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Cabecar serratus, a new genus and species of leptohyphid mayfly from Central America, and description of the imaginal stages of *Tricorythodes sordidus* Allen (Ephemeroptera: Leptohyphidae)

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Abstract

Cabecar serratus, gen. n., sp. n., is described based upon larvae and reared adults from the costal regions of Costa Rica, Nicaragua, and Panamá. The imago stage of *Tricorythodes sordidus* Allen is also described for the first time from reared larvae from Nicaragua and Costa Rica.

Key words: Ephemeroptera, Leptohyphidae, *Tricorythodes*, *Cabecar*, new genus, new species.

Introduction

Species of the New World mayfly family Leptohyphidae are common and widely distributed throughout North, Central, and South America, with several species known from the Caribbean Islands. The majority of these species have been described as either larvae or adults, but not both. While some progress has been made in associating the life stages of some species (Baumgardner and McCafferty 2000; Baumgardner 2003; Baumgardner *et al*. 2003; Molineri 2002; Molineri 2003), many others still remain unassociated. Other taxonomic problems within the family include a poor understanding of interspecific variation, leading to multiple descriptions of the same species (see Baumgardner and McCafferty 2000 for examples), and a number of new species from Central America awaiting description. The purpose of this paper is to: (1) describe a distinctive new genus and species of leptohyphid mayfly based upon larvae and reared adults from Nicaragua and Costa Rica, and (2) characterize, for the first time, the imago of

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Tricorythodes sordidus Allen, based upon reared specimens from Nicaragua and Costa Rica. Collections (and their acronyms) housing materials used in this study include: Florida A&M University, Tallahassee (FAMU); Institutio Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBio); Purdue University, West Lafayette, Indiana (PERC); and Texas A & M University, College Station (TAMU). In material examined summaries, larval collections are abbreviated by the capital letter "L", preceded by the number of specimens examined. Collectors are identified by the following initials: DEB (David E. Baumgardner); WDS (William D. Shepard). Global positioning measures are given in longitude/lattitude coordinates as degrees, minutes, seconds.

Larval chaetotaxy is an important character in the family Leptohyphidae when describing species, and has been used to separate species and higher-level taxa (Allen 1977; Allen 1978; Wiersema and McCafferty 2000). Descriptive terminology associated with the diverse chaetotaxic characters useful in characterizing leptohyphidae taxa has been inconsistently, and often incorrectly, applied (see Allen 1978 for examples). In order to establish a more standard chaetotaxal nomenclature for use within the Leptohyphidae, the following terminology is proposed, and will be used throughout this paper. Setae that are very long, thin, and hair-like will be termed **filiform**. **Acuminate** setae are similar to filiform setae, except that they have a wider base and taper to long points. Those setae that are three to four times as long as broad are termed **elongate**. Setae that are short and broad (approximately twice as long as broad) will be referred to as **robust**, while setae which are short and broad (approximately as wide as long) will be termed **stout**. The term **chalaza** will be used to refer to a seta which is inserted on an elevated, pimple-like process (Nichols and Schuh, 1989). Because the sizes and shapes of chalazate setae vary in leptohyphid mayflies, the following variants may be identified based on setal form: **Acuminate Chalaza, Elongate Chalaza**, and **Robust Chalaza**.

***Cabecar*, gen. n. Baumgardner**

Type Species: *Cabecar serratus*, sp. n.

Diagnosis: Differentiated from all other leptohyphid genera in the larval stage by the following combination of characters: (1) femur with transverse, longitudinal row of acuminate and elongate chalazae; (2) margins of femur with row of elongate chalazae; (2) presence of a two-segmented maxillary palp; (3) absence of the basal spine-like process on one ventral lamella of operculate gill on abdominal segment two; (4) absence of a dorsally elevated, mediolongitudinal ridge on the meso- and metatibia; and, (5) absence of a dorsal row of stout setae at base of meso- and metafemur (Molineri 2003). Adults of the new genus are most similar to those of *Asioplax*, due to their small size, absence of hindwings, and elongate hindfemora which are greater than three-fourths to equal the length of the hindtibiae and hindtarsi combined. Definitive characters to separate adults of *Cabecar*

from *Asioplax* have not yet been identified. However, one character that appears useful for separating male imagoes of the two genera is the ratio of the hindtarsi to hindtibia. For *Asioplax*, the hindtarsi are approximately two-thirds the length of the hindtibia, while in *Cabecar*, this ratio is approximately one-half.

Because synapmorphies defining genera within Leptohyphidae have not been definitively established (Wiersema and McCafferty 2000; Molineri 2003), it is not possible at this point to determine phylogenetic affinities of this new genus with other leptohyphid genera. The new genus does share several characters with *Tricorythodes* such as a reduced maxillary palp with an apical setae, absence of hindwing pads in both sexes, and absence of the basal spine-like process on one ventral lamella of operculate gill on abdominal segment two. It differs from *Tricorythodes* and other leptohyphid genera in that the femur possess a transverse, longitudinal row of acuminate and elongate chalaza and also possesses elongate chalaza along the margins of the femora. Additional phylogenetic research will be needed to assess the proper position of the new genus within Leptohyphidae.

Species Included: *Cabecar serratus* n. sp.

Etymology: Named after the indigenous Cabécar Indians, who inhabit the mountains and low-lying Caribbean costal areas of southeastern Costa Rica and northern Panama on the Talamanca reservation. Their original homeland include the type locality of the new species described herein. Nomenclatural gender: masculine, arbitrarily selected.

Cabecar serratus n. sp. Baumgardner and Ávila

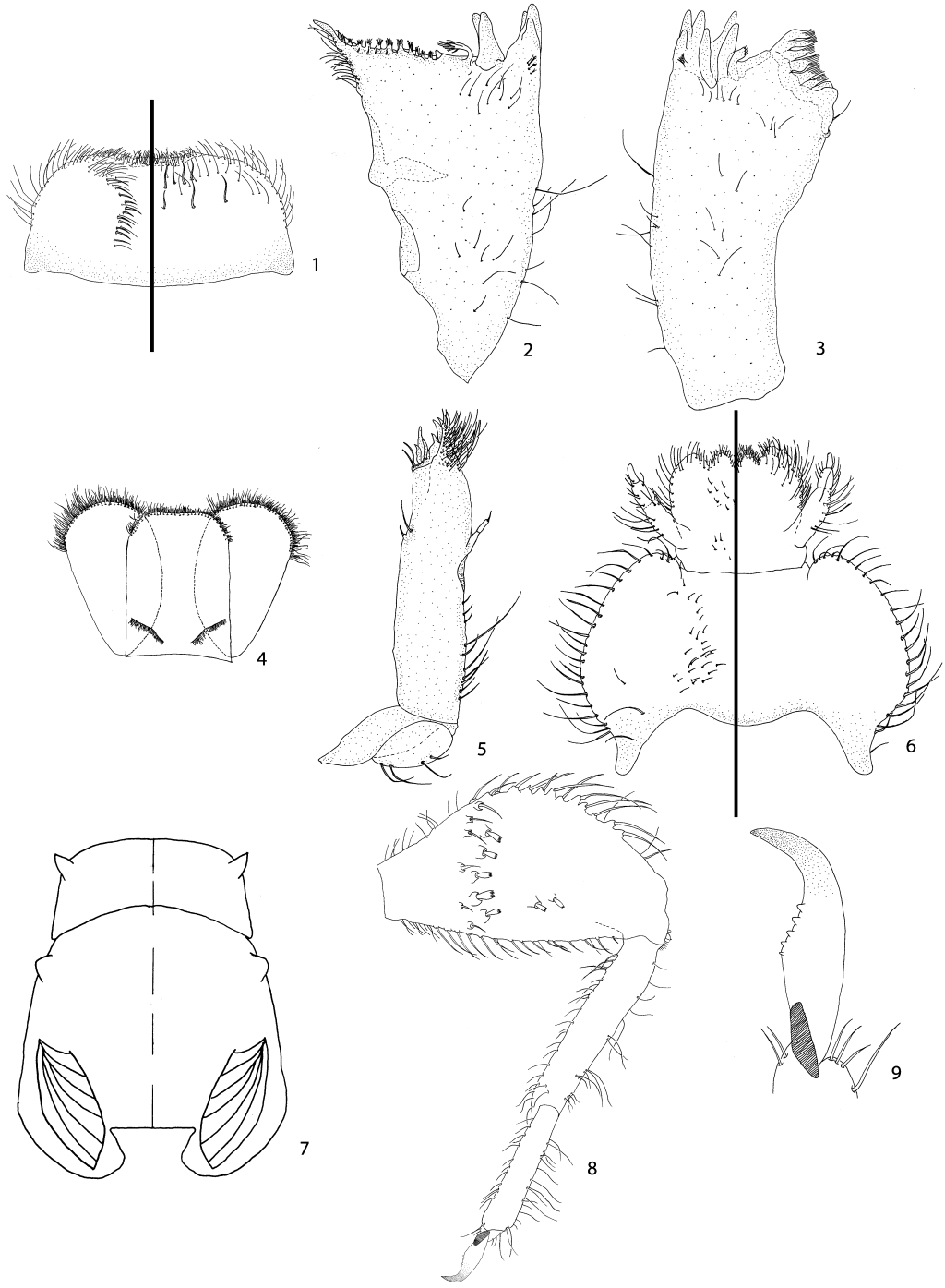
Mature Larva: Body length 3.5–4.0 mm; caudal filaments 2.0–3.0 mm. General color reddish-brown, frequently covered with extensive black maculations.

Head: Reddish brown with variable black maculations; small genal projections present; tubercles absent; compound eyes small and widely separated; three ocelli present; antennae pale, approximately two times length of head capsule. **Mouthparts:** Labrum (Fig. 1): dorsally with filiform setae along lateral margin; two rows of acuminate setae recessed from anterior margin; ventrally with one longitudinal row of acuminate setae near mid-line, with interspersed filiform setae; anterior margin with filiform setae. Right mandible (Fig. 2): outer incisor three lobed, with robust setae at base; inner incisor two lobed; prostheca and molar region as in figure 2; scattered filiform setae on dorsal surface. Left mandible (Fig. 3): outer incisor four lobed, mostly fused; inner incisor two lobed, mostly fused; prostheca arising at base of inner incisor, with filiform setae projecting towards molar region; molar region as in figure 3; mandible with scattered filiform setae on dorsal surface. Hypopharynx (Fig. 4): lingua apically truncate; numerous filiform and acuminate setae present on anterior margin; superlinguae oval, with numerous filiform and acuminate setae along anterior and lateral margins. Maxilla (Fig. 5): palp elongate, two-segmented, with an elongate terminal seta; two subapical setae on inner apical margin;

cluster of filiform setae on outer apical surface; filiform and acuminate setae along base of outer margin. Labium (Fig. 6): postmentum moderately developed, with regularly-spaced acuminate setae along lateral margins; ventrally with numerous robust setae most abundant near midline; prementum ventrally with numerous filiform setae; labial palp three-segmented with numerous filiform setae; glossae and paraglossae subequal, fused except distally, with smooth outer margins; glossae slightly recessed, rounded, and with robust setae; paraglossae with numerous filiform setae.

Thorax: Reddish brown, often with extensive black maculations; pronotum with a pair of distinctive, sharp projections on anterior lateral margin (Fig. 7); mesonotum with a pair of small, rounded anterolateral tubercles (Fig. 7). Femur reddish brown with extensive dorsal black maculation; tibia reddish brown to black with pale maculation basally and apically; tarsus reddish-brown. Profemur (Fig. 8): dorsal surface with a transverse row of five or six chalazae, apical setae elongate with apices serrate; a second and slightly basal row of five or six chalazae also present, with apical setae elongate; two chalazae with apical setae elongate, with apices serrate, near center of femur; anterior and posterior margins of femur with numerous acuminate and elongate chalazae, becoming shorter towards apex of femur; filiform setae along basal anterior and posterior margins. Tibia and tarsus: margins with numerous acuminate and filiform setae; tibia with numerous, multi-branched robust setae distally; tarsal claw with a single row of four or five denticles, basal denticle very small; remaining denticles similar in shape and size with equal spacing (Figure 9). Meso- and metaleg femur (Fig. 10): dorsal surface with distinct median longitudinal row of four or five chalazae with apical setae elongate with apices serrate (Fig. 11); anterior and posterior margins with numerous acuminate chalazae, becoming shorter towards apex of femur. Tibia (Fig. 10): acuminate setae present along anterior and posterior margins; row of 10-12 elongate setae present on dorsal surface; distally with numerous multi-branched robust setae (visible under high magnification). Tarsus: four to six acuminate setae along inner margin. Claw (Fig. 12): with five or six denticles; apical denticles larger and more flattened than smaller, more sharply pointed, basal denticles.

Abdomen: Reddish brown; some individuals with extensive black maculations; a median longitudinal pale line running length of terga; posterior margins of terga I-X with numerous acuminate setae; filiform setae present along lateral margins of terga I-X; posterolateral margins of abdominal segments VII-IX greatly expanded; segments VII and VIII, reaching approximately mid-point of next segment; segment IX projecting beyond posterior margin of segment X. Dorsal lamella of operculate gill (Fig. 13) on abdominal segment two subovate, reddish brown with extensive scattered black maculations; acuminate setae present along inner and apical margins; robust setae present along basal third of outer margin; gill formula (after Molineri, 2003): 2/3/4/4/2. Cerci with whorls of acuminate setae at each annulation.



FIGURES 1–9. *Cabecar serratus*. Figs. 1–6 larval mouthparts. 1, labrum: left, dorsal view; right, ventral view; 2, right mandible; 3, left mandible; 4, hypopharynx; 5, maxilla; 6, labium: left, dorsal; right, ventral view. Figs. 7–9 mature larva. 7, pronotum and mesonotum: dorsal view; 8, foreleg: dorsal view 9, foreclaw.

Male imago. Body length: 2.5–3.5 mm. Forewing length 2.5–3.5 mm. Hindwing absent. Cercus and median caudal filament length 11.0–12.0 mm.

Head: brown with black maculation posterior to ocelli and lateral to compound eyes; vertex pale brown; compound eyes small, widely separated; diameter of one eye less than distance between eyes; lateral ocelli black at base, clear in distal one-third; median ocellus mostly clear; antenna pale; scape enlarged, remaining segments filiform.

Thorax: tergum and sternum pale brown, contrasing strongly with the pale gray pleuron; tergum and pleuron with moderate to extensive black shading, most extensive on the pronotum.; membranous filaments on mesoscutellum (plumidium) absent. Femur: pale brown with very limited black maculation; foretibia purplish, dark brown at base; foretarsus purplish, three-fourths length of foretibia; meso- and metatibia pale reddish brown, dark brown at base; foreclaws similar and blunt; middle and hind claws dissimilar, one blunt, one pointed; hindfemur slightly shorter than hindtibia and handtarsus combined. Forewings (Fig. 14): translucent, margin opaque; costa, subcosta, and R_1 purplish black for one-half to three-quarters their length, heavily pigmented purplish-black beyond margin of vein; vein ICu_1 joined basally with vein CuP; vein CuP present, not converging with vein AA; vein ICu_2 joined basally with ICu_1.

Abdomen: tergites and sternites pale gray with moderate to extensive black overshading, mostly confined to medial region of tergites; cerci pale gray, bases with black stippling. Genitalia (Fig. 15): penes broad, fused for most of their distance, with shallow distomedial emargination; subgenital plate with moderately deep emargination; forceps three segmented, second segment with a basal swelling; segment one of forceps about as long as segments two and three combined.

Female imago. Body length: 3.0–4.0 mm. Forewing length 3.0–3.5 mm. Hind wing absent. Cercus length 3.0–3.5 mm. Median caudal filament 2.5–3.0 mm.

Head: as in male, except darker brown.

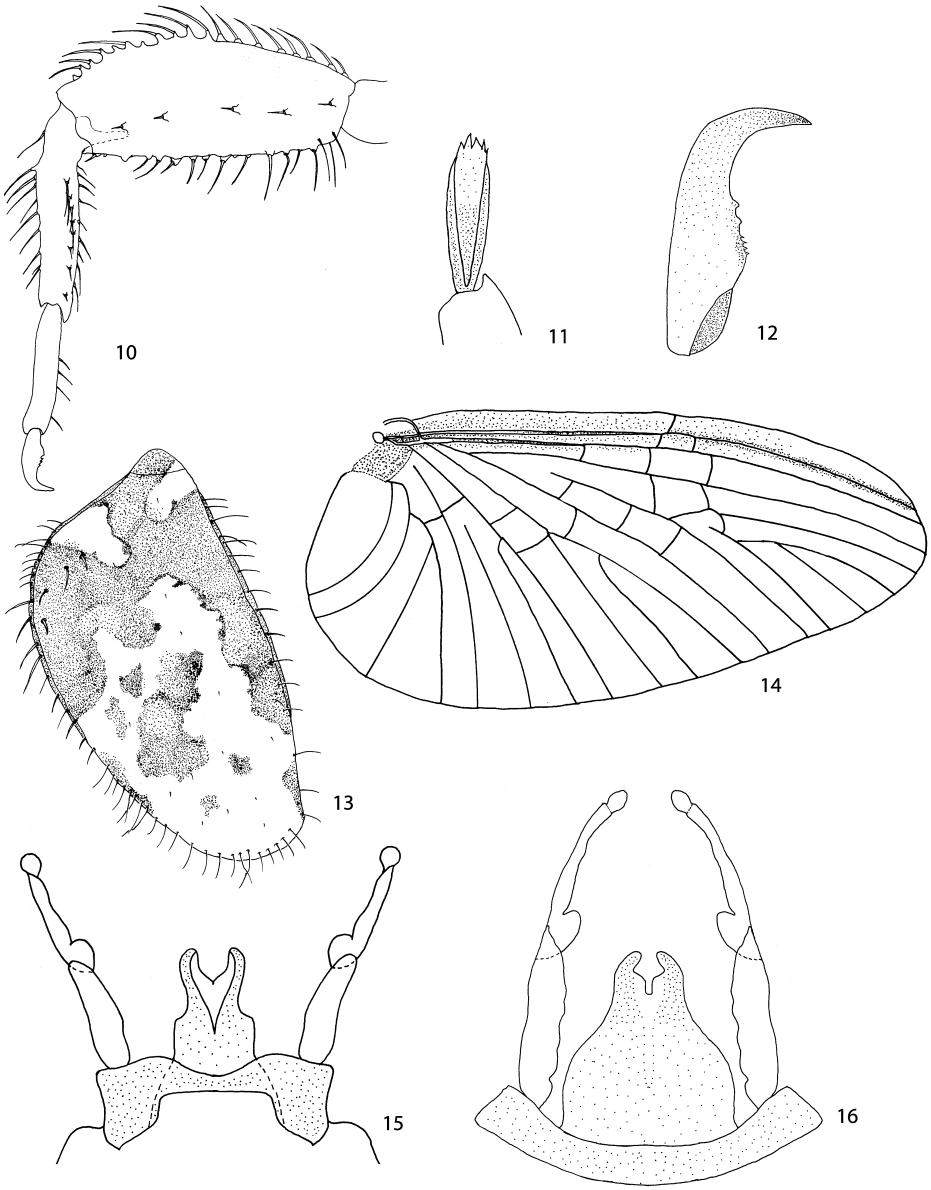
Thorax: tergum and sternum dark red-brown with extensive overshadings of black dorsally and laterally; pleural region pale brown. Legs: dark reddish-brown with extensive black stippling; base of tibia with black ring. Forewings as in male, except with extensive black maculation at wing base.

Abdomen: pale yellowish-brown, with extensive black stippling; subgential plate with posterior margin rounded; cercus and median pale gray; basal segments reddish-brown.

Etymology: The specific epithet of this species is an adjective from the Latin word *serratus* (m), meaning serrated. It alludes to the serrated appearance of the margin of the femur.

Discussion: The only significant variation observed in the larvae was the degree to which black maculations covered the body. Some larvae were entirely reddish brown with almost no black maculation, while other larvae were extensively covered with black. No morphological differences could be discerned between these two color variants, both of

which were observed for both sexes. This variable coloration is likely a developmentally-influenced character, as is typical with many species of mayflies. A similar situation has also been observed in *Leptohyphes zalope* Traver, in which mature larvae may become very dark in appearance (Baumgardner and McCafferty 2000) as they near emergence to the adult stage.



FIGURES 10–15. *Cabecar serratus*. Figs. 10–13 mature larva. 10, metaleg: dorsal view; 11, metaleg seta. 12, metaclaw; 13, abdominal gill 2 (operculate gill). Figs. 14–15 male imago. Fig. 14, for wing; Fig. 15, male genitalia, ventral view. **Figure 16.** *Tricorythodes sordidus* Allen, male genitalia, ventral view.

Distribution and Biology: *Cabecar serratus* is currently known only from low-land costal regions of both the Atlantic and Pacific slopes of Nicaragua, Costa Rica, and Panamá. Larvae were collected from leaf packs and the surface of rocks and woody debris found in the slower regions of small streams. Their bodies were frequently covered by thick periphyton biofilm.

HOLOTYPE: *Mature Female Larva*—**COSTA RICA**: *Limón* Province, unnamed creek at Hwy 32, ca. 3 km W Pocora (10º10'38"N, 83º37'03"W, elev. 110 m), 10.vi.2001, DE Baumgardner (DB 01-29), deposited in the Texas A&M University Insect Museum, College Station, Texas.

PARATYPES: Same data as holotype, 1 mature female larva (FAMU); **COSTA RICA**: *Puntarenas*.: Río Barú at Barú, ca. 5 km NE Dominical, 22.vi.2001, 3L, 1 slide (#DB02i2002), DEB (DB 01-49) (TAMU); Río Balsar at Hwy 34, ca. 8 km NW Palmar Norte (08º59'05"N, 83º31'07"W; elev. 65m), 22.vi.2001, 1L, DEB (DB 01-53) (PERC). Golfito, Quebrada Km. 20, 21.iii.2005, 1♂ subimago (reared), S. Avila (TAMU). Río Claro, Quebrada Chiricanos, puente de C.I.A., 12.iii.2005, 1♂ (reared), 1♂ (slide #DB05x2101), 1♀, S. Ávila (TAMU). Golfito, Río Claro, Golfito, Queb. Lagarto, 21.iii.2005, 2♂, 3♀, S. Ávila (TAMU). *Limón*: Río Suzrez at Hwy 36, ca. 17 Km NW Bribri (09º43'36"N, 82º50'21"W; elev. 20 m), 11.vi.2001, 1L, DEB (DB 01-30) (INBio). **NICARAGUA**: *Granada*: unnamed creek at Domitila Field Station, ca. 30 km S Granada (11º42'09"N, 85º57'06"W; elev. 80 m), 13-18.vi.2004, DEB (DB 04-41), 12L, 1 slide (#DB04x3001) (8L TAMU, 2L each FAMU, PERC).

Material Excluded From Type Series: NICARAGUA: *Río San Juan*: Bartola Field Station, Río San Juan, ca. 3 km SE El Castillo (10º58'22"N, 84º20'24"W; elev. 50 m), 19-24.vi.2004, 1L (immature), DEB (DB 04-43) (TAMU). **PANAMÁ**: *Panamá*, Capira, Río Capira, tierras bajas, 15-iv-1995, Coll. J. Coronado, 1L (TAMU).

Tricorythodes sordidus Allen

Tricorythodes sordidus was described by Allen (1967) based upon larvae collected from San Jose Province in Costa Rica. The species has also recently been documented from Guatemala (McCafferty *et al*. 2004). Records given below further document the species, for the first time, from México and Nicaragua.

Although Allen (1967) did not discuss in detail how this species differed from other species of *Tricorythodes*, the long setae on the head and thorax, and its general body coloration distinguish it from other *Tricorythodes* larvae. The holotype is presently deposited at Florida A&M University (Tallahassee), and is in good condition. The holotype label bears the name "*Tricorythodes caenosus*", as do four paratypes deposited at the California Academy of Sciences and eight paratypes deposited at Purdue University (Luke Jacobus, personal communication). An additional paratype, also deposited at Florida A&M University, bears a label with the name "*Tricorythodes casnosus*".

Evidently, both of these names are manuscript names used at some point by Allen. The locality labels in the vials correspond exactly with the locations given for *T. sordidus* in the original description. In addition, the specimens agree well with the original description, and all are considered here to belong to the original type series of *T. sordidus*. All of these specimens and specimen vials have been relabeled to indicate that they all belong to the types series of *T. sordidus*, and have been returned to their respective institutions. The following imago description is based upon 3 reared males and 7 reared females from Domitalia Field Station in Nicaragua, and Las Cruces Biological Station in Costa Rica.

Male imago. Body length: 3.0–3.5 mm. Forewing length 2.5–3.0 mm. Hindwing absent. Cercus and median caudal filament length 8.0–9.0 mm.

Head: pale to pale reddish brown with diffuse overshadings of black dorsally; compound eyes small, widely separated; diameter of one eye less than distance between eyes; lateral ocelli black at base, clear in distal one-third; median ocellus mostly clear; antenna white with black stippling.

Thorax: prothorax pale with extensive overshadings of black dorsally; meso- and metanota pale brown to reddish brown with diffuse overshadings of black stippling; lateral margins pale with black stippling; membranous filaments on mesoscutellum (plumidium) absent. Femur: pale to pale reddish brown with very limited black overshading; foretibia white to pale gray with black over shading; foretarsus pale, three-fourths length of foretibia; meso- and metatibia pale reddish brown with black stippling and median pale area; claws similar and blunt; hindfemur less than three-fourths length of hindtibia and handtarsus combined. Forewings: translucent, margin opaque; costa, subcosta, and R_1 purplish brown for one-half to three-quarters their length; subcosta heavily pigmented purplish-brown beyond margin of vein; vein ICu_1 joined basally with vein A, forming a triad where veins CuP and ICu_2 are included; vein CuP present, not converging with vein A; vein ICu_2 present, detached from ICu_1.

Abdomen: pale yellow with moderate to extensive black overshading; terga II-VI with pale median line; sternites pale with black stippling limited to margins; cerci pale gray, bases with black stippling. Genitalia (Fig. 16): penes broad, fused for most of their distance, with shallow distomedial emargination; subgenital plate with moderately deep emargination; forceps three segmented, second segment with a basal swelling; segment one of forceps about as long as segments two and three combined.

Female imago. Body length: 3.0–3.5 mm. Forewing length 2.5–3.0 mm. Hind wing absent. Cercus length 1.0–1.5 mm. Median caudal filament 2.0–2.5 mm.

Head: pale yellow with diffuse overshadings of black dorsally; shading most intense at base of ocelli and between compound eyes; compound eyes small, widely separated; diameter of one eye less than distance between eyes; lateral and median ocelli black at base, clear in distal one-third; antenna white.

Thorax: prothorax pale with extensive overshadings of black dorsally; meso- and metanotam reddish brown with black stippling medially and laterally; sterna pale yellow

to white, margins light brown. Femur: white, margins reddish brown with black stippling; tibia and tarsus pale reddish brown. Forewings as in male.

Abdomen: tergites I-VIII yellow, IX and X pale yellow to white; dorsally with extensive black stippling forming transverse black bands; sternites pale yellow; subgential plate triangular with posterior margin rounded; cercus and median caudal filament pale gray.

Discussion: Adults of *Tricorythodes sordidus* fit within the concepts of *Tricorythodes* given by both Molineri (2002) and Wiersema and McCafferty (2000), including characters of the male genitalia (number and relative length of forceps and shape of penes), absence of hindwings, and vein ICu_1 joined basally with vein A forming a triad where veins CuP and ICu_2 are included.

Currently, there are only two species of *Tricorythodes* known from Central America: *T. sordidus* and *T. costaricanus* (Ulmer). The holotype of *T. costaricanus* is based on a female imago deposited in the Bavarian State Collection, Zoology, Munich, Germany (Ernst-Gerhard Burmeister, personal communication). Because of the extremely fragile nature of the dried and pinned holotype, it was not available to be mailed for detailed study. However, Dr. Burmeister did provide pictures of the holotype and associated labels, which were sufficient for comparison with *T. sordidus*. The holotype is in relatively good condition with all three body regions, wings, and at least some of the legs, present and intact. The type locality of *T. costaricanus*, written on a label associated with the holotype, is "San José, Costa Rica" . No other specific information was given on the label.

Although *T. sordidus* was collected from the same province in Costa Rica as the holotype of *T. costaricanus*, it does not appear that *T. sordidus* is a synonym of *T costaricanus.* First, females of *T. costaricanus* are a little larger and described as possessing caudal filaments measuring about 3 mm in length, while females of *T. sordidus* have relatively short cerci (half to a little more than half length of caudal filament). Second, *T. costaricanus* has a body which is generally brown to dark brown in color. *Tricorythodes sordidus* adults are much paler, with a thorax which is more pale brown than *T. costaricanus*, and an abdomen which is generally pale yellow with moderate to extensive black shading. These characters should easily distinguish *T. sordidus* from *T. costaricanus* in the adult stage of both genders.

Distribution and Biology: *Tricorythodes sordidus* appears to be widely distributed and common in Latin America. It is known from northeastern Mexico south to Costa Rica. Larvae can be found in a wide variety of lotic habitats, from smaller creeks to large rivers, and are usually extensively covered with sediment.

Type Material Examined: HOLOTYPE: *Tricorythodes sordidus* Allen; COSTA RICA: San Jose Prov.: San Jose, 9-viii-62, G.G. Musser [FSCA(FAMU)—E2003.1T]. HOLOTYPE: *Tricorythodes costaricanus* (Ulmer); COSTA RICA: San Jose [Bavarian State Collection, Zoology, Munich, Germany] (electronic images of holotype only examined).

Other Type Material Examined: PARATYPES: 4 larvae, same data as holotype (CAS), originally designated paratopotypes. **COSTA RICA**: stream 11 mi. SE San Isidro del General, 200 ft., 22-vii-1962, G.G. Musser, 1 larva, 4 associated slides [FSCA(FAMU) - E2003. T].

Material Examined Not Belonging to Type Series: All specimens deposited at TAMU unless otherwise indicated. **COSTA RICA**: *Alajuela Prov.*: NE of Bijagua, nr. Las Flores, Río Areuo (10°21'06"N; 85°21'05"W), 07.vi.2000, 2L, WDS; 3 km SE Rio Cuarto, Hwy. 140, Río Hule (10°20'N; 84°12'W), 15.i.2000, 1L, WDS. *Guanacaste Prov.*: 4.8 km N Canas, Hwy. 142, Río Santa Rosa, 17.i.2000, 4L, WDS; Río Diria at unnamed road, ca. 1 Km. E of intersection with Hwy 21, (10°20'05"N; 85°34'04"W), 15.vi.2001, 3L, DEB; 6 km S San Miguel, Hwy 1, Quebrada Culvert (10°19'N; 85°03'W), 23.i.2000, 3L, WDS; unnamed creek at Hwy. 18, ca. 8 Km NW Nicoya (10°10'00"N; 85°26'08"W), 16.vi.2001, 2L, DEB. *Heredia Prov*: unnamed creek at Hwy 4, ca. 3 Km from jct. with Hwy 32 (10°15'10"N; 83°55'11"W), 10.vi.2001, 2L, DEB. *Limón Prov.*: Río Catarata at Hwy 36, 4 Km East of Bribri (09°37'50"N; 82°49'06"W), 11.vi.2001, 1L, DEB; unnamed creek at Hwy 32, ca. 3 Km W of Pocora (10°10'38"N; 83°37'03"W), 10.vi.2001, 2L, DEB; unnamed stream at road, ca. 2 Km NW Puerto Viejo (09°38'43"N; 82°47'12"W), 11.vi.2001, 1L, DEB. *Puntarenas Prov.*: 1 Km S Coloradito, Río Coloradito at Hwy. 2 (08°36'10"N; 82°54'07"W), 17.vi.2000, 3L, WDS; 4.1 Km N Dominical on Hwy. 243, unnamed river (09°16'51"N; 83°50'55"W), 14.vi.2000, 2L, WDS; Río Jaba at Las Cruces Biological Station, ca. 14 Km. S San Vito, 23, 24.vi.2001, 1L, 1♂ (reared), DEB; Estacion Biologica Monteverde, Quebrada Moquina (10°19'N; 84°48'W), 24.i.2000, 2L, WDS; Río Baru at Baru, ca. 5 Km NE Dominical, 22.vi.2001, 1L, DEB; 1 Km S Coloradito, Río Coloradito at Hwy 2 (08°36'10"N; 82°54'07"W), 17.vi.2000, 6L, WDS; Quebrada Culebra at Las Cruses Biological Station, ca. 14 Km S. San Vito, 24.vi.2001, 2L, DEB; NE Dominical, unnamed stream (09°16'48"N; 83°49'22"W), 19.vi.2000, 1L, WDS; unnamed creek at Hwy. 34, ca 37.5 Km SE Dominical (09°03'04"N; 83°37'00"W), 22.vi.2001, 5L, DEB; Río Caracol at CA Hwy. 2, ca. 7.3Km E. Río Claro (08°39'47"N; 83°00'41"W), 23.vi.2001, 3L, DEB; 5 Km SE Coloradito, unnamed river (08°34'41"N; 82°52'28"W), 17.vi.2000, 1L, WDS. *San Jose Prov.*: Río Pedregoso at Hwy. 243, ca. 4 Km S. San Isidro de El General (09°21'15"N; 83°43'35"W), 22.vi.2001, 1L, DEB. **GUATEMALA:** *Chiquimula Dept.*: Río Anguiatu, Frontera a Anquiata, 13.vii.1995, 1L, Bryan Yates; *El Progreso Dept*.: Río Hato at CA Hwy. 9, ca. 5.9 Km E. from jct. with Hwy. 17, Magdalena (14°55'11"N; 89°57'56'W), 14.vii.2001, 3L, DEB; Quebrada Las Pericas at Hwy. 17, 11.1 Km W. from jct. with Hwy. CA (09°14'54"N; 90°05'52"W), 12.vii.2001, 4L, DEB; *Izabel Dept*.: Río Cienega at CA Hwy. 13, ca. 4 Km. S. Shaila (15°43'53"N; 89°84'44"W), 16.vii.2001, 1L, DEB; *Zacapa Dept*.: Río Cayo at CA Hwy. 9, 2.3 Km E. Santa Cruz (15°00'54"N; 89°39'09'W), 14.vii.2001, 1L, DEB; Río Cayo at CA Hwy. 9, 2.3 Km E. Santa Cruz (15°00'54'N; 89°39'09'W), 14.vii.2001, 3L, DEB. **MEXICO:** *Nuevo Leon:* Río Cabazones at Hwy.

85, 15 mi. N. Linares., 5L, 16.v.1995; unnamed creek at road leading to Brownsville, nr. town of Galenana off Hwy. 60, 9L, 19.v.1995; *Queretaro*: Puerta de Alegriax, Arroyo Los Zunigas (20°20'28"N; 100°07'10"W), 1L, 08-vii-2000, WDS; 1 Km. S. Huasquilico, Arroyo Jalpan (21°09'04"N; 99°34'42"W), 7L, 11.vii.2000, WDS; 1 km SSE San Pedro, Arroyo Real (21°07'07"N; 99°32'05"W), 12L, 11.vii.2000, WDS; Chuveje, Río Chuveje (21°10'13"N; 99°33'18"W), 12.vii.2000, 1L, WDS; Pínal de Amoles, Agua Fria (UTM 2338413), 1L, 28.viii.1997, R. Jones; *San Luís Potosi*: Río Moctezuma at Tamazunchale on Hwy. 85, 2L, 18.viii.1977, R.K. Allen (CAS); *Tamaulipas*: Río San Marcos nr. Ciudad Victoria, 14L, 24/25.x.1968, R.K. Allen (CAS); Branch of Río Chihue at Hwy. 101, ca. 12 mi. S Juamave, nr. kilo. marker #91, 10L, 17.v.1995, DEB. **NICARAGUA:** *Granada*: Unnamed river at Domitila Field Station, ca. 30 km S Granada (N11º42'09"; W85º57'06"), 13-18.vi.2004, 68L, 2♂ (reared, 1 slide, #DB05012901 – genitalia drawn from this slide), 7♀ (reared), DEB.

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