

Revision of the Genus *Paracloeodes* (Ephemeroptera: Baetidae) in South America

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Abstract

Six new species of *Paracloeodes* are described: four from Brazil (*P. assu*, *P. atroari*, *P. peri* and *P. waimiri*), one from Argentina (*P. yuto*) and one from Bolivia (*P. pacawara*), based on nymphs. Three other species from South America: *P. binodulus*, *P. eurybranchus* and *P. ibicui* are revised. A cladistic analysis including most of the South American species of *Paracloeodes* and the monotypic genus *Iguaira* is presented. A key for all South American species is included.

Key words: Ephemeroptera, Baetidae, *Paracloeodes*, South America.

Introduction

Paracloeodes was established in 1955 by Day. The original description included one new species, *Paracloeodes abditus* known from nymphs and adults from the United States and one species transferred from *Cloeodes*, *P. portoricensis* (Traver, 1938) from Puerto Rico. The type species was later synonymized with *P. minutus* (Daggy) by McCafferty & Waltz (1990). Since then, six new species have been described in the genus. Four of these species, *P. binodulus*, *P. eurybranchus*, *P. ibicui* and *P. leptobranchnus* are reported from South America, distributed in Argentina, Brazil and Paraguay. The four South American species were described from nymphs and in the case of *P. eurybranchus*, also the reared female imago.

In 2003, Salles & Lugo-Ortiz established the new genus *Iguaira*, based on nymphs from Brazil. Recently, one of us (FFS) collected more material of this genus that provides new evidence with respect to the validity of *Iguaira*. This monotypic genus presents many diagnostic characters of the genus *Paracloeodes*. In order to confirm its generic status, a cladistic analysis was made, including most species of *Paracloeodes* and *I. poranga*. As a result of the analysis, *Iguaira* is proposed as a junior subjective synonym of *Paracloeodes*.

In this revision, six new species of *Paracloeodes* are described from nymphs, four from Brazil, one from Argentina and one from Bolivia. Three known species are redescribed: *P. binodulus* from Brazil, *P. eurybranchus* from Argentina and *P. ibicui* from Argentina and Paraguay. A key to all South American species is presented.

Materials and methods

The material examined is housed in the following institutions: Fundación-Instituto Miguel Lillo, Tucumán, Argentina (IFML); Instituto de Ecología, Unidad de Limnología, Universidad Mayor de San Andrés, La Paz, Bolivia (UMSA); Laboratório de Entomologia da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (IBRJ); Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA).

Cladistic analysis

A matrix of 17 taxa and 57 morphological characters was constructed. The ingroup is composed of 11 species: the type species of the genus, *Paracloeodes abditus*, nine *Paracloeodes* species (six newly described here), and *Iguaira poranga*. Six taxa, obtained in a previous cladistic analysis as closely related to *Paracloeodes*, were selected as outgroups: *Cloeodes penai*, *Callibaetis radiatus*, *Apobaetis* sp. and *Cryptonympha copiosa* were included to test the monophyly of the genus. The trees were rooted indistinctly in *Metamonius* (Siphonuridae) and *Siphlaenigma* (Siphlaenigmatidae), that are considered as the closest relatives of Baetidae (e.g., Kluge, 1995).

The characters are from external morphology of nymphs (45) and adults (12). Thirty-three characters are binary and the rest (24) are multistate characters, 20 of which are treated as non-additive (unordered). The list of all characters and their states is presented in Appendix 1. The matrix with the assignation of character states to each taxon is shown in Table 1.

TABLE 1. Matrix of 17 taxa and 57 characters. Character state codes as in appendix 1.

	0000000001	1111111112	2222222223	3333333334	4444444445	55555555
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567
<i>Metamonius anceps</i>	0001000000	0111120000	0201010?30	0010110000	0001110010	0000111
<i>Siphlaenigma janae</i>	?0?10??200	0111103?3?	1???00101?	?? ??110?0?	?????10010	?001111
<i>Apobaetis</i> sp.	0110102201	1100003030	0001203001	1100000112	22000?????	???????
<i>Callibaetis radiatus</i>	0123000201	1100003030	1200200?21	1000211111	0011101112	1111001
<i>Cloeodes penai</i>	0122022100	0200001020	0110110?11	2001010101	1011101211	0111000
<i>Cryptonympha copiosa</i>	0112011100	0010001010	1201212100	2000102100	10033?????	???????
<i>Iguaira poranga</i>	1122022211	1200012131	0101211001	2000310011	1101??????	???????
<i>Paracloeodes eurybranchus</i>	1112022100	0200012131	0001211000	2001310001	11022?1212	?111???
<i>Paracloeodes ibicui</i>	1122022210	1200012131	0101211001	2001310011	1102A?????	???????
<i>Paracloeodes abditus</i>	1112022100	0200012131	02?12?1000	2000300101	1101101B0?	?101011
<i>Paracloeodes yuto</i>	1112022100	0200012131	0201211001	2000300000	120?1?????	???????
<i>Paracloeodes binodulus</i>	01?2022100	0200012131	0001211000	2000300000	010?2?????	???????
<i>Paracloeodes assu</i>	0122012100	0200012121	0001211000	2000310000	21?11?????	???????
<i>Paracloeodes atroari</i>	1122022101	0200012131	0001211000	2000300010	21????????	???????
<i>Paracloeodes peri</i>	01?2022100	0200012131	0001211000	2000310000	01????????	???????
<i>Paracloeodes waimiri</i>	01?2022100	0200012131	0001211000	2000310000	01????????	???????
<i>Paracloeodes pacawara</i>	1112022200	0200012131	0001211000	2000300000	11011?????	???????

A=2,3

B=1,2

The matrix was analyzed with TNT (Goloboff *et al.*, 2003a), under implied weights (Goloboff, 1993). Shortest trees were obtained with the implicit enumeration command.

Group support was calculated as absolute and relative Bremer supports (Bremer, 1988, 1994) and as Frequency differences (Goloboff *et al.*, 2003b). Bremer supports were calculated for the most parsimonious trees and 10000 suboptimal trees up to 5 steps longer. Suboptimal trees were gathered in ten stages: 0.1, 0.2, 0.3, 0.4, 0.5, 1, 2, 3, 4, 5, each stage saving 1000 trees.

Frequency differences were calculated with 500 replicates of jackknifing (Farris *et al.*, 1996) by symmetrical resampling of the original matrix (each character presents the same probability to be positively or negatively reweighed, Goloboff *et al.*, 2003b). Each replicate of jackknifing was calculated by 10 random addition sequences plus TBR (tree bisection and reconnection), saving ten trees per replicate.

Results

Phylogenetic analysis

By the implicit enumeration of all possible trees, under implied weights, 9 shortest trees (length = 134, fit = 40.68) were obtained. The strict consensus tree is shown in Fig. A. The synapomorphies of the nodes common to the nine shortest trees are listed in Appendix 2.

Rooting the tree in *Metamonius anceps* or *Siphlaenigma janae* did not change the results.

The monophyly of the genus *Paracloeodes* (Node 28) is sustained by 7 synapomorphies: 1) frontal keel present, 2) molars of left mandible with constriction, 3) left mandible with inner set of incisors at right angle with outer set, 4) right mandible with inner set of incisors at right angle with outer set, 5) labial palpi: segment II with rounded projection, 6) tarsal claws with two rows of small denticles, 7) posterior margin of abdominal terga with spines. *Cloeodes* is the sister group of this genus by the synapomorphies of labrum with apical lateral setae bifid and prostheca of right mandible bifid.

Group support values can be seen in Fig. A. The genus *Paracloeodes* is well supported under the three estimators calculated. The monospecific genus *Iguaira* is included in *Paracloeodes*, as the sister species of *P. ibicui*. This pair of species share labrum with subapical setae absent and with spine-like setae ventrally, right mandible with external margin convex, lingua of hypopharynx with pointed projection, trochanter with spines ventrally, gills apically pointed and some trees proposed antennae long (3–5.5 times the head capsule).

The type species of the genus is placed in the base of the genus followed by *P. yuto*, and node 26 joins together the rest of the species by possession of lingua without projection. *Paracloeodes pacawara* is placed in the base of this group. Node 30 places *P. assu* as the sister species of *P. atroari* by shared characters of length of gills more than 3 times the width and some trees proposed antennae long (3–3.5 times the head capsule).

Node 25 joins two groups by two synapomorphies: cerci with long spines toward the external margin (every 2 segments) and hind wing pads present (some trees only). The first group: *P. eurybranchus* and (*Iguaira poranga* + *P. ibicui*) is joined by possession of long gills, 2–2.9 times the length of tergum. The other group: *P. binodulus*, *P. peri* and *P. waimiri* (node 29) shares the frontal keel being absent and the length of gills 1.1–1.9 times the width. The two groups with the strongest support under the three estimators calculated within the genus *Paracloeodes* are node 23 (*Iguaira poranga* + *P. ibicui*) and node 29 (*P. binodulus*, *P. peri* and *P. waimiri*).

Taxonomy

Paracloeodes Day

Paracloeodes Day, 1955: 121; Lugo-Ortiz & McCafferty, 1996: 162.

Iguaira Salles & Lugo-Ortiz, 2003: 202. SYN. NOV.

Type species: *Paracloeodes abditus* Day 1955 [synonym of *Pseudocloeon minutus* (Daggy) 1945]

Male Imago. Turbinate eyes oval, height of stalks half of eye diameter. Forewings with paired marginal intercalaries. Hind wings present or absent, if present with 2 longitudinal veins and with quadrangular costal process on basal third of anterior margin. Genitalia with forceps three-segmented, segment III elongate, bases of forceps widely separated.

Nymph. Head as long as wide. Frontal keel present or absent. Antennae 1.5–4 times the head capsule. Mouthparts: labrum (Fig. 1a) wider than long, cleft of anterior margin with a small central lobe, dorsal surface with bifid setae on anterior margin (Fig. 28b). Mandibles (Figs. 2a, 3) without a row of setae on anterior margin between prosthema and mola, incisors cleft in two sets, inner set at right angle with outer set. Left mandible with molars with constrictions (Fig. 2b), prosthema with 2–3 denticles (Fig. 2a). Prosthema of right mandible slender and bifid (Fig. 3). Hypopharynx as in Fig. 4. Maxillae (Fig. 5) with palpi two-segmented, longer than apex of galea-lacinia. Labium (Fig. 6a): glossae subequal to paraglossae, rounded apically and with short spines on external margins, paraglossae with a row of long spine-like setae; segment II of palpi with a distomedial projection, segment III conical, both segments with long setae (Figs. 6a, b). Legs (Fig. 7) with femora with a dorsal row of short spines, tibiae subequal to tarsi. Tarsal claws elongate, with two rows of denticles (Fig. 8). Hind wing pads present or absent. Posterior margins of abdominal terga with spines (Fig. 9). Gills (Fig. 10) present on abdominal segments I–VII, elongate, more than two times length of tergum. Paraprocts with spines apically (Fig. 11). Terminal filament subequal to cerci.

Discussion. The description of new species and the revision of known species showed new evidence for the genus *Paracloeodes*. Lugo-Ortiz & McCafferty (1996) proposed as diagnostic characteristics the small body size of the nymphs, distinct shape of labial palpi,

elongate tarsal claws with poorly defined denticulation, numerous minute ridges on the abdominal terga, relatively elongate gills and adults with small body size and a characteristic hind wing, when present. The cladistic analysis presented here isolated seven synapomorphies which change upon the diagnosis presented by Lugo-Ortiz & McCafferty (1996).

Iguaira was established by presenting a single synapomorphy: the segment I of labial palpi transverse to segments II and III. Only one specimen was studied at this moment. New material collected showed segment I of palpi orientated in the same way as the others two segments, subparallel to glossae and paraglossae. Our examination of material has shown that all characteristics present in *Iguaira poranga* are shared with other species of *Paracloeodes*. Results from the phylogenetic analysis clearly indicate that *Iguaira poranga* is a species of *Paracloeodes*, so *Iguaira* is placed as a junior subjective synonym of *Paracloeodes* and *I. poranga* is transferred to the genus.

Paracloeodes can be distinguished from the other genera of the family by the following combinations of characters. In the male imago: 1) hind wings, if present, with 2 longitudinal veins and with a quadrangular costal process; 2) forceps three-segmented, segment III elongate. In the nymphs: 1) mandibles (Figs. 2a, 3) with inner sets of incisors at right angle to outer set; 2) left mandible with molars with constrictions (Fig. 2b); 3) protheca of right mandible bifid; 4) labium (Fig. 6a) with glossae rounded apically, segment II of palpi with a distomedial projection, segment III conical (Fig. 6b); 5) tarsal claws with two rows of denticles (Fig. 8).

Key to the nymphs of South American species

- 1 Thorax with two small tubercles between fore wing pads (Fig. 25)..... *P. binodulus*
- Thorax without small tubercles 2
- 2 (1) Hind wing pads absent 3
- Hind wing pads present 5
- 3(2) Body with pronotum, mesonotum and abdominal segments II–VII dark, remaining segments whitish, pronotum and mesonotum with a longitudinal whitish band, mesonotum with three median whitish spots along midline (Fig. 12) *P. atroari* **sp. n.**
- Body color pattern not as above 4
- 4(3) Body color pattern with small brownish spots as in Fig. 50; tarsal claws 0.5 times the length of tarsi (Fig. 57) *P. pacawara* **sp. n.**
- Body color pattern not as above; tarsal claws 0.75 times the length of tarsi (Fig. 102) *P. yuto* **sp. n.**
- 5(2) Labrum without a pair of subapical setae (Figs. 40, 74a) 6
- Labrum with a pair of subapical setae near midline (Figs. 1a, 13) 7
- 6(5) Tarsal claws with two rows of minute denticles (Fig. 81); maxillary palp at least 2 times the length of galea-lacinia (Fig. 78); hypopharynx with lingua apically pointed

- (Fig. 77).....*P. poranga* comb. n.
- Tarsal claws with two rows of 5–6 small denticles basally and 3–5 larger denticles distally (Fig. 47); maxillary palp 1.5 times the length of galea-lacinia (Fig. 44); hypopharynx with lingua apically rounded (Fig. 43)..... *P. ibicui*
- 7(5) Head, apical 2/3 of forewing pads and abdominal segments I, VII–VIII whitish, remainder of body blackish (Fig. 63)..... *P. peri*
- Body color pattern variable, never as above 8
- 8(7) Frontal keel absent 9
- Frontal keel present 10
- 9(8) Tarsal claws 0.3 times the length of tarsi (Fig. 7); posterior margin of abdominal terga with spines as wide as long (Fig. 9); nymphs large, body length at least 7 mm. *P. assu* **sp. n.**
- Tarsal claws 0.6 times the length of tarsi (Fig. 90); posterior margin of abdominal terga with spines 2.0 times wider than long (Fig. 93); nymphs small, body length less than 6 mm *P. waimiri* **sp. n.**
- 10(9) Length of nymph 3.9–4.1 mm; gills elongate and slender, weakly tracheated *P. leptobranchus**
- Length of nymph 4.7–5.5 mm; gills broad, main branch of trachea pigmented (Fig. 37) *P. eurybranchus*

**P. leptobranchus* and *P. eurybranchus* are very similar and we have some doubts about the validity of the first one. However, until the type material can be examined we prefer to maintain both species separate.

***Paracloeodes assu* sp. n. (Figs. 1–11)**

Mature nymph. Length: body, 6.6–6.8 mm; cerci and terminal filament broken. Antennae, 3.5 mm, more than 3 times the head capsule. Head yellowish-brown. Frontal keel absent, ocelli dark brown. Antennae yellowish-brown. Mouthparts: labrum (Fig. 1a), dorsally with a pair of subapical setae near middle, apical margin with two kinds of setae: basally bifid setae near the midline and simple and bipectinate setae near lateral margin (Fig. 1b). Mandibles (Figs. 2a-3): external margins straight. Prosthema of left mandible (Fig. 2a) with 2 denticles. Lingua subequal in length to superlingua and rounded apically (Fig. 4). Maxillae with palpi 2.0 times the length of galea-lacinia (Fig. 5). Labium (Figs. 6a–b) with segment II of palpi with rounded distomedial projection, 2.1 times width of segment III, segment III conical.

Thorax yellowish-brown, without color pattern. Pleura and sterna yellowish brown. Legs (Fig. 7) yellowish-white, tarsal claws 0.3 times the length of tarsi, with 2 rows of denticles, small basally, increasing in size distally (Fig. 8). Hind wing pads present.

Abdomen yellowish-brown, without distinct color pattern. Posterior margin of terga

with spines as long as wide (Fig. 9). Sterna yellowish-brown. Gills whitish, external margin sclerotized, main branch of trachea weakly pigmented (Fig. 10). Paraprocts with 19 spines apically (Fig. 11).

Adults. Unknown.

Etymology. From the Tupi-guarani language *açu*, meaning large. An allusion to the size of the species.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel absent; 2) labrum with a pair of subapical setae near middle (Fig. 1a); 3) labium with segment II of palpi with rounded distomedial projection, 2.1 times the width of segment III (Fig. 6b); 4) tarsal claws 0.3 times the length of tarsi (Fig. 7); 5) hind wing pads present; 6) posterior margin of abdominal terga with spines as long as wide (Fig. 9); 7) gills with main branch of trachea poorly pigmented (Fig. 10); 8) paraprocts with 19 spines apically (Fig. 11).

Material. Holotype, female nymph: BRAZIL, Rio de Janeiro State, Itatiaia, córrego ao lado da estrada do Abrigo Rebouças km 10, 16/ X/ 1997, Salles col. Paratypes: 4 nymphs same data (mouthparts, legs and paraprocts of one nymph mounted on slides). The holotype and 2 paratypes are deposited at IBRJ. Other paratypes are deposited at IFML.

Paracloeodes atroari sp. n. (Figs. 12–22)

Mature nymph (Fig. 12). Length: body, 2.8–2.9 mm; cerci and terminal filament broken. Antennae partially broken. Head whitish, except for light brown mark between ocelli. Turbinate portion of male compound eyes light orange-brown. Frontal keel present, ocelli yellowish-brown. Antennae whitish. Mouthparts: labrum (Fig. 13), dorsally with a pair of subapical setae near middle. Left mandible with external margin convex, prosthema with 2 denticles (Fig. 14). Right mandible with external margin straight (Fig. 15). Lingua scarcely shorter than superlingua and rounded apically. Maxillae with palpi 2.2 times the length of galea-lacinia (Fig. 16). Labium (Figs. 17a–b) with segment II of palpi with rounded distomedial projection, 2.3 times width of segment III, segment III conical.

Thorax dark brown, mesonotum with three median whitish spots along midline. Pleura dark brown, sterna whitish. Legs (Fig. 18) whitish, femora tinged with light brown, tarsal claws 0.5 times the length of tarsi, with 2 rows of denticles, small basally, increasing in size distally (Fig. 19). Hind wing pads absent.

Abdomen light brown, terga I, and VIII–X whitish suffused with brown, terga II–VII entirely brown, except for two posterolateral whitish spots on segments II and IV (Fig. 12). Posterior margin of terga with spines 1.5 times wider than long (Fig. 20). Sterna whitish, including paraprocts. Gills whitish with external margin sclerotized, elongate, apically pointed, with main branch of trachea poorly pigmented (Fig. 21). Paraprocts with 12 spines apically (Fig. 22).

Adults. Unknown.

Etymology. *Atroari* is the name of one of the indigenous tribes that inhabit the area where the species was collected.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel present; 2) labrum with a pair of subapical setae near middle (Fig. 13); 3) labium with segment II of palpi with rounded distomedial projection, 2.3 times the width of segment III (Fig. 17b); 4) tarsal claws long, 0.5 times the length of tarsi (Fig. 18); 5) hind wing pads absent; 6) posterior margin of abdominal terga with spines 1.5 times wider than long (Fig. 20); 7) gills with main branch of trachea poorly pigmented (Fig. 21); 8) paraprocts with 12 spines apically (Fig. 22).

Material. Holotype, male nymph, BRAZIL, Amazonas State, Presidente Figueiredo, Sossego da. Pantera, km 20, folhiço de fundo, remanso, 7/ X/ 2003, Salles col. Paratypes: 3 nymphs same data. Holotype and 2 paratypes housed at INPA. Other paratype deposited at IFML.

***Paracloeodes binodulus* Lugo-Ortiz & McCafferty (Figs. 23–27)**

Paracloeodes binodulus Lugo-Ortiz & McCafferty (1996): 163.

This species was characterized by Lugo-Ortiz & McCafferty (1996). We collected new material assignable to this species by possession of a mesonotum with a pair of median tubercles (Fig. 25). Herein we include the following characteristics that were omitted or are not in agreement with the original description:

Mature nymph (Fig. 23). Head yellowish, with brownish and blackish marks, ocelli brown. Antennae pale yellow. Mouthparts: labrum (Fig. 24), dorsally with a pair of subapical setae near middle. Mandibles with inner set of incisors at right angle with outer set. Molars of left mandible with constrictions. Prosthema of right mandible bifid. Maxillae with palpi 2 times the length of galea-lacinia. Labium with segment II of palpi with rounded distomedial projection, 2.2 times the width of segment III, segment III conical. Thorax yellowish, with brownish and blackish marks as in Fig. 23. Pleura yellowish-brown, sterna yellowish. Legs with femora whitish-yellow, with subapical brown band, tibiae whitish-yellow with apical brown band, tarsal claws 0.5 times the length of tarsi, with 2 rows of denticles, small basally, increasing in size distally (Fig. 26). Hind wing pads absent.

Abdomen yellowish, with brownish and dark brown marks, posterior margin of abdominal terga with spines 1.2 times longer than wide. Sterna with basal half yellowish and distal half brown. Gills whitish, apically rounded, main branch of trachea poorly pigmented (Fig. 27). Paraprocts with 8 spines apically. Caudal filaments yellowish with two brown bands, one medial and one subapical.

Adults. Unknown.

Discussion. This species can be distinguished from the other species of the genus by

the following combination of characters, 1) frontal keel absent; 2) labrum with a pair of subapical setae near middle (Fig. 24); 4) labium with segment II of palpi with rounded distomedial projection, 2.2 times the width of segment III; 5) mesonotum with a pair of median tubercles (Fig. 25); 6) tarsal claws long, 0.5 times the length of tarsi; 7) hind wing pads absent; 8) posterior margin of abdominal terga with spines 1.2 times longer than wide; 9) gills with main branch of trachea poorly pigmented (Fig. 27); 10) paraprocts with 8 spines apically.

Material. 16 nymphs, BRAZIL, Amazonas State, Manaus, Estrada para Presidente Figueiredo, Igarapé Água Fria, 4/ VII/ 2005, Salles & Falcão colls. Twelve nymphs housed at INPA, other nymphs deposited at IFML.

Paracloeodes eurybranchus Lugo-Ortiz & McCafferty (Figs. 28–39)

P. eurybranchus Lugo-Ortiz & McCafferty, 1996: 166.

Nymph and female imago. Characterized by Lugo-Ortiz & McCafferty (1996) with the following necessary changes: tarsal claws with two rows of denticles, small basally and 6–7 larger denticles distally (Fig. 35). Caudal filaments with crown of spines on each segment, cerci with long spines toward the external margin every two segments (Fig. 39).

Discussion. *Paracloeodes eurybranchus* can be distinguished from the other species of the genus by the following combination of characters. In the nymphs, 1) frontal keel present; 2) antennae 2–2.5 times width of head capsule; 3) labrum with a pair of subapical setae near middle (Fig. 28a); 4) hypopharynx: lingua shorter than superlingua and scarcely projected apically (Fig. 31); 5) mandibles with external margins straight (Figs. 29–30); 6) maxillary palpi 1.2–1.4 times the length of galea-lacinia (Fig. 32); 7) segment II of labial palpi with rounded distomedial projection, 1.8 times width of segment III (Fig. 33); 8) hind wing pads present; 9) tarsal claws 0.45 times length of tarsi (Fig. 34), with two rows of denticles, small basally and 6–7 larger denticles distally (Fig. 35); 10) posterior margin of abdominal terga with spines 2.5 times longer than wide (Fig. 36); 11) gills with trachea pigmented (Fig. 37); 12) paraprocts with 16–18 spines apically (Fig. 38); 13) caudal filaments with crown of spines on each segment, cerci with long spines toward the external margin every two segments (Fig. 39).

Material. Twenty nymphs: ARGENTINA, Córdoba, Río Nono, 5 km de Mina Clavero, S 31°48'16", W65°00'14", 840 m, 14–15/ XI/ 2001, Nieto & Orce colls. Fifteen nymphs are housed at IFML, other nymphs deposited at IBRJ.

Paracloeodes ibicui Lugo-Ortiz & McCafferty (Figs. 40–49)

P. ibicui Lugo-Ortiz & McCafferty, 1996: 167.

Nymph. This species was described by Lugo-Ortiz & McCafferty (1996) from Paraguay. We collected new material assignable to this species that present two character differences from the original description. The longitudinal dark brown band on abdominal segments I–IX is absent and the tarsal claws have two rows of 5–6 small denticles basally and 3–5 larger denticles distally (Fig. 47). Additional new characters include, antennae long, 3.5–4 times the width of head capsule; maxillary palpi 1.5–1.6 times the length of galea-lacinia (Fig. 44); caudal filaments with crown of spines on each segment, cerci with long spines toward the external margin every two segments basally, and every four segments apically (Fig. 49).

Adult. Unknown.

Discussion. *Paracloeodes ibicui* can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel present; 2) antennae long, 3.5–4 times width of head capsule; 3) labrum with short setae dorsally, without a pair of subapical setae near middle (Fig. 40); 4) hypopharynx: lingua shorter than superlingua and slightly projected apically (Fig. 43); 5) left mandible with external margin straight (Fig. 41), right mandible with external margin convex (Fig. 42); 6) maxillary palpi 1.5–1.6 times the length of galea-lacinia (Fig. 44); 7) segment II of labial palpi with rounded distomedial projection, 2.25 times width of segment III (Fig. 45); 8) ventral edge of femora and tarsi with bipectinate spines (Fig. 46); 9) femora with a transverse dark band subapically (Fig. 46); 10) hind wing pads present; 11) tarsal claws 0.4 times the length of tarsi (Fig. 46), with two rows of 5–6 small denticles basally and 3–5 larger denticles distally (Fig. 47); 12) posterior margin of abdominal terga with spines 2.5 times longer than wide (as in Fig. 36); 13) gills with main branch of trachea and a few secondary branches pigmented (Fig. 48); 14) cerci with long spines toward the external margin every two segments basally, and every four segments apically (Fig. 49).

Material. Ten nymphs: ARGENTINA, Misiones, Pque. Prov. Uruguay-i, A° Uruzú, RP 19, 7-11/ XII/ 1999, Molineri col. Material housed at IFML.

***Paracloeodes pacawara* sp. n. (Figs. 50–62)**

Nymph (Fig. 50). Length: body, 3.0–3.4 mm; cerci, 1.2–1.3 mm; terminal filament, 1.1–1.2 mm. Antennae, 1.0–1.1 mm; 1.5–1.8 times the head capsule. Head yellowish with small dark spots, ocelli dark brown. Turbinate portion of compound eyes in male nymphs yellowish-brown. Frontal keel present. Antennae pale yellow. Mouthparts: labrum (Fig. 51a), dorsally without a pair of subapical setae near middle. Mandibles (Figs. 52–53): external margins straight. Left mandible (Fig. 52) with prosthema with 2–3 denticles. Hypopharynx with lingua (Fig. 54) subequal to superlingua and rounded apically. Maxillae (Fig. 55) with palpi 1.5 times the length of galea-lacinia. Labium (Figs. 56a–b) with segment II of palpi with a strong rounded distomedial projection, 3.1 times width of segment III, segment III conical.

Thorax (Fig. 50): pro-, meso- and metanota yellowish-brown with small brownish spots distributed throughout, and with a narrow pale yellow median band. Pleura yellowish-brown, sterna pale yellow. Legs (Fig. 57) pale yellow, with tarsal claws 0.5 times the length of tarsi and with two rows of minute denticles basally (Fig. 58). Hind wing pads absent.

Abdomen: segments II–III and IX brownish, remaining segments yellowish-brown, all segments with small brownish spots as in Fig. 50. Posterior margin of terga with spines as long as wide (Fig. 59). Sterna pale yellow, anterior margin of each segment and entire sterna IX–X brownish. Gills whitish (Fig. 60). Paraprocts with 9–10 spines (Fig. 61). Caudal filaments yellowish with crown of spines on each segment (Fig. 62).

Etymology. Pacawara is the name of a tribe that inhabit the north of Bolivia, where this species was collected.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel present; 2) antennae 1.5–1.8 times the head capsule; 3) labrum without a pair of subapical setae near middle (Fig. 51a); 4) lingua (Fig. 54) subequal to superlingua and rounded apically; 5) maxillary palpi 1.5 times the length of galea-lacinia (Fig. 55); 6) segment II of labial palpi with strong rounded distomedial projection 3.1 times width of segment III (Fig. 56b); 7) hind wing pads absent; 8) tarsal claws long, 0.5 times the length of tarsi (Fig. 57) and with two rows of minute denticles basally (Fig. 58); 9) posterior margin of abdominal terga with spines as long as wide (Fig. 59); 10) caudal filaments with crown of spines on each segment (Fig. 62); 11) body color pattern with small dark spots throughout (Fig. 50).

Material. Holotype male nymph: BOLIVIA, Depto. Beni, Prov. Ballivian, Río San Bernardo, S 14°45'16'', W 67°10'07'', 220 m, 22/ V/ 2002, Domínguez col. Paratypes: 44 nymphs same data and collector. The holotype and 5 paratypes are deposited at UMSA. Five paratypes deposited at IBRJ, other paratypes housed at IFML.

Paracloeodes peri sp. n. (Figs. 63–73)

Mature nymph (Fig. 63). Length: body, 3.8–4.2 mm; cerci and terminal filament broken. Antennae broken. Head white, vertex with irregular light brownish marks. Frontal keel absent, ocelli grayish. Antennae pale yellow. Mouthparts: labrum (Fig. 64), dorsally with a pair of subapical setae near middle. Left mandible with external margin straight, prosthema with 2 denticles (Fig. 65). Right mandible with external margin convex (Fig. 66). Lingua slightly shorter than superlingua and rounded apically. Maxillae (Fig. 67) with palpi 1.5 times the length of galea-lacinia. Labium (Figs. 68 a–b) with segment II of palpi with broadly rounded distomedial projection, 2.5 times width of segment III, segment III conical.

Thorax blackish, except for pale markings on mesonotum and apical 2/3 of forewing pads white (Fig. 63). Pleura blackish and sterna pale yellow. Legs (Fig. 69) whitish, coxae

and trochanter blackish, tarsal claws 0.4 times the length of tarsi, with 2 rows of denticles, small basally, increasing in size distally (Fig. 70). Hind wing pads present.

Abdomen with terga II–VI and IX–X blackish, with darker areas close to anterior margin; terga I, VII and VIII whitish (Fig. 63). Posterior margin of terga with spines as long as wide (Fig. 71). General coloration of sterna similar to terga, except segments II–VI lighter. Gills (Fig. 72) whitish, external margin sclerotized, apically rounded, main branch of trachea weakly pigmented. Paraprocts (Fig. 73) blackish with 9 spines.

Adults. Unknown.

Etymology. *Peri* is the name of an indigenous character from Brazilian literature, who inhabited the area where the nymphs were collected. The epithet is in honor of the late Brazilian writer José de Alencar.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel absent; 2) labrum (Fig. 64) with a pair of subapical setae near middle; 3) lingua slightly shorter than superlingua and rounded apically; 4) maxillary palpi 1.5 times the length of galea-lacinia; 5) segment II of labial palpi with broadly rounded distomedial projection, 2.5 times the width of segment III (Fig. 68b); 6) hind wing pads present; 7) tarsal claws long, 0.4 times the length of tarsi (Fig. 69) with 2 rows of denticles, small basally, increasing in size distally (Fig. 70); 8) posterior margin of abdominal terga with spines as long as wide (Fig. 71); 9) gills (Fig. 72) with main branch of trachea weakly pigmented; 10) body color pattern as in Fig. 63.

Material. Holotype male nymph: BRAZIL, Rio de Janeiro State, Nova Friburgo, Rio Cascatinha, 18/ IV/ 2001, Salles & Francischetti colls. Paratypes: 6 nymphs same data as holotype (mouthparts, legs and paraprocts of one nymph mounted on slides). Holotype and 4 nymphs housed at IBRJ, other paratypes deposited at IFML.

***Paracloeodes poranga* (Salles & Lugo-Ortiz) comb. n. (Figs. 74–84)**

Iguaira poranga Salles & Lugo-Ortiz, 2003: 203.

Nymph. Characterized by Salles & Lugo-Ortiz (2003) with the following necessary changes: 1) segment I of labial palpi subparallel to glossae and paraglossae (Fig. 79); 2) tarsal claws with two rows of minute denticles basally (Fig. 81).

Adult. Unknown.

Discussion. *Paracloeodes poranga* n. comb. can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel present; 2) antennae long, 3.5–4 times width of head capsule; 3) labrum (Figs. 74a–b) with short setae dorsally; 4) hypopharynx (Fig. 77) with lingua slightly longer than superlingua and with a pointed projection apically; 5) mandibles (Figs. 75–76) with external margins convex; 6) maxillary palpi 2 times the length of galea-lacinia (Fig. 78); 7) segment II of labial palpi with strong distomedial projection, more than 2.5 times the width of segment III (Fig. 79);

7) hind wing pads present; 8) tarsal claws 0.5 times the length of tarsi (Fig. 80), with two rows of minute denticles basally (Fig. 81); 9) posterior margin of abdominal terga with spines 1.5 times longer than wide (Fig. 82); 10) gills (Fig. 83) whitish and elongate; 11) paraproct with 19–20 spines (Fig. 84).

Material. Holotype female nymph: BRASIL, Minas Gerais, Itamonte, Rio Aiuruoca (pedra), 8/ IX/ 2000, Ferreira col. Five nymphs: Brasil, Minas Gerais, 1° Afluente Do Rio Aiuruoca; Entomologia UFRJ col. Three nymphs housed at IBRJ, remaining nymphs deposited at IFML.

***Paracloeodes waimiri* sp. n. (Figs. 85–95)**

Mature nymph. Length: body, 2.5–2.7 mm; cerci and terminal filament broken. Antennae broken. Head yellowish, vertex with irregular light brown marks. Frontal keel absent, ocelli brown. Antennae pale yellow. Mouthparts: labrum (Fig. 85), dorsally with a pair of subapical setae near middle. Mandibles (Figs. 86–87): external margins straight. Prosthema of left mandible (Fig. 86) with 2 denticles. Lingua slightly shorter than superlingua and rounded apically. Maxillae (Fig. 88) with palpi 1.5 times the length of galea-lacinia. Labium (Figs. 89a–b) with segment II of palpi with strong rounded distomedial projection, 2.25 times width of segment III, segment III conical, apically rounded.

Thorax yellowish brown, mesonotum with irregular light brown marks and with two brown spots near posterior margin. Fore wing pads whitish. Pleura brownish, sterna pale yellow. Legs (Fig. 90) yellowish white, apex of femora and tibiae brown, tarsal claws 0.6 times the length of tarsi, with 2 rows of denticles, small basally, increasing in size distally (Fig. 91). Hind wing pads present.

Abdominal coloration yellowish-brown, with brownish marks. Terga with median brownish spots and in females segment V with brownish markings as in Fig. 92a, and in males segments IV–VI as in Fig. 92b. Posterior margin of terga with spines 2.0 times wider than long (Fig. 93). Sterna yellowish-white. Gills whitish, apically rounded (Fig. 94). Paraprocts with 12 spines apically (Fig. 95).

Adults. Unknown.

Etymology. *Waimiri* is the name of one of the indigenous tribes that inhabit the area where the nymphs of this species were collected.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel absent; 2) labrum with a pair of subapical setae near middle (Fig. 85); 3) labium with segment II of palpi with strong rounded distomedial projection, 2.25 times the width of segment III (Fig. 89b); 4) tarsal claws long, 0.6 times the length of tarsi (Fig. 90); 5) hind wing pads present; 6) posterior margin of abdominal terga with spines 2.0 times wider than long (Fig. 93); 7) gills with main branch of trachea poorly pigmented (Fig. 94); 8) paraprocts with 12 spines apically (Fig. 95).

Material. Holotype female nymph: BRAZIL: Amazonas State, Presidente Figueiredo, Igarapé do km 24, remanso; 14/ X/ 2003, Salles col. Paratypes: 9 nymphs same data as holotype (mouthparts, legs and paraprocts of one nymph mounted on slides). Holotype and six paratypes housed at INPA, other paratypes deposited at IFML.

***Paracloeodes yuto* sp. n. (Figs. 96–107)**

Mature nymph. Length: body, 3.2–3.3 mm; cerci, 1.1–1.2 mm, terminal filament, 1.2 mm. Antennae, 1.0–1.1 mm, 2 times the head capsule. Head pale yellow. Frontal keel present, ocelli yellowish-brown. Antennae pale yellow. Mouthparts: labrum (Fig. 96), dorsally with a pair of subapical setae near middle. Mandibles (Figs. 97–98): external margins straight. Prosthema of left mandible (Fig. 97) with 2–3 denticles. Lingua (Fig. 99) slightly shorter than superlingua and rounded apically. Maxillae with palpi 1.5 times the length of galea-lacinia (Fig. 100). Labium (Figs. 101a–b) with segment II of palpi with a strong rounded distomedial projection, 2.8 times width of segment III, segment III conical. Thorax yellowish-brown. Pronotum with a pale yellow median band. Anterior margin of mesonotum brownish. Forewing pads yellowish-brown. Pleura and sterna pale yellow. Legs (Fig. 102) yellowish, tarsal claws yellowish brown, 0.75 times the length of tarsi, with 2 rows of minute denticles basally (Fig. 103). Hind wing pads absent.

Abdomen yellowish, anterior margins of terga brownish, tergum IX yellowish-brown. Posterior margin of terga with spines 1.8 times longer than wide (Fig. 104). Sterna pale yellow. Gills (Fig. 105) blackish. Paraprocts with 9 spines (Fig. 106). Caudal filaments yellowish with crown of spines on each segment (Fig. 107).

Adults. Unknown.

Etymology. Yuto is the name of the river where this species was collected.

Discussion. This species can be distinguished from the other species of the genus by the following combination of characters, 1) frontal keel present; 2) antennae 2 times the head capsule; 3) labrum with a pair of subapical setae near middle (Fig. 96); 4) lingua (Fig. 99) slightly shorter than superlingua and rounded apically; 5) maxillary palpi 1.5 times the length of galea-lacinia; 6) segment II of labial palpi with strong distomedial projection 2.8 times width of segment III (Fig. 101b); 7) hind wing pads absent; 8) tarsal claws long, 0.75 times the length of tarsi, with two rows of minute denticles (Figs. 102–103); 9) posterior margin of abdominal terga with spines 1.8 times longer than wide (Fig. 104); 10) caudal filaments with crown of spines on each segment (Fig. 107).

Material. Holotype: nymph, ARGENTINA: Jujuy, Depto. Ledesma, A° Yuto. S 23°38'36'', W 64°32'25'', 500 m; Ph: 6.5; T: 33°C; 4–5/ IV/ 2004, Nieto & Mesa col. Paratypes: 28 nymphs same data. The holotype and 20 paratypes are deposited at IFML. Other paratypes are housed at IBRJ.

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References

- Bremer, K. (1988) The limits of amino-acid sequence data in angiosperm phylogenetic reconstructions. *Evolution*. 42, 795–803.
- Bremer, K. (1994) Branch support and tree stability. *Cladistics*. 10, 295–304.
- Day, W.C. (1955) New genera of mayflies from California. *Pan-Pacific Entomologist*. 31, 121–137.
- Farris, J.S., Albert, V.A., Källersjö, M., Lipscomb, D. & Kluge, A.G. (1996) Parsimony jackknifing outperforms neighbor-joining. *Cladistics*. 12, 99–124.
- Goloboff, P. (1993) Estimating character weights during tree search. *Cladistics*. 9, 83–91.
- Goloboff, P.A., Farris, J.S. & Nixon, K. (2003a) TNT: Tree Analysis Using New Technology-version 1.0. Program and documentation available from the authors, and at www.zmuc.dk/public/phylogeny.
- Goloboff, P.A., Farris, J.S., Källersjö, M., Oxelman, B., Ramirez, M.J. & Szumick, C. (2003b) Improvements to resampling measures of group support. *Cladistics*. 19, 324–332.
- Kluge, N.J., Studemann, D., Landolt, P. & Gonser, T. (1995) A reclassification of Siphonuroidea (Ephemeroptera). *Bulletin de la Société Entomologique Suisse*. 68, 103–132.
- Lugo-Ortiz, C.R. & McCafferty, W.P. (1996) The genus *Paracloeodes* (Insecta: Ephemeroptera: Baetidae) and its presence in South America. *Annales Limnologie*. 32 (3), 161–169.
- McCafferty, W.P. & Waltz, R.D. (1990) Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. *Transactions of the American Entomological Society*. 116 (4), 769–799.
- Salles, F.F. & Lugo-Ortiz, C.R. (2003) Um novo genero e espécie de Baetidae (Ephemeroptera) do Estado de Minas Gerais, Sudeste do Brasil. *Iheringia, Série Zoologia, Porto Alegre*. 93 (2), 201–206.
- Traver, J.R. (1938) Mayflies of Puerto Rico. *The Journal of Agriculture of the University of Puerto Rico*. 22 (1), 5–42.

Appendix 1. List of characters and states

- {0 Frontal Keel: 0-Absent; 1-Present.
{1 Frontoclypeal suture: 0-at the level of or above the ocelli; 1-below the ocelli.
{2 Antennae length: 0-short (0.5 times the head capsule); 1-intermediate (1–2.5 times the head capsule); 2-long (3–5.5 times the head capsule). Additive.
{3 Labrum, anterior margin: 0-straight; 1-lightly concave; 2-concave with medial lobe; 3-deeply concave without lobe.
{4 Labrum, shape: 0-base width=apex width; 1-apex wider than base.
{5 Labrum, apical lateral setae: 0-simple setae; 1-simple bipectinate setae; 2-bifid setae.
{6 Labrum, apical setae near midline: 0-simple setae; 1-simple and bipectinate setae; 2-bifid setae.
{7 Labrum, subapical setae: 0-a row of setae; 1-1 seta centrally and 2-3 setae laterally; 2-absent.
{8 Labrum, setae ventrally: 0-absent; 1-spine-like setae.
{9 Left mandible, external margin: 0-straight; 1-convex.
{10 Right mandible, external margin: 0-straight; 1-convex.
{11 Prosthema of right mandible: 0-normal (with denticles apically); 1-seta-like; 2-bifid.
{12 Prosthema of right mandible: 0-without transverse setae; 1-with transverse setae.
{13 Prosthema of left mandible: 0-normal (with denticles apically); 1-seta-like.
{14 Prosthema of left mandible: 0-without transverse setae; 1-with transverse setae.
{15 Molars of left mandible: 0-without constrictions; 1-with constrictions; 2-branched.
{16 Incisors of left mandible: 0-fused; 1-fused but denticles visible; 2-incisors cleft in two sets; 3-incisors deeply cleft in two sets.
{17 Left mandible: 0-inner and outer incisors in the same plane; 1-inner set of incisors at right angle with outer set.
{18 Incisors of right mandible: 0-fused; 1-fused but denticles visible; 2-incisors cleft in two sets; 3-incisors deeply cleft in two sets.
{19 Right mandible: 0-inner and outer incisors in the same plane; 1-inner set of incisors at right angle with outer set.
{20 Setae between prosthema and mola: 0-absent; 1-present.
{21 Hypopharynx: 0-lingua without projection; 1-lingua with pointed projection; 2-lingua with rounded projection.
{22 Superlinguae: 0-without spines; 1-with small spines laterally.
{23 Lingua: 0-longer than superlinguae; 1-subequal to superlinguae.
{24 Maxillary palpi: 0-three-segmented; 1-two-segmented, segment II with apical constriction; 2-two-segmented.
{25 Glossae: 0-glossae wider than paraglossae; 1-glossae subequal to paraglossae.
{26 Labial palpi, segment II: 0-without projection; 1-with rounded projection; 2-with digitiform projection; 3-with a pointed projection.
{27 Labial palpi, segment II: 0-lateral projection; 1-apical projection.
{28 Labial palpi, segment III: 0-triangular; 1-pointed; 2-with a medial concavity; 3-globose.
{29 Trochanter: 0-without spines ventrally; 1-with spines ventrally.
{30 Femora, distal apex: 0-slightly concave; 1-deeply concave; 2-convex.
{31 Tibiae and tarsi: 0-tarsi subequal to tibia; 1-tarsi longer than tibia.
{32 Tibiae (I,II,III): 0-without a row of long setae; 1-with a row of long setae.
{33 Tarsi (I,II,III): 0-with simple spines; 1-with pectinate spines.
{34 Claw denticles: 0-absent; 1-2 rows of normal denticles; 2-2 rows of long and cylindrical denticles; 3-2 rows of small denticles. Transformation series:

2-1-3
 \|/
 0

- {35 Hind wing pads: 0-absent; 1-present.
- {36 Gill I: 0-normal; 1-with two lamellae; 2-racquet-shaped.
- {37 Gills: 0-serrated margins; 1-smooth margins.
- {38 Gills: 0-rounded; 1-apically pointed.
- {39 Length of gill/length of tergum: 0-1.1-1.9 times the length of tergum; 1-2.0-2.9 times the length of tergum; 2-3.0-3.5 times the length of tergum. Additive.
- {40 Length/width of gills: 0-1.1-1.9 times the width; 1-2.0-2.9 times the width; 2-more than 3 times the width. Additive.
- {41 Posterior margin of abdominal terga: 0-smooth; 1-with spines; 2-with rounded projections.
- {42 Caudal filaments: 0-simple setae; 1-flattened setae.
- {43 Terminal filament: 0-smooth; 1-with crown of spines on each segment; 2- long spines toward ex. margin (every 2 segments); 3- long spines toward ex. margin (every 4 segments).
- {44 Cerci, posterior margin of each segment: 0-smooth; 1-with crown of spines; 2-long spines toward ex. margin (every 2 segments); 3-long spines toward ex. margin (every 4 segments).
- {45 Eyes of male: 0-tuberculate; 1-not tuberculate.
- {46 Vein Ma2: 0-joined to MA1; 1-detached basally from MA1.
- {47 Forewings, crossveins (marginal intercalaries): 0-absent; 1-single; 2-double.
- {48 Hind wings: 0-absent; 1-present.
- {49 Hind wings: 0-with several longitudinal veins; 1-2 to 3 longitudinal veins, with pointed costal projection; 2-2 to 3 longitudinal veins, with quadrangular costal projection.
- {50 Metanotum: 0-with strong pointed projection; 1-with small rounded projection.
- {51 Tarsal claws I of male: 0-two pointed claws; 1-one blunt one pointed claw.
- {52 Number of segments of tarsi I: 0-five; 1-four.
- {53 Tarsi I, II, number of segments: 0-five; 1-four.
- {54 Forceps: 0-three-segmented; 1-four-segmented.
- {55 Forceps: 0-apical segment rounded; 1-apical segment elongate.
- {56 Forceps: 0-basal segment with internal projection; 1-basal segment without projection.

Appendix 2. Synapomorphies common to the 9 shortest trees

Numbered nodes refer to nodes on consensus tree (Fig. 1).

Siphlaenigma janae:

All trees:

- Glossae (25): 1-glossae subequal to paraglossae → 0-glossae wider than paraglossae
- Labial palpi: segment II (26): 0-without projection → 1-with rounded projection

Apobaetis sp.:

All trees:

- Labrum, shape (4): 0-base width=apex width → 1-apex wider than base
- Hypopharynx (21): 2-lingua with rounded projection → 0-lingua without projection
- Labial palpi: segment II (26): 0-without projection → 3-with a pointed projection
- Tibiae and tarsi (31): 0-tarsi subequal to tibia → 1-tarsi longer than tibia
- Length of gill/length of tergum (39): 1-2.0-2.9 times the length of tergum → 2-3.0-3.5 times the length of tergum
- Length/width of gills (40): 1-2.0-2.9 times the width → 2-more than 3 times the width
- Posterior margin of abdominal terga (41): 0-smooth → 2-with rounded projections
- Terminal filament (43): 1-with crown of spines on each segment → 0-smooth
- Cerci, posterior margin of each segment (44): 1-with crown of spines → 0-smooth

Callibaetis radiatus:

All trees:

- Antennae, length (2): 1-intermediate (1-2.5 times the head capsule) → 2-long (3-5.5 times the head capsule)
- Lingua (23): 1-subequal to superlinguae → 0-longer than superlinguae
- Labial palpi, segment III (28): 0-triangular → 2-with a medial concavity
- Claw denticles (34): 0-absent → 2-2 rows of long and cylindrical denticles
- Gill I (36): 0-normal → 1-with two lamellae
- Length/width of gills (40): 1-2.0-2.9 times the width → 0-1.1-1.9 times the width
- Caudal filaments (42): 0-simple setae → 1-flattened setae

Cloeodes penai:

All trees:

- Antennae, length (2): 1-intermediate (1-2.5 times the head capsule) → 2-long (3-5.5 times the head capsule)
- Incisors of right mandible (18): 3-incisors deeply cleft in two sets → 2-incisors cleft in two sets
- Hypopharynx (21): 2-lingua with rounded projection → 1-lingua with pointed projection
- Superlinguae (22): 0-without spines → 1-with small spines laterally
- Lingua (23): 1-subequal to superlinguae → 0-longer than superlinguae
- Maxillary palpi (24): 2-two-segmented → 1-two-segmented, segment II with apical constriction
- Labial palpi, segment III (28): 0-triangular → 1-pointed
- Tarsi (I,II,III) (33): 0-with simple spines → 1-with pectinate spines
- Caudal filaments (42): 0-simple setae → 1-flattened setae
- Hind wings (49): 2-2 to 3 longitudinal veins, with quadrangular costal projection → 1-2 to 3 longitudinal veins, with pointed costal projection
- Forceps (56): 1-basal segment without projection → 0-basal segment with internal projection

Cryptonympha copiosa:

All trees:

- Labrum, apical lateral setae (5): 0-simple setae → 1-simple bipectinate setae
- Protheca of right mandible (11): 1-setae-like → 0-normal (with denticles apically)
- Incisors of right mandible (18): 3-incisors deeply cleft in two sets → 1-fused but denticles visible
- Labial palpi, segment II (26): 0-without projection → 2-with digitiform projection
- Labial palpi, segment II (27): 0-lateral projection → 2-apical projection
- Gill I (36): 0-normal → 2-racquet-shaped
- Terminal filament (43): 1-with crown of spines on each segment → 3-long spines toward ex. margin (every 4 segments)
- Cerci, posterior margin of each segment (44): 1-with crown of spines → 3-long spines toward ex. margin (every 4 segments)

Iguaira poranga:

All trees:

- Left mandible, external margin (9): 0-straight → 1-convex

Paracloeodes abditus:

All trees:

- Hind wings (48): 1-present → 0-absent
- Number of segments of tarsi I (52): 1-four → 0-five

Paracloeodes yuto:

All trees:

-Posterior margin of abdominal terga (41): 1-with spines → 2-with rounded projections

Paracloeodes binodulus:

Some trees:

-Hind wing pads (35): 1-present → 0-absent

Paracloeodes assu:

All trees:

-Frontal Keel (0): 1-Present → 0-Absent

-Labrum, apical lateral setae (5): 2-bifid setae → 1-simple bipectinate setae

-Incisors of right mandible (18): 3-incisors deeply cleft in two sets → 2-incisors cleft in two sets

Some trees:

-Hind wing pads (35): 0-absent → 1-present

Paracloeodes atroari:

All trees:

-Left mandible, external margin (9): 0-straight → 1-convex

-Gills (38): 0-rounded → 1-apically pointed

Paracloeodes pacawara:

All trees:

-Labrum, subapical setae (7): 1-1 setae centrally and 2–3 setae laterally → 2-absent

Node 19:

All trees:

-Left mandible, external margin (9): 0-straight → 1-convex

-Right mandible, external margin (10): 0-straight → 1-convex

-Glossae (25): 1-glossae subequal to paraglossae → 0-glossae wider than paraglossae

-Femora, distal apex (30): 2-convex → 1-deeply concave

-Gills (38): 0-rounded → 1-apically pointed

Node 20:

All trees:

-Protheca of right mandible (12): 1-with transverse setae → 0-without transverse setae

-Claw denticles (34): 1-2 rows of normal denticles → 0-absent

-Length of gill/length of tergum (39): 0-1.1–1.9 times the length of tergum → 1-2.0–2.9 times the length of tergum

Node 21:

All trees:

-Frontoclypeal suture (1): 0-at the level or above the ocelli → 1-below the ocelli

-Labrum, anterior margin (3): 1-lightly concave → 2-concave with medial lobe

-Protheca of left mandible (13): 1-setae-like → 0-normal (with denticles apically)

-Protheca of left mandible (14): 1-with transverse setae → 0-without transverse setae

-Maxillary palpi (24): 0-three-segmented → 2-two-segmented

Node 22:

All trees:

- Labrum, apical lateral setae (5): 0-simple setae → 2-bifid setae
- Protheca of right mandible (11): 1-setae-like → 2-bifid

Node 23:

All trees:

- Labrum, subapical setae (7): 1-1 setae centrally and 2-3 setae laterally → 2-absent
- Labrum: setae ventrally (8): 0-absent → 1-spine-like setae
- Right mandible, external margin (10): 0-straight → 1-convex
- Hypopharynx (21): 0-lingua without projection → 1-lingua with pointed projection
- Trochanter (29): 0-without spines ventrally → 1-with spines ventrally
- Gills (38): 0-rounded → 1-apically pointed

Some trees:

- Antennae: length (2): 1-intermediate (1-2.5 times the head capsule) → 2-long (3-5.5 times the head capsule)

Node 24:

All trees:

- Length of gill/length of tergum (39): 0-1.1-1.9 times the length of tergum → 1-2.0-2.9 times the length of tergum

Node 25:

All trees:

- Cerci: posterior margin of each segment (44): 1-with crown of spines → 2-long spines toward ex. margin (every 2 segments)

Some trees:

- Hind wing pads (35): 0-absent → 1-present

Node 26:

All trees:

- Hypopharynx (21): 2-lingua with rounded projection → 0-lingua without projection

Node 27:

All trees:

- Gills (37): 1-smooth margins → 0-serrated margins
- Length of gill/length of tergum (39): 1-2.0-2.9 times the length of tergum → 0-1.1-1.9 times the length of tergum

Node 28:

All trees:

- Frontal Keel (0): 0-Absent → 1-Present
- Molars of left mandible (15): 0-without constrictions → 1-with constrictions
- Left mandible (17): 0-inner and outer incisors in the same plane → 1-inner set of incisors at right angle with outer set
- Right mandible (19): 0-inner and outer incisors in the same plane → 1-inner set of incisors at right angle with outer set
- Labial palpi, segment II (26): 0-without projection → 1-with rounded projection
- Claw denticles (34): 0-absent → 3-2 rows of small denticles
- Posterior margin of abdominal terga (41): 0-smooth → 1-with spines

Node 29:

All trees:

-Frontal Keel (0): 1-Present → 0-Absent

-Length/width of gills (40): 1-2.0–2.9 times the width → 0-1.1–1.9 times the width

Node 30:

All trees:

-Length/width of gills (40): 1-2.0–2.9 times the width → 2-more than 3 times the width

Some trees:

-Antennae: length (2): 1-intermediate (1–2.5 times the head capsule) → 2-long (3–5.5 times the head capsule)

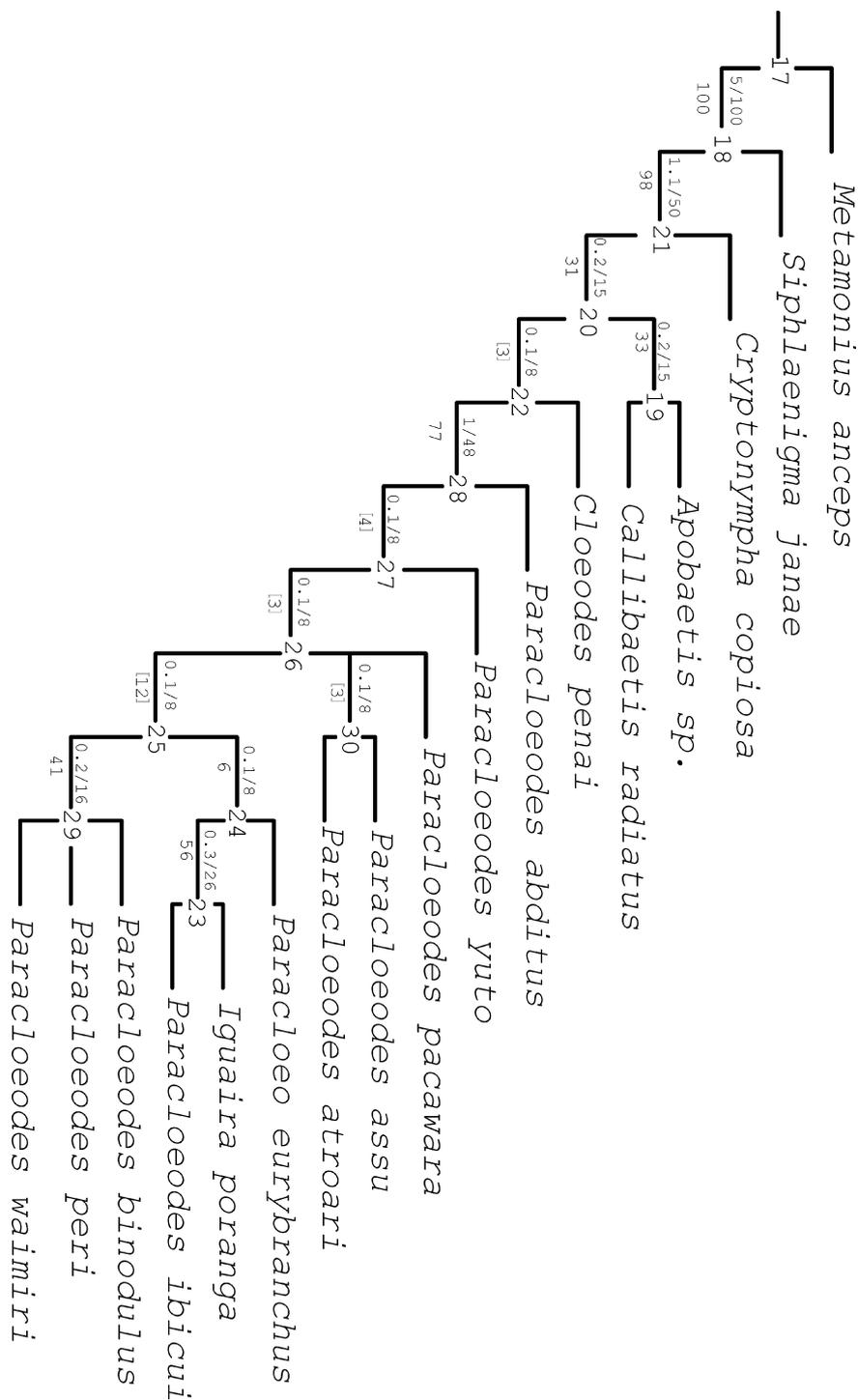


FIGURE A. Strict consensus of the 9 shortest trees obtained. Numbers above nodes represent absolute and relative Bremer supports. Numbers below nodes represent the support as Frequency differences.

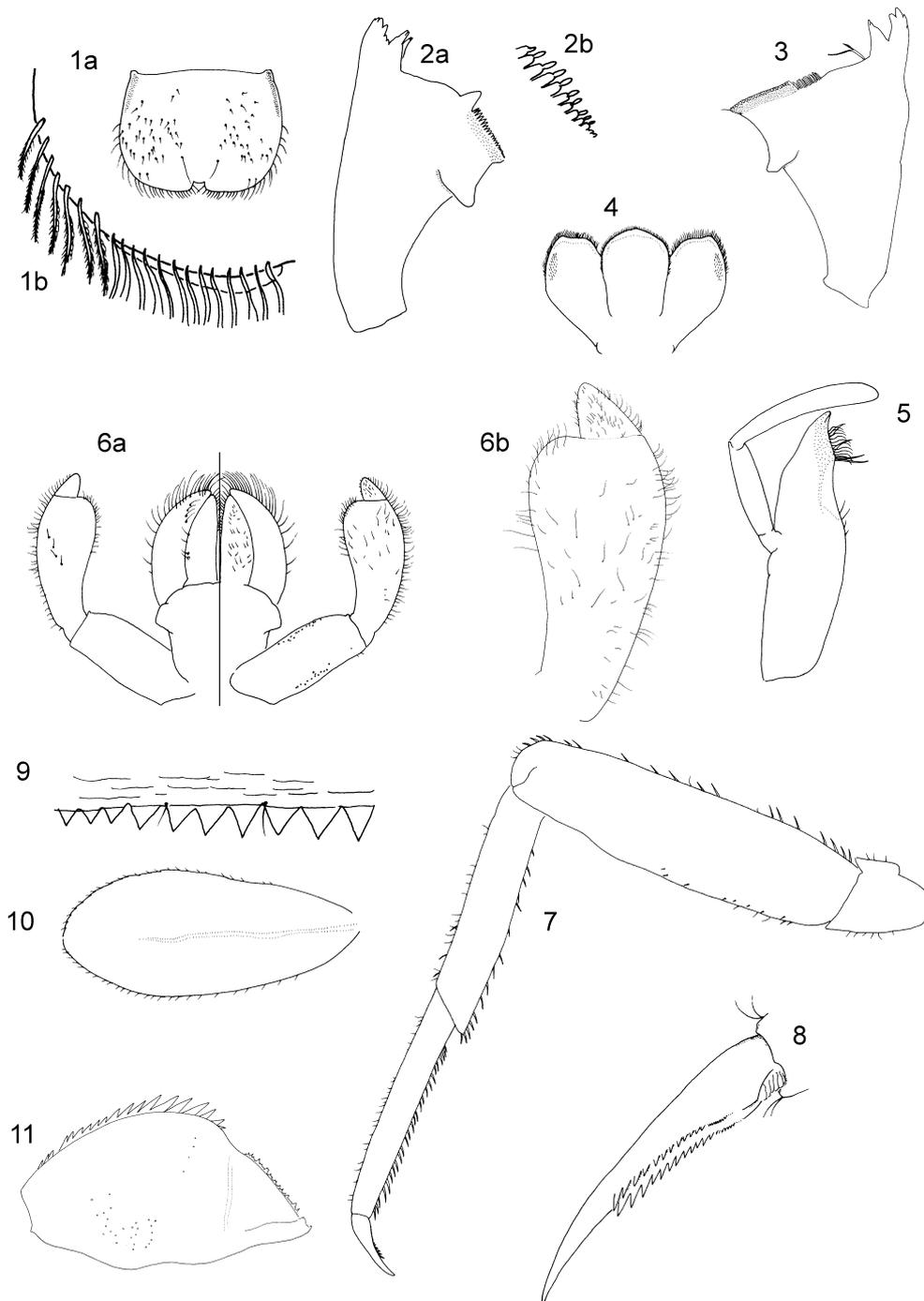


FIGURE 1–11. *Paracloeodes assu* sp. n. Nymph. Mouthparts (Figs. 1–6): 1a, labrum d.v.; 1b, labrum: apical setae; 2a, left mandible v.v.; 2b, detail of teeth of molars; 3, right mandible v.v.; 4, hypopharynx v.v.; 5, maxilla v.v.; 6a, labium, left d.v., right v.v.; 6b, palp: segments II–III. 7, leg I; 8, tarsal claw I. 9, posterior margin of tergum IV. 10, gill IV. 11, paraproct.

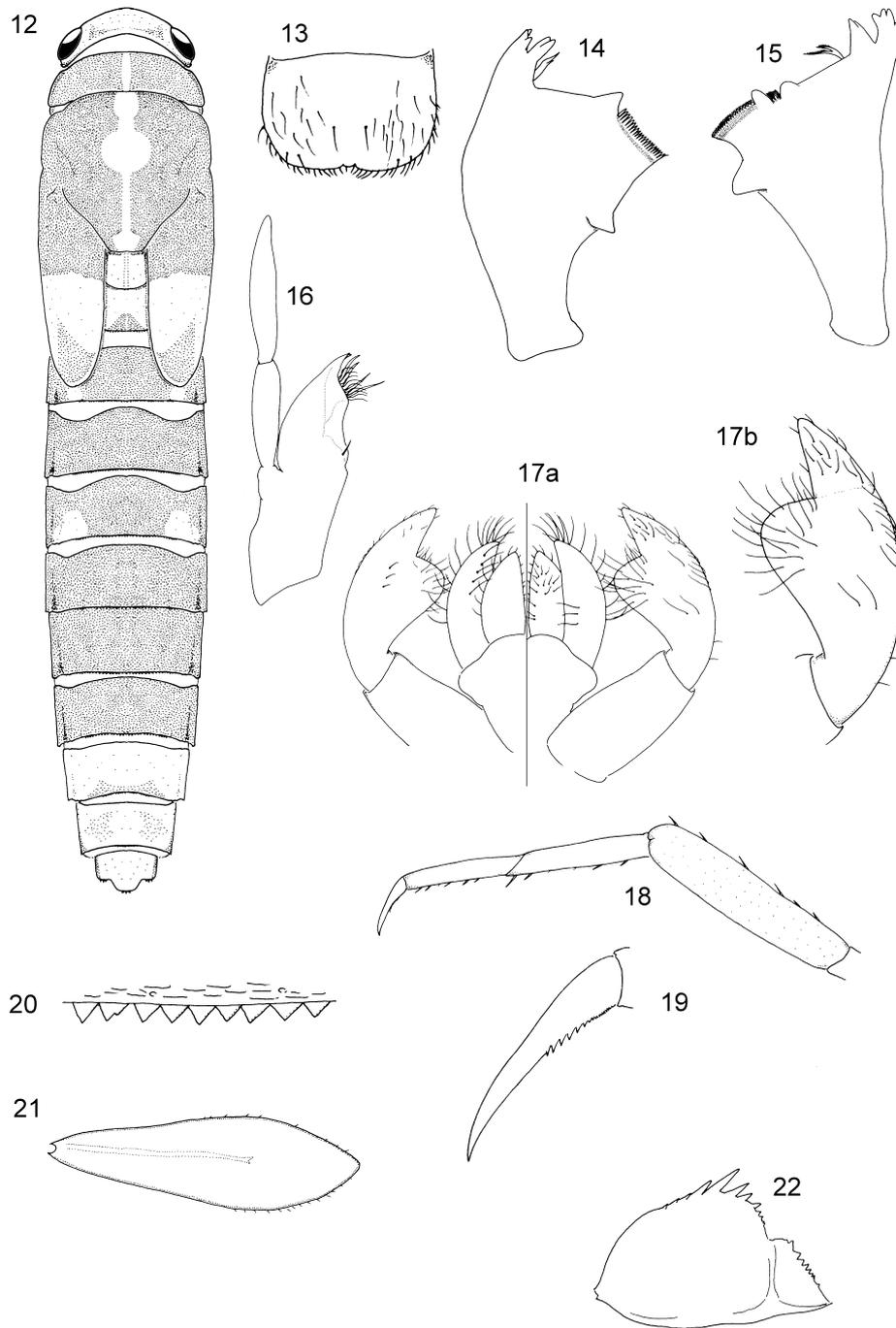


FIGURE 12–22. *Paracloeodes atroari* sp. n. Nymph. 12, General view. Mouthparts (Figs. 13–17): 13, labrum, d.v.; 14, left mandible v.v.; 15, right mandible v.v.; 16, maxilla v.v.; 17a, labium, left d.v., right v.v.; 17b, palp: segments II–III. 18, leg I; 19, tarsal claw I. 20, posterior margin of tergum IV. 21, gill IV. 22, paraproct.

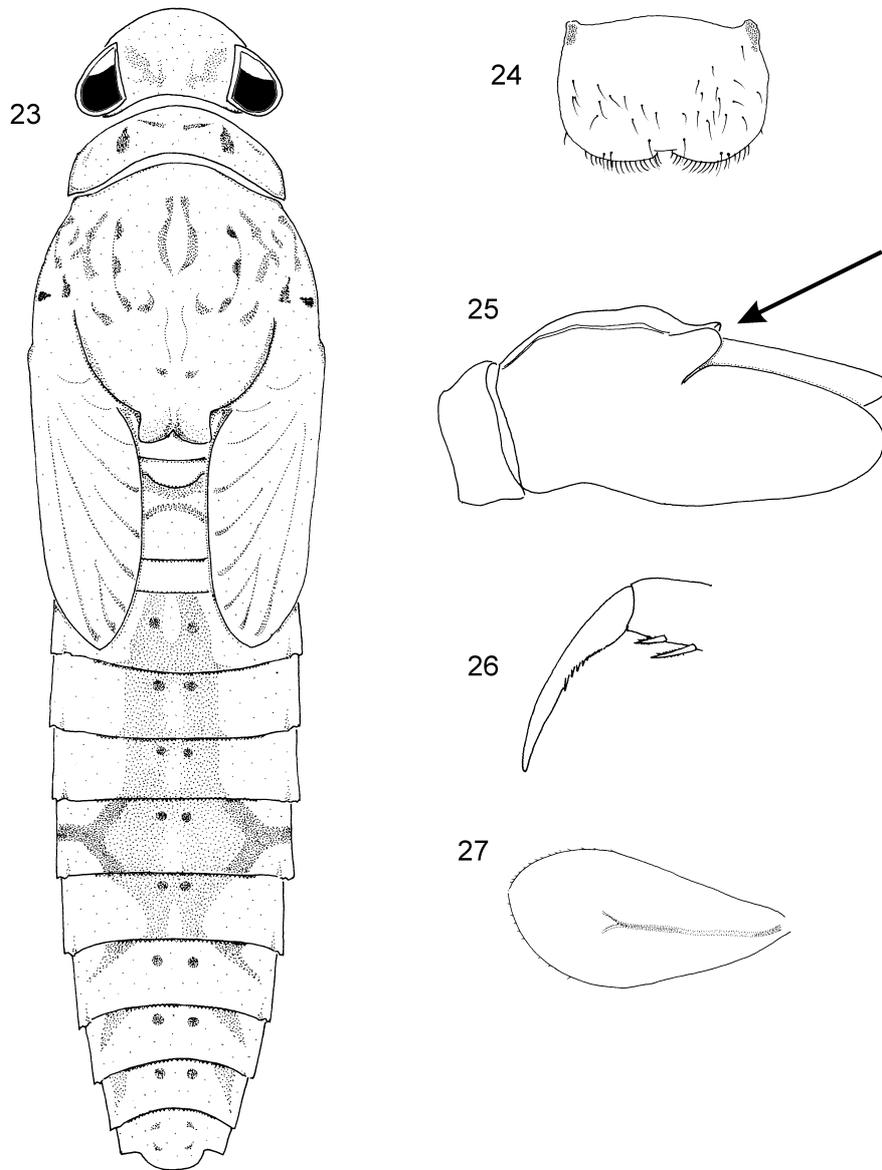


FIGURE 23–27. *Paracloeodes binodulus*. Nymph. 23, General view. 24, labrum, d.v. 25, thorax, lateral view with arrow pointing to median tubercles. 26, tarsal claw I. 27, gill IV.

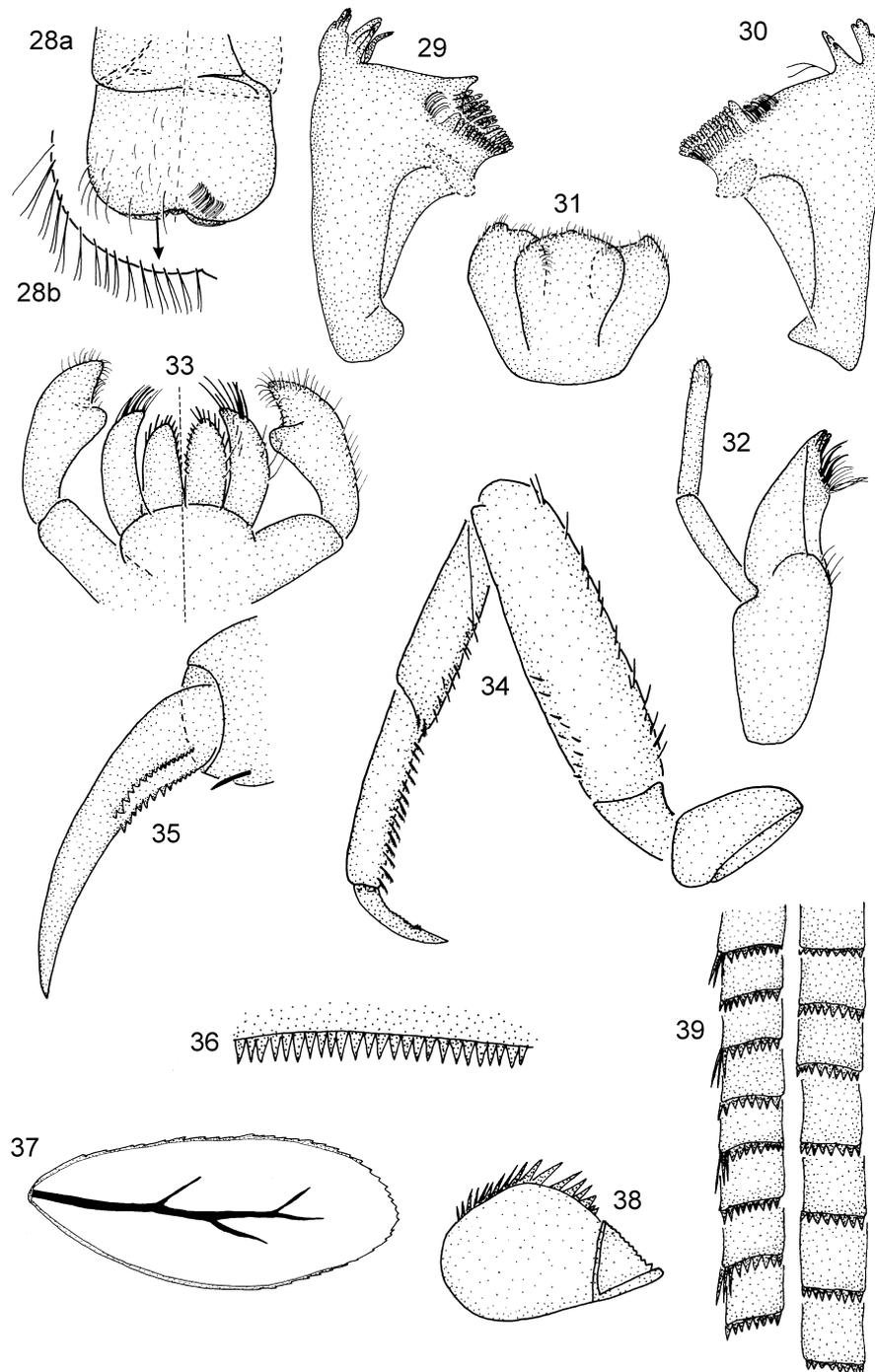


FIGURE 28–39. *Paracloeodes eurybranchus*. Nymph. Mouthparts (Figs. 28–33): 28a, labrum, left d.v., right v.v.; 28b, labrum: apical setae; 29, left mandible v.v.; 30, right mandible v.v.; 31, hypopharynx v.v.; 32, maxilla v.v.; 33, labium, left d.v., right v.v. 34, leg I; 35, tarsal claw I. 36, posterior margin of tergum IV. 37, gill IV. 38, paraproct. 39, caudal filament detail: left cercus, right terminal filament.

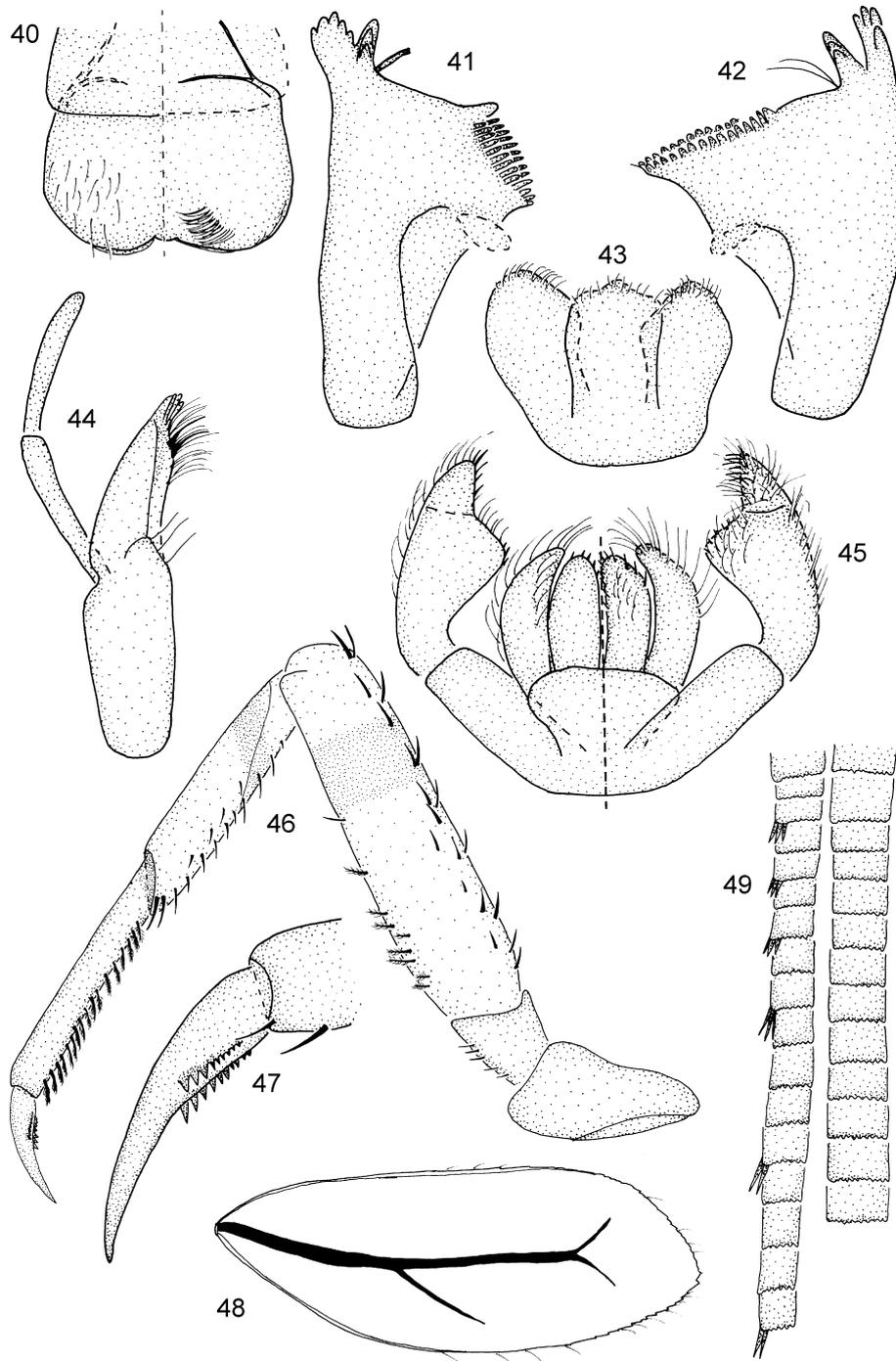


FIGURE 40–49. *Paracloeodes ibicui*. Nymph. Mouthparts (Figs. 40–45): 40, labrum, left d.v., right v.v. (apical setae omitted); 41, left mandible v.v.; 42, right mandible v.v.; 43, hypopharynx v.v.; 44, maxilla v.v.; 45, labium, left d.v., right v.v. 46, leg I; 47, tarsal claw I. 48, gill IV. 49, caudal filament detail: left cercus, right terminal filament.

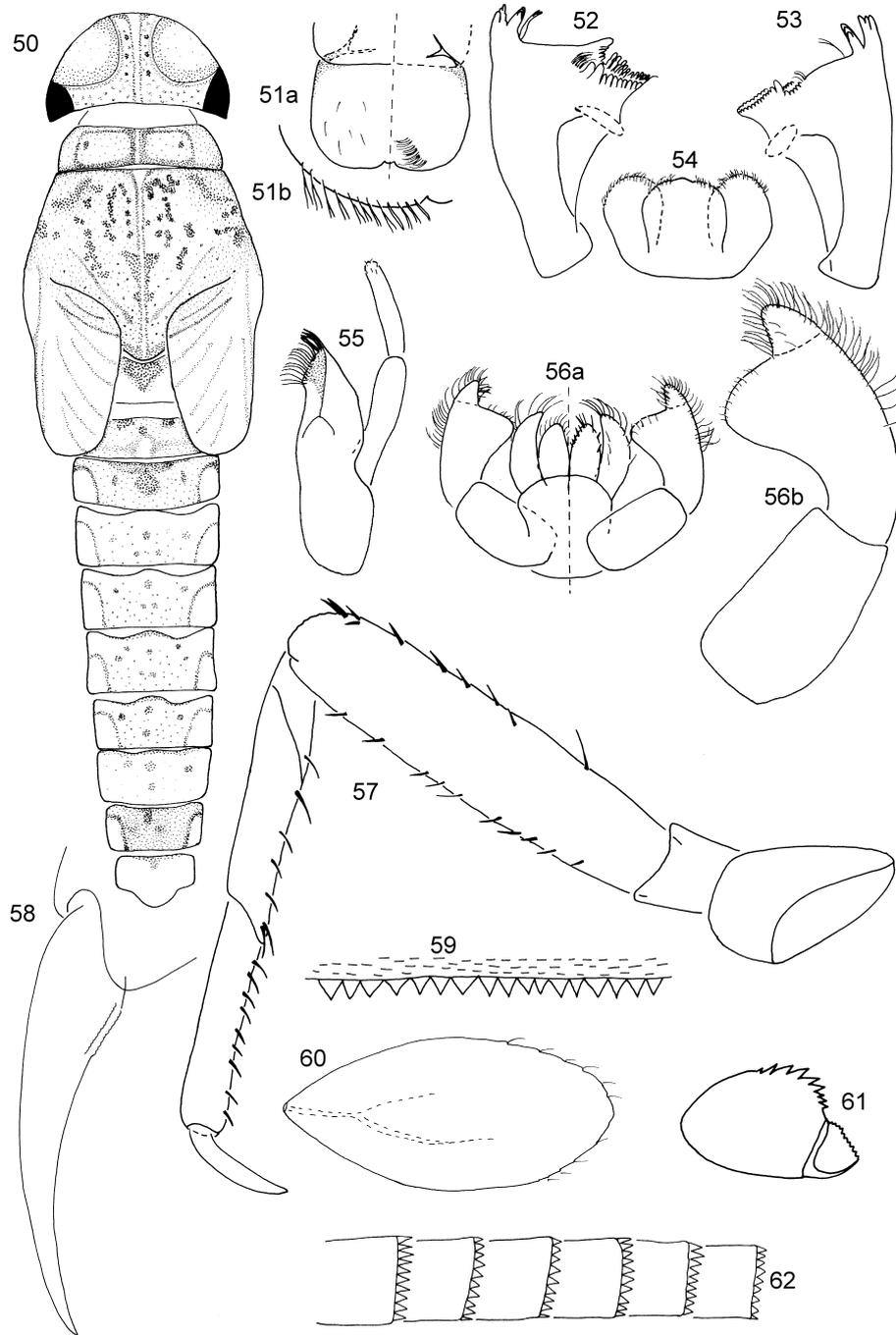


FIGURE 50–62. *Paracloeodes pacawara* sp. n. Nymph. 50, General view. Mouthparts (Figs. 51–56): 51a, labrum, left d.v., right v.v.; 51b, labrum: apical setae; 52, left mandible v.v.; 53, right mandible v.v.; 54, hypopharynx v.v.; 55, maxilla v.v.; 56a, labium, left d.v., right v.v.; 56b, palp: segments II–III. 57, leg I; 58, tarsal claw I. 59, posterior margin of tergum IV. 60, gill IV. 61, paraproct. 62, detail of cercus.

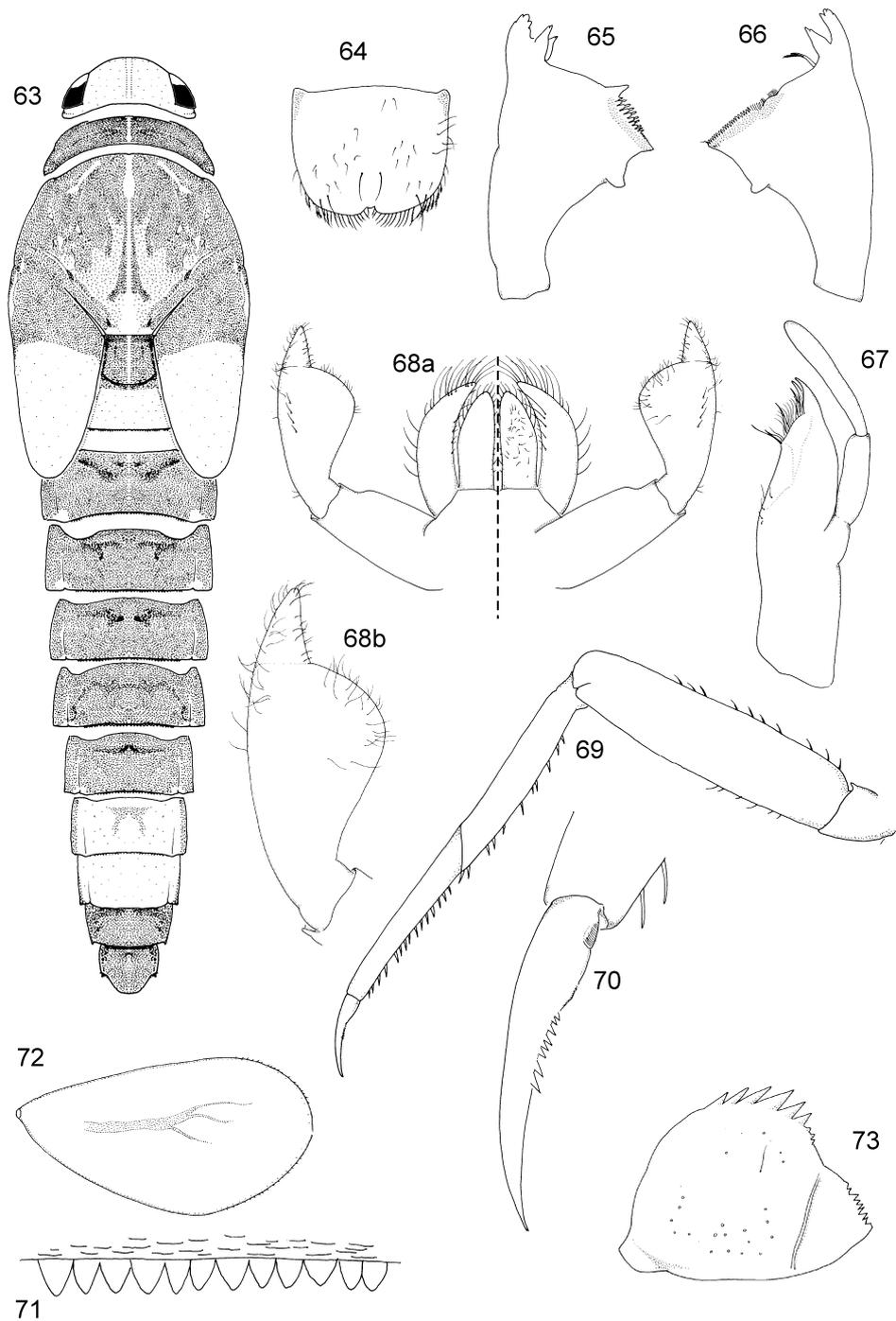


FIGURE 63–73. *Paracloeodes peri* sp. n. Nymph. 63, General view. Mouthparts (Figs. 64–68): 64, labrum d.v.; 65, left mandible v.v.; 66, right mandible v.v.; 67, maxilla v.v.; 68a, labium, left d.v., right v.v.; 68b, palp: segments II–III. 69, leg I; 70, tarsal claw I. 71, posterior margin of tergum IV. 72, gill IV. 73, paraproct.

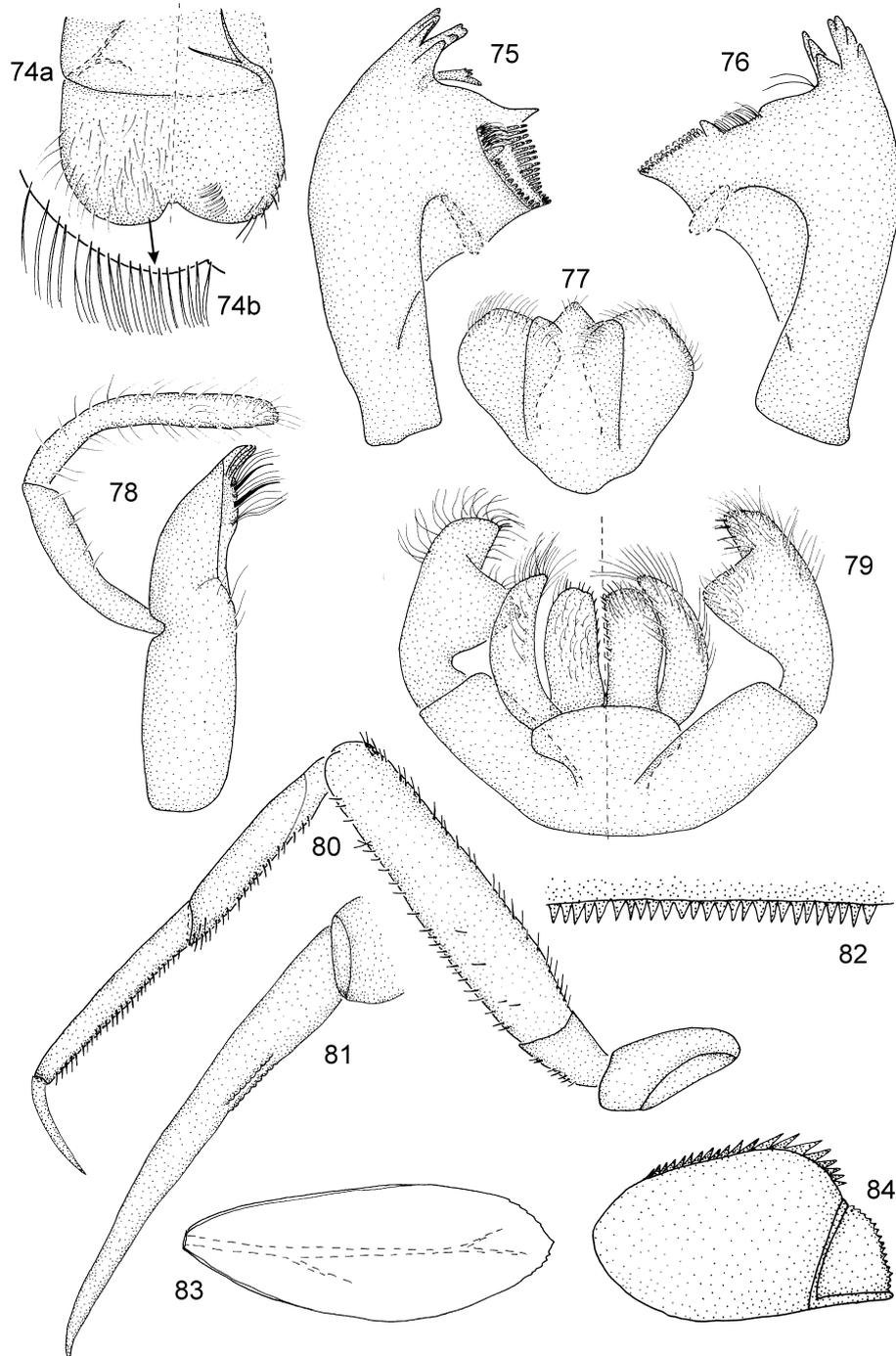


FIGURE 74–84. *Paracloeodes poranga* comb. n. Nymph. Mouthparts (Figs. 74–79): 74a, labrum, left d.v., right v.v.; 74b, labrum: apical setae; 75, left mandible v.v.; 76, right mandible v.v.; 77, hypopharynx v.v.; 78, maxilla v.v.; 79, labium, left d.v., right v.v. 80, leg I; 81, tarsal claw I. 82, posterior margin of tergum IV. 83, gill IV. 84, paraproct.

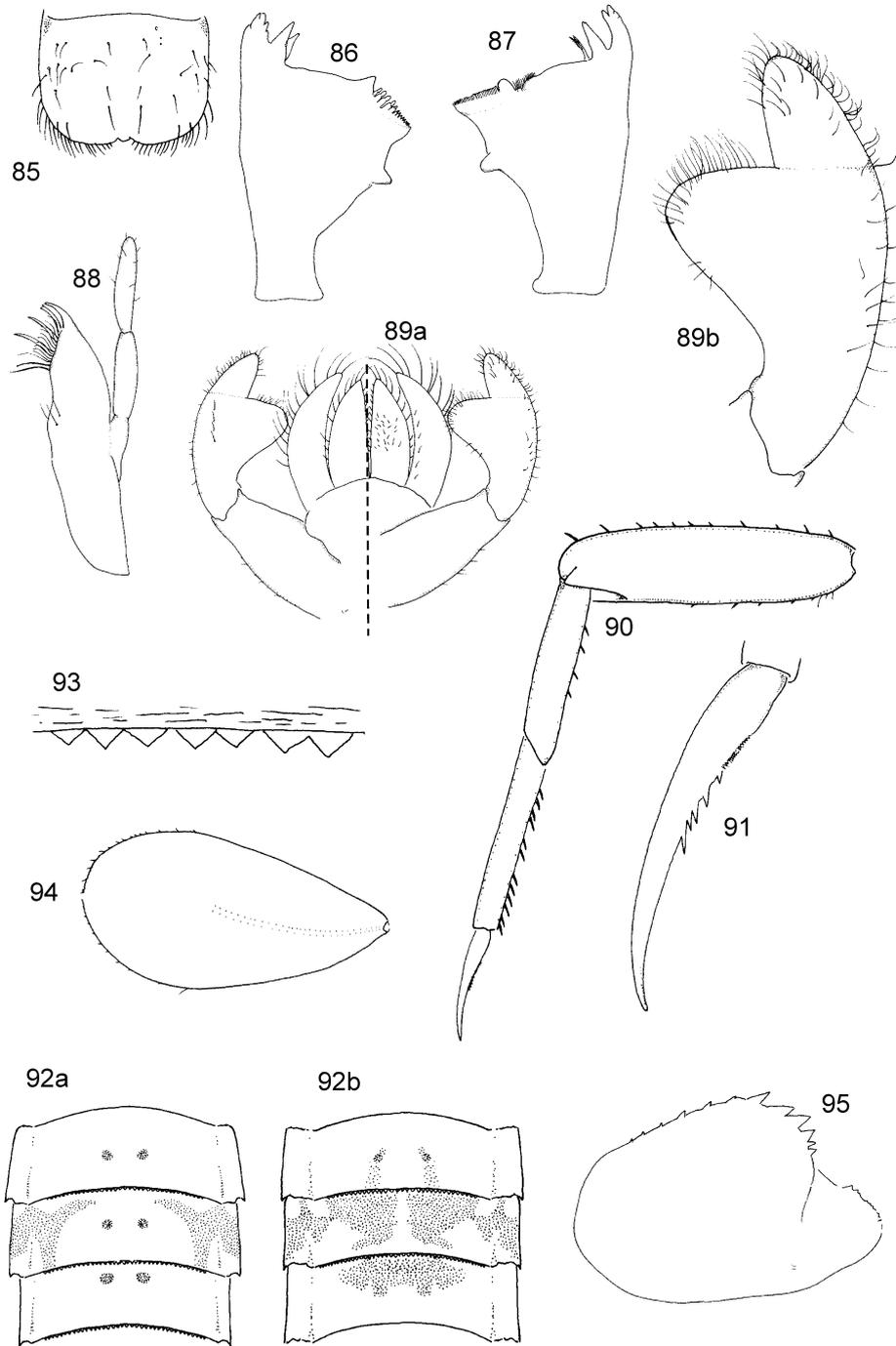


FIGURE 85–95. *Paracloeodes waimiri* sp. n. Nymph. Mouthparts (Figs. 85–89): 85, labrum d.v.; 86, left mandible v.v.; 87, right mandible v.v.; 88, maxilla v.v.; 89a, labium, left d.v., right v.v.; 89b, palp: segments II–III. 90, leg I; 91, tarsal claw I. 92a, female abdominal terga IV–VI; 92b, male abdominal terga IV–VI; 93, posterior margin of tergum IV. 94, gill IV. 95, paraproct.

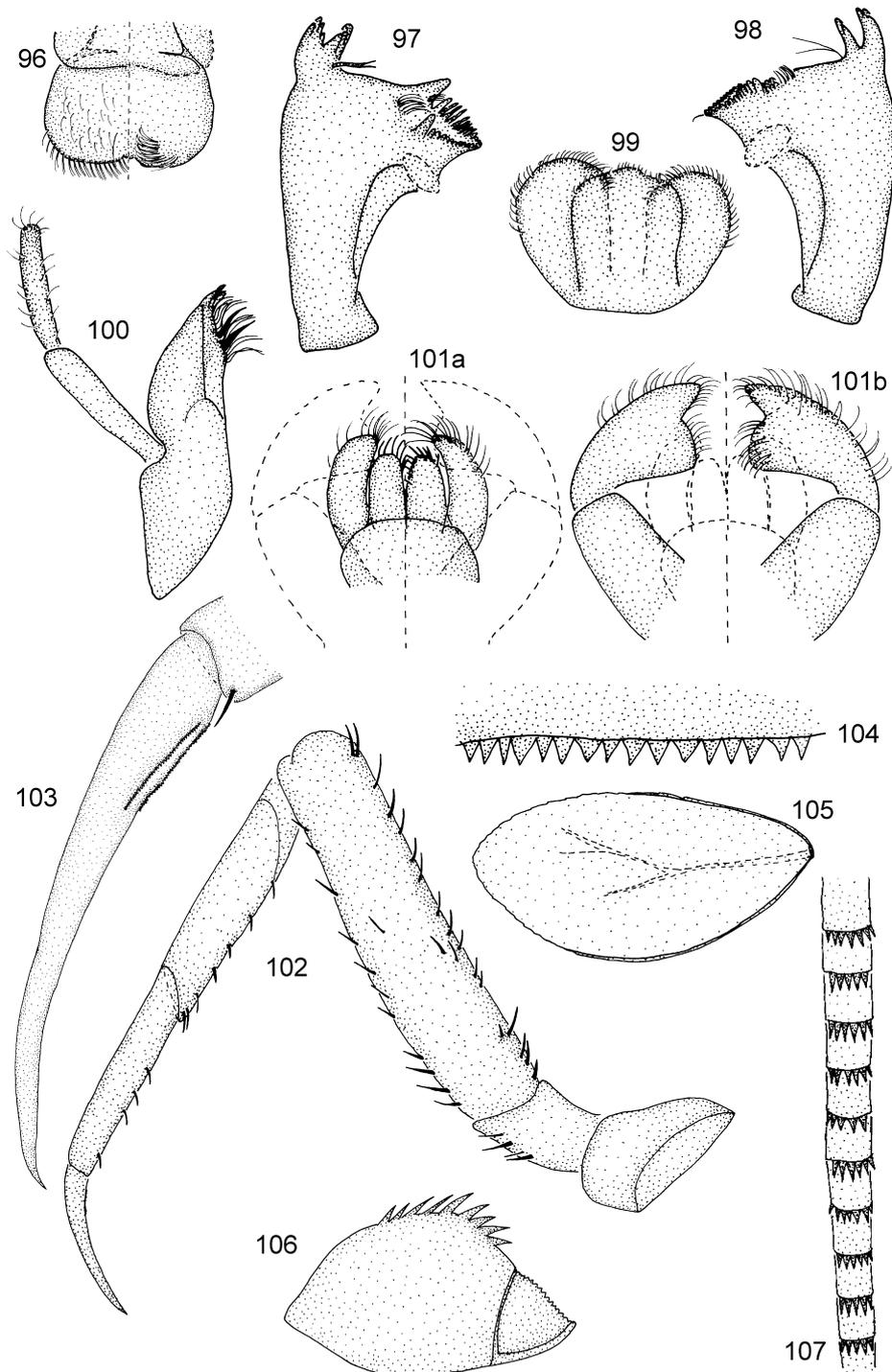


FIGURE 96–107. *Paracloeodes yuto* sp. n. Nymph. Mouthparts (Figs. 96–101): 96, labrum, left d.v., right v.v.; 97, left mandible v.v.; 98, right mandible v.v.; 99, hypopharynx v.v.; 100, maxilla v.v.; 101a, labium, left d.v., right v.v.; 101b, palpi, left d.v., right v.v. 102, leg I; 103, tarsal claw I. 104, posterior margin of tergum IV. 105, gill IV. 106, paraproct. 107, detail of cercus.