



THREE NEW SPECIES OF *PERLESTA* (PLECOPTERA: PERLIDAE) FROM EASTERN NORTH AMERICA AND NOTES ON NEW STATE RECORDS

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ABSTRACT

Three new species of the Nearctic Perlidae genus *Perlesta* are described from North Carolina and Virginia, USA. *Perlesta leathermani* sp. n. is described from Hoke/Moore County, North Carolina, *P. bjostadi*, sp. n. from the Harnett/Cumberland Co., North Carolina, and *P. cranshawi* sp. n. is described from Sussex Co., Virginia. The adult male, adult female, and egg are described and illustrated for *P. leathermani* and *P. cranshawi*, and the adult male and adult female for *P. bjostadi*. Three new state records for North Carolina are also reported, *P. puttmanni* Kondratieff and Kirchner, *P. roblei* Kondratieff and Kirchner and *Perlinella zwicki* Kondratieff, Kirchner, and Stewart.

Keywords: Plecoptera, Perlidae, *Perlesta*, *Perlinella*, new species, new state records, Nearctic, North Carolina, Virginia

INTRODUCTION

Stark (2004) provided an excellent review of the 22 species of *Perlesta* now recognized in North America. Recent collecting in North Carolina and Virginia revealed an additional three new species, which are described below. Unfortunately, the egg of one species is unknown, but the male paraprocts are so distinctive that a description is warranted. The descriptive terminology for the adults follows Stark (1989) and Stark (2004).

Perlesta leathermani, sp. n.

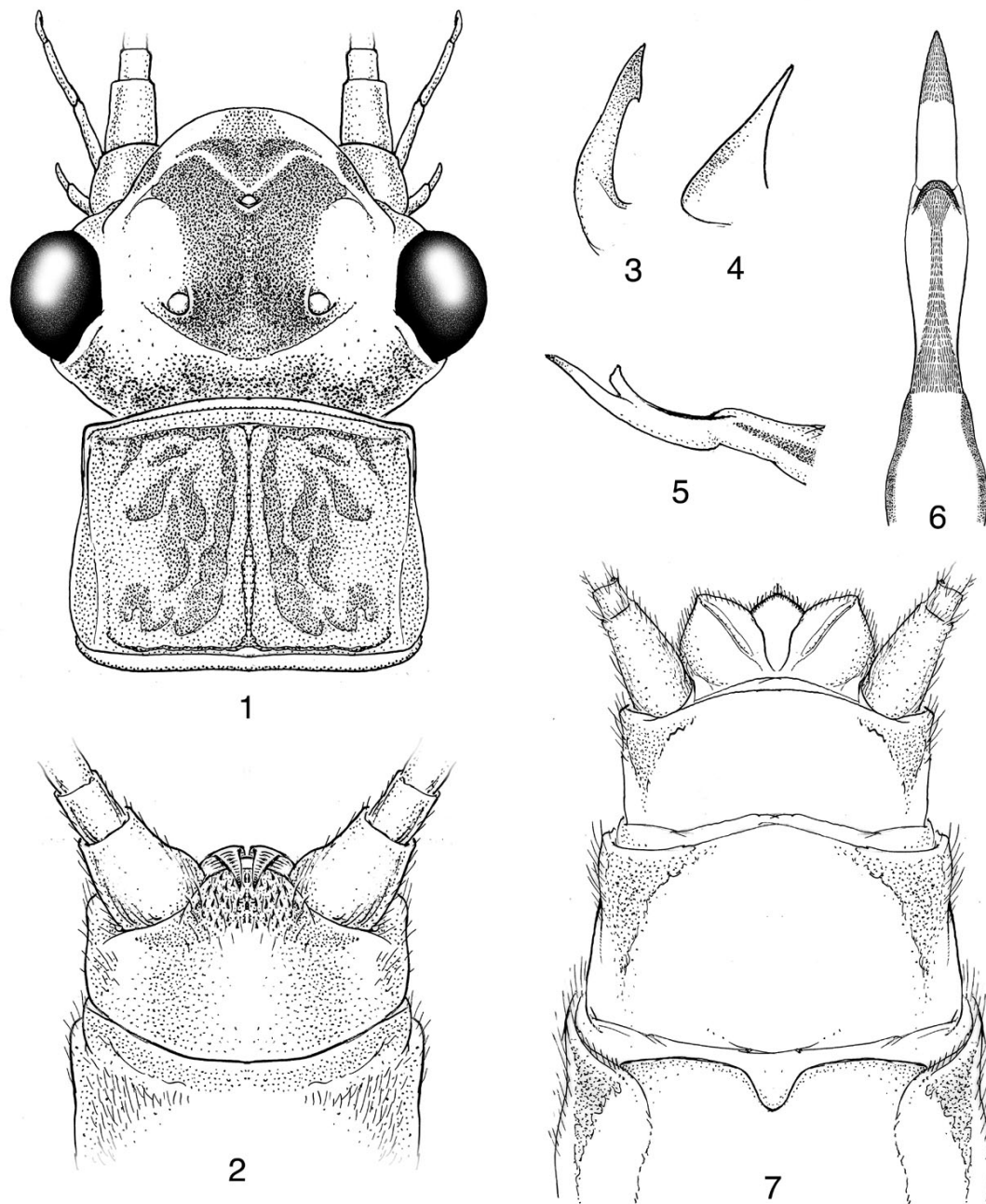
Kondratieff & Zuellig (Figs. 1-8).

Material examined. Holotype ♂ and 48 ♂, 24 ♀ paratypes from NORTH CAROLINA: Hoke/Moore Co., Little River, Morrison Bridge Road, East of Southern Pines, N 35°11'31" W 079°11'01", 18 May 2004, B. Kondratieff, R. Kirchner, R. E. Zuellig, and D.

Lenat.

The holotype is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D. C. Paratypes will be deposited at the following museums and individual collections: Bill P. Stark, Clinton, Mississippi (BPSC), C. P. Gillette Museum of Arthropod Diversity, Colorado State University (CSUC), and Ralph F. Kirchner (RFKC), Huntington, West Virginia.

Male. Forewing length 8 - 9 mm. Head yellow with a large black to brown ocellar patch and large diffuse dark spot anterior to patch, epicranial suture arms extending well beyond ocelli as a distinct dark line, prothorax brown (Fig. 1). Wing membrane and veins brown except for pale costal margin. Femora dorsally brown, proximally and distally yellow, tibiae brown basally, yellow apically. Abdominal terga yellow with transverse brown bands on terga 1-9, brown coloration diffuse on terga 1-3; sterna yellow. Cercus yellow



Figs. 1-7. *Perlesta leathermani*. 1, Adult head and pronotum. 2, Male terminalia, dorsal. 3, Paraproct, lateral. 4, Paraproct caudal. 5, Penis, lateral. 6, Penis, dorsal. 7, Female subgenital plate, ventral.

basally, distal segments brown. Tergum 10 mesal sclerite brown, sensilla basiconica patch distinct, not elevated into patches, also with long hairs (Fig. 2). Paraproct short, stout, broad at base, with a prominent subapical mesad directed tooth (Fig. 3), in caudal view

long and narrowly acute at tip, tooth not visible (Fig. 4). Penis tube + sac long, caecum prominent, longer than wide, lateral sclerite prominent, dorsal patch narrower medially, expanded basally, and slightly apically (Figs. 5 & 6).

Female. Forewing length 11 - 12 mm. Color pattern similar to male but paler. Subgenital plate lobes short, truncate and separated by a deep U to V-shaped notch (Fig. 7).

Egg. Oval. Collar buttonlike. Chorion slightly pitted, micropylar orifices distinct (Fig. 8).

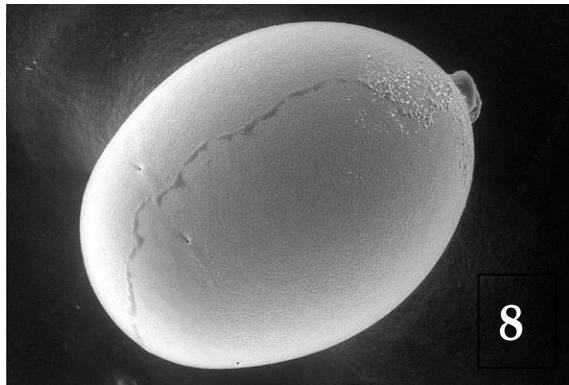


Fig. 8. *Perlesta leathermani*. Scanning electron photomicrograph of entire egg, 262 x.

Larva. Unknown.

Diagnosis. Males of *P. leathermani* will key in Stark (2004) to those species that have the epicranial suture arms that extend well beyond the ocelli as a distinct dark line (Fig. 1), and the adult head is largely dark brown ending at couplet 6, which includes *P. xube* Stark and Rhodes and *P. cinctipes* (Banks). The dorsal aedeagus patch is more similar to *P. cinctipes* (see Stark 2004, Fig. 7.300), but the dorsal patch of the aedeagus of *P. leathermani* is clearly expanded basally (Fig. 6). The lobes of the subgenital plate of the female of *P. leathermani* are short, truncate, and separated by a deep V-shaped notch (Fig. 7); whereas the subgenital plate of *P. cinctipes* has the lobes rounded (see Stark 2004, Fig. 7.377). The egg of *P. leathermani* is slightly pitted and lacks a micropylar ring. Additionally, the currently known geographic range of *P. cinctipes* is Midwestern including Arkansas and Oklahoma (Stark 2004).

Remarks. The (Lower) Little River comprises Cape Fear Subbasin 14 (<http://www.esb.enr.state.nc.us/bar.html>). The upper portion in Moore County (and running along the Moore/Hoke county line) is located in the Sandhills ecoregion (Griffith et al. 2002) and it is designated by the state of North Carolina (NC) as High Quality Waters (NCDENR

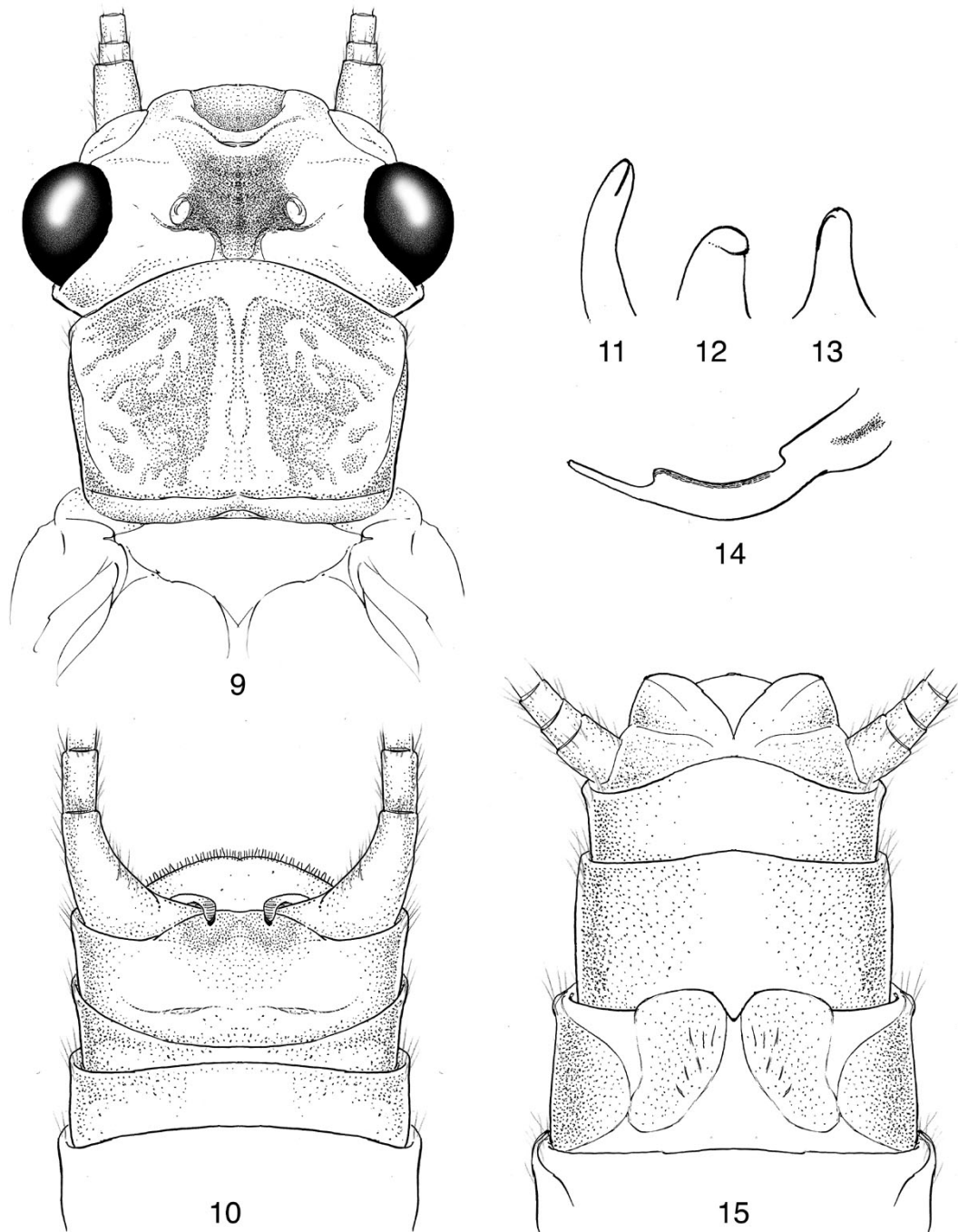
2004). Except for some problems following a drought in 2002, a site near the Morrison Bridge has been consistently rated as Excellent by NC Department Environment and Natural Resources (NCDENR) based on benthic macroinvertebrate community samples.

Mean width of the Lower Little River in this area is about 15 m. The substrate is mostly sand and gravel, although important habitats also include bank areas, snags, and leaf packs. The water is humic-colored, with median pH values of 5.8 and minimum pH values < 5.0. Median specific conductance has been about 35 umhos/cm (NCDENR, 2004) with no documented water quality problems.

Collections of both immature and adult aquatic insects at this site have documented a high diversity of "EPT" (Ephemeroptera/Plecoptera/Trichoptera) species. Many rare benthic macroinvertebrates have been recorded at this site, potentially making it one of the most important conservation areas in NC (NC Natural Heritage Program, in preparation). Rare stoneflies collected at the Morrison bridge site include *Haploperla fleeki* Kondratieff and Kirchner (type locality, Kondratieff et al. 2005) and the recently described *Alloperla lenati* Kondratieff and Kirchner (Kondratieff and Kirchner 2004). Additional stonefly species collected concurrently included *Acroneuria abnormis* (Newman), *Perlinella zwicki* Kondratieff, Kirchner, and Stewart (1 ♂, representing a new state record for North Carolina; Kondratieff et al. 1995), *P. ephyre* (Newman), *Neoperla clymene* (Newman), and at least one undescribed species of *Isoperla*. Adult caddisflies (Trichoptera) also were collected by the authors at this site, with identifications done by David Ruiter, Centennial, Colorado. These data include at least eight caddisfly species not previously listed as occurring in NC (Lenat, unpublished data).

The Fort Bragg Military Reservation provides protection of the area immediately adjacent to the Morrison Bridge site, but the upstream area near Southern Pines and the US 1 corridor is rapidly developing. Preservation of this portion of the Little River will be dependent on controlling both point and nonpoint sources of pollution.

Etymology. The patronym honors David A. Leatherman, a truly consummate naturalist, expert entomologist, and good friend to the senior author.



Figs. 9-15. *Perlesta bjostadi*. 9, Adult head and pronotum. 10, Male terminalia, dorsal. 11, Paraproct, lateral. 12, Paraproct tip, lateral. 13, Paraproct caudal, 14, Penis, 15, Subgenital plate, ventral.

Perlesta bjostadi, sp. n.

Kondratieff and Lenat (Figs. 9-15).

Material examined. Holotype: ♂ and 5 ♂, 19 ♀ paratypes, North Carolina: Harnett/Cumberland County, Little River, Hwy 401, South of Lillington, N 35°15'44", W 078°46'38", 18 May 2004, B. Kondratieff, R. Kirchner, R.E. Zuellig, and D. Lenat.

The holotype is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Paratypes are deposited in the following museums and individual collections: Bill P. Stark, Clinton, Mississippi (BPSC); and the C.P. Gillette Museum of Arthropod Diversity, Colorado State University (CSUC).

Male. Forewing length 8 - 9 mm. General body color light yellow brown. Head yellow except for brown quadrangular area over ocelli, and small brown triangular area forward of median ocellus, prothorax brown (Fig. 9). Wings light amber, veins brown. Femora dusky brown dorsally. Tergum 10 mesal sclerite light brown, not divided, sensilla basiconica sparse to absent (Fig. 10). Paraproct short, stout, broad at base, without a developed tooth, with a distinct apical carina (Fig. 11-12), in caudal view, short and rounded apically (Fig. 13). Penis tube + sac long, caecum prominent, as long as wide, lateral sclerite weakly developed, dorsal patch narrow; small nipple at the base of sac (Fig. 14).

Female. Forewing length 9 - 11 mm. Subgenital plate with short broad rounded lobes separated by shallow triangular notch (Fig. 15).

Egg. Unknown.

Larva. Unknown.

Diagnosis. In Stark (2004) male specimens of *P. bjostadi* will key to couplet 16 which ends in *P. golconda* DeWalt and Stark and *P. lagoi* Stark, however, the unique paraprocts of *P. bjostadi*, lacking a prominent subapical or antepical tooth will easily distinguish it from these two species. The aedeagus of *P. bjostadi* is similar to *P. golconda*, both species having a small nipple at the base of the sac (Fig. 14). Unfortunately, no eggs were available for study.

Remarks. This downstream portion of the Lower Little River is also in Cape Fear subbasin 14 (<http://www.esb.enr.state.nc.us/bar.html>) and located in the Sandhills ecoregion (Griffith et al. 2004, Kondratieff et al. 2005). There is no water chemistry

data collected at the Hwy 410 site, but there is a NC monitoring station at Hwy 210, about 24 km upstream. Relative to the Morrison Bridge site (discussed under *P. leathermani* section), this part of the river is much larger (mean width 25-30 m) with slightly higher pH (median = 6.3), higher specific conductance (median = 47 umhos/cm) and higher nutrient values (NCDENR 2004). Both the higher nutrients and reduced shading produce prolific periphyton growths during the summer, although this site has consistently been rated as Excellent by NCDENR based on the macroinvertebrate community. Like the Morrison Bridge site, the Hwy 410 site has a sand and gravel substrate with humic-colored water. While collecting *P. bjostadi* specimens, the authors also collected males and females of *P. puttmanni* Kondratieff and Kirchner (6 ♂, 3 ♀) a new state record for NC (Kondratieff et al. 1995). Additionally, *A. abnormis*, *Helopicus bogaloosa* Stark and Ray, *P. ephyre*, *P. zwicki*, *N. chlymene*, *Paragnetina fumosa* (Banks), and *A. lenati* were collected concurrently.

Etymology. We honor Dr. Louis Bjostad, Professor of Entomology, Colorado State University. Lou is a devoted colleague and a remarkable scientist.

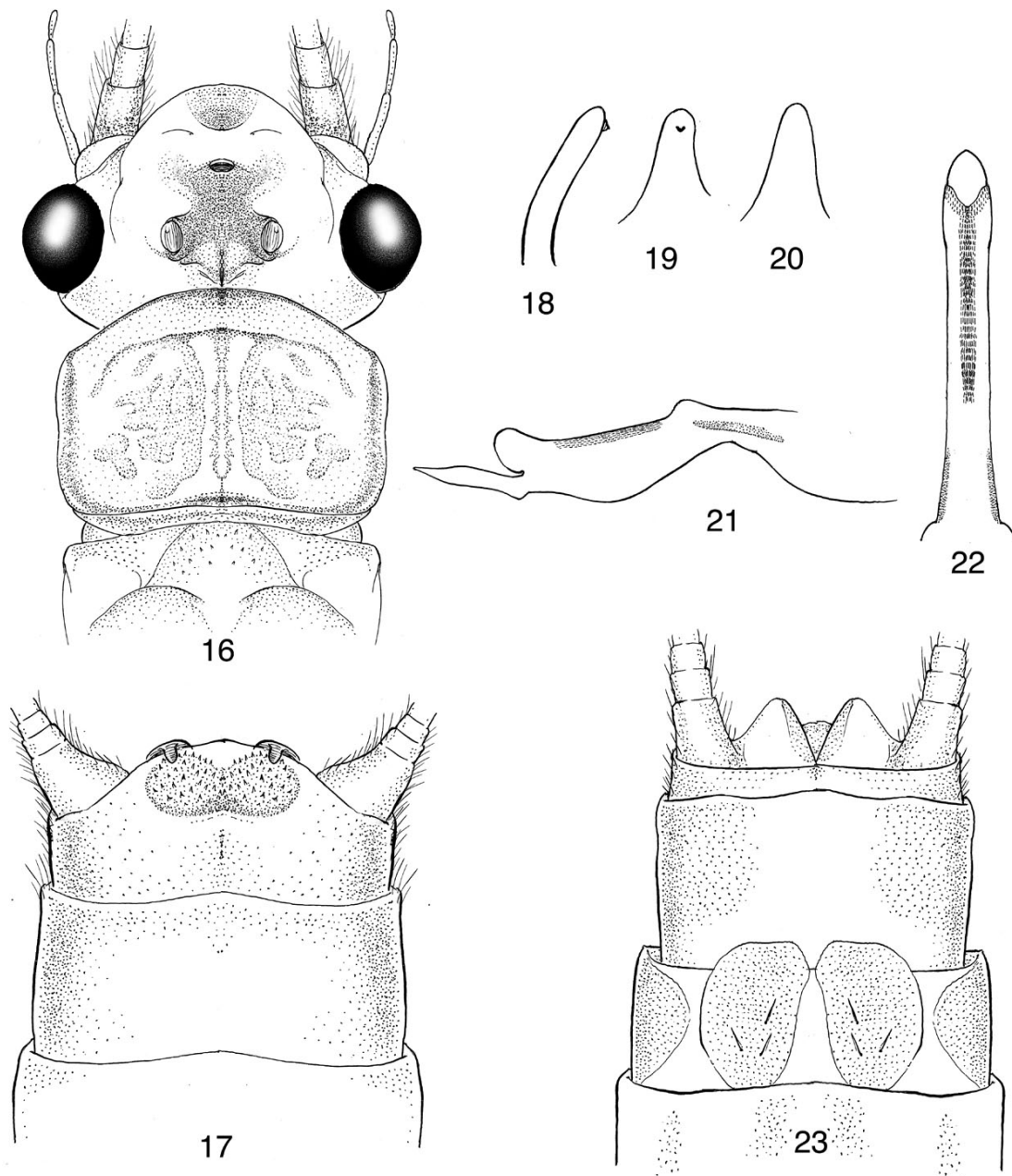
Perlesta cranshawii, sp. n.

Kondratieff and Kirchner (Figs.16-24).

Material examined. Holotype ♂ and 20 ♂, 15 ♀ paratypes, VIRGINIA: Sussex Co., Nottoway River, Nottoway River Road, CR 651, N Emporia, N 36°50'49", W 077°33'36", 19 May 2004, B.C. Kondratieff, R.F. Kirchner, and R.E. Zuellig.

The holotype is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D. C. Paratypes will be deposited at the following museums and individual collections: Bill P. Stark, Clinton, Mississippi (BPSC), and the C.P. Gillette Museum of Arthropod Diversity, Colorado State University (CSUC).

Male. Forewing length 8 - 9 mm. General body color pale yellow. Head pale yellow except for brown quadrangular patch over ocelli, diffuse darker area anterior to patch; pronotal brown rugosities forming a distinctive pattern (Fig. 16). Femora with dusky brown dorsal band. Wings hyaline, veins brown, costal margin pale. Tergum 10 mesal sclerite



Figs. 16-23. *Perlesta cranshawi*. 16, Adult head and pronotum. 17, Male terminalia, dorsal. 18, Paraproct, lateral. 19, Paraproct ventral. 20, Paraproct caudal, 21, Penis, lateral. 22, Penis, dorsal. 23, Subgenital plate, ventral.

light brown, not divided, sensilla basiconica distinct but small, not elevated into patches (Fig. 17). Paraproct short, with small subapical tooth (Figs. 18-19), not visible in caudal view (Fig. 20); in lateral

view, paraproct appearing narrow (Fig. 18). Penis tube + sac long, caecum prominent, 2x as wide as long, lateral sclerite not prominent, dorsal patch of the aedeagus a narrow parallel band enveloping the

caecum (Figs. 21-22).

Female. Forewing length 9 - 11mm. Subgenital plate with short broad lobes separated by deep wide V-shaped notch (Fig. 23).

Egg. Oval. Collar stalked, short, not wide. Chorion smooth (Fig. 24).

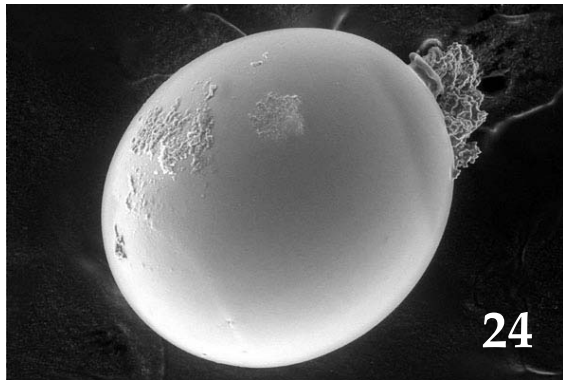


Fig. 24. *Perlesta cranshawi*. Scanning electron photograph of entire egg, 265x.

Larva. Unknown.

Diagnosis. The distinctive color pattern and hyaline wings with brown veins of *P. cranshawi* easily distinguishes both the male and female from all other described *Perlesta*, except *P. frisoni* Banks and *P. nelsoni* Stark. In the males, *P. frisoni* has the sensilla basiconica concentrated into two circular patches on tergum 10, and in *P. nelsoni* the penis + sac is long and slender lacking a caecum. Additionally, the paraprocts of the male of *P. cranshawi* are distinctive, closest to *P. nitida* Banks, but readily separable by the narrow lateral appearance (Fig. 18). In Stark (2004), the male of *P. cranshawi* will key to couplet 12, which ends in *P. puttmanni* and *P. decipiens* (Walsh); however, the paraprocts of *P. cranshawi* are distinctly different as described above. The female of *P. cranshawi* will key to couplet 10 (venation is as dark as *P. frisoni*) in Stark (2004), the egg being similar to *P. nelsoni*, but can be distinguished by darker wing venation and distinctively marked head and pronotum (Fig. 16).

Remarks. The Nottoway River is a major tributary of Chowan River system that flows into the Albemarle Sound in North Carolina. It originates on the Outer Piedmont Plateau Province of Virginia near Scholfield, Prince Edward County. At the type

location, down stream of "Double Bridge" and just upstream of the Fall Line, the Nottoway River has fast-flowing water with outcroppings of bedrock, riffles with large boulders, cobble, and shifting sand. The mean stream width at the site is about 37 m. Additionally, *A. abnormis*, *A. arenosa* (Pictet), *A. arida* (Hagen), *P. fumosa*, *Agnetina flavescens* (Walsh), and *Pteronarcys dorsata* (Say) were collected concurrently.

Perlesta roblei Kondratieff and Kirchner, a species originally described from Middlesex Co. on the Coastal Plain of Virginia, was collected in North Carolina from Edgecombe Co., Swift Creek, Seven Bridges Road, East of Rocky Mount (N 36°03'31" W 077°40'50"), 18 May 2004, B. Kondratieff, R.F. Kirchner, and R.E. Zuellig.

Etymology. The patronym honors Dr. Whitney Cranshaw, Professor of Entomology, Colorado State University, a remarkable entomologist and truly a friend to the senior author.

DISSCUSION

Taxonomy can be perceived as a fairly dry endeavor, replete with wing venation, paraprocts and subgenital plates. However, it can have a very direct connection to the management of our natural resources. This paper, combined with earlier investigations by the authors in the NC Sandhills (Kondratieff and Kirchner 2004, Kondratieff et al. 2005, and unpublished data), can provide some guidance to environmental managers on how to best protect aquatic communities in the Sandhills ecoregion (Griffith et al. 2002). Our conclusions are based on annual spring collections of aquatic insects (2003-2006), with emphasis on adult Plecoptera (stoneflies). Studying the distribution of stonefly species, especially in the genera *Perlesta*, *Isoperla* (unpublished work), *Alloperla* and *Perlinella*, make it apparent that the Sandhills ecoregion cannot be viewed as a homogeneous unit. Differences are apparent both between different drainage basins and between different size streams. The two *Perlesta* described here from the Lower Little River in the northern part of the NC Sandhills have not been found in the southern part of this NC ecoregion. Likewise, we observed some species that were found only in larger rivers (*P. bjostadi*, *P. zwicki*) and some species that were found only in smaller streams (*P. leathermani*, *Isoperla* n. sp.). Based on these findings,

the protection of aquatic diversity in the Sandhills will require undisturbed areas that include streams of different sizes that occur in several different parts of the ecoregion.

ACKNOWLEDGMENTS

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REFERENCES

Kondratieff, B.C. & R.F. Kirchner. 2004. *Alloperla lenati*, a new species of stonefly from North Carolina (Plecoptera: Chloroperlidae) and two new state records (Plecoptera: Perlodidae). *Annals of the Entomological Society of America*, 97:361-363.

Kondratieff, B.C., R.F. Kirchner, & D.R. Lenat. 1995. A review of stonefly records (Plecoptera: Hexapoda) of North Carolina and South Carolina. *Brimleyana*, 23:25-40.

Kondratieff, B.C., R.F. Kirchner, & D.R. Lenat. 2005. Two new species of *Haploperla* Navás (Plecoptera: Chloroperlidae) from North Carolina, U.S.A. *Proceedings of the Entomological Society of Washington*, 107:859-863.

Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Shafale, W.H. McNab, D.R. Lenat, J.B. Glover, & V.B. Shelburne. 2002. Ecoregions of North Carolina and South Carolina. U.S. Geological Survey (poster).

North Carolina Dept Environment and Natural Resources (NCDENR). 2004. Basinwide Assessment Report, Cape Fear River Basin.

Stark, B.P. 1989. *Perlesta placida* (Hagen), an eastern nearctic species complex (Plecoptera: Perlidae). *Entomologica Scandinavica*, 20:263-286.

Stark, B.P. 2004. Perlidae (The Stones). Pages 61-148. *In* Stark, B.P. & B.J. Armitage, editors. Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin New Series Volume 14. Columbus. 192 pp.

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