# *LEPTOHYPHES ZALOPE* (EPHEMEROPTERA: LEPTOHYPHIDAE): A POLYTYPIC NORTH AND CENTRAL AMERICAN SPECIES[1]

**D. E. Baumgardner[2], W. P. McCafferty[3]**

ABSTRACT: Reared larval to adult associations along with the study of extensive type materials and new collections from North and Central America indicate that the little stout crawler mayfly *Leptohyphes zalope* has been described under numerous synonymys, including *L. apache*, n. syn., *L. ferruginus*, n. syn., *L. hispidus*, n. syn., *L. lumas*, n. syn., *L. piraticus*, n. syn., *L. succinus*, n. syn., and *L. zelus*, n. syn. Variation in coloration and size of larvae and adults as well as head spiculation in larvae grades among and within populations of *L. zalope*. Somewhat variable head patterning in the larvae is obscured in pre-emergent larvae, but is otherwise diagnostic, together with the presence of a three-segmented maxillary palpi and a basal process on the outer ventral lamellae of the operculate gill. Adults have a slightly bulbous terminal forceps segment, and somewhat variable but apparently distinctive coloration. The species is wide ranging from the southwestern United States throughout much of Mexico, and Central America to Costa Rica.

The last comparative study of species of *Leptohyphes* Eaton was by Lugo-Ortiz and McCafferty (1995a), wherein six species of *Leptohyphes* along with species of *Haplohyphes* Allen and *Tricorythodes* Ulmer from Central America were treated. McCafferty (1996) listed another 21 species of *Leptohyphes* from Mexico and the USA, bringing the total, previous to the present study, to 36 species known from North and Central America. More specific distributions in Central America, Mexico, and the USA may be found, respectively, in McCafferty and Lugo-Ortiz (1996a), McCafferty and Lugo-Ortiz (1996b) and McCafferty (1997). The genus is clearly of Neotropical origin (e.g., McCafferty et al. 1992, McCafferty 1998), and no species of the genus are known from Canada (McCafferty and Randolph 1998).

Although *Leptohyphes* mayflies are common in streams throughout the southwestern USA, Mexico, Central America, and much of South America, species taxonomy has remained problematic mainly because the vast majority of species have been known only as larvae or only as adults. In fact, among North and Central American species, only three species have been known as both larvae and adults, and only two of those associations were authenticated by rearing. In addition to the lack of stage correlation in species of *Leptohyphes*, some larval characteristics historically used to distinguish the many species known only as larvae have proven to be variable and gradational among and between populations. Discrepancies in the original descriptions and figures of several species have also been cause of concern. For example, Allen variously

[1] Received June 5, 1999. Accepted August 26, 1999.

[2] Department of Entomology, Texas A & M University, College Station, TX 77843.

[3] Department of Entomology, Purdue University, West Lafayette, IN 47907.

described the size of the mature larvae of *L. apache* Allen as 5.5-6.5mm (Allen 1967) and as 4.5-5.5mm (Allen 1978); and Allen (1978, Fig. 36) assigned the exact same illustration to depict *L. zelus* Allen as had been used earlier to depict *L. lumas* Allen and Brusca by Allen and Brusca (1973, Fig. 25). In the adults, many species apparently have structural similarities, such as involve the wings and male genitalia, leaving only color pattern differences to distinguish them. Also, Traver (1958) had incorrectly drawn details of male genitalia. Additional discrepancies from the literature were discussed by Lugo-Ortiz and McCafferty (1995a), or were revealed in the present study and are discussed later in this paper.

In order to better understand species makeup within *Leptohyphes*, the present study initially entailed a detailed examination of the type material of several species described only as larvae by Allen (1967, 1978) and Allen and Brusca (1973). This phase of the study revealed that seven species names were equivalent, including *L. apache*, *L. ferruginus* Allen and Brusca, *L. hispidus* Allen and Brusca, *L. lumas*, *L. piraticus* Allen, *L. succinus* Allen, and *L. zelus*. The study therefore also confirmed the former synonymy by Allen (1978) of *L. lumas* with *L. hispidus*, as well as the former synonymy by Lugo-Ortiz and McCafferty (1995a) of *L. zelus* with *L. lumas*. *Leptohyphes apache* is the senior name among the above.

Another important aspect of the present study involved larva to adult rearings. In Texas, several samples of *Leptohyphes* larvae that fell within the larval morphological definition that is associated with all the above mentioned names (= *L. apache*) were reared. Adults of the reared materials appeared to possibly match the structural characteristics that had been described for *L. berneri* Traver and *L. zalope* Traver from Mexico, and *L. priapus* Traver from Costa Rica (Traver 1958). We thus compared our reared adults with adult types of those three species. Adults clearly matched the types of *L. zalope*, thus revealing the senior synonym applicable to a widespread polytypic species. This was a discovery that had not been anticipated. The conclusions could not have been made merely by comparing type material, at the exclusion of rearings, because *L. apache* (under any of the synonymous names) had been known only as larvae (Allen 1967, 1978; Allen and Brusca 1973), and *L. zalope* had been known only as adults (Traver 1958).

A new synonymy of *L. zalope* is presented below, along with diagnoses of the larval and adult stages, and data on synonymies, distribution, and variability of the species. Collections (and their acronyms) housing materials used in this study include The California Academy of Science, San Francisco (CAS); Florida A & M University, Tallahassee (FAMU); Purdue Entomological Research Collections, West Lafayette, Indiana (PERC); Texas A & M University, College Station (TAMU); Wilbur R. Enns Entomology Museum, University of Missouri, Columbia (UMC); and the University of North Texas, Denton (UNT).

## *Leptohyphes zalope* Traver

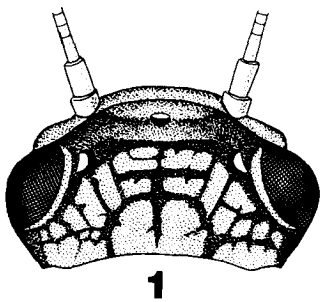
*Leptohyphes zalope* Traver 1958:85.
*Leptohyphes apache* Allen 1967:352. NEW SYNONYM.
*Leptohyphes ferruginus* Allen and Brusca 1973:88. NEW SYNONYM.
*Leptohyphes hispidus* Allen and Brusca 1973:88. NEW SYNONYM.
*Leptohyphes lumas* Allen and Brusca 1973:91. NEW SYNONYM.
*Leptohyphes piraticus* Allen 1978:554. NEW SYNONYM.
*Leptohyphes succinus* Allen 1978:555. NEW SYNONYM.
*Leptohyphes zelus* Allen 1978:557. NEW SYNONYM.

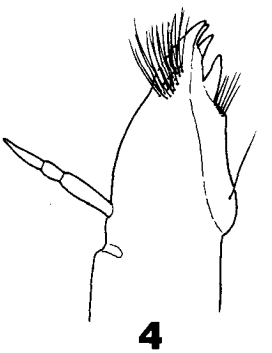
**Larval diagnosis.** Mature body length: 4.0-7.5mm. Mature caudal filaments length: 3.5-7.0mm. Coloration generally light brown to brown to reddish brown, with somewhat darker markings. Vertex penciling (in all but very early instar and very late instar larvae) ranging as that shown in Figures 1-3, with semicircle at middle third of posterior margin, with longer, more or less straight, oblique lines originating at bases of semicircle and diverging anteriorly, medial straight longitudinal line dissecting the semicircle and beyond anteriorly, and short transverse line anterior to semicircle extending between divergent long oblique lines originating from bases of semicircle; variants with lines incomplete or broken, although semicircle usually recognizable; occasionally vertex appearing entirely variegated or granular; pre-emergent larvae usually with unicolorous dark or dark granular head capsule, and linear markings usually indistinct or difficult to detect. Tarsal claws with row of denticles. Middle abdominal terga not elevated; terga 6 and/or 7 without groupings of highly elongate bristles. Maxillary palpi three segmented (Fig 4). Outer ventral lamellae of gills on abdominal segment 2 (operculate gill set) with well-developed basal beak-like process as in Figure 5.

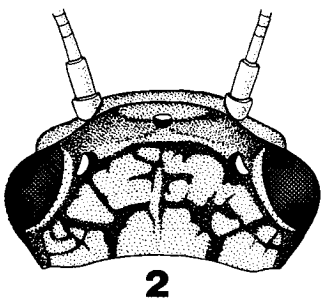
**Male adult diagnosis.** Body length: 3.0-5.5mm. Forewing length 4.0-6.0mm. Hindwing length 0.5-1.0mm. Cerci length 10.0-17.0mm. Coloration ranging from cream to yellow or gray to light to dark reddish brown. Head and pronotum overshadowed with black stippling giving a gray cast. Mesonotum ranging from shiny yellow-brown to light reddish brown to dark chestnut brown. Forefemora gray with dark black stippled longitudinal bands. Foreclaws similar and blunt. Wings similar to Figures 1 and 3 in Traver (1958). Abdomen distinctly lighter than thoracic nota, with cream to yellow to gray to reddish brown background color overshadowed by fine black stippling giving gray cast. Genitalia as in Figure 6, with apices of forceps rounded and slightly bulbous, with penes more or less Y shaped, and with each penal lobe with short linear incision subapically in dorsolateral aspect, giving rise to narrower dorsolateral process appressed to tip of penal lobe.

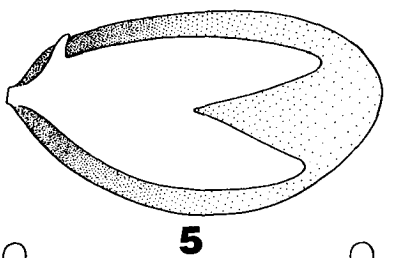
**Female adult diagnosis.** Body length: 3.5-6.0mm. Forewing length: 5.0-7.0mm. Hindwings absent. Cerci length 4.0-12mm. Body coloration and markings similar to male, although contrast between thoracic nota and abdominal terga often not as pronounced.

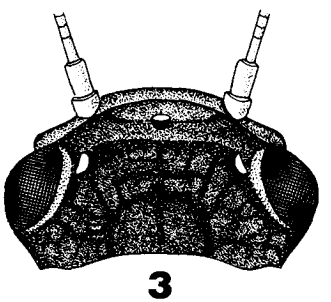
**Type material examined.** ***Leptohyphes apache*:** HOLOTYPE larva: ARIZONA, Navajo Co, N Fk White R at White River, Fort Apache Indian Reservation, VII-5-1964, R. K. Allen (CAS); PARATOPOTYPES: 14 larvae, one slide (CAS); PARATYPES: ARIZONA, 1 larva, Navajo Co, stream 8 mi N White R, VI-25-1951, S. J. Preece (FAMU), 2 slides (CAS); four larvae, White R 4 mi N White River, VI-15-1951, S. J. Preece (FAMU), 2 slides (CAS); 2 larvae, Yavapai Co, Beaver Cr at Beaver Creek Rangers Stat, VII-4-1964, R. K. Allen (CAS); 2 larvae, Greenlee Co, San Francisco R, at Clifton, VII-4-1964, R. K. Allen (CAS). NEW MEXICO, 11 larvae, four slides, Taylor Cr, Santa Fe Natl For VIII-26-1937, C. M. Tarzwell (CAS). UTAH, 1 larva, Virgin R, Zions Natl Prk, VI-1947, G. F. Edmunds (PERC), 3 slides (CAS).

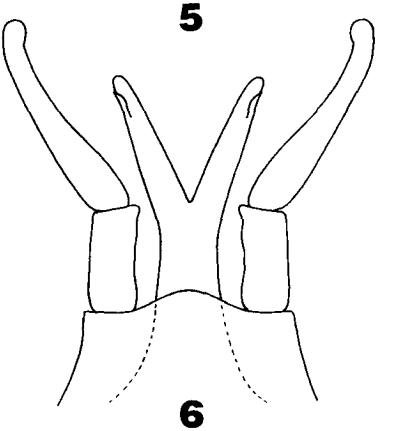



Figs. 1-6. *Leptohyphes zalope*. 1. Middle instar larval vertex (typical pattern). 2. Middle instar larval vertex (common variant pattern). 3. Pre-emergent instar larva vertex (dark variant). 4. Larval maxilla. 5. Larval gill lamellae of abdominal segment 2 (ventral view, lateral lamellae top). 6. Male adult genitalia.

***Leptohyphes berneri***: HOLOTYPE male adult: MEXICO, Metlac, XII-25-1940, H. H. Hobbs (FAMU). ALLOTYPE: same data as holotype. PARATYPES: 22 males, 8 females, same data as holotype.

***Leptohyphes ferruginus***: HOLOTYPE larva: MEXICO, Veracruz, R San Marcos, at Apapantilla, 3 mi SE Villa A Camacho, XI-12-1968, R. K. Allen (CAS). PARATOPOTYPES: 2 larvae, 4 slides (CAS).

***Leptohyphes hispidus***: HOLOTYPE larva: MEXICO, Veracruz State, stream 5 mi S Ciudad Mendoza, XI-7-1968, R. K. Allen (CAS). PARATOPOTYPES: 42 larvae (CAS), 1 larva (PERC). PARATYPES: 14 larvae, 2 slides, MEXICO, Veracruz State, R Jamapa, 3 mi NE Coscomatopec, XI-8-1968, R. K. Allen (CAS).

***Leptohypohes lumas***: HOLOTYPE larva: MEXICO, Chiapas State, stream 7 mi N Arriaga on Hwy 190, VII-20-1966, R. K. Allen (CAS). PARATOPOTYPES: 16 larvae (CAS), 1 larva (PERC). PARATYPES (all R. K. Allen, all CAS): MEXICO, 7 Larvae, Chiapas State, stream 7 mi N Arriaga on Hwy 190, X-23-1968, 3 larvae, stream at Santa Isabel, 12 mi above Arriaga on Hwy 190, X-23-1968, 3 larvae, R Teapa nr Ishuatan, VII-18-1966; 2 larvae, Oaxaca State, R Grande, 3 mi S Gualatao, XI-6-1968; 1 larva, Tabasco, R. Grifalva at Teapa, VII-18-1966; 1 larva, Chiapas, R. Huitla, 14 mi N Tapachula, XI-1-1968; 7 larvae, Veracruz State, R Jamapa, 3 mi NE Coscomatepec, XI-1-1968, 2 larvae, R. Jamapa, 3 mi NE Coscomatepec, VII-14-1966, 2 larvae, R Tecolapan, Santiago Tuxtla on Hwy 180, VII-16-1966, 5 larvae, R San Marcos, at Apapantilla, 3 mi SE Villa A. Camacho, XI-12-1968.

***Leptohyphes piraticus***: HOLOTYPE larva, 3 slides: HONDURAS, Dept Choluteca, small stream, Choluteca, ca 16 mi E Jicaro-Galán, Pan Am Hwy, X-10-1964, J. S. Packer (FAMU).

***Leptohyphes priapus***. HOLOTYPE male adult, slide mounted: COSTA RICA, Río Pedregosa, II-1939, D. L. Rounds (PERC). PARATYPES: 13 male adults and four female adults, same data and deposition as holotype.

***Leptohyphes succinus***: HOLOTYPE larva: TEXAS, Hays Co, San Marcos R, IV-3-1973, M. Peters (CAS). PARATYPES (all M. Peters, all CAS): 4 larvae, same data as holotype; 8 larvae, same data as holotype, except VI-6-1973; 1 larva, TEXAS, Kerr Co, North Fork Guadalupe R, 4 mi W Hunt, VIII-1973, Guadalupe R. SH 16 crossing, VII-27-1973; 1 larva, 3 slides.

***Leptohyphes zalope***: HOLOTYPE male adult: MEXICO, 4 mi S of Río Papagago Bridge on Río Zalope, I-4-1948, S. Mulaik (PERC). PARATYPES: 3 male adults, same data and deposition as holotype.

***Leptohyphes zelus***: HOLOTYPE larva: HONDURAS, Dept Comayagua, 3 mi N Taulabe on Hwy 1, large river, X-20-1964, J. S. Packer (FAMU). PARATOPOTYPES: 5 larvae, 2 slides (CAS). PARATYPES: GUATEMALA: 44 larvae, R Latoma at km 182 on CA 2, VII-24-1966, R. K. Allen (CAS). HONDURAS (all J. S. Packer, except where noted): 1 larva, Comayagua, steam 5 mi S on Hwy 1 at bridge, X-17-1964, 1 larva, R Humuya 1 mi N Comayagua at bridge, X-17-1964, (CAS); 1 larva, Dept Cortes, R Chamelecon, X-18-1964 (FAMU), 3 larvae, R Blanco 2 mi N Carcol at bridge on Hwy 1, X-18-1964, (CAS); 4 larvae, Dept. Francisco, Morazán, 10 mi E Guaimaca on Hwy 3, small stream XI-6-1964 (FAMU), 1 larva, stream nr La Venta at jct Hwy 3 & R Choluteca, XI-7-1964, Morazán, stream 6.5 mi from jct Hwy 3 & 5 on Hwy 5, XI-7-1964, (CAS); 1 larva, Dept. Olancho, stream 1 mi W Campamento, Galera turn-off on Hwy 3, XI-7-1964 (CAS); 2 larvae, Dept. El Paraiso, small stream ca 3 km E Danli, VIII-29-1964 (CAS), 5 larvae, stream ca 8 km E Danli, VIII-29-1964 (CAS, FAMU); 1 larva, 50 km E Danli, trib R. Guayambre at jct Hwy 14, IX-3-1964 (FAMU); 4 larvae, R Clarrita at San Morano on Hwy to Escuela Agricola, X-29-1968, R. K. Allen (CAS).

**Other material examined.** (All larvae, unless otherwise indicated.) ARIZONA: Gila

Co, San Carlos R at San Carlos, VII-20-1970, Salt R on Hwy 288, VII-20-1970 (CAS), East Verde R on rd 406, 10 mi E Payson, VII-19-1970 (CAS, FAMU), East Verde R on Hwy 87, VII-18-19-1970 (CAS); Yavapai Co, Oak Cr at Red Rock Crossing, VII-17-18-1970, Oak Cr nr Cornville, VII-18-1970 (CAS), Verde R at Verde Valley, VII-18-1970 (CAS, FAMU). BELIZE: Cayo District, Roaring Cr, riffle, VI-20-1974 (PERC), 13 mi SE Belmopan nr Caves Branch R, I-4-1996 (UMC); Stann Cr District, Dry Cr, 5.7 mi Middlesex on Hummingbird Hwy, I-11-1996, North Stann Cr, 2.7 mi SE Middlesex on Hummingbird Hwy, I-11-1996 (UMC); Toledo District, Agvacate Cr, 3.9 mi SW Blue Creek Village, I-9-1996, Golden Stream at golden Stream Village, I-10-1996 (UMC). COSTA RICA: Alajuela Prov, R Pizote ca 5 km N Dos Dioses, III-9-1986, R La Paz Pequena, 7.8 km N Vara Blanca, III-3-1986, P N Rincon de la Vieja, Quebrada Provision, III-4-1986 (FAMU); Cartago Prov, R Platanillo, 2.2 km E Tayutic, I-30-1986 (FAMU); Guanacaste Prov, R Los Ahogados, 11.3 km ENE Quebrada Grande, III-7, VI-26-1986 (FAMU); Limón Prov, R Uatisi, W Uatisi, II-2-1986 (FAMU); Punterenas Prov, 10 km N San Vito, at quarry waterfall, III-16-1969 (PERC), R Bellavista, ca 1.5 km NW Las Alturas, VI-15-17-1986, R Ceibro, rt 2, ca 6 km W rd to Buenos Aires, II-2-1986 (FAMU). EL SALVADOR: R Mizata, 27 mi W La Libertad, X-28-1968 (CAS). GUATEMALA: R Latoma at KM 182 on Hwy 2, X-24-1968 (CAS). MEXICO: Chihuahua State, small stream S Pecheco, I-22-1987, R Gavilán, Los Amarillos, VI-23-1987, Arroyo Lalo Varela, trib R Gavilán, VI-22-1987, R Piedras, Verdes nr Pacheco, VI-22-1987 (PERC); Nuevo León State, Cabezones R at Hwy 85, 15 mi N Linares, V-15-1995, Pobillo R, at St Hwy 115, V-15-1995 (TAMU); San Luis Potosí State, Naranjo R at Hwy 80, town of Naranjo, V-18-1995; Tamaulipas State, R Guayalejo (Tamasi) off Hwy 347 nr San Igancio, V-26-1993, Branch of Chihue R at Hwy 101, ca 12 mi S Jaumavae, between km marker 91 & 92, V-17-1995 (TAMU). NEW MEXICO: Catron Co, San Francisco R at Glenwood, VII-21-1970 (CAS); Grant Co, East Fork Gila R on Hwy 527, VI-21-1970, Gila R nr Clifton, Hwy 180, VII-21-1970 (CAS). TEXAS: Bandera Co, Medina R, V-1977, McCafferty et al. (PERC), Medina R at TX 16, 1 mi N Medina, III-8-1997 (TAMU); Bell Co, Little R at FM 2184 NE Holland, SW Rodgers IV-9-1993 (adults) (TAMU); Caldwell Co, San Marcos R, 6 mi NE luling off Hwy 80, VIII-9-1970 (CAS); Comal Co, Guadalupe R at end of Pk Rd 31 in Guadalupe St Prk, X-14, XII-23-1994 (UNT); Hays Co, San Marcos R at Cheatam St in San Marcos II-22-1997 (2 males reared) (TAMU), San Marcos R at Co Rd 101 (Caners Crossing), 1 mi below confluence with Blanco R, in San Marcos city limits, at Hays/Caldwell county line (males and females reared) (TAMU); Kendall Co, Guadalupe R, V-1977, McCafferty et al. (PERC); Kimble Co, Llano R at Texas Tech Field Stat, IV-11-1992 (UNT), Junction South Llano R at Hwy 956, X-13-1996 (TAMU); Menard Co, San Saba R st FM 864 low water bridge, IV-11-1992 (UNT), X-22-1992 (TAMU); Victoria Co, Guadalupe R at Riverside Prk, VIII-24-1997 (adults) (TAMU), VIII-20-1997 (larvae & adults) (TAMU).

**Distribution.** *Leptohyhes zalope* has been known from Arizona, New Mexico, Texas, and southern Utah in the north to Costa Rica in the south. The distribution patterns shown by the species (under its various synonyms) in Arizona, New Mexico, and Texas were reviewed respectively by Lugo-Ortiz and McCafferty (1995b), McCafferty et al. (1997), and Lugo-Ortiz and McCafferty (1995c). In Texas, the species was previously reported as *L. succinus* from Hays and Kerr Counties (Allen 1978) and from Bandera and Kendall Counties (Lugo-Ortiz and McCafferty 1995c). It is newly reported herein from Bell, Caldwell, Comal, Kimble, and Victoria Counties. In Central America, the species has been reported under various synonyms from Belize, El Salva-

dor, Costa Rica, Guatemala, and Honduras. In Mexico, it has been known from the states of Chiapas, Chihuahua, Guerrero, Oaxaca, Tabasco, and Veracruz. It is newly reported herein from the states of Nuevo León, San Luis Potosí, and Tamaulipas, indicating a general distribution throughout much of Mexico. The species distribution of *L. zalope* from the United States to southern Central America is similar to that of *L. packeri* Allen and certain other species in other families of mayflies, including *Americabaetis pleturus* (Lugo-Ortiz and McCafferty), *Baetodes deficiens* Cohen and Allen, *Callibaetis floridanus* Banks, *C. montanus* Eaton, *C. pictus* (Eaton), and *Cloeodes excogitatus* Waltz and McCafferty (Baetidae); *Caenis diminuta* Walker (Caenidae); *Stenonema mexicanum* (Ulmer) (Heptageniidae); *Isonychia sicca* Walsh (Isonychiidae); and *Thraulodes brunneus* Koss and *T. speciosus* Traver (Leptophlebiidae).

## DISCUSSION

Coloration and size of *L. zalope* larvae and adults vary. This is evident to some degree even within populations, sometimes with larger or freshly molted individuals tending to be darker. Abdominal color pattern of larvae was not found to be species specific, although it had been suggested as a specific character previously for some of the synonyms. For example, the abdominal color pattern described for *L. hispidus* by Allen (1978, Fig. 42) was found to be present, partially present, or entirely absent within populations. Both *L. ferruginus* and *L. piraticus* larvae were described as being red, although this color is no longer evident in the preserved type material. Many of the mature specimens of synonyms tend to take on the reddish cast. Type material of *L. lumas* and *L. ferruginus* were taken at the same time from the same locale on the Río San Marcos in Veracruz, Mexico, evidently only differing in general ground coloration. In addition, what Allen (1978) identified as *L. ferruginus* was reported by him from the type locality of *L. piraticus* in Honduras.

Extensive samples demonstrated that when *L. zalope* larvae approach the final molt, patterns on the head capsule are more difficult to detect and sometimes no longer evident as the head becomes much darker. For example, the holotype of *L. hispidus* was based on such a pre-emergent form of *L. zalope*. The remainder of the type series, however, consisted of larvae with characteristic head patterns (Figs. 1, 2). Of all the material examined, middle instar dark forms without distinct patterns were never found. The figure of *L. hispidus* (Allen and Brusca 1973, Fig. 23) is of a pre-emergent larva and explains why Lugo-Ortiz and McCafferty (1995a) continued to consider it a distinct species, although they had recognized the equivalency of *L. lumas* and *L. zelus*.

Reddish color morphs and inconsistent patterning within a single species of mayflies are known within larval populations of other families, for example, *Rhithrogena impersonata* (McDunnough) (Heptageniidae) and *Ephemerella needhami* McDunnough (Ephemerellidae). Sometimes reddish

morphs predominate, but often they are a small proportion of the population. Flowers and Hilsenhoff (1975) showed that the red color becomes more intense and any patterning is more inconsistent in older larvae of reddish morphs of *R. impersonata*. Usually highly diagnostic patterning of the larvae of *Baetis intercalaris* McDunnough (Baetidae) is occasionally absent in certain populations (Waltz et al. 1996), and otherwise distinctive markings are entirely absent in about 5 percent of large populations of *E. needhami* (W. P. McCafferty and A. V. Provonsha, unpublished).

Although adult coloration varies in intensity, consistent features appear to include the longitudinally banded smoky forelegs; the brighter and often darker coloration of the mesonotum as compared especially to the abdomen; and the fine over-stippling on the abdomen that gives it a gray cast no matter what the intensity of ground color (although the stippling is more difficult to detect when the ground color is darker). The main reason we do not consider *L. priapus* (known only as adults) to be a junior synonym of *L. zalope*, despite its evident structural similarities (Traver 1958), is the lack of the foreleg banding and absence of the black stippling on the abdomen in the type material of the latter. *Leptohyphes berneri*, which was another possible candidate for synonymy because of similar adult male foreclaws, genitalia, and wings, was not considered equivalent because of the concolorous body and other markings, including the apparent lack of fine over-stippling on the abdomen.

In general the only putative difference between *L. succinus* and the other synonyms was body size of larvae. The *L. succinus* type series is in the upper end of body size range (6.0-7.0mm) now known for *L. zalope*; however, Allen (1967) had originally considered larger individuals as *L. apache*, as noted above.

The presence of head spicules in the larvae was found to be a highly variable character that was used by Allen (1978) to separate a number of species of *Leptohyphes*. Even within the type series of *L. apache*, spicules were found to be present, present and sparse, or mostly absent and difficult to detect. The presence of fine spicules (along with reddish color) was used by Allen (1978) to distinguish *L. piraticus* (known only from a single type specimen) from other species, including *L. apache*. The fact that the presence and absence of head spicules can be stable characteristics in distinguishing species of Ephemerellidae (e.g., Allen and Edmunds 1963) may have influenced Allen's attempts to use such characters for distinguishing species of *Leptohyphes*.

Allen (1978) incorrectly indicated that *L. succinus* and *L. apache* lacked what he referred to as the "basal spine" on the operculate gill. Our examination of type material of both of the latter revealed the presence of this characteristic, which is actually a narrow, often pointed fleshy outgrowth, or process, on gill 2. Allen (1978) correctly indicated the presence of this larval characteristic in *L. ferruginus*, *L. hispidus*, *L. lumas*, *L. piraticus*, and *L. zelus*. However,

it is important to note that the structure in question is not an outgrowth of the operculate part of gill 2, as was shown by Figure 2 of Allen (1978), but is actually a colorless outgrowth of the outer ventral lamellae of the gill 2 (see Fig. 5 herein). This discrepancy has also been pointed out by Wang et al. (1998). The process can be difficult to detect because it can be nearly transparent. It is for this reason that close examination is required for accurate detection.

As indicated above, Allen (1978) synonymized *L. lumas* and *L. hispidus*; however, previous to this study, the types of *L. lumas* could not be found at CAS, although they were reportedly there. This was one reason the latter synonymy could not be confirmed prior to this time, for example, by Lugo-Ortiz and McCafferty (1995a). After examining a series of Allen material at CAS labeled as *L. hispidus*, it became apparent that it represented the lost type series of *L. lumas* because it possessed the precise locale labels and number of specimens given under the original description of *L. lumas*. Obviously, Allen, upon synonymyzing *L. lumas* with *L. hispidus*, inappropriately removed the original identification labels from the *L. lumas* series and replaced them with *L. hispidus* identification labels. We have restored the correct historical labeling in the materials residing at CAS.

The combination of larval characteristics given under the diagnosis above should serve to distinguish *Leptohyphes zalope* larvae in North and Central America. Further studies of *Leptohyphes*, however, are expected to clarify further the species makeup and diagnoses. It is certainly possible, for example, that even more species names of *Leptohyphes* will eventually fall as synonyms of *L. zalope*, once additional examinations of type materials and additional rearings take place.

Based on larval morphology, Allen (1978) placed, in addition to those now known to be equivalent to *L. zalope*, the following species into what he referred to as the *apache* group of *Leptohyphes*: *L. alleni* Brusca, *L. brunneus* Allen and Brusca, *L. castaneus* Allen, *L. dolani* Allen, *L. michaeli* Allen, *L. mirus*, *L. murdochi* Allen, *L. nanus* Allen, *L. packeri* Allen, *L. paraguttatus* Allen, *L. pilosus* Allen and Brusca, *L. quercus* Kilgore and Allen, *L. robacki* Allen, *L. sabinas* Traver, *L. spiculatus* Allen and Brusca, *L. vescus* Allen, and *L. vulturnus* Allen. We do not know if this is a natural grouping at this time or how many of these species are actually valid.

Although they all apparently share similar claw denticulation and abdominal morphology, such characteristics could very possibly prove to be symplesiomorphies.

The male genitalia of *L. zalope*, and others with similar genitalia (e.g., *L. berneri* and *L. priapus*), must be examined carefully in order to interpret them correctly. Depending on the slide mount, the short subapical incision of the penal lobes may not be apparent because the divided tip is normally closely appressed (Fig. 6). On the other hand, if the lobe is severely flattened out in a

slide preparation, the tip of the penal lobe can appear to be bifid and divergent. The latter was found to be the case with the examined slide mounts on which Traver (1958) based her Figures 4 and 5, which inaccurately showed the penal lobe tips as being highly divided. The forceps of *L. zalope* are rounded and slightly bulbous apically (Fig. 6). An apparent distinguishing feature in the forceps of *L. berneri* is evident if one were simply referring to Figure 4 of Traver (1958). In that figure of the genitalia of *L. berneri*, Traver showed the terminal forceps segment as being bluntly pointed and quite different from forceps of both *L. zalope* and *L. priapus* (Traver 1958, Fig. 5). Our examination of Traver's types, however, revealed that they were all exactly as that shown for *L. priapus* in her Figure 5, and Figure 6 of *L. zalope* herein. The male genitalia therefore would appear to be of limited use in certain specific diagnoses.

Based on wings with similar venation, and development of the hindwing costal process, genitalia described above and referred to as the *perterseni* type by Traver (1958), and foreclaws that are similar and blunt in the male adult, species closely related to *L. zalope* in North and Central America do indeed include *L. berneri* and *L. priapus*. There remains a possibility that these three species are syonymous as alluded to above, because the adult color differences presently used to distinguish them may eventually prove to be variable and gradational.

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