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

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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. liliiniae* 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.
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 Tennessee 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 eurycerus* Hebard
2. *Melanoplus benni* New Species
3. *Melanoplus viridipes* Scudder
4. *Melanoplus liliocerae* New Species
5. *Melanoplus acrophilus* Hebard
6. *Melanoplus pachy cercus* Hebard
7. *Melanoplus deceptus* Morse
8. *Melanoplus cherub* Hebard
9. *Melanoplus hubbellii* 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 eurycerus* 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. eurycerus* (shown in Fig. 1); they are *acrophilus*, *pachy cercus*, *cherub* and *deceptus*. *M. viridipes* and *M. liliocerae* 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. Forewings 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.


Other ANS specimens examined.—MASSACHUSETTS: Berkshire Co., GtBarrington, vi; Berkshire Co., New Lenox, vii. - MARYLAND: Garret Co., Jennings, vi; Garret Co., nr Jennings, vi. - MICHIGAN: Berrien
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. eury cercus 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. eury cercus and M. viridipes. It differs from M. eury cercus 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 aedagus, 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.— INDIGANEA: 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); Roscommon 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).

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 eury cercus. But the latter subspecies has been raised to species level because of considerable differences in the aedagus and cerci.

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

Recognition.— Most easily confused with M. benni and M. liliane. 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); White Heath, 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? IS); vii, Bureau Co., Princeton, vi; Calhoun Co., Kamps ville, vi; Champaign Co., Urbana, vi; Cook Co., Glenview, vii; Cook Co., (if Palos Springs or Palos Park IS), Palos, vii; Kankakee Co., Kankakee, vii; Lake Co., Lake Forest, ix; Lake Co., (if Zion City IS), Zion, vii; Macoupin Co., Beaver Dam St. Pk., 8 mi. SW Carlinville, IS.
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.
4. Melanoplus liliaceae 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.


**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.

**Specimen dissected.**—IOWA: Iowa Co., 23 v (ID-0004); Johnson Co., 30 v (ID-0012); Cedar Co., 29 v (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. pachy cercus*. 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.

**Specimen 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-Town border, Tray Mt., vi; Mt. Mitchell, v, viii; Mitchell Co., Penland, vi.

6. Melanoplus pachy cercus Hebard

**Fig. 11**

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


**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.

**Specimen 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, 17 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).
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.
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.
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.

M. cherokee not shown, see Fig. 13
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.
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. 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 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.


**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., Cramerton, viii; 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, vii; Jackson Co., Balsam, Jones Park, viii; Jackson Co., Balsam, Jones’ Peak, viii. - SOUTH CAROLINA: Greenville, Caesars Head, v, vi; Pickens, Rock Bottom, vii; Pickens, Sassafras

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**7. *Melanoplus deceptus* Morse**

Fig. 12

**Nomenclature.** — See OSF Online (Otter & 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 with 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.

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


10. *Melanoplus sylvaticus* McNeill

Figs 15, 16

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

**Taxonomy.**—Two genital 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 except upper margin. Sternite-9 black at base and midline. Cercus: middle section as narrow as end. Femur-3 dark bands on mediofossa: brownish, 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 (Otter & 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 and midline. Cercus: middle section as narrow as end. Femur-3 dark bands on mediofossa: brownish, not connected.

**Habitat.**—Not recorded.

**Life Cycle.**—Adults collected in June and July.

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.


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 Viridipides 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 Mississippi River and west of the Appalachians, except the deep south.


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.


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 falling 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 swapped 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. puchercus and M. acrophilus and between M. cherokei and M. deceptus. The genitalia difference between the former two species is quite small.
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 genital differences are large because of this. The genital 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. eury cercus* replace one another going eastwards from Illinois to Ohio. In northern Michigan (lower peninsula), *M. eury cercus* and *M. benni* are sympatric, but it remains to be seen if they coexist.

The geographic relations between *M. viridipes* and *M. lili anae* 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. eury cercus*. 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 Tennessee. 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 genitically so different, offers the possibility for investigating the origin of genital 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 genital 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?

Acknowledgments

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References


Melanoplus eury cercus

Fig. 6. *M. eury cercus*. 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, zy goma 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.
Melanoplus viridipes

**Melanoplus lilianae**

Melanoplus acrophilus

Melanoplus deceptus

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.
Fig. 16. *Melanoplus 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 *Melanoplus sylvaticus* (type B) see Fig. 15 H. NOTE: The appearance of a structure is highly dependent on the angle of view.
**Melanoplus longicornis**

**Melanoplus similis**

*Melanoplus gracilis*