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Transfer of the myrmecophilous soft scale insect *Neolecanium amazonensis* Foldi to *Foldilecanium* gen. nov. (Hemiptera: Coccidae), with description of a new species from Colombia.

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**Abstract.** *Neolecanium amazonensis* Foldi is redescribed and illustrated and is transferred to the **new genus** *Foldilecanium* Kondo as *Foldilecanium amazonensis* (Foldi) **comb. nov.** A **new species**, *Foldilecanium multisetosus* Kondo, is described and illustrated based on specimens collected in Cali, Colombia, on *Cananga odorata* (Lam.) Hook.f. and Thomson (Annonaceae). An updated taxonomic key to New World Myzolecaniinae and a key to separate the two species of *Foldilecanium* are provided.

**Key words.** Coccoidea, soft scale insect, taxonomic key, Myzolecaniinae, Toumeyella group.

**Resumen.** *Neolecanium amazonensis* Foldi se redescrive e ilustra y se transfiere al **nuevo género** *Foldilecanium* Kondo como *Foldilecanium amazonensis* (Foldi) **comb. nov.** Una **nueva especie**, *Foldilecanium multisetosus* Kondo, es descrita e ilustrada con base en ejemplares colectados sobre *Cananga odorata* (Lam.) Hook.f. y Thomson (Annonaceae) en Cali, Colombia. Se provee una clave actualizada para la subfamilia Myzolecaniinae del Nuevo Mundo y otra para separar las dos especies de *Foldilecanium*.

**Palabras clave.** Coccoidea, escamas blandas, clave taxonómica, Myzolecaniinae, grupo Toumeyella.

## Introduction

In March 2006, I collected specimens of a myrmecophilous soft scale insect in Cali, Colombia, on the twigs of a cananga tree (*Cananga odorata* (Lam.) Hook.f. and Thomson) inside ant shelters of an ant, *Azteca* sp. (Hymenoptera: Formicidae: Dolichoderinae). After studying the morphology of the insects under the microscope, it was determined to be similar to *Neolecanium amazonensis* Foldi (1988) from the Amazonian rain forest in Brazil. However, the two species are not conspecific and the Colombian species is herein described as a new species.

I agree with Kondo and Williams (2004), who considered the genus *Neolecanium* Parrot, 1901, as a synonym of *Toumeyella* Cockerell, 1895. But *N. amazonensis* is not congeneric with *Lecanium* (*Toumeyella*) *mirabile* Cockerell, 1895, the type species of the genus *Toumeyella*. *Neolecanium amazonensis* differs from *Toumeyella* (including *Neolecanium*) by the following combination of features (character states of *Toumeyella* in parenthesis): (1) anal plates located near mid-dorsum (anal plates located about 1/5 of body length near posterior margin); (2) anal plates together pyriform (anal plates together quadrate); (3) stigmatic setae totalling 2-7 in number (generally 0-3); (4) perivulvar pores absent (present); (5) ventral tubular ducts absent (present); (6) antennae and legs normal, although small (antennae and legs greatly reduced); and (7) prevulvar setae absent (3 pairs of long prevulvar setae present).

*Neolecanium amazonensis* and the new species from Colombia fit into the subfamily Myzolecaniinae, but the two species share some morphological features that differ from other taxa included in this subfamily, thus, the new genus *Foldilecanium* is here erected to accommodate them.

## Materials and Methods

Specimens were slide-mounted following the method described by Williams and Granara de Willink (1992), but xylene was used instead of clove oil. Descriptions are based on multiple slide-mounted specimens; the morphology of the adult female is described both as unmounted and as mounted on a micro-

scope slide. Each drawing is a generalization of several specimens and was made with the assistance of a camera lucida attached to a phase contrast compound microscope. The illustrations of the adult females show the dorsum on the left and the venter on the right following the traditional format for scale insect descriptions. The body length (at longest point) and width (at widest point) of the adult female is given in millimeters (mm) as mounted on the slide; other measurements are given in microns ( $\mu\text{m}$ ). The number of specimens measured for each description is given in parenthesis. The redescription of *N. amazonensis* [now *F. amazonensis*] is based on measurements and observations on paratypes deposited at the Museum National D'Histoire Naturelle (MNHN) in Paris, France. Specimens of the new species are deposited in the United States National Museum, Smithsonian Institution, Washington, DC (USNM).

Photographs of the insects in life were taken with a Nikon COOLPIX 3100 digital camera, and were processed using the computer program Adobe Photoshop 5.0. An updated taxonomic key to the adult females of the coccid genera of Myzolecaniinae that occur in the New World was modified from Kondo (2010) and Kondo and Williams (2009). The terminology used to describe the adult female follows mostly that of Hodgson (1994) except that the terms “microductule” and “spiracular disc-pores” were replaced with “microduct” and “spiracular pores” respectively.

## Taxonomy

### Key to genera of New World Myzolecaniinae based on adult females

(Modified from Kondo 2010; Kondo and Williams 2009)

1. Anal plates located near mid dorsum; ventral tubular ducts absent ..... 2
- Anal plates not located near mid dorsum, generally found at about 1/5 of body length from posterior margin; ventral tubular ducts present or absent ..... 3
  
- 2(1). Anterior spiracular pore band incomplete, not extending to margin, posterior spiracular pore band extending to margin; marginal setae cylindrical, peg-like; stigmatic setae absent ..... *Cyclolecanium Morrison*
- Anterior spiracular pore band complete, extending to margin; marginal setae sharply to bluntly spinulose, not peg-like; stigmatic setae present, totaling 2-7 ..... *Foldilecanium Kondo, gen. nov.*
  
- 3(1). Stigmatic clefts deep; dorsal sclerotized plates associated with each spiracle ..... *Cryptostigma Ferris*
- Stigmatic clefts shallow or absent, or rarely deep; without dorsal sclerotized plates associated with each spiracle ..... 4
  
- 4(3). Dorsal microducts around body margin conspicuously larger than rest of microducts on dorsum ..... *Octolecanium Kondo*
- Dorsal microducts around body margin not conspicuously larger than rest of microducts on dorsum ..... 5
  
- 5(4). Large bilocular pores (probably macroducts), present in 1 or 2 small groups anterior to anal plates; marginal setae slender, sharply spinose, with tips mostly pointed, but some with lanceolate, or bifurcate apices, arranged in 1 or 2 rows, numerous (distance between each marginal seta less than half the length of a seta) ..... *Aztecalecanium Kondo and Williams*
- Groups of large bilocular pores or macroducts absent from area anterior to anal plates; marginal setae variable, arranged in 1 row, not as numerous (distance between each marginal seta more than the length of a seta) ..... 6
  
- 6(5). Preopercular pores absent; dorsum with dense pattern of invaginated bilocular microducts; stigmatic setae absent ..... *Pseudophilippia Cockerell*
- Preopercular pores present; dorsal microducts variable, generally without dense pattern of invaginated bilocular microducts; stigmatic setae usually present, rarely absent ..... 7

- 7(6). Ventral tubular ducts absent ..... 8  
 – Ventral tubular ducts present at least around perivulvar area ..... 9
- 8(7). Dorsum of slide-mounted specimens with a dense pattern of microducts. Young adult females in life covered by a white cottony to powdery wax, although this powdery wax disappears in old specimens. Perivulvar pores mostly with 5 loculi and one central loculus ..... ***Bombacoccus* Kondo**  
 – Dorsum of slide-mounted specimens without a dense pattern of microducts. Adult females in life covered by a thin layer of glassy wax. Perivulvar pores mostly with 7 or 8 loculi and with 2 or 3 central loculi ..... ***Akermes* Cockerell**
- 9(7). Ventral tubular ducts present at least in a submarginal band on abdominal region and extending to area around posterior spiracular pore band ..... ***Neotoumeyella* Kondo and Williams**  
 – Ventral tubular ducts present, but not distributed as above ..... 10
- 10(9). Ventral tubular ducts located around vulva and mediolaterally on abdomen; dorsal setae lanceolate; stigmatic clefts deeply invaginated ..... ***Megasaissetia* Cockerell**  
 – Ventral tubular ducts located around vulva and often also on posterior abdominal segments, but absent mediolaterally on abdomen; dorsal setae generally sharply spinose, rarely lanceolate; stigmatic clefts absent or shallowly invaginated ..... ***Toumeyella* Cockerell**

### Genus *Foldilecanium* Kondo, new genus

Type species: *Neolecanium amazonensis* Foldi, 1988: 80.

**Generic description, adult female.** Insect body oval to broadly oval in shape.

**Dorsum.** Derm membranous, becoming sclerotized in older specimens. Dorsal setae absent. Dorsal microducts scattered over dorsum. Preopercular pores present around anal plates and extending in a narrow mid-dorsal line anteriorly up to area dorsad to mouthparts or antennae. Simple pores of 2 types: type (i) pore small, scattered over dorsum; type (ii) pore medium in size, under high magnification appearing as having numerous loculi, scattered over dorsum and intermixed with type (i) pores. Dorsal tubular ducts, dorsal tubercles and pocket-like sclerotizations absent. Anal plates together broadly pyriform, with smooth rounded outer angles, plates located near mid-dorsum, each plate with 9-14 setose setae on dorsal surface. Anal ring with 10 setae. A well-developed sclerotic area present around anal plates in mature specimens, or at least around upper half of plates.

**Margin.** Marginal setae sharply to bluntly spinose. Stigmatic clefts shallow to deep, each with 2-7 stigmatic setae; stigmatic setae bulbous, or sharply to bluntly spinose, all more or less subequal in length. Eyespots present or absent.

**Venter.** Derm entirely membranous. Perivulvar pores completely absent. Spiracular pores with 3-6 (mostly 5) loculi, present in a narrow band as wide as peritreme or narrower, with band of pores extending laterally from each spiracle to body margin. Ventral microducts scattered evenly throughout, but in dense concentration around labium. Ventral tubular ducts absent. Ventral submarginal setae slender, straight or slightly bent, present in a single row. Ventral setae across abdominal segments sharply spinose, longer and thicker than other setae. Anterior spiracular peritremes generally smaller than posterior peritremes. Legs well developed, but small compared to body size, claws with or without a denticle. Antennae each 6 segmented, with fleshy setae present on last three antennal segments. Interantennal setae totaling 3 pairs. Mouthparts well developed; labium 1 segmented, with 4 pairs of labial setae.

**Etymology.** The new genus *Foldilecanium* is named for Dr. Imre Foldi, coccidologist and author of the type species. The name is a combination of the name Foldi and “*lecanium*” which is an ending commonly used for scale insect names. Gender masculine.

**Key to separate the known species of *Foldilecanium* Kondo**

1. Stigmatic setae bulbose and/or spinose with sharp or rounded tips, totaling 3 (rarely 2 or 4) per stigmatic cleft; marginal setae bluntly to sharply spinose ..... *F. amazonensis* Foldi, **comb. nov.**
- Stigmatic setae spinose with rounded tips, totaling 5-7 per stigmatic cleft; marginal setae bluntly spinose, with parallel sides ..... *F. multisetosus* Kondo, **sp. nov.**

***Foldilecanium amazonensis* (Foldi) comb. nov.**

(Fig. 1)

**Proposed common names.** Spanish: Escama blanda de la Amazonia; English: Amazonian soft scale.**Holotype.** Adult female, 1(1) (Manaus: Instituto Nacional de Pesquisas da Amazonia, Coleção Sistemática de Entomologia, Brasil). Brazil, Manaus, km 60, 2.xii.1985, coll. Imre Foldi, ex *Pourouma cecropiifolia* Mart., inside ant shelters of ants.**Type material studied.** Holotype not studied. Paratypes, same data as holotype, 2 slides 3 specimens (MNHN).**Unmounted material.** Young adult female slightly convex, subspherical, yellowish-white. Old females, convex, strongly sclerotized, reddish-brown, dorsal margins rolled (Foldi 1988).**Slide-mounted material** (Fig. 1). Slide mounted specimens 1.7 mm long, 2.0 mm wide; body oval in shape (Foldi 1988).**Description.** Adult female (measurements based on n=3).**Dorsum.** Derm membranous, becoming sclerotized in older specimens. Dorsal setae absent. Dorsal microducts (dmic) each about 3.0 µm wide, scattered over dorsum. Simple pores (sp) of 2 types: type (i) pore small, with a thick sclerotized rim, often with a sclerotized center, each about 3.0 µm wide, scattered over dorsum; type (ii) pore median in size, each about 4.5 µm wide, under high magnification appearing as having about 8 loculi, scattered over dorsum and intermixed with type (i) pores. Preopercular pores (prop) each 4.0-5.5 µm wide, present around anal plates and extending medially towards head region. Anal plates (aplt) together broadly pyriform, with smooth rounded outer angles, plates located about mid-dorsum, dorsad to area between just posterior to metathoracic legs, each plate 232-248 µm long, 97-130 µm wide, anterolateral margin 173-200 µm long, posterolateral margin 108-124 µm long, with 13 or 14 setae on dorsal surface, 1 pair of fringe setae anteriorly, ventral subapical setae 3 pairs, and hypopygial setae about 8 pairs. Anal ring (ar) with 10 setae. Well-developed sclerotic area present around anterior part of anal plates.**Margin.** Marginal setae (mgset) bluntly to sharply spinose, each 10-15 µm long, arranged in an irregular single row, with 15-20 setae on each side between anterior and posterior stigmatic areas. Stigmatic clefts shallow, each with 2-4 (mostly 3) stigmatic seta (stgset) per stigmatic area, each clavate to bluntly spinose, 8-16 µm long. Eyespots present on dorsal margin.**Venter.** Derm entirely membranous. Spiracular pores (spp) each 3.5-4.5 µm wide, with 3-7 (mostly 5) loculi, present in a narrow band as wide as peritreme (about 2-4 pores wide), with band of pores extending laterally from each spiracle to body margin, fused pores often present. Ventral microducts (vmic) scattered evenly throughout, but in dense concentration around labium, each about 3.0 µm wide. Ventral setae (vset): submarginal setae slender, each 6.4-11.0 µm long, present in a single row; ventral setae across abdominal segments, sharply spinose, each 11-17 µm long; elsewhere setose and 8.5-11.0 µm long. Anterior spiracular peritremes each 62-72 µm wide, posterior peritremes each 72-81 µm wide. Legs well developed, but small, claw with a denticle; anterior tarsal digitules dissimilar, one spiniform, the other knobbed; meso- and methathoracic tarsal digitules similar, both knobbed. Antennae (ant) each 188-200 µm long, 6 segmented, with fleshy setae present on last three antennal segments. With 3 pairs of interantennal setae. Clypeolabral shield 164-187 µm wide; labium 1 segmented, with 4 pairs of labial setae.

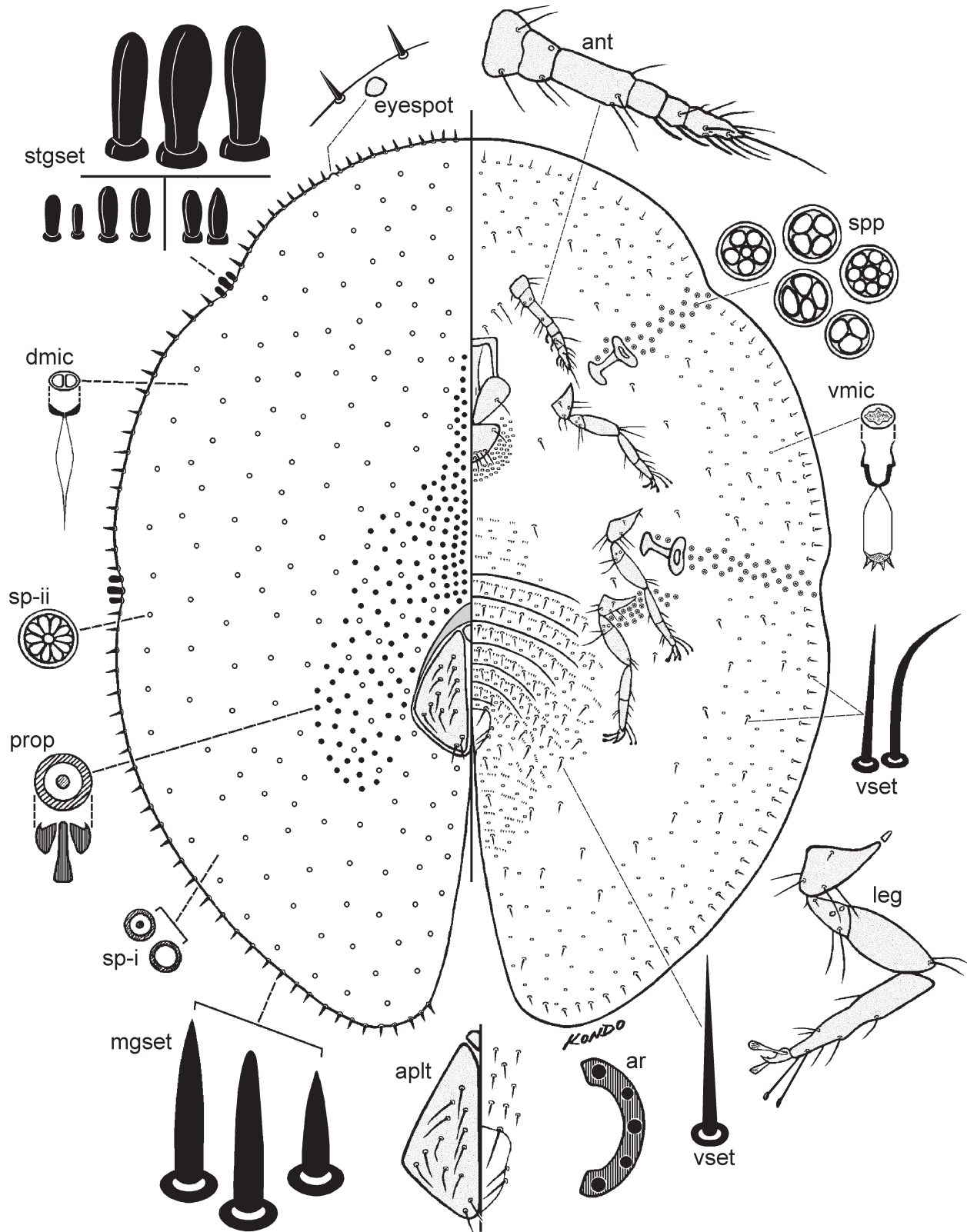
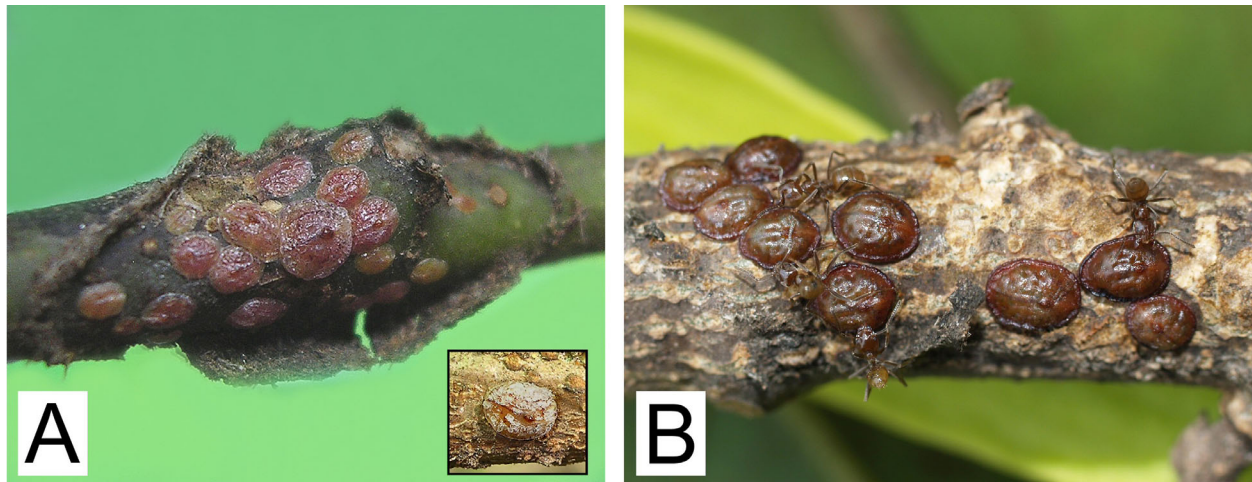


Figure 1. *Foldilecanium amazonensis* (Foldi), adult female.



**Figure 2.** *Foldilecanium multisetosus* Kondo. **A)** Colony of various growth stages, with adult females in center of photo. Inset photo showing an adult female with flaky, glassy wax cover. **B)** Colony of older and heavily sclerotized adult females being tended by *Azteca* sp. ants. All photos taken after removal of ant cartons.

**Diagnosis.** The adult female of *F. amazonensis* can be diagnosed by the combination of the following features: (1) dorsal setae completely absent; (2) simple pores of 2 types; (3) preopercular pores present around anal plates and extending medially towards head region; (4) anal plates together broadly pyriform, with 13-14 setae on dorsal surface; (5) sclerotic area present at least around anterior part of anal plates; (6) marginal setae spinose, with pointed or round tips, with 15-20 setae on each side between anterior and posterior stigmatic areas; (7) stigmatic clefts shallow, each with 2-4 (mostly 3) stigmatic setae; (8) eyespots present; (9) spiracular pores with 3-7 (mostly 5) loculi, (10) dense concentration of ventral microducts around labium; (11) ventral setae across abdominal segments, sharply spinose, setose elsewhere; (12) legs well developed, but small, claw with a denticle; (13) antennae 6 segmented. *Foldilecanium amazonensis* comes closest to its congener *F. multisetosus*, however, the two can be easily separated by the combination of the following features (features of *F. multisetosus* in parenthesis): (1) stigmatic setae bulbous to spinose with sharp or rounded tips, totaling 3 (rarely 2 or 4) per stigmatic cleft (stigmatic setae spinose with rounded tips, totaling 5-7 per stigmatic cleft); (2) marginal setae bluntly to sharply spinose (marginal setae bluntly spinose, with parallel sides).

**Biology.** The soft scales were found on the underside of the leaf blades near the petiole insertion. Colonies were covered by ant cartons (Foldi 1988).

**Distribution.** Neotropical region. Brazil.

**Hosts. Urticaceae:** *Pourouma cecropiifolia* Mart.

**Notes.** Eyespots were observed on specimens of *F. amazonensis*, a morphological feature which was not detected on specimens of *F. multisetosus*. The area of sclerotization around the anal plates was less pronounced in the studied material of *F. amazonensis* when compared to specimens of *F. multisetosus*, however, this difference in the amount of sclerotization may well be a result of age. There appears to be a difference also in the number of loculi of the type (ii) dorsal simple pores, with *F. amazonensis* having about 8-loculi and *F. multisetosus* with 10-loculi. Good quality slide-mounts and high magnification are needed in order to count the number of loculi on type (ii) simple pores, which are not easy to see.

***Foldilecanium multisetosus* Kondo sp. nov.**

(Fig. 2-3)



**Proposed common names.** Spanish: Escama blanda multisetosa; English: Multisetose soft scale.

**Type material examined.** Holotype, adult female. Colombia, Valle del Cauca, Cali, 03°18'08.7"N, 76°32'06.7"W, 1005 m a.s.l., 1.iii.2006, coll. Takumasa Kondo, ex twigs of *Cananga odorata* (Lam.) Hook.f. and Thomson, inside ant shelters of *Azteca* sp., 1(1) (USNM). Paratypes, same data, 19 (22 specimens: 17 adult females + 2 third-instar nymphs + 1 second-instar nymph + 2 first-instar nymphs) (USNM).

**Unmounted material (Fig. 2).** Adult female in life about 3.0 mm long, 2.8 mm wide, oval, moderately convex. Scale covered by a thin layer of a flaky glassy wax (see inset on Fig. 2A). Young adult females (Fig. 2A) slightly convex, orange to purplish red in color, often with mottlings of a darker color. Older specimens (Fig. 2B) becoming heavily sclerotized, brown in color, with thick and dark color elevated rim around body margins.

**Slide-mounted material (Fig. 3).** Slide mounted specimens 1.8-3.0 mm long, 1.5-2.6 mm wide, body oval in shape.

**Description.** Adult female (measurements based on n=18).

**Dorsum.** Derm membranous, becoming sclerotized in older specimens. Dorsal setae completely absent. Dorsal microducts (dmic) each about 2.0  $\mu$ m wide, scattered over dorsum. Simple pores (sp) of 2 types: type (i) pore small, with a thick sclerotized rim and a small central opening, each 2.5-3.0  $\mu$ m wide, scattered over dorsum; type (ii) pore median in size, each 4.0-5.0  $\mu$ m wide, with a thick rim, and a larger central opening, under high magnification appearing as having about 10 loculi, scattered over dorsum and intermixed with type (i) pores. Preopercular pores somewhat similar to type (ii) pore, each 4.0-6.0  $\mu$ m wide, surrounded by a sclerotized rim, present around anal plates and extending in a narrow mid-dorsal line anteriorly up to area dorsad to antennae. Dorsal tubular ducts, dorsal tubercles and pocket-like sclerotizations absent. Anal plates (aplt) together broadly pyriform, with smooth rounded outer angles, plates located about mid-dorsum, dorsad to area between just posterior to metathoracic legs, each plate 210-265  $\mu$ m long, 100-125  $\mu$ m wide, anterolateral margin 160-200  $\mu$ m long, posterolateral margin 135-150  $\mu$ m long, with 9-14 setose setae on dorsal surface, plus 1 pair of fringe setae anteriorly, ventral subapical setae 3 pairs, and hypopygial setae about 5 pairs. Anal ring (ar) with 10 setae. A well-developed sclerotic area present around anal plates in mature specimens.

**Margin.** Marginal setae (mset) bluntly spinose, straight, with parallel sides, each 10-15  $\mu$ m long, arranged in an irregular single row, with about 20-30 on each side between anterior and posterior stigmatic areas. Stigmatic clefts shallow to deep, each with 5-7 stigmatic seta (stgset) per stigmatic area, each conical, with shorter and longer setae, each 20-40  $\mu$ m long. Eyes not detected.

**Venter.** Derm entirely membranous. Spiracular pores (spp) each 4.0-5.0  $\mu$ m wide, with 3-6 (mostly 5) loculi, present in a narrow band as wide as peritreme (about 2-4 pores wide), with band of pores extending laterally from each spiracle to body margin. Ventral microducts (vmic) scattered evenly throughout, each about 2.5-3.0  $\mu$ m wide. Ventral tubular ducts absent. Ventral submarginal setae slender, straight or slightly bent, present in a single row; ventral setae each 7.5-28.0  $\mu$ m long, with longest setae present across abdominal segments. Anterior spiracular peritremes each 70-78  $\mu$ m wide, posterior peritremes each 73-83  $\mu$ m wide. Legs well developed, but small, each coxa 50-95  $\mu$ m long, trochanter + femur 108-133  $\mu$ m long; tibia + tarsus 118-155  $\mu$ m long, without tibio-tarsal scleroses; claw 18.0-23.0  $\mu$ m long, without a denticle. Antennae (ant) each 182-200  $\mu$ m long, 6 segmented, with fleshy setae present on last three antennal segments. With 3 pairs of interantennal setae, each interantennal setae 7.5-30.0  $\mu$ m long. Clypeolabral shield 163-213  $\mu$ m wide; labium 1 segmented, with 4 pairs of labial setae.

**Diagnosis.** The adult female of *F. multisetosus* can be diagnosed by the combination of the following features: (1) dorsal setae completely absent; (2) simple pores of 2 types; (3) preopercular pores present around anal plates and extending medially towards head region; (4) anal plates together broadly pyriform, with 9-14 setae on dorsal surface; (5) sclerotic area present around anal plates; (6) marginal setae bluntly spinose, with parallel sides, with 20-30 setae on each side between anterior and posterior stigmatic areas; (7) stigmatic clefts shallow, each with 5-7 stigmatic setae; (8) eyespots not detected; (9) spiracular pores with 3-6 (mostly 5) loculi, (10) dense concentration of ventral microducts around labium; (11) ventral setae across abdominal segments, sharply spinose, setose elsewhere; (12) legs well developed, but small, claw without a denticle; (13) antennae 6 segmented. *Foldilecanium multisetosus* comes closest to its

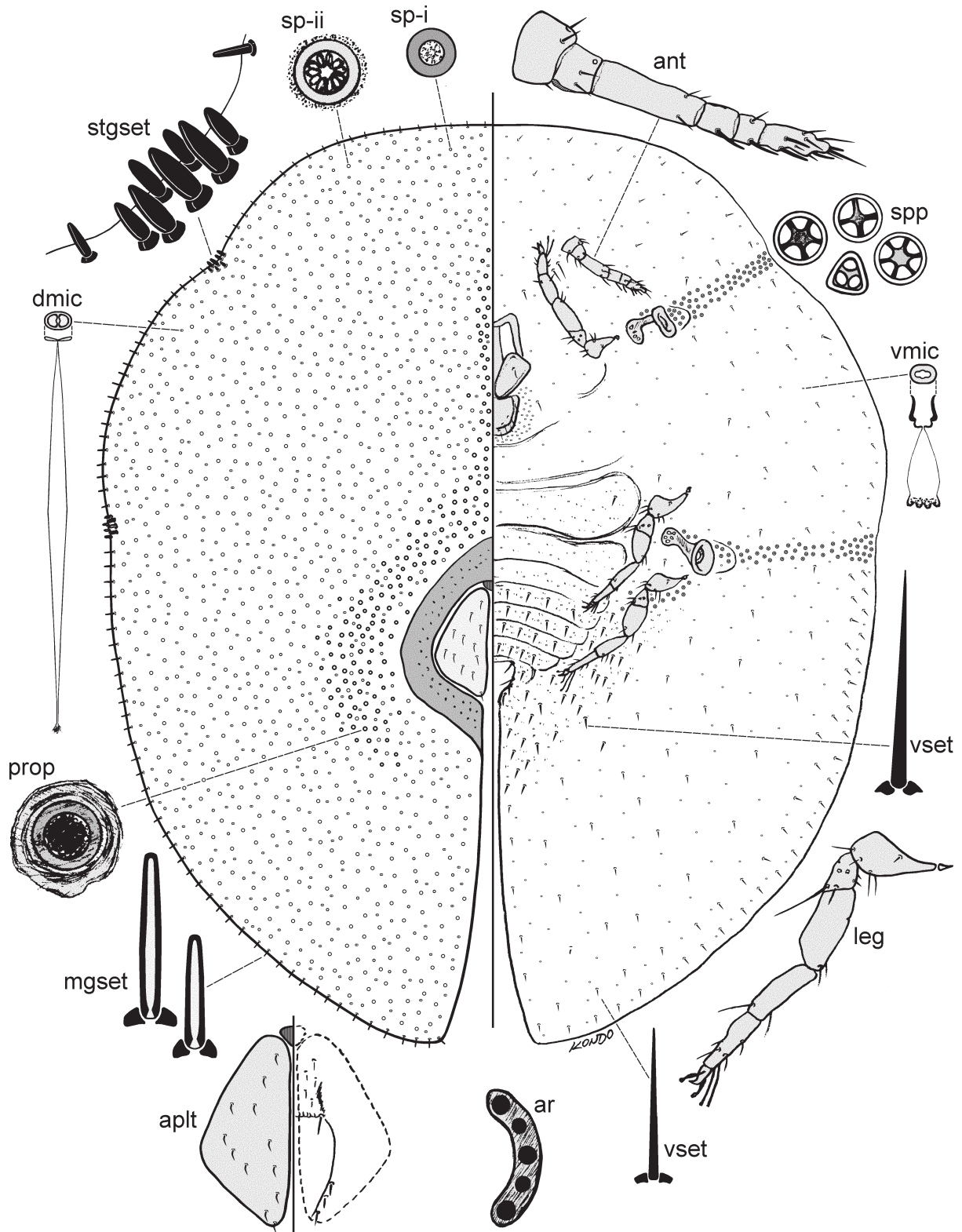


Figure 3. *Foldilecanium multisetosus* Kondo, adult female.

congener *F. amazonensis*, however, the two can be easily separated by the combination of features given in the diagnosis section of *F. amazonensis* (see also Notes under *F. amazonensis*).

**Etymology.** The species epithet “*multisetosus*” is named after the many (5-7) stigmatic setae of the species. Gender male.

**Biology.** The soft scales were abundant on the twigs of its host and tended by *Azteca* sp. ants inside ant cartons. Colonies were composed of different growth stages.

**Distribution.** Neotropical region. Colombia.

**Hosts. Annonaceae:** *Cananga odorata* (Lam.) Hook.f. and Thomson.

**Notes.** The cananga tree, *Cananga odorata* is common throughout Polynesia, Micronesia, Melanesia, throughout its native Indo-Malayan region, and is currently distributed pantropically (Manner and Elevitch 2006). *Foldilecanium* is likely endemic to the New World, thus *C. odorata* is probably not the original host of *F. multisetosus*.

The flaky wax covering the dorsum of *F. multisetosus* was observed on a single specimen found under an ant carton. Most specimens lack this flaky wax, possibly because the ants remove it either accidentally while tending the soft scales for their honeydew, or purposely to use it as part of the building material for their carton shelters.

Foldi (1988) described the adult female of *F. amazonensis* as having pronounced reddish-brown rolled margins (“brun-rougeâtre à bourrelet dorso-marginal prononcé”), probably describing the same type of margins observed on old adult females of *F. multisetosus* (see Fig. 2B).

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