

Cladistic analysis of the Neotropical genera *Cerqueirellum* Py-Daniel, 1983, *Coscaroniellum* Py-Daniel, 1983 and *Shelleyellum* Py-Daniel & Pessoa, 2005 (Diptera: Simuliidae)

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ABSTRACT

Females of simuliid black flies are haematophagous insects and vectors of several pathogenic agents of human diseases such as the filarial worms *Mansonella ozzardi* and *Onchocerca volvulus*. The genus *Cerqueirellum* is one of the most important groups of vectors of mansonellosis and onchocerciasis diseases in South America, and the genera *Coscaroniellum* and *Shelleyellum* are phylogenetically close to *Cerqueirellum*. There is not yet an agreement among authors about the generic classification of the species which compose these three genera, being all lumped by some taxonomists within *Psaroniocompsa*. A cladistic analysis of all species of *Coscaroniellum*, *Cerqueirellum*, and *Shelleyellum*, based on 41 morphological characters were done. Species closely related to *Cerqueirellum* were included in the analysis. The genera *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum* were demonstrated as consistent basal entities and well-defined monophyletic clades.

KEY WORDS: Phylogeny, *Cerqueirellum*, *Coscaroniellum*, *Shelleyellum*, *Psaroniocompsa*.

Análise cladística dos gêneros neotropicais *Cerqueirellum* Py-Daniel, 1983, *Coscaroniellum* Py-Daniel, 1983 e *Shelleyellum* Py-Daniel & Pessoa, 2005 (Diptera: Simuliidae)

RESUMO

As fêmeas de piuns ou borrachudos da família Simuliidae são hematófagas e vetoras de diversos patógenos, destacando-se os vermes filarióides *Mansonella ozzardi* e *Onchocerca volvulus*. Dentre os grupos supra-específicos que são vetores de mansonelose e oncocercose na América do Sul, destaca-se o gênero *Cerqueirellum*. Os gêneros *Coscaroniellum* e *Shelleyellum* são filogeneticamente muito próximos a *Cerqueirellum*. Não existia concordância quanto à validade de *Cerqueirellum* e *Coscaroniellum* como clados supra-específicos, sendo ambos os gêneros incluídos, por uma escola taxonômica, como grupos de espécies em *Psaroniocompsa*. Neste trabalho é feita uma análise filogenética baseada em caracteres morfológicos dos três gêneros.. Os gêneros *Cerqueirellum*, *Coscaroniellum* e *Shelleyellum*. apresentaram-se como entidades basais válidas, consistentes e monofiléticas.

PALAVRAS CHAVES: Filogenia, *Cerqueirellum*, *Coscaroniellum*, *Shelleyellum*, *Psaroniocompsa*.

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INTRODUCTION

Coscarón (1987) conducted the first phylogenetic study of the Neotropical Simuliidae. One of the clades found by Coscarón comprises five genera (treated by him as subgenera): *Notolepria* Enderlein, *Inaequalium* Wygodzinsky & Coscarón, *Psaroniocompsa* Enderlein, *Cerqueirellum* Py-Daniel and *Coscaroniellum* Py-Daniel and the monotypic quadrivittatum-group. That clade encompasses most of the onchocerciasis and mansonelliasis vector species in South America. In this study, the above mentioned clade found by Coscarón is referred to by the informal name “Notolepria–group”. Recently an informal group of the *Psaroniocompsa* genus, the siolii-group, was elevated to genus, called *Shelleyellum* by Py-Daniel and Pessoa (2005) based in synapomorphies of larvae and adult genitalia.

Cerqueirellum and *Coscaroniellum* were described as subgenus by Py-Daniel (1983), and later elevated to genus (Py-Daniel and Moreira-Sampaio, 1994, 1995). *Cerqueirellum* currently comprises nine species, distributed from Mexico to Argentina. According to Coscarón (1987), *Coscaroniellum* is the sister-group of *Cerqueirellum*. There still is some disagreement concerning the validity of *Cerqueirellum* and *Coscaroniellum* as valid supraspecific clades. Nonetheless, most South American authors in the last two decades have used *Cerqueirellum* and *Coscaroniellum* as valid taxa, either as independent genera or subgenera of *Simulium* Latreille (Coscarón, 1987; Coscarón *et al.*, 1992; Coscarón and Ibáñez-Bernal, 1994; Coscarón and Coscarón-Arias, 2000; Py-Daniel, 1983; Py-Daniel and Moreira-Sampaio, 1995; Almeida *et al.*, 1999; Medeiros and Py-Daniel, 1999; Muñoz de Hoyos, 1994; Muñoz de Hoyos and Miranda-Esquivel, 1997; Ginarte *et al.*, 2003; Strieder, 2004; Strieder and Py-Daniel, 2002; Takaoka and Davies, 1995; Craig and Currie, 1999). Crosskey and Howard (1997; 2004) included *Cerqueirellum* and *Coscaroniellum* as junior synonyms of *Simulium*, within the *Psaroniocompsa* subgenus, named as amazonicum- and quadrifidum-groups, respectively. The monotypic quadrivittatum-group was placed by Crosskey and Howard within *Psilopelmia* Enderlein, as a subgenus of Simuliidae. Recently, Hernández and Shelley (2005) placed the *Simulium quadrivittatum* into *Psaroniocompsa*, but that taxonomic act appears to be due a typographical error.

We do not agree with Edward's (1931) proposal, which was followed by Crosskey and Howard (1997; 2004), about the use of *Simulium* genus as a large genus, with several subgenera and many species-groups. Mayr (1969) and Ready *et al.* (1980) pointed that classifications ought to be explanatory and predictive, and should not be a simple easy-to-use filing system. In this work, we adopted the classification proposed by Py-Daniel and Moreira-Sampaio (1994, 1995), which considers the elevation of the subgenus to genus level with phylogenetic support. Due to this statement, we do not accept

the synonymisation of the genus *Shelleyellum* with *Simulium* *s.l.* Latreille done by Shelley *et al.* (2006).

Because of the nomenclatural problems of the supraspecific clades between the species of *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum*, and considering the medical importance of some species, it is necessary to establish phylogenetic relationships between them.

MATERIAL AND METHODS

For this study, we examined immature and adult morphology of holotypes, paratypes or topotypes of Simuliidae from the Collection of Simuliidae of Instituto Nacional de Pesquisas da Amazônia (INPA/LETEP). Morphological characters of *Cerqueirellum sanguineum* (we have only examined larvae previous to the last instar), *Coscaroniellum cerradense* (complementary data provided by Dr. Sixto Coscarón, Museo de La Plata, Argentina) and *Shelleyellum tergo-spinosum* were analyzed based upon information contained in their original descriptions and additional bibliography (Shelley, 1982; Smart, 1942; Ramírez-Pérez *et al.*, 1982; Py-Daniel, 1983; Goeldi, 1905; Lutz, 1910; 1917; Cerqueira and Nunes de Mello, 1964; Tidwell *et al.*, 1981; Knab, 1915; Coscarón *et al.*, 1992; Hamada, 2000). For all other species this information was obtained through examination of specimens using binocular stereoscopic microscopy and compound microscopy. Specimens of some species were slide mounted.

Photographs of the black flies were obtained using a Synoptics composite image analysis system from the ILMD/FIOCRUZ-AM. Those images were stored on CD disks and deposited in the Collection of Simuliidae from INPA and the Biological Collection of the ILMD/FIOCRUZ-AM.

The supraspecific denomination of taxa follows that of Py-Daniel and Moreira-Sampaio (1994; 1995). The gill formula is based on Py-Daniel and Coscarón (2001). The cladistic analysis included all known species of *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum* as inner group (21 species), plus three relative species: *Psaroniocompsa minuscula* (Lutz), *P. delponteiana* (Wygodzinsky) and *P. incrustata* (Lutz). *Aspathia metallica* Bellardi was used as outgroup. The species *Coscaroniellum rassi*, we examined just the mounted pupa of the holotype and we did not find any difference of *Coscaroniellum quadrifidum*, so we decided not to include in this study. A total of 41 morphological characters (Table 1) were used: 16 from adults (characters 1-16), 8 from pupae (characters 17-24) and 16 from larvae (characters 25-40) and are illustrated in figures: 1-6. The methodology used for the cladistic analysis was based on Miranda-Esquivel and Coscarón (2001). Firstly, was done an analysis by HENNIG86 program Windows version (Tree Gardener, version 2.2) (Ramos, 1996), and the algorithm ie* implicit enumeration.

This function can generate over than 100 trees obtaining the most parsimonious tree (Lipscomb, 1994). Strict consensus function was used to obtain only one tree.

RESULTS AND DISCUSSION

CHARACTERIZATION OF THE GENUS *Cerqueirellum* PY-DANIEL, 1983

Adults: General coloration black with silver pruinosity, body length 1.0-3.0 mm. Head with dark red eyes; frons, clypeus and occiput black with faint silver pruinosity. Male and female antennae length sub-equal. Sc, R₁ and R₂ wing veins without setae, including in the basal area. **Female:** Frons higher than wide, nudiocular area (NO) reduced, ratio of NO high/wide not bigger than 1.5; without infraocular suture (Fig. 1a). Cibarium with sclerotised area in the basal portion; and with four rows of well-sclerotised acuminate teeth, extending from borders of deep central area to the cornua; concavity of the central area in the proximal opening with proximally same wide of the distal end, without teeth (Fig. 1b-c). Scutum with three black vittae bordered by submedian silver pruinosity, showing elongated comma-shaped marks, with antero-superior light illumination. Tarsal claws curved without basal tooth (Fig. 1d). Gonapophyses subtriangular,

with microtrichia uniformly distributed, except in the basal area, distally divergent, with light sclerotisation on inner margin (Fig. 1e), cerci rounded, paraproct short with rounded border (Fig. 1f-g). **Male:** Ratio of the first flageromere size/wide not bigger than 1.5 (Fig. 1h-i). Scutum with 1+1 black, submedian silvery cunae extending for more than half of scutum, but generally not adjoining with silvery posterior area; length of cunae change with the light position, lateral borders with silver strips. Basimere rectangular/subrectangular, distimere shorter than basimere, with one or two subtriangular strong spurs on the apical or subapical margin (Fig. 1j-l). **Pupa:** General coloration light brown, gill pale. Cocoon light brown, slipper shaped (except in *C. argentiscutum*); gill comprised of four to ten branches (Fig. 2a-h), filaments 1/2 to subequal length of cocoon. Frontoclypeus with abundant, rounded platelets (Fig. 2i); 1+1 small hair like trichomes, not bigger than 1/3 of frontoclypeus wide, simple or bifid facial trichomes and 2+2 simple or bifid frontal trichomes as long as facial trichomes (Fig. 2j-l). Thorax with 5+5 hair like anterodorsal trichomes, bifid (usual) to quadrifid (Fig. 2m-n), 1+1 supralateral, 3+3 lateral simple or bifid hair like trichomes. Thorax with abundant, rounded and semi-elliptic platelets near wing sheath. Postscutellar bridge with 1+1 small and hair like simple setae; abdominal tergite I with 1+1 sublaterally hair

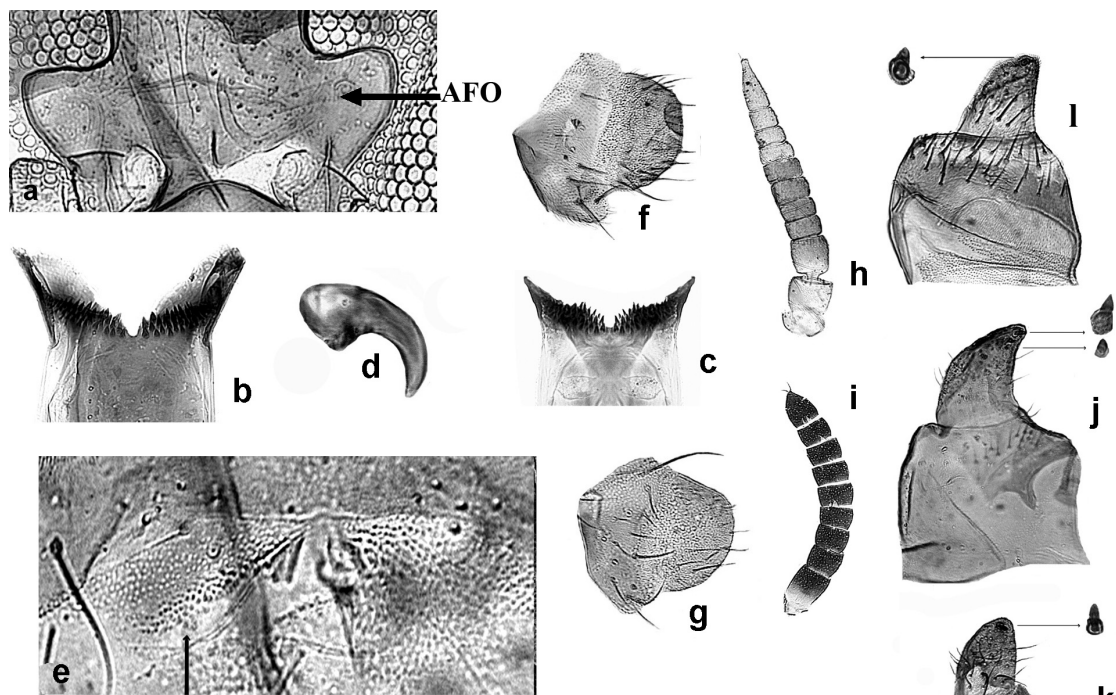


Figure 1 - Some adult characters used for the phylogenetic analyses in the genus *Cerqueirellum* -a- Female Fronto Ocular Area (AFO) of *C. amazonicum*; b-c cibarium of *C. cuneatum*, d- tarsal claws of *C. ganalesense*, e- gonapophyses of *C. oyapockense*, f-g- Cerci of *C. amazonicum*, *C. roraimense*, j-k- male Basimere and distimere of *C. chaquense*, *C. cunetatum* h-i- male antenna of *C. chaquense*, *C. venezuelense*. Arrow pointing to AFO.

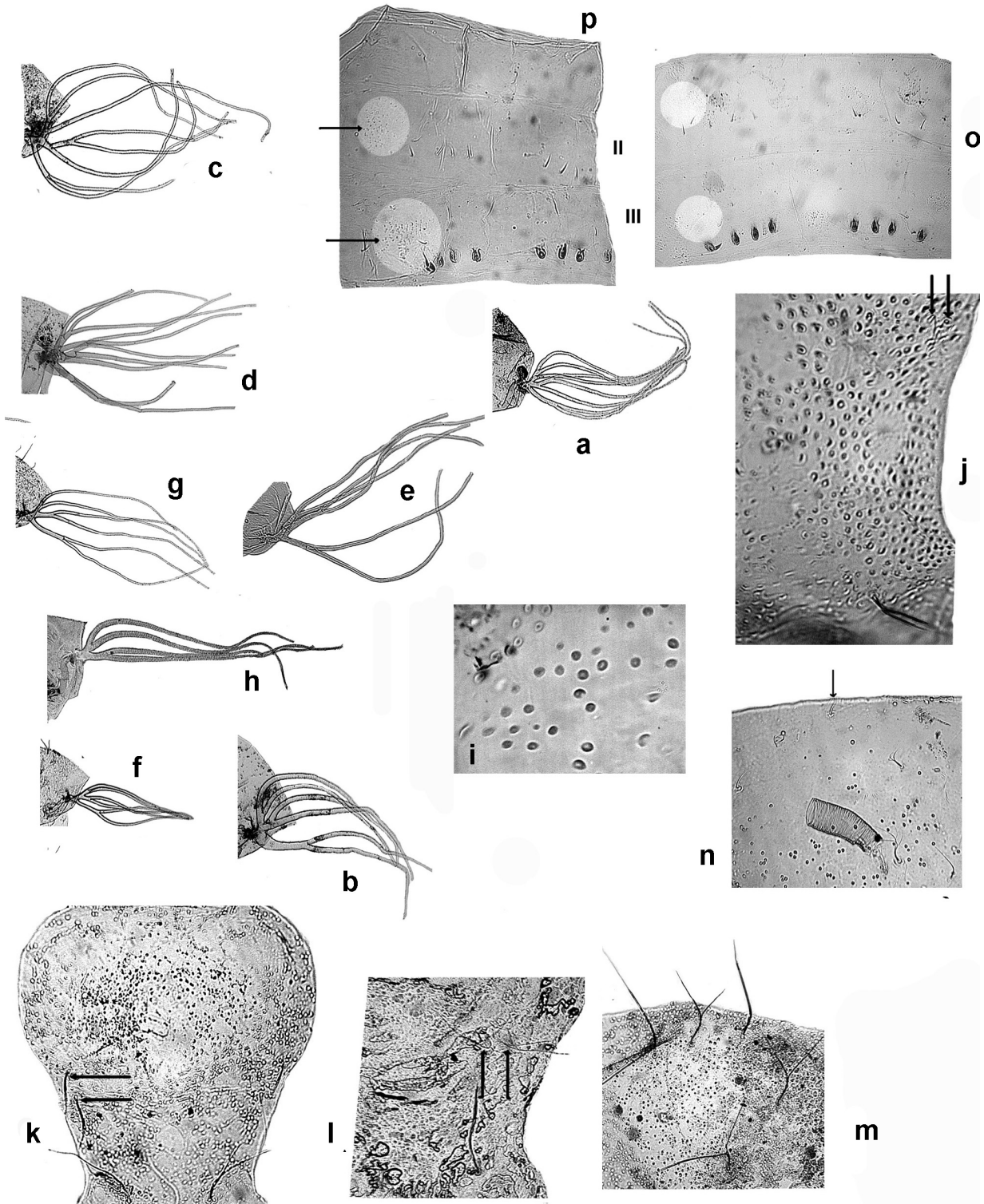


Figure 2 - Some pupal characters used for the phylogenetic analyses in the genus *Cerqueirellum* – gills of a- *C. amazonicum*, b- *C. argentiscutum*, c- *C. chaqueense*, d- *C. cuneatum*, e- *C. ganalesense*, f- *C. oyapockense*, g- *C. roraimense*, h- *C. venezuelense*; i- part of frontoclypeus with rounded platelets of *C. amazonicum*; j-l cephalic trichomes of j- *C. oyapockense*, k- *C. roraimense* l- *C. venezuelense*; m-n- thoracic trichomes of *C. chaqueense*, *C. roraimense*, o-p- second and third tergites of *C. roraimense* and *C. oyapockense*, brightness areas showing combs of spines in *C. oyapockense*, and the absence of the combs in *C. roraimense*. Arrows pointing to trichomes.

Table 1 - Data matrix for the *Cerqueirellum*, *Coscaroniellum*, *Shelleyellum*; *Psaroniocompsa delponteiana*, *P. minuscula* and *P. incrustata*, using *Aspathia* as outgroup.

Species/ Characters	01234567891111111112222222223333333334
	0123456789012345678901234567890
<i>A. metallica</i>	00
<i>C. amazonicum</i>	010101110011223020010002010100102??1100000
<i>C. argentiscutum</i>	0101011100112230201010012010000102??1101000
<i>C. chaquense</i>	010101110011223020010002010000102??1100000
<i>C. cuneatum</i>	010101110011223020010101010200112??1100000
<i>C. ganalesense</i>	01010111001122302001000101000010101100000
<i>C. oyapockense</i>	01010111001122302001000211001010001100000
<i>C. roraimense</i>	01010111001122302001000101001010101100000
<i>C. sanguineum</i>	01010111001122302001000101010010001100000
<i>C. venezuelense</i>	01010111001122302001?10?0???????????????????
<i>S. damasceni</i>	01110112201122401001300000202100100000101
<i>S. guaporense</i>	?1?10111221122411000110101302100100000110
<i>S. lourencoi</i>	?????11221??241?000100001202100100000100
<i>S. tergospinosum</i>	01100112201?22401001?0020000??0??00000100
<i>S. siolii</i>	01110112201122401000100101002100100000100
<i>C. cauchense</i>	11202112211011101000110000102000100010000
<i>C. cerradense</i>	00110112211011101010110000002000110010000
<i>C. daltanhani</i>	0010011221101110100000000002000110010000
<i>C. goeldii</i>	01101112211011101000210000102000110010000
<i>C. quadrifidum</i>	11202112211011101000110000102100?00010000
<i>C. quadrivittatum</i>	00100112121021101000000000102000100010000
<i>C. ulyssezi</i>	01101112211011101000210000102000120010000
<i>P. minuscula</i>	011001122001112201001300100000000100100000
<i>P. delponteiana</i>	0100011220111?211001000100000000110000000
<i>P. incrustata</i>	00 10011220112120100000000002000100000000

like setae; tergites II and III without spine combs (Fig. 2o) (except in *C. oyapockense*, Fig. 2p); tergite II with 5+5 hair like setae; tergites III and IV with 4+4 hooks on posterior margin, 1+1 spiniform setae between 1+1 outermost hooks, and 2+2 spiniform sublaterally setae; tergite V with 5+5 submedian hair like setae, tergites VI-IX with 1+1 spine combs in the anterior margin; tergites VI-VIII with 3+3 submedian hair like setae. Tergite IX with 1+1 small curved terminal spurs. Abdominal sternites III-VIII with 1+1 groups of spine combs medially on the anterior margin. Sternite IV with 1+1 submedian bifid or trifold hooks and 2+2 submedian simple setae; sternite V with 2+2 bifid hooks, separated by a longitudinal median striation, and 2+2 submedian lateral setae to outermost hooks; sternites VI-VII with 2+2 simple to quadrifid submedian hooks and 3+3 simple setae. Larva (last instar): Abdomen length 3.6-4.0 mm; head capsule lateral length 0.35-0.45 mm. General coloration (in alcohol) white with dorsal greenish to greenish transversal rings along body, without fixed pattern, with a dark stripe around the first abdominal segment. Cephalic apotome with positive spots, simple to multibranching well developed setae (Fig. 3a-c). Cervical sclerites small, elliptical free in membrane. Antenna longer than cephalic fan stem (except *C.*

argentiscutum); distal, medial, and proximal articles of similar size (1:0.9-1.0:0.9-1.0) (Fig. 3d-f). Labral fan of between 16 and 45 primary rays, microtrichia rows of primary labral fan rays following the standard pattern (Palmer and Craig, 2000), microtrichia uniforms, with the same size, or with not uniform sequences, but not being of weak complex pattern (Palmer and Craig, 2000) (Fig. 3g-h). Mandible with 1 apical, 2 external, 3 subapical teeth (being the first bigger than the others); 5 to 10 internal teeth, the first internal tooth subequal to the third subapical tooth; two marginal teeth, first large, second small to residual; 1 or 2 simple teeth. Lateromandibular process (PLM) absent or present, labral sclerite subtrapezoidal, covered with long setae and with 3+3 apical teeth. Mandible with a fringe of supramarginal setae (SSM) in the basal area (Fig. 3i-k). Hypostomium with central tooth, 1+1 corner teeth, 3+3 intermediate teeth, with equal or sub equal size, all teeth at same level; 2+2 lateral teeth. 3-7 lateral serrations, 3-4 hypostomal setae per side, and 1+1 setae in distal margin of hypostomal plate (Fig. 3l-n). Deep gular cleft longer than wide, subcircular or submitral; narrow or absent hypostomal bridge (Fig. 3o-p). Distal adoral brushes with predominant setae of simple to multiple tips (3q-r). Anal sclerite X-shaped, multilobed anal gill. Ventral tubercles small or absent.

GEOGRAPHICAL DISTRIBUTION AND REMARKS

The geographic distribution of the genus *Cerqueirellum* comprises the South and Central America; from Mexico to northern Argentina. This is a typical genus of large rivers, which is reflected in the type of microtrichia.

Characterization of the Genus *Coscaroniellum* Py-Daniel, 1983

DIAGNOSIS

Adults: General coloration black, head with blue greenish pruinosity, body length 1.3-2.4 mm. Antennae dark brown with scape, pedicel and first flagellomere orange brown, all the three antennal segments proportionally long, female antennae longer than male, mouth parts and palps dark brown. Sc, R₁ and R₂ wing veins without setae, including the basal area. **Female:** Head dichoptic, fronto-ocular triangle reduced to expanded, with infraocular suture, ratio of fronto-ocular area (AFO) high/wide 1.5-2.5 (Fig. 4a-b). Cibarium with basal sclerotised area, central deep with rounded teeth and 1+1 submedian elevation with small or large acuminate and rounded teeth, extending from cornua edge (Fig. 4c-e). Tarsal claws curved with basal tooth (Fig. 4f-g). Calcipala and pedisulcus present. Gonapophyses subtriangular, with microtrichia well distributed, until the basal part, distally divergent with slightly sclerotized inner margin (Fig. 4h). Genital fork stout and sclerotised, spatulate stem longer than lateral arms, cerci rounded, paraproct medium with rounded border (Fig. 4i-j). Spermatheca subspherical, with cuticular

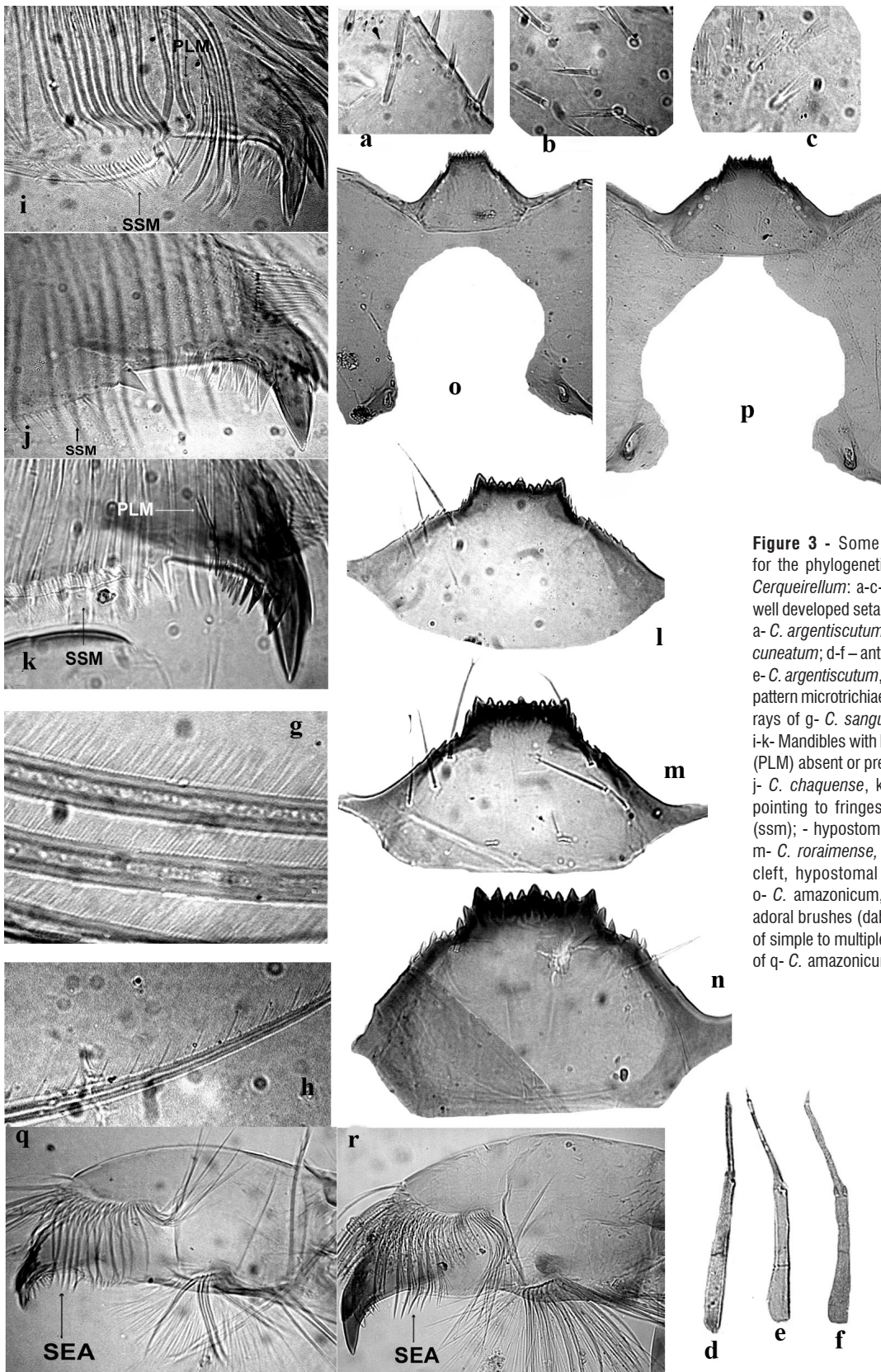


Figure 3 - Some larval characters used for the phylogenetic analyses in the genus *Cerqueirellum*: a-c- Simple to multibranch well developed setae of the cephalic apotome, a- *C. argentiscutum*, b- *C. ganalesense*, c- *C. cuneatum*; d-f – antennae, d- *C. amazonicum*, e- *C. argentiscutum*, f- *C. chaqueuse* ; standard pattern microtrichiae rows of primary labral fan rays of g- *C. sanguineum*; h- *C. roraimense* i-k- Mandibles with latero-mandibular process (PLM) absent or present of i- *C. sanguineum*, j- *C. chaqueuse*, k- *C. roraimense*; arrows pointing to fringes of supramarginal setae (ssm); - hypostomium of l- *C. ganalesense*, m- *C. roraimense*, n- *C. cuneatum* ; - gular cleft, hypostomal bridge and hypostoma; o- *C. amazonicum*, p- *C. roraimense*; distal adoral brushes (dab) with predominant setae of simple to multiple, arrows pointing to them of q- *C. amazonicum*, r- *C. cuneatum*.

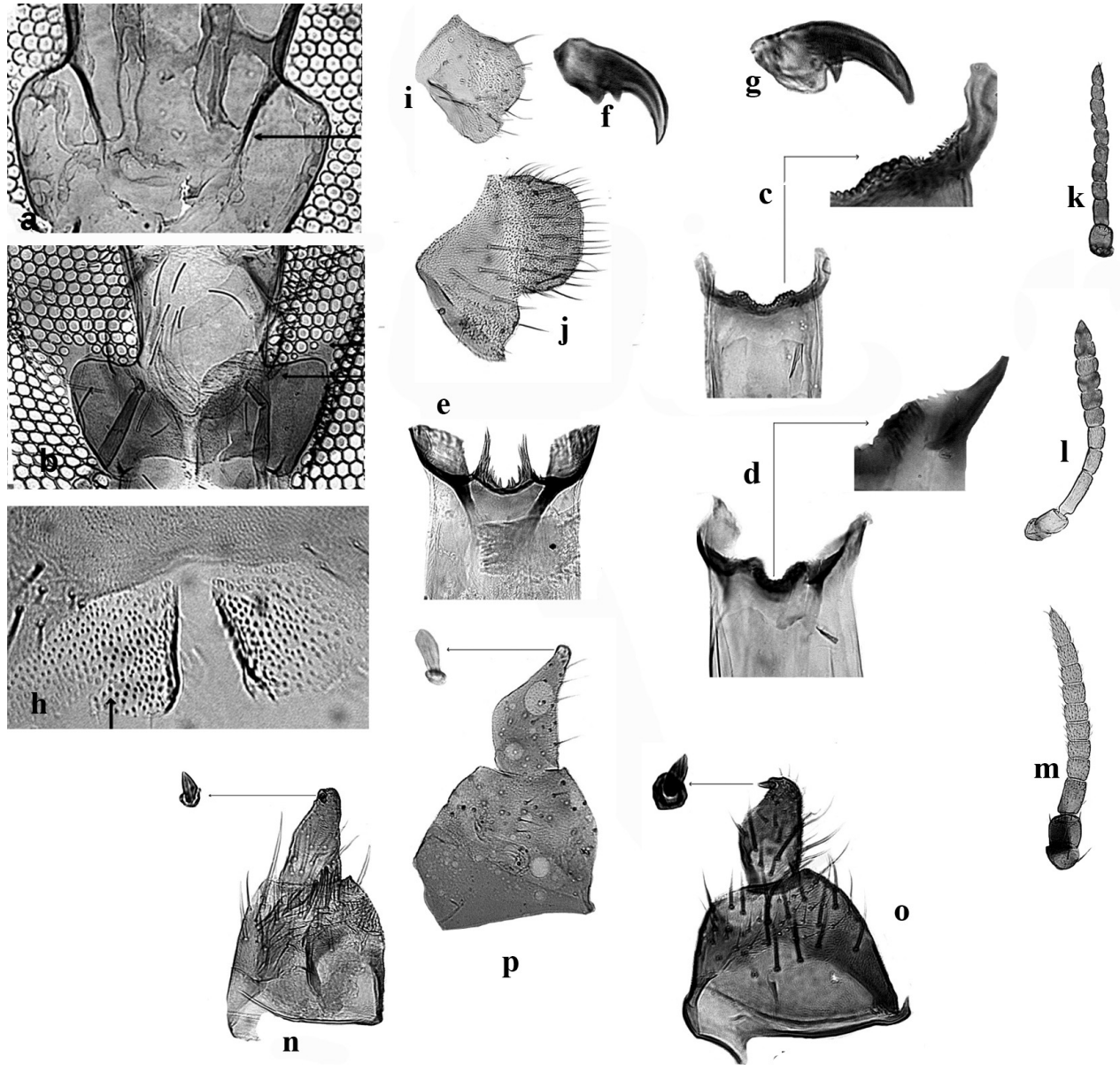


Figure 4 - Some adult characters used for the phylogenetic analyses in the genus *Coscaroniellum*- Female Fronto Ocular Area (AFO) of a- *C. quadrifidum* b- *C. daltanahni* Up arrow pointing to a fronto-ocular triangle, down arrow pointing a small infraocular suture; cibarium of c- *C. cauchense*, d- *C. quadrifidum*, e- *C. quadrivitattum* comb. Nov. increased area with acuminate and rounded teeth extending from cornua edge; tarsal claws of f- *C. goeldii*, g- *C. ulyssesi*; gonapophyses subtriangular, arrow pointing to microtrichia until the basal part of h- *C. daltanahni*; cerci of i- *C. cauchense*, j- *C. daltanahni*; antenna of k- *C. ulyssesi*, l- *C. goeldii*, m- *C. quadrivitattum* ; basimere and distimere, with one large, flat and strong apical or subapical spur of n- *C. cauchense*, o- *C. daltanahni*, p- *C. quadrivitattum* n. comb.

microspines, spermathecal ducts and area of attachment unpigmented. **Male:** Ratio of first flageromere length/wide bigger than 1.5 (Fig. 4k-m); basimere rectangular/subrectangular, distimere with podomorphic format, with one large, flat and strong apical or subapical spur (Fig. 4n-p). Pupa: General coloration light brown, gill pale. Cocoon light brown, slipper shaped, with reinforced anterior margin, anterodorsal

projection not uniform, lateral projections can be expanded. Frontoclypeus with abundant, acute, subtriangular platelets, but can occur rounded platelets in some species (Fig. 5a-b); 1+1 long (bigger 1/3 of frontoclypeus wide) hair like, simple or bifid or trifid facial trichomes and 2+2 simple, bifid or trifid frontal trichomes as long as facial trichomes (Fig. 5c-e), external surface of antennal sheaths not covered with tubercles.

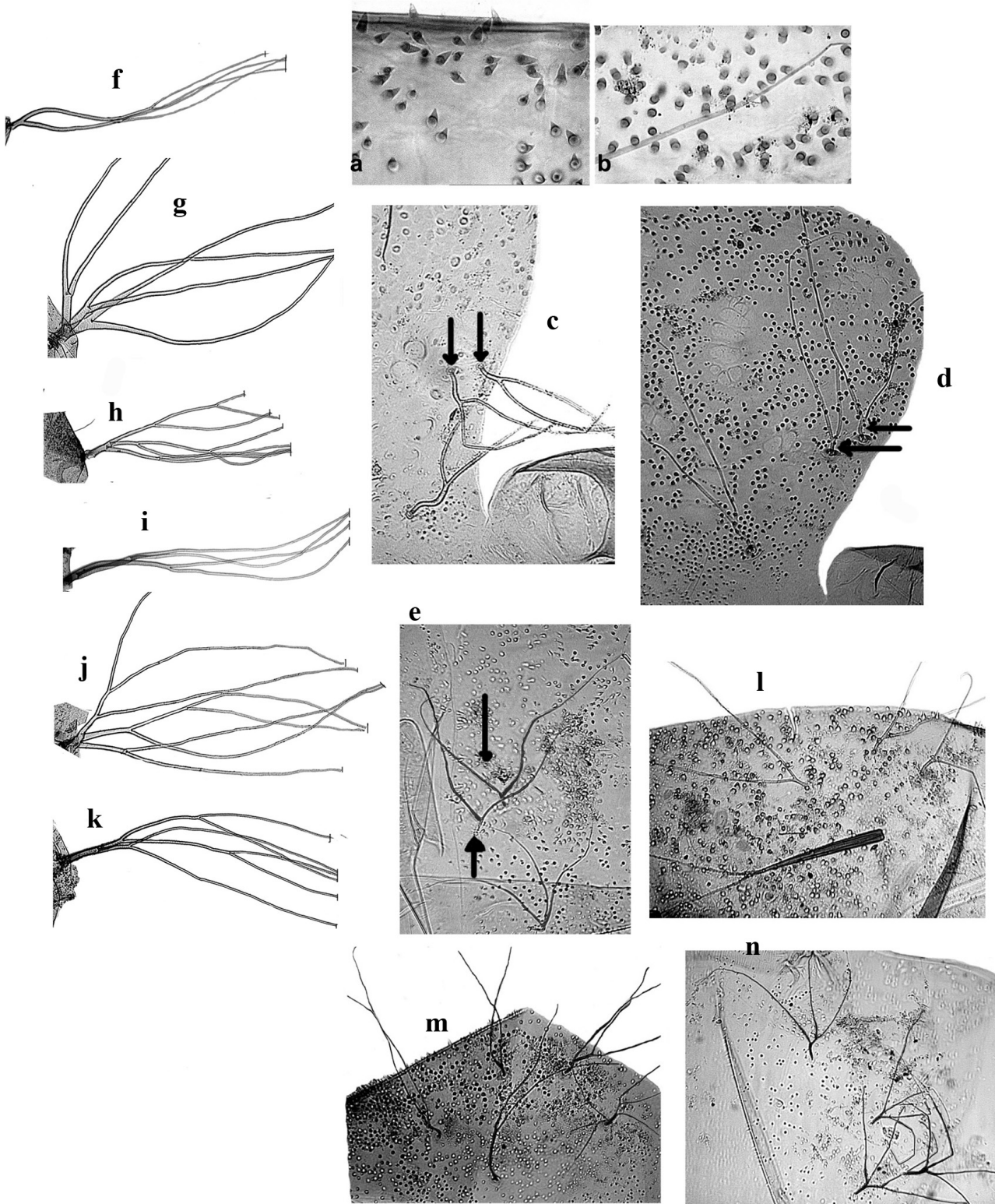


Figure 5 - Some pupal characters used for the phylogenetic analyses in the genus *Coscaroniellum* - a-b- part of frontoclypeus of a. *C. quadrifidum*, b. *C. goeldii*, cephalic trichomes of c. *C. cauchense*, d. *C. goeldii*, e. *C. ulyssesi*, arrows pointing to trichomes; pupal gills of f. *C. cauchense*, g. *C. daltanhani*, h. *C. goeldii*, i. *C. quadrifidum*, j. *C. quadrivittatum*, k. *C. ulyssesi*; thoracic trichomes of l- *C. quadrifidum*, m- *C. goeldii*, n- *C. ulyssesi*.

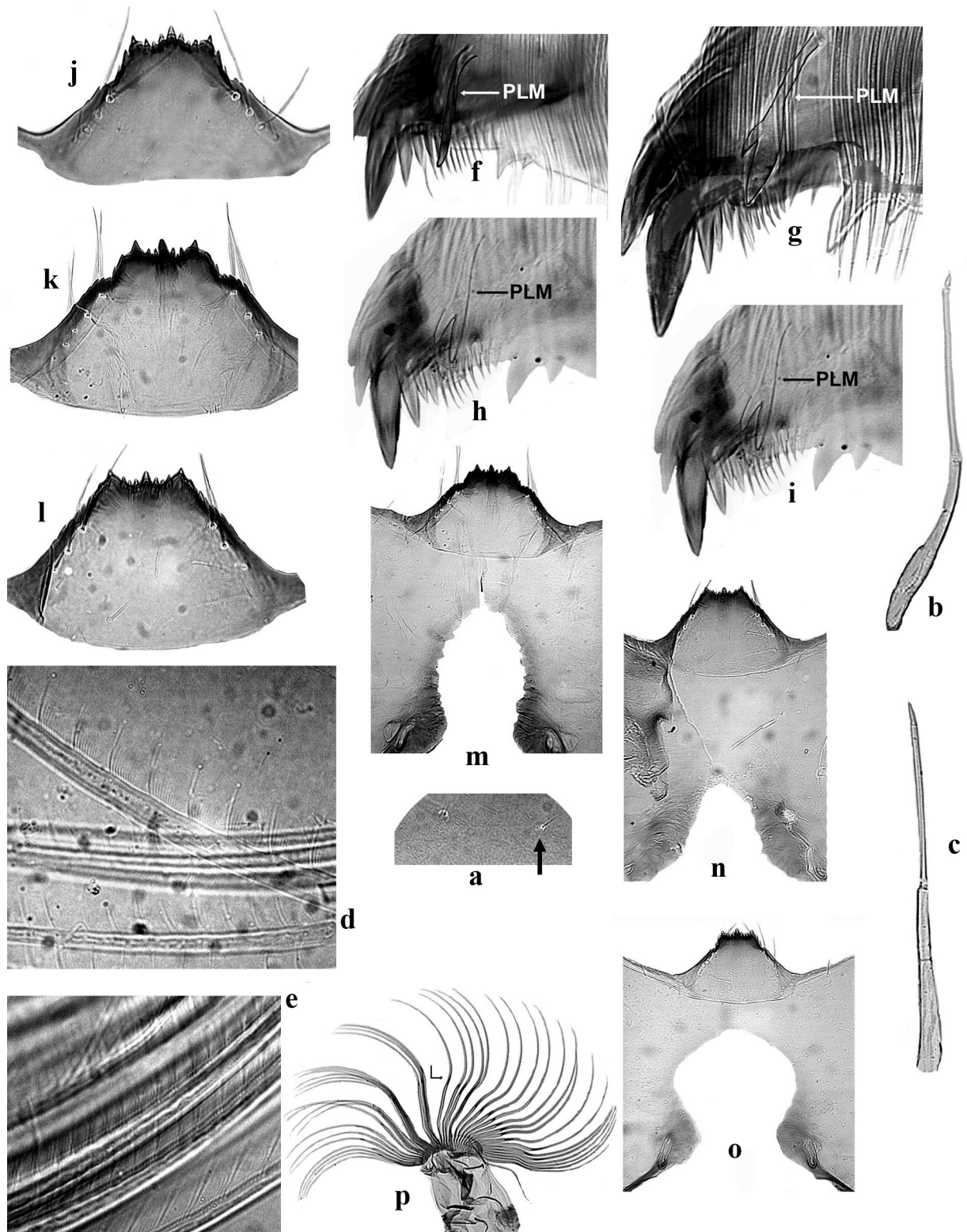


Figure 6 - Some larval characters used for the phylogenetic analyses in the genus *Coscaroniellum*/*Cerqueirellum* - cephalic apotome with simple hyaline setae of a- *C. quadrifidum*; antennae of b- *C. cauchense*, c- *C. goeldii*, rows of microtrichia of the primary ray of c- *C. quadrifidum*, d- *C. quadrivittatum*, mandible with simple latero-mandibular process of f- *C. cauchense*, g- *C. quadrifidum*, h- scale-like bifid of *C. daltanhani* and h- *C. goeldii*, i- scale-like trifid of *C. ulyssesi*, plm- latero-mandibular process; hypostomium of j- *C. cauchense*, k- *C. daltanhani*, l- *C. quadrivittatum*; hypostomal cleft and hypostomal bridge of m- *C. daltanhani*, n- *C. cauchense*, o- *C. quadrivittatum*; cephalic fan of *C. quadrifidum*, arrow pointing to spots in the basal quarter of the labral fan rays

Gill with four to eight branches (Fig. 5f-k), gill length bigger than cocoon length. Thorax with 5+5 centre-dorsal hair like bifid or trifid trichomes (Fig. 5l-m), 1+1 supralateral bifid hair like trichomes, 3+3 lateral simple or bifid hair like trichomes, chaetotaxy of abdominal segments similar as described to *Cerqueirellum*. **Larva (last instar):** Cephalic apotome with very small positive spots with, simple hyaline setae (Fig. 6a). Cervical sclerites small, elliptical, not fused to postocciput, free in membrane. Antenna longer than cephalic fan stem; the medial segment can be smaller than the other segments (Fig. 6b-c). Labral fan with 16-45 primary rays, rows of microtrichiae following the weak complex pattern (Palmer and Craig, 2000) (Fig. 6d-e). Mandible without fringe of supramarginal setae; 1 apical, 2 external, 3 subapical teeth, third smaller or equal than second and both smaller than first, 9 to 12 internal teeth, the first internal tooth subequal to the first subapical tooth; 2 marginal teeth (being the first large, the second smaller than the first) emerging in a lamellar projection of the first tooth base; 1 or 2 latero-mandibular process can be simple or scale-like (Fig. 6f-i); labral sclerite subtrapezoidal, covered with long setae and with 3+3 apical teeth. Hypostomium with central tooth equal to 1+1 corner teeth, 3+3 intermediate teeth which median tooth at least half of external tooth. Lateral teeth (2+2), 1-4+1-4 lateral serrations, 1-4+ 1-4 hypostomal setae per side, and 1+1 setae on distal margin of hypostomal plate (Fig 6j-l).). Hypostomal cleft longer than wide, subcircular or submitral; narrow or large hypostomal bridge (Fig. 6m-o). Abdomen with anal sclerite X-shaped, multilobed anal gill. Ventral tubercles well developed.

REMARKS

The geographic distribution of the genus *Coscaroniellum* comprises South and Central Americas; from Mexico to the Northeastern Region of Brazil. This is genus of small to medium rivers, which is reflected in the type of microtrichiae. Pessoa (2004) included *C. quadrivittatum* in the genus *Coscaroniellum*, followed by Coscarón & Coscarón-Árias (2007). This is an important species because it is a vector of some human filariasis and antropophilic.

Characterization of the Genus *Shelleyellum* Py-Daniel & Pessoa

Recently, Py-Daniel and Pessoa (2005; 2006) characterized and illustrated *Shelleyellum* and to avoid repetition of information, they will not be included here.

CLADISTIC ANALYSIS:

List of characters, character states and codes used for cladistic analysis of *Cerqueirellum*, *Coscaroniellum*, *Shelleyellum*, relative species (*Psaroniocompsa*) and outgroup.

0. Ratio of female fronto-ocular area height / width: (0) < or = 2X; (1) > 2X.
1. Female fronto-ocular triangle: (0) expanded; (1) reduced.
2. Female fronto-ocular suture: (0) absent; (1) small; (2) long.
3. Antenna size ratio of female / male: (0) bigger; (1) smaller o equal.
4. Ratio of male pedicel length / width: (0) < or = 1,5; (1) > 1,5 and < 2; (2) > 2.
5. Central area of cibarium: (0) sclerotised; (1) unsclerotised.
6. Central area angle of the cibarium: (0) straight; (1) concave.
7. Concavity of the central area of cibarium: (0) without concavity; (1) concavity with proximal opening as width as the bottom; (2) concavity of proximal opening wider than bottom.
8. Tooth from central area of cibarium: (0) absents or very small; (1) acuminate; (2). rounded.
9. 1+1 Lateral elevation in the central part of cibarium: (0) absent (1) with rounded and acuminate small tooth; (2) acuminate tooth of similar height to cornua.
10. Base of cibarial cornua: (0) with a very small styled like tooth; (1) acuminate tooth.
11. Female gonapophyses: (0) with microtrichia reaching the apex; (1) with microtrichia not reaching the apex.
12. Paraproct (length): to cerci (length): (0) large (bigger than cerci), (1) medium (subequal to cerci); (2) small (not surpass cerci).
13. Basal tooth in tarsal claws: (0) well developed; (1) small; (2) absent.
14. Distimere: (0) long (bigger than the basimere); (1) short (smaller than the basimere) and podomorphic; (2) short (smaller than the basimere) sub-quadratic; (3) short (smaller than the basimere) sub-triangular; (4) short (smaller than the basimere) conic with lateral carina.
15. Distimere spur: (0) few [1-3]; (1) many [5-9].
16. Distimere spur shape: (0) spine-like; (1) large and flat; (2) subtriangular.
17. Cocoon shape: (0) slipper; (1) shoe.
18. Thick of the cocoon: (0) individual threads distinct; (1) not individual threads
19. Frontal trichomes length: (0) long (longer than of half part width of the fronto-clypeus); (1) short (smaller than half part of the width of the fronto-clypeus).

19. Pupal fronto-clypeus platelets: (0) predominantly rounded; (1) predominantly acuminate; (2) predominantly rectangular; (3) absents.
 20. Pupal thoracic platelets: (0) predominantly rounded; (1) predominantly acuminate.
 21. Centro-dorsal trichomes length of pupal thorax: (0) normal (near 200µm); (1) small (< 100µm).
 22. Gill length: (0) longer than cocoon length; (1) equal or subequal to cocoon length (ratio 0.75-1.1); (2) smaller than cocoon length (ratio equal or less than 0.7).
 23. Tergite II of pupal abdomen: (0) without small tooth; (1) with small tooth.
 24. Cephalic larval apotome: (0) with very small, hyaline and simple spiniform setae; (1) with large simple to multiple branching setae.
 25. Ratio of larval antennal segments II and III size: (0) equal or subequal; (1) segment II near ½ of segment III; (2) segment II 1/3 bigger than segment I or III; (3) segment III bigger than segment II or I.
 27. Ray number of labral fan: (0) 30 or more; (1) 17 to 29; (2) less than 17.
 28. Microtrichial pattern of primary labral fan rays: (0) weak complex; (1) isomorphic standard; (2) not isomorphic standard.
 29. Primary rays of labral fan: (0) without dark spots; (1) with dark spots at basal part (Fig. 6p).
 30. Larval mandible with fringe of supramarginal setae: (0) absent; (1) present.
 31. Distal adoral rays brush of larval mandible: (0) with simple or bifid tips; (1) predominantly multiple branching tips.
 32. Latero-mandibular processes (PLM): (0) 2 PLM; (1) 1 PLM; (2) absent
 33. PLM type: (0) filiform, simple; (1) scale like in the third distal apex, simple or bifid; (2) scale like in the third distal apex, trifold.
 34. Internal teeth of larval mandible: (0) first teeth longer than last two pre-apical teeth; (1) first teeth equal or subequal to last two pre-apical teeth.
 35. Marginal second tooth of larval mandible: (0) always present, rising from a lamellar projection of the first marginal base tooth; (1) reduced or absent, when present, it rising in the base of first marginal base tooth.
 36. Median intermediated hypostomal tooth of the larvae: (0) equal or subequal to external intermediate tooth; (1) not surpassing the half size of the external intermediate tooth.
 37. Larval pos-genal cleft and bridge: (0) cleft deep and evident bridge; (1) very deep cleft and bridge absent or not evident.
 38. Tergites of larval abdomen: (0) without tubercles; (1) with tubercles.
 39. Tubercles on tergite I of larval abdomen: (0) absent; (1) present.
 40. Tubercles on tergite VIII of larval abdomen: (0) absent; (1) present.
- Coscarón (1987) mentioned that smooth basal portion of cibarium is a synapomorphy for *Psaroniocompsa* and *Cerqueirellum*. However, rounded tooth have been observed in the cibarium basal portion of *P. incrustata*, *P. delponteiana*, *P. anamariae* (Vulcano) and *P. schmidtummummi* (Wygodzinsky). Smooth concavity or very small teeth are presents in *Cerqueirellum* and *P. minuscula*.
- Shelley *et al.* (1987) proposed the hypothesis about the vectorial capacity of some simuliid species being optimized by the disarmed cibarium, e.g.: *Thyrsopelma guianense* (Wise) and *A. metallica*. Miranda-Esquivel and Coscarón (2001) and Py-Daniel *et al.* (2005) registered the occurrence of tooth in *T. guianense*. Reid (1994) also found small tooth (spicules) in cibarium of *A. metallica*. Probably there are other mechanisms that govern the vectorial efficiency besides the absence (not occurring in *A. metallica*) or presence of tooth.
- We follow the classification of labral-fan structure proposed by Palmer and Craig (2000). Here we found “standard” (the longest microtrichia is no longer than six times the length of the shortest microtrichia) and “weak complex” (the longest microtrichia is at least six times the length of the shortest microtrichia) fans type. The standard pattern was isomorphic (when all microtrichia had the same size) and not isomorphic (microtrichia were in different size, but not like the weak complex pattern). The weak complex pattern was found in species from small to medium streams (*Coscaroniellum*, *Shelleyellum*, *P. incrustata*, *A. metallica*). The Standard pattern was observed in species from large streams (*Cerqueirellum* and *P. minuscula*).
- The supramarginal setae of larval mandible can be found as very long setae in the Holoartic larvae of Gymnopaoidinae, in the genera *Gymnopaia*, *Twinnia* and *Greniera* (Py-Daniel and Moreira-Sampaio, 1995). However, these setae are very long in these genera (Py-Daniel, 1983).
- The character “tubercles on larval abdomen” were only found in *Shelleyellum* genus species for neotropical region. *Thyrsopelma guianense* (Wise), not phylogenetically near the genera examined here, was cited with tubercles by Shelley *et al.* (2002) as an atypical form, but probably is a technical error (preservation artifact). Larvae of *Byssodon* Palearctic genus and one *Edwardsellum* afrotropical genus have these tubercles too

(Shelley *et al.*, 2002). They are neither phylogenetically related with the genera studied here and the presence of tubercles is considered here as a convergent character.

Topology of the cladograms: Three equally parsimonious trees were obtained from the phylogenetic analysis. A strict consensus of these three trees of 114 steps (CI=55; RI=78) was obtained (Fig.7).

The genus *Cerqueirellum* is found to be a monophyletic taxon, supported by five synapomorphies: concavity of the central area of cibarium with proximal opening as width as the bottom (character 7:1); distimere short and sub-triangular (character 14:3); apical spur sub-triangular (character 16:2); larval mandible with fringe of supramarginal chaetae (character 30:1); internal teeth of larval mandible with the first teeth equal or subequal the height of the last two pre-apical teeth (character 34:1), which although is a morphometric character, is stable in all examined specimens. Four convergences supporting the genus *Cerqueirellum* are indicated in the figure 7. The first dichotomy occurs with *C. ganalesense* and the group (*C. oyapockense*, *C. roraimense*) (*C. sanguineum* (*C. cuneatum*, *C. venezuelense*) (*C. amazonicum* (*C. argentiscutum*, *C. chaquense*))) by the apomorphy 28:2 (microtrichiae standard not-isomorphic). The second dichotomy separates the group (*C. oyapockense*, *C. roraimense*) from the group (*C. sanguineum* (*C. cuneatum*, *C. venezuelense*) (*C. amazonicum* (*C. argentiscutum*, *C. chaquense*))) by the synapomorphy 27:1 (labral fan with less than 30 fan rays), the number of fan rays shows considerable intraspecific variation in Simuliidae, being considered a weak character. Besides its number is related to the available food in the environment, so larvae that live in low food environments have more rays than conspecifics that receive more food (c.f. Lucas and Hunter, 1999); however this character is used here just to separate this specific clade inside the *Cerqueirellum* in order to avoid a polytomy of reliable species). *C. sanguineum* is dichotomized with the group (*C. cuneatum*, *C. venezuelense*) (*C. amazonicum* (*C. argentiscutum*, *C. chaquense*))) by the apomorphy 32:2 (absence of lateromandibular process). The following dichotomy separates the group (*C. cuneatum*, *C. venezuelense*) from the group (*C. amazonicum* (*C. argentiscutum*, *C. chaquense*))) just by convergences; the next dichotomy separates *C. amazonicum* from the group (*C. argentiscutum*, *C. chaquense*). To all formed groups, only (*C. cuneatum*, *C. venezuelense*) apparently is well defined, with Bootstrap values relatively high (60) formed by convergence 21:1 (presence of predominant triangular tubercles in pupal thorax). *C. venezuelense* has been few studied, and the larva is not known, therefore is necessary to examine more specimens of this species to establish if this group is artificial or not. Other characters as cytotaxonomy and molecular dates

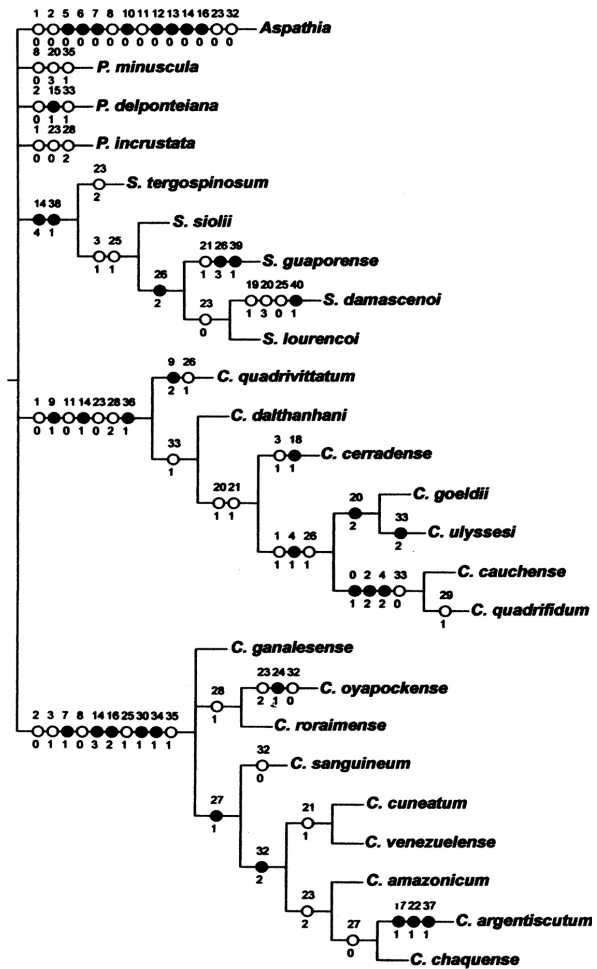


Figure 7 - Consensus of trees from equal weight analysis of the genera *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum* and outgroups. Three equally parsimonious trees of 114 steps (CI = 55; RI = 78). Filled circles mean synapomorphies, open circles mean homoplasies, numbers are those of character state as in Table 1.

probably will help to elucidate the polytomies found here in *Cerqueirellum*.

The genus *Coscaroniellum* was supported by three unique synapomorphies and three contradicted synapomorphies (convergences) (Bootstrap = 67): 1+1 lateral elevation in the central area of cibarium with rounded and acuminate small tooth (9:1); 1+1 lateral elevation in the central area of cibarium with acuminate tooth of similar height to cornua (9.2), which distinguishes *C. quadrivittatum* inside of *Coscaroniellum* and separate it from the group (*C. dalthanhani* (*C. cerradense* (*C. goeldii*, *C. ulyssei*) (*C. cauchense*, *C. quadrifidum*))); distimere short and podomorphic (14:1); and median intermediated hypostomal tooth of the larvae not surpassing the half size of the external intermediate tooth (36:1) (although this is a morphometric character, it is stable in all examined

specimens). The other characters that define *Coscaroniellum* are not unique synapomorphies for the clade (Fig. 7). The second dichotomy separates *C. daltanhani* from the clade (*C. cerradense* (*C. goeldii*, *C. ulyssesi*) (*C. cauchense*, *C. quadrifidum*)); and is caused by two convergences (Bootstrap 59). The following dichotomy separate *C. cerradense* from group (*C.*

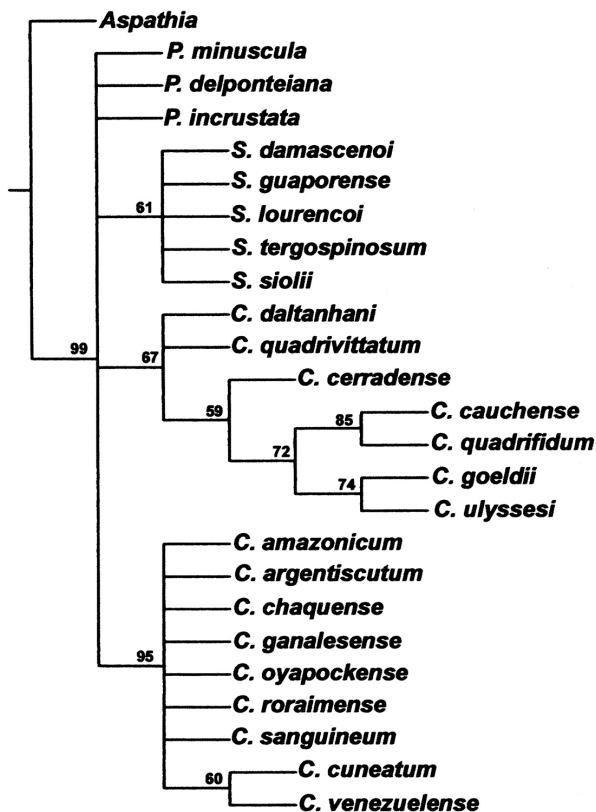


Figure 8 - Bootstrap test of the matrix of the genera *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum* and the outgroups.

goeldii, *C. ulyssesi*) (*C. cauchense*, *C. quadrifidum*))) and is caused by one synapomorphy (ratio of male pedicel height / width 1.5-2, character 4:1) and two convergences (maintained with Bootstrap value of 72). There are two final dichotomies: the dichotomy of the group (*C. goeldii*, *C. ulyssesi*), defined by the synapomorphy 20:2 (Pupal fronto-clypeus platelets predominantly rectangular) (Bootstrap = 74) and the group (*C. quadrifidum*, *C. cauchense*) (Bootstrap = 85) defined by three synapomorphies: 0:1 (ratio of female fronto-ocular area height / width bigger than the double size of the width); 2:2 (female fronto-ocular suture long); 4:2 (ratio of male pedicel height / width longer than 2). Besides of these three synapomorphies, there is a convergence.

The genus *Shelleyellum* was shown as a monophyletic group by two synapomorphies: distimere short conics with

lateral carina (14:4) and tergites of larval abdomen with tubercles (38:1). *Shelleyellum* clades have a Bootstrap value of 61, lower than *Cerqueirellum* and *Coscaroniellum*, but not lower than other analysis as *Trichodagmia* Enderlein (Miranda-Esquivel and Coscarón, 2001) and *Hearlea* (Vargas, Martínez-Palacios & Díaz-Nájera) (Coscarón *et al.*, 2004). The topology of the clade has the following configuration: The first dichotomy separates *S. tergospinosum* from the group (*S. siolii* (*S. guaporense* (*S. damascenoi*, *S. lourencoi*)))) by two convergences; the second dichotomy separates *S. siolii* from the group (*S. guaporense* (*S. damascenoi*, *S. lourencoi*)) by the character 26:2 (larval antennal segment II a third size bigger than segment I or III); the last dichotomy separates *S. guaporense* from (*S. damascenoi*, *S. lourencoi*). These internal dichotomies have not support when submitted to the Bootstrap test (Fig. 8).

CONCLUSIONS

According to the analysis showed in this paper, the genera *Cerqueirellum*, *Coscaroniellum* and *Shelleyellum* are monophyletic. The species *Psaroniocompsa minuscula sensu* Py-Daniel (1983; 1988), included in Amazonicum - group *sensu* Shelley (1982) and Crosskey and Howard (1997; 2004) and in *Cerqueirellum sensu* Coscarón (1987), and *P. delponteiana sensu* (Py-Daniel, 1983), included as *Cerqueirellum sensu* Coscarón (1987), do not belong to *Cerqueirellum* in the cladistic analysis and they kept paraphyletic between them and with *P. incrustata*, so we decided to maintain these species in *Psaroniocompsa* not grouped while the revision of the auristriatum and incrustatum groups *sensu* Crosskey and Howard (1997; 2004) has been done.

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- Cerqueirellum amazonicum*: Material preserved in alcohol - BRAZIL. Amazonas State, R. Içá, Ipiranga: 5215-2 (42 pupae, 30♀), 01/1977; Tabatinga Municipality, Ig. Armino Soares, R. Demini, tributary of R. Negro: INPA [5526 (32 pupae, 15 larvae 3♀, 4♂), 04/1980; Lábrea Municipality, R. Paciari, tributary of R. Ituxi: 5198 (7 pupae), 09/1976; Tabocal, R. Demini: 5102 (1 pupa), 13/09/1975; R. Ituxi, 5198-7 (7 pupae, 1 larva), 30/09/1976; 5228-19 (2 pupae), 09/1976; Barcelos Municipality, Posto Ajuricaba, R. Demini: 5247 (1 pupa), 07/1977; Paraná do Meruim, R. Demini: 5288-1 (1 pupa); 04/1978; 5257 (20 pupae), 06/08/1977; Ilha do Meruim, R. Demini: 5331 (34 pupae, 7 larvae), 08/1978; R. Cuieiras, tributary of R. Demini: 5089-5 (1 pupa), 07/1975. Pará State, Floresta Nacional da Amazônia, upper R. Tapajós: 5439 (1 pupa), 06/1979; Ig. São Luís, tributary of R. Tapajós, 5479 (2 pupae, 42 larvae), 10/1978. Roraima State, R. Branco: 5266 (4 pupae, 4 larvae), 08/1977. Slide material - BRAZIL. Amazonas State, Boca do Acre Municipality, Seringal Bom Lugar, R. Purús: 5320-1 (1♀, 1 pupa), 10/1979; 2340 (1♂, 1 pupal exuvia, 1 cocoon), 09/1961; 2342-1 (1 pupa), 09/1961].
- Cerqueirellum argentiscutum*: Material preserved in alcohol - BRAZIL. Acre State, Rio Branco Municipality, Estação de Piscicultura do INPA: INPA [5846 (23♀), 06/1981, Pereira. Amazonas State, Municipality of São Gabriel da Cachoeira: (8 pupae, 3 larvae), 02/1994. Rondonia State, Guajará Mirim Municipality, Cachoeira of R. Mamoré, 2544 (12 pupae, 1 larva), 05/09/1963; 2544-2 (21 pupae), 09/1963. Slide material - BRAZIL. Amazonas State, Porto Japão community, R. Solimões, (4♀), 02/2000; Municipality of Codajás, R. Solimões: Topotypes: 5328-A (2 larvae), 07/1976; 5180-A (1♀), 5180-B (1♀); Manaus Municipality, Praia do Brito, R. Negro: (1♀), 1994].
- Cerqueirellum chaquense*: The same material examined by Py-Daniel (1983).
- Cerqueirellum cuneatum*: The same material examined by Py-Daniel (1983).
- Cerqueirellum ganalesense*: MEXICO. Alcohol material with the same data of type series found in the ISET (actually INDRE: Instituto Nacional de Diagnóstico y Referencia Epidemiológicos), San Luis Potosí, Municipality of Guerrero, Hancieda de Ganales, ISET - 62 to 65 (5 larvae, 2♂, 2♀, 4 pupae), 04/1944, Mácias.
- Cerqueirellum oyapockense*: Material preserved in alcohol - BRAZIL. Amazonas State, Tabatinga Municipality, Armino Soares, R. Demini, INPA [5244 (10 pupae), 04/1980; Barcelos Municipality, Posto do Posto Ajuricaba, R. Demini: 5247 series 1 and 2 (4 pupae), 07/1977; 5099 (10 pupae, 13 larvae); 5242 and 5247 (116 pupae, 3 larvae), 07/1977; 5264: 07/1977; 5526-9 (1♀, 1♂, pupal exuviae); 5312 (1 pupa; Cachoeira da Aliança, R. Padaurí: 5328-6 (2 pupae),

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EXAMINED MATERIAL

Besides the specimens showed here, we also examined specimens reviewed in Py-Daniel (1983).

09/1975; 5267 (1 pupa), 07/1977; Ilha do Meruin, R. Demini, 5861 (12 pupae, 16 larvae), 10/1977; R. Uatumã, Itabora falls: 6005 (6 pupae), 12/1983; Cachoeira Tucumari falls: 5089 (2 pupae), 12/1983; R. Cuieiras, 5198 (1 pupa), 07/1975; 5228 (5 pupae), 09/1976; 6203 (42 pupae). *Rondonia State*, R. Mamoré, Guajará Mirim Municipality: 5276 (1 pupa), 08/1978; Porto Velho Municipality, R. Jaci Paraná: 5323 (2 pupae), 08/1978; 2791 (1 pupa); Setijipa: 2791 (3 pupae), 08/1966, 5169-1 (1 pupa). *Amapa State*, R. Oyapoque, Salto Cafésoca – Maripá, frontier with French Guiana: 5416 (numerous immature larvae), 09/1981; Para State, Amazônia National Park, R. Tapajós, Ig. Pimentel: 5433 (2♀, 12 larvae, 10 pupae), 16/06/1979; R. Jaminxim: 5439 (8 larvae, 11 pupae), 07/1979; R. Tapajós: 5441 (1 larva, 25 pupae), 06/1979; Ig. São José: 5463 (1♀), 06/1979; Uruá falls: 5480 (10 pupae, 1 larva, 1♀), 07/1978; R. Tapajós: 5816 (13 pupae, 27 larvae), 23/10/1978, Lacey L.; Cachoeira in the locality Buraco da Velha, R. Tapajós: 5945 (2 pupae, 3 larvae), 25/08/1979, Maciel J.C.; Oriximiná Municipality, R. Ierepecurú, tributary of R. Trombetas: 5228 (1 pupae), 05/1976. *Roraima State*, Campinho, BR174 road, between Boca da Mata and BV-8, 5197 (2 pupae), 12/1972; Rio Branco, Island near Santa Maria: 5288 (1 pupa), 08/1977; Paraná do Meruim, R. Demini, 5323 (1 pupa), 04/1978; R. Uraricoera, Maracá island, Tiporema falls, ig. Santa Rosa: 6207 (5 pupal exuviae, 16 larvae), 03/1987; Beiradão, Maracá island: 6211 (1 larva), 08/1987; Ig. Tupi: 6212 (1 larva), 08/1987; 6214 (27 pupae), 09/1987; Parimiú indian settlement: 6219 (2 pupae), 14/05/1987; Ig. Puruê: 6215 (4 pupae), 05/1987; Cajuma falls: 6220 (12 pupae, 15 larvae), 05/1987; (2 pupae), 03/1988; R. Catrimani: 6223 (4 pupae), 04/1994; BR 401, Km 113, Ig. Arraia: 6217 (3 pupae, 5 larvae), 10/1987 Finale team. *Mato Grosso State*, Dardanelo, R. Aripoanã: 6003 (1 pupa), 04/04/1978. Slide material BRAZIL. *Roraima State*, R. Branco, Caracará Municipality, Bem Querer falls, (3 larvae)].

Cerqueirellum roraimense: Material preserved in alcohol - BRAZIL. *Roraima State*, R. Demini, left side, near Porto Ajuricaba: INPA [5242 (20 pupae), 28/07/1977; 5242-10 (1 pupa); 6213 (3 pupae); R. Uraricoera, Cachoeira Pedra Motor: 6215 (3 pupae), 25/05/1987, Waicás team; Cachoeira Cajuma: (5 pupae), 05/1987].

Cerqueirellum sanguineum: The same material examined by Py-Daniel (1983).

Cerqueirellum venezuelense: Slide material-VENEZUELA. Type locality (1♂ and its pupal exuvia, 1♀ and its pupal exuvia), this material was cited by Ramírez-Pérez & Peterson (1981), from the Colection of the Laboratorio de la Sección de Estudios de Vectores, Instituto Nacional de Dermatología, Villa de Cura, Aragua, donation of Dr. Ramírez-Pérez

Coscaroniellum cauchense: Material preserved in alcohol - BRAZIL. *Amazonas State*, R. Urubú: INPA [5934 (135 pupae, 156 larvae), 09/1982; Ig. Cachoeira, R. Negro: 5203 (1 pupa), 10/1976; AM 010, Km 182: 5087 (13 pupae); BR 174, Km 115, Ig. Macumba falls, tributary of R. Urubu, BR174, Km 115: 5213, 5214 (6 pupae), 01/1977; Iga.rapé Urubú, tributary of R. Urubú, Cachoeira: 5337-1 (4 pupae, 2 larvae), 27/01/1977; Lábrea Municipality, Seringal Capacini, R. Purús: 5194 (2 pupae), 9/1976; 5194 (13 pupae), 9/1976; R. Ituxi, 5198 (2 pupae), 09/1976; 52288 (1 pupa), 09/1976; 5063 (16 pupae), 09/1954; Upper R. Solimões: 5064 (3 pupae); 1003 (4 pupae); Novo Airão municipality, Ig. Sobrado II, R. Negro: 5339 (3 pupae), 10/1978; Manaus Municipality, Ig. Gigante, Ponta Negra: 2344 (1 pupa), 07/1961; 2450 (1 pupa); 2479 (1 pupa), 11/1962; 2475 (1 pupa); 2512 (5 pupae, 1 larva), 11/1962; 2480 (3 pupae); 2487 (1 pupa), 01/1963; Ig. Mariano: 2439 (1 pupa), 08/1962; 2447 (1 pupa), 08/1962; Ig. Tarumã: 2507 (1 pupa), 04/1963; Ig. CEPLAC, AM-010, Km 29: 5176 (10 pupae, 3 larvae); 5176 (1 larva); R. Demini, 5232 (5 pupae), 04/1977; Tabocal, R. Demini, 5102-16 (3 pupae), 09/1975; Ig. Estrada do Aleixo: 1224 (1 pupa), 08/1955; Ig. Açú, R. Negro: 5349 (3 pupae), 01/1979; 5349 (8 pupae, 1♂), 01/1979; Tefé Municipality, Ig. Repartimento: 2345 (5 pupae, 1♀, numerous larvae), 10/1961. *Mato Grosso State*, R. Humboldt, Aripuanã: 5212 (1 larva); 5030 (1 pupa), 03/1973; 5126 (3 pupae), 11/1975. *Acre State*, Feijó, Canabrava, R. Envira, 6067 (4 pupae), 1976. *Pará State*, Amazônia National Park, R. Tapajós, Ig. Feichos: 5488 (1 pupa, numerous larvae), 09/1978; Ig. Mambuazinho, tributary of R. Tapajós: 5802-8 (3 pupae), 08/1979; Ig. Mambuá, 5434 (1 pupa, 1 larva), 06/1979. *Roraima State*, R. Demini, Posto Ajuricaba Port: 5242 (235 pupae, 14 larvae), 10/1976; R. Awaris: 5182 (46 pupae, 2♂, 13 larvae), 7/1976; Posto Omeva, R. Awaris: 6075 (14 pupae); 03/1977; Caracará Municipality, Ig. Corredeira, BR174 road Km 113: 5087 (1 pupa), 07/1975; 5212 (6 pupae); 5213 (26 pupae), 01/1977; BR174, KM 23: 1218 (7 pupae), 10/1954; Ig. Bolívia: 5082 (5 pupae), 10/1955; BR174, Ig. Cuanen, R. Surumú tributary, 1009 (7 pupae); Normadia, 1003,1004 (2♂, 3 pupae), 11/1954; R. Socó, 1214 (1 pupa), 11/1954. Slide material - BRAZIL. *Roraima State*, BR 174, Acampamento Boca da Mata, ig. Cuanen, R. Surumú tributary: 5929 (1 cocoon, 1 pupa); 5929 (4 pupae); 5929 (3♀, 1 larva) 11/1972; Marabá, Ig. Arateri, Icangui locality, of Tucuruí tributary: (1 pupa), 02/12/1987, Barbosa; R. Catrimani (5 pupae, 60 larvae), 04/1994].

Coscaroniellum daltanhani: Material preserved in alcohol - BRAZIL. *Amazonas State*, *Municipality of Manaus*, AM010 road, Km 51, Centro de Instrução de Guerra na Selva, CIGS, preservation area of the Brazilian Army, 02°45'S 59°51'W, Km 8, Topotypes (12 larvae, 8 pupae), 21/03/2004. Slide material - BRAZIL. *Amazonas State*, Manaus Municipality,

same area and collection of the material preserved in alcohol (2 larvae; 2♀, 2♂; 4 pupal exuviae).

Coscaroniellum goeldii: Material preserved in alcohol - BRAZIL. *Roraima State*, R. Socó: INPA [1002 (1 pupa, 17 larvae), 06/11/1954. *Pará State*, Floresta Nacional da Amazônia, R. Tapajós, Transamazônica road Km 119: 5450 (1 larva, 2 pupae, 1♀), 06/1979; Ig. São João: 5477 (3 pupae), 08/1978; Ig. Mamburí, Transamazônica road, Km 80: 5469 (17 pupae, 16 larvae), 08/1978; Ig. Mambuaí: 5434 (1 pupa), 06/1979; Transamazônica road Km 160: 5474 (1 pupa), 09/1978; Ig. Babaré: 5801 (1 pupa), 08/1979; Ig. Montanha na Ponte: 5453 (1 pupa, 2 larvae), 06/1979; Ig. Taborarí, Tapajós tributary; 5805 (3 larvae), 08/1979; Ig. Mambuazinho, R. Tapajós tributary; 5826 (1 pupa), 08/1979; Oriximiná, R. Eripecuru: 5201 (1 pupa), 10/1976. *Amazonas State*, BR174, Km 116; 5072 (1 pupa), 06/1975; Ig. Cuionan, R. Cuieiras tributary; 5202 (35 pupae), 10/1976; 5880 R. Cuieiras, (24 pupae), 10/1977; Itacoatiara Municipality, Ig. União, R. Tarumã tributary, AM010 road, Km 36; 6079 (2 pupae, 5 larvae), 01/1985; Novo Airão Municipality, Ig. Taupecaçu, Freguezia; 5205 (1 pupa), 11/1976; Ig. Sobrado II, R. Negro tributary: 5337 (1 pupa), 10/1978; Manaus Municipality, Reserva Florestal Adolpho Ducke, BR174 KM 22, Ig. Barro Branco, (14 pupae, 40 larvae), 05/1980; Reserva Campina - INPA/AM, BR 174 KM 45, (31 larvae), 11/1979; Ponta Negra, Ig. Gigante - 2480 (topotypes, 4 pupal exuviae). Slide material - BRAZIL. *Amazonas State*, Manaus Municipality, Reserva Florestal Adolpho Ducke: 5645 (4 larvae, 6 pupae, 4♂), 29/07/1980; (4 pupae, 3♀, 4♂, 3 larvae); 5156 (3 larvae); (1 pupal exuvia); 2764 (1♀); 6016 (1 larva); Presidente Figueiredo Municipality, BR174 road, Km 24, São Francisco, Ig. César, (3♀, 2♂), 08/09/2002; Ig. da Onça (1 pupa)].

Coscaroniellum quadrifidum- Material preserved in alcohol - BRAZIL. *Amazonas State*, AM010 road, Ig. KM 64: INPA [3035 (18 pupae, 1♀), 07/1970; 3035 (94 pupae, 2♂, 4♀), 07/1970; 3032 (1 pupa), 27/07/1970, Faustino A.; Igarapé not named on the right side of R. Demini, 5232 (26 pupae, 2 adults), 04/1977; 5232 (5 pupae), 04/1977; Ig. Cuianam, R. Cuieiras tributary, 5204 (10 pupae, 83 larvae), 10/1976; 5202 (35 pupae), 26/10/1976; 5204-1 (17 pupae), 10/1976; R. Cuieiras, Repartição, 6064 (229 pupae, numerous larvae), 07/1979; R. Tracajatuba, BR156, Km 163, 5940 (3 pupae, 3 larvae), 02/1982; Ig. 3 Bueiros, Porto Grande, 5942 (4 pupae), 09/02/1982; Colônia Santo Antônio: 2542 (6♀), 10/1963; Ig. Castanho, R. Padauri tributary, 5100 (14 pupae), 09/1975; Ipiranga, R. Içá, Brasil-Colômbia frontier: 5215 (1 pupa), 01/1977; Ilha do Meruim, R. Demini, 5331 (3 pupae, 1 larva), 08/1978; R. Cueiras, 5500 (3 larvae), 07/1979, Manaus Municipality, Estrada da Ponta Negra, Ig. Tarumã: 2507-8 (1 pupa), 16/04/1963; 1441-12 (1 pupa),

18/06/1956; Ig. do Mariano: 2439-4 (1 pupa), 22/08/1962; 2449 series 4 to 7 (3 pupae), 28/08/1962; 2466 series 1 to 2 (10 pupae), 12/09/1962; 2479-2 (1 pupa), 04/12/1962; 2447-5 (1 pupa), 22/08/1962; 2447-7 (2 pupae), 22/08/1962; Tabocal, R. Demini, tributary of R. Negro, 5101 (3 pupae, 3 larvae) 09/1975; 5102 (22 pupae), 09/1975; 5102-2 (9 pupae), 09/1975; 5102 (2 pupae), 09/1975; 5101 (4 pupae), 09/1979; 5102 (20 pupae, 3 larvae, 1♂, 1♀), 09/1975; Estrada da Ponta Negra, Ig. Tarumãzinho, 5143 (2 larvae, 2 adults), 01/1975; 5144 (2 pupae); Ig. Passarinho, 5145 (4 pupae), 01/1975; Ig. Gigante, 2476 (4 pupae), 10/1962; 2448 (2 pupae), 08/1962; 2487 (1 pupa); 2512 (1 larva, 2 adults), 05/1963; 2469-6 (1 pupa), 09/1962; 2469 (1 pupa), 09/1962; 2474 (1 pupa), 10/1962; 2480 (28 pupae), 11/1962, 2481 (1 pupa), 11/1962, 2469-8 (1 pupa), 11/1962; 2474 (2 pupae), 11/1962; 2480 (4 pupae), 11/1962; 2481 (1 pupa), 11/1962; 2481-5 (1 pupa, 1♂), 11/1962; 2481 (7 pupae), 11/1962; Ig. Cachoeira, R. Negro tributary, 5203 (30 pupae, 4 larvae), 27/10/1976; Ig. Porto Mauá: 2488 (1 pupa), 01/1963; Reserva Florestal Adolpho Ducke, (10 pupae, 9 larvae), 12/1986; 1009 (1♂, 1♀, 14 pupae, 2 larvae), 20/09/1954; 2432 (1 pupa), 07/1962; 2939 (1 pupa), 05/1969; Ig. Marajá, R. Negro tributary: 5290 (15 pupae, 14 larvae), 04/1978; 5351 (4 pupae, 11 larvae), 01/1979; Ig. Açu, R. Negro tributary, 5349 (46 pupae, 77 larvae, 1♀), 01/1979; 5349 (9 pupae, 1♂), 01/1979; 5349 (47 pupae), 01/1979; AM010 road, KM 30 Ig. Pereira, CEPLAC, (3 pupae), 09/1974; Fonte Boa Municipality, Ig. Fonte Boa, R. Solimões: 5179 (14 pupae), 07/1976; Tefé Municipality, Ig. Repartimento: 5056 (1 pupa), 10/1961; 2345 (1 pupa), 10/1961; 5119 (4 pupae, 3 larvae); Rio Preto, 2438-(2 pupae, 1 larva), 08/1962; Ig. Tefé, 2344-9 (1 pupa), 10/1961; Presidente Figueiredo Municipality, BR174 road, Km 116, 5072 (2 pupae, 4 larvae), 01/06/1975, Ig. Macumba, R. Urubú tributary: 5136 (2 pupae), 12/12/1975; Ig. Barreto, R. Uatumã tributary: 6006 (2 pupae, 18 larvae), 12/1983; BR-174, Ig. da Cachoeira, R. Urubú tributary: 5073 (4 pupae), 06/1975; R. Urubú: 5934 (11 pupae, 12 larvae), 09/1982; Lábrea Municipality, Seringal Capacini, Purus river, 5194 (3 pupae), 09/1976; 5194 (1 pupa), 9/1976; 5063-7 (1 pupa); 5196 (18 pupae), 09/1976; 5194 (2 pupae), 09/1975; 5194 (3 pupae), 25/09/1975; R. Ituxi: 5228-14 (1 pupa); 5228 (3 pupae); 5228 (1 pupa), 5228-9 (3 pupae); 5198 (2 pupae), 09/1976; 5228 (4 pupae), 09/1976; 5228-16 (1 pupa), 30/09/1976; R. Paciari, R. Ituxi tributary: 5198 (2 pupae), 09/1976; R. Demini, Posto Ajuricaba Port: 5242 (110 pupae, 14 larvae), 07/1977; 5242 (16 pupae), 07/1977; 5242-16 (3 pupae), 28/07/1977; R. Cuieiras: 5089-6 (1 pupa), 28/07/1975; Novo Airão Municipality, Ig. Tapuaçu, R. Negro tributary, Freguezia: 5205 (numerous larvae), 25/11/1976; 5205 (197 pupae), 11/1976; 5205 (65 pupae, 3♂ and 2♀ pharate, 2♂), 11/1976; Ig. Sobrado I, R. Negro tributary:

5337-1 (more than 150 pupae), 19/10/1978; Ig. Sobrado II, R. Negro tributary: 5337-1 (204 pupae, 8 larvae, 1♀), 10/1978; R. Negro tributary: 5337 (4 pupae), 10/1978; 5339 (14 pupae), 10/1978; Barcelos Municipality, Paraná do Meruim, R. Demini: 5257-1 (16 pupae), 08/1977; 5257 (4 pupae), 08/1977; 5288 (1 pupa), 04/1978; 5289 (6 pupae, 4 larvae); Ig. Taupeseaçu, R. Negro tributary: 5352 (15 pupae, 10 larvae), 01/1979; 5352 (15 pupae, 10 larvae), 01/1979; Ig. Sobrado, R. Negro tributary? 5353 (1 pupa), 01/1979; Posto Ajuricaba (FUNAI), R. Demini: 5247 (2 pupae, 1♀), 07/1977; 5244 (4 pupae), 07/1975; Itacoatiara Municipality, Ig. União, R. Tarumã tributary, AM010 road Km 36: 6079 (67 pupae, numerous larvae), 01/1985; Codajás Municipality, R. Solimões: 5227 (1 pupa), 03/1977. *Mato Grosso State*, Humboldt, Aripuaná, Andorinhas falls: 5125 (8 pupae, 3 larvae), 11/1975; Aripuaná: 5020 (31 pupae), 03/1973; 5030 (15 pupae, 9 larvae). *Roraima State*, Ig. Bate-Estaca, 2534 (20 pupae, 5 larvae), 09/1963; Rio Branco: 5266 (5 pupae), 08/1977; Rio Branco, Santa Maria: 5267 (1 pupa), 08/1977; R. Auaris: 5182 (53 pupae, 6♂, 14♀, 5 larvae), 07/1976; Posto Omeva, R. Auaris: 6075 (3 pupae), 03/1977; BR174 road, Campinho: 5945 (4 pupae, 5 larvae), 12/1972; Ig. Cuanen, BR174, Acampamento Boca da Mata, R. Surumú tributary: 5929 (70 pupae), 11/1972; R. Surumú: 5930 (1 pupa), 12/1972. *Pará State*, Floresta Nacional da Amazônia, Ig. Buburé, R. Tapajós tributary: 5417 (12 pupae, 25 larvae), 07/1979; Ig. Laginha: 5493 (6 pupae, 11 larvae), 12/1978; 5423 (38 larvae), 15/06/1979; R. Jaminxim, 5433 (2♂, 1 pupa), 07/1979; Ig. Mambugi: 5434 (6 pupae, 17 larvae), 06/1979; 5435 (1 larva), 06/1979; Transamazônica road, Km 119: 5444 (12 pupae, more than 100 larvae) /06/1979; 5450 (1 larva, 1 pupa, 1♂), 06/1979; Transamazônica road, Km 59, R. Tapajós: 5414 (9 pupae, 8 larvae, 2♂), 7/1979; Ig. Feichos: 5464 (25 larvae), 09/1978, Ig. Buriti, Ig. Mamburí tributary: 5472 (12 larvae, 1 pupa); Ig. São João: 5806 (2 pupae), 08/1979; 5477 (65 pupae), 08/1978; Transamazônica road, Km 140, Ig. Urubutá: 5821 (32 larvae) 08/1979; 5481 (39 pupae, 17 larvae), 05/09/1978; Transamazônica road, Ig. Km 133: 5485 (5

pupae), 09/1978; Ig. Babaré: 5801 (8 pupae, 2 larvae), 08/1979; Ig. Bambuazinho, Tapajós tributary: 5802 (4 pupae), 08/1979; Ig. São Vicente: 5812 (8 pupae), 08/1979; BR230; Ig. km 97: 5822 (1 pupa, 14 larvae), 08/1979; Ig. Boa Vista: 5823 (1 pupa), 08/1979; Ig. São José, R. Tapajós tributary, Km 60: 5420 (1 pupa, 22 larvae), 06/1979; 5824 (3 pupae), 08/1979; Oriximiná Municipality, R. Eripecurú: 5203 series (2 pupae); Ig. Canoal, R. Tocantins, near Praia do Breu Branco: 5542 (8 pupae), /07/1980; R. Tapajós, Jacaré-Acanga, 6021 (1 pupa, 2 larvae), 01/1984; Uruá Real, R. Tapajós: 5415 (20 pupae), 07/1979; Ig. Pimentel, R. Tapajós: 5416 (12 pupae, 6♂, 7♀, 54 larvae), 06/1979; 5800 (2 pupae, 1 larva), 08/1979; Ig. Feijós, R. Tapajós: 5422 (6 pupae, 82 larvae, 2♀, 1♂), 07/1979; Ig. São Raimundo, R. Tapajós: 5427 (30 pupae, 28 larvae, 2♀), 06/1979; Ig. Montanha, R. Tapajós: 5429 (83 pupae, 26♂, 20♀, 200 larvae), 06/1979; Ig. Tabuarú, R. Tapajós: 5436 (1 larva), 07/1979; Grota II, R. Tapajós: 5437 (1 pupa, 2 larvae), 07/1979. *Rondonia State*, Porto Velho Municipality, Ig. Bate-Estaca: 5329 (1 pupa), 08/1978; 2527 (5 pupae, 7 larvae), 09/1963; Jaci Paraná: 5323 (1 pupa), 08/1978; Slide material BRAZIL. *Rondonia State*, Porto Velho Municipality, Ig. Bate-Estaca: 5329-15 (3 larvae), 15/08/78. *Amazonas State*, Manaus Municipality, Ig. Cuianã, afluente do rio Cuieiras: 5879 (3 larvae, 3♀, 2 pupae); Presidente Figueiredo Municipality: (5 pupae, 5 larvae), 12/2001]. VENEZUELA- *Simulium rassi* (♀ and its pupa); Venezuela, Território Federal Amazonas, Cacuri Vetuari: (original material from the collection of the Laboratorio de la Sección de Estudios de Vectores, Instituto Nacional de Dermatología, Villa de Cura, Aragua, Venezuela, was donated by Dr. Ramírez – Pérez, and now, slides are component of the Coleção de Simuliidae do INPA/LETEP).

Coscaroniellum quadrivittatum comb. nov. MÉXICO, Las Choapas, Vera Cruz, collected in alcohol (10 pupae, 8 larvae, 1♂ e 1♀) and mounted in slide (1♂, 1♂ pharate, 1♀, 1♀ pharate, 3 larvae, 3 pupae), 02/1967, (INDRE, México).

Coscaroniellum ulyssei: Material preserved in alcohol Same type material listed by Py-Daniel and Coscarón (2001).