



LARVAE OF EIGHT EASTERN NEARCTIC *ALLOPERLA* SPECIES (PLECOPTERA: CHLOROPERLIDAE)

Bill P. Stark¹ & Boris C. Kondratieff²

¹Department of Biology, Box 4045, Mississippi College, Clinton, Mississippi, 39058, U.S.A.

E-mail: stark@mc.edu

²Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, Colorado 80523, U.S.A.

E-mail: Boris.Kondratieff@colostate.edu

ABSTRACT

Larval descriptions are provided for eight *Alloperla* species found in eastern North America. Five of these, *Alloperla atlantica* Baumann, *A. furcula* Surdick, *A. neglecta* Frison, *A. petasata* Surdick and *A. usa* Ricker, are described for the first time and three others, *A. concolor* Ricker, *A. imbecilla* (Say), and *A. natchez* Surdick & Stark have earlier descriptions supplemented with new data. A preliminary larval key is presented for nine eastern Nearctic species.

Keywords: *Alloperla*, Larval descriptions, Eastern North America, Plecoptera

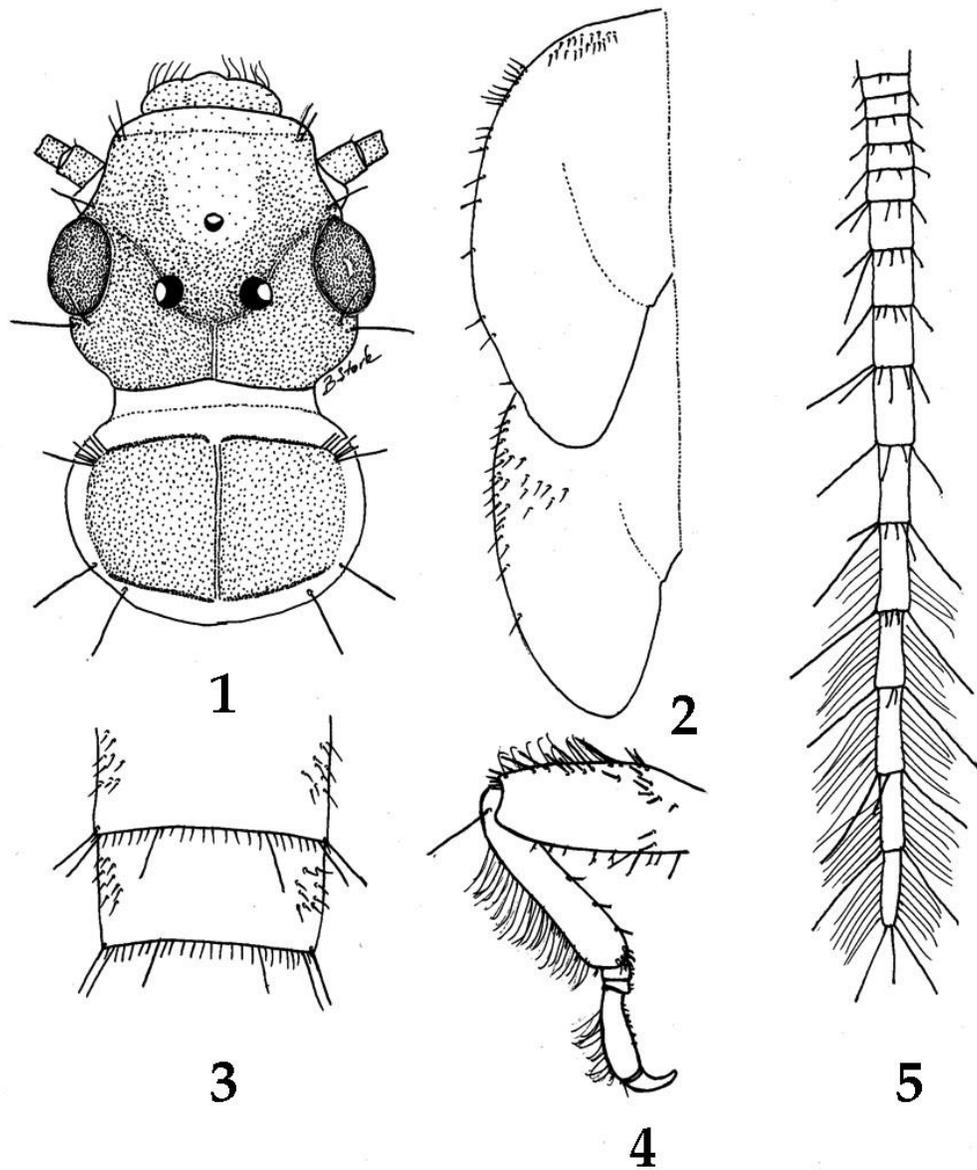
INTRODUCTION

Stewart & Stark (2002) indicate larvae of only 7 of the 23 *Alloperla* species known to occur in eastern North America at that time were at least partially described (Brown & Stark 1995; Fiance 1977; Frison 1942; Poulton & Stewart 1991; Stewart & Stark 1988) and the larva of only one additional species, *A. prognoides* Surdick & Stark, has subsequently been described (Ray et al. 2010). Unfortunately details of setal arrangements and numbers of cercal segments have not always been included which makes separation of these rather uniformly pigmented species difficult except perhaps on the basis of narrow regional analysis. In one of the few attempts to treat chloroperlid immatures at the species level, Poulton & Stewart (1991) were able to separate larvae of four of the five known Ozark-Ouachita *Alloperla* using a combination of characters such as pigment patterns, leg setation and general morphology, but similar efforts for other regions have not been made.

Stewart & Stark (1988, 2002) and Stark & Stewart (2005) encourage the comparative study and description of available associated material in large genera, even when few species are involved, in order to test generic keys and to discover new species specific characters. In this study we continue the chaetotaxic analysis of eastern North American *Alloperla* species initiated by Fiance (1977) by providing new descriptions for five species and supplementary data for three species previously described. Specimens of *A. caddo* Poulton & Stewart, *A. caudata* Frison and *A. hamata* Surdick examined by Poulton & Stewart (1991) were not available for this study and have not been included in the preliminary key presented below.

MATERIALS AND METHODS

Reared specimens, pharate males and field associated larvae and larval skins for *Alloperla atlantica* Baumann, *A. concolor* Ricker, *A. furcula*



Figs. 1-5. *Alloperla atlantica* larval structures. 1. Head and pronotum. 2. Mesonotum and metanotum. 3. Abdominal terga 8-9. 4. Right foreleg. 5. Lateral aspect of cercus, dorsum left.

Surdick, *A. imbecilla* (Say), *A. natchez* Surdick & Stark, *A. neglecta* Frison, *A. petasata* Surdick and *A. usa* Ricker were examined with light microscopy. Drawings were prepared using an Olympus SZH10 or a Wild M5 dissecting microscope with drawing tube. Setal patterns on dorsal thoracic and abdominal segments, lateral aspect of cercal segments and anterior aspect of legs were documented on single

specimens and compared with other specimens in the sample to check for variation, but all samples are limited in size and geographic distribution. Specimens are deposited in the C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado (CSU) and in the Stark Collection, Mississippi College, Clinton, Mississippi (BPS).

RESULTS AND DISCUSSION

Alloperla atlantica Baumann

(Figs. 1-5)

Alloperla atlantica Baumann, 1974:260. Holotype ♂ (United States National Museum), Maryland, Frederick Co., Fishing Creek, Mountindale

Material examined. New York: Hamilton Co., West Stony Creek, Hwy 30, North of Grant, Sacandaga Lake, 5 June 1997, B.C. Kondratieff, R.W. Baumann, 111♂, 42♀, 9 field associated larval skins (CSU). North Carolina: Burke Co., Jacob's Fork, Old NC Hwy 18, South of Pleasantford, 35.59° N, 81.57° W, 3 May 2005, B.C. Kondratieff, R.F. Kirchner, R.E. Zuellig, D.R. Lenat, 1♂, 2♀, 2 pharate larvae (CSU). **Mature larva.** Body length 7.5-8.5 mm. General body color brown without distinctive pattern. Head slightly paler forward of median ocellus (Fig. 1). Anterior pronotal margin with about 6-10 moderately long setae at corners and posterior margin with a pair of long setae at corners (Fig. 1). Mesonotal wingpads with ca. 15-20 outer marginal setae, metanotal wingpads with ca. 20 outer marginal setae beyond apex of mesonotal wingpad; inner marginal setae apparently absent (Fig. 2). Forelegs without ventral tibial fringes (Fig. 4), but mid and hind legs with sparse ventral tibial fringes. Abdominal terga without mesal pale spots; posterior tergal fringes consist of short thick setae with interspersed long thin setae (ca. 6 on each segment); patches of intercalary setae located laterally on each segment but absent on dorsum of segments (Fig. 3). Cerci consisting of 15-16 apparent segments (Fig. 5), vertical fringe developed on segments 12-16; longest dorsal setae in segmental whorls of mid cercal segments about as long as segment.

Alloperla concolor Ricker

(Figs. 6-10)

Alloperla concolor Ricker, 1935:256. Holotype ♂ (Royal Ontario Museum), Ontario, Dufferin Co., "E" Creek, headwaters of Pine River, Horning's Mills

Material examined. Newfoundland: Rocky Brook, north of Deer Lake, Reidville Road, 8 June 1998, B.C.

Kondratieff, R.W. Baumann, 56♂, 3♀, 5 larval skins from field associated adults, 1 pharate male larva (CSU). Boot Brook, Hwy 1 jct Hwy 401, northeast of Deer Lake, 8 June 1998, B.C. Kondratieff, R.W. Baumann, 5 larvae (CSU).

Mature larva. Body length 9.0-9.5 mm. General color brown without distinctive pattern. Head slightly paler forward of median ocellus (Fig. 6). Anterior pronotal margin with about 11-15 moderately long setae at corners and posterior margin with 2 long and 2 short setae at corners (Fig. 6). Mesonotal wingpads with ca. 12-16 outer marginal setae, metanotal wingpads with ca. 20 outer marginal setae beyond apex of mesonotal wingpad; inner marginal setae apparently absent (Fig. 7). All legs with sparse ventral tibial fringes (Fig. 9). Abdominal terga without mesal pale spots; posterior fringes on terga 8-9 with ca. 6 long thin setae and mixed shorter thick setae primarily located laterad to innermost long setae (Fig. 8); mesal section of posterior fringe occupied by a few very thin setae. Abdominal intercalary setae restricted to lateral areas of segments. Cerci consisting of 15 apparent segments, vertical fringe developed on segments 10-15 (Fig. 10); longest dorsal setae in segmental whorls of mid cercal segments about as long as segment.

Comments. The larva of this species was previously described by Fiance (1977) from Hubbard Brook, New Hampshire specimens. Figure 2C of that publication shows a lateral view of the cercus with 18 apparent segments and the vertical fringe present on segments 12-18. Although this is at variance with our specimens, in all other respects our findings are in agreement.

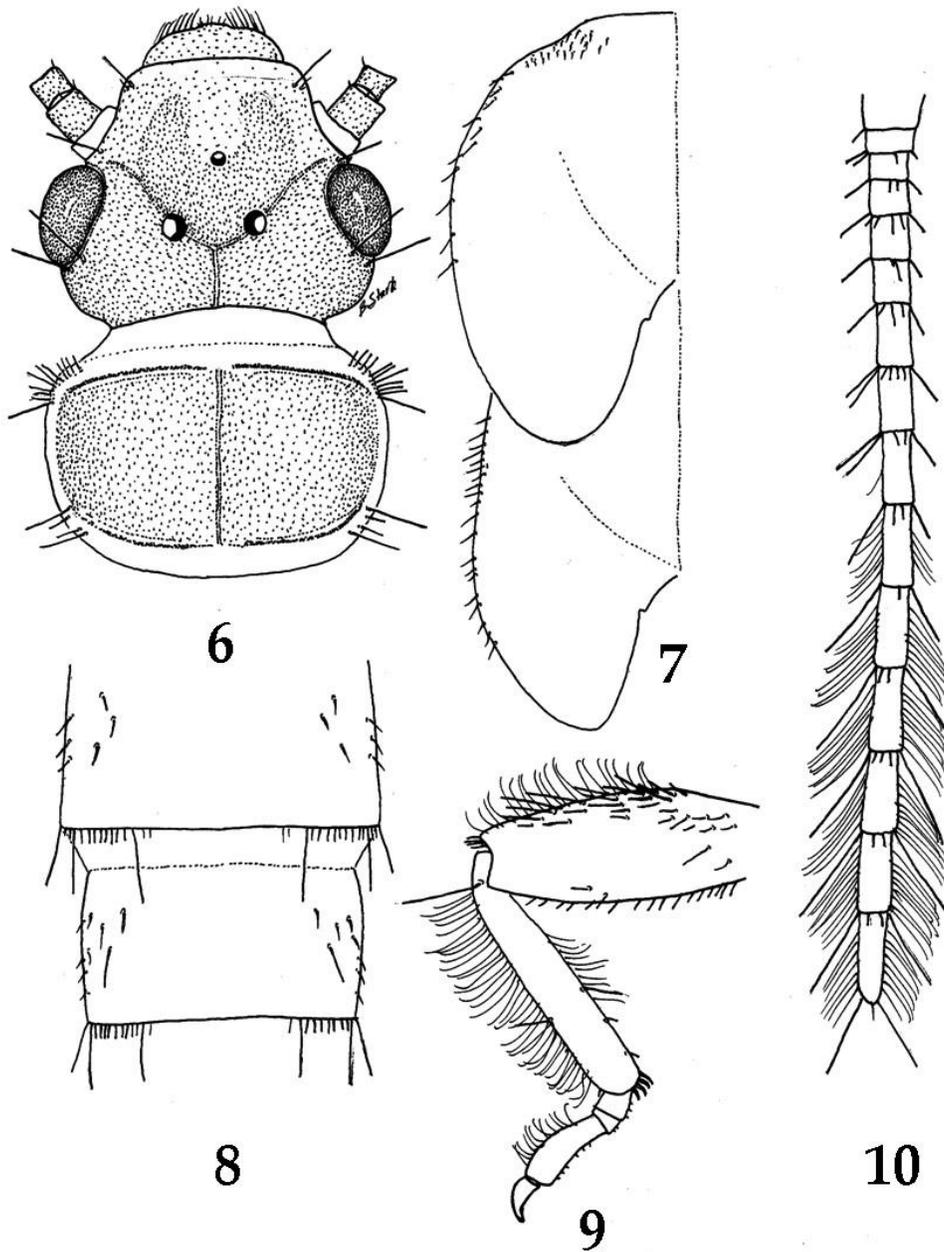
Alloperla furcula Surdick

(Figs. 11-15)

Alloperla furcula Surdick, 1981:349. Holotype ♂ (United States National Museum), South Carolina, Aiken Co., Upper Three Runs Creek, Savannah River Plant

Material examined. South Carolina: Aiken Co., Upper Three Runs Creek, Savannah River Plant, Road C, 2 May 1985, B.C. Kondratieff, 1 larva (CSU).

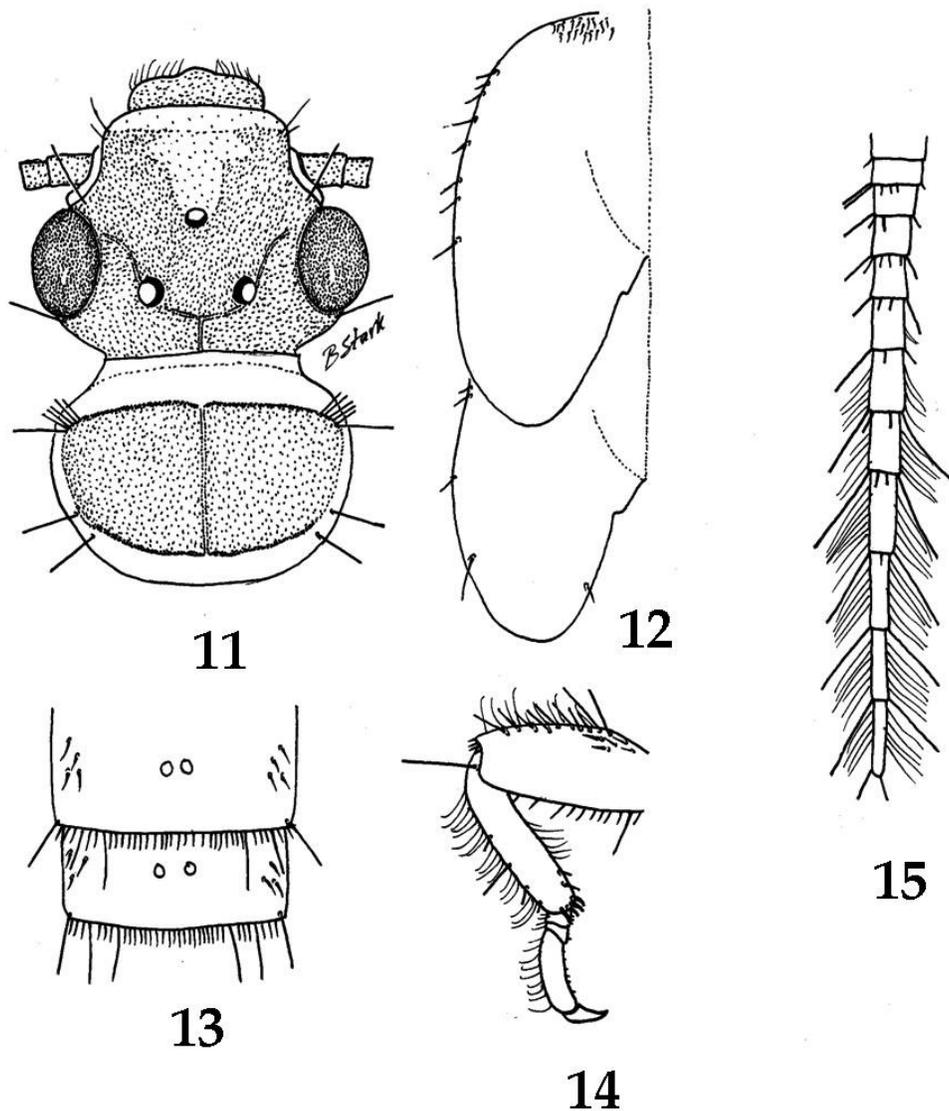
Mature larva. Body length 6.5 mm. General body color brown without distinctive pattern. Head slightly paler forward of median ocellus (Fig. 11).



Figs. 6-10. *Alloperla concolor* larval structures. 6. Head and pronotum. 7. Mesonotum and metanotum. 8. Abdominal terga 8-9. 9. Right foreleg. 10. Lateral aspect of cercus, dorsum left.

Anterior pronotal margin with about 5-6 moderately long setae at corners and posterior margin with a pair of long setae at corners (Fig. 11). Mesonotal wingpads with ca. 8-9 outer marginal setae, metanotal wingpads with ca. 4 outer marginal setae beyond apex of mesonotal wingpad and ca. 2 inner

marginals (Fig. 12). Fore, mid and hindlegs each with a sparse ventral fringe of long silky setae (Fig. 14). Abdominal terga with a pair of minute pale mesal spots; posterior tergal fringes consist of stout setae with several (ca. 5) interspersed long thin setae; a few intercalary setae occur near lateral margins but none



Figs. 11-15. *Alloperla furcula* larval structures. 11. Head and pronotum. 12. Mesonotum and metanotum. 13. Abdominal terga 8-9. 14. Right foreleg. 15. Lateral aspect of cercus, dorsum left.

are located in median tergal field (Fig. 13). Cerci consisting of 12 apparent segments (Fig. 15), vertical fringe developed on segments 7-12; longest dorsal setae in segmental whorls of mid cercal segments about as long as segment.

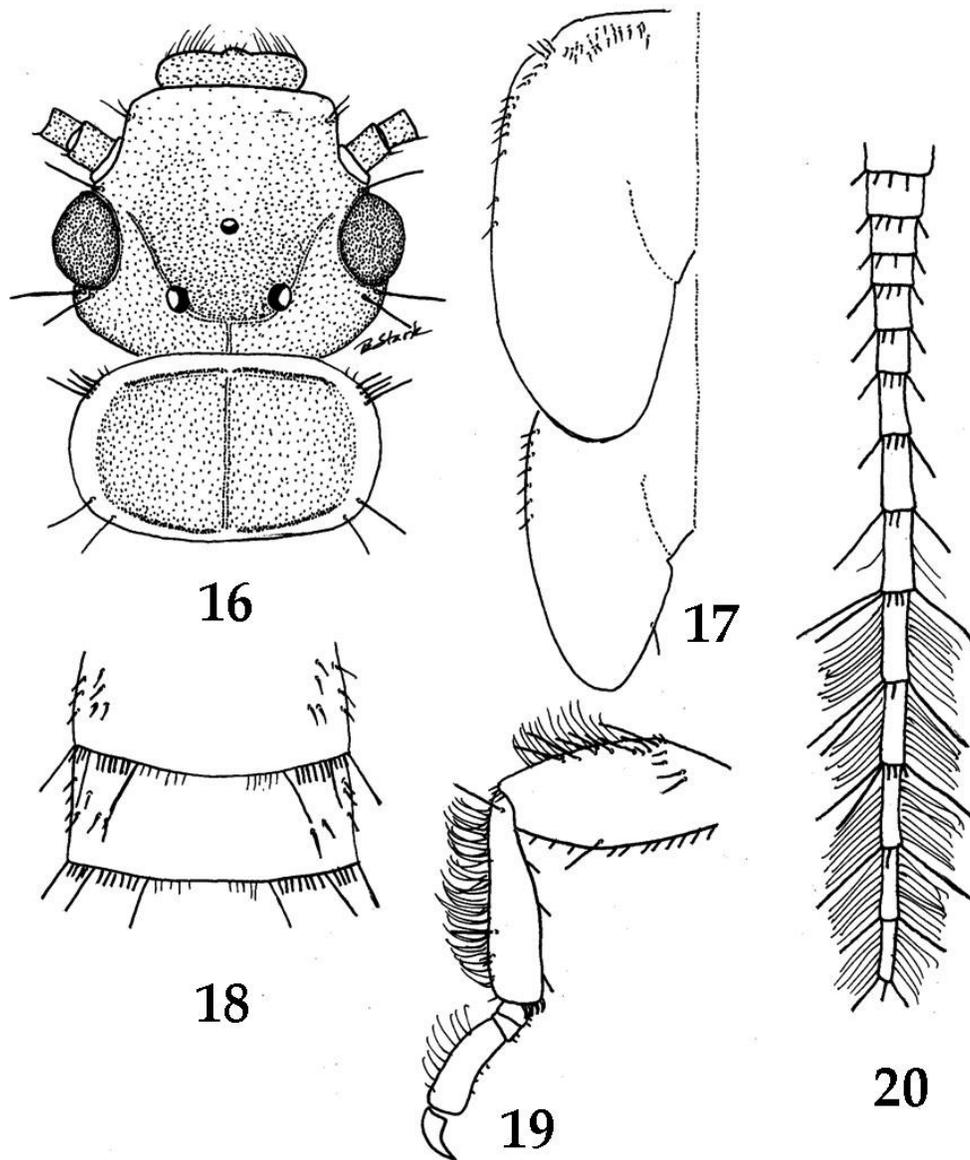
Comments. *Alloperla furcula* shares a reduced number of cercal segments (12-13) with *A. natchez* Surdick & Stark (Brown & Stark 1995) and *A. prognoides* (Ray et al. 2010). The three species are allopatric with *A. natchez* known only from Mississippi, *A. prognoides* known from southwestern Alabama and adjacent

areas of the Florida Panhandle, and *A. furcula* known from South Carolina. In addition, this species can apparently be distinguished from *A. natchez* and *A. prognoides* by the presence of a pair of pale spots on the abdominal terga.

***Alloperla imbecilla* (Say)**

(Fig. 16-20)

Sialis imbecilla Say, 1823:165. Type material lost, neotype ♂ (United States National Museum), Ohio,



Figs. 16-20. *Alloperla imbecilla* larval structures. 16. Head and pronotum. 17. Mesonotum and metanotum. 18. Abdominal terga 8-9. 19. Right foreleg. 20. Lateral aspect of cercus, dorsum left.

Adams Co., Lower Twin Creek, Vastine Run,
Designated by Baumann, 1974:258

Material examined. West Virginia: Wayne Co., tributary Millers Fork of Beech Fork, 15 May 1986, B.C. Kondratieff, 4 larvae (CSU).

Mature larva. Body length 6.5-7.5 mm. General color brown without distinctive pattern. Anterior pronotal margin with 6-9 moderately thick setae at corners

and posterior margin with a pair of long setae at corners (Fig. 16). Mesonotal wingpads with ca. 5-6 outer marginal setae, metanotal wingpads with ca. 7-8 outer marginal setae beyond apex of mesonotal wingpad and 1 apparent inner marginal (Fig. 17). Mid and hindlegs each with a sparse ventral fringe of long silky setae, forelegs without ventral fringe (Fig. 19). Abdominal tergal fringes consist of stout setae with ca. 4-6 interspersed long thin setae; a few

intercalary setae occur near lateral margins but none are located in median tergal field (Fig. 18). Cerci consisting of 14-15 apparent segments (Fig. 20), vertical fringe developed on segments 10-14, and a few fringe setae occur on segment 9; longest dorsal setae in segmental whorls of mid cercal segments about as long as segments.

Comments. Stewart & Stark (2002) provide a detailed larval description for this species based on Pennsylvania specimens and indicate the cerci are "approximately 14-16 segmented". In our sample the apparent number of segments for three specimens was 14 but in one specimen a small fragment of segment 15 remained on the left cercus. The anterior pronotal setal count also varied in our sample for each specimen; the maximum number of anterior pronotal setae ranged from 6-9.

Alloperla natchez Surdick & Stark

Alloperla natchez Surdick & Stark, 1980:71. Holotype ♂ (United States National Museum), Mississippi, Claiborne Co., Little Sand Creek, Natchez Trace Parkway

Material examined. Mississippi: Claiborne Co., Ragsdale Creek, Regan Road, 30 March 1994, B. Stark, J. Parham, 1 larva (BPS). Simpson Co., Tanyard Creek, Old Westville Road, 27 March 1993, B. Stark, L. Brown, 1 larva (BPS). Same site, 3 April 1993, B. Stark, 9 larvae (BPS). Rials Creek, Hwy 43, Merit Water Park, 4 April 1991, B. Stark, 1 larva (BPS).

Mature larva. Body length 5.7-6.7 mm. General color brown with obscure pattern. Anterior pronotal margin with approximately 6-10 moderately long setae on corners and posterior margin with two long thin setae on corners. Mesonotal wingpads with ca. 7-10 outer marginal setae, metanotal wingpads with ca. 16-20 outer marginal setae; inner marginal setae absent. Forelegs without ventral tibial fringe but mid and hindlegs with at least sparse fringes. Abdominal terga without pale mesal spots; posterior fringes on terga 8-9 include short and interspersed long setae; median field of fringes consist of moderate length, slightly thinner setae than those more laterad of innermost long thin setae. Cerci consist of 13 segments, vertical fringe developed on segments 8-13; longest dorsal setae in segmental whorls of mid

cercal segments slightly longer than segments.

Comments. Brown & Stark (1995) provided the first larval description of this species but did not include details of the ventral tibial fringes for mid and hind legs. See additional comments above for *A. furcula*.

Alloperla neglecta Frison

Alloperla neglecta Frison, 1935:336. Holotype ♂ (Illinois Natural History Survey), North Carolina, Newfoundland Gap

Material examined. North Carolina: Haywood Co., East Fork Pigeon River, Hwy 276, Shining Rock Wilderness, 23 May 1993, B.C. Kondratieff, R.F. Kirchner, 6♂, 5♀, 4 larval skins from field associated adults (CSU). Virginia: Grayson Co., Lewis Fork, Rt. 603, 18 May 1990, Kondratieff, Kirchner, Welch, 25♂, 19♀, 1 pharate larva, 5 larval skins from field associated adults (CSU).

Mature larva. Body length 8.0-9.0 mm. General color brown without distinctive pattern. Anterior pronotal margin with approximately 9-12 moderately thick setae at corners and posterior margin typically with two long and a single medially placed short seta. Mesonotal wingpads with ca. 3-4 outer marginal setae, metanotal wingpads with ca. 12-15 outer marginal setae beyond apex of mesonotal wingpad; inner marginal setae absent. Foreleg without ventral tibial fringe but dorsal fringes well developed on femora and tibia; fringes obscured on other legs. Abdominal terga with pair of small, pale mesal spots; posterior fringes on terga 8-9 with ca. 6 long thin setae and mixed shorter thick setae primarily located laterad to innermost long seta; mesal section of posterior fringe occupied by very thin setae. Abdominal intercalary setae restricted to lateral area of segments. Cerci consisting of 16-17 apparent segments, vertical fringe developed on segments 13-17; longest dorsal setae in segmental whorls of mid cercal segments slightly longer than segments.

Comments. Figures were not prepared from the larval skins available for this species.

Alloperla petasata Surdick

Alloperla petasata Surdick, 2004:19, Holotype ♂ (United States National Museum), Virginia, Shenandoah Co.,

Crisman Hollow, Massanutten Mountain

Material examined. Nova Scotia: Antigonish Co., Tracadie River, Hwy 16, 22 June 1993, B.C. Kondratieff, R.W. Baumann, 88♂, 10♀, 5 larval skins from field associated adults (CSU).

Mature larva. Body length 8.0-8.5 mm. General color brown without distinctive pattern. Anterior pronotal margin with approximately 10-12 moderately long setae at corners and posterior margin with 2 long and 1-2 medially placed short setae. Mesonotal wingpads with ca. 8-10 outer marginal setae, metanotal wingpads with ca. 12-15 outer marginal setae beyond apex of mesonotal wingpad; typically with a single inner marginal metanotal seta. Foreleg without ventral tibial fringe but sparse ventral fringes present on mid and hind tibiae. Abdominal terga without pale mesal spots; posterior fringes on terga 8-9 with ca. 6-8 long thin setae interspersed with short setae; mid fringe setae between innermost long setae similar in thickness and length to those more laterad. Abdominal intercalary setae restricted to lateral area of segments. Cerci consisting of 16-17 apparent segments, vertical fringe developed on segments 9-16; longest dorsal setae in segmental whorls of mid cercal segments slightly longer than segments.

Comments. Figures were not prepared from the larval skins available for this species.

Alloperla usa Ricker
(Figs. 21-25)

Alloperla usa Ricker, 1952:178. Holotype ♂ (Illinois Natural History Survey), Tennessee, Sevier Co., Little Pigeon River near Alum Cave Creek, Great Smoky Mountains National Park

Material examined. North Carolina: Burke Co., Jacob's Fork, Old NC Hwy 18, South of Pleasantford, 35.59° N, 81.57° W, 3 May 2005, B.C. Kondratieff, R.F. Kirchner, R.E. Zuellig, D.R. Lenat, 1 pharate male larva (CSU).

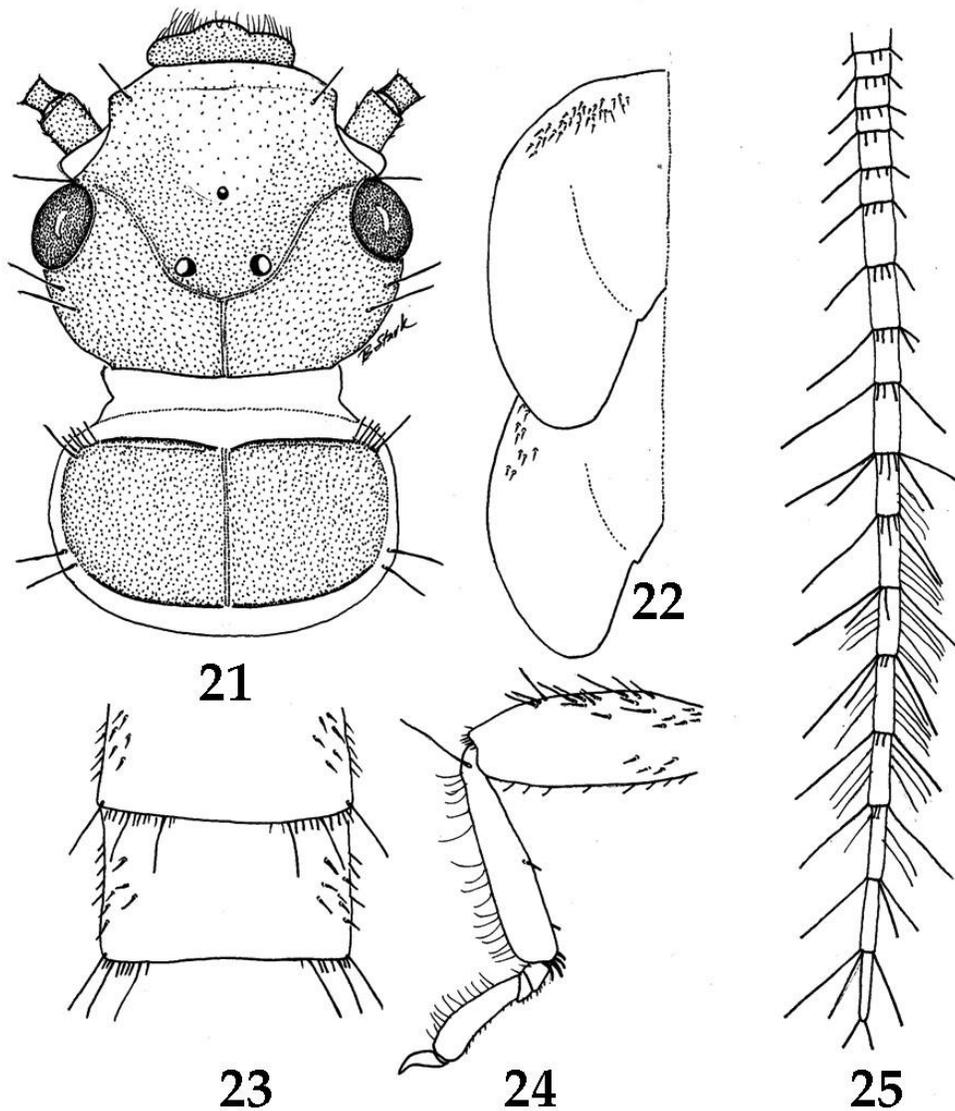
Mature larva. Body length 9.0 mm. General color brown without distinctive pattern. Head slightly darker over ocelli and pale forward of median ocellus (Fig. 21). Anterolateral margin of head somewhat angulate and slanted from near antennal base to labrum. Anterior pronotal margin with ca. 5-6

moderately thick setae on corners and 2 long thin setae on posterior corners (Fig. 21). Mesonotal and metanotal wingpads without obvious outer or inner marginal setae but short, thick basal setae abundant on both segments, extending slightly beyond mesonotal wingpad on surface of metanotal wingpad (Fig. 22). Ventral tibial fringes and dorsal femoral fringes apparently absent on all legs; dorsal tibial fringes sparse (Fig. 24). Abdominal terga without pale spots; posterior fringe reduced to a few short thick setae near lateral margins and several (ca. 6) long thin setae; intercalary setae restricted to areas near lateral margins (Fig. 23). Cerci with 18 apparent segments (Fig. 25), vertical fringe sparse and restricted to segments 11-16, primarily on ventral side; a few scattered dorsal fringe setae occur on segments 13-15.

Comments. Larvae of *A. usa* may have been incorrectly identified as a possible southeastern species of *Utaperla* in the past due to the slightly elongated head and the poorly developed cercal fringe. Mature larvae however are more robust than those of *Utaperla* and the two can be readily separated by the pronotal setation which consists of numerous long setae on both the anterior and posterior margin in species of that genus (Stewart & Stark 2002).

**Preliminary Key to Larvae of Nine Eastern
Nearctic *Alloperla***

- 1 Vertical cercal fringe poorly developed, sparse on ventral margin and obsolete or absent on dorsal margin (Fig. 25); anterolateral margins of frons slightly slanted, angulate from base of frontoclypeus to labrum (Fig. 21) *A. usa*
- 1' Vertical cercal fringe well developed on dorsal and ventral margins of several mid to apical segments (Fig. 5); anterolateral margins of frons smoothly rounded between frontoclypeus and labrum (Fig. 1) 2
- 2 Twelve or 13 cercal segments (Fig. 15); Coastal Plains populations generally found south of Jackson, Tuscaloosa, Atlanta line 3
- 2' At least 14 cercal segments (Fig. 20); populations found mostly north of Jackson, Tuscaloosa, Atlanta line 5
- 3 Thirteen cercal segments; ventral fringe on



Figs. 21-25. *Alloperla usa* larval structures. 21. Head and pronotum. 22. Mesonotum and metanotum. 23. Abdominal terga 8-9. 24. Right foreleg. 25. Lateral aspect of cercus, dorsum left.

foretibiae absent; abdominal terga without mesal pair of pale spots; known from central and southwest Mississippi *A. natchez*
 3' Twelve cercal segments (Fig. 15); sparse ventral fringe of fine setae on foretibiae (Fig. 14) 4
 4 Abdominal terga with a pair of pale, round spots (Fig. 13); known from South Carolina ... *A. furcula*
 4' Abdominal terga without pale, round spots; known from Alabama and Florida ... *A. prognoides*
 5 Posterior pronotal fringe consists of two rather

widely spaced long setae at corners (Fig. 16) 6
 5' Posterior pronotal fringe consists of 1 or 2 short setae placed between longer setae at corners (Fig. 6) 7
 6 Vertical cercal fringe begins on segment 10 (Fig. 20); less than 10 outer marginal setae present on mesonotum (Fig. 17) *A. imbecilla*
 6' Vertical cercal fringe begins on segment 12 (Fig. 5); at least 10 outer marginal setae present on mesonotum (Fig. 2) *A. atlantica*

- 7 Mid fringe setae on abdominal terga 8-9 similar to those located just laterad to innermost long thin setae; mesonotum with about 8 outer marginal setae; vertical cercal fringe begins on segment 9 *A. petasata*
- 7' Mid fringe setae on abdominal terga 8-9 much thinner and more widely spaced than those located laterad to innermost long thin setae (Fig. 8); mesonotum with about 4 or with about 12 outer marginal setae; vertical cercal fringe begins beyond segment 10 8
- 8 Vertical cercal fringe setae begin on segment 11 (Fig. 10); mesonotum with about 12 outer marginal setae (Fig. 7) *A. concolor*
- 8' Vertical cercal fringe setae begin on segment 13; mesonotum with about 4 outer marginal setae *A. neglecta*

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