

## AN ANNOTATED PRELIMINARY LIST OF THE CHIRONOMIDAE (DIPTERA) OF ZURQUÍ, COSTA RICA

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### Abstract

An annotated list of the species of Chironomidae found at a four-hectare site, mostly cloud forest, in Costa Rica is presented. A total of 137 species, 98 of them undescribed, in 63 genera (17 apparently new), were found.

### Introduction

The tropics have long been known as areas of great biodiversity (e.g. Erwin 1982), but our knowledge of many insect groups there remains poor. The two volume “Manual of Central American Diptera” (Brown et al. 2009, 2010) provided the first modern tools to analyze the diversity of one of the largest orders of insects, the Diptera (two-winged flies) of the northern portion of the Neotropics; Spies et al. (2009) covered the Chironomidae. These volumes offered the first family level identification keys for Central America (the first for any portion of the Neotropics) and also allow identification to the generic level of the described Central American Diptera. However, these volumes are just scratching the surface of Neotropical fly diversity. At both the genus and especially the species level, a tremendous amount of work remains to be done.

Art Borkent and Brian Brown conceived and developed a survey project for identifying all the Diptera species of a small area in Costa Rica. The study, patterned after an “All Taxa Biotic Inventory” (ATBI), but devoted entirely to the order Diptera, was called the Zurquí All Diptera Biodiversity Inventory (ZADBI). Fifty-nine collaborators took part in the project; I was fortunate to work with the Chironomidae. Borkent & Brown (2015) provided an overview of the project and its protocol.

As will be seen below, a large number of undescribed genera and species were found, as well as many new records for Costa Rica. This paper is also meant to update the generic synopses provided by Spies et al. (2009).

### Material and methods

The majority of material came from the main site at Zurquí de Moravia (hereafter Zurquí), located at 10.047313°N, 84.008457°W, in San José Province, Costa Rica, collected from September 2012

to October 2013. The 150 by 266 m site, at an elevation of ~1600 m, is mostly cloud forest, with adjacent small pastures; the site has one permanent and one temporary stream, located in heavily forested ravines.

Collecting methods included two malaise traps run continuously and additional traps run three days each month: three additional malaise traps, several emergence traps (over leaf litter; over dry branches; over vegetation; over stagnant water; over running water), CDC light traps, bucket light traps, yellow pan traps, flight intercept traps and mercury vapor light traps. Some specimens were collected by sweeping and by hand.

Samples were sorted and prepared by technicians at the Instituto Nacional de Biodiversidad (INBio). Given the difficulties of female identification, for the most part only males were removed from the samples for identification. Thus parthenogenetic species, such as *Phytotelmatocladius delarosai* Epler, known from the USA (Florida) to Argentina (Epler 2010, Siri & Donato 2014) may have been missed.

### Results

A total of 2,120 specimens were examined. Four subfamilies, 63 genera and 137 species were represented (Appendix 1). The majority of species (98), and 17 new genera, are apparently undescribed and were given letter/number designators. It is anticipated that a great deal of time will be necessary to describe all these new taxa. Workers whose work may involve some of these taxa are welcome to contact me with ideas for producing descriptions. Funding sources are also being sought.

All but one of the putatively new genera were orthoclads and are listed as “CHIRORTH-n”, referring to “Chironomidae: Orthoclaadiinae” followed by a number; e.g., “CHIRORTH-1 sp. ZUR-1”. The single CHIRCHIR-1 is a damaged specimen of a Chironominae, and may represent a known genus, but its combination of available characters does not allow generic placement. Undescribed species are listed with “ZUR-n”, referring to new taxa from the Zurquí project (I also have numerous other undescribed species from Costa Rica,

collected over the past several decades, that have been given different letter/number designators; with the possible exception of a single species of *Parametriocnemus*, none of these other undescribed taxa were found in the Zurquí material). A list of the taxa collected is presented in Appendix 1. An annotated accounting of these taxa follows below; any mention of morphological characters is not to be taken as a description of a taxon. Note also that the relative numbers or percentages given for species collected are not representative of the total catch, and pertain just to the material that was selected to be mounted.

#### PODONOMINAE

***Parochlus*** - A single taxon belonging to the *Parochlus araucanus* group (Brundin 1966) was collected. Because pupae are necessary for species delimitation in this group, species-level identification of this taxon will have to wait until pupae are collected and associated.

#### TANYPODINAE

***Procladius*** - To date, only one species of the subgenus *P. (Procladius)* has been reported from the Neotropics: *P. mozambique* Roback, from Colombia (Roback 1982b). The single species of *Procladius* collected at Zurquí, *P. (Procladius)* sp. ZUR-1, more closely resembles *P. (P.) paludicola* Skuse, an Australian species (Roback 1982a), but differs in coloration and morphology.

***Thienemannimyia*** - *Thienemannimyia (Thienemannimyia)* sp. ZUR-1 may be the species referred to by Watson & Heyn (1993) as *Thienemannimyia* nr *barberi* (Coq). It resembles *T. barberi* (Coquillett), a western US species, but the wing pattern appears slightly different; comparison of more Costa Rican and Nearctic material is necessary.

***Zavrelimyia*** - *Zavrelimyia (Paramerina) fasciata*, as *Paramerina fasciata* Sublette & Sasa, was described from Guatemala (Sublette & Sasa 1994); it is widespread in Costa Rica and was the most common tanypod collected in the study.

#### ORTHOCLADIINAE

***Antillocladius*** - Three species were collected; *A. pluspilalus* was the most common (59 specimens). The genus has most recently been reviewed by Mendes & Andersen (2008) and Mendes et al. (2011).

***Bryophaenocladius*** - Of the five *Bryophaenocladius* species collected, four are undescribed. The fifth species is listed here as *B. cf. psilacrus*. *Bryophaenocladius psilacrus* was described from South Carolina, USA, by Sæther (1982), based on

a single specimen. A key character for this species was the absence of acrostichal setae. The Zurquí material (41 specimens) all had some acrostichal setae; otherwise the specimens appear to be *B. psilacrus*. The type was not available for examination.

Although a widespread and speciose genus, few *Bryophaenocladius* species are known from the Neotropics. Wang et al. (2006) and Donato (2011) provided the most recent treatments of the genus for the area. It is possible that some of the taxa that I've grouped here may belong elsewhere.

***Comptosmittia*** - Three species were collected; the most common (104 specimens) was the undescribed *C. sp. ZUR-1*, followed by *C. nerius* (43 specimens). A single specimen of *C. sp. ZUR-2* was collected. The genus was most recently reviewed, for taxa from the area, by Mendes et al. (2004).

***Corynoneura*** - Two undescribed species were collected in addition to two described species: *C. ferebata* was described from Guatemala by Sublette & Sasa (1994); *C. guanacaste* was described from northern Costa Rica by Wiedenbrug et al. (2012).

***Cricotopus*** - About 15 species are recorded or described from the Central American-Caribbean area (Spies & Reiss 1996). All eight of the *Cricotopus* species that were collected at Zurquí appear to be undescribed; all belong with the subgenus *C. (Cricotopus)*.

***Diplosmittia*** - Two undescribed species were collected, in addition to *D. forficata*, described from La Selva, Costa Rica, by Andersen (1996). The genus has recently been reviewed by Pinho et al. (2009) and Wiedenbrug & Silva (2016) added an additional species from the Dominican Republic. The single specimen of *D. sp. ZUR-1* lacks antennae and bears a well developed inferior volsella; it may belong elsewhere but is placed in *Diplosmittia* until more complete material can be collected. *Diplosmittia* sp. ZUR-2 resembles *D. beluina* Andersen (described from La Selva, Costa Rica) but has 13 antennal flagellomeres, with an AR of 3.0-3.4, and a more sharply pointed anal point; *D. beluina* has 10 flagellomeres and an AR of 0.62. Both taxa have a long costal extension. The two taxa may be conspecific but more material is necessary to determine antennal variability.

***Eukiefferiella*** - Three undescribed species that fit *Eukiefferiella* were collected. No described species are known from the Neotropics; Watson & Heyn (1993) recorded larvae from Costa Rica.

**Gravatamberus** - The genus was established by Mendes & Andersen (2008); they included five species found in Brazil, Chile, Costa Rica, Guatemala, Mexico and Venezuela. *Gravatamberus curtus* Mendes & Andersen was described from material (three specimens) from Mexico and northwestern Costa Rica; *G. guatemaltecus* was described from a single specimen from Guatemala. The two species were diagnosed by the number of setae in cell m proximal to RM, number of setae on the subcosta, the length of the costal extension and the AR: *G. curtus* has <10 setae in cell m proximal to RM (*G. guatemaltecus* >10); subcosta with 6–15 setae (*G. guatemaltecus* 16), costal extension 68–86 µm (*G. guatemaltecus* 161); AR 0.64–0.69 (*G. guatemaltecus* 0.26).

Eighteen males of *Gravatamberus* were collected; unfortunately, antennae were missing on all of them. All had a costal extension, ranging from 128 to 200 µm (Table 1), greater than that recorded for *G. curtus*. However, the range of setae in cell m proximal to RM ranged from 0 to 24 in the Zurqui material, regardless of costal extension length, suggesting that this character does not aid in distinguishing *G. curtus* from *G. guatemaltecus*. All *Gravatamberus* collected in this study are considered to represent *G. guatemaltecus*.

Data also indicate that the midges had more setae in cell m and on the subcosta from February to

May, with fewer setae present in those wing areas from May (one specimen) through October.

**Irisobrillia** - Eight specimens of the sole species of the genus, *I. longistyla*, were collected.

**Krenosmittia** - Two specimens were collected of a species that appears to belong with *Krenosmittia*. This would be the first record for the genus from the Neotropics. Examination of more material is necessary.

**Limnophyes** - *Limnophyes* was one of the more common of the small orthoclad taxa collected (~8% of total mounted catch). Two species were collected: *L. mariae* (38 specimens) and the much more common *L. guatemalensis* (142 specimens), both described from Guatemala by Sublette & Sasa (1994).

**Lipuometriocnemus** - Four species were collected, three of them undescribed. *Lipuometriocnemus* was first described from the British West Indies by Sæther (1981), with *L. glabulus* as the sole species. Sæther (1982) then described *L. vixlobatus* from South Carolina, USA. The two species were supposedly separated by the absence of setae on R<sub>1</sub>, a weak inferior volsella and a “slight hump on tergite IX representing a reduced anal point” in *L. vixlobatus*. Cranston & Oliver (1988) reported *L. vixlobatus* from the Yukon Territory of Canada, and examined paratypes of *L. glabulus* and a sin-

Table 1. Selected measurements of *Gravatamberus guatemaltecus*

Specimen #	Month collected	cell m setae	subcosta setae	costal extension, µm
4399193	OCT	0	5	175
4401710	JUN-JUL	1	4	195
4401650	JUN-JUL	0	6	200
4401625	OCT	0	5	155
4400249	JUN	1	5	180
4405861	MAY	1	5	153
4401624	OCT	0	9	200
4400246	JUN	1	7	188
4399225	JUN	0	5	155
4399224	JUN	9	5	175
4406521	APR	18	12	163
4370228	MAY	17	17	153
4363952	APR	24	14	128
4363944	FEB	11	7	188
4363957	APR	19	11	133
4399449	MAY	15	10	165
4406482	APR	13	6	150
4406453	MAY	16	10	138

gle specimen (which they thought to also represent *L. glabalis*) from Braulio Carillo National Park in Costa Rica (the Zurquí site is adjacent to a portion of the huge park). They noted that the two species were difficult to separate because of variation in the supposedly diagnostic characters, but gave no reason why they assigned the Yukon specimen to *vixlobatus*, which following its description should lack any setae on  $R_1$ , instead of assigning it to *L. glabalis*. I noted such variation in the volsellae and “anal hump” in the Zurquí material I’ve designated as *L. glabalis*; there was variation in the length/breadth of the gonostylus but much appeared due to the viewing angle. I saw no specimens in which  $R_1$  was devoid of setae and considered all material I put in this group to be *L. glabalis* (63 specimens).

My *L. sp.* ZUR-1 (eight specimens) has genitalia similar to those of *L. glabalis* but has a very low AR (~0.32–0.58) compared to what is being called *L. glabalis* today (following Cranston & Oliver 1988 and Andersen et al. 2016). In Sæther’s (1981) original description of *L. glabalis*, all of the type material lacked antennae, but it is now apparently assumed that the species has an AR similar to that of *L. vixlobatus* – around 1.60–1.75. Zurquí material of *L. glabalis* had ARs > 1.70.

My *L. sp.* ZUR-2 (36 specimens) has an AR around 1.76–1.85 and genitalia very similar to those of *L. glabalis*, except the proximal portion of the gonostylus bears a hump that separates it from that of *L. glabalis*. Further work (i.e., measurements of other body parts, etc.) may show this taxon may also belong with *L. glabalis*.

My *L. sp.* ZUR-3 (two specimens) has an AR of about 1.0 or less and has a distinctively pronounced inferior volsella. Andersen et al. (2016) described two new *Lipuroetriocnemus* species from Brazil and provided a key for the known species. Their *L. biancae* has a pronounced inferior volsella, but not the same as *L. sp.* ZUR-3, and an AR of 1.29–1.45. Their *L. amazonicus* (AR 1.23–1.45) is very similar to *L. glabalis*, but has fewer dorsocentral setae.

**Litocladius** - A single species (34 specimens), *L. chavarriai*, was collected.

**Lopescladius** - Two undescribed species, both belonging with the subgenus *L. (Cordiella)*, were collected (seven of *L. sp.* ZUR-1; two of *L. sp.* ZUR-2).

**Mesosmittia** - The widespread *M. patrihortae* (22 specimens) and one undescribed species (one specimen) were collected. The genus was most recently reviewed by Andersen & Mendes (2002). They noted that *M. truncata* Sæther, described

from a single male specimen from Panama (Sæther 1985), was separable from *M. patrihortae* only by the length of the costal extension (116  $\mu\text{m}$  in *M. truncata*; 8–62  $\mu\text{m}$  in *M. patrihortae*). Costal extensions in Zurquí material ran from 50 to 140  $\mu\text{m}$ , indicating a wide range of lengths that would include the single measurement from the Panama specimen. I consider *M. truncata* to be a junior synonym of *M. patrihortae*.

**Metriocnemus** - Three species, two undescribed, were collected. The named species, *Metriocnemus costatus*, was described from Guatemala by Sublette & Sasa (1994). Their description stated “genitalia with a midventral notched, somewhat quadrangular plate”. One of the *Metriocnemus* species collected, initially designated *M. sp.* ZUR-2, was very similar to the description and illustrations for *M. costatus* (Sublette & Sasa 1994: fig. 88) except it apparently lacked this plate. I was able to examine 6 paratypes of *M. costatus* from the Sublette Collection, located at the University of Minnesota, St. Paul, MN. The specimens were all excessively squashed (typical of Sasa mounts) and the quadrangular plate was apparent. I then remounted the abdomen/genitalia of one of the Zurquí *M. sp.* ZUR-2 specimens and excessively squashed it – the quadrangular plate appeared! This plate is normally oriented in a dorsal-ventral manner and is visible as a thin sclerotized line when viewed in a typical genitalia mount that has not been excessively flattened. The structure may represent the aedeagus or an ejaculator (see Tuxen 1970: fig. 160).

**Nanocladius** - Eight specimens of a single undescribed species of *Nanocladius (Nanocladius)* were collected. The genus is poorly known from the Neotropics, with only three species described from the region to date (Epler 1986; Wiedenbrug & Silva (2013).

**Onconeura** - One undescribed species (six specimens) of *Onconeura* was collected. This would be the second species known from Costa Rica; Spies & Reiss 1996 recorded *O. semifimbriata* (Sæther) from the country. The most recent papers on *Onconeura* are Donato et al. (2012) and Wiedenbrug et al. (2009).

**Parakiefferiella** - The genus is unrecorded from Central America; Wiedenbrug & Andersen (2002) described several new species from South America and provided a review of the genus. Two specimens of an undescribed species were collected.

**Parametriocnemus** - Four species were collected; all appear to be undescribed. *Parametriocnemus sp.* ZUR-1 and *P. sp.* ZUR-2 resemble the Nearc-

tic *P. lundbeckii* (Johannsen) but have a lower AR; *P. sp.* ZUR-1 was 0.67–0.72; *P. sp.* ZUR-2 was 0.52–0.68 (for *P. lundbeckii* see below). Both may represent a single species; more measurements of other body parts are necessary.

Sublette (1967: 539) gave an AR of 1.40 based on a specimen (a “metatype”) from the type series; he also gave ARs of four Johannsen-determined specimens that ranged from 1.26–1.60, mean 1.36. Sæther (1969) gave a range of 0.90–1.30, mean 1.12, for the AR of *P. lundbeckii*.

Sublette & Sasa (1994) recorded larval, pupal and adult *P. lundbeckii* from Guatemala. I examined 4 females and one female pupal exuviae from this Guatemalan material (no males were available). None of these specimens could be reliably identified as *P. lundbeckii*.

Epler (2001: 7.117) discussed a *Parametrioctenus* from Great Smoky National Park that had genitalia similar to *P. lundbeckii* but had an AR of 0.40. Two other specimens resembling *P. lundbeckii* from the same area have an AR of around 0.84, and I’ve also examined *P. lundbeckii* from the same area with “typical” ARs (~1.40). It appears obvious that a thorough study of *P. lundbeckii* is necessary to determine just what that species is.

According to my notes, *P. sp.* ZUR-4 resembles a species I have seen from northwestern Costa Rica that I had designated *P. sp.* CR-3. Those specimens, and other Costa Rican *Parametrioctenus* species, are out on loan and were not available for comparison. All of the Zurquí *Parametrioctenus* specimens had an AR below 1.00.

***Paraphaenocladus*** - *Paraphaenocladus exagittans longipes* was one of the most common orthoclad collected, with 113 specimens examined. The subspecies was described from Costa Rica (type locality, Cacao (a volcano) in Guanacaste Province), St. Vincent and Trinidad (Sæther & Wang 1995).

***Pseudorthocladus*** - Two specimens of an apparently undescribed species were collected. Until this collection, *Pseudorthocladus* was not recorded from the Neotropical Region. The Zurquí species appears similar to *P. clavatosus* Sæther & Sublette, but has a smaller inferior volsella. *Pseudorthocladus clavatosus* was described from two males and a female from South Carolina, U.S.A. (Sæther & Sublette 1983); comparison with type material will be necessary to determine if the Zurquí specimens represent a new species.

***Pseudosmittia*** - Three species were collected, one undescribed. *Pseudosmittia windwardensis* was

the most common (75 mounted specimens), while 39 specimens of the widespread *P. forcipata* were collected. It should be noted that, pending further investigation, some of the putative new orthoclad genera found during this study may belong with *Pseudosmittia*. Ferrington & Sæther (2011) provided the most recent review of the genus.

***Stictocladus*** - One specimen of an undescribed species was collected. In the Western Hemisphere, this genus has been mostly recorded from Argentina, Chile and Peru, but has recently been found in North America (Sæther & Cranston 2012). This would be the first record of the genus from Central America. The new Costa Rican species has clear wings and a very low AR of 0.21.

***Synorthocladus*** - Two specimens of an undescribed species were collected. Watson & Heyn (1993) recorded “*Synorthocladus sp.*” from Costa Rica.

The following orthoclad taxa appear to represent undescribed genera. These taxa are discussed below with mention of morphological characters in order to inform other workers that may have similar taxa and may wish to collaborate or borrow material. Please note again that any mention of morphological characters is not to be taken as a description of a taxon.

**CHIRORTH-1** - A small species, represented by one specimen with bare eyes; 11 antennomeres; minute scalpellate (?) acrostichals; wing with strong punctation and bare squama; small rounded anal point; and each tarsal claw with 3 teeth.

**CHIRORTH-2** - A small species with bare eyes; 13 antennomeres with low (0.43) AR; elongate thorax with a few decumbent acrostichals; 0-1 squamal setae, with long costal extension; abdomen with weak bands; no virga, no anal point.

**CHIRORTH-3** - A small species with pubescent eyes; low AR (0.50); well developed scale-like virga; and a short, rounded anal point. Fifteen specimens were collected.

**CHIRORTH-4** - There appear to be two species in this putative new genus, which differ from each other by having a radically different virga. The head has a U-shaped frons as in *Jururumberus* Mendes & Andersen (Mendes & Andersen 2013). This small-bodied genus also has bare eyes; 8/9 antennomeres; no squamal setae; R ends just before fCu and no anal point. Numerous specimens were collected.

**CHIRORTH-5** - A genus similar to *Pseudosmittia*, represented by four specimens. It features

antennae with 13 flagellomeres; low AR (0.55); weak decumbent acrostichals; one squamal seta; wing veins without setae except near base of R; long costal extension; no pulvilli and deeply bifid tarsal claws.

**CHIRORTH-6** - This taxon, represented by four specimens, resembles *Saetheriella* Halvorsen, in having reniform, protruding hairy eyes and a rounded to triangular anal point. However, it has an extended costa; well developed pulvilli; a well developed, clear, scutal tubercle; lacks a virga; and has superior and inferior volsellae.

**CHIRORTH-7** - This genus has pubescent eyes; no observable acrostichal or squamal setae; a very long costal extension; a scale-like virga; and a short rounded anal point. Three specimens were collected.

**CHIRORTH-8** - A single specimen of this taxon was collected. It has eyes with very short pubescence; antennae with 13 flagellomeres and very low AR (0.19); no apparent acrostichals; no squamals, no pulvilli; apically bifid claws; no volsella and a gonostylus that is widened preapically.

**CHIRORTH-9** - Represented by two specimens, this genus has pubescent eyes, with pseudo-ocelli present; a grossly enlarged globose palpomere 3; numerous scalpellate acrostichals; a small patch of short setae lateral to and above the apex of the anteprenotal lobes; no squamals; a long costal extension; very recurved Cu1 and a *Mesosmittia*-like anal point.

**CHIRORTH-10** - A single specimen of this moderately large midge was collected. It has 13 flagellomeres; bare eyes; reduced 4<sup>th</sup> and 5<sup>th</sup> palpomeres; about 20 scalpellate acrostichals that originate at about 1/3 the length of the scutum; finely punctate wing membrane; no squamals; sinuate Cu1; no anal point but a *Mesosmittia*-like median hump; abdominal tergites with dark posterior bands; and a well developed inferior volsella with a median swelling posterior and ventral to it.

**CHIRORTH-11** - Two specimens were collected; both have lost their antennae. Eyes are bare; the acrostichals are absent or very minute; a weak virga is present; there are no volsellae present; and the gonostylus lacks a megaseta.

**CHIRORTH-12** - A single specimen that lost its antennae was collected. It has hairy eyes; four palpomeres; no squamal setae; apparently no acrostichals; a virga; *Mesosmittia*-like anal point; and a small inferior volsella.

**CHIRORTH-13** - This taxon has bare eyes; one

palpomere; apparently no acrostichals; bare squama; elongate virga; and broadly spatulate anal point. Three specimens were collected.

**CHIRORTH-14** - One specimen of this taxon was collected. It has bare eyes; 13 flagellomeres, with low AR (0.28) and a large seta on the last antennomere; no acrostichals; no squamals; a moderately long bare anal point and a well developed inferior volsella.

**CHIRORTH-15** - A series of 10 specimens represents this genus, which has bare eyes; short palpomeres; two acrostichals at mid-scutum; long pulvilli; and no anal point. All specimens have lost their antennae.

**CHIRORTH-16** - A single specimen of this midge was collected. It somewhat resembles *Pseudosmittia*, but has hairy eyes; no acrostichal or squamal setae; a long costal extension; weak virga; small inferior volsellae; arcuate gonostyli; and a short triangular/conical anal point lacking any large setae.

#### CHIRONOMINAE

*Beardius* - Two species were collected; *B. triangulatus* was described from Costa Rica by Andersen & Sæther (1996). One specimen of an undescribed species was collected. The genus was recently revised by Pinho et al. (2013).

*Caladomyia* - Two undescribed species were collected; one specimen of one species, two of the other. The genus was recently reviewed by Trivinho-Strixino (2012).

*Cryptochironomus* - Four specimens of an undescribed *Cryptochironomus* were collected.

*Dicrotendipes* - Fourteen specimens of an undescribed *Dicrotendipes* were collected. The species possesses an apically bifid inferior volsella. Although such a volsella is known from Afrotropical and Palaearctic species, as well as several Amazonian species (Epler 1988), this is the farthest north I have seen such a species in the Western Hemisphere.

*Einfeldia* - Five specimens of an undescribed *Einfeldia* were collected. The taxonomy of *Einfeldia* has been confused, with some species being allocated to other genera (Epler et al. 2013; Cranston et al. 2016). I examined the holotype of *E. atitlanensis* Sublette & Sasa, described from Guatemala (Sublette & Sasa 1994); this new species differs having a larger digitus of the superior volsella, a thinner gonostylus and darkened apices of the leg segments.

**Endotribelos** - Two described species and one undescribed species were collected. Fourteen specimens of *E. albatum* and 40 (including two intersex specimens) of *E. grodhausi* were examined; seven specimens of the undescribed species were collected. The undescribed species has a long thin anal point and appears similar to, but lighter than, an undescribed species from La Selva, of which I have several reared associations.

*Endotribelos* was established by Grodhaus (1987) for *Tendipes (Tribelos) hesperia* Sublette, 1960 (which thus became *Endotribelos hesperium* (Sublette)), a southern US species whose larva has an odd number of teeth on the mentum and a large gap (diastema) between the molar area and the proximal inner tooth of the mandible. Subsequently, Sublette & Sasa (1994) described two species from Guatemala, *E. albatum* and *E. grodhausi*; the larva of *E. grodhausi* has an even number of mental teeth and lacks the mandibular diastema (the larva of *E. albatum* remains unknown). Since then, several more species have been described from South America (Roque & Trivinho-Strixino 2008 and Trivinho-Strixino & Pepenelli 2015), the larvae of which display a variety of those character states. See also Epler et al. (2013).

Trivinho-Strixino & Pepenelli (2015) provided keys for the males and known larvae of *Endotribelos*. However, male *E. grodhausi* will not key correctly because couplet 4 gives one the choice of “base of superior volsella setose” or “base of superior volsella bare”. Choosing “bare” eventually leads to *E. grodhausi* at couplet 14. However, the base of the superior volsella of *E. grodhausi* is clothed, ventrally and dorsally, with fine setae. Thus, *E. grodhausi* will key to *E. jaragua* Trivinho-Strixino & Pepenelli in couplet 5, from which it may be separated by the darker thorax of *E. grodhausi* (preepisternum and adjacent sclerites are dark; light in *E. jaragua*). Sasa and Sublette’s illustration of the volsella (Sublette & Sasa 1994: fig. 141) does not indicate the presence of setae, which apparently led Trivinho-Strixino & Pepenelli (2015) to assume the structure was bare. Sublette & Sasa (1994: fig. 135) likewise illustrated the base of the superior volsella of *E. albatum* as bare, when it also is clothed with fine setae. I examined two paratypes of *E. albatum* and eight paratypes of *E. grodhausi*.

**Nandeva** - Two specimens of *N. latiloba* were collected; the species was described from Brazil by Sæther and Roque (2004). This is the first record of the genus from Costa Rica. Andersen et al. (2011) also recorded the species from Venezuela

and confirmed the genus’s position within the tribe Tanytarsini.

**Nilothauma** - Two undescribed species were collected. The genus was most recently reviewed by Mendes & Andersen (2009).

**Parachironomus** - Four specimens of an undescribed *Parachironomus* were collected. The Neotropical *Parachironomus* were documented by Spies et al. (1994).

**Phaenopsectra** - A single specimen of an undescribed *Phaenopsectra* was collected.

**Polypedilum** - A very speciose genus world-wide, *Polypedilum* was the most abundant chironomine genus collected in the study, with one undescribed species of *P. (Pentapedilum)*, one described and three undescribed *P. (Polypedilum)*, three described and one undescribed *P. (Tripodura)* and one undescribed species of *P. (Uresipedilum)*.

The undescribed *P. (Pentapedilum)* species was the most abundant *Polypedilum* collected, with 88 specimens mounted. Mendes, Andersen & Jocqué (2011) described *P. (Polypedilum) panacu* from bromeliad phytotelmata in Honduras. Of the three described *P. (Tripodura)* collected, two were described by Sublette & Sasa (1994) from Guatemala. One of these, *P. (Tripodura) luteopedis* was the second most abundant *Polypedilum* collected, with 75 specimens mounted; the widespread *P. (T.) apicatum* was described from New Mexico, U.S.A., by Townes (1945) and was also recorded from Guatemala by Sublette & Sasa (1994).

**Rheotanytarsus** - One undescribed species, two described species and two tentatively identified described species were collected. *Rheotanytarsus guanacastensis*, *R. scutulatus* and *R. subtilis* were described from northwestern Costa Rica by Kyerematen & Andersen (2002); *R. contrerasi* was described from Mexico by Andersen & Sæther in Kyerematen et al. (2000). Our specimens of *R. cf. contrerasi* and *R. cf. guanacastensis* differ slightly from their original descriptions and must be compared with type material for more positive identification.

**Riethia** - Fifteen male specimens of a genus from the putative tribe Pseudochironomini were collected; this genus is almost certainly *Riethia*, but there is a small chance they could be *Manoa*. Males of the two genera cannot at this time be separated utilizing morphological characters; only females and pupae may be separated at the generic level (Jacobsen & Perry 2002; Trivinho-Strixino et al. 2009). I’m calling the Zurquí specimens *Riethia* based on their close resemblance to *R. truncato-*

*caudata* (Edwards) as redescribed in Trivinho-Strixino et al. (2009) and *R. manauara* Neubern, Trivinho-Strixino & Silva (Neubern et al. 2011); the medial apices of the inferior volsellae of all three species have large, flattened, apically pectinate setae directed mediad (and dorsad in *R. truncatocaudata*). Such setae are unknown in *Manoa*. Note that the legs of the Zurquí specimens are unbanded and there are other differences, especially in the superior volsella; thus, they do not represent *R. truncatocaudata*. Likewise, differences in the genitalia indicate that *R. sp. ZUR-1* is not conspecific with *R. manauara*.

**Stempellinella** - Four specimens of one undescribed species were collected. The genus was recently reviewed by Ekrem (2007).

**Stenochironomus** - Ten species of *Stenochironomus* were collected, only one of which was positively identified as a previously described species: *S. nudipupa* is known from Brazil, Costa Rica, Ecuador and Venezuela (Borkent 1984; Reis et al. 2013). A single specimen of *S. cf. varius* appears to be *S. varius* but lacks any coloration on its fore femur; it does have a darkened fore coxa and trochanter, and may represent a slight color variation of the species. Since Borkent's (1984) excellent revision of *Stenochironomus* and its allies, numerous additional species have been described from the Neotropics; Dantas et al. (2016) provided the most recent key for Neotropical *Stenochironomus*. *Stenochironomus sp. ZUR-1* (six specimens) is similar to *S. impendens* Borkent, but has a different abdominal color pattern; *S. sp. ZUR-2* (one specimen) has a dark, broad anal point, but has different thoracic and abdominal color patterns from any described species; *S. sp. ZUR-3* (16 specimens) will key to *S. sebastiao* Andersen et al. (Andersen et al. 2008) in Dantas et al. (2016) but has a shorter, thicker superior volsella and other hypopygial differences; *S. sp. ZUR-4* (five specimens) and *S. sp. ZUR-5* (one specimen) somewhat resemble *S. leptopus* (Kieffer) but differ in coloration and genitalic structures; *S. sp. ZUR-6* (two specimens) is entirely pale like *S. palliaculeatus* Borkent, but has a stouter superior volsella; *S. sp. ZUR-7* (two specimens) has a dark thorax like *S. varius*, but has numerous darkened abdominal tergites; and *S. sp. ZUR-8* (two specimens) is unusual in having a globose/semi-pediform superior volsella.

**Tanytarsus** - *Tanytarsus* was by far the most common tanytarsine collected, with 140 specimens representing nine species. The majority did not fit descriptions of any known species, except *T. cf. capira* (two specimens) resembles *T. capira* described by Trivinho-Strixino & Strixino

(2007) from Brazil, but appears a bit different; *T. sp. ZUR-8* (one specimen) is also similar to *T. cf. capira* but is much smaller. *Tanytarsus sp. ZUR-5* (16 specimens) is similar to *T. cotopaxi* Gilka & Zakrzewska, described from Ecuador (Gilka & Zakrzewska 2013). The majority of specimens were *T. sp. ZUR-1* (47 specimens), including an intersex specimen; 23 specimens of *T. sp. ZUR-2*; 34 specimens of *T. sp. ZUR-3*; 14 specimens of *T. sp. ZUR-6*; and one specimen of *T. sp. ZUR-7*.

**Xestochironomus** - Four species were collected, one undescribed. I examined the holotype of *X. ankylis*, described from Guatemala by Sublette & Sasa (1994); *X. gilvus* and *X. latilobus* were described from Venezuela by Borkent. *Xestochironomus sp. ZUR-1*, represented by seven specimens, will key to couplet 6 in Borkent (1984) but is neither *X. subletti* Borkent nor *X. gilvus* Borkent; it differs in having a very long, thin, anal point and almost straight superior volsellae.

**CHIRCHIR -1** - This taxon is represented by one damaged specimen, missing its antennae and all tarsomeres. The wings are bare, the squama is fringed and the anteprenotal lobes do not appear to meet medially. The gonostylus has an apical row of medially directed setae, all of which are broken off. The specimen also lacks a subapical seta on the superior volsella but has a subapical pit/sensillum, from which I can observe no indication of a broken or lost seta. This taxon may represent a new genus or be an aberrant *Stenochironomus* with separated tibial spurs (these spurs are fused in *Stenochironomus*); the specimen lacks the posteromedial patch of short setae on the gonostylus found on *Xestochironomus*. More, undamaged, material is needed.

## Discussion

The Zurquí study has produced an impressive list of chironomid taxa, the majority of which (72%) are undescribed. Noticeable in their absence were some common and widespread taxa such as *Abalabesmyia*, *Chironomus*, *Coelotanypus*, *Goeldichironomus*, *Oukuriella* and *Tanypus*. This is no doubt due to a dearth of suitable habitats, as many of those genera are more common in ponds and lakes, especially those with a bit of eutrophication; no such water bodies were present at Zurquí.

Many of the taxa collected are considered terrestrial, semi-terrestrial or phytotelmatic; most of these belong with the subfamily Orthocladiinae: *Antillocladius*, *Bryophaenocladus*, *Comptosmittia*, *Lipurometriocnemus*, *Mesosmittia*, *Paraphaenocladus*, *Pseudosmittia* and probably *Diplosmittia*; at least one *Polypedilum*, *P. panacu*, is phytotelmatic.

It is unfortunate that the project's protocol did not include collecting the immature stages of Chironomidae, but a lack of funding (only half the requested amount for the grant was provided) made the laborious process of collecting larvae and pupae, and rearing them to adulthood, not possible. The likelihood that many of the taxa were probably terrestrial or semi-terrestrial (in wet moss, etc.), entailing an even more time-consuming process than collecting the immature stages from water, compounded the problem. One taxon collected in this survey, a member of *Parochlus araucanus* group, might have been identifiable to species if the pupal exuviae had been collected because the only species-specific characters for this group are found in the pupae (Brundin 1966).

As is demonstrated in this paper, the Neotropical Chironomidae (actually, all Diptera in the Neotropics) remain poorly known - and their immature stages, often used in environmental assessments in the Holarctic, even more so. Although Coffman et al. (1993) reported 266 species of chironomids from 13 streams in northwestern Costa Rica, based solely on pupal exuviae, none of those taxa have been supplied with an available name. Chironomid taxonomy relies mostly on characters of the male, especially the male genitalia, for species delimitation. Thus, collecting the immature stages *must* include rearing (or otherwise associating those stages, as with pharate pupae) to adulthood in order to associate those stages with the generally more better known adults, the bearers of the species' names. Alternatively, the use of suitable molecular markers (e.g. DNA bar codes), as shown by Trivinho-Strixino & Pepinelli (2015), may also help to associate life stages with available names.

While 137 species from a four-hectare area may seem impressive, it pales with the numbers from some of the other families from the ZADBI project. Chironomidae only placed eleventh on the list of total species collected. The Cecidomyiidae topped the list, with about 800 species found. A more complete analysis of these numbers, plus other aspects of diversity, biogeography, ecology, etc., will be presented in a series of multi-authored papers currently being written about the ZADBI project.

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## APPENDIX 1

List of Chironomidae collected at Zurquí de Moravia, Costa Rica, 2012–2013

PODONOMINAE	<i>Cricotopus</i> sp. ZUR-5
<i>Parochlus araucanus</i> Brundin, 1966, group sp. ZUR-1	<i>Cricotopus</i> sp. ZUR-6
	<i>Cricotopus</i> sp. ZUR-7
	<i>Cricotopus</i> sp. ZUR-8
TANYPODINAE	<i>Diplosmittia forficata</i> Andersen, 1997
<i>Procladius</i> ( <i>P.</i> ) sp. ZUR-1	<i>Diplosmittia</i> sp. ZUR-1
<i>Thienemannimyia</i> ( <i>T.</i> ) sp. ZUR-1	<i>Diplosmittia</i> sp. ZUR-2
<i>Zavrelimyia</i> ( <i>Paramerina</i> ) <i>fasciata</i> (Sublette & Sasa, 1994)	<i>Eukiefferiella</i> sp. ZUR-1
	<i>Eukiefferiella</i> sp. ZUR-2
	<i>Eukiefferiella</i> sp. ZUR-3
ORTHOCLADIINAE	<i>Gravatamberus guatemaltecus</i> Mendes & Andersen, 2008
<i>Antillocladius antecalvus</i> Sæther, 1981	<i>Irisobrillia longicosta</i> Oliver, 1985
<i>Antillocladius arcuatus</i> Sæther, 1982	<i>Krenosmittia</i> sp. ZUR-1
<i>Antillocladius pluspilalus</i> Sæther, 1981	<i>Limnophyes guatemalensis</i> Sublette & Sasa, 1994
<i>Bryophaenocladus cf. psilacrus</i> Sæther, 1982	<i>Limnophyes mariae</i> Sublette & Sasa, 1994
<i>Bryophaenocladus</i> sp. ZUR-1	<i>Lipurometriocnemus glabalis</i> Sæther, 1981
<i>Bryophaenocladus</i> sp. ZUR-2	<i>Lipurometriocnemus</i> sp. ZUR-1
<i>Bryophaenocladus</i> sp. ZUR-3	<i>Lipurometriocnemus</i> sp. ZUR-2
<i>Bryophaenocladus</i> sp. ZUR-4	<i>Lipurometriocnemus</i> sp. ZUR-3
<i>Comptosmittia nerius</i> (Curran, 1930)	<i>Litocladius chavarriai</i> Mendes, Andersen & Hagenlund, 2011
<i>Comptosmittia</i> sp. ZUR-1	<i>Lopescladius</i> ( <i>Cordiella</i> ) sp. ZUR-1
<i>Comptosmittia</i> sp. ZUR-2	<i>Lopescladius</i> ( <i>Cordiella</i> ) sp. ZUR-2
<i>Corynoneura ferelobata</i> Sublette & Sasa, 1994	<i>Mesosmittia patrihortae</i> Sæther, 1986
<i>Corynoneura guanacaste</i> Wiedenbrug, Lamas & Trivinho-Strixino, 2012	<i>Mesosmittia</i> sp. ZUR-1
<i>Corynoneura</i> sp. ZUR-1	<i>Metriocnemus costatus</i> Sublette & Sasa, 1994
<i>Corynoneura</i> sp. ZUR-2	<i>Metriocnemus</i> sp. ZUR-1
<i>Cricotopus</i> sp. ZUR-1	<i>Metriocnemus</i> sp. ZUR-3
<i>Cricotopus</i> sp. ZUR-2	<i>Nanocladius</i> sp. ZUR-1
<i>Cricotopus</i> sp. ZUR-3	<i>Onconeura</i> sp. ZUR-1
<i>Cricotopus</i> sp. ZUR-4	

*Parakiefferiella* sp. ZUR-1  
*Parametriocnemus* sp. ZUR-1  
*Parametriocnemus* sp. ZUR-2  
*Parametriocnemus* sp. ZUR-3  
*Parametriocnemus* sp. ZUR-4  
*Paraphaenocladus exagitans longipes* Sæther & Wang, 1995  
*Pseudorthocladus* sp. ZUR-1  
*Pseudosmittia forcipata* (Goetghebuer, 1921)  
*Pseudosmittia windwardensis* (Sæther, 1981)  
*Pseudosmittia* sp. ZUR-1  
*Stictocladus* sp. ZUR-1  
*Synorthocladus* sp. ZUR-1  
 CHIRORTH-1 sp. ZUR-1  
 CHIRORTH-2 sp. ZUR-1  
 CHIRORTH-3 sp. ZUR-1  
 CHIRORTH-4 sp. ZUR-1  
 CHIRORTH-4 sp. ZUR-2  
 CHIRORTH-5 sp. ZUR-1  
 CHIRORTH-6 sp. ZUR-1  
 CHIRORTH-7 sp. ZUR-1  
 CHIRORTH-8 sp. ZUR-1  
 CHIRORTH-9 sp. ZUR-1  
 CHIRORTH-10 sp. ZUR-1  
 CHIRORTH-11 sp. ZUR-1  
 CHIRORTH-12 sp. ZUR-1  
 CHIRORTH-13 sp. ZUR-1  
 CHIRORTH-14 sp. ZUR-1  
 CHIRORTH-15 sp. ZUR-1  
 CHIRORTH-16 sp. ZUR-1  
  
 CHIRONOMINAE  
*Beardius triangulatus* Andersen & Sæther, 1996  
*Beardius* sp. ZUR-1  
*Caladomyia* sp. ZUR-1  
*Caladomyia* sp. ZUR-2  
*Cryptochironomus* sp. ZUR-1  
*Dicrotendipes* sp. ZUR-1  
  
*Einfeldia* sp. ZUR-1  
*Endotribelos albatum* Sublette & Sasa, 1994  
*Endotribelos grodhausi* Sublette & Sasa, 1994  
*Endotribelos* sp. ZUR-1  
*Nandeva latiloba* Sæther & Roque, 2004  
*Nilothauma* sp. ZUR-1  
*Nilothauma* sp. ZUR-2  
*Parachironomus* sp. ZUR-1  
*Phaenopsectra* sp. ZUR-1  
*Polypedilum (Pentapedilum)* sp. ZUR-1  
*Polypedilum (Polypedilum) panacu* Mendes, Andersen & Jocqué, 2011  
*Polypedilum (Polypedilum)* sp. ZUR-1  
*Polypedilum (Polypedilum)* sp. ZUR-2  
*Polypedilum (Polypedilum)* sp. ZUR-3  
*Polypedilum (Tripodura) apicatum* Townes, 1945  
*Polypedilum (Tripodura) luteopedis* Sublette & Sasa, 1994  
*Polypedilum (Tripodura) obelos* Sublette & Sasa, 1994  
*Polypedilum (Tripodura)* sp. ZUR-2  
*Polypedilum (Uresipedilum)* sp. ZUR-1  
*Rheotanytarsus cf. contrerasi* Andersen & Sæther, 2000  
*Rheotanytarsus cf. guanacastensis* Kyerematen & Andersen, 2002  
*Rheotanytarsus scutulatus* Kyerematen & Andersen, 2002  
*Rheotanytarsus subtilis* Kyerematen & Andersen, 2002  
*Rheotanytarsus* sp. ZUR-1  
*Riethia* sp. ZUR-1  
*Stempellinella* sp. ZUR-1  
*Stenochironomus nudipupa* Borkent, 1984  
*Stenochironomus cf. varius* Borkent, 1984  
*Stenochironomus* sp. ZUR-1  
*Stenochironomus* sp. ZUR-2  
*Stenochironomus* sp. ZUR-3  
*Stenochironomus* sp. ZUR-4  
*Stenochironomus* sp. ZUR-5

*Stenochironomus* sp. ZUR-6

*Stenochironomus* sp. ZUR-7

*Stenochironomus* sp. ZUR-8

*Tanytarsus* cf. *caipira* Trivinho-Strixino & Strixino, 2007

*Tanytarsus* sp. ZUR-1

*Tanytarsus* sp. ZUR-2

*Tanytarsus* sp. ZUR-3

*Tanytarsus* sp. ZUR-4

*Tanytarsus* sp. ZUR-5

*Tanytarsus* sp. ZUR-6

*Tanytarsus* sp. ZUR-7

*Tanytarsus* sp. ZUR-8

*Xestochironomus ankylis* Sublette & Sasa, 1994

*Xestochironomus gilvus* Borkent, 1984

*Xestochironomus latilobus* Borkent, 1984

*Xestochironomus* sp. ZUR-1

CHIRCHIR-1 sp. ZUR-1

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