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AN ANNOTATED LIST AND NEW SPECIES DESCRIPTIONS OF COLLEMBOLA FOUND IN THE PROJECT ELF STUDY AREA OF MICHIGAN ¹

Richard J. Snider and Frank J. Calandrino ²

ABSTRACT

An annotated list of 80 collembolan species taken from the ELF Project area in Dickinson County, Michigan, is presented. Two new species are described, a new record for the United States is established, and new records for Michigan's Upper Peninsula are reported. Specimens were obtained using pitfall traps and extraction of litter and soil cores taken from deciduous forest.

The United States Navy Electronic Systems Command during 1981 was directed by the President to proceed with completion of an ELF (Extremely Low Frequency) communications system for submarines. This entailed the construction of a 58-mile-long antenna in Michigan's Upper Peninsula. Since 1982, our research team has been monitoring the deciduous forest arthropods associated with soil and litter of locations in Dickinson County. Our purpose is to establish baseline data about the composition and ecology of those populations before, during, and after erection and operation of the antenna.

Selection of suitable forest sites for study depended upon similarities of vegetation, soils, and climatic factors. During 1982 two sites were selected for initial investigations to validate methods, gather preliminary samples for analysis, and train our staff. One site, "Silver Lake" (T44N-R29W-S19), was used to evaluate the effects of spacing between pit-traps on catch (Snider and Snider 1986). The site is dominated by *Populus grandidentata* Michx., with *Acer saccharum* Marsh subdominant. Another site, "Turner Road" (T43N-R29W-S8), was looked at in 1982. *Acer saccharum* dominated, with *Tilia americana* L. subdominant.

Definitive sites for the ecological monitoring program were finally selected in 1983; these are designated "test" (T44N-R29W-S25) and "control" (T43N-R30W-S11). Both locations are dominated by *A. saccharum* with *T. americana* subdominant. Both soils are well drained spodosols. The A horizon in both sites is a mull, including small amounts of poorly developed moder. Climate conditions are given in Snider and Snider (1986).

The Collembola taken between summer of 1982 and 1985 were obtained by several collecting methods: pit-traps with and without barriers, day and night pickups; litter samples extracted by the Tullgren funnel method; soil cores and squares, Tullgren method; and hand collecting under logs, bark, and sweeping with white enamel pans. All specimens were preserved in 95% ethanol and, when necessary, examined as slide mounts with phase-contrast microscopy.

Previous records of Collembola taken in Michigan are available in Bernard (1973, 1976, 1977), Snider (1967a, 1967b, 1969a, 1969b, 1978), Snider and Fisher (1964),

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Snider and Husband (1966), and Snider and Snider (1986). In the following account, published records are designated LP (Lower Peninsula), UP (Upper Peninsula), DC (Dickinson County), followed by tier, range, and section. The system of classification follows Christiansen and Bellinger (1981). United States and Canadian distribution records are also taken from Christiansen and Bellinger (1981). Additions to the U.S. list are from Bellinger (1982) and Fjellberg (1984, 1985).

We have collected 80 species from the ELF Project area of which two are species new to science, one is recorded in the United States for the first time, 29 are new Michigan records, and 15 are new records from the Upper Peninsula.

Order COLLEMBOLA
Suborder ARTHROPLEONA
Family HYPOGASTRURIDAE
Subfamily HYPOGASTRURINAE

Hypogastrura (Hypogastrura) nivicola (Fitch), 1846. LP, UP, T44N-R29W-S25, 16–17 July, night pit-trap. While this species, known as “the snow flea,” has been observed by many people, mostly hikers and hunters, it has not actively been collected and recorded with frequency. The specimens were adult with fully developed black pigmentation. A species common in the northern half of the United States.

Xenylla acauda Gisin, 1947. UP, DC, T43N-R30W-S11, 7 May–15 Oct. from litter and soil cores; T44N-R29W-S25, 15 May–28 July, from litter and soil cores. U.S. records: California and Idaho.

Xenylla pallescens (Scott), 1960. T43N-R30W-S11, 22 May–17 July, litter and pit trap; T44N-R29W-S25, 22 May–3 July, pit-trap. Our studies show this species to be day-active. U.S. records: Colorado and New Mexico.

Willemia denisi Mills, 1932. T43N-R29W-S8, 10 Aug.–22 Oct., litter. U.S. records: Alaska (Fjellberg 1985), California, Colorado (Fjellberg 1984), Washington. Canadian records: Alberta and Northwest Territories.

Willemia intermedia Mills, 1934. LP, T43N-R29W-S8, 10 Aug.–16 Oct., litter and soil cores. Frequently taken with *W. denisi* and *W. similis*. U.S. records: California, Colorado (Fjellberg 1984), Connecticut, Iowa, Massachusetts, Tennessee, Utah. Canadian records: Quebec.

Willemia similis Mills, 1934. T43N-R29W-S8, 25–30 Aug., litter and soil cores. U.S. records: Arctic Alaska, California, Colorado (Fjellberg 1984), Indiana, Iowa, Kansas, Tennessee, Utah. Canadian records: Northern Canada.

Subfamily Neanurinae

Odontella substriata Wray, 1952. UP, DC, T43N-R29W-S8, 25–30 Aug., litter and soil cores. U.S. records: Connecticut, Illinois, North Carolina.

Friesia sublimis Macnamara, 1921. T43N-R29W-S8, 10 Aug.–22 Sept., litter. U.S. records: Connecticut, Illinois, Indiana, Massachusetts, New Hampshire, New York, Pennsylvania, Vermont (Bellinger 1982). Canadian records: Arnprior.

Pseudachorutes aureofasciatus (Harvey), 1898. LP, T43N-R30W-S11, 8 May–16 Oct., pit-trap. Our largest numbers were taken from diurnal pit traps. U.S. records: California, Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Montana, New York, North Carolina, South Carolina, Tennessee, Vermont (Bellinger 1982), West Virginia. Canadian records: Alberta, British Columbia, Quebec.

Pseudachorutes indiana Christiansen and Bellinger, 1980. T43N-R30W-S11, 7 May–7 Aug.; T44N-R29W-S25, 30 Aug.–29 Sept., litter. U.S. records: Alaska (Fjellberg 1985), Colorado (Fjellberg 1984), Indiana, West Virginia.

Pseudachorutes saxatilis Macnamara, 1920. LP, T43N-R30W-S11, 15 May–20 Oct.;

- T44n-R29W-S25, 15 May–20 Oct., litter, soil cores, pit-traps. Diel studies using pit-traps show this species to be predominantly day-active. Immature specimens were taken from soil cores; adults were litter inhabiting. U.S. records: Indiana, Iowa, Maryland, North Carolina, Pennsylvania, South Carolina, Tennessee, West Virginia. Canadian records: Ontario.
- Anurida (Anurida) granaria* (Nicolet), 1847. T43N-R30W-S11, 21 May–20 Oct.; T44N-R29W-S25, 7 May–29 Sept., litter soil cores. This species appears to prefer the soil-litter interface. U.S. records: Alaska, California, Connecticut, Illinois, Indiana, Iowa, Kentucky, Massachusetts, New York, North Carolina, Vermont (Bellinger 1982). West Virginia. Canadian records: Ontario, Northwest Territories, Quebec, Ellesmore Is.
- Anurida (Micranurida) furcifera* (Mills), 1934. T43N-R29W-S8, 16 Aug.–16 Oct., litter and soil cores. U.S. records: Connecticut, Iowa.
- Anurida (Micranurida) pygmaea* (Borner), 1901. LP, T43N-R29W-S8, 25 Aug., litter. U.S. records: Alaska (Fjellberg 1985), Colorado (Fjellberg 1984), Connecticut, Iowa, Kentucky, Maryland, Massachusetts, Vermont (Bellinger 1982) West Virginia. Canadian records: Alberta, Manitoba, Northwest Territories, Ontario, Quebec.
- Neanura (Neanura) muscorum* (Templeton), 1835. LP, UP, DC, T43N-R29W-S25, 7 May–16 Oct., litter, under bark, soil cores and pit-traps. This species appears to be active at night. It is frequently encountered in our samples. U.S. records: Arizona, California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, South Carolina, Tennessee, Utah, Vermont (Bellinger 1982), Washington. Virginia. Canadian records: Hudson Strait, Manitoba, Ontario, Ungava Bay.

Family ONYCHIURIDAE

- Onychiurus (Archaphorura) affinis* Agren, 1903. T43N-R29W-S8, 10 Aug.–22 Oct., litter. U.S. records: Colorado (Fjellberg 1984). Canadian records: Alberta, Manitoba, Quebec, Northwest Territories.
- Onychiurus (Archaphorura) allanae* Christiansen and Bellinger, 1980. T43N-R30W-S11, 28 July–20 Oct.; T44N-R29W-S25, 15 Aug.–20 Oct., litter and soil cores. U.S. records: Massachusetts, Oregon.
- Onychiurus (Protaphorura) encarpatus* Denis, 1931. T43N-R30W-S11, 21 May–15 Oct., litter and soil cores. U.S. records: California, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Missouri, New York, North Carolina, Ohio, Pennsylvania, Utah.
- Onychiurus (Protaphorura) parvicornis* Mills, 1934. T43N-R29W-S8, 10 Aug.–4 Oct., litter. U.S. records: Connecticut, Illinois, Indiana, Iowa, Massachusetts, Missouri, Vermont (Bellinger 1982), West Virginia.
- Onychiurus (Protaphorura) similis* Folsom, 1917. T43N-R29W-S8, 16 Aug.–16 Oct., T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 28 July–29 Sept., litter and soil cores. U.S. records: California, Connecticut, Illinois, Indiana, Iowa, Kentucky, Maine, Massachusetts, New Mexico, Texas, West Virginia, Wisconsin. Canadian records: Quebec.
- Onychiurus (Protaphorura) talus* Christiansen and Bellinger, 1980. T43N-R30W-S11, 16 Oct., pit-trap. U.S. records: New Hampshire, Oregon, Wisconsin.
- Tullbergia clavata* Mills, 1934. T43N-R30W-S11, 7 May–15 Oct.; T44N-R29W-S25, 28 July–20 Oct., soil cores. U.S. records: Idaho, Illinois, Indiana, Iowa, New York, North Carolina, Ohio, South Carolina, Tennessee, Utah, West Virginia. Canadian records: Quebec.
- Tullbergia granulata* Mills, 1934. LP, T43N-R29W-S8, 10 Aug.–16 Oct., T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 28 July–20 Oct., litter and soil cores. U.S. records: Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Maryland, Massa-

- chusetts, Missouri, New Hampshire, North Carolina, South Carolina, Utah, West Virginia, Wisconsin. Canadian records: Manitoba, Quebec.
- Tullbergia mala* Christiansen and Bellinger, 1980. T43N-R29W-S8, 16 Aug.–16 Oct.; T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 28 July–14 Sept., litter and soil cores. This is a very common species in litter and soil cores. U.S. records: Colorado, Connecticut, Illinois, Iowa. Canadian records: Alberta.
- Tullbergia yosiii* Rusek, 1967. T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 15 Aug.–20 Oct., litter and soil cores. U.S. records: Connecticut, Indiana, Iowa, Kentucky, Louisiana, Maine, New York. Canadian records: British Columbia.

Family ISOTOMIDAE

- Anurophorus (Anurophorus) altus* Christiansen and Bellinger, 1980. T43N-R29W-S8, 22 Sept., litter. U.S. records: New York, Pennsylvania.
- Anurophorus (Anurophorus) septentrionalis* Palissa, 1966. T43N-R30W-S11, 7 May–15 Oct., litter and soil cores. U.S. records: Alaska, Colorado, Connecticut, Illinois, Kentucky, Maine, Massachusetts, New Mexico, North Dakota, Oregon, Washington. Canadian records: Nova Scotia.
- Anurophorus (Pseudanurophorus) binocularis* (Kneseman), 1934. T43N-R29W-S8, 22 Sept.–11 Oct.; T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 7 May–20 Oct., litter, pit-trap, soil cores. Most of the collection was taken in litter, only a few in soil cores. U.S. records: Colorado (Fjellberg 1984), Connecticut, Massachusetts, Tennessee.
- Proisotoma (Proisotoma) minima* (Absolon), 1901. LP, T43N-R29W-S8, 12 Aug.–22 Sept.; T43N-R30W-S11, 7 May–10 Sept.; T44N-R29W-S25, 7 May–15 Oct. litter and soil cores. U.S. records: Connecticut, Iowa, Louisiana, Massachusetts, New York, North Carolina, Tennessee, Utah. Canadian records: Quebec.
- Cryptopygus decemoculatus* (Folsom), 1937. T43N-R30W-S11, 8 May–20 Oct.; T44N-R29W-S25, 7 May–20 Oct., litter and pit-trap. U.S. records: Idaho, Illinois, Utah, Washington.
- Folsomia bisetosa* Gisin, 1953. T43N-R30W-S11, 16 Sept., soil core. Canadian records: Ellesmere Is.
- Folsomia nivalis* (Packard), 1873. LP, T43N-R29W-S8, 10 Aug.–22 Oct.; T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 16 July–20 Oct., litter and soil cores. U.S. records: California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Montana, New Jersey, New York, North Carolina, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, Washington, Wisconsin, Wyoming. Canadian records: British Columbia, Manitoba, Northwest Territories, Nova Scotia, Quebec.
- Isotomiella minor* (Schaeffer), 1896. LP, T43N-R29W-S8, 11 Oct.; T43N-R30W-S11, 7 May–15 Oct.; T44N-R29W-S25, 7 May–15 Oct., soil cores. U.S. records: Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Maryland, Massachusetts, Missouri, New Jersey, New York, North Carolina, South Carolina, Tennessee, Utah, Vermont (Bellinger 1982).
- Isotoma (Desoria) creli* Fjellberg, 1978. T43N-R30W-S11, 8 May–16 Oct., pit-trap. U.S. records: Alaska.
- Isotoma (Desoria) nigrifrons* Folsom, 1937. LP, UP, DC, T43N-R29W-S8, 10 Aug.–22 Oct.; T44N-R29W-S19, 3 Aug.–8 Oct.; T43N-R30W-S11, 7 May–16 Oct.; T44N-R29W-S25, 7 May–16 Oct., litter, soil cores, pit-trap. This species and *I. notabilis* are very numerous in our samples. U.S. records: Colorado, Illinois, Iowa, Montana, Tennessee, Utah, Vermont (Bellinger 1982), West Virginia, Wyoming.
- Isotoma (Desoria) notabilis* Schaeffer, 1896. LP, T43N-R30W-S11, 7 May–16 Oct.; T44N-R29W-S25, 7 May–15 Oct., litter, soil cores, pit-trap. U.S. records: ubiquitous.

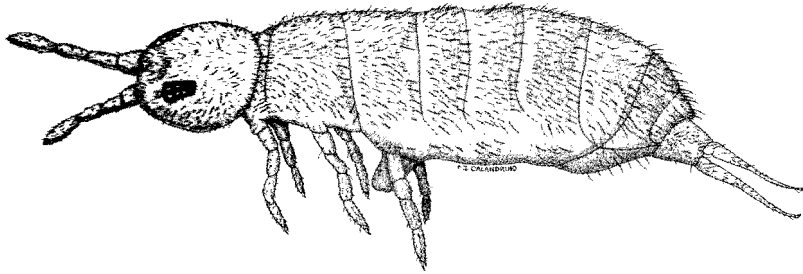


Fig. 1. *Isotoma (Desoria) nympha* n.sp. Habitus, drawn from specimen on microscope slide.

Isotoma (Desoria) nympha n.sp.
(Figs. 1–11)

COLOR AND PATTERN (Holotype, on slide): (Fig. 1). Body uniformly blue, with whitish intersegmental bands, pale or pigmentless areas on tergites and head. Head with dark blue pigment extending from frons posteriorly between the eyepatches and narrowing to form a dark spot medio-dorsally posterior to eyepatches, white patches medially anterior to eyepatches, V-shape mark extending from dark spot towards posterior edge of eyepatches. Antennae darker towards tip. Legs, manubrium and furcula lightly pigmented.

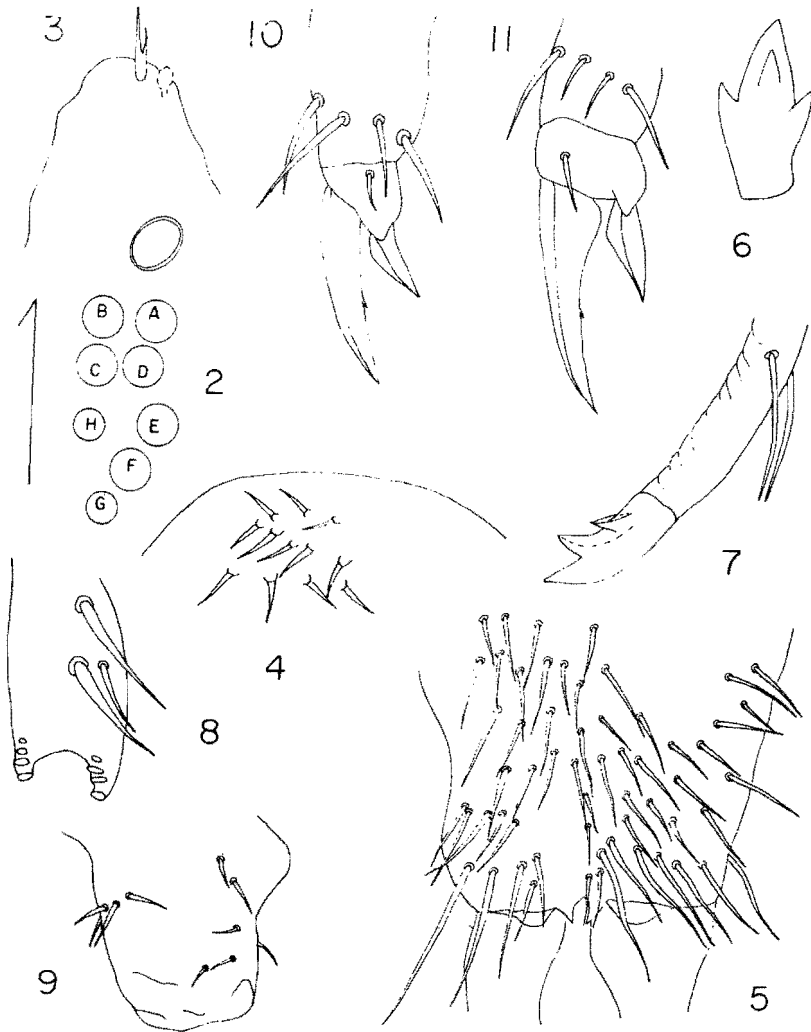
HEAD: eyes 8 + 8 with dark pigment, ocelli G and H subequal (Fig. 2). Postantennal organ elliptical, one and one-half as long as diameter of nearest eye. Apex of fourth antennal segment with "pin" seta and well developed secondary seta, subapical organ spherical (Fig. 3). First antennal segment without modified sensory setae on ventral surface. Labrum without visible ciliations (Fig. 4).

BODY: Abd. V–VI separate with smooth macrochaeta ranging from 2.5 to 4 times as long as inner hind unguis. Manubrium with free apical teeth and approx. 56 ventral setae (Fig. 5). Dens with many dorsal crenulations. Mucro quadridentate with apical tooth the longest and basal teeth subequal and on same level (Figs. 6–7). Retinaculum with 3 setae (Fig. 8). Collophore with 1 frontal seta, 5 lateral and 4 caudal setae (Fig. 9). unguis with minute inner tooth unguiculus with no corner tooth (Fig. 10–11). Length, 1. Imm.

DIAGNOSIS: *Isotoma (Desoria) nympha* n.sp. keys out nearest to *Isotoma (Desoria) japonica* Yosii in Christiansen and Bellinger (1981). However, besides morphological characteristics, color pattern will separate the two species. The following will distinguish the species

I.(D.) nympha
subapical antennal organ spherical
unguis without lateral tooth
56 ventral manubrial setae
basal teeth of mucro subequal

I.(D.) japonica
peg-like
lateral tooth
16 setae
unequal



Figs. 2-11. *Isotoma (Desoria) nympa* n.sp. (2) right ocellar patch, (3) apex of 4th antennal segment, (4) labrum, (5) manubrium, ventral view, (6) mucro, dorsal view, (7) mucro, lateral view, (8) retinaculum, (9) colophore, lateral view, (10) foreleg, claw, (11) metaleg, claw.

TYPES: Holotype and one paratype on slides. All types deposited in the Entomology Museum, Michigan State University.

Collection data: Michigan, Dickinson County T43N-R30W-S11, barrier pitfall trap 28-VI-84 and 16-VIII-84.

Isotoma (Isotoma) viridis Bourlet, 1839. LP, UP, DC, T43N-R29W-S8, 4 Oct.; T44N-R29W-S19, 3 Aug.–8 Oct.; T43N-R30W-S11, 7 May–27 Oct.; T44N-R29W-S25, 7 May–16 Oct., litter, soil cores, pit-trap. U.S. records: ubiquitous.

Family Entomobryidae
Subfamily Entomobryinae

Orchesella ainsliei Folsom, 1924. LP, UP, DC, T44N-R29W-S25, 4 Aug., pit-trap. U.S. records: Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Minnesota, Missouri, New York, North Carolina, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin, Texas. Canadian records: Ontario.

Orchesella hexfasciata Harvey, 1895. LP, UP, DC, T43N-R29W-S8, 25 Aug.–22 Oct.; T43N-R30W-S11, 7 May–27 Oct.; T44N-R29W-S25, 8 May–0 Oct., T44N-R29W-S19, 3 Aug.–5 Oct., litter, soil cores, pit-trap. U.S. records: Connecticut, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Missouri, New York, North Carolina, Ohio, Tennessee, Vermont, West Virginia. Canadian records: Nova Scotia, Ontario.

Entomobrya (Entomobrya) assuta Folsom, 1924. LP, UP, DC, T44N-R29W-S19, 5 Aug.–14 Sept.; T43N-R29W-S8, 19 Aug.–22 Oct.; T44N-R29W-S25, 28 July–6 Oct., litter, pit-trap. U.S. records: Arizona, Connecticut, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Missouri, New York, North Carolina, South Carolina, Texas, Utah, Vermont, Wisconsin. Canadian records: Ontario, Quebec.

Entomobrya (Entomobrya) clitellaria Guthrie, 1903. LP, UP, DC, T44N-R29W-S19, 7 Aug.–7 Oct.; T43N-R29W-S8, 19 Aug., pit-trap. U.S. records: California, Illinois, Indiana, Iowa, Louisiana, Massachusetts, Minnesota, New York, Oregon, Pennsylvania. Canadian records: Ontario, Quebec.

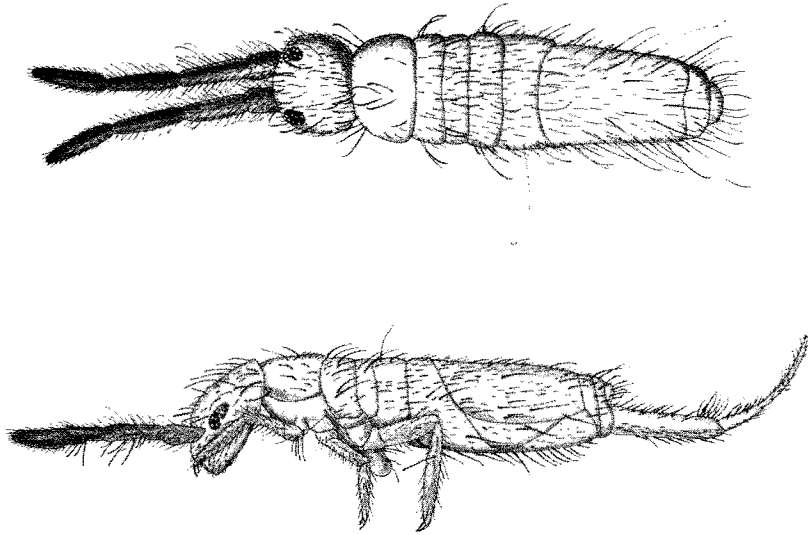
Entomobrya (Entomobrya) comparata Folsom, 1919. T44N-R29W-S19, 6–30 Aug.; T43N-R29W-S8, 3 Aug.–23 Oct.; T43N-R30W-S11, 7 May–15 Oct.; T44N-R29W-S25, 4 June–20 Oct., soil cores, pit-trap. Our specimens are yellow to flesh color with light purple intersegmental lines. Christiansen and Bellinger (1981) reported that this species has so far only been taken from mountainous regions. In the forests of the ELF Project area, this is a dominant species. In color pattern, it comes closest to the mountain tundra form illustrated by Christiansen and Bellinger (1981) (Figs. 12–13). U.S. records: Alaska, California, Colorado, Idaho, Maine, Montana, Nevada, New Hampshire, New Mexico, Washington, Wyoming. Canadian records: Alberta, Northwest Territories.

Entomobrya (Entomobrya) nivalis (L.), 1758. LP, UP, DC, T44N-R29W-S19, 16 Sept.–4 Oct.; T43N-R30W-S11, 22 May–27 Oct.; T44N-R29W-S25, 10 May–20 Oct. litter, soil cores, pit-trap. U.S. records: Massachusetts, North Carolina, Wisconsin. Canadian records: Ontario.

Entomobrya (Entomobryoides) purpurascens (Packard), 1873. LP, UP, DC, T44N-R29W-S19, 4–5 Aug.; T43N-R30W-S11, 4 June–15 Oct.; T44N-R29W-S25, 5 June–14 Sept., litter, soil core, pit-trap, U.S. and Canadian records: ubiquitous.

Willowsia buski (Lubbock), 1870. LP, UP, DC, T43N-R30W-S11, 30 Aug.; T44N-R29W-S25, 15 Aug.–6 Oct., litter, soil cores, pit-trap. U.S. records: California, Colorado, Connecticut, Illinois, Iowa, Louisiana, Maine, Massachusetts, Minnesota, New York, North Carolina, Utah, Washington, Wisconsin. Canadian records: British Columbia, Manitoba, Ontario, Quebec, Saskatchewan.

Lepidocryptus helena Snider, 1967. LP, UP, DC, T44N-R29W-S19, 4–6 Aug.; T43N-R29W-S8, 4 Aug.–27 Oct.; T43N-R30W-S11, 21 May–20 Oct.; T44N-R29W-S25, 29 May–29 Sept., litter, soil cores, pit-trap. U.S. records: Arkansas, Connecticut, Illinois, Indiana, Kentucky, Louisiana, Mississippi, Vermont (Bellinger 1982).



Figs. 12–13. *Entomobrya comparata* Folsom. (12) Habitus, lateral view, (13) Habitus, dorsal view.

- Lepidocyrtus hirtus* Christiansen and Bellinger, 1981. T44N-R29W-S19, 4 Aug., pit-trap. U.S. records: Iowa
- Lepidocyrtus lignorum* (Fabricius), 1775. LP, UP, DC, T44N-R29W-S19, 5 Aug.; T44N-R29W-S25, 21 May–2 Oct., pit-trap. U.S. records: Arkansas, Connecticut, Illinois, Indiana, Kansas, Louisiana, Tennessee, West Virginia.
- Lepidocyrtus paradoxus* Uzel, 1891. LP, UP, DC, T44N-R29W-S19, 5 Aug.–5 Oct.; T4 3N-R29W-S8, 10 Aug.–22 Oct.; T4 3N-R30W-S11, 8 May–15 Oct.; T44N-R29W-S25, 25 June–26 Sept., litter, pit-trap. This species was found in large numbers in the basement of our research facility and in a barn where soil samples were processed.
- Lepidocyrtus violaceus* (Fourcroy), 1785, LP, UP, DC, T44N-R29W-S19, 5–12 Aug., T43N-R30W-S11, 15 May–15 Oct., T44N-R29W-S25, 15 May–4 Sept., litter, soil cores, pit-trap. U.S. records: California, Colorado, Connecticut, Illinois, Indiana, Kentucky, Maine, Massachusetts, New York, Utah. Canadian records: Nova Scotia, Northwest Territories.
- Pseudosinella rolfsi* Mills, 1932. LP, T43N-R30W-S11, 20–21 Aug.; T44N-R29W-S25, 25 Aug.–14 Sept., litter, pit-trap. U.S. records: Arizona, California, Colorado, Connecticut, Florida, Illinois, Iowa, Louisiana, Massachusetts, New Mexico, New York, North Carolina, Ohio, Pennsylvania, Texas, Utah, Washington, Wisconsin.
- Pseudosinella violenta* (Folsom). 1924 LP, UP, T43N-R30W-S11, 18–21 Aug.; T44N-R29W-S25, 27 July–20 Oct., soil cores, pit-trap. U.S. records: Arkansas, California, Colorado, Connecticut, Florida, Illinois, Indiana, Iowa, Louisiana, Kentucky, Maryland, Massachusetts, Missouri, New Jersey, New Mexico, New York, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Washington. Canadian records: Nova Scotia, Ontario, Quebec.

Subfamily Tomocerinae

Tomocerus (Pogonognathellus) flavescens Tullberg, 1871. LP, UP, DC, T44N-R29W-S19, 4 Aug.–8 Oct.; T43N-R29W-S8, 4 Aug.–29 Oct.; T43N-R30W-S11, 7 May–16 Oct.; T44N-R29W-S25, 8 May–16 Oct.; litter, soil cores, pit-trap. A dominant species in the woodlots. U.S. records: ubiquitous.

Tomocerus (Tomocera) lamelliferus Mills, 1934. LP, UP, DC, T44N-R29W-S19, 4–30 May.; T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 28 July–20 Oct.; litter, soil cores, pit-trap. U.S. records: east coast, California, Indiana, Washington. Canadian records: Ontario.

Suborder SYMPHYPLEONA
Family NEELIDAE

Neelus (Megalothorax) minimus (Willem), 1900. T43N-R29W-S8, 10 Aug.–22 Oct.; T43N-R30W-S11, 28 July–20 Oct.; T44N-R29W-S25, 28 July–15 Aug., litter, soil cores. U.S. records: Alabama, Alaska, Colorado, (Fjellberg 1984), Connecticut, Florida, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Missouri, New York, Tennessee, Utah, Vermont (Bellinger 1982), Virginia, Wisconsin. Canadian records: Alberta, Ellesmere Is., Northwest Territories, Nova Scotia, Quebec.

Neelus (Megalothorax) incertus (Börner), 1903. T43N-R29W-S8, 10 Aug.–4 Oct.; T43N-R30W-S11, 28 July–30 Aug.; T44N-R29W-S25, 28 July–30 Aug., litter, soil cores. We believe this species shows enough variation with *Neelus (Megalothorax) tristani* Denis, 1933 to be the same. U.S. records: California, Illinois, Indiana, Iowa, Kansas, Louisiana, North Carolina, South Carolina, Tennessee. Canadian records: Quebec.

Neelus (Neelides) minutus (Folsom), 1901. LP, T43N-R29W-S8, 10–12 Aug.; T43N-R30W-S11, 28 July–30 Aug., litter, soil cores. U.S. records: Alaska, California, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Massachusetts, Mississippi, New York, North Carolina, Tennessee, Utah, Vermont (Bellinger 1982).

Neelus (Neelides) snideri (Bernard), 1975. LP, T43N-R29W-S8, 10 Aug.–22 Oct.; T43N-R30W-S11, 3 July., litter, pit-trap. U.S. records: Michigan (type).

Family SMINTHURIDAE
Subfamily Sminthuridinae

Sminthurides (Sphaeridia) pumilis Krausbauer, 1898. LP, T44N-R29W-S25, 17 July, pit-trap. U.S. records: Alaska, California, Colorado, Idaho, Indiana, Iowa, Louisiana, Minnesota, Mississippi, Missouri, Nebraska, New Mexico, New York, Oklahoma, South Carolina, Tennessee, Utah. Canadian records: Manitoba, Northwest Territories.

Sminthurides (Sminthurides) lepus Mills, 1934. LP, UP, DC, T44N-R29W-S19, 3 Aug.–8 Oct.; T43N-R29W-S8, 10 Aug.–4 Oct.; T43N-R30W-S11, 7 May–20 Oct.; T44N-R29W-S25, 21 May–16 Oct.; litter, soil cores, pit-trap. This is one of the most numerous species to be found in the ELF Project area. U.S. records: Connecticut, Illinois, Indiana, Iowa, Louisiana, Maryland, New York, North Carolina, South Carolina, Vermont (Bellinger 1982). Canadian records: Ontario.

Sminthurides (Sminthurides) occultus Mills, 1934. LP, UP, DC, T44N-R29W-S25, 16 July, pit-trap. U.S. records: California, Illinois, Indiana, Iowa, New York, North Carolina, South Carolina, Tennessee. Canadian records: Manitoba, Northwest Territories, Ontario.

Subfamily Katianninae

- Arrhopalites amarus* Christiansen, 1966. UP, DC, T44N-R29W-S19, 4 Aug.–8 Oct.; T43N-R29W-S8, 3 Aug.–4 Oct.; T43N-R30W-S11, 15–30 Aug.; T44N-R29W-S25, 28 July–20 Oct., litter, pit-trap. U.S. records: California, Colorado (Fjellberg 1984), Connecticut, Illinois. Canadian records: Labrador, Ontario.
- Arrhopalites benitus* (Folsom) 1896. LP, UP, DC, T44N-R29W-S19, 4 Aug.–8 Oct.; T43N-R29W-S8, 7–9 Sept.; T43N-R30W-S11, 7 May–16 Oct.; T44N-R29W-S25, 11 June–20 Oct., litter, soil cores, pit-trap. U.S. records: Illinois, Massachusetts, North Carolina, Oregon, South Dakota, Virginia, West Virginia, Wisconsin.
- Arrhopalites caecus* (Tullberg), 1871. LP, UP, DC, T43N-R30W-S11, 28 July–4 Sept., soil cores, pit-trap. U.S. records: California, Colorado, Illinois, Indiana, Iowa, Massachusetts, Minnesota, New York, North Carolina, South Dakota, Tennessee, Utah, Wisconsin. Canadian records: Alberta.
- Sminthurinus (Katiannina) macgillivrayi* (Banks), 1897. LP, UP, T43N-R29W-S8, 29 Sept.; T43N-R30W-S11, 7 May–12 June.; T44N-R29W-S25, 15 May–26 June., pit-trap. U.S. records: Illinois, Indiana, Kentucky, Maryland, Missouri, New York, North Carolina, Pennsylvania, Tennessee, Vermont (Bellinger 1982) Canadian records: Ontario.
- Sminthurinus (Polykatianna) intermedius* Snider, 1978. UP, DC, T44N-R29W-S19, 7 Aug.–6 Oct., pit-trap. U.S. records: Connecticut, Illinois, Indiana, Iowa, Maryland.
- Sminthurinus (Sminthurinus) conchyliatus* Snider, 1978. UP, DC, T44N-R29W-S19, 7 Aug.–6 Oct., pit-trap. U.S. records: Illinois.
- Sminthurinus (Sminthurinus) henshawi* (Folsom), 1906. LP, UP, DC, T44N-R29W-S19, 3 Aug.–8 Oct.; T43N-R29W-S8, 4 Aug.–29 Oct.; T43N-R30W-S11, 15 May–27 Oct.; T44N-R29W-S25, 21 May–27 Oct., litter, pit-trap. This is a very common species in our woodlots. U.S. records: ubiquitous.
- Sminthurinus (Sminthurinus) quadrimaculatus* (Ryder), 1879. LP, UP, DC, T44N-R29W-S19, 4 Aug.–7 Oct.; T43N-R29W-S8, 2 Sept.; T43N-R30W-S11, 5 July–4 Sept.; T44N-R29W-S25, 14 May–2 Oct., pit-trap. The two-spotted form occurs in the woodlots. U.S. records: California, Colorado (Fjellberg 1984), Connecticut, District of Columbia, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, New York, North Carolina, Pennsylvania, Tennessee, Wyoming. Canadian records: New Brunswick, Quebec, Ungava Bay.

Subfamily Sminthurinae

- Bourletiella (Bourletiella) hortensis* (Fitch), 1868. LP, UP, DC, T44N-R29W-S19, 30 Aug.; T43N-R29W-S8, 10 Aug.–4 Oct.; T43N-R30W-S11, 11–12 June, litter, pit-trap. U.S. records: ubiquitous.
- Bourletiella (Deuteriosminthurus) russata* Maynard, 1951. LP, UP, T43N-R30W-S11, 5 June–3 July.; T44N-R29W-S25, 17 July, pit-trap. U.S. records: Illinois, Indiana, Iowa, New York, Utah.

Bourletiella (Heterosminthurus) koontzi, n.sp. (Figs. 14–46)

During the summer of 1984, sminthurids were collected in Dickinson County, Michigan (T43N-R30W-S8). The specimens were taken in a field by using a white enamel pan for sweeping grass and shrubs. It was a sunny, windy day with a temperature of approximately 24°C.

COLOR AND PATTERN (female): (Figs. 14–15). Background faint yellow. Antennae uniformly purple. Head with olive green mosaics forming two lines originating from behind the head and extending to approximately the posterior edge of the

eyepatches. Frons with light patches of green. Thorax with light green paramedial broken lines. Lateral olive green mosaics originating on the third thoracic segment converging with the paramedial lines on the greater abdomen; fifth abdominal segment with dark green bands on the posterior margins; abdominal segment VI with two black maculae. Bothriotricha A.B.C surrounded by black pigment. Venter, legs, furcula colorless.

HEAD: eyes 8 + 8 with dark pigment; ocelli A and H subequal (Fig. 16). Antennal segment ratio 1:2.3:7; ANT IV with 9 subsegments, apical bulb (Fig. 17), subsegments with or without fine setulae in the following distribution: II, III, VII, VIII, IX with none, I-1, IV-2, V-2, VI-1 (Fig. 18) with sense organ with two blunt setae withdrawn into a pit with accessory seta (Fig. 19). Dorsum of head with 4 spine-like setae (Fig. 20).

FORELEG: coxa with 1 seta and no oval organs (Fig. 21); trochanter with 1 anterior and 2 posterior setae and no oval organs (Fig. 22); femur with 7 anterior and 8 posterior setae and one oval organ (Fig. 23); anterior and posterior surface with 3 oval organs (Figs. 24-25); tibiotarsus with 3 strongly clavate tenent hairs; pretarsus with posterior curving setulae; unguis curving—lanceolate with no inner or outer teeth, without tunica; unguiculus lanceolate, without lamella, with long strong apical filament (Fig. 26).

MESOLEG: coxa with 2 setae and 1 oval organ (Fig. 27); trochanter with 5 anterior setae and 1 posterior seta, with 1 oval organ (Fig. 28); femur with 1 oval organ, 12 anterior and 4 posterior setae (Fig. 29); anterior and posterior surface of tibiotarsus with 3 oval organs (Figs. 30-31); tibiotarsus with 3 strongly clavate tenent hairs; unguis similar to forefoot; unguiculus with large basal lamella, apical filament stout, pointed.

METALEG: coxa with 4 setae and 1 oval organ (Fig. 32); trochanter with 1 oval organ, 5 anterior and 1 posterior setae (Fig. 33); femur with 1 oval organ, 10 anterior and 5 posterior setae (Fig. 34); anterior and posterior surface of tibiotarsus with 3 oval organs (Figs. 37-38); tibiotarsus with 2 strongly clavate tenent hairs; pretarsus with anterior curving setulae; unguis curving, lanceolate; unguiculus with large basal lamella, apical filament stout and pointed (Fig. 35). NOTE: oval organs are reported, but we suspect others will be found.

BODY: Collophore with 1 + 1 subapical setae (Fig. 39). Tenaculum with 3 setulae, ramus with 2 teeth (Fig. 36). Manubrium with 8 + 8 dorsal setae (Fig. 40). Dens ventrally with 5 V_e setae and 3 V_{e2} dens dorsally with 9 E setae, 7 ID setae, 7 L setae (Figs. 44-45). Mucro with external margin weakly crenulate, internal margin smooth (Figs. 41-42). Female subanal appendage acuminate (Fig. 43). Bothriotrichia A, B, C, D. Body setae smooth. Length, 0.75 mm.

DIAGNOSIS: *Bourletiella (Heterosminthurus) koontzi* n.sp. keys out nearest to *Bourletiella (Heterosminthurus) dreisbachi* (Snider) in Christiansen and Bellinger (1981). However, besides morphological characteristics, color pattern will separate the two species. The following will distinguish the species:

<i>B. (H.) koontzi</i>	<i>B. (H.) dreisbachi</i>
Dorsum of head with 4 spine-like setae	no spine-like setae
ocelli A and H subequal, others reduced in diameter	ocelli C and H subequal others subequal
metaunguiculus with lamella tapering	lamella rounded

TYPES: Holotype (female), allotype (male) and 50 paratypes in ethanol; three females and three males on slides. All types deposited in the Entomology Museum, Michigan State University.

Collection data: Michigan, Dickinson county T43N-R30W-S8, sweeping shrubs in field, 18-VI-84 and 24-VI-84, F.J. Calandrino, collector.

We take pleasure in naming this species for Captain Ronald L. Koontz, Program Manager, ELF Communication System, Department of the Navy Space and Naval Warfare Systems Command.

Neosminthurus bakeri Snider, 1978. T44N-R29W-S25, 18 June, pit-trap. This is the northern-most range so far recorded for this species. U.S. records: Kentucky, North Carolina. Tennessee.



Figs. 14–15. *Bourletietta (Heterosminthurus) koontzi*, n.sp. (14) Habitus, dorsal view, (15) Habitus, lateral view.

Sminthurus (Sminthurus) butcheri Snider, 1969. LP, UP, DC, T44N-R29W-S19, 3 Aug.; T43N-R29W-S8, 4 Aug.–9 Sept.; T43N-R30W-S11, 17 July, litter, pit-trap. U.S. records: Connecticut, Louisiana, Utah.

Sminthurus (Sminthurus) nigromaculatus Tullberg, 1871. T43N-R30W-S8, 27 July–16 Sept., grass sweeping. This species has been in doubt until recently. Its color pattern (Figs. 47–48) is similar to *Sminthurus viridis* (L.) and the two are frequently confused. Hammer (1953) reported *S. viridis* from Canada. Examination of her slides revealed that the specimens were *S. nigromaculatus*. The two species appear to occupy the same range in Europe, however only *S. nigromaculatus* ranges into North America. *S. viridis* feeds on plant fluids while *S. nigromaculatus* gut contents contain hyphae and spores. Morphological separation is possible by examination of the collophore; *S. viridis* lacks a pair of lateral setulae. For a discussion of population variation and habitat descriptions, see Wallace (1973). Canadian records: Northwest Territories.

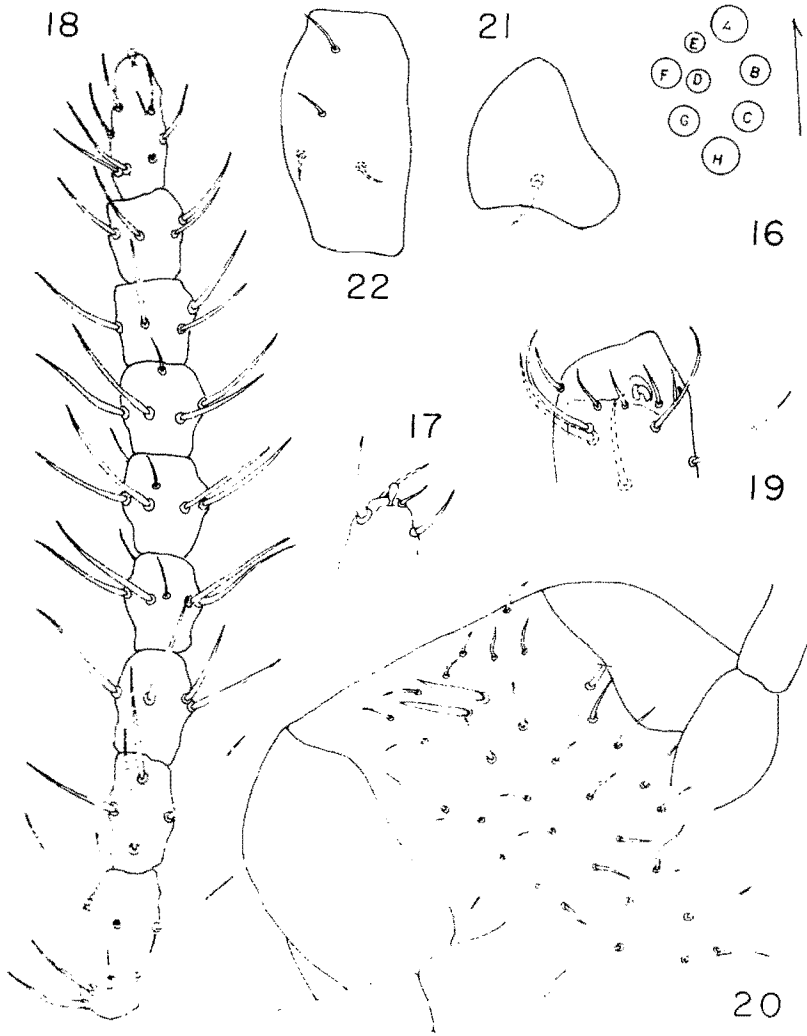
Sminthurus (Allacma) purpurescens (MacGillivray), 1894. T43N-R30W-S11, 16–17 July, pit-traps. The specimens reported here are patterned with white not frequently seen in published illustrations (Figs. 49–50). U.S. records: Massachusetts, Minnesota, New York, North Carolina, Tennessee. Canadian records: Newfoundland.

Subfamily Dicyrtominae

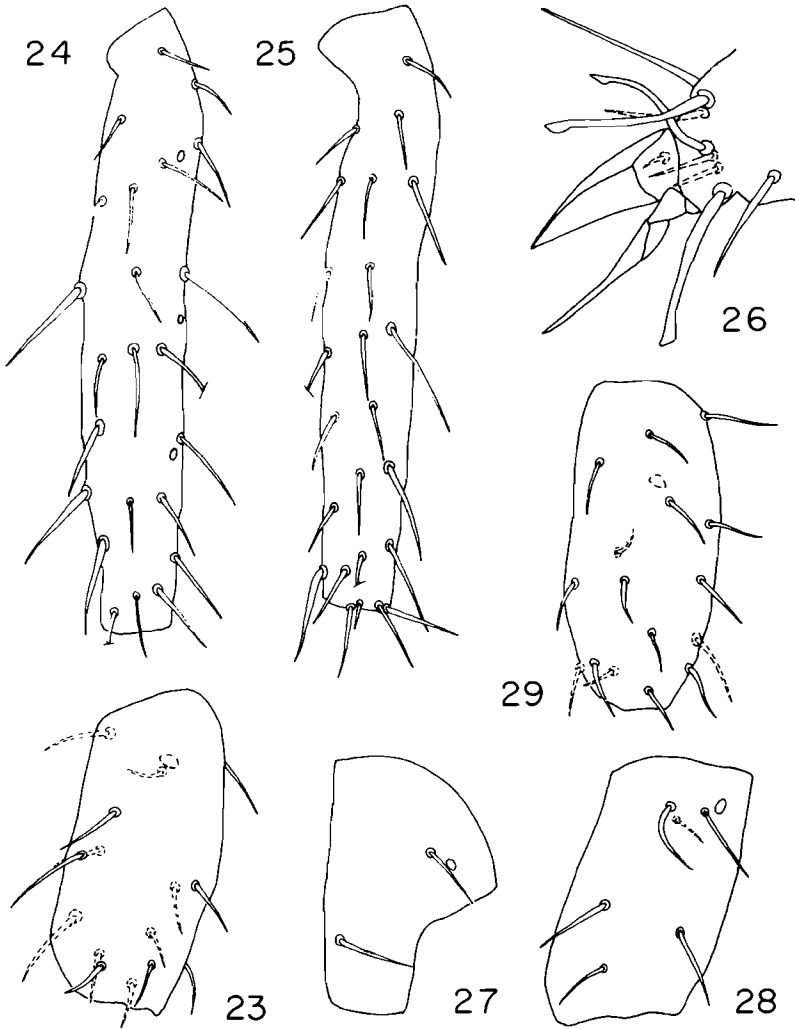
Dicyrtoma (Dicyrtoma) aurata (Mills), 1934. T43N-R30W-S11, 7 May–16 Oct.; T44N-R29W-S11, 7 May–16 Oct.; T44N-R29W-S25, 3–29 Sept., pit-trap. U.S. records: Iowa, North Carolina.

Dicyrtoma (Ptenothrix) atra (L.), 1758. LP, UP, DC, T43N-R30W-S11, 25 Aug., pit-trap. U.S. records: Arkansas, Connecticut, Illinois, Indiana, Iowa, Idaho, Kentucky, Louisiana, Maine, Massachusetts, Minnesota, New Hampshire, New York, North Carolina, Ohio, South Carolina, Vermont, Wisconsin. Canadian records: Nova Scotia, Ontario, Quebec.

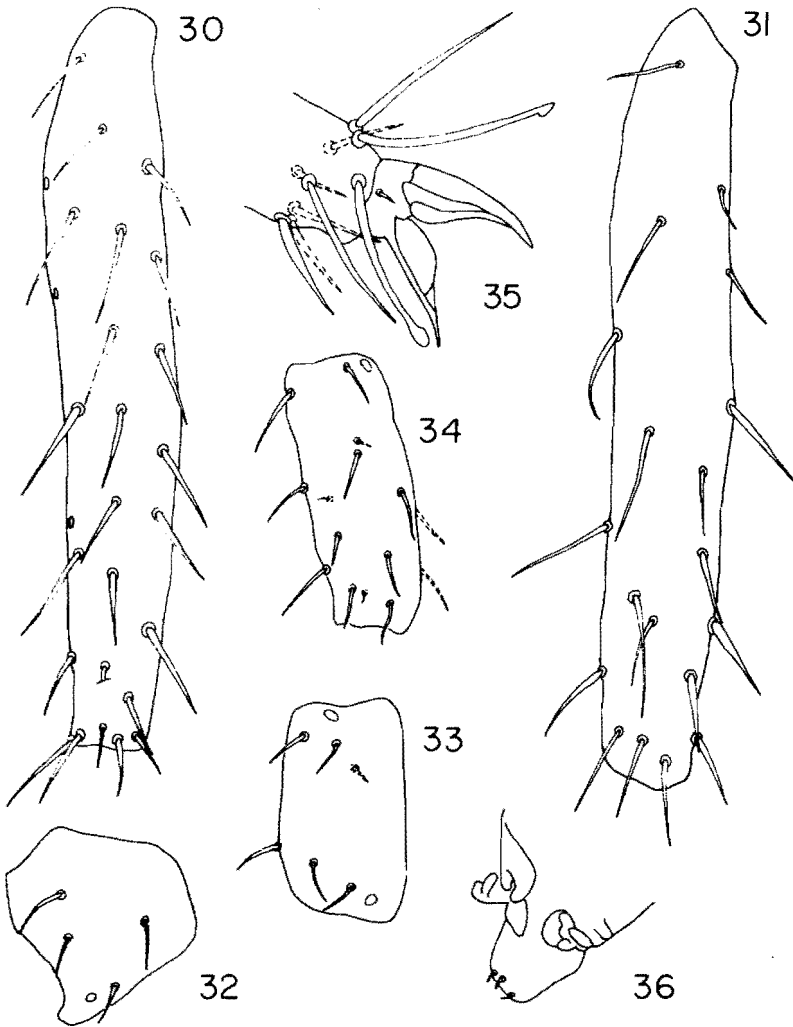
Dicyrtoma (Ptenothrix) marmorata (Packard), 1873. LP, UP, DC, T44N-R29W-S19, 3 Aug.–14 Sept.; T43N-R29W-S8, 10 Aug.–29 Sept.; T43N-R30W-S11, 8 May–16 Oct.; T44N-R29W-S25, 3 July–4 Sept., litter, pit-trap. U.S. records: ubiquitous.



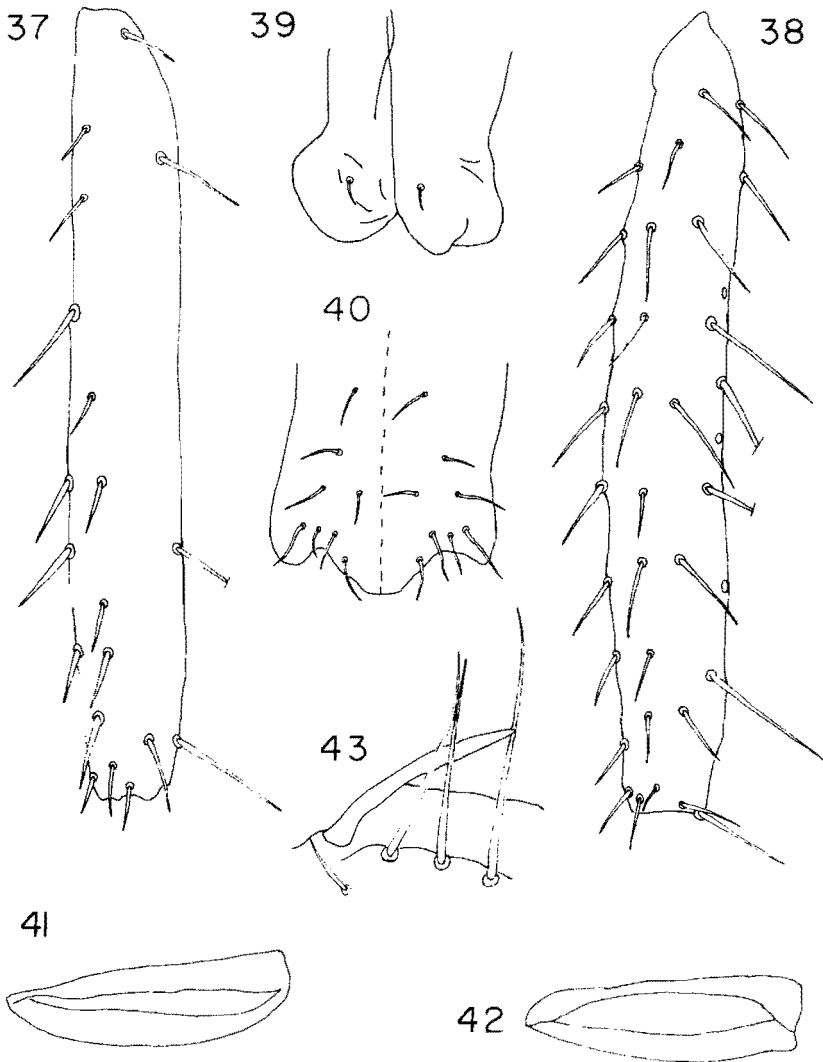
Figs. 16-22. *Bourletiella (Heterosminthurus) koontzi*, n.sp. (16) left ocellar patch, (17) apex of 4th antennal segment, (18) antennal segment 4, (19) antennal segment 3, (20) setal pattern of head, (21) foreleg. coxa, (22) foreleg. trochanter.



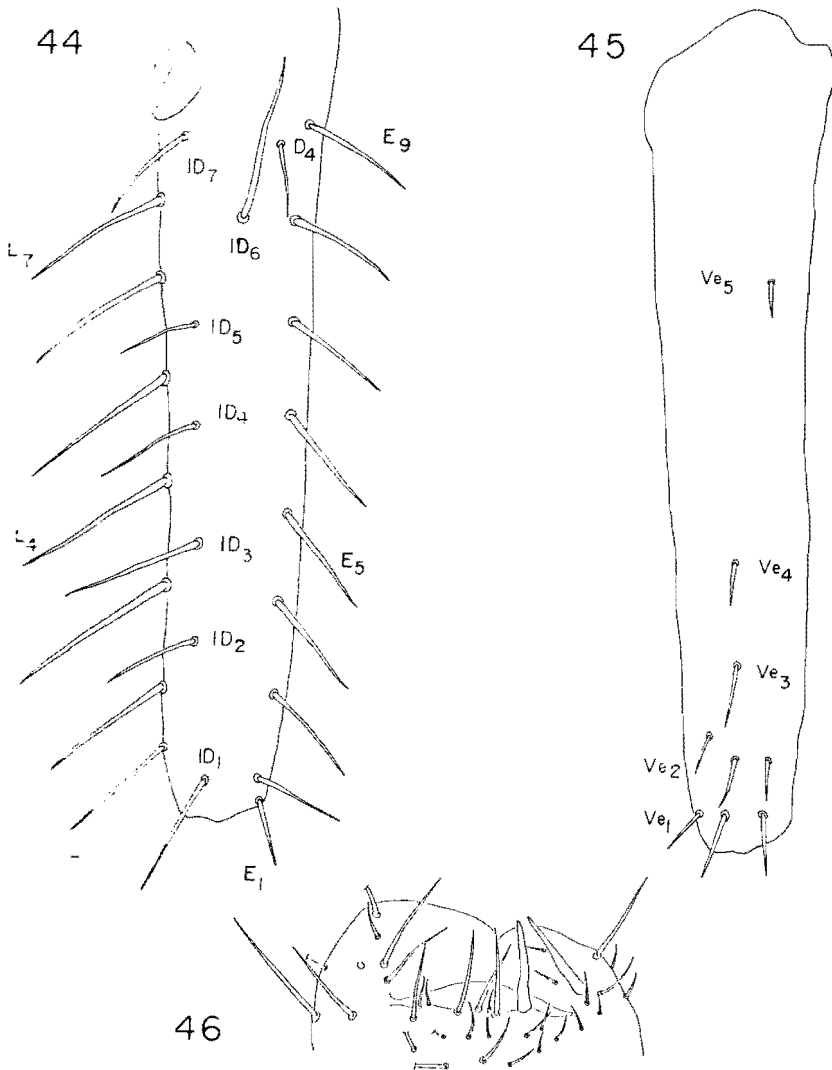
Figs. 23-29. *Bourletiella (Heterosminthurus) koontzi*, n.sp. (23) foreleg, femur, (24) foreleg, posterior surface of tibia, (25) foreleg, anterior surface of tibia, (26) foreleg, claw, (27) mesoleg, coxa, (28) mesoleg, trochanter, (29) mesoleg; femur.



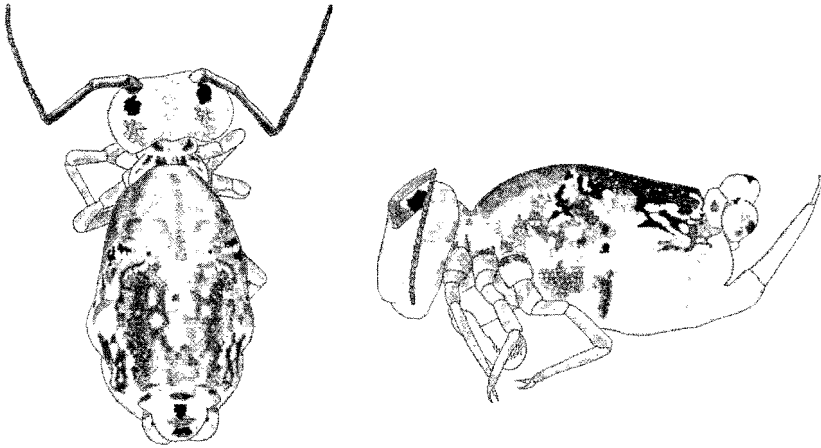
Figs. 30-36. *Bourletiella (Heterosminthurus) koontzi*, n.sp. (30) mesoleg, anterior surface of tibia, (31) mesoleg, posterior surface of tibia, (32) metaleg, coxa, (33) metaleg, trochanter, (34) metaleg, femur, (35) metaleg, claw, (36) retinaculum.



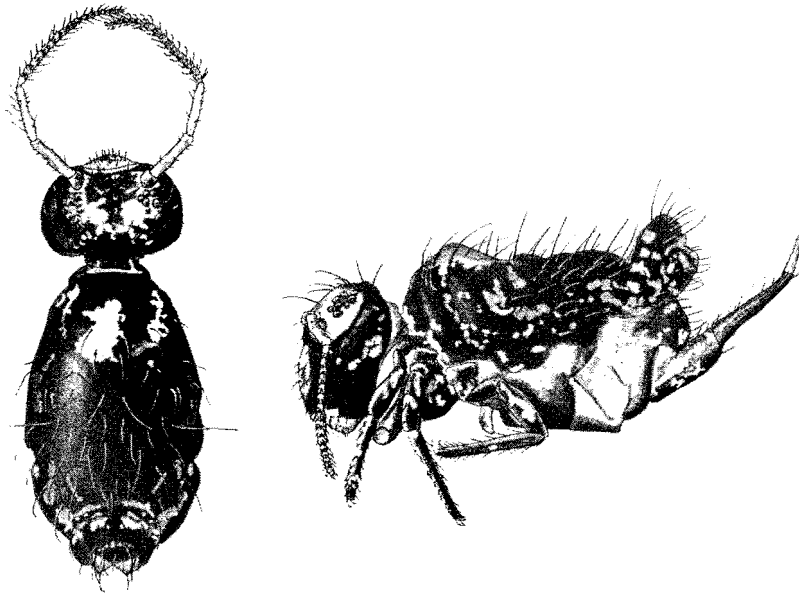
Figs. 37-43. *Bourletiella (Heterosminthurus) koontzi*, n.sp. (37) metaleg, posterior surface of tibia, (38) metaleg, anterior surface of tibia, (39) colophore, posterior view, (40) manubrial setae, (41) mucro, lateral view, (42) mucro, dorsal view, (43) female subanal appendage.



Figs. 44-46. *Bourletiella (Heterosminthurus) koontzi*, n.sp. (44) dens, dorsal view, (45) dens, ventral view, (46) female anal papilla.



Figs. 47-48. *Sminthurus (Sminthurus) nigromaculatus* Tullberg. (47) Habitus, dorsal view, (48) Habitus, lateral view.



Figs. 49-50. *Sminthurus (Allacma) purpurescens* (MacGillivray). (49) Habitus, dorsal view, (50) Habitus, lateral view.

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