



A review of the Nearctic species of the genus *Eurygarka* Quate (Diptera: Psychodidae)

GREGORY R. CURLER & JOHN K. MOULTON

Department of Entomology and Plant Pathology, 2431 Joe Johnson Drive, 205 Ellington Plant Sciences Bldg., The University of Tennessee, Knoxville, Tennessee 37996-4560, USA. E-mails: gcurler@utk.edu and jmoulton@utk.edu.

Abstract

The moth-fly genus *Eurygarka* Quate (Diptera: Psychodidae) is revised to include three species. Two new species: *E. cyphostylus*, **n. sp.** and *E. nelderi*, **n. sp.** from the southeastern United States are described. The adult male and female of *E. helicis* (Dyar) are redescribed. A key to adult males of the three known species of *Eurygarka* is provided. The generic placement of *Eurygarka* is discussed.

Key Words: Psychodidae, *Eurygarka*, Nearctic, southeastern United States, revision, new species

Introduction

The genus *Eurygarka* was proposed by Quate (1959) to receive a single species of Psychodinae, *Psychoda helicis* Dyar, which was first reared from a dead terrestrial snail in Cuba. At this point, the distribution of the genus was considered "mainly Neotropical", though some specimens of *E. helicis* had been collected from the southeastern United States. Subsequently, Duckhouse (1973) placed *Eurygarka* as a subgenus of *Philosepedon* Eaton, while Quate and Vockeroth (1981) regarded it as a genus in a key to Nearctic genera of Psychodidae. In this study, two new species of *Eurygarka* from the southeastern United States are described, the limits of this genus are expanded, and the monophyly of this taxon is discussed.

Methods

Study area. This study focused on specimens collected from east Tennessee and central and northwest South Carolina. Several specimens from northern Alabama were also examined.

Material. This research is based on an examination of adult males and females of *Eurygarka helicis* and *E. cyphostylus* **n. sp.**, and males of *E. nelderi* **n. sp.** Most specimens were collected during 2006 and 2007 by CDC trap, except two female specimens of *E. cyphostylus*, which were collected by hand. Association of adult males and females of *E. cyphostylus* is somewhat tenuous, being based on collections from locations where other species of *Eurygarka* have not been collected.

Additional specimens were borrowed from, or are deposited with the following (acronyms used throughout the text): CUAC, Clemson University Arthropod Collection, Clemson, SC.; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; UTK, Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN.

Specimen preparation. Specimens were fixed in 70 or 95% EtOH. Morphological studies were based on slide-mounted and pinned specimens. Slides were prepared using sodium hydroxide to clear specimens and

Canada balsam as a mounting medium. Specimens were observed by using a Meiji Techno RZ dissecting microscope and a Nikon Optiphot compound microscope, the former fitted with an optical micrometer. Drawings were rendered with the aid of a drawing tube on the Nikon system.

Terminology. Descriptions of adult morphology follow mainly Merz and Haenni (2000) as well as papers on Psychodidae (Quate & Brown 2004; Wagner & Hribar 2004). Terminology of the male terminalia is that of Sinclair (2000) and Wagner & Hribar (2004). General female postabdomen terminology follows Kotrba (2000) and Quate & Brown (2004), except the use of "genital complex" which is substituted for "spermathecal complex" and "larviduct" which is substituted for "oviduct".

Descriptive format. Diagnoses are provided for all species. Complete descriptions of the adult male and female are provided for new species, where specimens are available. Revised descriptions of known life stages are given for described species, where appropriate. When applicable, sample sizes are provided before each description with measurements in millimeters presented as a mean followed by a range in parentheses. Adult head width was measured at the point of greatest width of the eyes. Adult head length was measured from the vertex to the anterior margin of the clypeus. Palpal ratios were computed as proportions, considering the basal palpomere as 1. Wing length and width were measured at the points of greatest length and width, respectively. Measurements were not taken from shriveled or damaged pinned specimens.

Key to Males of *Eurygarka*

1. Apices of gonostyli curved approximately 45° medially (Fig. 4)..... *E. cyphostylus* **n.sp.**
- Apices of gonostyli tapered, not curved (Figs. 8–9)2
- 2(1). Gonostyli swollen dorsobasally, with a patch of setiform sensilla dorsally (Fig. 8); eye bridge narrowly divided (Fig. 7)..... *E. helicis* (Dyar)
- Gonostyli not swollen dorsobasally, with few elongate setiform sensilla dorsally (Fig. 9); eye bridge contiguous (as in Fig. 1)..... *E. nelderi* **n.sp.**

Eurygarka Quate 1959

Philosepedon (*Eurygarka*) (Quate), Duckhouse 1973, 6A: 11 (as subgenus).

Eurygarka Quate, Quate & Vockeroth 1981, p. 299 (key to Nearctic genera, as genus) *Psychoda helicis* Dyar 1929, 31: 64 (type species by monotypy).

Diagnosis. Larva: Unknown. **Pupa:** Unknown. **Adult:** Male eye bridge contiguous or slightly separated, with 4 facet rows. Antenna 16-segmented; flagellomeres with nodes strongly bulbous, terminal 3 diminutive. Ascoids paired, with 1 posterior and 2 anterior branches inserted dorsomedially and ventrolaterally on node of flagellomeres 1–11; posterior branch of ascoids spathiform, anterior branches of ascoids leaf-shaped, each with 4–7 longitudinal veins. Mouthparts reduced; labellum bulbous, without blunt apical teeth. Wing without Sc vein ending in R₁. Male terminalia: gonocoxites with a posteromedial lobe bearing 5–7 setiform sensilla; aedeagus symmetrical, consisting of a single sclerite, laterally compressed basally, furcate or acuminate apically, with sternal bridge; cercopods cylindrical or tapered, curved slightly dorsad, with a pair of simple retinacula placed side by side, inserted dorsoapically. Female terminalia: cerci semi-circular in shape from lateral aspect, slightly longer than tall, their medial surface with dense vestiture of microtrichia; hypovalvae digitiform.

Description. Larva: Unknown.

Pupa: Unknown.

Adult Male: Head strongly rounded from anterior aspect. Vertex rounded. Postocular bristles prominent, numbering 20–22. Eyebridge with 4 rows of facets, narrowly divided or contiguous at median. Frontal scar patch subquadrate anteriorly, bilobed posteriorly, with median spur in some species. Antenna 16-segmented, flagellomeres with nodes strongly bulbous, flagellomeres 1–8 gradually increasing in length, 9–11 decreasing in length, apical 3 diminutive. Ascoids numbering 2, with 1 posterior and 2 anterior branches, inserted dorso-medially and ventrolaterally on node of flagellomeres 1–11; posterior branch of ascoids spathiform, anterior branches of ascoids leaf-shaped, each with 4–7 longitudinal veins. Palpi typical of Psychodinae; first palpomere never more than 1/2 length of second palpomere, distal 3 palpomeres subequal or increasing in length; medial surface of palpomeres with numerous setiform sensilla directed medially, palpomere 4 with pair of setiform sensilla inserted at apex. Mouthparts extending slightly beyond palpomere 1; labellum bulbous or somewhat laterally compressed, bearing numerous setiform sensilla of varying length. Body with vestiture typical of Psychodinae; dense patches of spatulate hairs. Wings ovate, with apex acuminate; distal half of each cell with longitudinal patch of spatulate hairs; base of costa with single break, wings held horizontally over body in life; veins R_5 and CuA_1 basally wider than adjacent veins, vein Sc subequal in width to costa, parallel to, not ending in vein R_1 . Legs typical of Psychodinae, with femora and tibia slender, parallel-sided; tibial spurs absent. Terminalia with hypandrium (sternite IX) represented by narrow transverse sclerite; epandrium (tergite IX) short, subequal in length to, or slightly longer than gonocoxites, with suboval depression anterodorsally, directly below distiphallus, bearing numerous erect macrotrichia; aedeagus symmetrical, consisting of single sclerite; basiphallus laterally compressed; distiphallus furcate or acuminate, with ventral transverse bridge; parameres articulated at ventral bridge of aedeagus and gonocoxal apodeme, bridged dorsally forming sheath around base of distiphallus, with acuminate or sinuate extensions ventrally, flanking aedeagus. Gonocoxites nearly contiguous anterodorsally, with posteromedial lobe bearing 5–7 setiform sensilla. Gonostyli simple, tapered, with single stout setiform sensillum inserted subapically, directed medially. Cercopodia cylindrical or tapered, curved slightly dorsad, with pair of retinacula placed side by side, inserted dorsoapically; retinacula length greater than, or about equal to 1/2 length of cercopod.

Adult Female: Head shape as in male. Frontal scar patch shape identical to male. Eyebridge with 4 rows of facets, divided by 1 or more facet diameters. Postocular bristles prominent, numbering 35 or more. Palpomeres 2 and 3 slightly swollen and sinuous. Palpomeres 1–3 each with transverse, ovoid sensory organ placed mid-length on their lateral surface; sensory organs bearing several hundred digitiform papillae. Length of palpi typical of Psychodinae; first palpomere greater than or equal to 1/2 the length of second, distal 3 palpomeres subequal or slightly increasing in length. Antenna 16-segmented, flagellomeres with nodes strongly bulbous, flagellomeres 1–10 subequal in length, flagellomere 11 with little or no distal neck, apical 3 diminutive. Ascoids numbering 2, Y-shaped, with 1 slender, digitiform posterior branch and 2 broad, spathiform anterior branches, inserted dorso-medially and ventrolaterally on the node of flagellomeres 1–11; anterior branches without veins. Mouthparts extending slightly beyond palpomere 1; somewhat laterally compressed, bearing numerous setiform sensilla of varying length. Wings as in male, except for having 2 breaks at base of costa, and held roof-like over body in life. Legs as in male. Terminalia with tergite X lightly sclerotized, uniformly covered in setulae dorsally and laterally. Cerci semi-circular in shape from lateral aspect, slightly longer than broad in some species, not elongate or arched dorsally; with uniform covering of setulae; bearing numerous macrotrichia dorsally and apically. Subgenital plate (hypogynium) short, about 1/2 length of tergite X. Hypovalvae with single median protuberance, not emarginate, rounded or subquadrate. General structure of genital complex typical of Psychodinae; paired ovoid components, with reticulated pattern ventrally; lateral struts simple, transverse bands, about 1/4 width of genital duct; longitudinal struts narrow, less than 1/2 width of lateral struts; larviduct about as wide as paired ovoid components, some species with larviduct bearing numerous spiniform projections internally; spiniform projections directed posteriorly.

Remarks. Adult *Eurygarka* are easily distinguished from all other Psychodinae by the shape of the male and female terminalia; specifically by the structure of the gonopods, parameres and aedeagus of males, and

the subgenital plate, cerci and larviduct of females. Characteristics of the antenna are also useful for distinguishing *Eurygarka* from related genera. Previous authors have described the ascoids of *Eurygarka* males and females as having 2 anterior branches and no posterior branch, but close examination of ascoids in the males of all known species, and the female of *E. cyphostylus* n.sp. confirmed that a posterior branch is indeed present.

***Eurygarka helicis* (Dyar 1929)**

(Figs. 7–8, 10)

Psychoda helicis Dyar, 1929, 31: 64 (original description); del Rosario, 1936, 59: 134; Rapp, 1944, 52: 205; 1945, 53: 29; Quate, 1955, 10: 235.

Philosepedon (Eurygarka) helicis (Dyar), Duckhouse, 1973, 6A: 11 (new combination).

Diagnosis. Larva: Unknown. **Pupa:** Unknown. **Adult:** Male eye bridge divided by less than 1 facet diameter. Female eye bridge divided by nearly 2 facet diameters. Male ascoids: medial anterior branches with 6, and lateral anterior branches with 5 longitudinal veins. Male palpi with palpomere 2 slightly laterally expanded. Male terminalia: gonocoxites with a posteromedial lobe bearing 5 setiform sensilla; gonostyles tapering progressively from base to apex, not curved apically, with a bulge dorsobasally; bulge covered with setiform sensilla; aedeagus furcate apically; sternal bridge quadrate; ventral extensions of parameres sinuous; cercopods cylindrical, retinacula length greater than 1/2 length of cercopod. Female terminalia: hypovalvae digitiform, with apex rounded.

Description. Larva: Unknown.

Pupa: Unknown.

Adult Male (Figs. 7–8, 10): Measurements, (N = 2) head width 0.43 mm, head length 0.37 mm, wing length 1.67 mm (1.63–1.70), wing width 0.67 mm, palpomere proportion: 1–1.6–2.4–3.4. Eye bridge divided by less than 1 facet diameter. Frontal scar patch subquadrate anteriorly, bilobed posteriorly, with a median spur. Antennal flagellum typical of *Eurygarka*. Ascoids: medial anterior branches with 6, and lateral anterior branches with 5 longitudinal veins. Palpi with palpomere 2 slightly laterally expanded. Mouthparts slightly laterally compressed. Wing: radial and medial forks at same level, arising basal to apex of CuA₂; base of M₂ complete. Terminalia: gonocoxites with posteromedial lobe bearing 5 setiform sensilla; gonostyles tapering progressively from base to apex, not curved apically, with dorsobasally bulge covered with setiform sensilla. Aedeagus furcate apically; sternal bridge quadrate, with knob-like projections laterally; ventral extensions of parameres sinuous; cercopods cylindrical, retinacula length greater than 1/2 length of cercopod.

Adult Female: Eyebridge divided by 1 facet diameter. Frontal scar patch as in male. Antenna typical of *Eurygarka*. Palpi typical of *Eurygarka*. Mouthparts as in male. Wing venation as in male, but with 2 breaks at base of costa. Terminalia: Cerci as long as broad. Subgenital plate with hypovalvae digitiform, with apex rounded.

Type material. Holotype [adult male]: CUBA. Jaronú, 26.ix.1927, reared from snails, H. K. Plank. Type deposited at U.S.N.M.

Other Records. U.S.A. FLORIDA: Atlantic Beach, 1.v.1945, coll. A.E. Pritchard. ALABAMA: Auburn, 29.viii.1948, coll. J. Robinson.

Distribution. Known from two locations in the southeastern United States, and a single location in Cuba.

Remarks. Adults of *E. helicis* are unique among known species of *Eurygarka*, and can be readily distinguished by the divided eye bridge and shape of the gonostyles in the male and the shape of the subgenital plate in the female.

***Eurygarka cyphostylus* Curler n. sp.**

(Figs. 1–6)

Diagnosis. **Larva:** Unknown. **Pupa:** Unknown. **Adult:** Male eye bridge contiguous. Female eye bridge divided by less than 1 facet diameter. Male ascoids: medial anterior branches with 7, and lateral anterior branches with 6 longitudinal veins. Male terminalia: gonocoxites with a posteromedial lobe bearing 6 setiform sensilla; gonostyles tapering progressively from base to apex, with apices bent approximately 45° medially, aedeagus acuminate apically; sternal bridge transverse, slightly arcuate; ventral extensions of parameres acuminate, terminating at same point as aedeagus; cercopods tapered from base to apex, retinacula length greater than 1/2 length of cercopod. Female terminalia: hypovalvae digitiform, with apex subquadrate.

Description. **Larva** Unknown.

Pupa Unknown.

Adult Male (Figs. 1–4): Measurements, (N = 10) head width 0.38 (0.33–0.40) mm, head length 0.35 (0.30–0.37) mm, wing length 1.55 (1.33–1.70) mm, wing width 0.64 (0.55–0.70) mm, palpomere proportion: 1–1.5–2.1–2.4. Eye bridge contiguous. Frontal scar patch subquadrate anteriorly, bilobed posteriorly, without median spur. Antennal flagellum typical of *Eurygarka*; Ascoids: medial anterior branches with 7, and lateral anterior branches with 6 longitudinal veins. Palpi with palpomeres of subequal width. Mouthparts with labellum bulbous. Wing: medial fork placed slightly basal to radial fork, both arising basal to apex of CuA₂; M₂ weakened at base. Terminalia: gonocoxites with a posteromedial lobe bearing 6 setiform sensilla; gonostyles tapering progressively from base to apex, with apices curved approximately 45° medially. Aedeagus acuminate apically; sternal bridge transverse, slightly arcuate; ventral extensions of parameres acuminate, terminating at same point as aedeagus; cercopods tapered from base to apex, retinacula length greater than 1/2 length of cercopod.

Adult Female (Figs. 5–6): Eyebridge divided by less than 1 facet diameter. Frontal scar patch as in male. Antenna typical of *Eurygarka*. Palpi typical of *Eurygarka*. Mouthparts as in male. Wing venation as in male, but with 2 breaks at base of costa. Terminalia: Cerci slightly longer than broad. Subgenital plate with hypovalvae digitiform, with apex subquadrate.

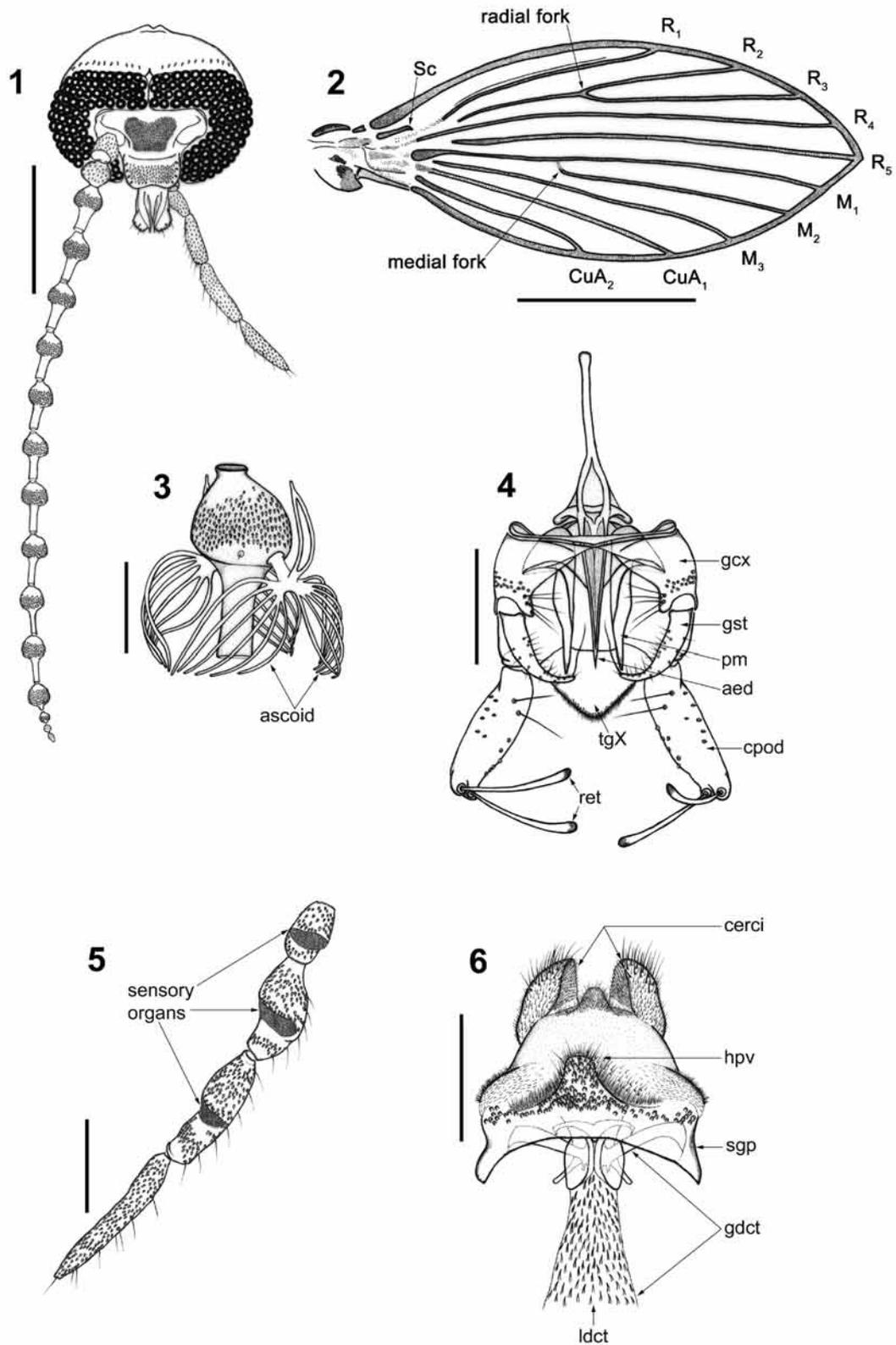
Type material. Holotype [adult male]: U.S.A. TENNESSEE: *Union Co*: property of R.S. Donahoo, 36°10'N 83°52'W, 23.viii.2006, coll. G.R. Curler, CDC trap; deposited USNM. Specimen dissected, mounted on micro-slide. Allotype [adult female]: TENNESSEE: *Knox Co*: patio at 2705 W. Glenwood Ave., Knoxville, 35°59'N 83°56'W, 10.ix.2005, coll. G.R. Curler, resting on wall; deposited USNM. Specimen dissected, mounted on micro-slide. Paratypes: same locality as holotype, 21.viii.2006 [4 adult male (slides)], coll. G.R. Curler; same data as holotype [6 adult male (slides)] coll. G.R. Curler; TENNESSEE: *Knox Co*: 1137 Winterberry Ln., W. Knoxville, 35°55'N 84°08'W, 30.vi.2007 [1 adult female (slide)], coll. J.K. Moulton; 10.vii.2007 [1 adult male (slide)], coll. G.R. Curler and J.K. Moulton; SOUTH CAROLINA: *Richland Co*: Riverbanks Zoo & Botanical Gardens, 34°00'N 81°04'W, 22.viii.2006, coll. M.P. Nelder, Fay-Prince UV trap. Paratypes deposited in USNM, and UTK.

Other material examined. U.S.A. Same location and collector as holotype, 21.viii.2006 [7 adult male]; 23.viii.2006 [5 adult male]; SOUTH CAROLINA: *Richland Co*: Riverbanks Zoo & Botanical Gardens, 34°00'N 81°04'W, 22.vi.2007, coll. M.P. Nelder, Fay-Prince UV trap.

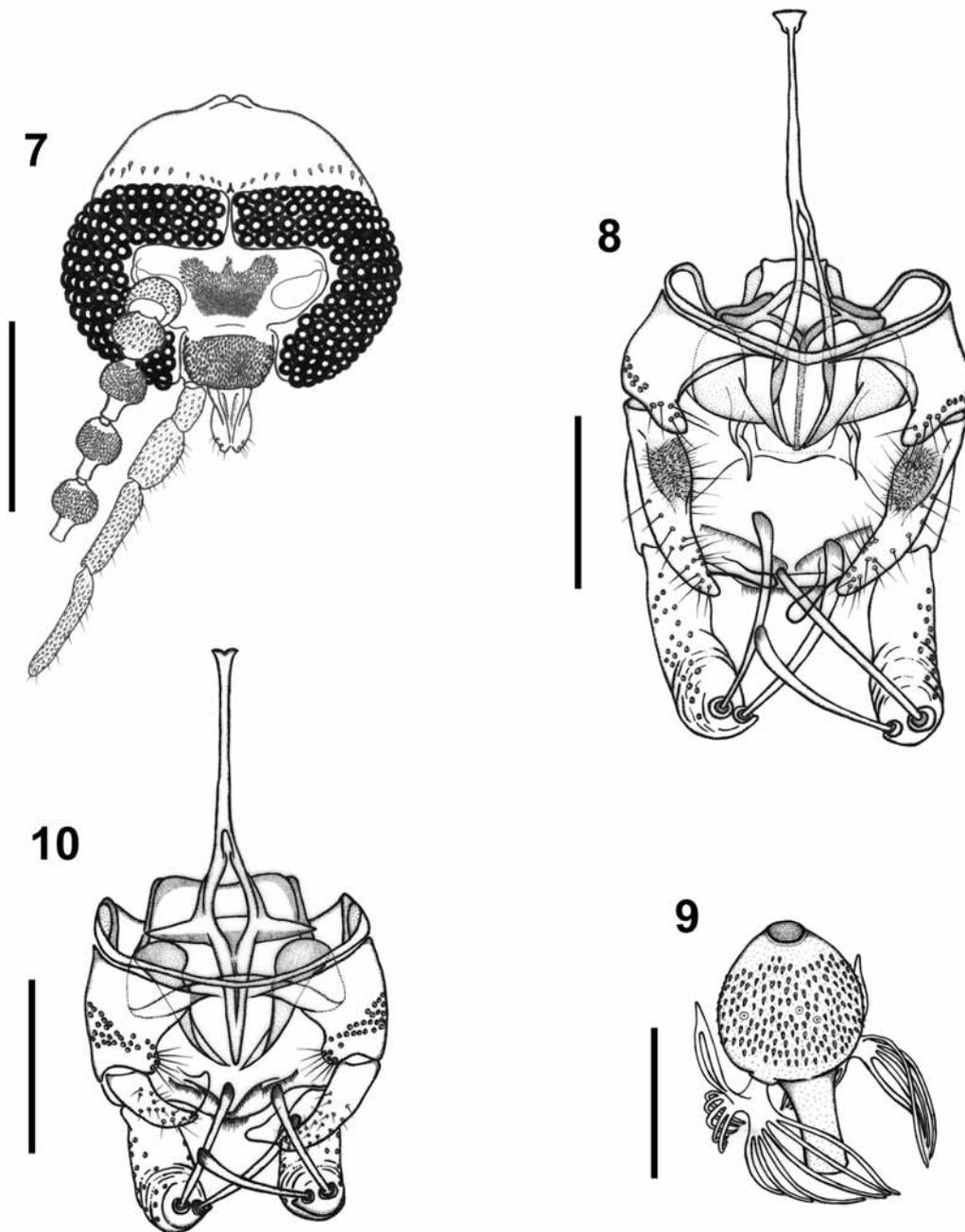
Etymology. From the Greek *cypho*, meaning "bent", in reference to the shape of the gonostyles.

Distribution. Collected from several locations in eastern Tennessee, and two locations in South Carolina.

Remarks. Adults of *E. cyphostylus* can be easily distinguished by the shape of the gonostyles, parameres and aedeagus in the male, and the shape of the subgenital plate in the female.



FIGURES 1–6. *Eurygarka cyphostylus* Curler n. sp. **1.** Male head, frontal view. **2.** Wing. **3.** Male antennal flagellomere 8 with ascoids, right antenna, frontal view. **4.** Male terminalia, dorsal view. **5.** Female left palpus, frontal view. **6.** Female terminalia, ventral view. Scale bars = 0.25 mm (1), 0.5 mm (2, 5–6), 0.1 mm (4), 0.05 mm (3). (abbreviations: gcx = gonocoxite; gst = gonostyle; pm = paramere; aed = aedeagus; cpod = cercopod; tgX = tergite X; ret = retinacula; hvp = hypovalvae; sgp = subgenital plate; gdct = genital duct; ldct = larviduct).



FIGURES 7–10. *Eurygarka helicis* (Dyar). **7.** Male head, frontal view. **8.** Male terminalia, dorsal view. **9.** Male antennal flagellomere 8 with ascoids, left antenna, frontal view. *Eurygarka nelderi* Curler **n. sp.** **10.** Male terminalia, dorsal view. Scale bars = 0.25 mm (7), 0.1 mm (8, 10), 0.05 mm (9).

***Eurygarka nelderi* Curler n. sp.**
(Fig. 9)

Diagnosis. **Larva:** Unknown. **Pupa:** Unknown. **Adult:** Male eye bridge contiguous. Male ascoids: medial anterior branches with 6, and lateral anterior branches with 6 longitudinal veins. Male terminalia: gonocoxites with a posteromedial lobe bearing 6 setiform sensilla; gonostyles tapering progressively from base to apex, with apices curved slightly, not bent 45° medially; aedeagus acuminate apically; sternal bridge transverse, quadrangular, with triangular projections laterally; ventral extensions of parameres acuminate, arcuate,

directed medially, terminating at same point as aedeagus; apices of cercopods tapered, retinacula length about equal to 1/2 length of cercopod.

Description. Larva Unknown.

Pupa Unknown.

Adult Male (Fig. 9): Measurements, (N = 4) head width 0.38 (0.37–0.40) mm, head length 0.36 (0.35–0.37) mm, wing length 1.64 (1.63–1.67) mm, wing width 0.62 (0.60–0.63) mm, palpomere proportion: 1–1.8–2.6–3.4. Eye bridge contiguous. Frontal scar patch subquadrate anteriorly, bilobed posteriorly, without median spur. Antennal flagellum typical of *Eurygarka*; Ascoids: medial anterior branches with 6, and lateral anterior branches with 6 longitudinal veins. Palpi with palpomeres of subequal width. Mouthparts with labellum slightly laterally compressed. Wing: medial fork placed slightly basal to radial fork, both arising basal to apex of CuA₂; R₃ and M₂ weakened at base. Terminalia: gonocoxites with a posteromedial lobe bearing 6 setiform sensilla; gonostyles tapering progressively from base to apex, with apices curved slightly, not bent 45° medially; aedeagus acuminate apically; sternal bridge transverse, quadrangular, with triangular, lateral projections; ventral extensions of parameres acuminate, arcuate, directed medially, terminating at same point as aedeagus; apices of cercopods tapered, retinacula length about equal to 1/2 length of cercopod.

Adult Female: Unknown.

Type material. Holotype [adult male]: U.S.A. SOUTH CAROLINA: *Richland Co*: Riverbanks Zoo & Botanical Gardens, 34°00'N 81°04'W, 22.vi.2007, coll. M.P. Nelder, Fay-Prince UV trap; deposited USNM. Specimen dissected, mounted on micro slide. Paratypes [3 adult male (slides)]: same location as holotype, 22.viii.2006, coll. M.P. Nelder, Fay-Prince UV trap. Paratypes deposited in USNM, CUAC and UTK.

ETYMOLOGY. Named for Mark P. Nelder, in recognition of his contribution of numerous specimens for this study.

Distribution. Known from one location in South Carolina.

Remarks. Adult males can be easily recognized by the shape of the gonostyli and parameres, and length of the retinacula.

General discussion

Taxonomy. The main objectives of this study were to expand the existing generic diagnosis and description of *Eurygarka* to include previously unknown species, to revise the description of *E. helicis* to clarify its distinction from congeners, and to describe two new species within the genus. Focused collecting efforts, especially with CDC traps, are likely to produce additional new species of *Eurygarka*, in which case the generic diagnosis and description may need to be expanded further.

Previous authors have treated *Eurygarka* as a genus or as a subgenus of *Philosepedon* Eaton, but the generic limits of *Philosepedon* are unclear. Vaillant (1974) divided *Philosepedon* into several genera, but Quate (1996) maintained the use of *Philosepedon s. lat.*, while noting that it is "probably polyphyletic". In recognition of the monophyly of *Eurygarka* and its distinction from *Philosepedon (sensu Vaillant)*, we follow Quate (1959) and Quate & Vockeroth (1981) by treating it as a genus. The monophyly of *Eurygarka* is supported by the following proposed synapomorphies: (1) anterior branches of male ascoids leaf-shaped, with multiple longitudinal veins; (2) gonocoxites with posteromedial lobe bearing 5 or more setiform sensilla; (3) epandrium with suboval depression anterodorsally, directly below distiphallus, bearing numerous erect macrotrichia; (4) female subgenital plate with unilobate hypovalvae.

Biology. Adult females of this genus are not commonly collected in CDC traps, but rather incidentally hand-captured while resting in areas where males are known to be present. Immatures of *Eurygarka* remain unknown, except for the fact that females deposit first instar larvae (larvipary) on dead terrestrial snails (Dyar 1929).

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