



THE WINTER STONEFLIES (PLECOPTERA: CAPNIIDAE) OF MISSISSIPPI

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ABSTRACT

The Mississippi winter stonefly fauna includes seven *Allocapnia* species [*A. aurora* Ricker, *A. granulata* (Claassen), *A. mystica* Frison, *A. polemistis* Ross & Ricker, *A. rickeri* Frison, *A. starki* Kondratieff & Kirchner and *A. virginiana* Frison] and *Nemocapnia carolina* Banks; *Allocapnia recta* (Claassen), previously recorded from the state, is deleted from the list and all records for this species are assigned to *A. starki*. The male epiproct and 8th tergal process of the Mississippi Capniidae were examined with scanning electron microscopy, and the female subgenital plates were also studied to determine if these could be reliably separated. A brief description is given for female genital segments of *A. polemistis*.

Keywords: Plecoptera, Capniidae, *Allocapnia*, *Nemocapnia*, Mississippi

INTRODUCTION

Winter stoneflies (Capniidae) comprise the largest family of Plecoptera in North America (Alford 1998; Stark & Baumann 2006). The family is a Holarctic euholognathan group of 17 genera and approximately 250 primarily winter emerging species. Adults are small, dark bodied stoneflies with multisegmented cerci (Kirchner et al. unpublished). External reproductive structures of males include a well developed dorsal epiproct, and in many cases, there are dorsal tubercles on one or more abdominal terga. In addition, males of many species are short winged or wingless. Adult females lack extensive external genital structures but have a small, modified subgenital plate covering the gonopore on sternum 8.

The first published records of Capniidae for Mississippi are from the Ross & Ricker (1971) monograph on genus *Allocapnia*. This publication includes single map plots for four species widely distributed in eastern North America, *A. granulata* (Claassen), *A. recta* (Claassen), *A. rickeri* Frison and *A.*

virginiana Frison. New records for three of these (*A. recta*, *A. rickeri*, *A. virginiana*) were subsequently reported by Stark (1979) and Alford (1998), and the first Mississippi records for *A. aurora* Ricker, *A. mystica* Frison and *Nemocapnia carolina* Banks were reported by Stark (1979). *Allocapnia polemistis* Ross and Ricker was recently reported from the state by Stark et al. (2000), and a few additional Mississippi locality records were given by Stark & Lacey (2005).

There are apparently seven Mississippi *Allocapnia* species but Stark & Lacey (2005) list eight. This discrepancy follows the description of *Allocapnia starki* by Kondratieff & Kirchner (2000) from southwestern Mississippi populations previously identified as *A. recta*. Populations from other regions of the state not analyzed by Kondratieff & Kirchner (2000) were still considered by Stark & Lacey (2005) to be *A. recta*, but it now appears *A. recta* should be deleted from the current list of Mississippi stoneflies.

Scanning electron microscopy (SEM) has been widely used in the study of stonefly eggs (e.g. Stark

& Szczytko 1976; Szczytko & Stewart 1979) and more recently it has been adapted for study of other structures including male genitalia (e.g. Nelson & Baumann 1987; Young et al. 1989; Stark & Gustafson 2004) and nymphal setation (e.g. Stark & Stewart 2005; Stark & Lacey 2005). Scanning electron microscopy provides a reliable way to distinguish among species of Mississippi Capniidae. The use of SEM clearly reveals subtle differences in surface detail of male epiprocts, tergal processes and similar structures. Alford (1998) published the first SEM data for Mississippi Capniidae by providing figures of the male epiprocts for *Allocapnia aurora*, *A. starki* and *A. virginiana*. Stark et al. (2000) presented SEM data for male *A. polemistic* and Kondratieff & Kirchner (2000) included SEM images for *A. starki* in their original description of this species. More recently, Stark & Lacey (2005) described the nymphs of several Mississippi *Allocapnia* based largely on SEM data and they also included comparative figures of the epiprocts of *A. aurora*, *A. mystica*, *A. starki* and *A. virginiana*. In this study an effort has been made to bring together all known records of Mississippi Capniidae and to provide comparative scanning electron microscopy data for males of all species known for the state. This includes the first SEM images for *Allocapnia granulata*, *A. rickeri* and

Nemocapnia carolina. It is hoped this effort will facilitate recognition of these species.

MATERIALS AND METHODS

Adult *Allocapnia* were collected in December 2005 through January 2007 at sites throughout Mississippi and archived specimens were obtained from the Stark collection at Mississippi College. Specimens used in scanning electron microscopy, and stored in 80% ethanol, were transferred through a serial dilution of 90, 95, and 100% ethanol for ten minutes each. They were then placed in clean 100% ethanol and sonicated for 10-15 seconds to remove debris. Specimens were then transferred through two Hexamethyldisilazane washes for thirty minutes each, placed on double stick copper tape attached to an aluminium stub, sputter coated with gold-palladium, and studied with an AMRAY 1810D scanning electron microscope.

Some female specimens were dissected and the terminal abdominal segments treated with hot 10% KOH. Specimens were removed to distilled water and examined with a dissecting microscope equipped with camera lucida and drawn for comparison. SEM stubs and voucher specimens are archived in the Stark collection at Mississippi College.



Figs. 1-2. Head and pronotum, lateral aspect. 1. *Allocapnia rickeri*, 2. *Nemocapnia carolina*.

RESULTS AND DISCUSSION

More than 1800 adult specimens of two winter stonefly genera, *Allocapnia* and *Nemocapnia*, and eight species from 50 of Mississippi's 82 counties were

observed during this study and SEM images were prepared for both male and female specimens. Males of the two genera are easily separated by wing length; *Nemocapnia* males are fully winged with the

tips reaching beyond the abdominal apex, but *Allocapnia* males are short winged with the tips not reaching the abdominal apex. In addition, the epiproct is a double limb structure in *Allocapnia* (Fig. 5) but consists of a single, usually upright probe in *Nemocapnia* (Fig. 54). Females are also easily distinguished by genitalic characters and by the shorter cerci in *Nemocapnia*. In addition, *Nemocapnia* adults are covered with fine long setae (Fig. 2) which give specimens a fuzzy appearance, but *Allocapnia* adults are covered by much shorter setation (Fig. 1). The following key, modified from Kirchner et al. (unpublished) can be used to distinguish these genera.

Key to Mississippi Genera of Capniidae

(Modified from Kirchner et al. unpublished and Stewart & Harper 1996)

- 1 Male wings reach beyond tip of abdomen; epiproct consists of a single slender probe, usually projecting dorsad between cerci (Fig. 54); male tergum 8 without dorsal process (Fig. 53); cerci with less than 11 segments; female subgenital plate subterminal in position on sternum 8 and with a transverse bar-shaped sclerite located distal to plate (Fig. 66) *Nemocapnia*
- 1' Male wings not reaching tip of abdomen; epiproct consists of dorsal and ventral arms oriented horizontally over tip of abdomen (Fig. 5); tergum 8 with dorsal process (Fig. 7); cerci with more than 11 segments; female subgenital plate in terminal position on sternum 8 (Fig. 63), transverse bar-shaped sclerite absent (Fig. 63) *Allocapnia*

Genus *Allocapnia* Claassen, 1928

Type species. *Allocapnia granulata* (Claassen)

Distribution. An eastern Nearctic endemic genus found from the southern Maritime Provinces of Canada to the Gulf Coastal States and westward to the Wichita Mountains of Oklahoma and the eastern counties of the Dakotas (Kirchner et al. unpublished).

Diversity. *Allocapnia* currently includes 44 species (Stark & Baumann 2006) with seven recognized for Mississippi. The following keys modified from

Kirchner et al. (unpublished) will assist in the identification of adult specimens. Most Mississippi nymphal specimens can be identified using Stark & Lacey (2005).

Key to Adult Mississippi *Allocapnia*

(Modified from Kirchner et al. unpublished)

- 1 Tip of abdomen bearing a dorsal epiproct (Figs. 4-5), and a dorsal process on abdominal segment 8 (Fig. 7); wings not reaching tip of abdomen males (2)
- 1' Tip of abdomen without dorsal epiproct and process on tergum 8, but with a conspicuous pale, unsclerotized dorsal band extending from abdominal base to segment 8; abdominal sternum 8 modified to form a small subgenital plate (Fig. 9); wings usually reaching almost to, or slightly beyond tip of abdomen females (8)
- 2 Tergal process on segment 8 with a wide, conspicuous notch (Fig. 14) 3
- 2' Tergal process on segment 8 without notch (Fig. 28), or with a narrow inconspicuous notch (Fig. 21) 5
- 3 Tergum 8 with a small membranous, hairy knob located posterolaterad of each lobe of dorsal process (Figs. 12-14) *granulata*
- 3' Tergum 8 without membranous hairy knob behind lobes of dorsal process 4
- 4 Dorsal process of tergum 8 more or less chair shaped in lateral aspect; notch moderately deep but not extending to level of tergum 7 (Figs. 5, 7) *aurora*
- 4' Dorsal process of tergum 8 not chair shaped in lateral aspect; notch of process deep, extending to level of tergum 7 (Fig. 33, 36) *rickeri*
- 5 Dorsal process of tergum 8 large, flat, cushion-like and bearing a second, small, ridge-like process on anterior margin of tergum 8 (Figs. 49-50; apical segment of epiproct upper limb wide (Fig. 46) *virginiana*
- 5' Dorsal process of tergum 8 variable but not as above; apical segment of epiproct upper limb narrower (Fig. 18) 6
- 6 Dorsal process of tergum 8 with a narrow notch (Fig. 21) *mystica*
- 6' Dorsal process of tergum 8 without notch (Fig. 28) 7
- 7 Anterior margin of dorsal process of tergum 8

- bent abruptly near apex in lateral aspect (Fig. 29); dorsal aspect of 8th tergal process a thin, almost straight, transverse ridge (Fig. 28) *polemistis*
- 7' Anterior margin of dorsal process of tergum 8 not bent (Fig. 43); dorsal aspect of 8th tergal process U or V-shaped *starki*
- 8 Abdominal sterna 7 and 8 at least partially fused by a distinct transverse sclerotized area (Figs. 9, 37) 9
- 8' Abdominal sterna 7 and 8 separated by membrane (Fig. 16) 10
- 9 Sclerotized bridge between abdominal sterna 7 and 8 with conspicuous lateral membranous notches (Figs. 37, 63) *rickeri*
- 9' Sclerotized bridge between abdominal sterna 7 and 8 folded under posterior margin of sternum 7 forming a thin, dark line without lateral notches (Figs. 9, 59) *aurora*
- 10 Projecting subgenital plate with small basolateral notches (Figs. 16, 60) *granulata*
- 10' Subgenital plate, if projecting, without basolateral notches (Fig. 30) 11
- 11 Subgenital plate scarcely projecting beyond lateral margins of sternum 8 (Figs. 30, 62); known from Tishomingo Co *polemistis*
- 11' Subgenital plate at least slightly projecting beyond lateral margins of sternum 8 (Fig. 44); found more or less statewide 12

- 12 Subgenital plate broadly arcuate (Figs. 51, 65) *virginiana*
- 12' Subgenital plate narrow (Fig. 44) 13
- 13 Base of subgenital plate with a pair of small, mesal lobes (Fig. 64) *starki*
- 13' Base of subgenital plate without small, mesal lobes (Fig. 61) *mystica*

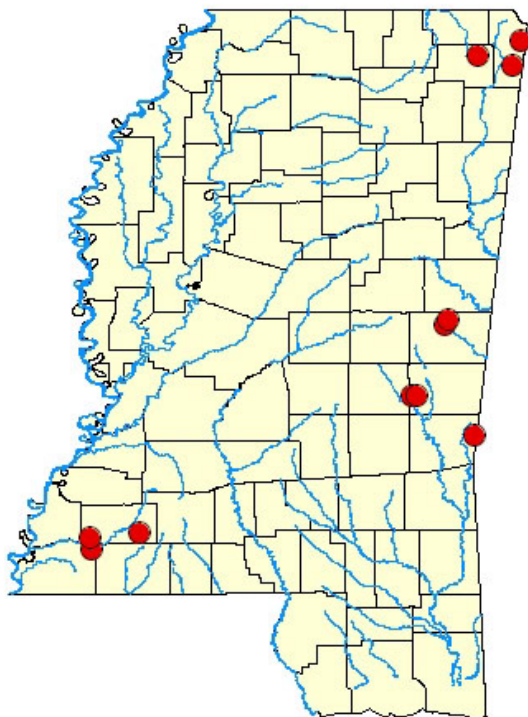
Allocapnia aurora Ricker

Allocapnia aurora Ricker, 1952. Holotype male, Pigeon River, Woodrow, North Carolina

Allocapnia aurora: Alford, 1998. SEM of male

Allocapnia aurora: Stark & Lacey, 2005. SEM of male and nymph

Distribution. AL, DC, GA, MD, MS, NC, PA, SC, TN, VA (Stark & Baumann 2006). Mississippi populations have been reported in Amite, Clarke, Franklin, Lauderdale and Tishomingo counties (Stark 1979; Alford 1998; Stark & Lacey 2005) and in this paper new records are given for Kemper County and Prentiss County. The base distribution lies along the Alabama line from Tishomingo Co. to Clarke Co. with an apparent small disjunct population in the Homochitto National Forest of southwest Mississippi (Fig. 3); only three specimens have been taken from the disjunct area.



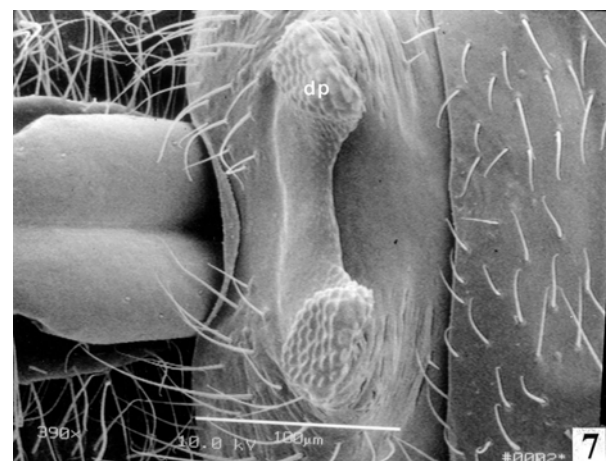
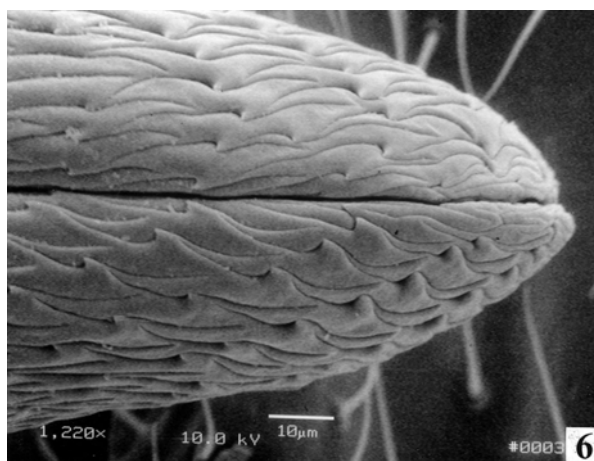
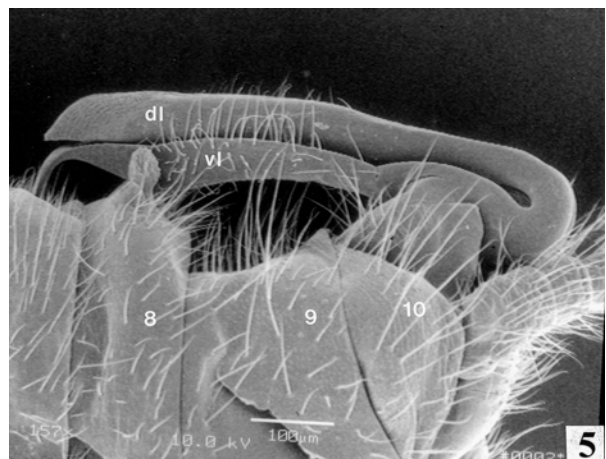
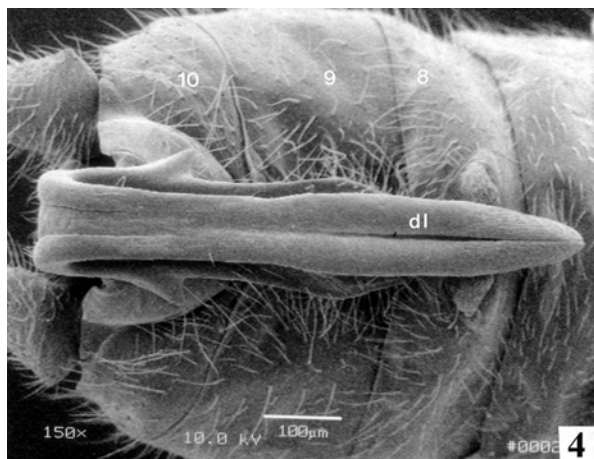
Allocapnia aurora

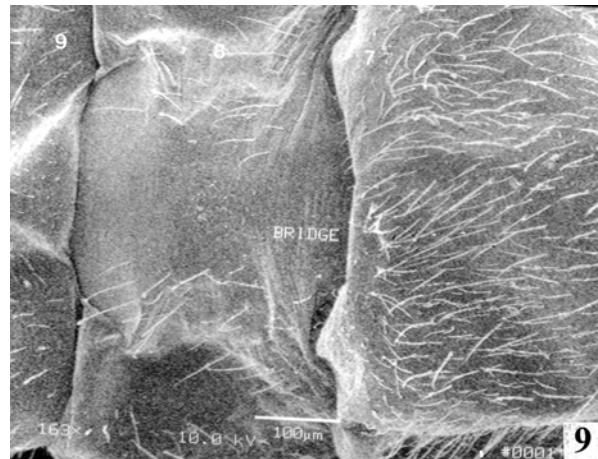
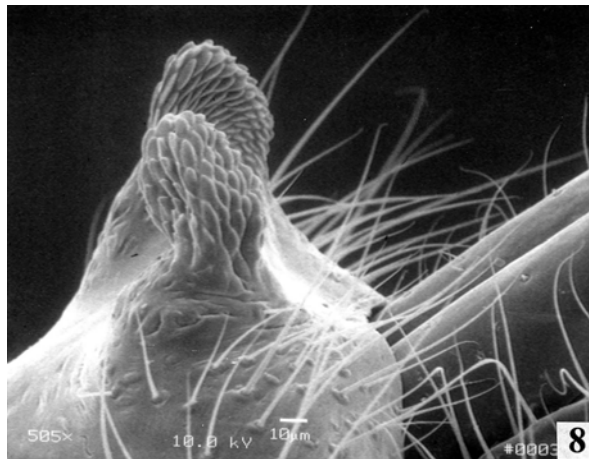
Fig. 3. Distribution of *Allocapnia aurora* in Mississippi.

Mississippi collection data. (Fig. 3). **Amite Co.**, Foster Creek at Hwy 33, 26 December 1997, M. Alford, 1 ♂. **Clarke Co.**, Little Okatuppa Creek, Hwy 18, 29 December 1999, B. Stark, 1 ♀; Same location, 7 December 2002, B. Stark, 2 ♂; Same location, 18 December 2002, B. Stark and J. Lacey, 9 ♂, 1 ♀; Same location, 18 January 2003, B. Stark, W. Hawkins and S. Cope, 1 ♂; Same location, 8 January 2005, B. Stark, 1 ♂. **Franklin Co.**, Cane Mill Branch, 29 December 1996, M. Alford, 1 ♂; Same location, 26 December 1997, M. Alford, 1 ♂; Dry Creek at USFS Road 145, 5 December 1997, M. Alford, 1 ♂. **Kemper Co.**, Straight Creek, Hwy 39, 14 December 2006, B. Stark and M. Hicks, 2 ♂, 1 ♀; Wahalak Creek, Holly Haley Road, 32° 51' 92.2" N, 88° 38' 12.1" W, 14 December 2006, B. Stark and M. Hicks, 2 ♂. **Lauderdale Co.**, Cow Creek, I-20, 12 January 1979, B. Stark and P. Hartfield, 3 ♂, 1 ♀; Cow Creek, Cow Creek Road, 32° 22' 75.0" N, 88° 50' 36.8" W, 12 January 2007, B. Stark, 1 ♂; Tallahatta Creek, I-20, 12 January 1979, B. Stark and P. Hartfield, 1 ♂. **Prentiss Co.**, Big Brown Creek, Hwy

364, 34° 40' 22.8" N, 88° 25' 79.9" W, 23 December 2006, B. Stark, 1 ♀. **Tishomingo Co.**, Clear Creek, 4 miles E Iuka, Hwy 72, 5 February 1977, B. Stark, 1 ♂, 4 ♀; Rock Quarry Creek, Tishomingo State Park, 34° 36' 73.4" N, 88° 12', 25.1" W, 28 December 2005, T. Nations and B. Stark, 1 ♀; Same location 23 December 2006, B. Stark, 3 ♂; Same location, 8 January 2007, B. Stark, 1 ♂; Tishomingo State Park, 16 January 1981, J. Goddard, 2 ♀ (University of Mississippi); Same location, 10 February 1979, M.O. Mann, 1 ♀ (University of Mississippi); Jourdan Creek, CR 16, 8 January 2007, B. Stark, 2 ♂; Rock Creek, CR 1, 34° 29' 93.2" N, 88° 18' 87.7" W, 8 January 2007, B. Stark, 5 ♂, 1 ♀

Male epiproct. Epiproct long, slender, and spear shaped in dorsal aspect (Fig. 4), armed in the apical fourth with smooth, undulant ridges (Figs. 4-6), but smooth in basal three quarters. A prominent, narrow, longitudinal groove divides most of the apical half in dorsal aspect, and a broad, shallow trough is present on the basal third. In lateral aspect, apex slightly





Figs. 4-9 *Allocapnia aurora*, Tishomingo Co., Rock Quarry Creek, Tishomingo State Park. 4. Epiproct, dorsal, 5. Epiproct, lateral, 6. Epiproct tip, 7. Male tergum 8 and dorsal process, 8. Male tergum 8, lateral aspect, 9. Female abdominal sterna 7-9; dp = dorsal process; dl = dorsal epiproct limb; vl= ventral epiproct limb.

inflated to a terminal acute tip; lower limb apex not visible in dorsal aspect but in lateral aspect it bends sharply ventrad near dorsal limb tip (Fig. 5), and lower limb slightly wider in dorsal aspect than upper limb from base to beyond midlength (Fig. 4).

Male tergal process. Tergum 8 bears a single process with moderately deep notch (Figs.5, 7), narrow and upright in lateral aspect (Fig.8); notch slightly wider than tall, oval knobs at each end of process; knobs covered over most of surface with scale-like tubercles (Figs.7-8).

Female subgenital plate. The truncate hind margin of sternum 8 does not project beyond lateral margins of segment and mesal sclerite on sternum 8 completely fused with mesal sclerite on sternum 7; fusion point between segments 7-8 marked by dark transverse line (Fig. 59) formed from infolding of bridge sclerite beneath segment 7 (Fig. 9).

Allocapnia granulata Claassen

Capnella granulata Claassen, 1924. Holotype male, Johnstown, New York

Allocapnia granulata: Ross & Ricker, 1971. Mississippi record

Distribution. AL, AR, DC, IA, IL, IN, KS, KY, LA, MB, MD, MI, MN, MO, MS, NJ, NY, OH, OK, ON, PA, PQ, TN, TX, VA, WI, WV (Stark & Baumann 2006). The published Mississippi record is from a single female specimen housed in the Illinois Natural

History Survey, and collected in Marshall County in 1941 (Ross & Ricker 1971; Stark 1979). Several efforts to recollect the species from streams in the Potts Camp area have been unsuccessful but populations were discovered at four sites in Noxubee County and Kemper County during December 2006.

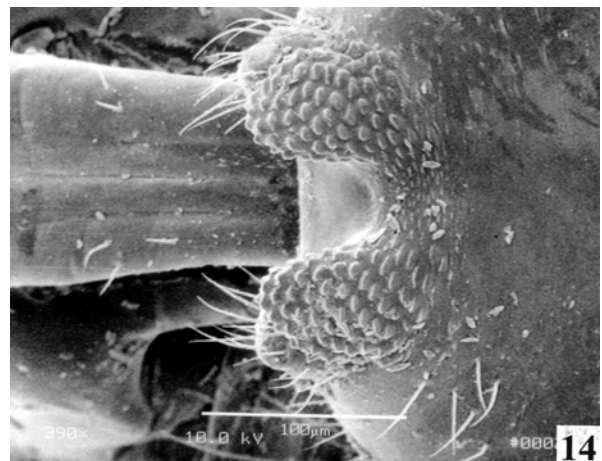
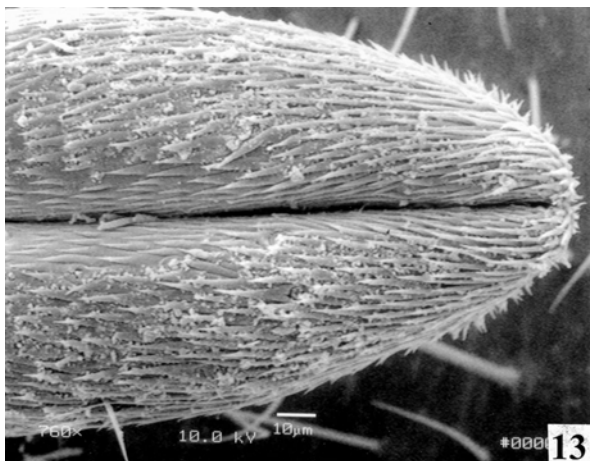
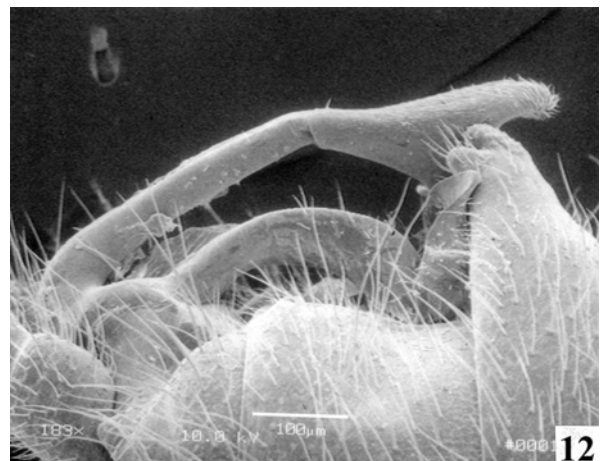
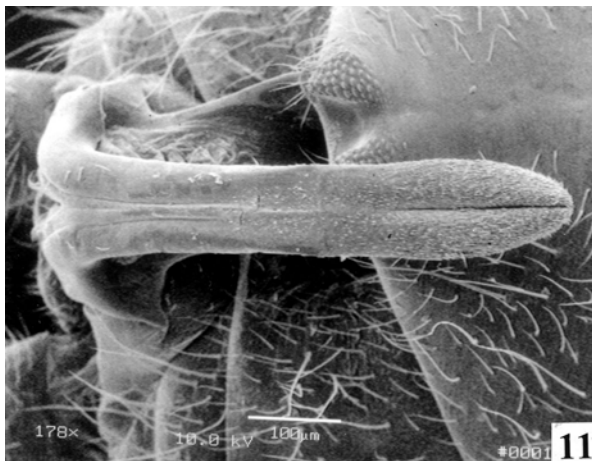
Mississippi collection data. (Fig. 10). **Kemper Co.,** Shy Hammock Creek, Hwy 16, 32° 49' 85.8" N, 88° 23' 74.7" W, 28 December 2006, M. Hicks, 1 ♂, 1 ♀; Same location, 12 January 2007, B. Stark, 1 ♀; Pushacoona Creek, Hwy 16, 32° 49' 77.5" N, 88° 25' 20.0" W, 28 December 2006, M. Hicks, 25 ♂, 10 ♀; Same location, 12 January 2007, B. Stark, 11 ♂, 5 ♀; Bodka Creek, Hwy 45, 28 December 2006, M. Hicks, 1 ♀; **Marshall Co.,** Potts Camp, 17 February 1941, no collector known, 1 ♀ (Illinois Natural History Survey). **Noxubee Co.,** Shuqualak Creek, Hwy 45, 20 December 2006, M. Hicks and M. Howarter, 7 ♂, 2 ♀.

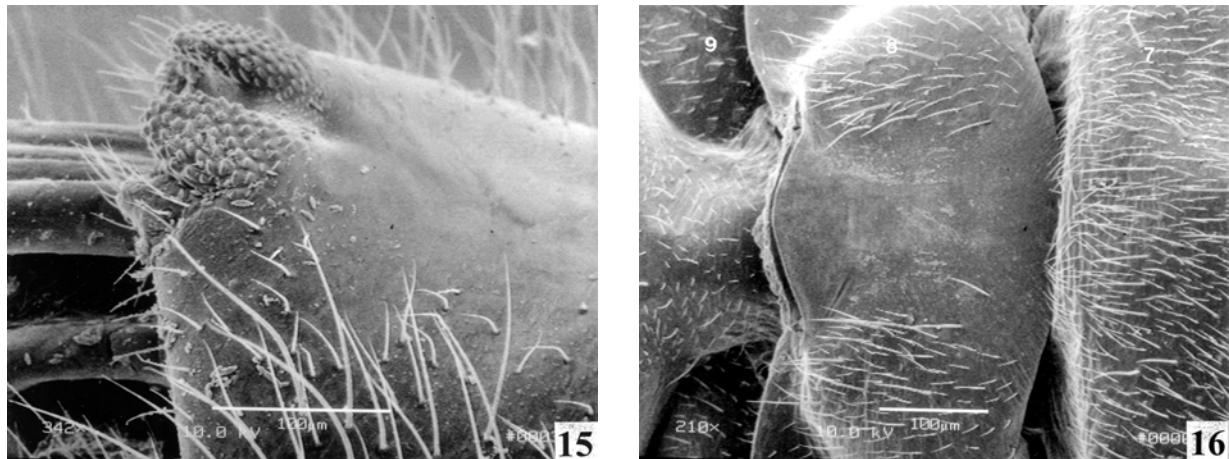
Male epiproct. Epiproct dorsal arm conspicuously angled near midlength, becoming slightly wider subapically and forming a more or less paddle shaped apical section (Fig. 11). Apical half of dorsal arm bears numerous, short, spiny projections (Fig.13); projections become smaller and more sparsely distributed toward apical section base. In dorsal aspect a median, narrow, shallow groove divides apical section of dorsal arm (Figs.11, 13). In lateral aspect, dorsal arm slightly inflated and densely spinose near tip, ventral arm slightly recurved and smooth at apex (Fig.12).



Allocapnia granulata

Fig. 10. Distribution of *Allocapnia granulata* in Mississippi.





Figs. 11-16. *Allocapnia granulata*, Noxubee Co., Shuqualak Creek, Hwy 45. 11. Epiproct, dorsal, 12. Epiproct, lateral, 13. Epiproct tip, 14. Male tergum 8 and dorsal process, 15. Male tergum 8, lateral aspect, 16. Female abdominal sterna 7-9.

Male tergal process. Tergum 8 process deeply notched in dorsal aspect, forming a pair of elongate knobs in V-shaped pattern (Fig.14); knobs armed with scale-like tubercles and an additional small, hairy scaleless knob is located behind larger scaled knobs. In lateral aspect, scaled knobs are low at anterior margin and are slanted upward toward projecting, hairy, posterior knobs (Fig.15).

Female subgenital plate. Abdominal sternum 8 bears a slightly projecting median plate with low

mesal point and base constricted by small lateral notches (Figs.16, 60). Sterna 7 and 8 completely separated by membrane.

Allocapnia mystica Frison

Allocapnia mystica Frison, 1929. Holotype male, small tributary to Salt Fork River, Oakwood, Illinois

Allocapnia mystica: Stark & Lacey, 2005. SEM of male

Allocapnia mystica

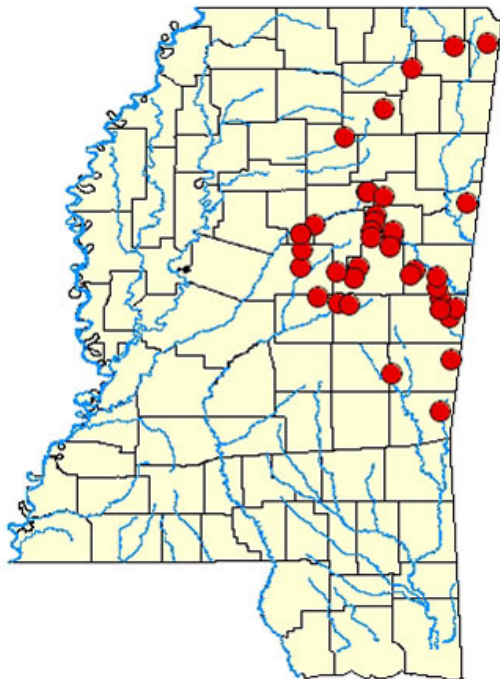
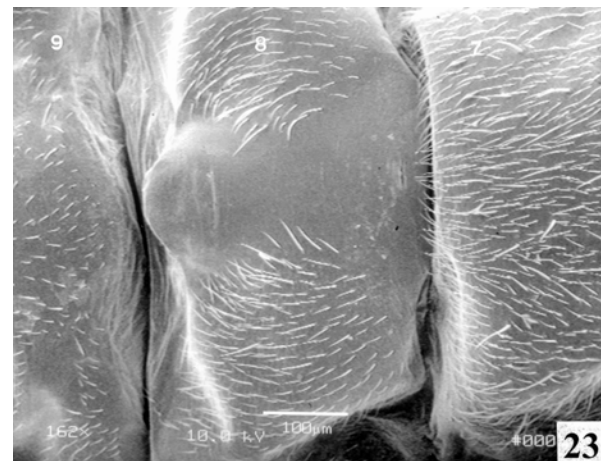
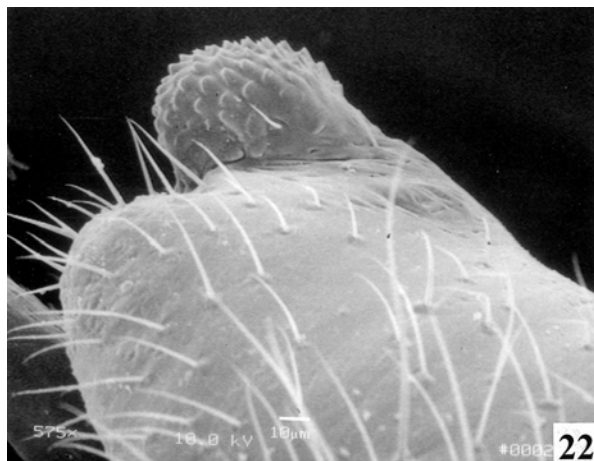
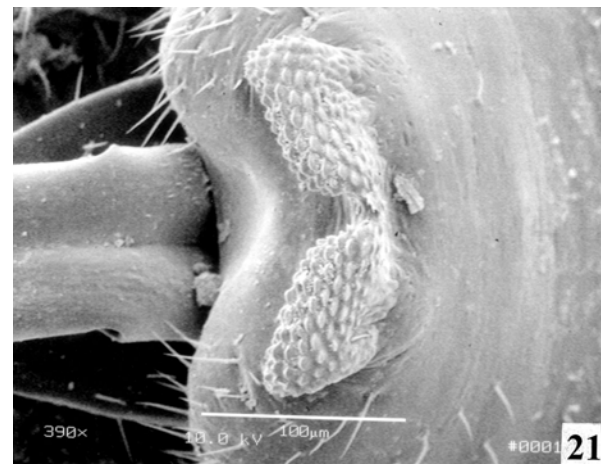
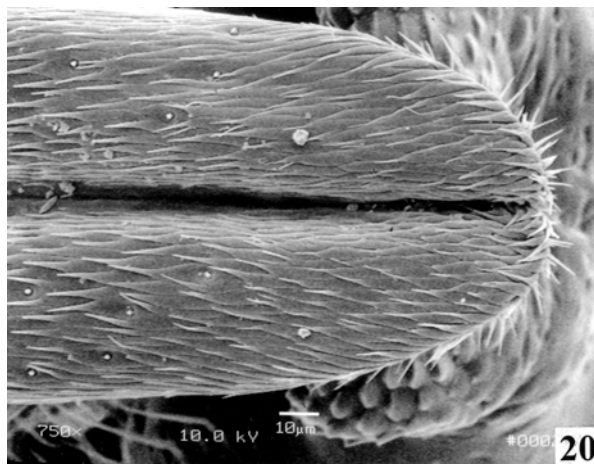
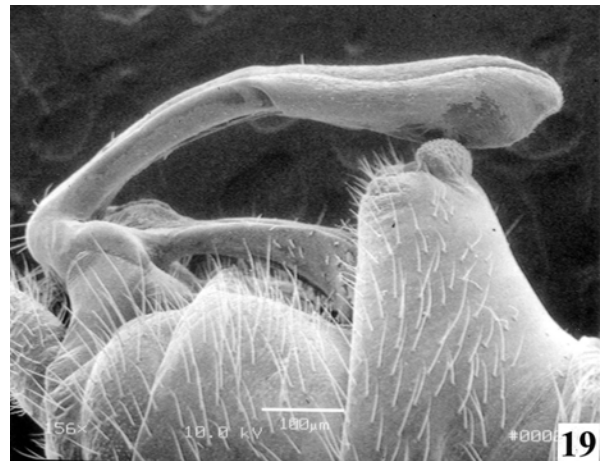
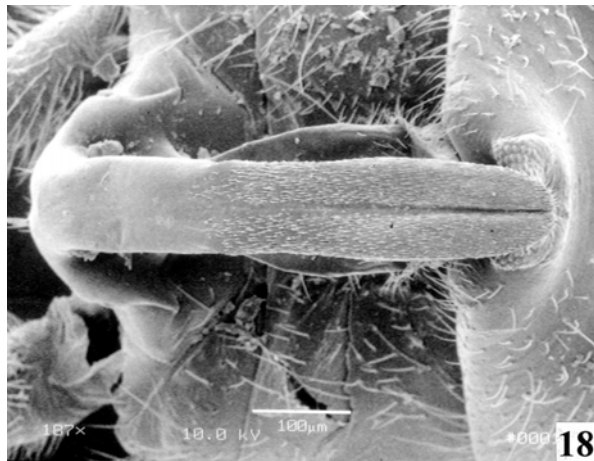


Fig. 17. Distribution of *Allocapnia mystica* in Mississippi.

Distribution. AL, AR, GA, IL, IN, KY, MO, MS, OH, IN, VA, WV (Stark & Baumann 2006). Mississippi populations have been reported in Clarke, Lauderdale, Lowndes, Pontotoc, Tishomingo, Union and Webster counties (Stark 1979; Stark & Lacey 2005) and in this paper new records are given for Alcorn County, Attala County, Calhoun County, Chickasaw County, Choctaw County, Clay County, Kemper County, Leake County, Montgomery County, Neshoba County, Noxubee County, Oktibbeha County, Panola County, Prentiss County and Winston County. This species is particularly common in east central counties and also occurs in several northern counties but all known sites are well to the east of Interstate 55 except for those in Panola County.

Mississippi collection data. (Fig. 17). **Alcorn Co.,** Clear Creek, Hwy 72, 34° 54' 04.0" N, 88° 28' 64.7" W, 8 January 2007, B. Stark, 1 ♂. **Attala Co.,** Hurricane Creek, CR 3022, 33° 06' 93.2" N, 89° 32' 58.6" W, 19 December 2006, B. Stark, 34 ♂, 9 ♀; Zilpha Creek, Hwy 43, 33° 14' 83.5" N, 89° 32' 03.1" W, 19 December 2006, B. Stark, 3 ♂, 1 ♀. **Calhoun Co.,** Tributary to Skuna River, Hwy 32 at CR 155, 34° 03' 11.6" N, 89° 13' 67.7" W, 22 December 2006, B. Stark, 3 ♂, 2 ♀. **Chickasaw Co.,** Cane Creek, Hwy 15, 33° 46' 60.5" N, 89° 02' 74.6" W, 8 January 2007, B. Stark, 1 ♂; Cane Creek, Hwy 389, 3 January 2000, B. Stark, M. Alford, 3 ♀. **Choctaw Co.,** Big Bywy Ditch, Huntsville Road, 33° 25' 53.5" N, 89° 26' 19.1" W, 19 December 2006, B. Stark, 2 ♂, 2 ♀. **Clarke Co.,** Rocky Creek, Hwy 18, 18 December 2002, B. Stark and J. Lacey, 3 ♂. **Clay Co.,** Johnson Creek, Billy Wooten Road, 26 January 2006, M. Hicks, 2 ♂, 1 ♀; Prairie Creek, Hwy 46, 3 January 2000, B. Stark, M. Alford, 1 ♀. **Kemper Co.,** Wahalak Creek, Wahalak Road, 32° 52' 94.9" N, 88° 33' 96.4" W, 14 December 2006, B. Stark and M. Hicks, 9 ♂; Scooba Creek, Hwy 16, 32° 48' 73.5" N, 88° 31' 92.3" W, 14 December 2006, B. Stark and M. Hicks, 21 ♂, 11 ♀; Pushacoona Creek, Hwy 16, 28 December 2006, M. Hicks, 1 ♂, 5 ♀; Bodka Creek, Hwy 45, 28 December 2006, M. Hicks, 1 ♂, 4 ♀. **Lauderdale Co.,** Tallahatta Creek, I-20, 10 miles West of Meridian, 15 January 1977, B. Stark and L. Temple, 1 ♂, 2 ♀; Sucatolba Creek, Kewanee Road, 28 December 2006, M. Hicks, 1 ♂. **Leake Co.,** Bibalucta Creek, Salem Rd, 28 December 2006, M. Hicks, 2 ♂. **Lowndes Co.,** Mayhew Creek, Hwy 12, 29

December 1998, B. Stark, 7 ♂. **Montgomery Co.,** Little Poplar Creek, Hwy 407, 33° 21' 01.8" N, 89° 32' 54.3" N, 19 December 2006, B. Stark, 5 ♂, 1 ♀; Poplar Creek, Bethel Road, 33° 21' 25.3" N, 89° 32' 31.4" W, 19 December 2006, B. Stark, 9 ♂. **Neshoba Co.,** Jofuska Creek, River Road, 28 December 2006, M. Hicks, 2 ♂; Lukfapa Crk, River Rd, 28 December 2006, M. Hicks, 1 ♀. **Noxubee Co.,** Shuqualak Creek, Hwy 45, 20 December 2006, M. Hicks and M. Howarter, 20 ♂; Hashuqua Creek, Butler Road, 20 December 2006, M. Hicks and M. Howarter, 2 ♂; Dry Creek, Hwy 45, 20 December 2006, M. Hicks and M. Howarter, 1 ♂, 1 ♀; Wolf Creek, Simmons Road, 20 December 2006, M. Hicks and M. Howarter, 20 ♂, 3 ♀. **Oktibbeha Co.,** Sand Creek, 27 December 2006, M. Hicks, 3 ♂, 2 ♀; Lick Creek, Tobe Henry Road, 27 December 2006, M. Hicks, 14 ♂, 9 ♀; Chinchahoma Creek, Hwy 25, 27 December 2006, M. Hicks, 1 ♂, 4 ♀; Cypress Creek, Sturgis West Point Road, 27 December 2006, M. Hicks, 2 ♂, 3 ♀; Self Creek, Self Creek Road, 27 December 2006, M. Hicks, 10 ♂, 1 ♀; Talking Warrior Creek, Hwy 25, 27 December 2006, M. Hicks, 4 ♂; Trim Cane Creek, Sturgis West Point Road, 27 December 2006, M. Hicks, 22 ♂, 2 ♀. **Panola Co.,** East Floyd Creek, Hwy 315, 34° 26' 27.7" N, 90° 02' 13.6" W, 6 January 2007, B. Stark, 30 ♂, 5 ♀; Tributary McIvor Canal, Hwy 315, 34° 26' 27.2" N, 90° 00' 05.7" W, 6 January 2007, B. Stark, 4 ♂, 2 ♀. **Pontotoc Co.,** Miller Creek, Hwy 6, 10 February 1979, B. Stark, P. Hartfield and C. Cooper, 1 pharate ♂. **Prentiss Co.,** Tributary to Big Brown Creek, CR 1341, 34° 41' 53.5" N, 88° 26' 30.5" W, 23 December 2006, B. Stark, 1 ♂. **Tishomingo Co.,** Little Cripple Deer Creek, Route 957, 4 January 2000, B. Stark and M. Alford, 12 ♂. **Union Co.,** Tishomingo Creek, Hwy 30, East of Graham, 9 February 1977, B. Stark, P. Hartfield and C. Cooper, 2 ♂, 2 ♀. **Webster Co.,** Line Creek, 9 miles N Mathiston, Natchez Trace Parkway, 5 February 1977, B. Stark, 10 ♂, 2 ♀; Line Creek, Hwy 15, 3 January 2002, 33° 39' 31.7" N, 89° 03' 67.8" W, B. Stark and M. Alford, 22 ♂, 8 ♀; Same location, December 2002, B. Stark, 15 ♂, 6 ♀; Same location, 28 December 2005, B. Stark and T. Nations, 50 ♂, 10 ♀; Same location, 26 January 2006, M. Hicks, 7 ♂, 1 ♀; Same location 8 January 2007, B. Stark, 15 ♂, 1 ♀. **Winston Co.,** McQuirter Creek, Hwy 14, 27 December 2006, M. Hicks, 14 ♂, 5 ♀; Jones Creek, Loakfoma Road, 27 December 2006, M. Hicks, 2 ♂, 1



Figs. 18-23. *Allocapnia mystica*, Webster Co., Line Creek, Hwy 15. 18. Epiproct, dorsal, 19. Epiproct, lateral, 20. Epiproct tip, 21. Male tergum 8 and dorsal process, 22. Male tergum 8, lateral aspect, 23. Female abdominal sterna 7-9.

♀; Noxapater Creek, Hwy 25, 27 December 2006, M. Hicks, 31 ♂, 11 ♀; Tallahaga Creek, Hwy 14, 27

December 2006, M. Hicks, 1 ♀.

Male epiproct. Upper limb of epiproct long,

conspicuously angled near midlength, ending in a broadly rounded tip (Fig.19). Apical half of upper limb covered with short, posteriorly directed, appressed spines; a narrow, median groove divides apical section of upper limb (Figs.18, 20). Tip of upper limb has an irregular cluster of short hairs extending beneath the epiproct for about 1/8th of its length. In lateral aspect, upper limb only slightly inflated at apex and lower limb bears deep, subapical notches and a small downturned tip (Fig.19).

Male tergal process. The relatively wide and thin 8th tergal process forms a shallow chevron shaped, and mesally notched projection in dorsal aspect. The small notch separates a pair of narrowly divided, thin knobs; these knobs are covered with scale-like tubercles over most of surface (Figs. 21-22).

Female subgenital plate. Abdominal sterna 7 and 8 completely separated by membrane. Posterior margin of subgenital plate typically produced as a narrow lobe; anterior margin of sternum 8 without small lobes (Figs. 23, 61).

Allocapnia polemistis Ross and Ricker

Allocapnia polemistis Ross and Ricker. 1971. Holotype male, Alabama, Walker County, 10 miles NE of Jasper
Allocapnia polemistis Stark et al. 2000. SEM of male



Distribution. AL, MS (Stark & Baumann 2006). Mississippi populations have been reported in Tishomingo County (Stark et al. 2000).

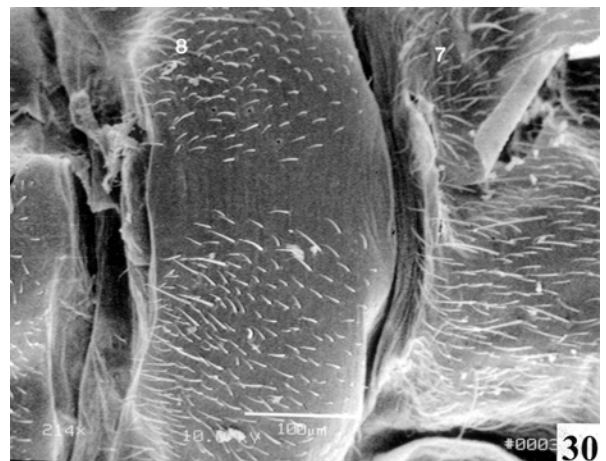
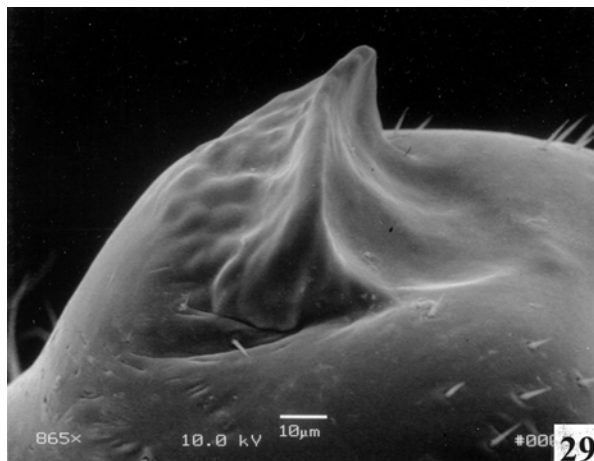
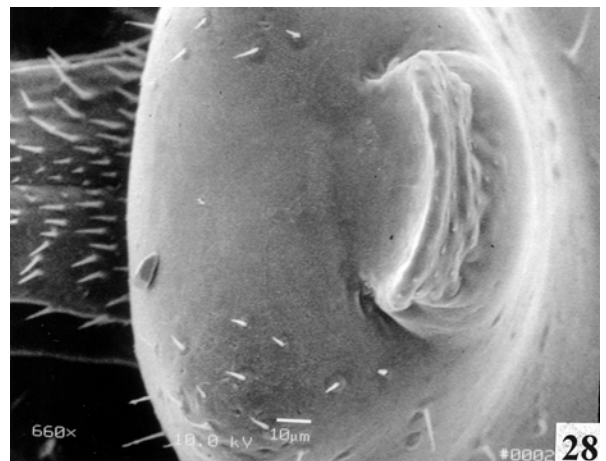
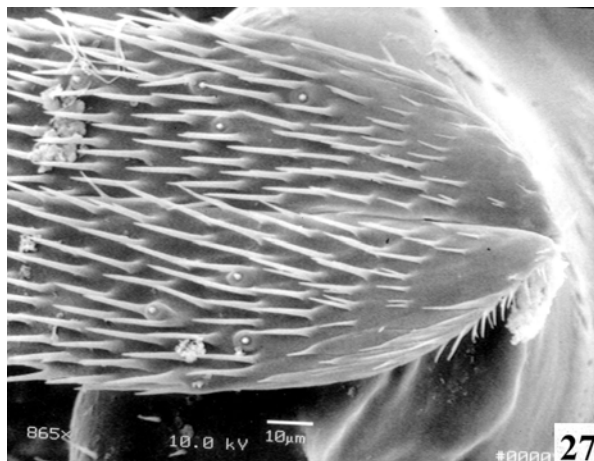
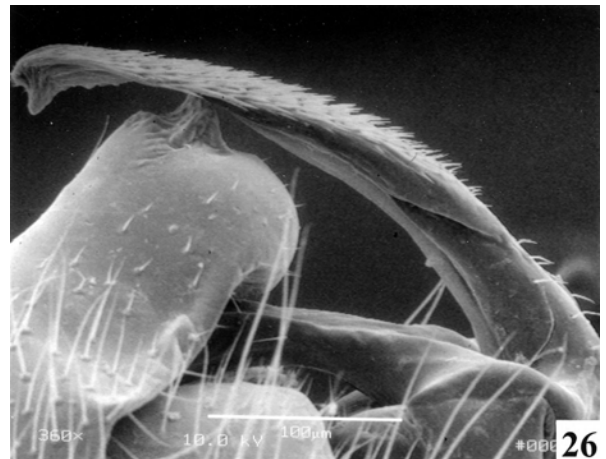
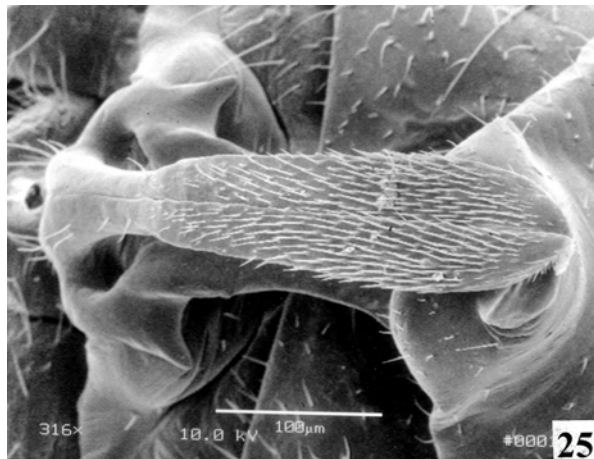
Mississippi collection data. (Fig. 24). Tishomingo Co., Tishomingo State Park, 5 February 1992, M. Caterino, 1 ♂, 2 ♀ (University of Mississippi); Rock Quarry Creek, Tishomingo State Park, 34° 36' 73.4" N, 88° 12' 25.1" W, 4 January 2000, B. Stark and M. Alford, 3 ♂; Same location, 28 December 2005, T. Nations and B. Stark, 11 ♂, 6 ♀; Same location, 23 December 2006, B. Stark, 7 ♂; Same location, 8 January 2007, B. Stark, 2 ♂; Rock Creek, CR 1, 34° 29' 93.2" N, 88° 18' 87.7" W, 8 January 2007, B. Stark, 1 ♂.

Male epiproct. Epiproct angled near midlength, paddle shaped in dorsal aspect, flattened in lateral aspect and bearing a rounded apex (Fig. 26). Dorsum of upper limb covered with short, spines in a rather dense patch over apical half (Figs. 25, 27), and divided mesally by a shallow groove. Dorsal limb thin in lateral aspect, throughout length of apical half (Fig. 26).

Male tergal process. Tergum 8 process rests on a large oval ridge and bears a thin, compressed dorsal crest. Anterior face of process bent abruptly near apex, and anterodorsal surface devoid of scale-like tubercles (Figs.28-29).

Allocapnia polemistis

Fig. 24. Distribution of *Allocapnia polemistis* in Mississippi.



Figs. 25-30. *Allocapnia polemistis*, Tishomingo Co., Rock Quarry Creek, Tishomingo State Park. 25. Epiproct, dorsal, 26. Epiproct, lateral, 27. Epiproct tip, 28. Male tergum 8 and dorsal process, 29. Male tergum 8, lateral aspect, 30. Female abdominal sterna 7-9.

Female subgenital plate. Abdominal sterna 7 and 8 completely separated by membrane. Posterior

margin of subgenital plate usually without projecting mesal lobe; anterior margin of sternum 8 bears a pair

of small basolateral lobes (Figs. 30, 62).

***Allocapnia rickeri* Frison**

Allocapnia rickeri Frison, 1942. Holotype male, Big Grand Pierre River, Golconda, Pope County, Illinois.

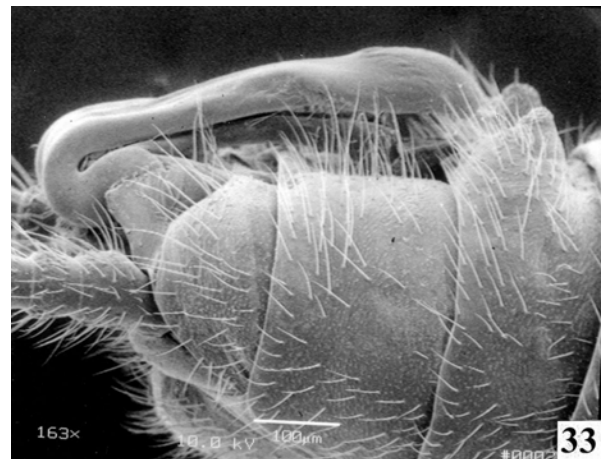
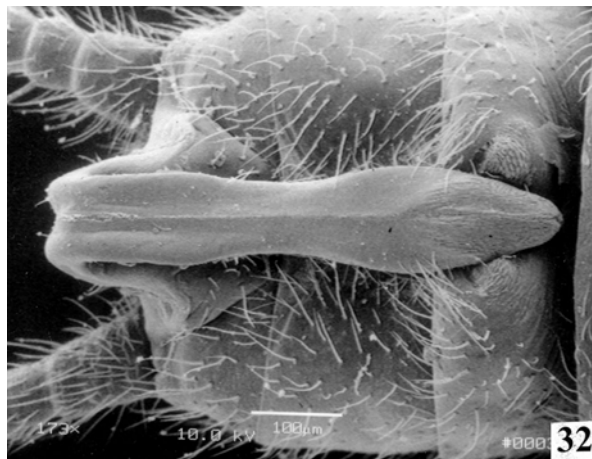
Distribution. AL, AR, DC, DE, GA, IA, IN, KS, KY, MD, MN, MO, MS, NC, NJ, OH, OK, ON, PA, TN, VA, WI, WV (Stark & Baumann 2006). Mississippi populations have been reported only in Tishomingo County (Stark 1979).

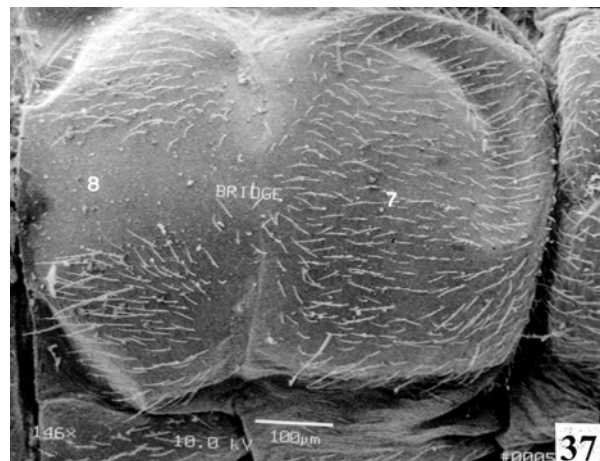
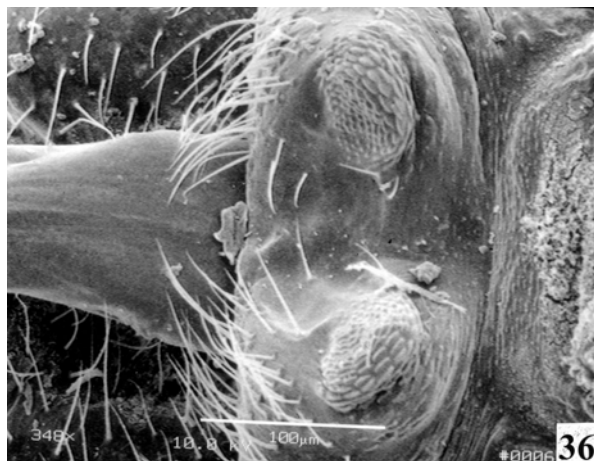
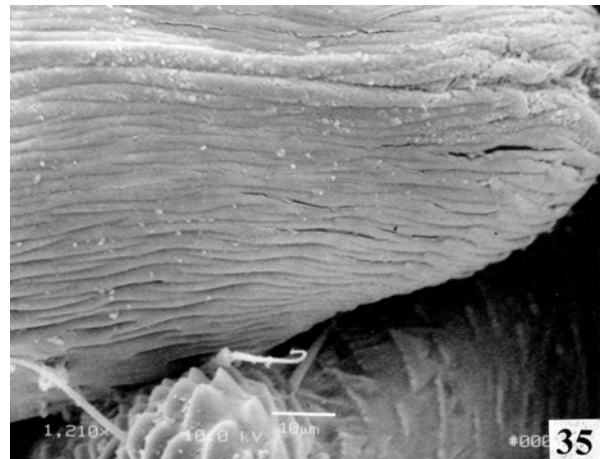
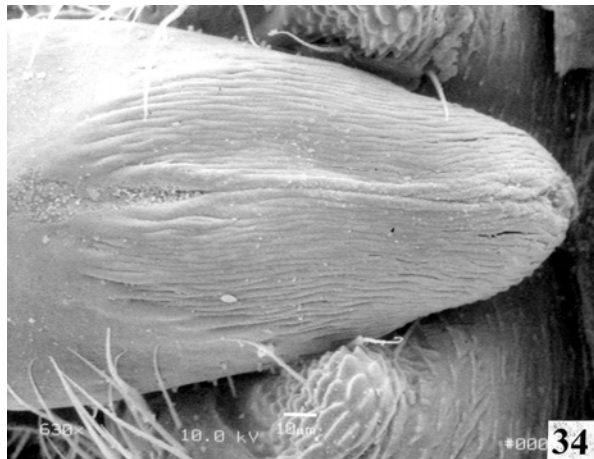
Mississippi collection data. (Fig. 31). Tishomingo Co., Clear Creek, Hwy 72, 4 miles East of Iuka, 34° 46' 40.4" N, 88° 08' 46.6" W, 10 February 1979, B. Stark, P. Hartfield and C. Cooper, 2 ♀; Same location, 8 January 2007, B. Stark, 43 ♂, 6 ♀; Tributary of Bear Creek, Tishomingo State Park, 10 February 1979, B. Stark, P. Lago, P. Hartfield and C. Cooper, 8 ♂, 5 ♀; Tishomingo State Park, 5 February 1992, M. Caterino, 1 ♂ (University of Mississippi); Same location, 16 January 1981, J. Goddard, 1 ♀ (University of Mississippi); Same location, 8 February 1986, S. Testa, 1 ♀ (University of Mississippi).



Allocapnia rickeri

Fig. 31. Distribution of *Allocapnia rickeri* in Mississippi.





Figs. 32-37. *Allocapnia rickeri*, Tishomingo Co., Clear Creek, Hwy 172. 32. Epiproct, dorsal, 33. Epiproct, lateral, 34. Epiproct tip, 35. Detail epiproct tip, 36. Male tergum 8 and dorsal process, 37. Female abdominal sterna 7-9.

Male epiproct. Epiproct upper limb long, somewhat spear-shaped in dorsal aspect, with no basal angulation (Fig. 32), and the tip bears a small, swollen section covered with short ridges and a short mesal groove (Figs. 33-34). Posterior to grooved apical section, a long, low, median ridge extends for most of upper limb length (Fig. 32), and a broad, shallow, median trough extends forward from base. In lateral aspect, short apical section reflexed slightly downward (Fig. 33) and some ridges have obscure undulations similar to those of *A. aurora* (Fig. 35).

Male tergal process. The tergal process rises from the 8th abdominal segment as two knobs covered with scale-like tubercles; knobs widely separated by notch which extends completely to base of process (Fig. 36). In lateral aspect, anterior margin of process projects somewhat higher than posterior margin.

Female subgenital plate. Abdominal sterna 7 and 8

joined by bridge sclerite but bridge narrowly notched on midlateral margins by membrane (Figs. 37, 63). Apex of subgenital plate truncate and scarcely projecting beyond lateral margins of sternum 8.

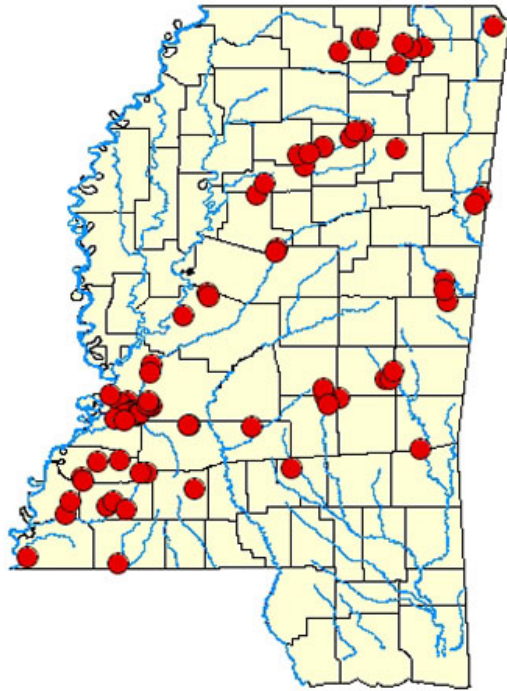
Allocapnia starki Kondratieff and Kirchner

Allocapnia starki Kondratieff and Kirchner, 2000. Holotype male, Mississippi, Claiborne County, Kennison Creek, Old Hwy. 61.

Distribution. LA and MS (Stark & Baumann 2006). Mississippi populations have been reported, sometimes as *A. recta*, in Amite, Claiborne, Copiah, Franklin, Hinds, Jefferson, Lincoln, Lowndes, Marshall, Newton, Scott, Simpson, Smith, Warren and Wilkinson counties (Alford 1998; Stark 1979; Kondratieff & Kirchner 2000; Stark & Lacey 2005) and

in this paper new records are given for Adams County, Benton County, Calhoun County, Carroll County, Chickasaw County, Covington Co., Grenada County, Holmes County, Jasper County, Kemper County, Noxubee County, Panola County, Pontotoc

County, Prentiss County, Tallahatchie County, Tippah County, Union County, Wayne County, Yalobusha County and Yazoo County. The species has been found almost statewide except for coastal counties and the Delta.



Allocapnia starki

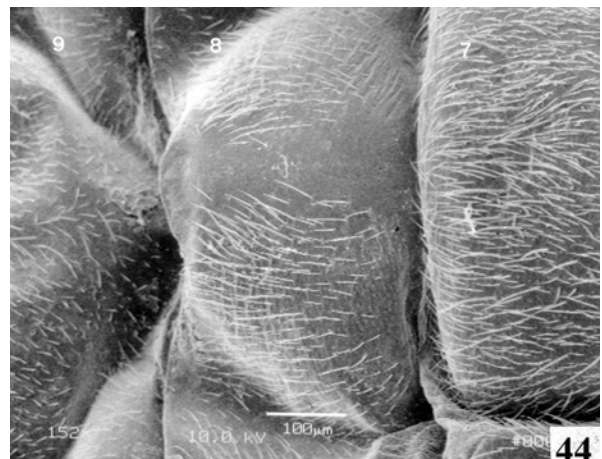
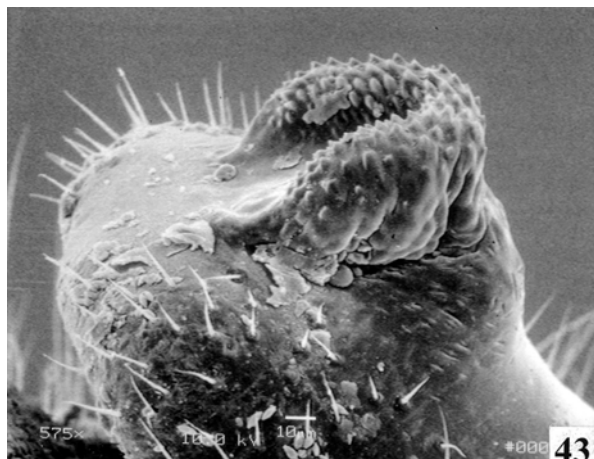
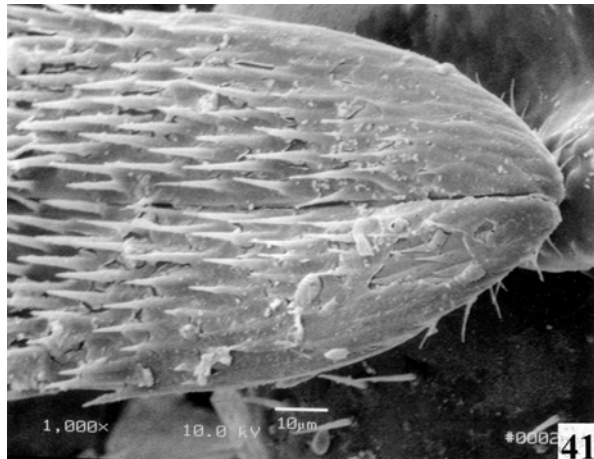
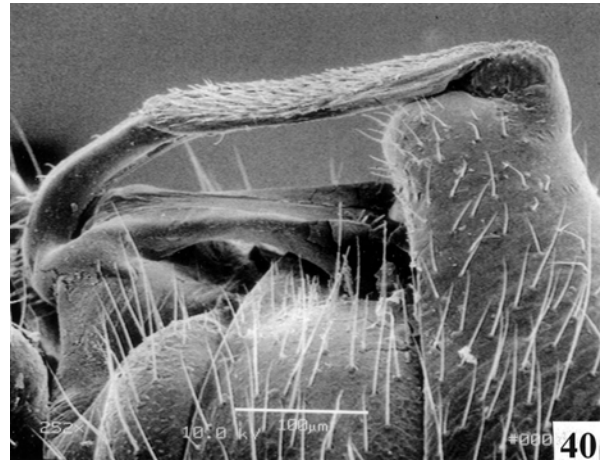
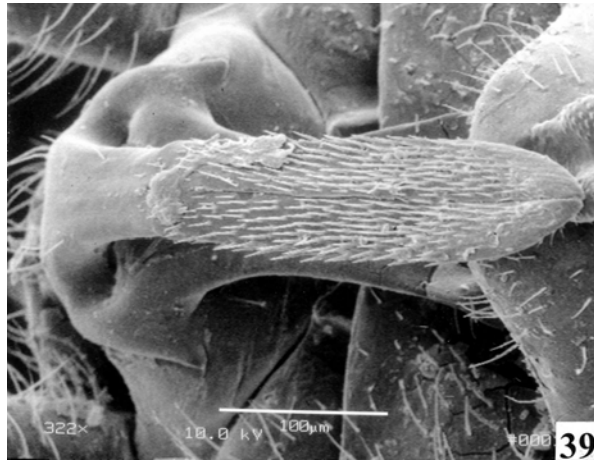
Fig. 38. Distribution of *Allocapnia starki* in Mississippi.

Mississippi collection data. (Fig. 38). **Adams Co.,** Sandy Creek, Deerfield Road, 31° 22' 94.3" N, 91° 14' 74.5" W, 20 December 2006, B. Stark, 12 ♂, 2 ♀; Sandy Creek, Liberty Road, 31° 28' 10.7" N, 91° 12' 51.6" W, 20 December 2006, B. Stark, 3 ♂; Tributary St. Catherine Creek, Hwy 61, 31° 36' 08" N, 91° 16' 04" W, 27 December 2006, M. Alford, 2 ♂. **Amite Co.,** Amite River, unnamed tributary to West Fork, 26 December 1997, M. Alford, 2 ♂, 1 ♀; Robinson Creek, CR 569, 1 January 1998, M. Alford, 5 ♂; Brushy Creek, Robertson Road, 22 December 1999, M. Alford, 1 ♂. **Benton Co.,** Curtis Creek, Hwy 4, 34° 45' 62.5" N, 89° 07' 04.0" W, 23 December 2006, B. Stark, 2 ♂; Shelby Creek, Hwy 4, 34° 45' 06.9" N, 89° 06' 12.4" W, 23 December 2006, B. Stark, 1 ♂, 1 ♀. **Calhoun Co.,** Persimmon Creek, Hwy 330, 33° 59' 20.4" N, 89° 25' 15.9" W, 22 December 2006, B. Stark, 32 ♂; Tributary to Persimmon Creek, Hwy 330, 33° 59' 20.5" N, 89° 24' 97.4" W, 22 December 2006, B. Stark, 6 ♂; Tributary to Skuna River, Hwy 32 at CR

155, 34° 03' 11.6" N, 89° 13' 67.7" W, 22 December 2006, B. Stark, 36 ♂, 2 ♀. **Carroll Co.,** Peachahala Creek, Hwy 51, 33° 15' 68.1" N, 89° 44' 55.8" W, 22 December 2006, B. Stark, 19 ♂, 4 ♀; Hudson Creek, Hwy 51, 33° 14' 26.6" N, 89° 45' 14.1" W, 22 December 2006, B. Stark, 2 ♂, 1 ♀; Potacocowa Creek, CR 100, 33° 39' 11.3" N, 89° 53' 21.0" W, 22 December 2006, B. Stark, 1 ♂. **Chickasaw Co.,** Dicks Creek, Hwy 164, 1 mile S Van Vleet, 3 January 2000, B. Stark and M. Alford, 2 ♂. **Claiborne Co.,** Kennison Creek, Old Hwy. 61, 32° 03' 39.3" N, 90° 53' 47.9" W, 30 December 1998, B. Stark, 1 ♂; Same location, 22 December 2006, M. Howarter, 6 ♂, 6 ♀; Little Sand Creek, Old Port Gibson Road, 32° 05' 96.4" N, 90° 47' 91.6" W, 10 January 1996, B. Stark, 2 ♂, 2 ♀; Same location, 20 January 1996, B. Stark and S. Tucker, 3 ♂; Same location, 23 December 2002, B. Stark, 11 ♂, 1 ♀; Same location, 15 January 2005, B. Stark, 12 ♂, 3 ♀; Same location, 10 February 2001, B. Stark, 8 ♂, 2 ♀; Little Sand Creek, Natchez Trace Parkway, Rocky

Springs, 32° 05' 31.2" N, 90° 47' 77.3" W, 12 January 1977, B. Stark, 1 ♂; Same location, 7 February 1977, B.

Stark, 2 ♂; Owens Creek Natural Area, Natchez Trace Parkway, 32° 03' 64.0" N, 90° 49' 56.4" W, 12



Figs. 39-44. *Allocapnia starki*, Noxubee Co., Macedonia Creek, Hwy 45. 39. Epiproct, dorsal, 40. Epiproct, lateral, 41. Epiproct tip, 42. Male tergum 8 and dorsal process, 43. Male tergum 8, lateral aspect, 44. Female abdominal sterna 7-9.

January 1977, B. Stark, 1 ♂; Owens Creek tributary,

Curtis-Lester Road, 32° 05' 14.4" N, 90° 44' 27.7" W,

23 December 2002, B. Stark, 1 ♂; Same location, 15 January 2005, B. Stark, 11 ♂; Owens Creek, Dillon Road, 32° 04' 91.8" N, 90° 44' 41.1" W, 23 December 2002, B. Stark, 17 ♂; Same location, 15 January 2005 B. Stark, 1 ♂; Same location, 19 January 2006, R. Rooks, 5 ♂; Same location, 20 January 2007, B. Stark, 1 ♂; Owens Creek, Curtis-Lester Road, 32° 05' 46.3" N, 90° 43' 77.1" W, 15 January 2005, B. Stark, 4 ♂; Same location, 23 December 2002, B. Stark, 19 ♂, 2 ♀; Ragsdale Creek, Regan Road, 32° 05' 14.5" N, 90° 49' 74.7" W, 23 December 2002, B. Stark, 17 ♂, 4 ♀; Same location, 15 January 2005, B. Stark, 29 ♂, 2 ♀; Same location, 2 January 2006, B. Stark, 10 ♂; Same location, 19 January 2006, B. Stark, 3 ♂; Same location 20 January 2005, B. Stark and M. Clark, 3 ♂; Same location 10 February 2001, B. Stark, 10 ♂; Same location, 1 December 2006, B. Stark, 3 ♂; Same location, 20 January 2007, B. Stark, 5 ♂, 2 ♀; Big Sand Creek, Old Port Gibson Road, 32° 07' 03.3" N, 90° 46' 40.8" W, 23 December 2002, B. Stark, 4 ♂; Same location, 10 February 2001, B. Stark, 2 ♂, 1 ♀; Big Sand Creek, Natchez Trace Parkway, 3 miles N Rocky Springs, 32° 06' 99.2" N, 90° 46' 03.0" W, 12 January 1977, B. Stark, 1 ♂; Same location 7 February 1977, B. Stark, 1 ♂; **Copiah Co.**, Tributary of White Oak Creek, 1 mile N Crystal Springs, I-55, 13 February 1977, B. Stark and M. Stegall, 1 ♂; Clear Creek, Utica Road, 32° 00' 95.1" N, 90° 22' 39.9" W, 20 December 2006, B. Stark, 6 ♂; **Covington Co.**, Burtons Creek, Burton Creek Road, 31° 42' 16.4" N, 89° 38' 69.5" W, 13 December 2006, B. Stark and M. Hicks, 10 ♂, 4 ♀; **Franklin Co.**, Middle Fork Homochitto River, Hwy. 84, 23 December 1996, B. Stark, 2 ♀; Porter Creek at USFS Road 108, 26 December 1997, M. Alford, 1 ♂; Same location, 21 December 1998, B. Stark, 2 ♂; Tally's Creek, Homochitto National Forest, 21 December 1998, B. Stark, 3 ♂, 1 ♀; **Grenada Co.**, Tributary to Perry Creek, Carrollton Rd, 33° 43' 57.3" N, 89° 49' 96.1" W, 22 December 2006, B. Stark, 1 ♂; Clark Creek, Graysport Crossing Rd, 33° 50' 71.3" N, 89° 35' 80.5" W, 22 December 2006, B. Stark, 15 ♂, 3 ♀; Tributary Yalobusha River, Long Creek Rd, 33° 49' 43.4" N, 89° 51' 67.6" W, 6 January 2007, B. Stark, 1 ♀; **Hinds Co.**, Sand Creek, Hunt Road, 32° 06' 17.5" N, 90° 43' 15.1" W, 18 February 1999, B. Stark, 1 ♂; Same location, 10 January 1996, B. Stark, 9 ♂; Same location, 23 December 2002, B. Stark, 4 ♂; Same location 15 January 2005, B. Stark, 2 ♂, 1 ♀; Five Mile Creek, Old

Port Gibson Road, 32° 10' 51.5" N, 90° 39' 86.1" W, 28 December 2002, B. Stark, 8 ♂, 1 ♀; Same location, 10 February 2001, B. Stark, 1 ♂; Harts Creek, Cayuga Road, 32° 08' 82.9" N, 90° 39' 11.7" W, 28 December 2002, B. Stark, 17 ♂, 1 ♀; Jones Creek, Tom Cain Road, 32° 09' 78.5" N, 90° 40' 11.5" W, 28 December 2002, B. Stark, 4 ♂, 4 ♀; Murphy Creek, Cayuga Road, 32° 08' 64.9" N, 90° 38' 49.6" W, 28 December 2002, B. Stark, 2 ♂; West Fork Harts Creek, Tom Cain Road, 32° 08' 82.9" N, 90° 39' 37.8" W, 28 December 2002, B. Stark, 4 ♂; Maxie Creek, Betigheimer Road, 32° 12' 99.0" N, 90° 39' 35.4" W, 5 January 2007, B. Stark, 8 ♂, 1 ♀; Tributary Maxie Creek, Canada Cross Road, 32° 14' 11.1" N, 90° 41' 00.9" W, 5 January 2007, B. Stark, 15 ♂, 1 ♀. **Holmes Co.**, Harland Creek, Hebron Road, 9 December 2006, B. Stark, 1 ♀; Williams Creek, Hebron Road, 9 December 2006, B. Stark, 1 ♂. **Jasper Co.**, Cedar Creek, CR 24, 32° 12' 05.8" N, 89° 18' 02.1" W, 13 December 2006, B. Stark and M. Hicks, 2 ♂, 2 ♀. **Jefferson Co.**, Clarks Creek, Hwy 552, 1 January 2005, B. Stark, 5 ♂, 1 ♀; North Fork Coles Creek, Redlick Road, 1 January 2005, B. Stark, 13 ♂, 1 ♀; Compton Creek, Stampley Road, 1 January 2005, B. Stark, 1 ♂; Stampley Creek, Stampley Road, 1 January 2005, B. Stark, 2 ♂. **Kemper Co.**, Wahalak Creek, Wahalak Road, 32° 52' 94.9" N, 88° 33' 96.4" W, 14 December 2006, B. Stark and M. Hicks, 20 ♂, 4 ♀. **Lincoln Co.**, Fair River, Hwy 84, 5 January 2005, B. Stark, 1 ♂; Homochitto River, Hwy 550, 31° 40' 19.3" N, 90° 43' 06.9" W, 20 December 2006, B. Stark, 1 ♂; Cedar Creek, Hwy 550, 31° 40' 39.0" N, 90° 40' 20.4" W, 20 December 2006, B. Stark, 21 ♂, 2 ♀. **Lowndes Co.**, Mayhew Creek, Hwy 12, 20 January 1996, B. Stark and S. Tucker, 5 ♂, 1 ♀; Howard Creek, Hwy 12, 6.5 miles NE of Hwy 82, 29 December 1998, B. Stark, 2 ♂. **Marshall Co.**, Tippah River, Potts Camp, 5 February 1977, B. Stark, 1 ♂. **Newton Co.**, Specific location unknown, 7 January 1978, B. Stark and M. Stegall, 1 ♂; Chunky River, I-20, 15 January 1977, B. Stark, 1 ♂; Tonacana Creek, I-20, 12 January 1979, B. Stark and P. Hartfield, 2 ♀; Tallahatta Creek, Dean Road, 18 December 2002, B. Stark and J. Lacey, 5 ♂. **Noxubee Co.**, Macedonia Creek, Hwy 45, 20 December 2006, M. Hicks, M. Howarter, 13 ♂, 7 ♀; Shuqualak Creek, Hwy 45, 20 December 2006, M. Hicks, M. Howarter, 1 ♂. **Panola Co.**, Long Creek, Hentz Road, 34° 13' 68.8" N, 89° 54' 71.4" W, 6 January 2007, B. Stark, 6 ♂; Johnson Creek, Hentz Road, 34° 14' 58.0" N, 89° 55' 06.8" W, 6 January 2007,

B. Stark, 7 ♂; McIvor Canal, Hwy 315, 34° 26' 26.7" N, 89° 59' 83.1" W, 6 January 2007, B. Stark, 2 ♂. **Pontotoc Co.**, Indian Creek, Hwy 341, 34° 06' 17.6" N, 89° 11' 40.7" W, 22 December 2006, B. Stark, 36 ♂, 2 ♀; Kittahutty Creek, Hwy 341, 34° 05' 77.7" N, 89° 12' 69.4" W, 22 December 2006, B. Stark, 14 ♂, 3 ♀. **Prentiss Co.**, Dry Creek, Hwy 4, 34° 41' 92.3" N, 88° 42' 51.9" W, 23 December 2006, B. Stark, 12 ♂, 1 ♀; Big Rock Hollow, CR 1341, 4 January 2000, B. Stark and M. Alford, 1 ♀. **Scott Co.**, Leaf River, Hwy 501, 1 February 2003, B. Stark, 1 ♂, 1 ♀; Leaf River, Sherman-Hill Road, 1 February 2003, B. Stark, 1 ♂. **Simpson Co.**, Dabbs Creek, 1 mile N D'Lo, 9 February 1977, B. Stark, 1 ♀; Bush Creek, Schoolhouse Road, 30 December 2002, B. Stark, 1 ♂. **Smith Co.**, Ichusa Creek, Boyte Road, 1 February 2003, B. Stark, 3 ♂; Turkey Creek, Hwy 501, 1 February 2003, B. Stark, 5 ♂. **Tallahatchie Co.**, Hunter Creek, Hwy 32, 6 January 2007, B. Stark, 23 ♂, 2 ♀; Little Creek, McNulty Road, 6 January 2007, B. Stark, 20 ♂, 1 ♀. **Tippah Co.**, Clear Creek, CR 615, 34° 41' 44.6" N, 88° 47' 92.4" W, 23 December 2006, B. Stark, 1 ♂, 1 ♀; Little Hatchie River, Hwy 4, 34° 43' 22.7" N, 88° 51' 35.2" W, 23 December 2006, B. Stark, 1 ♂. **Tishomingo Co.**, Indian Creek, Hwy 25, 1 mile N Iuka, 3 January 2000, B. Stark and M. Alford, 2 ♂. **Union Co.**, Little Tallahatchie River, CR 150, 34° 34' 25.4" N, 88° 54' 15.7" W, 23 December 2006, B. Stark, 9 ♂, 3 ♀. **Warren Co.**, Bear Creek, Youngton Road, 20 December 1978, B. Stark, 6 ♂; Fox Creek, 20 December 1978, B. Stark, 1 ♂; Hamer Bayou, Fisher Ferry Road, 22 December 2006, M. Howarter, 1 ♂; Paces Bayou, Hwy 61, 22 December 2006, M. Howarter, 2 ♀; Tributary Jims Bayou, Campbell Swamp Road, 22 December 2006, M. Howarter, 1 ♀; Tributary Markham Creek, Bovina Cut-off Road, 32° 15' 72.4" N, 90° 44' 93.1" W, 5 January 2007, B. Stark, 5 ♂. **Wayne Co.**, Eucutta Creek, 30 January 2007, M. Hicks, 3 ♂. **Wilkinson Co.**, Clark Creek at Natural Area, 26 December 1997, M. Alford, 1 ♂. **Yalobusha Co.**, Cypress Creek, Hwy 7, 33° 57' 44.0" N, 89° 41' 74.7" W, 22 December 2006, B. Stark, 1 ♀; York Creek, Hwy 330, 33° 55' 61.2" N, 89° 35' 86.2" W, 22 December 2006, B. Stark, 8 ♂; Tributary to Skuna River Canal, Hwy 330, W of Benwood, 33° 56' 27.1" N, 89° 31' 37.1" W, 22 December 2006, B. Stark, 2 ♂, 2 ♀. **Yazoo Co.**, Short Creek, Ridge Road, 32° 47' 37.6" N, 90° 24' 73.1" W, 6 December 2006, B. Stark, 2 ♂, 1 ♀

Tesheva Creek, Woods Road, 32° 56' 81.6" N, 90° 13' 53.6" W, 6 December 2006, B. Stark, 30 ♂, 3 ♀; Tesheva Creek, Sharper Road, 32° 55' 49.8" N, 90° 13' 53.6" W, 6 December 2006, B. Stark, 43 ♂, 1 ♀.

Male epiproct. Apical section of epiproct upper limb paddle shaped in dorsal aspect and very thin in lateral aspect (Figs. 39-40); apical section armed with numerous spines which extend to, or slightly beyond, angulation between apical and basal sections of upper arm (Figs. 39, 41); a narrow, median groove extends through field of spines.

Male tergal process. Tergum 8 bears a single, prominent, upright process; in dorsal aspect anterior and lateral rim capped by narrow, U or V-shaped ridge armed with scale-like tubercles (Figs. 42-43); bare area caudal to ridge depressed to basal level of process.

Female subgenital plate. Abdominal sterna 7 and 8 completely separated by membrane. Posterior margin of subgenital plate usually with narrow, projecting lobe; anterior margin of sternum 8 with a pair of small mesal lobes (Figs. 44, 64).

Allocapnia virginiana Frison

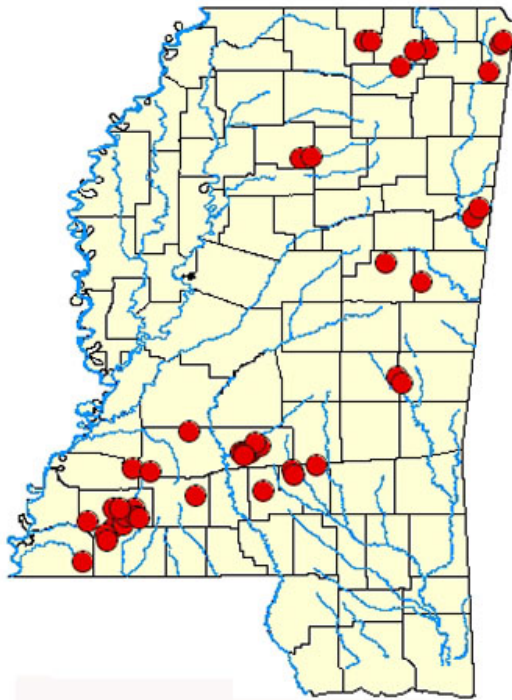
Allocapnia virginiana Frison, 1942. Holotype male, Rapidan River, Shelby, Virginia

Allocapnia virginiana: Ross & Ricker, 1971. Mississippi record

Allocapnia virginiana: Alford, 1998. SEM of male

Allocapnia virginiana: Stark & Lacey, 2005. SEM of male and nymph

Distribution: AL, DE, GA, LA, MS, NC, SC, VA (Stark & Baumann 2006). Mississippi populations have been reported from Amite, Franklin, Lauderdale, Lowndes, Newton, Simpson, Tishomingo and Wilkinson counties (Stark 1979; Alford 1998; Stark & Lacey 2005) and in this paper new records are given for Benton County, Copiah County, Covington County, Jefferson Davis County, Lincoln County, Marion County, Noxubee County, Prentiss County, Tippah County, Union County, Winston County and Yalobusha County. This species is widely distributed from the northern counties, along the Alabama line and spreading to the southwest, south of Interstate 20. Its distribution is similar to that of *A. starki* but it does not extend very far westward in the northcentral counties.

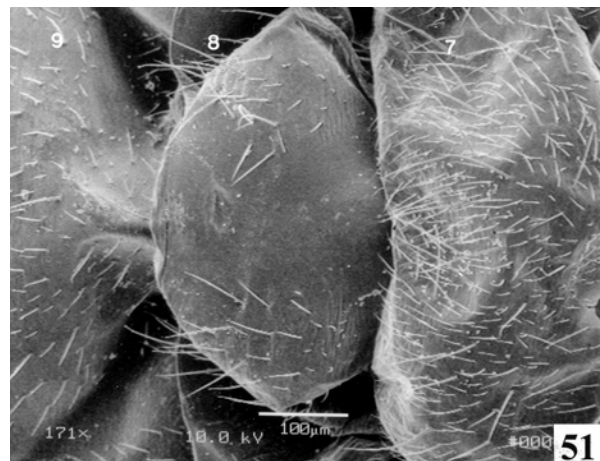
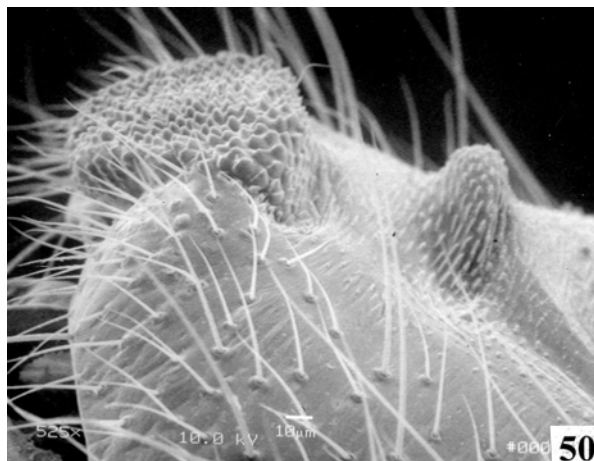
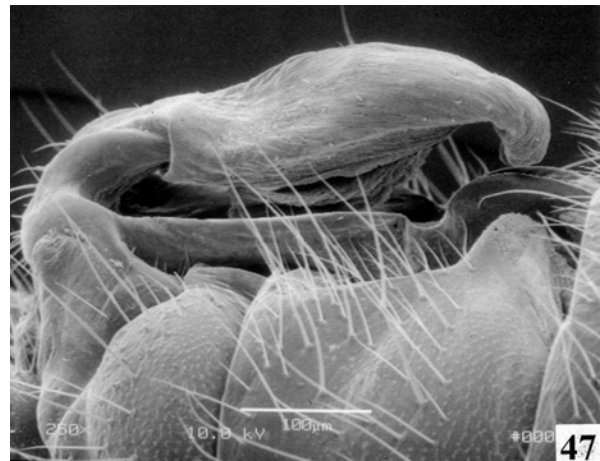
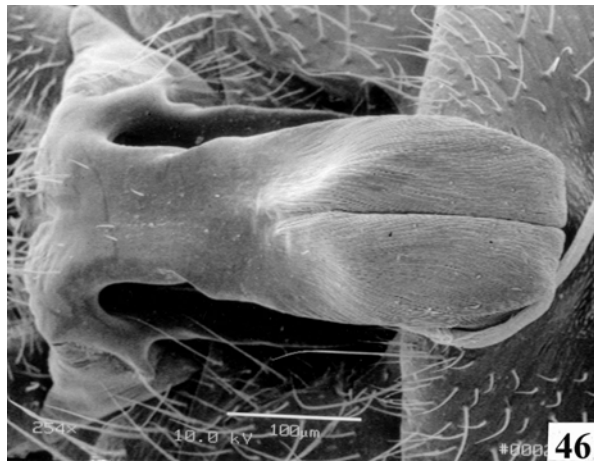


Allocapnia virginiana

Fig. 45. Distribution of *Allocapnia virginiana* in Mississippi.

Mississippi collection data: (Fig. 45). **Amite Co.,** Brushy Creek, 3 December 1980, P. Hartfield, 1 ♂; Brushy Creek, Cobb Road, 28 January 1996, M. Alford, 1 ♀; Brushy Creek, New Hope Road, 28 January 1996, M. Alford, 3 ♂; Brushy Creek, Robertson Road, 22 December 1999, M. Alford, 3 ♂, 1 ♀; Foster Creek, CR 33, 17 December 1997, M. Alford, 18 ♂, 8 ♀; Same location, 19 December 1996, M. Alford, 3 ♂, 4 ♀; Caston Creek, Oxford-Meadville Road, date unknown, M. Alford, 1 ♂. **Benton Co.,** Curtis Creek, Hwy 4, 34° 45' 62.5" N, 89° 07' 04.0" W, 23 December 2006, B. Stark, 2 ♂, 1 ♀; Shelby Creek, Hwy 4, 34° 45' 06.9" N, 89° 06' 12.4" W, 23 December 2006, B. Stark, 4 ♂, 3 ♀. **Copiah Co.,** Slayton Creek, FR 130B, 31° 43' 83.6" N, 90° 38' 85.3" W, 10 December 2006, B. Stark, 1 ♀; Clear Creek, Utica Road, 32° 00' 95.1" N, 90° 22' 39.9" W, 20 December 2006, B. Stark, 1 ♂; **Covington Co.,** Leonards Mill Creek, Rock Hill Road, 31° 44' 42.9" N, 89° 39' 06.3" W, 13 December 2006, B. Stark and M. Hicks, 2 ♀; Burtons Creek, Burton Creek Road, 31° 42' 16.4" N, 89° 38' 69.5" W, 13 December 2006, B. Stark and M. Hicks, 7 ♂, 7 ♀; Same location, 2 January 2007, B. Stark, 1 ♂; Mayfield Branch, Gilmore Road, 31° 44' 54.1" N, 89° 27' 39.5" W, 13 December 2006, B. Stark and M. Hicks, 1 ♂. **Franklin Co.,** Middleton Creek,

FR 100, 15 December 1996, M. Alford, 23 ♂, 3 ♀; Porter Creek, FR 108, 21 December 1998, B. Stark, 12 ♂, 2 ♀; Dry Creek, FR 145, 15 December 1996, M. Alford, 2 ♂; McGehee Creek, low water bridge, 15 December 1996, M. Alford, 10 ♂; Cane Mill Creek, near Little Springs, 29 December 1996, M. Alford, 7 ♂; Goober Creek, Little Springs, 29 December 1996, M. Alford, 14 ♂, 5 ♀; North Dry Creek, Hwy 84, 23 December 1996, B. Stark, 1 ♂; Middle Fork Homochitto River, 6 mi N Meadville, 17 December 1997, M. Alford, 1 ♂. **Jefferson Davis Co.,** Whitesand Creek, East Street, Prentiss, 31° 35' 56.5" N, 89° 51' 60.6" W, 11 December 2006, B. Stark, 1 ♂, 1 ♀. **Lauderdale Co.,** Tallahatta Creek, I-20, 12 January 1979, B. Stark and P. Hartfield, 1 ♂. **Lincoln Co.,** Fair River, Hwy 84, 5 January 2005, B. Stark, 1 ♂, 2 ♀. **Lowndes Co.,** Luxapapila River, Columbus, date and collector unknown, 1 ♂; Mayhew Creek, Hwy 12, 29 December 1998, B. Stark, 3 ♂. **Marion Co.,** Lower Little Creek, Pine Burr Road, 31° 08' 09" N, 89° 42' 06" W, 12 January 2007, M. Alford, 3 ♂, 1 ♀. **Newton Co.,** Tallahatta Creek, Dean Road, 32° 23' 62.1" N, 88° 54' 97.0" W, 18 December 2002, B. Stark and J. Lacey, 26 ♂; Same location, 9 December 2000, B. Stark, 8 ♂; Same location, 10 January 2002, B. Stark, 8 ♂, 2 ♀; Same location 3 December 2002, B. Stark, 5 ♂; Same



Figs. 46-51. *Allocapnia virginiana*, Tishomingo Co., Little Cripple Deer Creek, CR 957. 46. Epiproct, dorsal, 47. Epiproct, lateral, 48. Epiproct tip, 49. Male tergum 8 and dorsal process, 50. Male tergum 8, lateral aspect, 51. Female abdominal sterna 7-9.

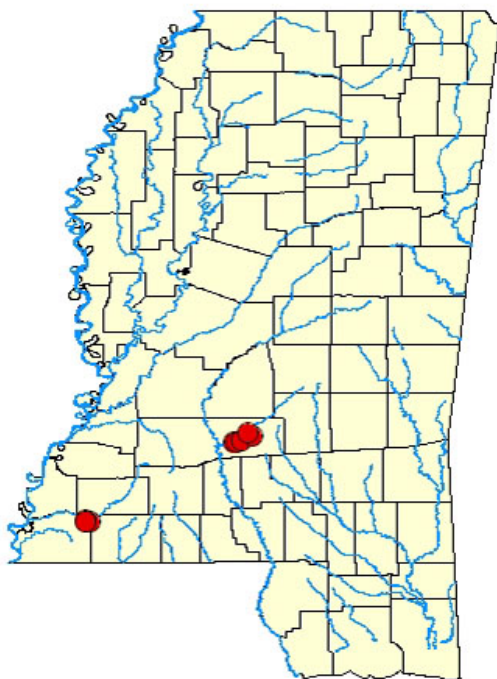
location 7 December 2002, B. Stark, 10 ♂, 3 ♀; Same location 12 January 2007, B. Stark, 1 ♂, 1 ♀; **Noxubee**

Co., Hashuqua Creek, Butler Road, 20 December 2006, M. Hicks and M. Howarter, 1 ♂, 1 ♀; **Prentiss**

Co., Dry Creek, Hwy 4, 34° 41' 92.3" N, 88° 42' 51.9" W, 23 December 2006, B. Stark, 1 ♂. **Simpson Co.**, Mill Creek, Hwy 472, 31° 51' 81.6" N, 89° 59' 51.5" W, 11 December 2002, B. Stark and J. Lacey, 1 ♂, 1 ♀; Same location, 10 January 2002, B. Stark, 5 ♂; Same location, 29 November 2000, B. Stark, 11 ♂, 2 ♀; Same location 9 January 1979, B. Stark, 1 ♂, 2 ♀; Same location 7 February 1981, B. Stark, 3 ♂, 1 ♀; Same location 2 December 2003, B. Stark, 9 ♂; Mill Creek, Bushtown Shivers Road, 30 December 2002, B. Stark, 2 ♂; Westville Creek, Hwy 43, 31° 52' 80.0" N, 89° 57' 47.3" W, 2 December 2002, B. Stark, 5 ♂; Same location, 16 December 2005, B. Stark, 3 ♂; Same location, 19 December 1992, B. Stark, 8 ♂; Same location, 30 December 2002, B. Stark, 6 ♂, 1 ♀; Rials Creek, Merit, 31° 55' 65.3" N, 89° 54' 60.4" W, 3 January 2006, B. Stark, 10 ♂, 2 ♀; Same location, 6 January 1994, B. Stark, 2 ♂; Same location, 19 December 1992, B. Stark, 2 ♂, 2 ♀; Rials Creek, Main Street, 31° 54' 76.6" N, 89° 52' 69.2" W, 30 December 2002, B. Stark, 5 ♂, 7 ♀; Same location, 16 December 2005, B. Stark, 2 ♂, 1 ♀; Same location, 5 January 2005, B. Stark, 1 ♂; Tanyard Creek, Cemetery Road, 30 December 2002, B. Stark, 2 ♂; Same location, 16 December 2005, B. Stark, 3 ♂; Bush Creek, Schoolhouse Road, 30 December 2002, B. Stark, 2 ♂, 2 ♀. **Tippah Co.**, Clear Creek, CR 615, 34° 41' 44.6" N, 88° 47' 92.4" W, 22 December 2006, B. Stark, 11 ♂, 1

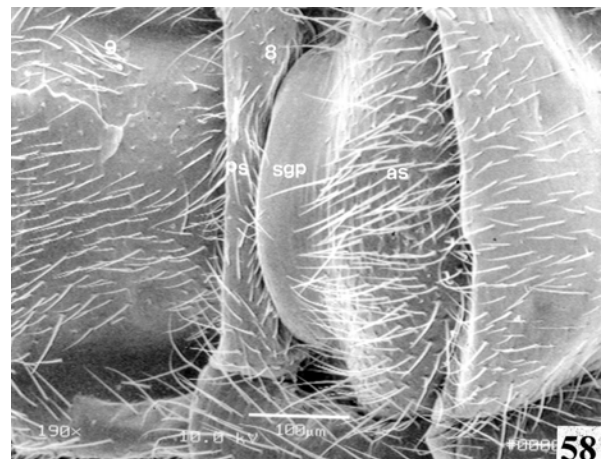
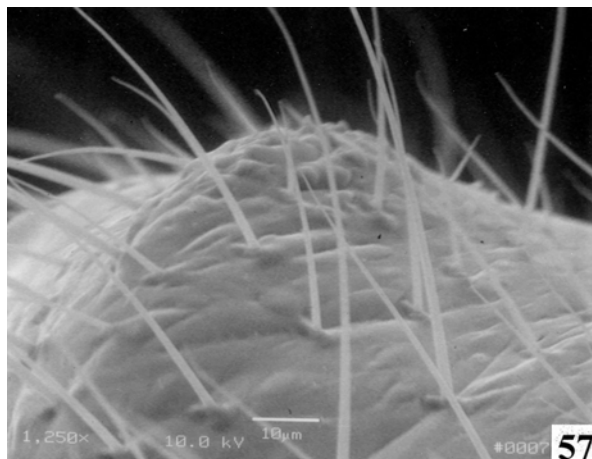
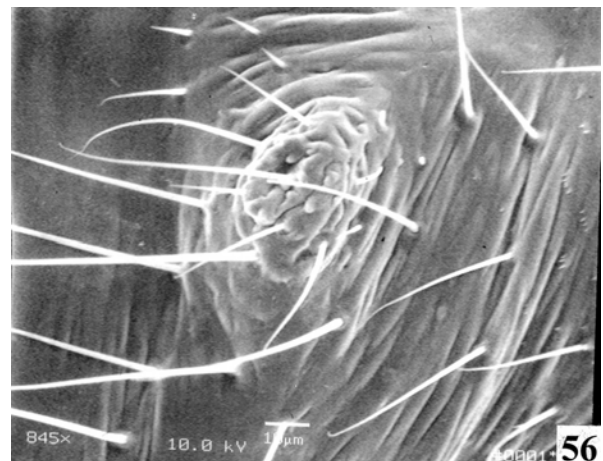
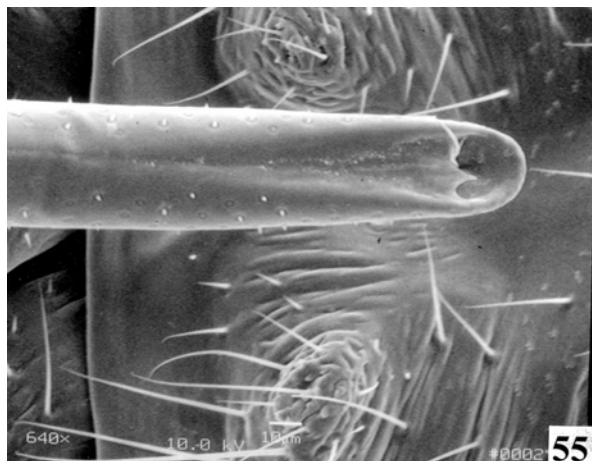
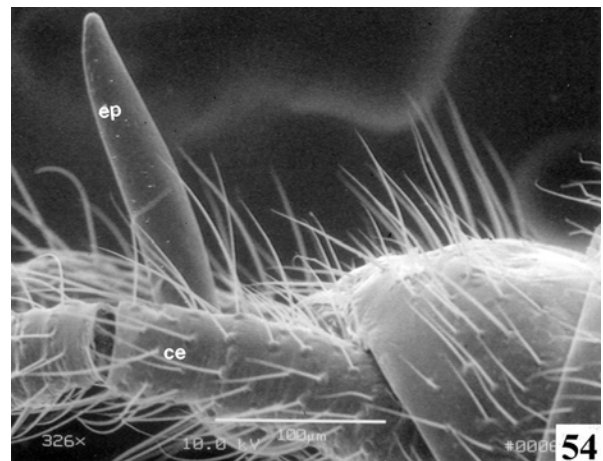
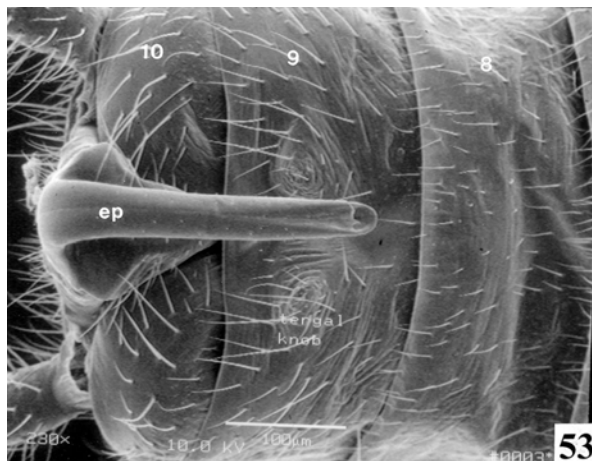
♀. **Tishomingo Co.**, Little Cripple Deer Creek, CR 957, 4 January 2000, B. Stark and M. Alford, 39 ♂, 1 ♀; Jourdan Creek, Hwy 4, 3 January 2000, B. Stark and M. Alford, 1 ♂; Clear Creek, Hwy 172, 34° 46' 40.4" N, 88° 08' 46.6" W, 8 January 2007, B. Stark, 1 ♂, 1 ♀; Rock Creek, CR 1, 34° 29' 93.2" N, 88° 18' 87.7" W, 8 January 2007, B. Stark, 5 ♂, 1 ♀; Pennywinkle Creek, CR 191, 3 January 2000, B. Stark and M. Alford, 3 ♂. **Union Co.**, Little Tallahatchie River, CR 150, 34° 34' 25.4" N, 88° 54' 15.7" W, 23 December 2006, B. Stark, 6 ♂. **Wilkinson Co.**, Buffalo River, Hiram McGraw Road, 17 December 1997, M. Alford, 7 ♂, 4 ♀. **Winston Co.**, Mill Creek, Hwy 25, 27 December 2006, M. Hicks, 2 ♂. **Yalobusha Co.**, Tributary Skuna River Canal, W of Benwood, Hwy 330, 33° 56' 27.1" N, 89° 31' 37.1" W, 22 December 2006, B. Stark, 3 ♂, 1 ♀; York Creek, Hwy 330, 33° 55' 61.2" N, 89° 35' 86.2" W, 22 December 2006, B. Stark, 1 ♂, 1 ♀.

Male epiproct. Epiproct dorsal limb usually apically truncate, and bearing a prominent, suture in apical half of limb (Fig. 46); apical section of limb bears numerous fine anastomosed grooves and ridges covering apical half (Fig. 48); basally the wide, apical, ridged section is separated from smooth and narrowed base by a pair of lateral concavities (Figs. 46-47). Lower limb slightly wider than upper limb for most of length and bearing subapical notches.



Nemocapnia carolina

Fig. 52. Distribution of *Nemocapnia carolina* in Mississippi.



Figs. 53-58. *Nemocapnia carolina*, Simpson Co., Rials Creek, Hwy 43. 53. Epiproct, dorsal, 54. Epiproct, lateral, 55. Epiproct tip, 56. Male tergum 9 dorsal process, 57. Male tergum 9 process, lateral aspect, 58. Female abdominal sterna 7-9. ep = epiproct; ce = cercus; as = anterior sclerite; ps = posterior sclerite; sgp = subgenital plate.

Male tergal process. Abdominal segment 8 bears a pair of low tergal processes; anterior process a low,

thin, tongue shaped mound covered with scale-like tubercles, and posterior process a wider and higher

mound also covered with scale-like tubercles (Figs. 49-50); posterior process with a shallow postero-median notch.

Female subgenital plate. Abdominal sterna 7 and 8 separated by membrane, or sometimes poorly fused by faint sclerite. Subgenital plate broadly arcuate and usually projecting slightly beyond posterolateral margins of sternum 8 (Figs. 51, 65).

Genus *Nemocapnia* Banks, 1938

Type species. *Nemocapnia carolina* Banks

Distribution. Known from scattered localities in eastern North America (Stark & Baumann 2006) and Japan (Kawai 1967).

Diversity. *Nemocapnia* currently includes two species; *N. carolina* is the only one recognized in North America.

Nemocapnia carolina Banks

Nemocapnia carolina Banks, 1938. Type series, Morgantown, North Carolina.

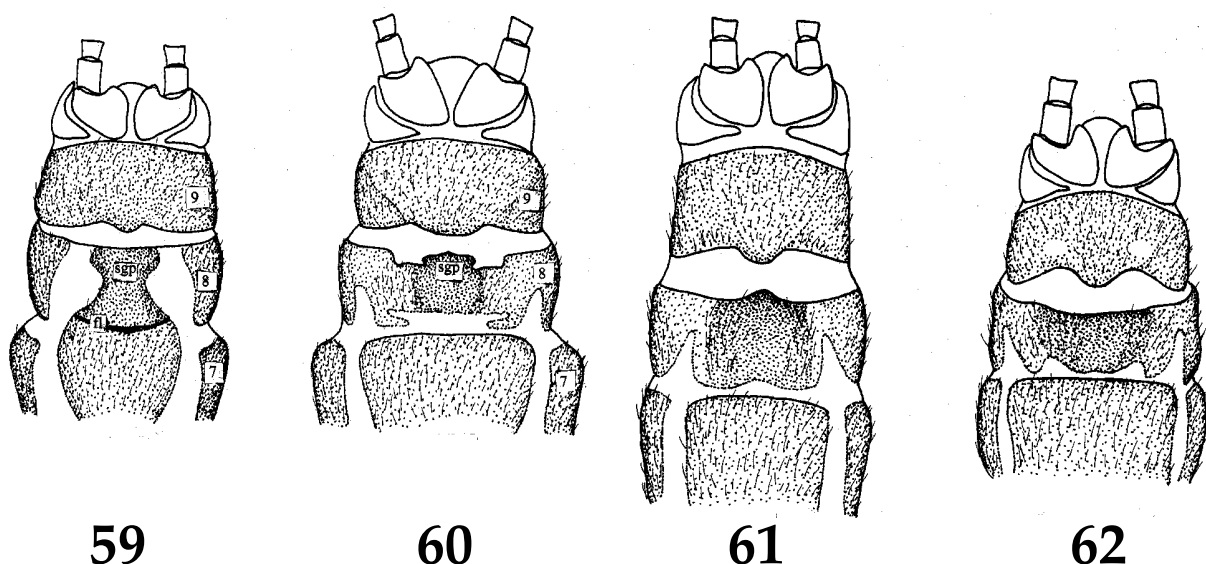
Nemocapnia carolina: Frison, 1942. Redescription.

Distribution. AL, AR, FL, IL, IN, MS, NC, PQ, SC, VA (Stark & Baumann 2006). Mississippi populations

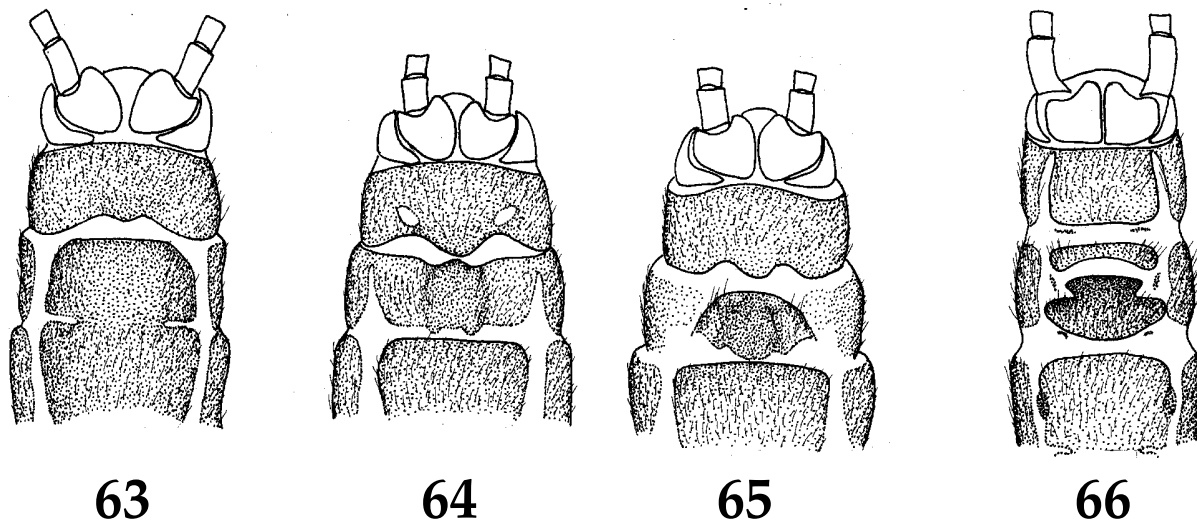
have been reported in Simpson and Wilkinson counties (Stark 1979) and in this paper a new record is given for Amite County.

Mississippi collection data. (Fig. 52). **Amite Co.,** Tributary Foster Creek, Hwy 33, 26 December 1997, M. Alford, 1 ♂, 1 ♀; Foster Creek, FR 167, 29 December 1997, M. Alford, 1 ♀. **Simpson Co.,** Mill Creek, Hwy 472, 31° 51' 81.6" N, 89° 59' 51.5" W, 20 February 1981, B. Stark, 1 ♀; Same location, 16 January 1981, B. Stark, 1 ♂; Same location 7 March 1985, B. Stark, 1 ♀; Same location, 16 January 2002, B. Stark, 5 ♂, 2 ♀; Westville Creek, Hwy 43, 31° 52' 80.0" N, 89° 57' 47.3" W, 19 December 1992, B. Stark, 1 ♂; Bush Creek, Schoolhouse Road, 30 December 2002, B. Stark, 1 ♂; Rials Creek, Main Street, 31° 54' 76.6" N, 89° 52' 69.2" W, 12 February 1981, B. Stark, and J. McGuire, 1 ♀; Rials Creek, Merit, Hwy 43, 31° 55' 65.3" N, 89° 54' 60.4" W, 16 February 1979, B. Stark, 1 ♀; Same location, 19 December 1992, B. Stark, 9 ♂, 5 ♀. **Wilkinson Co.,** Tributary Foster Creek, Hwy 33 N of Hwy 563 jct, 22 January 1977, B. Stark and L. Temple, 1 ♂.

Male epiproct. Epiproct a single, slender, cylindrical, probe, bearing an apical orifice (Figs. 52, 55); dorsal surface relatively smooth but bearing a prominent suture; epiproct carried in an upright position in most specimens (Fig. 54).



Figs. 59-62. Female terminalia. 59. *Allocapnia aurora*, 60. *Allocapnia granulata*, 61. *Allocapnia mystica*, 62. *Allocapnia polemistis*. fl = fusion line; sgp = subgenital plate.



Figs. 63-66. Female terminalia. 63. *Allocaupnia rickeri*, 64. *Allocaupnia starki*, 65. *Allocaupnia virginiana*, 66. *Nemocaupnia carolina*.

Male tergal process. Abdominal tergum 8 without process, but tergum 9 bears a low knob lateral to epiproct on either side of segment (Figs. 53, 55-57).

Female subgenital plate. Abdominal sternum 7 and 8 completely separated by membrane. Mesal portion of sternum 8 divided into a large, somewhat mushroom shaped anterior sclerite and a narrow, transverse posterior sclerite (Figs. 58, 66).

ACKNOWLEDGMENTS

We thank M.H. Alford and M. Howarter for their assistance in collecting, particularly during the 2006-2007 field season, and P. Lago for providing records from the University of Mississippi collection.

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