PHYLOGENETIC ANALYSIS OF *GIGANTODAX* (DIPTERA: SIMULIIDAE)

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RESUMEN

TITULO: ANÁLISIS FILOGENÉTICO DE *GIGANTODAX* (DIPTERA: SIMULIIDAE). *

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PALABRAS CLAVES: Filogenia, Evidencia Total, Simuliidae, *Gigantodax*.

CONTENIDO:

Se analizó la monofilia de los grupos de *Gigantodax* y las relaciones filogenéticas entre ellos, para esto se usaron 75 caracteres, 57 caracteres morfológicos provenientes de 64 especies y 18 caracteres cit
ogenéticos con 10 de las 64 especies trabajadas. Se realizaron dos análisis, pesos iguales y pesos implícitos.

Con el análisis de pesos iguales, se obtuvieron 578 árboles igualmente parsimoniosos de 275 pasos (Ci=0.43, Ri=0.65). Con el análisis de pesos implícitos se obtuvieron 36 árboles, la concavidad que recuperó la mayoría de los grupos fue la concavidad de uno ($Fit_{conc=1}$=436.4). El análisis filogenético usando parsimonia lineal mantuvo dos grupos (*igniculus* y *cormonsi*). Los cuatro grupos restantes ("*minor*", "*brophyi*", "*multifilis*" "*wrighti*" y "*cilicinus*") son grupos parafiléticos, y *multifilis* es un grupo monotípico.

Basados sobre el cladograma sugerimos la creación de los siguientes subgéneros: *Igniculus* (grupo *igniculus*), *Minor* (grupo *minor* + *multifilis*) y *Fulvescens*. Este último subgénero esta conformado por el grupo *brophyi* (*G. brophyi, G. rufidulus, G. femineus, G. antarcticus, G. trifidus*), grupo *shannoni* (*G. shannoni*, *G. pennipunctus*, *G. incomitatus*, *G. mariobordai, G. bettyae* y *G. septenarius*); y dos clados, *destitutus* (grupo *cormonsi* y las especies *G. cypellus*, *G. impossibilis*, *G. herreri*, *G. incapucara*, *G. dryadicaudicis, G. rufescens*, *G. nasutus*, *G. wrighti*, *G. corniculatus*, *G. cervicornis*, *G. aquamarensis*, *G. horcotiani*, *G. cilicinus*, *G. clandestinus*, *G. arrarteorum*, *G. basinflatus*, *G. destitutus*), y *rufescens* (grupo *shannoni* y el clado *destitutus*). Algunas especies previamente asignadas a los grupos "*cilicinus*", "*wrighti*" y "*brophyi*" permanecen *inquerandae*.

SUMMARY

TITLE: PHYLOGENETIC ANALYSIS OF *GIGANTODAX* (DIPTERA: SIMULIIDAE)

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KEY WORDS: Phylogeny, Total evidence, Simuliidae, *Gigantodax*.

CONTENT:

The monophyly and phylogenetic relationships among the *Gigantodax* species-groups were analyzed using 75 characters, 57 of them morphological characters derived from 64 species, and 18 of them cytological characters from 10 species. We conducted two analyses under linear parsimony and implied weights.

Under linear parsimony we obtained 578 equally parsimonious trees of 275 steps (Ci=0.40, Ri=0.65). Under implied weights we obtained 36 trees, the concavity value that recovers the most number of groups was one ($Fit_{conc=1}$=436.4). Under linear parsimony the phylogenetic analysis recovered two *igniculus* and *cormonsi* species groups. The remaining four groups ("*minor*", "*brophyi*", "*wrighti*" and "*cilicinus*") are paraphyletic.

Based on the cladogram we suggest the following subgenera: *Igniculus* (*igniculus* group), *Minor* ("*minor*" + "*multifilis*" groups) and *Fulvescens.* The latter subgenus includes the *brophyi* group (*G. brophyi, G. rufidulus, G. femineus, G. antarcticus, G. trifidus*), the *shannoni* group (*G. shannoni*, *G. pennipunctus*, *G. incomitatus*, *G. mariobordai, G. bettyae* and *G. septenarius*), and two clades, the *destitutus* (*cormonsi* group and *G. cypellus*, *G. impossibilis*, *G. herreri*, *G. incapucara*, *G. dryadicaudicis, G. rufescens*, *G. nasutus*, *G. wrighti*, *G. corniculatus*, *G. cervicornis*, *G. aquamarensis*, *G. horcotiani*, *G. cilicinus*, *G. clandestinus*, *G. arrarteorum*, *G. basinflatus*, *G. destitutus*) and the *rufescens* (*shannoni* group + *destitutus* clade). Some species previously assigned to "*cilicinus*", "*wrighti*" and "*brophyi*" groups are kept as *inquerandae*.

Phylogenetic analysis of *Gigantodax* (Diptera: Simuliidae)

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INTRODUCTION

Gigantodax Enderlein is a Simuliidae genus which has been assigned to Prosimuliini (s*ensu* Crosskey & Howard 1997) or to Simuliini (*sensu* Currie 1988; Moulton 2000). Currie (1988) and Moulton (2000) recognized the monophyly of Simuliini, supported by five synapomorphies of the adult morphology: presence of calcipala, radial sector unbranched (or represented by an obscure apical fork), costa vein with dimorphic setae, “strap-like connection” between the paramere and the ventral plate of the male, arising subapically on the anterolateral apodeme of the ventral plate, and paramere of male apically with spines.

Wygodzinsky & Coscarón (1989), based on morphological characters, assigned the species of *Gigantodax* to eight groups *cortesi*, *igniculus*, *minor*, *multifilis*, *brophyi*, *cilicinus*, *cormonsi*, and *wrighti*. Although they considered each species group as monophyletic, they did not present a formal phylogenetic analysis.

Subsequently, Coscarón & Miranda-Esquivel (1998) studied the phylogenetic relationship between the *cortesi* group and the remaining groups of *Gigantodax* showing that the *cortesi* group renders *Gigantodax* to be paraphyletic. Therefore, the *cortesi* group was elevated to the generic rank as *Pedrowygomyia,* being this genus more related to *Prosimulium* Roubaud that to *Gigantodax*, while *Gigantodax* was more related to *Cnesia* Edwards, as proposed by Py-Daniel (1990) and Py-Daniel & Moreira (1994).

Currently *Gigantodax* is conformed by 62 species assigned to seven species groups (Coscarón & Miranda-Esquivel 1998) distributed from southern USA along the Mesoamerican Mountains through the Andes to Tierra del Fuego. Coscarón & Miranda-Esquivel (1998) defined the *Gigantodax* genus by the lack of the frontal trichomes in the frontoclypeous and the apical shape of the ventral plate strongly bilobed.

The phylogenetic analyses were based on morphological (Coscarón & Miranda-Esquivel 1998) or cytogenetical information for the species groups of *Gigantodax* (Coscarón-Arias 1998), but not on total evidence. There is only one phylogenetic analysis (Coscarón & Miranda-Esquivel 1998) of *Gigantodax* that shown the monophyly of this genus and provided a hypothesis of relationship among the species groups. However, they did not suggest any hypothesis of monophyly of the groups because they used only the type species.

The purpose of this study is to evaluate the monophyly of *Gigantodax* species groups and the relationships within these species groups, using morphological and cytogenetical evidence.

MATERIALS AND METHODS

Species studied

We used 64 terminal taxa. 60 of these comprising the ingroup and four (*Gymnopais* Stone, *Prosimulium* Robaud, *Pedrowygomyia* Coscarón & Miranda-Esquivel, and *Cnesia* Enderlein) the outgroup, leaving *Gymnopais* as the basal taxon. All the species of *Gigantodax* were included, except *G. adleri* Moulton and *G. conviti* Ramírez Pérez, because the information about them was not available.

Morphological characters

We used 57 morphological characters, 15 based on larval morphology (characters 1 to 15), 18 on pupal morphology (characters 16 to 33), 7 on general adult morphology (characters 34 to 40), 10 on adult female morphology (characters 41 to 50), and 7 on adult male morphology (characters 51 to 57). We obtained the data set from the following literature sources: *Gigantodax* groups, *Pedrowygomyia* and *Cnesia* (from Wygodzinsky & Coscarón 1989; Coscarón 1991; Muñoz de Hoyos 1995; Coscarón & Miranda-Esquivel 1998); *Gymnopais* and *Prosimulium* (from Py-Daniel 1990; Rubtsov 1989).

Antenna color (character 4), position of the maxillary palpal sensilla in the first-instar larva (character 6), hypostomium paralateral teeth (character 8), and the accessory parameral spines (character 57) were coded following Currie (1988); while the character apical shape of the ventral plate (character 54) was coded according to Coscarón & Miranda-Esquivel (1998). All measures and the quantitative characters were coded using "gap coding" (Mickevich & Johnson 1976). Appendix 1 lists the specimens examined.

Chromosomal characters

We used 18 chromosomal characters, 5 based on Chromosome I (characters 58 to 62), 8 on chromosome II (characters 63 to 70), 3 on Chromosome III (characters 71 to 73), and two on sexual differentiation (characters 74 to 75).

The chromosomal maps were obtained from different sources: The maps of *G. basinflatus* Wygodzinsky & Coscarón, *G. brevis* Wygodzinsky & Coscarón, and *G. cypellus* Wygodzinsky & Coscarón from Muñoz de Hoyos (unpublished); *G. ortizi* Wygodzinsky map from Moreno (1990) and Muñoz de Hoyos (unpublished); *G. osornorum* Muñoz de Hoyos, Martínez, Mejía & Bueno map from Muñoz de Hoyos (1995) and Muñoz de Hoyos (unpublished); *G. fulvescens* Blanchard, *G. chilensis* Philippi, *G. marginalis* Edwards, *Cnesia dissimilis* and *Prosimulium mixtum* maps from Coscarón-Arias (1998).

Briefly, the three chromosomes are numbered in descending order of length using roman numerals, S (short) or L (long) to denote the arm. Inversions are numbered in order of their discovery. The landmarks used were: ring of Balbiani (RB), paraBalbiani (PB), nucleolar organizer (NO), grey band (GB), blister (B), basal 3 (Basal 3), heavy band group (3HG), frazzled end (F), basal marker (Mb), and Trapezoid (Tp). Each idiogram of the chromosome arm was divided in three segments, (proximal, medial and distal) in relation to the centromere. At the same time each segment was divided in three sections numbered from one to three in relation to the centromere position (see Figures 1, 2, 3). We codified the landmarks according to their relative position. Finally, we considered multistate characters as non-additive. Characters, character states and codes are shown in Appendix 2, and the data matrix is shown in Appendix 3.

Cladistic analyses

We conducted two phylogenetic analyses, linear parsimony search using NONA 2.0 (Goloboff 1998) and implied weights search using PEE-WEE 3.0 (Goloboff 1998).

We used the ratchet search option (Nixon 1999), with both programs NONA and PEE-WEE using 500 searches with tree bisection reconnection (TBR) (Swofford &

Olsen 1990), with 200 iterations. With the linear parsimony search, two different analyses were performed in order to evaluate the effect of quantitative characters, the first with all the data and the second excluding the quantitative data. The percentage of the shared nodes was calculated as the amount of recovered nodes with respect to the total evidence nodes. The unique nodes number was the nodes exclusively recovered by each one of the topologies that eliminated some kind of evidence, rescaled to the number of nodes in the analysis.

The choice of the concavity value in implied weights analysis has been criticized, because this value in the analysis can be "selected" by the researcher, so this value could be considered as subjective (Turner & Zandee 1995). To tackle this problem we considered the best concavity value for the implied weights analysis to be the value that recovered the majority of the groups after Jackknife resampling as suggested by Goloboff (1997). We made a tree search after randomly eliminated 33 characters (37%); then, we calculated the number of initial groups (those without resampling) recovered after jackknife (the frequency index of Goloboff 1997 and Ramirez 1999). This procedure was replicated 1000 times for each possible concavity integer value from one to six and also for linear parsimony. We used the "honestly significant difference test" (Tukey test) (Zar 1999) to compare the average number of nodes recovered after resampling.

We analyzed the character distribution with WINCLADA 1.00.08 (Nixon 2002) and Mesquite 1.01 (Maddison & Maddison 2004) under the unambiguous reconstruction.

In the linear parsimony search analysis, we calculated the relative Bremer support (Goloboff & Farris, 2001) to evaluate the branch reliability, retaining 32000 suboptimal trees, 36 steps longer in NONA and using the command line mult//; mult*32000; su 36; find *; bs/; bs*. To minimize the effect of dependence on the amount of trees the procedure was repeated 10 times, as suggested by Goloboff & Farris (2001). All the 10 replicates generated the same relative Bremer support values. The relative Bremer support provides an approximate measure of the amount of favourable/contradictory evidence (for example, if the relative Bremer support is

0.25, the amount of favourable and contradictory evidence is 75% and 25% respectively (Goloboff & Farris, 2001)).

RESULTS AND DISCUSSION

NONA found 578 equally parsimonious trees of 275 steps (CI=0.40 RI=0.65), the strict consensus is shown in Figure 4. Under implied weights, the value that recovered the most of the groups was one (Table 1). We obtained 36 trees ($Fit_{conc=1}$=436.4). Only the *Igniculus* and *Minor* subgenera were recovered by both analyses (linear parsimony and implicit weights K=1). The results with implicit weights are significantly different from those obtained under linear optimization because the transformations evaluated in the character optimization are highly homoplastic. For instance the “*minor*” + “*multifilis*” group is supported by the homoplastic character ratio length/width of the antenna terminal sensillum (character 5:1); this character is optimized in the linear parsimony topology as two independent apparitions, while in the K=1 topology the same character is optimized as six independent apparitions.
Goloboff (1997) suggested that when *K* decreases the homoplastic transformations are downweighted more strongly, we considered the former as a result close to character compatibility. This does not mean that if a clade is supported by only homoplastic characters it will collapsed, because if the homoplasy that supports the clades is congruent, the groups do not collapse.

The recovered nodes with each concavity values and linear parsimony are shown in Figure 5. The relative Bremer support is shown for the preferred topology in Figure 6. The relative Bremer support values range from 34% to 67%.

Under implied weights search with all concavity values, and linear parsimony, we found that *Gigantodax* is a monophyletic taxon (Figures 4 and 5). This group was relatively not supported (34%) (Figure 6), because only two characters support the group, and one of these characters is homoplastic. The characters are the lack of the frontal trichomes (character 26:1), and the apical shape of the ventral plate strongly bilobed (character 54:1 with reversal in the *rufescens* clade and a regain in the *cormonsi* group); these two characters are in concordance with the analysis of Coscarón & Miranda-Esquivel (1998). In the other hand, some characters that formerly defined the *Gigantodax* genus (Wygozinsky & Coscarón 1989) as the anal sclerites with an accessory ring (character 16:1) and the curvature of the veins Cu2 and A1 (character 44:1), were found homoplastic, as also proposed by Coscarón & Miranda-Esquivel (1998).

Gigantodax is more related to *Cnesia* than to *Pedrowygomyia*. The support of this group is low (34%) due that the most of the characters are homoplastic. This relationship is supported by seven synapomorphic characters, five of these are quantitative characters, which is in agreement with Coscarón & Miranda-Esquivel (1998): second antennal segment shorter than the first (character 1:1, with reversal in the *Igniculus* subgenus), frons width (character 42:1), the fucarsternum median arm width (character 46:1), the strong head curvature (character 51:1) and endoparameres hooks elongated (character 55:1). The remaining two characters are qualitative: transversal sulci in the tooth of the claw (character 49:1), and the presence of calcipala (character 40:1) (Figure 4). Currie (1988) considered the last character as part of the Simuliini grounplan. We observed that *Pedrowygomyia* (currently Simuliini) has not the calcipala, as a difference to Simuliini grounplan as proposed by Currie (1988). The only simuliines without calcipala are *Crozetia*, *Sulcicnephia*, *Metacnephia*, and certain members of *Simulium s. lato* (Currie & Grimaldi, 2000). We propose to revaluate the calcipala as a synapomorphic character of *Cnesia+Gigantodax*.

The sistergroup relationship between *Gigantodax* and *Cnesia* has been confirmed using morphologic (Py-Daniel 1990; Py-Daniel & Moreira 1994; Coscarón & Miranda-Esquivel 1998), cytogenetic (Coscarón-Arias 1998) and biogeographic data sets (Coscarón & Coscarón-Arias 1995). These genera show an interesting similarity with the Australian fauna which is considered by Coscarón & Coscarón-Arias (1995) as an “evidence” of their phylogenetic relationship.

The *igniculus* and *cormonsi* groups as defined by Wygodzinsky & Coscarón (1989) are monophyletic groups while "*brophyi"*, "*cilicinus"*, "*wrighti"*, and "*minor*" are no natural groups, the *multifilis* group is a monotypic taxon. The *Igniculus* subgenus is supported by the 16-30 marginal serrations (character 9:1) and four homoplastic transitions: cephalic apotome widest near the middle (character 11:0, also found in *Gymnopais*), cocoon coverage only the abdomen (character 16:0 is also found in some species of *brophyi* group and *Minor* and *Fulvescens* subgenera), the presence of terminal filaments (character 23:1, shared with *rufescens* clade) and the aedeagal membrane with strong spinules, some of them basally fused (character 56:1 used by Wygodzinsky & Coscarón (1989) as a diagnostic character of the *Minor* and *Igniculus* subgenera). The subgenus has a relatively "high" support (46%), because the characters are congruent homoplastic and it is found in all analyses (Figures 5 and 6).

Two homologous characters support the *cormonsi* group. The support is relatively low (34%) because there is contradictory evidence (Figure 6). The first character is the arrangement of the gill branches as a shield (character 20:2); this character is used as diagnostic character by Wygodzinsky & Coscarón (1989) for the group. The second character is the reduction of the gill branches indicated by rows of small perforations (character 21:2 with reversal in *G. gracilis* and *G. misitu*). The group is recovered using linear parsimony (Figure 4) and the concavity values from four to six (Figure 5).

The "*brophyi*" group as defined by Wygodzinsky & Coscarón (1989) is not a natural group. The "*brophyi*" group is not recovered using any concavity value nor by linear parsimony, moreover, we did observe that the diagnostic characters used by Wygodzinsky & Coscarón (1989) do not support this group. With the actual evidence, we restrict the *brophyi* group to *G. brophyi* Wygodzinsky, *G. rufidulus* Wygodzinsky & Coscarón, *G. antarcticus* Bigot, *G. trifidus* Wygodzinsky & Coscarón and *G. femineus* Edwards (Figure 4). The relative Bremer support for the *brophyi* group is relatively high (50%) because the group is supported by a synapomorphy and the homoplastic characters are congruent. The synapomorphy is the arrangement of the free gill branches in two or three distinct groups (character 21:1) and the two homoplastic characters are facial trichomes like hair ((character 28:0) also found in the *rufescens* clade) and the radial vein 1 (R1) without spinules (character 43:0, G. *rufidulus* presents the derived state). This group is restricted to the Southern South America; inhabiting the Chilean *Nothofagus* Forest (Coscarón & Coscarón-Arias 1995). This group was recovered with the concavity values from four to six and with linear parsimony (Figure 5).

The "*minor*" group is a paraphyletic group in relation to the "*multifilis*" group. Therefore, we considered the *Minor* subgenus constituted just by the "*minor*" + "*multifilis*" species groups. This clade is in agreement with Wygodzinsky & Coscarón (1989:63) and has a relatively high support (67%, Figure 6), because there is few contradictory evidence. The synapomorphic character is the terminal hook slender (character 33:1). Two homoplastic transitions support this clade (Figure 4), the length/width ratio of the antenna terminal sensillum (character 5:1 also present in *shannoni* group) and the anal scales not completing a perianal ring (character 13:0). The *Minor* subgenus is also recovered under implied weights using concavity values of one and four to six (Figure 5).

The "*cilicinus*" and "*wrighti*" groups as defined by Wygodzinsky & Coscarón (1989) are not monophyletic, because the characters used by these authors to define these groups are homoplastic and incongruent with the topology. Some species of these "groups" constitute the monophyletic group *shannoni*. This group is composed by the *G. shannoni, G. pennipunctus, G. incomitatus, G. bettyae* and *G. septenarius* species (see Figure 4). This group has a relatively low support (34%, Figure 6), because only the homoplastic character length/width ratio of the antenna terminal sensillum (character 5:1 also present in *Minor* subgenus) supports this relationship. This group is also recovered using implied weights with the concavity values of five and six (Figure 5).

Relationship among of groups

Coscarón & Miranda-Esquivel (1998) proposed a hypothesis of relationship among *Gigantodax* groups; they found that the *igniculus* group was the basal group of *Gigantodax*. This result is concordant with our analysis with linear parsimony and implicit weights with concavity values from four to six (Figures 4 and 5).

As Coscarón & Miranda-Esquivel (1998) used only type species of the groups, they could not formulate hypothesis of monophyly of the groups, which was an objective of our study. We propose the following hypothesis of monophyly of the groups of *Gigantodax*.

The *destitutus* clade is composed by the *cormonsi* group plus some "*cilicinus*" and "*wrighti*" species. The support of this group is low (34%) because the characters that did support the node were all homoplastic transitions (Figure 6). These characters are the frontoclypeus with verrucose platelets (character 30:0 also is present in *G. awa* and *G. multituberculatus*) and the thorax with verrucose platelets (character 32:0, also present in *G. awa* and *G. multituberculatus*) (Figure 4).

The *rufescens* clade is composed by the *shannoni* group plus the *destitutus* clade. The *rufescens* clade has a relatively low support (34%) because is supported only by homoplastic characters. The five homoplastic transitions are: terminal filaments (character 23:1), gill cuticular process (character 24:1), facial trichomes like hairs (character 28:0), subtriangular subbasal tooth of the claw (character 50:2), and the ventral plate with smoothly bilobed apical shape (character 54:0) (Figure 4).

The *Fulvescens* subgenus is composed by the "*brophyi*", "*cilicinus*", "*wrighti*" and *cormonsi* groups. This taxon has a relatively high support (45%), because of the scarce contradictory evidence and the congruence of characters that supported the group. This group is supported by the synapomorphy rigid gill branches (character 18:2) except the species *G. brophyi, G. viannamartinsi* with the flexible branches and *G. incomitatus, G. mariobordai, G. bettyae, G. septenarius,* and *G. aquamarensis* with the semirrigid branches (Figure 4). This group is also supported by two homoplastic transitions, 17-18 terminal branches of the gill (character 22:1) and the subbasal tooth of the claw subrhomboidal (character 50:3). The *Fulvescens* subgenus is also present under implied weights using any concavity value from four to six (Figure 5).

Effect of eliminated quantitative and cytogenetical characters of the analysis:

We evaluated the effect of the removal of quantitative characters from the analysis and noticed the lacking of the monophyly for the genus, due to the change in the optimization of the characters. The characters that support the *Gigantodax* clade are collapsed at the expense of gaining characters with less homoplasy.

The qualitative characters only maintained the monophyly of the "*minor*", *brophyi*, and *cormonsi* groups and *Igniculus* subgenus. The remaining groups ("*multifilis"*, *shannoni* groups; the *destitutus*, *rufescens* clades; and the *Fulvescens* subgenus) were collapsed.

We observed the lack of relationships among the species groups (Figure 5, Table 2), the topology of linear parsimony with total evidence recovered as 25 (100%) nodes, the analysis of qualitative characters recovered only 8 (32%) of the nodes shown in the total evidence topology. The analysis with qualitative characters recovered two unique nodes which did not contradict the topology of the total evidence analysis (Table 2).

Cranston & Humphries (1988) recommended excluding quantitative data from the analysis in order to decrease the homoplasy. In our analyses when the quantitative characters were eliminated, the retention index incremented from 0.65 to 0.69, which shown that the homoplasy decreases, but due to the effect of removing characters

(Rae 1998). There is not a solid base for the elimination of quantitative characters from the analysis (Rae 1998).

The quantitative characters are useful for differentiating some species since the *Gigantodax* adults are very homogeneous in external and genital morphology. For instance, the larvae of *G. paramorum, G. ortizi* and *G. multituberculatus* are separated by the ratio of antennal segment, large/width ratio of antenna terminal sensillum and number of mandible serrulations and others. Therefore, we considered that the quantitative characters give support to the clades and both (qualitative and quantitative) characters provide the most resolved cladogram (Table 2).

In the same way, we evaluated the effect of removing cytogenetical characters, observing that these characters did not support any clade (see Figure 4), because the evidence is weak (there are data only for the 15% of the species and this evidence does not support groups). However, we observed that after eliminating the cytogenetical characters, the morphological evidence maintains only 10 of the 25 (40%) recovered nodes with the total evidence analyses, as well as the groups *brophyi* and *cormonsi* and the *Igniculus* subgenus (Table 2 and Figure 5). This analysis presents two uniques nodes that shown the relationship within the species of the *brophyi* group (Table 2). Another interesting result is that the relationships among the species groups are lost (Figure 5).

Then, the relationship within species groups and the monophyly of the groups presented in this study must be used with caution, because 85% of the species did not have cytogenetical information. The question marks in the matrix can lead to the generation of multiple equally most parsimonious cladograms generating spurious cladogram (Platnick et al 1991b). We preferred the topology of linear parsimony with cytogenetical and morphological information because it shows all the actual evidence available and has the highest resolution.

In summary, we concluded that classifications based on non-cladistic approaches to systematics are less informative than those based on cladistic relationships because the former often recognize non-monophyletic clusters of species, such as occurs with *Gigantodax* groups presented by Wygodzinsky & Coscarón (1989).

Given the cladogram, we suggest to divide *Gigantodax* in three monophyletic subgenera: *Igniculus*, *Minor* and *Fulvescens*. The last subgenus is conformed by three species groups *brophyi*, *shannoni*, *cormonsi*; and two clades *destitutus*, and *rufescens*. According to the relationship among the *Fulvescens* subgenus species, we observed that the *shannoni* group is more related to the *destitutus* clade. Most of unplaced species were either known only from one or two life-stages or because the morphological information is not enough. Thus in orders to clarify the relationship among the species groups, additional studies are needed, including morphological of all stages, cytogenetical and molecular approaches. Although our results are preliminary, the monophyly of the groups of *Gigantodax* and the relationship between the groups are based in the most parsimonious cladogram, which is the less refuted with actual evidence, and "this cladogram is only the focus of the next round of testing, and so it goes" (Kluge 1997:93).

Taxonomy

Based on the relationships depicted in the cladogram we propose the following subgenus: *Igniculus*, *Minor* and *Fulvescens.* The taxonomy of the subgenus is given below with the subgeneric diagnosis and details of the component species.

Subgenus ***Igniculus*** Coscarón & Wygodzinsky 1962

Type species: *Gigantodax igniculus* Coscarón & Wygodzinsky, 1962: 296. Vulcano, 1967: 3; 1977: 290. [Incorrect gender]. Coscarón & Miranda-Esquivel, 1998: 161.

Diagnosis. – In the larva the mandible with 2-15 marginal serrations. In the pupae the cephalic apotome widest near middle, the cocoon coverage only the abdomen and the presence of the gill terminal filaments. In the adult the aedeagal membrane with strong spinules, some of them basally fused. The subgenus includes the following two species that have been assigned to the *igniculus* group: *G. igniculus* Coscarón & Wygodzinsky 1962, *G. carmenae* Wygodzinsky & Coscarón 1989.

Etymology:

After the name type specie of the *igniculus* group nominated by Wygodzinsky & Coscarón 1989.

Subgenus ***Minor*** Wygodzinsky & Coscarón 1989

Type species: *Gigantodax minor* Wygodzinsky & Coscarón 1989, 1989:54. Coscarón & Miranda-Esquivel, 1998: 161.

Diagnosis. – In the larvae the length/width ratio from 6 to 8 of the antenna terminal sensillum, the anal scales not completing a perianal ring. The terminal hooks of the pupa slender.

This subgenus comprises the following five species that have been assigned to the *minor* and *multifilis* group: *G. bolivianus* Enderlenin 1925, *G. araucanius* Edwards 1931, *G. minor* Wygodzinsky & Coscarón 1989, *G. eremicus* Wygodzinsky & Coscarón 1989 and *G. multifilis* Wygodzinsky & Coscarón 1989.

Etymology:

After the name type specie of the *minor* group nominated by Wygodzinsky & Coscarón 1989.

Subgenus ***Fulvescens*** Blanchard 1852

Type species: *Simulium fulvescens* Blanchard, 1852: 353.

Simulium (*Gigantodax*) *fulvescens*: Edwards, 1931: 137.

Gigantodax fulvescens: Wygodzinsky, 1961a: 460; 1961b: 563. Vulcano, 1967: 3; 1977: 290.

Diagnosis. – In the pupae the rigid gill branches, the 17-18 terminal branches of the gill. In the adult the subbasal tooth of the claw subrhomboidal. This subgenus includes the following species: *G. siberianus* Wygodzinsky & Coscarón 1989, *G. vulcanius* Wygodzinsky & Coscarón 1989, *G. praealtus* Wygodzinsky & Coscarón 1989, *G. cormonsi* Wygodzinsky & Coscarón 1989, *G. leonorum* Wygodzinsky & Coscarón 1989, *G. wygodzinskyi* Moncada, de Hoyos & Bueno 1981, *G. brevis* Wygodzinsky & Coscarón 1989, *G. misitu* Wygodzinsky & Coscarón 1989, *G. gracilis* Wygodzinsky & Coscarón 1989, *G. abalosi* Wygodzinsky 1958, *G. cypellus* Wygodzinsky & Coscarón 1989, *G. impossibilis* Wygodzinsky 1974, *G. herreri* Wygodzinsky & Coscarón 1989, *G. incapucara* Wygodzinsky & Coscarón 1989, *G. dryadicaudicis* Wygodzinsky & Coscarón 1989, *G. rufescens* Edwards 1931, *G. nasutus* Wygodzinsky & Coscarón 1989, *G. wrighti* Vargas, Martinez, & Díaz Nájera 1944, *G. corniculatus* Wygodzinsky 1974, *G. cervicornis* Wygodzinsky 1974, *G. aquamarensis* De Leon 1945, *G. horcotiani* Wygodzinsky 1949, *G. cilicinus* Wygodzinsky & Coscarón 1989, *G. clandestinus* Wygodzinsky & Coscarón 1989, *G. arrarteorum* Wygodzinsky & Coscarón 1989, *G. basinflatus* Wygodzinsky & Coscarón 1989, *G. destitutus* Wygodzinsky & Coscarón 1989, *G. septenarius* Wygodzinsky & Coscarón 1989, *G. bettyae* Wygodzinsky 1974, *G. mariobordai* Wygodzinsky & Coscarón 1989, *G. incomitatus* Wygodzinsky & Coscarón 1989, *G. pennipunctus* Wygodzinsky & Coscarón 1989, *G. shannoni* Edwards 1931, *G. trifidus* Wygodzinsky & Coscarón 1989, *G. antarcticus* Bigot 1888, *G. femineus* Edwards 1931, *G. rufidulus* Wygodzinsky & Coscarón 1989, *G. brophyi* Edwards 1931, *G. kuscheli* Wygodzinsky 1952, *G. marginalis* Edwards 1931, *G. fulvescens* Blanchard 1852, *G. chilensis* Philippi 1865, *G. osornorum* Muñoz de Hoyos, Martínez, Mejía & Bueno 1995, *G. zumbahuae* Wygodzinsky & Coscarón 1989, *G. laevigatus* Wygodzinsky & Coscarón 1989, *G. patihuaycensis* Wygodzinsky & Coscarón 1989, *G. multituberculatus* Wygodzinsky & Coscarón 1989, *G. ortizi* Wygodzinsky 1974, *G. viannamartinsi* Ramírez Pérez 1980, *G. paramorum* Wygodzinsky & Coscarón 1989, *G. awa* Wygodzinsky & Coscarón 1989, *G. flabellus* Wygodzinsky & Coscarón 1989, *G. luispenai* Wygodzinsky & Coscarón 1989.

Etymology:

After the name of the first described *Gigantodax* species.

ACKNOWLEDGEMENTS

We acknowledge S. Coscarón kindly loaned us material of *Gigantodax* and *Cnesia*. Useful comments on the manuscript were provided by S. Coscarón, D. Currie and S. Arias**.** The first author thank the Instituto de Ciencias Naturales, Universidad Nacional de Colombia witch kindly permitted to revise the *Gigantodax* material; the laboratory of Biología Reproductiva de Vertebrados for the hospitality and to the Simuliidae in special to *Gigantodax* specie for has a passionate morphology. This research is part of the first author undergraduate dissertation presented at the Universidad Industrial de Santander, Escuela de Biología. Dr. M. P. Ramírez Pinilla and M. Torres helped with the English grammar. The second author is much indebt to DIF-UIS 5112 and Colciencias.

REFERENCES

Coscarón, S. & Coscarón-Arias. (1995) Distribution of Neotropical Simuliidae (Insecta. Diptera) and its areas of endemism. *Revista de la Academia Colombiana de Ciencias* 19: 717-732.

Coscarón, S. & Miranda-Esquivel, D. R. (1998) *Pedrowygomyia*, a new Neotropical prosimuliini genus (Simuliidae: Diptera): *Gigantodax s. lat.* split into two genera. *Entomologica Scandinavica* 29 (2): 161-167.

Coscarón, S. (1991) Fauna de agua dulce de la República Argentina. Insecta. Diptera. Simuliidae. Vol. 38 (2): 1-134. Buenos Aires.

Coscarón-Arias. (1998) The Polytene Chromosomes of *Cnesia Dissimilis* (Edwards) and three Species of *Gigantodax* Enderlein (Diptera: Simuliidae) from Lanin National Park (Argentina). *Memorias do Instituto Oswaldo Cruz*, Río de Janeiro 93 (4): 445-458.

Cranston, P. & Humphries, C. (1988) Cladistics and computers: a chironomed conundrum? *Cladistics* 4: 72-92.

Crosskey, R. W. & Howard, T. M. (1997) *A new Taxonomic and geographical Inventory of world Blackflies (Diptera: Simuliidae)*. 144 pp. London.

Currie, D. C. & Grimaldi, D. (2000) A new black fly (Diptera: Simuliidae) genus from mid Cretaceous (Turonian) amber of New Jersey. Pp. 473-485 *in* Grimaldi, D.:

Studies on fossils in amber, with particular reference to the Cretaceous of New Jersey. Blackhuys Publishers, Leiden.

Currie, D. C. (1988) Morphology and Systematics of primitive Simuliidae (Diptera: Culicomorpha). Ph. D. Thesis Dissertation. University of Alberta. Canada. 330 pp.

Goloboff, P. A. & Farris, J. S. (2001) Methods for quick consensus estimation. *Cladistics* 17: S26-S34.

Goloboff, P. A. (1997) Self-weighted optimization: tree searches and character state reconstructions under implied transformation cost. *Cladistics* 13: 225-245.

Goloboff, P. A. (1998) *NONA/PEE-WEE Version 2.0*. Software implementation, Manual published by author. Available at www.cladistics.com.

Kluge, A. G. 1997 Testability and the refutation and corroboration of cladistic hypotheses. *Cladistics* 13: 81-96.

Maddison, W.P. & Maddison, D.R. 2004. Mesquite: A Modular Programming System for Evolutionary Analysis. Available at http://www.mesquiteproject.org.

Mickevick, M. F. & Johnson, M. F. (1976) Congruence between morphological and allozyme data. *Systematic Zoology* 25: 260-270.

Moreno-R. (1990) Estudios citogenéticos de *Gigantodax ortizi* Wygodszinsky, 1973 (Diptera: Simuliidae) de la región de Chisacá. B. Sc. dissertation. Universidad Nacional de Colombia, Facultad de Ciencias, Departamento de Biología, Bogotá. 61pp.

Moulton, K. (2000) Molecular sequence data resolves basal divergences within Simuliidae (Diptera). *Systematic Entomology* 25: 95-113.

Muñoz de Hoyos, P. (1995) Género *Gigantodax* (Diptera: Simuliidae) en Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 19: 607-629.

Muñoz de Hoyos, P., Martínez, X., Mejía, A. & Bueno, M. L. (1994) Simúlidos (Diptera: Simuliidae) de la Región de Chisacá, Cundinamarca, Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 9 (73): 393-412.

Nixon, K. C. (1999) The Parsimony ratchet, a New Method for Rapid Parsimony Analysis, *Cladistics* 15 (4): 407-414.

Nixon, K. C. (2002). *WinClada Version 0.99*. Sofware implementation. Published by the author. Ithaca. New York.

Platnick, N. I., Griswold, C. E. & Coddington, J. A. (1991b) On missing entries in cladistic analysis. *Cladistics* 7: 337-343.

Py-Daniel, V. & Moreira, R. T. (1994) *Jalacingomyia* gen. n. (Culicomorpha); a ressurreição de Gymnopaidinae; a eliminação do nivel tribal; a presentação de novos caracteres e a redescrição dos estágios larval e pupal de *Simulium colombaschense* (Fabricius, 1787) (Diptera: Simuliidae). Memorias del *CAICET* 4 (1-2): 101-148.

Py-Daniel, V. (1990) Revisão da tribo Prosimuliini seg. Crosskey (Diptera, Culicomorpha, Simulidae) nas Regiões Zoogeográficas Neártica e Neotropical (Larvas e Pupas). Ph. D. Thesis dissertation. Instituto da Amazônia, Manaus. 334 pp.

Rae, T. (1998) The logical Basis for the use of Continuous Characters in Phylogenetic Systematics *Cladistics* 14: 221-228.

Ramirez, M. J. (1999) Revisión filogenética de los géneros de arañas de la subfamiia Amaurobioidinae (Anyphaenidae). Ph. D. Thesis Dissertation. UBA.

Rubtsov, I. A. (1989) Fauna of the USSR diptera. Volume 6, Part 6. Blackflies (Simuliidae). 1042 pp. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Swofford, D. L. & Olsen, E. J. (1990) Phylogeny reconstruction. Pp 411-501 *in* Hillis, D. M. & Moritz : *Molecular systematics*. Sinauer Associates. Sunderland.

Turner, H. & Zandee, R. (1995) The behaviour of Goloboff`s tree fitness measure F. *Cladistics* 11: 57-72.

Wygodzinsky, P. & Coscarón, S. (1989) Revision of the black fly genus *Gigantodax* (Diptera: Simuliidae*). Bulletin of the American Museum of Natural History* 189: 1-269.

Zar, J. H. (1999) Biostatistical analysis. 663 pp. Ptentice Hall. Upper Saddle River.

Figure list

Table 1. Average number of recovered nodes after Jackknife with integer concavity values from one to six under implicit weights and linear parsimony analysis (EW). [*significance $p<0.05$]

Table 2. Number of Recovered nodes with the different tests performed, the values show the shared and unique nodes. The shared nodes number was rescaled with respect to the total evidence nodes and the unique nodes number was rescaled with respect to the number of nodes in the respective analysis.

Table 1.

Concavity value	Average of the shared consensus nodes
1	**0,424***
2	0,309
3	0,212
4	0,240
5	0,243
6	0,267
EW	0,076

Table 2.

	Total evidence	Total evidence without quantitative evidence		Total evidence without cytogenetical evidence	
		Shared nodes	**Unique nodes**	**Shared nodes**	**Unique nodes**
Total nodes recovered	25	8	2	10	2
Percentage respect to total evidence	100%	32%	20%	40%	17%

Figure list

Figure 1. Idiogram comparisons for chromosome I for species included in the chromosomic analysis. CYP: *G. cypellus*; BAS: *G. basinflatus*; BRE: *G. brevis*; OSO: *G. osornorum*; ORT: *G. ortizi*. Relative positions of markers are shown. C, centromere; NOR, nucleolar organizer region; Cp, capsule; H, heavy; Tp, trapezoidal, Basal 3 and M1. Solid brackets on left indicate fixed inversions; those on the right are floating inversions.

Figure 1.1. Idiogram comparisons of chromosome I for species included in the chromosomic analysis. PRO: *Prosimulium*; CNE: *Cnesia*; MAR: *G. marginalis*; CHIL: *G. chilensis*; FUL: *G. fulvescens*. Relative positions of markers are shown. C, centromere; NOR, nucleolar organizer region and basal 3. Solid brackets on left indicate fixed inversions; those on the right are floating inversions.

Figure 2. Idiogram comparisons of chromosome II for species included in the chromosomic analysis. CYP: *G. cypellus*; BAS: *G. basinflatus*; BRE: *G. brevis*; OSO: *G. osornorum*; ORT: *G. ortizi*. Relative positions of markers are shown. C, centromere; RB, ring Balbiani; b, bubble; M3; M4; PB, paraBalbiani; Jg, Jagged; DNA; GB, gray band . Solid brackets on left indicate fixed inversions; those on the right are floating inversions.

Figure 2.1. Idiogram comparisons of chromosome II for species included in the chromosomic analysis. PRO: *Prosimulium*; CNE: *Cnesia*; MAR: *G. marginalis*; CHIL: *G. chilensis*; FUL: *G. fulvescens*. Relative positions of markers are shown. C, centromere; RB, ring Balbiani; b, bubble; M3; M4; PB, paraBalbiani; Jg, Jagged; DNA; GB, gray band . Solid brackets on left indicate fixed inversions; those on the right are floating inversions.

Figure 3. Idiogram comparisons of chromosome III for species included in the chromosomic analysis. CYP: *G. cypellus*; BAS: *G. basinflatus*; BRE: *G. brevis*; OSO: *G. osornorum*; ORT: *G. ortizi*. Relative positions of markers are shown. C, centromere; B, Blister; H, Heavy; Mb, basal marker; 3 HG, three heavy groups and F, frazzled end. Solid brackets on left indicate fixed inversions; those on the right are floating inversions

Figure 3.1. Idiogram comparisons of chromosome III for species included in the chromosomic analysis. PRO: *Prosimulium*; CNE: *Cnesia*; MAR: *G. marginalis*; CHIL: *G. chilensis*; FUL: *G. fulvescens*. Relative positions of markers are shown. C, centromere; B, Blister; F, frazzled end; Sh, shield. Solid brackets on left indicate fixed inversions; those on the right are floating inversions.

Figure 4. The strict consensus of 578 equally parsimonious trees using linear parsimony search and total evidence. Initial trees of 275 steps (CI=0.40 RI=0.65). The conventions of the groups in the topology are I (*igniculus*), M (*minor*), MM (*multifilis*), B (*brophyi*), Ci (*cilicinus*), W (*wrighti*) and Co (*cormonsi*). The groups former is referring to the groups considered by Wygodzinskyi & Coscarón (1989).

Figure 5. “Sensivity” tree for the tree shown in Fig.4. The numbers in the nodes indicate the concavity values (1-6) that recovered the node. The symbols means the recovered clades (* indicates total evidence, △ total evidence without quantitative characters and ○ total evidence without cytogenetic characters). The conventions of the groups are the same as in the figure 4.

Figure 6. The relative Bremer support values for the tree shown in Figures 4. The values were calculated with linear parsimony, retaining 32000 suboptimal trees, 36 steps longer in NONA. The conventions of the groups are the same as in the figure 4.

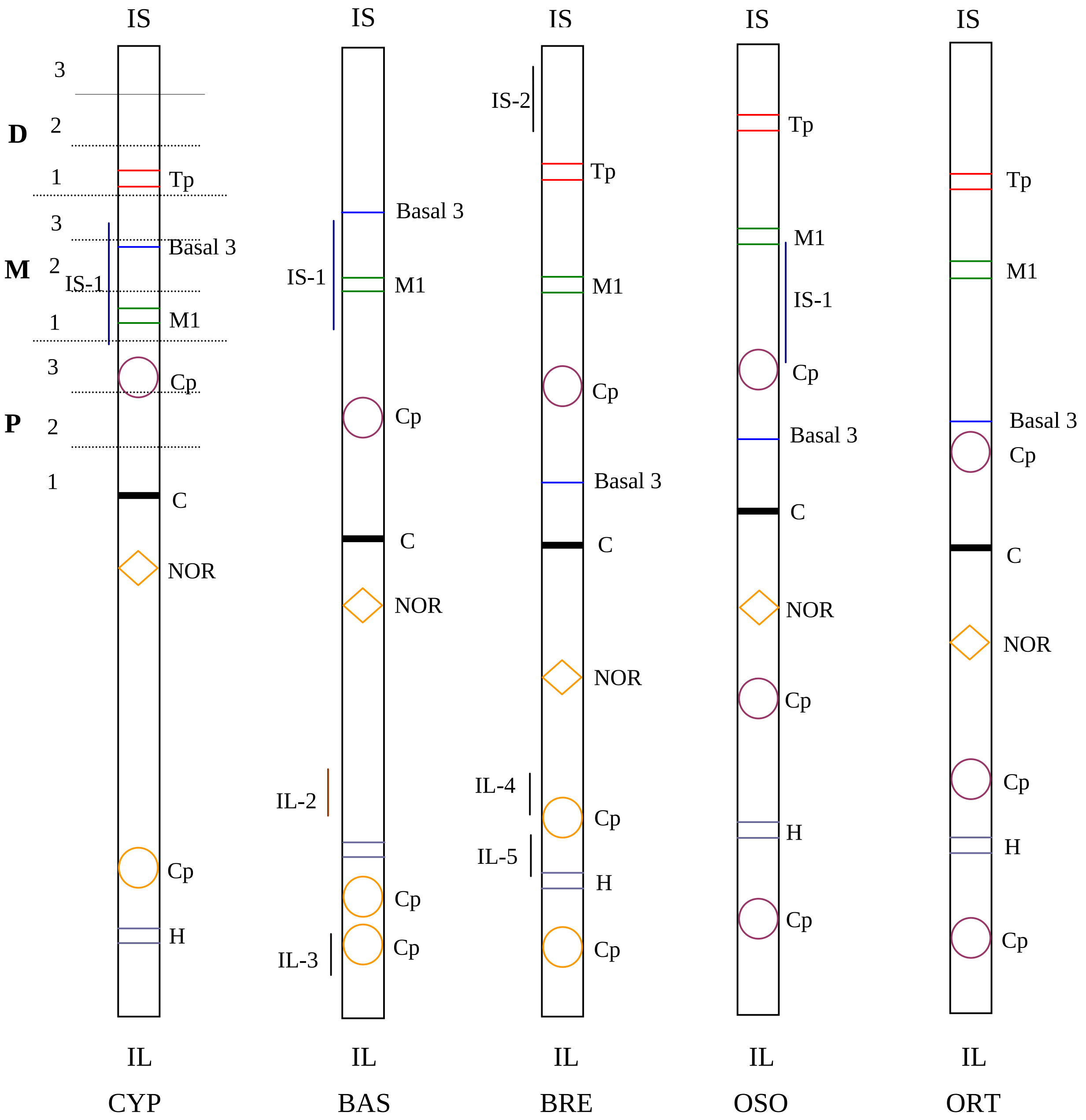
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Figure 1.

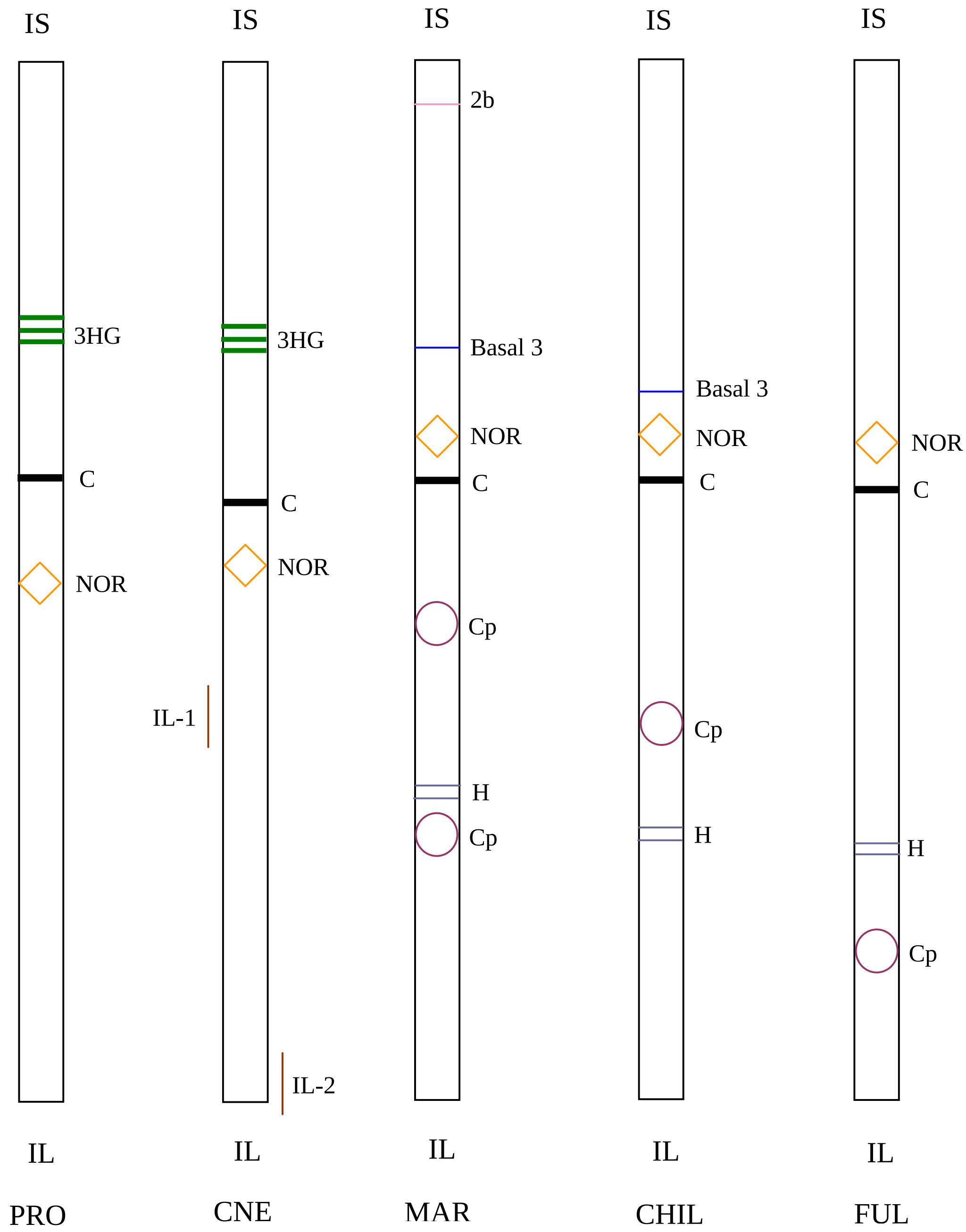
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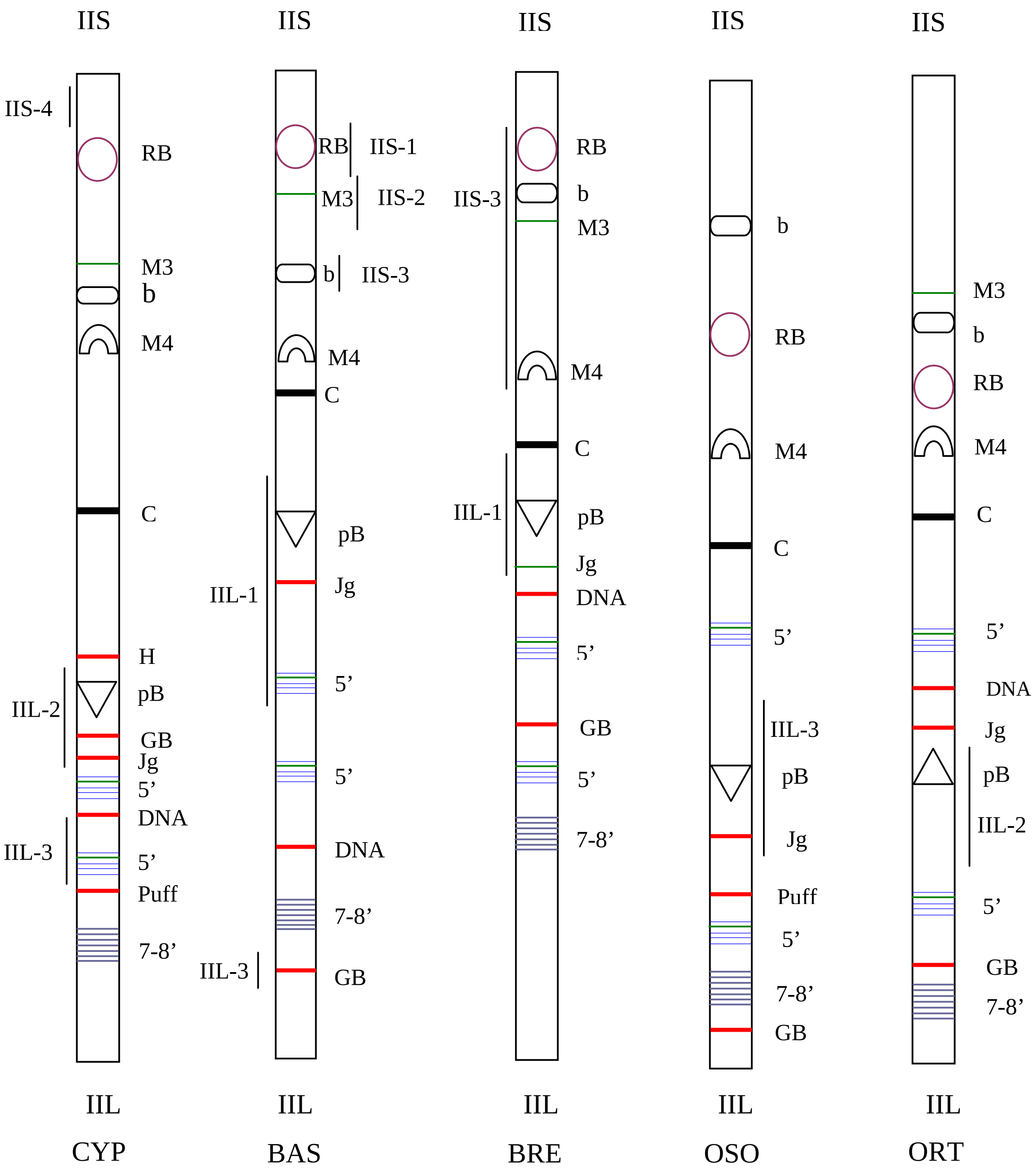
Figure 1.1.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IIL-3
5’
Puff
7-8’
RB
IIS-1
M3
IIS-2
b
IIS-3
M4
C
IIL-1
pB
Jg
5’
5’
DNA
7-8’
IIL-3
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M3
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Figure 2.

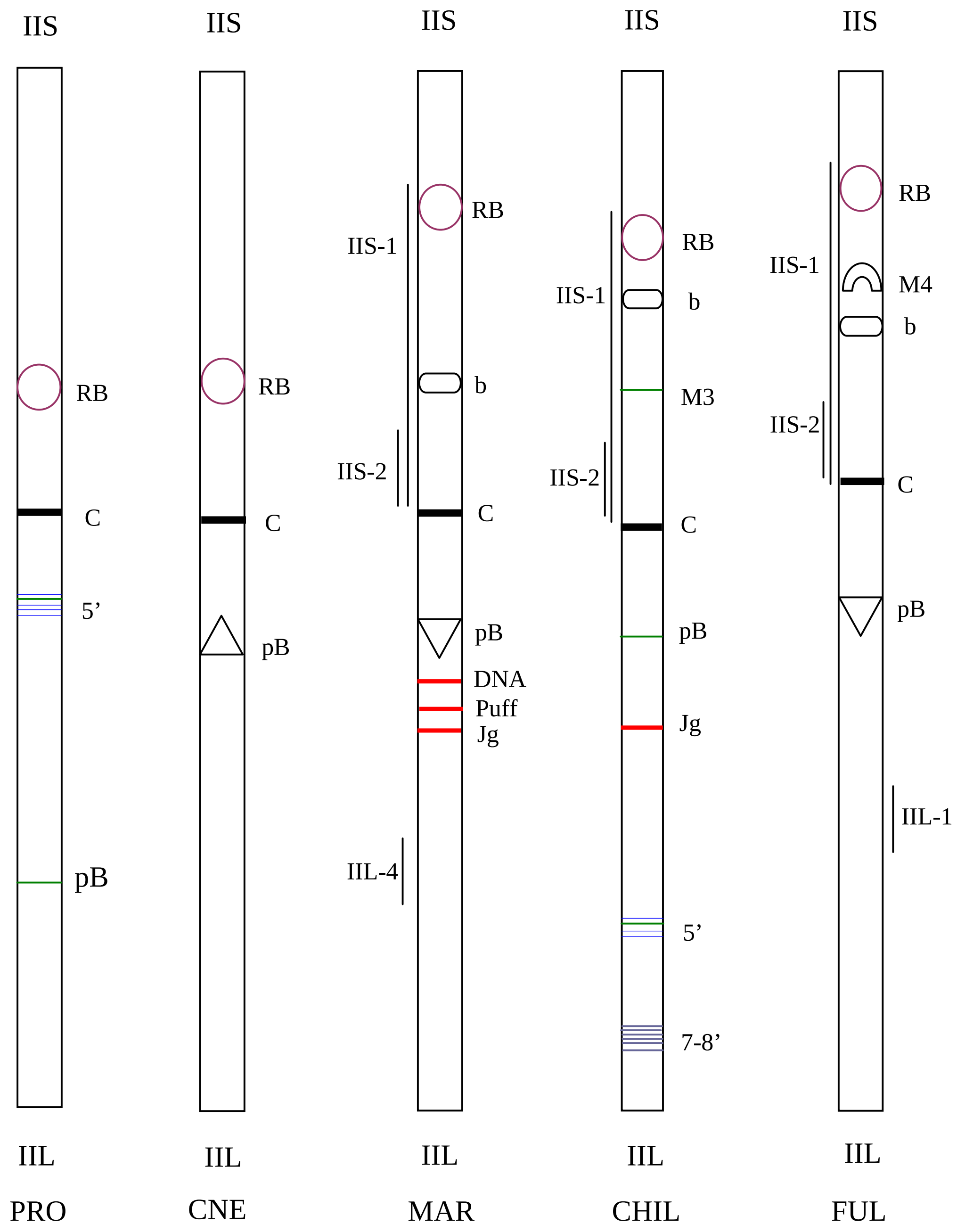
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Figure 2.1.

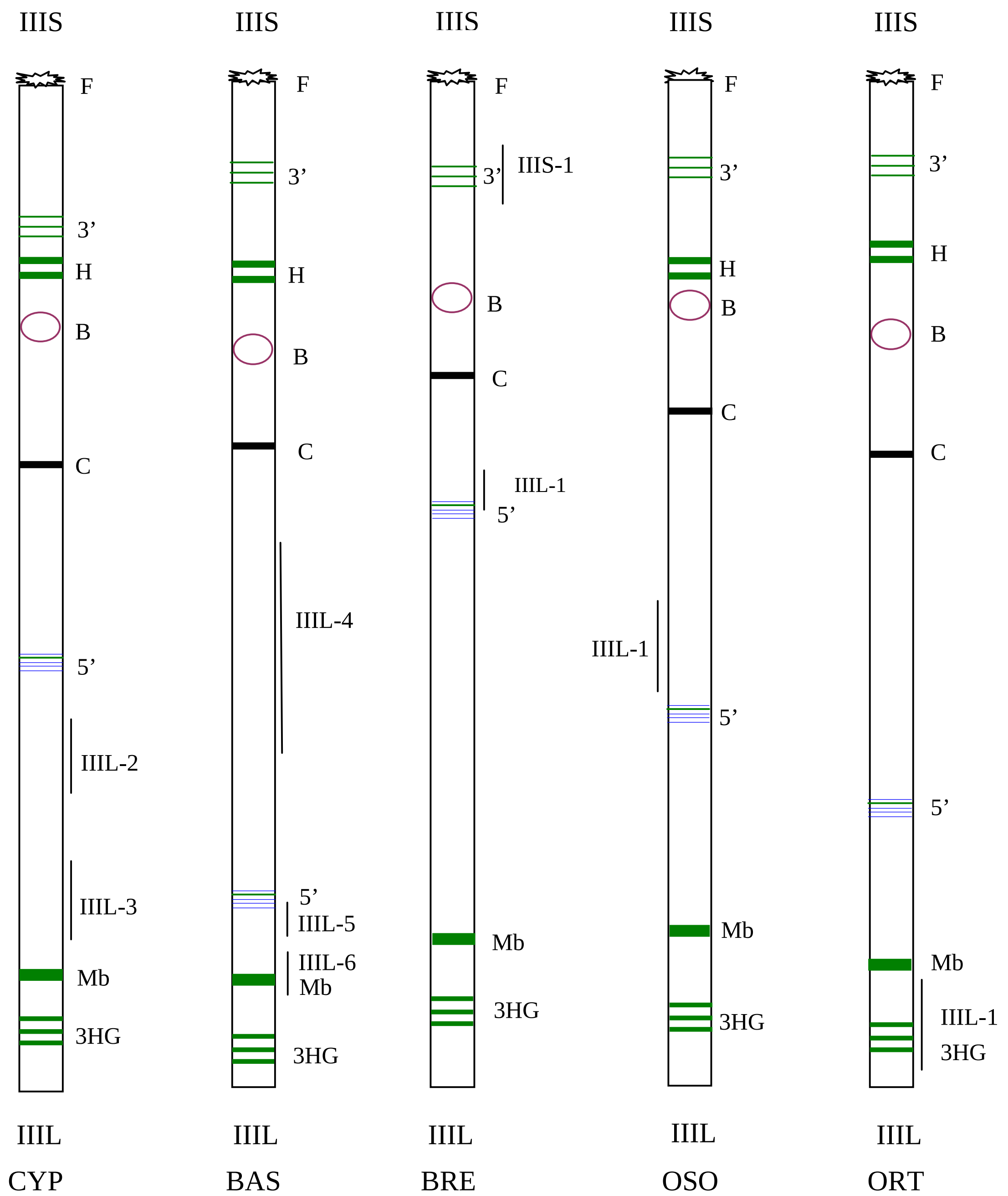

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Figure 3.

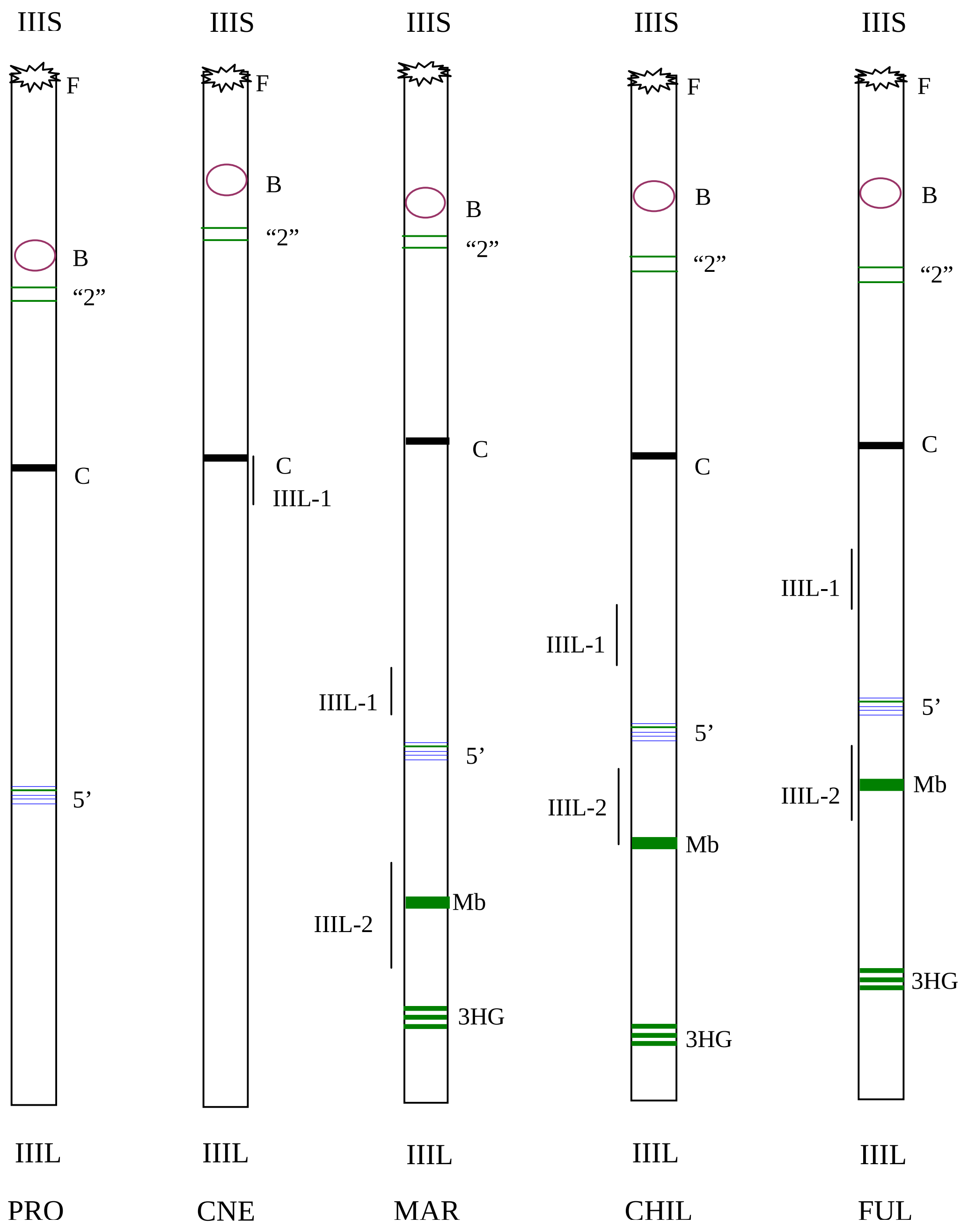
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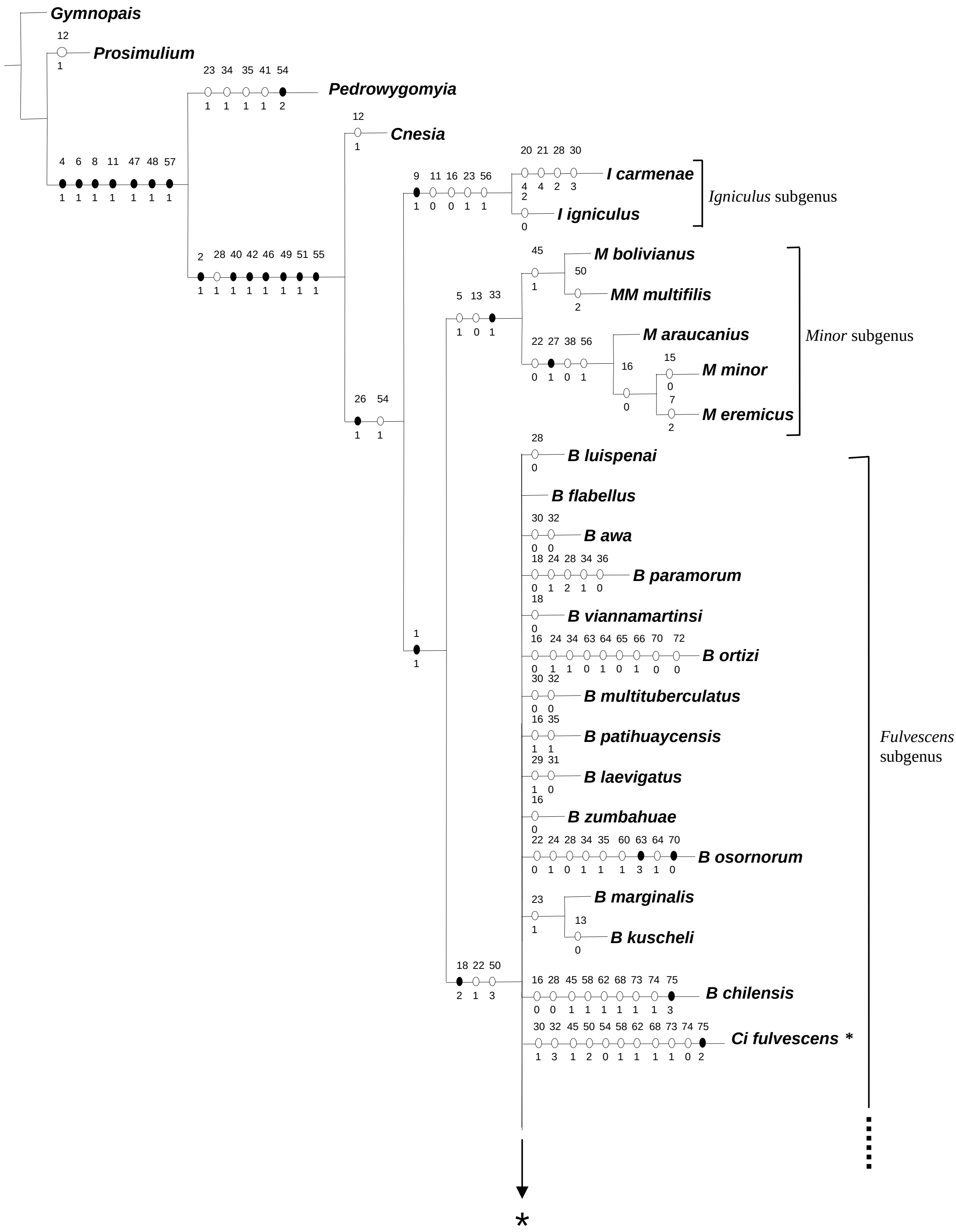
Figure 3.1.



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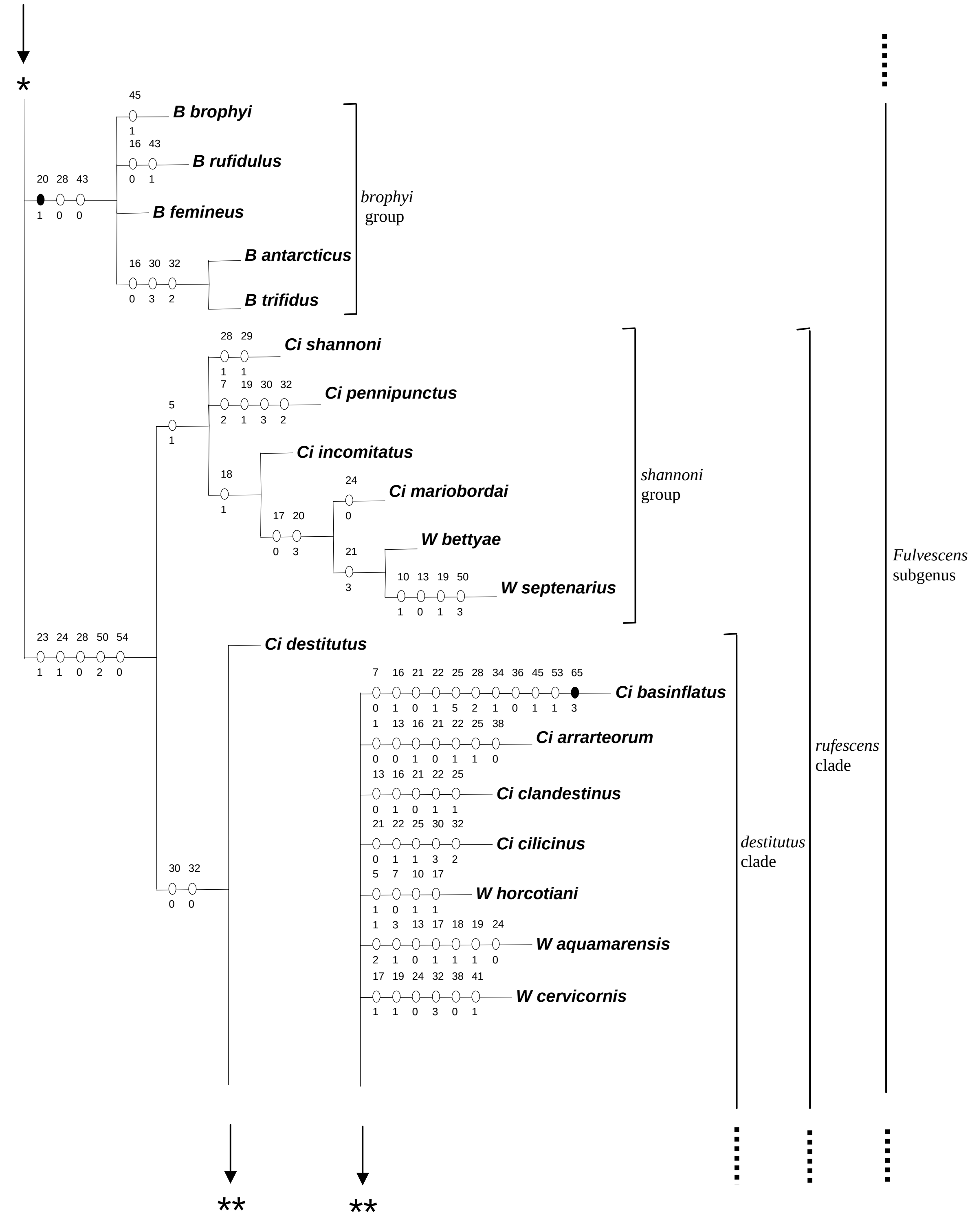
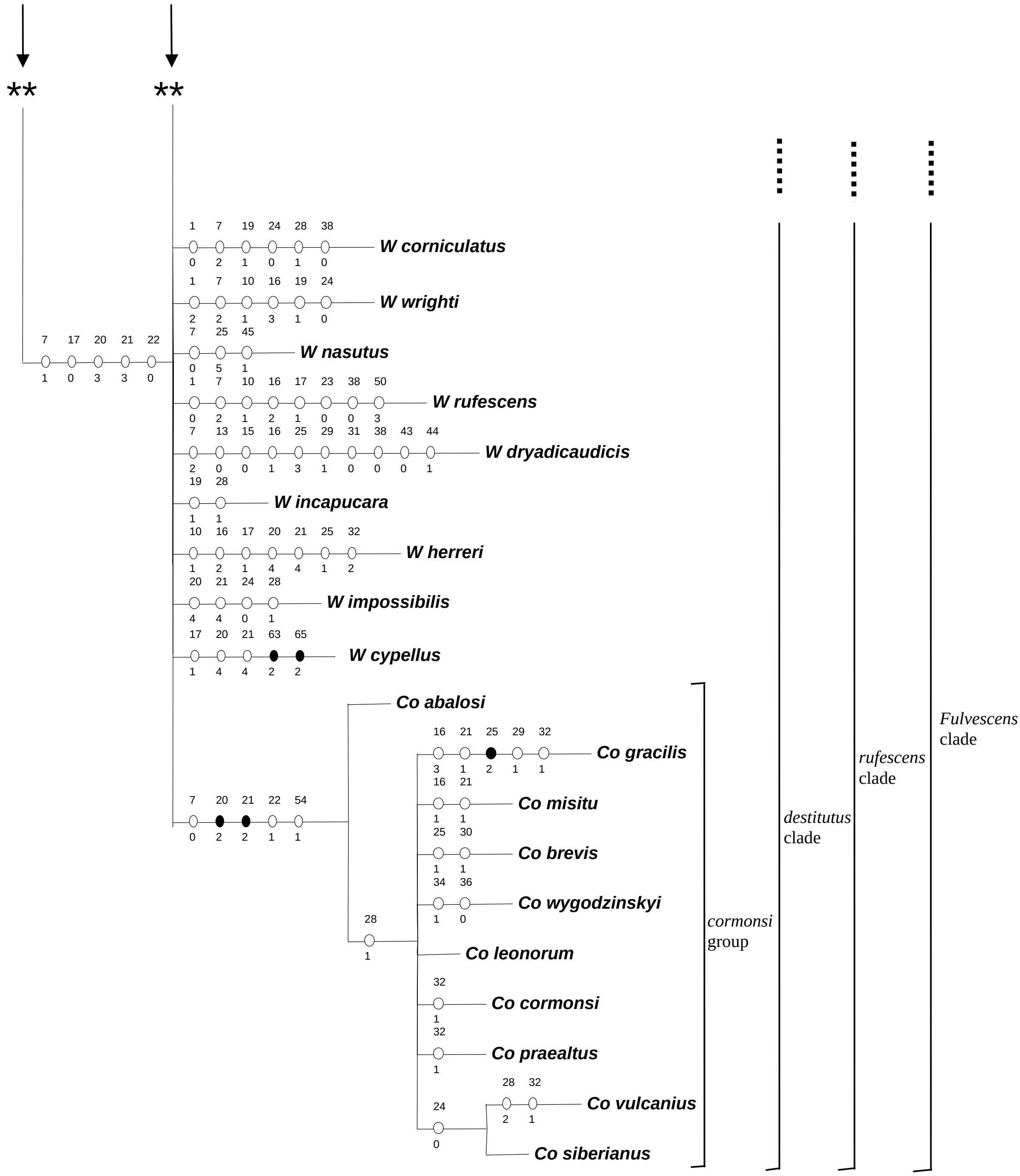


Figure 4. Continued in the next page.


**
**
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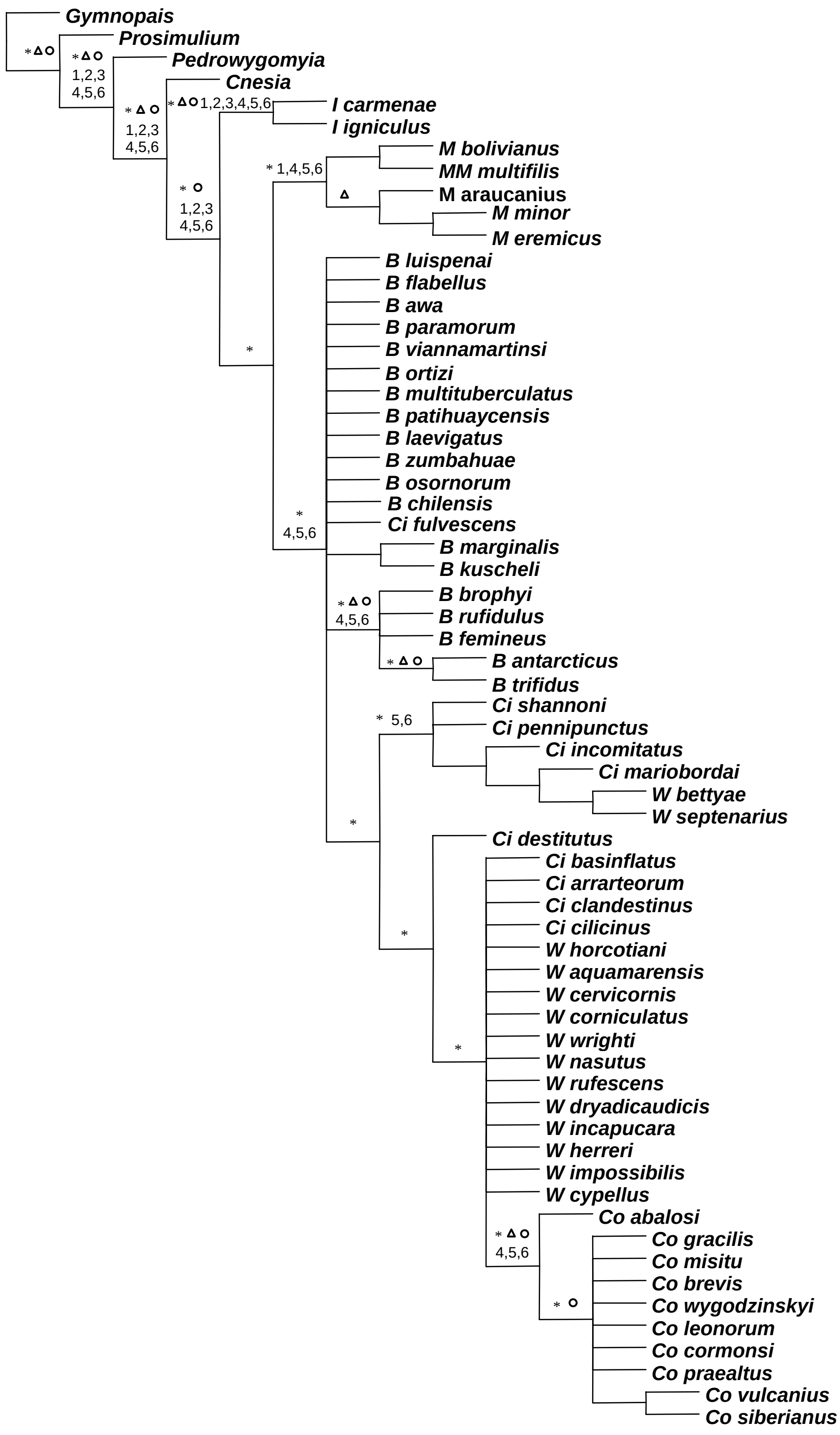
W wrighti
W nasutus
W rufescens
W dryadicaudicis
W incapucara
W herreri
W impossibilis
W cypellus
Co abalosi
Co gracilis
Co misitu
Co brevis
Co wygodzinskyi
Co leonorum
Co cormonsi
Co praealtus
Co vulcanius
Co siberianus
cormonsi group
destitutus clade
rufescens clade
Fulvescens clade

Figure 4.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Prosimulium
Pedrowygomyia
Cnesia
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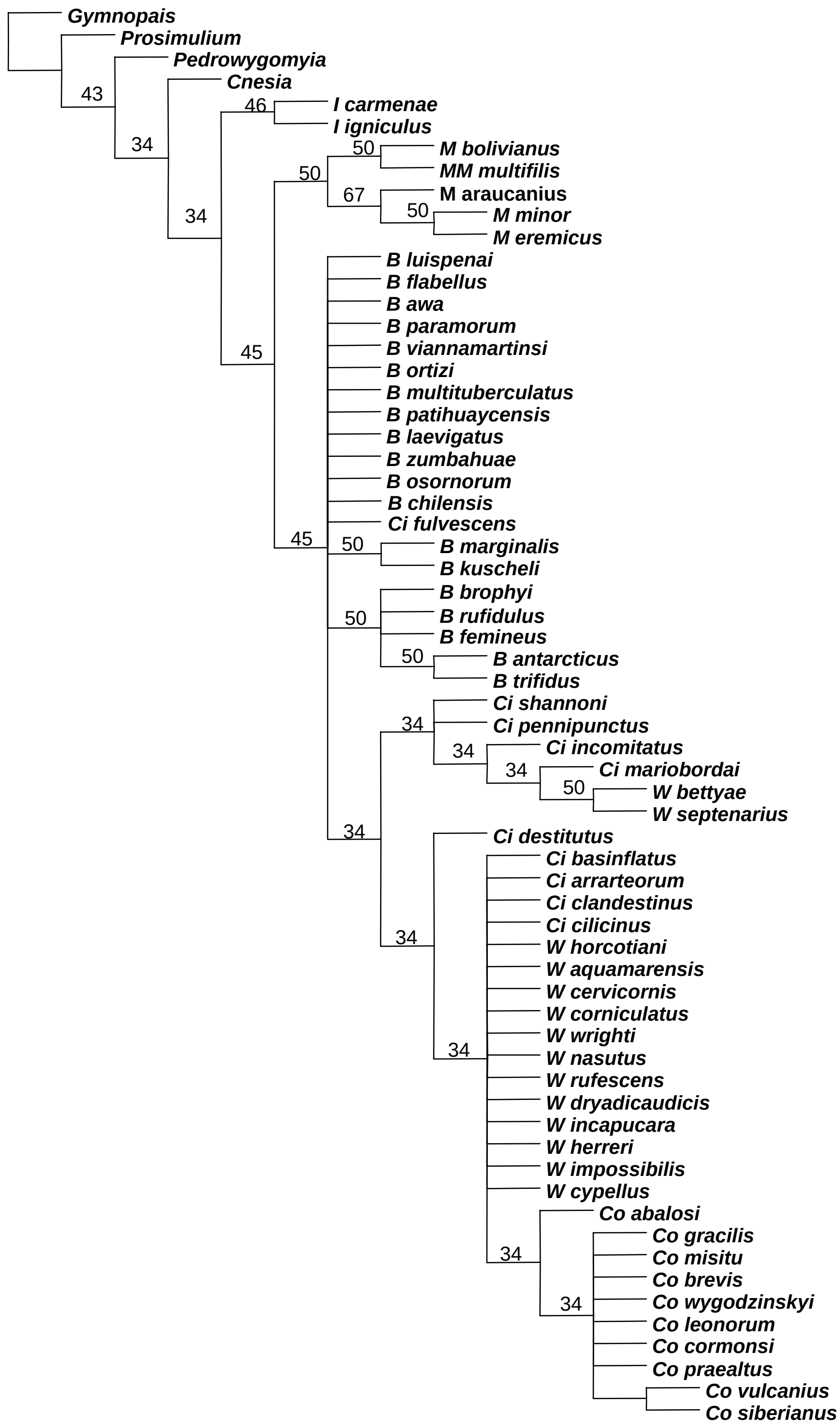
M bolivianus
MM multifilis
M araucanius
M minor
M eremicus
B luispenai
B flabellus
B awa
B paramorum
B viannamartinsi
B ortizi
B multituberculatus
B patihuaycensis
B laevigatus
B zumbahuae
B osornorum
B chilensis
Ci fulvescens
B marginalis
B kuscheli
B brophyi
B rufidulus
B femineus
B antarcticus
B trifidus
Ci shannoni
Ci pennipunctus
Ci incomitatus
Ci mariobordai
W bettyae
W septenarius
Ci destitutus
Ci basinflatus
Ci arrarteorum
Ci clandestinus
Ci cilicinus
W horcotiani
W aquamarensis
W cervicornis
W corniculatus
W wrighti
W nasutus
W rufescens
W dryadicaudicis
W incapucara
W herreri
W impossibilis
W cypellus
Co abalosi
Co gracilis
Co misitu
Co brevis
Co wygodzinskyi
Co leonorum
Co cormonsi
Co praealtus
Co vulcanius
Co siberianus
1,2,3
4,5,6
1,2,3,4,5,6
1,4,5,6
5,6

Figure 5.


Gymnopais
Prosimulium
Pedrowygomyia
Cnesia
I carmenae
I igniculus
M bolivianus
MM multifilis
M araucanius
M minor
M eremicus
B luispenai
B flabellus
B awa
B paramorum
B viannamartinsi
B ortizi
B multituberculatus
B patihuaycensis
B laevigatus
B zumbahuae
B osornorum
B chilensis
Ci fulvescens
B marginalis
B kuscheli
B brophyi
B rufidulus
B femineus
B antarcticus
B trifidus
Ci shannoni
Ci pennipunctus
Ci incomitatus
Ci mariobordai
W bettyae
W septenarius
Ci destitutus
Ci basinflatus
Ci arrarteorum
Ci clandestinus
Ci cilicinus
W horcotiani
W aquamarensis
W cervicornis
W corniculatus
W wrighti
W nasutus
W rufescens
W dryadicaudicis
W incapucara
W herreri
W impossibilis
W cypellus
Co abalosi
Co gracilis
Co misitu
Co brevis
Co wygodzinskyi
Co leonorum
Co cormonsi
Co praealtus
Co vulcanius
Co siberianus
43
34
34
46
50
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67
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45
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34
34

Figure 6.

Appendix list

Appendix 1. Material examined. ICN= Instituto de Ciencias Naturales. Bogotá. Colombia. MLP=Museo de la Plata. La Plata. Argentina.

Appendix 2. Morphologic and cytogenetic character list and coding.

Appendix 3. Data matrix used in the analysis, all characters coded as unordered. ?=not scored, - = inapplicable. The conventions of the groups are the same as in the figure 4.

Appendix 1.

CILICINUS GROUP

Gigantodax destitutus

In slide: Larva: Colombia. Cundinamarca. Albán. Vía Alban-Sasaima (Km. 90). 2095 m. 16-IV-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1238). Larva: Colombia. Cundinamarca. San Antonio del Tequendama. Hidroeléctrica del Salto. 2040 m. 28-III-95. Coll. C. Moreno. Det. P. Muñoz. (ICN-1786). Larva: Colombia. Cundinamarca. Aguadita. Río Blanco. 1930 m. 16-IX-91. Coll. P. Muñoz. Det. P. Muñoz. (ICN-2438a), (ICN-2438b). Larva: Colombia. Cundinamarca. Aguadita. Río Blanco. 1930 m. 20-II-95. Coll. C. Moreno. Det. P. Muñoz. (ICN-2429). Exhuvia: Colombia. Cundinamarca. Santandercito. Quebrada San Juan. 1900 m. 28-III-95. Coll. C. Moreno. Det. P. Muñoz. (ICN-1783). In alcohol: 4 Larvae: Colombia. Cundinamarca. Albán. Vía Albán-Sasaima (Km. 90). 2095 m. 16-IV-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-1238). 1 Larva: Colombia. Cundinamarca. Albán. Vía Albán-Sasaima. (Km. 90). 2095 m. 16-IV-94. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1445). 1 Larva + 1 pupa: Colombia. Cundinamarca. Gacheta. Piqueteadero Campo Alegre. 1745 m. 19-XI-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-1516). 1 Pupa: Colombia. Cundinamarca. San Antonio del Tequendama. Zool. Santa Cruz. 1880 m. 6-IV-91. Coll. C. Moreno. Det. P. Muñoz. (ICN-1432).

Gigantodax basinflatus

In slide: Larva: Colombia. Boyacá. Páramo de Pisba. 3900 m. 13-VIII-76. Coll. M. Bueno. Det. P. Muñoz. (ICN-371), (ICN-373). Larva: Colombia. Boyacá. Páramo de Pisba. 3900 m. 13-VIII-76. Coll. L. Moncada. Det. M. Bueno. (ICN-372), (ICN-372). Larva: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 5-X-87. Coll. J. Campos. Det. P. Muñoz. (ICN-375). Larva: Colombia. Cundinamarca. Usme. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 15-III-89. Coll. J. Campos. Det. X. Martínez. (ICN-376). Larva: Colombia. Cundinamarca. La Marca. Neme. Chisacá. Las Ruinas. 3590 m. 5-X-87. Coll. J. Campos. Det. P. Muñoz. (ICN-375). Pupa: Colombia. Santander. Berlín-Vetas. Quebrada Hilada. 3590 m. 23-XI-95. Coll. R. Miranda. Det. P. Muñoz. (ICN-2024a). Male pupa:

Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso, Santa Helena. Vía Usme San Juan de Sumapaz (Km. 22-23). 3410 m. 10-VIII-87. Coll. C. Moreno. Det. P. Muñoz. (ICN-368). Male Pupa: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso, Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). 3410 m. 10-VII-87. Coll. X. Martínez & A. Mejía. (ICN-369). Female adult: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso, Santa Helena. Vía Usme San Juan de Sumapaz (Km. 22-23). 3900 m. 10-VIII-87. Coll. X. Martínez. Det. P. Muñoz. (ICN-370). In alcohol: 1 Larva: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada La Brecha. 3410 m. 7-VI-94. Coll. R. Miranda. Det. P. Muñoz. (ICN- 1435). 1 Larva: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VI-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-1442). 5 Larvae: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 8-XII-90. Coll. L P. Muñoz. Det. P. Muñoz. (ICN-206). 2 Larvae: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 2-V-89. Coll. V. Acero. Det. P. Muñoz. (ICN-521). 2 Larvae: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). 3410 m. 10-VI-87. Coll. J. Campos. Det. P. Muñoz. (ICN-503). 27 Larvae: Colombia. Cundinamarca. Vía Bogotá-Choachí. Río Teusacá. 3270 m. 23-X-93. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1044). 1 pupa: Colombia. Cundinamarca. Vía Bogotá-Choachí. Río Teusacá. 3270 m. 14-V-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-1190). 1 pupa: Colombia. Tolima. Cajamarca. Reserva Anaime. 3440 m. 7-VI-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1430). 1 female pupa: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VI-94. Coll. R. Miranda. Det. P. Muñoz.

Gigantodax fulvescens

In alcohol: 1 larva + 2 pupae: Argentina. Río Negro. Bariloche. Ao. Pulmaiquen. No altitude. 20-I-79. Coll. S. Coscarón. (MLP).

CORMONSI GROUP

Gigantodax siberianus

In slide: Larva: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda El Brasil. Vía Usme-San Juan de Sumapaz. 3240 m. 17-IV-89. Coll. C. Moreno. Det. P. Muñoz. (ICN- 444). Larva: Colombia. Cundinamarca. Usme. Vereda El Hato. Río Chisacá. Hacienda El Hato. Vía Usme-San Juan de Sumapaz (Km. 17). No altitude. 23-No month-89. Coll. V. Acero. Det. X. Martínez. (ICN-445). Pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Río Chisacá, Ruinas. Vía Usme San Juan de Sumapaz (Km. 27). 3590 m. 16-II-91. Coll. X. Martínez. A. Mejía & M. Bueno. (ICN- 443).

Gigantodax wygodzinskyi

In slide: Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 14-III-78. Coll. L. Moncada, et al. Det. P. Muñoz. (ICN-469), (ICN-470), (ICN-471), (ICN-472). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 11.XI-76. Coll. P. Muñoz & M. Bueno. Det. P. Muñoz. (ICN-489). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 8-VI-76. Coll. L. Moncada, et al. Det. P. Muñoz (ICN-490). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 5-I-77. Coll. L. Moncada & M. Bueno. Det. P. Muñoz. (ICN-491). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 15-IV-77. Coll. L. Moncada & P. Muñoz. Det. P. Muñoz. (ICN-492). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 15-IV-77. Coll. M. Bueno. Det. P. Muñoz. (ICN-493). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 14-III-77. Coll. L. Moncada, et al. Det. P. Muñoz. (ICN-473), (ICN-494). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 14-IV-77. Coll. P. Muñoz. Det. P. Muñoz. (ICN-495). Larva: Colombia. Boyacá. Páramo de Pisba. 3900 m. 13-VIII-76. Coll. L. Moncada. Det. P. Muñoz. (ICN-498). Larva: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda. El Brasil. Vía Usme San Juan de Sumapaz (Km. 20). 3240 m. 20-I-90. Coll. X. Martínez & A. Mejía. Det. P. Muñoz. (ICN-499). Larva: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso, Santa Helena. Vía Usme San Juan de Sumapaz (Km. 22-23). 3410 m. 6-II-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-488). Pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 1-VI-76. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic).

(ICN-463). Pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 8-VI-76. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-464). Pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 24-VIII-79. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-468). Pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 13-III-78. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-467). Pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 15-IV-77. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-465), (ICN-466).Male pupa: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. No date. Coll. M. Bueno. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-457). Female adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 14-I-76. Coll. M. Bueno. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-458). Female adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 12-III-77. Coll. L. Moncada, et al. Det. P. Muñoz. (“Paratopotipo”. Sic). (ICN-459), (ICN-460), (ICN-461), (ICN-446). Female adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 12-III-77. Coll. L. Moncada, et al. Det. P. Muñoz. (“Alotype”). (ICN-447). Male adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 9-XII-76. Coll. L. Moncada, et al. Det. P. Muñoz. (“Alotype”). (ICN-448). Male adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 12-III-77. Coll. L. Moncada, et al. Det. P. Muñoz. (“Alotype”). (ICN-449), (ICN-450). Male adult: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 28-IX-78. Coll. L. Moncada, et al. Det. P. Muñoz. (“Alotype”). (ICN-451), (ICN-452). In alcohol: 3 Larvae: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. No date. Coll. P. Muñoz. Det. P. Muñoz. (ICN-608). 12 Larvae: Colombia. Cundinamarca. Subachoque. 2663 m. 18-I-75. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1605). 2 Larvae: Colombia. Cundinamarca. Sibaté. Muga. Vía Sibaté–Aguadita (Km. 31-32). 2610 m. 16-XI-91. Coll. P. Muñoz. Det. P. Muñoz. (ICN-0083). 9 Larvae: Colombia. Cundinamarca. Sibaté. Muga. Vía Sibaté–Aguadita (Km. 31-32). 2610 m. 31-III-92. Coll. Sc. Det. P. Muñoz. (ICN-0081). 3 pupae: Colombia. Norte de Santander. Pamplona. Quebrada cerca a la Normal de Varones. 2287 m. 27-XII-77. Coll. Sc. Det. P. Muñoz. (ICN-605). 9 pupae: Colombia. Cundinamarca. La Calera Río Teusacá. 3025 m. 13-III-77. Coll. M. Bueno & L. Moncada. Det. P. Muñoz. (ICN-0078). 1 pupa: Colombia. Cundinamarca. Sibaté-Aguadita (Km. 31-32). 2610 m. No date. Coll. C. Moreno. Det. P. Muñoz. (ICN-1931). 1 pupa: Colombia. Cundinamarca. La Calera. Río

Teusacá. 3025 m. No date. Coll. P. Muñoz. Det. Sc. (ICN-606). 1 female pupa: Colombia. Cundinamarca. Sibaté. Muna. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 20-IV-96. Coll. C. Moreno. Det. P. Muñoz. (ICN-2201). 1 male pupa: Colombia. Cundinamarca. Sibaté. Muna. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 3-II-96. Coll. C. Moreno. Det. P. Muñoz. (ICN-2015), (ICN- 2016). 1 pupa + 1 female adult: Colombia. Cundinamarca. Sibaté. Muna. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 8-VII-95. Coll. C. Moreno. Det. P. Muñoz. (ICN-1919). 1 pupa + 1 male adult: Colombia. Cundinamarca. Sibaté-Aguadita (Km. 31-32). 2610 m. 21-IV-92. Coll. C. Moreno. Det. P. Muñoz. (ICN-080).

Gigantodax leonorum

In slide: Larva: Colombia. Boyacá. Sogamoso. El Crucero. 3130 m. 22-II-89. Coll. V. Acero. Det. P. Muñoz. (ICN-645). Larva: Colombia. Valle. Dagua. 1450 m. No day-V-84. Coll. M. Rojas. Det. P. Muñoz. (ICN-1591).

Gigantodax misitu

In slide: Larva: Colombia. Cundinamarca. Vía Bogotá-Choachí. Río Teusacá. 3270 m. 23-X-93. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1056). Larva: Colombia. Tolima. Reserva Anaime. Quebrada la Mina. 3500m. 7-VIII-94. Coll. R. Miranda. Det. P. Muñoz. (ICN-1511). Pupa + Female pharate: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 16-II-91. Coll. V. Acero. Det. A. Mejía. (ICN-402). In alcohol: 11 Larvae: Colombia. Cundinamarca. Vía Bogotá-Choachí. Río Teusacá. 3270 m. 23-X-93. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1039). 1 Larva + 1 pupa: Colombia. Cundinamarca. Río Teusacá-Choachí. No altitude. 14-V-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1191). 1 pupa: Colombia. Tolima. Cajamarca. Reserva Anaime. 3530m. 7-VIII-94. Coll. R. Miranda. Det. P. Muñoz. (ICN-1353).

Gigantodax brevis

In slide: Larva: Colombia. Boyacá. Páramo de Pisba. 3900m. 13-VIII-76. Coll. L. Moncada. Det. M. Bueno. (ICN-393). Larva: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Honda, El brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 13-VIII-76. Coll. C. Moreno. Det. M. Bueno. (ICN-394).

Larva: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 17-IV-89. Coll. X. Martínez & A. Mejía. Det. M. Bueno. (ICN-395). Female pupa: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Onda, El Brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 2-V-89. Coll. P. Muñoz. Det. P. Muñoz. (ICN-391). Female pupa: Colombia. Cundinamarca. Marca-Usme. Vereda El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 8-XII-90. Coll. X. Martínez & A. Mejía. Det. X. Martínez. (ICN-392). Female pupa: Colombia. Cundinamarca. Usme. Vereda el Hato, Río Chisacá, Hacienda el Hato. Vía Usme-San Juan de Sumapaz. (Km. 17). 3150 m. 9-V-88. Coll. X. Martínez & A. Mejía. Det. P. Muñoz. (ICN-388). Male pupa: Colombia. Cundinamarca. Usme. Vereda el Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz (Km. 27). 3590 m. 8-XII-90. Coll. X. Martínez & A. Mejía. Det. X. Martínez. (ICN-387). In alcohol: 4 Larvae: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 17). No altitude. 9-V-87. Coll. C. Moreno. Det. P. Muñoz. (ICN-169). 4 Larvae: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 27). 3590 m. 23-VI-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-303). 2 Larvae: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 17). 3150 m. IX-86. Coll. J. Campos. Det. P. Muñoz. (ICN-549). 2 Larvae: Colombia. Cundinamarca. Usme. Quebrada del Oso, Santa Helena. Vía Usme-San Juan de Sumapaz. (Km. 22-23). 3410 m. 3-IV-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-664). 2 Larvae: Colombia. Cundinamarca. Usme. Quebrada Hoya Honda, El Brasil. 3240 m. 15-V-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-665). 2 pupae: Colombia. Cundinamarca. Usme. Quebrada del Oso, Santa Helena. Vía Usme-San Juan de Sumapaz. (Km. 22-23). 3410 m. 23-I-89. Coll. P. Muñoz. Det. P. Muñoz. (ICN-195). 4 pupae: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 27). 3590 m. 29-VI-91. Coll. A. Mejía. Det. P. Muñoz. (ICN-196). 1 pupa: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 27). 3590 m. 1-IV-91. Coll. V. Acer. Det. P. Muñoz. (ICN-302). 1 pupa: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 27). 3590 m. 15-V-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-202). 1 pupa

+ 1 adult: Colombia. Cundinamarca. Usme. El Hato, Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. (Km. 27). 3590 m. 1-IV-91. Coll. V. Acer. Det. P. Muñoz. (ICN-663).

WRIGHT GROUP

Gigantodax cervicornis

In slide: Larva: Colombia. Norte de Santander. Pamplona. 2287 m. 4-I-87. Coll. L. Moncada. Det. L. Moncada. (ICN-400). Pupa: Colombia. Norte de Santander. Pamplona. 2287 m. No date. Coll. L. Moncada. Det. L. Moncada. (ICN-397). Pupa: Colombia. Cundinamarca. La Calera. 3025 m. 9-III-78. Coll. L. Moncada. Det. M. Bueno. (ICN- 399). Male Pupa: Colombia. Norte de Santander. Pamplona. 2287 m. 27-XII-76. Coll. L. Moncada. Det. P. Muñoz. (ICN-396). In alcohol: 1 Larva: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VIII-94. Coll. R. Miranda. Det. P Muñoz. (ICN-1443). 6 Larvae: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada Potosí. 3285 m. 7-VIII-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-1433). 8 Larvae: Colombia. Cundinamarca. Sibaté. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 20-II-95. Coll. P. Muñoz. Det. P. Muñoz. (ICN-0070). 4 pupae: Colombia. Tolima. Cajamarca. Río de Anaime. Quebrada La Mina. 3500 m. 7-VI-94. Coll. S. Coscarón. Det. P. Muñoz. (ICN-1427). 19 pupae: Colombia. Cundinamarca. Muna. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 31-III-92. Coll. P Muñoz. Det. P. Muñoz. (ICN-068). 8 pupae: Colombia. Norte de Santander. Pamplona. No altitude. 27-XII-76. Coll. L. Moncada. Det. P. Muñoz. (ICN-071). 6 pupae: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. No date. Coll. P. Muñoz. Det. P. Muñoz. (ICN-067). 3 pupae: Colombia. Santander. Berlín. Quebrada Hilada. 3590 m. 25-XI-95. Coll. P. Muñoz. Det. P. Muñoz. (ICN-2009). 1 pupa + 1female adult: Colombia. Cundinamarca. Muna. Vía Sibaté-Aguadita (Km. 31-32). 2610 m. 20-II-95. Coll. C. Moreno. Det. P. Muñoz. (ICN-1827).

Gigantodax septenarius

In slide: Larva: Colombia. Cundinamarca. Albán. Quebrada Garbanzal. 2265 m. 13-III-93. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1444). In alcohol: 4 Larvae: Colombia.

Cundinamarca. Albán. Quebrada Garbanzal. 2265 m. 13-III-93. Coll. P. Muñoz. Det. P. Muñoz. (ICN-1444).

Gigantodax cypellus

In slide: Larva: Colombia. Cauca. Vía Puracé-La Plata. Quebrada Cocuy. 3300 m. 24-I-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1154), (ICN-1155), (ICN-1156). In alcohol: 1 pupa: Colombia. Cauca. Vía Puracé-La Plata. Quebrada Cocuy. 3300 m. 24-I-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1113).

Gigantodax nasutus

In slide: Larva: Colombia. Cundinamarca. Marca. Usme. CH-O. Río Chisacá. No altitude. 19-VIII-89. Coll. R. Miranda. Det. P. Muñoz, X. Martínez & A. Mejía. (ICN-403).

MULTIFILIS GROUP

Gigantodax multifilis

In slide: Larva: Colombia. Tolima. Reserva Anaime. Quebrada Potosí. 3285 m. 7-VIII-94. Coll. S. Coscarón. (ICN-1500). Larva: Colombia. Boyacá. Tunja. Santuario de Flora y Fauna de Iguaque. Quebrada Carrizal. 2850 m. 12-IV-95. Coll. N. Pineda. Det. P. Muñoz. (ICN-2258), (ICN-2259), (ICN-2260). In alcohol: 2 Larvae: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada Potosí. 3285 m. 7-VIII-94. Coll. S. Coscarón. Det. P. Muñoz. (ICN-1437).

BROPHYI GROUP

Gigantodax zumbahuae

In slide: Larva + male adult: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada Potosí. 3290 m. 7-VIII-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1836). Larva + male adult: Colombia. Tolima. Cajamarca. Reserva Anaime. Quebrada Potosí. 3290 m. 7-VIII-94. Coll. R. Miranda. Det. P. Muñoz. (ICN-1449). In alcohol: 3 Larvae: Colombia. Tolima.

Cajamarca. Reserva Anaime. Quebrada Potosí. 3285 m. 7-VIII-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1441).

Gigantodax osornorum

In slide: Pupa: Colombia. Cundinamarca. Usme. Quebrada Oso. 3410 m. 23-I-89. Coll. P. Muñoz. Det. P. Muñoz. (ICN-529). In alcohol: 1 Larva. Colombia. Cundinamarca. Usme. Vereda El hato. Quebrada Hoya Honda, El Brasil. Vía Usme San Juan de Sumapaz. (Km. 20). 3240 m. 24-X-88. Coll. P. Muñoz. Det. P. Muñoz. (ICN-525). 2 Larvae: Colombia. Cundinamarca. Usme. Vereda El hato. Río Chisacá, Hacienda el Hato. Vía Usme San Juan de Sumapaz (Km. 17). 3410 m. 19-XI-89. Coll. P. Muñoz. Det. P. Muñoz. (ICN-565). 2 Larvae: Colombia. Cundinamarca. Usme. Vereda El hato. Quebrada Hoya Honda, El Brasil. Vía Usme San Juan de Sumapaz. (Km. 20). 3240 m. 19-IX-89. Coll. C. Moreno. Det. P. Muñoz. (ICN-509). 1 Larva: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso. Santa Helena. Vía Usme San Juan de Sumapaz. (Km. 22-23). 3410 m. 15-II-88. Coll. P. Muñoz. Det. P. Muñoz. (ICN- 506). 2 Larvae: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz. Km. 22-23. 3410 m. 6-VIII-94. Coll. S. Coscarón. Det. P. Muñoz. (ICN-1614).

Gigantodax multituberculatus

In slide: Larva: Colombia. Tolima. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VIII-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1512). Larva: Colombia. Tolima. Reserva Anaime. Quebrada Potosí. 3290 m. 7-VIII-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1835). Larva: Colombia. Boyacá. Aquitania. Cajón. Quebrada Pozos. 2970 m. 22-III-89. Coll. V. Acero. Det. P. Muñoz. (ICN-648), (ICN-1520). Pupa: Colombia. Boyacá. Tota. Quebrada Guachata. 3100 m. 20-III-89. Coll. J. Barrera. Det. P. Muñoz. (ICN-647). In alcohol: 1 Larva: Colombia. Tolima. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VIII-94. Coll. C. Moreno. Det. P. Muñoz. (ICN-1429). 3 Larvae: Colombia. Tolima. Reserva Anaime. Quebrada La Mina. 3500 m. 7-VIII-94. Coll. S. Coscarón. Det. P. Muñoz. (ICN-1436). 1 Larva: Colombia. Boyacá. Sogamoso. 3130 m. 22-III-89. Coll. V. Acero. Det. P. Muñoz. (ICN-1440). 1 pupa: Colombia. Tolima. Cajamarca. Vereda La Palma. Quebrada Perales. 2490 m. 26-II-96. Coll. C. Moreno. Det. P. Muñoz. (ICN-2053).

Gigantodax ortizi

In slide: Larva: Colombia. Cundinamarca. Subachoque. La Pradera. No altitude. 18-I-75. Coll. P. Muñoz. Det. M. Bueno. (ICN-426). Larva: Colombia. Boyacá. Páramo de Pisba. 3900 m. 13-VIII-76. Coll. M. Bueno. Det. P. Muñoz. (ICN- 427), (ICN- 428), (ICN- 429). Larva: Colombia. Boyacá. Páramo de Pisba. 3900 m. 13-VIII-76. Coll. M. Bueno. Det. L. Moncada. (ICN- 431). Larva: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 24-VIII-78. Coll. M. Bueno. Det. M. Bueno. (ICN-430). Female adult + Pupa: Colombia. Cundinamarca. La Marca. Usme. Chisacá2. Quebrada Hoya Honda. 3240 m. 15-VI-87. Coll. X. Martínez & A. Mejía. (ICN- 415). Female Pupa: Colombia. Cundinamarca. Chisacá. Quebrada Hoya Honda. 3240 m. 11-04-88. Coll. J. Campos. Det. M. Bueno. (ICN-416). Female Pupa: Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Hacienda el Hato. Vía Usme San Juan de Sumapaz (Km. 17). 3150 m. 9-V-88. Coll. X. Martínez & A. Mejía. Det. P. Muñoz. (ICN-417). Female Pupa: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). No altitude. 11-X-88. Coll. X. Mejía. (ICN-418). Female pupa: Colombia. Cundinamarca. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). 3410 m. 23-I-89. Coll. X. Martínez & A. Mejía. Det. M. Bueno. (ICN-419). Male pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda, El Brasil. Vía Usme-San Juan de Sumapaz. (Km. 20). 3240 m. 25-I-88. Coll. X. Martínez & A. Mejía. Det. P. Muñoz (ICN-404). Male pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda, El Brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 25-I-88. Coll. V. Acero. Det. P. Muñoz (ICN-405). Male pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda, El Brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 20-II-89. Coll. X. Martínez & A. Mejía. Det. M. Bueno. (ICN-407). Male pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda, El Brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 10-VIII-89. Coll. X. Martínez & A. Mejía. Det. X. Martínez. (ICN-408). Male pupa: Colombia. Cundinamarca. Usme. Vereda El Hato. Quebrada Hoya Honda, El Brasil. Vía Usme-San Juan de Sumapaz (Km. 20). 3240 m. 9-VII-90. Coll. X. Martínez & A. Mejía. Det. A. Mejía. (ICN-411). Male pupa: Colombia. Cundinamarca. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). 3410 m. 23-I-89. Coll. X. Martínez & A.

Mejía. Det. A. Mejía. (ICN-406). In alcohol: 6 Larvae: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Honda. El Brasil. Vía Usme-San Juan de Sumapaz. 3240 m. 10-XI-90. Coll. A. Mejía. Det. P. Muñoz. (ICN-183). 3 pupae: Colombia. Boyacá. Tota. Vereda Tobal. 3300 m. 20-III-87. Coll. I. Barrero. Det. P. Muñoz. (ICN- 1431). 1 Pupa: Colombia. Boyacá. Aquitania. Vereda Xajon. Quebrada los Pozos. 2970 m. 22-XI-89. Coll. V. Acero. Det. P. Muñoz. (ICN-1438). 2 pupae: Colombia. Cundinamarca. Vía Bogotá-Chipaque Km. 8-9. 2900 m. 17-IX-94. Coll. L. Arteaga. Det. P. Muñoz. (ICN-161). 2 pupae. Colombia. Cundinamarca. Usme. Vereda el Hato. Río Chisacá, Ruinas. Vía Usme-San Juan de Sumapaz. Km. 27. 3590 m. 15-V-89. Coll. V. Acero. Det. P. Muñoz. (ICN-201). 1 pupa + pupa female: Colombia. Cundinamarca. La Calera. Río Teusacá. 3025 m. 16-IV-76. Coll. P. Muñoz. Det. P. Muñoz. (ICN-074). 1 pupa + 1 female adult: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Honda. El Brasil. Vía Usme-San Juan de Sumapaz. 3240 m. 23-I-89. Coll. A. Mejía. Det. P. Muñoz. (ICN-666). 1 pupa + 1 female adult: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Honda. El Brasil. Vía Usme-San Juan de Sumapaz. 3240 m. 19-V-90. Coll. A. Mejía. Det. P. Muñoz. (ICN-182). 1 pupa + 1 female adult: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso. Santa Helena. Vía Usme-San Juan de Sumapaz. 3410 m. 30-IX-88. Coll. C. Moreno. Det. P. Muñoz. (ICN-076). 1 pupa + 1 female adult: Colombia. Cundinamarca. Usme. Vereda el Hato. Quebrada Hoya Honda. El Brasil. Vía Usme-San Juan de Sumapaz. 3240 m. 25-I-88. Coll. X. Martínez. Det. P. Muñoz. (ICN-179).

Gigantodax paramorum

In slide: Pupa: Colombia. Cundinamarca. Usme. Río Tunjuelo. 3010 m. 15-IX-86. Coll. J. Campos. Det. P. Muñoz. (ICN-919). Female adult: Colombia. Cundinamarca. Usme. Vereda Chisacá. Quebrada Oso, Santa Helena. Vía Usme-San Juan de Sumapaz (Km. 22-23). 3410 m. 23-I-89. Coll. P. Muñoz. Det. P. Muñoz. (ICN-530). In alcohol: 1 pupa: Colombia. Cundinamarca. Usme. San Juan de Sumapaz. (Km. 22-23). 3410 m. 13-IV-88. Coll. P. Muñoz. Det. P. Muñoz. (ICN-2208). 6 pupae: Colombia. Cundinamarca. Usme. Laguna Negra. 3650 m. 15-VI-87. Coll. X. Martínez & A. Mejía. Det. P. Muñoz. (ICN-616).

Gigantodax chilensis:

In alcohol: 3 larvae + 2 pupae: Argentina. Neuquén. S. M. de los Andes. Ao. Jaco. No altitude. 3-I-82. Coll. S. Coscarón. (MLP).

MINOR GROUP

Gigantodax minor

In alcohol: 1 pupa: Argentina. Argentina. Río Negro. Bariloche. Colonia Suiza. No altitude. 26-VI-89. Coll. S. Coscarón. (MLP).

IGNICULUS GROUP

Gigantodax igniculus

In alcohol: 2 larvae + 2 pupae: Argentina. Tierra de Fuego. No altitude. No day-no month-87 Coll. S. Coscarón & Wygodzinsky. (MLP).

Pedrowygomyia cortesi

In alcohol: 2 Larvae: Chile. Parinocota. Collo. 4200 m. 19-XII-80. Coll. D. Bobadilla. (ICN-2569).

1 larva + 1 pupa: Chile. Parinocota. Putre. 3600 m. 13-X-67. Coll. S. Coscarón. (MLP).

Cnesia dissimilis

In alcohol: 4 larvae + 6 pupae: Argentina. Chubut. Parque los Alerces. Ao. Centinelas. No altitude. 24-I-93. Coll. S. Coscarón. (MLP).

Appendix 2.

Abbreviations: W&C: 89 =Wygodzinsky & Coscarón (1989).

MORPHOLOGICAL CHARACTERS

LARVAE

1. Antenna, ratio between the second/first segment lengths; (0) 1.1-3 (Figs. 16g, 103 e, W&C:1989), (1) 0.4-0.9 (Figs. 61j, 46f, W&C:1989), (2) 1 (Figs. 40d, 48i, 50h, W&C:1989). Wygodzinsky & Coscarón (1989:8).

Wygodzinsky & Coscarón (1989) considered the state 0 as a diagnostic character for the *igniculus* group + *Pedrowygomyia*. Coscarón & Miranda-Esquivel (1998) considered this state as a plesiomorphic character due its presence in *Prosimulium*.

2. Antenna, ratio between the second/third segment lengths; (0) 1.2-1.4 (Figs. 22c, 4f, W&C:1989), (1) 0.2-0.9 (Figs. 40d, 46f, W&C:1989). Wygodzinsky & Coscarón (1989:8).

Coscarón & Miranda-Esquivel (1998) considered state 1, as a synapomorphic character for *Gigantodax* + *Cnesia*.

3. Antenna, ratio between the third/(first+second) segment lengths; (0) 0.6-0.9 (Figs. 72b, 83f, W&C:1989), (1) 1.1 (Figs. 26h, 30e, W&C:1989). Character # 3 in Wygodzinsky & Coscarón (1989:8).

Wygodzinsky & Coscarón (1989) considered the state 1 as a diagnostic character for *minor* group.

4. Antenna, colors; (0) larval antenna with the first and second articles unpigmented contrasted with the black third article (Fig. 58, Currie 1988), (1) larval antenna with the first and second articles pigmented uncontrasted with black third article (Figs. 7d, 16h, Wygodzinsky & Coscarón 1989). Character # 2 in Currie (1988:185).

Currie (1988) considered the state 0 as a synapomorphy for Prosimuliini (*sensu* Currie 1988). We codified *Gigantodax* and *Pedrowygomyia* as state 1, according to Currie (1988:185).

5. Antenna terminal sensillum, ratio length/width; (0) 2.8-5.5 (Figs. 153a, 154y, W&C:1989), (1) 6-8 (Figs. 86 b, 98b, W&C:1989). Character # 10, 16 in Coscarón (1991:36).
Wygodzinsky & Coscarón (1989) considered the character state 1 as a diagnostic character for *minor* group; this character is also found in the *multifilis* group and some species of the *wrighti* group.

6. Palpus, position and configuration of the maxillary palpal sensilla in the first-instar larva; (0) subapically and in a linear configuration (Fig. 60, Currie 1988), (1) apically and in a circular configuration. (Figs. 22e, 40f, W&C:1989). Character # 5 in Currie (1988:186).
Currie (1988) considered the state 0, as an apomorphic feature, due its presence in *Prosimulium* (s*ensu* Currie, 1988). We codified *Gigantodax* and *Pedrowygomyia* as state 1, according to Currie (1988).

7. Hypostomomial teeth (0) median tooth shorter than the corner tooth (Figs. 40i, 50i, W&C:1989) (1) median tooth longer than the corner tooth (Figs. 105m, 108d, W&C:1989), (2) median tooth as long as the corner tooth (Figs. 26 m, 98 d, W&C:1989). Character # 41 in Coscarón & Miranda-Esquivel (1998:163).
Wygodzinsky & Coscarón (1989) considered the state 1 as a diagnostic character for *Pedrowygomyia* + *igniculus* group (this character is also present in three species of the *cilicinus* group).
The state 2 is present in *wrighti* group species; this state is new for the present analysis.

8. Hypostomium; (0) without paralateral teeth (Fig. 28, Currie 1988), (1) with paralateral teeth (Figs. 26m, 40i, W&C:1989). Character # 3 in Currie (1988:186).
Currie (1988) considered the state 0 as a synapomorphy for *Prosimulium*. “The hypostoma of all other Simuliidae larvae possess one or more paralateral teeth, which are considered primitive” (Currie, 1988). We codified *Gigantodax* and *Pedrowygomyia* as state 1, according to Currie (1988).

9. Mandible, number of marginal serrations; (0) 2-15 (Figs. 30i, 40e, W&C:1989), (1) 16-30 (Figs. 16l, 22d, W&C:1989). Character # 1 in Coscarón (1991:34).

10. Cephalic capsule, width (mm); (0) 0.1-1.1, (1) 6-10.

11. Cephalic apotome, width; (0) widest near middle (Figs. 16b, 22a, W&C:1989), (1) widest near the base (Figs. 36a, 42h, W&C:1989). Character # 2 in Wygodzinsky & Coscarón (1989:8).

Wygodzinsky & Coscarón (1989) considered the state 0 as a diagnostic character for *igniculus* group. This character resemble other Prosimuliini genera (*sensu* Currie, 1988), as *Gymnopais.*

12. Gular cleft; (0) absent (Figs. 16d, 40c, 46e, W&C:1989), (1) present (Fig. 7n, Coscarón 1991). Character # 43 in Coscarón & Miranda-Esquivel (1998:163).

13. Anal scales, conformation; (0) not completing a perianal ring (Figs. 26p, 103j, W&C:1989), (1) forming a perianal ring (Figs. 22h, 40k, W&C:1989). Wygodzinsky & Coscarón (1989:8).

Wygodzinsky & Coscarón (1989) considered the state 0 as a diagnostic character for the *minor* group.

14. Anal sclerite; (0) without accessory ring (Fig. 6m, Coscarón 1991), (1) with accessory ring (Figs. 22h, 26p, W&C:1989). Character # 47 in Coscarón & Miranda-Esquivel (1998:163).

15. Anal sclerite, struts; (0) absent (Fig. 6m, Coscarón 1991), (1) present (Fig. 40k, W&C:1989). Character # 48 in Coscarón & Miranda-Esquivel (1998:163).

PUPAE

16. Cocoon, relative coverage on the body of the pupa (0) head and thorax free (Figs. 15b, 29a, W&C:1989), (1) head free (Figs. 20a, 93a, 101a, W&C:1989), (2) head, thorax and I,

II tergite free (Figs. 96a-b, W&C:1989), (3) respiratory organs free (Figs. 34, 53a, 63a, W&C:1989).

We considered the state 0 as thorax free even if the cocoon cover the base of the thorax. The state 2 abdomen free refers to tergites I and II free

17. Gill branches, ramification; (0) at the peduncle base (Fig. 120a, W&C:1989), (1) above peduncle base (Fig. 70d, W&C:1989).

In this character the base is the peduncle support. We considered the species *G. destitutus, G. basinflatus, G. arrarteorum* and *G. clandestinus* as state 1.

18. Gill branches, flexibility; (0) flexible (Figs. 3b, 20c, 29a, W&C:1989), (1) semirigid (Figs. 55a-b, W&C:1989), (2) rigid (Figs. 39a, 42a, 45a-f, 48a, 53a-e, 82a-h, W&C:1989).

19. Gill branches, surface; (0) smooth (Figs. 20d, 45h, 85c, W&C:1989), (1) wrinkled (Fig. 155h, W&C:1989).

20. Gill branches, arrangement; (0) branches independent, not forming groups (Figs. 105a-d, 107b-d, W&C:1989), (1) branches independent, with two or three distinct groups (Figs. 39c, 48c, 50f, W&C:1989), (2) branches often fused, making a shield-like structure (Figs. 116a, 131a, 135b, W&C:1989), (3) tube like structure (Figs. 107d, 139a-c, 141a-c, 155a-f, W&C:1989), (4) globose (Fig. 15b, W&C:1989). Character # 7 in Wygodzinsky & Coscarón (1989:7).

This character is referring to the disposition of the gill branches, the fusion of the gill branches in globose, tubular or shield structures is assumed.

21. Gill branches, reduction; (0) free branches gill (Figs. 66a, 70a, W&C:1989), (1) indicated by a series of irregularly shaped perforations (Figs. 111a, 113e W&C:1989), (2) indicated by rows of small perforations (Figs. 116a, 120c, 122a-b, 124c-e, 127d, 129e, W&C:1989), (3) indicated by some prominent short protuberances (Figs. 148a-c, 155a-g, 156a-d, W&C:1989), (4) indicated by the branches of the gill forming a spherical structure (Figs. 15b, 172b, W&C:1989).

According to Wygodzinsky & Coscarón (1989:183), the rows of perforations in the shield are considered the evidence of fusion branches. The short protuberances with apical respiratory filaments are interpreted by Wygodzinsky & Coscarón (1989:230) as strongly reduced branches.

22. Terminal branches of the gill, number; (0) 1-14 (Figs. 25b, 29b, 139a, 140b, 156a, W&C:1989), (1) 17-18 (Figs. 39d, 42b, 50f, 58a, 82b, 107b, 111a, 119d, W&C:1989), (2) 35-40 (Fig. 6 b, Coscarón 1991), (3) more than 55 (Figs. 3b, 15b, 20c, 35a, W&C:1989). Character # 31 in Coscarón & Miranda-Esquivel (1998:163).

According to Wygodzinsky & Coscarón (1989) more than 55 filaments defined the *igniculus, multifilis* groups and *Pedrowygomyia*.

23. Terminal filaments; (0) absent (Fig. 11a, W&C:1989), (1) present (Figs. 116a, 131a, 135b, W&C:1989).

The filaments are terminal prolongations very slender and caducous of the gill. This characteristic difference the terminals filaments from the terminals branches of the gill.

24. Gill cuticular process; (0) absent (Figs. 64n, 63e, W&C:1989), (1) present (Figs. 70c, 101c, W&C:1989). Character # 37 in Coscarón & Miranda-Esquivel (1998:163).

Wygodzinsky & Coscarón (1989) recognized the *multifilis* group by the state 1.

25. Gill cuticular process, shape; (0) minute, dotted like (Fig. 70c, W&C:1989), (1) hair like (Figs. 101c, 105l, W&C:1989), (2) peg like (Fig. 111b, W&C:1989), (3) spine like (Fig. 113g, W&C:1989), (4) tubercle like (Figs. 127h, 129f, W&C:1989), (5) pit like, (6) bristle like (Fig. 124f, W&C:1989). Character # 38 in Coscarón & Miranda-Esquivel (1998:163).

26. Frontoclypeus frontal trichomes; (0) present (Fig. 6c, Coscarón 1991), (1) absent. (Figs. 15c, 46a, W&C:1989). Character # 27 in Coscarón & Miranda-Esquivel (1998:163).

Coscarón & Miranda-Esquivel (1998) defined *Gigantodax* by the state 1.

27. Thorax trichomes, curvature; (0) straight (Fig. 15d, W&C:1989), (1) hooked distally (Figs. 29g-h, 26d, W&C:1989). Character # 28 in Coscarón & Miranda-Esquivel (1998:163).

Wygodzinsky & Coscarón (1989) considered the state 1 as a diagnostic character for the *minor* group.

28. Facial trichomes, shape; (0) hair like (Figs. 97b, 102c, W&C:1989), (1) spine like (Figs. 20g, 64m, W&C:1989), (2) setae like (Figs. 15c, 66i, W&C:1989). Character # 29 in Coscarón & Miranda-Esquivel (1998:163)

29. Frontoclypeus, platelets; (0) present (Figs. 91d, 107e, W&C:1989), (1) absent (Fig. 111k, W&C:1989).

30. Frontoclypeus, type of platelets; (0) verrucose (Figs. 91d, f, W&C:1989), (1) rugose (Fig. 83l, W&C:1989), (2) smooth (Fig. 20g, W&C:1989), (3) glabrous (Figs. 15c, 107e, W&C:1989). Character # 30 in Coscarón & Miranda-Esquivel (1998:163).

31. Thorax, platelets; (0) absent (Fig. 77h, W&C:1989), (1) present (Figs. 88j, 97c, W&C:1989).

32. Thorax, type of platelets; (0) verrucose (Figs. 88j, 113i, 114h, 116e, W&C:1989), (1) smooth (Figs. 93k,s, 111j, 127i, W&C:1989), (2) glabrous (Fig. 97c, W&C:1989), (3) rugose (Figs. 82f, j, W&C:1989). Character # 30 in Coscarón & Miranda-Esquivel (1998:163).

G. shannoni has “obsolescent platelets” and *G. mariobordai* “small platelets” accordinto to Wygodzinsky & Coscarón (1989), we considered these two species states as “smooth platelets”.

33. Terminal hooks, diameter; (0) stout (Fig. 15g, W&C:1989), (1) slender (Figs. 25h, 26f, W&C:1989). Character # 5 in Wygodzinsky & Coscarón (1989:7).

Wygodzinsky & Coscarón (1989) considered the state 1 as a shared character between the *minor* and the *multifilis* groups.

ADULTS

34. Antenna, hairs of the basal flagellomeres and basal article; (0) shorter than article (Figs. 14a, 24a, W&C:1989), (1) longer than article (Fig. 2b, W&C:1989). Character # 2 in Coscarón & Miranda-Esquivel (1998:163).

Coscarón & Miranda-Esquivel (1998) considered the state 1 as a synapomorphy for *Pedrowygomyia*.

The formulated character is referring to the hair; where it surpasses or not the basal palpomeres.

35. Basal palpomeres, shape; (0) normal [basal palpomere less wide than the sensorial article] (Figs. 24e, 33c, W&C:1989), (1) stout [basal palpomere as wide as or wider than the sensorial article] (Fig. 2c, W&C:1989). Character # 3 in Coscarón & Miranda-Esquivel (1998:163).

This ratio was established between basal palpomere width and sensorial article width. Coscarón & Miranda-Esquivel (1998) considered the character state 1 as a synapomorphy for *Pedrowygomyia*.

The formulated character is referring to the basal palpomere; if it as wide as or wider than the sensorial article.

36. Clypeus, shape (male and female); (0) as long as wide (Fig. 8b, W&C:1989), (1) longer than wide (Fig. 37c, W&C:1989). Character # 5 in Coscarón & Miranda-Esquivel (1998:163).

Coscarón & Miranda-Esquivel (1998) considered the state 0 as a synapomorphy for *Pedrowygomyia*.

37. Mandible, teeth; (0) absent (Fig. 1e, W&C:1989), (1) present (Figs. 17e, 27c, W&C:1989).

We considered the character state 0 as a synapomorphy for *Pedrowygomyia*.

38. Mandible, distribution of the teeth; (0) side internal and external (Figs. 27c, 23c-d, 99b, W&C:1989), (1) side internal (Figs. 17e, 126b, 133a, W&C:1989).
According to Wygodzinsky & Coscarón (1989) the state 0 is a diagnostic character for the *minor* group (though it is present in *G. osornorum, G. arrarteorum, G. dryadicaudicis,* and *G. incapucara*). This character is also found in other Neotropical Prosimuliini.

39. Cu2 and A1 veins, curvature; (0) curved (Fig. 5c, Coscarón 1991), (1) straight (Fig. 23h, W&C:1989). Character # 9 in Coscarón & Miranda-Esquivel (1998:163).
Coscarón & Miranda-Esquivel (1998) considered the state 1 formerly considered to define the *Gigantodax* genus and *Pedrowygomyia*, as a homoplastic character.

40. Calcipala; (0) absent (Fig. 1h, W&C:1989), (1) present (Figs. 14i, 17l, 18g, W&C:1989). Character # 11 in Coscarón & Miranda-Esquivel (1998:163).
Currie (1988) and Currie & Grimaldi (2000) considered that the groundplan of Simuliini is the presence of calcipala, and stated that this plesiomorphic character is found in Parasimuliini and Prosimuliini (*sensu* Currie 1988).

FEMALES

41. Sensory organ; (0) more than 1/4 of the palpomere length (more or equal 20%) (Figs. 23e, 47c, W&C:1989), (1) less than 1/6 of the palpomere length (less 20%) (Fig. 1d, W&C:1989). Character # 4 in Coscarón & Miranda-Esquivel (1998:163).
Coscarón & Miranda-Esquivel (1998) considered the state 1 as a synapomorphy for *Pedrowygomyia*.

42. Frons, width; (0) wide (>110°) (Fig. 1a, W&C:1989), (1) narrow (< 90°) (Fig. 17a, W&C:1989). Character # 6 in Coscarón & Miranda-Esquivel (1998:163).
Wygodzinsky & Coscarón (1989) considered the state 0 as a diagnostic character for *Pedrowygomyia*. Coscarón & Miranda-Esquivel (1998) considered the character state 1 as a synapomorphy for *Gigantodax* + *Cnesia*.

43. R1, spinules; (0) without spinules (Fig. 2e, W&C:1989), (1) with spinules (Figs. 24h, 41d, W&C:1989). Character # 14 in Coscarón (1991:29).

44. Gonapophysis, border shape; (0) approximately straight (Figs. 1l, 41j, W&C:1989), (1) elongated distally (17o, W&C:1989). Character # 15 in Coscarón & Miranda-Esquivel (1998:163).

Wygodzinsky & Coscarón (1989) considered the state 1 as a diagnostic character for *igniculus* group.

45. Spermatheca neck, surface; (0) not sclerotized showing a transluced area on the spermatheca apex (Fig. 17r, W&C:1989), (1) sclerotized extended until the duct base (Figs. 89q, 157s, W&C:1989).

46. Furcasternum mediam arm, diameter; (0) wide (Fig. 8p, W&C:1989), (1) narrow (Fig. 43bb, W&C:1989). Character # 8 in Coscarón & Miranda-Esquivel (1998:163).

Coscarón & Miranda-Esquivel (1998) considered the state 1 as synapomorphy of the monophyly of the *Gigantodax* + *Cnesia* clade.

47. Genital fork, length of the apodemes; (0) short (Fig. 5i, Coscarón 1991), (1) long (Fig. 27m, W&C:1989).

48. Claw, subbasal tooth; (0) absent or reduced (Fig. 1j, W&C:1989), (1) present (Fig. 27j, W&C:1989). Wygodzinsky & Coscarón (1989:8).

49. Claw, transversal sulci of the tooth; (0) absent, (1) present. Wygodzinsky & Coscarón (1989:8)

50. Claw, shape of the subbasal tooth; (0) spine like (Fig. 1j, W&C:1989), (1) hook like (Figs. 17m, 27j, W&C:1989), (2) subtriangular (Figs. 81q, 92d, W&C:1989), (3) subrhomboidal (Fig. 37p, W&C:1989). Character # 14 in Coscarón & Miranda-Esquivel (1998:163).

Wygodzinsky & Coscarón (1989) found the state 1 as a shared diagnostic character for *minor* and *igniculus* group. According to Wygodzinsky & Coscarón (1989) the subbasal tooth shape could be derived from the subrhomboidal tooth shape present in the most plesiomorphic Neotropical Prosimuliini.

MALES

51. Head, curvature. (In the ocellar portion); (0) softly pronounced (Fig. 9b, W&C:1989), (1) strongly pronounced (Fig. 38b, W&C:1989). Character # 20 in Coscarón & Miranda-Esquivel (1998:163).

52. Interocular space; (0) present (Fig. 2a, W&C:1989), (1) absent (Fig. 38a, W&C:1989).
Wygodzinsky & Coscarón (1989) presented the character state 0 as diagnostic for *Pedrowygomyia.*

53. Interocular space, presence of a row of hairs; (0) without hairs (Fig. 38a, W&C:1989), (1) with a row of hairs (Fig. 2a, W&C:1989). Character # 19 in Coscarón & Miranda-Esquivel (1998:163).
Coscarón & Miranda-Esquivel (1998) considered the state 1 as a synapomorphic character for *Pedrowygomyia.*

54. Ventral plate, apical shape; (0) smoothly bilobed (Figs. 81i, 95j, W&C:1989), (1) strongly bilobed (Fig. 38n, W&C:1989), (2) straight (Fig. 2l, W&C:1989). Character # 24 in Coscarón & Miranda-Esquivel (1998:163).
Coscarón & Miranda-Esquivel (1998) considered the state 2 as a synapomorphy for *Pedrowygomyia.*

55. Endoparameres, hooks size; (0) short (Fig. 2q, W&C:1989), (1) elongated (Fig. 19d, W&C:1989). Character # 25 in Coscarón & Miranda-Esquivel (1998:163).
Coscarón & Miranda-Esquivel (1998) considered the state 1 as synapomorphy for *Gigantodax* + *Cnesia.*

56. Aedeagal membrane; (0) without strong spinules (Fig. 24p, W&C:1989), (1) with strong spinules some of them basally fusioned (Fig. 14j, W&C:1989). Character # 26 in Coscarón & Miranda-Esquivel (1998:163).

Wygodzinsky & Coscarón (1989) considered the state 1 as a diagnostic character for the *igniculus* and *minor* groups.

57. Accessories parameral spines; (0) absent (Fig 16, Currie 1988), (1) present (Figs.19d, g, W&C:1989). Character # 61 in Currie (1989:85).

According to Currie (1988) the typical condition for the paramere in Diptera is to be simple posteriorly (without spines), a feature shared by members of Parasimuliinae and Prosimuliini. The presence of parameral spines therefore must be derived; he defined it as a synapomorphy of Simuliini.

CYTOGENETICAL CHARACTERS

Chromosome I

58. NO position; (0) NO in IL, (1) NO in IS. Character # 2 in Coscarón-Arias (1998:448).

According to Moreno (1990) the NO is found in the Chromosome I for the Prosimuliini tribe, while in Simuliini tribe is found in whatever chromosome.

59. "Basal 3" relative position in relation to centromere; (0) proximal 3, (1) proximal 2, (2) medial 3.

60. Capsule (Cp) relative position in IS; (0) proximal 2, (1) proximal 3.

61. Fixed Inversion in IS-1; (0) absent, (1) present.

62. Centromeric region in chromosome I; (0) with synapses regions, (1) without synapses regions

Chromosome II

63. Relative position of RB; (0) proximal 3, (1) distal 1, (2) distal 2, (3) medial 1. Character # 5 in Coscarón-Arias (1998:448)

64. Relative position of b-RB; (0) centromere-b-RB, (1) centromere-RB-b

65. Relative position of Pb; (0) medial 3, (1) proximal 2, (2) medial 1, (3) proximal 3. Character # 7 in Coscarón-Arias (1998:448)

66. Position of Pb heavy band; (0) proximal to the centromere, (1) distal to the centromere.

67. Fixed inversion in IIS 1.2; (0) absent, (1) present. Character # 6 (Coscarón-Arias 1998:448).

68. Fixed inversion in IIL-1; (0) absent, (1) present.

69. Fixed inversion in IIL-3; (0) absent, (1) present.

70. Centromeric region in Chromosome II; (0) condensed, (1) expanded.

Chromosome III

71. Three heavy groups (3HG), position; (0) IS, (1) IIIL.

72. Fixed inversion in IIIL-1; (0) absent, (1) present. Character #8 (Coscarón-Arias 1998:448)

73. Fixed inversion in IIIL-2; (0) absent, (1) present.

Sexual differentiation

74. Sexual differentiation of males; (0) absent, (1) IL-2, (2) centromere II without synapses region. Character # 3 in Coscarón-Arias (1998:448)

75. Sexual differentiation of females; (0) absent, (1) IL-1, (2) IL-3, (3) IL-4, (4) centromere II with synapses region. Character # 4 in Coscarón-Arias (1998:448).

Appendix 3.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Gymnopais	?	?	?	0	?	0	0	0	0	?	0	0	?	0	0	-	0	0	0	0	0	0	0	0
Prosimulium	0	0	0	0	?	0	1	0	0	?	0	1	?	0	0	0	1	0	0	0	0	2	0	0
Pedrowygomyia	0	0	0	1	0	1	1	1	[01]	0	1	0	1	1	1	3	1	0	0	0	0	3	1	0
Cnesia	0	1	0	1	?	1	0	1	0	?	1	1	-	0	0	3	1	0	0	0	0	2	0	0
I_carmenae	0	1	0	1	0	1	1	1	1	?	0	0	?	1	?	0	1	-	0	4	4	3	1	0
I_igniculus	0	0	0	1	0	1	1	1	1	1	0	0	1	1	1	0	1	0	0	0	0	3	1	0
M_minor	1	1	1	1	1	1	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0
M_araucanius	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	3	1	0	0	0	0	0	0	0
M_eremicus	1	1	1	1	1	1	2	1	0	?	1	0	0	1	1	0	1	0	0	0	0	0	0	0
M_bolivianus	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
MM_multifilis	1	1	0	1	1	1	0	1	0	0	1	0	0	1	1	3	1	0	0	0	0	3	1	1
B_brophyi	2	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	1	0	1	0	0
B_rufidulus	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	1	0	1	0	0
B_antarcticus	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	1	0	1	0	0
B_trifidus	2	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	1	0	1	0	0
B_femineus	2	1	0	1	?	1	0	1	0	0	1	0	1	1	1	3	1	2	0	1	0	1	0	0
B_marginalis	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	0	0	1	1	0
B_kuscheli	1	1	0	1	0	1	[02]	1	0	0	1	0	0	1	1	3	1	?	?	0	0	1	1	?
B_luispenai	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	0	0	1	0	0
B_chilensis	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	0	0	1	0	0
B_flabellus	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	3	1	2	0	0	0	1	0	0
B_awa	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	3	1	2	0	0	0	1	0	0
B_paramorum	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	0	0	0	0	1	0	1
B_viannamartinsi	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	3	1	0	0	0	0	1	0	?
B_ortizi	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	0	0	1	0	1
B_multituberculatus	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	0	0	1	0	0
B_patihuaycensis	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	1	1	2	0	0	0	1	0	0
B_laevigatus	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	0	0	1	0	0
B_zumbahuae	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	1	2	0	0	0	1	0	0
B_osornorum	1	1	0	?	0	1	0	1	0	0	1	0	1	1	1	?	1	2	0	0	0	0	0	1
Ci_fulvescens	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	1	2	0	0	0	1	0	0
Ci_shannoni	1	1	0	1	1	1	0	1	0	0	1	0	1	1	1	1	1	2	0	0	0	1	1	1
Ci_destitutus	1	1	0	1	0	1	0	1	0	?	1	0	1	1	1	3	1	2	0	0	0	1	1	1
Ci_basinflatus	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	2	0	3	0	1	1	1
Ci_mariobordai	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	?	0	1	0	3	0	1	?	0
Ci_incomitatus	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	0	1	1	0	0	0	0	1	1
Ci_pennipunctus	1	1	0	1	1	1	2	1	0	0	1	0	1	1	1	2	1	2	1	0	0	1	1	1
Ci_arranteorum	0	1	0	1	0	1	1	1	[01]	0	1	0	0	1	1	1	0	2	0	3	0	1	1	1
Ci_clandestinus	1	1	0	1	0	1	1	1	[01]	0	1	0	0	1	1	1	0	2	0	3	0	1	1	1
Ci_cilicinus	1	1	0	1	0	1	1	1	[01]	0	1	0	1	1	1	0	0	2	0	3	0	1	1	1
Co_gracilis	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	3	0	2	0	2	1	1	?	1
Co_misitu	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	2	0	2	1	1	1	1
Co_brevis	1	1	0	1	0	1	0	1	0	0	1	0	0	1	1	0	0	2	0	2	2	1	1	1
Co_wygodzinskyi	1	1	0	1	0	1	0	1	0	0	1	0	0	1	1	0	0	2	0	2	2	1	1	1
Co_leonorum	1	1	0	1	0	1	0	1	0	0	1	0	0	1	1	[01]	0	2	0	2	2	1	1	1
Co_abalosi	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	0	2	0	2	2	1	1	1
Co_cormonsi	1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	0	2	0	2	2	1	1	1
Co_praealtus	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	0	0	2	0	2	2	1	1	1
Co_vulcanius	1	1	0	1	0	1	0	1	0	0	1	0	0	1	1	0	0	2	0	2	2	1	1	0
Co_siberianus	1	1	0	1	0	1	0	1	0	0	1	0	0	1	1	0	0	2	0	2	2	1	1	0
W_horcotiani	1	1	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	2	0	3	3	0	1	1
W_bettyae	1	1	0	1	1	1	0	1	0	0	1	0	1	1	1	0	0	1	0	3	3	0	1	1
W_septenarius	1	1	0	1	1	1	0	1	0	1	1	0	0	1	1	2	0	1	1	3	3	0	1	1
W_aquamarensis	2	1	1	1	0	1	1	1	0	0	1	0	0	1	1	0	1	1	1	3	-	0	1	0
W_cervicornis	1	1	0	1	0	1	1	1	0	0	1	0	1	1	1	0	1	2	1	3	3	0	1	0
W_corniculatus	0	1	0	1	0	1	2	1	0	0	1	0	1	1	1	0	0	2	1	3	3	0	1	0
W_wrighti	2	1	0	1	0	1	2	1	0	1	1	0	1	1	1	3	0	2	1	3	3	0	1	0
W_nasutus	1	1	0	1	0	1	0	1	0	?	1	0	1	1	1	0	0	2	0	3	3	0	?	1
W_rufescens	0	1	0	1	0	1	2	1	0	1	1	0	1	1	1	2	1	2	0	3	3	0	0	1
W_dryadicaudicis	1	1	0	1	0	1	2	1	0	0	1	0	0	1	0	1	0	2	0	3	3	0	?	1
W_incapucara	1	1	0	1	0	1	1	1	0	?	1	0	1	1	1	0	0	2	1	3	3	0	1	1
W_herreri	1	1	0	1	0	1	1	1	[01]	1	1	0	1	1	1	2	1	2	0	4	4	0	1	1
W_impossibilis	1	1	0	1	0	1	1	1	0	0	1	0	?	1	1	0	0	2	[01]	4	4	0	1	0
W_cypellus	1	1	0	1	0	1	1	1	0	0	1	0	1	1	1	0	1	2	0	4	4	0	1	1

	25	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Gymnopais	-	0	0	?	?	?	0	-	?	0	0	0	0	-	0	0	0	0	0	0	?
Prosimulium	-	0	0	0	0	?	1	?	?	0	0	1	1	0	0	0	0	0	1	0	?
Pedrowygomyia	-	0	0	0	0	1	1	3	0	1	1	0	0	-	1	0	1	0	0	0	0
Cnesia	-	0	0	1	?	?	?	?	0	0	0	1	1	1	0	1	0	1	1	0	0
I_carmenae	-	1	0	2	0	3	1	?	0	0	0	?	?	?	1	1	?	?	1	?	?
I_igniculus	-	1	0	1	0	2	1	1	0	0	0	1	1	1	1	1	0	1	?	1	0
M_minor	-	1	1	0	?	?	1	?	1	0	0	1	1	0	1	1	0	1	0	0	0
M_araucanius	-	1	1	?	?	?	?	?	1	0	0	1	1	0	1	1	0	1	1	0	0
M_eremicus	-	1	1	0	0	2	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?
M_bolivianus	?	?	?	?	?	?	?	?	?	?	?	?	1	1	1	1	0	1	1	0	1
MM_multifilis	5	1	0	1	0	0	1	?	1	0	0	1	1	1	1	1	0	1	1	0	1
B_brophyi	-	1	0	0	0	2	1	1	0	0	0	1	1	1	1	1	0	1	0	0	1
B_rufidulus	-	1	0	0	0	2	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
B_antarcticus	-	1	0	0	0	3	1	2	0	0	0	1	1	1	1	1	0	1	0	0	0
B_trifidus	-	1	0	0	0	3	1	2	0	0	0	1	1	1	1	1	0	1	0	0	0
B_femineus	-	1	0	0	0	?	1	?	0	0	0	1	1	1	1	1	0	1	0	0	0
B_marginalis	-	1	0	0	0	2	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
B_kuscheli	?	?	?	?	?	?	?	?	?	0	0	1	1	1	1	1	0	1	1	0	0
B_luispenai	-	1	0	0	0	?	1	?	0	0	0	1	1	1	1	1	0	1	1	0	0
B_chilensis	-	1	0	0	0	?	1	?	0	0	0	1	1	1	1	1	0	1	1	0	1
B_flabellus	-	1	0	1	0	[02]	1	[01]	0	0	0	1	1	1	1	1	0	1	?	?	0
B_awa	-	1	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0
B_paramorum	0	1	0	2	0	[02]	1	[01]	0	1	0	0	1	1	1	1	0	1	?	0	0
B_viannamartinsi	?	?	?	?	?	?	?	?	?	0	0	1	1	1	1	1	?	?	?	?	?
B_ortizi	0	1	0	1	0	2	1	1	0	1	0	[01]	1	1	1	1	0	1	1	0	0
B_multituberculatus	-	1	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0
B_patihuaycensis	-	1	0	1	0	?	1	1	0	0	1	?	1	?	1	?	?	?	1	?	?
B_laevigatus	-	1	0	1	1	-	0	-	0	0	0	1	1	1	1	1	0	1	1	0	0
B_zumbahuae	-	1	0	1	0	2	1	1	0	?	?	?	?	?	?	?	?	?	?	?	?
B_osornorum	0	1	?	0	0	?	1	?	0	1	1	1	?	?	1	1	0	1	1	0	0
Ci_fulvescens	-	1	0	?	0	1	1	3	0	0	0	1	1	1	1	1	0	1	1	0	1
Ci_shannoni	0	1	0	1	1	-	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
Ci_destitutus	0	1	0	0	0	0	1	0	0	?	0	?	1	?	1	1	0	1	1	0	0
Ci_basinflatus	5	1	0	2	0	0	1	0	0	1	0	0	1	?	1	1	0	1	1	0	1
Ci_mariobordai	-	1	0	?	?	?	1	1	0	?	?	?	?	?	?	1	?	?	?	?	?
Ci_incomitatus	0	?	?	?	0	2	1	1	0	?	?	?	?	?	1	1	?	?	?	?	?
Ci_pennipunctus	0	1	0	0	0	3	1	2	0	?	0	?	1	1	1	1	0	1	1	0	0
Ci_arranteorum	1	1	0	0	0	?	?	?	0	0	0	?	1	0	1	1	0	1	1	0	0
Ci_clandestinus	1	1	0	0	0	0	1	?	0	0	0	?	1	1	1	1	0	1	1	0	0
Ci_cilicinus	1	1	0	0	0	3	1	2	0	0	0	?	1	?	1	1	?	?	?	?	?
Co_gracilis	2	1	0	1	1	-	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
Co_misitu	3	1	0	1	0	0	1	0	0	0	0	1	1	?	1	1	0	1	1	0	0
Co_brevis	1	1	0	1	0	1	1	0	0	0	0	[01]	1	1	1	1	0	1	1	0	0
Co_wygodzinskyi	3	1	0	1	0	0	1	0	0	1	0	0	1	1	1	1	0	1	1	0	0
Co_leonorum	6	1	0	1	0	0	1	0	0	0	?	1	1	1	1	1	0	1	1	0	0
Co_abalosi	6	1	0	0	0	?	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0
Co_cormonsi	4	1	0	1	0	?	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
Co_praealtus	4	1	0	?	0	?	1	1	0	0	0	1	1	?	1	1	0	1	1	0	0
Co_vulcanius	-	1	0	2	0	0	1	1	0	0	0	1	1	1	1	1	0	1	1	0	0
Co_siberianus	-	1	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0
W_horcotiani	0	1	0	0	0	0	1	0	0	0	0	1	1	?	1	1	0	1	1	0	0
W_bettyae	[02]	1	0	0	0	2	1	1	0	0	0	1	1	?	1	1	0	1	1	0	0
W_septenarius	[02]	1	0	0	0	2	1	1	0	0	?	?	1	1	1	1	0	1	1	0	0
W_aquamarensis	-	1	0	0	0	0	1	0	0	0	0	?	1	?	1	1	0	1	1	0	0
W_cervicornis	-	1	0	0	0	0	1	3	0	0	0	?	-	0	1	1	1	1	1	0	0
W_corniculatus	-	1	0	1	0	0	1	0	0	0	0	?	1	0	1	1	0	1	1	0	0
W_wrighti	-	1	0	0	0	0	1	0	0	0	0	?	1	1	1	1	0	1	1	0	0
W_nasutus	5	1	0	0	0	0	1	0	0	0	0	?	1	1	1	1	0	1	1	0	1
W_rufescens	0	1	0	0	0	0	1	?	0	0	0	?	1	0	1	1	0	1	[01]	0	0
W_dryadicaudicis	3	1	0	0	1	-	0	-	0	0	0	?	1	0	1	1	0	1	0	1	0
W_incapucara	0	1	0	1	?	0	1	0	0	0	0	?	1	1	1	1	0	1	1	0	0
W_herreri	1	1	0	0	0	0	1	2	0	0	0	?	1	?	1	1	0	1	1	0	0
W_impossibilis	-	1	-	1	0	0	1	0	0	0	0	?	1	1	1	1	0	1	1	0	0
W_cypellus	0	1	0	0	0	0	1	0	0	0	0	?	1	?	1	1	-	1	1	0	0

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
Gymnopais	0	0	0	0	-	0	0	0	0	0	0	0	?	?	?	?	?	?	?	?	?	?	?
Prosimulium	0	0	0	0	-	0	1	1	?	?	0	0	0	?	?	0	?	0	?	0	?	0	0
Pedrowygomyia	0	1	1	0	0	0	0	1	2	0	0	1	?	?	?	?	?	?	?	?	?	?	?
Cnesia	1	1	1	1	2	1	1	0	0	1	0	1	0	?	?	0	?	0	?	1	1	0	0
I_carmenae	?	?	?	?	?	1	1	0	1	1	1	1	?	?	?	?	?	?	?	?	?	?	?
I_igniculus	1	1	1	1	1	1	1	0	1	1	1	1	?	?	?	?	?	?	?	?	?	?	?
M_minor	1	1	1	1	1	1	1	0	1	1	1	1	?	?	?	?	?	?	?	?	?	?	?
M_araucanius	1	1	1	1	1	1	1	0	1	1	1	1	?	?	?	?	?	?	?	?	?	?	?
M_eremicus	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
M_bolivianus	1	1	1	1	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
MM_multifilis	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_brophyi	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_rufidulus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_antarcticus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_trifidus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_femineus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_marginalis	1	1	1	1	3	1	1	0	1	1	0	1	1	0	?	0	0	1	0	1	0	0	1
B_kuscheli	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_luispenai	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_chilensis	1	1	1	1	3	1	1	0	1	1	0	1	1	1	?	0	1	1	0	1	?	0	1
B_flabellus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_awa	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_paramorum	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_viannamartinsi	?	?	?	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_ortizi	1	1	1	1	3	1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0
B_multituberculatus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_patihuaycensis	?	?	?	1	3	1	1	0	?	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_laevigatus	1	1	1	1	3	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
B_zumbahuae	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
B_osornorum	1	1	1	1	3	1	1	?	?	1	0	1	0	1	1	0	?	3	1	1	0	0	0
Ci_fulvescens	1	1	1	1	2	1	1	0	0	1	0	1	1	?	?	0	1	1	0	1	0	0	1
Ci_shannoni	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_destitutus	1	1	1	1	2	1	1	?	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_basinflatus	1	-	1	1	2	1	1	1	0	1	0	1	0	2	0	1	0	1	0	3	0	1	0
Ci_mariobordai	?	?	?	1	2	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Ci_incomitatus	?	?	?	?	?	1	1	?	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_pennipunctus	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_arranteorum	1	-	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_clandestinus	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Ci_cilicinus	?	?	?	?	?	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_gracilis	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_misitu	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_brevis	1	1	1	1	2	1	1	0	1	1	0	1	0	1	1	0	1	1	0	1	0	0	0
Co_wygodzinskyi	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_leonorum	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_abalosi	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_cormonsi	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_praealtus	1	1	1	1	2	1	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?
Co_vulcanius	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
Co_siberianus	1	1	1	1	2	1	1	0	1	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_horcotiani	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_bettyae	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_septenarius	1	1	1	1	3	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_aquamarensis	1	1	1	1	2	1	1	0	?	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_cervicornis	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_corniculatus	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_wrighti	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_nasutus	1	1	1	1	2	1	1	0	?	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_rufescens	1	1	1	1	3	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_dryadicaudicis	1	1	1	1	2	1	1	0	?	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_incapucara	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_herreri	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_impossibilis	1	1	1	1	2	1	1	0	0	1	0	1	?	?	?	?	?	?	?	?	?	?	?
W_cypellus	1	1	1	1	2	1	1	0	0	1	0	1	0	2	0	1	0	2	0	2	0	1	0

	69	70	71	72	73	74	75
Gymnopais	?	?	?	?	?	?	?
Prosimulium	0	1	0	0	0	0	0
Pedrowygomyia	?	?	?	?	?	?	?
Cnesia	0	1	0	0	0	0	0
I_carmenae	?	?	?	?	?	?	?
I_igniculus	?	?	?	?	?	?	?
M_minor	?	?	?	?	?	?	?
M_araucanius	?	?	?	?	?	?	?
M_eremicus	?	?	?	?	?	?	?
M_bolivianus	?	?	?	?	?	?	?
MM_multifilis	?	?	?	?	?	?	?
B_brophyi	?	?	?	?	?	?	?
B_rufidulus	?	?	?	?	?	?	?
B_antarcticus	?	?	?	?	?	?	?
B_trifidus	?	?	?	?	?	?	?
B_femineus	?	?	?	?	?	?	?
B_marginalis	0	1	1	1	1	1	1
B_kuscheli	?	?	?	?	?	?	?
B_luispenai	?	?	?	?	?	?	?
B_chilensis	0	1	1	1	1	1	3
B_flabellus	?	?	?	?	?	?	?
B_awa	?	?	?	?	?	?	?
B_paramorum	?	?	?	?	?	?	?
B_viannamartinsi	?	?	?	?	?	?	?
B_ortizi	0	0	1	0	0	2	4
B_multituberculatus	?	?	?	?	?	?	?
B_patihuaycensis	?	?	?	?	?	?	?
B_laevigatus	?	?	?	?	?	?	?
B_zumbahuae	?	?	?	?	?	?	?
B_osornorum	0	0	1	1	0	2	4
Ci_fulvescens	0	1	1	1	1	0	2
Ci_shannoni	?	?	?	?	?	?	?
Ci_destitutus	?	?	?	?	?	?	?
Ci_basinflatus	1	0	1	0	0	2	4
Ci_mariobordai	?	?	?	?	?	?	?
Ci_incomitatus	?	?	?	?	?	?	?
Ci_pennipunctus	?	?	?	?	?	?	?
Ci_arranteorum	?	?	?	?	?	?	?
Ci_clandestinus	?	?	?	?	?	?	?
Ci_cilicinus	?	?	?	?	?	?	?
Co_gracilis	?	?	?	?	?	?	?
Co_misitu	?	?	?	?	?	?	?
Co_brevis	1	0	1	0	0	?	?
Co_wygodzinskyi	?	?	?	?	?	?	?
Co_leonorum	?	?	?	?	?	?	?
Co_abalosi	?	?	?	?	?	?	?
Co_cormonsi	?	?	?	?	?	?	?
Co_praealtus	?	?	?	?	?	?	?
Co_vulcanius	?	?	?	?	?	?	?
Co_siberianus	?	?	?	?	?	?	?
W_horcotiani	?	?	?	?	?	?	?
W_bettyae	?	?	?	?	?	?	?
W_septenarius	?	?	?	?	?	?	?
W_aquamarensis	?	?	?	?	?	?	?
W_cervicornis	?	?	?	?	?	?	?
W_corniculatus	?	?	?	?	?	?	?
W_wrighti	?	?	?	?	?	?	?
W_nasutus	?	?	?	?	?	?	?
W_rufescens	?	?	?	?	?	?	?
W_dryadicaudicis	?	?	?	-	-	?	?
W_incapucara	?	?	?	?	?	?	?
W_herreri	?	?	?	?	?	?	?
W_impossibilis	?	?	?	?	?	?	?
W_cypellus	0	0	1	0	0	?	?