surface of abdominal

- segment I with only hs; dorsal midcranial ridge with  $\approx 15$ -fs +  $\approx 10$  hs ..... *H. petasus* (Hodgson)
3. Tergite of abdominal segment VIII without setae; membranous area of scutum with only one pair of small hs seta; with more than 10 fs postmetaspiracular setae ..... *H. guanabana* Kondo & Hodgson, sp. n.
- Tergite of abdominal segment VIII with setae; membranous area of scutum with 4+ pairs of setae; with fewer than 10 fs postmetaspiracular setae .....4
4. Hair-like ventral abdominal setae absent from medial areas of anterior abdominal segments; antennal segment III without a cluster of basiconic sensilla; dorsal midcranial ridge with six or seven fs+one or two hs ..... *H. villiersi* (Matile-Fererro)
- Hair-like ventral abdominal setae present on medial areas of anterior abdominal segments; antennal segment III with a conspicuous cluster of basiconic sensilla; dorsal midcranial ridge with two or three fs+four to eight hs ..... *H. theobromae* Newstead
- Key to known first-instars of Hemilecanium Newstead*
- [Adapted from Kondo & Hardy (2008) and Hodgson (2008)]
1. Dorsum with four subcircular clusters of four-ocular pores (cribriform plates), each spiracle associated with one spiracular pore only; all femora without setae as long as length of tibia plus tarsus .....2
- Dorsum without clusters of four-ocular pores (cribriform plates), each spiracle associated with two to four spiracular pores; femur of all legs, or at least femur of metathoracic legs, with a seta as long as or longer than tibia plus tarsus.....5
2. Most spiracular pores with two loculi, although occasionally with three or four loculi .....3
- Spiracular pores each with three or four loculi, no pores with two loculi.....4
3. Marginal setae totaling 72–76 around body .....*H. theobromae* Newstead
- Marginal setae totaling 47–50 around body .....*H. villiersi* (Matile-Ferrero)
4. Anterior cribriform plates each with 18–25 pores; posterior cribriform plates each with 21–30 pores; marginal setae 15–35  $\mu\text{m}$  long, gradually becoming longer towards anal lobes, with longest setae on anal lobes 35  $\mu\text{m}$  long .....*H. mangiferae* Kondo & Williams
- Anterior cribriform plates each with 30–48 pores; posterior cribriform plates each with 34–55 pores; marginal setae 39–57  $\mu\text{m}$  long, with longest setae on anal lobes up to 100  $\mu\text{m}$  long .....*H. imbricans* (Green)
5. Very long seta present on femur of metathoracic legs only.....*H. uesatoi* Kondo & Hardy
- Very long seta present on femur of all legs .....6
6. Dorsum with triangular or cone-shaped protuberances medially on most body segments.... *H. cedrelus* Hodgson
- Dorsum without triangular or cone-shaped protuberances .....7
7. A pair of dorsal setae on head region, each seta short, each about 2  $\mu\text{m}$  long. Known from South America .....*H. guanabana* Kondo & Hodgson
- Without a pair of dorsal setae on head region. Known from Africa.....8
8. Anal plates each narrow and long, each 80  $\mu\text{m}$  long and 32–37  $\mu\text{m}$  wide .....*H. multituberculum* (Hodgson)
- Anal plates not narrow and long, each 42–69  $\mu\text{m}$  long and 23–36  $\mu\text{m}$  wide .....9
9. Stigmatic spines short, median spine 17–22  $\mu\text{m}$  long, lateral spine 2–4  $\mu\text{m}$  long .....*H. ferox* (Newstead)
- Stigmatic spines longer, median spine 28–67  $\mu\text{m}$  long, lateral spine 2–9  $\mu\text{m}$  long .....10
10. Anal plates each 62–69  $\mu\text{m}$  long, 34–36  $\mu\text{m}$  wide; median stigmatic spines each 40–67  $\mu\text{m}$  long, lateral stigmatic spines each 6–9  $\mu\text{m}$  long .....*H. petasus* (Hodgson)
- Anal plates each 50–58  $\mu\text{m}$  long, 23–24  $\mu\text{m}$  wide; median stigmatic spines each 28–40  $\mu\text{m}$  long, lateral stigmatic spines each 2–8 mm long .....11
11. Spiracular pores totaling two or three per spiracle; lateral stigmatic spines each 5–8  $\mu\text{m}$  long .....*H. montrichardiae* (Newstead)
- Spiracular pores totaling three or four per spiracle; lateral stigmatic spines each 2–4  $\mu\text{m}$  long .....*H. sinetuberculum* (Hodgson)
- Hemilecanium *guanabana* Kondo & Hodgson n. sp.
- Proposed common names.* English: soursop giant soft scale; Spanish: escama blanda gigante de la guanábana; Portuguese: cochonilha gigante da graviola.

**Type material.** Holotype. Adult female. Colombia. Valle del Cauca: Palmira; Corporación Colombiana de Investigación Agropecuaria (Corpoica), Palmira Research Station, 06.v.2009, coll. T. Kondo, ex branches of *A. muricata* (soursop), one slide, one specimen (USNM). Paratypes. Same data as holotype. Seven adult females and ten first instars (USNM). Colombia. Valle del Cauca: Palmira, Corpoica, 11.viii.2010, coll. Rodrigo Lopez Bermudez, ex branches of *A. muricata* (soursop), six adult males (fair) (BMNH). Colombia. Valle del Cauca: Palmira, Corpoica, 03°30'34.6"N, 76°19'28.5"W, 1,007 m asl, 18.vi.2013, coll. Takumasa Kondo, ex branch of *A. muricata* (soursop), three boxes of dry material (MECP)(CEUNP)(UVCO).

#### Description of adult female

**Live appearance (Fig 1).** Adult females yellow ochre to brown in color; covered by an ornate waxy test; wax on mid-dorsal area of insect body light brown, with about 14 to 15 radial ridges, and two horn-like waxy protrusions on submedian area. A pair of small circular depressions present on mid-dorsum. Anal plates represented by dark spots. Wax at base dark brown.

**Mounted material (Fig 2).** Length 6.0–12.5 mm, width 5.5–10.5 mm. Body broadly oval. Measurements based on eight specimens.

**Dorsum.** Derm of young specimens membranous, with oval areolations, each areolation variable in shape, appearing to radiate from mid-dorsal area; each areolation with one microduct; derm becoming heavily sclerotized throughout on older specimens; anal cleft closely adpressed, approximately 1/4–1/5 body length. Dorsal setae (dset) each sharply to bluntly spinose, 12.5–22.5  $\mu\text{m}$  long, each with a heavily sclerotized socket; present more or less evenly throughout dorsum. Cribriform plates absent. Dorsal microducts (dm) oval, each 4.5–5.0  $\mu\text{m}$  wide, with a long inner ductule. Simple pores (sp) each approximately 1.8–2.0  $\mu\text{m}$  wide,



Fig 1 *Hemilecanium guanabana* n. sp. adult females and nymphs of various stages on branch of soursop, *Annona muricata*. Photo by T. Kondo.

scattered evenly on dorsum. Dorsal tubular ducts absent. Each dorsal tubercle (dtb) sclerotized, round to irregularly oval, large, each 25–35  $\mu\text{m}$  wide, without satellite tubular ducts on outer rim, but with one small subcentral microduct; rather scarce, present marginally and submarginally, with 10–12 around body, mainly on thorax and abdomen, scarce or absent on head. Pocket-like sclerotizations absent. Preopercular pores (prp) circular, slightly convex, each 7–12  $\mu\text{m}$  wide, present in two groups, one on each side antero-laterad of anal plates, rare or absent on mid-line just anterior to anal plates. Anal plates (anplt) together quadrate, with rounded outer angles; each plate 115–138  $\mu\text{m}$  long, 50–63  $\mu\text{m}$  wide, anterolateral margin 63–75  $\mu\text{m}$  long, posterolateral margin 92–105  $\mu\text{m}$  long; each plate with three setae on dorsal surface; with one pair of fringe setae, two pairs of hypopygial setae and approximately three ventral subapical setae on each side. Older specimens with a large heavily sclerotized area surrounding anal plates. Anal ring (not illustrated) heavily sclerotized, number of setae uncertain, but probably eight or ten.

**Margin.** Marginal setae (mset) spinose, with broad bases, each with heavily sclerotized socket; numerous, forming a marginal fringe, each marginal seta very close to neighboring setae; each 20–25  $\mu\text{m}$  long, with a few longer setae at apex of each anal lobe; with 52–88 on each side between anterior and posterior stigmatic clefts. Stigmatic clefts shallow or absent; stigmatic spines not differentiated from marginal setae. Eyespots present on dorsal margin just above level of antennal scape.

**Venter.** Derm entirely membranous. Multilocular pores (mp) each with 6–12 (mostly 10) loculi, each 7.5–10  $\mu\text{m}$  wide, abundant on perivulvar region; absent elsewhere. Spiracular pores (spp) mostly with five loculi, rarely a few pores with six loculi, present in a narrow band one to two pores wide between each spiracle and body margin; anterior spiracular pore band complete; posterior spiracular pore band usually incomplete, with pores usually clustering just anterior to posterior peritremes, occasionally with a few pores extending closer to margin. Ventral microducts (vm) each 3–4  $\mu\text{m}$  wide, scattered rather evenly throughout venter. Ventral tubular ducts (vtdct) of one type, each with a large terminal gland; present in a wide submarginal band. Ventral setae (vset) present, each 10–15  $\mu\text{m}$  long, with three pairs of ventral median setae on abdominal segments VI–VIII, each 88–124  $\mu\text{m}$  long; ventral submarginal setae present, less frequent than marginal setae. Spiracles normal, anterior peritremes each 55–63  $\mu\text{m}$  wide, posterior peritremes each 63–68  $\mu\text{m}$  wide. Legs normal, but very small in relation to body size, without a tibiotarsal articulatory scleriosis, all segments with few setae; claw denticles absent; with one claw digitule broader than other; tarsal



digitules knobbed, slender, one slightly thicker than other; prothoracic legs smallest; dimensions (prothoracic legs): coxa 140–150  $\mu\text{m}$  long, trochanter+femur 170–180  $\mu\text{m}$  long, tibia+tarsus 173–180  $\mu\text{m}$  long, claw 23–25  $\mu\text{m}$  long; meso- and metathoracic legs: coxa 165–178  $\mu\text{m}$  long, trochanter+femur 165–180  $\mu\text{m}$  long, tibia+tarsus 185–205  $\mu\text{m}$  long, claw 23–28  $\mu\text{m}$  long. Antennae (ant) each with seven segments; total length 158–185  $\mu\text{m}$ ; interantennal setae on each side of body composed of four or five setae, present near each scape. Clypeolabral shield+tentorium 210–270  $\mu\text{m}$  wide.

#### Description of adult male

**Unmounted material.** Insects dark red brown to purplish brown, eyes dark. Likely with a pair of caudal wax filaments. Wings translucent, except for a narrow purplish area along the radius.

**Mounted material (Fig 3).** Moderate in size; slender, body 1.75–1.95 mm long; 445–500  $\mu\text{m}$  across mesothorax. Measurements based on six specimens.

Antennae slightly longer than half total length of body. Body with few setae, mostly fleshy setae (fs); hair-like setae (hs) few but mostly easily separable from fs. Pores absent apart from on margin of ventral simple eyes. Wings rather short, length only two thirds total body length; width about half length.

**Head.** Outline oval, with a distinct posterior bulge ventrally with ventral simple eyes. Median crest (mc) well developed and reticulated, with about six or seven fs and two to four hs dorsal head setae (dhs) on each side. Dorsal mid-cranial ridge absent; ventral mid-cranial ridge (vmcr) represented by a quite long medial ridge, with a pair of well-developed lateral arms (lmcr) at anterior end; with one or two hs ventral mid-cranial ridge setae near posterior end of vmcr. Genae (g) membranous, with about 18–20 fs+7 or 8 hs genal setae (gs). Eyes: two pairs of simple eyes, dorsal pair (dse) slightly smaller than ventral pair (vse) (dse 50–60  $\mu\text{m}$  wide; vse 60–70  $\mu\text{m}$ ); posterior pair positioned a long way posteriorly; each vse with a line of small convex pores on outer margin, number uncertain. Ocelli (o) quite large and oval, about 29–33 $\times$ 18–20  $\mu\text{m}$  wide; more or less surrounded by sclerotization from postocular ridge (pocr). Ocular sclerite (ocs) sclerotized, with polygonal reticulations, each reticulation without small inner microridges. Preocular ridge (procr) fairly short, not nearly reaching mid-cranial ridge medially.

Postocular ridge (pocr) well developed and dorsally extending well past inner margin of dorsal simple eyes. Interocular ridge absent. Dorsal ocular setae present, one or two on each side. Ventral head setae: 0 or 1 anterior to each ventral eye. Tentorial bridge well developed. Cranial

apophysis (ca) elongate, 65–78  $\mu\text{m}$  long, with an almost straight to slightly bifurcate distal margin.

**Antennae.** Ten-segmented, filiform; total length 1.0–1.2 mm; scape (scp) 33–54  $\mu\text{m}$  long, 50–55  $\mu\text{m}$  wide, with one hs on ventral surface and one or two hs near anterodorsal margin; pedicel (pdc) faintly reticulated, 60–62  $\mu\text{m}$  long, 50–60  $\mu\text{m}$  wide, with 15–19 fs+1 or 2 hs (no sensilla placodeum detected); segments III–X rather narrow, width mainly 30–45  $\mu\text{m}$ , with mainly fs, each slightly longer (35–40  $\mu\text{m}$ ) than width of segment, as follows: III 58–66  $\mu\text{m}$  long, with about 10 fs+0–2 basiconic sensilla; IV 170–195  $\mu\text{m}$  long, with 33–43 fs+0 or 1 hs; V 140–145  $\mu\text{m}$  long, with 32–36 fs+0 or 1 hs; VI 125–145  $\mu\text{m}$  long with 26–30 fs+0 or 1 hs; VII 115–157  $\mu\text{m}$  long with 20–40 fs+0 or 1 hs; VIII 78–100  $\mu\text{m}$  long with 17–26 fs, 1 antennal bristle (ab); IX 75–92  $\mu\text{m}$  long with 14–24 fs+1 ab; X 78–92 long, with about 30 fs, two hs, three large and two small ab+three capitate setae (caps).

**Thorax. Prothorax:** pronotal ridge (prnr) well developed but not fused dorsally; with a lateral pronotal sclerite. All setae absent on prothorax. Post-tergite not detected, considered to be absent. Prosternum (stn1) with a well-sclerotized transverse ridge but median ridge poorly sclerotized. Proepisternum+cervical sclerite (pepcv) well developed. **Mesothorax:** Prescutum (prsc) wider than long, slightly rounded anteriorly, sclerotized; probably rather convex in life, length about 145  $\mu\text{m}$ , width 215–220  $\mu\text{m}$ ; without prescutal setae. Prescutal ridge (pscr) and prescutal sclerite well developed. Prealare and triangular plate well developed. Scutum (sct): median membranous area probably rather narrow, length unclear, width about 270  $\mu\text{m}$ ; with 0 or 1 pair of very small hs scutal setae; lateral sclerites sclerotized and heavily reticulated laterad to scutellum (anterior arms also lightly reticulated on well-stained specimens); prealare ridges well developed, terminating in a well-developed anterior notal wing process. Tegula well developed, with 5–7 hs tegular setae (tegs). Scutellum (scl) semitubular, with a large foramen; length 66–90  $\mu\text{m}$ ; width 270–290  $\mu\text{m}$ ; scutellar setae absent. Mesopostnotum (pn2) showing nothing distinctive; postnotal apophysis well developed. Mesepisternum (eps2) without reticulations. Basisternum (stn2) generally quite large, 175–212  $\mu\text{m}$  long, 340–375  $\mu\text{m}$  wide; median ridge well developed but weak at anterior end; basisternum bounded by sclerotized marginal ridges and strong precoxal ridges (pcr2); without basisternal setae; furca (f) basally broad, furcal arms extending anteriorly to at least halfway to marginal ridge. Lateropleurite large. Subepisternal ridge (ser) well developed. Postalare (pa) not apparently striated and without postalare setae. Mesothoracic spiracle (sp2) 33–36  $\mu\text{m}$  wide. Postmesospiracular setae absent. **Metathorax:** metatergal setae and dorsospiracular setae

absent. Metapleural ridge absent. Episternum unsclerotized, with 4–20 fs postmetaspiracular setae (eps3s). Metepimeron present but weak; without setae. Antemetaspiracular setae absent. Metathoracic spiracle (sp3) about 35  $\mu\text{m}$  wide. Metasternum membranous. With about 25 to at least 40 fs anterior metasternal setae (amss) (occasionally one hs) and 18–20 fs posterior metasternal setae (pmss). Hamulohalteres and all associated structures absent. Metapostnotum not detected.

**Wings.** Hyaline, 1.38 mm long, 0.67–0.68 mm wide; without alar lobes or alar setae.

**Legs.** metathoracic legs longest; fairly setose. Lengths ( $\mu\text{m}$ ): coxae (cx) I 107–115, II 120–133, III 140; III with many setae, mainly fs. Trochanter (tr)+femur (fm): I 310–330, II 285–300, III 335–350; trochanter without a long ventral seta; both trochanter and femur with mainly fs. Tibia (ti) I 365–395, II 350–405, III 500–510; setae mainly fs but with some hs and spur-like setae, particularly on distal third of leg; with one large apical spur (tibs) each 33–37  $\mu\text{m}$  long. Tarsi (ta): I 150–155, II 125–160, III 165; with mainly fs; tarsal spur 30–34  $\mu\text{m}$  long; tarsal campaniform pore absent; tarsal digitules (tdt) fairly short and apically clubbed; rather shorter than claw. Claws (c) rather elongate and narrow, subequal to or slightly shorter than width of tarsi, about 28–30  $\mu\text{m}$  long, with a distinct denticle; claw digitules (cdt) narrow, clubbed, a little longer than claw.

**Abdomen.** Mainly membranous, but with weak sclerotization on tergite and sternite VIII; membranous areas posterior to sternites II, III, IV and V well developed medially. Caudal extension (ce) of segment VII well developed. Dorsal abdominal setae (ads) extremely few, with 0 or 1 pair of hs submedially on segments IV–VII. Dorsopleural setae few, present on segments IV–VII, mainly fs but with about 18 fs+2 hs on ce of segment VII. Ventropleural setae slightly more frequent and mainly fs. Ventral abdominal setae (avs) more abundant than on dorsum: II about 11–20 fs+0 or 1; III 12–16 fs, IV 3–9 fs+1 or 2 hs, V 4–12 fs+1–4 hs, VI 4–10 fs+1–5 hs, and VII 7–10 fs+2–6 hs. Segment VIII: tergite lightly sclerotized; with a small group of two to four hs setae on each side of anus on a small fleshy protuberance, perhaps all that remains of caudal extension VIII. Without ante-anal setae medially. Sternite (as VIII) sclerotized, forming anterior section of penial sheath, without setae. Glandular pouches absent.

Genital segment: penial sheath (ps) well developed, long and stout, 355–410  $\mu\text{m}$  long, and about 115  $\mu\text{m}$  wide at base, narrowing to about 50  $\mu\text{m}$  wide for most of length; articulating anteriorly with sclerotized sternite of segment VIII; posterior end with numerous small sensilla; and ps with

about 15 small setae. Anus (an) clearly present dorsally. Basal rod (bra) quite long, about 250–320  $\mu\text{m}$  long but also with an extension down aedeagus; more or less reaching basal membranous area anteriorly. Aedeagus (aed) short, only 190–205  $\mu\text{m}$  long, with a blunt apex; not nearly reaching apex of penial sheath.

#### *Description of first instar*

**Unmounted material.** Newly hatched first-instar nymphs (before producing their waxy test) purplish brown, with a yellowish submargin and a yellowish to lighter mid-dorsal line.

**Mounted material.** Body elongate oval. Length 480–570  $\mu\text{m}$ , width 250–320  $\mu\text{m}$ . Stigmatic clefts shallow. Anal cleft well developed. Measurements based on ten specimens.

**Dorsum.** Derm membranous throughout and smooth. One pair of dorsal setae (dset) on head region, very short, 2  $\mu\text{m}$  long, often hard to detect and may appear like a pore (Fig 4 shows their different appearances). One pair of trilocular pores (trp) present on head near margin, each about 2.5  $\mu\text{m}$  at widest point. Small microducts (dm), each 3  $\mu\text{m}$  wide and appearing bilocular, found submedially and submarginally from head toward apical region in six longitudinal rows. Simple pores not detected. Subcircular clusters of four-locular pores absent. Anal plates mildly sclerotized, each 57–58  $\mu\text{m}$  long, 17–27  $\mu\text{m}$  wide; antero-lateral margin each 30–31  $\mu\text{m}$  long, postero-lateral margin each 22–23  $\mu\text{m}$  long. Each plate with four postero-dorsal setae: one on mesal margin and three apical; median apical seta as long as half body length. Anal fold with one pair of anterior margin setae. Anal ring (ar) with a row of irregularly shaped pores and six anal ring setae.

**Margin.** Margins smooth. Stigmatic clefts shallow. Marginal setae (mset), sharply spinose, straight or slightly bent. Total number of marginal setae 32 or 33: with 8 anteriorly between eyes; 2 or 3 between each eye and anterior stigmatic setae; 2 or 3 between each group of anterior and posterior spiracular setae, and 8 between posterior spiracular setae and body apex. Stigmatic setae (stgset) rather variable, usually totaling three, sharply or bluntly spinose, with median seta longest, 40–45  $\mu\text{m}$  long, lateral setae 4–10  $\mu\text{m}$  long; but often with a single long stigmatic seta, and one or two marginal setae nearest to stigmatic setae thickened. Eyespots present on margin just above level of antennal scape.

**Venter.** Derm membranous. Spiracles small, round or oval in shape; peritremes each 7.5–8.8  $\mu\text{m}$  wide. Spiracular

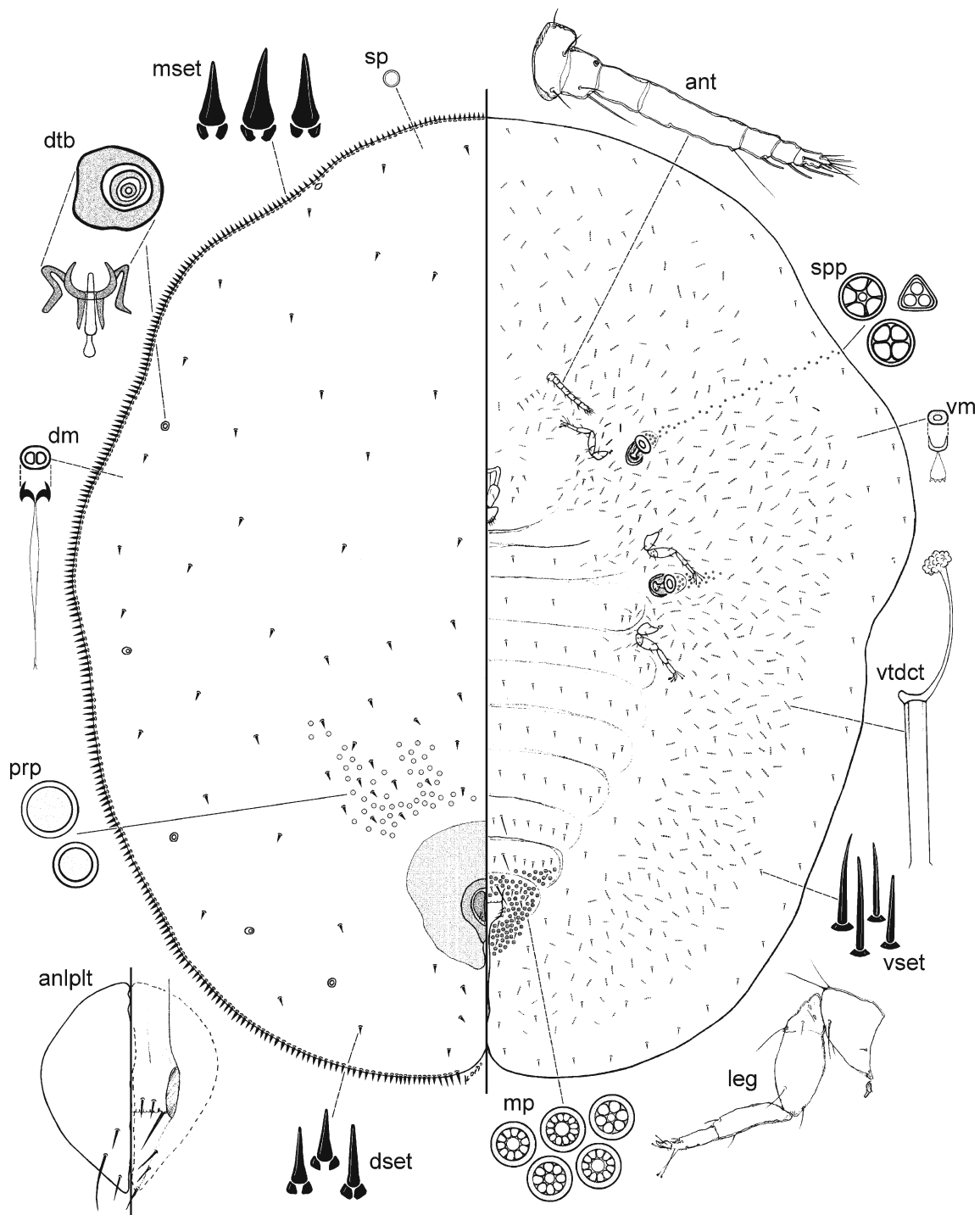


Fig 2 *Hemilecanium guanabana* n. sp., adult female (Refer to Material and Methods for the list of abbreviations).

pores (spp) each 3  $\mu\text{m}$  wide with four loculi; with three lateral to each anterior spiracle and four lateral to each posterior spiracle. Ventral submarginal setae (vsset) slender, each 7–10  $\mu\text{m}$  long; with seven pairs in two parallel longitudinal rows on each side of body between posterior spiracle and anal cleft, one seta on area between anterior and posterior stigmatic areas, and one pair of longer ventral cephalic setae (vcset), each 8–12  $\mu\text{m}$  long. Three pairs of

ventral submedian setae on posterior abdominal segments; and one pair of interantennal setae between antennal scapes. Ventral microducts (vmic) present submarginally, each 2  $\mu\text{m}$  wide, with (on each side) two between antennal base and each anterior spiracle, three between spiracles, and six between inner and outer submarginal setae in abdominal region on each side of body. Legs well developed, with separate tibia and tarsus, without tibio-tarsal

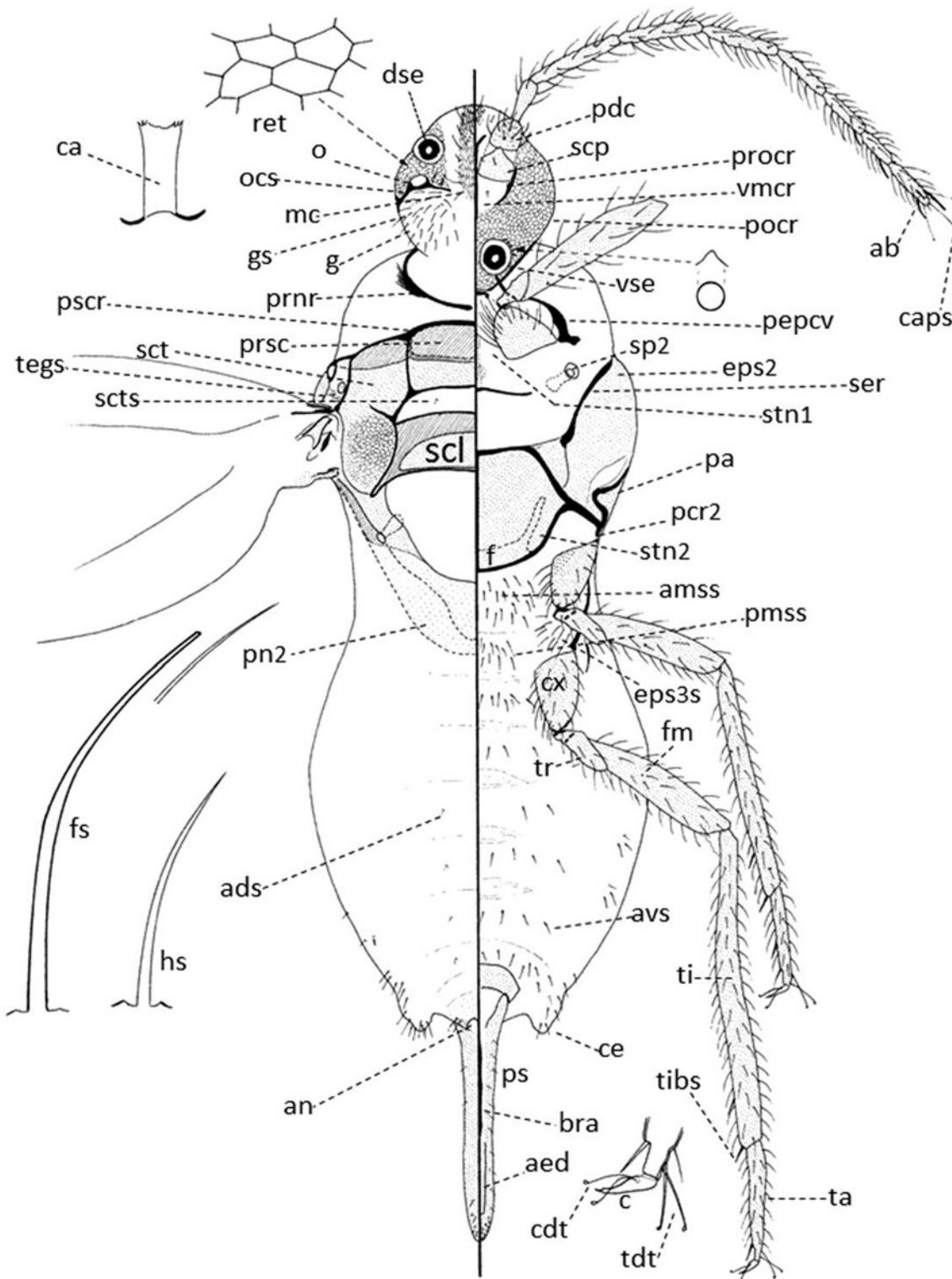


Fig 3 *Hemilecanium guanabana* n. sp., adult male (Refer to Material and Methods for the list of abbreviations).

scleroses; claw with a small denticle. Tarsal digitules slender, knobbed, subequal in length and longer than claw digitules; latter also knobbed, one thicker than the other, longer than claw and subequal in length. Dimensions (all legs): coxa 48–60  $\mu\text{m}$  long (at widest point), trochanter+femur 70–87  $\mu\text{m}$

long, tibia+tarsus, 103–125  $\mu\text{m}$  long, claw 19–20  $\mu\text{m}$  long. Antennae six segmented, 135–193 mm long, each with extremely long setae on segments III and VI. Mouthparts normal, clypeolabral shield+tentorium 75–100  $\mu\text{m}$  wide; labium one segmented, with four pairs of setae.

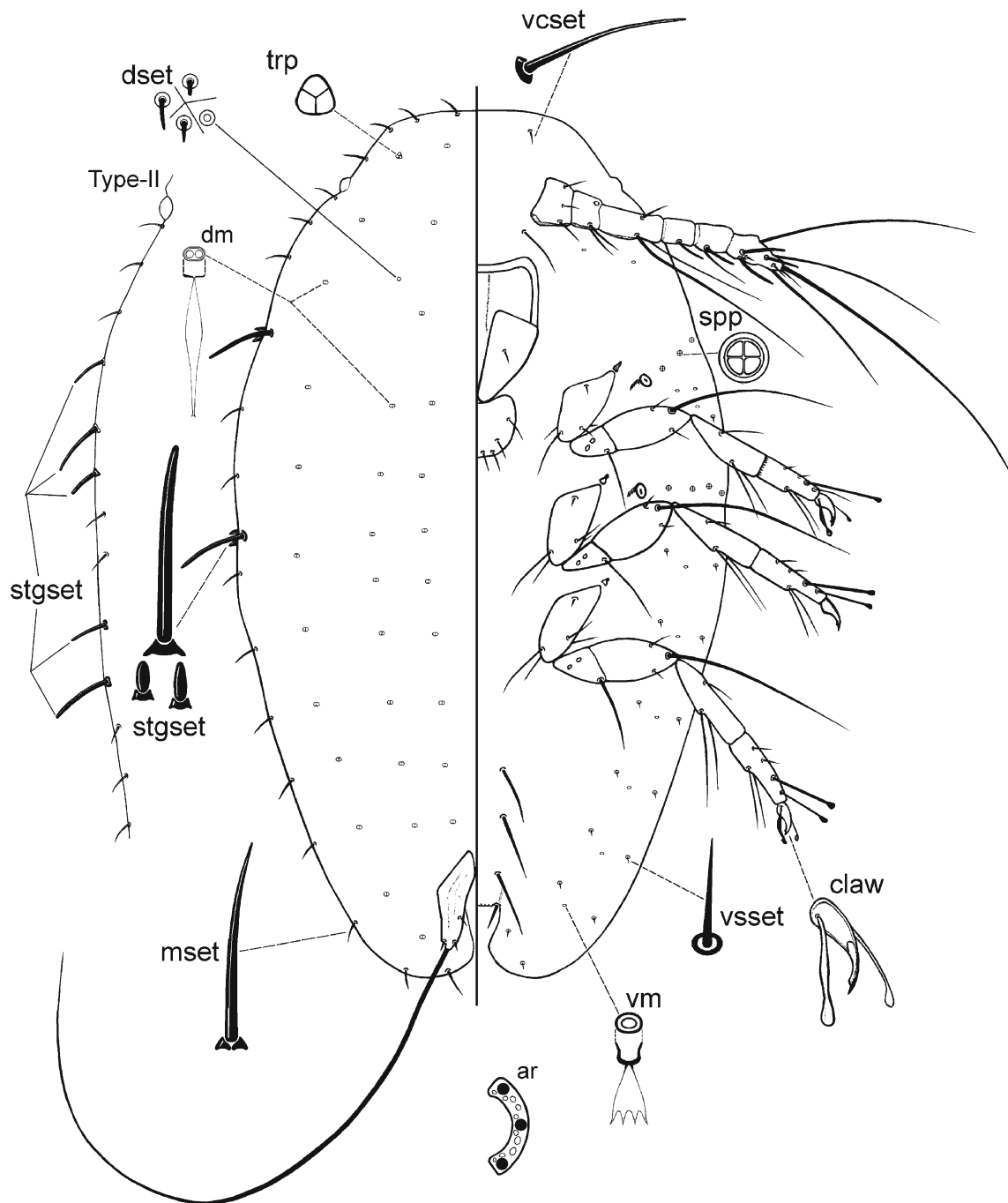


Fig 4 *Hemilecanium guanabana* n. sp., first-instar nymph (Refer to Material and Methods for the list of abbreviations).

**Etymology.** The species epithet 'guanabana' is the Spanish name for soursop, the only known host of the species. It is a noun in apposition.

**Host plants.** *Annona muricata* (Annonaceae).

**Distribution.** Neotropical Region. Colombia: Valle del Cauca, Palmira.

**Biology.** Sexual. Insects found in association with *Azteca* sp. (Hymenoptera: Formicidae: Dolichoderinae) ants and often

covered by ant cartons. Different growth stages commonly observed on infested twigs and branches. Collected throughout the year.

**Notes.** The adult female of *H. guanabana* can be separated from its congeners by the combination of the following features: (1) lack of dorsal cribriform plates; (2) lack of dorsal tubular ducts; (3) dorsal tubercles of the type lacking satellite tubular ducts, restricted to dorsal margins and submargins; (4) preopercular pores present in two groups,

one on each side antero-laterad of anal plates, rare or absent on mid-line just anterior to anal plates; (5) stigmatic spines not differentiated from marginal setae; (6) marginal setae sharply spinose; (7) presence of a broad submarginal band of ventral tubular ducts; (8) multilocular pores abundant but restricted to segments VI and VII; and (9) antennae with 7 segments. The morphology of the male of *H. guanabana* agrees well with the generic diagnosis of the adult male of *Hemilecanium* as given by Kondo & Hardy (2008). All the known *Hemilecanium* males are very similar, only differing in a few small features. First instars of *H. guanabana* are typical of the *petasus* group characterized by having a very long seta on the femur of all legs; but can be separated from other species in the *petasus* group by the presence of a pair of short setae on the dorsum.

#### Scale insects on soursop, *A. muricata*

According to the scale insect database ScaleNet (Ben-Dov et al 2012), there are 75 species of scale insects (Hemiptera: Coccoidea) distributed in eight families recorded on soursop, *A. muricata*, distributed as follows: Coccidae (21 spp.), Diaspididae (18 spp.), Eriococcidae (1 sp.), Kerriidae (3 spp.), Lecanodiaspididae (1 sp.), Monophlebidae (3 spp.), Pseudococcidae (24 spp.) and Stictococcidae (4 spp.). With the addition of *H. guanabana* and *C. cirripediformis* [reported by Kondo (2008), but not in ScaleNet (Ben-Dov et al 2012)], the list of soft scale insects on soursop in Colombia is elevated to ten species. Furthermore, although not reported in ScaleNet (Ben-Dov et al 2012), *Ceroplastes eugeniae*, *Ceroplastes lamborni*, *Ceroplastes theobromae* and *Waxiella egbara* (as *Ceroplastes ugandae*) have also been recorded on soursop (Newstead 1910, 1911, 1913, Kondo 2008; Hodgson & Peronti 2012), thus the list of soft scale species (Coccidae) on soursop worldwide is elevated to 27 species; and the total number of scale insects (Coccoidea) is increased to 81 species.

Below is a list of species of soft scale insects (Hemiptera: Coccidae) found on soursop in Colombia and worldwide (compiled from Newstead 1910, 1911, 1913, Mosquera 1984, Ochoa-Lázaro 1989, Kondo 2001, 2008, Ben-Dov et al 2012, Hodgson & Peronti 2012). Species reported from Colombia are marked as [Col]. Species not listed in ScaleNet (Ben-Dov et al 2012) are marked with an asterisk (\*): *Anthococcus keravatae* Williams & Watson, *Ceroplastes cirripediformis* Comstock [Col], *Ceroplastes deodorensis* Hempel, \**Ceroplastes eugeniae* Hall, *Ceroplastes floridensis* Comstock [Col], \**Ceroplastes lamborni* Newstead, *Ceroplastes quadrilineatus* Newstead, *Ceroplastes rusci* (Linnaeus), \**Ceroplastes theobromae* Newstead, *Ceroplastodes ritchiei* Laing, *Coccus celatus* De Lotto, *Coccus hesperidum* Linnaeus [Col], *Coccus longulus* (Douglas) [Col], *Drepanococcus chiton* (Green), *Eucalymnatus tessellatus* (Signoret) [Col], *Hemilecanium guanabana* Kondo & Hodgson

[Col], *Milviscutulus mangiferae* (Green), *Paralecanium milleri* Takahashi, *Parasaissetia nigra* (Nietner) [Col], *Phalacrocooccus howertoni* Hodges & Hodgson, *Philephedra broadwayi* (Cockerell) [Col], *Philephedra tuberculosa* Nakahara & Gill, *Pulvinaria urbicola* Cockerell, *Saissetia coffeae* (Walker) [Col], *Saissetia neglecta* De Lotto [Col], *Trijuba oculata* (Brain), and \**Waxiella egbara* (Cockerell).

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