



## A new species of *Thraulodes* (Ephemeroptera: Leptophlebiidae, Atalophlebiinae) from a highly altered river in western Ecuador

R. WILLS FLOWERS

Center for Biological Control, Florida A&M University, Tallahassee, FL 32307 USA. E-mail: rflowers7@earthlink.net

### Abstract

*Thraulodes quevedoensis* **new species** (type locality: Quevedo, Ecuador) is described from adults and nymphs. This species was found in a moderately polluted river running through a highly altered agricultural and urban landscape of western Ecuador.

**Key words:** *Thraulodes*, Ephemeroptera, Leptophlebiidae, Ecuador, Quevedo, indicators

### Resumen

Se describen imagos y ninfas de *Thraulodes quevedoensis* una **especie nueva** (localidad tipo: Quevedo, Ecuador). Esta especie fue encontrada en un río de contaminación moderada que atraviesa por un paisaje agrícola y urbano muy alterado en el oeste del Ecuador.

### Introduction

In 2007 during a visit to the downtown area of the city of Quevedo in western Ecuador, male and female imagos of a species of *Thraulodes* Ulmer were collected in the evening at light at the city's 'Malecón' (river walk) (Fig. 1). Additional adults were collected the following year at the same location, and associated nymphs were collected in a riffle in the Río Quevedo 0.5 km upstream from where the adults were found. Additional nymphs were collected at Holandesa, a river crossing north of Quevedo. On comparing the Quevedo species with descriptions of all other known *Thraulodes* in Dominguez *et al.* (2006), it became apparent that this species was undescribed. *Thraulodes* is one of the most ubiquitous Neotropical mayfly genera in low- and mid-elevation streams. However, of the 27 known South American species only eight are known from the nymphal stage (Domínguez *et al.* 2006, Giordano & Domínguez 2005). In this paper I describe the adults and nymphs of this new species and provide some ecological notes.

### Materials and methods

Adults were collected into alcohol by hand from the walls and lampposts in the Malecón. Nymphs were collected by kick-sampling riffles with a D-frame net at Quevedo and at an upstream riffle at Holandesa. In the following description, terms referring to the adult thorax follow Kluge (1994) and terms referring to the genitalia follow Traver and Edmunds (1967). Specimens are deposited in the following institutions: FAMU, Florida A&M University, Tallahassee, Florida, USA; MECN, Museo Ecuatoriano de Ciencias Naturales, Quito, Ecuador.



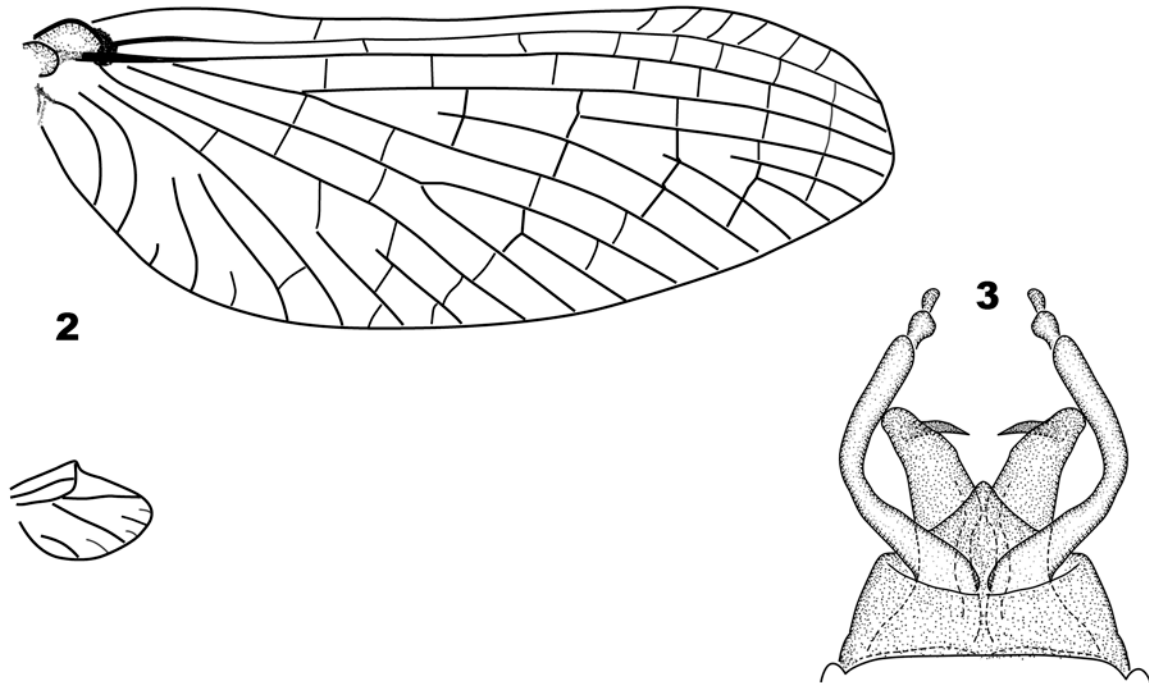
**FIGURE 1.** Type locality of *Thraulodes quevedoensis*: view of the Malecón and the Río Quevedo of Quevedo, Ecuador. Inset: living *Thraulodes quevedoensis* male imago.

***Thraulodes quevedoensis* Flowers, new species**

(Figs. 1–18)

**Description. Holotype.** Male imago (in alcohol): Body length 5.6 mm, forewing 5.2 mm, hind wing 1 mm. General coloration yellowish brown, abdomen translucent. Head: Blackish brown. Upper portion of eyes yellowish orange, lower portion dark grey. Ocelli white, a black ring at base. Antennae with scape and pedicel yellowish tan, flagellum translucent. Thorax: Pronotum pale yellow. Mesonotum yellowish brown, sides of metascutum and posterior scutal protuberances of mesoscutellum chestnut brown. Metanotum chestnut-brown. Pleura yellowish white with anepisterna and katepisterna 2 and 3, and subalar sclerite chestnut-brown. Sterna yellowish white; furcasternum 2 with chestnut-brown lateral furcasternal protuberances. Wings (Fig. 2) with membrane and veins hyaline, milky white in subcostal area, a black spot on basal arc; 2 crossveins basal and 12 distal to bulla. Legs: Coxae, trochanters, and femora whitish; femora with chestnut-brown band in apical fourth. Tibiae and tarsi whitish, tarsal claws dark yellow apically. Abdomen (Fig. 4): Tergum I yellowish white, washed with black on anterior margin and median area; terga II–IV whitish, translucent, with a pair of brownish-black sublateral spots on anterior fourth, and with a black spot on spiracles. Terga VI–X reddish brown with small blackish-brown sublateral spots at anterior margin; terga VI and VII with four rounded whitish spots along anterior margin; tergum VII with large pale yellowish-white spot at posterolateral corners. Tergum X reddish brown with a pair of small submedian paler dots. Sterna I–V translucent whitish;

sterna VI–IX yellowish white. Lateral margins of sterna VI and VII reddish brown; median area of sternum VII washed with black, subgenital plate and lateral margins washed with brown. Genitalia (Fig. 3): forceps yellowish white, angulate in center of first segment; subgenital plate with a triangular posterior projection. Penes yellowish brown, elongate, outwardly curved, a pair of inwardly directed spines apically, lateral flaps lacking. Caudal filaments white, every second annulus marked with dark brown.



FIGURES 2–3. *Thraulodes quevedoensis*. 2, wings; 3, male genitalia.



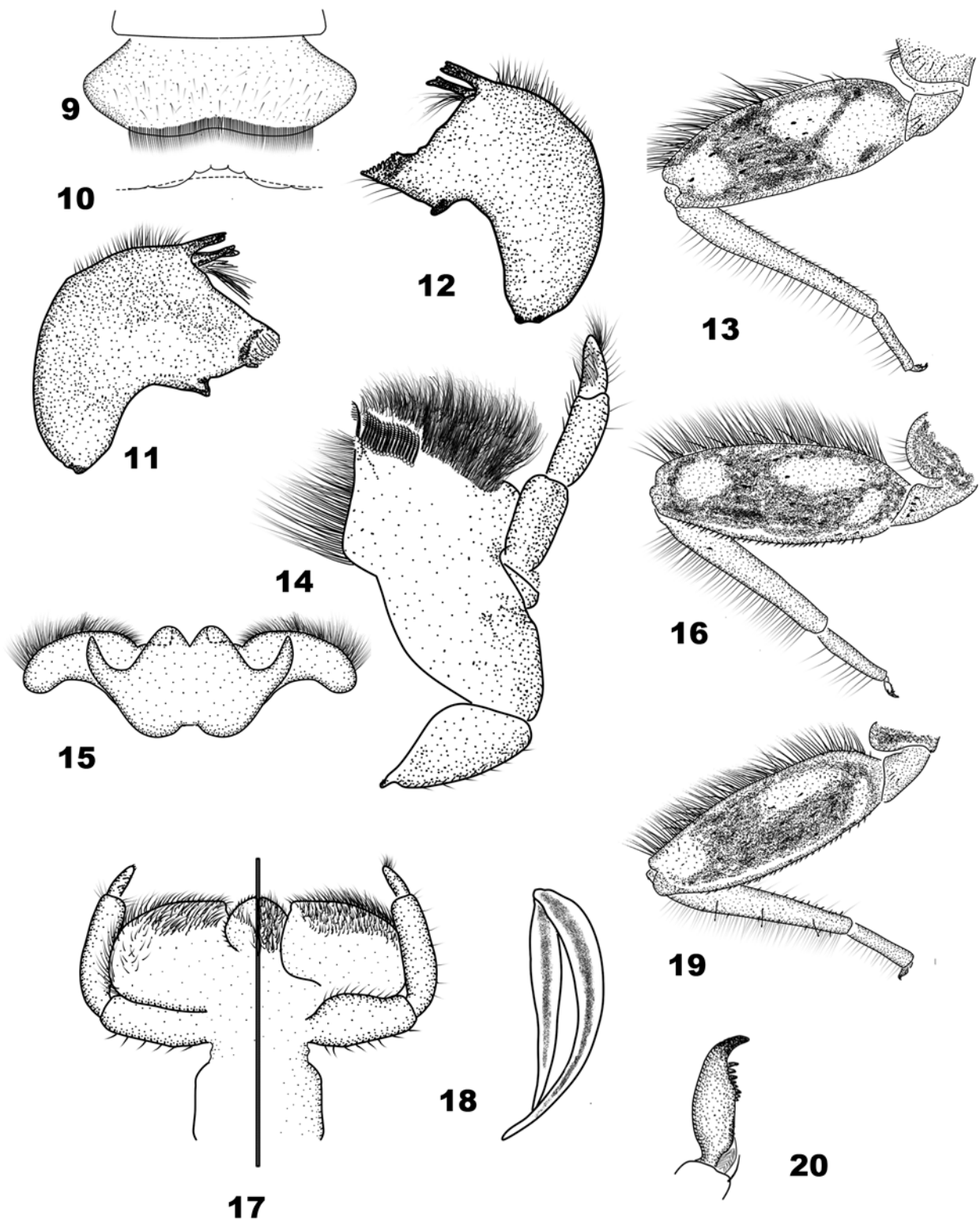
FIGURES 4–8. *Thraulodes quevedoensis*. Figs. 4–6, abdomen of imago: 4, male; 5, female, light form; 6, female, dark form. Figs. 7–8, abdomen of mature nymph: 7, mature female nymph; 8, pterothorax and abdomen of male nymph.

**Allotype.** Female imago (in alcohol): Body length 3.5 mm, forewing 5.5 mm, hind wing 0.9 mm. General coloration yellowish white. Head: Yellowish tan, a chestnut-brown mark on middle of clypeal ridge. Eye dark grey; ocelli translucent white, a black ring around the base of each ocellus. Antenna with scape and pedicel pale brown, flagellum translucent white. Thorax: Prothorax translucent creamy white with irregular chalky

white markings. Mesonotum yellowish white with chalky white markings laterally, mesoscutellum washed with tan and edged with chalky white, metanotum yellowish white with median and posterior chalky white markings. Pleura yellowish white with extensive chalky white areas, anepisterna and katepisterna 2 and 3 washed with dark brown. Sterna yellowish white. Legs: Yellowish white, a dark brown band on apical fourth of each femur. Abdomen (Fig. 5): Tergum I washed with brown, darker in central area; terga II–V yellowish white with black spiracular and submedian spots, and a faint brown transverse band between submedian spots. Tergum VI whitish with a dark brown undulating band in basal half; tergum VII whitish with narrow, undulating markings on basal fourth. Tergum VIII whitish; terga IX and X brown with a narrow, whitish mid-dorsal line. Sterna yellowish white, sterna VI–IX with irregular chalky white markings. Caudal filaments translucent white, the base of every second to third annulus in basal one-fourth of the filaments with a narrow, dark brown band.

**Mature nymph** (in alcohol): Body length 4.6 mm, cerci 5.4 mm, caudal filaments 6 mm. Head: yellowish brown, anterior third darker, eyes and ocelli black, area between ocelli washed with black. Antenna with scape and pedicel pale yellowish brown, flagellum pale yellowish white. Mouthparts: Labrum and dorsal surface of mandibles yellowish brown, washed with black. Clypeus slightly divergent apically. Labrum (Fig. 9) transverse, lateral angles subangulate, dorsal surface with a subapical line of strong setae, scattered fine setae basally. Apical denticles (Fig. 10) short, very broad, covered by a shallow hood. Mandibles (Figs. 11, 12) strongly curved, apical half of lateral margin lined with setae, two patches of setae on basal third of ventral surface, incisors narrow with three apical teeth; right prosthema with a strong pectinate seta, left prosthema with a strong dentate basal spur. Maxilla (Fig. 14) broad, a row of 17 subapical pectinate setae present, cardo with a row of short strong setae on outer margin. Maxillary palp with 5–7 strong setae on apical half of inner margin of segment 2, apical segment with a single strong seta at base of inner margin and a brush of long fine setae on ventral surface. Hypopharynx (Fig. 15) with narrow curved linguae, superlingua with short curved lateral arms, a field of long, laterally directed setae on dorsal side of apices (indicated by dotted lines in Fig. 15). Labium (Fig. 17): Glossae with hair-like setae on ventral surface, strong spine-like setae on lateral and medial margins, a diagonal row of setae on dorsal surface. Paraglossae with fields of long inwardly directed setae on apical fourth. Labial palpi with third segment small, bearing two stout setae on dorsal surface. Thorax: Pronotum of male pale yellow with vague yellowish-brown markings laterally; pronotum of female yellowish brown, vague yellow markings on either side of midline. Mesonotum (Fig. 8) yellowish brown with yellow lyre-shaped mark at midline and yellow spots on humeri, submedially inside wingpads, and mesoscutellum. Wingpads yellowish brown with veins darker. Thoracic sterna yellowish white. Legs: Foreleg (Fig. 19) with femur pale yellowish brown with a large basal and a smaller apical yellowish-white spots. Middle (Fig. 16) and hind (Fig. 13) femora yellowish white, washed with yellowish brown in apical half, apices yellowish white. Tibiae, tarsi, and claws yellowish white, apex of claws brown. Dorsal margin of femur with long fine setae, 6–7 long blunt-tipped setae, and short spine-like setae. Anterior surface with scattered short spatulate setae, a few very short spine-like setae on ventral margin. Fore tibia with a row of short spine-like setae on inner margin, and long fine setae along outer margin. Middle leg similar to foreleg but with a row of short spatulate setae on ventral margin of femur. Hind leg similar to middle leg except spatulate setae on ventral margin of femur more numerous, and outer margin of tibia with long and short stout blunt setae in addition to fine hairs. Tarsal claws (Fig. 20) with a row of 8 subequal denticles. Abdomen of male yellowish brown with sublateral pale yellow spots; tergum IX and a horizontal median band on terga IV and V pale yellow. Female abdomen (Fig. 7) with pale markings smaller than in male, or absent; terga IV and V often with a vertical pale yellow spot. Abdominal sterna pale yellow. Gills narrow, hyaline, tracheae blackish, lacking lateral branches, width of tracheae subequal to half the width of entire gill. Caudal filaments pale yellowish brown with a ring of short erect setae on each segment.

**Etymology.** *quevedonensis*, from Quevedo, noun; and *-ensis*, L., suffix, meaning locality or place. This species is named for both the city and the river where the type material was collected: Quevedo, Los Ríos Province, Ecuador.



**FIGURES 9–18.** *Thraulodes quevedoensis*. Figs. 9–12, 14–15, 17, nymphal mouthparts: 9, labrum; 10, labral denticles; 11, left mandible; 12, right mandible; 14, maxilla; 15, hypopharynx: dorsal seta fields on lingua indicated by dotted lines; 17, labium: right, ventral view; left, dorsal view. Figs. 13, 16, 19, legs of nymph: 13, hind leg; 16, middle leg; 19, foreleg. Fig. 19, fifth gill. Fig. 20, tarsal claw.

**Specimens examined.** (17 ♂♂, 21 ♀♀, 19 nymphs) (MECN) Male imago HOLOTYPE labeled ECUADOR, Los Ríos, Quevedo, Malecón, 15-VII-2008, R. W. Flowers, J. Cabanilla. (MECN) Female imago ALLOTYPE, same locality and collectors as holotype. PARATYPES: Los Ríos Province: 6 ♂♂, 1 ♀ (2 ♂♂

MECN, 4 ♂♂, 1 ♀ FAMU), same locality, date, and collectors as holotype; 10 ♂♂, 19 ♀♀ (5 ♂♂, 6 ♀♀ MECN, remainder FAMU), same locality date and collectors as allotype; 3 ♂♂, same locality and collectors as holotype, 12-VII-2007; 9 nymphs (FAMU), Quevedo, San Camillo, riffle, R. W. Flowers; 10 nymphs (6 MECN, 4 FAMU), Río Quevedo at Holandesa, UTM 672348/9921014, 1-VII-2007, R. W. Flowers, M. Martinez, S. Perez, L. Ledesma.

**Ecology.** The Río Quevedo is a large river flowing through highly impacted agricultural land. Residents of Quevedo assert that the river receives the wastewaters from Quevedo and all communities upstream, as well agricultural runoff that includes heavy loads of fertilizers and pesticides. Notwithstanding, many people use the river for laundry, bathing, and fishing. In addition to a substantial population of the *Thraulodes* described here, the river at Quevedo is also home to *Americabaetis* Kluge, *Baetodes* Needham & Murphy, *Camelobaetidius* Demoulin, and *Guajirulus* Flowers (Baetidae), and *Leptohyphes* Eaton and *Tricorythodes* Ulmer (Leptohyphidae). At Holandesa, *Varipes* Lugo-Ortiz & McCafferty (Baetidae) was collected in addition to the above genera but *Thraulodes quevedoensis* was the dominant invertebrate (unpublished data). An environmental impact assessment, published in 2006, for the 'Proyecto Baba' (Consorcio Hidroenergético del Litoral 2006), a water diversion structure planned for the river upstream from Quevedo, listed fecal coliforms and mercury as significant contaminants of the river from the town of Patricia Pilar downstream to Quevedo. Commonly used pesticides and fertilizers were not detected during this assessment. Ironically, this impact study also failed to detect most of the aquatic fauna we found in the river, possibly due to use of inappropriate sampling techniques. Although the mayfly diversity of the Río Quevedo is undoubtedly affected by the intense agricultural and urban land use, hydrological factors may be ameliorating some of the negative effects. During the rainy season, the river has a very high discharge, while in the dry season water levels and flow are reduced; the riverbed consists of many broad shallow riffles that are well aerated. This combination probably accelerates breakdown of any toxic chemicals, and certainly prevents buildup of sediment, which is the principal threat to aquatic insect communities in the Neotropics.

In several water-quality metrics in use in Central and northern South America, Leptophlebiidae is scored as an indicator of the highest level of water quality (Peruvian Andes, Acosta, Ríos, Rieradevall & Prat, unpublished data) or at the next to highest level (Costa Rica, La Gaceta 2007; Colombia, Roldán Pérez 2003). Given the abundance of *Thraulodes quevedoensis* in the disturbed habitats of the Río Quevedo and perhaps also in similar rivers in western Ecuador, the assumption that Leptophlebiidae collectively indicate good to high water quality is open to question. As experience in temperate countries has shown, tolerance values should be revisited as more data become available and the freshwater fauna becomes better known.

**Diagnosis.** Males of *Thraulodes quevedoensis* can be separated from all other known *Thraulodes* by the combination of the dark abdominal tergum VI, the elongated penes lacking lateral pouches, and two crossveins basal to the bulla. Adult females and nymphs of too few *Thraulodes* species have been described to permit meaningful comparisons between species of these stages. Adults of *T. quevedoensis* appear to have two color forms. Specimens collected in 2007 and in January and July 2008 were colored as described for the holotype and allotype. Specimens collected in August 2008 had darker shades of brown, and a few of the females had abdomens with significantly more brown markings (Fig. 6).

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