

CONTRIBUTION TO THE TAXONOMY OF *ASIOPLAX* (EPHEMEROPTERA: LEPTOHYPHIDAE: TRICORYTHODINAE) IN THE NEW WORLD¹

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ABSTRACT: North, Central, and South American species of the genus *Asioplax* (Leptohyphidae: Tricorythodinae) are comparatively reviewed and diagnosed. The male adult of *A. dolani* and male and female adults of *A. edmundsi* are described for the first time. Adults of *A. texana* are comparatively redescribed. Two South American species previously considered in *Tricorythodes* are newly transferred to *Asioplax*: *A. santarita*, n. comb. and *A. zunigae*, n. comb. *Asioplax corpulenta* is shown to be a junior subjective synonym of *A. edmundsi*, n. syn. Stage correlated identification keys to species, incorporating range characteristics, are provided.

KEY WORDS: *Asioplax*, Ephemeroptera, Leptohyphidae, Tricorythodinae, New World

In the early mid-1990s we became aware initially of two species of Leptohyphidae with highly unusual larvae that could not be clearly placed to any of the genera that had historically constituted that Western Hemisphere family. One of these species was described from Costa Rica by Lugo-Ortiz and McCafferty (1995a) as *Leptohyphes curiosus* Lugo-Ortiz and McCafferty. Those authors stated that their species was unique because of its small size, flattened body, posterolateral projections on abdominal segments 7 and 8, leg setation, and shape of the operculate gills. Lugo-Ortiz and McCafferty (1995a), while describing this species in the genus *Leptohyphes* Eaton, pointed out that it possessed some characteristics that were historically associated with *Tricorythodes* Ulmer. A generically similar second species had been collected in Texas and was even more dramatic with respect to its characterization of being small, squat and depressed. Our suspicions that these species represented a distinct new genus were borne out by subsequent revisionary work on the Leptohyphidae (Wiersema and McCafferty 2000). The review of species incorporated in the latter study resulted in a small number of additional congeners (previously in either *Leptohyphes* or *Tricorythodes*) all being placed in the new genus *Asioplax* Wiersema and McCafferty in the subfamily Tricorythodinae (Wiersema and McCafferty 2000).

The nine species originally placed in *Asioplax* included the unnamed species from Texas referred to above, which has since been described as *A. numinuh* Wiersema, McCafferty and Baumgardner (Wiersema et al. 2001). Five of the species were North American, but the genus also included the Central American species *A. curiosa*, mentioned above, and *A. nicholsae* (Wang, Sites, and McCafferty) from South America, a species that had been noted by its authors (Wang et al. 1998) as being similar in generic characterization to *A. curiosa*. In addition, two species known only from Cuba, *A. sacculobranchis* (Kluge and Naranjo) and

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A. sierramaestrae (Kluge and Naranjo) were included in the genus on the basis of somewhat incomplete descriptions (Kluge and Naranjo 1990). Because these latter two species have not been available for further study, they are not treated herein and their placement in *Asioplax* is considered provisional. Recently, Molineri (2002) provided a taxonomic treatment of South American *Tricorythodes* species including two species that are congeneric with *Asioplax*: *A. santarita* (Traver), n. comb., and *A. zunigae* (Molineri), n. comb. The phylogenetics presented by Molineri (2002) support the recognition of this grouping as a distinct genus, although that author chose to retain a broadly encompassing, less informative taxonomic concept of *Tricorythodes* consisting of multiple clades.

The purpose of this paper is to present synonymies of current North, Central, and South American species; the first descriptions or comparative redescriptions of the adult stage of certain of the species that have not been well understood in that regard; and comparative diagnoses of species accompanied by identification keys.

Asioplax

Asioplax Wiersema and McCafferty, 2000:347.

Type species: *Tricorythodes edmundsi* Allen.

Diagnosis. Larva: These are relatively small, broad forms only rarely greater than 4.0mm in length, often 2.6 to 3.3mm and only rarely as much as 5.5mm. Larvae of *Asioplax* have in common with most other Tricorythodinae genera a combination of having abdominal terga 1-6 lacking spines at their posterior margins, hindtarsi that are more than one-half the length of the hindtibiae, and a thorax devoid of hingwingpads in both sexes. *Asioplax* larvae may be distinguished from those of other Tricorythodinae genera and leptohyphids in general by a combination of the relatively small, depressed and broad appearing, setate body and legs; well-developed posterolateral projections of abdominal segments 8 and 9 that are generally longer than the midlength of their respective terga; broadened forefemora that are as wide or nearly as wide as long, that have their transverse dorsal setal row located near the base of the femur, and that have well-developed marginal setae; and either an absence of the inner ventral lamellae of operculate gills or the presence of one that is less than one-half the length of the outer lamellae. See also key characters discussed by Wiersema and McCafferty (2000) and further modified by Wiersema and McCafferty (2004).

Adult: As per other Tricorythodinae, *Asioplax* adults lack hindwings in both sexes; have ventrodistally extended hindtibiae on all legs of females and on the mid- and hindtibiae of males; have a mesonotum [Fig. 4 (Wiersema and McCafferty 2000)] that has the paired longitudinal posterior and anterior parapsidal sutures merging anterior to the transverse interscutal suture, that has poorly developed and anteriorly well separated posterior scutal lobes, and that does not have a developed posterior transverse sulcus; and have forewings that are widest at the base in males and widest at midlength in the females. Among Tricorythodinae adults, *Asioplax* is most similar to *Epiphraides* Wiersema and McCafferty and some *Tricorythodes* in that both may be diagnosed as having three-segmented forceps, eyes that are not

sexually dimorphic (i.e. not greatly enlarged in the males), an IMP vein that is not longer than MP_2 , lateral ocelli that are widely separated, and male foretarsi that are greater than one-half the length of the foretibiae. In addition, *Asioplax* adults share with *Epiphraodes* and some species presently considered *Tricorythodes*, a male subgenital plate that is not extended beyond the forceps bases and in females reduced cerci, lacking fine setae and elongated medial caudal filament with extensive setation. *Asioplax* adults, however, can be differentiated from those of all other species presently considered *Tricorythodes* and *Epiphraodes* by a combination of relatively small body size (2.4-4.0mm) and hindfemora that are about three-fourths or more of the length of the hindtibiae and hindtarsi combined.

Asioplax curiosus

Leptohyphes curiosus Lugo-Ortiz and McCafferty, 1995a:170.

Asioplax curiosus (Lugo-Ortiz and McCafferty): Wiersema and McCafferty, 2000:348.

Diagnosis. Larva: The only known body length is 2.8mm. The maxillae are devoid of palps. The setae of dorsal transverse row on the forefemora are hairlike. Anterior lateral setae of the mid- and hindfemora are longer than the posterior lateral setae. Tarsi do not have a dark blue pigmentation basally. Claws have five to six denticles and a subapical seta. Tubercles are not found on the abdominal terga. Posterolateral projections of abdominal segment 9 are very poorly developed [Fig. 10 (Lugo-Ortiz and McCafferty 1995a)]. Operculate gills are somewhat ovate and somewhat pointed.

Adult: Unknown.

Material Examined. Holotype female larva, Costa Rica, Guanacaste Prov., Río Tenerio at Ficna La Pacifica, E of Panamerican Hwy., II-2-1969, WP McCafferty, Purdue Entomological Research Collection (PERC).

Distribution. Central America: Costa Rica and Panama.

Asioplax dolani

Leptohyphes dolani Allen, 1967:351.

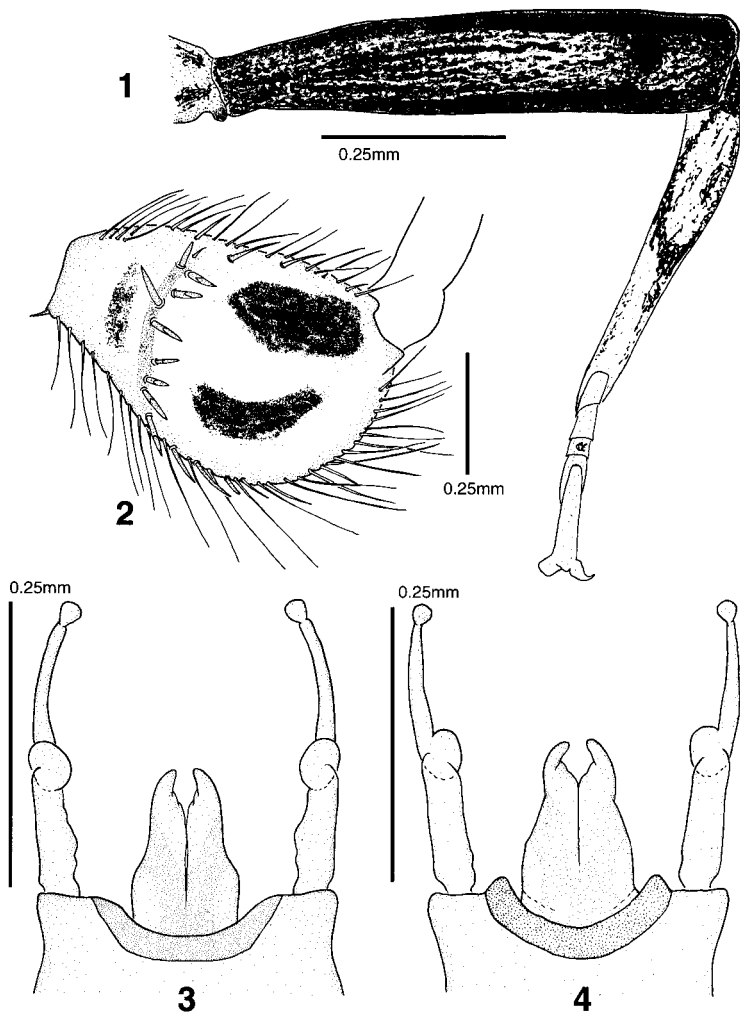
Asioplax dolani (Allen): Wiersema and McCafferty, 2000:348.

Male adult. Body: Length 2.6mm. General coloration red-brown with extensive black markings. Head: Coloration almost entirely black with medial triangulate pale area between lateral ocelli with epicranial sutures not darkly pigmented, and ocelli encircled with black basally. Eyes widely separated, with diameter greater than basal width of lateral ocelli. Thorax: Not a deep red-brown with extensive black markings. Forewings length 3.5mm. Forelegs approximately one and one-half times length of body. Femora, tibiae and tarsi of mid- and hindlegs extensively covered with black markings (Fig. 1). Mid- and hindtibiae with black shading and speckling basally extending down to a U-shaped mark at half the tibial length. Hindfemora subequal in length to hindtibiae and hindtarsi combined. Abdomen: Terga with sublateral, submedial and medial dark maculae, appearing as alternating dark and light longitudinal stripes. Sterna with lateral muscle insertion marks blue-black. Genitalia unknown. Caudal filaments gray-white.

Female adult. Unknown.

Diagnosis. Larva: The mature body length may be as much as 4.5mm. Maxillary palps are present and two-segmented. The setae making up the dorsal transverse row are spatulate, and these spatulate setae are also interspersed with hairlike setae

along the posterior margin of the forefemora (Fig. 2). Tarsi lack any bluish or blue-black pigmentation basally. Claws have two or more (commonly three) small denticles at the base of the inner curvature. Abdominal terga lack tubercles and have conspicuous paired submedian maculae across the width of each tergum. Posterolateral projections of abdominal segment 9 are well developed, narrowly pointed, and have straight margins. Operculate gills are subovate and could be interpreted as only broadly pointed at most.



Figures 1-4. *Astioplax*. 1. *A. dolani*, male adult hindleg. 2. *A. dolani*, larval forefemera. 3. *A. edmundsi*, male adult genitalia, ventral view. 4. *A. texana*, male adult genitalia, ventral view.

Adult: The male may be distinguished from male adults of other known species

by the head color pattern consisting of black pigmentation except for a conspicuously pale wedge-shaped area between the lateral ocelli.

Material Examined. Larvae, North Carolina, Johnston Co, Neuse R, nr Princeton, VII-1991, and Sampson Co, Black R, nr Tomahawk, VII-1988, DR Lenat, PERC. Reared male adult, exuviae, and 6 larvae, South Carolina, Barnwell Co, Steel Creek at Cypress Bridge, IX-15-1984, BC Kondratieff, collection of NA Wiersema (NAW).

Distribution. North America: USA: Alabama, Florida, Georgia, North Carolina, South Carolina, and east Texas.

Remarks. The above represents the first adult description of *A. dolani*. The female adult remains unknown, and because there are no genitalia from the single reared adult specimen available for study, further documentation of this life stage will be necessary.

This is the only species of *Asioplax* known from the Southeast or eastern North America in general. Allen (1978) reported this species from Victoria County, Texas. We have been unable to locate the larvae on which the record was based. Although, this species was recently confirmed from east Texas by Baumgardner et al. (2003), we believe the records from Victoria County could be representative *A. dolani*, *A. numinuh*, or even the unknown larva of *A. texana* (Traver).

Asioplax edmundsi

Tricorythodes edmundsi Allen, 1967:370.

Tricorythodes corpulentus Kilgore and Allen, 1973:330, n. syn.

Asioplax edmundsi (Allen): Wiersema and McCafferty, 2000:348.

Asioplax corpulenta (Kilgore and Allen): Wiersema and McCafferty, 2000:348, n. syn.

Male adult. Body: Length 2.8-3.1mm. Coloration pale brown with black markings. Head: Coloration yellow-brown with epicranial sutures darkly pigmented, sometimes with blackish speckling, and with ocelli circled with red-brown basally. Eyes widely separated, with diameter slightly more than basal width of lateral ocelli. Thorax: Not a deep yellow-brown with sparse red-brown to black-blue markings. Forewings length 3.2-4.0mm. Forelegs approximately one and one-half times length of body. Mid- and hindfemora with sparse red-brown to black-blue markings. Mid- and hindtarsi shaded basally with blue-black. Hindfemora subequal in length to hindtibiae and hindtarsi combined. Abdomen: Terga with sublateral, submedial and medial dark maculae, appearing as alternating dark and light longitudinal stripes. Sterna with lateral muscle insertion marks not pigmented. Subgenital plate shallowly emarginated (Fig. 3). Basal swelling of second forcep segment basomedially directed. Caudal filaments gray-white.

Female adult. Body: Length 2.7mm. Coloration generally black-brown with few light markings (legs light except marked with black-brown at joints, and caudal filaments light). Head brown, except for narrow pale epicranial suture margins and narrow pale transverse band at posterior border of head. Forewings length 4.4mm. Subanal plate well developed into transparent convexity extending beyond bases of caudal filaments.

Diagnosis. Larva: The mature body length may be as much as 5.5mm, according to Kilgore and Allen (1973); however, most mature larvae we have seen are not longer than 4.0mm. Maxillary palps are absent. The setae making up the dorsal transverse row on the forefemora are hairlike [Fig. 1 (Wiersema and McCafferty 2000)]. Tarsi typically have a blue-black pigmentation basally. Claws have a basal row of five to seven denticles and paired denticles (can be very minute) located at the lateral, subdistal edges of the claws. Abdominal terga lack tubercles. The pos-

terolateral projections on abdominal segment 9 are well developed and narrowly pointed but extend only to about the length of sternum 9. Posterolateral projections of segment 8 appear much more posteriorly oriented from their base than those of segment 7, which are posterolaterally oriented from the base. Sternum 9 of female larvae is truncate distally. Operculate gills are broadly subovate (or what could also be interpreted as subtriangulate) and appear nearly round except for a somewhat straight lateral margin.

Adult: Males have a yellow-brown head with dark sutures and sometimes some degree of dark speckling. The subgenital plate is wide and shallowly emarginate. Both sexes have dark blue pigmentation basally on the tarsi, and both lack dark lateral dashes on the abdominal sterna. Females have a primarily solid black-brown body and dark brown head with a pale posterior border. The subanal plate of female reaches distally, considerably beyond the bases of the caudal filaments.

Material Examined. Larval paratypes, Utah, Daggett Co, Green R, IX-11-1952, GF Edmunds, PERC; 2 larvae, Colorado, Moffatt Co, Yampa R, NAW; 2 larvae, Colorado, Moffatt Co, Green R, VII-24-1992, NAW; Larvae, Colorado, Moffatt Co, Green R, VI-28-1956, E Mills, PERC; reared male adults and larval exuviae, Saskatchewan, Torch R, N of Hwy 35, VII-16-2001, JM Webb, in collection of collector; reared female adult and larval exuviae, Saskatchewan, South Saskatchewan R, at Lemsford Ferry, IX-16-2000, JM Webb, in collection of the collector; 10 male adults, Utah, Uintah Co, White River, 1 mi south of Bonanza, VII-24-1988, GF Edmunds, PERC.

Distribution. North America: Canada: Saskatchewan; USA: Colorado, Idaho, New Mexico, and Utah.

Remarks. The above represents the first formal description of the adults of this species, although some adult figures were published by Wiersema and McCafferty (2000).

We have herein placed *A. corpulenta* as a junior subjective synonym of *A. edmundsi*, n. syn., based on the following: The only structural larval characteristic that Kilgore and Allen (1973) could ostensibly use to distinguish their *A. corpulenta* from *A. edmundsi* was the presence of paired subapical denticles in the former. Allen (1967) had not mentioned the presence of such denticles in his description of *A. edmundsi*. Examination of the paratopotypes of *A. edmundsi* under compound high magnification, however, has revealed the presence of these paired subapical denticles. These structures can be difficult to detect and this situation has evidently contributed to other previous identifications as *A. corpulenta*. Color pattern characters of the forefemora and operculate gills that Kilgore and Allen (1973) assigned to either *A. corpulenta* or *A. edmundsi* are not consistent among and within populations. The availability of only one or very few specimens, however, evidently also led to previous identifications of *A. corpulenta*.

A reared female (and only female adult known of *A. edmundsi*) has a dimorphic much longer forewing than that of the male (compare 4.4mm in the female vs. 3.2mm in the male of northern populations, although body lengths are 2.7 and 3.0, respectively). The female body also has a much more solid blackish color rather than the more granular black patterning on the yellow ground color seen in the male. This striking sexual dimorphism with respect to coloration is not seen in *A. numinuh* or *A. texana* (Traver).

Lugo-Ortiz and McCafferty (1995b) reported *A. edmundsi* from central Texas both as *T. edmundsi* and *T. corpulentus*. These reports, however, are referable to *A. numinuh*, and Wiersema et al. (2001) pointed out that larval paratypes of

T. edmundsi from Tamaulipas, Mexico, were actually misidentified *A. numinuh*. Therefore, *A. edmundsi* remains known only from western Canadian and USA drainage systems. Lester et al. (2002) noted that the species appeared limited to low-gradient streams and rivers and was tolerant of high sediment levels and warm summer temperatures.

Asioplax nicholsae

Leptohyphes nicholsae Wang, Sites, and McCafferty, 1998:69.

Asioplax nicholsae (Wang, Sites, and McCafferty): Wiersema and McCafferty, 2000:348.

Diagnosis. Larva: The body length of the single known specimen is 3.0mm. Maxillae are devoid of palps. The setae making up the dorsal transverse row on the forefemora are hairlike. Tarsi lack any blue or blue-black pigmentation basally. Tarsal claws have a row of four to six denticles. Abdominal terga 3-9 have mid-posterior tubercles, and these tubercles are relatively strongly developed on terga 6-9 [Fig. 9 (Wang et al. 1998)]. Posterolateral projections of abdominal segment 9 are small yet distinctive, being only somewhat developed. Operculate gills are subovate and posterolaterally somewhat falcate, making them appear slightly pointed.

Adult: Unknown.

Distribution. South America: Ecuador.

Remarks. *Asioplax nicholsae* larvae have tergal tubercles, a distinctive feature shared only with the South American species *A. santarita*.

Material Examined. Holotype (male larva) and paratype (female larva), Ecuador, Pichincha Prov, Rio Peripa at Puerta Limon, VII-18-1993, PERC.

Asioplax numinuh

Asioplax numinuh Wiersema, McCafferty, and Baumgardner, 2001: 301.

Diagnosis. Larva: The mature body length ranges from 2.6 to 3.8mm. Maxillae are devoid of maxillary palps. The setae making up the dorsal transverse row of the forefemora are hairlike. Tarsi lack any blue-black pigmentation. Claws have a row of five to six basal denticles and lack subapical paired denticles. Abdominal terga lack tubercles [Fig. 1 (Wiersema et al. 2001)]. The posterolateral projections of abdominal segment 9 are well developed, extending well beyond sternum 9. Posterolateral projections of abdominal segments 7, 8, and 9 are essentially posteriorly oriented from their base. Sternum 9 in the female larvae is slightly emarginate distally to nearly truncate [Fig. 2 (Wiersema et al. 2001)]. Operculate gills are relatively elongate with a somewhat rounded medial margin and a somewhat straight lateral margin.

Adult: Males range from 2.8-3.0mm in length, with their wing length ranging from 3.8 to 4.0mm. The dark coloration of the head and a deep and narrowly emarginate of the subgenital plate [Fig. 4 (Wiersema et al. 2001)] are important distinguishing characteristics. Both sexes have hindfemora that are subequal in length to the hindtibiae and hindtarsi combined [Fig. 3 (Wiersema et al. 2001)], and they lack lateral dashes on the abdominal sterna. Females range from 3.6 to 3.8mm in length,

with their wing length ranging from 4.2 to 4.6mm. They are much lighter than females of *A. edmundsi*, and the convex subanal plate is not as distally developed, only reaching the base of the caudal filaments.

Material Examined. Holotype (male larva) and paratypes (male and female larvae and reared male and female adults), Texas, Kerr Co, Guadalupe R, Hwy 27, nr Center Point, IV-14-2000, PERC; 23 larvae, Texas, Val Verde Co, Rio Grande, Del Rio, VIII- 11-1977, JR Davis, NAW; 12 larvae, Texas, Terrell Co, Independence Cr, Chandler Ranch, IV-24-1994, G Larson, NAW; Larvae, Texas, Blanco Co, Blanco R, V-1977, PERC; larvae, Texas, Kerr Co, Robinson Cr, V-1977, PERC; larvae, Texas, Kimble Co, South Llano R, Hwy 456, X-13-1966, R. Waugaman, PERC. See also Material Examined in Wiersema et al. (2001).

Distribution. North America: Mexico: Querétaro and Tamaulipas; USA: central and south Texas.

Remarks. As indicated above, *A. numinuh* has occasionally been reported as *A. edmundsi* in the past. Wiersema et al. (2001) indicated that larvae of this species in Texas were commonly associated with silt-laden periphyton on the tops of flat cobble in stream habitats with rapid but nonturbulent currents.

Asioplax santarita, n. comb.

Tricorythodes santarita Traver, 1959: 130; Molineri, 2002: 293.

Diagnosis. Larva: Body length 3.7mm. Maxillae palps highly reduced and one segmented. The setae making up the dorsal transverse row on the forefemora are hairlike. Tarsi lack any blue or blue-black pigmentation basally. Tarsal claws apparently devoid of marginal denticles, with only paired subapical, submarginal denticles. Large midposterior tubercles present on abdominal terga 7-9. Posterolateral projections of abdominal segment 9 are small yet distinctive, being only somewhat developed. Operculate gills are subovate, lack an interior ventral lamella, and have a highly reduced outer lamella.

Adult: Males range from 3.0-3.1mm in length, with their wing length ranging from 3.0 to 3.5mm. The dark shading of the basal third of the wings and the distinct lateral projections of the subgenital plate are important distinguishing characteristics. Both sexes have hindfemora that are subequal in length to the hindtibiae and hindtarsi combined. Females range from 2.2 (without eggs) to 3.2mm in length, with their wing length ranging from 3.9 to 4.5mm. Vein CuP often merges with vein A, or is reduced, not extending to the hind margin of the wings.

Distribution. South America: Argentina, Brazil and Uruguay.

Remarks. As noted above the larvae of this species should be readily recognizable due to the presence of large tubercles on terga 7-9.

Asioplax texana

Tricorythodes texanus Traver, 1935:638.

Asioplax texana (Traver): Wiersema and McCafferty, 2000:348.

Male adult. Body: Length: 2.8-3.4mm. Coloration pale yellow-brown with black markings. Head: Coloration pale yellow to yellow-brown without dark markings, and with ocelli encircled with black basally. Eyes widely separated, with diameter greater than basal width of lateral ocelli. Thorax: Nota

deep yellow-brown to pale yellow often with darker shading and speckling adjacent to sutures. Forewings length 3.6-4.2mm. Forelegs approximately one and one-half times length of body. Mid- and hindfemora pale yellow to yellow-brown, with sparse black markings. Mid- and hindtibiae usually with black shading and speckling basally extending down to a U-shaped mark at half the tibial length. Hindfemora approximately three-fourths length of hindtibiae and hindtarsi combined. Abdomen: Terga with median transverse black marking, with heaviest pigmentation medially and sublaterally. Sterna with lateral muscle insertion marks black. Subgenital plate with posteriorly produced lateral projections (Fig. 4). Basal swellings of forcep segment two posteriorly directed. Caudal filaments white.

Female adult. Body: Length: 3.2-3.5mm. Coloration pale yellow to yellow-brown with sparse black markings (legs light except for black markings basally and subdistally on the femora and basally extending to the midlength of the tibiae, and caudal filaments light). Head entirely pale yellow to yellow-brown, venter of head with black shading. Forewings length 4.5-5.0mm. Subanal plate well developed into transparent convexity, which extends distally well beyond the bases of caudal filaments.

Diagnosis. Larva: Unknown.

Adult: In both sexes the vertex of the head is entirely pale yellow; the length of the hindfemora is about three-fourths the length of the hindtibiae and hindtarsi combined; and abdominal sterna have paired dark lateral dashes, although these may be faint or not seen on all sterna in extremely pale specimens. The subgenital plate of the male is moderately emarginated with posteriorly produced lateral projections. The subanal plate of the female extends distally, well beyond the bases of the caudal filaments.

Material Examined. Paratype adult parts on slides, Texas, Devil's R, VII-2-1917, PERC; 50+ male and female adults, Texas: Val Verde Co, Devils River at Dolan Falls, VIII-4-1994 and X-17-1995, CR Nelson, NAW, PERC.

Distribution. North America: USA: west Texas.

Remarks. A redescription of the adult stage of *A. texana* has been given herein in order to augment Travers (1935) and address comparative characters now known to be of interspecific importance in *Asioplax*. It should be noted that *A. texana* is only provisionally included in *Asioplax*, pending the discovery of its larva.

***Asioplax zunigae*, n. comb.**

Tricorythodes zunigae Molineri, 2002: 293.

Diagnosis. Larva: Body length 2.0 mm. Maxillae palps present and two-segmented. The setae making up the dorsal transverse row on the forefemora are spatulate. Tarsi lack any blue or blue-black pigmentation basally. Tarsal claws have three to four marginal denticles and paired subapical, submarginal denticles. Abdominal terga lack tubercles. Posterolateral projections of abdominal segment 8 and 9 are well developed with nearly straight lateral margins. Operculate gills are subovate, and their interior ventral lamella is reduced.

Adult: Holotype Male 3.0mm in length, with wing length 3.0mm. The dark longitudinal shading on the thorax and abdomen are important distinguishing characteristics. Hindfemora are subequal in length to the hindtibiae and hindtarsi combined. Females are unknown.

Distribution. South America: Colombia.

Remarks. On the basis of maxillary palpi morphology, similarities in larval body form, coloration and setation, and distinctively large eyes of the male adult, *A. zunigae* appears most closely related to *A. dolani* and possibly the provisional Cuban species *A. sacculobranchis* and *A. sierramaestrae*.

**KEY TO LARVAE OF
NORTH, CENTRAL, AND SOUTH AMERICAN *ASIOPLAX***

- 1a. Forefemora with dorsal row of short, stout setae (Fig. 2). Maxillae with two-segmented palpi.....2
- 1b. Forefemora with dorsal row of long fine setae [Fig. 1 (Wiersema and McCafferty 2000)]. Maxillae without palpi, or with very short one-segmented palpi.....3
- 2a. Abdominal terga with medial band of black shading. Distribution: Colombia..
.....*A. zunigae*
- 2b. Abdominal terga with paired submedial dark maculae, giving the appearance of paired submedial, longitudinal stripes. Distribution: southeastern U.S.A.....
.....*A. dolani*
- 3a. Abdominal terga with posteromedial tubercles. Distribution: South America. 4
- 3b. Abdominal terga without posteromedial tubercles. Distribution: southwestern U.S.A. to Central America.5
- 4a. Posteromedial tubercles present on abdominal terga 3-9, larger on terga 6-9. Maxillae without palp. Claws with marginal denticles. Distribution: Ecuador..
.....*A. nicholsae*
- 4b. Posteromedial abdominal tubercles present on terga 7-9. Maxillae with small one-segmented palp. Claws without marginal denticles. Distribution: Argentina, Brazil and Uruguay.....*A. santarita*
- 5a. Abdominal segment 9 with poorly developed posterolateral projections [Fig. 10 (Lugo-Ortiz and McCafferty 1995a)]. Operculate gills ovate. Anterior lateral setae of mid- and hindfemora longer than posterior lateral setae. Distribution: Costa Rica.*A. curiosus*
- 5b. Abdominal segment 9 [Fig. 2 (Wiersema et al. 2001)] with well developed posterolateral projections. Operculate gills subtriangulate. Anterior and posterior lateral setae of mid- and hindfemora of approximately same length. Distribution: west and south-central North America.6
- 6a. Tarsi with dark blue pigmentation basally. Claws with paired submarginal denticles. Distribution: West-central Canada; intermountain U.S.A.*A. edmundsi*
- 6b. Tarsi not basally pigmented as above. Claws without paired submarginal denticles. Distribution: east and south Mexico; central, south, and west Texas.
.....*A. numinuh*

KEY TO ADULT OF NORTH AND SOUTH AMERICA *ASIOPLAX*

- 1a. Distribution: South America2
- 1b. Distribution: North America (including Mexico)3
- 2a. Basal third of wings with black shading. Distribution: Argentina, Brazil, and Uruguay*A. santarita*
- 2b. Black shading limited to costal margin of wings. Distribution: Colombia*A. zunigae*
- 3a. Mid- and hindfemora of male (possibly unknown female) extensively shaded in blue-black (Fig. 1). Vertex of head with posterior lateral areas shaded in blue-black. Distribution: southeastern USA*A. dolani*
- 3b. Mid- and hindfemora not as extensively shaded in blue-black as above. Vertex of head not as above, either entirely shaded in blue-brown to red brown, yellow-brown with epicranial sutures shaded in red-brown, or entirely pale yellow-brown. Distribution: west and south-central North America4
- 4a. Vertex of head entirely pale yellow to yellow-brown. Hindfemora approximately three-fourths as long as hindtibiae and tarsi combined. Abdominal sternum with lateral dark dashes. Distribution: west Texas*A. texana*
- 4b. Vertex of head not as above. Hindfemora subequal in length to hindtibiae and tarsi combined, similar to Figure 1. Abdominal sternum without lateral dark dashes. Distribution: west and south-central North America.....5
- 5a. Males with tarsi with dark bluish pigmentation basally. Vertex of male head yellow-brown with dark pigmented epicranial sutures and sometimes black speckling; vertex of female head dark brown-black, with pale epicranial suture margins and a pale transverse band at posterior margin of head capsule. Subgenital plate with wide, shallow emargination (Fig. 3). Distribution: west-central Canada; intermountain USA.....*A. edmundsi*
- 5b. Tarsi without dark bluish pigmentation basally [Fig. 3 (Wiersema et al. 2001)]. Vertex of head entirely brown-blue. Subgenital plate with narrow and deep emargination [Fig. 4 (Wiersema et al. 2001)]. Distribution: east and south Mexico; central, south, and west Texas.....*A. numinuh*

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LITERATURE CITED

- Allen, R. K.** 1967. New species of New World Leptohiphinae (Ephemeroptera: Tricorythidae). *Canadian Entomologist* 99: 350-375.
- Allen, R. K.** 1978. The nymphs of North and Central American *Leptohiphes* (Ephemeroptera: Tricorythidae). *Annals of the Entomological Society of America* 71: 537-558.
- Baumgardner, D. E., S. K. Burian, and D. Bass.** 2003. Life stage descriptions, taxonomic notes, and new records for the mayfly family Leptohiphidae (Ephemeroptera). *Zootaxa* 332: 1-12.
- Kilgore, J. I. and R. K. Allen.** 1973. Mayflies of the Southwest: new species, descriptions, and records (Ephemeroptera). *Annals of the Entomological Society of America* 66: 321-332.
- Kluge, N. and K. Naranjo.** 1990. Mayflies of the family Leptohiphidae (Ephemeroptera) from Cuba. *Entomologicheskoye Obozreniye*. 3: 564-578.
- Lester, G. T., W. P. McCafferty, and M. R. Edmondson.** 2002. New mayfly (Ephemeroptera) records from Idaho. *Entomological News* 113: 131-136.
- Lugo-Ortiz, C. R. and W. P. McCafferty.** 1995a. Contribution to the taxonomy of the Leptohiphidae (Insecta: Ephemeroptera) of Central America. *Studies on Neotropical Fauna and Environment*. 30: 165-176.
- Lugo-Ortiz, C. R. and W. P. McCafferty.** 1995b. The mayflies (Ephemeroptera) of Texas and their biogeographic affinities. pp. 151-169. *In: Current directions in research on Ephemeroptera*. L. Corkum and J. Ciborowski (Editors). Canadian Scholars' Press. Toronto, Canada. 478 pp.
- Molineri, C.** 2002. Cladistic analysis of South American species of *Tricorythodes* Ephemeroptera: Leptohiphidae) with the description of new species and stages. *Aquatic Insects* 24: 273-308.
- Traver, J. R.** 1935. Part II Systematic. pp. 239-739. *In*, J.G. Needham, J.R. Traver and Y.-C. Hsu [Editors]. *The biology of mayflies with a systematic account of the North American species*. Comstock. Ithaca, New York, U.S.A. 759 pp.
- Traver, J. R.** 1959. The subfamily Leptohiphinae. Part II: Five new species of *Tricorythodes* (Ephemeroptera: Tricorythidae). *Proceedings of the Entomological Society of Washington* 61: 121-131.
- Wang, T.-Q., R. W. Sites, and W. P. McCafferty.** 1998. Two new species of *Leptohiphes* (Ephemeroptera: Leptohiphidae) from Ecuador. *Florida Entomologist* 81: 68-75.
- Wiersema, N. A. and W. P. McCafferty.** 2000. Generic revision of the North and Central American Leptohiphidae (Ephemeroptera: Pannota). *Transactions of the American Entomological Society* 126: 337-371.
- Wiersema, N. A. and W. P. McCafferty.** 2004. *Ableptemetes*: A new genus of Tricorythodinae (Ephemeroptera: Leptohiphidae) from Mexico and Central America. *Entomological News* 114: 37-40.
- Wiersema, N. A., W. P. McCafferty, and D. E. Baumgardner.** 2001. *Asioplax numinuh*, a new species of Ephemeroptera (Leptohiphidae) from Texas and Mexico. *Entomological News* 112: 301-304.