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Phylogeny and divergence times of calyptrate flies (Diptera: Schizophora: Calyptratae), and classification of the tribe Tachinini (Oestroidea: Tachinidae).

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ABSTRACT

GUDIN, Filipe Macedo. **Phylogeny and divergence times of calyptrate flies (Diptera: Schizophora: Calyptratae) and classification of the tribe Tachinini (Oestroidea: Tachinidae).** 2020. 228 f. Tese (Doutorado) – Instituto de Biociências, Universidade de São Paulo, São Paulo, 2020.

In this thesis, divided in two chapters, we estimate the divergence times of Calyptratae and all its families, and we focus on the classification of the family Tachinidae proposing a phylogenetic hypothesis for the tribe Tachinini. Calyptratae is one of the most species-rich group of true flies and includes 18 families. The origin of Calyptratae was estimated between the mid-Paleocene to the Cretaceous-Paleogene boundary, but based on few taxa of some families. Using 458 species of Calyptratae, we estimate the divergence times for all families of Calyptratae, reflecting the relative diversity of species of each family. Using bayesian inference and models that include parameters of speciation, extinction and fossil sampling rates, we estimate that the origin of Calyptratae is older than previous estimates, having occurred in the mid-Late Cretaceous around 84.6 million years ago. Moreover, the diversification of all families happened throughout the Tertiary, mainly in the Eocene and Oligocene, confirming previous hypothesis of diversification of the group. In the second chapter, we focused on the classification of the family Tachinidae and worked with the tribe Tachinini, one of the largest tribes of the family. The tribe Tachinini exhibits severe problems of classification, especially in the Neotropical Region. Sampling 111 genera and 193 species of Tachinini, we propose a phylogenetic hypothesis inferred from morphological characters. Using parsimony as optimality criterion, the monophyly of Tachinini was confirmed and several genus groups were proposed and diagnosed with phylogenetic characters.

Keywords: Taxonomy. Phylogenetic systematics. Neotropical Region. Entomology.

RESUMO

GUDIN, Filipe Macedo. **Filogenia e tempos de divergência das moscas caliptradas (Diptera: Schizophora: Calyptratae) e classificação da tribo Tachinini (Oestroidea: Tachinidae).** 2020. 228 f. Tese (Doutorado) – Instituto de Biociências, Universidade de São Paulo, São Paulo, 2020.

Nesta tese, dividida em dois capítulos, nós estimamos os tempos de divergência de Calyptratae e todas as suas famílias, e focamos na classificação da família Tachinidae, propondo uma hipótese filogenética para a tribo Tachinini. Calyptratae é um dos grupos com maior diversidade de espécies em Brachycera, sendo classificado em 18 famílias. A origem de Calyptratae foi estimada entre a metade do Paleoceno e a transição Cretáceo-Paleoceno, mas baseada somente em poucos táxons de algumas famílias. Utilizando 458 espécies de Calyptratae, nós estimamos os tempos de divergência para todas as famílias de Calyptratae, refletindo a diversidade relativa de espécies de cada família. Utilizando inferência bayesiana como critério de otimização e modelos que incluem parâmetros de taxas de especiação, extinção e amostragem de fósseis, nós estimamos que a origem de Calyptratae é mais antiga que o estimado anteriormente, tendo ocorrido no Cretáceo Superior por volta de 84,6 milhões de anos atrás. Além disso, a diversificação de todas as famílias ocorreu ao longo do Terciário, principalmente no Eoceno e Oligoceno, confirmando hipóteses prévias sobre a diversificação do grupo. No segundo capítulo, nós focamos na classificação da família Tachinidae e trabalhos com a tribo Tachinini, uma das maiores tribos da família. A tribo Tachinini apresenta graves problemas de classificação, especialmente na Região Neotropical. Amostrando 111 gêneros e 193 espécies de Tachinini, nós propomos uma hipótese filogenética inferida com caracteres morfológicos. Utilizando parsimônia como critério de otimização, a monofilia de Tachinini foi confirmada e diversos grupos de gêneros foram propostos e diagnosticados com caracteres filogenéticos.

Palavras-chave: Taxonomia. Sistemática filogenética. Região Neotropical. Entomologia.

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GENERAL INTRODUCTION

When preparing the thesis project, Silvio and I were focused on answering questions about the phylogenetic relationships, the time of origin and the biogeographic events that impacted the history of the tribe Tachinini, one of the largest tribes of the family Tachinidae. Tachinidae is one of the most species-rich groups in Diptera and certainly the largest family of parasitic flies, having 8592 valid species around the world (O'HARA; HENDERSON; WOOD, 2020). Tachinids have endoparasitic first instar larvae that use arthropods, mainly insects, as hosts (STIREMAN; O'HARA; WOOD, 2006). This behavior associated with the diversity of species of hosts make many species of Tachinidae potential agents of biological control of pests (GRENIER, 1988) (DINDO; GRENIER, 2014) (CONTI et al., 2020).

This first project, however, proved to be much more challenging than expected. First of all, the current state of the taxonomy of the tribe Tachinini is a great impediment to assess questions about the divergence times of the group and even the biogeographic events that impacted its diversity. Tachinini have many monotypic genera, especially in the Neotropical Region (EVENHUIS; PONT; WHITMORE, 2015) (O'HARA; HENDERSON; WOOD, 2020), which makes the correct identification of specimens more difficult and, consequently, the sampling of genetic material and geographical data. Moreover, the fossil record in Tachinidae is very scarce and none fossil specimen can be unambiguously classified in a certain group (O'HARA et al., 2013). To obtain accurate estimates of divergence times of Tachinini, we had to include fossils of other families of Calyptratae, therefore amplifying the scope of our project.

Considering these questions, we reformulated our project to address both a broader question and a more specific question. Combining the data generated for the molecular phylogeny of Calyptratae (a parallel project conducted by several Brazilian dipterists) and for our own project, we aimed to estimate accurate diverge times not only for Tachinidae, but for all calyptrate families using the few unambiguous fossils described for the group and a broad sampling of species to represent the relative diversity of each family of Calyptratae. This is the content of Chapter 1. In addition, we also focused on the main issue of the tribe Tachinini, i.e., its classification of genera. We aimed to improve the classification of genera of Tachinini by inferring a phylogenetic hypothesis based on morphological data, sampling the majority of monotypic genera. This is the content of Chapter 2.

We expect the results of these two questions will open new possibilities for investigations on the systematics, evolution and biogeography not only of tachinid flies, but for all families of Calyptratae.

CHAPTER 1. YOUNG, BUT WITH BACKGROUND: THE MID-LATE CRETACEOUS ORIGIN OF CALYPTRATE FLIES (DIPTERA: SCHIZOPHORA) AND THEIR DIVERSIFICATION DURING THE TERTIARY.

1.1 ABSTRACT

The Calyptratae group is comprised by some of the most species-rich and well known lineages of true flies. There are several hypotheses about the origin of Calyptratae, ranging from mid-Eocene to, at most, the Cretaceous-Paleogene boundary, with the diversification of its families during the Tertiary. These estimates, however, did not contemplate the diversity of species of most families of Calyptratae. We estimate the timing of diversification of all families of Calyptratae with the largest sampling of calyptrates so far (more than 450 taxa), including six fossil species of Calyptratae, and using eight loci (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α). To provide accurate estimates of divergence times, we did a series of phylogenetic analyses and search for wildcards to infer more stable phylogenetic relationships. We also compared three models of calibration: node dating using a pure-birth tree prior (Yule), node dating using a birth-death tree prior with calibration densities estimated with CladeAge (CA), and tip dating with a fossilized birth-death tree prior (FBD). Our results suggest that the CA model is a more suitable option than the other two to estimate divergence times of Calyptratae, providing more accurate and less biased age estimates. The origin of Calyptratae is older than previous estimates, having occurred in the mid-Late Cretaceous around 84.6 Ma. Moreover, the diversification of all families indeed happened throughout the Tertiary, mainly in the Eocene and Oligocene, confirming previous hypotheses. Estimates for the families of Hippoboscoidea are provided for the first time, and congruences and conflicts regarding the origin of families of the muscoid grade and the superfamily Oestroidea are discussed.

1.2 INTRODUCTION

Among Diptera, the Calyptratae group (Brachycera: Schizophora) is comprised by some of the most species-rich and well known lineages of true flies, including about 22,000 species (PAPE; BLAGODEROV; MOSTOVSKI, 2011). This diversity is reflected not solely by the number of taxa, but also by the variety of ecological roles exhibited by larvae and adults, such as haematophagy, saprophagy, phytophagy, ectoparasitism of vertebrates, and endoparasitism of invertebrates (KUTTY et al., 2010). The classical classification of Calyptratae consists of three main superfamilies, namely Hippoboscoidea, Muscoidea and Oestroidea (MCALPINE, 1989).

Although the monophyly of Calyptratae has been confirmed by numerous phylogenetic studies (KUTTY et al., 2010, 2019; WIEGMANN et al., 2011; LAMBKIN et al., 2013; JUNQUEIRA et al., 2016), the validity of and the relationships between many families of Calyptratae remain unclear and debatable. Hippoboscoidea is the sister group of the remaining Calyptratae, including four families of haematophagous flies, most of them ectoparasites of birds and mammals, namely Glossinidae, Hippoboscidae, Nycteribiidae and Streblidae (DITTMAR et al., 2006; PETERSEN et al., 2007). The superfamily Muscoidea sensu McAlpine (1989) has been consistently recovered as a paraphyletic grade with four families, namely Anthomyiidae, Fanniidae, Muscidae and Scathophagidae (KUTTY et al., 2008, 2010, 2019). And lastly, the monophyletic Oestroidea includes the majority of species of Calyptratae, having several contentious hypotheses of relationship proposed for the ten families, namely Calliphoridae, Mesembrinellidae, Mystacinobiidae, Oestridae, Polleniidae, Rhiniidae, Rhinophoridae, Sarcophagidae, Tachinidae and Ulurumyiidae (PAPE, 1992; ROGNES, 1997; KUTTY et al., 2010; MARINHO et al., 2012; 2016; CERRETTI et al., 2017; 2019).

The evolution of Calyptratae seems to have followed a similar pattern found in all sister lineages nested in Schizophora, showing rapid radiations during the Tertiary and with origin estimated between 50.1 and 67.5 million years ago (Ma) (WIEGMANN et al., 2011; ZHAO et al., 2013; DING et al., 2015; JUNQUEIRA et al., 2016; CERRETTI et al., 2017). This hypothesis of rapid radiations is also supported by the paucity of calyptrate specimens in the fossil record throughout the Tertiary (GRIMALDI; ENGEL, 2005), and by the recurrence of short branch lengths estimated in the backbone of recent molecular phylogenies of the group, either in multilocus or phylogenomic approaches (KUTTY et al., 2010; 2019; CERRETTI et al., 2017).

These estimates of divergence times of Calyptratae, however, should be verified carefully, since the number of terminals and loci sampled in the study associated with the choice of calibration points in a phylogeny may have a considerable impact in branch lengths and in final estimates of divergence times (PARHAM et al., 2012; WARNOCK; YANG; DONOGHUE, 2012; HO; DUCHÊNE, 2014). Regarding the sampling of terminals and loci, for instance, the analysis of Wiegmann et al. (WIEGMANN et al., 2011), although comprehending more than 200 dipteran taxa and at least five loci for each terminal, included only 13 taxa of Calyptratae. In a similar way, the estimates of Zhao et al. (ZHAO et al., 2013), Ding et al. (DING et al., 2015) and Junqueira et al. (JUNQUEIRA et al., 2016) were inferred from complete mitochondrial genomes, but with nine, 10 and 34 species of Calyptratae, respectively. Later, Cerretti et al. (CERRETTI et al., 2017) sampled a much higher number of calyptrates by including 89 taxa, but using only three loci. Since Calyptratae is a large group with multiple lineages exhibiting evidences of rapid radiations in a short period of time, it is expected that phylogenetic hypotheses with a reduced sampling of taxa might suffer effects of long branch attraction, generating inaccurate phylogenetic relationships (BERGSTEN, 2005; NABHAN; SARKAR, 2012). For instance, Kutty et al. (KUTTY et al., 2010) recovered the monotypic families Mystacinobiidae and Ulurumyiidae as sister groups in a large data set of 246 terminals and nine loci, sampling 131 different genera of calyptrates. In a later phylogenomic approach, Kutty et al. (2019) presented well supported molecular evidence that both families are not related at all. And lastly, regarding the choice of calibration points, only Cerretti et al. (2017) calibrated nodes in all superfamilies of Calyptratae using specimen-based fossil evidence, including the first unambiguous fossil of Oestroidea and estimating the oldest origin of the group: at the end of Cretaceous, about 67.5 Ma.

The superfamily Oestroidea certainly represents the biggest challenge to provide accurate estimates of divergence times in Calyptratae, since the relationships between the ten families lack stability and support in the most recent molecular phylogenies (KUTTY et al., 2010; 2019; MARINHO et al., 2012; 2016; SINGH; WELLS, 2013; CERRETTI et al., 2017; 2019). The scarcity of reliable fossils of oestroid species also increases the uncertainty about the timing of diversification of lineages in the group (O'HARA et al., 2013; CERRETTI et al., 2017). Moreover, with almost 14,000 valid species (PAPE; BLAGODEROV; MOSTOVSKI, 2011; O'HARA; HENDERSON; WOOD, 2020), the relative diversity of species of oestroid families is not adequately sampled in recent molecular phylogenies of calyptrates. For instance, the family Tachinidae represents about 60% of species in Oestroidea (O'HARA; HENDERSON; WOOD, 2020) and was represented by only four to 22 species in published phylogenetic hypotheses of calyptrate groups. All these aspects combined increase the gap of knowledge about the origin and diversification of oestroid lineages and, consequently, of Calyptratae.

Here we estimate the timing of diversification of all families of Calyptratae with the largest sampling of calyptrates so far (more than 450 taxa), including six fossil species of Calyptratae, and using eight loci (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α). The increased sampling of calyptrate taxa, mainly in the superfamily Oestroidea, aims to break up potential long branches in the group, providing more accurate phylogenetic hypotheses and estimates of branch lengths and divergence times.

1.3 MATERIALS AND METHODS

1.3.1 Taxonomic and sequence sampling

We sequenced a total of 131 taxa of Calyptratae for this study, covering all superfamilies, mostly from the Neotropical Region (Table 1). The vouchers are deposited in the collection of the Laboratório de Sistemática e Biogeografia de Insecta (LASBI), in the University of São Paulo, Brazil. In order to increase our sampling of Calyptratae, we also included in our data sets sequences of calyptrate taxa deposited on GenBank (Table 2) that were sampled in published phylogenetic studies (BERNASCONI et al., 2000; NIRMALA; HYPŠA; ŽUROVEC, 2001; STIREMAN, 2002; DITTMAR et al., 2006; KUTTY et al., 2007, 2008, 2010, 2014; PETERSEN et al., 2007; TACHI; SHIMA, 2010; MARINHO et al., 2012, 2016; SINGH; WELLS, 2013; TACHI, 2013; ZHAO et al., 2013; PIWCZYŃSKI et al., 2014; 2017; HASEYAMA et al., 2015; WINKLER et al., 2015; CERRETTI et al., 2017; PAPE et al., 2017; BLASCHKE et al., 2018). To find duplicate sequences and to verify and exclude sequences with possible contamination and/or corresponding to misidentified taxa we used FAST: FAST Analysis of Sequences Toolbox v. 1.06 (LAWRENCE et al., 2015). Molecular markers of protein-coding genes that did not translate accurately were also excluded. A total of 480 terminals of Calyptratae were selected for the phylogenetic analyses, representing 328 different genera and reflecting the relative diversity of species in each family. Twelve species of Cyclorrhapha included in Su, Kutty and Meier (SU; KUTTY; MEIER, 2008) and Gibson, Skevington and Kelso (GIBSON; SKEVINGTON; KELSO, 2010) were selected as outgroups (Table 2), using a species of *Platypeza* (Platypezidae) as root.

1.3.2 DNA extraction, amplification and sequencing

For DNA extraction, one to three legs of each specimen preserved in ethanol were dried on tissue paper, chopped and incubated overnight at 55 °C in lysis solution and proteinase K. Proteins and DNA were precipitated with ammonium acetate and isopropanol, respectively, with the final concentrated DNA diluted in 50 µL of TLE buffer. Eight molecular markers were amplified: the mitochondrial 12S, 16S, cytochrome oxidase I (COI) and cytochrome b (Cytb), and the nuclear 18S, 28S, a fragment of the carbamoylphosphate synthase region of the CAD (rudimentary) gene and the elongation factor-1-alpha (Ef1α). The primers used for each marker and their respective annealing temperatures are listed in Table 3.

Polymerase chain reactions (PCR) had a final volume of 25 µL consisting of 1µL of the extracted DNA, 0.05 µL of GoTaq™ G2 Flexi DNA Polymerase, 5 µL 5x reaction of buffer, 2 µL of 25 mM $MgCL_2$, 1 µL of 2 mM dNTPs (Sinapse Biotechnologia) and 1µL of each primer, completing with 13.95 µL of MQ H_2O. To amplify the 18S, we also added 1.25 µL of dimethyl sulfoxide (DMSO) to the final solution. The PCR were set with 35 cycles of an initial denaturation step at 95 °C for 30 s, annealing at temperatures ranging from 45 °C to 58 °C (Table 3) for 30 s, and extension at 72 °C for one minute. At the end of the whole cycle a final extension of 72 °C for seven minutes was added. For CAD alone we followed a touchdown PCR protocol using two sets of primers (Table 3), starting with five cycles at 57 °C for 30 s, followed by five cycles at 52 °C for 30 s, and finishing with 35 cycles at 45 °C for 30 s. For DNA extractions and markers that did not amplify, we used Phusion High-Fidelity DNA Polimerase Taq (Thermos Scientific), following the manufacturer's protocol for 1 µL of extracted DNA.

We inspected PCR products by agarose gel electrophoresis (1.5% w/v), purifying them using Agencourt Ampure XP (Beckman Coulter). Sequencing reactions were prepared with the BigDye® Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems), with final PCR products precipitated with sodium acetate 3M and sequenced using 3730 DNA Analyzer (Thermo Fisher Scientific). We assembled contiguous sequences using the package Consed/PhredPhrap (EWING et al., 1998; EWING; GREEN, 1998; GORDON; ABAJIAN; GREEN, 1998; GORDON; DESMARAIS; GREEN, 2001). The resulting sequences were visualized and edited in SeaView v. 4.6.4 (GALTIER; GOUY; GAUTIER, 1996; GOUY; GUINDON; GASCUEL., 2010) and AliView v. 1.26 (LARSSON, 2014).

1.3.3 Alignment and trimming

Nucleotide sequences were aligned using MAFFT v. 7.450 (KATOH et al., 2002; KATOH; STANDLEY, 2013) with the maxiterate option set as 1000. For molecular markers of protein-coding genes, the nucleotides were aligned as translated amino acids to keep the codon structure and to search for stop codons. Ambiguous sites of aligned sequences were trimmed in trimAl v. 1.2 (CAPELLA-GUTIÉRREZ; SILLA-MARTÍNEZ; GABALDÓN, 2009), using the automated option. Trimmed alignments were concatenated using SequenceMatrix v. 1.8 (VAIDYA; LOHMAN; MEIER, 2010).

1.3.4 Substitution models and phylogenetic analysis

The choice of nucleotide substitution models for each phylogenetic analysis was carried out in IQ-TREE v. 1.6.10 (NGUYEN et al., 2015) allowing a FreeRate model (SOUBRIER et al., 2012). Substitution models were chosen based on the Bayesian information criterion. Phylogenetic analyses were executed under a maximum likelihood criterion using the IQ-TREE software implemented on CIPRES Science Gateway v. 3.3 (MILLER; PFEIFFER; SCHWARTZ, 2010). A sensitivity analysis was carried out using four different partition schemes and their respective substitution models (Table 4), allowing each partition to have different evolutionary speeds with the option -spp in IQ-TREE. Further explanation about the objective of sensitivity analysis can be found in the section 1.3.5 about wildcards. After detection and removal of wildcards, we inferred the topology of Calyptratae with all molecular markers as one partition, applying the same substitution model for each marker. To assess branch supports, we used the ultrafast bootstrap approximation (UFBoot) with 1000 replicates (MINH; NGUYEN; VON HAESELER, 2013; HOANG et al., 2018). Phylogenetic trees were viewed and edited in FigTree v. 1.4.4, Inkscape v. 0.92 and GIMP v. 2.10.14.

1.3.5 Missing data and search for wildcards

To sample a large number of calyptrate taxa we had to include a considerable amount of highly incomplete taxa (Tables 2 and 5), increasing the number of missing data. Although the inclusion of highly incomplete taxa may not be advisable (LEMMON et al., 2009; XI; LIU; DAVIS, 2016), phylogenetic analyses using either empiric or simulated data sets including highly incomplete taxa showed an improvement in the phylogenetic accuracy (WIENS; TIU, 2012; JIANG et al., 2014; STREICHER; SCHULTE; WIENS, 2016). Therefore, we carried out a series of analyses to mitigate the possible effects of missing data in our data set, such as the occurrence of wildcards, i.e., terminals that become unstable during tree search, floating in many different positions on a topology (NIXON; WHEELER, 1992; KEARNEY, 2002).

First, through the sensitivity analysis explained above (see section 1.3.4) we generated ten trees for each partition scheme (Table 4), resulting in 40 trees including all terminals sampled according to the section 1.3.1. These trees were used to rank potential wildcards. First, if there is a wildcard terminal in a set of trees, it is expected that it will group with different clades in each tree, increasing the total amount of different clades in all trees. Therefore, using YBYRÁ (MACHADO, 2015) we ranked all terminals according to the number of different clades in all trees after each one of them was pruned one terminal at a time. When the most probable wildcards are pruned, the total set of trees will present a much lower number of different clades when compared with the pruning of more stable terminals. To refine the rank generated by YBYRÁ, we also ranked all terminals based on the SPR distances and similarity index between all trees using the heuristic method of Goloboff (2008); replicates=10, stratification level=10) implemented in TNT 1.5 (GOLOBOFF; CATALANO, 2016), pruning one terminal at a time. When the most probable wildcards are pruned, the trees will become more similar to each other, demanding fewer SPR steps. After acquiring both rankings and calculating the strict consensus for all 40 trees, we compared the top positions of each ranking with the terminals collapsed at the base of Calyptratae in the strict consensus, removing the most probable wildcards until a more stable strict consensus was reached at family level. The number of different clades, the sum of SPR distances and the average of similarity index for each pruned taxon were summarized in charts built in LibreOffice Calc 7.0.3.1.

To understand better the occurrence of wildcards in our data set and the effects of missing data, we also evaluated the quality of missing data, i.e., which markers contain more information to infer the relationships of the phylogenetic hypothesis. We used a reduced data set with 82 terminals that have all eight molecular markers (Table 5) to infer the phylogeny of Calyptratae, including one outgroup taxon and representatives of all superfamilies. We mapped the UFBoot values of each marker on the phylogenetic tree generated with the concatenated data set using their respective substitution models and the option “-sup” in IQ-TREE. Moreover, the phylogenetic informativeness of each marker (TOWNSEND, 2007) was estimated in the software HyPhy (POND; FROST; MUSE, 2005) implemented on

PhyDesign (LÁPEZ-GIRÁLDEZ; TOWNSEND, 2011). The phylogenetic informativeness profiles for each marker provided by HyPhy represent the density of substitution rates for each branch of the tree that are parsimony-informative. Base frequencies and the substitution rate matrix for nucleotides included in HyPhy were obtained from the log file of the phylogenetic analysis in IQ-TREE. Since the tree used in HyPhy must look like a chronogram, we edited the tree of Calyptratae in FigTree to exhibit proportional branch lengths among each terminal.

1.3.6 Divergence times

After removal of wildcards and inferring the topology of Calyptratae, we estimated the divergence times of Calyptratae using BEAST v. 2.6.2 (BOUCKAERT et al., 2019), implemented on CIPRES Science Gateway v. 3.3 (MILLER; PFEIFFER; SCHWARTZ, 2010). Nucleotide substitution models were averaged simultaneously with estimation of parameters using bModelTest (BOUCKAERT; DRUMMOND, 2017), with all molecular markers concatenated as one partition and keeping default distribution priors on the respective parameters. Aiming to compare our estimates of divergence times directly with methods used in previous publications, we used three different models: node dating using a pure-birth tree prior with the same calibration settings used in Cerretti et al. (2017) (hereafter referred as Yule), node dating using a birth-death tree prior with calibration densities estimated with CladeAge (MATSCHINER et al., 2017) (hereafter referred as CA), and tip dating with a fossilized birth-death tree prior (HEATH; HUELSENBECK; STADLER, 2014) (hereafter referred as FBD).

For calibration information, we checked all fossil species described in families of Calyptratae, selecting only those that can be unambiguously classified in a particular group. Therefore, we selected six crown fossils, namely *Archaeopolietes tertiaria* Pont & Carvalho, 1997 and *Phaonia electrica* Pont & Carvalho, 1997 (Muscidae) found in Dominican amber (13.65–20.43 Ma) (PONT; DE CARVALHO, 1997), *Enischnomyia stegosoma* Poinar & Brown, 2012 (Streblidae) found in Dominican amber (13.65–20.43 Ma) (POINAR; BROWN, 2012), *Glossina oligocenus* (Scudder, 1892) (Glossinidae) found in Florissant Fossil Beds in Colorado (33.9–37.2 Ma) (GRIMALDI, 1992; SMITH; MOE-HOFFMAN, 2007), *Mesembrinella caenozoica* Cerretti et al. (Mesembrinellidae) found in Dominican amber (13.65–20.43 Ma) (CERRETTI et al., 2017), and *Protanthomyia minuta* Michelsen, 2000

(Anthomyiidae) found in Baltic amber (33.9–37.2 Ma) (MICHELSEN, 2000). The position of each fossil in the phylogeny was based on its systematic classification proposed in the original descriptions and taxonomic revisions. Time intervals of each fossil were based on stratigraphic units obtained on Fossilworks (fossilworks.org), except those used in Yule as explained below.

In Yule, we used the same settings of Cerretti et al. (2017), selecting four calibration points with the same time intervals used for each fossil, which do not correspond exactly to the time intervals of stratigraphic units on Fossilworks, and placing lognormal distributed priors on calibration densities (M=2.0, S=2.5): *Phaonia electrica* used to constrain species of the genera *Dichaetomyia*, *Dolichophaonia*, *Helina* and *Phaonia* of the late tribe Phaoniini (corresponding to *Phaonia* + *Cordiluroides*, prior offset=15), *G. oligocenus* used to constrain Hippoboscoidea (corresponding to *Glossina* + *Ornithoctona*, prior offset=35), *P. minuta* used to constrain Anthomyiidae (prior offset=42), and *M. caenozoica* used to constrain Mesembrinellidae (prior offset=15).

The pure-birth tree prior in Yule assumes only the birth rate as parameter, which corresponds to the speciation rate (λ) (HO; DUCHÊNE, 2014). This, however, is not an adequate prior to estimate divergence times, because it does not consider extinction rates (μ) and fossil recovery rates (ψ) as parameters in the evolution model of lineages. In CA and FBD, the speciation and extinction rates are used to calculate the net diversification rate ($d = \lambda - \mu$) and the turnover rate ($r = \mu/\lambda$), and include the fossil recovery rate (ψ). We obtained the values for the net diversification and turnover rates from the estimates provided by Condamine, Clapham and Kergoat (2016) for the diversification of Diptera during the Tertiary: d=0.04–0.06, r=0.15–0.25. We used the default settings for the fossil recovery rate, since the fossil recovery rate in Diptera was not estimated in Condamine, Clapham and Kergoat (2016).

In CA, the prior distribution of the calibration density of each constrained node is not chosen arbitrarily, but is estimated using the net diversification, turnover and fossil recovery rates before the analysis (MATSCHINER et al., 2017). For the birth-death tree prior of CA we placed a lognormal distributed prior on turnover rate (M=0.05, S=0.15) and a uniform distributed prior on net diversification rate. In addition to the calibration points used in Yule, we used *A. tertiaria* to constrain species of the genera *Drymeia*, *Eudasyphora*, *Haematobosca*, *Hydrotaea*, *Huckettomyia*, *Mesembrina*, *Morellia*, *Musca*, *Ophyra*, *Polietes*, *Polietina*, *Stomoxys* and *Thricops* of the late tribe Muscini, *E. stegosoma* to constrain Streblidae and *G. oligocenus* to constrain Glossinidae.

In FBD, the tree prior is more complex than the other two and includes more parameters. In addition to the diversification and turnover rates, it is necessary to specify in the model the time of origin of the tree and the proportion of sampled extant species in the phylogeny (ρ). The fossil recovery rate (ψ) is also included in a parameter that measures the probability of fossil observation prior to species extinction ($s= \psi/(\mu + \psi)$). Therefore, in contrast to CA, all these parameters of the tree prior are estimated during the analysis. The time intervals for the time of origin were obtained from the estimates for Calyptratae of Cerretti et al. (CERRETTI et al., 2017), on which we placed a uniform distributed prior between 50 and 100 Ma. We fixed the ρ parameter as 0.019, which corresponds to the ratio between the number of species of Calyptratae sampled in our phylogeny (=458) and valid species of Calyptratae (=23,716) (PAPE; BLAGODEROV; MOSTOVSKI, 2011; O'HARA; HENDERSON; WOOD, 2020). We placed a lognormal distributed prior on net diversification rate (M=0.05, S=0.15), a beta distributed prior on the probability of fossil observation prior to species extinction (Alpha=1.0, Beta=20.0), and a default uniform distributed prior on turnover rate. The same constrains used in CA were adopted herein, including the respective fossils of each constrained group as terminals.

We applied an uncorrelated relaxed lognormal clock for the three models (DRUMMOND et al., 2006), placing an exponential distribution (ucldMean.c, mean=10) on the clock rate prior and a gamma distribution with default parameters on the standard deviation prior (ucldStdev). The outgroups used in the phylogenetic inference were excluded, and the root was placed between Hippoboscoidea and Muscoidea + Oestroidea constraining both clades as monophyletic. Starting trees produced in preliminary runs using Markov chain Monte Carlo (MCMC) algorithm were provided for each analysis to reduce unnecessary consumption of computational resources and to accelerate the likelihood estimates of the trees. We ran each analysis for 700 million generations, sampling trees every 20,000 generations. We evaluated the convergence of each run by accessing log files in Tracer v1.7.1 (RAMBAUT et al., 2018), and TreeAnnotator v.2.6.0 (BEAST package) was used to generate the maximum clade credibility tree with a burn-in of 25%.

1.4 RESULTS

1.4.1 Detection of wildcards and quality of missing data

We sampled a total of 470 terminals of Calyptratae and 12 terminals of outgroups. The rankings of potential wildcards according to the number of different clades and to the SPR distances between the trees of the sensitivity analysis are summarized in Figures 1–2 and in Table 6. The number of different clades decrease drastically in the range of the first 50 terminals pruned from the trees (Figure 1), delimiting a first set of potential wildcards (Table 6). At first sight, the amount of missing data is not concentrated in the range of potential wildcards, being distributed throughout the ranking. The values of SPR distances and similarity indexes between trees when pruning the 50 potential wildcards ranked in YBYRÁ vary gradually and inversely, where the lowest value of SPR distance is correlated to more similar trees (Figure 2). After comparing both rankings with the strict consensus of the trees of the sensitivity analysis, we identified 22 wildcards (Table 6) which decrease the resolution of the relationships between the families of Calyptratae in our data set. The number of collapsed nodes in the strict consensus of all 40 trees of the sensitivity analysis is 57.5%. After removal of the 22 wildcards, we generated 10 trees using the same substitution model for all markers (Table 4, see all sequences, 470 terminals) with only 19.8% of collapsed nodes in the strict consensus, exhibiting an increase in the resolution of tree topology. The clades collapsed in the strict consensus are restricted to groups inside some families, but the main relationships between calyptrate families remain constant.

Regarding the quality of missing data, each marker exhibits a different amount of phylogenetic signal for the topology of Calyptratae. The topology inferred from our reduced data set comprising 82 terminals and eight molecular markers confirms the main relationships in Calyptratae inferred in previous studies (Figure 3.A), with a basal and monophyletic Hippoboscoidea, sister group of a monophyletic Oestroidea nested within a paraphyletic muscoid grade. About 60% of the branches of the tree exhibit UFBoot values above 95% (Figures 3.A and 4). When calculating UFBoot values for each molecular marker, however, we verify that CAD and 28S have more information to infer the phylogeny of Calyptratae than the other markers (Figure 4). Both markers exhibit UFBoot values above 95% for at least 30% of the branches of the tree, specially for the backbone of Calyptratae and for the families Streblidae, Fanniidae, Muscidae, Sarcophagidae, Calliphoridae, Mesembrinellidae and Tachinidae. Molecular markers such as 12S, 16S, COI, Cytb and Ef1α recover less than 20%

of the branches in the topology of Calyptratae, whereas 18S has no information to resolve any relationship in the group, exhibiting zero UFBoot values for all branches of the tree.

The profiles obtained in HyPhy (Figures 3.B and 5) shed more light to the amount of phylogenetic signal of each marker. In Figure 3.B we verify that the higher densities of phylogenetic informativeness per site are concentrated in less inclusive nodes of the phylogeny of Calyptratae, showing lower densities in deeper divergences. The highest peaks of phylogenetic informativeness correspond to the markers of Cytb, CAD and COI, followed by median values for 12S, 16S, 28S and Ef1α and almost zero phylogenetic informativeness values for 18S. The profiles of markers of protein-coding genes, however, change completely when we calculate the phylogenetic informativeness densities removing the third codon position (Figure 5). The topology of Calyptratae changes slightly regarding the relationships in Oestroidea, with Sarcophagidae and Calliphoridae as sister groups at the base of Oestroidea, and Polleniidae as the sister group of Tachinidae, with Rhinophoridae nested within Tachinidae. The peaks of phylogenetic informativeness of CAD, COI, Cytb and Ef1α are concentrated at the level of less inclusive nodes still, but with much lower densities, exhibiting a decrease of approximately 87.5%, 80.6%, 76.6% and 83.6% respectively. This pattern shows that the majority of substitution rates for these markers are actually found in the third codon position.

The amount and quality of missing data for each one of the 22 wildcards found in our data set are therefore heterogeneous, since each marker contributes differently to the phylogeny of Calyptratae (Table 6). The average of markers per each wildcard is 3.72, while 64% of wildcards have 18S, which is almost ineffective for the phylogeny of Calyptratae, and less then 10% have CAD, which is the marker with more phylogenetic signal for most branches of the tree. About 86% of wildcards have 28S, while the remaining markers are distributed between 20% and 60% of wildcards. When comparing the amount and quality of missing data between wildcards and the last 50 terminals ranked in YBYRÁ, i.e., the potentially more stable terminals in our data set, the average of markers per terminal is higher in more stable terminals, about 5.38 markers per terminal. About 40% of more stable terminals have CAD, with the remaining markers being distributed between 60% and 80% of the terminals. Among more stable terminals, however, there are 18 terminals with two to four markers only, and none of them have CAD.

1.4.2 Phylogeny of Calyptratae

After removal of wildcards, the phylogenetic analysis includes 458 terminals of Calyptratae (Figures 6–12). The length of trimmed alignments is 347 base pairs (bp) for 12S, 980 bp for 16S, 1643 bp for 18S, 1313 bp for 28S, 663 bp for CAD, 552 bp for COI, 933 bp for Cytb and 621 bp for Ef1α, resulting in a data set with total length of 7,525 bp with 2,885 parsimony-informative, 802 singleton sites and 3,837 constant sites. The phylogeny of Calyptratae was recovered with a similar structure found in previous studies, with a monophyletic Hippoboscoidea as sister group of a monophyletic Oestroidea nested within a muscoid grade, with Anthomyiidae + Scathophagidae as sister group of Oestroidea (Figure 6). The majority of branches in Hippoboscoidea and in the muscoid grade exhibit significant UFBoot values, i.e., ≥ 95%, whereas several relationships between the families of Oestroidea show lower UFBoot values. The strict consensus of ten trees resulted in a stable topology at family level, except by some differences inside Oestroidea as discussed below. One of the trees was used to discuss the relationships below.

1.4.2.1 Superfamily Hippoboscoidea

The main relationships in Hippoboscoidea show significant UFBoot values, with all families recovered as monophyletic (Figure 7). Glossinidae is the first split of the clade, being the sister group of Hippoboscidae and bat flies. The next clade is composed of Hippoboscidae as sister group of Nycteribiidae and Streblidae.

1.4.2.2 Muscoid grade

The main relationships in the muscoid grade exhibit significant UFBoot values, with Fanniidae, Muscidae and Scathophagidae recovered as monophyletic and Anthomyiidae as a paraphyletic grade with Scathophagidae nested within it (Figure 8). Fanniidae is the first split of the muscoid grade, with the next clade nesting the remaining muscoid families and the superfamily Oestroidea. The largest muscoid family, Muscidae, is the sister group of “Anthomyiidae” + Scathophagidae and Oestroidea. The family Anthomyiidae is paraphyletic in relation to Scathophagidae.

1.4.2.3 Superfamily Oestroidea

The superfamily Oestroidea and the majority of its families are monophyletic with significant UFBoot values (Figures 9–12). The relationships between some clades within the superfamily, however, still show some uncertainty. The first divergence of the group is the clade nesting Mystacinobiidae and Oestridae (Figure 9), which is consistently recovered in the strict consensus despite the low UFBoot value. The next clade is composed of Sarcophagidae and the rest of oestroid families (Figure 9).The clade nesting calliphorid lineages is the most uncertain in Oestroidea, with many clades collapsed in the strict consensus (Figure 10). Calliphoridae *sensu stricto*, i.e., including all subfamilies except Mesembrinellidae, Polleniidae and Rhiniidae (MARINHO et al., 2012), is paraphyletic due to the ambiguous position of the species *Bengalia peuhi*, *Cordylobia anthropophaga* and *Protocalliphora azurea* and to the monophyletic family Rhiniidae nested within it. Ulurumyiidae is frequently recovered as sister group of the monophyletic Mesembrinellidae (Figure 10), but its position is also uncertain, being collapsed at the base of the clade nesting calliphorid lineages in the strict consensus. Mesembrinellidae is the sister group of Rhinophoridae, Polleniidae and Tachinidae (Figures 10 and 11). Rhinophoridae is monophyletic, being sister group of Polleniidae and Tachinidae, also monophyletic. Tachinidae is mainly divided into two clades, with Phasiinae as sister group of Dexiinae and Tachininae as sister group of Exoristinae (Figures 11 and 12).

1.4.3 Divergence times of Calyptratae

A comparison of age estimates for each family using the three models are represented in Table 8 and the chronograms generated are represented in Supplementary information 1–3. Specifically in Yule, MCMC runs did not converge for all parameters, exhibiting low effective sample size (ESS) values in the Yule model and prior even when extending MCMC runs to more than a billion generations. The main inconsistency of the Yule model is the restrictive calibration point of the Anthomyiidae + Scathophagidae clade, which is exhibited by the low variation in age estimates for this clade (Table 8, Supplementary information 1). Moreover, the age of Calyptratae and other families and clades in Yule are overestimated when compared to CA and FBD, e.g., placing the origin of Calyptratae in the Early Cretaceous around 117 Ma and the divergence of Hippoboscoidea and Muscoidea + Oestroidea around 115.5 and 78.1 Ma, respectively. In comparison, MCMC runs of FBD and

CA converged faster than Yule, with chains no longer than 580 and 150 million generations, respectively. Age estimates in FBD for each family are somewhat similar to those in Yule (Supplementary information 3), except in deeper divergences of Calyptratae. Age estimates in CA are generally younger for each family (Supplementary information 2). Considering the inconsistency of the model and the overestimated ages in Yule, we select the chronogram generated in CA (Figure 13, Supplementary information 2) to show the age estimates of each main group of Calyptratae, comparing it with the estimates in FBD.

Calyptratae originated in the mid-Late Cretaceous around 84.6 Ma (Figure 13) in the Santonian age. In FBD, however, Calyptratae is pushed back to the Cenomanian age, around 95.3. The first splits in Calyptratae, Hippoboscoidea and Muscoidea + Oestroidea, occurred in different periods: Hippoboscoidea in the Late Cretaceous around 83.4 Ma, and Muscoidea + Oestroidea in the Paleocene around 57.5; whereas in FBD both splits happened in the Late Cretaceous.

In Hippoboscoidea, the family Hippoboscidae is the oldest one, occurring in the Paleocene around 59 Ma; Nycteribiidae and Streblidae originated in the Eocene around 44.6 and 49.7 Ma, respectively; and Glossinidae occurred only in the Oligocene around 29.4 Ma. In FBD, however, the origin of all hippoboscoid families happened during the Paleocene and Eocene, exhibiting older ages than in CA. Among families of the muscoid grade, Muscidae is the oldest one, occurring in the Eocene around 42.8 Ma. Fanniidae and Anthomyiidae + Scathophagidae originated in the Oligocene, around 30.5 and 28.9 Ma, respectively. In FBD, Muscidae originated in the Paleocene and Fanniidae and Anthomyiidae + Scathophagidae in the Eocene.

The superfamily Oestroidea originated in the Eocene around 47.1 Ma, whereas in FBD its origin is pushed back to the edge of Cretaceous-Paleogene boundary, around 67.5 Ma. The families Tachinidae and Sarcophagidae are the oldest ones of the group, occurring in the Eocene with 38.4 and 34.8 Ma, respectively. The split between Mesembrinellidae and Ulurumyiidae also happened during the Eocene, around 38 Ma, although the origin of Mesembrinellidae occurred in the beginning of Oligocene, around 33.3 Ma. The family Rhinophoridae and the clade nesting calliphorid lineages + Rhiniidae originated in the Oligocene, with 28.7 and 27.3 Ma, respectively. And the families Oestridae, Rhiniidae and Polleniidae are the youngest families of the group, occurring only in the Miocene with 19.8, 17.6 and 15.4 Ma, respectively. The split between Oestridae and Mystacinobiidae, however, occurred in the Eocene around 41.5 Ma. In FBD, Tachinidae and Sarcophagidae originated in the beginning of Eocene, Mesembrinellidae and the clade nesting calliphorid lineages + Rhiniidae + Rhinophoridae in the middle of the Eocene, and Oestridae, Rhiniidae and Polleniidae in the Oligocene.

1.5 DISCUSSION

1.5.1 Is missing data the cause of wildcard behavior?

The appearance of wildcards in a data set is usually attributed to the amount of missing data, conflicting data or both (KEARNEY, 2002), which usually lead many researchers to avoid including highly incomplete taxa or incomplete sequences in a phylogenetic matrix. However, our results suggest that it is not necessarily the amount of missing data by itself what causes a wildcard behavior, but the amount of missing data in the most informative characters. For instance, we identified the species *Masiphya townsendi* as the most unstable terminal in our data set (Table 6, Figure 2), which have only Ef1α and 28S. Ef1α is one of the least informative markers in our data set, with few parsimony-informative characters and recovering few clades in the phylogeny of Calyptratae (Figures 3–5). Although 28S is one of the most informative markers used herein and recovers many clades in the phylogeny of Calyptratae (Figure 4), CAD is the marker with most phylogenetic signal for either deep or recent divergences in the group, confirming what Moulton and Wiegmann proposed (2004).

The majority of wildcards have only three or four markers, most of them without CAD and including the 18S, which has insufficient information for the phylogeny of Calyptratae. The absence of CAD may lead to this wildcard behavior in some wildcards, since less than 10% of wildcards have it. There are some exceptions though, such as the species *Eurychaeta palpalis*, *Iceliopsis borgmeieri* and *Polygaster* sp., which were identified as wildcards and have at least seven markers, including CAD. The wildcard behavior in these three terminals specifically may be due to conflicting data instead, probably having chimeric sequences caused by contamination with samples of closely related taxa that failed to be recognized during our sampling process. The inclusion of highly incomplete taxa, however, does not necessarily decrease the resolution of a phylogenetic tree. Several stable terminals in our data set have only two to four molecular markers and do not affect the strict consensus, at least at family level.

1.5.2 Relationships between calyptrate families

As expected, the most contentious relationships in the phylogeny of Calyptratae are found in the superfamily Oestroidea. These conflicts are probably due to the lack of phylogenetic signal in the molecular markers sampled herein to resolve the main branches in Oestroidea (Figure 3). In general, we recovered similar patterns of relationships for the families of Hippoboscoidea and of the muscoid grade found by Kutty et al. (2010. 2019), except that the monophyly of Hippoboscidae, Nycteribiidae and Streblidae were confirmed herein. In Oestroidea, our topology confirms several patterns of relationships found both in multilocus and/or phylogenomic approaches (KUTTY et al., 2010, 2019; MARINHO et al., 2012; CERRETTI et al., 2017), e.g., the clade nesting Oestroidea + Mystacinobiidae. Comparisons between the phylogenetic relationships of all families of Oestroidea with our results are summarized in Table 7.

1.5.3 Comparison between CA and FBD estimates

Putting the inconsistency of the Yule model aside, the ages estimated in CA and FBD differed considerably, with FBD estimating much older ages for each calyptrate group than CA. The FBD model allows the estimation of divergence times considering fossil sampling along the diversification of lineages, but it assumes that the sampling of extant and fossil species is complete or at least random (HEATH; HUELSENBECK; STADLER, 2014; MATSCHINER, 2019). This assumption, however, is usually violated in most studies dealing with species-rich groups, such as Calyptratae, in which the sampling of extant and fossil species is selective due to the diversity of the group and the scarcity of the fossil record (MATSCHINER, 2019). Matschiner (2019) simulated the impacts of this model violation and verified that the FBD model tends to overestimate the ages of all nodes, an effect caused by sampling only the oldest fossils of each group. In contrast to the FBD model, using only the oldest fossils of each group and sampling a selective set of extant species do not violate the assumptions of the CA model, which accurately estimated the ages of nodes in simulated data (MATSCHINER, 2019). Our results confirm this pattern since all age estimates for all nodes in FBD are much older than those in CA. Moreover, age estimates of constrained nodes in CA are not necessarily restricted to the calibration information of fossils, e.g., the origin of clades nesting the extant species of Anthomyiidae + Scathophagidae and Glossinidae is younger than the ages of stratigraphic units of *P. minuta* and *G. oligocenus*, and the origin of the clade nesting extant species of Mesembrinellidae is older than the stratigraphic units of *M. caenozoica*. Therefore, we consider CA as a suitable model for estimating divergence times in Calyptratae and other species-rich groups as well.

1.5.4 Congruences and conflicts about the origin of calyptrate flies

We propose herein the first hypothesis of divergence times of Calyptratae representing the relative diversity of species of each family of the group. Our results confirm the hypothesis of rapid radiations in the Tertiary inferred for lineages of Schizophora (WIEGMANN et al., 2011). The origin of Calyptratae, however, is pushed back to the mid-Late Cretaceous rather than at the edge of the Cretaceous-Paleogene boundary or even at the Paleocene (ZHAO et al., 2013; DING et al., 2015; JUNQUEIRA et al., 2016; CERRETTI et al., 2017), although all extant families of Calyptratae have originated throughout the Tertiary, mainly during the Eocene and Oligocene.

Many causes and correlations with biogeographic, climatic and ecological events were already proposed and discussed in the literature dealing with divergence times of calyptrate groups (WIEGMANN et al., 2011; JUNQUEIRA et al., 2016; CERRETTI et al., 2017). We understand that these scenarios are helpful to comprehend and hypothesize about the processes that contributed to the diversification of these flies, mainly during the Tertiary. We intend to deepen and amplify this discussion about the diversification of each family of Calyptratae in the final publication, but our main highlights are noted below.

The origin of Hippoboscoidea in the Late Cretaceous is proposed herein for the first time. Wiegmann et al. (2011) and Cerretti et al. (2017) estimated the origin of Hippoboscoidea in the Eocene, but this may be caused by the low sampling of hippoboscoid taxa and a possible restrictive effect of calibrating the node with *G. oligocenus*. All species of Hippoboscoidea have a close relationship of haematophagy with either mammals or birds, both groups that exhibit a fast diversification right after the Cretaceous-Paleogene mass extinction, around 66 Ma (MEREDITH et al., 2011; BRUSATTE; O'CONNOR; JARVIS, 2015).

We estimate a slightly younger origin of muscoid flies than those proposed by Haseyama et al. (2015) and Cerretti et al. (2017). Usually Anthomyiidae + Scathophagidae were estimated as the oldest family of the muscoid grade, but this may be caused by a restrictive effect of calibrating the node with *P. minuta*. We recovered Muscidae as the oldest family of the muscoid grade, with a younger Anthomyiidae + Scathophagidae.

The origin of the superfamily Oestroidea is similar to that estimated by Cerretti et al. (2017), around mid-Eocene. The origins of the most species-rich families in Oestroidea, Tachinidae and Sarcophagidae, however, differ considerably from the estimates of Cerretti et al. (2017), being pushed back to the Eocene instead of the Oligocene. Our results confirm the estimates of Mesembrinellidae as one of the oldest families in Oestroidea, with origin in the Eocene. The age estimates for Rhinophoridae and the clade nesting calliphorid lineages are somewhat similar to those in Cerretti et al. (2017), around the mid-Oligocene. Cerretti et al. (2017) also proposed a very recent origin of the families Polleniidae and Rhiniidae, around the Miocene; but the origin of the family Oestridae was placed in the early Oligocene, whereas we recovered it in the Miocene.

Table 1: List of species collected and sequenced for this study, including their respective families, voucher identification and collecting data (ordered from country to the more inclusive locality). All vouchers are deposited in the collection of the Laboratório de Sistemática e Biogeografia de Insecta (LASBI), in the University of São Paulo, Brazil.

Species	**Voucher**	**Collecting data**
OUTGROUPS		
Syrphidae		
Ornidia obesa (Fabricius, 1775)	OD1287	Brazil, São Paulo, São Paulo
HIPPOBOSCOIDEA		
Paradyschiria parvula Falcoz, 1931	DMA172	Brazil, Mato Grosso do Sul, Miranda
Nycteribiidae		
Basilia carteri Scott, 1936	DMA165	Brazil, Mato Grosso do Sul, Miranda
Basilia speiseri (Miranda-Ribeiro, 1907)	DMA164	Brazil, Mato Grosso do Sul, Miranda
Streblidae		
Anastrebla caudiferae Wenzel, 1976	DMA171	Brazil, São Paulo, São Paulo
Megistopoda aranea (Coquillett, 1899)	DMA170	Brazil, São Paulo, São Paulo
Noctiliostrebla morena Alcantara et al., 2019	DMA173	Brazil, Mato Grosso do Sul, Miranda
Paratrichobius longicrus (Miranda-Ribeiro, 1907)	DMA169	Brazil, São Paulo, São Paulo
Strebla consocia Wenzel, 1966	DMA163	Brazil, Amazonas, Borba
Strebla wiedemanii Kolenati, 1856	DMA160	Brazil, Amapá, Terra Indígena Wajãpi
Trichobius dugesioides Wenzel, 1966	DMA162	Brazil, Amazonas, Borba
Trichobius tiptoni Wenzel, 1976	DMA159	Brazil, São Paulo, São Paulo
MUSCOIDEA		
Anthomyiidae		
Anthomyia sp.	OD0502	Brazil, Rio de Janeiro, Itatiaia
Anthomyia xanthopyga (Albuquerque, 1959)	M0141	Brazil, Rio de Janeiro, Itatiaia
Emmesomyia (Taeniomyia) auricolis Stein, 1918	OD0421	Brazil, São Paulo, Salesópolis
Phaonantho mallochi Curran, 1934	OD0476	Brazil, Rio de Janeiro, Itatiaia
Fanniidae		
Fannia itatiaiensis Albuquerque, 1956	OD1036	Brazil, São Paulo, Santo André
Fannia penicilaris Stein, 1900	OD1262	Brazil, Rio de Janeiro, Itatiaia
Fannia sp. nov. Paramo	MW05	
Fannia tumidifemur Stein, 1911	OD1032	Brazil, São Paulo, Santo André
Muscidae		
Cyrtoneurina alifusca Couri, 1982	M0063	Brazil, São Paulo, Santo André
Cyrtoneuropsis maculipennis (Macquart, 1843)	M0005	Brazil, São Paulo, Santo André
Dolichophaonia plaumanni Carvalho,1983	M0068	Brazil, São Paulo, Jacareí
Morellia humeralis (Stein, 1918)	M0032	Brazil, São Paulo, Santo André
Morellia nigricosta Hough, 1900	M0033	Brazil, São Paulo, Santo André
Neomuscina nigricosta Snyder, 1949	M0067	Brazil, São Paulo, São Paulo
Ophyra sp.	M0103	Brazil, Rio de Janeiro, Itatiaia
Phaonia grandis Couri, 1982	M0037	Brazil, São Paulo, Santo André
Phaonia praesuturalis (Stein, 1904)	OD0826	Brazil, São Paulo, Salesópolis
Philornis aff. *aitkeni* Dodge, 1963	OD0881	Brazil, Pará, Abel Figueiredo
Polietina minor Albuquerque, 1956	M0060	Brazil, São Paulo, Santo André
Polietina univittata Couri & Carvalho, 1996	M0029	Brazil, São Paulo, Santo André
Pseudoptilolepis fulvapoda Snyder, 1949	M0030	Brazil, São Paulo, Santo André
Syllimnophora sp.	OD1048	Brazil, São Paulo, Santo André
Scathophagidae		
Scatogera primogenita Albuquerque, 1984	OD1221	Colombia, Antioquia, San José de la Montaña
OESTROIDEA		
Calliphoridae		
Blepharicnema splendens Macquart, 1843	MW10	Colombia, Antioquia, San José de la Montana

Species	**Voucher**	**Collecting data**
Calliphora nigribasis Macquart, 1851	MW02	Colombia, Antioquia, San José de la Montana
Calliphora vicina Robineau-Desvoidy, 1830	MW03	Colombia, Antioquia, San José de la Montana
Mesembrinellidae		
Laneella nigripes Guimarães, 1977	C51	Brazil, São Paulo, Santo André
Mesembrinella batesi Aldrich, 1922	C56	Brazil, Alagoas, Murici
Mesembrinella bellardiana Aldrich, 1922	C43	Brazil, São Paulo, Paranapiacaba
Mesembrinella bicolor (Fabricius, 1805)	C39	Brazil, Mato Grosso, Chapada dos Guimarães
Mesembrinella purpurata Aldrich, 1922	C13	Brazil, São Paulo, Santo André
Mesembrinella semihyalina Mello, 1967	C57	Brazil, Alagoas, Murici
Oestridae		
Metacuterebra apicalis (Guérin-Meneville, 1835)	OD1227	Brazil, São Paulo, São Paulo
Sarcophagidae		
Argoravinia aurea (Townsend, 1918)	OD1097	Brazil, Pará, Abel Figueiredo
Dexosarcophaga carvalhoi (Lopes, 1980)	OD1081	Brazil, Pará, Abel Figueiredo
Helicobia aurescens (Townsend, 1927)	OD0465	Brazil, Mato Grosso do Sul, Porto Murtinho
Lepidodexia sp. 1	OD0961	Brazil, São Paulo, Salesópolis
Lepidodexia sp. 4	OD1105	Brazil, Pará, Abel Figueiredo
Lipoptilocnema crispina (Lopes, 1938)	OD1044	Brazil, São Paulo, Santo André
Nephochaetopteryx pallidiventris Townsend, 1934	T1835	Brazil, Paraná, Bandeirantes
Oxysarcodexia avuncula (Lopes, 1933)	T1869	Brazil, Espírito Santo, Ibitirama
Pacatuba matthewsi Lopes, 1975	OD0503	Brazil, Maranhão, São Pedro da Água Branca
Peckia chrysostoma (Wiedemann, 1830)	OD1173	Brazil, Maranhão, São Pedro da Água Branca
Retrocitomyia retrocita (Hall, 1933)	OD1123	Brazil, Pará, Abel Figueiredo
Titanogrypa larvicida (Lopes, 1935)	OD1121	Brazil, Pará, Abel Figueiredo
Titanogrypa (Cucullomyia) placida (Aldrich, 1925)	T1734	Costa Rica, Guanacaste, Parque Nacional Guanacaste
Tricharaea (Sarcophagula) canuta (Wulp, 1896)	OD0495	Brazil, Pará, Abel Figueiredo
Tachinidae		
Abepalpus sp.	T2660	Brazil, Rio de Janeiro, Itatiaia
Adejeania sp. 1	T2389	Brazil, São Paulo, Salesópolis
Adejeania sp. 2	T2917	Brazil, Paraná, Colombo
Archytas sp. 1	T2539	Brazil, São Paulo, São Paulo, Cidade Universitária
Archytas sp. 2	T2350	Brazil, Minas Gerais, Caeté
Archytas sp. 3	T2690	Brazil, Bahia, Camacan
Archytas sp. 4	T2714	Brazil, Espírito Santo, Sooretama
Belvosia sp.	T0263	Brazil, Mato Grosso, Tangará da Serra
Beskia sp.	T1484	Brazil, Pará, Rondon do Pará
Bombyliomyia sp.	T1873	Brazil, Espírito Santo, Ibitirama
Chetogena sp. 1	T0064	Brazil, Mato Grosso do Sul, Porto Murtinho
Cholomyia inaequipes Bigot, 1884	T0309	Brazil, São Paulo, Salesópolis
Chrysotachina sp.	T2543	Brazil, São Paulo, São Paulo
Copecrypta sp.	T2668	Brazil, Rio de Janeiro, Itatiaia
Cordyligaster analis (Macquart, 1851)	T1706	Brazil, Pará, Belterra
Cyanogymnomma coerulea Townsend, 1927	T1235	Brazil, São Paulo, São Paulo
Cyanogymnomma sp.	T1353	Brazil, São Paulo, Santo André
Cylindromyia sp.	T2529	Brazil, São Paulo, São Paulo
Dasyuromyia sp.	T1376	Chile, Región de Magallanes y Antártica Chilena, Isla Navarino
Deopalpus sp. 1	T0664	Bolivia, La Paz, Larecaja
Deopalpus sp. 2	T3050	Brazil, Amazonas, Manaus
Diaphanomyia sp.	T2129	Brazil, São Paulo, Salesópolis
Diaugia angusta Perty, 1833	T0741	Brazil, Bahia, Camacan
Empheremyia sp.	T1338	Brazil, São Paulo, Santo André
Epigrimyia sp.	T2544	Brazil, São Paulo, São Paulo
Euempheremyia sp.	T2128	Brazil, São Paulo, Salesópolis
Euepalpus sp. 1	T2919	Brazil, Roraima, Ilha de Maracá
Euepalpus sp. 2	T2602	Brazil, Rio de Janeiro, Itatiaia

Species	Voucher	Collecting data
Eutrichophora sp.	T2705	Brazil, Bahia, Camacan
Eutrichopoda sp.	T1420	Brazil, Pará, Abel Figueiredo
Exopalpus sp. 1	T2365	Brazil, Rio de Janeiro, Itatiaia
Exopalpus sp. 2	T3033	Brazil, Roraima, Caracaí
Genea sp.	T1101	Brazil, São Paulo, Santo André
Gnadochaeta sp.	T2456	Brazil, São Paulo, Santo André
Gonia sp.	T0049	Brazil, Mato Grosso do Sul, Porto Murtinho
Gymnoclytia paulista Townsend, 1929	T2528	Brazil, São Paulo, São Paulo
Hypotachina sp.	T1439	Brazil, Pará, Abel Figueiredo
Hystricia sp.	T2126	Brazil, São Paulo, Salesópolis
Iceliopsis borgmeieri Guimarães, 1976	T0026	Brazil, São Paulo, Salesópolis
Jurinella sp. 1	T2578	Brazil, São Paulo, São Paulo
Jurinella sp. 2	T2913	Brazil, Paraná, Colombo
Jurinia sp.	T2641	Brazil, Rio de Janeiro, Itatiaia
Juriniosoma sp.	T1858	Brazil, Rio de Janeiro, Maricá
Leskia sp.	T1675	Costa Rica, San José, Moravia
Lespesia lata (Wiedemann, 1830)	T1073	Brazil, Rio de Janeiro, Magé
Macromya sp.	T1690	Brazil, Pará, Belterra
Microgymnomma sp.	T2640	Brazil, Rio de Janeiro, Itatiaia
Microtrichomma sp.	T3052	Brazil, Amazonas, Manaus
Neocuphocera sp.	T2066	Brazil, Mato Grosso do Sul, Bodoquena
Neoeuantha sabroskyi Guimarães, 1982	T1092	Brazil, Bahia, Camacan
Neosophia elongata Guimarães, 1982	T0157	Brazil, São Paulo, Salesópolis
Ormia sp.	T1539	Brazil, Pará, Abel Figueiredo
Ormiophasia cruzi Tavares, 1964	T2412	Brazil, São Paulo, Salesópolis
Ormiophasia sp.	T1816	Brazil, São Paulo, Salesópolis
Oxyepalpus sp.	T2635	Brazil, Rio de Janeiro, Itatiaia
Paradidyma sp.	T1932	Brazil, São Paulo, Santo André
Parepalpus sp.	T2610	Brazil, Rio de Janeiro, Itatiaia
Peleteria semiglabra (Zimin, 1961)	T2924	China
Peleteria sp. 1	T1984	Brazil, Roraima, Porto Velho
Peleteria sp. 2	T2713	Brazil, Espírito Santo, Sooretama
Phasia xenos (Townsend, 1934)	T2533	Brazil, São Paulo, São Paulo
Polygaster sp.	T0755	Brazil, São Paulo, Santo André
Prophorostoma pulchra Townsend, 1927	T0346	Brazil, São Paulo, São Paulo
Talarocera sp.	T2387	Brazil, Mato Grosso, Chapada dos Guimarães
Trichophora sp.	T2637	Brazil, Rio de Janeiro, Itatiaia
Trichopoda sp.	T2163	Brazil, São Paulo, São Paulo
Uramya brevicauda Curran, 1934	T1002	Brazil, Minas Gerais, Ingaí
Uramya townsendi Guimarães, 1980	T0455	Brazil, Paraná, Tunas
Xanthomelanodes sp.	T0217	Brazil, São Paulo, Salesópolis
Xanthophyto sp.	T1360	Brazil, São Paulo, Santo André
Xanthozona melanopyga (Wiedemann, 1830)	T2345	Brazil, São Paulo, São Paulo
Zonoepalpus sp.	T2127	Brazil, São Paulo, Salesópolis

Table 2: List of species used to infer the molecular phylogeny of Calyptratae, including their respective families, voucher identification of specimens sequenced for the study and GenBank accession numbers.

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
OUTGROUPS									
Coelopidae									
Gluma nitida McAlpine, 1991		EU435516	AF403468	EU435622	EU435695		EU435770	EU435902	AY048533
Lopa convexa McAlpine, 1991		EU435514	AF403450	EU435620	EU435693	KC177184	EU435768	EU435900	AY048515
Drosophilidae									
Drosophila melanogaster Meigen, 1830		U37541	EF531105	KC177303	EF531127		U37541	U37541	X06870
Helcomyzidae									
Helcomyza mirabilis Melander, 1920		EU435517	AF403449	EU435623	EU435696		EU435771	EU435903	AY048514
Heterocheilidae									
Heterocheila buccata (Fallén, 1820)		EU435518	AF403446	EU435624			EU435772	EU435904	AY048511
Lonchopteridae									
Lonchoptera tristis (Meigen, 1824)		HM062584			HM062612	HM062731	HM062534	HM062558	HM062661
Platypezidae									
Platypeza sp.		HM062590			HM062618	HM062736	HM062540	HM062563	HM062666
Platystomatidae									
Lamprogaster nigripes (Macquart, 1851)		HM062591			HM062619	HM062737	HM062541	HM062564	HM062667
Syrphidae									
Ornidia obesa (Fabricius, 1775)	OD1287	475 (64 indels)	525 (103 indels)	677 (35 indels)	1858 (979 indels)		557	894 (251 'N', 1 indels)	493 (94 'N', 1 indels)
Toxomerus spp.		AF154744 (*T. geminatus* (Say, 1823))	AF154819 (*T. geminatus*)	EU409275 (*T. geminatus*)	HM062624 (*T. marginatus* (Say, 1823))	HM062742 (*T. marginatus*)	HM062546 (*T. marginatus*)	HM062568 (*T. marginatus*)	HM062672 (*T. marginatus*)
Tephritidae									
Anastrepha fraterculus (Wiedemann, 1830)		KX926433	KX926433	AF187101			KX926433	KX926433	KY428439
Ceratitis capitata (Wiedemann, 1824)		NC000857	NC000857	KC177300		XM004529679	NC000857	NC000857	XM004517877
HIPPOBOSCOIDEA									
Glossinidae									
Glossina austeni Newstead, 1912			EF531108		EF531133	EF531177	EF531198		
Glossina brevipalpis Newstead, 1910			EF531109		EF531134	EF531166	EF531199		
Glossina morsitans Westwood, 1851			JQ246760	KC177312	EF531135	EF531178	JQ246706	KC177594	JF439518
Glossina pallidipes Austen, 1903			EF531111		EF531136	EF531179	EF531201		

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Glossina palpalis (Robineau-Desvoidy, 1830)			EF531112	AF322431	EF531137	EF531180	EF531202		
Glossina swynnertoni Austen, 1923			EF531113		EF531138	EF531181	EF531203		
Hippoboscidae									
Crataerina pallida (Latreille, 1811)			EF531107		EF531131	EF531165	EF531196		
Hippobosca equina Linnaeus, 1758			EF531116		EF531143	EF531189	EF531208		
Hippobosca rufipes Olfers, 1816			EF531115		EF531142	EF531188	EF531207		
Lipoptena cervi (Linnaeus, 1758)			AF322437	AF322426	EF531139	EF531185	EF531204		
Lipoptena depressa (Say, 1823)					EF531141	EF531187	EF531206		
Melophagus ovinus (Linnaeus, 1758)			EF531104		EF531144	EF531190	EF531209		
Ornithoctona erythrocephala (Leach, 1817)			JQ246761		JQ246657		JQ246707	894 (519 'N', 1 indels)	
Ornithomya avicularia (Linnaeus, 1758)			EF531118	AF322421	EF531146	EF531168	EF531211		
Ornithomya biloba (Dufour, 1827)			EF531119		EF531147	EF531169	EF531212		
Ortholfersia minuta Paramonov, 1954			EF531123		EF531156	EF531182	EF531221		
Pseudolynchia sp.			EF531103		EF531155	EF531162	EF531220		
Stenepteryx hirundinis (Linnaeus, 1758)			EF531121		EF531150	EF531172	EF531215		
Nycteribiidae									
Basilia carteri Scott, 1936	DMA165		525 (111 indels)			684 (19 indels)	557		
Basilia (Tripselia) coronata inivisa Theodor 1967			DQ133037	DQ133071				DQ133143	
Basilia corynorhini Ferris, 1916				DQ133025	DQ133057				DQ133129
Basilia forcipata Ferris, 1924			DQ133030	DQ133064				DQ133136	
Basilia speiseri (Miranda-Ribeiro, 1907)	DMA164	424 (1 'N', 61 indels)	525 (111 indels)	1469 (846 indels)		684 (19 indels)	557		
Dipseliopoda spp.			DQ133038 (D. biannulata Oldrich, 1953)	DQ133073 (D. biannulata)		EF531183 (D. setosa Theodor, 1955)	EF531224 (D. setosa)	DQ133145 (D. biannulata)	
Eucampsipoda inermis Theodor, 1955			DQ133041	DQ133076				DQ133148	
Eucampsipoda penthetoris Theodor, 1955			DQ133034	DQ133068				DQ133140	
Phthiridium fraterna Theodor, 1967			DQ133026	DQ133058				DQ133130	
Streblidae									
Anastrebla caudiferae Wenzel, 1976	DMA171	477 (69 indels)	525 (106 indels)	645 (34 indels)		684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Megistopoda aranea (Coquillett, 1899)	DMA170	477 (69 indels)	476 (92 indels)	646 (34 indels)	1832 (908 indels)	684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Noctiliostrebla morena Alcantara et al., 2019	DMA173	460 (69 indels)	525 (103 indels)	644 (34 indels)	1832 (913 indels)	684 (16 indels)	557	894 (251 'N', 1 indels)	493 (52 'N', 1 indels)
Paradyschiria parvula Falcoz, 1931	DMA172	463 (70 indels)	525 (105 indels)	671 (36 indels)	1832 (916 indels)	684 (16 indels)	557	895 (251 'N', 2 indels)	
Paratrichobius longicrus (Miranda-Ribeiro, 1907)	DMA169	477 (69 indels)	525 (106 indels)	646 (34 indels)		684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Strebla consocia Wenzel, 1966	DMA163	462 (68 indels)	525 (106 indels)	646 (34 indels)	1837 (921 indels)	684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Strebla mirabilis Waterhouse, 1879			DQ133047	DQ133082				DQ133153	
Strebla wiedemanii Kolenati, 1856	DMA160	465 (68 indels)	455 (101 indels)	645 (34 indels)	2547 (1617 indels)	684 (16 indels)	557 (32 'N')	895 (251 'N', 2 indels)	
Trichobius caecus Edwards, 1918			DQ133029	DQ133063				DQ133135	
Trichobius dugesii Townsend, 1891			DQ133035	DQ133069				DQ133141	
Trichobius dugesioides Wenzel, 1966	DMA162	462 (70 indels)	525 (105 indels)	645 (34 indels)	1753 (873 indels)	684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Trichobius longipes Rudow, 1871			DQ133052	DQ133088				DQ133158	
Trichobius major Coquillett, 1899			DQ133046	DQ133084				DQ133152	
Trichobius tiptoni Wenzel, 1976	DMA159	477 (68 indels)	525 (105 indels)	666 (35 indels)	1831 (916 indels)	684 (16 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
MUSCOIDEA									
Anthomyiidae									
Anthomyia sp.	OD0502	477 (69 indels)	525 (109 indels)	672 (35 indels)	1833 (982 indels)		557	894 (251 'N', 1 indels)	493 (55 'N', 1 indels)
Anthomyia xanthopyga (Albuquerque, 1959)	M0141	477 (69 indels)	525 (109 indels)	1143 (48 indels)	1838 (977 indels)	684 (36 'N', 19 indels)	557	895 (326 'N', 2 indels)	493 (56 'N', 1 indels)
Delia platura (Meigen, 1826)		DQ656894	FJ025429	FJ025486	DQ656972		DQ657045	DQ657062	
Emmesomyia (Taeniomyia) auricolis Stein, 1918	OD0421	477 (68 indels)	525 (109 indels)	1143 (48 indels)	1858 (986 indels)	684 (19 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Emmesomyia grisea (Robineau-Desvoidy, 1830)		FJ025372	FJ025432	FJ025487	FJ025510		FJ025610	FJ025712	
Hydrophoria lancifer (Harris, 1780)		DQ656891			EF531129	EF531164	DQ657043	DQ657058	FJ025677
Lasiomma seminitidum (Zetterstedt, 1845)		DQ656893	DQ648649		DQ656971		JX438037	DQ657061	DQ657112
Pegoplata infirma (Meigen, 1826)		FJ025408		FJ025497	FJ025554		FJ025650	FJ025746	
Phaonantho mallochi Curran; 1934	OD0476	477 (68 indels)	525 (109 indels)	1143 (48 indels)	1858 (993 indels)	684 (19 indels)	557	895 (335 'N', 2 indels)	493 (1 indels)

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Fanniidae									
Fannia armata (Meigen, 1826)		DQ656883	DQ648646		DQ656960			DQ657050	
Fannia canicularis (Linnaeus, 1761)		DQ656884	DQ648647	FJ025489	EF531132	EF531184	DQ657037	DQ657051	AJ871202
Fannia itatiaiensis Albuquerque, 1956	OD1036	477 (68 indels)		673 (34 indels)	1858 (985 indels)	684 (19 indels)	557 (61 'N')	895 (251 'N', 2 indels)	
Fannia manicata (Meigen, 1826)		DQ656885	FJ025435	FJ025490	DQ656962			DQ657052	
Fannia penicilaris Stein, 1900	OD1262	477 (68 indels)	525 (108 indels)					895 (251 'N', 2 indels)	
Fannia sp. nov. Paramo	MW05	477 (68 indels)	525 (109 indels)	675 (35 indels)	1858 (996 indels)	684 (19 indels)	557	895 (251 'N', 2 indels)	
Fannia tumidifemur Stein, 1911	OD1032	477 (68 indels)	525 (109 indels)	677 (34 indels)	1858 (988 indels)	684 (19 indels)	557	895 (251 'N', 2 indels)	493 (69 'N', 1 indels)
Muscidae									
Achanthiptera rohrelliformis (Robineau-Desvoidy, 1830)		KJ476258	KJ476294		KJ476331		KJ510606	KJ510542	KJ510580
Atherigona seticauda Malloch, 1926		KJ476259	KJ476295				KJ510607	KJ510543	KJ510581
Atherigona theodori Henning, 1963		KJ476260	KJ476296		KJ476332		KJ510608	KJ510544	KJ510582
Cephalispa sp.		KJ476262	KJ476298		KJ476334		KJ510610	KJ510545	
Coenosia obscuricula (Rondani, 1871)		KJ476264	KJ476300		KJ476335		KJ510612	KJ510546	KJ510585
Coenosia semifumosa Stein, 1914		KJ476265	KJ476301		KJ476336		KJ510613	KJ510547	KJ510586
Cyrtoneurina alifusca Couri, 1982	M0063	477 (68 indels)		1143 (48 indels)	1858 (997 indels)	684 (159 'N', 19 indels)	557 (49 'N')	895 (246 'N', 2 indels)	493 (1 indels)
Cyrtoneuropsis maculipennis (Macquart, 1843)	M0005	477 (69 indels)	413 (106 indels)	1143 (48 indels)	1761 (955 indels)	684 (35 'N', 19 indels)	557	894 (251 'N', 1 indels)	493 (1 indels)
Cyrtoneuropsis veniseta (Stein, 1904)		KJ476266	KJ476302			KP161819	KJ510614	KJ510548	KP161735
Dichaetomyia bibax (Wiedemann, 1830)		KJ476267	KJ476303		KJ476337	KP161821	KJ510615	KJ510549	KJ510588
Dolichophaonia machadoi (Albuquerque, 1958)			525 (113 indels)		1858 (995 indels)	684 (21 'N', 19 indels)	557	895 (520 'N', 2 indels)	
Dolichophaonia plaumanni Carvalho,1983	M0068	429 (54 indels)	525 (113 indels)	907 (43 indels)	1858 (995 indels)	684 (19 indels)	557	895 (246 'N', 2 indels)	
Drymeia alpicola (Rondani, 1871)		FJ025370	FJ025430		FJ025508	FJ025572	FJ025608	FJ025710	FJ025669
Drymeia hamata (Fállen, 1823)		FJ025371	FJ025431		FJ025509	FJ025573		FJ025711	FJ025670
Eudasyphora cyanella (Meigen, 1826)		FJ025373	FJ025433		FJ025511	FJ025574	FJ025611		FJ025671
Gymnodia humilis (Zetterstedt, 1860)		KJ476270	KJ476306		KJ476340		KJ510618	KJ510552	KJ510590
Gymnodia marshalli (Malloch, 1921)		KJ476271	KJ476307		KJ476341		KJ510619	KJ510553	KJ510591

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
Haematobosca stimulans (Meigen, 1824)		FJ025375	FJ025437		FJ025518	FJ025576	FJ025615	FJ025716	FJ025673
Helina celsa (Harris, 1780)		FJ025376	FJ025438		FJ025521		FJ025618	FJ025718	FJ025674
Helina evecta (Harris, 1780)		FJ025377	FJ025439		FJ025522		FJ025619	FJ025719	FJ025675
Heliographa ceylanica Emden, 1965		KJ476275	KJ476310		KJ476345		KJ510623	KJ510556	
Huckettomyia watanabei Pont & Shinonaga, 1970		KJ476276	KJ476311		KJ476346	KP161824	KJ510624	KJ510557	KP161738
Hydrotaea cyrtoneurina (Zetterstedt, 1845)		FJ025380	FJ025441		FJ025526	KJ510578	FJ025622	FJ025721	FJ025678
Hydrotaea dentipes (Fabricius, 1805)		FJ025381	FJ025442		FJ025527	FJ025579	FJ025623	FJ025722	FJ025679
Limnophora exuta (Kowarz, 1893)		FJ025384	FJ025446		FJ025530	FJ025581		FJ025725	FJ025684
Limnophora maculosa (Meigen, 1826)		FJ025385	FJ025447		FJ025531	FJ025582		FJ025726	FJ025685
Lispe nana Macquart, 1835		KJ476279	KJ476314		KJ476349		KJ510627	KJ510560	KJ510595
Lispe tentaculata de Geer, 1776		FJ025388	FJ025450		FJ025534	FJ025585		FJ025729	FJ025687
Lophosceles cinereiventris (Zetterstedt, 1845)		KJ476280	KJ476316		KJ476351	KJ510579		KJ510562	
Mesembrina meridiana (Linnaeus, 1758)		FJ025390	FJ025452		FJ025537	FJ025586	FJ025633		FR719262
Mesembrina mystacea (Linnaeus, 1758)		DQ656895	FJ025453	FJ025493	DQ656973			DQ657063	
Metopomyia atropunctipes Malloch, 1922		KJ476281	KJ476317		KJ476352		KJ510630	KJ510563	KJ510596
Morellia hortorum (Fállen, 1817)		FJ025392	FJ025455		FJ025540	FJ025588	FJ025635	FJ025732	
Morellia humeralis (Stein, 1918)	M0032	477 (70 indels)	525 (109 indels)	1143 (48 indels)	1858 (995 indels)	684 (19 indels)		895 (372 'N', 2 indels)	493 (1 indels)
Morellia nigricosta Hough, 1900	M0033	477 (69 indels)	418 (107 indels)	1143 (48 indels)	1858 (994 indels)	684 (19 indels)	557	895 (349 'N', 2 indels)	493 (1 indels)
Musca confiscata Speiser, 1924		KJ476282	KJ476318		KJ476354		KJ510631	KJ510564	KJ510597
Musca domestica Linnaeus, 1758		DQ656896	JQ246756	DQ133074	JQ246652	FJ025591	AF104622	DQ657064	DQ657113
Muscina levida (Harris, 1780)		FJ025395	FJ025458		FJ025544		MK249071	FJ025735	FJ025688
Muscina stabulans (Fállen, 1817)		FJ025396	EF531117		EF531145	EF531167	EF531210	FJ025736	FJ025689
Mydaea ancilla (Meigen, 1826)		FJ025398	FJ025460		FJ025547	FJ025592	FJ025639	FJ025737	FJ025690
Mydaea urbana (Meigein, 1826)		FJ025399			FJ025548	FJ025593		FJ025739	FJ025691
Myospila meditabunda (Fabricius, 1791)		FJ025400			FJ025549	FJ025594	FJ025642		FJ025692
Neomuscina instabilis Snyder, 1949		KJ476284	KJ476320		KJ476356		KJ510634	KJ510567	KJ510598
Neomuscina nigricosta Snyder, 1949	M0067	361 (57 indels)	525 (109 indels)	1143 (48 indels)	1858 (995 indels)	684 (1 'N', 19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Ophyra sp.	M0103		525 (109 indels)	674 (34 indels)	1838 (992 indels)	684 (19 indels)	557 (33 'N')	894 (251 'N', 1 indels)	
Passeromyia indecora Walker, 1858		KJ476285	KJ476321		KJ476357		KJ510635	KJ510568	KJ510599
Phaonia gobertii (Mik, 1881)		KJ476288	KJ476324		KJ476359		KJ510638	KJ510571	KJ510602

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Phaonia grandis Couri, 1982	M0037	477 (75 indels)	517 (110 indels)	1143 (48 indels)	1858 (991 indels)	684 (48 'N', 19 indels)	557 (3 'N')	895 (326 'N', 2 indels)	493 (1 indels)
Phaonia praesuturalis (Stein, 1904)	OD0826	477 (75 indels)	525 (110 indels)	675 (34 indels)	1858 (992 indels)	684 (19 indels)	557	894 (251 'N', 1 indels)	
Philornis aff. *aitkeni* Dodge, 1963	OD0881	477 (68 indels)		641 (33 indels)	1858 (986 indels)	684 (19 indels)		894 (251 'N', 1 indels)	493 (55 'N', 1 indels)
Polietes lardarius (Fabricius, 1781)		FJ025411	FJ025471		FJ025557	FJ025597	KJ510640		FJ025695
Polietina minor Albuquerque, 1956	M0060	477 (67 indels)	525 (108 indels)	1115 (48 indels)	1748 (973 indels)	684 (37 'N', 19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Polietina univittata Couri & Carvalho, 1996	M0029	477 (67 indels)	525 (108 indels)	1143 (48 indels)	1858 (991 indels)	684 (19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Potamia littoralis Robineau-Desvoidy, 1830		FJ025412	FJ025472		FJ025558	FJ025598	FJ025654	KU932176	KU932201
Pseudoptilolepis fulvapoda Snyder, 1949	M0030	477 (68 indels)	525 (108 indels)	1143 (47 indels)	1858 (992 indels)	684 (38 'N', 19 indels)	557	895 (286 'N', 2 indels)	493 (1 indels)
Spilogona dispar (Fállen, 1823)		FJ025415	FJ025475		FJ025560	FJ025599		FJ025751	
Stomoxys calcitrans (Linnaeus, 1748)		DQ656886	JQ246757	FJ025499	EF531151	EF531173	DQ657039	DQ657053	FJ025698
Syllimnophora sp.	OD1048	477 (69 indels)	525 (109 indels)	671 (34 indels)	1858 (995 indels)	684 (19 indels)		895 (251 'N', 2 indels)	
Thricops aculeipes (Zetterstedt, 1838)		FJ025417	FJ025477		GQ409285			FJ025752	FJ025699
Thricops cunctans (Meigen, 1826)		FJ025418	FJ025478		FJ025564	FJ025600	FJ025661	FJ025753	FJ025700
Scathophagidae									
Acerocnema macrocera (Meigen, 1826)		DQ656898	DQ648652		DQ656976			DQ657066	DQ657114
Ceratinostoma ostiorum (Haliday, 1832)		DQ656914	DQ648668		DQ656992			AF180986	DQ657123
Chaetosa (Opsiomyia) palpalis Coquillett, 1898		DQ656915	DQ648669		DQ656993			DQ657082	DQ657124
Cleigastra apicalis (Meigen, 1826)		DQ656901	DQ648655		DQ656979			DQ657069	DQ657115
Cordilura carbonaria (Walker, 1849)		DQ656904	DQ648658		DQ656982			DQ657072	DQ657117
Cordilura ciliata (Meigen, 1826)		DQ656905	DQ648659		EF531130	EF531159	AF180989	DQ657073	
Gimnomera cerea (Coquillett, 1908)		DQ656917	DQ648671		DQ656995			DQ657084	DQ657125
Hydromyza confluens Loew, 1863		DQ656921	DQ648675		DQ656999			DQ657088	DQ657126
Nanna articulata (Becker, 1894)		DQ656924	DQ648678	FJ025495	DQ657001			DQ657091	
Nanna brunneicosta (Johnson, 1927)		DQ656925	DQ648679		DQ657002			DQ657092	DQ657127
Neorthacheta dissimilis (Malloch, 1924)		DQ656930	DQ648684		DQ657007			DQ657097	DQ657129
Norellisoma (Norellisoma) flavicorne (Meigen, 1826)		DQ656931	DQ648685		DQ657008			DQ657098	DQ657130
Norellisoma (Norellisoma) lituratum		DQ656932	DQ648686		DQ657009			DQ657099	DQ657131

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
(Wiedemann, 1826)									
Orthacheta cornuta (Loew, 1863)		DQ656938	DQ648692		DQ657015			DQ657105	DQ657134
Scathophaga litorea (Fallén, 1819)		DQ656948	DQ648702		DQ657025			AF180983	DQ657139
Scathophaga lutaria (Fabricius, 1794)		DQ656949	DQ648703		DQ657026			AF180975	DQ657140
Scathophaga stercoraria (Linnaeus, 1758)		DQ656952	DQ648706		DQ657029		KM200724	AF180971	DQ657141
Scatogera primogenita Albuquerque, 1984	OD1221	477 (67 indels)	525 (109 indels)		1765 (1175 indels)		557	895 (246 'N', 2 indels)	
OESTROIDEA									
Calliphoridae									
Amenia sp.			GGGW01018209	GGGW01001029	GGGW01000101				GGGW01001278
Bellardia vulgaris (Robineau-Desvoidy, 1830)		GQ409054	GQ409119	GQ409172	GQ409231	GQ409290	GQ409316	GQ409386	GQ409452
Bengalia peuhi Villeneuve, 1914		FJ025363	JQ246734		JQ246631	FJ025566	FJ025601	FJ025704	
Blepharicnema splendens Macquart, 1843	MW10	477 (68 indels)	525 (109 indels)	674 (34 indels)	1858 (997 indels)	685 (127 'N', 20 indels)	557 (155 'N')	895 (251 'N', 2 indels)	493 (1 indels)
Calliphora nigribasis Macquart, 1851	MW02	476 (65 indels)	525 (109 indels)	675 (34 indels)	1858 (997 indels)	684 (226 'N', 19 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Calliphora vicina Robineau-Desvoidy, 1830	MW03	477 (68 indels)		672 (36 indels)	1858 (996 indels)	684 (19 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Calliphora vomitoria (Linnaeus, 1758)		FJ025365	JQ246722	FJ025482	JQ246618	FJ025567	FJ025603	KY749703	KY749861
Chrysomya megacephala Fabricius, 1794		FJ025366		FJ025483	JF439576	GQ409292	FJ025604	FJ025706	JF439533
Chrysomya rufifacies (Macquart, 1843)		GQ409060	JQ246713		JQ246609	GQ409293	JQ246664	JQ655235	JF439532
Cochliomyia hominivorax (Coquerel, 1858)		FM867739	JQ246714		JQ246610		JQ246665	895 (264 'N', 2 indels)	FM867789
Cochliomyia macellaria (Fabricius,1775)			JQ246715	KC177310	JQ246611	FJ169333	JQ246666		JF439534
Compsomyiops fulvicrura Robineau- Desvoidy, 1830		FJ025369	FJ025428	FJ025484	FJ025504	FJ025571	FJ025607	FJ025709	FJ025667
Cordylobia anthropophaga (Blanchard & Berenger-Feraud, 1872)			JQ246730		JQ246627		JQ246681	895 (550 'N', 2 indels)	FR719229
Cynomya spp.		GQ409061 (*C. mortuorum* (Linnaeus, 1761))	GQ409125 (*C. mortuorum*)	GQ409176 (*C. mortuorum*)	GQ409235 (*C. mortuorum*)	JF439561 (*C. cadaverina* Robineau-Desvoidy, 1830)	GQ409321 (*C. mortuorum*)	GQ409392 (*C. mortuorum*)	GQ409459 (*C. mortuorum*)
Eurychaeta palpalis (Robineau-Desvoidy, 1830)		FJ025374	FJ025434		FJ025512	FJ025575	FJ025612	KY749704	KY749862

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
Hemilucilia segmentaria (Fabricius, 1805)			JQ246716		JQ246612	684 (56 'N', 19 indels)	JQ246667	894 (264 'N', 1 indels)	
Hypopygiopsis violacea (Macquart, 1835)		GQ409070		GQ409185	GQ409245		GQ409333		GQ409467
Lucilia cuprina (Wiedemann, 1830)			JQ246726		JQ246622		JQ246677	895 (375 'N', 2 indels)	JX027598
Lucilia sericata (Meigen, 1826)		AJ422212	EF531106	KP954339	EF531128		JQ246679	AJ422212	JF439528
Melinda viridicyanea (Robineau-Desvoidy, 1830)		GQ409072	GQ409134	AF322424	GQ409248	GQ409299	GQ409335	GQ409403	GQ409469
Protocalliphora azurea (Fallén, 1817)		GQ409089	GQ409147	GQ409203	GQ409264			GQ409420	GQ409479
Sarconesia chlorogaster (Wiedemann, 1830)		GQ409095	JQ246723	GQ409207	JQ246619	GQ409310	GQ409359	GQ409426	GQ409482
Sarconesia versicolor Bigot, 1857		GQ409058	GQ409121	GQ409175		GQ409291	GQ409319	GQ409389	GQ409456
Mesembrinellidae									
Laneella nigripes Guimarães, 1977	C51	477 (71 indels)	525 (108 indels)	674 (35 indels)	1858 (966 indels)	684 (35 'N', 19 indels)	557	895 (286 'N', 2 indels)	493 (1 indels)
Mesembrinella apollinaris Séguy, 1925			KR820853		KR820891		KR820707		
Mesembrinella benoisti (Séguy, 1925)			KR820870		JQ246632		JQ246686	gblasbi	
Mesembrinella batesi Aldrich, 1922	C56	429 (55 indels)	525 (109 indels)				557 (85 'N')	894 (246 'N', 1 indels)	
Mesembrinella bellardiana Aldrich, 1922	C43	477 (72 indels)	525 (109 indels)	676 (35 indels)	1542 (912 indels)	684 (19 indels)	557	895 (286 'N', 2 indels)	493 (1 indels)
Mesembrinella bicolor (Fabricius, 1805)	C39	477 (70 indels)	525 (109 indels)	1143 (48 indels)	1858 (940 indels)	684 (19 indels)	557	895 (296 'N', 2 indels)	493 (1 indels)
Mesembrinella currani Guimarães, 1977			KR820863		KR820901		KR820717		
Mesembrinella cyaneicincta (Surcouf, 1919)			KR820873		KR820914	gblasbi	KR820729	gblasbi	
Mesembrinella peregrina Aldrich, 1922			JQ246741		JQ246638		JQ246690		
Mesembrinella pictipennis Aldrich, 1922			KR820865		KR820904		KR820719		
Mesembrinella purpurata Aldrich, 1922	C13	477 (73 indels)	508 (109 indels)	676 (35 indels)	1552 (936 indels)	684 (90 'N', 19 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Mesembrinella quadrilineata (Fabricius, 1805)		GQ409073	JQ246736	GQ409188	JQ246633		GQ409336	GQ409404	GQ409470
Mesembrinella semihyalina Mello, 1967	C57	477 (70 indels)	525 (109 indels)		1527 (921 indels)		557 (44 'N')	949 (372 'N', 56 indels)	493 (1 indels)
Souzalopesiella facialis (Aldrich, 1922)			525 (108 indels)				557	895 (264 'N', 2 indels)	
Mystacinobiidae									
Mystacinobia zelandica Holloway, 1976		GQ409075	GQ409136	GQ409191	JF439567		JF439542	GQ409406	

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
Oestridae									
Cuterebra austeni Sabrosky, 1986				KP954330	KP954361				KP899710
Cuterebra baeri Shannon & Greene, 1926			GQ409124			GQ409294		GQ409391	GQ409458
Cuterebra fontinella Clark, 1827					JF439574		JF439549		JF439525
Cuterebra sp.			AF322440	DQ133075	JQ246649	684 (16 'N', 19 indels)	JQ246700	DQ133147	
Metacuterebra apicalis (Guérin-Meneville, 1835)	OD1227	477 (68 indels)	525 (109 indels)	1122 (47 indels)	1830 (807 indels)		557 (53 'N')	895 (251 'N', 2 indels)	493 (1 indels)
Polleniidae									
Pollenia amentaria (Scopoli, 1763)		GQ409087	GQ409145	GQ409201	GQ409262			GQ409418	GQ409478
Pollenia angustigena Wainwright, 1940							KY749783	KY749705	KY749863
Pollenia pediculata Macquart, 1834				KP954345	KP954375		KY749784	KY749706	KY749864
Pollenia rudis (Fabricius, 1794)		GQ409088	KR820849	GQ409202	GQ409263	GQ409307	GQ409351	KY749707	KY749865
Rhiniidae									
Cosmina fuscipennis Robineau-Desvoidy, 1830			JQ246742		JQ246639		JQ246691		
Isomyia gomezmenori (Peris, 1951)					JF439579	JF439565	JF439553		JF439539
Metallea erinacea Fang & Fan, 1984		GQ409074	GQ409135	GQ409189		GQ409300	GQ409337	GQ409405	GQ409471
Rhinia sp.			JQ246743		JQ246640		JQ246692	895 (264 'N', 2 indels)	
Rhyncomya nigripes (Séguy, 1933)		GQ409092		GQ409205	GQ409268	GQ409308	GQ409356	GQ409423	GQ409481
Rhyncomya soyauxi Karsch, 1886			JQ246744		JQ246641		JQ246693	895 (519 'N', 2 indels)	
Stomorhina discolor (Fabricius, 1794)		GQ409110		GQ409222		GQ409312	GQ409375	GQ409441	
Stomorhina lunata (Fabricius, 1794)							KY749786	KY749708	KY749866
Thoracites sp.			JQ246745		JQ246642		JQ246694		
Rhinophoridae									
Melanophora roralis (Linnaeus, 1758)			KP004682				KP899688	KP004812	KP899712
Paykullia maculata (Fallén, 1815)		FJ025404	FJ025466	FJ025496		FJ025595	FJ025646	FJ025742	FJ025694
Phyto cingulata (Zetterstedt, 1844)			KP004691		KP004523			KP004820	
Rhinomorinia sarcophagina (Schiner, 1862)			AF322434		KY945990			KP004824	
Rhinophora lepida (Meigen, 1824)			KP004699		JF439571		GQ409355	KP004825	JF439522
Stevenia atramentaria (Meigen, 1824)			GQ409161	GQ409220	GQ409281				GQ409492
Stevenia hertingi Kugler, 1978		GQ409109	GQ409162	GQ409221	KY945991	GQ409311	GQ409374	GQ409440	GQ409493
Sarcophagidae									

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Angiometopa falleni (Pape, 1986)							KY749765	KY749687	KY749844
Apodacra dispar Villeneuve, 1916							KY749710	KY749630	KY749788
Apodacra nigropicta (Rohdendorf, 1934)							KY749711	KY749631	KY749789
Argoravinia aurea (Townsend, 1918)	OD1097	477 (69 indels)	525 (109 indels)	1143 (47 indels)	1858 (994 indels)	684 (19 indels)	557	894 (251 'N', 1 indels)	493 (1 indels)
Argoravinia rufiventris (Wiedemann, 1830)		GQ409053		GQ409171	GQ409230			GQ409385	GQ409451
Blaesoxipha plinthopyga (Wiedemann, 1830)		GQ409055	GQ409120	GQ409173	GQ409232			GQ409387	GQ409453
Boettcheria cimbicis (Townsend, 1892)		GQ409057		GQ409174	GQ409234			GQ409388	GQ409455
Brachicoma devia (Fallén, 1820)							KY749766	KY749688	KY749845
Craticulina diffusa Villeneuve, 1934							KY749714	KY749635	KY749795
Craticulina genesae Verves, 2000							KY749715	KY749636	KY749796
Dexagria ushinskyi Rohdendorf, 1978							KY749767	KY749689	KY749846
Dexosarcophaga carvalhoi (Lopes, 1980)	OD1081	477 (68 indels)	525 (109 indels)	897 (42 indels)		684 (19 indels)	557 (3 'N')	895 (251 'N', 2 indels)	493 (1 indels)
Dolichotachina marginella (Wiedemann, 1830)							KY749717	KY749638	KY749798
Duckemyia latifrons Kano & Lopes, 1969		GQ409062	GQ409127	GQ409178	GQ409237			GQ409394	GQ409460
Engelimyia inops (Walker, 1849)		GQ409063	GQ409128	GQ409179	GQ409238			GQ409395	
Goniophyto honshuensis Rohdendorf, 1962							KY749768	KY749690	KY749847
Goniophyto horii Kurahashi & Suenaga, 1994							KY749769	KY749691	KY749848
Helicobia aurescens (Townsend, 1927)	OD0465	477 (68 indels)	525 (109 indels)	1143 (47 indels)	1858 (995 indels)	684 (19 indels)	557	895 (335 'N', 2 indels)	493 (1 indels)
Helicobia pilipleura Lopes, 1939		GQ409066	GQ409131	GQ409182	GQ409242		GQ409329	GQ409399	GQ409464
Kurahashiodes suenagai (Kurahashi, 1994)							KY749770	KY749692	KY749849
Lepidodexia (Notochaeta) sp.				GQ409192	GQ409252	GQ409301		GQ409407	GQ409473
Lepidodexia sp. 1	OD0961	477 (73 indels)	525 (108 indels)	1143 (47 indels)	1858 (987 indels)	684 (19 indels)	557	894 (251 'N', 1 indels)	493 (1 indels)
Lepidodexia sp. 4	OD1105	477 (68 indels)	525 (110 indels)	1143 (46 indels)	1858 (988 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (52 'N', 1 indels)
Lipoptilocnema crispina (Lopes, 1938)	OD1044	477 (68 indels)	525 (109 indels)	1143 (47 indels)	1858 (998 indels)	684 (19 indels)	557	894 (251 'N', 1 indels)	493 (1 indels)
Macronychia griseola (Fallén, 1820)							KY749719	KY749641	KY749799
Mesomelena mesomelaena (Loew, 1848)							KY749722	KY749644	KY749802
Metopia argentata Macquart, 1850							KY749723	KY749645	KY749803
Metopia campestris (Fallén, 1810)					JF439573	JF439558	JF439548	KY749647	JF439524
Metopodia pilicornis (Pandellé, 1895)							KY749727	KY749649	KY749807

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Miltogramma aurifrons Dufour, 1850							KY749728	KY749650	KY749808
Nephochaetopteryx pallidiventris Townsend, 1934	T1835	448 (67 indels)	525 (109 indels)	1143 (47 indels)	1858 (998 indels)	684 (19 indels)	557 (48 'N')	895 (251 'N', 2 indels)	493 (1 indels)
Nyctia lugubris (Macquart, 1843)		GQ409077	GQ409138	GQ409193	GQ409253		GQ409340	GQ409408	GQ409474
Oebalia praeclusa (Pandellé, 1895)							KY749740	KY749662	KY749820
Oxysarcodexia avuncula (Lopes, 1933)	T1869	406 (53 indels)	525 (109 indels)	1143 (47 indels)	1858 (998 indels)	684 (19 indels)	557	895 (370 'N', 2 indels)	493 (1 indels)
Pacatuba matthewsi Lopes, 1975	OD0503	477 (68 indels)		672 (34 indels)	1838 (998 indels)	684 (10 'N', 19 indels)	557 (12 'N')	895 (351 'N', 2 indels)	493 (52 'N', 1 indels)
Paramacronychia flavipalpis (Girschner, 1881)							KY749771	KY749693	KY749850
Peckia chrysostoma (Wiedemann, 1830)	OD1173	477 (68 indels)	525 (109 indels)	677 (35 indels)	1858 (999 indels)		557 (3 'N')	895 (370 'N', 2 indels)	493 (1 indels)
Peckia (Pattonella) intermutans (Walker, 1861)		GQ409082		GQ409196	GQ409256		GQ409345	GQ409413	GQ409475
Peckia (Peckia) uncinata (Hall, 1933)		GQ409083	GQ409141	GQ409197	GQ409257	GQ409304	GQ409346	GQ409414	
Peckiamyia minutipenis (Hall, 1937)		GQ409084	GQ409142	GQ409198	GQ409258			GQ409415	GQ409476
Phrosinella fedtshenkoi (Rohdendorf, 1925)							KY749741	KY749663	KY749821
Phrosinella fulvicornis (Coquillett, 1895)							KY749742	KY749664	KY749822
Protomiltogramma fasciata (Meigen, 1824)							KY749746	KY749668	KY749826
Pterella grisea (Meigen, 1824)							KY749748	KY749670	KY749827
Pterella nigrofasciata (Rohdendorf, 1935)		GQ409090		GQ409204	GQ409265			GQ409421	GQ409480
Retrocitomyia retrocita (Hall, 1933)	OD1123	477 (67 indels)	525 (109 indels)	1143 (47 indels)			557	895 (355 'N', 2 indels)	493 (1 indels)
Sarcodexia lambens (Wiedemann, 1830)				GQ409206	GQ409269	GQ409309	GQ409357	GQ409424	
Sarcophaga arizonica (Townsend, 1919)		FJ025413	FJ025473	FJ025498	FJ025559		FJ025655	FJ025749	FJ025696
Sarcophaga crassipalpis Macquart, 1839		GQ409097	GQ409152	GQ409208	JF439572	JF439557	GQ409361	GQ409428	JF439523
Sarcophaga omikron Johnston & Tiegs, 1921		GQ409100	GQ409156	GQ409212	GQ409275		GQ409365	GQ409432	GQ409487
Sarcophila meridionalis Rohdendorf & Verves, 1985		GQ409103		GQ409215	GQ409277		GQ409368	GQ409434	GQ409489
Sarcophila sp.			GQ409157	GQ409216	GQ409278		GQ409369	GQ409435	
Sarcotachina aegyptiaca Villeneuve, 1910							KY749773	KY749695	KY749852
Sarcotachina subcylindrica Portschinsky, 1881							KY749774	KY749696	KY749853
Senotainia albifrons (Rondani, 1859)							KY749750	KY749672	KY749829
Senotainia conica (Fallén, 1810)							KY749751	KY749673	KY749830
Sinopiella rufopilosa Lopes & Tibana, 1982			GQ409158	GQ409217	GQ409279		GQ409370	GQ409436	
Sphenometopa claripennis (Villeneuve, 1933)		GQ409106	GQ409159	GQ409218			GQ409371	KY749679	KY749836

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
Spirobolomyia flavipalpis (Aldrich, 1916)		GQ409107		GQ409219	GQ409280			GQ409438	GQ409491
Taxigramma hilarella (Zetterstedt, 1844)							KY749762	KY749684	KY749841
Taxigramma multipunctata (Rondani, 1859)		GQ409112		GQ409224	GQ409284		GQ409377	KY749685	KY749842
Titanogrypa larvicida (Lopes, 1935)	OD1121	477 (68 indels)	525 (108 indels)	1143 (47 indels)	1858 (996 indels)		557	895 (334 'N', 2 indels)	493 (1 indels)
Titanogrypa (Cucullomyia) luculenta (Lopes, 1938)		GQ409113	GQ409165	GQ409225	GQ409287		GQ409378	GQ409445	GQ409495
Titanogrypa (Cucullomyia) placida (Aldrich, 1925)	T1734	477 (68 indels)	525 (109 indels)	1143 (47 indels)	1858 (997 indels)	684 (19 indels)	557	895 (370 'N', 2 indels)	493 (1 indels)
Tricharaea (Sarcophagula) canuta (Wulp, 1896)	OD0495	477 (68 indels)	525 (108 indels)	1143 (47 indels)	1858 (998 indels)	684 (19 indels)	557	895 (335 'N', 2 indels)	493 (1 indels)
Villegasia postuncinata (Hall, 1933)		GQ409116		GQ409228	GQ409289			GQ409448	GQ409497
Wohlfahrtia magnifica (Schiner, 1862)							GQ409382	KY749697	KY749856
Wohlfahrtia nuba (Wiedemann, 1830)		GQ409117	GQ409169	GQ409229			GQ409383	GQ409449	
Tachinidae									
Abepalpus sp.	T2660	489 (69 indels)	557 (108 indels)	729 (40 indels)	1896 (986 indels)	748 (20 indels)	1682 (1070 indels)	681 (4 indels)	734 (8 indels)
Adejeania sp. 1	T2389	486 (69 indels)	551 (108 indels)	718 (42 indels)	2792 (1867 indels)	748 (20 indels)	1683 (1070 indels)	688 (5 indels)	724 (6 indels)
Adejeania sp. 2	T2917						557	895 (251 'N', 2 indels)	
Admontia sp.			AB465900	AB465968	AB466041				
Ametadoria harrisinae (Coquillett, 1897)					AF366651				AF364345
Aplomya confinis (Fallén, 1820)			AB465916	AB465984	AB466057				
Aplomya metallica (Wiedemann, 1824)		AB699934	AB257240	AB699974	AB700002		AB700037		
Archytas sp. 1	T2539	477 (67 indels)	525 (107 indels)	1143 (46 indels)	1858 (988 indels)	684 (42 'N', 19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Archytas sp. 2	T2350	512 (66 indels)	563 (103 indels)	719 (40 indels)	1901 (1 'N', 985 indels)	748 (20 indels)	1683 (1070 indels)	686 (5 indels)	724 (6 indels)
Archytas sp. 3	T2690	489 (67 indels)	557 (108 indels)	729 (42 indels)	1898 (5 'N', 988 indels)	748 (20 indels)	1682 (1070 indels)	685 (4 indels)	678 (7 indels)
Archytas sp. 4	T2714	489 (67 indels)	557 (108 indels)	727 (44 indels)	1898 (985 indels)	748 (20 indels)	1683 (1 'N', 1070 indels)	681 (4 indels)	735 (7 'N', 9 indels)
Atylostoma towadensis (Matsumura, 1916)			AB465949	AB466022	AB466095				
Austrophorocera sp.					AF366653				AF364347

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Belvosia sp.	T0263		DQ133027	DQ133059	1858 (987 indels)		557	DQ133131	
Beskia sp.	T1484	477 (70 indels)	525 (109 indels)	1143 (45 indels)	1858 (968 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Bessa parallela (Meigen, 1824)		AB699901	AB257220	AB699950	AB699976		AB700004		
Biomeigenia sp.			AB465901	AB465969	AB466042				
Blepharipa sugens Wiedemann, 1830			AB465932	AB466004	AB466077				
Blepharomyia sp.					AF366654				AF364348
Blondelia spp.			AB465902 (*B. nigripes* (Fallén, 1810))	AB465970 (*B. nigripes*)	KP954356 (*B. hyphantriae* (Tothill, 1922))		KP899668 (*B. hyphantriae*)		AF364349 (*B. eufitchiae* Mesnil & Pschorn, 1968)
Bombyliomyia sp.	T1873	477 (69 indels)		672 (33 indels)			557 (3 'N')		493 (1 indels)
Botria japonica Mesnil, 1957			AB465933	AB466005	AB466078				
Calozenillia tamara (Portschinsky, 1884)			AB465934	AB466006	AB466079				
Campylocheta semiothisae (Brooks, 1945)				KP954326	KP954357		KP899669		KP899691
Carcelia reclinata (Aldrich & Webber, 1924)					AF366656				AF364350
Carcelia sp.			AB465917	AB465985	AB466058				
Catharosia cf. *nebulosa* (Coquillett, 1897)				KP954327	KP954358		KP899682		
Ceracia dentata (Coquillett, 1895)				KP954329	AF366657		KP899676		AF364351
Ceromya spp.			AB465952 (*C. silacea* (Meigen, 1824))	AB466025 (*C. silacea*)	AB466098 (*C. silacea*)		2206 (1707 indels)		
Chaetoria stylata Becker, 1908		AB699903	AB699938	AB699951	AB699977		AB700006		
Chaetexorista sp.		AB699902	AB257221	AB465996	AB466069		AB700005		
Chaetogaedia monticola (Bigot, 1887)					AF366659				AF364352
Chetogena parvipalpis (van der Wulp, 1890)					AF366672				AF364355
Chetogena sp. 1	T0064	477 (67 indels)	525 (108 indels)	1143 (47 indels)	1731 (952 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Chetogena sp. 2		AB699904	JQ246750	AB699952	AB699978		AB700007		
Cholomyia inaequipes Bigot, 1884	T0309	477 (67 indels)	525 (109 indels)	1143 (47 indels)	1858 (984 indels)	684 (19 indels)	557 (3 'N')	895 (246 'N', 2 indels)	
Chrysotachina sp.	T2543	472 (69 indels)	461 (107 indels)	1143 (47 indels)	1858 (990 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Compsiluroides flavipalpis Mesnil, 1957			AB465903	AB465971	AB466044				

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Copecrypta sp.	T2668	489 (67 indels)	557 (109 indels)	729 (43 indels)	1895 (986 indels)	748 (6 'N', 20 indels)	1683 (1070 indels)	684 (2 'N', 3 indels)	737 (8 'N', 8 indels)
Cordyligaster analis (Macquart, 1851)	T1706	477 (71 indels)	513 (110 indels)	1143 (47 indels)	1858 (958 indels)	684 (114 'N', 19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Cryptomeigenia sp.					AF366662				AF364358
Ctenophorinia adiscalis Mesnil, 1963			AB465928	AB465997	AB466070				
Ctenophorinia christianae Ziegler & Shima, 1996		AB699905	AB257222	AB699953	AB699979		AB700008		
Cyanogymnomma coerulea Townsend, 1927	T1235		345 (95 indels)	685 (5 'N', 40 indels)	834 (531 indels)			614 (4 'N', 3 indels)	
Cyanogymnomma sp.	T1353	501 (65 indels)	556 (110 indels)		1896 (986 indels)	762 (21 indels)	2236 (1650 indels)	682 (4 indels)	748 (1 'N', 8 indels)
Cylindromyia binotata (Bigot, 1878)				KP954331	KP954362		KP899677		KP899699
Cylindromyia euchenor (Walker, 1849)					AF366663				AF364360
Cylindromyia sp.	T2529	477 (68 indels)	525 (108 indels)	1143 (48 indels)	1858 (968 indels)		557	895 (327 'N', 2 indels)	493 (1 indels)
Cyrtophleba nitida (Curran, 1930)					JF439569	JF439554	JF439544		JF439520
Dasyuromyia sp.	T1376			1143 (47 indels)	1835 (985 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Degeeriopsis sp.			AB465904	AB465972	AB466045				
Deopalpus sp. 1	T0664					761 (21 indels)	2145 (1708 indels)	682 (4 'N', 4 indels)	
Deopalpus sp. 2	T3050		578 (112 indels)	740 (45 indels)	1902 (4 'N', 986 indels)	748 (20 indels)		636 (1 'N', 3 indels)	697 (4 indels)
Dexia fulvifera Roder, 1893			AB465957	AB466030	AB466103				
Diaphanomyia sp.	T2129	477 (68 indels)					557	895 (251 'N', 2 indels)	
Diaugia angusta Perty, 1833	T0741		525 (105 indels)	1143 (46 indels)	1858 (970 indels)	681 (51 'N', 16 indels)	557 (17 'N')	895 (246 'N', 2 indels)	
Dinera takanoi (Mesnil, 1957)			AB465958	AB466031	AB466104				
Drinomyia hokkaidensis (Baranov, 1935)		AB699933	AB257241	AB699973	AB700001		AB700036		
Ectophasia rotundiventris (Loew, 1858)			AB465961	AB466034	AB466107				
Empheremyia sp.	T1338	501 (66 indels)	574 (109 indels)		1897 (986 indels)	761 (21 indels)	2304 (1708 indels)	699 (5 indels)	683 (7 indels)
Epalpus signifer (Walker, 1849)				KP954332	JF439568		JF439543		JF439519

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Epicampocera succincta (Meigen, 1824)			AB465918	AB465986	AB466059				
Epigrimyia illinoensis Robertson, 1901				KP954333	KP954364				
Epigrimyia sp.	T2544	429 (53 indels)	525 (108 indels)	1143 (45 indels)	1858 (945 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Eucelatoria armigera (Coquillett, 1889)					AF366665				AF364362
Euempheremyia sp.	T2128	436 (52 indels)	556 (107 indels)	729 (42 indels)	1893 (986 indels)	740 (20 indels)	1683 (1070 indels)	686 (1 'N', 4 indels)	735 (8 indels)
Euepalpus sp. 1	T2919	487 (66 indels)	551 (108 indels)	718 (42 indels)	1906 (987 indels)	748 (20 indels)	1684 (1070 indels)	697 (5 indels)	736 (8 indels)
Euepalpus sp. 2	T2602	487 (68 indels)	557 (108 indels)	729 (40 indels)	1898 (983 indels)	748 (20 indels)	1682 (1 'N', 1070 indels)		672 (6 indels)
Eumea linearicornis (Zetterstedt, 1844)			AB465935	AB466007	AB466080				
Euthera setifacies Brooks, 1945				KP954334	KP954365		KP899685		
Eutrichophora sp.	T2705	489 (68 indels)	556 (109 indels)	729 (46 indels)	1896 (1 'N', 974 indels)	735 (20 indels)	1683 (1070 indels)	690 (3 indels)	748 (8 indels)
Eutrichopoda sp.	T1420	392 (59 indels)	472 (106 indels)	1143 (45 indels)	1858 (969 indels)	684 (78 'N', 19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Exopalpus sp. 1	T2365	489 (69 indels)	556 (107 indels)	728 (43 indels)	1896 (985 indels)	748 (20 indels)	1682 (1069 indels)	681 (4 indels)	670 (1 'N', 6 indels)
Exopalpus sp. 2	T3033			676 (40 indels)				677 (1 'N', 3 indels)	
Exorista (Adenia) mimula (Meigen, 1824)		AB699906	AB257223	AB465998	AB466071		AB700009		
Exorista (Adenia) rustica (Fallén, 1810)		AB699907	AB699940	AB699954	AB699980		AB700010		
Exorista (Exorista) japonica (Townsend, 1909)		AB699909	AB257225	AB699956	AB699982		AB700012		
Exorista (Exorista) larvarum (Linnaeus, 1758)		AB699910	AB257226	AB465999	AB466072		AB700013		
Exorista (Podotachina) cantans Mesnil, 1960		AB699911	AB257230	AB699957	AB699983		AB700014		
Exorista(Podotachina) sorbillans (Wiedemann, 1830)		AB699912	AB257227	AB699958	AB699984		AB700015	JX500857	
Exorista (Spixomyia) aureifrons (Baranov, 1936)		AB699915	AB257228	AB699961	AB699987		AB700018		
Exorista (Spixomyia) bisetosa Mesnil, 1940		AB699916	AB257229	AB466000	AB466073		AB700019		
Frontina laeta (Meigen, 1824)			AB465936	AB466008	AB466081				
Frontiniella parancilla Townsend, 1918					AF366669				AF364366
Frontiniella regilla (Reinhard, 1959)					AF366664				AF364365
Genea sp.	T1101	501 (75 indels)	558 (111 indels)	671 (34 indels)	1896 (1 'N', 986	761 (21 indels)	2274 (1708	690 (4 indels)	680 (6 indels)

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
					indels)		indels)		
Gnadochaeta sp.	T2456	477 (70 indels)	525 (108 indels)	647 (32 indels)	1858 (984 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Gonia chinensis Wiedemann, 1824			AB465937	AB466009	AB466082				
Gonia sp.	T0049		525 (109 indels)		1858 (986 indels)	684 (15 'N', 28 indels)	557	895 (474 'N', 2 indels)	
Gymnocheta viridis (Fallén, 1810)		GQ409065	GQ409129	GQ409181	GQ409240	GQ409296	GQ409327	GQ409397	GQ409463
Gymnoclytia paulista Townsend, 1929	T2528	477 (68 indels)	409 (116 indels)	1143 (46 indels)	1858 (987 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Gymnosoma nitens Meigen, 1824		GQ409064			GQ409239	GQ409295	GQ409326	GQ409396	GQ409462
Gymnosoma nudifrons Herting, 1966			GQ409130		GQ409241	GQ409297	GQ409328	GQ409398	
Gymnosoma rotundatum (Linnaeus, 1758)			AB465962	AB466035	AB466108				
Heliodorus cochisensis Reinhard, 1964					AF366673				AF364368
Hermya beelzebul (Wiedemann, 1830)			AB465960	AB466033	AB466106				
Hyphantrophaga hyphantriae (Townsend, 1891)					AF366650				AF364369
Hyphantrophaga virilis (Aldrich & Webber, 1924)				KP954337	KP954367		KP899673		AF364370
Hypotachina sp.	T1439			688 (44 indels)	1897 (978 indels)	741 (20 indels)		691 (4 indels)	673 (1 'N', 6 indels)
Hystricia sp.	T2126	477 (69 indels)	525 (108 indels)				557	895 (251 'N', 2 indels)	
Iceliopsis borgmeieri Guimarães, 1976	T0026	477 (67 indels)	525 (110 indels)	666 (33 indels)	1858 (980 indels)		557	895 (293 'N', 2 indels)	493 (1 indels)
Isosturmia japonica (Mesnil, 1957)			AB465919	AB465987	AB466060				
Istocheta sp.			AB465905	AB465973	AB466046				
Janthinomyia elegans (Matsumura, 1905)			AB465947	AB466020	AB466093				
Jurinella sp. 1	T2578	501 (68 indels)	533 (106 indels)	719 (44 indels)	1901 (980 indels)	748 (20 indels)	1684 (1071 indels)	699 (5 indels)	737 (8 indels)
Jurinella sp. 2	T2913						557	895 (251 'N', 2 indels)	
Jurinia sp.	T2641	489 (68 indels)	555 (110 indels)	728 (45 indels)	1897 (986 indels)	748 (20 indels)	1683 (1070 indels)	685 (4 indels)	473 (1 indels)
Juriniosoma sp.	T1858	488 (68 indels)	555 (110 indels)	724 (43 indels)	1906 (987 indels)	761 (20 indels)	1683 (1070 indels)	721 (6 indels)	672 (7 indels)
Leskia sp.	T1675	501 (73 indels)	556 (108 indels)	661 (33 indels)	1892 (990	753 (1 'N', 21	2299 (1708	691 (5 indels)	748 (1 'N', 9

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
					indels)	indels)	indels)		indels)
Lespesia aletiae (Riley, 1879)				KP954338	KP954368		KP899665		KP899695
Lespesia archippivora (Riley, 1871)					AF366676				AF364372
Lespesia lata (Wiedemann, 1830)	T1073		525 (108 indels)	678 (34 indels)	1858 (991 indels)	684 (80 'N', 19 indels)	557	895 (251 'N', 2 indels)	
Lixophaga latigena Shima, 1979			AB465906	AB465974	AB466047				
Macromya sp.	T1690	481 (69 indels)	548 (117 indels)	698 (42 indels)	1893 (981 indels)	770 (20 indels)	1801 (1178 indels)	633 (1 indels)	742 (7 indels)
Masiphya townsendi Aldrich, 1925					AF366677				AF364376
Medina sp.			AB465907	AB465975	AB466048				
Medinodexia sp.			AB465908	AB465976	AB466049				
Meigenia majuscula (Rondani, 1859)			AB465909	AB465977	AB466050				
Microgymnomma sp.	T2640	489 (65 indels)	556 (110 indels)	728 (45 indels)	833 (531 indels)	748 (20 indels)	1683 (1070 indels)	681 (4 indels)	671 (7 indels)
Microtrichomma sp.	T3052			741 (46 indels)	1662 (922 indels)	747 (20 indels)		675 (2 'N', 4 indels)	
Mikia patellipalpis (Mesnil, 1953)			AB465956	AB466029	AB466102				
Muscopteryx sp.					AF366679				AF364378
Mycteromyiella marginalis Shima, 1976			AB465924	AB465992	AB466065				
Myiopharus doryphorae (Riley, 1869)					AF366680				AF364381
Myiopharus moestus (Wulp, 1890)					AF366661				AF364382
Mystacella frioensis (Reinhard, 1922)					AF366681				AF364383
Nealsomyia rufella (Bezzi, 1925)			AB465938	AB466010	AB466083				
Nemoraea pellucida (Meigen, 1824)			AF322432	AF322418					
Nemoraea takanoi (Baranov, 1935)			AB465951	AB466024	AB466097				
Nemorilla floralis (Fallén, 1810)			AB465946	AB466018	JF439570	JF439555	JF439545		JF439521
Neocuphocera sp.	T2066	488 (69 indels)	554 (110 indels)	660 (39 indels)	1824 (4 'N', 977 indels)		1682 (1070 indels)	682 (1 'N', 3 indels)	
Neoeuantha sabroskyi Guimarães, 1982	T1092	468 (73 indels)	441 (108 indels)	672 (36 indels)	1680 (932 indels)	684 (73 'N', 19 indels)	557	894 (246 'N', 1 indels)	493 (1 indels)
Neophryxe psychidis Townsend, 1916		AB699925	AB257232	AB699970	AB699996		AB700028		
Neosophia elongata Guimarães, 1982	T0157	477 (74 indels)	525 (108 indels)	1143 (47 indels)	1548 (952 indels)	684 (16 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Orasturmia vallicola Reinhard, 1947					AF366682				AF364385
Ormia sp.	T1539	501 (63 indels)		741 (47 indels)	1897 (1 'N', 984	347 (3 indels)	2304 (1725	704 (5 indels)	742 (7 indels)

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
					indels)		indels)		
Ormiophasia cruzi Tavares, 1964	T2412	501 (69 indels)	565 (110 indels)	682 (42 indels)		606 (15 indels)	1684 (1070 indels)	691 (6 indels)	739 (7 indels)
Ormiophasia sp.	T1816	489 (68 indels)	556 (108 indels)	715 (44 indels)	1898 (985 indels)	758 (19 indels)	1674 (1071 indels)	680 (3 indels)	671 (7 indels)
Oxyepalpus sp.	T2635	501 (69 indels)	552 (109 indels)		1906 (987 indels)	780 (22 indels)	1684 (1070 indels)	697 (10 'N', 5 indels)	734 (2 'N', 8 indels)
Panzeria ampelus (Walker, 1849)				KP954343	KP954373		KP899674		KP899704
Panzeria melanopyga (Zimin, 1960)			AB465948	AB466021	AB466094				
Paradidyma sp.	T1932	477 (71 indels)		670 (33 indels)			557	895 (251 'N', 2 indels)	
Parasetigena bicolor (Chao, 1964)		AB699926	AB257233	AB699971	AB699997		AB700029		
Parasetigena silvestris (Robineau-Desvoidy, 1863)		AB699927	AB257234	AB466001	AB466074		AB700030		
Paratryphera minor Shima, 1980			AB465925	AB465993	AB466066				
Parepalpus sp.	T2610	489 (68 indels)	557 (110 indels)	727 (45 indels)	1899 (986 indels)	748 (18 indels)	1683 (1071 indels)	690 (4 indels)	734 (1 'N', 8 indels)
Patelloa facialis (Coquillett, 1897)					AF366683				AF364387
Peleteria (Sphyrimyia) biangulata Curran, 1925					AF366684				AF364388
Peleteria rubescens (Robineau-Desvoidy, 1830)		GQ409085	GQ409143	GQ409199	GQ409259	GQ409305	GQ409348	GQ409416	
Peleteria semiglabra (Zimin, 1961)	T2924	477 (68 indels)	525 (108 indels)		1858 (986 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Peleteria sp. 1	T1984	477 (68 indels)	525 (110 indels)	631 (29 indels)	1858 (989 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Peleteria sp. 2	T2713	489 (68 indels)	557 (109 indels)	729 (41 indels)	1899 (987 indels)	735 (20 indels)	1683 (3 'N', 1070 indels)	681 (4 indels)	736 (7 'N', 8 indels)
Peribaea tibialis (Robineau-Desvoidy, 1851)			AB465953	AB466026	AB466099				
Pexopsis pilosa Mesnil, 1957			AB465940	AB466012	AB466085				
Phania funesta (Meigen, 1824)		GQ409086	GQ409144	GQ409200	GQ409260	GQ409306	GQ409349	GQ409417	GQ409477
Phasia xenos (Townsend, 1934)	T2533	477 (69 indels)	483 (106 indels)	1143 (48 indels)	1858 (962 indels)		557	895 (326 'N', 2 indels)	493 (1 indels)
Phebellia glauca (Meigen, 1824)			AB465920	AB465988	AB466061				
Phorinia breviata Tachi & Shima, 2006		AB699928	AB257235		AB699998		AB700031		
Phorinia spinulosa Tachi & Shima, 2006		AB699930	AB257237	AB466003	AB466076		AB700033		
Phorocera grandis Macquart, 1851		AB699931	AB257238	AB699972	AB700000		AB700034		

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Phorocera obscura (Fallén, 1810)		AB699932	AB257239	AB466002	AB466075		AB700035		
Phorocerosoma vicarium (Walker, 1856)		AB699935	AB465926	AB465994	AB466067		AB700038		
Phryno katoi Mesnil, 1963			AB465941	AB466013	AB466086				
Phryxe heraclei (Meigen, 1824)			AB465921	AB465989	AB466062				
Phyllophilopsis sp.					AF366686				AF364389
Polygaster sp.	T0755	430 (54 indels)	517 (110 indels)	1143 (47 indels)	1858 (950 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Prodegeeria japonica (Mesnil, 1957)			AB465910	AB465978	AB466051				
Prooppia nigripalpis (Robineau-Desvoidy, 1848)			AB465922	AB465990	AB466063				
Prophorostoma pulchra Townsend, 1927	T0346	477 (69 indels)	483 (109 indels)	1143 (47 indels)	1858 (987 indels)	684 (19 indels)	557	895 (246 'N', 2 indels)	493 (1 indels)
Pseudochaeta siminina Reinhard, 1946					AF366687				AF364391
Pseudogonia rufifrons (Wiedemann, 1830)			AB465942	AB466014	AB466087				
Ptilodexia conjuncta (Wulp, 1891)				KP954346	KP954376		KP899670		KP899690
Senometopia cariniforceps (Chao & Liang, 2002)			AB465923	AB465991	AB466064				
Siphona plusiae Coquillett, 1895				KP954348	KP954378		KP899664		KP899705
Siphona sp.					AF366658				AF364393
Siphosturmia sp.					AF366688				AF364394
Smidtia japonica (Mesnil, 1957)		AB699937		AB699975	AB700003		AB700040		
Strongygaster triangulifera (Loew, 1863)				KP954349	KP954379		KP899679		
Sturmia bella (Meigen, 1824)			AB465943	AB466015	AB466088				
Suensonomyia nudinerva Mesnil, 1957			AB465944	AB466016	AB466089				
Tachina (Nowickia) ferox Panzer, 1806		FJ025416	Tachina_ferox	FJ025500	FJ025562		FJ025659		
Tachina (Servillia) minuta (Chao, 1962)			AB465955	AB466028	AB466101				
Tachina (Tachina) grossa (Linnaeus, 1758)		FJ222684	GQ409163		AJ300130	KC177242	KU146899	GQ409442	GQ409494
Tachina (Tachina) magnicornis (Zetterstedt, 1844)		GQ409111	GQ409164	GQ409223	GQ409283		GQ409376	GQ409443	
Tachina (Tachina) nupta (Rondani, 1859)			AB465954	AB466027	AB466100				
Tachinomyia nigricans Webber, 1941				KP954350	KP954380		KP899672		KP899698
Talarocera sp.	T2387		557 (109 indels)	728 (44 indels)	1896 (988 indels)	748 (20 indels)	1433 (4 'N', 899 indels)	681 (4 indels)	735 (8 indels)
Thelaira americana Brooks, 1945				KP954351	KP954381		KP899684		KP899692
Thelairoleskia sp.			AB465950	AB466023	AB466096				

Species	Voucher	12S	16S	18S	28S	CAD	COI	Cytb	Ef1α
Triarthria setipennis (Fallén, 1810)		GQ409114	GQ409166	GQ409226	GQ409288	GQ409313	GQ409379	GQ409446	
Trichophora sp.	T2637	491 (68 indels)	557 (109 indels)	728 (41 indels)	1899 (985 indels)	748 (19 indels)	1683 (1070 indels)	692 (6 indels)	671 (8 indels)
Trichopoda (Galactomyia) pennipes (Fabricius, 1781)				KP954352	KP954382		KP899678		
Trichopoda (Trichopoda) indivisa Townsend, 1897					AF366689				AF364395
Trichopoda sp.	T2163	477 (67 indels)	501 (107 indels)	1143 (45 indels)	1858 (977 indels)	684 (159 'N', 19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Trigonospila transvittata (Pandellé, 1896)			AB465911	AB465979	AB466052				
Uramya brevicauda Curran, 1934	T1002	477 (66 indels)	498 (110 indels)	1143 (47 indels)	1858 (995 indels)	684 (73 'N', 19 indels)	557	895 (326 'N', 2 indels)	
Uramya townsendi Guimarães, 1980	T0455	477 (70 indels)	525 (102 indels)	1143 (48 indels)	1808 (1222 indels)	684 (19 indels)	557	895 (326 'N', 2 indels)	493 (1 indels)
Urodexia uramyoides (Townsend, 1927)			AB465912	AB465980	AB466053				
Uroeuantha longipes Townsend, 1927			AB465913	AB465981	AB466054				
Uromedina eumorphophaga (Baranov, 1934)			AB465914	AB465982	AB466055				
Vibrissina aurifrons (Curran, 1930)					AF366690				AF364396
Vibrissina turrita (Meigen, 1824)			AB465915	AB465983	AB466056				
Voria ruralis (Fallén, 1810)			AB465959	AB466032	KP954384		KP899671		
Winthemia rufonotata (Bigot, 1889)					AF366691				AF364397
Winthemia sinuata Reinhard, 1931				KP954355	KP954385				KP899696
Winthemia venusta (Meigen, 1824)		AB699936	AB257243	AB466019	AB466092		AB700039		
Xanthomelanodes sp.	T0217	472 (61 indels)	485 (229 indels)	1143 (47 indels)	1543 (928 indels)	684 (28 'N', 19 indels)	557	895 (251 'N', 2 indels)	493 (1 indels)
Xanthophyto sp.	T1360	477 (70 indels)	525 (116 indels)	671 (33 indels)	1858 (980 indels)		557	895 (251 'N', 2 indels)	493 (1 indels)
Xanthozona melanopyga (Wiedemann, 1830)	T2345	517 (68 indels)	555 (109 indels)	718 (42 indels)	1904 (987 indels)	748 (20 indels)	1685 (1070 indels)		732 (8 indels)
Zenillia dolosa (Meigen, 1824)			AB465945	AB466017	AB466090				
Zenilliana sp.			AB465927	AB465995	AB466068				
Zizyphomyia crescentis (Reinhard, 1944)					AF366667				AF364399
Zonoepalpus sp.	T2127	489 (68 indels)	556 (109 indels)	729 (42 indels)	1893 (989 indels)	735 (20 indels)	1682 (1070 indels)	681 (1 'N', 54 indels)	671 (7 indels)
Ulurumyiidae									

Species	**Voucher**	**12S**	**16S**	**18S**	**28S**	**CAD**	**COI**	**Cytb**	**Ef1α**
Ulurumyia macalpinei Michelsen & Pape, 2017		GQ409071	GQ409133	GQ409186	KY945986			GQ409402	GQ409468

Table 3: List of primer sequences used for amplification and sequencing, with their respective references and annealing temperatures. Asterisks refer to the protocol adopted in the touchdown polymerase chain reaction.

Region	**Primer name**	**Orientation**	**Primer sequence (5' to 3')**	**Reference**	**Annealing**
12S	12SAIN	Forward	AAAAACWAGGATTAGATACCCT	Pinto-da-Rocha *et al.*(2014)	45 °C
	12SOP2RN	Reverse	CCCTTAAAYYTACTTTGTTACGAC	Pinto-da-Rocha *et al.*(2014)	45 °C
16S	16SpotFN	Forward	GACTGTGCAAAGGTAGCATAATC	Pinto-da-Rocha *et al.*(2014)	45 °C
	16SBR	Reverse	CCGGTCTGAACTCAGATCACGT	Palumbi (1996)	45 °C
18S	18SA	Forward	AACCTGGTTGATCCTGCCAGT	Medlin *et al.* (1988)	52 °C
	18S9R	Reverse	GATCCTTCCGCAGGTTCACCTAC	Whiting (2002)	52 °C
28S	rc28A	Forward	AGCGGAGGAAAAGAAAC	Bertone *et al.* (2008)	58 °C
	28C	Reverse	GCTATCCTGAGGGAAACTTCGG	Bertone *et al.* (2008)	58 °C
CAD	787F	Forward	GGDGTNACNACNGCNTGYTTYGARCC	Moulton & Wiegmann (2004)	*57/52/45 °C
	1124R	Reverse	CATNCGNGARAAYTTRAARCGATTYTC	Moulton & Wiegmann (2004)	*57/52/45 °C
	806F	Forward	GTNGTNAARATGCCNMGNTGGGA	Moulton & Wiegmann (2004)	*57/52/45 °C
	1098R	Reverse	TTNGGNAGYTGNCCNCCCAT	Moulton & Wiegmann (2004)	*57/52/45 °C
COI	LCO1490	Forward	GGTCAACAAATCATAAAGATATTGG	Folmer *et al.* (1994)	45 °C
	HCO2198	Reverse	TAAACTTCAGGGTGACCAAAAAATCA	Folmer *et al.* (1994)	45 °C
Cytb	CB-J-10933	Forward	TATGTTTTACCTTGAGGACAAATATC	Simon *et al.* (1994)	52 °C
	TS1-N-11683	Reverse	AAATTCTATCTTATGTTTTCAAAAC	Simon *et al.* (1994)	52 °C
Ef1α	EF1-OP2	Forward	GATTTCATCAARAACATGATYAC	Hedin *et al.* (2010)	52 °C
	EF1-OPR4C4	Reverse	GAACTTGCANGCAATGTGAGC	Hedin *et al.* (2010)	52 °C

Table 4: List of partition schemes and data sets used in phylogenetic analyses with their respective substitution models chosen under the Bayesian information criterion in IQ-TREE. Abbreviations: mit = markers of mitochondrial protein-coding genes; nuc = markers of nuclear protein-coding genes; pc = markers of protein-coding genes; rib = markers of mitochondrial and nuclear ribosomal genes.

Partition scheme	**Substitution model**
All sequences (492 terminals)	GTR+F+R8
All sequences (470 terminals)	GTR+F+R6
All sequences (82 terminals)	GTR+F+R5
All sequences (82 terminals, pc without 3rd position)	GTR+F+R4
12S (83 terminals)	TIM+R5
16S (83 terminals)	TIM3+I+G4
18S (83 terminals)	HKY+R2
28S (83 terminals)	TVM+R4
CAD (83 terminals)	TPM2u+R4
COI (83 terminals)	TPM2u+R7
Cytb (83 terminals)	GTR+R6
Ef1α (83 terminals)	GTR+R4
rib + pc (1st and 2nd position only)	(TVM+F+R10) + (GTR+F+R10)
rib + pc (1st and 2nd position) + pc (3rd position)	(TVM+F+R10) + (GTR+F+R10) + (GTR+F+R8)
rib + nuc + mit	(TVM+F+R10) + (GTR+F+R7) + (GTR+F+R8)

Table 5: Number of molecular markers per terminal used in the phylogenetic analysis of Calyptratae (including outgroups), representing the amount of highly incomplete taxa in the character matrix. Most Calyptratae groups are covered with at least five molecular markers, with highly incomplete taxa being more frequent in oestroid lineages, specially in Tachinidae. Further information about the amount of markers for each species can be checked in Table 2.

Amount of markers	**Amount of terminals**	**Percentage**	**Taxonomic groups covered**
8	83	16.8%	all superfamilies of Calyptratae
7	67	13.6%	all superfamilies of Calyptratae
6	65	13.2%	all superfamilies of Calyptratae
5	82	16.6%	all superfamilies of Calyptratae
4	44	9%	mostly Hippoboscoidea and Oestroidea
3	116	23.7%	mostly Oestroidea
2	35	7.1%	Tachinidae

Table 6: List of potential wildcards ordered according to the lowest sum of SPR distances and highest average of similarity indexes (see Figure 2 for more details). Each taxa is listed with their respective position in the ranking provided by YBYRÁ and the amount and type of molecular markers. The molecular markers are ordered according to their phylogenetic informativeness for the phylogeny of Calyptratae, starting with the less informative (18S) to the more informative (CAD). Discussion about the phylogenetic informativeness of each marker can be found in the text and in Figures 3, 4 and 5. The 22 species listed in bold were detected as wildcards when examining both ranks and the strict consensus and were removed from the data set.

Terminals	**Ranking number YBYRÁ**	**Amount of markers**	**18S**	**COI**	**16S**	**Cytb**	**Ef1α**	**12S**	**28S**	**CAD**
Masiphya townsendi	5th	2					X		X	
***Hystricia* sp. T2126**	2nd	4		X	X	X		X		
Ceracia dentata	11th	4	X	X			X		X	
Campylocheta semiothisae	6th	4	X	X			X		X	
Ptilodexia conjuncta	7th	4	X	X			X		X	
Pseudochaeta siminina	12th	2					X		X	
Heliodorus cochisensis	3rd	2					X		X	
***Paradidyma* sp. T1932**	4th	4	X	X		X		X		
Trigonospila transvittata	13th	3	X		X				X	
Catharosia* cf. *nebulosa	45th	2	X						X	
***Iceliopsis borgmeieri* T0026**	10th	7	X	X	X	X	X	X	X	
Senometopia cariniforceps	31st	3	X		X				X	
***Amenia* sp.**	23rd	4	X		X		X		X	
Thelaira americana	8th	4	X	X			X		X	
Eucelatoria armigera	16th	2					X		X	
Mycteromyiella marginalis	29th	3	X		X				X	
Isosturmia japonica	41st	3	X		X				X	
Brachicoma devia	9th	3		X		X	X			
Paratryphera minor	24th	3	X		X				X	
Dexosarcophaga carvalhoi OD1081	44th	7	X	X	X	X	X	X		X
Sphenometopa claripennis	22nd	6	X	X	X	X	X	X		
Epicampocera succincta	14th	3	X		X				X	
Melanophora roralis	1st	4		X	X	X	X			
***Polygaster* sp. T0755**	21st	8	X	X	X	X	X	X	X	X
Retrocitomyia retrocita OD1123	37th	6	X	X	X	X	X	X		
Sturmia bella	27th	3	X		X				X	
Bessa parallela	33rd	5	X	X	X			X	X	
Protocalliphora azurea	17th	6	X		X	X	X	X	X	

Terminals	**Ranking number YBYRÁ**	**Amount of markers**	**18S**	**COI**	**16S**	**Cytb**	**Ef1α**	**12S**	**28S**	**CAD**
Dexia fulvifera	18th	3	X		X				X	
Suensonomyia nudinerva	28th	3	X		X				X	
Mystacinobia zelandica	50th	6	X	X	X	X		X	X	
Eurychaeta palpalis	48th	7		X	X	X	X	X	X	X
Dexagria ushinskyi	47th	3		X		X	X			
Phyto cingulata	20th	3			X	X			X	
Nealsomyia rufella	25th	3	X		X				X	
Chaetogaedia monticola	34th	2					X		X	
Phania funesta	19th	8	X	X	X	X	X	X	X	X
Gnadochaeta sp. T2456	49th	7	X	X	X	X	X	X	X	
Cholomyia inaequipes T0309	35th	7	X	X	X	X		X	X	X
Uroeuantha longipes	39th	3	X		X				X	
Nemoraea pellucida	15th	2	X		X					
Admontia sp.	32nd	3	X		X				X	
Eumea linearicornis	26th	3	X		X				X	
Boettcheria cimbicis	43rd	5	X			X	X	X	X	
Phrosinella fedtshenkoi	30th	3		X		X	X			
Patelloa facialis	42nd	2					X		X	
Vibrissina aurifrons	40th	2					X		X	
Lixophaga latigena	36th	3	X		X				X	
Dasyuromyia sp. T1376	46th	5	X	X		X	X		X	
Senotainia albifrons	38th	3		X		X	X			

Table 7: Summary of phylogenetic relationships of the families of Oestroidea inferred using the maximum likelihood criterion in the most recent molecular phylogenetic studies of the superfamily, in comparison to the phylogenetic hypothesis inferred herein.

Families	**KUTTY et al. 2010**	**MARINHO et al. 2012**	**CERRETTI et al. 2017**	**KUTTY et al. 2019**	**GUDIN; NIHEI**
First split	Oestridae	Tachinidae + Mesembrinellidae	Oestridae + Sarcophagidae	Ulurumyiidae	Mystacinobiidae + Oestridae
Calliphoridae *sensu stricto*	Paraphyletic, sister group of the clade with Helicoboscinae + Rhinophoridae and Mesembrinellidae + Polleniidae + Tachinidae	Monophyletic, sister group of Sarcophagidae	Paraphyletic, with Rhiniidae nested within it and Chrysomyinae as sister group of the clade with "Calliphoridae *sensu stricto*" + Rhiniidae and Rhinophoridae + Polleniidae + Tachinidae	Paraphyletic, with Rhiniidae and Rhinophoridae nested within it	Paraphyletic, with Rhiniidae nested within it
Mesembrinellidae	Sister group of Polleniidae	Sister group of Tachinidae	Sister group of Ulurumyiidae	Sister group of all oestroid families, except Ulurumyiidae	Sister group of the clade with Rhinophoridae + Polleniidae + Tachinidae
Mystacinobiidae	Sister group of Ulurumyiidae	Not included	Sister group of the clade with Anthomyiidae + Scathophagidae and Oestroidea	Sister group of Oestridae	Sister group of Oestridae
Oestridae	Sister group of all oestroid families	Sister group of Rhiniidae	Sister group of Sarcophagidae	Sister group of Mystacinobiidae	Sister group of Mystacinobiidae
Polleniidae	Sister group of Mesembrinellidae	Not included	Sister group of Tachinidae	Sister group of Tachinidae	Sister group of Tachinidae

Families	**KUTTY et al. 2010**	**MARINHO et al. 2012**	**CERRETTI et al. 2017**	**KUTTY et al. 2019**	**GUDIN; NIHEI**
Rhiniidae	Sister group of the clade with “Calliphoridae *sensu stricto*” + Rhinophoridae + Mesembrinellidae + Polleniidae + Tachinidae	Sister group of Oestridae	Sister group of Bengaliinae	Sister group of Bengaliinae	Nested within Calliphoridae *sensu stricto*
Rhinophoridae	Sister group of Helicoboscinae	Not included	Sister group of Polleniidae + Tachinidae	Sister group of Ameniinae + Helicoboscinae	Sister group of Polleniidae + Tachinidae
Sarcophagidae	Sister group of Mystacinobiidae + Ulurumyiidae	Sister group of Calliphoridae *sensu stricto*	Sister group of Oestridae	Sister group of Mystacinobiidae + Oestridae	Sister group of all oestroid families, except Mystacinobiidae + Oestridae
Tachinidae	Sister group of Mesembrinellidae + Polleniidae	Sister group of Mesembrinellidae	Sister group of Polleniidae	Sister group of Polleniidae	Sister group of Polleniidae
Ulurumyiidae	Sister group of Mystacinobiidae	Not included	Sister group of Mesembrinellidae	Sister group of all oestroid families	Sister group of the clade with Mesembrinellidae + Rhinophoridae + Polleniidae + Tachinidae

Table 8: Divergence times of families of Calyptratae estimated with Yule, CA and FBD methods in BEAST 2. The mean (M) and 95% highest posterior density (HPD) are provided in millions of years (Ma) for each taxon. The order of each taxa follows the topology of Calyptratae to facilitate comparison between groups.

Taxa	**Yule**		**CA**		**FBD**	
	M	**95% HPD**	**M**	**95% HPD**	**M**	**95% HPD**
Calyptratae	117.2	90.6–146	84.6	64–105.5	95.3	89.3–99.8
Glossinidae	39.6	24.5–56	29.4	16.8–42	47.3	26.3–47.9
Hippoboscidae	81.8	60.9–105.1	59	42.8–75.6	67.4	57.7–77.2
Nycteribiidae	61	44.4–79.5	44.6	31.7–58.2	54.9	45–64.4
Streblidae	69.4	51.5–88.3	49.7	36–63.5	59.4	51–67.7
Fanniidae	41	26.8–55.5	30.4	19.2–42.1	42.2	30.7–55.4
Muscidae	57.7	45–71	42.8	31.3–53.2	59.3	50.1–68.2
Anthomyiidae + Scathophagidae	42.2	42–43.4	28.9	20.5–37.5	44.3	36.6–53
Oestridae	26.7	17.2–37.2	19.8	12.1–27.4	28.7	19.7–37.9
Sarcophagidae	47.9	37.7–58.5	34.8	25.4–43.1	48.4	41.6–55.4
Calliphorid lineages + Rhiniidae	37.2	28.2–46.9	27.3	19.6–34.6	42.3	35.2–49.5
Rhiniidae	24	17.3–30.9	17.6	12.1–22.9	28.1	22–34.1
Mesembrinellidae	44.9	33.8–56.1	33.3	28.9–41.7	47.5	39.5–55.6
Rhinophoridae	38.5	25.7–51.8	28.7	19–39.3	29.2	22.7–35.8
Polleniidae	20.8	12.4–30.7	15.4	8.6–21.8	24.1	14.9–33.6
Tachinidae	52.1	41.6–62.4	38.4	29.3–47	54.6	48.3–61.2

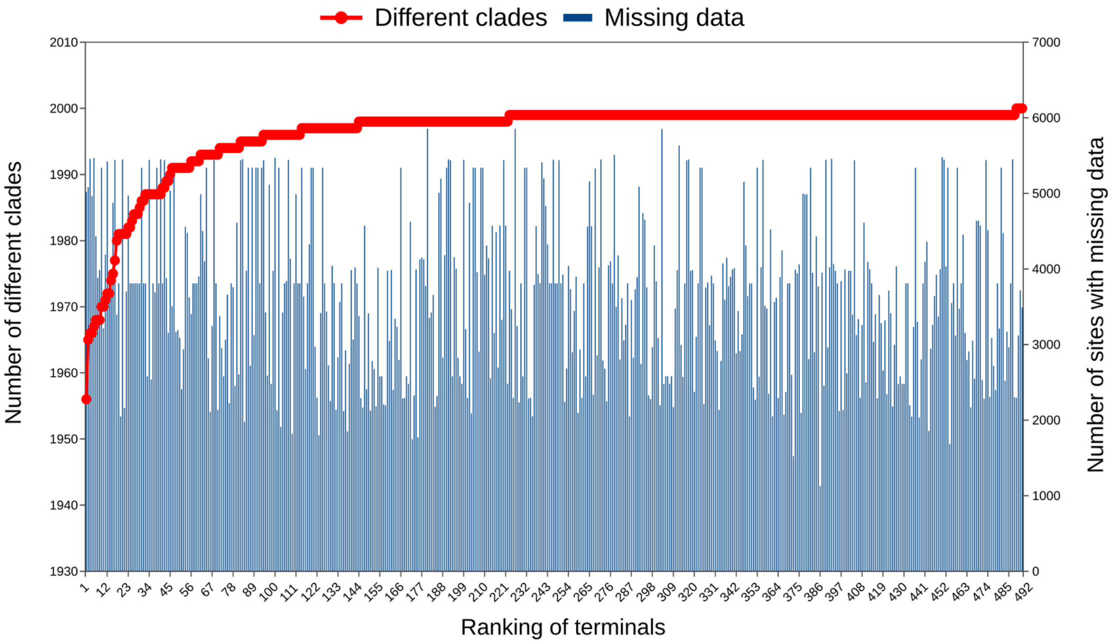


Figure 1: Ranking of 492 terminals included in the phylogeny of Calyptratae according to the number of different clades in all 40 trees of the sensitivity analysis, with each tree being pruned one terminal at a time. The respective amount of sites with missing data per terminal is shown in blue bars. See more information in Table 6.

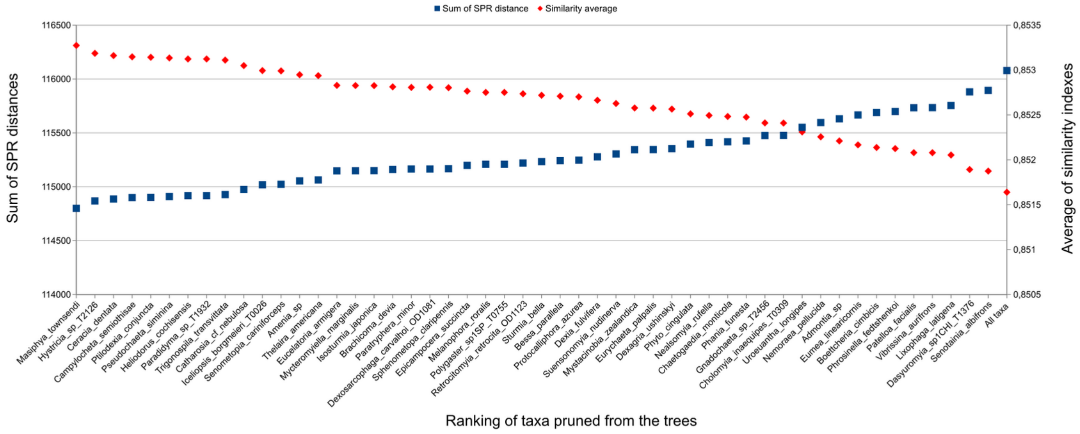


Figure 2: Ranking of 50 potential wildcards acquired in YBYRÁ (see Figure 1 and Table 6) according to the SPR distances and similarity indexes between all 40 trees of the sensitivity analysis, with each tree being pruned one terminal at a time. The SPR distance and similarity index including all taxa are shown at the end of the ranking for comparison.

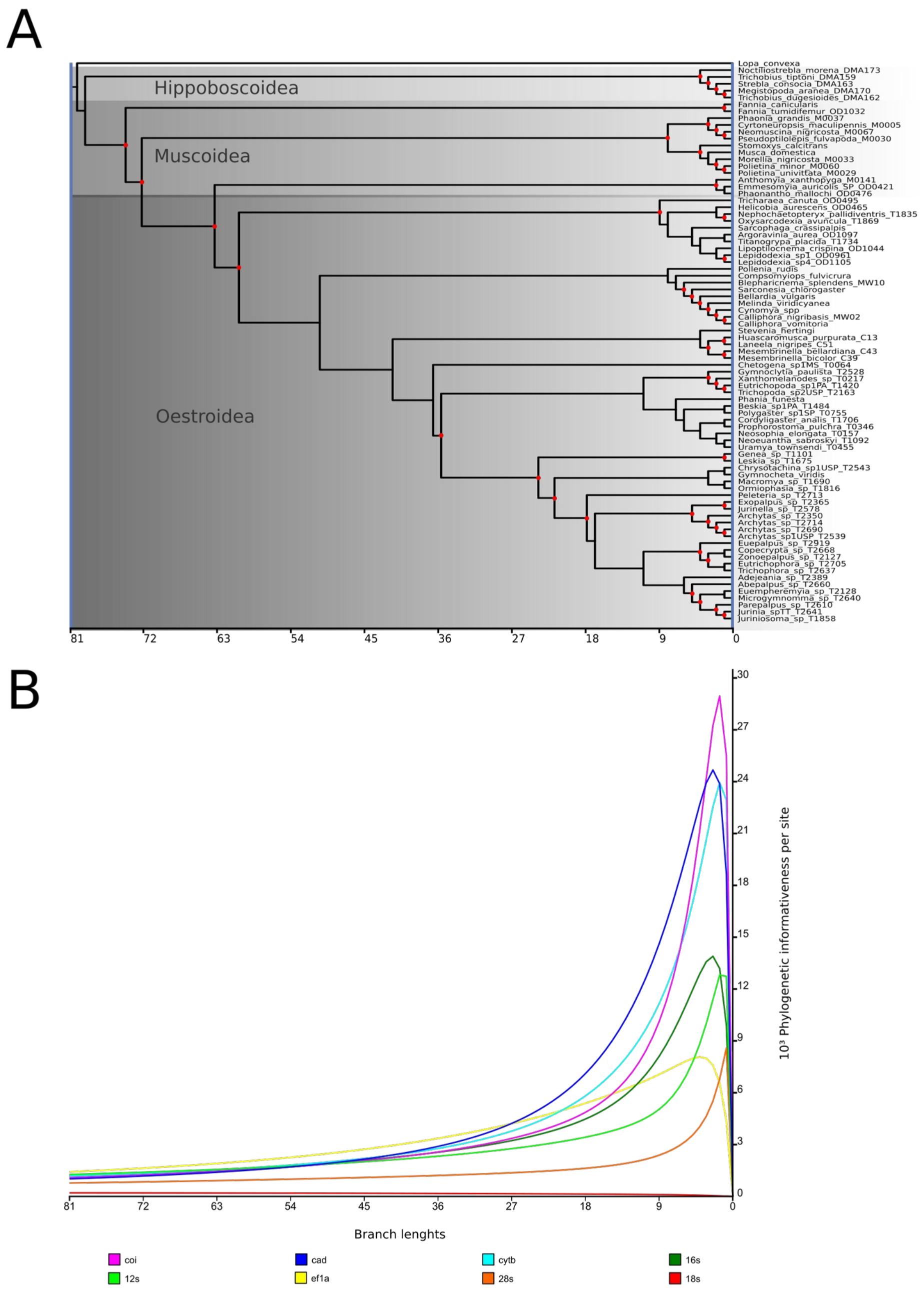


Figure 3: Phylogenetic informativeness profiles obtained from the phylogeny of Calyptratae, inferred from 82 terminals and eight molecular markers. A. Phylogenetic tree of Calyptratae, with branches arranged proportionally to their branch lengths. Red circles at nodes represent UFBoot values ≥ 95%. B. Phylogenetic informativeness profiles per site for 12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α according to the proportion of branch lengths of the topology. The molecular markers are ordered from highest to lowest density values.

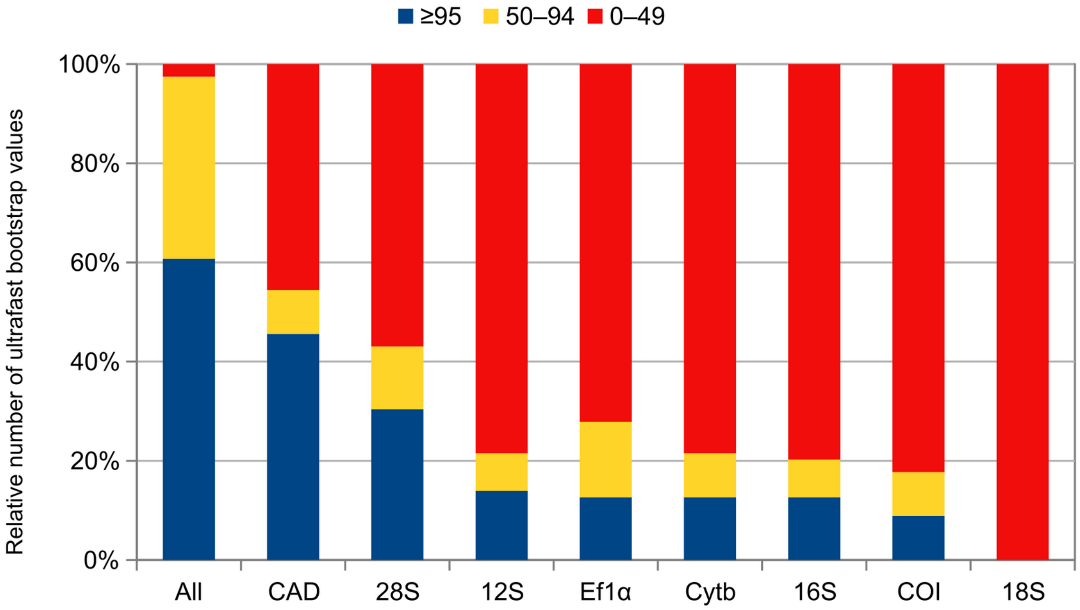


Figure 4: Frequency of UFBoot values calculated in the phylogeny of Calyptratae, inferred from 82 terminals and eight molecular markers. The frequency of UFBoot for each molecular marker calculated and mapped in the topology of Calyptratae is also shown, ordered from most informative to least informative.

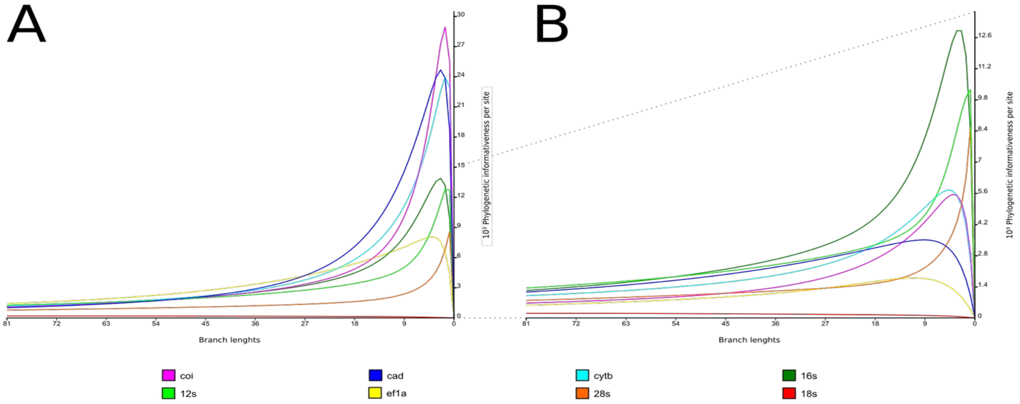


Figure 5: Comparison between phylogenetic informativeness profiles obtained from the phylogeny of Calyptratae, inferred from 82 terminals (see also Figure 3) and two different partition schemes. A. Phylogenetic informativeness profiles per site for 12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α, including the third codon position of markers of protein-coding genes. B. Phylogenetic informativeness profiles per site for the same eight molecular markers, excluding the third codon position of markers of protein-coding genes. Note the difference of scale in y-axis between the two charts.

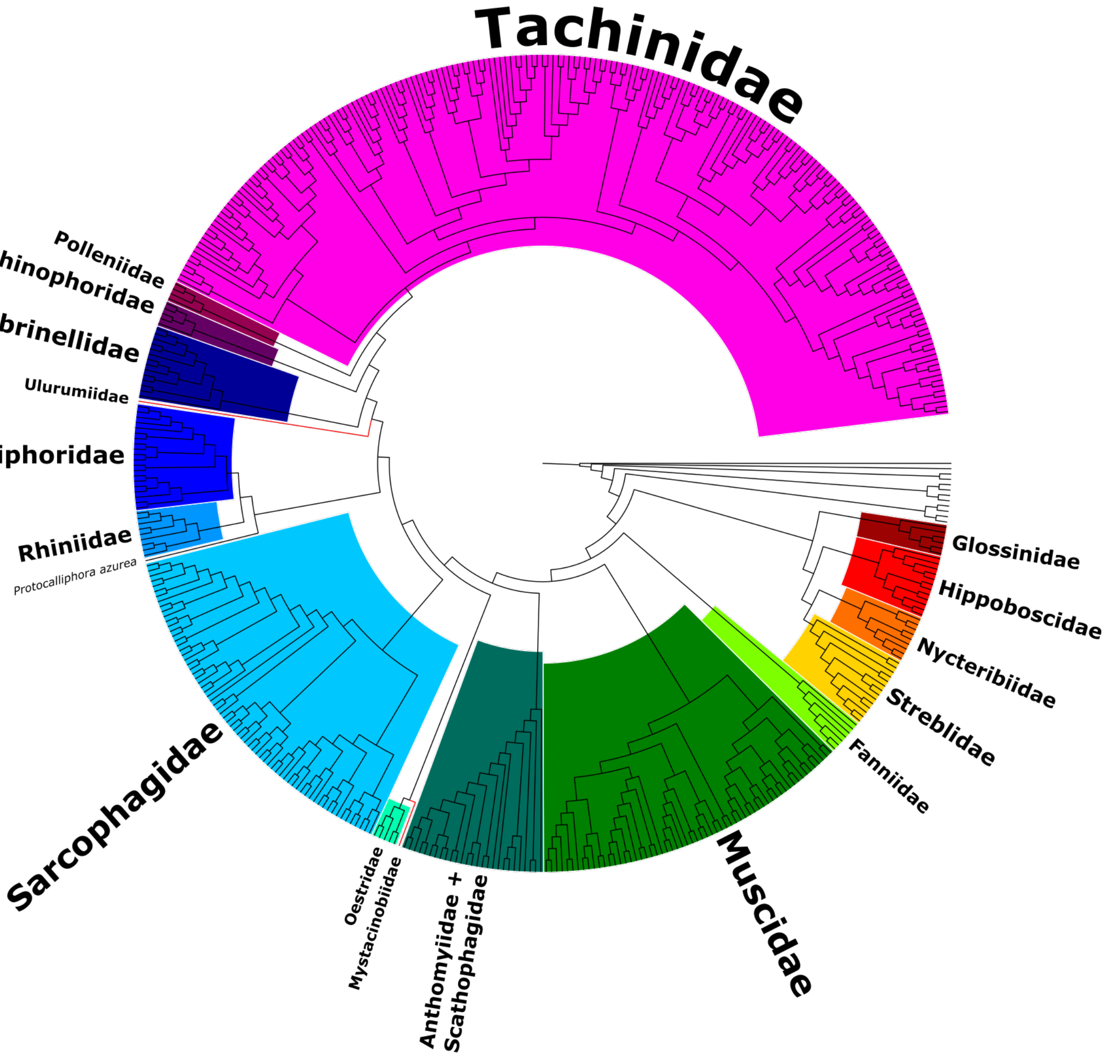


Figure 6: Phylogram of Calyptratae inferred from 458 terminals of calyptrates and eight molecular markers (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α) under the maximum likelihood criterion in IQ-TREE. Branch lengths and the name of terminals were omitted to facilitate the visualization of the main relationships between families and superfamilies. The tree with branch lengths and UFBoot values is displayed in detail in Figures 7–12, showing each family with their respective colors.

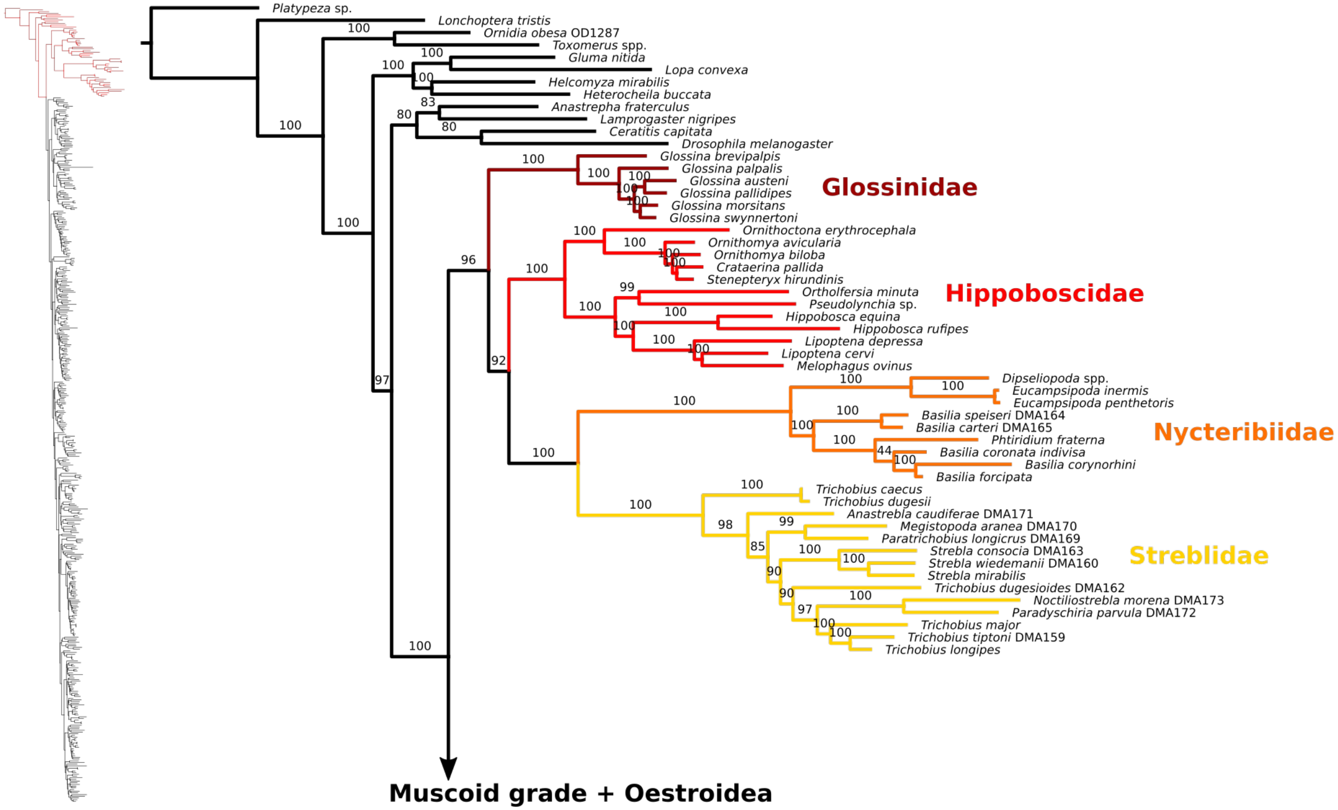


Figure 7: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the branches of outgroups and of families of Hippoboscoidea. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

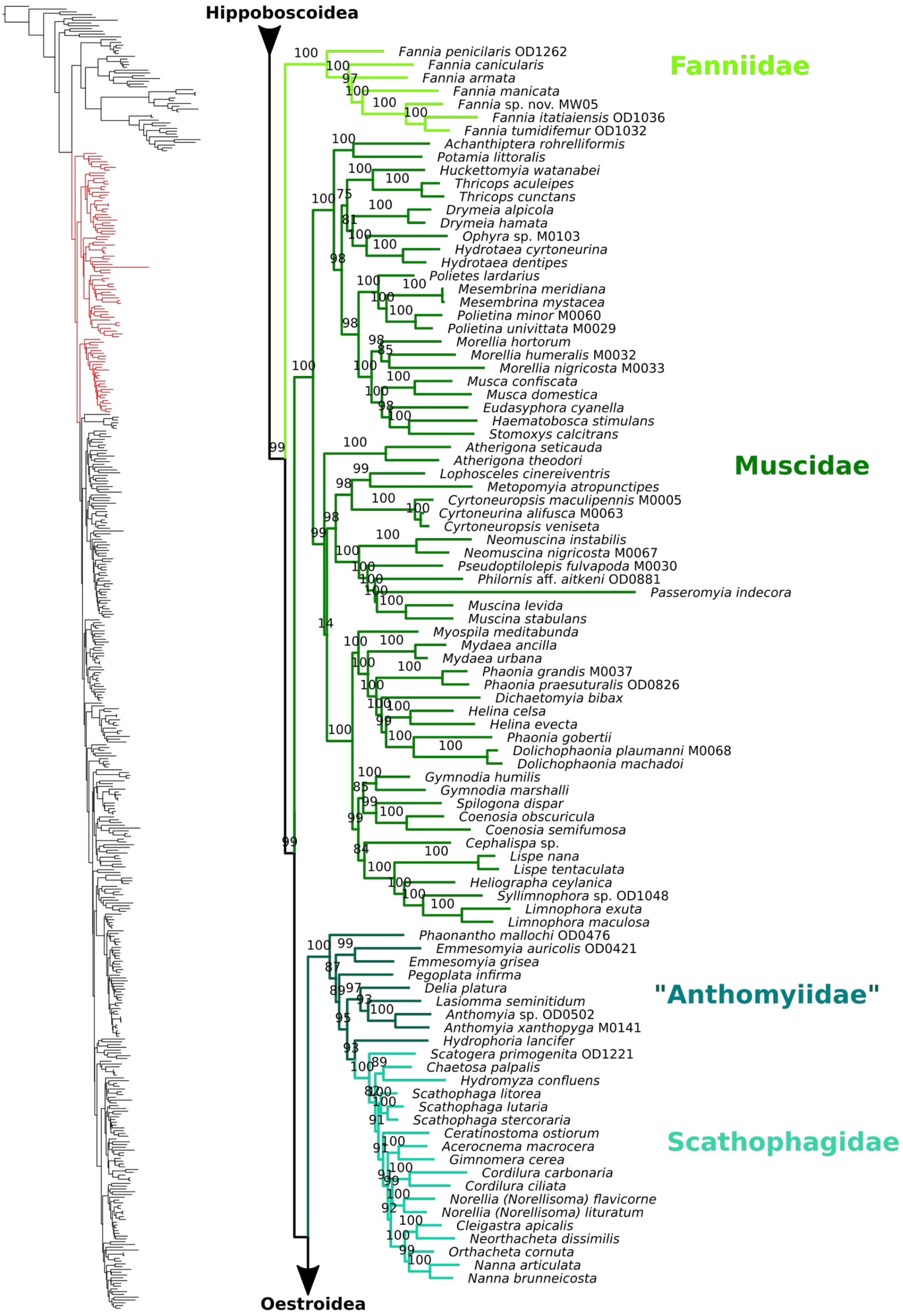


Figure 8: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the branches of families of the muscoid grade. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

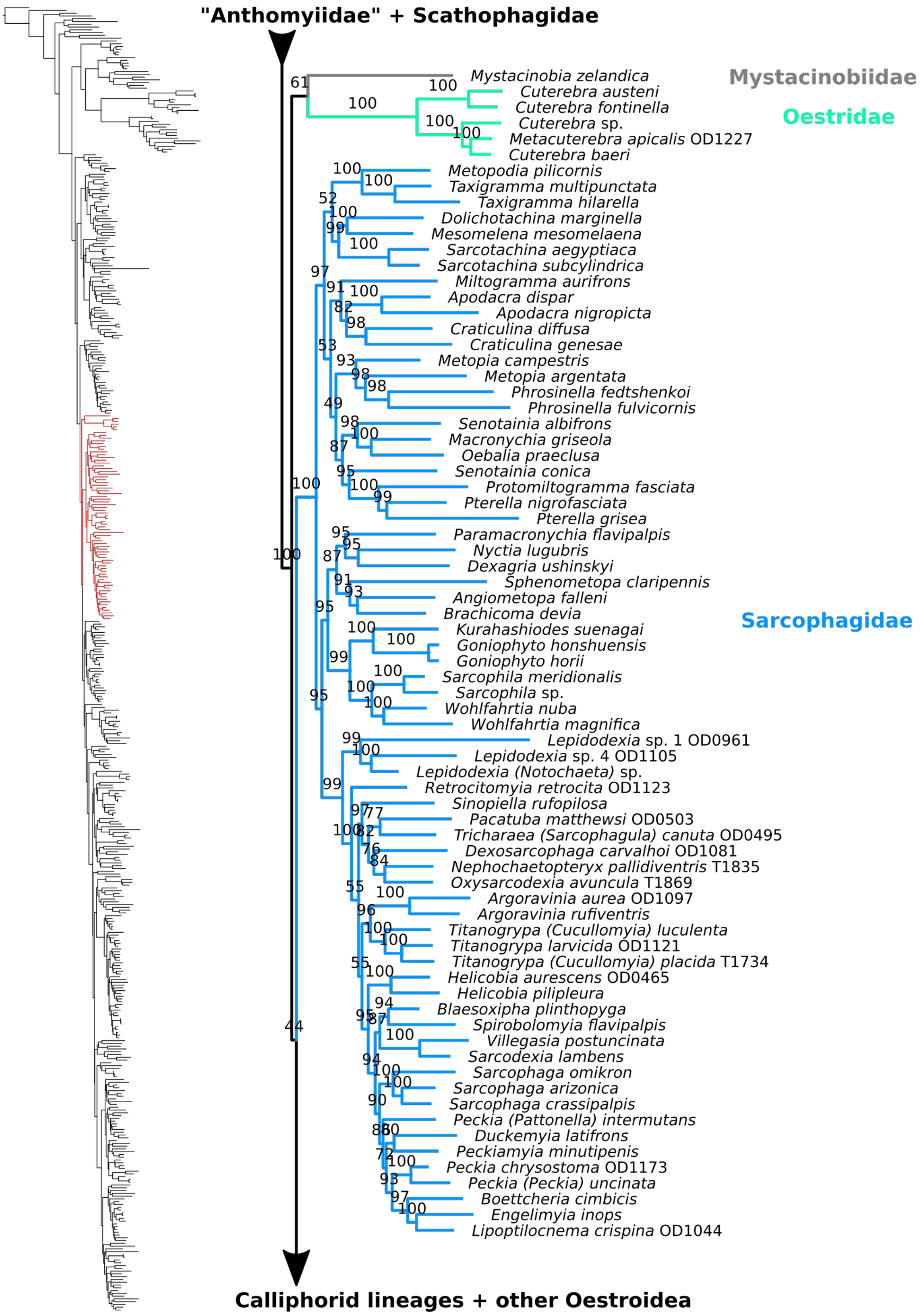


Figure 9: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the first branches and divergences of Oestroidea. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

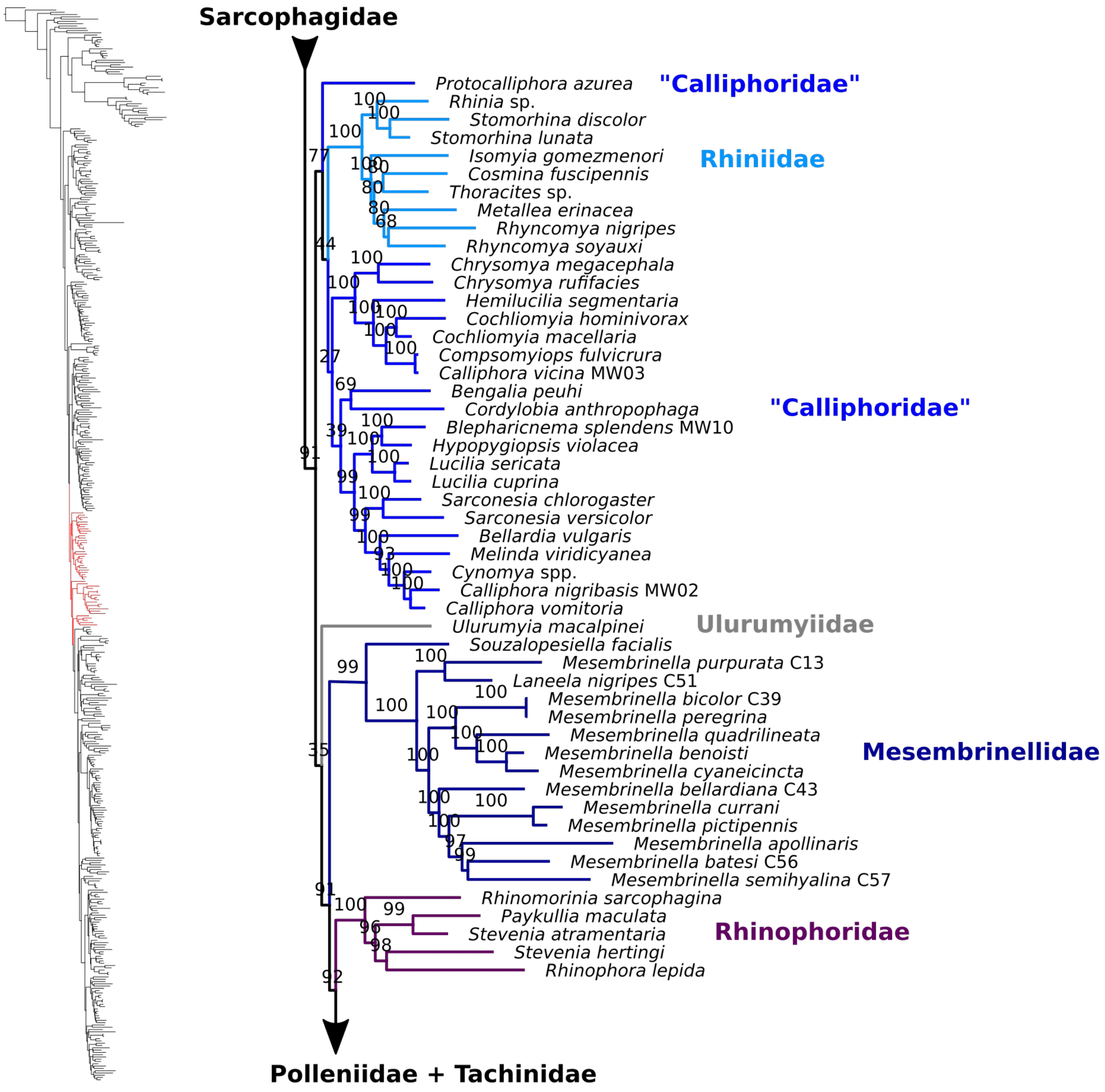


Figure 10: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the branches of calliphorid lineages in Oestroidea. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

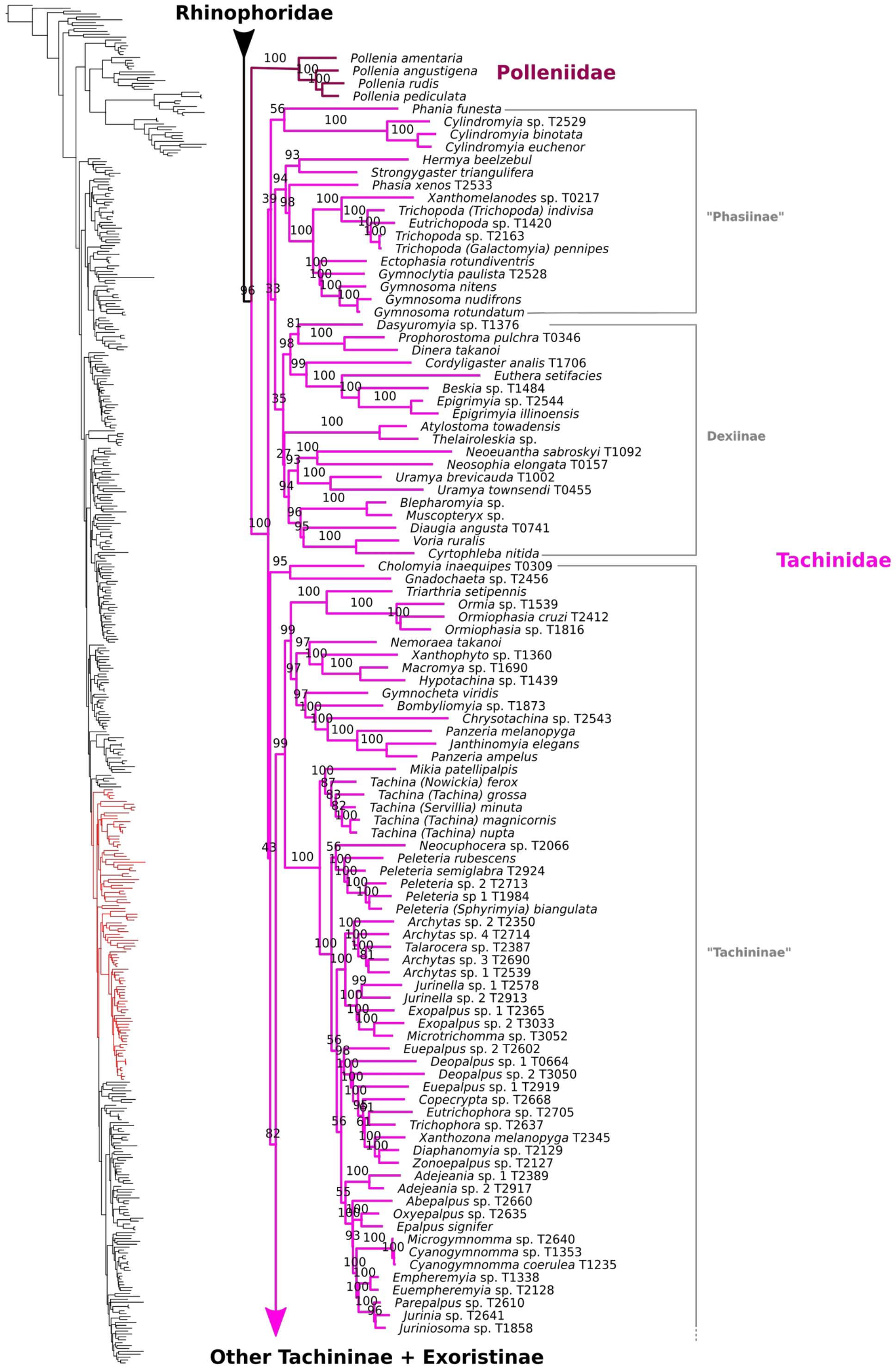


Figure 11: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the branches of Polleniidae and the subfamilies of Tachinidae. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

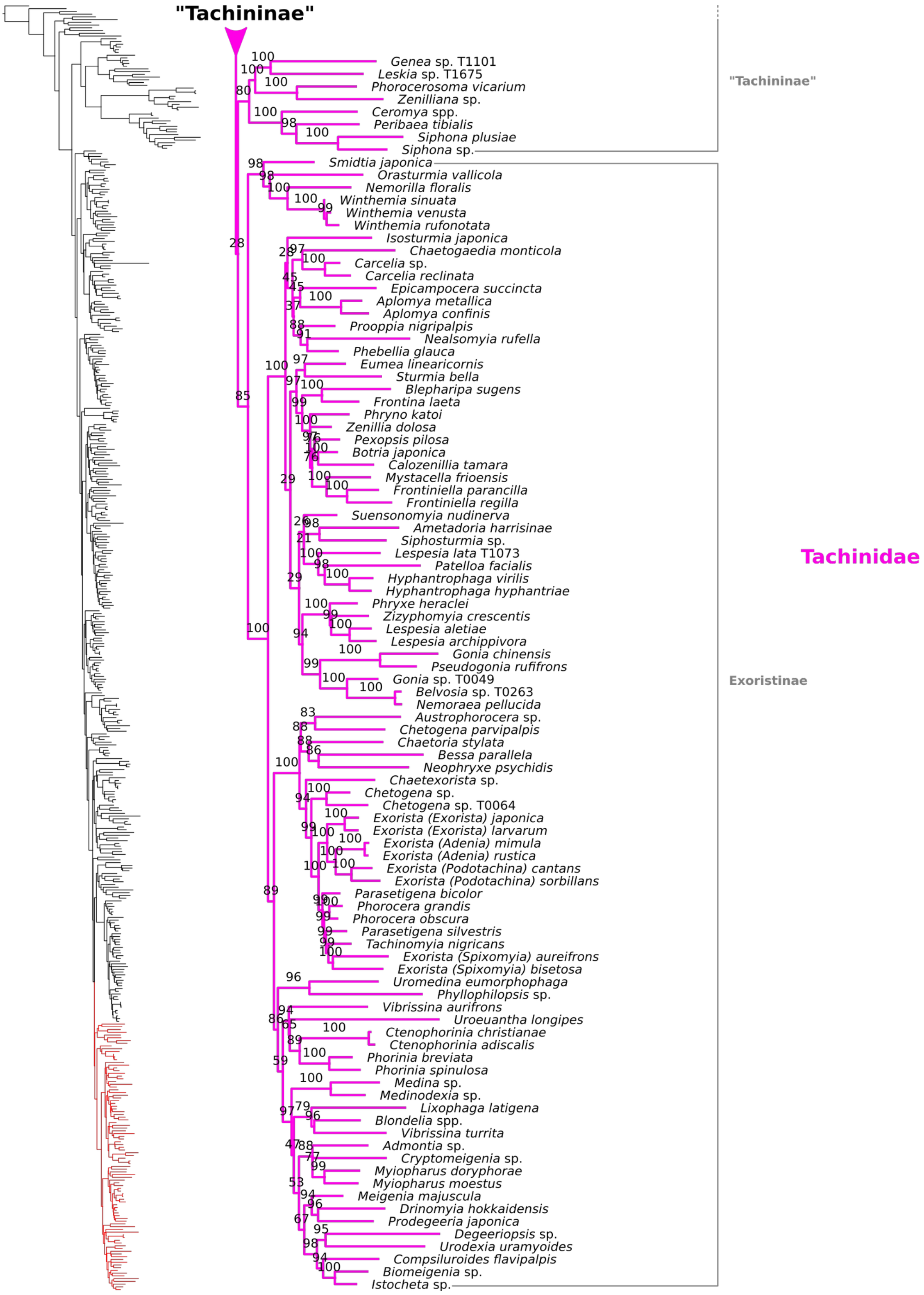


Figure 12: Detail of the phylogram of Calyptratae (see more information in the text and Figure 6), exhibiting the branches of the subfamilies of Tachinidae. The whole phylogram is shown on the left, with the highlighted branches in red. UFBoot values are presented above branches.

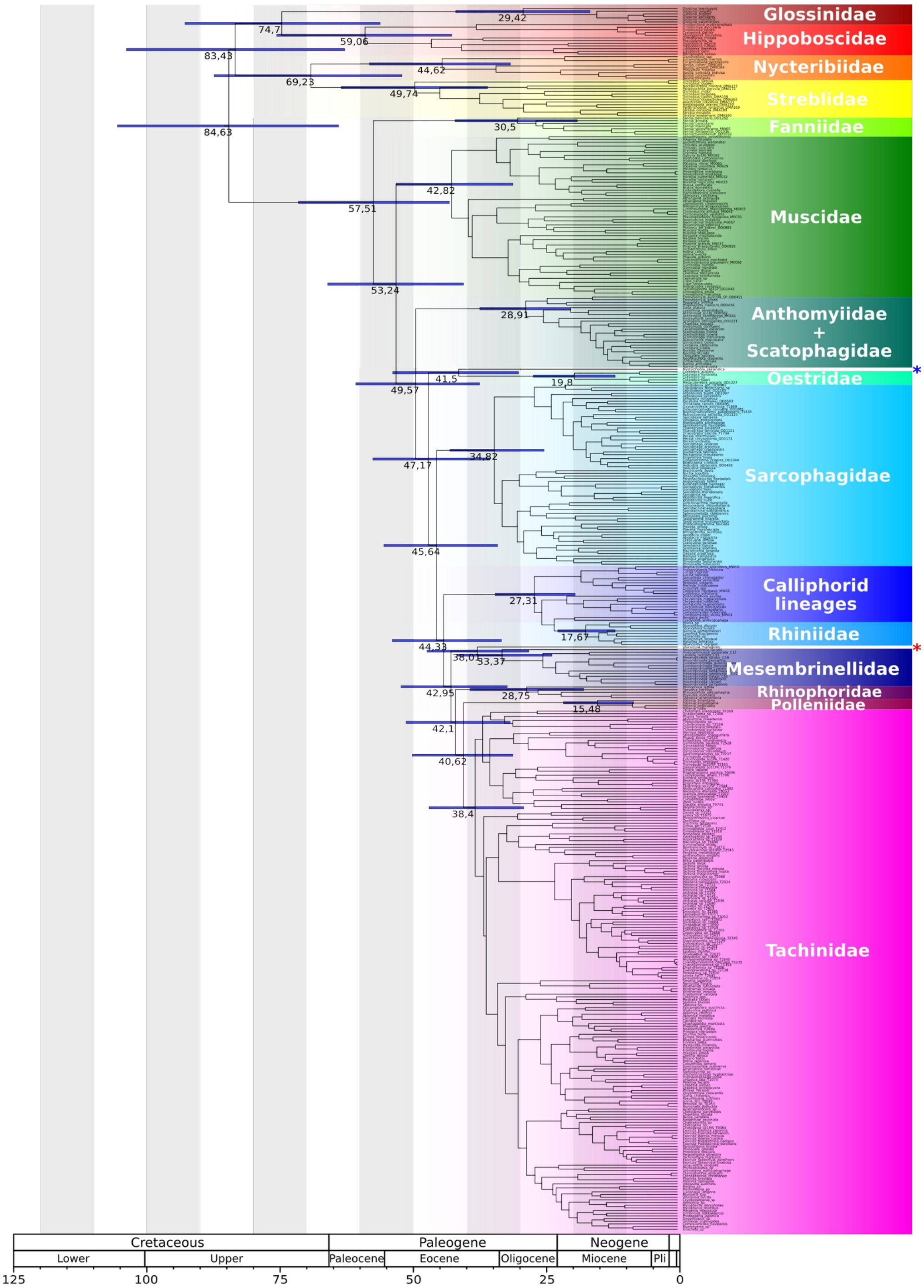
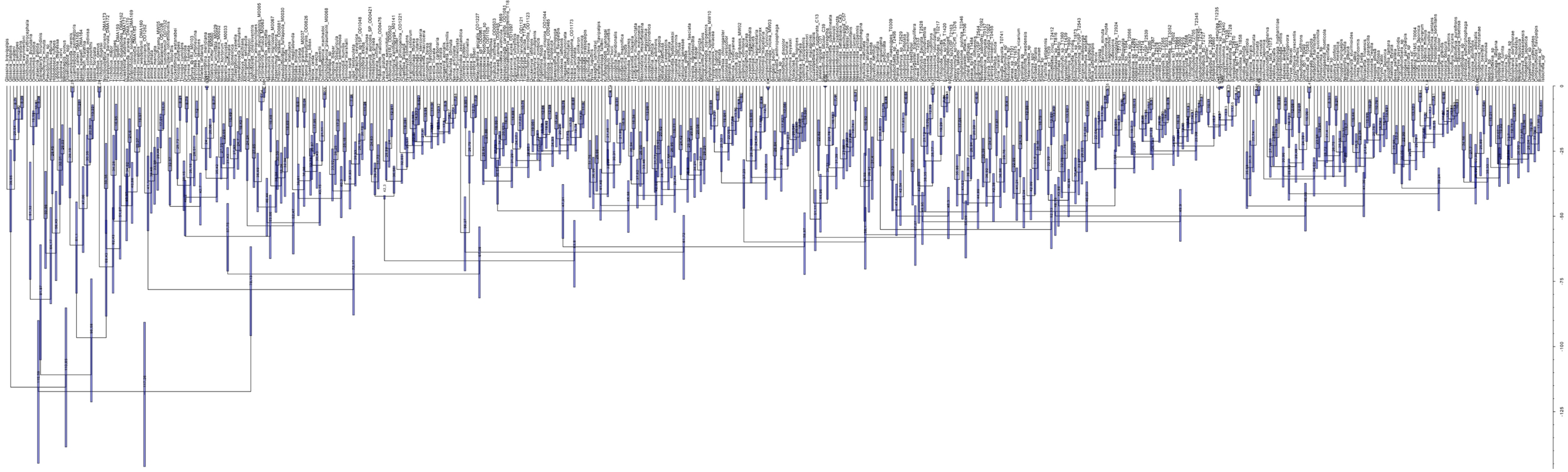


Figure 13: Chronogram of Calyptratae estimated from 458 terminals of calyptrates and eight molecular markers (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α) under the bayesian criterion in BEAST 2 using a node dating method with a birth-death prior and calibration densities estimated with CladeAges. Values on nodes represent the mean age and blue bars indicate the 95% highest posterior density intervals for divergence time estimates.

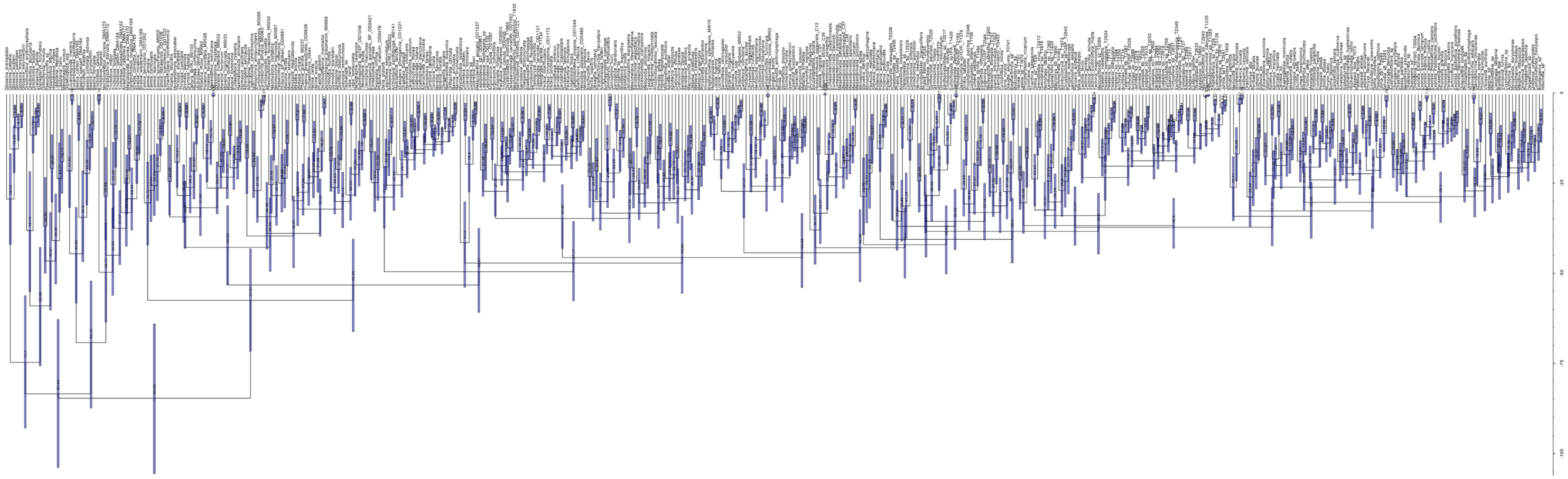
1.6 Supplementary information 1

Chronogram of Calyptratae estimated from 458 terminals of calyptrates and eight molecular markers (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α) under the bayesian criterion in BEAST 2 using a node dating method with a pure-birth prior and calibration based on Cerretti et al. (2017). Values on nodes represent the mean age and blue bars indicate the 95% highest posterior density intervals for divergence time estimates.



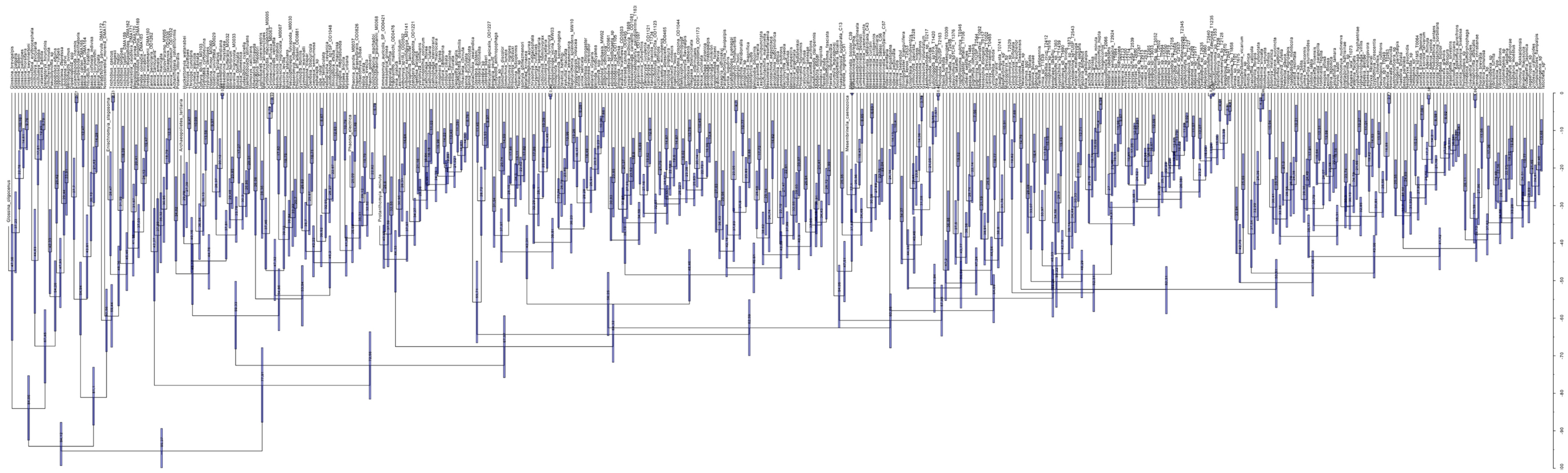
1.7 Supplementary information 2

Chronogram of Calyptratae estimated from 458 terminals of calyptrates and eight molecular markers (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α) under the bayesian criterion in BEAST 2 using a node dating method with a birth-death prior and calibration densities estimated with CladeAges. Values on nodes represent the mean age and blue bars indicate the 95% highest posterior density intervals for divergence time estimates.



1.8 SUPPLEMENTARY INFORMATION 3

Chronogram of Calyptratae estimated from 458 terminals of calyptrates and eight molecular markers (12S, 16S, 18S, 28S, CAD, COI, Cytb and Ef1α) under the bayesian criterion in BEAST 2 using a tip dating method with a fossilized birth-death prior. Values on nodes represent the mean age and blue bars indicate the 95% highest posterior density intervals for divergence time estimates



CHAPTER 2. CLASSIFICATION AND PHYLOGENY OF THE TRIBE TACHININI (DIPTERA: TACHINIDAE) INFERRED FROM MORPHOLOGICAL CHARACTERS.

2.1 ABSTRACT

The tribe Tachinini is one of the largest tribes of the family Tachinidae (Diptera), being distributed worldwide with 938 valid species and 140 genera. The classification of Tachinini suffered several changes throughout the XIX and early XX centuries with many monotypic genera being described, mainly in the Neotropical Region. The identification of Tachinini genera, therefore, remains challenging due to the lack of recent taxonomic works and phylogenetic hypothesis of relationship between taxa. Aiming to provide a phylogenetic perspective to improve the classification of the tribe, we provide herein the first phylogenetic hypothesis for Tachinini inferred from morphological characters, using parsimony as optimality criterion. We sampled 193 species of 111 genera of Tachinini, including most of the Neotropical monotypic genera. A total of 146 morphological characters were coded, most of them based on a detailed comparative study of the male terminalia. The monophyly of Tachinini is confirmed, with new synapomorphies found in features of mouthparts and male terminalia. None of the suprageneric taxa proposed by previous authors for the fauna of Tachinini were confirmed as monophyletic. The majority of genera of Tachinini were assigned to genus groups, in which we discuss affinities between genera and taxa that are likely synonymous based on morphological characters.

2.2 INTRODUCTION

The tribe Tachinini is one of the largest tribes of the family Tachinidae (Diptera), being distributed worldwide with 938 valid species and 140 genera (O’HARA; HENDERSON; WOOD, 2020). According to our estimates of divergence times in Chapter 1, Tachinini originated at the transition of the Oligocene to Miocene, around 23 million years ago (Supplementary information 2 of Chapter 1), suggesting a recent and fast diversification of species around the globe. Tachinini flies are usually large, stout specimens with densely bristly abdomens (Figure 14), diagnosed from other tachinids by a combination of characters of antennae and chaetotaxy of thorax and legs, such as the first flagellomere bean-shaped, the prosternum bare, the first postsutural supra-alar seta as long and stout as the first postsutural dorsocentral seta, and the hind coxae setulose on posterolateral corner (MESNIL, 1966;

WOOD; ZUMBADO, 2010; FLEMING et al., 2016). Although tachinids are well known for having endoparasitic first instar larvae attacking a wide range of arthropods (STIREMAN; O'HARA; WOOD, 2006), species of Tachinini have been recorded solely in Lepidoptera (GUIMARÃES, 1977; ARNAUD, 1978). Females deposit membranous eggs with fully developed and well sclerotized first instar larvae called planidia directly on the foliage of host plants of caterpillars (PANTEL, 1910; HERTING, 1960). After hatching, the larvae remain attached on the surface of the plant through the remnants of the membranous chorion and wait for the caterpillars to cross their path. When the host approaches, the larvae start to swing their heads in circles, trying to attach to the host's cuticle to complete the infection (ALLEN, 1926).

About 84% of genera and 62% of species of Tachinini are endemic to the Neotropical Region, reflecting a similar biogeographic pattern of genera endemicity and species richness exhibited by other groups of Tachinidae (O'HARA; HENDERSON, 2020). Although this pattern reflects a higher diversity of species of Tachinini in the Neotropical Region, the high number of genera is likely overestimated due to taxonomic practices of over-splitting taxa in multiple monotypic genera in the family, common in the early 20th century (O'HARA, 2013; EVENHUIS; PONT; WHITMORE, 2015). For instance, 72 genera of Tachinini are monotypic, of which 91% are restricted to the Neotropical Region (O'HARA; HENDERSON; WOOD, 2020). Despite its great diversity and ecological importance, the current state of the taxonomy of Neotropical Tachinini is an impediment for studies on the ecology and evolution of the group.

Tachinini is included in the subfamily Tachininae (O'HARA; CERRETTI, 2016), one of the four subfamilies of Tachinidae, namely Dexiinae, Exoristinae and Phasiinae. The classification of the tribe Tachinini changed considerably throughout the XIX and early XX centuries. Meigen (1803) described the genus *Tachina* to include three Palearctic species: *Musca grossa* Linnaeus, 1758, *Musca fera* Linnaeus, 1760, and *Musca lurida* Fabricius, 1781, with *M. grossa* being designated as the type species later by Brauer (1893). The suprageneric ranks assigned to Tachinini flies, however, varied greatly in the literature, mostly because of uncertainty regarding the validity of the name *Tachina* and their synonyms, specially *Larvaevora* Meigen, 1800, and *Echinomya* Latreille, 1805. Meigen (1800) described the genus *Larvaevora* without naming any species, and this work remained unknown to many dipterists at the time until it was revived by Hendel (1908), who established the synonyms between *Larvaevora* and *Tachina*. Coquillett (1910) followed the concept of Hendel and designated *M. grossa* as the type species of *Larvaevora*. After much debate among dipterists of early XX century (SMART, 1944), the work of Meigen (1800) was suppressed (SABROSKY, 1999), making this senior synonym unavailable. The genus *Echinomya* was described by Latreille (1805) as an alternative to *Tachina*, justifying that this name was used before to describe the genus *Tachinus* Gravenhorst, 1802, in Staphylinidae, Coleoptera (SABROSKY, 1999). Later, the rules regarding the homonymy between *Tachina* Meigen and *Tachinus* Gravenhorst were suspended by the International Commission of Zoological Nomenclature in 1993 (SABROSKY, 1999). Adding more confusion to the identity and validity of the genus, the name *Tachina* was incorrectly attributed to species of the genus *Exorista* Meigen, 1803, by Robineau-Desvoidy (1830). *Exorista* is currently included in the subfamily Exoristinae and Robineau-Desvoidy's incorrect concept of *Tachina* was followed by many authors for several years, contributing to the instability in the classification of the tribe Tachinini and the family Tachinidae as a whole (O'HARA, 2013).

The first attempt to provide suprageneric ranks to Tachinini flies was made by Robineau-Desvoidy (1830), grouping European and exotic species under the section Macromydae. Later, Robineau-Desvoidy (1863) proposed his tribe Echinomydae for the same set of taxa. Brauer and Bergenstamm (1889) proposed a new classification that became the main reference for several authors in the following years, dividing the Tachinini flies in five families, namely Hystriciidae, Micropalpidae, Pyrrhosiidae, Schineriidae and Tachinidae. The family Hystriciidae, which included most of the Neotropical genera of Tachinini, was explored further by Engel (1920), who divided the family in subfamilies based on characters of external morphology and male terminalia. In parallel, Townsend began his studies in the classification of Neotropical Tachinini using the concept of Hystriciidae of Brauer and Bergenstamm (TOWNSEND, 1913). During the beginning of the XX century, Townsend described several genera of Tachinini, of which 57 are monotypic and currently valid. In his major work, the Manual of Myiology, Townsend proposed his final classification for the "Oestromuscaria" (mainly Muscoidea and Oestroidea), dividing the Tachinini flies in seven tribes, namely Cuphoceratini, Dejeaniini, Juriniini, Metopotachinini, Microtropesini, Schineriini and Tachinini (TOWNSEND, 1936), and providing an identification key to genera of each tribe (TOWNSEND, 1939). The current concept and delimitation of the tribe Tachinini began in the work of Zimin (1935), who classified the Palearctic fauna of Tachinini based on characters of external morphology and male terminalia. Mesnil (1966) was responsible to group all the fauna of Tachinini known at the time in his subtribe Tachinina providing solid diagnostic characters used to this day, although he had reviewed only the fauna of the Palearctic Region as well. The classification of Tachinini of Mesnil (1966) has been followed in all catalogs since then (CROSSKEY, 1976; HERTING, 1984; CANTRELL; CROSSKEY, 1989; HERTING; DELY-DRASKOVITS, 1993; O'HARA; WOOD, 2004; O'HARA; SHIMA; ZHANG, 2009; SHIMA, 2014; O'HARA; CERRETTI, 2016).

Although the validity of the tribe Tachinini is not a subject of discussion as it was before, the validity and relationships between genera are far from being clear. Phylogenetic hypotheses for the whole family Tachinidae began to shed some light on the relationships between subfamilies and tribes (CERRETTI et al., 2014; STIREMAN et al., 2019), but only a few studies were done at tribal level (ANDERSEN, 1983; O'HARA, 2002; INCLÁN et al., 2018; LOPES; DE CARVALHO; NIHEI, 2020), most of them with a poor sampling of Neotropical tachinids. The subfamilies Exoristinae and Phasiinae are monophyletic (STIREMAN, 2002; TACHI; SHIMA, 2010; BLASCHKE et al., 2018), but the monophyly of Dexiinae and Tachininae were not confirmed in the most comprehensive phylogenetic hypotheses inferred with morphological and molecular characters (CERRETTI et al., 2014; STIREMAN et al., 2019). Although the monophyly of Tachininae is still debatable, the tribe Tachinini is monophyletic, nested within a monophyletic clade called the Tachinini group (TSCHORSNIG, 1985; CERRETTI et al., 2014; STIREMAN et al., 2019), whose tribes include species with well sclerotized first instar larvae, such as Ernestiini, Glaurocarini, Loewiini, Nemoraeini, Ormiini, Polideini and other smaller tribes. Using morphological characters, Cerretti et al. (CERRETTI et al., 2014) recovered Tachinini as sister group of *Linnaemyia* Robineau-Desvoidy (Ernestiini) and *Germaria* Robineau-Desvoidy (Germariini), nested within the Tachinini group. However, in the most recent hypothesis proposed by Stireman et al. (STIREMAN et al., 2019), including a bigger sampling of Tachinini flies and using molecular characters, Tachinini was recovered as sister group of the remaining tribes of the Tachinini group.

Here we propose a new phylogenetic hypothesis for the tribe Tachinini inferred from morphological characters, with larger sampling of Neotropical genera. This is the first comprehensive phylogenetic study of the tribe, with focus on detailed examination of the external morphology and male terminalia of adults. We aim to provide a phylogenetic perspective to improve the classification of Tachinini, mainly of the Neotropical fauna.

2.3 MATERIALS AND METHODS

2.3.1 Taxonomic sampling

A total of 193 species from 111 genera of Tachinini were sampled as terminals for this phylogenetic study (Table 9), representing 79% of the diversity of genera. Due to unavailability of material, we could not include 29 genera of Tachinini in the phylogenetic inference (Table 10). We tried to select at least two species for each genus, sampling more species only for species-rich genera (e.g., *Archytas*, *Epalpus*, *Peleteria, Tachina*), always including the type species when available. Eleven species of the tribes Ernestiini, Leskiini, Nemoraeini and Polideini were included as outgroups (Table 9). The classification of Tachinidae adopted herein follows O'Hara, Henderson and Wood (2020). The identification of Neotropical Tachinini is a challenging task due to the high amount of monotypic genera. Therefore, we identified all Neotropical genera and species using the keys provided by Townsend (1936) and Wood and Zumbado (2010) and confirmed our identifications by the examination of type material (Table 9). Since the fauna of Tachinini of the Afrotropical, Nearctic and Palearctic Regions are better studied, we based our observations on determined material deposited in collections. The examined material is deposited in the following natural history collections, with their respective curators:

CEIOC—Coleção Entomológica do Instituto Oswaldo Cruz, Rio de Janeiro, Brazil. Curator: Jane Margaret Costa de Frontin Werneck.

CNC—Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Canada. Curator: James E. O'Hara.

DZUP—Coleção Entomológica Padre Jesus Santiago Moure, Curitiba, Brazil. Curator: Cláudio José Barros de Carvalho.

INPA—Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil. Curator: Marcio Luiz de Oliveira.

MNHN—Muséum National d'Histoire Naturelle, Paris, France. Curator: Christophe Daugeron.

MNRJ—Museu Nacional, Rio de Janeiro, Brazil. Curator: Márcia Couri.

MZSP—Museu de Zoologia da Universidade de São Paulo, Sao Paulo, Brazil. Curator: Carlos José Einicker Lamas.

NHMUK—Natural History Museum, London, United Kingdom. Curator: Nigel Wyatt.

USNM—National Museum of Natural History, Washington, D.C., United States of America. Curator: Torsten Dikow.

2.3.2 Morphological analysis

The analysis of external morphology of pinned specimens was made with help of stereo microscopes. For the study of male terminalia, the abdomens were detached from pinned specimens, placed in a 10% KOH solution and heated at 60 ºC for 10 minutes to soften the membranes and clear the tissues. The terminalia were then dissected and heated for 10 more minutes to lighten the structures. Both terminalia and abdomens were neutralized in a 5% acetic acid solution and rinsed with water. The abdomens were dried and glued back to the specimens, and the terminalia were placed in glycerine in plastic microvials and pinned with their respective specimens. Morphological terminology follows Cumming and Wood (2017).

Photographs were taken with a Leica MC170 HD digital camera attached to a Leica MZ16 stereo microscope, using the software Leica Application Suite version 4.12.0 (Leica Microsystems, Wetzlar, Germany), and using a RK Science Factory dome light. Type specimens from USNM were photographed with a Micro 4/3 Olympus OM-D E-M5 camera with 60 mm f2.8 Macro, attached to a stand, and StackShot from Visionary Digital Passport II system, using a Falcon FLDM-i250-W dome light. Photographs were stacked with the software Helicon Focus 6.7.1 (HeliconSoft, Ukraine) and edited in GIMP v. 2.10.14. Illustrations of terminalia and measures were made using a Leica MZ16 stereo microscope with camera lucida and will be edited in Inkscape v. 0.92 for the final publication. Plates were composed in GIMP v. 2.10.14.

2.3.3 Character coding and phylogenetic analysis

Morphological characters used to infer the phylogeny of Tachinini were directly observed in examined specimens. We propose several new characters herein based in our observations. Characters previously proposed in the literature were also included, whose references are properly cited in the remarks section of the list of morphological characters. The codification follows the basic structure of Sereno (2007). Contingent coding was used for some characters, with inapplicable character states coded as “-”. Unknown character states due to unavailability of material or damaged specimens were coded as “?”. The character matrix was made in Mesquite v. 3.61 (MADDISON; MADDISON, 2019). All characters were treated with equal weights, and multistate characters as nonadditive (unordered).

The phylogenetic analyses were executed under a parsimony criterion using the software TNT v. 1.5 (GOLOBOFF; CATALANO, 2016). Analyses were run holding 100,000 trees in memory, with random seed 0 and collapsing branches lacking support. To find the most parsimonious trees, we used the New Technology Search (NTS) implemented in the software, running 10 cycles of ratchet, 10 of drifting, 10 of tree fusing and default parameters of sectorial searches, finding the minimum tree length at least 50 times using five replications as starting point for each hit. Additional analyses using 1,000 replications were also made. A species of Leskiini was used to root the trees. Bremer support values (BREMER, 1994) were calculated in TNT, sampling trees one to 10 steps longer than the most parsimonious trees found using NTS, adding 20,000 suboptimal trees at each cycle. Character optimization and statistics, such as length (L), consistency index (CI) and retention index (RI), were verified using the software Winclada v. 1.61 (NIXON, 2002). For this chapter, we used only unambiguous optimization to assess character transformations, without considering fast (ACCTRAN) or slow (DELTRAN) optimizations. Trees were edited in Inkscape v. 0.92.

2.4 RESULTS

2.4.1 List of morphological characters

A total of 146 morphological characters are proposed herein for males and females of Tachinini: 34 characters related to features of the head, 21 to the thorax, five to the wings, four to the legs, 20 to the preabdomen, and 62 to the male terminalia. The male terminalia was dissected in all outgroups and in 110 terminals of Tachinini, representing 59% of terminals included in the character matrix. The codification of characters and their respective character states are listed below, with remarks regarding character state delimitation when necessary. The character matrix is in Supplementary information 3 and the optimization of characters is represented in one of the trees of the strict consensus in Supplementary information 2.

1. Head, eye: bare (0), covered with conspicuous dense hairs (1). L=7, CI=14, RI=81.

2. Head, presence of ocellar setae: present (0), absent (1). L=14, CI=7, RI=83.

3. Head, development of fronto-orbital plate: well projected forward, about same length of one eye in dorsal view (0), not projected, at most half length of one eye in dorsal view (1). L=14, CI=7, RI=70.

4. Head, orientation of inner vertical setae: crossed (0), parallel (1). L=9, CI=11, RI=80.

5. Head, length of outer vertical setae: at most 2/3 length of inner vertical setae (0), subequal to length of inner vertical setae (1). L=28, CI=3, RI=64.

6. Head, number of proclinate orbital setae in male: zero (0), one (1), two (2), three (3). L=19, CI=15, RI=64.

7. Head, number of proclinate orbital setae in female: one (0), two (1), three (2). L=7, CI=28, RI=70.

8. Head, presence of upper orbital setae in male: present (0), absent (1). L=6, CI=16, RI=61.

9. Head, number of upper orbital setae in female: one (0), two (1). L=18, CI=5, RI=79.
   Remarks. Character extracted from Cerretti et al. (2014, character 21).

10. Head, number of rows of lower frontal setae in male: one (0), two (1). L=24, CI=4, RI=73.

11. Head, orientation of upper frontal setae: inclined medially (0), reclinate (1). L=14, CI=7, RI=81.
    Remarks. The frontal setae can be separated in two sets: the lower frontal setae and upper frontal setae. The lower frontal setae are inclined medially, interdigitating each other, starting at scape level and they may extend a little beyond the anterior proclinate orbital setae (e.g., in *Peleteria*). The upper frontal setae start after anterior proclinate orbital setae and extend to posterior upper orbital setae. The upper frontal setae exhibit different states of orientation.

12. Head, antenna, length of first flagellomere: shorter than pedicel, with ratio less than 1.0 (0), longer than pedicel, with ratio about 1.5 or higher (1). L=10, CI=10, RI=75.

13. Head, antenna, shape of anterior margin of first flagellomere in male: convex in relation to the posterior margin (0), straight in relation to the posterior margin, almost parallel (1), forming an acute or obtuse angle in relation to the posterior margin (2), multifissicorn (3). L=33, CI=9, RI=68.
Remarks. The convex shape of anterior margin of first flagellomere, also referred as bean-shaped or kidney-shaped (WOOD; ZUMBADO, 2010), is generally used as a diagnostic character of Tachinini, but the shape of first flagellomere is actually diversified in the tribe. This character is sexually dimorphic in most species of Tachinini, with males exhibiting major differences in morphology.

14. Head, antenna, arista, length of first aristomere: short, as long as wide (0), elongate, at most five times longer than wide (1), very long, about ten times longer than wide (2). L=9, CI=22, RI=79.
Remarks. Character extracted from Cerretti et al. (2014, character 38).

15. Head, antenna, arista, length of second aristomere: short, as long as wide (0), elongate, at most five times longer than wide (1), very long, about ten times longer than wide (2). L=19, CI=10, RI=52.
Remarks. Character extracted from Cerretti et al. (2014, character 39).

16. Head, presence of parafacial setulae: present (0), absent (1). L=3, CI=33, RI=71.
Remarks. This character was proposed as a diagnostic character of Tachinini by Emden (1960) and Crosskey (1976). All species of Tachinini examined herein have parafacial setulae.

17. Head, color of parafacial setulae (contingent for character state 16:0): mostly white or yellowish, sometimes with a few scattered black setulae (0), all setulae black (1). L=21, CI=4, RI=72.

18. Head, number of parafacial setae: zero (0), one (1), two (2), three or more, almost forming a continuous row with lower frontal setae (3). L=15, CI=20, RI=78.

19. Head, shape of parafacial setae (contingent for character states 18:1–3): well developed (0), vestigial, very thin (1). L=3, CI=33, RI=50.

20. Head, level of vibrissa in relation to lower margin of eye: about half height of gena, arising below the level of eye margin (0), subequal to height of gena, arising at the same level of eye margin (1). L=25, CI=4, RI=73.

21. Head, face, degree of projection of lower facial margin: straight, not projected (0), slightly projected, forming a rounded profile with the upper surface of face (1), well projected, forming an angled profile with the upper surface of face (2). L=18, CI=11, RI=84.

22. Head, presence of setae on genal dilation: present (0), absent (1). L=6, CI=16, RI=37.

23. Head, disposition of postocular setae: extending to genal margin as a single row (0), ending before lower edge of eye (1). L=5, CI=20, RI=50.

24. Head, development of palpus. vestigial, represented at most by a papilla or a small seta (0), developed, but shorter than antenna (1), developed, subequal to or at most 1.5 times length antenna (2), well developed, at least twice length of antenna (3). L=14, CI=21, RI=86.

25. Head, shape of vestigial palpus (contingent for character state 24:0): papilla-like (0), represented by a single seta (1), completely absent (2). L=20, CI=10, RI=64.

26. Head, chaetotaxy of palpus (contingent for character states 24:1–3): covered with short appressed setae along entire dorsal surface (0), covered with long setae along entire margin (1), with long erect setae only at apex (2). L=7, CI=28, RI=54.
Remarks. Character extracted from the keys provided by Townsend (1936) and Wood and Zumbado (2010).

27. Head, width of palpus (contingent for character states 24:1–3): filiform, with at most the same width of basal aristomeres (0), broad, wider than basal aristomeres (1). L=5, CI=20, RI=80.

28. Head, shape of palpus (contingent for character state 24:1–3): enlarged apically (0), same thickness along its entire length (1). L=7, CI=14, RI=84.
Remarks. Character extracted from the keys provided by Townsend (1936) and Wood and Zumbado (2010).

29. Head, length of prementum: short, about half height of head (0), medium-sized, from 2/3 to same height of head (1), long, more than 1.3 times height of head (2). L=29, CI=6, RI=68.
Remarks. This character corresponds to the length of the ventral margin of prementum. The height of head corresponds to the measure from genal margin to the ocellar triangle.

30. Head, presence of setulae on prementum: present, forming a patch of setulae on ventral surface (0), absent (1). L=2, CI=50, RI=91.

31. Head, shape of prementum: covering the labrum, forming a closed sheath (0), not covering the labrum, which is visible throughout its entire length (1). L=2, CI=50, RI=90.

32. Head, labellum, level of sclerotization of basal sclerite: membranous (0), heavily sclerotized (1). L=8, CI=12, RI=22.

33. Head, labellum, width of distal end of the lateral process of furca: thin, tapering towards tip (0), large, twice width of basal portion of sclerite (1). L=7, CI=14, RI=33.

34. Head, labellum, development of ventral margin: with an extended ventral lobe emerging from central process of furca (0), with a very short ventral lobe emerging from central process of furca (1). L=2, CI=50, RI=91.

35. Thorax, presence of presutural acrostichal setae: present (0), absent (1). L=9, CI=11, RI=55.

36. Thorax, number of postsutural acrostichal setae: zero (0), one (1), two (2), three (3), four (4). L=36, CI=11, RI=43.

37. Thorax, aspect of postsutural acrostichal setae (contingent for character state 36:0): hair-like (0), bristle-like (1), spine-like (2). L=7, CI=28, RI=44.

38. Thorax, number of postsutural dorsocentral setae: one (0), two (1), three (2), four (3). L=33, CI=9, RI=68.

39. Thorax, aspect of postsutural dorsocentral setae: hair-like (0), bristle-like (1). L=4, CI=25, RI=66.

40. Thorax, number of postsutural intra-alar setae: one (0), two (1), three (2). L=15, CI=13, RI=55.

41. Thorax, number of postsutural supra-alar setae: three (0), four or five, with weaker setae inserted between stronger setae (1). L=2, CI=50, RI=87.

42. Thorax, width of first postsutural supra-alar seta: at most the same width as first postsutural dorsocentral seta (0), stronger than first postsutural dorsocentral seta (1). L=2, CI=50, RI=91.
Remarks. Character extracted from the key provided by Wood and Zumbado (2010).

43. Thorax, number of notopleural setae: two (0), two plus one additional small seta at the base of posterior notopleural seta (1). L=26, CI=3, RI=56.
Remarks. The additional small seta is generally stronger than those setae arising as a patch in upper anterior margin of anepisternum (see character 46).

44. Thorax, chaetotaxy of proepisternum: setulose (0), bare (1). L=16, CI=6, RI=84.

45. Thorax, number of katepisternal setae: one (0), two (1), three (2), five (3). L=11, CI=27, RI=46.

46. Thorax, chaetotaxy of anterior upper anterior margin of anepisternum: covered with setulae only (0), setose (1). L=11, CI=9, RI=23.

47. Thorax, number of anepimeral setae: one (0), two (1), three (2). L=18, CI=11, RI=50.

48. Thorax, posterior spiracle, shape of posterior lappet: more developed than anterior lappet, shaped as an operculum (0), as developed as anterior lappet, fringed (1). L=2, CI=50, RI=66.

49. Thorax, scutellum, presence of apical scutellar setae: present (0), absent (1). L=16, CI=6, RI=81.
Remarks. Character extracted from Cerretti et al. (2014, character 54).

50. Thorax, scutellum, aspect of subapical scutellar setae: bristle-like (0), spine-like (1). L=8, CI=12, RI=83.

51. Thorax, scutellum, presence of lateral scutellar setae: present (0), absent (1). L=19, CI=5, RI=66.
Remarks. Character extracted from Cerretti et al. (2014, character 52).

52. Thorax, scutellum, aspect of lateral scutellar setae (contingent for character state 51:0): bristle-like (0), spine-like (1). L=5, CI=20, RI=90.

53. Thorax, scutellum, presence of anterobasal scutellar setae: present (0), absent (1). L=25, CI=4, RI=64.

54. Thorax, scutellum, number of discal setae: one pair (0), two pairs (1), three pairs or more (2). L=27, CI=7, RI=72.

55. Thorax, scutellum, aspect of discal setae: bristle-like (0), spine-like (1). L=8, CI=12, RI=91.

56. Thorax, pigmentation of wing: hyaline (0), infuscated throughout entire wing (1), infuscated only on costal margin (2), infuscated from base to the level of crossvein dm-m (3), infuscated only at base, to the level of crossvein bm-m (4), infuscated only at level of dm-m (5). L=24, CI=20, RI=77.

57. Thorax, wing, disposition of setae on dorsal surface of vein R4+5: few setae at base only, not extending to crossvein r-m (0), setose on halfway or more from its base at junction of veins R2+3 and R4+5 to crossvein r-m (1). L=8, CI=12, RI=73.
Remarks. Character extracted from the key provided in Wood and Zumbado (2010).

58. Thorax, wing, length of costal section three: about the same length of costal section two (0), more than 1.5 times length of costal section two (1). L=3, CI=33, RI=66.
Remarks. The nomenclature of costal sections for this character follows Cerretti et al. (2014), not Cumming and Wood (2017).

59. Thorax, wing, shape of vein M: sinuous towards costal vein, with basal section strongly bent inwardly (0), arcuate towards costal vein, with basal section slightly curved inwardly (1), straight towards costal vein (2). L=6, CI=33, RI=71.

60. Thorax, wing, opening of cell r4+5: open, with vein M ending at costal margin (0), closed, with vein M ending at vein R4+5 forming a petiole (1). L=1, CI=100, RI=100.

61. Thorax, fore leg, width of tarsomeres 2–5 in female: about the same width as basitarsus (0), conspicuously wider than basitarsus (1). L=35, CI=2, RI=58.

62. Thorax, hind leg, presence of setulae on posterodorsal surface of coxa: present (0), absent (1). L=2, CI=50, RI=91.
Remarks. Character extracted from Cerretti et al. (2014, character 83).

63. Thorax, hind leg, chaetotaxy of dorsal surface of tibia: bare from base to apex (0), setulose throughout its entire length (1). L=2, CI=50, RI=88.

64. Thorax, legs, length of tarsal claws in male: subequal to length of tarsomere 5 (0), about 1.5 times longer than tarsomere 5 (1). L=27, CI=3, RI=66.

65. Preabdomen, degree of fusion of dorsal surface of tergites: posterior margin of tergites three and four fused, with only a faint suture between them (0), posterior margin of tergites three and four not fused (1). L=11, CI=9, RI=86.
Remarks. Character adapted from Cerretti et al. (2014, character 84). The degree of fusion between the dorsal surface of tergites was verified checking the thickness of the posterior margin of tergites. If the posterior margin is very thin, the dorsal surface of tergites are considered fused.

66. Preabdomen, tergites, aspect of setulae: hair-like (0), bristle-like (1). L=13, CI=7, RI=83.

67. Preabdomen, tergites, aspect of setae: bristle-like (0), spine-like (1). L=10, CI=10, RI=89.

68. Preabdomen, syntergite 1+2, presence of median marginal setae: present (0), absent (1). L=5, CI=20, RI=66.

69. Preabdomen, tergite three, disposition of median marginal setae: with one median marginal pair of setae (0), with a set of median marginal pairs of setae (1), with a complete row in the dorsal surface, connecting to lateral marginal setae (2). L=34, CI=5, RI=67.

70. Preabdomen, tergite three, presence of discal setae: present (0), absent (1). L=20, CI=5, RI=80.

71. Preabdomen, tergite three, disposition of discal setae (contingent for character state 70:0): with one median discal pair of setae (0), with a patch of median discal pairs of setae (1), with a complete row in the dorsal surface, connecting to lateral discal setae (2). L=11, CI=18, RI=74.

72. Preabdomen, tergite four, presence of discal setae: present (0), absent (1). L=17, CI=5, RI=80.

73. Preabdomen, tergite four, disposition of discal setae (contingent for character state 72:0): with one median discal pair of setae (0), with a patch of median discal pairs of setae (1), with a complete row in the dorsal surface, connecting to lateral discal setae (2). L=11, CI=18, RI=76.

74. Preabdomen, tergite five, shape of posterior margin: pointed, being sometimes slightly rounded (0), subquadrate with a median groove forming two distinct lobes (1). L=6, CI=16, RI=88.

75. Preabdomen, tergite five, disposition of discal setae: disposed as transverse rows (0), disposed as bunches of spines on each lobe (1). L=6, CI=16, RI=86.

76. Preabdomen, tergite five, covered by a patch of thin, appressed setae on dorsal surface in male: present (0), absent (1). L=1, CI=100, RI=100.

77. Preabdomen, degree of exposition of sternites: almost entirely covered by tergites, with only posterior third visible (0), partially covered by tergites, visible from base to apex as a triangle (1), well exposed, visible from base to apex as a trapezium (2). L=31, CI=6, RI=75.

78. Preabdomen, sternites, disposition of marginal setae: with all marginal setae arising near the margin, forming a straight row (0), with median marginal setae arising slightly farther forward than lateral ones, forming a sagitate row (1). L=10, CI=10, RI=80.

79. Preabdomen, sternite four in male, presence of setae: present (0), absent (1). L=11, CI=9, RI=47.

80. Preabdomen, shape of sternite five: subquadrate, with base subequal to width of apex (0), subtriangular, with base narrower than apex (1). L=6, CI=16, RI=83.

81. Preabdomen, sternite five, shape of anterior margin: with a forked apodeme, with well pronounced lateral edges (0), with a short and subrectangular apodeme extended along entire anterior surface (1). L=1, CI=100, RI=100.

82. Preabdomen, sternite five, presence of spicules on inner surface of posterior lobes: present (0), absent (1). L=7, CI=14, RI=50.

83. Preabdomen, sternite five, shape of posterior margin of lobe: smooth (0), with a cuticular process directed inward (1). L=13, CI=7, RI=55.

84. Preabdomen, disposition of male terminalia: partially or completely hidden by tergite five, with arthrodial membrane well visible and concave (0), well exposed, with arthrodial membrane barely visible or narrow (1). L=7, CI=14, RI=84.

85. Male terminalia, shape of tergite six: with median region narrow, ribbon-like, giving the general appearance of two hemitergites (0), as a complete and even sclerite (1). L=4, CI=25, RI=40.

86. Male terminalia, tergite six, presence of setae: present (0), absent (1). L=3, CI=33, RI=0.

87. Male terminalia, tergite six, degree of fusion with syntergosternite 7+8: free, not fused (0), completely fused, with a faint suture between sclerites (1). L=3, CI=33, RI=0.

88. Male terminalia, sternite six, shape of right lateral edge: with anterior margin enlarging towards tip, forming a lobe (0), narrowing towards tip (1). L=1, CI=100, RI=100.

89. Male terminalia, chaetotaxy of syntergosternite 7+8: covered with setulae only (0), with strong, erect setae (1). L=6, CI=16, RI=61.

90. Male terminalia, length of syntergosternite 7+8: at least twice length of dorsal surface of epandrium (0), subequal to length of dorsal surface of epandrium (1). L=4, CI=25, RI=50.

91. Male terminalia, epandrium, chaetotaxy of dorsal surface: covered with long setulae only (0), with row or patch of strong, erect setae (1). L=14, CI=7, RI=64.

92. Male terminalia, epandrium, shape of lateroventral margin: slightly curved and pronounced ventrally (0), folded inward, extending to ventral surface (1), well pronounced ventrally, shaping a lateral arm longer than surstylus (2). L=4, CI=50, RI=75.

93. Male terminalia, epandrium, shape of lower posterior margin: smooth (0), with posterior margin pronounced, forming a posterior lobe (1), folded upward (2). L=2, CI=100, RI=100.

94. Male terminalia, epandrium, presence of fringe of setae along lateroventral margin: present (0), absent (1). L=1, CI=100, RI=100.

95. Male terminalia, epandrium, shape of anterior margin: smooth, not pronounced (0), anterior margin well pronounced forward, forming a deep concavity throughout the margin (1). L=1, CI=100, RI=100.

96. Male terminalia, surstylus: fused with epandrium (0), not fused with epandrium, with membranous connection (1). L=2, CI=50, RI=92.
Remarks. Character extracted from Tschorsnig (1985).

97. Male terminalia, shape of connection of surstylus with epandrium (contingent for character state 96:0): outer margin at the same level as inner margin (0), outer margin below inner margin (1), outer margin above inner margin (2). L=12, CI=16, RI=73.

98. Male terminalia, development of surstylus: well developed (0), with apical part very short, almost vestigial (1). L=1, CI=100, RI=100.

99. Male terminalia, shape of surstylus: with median part bent forward, forming a median posterior lobe (0), straight from base to apex (1). L=6, CI=16, RI=70.

100. Male terminalia, symmetry of surstyli: symmetric (0), asymmetric (1). L=1, CI=100, RI=100.

101. Male terminalia, surstylus, development of median posterior lobe (contingent for character state 99:0): weakly developed (0), well developed, reaching up to at most half of surstylus (1), well developed, reaching up to the apex of surstylus (2). L=16, CI=12, RI=64.

102. Male terminalia, surstylus, chaetotaxy of median posterior lobe: bare (0), covered with thin, short setae (1), covered with strong, long setae (2). L=5, CI=40, RI=72.

103. Male terminalia, surstylus, chaetotaxy of anterior inner surface: bare (0), covered with thin, short setae (1), covered with strong, long setae (2). L=15, CI=13, RI=67.

104. Male terminalia, orientation of apical part of surstyli: arched and curved inward towards each other (0), curved towards posterior region (1), parallel to each other (2). L=17, CI=11, RI=74.

105. Male terminalia, presence of spines at the outer apex of surstylus: present (0), absent (1). L=4, CI=25, RI=25.

106. Male terminalia, shape of apex of surstylus: rounded (0), pointed (1). L=2, CI=50, RI=80.

107. Male terminalia, shape of concavity on inner surface of apex of surstylus: circular and deep, spatulate (0), longitudinal and shallow, extending along the apical part of surstylus (1), concavity weakly developed (2), oblong and deep, restricted to the apex (3). L=6, CI=50, RI=84.

108. Male terminalia, hypandrium, degree of concavity of hypandrial apodeme: as a slightly concave plate (0), as a semicylinder, with well developed lateral margins (1), with well developed and closed lateral margins, shaped as a keel (2). L=7, CI=28, RI=80.

109. Male terminalia, hypandrium, hypandrial arms: fused with each other (0), not fused with each other (1). L=5, CI=20, RI=80.

110. Male terminalia, hypandrium, width of apical part of hypandrial arms: with a similar width of basal part of hypandrial arms (0), larger than basal part, with upper margin well developed and pronounced upward (1). L=4, CI=25, RI=40.

111. Male terminalia, hypandrium, connection of hypandrial arm with basal process of basiphallus: not fused with basal process (0), fused with the lateral part of basal process (1), fused with median part of basal process (2). L=8, CI=25, RI=85.

112. Male terminalia, bacilliform sclerite, shape of apex connected with hypandrial arm: broad, extending to the middle of basal process of basiphallus (0), narrow, not reaching the end of hypandrial arms (1). L=10, CI=10, RI=72.

113. Male terminalia, degree of fusion between bacilliform sclerites: not fused (0), fused apically, near the connection with hypandrial arms (1), fused from mid surface to apex (2). L=11, CI=18, RI=62.

114. Male terminalia, presence of sclerite in the membrane between bacilliform sclerites: present (0), absent (1). L=1, CI=100, RI=100.

115. Male terminalia, presence of patch of strong setae in the membrane between bacilliform sclerites: present (0), absent (1). L=1, CI=100, RI=100.

116. Male terminalia, length of phallic guide: short, being at most a short stem near the base of phallapodem (0), long, at most reaching the central plate of hypandrium (1). L=12, CI=8, RI=47.

117. Male terminalia, pregonite: with membranous connection with central plate of hypandrium (0), fused with central plate of hypandrium (1). L=12, CI=8, RI=62.

118. Male terminalia, shape of posterior basal part of pregonite: pronounced posteriorly, surrounding the outer lateral base of postgonite (0), ending right at the beginning of outer lateral base of postgonite (1). L=7, CI=14, RI=87.

119. Male terminalia, apex of pregonite: oblong (0), pointed (1). L=3, CI=33, RI=66.

120. Male terminalia, shape of anterior margin of pregonite: smooth (0), with angular projection right before the apex (0), with rounded projection right before the apex (2). L=20, CI=10, RI=73.

121. Male terminalia, presence of setae on pregonite: present (0), absent (1). L=18, CI=5, RI=46.

122. Male terminalia, shape of postgonite: bacilliform, with a rounded apex (0), as a short and narrow sclerite attached to the posterior base of pregonite (1), stout and curved posteriorly (2), vestigial (3), long, with a broad and truncate apex (4), long, with a notched apex (5). L=10, CI=50, RI=44.

123. Male terminalia, presence of setae on postgonite: present (0), absent (1). L=5, CI=20, RI=33.

124. Male terminalia, postgonite, presence of articular process: present (0), absent (1). L=6, CI=16, RI=50.

125. Male terminalia, shape of basal part of ejaculatory apodeme: bacilliform (0), T-shaped (1), fan-like (2). L=3, CI=66, RI=50.

126. Male terminalia, phallus, shape of basal process of basiphallus: straight in lateral view (0), arched in lateral view (1), bent into an angular shape in lateral view (2). L=6, CI=33, RI=63.

127. Male terminalia, phallus, length of basiphallus: with more than twice length of distiphallus (0), with at most 1.5 times length of distiphallus (1). L=8, CI=12, RI=36.

128. Male terminalia, phallus, presence of epiphallus: present, located near the connection of basiphallus and distiphallus (0), absent (1). L=4, CI=25, RI=0.

129. Male terminalia, phallus, angle between basiphallus and distiphallus: obtuse, with curved shape (0), perpendicular or even acute (1). L=12, CI=8, RI=59.

130. Male terminalia, phallus, distiphallus, shape of dorsal sclerite: straight towards lateroventral sclerites (0), with basal part arched (1). L=3, CI=33, RI=77.

131. Male terminalia, phallus, distiphallus, length of lateroventral sclerite: with apex ending at the beginning of ventral median groove (0), with apex extending beyond the beginning of ventral median groove (1), with apex ending before reaching the ventral median groove (2), with apex extending to the apex of distiphallus (3). L=7, CI=42, RI=88.

Remarks. Due to the complexity and diversity of features in the distiphallus of Tachinini, we are adapting the terminology proposed by Tschorsnig. The "median ridge" *sensu* Tschorsnig is referred as ventral median groove, the "ventral sclerites" as lateroventral sclerites, the "lateroventral region" as lateroventral ridge, and the "x" as apical dorsolateral sclerite. We are also naming the outer lateral fold, not mentioned by Tschorsnig, as lateral ridge.

132. Male terminalia, phallus, distiphallus, shape of apex of lateroventral sclerite: serrated (0), smooth (1). L=4, CI=25, RI=86.

133. Male terminalia, phallus, distiphallus, ventral median groove: membranous (0), sclerotized (1). L=10, CI=10, RI=52.

134. Male terminalia, phallus, distiphallus, width of sclerotized ventral median groove (contingent for character state 133:1): large, reaching the edges of lateroventral ridges (0), thin, with less than half distance between lateroventral ridges (1). L=12, CI=8, RI=38.

135. Male terminalia, phallus, distiphallus, shape of apex of sclerotized median groove (contingent for character state 133:1): smooth (0), bifurcate, forming two short apical

processes (1), shaped H-like (2), bifurcate, forming two long and curved ventrally apical processes (3). L=10, CI=30, RI=73.

136. Male terminalia, phallus, distiphallus, lateroventral ridges: membranous, with spicules or granules only (0), slightly sclerotized, exhibiting transparency (1), heavily sclerotized, without transparency (2). L=16, CI=12, RI=39.

137. Male terminalia, phallus, distiphallus, lateral ridges: membranous, with spicules or granules only (0), heavily sclerotized along the edges (1). L=1, CI=100, RI=100.

138. Male terminalia, phallus, distiphallus, shape of lateral ridge in ventral view: parallel and close to lateroventral ridge, forming a narrow concavity between each other (0), curved and pronounced outward, forming a large concavity with lateroventral ridge (1), vestigial, not well developed and not forming a concavity with lateroventral ridge (2), parallel to and distant from lateroventral ridge, forming a wide gap between each other (3). L=7, CI=42, RI=90.

139. Male terminalia, phallus, distiphallus, apical laterodorsal surface: membranous (0), slightly sclerotized (1), with an apical laterodorsal sclerite (2). L=16, CI=12, RI=53.

140. Male terminalia, phallus, distiphallus, shape of apical dorsal surface: smooth (0), with a large and long membranous lobe arising right after the end of dorsal sclerite of distiphallus (1), with a thin and long lobe arising at the apex (2), with a large, saddle-like lobe arising at the apex (3). L=8, CI=37, RI=87.

141. Male terminalia, phallus, distiphallus, shape of apical dorsal sclerite (contingent for character state 139:2): wide, beginning at the lateral ridge and extending to the end of dorsal surface (0), as a longitudinal sclerite bordering the lateral ridge (1), as a long and thin sclerite bordering the lateral ridge (2). L=2, CI=100, RI=100.

142. Male terminalia, phallus, distiphallus, degree of fusion between apical dorsal sclerites (contingent for character state 139:2): not fused, with at most a narrow membranous distance between each other (0), entirely fused (1). L=1, CI=100, RI=100.

143. Male terminalia, syncercus, shape of median surface: slightly convex or even flat (0), well concave throughout its entire length, with apex curved and pronounced posteriorly (1), concave longitudinally, separating the lateral edges of syncercus as two parallel lobes (2), with lower half well concave, forming a deep median ventral concavity and an upper large lobe (3), concave longitudinally, forming two upper lateral lobes on each side (4), concave longitudinally, forming two large lateral lobes on each side connected by a short median area (5), well compressed and thin (6), with a disruption between the lateral edges of syncercus, densely covered with microtrichia (7), compressed and stout, with apex shaped like a beak (8), convex and globose, heart-shaped (9), folded towards anterior region, with median surface projected posteriorly and forming a median posterior process (A). L=12, CI=75, RI=94.

144. Male terminalia, syncercus, presence of longitudinal glabrous vitta: present (0), absent (1). L=1, CI=100, RI=100.

145. Male terminalia, syncercus, shape of apical part: with one point (0), divided into two points (1). L=6, CI=16, RI=83.

146. Male terminalia, syncercus, shape of apex: pointed (0), notched at apex (1), with short subquadrate point (2), wide and subrectangular or oblong (3), enlarged and projected posteriorly (4), wide and subquadrate (5), narrow and subrectangular (6). L=21, CI=28, RI=60.

2.4.2 Phylogeny of Tachinini

The equally weighted parsimony analysis of the character matrix including all 204 terminals resulted in 252 trees with 1520 steps (CI=14, RI=73). The strict consensus topology, however, was poorly resolved, with 88 nodes collapsed and 2060 steps (CI=10, RI=62), indicating the presence of terminals likely acting as wildcards. After inspection of each terminal collapsed at the base, the exclusion of the monotypic genus *Corpulentosoma* resulted in the best improvement in the resolution of the strict consensus topology. The analysis without this genus resulted in 256 trees with 1510 steps (CI=14, RI=73), and a strict consensus topology with 51 nodes collapsed and 1612 steps (CI=14, RI=71) (Figures 15–19, Supplementary information 1). An additional analysis with 1,000 replications and 203 terminals resulted in 403 trees with the same number of steps and same strict consensus topology. We decided to present and discuss the clades preserved in the strict consensus tree (Figures 15–19), optimizing the characters in one of the most parsimonious trees (Supplementary information 2). Bremer supports are presented in the strict consensus tree (Figures 15–19). To facilitate the representation and discussion of the topology we named a few monophyletic groups that include different genera as genus groups. These genus groups may be helpful to understand the diversity of different taxa in each clade, even suggesting possible synonyms between genera nested within the same genus group.

2.4.2.1 Monophyly of Tachinini and outgroups

The monophyly of the tribe Tachinini is confirmed, with Tachinini recovered as sister group of the remaining tribes of the Tachinini group (Figure 15): Ernestiini, Nemoraeini and Polideini. The clade Ernestiini+Nemoraeini+Polideini is supported by five homoplasious apomorphic character states (1:1, 20:0, 29:0, 31:1, 110:1) and one synapomorphic character state: four or five postsutural supra-alar setae, with weaker setae inserted between stronger setae (41.1, with reversal in *Bombyliomyia*).

The clade nesting all Tachinini is supported by eight homoplasious apomorphic character states (8:0, 15:1, 16:0, 85:0, 90:1, 104:1, 107:1, 112:0) and eight synapomorphic character states: prementum without setulae (33:1, with reversal in *Chromatophania*), ventral margin of labellum with an extended ventral lobe emerging from central process of furca (34:1, with reversal in *Chromatophania*), first postsutural supra-alar seta stronger than first postsutural dorsocentral seta (42:1), posterodorsal surface of hind coxa setulose (62:0), anterior margin of sternite five of male with a forked apodeme (81:0), sternite six of male with anterior margin enlarging towards tip, forming a lobe (88:0), surstylus fused with epandrium (96:0, with reversal in the clade nesting the subgenera *Nowickia* and *Rhachogaster* of the genus *Tachina*), and hypandrial arms not fused with each other (109:1, with reversals in the *Dejeania* group and *Cryptopalpus*, *Epalpodes* and *Protodejeania*).

2.4.2.2 *Tachina* group

The *Tachina* group is the first split in the tribe, being the sister group of the remaining Tachinini (Figure 15), and is supported by one homoplasious apomorphic state (8:0, with reversals in *Epalpodes, Ruiziella* and other Tachinini). This clade includes a paraphyletic genus *Tachina* and the genera *Epalpodes*, *Ruiziella* and *Steatosoma*. In the genus *Tachina*, the subgenus *Tachina* is monophyletic, supported by one synapomorphic character state: apical part of surstylus vestigial (98:1); the clade nesting *Tachina* (*Nowickia) ferox* and the subgenus *Rhachogaster* is supported by one synapomorphic character state: hypandrial apodeme with well developed and closed lateral margins, shaped as a keel (108:2); and the subgenus *Rhachogaster* is supported by one synapomorphic character state: median surface of syncercus of male compressed and stout, with apex shaped like a beak (143:8). The genus *Steatosoma* is the sister group of the clade including *Epalpodes* and *Ruiziella* and has two autapomorphic character states: five katepisternal setae (45:3), and lateroventral margin of epandrium well pronounced ventrally, shaping a lateral arm longer than surstylus (92:2).

The sister group of the *Tachina* group is supported by five homoplasious apomorphic character states (11:1, 36:3, 80:1, 89:0, 101:1) and one synapomorphic character state: median posterior lobe of surstylus bare (102:0, with reversals in *Echinopyrrhosia*, *Euempheremyia*, *Euhuascaraya* and *Vertepalpus*). This clade splits into two clades: the first clade nesting the genus *Chromatophania* and the *Dumerillia* group, sister group of the clade with the *Epalpus* group, the *Jurinia* group and the *Gymnomma* grade, and the second clade nesting the remaining Tachinini.

2.4.2.3 Genus *Chromatophania* and *Dumerillia* group

This clade is supported by five homoplasious apomorphic character states (17:0, 20:0, 29:0, 54:0, 117:0). The genus *Chromatophania* is the sister group of the *Dumerillia* group (Figure 15) and is supported by 16 homoplasious apomorphic character states (6:1, 11:0, 12:0, 15:2, 21:0, 22:0, 30:0, 31:1, 34:0, 51:1, 58:0, 64:0, 84:0, 113:2, 138: 2, 139:0) and two synapomorphic character states: wing infuscated only at level of dm-m (56:5), apex of sclerotized median groove of distiphallus bifurcate, forming two long and curved ventrally apical processes (135:3).

The *Dumerillia* group includes the genera *Amicrotrichomma*, *Catajurinia*, *Dumerillia*, *Exopalpus*, *Jurinella*, *Periopticochaeta*, and species of *Fabriciopsis* and *Jurinia*; and is supported by ten homoplasious apomorphic character states (1:1, 2:1, 14:1, 53:1, 70:0, 72:0, 92:1, 112:1, 126:1, 146:6) and three synapomorphic character states: hypandrial arms fused with median part of basal process of basiphallus (111:2), lateroventral sclerite of distiphallus with apex ending before reaching the ventral median groove (131:2), and lateral ridges of distiphallus heavily sclerotized (137:1). The clade nesting the genera *Exopalpus*, *Dumerillia*, *Jurinella*, and the species *Amicrotrichomma ada* and *Fabriciopsis hystrix* is supported by one synapomorphic character state: syncercus of male folded towards anterior region, with median surface projected posteriorly and forming a median posterior process (143:A).

2.4.2.4 *Epalpus* group, *Jurinia* group, and *Gymnomma* grade

This clade is supported by four homoplasious apomorphic character states (24:0, 91:0, 143:9, 145:1). The *Gymnomma* grade (Figure 16) is a paraphyletic group composed by nine genera, namely *Cyanogymnomma, Empheremyiops, Euempheremyia, Eufabriciopsis, Gymnomma, Itacuphocera*, *Microgymnomma*, *Neosarromyia*, *Phosocephala*, and some species of *Euhuascaraya*, all of them sharing plesiomorphic character states, such as parallel inner vertical setae (4:1). The clade nesting the genera *Itacuphocera* and *Neosarromyia* is supported by one synapomorphic character state: syncercus of male concave longitudinally, forming two large lateral lobes on each side connected by a short median area (143:5). The clade nesting *Euhuascaraya siesta* and the genera *Euempheremyia* and *Eufabriciopsis* is supported by one synapomorphic character state: epandrium with fringe of setae along lateroventral margin (94:0).

The *Jurinia* group is the sister group of the *Epalpus* group and is composed by thirteen genera, namely *Archytoepalpus*, *Bischofimyia*, *Corpulentoepalpus*, *Eubischofimyia*, *Euepalpodes*, *Euhuascaraya*, *Gymnommopsis*, *Huascarayopsis*, *Jurinia*, *Juriniosoma*, *Melanepalpellus*, *Ochroepalpus*, *Opsoempheria*. This clade is supported by three homoplasious apomorphic character states (129:1, 130:1, 139:2) and one synapomorphic character state: shape of apical dorsal surface of distiphallus with a large, saddle-like lobe arising at the apex (140:3).

The *Epalpus* group is composed by the genera *Epalpellus*, *Epalpus*, *Oxyepalpus*, *Parepalpus*, *Saundersiops*, *Signosomopsis*, *Uruhuasia*, *Uruhuasiops*, and some species of

Trichosaundersia. This clade is supported by four homoplasious apomorphic character states (11:0, 44:0, 51:1, 53:1). The genus *Parepalpus* is supported by one synapomorphic character state: presence of patch of strong setae in the membrane between bacilliform sclerites of male (115:0).

2.4.2.5 *Peleteria* group

The sister group of the clade nesting the groups described in sections 2.4.2.3 and 2.4.2.4 includes the *Peleteria* group (Figure 17), which is the sister group of the clade nesting the *Archytas* group and the remaining Tachinini. This clade is supported by four homoplasious apomorphic character states (2:1, 13:0, 25:2, 61:1).

The *Peleteria* group is composed solely by the genera *Neocuphocera* and *Peleteria*, supported by three homoplasious apomorphic character states (14:1, 18:2, 84:0) and one synapomorphic character state: syncercus of male concave longitudinally, separating the lateral edges of syncercus as two parallel lobes (143:2). The genus *Peleteria* is the sister group of *Neocuphocera* and is supported by one synapomorphic character state: lower margin of epandrium with posterior part pronounced, forming a posterior lobe (93:1).

2.4.2.6 *Archytas* group

The clade nesting the *Archytas* group and the remaining Tachinini is supported by three homoplasious apomorphic character states (4:0, 28:0, 91:0). The *Archytas* group (Figure 17) is composed by the genera *Archytas*, *Juriniopsis*, *Palpotachina*, *Pararchytas*, *Protodejeania* and *Talarocera*, and is supported by three homoplasious apomorphic character states (9:1, 10:1, 135:1). The genus *Protodejeania* has one autapomorphic character state: anterior margin of epandrium well pronounced forward forming a deep concavity throughout the margin (95:1). The genus *Juriniopsis* is supported by one synapomorphic character state: basal part of ejaculatory apodeme T-shaped (125:1). The genus *Archytas* is supported by one synapomorphic character state: syncercus of male with lower half well concave, forming a deep median ventral concavity and an upper large lobe (143:4); the genus *Talarocera* is nested within *Archytas* and has one autapomorphic character state: first flagellomere of male multifissicorn (13:3); and the clade nesting the species *A. (Archytas) marmoratus* and *A. incertus* is supported by three synapomorphic character state: postgonite stout and curved posteriorly (122:2), dorsal apical surface of distiphallus with a large and long membranous lobe arising right after the end of dorsal sclerite of distiphallus (140:1), apical dorsal sclerite of distiphallus as a long and thin sclerite bordering the lateral ridge (141:2).

2.4.2.7 *Copecrypta* group, *Trichophora* grade and other genera

The sister group of the *Archytas* group is the clade nesting the *Camposiana* group, *Copecrypta* group, *Dejeania* group, *Rhachoepalpus* group, *Trichophora* grade, *Xanthoepalpus* group, and a few isolated genera. This clade is supported by eight homoplasious apomorphic character state (24:0, 56:1, 80:0, 111:1, 117:0, 139:2, 140:2, 143:9) and one synapomorphic character state: lateral ridge of distiphallus parallel to and distant from lateroventral ridge, forming a wide gap between each other (138:3, with reversals in the *Dejeania* group, *Rhachoepalpus* group and *Chromoepalpus*). The genus *Abepalpus* is the first split of this clade. The genus *Euepalpus* is the second split and has two autapomorphic character states: tergite five of male covered by a patch of thin, appressed setae on dorsal surface (76:0), basal process of basiphallus bent into an angular shape in lateral view (126:2).

The following clade includes the *Trichophora* grade and the remaining genus groups (Figures 18–19). This clade is supported by seven homoplasious apomorphic character states (5:1, 9:1, 20:0, 43:1, 64:0, 72:0, 104:2) and two synapomorphic character states: lateroventral sclerite of distiphallus with apex extending beyond the beginning of ventral median groove (131:1, with reversals in the *Dejeania* group, *Rhachoepalpus* group, and *Chromoepalpus*, *Cyanopsis* and *Deopalpus pictipennis*), apex of lateroventral sclerite of distiphallus serrated (132:0, with reversals in *Dejeania* group, *Rhachoepalpus* group, and *Acroceronia*, *Beskiocephala*, *Chromoepalpus*, *Copecrypta*, *Cyanopsis*, *Deopalpus*, *Epicuphocera*, *Formicomyia* and *Prospanipalpus*). The clade nesting the *Trichophora* grade (except *Austeniops* and *Xanthozona*), *Copecrypta* group and the remaining genus groups is supported by one synapomorphic character state: apical dorsal sclerite of distiphallus wide, beginning at the lateral ridge and extending to the end of dorsal surface (141:0).

The *Trichophora* grade is a paraphyletic group composed by eight genera (Figure 18), namely *Austeniops*, *Diaphanomyia*, *Helioprosopa*, *Neogymnomma*, *Pseudoxanthozonella*, *Trichophora*, *Xanthozona* and *Zonoepalpus*, most of them sharing a homoplasious apomorphic state: one parafacial seta (18:1).

The *Copecrypta* group is composed by fifteen genera, namely *Acroceronia*, *Agicuphocera*, *Beskiocephala*, *Chiloepalpus*, *Copecrypta*, *Cyanopsis*, *Deopalpus*, *Edwynia*, *Epicuphocera*, *Eutrichophora*, *Formicomyia*, *Palpolinnaemyia*, *Prospanipalpus*, *Sorochemyia* and *Vibrissomyia*. This clade is supported by two homoplasious apomorphic character states (54:2, 80:1). The genus *Eutrichophora* has one autapomorphic character state: lower posterior margin of epandrium folded upward (93:2). The genus *Beskiocephala* has one autapomorphic character state: first aristomere very long, about ten times longer than wide (14:2). The clade nesting the genera *Andinomyia* and *Vibrissomyia* is supported by one synapomorphic character state: surstyli asymmetric (100:1).

2.4.2.8 *Camposiana* group, *Dejeania* group, *Rhachoepalpus* group, *Xanthoepalpus* group and other genera

The sister group of the *Copecrypta* group and *Trichophora* grade is the clade nesting the *Camposiana* group, *Dejeania* group, *Rhachoepalpus* group, *Xanthoepalpus* group, and the genera *Anepalpus*, *Homosaundersiops*, *Oharamyia*, *Pictoepalpus* and *Vibrissoepalpus* (Figure 19). This clade is supported by seven homoplasious apomorphic character states (18:0, 21:2, 25:1, 49:1, 50:1, 55:1, 67:1). The genus *Anepalpus* is the first split of this clade, with the genus *Vibrissoepalpus* being the second split.

The *Xanthoepalpus* group is the next split of this clade and is composed by the genera *Itasaundersia*, *Xanthoepalpodes* and *Xanthoepalpus*, being supported by four homoplasious apomorphic states (13:0, 20:0, 32:1, 146:3).

The genus *Pictoepalpus* is the sister group of the clades nesting the *Dejeania* group, *Rhachoepalpus* group, *Homosaundersiops* and *Oharamyia*. The following split is the clade nesting *Homosaundersiops* and *Oharamyia* and is supported by one homoplasious apomorphic character state (68:0).

The *Camposiana* group is composed by eleven genera, namely *Camposiana*, *Chromoepalpus*, *Eucorpulentosoma*, *Homosaundersia*, *Lindigepalpus*, *Melanepalpus*, *Quadratosoma*, *Rhachosaundersia*, *Signosoma*, *Trichoepalpus* and *Trichosaundersia*, and is supported by three homoplasious apomorphic character states (47:0, 53:0, 146:3) and one synapomorphic character state: lateroventral ridge of distiphallus heavily sclerotized, without transparency (136:2, with reversal in the clade nesting *Chromoepalpus*, *Eucorpulentosoma*, *Lindigepalpus*, *Rhachosaundersia*, *Signosoma* and *Trichosaundersia*). The genus *Lindigepalpus* has one autapomorphic character state: syncercus of male with a longitudinal glabrous vitta (144:0). The clade nesting the genera *Chromoepalpus*, *Eucorpulentosoma*, *Rhachosaundersia* and *Signosoma* is supported by one synapomorphic character state: apical dorsal sclerites of distiphallus entirely fused (142:1). The *Camposiana* group is the sister group of the *Dejeania* group and *Rhachoepalpus* group.

The *Rhachoepalpus* group is composed by the genera *Cryptopalpus*, *Echinopyrrhosia*, *Echinopyrrhosiops*, *Eumelanepalpus*, *Eusaundersiops*, *Oestrohystricia*, *Rhachoepalpus* and *Vertepalpus*, and is supported by two homoplasious apomorphic character states (36:1, 113:2). The clade nesting species of *Rhachoepalpus* (except *R. ethelius*) is supported by one synapomorphic character state: syncercus of male with a disruption between the lateral edges of syncercus, densely covered with microtrichia (143:7). The species *Cryptopalpus ornatus* has one autapomorphic character state: apex of syncercus of male wide and subquadrate (146:5).

The *Dejeania* group is composed by the genera *Adejeania*, *Dejeania*, *Dejeaniops*, *Eudejeania*, *Eulasiopalpus*, *Paradejeania* and *Parechinotachina*, and is supported by five homoplasious apomorphic character states (29:2, 44:0, 70:1, 111:0, 143:0) and one synapomorphic character state: palpus well developed, at least twice length of antenna (24:3, with reversal in *Paradejeania*). The clade nesting all taxa of *Dejeania* group (except the genus *Dejeania*) is supported by one synapomorphic character state: dorsal surface of hind tibia bare from base to apex (63:0). The species *Eulasiopalpus vittatus* has one autapomorphic character state: syncercus of male with lower half well concave, forming a deep median ventral concavity and an upper large lobe (143:3). The species *Dejeaniops beckeri* has one autapomorphic character state: syncercus of male well compressed and thin (143:6). The genus *Adejeania* is supported by two synapomorphic character states: syncercus of male well concave throughout its entire length, with apex curved and pronounced posteriorly (143:1), apex of syncercus of male enlarged and projected posteriorly (146:4).

2.5 DISCUSSION

To infer the phylogeny of Tachinini is a great challenge not only due to the rich diversity of genera and species, but also because of the plasticity of morphological traits found in the group. Considering the variation in chaetotaxy and body color, and the lack of knowledge about structures of the male terminalia, it is no wonder why the classification of Tachinini genera, especially from the Neotropical Region, is so poorly understood. Moreover, as pointed out by Engel: "*Als weitere Schwierigkeit kommt besonders bei den* *südamerikanischen Arten dieser Dipteren die Tendenz hinzu, Arten einer verwandten Gattung nachzuahmen. Solche Formen werde ich als „Täuschungsformen" bezeichnen.*" [Another difficulty, especially with the South American species of these Diptera, is the tendency to mimic species of a related genus. I shall call such forms "forms of illusion".] (ENGEL, 1920, p. 274, our translation), it seems that there is an apparent mimicry between many species of different genera of Tachinini, e.g., species of the *Gymnomma* grade and the *Jurinia* group (Figure 20). This is why, for many groups, the main diagnostic characters that may be used to support more inclusive genera are found in the male terminalia.

As presented before, the classification of Tachinini changed many times throughout the XIX and early XX centuries, with several propositions of different suprageneric groups. Our results reassure that Tachinini is indeed a monophyletic group supported by several morphological synapomorphies, confirming what was proposed in previous phylogenetic hypotheses for Tachinidae (CERRETTI et al., 2014; STIREMAN et al., 2019) and in our phylogeny of Chapter 1. Moreover, as Stireman et al. (STIREMAN et al., 2019) proposed, Tachinini is again recovered as the first split of the monophyletic Tachinini group of the subfamily Tachininae.

The suprageneric taxa proposed for specific lineages of the tribe Tachinini by earlier authors, however, were not confirmed herein. Most of this suprageneric taxa were proposed based on the relative size of the first flagellomere and pedicel, chaetotaxy, development of palpi and presence of parafacial setae, but these character states are homoplastic in our phylogeny, although they support some clades as homoplasious apomorphic character states. The phylogeny of Tachinidae inferred with morphological characters of Cerretti et al. (2014) included four species of Tachinini, whereas Stireman et al. (2019) sampled 19 species in their molecular phylogeny of Tachinidae, providing a better preliminary resolution of the relationships in the tribe. In our molecular phylogeny of Calyptratae, in Chapter 1, we sampled 45 species of Tachinini. To discuss the topology of Tachinini inferred herein, thus, we will focus on the works of Stireman et al. (2019) and our Chapter 1.

2.5.1 *Tachina* group at base of Tachinini

The *Tachina* group was recovered in all phylogenies as the first split of Tachinini. Stireman et al. (2019) also recovered as sister groups of the genus *Tachina* the Australasian genus *Microtropesa* (not included herein, see Table 10) and the Afrotropical genus

Chromatophania. In Chapter 1, we also recovered the Oriental and Palearctic genus *Mikia* (not included herein) as the sister group of *Tachina*. In our phylogeny, the genus *Chromatophania* is recovered as the sister group of the *Dumerillia* group. This different position of *Chromatophania* found in our hypothesis, however, may be due to shared homoplasious apomorphic and plesiomorphic character states between *Chromatophania* and basal taxa of the *Dumerillia* group, such as the genera *Catajurinia* and *Periopticochaeta*. Species of *Chromatophania* are the only Tachinini studied herein that exhibit plesiomorphic character states in their mouthparts, such as the prementum setulose (30:0) and the ventral margin of labellum with an extended ventral lobe (34:0). In addition, species of *Chromatophania* also have a prementum that do not cover the labrum (31:1), a state also found in the tribes of the Tachinini group.

The genus *Tachina* was already recovered as paraphyletic in the phylogenetic hypothesis proposed by Novotná et al. (2009), with *T. (Nowickia) ferox* not nested in *Tachina*. This species was recovered at the base of the genus *Tachina* in our molecular phylogeny (Figure 11 of Chapter 1). Despite our reduced sampling of species and subgenera of *Tachina*, our analysis of morphological characters also indicates that the subgenus *Nowickia* may be a distinct genus from *Tachina*, including Palearctic (subgenus *Nowickia*) and Nearctic species (subgenus *Rhachogaster*), especially when considering the development of the apical part of surstyli (98) and the shape of syncercus of male (143).

The species *Steatosoma rufiventris* exhibits many autapomorphic character states, suggesting that the genus *Steatosoma* may be a distinct genus from *Epalpodes* and *Ruiziella*. Both of these genera, however, are likely synonyms based on homoplasious apomorphic character states in the male terminalia, such as the inner surface of apex of surstyli with a oblong and deep concavity (107:3).

2.5.2 Everything from nothing: the development of palpi in Tachinini

The species of Tachinini with regular palpi are coded herein with the character state 24:2, which delimits the general size of palpi in most tachinids and is the plesiomorphic state in our analysis. All the New World taxa of the *Dumerillia* group and *Archytas* group are characterized by having regular palpi and were recovered as monophyletic in Chapter 1 and in Stireman et al. (2019). According to our results, however, both groups do not form a monophyletic group. The *Dumerillia* group is clearly monophyletic, being supported by synapomorphies in the male terminalia. Its position in the topology of Tachinini, however, was likely affected by the genus *Chromatophania* as pointed out in the last section. The *Archytas* group is monophyletic, presenting a curious result: the monotypic genus *Talarocera*, the unique genus in Tachinini exhibiting males with multifissicorn antenna, is nested within *Archytas*, a pattern also found in Chapter 1.

The development of palpi in Tachinini is probably the most varied in all the family, ranging from complete absence (24:0, 25:2) to the hypertrophied palpi of species of the *Dejeania* group (24:3). Previous classifications considered the development of palpi in Tachinini as a valuable character, e.g., Hystriciidae *sensu* Brauer and Bergenstamm (1889) and Dejeaniini *sensu* Townsend (1936) roughly included species with hypertrophied palpi, whereas the Micropalpidae *sensu* Brauer & Bergenstamm and Cuphoceratini and Juriniini *sensu* Townsend roughly included the species with vestigial palpi. Any of these groups were supported in our analysis, except the *Dejeania* group. The reduction and eventual loss of palpi happened in at least four different lineages of Tachinini. Moreover, the *Dejeania* group is the sister group of the *Rhachoepalpus* group, a clade including species with reduced or vestigial palpi.

Stireman et al. (2019) recovered the Tachinini with vestigial palpi (genera *Deopalpus*, *Epalpus*, *Parepalpus*, *Lindigepalpus*, *Rhachoepalpus* and *Trichophora*) as a monophyletic group, being the sister group of *Adejeania* and *Paradejeania* (herein in the *Dejeania* group). In Chapter 1, we recovered a clade of species with vestigial palpi with the genus *Adejeania* nested within it. In this hypothesis, however, *Adejeania* is the sister group of the clade including the herein called *Epalpus* group, *Gymnomma* grade and *Jurinia* group, although we could not sample any species of the *Camposiana* group and *Rhachoepalpus* group.

The idea of transition to hypertrophied palpi coming from regular palpi is tempting, but our results suggest that it may be misleading. The same goes for the hypothesis that losing palpi is a unique event in the evolution of the group. Even when we disturbed the analysis turning the character 24 to additive with Sankoff matrices or changing the costs of transformation between states, the topology and the strict consensus remained stable.

2.5.3 Tachinini with parafacial setae

Tachinini exhibits a great diversity of species with parafacial setae (18:1–3), some of them differing from the characteristic stout body shape found in specimens of the tribe. For instance, the genera *Copecrypta* and *Beskiocephala* include species with slender abdomens, and the genus *Neosarromyia* includes the smallest specimens of Tachinini studied herein, with a little more than one centimeter. Townsend (1936) roughly classified this fauna in the tribes Cuphoceratini and Juriniini. However, we did not recover a monophyletic group with all species with parafacial setae. For instance, the clade nesting *Epalpodes*, *Ruiziella* and *Steatosoma* is in the *Tachina* group; the clade nesting *Itacuphocera* and *Neosarromyia* is in the *Gymnomma* grade; the *Peleteria* group is a single clade; and the majority of species with parafacial setae are found in the *Copecrypta* group and *Trichophora* grade. Species with vestigial parafacial setae (19:1) are also found in the genera *Dejeania* (*Dejeania* group) and *Juriniopsis* (*Archytas* group).

Stireman et al. (2019) recovered the herein called *Peleteria* group as monophyletic. The genera *Deopalpus* (of the *Copecrypta* group) and *Trichophora* (of the *Trichophora* grade) included in their phylogenetic inference do not form a monophyletic group, having the genus *Lindigepalpus* (of the *Camposiana* group), which do not have parafacial setae, nested within the clade. In Chapter 1, we also recovered a monophyletic *Peleteria* group and a monophyletic clade nesting species of the *Copecrypta* group and *Trichophora* grade.

2.5.4 The biggest challenge of Neotropical Tachinini: classification of species with vestigial palpi

We consider vestigial palpi (24:0, 25:0–2) the forms represented by papillae or short setae, and even the complete absence of palpal structures. Although the loss of palpi seems to have occurred several times in the evolution of Tachinini according to our results, we realize that only the fauna of the New World has species with vestigial palpi, except for some species of *Peleteria* from the Old World previously classified in the genus *Cuphocera*. Moreover, most of the monotypic genera described in the tribe include species with vestigial palpi, and the apparent mimicry between species from different genera mentioned before and noted by Engel (1920) is more common in specimens with vestigial palpi. Therefore, we can say that the biggest challenge to classify the Neotropical fauna of Tachinini relies in a better understanding of the diversity of species with vestigial palpi. We consider that the genus groups proposed herein help to understand this diversity, namely *Copecrypta* group, *Camposiana* group, *Epalpus* group, *Gymnomma* grade, *Rhachoepalpus* group, *Trichophora* grade and *Xanthoepalpus* group. We provide below a summary of the relative diversity of each genus group and their respective diagnostic characters.

The *Epalpus* group and the *Gymnomma* grade include species having males with syncercus heart-shaped (143:9, except in the genera *Itacuphocera* and *Neosarromyia*) with apex divided in two points (145:1, except in the genus *Phosocephala*). Species of the genus *Phosocephala* have males with syncercus with only one point (145:0), and species of *Itacuphocera* and *Neosarromyia* are the exception of the *Gymnomma* grade, having short palpi (24:1) and males with syncercus concave longitudinally, forming two large lateral lobes on each side connected by a short median area (143:5). In spite of these three genera, species of the *Gymnomma* grade may be roughly classified in the genus *Gymnomma* and species of the *Jurinia* group may be roughly classified in the genus *Jurinia*. Both genera are very similar, having strong ocellar setae (2:0), but the main differences between them are found in the orientation of inner vertical setae (parallel in *Gymnomma* and crossed in *Jurinia*) and in the males. Males of *Gymnomma* have a pair of proclinate orbital setae (6:2), whereas males of *Jurinia* do not; and the apical dorsal surface of the distiphallus of males of *Jurinia* have a large, saddle-like lobe arising at the apex (140:3), whereas in males of *Gymnomma* the apical dorsal surface of distiphallus is smooth. Species of the *Epalpus* group do not have ocellar setae and may be roughly classified in the genera *Epalpus* and *Parepalpus*. Males of *Epalpus* have the apical part of surstyli arched and curved inward towards each other (104:0), usually with patches of median discal pairs of setae on tergites three and four (71:1, 73:1), whereas males of *Parepalpus* have the apical part of surstyli parallel to each other (104:2), only one pair of discal setae on tergites three and four (71:0, 73:0), and a patch of strong setae in the membrane between bacilliform sclerites (115:0).

The *Copecrypta* group and the *Trichophora* grade include species with parafacial setae (18:1–3) and males with syncercus heart-shaped (143:9) with apex with only one point (145:0). Species of the *Trichophora* grade may be roughly classified in the genus *Trichophora*, having specimens with only one parafacial seta (18:1) and males having the sternite five subquadrate (80:0) and the anterior margin of pregonites with rounded projection right before the apex (120:2). Species of the *Copecrypta* group usually have two, three or more parafacial setae (18:2–3) and include several different genera. Species of this group may be roughly classified in the genera *Chiloepalpus*, *Copecrypta*, *Deopalpus* and *Vibrissomyia*, but a few varied species, such as *Beskiocephala flava* and *Palpolinnaemyia perorbitalis*, are difficult to classify. Species of *Chiloepalpus* and *Vibrissomyia* are the only ones of the group having ocellar setae (2:0), but males of *Vibrissomyia* have asymmetric surstyli (100:1) and pregonites setose (121:0), whereas males of *Chiloepalpus* have symmetric surstyli (100:0) and pregonites bare (121:1). Species of *Deopalpus* are the only members of the *Copecrypta* group that have males with hypandrial arms not fused basal process (111:0), whereas species of *Copecrypta* have wings with costal section three about the same length of costal section two (58:0) and males with hypandrial arms fused with the lateral part of basal process (111:1).

The *Xanthoepalpus* group and the *Camposiana* group include species with males having the apex of syncercus wide and subrectangular or oblong (146:3). Species of the *Xanthoepalpus* group have the basal sclerite of the labellum highly sclerotized (32:1) and males with the apical part laterodorsal surface of distiphallus membranous (139:0). The *Camposiana* group is composed by several different genera. Species of this group may be roughly classified in the genera *Camposiana*, *Lindigepalpus* and *Rhachosaundersia*. Species of *Camposiana* have males with the lateroventral ridges of the distiphallus heavily sclerotized (136:2). Species of *Lindigepalpus* have males with syncercus with a longitudinal glabrous vitta (144:0). And species of *Rhachosaundersia* have an apical dorsal sclerite on distiphallus entirely fused (142:1).

The *Rhachoepalpus* group include species usually with only one pair of postsutural acrostichal setae (36:1) and males with bacilliform sclerites fused from mid surface to apex (113:2). Species of this group may be roughly classified in the genera *Cryptopalpus* and *Rhachoepalpus*. Species of *Cryptopalpus* usually have eyes densely haired (1:1) and postsutural acrostichal and dorsocentral setae hair-like (37:0, 39:0). Species of *Rhachoepalpus* have vestigial palpi shaped as papillae (25:0) and males with pregonites setose (121:0) and syncercus with a disruption between the lateral edges of syncercus, densely covered with microtrichia (143:7).

Comparing all genus groups of Tachinini with vestigial palpi, it is possible to realize the extreme importance of characters of the male terminalia, which bear most of the diagnostic characters of each group. Although there are species of smaller genera with vestigial palpi that may fail to be diagnosed by these characters, we consider that these genus groups summarize the morphological diversity exhibited by this particular fauna of Tachinini, providing an evidence-based context for future taxonomic revisions of the group.

Table 9: List of 204 species examined and included in the phylogenetic inference of Neotropical Tachinini, with the countries and depositories of examined specimens. Species of monotypic genera and species whose male terminalia were dissected are identified with an asterisk (*). Species whose type material was examined are indicated. Classification follows O'Hara, Henderson and Wood (2020). Acronyms of depositories refer to the following collections: AMNH (American Museum of Natural History), CEIOC (Coleção Entomológica do Instituto Oswaldo Cruz), CNC (Canadian National Collection of Insects), DZUP (Museu de Entomologia Pe. Jesus Santiago Moure), INPA (Instituto Nacional de Pesquisas da Amazônia), MNHN (Muséum National d'Histoire Naturelle), NHMUK (Natural History Museum), MNRJ (Museu Nacional), MZSP (Museu de Zoologia da Universidade de São Paulo), USNM (National Museum of Natural History).

Species	**Species of monotypic genus**	**Country of examined specimens**	**Type material examined**	**Dissection of male terminalia**	**Depository**
OUTGROUPS					
Ernestiini					
Bombyliomyia flavipalpis (Macquart, 1846)		Brazil		*	MZSP
Gymnocheta viridis (Fallén, 1810)		France		*	MNRJ
Linnaemya comta (Fallén, 1810)		United States of America		*	MZSP
Panzeria rudis (Fallén, 1810)		France		*	MNRJ
Zophomyia temula (Scopoli, 1763)		France		*	MZSP
Leskiini					
Leskia cf. *flavipennis* (Wiedemann, 1830)		Brazil		*	MZSP
Nemoraeini					
Macromya pyrrhaspis (Wiedemann, 1830)		Brazil		*	MZSP
Nemoraea pellucida (Meigen, 1824)		France		*	MNRJ
Polideini					
Chlorohystricia reinwardtii (Wiedemann, 1830)		Brazil		*	MZSP

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
Hystricia abrupta (Wiedemann, 1830)		United States of America		*	MZSP
Lypha melobosis (Walker, 1849)		United States of America		*	MZSP
TACHININI					
Abepalpus archytoides Townsend, 1931	*	Brazil		*	MZSP
Acroceronia elquiensis Cortés, 1951	*	Chile	Paratype		CNC, USNM
Adejeania andina (Townsend, 1912)		Argentina, Bolivia, Brazil, Paraguay, Peru	Holotype	*	CNC, MZSP, USNM
Adejeania bicaudata Curran, 1947		Brazil			CNC
Adejeania vexatrix (Osten Sacken, 1877)		Canada, Mexico, United States of America		*	CNC, USNM
Agicuphocera nigra Townsend, 1915	*	Chile, Peru	Holotype		CNC, USNM
Amicrotrichomma ada Curran, 1947		Brazil	Holotype		AMNH
Amicrotrichomma orbitalis Townsend, 1927		Brazil	Holotype		USNM
Amicrotrichomma sp. nov.		Brazil		*	CEIOC
Andinomyia cruciata Townsend, 1912		Peru	Holotype		USNM
Anepalpus hystrix Townsend, 1931	*	Ecuador, Peru	Holotype	*	CNC, USNM
Archytas (Archytas) analis (Fabricius, 1805)		United States of America			USNM
Archytas (Archytas) apicifer (Walker, 1849)		United States of America			MNRJ, USNM
Archytas (Archytas) marmoratus (Townsend, 1915)		Brazil, Peru, United States of America	Holotype	*	CEIOC, MZSP, USNM
Archytas (Nemochaeta) metallicus (Robineau-Desvoidy, 1830)		United States of America			USNM
Archytas daemon (Wiedemann, 1830)		Brazil		*	DZUP
Archytas incertus (Macquart, 1851)		United States of America		*	USNM
Archytas seminiger (Wiedemann, 1830)		Brazil		*	CEIOC

Species	**Species of monotypic genus**	**Country of examined specimens**	**Type material examined**	**Dissection of male terminalia**	**Depository**
Archytoepalpus rufiventris Townsend, 1927	*	Brazil, Paraguay	Holotype	*	MZSP, USNM
Austeniops truncaticornis (Wulp, 1888)	*	Central America	Holotype		NHMUK
Beskiocephala flava Townsend, 1916	*	Brazil	Holotype	*	AMNH, CEIOC, CNC, DZUP, MZSP, USNM
Bischofimyia atra Townsend, 1927	*	Brazil	Holotype		USNM
Camposiana emarginata Townsend, 1915	*	Brazil	Holotype	*	MZSP, USNM
Catajurinia angusta Townsend, 1927	*	Brazil	Holotype	*	MNRJ, USNM
Chiloepalpus aureus (Aldrich, 1926)		Chile	Holotype		AMNH, USNM
Chiloepalpus callipygus (Bigot, 1857)		Argentina, Chile		*	CNC, MZSP, USNM
Chromatophania distinguenda Villeneuve, 1913		Uganda		*	CNC
Chromatophania fenestrata Villeneuve, 1913		Uganda		*	CNC
Chromoepalpus uruhuasi Townsend, 1914	*	Bolivia, Peru	Holotype	*	CNC, USNM
Copecrypta nitens (Wiedemann, 1830)		Brazil, Trinidad and Tobago		*	CNC, MZSP, USNM
Copecrypta ruficauda (Wulp, 1867)		Canada, Mexico, United States of America		*	CNC, MZSP, USNM
Corpulentoepalpus rufus Townsend, 1927	*	Brazil	Holotype	*	USNM
Corpulentosoma cornutum Townsend, 1914	*	Bolivia, Ecuador, Peru	Holotype		CNC, USNM
Cryptopalpus ornatus (Macquart, 1843)		Colombia, Ecuador, Peru, Venezuela		*	AMNH, CNC, MZSP, USNM
Cryptopalpus rubrum (Townsend), 1915		Peru	Holotype		USNM
Cyanogymnomma coerulea Townsend, 1927	*	Brazil	Holotype	*	MZSP, USNM
Cyanopsis costalis Townsend, 1917		Brazil, Paraguay	Holotype	*	AMNH, MZSP, USNM

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
Dejeania bombylans (Fabricius, 1798)		Uganda		*	CNC
Dejeania hecate Karsch, 1886		Uganda		*	CNC
Dejeaniops beckeri Engel, 1920		Colombia, Ecuador		*	CNC
Dejeaniops ollachea Townsend, 1913		Bolivia, Peru	Holotype		CNC, USNM
Deopalpus australis (Townsend, 1928)		Chile	Holotype		CNC, USNM
Deopalpus contiguus (Reinhard, 1934)		Canada, United States of America		*	CNC, USNM
Deopalpus hirsutus Townsend, 1908		Canada, Costa Rica, Mexico, United States of America	Holotype	*	AMNH, CNC, MZSP, USNM
Deopalpus pictipennis (Townsend, 1934)		Brazil, Ecuador	Holotype	*	DZUP, USNM
Diaphanomyia aurea Townsend, 1917		Bolivia, Brazil, Guyana, Paraguay, Peru, Venezuela	Holotype	*	AMNH, CNC, MZSP, USNM
Diaphanomyia aurifacies (Robineau-Desvoidy, 1830)		Brazil	Holotype	*	AMNH, CNC, MNHN, MZSP, USNM
Dumerillia rubida Robineau-Desvoidy, 1830		Brazil	Holotype	*	MNHN, MZSP
Echinopyrrhosia alpina Townsend, 1914		Bolivia, Peru			AMNH, CNC, USNM
Echinopyrrhosia browni Curran, 1941		Ecuador	Holotype	*	AMNH, CNC
Echinopyrrhosia pictipennis Curran,1941		Ecuador	Holotype	*	AMNH, CNC
Echinopyrrhosiops decorata (Townsend, 1931)	*	Bolivia	Holotype		USNM
Edwynia robusta (Aldrich, 1928)	*	Chile	Holotype	*	CNC, MZSP, USNM
Empheremyiops discalis Townsend, 1927	*	Brazil	Holotype		USNM
Epalpellus corpulentus Townsend, 1914	*	Peru	Holotype		USNM
Epalpodes equatorialis (Macquart, 1854)		Colombia, Ecuador, Peru		*	AMNH, CNC,

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
					MZSP, USNM
Epalpus albomaculatus (Jaennicke, 1867)		Costa Rica, Guatemala, Mexico, United States of America		*	CNC, USNM
Epalpus lineatus Townsend, 1914		Ecuador, Peru	Holotype	*	CNC, USNM
Epalpus niveus Townsend, 1914		Ecuador, Peru	Holotype	*	CNC, USNM
Epalpus rufipennis (Macquart, 1846)		Colombia			USNM
Epalpus signifer (Walker, 1849)		Canada, Mexico, United States of America		*	CNC, USNM
Epicuphocera andina Townsend, 1927	*	Peru	Holotype		USNM
Eubischofimyia analis Townsend, 1927	*	Brazil	Holotype		USNM
Eucorpulentosoma simile Townsend, 1914	*	Bolivia, Peru	Holotype	*	CNC, USNM
Eudejeania aldrichi Sabrosky, 1947		Colombia	Holotype	*	MZSP, USNM
Eudejeania subalpina Townsend, 1912		Bolivia, Colombia, Peru	Holotype		CNC, USNM
Euempheremyia nemo (Curran, 1947)		Brazil	Holotype	*	AMNH, MZSP
Euempheremyia paulensis Townsend, 1927		Brazil	Holotype	*	CNC, DZUP, USNM
Euepalpodes arcuatus Townsend, 1915	*	Peru	Holotype		USNM
Euepalpus vestitus (Townsend, 1916)		Brazil, Paraguay, Peru	Holotype	*	AMNH, CNC, MZSP, USNM
Eufabriciopsis quadrisetosa (Coquillett, 1902)	*	Mexico	Holotype		USNM
Euhuascaraya atra Townsend, 1927		Brazil	Holotype		USNM
Euhuascaraya obscura Curran, 1947		Brazil	Holotype		AMNH
Euhuascaraya siesta Curran, 1947		Brazil	Holotype	*	AMNH, MZSP
Eulasiopalpus albipes (Townsend, 1913)		Peru	Holotype		USNM

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
Eulasiopalpus vittatus Curran, 1947		Ecuador	Holotype	*	AMNH, MZSP
Eumelanepalpus ruber Townsend, 1915	*	Peru	Holotype		USNM
Eusaundersiops inortatus (Schiner, 1868)	*	Peru	Holotype of *Eusaundersiops notata* Townsend, junior synonym of *E. inornatus* (Schiner)		USNM
Eutrichophora punensis Townsend, 1915	*	Peru	Holotype	*	USNM
Exopalpus elegans (Townsend, 1927)		Brazil	Holotype	*	MZSP, USNM
Exopalpus ochracea (Townsend, 1914)		Peru	Holotype	*	USNM
Fabriciopsis hystrix Townsend, 1914		Peru	Holotype		USNM
Formicomyia ovata Townsend, 1916	*	Brazil	Holotype		AMNH
Formicomyia sp. nov.		Brazil			USNM
Gymnomma diaphanoides Curran, 1925		Brazil, Paraguay	Holotype		AMNH, MNRJ, USNM
Gymnomma sp. nov.		Brazil			MZSP
Gymnommopsis gagatea Townsend, 1927		Brazil	Holotype		USNM
Helioprosopa electilis Reinhard, 1964		Dominican Republic, Mexico	Holotype	*	CNC, USNM
Helioprosopa facialis Townsend, 1927		Brazil	Holotype	*	CNC, MZSP, USNM
Homosaundersia rufa (Schiner, 1868)	*	Venezuela	Paralectotype		USNM
Homosaundersia sp. nov. 1		Bolivia		*	CNC
Homosaundersia sp. nov. 2		Ecuador		*	MZSP

Species	**Species of monotypic genus**	**Country of examined specimens**	**Type material examined**	**Dissection of male terminalia**	**Depository**
Homosaundersiops haenschi Townsend, 1931	*	Colombia			USNM
Huascarayopsis paulensis Townsend, 1927	*	Brazil	Holotype	*	CNC, MZSP, USNM
Itacuphocera ocellaris Townsend, 1927		Brazil	Holotype	*	MZSP, USNM
Itasaundersia robusta Townsend, 1927	*	Brazil, Paraguay	Holotype	*	AMNH, USNM
Jurinella anax Curran, 1947		Brazil			AMNH
Jurinella bella Curran, 1947		Brazil			AMNH
Jurinella lutzi Curran, 1947		Mexico, United States of America			AMNH, CNC
Jurinella varians Curran, 1947		Brazil		*	AMNH
Jurinia paulensis (Townsend, 1927)		Brazil	Holotype	*	MZSP, USNM
Jurinia pompalis (Reinhard, 1941)		Canada, United States of America			CNC, USNM
Juriniopsis adusta Wulp, 1888		Canada, United States of America		*	CNC
Juriniopsis aurifrons Brooks, 1949		Mexico, United States of America	Holotype	*	CNC, USNM
Juriniosoma gagateum Townsend, 1927	*	Argentina, Brazil, Paraguay	Holotype	*	CNC, MZSP, USNM
Lindigepalpus townsendi Guimarães, 1971		Bolivia, Colombia, Peru, Venezuela	Holotype	*	CNC, USNM
Melanepalpellus corpulentus Townsend, 1927	*	Brazil	Holotype		USNM
Melanepalpus albipes Townsend, 1914		Peru	Holotype		USNM
Melanepalpus fulvus Townsend, 1914		Peru	Holotype		USNM
Microgymnomma orbitalis Townsend, 1916		Brazil	Holotype		AMNH, USNM
Microgymnomma paulensis Townsend, 1929		Brazil	Holotype	*	MZSP, USNM

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
Neocuphocera nepos Townsend, 1927		Brazil, Mexico, Trinidad and Tobago	Holotype	*	CNC, MZSP, USNM
Neocuphocera orbitalis (Aldrich, 1929)		Ecuador	Holotype		USNM
Neogymnomma rufa Townsend, 1915	*	Peru	Holotype		USNM
Neosarromyia neotropica Townsend, 1927		Brazil	Holotype		USNM
Neosarromyia trinitatis (Thompson, 1963)		Brazil, Trinidad and Tobago	Holotype	*	CNC, MNRJ
Ochroepalpus ochraceus Townsend, 1927		Brazil	Holotype	*	AMNH, CNC, MZSP, USNM
Oestrohystricia subalpina Townsend, 1912	*	Peru	Holotype		USNM
Oharamyia browni Curran, 1947		Bolivia, Ecuador	Holotype		AMNH, CNC
Oharamyia vierecki Curran, 1947		Colombia	Holotype		AMNH
Opsoempheria atra Townsend, 1927	*	Brazil	Holotype		USNM
Oxyepalpus flavoscutellatus (Bischof, 1904)	*	Brazil, Paraguay	Holotype	*	MZSP, USNM
Palpolinnaemyia perorbitalis Townsend, 1927	*	Peru	Holotype		USNM
Palpotachina similis Townsend, 1915	*	Mexico	Holotype		USNM
Paradejeania rutilioides rutilioides (Jaennicke, 1867)		Costa Rica, Guatemala, Mexico, United States of America		*	CNC, MZSP
Paradejeania xenisma Woodley, 1993		Dominican Republic	Holotype	*	USNM
Pararchytas apache Woodley, 1998		Mexico, United States of America		*	CNC
Pararchytas decisus (Walker, 1849)		United States of America	Holotype	*	CNC, NHMUK
Parechinotachina plumitarsis (Wulp, 1886)	*	Guatemala	Holotype		NHMUK
Parepalpus auroanalis (Townsend, 1931)		Bolivia, Peru	Holotype		CNC, USNM

Species	**Species of monotypic genus**	**Country of examined specimens**	**Type material examined**	**Dissection of male terminalia**	**Depository**
Parepalpus flavidus Coquillett, 1902		United States of America	Holotype	*	CNC, USNM
Parepalpus similis Townsend, 1914		Brazil, Peru	Holotype	*	MZSP, USNM
Peleteria (Oxydosphiria) iterans (Walker, 1849)		Canada, Mexico, United States of America			USNM
Peleteria (Panzeriopsis) cornigera Curran, 1925		United States of America			USNM
Peleteria (Panzeriopsis) cornuta Curran, 1925		United States of America			USNM
Peleteria (Peleteria) abdominalis Robineau-Desvoidy, 1830		Greece			USNM
Peleteria (Peleteria) aldrichi Curran, 1925		United States of America			USNM
Peleteria (Sphyrimyia) malleola (Bigot,1883)		United States of America		*	CEIOC
Peleteria (Sphyrimyia) obsoleta Curran, 1925		United States of America			USNM
Peleteria (Sphyrimyia) setosa Curran, 1925		Mexico, United States of America			USNM
Peleteria filipalpis (Rondani, 1963)		Mexico			MZSP
Peleteria pygmaea (Macquart, 1851)		Brazil, Chile		*	CEIOC
Peleteria robusta (Wiedemann, 1830)		Brazil		*	CEIOC, USNM
Periopticochaeta pendula Townsend, 1927	*	Brazil	Holotype	*	MZSP, USNM
Phosocephala metallica Townsend, 1908		Costa Rica	Holotype	*	CNC, INPA, USNM
Phosocephala sp. nov.		Costa Rica	Holotype	*	CNC
Pictoepalpus clarus Townsend, 1915	*	Peru	Holotype		AMNH, USNM
Prospanipalpus peruvianus Townsend, 1931	*	Peru	Holotype		USNM
Protodejeania hystricosa (Williston, 1886)		Canada, Mexico, United States of America		*	CNC, MZSP
Pseudoxanthozonella similis Townsend, 1931	*	Ecuador	Holotype		NHMUK

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
Quadratosoma rufum Townsend, 1914	*	Ecuador, Peru	Holotype		CNC, USNM
Rhachoepalpus cinereus Townsend, 1914		Peru			
Rhachoepalpus ethelius Curran, 1947		Brazil	Holotype		AMNH
Rhachoepalpus olivaceus Townsend, 1908		Costa Rica, Guatemala, Mexico, United States of America	Holotype	*	CNC, USNM
Rhachoepalpus pulverulentus (Schiner, 1868)		Ecuador		*	MZSP
Rhachosaundersia boliviana Townsend, 1931	*	Bolivia		*	CNC
Ruiziella frontosa Cortés, 1951		Argentina, Chile			CNC, USNM
Ruiziella luctuosa Cortés, 1951		Argentina, Chile	Paratype	*	CNC, USNM
Saundersiops cayensis Townsend, 1914		Peru	Holotype		USNM
Saundersiops confluens Townsend, 1914		Peru	Holotype	*	CNC, USNM
Saundersiops cruciatus Townsend, 1914		Chile, Peru	Holotype		USNM
Signosoma impressum Townsend, 1914	*	Peru	Holotype		USNM
Signosomopsis argentea Townsend, 1914		Peru	Holotype		USNM
Signosomopsis eronis Curran, 1929		Peru	Holotype		USNM
Signosomopsis townsendi Curran, 1929		Colombia, Ecuador, Peru	Holotype	*	CNC, USNM
Sorochemyia oroya Townsend, 1915	*	Peru	Holotype		USNM
Steatosoma rufiventris Aldrich, 1934		Chile			MZSP
Tachina (Nowickia) egula (Reinhard, 1938)		United States of America			USNM
Tachina (Nowickia) ferox (Panzer, 1809)		Germany		*	MZSP
Tachina (Rhachogaster) algens Wiedemann, 1830		Canada, United States of America		*	CEIOC
Tachina (Rhachogaster) nitida (Wulp, 1882)		Canada, United States of		*	MZSP, USNM

Species	**Species of monotypic genus**	**Country of examined specimens**	**Type material examined**	**Dissection of male terminalia**	**Depository**
		America			
Tachina (Tachina) fera (Linnaeus, 1761)		Italy, Switzerland		*	CEIOC, USNM
Tachina (Tachina) grossa (Linnaeus, 1758)		France			MNRJ
Tachina (Tachina) lurida (Fabricius, 1781)		France		*	MNRJ
Tachina (Tachina) ursina Meigen, 1824		France		*	MNRJ
Talarocera nigripennis (Wiedemann, 1830)	*	Brazil		*	MZSP
Trichoepalpus emarginatus Townsend, 1914	*	Ecuador	Holotype		USNM
Trichophora analis Schiner, 1868		Colombia			USNM
Trichophora nigra Macquart, 1843		Bolivia, Brazil, Costa Rica, Ecuador, Peru		*	CNC, MZSP, USNM
Trichosaundersia dorsopunctata (Macquart, 1843)		Venezuela		*	MZSP
Trichosaundersia lineata Townsend, 1914		Peru, Panama	Holotype		USNM
Trichosaundersia rufopilosa (Wulp, 1888)		Costa Rica, Mexico	Holotype		NHMUK, USNM
Uruhuasia cruciata Townsend, 1914		Peru	Holotype		USNM
Uruhuasiopsis analis Townsend, 1915	*	Peru	Holotype		USNM
Vertepalpus verdans Curran, 1947	*	Ecuador	Holotype	*	AMNH, CNC, MZSP
Vibrissoepalpus flavipes Townsend, 1915	*	Peru	Holotype		USNM
Vibrissomyia bicolor Townsend, 1912		Peru	Holotype	*	MZSP, USNM
Vibrissomyia lineolata (Bigot, 1888)		Chile, Peru	Holotype	*	CNC, NHMUK, USNM
Vibrissomyia oroyensis Townsend, 1914		Peru	Holotype		USNM
Xanthoepalpodes bischofi Townsend, 1931	*	Bolivia		*	CNC
Xanthoepalpus bicolor (Williston, 1886)		Canada, Mexico, Panama,		*	AMNH, CNC,

Species	Species of monotypic genus	Country of examined specimens	Type material examined	Dissection of male terminalia	Depository
		United States of America			MZSP, USNM
Xanthozona melanopyga (Wiedemann, 1830)		Brazil, Colombia, Ecuador, French Guiana, Panama, Paraguay, Peru		*	AMNH, CNC, DZUP, MNHN, MNRJ, MZSP, USNM
Zonoepalpus testaceus (Robineau-Desvoidy, 1830)		Brazil		*	AMNH, MZSP, USNM

Table 10: List of genera not included in the phylogenetic inference of Neotropical Tachinini due to lack of available material. The respective biogeographical regions where each genus is found are included, and each monotypic genus is identified with an asterisk (*). Classification follows O'Hara, Henderson and Wood (2020).

Genera	**Monotypic**	**Biogeographical region**
Acuphoceropsis Blanchard, 1943	*	Neotropical
Allelomyia González, 1992	*	Neotropical
Anaeudora Townsend, 1933		Oriental, Palearctic
Androsoma Cortés & Campos, 1971	*	Neotropical
Chaetoepalpus Vimmer & Soukup, 1940	*	Neotropical
Chrysomikia Mesnil, 1970		Oriental, Palearctic
Comopsis Cortés, 1986	*	Neotropical
Empheremyia Bischof, 1904		Neotropical
Eristaliomyia Townsend, 1926	*	Australasian, Oriental
Erythroepalpus Townsend, 1931	*	Neotropical
Eujuriniodes Townsend, 1935		Neotropical
Gigantoepalpus Townsend, 1931	*	Neotropical
Hegesinus Reinhard, 1964	*	Neotropical
Laufferiella Villeneuve, 1929		Palearctic
Macrojurinia Townsend, 1916	*	Neotropical
Mesnilisca Zimin, 1974	*	Palearctic
Microtropesa Macquart, 1846		Australasian
Mikia Kowarz, 1885		Oriental, Palearctic
Paratachina Brauer & Bergenstamm, 1891		Afrotropical
Paratropeza Paramonov, 1963		Australasian
Platyschineria Villeneuve, 1942	*	Afrotropical
Pseudoepalpodes Vimmer & Soukup, 1940	*	Neotropical
Pseudoxanthozona Townsend, 1931	*	Neotropical
Pyrrhotachina Townsend, 1931	*	Neotropical
Sarromyia Pokorny, 1893	*	Palearctic
Schineria Rondani, 1857		Palearctic, Oriental
Sericotachina Townsend, 1916	*	Oriental
Tothillia Crosskey, 1976		Oriental
Trypherina Malloch, 1938	*	Australasian

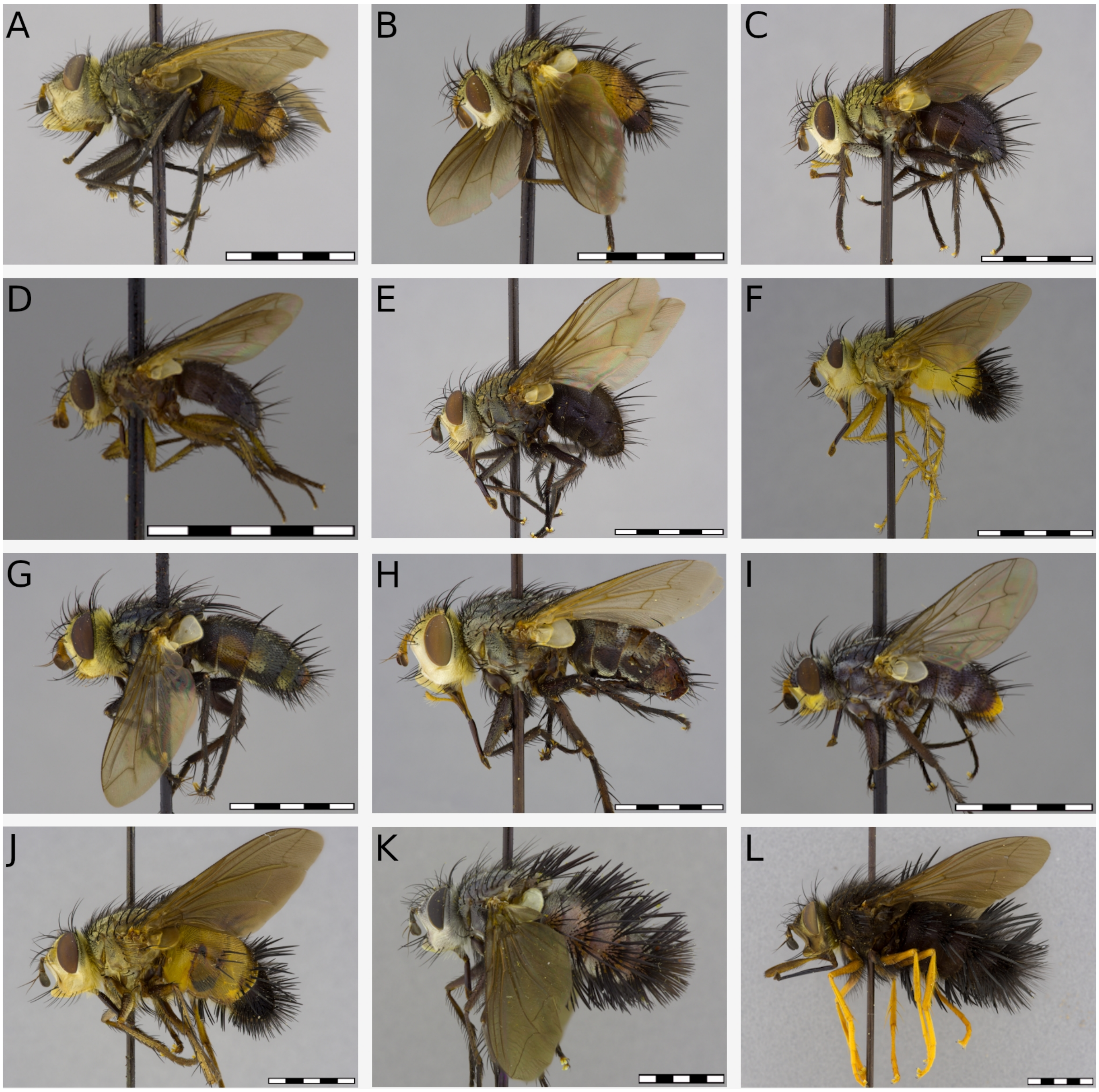


Figure 14: Diversity of species of Tachinini. **A.** *Epalpodes equatorialis* (Macquart, 1854). **B.** *Periopticochaeta pendula* Townsend, 1927. **C.** *Exopalpus elegans* (Townsend, 1927). **D.** *Neosarromyia neotropica* Townsend, 1927. **E.** *Euhuascaraya atra* Townsend, 1927. **F.** *Oxyepalpus flavoscutellatus* (Bischof, 1904). **G.** *Neocuphocera nepos* Townsend, 1927. **H.** *Archytas (Archytas) marmoratus* (Townsend, 1915). **I.** *Helioprosopa facialis* Townsend, 1927. **J.** *Itasaundersia robusta* Townsend, 1927. **K.** *Rhachoepalpus argenteus* Townsend, 1914. **L.** *Eudejeania nigra* Townsend, 1912. Scale bar = 5 mm.

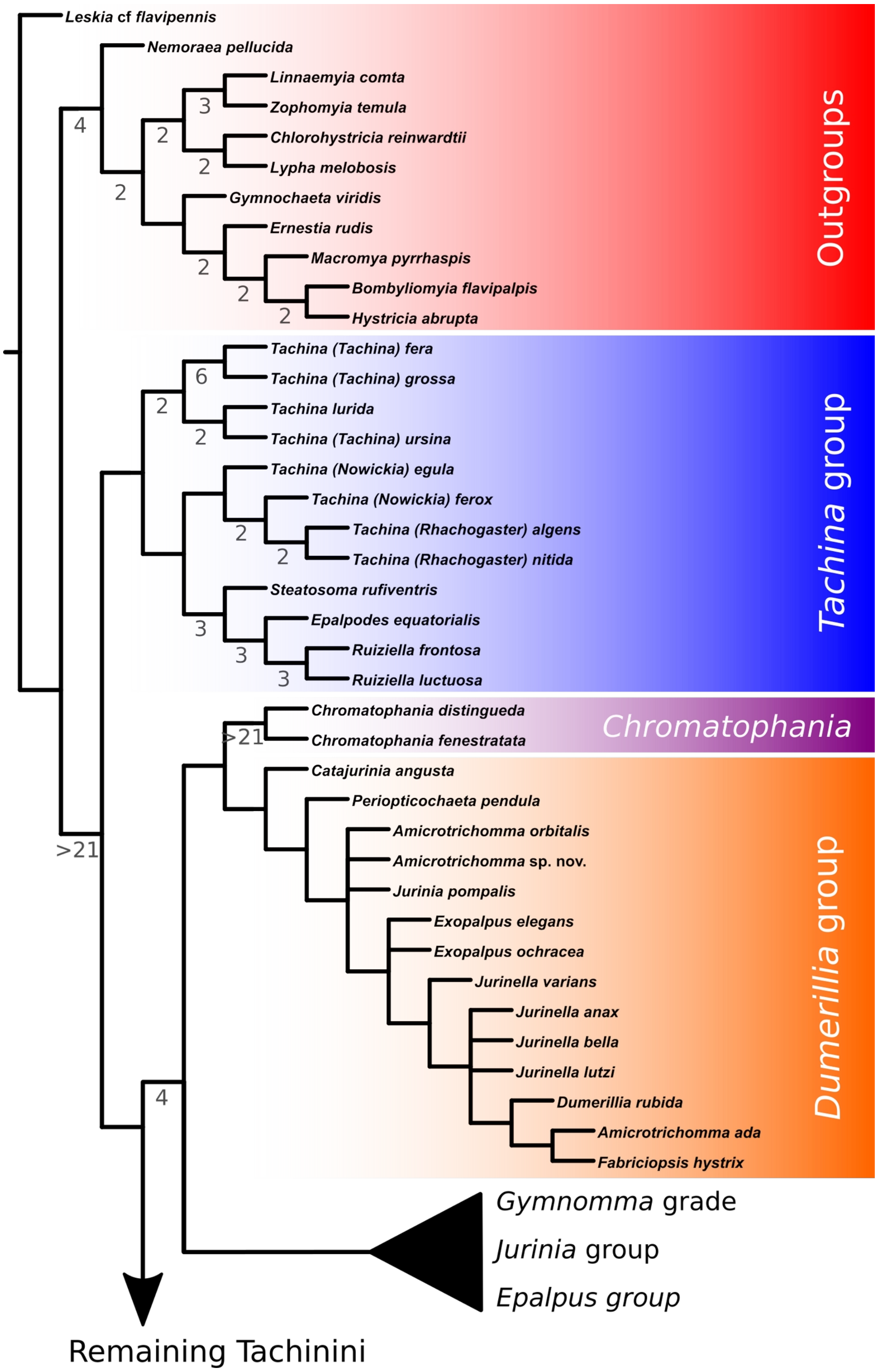


Figure 15: Strict consensus tree (part 1 of 5) of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters. Only values of Bremer support higher than 1 are indicated below their respective nodes.

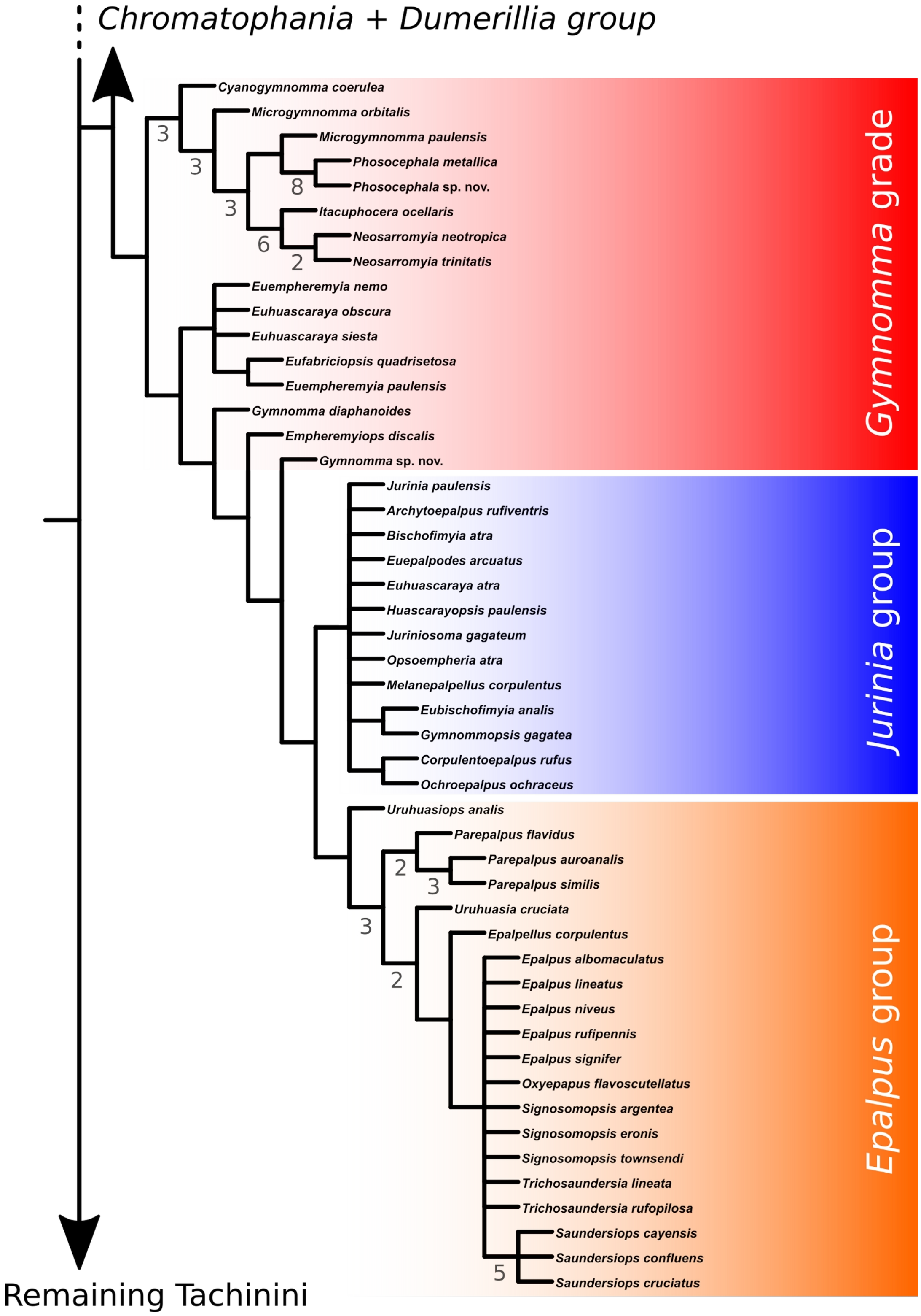


Figure 16: Strict consensus tree (part 2 of 5) of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters. Only values of Bremer support higher than 1 are indicated below their respective nodes.

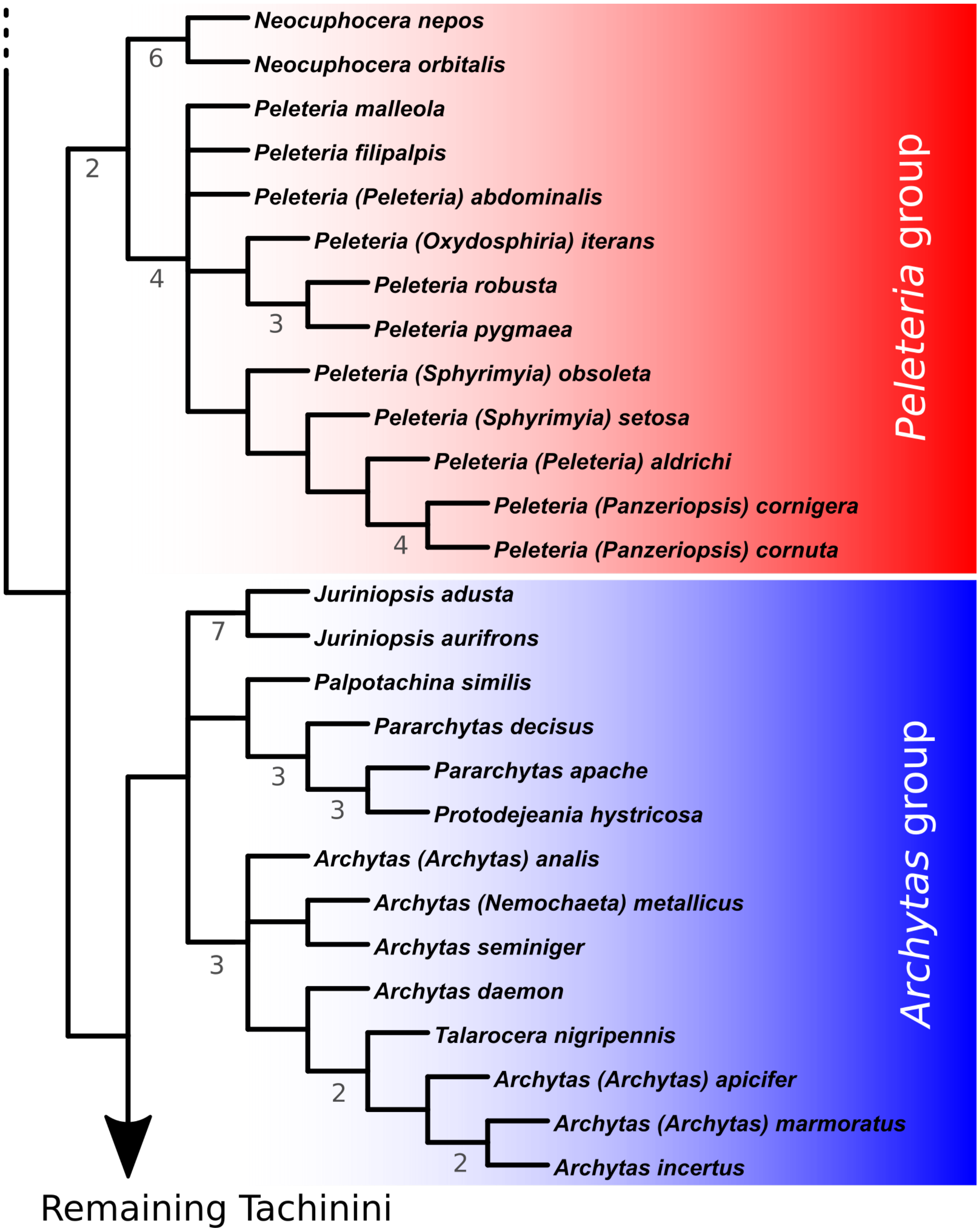


Figure 17: Strict consensus tree (part 3 of 5) of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters. Only values of Bremer support higher than 1 are indicated below their respective nodes.

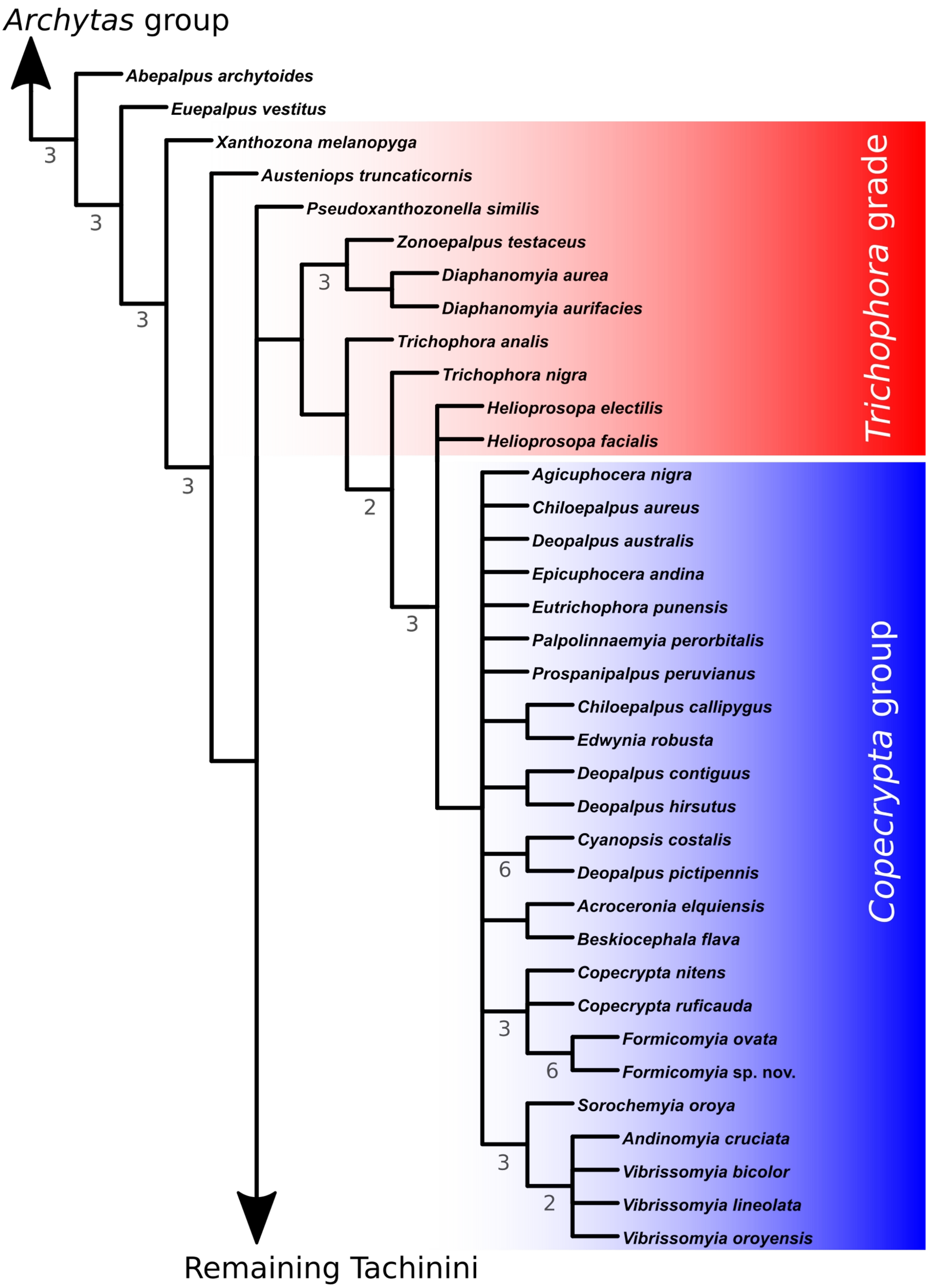


Figure 18: Strict consensus tree (part 4 of 5) of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters. Only values of Bremer support higher than 1 are indicated below their respective nodes.

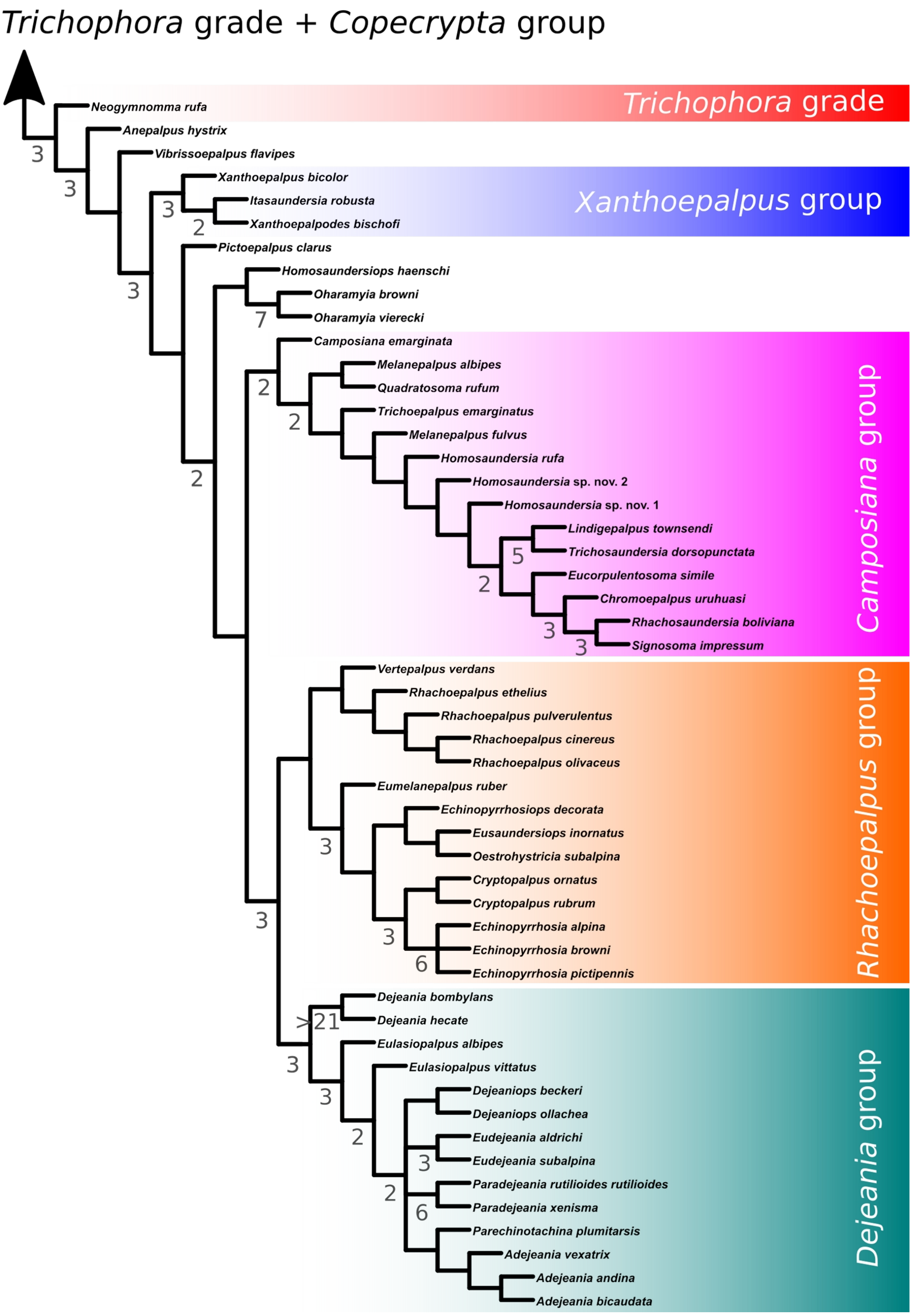


Figure 19: Strict consensus tree (part 5 of 5) of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters. Only values of Bremer support higher than 1 are indicated below their respective nodes.

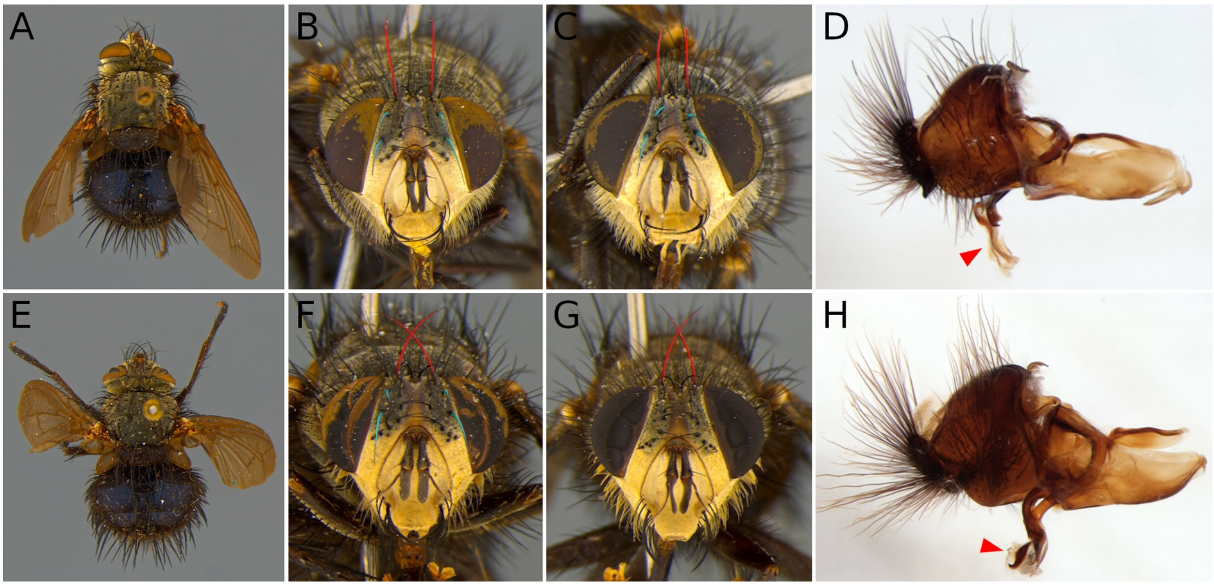
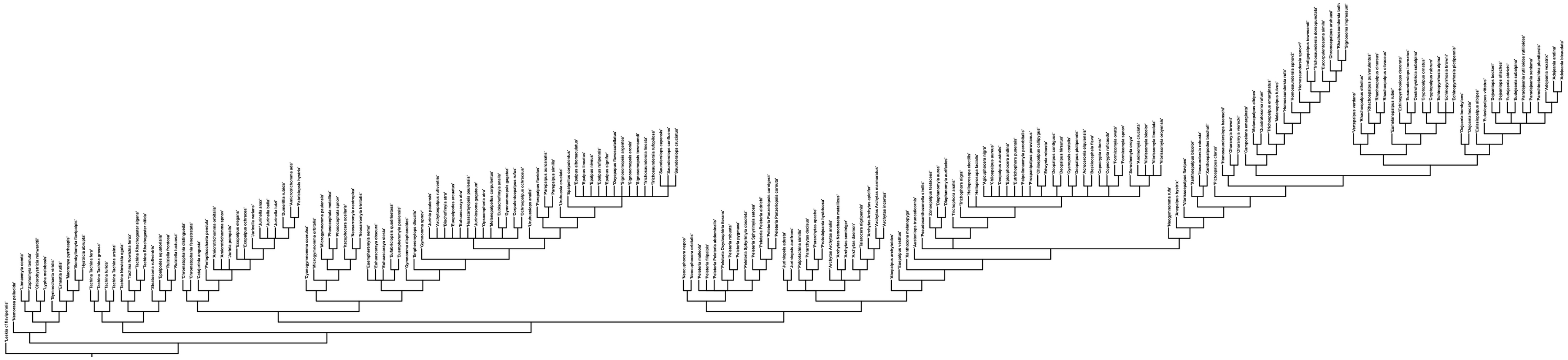


Figure 20: Comparison of a new species of *Gymnomma* (A–D) with *Jurinia paulensis* (Townsend) (E–H), showing dorsal habitus of female (A, E), head of female (B, F), head of male (C, G), and male terminalia (D, H). Note the differences in diagnostic characters of both genera, such as the orientation of inner vertical setae (marked in red), the presence of proclinate orbital setae on males (marked in blue), and the shape of apical part of distiphallus (red arrow). Both species occur in the Atlantic Forest of Southeast Region of Brazil.

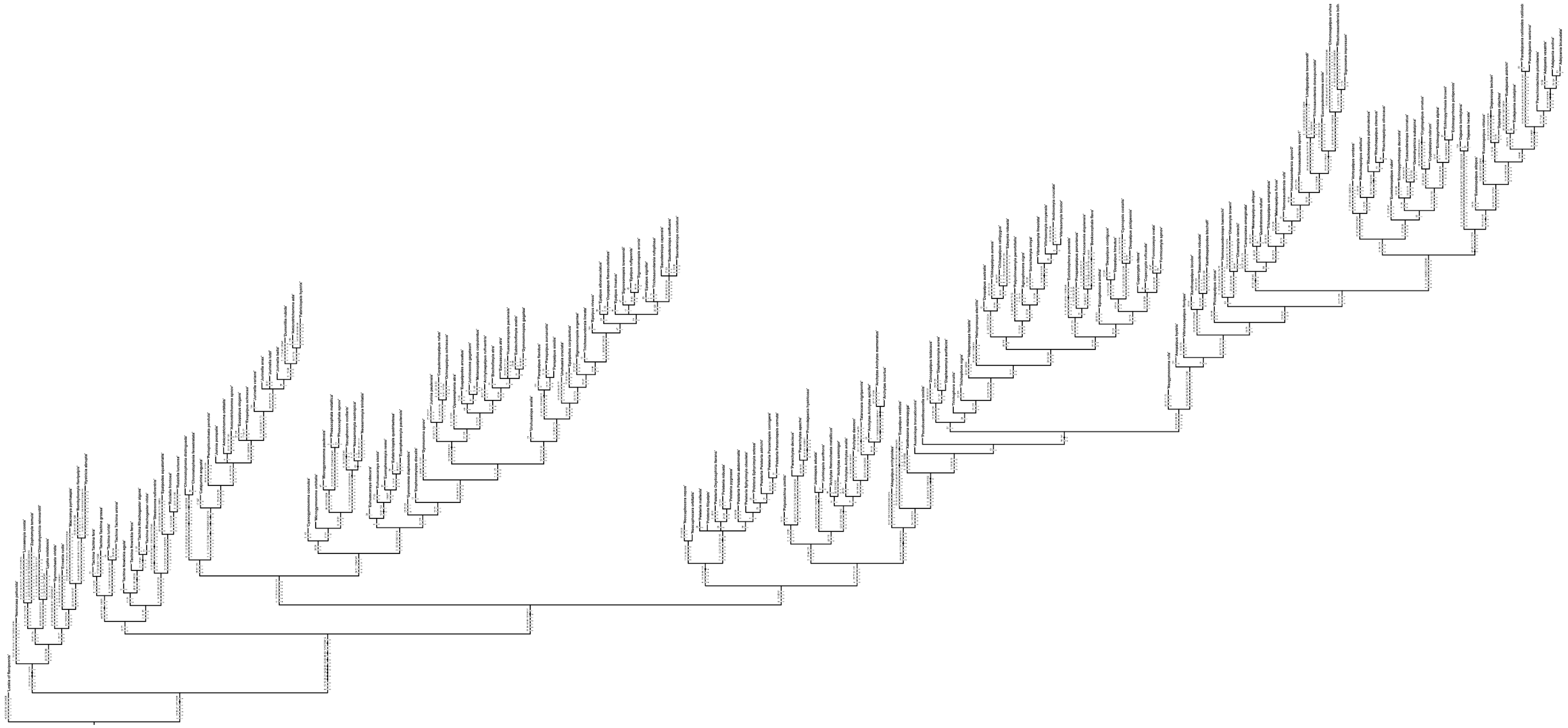
SUPPLEMENTARY INFORMATION 1

Strict consensus tree of 256 most parsimonious trees under equal weights generated under the parsimony criterion in TNT, using 192 species of Tachinini and 146 morphological characters.



SUPPLEMENTARY INFORMATION 2

Unambiguous optimization of 146 morphological characters in one of the most parsimonious trees generated under the parsimony criterion in TNT, using 192 species of Tachinini. Black circles on nodes represent synapomorphic characters states and white circles on nodes represent homoplastic character states. Numbers above nodes correspond to the number of the character in the list of morphological characters (section 2.4.1), and numbers below nodes correspond to the respective character state.



Supplementary information 3

Morphological character matrix used to infer the phylogeny of Tachinini (part 1of 4).

Species/ Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Abepalpus archytoides	0	0	1	-	1	0	0	0	1	0	0	-	1	0	-	1	1	0	0	1	0	0	1	0	-	1	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Acroceronia elquiensis	0	0	0	1	0	1	0	0	1	0	1	0	1	1	0	0	1	1	0	2	1	0	1	2	0	0	1	1	1	0	1	-	-	-	2	1	0	0	0	1
Adejeania andina	0	0	1	-	1	0	0	0	1	0	1	0	0	0	-	1	1	0	0	0	0	0	0	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Adejeania bicaudata	0	0	1	-	1	0	0	0	1	0	1	0	0	0	-	1	1	0	0	0	0	0	0	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Adejeania vexatrix	0	0	1	-	1	0	0	0	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Agicuphocera nigra	0	0	0	0	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	1	0	0	1	2	0	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Amicrotrichomma ada	1	0	1	-	1	0	0	1	?	0	?	?	1	0	-	1	1	0	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Amicrotrichomma orbitalis	1	0	1	-	1	0	1	1	?	0	?	?	1	0	-	1	1	1	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Amicrotrichomma sp. nov.	1	0	1	-	1	0	1	1	?	0	?	?	1	0	-	1	1	1	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Andinomyia cruciata	0	0	0	0	0	0	0	0	2	0	1	0	1	1	0	0	0	2	0	1	1	0	1	3	0	1	2	1	1	0	1	-	-	-	2	1	0	0	0	1
Anepalpus hystrix	0	0	1	-	1	0	1	0	1	0	1	0	1	1	0	1	1	2	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Archytas (Archytas) analis	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	-	1	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Archytas (Archytas) apicifer	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	-	1	1	1	1	2	-	0	1	0	1	1	0	1	0	1
Archytas (Archytas) marmoratus	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	1	0	0	0	-	1	1	1	1	2	-	0	1	0	1	1	0	1	0	1
Archytas daemon	0	0	1	-	1	0	0	2	1	0	1	0	1	0	-	1	0	0	0	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	1	1	1
Archytas incertus	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	1	0	0	0	-	1	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Archytas (Nemochaeta) metallicus	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	0	0	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Archytas seminiger	0	0	1	-	1	0	0	0	?	0	?	?	1	1	0	1	0	0	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Archytoepalpus rufiventris	0	1	0	1	1	0	1	0	1	0	0	-	1	1	0	1	1	0	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Austeniops truncaticornis	0	0	1	-	1	0	1	0	?	0	?	?	1	0	-	1	1	2	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Beskiocephala flava	0	0	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	1	2	2	0	0	0	1	0	0	1	1	1	0	2	-	-	-	2	1	0	0	0	1
Bischofimyia atra	0	1	0	1	1	0	1	?	1	?	0	-	1	?	?	1	1	?	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1

Species/ Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Bombyliomyia flavipalpis	1	1	0	0	1	0	-	0	1	1	0	-	0	0	-	0	1	0	0	0	1	0	1	0	-	0	1	0	1	2	-	0	1	1	0	0	1	0	0	0
Camposiana emarginata	0	0	1	-	1	0	1	0	1	0	1	0	1	0	-	1	1	1	0	1	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Catajurinia angusta	1	0	1	-	1	1	0	2	1	0	0	-	0	0	-	1	1	1	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Chiloepalpus aureus	0	0	0	0	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	2	0	0	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Chiloepalpus callipygus	0	1	0	0	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	2	0	1	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Chlorohystricia reinwardtii	1	0	1	-	1	0	0	0	1	0	0	-	0	0	-	1	1	1	0	0	0	1	-	0	-	0	1	1	1	2	-	0	1	1	0	0	1	0	0	0
Chromatophania distingueda	0	1	0	1	1	1	0	1	1	0	0	-	0	0	-	0	0	1	0	2	1	0	0	0	-	0	0	0	1	2	-	0	1	0	0	0	1	0	0	0
Chromatophania fenestratata	0	1	0	1	1	1	0	1	1	0	0	-	0	0	-	0	0	1	0	2	1	0	0	0	-	0	0	0	1	2	-	0	1	0	0	0	1	0	0	0
Chromoepalpus uruhuasi	0	0	1	-	1	0	1	0	0	0	0	-	1	0	-	0	1	0	0	0	0	0	1	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Copecrypta nitens	0	0	1	-	1	0	1	0	1	0	1	0	0	1	1	1	1	2	0	2	0	0	1	2	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Copecrypta ruficauda	0	0	1	-	1	0	1	0	1	0	1	0	0	1	1	1	1	2	0	2	0	0	1	2	0	0	1	1	1	0	2	-	-	-	0	1	0	0	0	1
Corpulentoepalpus rufus	0	1	1	-	1	0	0	?	1	?	1	0	?	?	?	?	1	?	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Corpulentosoma cornutum	0	0	1	-	1	0	0	1	1	0	1	0	1	0	-	1	1	2	0	1	0	0	1	1	0	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Cryptopalpus ornatus	1	0	1	-	0	0	0	0	1	0	0	-	1	0	-	0	1	1	0	0	1	0	1	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Cryptopalpus rubrum	1	0	1	-	0	0	0	?	1	?	0	-	1	?	?	0	1	?	0	0	1	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Cyanogymnomma coerulea	0	1	0	0	1	1	0	0	1	0	0	-	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Cyanopsis costalis	0	1	0	0	1	0	0	0	1	0	0	-	0	0	-	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	2	-	-	-	1	1	0	0	1	1
Dejeania bombylans	0	1	0	1	1	0	0	3	1	0	0	-	1	0	-	0	0	2	0	1	0	0	1	1	1	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Dejeania hecate	0	1	0	1	1	0	0	3	1	0	0	-	1	0	-	0	0	2	0	1	0	0	1	1	1	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Dejeaniops beckeri	1	0	1	-	1	0	0	0	1	0	1	0	0	0	-	1	1	0	0	0	0	0	1	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Dejeaniops ollachea	1	0	1	-	1	0	0	?	1	?	1	0	0	?	?	1	1	?	0	0	0	0	1	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Deopalpus australis	0	1	0	0	1	0	1	0	1	0	1	0	1	1	0	1	1	1	0	1	0	0	1	2	0	1	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Deopalpus contiguus	0	0	1	-	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	1	0	0	1	2	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Deopalpus hirsutus	0	0	1	-	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	1	0	0	1	2	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Deopalpus pictipennis	0	1	1	-	1	0	1	0	1	0	0	-	0	1	0	1	1	1	0	0	0	0	0	2	0	0	1	1	0	0	2	-	-	-	1	1	0	1	1	1

Species/ Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Diaphanomyia aurea	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Diaphanomyia aurifacies	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Dumerillia rubida	1	0	1	-	1	0	0	2	1	0	1	0	0	0	-	1	1	0	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	1	1
Echinopyrrhosia alpina	1	0	1	-	0	0	0	0	1	1	0	-	1	0	-	0	0	1	0	0	1	0	1	0	-	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Echinopyrrhosia browni	1	0	1	-	0	0	0	0	1	1	0	-	1	0	-	0	1	1	0	0	1	0	1	0	-	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Echinopyrrhosia pictipennis	1	0	1	-	0	0	0	0	1	1	0	-	1	0	-	0	1	1	0	0	1	0	1	0	-	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Echinopyrrhosiops decorata	0	0	0	0	0	0	0	?	1	?	0	-	1	?	?	0	1	?	0	1	1	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Edwynia robusta	0	1	0	1	1	0	0	0	2	0	1	1	1	1	0	1	1	0	0	1	0	0	1	2	0	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Empheremyiops discalis	0	0	0	1	1	1	1	2	?	0	?	?	1	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Epalpellus corpulentus	0	1	1	-	1	0	1	0	?	0	?	?	1	1	0	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Epalpodes equatorialis	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	1	1	1	0	1	3	0	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Epalpus albomaculatus	0	1	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Epalpus lineatus	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Epalpus niveus	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Epalpus rufipennis	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Epalpus signifer	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Epicuphocera andina	0	0	1	-	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	0	2	-	-	-	1	1	0	0	0	1
Ernestia rudis	1	1	0	1	1	0	1	0	1	1	0	-	0	0	-	0	1	1	0	1	1	1	-	0	-	1	1	1	1	2	-	0	1	1	0	0	1	0	0	0
Eubischofimyia analis	0	1	0	1	1	0	1	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	1	1	1	0	2	-	-	-	0	1	0	0	0	1
Eucorpulentosoma simile	0	0	0	0	1	0	0	2	1	0	0	-	0	0	-	-	1	1	0	1	0	0	1	0	-	1	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Eudejeania aldrichi	0	0	1	-	1	0	0	0	1	0	0	-	0	0	-	1	1	0	0	1	1	0	1	0	-	0	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Eudejeania subalpina	0	0	1	-	1	0	0	0	-	0	0	-	0	0	-	1	1	0	0	1	1	0	1	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Euempheremyia nemo	0	1	0	0	1	1	1	2	1	0	1	0	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Euempheremyia paulensis	0	0	0	1	1	1	0	2	1	0	1	0	1	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Euepalpodes arcuatus	0	0	0	?	1	0	1	?	1	?	0	-	1	?	?	1	1	?	0	0	0	0	0	0	-	1	2	1	1	0	2	-	-	-	0	1	0	0	0	1
Euepalpus vestitus	0	1	1	-	1	0	0	0	1	0	0	-	1	1	0	1	1	1	0	0	1	0	1	0	-	1	1	1	1	0	2	-	-	-	0	1	0	1	1	1

Species/ Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Eufabriciopsis quadrisetosa	0	0	0	1	1	1	0	2	?	0	?	?	1	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Euhuascaraya atra	0	1	0	0	1	0	1	?	1	?	0	-	1	?	?	0	1	?	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Euhuascaraya obscura	0	0	0	0	1	1	1	2	1	0	1	0	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Euhuascaraya siesta	0	1	0	0	1	1	1	2	1	0	1	0	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Eulasiopalpus albipes	0	1	1	-	1	0	0	0	1	0	0	-	0	0	-	1	1	1	0	1	1	0	1	0	-	1	2	1	1	3	-	1	1	1	2	1	0	0	0	1
Eulasiopalpus vittatus	0	1	1	-	1	0	0	0	1	0	0	-	0	0	-	1	1	1	0	0	1	0	1	0	-	1	2	1	1	3	-	1	1	1	2	1	0	0	0	1
Eumelanepalpus ruber	0	0	1	-	0	0	1	0	1	0	0	-	1	0	-	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Eusaundersiops inornatus	0	0	0	0	0	0	0	0	?	0	?	?	1	0	-	0	1	1	0	0	0	0	1	0	-	1	2	1	1	0	0	-	-	-	1	1	0	0	0	1
Eutrichophora punensis	0	2	0	1	0	0	0	0	1	0	1	1	1	1	0	1	1	1	0	1	0	0	1	3	0	0	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Exopalpus elegans	1	0	1	-	1	0	1	0	1	0	0	-	1	1	0	1	1	1	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Exopalpus ochracea	1	0	1	-	1	0	1	0	1	0	0	-	1	1	0	1	1	1	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Fabriciopsis hystrix	0	0	1	-	1	0	0	2	?	0	?	?	1	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	1	1	1
Formicomyia ovata	0	0	1	-	1	0	1	?	1	?	1	0	0	?	?	0	1	?	0	2	0	0	1	2	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Formicomyia sp. nov.	0	0	1	-	1	0	1	0	1	0	1	0	0	1	0	1	1	2	0	2	0	0	1	2	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Gymnochaeta viridis	1	0	0	1	1	0	0	0	1	1	0	-	1	0	-	0	1	1	0	0	0	1	-	0	-	0	0	1	1	2	-	0	1	0	0	0	1	0	0	0
Gymnomma diaphanoides	0	0	0	0	1	1	1	2	1	0	0	-	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Gymnomma sp. nov.	0	0	0	0	1	1	0	2	1	0	0	-	1	0	-	1	1	1	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Gymnommopsis gagatea	0	1	0	1	1	0	1	?	1	?	0	-	1	?	?	0	1	?	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Helioprosopa electilis	0	1	1	-	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	1	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Helioprosopa facialis	0	2	1	-	1	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Homosaundersia rufa	0	0	1	-	1	0	1	?	1	?	0	-	1	?	?	1	1	?	0	1	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Homosaundersia sp. nov. 1	0	0	1	-	1	0	1	0	1	0	0	-	0	0	-	1	1	0	0	1	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Homosaundersia sp. nov. 2	0	0	1	-	1	0	1	0	1	0	0	-	0	0	-	1	1	1	0	1	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Homosaundersiops haenschi	0	0	1	-	1	0	0	?	1	?	1	1	1	?	?	1	1	?	0	0	0	0	1	0	-	1	2	1	1	0	2	-	-	-	0	1	0	1	0	1
Huascarayopsis paulensis	0	1	0	0	1	0	1	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Hystricia abrupta	1	0	0	1	1	0	0	0	0	1	0	-	0	0	-	0	1	1	0	1	1	0	1	0	-	0	1	0	1	2	-	0	1	1	0	0	1	0	0	0

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Itacuphocera ocellaris	0	0	0	1	1	0	0	0	1	0	1	0	0	0	-	1	1	1	0	1	0	0	1	2	0	0	1	1	0	1	-	0	0	1	0	1	0	0	0	1
Itasaundersia robusta	0	0	1	-	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	0	-	0	2	1	1	0	2	-	-	-	0	1	0	1	1	1
Jurinella anax	1	0	1	-	1	0	0	0	1	0	0	-	1	1	0	1	1	0	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Jurinella bella	1	0	1	-	1	0	0	0	1	0	0	-	1	1	0	1	1	0	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Jurinella lutzi	1	0	1	-	1	0	0	0	1	0	0	-	1	1	0	1	1	0	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Jurinella varians	1	0	1	-	1	0	0	0	1	0	0	-	1	1	0	1	1	0	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Jurinia paulensis	0	0	0	1	1	0	1	0	1	0	0	-	1	0	-	1	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Jurinia pompalis	1	0	1	-	1	0	1	0	1	0	0	-	1	0	-	1	1	1	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	0	1	0	0	0	1
Juriniopsis adusta	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	1	1	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Juriniopsis aurifrons	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	1	1	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Juriniosoma gagateum	0	1	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Leskia cf *flavipennis*	0	1	0	1	1	0	0	0	1	1	0	-	0	0	-	0	1	1	0	0	2	1	-	0	-	1	1	1	1	2	-	0	1	0	1	0	0	0	0	0
Lindigepalpus townsendi	0	0	1	-	1	0	0	0	1	0	0	-	1	0	-	1	1	2	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Linnaemyia comta	1	1	0	1	1	1	0	2	1	0	0	-	1	1	0	0	1	1	0	1	1	0	0	0	-	0	1	1	1	1	-	2	0	1	0	0	1	0	0	0
Lypha melobosis	1	1	0	0	1	1	0	0	1	1	0	-	0	0	-	0	1	1	0	0	1	1	-	0	-	0	0	1	1	1	-	0	1	1	0	0	1	0	0	0
Macromya pyrrhaspis	1	1	0	0	1	0	0	0	1	1	0	-	0	0	-	0	1	1	0	0	1	1	-	0	-	0	1	0	0	2	-	0	1	1	0	0	1	0	0	0
Melanepalpellus corpulentus	0	1	0	1	1	0	0	0	?	0	?	?	1	1	0	1	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Melanepalpus albipes	0	1	1	-	1	0	0	?	1	?	1	0	1	?	?	1	1	?	0	1	0	0	1	0	-	0	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Melanepalpus fulvus	0	0	1	-	1	0	1	0	?	0	?	?	1	1	0	1	1	1	0	0	0	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Microgymnomma orbitalis	0	1	0	1	1	1	0	2	?	0	?	?	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Microgymnomma paulensis	0	1	0	1	1	1	0	2	1	0	1	0	1	0	-	1	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Nemoraea pellucida	1	0	0	1	1	1	0	0	2	1	0	-	0	1	0	0	1	1	0	0	1	1	-	0	-	0	0	0	1	2	-	0	1	1	0	0	1	0	0	0
Neocuphocera nepos	0	0	1	-	1	1	0	2	1	0	0	-	1	0	-	1	1	0	1	1	0	0	0	2	0	1	1	1	1	0	2	-	-	-	1	1	0	0	1	1
Neocuphocera orbitalis	0	0	1	-	1	1	0	2	1	0	0	-	1	0	-	1	1	0	1	1	0	0	0	2	0	1	1	1	1	0	2	-	-	-	1	1	0	0	1	1
Neogymnomma rufa	0	0	1	-	1	0	1	?	1	?	1	0	1	?	?	1	1	?	0	1	0	0	1	1	0	1	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Neosarromyia neotropica	0	0	0	1	1	0	1	2	1	0	1	0	0	0	-	1	1	1	0	1	0	0	1	2	0	0	1	1	0	1	-	0	0	1	0	1	0	0	0	1

Species/ Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Neosarromyia trinitatis	0	0	0	1	1	0	0	2	1	0	1	0	0	0	-	1	1	1	0	1	0	0	1	2	0	0	1	1	0	1	-	0	0	1	1	1	0	0	0	1
Ochroepalpus ochraceus	0	0	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Oestrohystricia subalpina	0	0	0	0	0	0	0	?	1	?	0	-	1	?	?	0	0	?	0	1	1	0	1	0	-	1	2	1	1	0	0	-	-	-	1	1	0	0	0	1
Oharamyia browni	1	0	1	-	1	0	1	0	?	0	?	?	0	1	0	1	1	1	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Oharamyia vierecki	1	0	1	-	1	0	1	?	1	?	1	0	0	?	?	1	1	1	0	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Opsoempheria atra	0	0	0	0	1	0	1	0	1	0	1	0	1	0	-	1	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Oxyepapus flavoscutellatus	0	1	1	-	1	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Palpolinnaemyia perorbitalis	1	0	1	-	1	0	1	3	?	0	?	?	1	1	1	1	1	0	0	1	0	0	1	3	0	1	2	0	1	2	-	0	1	0	1	1	0	0	0	1
Palpotachina similis	0	1	0	1	0	0	0	0	?	0	?	?	1	1	0	1	1	1	0	1	0	0	1	0	-	1	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Paradejeania rutilioides rutilioides	0	0	1	-	1	0	0	0	1	0	1	0	0	1	0	1	1	0	0	1	0	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Paradejeania xenisma	0	0	1	-	1	0	0	0	1	0	1	0	0	1	0	1	1	0	0	1	0	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Pararchytas apache	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Pararchytas decisus	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Parechinotachina plumitarsis	0	0	1	-	1	0	0	0	?	0	?	?	0	0	-	1	1	0	0	0	0	0	0	0	-	1	2	1	1	3	-	0	1	1	2	1	0	0	0	1
Parepalpus auroanalis	0	0	1	-	1	0	0	0	1	0	0	-	1	1	0	0	1	1	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Parepalpus flavidus	0	0	1	-	1	0	1	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	1	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Parepalpus similis	0	0	1	-	1	0	1	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	0	1	0	0	0	1
Peleteria filipalpis	0	0	1	-	1	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria malleola	0	0	1	-	1	1	0	2	?	0	?	?	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria (Oxydosphiria) iterans	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	0	2	1	1	2	-	2	0	1	1	1	0	0	0	1
Peleteria (Panzeriopsis) cornigera	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	1	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria (Panzeriopsis) cornuta	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	1	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria (Peleteria) abdominalis	0	0	1	-	1	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1

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Peleteria (Peleteria) aldrichi	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	1	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria pygmaea	0	0	1	-	1	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Peleteria robusta	0	0	1	-	1	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Peleteria (Sphyrimyia) obsoleta	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	2	-	0	0	1	1	1	0	0	0	1
Peleteria (Sphyrimyia) setosa	0	0	1	-	0	1	0	2	2	0	1	0	1	0	-	1	0	0	1	1	1	0	1	2	0	1	2	1	1	2	-	2	0	1	1	1	0	0	0	1
Periopticochaeta pendula	1	0	1	-	1	1	1	2	1	0	0	-	0	0	-	1	1	1	1	1	0	0	0	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Phosocephala metallica	0	0	0	1	1	1	1	2	1	0	1	0	1	0	-	1	1	1	0	0	0	0	0	0	-	0	1	1	0	0	2	-	-	-	0	1	0	0	0	1
Phosocephala sp. nov.	0	0	0	1	1	1	0	2	1	0	1	0	1	0	-	1	1	1	0	0	0	0	0	0	-	0	1	1	0	0	2	-	-	-	0	1	0	0	0	1
Pictoepalpus clarus	0	0	1	-	0	0	1	0	1	0	1	0	1	1	0	1	1	2	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Prospanipalpus peruvianus	0	0	0	0	1	0	1	2	1	0	1	0	1	0	-	0	1	0	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Protodejeania hystricosa	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Pseudoxanthozonella similis	0	0	1	-	1	0	1	0	?	0	?	?	1	1	0	1	1	2	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Quadratosoma rufum	0	1	1	-	1	0	0	0	?	0	?	?	0	0	-	1	1	1	0	1	1	0	1	0	-	0	2	1	1	0	2	-	-	-	2	1	0	0	0	1
Rhachoepalpus cinereus	0	0	0	0	1	0	0	0	1	0	0	-	1	0	-	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	0	-	-	-	0	1	0	0	0	1
Rhachoepalpus ethelius	0	1	0	0	1	0	0	0	1	1	0	-	1	0	-	0	1	1	0	1	0	0	1	0	-	1	2	1	1	0	0	-	-	-	0	1	0	0	0	1
Rhachoepalpus olivaceus	0	0	0	0	1	0	0	0	1	0	0	-	1	0	-	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	0	-	-	-	0	1	0	0	0	1
Rhachoepalpus pulverulentus	0	0	0	0	1	0	0	0	1	0	0	-	1	0	-	0	1	1	0	1	0	0	1	0	-	1	2	1	1	0	0	-	-	-	0	1	0	0	0	1
Rhachosaundersia boliviana	0	0	1	-	1	0	0	0	0	0	1	0	0	0	-	1	1	1	0	1	0	0	1	0	-	0	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Ruiziella frontosa	0	1	0	1	0	0	0	2	1	0	1	0	1	1	0	0	1	2	1	1	1	0	1	3	0	1	2	1	1	1	-	2	0	1	1	1	0	0	0	1
Ruiziella luctuosa	0	1	0	1	0	0	0	2	1	0	0	0	1	1	0	0	1	2	1	1	1	0	1	3	0	1	2	1	1	1	-	2	0	1	2	1	0	0	0	1
Saundersiops cayensis	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Saundersiops confluens	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Saundersiops cruciatus	0	0	1	-	0	0	1	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Signosoma impressum	0	0	1	-	1	0	0	0	?	0	?	?	0	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Signosomopsis argentea	0	0	1	-	1	0	1	?	1	?	0	-	1	?	?	0	1	?	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	0	1	0	0	0	1

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Signosomopsis eronis	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	0	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Signosomopsis townsendi	0	0	1	-	0	0	0	0	1	0	0	-	1	1	0	0	1	0	0	1	0	0	1	0	-	0	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Sorochemyia oroya	0	1	0	1	0	0	0	0	1	0	1	0	1	1	0	1	1	2	0	1	1	0	1	3	0	0	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Steatosoma rufiventris	0	1	0	1	0	0	0	0	1	0	1	0	1	0	-	0	0	2	1	1	1	0	1	3	0	1	2	0	1	1	-	2	0	1	1	1	0	0	0	1
Tachina lurida	0	1	0	1	1	1	0	0	1	1	0	-	1	1	0	0	0	1	0	1	1	0	1	0	-	1	1	1	1	2	-	0	1	1	0	1	0	0	0	1
Tachina (Nowickia) egula	0	0	0	1	0	1	0	2	1	0	1	0	1	0	-	0	0	1	0	1	1	0	1	0	-	1	1	1	1	2	-	0	1	1	1	1	0	0	0	1
Tachina (Nowickia) ferox	0	1	0	1	0	1	0	0	1	0	1	0	1	0	-	0	0	1	0	1	1	0	1	0	-	1	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Tachina (Rhachogaster) algens	0	0	0	1	1	1	0	0	1	0	1	0	1	0	-	0	0	1	0	1	1	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Tachina (Rhachogaster) nitida	0	0	0	1	0	1	0	0	1	0	1	0	1	0	-	0	0	1	1	1	1	0	1	0	-	1	2	1	1	2	-	0	1	0	1	1	0	0	0	1
Tachina (Tachina) fera	0	0	0	1	1	1	0	0	1	0	1	0	1	0	-	0	0	1	0	1	1	0	0	0	-	1	1	1	1	2	-	0	1	1	1	1	0	0	0	1
Tachina (Tachina) grossa	0	0	0	1	1	1	0	0	1	0	1	0	1	0	-	0	0	1	0	1	1	0	0	0	-	1	1	1	1	2	-	0	1	1	1	1	0	0	0	1
Tachina (Tachina) ursina	0	0	0	1	1	1	0	0	1	1	0	-	1	1	0	0	0	1	0	1	1	0	1	0	-	1	1	1	1	2	-	0	1	1	0	1	0	0	0	1
Talarocera nigripennis	0	0	1	-	1	0	0	0	1	0	1	0	1	0	-	0	1	3	1	1	0	0	1	0	-	0	1	1	1	2	-	0	1	0	1	1	0	0	0	1
Trichoepalpus emarginatus	0	0	1	-	1	0	1	?	1	?	1	0	1	?	?	1	1	?	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Trichophora analis	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	2	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Trichophora nigra	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	1	0	2	-	-	-	1	1	0	0	0	1
Trichosaundersia dorsopunctata	0	0	1	-	1	0	1	0	?	0	?	?	1	0	-	0	1	0	0	1	0	0	1	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Trichosaundersia lineata	0	0	1	-	1	0	1	0	1	0	0	-	1	0	-	0	1	0	0	1	0	0	0	0	-	0	2	1	1	0	1	-	-	-	0	1	0	0	0	1
Trichosaundersia rufopilosa	0	0	1	-	1	0	0	0	1	0	0	-	1	0	-	0	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Uruhuasia cruciata	0	1	1	-	1	0	1	0	?	0	?	?	0	0	-	0	1	0	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Uruhuasiops analis	0	0	0	0	1	0	1	0	?	0	?	?	1	1	0	0	1	1	0	1	0	0	0	0	-	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Vertepalpus verdans	0	0	1	-	1	0	0	0	0	0	0	-	1	0	-	0	1	1	0	1	1	0	1	0	-	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1
Vibrissoepalpus flavipes	0	0	1	-	1	0	0	0	1	0	1	0	1	1	0	1	1	2	0	1	0	0	1	3	0	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Vibrissomyia bicolor	0	2	0	1	0	0	0	0	?	0	?	?	1	1	0	1	0	2	0	1	1	0	1	3	0	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Vibrissomyia lineolata	0	0	0	1	0	0	1	0	2	0	1	0	1	1	0	1	0	2	0	1	1	0	1	3	0	1	2	1	1	0	2	-	-	-	1	1	0	0	0	1

Species/ Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Vibrissomyia oroyensis	0	0	0	1	0	0	1	0	2	0	1	0	1	1	0	1	0	2	0	1	1	0	1	3	0	1	2	1	1	0	1	-	-	-	1	1	0	0	0	1
Xanthoepalpodes bischofi	0	0	1	-	1	0	1	0	1	0	1	0	1	0	-	1	1	0	0	1	0	0	1	0	-	0	2	1	1	0	2	-	-	-	1	1	0	1	1	1
Xanthoepalpus bicolor	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	0	0	1	0	-	0	2	1	1	0	1	-	-	-	1	1	0	1	0	1
Xanthozona melanopyga	0	0	1	-	1	0	1	2	1	0	1	0	1	0	-	1	1	0	0	1	0	0	0	0	-	0	1	1	1	0	2	-	-	-	0	1	0	0	0	1
Zonoepalpus testaceus	0	0	1	-	1	0	1	0	1	0	1	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	1	1	1	0	1	-	-	-	1	1	0	0	0	1
Zophomyia temula	1	2	0	1	0	1	0	2	1	0	0	-	1	1	0	0	1	1	0	0	1	1	-	0	-	0	1	1	0	2	-	0	1	1	0	0	1	0	0	0

Morphological character matrix used to infer the phylogeny of Tachinini (part 2of 4).

Species/ Characters	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Abepalpus archytoides	0	3	1	3	1	2	0	1	0	1	2	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Acroceronia elquiensis	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	1	-	1	2	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
Adejeania andina	0	3	1	3	1	2	0	1	0	0	1	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	0	0	1	0	1	0	1	1	-	1	-	1
Adejeania bicaudata	0	3	1	3	1	2	0	1	0	0	1	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	0	0	1	0	1	0	2	1	-	1	-	1
Adejeania vexatrix	0	3	1	3	1	2	0	1	0	0	1	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	0	0	1	0	1	0	2	1	-	1	-	1
Agicuphocera nigra	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	1	-	0	2	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Amicrotrichomma ada	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	0	0	1	0	0	?	0	1	1	0	1	1	1	1	0	1	0	1	0
Amicrotrichomma orbitalis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	0	3	0	1	0	0	?	0	1	1	0	1	0	1	0	0	0	0	0	0
Amicrotrichomma sp. nov.	0	4	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	3	0	1	0	0	?	0	1	1	0	1	0	1	0	0	0	0	0	0
Andinomyia cruciata	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	2	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Anepalpus hystrix	0	3	1	3	1	2	0	1	1	1	2	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	1	0	0	0	1	1	2	0	1	0	1	0
Archytas (Archytas) analis	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Archytas (Archytas) apicifer	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Archytas (Archytas) marmoratus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Archytas daemon	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Archytas incertus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Archytas (Nemochaeta) metallicus	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Archytas seminiger	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	?	0	1	1	0	1	0	1	0	1	-	1	-	0
Archytoepalpus rufiventris	0	4	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Austeniops truncaticornis	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	?	0	1	0	0	1	0	1	0	0	0	0	0	0
Beskiocephala flava	0	2	1	2	1	0	0	1	1	1	2	1	1	0	1	0	1	-	1	-	-	3	1	0	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Bischofimyia atra	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	?	0	1	0	1	0	1	-	1	-	0
Bombyliomyia flavipalpis	0	2	1	2	1	2	0	0	0	1	2	1	1	1	1	1	0	0	0	2	1	0	0	1	0	0	0	1	1	0	1	0	1	1	2	0	2	0	2	0
Camposiana emarginata	0	2	0	2	0	2	0	1	0	1	2	1	0	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	0	1	0	1	1	2	0	0	1	-	1

Species/ Characters	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Catajurinia angusta	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0
Chiloepalpus aureus	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	0	0	1	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0
Chiloepalpus callipygus	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	0	0	1	1	0	0	1	0	1	1	0	1	0	1	1	1	-	1	-	0
Chlorohystricia reinwardtii	0	3	1	2	1	2	1	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	1	2	0	1	0	2	0
Chromatophania distingueda	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	1	-	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Chromatophania fenestratata	0	4	1	3	1	2	0	1	0	0	2	1	1	0	0	0	1	-	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Chromoepalpus uruhuasi	1	0	-	2	1	1	0	1	0	1	1	0	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	0	1
Copecrypta nitens	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Copecrypta ruficauda	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Corpulentoepalpus rufus	0	4	1	3	1	2	0	1	0	1	2	1	1	0	1	0	1	-	0	2	1	1	0	1	0	0	1	0	1	?	0	1	1	1	1	0	1	0	1	0
Corpulentosoma cornutum	0	3	1	2	1	1	0	1	1	1	1	1	0	0	0	0	1	-	0	-	-	1	0	1	0	0	0	0	1	0	0	0	0	1	2	0	1	0	1	0
Cryptopalpus ornatus	0	1	1	2	1	1	0	1	0	1	2	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	0	1	0	1	1	2	0	1	1	-	1
Cryptopalpus rubrum	0	1	1	2	1	1	0	1	0	1	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	?	1	0	1	1	2	0	1	1	-	1
Cyanogymnomma coerulea	0	3	1	2	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Cyanopsis costalis	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	2	1	1	1	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Dejeania bombylans	0	3	1	3	1	2	0	0	0	0	2	1	0	0	1	0	0	0	1	2	1	1	0	1	0	0	0	0	1	1	1	0	1	0	2	1	-	1	-	1
Dejeania hecate	0	3	1	3	1	2	0	0	0	0	2	1	0	0	1	0	0	0	1	2	1	1	0	1	0	0	0	0	1	1	1	0	1	0	2	1	-	1	-	1
Dejeaniops beckeri	1	0	-	0	1	-	0	1	0	0	0	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	0	1	1	0	1	1	1	1	-	1	-	1
Dejeaniops ollachea	0	1	1	1	1	0	0	1	0	0	1	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	0	?	1	0	1	1	1	1	-	1	-	1
Deopalpus australis	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	1	2	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Deopalpus contiguus	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Deopalpus hirsutus	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Deopalpus pictipennis	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	2	1	1	1	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Diaphanomyia aurea	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	-	-	1	1	1	0	0	0	0	1	0	0	1	0	1	0	1	-	0	0	0
Diaphanomyia aurifacies	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	-	-	1	1	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0

Species/ Characters	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Dumerillia rubida	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	1	2	1	1	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Echinopyrrhosia alpina	0	2	0	3	0	1	0	1	0	1	2	0	2	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Echinopyrrhosia browni	0	2	0	3	0	1	0	1	0	1	2	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Echinopyrrhosia pictipennis	0	2	0	3	0	1	0	1	0	1	2	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Echinopyrrhosiops decorata	0	3	0	3	0	2	0	1	0	1	2	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	1	?	1	0	1	1	1	0	1	1	-	1
Edwynia robusta	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	1	1	2	1	0	0	1	0	0	1	0	1	0	0	1	1	1	1	1	-	1	-	0
Empheremyiops discalis	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	?	0	1	1	0	1	0	1	0	1	-	0	0	0
Epalpellus corpulentus	1	1	1	2	1	2	0	1	1	0	2	1	0	0	0	0	1	-	1	2	1	1	0	1	0	0	?	0	1	0	0	0	0	1	2	0	1	0	1	0
Epalpodes equatorialis	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	2	0	1	0	1	0	0	1	0	1	1	1	1	0	1	2	0	0	0	0	1
Epalpus albomaculatus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	2	1	0	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Epalpus lineatus	0	3	1	2	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	0	1	0
Epalpus niveus	0	3	1	2	1	2	0	1	1	0	2	1	0	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Epalpus rufipennis	0	1	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Epalpus signifer	0	3	1	2	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	0	1	0
Epicuphocera andina	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	1	0	1	0	1	-	1	-	0
Ernestia rudis	0	3	1	3	1	2	1	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0
Eubischofimyia analis	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Eucorpulentosoma simile	1	0	-	0	1	0	0	1	0	1	2	1	0	0	1	1	1	-	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	0	1	1
Eudejeania aldrichi	0	1	0	0	0	0	0	1	0	0	1	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	0	0	1	0	1	1	1	1	-	1	-	1
Eudejeania subalpina	0	0	-	1	0	0	0	1	0	0	1	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	0	0	1	0	1	1	1	1	-	1	-	1
Euempheremyia nemo	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Euempheremyia paulensis	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Euepalpodes arcuatus	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	?	0	1	0	1	1	1	-	1	-	0
Euepalpus vestitus	0	3	1	3	1	1	0	1	0	1	2	1	2	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	1	1	0	1	1	1	1	1	-	1	-	1
Eufabriciopsis quadrisetosa	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	?	0	1	1	0	1	0	1	0	1	-	1	-	0

Species/ Characters	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Euhuascaraya atra	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	?	0	1	0	1	0	1	-	1	-	0
Euhuascaraya obscura	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Euhuascaraya siesta	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Eulasiopalpus albipes	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	0	0	1	0	1	1	1	1	-	1	-	1
Eulasiopalpus vittatus	1	0	-	0	1	0	0	1	0	0	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	0	0	1	0	1	1	1	1	-	1	-	1
Eumelanepalpus ruber	1	1	0	3	0	2	0	1	0	1	2	1	2	0	1	1	0	1	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Eusaundersiops inornatus	0	1	0	3	0	2	0	1	0	1	2	0	1	0	1	1	0	1	0	2	1	1	0	1	0	0	?	0	1	1	1	0	1	1	2	0	1	1	-	0
Eutrichophora punensis	0	3	1	2	1	1	0	1	1	1	2	1	1	0	0	0	1	-	0	2	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Exopalpus elegans	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0
Exopalpus ochracea	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	0	1	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0
Fabriciopsis hystrix	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	0	2	1	0	0	1	0	0	?	0	1	0	0	0	1	1	1	0	1	0	1	0
Formicomyia ovata	0	3	1	2	1	2	0	1	0	1	2	1	0	0	1	0	1	-	0	0	0	2	1	0	1	0	?	1	1	?	0	1	0	1	0	1	-	1	-	0
Formicomyia sp. nov.	0	3	1	2	1	2	0	1	0	1	2	1	1	0	1	0	1	-	0	0	0	2	1	0	1	0	0	1	1	1	0	1	0	1	0	1	-	1	-	0
Gymnochaeta viridis	0	3	1	3	1	2	1	0	0	1	2	1	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
Gymnomma diaphanoides	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Gymnomma sp. nov.	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	1	0	1	0	1	0
Gymnommopsis gagatea	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	1	?	0	1	0	1	0	1	-	1	-	0
Helioprosopa electilis	0	2	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	1	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Helioprosopa facialis	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	1	-	1	1	0	0	1	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Homosaundersia rufa	1	0	-	1	1	1	0	1	0	1	2	1	0	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	?	1	0	1	1	2	1	-	1	-	1
Homosaundersia sp. nov. 1	1	0	-	1	1	0	0	1	0	1	0	1	0	0	1	1	1	-	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	1	-	1	-	1
Homosaundersia sp. nov. 2	1	0	-	1	1	0	0	1	0	1	2	0	0	0	1	1	0	0	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	1	-	1	-	1
Homosaundersiops haenschi	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	0	0	1	?	1	0	1	0	2	0	1	0	1	0
Huascarayopsis paulensis	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	1	0	0	0	0	0
Hystricia abrupta	0	3	1	1	1	2	1	0	0	1	1	1	0	1	1	1	0	0	0	2	1	1	0	1	0	0	0	1	1	0	1	0	1	1	2	0	2	0	2	0

Species/ Characters	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Itacuphocera ocellaris	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	2	1	1	1	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Itasaundersia robusta	0	3	1	3	1	2	0	1	1	1	2	1	1	0	1	1	0	0	1	2	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	0	1	1
Jurinella anax	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	1	0	1	0	0	1	0	1	1	0	0	1	1	1	0	1	0	1	0
Jurinella bella	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	1	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Jurinella lutzi	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	0	0	1	0	0	0	0	1	1	0	0	1	1	1	0	1	0	1	0
Jurinella varians	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	1	1	0	1	0	0	1	0	1	1	0	0	0	1	0	0	1	0	1	0
Jurinia paulensis	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Jurinia pompalis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	0	0	0	1	2	0	3	0	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0
Juriniopsis adusta	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	0	1	0	4	0	1	0	0	1	0	1	1	0	1	1	1	1	1	-	1	-	0
Juriniopsis aurifrons	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	0	0	0	1	0	4	0	1	0	0	0	0	1	1	0	1	1	1	1	1	-	1	-	0
Juriniosoma gagateum	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	1	1	1	1	-	1	-	0
Leskia cf *flavipennis*	0	2	1	2	1	2	0	0	0	1	2	1	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	1	1	1	1	1	0	1	0	1	-	1	-	0
Lindigepalpus townsendi	1	1	1	1	1	1	0	1	0	1	2	1	0	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	0	0	1	1	1	0	1	0	1	0
Linnaemyia comta	0	3	1	2	1	2	1	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0
Lypha melobosis	0	3	1	2	1	2	1	0	0	1	2	1	0	1	0	0	1	-	0	1	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0
Macromya pyrrhaspis	0	3	1	2	1	2	1	0	1	1	2	1	1	0	1	0	0	0	0	2	1	1	0	1	0	0	0	1	1	1	1	0	1	1	1	0	1	0	1	0
Melanepalpellus corpulentus	0	3	1	3	1	2	0	1	1	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	0	0	?	0	1	1	0	1	1	1	1	1	-	1	-	0
Melanepalpus albipes	0	4	1	3	1	2	0	1	0	1	2	1	0	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	?	1	0	1	1	1	1	-	1	-	1
Melanepalpus fulvus	1	0	-	1	1	1	0	1	0	1	2	0	0	0	1	1	0	1	0	2	1	1	0	1	0	0	?	0	1	0	1	0	1	1	1	1	-	1	-	1
Microgymnomma orbitalis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	?	0	1	0	0	1	0	1	0	1	-	1	-	0
Microgymnomma paulensis	0	3	1	2	1	2	0	1	0	0	2	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Nemoraea pellucida	0	2	1	3	1	2	1	0	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	1	1	0	1	0	1	-	1	-	0
Neocuphocera nepos	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Neocuphocera orbitalis	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Neogymnomma rufa	0	4	1	3	1	2	0	1	1	1	2	1	1	0	0	0	1	-	1	2	0	1	0	1	0	0	1	0	1	?	0	0	0	1	2	0	2	0	2	0

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Neosarromyia neotropica	0	3	1	2	1	2	0	1	0	0	2	1	0	0	0	0	0	0	0	1	0	2	1	1	1	1	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Neosarromyia trinitatis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	3	1	1	1	1	1	0	1	0	0	1	0	1	0	1	-	1	-	0
Ochroepalpus ochraceus	0	3	1	3	1	2	0	1	0	1	2	1	1	0	1	0	1	-	0	2	0	1	0	1	0	0	0	0	1	1	0	1	1	1	1	0	1	0	1	0
Oestrohystricia subalpina	0	1	2	3	0	2	0	1	0	1	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	?	1	0	1	1	1	0	1	1	-	0
Oharamyia browni	1	0	-	0	1	1	0	1	0	0	2	0	1	0	1	1	0	1	1	2	1	1	0	1	0	0	?	0	1	?	1	0	1	0	2	0	1	0	1	1
Oharamyia vierecki	0	1	2	2	1	1	0	1	0	0	2	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	0	0	1	?	1	0	1	0	2	0	1	0	1	1
Opsoempheria atra	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0
Oxyepapus flavoscutellatus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	0	1	0
Palpolinnaemyia perorbitalis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	2	0	0	1	1	0	0	?	0	1	0	0	1	0	1	0	0	0	0	0	0
Palpotachina similis	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	?	0	1	1	0	1	0	1	1	1	-	1	-	0
Paradejeania rutilioides rutilioides	0	3	1	3	1	1	0	1	1	0	2	1	1	0	1	0	0	1	1	2	1	1	0	1	0	0	1	0	1	0	1	0	1	1	2	0	1	0	1	1
Paradejeania xenisma	0	3	1	3	1	1	0	1	1	0	2	1	1	0	1	0	0	1	1	2	1	1	0	1	0	0	1	0	1	0	1	0	1	1	1	0	1	0	1	1
Pararchytas apache	0	3	1	3	1	2	0	1	1	0	2	1	1	0	1	0	0	0	0	2	1	4	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Pararchytas decisus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	0	0	0	1	0	4	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Parechinotachina plumitarsis	0	3	1	3	1	2	0	1	0	0	1	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	?	0	0	0	1	0	1	1	1	1	-	1	-	1
Parepalpus auroanalis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0
Parepalpus flavidus	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0
Parepalpus similis	0	3	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0
Peleteria filipalpis	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Peleteria malleola	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	?	0	1	1	0	1	0	1	0	1	-	1	-	0
Peleteria (Oxydosphiria) iterans	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Peleteria (Panzeriopsis) cornigera	0	1	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0
Peleteria (Panzeriopsis) cornuta	0	1	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0
Peleteria (Peleteria)	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	1	1	0	1	0	1	1	1	-	1	-	0

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abdominalis																																								
Peleteria (Peleteria) aldrichi	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Peleteria pygmaea	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	1	0	1	-	1	-	0
Peleteria robusta	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	1	0	1	-	1	-	0
Peleteria Sphyrimyia obsoleta	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Peleteria Sphyrimyia setosa	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Periopticochaeta pendula	0	3	1	2	1	2	0	1	0	0	2	1	0	0	1	0	0	0	1	2	0	3	1	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
Phosocephala metallica	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Phosocephala sp. nov.	0	3	1	3	1	1	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Pictoepalpus clarus	0	3	1	2	1	2	0	1	0	1	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	0	1	0	1	1	1	0	1	0	1	1
Prospanipalpus peruvianus	0	4	1	3	1	2	0	1	1	1	2	1	1	0	0	0	1	-	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Protodejeania hystricosa	0	3	1	3	1	2	0	1	0	0	2	1	1	0	1	0	1	-	0	2	1	4	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1	0	1	0
Pseudoxanthozonella similis	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	-	-	1	0	1	0	0	?	0	1	0	0	1	0	1	0	0	0	0	0	0
Quadratosoma rufum	0	3	1	3	1	2	0	1	0	1	2	1	0	0	1	1	0	1	0	2	1	1	0	1	0	0	?	0	1	0	1	0	1	1	1	0	1	1	-	1
Rhachoepalpus cinereus	0	1	1	2	1	2	0	1	0	0	2	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Rhachoepalpus ethelius	0	3	1	2	1	2	0	1	0	0	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Rhachoepalpus olivaceus	0	1	1	2	1	2	0	1	0	0	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Rhachoepalpus pulverulentus	0	1	1	2	1	2	0	1	0	0	2	1	1	0	1	1	0	1	1	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	2	0	1	1	-	1
Rhachosaundersia boliviana	1	1	1	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	1	-	1	-	1
Ruiziella frontosa	0	3	1	3	1	1	0	1	0	1	2	1	1	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0
Ruiziella luctuosa	0	3	1	3	1	1	0	1	0	1	2	1	1	0	0	0	0	0	1	2	0	0	0	1	0	0	1	0	1	1	0	1	0	1	1	0	0	0	0	0
Saundersiops cayensis	0	3	1	3	1	2	0	1	1	0	2	1	1	0	1	0	1	-	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	1	0	1	0	1	0
Saundersiops confluens	0	3	1	3	1	2	0	1	1	0	2	1	1	0	1	0	1	-	0	2	1	1	0	1	0	0	0	0	1	0	1	0	1	1	1	0	1	0	1	0
Saundersiops cruciatus	0	3	1	3	1	2	0	1	1	0	2	1	1	0	1	0	1	-	0	2	1	1	0	1	0	0	0	0	1	0	1	1	1	1	0	0	1	0	1	0

Species/ Characters	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Signosoma impressum	1	0	-	1	1	0	0	1	0	1	1	1	0	0	1	0	1	-	1	2	1	1	0	1	0	0	?	0	1	1	1	0	1	1	1	1	-	1	-	1
Signosomopsis argentea	0	1	1	2	1	2	0	1	0	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	?	1	0	1	1	0	0	1	0	1	0
Signosomopsis eronis	1	1	1	2	1	2	0	1	0	0	2	0	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Signosomopsis townsendi	0	3	1	2	1	2	0	1	1	0	2	1	0	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Sorochemyia oroya	0	1	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Steatosoma rufiventris	0	2	1	3	1	2	0	1	0	1	3	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	1	1	0	1	0	1	-	1	-	0
Tachina lurida	0	2	1	3	1	1	0	1	0	0	0	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	-	1	-	0
Tachina (Nowickia) egula	0	2	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0	1	-	1	-	0
Tachina (Nowickia) ferox	0	2	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Tachina (Rhachogaster) algens	0	2	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Tachina (Rhachogaster) nitida	0	2	1	3	1	2	0	1	0	0	2	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Tachina (Tachina) fera	0	3	1	3	1	2	0	1	0	0	2	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	0	0	1	-	1	-	0
Tachina (Tachina) grossa	0	3	1	3	1	2	0	1	0	0	2	1	2	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	1	1	0	1	0	0	1	1	-	1	-	0
Tachina (Tachina) ursina	0	2	1	2	1	1	0	1	0	0	1	1	1	0	0	0	1	-	0	2	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	-	1	-	0
Talarocera nigripennis	0	3	1	3	1	2	0	1	0	1	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	1	0	1	0	1	-	1	-	0
Trichoepalpus emarginatus	1	1	1	1	1	2	0	1	0	1	1	1	0	0	1	1	0	1	0	2	1	1	0	1	0	0	0	0	1	?	1	0	1	1	1	1	-	1	-	1
Trichophora analis	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	1	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0
Trichophora nigra	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
Trichosaundersia dorsopunctata	1	1	1	1	1	1	0	1	0	1	2	1	0	0	1	0	1	-	1	2	1	1	0	1	0	0	?	0	1	1	1	0	1	1	2	0	1	0	1	0
Trichosaundersia lineata	0	1	1	2	1	2	0	1	1	0	2	1	0	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Trichosaundersia rufopilosa	0	3	1	2	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0
Uruhuasia cruciata	0	1	1	2	1	2	0	1	0	0	2	1	0	0	0	0	1	-	1	2	0	1	0	1	0	0	?	0	1	0	0	0	0	1	2	0	0	0	0	0
Uruhuasiops analis	0	3	1	3	1	2	0	1	1	0	2	1	1	0	0	0	1	-	1	1	0	1	0	1	0	0	?	0	1	1	0	1	0	1	0	0	0	0	0	0
Vertepalpus verdans	0	1	2	2	1	2	0	1	0	0	2	0	1	0	1	1	0	1	1	2	1	1	0	1	0	0	1	0	1	0	1	0	1	0	2	0	1	1	-	1

Species/ Characters	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
Vibrissoepalpus flavipes	0	3	1	3	1	2	0	1	0	1	2	1	1	0	1	1	0	1	0	2	1	1	0	1	0	0	1	0	1	0	0	0	1	1	2	0	1	0	1	0
Vibrissomyia bicolor	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	?	0	1	1	0	1	0	1	0	1	-	1	-	0
Vibrissomyia lineolata	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Vibrissomyia oroyensis	0	3	1	2	1	2	0	1	0	1	2	1	1	0	0	0	1	-	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	-	1	-	0
Xanthoepalpodes bischofi	1	1	1	2	1	2	0	1	0	1	2	1	1	0	1	0	0	1	1	2	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	0	1	0	1	1
Xanthoepalpus bicolor	0	3	1	3	1	2	0	1	0	1	2	1	1	0	1	1	1	-	1	2	1	1	0	1	0	0	1	0	1	0	1	1	1	1	1	0	1	0	1	1
Xanthozona melanopyga	0	3	1	3	1	2	0	1	1	1	2	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1	0	1	-	0	0	0
Zonoepalpus testaceus	0	3	1	2	1	2	0	1	1	1	2	1	1	0	0	0	1	-	0	2	0	1	1	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0
Zophomyia temula	1	1	1	2	1	2	1	0	0	1	2	1	0	0	0	0	0	0	0	0	0	2	0	1	2	0	0	1	1	1	0	1	0	1	0	0	0	0	0	0

Morphological character matrix used to infer the phylogeny of Tachinini (part 3of 4).

Species/ Characters	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	11 0	11 1	11 2	11 3	11 4	11 5	11 6	11 7	11 8	11 9	120
Abepalpus archytoides	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	1	1	1	1	0	1	0	1	0	1	1
Acroceronia elquiensis	0	1	1	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Adejeania andina	1	1	2	1	1	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	1
Adejeania bicaudata	1	1	2	1	1	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	1
Adejeania vexatrix	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	1
Agicuphocera nigra	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Amicrotrichomma ada	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Amicrotrichomma orbitalis	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Amicrotrichomma sp. nov.	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	2	1	0	1
Andinomyia cruciata	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Anepalpus hystrix	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	2	1	1	1	0	1	0	1	0	0	1
Archytas (Archytas) analis	0	1	1	0	0	1	0	1	0	1	?	?	?	?	?	?	0	0	0	1	0	0	1	0	0	0	1	0	2	1	1	1	?	?	?	?	?	?	?	?
Archytas (Archytas) apicifer	0	1	1	0	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	2	0	2	2	1	1	1	0	1	0	0	0	0	1
Archytas (Archytas) marmoratus	0	1	0	0	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	2	1	1	1	1	0	1	0	0	1	0	1
Archytas daemon	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Archytas incertus	0	1	1	0	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	2	0	2	2	1	1	1	0	1	0	0	1	0	1
Archytas (Nemochaeta) metallicus	0	1	1	0	0	1	0	1	0	1	?	?	?	?	?	?	0	0	0	1	0	0	1	0	0	0	1	0	2	-	1	1	?	?	?	?	?	?	?	?
Archytas seminiger	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	2	1	1	1	1	0	1	0	0	1	0	1
Archytoepalpus rufiventris	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	1	0	2	1	1	1	1	1	1	0	0	0	1	1
Austeniops truncaticornis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Beskiocephala flava	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	0

Species/ Characters	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Bischofimyia atra	0	?	0	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Bombyliomyia flavipalpis	0	1	2	0	0	0	1	1	0	1	0	1	0	1	0	1	1	0	0	1	0	1	-	0	1	0	-	-	0	2	1	1	2	0	0	1	0	1	0	1
Camposiana emarginata	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Catajurinia angusta	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	2	1	0	1
Chiloepalpus aureus	0	1	1	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Chiloepalpus callipygus	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Chlorohystricia reinwardtii	0	1	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0	0	1	0	1	-	0	1	0	-	-	0	2	0	1	2	0	0	0	0	1	0	1
Chromatophania distingueda	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	2	1
Chromatophania fenestratata	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	2	1
Chromoepalpus uruhuasi	1	1	2	1	0	1	0	1	1	1	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	1	1	0	1
Copecrypta nitens	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Copecrypta ruficauda	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Corpulentoepalpus rufus	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Corpulentosoma cornutum	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cryptopalpus ornatus	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	2	1
Cryptopalpus rubrum	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cyanogymnomma coerulea	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cyanopsis costalis	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	1	3	0	1	0	0	0	0	1
Dejeania bombylans	0	1	2	1	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	1
Dejeania hecate	0	1	2	1	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	1
Dejeaniops beckeri	1	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	0	1
Dejeaniops ollachea	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Deopalpus australis	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1

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Deopalpus contiguus	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	1	3	0	1	0	0	0	0	1
Deopalpus hirsutus	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	?	2	1	1	3	0	1	0	0	0	0	1
Deopalpus pictipennis	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	3	0	1	0	0	0	0	1
Diaphanomyia aurea	0	1	1	0	0	0	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	2	2	1	1	1	0	1	0	1	0	0	1
Diaphanomyia aurifacies	0	1	1	0	0	0	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	2	2	1	1	1	0	1	0	1	0	0	1
Dumerillia rubida	0	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	2	1	0	1
Echinopyrrhosia alpina	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Echinopyrrhosia browni	1	1	2	1	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	2	1	1	1	1	1	0	1	0	1	0	2	1
Echinopyrrhosia pictipennis	1	1	2	1	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	2	1	1	1	1	1	0	1	0	1	0	2	1
Echinopyrrhosiops decorata	0	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Edwynia robusta	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Empheremyiops discalis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpellus corpulentus	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpodes equatorialis	1	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	-	?	0	2	1	1	3	0	0	0	0	0	2	1
Epalpus albomaculatus	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Epalpus lineatus	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Epalpus niveus	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	0	1	1	1	0	0	0	0	1
Epalpus rufipennis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpus signifer	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Epicuphocera andina	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Ernestia rudis	0	1	2	0	0	0	1	1	0	1	1	1	0	1	0	0	1	0	0	1	0	1	-	0	1	0	-	-	0	2	0	1	2	0	0	1	0	1	0	1
Eubischofimyia analis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eucorpulentosoma simile	1	1	2	1	1	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Eudejeania aldrichi	1	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	-	-	0	2	1	1	1	0	0	0	0	0	0	1
Eudejeania subalpina	1	1	2	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

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Euempheremyia nemo	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	1	0	0	0	1	1
Euempheremyia paulensis	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	1	0	0	0	1	1
Euepalpodes arcuatus	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euepalpus vestitus	0	0	2	1	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	0	1
Eufabriciopsis quadrisetosa	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euhuascaraya atra	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euhuascaraya obscura	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euhuascaraya siesta	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	1	0	0	0	1	1
Eulasiopalpus albipes	1	1	2	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eulasiopalpus vittatus	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	2	0	1	0	0	1	0	1
Eumelanepalpus ruber	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eusaundersiops inornatus	0	1	2	1	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eutrichophora punensis	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	2	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	1	1
Exopalpus elegans	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	2	1	0	1
Exopalpus ochracea	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Fabriciopsis hystrix	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Formicomyia ovata	0	?	0	0	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Formicomyia sp. nov.	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Gymnochaeta viridis	0	1	2	0	0	0	1	1	1	1	0	1	1	1	0	0	0	0	0	1	0	1	-	0	1	0	-	-	0	2	1	1	2	0	0	1	0	1	0	1
Gymnomma diaphanoides	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	2	1	1	1	1	1	1	0	0	0	1	1
Gymnomma sp. nov.	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1
Gymnommopsis gagatea	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Helioprosopa electilis	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	1	1
Helioprosopa facialis	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Homosaundersia rufa	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

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Homosaundersia sp. nov. 1	1	1	2	1	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Homosaundersia sp. nov. 2	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Homosaundersiops haenschi	0	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Huascarayopsis paulensis	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1
Hystricia abrupta	0	1	1	0	0	0	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1	-	0	1	0	-	-	0	2	0	1	2	0	0	0	0	1	0	1
Itacuphocera ocellaris	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	1
Itasaundersia robusta	0	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Jurinella anax	0	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Jurinella bella	0	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Jurinella lutzi	0	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Jurinella varians	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	2	1	0	1
Jurinia paulensis	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1
Jurinia pompalis	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Juriniopsis adusta	0	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	1
Juriniopsis aurifrons	0	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	1
Juriniosoma gagateum	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1
Leskia cf *flavipennis*	0	1	0	0	0	0	1	1	0	1	1	1	1	1	1	0	1	0	0	1	0	1	-	0	1	0	-	-	0	2	1	1	2	0	0	0	0	1	0	1
Lindigepalpus townsendi	0	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	0	0	0	?	0	0	0	0	0	0	1	0	2	2	1	1	1	0	1	0	1	0	0	1
Linnaemyia comta	0	1	1	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1	-	0	1	0	-	-	0	2	1	1	2	0	0	1	0	1	0	1
Lypha melobosis	0	1	1	0	0	0	1	1	0	1	0	1	1	1	1	0	1	0	0	1	0	1	-	0	1	0	-	-	0	2	0	1	2	0	0	0	0	1	0	1
Macromya pyrrhaspis	0	1	2	1	0	0	1	1	0	1	1	0	1	1	1	0	0	0	0	1	0	1	-	0	1	0	-	-	1	1	1	1	1	0	0	0	0	1	0	1
Melanepalpellus corpulentus	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Melanepalpus albipes	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Melanepalpus fulvus	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

Species/ Characters	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Microgymnomma orbitalis	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Microgymnomma paulensis	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	1
Nemoraea pellucida	0	1	1	0	0	0	1	1	0	1	1	0	1	1	1	0	1	0	0	1	0	1	-	0	0	0	0	1	0	2	1	1	2	0	0	1	0	1	0	1
Neocuphocera nepos	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Neocuphocera orbitalis	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neogymnomma rufa	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neosarromyia neotropica	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neosarromyia trinitatis	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	1	0	1
Ochroepalpus ochraceus	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	2	1	1	1	1	1	1	0	0	0	1	1
Oestrohystricia subalpina	0	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Oharamyia browni	1	1	1	1	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Oharamyia vierecki	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Opsoempheria atra	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	1	0	2	1	1	1	1	1	1	0	0	0	1	1
Oxyepapus flavoscutellatus	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Palpolinnaemyia perorbitalis	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Palpotachina similis	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Paradejeania rutilioides rutilioides	1	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	1	0	-	-	0	2	1	0	0	0	0	0	0	1	0	1
Paradejeania xenisma	1	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	1	0	-	-	0	2	1	0	0	0	0	0	0	1	0	1
Pararchytas apache	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	-	-	0	0	1	1	1	0	1	0	0	1	0	1
Pararchytas decisus	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	-	-	0	0	1	1	1	0	1	0	0	1	0	1
Parechinotachina plumitarsis	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Parepalpus auroanalis	0	1	0	0	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Parepalpus flavidus	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	0	1	0	1

Species/ Characters	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Parepalpus similis	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	0	1	0	1
Peleteria filipalpis	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Peleteria malleola	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Peleteria (Oxydosphiria) iterans	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Panzeriopsis) cornigera	0	1	0	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Panzeriopsis) cornuta	0	1	1	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Peleteria) abdominalis	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Peleteria) aldrichi	0	1	0	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria pygmaea	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Peleteria robusta	0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1
Peleteria Sphyrimyia obsoleta	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria Sphyrimyia setosa	0	1	0	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Periopticochaeta pendula	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	0	1	0	2	1	0	1
Phosocephala metallica	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	2	1	1	1	0	1	0	1	0	0	1
Phosocephala sp. nov.	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	2	1	1	1	0	1	0	1	0	0	1
Pictoepalpus clarus	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Prospanipalpus peruvianus	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Protodejeania hystricosa	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	1	0	0	0	1	0	-	-	0	2	1	1	1	0	0	0	0	1	0	1
Pseudoxanthozonella similis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Quadratosoma rufum	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Rhachoepalpus cinereus	1	1	2	1	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Rhachoepalpus ethelius	1	1	2	1	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

Species/ Characters	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
Rhachoepalpus olivaceus	1	1	2	1	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	2	1
Rhachoepalpus pulverulentus	1	1	2	1	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	2	1
Rhachosaundersia boliviana	1	1	2	1	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	2	1	1	1	1	1	0	1	0	1	1
Ruiziella frontosa	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Ruiziella luctuosa	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	1	0	-	?	0	2	1	1	3	1	1	0	0	0	0	1
Saundersiops cayensis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Saundersiops confluens	0	1	2	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Saundersiops cruciatus	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosoma impressum	1	1	2	1	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis argentea	0	?	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis eronis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis townsendi	0	1	1	0	0	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	2	0	1	1	1	1	1	0	0	0	0	1
Sorochemyia oroya	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Steatosoma rufiventris	0	1	1	0	0	1	0	1	1	0	0	1	1	0	0	1	0	2	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	2	1
Tachina lurida	0	1	1	0	0	0	0	1	0	1	0	1	1	0	1	1	1	0	0	1	0	0	1	1	-	0	-	?	-	-	1	1	-	1	1	0	0	0	0	1
Tachina (Nowickia) egula	0	1	1	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Tachina (Nowickia) ferox	0	1	1	0	1	0	0	1	0	1	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	1	1	1	2	1	0	0	0	0	1
Tachina (Rhachogaster) algens	0	1	1	0	1	0	0	1	0	1	0	1	1	0	1	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	1	1	1	2	1	0	0	0	0	1
Tachina (Rhachogaster) nitida	0	1	1	0	1	0	0	1	0	1	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	1	1	1	2	1	0	0	0	0	1
Tachina (Tachina) fera	0	1	1	0	0	0	0	1	0	1	0	1	1	0	1	1	1	0	0	1	0	0	1	1	-	0	-	?	-	-	1	1	-	1	1	0	0	0	0	1
Tachina (Tachina) grossa	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	1	1	-	0	-	?	-	-	1	1	-	1	1	0	0	0	1	1
Tachina (Tachina) ursina	0	1	1	0	0	0	0	1	0	1	0	1	1	0	1	1	1	0	0	1	0	0	1	1	-	0	-	?	-	-	1	1	-	1	1	0	0	0	0	1
Talarocera nigripennis	0	1	1	0	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	2	0	2	2	1	1	1	0	1	0	0	0	0	1
Trichoepalpus	1	?	2	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

Species/ Characters	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
emarginatus																																								
Trichophora analis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Trichophora nigra	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Trichosaundersia dorsopunctata	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	1	0	0	1
Trichosaundersia lineata	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Trichosaundersia rufopilosa	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Uruhuasia cruciata	0	1	0	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Uruhuasiops analis	0	1	1	0	0	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Vertepalpus verdans	1	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	2	2	0	1	1	1	0	1	0	1	0	2	1
Vibrissoepalpus flavipes	0	1	1	0	1	?	?	?	?	1	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Vibrissomyia bicolor	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	2	1	1	1	0	1	0	1	0	0	1
Vibrissomyia lineolata	0	1	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	2	1	1	1	0	1	0	1	0	0	1
Vibrissomyia oroyensis	0	1	0	0	0	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Xanthoepalpodes bischofi	0	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Xanthoepalpus bicolor	0	1	2	1	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	2	1	1	1	0	1	0	1	0	0	1
Xanthozona melanopyga	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	2	2	1	1	1	0	1	0	1	0	0	1
Zonoepalpus testaceus	0	1	1	0	0	0	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	2	2	1	1	1	0	1	0	1	0	0	1
Zophomyia temula	0	1	0	0	0	0	1	1	0	1	1	0	0	1	1	0	1	1	0	1	0	1	-	0	1	0	-	-	0	2	0	1	2	0	0	1	0	1	0	1

Morphological character matrix used to infer the phylogeny of Tachinini (part 4of 4).

Species/Characters	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**
Abepalpus archytoides	1	1	0	0	1	1	1	0	1	1	0	1	0	1	1	0	0	1	1	0	0	1	0	3	2	2	1	0	9	1	1	0
Acroceronia elquiensis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Adejeania andina	1	1	0	0	1	1	1	0	1	1	0	0	1	1	0	0	0	1	0	-	-	0	0	1	1	0	-	-	1	1	0	4
Adejeania bicaudata	1	1	0	0	1	1	1	0	1	1	0	0	1	1	0	0	0	1	0	-	-	0	0	1	1	0	-	-	1	1	0	4
Adejeania vexatrix	1	1	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	0	-	-	0	0	1	1	0	-	-	1	1	0	4
Agicuphocera nigra	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Amicrotrichomma ada	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	A	1	0	1
Amicrotrichomma orbitalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Amicrotrichomma sp. nov.	1	1	0	0	1	0	1	0	1	0	0	1	0	1	1	0	2	1	1	0	1	0	1	0	1	0	-	-	0	1	0	6
Andinomyia cruciata	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Anepalpus hystrix	1	0	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	2	2	0	0	9	1	0	0
Archytas (Archytas) analis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	4	1	0	0
Archytas (Archytas) apicifer	1	1	0	1	1	0	1	0	1	0	0	1	1	1	0	0	0	1	0	-	-	0	0	0	1	0	-	-	4	1	0	1
Archytas (Archytas) marmoratus	1	1	0	1	1	0	1	2	0	0	0	0	1	1	1	0	0	1	0	-	-	0	0	0	2	1	2	0	4	1	0	1
Archytas daemon	1	1	0	1	1	1	1	3	1	0	0	1	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	4	1	0	1
Archytas incertus	1	1	0	1	1	0	1	2	0	0	0	0	1	1	1	0	0	1	0	-	-	0	0	0	2	1	2	0	4	1	0	1
Archytas (Nemochaeta) metallicus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	4	1	0	0
Archytas seminiger	1	1	0	1	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	-	-	4	1	0	0
Archytoepalpus rufiventris	1	1	0	1	1	2	0	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	2	3	1	0	9	1	1	0
Austeniops truncaticornis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	9	1	0	0
Beskiocephala flava	1	1	0	1	1	0	1	3	1	0	0	0	1	1	0	0	1	1	0	-	-	0	0	3	1	2	-	-	9	1	0	0
Bischofimyia atra	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Bombyliomyia flavipalpis	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	0
Camposiana emarginata	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	2	0	3	1	2	-	-	9	1	0	3

Species/Characters	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**
Catajurinia angusta	1	1	0	0	1	1	1	0	1	0	0	1	0	1	0	0	2	1	1	0	1	0	1	0	1	0	-	-	0	1	0	6
Chiloepalpus aureus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Chiloepalpus callipygus	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	0	1	1	0	0	0	3	1	2	-	-	9	1	0	6
Chlorohystricia reinwardtii	1	0	0	-	1	0	1	0	1	1	0	0	0	1	0	0	0	1	1	0	2	0	0	0	1	0	-	-	0	1	0	0
Chromatophania distingueda	1	1	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	0	3	0	0	2	0	0	-	-	0	1	0	0
Chromatophania fenestratata	1	1	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	0	3	0	0	2	0	0	-	-	0	1	0	0
Chromoepalpus uruhuasi	1	0	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	0	-	-	0	0	0	1	0	-	-	9	1	0	2
Copecrypta nitens	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	1	1	0	0	0	0	3	1	2	-	-	9	1	0	0
Copecrypta ruficauda	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	1	1	0	0	0	0	3	1	2	-	-	9	1	0	0
Corpulentoepalpus rufus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Corpulentosoma cornutum	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cryptopalpus ornatus	1	1	0	1	1	1	1	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	0	5
Cryptopalpus rubrum	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cyanogymnomma coerulea	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Cyanopsis costalis	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	3	1	0	-	-	9	1	0	0
Dejeania bombylans	1	1	0	1	1	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	0	0	-	-	0	1	0	0
Dejeania hecate	1	1	0	1	1	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	1	0	-	-	0	1	0	0
Dejeaniops beckeri	1	1	0	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	0	-	-	0	0	1	1	0	-	-	6	1	0	0
Dejeaniops ollachea	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Deopalpus australis	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	0	1	1	0	0	0	3	1	2	-	-	9	1	0	6
Deopalpus contiguus	1	1	0	1	1	0	0	0	1	0	0	0	1	1	0	0	3	1	0	-	-	0	0	3	1	2	-	-	9	1	0	6
Deopalpus hirsutus	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	3	1	0	-	-	0	0	3	1	2	-	-	9	1	0	0
Deopalpus pictipennis	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	3	1	2	-	-	9	1	0	0
Diaphanomyia aurea	1	0	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	2	2	0	0	9	1	0	0
Diaphanomyia aurifacies	1	0	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	2	2	0	0	9	1	0	0
Dumerillia rubida	1	1	0	0	1	0	1	1	1	0	0	1	0	1	1	1	2	1	1	0	1	0	1	0	1	0	-	-	A	1	0	6

Species/Characters	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**
Echinopyrrhosia alpina	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Echinopyrrhosia browni	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	-	-	9	1	0	1
Echinopyrrhosia pictipennis	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	-	-	9	1	0	1
Echinopyrrhosiops decorata	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Edwynia robusta	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	1	0	0	0	3	1	2	-	-	9	1	0	6
Empheremyiops discalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpellus corpulentus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpodes equatorialis	1	1	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	0	1	0	0
Epalpus albomaculatus	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Epalpus lineatus	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Epalpus niveus	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Epalpus rufipennis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Epalpus signifer	1	1	0	1	1	2	1	0	1	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Epicuphocera andina	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Ernestia rudis	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	0
Eubischofimyia analis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	9	1	1	0
Eucorpulentosoma simile	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	0	-	-	1	0	3	2	2	0	1	9	1	0	3
Eudejeania aldrichi	1	1	1	0	1	1	1	0	1	0	0	0	1	1	1	0	0	1	1	1	0	0	0	1	1	0	-	-	0	1	0	1
Eudejeania subalpina	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euempheremyia nemo	1	1	0	1	1	2	1	0	1	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Euempheremyia paulensis	1	1	0	1	1	2	1	0	1	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Euepalpodes arcuatus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euepalpus vestitus	1	0	0	1	1	2	1	0	1	0	0	2	1	1	0	0	0	1	1	1	0	0	0	3	0	2	-	-	9	1	0	0
Eufabriciopsis quadrisetosa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	9	1	1	0
Euhuascaraya atra	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Euhuascaraya obscura	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	9	1	1	0

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Euhuascaraya siesta	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Eulasiopalpus albipes	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eulasiopalpus vittatus	1	1	1	1	1	1	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	-	-	3	1	-	-
Eumelanepalpus ruber	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eusaundersiops inornatus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Eutrichophora punensis	1	0	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	1	0	-	-	0	0	3	1	2	-	-	9	1	0	2
Exopalpus elegans	1	1	0	0	1	1	1	1	1	0	0	1	0	1	1	1	2	1	1	0	1	1	1	0	1	0	-	-	A	1	0	0
Exopalpus ochracea	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Fabriciopsis hystrix	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Formicomyia ovata	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Formicomyia sp. nov.	1	1	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	1	1	0	0	0	0	3	1	2	-	-	9	1	0	0
Gymnochaeta viridis	1	1	1	0	1	0	1	5	1	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0	-	-	0	1	0	0
Gymnomma diaphanoides	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Gymnomma sp. nov.	1	1	0	1	1	2	1	0	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Gymnommopsis gagatea	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Helioprosopa electilis	1	0	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	0	3	2	2	0	0	9	1	0	0
Helioprosopa facialis	1	0	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	0	0	-	-	0	0	3	1	2	-	-	9	1	0	0
Homosaundersia rufa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Homosaundersia sp. nov. 1	1	1	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	2	0	3	0	2	-	-	9	1	0	3
Homosaundersia sp. nov. 2	1	1	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	2	0	3	1	2	-	-	9	1	0	3
Homosaundersiops haenschi	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Huascarayopsis paulensis	1	1	0	1	1	0	0	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	2	3	1	0	9	1	1	0
Hystricia abrupta	1	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	1	0	2	1	0	0	1	0	-	-	0	1	0	3
Itacuphocera ocellaris	1	1	0	0	1	1	1	4	1	0	0	0	1	1	0	0	3	1	0	-	-	0	0	0	1	2	-	-	5	1	1	0
Itasaundersia robusta	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	0	2	-	-	9	1	0	3
Jurinella anax	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	0	1	0	0

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Jurinella bella	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Jurinella lutzi	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Jurinella varians	1	1	0	0	1	1	1	1	1	0	0	1	0	1	1	1	2	1	1	0	1	1	1	0	1	0	-	-	A	1	0	0
Jurinia paulensis	1	1	0	1	1	2	0	0	1	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	2	3	1	0	9	1	1	0
Jurinia pompalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Juriniopsis adusta	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	1
Juriniopsis aurifrons	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	1
Juriniosoma gagateum	1	1	0	1	1	2	1	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	2	3	1	0	9	1	1	0
Leskia cf *flavipennis*	1	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1	0	0	0	2	0	0	-	-	0	1	0	0
Lindigepalpus townsendi	1	1	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	0	3	2	2	0	0	9	0	0	3
Linnaemyia comta	1	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	-	-	0	0	0	1	0	-	-	0	1	0	0
Lypha melobosis	1	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	0	1	1	0	2	0	0	0	1	2	-	-	0	1	0	3
Macromya pyrrhaspis	1	1	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	0	-	-	0	0	0	1	0	-	-	0	1	0	1
Melanepalpellus corpulentus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Melanepalpus albipes	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Melanepalpus fulvus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Microgymnomma orbitalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Microgymnomma paulensis	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	-	-	9	1	1	0
Nemoraea pellucida	1	1	1	0	1	0	1	5	1	0	2	0	1	1	0	0	0	1	1	0	0	1	0	0	1	0	-	-	0	1	0	1
Neocuphocera nepos	1	1	1	1	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	1	0	-	-	2	1	0	0
Neocuphocera orbitalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neogymnomma rufa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neosarromyia neotropica	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Neosarromyia trinitatis	1	1	0	0	1	1	1	0	1	0	0	0	1	1	0	0	3	1	0	-	-	0	0	0	1	0	-	-	5	1	1	0
Ochroepalpus ochraceus	1	1	0	1	1	2	1	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	2	3	1	0	9	1	1	0
Oestrohystricia subalpina	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

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Oharamyia browni	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	0	1	1	0
Oharamyia vierecki	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Opsoempheria atra	1	1	0	1	1	2	0	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	2	3	1	0	9	1	1	0
Oxyepapus flavoscutellatus	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Palpolinnaemyia perorbitalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Palpotachina similis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Paradejeania rutilioides rutilioides	1	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	1	1	0	-	-	0	1	0	1
Paradejeania xenisma	1	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	1	1	0	-	-	0	1	0	1
Pararchytas apache	1	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	1	0	-	-	0	1	0	0
Pararchytas decisus	1	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	1	0	-	-	0	1	0	0
Parechinotachina plumitarsis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Parepalpus auroanalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Parepalpus flavidus	0	1	0	1	1	2	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Parepalpus similis	0	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	9	1	1	0
Peleteria filipalpis	1	0	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	2	1	-	-
Peleteria malleola	1	0	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	2	1	-	-
Peleteria (Oxydosphiria) iterans	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Panzeriopsis) cornigera	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Panzeriopsis) cornuta	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Peleteria) abdominalis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria (Peleteria) aldrichi	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Peleteria pygmaea	1	0	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	2	1	-	-
Peleteria robusta	1	0	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	-	-	2	1	-	-
Peleteria Sphyrimyia obsoleta	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

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Peleteria Sphyrimyia setosa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Periopticochaeta pendula	1	1	0	0	1	2	1	0	1	0	0	1	1	1	0	0	2	1	1	0	1	0	1	0	1	0	-	-	0	1	0	6
Phosocephala metallica	1	1	0	1	1	2	1	1	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	-	-	9	1	0	0
Phosocephala sp. nov.	1	1	0	1	1	2	1	1	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	-	-	9	1	0	0
Pictoepalpus clarus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Prospanipalpus peruvianus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Protodejeania hystricosa	1	1	1	0	1	1	0	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	1	0	-	-	0	1	0	0
Pseudoxanthozonella similis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	9	1	0	0
Quadratosoma rufum	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Rhachoepalpus cinereus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Rhachoepalpus ethelius	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Rhachoepalpus olivaceus	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	-	-	7	1	1	0
Rhachoepalpus pulverulentus	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	-	-	7	1	1	0
Rhachosaundersia boliviana	1	0	0	1	1	0	1	1	1	0	0	0	1	1	1	1	1	0	0	-	-	0	0	3	2	2	0	1	9	1	0	3
Ruiziella frontosa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Ruiziella luctuosa	1	1	1	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	-	-	0	1	0	0
Saundersiops cayensis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Saundersiops confluens	1	1	0	1	1	2	1	0	1	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Saundersiops cruciatus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosoma impressum	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis argentea	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis eronis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Signosomopsis townsendi	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	-	-	9	1	1	0
Sorochemyia oroya	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Steatosoma rufiventris	1	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	-	-	0	1	1	0
Tachina lurida	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	0

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Tachina (Nowickia) egula	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Tachina (Nowickia) ferox	1	1	1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	1	0	-	-	0	1	0	0
Tachina (Rhachogaster) algens	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0	1	0	-	-	8	1	0	0
Tachina (Rhachogaster) nitida	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0	1	0	-	-	8	1	0	0
Tachina (Tachina) fera	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	-	-	0	1	0	0
Tachina (Tachina) grossa	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	-	-	0	1	0	0
Tachina (Tachina) ursina	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	1	0	-	-	0	1	0	0
Talarocera nigripennis	1	1	0	1	1	0	1	0	1	0	0	1	1	1	0	0	0	1	0	-	-	0	0	0	1	0	-	-	4	1	0	1
Trichoepalpus emarginatus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Trichophora analis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Trichophora nigra	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	1	2	-	-	9	1	0	0
Trichosaundersia dorsopunctata	1	0	0	1	1	2	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	0	3	2	2	0	0	9	1	0	3
Trichosaundersia lineata	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Trichosaundersia rufopilosa	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Uruhuasia cruciata	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Uruhuasiops analis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Vertepalpus verdans	1	1	0	0	1	1	0	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	-	-	9	1	0	0
Vibrissoepalpus flavipes	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Vibrissomyia bicolor	1	0	0	1	1	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	1	2	-	-	9	1	0	6
Vibrissomyia lineolata	1	0	0	1	1	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	1	2	-	-	9	1	0	6
Vibrissomyia oroyensis	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Xanthoepalpodes bischofi	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	0	3	0	2	-	-	9	1	0	3
Xanthoepalpus bicolor	1	1	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	0	2	-	-	9	1	0	3
Xanthozona melanopyga	1	0	0	1	1	2	1	1	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	2	2	1	0	9	1	0	0
Zonoepalpus testaceus	1	0	0	1	1	2	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	3	2	2	0	0	9	1	0	0

Species/Characters	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
Zophomyia temula	1	1	1	0	0	0	1	0	0	1	2	0	1	1	1	0	0	1	1	0	0	1	0	0	0	0	-	-	0	1	0	1

GENERAL CONCLUSION

The results of Chapters 1 and 2, although preliminary, offer robust and evidence-based conclusions that will certainly be essential for investigations regarding the systematics, evolution and biogeography of calyptrate flies. The main conclusions of each chapter are described below.

The origin of Calyptratae is older than previously estimated, occurring in the mid-Late Cretaceous, although all its families originated only during the Tertiary. However, the diversification of families throughout the Tertiary did not happen at the same time interval. The oldest family is Hippoboscidae, occurring in the Paleocene, followed by the origin of the families Muscidae, Nycteribiidae, Streblidae, Tachinidae and Sarcophagidae in the Eocene. The majority of families originated during the Oligocene, and the oestroid families Oestridae, Polleniidae and Rhiniidae are the youngest in Calyptratae, having originated in the Miocene. The superfamily Hippoboscoidea appeared very early in the diversification of calyptrate flies, in the Late Cretaceous, whereas the origin of the superfamily Oestroidea occurred only in the Early Eocene. The divergences of the monotypic families Mystacinobiidae (from Oestridae) and Ulurumyiidae (from Mesembrinellidae) are old, having occurred in the Late Eocene. The node dating approach using CladeAges proved to be a suitable model to estimate divergence times in Calyptratae, which will serve as a reference for future studies of divergence times in Diptera and other lineages of species-rich groups. This is the first hypothesis of divergence times for all families of Calyptratae, including several of their respective subfamilies and tribes due to the increased sampling of calyptrate species. For instance, as originally intended in our first project, the tribe Tachinini originated at the transition of the Oligocene to Miocene, suggesting a recent and fast diversification of a group that has so many species distributed around the world.

Moreover, the diversity of genera and morphological features of species of the tribe Tachinini were summarized in the phylogenetic hypothesis of Chapter 2. This is the first comprehensive phylogenetic hypothesis for the group, representing 79% of genera of the tribe. Despite previous classifications that divided the fauna of Tachinini in different suprageneric groups, Tachinini is indeed a monophyletic group. Traditional diagnostic characters used to classify the fauna of Tachinini (e.g., relative size of the first flagellomere and pedicel, development of palpi and presence of parafacial setae) are actually homoplastic and no traditional suprageneric taxa previously proposed for Tachinini was recovered as monophyletic. The most informative characters to delimit and diagnose genus groups of Tachinini are usually found in features of the male terminalia. Additional characters, however, such as the female terminalia, first instar larvae and molecular sequences, might shed more light and provide a higher support for the genus groups proposed herein.

After our efforts to understand the origin of calyptrate flies and to provide phylogenetic evidence to improve the classification of Tachinini, we consider that our results are going to positively impact and promote new taxonomic revisions, phylogenetic hypotheses, macroevolutionary studies and recovery of the biogeographical history of these flies.

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