

**A NEW SPECIES OF *STENONEMA*  
(EPHEMEROPTERA: HEPTAGENIIDAE)  
FROM NORTH CAROLINA**

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*Abstract.*—The new species, *Stenonema lenati* McCafferty, is described and figured from larval specimens taken from unpolluted reaches of Piedmont rivers in North Carolina. The new species has a distinctive dorsal color pattern and is easily keyed from other *Stenonema* larvae. It apparently belongs to Cluster IIIB of the subgenus *Maccaffertium* and is perhaps most closely related to *Stenonema mexicanum*. It and some other *Stenonema* species demonstrate highly restricted geographic and ecological distributions.

*Key Words:* mayflies, Heptageniidae, *Stenonema*, new species

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*Stenonema* larvae that were taken in larger rivers of the North Carolina inner coastal plain but that could not be definitively identified to any known species using Bednarik and McCafferty (1979) were first found and brought to my attention in 1985. Subsequent examination of this material revealed that these populations represent a new species of *Stenonema*, the second of which to have been discovered since the extensive revision of the genus by Bednarik and McCafferty (1979). Its discovery, much like that of *Stenonema bednariki* McCafferty in Kentucky and Missouri (McCafferty 1981), was precipitated by aquatic biologists conducting water quality studies and then being able to recognize enigmatic populations through the use of comprehensive taxonomic literature.

The new species is based on the larval stage alone since adults have yet to be reared. The species-level morphological characters in *Stenonema*, however, are primarily and sometimes entirely based on the larval stage. Whereas larvae tend to have specific characterization, perhaps related to adaptations to specific running water habitats and ecol-

ogy, adults have been less prone to morphological evolution, possibly due to the relatively young geological age of the group as hypothesized by Bednarik and McCafferty (1979). The new species belongs to the subgenus *Maccaffertium*. I name it in honor of David Lenat in recognition of his collecting of the new material.

***Stenonema lenati* McCafferty**

**NEW SPECIES**

Fig. 1

Larva (in alcohol).—Mature length excluding caudal filaments: 11.0 mm (male) to 14.0 (female).

*Head:* Vertex (Fig. 1) generally medium to dark brown with fine, pale speckling and with small pale area anterior to median ocellus, pair of pale areas extending between compound eyes and lateral ocelli, large pale areas anterolateral and lateral to compound eyes, and 3 pale areas along posterior margin between compound eyes, sometimes becoming continuous; narrow brown band sometimes extending laterad of each compound eye, dividing anterolateral pale areas from lateral pale areas; lateral and posterior

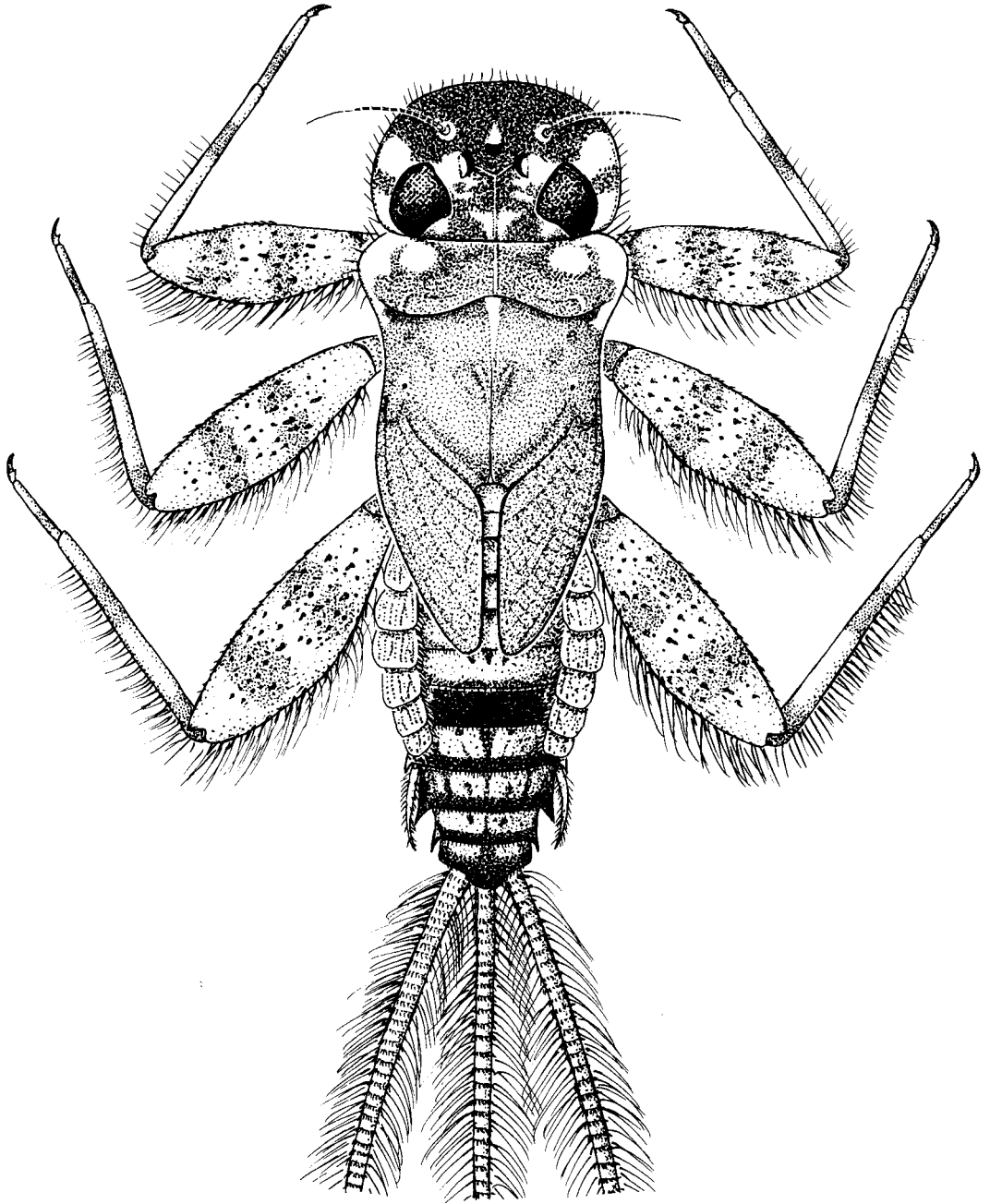


Fig. 1. *Stenonema lenati*, larva.

pale areas obliterated to large degree in mature males by well-developed compound eyes. Scapes of antennae light; pedicels and bases of flagella dark brown; remainder of

flagella light. Mandibles each with 8–10 teeth on inner margin of outer incisor. Maxillae each with 1–3 spinelike setae on crown of galealaciniae (usually 2, with pectination

poorly developed on subapical spinelike seta and hardly developed on terminal seta), and with 25–35 hairlike setae on galealacinal crown, and 19–26 setae in submedial row of galealacinae.

*Thorax:* Nota (Fig. 1) generally medium brown; pronotum with pale lateral and anterolateral marginal areas and pair of distinctive sublateral, pale spots at anterior margin. Legs (Fig. 1) generally pale with brown banding dorsally; all tarsi with single, brown band at midlength; fore- and midtibiae with single, broad bands at approximately midlength, most prominent on foretibiae; hindtibiae without bands; all femora with pair of broad bands, sometimes appearing diffuse or coalescing with each other, more basal bands of mid- and hindfemora often broken and appearing more as 2 large markings. Dorsal armature of forefemora consisting of small, mostly blunt, spinelike setae scattered over apical  $\frac{1}{2}$  to  $\frac{3}{4}$  of surface; posterior margin of forefemora with short, spinelike setae and long, hairlike setae; anterior margin without distinct rows of either spinelike or hairlike setae. Foretarsal claws adenticulate. Hindfemora not conspicuously broader than fore- and midfemora.

*Abdomen:* Dorsally (Fig. 1) pale with conspicuous dark brown and light brown patterns: terga 1–5 with variable markings but often with triangulate anteromedial mark, pair of submedian small spots, and some sublateral markings, sometimes diffuse. Some individuals, however, with terga 1 and 2 generally light; tergum 3 almost completely dark; tergum 4 with large, dark, sublateral markings; and tergum 5 with pair of small, dark, submedian spots and posterior, dark brown transverse band. Terga 6–10 more consistently patterned among individuals, varying mostly in degree and extent of pigmentation: terga 6 almost entirely brown to dark brown; terga 7–9 with conspicuous, dark, transverse bands at posterior margin, often dark, medial, longitudinal stripe with shape somewhat variable, darkened lateral

areas under gills, and pair of small, submedian spots; tergum 10 with dark pigmentation covering anywhere from posterior half to virtually entire tergum. Rows of well-developed spinules along posterior borders of all terga. Lateral patches of light, hairlike setae well developed on terga 3–7. Ventrally, sterna 1–6 pale, without markings; sterna 7 and 8 entirely pale with no markings to somewhat ferruginous with small, dark, anteromedial, triangulate markings (anterior markings usually seen beneath overlapping edge of preceding sternum) and narrow, diffuse shadings or markings; sternum 9 of females ranging from pale to ferruginous with markings ranging from having no anterolateral markings and pair of sublateral, dark spots at posterior margin to having anterolateral markings and well-developed dark band following rather horseshoe shaped distal margin, darkest at sublateral areas corresponding to spotted areas of lighter individuals; sternum 9 of males instead usually with pair of diffuse to well-defined spots sublaterally and subterminally and diffuse, subterminal, transverse band (tips of developing genital forceps also shaded with ferruginous in mature individuals). Posterolateral projections not developed on segments 1–5; projections on segment 8 slightly larger than those of segment 7 and much larger than those of segment 10. Gills 1–6 truncate apically; gills 7 untracheated. Caudal filaments uniformly ferruginous, with short, spinelike setae and long, hairlike setae well developed on each segment.

*Holotype.*—Mature male larva, North Carolina: Stanley Co.: Rocky River at Norwood, March, 1985, D. R. Lenat, deposited in the Purdue Entomological Research Collection (PERC), West Lafayette, IN.

*Paratypes.*—Five mature female and four mature male larvae (some mouthparts slidemounted), same data as holotype, all in PERC except one mature male larva at United State National Museum, Washington, D.C.

Additional material examined.—Ten larvae, North Carolina: Chatham Co., Haw River, May, 1985, D. R. Lenat, in PERC; nine larvae, North Carolina: Moore/Randolph Cos., Deep River, August, 1985, D. R. Lenat, in PERC.

Discussion.—The dorsal color pattern of abdominal segments 6–10 (Fig. 1) found in *S. lenati* is unlike that of any other *Stenonema*. Many species have a darkened tergum 6, e.g. *S. pulchellum*, *S. mexicanum*, and *S. exiguum*; however, their following terga differ considerably from those of *S. lenati*. The pattern of sternum 9 of either males or females are also distinctive but are subject to considerable individual variability. Sternum 9 of *S. femoratum* may have a darkened, horseshoe-shaped, posterior margin similar to that of the female larva of *S. lenati*, but the remainder of the ventral abdominal pattern is very different. The pattern of the vertex and pronotum together can also be used to diagnose this species, particularly when taken in combination with other characters.

By using the larval key of Bednarik and McCafferty (1979) and ignoring the color patterns mentioned above, one would tend to key *S. lenati* to couplet 18 and *S. integrum* [= *S. mexicanum* (see McCafferty 1984)]. This is due to the large number of hairlike setae but only one or two spinelike setae found on the crown of the galealacinia. Couplet 18 should be modified into a triplet as follows to accommodate identification of *S. lenati*:

- 18. Abdominal terga 7, 8, and 9 together with a distinct V-shaped pale area; galealacinal crown with 2–3 spinelike setae . . . *S. mexicanum*
- Abdominal terga 7, 8, and 9 each pale with darkened lateral areas, posterior borders, variable median stripe, and pair of submedian, small spots; galealacinal crown with 1–3 spinelike setae (usually 2 and with only 1 conspicuously pectinate) . . . . . *S. lenati*
- Abdominal terga 7, 8, and 9 with various patterns but not exactly as either of above patterns; galealacinal crown with 3–7 spinelike setae (if only 3, then terga 8 and 9 mostly dark) . . . . . 19

It is difficult to determine the exact relationships of *S. lenati*. It is definitely a member of the subgenus *Maccaffertium*, sharing truncated gills 1–6 and untracheated gills 7 with other members of that subgenus. The new species probably belongs to species Cluster III (Bednarik and McCafferty 1979) because of the loss of posterolateral projections on anterior segments of the larval abdomen. This proposition, however, is contingent on male adult penes and eye separation characters proving to be consistent with others in this phyletic position. This appears likely because, based on its larval characteristics, the species would furthermore belong to Cluster IIIB, a group which retains considerable hairlike setae on the galealacinal crown. Cluster IIIB also includes *S. modestum*, *S. smithae*, and *S. mexicanum*.

The reduction of spinelike setae on the galealacinal crown of *S. mexicanum* and *S. lenati* suggests a possible sister relationship of these two species. Based on published distributions, the geographically restricted *S. lenati* apparently does not overlap with the relatively very widespread *S. mexicanum* (see Bednarik and McCafferty 1979 under *S. integrum*). This suspected allopatry is supported by collecting records of D. R. Lenat (pers. comm.), who has not collected the two species together in North Carolina. *Stenonema lenati* has been taken only in coastal plains, whereas records of *S. mexicanum* in North Carolina are from other regions of the state.

*Stenonema lenati* larvae appear to be limited to unpolluted sections of Piedmont rivers near the fall line. They have been found in slower currents and have been taken cohabiting with the following other heptageniid mayflies: *Stenonema exiguum*, *S. femoratum* (rarely), *S. modestum*, *S. terminatum*, *Stenacron interpunctatum*, *S. pallidum*, *Heptagenia marginalis*, and *Leucrocuta aphrodite*.

With the discovery of *S. lenati*, there are now four species of *Stenonema* known to

have highly restricted distributions and what appear to be highly restricted ecological requirements. The other three are *S. bednariki*, *S. carlsoni*, and *S. sinclairi*. All of these are clean-water species (Lewis 1974, 1979, McCafferty 1981) and may be in jeopardy of survival because of narrow ecological tolerances. Of the four, only *S. lenati* is found in large rivers, the others occurring in smaller streams.

Collections of *S. lenati* larvae were made in March, May, and August. Only the March collections included mature individuals with darkened wingpads. May and August samples contained predominantly middle instar larvae and no mature individuals. While such data suggest an early spring emergence and possibly suggest another mid-summer emergence, data are too limited to draw definite conclusions about voltinism and other aspects of phenology at this time.

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