



Three new species of the genus *Cloeodes* Traver (Ephemeroptera: Baetidae) from Uruguay

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Abstract

The genus *Cloeodes* is poorly reported for Uruguay, until now only *C. aymara* was described from this region. Here we describe three new species of *Cloeodes* from this country: *C. dialutoi*, *C. guenoa* and *C. vaimaca*, all of them based on nymphs. The species *C. opacus* is reported for the first time in Uruguay. A discussion of each taxon is included as well as drawings of the new species. A revised and updated key for male imago and nymphs of South American species of *Cloeodes* is presented.

Key words. South America, taxonomy, aquatic insects, biodiversity

Resumen

El género *Cloeodes* está pobremente representado en Uruguay, hasta el momento solo *C. aymara* fue descrita para esta región. En este trabajo describimos, a partir de ninfas, tres especies nuevas de *Cloeodes* para este país: *C. dialutoi*, *C. guenoa* y *C. vaimaca*. La especie *C. opacus* es reportada por primera vez para Uruguay. Se incluye una discusión para cada taxón así como dibujos de las especies nuevas. Se incluye también una clave actualizada para los machos adultos y las ninfas de todas las especies de *Cloeodes* para América del Sur.

Palabras claves. América del Sur, taxonomía, insectos acuáticos, biodiversidad

Introduction

Traver (1938) established the genus *Cloeodes* based on three species from Puerto Rico. Waltz & McCafferty (1987b) redefined the genus keeping only one of the initial species in the genus: *C. maculipes*. They redefined the genus and transferred some species to *Cloeodes*. They also established a monotypic genus *Bernerius* (1987a) and placed it as the “sister genus of *Cloeodes*”. In 2008, Nieto & Richard synonymized *Bernerius* with *Cloeodes* based on cladistic analysis.

Cloeodes has a pantropical distribution and can be found in a broad diversity of habitats (Domínguez et al., 2006). Currently this genus includes 14 recognized species in South America, known as follows: five from nymphs, four from adults and five from both nymphs and adults (Nieto & Richard, 2008; Gonçalves et al., 2010). We do not include *C. stelzneri* (Weyenbergh) and *C. nocturnus* (Navás) following Nieto & Richard (2008) who proposed both species as *nomen dubia*.

In Uruguay *Cloeodes* was reported for the first time in 1987b, when Waltz & McCafferty transferred *Baetis aymara* (Traver, 1971) to this genus. Until now, this species, known from adults, was the only species reported from this country. In this paper, three new species are described, based on nymphs. *Cloeodes opacus* Nieto & Rich-

ard, 2008 is reported for the first time in this country. A revised and updated key to the male imagos and nymphs of the South American species of *Cloeodes* are presented.

Material and methods

Nymphs were collected from all benthic substrates or microhabitats by manually picking the specimens or using a D-frame dipnet.

Dissected parts of the specimens studied were mounted on microscope slides using Canada Balsam as mounting media. All the material was preserved in ethyl alcohol 96%. Line drawings were done using a camera lucida attached to a compound microscope. Pictures were taken using a Nikon SMZ-10 stereomicroscope or a compound microscope, with a Nikon D5000 digital camera. For some of the pictures a series of partially focused images were processed with the program CombineZP to produce final images with enhanced quality.

The key to South American species of *Cloeodes*, proposed by Nieto & Richard (2008), is modified here to include the three new species and the adult of *C. jaragua* Salles & Lugo-Ortiz (2003) recently described by Gonçalves *et al.* (2010).

The holotypes are deposited in the Museo de la Universidad de la República, Montevideo, Uruguay (MUR), paratypes are deposited in Instituto Miguel Lillo, Tucumán, Argentina (IML).

Key to South American *Cloeodes* (modified from Nieto & Richard, 2008)

Male imagos¹

- | | | |
|------|--|--|
| 1 | Hind wings present | 2 |
| | Hind wings absent | 6 |
| 2(1) | Hind wings with costal projection in the center of anterior margin (Nieto & Richard, 2008: Fig. 53b) | <i>C. penai</i> |
| | Hind wings with costal projection in the first third of anterior margin (Nieto & Richard, 2008: Fig. 17b) | 3 |
| 3(2) | Hind wings with 3 longitudinal veins (Nieto & Richard, 2008: Fig. 17b) | <i>C. espinillo</i> |
| | Hind wings with 2 longitudinal veins | 4 |
| 4(3) | Segment II of forceps with a basal constriction (McCafferty & Lugo-Ortiz, 1995: Fig. 12) | 5 |
| | Segment II of forceps without constriction | <i>C. aymara</i> |
| 5(4) | Segment II of forceps with distolateral projection immediately adjacent to constriction; segment I with distolateral projection (Gonçalves <i>et al.</i> , 2010: Fig. 9) | <i>C. jaragua</i> |
| | Segment II and segment I of forceps without projection (McCafferty & Lugo-Ortiz, 1995: Fig. 12) | <i>C. hydration</i> |
| 6(1) | Compound eyes erect, almost contiguous apically | <i>C. anduzei</i> / <i>C. binocularis</i> ² |
| | Compound eyes not as above and not contiguous apically | <i>C. barituensis</i> |

- C. turbinops* is not included in the key because the original description does not have enough characters to distinguish this species from the others.
- C. anduzei* and *C. binocularis* are presently indistinguishable.

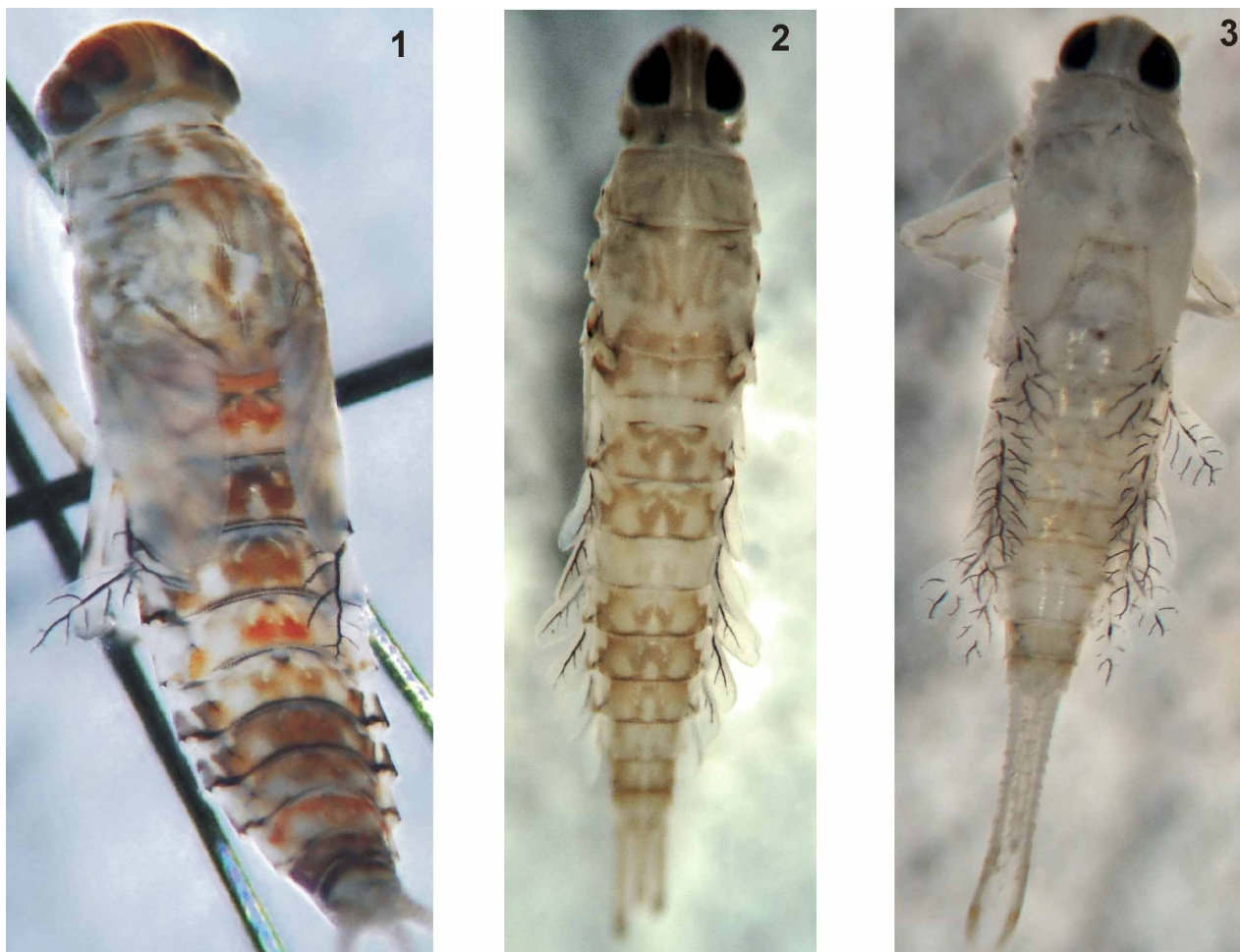
Nymphs

- | | | |
|------|--|-----------------------|
| 1 | Hind wing pads absent | 2 |
| | Hind wing pads present | 4 |
| 2(1) | Labium with segment III of palpi truncate; maxillae with palpi longer than galea-lacinia | <i>C. auwe</i> |
| | Labium with segment III of palpi conical (Nieto & Richard, 2008: Fig. 61); maxillae with palpi subequal to galealacinia (Nieto & Richard, 2008: Fig. 10) | 3 |
| 3(2) | Abdominal tergum I with posterior margin smooth; abdominal color pattern as in Nieto & Richard, 2008: Fig. 5; nymphs bigger (6 mm) | <i>C. barituensis</i> |
| | Abdominal tergum I with spines on posterior margin; abdominal color pattern not as above; nymphs smaller (4 mm) | <i>C. redactus</i> |
| 4(1) | General color pattern with head, thorax, and segments I–V of abdomen dark | <i>C. jaragua</i> |
| | General color pattern not as above | 5 |
| 5(4) | Femora with 2–3 blunt spines apically (Fig. 10) | 6 |
| | Femora with 2–3 pointed spines apically (Nieto & Richard, 2008: Fig. 63) | 11 |
| 6(5) | Dorsal edge of femora with blunt spines (Fig. 10) | 7 |
| | Dorsal edge of femora with pointed spines, except a pair of blunt spines apically (Fig. 21) | 8 |
| 7(6) | Labium with segment III of palpi rounded (Fig. 9); abdominal color pattern as in Fig. 1, with segments I, IV, VIII with reddish | |

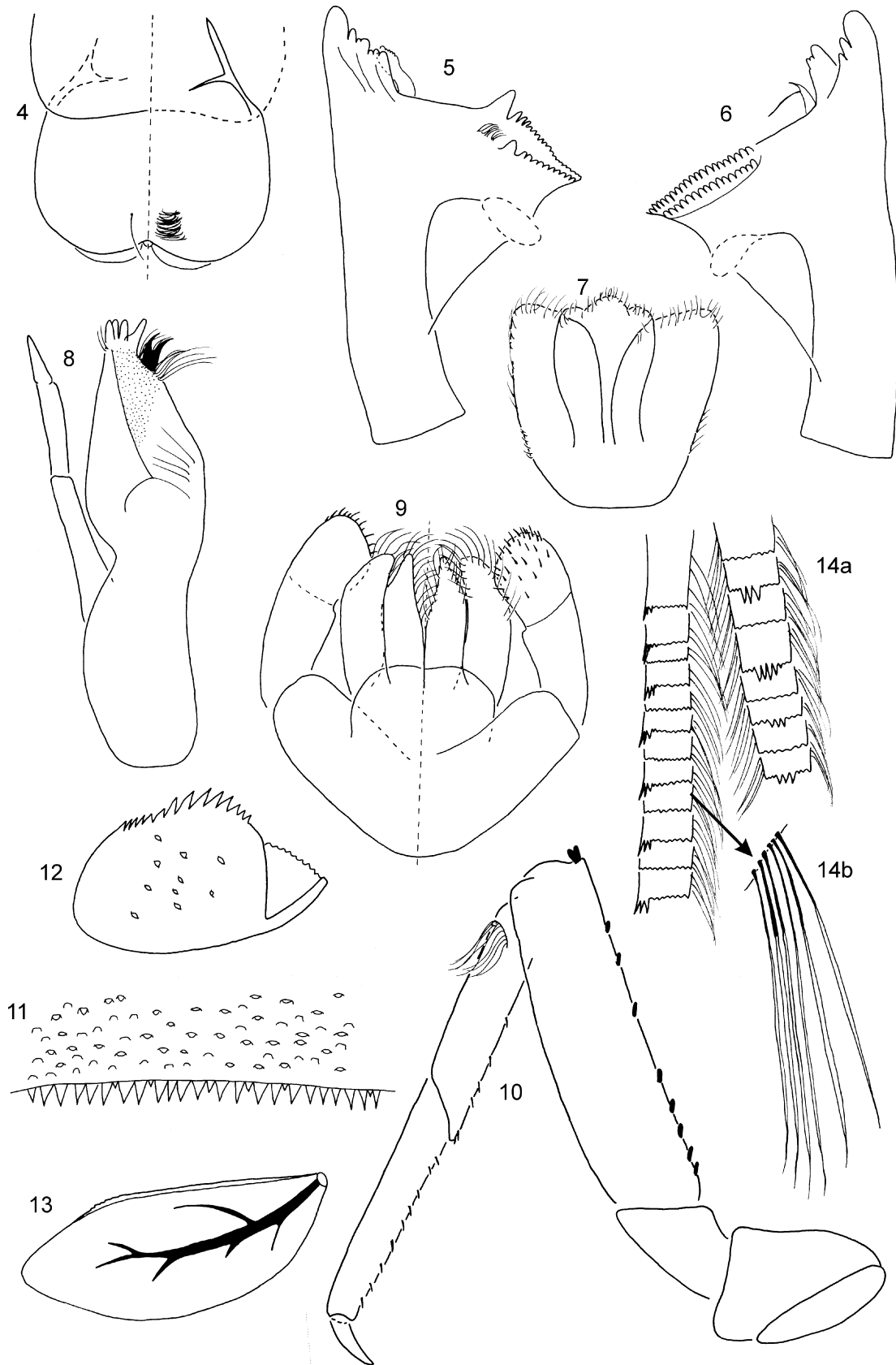
- spots, segments II-III, VI-VII, IX-X brownish, segment V pale brown *C. dialutoi* sp. nov.
 Labium with segment III of palpi subquadrangular (Nieto & Richard, 2008: Fig. 46); abdominal color pattern (Nieto & Richard, 2008: Fig. 43), with segments I-X dark brown, segments I-IX with medial yellow marking *C. opacus*
- 8(6) Tarsal claws at least half the length of tarsi *C. irvingi*
 Tarsal claws less than half the length of tarsi 9
- 9(8) Labial palpi with segment III truncate (McCafferty & Lugo-Ortiz, 1995: Fig. 6); maxillary palpi longer than galea-lacinia *C. hydatation*
 Labial palpi with segment III rounded (Fig. 20); maxillary palpi subequal or shorter than galea-lacinia 10
- 10(9) Lingua shorter than superlinguae (Nieto & Richard, 2008: Fig. 23); abdominal color pattern with segments II-III and VI with brown spots (Nieto & Richard, 2008: Fig. 20) *C. espinillo*
 Lingua longer than superlinguae (Fig. 18); abdominal color pattern not as above 11
- 11(10) Abdominal color pattern with segments III-VII with two whitish spots near midline, segments IV and VIII pale brown (Fig. 2) *C. guenoa* sp. nov.
 Abdominal color pattern with segments I-V with a reddish spot in the midline (Fig. 3) *C. vaimaca* sp. nov.
- 12(5) Maxillary palpi longer than galea-lacinia (Nieto & Richard, 2008: Fig. 35); thumb of molar area of the left mandible in the same plane as anterior margin (Nieto & Richard, 2008: Fig. 32); tarsal claws with minute denticles basally (Nieto & Richard, 2008: Fig. 38) *C. incus*
 Maxillary palpi subequal to galea-lacinia (Nieto & Richard, 2008: Fig. 60); thumb of molar area of the left mandible transverse to anterior margin (Nieto & Richard, 2008: Fig. 57); tarsal claws without denticles (Nieto & Richard, 2008: Fig. 64) *C. penai*

***Cloeodes dialutoi* sp. nov.**

(Figs. 1, 4–14)



FIGURES 1–3. Nymphs, dorsal habitus. 1, *Cloeodes dialutoi* sp. nov. 2, *Cloeodes guenoa* sp. nov. 3, *Cloeodes vaimaca* sp. nov.



FIGURES 4–14. *Cloeodes dialutoi* sp. nov. Nymph. Mouthparts (Figs. 4–9): 4, labrum, left d.v., right v.v.; 5, left mandible v.v.; 6, right mandible v.v.; 7, hypopharynx v.v.; 8, maxilla v.v.; 9, labium, left d.v., right v.v. 10, leg I. 11, posterior margin of tergum IV. 12, paraproct. 13, gill IV. 14a, cercus and terminal filament; 14b, cercus, detail of setae.

Nymph (Fig. 1). Length: body, 4.6–4.7 mm; cerci, 1.9–2.0 mm; terminal filament, 1.7–1.8 mm. Antennae broken. Head yellowish brown, longer than wide, compound eyes reddish brown. Antennae pale yellow. Mouthparts (Figs. 4–9): labrum (Fig. 4) with one subapical seta centrally, anterior margin with bifid setae (similar to Fig. 15b). Left mandible (Fig. 5) without setae between prostheca and mola, thumb of molar area transverse to anterior margin. Right mandible (Fig. 6) without setae between prostheca and mola. Hypopharynx (Fig. 7): lingua with rounded projection and subequal in length to superlinguae. Maxillae (Fig. 8), palpi as long as galea-lacinia, two segmented, segment II with a constriction. Labium (Fig. 9) with segment III of palpi rounded.

Thorax yellowish brown. Fore wing pads yellowish. Pleura brownish, sterna pale yellow. Legs pale yellow, femora with median brownish bands, apical margin of tibiae and basal margin of tarsi brownish. Dorsal margin of femora (Fig. 10) with a row of blunt spines, apically with a subquadrangular projection and two blunt spines. Tarsal claws 0.3 times the length of tarsi. Hind wing pads present.

Abdomen as in Fig. 1, segments I, IV, VIII with reddish markings, segments II–III, VI–VII, IX–X brownish, segment V pale brown, segments I–VI with two pale spots near midline. Abdominal terga with covers and some scales (following Kluge, 1997), posterior margin of terga with spines as in Fig. 11. Paraprocts (Fig. 12) with 12–13 spines apically. Gills (Fig. 13) translucent, trachea pigmented, 2 times the length of each tergum. Caudal filaments pale yellow, except apically brownish, with flattened setae basally sclerotized (Fig. 14b). Cerci with long spines toward external margin every two segments, terminal filament with long spines toward midline every two segments (Fig. 14a).

Adults. Unknown

Etymology. This species is dedicated to William Dialuto, because of him the richness of Rocha's ecosystems is known. His commitment to preservation of the environment is invaluable.

Diagnosis. *Cloeodes dialutoi* sp. nov. can be distinguished from the other species of the genus by the following combination of characters: 1) hind wing pads present; 2) labium with segment III of palpi rounded (Fig. 9); 3) dorsal margin of femora with a row of blunt spines, apically with a subquadrangular projection and two blunt spines (Fig. 10); 4) abdominal color pattern in Fig. 1, with segments I, IV, VIII with reddish spots, segments II–III, VI–VII, IX–X brownish, segment V pale brown.

Material. Holotype male mature nymph: URUGUAY, Rocha, Paraje. El Oratorio, Finca Sr. Cabrera, Arroyo Sauce Chico de los Méndez, S 34° 01' 16'', W 53° 57' 32.6'', 121m, 24/ 3/ 2010, Emmerich & Molineri colls. Paratypes: six nymphs (one dissected) same data as holotype. Two nymphs: Maldonado, R 109, Cerro Cordillera, Arroyo sin nombre, S 34° 20' 29.4'', W 54° 37' 40.5'', 301 m. 23/ 3/ 2010. D. Emmerich & C. Molineri colls.

Cloeodes guenoa sp. nov.

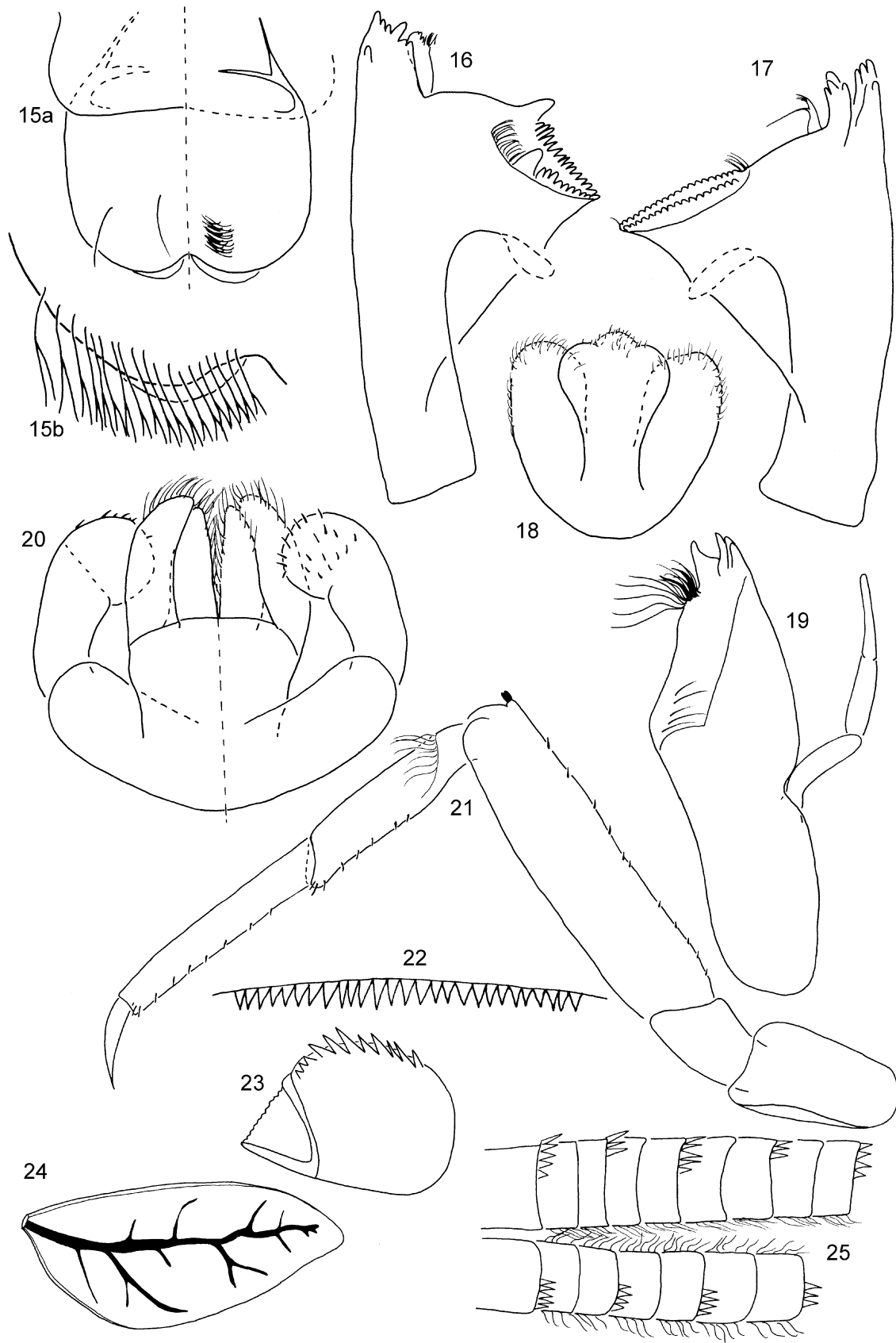
(Figs. 2, 15–25)

Nymph (Fig. 2). Length: body, 4.9–5.1 mm; cerci, 1.4–1.5 mm; terminal filament, 1.2–1.3 mm. Antennae broken. Head yellowish brown, longer than wide, compound eyes yellowish brown. Antennae pale yellow. Mouthparts (Figs. 15–20): labrum (Fig. 15a) with one subapical seta centrally and one seta near lateral margin, anterior margin with bifid setae (Fig. 15b). Left mandible (Fig. 16) without setae between prostheca and mola, thumb of molar area transverse to anterior margin. Right mandible (Fig. 17) without setae between prostheca and mola. Hypopharynx (Fig. 18): lingua with rounded projection and longer than superlinguae. Maxillae (Fig. 19), palpi as long as galea-lacinia, two segmented, segment II with a constriction. Labium (Fig. 20) with segment III of palpi rounded.

Thorax pale yellow. Pleura yellowish brown, sterna pale yellow. Legs yellowish brown. Dorsal margin of femora with a row of pointed spines, apically with a subquadrangular projection and two blunt spines (Fig. 21). Tarsal claws 0.3 times the length of tarsi. Hind wing pads present.

Abdomen yellowish brown (Fig. 2), segments III–VII with two whitish spots near midline, segments IV and VIII pale brown. Abdominal terga with covers, posterior margin of terga with spines as in Fig. 22. Paraprocts with 10–11 spines apically (Fig. 23). Gills translucent white, main and secondary trachea pigmented (Fig. 24), 2 times the length of each tergum. Caudal filament yellowish, with flattened setae basally sclerotized (similar to Fig. 14b). Cerci with long spines toward external margin every two segments, terminal filament with long spines toward midline every two segments (Fig. 25).

Adults. Unknown.



FIGURES 15–25. *Cloeodes guenoa* sp. nov. Nymph. Mouthparts (Figs. 15–20): 15a, labrum, left d.v., right v.v.; 15b, labrum: apical setae; 16, left mandible v.v.; 17, right mandible v.v.; 18, hypopharynx v.v.; 19, maxilla v.v.; 20, labium, left d.v., right v.v. 21, leg I. 22, posterior margin of tergum IV. 23, paraproct. 24, gill IV. 25, cercus and terminal filament.

Etymology. “Guenoa” is the name of the native people who inhabits the current districts of Treinta y Tres, Cerro Largo and Tacuarembó.

Diagnosis. *Cloeodes guenoa* **sp. nov.** can be distinguished from the other species of the genus by the following combination of characters: 1) hind wing pads present; 2) lingua with rounded projection and longer than superlinguae (Fig. 18); 3) labium with segment III of palpi rounded (Fig. 20); 4) dorsal margin of femora with a row of pointed spines, apically with a subquadrangular projection and two blunt spines (Fig. 21); 5) abdominal color pattern as in Fig. 2, with segments III–VII with two whitish spots near midline, segments IV and VIII pale brown.

Material. Holotype female mature nymph, URUGUAY, Tacuarembó, R5, km 379, Arroyo Tranqueras, S 31°47'29'', W 55° 58'51'', 124m, 22/ 2/ 2008, Emmerich & Molineri colls. Paratypes six nymphs (one dissected) same data as holotype. Three nymphs: Lavalleja, R8, km 190, Arroyo Tapes Chico, S 33° 59'18'', W 54° 46'54'', 130m, 4/ 3/ 2008, Emmerich & Pérez colls. One nymph: Treinta y Tres, Quebrada de los Cuervos, Arroyo Los Helechos, S 32° 55' 27.3'', W 54° 27' 34.4'', 125 m. 8/ 11/ 2004, D. Emmerich & E. Morelli colls. Six nymphs: Maldonado, R 109, Cerro Cordillera, Arroyo sin nombre, S 34° 20' 29.4'', W 54° 37' 40.5'', 301 m, 23/ 3/ 10, D. Emmerich & C. Molineri colls.

Cloeodes opacus Nieto & Richard

Cloeodes opacus Nieto & Richard, 2008: 13

Diagnosis. *Cloeodes opacus* can be distinguished from the other species of the genus by the following combination of characters: 1) hind wing pads present; 2) segment III of labial palpi subquadrangular (Nieto & Richard, 2008: Fig. 46); 3) dorsal margin of femora with a row of blunt spines, apically with a subquadrangular projection and two blunt spines (Nieto & Richard, 2008: Fig. 48); 4) abdominal color pattern dark brown with segments I–IX with medial yellow markings as in Nieto & Richard, 2008: Fig. 43, segment X brown; 5) caudal filaments with flattened setae basally sclerotized, cerci with long spines toward external margin every two segments, terminal filament with long spines toward midline dorsally and ventrally every two segments.

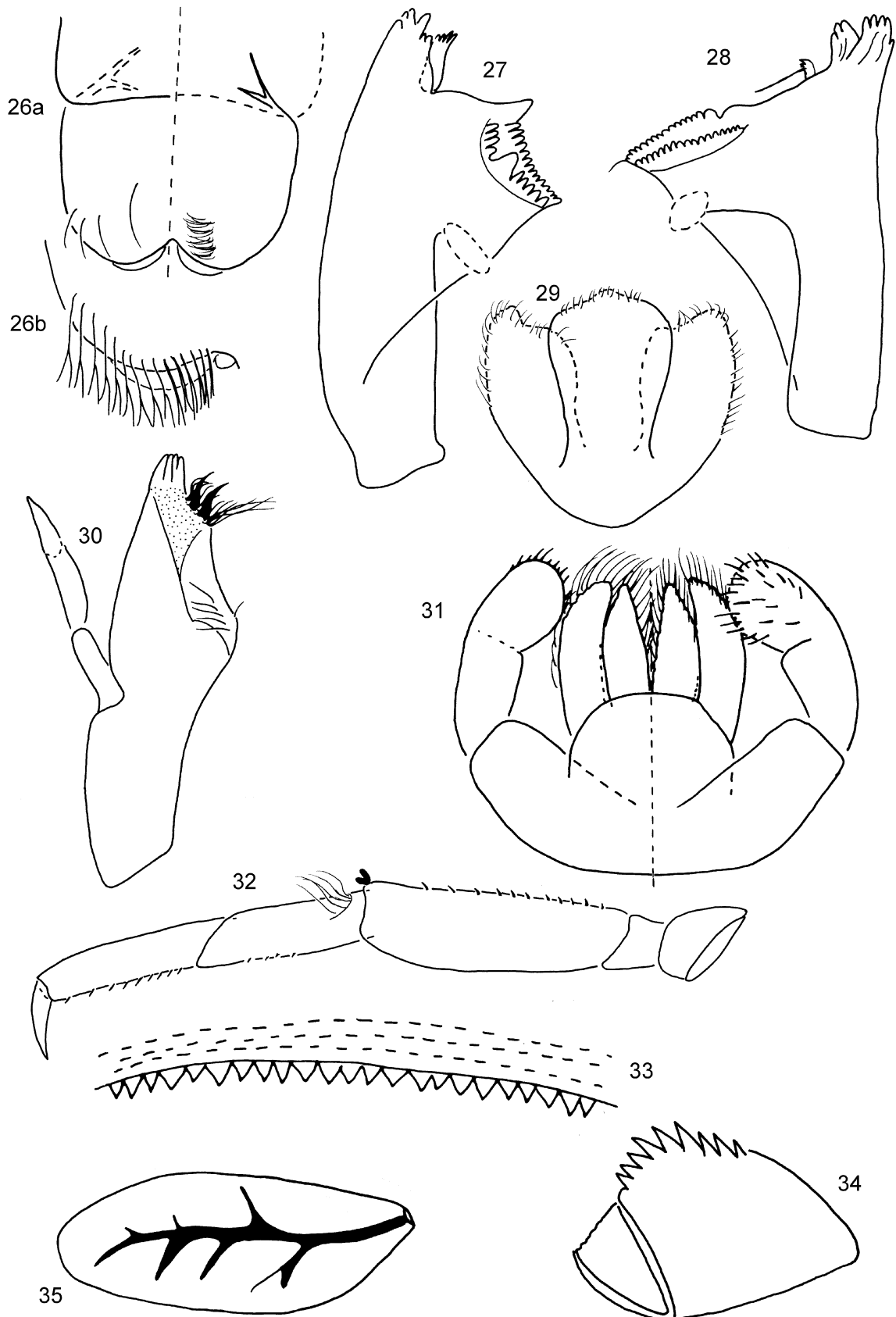
Material. One nymph: URUGUAY, Rivera, Mina de los Corrales, Arroyo Corrales, S 31° 34' 34'', W 55° 27' 58'', 135m, 19/ 2/ 2008, Emmerich & Molineri colls. Two nymphs: Treinta Tres, R7, km 279, Arroyo La Yeguada, S 32° 57' 34'', W 54° 59' 11'', 232m, 21/ 2/ 2008, Emmerich & Molineri colls. One nymph: Rivera, Santa Ernestina, R. 29, cerca Mina Corrales, Arroyo sin nombre, S 31° 32' 23.8" W 55° 33' 42", 146m, 19/2/2008, D. Emmerich & C. Molineri colls. Twenty-two nymphs: Rocha, Tahona, Finca Sr. Fernández, Cascada de los Helechos, S 34° 20' 49.5'' W 54° 25' 40.8'', 122m, 23/ 3/ 2010, D. Emmerich & C. Molineri colls. Seventeen nymphs: Treinta y Tres, Quebrada de los Cuervos, Arroyo Yermal Chico, S 32° 55' 35.2'', W 54° 27' 39.6'', 78 m, 25/ 3/10, D. Emmerich & C. Molineri colls.

Cloeodes vaimaca **sp. nov.**

(Figs. 3, 26–35)

Nymph (Fig. 3). Length: body, 4.1–4.2 mm; cerci, 1.4–1.5 mm; terminal filament, 1.3–1.4 mm. Antennae partially broken. Head pale yellow, longer than wide, compound eyes pale yellow. Antennae pale yellow. Mouthparts (Figs. 26–31): labrum (Fig. 26a) with one subapical seta centrally and two–three setae near lateral margin, anterior margin with bifid setae (Fig. 26b). Left mandible (Fig. 27) without setae between prosthema and mola, thumb of molar area transverse to anterior margin. Right mandible (Fig. 28) without setae between prosthema and mola. Hypopharynx (Fig. 29): lingua with rounded projection and longer than superlinguae. Maxillae (Fig. 30), palpi scarcely shorter than galea-lacinia, two segmented, segment II with a constriction. Labium (Fig. 31) with segment III of palpi rounded.

Thorax pale yellow. Pleura pale yellow, sterna whitish. Legs pale yellow. Dorsal edge of femora with a row of pointed spines, apically with a rounded projection and two blunt spines (Fig. 32). Tarsal claws 0.4 times the length of tarsi. Hind wing pads present.



FIGURES 26–35. *Cloeodes vaimaca* sp. nov. Nymph. Mouthparts (Figs. 26–31): 26a, labrum, left d.v., right v.v.; 26b, labrum: apical setae; 27, left mandible v.v.; 28, right mandible v.v.; 29, hypopharynx v.v.; 30, maxilla v.v.; 31, labium, left d.v., right v.v. 32, leg I. 33, posterior margin of tergum IV. 34, paraproct. 35, gill IV.

Abdomen pale yellow, segments I–V with a reddish spot in the midline. Abdominal terga with covers, posterior margin of terga with spines as in Fig. 33. Sterna pale yellow with trachea pigmented, sterna II–VI with a tuft of long fine setae laterally on each side. Paraprocts with spines apically (Fig. 34). Gills (Fig. 35) translucent, trachea pigmented, 2.5 times the length of each tergum. Caudal filaments pale yellow, with flattened setae basally sclerotized (similar to Fig. 14b). Cerci with long spines toward external margin every two segments, terminal filament with long spines toward midline every two segments (similar to Fig. 35).

Etymology. *Vaimaca* was one of the four charrúas taken to Paris in 1833 to be exhibited in the "Museum of the Man". This fact crowned the humiliation and destruction of this people for the colonial Spanish model. We dedicate respectfully this species to his memory.

Diagnosis. *Cloeodes vaimaca* sp. nov. can be distinguished from the other species of the genus by the following combination of characters: 1) hind wing pads present; 2) lingua with rounded projection and longer than superlinguae (Fig. 29); 3) labium (Fig. 31) with segment III of palpi rounded; 3) dorsal margin of femora with a row of pointed spines, apically with a rounded projection and two blunt spines (Fig. 32); 4) abdominal color pattern as in Fig. 3, with segments I–V with a reddish spot in the midline

Material. Holotype male nymph: URUGUAY, Flores, R. 57, km 30, Arroyo Guardia Vieja, S 33° 42' 12'', W 57° 06' 17'', 120m, 6/ 3/ 2008, Emmerich & Pérez colls. Paratypes: three nymphs (one dissected) same data as holotype. One nymph: Paysandú, R. 3, km 366, Arroyo Sacra, S 32° 21' 02'', W 58° 03' 04'', 10m, 7/ 3/ 2008, Emmerich & Pérez colls. One nymph: Río Negro, R 3, Km 291, Camping. Arroyo San Esteban, S 32° 50' 07'', W 57° 30' 59'', 34 m, 2/ 3/ 08, D. Emmerich & S. Pérez colls.

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