

VARIABILITY IN THE LARVAE OF *SERRATELLA SERRATA* (EPHEMEROPTERA: EPHEMERELLIDAE)¹

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ABSTRACT: Series of larval specimens of *Serratella serrata* from eastern North America exhibit previously undocumented variability in abdominal characters, especially tubercle armature. A redescription of the species takes this variability into account. Study of the specimens revealed errors in the larval key to the *Serratella* species. The mistakes are noted and corrected.

A character of fundamental importance for the species identification of the larvae of many North American Ephemerellidae has been the relative development and placement of dorsal paired tubercles on the abdomen. This importance is best illustrated by the much used specific keys to larvae in the genera *Caudatella* (Allen and Edmunds 1961a), *Attenella* (Allen and Edmunds 1961b), *Drunella* (Allen and Edmunds 1962), *Serratella* (Allen and Edmunds 1963a), *Eurylophella* (Allen and Edmunds 1963b, Funk and Sweeney 1994), and *Ephemera* (Allen and Edmunds 1965). Whereas this characterization is presumed to be relatively stable within stated limits, we discovered an unexpected and critical level of variability with respect to such characterization in the common eastern species *Serratella serrata* (Morgan). The discovery has prompted this report and the redescription of the larval stage of *S. serrata* given below. Material examined is deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana.

Series of late instar larvae of *S. serrata* collected from New York, Quebec, and West Virginia exhibited a wide range of variability in abdominal characters, especially in the development of the paired, submedian tubercles on the terga. In the initial description of the larval stage by Morgan (1911), and in a subsequent description by Lestage (1925) (essentially paraphrasing Morgan), these tubercles were described as occurring on terga 4-7. A redescription by Allen and Edmunds (1963a) noted small tubercles sometimes also appearing on terga 3 and 8. Material we have studied demonstrated development of tubercles from tergum 2 to tergum 9. Individual specimens exhibited a series of tubercles on the terga in the following combinations: terga 2-9 (Figs. 1, 2), terga 3-9 (Figs. 3, 4, 5, 6), terga 3-8 (Figs. 9, 10), terga 4-8 (Figs. 7, 8). The smallest tubercles are often best seen in lateral perspective. This armature sometimes appeared more darkly sclerotized than the surrounding integument (Figs. 1, 5, 7), and in some individuals was margined or thickly covered with short, robust, dark setae, referred to as spicules (Figs. 5, 7), while others

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were bare (Figs. 1, 3, 9). The most highly developed tubercles were somewhat hook-like, as seen in lateral view (Fig. 2), while others were smaller to minute and not curved (see especially terga 3 and 9 in Fig. 4).

In addition to structural variability, we also noted stability and variability in abdominal color patterns that have been used in the diagnosis of *S. serrata*. Allen and Edmunds (1963a) described tergum 9 of *S. serrata* with paired sublateral maculae. The specimens we examined also had these maculae; however, most specimens had sublateral maculae present on other terga as well (Figs. 1,3,7,9); in some, maculae were present on terga anteriorly to segment 9, including the first abdominal tergum (Figs. 3,9).

Abdominal terga 5 and 6 on the larvae of *S. serrata* were described by Morgan (1911) as "pale marked with brown pencillings." Traver (1935) also mentioned these pencillings. Later, Allen and Edmunds (1963a) described terga 4-6 as "often pale." The specimens we examined varied in the degree of pencillings present (contrast Fig. 1 and Fig. 5) and also in the situation of pale areas on the terga (contrast Fig. 5 and Fig. 7). Terga 4-7 in our material varied with respect to the pale markings. In some specimens, terga 4 was pale in the posterior half (Figs. 1,3,5); sometimes it was entirely tan or brown (Fig. 7). Terga 5 and 6 most consistently were pale (Figs. 1, 3, 5, 9); however, in one specimen, tergum 5 was dark, and terga 6 and 7 were pale (Fig. 7).

The larval foreleg of *S. serrata*, as figured by Morgan (1913), differed somewhat from the foreleg figured by Allen and Edmunds (1963a). Specimens we examined most closely matched the figure by Allen and Edmunds (1963a); however, there was some variation in setation that would explain the slight discrepancy between the two figures.

In view of these observations, we provide a redescription of the larva of *S. serrata* below. Our description may facilitate more accurate identification of larvae, particularly when only one or few specimens are available in a sample. The description of *S. serrata* is of additional importance, because this species is the type of the genus *Serratella*, which was erected initially as a subgenus by Edmunds (1959) and later given generic status by Allen (1980).

Serratella serrata (Morgan)

Mature Larva. Length: body 5.0-6.0 mm; caudal filaments 1.5-2.0 mm. General color tan to light brown, with varied markings, pale to dark brown. Head: Vertex roughened with no distinct occipital tubercles, but with patches of spicules, often slightly raised. Scape and pedicel of antennae margined with dark brown. Maxillary palpi reduced, three segmented. Thorax: Pronotum with pair of minute submedial tubercles. Legs with femoral, tibial, and tarsal brown bands; femora stout, with long hairlike setae along hind margin; tarsal claws with 3-5 denticles. Abdomen: Gill lamellae on segments 3-7, imbricated, with gills 7 somewhat reduced, often obscured below gills 6; lower fimbriate portion of gills lamelliform. Segments 4-9 with well-developed, dorsoventrally flattened, posterolateral processes; processes brown medially, pale posteriorly, with row of short, robust setae laterally; posterolateral processes of segment 9 most acuminate. Terga vari-

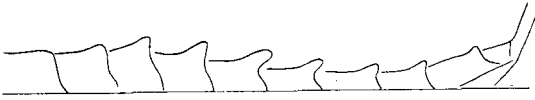
ously marked with dark brown, with sublateral maculae present, most apparent on tergum 9; terga 4-7 with variable large pale regions, usually most prominent on terga 5 and 6; tergum 4 often pale posteriorly only; tergum 7 variable. Paired submedian tubercles, on terga 2-9, 3-7, 3-8, 3-9, 4-8, or 4-7; most prominent and always present on terga 4-7; tubercle shape varies from broadly rounded protuberances to narrowly acute, sometimes slightly hooked processes; in some individuals some or all tubercles without spicules, in some individuals some tubercles with marginal spicules only, and in some individuals some tubercles with surface spicules. Sterna yellowish to light tan, with row of dark dashes in each half. Caudal filaments subequal, pale to brown, with darker median band, without intersegmental setae, with whorls of coarse setae distributed sparsely on apical margins of segments; whorl setae usually longest at approximately two-thirds distance from base to apex of filaments.

Material examined. Five larvae, New York, Sullivan Co., Neversink River below Monticello, 1.5 mi south of SR 17, VII-18-1997, K. Riva-Murray. Six larvae, Quebec, Wakefield, VII-8-1931, L. J. Milne. One larva, West Virginia, Lost River, VIII-12-1930, J. G. Needham.

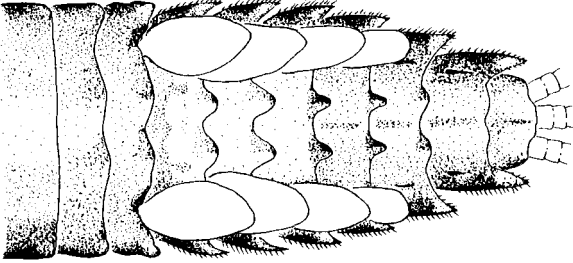
Remarks. From the redescription above, it is apparent that, depending on what variant is being keyed when using the key of Allen and Edmunds (1963a), larvae of *S. serrata* could be keyed to *S. carolina* (Berner and Allen) on the basis of the dorsal abdominal armature and an incorrect occipital figure citation (see below). It may also be possible that some individuals of *S. serrata* could be keyed to *S. spiculosa* (Berner and Allen). These three species share the presence of occipital spicules and a pair of pronotal tubercles by which they may be distinguished from *S. serratoides* (McDunnough), *S. sordida* (McDunnough), and *S. frisoni* (McDunnough). McDunnough (1931) stated that sternal markings could be used to separate such species as *S. serrata* and *S. serratoides* from each other. We found that the sternal color patterns of the larvae of *S. serrata*, however, varied to such an extent that some individuals might be perceived as *S. serratoides*. If sternal markings were used exclusively, *S. serrata* and *S. serratoides* could be easily confused. In all cases, the presence of pronotal tubercles will separate individuals of *S. serrata* from *S. serratoides*, as noted by Traver (1932).

Allen and Edmunds (1963a) described the caudal filaments of *S. serrata* as being "without setae". This could be somewhat misleading because the segments of the caudal filaments indeed have setae on the apical margins, although they do lack intersegmental setae.

Couplet 8 of the Allen and Edmunds' (1963a) larval key to the *Serratella* species refers to figures of larval heads, portraying "paired, submedial, occipital tubercles". The numbering of the figures to which the text of the key refers was evidently inadvertently reversed. Their figure 12 clearly shows occipital tubercles as described in the key and should be labelled as figure 11; consequently, figure 11 should be labelled as 12. We have modified couplets 8 and 9 from Allen and Edmunds (1963a:587) as follows to take into account the new-found variability and figure labelling error reported here. Figures correctly referred to in the following couplets are those of Allen and Edmunds (1963a).



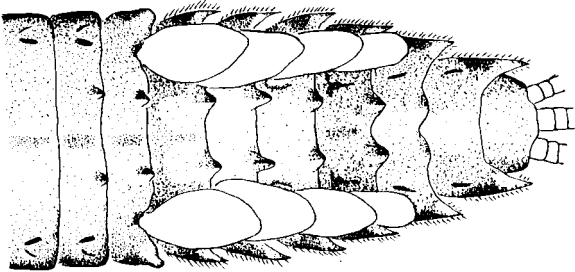
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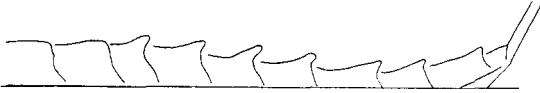
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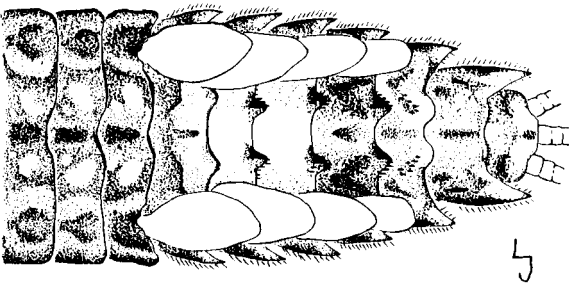
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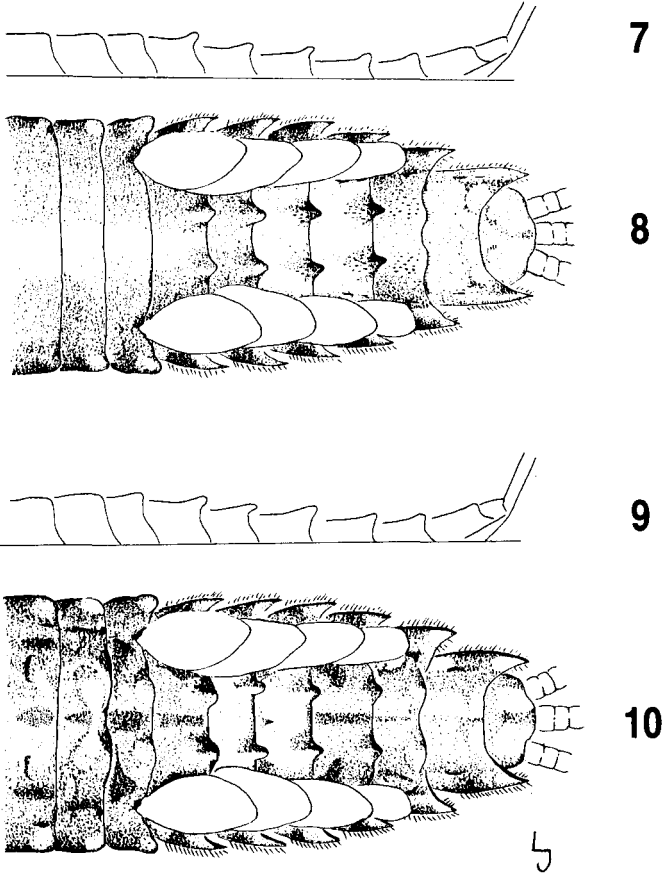
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6



Figs. 1-10. *Serratella serrata* late instar abdominal variability. 1. Variant 1 (dorsal). 2. Variant 1 (lateral). 3. Variant 2 (dorsal). 4. Variant 2 (lateral). 5. Variant 3 (dorsal). 6. Variant 3 (lateral). 7. Variant 4 (slightly less mature) (dorsal). 8. Variant 4 (slightly less mature) (lateral). 9. Variant 5 (dorsal). 10. Variant 5 (lateral).

- 8 (7). Head with paired, submedian, occipital tubercles (fig. 12) *carolina*
 Head without tubercles (fig. 11) or only roughened (fig. 13) 9
- 9 (8). Head without tubercles, covered with numerous fine spicules as in
 figure 11; maxillary palpi with single segment (fig. 49); tarsal
 claws usually with 6 to 8 denticles (fig. 61) *spiculosa*
 Head roughened and with only patches of spicules as in figure 13;
 maxillary palpi three-segmented (fig. 50); tarsal claws usually
 with 3-5 denticles (fig. 62) *serrata*

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