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## Redescription of *Varipes* (Ephemeroptera: Baetidae), with the Description of New Species from Bolivia and Argentina

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### Abstract

The adult stage of the genus *Varipes* is described for the first time. *Varipes cajuato* sp. n. from Bolivia, *Varipes minutus* sp. n. and *Varipes singuil* sp. n. from Argentina are described and illustrated. The description of the first species is based on nymphs, the second on nymph and male and female subimagos and the third on nymph and male imago. A key to separate the nymphs of all the known species of the genus is included. The genus is redefined based on the type material of *V. lasiobranchius* and the new material available.

### Resumen

*Varipes cajuato* sp. n. de Bolivia, *Varipes minutus* sp. n. y *Varipes singuil* sp. n. de Argentina son descritas e ilustradas. La primera especie es conocida solo de ninfas, la segunda de ninfas y de machos y hembras subimago y la tercera de ninfas y machos imagos. Se describe aquí por primera vez el adulto del género, desconocido hasta el momento. Se incluye una clave para separar todas las especies conocidas del género. También se redefine el género, sobre la base del nuevo material disponible.

**Keywords:** Ephemeroptera, Baetidae, *Varipes*, South America.

### Introduction

In recent years many new South American Baetidae genera were described. In most cases these genera are monotypic and generally known only from nymphs. *Varipes* (Lugo-Ortiz & McCafferty, 1998) was established for a single species, *V. lasiobranchius*, known from nymphs from Ecuador and Colombia. *V. helenae* was recently

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described from Brazil by Salles and Batista (2004) based also on nymphs. These authors noted some generic character variations between their new species and the type species.

In this paper the type material of *V. lasiobranchius* is examined and three new species are described. In the original description of the type species some important characters were omitted. For this reason, a more complete description of the genus is provided. The male imago is described for the first time, based on reared material.

Two of the new species are described from Argentina, one based on nymphs and male and female subimagos and the other on nymphs and male imagos. Another new species is described from Bolivia, based only on nymphs.

The distribution range of the genus *Varipes* is thus greatly expanded.

### Genus *Varipes* Lugo-Ortiz & McCafferty, 1998

*Varipes* Lugo-Ortiz & McCafferty, 1998: 67–70, Figs. 42–53.

*Varipes* Salles & Batista, 2004: 1.

*Type species: Varipes lasiobranchius* Lugo-Ortiz & McCafferty, original designation.

*Other species included: V. cajuato* sp. n.; *V. helenae* Salles & Batista, 2004; *V. minutus* sp. n.; *V. singuil* sp. n.

### Diagnosis

#### *Imago*

*Male imago* (Fig. 29). Head. Turbinate eyes oval, height of stalk  $\frac{1}{2}$  of eye diameter (Fig. 29). Legs of male. Leg I with tibia almost twice length of femur, tarsi twice length of femur; tarsi with four segments decreasing in length distally. Legs II and III with tibiae and tarsi as long as femora.

*Wings*. Forewing with paired marginal intercalaries (Fig. 30). Hind wings absent.

*Abdomen*. Male genitalia (Fig. 31): forceps three-segmented; basal segment with internal projection in the middle of the segment (Fig. 31, IP). Hind margin of styliiger plate with a small projection on both sides (Fig. 31, P).

#### *Nymph*

*Antenna*: variable in length (from 1.5 to 3 times length of head), scape and pedicel with scale-like tubercles (Fig. 1). Mouthparts: labrum wider than long (Figs. 2, 17, 32); apical margin with bifid setae. Left mandible (Figs. 3a, 18, 33) with incisors fused, molar teeth with constrictions (Fig. 3b), prosthema with 2–3 denticles. Right mandible with incisors fused (Fig. 4) or cleft in two sets apically (Figs. 19, 34); prosthema reduced, appearing as a simple (Fig. 4) or bifid (Fig. 19, 34) long and fine seta. Hypopharynx (Figs. 5, 35) with lingua subequal in length to superlingua. Maxilla (Figs. 6, 20, 36) with two-segmented palp; 1–1.5× length of apex of galea-lacinia. Labium with glossae subequal in length to paraglossae (Figs. 7, 21) or shorter than paraglossae (Fig. 37). Glossae and paraglossae with outer margins with a row of spine-like setae. Segment II of palp more or less expanded in a distomedial process; segment III variable.

*Thorax*: femora with abundant and long spine-like setae on dorsal and ventral margins (Figs. 8, 10, 22, 24, 38, 40). Anterior face of femora I with (Figs. 8, 22) or without (Fig. 38) a transverse row of strong and long spine-like setae on proximal third (Fig. 8) or distal half (Fig. 22). Femora II and III with a transverse row of strong and long spine-like setae on proximal third (Figs. 10, 24, 40). Tarsal claws widened (Figs. 9, 23) or elongated (Fig. 39), with two rows of denticles. Abdomen (Fig. 11): two dark brown bands, one at the anterior margin of segments I, I–III or II–III, and the other at the rear margin of segments VII–VIII, VII–IX or VIII. Hind margins of terga serrated (Figs. 12, 41) or smooth. Gills present on segments I–VII, tracheation absent. Paraprocts with marginal spines (Figs. 3, 5, 8). Terminal filament subequal in length to cerci.

#### *Distribution*

Colombia, Ecuador, Peru, Bolivia, Brazil and Argentina.

#### **Discussion**

According to Lugo-Ortiz & McCafferty (1998), *Varipes* is distinguished from the other genera of Baetidae by the following combination of nymphal characters: (1) right prostheca reduced, appearing as a simple long and fine seta (Fig. 4); (2) tarsal claws with a peculiar arrangement of denticles consisting of two marginal rows tending to form a U.

Based on our material, we can add some more characters shared by all examined species: (1) femora with abundant and long spine-like setae on dorsal and ventral margins (Figs. 8, 10, 22, 24, 38, 40); (2) femora II and III with a transverse row of strong and long spine-like setae on proximal third (Figs. 10, 24, 40); (3) right prostheca reduced appearing as simple (Fig. 4) or bifid (Fig. 19, 34) long and fine seta, but never robust with denticles apically; (4) abdomen (Fig. 11): two dark brown bands, one at the anterior margin of segments I, I–III or II–III, and the other at the rear margin of segments VII–VIII, VII–IX or VIII; (5) tarsal claws widened (Figs. 9, 23) or elongated (Fig. 39), with two rows of denticles.

The adults of this genus are less distinctive. However, they can be characterized by: (1) the absence of hind wings; (2) the presence of an internal projection on the basal segment of the forceps (Fig. 31); (3) the shape of the male eyes (Fig. 29); (4) a small projection on each side of the hind margin of styliger plate (Fig. 31).

Lugo-Ortiz and McCafferty (1998) suggest that *Varipes* could be related to *Camelobaetidius*; however, the phylogenetic relationships of this genus and of the other South America genera could only be assessed through a cladistic analysis.

#### **Key to species of *Varipes*, nymphs**

- 1a Femora I without transverse row of spine-like setae (Fig. 38) .... *V. singuil* sp. n.  
 — Femora I with transverse row of spine-like setae (Figs. 8, 22) ..... 2

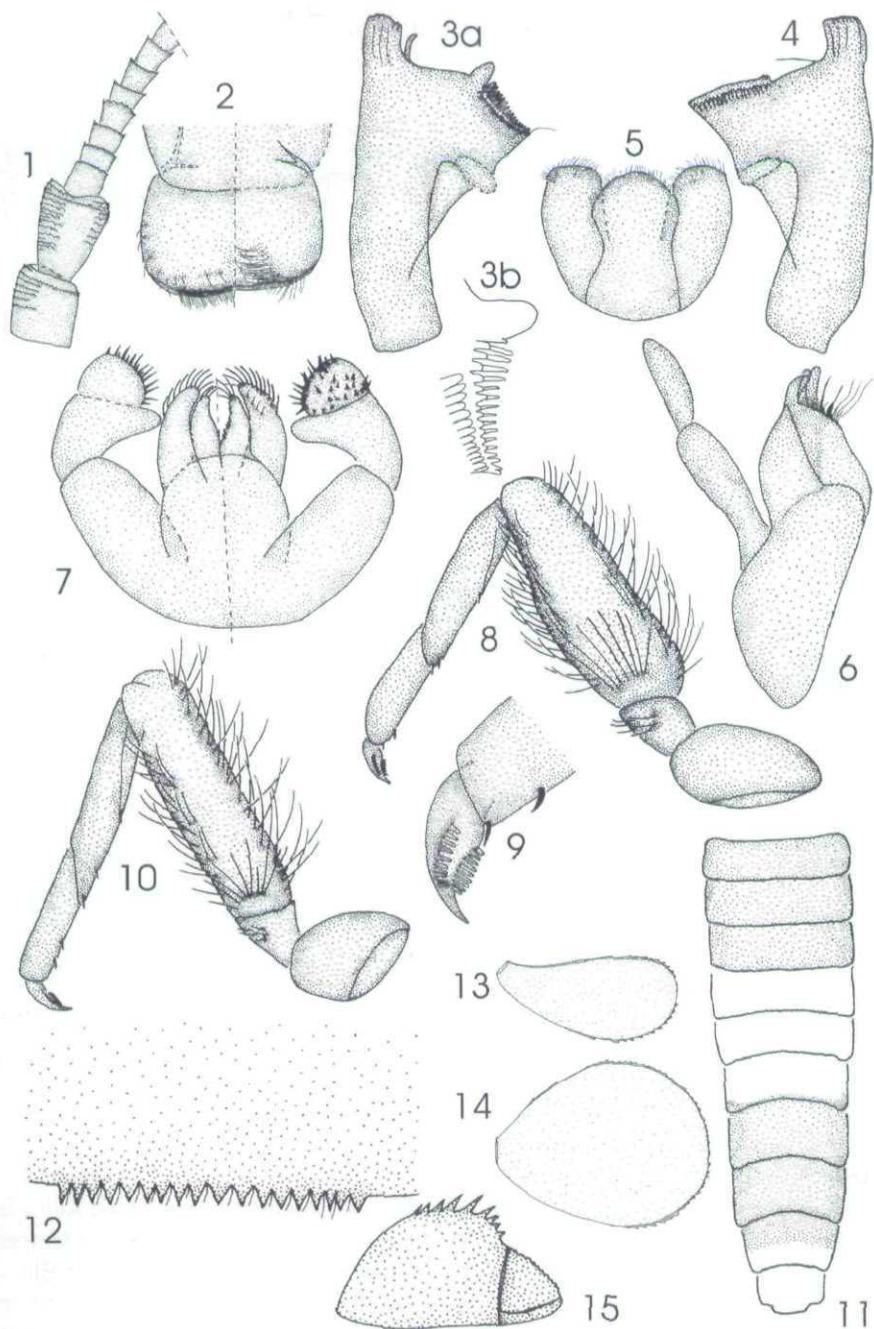
- 2a Transverse row of spine-like setae on femora I in proximal third (Fig. 8), antenna short, nearly 1.5× length of head; right prosthema reduced, appearing as a simple long and fine seta (Fig. 4) ..... 3
- Transverse row of spine-like setae on femora I in distal half (Fig. 22), antenna long, nearly 3× length of head; right prosthema bifid (Fig. 19) ..... 4
- 3a Hypopharynx: lingua and superlingua rounded apically (Fig. 5); maxilla with palp 1.4–1.5× longer than apex of galea-lacinia (Fig. 6); segment II of labial palp with a thumb-like distomedial process (Fig. 7); tarsal claws with two rows of 9–10 denticles each (Fig. 9) ..... *V. cajuato* sp. n.
- Hypopharynx: lingua and superlingua pointed apically (Lugo-Ortiz & McCafferty, 1998: Fig. 44); maxilla with palp reaching apex of galea-lacinia (Lugo-Ortiz & McCafferty, 1998: Fig. 47); segment II of labial palp with moderately developed and somewhat narrowly pointed distomedial process (Lugo-Ortiz & McCafferty, 1998: Fig. 48); tarsal claws with two rows of 5–7 denticles each (Lugo-Ortiz & McCafferty, 1998: Fig. 50) ..... *V. lasiobranchius*
- 4a Labrum: dorsal subapical setae as in Fig. 17; hypopharynx: superlingua rounded (as in Fig. 5), maxilla (Fig. 20) with palp elongated, 1.4–1.5× length of apex of galea-lacinia, segment II 0.9–1× length of segment I ..... *V. minutus* sp. n.
- Labrum: dorsal subapical setae like in Fig. 1 of Salles & Batista (2004); hypopharynx: superlingua pointed (Salles & Batista, 2004: Fig. 2); maxilla with palp robust reaching apex of galea-lacinia, segment II 0.5× length of segment I (Salles & Batista, 2004: Fig. 5) ..... *V. helena*

*Varipes cajuato* sp. n. (Figs. 1–15)

*Nymph* (Figs. 1–15)

Length: body, 5.6–5.7 mm; cerci, 2.3–2.4 mm; terminal filament, 2.1–2.2 mm. Antenna (Fig. 1): 1.1–1.2 mm, nearly 1.5× length of head. Head yellowish brown, compound eyes pale brown. Antenna pale yellow. Mouthparts (Figs. 2–7): labrum (Fig. 2) dorsal surface with 3–4 short setae near midline, 3–4 short ones near lateral margin. Left mandible (Fig. 3a) with molar teeth with constrictions (Fig. 3b). Right mandible (Fig. 4) with incisors fused apically, prosthema reduced, appearing as a simple long and fine seta. Hypopharynx (Fig. 5): lingua and superlingua rounded apically. Maxilla (Fig. 6) with palp 1.4–1.5× longer than apex of galea-lacinia. Labium (Fig. 7): segment II of palp with a thumb-like distomedial process, segment III broad and rounded.

Thorax yellowish. Pleura yellowish brown. Sterna pale yellow. Legs (Figs. 8–10) yellowish brown. Femora I robust. Femora (Figs. 8, 10) with a transverse row of strong and long spine-like setae on proximal third. Tarsal claws (Fig. 9) widened with two rows of 9–10 denticles each. Abdomen (Fig. 11): terga yellowish brown, except segments I–III and VII–IX dark brown. Tergal hind margin serrated (Fig. 12). Sterna yellowish brown. Gills rounded (Fig. 14), whitish except gills I and VII pale brown; gill I half the width of the others (Fig. 13). Paraprocts (Fig. 15) with 8–10 marginal spines. Caudal filaments pale yellow.



Figures 1-15. *Varipes cajuato* sp. n., nymph. (1) Antenna dorsal. Mouthparts: (2) labrum, left dorsal, right ventral; (3a) left mandible ventral; (3b) detail of teeth of molar; (4) right mandible ventral; (5) hypopharynx ventral; (6) maxilla ventral; (7) labium, left dorsal, right ventral. Legs: (8) leg I dorsal; (9) detail of tarsal claw I; (10) leg III dorsal. (11) Abdomen dorsal. (12) Posterior margin of tergum IV dorsal. Gills: (13) gill I; (14) gill IV. (15) Paraproct.

### Material

BOLIVIA: Holotype (male nymph), Depto. La Paz, río Huarinillas S16°11'45", W67°45'05", 1250 m, 21/ XI/ 2000, Domínguez, Molineri & Nieto cols. Paratypes: 34 nymphs same data and collectors; three nymphs, río Suapi S16°06'41", W67°47'09", 1200 m, 19/ XI/ 2000, same collectors; two nymphs: Prov. Sudyungas, río Unduavi, pasando Yamacachi antes de Chulis, S16°24'18", W67°38'12", 1410 m, 15/ V/ 2002, Domínguez col; six nymphs: Colonia San Pedro, río Copacabana, S16°00'51", W67°36'57", 1000 m, 25/ XI/ 2000, same collector; four nymphs: Prov. Inquisivi, río Cajuato, S16°42'28", W67°09'59", 1600 m, 17/ V/ 2002, same collector; two nymphs: Prov. Lare Cajas, río Coroico, 30 km W de Caranavi, S15°40'18", W67°42'14", 440 m, 25/ V/ 2002, same collectors. Holotype and half of paratypes placed at Instituto de Ecología, Unidad de Limnología, Universidad Mayor de San Andrés, La Paz, Bolivia. Other material deposited at Fundación-Instituto Miguel Lillo, Tucumán, Argentina.

### Etymology

Cajuato is the name of one of the rivers where this species was collected.

### Discussion

*V. cajuato* can be distinguished from the other species of the genus by the following combination of characters: (1) antenna short, nearly 1.5× length of head; (2) femora (Figs. 8, 10) with a transverse row of strong and long spine-like setae on proximal third; (3) right prosthema (Fig. 4) reduced, appearing as a simple long and fine seta; (4) segment II of labial palp (Fig. 7) with a thumb-like distomedial process, segment III broad and rounded; (5) lingua and superlingua rounded apically (Fig. 5); (6) maxilla with palp 1.5× length of apex of galea-lacinia (Fig. 6); (7) tarsal claws (Fig. 9) widened with two rows of 9–10 denticles each.

### *Varipes helenae* Salles & Batista

*Varipes helenae* Salles & Batista, 2004: 2. Figs. 1–13.

### Imago

Unknown.

### Nymph

Adequately characterized by Salles and Batista (2004) with the following necessary change: gills I and II racquet-like.

### Discussion

*V. helenae* can be distinguished from the other species of the genus by the following combination of characters. In the nymph, (1) gills I and II racquet-like; (2) femora I with a transverse row of strong and long spine-like setae on distal half (Salles & Batista, 2004: Fig. 7); (3) right mandible (Salles & Batista, 2004: Fig. 4) with incisors cleft in two sets, prosthema bifid; (4) segment II of labial palp (Salles & Batista, 2004: Fig. 6) with a rounded distomedial process, segment III rounded; (5) labrum (Salles & Batista, 2004: Fig. 1) with dorsal surface with two submedian long setae and 2–3 disto-lateral long setae; (6) hypopharynx (Salles & Batista, 2004: Fig. 2): lingua

rounded and superlingua pointed apically; (7) maxilla with palp robust, reaching apex of galea-lacinia, segment II 0.5× length of segment I (Salles & Batista, 2004: Fig. 5).

*Varipes lasiobrachus* Lugo-Ortiz & McCafferty

*Varipes lasiobrachus* Lugo-Ortiz & McCafferty, 1998: 69–70. Figs. 42–53.

*Imago*

Unknown.

*Nymph*

Characterized by Lugo-Ortiz & McCafferty (1998) with the following necessary important change: femora with a transverse row of strong and long spine-like setae on proximal third (as in Figs. 8, 10).

*Discussion*

*V. lasiobrachus* can be distinguished from the other species of the genus by the following combination of characters: (1) prosthema of right mandible reduced, appearing as a simple long and fine seta (Lugo-Ortiz & McCafferty, 1998: Fig. 46); (2) segment II of labial palp with moderately developed and somewhat narrowly pointed distomedial process, segment III broadly rounded (Lugo-Ortiz & McCafferty, 1998: Fig. 48); (3) tarsal claws widened with two row of 5–7 denticles each (Lugo-Ortiz & McCafferty, 1998: Fig. 50); (4) hypopharynx with lingua and superlingua pointed apically (Lugo-Ortiz & McCafferty, 1998: Fig. 44); (5) maxilla with palp reaching apex of galea-lacinia (Lugo-Ortiz & McCafferty, 1998: Fig. 47).

*Material studied*

ECUADOR: Paratype (one nymph), Pichincha Province, Río Guajalito at Las Palmeras, 36.2 km NE on Old Quito Rd, 1949 m, 15°C, 19/ VII/ 1993, Sites, Linit, Nichols. The paratype is housed at Entomological Collection of the University of Missouri, Columbia.

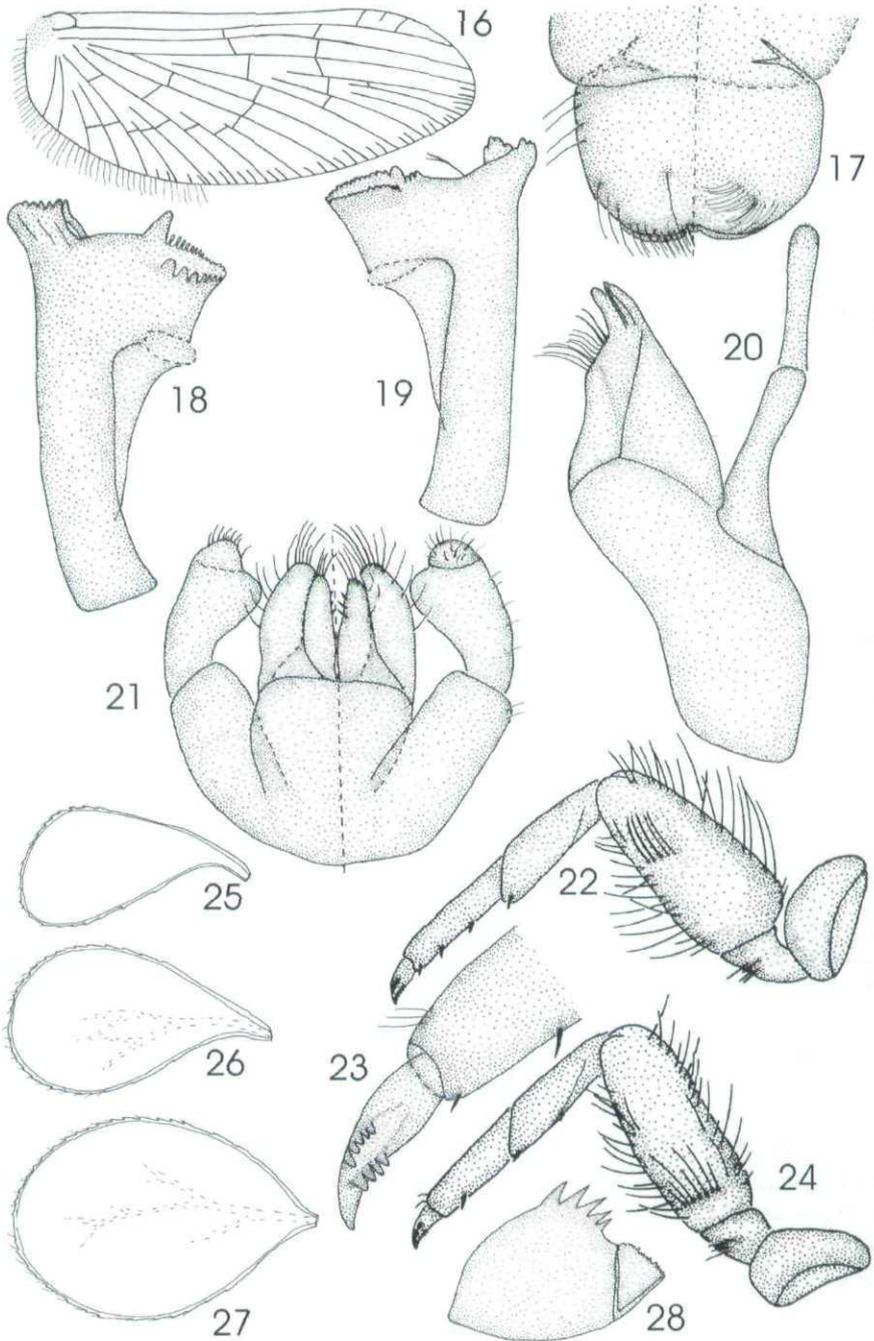
*Varipes minutus* sp. n. (Figs. 16–28)

*Subimago*

Length: body of male, 3.6–3.7 mm; body of female, 3.3–3.4 mm. Head yellowish brown. Antenna yellowish. Eyes: dorsal portion orange brown, ventral portion black. Thorax yellowish brown, mesonotum with three yellowish longitudinal lines. Sterna yellowish. Legs yellowish. Wings translucent (Fig. 16). Abdomen yellowish. Genitalia and cerci pale yellow.

*Nymph* (Figs. 17–28)

Length: body, 3.4–3.5 mm; cerci, 1.3–1.4 mm; terminal filament, 1.2–1.3 mm. Antenna: 1.1–1.2 mm, 3× length of head. Head pale yellow, compound eyes orange



Figures 16–28. *Varipes minutus* sp. n., male subimago. (16) forewing. Nymph. Mouthparts: (17) labrum, left dorsal, right ventral; (18) left mandible ventral; (19) right mandible ventral; (20) right maxilla ventral; (21) labium, left dorsal, right ventral. Legs: (22) leg I dorsal; (23) detail of tarsal claw I; (24) leg III dorsal. Gills: (25) gill I; (26) gill II; (27) gill IV. (28) paraprot.

brown. Antenna pale yellow. Mouthparts (Figs. 17–21): labrum (Fig. 17) dorsal surface with a submedian long seta and 2–3 disto-lateral long setae. Left mandible (Fig. 18). Right mandible (Fig. 19) with incisors cleft in two sets apically, prostheca bifid. Hypopharynx similar to Fig. 5, with lingua and superlingua rounded apically. Maxilla (Fig. 20) with palp elongated, 1.4–1.5× longer than apex of galea-lacinia, segment II 0.9–1× length of segment I. Labium (Fig. 21): segment II of palp with a rounded distomedial process, segment III rounded.

Thorax yellowish, anterior margin of mesonotum yellowish brown. Pleura yellowish brown, sterna pale yellow. Legs (Figs. 22–24) pale yellow. Femur I (Fig. 22) robust, with a transverse row of strong and long spine-like setae on distal half. Femora II and III (Fig. 24) with row of spine-like setae placed on proximal third. Tarsal claws (Fig. 23) widened with two rows of 4–5 denticles each.

Abdomen yellowish brown, segments II–III and VII–VIII brownish. Tergal hind margin of segments I–IV smooth, terga V–IX serrated. Sterna I–VI and IX–X pale yellow, sterna VII–VIII brownish. Gills (Fig. 27) whitish and rounded, gills I and II (Figs. 25, 26) racquet-like. Paraprocts (Fig. 28) with 5–6 marginal spines. Caudal filaments pale yellow.

#### Material

ARGENTINA: Holotype (male nymph), Córdoba, Depto. San Alberto, Cura Brochero, arroyo, S31°42'01", W65°01'23", 890m, 14/ XI/ 2001, Orce & Nieto cols. Paratypes: 18 nymphs, same data and collectors; one male and two female nymphs (reared, with subimaginal exuvia), 34 male and 26 female subimagos same data and collectors; two nymphs: La Rioja, Huaco 1300m, S29°10'45", W67°04'48", 18/ XI/ 1998, Manzo col; 28 nymphs: Tucumán, Río Lules, S26°53'49", W65°22'18", 8/ XII, 1998, Nieto col. Holotype and paratypes are housed at Fundación-Instituto Miguel Lillo, Tucumán, Argentina.

#### Etymology

*Minutus*: Latin adjective that means small, related to the reduced size of this species.

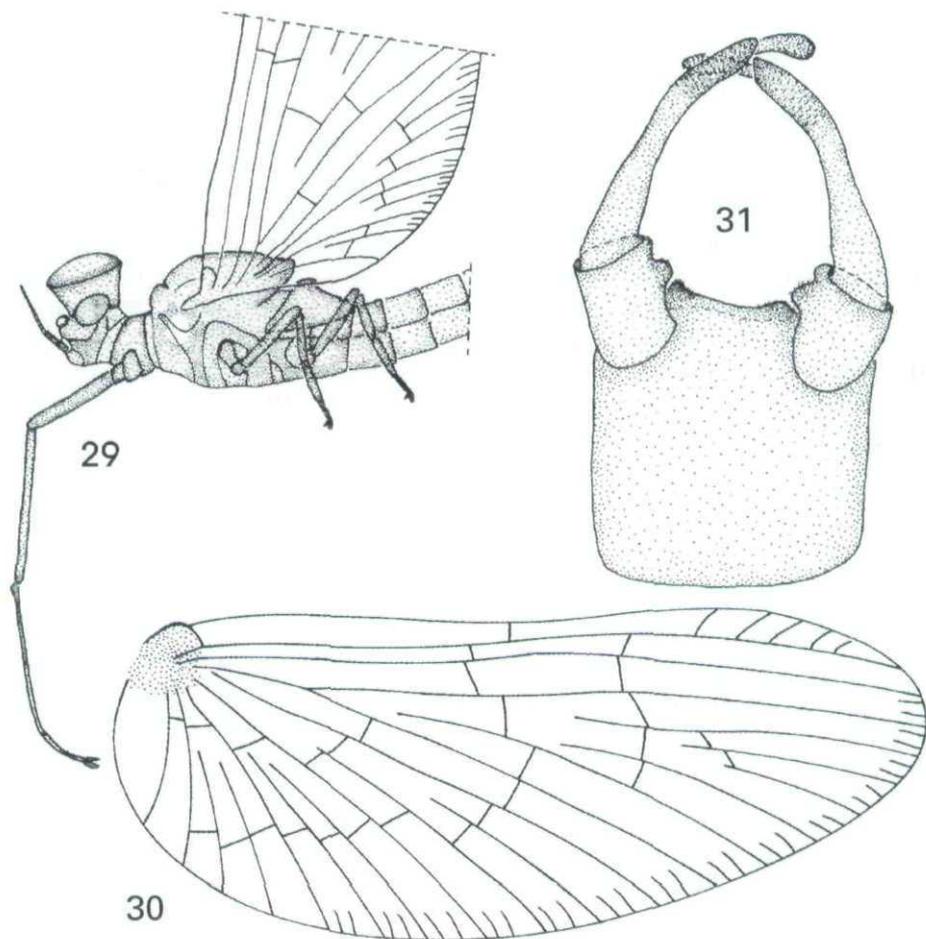
#### Discussion

*Varipes minutus* sp. n. can be distinguished from the other species of the genus by the following combination of characters: (1) gills I and II (Figs. 25, 26) racquet-like; (2) antenna long, nearly 3× length of head; (3) femora I (Fig. 22) with a transverse row of strong and long spine-like setae on distal half; (4) femora II and III (Fig. 24) with the transverse row of strong and long spine-like setae on proximal third; (5) right mandible (Fig. 19) with incisors cleft in two sets, prostheca bifid; (6) segment II of labial palp (Fig. 21) with a rounded distomedial process, segment III rounded; (7) labrum (Fig. 17): dorsal surface with a submedian long seta and 2–3 disto-lateral long setae; (8) maxilla (Fig. 20) with palp elongated, 1.4–1.5× longer than apex of galea-lacinia, segment II 0.9–1× length of segment I.

#### *Varipes singuil* sp. n. (Figs. 29–43)

##### *Male imago* (Figs. 29–31)

Length: body, 4.3–4.4mm; forewings (Fig. 30), 4.4–4.5mm; cerci, 8mm. Head orange brown, antenna yellowish brown. Eyes: apical portion yellowish, basal portion

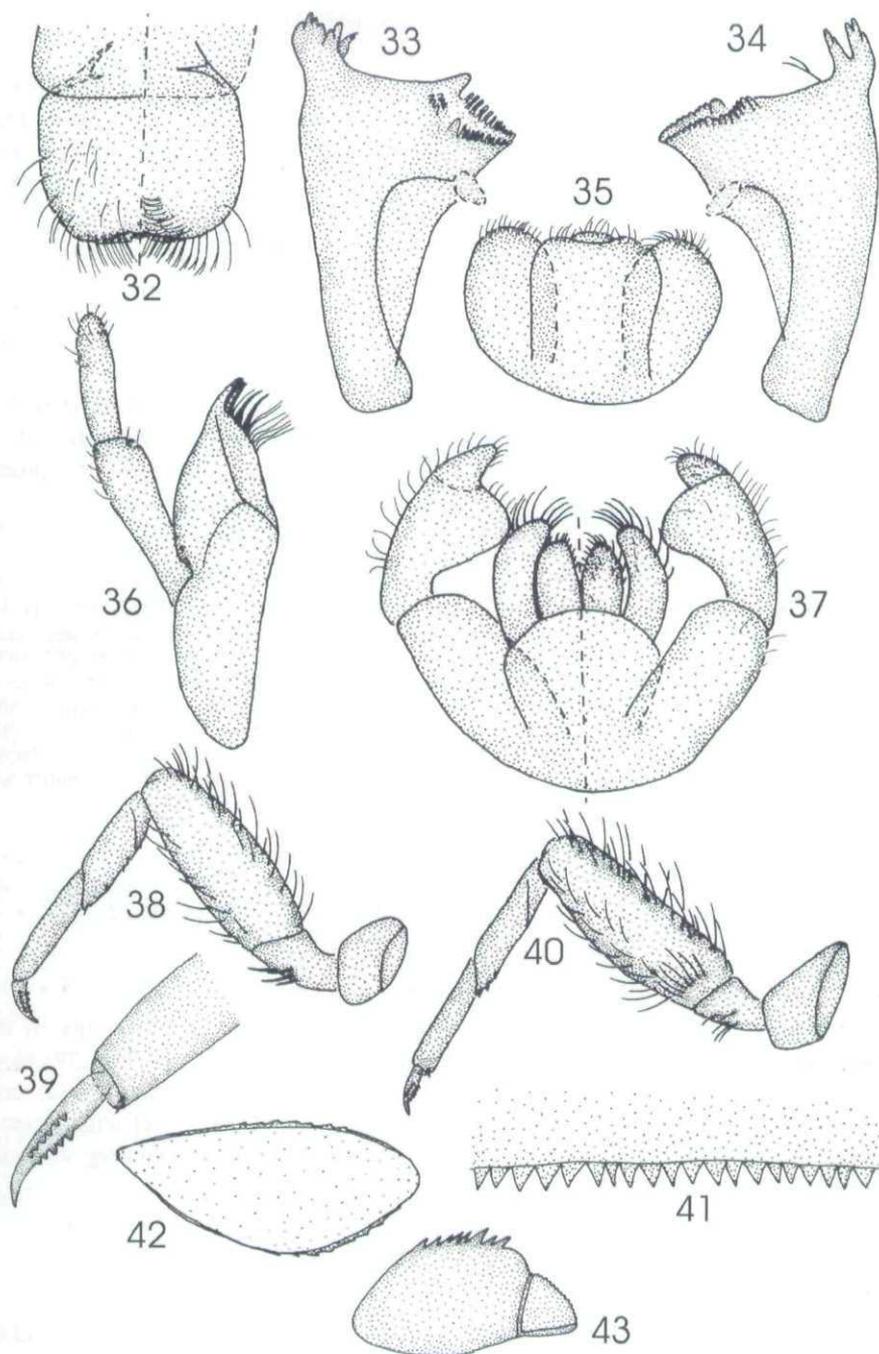


Figures 29–31. *Varipes singuil* sp. n., male imago. (29) Lateral view. (30) Forewing. (31) Genitalia ventral.

black, stalk of turbinate eyes orange yellow, bases of ocelli brownish. Thorax (Fig. 29) yellowish brown, mesoscutellum dark brown. Pleura and sterna yellowish brown. Legs pale yellow. Wings hyaline, costal and subcostal spaces translucent. Abdomen: segment I yellowish brown, segments II–VI pale yellow, segments VII–IX pale brown. Genitalia (Fig. 31) pale brown, apical 1/3 of segment II and segment III striated. Cerci pale yellow.

*Nymph* (Figs. 32–43)

Length: body, 4.3–4.4 mm; cerci, 1.5–1.6 mm; terminal filament, 1.4–1.5 mm. Antenna: 1.1–1.2 mm, nearly 1.5× length of head. Head: yellowish brown, compound



Figures 32–43. *Varipes singuil* sp. n., nymph. Mouthparts: (32) labrum, left dorsal, right ventral; (33) left mandible ventral; (34) right mandible ventral; (35) hypopharynx ventral; (36) maxilla ventral; (37) labium, left dorsal, right ventral. Legs: (38) leg I dorsal; (39) tarsal claw I detail; (40) leg III dorsal. (41) posterior margin of tergum IV dorsal. (42) gill IV. (43) paraproct.

eyes orange brown. Antenna pale yellow. Mouthparts (Figs. 32–37): labrum (Fig. 32) dorsal surface with a submedian long seta and 2–3 disto-lateral long setae. Left mandible (Fig. 33). Right mandible (Fig. 34) with incisors cleft in two sets apically, prosthema bifid. Hypopharynx (Fig. 35): lingua with a small and rounded apical projection, superlingua rounded apically. Maxilla (Fig. 36) with palp 1.5× length of apex of galea-lacinia. Labium (Fig. 37) with glossae shorter than paraglossae, segment II of palp with a rounded distomedial process, segment III conical.

Thorax yellowish brown, metathorax dark brown. Propleura yellow, meso- and metapleura dark brown. Sterna pale yellow. Legs (Figs. 38–40) pale yellow. Femur I (Fig. 38) without a transverse row of strong and long spine-like setae. Femora II and III (Fig. 40) with a transverse row of strong and long spine-like setae on proximal third. Tarsal claws (Fig. 39) elongated with two rows of 5–6 denticles each.

Abdomen yellowish brown. Segments I and VIII dark brown, segment II with a brown spot at midline. Posterior margin of terga serrated (Fig. 41). Sterna pale yellow, sterna VII–IX dark brown. Gills (Fig. 42) whitish, more or less elongated. Paraprocts (Fig. 43) with 8–9 marginal spines. Caudal filaments pale yellow.

#### Material

ARGENTINA: Holotype (male nymph), Tucumán: río Medina, S26°32'27", W65°01'45", 860 m, 14/ VI/ 2001, Molineri, Manzo, Orce & Nieto cols. Paratypes: 21 nymphs and one male subimago (reared), same data and collectors; 16 nymphs and two male subimagos (reared), Escaba, río Singuil, 5/ VIII/ 1999, Molineri col; five nymphs, Jujuy: río Piedras, S23°30'47", W64°33'09", 580 m, 1/ VI/ 2000, Romero, Molineri, Manzo & Nieto cols; one nymph, and one male subimago and one male imago (reared), Salta: P.N. El Rey, A° de Las Salas, 6/ VI/ 1998, Domínguez col; two nymphs: río Colorado, S23°22'09", W64°28'11", 406 m, 1/ VI/ 2000, Romero, Molineri, Manzo & Nieto cols; seven nymphs, Depto. Guachipas, Río Grande de El Sauce, 15/ IX/ 1998, Domínguez, Molineri & Ubero cols. The holotype and paratypes are housed at Fundación-Instituto Miguel Lillo, Tucumán, Argentina.

#### Etymology

Singuil is the name of one of the rivers where this species was collected.

#### Discussion

*Varipes singuil* sp. n. can be distinguished from the other species of the genus by the following combination of characters: in the nymph, (1) tarsal claws (Fig. 39) elongated with two rows of 5–6 denticles each; (2) femora I (Fig. 38) without a transverse row of strong and long spine-like setae; (3) right mandible (Fig. 34) with incisors cleft in two sets apically, prosthema bifid; (4) segment II of labial palp (Fig. 37) with a rounded distomedial process, segment III conical.

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