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A cladistic approach for generic delimitation of *Paracloeodes* Day, *Rivudiva* Lugo-Ortiz & McCafferty, and *Varipes* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae)

Paulo Vilela Cruza, Frederico Falcão Salles and Neusa Hamada

Abstract

The taxonomic knowledge of Baetidae has been greatly improved in the last decades in South America. Despite the advances, there are problems that need to be addressed. One of these problems is doubt concerning the systematics of species assigned to the genera *Paracloeodes* Day, *Rivudiva* Lugo-Ortiz & McCafferty, and *Varipes* Lugo-Ortiz & McCafferty, and the evolution of long setae on femora. In the present paper, the monophyly of these three genera is tested using a cladistic approach. The matrix included 53 species and 151 morphological characters: 127 for nymphs and 24 for adults. The dataset was analyzed under equal and implied weights with nine values of k . Group support was estimated with relative Bremer and frequency differences. The results corroborate (i) the paraphyly of *Paracloeodes* and *Varipes*, which become monophyletic without *P. caldensis* + *V. singuil*, proposed as a new genus *Rhopyscelis* **gen. n.**, (ii) the long setae on femora as an independent acquisition between *Rhopyscelis* **gen. n.** + *Varipes* and *Rivudiva*, (iii) the transversal rows of setae on femora as an independent acquisition between *Rhopyscelis* **gen. n.** + *Varipes* and *Rivudiva*, (iv) the spine on subgenital plate as an independent acquisition between *Paracloeodes*, *Rivudiva* and Gen. A.

Keywords

aquatic insect; mayfly; new genus; Neotropics; new combination

ZooBank: <http://zoobank.org/217D79EE-A577-4B7F-8AB0-1107C9FC4857>

Characters

Nymphs

0. 0. *Frontoclypeal suture*: **(0)** at the level or above the ocelli; **(1)** below the ocelli.
1. 1. *Elevation on frons*: **(0)** absent; **(1)** present. (Figs 3 and 4)
2. 2. *Type of elevation of frons*: **(0)** elevated (straight surface); **(1)** elevated forming a keel (or small tubercle); **(2)** with two keels; **(3)** with two keels fused in mid length. (Figs 3 and 4)
3. 3. *Medial lobe on distal margin of labrum*: **(0)** absent; **(1)** present.
4. 4. *Shape of medial concavity on distal margin of labrum*: **(0)** slightly concave; **(1)** U-shape; **(2)** V-shape.
5. 5. *Lateral arc of setae of labrum*: **(0)** absent; **(1)** present.
6. 6. *Distal arc setae of labrum*: **(0)** absent; **(1)** present.
7. 7. *Type of setae on distal arc of labrum*: **(0)** simple; **(1)** bifid; **(2)** pectinate.
8. 8. *Distomedial arc of setae of labrum*: **(0)** absent; **(1)** present.
9. 9. *Type of setae on distomedial arc of labrum*: **(0)** simple; **(1)** bifid; **(2)** frayed; **(3)** pectinate.
10. 10. *Distodorsal arc of setae of labrum*: **(0)** absent; **(1)** present.
11. 11. *Type of setae on distodorsal arc of labrum*: **(0)** simple; **(1)** bifid; **(2)** spatulated.
12. 12. *Sub-distolateral arc of setae on dorsal surface of labrum*: **(0)** absent; **(1)** present. (Fig. 6)
13. 13. *Type of setae on sub-distolateral arc on dorsal surface of labrum*: **(0)** simple; **(1)** bifid.
14. 14. *Sub-distomedial arc of setae on dorsal surface of labrum*: **(0)** absent; **(1)** present. (Fig. 5)
15. 15. *Subdistal arc of setae on ventral surface of labrum*: **(0)** absent; **(1)** present. (Fig. 4)
16. 16. *Mediodorsal arc of setae extending laterally on labrum*: **(0)** no; **(1)** yes. (Fig. 4)
17. 17. *Arrangement of incomplete mediodorsal arc of setae of labrum*: **(0)** 1 subapical + 2 or 3 distolateral; **(1)** 1 subapical + row following the shape of disto-lateral and lateral ; **(2)** 1 subapical + straight row ; **(3)** 1 subapical.
18. 18. *Pair of denticles on medial emargination of labrum*: **(0)** absent; **(1)** present.
19. 19. *Tuft of setae ventrally on anterolateral margin of labrum*: **(0)** absent; **(1)** present. (Fig. 4)
20. 20. *Spine-like setae ventrally on lateral margin of labrum*: **(0)** absent; **(1)** present. (Fig. 4)
21. 21. *External margin of mandibles*: **(0)** convex; **(1)** straight (or almost).
22. 22. *Slender and frayed process at base on right prosthema*: **(0)** absent; **(1)** present.
23. 23. *Prosthema of right mandible*: **(0)** stout (with denticles apically); **(1)** seta-like; **(2)** slender and bifid.
24. 24. *Prosthema of left mandible*: **(0)** stout (with denticles apically); **(1)** robust and bifid.
25. 25. *Constrictions on molars of left mandible*: **(0)** absent; **(1)** present.
26. 26. *Fusion of left mandible incisors*: **(0)** absent; **(1)** present.
27. 27. *Deepness of fusion of left mandible incisors*: **(0)** cleft (Fig. 7); **(1)** partially fused; **(2)** fused but incisors recognizable; **(3)** completely fused (Fig. 8).
28. 28. *Type of triangular process of left mandible*: **(0)** as wide as long; **(1)** longer than wide.
29. 29. *Fusion of right mandible incisors*: **(0)** absent; **(1)** present.
30. 30. *Deepness of fusion of right mandible incisors*: **(0)** cleft; **(1)** completely fused; **(2)** fused but incisors recognizable; **(3)** partially fused.

31. 31. *Plane of mandible incisors*: **(0)** in the same plane; **(1)** inner set of incisors at right angle with outer set.
32. 32. *Setae between prostheca and mola on right mandible*: **(0)** absent; **(1)** present.
33. 33. *Length of setae between prostheca and mola on right mandible in relation to prostheca*: **(0)** shorter; **(1)** same length.
34. 34. *Lingua distomedial projection*: **(0)** absent; **(1)** present.
35. 35. *Shape of lingua projection*: **(0)** pointed; **(1)** rounded.
36. 36. *Length of lingua in relation to superlingua*: **(0)** longer; **(1)** subequal; **(2)** shorter.
37. 37. *Distal margin of superlingua*: **(0)** straight; **(1)** rounded.
38. 38. *Ventral setae near maxillary canines*: **(0)** curved upon denticles; **(1)** not curved upon denticles.
39. 39. *Number of maxillary palpi segments*: **(0)** three; **(1)** two.
40. 40. *Fusion of maxillary palp segments II and III*: **(0)** complete; **(1)** incomplete.
41. 41. *Spine-like setae on maxillary palp surface*: **(0)** present; **(1)** absent.
42. 42. *Distal margin of last segment of maxillary palpi*: **(0)** straight ; **(1)** curved inwardly.
43. 43. *Small lobe on apex of last segment of maxillary palp*: **(0)** absent; **(1)** present. (Fig. 9)
44. 44. *Number of rows of setae on crown galea-lacinia of maxilla*: **(0)** two; **(1)** three.
45. 45. *Shape of maxillary canines*: **(0)** robust and apically blunt; **(1)** apically pointed (spine-like); **(2)** robust and apically pointed.
46. 46. *Robustness of first dentiseta*: **(0)** same as others; **(1)** more robust.
47. 47. *Basal projection of first dentiseta coupling with canine*: **(0)** absent; **(1)** present. (Fig. 10)
48. 48. *Shape of external margin of maxilla*: **(0)** convex; **(1)** straight (or almost).
49. 49. *Row of spine-like setae on outer margin of maxilla*: **(0)** absent; **(1)** present.
50. 50. *Arrangement of row of spine-like setae on outer margin of maxilla*: **(0)** complete with many setae ; **(1)** complete with one row; **(2)** incomplete with tuft at apex; **(3)** incomplete with two tufts, one apical and other basal.
51. 51. *Surface of row of spine-like setae on outer margin of maxilla*: **(0)** restrict on outer margin ; **(1)** basal half of row on dorsal surface.
52. 52. *Shape of mentum*: **(0)** elongate; **(1)** not elongate.
53. 53. *Glossae length*: **(0)** longer than paraglossae; **(1)** subequal to paraglossae; **(2)** shorter than paraglossae.
54. 54. *Shape of glossa*: **(0)** subtriangular; **(1)** semicircular; **(2)** subrectangular; **(3)** semielliptical.
55. 55. *Base of glossa overlapping base of paraglossa*: **(0)** yes; **(1)** no.
56. 56. *Row of setae on inner margin of glossa*: **(0)** absent; **(1)** present.
57. 57. *Shape of paraglossa*: **(0)** subtriangular; **(1)** semicircular; **(2)** subrectangular.
58. 58. *Shape of paraglossa apex*: **(0)** broadly pointed; **(1)** rounded; **(2)** truncated.
59. 59. *Row of setae on outer margin of paraglossa* : **(0)** absent; **(1)** present. (Fig. 11)
60. 60. *Number of longitudinal rows of setae on paraglossa dorsal surface*: **(0)** without row of setae; **(1)** with 3 rows of setae; **(2)** with 1 row of setae.
61. 61. *Number of rows of spine-like setae on distal margin of paraglossa*: **(0)** one; **(1)** two; **(2)** three; **(3)** more than three.
62. 62. *Spine-like setae on segment I of labial palp*: **(0)** absent; **(1)** present.
63. 63. *Distomedial projection on labial palp segment II*: **(0)** absent ; **(1)** present.
64. 64. *Shape of distomedial projection of labial palp segment II*: **(0)** rounded; **(1)** digitiform; **(2)** triangular; **(3)** quadrangular.

65. 65. *Direction of distomedial projection of labial palp segment II:* **(0)** lateral (180°); **(1)** apical (90° to 160°); **(2)** basal (200° to 240°). (Fig. 12)
66. 66. *Many (10-20) long, thin and simple setae on outer margin of labial palp segments II and III:* **(0)** absent; **(1)** present.
67. 67. *Concavity at union of labial palp segment II and III:* **(0)** absent; **(1)** present.
68. 68. *Medial concavity on labial palp segment III:* **(0)** absent; **(1)** present. (Fig. 13)
69. 69. *Orientation of row of spine-like setae on labial palp segment III:* **(0)** inner-apical; **(1)** outer-apical.
70. 70. *Orientation of inner apical row of spine-like setae on labial palp segment III:* **(0)** apical margin; **(1)** inner margin; **(2)** inner and apical margins.
71. 71. *Insertion of segment III of labial palp on segment II:* **(0)** ventrally; **(1)** dorsally.
72. 72. *Shape of labial palpi segment III:* **(0)** triangular (apex pointed); **(1)** globose; **(2)** quadrangular; **(3)** semielliptical (apex rounded); **(4)** rectangular (apex truncated); **(5)** trapezoid; **(6)** conical (apex broadly pointed).
73. 73. *Trochanter inserted along entire base of femur:* **(0)** no (ventral margin only); **(1)** yes. (Figs 14 and 15)
74. 74. *Dorsal margin of femora:* **(0)** parallel to the ventral; **(1)** convex to the ventral.
75. 75. *Apical concavity on femora:* **(0)** present; **(1)** absent.
76. 76. *Forefemur spine-like setae on dorsal margin:* **(0)** absent; **(1)** present.
77. 77. *Type of forefemur setae on dorsal margin:* **(0)** not concave; **(1)** concave. (Fig. 16)
78. 78. *Shape of forefemur setae on dorsal margin:* **(0)** pointed; **(1)** blunt.
79. 79. *Size of forefemur setae on dorsal margin:* **(0)** very long; **(1)** long; **(2)** short.
80. 80. *Forefemur longitudinal row of setae near dorsal margin on anterior surface:* **(0)** absent; **(1)** present. (Fig. 17)
81. 81. *Type of forefemur longitudinal row of setae near dorsal margin on anterior surface:* **(0)** with spine-like setae; **(1)** with blunt setae; **(2)** with long and thin setae; **(3)** with spine-like and blunt setae; **(4)** with, blunt and pectinate spine-like; **(5)** with simple spine-like and trifid spine-like setae.
82. 82. *Forefemur longitudinal row of setae at middle on anterior surface:* **(0)** present; **(1)** absent.
83. 83. *Type of forefemur longitudinal row of setae at middle on anterior surface:* **(0)** pointed; **(1)** blunt.
84. 84. *Forefemur longitudinal row of setae near ventral margin on anterior surface:* **(0)** absent; **(1)** present.
85. 85. *Forefemur transversal row of long setae:* **(0)** absent; **(1)** present. (Fig. 19)
86. 86. *Transversal row of long setae on forefemur reduced:* **(0)** no; **(1)** yes. (Figs 19 and 21)
87. 87. *Position of transversal row of long setae:* **(0)** distal half; **(1)** proximal third. (Fig. 21)
88. 88. *Distance between setae sockets of forefemur transverse row of long state:* **(0)** very near each other, touching each other; **(1)** not touching each other.
89. 89. *Mid and hind femora transverse row of long state:* **(0)** absent; **(1)** present. (Figs 20 and 22) (Figs 23 and 24)
90. 90. *Position of transversal row of long setae on mid and hind femora:* **(0)** distal half; **(1)** proximal third. (Figs 20 and 22)
91. 91. *Distance of setae sockets of mid and hind femora transverse row of long state:* **(0)** very near each other, touching each other; **(1)** not touching each other. (Figs 23 and 24)
92. 92. *Subproximal arc of fine setae on tibiae:* **(0)** absent; **(1)** present.

93. 93. *Type of setae on ventral margin of foretarsus: (0) spine-like setae; (1) pectinate spine-like setae; (2) bifid and trifid spine-like setae.*
94. 94. *Setae on foretarsus anterior surface: (0) absent; (1) present. (Figs 25 – 27)*
95. 95. *Type of setae on foretarsus anterior surface: (0) spine-like setae; (1) pectinate spine-like setae; (2) long and thin setae; (3) blunt spine-like setae. (Figs 25 – 27)*
96. 96. *Foreclaw denticles: (0) absent; (1) present.*
97. 97. *Number of rows on claw denticles: (0) two; (1) one.*
98. 98. *Reduction in one row of denticles in foreclaw: (0) absent; (1) present. (Figs 25 – 27)*
99. 99. *Irregular row of foreclaw denticles: (0) absent; (1) present.*
100. 100. *Position of denticles irregularity (non-uniform) on foreclaw: (0) basal; (1) apical. (Figs 25 – 27)*
101. 101. *Direction of foreclaw denticles (apical): (0) perpendicular with claw; (1) apically directed.*
102. 102. *Type of foreclaw denticles without irregularity: (0) triangular; (1) long and cylindrical; (2) minute; (3) conical. (Fig. 28)*
103. 103. *Size of foreclaw denticles without irregularity: (0) same size; (1) slightly increasing toward apex.*
104. 104. *Apical denticles on claw extremely higher than others: (0) no; (1) yes. (Fig. 30)*
105. 105. *Apex of foreclaw curved: (0) no; (1) yes.*
106. 106. *Length of row of foreclaw denticles: (0) base to apex; (1) less than half; (2) more than half but not all claw; (3) half. (Fig. 29)*
107. 107. *Row of denticles of foreclaw starts: (0) at base; (1) at medial third. (Fig. 29)*
108. 108. *Mid and hind tarsal claw denticles: (0) same size of foreclaw; (1) smaller than foreclaw.*
109. 109. *Setae on apex of claw: (0) present; (1) absent.*
110. 110. *Metanotum, dorsally, with a broad projection (last instar and imagoes): (0) absent; (1) present.*
111. 111. *Hind wing pads: (0) present; (1) absent.*
112. 112. *Thoracic mesosternum projection: (0) absent; (1) present.*
113. 113. *Number of lamella on gill I: (0) one; (1) with two or more .*
114. 114. *Type of gill I with one lamella: (0) not racquet-shaped; (1) racquet-shaped.*
115. 115. *Symmetry of gill I: (0) asymmetric; (1) symmetric.*
116. 116. *Gills margins: (0) serrated; (1) smooth.*
117. 117. *Number of gills ribs: (0) 2 ribs ; (1) 1 rib.*
118. 118. *Gills trachea: (0) pigmented; (1) hyaline.*
119. 119. *Posterior margin of abdominal terga: (0) smooth ; (1) with spines.*
120. 120. *Type of spines on posterior margin of abdominal terga: (0) pointed; (1) rounded.*
121. 121. *Abdominal terga surface: (0) smooth; (1) creased.*
122. 122. *Abdominal terga scale-like setae/socket of scale-like setae: (0) present ; (1) absent .*
123. 123. *Type of setae on caudal filaments : (0) simple setae; (1) flattened setae.*
124. 124. *Terminal filament spines: (0) absent; (1) present.*
125. 125. *Arrangement of long spines on terminal filament: (0) on each segment; (1) every one segment; (2) every three segments.*

126. 126. Cerci spines: **(0)** absent ; **(1)** present.

Imago

0. 127. Dorsal portion of turbinate eyes: **(0)** absent; **(1)** present.
1. 128. Direction of dorsal portion of turbinate eyes on imago: **(0)** parallel; **(1)** anteriorly divergent.
2. 129. Shape of dorsal portion of turbinate eyes on imago: **(0)** oval; **(1)** circular.
3. 130. Free marginal intercalary veins on forewings on male imago: **(0)** absent; **(1)** present.
4. 131. Number of free marginal intercalary veins on forewings on male imago: **(0)** single; **(1)** double.
5. 132. Fork MA1-MA2: **(0)** absent; **(1)** present.
6. 133. Fork MP1-MP2: **(0)** absent; **(1)** present.
7. 134. Number of longitudinal veins on hind wing of male imago: **(0)** 3; **(1)** 2; **(2)** more than 3.
8. 135. Free marginal intercalary veins on hind wing: **(0)** absent; **(1)** present.
9. 136. Shape of costal process: **(0)** pointed; **(1)** rounded; **(2)** quadrangular; **(3)** rectangular.
10. 137. Male fore tarsal claws: **(0)** similar; **(1)** different.
11. 138. Male tarsal claws II and III: **(0)** similar; **(1)** different.
12. 139. Number of tarsomers of protarsi: **(0)** five; **(1)** four.
13. 140. Number of tarsomers of meso and metatarsi: **(0)** five; **(1)** four.
14. 141. Forceps: **(0)** four-segmented; **(1)** three-segmented.
15. 142. Unistyliger inner projection: **(0)** present; **(1)** absent. (Figs 31 – 36)
16. 143. Unistyliger base: **(0)** wider than apex; **(1)** same width. (Figs 31 – 36)
17. 144. Last segment of forceps: **(0)** Rod-like; **(1)** Clave-like; **(2)** Rounded. (Figs 31 – 36)
18. 145. Process of projected subgenital plate: **(0)** absent; **(1)** present. (Figs 31 – 36)
19. 146. Type of subgenital plate projection: **(0)** long; **(1)** short. (Figs 31 – 36)
20. 147. Shape of subgenital plate projection: **(0)** rounded; **(1)** quadrangular; **(2)** triangular. (Figs 31 – 36)
21. 148. Apex of subgenital plate projection: **(0)** straight; **(1)** concave; **(2)** convex. (Figs 31 – 36)
22. 149. Spine on process of subgenital plate: **(0)** absent; **(1)** present. (Figs 32 and 34)
23. 150. Penis: **(0)** sclerotized; **(1)** not sclerotized.

Table 1. List of material examined (Stage acronyms: N, nymph; ♂I, male imago; ♀I, female imago.) MZB: Museo de Zoología de Barcelona - Spain ;UFES: Universidade Federal do Espírito Santo – Brazil; INPA: Instituto Nacional de Pesquisa da Amazonia – Brazil; PURDUE: Purdue University – Entomological Research Collection – U.S.A.; Lillo: Museo Miguel Lillo de Ciencias Naturales – Argentina; LONDON: Natural History Museum of London – U.K.

Species	Material examined	Literature
<i>Siphlaenigma janae</i>	N, ♂I reared, Paratype, PURDUE	--
<i>Spiritiops silvudus</i>	N, INPA; N, Paratype, PURDUE	Lugo-Ortiz & McCafferty 1998; Nieto & Derka 2012
<i>Cryptonympha copiosa</i>	N, ♂I reared, not described, INPA; N, Holotype and Paratype, PURDUE	Lugo-Ortiz & McCafferty 1998
<i>Cryptonympha dasilvai</i>	N, INPA	Salles & Francischetti 2004
<i>Americabaetis alphas</i>	N, Paratype, PURDUE	Salles et al. 2011
<i>Aturbina georgei</i>	N, Paratype, PURDUE	Salles et al. 2011
<i>Cloeodes penai</i>	N, ♂I, Holotype and Paratype, PURDUE	--
<i>Kirmaushenkreena zarankoe</i>	N, Holotype, PURDUE	--
<i>Paracloeodes caldensis</i>	N, Paratype, INPA	Gutiérrez et al. 2013
<i>Varipes singuil</i>	N; Paratype; Lillo	Nieto 2004
Gen. A	N, ♂I reared, not described; INPA	Falcão et al. 2011
<i>Adebrotus amazonicus</i>	N, Holotype, PURDUE	Salles 2010
<i>Adebrotus lugoi</i>	N, UFES	Salles 2010
<i>Rivudiva trichobasis</i>	N, ♂I, Paratype, Lillo	Cruz, Boldrini, Salles & Hamada 2011
<i>Rivudiva minantenna</i>	N, Paratypes, Lillo, PURDUE	Lugo-Ortiz & McCafferty 1998
<i>Rivudiva coveloae</i>	♂I, Holotype, PURDUE	Salles & Nascimento 2009
<i>Rivudiva venezuelensis</i>	♂I, Holotype, PURDUE	Salles & Nascimento 2009
<i>Varipes lasiobranchius</i>	N, Holotype and Paratype, PURDUE	Lugo-Ortiz & McCafferty 1998
<i>Varipes minutus</i>	--	Nieto 2004

<i>Varipes sancarlos</i>	--	Castillo & Pérez 2011
<i>Varipes helenae</i>	N, Paratype, INPA	Salles & Batista 2004
<i>Varipes cajuato</i>	--	Nieto 2004
<i>Apobaetis fiuzai</i>	N, Paratype, UFES	Salles & Lugo-Ortiz 2002
<i>Apobaetis kallawayi</i>	N, INPA	Nieto 2006
<i>Apobaetis lakota</i>	N, Holotype, PURDUE	McCafferty 2000
<i>Apobaetis etowah</i>	♂I, Paratype of <i>Pseudocloeon etowah</i> , PURDUE; N, Paratype of <i>Apobaetis indepressus</i> , PURDUE	Day 1955
<i>Waltzophius fasciatus</i>	N; INPA	Salles et al. 2016
<i>Waltzophius roberti</i>	N; INPA	Thomas & Peru 2002
<i>Callibaetis capixaba</i>	N, ♂I, ♀I, Holotype and Paratypes, INPA	Cruz et al. 2009
<i>Callibaetis pictus</i>	♂I, ♀I, Holotype and Paratype, LONDON; N, PURDUE	--
<i>Callibaetis guttatus</i>	N, ♂I, ♀I, Type material of <i>C. apicatus</i> , <i>C. zonatus</i> , <i>C. guttatus</i> in MZB; N, ♂I, ♀I, new collected and reared in Brazil, INPA	Cruz et al. 2014
<i>Callibaetis itannae</i>	N, ♂I, ♀I, Holotype and Paratypes, INPA	Cruz et al. 2014
<i>Callibaetis nigracyclus</i>	N, ♂I, ♀I, Holotype and Paratypes, INPA	Cruz et al. 2014
<i>Callibaetoides caaigua</i>	♂I, ♀I, N, Paratypes, INPA	Cruz et al. 2013
<i>Paracloeodes atroari</i>	N, Paratype, INPA	Salles & Nieto 2006
<i>Paracloeodes binodulus</i>	N, Holotype, PURDUE	Lugo-Ortiz & McCafferty 1996
<i>Paracloeodes ibicui</i>	N, Holotype, PURDUE	Lugo-Ortiz & McCafferty 1996
<i>Paracloeodes peri</i>	N, ♂I reared, not described, INPA	Salles & Nieto 2006
<i>Paracloeodes waimiri</i>	N, Holotype, ♂I reared, not described, INPA	Salles & Nieto 2006
<i>Paracloeodes charrua</i>	N, Paratypes, Lillo	Emmerich & Nieto 2009
<i>Paracloeodes poranga</i>	N, INPA	Salles & Nieto 2006
<i>Paracloeodes quadridentatus</i>	N, Paratype, INPA	Lima & Salles 2010
<i>Paracloeodes lilliputian</i>	N, INPA	Kluge 1991
<i>Paracloeodes yuto</i>	N, Paratype, INPA	Salles & Nieto 2006
<i>Paracloeodes fleeki</i>	N, Holotype and Paratype, PURDUE	McCafferty & Lenat 2004
<i>Paracloeodes minutus</i>	♂I, Holotype, PURDUE; N,	Day 1955; Daggy 1945

[illegible]

<i>Apobaetis lakota</i>	???0-0100-120-1001000002001010-10-0-11110100010000--10110001200101110011010010120-1
<i>Apobaetis etowah</i>	0??0-0100-120-1???000002001010-10-0-111100010000--10110001200120110011410010120-1
<i>Waltzoyphius fasciatus</i>	0100-1100-10100001000002000-10-0-21110100010000--1001000120011111002141001002101
<i>Waltzoyphius roberti</i>	0100-1100-10110001000002000-10-0-21110100010000--1001000120011111002141001002101
<i>Callibaetis capixaba</i>	01212110120-0-0100111002100-10-110110111010012000131121112211010--01102121001002101
<i>Callibaetis pictus</i>	01211110100-0-0100111002100-10-110110111000002000130113110011010--01102131001002101
<i>Callibaetis guttatus</i>	01211110100-0-0100111002100-10-110110111000002000130113110011010--01102131001002101
<i>Callibaetis itannae</i>	01211110100-0-0100111002100-10-110110111000002000100113110011010--01102131001002101
<i>Callibaetis nigracyclus</i>	01211110100-0-0100111002100-10-110110111000002000120113110011010--01102131001002101
<i>Callibaetoides caaigua</i>	01012010120-0-0100111002000-10-110110110-10011000111123102211300--11000141001002111
<i>Paracloeodes atroari</i>	01111011110-0-0001101002011111010-0-11110100020000--11011001200100000011610011120-1
<i>Paracloeodes binodulus</i>	01211011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112101
<i>Paracloeodes ibicui</i>	01211011110-0-0001101002011111010-101110100020000--1101100120010000001161001112111
<i>Paracloeodes peri</i>	01211011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112111
<i>Paracloeodes waimiri</i>	01211011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112111
<i>Paracloeodes charrua</i>	01211011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112111
<i>Paracloeodes poranga</i>	01211011110-0-0001101002011111010-111110100020000--1111100120010000001161001112111
<i>Paracloeodes quadridentatus</i>	01211011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112111
<i>Paracloeodes lilliputian</i>	01311011110-0-0001101002011111010-0-11110100020000--1101100120010000001161001112111
<i>Paracloeodes yuto</i>	01?11011110-0-0001101002011111010-0-11110100020000--1211111120010000001161001112110
<i>Paracloeodes fleeki</i>	01?11011110-0-0001101002011111010-0-11110100020000--1211111120010000001161001112110
<i>Paracloeodes minutus</i>	01?11011110-0-0001101002011111010-0-11110100020000--1211111120010000001161001112110
<i>Paracloeodes pacawara</i>	01311011110-0-0001101002011111010-0-11110100020000--1211111120010000001161001112110
<i>Paracloeodes morellii</i>	01311011110-0-0001101002011111010-0-11110100020000--1211111120010000001161001112110
<i>Paracloeodes lotor</i>	01311011110-0-0001101002011111010-0-11110100020000--1211100120010000001161001112110
<i>Paracloeodes lugoi</i>	01311011110-0-0001101002011111010-0-11110100020000--1211111120010200001161001112111
<i>Paracloeodes assu</i>	01211011110-0-0001101002011111310-0-11110100020000--1201100120010000001161001102100
<i>Paracloeodes eurybranchus</i>	01211011110-0-0001101002011111010-0-11110100020000--1201100120010000001161001102111
<i>Paracloeodes leptobranchus</i>	01211011110-0-0001101002011111010-0-11110100020000--1201100120010000001161001112111

Table 2. Matrix

	9	10	11	12	13	14	15
	01234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
<i>Siphlaenigma janae</i>	--00101000-	0010030110	00??????10	010????0--0	-102100101	01110---00	
<i>Spiritiops silvudus</i>	--00131000-	0001010000	0000100011	0001011101	1000101111	11000---01	
<i>Cryptonympha dasilvai</i>	--000-1010-	0010020010	10000000010	0101011???	????--????	???????????	
<i>Cryptonympha copiosa</i>	--000-1000-	0010010010	1000010010	0001011101	1??--1111	1010100201	
<i>Americabaetis alphas</i>	--000-11-0-	0000020010	1000100010	0001011001	1??--????	?0100---01	
<i>Aturbina georgei</i>	--000-1000-	0010010010	0000100010	0001210--1	1001001111	1002101201	
<i>Cloeodes penai</i>	--11110--0-	---0--10	0000100010	0011011001	1001031111	11020---01	
<i>Kirmaushenkreena zarankoe</i>	--010-1000-	0010020000	00001001??	11????????	???????????	???????????	
<i>Paracloeodes caldensis</i>	11000-10011	1---010010	1000100110	1101011???	???--????	???????????	
<i>Varipes singuil</i>	11000-10011	1---010010	1000100110	1101011?01	1??--1111	1010111101	
Gen. A	--000-1010-	0001120010	1000100110	1101111101	1??--1111	1110110111	
<i>Adebrotus amazonicus</i>	--000-1000-	0010010010	1000100110	1101011???	???--????	???????????	
<i>Adebrotus lugoi</i>	--000-11-0-	0010020010	1000100110	1101011???	???--????	???????????	
<i>Rivudiva trichobasis</i>	11000-1000-	0300000011	1000100110	1101011101	1??--1111	1111100101	
<i>Rivudiva minantenna</i>	11000-1000-	0300000010	0000100110	110????1001	1001001111	1110100211	
<i>Rivudiva coveioae</i>	???????????	???????????	???????????	???????1011	1001011111	1110100111	
<i>Rivudiva venezuelensis</i>	???????????	???????????	???????????	???????1001	100--1111	111?100211	
<i>Varipes lasiobranchius</i>	10000-10010	0--0111010	1001000110	1101??1???	???--????	???????????	
<i>Varipes minutus</i>	10000-10010	0--0111010	100100010-	1101?11???	1??--????	???????????	
<i>Varipes sancarlos</i>	10000-10010	0--0111010	100100010-	1101??1???	???--????	???????????	
<i>Varipes helenae</i>	10000-10010	0--0111010	100100010-	1101011???	???--????	???????????	
<i>Varipes cajuato</i>	10000-10010	0--0111010	1001000110	1101?11???	???--????	???????????	
<i>Apobaetis fiuzai</i>	--000-0----	---0---11	1000100010	1101011101	1??--1111	1110102201	
<i>Apobaetis kallawaya</i>	--000-1000-	0200010011	1000100111	1101011???	???--????	???????????	
<i>Apobaetis lakota</i>	--000-0----	-----11	10????????	???????1???	???????????	???????????	
<i>Apobaetis etowah</i>	--000-0----	-----11	100010?0??	?1????1101	100--1111	1110102201	
<i>Waltzoyphius fasciatus</i>	--00101000-	0010030010	1100100010	1111211111	1??--1111	1101102201	
<i>Waltzoyphius roberti</i>	--00101000-	0010030010	1100100010	1111211111	1??--1111	1101102201	
<i>Callibaetis capixaba</i>	--020-1000-	0110020110	001-011010	1111011001	1000021111	1102110201	
<i>Callibaetis pictus</i>	--02101000-	0110010110	001-011010	1111111001	1000021111	1101110201	
<i>Callibaetis guttatus</i>	--020-1000-	0110010110	001-011010	1111111001	1000121111	1100110201	
<i>Callibaetis itannae</i>	--020-1000-	0110010110	001-011010	1111111001	1000021111	1102110201	
<i>Callibaetis nigracyclus</i>	--000-1000-	0110010110	001-011010	1111211011	1000021111	1110110201	
<i>Callibaetoides caaigua</i>	--000-1000-	0110020110	001-011010	1011211101	1001031111	1111110201	
<i>Paracloeodes atroari</i>	--000-1000-	0010010010	1000100010	1100-11111	100--1111	1110110211	

<i>Paracloeodes binodulus</i>	--010-1000-	0010010010	1000100010	1101011111	100---1111	1110110211
<i>Paracloeodes ibicui</i>	--010-1000-	0010010010	0000100010	110101111?	1??102????	?110110111
<i>Paracloeodes peri</i>	--010-1000-	0010010010	0000100010	1101011111	1001021111	1110110111
<i>Paracloeodes waimiri</i>	--010-1000-	0010010010	0000100010	1101011111	1001021111	1110110111
<i>Paracloeodes charrua</i>	--010-1000-	0010010010	0000100010	1101011111	1001021111	1110110111
<i>Paracloeodes poranga</i>	--010-1000-	0010010010	0000100010	1101011???	??????????	?????????11
<i>Paracloeodes quadridentatus</i>	--010-1000-	0010010010	1000100010	1101011???	???--????	???????????
<i>Paracloeodes lilliputian</i>	--000-1000-	0210010110	1000100110	1101011???	1??--????	???????????
<i>Paracloeodes yuto</i>	--000-1000-	0210010110	1000100110	1101011???	???--????	???????????
<i>Paracloeodes fleeki</i>	--000-1000-	0210010110	1000100010	1101011???	???--????	???????????
<i>Paracloeodes minutus</i>	--000-1000-	0210010110	1000100110	1101011111	100---1111	1010110101
<i>Paracloeodes pacawara</i>	--000-1000-	0210010110	1000100110	1101011111	100---1111	1010111001
<i>Paracloeodes morellii</i>	--000-1000-	0210010110	1000100110	1101011111	100---1111	1010111001
<i>Paracloeodes lotor</i>	--000-1000-	-210010110	1000100110	1101011???	100---1111	1110110111
<i>Paracloeodes lugoi</i>	--000-1000-	0210010110	1000100110	11????1???	???--1111	???????????
<i>Paracloeodes assu</i>	--00101000-	0010010010	0000100110	11????1???	??????1111	???????????
<i>Paracloeodes eurybranchus</i>	--00101000-	0010010010	0000100110	1101011???	??????1111	1???????11
<i>Paracloeodes leptobranchus</i>	--010-1000-	0010010010	0000100110	1101011???	??????1111	1?????????

Table 2. Matrix cont.