Comparison of Male Genitalia of *Euschistus* spp. in the Midwestern United States (Hemiptera: Heteroptera: Pentatomidae)

J. E. McPherson¹ AND IMTIAZ AHMAD²

Department of Zoology, Southern Illinois University, Carbondale, IL 62901

ABSTRACT  Male genitalia, including the pygophore, parameres, and inflated aedeagi, are compared between the midwestern species of *Euschistus* [i.e., *E. ictericus* (L.), *E. politus* Uhler, *E. servus* (Say) (including *E. s. servus* and *E. s. euschistoides* (Vollenhoven), *E. tristigmus* (Say) (including *E. t. tristigmus* and *E. t. luridus* Dallas), and *E. variolarius* (Palisot de Beauvois)]. These structures differ markedly between these taxa with the exception of the two subspecies of *E. servus* and of *E. tristigmus*, thus confirming their subspecific status.

KEY WORDS  Heteroptera, Hemiptera, *Euschistus*, midwestern, male genitalia

The stink bug genus *Euschistus* is one of the largest of the pentatomine genera in the Western Hemisphere (Rolston 1974, Froeschner 1988). It is well represented in America north of Mexico with 21 species and subspecies (Froeschner 1988), several of which are of economic importance (McPherson and McPherson 2000). Five species occur throughout much of the Midwest, including *E. ictericus* (L.), *E. politus* Uhler, *E. servus* (Say) [including *E. s. servus* and *E. s. euschistoides* (Vollenhoven)], *E. tristigmus* (Say) (including *E. t. tristigmus* and *E. t. luridus* Dallas), and *E. variolarius* (Palisot de Beauvois). The Midwest is defined here as Michigan and Ohio west to North Dakota, Nebraska, and Kansas. *E. latimarginatus* Zimmer has been reported only from Colorado and Nebraska (Froeschner 1988) so is not considered further.

*Euschistus* is separated easily from other pentatomine stink bugs in America north of Mexico by several characters, among which are the drab dorsal coloration of shades of brown or yellow, often suffused with black or red; the lack of an anteriorly directed spine or tubercle on abdominal segment 2 (actually 3); ostiole with a distinct auricle; hind tibiae distinctly sulcate throughout their lengths; and pronotum with the anterolateral margins crenulate (McPherson 1982) ("entire or undulating apically" in *E. integer* Stål [Rolston 1974]).

During our continuing study of the Heteroptera of North America, we compared the male genitalia of the five widespread midwestern species of *Euschistus* to determine morphological differences in the pygophore, parameres, and inflated aedeagus. Although we were not concerned with the taxonomic status of the five species because each is identified easily based on nongenitalic characters, we were interested in the variation in the male genitalia within each species, particularly in the inflated aedeagus. We included the two subspecies of *E. servus* and of *E. tristigmus* to confirm that subspecific status was warranted for these taxa. Presented here are the results of our study including detailed descriptions and illustrations.

Materials and Methods

Pinned male specimens were relaxed, the pygophores extracted, and the aedeagi removed and inflated using the methods of Ahmad (1986) and Ahmad and McPherson (1990). Drawings were made with a camera lucida or with an ocular grid and graph paper, modified freehand, scanned into a computer, and digitized.

Terminology for the inflated aedeagi and parameres follows that of Ahmad and McPherson (1990), and the terminology for the pygophores generally follows that of Schaefer (1981). The length medially and width at widest point (usually at lateral lobes) of the pygophore were measured along the posteroventral surface.

Voucher Specimens. Specimens used in this study are deposited in the Southern Illinois University Insect Collection.

Results

*Euschistus ictericus* (Figs. 1–5)

Pygophore subrectangular, longer than broad medially (Fig. 1). Dorsal rim broadly concave; substraight laterally, convex medially, with heavily sclerotized bilobed medial plate that projects inwardly, lobes sep...
arated by deep U-shaped notch; rim infolded submedially and sublaterally, submedial infolding reflexed forming channel, well-developed elongate lobe projecting inwardly at juncture of submedial and sublateral infoldings; sublateral infolding merging laterally with infolded area of lateral lobes. Lateral lobes weakly defined, broadly rounded, infolded margin with tumescence mediad. Ventral rim weakly concave, infolded, merging laterally with infolding of lateral lobes, extending medially into cuplike sclerite.

Aedeagus, in dorsal view, with theca strongly sclerotized; distal margin broadly V-shaped mediadly, laterally projecting into broad lobe either side, lobe widest basally, subacute distally (Fig. 2); medially with pair of strongly sclerotized thecal appendages, widest and joined basally, elongate, slender and divergent distally, each appendage subparallel beyond middle (Fig. 2). Penial lobes moderately sclerotized, broadened and joined basally, narrowed distally. Vesica, in lateral view, emerging from sperm reservoir, reservoir sclerotized laterally, membranous ventrally; vesica then continuing through membranous extension after reservoir, emerging and then terminating as 1 1/2 long coils, apex of which is above and beyond apices of dorsal lobes of conjunctival appendages (Fig. 2) (see below). Pair of ventrolateral largely membranous conjunctival appendages present, each appendage divided into dorsal and ventral lobes, both lobes with apices distinctly sclerotized (Fig. 2).

Paramere somewhat L-shaped, blade moderately sclerotized, stem weakly sclerotized (Figs. 3, 4); blade straight in lateral (Fig. 3) and medial (Fig. 4) views, widest basally, narrowed distally, curved upward apically, inner margin with longitudinal roughened area (Fig. 3), basally with large, thumblike lobe (Figs. 3, 4), blade curved outwardly in dorsal view (Fig. 5); stem subrectangular, inner margin convex, outer margin substraight (Figs. 3, 4).

**Euschistus politus**

(Figs. 6–10)

Pygophore subrectangular, longer than broad mediadly (Fig. 6). Dorsal rim broadly concave; weakly curved laterally, straight medially, with heavily scler-
rotized bilobed medial plate that projects inwardly, lobes separated by deep V-shaped notch; rim infolded submedially and sublaterally, submedial infolding reflexed forming channel, well-developed short lobe projecting inwardly at juncture of submedial and sublateral infoldings, sublateral infoldings merging laterally with infolded area of lateral lobes. Lateral lobes weakly defined, broadly rounded, infolded margin with tumescence mediad. Ventral rim deeply V-shaped medially, delimited by small U-shaped notch on either side, rim infolded, merging laterally with infolding of lateral lobes, extending medially into cup-like sclerite.

Aedeagus, in dorsal view, with theca strongly sclerotized; distal margin broadly V-shaped medially, laterally projecting into broad lobe either side, lobe widest basally, subacute distally; medially with pair of strongly sclerotized thecal appendages, widest and joined basally, elongate and slender distally, weakly divergent. Penial lobes slightly sclerotized, broadened and approximate basally, narrowed distally. Vesica, in lateral view, emerging from sperm reservoir, reservoir weakly sclerotized laterally, membranous ventrally; vesica then continuing through membranous extension after reservoir, emerging and then terminating as 1 1/2 long coils, apex of which is beyond and divergent from apices of ventral lobes of conjunctival appendages (Fig. 7) (see below). Pair of ventrolateral largely membranous conjunctival appendages present, each appendage divided into dorsal and ventral lobes, dorsal lobe with apex unsclerotized, ventral lobe with apex sclerotized (Fig. 7).

Paramere hatchet-shaped, blade moderately sclerotized (Figs. 8, 9), stem weakly sclerotized; blade substraight in lateral (Fig. 8) and medial (Fig. 9) views, widest basally, narrower distally but with apical/subapical area apparently reflexed (Fig. 8), basally with broad lobe (Figs. 8, 9), substraight in dorsal view (Fig. 10); stem subquadrate, inner margin convex, outer margin substraight (Figs. 8, 9).

Euschistus servus
(Figs. 11–15)

Pygophore subrectangular, longer than broad medially (Fig. 11). Dorsal rim broadly concave; weakly concave laterally, substraight medially, with heavily sclerotized bilobed medial plate that projects inwardly, lobes separated by relatively shallow V-shaped notch; rim infolded submedially and sublaterally, submedial infolding reflexed forming channel, well-developed short lobe projecting inwardly at juncture of submedial and sublateral infoldings, sublateral infolding merging laterally with infolded area of lateral lobes. Lateral lobes weakly defined, broadly...
rounded, infolded margin with tumescence mediad. Ventral rim broadly V-shaped, infolded, merging laterally with infolding of lateral lobes, extending medi-
ally into cuplike sclerite.

Aedeagus, in dorsal view, with theca heavily scler-
rotized; distal margin broadly V-shaped medially, lat-
erally projecting into broad lobe either side, lobe wid-
est basally, subacute distally; medially with pair of
strongly sclerotized thecal appendages, widest and
joined basally, elongate, slender, and divergent dis-
tally, sides subparallel in apical 1/3-1/4. Penial lobes
moderately sclerotized, broadened and approximate
basally, narrowed distally. Vesica, in lateral view,
emerging from sperm reservoir, reservoir sclerotized
laterally, membranous ventrally; vesica then continu-
ing through membranous extension after reservoir,
emerging and then terminating as 3 1/2 long coils, apex
of which is below and just beyond apices of ventral
lobes of conjunctival appendages (Fig. 12) (see be-
low). Pair of ventrolateral largely membranous con-
junctival appendages present, each appendage di-
vided into dorsal and ventral lobes, each lobe sclerotized apically, particularly ventral lobes (Fig. 12).

Paramere somewhat L-shaped, blade moderately
sclerotized, stem weakly sclerotized (Figs. 13, 14);
blade weakly curved upward and substraight distally
in lateral (Fig. 13) and medial (Fig. 14) views, widest
basally, narrowed distally, basally with large
thumblike lobe (Figs. 13, 14), curved outwardly in
dorsal view (Fig. 15); stem subrectangular, inner mar-
gin concave, outer margin straight to weakly convex
(Figs. 13, 14), lateral surface basally and inner margin
heavily setose, setae long, extending onto inner margin
of blade (Fig. 13).

E. s. euschistoides and E. s. servus

Euschistus servus ranges over much of North Amer-
ica and comprises two subspecies, E. s. euschistoides,
which occurs across the northern part of the contin-
ent; and E. s. servus, which occurs primarily in the
southern part of the United States as far south as
Florida, Texas, and New Mexico (McPherson 1982).
Sailer (1954) indicated the two subspecies meet in a
broad band of intergradation from Maryland to Kan-
sas. The two subspecies are identified easily based on
external morphological features (McPherson 1982).
Therefore, we examined the genitalia of specimens
from MB, Canada, southern Illinois, and Florida to
determine the degree of similarity between these dis-
tant populations. We found some minor variation in
the genitalic morphology but nothing of species-level
significance. Therefore, we consider the two subspe-
cies valid.
Euschistus tristigmus
(Figs. 16–20)

Pygophore subrectangular, longer than broad medially (Fig. 16). Dorsal rim biconcave with heavily sclerotized triangular medial plate, not bilobed, that projects inwardly; rim infolded submedially and sublaterally, submedial infolding reflexed forming channel, well-developed short lobe projecting inwardly at juncture of submedial and sublateral infoldings, sublateral infolding merging laterally with infolded area of lateral lobes. Lateral lobes weakly defined, broadly rounded, infolded margin with tumescence medially. Ventral rim weakly concave, infolded, merging laterally with infolding of lateral lobes, extending medially into cuplike sclerite.

Aedeagus, in dorsal view, with theca strongly sclerotized; distal margin broadly V-shaped medially, laterally projecting into broad lobe either side, lobe widest basally, subacute distally; medially with pair of strongly sclerotized thecal appendages, widest and joined basally, elongate, slender, and divergent distally, each appendage tapering in basal 2/3, sides subparallel in distal 1/3. Penial lobes moderately sclerotized, broadened and joined basally, subacute distally. Vesica, in lateral view, emerging from sperm reservoir, reservoir sclerotized laterally, membranous ventrally; vesica then continuing through membranous extension after reservoir, emerging and then terminating as 1 1/2 long coils, apex of which is beneath but short of apices of dorsal lobes of conjunctival appendages (Fig. 17) (see below). Pair of ventrolateral largely membranous conjunctival appendages present, each appendage divided into dorsal and ventral lobes, each lobe sclerotized apically, particularly dorsal lobes (Fig. 17).

Paramere somewhat L-shaped, blade moderately sclerotized, stem weakly sclerotized (Figs. 18, 19); blade substraight in lateral (Fig. 18) and medial (Fig. 19) views, widest basally, narrowed distally, with dorsal margin weakly sinuate, ventrolateral margin with longitudinal roughened strip (Fig. 18); basally with large thumblike lobe (Figs. 18, 19), blade substraight in dorsal view (Fig. 20); stem subcircular, inner margin convex, outer margin straight to weakly convex (Figs. 18, 19).

E. t. luridus and E. t. tristigmus

This species ranges over much of North America and comprises two subspecies, E. t. luridus, which occurs primarily north; and E. t. tristigmus, primarily south, of latitude 41° (McPherson 1982). The two subspecies are easily identified based on external morphological features (McPherson 1982). Therefore, we
examined the genitalia of specimens from MB, Canada and Georgia to determine the degree of similarity between these distant populations. We found some minor variation in the genitalic morphology but nothing of species-level significance. Therefore, we consider the two subspecies valid.

**Euschistus variolarius**

(Figs. 21–25)

Pygophore subrectangular, longer than broad medially (Fig. 21). Dorsal rim broadly concave; weakly concave laterally, substraight medially, with heavily sclerotized bilobed medial plate that projects inwardly, lobes separated by V-shaped notch; rim infolded submedially and sublaterally, submedial infolding reflexed forming channel, well-developed short lobe projecting inwardly at juncture of submedial and sublateral infoldings; sublateral infolding merging laterally with infolded area of lateral lobes. Lateral lobes weakly defined, broadly rounded, infolded margin with tumescence medially. Ventral rim weakly concave, infolded, merging laterally with infolding of lateral lobes, extending medially into cuplike sclerite; posteroventral surface with centrally located dark spot.

Aedeagus, in dorsal view, with theca strongly sclerotized; distal margin broadly V-shaped, laterally projecting into broad lobe either side, lobe widest basally, subacute distally; medially with pair of strongly sclerotized thecal appendages, widest and joined basally, elongate, slender, and divergent distally, each appendage with sides subparallel in distal 2/3. Penial lobes moderately sclerotized, broadened and joined basally, subacute distally. Vesica, in lateral view, emerging from sperm reservoir, reservoir sclerotized laterally, membranous ventrally; vesica then continuing through membranous extension after reservoir, emerging and then terminating as 2 1/2 long coils, apex of which is beneath but not reaching apices of ventral lobes of conjunctival appendages (Fig. 22) (see below). Pair of ventrolateral largely membranous conjunctival appendages present, each appendage divided into dorsal and ventral lobes, each lobe sclerotized apically (Fig. 22).

Paramere somewhat L-shaped, blade strongly sclerotized, stem weakly sclerotized (Figs. 23, 24); blade weakly curved upward and substraight distally in lateral (Fig. 23) and medial (Fig. 24) views, widest basally, narrowed distally, basally with large thumblike lobe (Figs. 23, 24), curved outwardly in dorsal view (Fig. 25); stem subquadrate, inner margin concave, outer margin straight to weakly convex (Figs. 23, 24), lateral surface basally and inner margin heavily setose.
E. variolarius
Dorsal rim broadly concave; ventral rim weakly concave

E. politus
Dorsal rim broadly concave; ventral rim weakly concave

E. servus
Dorsal rim broadly concave; ventral rim weakly concave

E. tristigmus
Dorsal rim biconcave, ventral rim weakly concave

setae long, extending onto inner margin of blade (Fig. 23).

Discussion

Based on the morphology of the male genitalia, it is appears that E. servus and E. variolarius are more closely related to each other than to the other three species (Table 1). The pygophores of the two species have a bilobed medial plate on the dorsal rim, and the ventral rim is slightly concave without a notch either side of the concavity. Furthermore, the parameres are L-shaped and heavily setose on the lateral surface and inner margin. E. servus can be separated from E. variolarius by the number of coils of the vesica (E. servus, 3 1/2 coils, E. variolarius, 2 1/2 coils; this difference is obvious). Also, the pygophore of E. variolarius has a centrally located dark spot on the posteroventral surface.

For the other three species (i.e., E. politus, E. tristigmus, E. ictericus), a combination of characters can be used for diagnosis (Table 1). First, E. politus has a distinctive pygophore; the ventral rim is deeply V-shaped with the “V” delimited by a U-shaped notch either side. Also, the paramere is hatchet-shaped because the apical and subapical area apparently is reflexed. E. tristigmus also has a distinctive pygophore because the medial plate on the dorsal rim is triangular rather than bilobed, as in the other four species. Finally, E. ictericus can be recognized because there is no character that separates it from the other four species except for the roughened area along the inner margin of the blade.

Table 1. Comparison of selected characters of the male genitalia of midwestern Euschistus spp.

| Species      | Pygophore                                      | Aedeagus                                      | Paramere                                      |
|--------------|------------------------------------------------|-----------------------------------------------|------------------------------------------------|
| E. ictericus | Dorsal rim broadly concave; substraight laterally, convex medially, lobes of medial plate separated by deep U-shaped notch; ventral rim weakly concave | Vesica with 1 1/2 coils; conjunctival appendages with apices of dorsal and ventral lobes sclerotized | Somewhat L-shaped; blade substraight in lateral and medial views, curved outwardly in dorsal view, longitudinal roughened area on inner margin; stem subrectangular, inner margin convex, outer margin substraight |
| E. politus   | Dorsal rim broadly concave; weakly concave laterally, substraight medially, lobes of medial plate separated by shallow V-shaped notch; ventral rim broadly V-shaped | Vesica with 1 1/2 coils; conjunctival appendages with apices of dorsal lobes unsclerotized, those of ventral lobes sclerotized | Hatchet-shaped; blade substraight in lateral, medial, and dorsal views, apical/subapical area apparently reflexed; stem subquadrature, inner margin convex, outer margin substraight |
| E. servus    | Dorsal rim broadly concave; weakly concave laterally, substraight medially, lobes of medial plate separated by shallow V-shaped notch; ventral rim weakly concave | Vesica with 3 1/2 coils; conjunctival appendages with apices of dorsal lobes and ventral lobes sclerotized, particularly ventral lobes | Somewhat L-shaped; blade weakly curved upward and substraight distally in lateral and medial views, curved outwardly in dorsal view; stem subrectangular, inner margin concave, outer margin straight to weakly convex, lateral surface basally and inner margin heavily setose, setae long |
| E. tristigmus| Dorsal rim biconcave, medial plate triangular, not bilobed; ventral rim weakly concave | Vesica with 1 1/2 coils; conjunctival appendages with apices of dorsal and ventral lobes sclerotized, particularly dorsal lobes | Somewhat L-shaped; blade substraight in lateral, medial, and dorsal views; stem subcircular, inner margin convex, outer margin straight to weakly convex |
| E. variolarius| Dorsal rim broadly concave; weakly concave laterally, substraight medially, lobes of medial plate separated by V-shaped notch; ventral rim weakly concave, posteroventral surface with centrally located dark spot | Vesica with 2 1/2 coils; conjunctival appendages with apices of dorsal and ventral lobes sclerotized | Somewhat L-shaped, blade weakly curved upward and substraight distally in lateral and medial views, curved outwardly in dorsal view; stem subquadrangular, inner margin concave, outer margin convex, lateral surface basally and inner margin heavily setose, setae long |

Acknowledgments

We are grateful to Syed Salahuddin Qadri (Department of Zoology, Government Jamia-e-Millia Degree College, Malir, Karachi) for his help with the preliminary drawings of the illustrations used in this manuscript. We also thank Steven C. Mueller (Integrated Microscopy and Graphic Expertise, Southern Illinois University, Carbondale [SIUC]), Rachel Shurtz (Department of Zoology, SIU), and C. S. Bundy (Department of Entomology, Plant Pathology, and Weed Science, New Mexico State University, Las Cruces), for final changes and preparations of figures for publication.

References Cited

Ahmad, I. 1986. A fool-proof technique for inflation of male genitalia in Hemiptera (Insecta). Pak. J. Entomol. Karachi 1: 111–112.

Ahmad, L, and J. E. McPherson. 1990. Male genitalia of the type species of Corimelaena White, Galgupha Amyot and Serville, and Cydnoides Malloch (Hemiptera: Cydnidae: Corimelaeninae) and their bearing on classification. Ann. Entomol. Soc. Am. 83: 162–170.
Froeschner, R. C. 1988. Family Pentatomidae Leach, 1815. The stink bugs, pp. 544–597. In T. J. Henry and R. C. Froeschner (eds.), Catalog of the Heteroptera, or true bugs, of Canada and the continental United States. E. J. Brill, New York.

McPherson, J. E. 1982. The Pentatomoidea (Hemiptera) of northeastern North America with emphasis on the fauna of Illinois. Southern Illinois University Press, Carbondale and Edwardsville, IL.

McPherson, J. E., and R. M. McPherson. 2000. Stink bugs of economic importance in America north of Mexico. CRC, Boca Raton, FL.

Bolton, L. H. 1974. Revision of the genus Euschistus in Middle America (Hemiptera, Pentatomidae, Pentatomini). Entomol. Am. 48: 1–102.

Sailer, R. I. 1954. Interspecific hybridization among insects with a report on crossbreeding experiments with stink bugs. J. Econ. Entomol. 47: 377–383.

Schaefer, C. W. 1981. Genital capsules, trichobotria, and host plants of the Podopinae (Pentatomidae). Ann. Entomol. Soc. Am. 74: 590–601.

Received 23 November 2011; accepted 25 January 2012.