

Two New Species of *Farrodes* from Continental South America with Comments on the Distribution of Faunal Components in Argentina (Ephemeroptera: Leptophlebiidae).

Eduardo DOMINGUEZ and Harry M. SAVAGE



DOMINGUEZ, E. and H.M. SAVAGE: Two New Species of *Farrodes* from Continental South America with Comments on the Distribution of Faunal Components in Argentine (Ephemeroptera: Leptophlebiidae). Studies on Neotropical Fauna and Environment 22 (1987), pp. 43-52.

Two new species of *Farrodes* Peters are described. These new species are the first records of *Farrodes* from continental South America and Argentina, and represent a southward range extension of roughly 4,500 km. Both primary faunal components of Neotropical Leptophlebiidae are present in the north-argentinean province of Tucumán (27° S). However, these two faunal components are geographically separated along a temperature-elevation gradient. *Farrodes* and *Thraulodes* Ulmer of the Guiana & Brazilian Shields, Warm-Adapted Genera are common in streams at elevations below 1,550 m. In contrast, the leptophlebiid fauna at elevations above 2,000 m is composed entirely of Patagonian Shield, South Andean, Cold-Adapted Genera with *Meridialaris* Peters & Edmunds and *Massartellopsis* Demoulin being particularly abundant. Streams between 1,550-2,000 m in Tucumán Province remain uncollected and the elevation and conditions at which faunal mixing or replacement occurs remain unknown.

Dr. Eduardo Dominguez, CONICET, Fundación Miguel Lillo, Miguel Lillo 251, 4.000 Tucumán, Argentina

Dr. Harry M. Savage, Zoologische Staatssammlung, Münchhausenstrasse 21, D-8000 München 60, Bundesrepublik Deutschland

Introduction

Herein, we describe two new species of *Farrodes* Peters. These new species are the first published records of *Farrodes* from continental South America and Argentina, and represent a southward range extension of roughly 4,500 km.

Farrodes was established by Peters (1971) for three species from the Antilles: *F. hyalinus* Peters from Jamaica; *F. bimaculatus* Peters & Alayo from Cuba; and *F. grenadae* Peters from Grenada. Recently, a new species of *Farrodes*

from Texas has been reared (Davis - submitted manuscript). Based on revisionary studies in progress (Savage, in prep.), *Farrodes* is a common and widespread genus ranging from northern Argentina to southern Mexico, with isolated species-groups occurring in the Antilles and the southwestern U.S. The two new species from Argentina described here represent a species-group distinct from species currently known from the Antilles and Texas. The species from Argentina differ from the generic diagnosis of Peters (1971) in the following details: upper portions of male imaginal eyes are contiguous to separated by a small distance on meson of head; sternum 9 of female imagines has a shallow posteromedian indentation and submedian projections (Fig. 5); and nymphal antennae are 2.4-3.3 times as long as the length of the head. However, only character 2 is diagnostic of the species-group including the two argentinean species as characters 1 and 3 also occur in undescribed species of other species-groups.

The Neotropical leptophlebiid fauna is composed of two primary faunal components (Savage 1987-in press): the Guiana & Brazilian Shields, Warm-Adapted Genera; and the Patagonian Shield, South Andean, Cold-Adapted Genera. *Farrodes* and other members of the Guiana & Brazilian Shields, Warm-Adapted Genera occur in warm water streams of the northern Neotropics. Patagonian Shield, South Andean, Cold-Adapted Genera are common in cold water streams of southern South America, the southern coastal mountains of Brazil and at high elevations in the central and northern Andes. Both faunal components occur in the north-argentinean province of Tucumán; but, they appear to be geographically separated along a temperature-elevation gradient. In the Aconquija Mountains (27° S: 66° W), the leptophlebiid fauna at elevations between 2,000 and 4,300 m is composed entirely of Patagonian Shield, South Andean, Cold-Adapted Genera with *Meridialaris* Peters & Edmunds and *Massartellopsis* Demoulin being particularly abundant. In contrast, the leptophlebiid fauna below 1,000 m is represented by *Farrodes* and *Thraulodes* Ulmer of the Guiana & Brazilian Shields, Warm-Adapted Genera. Streams between 1,000-2,000 m in the Aconquija Mountains remain uncollected, and the elevation and conditions at which faunal mixing or replacement occurs remain unknown. However, collections made by Dominguez in the neighboring hills of Medina and Burruyacú demonstrate that *Farrodes* and *Thraulodes* are abundant at 1,550 m in the absence of Patagonian Shield Genera. Available data suggest that at this latitude (27° S) faunal replacement occurs between 1,550 and 2,000 m.

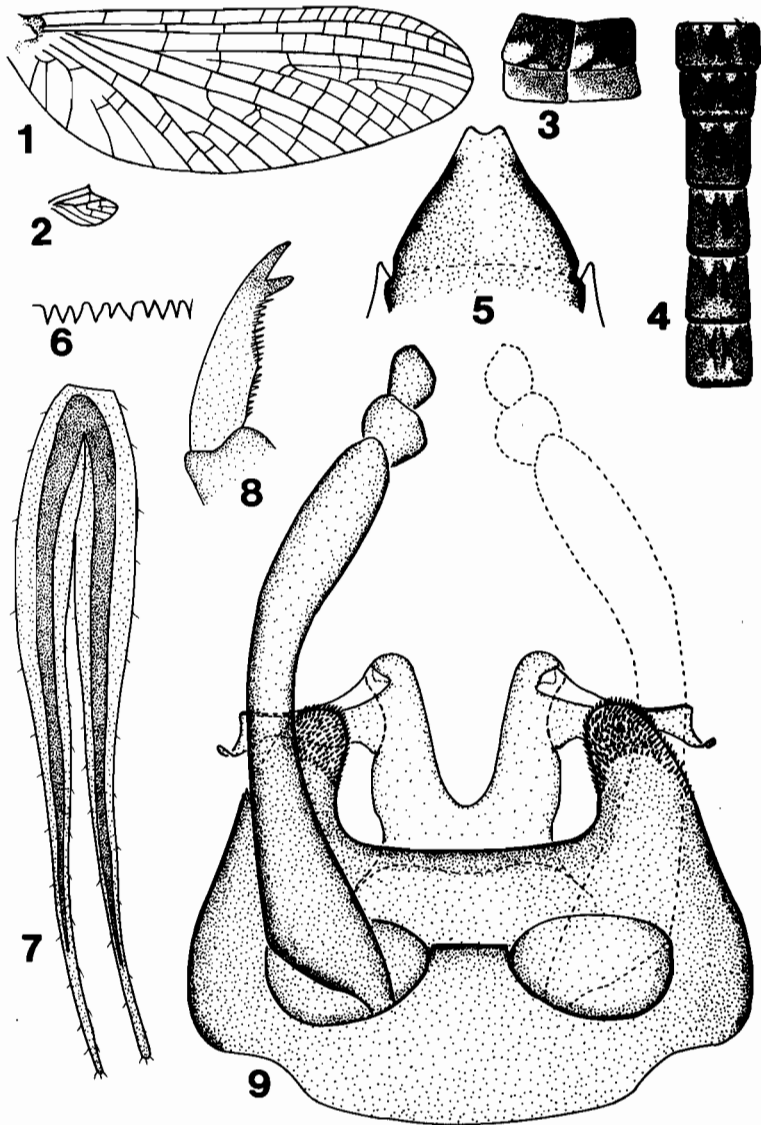
Additional collections made by Dominguez in the Yungas of Bolivia (17° S: 65° W) at 2,300 m include only *Thraulodes* of the Guiana & Brazilian Shields, Warm-Adapted Genera. These Bolivian collections support the contention that members of the Patagonian Shield, South Andean, Cold-Adapted Genera are restricted to even higher elevations in the central and northern Andes (Savage 1987-in press).

***Farrodes yungaensis* spec.nov.**
(Figs. 1-9, 14)

Male Imago (in alcohol).

Length: body, 5.5-6.5 mm; fore wings, 6.4-8.1 mm; hind wings, 0.9-1.0 mm. Eyes: upper portion with medium-sized square facets, orange-brown; facets of lower portion hexagonal, black. Head brownish yellow, with heavy brownish black wash. Scape and pedicel brownish yellow, pedicel with moderate to heavy brownish black wash, flagellum pale yellow to smoky. Thorax: pronotum brownish yellow, median line, posterior and lateral margins, and longitudinal submedian marks black; meso- and metanota brown except posteromedian portion of mesonotum brownish yellow with to without heavy brownish black wash, sutures and margins of sclerites brownish black; pleura brown, washed heavily with brownish black; sterna brownish yellow, median area paler, carinae and margins of sclerites black. Wings (Figs. 1-2): membrane of fore wing hyaline with to without brown tinge, wing base brown washed lightly with brownish black, pterostigma cloudy white; longitudinal veins and crossveins of fore wing brownish yellow; membrane of hind wing hyaline, basally washed with brownish black; veins C, Sc and R of hind wing brownish yellow, vein C and basal portions of Sc and R with brownish black wash, remainder of veins semihyaline, whitish. Legs: coxae yellowish brown, mesocoxa and carinae with heavy brownish black wash; fore femur brownish yellow, remainder of legs yellowish white except apical 1/5 of femora and basal 1/5 of tibiae brownish yellow, fore and mid femora, basal portions of tibiae, apical portions of all femora and carinae without to with light brownish black wash, wash darker on fore femur, hind femur with prominent, large, apical black band.

Abdomen (Figs. 3-4): terga and sterna semihyaline, whitish, covered with brownish black wash except as noted, wash heavy on terga; terga 2-8 and 10 with anterosubmedian pale areas (Fig. 4), terga 2-8 with anterolateral corners pale (Fig. 3), terga 2-8 with narrow anterior margin lighter to pale, lateral margins of terga 2-8 with narrow median pale area accented by darker anterior and posterior areas (Fig. 3), terga 2-8 with to without a pale transverse line anterior to darker posterior band, terga 6-8 with posteromedian area or posterosubmedian areas lighter to pale anterior to darker posterior band, posterior pale areas most prominent on tergum 7, lateral areas of terga 9-10 lighter, terga 2-7 and 10 with heavier wash producing narrow submedian longitudinal darker marks (Fig. 4); tracheae smoky, spiracles black; sternum 1 lighter medially, sterna 2-8 with anterior and median areas lighter to pale, pale area broad anteriorly, lateral and posterior areas darker, sternum 9 dark. Genitalia (Fig. 9): shaped as in Fig. 9; basal 1/2 of forceps segment 1 brown washed lightly with brownish black, remainder of segment 1 and segments 2 and 3 yellowish white; apical 0.54-0.66 of penes divided, appendages as in Fig. 9, pale yellow; styliiger plate brown washed with brownish black. Caudal filaments semihyaline, whitish, articulations of basal segments light brown [broken apically and missing].



Figs. 1-9. *Farrodes yungaensis* spec. nov.: 1, fore wing, ♂; 2, hind wing, ♂; 3, abdominal segments 5-6, ♂, lateral; 4, abdominal terga 2-7, ♂; 5, sternum ♀, ventral; 6, spines on posteromedian margin of tergum 6, nymph; 7, nymphal gill 4; 8, nymphal foreclaw; 9, ♂ genitalia, ventral.

Female Imago (in alcohol).

Length: body, 5.0-6.2 mm; fore wings, 6.2-7.0 mm; hind wings, 0.8-1.0 mm. Posteromedian margin of head broadly rounded, color as in male. Eyes black. Antenna as in male. Thorax: as in male except pronotum with median transverse area of brownish black wash connecting submedian longitudinal marks, and posteromedian portion of mesonotum washed with brownish black. Wings: as in male except fore wing veins brown. Legs: as in male. Abdomen (Fig. 5): similar to male except darker; terga 2-8 with pale transverse line anterior to posterior band, and pale narrow anterior margins present or absent; sterna 1-8 with lighter anterior and median areas reduced to absent; sternum 7 with small, rounded posteromedian genital extension; sternum 9 with small posteromedian indentation and submedian projections (Fig. 5), lateral margins dark, median area pale. Caudal filaments semihyaline, whitish.

Mature Nymph (in alcohol).

Body length, 4.5-6.7 mm. Dorsum of head, labrum and lateral portions of mandibles yellowish brown washed with brownish black; wash heavy on genae and around antennal sockets; wash on genae extends medially forming transverse dark area posterior to median ocellus; area anterior to median ocellus pale; wash on genae extends anteromedially onto clypeus producing marks, marks typically connected by wash anteriorly to produce broad U-shaped mark enclosing pale area anterior to median ocellus; in females, heavy wash forming transverse sublateral dashes between compound eyes. Ventrums of head, labium and maxillae pale yellow except submentum washed with brownish black. Eyes: as in imagines. Ocelli black. Antenna 2.4-3.3 length of head; yellowish white except pedicel with to without distinct blackish brown wash.

Thorax: color and marks similar to imagines; pronotum with posterior and anterior margins brownish black, and with lateral, anterosubmedian and posteromedian marks, lateral marks widen anteriorly, anterosubmedian marks connected medially by wash; mesonotum with heavy wash on anterolateral corners, sublaterally near developing anterior notal wing processes and posteromedially; anterior and lateral margins of prosternite black. Wing pads pale yellow to light brown with light to heavy wash, wash darker basally. Legs (Fig. 8): coxae as in male; femora, tibiae and tarsi whitish yellow, femora with to without brownish black wash basally and medially, subapical portions of femora, basal and subapical portions of tibiae, and subbasal portions of tarsi light brown with very light to heavy brownish black wash, wash darker on femora than on tibiae and tarsi, and slightly darker on hind femur than on fore and mid femora, dark area on fore tarsus longer than on mid and hind tarsi; claws with 16-20 denticles, denticles progressively larger apically except apical denticle much larger (Fig. 8). Abdomen (Fig. 6): brownish yellow with heavy wash; terga with wash as in imagines to with median and submedian pale areas reduced and not apparent; sterna as in imagines to with lateral margins pale, with to without heavy wash forming posterosublateral marks; terga with short spines on posterior margin (Fig. 6). Gills (Fig. 7): semihyaline, whitish, tracheae black. Caudal filaments brownish yellow, apical 1/2 of segments with light brownish black wash, wash darker apically except apices of filaments light.

Specimens Examined (Fig. 14): Holotype male imago, ARGENTINA: Salta Prov., Aguas Blancas, E. Jakulica, Arroyo El Arrazayal, E. Dominguez, 19-XI-85. Allotype female imago, same data as holotype except date of collection is 7-XI-84. Paratypes: 4 nymphs, same data as holotype; 1 male imago, 5 male subimagines, 6 female subimagines, 42 nymphs, same data as allotype; Salta Prov., Aguas Blancas, E. Jakulica, Angosto Rio Pescado, E. Dominguez, 11-XII-84, 2 male imagines, 1 male subimago, 1 nymph; Salta Prov., Parque Nac. "El Rey", Arroyo Las Salas, E. Dominguez, 15-XII-82, 1 female imago; Tucumán Prov., Cerro San Javier, Cascada Las Salas, E. Dominguez, 7-XI-81, 1 male imago, 4 female imagines; Tucumán Prov., Concepción, Arroyo Celeste, afluente Rio Cochuna, E. Dominguez, 10-IV-83, 1 female subimago; same data as previous paratypes except date of collection 26-IV-83, 4 male imagines, 8 female imagines, 1 male subimago, 5 female subimagines, 15 nymphs.

Holotype, allotype, 6 male imaginal, 11 female imaginal, 5 male subimaginal, 16 female subimaginal and 49 nymphal paratypes are deposited in collections of Instituto - Fundación Miguel Lillo. One male imaginal, 2 female imaginal, 3 male subimaginal, 4 female subimaginal and 8 nymphal paratypes are deposited in Florida A & M University collections, Tallahassee. One male subimaginal, 2 female subimaginal, and 5 nymphal paratypes are deposited in collections of the Zoologische Staatssammlung, München.

Life Cycle Associations: rearing by E. Dominguez.

Etymology: species is named for the Yungas, a type of forest (Hueck & Seibert 1972). Most specimens were collected from streams in this forest-type.

Discussion. Imagines of *F. yungaensis* can be distinguished from all other species of *Farrodes* by the following combination of characters: 1) appendages of penes are large and shaped as in Fig. 9; 2) apical 0.54-0.66 of penes is divided; 3) sternum 9 of female has a small median notch and submedian projections (Fig. 5); 4) each hind femur has a prominent brownish black subapical band that is distinctly darker than the brownish black wash on subapical portions of the fore and mid femora; 5) abdominal segments are dark with pale anterosubmedian areas (Fig. 4), anterolateral corners and mid-lateral areas (Fig. 3); and 6) basal portion of forceps segment 1 is brown, apical portion and segments 2 and 3 are yellowish white.

Nymphs of *F. yungaensis* can be distinguished from all other species of *Farrodes* by the following combination of characters: 1) legs are pale with subapical portions of femora, basal and subapical portions of tibiae, and subbasal portions of tarsi light brown with very light to heavy brownish black wash, wash darker on femora than on tibiae and tarsi, dark area on fore tarsus longer than on mid and hind tarsi; 2) abdominal segments are dark, similar to Figs. 3-4, or darker with median and submedian pale areas not apparent; 3) head has heavy wash on genae and around antennal sockets; wash on genae extends medially forming transverse dark area posterior to median ocellus, and anteromedially onto clypeus producing broad U-shaped mark that encloses pale area anterior to median ocellus; 4) pronotum has lateral, anterosubmedian and posteromedian black marks, with anterosubmedian marks connected medially by wash; anterolateral corners of mesonotum are heavily washed with brownish black; and 5) claws have 16-20 denticles as in Fig. 8.

Some variations between specimens from Tucumán and Salta Provinces were noted. The abdomens of specimens from Salta Province often have an orangeish brown tinge, while those from Tucumán Province are blacker. More impor-

tantly, the markings on the nymphal legs are much darker on nymphs from Salta Province than on those from Tucumán Province. Mature nymphs from Salta Province typically have all leg markings distinctly and approximately equally washed with brownish black. In nymphs from Tucumán Province, the light brown tibial and tarsal marks have a very light wash and appear distinctly lighter than the subapical marks on the femora.

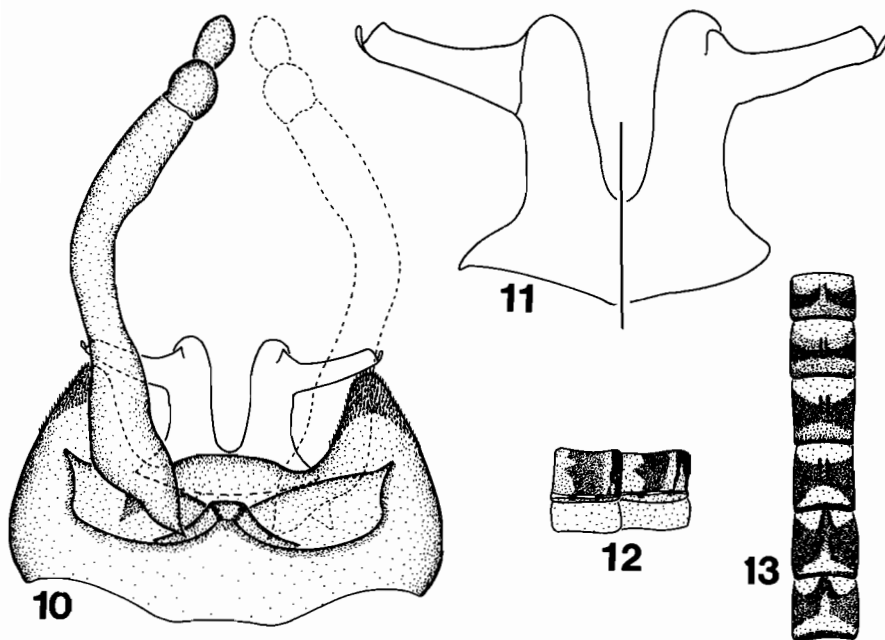
Biology. Most specimens were collected in a low to middle elevation forest-type known as Yungas. The elevation of stream sites sampled ranged between 550 and 1,000 m. In Salta Province, nymphs were collected from streams 10-15 m wide and 45-70 cm deep with exposed bedrock bottoms. Nymphs were frequently collected from the bottom side of stones at depths of 20-30 cm. In Tucumán Province, nymphs were collected from leaves in shallow water with fast current in streams 3-4 m wide and 40-50 cm deep.

Imagines were collected from November to April, but collections of mature nymphs in April indicate that emergence continues at least into May. Subimagines were observed to emerge at dusk and molt to the imaginal stage at sunrise. Swarming was not observed.

***Farrodes iguazuanus* spec. nov.**
(Figs. 10-14)

Male Imago (in alcohol).

Length: body, 5.1-5.2 mm; fore wings, 5.2-5.3 mm; hind wings, 0.7-0.8 mm. Eyes: upper portion with medium-sized square facets, orange-yellow; facets of lower portion hexagonal, black. Head brownish yellow. Scape and pedicel yellow, flagellum [broken off and missing]. Thorax: pronotum yellowish white, lateral and posterior margins washed with brownish black; meso- and metanota light brown, sutures paler, lateral margins and posteromedian area of mesonotum washed with brownish black; pleural sclerites light brown, membranous areas paler, washed with brownish black; sterna pale yellow, carinae and margins of sclerites darker. Wings: membrane of fore wing hyaline, base light brown and pterostigma cloudy white; longitudinal veins of fore wing brownish yellow, crossveins pale yellow; membrane of hind wing hyaline except base washed with brownish black; veins C, Sc and base of R blackish brown, remainder of veins in hind wing pale yellow. Legs: coxae brown, trochanters brownish yellow, [remainder of legs broken off and missing]. Abdomen (Figs. 12-13): terga 1-7 and sterna whitish, translucent, terga 8-10 light yellow; all terga with variable brownish black wash and dark posterior margins; tergum 1 covered with heavy wash; terga 2-8 with pale anterolateral corners; terga 2-7 with large semicircular anteromedian pale area, terga 6-7 with anteromedian pale area divided by dark wedge extending anteriorly from median dark area; terga 5-7 with pale semicircular, posteromedian area anterior to posterior band; terga 8-10 with patterns similar to tergum 7 (Fig. 13); tracheae smoky, marked as in Fig. 12, spiracles black; sterna without distinct markings. Genitalia (Figs. 10-11): basal 1/2 of forceps segment 1 yellow, remainder of segment 1 and



Figs. 10-13. *Farrodes iguazuanus* spec.nov., ♂: 10, genitalia, ventral; 11, penes, left - dorsal, right - ventral; 12, abdominal segments 5-6, lateral; 13, abdominal terga 2-7.

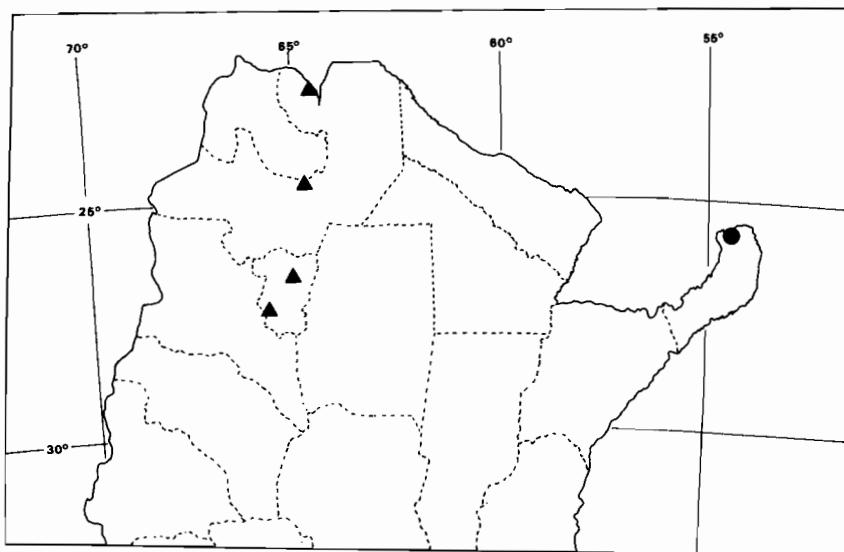


Fig. 14. Known distributions: *Farrodes yungaensis* spec.nov., triangles; *Farrodes iguazuanus* spec.nov., dot.

segments 2 and 3 yellowish white; apical 2/3 of penes divided, appendages as in Figs. 10-11, yellowish white; styliger plate yellow. Caudal filaments [broken off and missing].

Female Imago (in alcohol).

Length: body, 4.9-5.0 mm; fore wings, 6.5-6.6 mm; hind wings, 0.9-1.0 mm. Head yellowish white, a black ring around each antennal socket. Eyes black. Antenna yellow, paler apically. Thorax and wings with color and marks as in male. Fore and mid legs: [hind legs broken off and missing], coxae brown washed with brownish black, femora and tibiae orangeish yellow, remainder of legs yellow, paler apically, joints darker. Abdomen: terga grayish brown, translucent, posterior margins darker; tracheae smoky, spiracles black; sterna light yellow, translucent, sternum 9 with small posteromedian indentation and submedian projections. Caudal filaments [broken off and missing].

Nymphs: Unknown.

Specimens Examined (Fig. 14). Holotype male imago, ARGENTINA: Misiones Prov., Parque Nacional Iguazú, Cataratas, E. Dominguez, 18-XI-80. Allotype female imago, same data as holotype. Holotype and allotype are deposited in collections of the Instituto - Fundación Miguel Lillo.

Etymology: species is named for Rio Iguazú, type locality; masculine.

Discussion. Imagines of *F. iguazuanus* can be distinguished from all other species of *Farrodes* by the following combination of characters: 1) appendages of penes are large and shaped as in Figs. 10-11; 2) apical 2/3 of penes is divided; 3) sternum 9 of female has a small median notch and submedian projections, similar to Fig. 5; 4) abdominal segments are dark with patterns as in Figs. 12-13; terga 2-7 have semicircular anteromedian pale areas, pale area divided by dark wedge on terga 6-7; and 6) basal portion of forceps segment 1 is yellow, apical portion and segments 2 and 3 are yellowish white.

Biology. Imagines were collected at light in November on the banks of the Rio Iguazú near Iguazú Falls.

Acknowledgements

The authors thank J.R. Davis, Texas Water Commission, for access to an unpublished manuscript. This manuscript was prepared while one of us (HMS) was supported by an Alexander von Humboldt Fellowship at the Zoologische Staatssammlung.

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