EUROPEAN JOURNAL OF ENTOMOLOGY
ISSN (online): 1802-8829
http://www.eje.cz
Eur. J. Entomol. **121**: 182–196, 2024
doi: 10.14411/eje.2024.019
ORIGINAL ARTICLE

Kevinilla, a new velvet ant genus in the Sphaeropthalminae (Hymenoptera: Mutillidae)

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Key words. Taxonomy, Pseudomethocini, molecular analysis, seasonal flight activity, Neotropical, Panama

Abstract. The new genus *Kevinilla* Bartholomay & Cambra includes the following four Neotropical species: *Kevinilla ludovica* (Cameron, 1895) comb. n. (the type species), *K. bicarinata* (Cambra & Quintero, 2008) comb. n., *K. bimaculata* (Cambra & Quintero, 2008) comb. n., and *K. hansoni* (Cambra & Quintero, 2008) comb. n., all transferred from *Pseudomethoca*. A neighbour joining tree clustered IST1 sequences of *Kevinilla* in a subclade of the main clade, which includes species of *Pseudomethoca* and *Dasymutilla*. Therefore, here *Kevinilla* is considered to be a member of the subfamily Sphaeropthalminae, tribe Pseudomethocini. A key for both sexes of the known species of *Kevinilla* is given, as well as an account of seasonal flight activity of males recorded over six years using Malaise traps on Barro Colorado Island, Panama.

ZooBank Article Registration: https://zoobank.org/urn:lsid:zoobank.org:pub:2C07D282-36E9-445D-940E-EBB7CAE41A86

INTRODUCTION

Mutillidae (commonly known as velvet ants) are a group of solitary wasps with marked sexual dimorphism in which the males are mostly winged, rarely brachypterous or apterous, whereas females are always wingless. Such differences make sexual associations in this family very difficult, which results in most species and indeed many genera being known only from a single sex (Lelej & Brothers, 2008). In addition, until the turn of the 20th century the overwhelming majority of mutillid species described in the world were in a single genus, *Mutilla* Linnaeus, 1758, which is restricted to the Old World (Klug, 1821; Gerstaecker, 1874; Cresson, 1902).

This complex taxonomic scenario resulted in many "dumping ground" genera (or "wastebasket" genera), i.e. presumably polyphyletic supraspecific taxa in which species of unclear affinities are placed (Gould, 1985). Sexual associations play an important role in such cases for Mutillidae by helping to better understand the placement of certain groups of species whose generic position is doubtful, since such associations can provide additional morphological characters. Such was the case for the two of the most widespread and morphologically diverse mutillid genera in the Neotropical region, *Dasymutilla* Ashmead, 1899 and *Traumatomutilla* André, 1901 (Dasymutillini), which at some stage in their history included other distinct and undescribed genera (Williams et al., 2019a; Bartholomay et al., 2019b).

A similar situation appears to occur in the highly variable *Pseudomethoca* Ashmead, 1896 (Pseudomethocini), which is widespread in the New World (Pagliano et al., 2020), lacks a comprehensive review of its 130+ species (Brothers & Lelej, 2017; Pagliano et al., 2020) and according to the recent phylogeny of Waldren et al. (2023) is nonmonophyletic. Cambra & Quintero (2008) described three new species of *Pseudomethoca* related to *Pseudomethoca ludovica* (Cameron, 1895), all based only on females, which are considered to be a species group with common morphological characteristics. The sexual associations and morphological characters of females and males

of *Pseudomethoca ludovica* (Cameron, 1895), *P. bimaculata* (Cambra & Quintero, 2008) and *P. hansoni* (Cambra & Quintero, 2008) allow the recognition of these species as belonging to a new genus in the Sphaeropthalminae. Here the new genus *Kevinilla* Bartholomay & Cambra is described to include these three species and their hitherto unknown males are also described. Molecular analyses and phylogenetic relationships of this new genus are discussed. In addition, a key for males is presented as well as information on their seasonal flight activity.

MATERIAL AND METHODS

Taxonomic treatment

The following acronyms are used for morphological structures: T2, T3, etc., for second, third, etc. metasomal terga; S for metasomal sterna. Measurements of flagellomere lengths follow those of Bartholomay et al. (2019a). The length of the lateral felt line in relation to the length of T2 was measured in lateral view from base to apex of T2.

Photographs of both sexes of *Kevinilla bimaculata* and *K. hansoni* and of the male of *K. ludovica* were taken using a Leica M205A stereomicroscope coupled with a Leica DMC 4500 camera and the photographs stacked using the software Leica Application Suite v4.10.0 Interactive Measurements, Montage. Photographs of the females of *K. bicarinata* and *K. ludovica* were taken using a CMOS digital camera adapted to Leica Microsystems stereomicroscope model S9i LED2500 using the Leica Application Suite X software and stacked using Adobe Photoshop version CS6 software.

The specimens examined were deposited in the Museo de Invertebrados G.B. Fairchild, University of Panama, Panama (MIUP); Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazonia, Manaus, Amazonas, Brazil (INPA); Instituto Nacional de Biodiversidad (INBio, currently Museo Nacional de Costa Rica); and Natural History Museum, London, England (BMNH).

Seasonal flight activity

The seasonal flight activity of males of three of the four known species of *Kevinilla* (*K. bimaculata*, *K. hansoni* and *K. ludovica*) was recorded at the field station of the Smithsonian Tropical Research Institute on Barro Colorado Island (BCI). Information on the study site and the Malaise traps used are discussed in Cambra et al. (2018).

Molecular methods

Each specimen was transferred to a 1.5 ml Eppendorf tube and frozen in liquid nitrogen. The frozen specimens were each crushed with a glass rod modified to fit the bottom of the tube. DNA was extracted using an EZNA Tissue DNA kit (Omega Biotek, Georgia, USA, D3396-01) following the manufacturer's protocol. Polymerase chain reaction (PCR) was used to amplify ITS1 region of nuclear genome with primers 5′-GATTACGTCCCTGCCCTTTG-3′and 5′-CGATGATCAAGTGTCCTGCA-3′ (Pilgrim & Pitts, 2006).

PCR amplification was done in 25 ml volumes containing 2 ml DNA template (~200 ng), 12.5 ml 2× PCR Mastermix (Omega, Bio-Tek TQ 2200-01), 0.5 ml of each primers (10 mM) and 12 ml of nuclease free water. Thermal cycler conditions were 1.5 min at 94°C, followed by 35 cycles of 30 s at 94°C, 60 s at 52°C and 60 s at 72°C with a final extension of 5 min at 72°C (Pilgrim & Pitts, 2006). Amplified DNA fragments of approximately 800 bp were visualized in agarose gels containing GelRed (Biotium, catalog 41003) and sent to Psomagen (Psomagen, Maryland, USA) for purification and sequencing in both directions using the same PCR primers.

Table 1. Sequences used for construction of the phylogenetic tree (Fig. 9).

Species	Gene	GenBank Acc. No.
Odontophotopsis piute	ITS1	GU814321.1
Sphaeropthalma angulifera	ITS1	GU814383.1
Dasymutilla castor	ITS1	EU627533.1
Pseudomethoca propinqua	ITS1	DQ408487.1
Photomorphus bicolor	ITS1	GU814335.1
Kevinilla bimaculata	ITS1	PP002413
Kevinilla hansoni	ITS1	PP002414

Sequences were edited and aligned with Sequencher 5.4.6 software (Gene Codes Corporation, Ann Arbor, USA) to obtain a 708 bp sequence from a specimen of *Kevinilla bimaculata* and a 730 bp sequence of *Kevinilla hansoni*. The sequences obtained were compared with sequences from Genbank using Blastn. The ITS1 of *K. hansoni* and *K. bimaculata* were compared by aligning both sequences in Blastn (Supplement S1). In addition, a Neighbour-Joining phylogenetic tree was constructed using these ITS1 sequences and those of species of Mutillidae deposited in Genbank (Table 1). Supplement S2 shows the complete alignment.

RESULTS AND DISCUSSION

Taxonomy

Genus *Kevinilla* Bartholomay & Cambra, gen. n.

Type species. *Sphaerophthalma* (sic!) *ludovica* Cameron, 1895, here designated.

ZooBank taxon LSID:
5AA9B98E-AEED-434E-A55B-7F52B9727280

Diagnosis. FEMALE. Females of *Kevinilla* can be recognized by the following combination of characters: head subrectangular transverse. Mandible slender, edentate at apex, with small inner tooth near middle. Genal and hypostomal carinae present and simple. Clypeus slightly elevated posteriorly at middle between antennal tubercles, anterior margin straight and with very small tubercle in front of each antennal tubercle. Mesosoma distinctly longer than broad and constricted at propodeal spiracles; with scutellar scale small, sometimes poorly visible. T1 subsessile with T2. Anterolateral area of T2 slightly elevated and either with several short longitudinal carinae or one long carina on each side anterolaterally. T6 with defined pygidial area.

MALE. Males of *Kevinilla* have the following combination of characters: head subglobose, slightly narrower than mesosoma. Mandibles moderately slender, narrowed near apex, with small preapical tooth. Genal carina absent. Clypeus almost flat posteromedially, with anterior margin concave forming one tubercle on each side of concavity. Epaulets and mesopleuron unarmed. Axillae connected to scutellum. Dorsum of scutellum almost flat. T1 slightly elongate and subsessile with T2. Apical margin of hypopygium truncate, not emarginated. Parameres in dorsal and ventral view: slightly sinuous, somewhat convergent on basal two thirds and divergent on apical third; in lateral view smoothly evenly curved ventrally, with dense setae on basal two thirds, apical third with sparse inconspicuous setae. Penis valve slender and elongate, with single rounded apicoventral tooth.

Description. FEMALE. *Head*. Subrectangular transverse, punctate, clothed with simple decumbent and erect setae; eye subcircular; antennal tubercles unarmed, basally separated; antennal scrobe with dorsal carina inconspicuous or absent; clypeus slightly elevated posteriorly at the middle between the antennal tubercles, with anterior margin straight and with very small tubercle in front of each antennal tubercle; genal carina present, extending nearly from hypostomal carina to posterolateral angle of head; hypostomal carina distinct, simple; proboscidal and mandibular fossae separated by complete bridge; scape simple, without carinae; first flagellomere about 1.5× longer than second; mandible slender, edentate at apex, with a small inner tooth near middle, unarmed ventrally; maxillary palp 6-segmented, labial palp 4-segmented. *Mesosoma.* Longer than wide; pronotal sides subparallel; mesonotum slightly expanded without lateral tooth; scutellar scale small, located dorsomedially between propodeal spiracles; propodeum constricted at the propodeal spiracles, broadened posteriorly; pronotal dorsal face (excluding anterior collar) with anterior margin slightly convex, epaulet inconspicuous, humeral angle vertically carinate; metasternal process triangular, unidentate acute apically. *Legs.* Tibial spur formula 1-2-2; foreleg without tarsal comb; mid and hind tibiae each with single row of four or five spines, apical spines not inserted on any process; apical spurs narrow, finely and shallowly pectinate; metacoxa with even longitudinal carina on inner margin. *Metasoma.* T1 subsessile with T2, convex; anterolateral area of T2 slightly elevated and with several short longitudinal carinae or with one long carina in each anterolateral area; T2 with lateral felt line, ~0.3–0.4× T2 length laterally; T6 with flattened medioapical pygidial area defined by distinct lateral carinae, surface sculptured or partially smooth; S1 with longitudinal median carina; S2 without felt line.

MALE. *Head*. Subglobose, slightly small, dorsoventrally flattened, width including outer eye margin equal to mesosomal width including tegula; Vertex and gena densely punctate, clothed with simple decumbent and erect setae, ventral surface smooth and mostly impunctate; occipital carina distinct dorsally; vertex evenly convex behind ocelli; eye subcircular, protruding, ommatidia distinct; ocelli small; mandible moderately slender, narrowed apicad, with small preapical tooth, unarmed ventrally; maxillary palp 6-segmented; labial palp 4-segmented; mentum basically flat with longitudinal medial carina; gena ecarinate; clypeus almost flat posteriorly at middle, with anterior margin concave forming a tubercle on each side of concavity; antennal scrobe ecarinate, with weak tubercle above; antennal tubercles mostly smooth; scape with low carina, unicarinate basally, bicarinate on apical fifth; pedicel as wide as long, shorter than first flagellomere, the latter slightly shorter than second flagellomere. *Mesosoma*. Dorsum shiny between punctures, mostly with medium-sized punctures except on propodeum, which is reticulate, clothed with simple decumbent and erect setae; lateral surface predominantly micropunctate and microsetose; pronotal dorsal face (excluding anterior collar/flange) with anterior margin straight, epaulet scarcely evident, humeral angle rounded and ecarinate; tegula subcircular, evenly convex, mostly smooth; mesoscutum without notauli, parapsidal furrows distinct and extending forward past mid-point of tegula; posterolateral corner forming a slightly raised angular lobe; epaulets and mesopleuron unarmed; axillae without posteriorly directed tooth or lobe; dorsum of scutellum almost flat. *Legs*. Pro and mesocoxae without denticle, tubercle or carina; metacoxa inner margin with even longitudinal carina on basal half. *Metasoma*. T1 slightly elongate and subsessile with T2; apical margin of hypopygium truncate, neither an emargination nor denticle present. *Genitalia*. Parameres in dorsal and ventral view: slightly sinuous, somewhat convergent on basal two thirds and divergent on apical third; in lateral view smoothly evenly curved ventrally, with dense setae on basal two thirds, apical third with sparse inconspicuous setae. Cuspis short, approximately one third of paramere free length; narrowing apicad and with rounded apex in lateral view; densely setose on ventral margin. Digitus short, half or less the length of cuspis; slightly curved dorsally; asetose. Penis valve slender and elongate, with single rounded apicoventral tooth; asetose.

Included species. *Kevinilla ludovica* (Cameron, 1895), comb. n.; *K. bicarinata* (Cambra & Quintero, 2008), comb. n.; *K. bimaculata* (Cambra & Quintero, 2008), comb. n.; *K. hansoni* (Cambra & Quintero, 2008), comb. n.

Distribution. Central America (Honduras, El Salvador, Nicaragua, Costa Rica, Panama) and northern South America (Ecuador).

Etymology. From the first name of Dr. Kevin A. Williams, an authority on Mutillidae taxonomy, good friend, and colleague of PRB and RAC, followed by the common suffix for mutillid genera.

Remarks. Mickel (1924) mentioned that despite its uncertain placement, *Kevinilla ludovica* probably belonged in *Pseudomethoca*. The same author justified this placement based on the presence of a genal carina, constricted mesosoma and T6 with the pygidial area defined by distinct lateral carinae, traits usually associated with *Pseudomethoca* s.l. Cambra & Quintero (1992) also treated *K. ludovica* as a member of *Pseudomethoca* and, subsequently, Cambra & Quintero (2008) described three new species of the same genus which they included in a species group with *K. ludovica* (then *P. ludovica*) based on shared morphological characteristics.

Sex associations were established by observing mating in situ and in laboratory conditions, which are further discussed in the remarks for each species known from both sexes.

Kevinilla females are similar in some morphological features with *Lophostigma* Mickel, 1952, such as the subrectangular transverse head; mandibles slender, edentate at apex and unarmed ventrally; mesosoma fiddle-shaped; propodeal sides divergent behind propodeal spiracle in dorsal view; and anterolateral areas of T2 bearing carinae. Female *Lophostigma*, however, lack a scutellar scale, their first metasomal segment is disciform and the pygidial

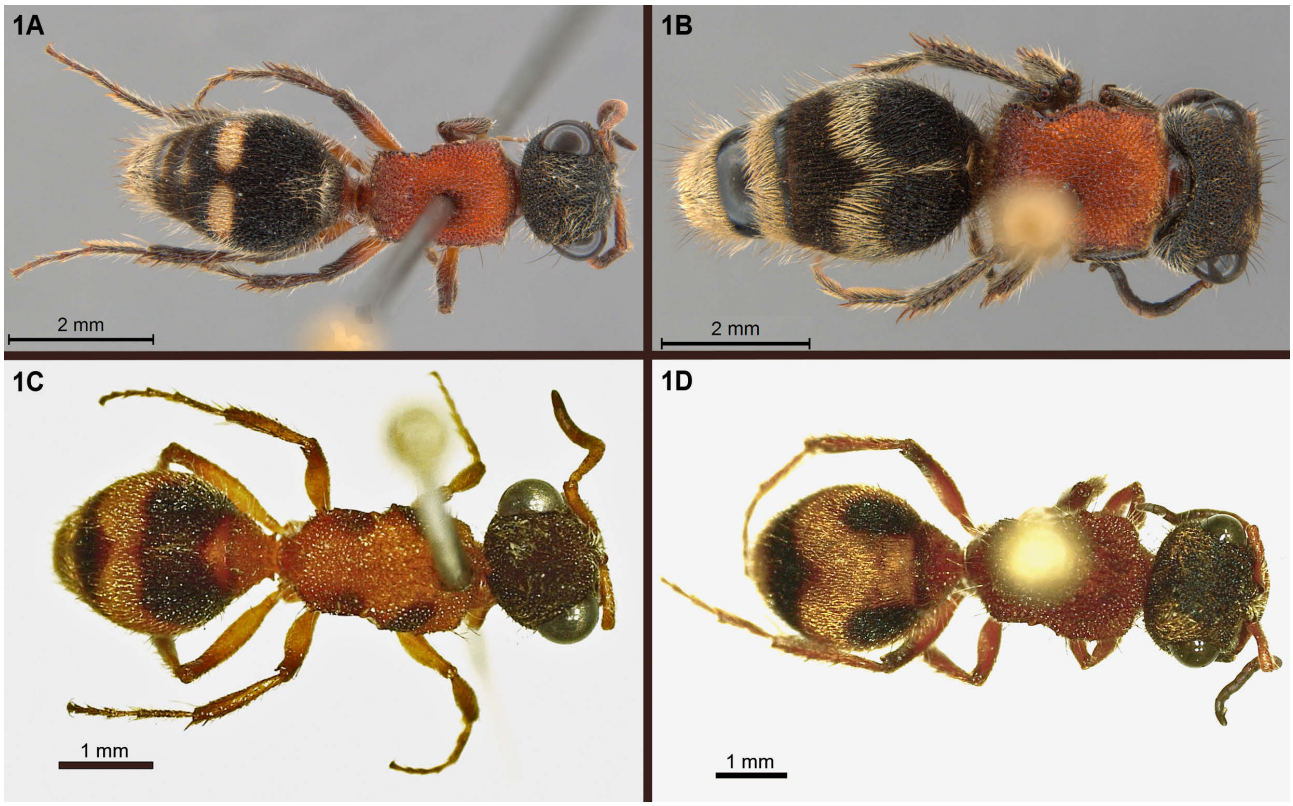

Fig. 1. Dorsal habitus of females of *Kevinilla*: A – *Kevinilla bimaculata*; B – *Kevinilla hansoni*; C – *Kevinilla ludovica*; D – *Kevinilla bicarinata*.

area is not defined by lateral carinae. Males of *Kevinilla* have a similar morphology to that of the males of many Pseudomethocini genera (e.g. *Lophomutilla*, *Lophostigma*, *Pseudomethoca* s.l.), but differ markedly in the shape of the penis valve, which varies little within the tribe (Fig. 8A–E). In addition, *Kevinilla* has other morphological characters not seen in "typical" *Pseudomethoca*, such as, the first metasomal segment sub sessile (sessile in *Pseudomethoca*); anterolateral area of T2 slightly elevated and with several short longitudinal carinae (anterior area of T2 evenly convex, rarely with carinae in *Pseudomethoca*).

The unique combination of these characters in both sexes is the basis of the proposal here that these four species belong to a new genus, *Kevinilla*, in the subfamily Sphaeropthalminae, tribe Pseudomethocini, according to the classification of Waldren et al. (2023).

Key to species of *Kevinilla* gen. n.

(Male of *K. bicarinata* unknown.)

Even though females of *Kevinilla* can be distinguished by certain structural characters, males cannot. After examining a total of 222 male specimens (55 of *K. bimaculata*, 112 of *K. hansoni* and 55 of *K. ludovica*), no distinguishing characters between species other than colouration and setae were found. The same can be said about the characters of the genitalia, which are remarkably similar in the three species. Colouration and setae alone are considered to be unreliable for distinguishing Mutillidae species due to their highly variable nature. No setal characters or colour variations, however, were recorded in the males examined, a common feature in other genera of Pseudomethocini (Luz & Williams, 2014; Williams et al., 2019b; Cambra et al., 2022a). It is also important to mention that in the highly diverse and widely distributed *Timulla* Ashmead, 1899, most females are separated by seemingly invariable colour and setal characters and males have many distinguishing structural characters (Cambra et al., 2018b). Sex associations within *Timulla* have shown that in certain cases these characters can be reliably used to separate species.

1 Females, apterous (data from Cambra & Quintero, 2008, p. 70) 2
– Males, winged 5
2 Anterolateral elevated areas of T2 with one long, longitudinal, carina about 0.4× as long as T2; T2 integument orange-red except apical margin and anterolateral margins, black (Figs 1D, 2D) ..... *K. bicarinata*
– Anterolateral elevated areas of T2 with short, longitudinal, carinae; T2 integument black or with two or three integumental spots 3
3 Dorsum of mesosoma orange red except for four black integumental spots, propodeal sides weakly divergent behind propodeal spiracle (Fig. 1C); T2 with two or three orange integumental spots ..... *K. ludovica*
– Dorsum of mesosoma totally orange-red, with propodeal sides strongly divergent behind propodeal spiracle (Fig. 1B); T2 with or without integumental spots 4
4 T2 integument black, with a postmedial, transverse, arcuate band of white pubescence and an anteromedial, longitudinal band of white pubescence united in middle of transverse band (Fig. 1B); prosternum black ..... *K. hansoni*
– T2 black with two small suboval, pale yellow integumental spots (Fig. 1A); prosternum orange red ..... *K. bimaculata*
5 Metasoma with integument and setae orange (Fig. 5C, D) .... *K. ludovica*

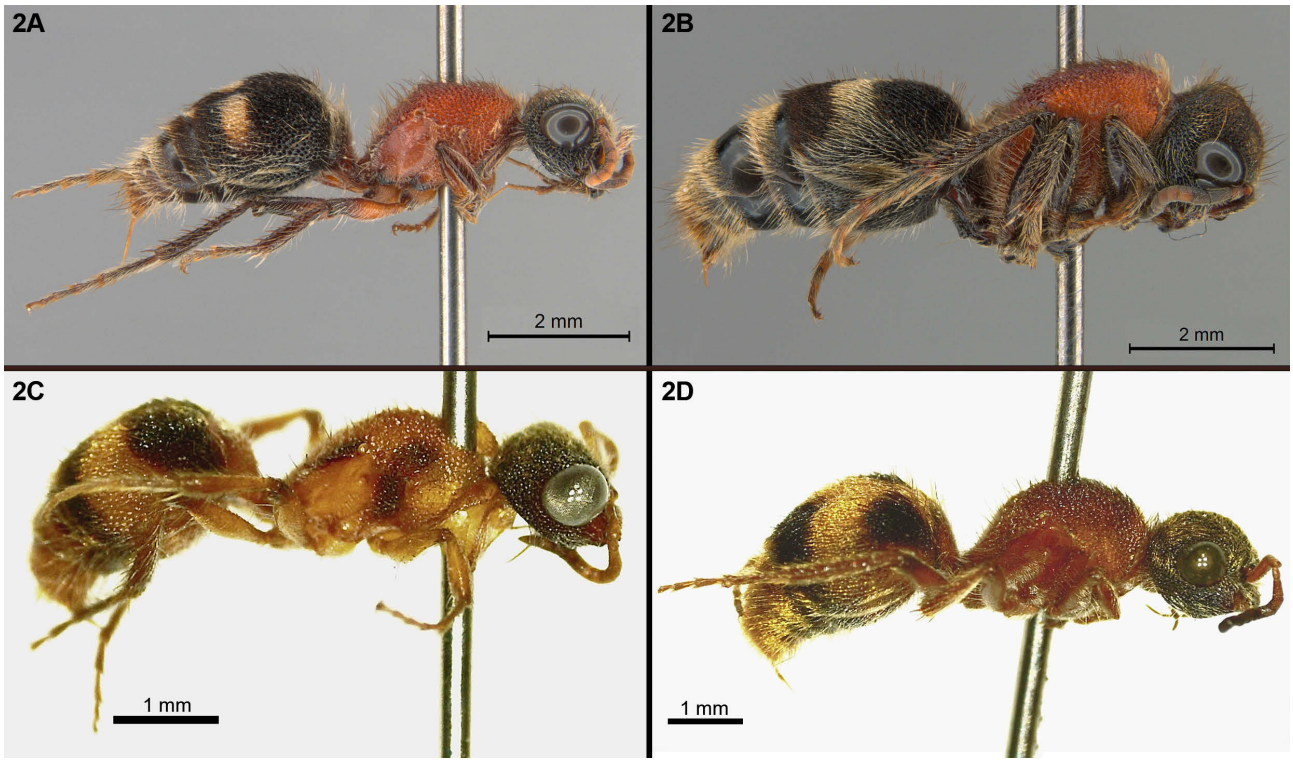

Fig. 2. Lateral habitus of females of *Kevinilla*: A – *Kevinilla bimaculata*; B – *Kevinilla hansoni*; C – *Kevinilla ludovica*; D – *Kevinilla bicarinata*.

– Metasoma with integument black 6
6 Metasoma with black and white setae, not entirely covering the integument (Fig. 5A, B) ..... *K. bimaculata*
– Metasoma with golden setae, covering most of dorsal integument (Fig. 5E, F) ..... *K. hansoni*

Kevinilla bicarinata (Cambra & Quintero, 2008), comb. n.

(Figs 1D, 2D, 3D, 4D)

Pseudomethoca bicarinata Cambra & Quintero, 2008: 71, female, MIUP.

Diagnosis. FEMALE. T2 anterolateral areas with one longitudinal carina about 0.4× as long as T2; mesosomal dorsum completely orange-red; T2 orange-red except apical margin and anterolateral margins black. MALE. Unknown.

Material examined. Six females: see Cambra & Quintero, 2008.

Distribution. Honduras, El Salvador, Nicaragua and Costa Rica (Cambra & Quintero, 2008).

Kevinilla bimaculata (Cambra & Quintero, 2008), comb. n.

(Figs 1A, 2A, 3A, 4A, 5A, B, 6A–D, 7A)

Pseudomethoca bimaculata Cambra & Quintero, 2008: 72, female, MIUP.

Diagnosis. FEMALE. Mesosoma fiddle-shaped, propodeal sides strongly divergent behind propodeal spiracle (Fig. 1B); mesosomal dorsum completely orange-red; T2 integument entirely black except for two small suboval, pale yellow integumental spots. MALE. Metasomal integument black, covered with black and white setae.

Description. MALE (hitherto undescribed). *Body length*. 10.1 mm. *Colouration and setae*. Integument black; tibial spurs white; wings infuscated; vertex with long, semierect simple pale white and black setae; frons, clypeus, mandibles and scape with pale white setae; pronotum dorsum, mesoscutum and scutellum with long, semierect simple black setae; pronotum laterally, mesopleuron, propodeum dorsum and legs with long, semierect and decumbent pale white setae; metasomal segment one, basal two-thirds of T2, lateral area of T3–6, S2–6 with erect and semierect pale white setae; apical third of T2, T2–7 and S7 with black setae. *Structure and sculpture*. *Head.* Vertex, frons and gena densely covered with small punctures; distance between eye margin and lateral ocellus 3.25× as long as diameter of ocellus; F1 1.2× pedicel length; F2 1.42× pedicel length. *Mesosoma*. Pronotum, mesoscutum, scutellum and mesopleuron with medium-sized, contiguous punctures, metapleuron micropunctate; tegula mostly glabrous, except anterior and inner margins that are setigerously punctate; propodeum dorsum totally reticulate; fore wing with three submarginal and two discal cells, veins 3rs-m and 2m-cu faintly indicated or interrupted; marginal cell with broadly acute apex. *Metasoma*. T1 dorsal face 1.25× as long as wide; T1, T2 and S2 mostly with a dense covering of medium-sized punctures; metasomal segments 3–7 mostly with a dense covering of small punctures; S1 without a spine near base, with a low even longitudinal carinae. *Genitalia.* Parameres, digitus and cuspis on Fig. 6A–C; penial valve on Fig. 6D.

Fig. 3. Frons of females of *Kevinilla*: A – *Kevinilla bimaculata*; B – *Kevinilla hansoni*; C – *Kevinilla ludovica*; D – *Kevinilla bicarinata*.

Material examined. PANAMA: *Darién* Prov.: P. Nac. Darién, Pirre, Est. Rancho Frío (8.01972, –77.73250), col. R. Cambra & A. Santos: 20.iii–5.iv.2000, 5♂; 7.–16.xi.2000, 3♂, 16.xi.2000–17.i.2001, 7♂; 18.–24.i.2001, 4♂; 30.vii.–8.viii.2002, 1♂; 8.viii.–17.x.2002, 2♂. Estac. Cruce de Mono (7.914879, –77.642682), INRENARE, P. Nac. Darién, col. R. Cambra, J. Coronado: 12.–16.ii.1993, 1♂, 18.ii.1993, 1♂; Cana (7.755370, –77.684167), P. Nac. Darién, col. R. Cambra: 6.–12.iv.1991, 1♂. *Panamá* Prov.: Barro Colorado Island, 9°9′N, 79°51′W, 2001–2006, col. D. Windsor, Malaise trap: 27♂ (MIUP). P. Nac. Altos de Campana: 10.–14.viii.1999, col. A. Santos, P. González, 2♂; Cerro Azul, residencial Las Nubes, 9.–15.x.1999, R. Cambra, A. Santos, 1♂.

Distribution. Panama and Ecuador.

Remarks. *Kevinilla bimaculata*, *K. hansoni* and *K. ludovica* are sympatric on Barro Colorado Island, Panama. *Kevinilla bimaculata* is distributed from the central part of Panama to Ecuador and sympatric with *K. hansoni* at three localities in Darién (Rancho Frío, Cana and Cruce de Mono); *K. bimaculata* is likely to be present in Colombia. The sex association of *Kevinilla bimaculata* was based on field observations of males attempting to mate with females. These specimens were then captured and placed alive in petri dishes where successful mating was observed.

Kevinilla hansoni (Cambra & Quintero, 2008), comb. n.

(Figs 1B, 2B, 3B, 4B, 5E, F, 6E–H, 7B)

Pseudomethoca hansoni Cambra & Quintero, 2008: 73, female, MIUP.

Diagnosis. FEMALE. Mesosoma fiddle-shaped, propodeal sides strongly divergent behind propodeal spiracle (Fig. 1B); mesosomal dorsum completely orange-red; T2 black, with posteromedial, transverse, arcuate band of white pubescence continuous with anteromedial, longitudinal band of white pubescence united in middle of transverse band. MALE. Metasomal integument entirely black, covered mostly with golden setae.

Description. MALE (previously undescribed). *Body length*. 9.8 mm. *Colouration and setae*. Integument black; tibial spurs white; wings weakly infuscated; head, pronotum, scutellum, mesopleuron, propodeum dorsally and legs with long, erect and semierect simple white setae; mesoscutum mostly with black semierect setae; metapleuron and sides of propodeum with short decumbent, simple white setae; metasoma with golden setae; integument of T2–7 mostly with a dense covering of setae. *Structure and*

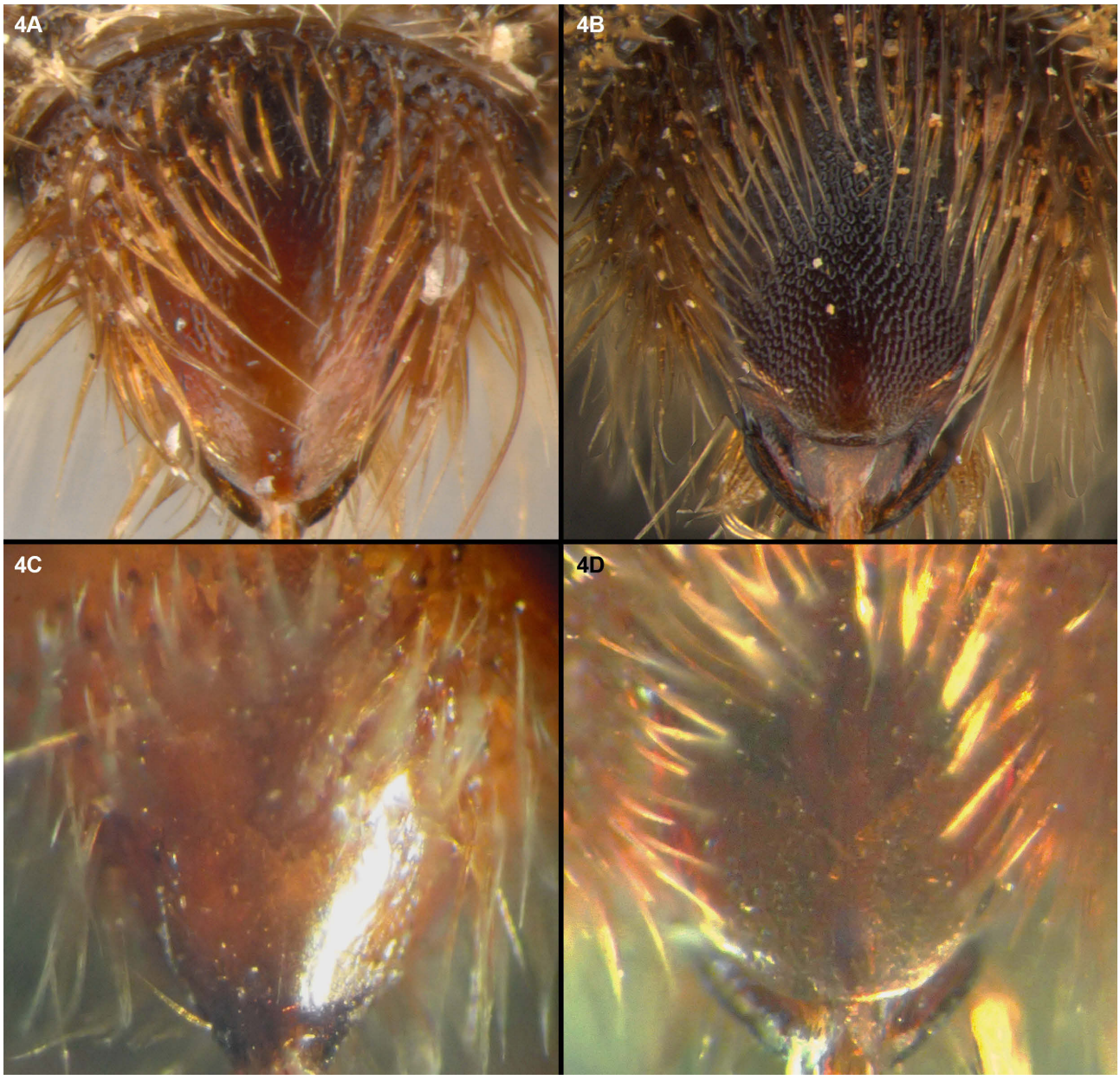

Fig. 4. Pygidium of females of *Kevinilla*: A – *Kevinilla bimaculata*; B – *Kevinilla hansoni*; C – *Kevinilla ludovica*; D – *Kevinilla bicarinata*.

sculpture. *Head.* Vertex, frons and gena with dense covering of small punctures; distance between eye margin and lateral ocellus 3.33× as long as diameter of ocellus; F1 1.46× pedicel length; F2 1.61× pedicel length. *Mesosoma.* Pronotum, mesoscutum, scutellum and mesopleuron with medium-sized, contiguous punctures, metapleuron micropunctate; tegula mostly glabrous, except anterior and inner margins that are setigerously punctate; propodeum dorsum totally reticulate; fore wing with three submarginal and two discal cells, veins 3rs-m and 2m-cu faintly indicated or interrupted; marginal cell with broadly acute apex. *Metasoma.* T1 dorsal face 1.08× as long as wide; T1, T2 and S2 mostly with close medium-sized punctures; metasomal segments 3–7 mostly with dense covering of small punctures; S1 without a spine near base, with a low even longitudinal carinae. *Genitalia.* Parameres, digitus and cuspis on Fig. 6E–G; penial valve on Fig. 6H.

Material examined. COSTA RICA (INBIO): *Guanacaste* Prov.: Est. Pitilla, 700 m, 9 km S Sta. Cecilia, i.1989, 1♂; iii.1991, C. Moraga, 1♂; S. Cañas Exp. Sta, 8.–18.iii.1988, F. Parker, 1♂ (MIUP). *Limón* Prov.: Valle La Estrella, R.B. Hitoy Cerere, A.C. Amistad, 100 m, vii.1994, M. Segura, 1♂; 19.–29.v.1992, E. Lopez, 3♂; Amubri, A.C. Amistad, 70 m, 8.–30.iii.1994, G. Gallardo, 1♂; 1.–19.ii.1994, G. Gallardo, 1♂; Sector Cerro Cocori, Fca. de E. Rojas, 150 m, v.1993, E. Rojas, 1♂. *Puntarenas* Prov.: Est. Sirena, 0–100 m, P.N. Corcovado, vi.1991, J. Saborio, 5♂; iii.1990, G. Fonseca, 2♂; x.1990, C. Saborio, 1♂ (MIUP); Est. Queb. Bonita, 50 m, Res. Biol. Carara, vi.1990, E. Rojas, 2♂; i.1993, J. Saborio, 2♂; Golfito, P.N. Corcovado, 5.v.2001, J. Azofeifa, 1♂; R.F. Golfo Dulce, Est. Agujas, 300 m, 12.v.2001, J. Azofeifa, 1♂; 13.–28.vi.2000, J. Azofeifa, 1♂; San Luis, Monteverde, R.B. Monteverde, A.C. Arenal, 1000–1350 m, 20.–27.vi.1994, Z. Fuentes, 1♂; Rancho Quemado, Pen. Osa, 200 m, 14.–28.vii.1992, A. Gutierrez, 1♂; Estero de Guerra, Pen. Osa, 50 m, 12.–15.i.1992, A. Gutierrez, 1♂. *Cartago* Prov.: Qbda. Segunda, P.N. Tapanti, 1250 m, vii.1992, G. Mora, 1♂; Turrialba,

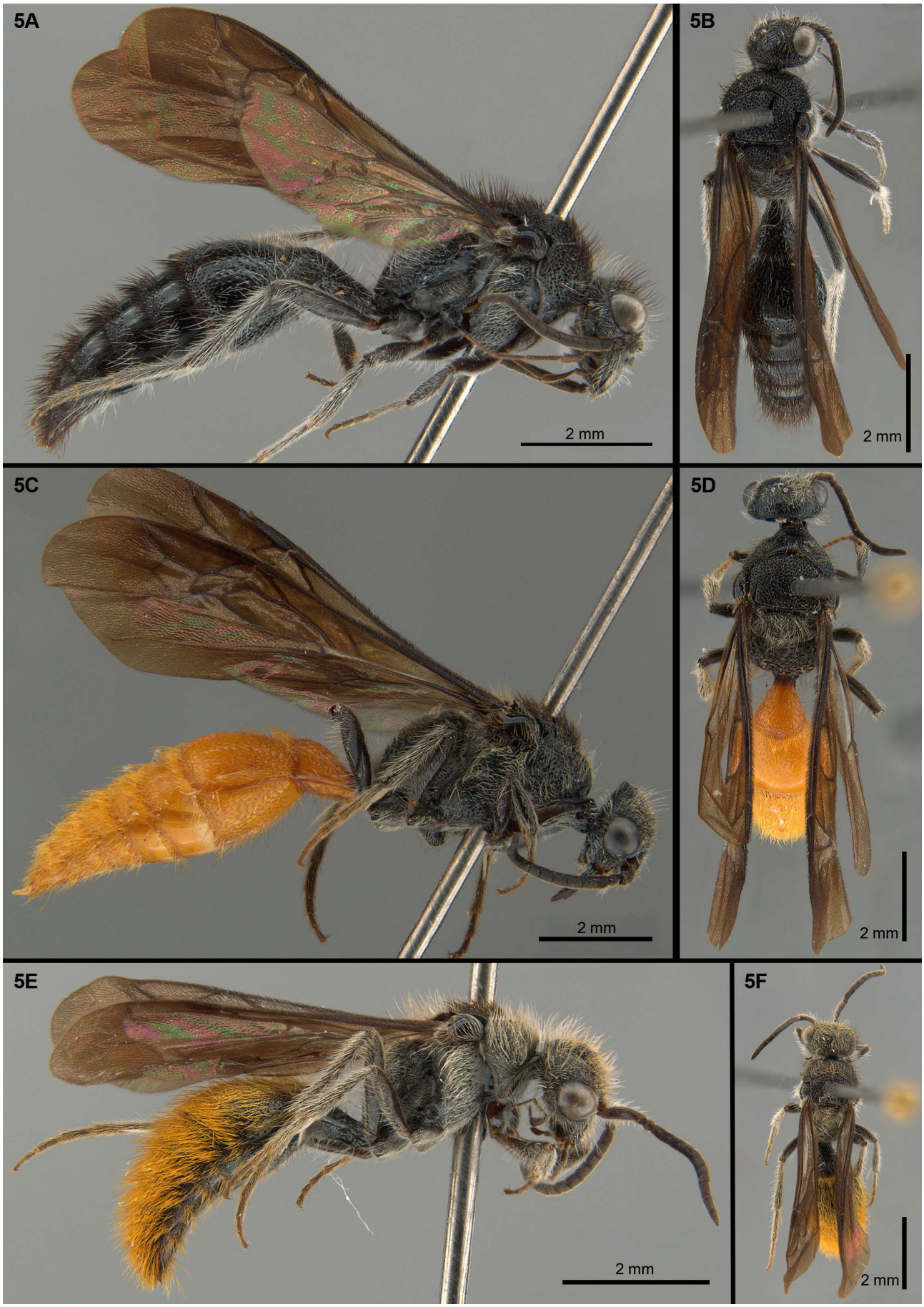

Fig. 5. Lateral and dorsal habitus of males of *Kevinilla*: A, B – *Kevinilla bimaculata*; C, D – *Kevinilla ludovica*; E, F – *Kevinilla hansoni*.

Fig. 6. Genitalia in dorsal view, genitalia in ventral view, genitalia in mesal view (halved, penis valve removed), and removed penis valve in lateral view (not to scale) of males of *Kevinilla*: A–D – *Kevinilla bimaculata*; E–H – *Kevinilla hansoni*; I–L – *Kevinilla ludovica*.

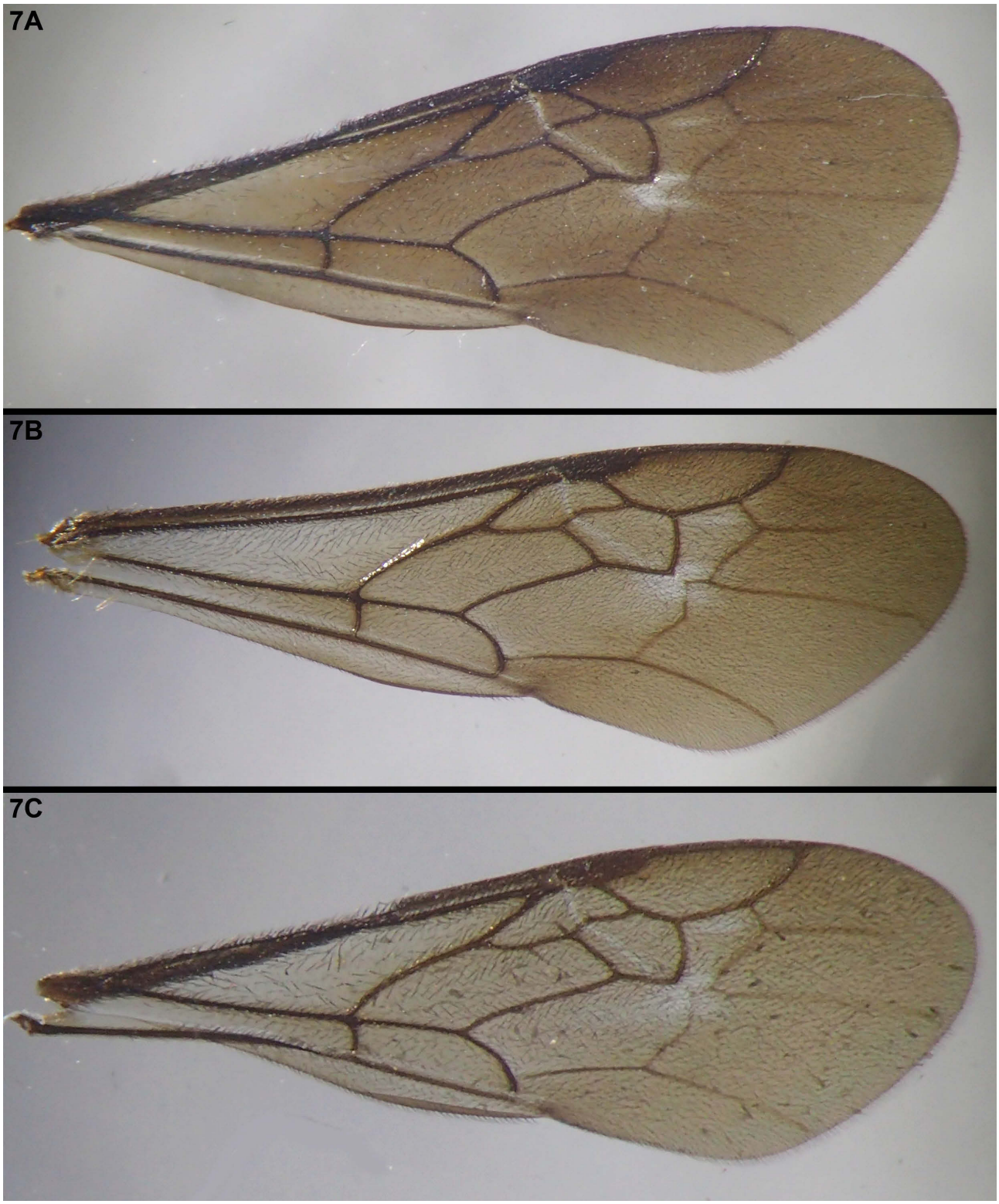

Fig. 7. Forewing of males of *Kevinilla*: A – *Kevinilla bimaculata*; B – *Kevinilla hansoni*; C – *Kevinilla ludovica*.

CATIE, en plantación de cacao, 5.–10.viii.1991, R. Cambra, 3♂, (MIUP). *Alajuela* Prov.: San Carlos, Res. For. Arenal, iii.1999, G. Carballo, 1♂. *Heredia* Prov.: Los Arbolitos, Sarapiqui, 10–30 m, 20–27.iii.1993, F. Araya, 2♂. PANAMÁ (MIUP): *Bocas del Toro* Prov: P. Int. La Amistad, Wekso-Teribe, 17.–24.x.1999, A. Santos, 11♂; P. Nac. Humedales de San San, 26.–28. x. 1999, A. Santos, 3♂. *Darién* Prov.: Estac. Cruce de Mono, INRENARE, Parq. Nac. Darién, ii.1993, R. Cambra, J. Coronado, 2♂; P. Nac. Darién, Cana, 2.–12.iv.1991, R. Cambra, 8♂; P. Nac. Darién, Pirre, Est. Rancho Frío, 21.iii–4.iv.2000, Cambra, Santos, Bermúdez, 1♂. *Coclé* Prov.: trocha del aserradero, Div. Cont., El Copé, 27.–28.xi.1992, R. Cambra, D. Quintero, 1♂; ix.1990, R. Cambra, D. Quintero, 5♂; 14.vi.1990, R. Cambra, D. Quintero, 3♂. *San Blas* Prov.: Nusagandi, 22.ii.1990, R. Cambra, A. Mena, 2♂; *Colón* Prov.: Pavon Hill Road, antes de Ft. San Lorenzo, Ft. Sherman, 17.ix.1987, R. Rodríguez, 1♂; P. Nac. Soberanía, cam. oleoducto, 26.iv.1997, R. Cambra, D. Quintero, 2♂. *Panamá* Prov.: P. Nac. Cerro Campana, 7.xi.1992, R. Cambra, 1♂;

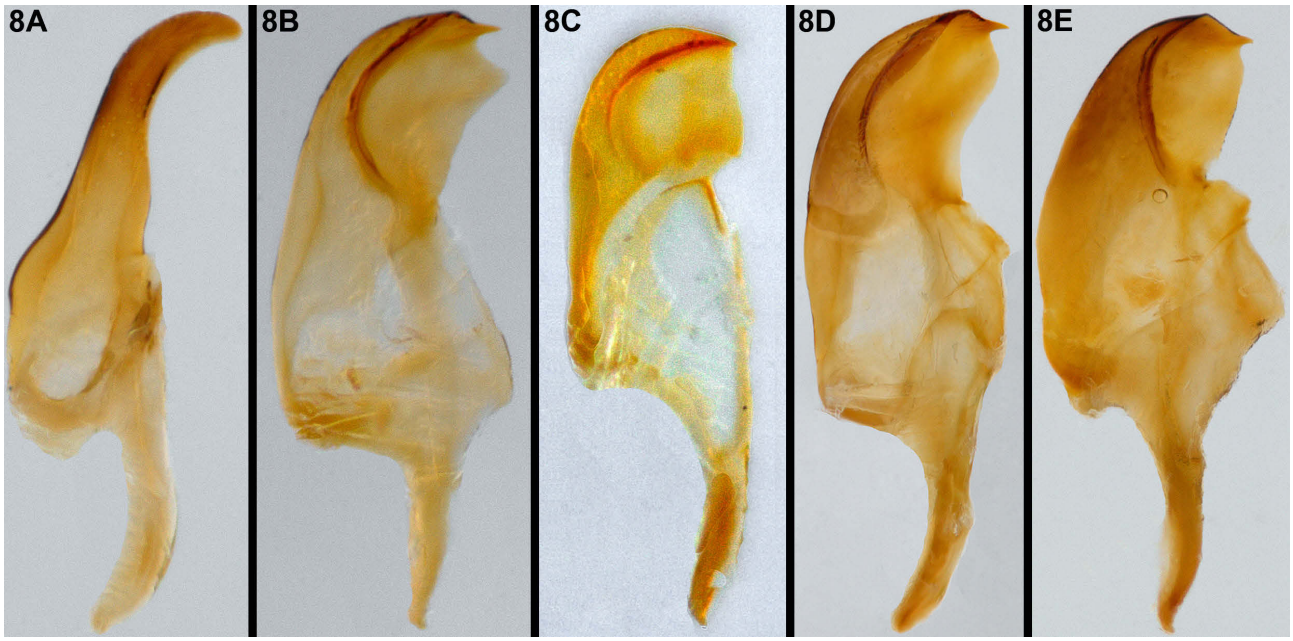

Fig. 8. Penis valve of males of different Pseudomethocini genera (removed, not to scale): A – *Kevinilla bimaculata* (Cambra & Quintero, 2008) comb. n.; B – *Hoplognathoca costarricensis* Suárez, 1962; C – *Hoplomutilla excentrica* (Cameron, 1893); D – *Lophomutilla* sp.; E – *Pseudomethoca hesperus* Brothers, 1982.

10.–14. viii. 1999, A. Santos, P. González, 1♂; P. Nac. Soberanía, 22.x.1993, R. Cambra, A. Rodríguez, 1♂; bosque en residencial Las Nubes, Cerro Azul, 9.–15.x.1999, A. Santos, 1♂; Barro Colorado Island, 9°9′N, 79°51′W, 2001–2006, col. D. Windsor, Malaise trap: 39♂ (MIUP).

Distribution. Costa Rica and Panamá.

Remarks. *Kevinilla hansoni* is very widely distributed in Panama and is sympatric with *K. ludovica* from central Panama to Costa Rica. As with *K. bimaculata* the sex association of *K. hansoni* was based on field observations of mating attempts, which were later confirmed in the laboratory.

Kevinilla ludovica (Cameron, 1895), comb. n.

(Figs 1C, 2C, 3C, 4C, 5C, D, 6I–L, 7C)

Sphaerophthalma (sic) *ludovica* Cameron, 1895: 342, female, BMNH.
Pseudomethoca? *ludovica*: Mickel, 1924.
Pseudomethoca ludovica: Cambra & Quintero, 1992.

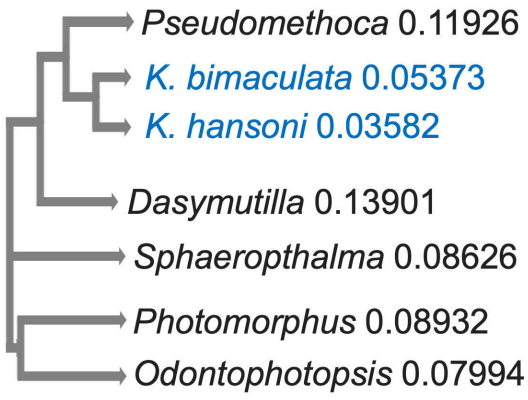

Fig. 9. ITS1 Neighbour-Joining phylogenetic tree without distance corrections.

Diagnosis. FEMALE. Mesosoma fiddle-shaped, propodeal sides weakly divergent behind propodeal spiracle (Fig. 1C); mesosomal dorsum orange-red with four black integumental spots, two on mesonotum and two on propodeum; T2 black with two or three orange integumental spots. MALE. Metasomal integument entirely orange.

Description. MALE (previously undescribed). *Body length*. 5.9 mm. *Colouration and setae.* Integument on head and mesosoma black, metasoma orange; tibial spurs white; wings weakly infuscated; head, pronotum, scutellum, mesopleuron, propodeum dorsally and legs with long, erect and semierect simple white setae; mesoscutum mostly with black semierect setae; metapleuron and propodeum laterally with short decumbent, simple white setae; metasoma with orange setae. *Structure and sculpture*. *Head.* Vertex, frons and gena with dense covering of small punctures; distance between eye margin and lateral ocellus 2.86× as long as diameter of ocellus; F1 1.36× pedicel length; F2 1.59× pedicel length. *Mesosoma*. Pronotum, mesoscutum, scutellum and mesopleuron with medium-sized, contiguous punctures, metapleuron micropunctate; tegula mostly glabrous, except anterior and inner margins that are setigerously punctate; propodeum dorsum totally reticulate; fore wing with three submarginal and two discal cells, veins 3rs-m and 2m-cu faintly indicated or interrupted; marginal cell with broadly acute apex. *Metasoma*. T1 dorsal face 1.05× as long as wide; T1, T2 and S2 mostly densely covered with medium-sized punctures; metasomal segments 3–7 mostly densely covered with small punctures; S1 without a spine near base, with a low even longitudinal carinae. *Genitalia.* Parameres, digitus and cuspis on Fig. 6I–K; penial valve on Fig. 6L.

Material examined. COSTA RICA, *Limón* Prov.: Sector Cerro Cocori, Fca. E. Rojas, 150 m, 28.v.–17.vi.1992, E. Rojas, 1H. *Puntarenas* Prov.: Est. La Casona, Res. Biol. Monteverde,

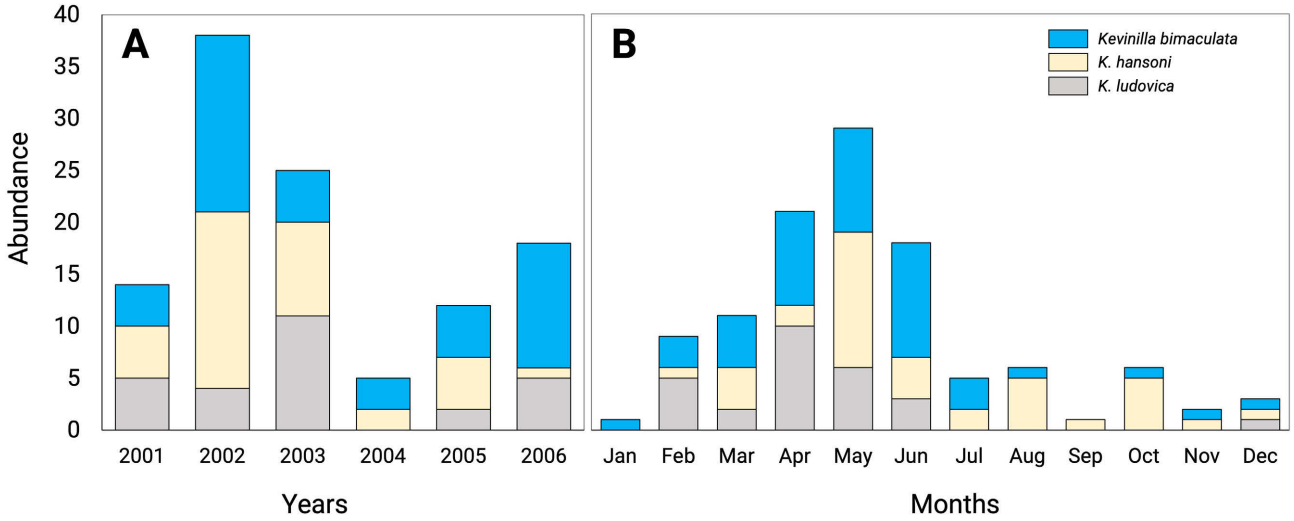

Fig. 10. *Kevinilla* specimens (males) captured on Barro Colorado Island in Malaise traps (years 2001–2006). A – Total captured by year; B – Total captured by month.

1520 m, xii.1990, N. Obando, 1♂; Est. Hitoy Cerere, Res. Biol. Monteverde, 1520 m, vii.1992, G. Carballo, 1♂. *Heredia* Prov.: Est. Magsasay, P.N. Braulio Carrillo, 200 m, i.1991, M. Barrelier, 1♂. PANAMÁ: Barro Colorado Island, 9°9′N, 79°51′W, 2001–2006, col. D. Windsor, Malaise trap: 46♂ (MIUP). CHIRIQUI: Fortuna, iv.1999, R. Cambra, 2♂ (MIUP). NICARAGUA: Granada, Volcan Mombacho, San Joaquin, Malaise trap, J. Maes: 3.iii.1998, 1♂; 21.vi.1998, 2♂; 30.vi.1998, 1♂ (MIUP).

Distribution. Nicaragua, Costa Rica and Panama. First record for Nicaragua.

Remarks. Sex association in *K. ludovica* was based on a process of elimination and on the distribution of both sexes in Costa Rica and Panama. After the identification of the males of *K. bimaculata* and *K. hansoni* the only unassociated males and females of *Kevinilla* to occur in both of the areas where those of *K. ludovica*.

Molecular analysis

Sequenced samples from two specimens were successfully amplified resulting in a sequence of 708 bp obtained from a specimen identified as the female of *Kevinilla bimaculata* and a 730 bp sequence from a specimen identified as the male of *Kevinilla hansoni*. Both sequences were deposited in Genbank and include most of the 18S ribosomal gene, the entire ITS1 region and part of the 5.8S ribosomal gene.

The *K. bimaculata* sequence had a percentage identity of 84.54 with *Odontophotopsis erebus* and maximum score of 675 with E value of 0.0. The sequence obtained from the *K. hansoni* specimen had a percentage identity of 88.06 with *Pseudomethoca propinqua* and maximum score of 850 with E value of 0.0.

The alignment of the *P. propinqua* sequence with *K. hansoni* reveals that the length of its ITS1 is approximately 492 bp. On the other hand, the ITS1 length of *K. bimaculata* is 470 bp using *Odontophotopsis erebus* as a reference sequence. Alignment of *K. bimaculata* and *K. hansoni* ITS1 sequences revealed a 92% similarity (Supplement S1).

Alignments of multiple ITS1 sequences of *K. hansoni*, *K. bimaculata* and other Mutillidae (Supplement S2) revealed variation in nucleotide sequences and also in ITS1 length. The Neighbour-Joining (NJ) phylogenetic tree presented in this study (Fig. 9) recovered ITS1 sequences of *K. hansoni* and *K. bimaculata* grouped in a single subclade distinct from, but closely related to *Pseudomethoca*.

Seasonal and annual abundance

A total of 112 male specimens of *Kevinilla* was captured during six years of continuous sampling (2001–2006) using 10 Malaise traps on Barro Colorado Island (BCI), Panama. These individuals belong to three species: *Kevinilla bimaculata* (27), *K. hansoni* (39) and *K. ludovica* (46). The years with the highest abundance were 2002 and 2003, during which 56% of the specimens were collected (Fig. 10A). Over this period, 88 (78.5%) specimens were collected, with a peak in May with 29 individuals (25.8%) (Fig. 10B).

The abundance pattern is similar to that reported for other genera of Mutillidae, such as *Dasymutilla* Ashmead, 1899, *Ephuta* Say, 1836 and *Xystromutilla* André, 1905 on BCI (Cambra et al., 2018a, 2021; Añino et al., 2020). Monthly variations in the abundance of these wasps may be related to temperature fluctuations. Studies conducted by Cambra et al. (2022b) in temperate zones (Virginia, USA) recorded the highest number of mutillids collected in June and October when temperatures are high. Similarly, a study conducted on BCI reports that the abundance of the genus *Ephuta* is related to temperature (Añino et al., 2020).

AUTHOR CONTRIBUTIONS. PRB: Conceptualization, writing, review and editing. RAC: Conceptualization, writing of original draft, review and editing. CWR: Molecular analysis, writing, review and editing. EW: Molecular analysis, review and editing. MLO: Access to specimens and photographic equipment. YJA: Seasonal and annual abundance data processing and analysis, and writing.

ACKNOWLEDGEMENTS. We thank D. Windsor, Smithsonian Tropical Research Institute, for the donation of the specimens from BCI and other facilities; A. Garrido, University of Panama, for photographs of the female specimens of *K. bicarinata* and *K. ludovica*; long-term Malaise trap sampling on BCI was sup-

ported by funding from the "Environmental Sciences Program" of the Smithsonian Institution. PRB is grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Programa de Capacitação Institucional (PCI) of the Ministério da Ciência, Tecnologia e Inovações (MCTI) and support of the Instituto Nacional da Mata Atlântica (INMA).

COMPLIANCE WITH ETHICAL STANDARDS. The authors declare that there is no conflict of interest related to the current research.

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Received January 29, 2024; revised and accepted April 1, 2024
Published online April 18, 2024

Supplementary material (on following pages):

Supplement S1: Alignment of ITS1 sequences of *Kevinilla bimaculata* and *K. hansoni*.

Supplement S2: Complete ITS1 alignment of all species in Table 1 and Fig. 9.

Supplement S1: Alignment of ITS1 sequences of *Kevinilla bimaculata* and *K. hansoni*.

```
Query: Kevinilla bimaculata  ITS1 470 bp Query ID: lcl|Query_1281329 Length: 470


>Kevinilla hansoni ITS1 492 bp
Sequence ID: Query_1281331 Length: 492
Range 1: 1 to 492

Score:676 bits(366), Expect:0.0,
Identities:455/493(92%),  Gaps:25/493(5%), Strand: Plus/Plus

K. bimaculata  1    ACGTATGCTCGAAGCAGCGAATGAGAAAAAAGGAGCGAAAAGCGGCACACCCGGCTACGT  60
                    ||||||||||||||||||||||||||||||||||||||||||||||||||||||| | |
K. hansoni     1    ACGTATGCTCGAAGCAGCGAATGAGAAAAAAGGAGCGAAAAGCGGCACACCCGGCTGCAT  60

K. bimaculata  61   CGG-----GT-ACG-TG-C-TC-G-C----ACG-G-----A--GAGAGAGGGAGAATTTG  97
                    |||     || ||| || | |  | |    | | |     |  ||||||||||||||||
K. hansoni     61   CGGCCACCGTCACGATGGCGTGAGTCGGGTATGTGTTCGCACGGAGAGAGGGAGAATTTG  120

K. bimaculata  98   GAAAGCCTCCAAATATTGCATATACGCGTGATGTATAATTGAACGAGCGCGTGTGACGCG  157
                    ||||||||||||||||||||||||||||||||||||| ||||||||||||||||||||
K. hansoni     121  GAAAGCCTCCAAATATTGCATATACGCGTGATGTATAATGGAACGAGCGCGTGTGACGCG  180

K. bimaculata  158  GAGCC-TTTTCTGCGTCATACGTCGCCGGAGTTGTCGGCGGTCACGGTGCAACCTATGCG  216
                     || | |||||||||||||||||||||||| ||||| ||||| ||||||||||||||||
K. hansoni     181  AAGTCTTTTTCTGCGTCATACGTCGCCGGAG-TGTCGACGGTCCCGGTGCAACCTATGCG  239

K. bimaculata  217  GAGTCTATCGTACGGTAGTGCCGCGAGAGGGCCTTGTGCCCGAGGTTTTTAAAAGATGTT  276
                    |||||||||||||||||||||||||||||||||||||||||||||||||||||||| |||
K. hansoni     240  GAGTCTATCGTACGGTAGTGCCGCGAGAGGGCCTTGTGCCCGAGGTTTTTAAAAGAAGTT  299

K. bimaculata  277  ACGCCCGGCTAAGTGCTTTTTCAAAGCGCCATCGACAACTCCCTATGCCGCCGTCGAAAC  336
                    |||||||||||||||||||||||||||||||||||||||||||||||| ||||||||||
K. hansoni     300  ACGCCCGGCTAAGTGCTTTTTCAAAGCGCCATCGACAACTCCCTATGCCACCGTCGAAAC  359

K. bimaculata  337  TTTTGTTCCGGCGGTAGGTCCGTATCTCCTGCGGGAGTACGGCTCGGCTGGAACCCACCG  396
                    ||||||| |||||||||||||||||||||||| |||||||||||||||||||||||||
K. hansoni     360  TTTTGTTTCGGCGGTAGGTCCGTATCTCCTGCGGGAATACGGCTCGGCTGGAACCCACCG  419

K. bimaculata  397  AGAGACACTTTAAAGACGACGTGGACACAAATGAGAGATATGCAATGCATATAAAATTAA  456
                    ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
K. hansoni     420  AGAGACACTTTAAAGACGACGTGGACACAAATGAGAGATATGCAATGCATATAAAATTAA  479

K. bimaculata  457  ACGATTACCCTGA  469
                    |||||||||||||
K. hansoni     480  ACGATTACCCTGA  492
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Supplement S2: Complete ITS1 alignment of all species in Table 1 and Fig. 9.

```
CLUSTAL O(1.2.4) multiple sequence alignment

Pseudomethoca        ACGTAGACGATGCGAGAAGCAGCGAATGAGAAAAATAGGAGCGAATGCGGCACACCCGGC     60
Kbimaculata          -----ACGTATGCTCGAAGCAGCGAATGAGAAAAAAGGAGCGAAAAGCGGCACACCCGGC     55
Khansoni             -----ACGTATGCTCGAAGCAGCGAATGAGAAAAAAGGAGCGAAAAGCGGCACACCCGGC     55
Dasymutilla          ACGTATATGTTGCTTGAAGCAGCGAATGAAAGAAAAATAAATAAGCTGCA----CGCC--     54
Sphaeropthalma       ACGTATAAGTTGCTCGAAGCAGCGAATGAGAGAGAGAGAAAAGCGTCACA----CCCG--     54
Photomorphus         -ACGTATAGTTGCTCGAAGCAGCGAATGCGAGTGAGAAAGTGTCACACCC----GGCA--     53
Odontophotopsis      -ACGTATAGTTGCTCGAAGCAGCGAATGCGAGTGAGAAAAGAGCGCGTCA----CACC--     53
                              ***  *************  *   *                    *

Pseudomethoca        TGCACCGGCCACCGTCGCGATGGCGTGAGTCGGGTATGTGCGCGCT-TTTTATAAATAAG     119
Kbimaculata          TACGTCGGGTACG-----------------------TGCTCGCACG-GAGAGAGAGGGA-     90
Khansoni             TGCATCGGCCACCGTCACGATGGCGTGAGTCGGGTATGTGTTCGCA-CGGAGAGAGGGA-     113
Dasymutilla          ----------------CGGA-----------------GTG-------ATCCGGGTGTGGG     74
Sphaeropthalma       ----------------GCAG--C--------------AATGCAGGGT--GCGTGACAATAC     81
Photomorphus         ----------------ACACTGA-------------CGGG-TACGTGAACGCAAAATACA     83
Odontophotopsis      ----------------GGGCAAT-------------ACTGCCCGGGATACGTGAGCGCGC     84


Pseudomethoca        AGAGGAGGAGGAGGAATTTGGAAAGTCTCCAAATATATA----------TTATGTA-ATT     168
Kbimaculata          -------------GAATTTGGAAAGCCTCCAAATATTGCATATACGCGTGATGTAT-AAT     136
Khansoni             -------------GAATTTGGAAAGCCTCCAAATATTGCATATACGCGTGATGTAT-AAT     159
Dasymutilla          AAGGCTTAATTCAAAATTTGGAATGCATCCAAA---------------CA--------TT     111
Sphaeropthalma       AGAACA-AAAGCAAAAGTGGAAAAGCATTCCAA---------------AGTTCTTTATTC     125
Photomorphus         CGAATGTGTAACAAAATTTGGAAAGC-ATCCAA---------------AATTGTT---TT     124
Odontophotopsis      AATACGTGTAACAAAATTTGGAAAGC-ATCCAA---------------GTTTTTT--TTA     126
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Pseudomethoca        TGAACGAGCGCGTGTGAATTCAGAGTTCTTCTGTTTTTATGCGTCGCCGGAGTGTCGGCG     228
Kbimaculata          TGAACGAGCGCGTGTGACGCGGAGCCTTTTCTGCGTCATACGTCGCCGGAGTTGTCGGCG     196
Khansoni             GGAACGAGCGCGTGTGACGCGAAGTCTTTTTCTGCGTCATACGTCGCCGGAGTGTCGACG     219
Dasymutilla          CGAACGA-GCGTT-GTACGATTCAGATTTCTTCTGTTTCTTACTCGCCGGAGGGTCGACG     169
Sphaeropthalma       GAAAACAGCGTGT-GTGATTCAGAGTTCTTCTGTCGTTCACATACGCCGGAGTGTCGGTG     184
Photomorphus         CGAAAGAGCGTGT-GT--ATTTCA-GAGTTCTTCTGTTTGCACACGCCGGAGTGTCGGCG     180
Odontophotopsis      CGAAAGAGCGTGC-GTGACTCAGA-GTTGTTTTCTGTTAACGTACGCCGGAGTGTCGGCG     184
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Pseudomethoca        GTTCCGGTGCAACCTATGCGGAGTCTACCGAGCACGGTAGTGCCGCGAGAGGGCTC-TTC     287
Kbimaculata          GTCACGGTGCAACCTATGCGGAGTCTATC--GTACGGTAGTGCCGCGAGAGGGCCT-TGT     253
Khansoni             GTCCCGGTGCAACCTATGCGGAGTCTATC--GTACGGTAGTGCCGCGAGAGGGCCT-TGT     276
Dasymutilla          GTCCCGGCGCAACCTATGCGGAGTCTACC--GTACGGTAGTACCGCGGGAGGGCAT-TAC     226
Sphaeropthalma       GTCCCGGTGCAACCTACGCGGAGTCTACC--GTATGGTAGTGCCGTGAGAGGGCAA-CAT     241
Photomorphus         GTCCCGGCGCAACCTATGCGGAGTCTACC--ATACGGTAGTGCCGTGAGAGGGCAA-CGT     237
Odontophotopsis      GTCCCGGCGCAACCTATGCGGAGTCTATC--GTACGGTAGTGCCGCGAGAGGGCAAATAT     242
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Pseudomethoca        GCCCGAGGTTTTTGAAAGATGTTACGCCCGGCTCAGTGCTTTTTCAAAGCGCCATCGACT     347
Kbimaculata          GCCCGAGGTTTTTAAAAGATGTTACGCCCGGCTAAGTGCTTTTTCAAAGCGCCATCGACA     313
Khansoni             GCCCGAGGTTTTTAAAAGAAGTTACGCCCGGCTAAGTGCTTTTTCAAAGCGCCATCGACA     336
Dasymutilla          GCCCAAGGTTTTTAGAAGATGCTACGCCCGGCTCG-TGCTTTTTCAAAGCGCCGTTGACA     285
Sphaeropthalma       GCCCGAGGTTTTTAAAAGATATTACGCCCGGCTTAGTGCTTTTTCAAAGCGCCATCGACA     301
Photomorphus         GCCCGAGGTTTTTAGAAGATATTACGCCCGGCTTAGTGCTTTTTCAAAGCGCCATCGACA     297
Odontophotopsis      GCCCGAGGTTTTTAGAAGATATTACGCCCGGCTTAGTGCTTTTTCAAAGCGCCATCGACA     302
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Pseudomethoca        AC-TCCCTATGCCACCGTCGAAACTCTTCGACGGTCGGTCCGTAT-----TCCCGCGGGA     401
Kbimaculata          AC-TCCCTATGCCGCCGTCGAAACTTTTGTTCCGGCGGTAGGTCCGTATCTCCTGCGGGA     372
Khansoni             AC-TCCCTATGCCACCGTCGAAACTTTTGTTTCGGCGGTAGGTCCGTATCTCCTGCGGGA     395
Dasymutilla          AC-TCCCTATGCCATCGACGATA--CTTTCGAAGGTGGTCCGTAT---CTCCTGCG-GGA     338
Sphaeropthalma       AC-TCCCTATGCCACCGACGAAACGCTTTCGACGGTGGTCCGTAT---TTCCTGCGGGAA     357
Photomorphus         AC-TCCCAATGCCATCGACGAAACTCTTTCGACGATGGTCCGTAT---TCCT--GCGGGA     351
Odontophotopsis      AACTCCCTATGCCATTGACGAAACTGTTTCGACGGTGGCCCGTAT---TTCCTACGGGAA     359
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Pseudomethoca        GTACGGCTCGGCTTGAAACACCGAGAGAAACTTTTAAAGAC-GACATAGACACAATGAGA     460
Kbimaculata          GTACGGCTCGGCTGGAACCCACCGAGAGACACTTTAAAGACGACGTGGACACAAATGAGA     432
Khansoni             ATACGGCTCGGCTGGAACCCACCGAGAGACACTTTAAAGACGACGTGGACACAAATGAGA     455
Dasymutilla          GTACGGCTCGGCTTGAAACACCGAGAGGAAACTTAAAGACGACCCTGGACACTATGAT-A     397
Sphaeropthalma       -TACGGCTCGGCTTGAAA--CCGAGAGTGAATTTTAAAGACGATGTAGACACAAAGAA-A     413
Photomorphus         ATACGGCTCGGCTTGAAACACCGAGAGCAAATTTTAAAGACGACGTAGACACAAAGAA-A     410
Odontophotopsis      ATACGGCTCGGCTTGAAACACCGAGGGTGAATTTTAAAGACGACTTAGACACAAAGAGCA     419
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Pseudomethoca        GATATGCAATGCATATAAAATGAAACGATTACCCTGA--        497
Kbimaculata          GATATGCAATGCATATAAAATTAAACGATTACCCTGAA-        470
Khansoni             GATATGCAATGCATATAAAATTAAACGATTACCCTGA--        492
Dasymutilla          TATATGCAATGCATATAAAATCAAACGAT----------        426
Sphaeropthalma       TATATGCAATGCATATAGAAATAAAACGATTACCCTGAA        452
Photomorphus         AATATGCAATGCATATAGAAATAAAACGATTACCCTGAA        449
Odontophotopsis      AATATGCAATGCATATAGAAATAAAACGATTACCCTGAA        458
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