Diversity and distribution of the Caddisflies (Insecta: Trichoptera) of Ecuador

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ABSTRACT

Background. Aquatic insects and other freshwater animals are some of the most threatened forms of life on Earth. Caddisflies (Trichoptera) are highly biodiverse in the Neotropics and occupy a wide variety of freshwater habitats. In Andean countries, including Ecuador, knowledge of the aquatic biota is limited, and there is a great need for baseline data on the species found in these countries. Here we present the first list of Trichoptera known from Ecuador, a country that harbors two global biodiversity “hotspots.”

Methods. We conducted a literature review of species previously reported from Ecuador and supplemented these data with material we collected during five recent field inventories from about 40 localities spanning both hotspots. Using species presence data for each Ecuadorian province, we calculated the CHAO 2 species estimator to obtain the minimum species richness for the country.

Results. We recorded 310 species, including 48 new records from our own field inventories for the country. CHAO 2 calculations showed that only 54% of the species have been found. Hydroptilidae and Hydropsychidae were the most species rich families. We report the family Xiphocentronidae for the first time from Ecuador as well as several new records of genera from different families.

Discussion. As in the neighboring Andean countries of Colombia and Peru, it is common to find undescribed species of caddisflies. There are vast areas of Ecuador and the northern Andes that are completely unexplored, and we expect that hundreds of new species are yet to be discovered.

INTRODUCTION

Aquatic ecosystems are among the most threatened on Earth, and the biodiversity they contain, particularly insects, is still largely undiscovered in many parts of the world (Vörösmarty et al., 2010). For example, according to species estimators we only know about 30% of the caddisfly species from the northern Andean region of South America.
(Venezuela, Colombia, Ecuador, Peru) (RW Holzenthal & B Ríos-Touma, unpublished data). The lack of information on the diversity of species, and their distribution and functional role in aquatic ecosystems, makes predictions of the effects of climate change on these ecosystems and their biota difficult, if not impossible (Holzenthal, Thomson & Ríos-Touma, 2015).

Trichoptera, or caddisflies, are exclusively aquatic in the larval and pupal stages except for a very few terrestrial or semi-terrestrial and brackish-water species and one family whose members are marine (Holzenthal, Thomson & Ríos-Touma, 2015). The members of this order are considered to be biological indicators of good to excellent water quality and are highly sensitive to human disturbance to running waters worldwide (Chang et al., 2014). Currently, there are about 15,000 species described, making Trichoptera the second most diverse monophyletic group of aquatic animals, surpassed only by the clade Diptera: Culicomorpha/Psychodomorpha (Malm, Johanson & Wahlberg, 2013). In Trichoptera, the Neotropical region is the 3rd most species rich in the world with 2100 species recorded as of 2008 after the Oriental and Palearctic regions (De Moor & Ivanov, 2008). In terms of endemism of genera, the Neotropics (115 endemic genera) are second only to the Australasian region (120 endemic genera) (De Moor & Ivanov, 2008).

The Neotropical country of Ecuador hosts an amazing diversity of species, many of them threatened, in two biodiversity “hotspots;” the Tropical Andes and the Tumbes-Choco-Magdalena (Myers et al., 2000). The designation of these hotspots did not include insects or any aquatic biota other than fish. However, the diversity and endemicity of aquatic insects are probably much greater in terms of species numbers than the vertebrate fauna. Considering the importance and sensitivity of aquatic invertebrate biota to changes in habitat, spanning across the watershed, increased knowledge of their taxonomy and biology is urgently needed. Trichoptera are probably one of the best known aquatic groups from the Andes of Ecuador, with some available catalogues of species and their distributions (Flint, Holzenthal & Harris, 1999; Holzenthal & Calor, in press). These baseline data, in addition to the wide range of trophic relationships and microhabitats caddisflies exploit, makes this group ideal for biodiversity and biogeographic studies (Holzenthal, Thomson & Ríos-Touma, 2015). The neighboring countries of Colombia and Peru, have full country or regional Trichoptera checklists (Flint & Reyes, 1991; Flint, 1991; Flint, 1996a; Medellín, Ramírez & Rincón, 2004; Muñoz-Quesada, 2000; Rincón-Hernández, 1999). However, there is no checklist or review of species or their distributions for any aquatic insect order for Ecuador. For these reasons the objectives in this study are to: (1) compile the first list of species of the caddisflies of Ecuador with in-country distribution data from the literature and from our own recent collections; and (2) estimate the total species richness of Ecuadorian caddisflies and define priority areas for future surveys.

**MATERIALS & METHODS**

To gather species information, we referred to the latest version of the Catalog of Neotropical Trichoptera (Holzenthal & Calor, in press). We then searched in the original sources to find more detailed locality information and, especially, the Ecuadorian provinces where
the species were recorded. Collections of specimens are recorded in the literature from as early as 1899 (*Ulmer, 1905*), followed by collections in the early 1900s by Paul Rivet (*Navás, 1913*) with a large set of collections not appearing until the 1970s by Jeffrey Cohen and Andrea Langley under the Ecuador Peace Corps-Smithsonian Institution Aquatic Insect Survey project which are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, (NMNH). The main taxonomic work on this material was done by O.S. Flint, Jr. (NMNH) during the 1980–90s.

During the period covered by the literature (1899 until present), several new provinces were created in Ecuador, including Morona Santiago (1952), Napo (1959), Orellana (1998), Santa Elena (2007), Santo Domingo (2007), Sucumbios (1989), and Zamora Chinchipe (1953). Since the historical records do not reflect these new political subdivisions, we tried to relate the locality descriptions to the current province. However, the majority of records did not have exact coordinates and others lacked sufficient locality information to allow us to be certain about the collection site. With the literature information at hand, we made a first list of species (Table 1) that we then compared with our own recent collections from Ecuador from 2010 to 2015 (Table S1). Collection methods used ranged from sweep netting (mainly in páramo locations) to collecting at black lights during the early evening (at all sites). See *Blahnik & Holzenthal (2004)* and *Blahnik, Holzenthal & Prather (2007)* for a review of collecting methods, field techniques, and genitalia preparation for adult Trichoptera. We made at least two different collections in each of Chimborazo, Imbabura, Morona Santiago, Napo, Pichincha, and Santo Domingo provinces (for exact locations refer to Table S1 and Fig. 1). Specimens collected in our own research are deposited in the University of Minnesota Insect Collection, St. Paul, Minnesota, USA (UMSP), the Museo Ecuatoriano de Ciencias Naturales, Quito, Ecuador (MECN), the Museo de Ecología Acuática de la Universidad San Francisco de Quito, Ecuador (MUEA-USFQ), and the Museo de Zoología de la Universidad Tecnológica Indoamérica, Quito, Ecuador (MZUTI).

From the final list of species (Table 1), we calculated both country richness and province richness. We used the presence of the species per province to calculate an incidence based richness estimator (CHAO 2). This nonparametric species estimator allows for estimation of the potential richness based on the number of observed species, species that are found only in one location, and species that are observed in two locations. Despite its simplicity, a rigorous body of statistical theory demonstrates that CHAO 2 is a robust estimator of minimum richness (*Shen, Chao & Lin, 2003*) and is more rigorous and performs better in benchmark surveys than extrapolated asymptotic functions or other parametric species richness estimators (*Gotelli & Colwell, 2011*) with the kind of data used in this study.

**RESULTS**

We recorded 310 species of Trichoptera in Ecuador, belonging to 15 families and 52 genera. Literature records contained 264 species for the country (Table 1). Of these, 15 did not have specific locality data, although for nine of them we were able to collect additional specimens representing new locality records. We found 48 species that were
Table 1  *Trichoptera of Ecuador*. Caddisfly species found in Ecuador with their distribution, based on literature records as well as recent collections. Endemic species and new records are indicated.

| Species                      | Province                  | Endemic | Altitude | Source                                      |
|------------------------------|---------------------------|---------|----------|---------------------------------------------|
| **Anomalopsychidae**         |                           |         |          |                                             |
| *Contulma*                   |                           |         |          |                                             |
| *bacula* Holzenthal & Flint, 1995 | Napo, Morona Santiago     | E       | 2,770    | Holzenthal & Flint (1995)                   |
| *cataracta* Holzenthal & Flint, 1995 | Napo, Morona Santiago     | E       | 1,800–3,516 | Holzenthal & Flint (1995)                   |
| *echinata* Holzenthal & Flint, 1995 | Napo                     | E       | 3,690    | Holzenthal & Flint (1995)                   |
| *ecuadorensis* Holzenthal & Flint, 1995 | Imbabura               | E       | 2,200    | Holzenthal & Flint (1995)                   |
| *lancoylata* Holzenthal & Flint, 1995 | Napo                    | E       | 1,260    | Holzenthal & Flint (1995)                   |
| *paluguillensis* Holzenthal & Ríos-Touma, 2012 | Pichincha               | E       | 3,848    | Holzenthal & Ríos-Touma (2012)              |
| *pappallacta* Holzenthal & Flint, 1995 | Tungurahua, Zamora Chinchipe | E       | 1,539–2,000 | Holzenthal & Flint (1995)                   |
| *penai* Holzenthal & Flint, 1995 | Azuay, Pichincha, Zamora Chinchipe | E       | 1,600–3,700 | Holzenthal & Flint (1995)                   |
| *spinosa* Holzenthal & Flint, in Flint, 1991 |                           |         |          |                                             |
| **Atriplectididae**          |                           |         |          |                                             |
| *Neoatriplectides* sp. (larval record only) | Not known (probable in Ecuador) |         |          | Holzenthal (1997)                          |
| **Calamoceratidae**          |                           |         |          |                                             |
| *Banyallarga*                |                           |         |          |                                             |
| *loxana* (Navás), 1934        | Azuay, Loja, Zamora Chinchipe |         | 2,000–3,100 | Prather (2004)                             |
| *penai* Prather, 2004         | Loja                      |         | 2,750    | Prather (2004)                             |
| *villosa* (Navás), 1934       | Loja                      | E       | 2,500–2,750 | Prather (2004)                             |
| **Phylloicus**               |                           |         |          |                                             |
| *cressae* Prather, 2003       | Napo, Pichincha           | E       | 950–1,250 | Prather (2003)                             |
| *elegans* Hogue & Denning, in Denning et al., 1983 | Santo Domingo               |         | 229      | Prather (2003)                             |
| *ephippium* Prather, 2003     | Tungurahua                | E       | 15,50    | Prather (2003)                             |
| *fenestratus* Flint, 1974     | Napo, Pastaza             |         |          | Prather (2003)                             |
| *lituratus* Banks, 1920       | Napo, Pastaza, Santo Domingo |         | 229–1,200 | Prather (2003)                             |
| *llaviuco* Prather, 2003      | Azuay                     |         | 3,010    | Prather (2003)                             |
| *paucartamo* Prather, 2003    | Napo                      |         | 1,750    | Prather (2003)                             |
| *trichothyax* Prather, 2003   | Cotopaxi                  |         | 1,372    | Prather (2003)                             |
| **Ecnomidae**                |                           |         |          |                                             |
| *Austrotinodes*               |                           |         |          |                                             |
| *ancylus* Flint & Denning, 1989 | Pastaza               |         |          | Flint & Denning (1989b)                    |
| **Glossosomatidae**          |                           |         |          |                                             |
| *Mortoniella*                |                           |         |          |                                             |
| *angulata* Flint, 1963        | Napo, Pichincha           | E       | 3,810    | Flint (1963)                               |
| *apiculata* Flint, 1963       | Napo, Pichincha           | E       | 2,600    | Flint (1963)                               |
| *aries* (Flint), 1963         | Napo, Pastaza, Pichincha  | E       | 2,440    | Flint (1963); this paper                   |
| *ateruata* (Flint), 1963      | Napo                      |         | 543      | NEW RECORD                                 |

(continued on next page)
| Species          | Province                              | Endemic | Altitude  | Source                  |
|------------------|----------------------------------------|---------|-----------|-------------------------|
| bilineata Ulmer, 1906 | Chimborazo, Pichincha, Morona Santiago | E       | 550–1,370 | Flint (1963)             |
| chicana Sykora, 1999 | Chimborazo, Pastaza, Napo, Morona Chinchipe | E       | 880       | Sykora (1999)           |
| hodgesi Flint, 1963  | Napo, Pichincha                        | E       | 4,115     | Flint (1963)             |
| leei (Flint) 1974    | Pichincha                              | E       | 570       | NEW RECORD             |
| paralineata Sykora, 1999 | Chimborazo, Morona Santiago            | E       | 1,340–1,531 | Sykora (1999)         |
| quinuas Harper & Turcotte, 1985 | Azuay                                 | E       | 3,300     | Harper & Turcotte (1985) |
| roldani Flint 1991   | Pichincha                              |         | 570–700   | NEW RECORD             |
| santiaga Sykora, 1999 | Morona Santiago                       | E       | 2,200     | Sykora (1999)          |
| similis Sykora, 1999 | Santo Domingo                           | E       | 1,900     | Sykora (1999)          |
| squamata Sykora, 1999 | Napo                                  | E       | 1,900     | Sykora (1999)          |
| wygodzinskii (Schmid), 1958 | Morona Chinchipe                    |         |           | Sykora (1999)          |
| Protoptila disticha Flint 1971 | Orellana                        |         | 240–250   | NEW RECORD             |

**Helicopsychidae**

| Species          | Province                              | Endemic | Altitude  | Source                  |
|------------------|----------------------------------------|---------|-----------|-------------------------|
| angulata (Feropsycha) Flint, 1981 | Napo                                 |         | 1,312–1,587 | NEW RECORD             |
| blahniki (Cochliopsyche) Johanson, 2003 | Pastaza, Napo, Sucumbios            |         | 300       | Johanson (2003)         |
| breviterga (Feropsycha) Flint 1991 | Imbabura, Pichincha                  |         | 1,646     | NEW RECORD             |
| clara (Cochliopsyche) (Ulmer), 1905 | Pastaza                               |         | 400       | Johanson (2003)         |
| cochleura (Feropsycha) Johanson, 1999 | Pastaza                             |         | E         | Johanson (2003)         |
| cotopaxi (Feropsycha) Botosaneanu & Flint, 1982 | Cotopaxi                      |         | 3,500     | Johanson (2002)         |
| fistulata (Feropsycha) Flint 1991 | Morona Santiago                       |         | 1,646     | NEW RECORD             |
| napoa (Cochliopsyche) Johanson, 2003 | Napo (Sucumbios), Pastaza            |         | 1,646     | Johanson (2003)         |
| opallescens (Cochliopsyche) Flint, 1972 | Pastaza, Orellana, Sucumbios       |         |           | Johanson (2003)         |
| puyoa (Cochliopsyche) Johanson, 2003 | Pastaza, Orellana, Sucumbios         |         |           | Johanson (2003)         |
| vazquezae (Cochliopsyche) Flint, 1986 | Napo, Morona Chinchipe               |         | 950–1,340 | Johanson (2003)         |
| vergelana (Feropsycha) Ross 1956 | Pichincha                            |         | 570       | NEW RECORD             |
| woytkowskii (Feropsycha) Ross 1956 | Morona Santiago. Santo Domingo       |         | 1,646     | NEW RECORD             |

**Hydrobiosidae**

| Species          | Province                              | Endemic | Altitude  | Source                  |
|------------------|----------------------------------------|---------|-----------|-------------------------|
| banksi (Atopsyche) Ross, 1953 | Chimonbarazo                         |         | 2,800     | Sykora (1991)           |
| cajas (unplaced) Harper & Turcotte, 1985 | Azuay                               |         | E         | Harper & Turcotte (1985) |
| callosa (Atopsaura) (Navás), 1924 | Azuay, Pichincha, Loja, Santo Domingo, Zamora Chinchipe |         | 550–570, 1,860 | Sykora (1991); this paper |
| catherinae (Atopsyche) Harper & Turcotte, 1985 | Azuay                         |         | 3,300     | Harper & Turcotte (1985) |
| chirihuana (Atopsyche) Schmid, 1989 | Pichincha                           |         | E         | Schmid (1989)           |

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Table 1 (continued)

| Species                      | Province       | Endemic | Altitude | Source                        |
|------------------------------|----------------|---------|----------|-------------------------------|
| chirimachaya (unplaced)      | Azuay          |         | 3,300    | Harper & Turcotte (1985)      |
| clarkei (Atopsaura)          | Morona Santiago|         | 2,200    | Sykora (1991)                 |
| copayapu (Atopsyche)         | Pichincha, Loja| E       | 1,780–1,860| Sykora (1991); this paper   |
| davidsoni (unplaced)         | Bolivar        | E       | 3,420    | Sykora (1991)                 |
| flinti (unplaced)            | Chimbaborazo   | E       | 3,500    | Sykora (1991)                 |
| incattapac (Atopsyche)       | Cotopaxi, El Oro| E | 1,780–1,860| Sykora (1991)                 |
| janethae (Atopsyche)         | Azuay          |         | 3,300    | Harper & Turcotte (1985)      |
| lobosa (Atopsaura)           | Pichincha      |         | 2,807    | NEW RECORD                    |
| maitacapac (Atopsyche)       | Napo           |         | 2,000    | Sykora (1991)                 |
| mancocapac (Atopsyche)       | Pastaza        |         | 1,600–2,500| Sykora (1991)                 |
| milestone (unplaced)         | Bolivar        | E       | 3,200    | Sykora (1991)                 |
| neolobosa (Atopsaura)        | Napo, Loja     | E       | 3,200    | Sykora (1991)                 |
| onorei (unplaced)            | Loja           |         | 3,200    | Sykora (1991)                 |
| pachacutec (Atopsyche)       | Cotopaxi, El Oro| E | 2,200    | Sykora (1991)                 |
| pularcocha (Atopsaura)       | Morona Santiago|         | 2,200    | Sykora (1991)                 |
| rawlinsi (Atopsaura)         | Loja           | E       | 3,130    | Sykora (1991)                 |
| sinchicurac (Atopsaura)      | Loja, Zamora Chinchipe| E | 1,600–2,500| Schmid (1989)                 |
| tampurina (Atopsyche)        | Napo, Zamora Chinchipe|         | 1,420    | Schmid (1989) and Sykora (1991) |
| tlapac (Atopsyche)           | Azuay          | E       | 2,200–2,400| Schmid (1989) and Sykora (1991) |
| vatucra (Atopsyche)          | Morona Santiago|         | 1,076    | NEW RECORD                    |
| youngi (unplaced)            | Azuay          | E       | 2,600    | Sykora (1991)                 |

**Cailloma**

| Species                      | Province       | Endemic | Altitude | Source                        |
|------------------------------|----------------|---------|----------|-------------------------------|
| lucidula (Ulmer)             | Chimborazo, Pichincha|         | 3,500–3,850| Sykora (1991); this paper.    |

**Hydropsychidae**

**Centromacronema**

| Species                      | Province       | Endemic | Altitude | Source                        |
|------------------------------|----------------|---------|----------|-------------------------------|
| excisum (Ulmer)              | Pichincha      |         | 700      | Ulmer (1905); this paper      |
| obscurum (Ulmer)             | Imbabura       |         | 1,312    | NEW RECORD                    |

**Leptonema**

| Species                      | Province       | Endemic | Altitude | Source                        |
|------------------------------|----------------|---------|----------|-------------------------------|
| album Mosely, 1933:49        | Santo Domingo  | E       | 1,420    | Oláh & Johanson (2012)        |
| andrea Flint, McAlpine & Ross, 1987 | Pastaza | E | 700–1,180| Flint, McAlpine & Ross (1987) |

| Species                      | Province       | Endemic | Altitude | Source                        |
|------------------------------|----------------|---------|----------|-------------------------------|
| cheesmanae Mosely 1933       | Pichincha      |         | 570–570  | NEW RECORD                    |
| cinctum Ulmer, 1905          | Bolivar        |         | 570–570  | NEW RECORD                    |
| coheni Flint, McAlpine & Ross, 1987 | Cotopaxi | E | 570–570  | NEW RECORD                    |
| divaricatrum Flint, McAlpine & Ross, 1987 | Pichincha |         | 570–570  | NEW RECORD                    |
| forficulum Mosely 1933       | Pichincha      |         | 570–570  | NEW RECORD                    |

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| Species         | Province                  | Endemic | Altitude | Source                                      |
|-----------------|---------------------------|---------|----------|---------------------------------------------|
| *intermedium*   | Mosely, 1933              |         |          |                                             |
|                 | Bolivar, Santo Domingo    | E       | 600–2,500| Oláh & Johanson (2012)                      |
| *janolah*      | Oláh & Johanson, 2012     |         |          |                                             |
|                 | Pichincha                | E       |          | Oláh & Johanson (2012)                      |
| *lojaense*     | Flint, McAlpine & Ross, 1987 |         |          |                                             |
|                 | Loja                      | E       |          | Flint, McAlpine & Ross (1987)              |
| *mexibulatum*  | Flint, McAlpine & Ross, 1987 |         |          |                                             |
|                 | Pastaza, Orellana, Sucumbios |         |          | Flint, McAlpine & Ross (1987)              |
| *mastigion*    | Flint, McAlpine & Ross, 1987 |         |          |                                             |
|                 | Los Rios, Santo Domingo   | E       | 229–600  | Flint, McAlpine & Ross (1987); Oláh & Johanson (2012) |
| *olmos*        | Oláh & Johanson, 2012     |         |          |                                             |
|                 | Morona Santiago           |         | 1,646    | NEW RECORD                                  |
| *pseudocinctum*| Flint, McAlpine & Ross, 1987 |         |          |                                             |
|                 | Tungurahua                | E       | 1,280    | Flint, McAlpine & Ross (1987)              |
| *rosenbergi*   | Mosely, 1933              |         |          |                                             |
|                 | Loja                      | E       |          | Flint, McAlpine & Ross (1987)              |
| *simplex*      | Mosely, 1933              |         |          |                                             |
|                 | Loja                      | E       |          | Flint, McAlpine & Ross (1987)              |
| *sociale*      | Flint, 2008               |         |          |                                             |
| *sparsum*      | Ulmer, 1905               |         |          |                                             |
| *spirillum*    | Flint, McAlpine & Ross, 1987 |         |          |                                             |
|                 | Tungurahua, Pastaza, Napo, Morona Santiago |         |          |                                             |
| *stigmus*      | Ulmer, 1905               |         |          |                                             |
| *trifidum*     | Flint, McAlpine & Ross, 1987 |         |          |                                             |
| *viridianum*   | Navás, 1916               |         |          |                                             |
|                 | Napo                      |         | 300–400  | Oláh & Johanson (2012)                      |

**Macronema**

| Species         | Province                  | Endemic | Altitude | Source                                      |
|-----------------|---------------------------|---------|----------|---------------------------------------------|
| *burmeisteri*   | Banks, 1924               |         |          |                                             |
| *fratrum*      | Banks, 1910               |         |          |                                             |
| *hageni*       | Banks, 1924               |         |          |                                             |
| *variipenne*   | Flint & Bueno-Soria, 1979 |         |          |                                             |

**Macrostemum**

| Species         | Province                  | Endemic | Altitude | Source                                      |
|-----------------|---------------------------|---------|----------|---------------------------------------------|
| *ulmeri*        | (Banks), 1913             |         |          |                                             |

**Smicridea**

| Species         | Province                  | Endemic | Altitude | Source                                      |
|-----------------|---------------------------|---------|----------|---------------------------------------------|
| *acuminata*     | (Rhyacophylax) Flint, 1974 |         |          |                                             |
| *andicola*      | (Rhyacophylax) Flint, 1991 |         |          |                                             |
| *bogorba*      | (Rhyacophylax) Oláh & Johanson, 2012 |         |          |                                             |
| *bidactyla*     | (Rhyacophylax) Flint & Reyes, 1991 |         |          |                                             |
| *biserrellata*  | (Rhyacophylax) Flint, 1991 |         |          |                                             |
| *bivittata*     | (Smicridea) (Hagen) 1861   |         |          |                                             |
| *curvipes*      | (Smicridea) Flint, 1991   |         |          |                                             |

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| Species          | Province                      | Endemic | Altitude | Source                                         |
|------------------|-------------------------------|---------|----------|                                               |
| *felsa* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           | E       | 400      | Oláh & Johanson (2012)                        |
| *fogasa* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           | E       | 1,660    | Oláh & Johanson (2012)                        |
| *furesa* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           |         | 1,100    | Oláh & Johanson (2012)                        |
| *gemina* (Smicridea) Blahnik, 1995       | Cotopaxi, Santo Domingo, Pichincha, Guayas, Esmeraldas, Los Ríos |         | 220–600  | Blahnik (1995); this paper                    |
| *hajla* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           | E       | 400      | Oláh & Johanson (2012)                        |
| *homora* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           |         | 400      | Oláh & Johanson (2012)                        |
| *horga* (Smicridea) Oláh & Johanson, 2012 | Pichincha, Santo Domingo       | E       | 550–600  | Oláh & Johanson (2012)                        |
| *kapara* (Rhyacophylax) Oláh & Johanson, 2012 | Morona Santiago                |         | 1,076    | NEW RECORD                                    |
| *lebena* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           |         | 1,966    | NEW RECORD                                    |
| *medena* (Rhyacophylax) Oláh & Johanson, 2012 | Imbabura, Morona Santiago      |         | 1,312–1,587 | NEW RECORD                                  |
| *murina* (Rhyacophylax) McLachlan, 1871  | Pichincha, Napo                |         | 570      | Flint (1991); Flint (1981a); this paper        |
| *nemtompa* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           |         | 400      | Oláh & Johanson (2012)                        |
| *nigricans* (Smicridea) Flint, 1991     | Tungurahua                     |         | 1,780    | Flint (1991); Flint (1991)                    |
| *petasata* (Rhyacophylax) Flint, 1981   | Pastaza                        |         | 1,312    | Flint (1981a); Flint (1991)                   |
| *polyfasciata* (Smicridea) Martynov, 1912 | unspecified locality          |         |          |                                               |
| *probolophora* (Rhyacophylax) Flint, 1991 | Morona Santiago                |         | 1,531    | NEW RECORD                                    |
| *radula* (Rhyacophylax) Flint, 1974     | Imbabura                       |         | 1,312    | NEW RECORD                                    |
| *sarkoska* (Rhyacophylax) Oláh & Johanson, 2012 | Pichincha, Santo Domingo       |         | 1,600    | Oláh & Johanson (2012)                        |
| *sudara* (Rhyacophylax) Oláh & Johanson, 2012 | Pichincha, Santo Domingo       |         | 600      | Oláh & Johanson (2012)                        |
| *tavola* (Rhyacophylax) Oláh & Johanson, 2012 | Napo                           | E       | 400      | Oláh & Johanson (2012)                        |
| *tina* Oláh & Johanson, 2012            | Santo Domingo                  |         | 600      | Oláh & Johanson (2012)                        |
| *truncata* (Smicridea) Flint, 1974      | Orellana                       |         | 240–250  | NEW RECORD                                    |
| *varia* (Smicridea) (Banks), 1913       | Esmeraldas, Los Ríos, Pichincha, Manabi, Santo Domingo |         | 0–580    | Blahnik (1995)                                |
| *ventridenticulata* (Rhyacophylax) Flint, 1991 | Morona Santiago, Chimborazo, Cotopaxi, Imbabura |         | 800–2,200 | Flint (1991); Flint (1981a)                   |
| *Synoestropsis punctipennis* Ulmer, 1905 | unspecified locality          |         |          |                                               |
| Species                     | Province                  | Endemic | Altitude | Source                              |
|-----------------------------|---------------------------|---------|----------|-------------------------------------|
| **Hydroptilidae**           |                           |         |          |                                     |
|                             | **Acostatrichia**         |         |          |                                     |
| *Acostatrichia cerna* Oláh & Flint, 2012 | Los Ríos                   | E       | 250      | Oláh & Flint (2012)                |
| *Acostatrichia hosulaba* Oláh & Flint, 2012 | Pastaza                    | E       | 250      | Oláh & Flint (2012)                |
| *Acostatrichia kihara* Oláh & Flint, 2012 | Napo                       | E       | 580      | Oláh & Flint (2012)                |
| *Acostatrichia pika* Oláh & Flint, 2012 | Pichincha, Santo Domingo   | E       |          | Oláh & Flint (2012)                |
| *Acostatrichia ujasà* Oláh & Flint, 2012 | Pastaza                    | E       | 250      | Oláh & Flint (2012)                |
|                             | **Anchitrichia**           |         |          |                                     |
| *Anchitrichia agaboga* Oláh & Flint, 2012 | Cotopaxi                   | E       | 1,080    | Oláh & Flint (2012)                |
| *Anchitrichia holzenthali* Oláh & Flint, 2012 | Napo                       | E       | 950      | Oláh & Flint (2012)                |
| *Anchitrichia palmatiloba* Flint, 1991 | Pichincha, Pastaza, Cotopaxi | E      | 330–575  | Oláh & Flint (2012); this paper    |
|                             | **Betrichia**              |         |          |                                     |
| *Betrichia rovatka* Oláh & Johanson, 2011 | Pastaza, Napo, Orellana, Sucumbios | E     |          | Oláh & Flint (2012)                |
|                             | **Bredinia**               |         |          |                                     |
| *Bredinia dominicensis* Flint, 1968 | Esmeraldas, Pichincha      | E       |          | Harris, Holzenthal & Flint (2002)  |
|                             |                           |         |          |                                     |
| *Byrsopteryx loja* Harris, Holzenthal & Flint, 2002 | Zamora Chinchipe           | E       | 2,000    | Harris, Holzenthal & Flint (2002)  |
| *Byrsopteryx rayada* Harris & Holzenthal, 1994 | Cañar                      | E       | 2,910    | Harris, Holzenthal & Flint (1994)  |
|                             | **Ceratotrichia**          |         |          |                                     |
| *Ceratotrichia felgorba* Oláh & Flint, 2012 | Napo                       | E       | 580      | Oláh & Flint (2012)                |
| *Ceratotrichia flavicoma* Flint, 1992 | Pastaza, Napo, El Oro, Cotopaxi | E     | 335      | Oláh & Flint (1992a)               |
| *Ceratotrichia jobbra* Oláh & Flint, 2012 | Manabi, Esmeraldas         | E       | 1,100    | Oláh & Flint (2012)                |
|                             | **Costatrichia**           |         |          |                                     |
| *Costatrichia noite* Angrisano, 1995 | Napo, Sucumbios            | E       |          | Oláh & Flint (2012)                |
|                             | **Flintiella**             |         |          |                                     |
| *Flintiella astilla* Harris, Flint & Holzenthal, 2002 | Napo                       | E       |          | Harris, Flint & Holzenthal (2002)  |
| *Flintiella heredia* Harris, Flint & Holzenthal, 2002 | Pastaza                    | E       |          | Harris, Flint & Holzenthal (2002)  |
| *Flintiella pizotensis* Harris, Flint & Holzenthal, 2002 | Esmeraldas, Cotopaxi, Napo, Los Rios, Pichincha | E | 340 | Harris, Flint & Holzenthal (2002)  |
|                             | **Hydroptila**             |         |          |                                     |
| *Hydroptila ditalea* Flint, 1968 | unspecified locality       | E       |          | Flint & Reyes (1991)               |

(continued on next page)
| Species            | Province, Province | Endemic | Altitude | Source                        |
|--------------------|--------------------|---------|----------|-------------------------------|
| *grenadensis* Flint, 1968 | Napo, Pichincha    |         | 400      | Oláh & Johanson (2011)        |
| *paschia* Mosely, 1937 |                    |         |          |                               |
| *spada* Flint, 1991  | Morona Santiago, Pichincha |         | 1,646    | NEW RECORD                    |
| *venezuelensis* Flint, 1981 | Napo, Morona Santiago |         | 400      | Oláh & Johanson (2011)        |

**Leucotrichia**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *fairchildi* Flint, 1970 | Los Rios        |         | 250      | Thomson & Holzenthal (2015)   |
| *forrota* Oláh & Johanson, 2011 | Napo, Pastaza  |         |          |                               |
| *fulminea* Thomson & Holzenthal, 2015 | Cañar         |         | 2,910    | Thomson & Holzenthal (2015)   |
| *inops* Flint, 1991  | Pichincha       |         | 1,800    | Thomson & Holzenthal (2015)   |
| *pectinata* Thomson & Holzenthal, 2015 | Tungurahua    |         | 1,550    | Thomson & Holzenthal (2015)   |

**Mayatrichia**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *illobia* Harris & Holzenthal, 1990 | Pastaza        |         |          | Harris & Holzenthal (1990)    |

**Metrichia**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *argentinica* (Schmid, 1958) | Pichincha        |         | 2,807    | NEW RECORD                    |
| *cuenca* (Harper & Turcotte), 1985 | Azuay           |         | 3,300    | Harper & Turcotte (1985)      |
| *patagonica* (Flint), 1983 | Pichincha, Morona Santiago |         | 3,848    | NEW RECORD                    |
| *spica* Bueno-Soria & Holzenthal, 2003 | Pichincha    |         |          | NEW RECORD                    |

**Neotrichia**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *biuncifera* Flint, 1974 | Morona Santiago |         | 1,076    | NEW RECORD                    |
| *delgadeza* Harris, in Harris & Davenport, 1992 | Pastaza        |         |          | Harris & Davenport (1992)    |
| *napoensis* Harris, in Harris & Davenport, 1992 | Napo           |         | E        | Harris & Davenport (1992)    |

**Ochrotrichia**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *ecuatoriana* Bueno-Soria & Santiago-Fragoso, 1992 | Pastaza        |         |          | Bueno-Soria & Santiago-Fragoso (1992) |
| *puyana* Bueno-Soria & Santiago-Fragoso, 1992 | Pastaza        |         | E        | Bueno-Soria & Santiago-Fragoso (1992) |
| *raposa* Bueno-Soria & Santiago-Fragoso, 1992 | Esmeraldas, Los Ríos |         |          | Bueno-Soria & Santiago-Fragoso (1992) |
| *yanayacuana* Bueno-Soria & Santiago-Fragoso, 1992 | Tungurahua    |         | E        | Bueno-Soria & Santiago-Fragoso (1992) |

**Oxyethira**

| Species            | Province        | Endemic | Altitude | Source                        |
|--------------------|-----------------|---------|----------|-------------------------------|
| *azteca* (Loxotrichia) (Mosely), 1937 | unspecified locality |         | 700      | Flint (1996b)                 |
| *apinolada* (Oxytrichia) Holzenthal & Harris, 1992 | Pichincha      |         |          | NEW RECORD                    |
| *circaverna* (Dampfitrichia) Kelley, 1983 | Napo           |         |          | Kelley (1983)                 |

(continued on next page)
| Species                     | Province                  | Endemic | Altitude | Source                                |
|-----------------------------|---------------------------|---------|----------|---------------------------------------|
| *colombiensis* (*Tanytrichia*) Kelley, 1983 | Los Ríos                 |         |          | Kelley (1983)                         |
| *matadero* (*Dactylotrichia*) Harper & Turcotte, 1985 | Azuay                    | E       | 3,300    | Harper & Turcotte (1985)              |
| *parazteca* (*Loxotrichia*) Kelley, 1983 | Cotopaxi                  |         |          | Kelley (1983)                         |
| *parce* (*Loxotrichia*) (Edwards & Arnold), 1961 | Pichincha, Morona Santiago |         |          | Flint (1996b); this paper            |
| *quinquaginta* (*incertae sedis*) Kelley, 1983 | Pastaza                  | E       |          | Kelley (1983)                         |
| *scaecodactyla* (*Dactylotrichia*) Kelley, 1983 | Pastaza                  | E       |          | Kelley (1983)                         |
| *simanka* (unplaced) Oláh & Johanson, 2011 | Napo                      | E       |          | Oláh & Johanson (2011)                |
| *tica* (*Loxotrichia*) Holzenthal & Harris, 1992 | unknown                  |         |          | Flint (1996b)                         |
| **Rhyacopsyche**            |                           |         |          |                                       |
| *benna* Wasmund & Holzenthal, 2007 | Napo                      |         | 580      | Wasmund & Holzenthal (2007)           |
| *bunkotala* Oláh & Johanson, 2011 | Napo                      | E       |          | Oláh & Johanson (2011)                |
| *colubrinosa* Wasmund & Holzenthal, 2007 | Cotopaxi, Pastaza, Pichincha, Zamora Chinchipe |         | 330–1,250 | Wasmund & Holzenthal (2007)           |
| *hajtoka* Oláh & Johanson, 2011 | Pichincha                | E       |          | Oláh & Johanson (2011)                |
| *peruviana* Flint, 1975     | Pastaza, Zamora Chinchipe |         |          | Wasmund & Holzenthal (2007)           |
| *tanylobosa* Wasmund & Holzenthal, 2007 | Morona Santiago, Napo, Pastaza, Pichincha, Santo Domingo, Zamora Chinchipe |         | 950–1,531 | Wasmund & Holzenthal (2007); this paper |
| **Zumatrichia**             |                           |         |          |                                       |
| *antilliensis* Flint, 1968  | Napo                      |         | 600      | Oláh & Flint (2012)                   |
| *bevagota* Oláh & Flint, 2012 | Cotopaxi                 | E       | 1,100    | Oláh & Flint (2012)                   |
| *corosa* Oláh & Flint, 2012 | Cotopaxi                 | E       | 1,101    | Oláh & Flint (2012)                   |
| *jesuka* Oláh & Flint, 2012 | Napo                      | E       | 580      | Oláh & Flint (2012)                   |
| *gorba* Oláh & Flint, 2012  | Zamora Chinchipe          | E       | 880      | Oláh & Flint (2012)                   |
| *kerekeda* Oláh & Flint, 2012 | Santo Domingo, Pichincha, Cotopaxi, Napo, Manabi, Loja, El Oro, Los Ríos |         | 300–425  | Oláh & Flint (2012); this paper       |
| *kisgula* Oláh & Flint, 2012 | Napo                      | E       |          | Oláh & Flint (2012)                   |
| *kislaba* Oláh & Flint, 2012 | Pastaza                   | E       |          | Oláh & Flint (2012)                   |
| *lapa* Oláh & Flint, 2012   | Pastaza                   | E       |          | Oláh & Flint (2012)                   |
| *masa* Oláh & Flint, 2012   | Pastaza                   | E       |          | Oláh & Flint (2012)                   |
| *palmara* Flint, 1970       | unknown                   |         |          | Flint & Reyes (1991)                  |
| *picigula* Oláh & Flint, 2012 | Napo, Cotopaxi            | E       | 330–950  | Oláh & Flint (2012)                   |
| *sima* Oláh & Flint, 2012   | Pichincha                 | E       |          | Oláh & Flint (2012)                   |
| Species                  | Province                       | Endemic | Altitude       | Source                                      |
|-------------------------|--------------------------------|---------|----------------|---------------------------------------------|
| **Leptoceridae**        |                                |         |                |                                             |
| *Achoropsyche*          |                                |         |                |                                             |
| *duodecimpunctata* (Navás), 1916 | Orellana               |         | 250            | This paper, locality previously unspecified |
| **Amphoropsyche**       |                                |         |                |                                             |
| *napo* Holzenthal, 1985 | Napo                          | E       | 1,800          | Holzenthal (1985)                           |
| *tayapa* Holzenthal & Rázuri-Gonzales, 2011 | Pichincha | E   | 2,500–3,650   | Holzenthal & Rázuri-Gonzales (2011)         |
| **Atanatolica**         |                                |         |                |                                             |
| *acuminata* Holzenthal, 1988 | Zamora Chinchipe | E       | 820–1,800      | Holzenthal (1988b)                          |
| *cotopaxi* Holzenthal, 1988 | Cotopaxi, Morona Santiago, Pichincha | E | 2,500–3,650 | Holzenthal (1988b) |
| *manabi* Holzenthal, 1988 | Manabi, Pichincha            | E       | 2,772          | NEW RECORD                                  |
| **Grumichella**         |                                |         |                |                                             |
| *flaveola* (Ulmer), 1911 | Loja, Napo, Pastaza, Morona Santiago, Zamora Chinchipe |         |                | Holzenthal (1988b) |
| *trujilloi* Calor & Holzenthal, 2015 | Morona Santiago |         |                | NEW RECORD                                  |
| **Nectopsyche**         |                                |         |                |                                             |
| *argentata* Flint, 1991 | Imbabura, Pichincha          |         | 1,180–1,587    | Flint (1991)                                |
| *gemma* (Müller), 1880  | Loja                          |         | 1,076          | Navás (1913)                               |
| *gemmoides* Flint, 1981 | Morona Santiago                |         |                | This paper, locality previously unspecified |
| *maculipennis* Flint 1983 | Orellana                       |         | 240–250        | NEW RECORD                                  |
| *muhni* (Navás), 1916   | unspecified locality            |         |                | Flint (1974)                                |
| *onyx* Holzenthal 1995  | Pichincha                     |         | 570–700        | NEW RECORD                                  |
| *pavida* (Hagen) 1861   | Morona Santiago                 |         | 1,076          | NEW RECORD                                  |
| *punctata* (Ulmer), 1905 | Pichincha, Napo             |         | 570            | This paper, locality previously unspecified |
| *quattuorguttata* (Navas) 1922 | Orellana                   |         | 240–250        | NEW RECORD                                  |
| *spiloma* (Ross), 1944  | unspecified locality            |         |                | Flint & Reyes (1991)                        |
| *splendida* (Navás), 1917 | Orellana                     |         | 240            | Flint (1992b) (unspecified locality); this paper |
| **Oecetis**             |                                |         |                |                                             |
| *acciprīna* Blahnik & Holzenthal, 2014 | Los Ríos, Pichincha     |         | 550–750        | Blahnik & Holzenthal (2014)                 |
| *angulāris* Blahnik & Holzenthal, 2014 | Cotopaxi, Loja, Pichincha, Santo Domingo |         | 300–1,080      | Blahnik & Holzenthal (2014)                 |
| *campana* Blahnik & Holzenthal, 2014 | Zamora Chinchipe, Napo, Pastaza |         | 580–980        | Blahnik & Holzenthal (2014)                 |
| *constricta* Blahnik & Holzenthal, 2014 | Cotopaxi, Guayas, Napo       |         | 305–580        | Blahnik & Holzenthal (2014)                 |
| *excīsa* Ulmer, 1907    | Orellana, Morona Santiago       |         | 240–1,076      | NEW RECORD                                  |
| *mexicana* Blahnik & Holzenthal, 2014 | Los Ríos                     |         | 250            | Blahnik & Holzenthal (2014)                 |

(continued on next page)
Table 1 (continued)

| Species          | Province                      | Endemic | Altitude | Source                                      |
|------------------|-------------------------------|---------|----------|---------------------------------------------|
| protrusa Blahnik & Holzenthal, 2014 | Loja, Pichincha               |         | 300–570 | Blahnik & Holzenthal (2014); this paper     |
| pseudoinconspicua Bueno 1981  | Orellana                      |         | 240–250 | NEW RECORD                                  |
| punctata (Navás) 1924   | Pichincha                     |         | 570–700 | NEW RECORD                                  |
| punctipennis (Ulmer), 1905 | Orellana                      |         | 240–250 | Quinteiro & Calor (2015) (unspecified locality); this paper |
| tumida Blahnik & Holzenthal 2014 | Pichincha                     |         | 550–575 | NEW RECORD                                  |

Triaenodes

| hodgesi Holzenthal & Andersen, 2004 | Pichincha, Esmeraldas | E     | 152     | Holzenthal & Andersen (2004)                |
| peruanus Flint & Reyes, 1991        | Santo Domingo           |       | 229     | Holzenthal & Andersen (2004)                |

Triplectides

| flintorum Holzenthal, 1988 | Loja | 2,000 | Holzenthal (1988a) |

Limnephilidae

Anomalocosmoecus

| illiesi (Marlier), 1962 | Pichincha | 3,848 | Flint (1991) |

Odontoceridae

Marilia

| gigas Flint, 1991 | Pastaza |       | Flint (1991) |

Philopotamidae

Chimarra

| acinaciformis (Curgia) Flint, 1998 | Pastaza |          |              |
| centralis (Curgia) Ross, 1959      | Pichincha |         |              |
| coheni (Chimarra) Blahnik, 1998    | Pichincha |         |              |
| creagra (Chimarra) Flint, 1981     | Morona Santiago, Napo | E   | 335     | Blahnik (1998) |
| decimlobata (Chimarra) Flint, 1991| Imbabura |       | 1,076   | Blahnik (1998) |
| didyma (Curgia) Flint, 1998        | Pichincha, Cotopaxi |     | 1,312–1,587 | NEW RECORD |
| dolabrifera (Chimarra) Flint & Reyes, 1991 | Pichincha, Cotopaxi, Esmeraldas, Los Rios |     | 335     | Blahnik (1998) |

| duckworthi (Chimarra) Flint, 1967  | Pastaza |         |              |
| emima (Chimarra) Ross, 1959        | Pichincha, Cotopaxi, Loja, Los Rios, Santo Domingo |     | 220–550 | Blahnik (1998) |
| geranoides (Curgia) Flint, 1998    | Pichincha, Pastaza, Tungurahua, Zamora Chinchipe |     | 980–4,200 | Blahnik (1998); this paper |

| immaculata (Curgia) Ulmer, 1911    | Napo, Pastaza, Sucumbios |       |              |
| inflata (Chimarra) Blahnik, 1998   | Napo (Sucumbios) | E   |              | Blahnik (1998) |
| langleyae (Chimarra) Blahnik, 1998 | Napo (Sucumbios) | E   | 2,000   | Blahnik (1998) |
| lojaensis (Curgia) Flint, 1998    | Zamora Chinchipe | E   |              | Blahnik (1998) |
| longiterga (Chimarra) Blahnik & Holzenthal, 1992 | Manabi, Pichincha (Santo Domingo) |     | 220     | Blahnik (1998) |
| macara (Curgia) Flint, 1998       | Loja | E     | 650     | Blahnik (1998) |
| margaritae (Curgia) Flint, 1991:26| Tungurahua |     | 1,550   | Blahnik (1998) |

(continued on next page)
| Species                     | Province                                      | Endemic | Altitude     | Source                      |
|-----------------------------|-----------------------------------------------|---------|--------------|-----------------------------|
| munozii (Chimarra) Blahnik & Holzenthal 1992 | Pichincha                                    |         | 570–700      | NEW RECORD                 |
| onina (Chimarra) Flint 1991  | Pichincha, Santo Domingo                      |         | 700          | NEW RECORD                 |
| otuzcoensis (Curgia) Flint & Reyes, 1991 | Pichincha                                    |         | 2,000        | Flint (1998)                |
| pablito (Curgia) Flint, 1998 | Pichincha                                    |         | 570          | Flint (1998)                |
| paracazara (Chimarra) Blahnik, 1998 | Pastaza, Morona Santiago, Tungurahua          |         | 1,280–1,531  | Flint (1998)                |
| peineta (Chimarra) Blahnik & Holzenthal, 1992 | Los Rios, Santo Domingo, Pichincha           |         | 220–550      | Blahnik (1998); this paper |
| persimilis (Curgia) Banks, 1920 | Los Rios, Esmeraldas, Pichincha, Loja, Cotopaxi, Manabi |         | 225–600      | Flint (1998)                |
| peruviana (Curgia) Flint, 1998 | Napo, Pastaza                                 |         | 950          | Flint (1998)                |
| prolata (Chimarrrita) Blahnik, 1997 | Pastaza                                      | E       | 1,000        | Blahnik (1998)              |
| pumila (Chimarra) (Banks), 1920 | Los Rios                                     | E       | 1,100        | Blahnik (1998)              |
| paya (Curgia) Flint, 1998 | Pastaza                                       | E       | 980–1,340    | Blahnik (1998)              |
| quadratiterga (Chimarra) Blahnik, 1998 | Zamora Chinchipe                             | E       |             | Blahnik (1998)              |
| rafita (Chimarra) Blahnik, 1998 | Pastaza                                      | E       | 1,076        | Blahnik (1998); this paper |
| strongyla (Chimarra) Blahnik, 1998 | Pichincha                                    | E       |             | Blahnik (1998)              |
| utra (Chimarra) Blahnik, 1998 | Pastaza, Morona Santiago                      | E       |             | Blahnik (1998); this paper |
| xus (Chimarra) Blahnik, 1998 | Pastaza, Napo                                |         |             | Blahnik (1998)              |
| zamora (Chimarra) Blahnik, 1998 | Zamora Chinchipe,                             |         |             | Blahnik (1998)              |

**Chimarrhodella**

| aequatoria (Navás), 1934 | Loja                                           | E       | 1,600        | Navás (1934)                |
| ornata Blahnik, 2004     | Tungurahua                                    | E       |             | Blahnik (2004)              |
| ulmeri (Ross), 1956      | Morona Santiago, Pastaza, Tungurahua          | E       | 1,076–1,280  | Blahnik (2004)              |

**Wormaldia**

| andreia Muñoz-Quesada & Holzenthal, 2015 | Tungurahua                                   | E       | 1,550        | Muñoz-Quesada & Holzenthal (2015) |
| araujoi Muñoz-Quesada & Holzenthal, 2015 | Napo                                         | E       | 640          | Muñoz-Quesada & Holzenthal (2015) |
| planae Ross & King, in Ross, 1956       | Los Rios, Pichincha, Santo Domingo           |         | 250–1,250    | Muñoz-Quesada & Holzenthal (2015); this paper |

**Polycentropodidae**

**Cernotina**

| cegne Flint 1971        | Orellana                                      |         | 240–250      | NEW RECORD                 |
| lobismen Santos & Nessimian 2008 | Orellana                                      |         | 240–250      | NEW RECORD                 |

**Cynellus**

| fraternus (Banks), 1905 | unspecified locality                          |         |             | Flint (1982)                |
| mammillatus Flint, 1971 | Orellana                                      |         | 240–250      | Flint (1982) (unspecified locality); this paper |

**Polycentropus**

| altmani Yamamoto, 1967 | unspecified locality                          |         |             | Flint (1981a)               |

(continued on next page)
Table 1 (continued)

| Species               | Province                          | Endemic | Altitude         | Source                                                                 |
|-----------------------|-----------------------------------|---------|------------------|----------------------------------------------------------------------|
| *ceciiae* Flint 1991  | Imbabura, Pichincha, Pastaza      |         | 1,180–1,587      | NEW RECORD                                                            |
| *cuspidatus* Flint, 1981 | Flint, 1981                       |         |                  |                                                                     |
| *exsertus* Flint, 1981 | Pastaza                           |         |                  | NEW RECORD                                                            |
| *joergensenii* Ulmer, 1909b:75 | Napo, Morona Santiago          |         | 1,646–2,772      |                                                                      |
| *quadricuspidis* Hamilton & Holzenthal, 2005 | Zamora Chinchipe               |         | 2,000            | Hamilton & Holzenthal (2005)                                         |
| *silex* Hamilton & Holzenthal, 2005 | Pichincha                        |         | 1,400            | Hamilton & Holzenthal (2005)                                         |
| **Polyplectopus**     |                                   |         |                  |                                                                     |
| *buborichorum* Chamorro & Holzenthal, 2010 | Pastaza                          |         |                  | Chamorro & Holzenthal (2010)                                         |
| *buchwaldi* (Ulmer), 1911 | unspecified locality              |         |                  | Chamorro & Holzenthal (2010)                                         |
| *ecuadoriensis* Chamorro & Holzenthal, 2010 | Sucumbios, Napo, Pastaza, Cotopaxi |         |                  | Chamorro & Holzenthal (2010)                                         |
| *inarmatus* Flint, 1971 | Pastaza, Sucumbios, Orellana      |         | 240–1,200        | Chamorro & Holzenthal (2010)                                         |
| *laminatus* (Yamamoto), 1966 | El Oro, Pichincha                 |         | 250–570          | Chamorro & Holzenthal (2010)                                         |
| *puyoensis* Chamorro & Holzenthal, 2010 | Pastaza                          |         |                  | Chamorro & Holzenthal (2010)                                         |
| *recurvatus* (Yamamoto), 1966 | Cotopaxi, Los Rios               |         | 250–330          | Chamorro & Holzenthal (2010)                                         |
| **Xiphocentronidae**  |                                   |         |                  |                                                                     |
| **Machairocentron**   |                                   |         |                  |                                                                     |
| *echinatum* (Flint) 1981 | Orellana                         |         | 240–250          | NEW RECORD                                                            |
| **Xiphocentron**      |                                   |         |                  |                                                                     |
| sp. (undetermined females only) | Napo                             |         | 1,966            | NEW RECORD                                                            |

not previously reported (Table 1 and Table S1). Pichincha (n = 78), Napo (n = 75), and Pastaza (n = 70) were the provinces with the most species recorded in total. However, since these provinces have been divided into new provinces (see Methods), we could not update all records accurately by province because of incomplete locality descriptions in the historical literature. Accordingly, records for Santo Domingo, Sucumbíos, and Orellana provinces could be diminished. On the other hand, Cañar, Guayas, Bolivar, Chimborazo, El Oro, Manabí, and Esmeraldas provinces have less than 10 species recorded (Fig. 1). Carchi, Santa Elena (which was previously part of Guayas) and Galápagos have no species recorded.

A total of 188 species are only known from one province, and 66 species from three or more provinces. According to the species estimator CHAO 2, the estimated caddisfly richness for the country is 578 species, indicating that only 54% of the Ecuadorian caddisfly fauna is known.
Figure 1  Trichoptera species richness in Ecuador. Caddisfly species per province. Number of species indicated by color intensity. Localities for recent collections indicated by circles.

Family overview

**Anomalopsychidae**

This Neotropical endemic family contains two genera, *Anomalopsyche* and *Contulma*, the latter with 27 species distributed from Costa Rica to Chile and southeastern Brazil. Only *Contulma* is found in Ecuador, where nine species occur (Table 1), of which one is newly recorded from the country.

**Atriplectididae**

This is a very rare family known from only a few widely separated regions (*Holzenthal, 1997*). The genus is known from Ecuador, but only from one published larval record (Table 1, *Holzenthal, 1997*) The larvae are unique among all Trichoptera. The head and pronotum are very small and narrow and the anterior portions of the mesothorax are narrow, very elongate, and retractile. Like the adults, they are very rarely collected.

**Calamoceratidae**

This family is cosmopolitan, but most of its 180 species distributed in six genera occur in tropical regions. Two genera, *Banyallarga* and *Phylloicus*, are known for Ecuador with three and eight species respectively (Table 1).
Ecnomidae
Only a single genus, *Austrotinodes*, occurs in Ecuador with one recorded species found only in one province (Table 1). In the New World *Austrotinodes* species occur from southern Texas to Chile, with 43 species recorded in the Neotropics (Holzenthal & Calor, in press).

Glossosomatidae
The family is cosmopolitan, but only members of the New World, subfamily Protoptilinae occur in the Neotropics. Only the genus *Mortoniella*, with 15 species (Table 1), has been recorded from Ecuador (Holzenthal & Calor, in press). Here we are adding *Protoptila* to the country list with one species (Table 1).

Helicopsychidae
All of the species in this cosmopolitan family except one are placed in the genus *Helicopsyche*. Johanson (1998) placed all the Neotropical species in two subgenera, *Feropsyche* and *Cochliopsyche*, both present in Ecuador. Thirteen species of *Helicopsyche* are recorded in Ecuador (with four new records provided in the present study), seven belonging to *Feropsyche* and six to *Cochliopsyche*.

Hydrobiosidae
Most of the 52 genera placed in this family occur in the Australian and southern Neotropical regions (Chile and Argentina), a few species are found in the Oriental, Nearctic, and Palearctic regions. Two genera occur in Ecuador (Table 1), *Atopsyche* with 26 species (two new records) and *Cailloma* with 1 species. The genus *Cailloma* occurs only at high altitudes (Sykora, 1991).

Hydropsychidae
This is a taxonomically diverse, cosmopolitan family. Five of the six genera known from Ecuador belong to the subfamily Macronematinae (*Centromacronema, Leptonema, Macronema, Macrostemum*, and *Synoestropsis*). *Smicridea* is in the subfamily Smicridiinae. There are 61 species in the family in Ecuador (Table 1) of which we are providing 11 new records. *Smicridea* is by far the most diverse, with 31 species, followed by *Leptonema* with 22. On the other hand, *Macrostemum* and *Synoestropsis* are only known from one species each, both from records with unspecified localities. Adult males of many of the Ecuador species of *Centromacronema, Macronema*, and *Macrostemum* swarm during the daytime and do not readily come to lights. After Hydroptilidae, this is the second most species rich family in the country.

Hydroptilidae
Microtrichoptera are found around the world and appear to be very diverse in the Neotropics. It is the most diverse family of Trichoptera found in Ecuador, and the most diverse family in the Neotropics. Seven genera and 78 species are recorded for the country, but certainly many more genera and species are yet to be collected. *Zumatrichia* and *Oxyethira* are the most species rich genera in Ecuador. *Betrichia, Costatrichia*, and *Mayatrichia* are only known from one species each in the country.
**Leptoceridae**
This is a large, cosmopolitan family of about 50 genera and more than 2,000 species. Eight genera and 33 species are known from Ecuador. The genera present in the country include *Achoropsyche, Amphoropsyche, Atanatolica, Grumichella, Nectopsyche, Oecetis, Trianodes,* and *Triplectides*. *Nectopsyche* and *Oecetis* are the most species rich genera in the country and *Achoropsyche* and *Triplectides* are each only known from one species.

**Limnephilidae**
This is a large and taxonomically diverse family. Most of its 100 genera and almost 900 species occur in cool lakes and rivers of the northern hemisphere. In the Neotropics they are known only from the higher elevations of Mexico and Central America, the northern and central Andes, and from temperate, southern South America. In Ecuador, the family is known from one species in the genus *Anomalocosmoecus*, from small streams in the high páramo (Table 1).

**Odontoceridae**
About 160 species in 18 genera occur in all faunal regions except the Afrotropical. There are 3 genera in the Neotropics, *Anastomoneura, Barypenthus,* and *Marilia*. Only *Marilia* occurs in Ecuador, with one recorded species (Table 1) in the Amazonian region.

**Philopotamidae**
Philopotamids occur in all faunal regions. The Ecuadorian fauna is dominated, both in terms of species diversity and abundance of individuals appearing at lights, by the genus *Chimarra*. Thirty-four *Chimarra* species are known from Ecuador (only 23 have been reported from all of North America). *Chimarrhodella* and *Wormaldia*, with three species each, are also known from Ecuador.

**Polycentropodidae**
Approximately 900 species are known from all faunal regions. Only three genera *Cyrnellus, Polycentropus,* and *Polyplectropus* were previously recorded from Ecuador. We are adding the genus *Cernotina* to the species list with two new records from the Tiputini Biological Research Station. Currently, 18 species in the family are known from Ecuador.

**Xiphocentronidae**
About 170 species are known from the Oriental, Ethiopian, and Neotropical regions (one species extends northward into southern Texas in North America). In the current catalog of Neotropical caddisflies (*Holzenthal & Calor, in press*) none of the species in this family are recorded from Ecuador. We have collected only three specimens in this family in Ecuador, one of *Machairocentron echinatum* and two unidentifiable female specimens of *Xiphocentron*. This may be because many species are day active and do not come to lights; nevertheless, they are not at all common in the field or in collections.

**DISCUSSION**
Hydroptilidae, Hydropsychidae, and Philopotamidae accounted for 58% of the diversity of all Ecuadorian caddisfly species. This pattern is similar to other neotropical countries.
Forty-eight new records were added to those that are listed for the country in the current Catalog of Neotropical Caddisflies (Holzenthal & Calor, in press), yet the species estimator suggests that 46% of the species present in the country are yet to be discovered. This does not seem far from reality since, for example, Costa Rica has around 460 species recorded (Holzenthal & Calor, in press). Colombia, a country 22 times as large as Costa Rica and four times the size of Ecuador has only 210 species known (Muñoz-Quesada, 2000). Panama, on the other hand has 300 species recorded (Armitage & Cornejo, 2016). The differences between the published records are clearly related to the number of studies and surveys performed in these countries, with Costa Rica and Panama having a long tradition of biodiversity surveys. Considering the diversity of Ecuadorian ecosystems and the fact that some provinces have less than ten records, we are confident that future surveys will find more species. Most of the coastal provinces, including the Ecuadorian Chocó, are understudied and probably harbor species not known from the Amazon or the Andes. These unexplored provinces are priority areas to conduct future collections and surveys. It is important to emphasize that most of the species recorded and added through our own surveys are represented by one or a few individuals.

The land cover loss in the country is high (Sarmiento, 2002; Eva et al., 2004), especially in the Andean and coastal regions. Since several groups of Trichoptera are known to be highly regionally endemic (Previsic et al., 2009), probably some undescribed species are already lost. Also, climate change might play an important role affecting specialist species, such as those found in glacier-fed streams (Jacobsen et al., 2012). Many protected areas in the Andean and coastal regions are located in mountainous areas, protecting only certain species. We have seen that there is an altitudinal segregation for several groups (Helicopsychidae, Mortoniella), and altitudinal stratification of caddisfly assemblages has been noted (Rincón-Hernández, 1999; Blinn & Ruiter, 2009). This is also a consideration to take into account for future surveys, and the establishment of protected areas should also address altitudinal zonation.

Many new species of Neotropical caddisflies have been described in recent decades. For example, the number of described species increased from 2,214 in 1999 (Flint et al. 1999) to almost 3,260 species today (Holzenthal & Calor, in press) or an increase of more than 1,000 species in 16 years. Currently, in the material we have collected since 2010 we have tentatively identified around 80 new species and some dozens of species known from unidentifiable females. The description of these new species and the identification of others will increase the number of Ecuadorian species to around 400 with material already in hand.

A list of species is a first step in the chain of knowledge of this diverse and sensitive group of insects. However, other important factors in the protection of species diversity is an understanding of their life history and habitat requirements. Currently, we only have these data for one Ecuadorian caddisfly species, Contulma paluguillensis (Holzenthal & Ríos-Touma, 2012). Worldwide, there is a tremendous lack of information on natural history of the world’s biota (Able, 2016). Even in Europe, where almost all the species are described, life-cycle duration, reproduction, and distribution are known for <10% of
However, this information is crucial to protect and forecast the effects of climate and land use change on populations and their distributions of this fascinating group of aquatic insects.

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**Competing Interests**

The authors declare there are no competing interests.

**Author Contributions**

- Blanca Ríos-Touma conceived and designed the study, performed the study, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper, was also in charge of all the collecting permits.

- Ralph W. Holzenthal conceived and designed the study, performed the study, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
Jolanda Huisman, Robin Thomson and Ernesto Rázuri-Gonzalez performed the study, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, reviewed drafts of the paper.

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Data Availability
The following information was supplied regarding data availability:

The raw data has been supplied as a Table S1.

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