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Author: Otte, Daniel

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Studies of *Melanoplus*. 1. Review of the Viridipes Group (Acrididae: Melanoplinae)

DANIEL OTTE

Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103 USA. Email: otte@acnatsci.org

Abstract

The genus *Melanoplus* is currently subdivided into numerous species groups, mostly informally by arrangement in collections. Most of the groups need further study. This paper treats the Viridipes Group which previously included 11 species. In this paper we have described two new species: *M. lilianae* n. sp. and *M. benni* n. sp. One species, *M. gracilis,* probably does not belong to this group. I have included it here because its affinities with other *Melanoplus* species remain unknown. Like the Viridipes Group it is characterized by its green legs.

The members of this group are distributed mostly east of the Mississippi River. Two species, *M. sylvatica* and *M. beameri,* are known from west of the river. Most of the species emerge as adults in the spring or early summer and some are believed to overwinter in later nymphal stages. These species also prefer woodland habitats, especially along woods margins and small openings in woods. But sometimes they may be found some distance from the woodland edge, especially on larger balds in the southern Appalachian mountains.

Key words

Acrididae, Melanoplinae, *Melanoplus*, Viridipes Group, systematics, distribution

Introduction

The genus *Melanoplus* is the world's largest grasshopper genus (Otte 1995, Otte & Naskrecki 1997, Otte & Eades 2002). To date the single most important work on the genus was the monograph by Scudder (1897). Subsequently, there were a number of large works including those of Hebard (1917, 1918, 1919, 1920, 1922, 1936, 1937), Gurney & Brooks (1959), Hubbell (1932) and Rentz (1978). But a full summary has eluded us for over 100 y.

I have been working on the genus for at least 10 y. Early in my studies I believed I could provide a single book on the genus. But this has proved to be an insurmountable task. The main difficulty is that the treatments of species have been inconsistent and many of the original papers are not useful in distinguishing the species. Consequently the entire genus requires revision as well as a new set of comparative illustrations. The strategy is to publish on each of the species groups first. This allows one to be more thorough than would be possible in a single volume. A summarizing volume covering the Melanoplinae (North American Grasshoppers, volume 3) is anticipated within the next 3 y.

The present review of the Viridipes Group was mostly completed some years ago. But I have learned that a more thorough dissection of the reproductive apparatus is needed for seeing differences and relationships among species. Fortunately digital technology has made the task easier and more accurate.

The emphasis in the present work is on illustrating the most important diagnostic features of males within this group, as well as providing information on distribution and habitat. Since 1998 I have spent considerable time collecting *Melanoplus* spp. along the Appalachian Mountains, mainly with an interest in understanding the barriers needed to produce speciation. This work also allowed me to solve questions on the limits of various species. Single individuals in museum collections were once thought to represent new species. However, additional collecting shows that they are only variants of existing species.

This work does not yet clarify the position of the Viridipes Group within *Melanoplus* as a whole. That cannot be accomplished until all groups are studied. Therefore, this study indicates merely which species are now thought to belong to the group. The group itself is composed of several subgroups, which are defined on the basis of coloration and the structure of the internal genitalia. Tables for comparison and numerous illustrations are provided.

Geographic Range.—This group is found principally east of the Mississippi and most species are found in the Appalachian region. Within the mountains, most species are quite widespread— certainly not confined to very small ranges as seen in some of the western *Melanoplus* species. Evidently they move quite readily along ridge tops and perhaps through lower altitudes as well. Currently in the eastern USA they tend to be found along the crests of mountains. How closely the present distribution matches that of these species prior to man's activities (principally burning and logging) is very difficult to tell. Photographs of the Appalachians taken in the 1800's remind one of how extensive logging was. Places that are now completely forested were laid bare. These activities must have made colonization of new areas possible for most of the species and they may have expanded their ranges considerably during that time.

Most of the species live in forest openings and forest edges. Some live within the forest where much sunlight penetrates to the ground. Now that the forest is closing in again it seems probable that the current distribution of the species is far less than it was when the forest was thinned by logging.

Morphological terminology.—I do not often refer to morphological features in the text. Names for the most important parts of the genital apparatus are given in Figs 3 and 6.

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Interpretation of figures.—Females are very difficult or impossible for me to separate. Generally one can do this only by association with males collected at the same time and place. Traditionally in taxonomy, anatomical features are illustrated in some diagrammatic fashion. This was (and is) especially true when cameras were not used. There are two problems with this method. The first is that the artist encodes data (using stippling or strokes to indicate shading, for instance). Then the reader must decode the data. If encoding and decoding by artist and reader are quite different, then interpretations of structures are difficult or false. I have adopted both drawings and digital photos to convey anatomy. For the more delicate internal male structures I prefer digital photos, because they more accurately reflect what the user might see under the microscope.

Ecology.—As already noted, the members of this group are found in openings in woods. On occasion they may be found quite far from the edges of the woods as on the crest of Roan Mountain along the Appalachian Trail between North Carolina and Tennesee or on Max Patch farther to the southeast. Occasionally they are found inside the woods, but (almost) only when they can walk about sunning themselves in sunlit areas. Quite often they are distributed along roads which run through the forest, especially if the road margins are not mowed up to the trees. Deep woods or woodlands with just occasional small patches of sunlight are never inhabited.

Most of the species prefer lush green vegetation that one finds along woods margins or in old fields. Often they are found more among herbaceous plants in open grassy areas. Pure stands of grass or sedge are usually not inhabited. Usually the vegetation in which they are found is shorter than knee height.

Judging from the early emergence of adults, some of the species apparently overwinter in the late nymphal stages, rather than the egg stage. This causes them to be among the first grasshoppers to emerge as adults in the spring and early summer. At this time the vegetation in forest openings is also shorter than it becomes late in the summer, and the sun is able to penetrate to the ground more readily.

List of species

Viridipes Group of *Melanoplus*
1. *Melanoplus eurycercus* Hebard
2. *Melanoplus benni* New Species
3. *Melanoplus viridipes* Scudder
4. *Melanoplus lilianae* New Species
5. *Melanoplus acrophilus* Hebard
6. *Melanoplus pachycercus* Hebard
7. *Melanoplus deceptus* Morse
8. *Melanoplus cherokee* Hebard
9. *Melanoplus hubbelli* Hebard
10. *Melanoplus sylvaticus* McNeill
11. *Melanoplus longicornis* Saussure
12. *Melanoplus beameri* Hebard
13. *Melanoplus similis* Morse

Group Uncertain
14. *Melanoplus gracilis* Bruner

MELANOPLUS VIRIDIPES GROUP

Recognition.— Legs 1 and 2 usually green. Legs 3 from moderately to strongly banded. When darkly banded colors are yellowish or white and black. Several species have hind femora only slightly banded. Body often very strikingly marked with black, white and green. Male genitalia have dorsal valve usually flattened and flared out, with thicker sclerotizations giving support; ventral valves extending beyond dorsal valves. Describing these features is best achieved with illustrations.

1. ***Melanoplus eurycercus* Hebard**
Fig. 6

Nomenclature.— See OSF Online (Otte & Eades 2002).

Taxonomy.— This species was previously thought to be a subspecies of *M. viridipes*. But the male reproductive structures and body coloration indicate it is a separate species.

Distribution.—Widespread through the northeastern states from Wisconsin to Vermont and south to North Carolina.

Recognition.—In overall appearance, especially in color pattern, four species are remarkably similar to *M. eurycercus* (shown in Fig. 1); they are *acrophilus, pachycercus, cherokee* and *deceptus*. *M. viridipes* and *M. lilianae* are also similar superficially, but are not as contrastingly colored. Body length to end of femur-3: 17-21 mm in males; 22-26 mm in females. Forewing variable in length, from about same length as pronotum to slightly longer than pronotum; never reaching middle of abdomen. Lower margin of lateral lobe dark band bowed. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 black at base at midline. Cercus: middle section wider or slightly wider than end. Femur-3 dark bands on medial area: black, connected in medial area.

Habitat.— Margins of woods, openings in woods and old fields near woods.

Life Cycle.— Adults most common in May, June, but present July and August.

Specimens dissected.— MASSACHUSETTS: Gt Barrington, 15 vi (ID-0048). - MARYLAND: Jennings, 24 vi (ID-0053). - MICHIGAN: Washtenaw Co., Ann Arbor, 28 v (ID-0077). - NEW YORK: Cattaraugus Co., Mix Creek Valley, 11 vi (ID-0043). - NORTH CAROLINA: Bakersville, v (ID-0044). - PENNSYLVANIA: Westmorland Co., Ligonier, viii (ID-0047, ID-0050); Derrick City, 6 vi (ID-0049). - VERMONT: St Albans, 21 vi (ID-0051). - VIRGINIA: Elliot Knob, 30 vi (ID-0054); WEST VIRGINIA: Bluestone State Park, 20 v 1963 (ID-0092); Highland Co., Sounding Knob, 21 viii (ID-0045); OHIO: Gambier [or Gambler], 6 vi (ID-0046); White Sulpher Springs (ID-0052); Randolph Co., Gandy Creek at 38.7389N on Rd CR, 29 June 1998 (D. Otte) 98-A3 (ID-1474); Pendleton Co., Spruce Knob, on road FR 104, 29 July 1998 (D. Otte) 98-A2 (ID-1475, ID-1476); Pocahontas Co., Snowshoe resort area, W of Cass, 17 July 1999 (D. Otte) 99-02 (ID-1466, ID-1467).

Other ANS specimens examined.— MASSACHUSETTS: Berkshire Co., Gt Barrington, vi; Berkshire Co., New Lenox, vii.- MARYLAND: Garret Co., Jennings, vi; Garret Co., nr Jennings, vi. - MICHIGAN: Berrien

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Co., Lakeside, vi, vii; Calhoun Co., W. of Tekonsha, vi; Otsego Co., , vii; Roscommon Co., Houghton Lake, vi; Washtenaw Co., Ann Arbor, 5 vi; Washtenaw Co., Fiegel's Woods, Ann Arbor, v; Washtenaw Co., Ann Arbor, 3rd Woods, vi, v; Washtenaw Co., Fiegel's roads, Ann Arbor, v.- NORTH CAROLINA: Mitchell Co., Bakersville, v.- NEW YORK: Caroline-Hartford , vi; Cattaraugus Co., Mix Creek Valley, vi; Monroe Co., Honeoye Falls, vii; Tompkins Co., Freev'le, vii; Tompkins Co., Groton, vi; Tompkins Co., Ithaca, v, vi, vii.- OHIO: Franklin Co., Georgesville, v; Greene Co., Cedarville, vii; Greene Co., Clifton, vi; Hamilton Co., Cincinnati, vi; Holmes Co., Paint, Vii; Knox Co., Gambler, v, vi; Lickling Co., Rocky Fk., vi; Mercer Co., Mendon, vi. - PENNSYLVANIA: Allegany Co., Pucketa Creek, v; Lakawanna Co., Moosic Lake, viii; McKean Co., Derrick City, vi; McKean Co., Pt. Allegany, vi; Monroe Co., Skytop, vii; Westmoreland Co., Ligonier, vii.- VIRGINIA: 1.5 m. N of Sprg on Elliott Knob, vi; Highland Co., Sounding Knob, viii; Wise Co., nr. High Knob, viii.- VERMONT: Franklin Co., St. Albans, vi.- WEST VIRGINIA: Blue Stem St. Pk. , nr lake, v; Greenbrier Co., White Sulfur Springs, vi; Pocahontas Co., between "Birthplace of Rivers" and Thornwood, vii.

2. *Melanoplus benni* new species
Fig. 8

Type.— Holotype male. Michigan: Montmorency County, 14 vii 1923 (T. H. Hubbell). Deposited in Academy of Natural Sciences, Philadelphia.

Taxonomy.— This species was usually confused with *M. eurycercus* and was often labeled as "atypical" or "intermediate" in the Philadelphia and University of Michigan collections.

Etymology.—Named in honor of the Benn family of Dearborn, Michigan.

Distribution.— Known from south-central Indiana to northern lower Michigan, and from upper Michigan and northern Wisconsin.

Diagnosis.— Most similar to *M. eurycercus* and *M. viridipes*. It differs from *M. eurycercus* mainly in the shape and sclerification of the male genitalia (*cf*. Figs 6 and 8). *M. beameri* is superficially similar in color pattern. It differs from *M. viridipes* slightly in the male aedeagus, and more strongly in the shape of the cerci. The almost complete lack of overlap in cercal shape is shown in Fig. 2, especially in the ratio of cercal length to the width of the cercus near the base.

Recognition.— Body length to end of femur-3: 17-20 mm in males; 21-23 mm in females. Forewings slightly shorter to slightly longer than pronotum in both sexes. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 pale at base at midline. Cercus: middle section wider than end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.— Margins of woods and openings in woods.

Life Cycle.— Adults mature in June, July and August.

Specimens dissected.— INDIANA: Lake Co., 20 vi (ID-0003); Marion Co., (ID-0009) x; Marion Co., 1 vi (ID-0014); Tremont, 9 vi (ID-0025); Marion Co. (ID-0078). - MICHIGAN: Montmorency Co. 14 vii 1923 (ID-0001); Montmorency Co., 14 vii (ID-0085); Berrien Co. (ID-0091); Berrien Co., Lakeside (ID-0011); Berrien Co., Warren Preserve, 28 vi (ID-0015); Missaukee Co., SE Moddersville (ID-0082); Clair Co., Lecta, 15 vii (ID-0083); Rosccommon Co., Higgins Lake (ID-0084); Otsego Co., 19 vii (ID-0005). - WISCONSIN: Merrill, 1 vii (ID-0002); Merrill, 1 vi (ID-0026); Polk Co., vii (ID-0016)

Specimens from ANS and UMMZ examined.— INDIANA: Tremont, vi; Marion Co.; vi, 10 vi; Monroe Co., Bloomington, vi. - MICHIGAN: Berrien Co., Lakeside, vi. Berrien Co., E.K. Warren Presrve, Warren Woods, vi, vii; Sawyer Dunes, vii; New Buffalo, ix. Clare Co., (misspelled as Clair on label) Leota, vii. Crawford Co., S of Military Res., vii; 1 m. E of Grayling, viii; Grayling, vii; 7 M. S of Military Res., vii. Dickinson Co., vii. Grand Traverse Co., vii. Iosco Co., Oscola, viii; Oscoda, viii; Iosco State Game Refuge, viii. Iron Co., vi. Missaukee Co., S.E. Moddersville, vii; T23N, R5W, S 35 on Hwy M55, just W of bridge at Muskegon River, vi. SE Moddersville, vii. Montmorency Co., vii). Oscoda Co., 8 m. SE Mio, (T25N R3E,S2), vii. Otsego Co., vii; Pigeon R., Trout Res., viii; Roscommon Co., Higgins Lake, Lyon Manor, vii. - WISCONSIN: Lincoln Co., Merrill, vii. Polk Co., vii.

3. *Melanoplus viridipes* Scudder
Fig. 7

Nomenclature.— See OSF Online (Otte & Eades 2002).

Taxonomy.—This species was previously thought to be comprised of two subspecies: *M. viridipes viridipes* and *M. viridipes eurycercus*. But the latter subspecies has been raised to species level because of considerable differences in the aedeagus and cerci.

Distribution.— Known from western Indiana, all of Illinois, eastern Iowa and eastern Minnesota.

Recognition.— Most easily confused with *M. benni* and *M. lilianae*. Distinguished from the former mainly by the cercal shape (but genitalia are also slightly different). Distinguished from the latter mainly by the configuration of the internal male genitalia. Body length to end of femur-3: 16.5-18.5 mm in males; 19.5-22 mm in females. Lower margin of lateral lobe dark band bowed. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 black at base at midline. Cercus: middle section as narrow as end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.— Margins of woods and openings in woods.

Life Cycle.— Adults most common in June, but present from May to August. A single male was collected in Lake County Illinois in September.

Specimens dissected.— ILLINOIS: Ogle (ID-0007); Muncie, 30 vi (ID-0008); Rockford, 11 vi (ID-0022); Pulaski, bluff, 10 vi (ID-0023); Whiteheath, woods, 20 vi (ID-0024). - IOWA: Bremer Co., 20 vi (ID-0019); Clayton Co., 9 vi (ID-0020); Monticello (ID-0021). - MINNESOTA: Faribault, 12 vi (ID-0013).

Other ANS specimens examined.— ILLINOIS: River de Pare (Spelling? JS), vi; Bureau Co., Princeton, vi; Calhoun Co., Kampsville, vi; Champaign Co., Urbana, vi; Cook Co., Glenview, vii; Cook Co., (if Palos Springs or Palos Park JS), Palos, vii; Kankakee Co., Kankakee, vii; Lake Co., Lake Forest, ix; Lake Co., (if Zion City JS), Zion, vii; Macoupin Co., Beaver Dam St. Pk., 8 mi. SW Carlinville,

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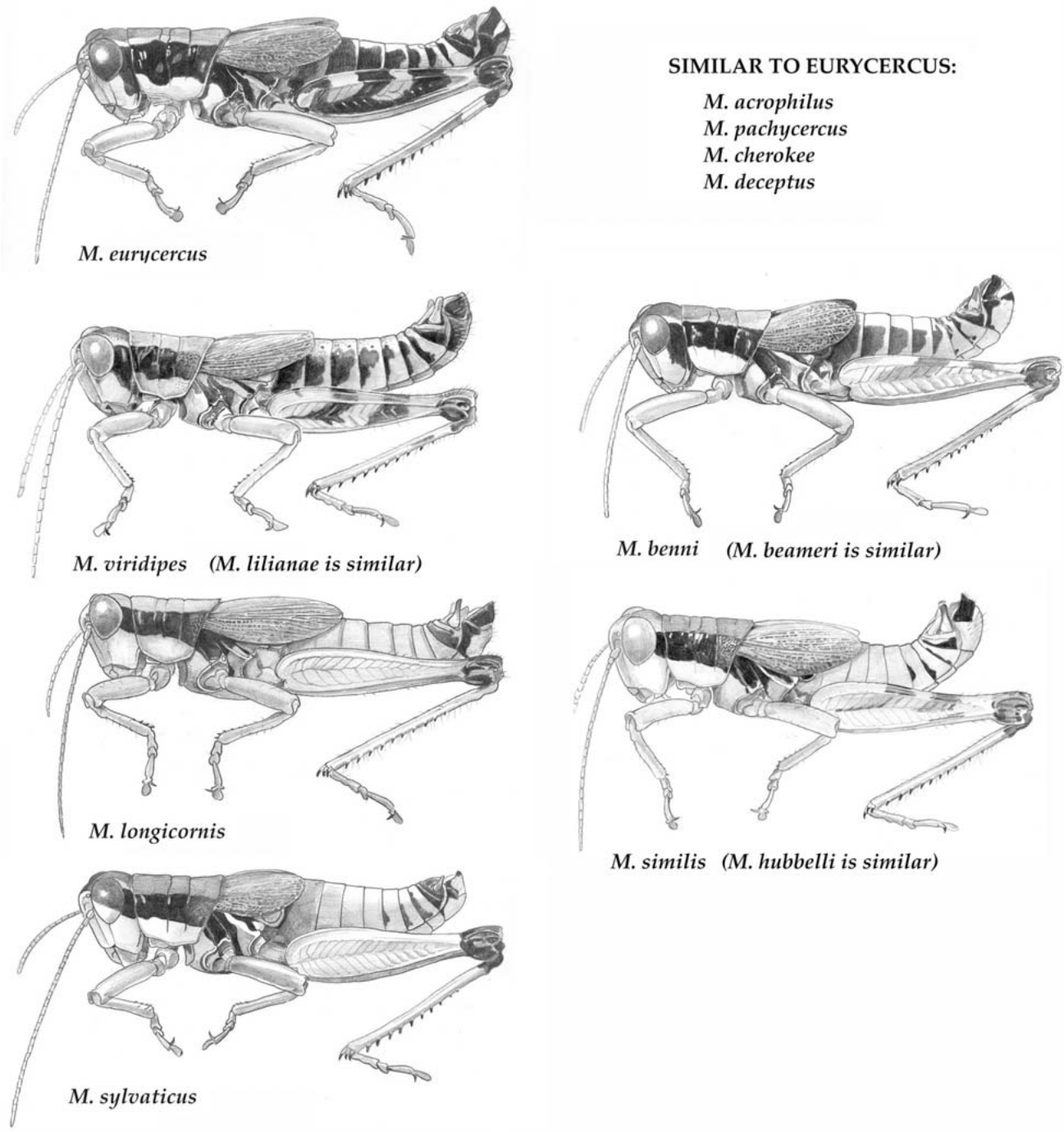


Fig. 1. Portraits of species which provide the reader with a general picture of the major differences in color pattern. Examination of other structures is needed to distinguish among *acrophilus, pachycercus, cherokee* and *deceptus*, or between *lilianae* and *viridipes*, or between *similis* and *hubbelli*, or between *benni* and *beameri*. But the ranges of some of these species do not overlap. In all species the front and middle legs are green. In the strikingly contrasting species the hind legs are black and yellowish green.

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6; Montgomery Co., 1 m. Hillsboro, on Ill. 16, vi; Ogle Co., ; Ogle Co., vi; Ogle Co., Oregon, vii; Piatt Co., Monticello, vi; Piatt Co., White Heath, vi; Pulaski Co., Pulaski, vi; Rock Island Co., Moline, 6-5-88; Vermilion Co., Oakwood, vi; Vermillion Co., Muncie, vi, vii; Winnebago Co., Rockford, vi. - IOWA: Bremer Co., vi; Clayton Co., vi; Clinton Co., vi; Delaware Co., vi; Jackson Co., vi; Jones Co., Monticello, vi; Linn Co., vi; Pocahontas Co., vi. - INDIANA: Tippacanoe Co., LaFayette, vi; Vigo Co. - MINNESOTA: Chicago Co., S. Croix Springs, Vii; Houston Co., v; Pine Co., Pine City, vii; Ramsey Co., St. Anthony Park, vi; Rice Co., Faribault, vi.

4. *Melanoplus lilianae* new species
Fig. 9

Type.— Holotype male. Iowa: Iowa County, 23 v 1935 (R. I. King). Deposited in the Academy of Natural Sciences, Philadelphia.

Taxonomy.— Ten paratype males and 5 paratype females were collected at the localities indicated under distribution. These are deposited in the Academy of Natural Sciences, Philadelphia.

Etymology.— Named after my mother, Lilian Young, who was born in Eagle Grove, Iowa in 1901.

Distribution.— Eastern Iowa. Collected at the following localities: Iowa: Cedar Co. (June). Clayton Co. (June). Iowa Co. (May, June). Johnson Co. (May, June)

Diagnosis.— This species is very similar to *M. viridipes*. But the male genitalia are consistently different in shape. These differences are shown in Figs 7 and 9

Recognition.— Body length to end of femur-3: 18-18.5 mm in males; 19-21 mm in females. Forewings about as long as pronotum or slightly longer. Lower margin of lateral lobe dark band bowed (Fig. 9G); sometimes only slightly. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 pale at median base. Cercus: middle section as narrow as end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.—Not recorded. Probably wood margins and openings.

Life Cycle.—All adults collected in May and June.

Specimens dissected.— IOWA: Iowa Co., 23 vi (ID-0004); Johnson Co., 30 vi (ID-0012); Cedar Co., 29 vi (ID-0017); Iowa Co. (ID-0018).

5. *Melanoplus acrophilus* Hebard
Fig. 10

Nomenclature.— See OSF Online (Otte & Eades 2002).

Distribution.— Western Virginia, western North Carolina, northern Georgia.

Recognition.— Most similar to *M. pachycercus*. These two species may overlap slightly along the Blue Ridge Parkway. They are most reliably separated by the internal male genitalia. Body length to end of femur-3: 16-19 mm in males; 18-22 mm in females. Forewings from slightly shorter to slightly longer than pronotum. Lower margin of lateral lobe dark band bowed. Furculae represented by indistinct mounds. Sternite-10 entirely black. Sternite-9 pale at base, or with very narrow dark band. Cercus: middle section narrower than end. Femur-3 dark bands on medial area: black, connected in medial area.

Habitat.— Mountain slopes and ridges. Probably in open woods or woods margins.

Life Cycle.— Most adults collected in May and June; a few were taken in July and August.

Specimens dissected.— GEORGIA: Lumpkin Co., DeSoto Falls, vi (ID-2226). - NORTH CAROLINA: Yancy Co., Mt. Mitchell State Park, vicinity of Ranger Station near parking lot, 7-8 vi 2000 (Otte *et al.*) 00-02 (ID-1760, ID-1759, ID-1758, ID-1758; Yancy Co., Blue Ridge Parkway, between miles 341-342, *ca*. 1 mile N of Route I-80, 7 vi 2000 (Otte *et al.*) 00-03 (ID-1761); Watauga Co., Blue Ridge Parkway, Moses Cone Overlook, 19 June 2002 (D. Otte) 02-01 (ID-2204); Mt Mitchell, 29 v (ID-0006); Mt Greybeard (not found in any geographic source), 23 v (ID-0081).

Other ANS specimens examined.— GEORGIA: Habersham-Towns border, Tray Mt., vi; Mt. Mitchell, v, viii; Mitchell Co., Penland, vi.

6. *Melanoplus pachycercus* Hebard
Fig. 11

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Western Virginia and western North Carolina. Collected at the following localities: Virginia: Giles Co., Mountain Lake (July). North Carolina: Macon Co., Franklin (August).

Recognition.—Body length to end of femur-3: 17-19 mm in males; 18-22 mm in females. Forewings from slightly shorter to slightly longer than pronotum. Lower margin of lateral lobe dark band usually straight. Furculae distinct but small or absent. Sternite-10 black at base and tip or mostly pale. Sternite-9 black at base at midline. Cercus: middle section as narrow as or narrower than end. Femur-3 dark bands on medial area: black, connected in medial area.

Habitat.— Margins of woods, sunny openings in woods and grassy mountain balds.

Life Cycle.— Adults collected in June, July and August.

Specimens dissected.— NORTH CAROLINA: Mitchell Co., Roan Mt, along Appalachian Trail, above Carvers Gap, 7 vi 2000 (Otte *et al.*) 00-01 (ID-1755, ID-1756, ID-1757); Yancy Co., Blue Ridge Parkway, between miles 341-342, *ca.* 1 mile N of Route I-80, 7 vi 2000 (Otte *et al.*) 00-03 (ID-1762, ID-1763); Avery Co., Blue Ridge Parkway, between mile 309-310, near Flat Rock, 9 vi 2000 (Otte *et al.*) 00-04 (ID-1745, ID-1744); Mitchell Co., Roan Mt, along Appalachian Trail, above Carvers Gap, 7 June 2000 (Otte *et al.*) 02-03 (ID-2218). - VIRGINIA: Giles Co., Mt Lake, 18 vii (ID-0079, ID-0080); Giles Co. Mt Lake Biol. Station, 1 vii (ID-0088); Mt. Lake, just N of Minnie Ball Hill (ID-0093, ID-0094); Grayson Co., Mt. Rogers State Park, 24 vii (ID-0095).

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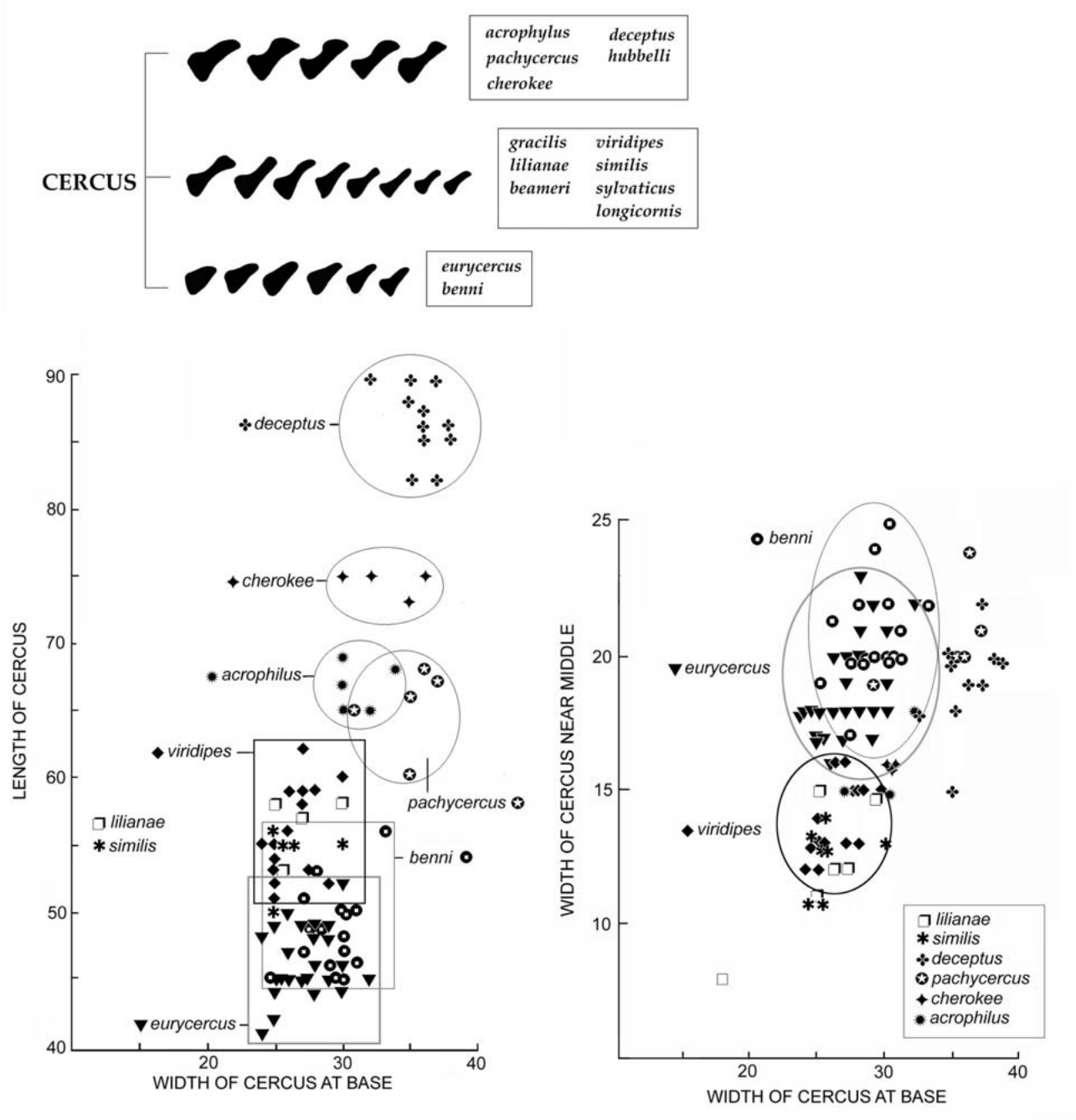


Fig. 2. Identification of Viridipes Group species is best begun with an examination of the cerci. These may be clustered into three basic types. Within those types there may be morphological overlap between some of the species. Units of measurement are micrometer units.

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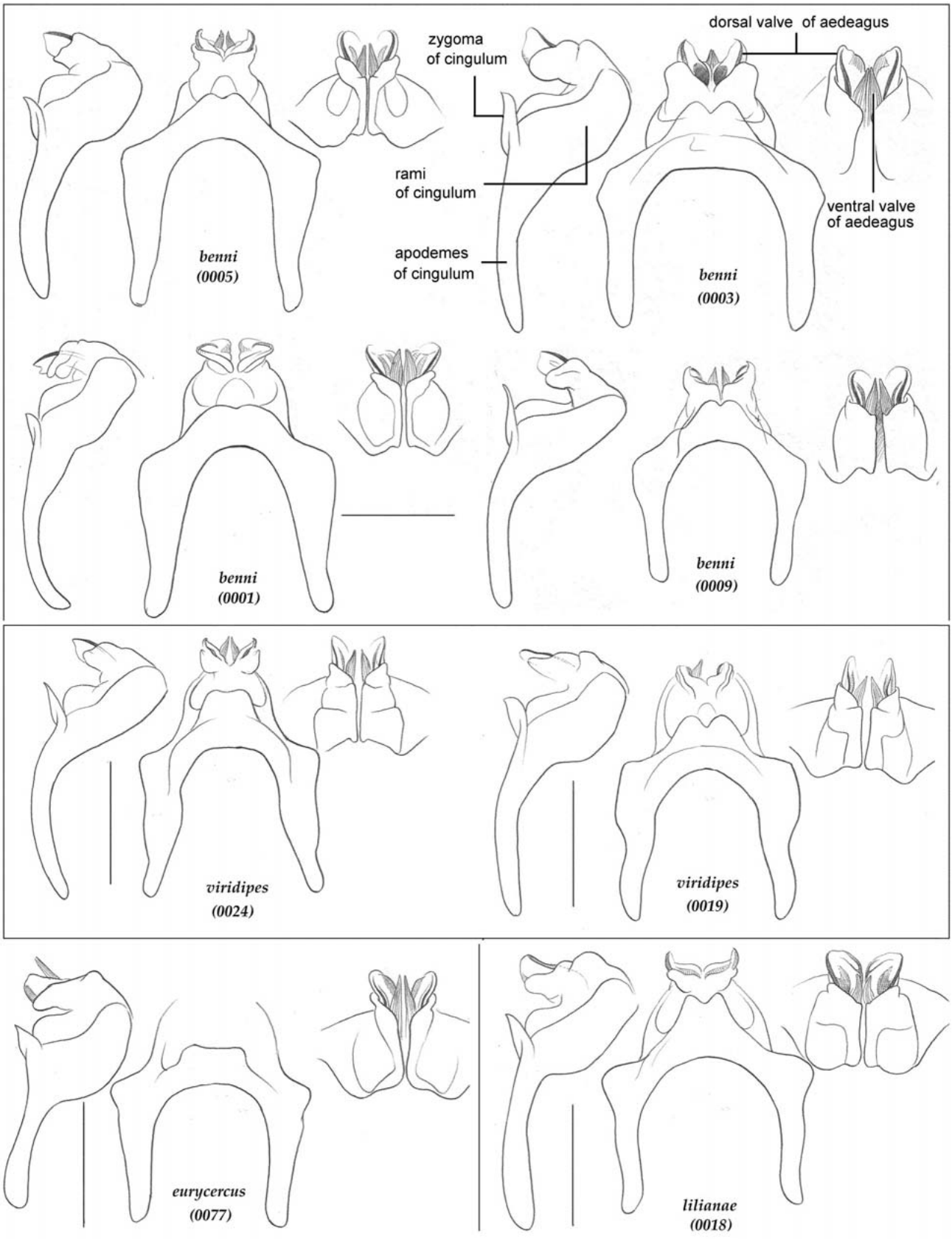


Fig. 3. Ectophallus showing cingulum and emerging aedeagus. In each case the view is lateral, dorsal, and rear. In two of the species some variation in structures is shown. Scale = 0.5 mm. NOTE: The appearance of the shape of the aedeagus is highly dependent on the angle of view.

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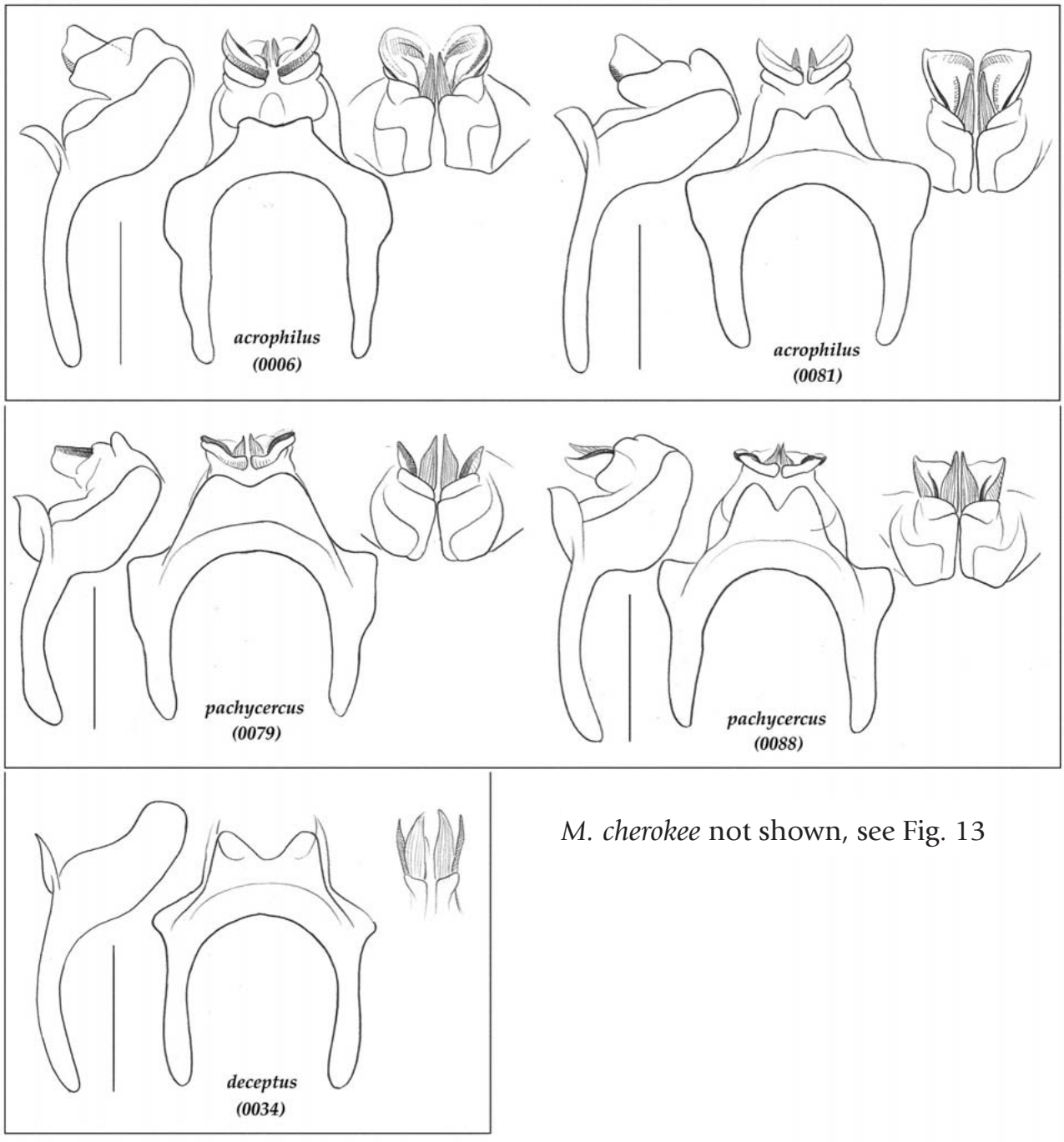


Fig. 4. Ectophallus showing cingulum and emerging aedeagus. In each case the view is lateral, dorsal, and rear. In two of the species some variation in structures is shown. Scale = 0.5 mm. NOTE: The appearance of the shape of the aedeagus is highly dependent on the angle of view.

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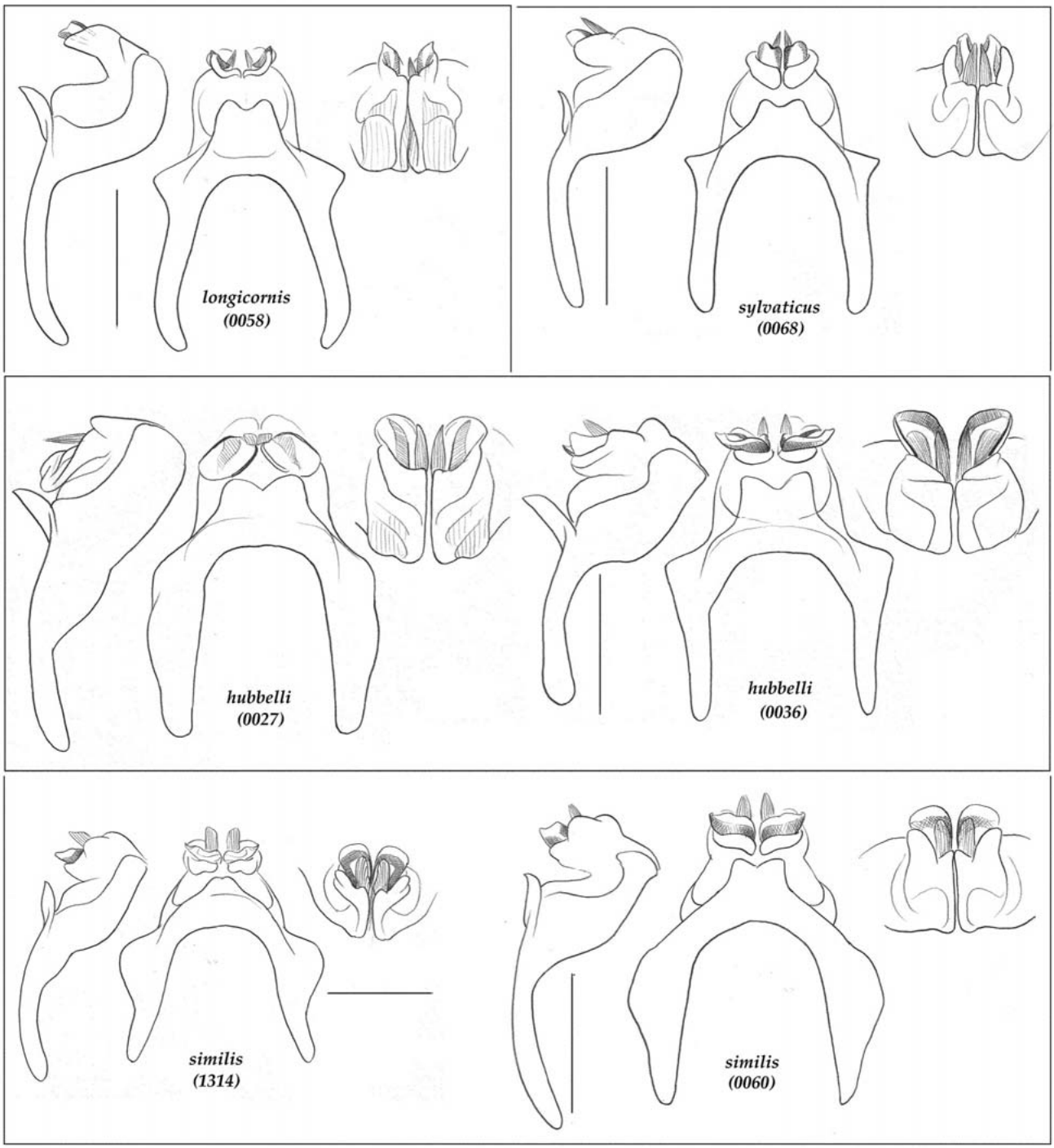


Fig. 5. Ectophallus showing cingulum and emerging aedeagus. In each case the view is lateral, dorsal, and rear. In two of the species some variation in structures is shown. Scale = 0.5 mm. NOTE: The appearance of the shape of the aedeagus is highly dependent on the angle of view.

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Other ANS localities.—NORTH CAROLINA: Crabtre Mdws, Blue Ridge Pkwy., v. - VIRGINIA: Grayson Co., Mt. Rogers, Elk Garden Ridge, vii; Giles Co., Mountain Lake Biol. Sta., vi, vii, viii, Giles Co., Roadside Spring, vi; Giles Co., Sinking Creek, vi; Grayson Co., Mt. Rogers St. Pk., Haw Orchard Mtn., vii; Grayson Co., Whitetop Mt., viii.

7. *Melanoplus deceptus* Morse
Fig. 12

Nomenclature.— See OSF Online (Otte & Eades 2002).

Distribution.—Known from a small region where the states of Tennessee, North Carolina, Georgia and South Carolina come together.

Recognition.—This species sometimes overlaps geographically with *M. cherokee*. Superficially they are very similar. However, the internal male genitalia are very different (see figures). Body length to end of femur-3: 18-20 mm in males; 19-24 mm in females. Forewings slightly shorter to slightly longer than pronotum in both sexes. Lower margin of lateral lobe dark band usually bowed. Furculae represented by indistinct mounds. Sternite-10 entirely black. Sternite-9 black at base at midline. Cercus: middle section narrower than end. Femur-3 dark bands on medial area: black, connected in medial area.

Habitat.—Mountain slopes and mountain tops. Probably woods margins and openings.

Life Cycle.—Adults from May to August.

Specimens dissected.— NORTH CAROLINA: Haywood Co., Sunburst, 14 vi (ID-0033); Mt Pisgah Ridge, 17 v (ID-0034); Mt Pisgah. 23 vi (ID-0037); Haywood Co., Sunburst (ID-0038); Jackson Co., Balsam, 19 viii (ID-0039); Jackson Co., 3 road mi east Balsam, viii 1956 (ID-0090); Gt Smoky Mt Nat. Park, Shot Beech Ridge, at US 441, 3 June 2001 (D. Otte) 01-03 (ID-1699); Gt Smoky Mt Nat. Park, Shot Beech Ridge, at US 441, 3 June 2001 (D. Otte) 01-03 (ID-1712); Gt Smoky Mt Nat. Park, Balsam Mt, Parkway Extension, near Masonic Monument, 3 June 2001 (D. Otte) 01-01 (ID-1692, ID-1693, ID-1694, ID-1695); Gt Smoky Mt Nat. Park, Shot Beech Ridge, at US 441, 3 vi 2001 (D. Otte) 01-03 (ID-1698, ID-1697); Madison Co., Max Patch Mt., lat 35° 47' 47'' N, long 82° 57' 39.8'' W, 21 June 2002 (Otte, Spearman, Weintraub) 02-04 (ID-2220); Haywood Co., Pisgah Mts, Sam Knob, lat 35° 19' 30.2'' N, long 82° 52' 58.5'' W 23 June 2002 (Otte, Spearman, Weintraub) 02-05 (ID-2223, ID-2224); Macon Co., Nantahala Mts, Wine Spring Bald, Appalachian Trail, 5 June 2001 (D. Otte) 01-04 (ID-1705, ID-1701, ID-1702, ID-1703, ID-1704). - TN-NORTH CAROLINA: Silers Bald Mt, 31 vii (ID-0035) . - TENNESSEE: Sevier Co., Gt. Smoky Mt Nat. Pk. (ID-0089). - SOUTH CAROLINA: Rocky Bottom, 16 viii (ID-0040); SOUTH CAROLINA: Caesars Head, 30 v (ID-0041); Pickens Co., Sassafras Mt, 31 v (ID-0042).

Other ANS specimens examined.— GEORGIA: Rabun Co., Rabun Bald, vi. - NORTH CAROLINA: Mt. Pisgah, vi; Buncombe Co., Black Mts., vi; Catawba Co. or Macon, Highlands, vii; Haywood Co., Crestmont, vii; Haywood Co., Sunburst, vi, v; Great Smoky Mtns Nat'l Park, Andrew's Bald, vi; Jackson Co., 1.5 mi N. Balsam on Jones Knob Road, Jun; Jackson Co., 3 road mi east Balsam on rd to Jones Knob, viii; Jackson Co., Balsam, Jones Park, viii; Jackson Co., Balsam, Jones' Peak, viii. - SOUTH CAROLINA: Greenville, Ceasars Head, v, vi; Pickens, Rock Bottom, viii; Pickens, Sassafras Mts, v. - TENNESSEE: Sevier, Great Smoky Mtns Nat'l Park, approx. 7 mi SSE Gatlinburg, v; Sevier, Silers Bald Mt., vii; Sevier or Blount or Cocke, Great Smoky Mtns Nat'l Park, vi.

8. *Melanoplus cherokee* Hebard
Fig. 13

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Extreme western North Carolina and northern Georgia.

Recognition.—Body length to end of femur-3: 18-21 mm in males; *ca*. 21 mm in females. Forewing from slightly shorter to slightly longer than pronotum. Lower margin of lateral lobe dark band bowed. Furculae represented by indistinct mounds. Sternite-10 entirely black. Sternite-9 black at base at midline. Cercus: middle section narrower than end. Femur-3 with distinct black bands.

Habitat.—On grassy mountain tops and mountain crests; also in margins of woods and openings in woods where the sun penetrates readily.

Life Cycle.—Adults were collected in May in the Great Smoky Mountains National Park, in June in Rabun County, Georgia, in July in Buncombe and Haywood counties, North Carolina.

Distribution.—Georgia: Rabun Co., Clayton, 2000-3700 feet (July). North Carolina: Swain Co., Great Smoky Mountains (May). Buncombe Co., Sandymush (July). Haywood Co., Crestmont (or Crestmount), 1800-4200 feet; Mt. Sterling, 5100 feet (August).

Specimens dissected.—NORTH CAROLINA: Haywood Co., Crestmont, 28 July 1924 (ID-0057); Haywood Co., Cruso, 28 vi (ID-0059); Madison Co., Max Patch Mt., lat 35° 47' 47'' N, long 82° 57' 39.8'' W, 21 June 2002 (Otte, Spearman, Weintraub) 02-04 (ID-2189); Pisgah Mts, Sam Knob, lat 35° 19' 30.2'' N, long 82° 52' 58.5'' W 23 June 2002 (Otte, Spearman, Weintraub) 02-05 (ID-2222).

9. *Melanoplus hubbelli* Hebard
Fig. 14

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Widespread from southern Indiana east to Maryland and southeast to northern Georgia and South Carolina.

Recognition.—Body length to end of femur-3: 18-21 mm in males; 22-25 mm in females. Lower margin of lateral lobe dark band straight. Furculae represented by indistinct mounds. Sternite-10 mostly black. Sternite-9 black at base at midline. Cercus: middle section narrower than end; pointed at lower distal end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.—These species appear most commonly associated with woods edges and openings in the forest, but may be found in old fields. Some have been collected on bald mountain tops. Some of these may not be natural balds. Dakin and Hays (1970) report this species from vegetation near the edges of a small stream and near the edges of lakes, and also in blueberry bushes at the summit of Cheaha Mountain in Alabama.

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Life Cycle.—Most adults have been collected in June and July.

Specimens dissected.—GEORGIA: Jasper, 26 vii (ID-0032). - MARYLAND: Thurmont, Catectia (sp?) Mts, 4 vii (ID-0027). - NORTH CAROLINA: Black Mts. (ID-0036). - OHIO: Knox Co., 17 vi (ID-0030); Franklin Co., Red Hills, 1 vii (ID-0031). - SOUTH CAROLINA: Oconee Co., CCC Camp F2, 26 vi (ID-0028). - TENNESSEE: Fentress Co., Allardt, 13 vi (ID-0029).

Other ANS specimens examined.—GEORGIA: Pickens Co., Jasper, vii; Rabun, Clayton Co., vi; Rabun, Tuckulage Co. (?), vii. - INDIANA: Lawrence Co., vii; Orange Co., 5.6 m. S Paoli, vi; Vigo Co., vi. - MARYLAND: Frederick Co., Catocin Mts., nr. Thurmont, vii; Frederick Co., Catoctin Mts., nr. Thurmont, vii; Frederick Co. & Washington Co. border, Blue Ridge, South Mt., vii.- NORTH CAROLINA: Buncombe Co., Black Mts., vi; Franklin Co., Red Hills, vii; Polk Co., Columbus, Red Hills, vii.- OHIO: Franklin Co., Columbus, vi; Franklin Co., Red Hills, vii; Hocking Co., Good Hope, vi; Knox Co., vi; Knox Co., vi; Knox Co., Millwood, vi, vii. - SOUTH CAROLINA: Pinnacle Mtn., vi; Oconee Co., CCCCamp F2, vi; Oconee Co., Jocassee, vii; Pickens Co., Rocky Bottom, v, vi, vii, viii; Pickens Co., Sassafras Mtn., vi. - TENNESSEE: Fentress Co., Allardt, vi. - VIRGINIA: Big Bald Knob Mt., vi; Augusta Co., Deerfield, vi; Augusta Co., Mt. Elliott, vii; Fauquier Co., near Paris, vii; Loudoun Co., Bluemont, vii; Bull Run Mt., vi, vii; Hopewell Gap, Bull Run Mts., vii; Fauquier?, Bull Run Mt. nr. Broad Run, vii. - WEST VIRGINIA: Pendleton, headwaters Dig Run nr Spruce Knob, v.

10. *Melanoplus sylvaticus* McNeill
Figs 15, 16

Nomenclature.— See OSF Online (Otte & Eades 2002).

Taxonomy.—Two genitalic types were encountered in this study. Whether these represent two species or not remains unknown. I have termed the two *M. sylvaticus A* and *M. sylvaticus B*. The map of *sylvaticus* is puzzling. While the two types have not been collected at the same localities, they have been found in both Arkansas and Missouri, not too far from one another. I believe there is the strong likelihood that they represent different species.

Distribution.—Known only from southern Missouri and northern Arkansas.

Recognition.—Body length to end of femur-3: 18-21 mm in males; 22-25 mm in females. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 black only at base and tip. Sternite-9 pale at base at midline. Cercus: middle section as narrow as end. Femur-3 dark bands on medial area: absent or if distinct not connected.

Habitat.—These species are found along the margins of woods and in small clearings in woods. On Magazine Mountain, Arkansas, they were found in small patches of sunlight that was penetrating the canopy. Some of these sun patches were not more than a few feet in diameter. I suspect that animals move about following the sun as it moves.

Life Cycle.—Adults have been collected in June and July. The overwintering stage is not known.

Specimens dissected.—*M. sylvaticus* B: - MISSOURI: Willard, 4 vii 1912 (ID-0068). - ARKANSAS: Logan Co., Magazine Mt., crest in woods, 11 vi 2001 (D. Otte) 01-13 (ID-1686, ID-1687). *M. sylvaticus* A: - ARKANSAS: Ozone, 6.11.32 (ID-0069). - MISSOURI: Mountain Grove, 1 vii 1915 (ID-0070).

Other ANS specimens examined.—ARKANSAS: Johnson Co., Ozone vi; Logan Co., Mt. Magazine, Brown Spring, vi; Logan Co., Mt. Magazine, Cameron Bluff, vi; Logan Co., Mt. Magazine, lodge area, vi. - MISSOURI: Greene Co., Willard, vi, vii; Greene Co., Willard, vii, viii; Wright Co., Mtn. Grove, 7-1-15.

11. *Melanoplus longicornis* Saussure
Fig. 17

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Known only from Clayton Co., Georgia.

Recognition.—Body length to end of femur-3: 18 mm in one male. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 black except upper margin. Sternite-9 black at base at midline. Cercus: middle section wider than or as narrow as end. Femur-3 dark bands on medial area: absent or if distinct not connected.

Habitat.—Not recorded. Collected on mountain slopes between 2000 and 3700 ft.

Life Cycle.—Adults collected in June.

Specimens dissected.—GEORGIA: Clayton Co., vi (ID-0058).

12. *Melanoplus beameri* Hebard
Fig. 18

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Known only from extreme northeastern Kansas (Leavenworth Co.) and western Missouri (Jackson Co.).

Recognition.—Body length to end of femur-3: 18-20 mm in males; 20-22 mm in females. Forewings about as long as pronotum or slightly shorter in both sexes. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 black at base at midline. Cercus: middle section as narrow as end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.—Not recorded.

Life Cycle.—Adults collected in June and July.

Specimens dissected.—KANSAS: Leavenworth Co. (ID-0055). - MISSOURI: Kansas City (ID-0056).

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13. ***Melanoplus similis* Morse**
Fig. 19

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Southern Ohio to northwestern South Carolina and east to southern New York.

Recognition.— Body length to end of femur-3: 18-20 mm in males; 20-23 mm in females. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 entirely black. Sternite-9 pale at base at midline. Cercus: middle section as narrow as end. Femur-3 dark bands on medial area: brownish, not connected.

Habitat.—Dry upland forests of pine and oak; living in bushes or leaf litter; also present and sometimes more abundant in wetter portions than drier slopes. Collected on mountain slopes from 800 to 3000 ft.

Life Cycle.—Most adults collected in June and July.

Specimens dissected.—NEW YORK: West Point, 14 vi (ID-0067). - NORTH CAROLINA: Haywood Co., Mt. Sterling 29 vii (ID-0062); Murphy (ID-0063); Murphy, 25 vii 1903 (ID-1314). - OHIO: Jackson Co., Jackson, 11 vii (ID-0064). - TENNESSEE: Cumberland Co., Grassy Cove, 5 vii (ID-0065); Fentress Co., Allardt, 19 vii (ID-0066). - VIRGINIA: Bath Co., Collison Ridge, 5 vii (ID-0061). - WEST VIRGINIA: White Sulpher Springs, 3 vii (ID-0060).

GROUP UNCERTAIN

Based on the very different male genitalia and other features, I do not think that *M. gracilis* is closely related to members of the Viridipes Group. I place it here to show how it differs from those species.

14. ***Melanoplus gracilis* Bruner**
Fig. 20

Nomenclature.—See OSF Online (Otte & Eades 2002).

Distribution.—Distributed over much of the eastern United States, mainly east of the Missouri River and west of the Appalachians, except the deep south.

Recognition.—Body length to end of femur-3: 17-20 mm in males; 19-22 mm in females. Lower margin of lateral lobe dark band straight. Furculae distinct but small. Sternite-10 pale except dark on upper margin. Sternite-9 pale at base at midline. Cercus: middle section narrower than end. Femur-3 dark bands on medial area: absent.

Habitat.—This is a woodland species. It prefers such tangles as shrubby plants, and thickets of elder undergrowth with blackberry, and the lower parts of woodlands, as along streams. In southern states, in tall grasses and weeds along edges of woods and mountains slopes in the undergrowth of open woods. In Indiana, Blatchley (1920) reports it from low wooded blue-grass pastures, in foliage of iron weeds, along paths through woods, in tall grass growing in ravines and along borders of sloughs and marshes. In Arkansas he reports it from a cool damp mountain thicket.

Life Cycle.—This species appears to overwinter in the egg stage. Adults have been collected from June to September, but numbers seem to peak in July.

Specimens dissected.—INDIANA: Lake Co., 24 vi 1902 (ID-0072). - MICHIGAN: Berrien Co. Three Oaks, 9 ix 1920 (ID-0071). - MINNESOTA: Burnside, along Cannon River, 29 vii 1935 (ID-0073). - MISSISSIPPI: Iuka, 14 vii 1930 (ID-0076). - NEBRASKA: Omaha (ID-0075). - OHIO: Champaign Co. Cedar Swamp, 14 ix 1932 (ID-0074).

Other ANS specimens examined.—ALABAMA: Dallas Co., Marion Jct., vii; Jackson, 4 m. W. Scottsboro, viii; Logan, Magazine Mt., Aug.- IOWA: Dallas, Aug; Muscatine Co., viii. - ILLINOIS: Champaign Co., Urbana, viii; Champaign or Clark, Homer, vii; Clark Co., West Union, vi; Coles Co., Charleston, viii; Cook Co., Kenilworth, viii; Fulton Co., West Havana, Oct; Jersey or Montgomery Co., Chautauqua, vii; Johnson Co., Karnak, ix; Lee Co., Dixon Springs, x; Mason Co., Havana, viii; Vermillion Co., Muncie, ix; Washington Co., Dubois, vi. - INDIANA: Franklin Co., Mt. Carmel, vi; Jackson Co., Medora, vii; Lake Co., vii; Lake Co., Millers, x; Marion Co., x; Porter Co., ix; Porter Co., Mineral Springs, vii; Putnam Co.; St. Joixh Co., Osceola, vii; Tippecanoe Co., Battle Ground, viii; Tippecanoe Co., LaFayette, ix; Tippecanoe Co., W. Lafayette, vii; Vigo Co., x; Wells Co., 9-11-01. - KANSAS: Leavenworth Co., vii. - MICHIGAN: Berrien Co., New Buffalo, ix; Berrien Co., Three Oaks, ix; Jackson Co., Bullardt Lake, ix; Berrien Co, Lakeside, vii. - MINNESOTA: Scott Co., Savage Trout Stream, viii; SE Minnesota, Burnside, along Cannon R., vii, viii; Winona Co., Winona, ix. - MISSOURI: Boone Co. Columbia, x; Greene Co., Willard, vii. - MS: Tishomingo Co., Iuka, vii. - NEBRASKA: Cass, Co. Weeping Water, ix; Douglas Co., Omaha, ix. - OHIO: Champaign Co., Cedar Sw., ix; Huron Co., ix. - PENNSYLVANIA: Columbia Co., Bloomsburg, ix; Westmoreland Co., Ligonier, vii. - TENNESSEE: Grossville, ix; Montgomery Co., Clarksville, xi, ix, vii. - VIRGINIA: Highland Co., Monterey, viii.

Discussion

This paper gives only a sketch of an interesting group of grasshoppers. A cladistic analysis of relationships among the species has not been attempted. They are so similar to one another that it is difficult to find characters which may be used. Such an analysis would best be based on molecular data. Tissue from the Appalachian species collected since 1998 is stored in the Academy of Natural Sciences collection where it is available to persons with the necessary skills. The material is stored in 70% or 99% ethanol.

A few comments on the genus are in order.

After the felling of most of the eastern forests, distributions of grasshoppers must have changed drastically. While the outer limits of distribution may not have changed much, the opening of habitats such as forest edges must have caused a huge increase in the distribution within the overall range and perhaps extensive gene flow among formerly isolated or semi-isolated populations. Morphological differences which may have evolved in isolated regions may have been swamped by the exchange. Because of the considerable similarities among the species, one wonders how much hybridization occurred. Outside of the southern Appalachians, we have no direct evidence that two species occur together at one site. Geographic overlap between species is seen between *M. pachycercus* and *M. acrophilus* and between *M. cherokee* and *M. deceptus*. The genitalia difference between the former two species is quite small.

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Perhaps these two species were not sympatric prior to deforestation. However, the large difference in the genitalia between *M. cherokee* and *M. deceptus* and their co-occurrence in areas that must not have changed all that much suggests that they have co-evolved and the genitalic differences are large because of this. The genitalic differences are as great as can be found between any two species in this complex, and yet externally they are very similar. This relationship needs to be investigated further, and mating studies between them should be done.

The status of *M. benni* is somewhat problematical. Currently the main distribution is north of the suture zone which runs across central Michigan, but specimens from Berrien Co., Michigan, and from central Indiana, appear to belong in *M. benni* as well. This seems to be an odd distribution and might indicate an incorrect identification. If no mistake was made, then *M. benni* and *M. viridipes* must now be sympatric in western Indiana. It appears from the distribution maps that *M. viridipes*, *M. benni*, and *M. eurycercus* replace one another going eastwards from Illinois to Ohio. In northern Michigan (lower peninsula), *M. eurycercus* and *M. benni* are sympatric, but it remains to be seen if they coexist.

The geographic relations between *M. viridipes* and *M. lilianae* in Iowa also must be looked at more closely. These two appear to be sister species, but the map shows overlap between them in northeastern Iowa.

The map also shows virtually no overlap between *M. viridipes* and *M. eurycercus*. They come closest to one another in Indiana and Ohio and in northwest Wisconsin.

M. pachycercus and *M. acrophilus* have overlapping distributions in western North Carolina. Mostly they are microgeographically allopatric, but both have been collected at one site.

M. deceptus is clumped into a small pocket of western North Carolina, northwest South Carolina, northeast Georgia and eastern Tennesee. Within its range it appears to be one of the most abundant species and large populations may be encountered. Its geographic overlap with *M. cherokee*, which is genitalically so different, offers the possibility for investigating the origin of genitalic differences between closely related species.

The status of *M. hubbelli* remains puzzling. I have not encountered it even though I have collected in areas where it has been taken. Can this be due to the fact that it spread widely into the east after deforestation and is now retreating as the forest closes in?

The *M. sylvaticus* situation offers more opportunities for study. I have noted that there appear to be two different genitalic types. The two kinds have not been collected together. Possibly they represent two different species, but the paucity of collections make it necessary to collect more, especially in areas between the two types.

M. longicornis need to be studied further. Why has this species only been taken at one locality?

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I thank Mark O'Brien of the University of Michigan Museum of Zoology for the loan of specimens. I very much enjoyed the company and help of John LaPolla, Lauren Spearman, Ashley Spearman, and Jason Weintraub while collecting in the Appalachians. The two Spearmans made me aware of the fact that two members of this species group may occur at one place. Ashley Spearman pointed out to me on Sam Knob in the Pisgah National Forest that two specimens encountered did not appear to be the same species. I doubted him, but have discovered that he was correct. Had it not been for his sharp eyes we would have missed both very rare species altogether.

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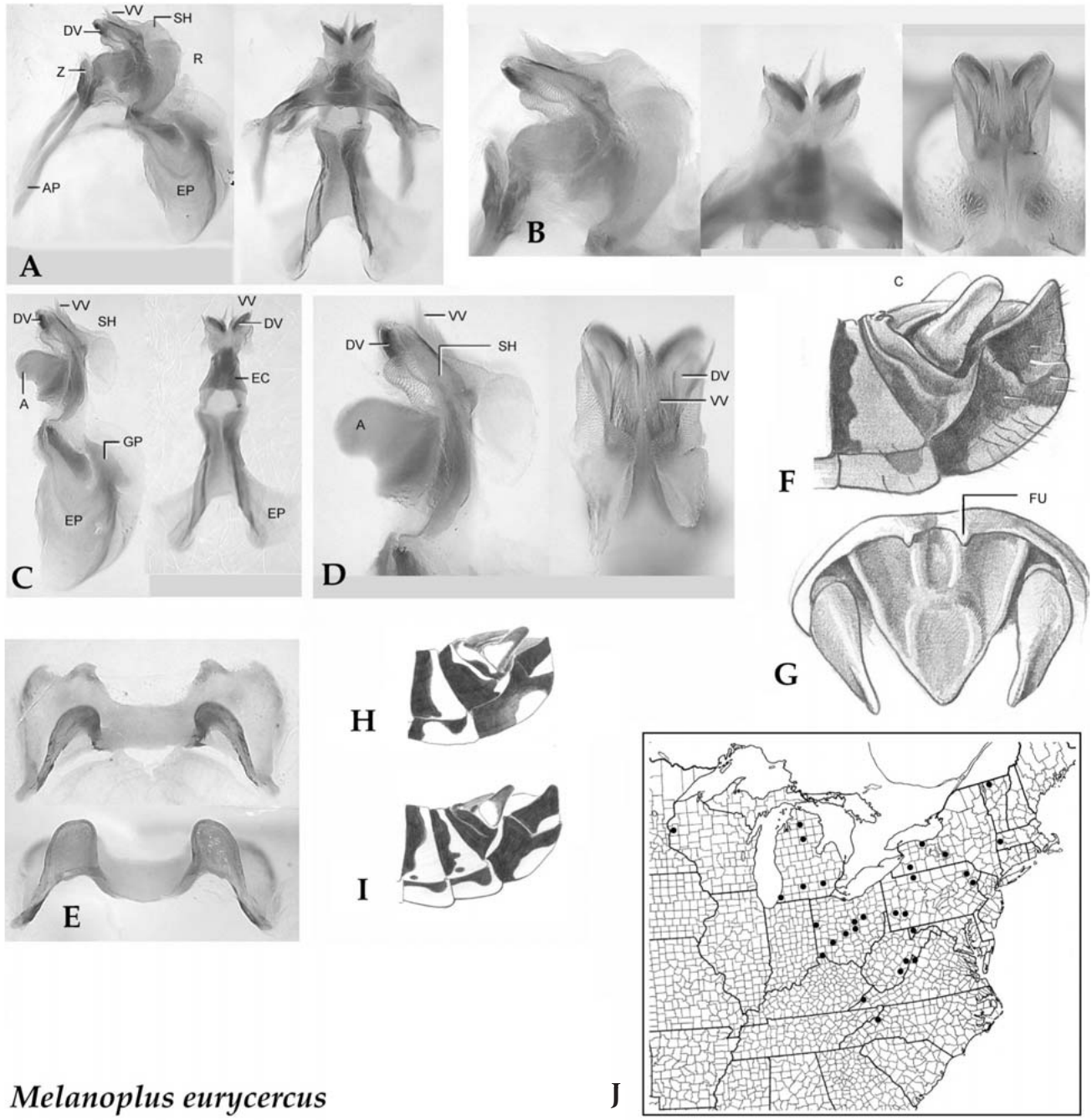


Fig. 6. *M. eurycercus*. A, phallic complex (lateral and dorsal views). B., closer view of phallic complex (lateral, dorsal, and ventral views). C, phallic complex with cingulum removed (lateral and dorsal views). D, close-up view of aedeagus (lateral and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen (lateral and dorsal views respectively). H, I, end of male abdomen, showing slight variation in pattern and cercus shape. J, distribution of species. NOTE: The appearance of the shape of the aedeagus is highly dependent on the angle of view. Key to abbreviations: AP, apodeme of cingulum; Z, zygoma of cingulum; R, ramus of cingulum; DV, dorsal valve of aedeagus; VV, ventral valve of aedeagus; SH, sheath of aedeagus; EP, endophallic plate; A, arch of aedeagus; GP, gonopore plate; EC, ectophallus.

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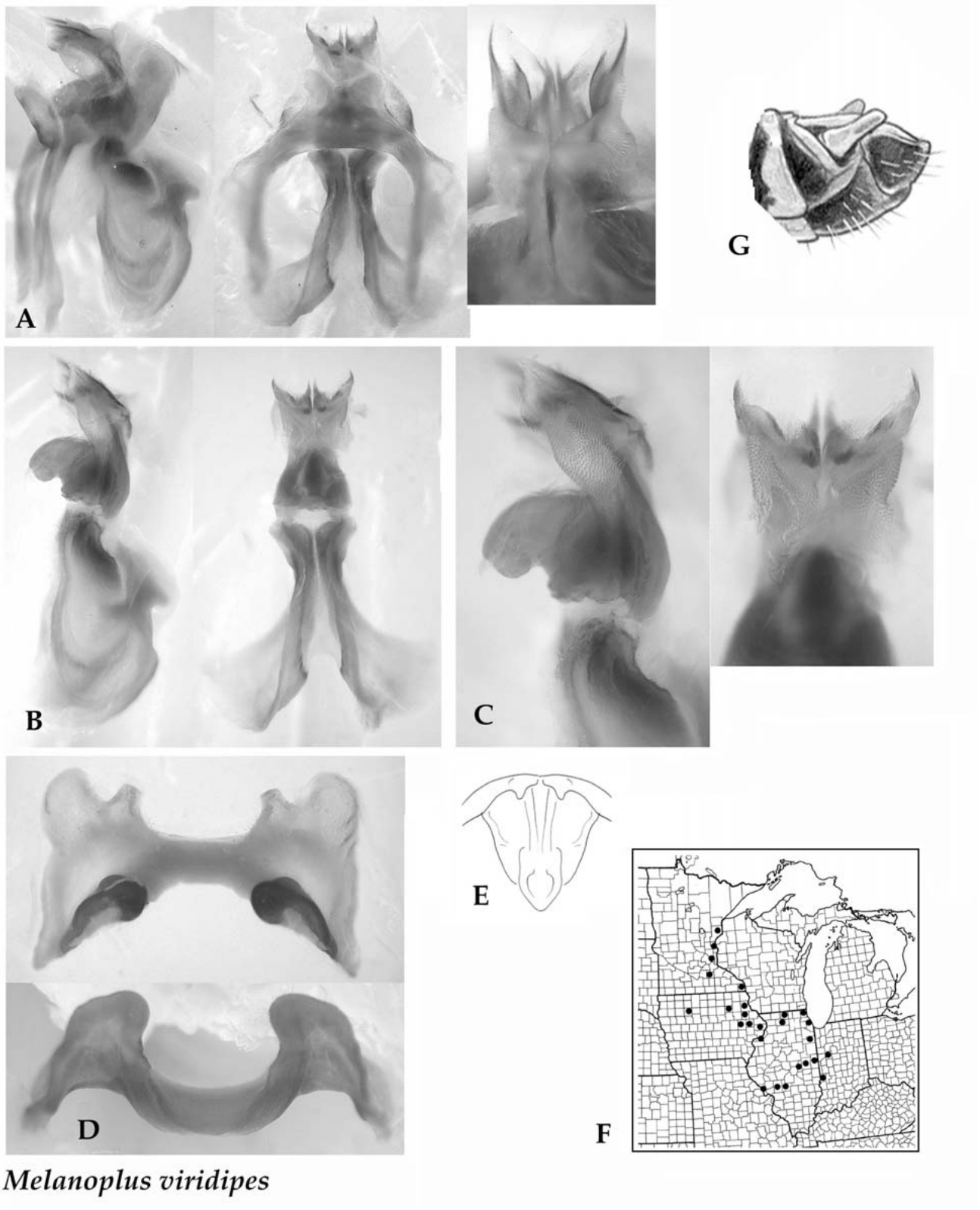


Fig. 7. *M. viridipes*. A, phallic complex (side, dorsal, and rear views). B, phallic complex with cingulum removed (side and dorsal views). C, close-up view of aedeagus (side and ventral views). D, epiphallus (dorsal and rear views). E, last segments of male abdomen (dorsal). G, cerci. F, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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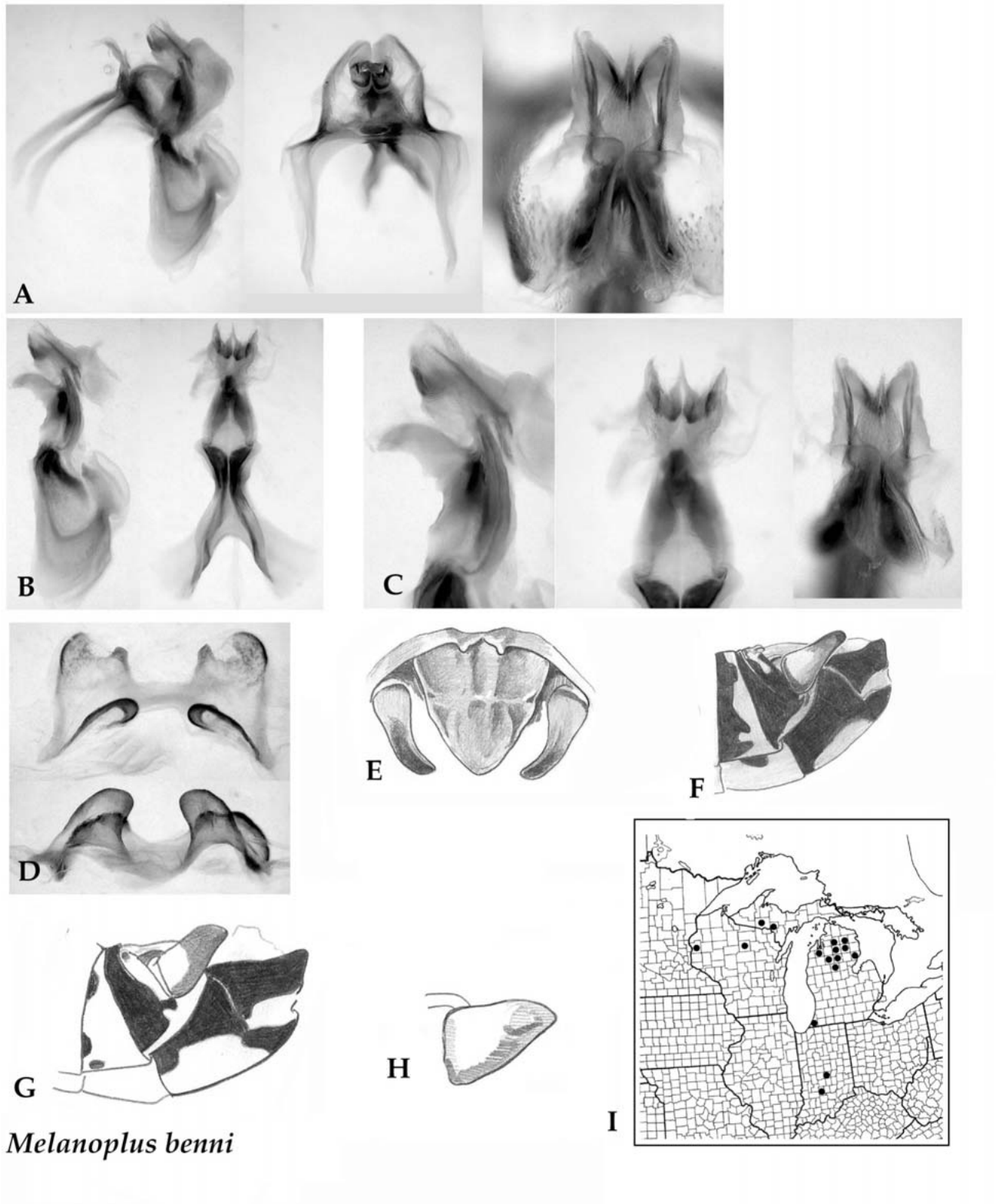


Fig. 8. *M. benni*. A, phallic complex (side, dorsal, and rear views). B, phallic complex with cingulum removed (side and dorsal views. C, close-up view of aedeagus (side, dorsal and ventral views). D, epiphallus (dorsal and rear views). E, last segments of male abdomen (dorsal view). F, G, end of abdomen showing some variation. H, shorter version of cercus. I, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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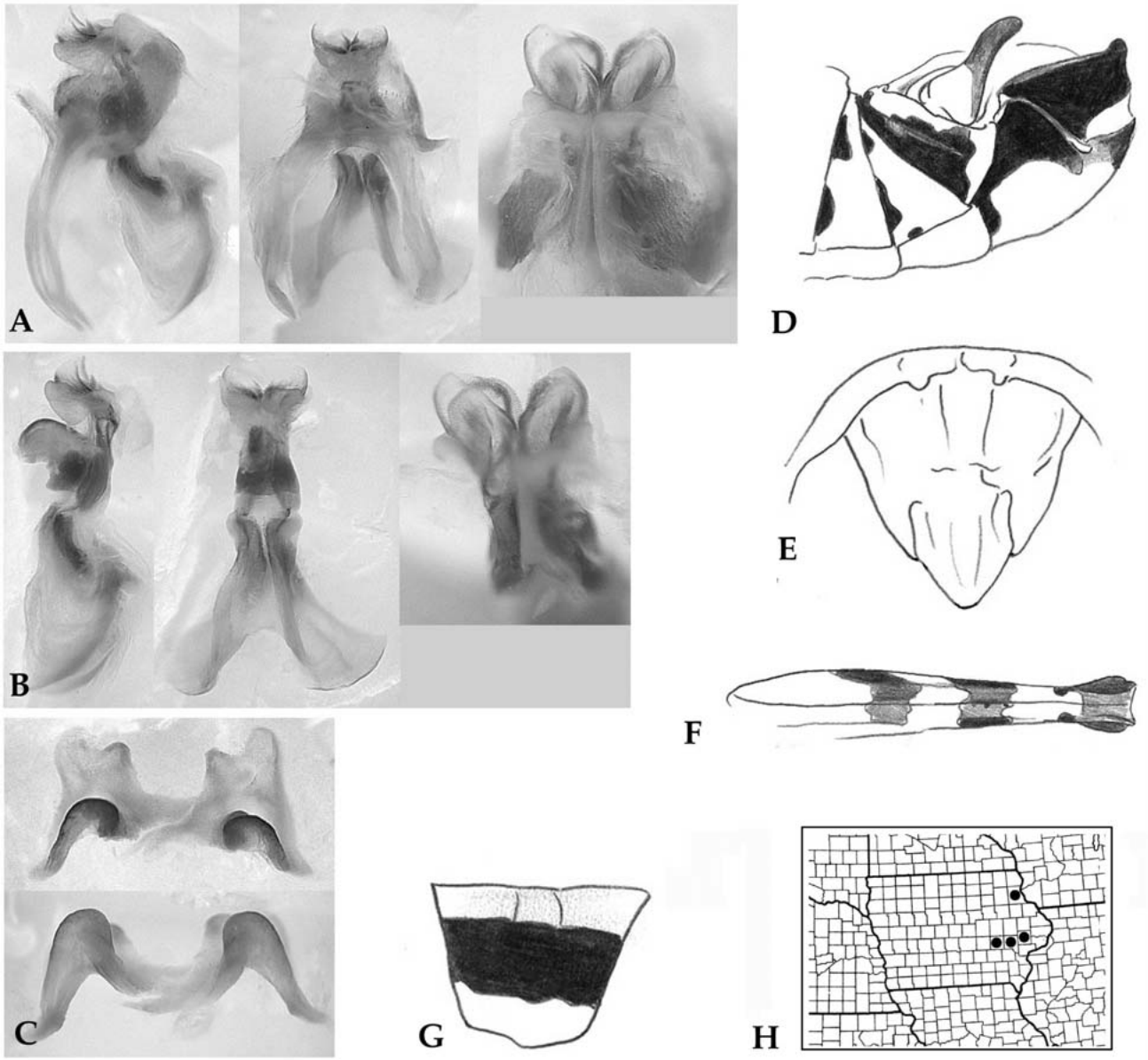


Fig. 9. *M. lilianae*. A, phallic complex (side, dorsal, and rear views). B, phallic complex with cingulum removed (side, dorsal and rear views). C, epiphallus (dorsal and rear views). D, E, last segments of male abdomen (side and dorsal views). F, dorsal aspect of hind femur. G, lateral face of pronotum. H, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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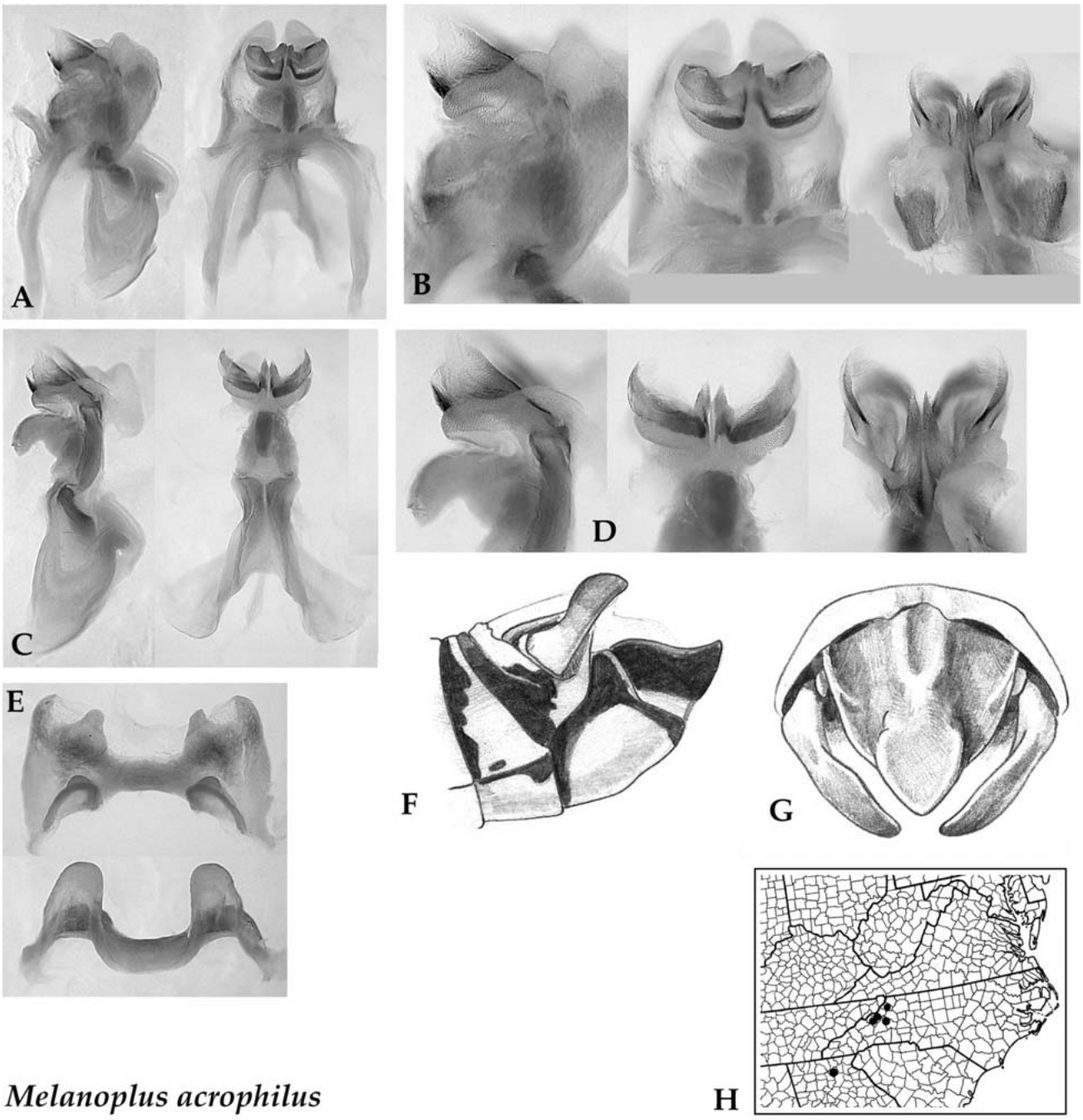


Fig. 10. *M. acrophilus*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and ventral views). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side, dorsal and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen (side and dorsal views). H, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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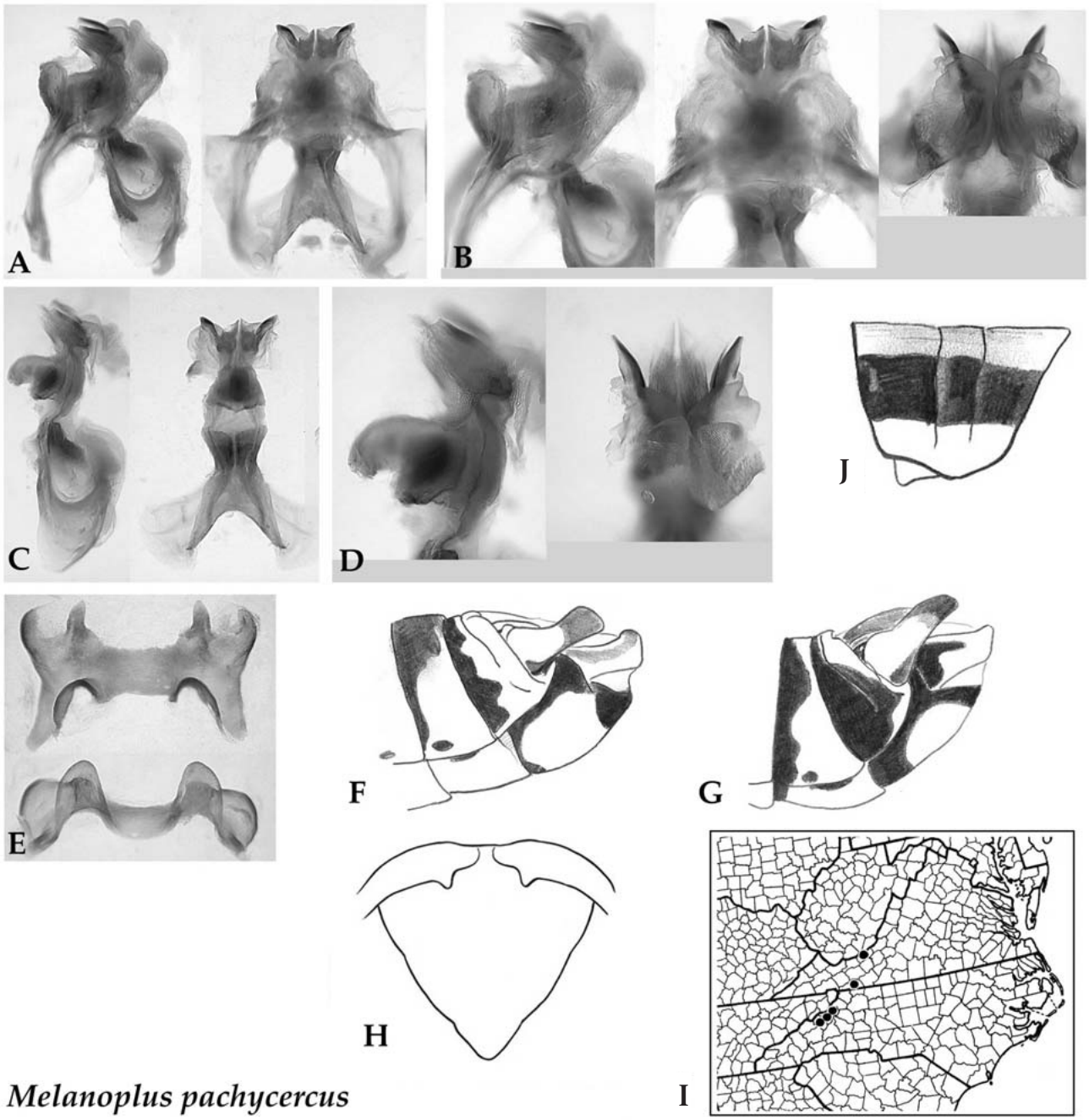


Fig. 11. *M. pachycercus*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and rear views). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side and ventral views). E, epiphallus (dorsal and rear views). F, G, variation in last abdominal segments. H, last abdominal segment (dorsal view). I, distribution of species. J, side of male pronotum. NOTE: The appearance of a structure is highly dependent on the angle of view.

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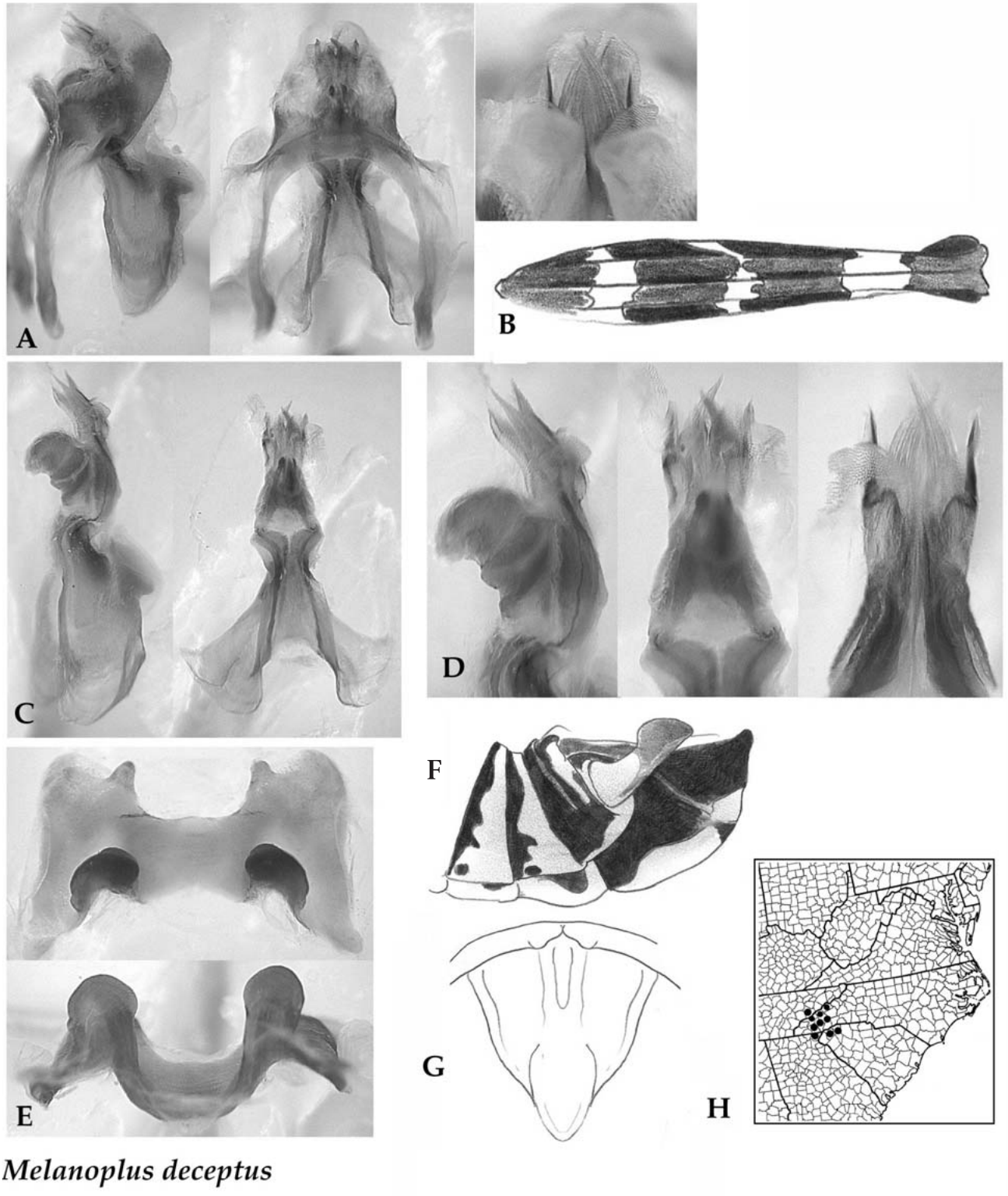


Fig. 12. *M. deceptus*. A, phallic complex (side, dorsal, and rear views). B, hind femur (dorsal view). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side, dorsal and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen (side and dorsal views respectively). H, distribution of species.

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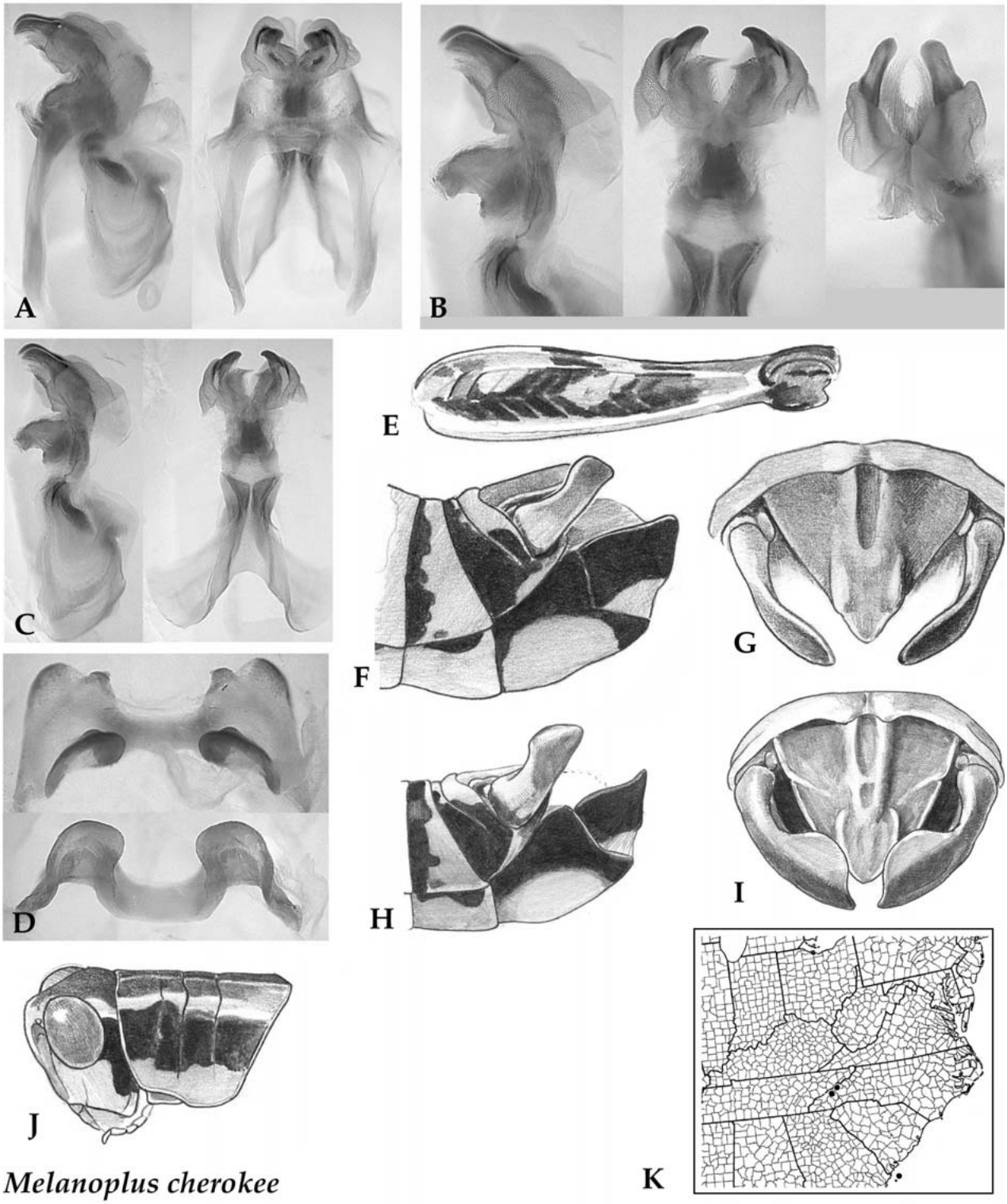


Fig. 13. *M. cherokee*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and rear views). C, phallic complex with cingulum removed (side and dorsal views). D, epiphallus (dorsal and rear views). E, hind femur in lateral aspect. F-I, last segments of male abdomen, showing some variation (side and dorsal views respectively). J, male head and pronotum. K, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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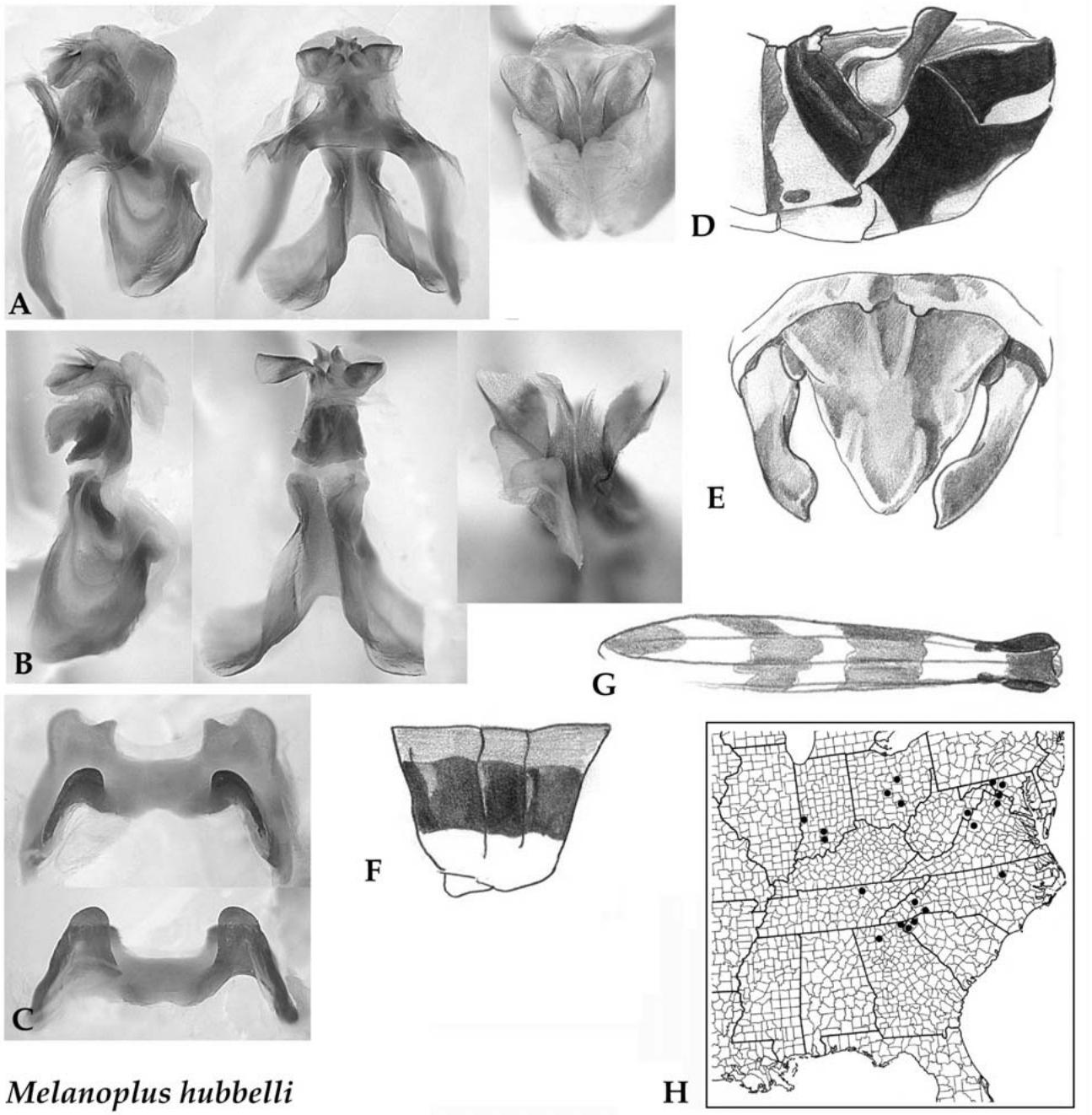


Fig. 14. *M. hubbelli*. A, phallic complex (side, dorsal and rear views). B, phallic complex with cingulum removed (side, dorsal and ventral views). C, epiphallus (dorsal and rear views). D, E, last segments of male abdomen (side and dorsal views respectively). F, side of male pronotum. G, male hind femur (dorsal view). H, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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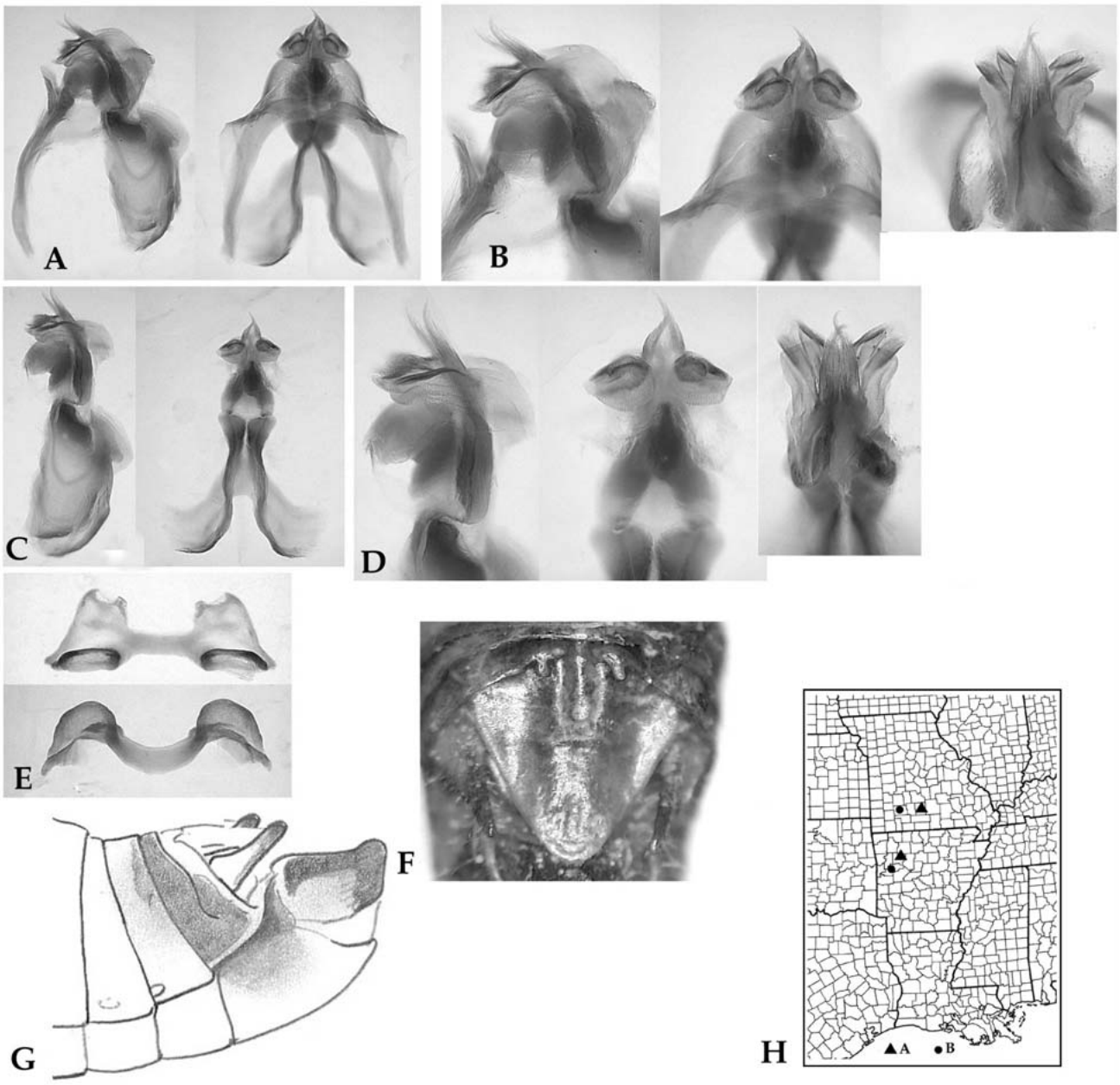


Fig. 15. *M. sylvaticus* (type A) - individual No. 0069. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and ventral views). C, phallic complex with cingulum removed(side and dorsal views). D, close-up view of aedeagus (side, dorsal and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen (dorsal and side views respectively). H, distribution of *M. sylvaticus* type A ▲ and type B ●. NOTE: The appearance of a structure is highly dependent on the angle of view.

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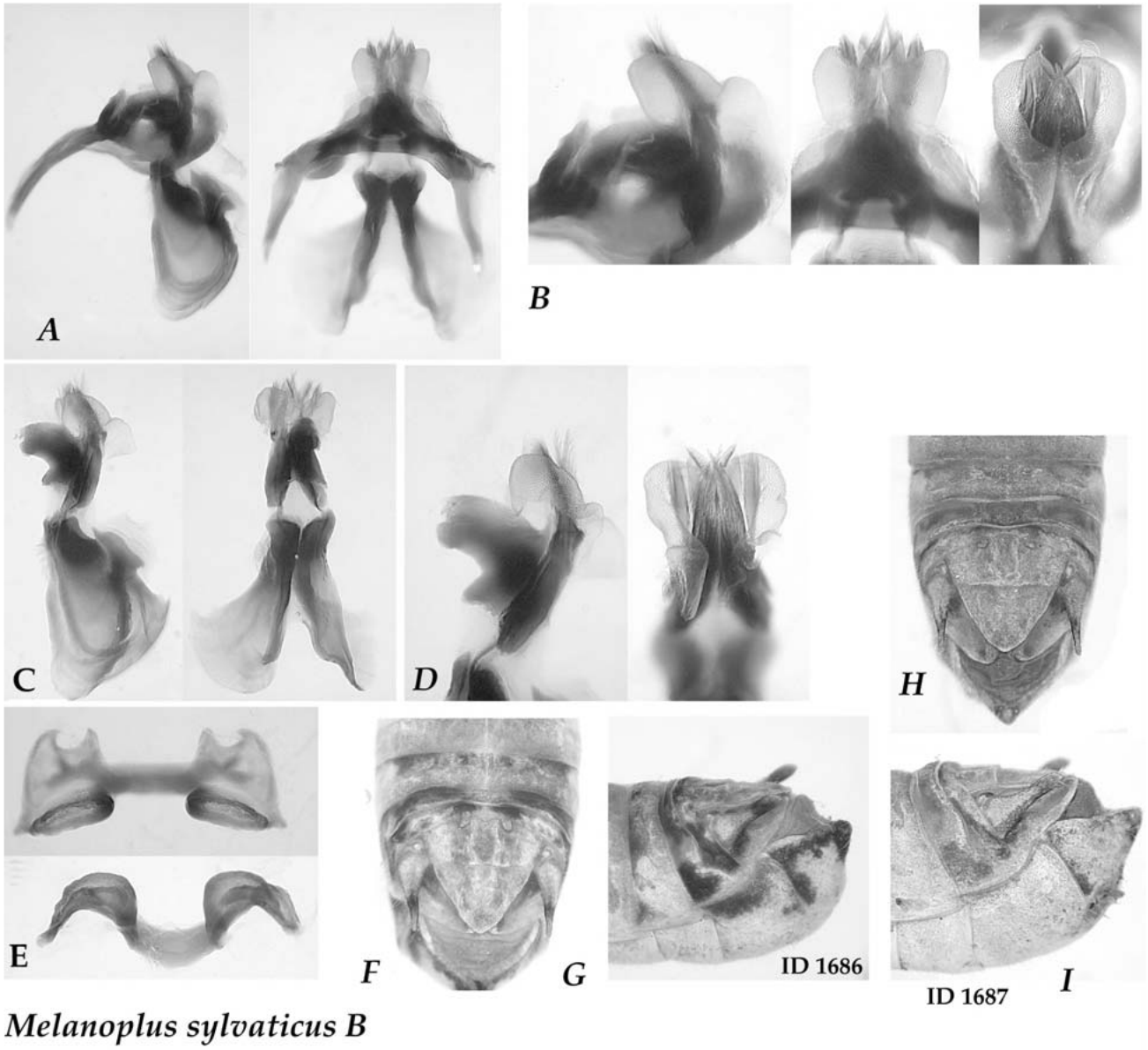


Fig. 16. *M. sylvaticus* (type B) - individual No. 0068. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and ventral views). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side and ventral views). E, Epiphallus (dorsal and rear views). F-I, last segments of abdomen of individuals ID 1686 and ID 1687 (dorsal and side views respectively). For distribution of *M. sylvaticus* (type B) see Fig. 15 H. NOTE: The appearance of a structure is highly dependent on the angle of view.

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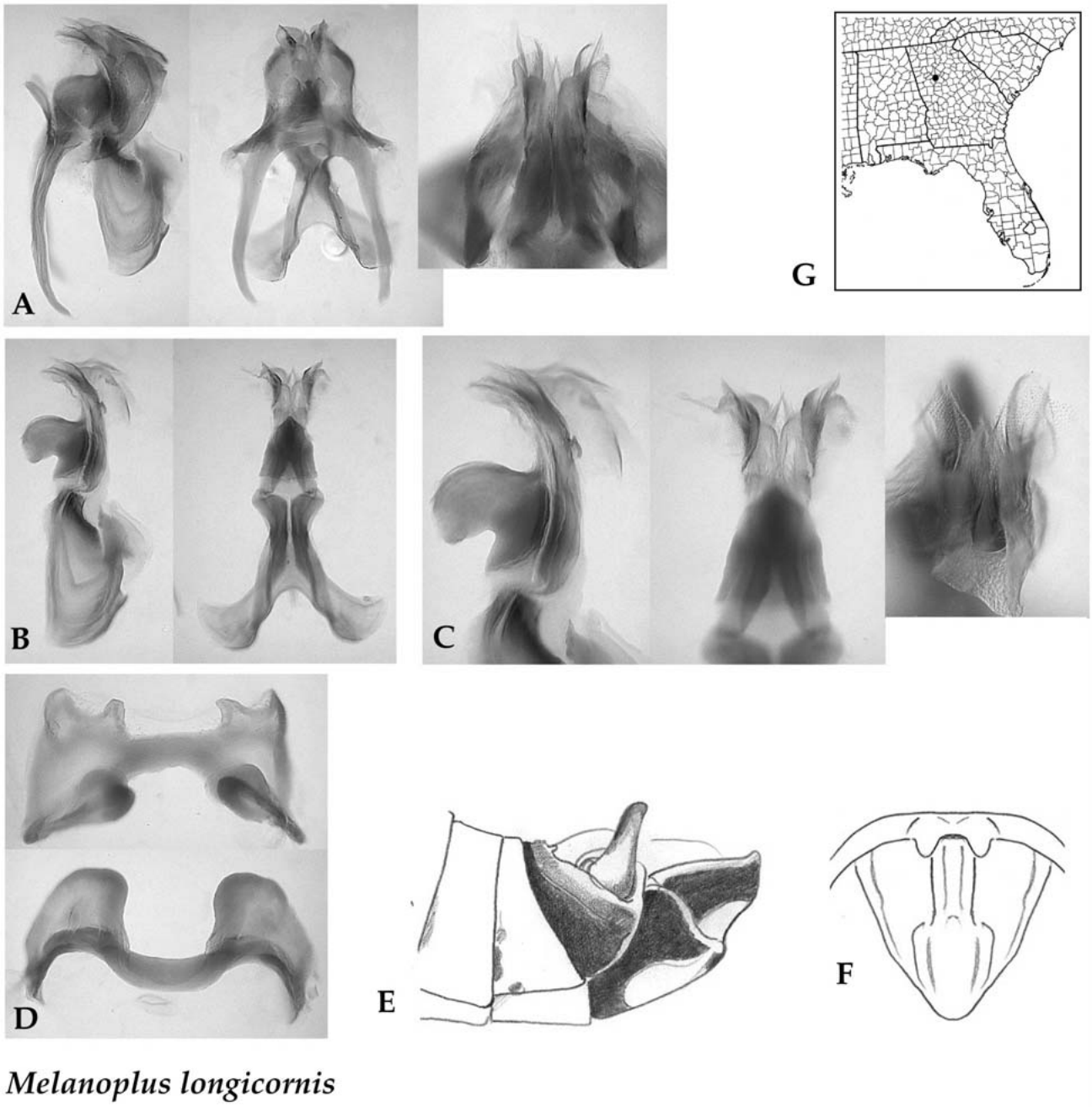


Fig. 17. *M. longicornis*. A, phallic complex (side, dorsal and ventral views). B, phallic complex with cingulum removed (side and dorsal views). C, close-up view of aedeagus (side and ventral views). D, epiphallus (dorsal and rear views). E, F, last segments of male abdomen (side and dorsal views). G, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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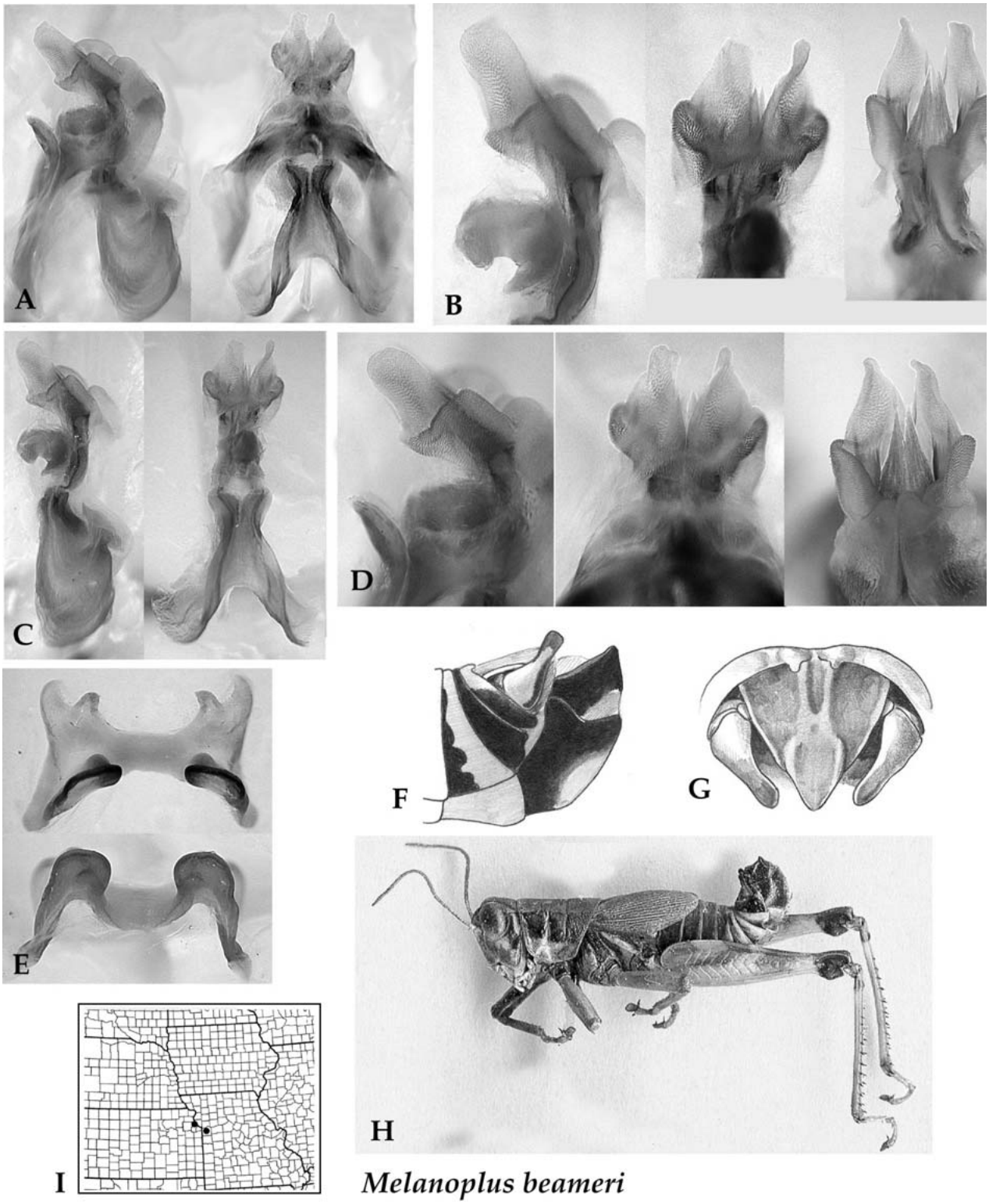


Fig. 18. *M. beameri*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and ventral views). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side, dorsal and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen. (side and dorsal views respectively). H, portrait of male. I, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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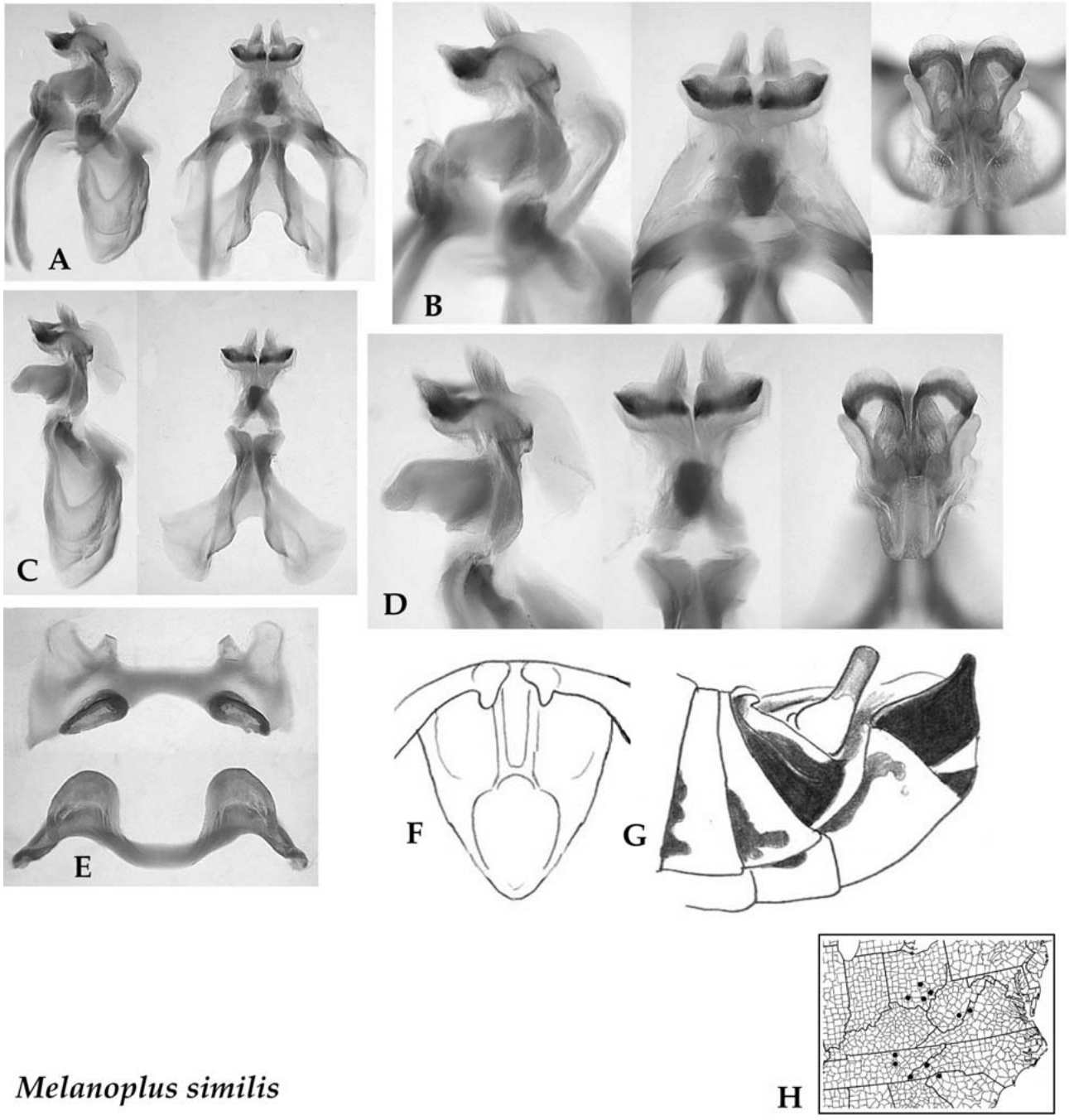


Fig. 19. *M. similis*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side, dorsal and ventral views). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side, dorsal and ventral views). E, epiphallus (dorsal and rear views). F, G, last segments of male abdomen (dorsal and side views respectively). H, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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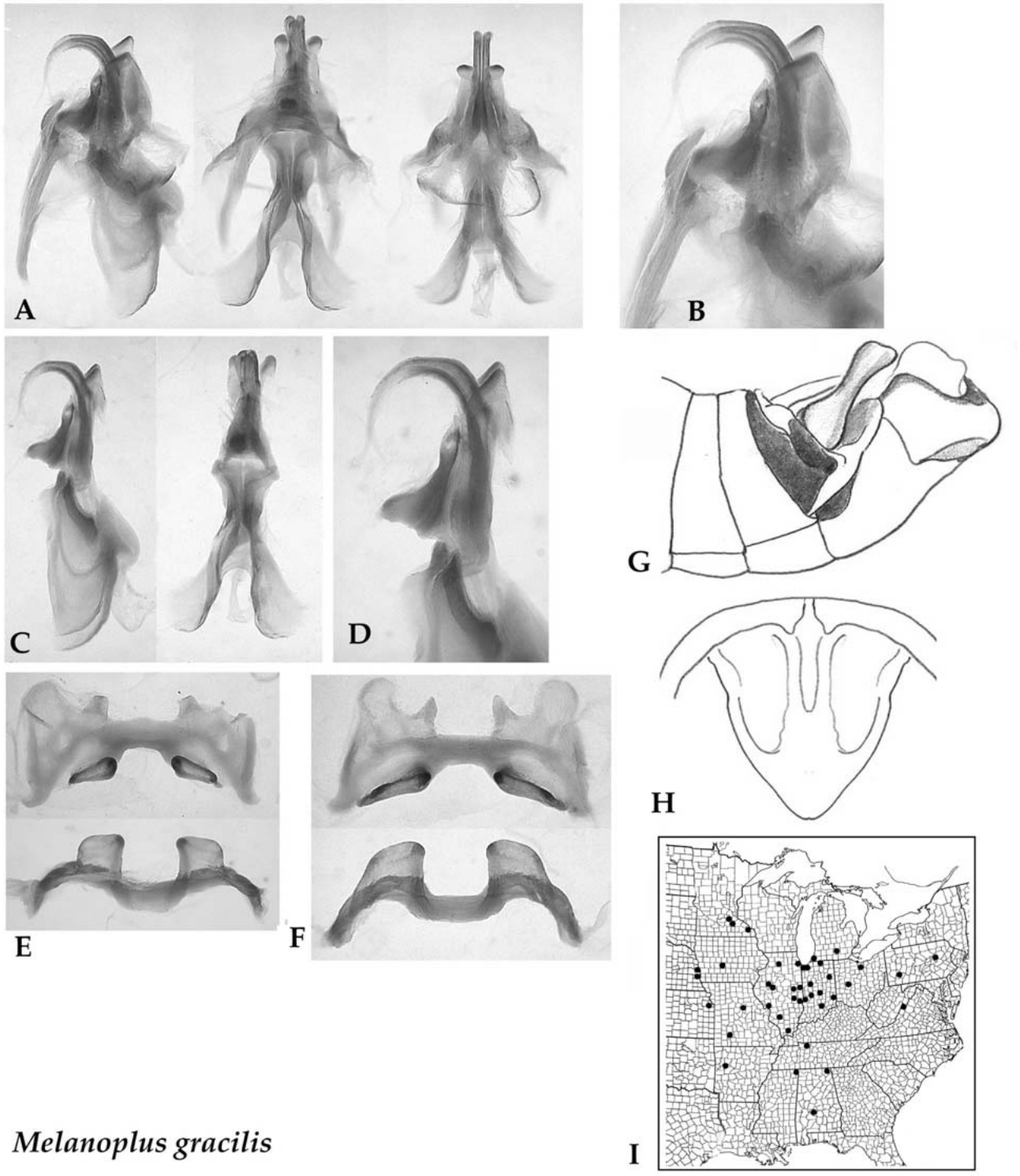


Fig. 20. *M. gracilis*. A, phallic complex (side and dorsal views). B, closer view of phallic complex (side). C, phallic complex with cingulum removed (side and dorsal views). D, close-up view of aedeagus (side). E, F, epiphallus (dorsal and rear views). G, H, last segments of male abdomen (side and dorsal views respectively). I, distribution of species. NOTE: The appearance of a structure is highly dependent on the angle of view.

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