

**Biological Notes on Some Species of the *Melanoplus tribulus* Species Group (Orthoptera: Acrididae: Melanoplineae) from the Southeastern United States with a Description of Two New Species.**

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ABSTRACT

Members of the *Melanoplus tribulus* species group are flightless grasshoppers that inhabit open forests and forest edges throughout a large portion of the eastern United States. Here distributional, habitat, and morphological information is provided for several species of the group from the southeastern United States, including *Melanoplus morsei*, *Melanoplus tepidus*, and *Melanoplus vulnus*. Two new species, *Melanoplus harrisi* and *Melanoplus nossi* are described.

INTRODUCTION

Species in the *Melanoplus tribulus* group are brachypterous, flightless grasshoppers that inhabit open forests and forest edges of the eastern United States. The *tribulus* group, as listed by Eades et al. (2013), contains six species: *Melanoplus decoratus* Morse, *Melanoplus moresi* Blatchley, *Melanoplus rusticus* (Stål), *Melanoplus tepidus*, Morse, *Melanoplus tribuloides* Morse, and *Melanoplus tribulus* Morse, but based on external morphology, species such as *Melanoplus devius* Morse, *Melanoplus primeastivus* Dakin, and *Melanoplus vulnus* Eades could also be included in the group. Recent collections of grasshoppers across the southeastern United States have produced enough specimens to 1) indicate that *M. tepidus*, a species upon which little has been published, is a common inhabitant of a large portion of Mississippi, Alabama, and southern Tennessee, 2) clarify the taxonomic status and distribution of *M. vulnus*, and 3) describe two new species with affinities to the *M. tribulus* group from the region. Here, descriptions of two new species and biological notes on *M. tepidus* and *M. vulnus* are presented.

METHODS

Habitus and internal genitalia photographs were taken with a Leica Z16 stereoscope equipped with a Leica DFC420 camera at different stages during dissection. Images were automontaged with the Leica Application Suite. For scanning electron micrographs, specimens were mounted on stubs with silver paste and coated with 30 nm of platinum, then imaged with a JEOL – JSM65600F SEM. Measurements were made with a measuring reticle mounted inside a Leica MZ12.4 stereomicroscope. Abdomens in Orthoptera specimens can be contracted or distended, thus providing a wide range of variation in length; therefore, overall length of the specimens was measured dorsally from the fastigium vertices to the distal end of the caudal femur in a parallel plane with the abdomen. Tegmen length was measured laterally from the junction of the ventral margin of the tegmen and the caudal margin of the pronotum to their apices. Lengths of cerci were measured from their lateral views. Specimens were examined from the Auburn University Museum of Natural History (AUMNH), Florida State Collection of Arthropods (FSCA), Mississippi Entomological

Museum (MEM), and the University of Michigan Museum Zoology (UMMZ). The map was produced using Google Earth Pro® software.

### *Melanoplus tepidus* Morse

*Melanoplus tepidus* (Fig. 1A-J, Fig. 2A) was described from Meridian, MS (Morse 1906). With the exception of Dakin and Hays (1970) and Hill (2007), little novel information has been published about this species since its description. Capinera et al. (2001) list *M. tepidus* as occurring Florida; however, their range map was not representative of the published distribution, and did not include the type locality. Examination of the only male in a series of specimens identified as *M. tepidus* in the FSCA indicated that the Florida species was undescribed. Collecting trips were made to obtain additional material, whereupon it was apparent that the species listed as *M. tepidus* in Florida was undescribed. This new species will be described below.

*Melanoplus tepidus* is typically the most common grasshopper in forested habitats across most of its distribution during the early summer months. It is sympatric with species in the *Melanoplus viridipes* group during late May and June and members of the *Melanoplus nigrescens* group afterward. Morse provided only a brief description of *M. tepidus* based a small series of specimens, and a redescription is provided here.

#### Male Redescription

*Measurements* (mm).—(n = 29) Body length 15.5 – 22.5 (mean = 19.5); pronotum length 3.5 – 5.0 (mean = 4.2); tegmen length 3.0 – 4.5 (mean = 3.8); hind femur length 8.4 – 11.5 (mean = 10.4); cerci length 1.0 - 1.3 (mean = 1.1); basal width of cerci 0.4 - 0.5 (mean = 0.5); mid-cercal width 0.3 - 0.4 (mean = 0.3); cerci apex width 0.4-0.5 (mean = 0.4).

Head slightly wider than pronotum. Pronotum with anterior margin sub-truncate, with some specimens having small median notch anteriorly; lateral margins diverging posteriorly; median carina weak, but distinct; anterior and median sulci present laterally, indistinct near the median carina; posterior sulci dissecting the median carina; prozona mostly

smooth, with light punctation ventrally; metazona densely punctate; posterior margin subtruncate, a slight medial indentation present in some specimens; Prosternal spine acute. Tegmina ovate, apices subacuminate; dorsal margins not attinent, typically extending to the anterior edge of the second abdominal tergite. Pro- and mesothoracic legs moderately stout, the femora subequal in size; metathoracic legs with the femora greatly swollen, extending to the caudal end of abdomen. Furcula distinct, raised, comma-shaped protuberances extending about one fourth the length of the supra-anal plate; bases minutely separated. Supra-anal plate (Fig. 1a) triangular, slightly longer than wide, with the median groove anteriorly distinct with elevated sides, and becoming less distinct posteriorly. Cercus (Fig. 1b) broader at base than apex, narrowed at middle, apex rounded. Subgenital plate tuberculate. Internal genitalia figured. (Fig. 1C-I).

*Coloration*.— Antenna dark brown with dark spots on the ventral surfaces of first two basal segments. Antennal crescent complete. A black spot present at the juncture of the clypeus, cheek, and frons. Head, thorax, and abdomen brownish-grey, infuscated with darker brown spots dorsally, yellowish - grey ventrally. A lateral, well-defined, black, post-ocular stripe extending from the caudal margin of the eye to the second abdominal tergite; area of head, prothorax, and mesothorax below post-ocular stripe creamy – white. Episternum with a weak black spot anteriorly. Mesothorax and metathorax brown below post – ocular stripe. Tegmina brownish grey with light brown venation. Hind femora with two faint dark stripes dorsally, brown laterally, yellowish - grey ventrally, knees black. Hind tibia blueish-grey with black or black tipped spines. (Fig. 1J)

#### Female

*Measurements* (mm).— (n = 23) Body length 19.9 – 26.8 (mean = 23.3); pronotum length 4.8 – 6.5 (mean = 5.3); tegmen length 3.8 – 5.4 (mean = 4.7); hind femur length 11.8 – 14.1 (mean = 12.6).

Typical of the group (Fig. 2A). Much larger, plumper than male. Coloration similar to male,

but with a black band between the ocellus and antennae. Tegmina ovate with more broadly rounded tips. Blueish-grey coloration typically covers less of the hind tibia than in males, but the amount varies between individuals of each sex.

Types.— Mississippi, Meridian, 16 July. Deposited in the Academy of Natural Sciences of Philadelphia. (not examined)

*Specimens Examined.*— **Alabama:** Baldwin Co., 7.1 mi N Stockton, 31°05'40"N 87°49'58"W, 19 July 2012, J.G. Hill & M.J. Thorn (1M, 1F). Butler Co., Greenville, 23 August 1962, M.E. Dakin (1M). Colbert Co., 11.5 miles South of Cherokee, 34°35'28"N 87°56'11"W, 30 June 2011, J. G. Hill (1M, 1F). Conecuh Co., Evergreen, 21 August 1959, M.E. Dakin (2M, 1F), 23 August 1962 (4M), 17 August 1963 (6M, 1F). Escambia Co., 4.3 mi E Brewton, 25 August 1962, M. E. Dakin (2F); 8 mi E Brewton, 31°07'34"N 86°55'24"W, 17 July 2012, J. Hill, M. Dakin, & M. Thorn (1F); 3 mi W Dixie, 31°09'30"N 86°45'36"W, 17 July 2012, J. Hill, M. Dakin, & M. Thorn (1F). Jackson Co., 3 mi SW Scottsboro, 18 July 1964, W.E. Baker, (1M, 2F). Madison Co., Overlook Pt. on Monte Sano, 19 August 1951, I.J. Cantrall (2M, 2F); Monte Sano State Park, 30 June 1962, M.E. Dakin (14M, 9F), 26 July 1963, E. U Balsbaugh (1F). Pickens Co., 6.2 mi E Ethelsville, 24 August 1965, M.E. Dakin (1M, 1F); 0.7 miles west of Ethelsville, 33°25'21"N 88°13'35"W, 8 August 2010, J.G. Hill, (1M). Pike Co., The Pocosine, 20 August 1951, I.J. Cantrall (2M, 3F). Winston Co., Natural Bridge Rec. Area, 17 August 1962, M.E. Dakin (4M, 3F), 26 June 1963 (17M, 8F). **Mississippi:** Attala Co., Natchez Trace mi 168, 33°10'16"N 89°27'38"W, 27 June 2011, J.G. Hill (2F). Benton Co., Holly Springs N.F., 34°39'46"N 89°11'21"W, 22 July 2011, J.G. Hill (2M, 5F). Carroll Co., Malmaison WMA, 10 June 1967, Dakin et al. (3M), Chickasaw Co., Tombigbee National Forest, 33°55'39"N 88°51'18"W, 11 June 2004, J.G. Hill (3M, 2F); Natchez Trace mile 247.5, 34°05'49"N 88°51'38"W, 29 June 2011, J.G. Hill (1F). Choctaw Co., Natchez Trace mi 198, 33°24'49"N 89°15'39"W, 19 May 2011, J.G. Hill (3M, 3F). Clarke Co., Clarkco State Park,

32°06'05"N 88°41'59"W, 2 June 2010, J.G. Hill (3M, 1F). Grenada Co., T21N R2E, Sec 12, 7-13 July 1991, R.L. Brown (1M 1F), 7-13 August 1991, T.L. Schiefer (1M, 1F); Grenada Lake, 33°47'53"N 89°46'07"W, 12 June 2006, J.G. Hill (1M 1F); Hugh White State Park, 33°48'01"N 33°48'01"W, 12 June 2006, J.G. Hill (1F). Itawamba Co., Tremont, 34°12'18"N 88°15'09"W, 22 August 2007, J.G. Hill (1M); 2 miles east of Fulton, 34°14'29"N 88°26'39"W, 22 August 2007, J.G. Hill (1M). Lauderdale Co., Meridian, 16 July 1905 [A. P. Morse] (1M) (Paratype); 32°21'13"N 88°39'36"W, 19 August 2005, J. G. Hill (7M, 4F); 3 miles south of Meridian, 32°18'34"N 88°41'53"W, J.G. Hill & L.C. Majure (2M, 1F); Meehan, 32°23'18"N 88°54'21"W, 1-4 June 2005, J.G. Hill, (1M); Arundel, 32°20'02"N 88°46'59"W, 14 June 2008 J.G. Hill (1M, 2F). Leake Co., Natchez Trace Parkway mile 143, 32°48'15"N 89°41'11"W, 27 June 2011, J.G. Hill (3M); Okatibbee Res. 32°28'26" N 88°47'56" W, 18 Aug 2005, J.G. Hill (1M). Lee Co., Natchez Trace Parkway, 34°21'53" N 88°40'26"W, 30 June 2011, J.G. Hill (1M). Lowndes Co., Lake Lowndes St. Park, 33°26'24"N 88°18'12"W, 9 June 2010, J. G. Hill (1F). Marshall Co., Wall Doxey St. Park, 34°39'41"N 89°27'56"W, 11 June 2006, J.G. Hill (2M). Monroe Co., Peacely Ferry Road, 34°00'20"N 88°34'23"W, 28 August 2006, J.G. Hill (1M). Newton Co., Highway 80 X I20, 32°20'07"N 89°17'10"W, 1 June 2005, J.G. Hill, (1M). Noxubee Co., 1 mi E Macon, 33°06'01"N 88°31'14"W, 17 June 2008, J.G. Hill (3M, 2F); Noxubee NWR, 33°18'02"N 88°52'07"W, 6 August 2009, J.G. Hill (1M), 33°16'38"N 88°47'31"W, 5 June 2008, J. G. Hill (2M). Oktibbeha Co., John Star. For., T17N R13E Sec 14, 7-24, July 2001, J.G. Hill (3M); Noxubee NWR, 33°17'58"N 88°52'10"W, 12 June 2008, J.G. Hill (2M, 1F). Pontotoc Co., Trace State Park, 34°15'24"N 88°53'12"W, 15 June 2006, J.G. Hill (3M). Prentiss Co., Natchez Trace Parkway, mi. 286, 34°28'15"N 88°15'14"W, 30 June 2011, J.G. Hill (2M, 1F). Rankin Co., 2.5 mi NNW Sandhill, 32° 31'12"N 89°51'48"W, 18 June 2011, J.G. Hill (1M). Scott Co., Roosevelt State Park, 32°18'46" N 89°40'29"W, 2 June 2012, J. G. Hill (4M, 1F), 32°19'14" N 89°40'47"W, 15 Aug, 2006, J.G. Hill

(1M). Tishomingo Co., Woodall Mtn., 28 June 1977, M.E. and P.L. Dakin (2M, 1F). Wayne Co., DeSoto N.F. 31°27'32"N 88°45'05"W, 2 July 2008, J. G. Hill, (1M, 1F). Winston Co., Noxubee NWR, 33°13'10"N 88°54'47"W, 12 June 2008, J.G. Hill, (2M), 33°15'45"N 88°54'46"W, 5 June 2008, J.G. Hill (1M), 33°16'00"N 88°50'51"W, 29 May 2009, J.G. Hill (2M, 2F); Legion St. Park, 33°09'04"N 89°02'33"W, 9 June 2010, J.G. Hill (1M, 2F), 4 Aug 2006, J.G. Hill (3M, 2F); Tombigbee N.F., 33°11'25"N 89°00'27"W, 20 May 2011, J.G. Hill (2M). **Tennessee:** Fayette Co., Wolf River WMA, 35°02'10"N 89°14'40"W, 22 July 2011, J.G. Hill (3M, 2F); Franklin Co., Hawkins Cove N.A., 35°10'27"N 85°57'56"W, 16-18 June 2010, J.G. Hill (10M, 1F), Tims Ford State Park, 35°12'43"N 86°15'04"W 14 June 2010, J.G. Hill (7M). McNairy Co., Big Hill Pond State Park, 35°02'39"N 88°43'55"W, 7 July 2011 J.G. Hill (2 M, 2F); 9 July 2012 (1M). Shelby Co., Meeman-Shelby Forest State Park, 25 June 1977, M.E. and P.L. Dakin (5M, 6F).

**Diagnosis** — Distinguished from other species in the group by the shape of the structures on the male terminalia (Fig. 1A-B) and the internal male genitalia (Fig. 1 C-I).

**Distribution.**— Southern Alabama and northern Alabama and southern Tennessee to central Mississippi. (Fig 3).

**Habitat.**— *Melanoplus tepidus* typically inhabits forest edges or forests with open understories that have some herbaceous vegetation, but on rare occasions occurs a short distance from the forest edge, such as on powerline right of ways or in Black Belt prairie remnants and limestone outcrops. Many differing forest types and a variety of edaphic conditions are inhabited by this species including upland and bottomland hardwood forests, mixed-pine hardwood forests, pine forests, and sandhills. This species has been found in clumps of wild grape (*Vitis* spp.) and gopher apple (*Licania michauxii* Prance) growing along the ground.

### *Melanoplus harrisi* new species

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While investigating the grasshopper fauna of xeric limestone prairies in the Western Highland Rim physiographic region of Tennessee, a species similar in appearance to *M. tepidus* was collected. Examination of the male aedeagus of these specimens revealed a significantly different structure from that of *M. tepidus*, as well as some minor external differences. This species is described here as *Melanoplus harrisi* (Fig 4A-J, Fig 2B.)

#### *Male Description*

**Measurements** (mm).—(n = 10) Body length 18.3 – 21.5 (mean = 19.3); pronotum length 4.0 – 4.8 (mean = 4.3); tegmen length 3.3 – 4.0 (mean = 3.7); hind femur length 10.2 – 11.0 (mean = 10.6); cerci length 1.2 (mean = 1.2); basal width of cerci 0.5 - 0.5 (mean = 0.5); mid-cercal width 0.3 - 0.4 (mean = 0.3.8); cerci apex width 0.4- 0.5 (mean = 0.42).

Head subequal in width to apical margin of pronotum. Pronotum with anterior margin truncate, without a median notch anteriorly; lateral margins diverging posteriorly; median carina weak on prozona, but more distinct on the metazona; anterior and median sulci present laterally, indistinct near the median carina; posterior sulci dissecting the median carina; prozona mostly smooth, with light punctation ventrally; metazoan densely punctate; posterior margin subtruncate, a slight medial notch; Prosternal spine acute. Tegmina ovate, apices rounded; dorsal margins not attingent, typically extending to the anterior edge of the second abdominal tergite. Pro- and mesothoracic legs moderately stout, the femora subequal in size, metathoracic legs with the femora greatly swollen, extending to the caudal end of abdomen. Furcula distinct, raised, finger like protuberances extending about one third the length of the supra-anal plate; bases minutely separated. Supra-anal plate (Fig. 4a) triangular, slightly longer than wide, with the median groove anteriorly distinct with elevated sides, crimped in the middle

and becoming less distinct posteriorly. Cercus (Fig. 4b) broader at base than apex, narrowed at middle, apex rounded. Subgenital plate truncate (Fig. A-B). Internal genitalia figured. (Fig. 4C-I).

*Coloration*.—Antenna light brown with dark spot on the ventral surface of each of the first two basal segments. Antennal crescent complete. A black spot present at the juncture of the clypeus, cheek, and frons. Head, thorax, and abdomen dark brown, infuscated with darker brown spots dorsally, light brown ventrally. A lateral, well-defined, black, post-ocular stripe extending from the caudal margin of the eye to the second abdominal tergite; area of head, prothorax, and mesothorax below post-ocular stripe creamy – white. Episternum with a weak black spot anteriorly. Mesothorax and metathorax light brown below post-ocular stripe. Tegmina brownish grey with light brown venation. Hind femora with two faint dark stripes dorsally, brown laterally, light brown ventrally, and knees black. Hind tibia blueish-grey with black or black tipped spines. (Fig. 4J)

#### Female

*Measurements* (mm).—(n = 7) Length 22.5 – 24.8 (mean = 23.7); pronotum length 5.5 – 5.8 (mean = 5.7); tegmen length 3.3 – 4.7 (mean = 4.2); hind femur length 11.6 – 12.8 (mean = 12.4).

Typical of the group. (Fig. 2B) Much larger and plumper than male. Coloration similar to male, but with a black band between the ocellus and antennae. Tegmina ovate with more broadly rounded tips. Blueish-grey coloration typically covers less of the hind tibia than in males, but the amount varies between individuals of each sex. Cercus triangular. Upper valves of ovipositor armed with several teeth anteriorly.

*Holotype*.—TENN, Decatur County, Carroll Cabin Barrens, 35°27'45"N 88°03'18"W, 7 July 2011, J. G. Hill, Collected from hardwood forest. Deposited in the United States National Museum of Natural History.

*Paratypes*.—same data as type (4M, 3F), 30 May 2011 (4M), 13 September 2012 (1 F) Paratypes deposited in the MEM, UMMZ and

the Academy of Natural Sciences Philadelphia (ANSP).

*Etymology*.—This species is named in honor of the late Billy Harris, who shared a childhood dream of exploring the wilderness of Tennessee.

*Diagnosis*.—Distinguished from other species in the group by the shape of the structures on the male terminalia (Fig. 4A-B), the internal male genitalia (Fig. 4 C-I), and the somewhat lighter coloration.

*Distribution*.—Known only from the type locality at this time. (Fig 3.)

*Habitat*.—Thus far, *M. harrisi* has only been found inhabiting the upland hardwood forests surrounding xeric limestone prairies and along the prairie/forest edge under eastern red cedars (*Juniperus virginiana* L.) at the type locality.

#### *Melanoplus morsei* Blatchley

Blatchley 1920 and Eades 1959 adequately describe *M. morsei*, but the species is figured here (Fig 3A-J, Fig. 8A.) for convenience and diagnostic purposes. Locality data for the southeastern United States used in Figure 3 was taken from Eades (1959) and specimens in the MEM collection.

#### *Melanoplus nossi* new species

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As mentioned previously, this undescribed species was listed in Capinera et al. 2001 as *M. tepidus*. This error was likely caused by a series of seven specimens collected in 1941 and 1962 from Liberty Co., Florida, containing one male only, and identified as *M. tepidus*. Examination of these specimens as well as others collected by the author revealed significant differences in external morphology as well as the internal genitalia between this species and *M. tepidus*. The species is described here as *Melanoplus nossi* (Fig. 6A-J, Fig. 2C, Fig. 8B) accordingly.

*Male*

*Measurements* (mm).—(n = 9) Body length 19.5 – 22 (mean = 20.6); pronotum length 4.2 – 4.5 (mean = 4.4); tegmen length 3.4 – 4.0 (mean = 3.8); hind femur length 11.1 – 11.7 (mean = 11.6); cerci length 1.4 – 1.5 (mean = 1.45); basal width of cerci 0.4 – 0.6 (mean = 0.5); mid-cercal width 0.3 (mean = 0.3); cerci apex width 0.3– 0.4 (mean = 0.38).

Head subequal in width to apical margin of pronotum. Pronotum with anterior margin truncate and a small median notch; lateral margins subparallel; median carina distinct on anterior portion of the prozona, less distinct on the posterior portion, and very distinct on the metazona; anterior and median sulci present laterally, terminating at, but not dissecting the median carina; posterior sulci dissecting the median carina; prozona mostly smooth, with light punctation laterally on the anterior ventral margin; metazona densely punctate dorsally and laterally; posterior margin subtruncate, with a distinct medial notch; Prosternal spine acute. Tegmina ovate, apices subacute; dorsal margins not attingent, typically extending to the anterior edge of the second abdominal tergite. Pro- and mesothoracic legs moderately stout, the femora subequal in size, metathoracic legs with the femora greatly swollen, extending to the caudal end of abdomen. Furcula distinct, raised, finger like protuberances extending about one fourth the length of the supra-anal plate; bases minutely separated (Fig. 6A-B). Supra-anal plate (Fig. 6A) triangular, slightly longer than wide, with the median groove anteriorly distinct with elevated sides running the entire length of the plate. Cercus (Fig. 6b) broader at base, sides subparallel, apex rounded. Dorsal margin of subgenital plate triangular (Fig. 6A-B). Internal genitalia figured. (Fig. 6C-I).

*Coloration*.—Antenna dark brown with a dark spot on the ventral surface on each of the first two basal segments. Antennal crescent complete. Black spots present at the juncture of the clypeus, cheek, and frons. Head, thorax, and abdomen dark brown, infuscated with darker brown spots dorsally, light brown ventrally. A lateral, well-defined, black, post-ocular stripe extending from the caudal margin of the eye to the second abdominal tergite; area of

head, prothorax, and mesothorax below post-ocular stripe creamy – white. Episternum with a weak black spot anteriorly. Mesothorax and metathorax light brown below post-ocular stripe. Tegmina dark brown with light brown venation. Hind femora with two faint dark stripes dorsally, brown laterally, light brown ventrally, and knees black. Hind tibia bluish-grey with black or black tipped spines. (Fig. 6J)

*Female*

*Measurements* (mm).—(n = 15) Body length 22.5 – 26 (mean = 23.9); pronotum length 4.8 – 6 (mean = 5.4); tegmen length 3.3 – 5.8 (mean = 4.6); hind femur length 11.9 – 14.6 (mean = 13.2).

Typical of the group (Fig 2C). Much larger, plumper than male. Pronotum with lateral margins more divergent caudally than male. Coloration similar to male, but with a dark band between the ocellus and the base of the antenna. Cercus triangular. Upper valves of ovipositor armed with several teeth anteriorly.

*Type*.—Florida, Liberty County, Torreya State Park, 30°33'16"N 84°57'29"W, 18 July 2012, J. G. Hill, Collected in hardwood forest in ravine. Deposited in the United States National Collection.

*Paratypes*.—Florida: Same data as type (2M, 3F), 13 June 1962 (1M 3F), 3 August 2011 (3 F), Liberty Co., 20 August 1941 (3F). Georgia: Decatur Co., 6. mi W Faceville, 30°44'09"N 84°44'25"W, 19 June 2011, J. G. Hill (3M, 3F).

*Etymology*.—This species is named in honor of Dr. Reed Noss, for his efforts in the field of Conservation Biology, particularly for his work with endangered habitats of the southeastern United States.

*Diagnosis*.—Distinguished from other species in the group by the shape of the structures on the male terminalia (Fig. 6A-B) and the internal male genitalia (Fig. 6 C-I).

*Distribution*.—At present, *M. nossi* is known only from the east side of the Apalachicola River in Florida and north along the east side of the Flint River in southwestern Georgia (Fig. 3). This

region was apparently important refugia during the Pleistocene and harbors at least twenty species of plants that are either endemic to the region, are relict populations of species that range well to the north and west, or are Arcto-Tertiary relics (Sorrie and Weakly 2001). *Melanoplus apalachicola* Hubbell, a species belonging to the *Melanoplus puer* species group, is endemic to the same region, but alternatively inhabits xeric sandhill habitats (Hubbell 1932).

*Habitat.*—The Florida specimens collected by the author were taken in the understory of hardwood forest ravines in Torreya State Park that were also inhabited by small individuals of the Florida torreyia (*Torreya taxifolia* Arn.). The Georgia specimens were collected around an abandoned home site that was converting back to forest. The specimens were captured in a somewhat open area, which was likely the former yard of the house as evident by scattered patches of St. Augustine Grass [*Stenotaphium secundatum* (Walt.) Kuntze] and cultivated Azaleas (*Rhododendron* sp.) growing around the bases of the large pine trees. Here, *M. nossi* was collected among wild grape (*Vitis* sp.) and Carolina jasmine [*Gelsemium sempervirens* (L.) growing along the ground.

### ***Melanoplus vulnus* Eades**

*Melanoplus vulnus* (Fig. 7A-J, Fig. 8C) has an interesting history. A.P. Morse collected a pair of specimens of this species in Hattiesburg, MS during his second expedition to study the orthopteran fauna of the southern United States in 1906, and identified them as *M. morsei* (Morse, 1907). Hubble (1934) examined Morse's Mississippi specimens and commented that they were typical of *M. morsei*, but were also "very large". Morse (1906) gives the body length of the male specimen as 22 mm and the female as 28 mm. While working on the description of *Melanoplus vulnus* from material collected in Kentucky and Tennessee, D. Eades examined Morse's two specimens from Mississippi and found them to agree with *M. vulnus*. Eades also commented on the size of these specimens

stating that "the Mississippi specimens are clearly larger than the more northern ones" and suggested that the northern and southern populations could be split into subspecies, but exercised caution lacking sufficient specimens (Eades 1959).

In recent years, collections in Mississippi and Tennessee have yielded additional specimens of *M. vulnus* from several locales. Examination of these specimens suggests suggest that specimens from Mississippi are on average larger than specimens from Tennessee (Table 1.). Morse's female specimen is exceptionally large and not the norm for the species, whereas the male specimen fits into the parameters for the southern population. With other characters there doesn't appear to be any significant variation, particularly that of the male genitalia. It is also interesting to note that the sizes of the terminalia structures are similarly sized between the two populations.

Finding this little variation, particularly that of the internal male genitalia, between these two populations presents an interesting biogeographical conundrum as they are apparently separated by approximately 467 km (290) miles (Fig. 3). Further the territory between these two populations is occupied by *M. tepidus*. Male genitalia in *Melanoplus* are thought to be under strong sexual selection, which leads to rapid speciation (Knowles and Otte 2000). Finding these two widely (for a flightless grasshopper) separated species with such little variation in the male genitalia suggests that the separation may be recent and that these populations have not had time to diverge.

*Specimens examined.*—**Kentucky:** Henderson Co., Audubon State Park, D.C. Eades, 15 June 1959, #41, D.C. Eades (1M)(paratype), taken as juvs 7 June; matured 14-18 June 1958, # 17, (F). **Mississippi:** Claiborne Co., Natchez Trace Parkway, mi. 49, 22 June 1977, M.E. and P.L. Dakin (2M, 1F). Copiah Co, 4.1 mi SW Hazlehurst, 31°48'41"N 90°26'04"W, 18 June 2012, J. G. Hill, (1M, 1F). Forrest Co., DeSoto National Forest, 31°01'54"N 89°10'16"W, 13 July 2011, J.G. Hill (5F). Jefferson Co., Natchez Trace Parkway, mi. 18, 31°43'25"N 91°10'32"W, 21 June 2012, J. G. Hill (1M). Perry Co., DeSoto National Forest,

30°59'17"N 89°03'07"W, 11 May 2006, J. G. Hill, J.A. MacGown (2M). Wilkinson Co, Clark Creek Nat. Area, 31°04'17"N 91°30'41"W, 7 July 2005, J.G. Hill, J. A. MacGown (2M). **Tennessee:** Lewis Co., Natchez Trace Parkway, mi. 377, 35° 24'50"N 87°30'59" W, 13 June 2012, J.G. Hill & J.L. Seltzer (2M, 1F), Lewis Co., Natchez Trace Parkway, mi. 382.8, 35.46324°N 87.47897°W, 31 May 2012, J.G. Hill & J.L. Seltzer (2M, 1F). Lewis Co., Natchez Trace Parkway, mi. 385.9, 35.52883°N 87.45373°W, 31 May 2012, J.G. Hill & J.L. Seltzer (7M), 13 June 2012 (5M, 3F). Wayne Co., Natchez Trace, mi 349.9, 35.11263°N 87.77397°W, 31 May 2012, J.G. Hill & J.L. Seltzer (1M). Wayne Co., Natchez Trace Parkway, mi. 346, 35° 03'57"N 87°48'04" W, 14 June 2012, J.G. Hill & J.L. Seltzer (1M).

*Distribution.*—Two apparently disjunct populations: one occurring from southern Tennessee to northern Kentucky, and the other occupying the southern third of Mississippi (Fig 3).

#### DISCUSSION

Though the southeastern United States has been relatively well surveyed with 177 species having been documented from the region (Hill and Dakin 2011, Otte 2012), there are still species awaiting description. Beyond descriptive work, biogeographical, ecological, and phylogenetic studies are clearly needed. A prime example of this need is presented here with the *tribulus* group. Examination of the internal male genitalia of species in this group suggest that the group could be split into several species groups, as the aedeagus of *M. tepidus* and *M. harrisi* are obviously dissimilar from *M. morsei*, *M. nossi*, and *M. vulnus*. A full revision of this group including molecular data should be conducted to examine the relationship of the species in the group and could possibly shed some insight into the biogeography of forested habitats in the eastern United States.

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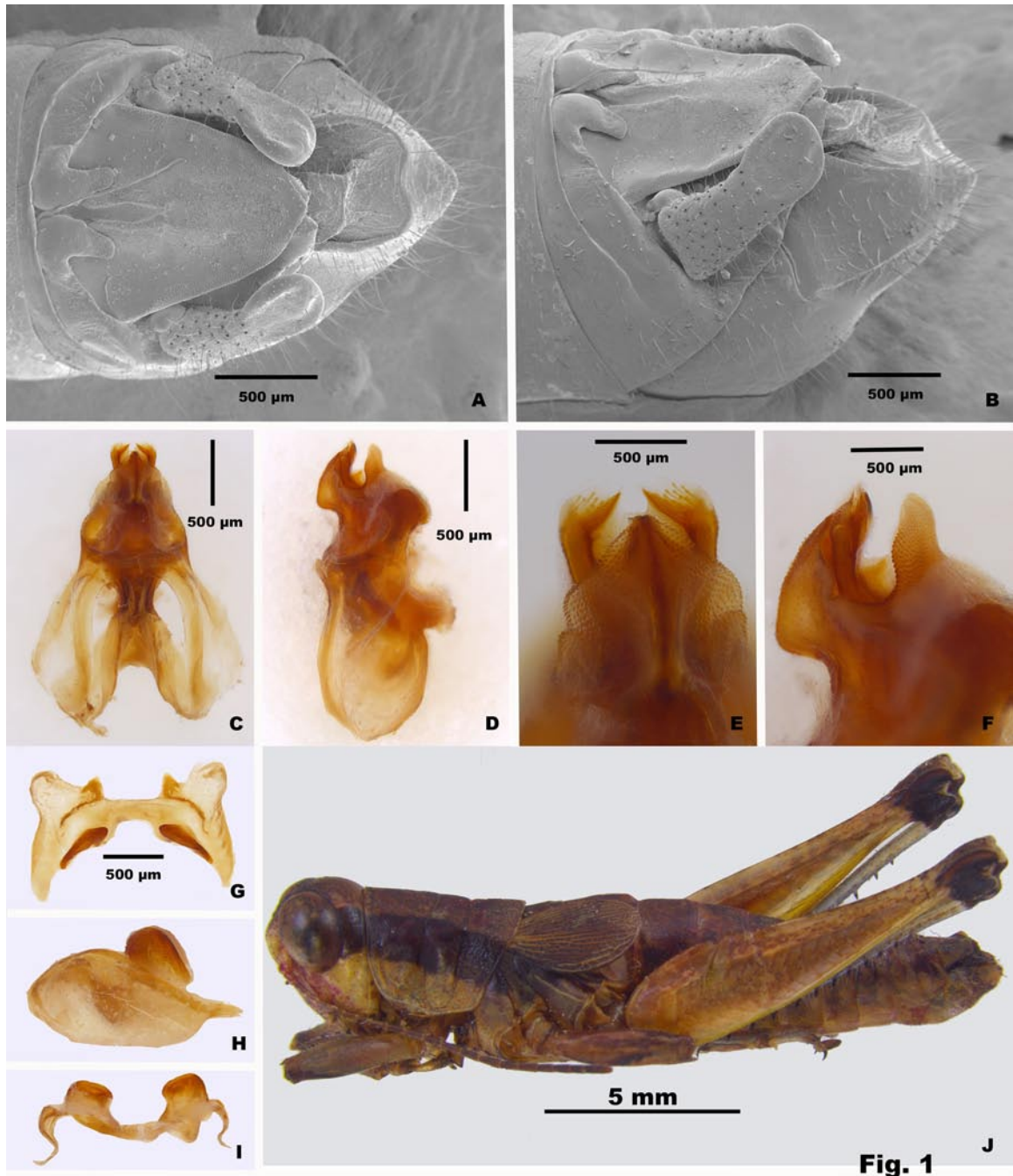


Figure 1. *Melanoplus tepidus*: A. dorsal view of terminalia, B. lateral view of terminalia, C. dorsal view of phallic complex, D. lateral view of phallic complex, E. dorsal view of aedeagus, F. lateral view of aedeagus, G. dorsal view of epiphallus, H. lateral view of epiphallus, I. caudal view of epiphallus, J. habitus.

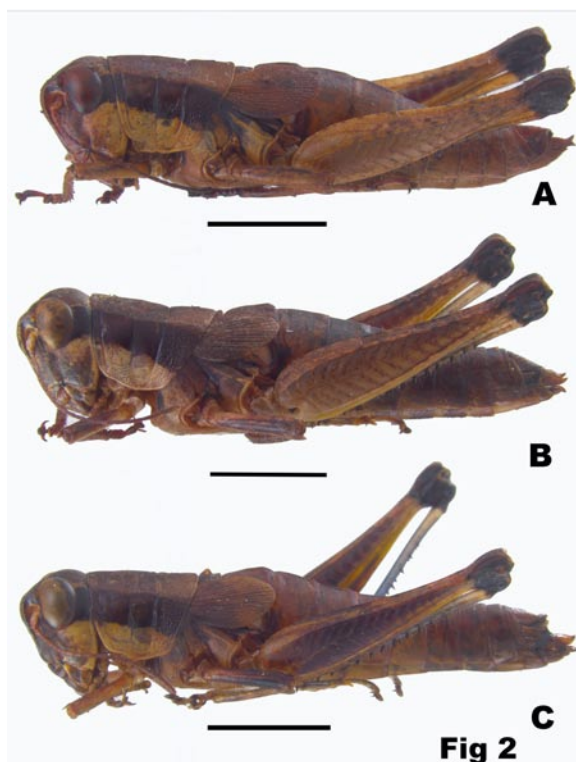


Figure 2. Habitus of females: A. *Melanoplus tepidus*, B. *Melanoplus harrisi*, and C. *Melanoplus nossi*. Scale bar = 5 mm.

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Table 1. Measurements of *Melanoplus vulnus* specimens from Kentucky, Mississippi, and Tennessee in mm.

	MS male (n = 5)	KY/TN male (n=8)	MS female (n = 6)	KY/TN female (n =4)
Body length	20.1 – 21.5 (20.6)	18.6 – 20.5 (19.6)	22.1 – 24.2 (23.2)	22.3 – 24.0 (23.4)
Tegmen length	3.5 – 4.3 (3.8)	3.5 – 4.7 (4.7)	4.5 – 5.5 (4.9)	4.3 – 5.3 (4.7)
Pronotum length	3.3 – 4.5 (4.1)	3.5 – 4.5 (3.6)	5.0 – 5.8 (5.4)	5.5 – 5.7 (5.6)
Hind femur length	10.1 – 11.5 (11.1)	10.7 – 11.5 (11.0)	12.2 – 14.5 (13.6)	12.0-14.0 (12.8)
Cerci length	1.1 -1.2 (1.2)	1.3 (1.3)		
Cerci basal width	0.6 (0.6)	0.5 – 0.7 (0.6)		
Cerci minimum width	0.4 (0.4)	0.4 (0.4)		
Cerci apical width	0.3 (0.3)	0.3 (0.3)		



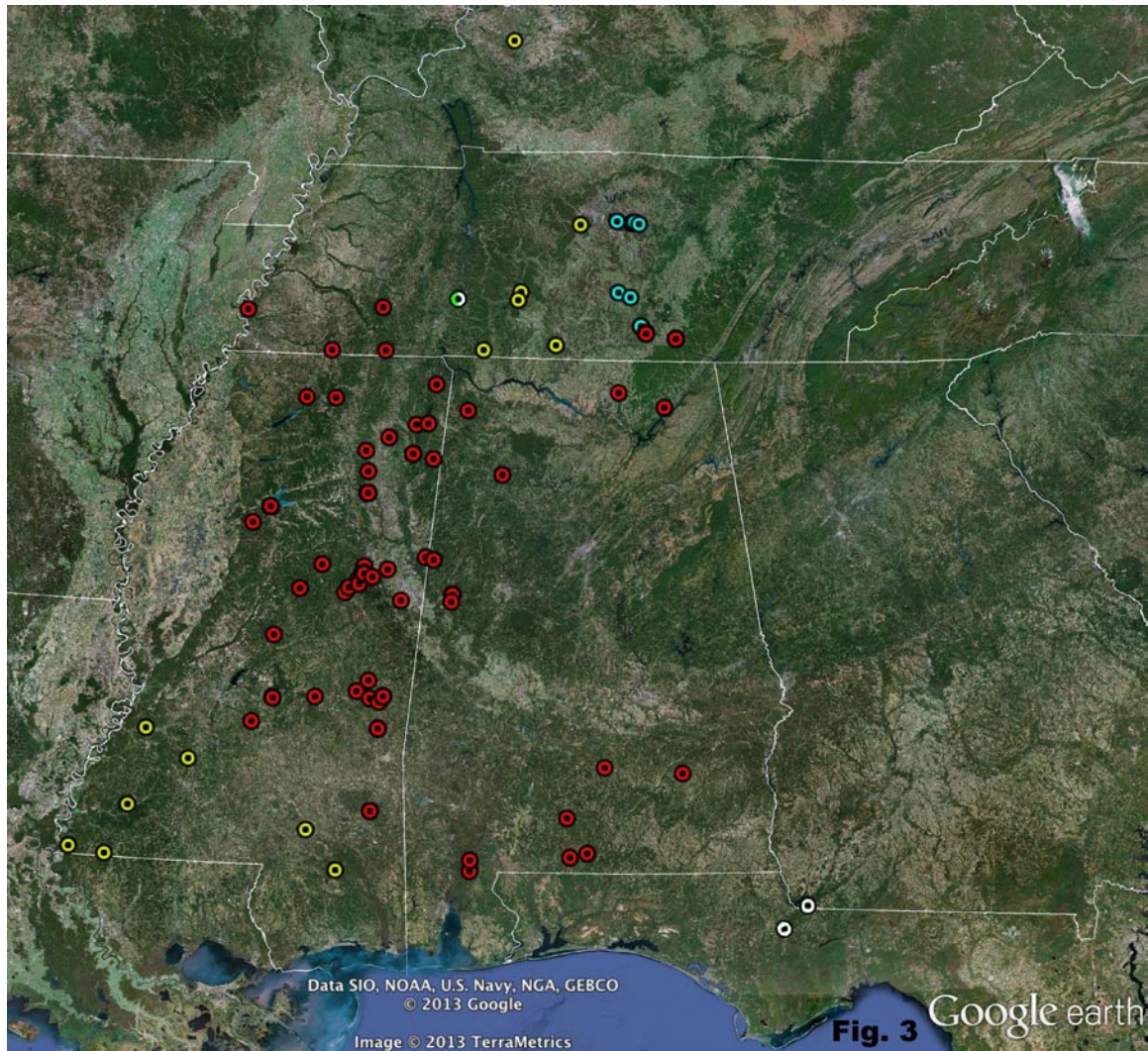


Figure 3. Distribution of species covered in this manuscript. Red circles = *M. tepidus*, half green circles = *M. harrisi*, blue circles = *M. morsei*, yellow circles = *M. vulnus*, white circles = *M. nossi*.

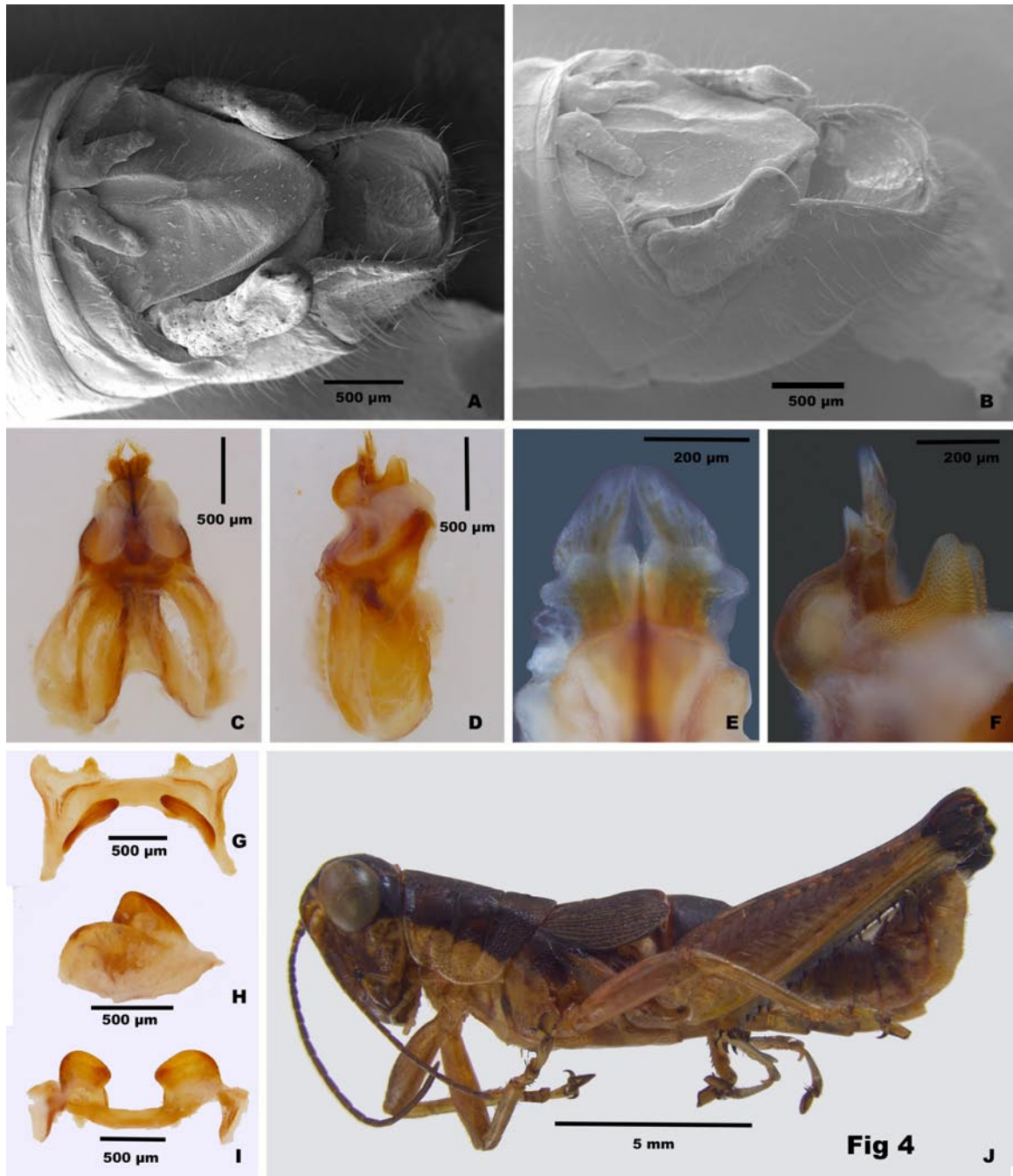


Figure 4. *Melanoplus harrisi*: A. dorsal view of terminalia, B. lateral view of terminalia, C. dorsal view of phallic complex, D. lateral view of phallic complex, E. dorsal view of aedeagus, F. lateral view of aedeagus, G. dorsal view of epiphallus, H. lateral view of epiphallus, I. caudal view of epiphallus, J. habitus.



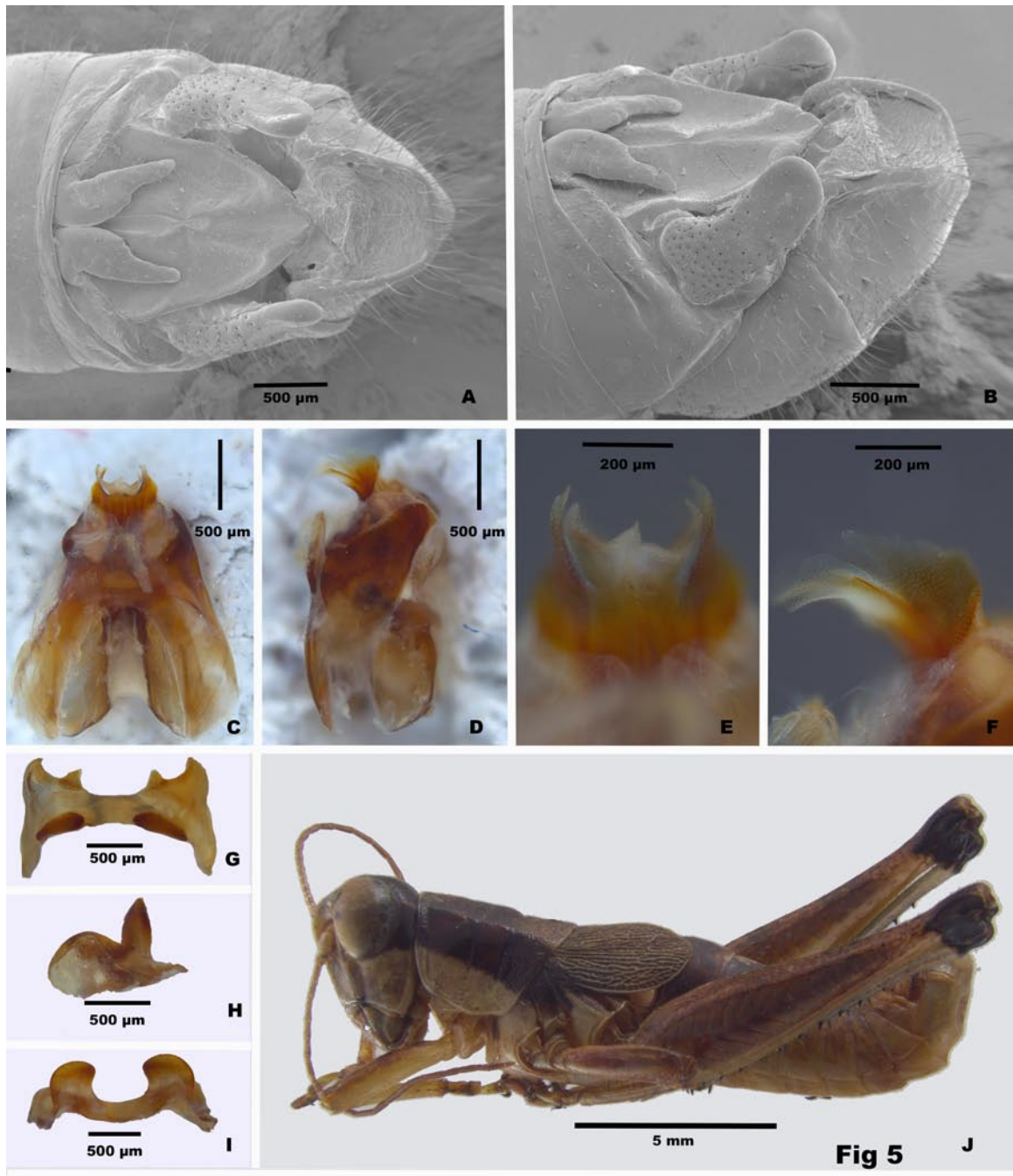


Figure 5. *Melanoplus morsei*: A. dorsal view of terminalia, B. lateral view of terminalia, C. dorsal view of phallic complex, D. lateral view of phallic complex, E. dorsal view of aedeagus, F. lateral view of aedeagus, G. dorsal view of epiphallus, H. lateral view of epiphallus, I. caudal view of epiphallus, J. habitus.

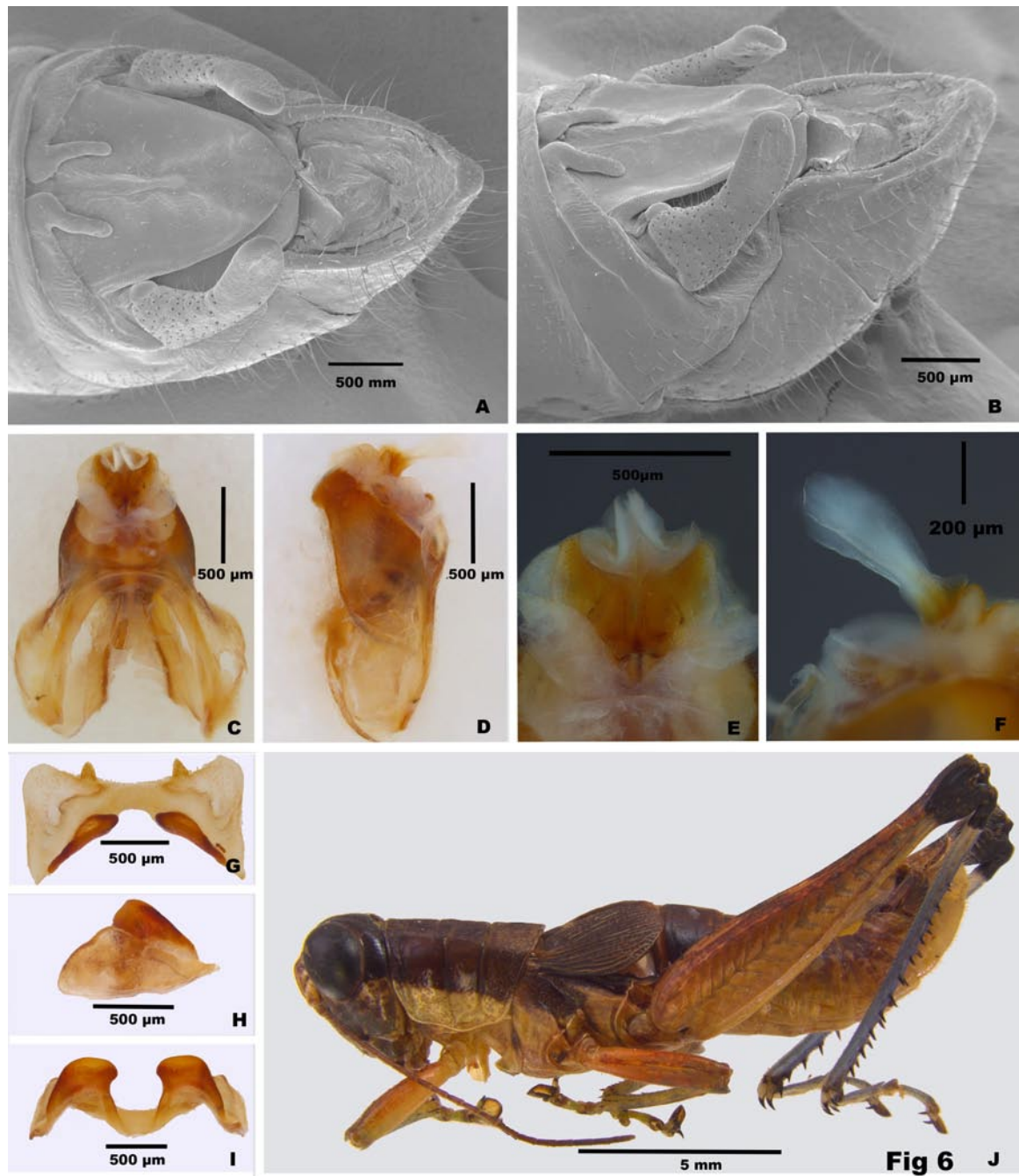


Figure 6. *Melanoplus nossi*: A. dorsal view of terminalia, B. lateral view of terminalia, C. dorsal view of phallic complex, D. lateral view of phallic complex, E. dorsal view of aedeagus, F. lateral view of aedeagus, G. dorsal view of epiphallus, H. lateral view of epiphallus, I. caudal view of epiphallus, J. habitus.

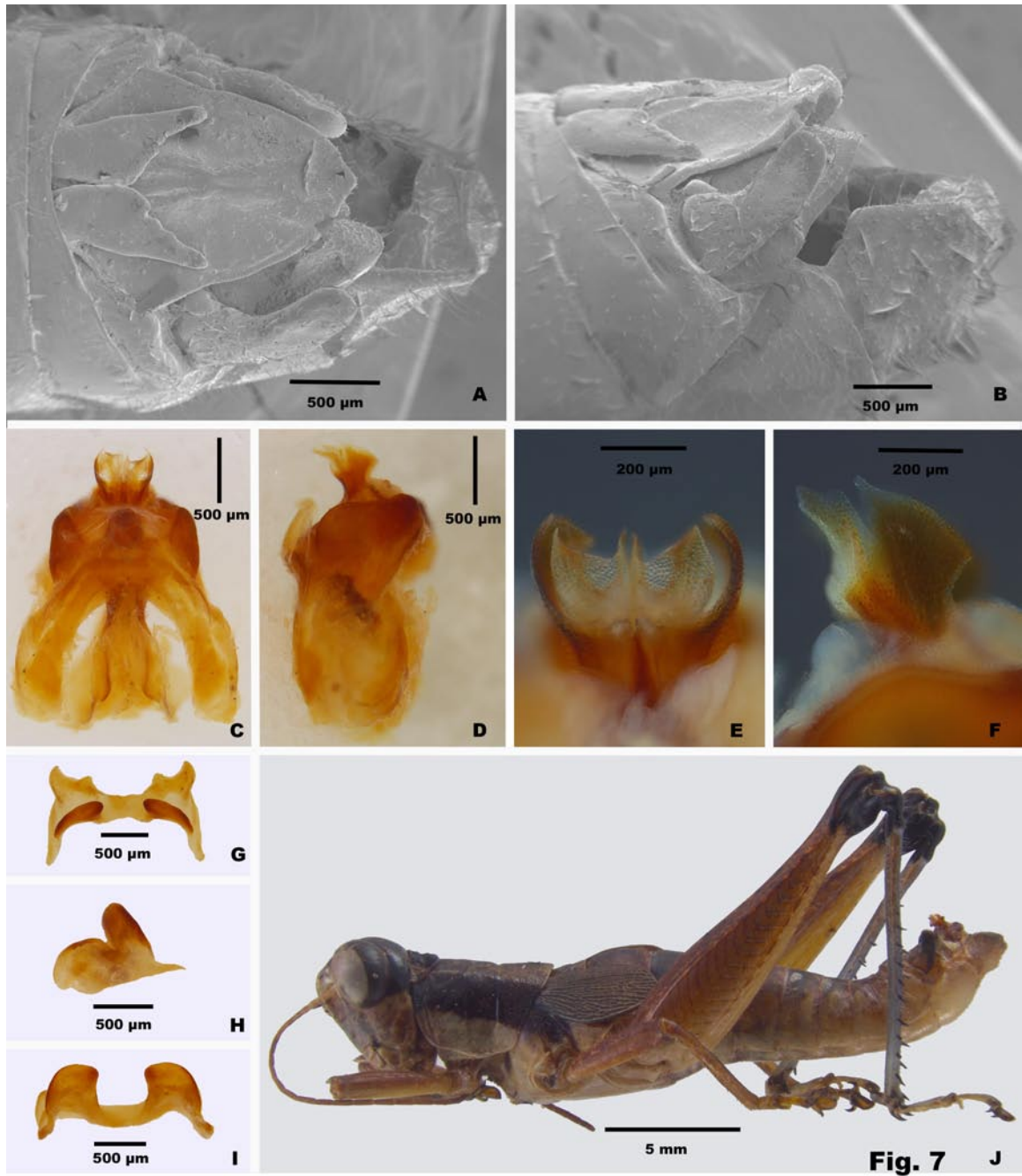


Figure 7. *Melanoplus vulnus*: A. dorsal view of terminalia, B. lateral view of terminalia, C. dorsal view of phallic complex, D. lateral view of phallic complex, E. dorsal view of aedeagus, F. lateral view of aedeagus, G. dorsal view of epiphallus, H. lateral view of epiphallus, I. caudal view of epiphallus, J. habitus.

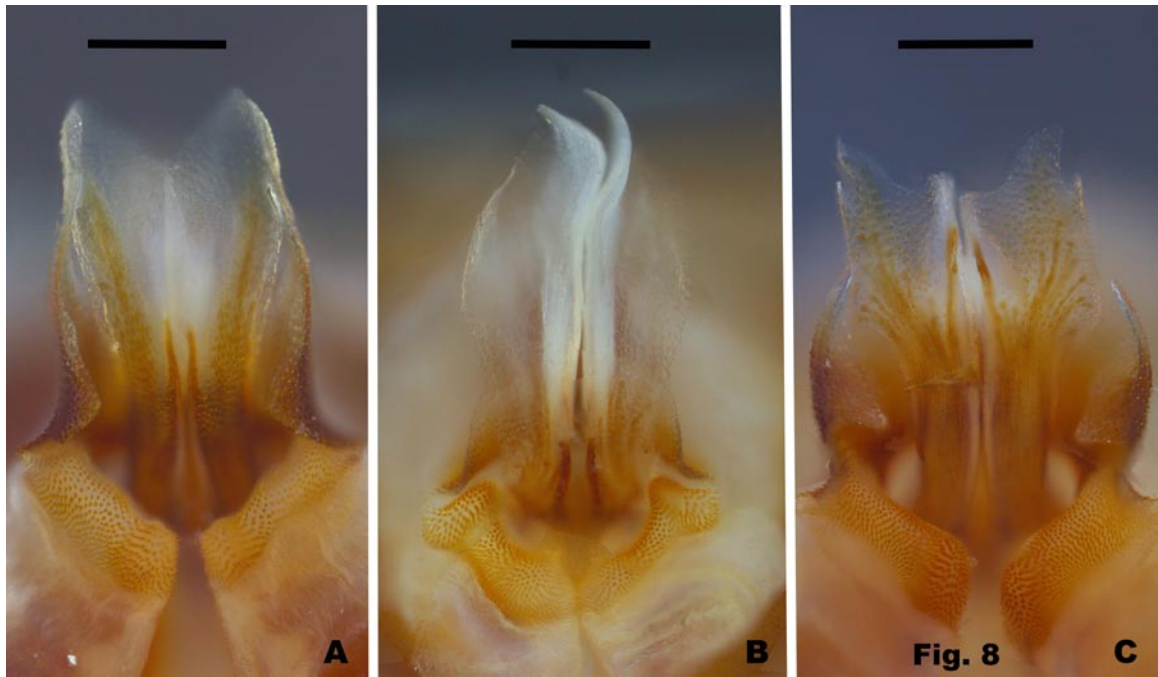


Figure 8. Caudal view of aedeagus of A. *Melanoplus morsei*, B. *Melanoplus nossi*, and C. *Melanoplus vulnus*. Scale bar = 200  $\mu$ m.