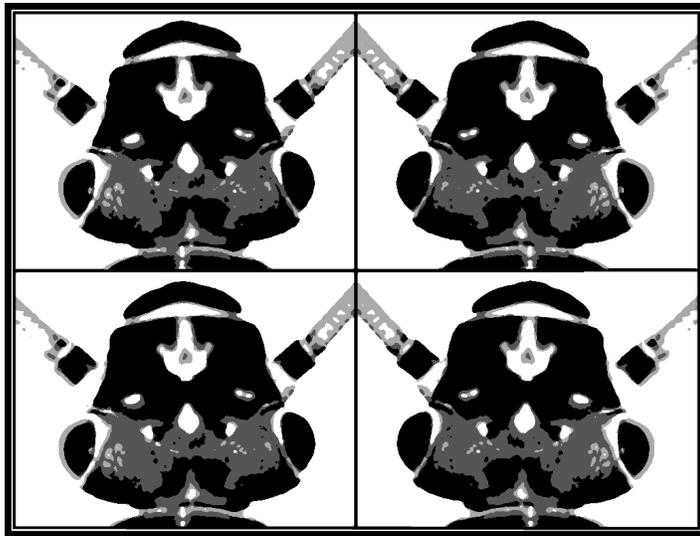


The
P L E C O P T E R A
of North Carolina



Isoperla sp. A

**A Biologist's Handbook with
Standard Taxonomic Effort Levels**

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Division of Water Quality
North Carolina Department of Environment and Natural Resources**

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Families and genera of known Plecoptera occurring in North Carolina

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Introduction

The Order Plecoptera occurring in North Carolina consists of a total of 9 families, 46 genera and 144 species. Stoneflies occur in almost all flowing waters of North Carolina with an abundance particularly in cool streams and rivers in the Piedmont and Mountains. Like other aquatic insects, stoneflies are an important link in trophic interactions and serving as both predator and prey to other macroinvertebrates, fish, and birds. Stoneflies are also important economically, not as pests but as a universally utilized bait for sportsmen angling for trout, bass and other sport fishes. Also, stoneflies are among the most intolerant insects occurring in aquatic habitats. Many stonefly species disappear from aquatic systems before any other group of insects, including other intolerant orders such as mayflies (Ephemeroptera) and caddisflies (Trichoptera). Because larval stoneflies (among others) reflect the general health of streams and rivers, they are important diagnostic insects in water quality programs across the United States and the world. Whether attributable to reduced habitat, degraded water quality, or increased water temperatures and reduced flows caused by climate changes, the disappearance of stoneflies from some State waters is occurring at an increasing rate. Aside from their usefulness in determining water quality, Plecoptera are exceedingly interesting and exhibit innumerable fascinating behaviors and life histories. Unfortunately, as a complication to identification, many stoneflies are unknown or undescribed in the larval stage. With the continued degradation of North Carolina streams and with the threat of extirpation of some stoneflies from local waters, it will become increasingly difficult to associate and describe larval stoneflies with their adult counterparts.

North Carolina's Division of Water Quality Biological Assessment Unit (BAU) has one of the most rigorous macroinvertebrate sampling protocols in the nation and has over 30 years of long-term data on many North Carolina water bodies. Most large rivers and streams have been sampled extensively over this 30-year period, with many small headwater streams inventoried as well, resulting in over 6600 site records. This has yielded the discovery of several new stonefly species from within the state, many of which are endemic to North Carolina. A few of these recently discovered species are named in honor of BAU biologists. It is our hope that protections to our state's waters will facilitate the discovery of even more species, help associate life stages of existing species, and protect those species which are vulnerable to habitat loss and water degradation.

This document was created to help North Carolina Division of Water Quality biologists as well as biologists in independent labs identify the mayfly taxa present in local North Carolina waters and to stay current on recent taxonomic changes (e.g. synonymies). There are, however, NO keys in this document (although many keys were consulted to generate taxa descriptions). This manual also provides information about mayfly distributions within North Carolina's Level III ecoregions (BAU has historically recognized three Level III ecoregions: Mountains, Piedmont, and Coastal Plain) with some mention of taxonomically important Level IV ecoregions as well (Sand Hills, etc.). Maintaining a consistent level of taxonomic resolution is important for rigorous and defensible data sets and reproducible results between laboratories, therefore the suggested level of taxonomic resolution for each genus is noted. In the document's appendix table the tolerance value of each species, when appropriate, is also presented. Comparative material of related species is important to have while identifying aquatic insects; therefore a reference collection is maintained in-house. Notes on the absence or type of reference specimens for many taxa are included in the appendix as a way to update and improve the voucher collection stored at NC DWQ's Environmental Sciences Section laboratory.

How to Use this Manual

The target users of this manual are taxonomic workers in North Carolina and surrounding states. It is therefore assumed that the user has some basic knowledge of stoneflies including taxonomy, morphology, and life histories. Users not acquainted with these organisms are advised to familiarize themselves with the first eight chapters of *An Introduction to the Aquatic Insects of North America* (Merritt *et al*, 2008) which describes, to name a few, sampling techniques, ecology, and morphology of aquatic insects. Also, *Nymphs of North American Stonefly Genera (Plecoptera)* (Stewart and Stark, 2002) is unsurpassed in both information as well as quality of illustrations of all genera of stonefly nymphs occurring the North America. This document is not intended as an exhaustive resource of stoneflies occurring within North Carolina. Instead, it should be used in conjunction with other literature and be considered more of a quality control document. The user assumes all risk and responsibility in taxonomic determinations made in conjunction with this manual.

The stonefly taxa documented herein are presented in phylogenetic order based on that of Merritt *et al* (2008). Genera within each family or subfamily are presented in alphabetical order. Along with primary literature, valid genus/species names were verified using the Plecoptera Society of North America web page (<http://plsa.inhs.uiuc.edu/plecoptera>), and Plecoptera Species File Online (<http://plecoptera.speciesfile.org>). Taxonomic names used herein are valid as of mid-2011 unless otherwise noted.

Each genus has an accompanying diagnosis for the aquatic larval stage only with the primary characters for each genus *italicized*. The order in which the identification characters are listed typically follows that of the anterior regions to the posterior regions (head to tail). Distributional and general habitat notes are included with each genus. The suggested level of taxonomic resolution is noted which represents the operational taxonomic unit (OTU) used by NCDWQ biologists. This is followed by a list of species known to occur in or around North Carolina. If the genus in question is to be identified to species, a list of species characteristics is given unless only one species is present in North Carolina or it is a monotypic genus. Some genera that are not identifiable to the species level have species notes included for reference and are provisional only. A “Notes” section follows with comments on taxonomic difficulties, synonymies, or special status. Finally, a list of literature finishes each genus section with suggested keys denoted by an arrow (⇒). Additional literature for adults is presented to facilitate identifications when biologists have associated material. While most literature is on the BAU server, grayed out literature is not currently available. Many of the references are duplicated from genus to genus for convenience.

One final caveat: Typically, as with most published taxonomic descriptions, those presented here are often based on a series of mature specimens as well as available published literature. However, as variation among individuals and between populations is frequent in many insects, not every specimen will fit the appropriate description, particularly those that are damaged or immature. Those situations may be times when the specimen in question is best left at genus. Often, ecoregion or seasonality data, in conjunction with the description may be helpful to verify the identity of the taxon. Other times the opinion of another taxonomist is needed. Sometimes it is prudent to simply take your losses and move on to the next specimen.

Additional symbols used with taxonomic nomenclature in this document are as follows:

() = published records for North Carolina but no BAU larval records, or is undescribed

* = no published records for North Carolina but may eventually be found.

Species names in grey have been synonymized or combined with other species but are still recognized by BAU.

A list of general taxonomic literature that may also be useful as well as regional checklists follows the taxonomic entries. Finally, an appendix table with list of species (alphabetical on Family then Genus then species), associated distributional and tolerance data, number of DWQ- BAU records, available reference specimens and important notes follows at the end of the manual.

CAPNIIDAE

Allocapnia

Genus Diagnosis: Nymphs ~ 5-10 mm; labial palpi do not extend beyond labium; *inner margin of hind wings pads unnotched or notched apically, sometimes reduced*; abdomen elongate and cylindrical, usually with segments 5 or 6-8 wider than anterior segments (i.e. not parallel sided); *all nine abdominal segments with pleural fold*; abdominal terga with posterior setal fringe; *cercal segments without intercalary hairs*; body hair inconspicuous.

Habitat: Nymphs prefer leaf packs during active their growing stage in the fall and winter and many species may diapause in the hyporheic zone during the summer. Detritivorous (shredders).

Distribution and Occurrence: Primarily Mountain and Piedmont ecoregions. Common late fall through winter.

Species in NC: LEAVE AT GENUS – (*aurora*), (*fumosa*), (*nivicola*), (*recta*), (*rickeri*), (*stannardi*), (*virginiana*), (*wrayi*)

Notes: There are at least eight species of *Allocapnia* in North Carolina many of which are undescribed as nymphs. Spring and summer records of *Allocapnia* are most likely misidentifications *Leuctra*. *Allocapnia fumosa* is listed as “vulnerable to extirpation” by Morse *et al.* (1997). *Allocapnia* generally have fast univoltine life cycles.

Taxonomic references:

nymphs:

Harper, P. P. and H. B. N. Hynes. 1971. The Capniidae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 921-940.

adults:

Ross, H. H. and W. E. Ricker. 1971. The classification, evolution, and dispersal of the winter stonefly genus *Allocapnia*. Illinois Biological Monograph 45.

Nemocapnia

Genus Diagnosis: Nymphs 5-7 mm; purplish-brown reticulations on head, most conspicuous within ocellar triangle; *hind wing pads notched medially*; *cerci with vertical hair fringe*.

Habitat: Gravel and detritus in areas of faster flows of smaller streams. Nymphs may diapause in the hyporheic zone during the summer and fall. Possibly Detritivorous (shredders).

Distribution and Occurrence: Nymphs occur January through February but are rarely collected.

Species in NC: MONOTYPIC – *carolina*

Notes: Little is known about the habitat requirements or the life history for *Nemocapnia carolina* and few habitat references could be found in the primary literature. The above habitat information is general information that pertains to many members of the Capniidae. NCDWQ BAU has one Sand Hills record from Jackson Creek in Moore County (1989).

Taxonomic references:

nymphs and adults:

⇒ Harper, P. P. and H. B. N. Hynes. 1971. The Capniidae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 921-940.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

Paracapnia

Genus Diagnosis: Nymphs 6-8 mm; purplish-brown reticulate color pattern on head; *cerci with apical circlet of hairs and with, at most, 1 short dorsal and 2 ventral intercalary hairs*; *setose body*.

Habitat: Nymphs typically occur in small headwater streams, possibly in leaf packs. Detritivorous (shredders).

Distribution and Occurrence: Nymphs are collected late fall through mid-winter in the Mountains only.

Species in NC: TAKE TO SPECIES – *angulata*

P. angulata – middle and distal segments of cerci each with one long intermediate hair on ventral surface near the base; setae on inner surface of tibia short, only half as long as width of tibia.

Notes: *Paracapnia angulata* is the only species of *Paracapnia* in the southeastern United States. *Paracapnia opis* has a much more northerly distribution. *Paracapnia* have univoltine life cycles.

Taxonomic references:

nymphs and adults:

Harper, P.P. and H.B.N. Hynes. 1971. The Capniidae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 921-940.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

Stark, B. P. and R. W. Baumann. 2004. The winter stonefly genus *Paracapnia* (Plecoptera: Capniidae). Monograph of the Western North American Naturalist. 2: 96-108.

LEUCTRIDAE

Leuctra

Genus Diagnosis: Nymphs 6-9 mm; labial palpi extend past rest of labium; hind wing pad longer than its greatest width; *first four abdominal sternites with pleural folds*; abdomen parallel sided; *pair of terminal setae on lobe of last abdominal segment*.

Habitat: Nymphs occur in small streams to larger rivers, often in sandy or gravelly areas but also on cobbles in riffles. Detritivorous (shredders).

Distribution and Occurrence: Widespread and very common during the spring and summer.

Species in NC: LEAVE AT GENUS – (*alexanderi*), (*biloba*), (*carolinensis*), (*ferruginea*), (*grandis*), *maria**, (*mitchellensis*), *moha**, (*monticola*), (*nephophila*), (*sibleyi*), *tenella**, *tenuis**, (*triloba*), *truncata**, *variabilis**

Notes: North Carolina has at least ten species of *Leuctra*. Species determinations are not recommended as the nymphs of many species are still undescribed. *Leuctra maria*, *L. tenella*, *L. tenuis*, *L. truncata*, and *L. variabilis* have been recorded from Great Smoky Mountain National Park (GSMNP). Some species of *Leuctra* may be semivoltine in smaller streams and univoltine in larger, warmer rivers.

Taxonomic references:

nymphs and adults:

Harper, P. P. and H. B. N. Hynes. 1971. The Leuctridae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 915-920.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp. **NOTE: keys 8 species of which only 3 occur in NC. **

Megaleuctra

Genus Diagnosis: *Large, stout, nymphs 15-20 mm*; males have characteristic 10th tergum composed of fused paraprocts forming a long, caudal projection, body setose, with dense covering of surface hair.

Habitat: Nymphs are found in leaf matter that has a thin cover of flowing water within high elevations headwaters, springs and seeps. Detritivorous (shredders).

Distribution and Occurrence: High elevation Mountains only. Rare.

Species in NC: TAKE TO SPECIES – *williamsae*

Notes: *Megaleuctra williamsae* is the only known species in North Carolina and has been collected by BAU only from Beech Flats Prong in GSMNP, although there are other non-BAU records (B. Kondratieff *et al.*). The life history and habits of *Megaleuctra williamsae* are unknown. Listed by both the NC Natural Heritage Program as Significantly Rare (2010) and by Morse *et al.* (1997) as “vulnerable to extirpation”.

Taxonomic references:

nymphs and adults:

none

(*Paraleuctra*)

Genus Diagnosis: Nymphs 6-9 mm; labial palpi short; mesosternal Y-arms with double stem; *first six abdominal segments with pleural fold*; *abdominal hairs sparse*; body typically patterned.

Habitat: Unknown. Pre-emergent nymphs are hyporheic. Possibly detritivorous (shredders).

Distribution and Occurrence: Nymphs should be collected late winter through early spring in the Mountains

Species in NC: TAKE TO SPECIES – (*sara*)

Notes: *Paraleuctra sara* is only species in eastern North America and has been recorded from GSMNP. Adult *P. sara* were collected in 2010 from Little Bear Creek in Mitchell County, NC. The BAU reference specimen (nymph) is from an outside collection and unknown location in Haywood County (1988). There are no published life history studies on *Paraleuctra*.

Taxonomic references:

nymphs and adults:

Harper, P. P. and H. B. N. Hynes. 1971. The Leuctridae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 915-920.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

Stark, B. P. & J. W. Kyzar. 2000. Systematics of Nearctic *Paraleuctra* with description of a new genus (Plecoptera: Leuctridae). – Tijdschrift voor Entomologie 144: 119-135.

NEMOURIDAE

Amphinemura

Genus Diagnosis: Nymphs 5-8 mm; pro- and mesonotum well fringed by short, stout setae; *four anterior thoracic gill clusters, consisting of two lateral pairs each with each cluster of five or more equal length branches, present ventrally in the prosternal region.*

Habitat: In both small, headwater streams and larger streams and rivers (may be species specific); detritivorous (shedders and facultative collectors).

Distribution and Occurrence: *Amphinemura* nymphs are typically collected winter through spring with a diapause during summer and emergence in the fall. Widespread, though less common in the Coastal Plain.

Species in NC: LEAVE AT GENUS – (*appalachia*), *delosa**, (*nigritta*), (*wui*)

Notes: The four above *Amphinemura* species have been recorded from GSMNP. Male and female adults of *A. appalachia* are described in Baumann (1996) although the nymphs are not described. BAU records of *A. delosa* nymphs may be erroneous as there are no documented adult records in North Carolina. Records of *A. delosa* from GSMNP do not report which state (TN or NC) the specimens were obtained from. Univoltine. A nymphal key to the eastern species of *Amphinemura* is currently in preparation by B. P. Stark.

Taxonomic references:

nymphs and adults:

Baumann, R. W. 1996. Three species of *Amphinemura* (Plecoptera: Nemouridae) from eastern North America. *Entomological News* 107(5) 249-254.

adults only

Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). *Canadian Journal of Zoology*. 49: 1129-1142.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. *Bulletin of the State Geological and Natural History Survey of Connecticut*. 107. vi + 262 pp.

(Ostrocerca)

Genus Diagnosis: Nymphs 5-7 mm; *pronotum with an irregular lateral fringe of moderate spines; anterior thoracic gills absent; fore tibia with two rows of large, heavy bristles along outer margins and a sparse fringe of silky hairs; ventral bristles of cercal whorls of apical segments longer than other bristles; tenth tergite of male extended and apically cleft.*

Habitat: Found in springs and small, cold headwater streams; in gravel and leaf packs. Detritivorous (shredders).

Distribution and Occurrence: A spring emergent taxon. Mountains only. Nymphs are rarely collected.

Species in NC: LEAVE AT GENUS (if collected) – (*albidipennis*), *complexa**, *prolongata**, (*truncata*)

Notes: Two species of *Ostrocerca* have been collected from North Carolina (although not yet published) and an additional two species occur in WV and VA which may eventually be found here. B. Kondratieff has records for *O. truncata* from Haywood, Madison, and Watauga Counties and records of *O. albidipennis* from Ashe County (personal communication) although there are no BAU records. North Carolina specimens from Wilkes County (courtesy of D. Lenat) have tergites 1-6 dorsally brown and getting lighter towards segments 8-10. *Ostrocerca* nymphs are univoltine.

Taxonomic references:

nymphs and adults:

Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). *Canadian Journal of Zoology*. 49: 1129-1142.

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. *Bulletin of the State Geological and Natural History Survey of Connecticut*. 107. vi + 262 pp.

Stewart, K. W. & N. H. Anderson. 2010. The life history of *Ostrocerca dimicki* (Frison) in a short-flow, summer-dry Oregon stream. *Illiesia*, 6(06):52-57.

(Paranemoura)

Genus Diagnosis: Robust, though small, nymphs 4.5-6.0 mm; anterior thoracic gills absent; *sparse foretibial silky hair; tenth tergum of male nymph produced apically; female nymph with a concave emargination on the posterior margin of the seventh sternal segment; cerci with short and sparse intersegmental setae; light mid-dorsal abdominal stripe.*

Habitat: Unknown. Nymphs occur in small to medium sized streams.

Distribution and Occurrence: Nymphs may be collected during the winter, emergence from March through June. Ecoregions are unknown but may occur in Mountain and Piedmont areas.

Species in NC: TAKE TO SPECIES – (*perfecta*)

NEMOURIDAE

Notes: *Paranemoura perfecta* is the only species in southeastern United States. Much is unknown about the life history and habitat of *Paranemoura perfecta* nymphs but it may be similar to other nemourids.

Taxonomic references:

nymphs and adults:

- Baumann, R. W. 1996. A review of the stonefly genus *Paranemoura* (Plecoptera: Nemouridae) and a new species from the northeast. Proceedings of the Entomological Society of Washington. 98(4): 818-826. ****adults only****
- Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 1129-1142.
- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

Prostoia

Genus Diagnosis: Nymphs small, 5-6 mm, and stout; *rounded pronotum with no marginal fringe (or of very small spines)*; anterior thoracic gills absent; *fore tibiae with complete fringe of fine outer hairs and two rows of stout spines on outer margin in apical half*.

Habitat: Nymphs occur in fast and slow areas of streams on rocks and in leaf packs. Detritivorous (shredders and facultative scrapers).

Distribution and Occurrence: Widespread, though primarily Mountains and Piedmont. Nymphs are relatively common during winter and early spring.

Species in NC: LEAVE AT GENUS – (*completa*), (*hallasi*), *similis**

Notes: Leg spines can be difficult to observe even with leg mounted and cleared thus making this genus difficult to separate from *Shipsa*. *Prostoia hallasi* was described from the Great Dismal Swamp and recorded from streams that only flow early. *Prostoia similis* has been recorded from SC, VA, and WV as well as GSMNP. Adults have a banded wing pattern. Univoltine.

Taxonomic references:

nymphs and adults:

- Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 1129-1142.
- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.
- Kondratieff, B. C. and R. F. Kirchner. 1984. A new species of Nemouridae (Plecoptera) from the Great Dismal Swamp, Virginia, USA. Proceedings of the Entomological Society of Washington. 86(3) 578-581. (description of *P. hallasi*)

Shipsa

Genus Diagnosis: Nymphs 6-8.5 mm; long pronotum; *long pronotum with no marginal fringe (or of very small spines)*; anterior thoracic gills absent; *complete outer tibial fringe; tibia without short stout spines on outer margins*; cerci with fringe longest ventrally but also with a short dorsal setal fringe.

Habitat: Nymphs occur in fast and slow areas of streams on rocks and in leaf packs. Detritivorous (shredders and scrapers).

Distribution and Occurrence: Mostly collected from east of the Slate Belt during the winter months. Relatively uncommon.

Species in NC: MONOTYPIC – *rotunda*

Notes: Separation of *Shipsa* from *Prostoia* can be difficult, particularly on small immature specimens, even if the tibiae are slide mounted. *Shipsa rotunda* is not on Stark's Plecoptera of North America checklist (last updated 19 March 2009) as occurring in North Carolina. Univoltine.

Taxonomic references:

nymphs and adults:

- Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 1129-1142.
- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

NEMOURIDAE

Soyedina

Genus Diagnosis: Nymphs 6.5-8.5 mm; *pronotum with angular corners and a distinct posterolateral notch, with well developed lateral fringe; wing pads divergent; anterior thoracic gills absent.*

Habitat: Found in leaf packs in seeps and small, cold streams. Detritivorous (shredders).

Distribution and Occurrence: Nymphs are typically collected from December to April, mostly in the Mountains. Relatively rare.

Species in NC: LEAVE AT GENUS – (*carolinensis*), (*kondratieffi*), *n. sp.* *, *vallicularia**, (*washingtoni*)

Notes: Taxonomically, *Soyedina* may be confused with *Nemoura*, a taxon that does not occur in the southeastern United States. The only eastern nymph to be described is *S. vallicularia* which has been recorded from VA, TN, and WV. Adults of *S. kondratieffi* were described from Upper Ball Creek in Macon County (Coweeta Hydrologic Laboratory) and co-occurred with *S. carolinensis* and *S. washingtoni*. A new species of *Soyedina* has been recorded from GSMNP but, as of yet, has not been described. *Soyedina* has a univoltine life cycle.

Taxonomic references:

nymphs and adults:

- Baumann, R. W. and S. A. Grubbs. 1996. Two new species of *Soyedina* (Plecoptera: Nemouridae) from the Appalachian Mountains. *Entomological News*. 107(4): 220-224. ****adults only****
- Grubbs, S. A. 2006. *Soyedina alexandria* and *S. calcarea* (Plecoptera: Nemouridae), new stonefly species from the eastern Nearctic region and notes on the life cycle of *S. calcarea*. *Illesia* 2(6): 39-49.
- Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). *Canadian Journal of Zoology*. 49: 1129-1142.
- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. *Bulletin of the State Geological and Natural History Survey of Connecticut*. 107. vi + 262 pp.

Zapada

Genus Diagnosis: Nymphs 5-8 mm; *anterior thoracic gills simple or with 2-4 branches; prominent pronotal fringe of blunt, stiff setae; distinct transverse row of spines on all femora.*

Habitat: Nymphs occur in small, cold, high elevation headwater streams and springs; on leaf packs. Detritivorous (shredders).

Distribution and Occurrence: Collected during fall and winter in the Mountains only. Rare.

Species in NC: TAKE TO SPECIES – *chila*

Notes: The nymph of *Zapada chila* is undescribed. So far this is the only described species in the southeastern United States and it is known only from NC, TN, and from high elevations in GSMNP (Beech Flats Prong). A new species of *Zapada* has been collected from along the Blue Ridge Parkway and a second new species from Mt. Rogers in Virginia (B. Kondratieff, personal communication). While *Zapada* species are common in the western United States, *Zapada chila* is listed by both the NC Natural Heritage Program as Significantly Rare (2010) and by Morse *et al.* (1997) as “vulnerable to extirpation”. Some *Zapada* species have been widely reported as being semivoltine while others have been reported as univoltine.

Taxonomic references:

nymphs and adults:

- Harper, P. P. and H. B. N. Hynes. 1971. The nymphs of the Nemouridae of eastern Canada (Insecta: Plecoptera). *Canadian Journal of Zoology*. 49: 1129-1142.
- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. *Bulletin of the State Geological and Natural History Survey of Connecticut*. 107. vi + 262 pp.

TAENIOPTERYGIDAE

Bolotoperla

Genus Diagnosis: Nymphs stout, 8-10 mm; coxae without gills; maxillary lacinia without dense short hairs on palm and with a ventral bristle comb; *distinct mediodorsal fringe of hairs on the first few antennal segments*; clothing hairs sparse on basal half of ninth sternal segment; *dorsal fringe of fine, silky hairs on basal cercal segments*.

Habitat: Unknown. *Bolotoperla* prefers rocky riffles of second through fourth order streams.

Distribution and Occurrence: Nymphs occur February through March in the Mountains. Rarely collected.

Species in NC: MONOTYPIC – *rossi*

Notes: The life history of *Bolotoperla rossi* is unknown. Recorded from GSMNP. Listed by NC Natural Heritage Program as Significantly Rare (2010). The BAU reference specimen is from Johns River (1989) though last collected in 1992.

Taxonomic references:

nymphs:

⇒ Kirchner, R. F. and P.P. Harper. 1983. The nymph of *Bolotoperla rossi* (Frison) (Plecoptera: Taeniopterygidae: Brachypterinae). Journal of the Kansas Entomological Society 56(3): 411-414.

adults:

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp. (as *Brachyptera* – male only)

Stewart, K. W. 2000. Taeniopterygidae (The Willowflies), pp. 55-87. In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 No. 1, vii + 100 p.

(Oemopteryx)

Genus Diagnosis: Nymphs 10-15 mm; coxal gills absent; *maxillary lacinia with dense short hairs on palm and no ventral bristle comb*; *inner hair row of mandible not extending onto molar surface*; distinct dorsal basal antennal segments without fringe of silky hairs, although 1-2 hairs may be present basally; pronotum equal to or less than width of head; *tibiae only with outer (dorsal) hair fringe*; *apical half of ninth sternal segment straight to convex laterally, clothing hairs numerous on basal half*; cerci of *O. contorta* without silky hairs on first 10-12 basal segments (present in other *Oemopteryx* species).

Habitat: Nymphs may diapause in hyporheic during the summer. Possibly detritivorous (shredders).

Distribution and Occurrence: Collected in the winter from the Mountains only. Rarely collected.

Species in NC: TAKE TO SPECIES – (*contorta*)

Notes: *Oemopteryx contorta* is the only recorded species in NC and from GSMNP. This species was collected in one EPA sample from the Pigeon River (January 1993). *Oemopteryx contorta* has also been recorded from TN, VA, and WV. The absence of a basal antennal fringe will separate this genus from *Bolotoperla* while the absence of a ventral comb on the lacinia and the shape and setation of the ninth sternite will separate it from *Strophopteryx limata*. *Oemopteryx contorta* is reported as univoltine.

Taxonomic references:

nymphs:

Nelson, C. H. 1982. Notes on the life histories of *Strophopteryx limata* (Frison) and *Oemopteryx contorta* (Needham and Claassen) (Plecoptera: Taeniopterygidae) in Tennessee. Tennessee Academy of Science. 57: 9-15.

adults:

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp. (as *Brachyptera*)

Stewart, K. W. 2000. Taeniopterygidae (The Willowflies), pp. 55-87. In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 No. 1, vii + 100 p.

Strophopteryx

Genus Diagnosis: Nymphs 7-13 mm; coxal gills absent; *maxillary lacinia without dense short hairs on palm and with a ventral bristle comb*; *inner hair row of mandible not extending to but not onto molar surface*; *tibiae with outer (dorsal) and inner (ventral) hair fringe* (except *S. limata*); *a single dorsal hair on basal cercal segments* (absent in *S. fasciata*); *apical half of ninth sternal segment concave laterally, clothing hairs sparse on basal half*; typically with a contrasting body pattern.

Habitat: Nymphs prefer organic materials trapped within rocky riffles. Detritivorous (shredders) and herbivorous (scrapers).

Distribution and Occurrence: Widespread, less common on the Coastal Plain. Collected during fall and winter.

Species in NC: TAKE TO SPECIES – (*appalachia*), (*fasciata*), (*limata*)

TAENIOPTERYGIDAE

- (*S. appalachia*) – nymphs 7-8.5 mm; abdominal terga yellow with darker yellow or light brown transverse bands on anterior half of each tergite; abdominal tergites lacking median transverse row of dots; sparse dorsal fringe of hair on the basal segments of cerci.
- (*S. fasciata*) – nymphs 9.5-10 mm; abdominal terga yellow with uneven, dark brown transverse bands on anterior half of each tergite; median row of transverse dark dots on each tergite; ventral tibial hair fringe present but sparse; no hair fringe on the basal segments of cerci. Recorded from GSMNP.
- (*S. limata*) – nymphs 6.0-7.0 mm; dorsum uniformly brown, tergites with distinct transverse row of dark spots with lateral spots more closely spaced and elongate; tibiae only with outer (dorsal) hair fringe; sparse dorsal fringe of hair on the basal segments of cerci. Collected from West Fork Pigeon River near the Blue Ridge Parkway (March, 2011) and also recorded from GSMNP.

Notes: Specimens of *Strophopteryx limata* may be difficult to be separate from *Oemopteryx contorta* but the presence of a ventral comb on the lacinia of *Strophopteryx* should eliminate any confusion between the two. Of course, the lacinia is very small... Stewart (2000) placed *S. inaya* as a synonym of *S. appalachia*. *Strophopteryx* are univoltine.

Taxonomic references:

nymphs:

Nelson, C. H. 1982. Notes on the life histories of *Strophopteryx limata* (Frison) and *Oemopteryx contorta* (Needham and Claassen) (Plecoptera: Taeniopterygidae) in Tennessee. Tennessee Academy of Science. 57: 9-15.

⇒ Earle, J. I. and K. W. Stewart. 2008. Description of the Nymph of *Strophopteryx appalachia* Ross and Ricker (Plecoptera: Taeniopterygidae), and Key to *Strophopteryx* Nymphs. Proceedings of the Entomological Society of Washington 110(3): 551-555.

⇒ Unzicker, J.D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A.R. Brigham, W. U. Brigham, and A. Gnilka, editors. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp.

adults:

Stewart, K. W. 2000. Taeniopterygidae (The Willowflies), pp. 55-87. In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 No. 1, vii + 100 p.

Taenionema

Genus Diagnosis: Nymphs 6.5-11 mm; coxal gills absent; *dorsal cercal fringe absent*; lacinia with ventral comb of bristles; palm mostly devoid of hairs, *inner patch of mandibular hairs not extending to or near the scraping ridge (unique generic feature)*; tibiae without ventral hair fringe; ninth sternal plate broad apically, clothing hairs sparse on basal half; body color brown.

Habitat: Found in small streams, most likely in riffles with leaf detritus. Detritivorous (shredders) and herbivorous (scrapers).

Distribution and Occurrence: In the mountains with nymphs collected during winter months. Rarely collected.

Species in NC: TAKE TO SPECIES – *atlanticum*

Notes: *Taenionema atlanticum* is the only species to occur in the eastern United States and has been recorded from GSMNP. *Taenionema*, particularly small specimens, can be difficult to separate from *Strophopteryx*. However, the combination of the lack of ventral tibial hair fringe and lack of basal dorsal cercal fringe should separate these two genera. Slide mounting the mandible is also recommended. Historic identifications (January 1996) have not been verified and may be erroneous. *Taenionema* is univoltine.

Taxonomic references:

nymphs:

Harper, P.P. and H. B. N. Hynes. 1971. The nymphs of the Taeniopterygidae of eastern Canada (Insecta: Plecoptera). Canadian Journal of Zoology. 49: 941-947. (as *Brachyptera pacifica*)

Stewart, K.W. 2009. New descriptions of North American *Taenionema* larvae (Plecoptera: Taeniopterygidae). *Illiesia*, 5(12):128-145.

adults:

Stewart, K. W. 2000. Taeniopterygidae (The Willowflies), pp. 55-87. In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 No. 1, vii + 100 p.

TAENIOPTERYGIDAE

Taeniopteryx

Genus Diagnosis: *Nymphs have a single telescopic gill (sometimes retracted) on the coxa of each leg; complete dorsal cercal fringe; some species have a median dorsal stripe.*

Habitat: Collected from leaf detritus in slow water areas. Detritivorous (shredders and collectors), herbivorous (scrapers), and some species may be facultatively predaceous.

Distribution and Occurrence: Widespread. Primarily found in late fall through winter.

Species in NC: LEAVE AT GENUS – *burksi*, *lita*, (*lonicera*), (*maura*), *metequi*, *nelsoni**, *parvula*, *ugola*

T. burksi – male nymphs 8.7-9.5 mm, female nymphs 10-12 mm; femora almost entirely light; light dorsal abdominal stripe bordered by dark stripes; light stripe continues onto head to the epicranial suture; terga with slender bristles and posterior margin with short blunt setae and the occasional long hair; cerci half as long as body with proximal third dark and the remainder yellow.

T. lita – nymphs 8-9.5 mm, female nymphs 8.3-10.2 mm; light dorsal stripe not bordered by dark brown; light stripe very narrow on head but then expands to become rectangular between eyes; dark femora; developing cerci not twisted (sometimes visible through exuvium).

(*T. lonicera*) – nymphs ~ 6-7.5 mm, female nymphs ~ 8-10 mm; head mostly light with two dark rectangular bars in front of eyes; developing cerci twisted. Collected by Boris Kondratieff at Hector Creek in Harnett County.

(*T. maura*) – Nymphs ~ 8.7-9.5 mm, female nymphs ~ 10-12 mm; pale abdominal stripe similar to *T. burksi*; inner margin of hind femur with developing femoral spur of adult. Recorded from GSMNP.

T. metequi – nymphs 7.5-8.1 mm, female nymphs 10-11 mm; dorsal stripe wide on occiput; mostly dark femora; all bristles on tergites long and curled.

T. nelsoni * – nymphs 6-7.5 mm, female nymphs 10-12 mm; no mid-dorsal stripe; proximal third of antennae with whorls of long setae; cerci with whorls of long setae; nymph setose, cryptic with detrital material on body hairs. Described from VA. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

T. parvula – nymphs 6.8 mm, female nymphs 7.3-12.3 mm; abdomen not striped; pronotum margined with yellow; abdominal terga with long bristles, many apically curved; epiproct triangular when viewed dorsally.

T. ugola – nymphs 7.6 mm, female nymph 7-9.7 mm; abdominal stripe present but faint; stripe on thorax reduced to light patches on posterior of meso- and metanotum; broad V-shaped yellow patch between eyes narrowed posteriorly into fine yellow line.

Notes: The general consensus is that there is a lack of confidence in species key due to either geographic differences and/or variation in nymphal coloration. Also, it may be very difficult to separate *T. burksi* and *T. maura* nymphs without associated adults. Therefore, it is best to leave *Taeniopteryx* at genus. Most species of *Taeniopteryx* are probably univoltine.

Taxonomic references:

nymphs:

⇒ Fullington, K. E. and K. W. Stewart. 1980. Nymphs of the stonefly genus *Taeniopteryx* (Plecoptera: Taeniopterygidae) of North America. *Journal of the Kansas Entomological Society* 53(2): 237-259.

Harper, P.P. and H. B. N. Hynes. 1971. The nymphs of the Taeniopterygidae of eastern Canada (Insecta: Plecoptera). *Canadian Journal of Zoology*. 49: 941-947.

⇒ Kondratieff, B. C. and R. F. Kirchner. 1982. *Taeniopteryx nelsoni*, a new species of winter stonefly from Virginia (Plecoptera: Taeniopterygidae). *Journal of the Kansas Entomological Society* 55(1): 1-7.

Kondratieff, B. C. and R. F. Kirchner. 1984. New species of *Taeniopteryx* (Plecoptera: Taeniopterygidae) from South Carolina. *Annals of the Entomological Society of America* 77(6): 733-736.

adults:

Kondratieff, B. C. and R. F. Kirchner. 1984. New species of *Taeniopteryx* (Plecoptera: Taeniopterygidae) from South Carolina. *Annals of the Entomological Society of America* 77(6): 733-736.

Stewart, K. W. 2000. Taeniopterygidae (The Willowflies), pp. 55-87. In B. P. Stark and B. J. Armitage (editors). *Stoneflies (Plecoptera) of Eastern North America*. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 No. 1, vii + 100 p.

CHLOROPERLIDAE

Alloperla

Genus Diagnosis: Nymphs ?? mm; pronotum with setae usually restricted to corners; mesal portion of posterior margin of abdominal sternite eight lacking setae; *distal end of cerci with feather-like surface (in lateral view) due to 2-6 long setae between apical coronas.*

Habitat: Primarily found in gravel and riffle areas of small to medium streams but can also be found in leaf packs. Nymphs are generalist feeders and also predaceous on chironomid larvae.

Distribution and Occurrence: Mainly collected January through May in the Mountains. Uncommon.

Species in NC: LEAVE AT GENUS – (*atlantica*), (*chloris*), (*lenati*), (*nanina*), (*neglecta*), (*petasata*), (*usa*)

Notes: North Carolina has at least seven species of *Alloperla* of which the nymphs of most of these species are undescribed (including *A. lenati*). At least some species of *Alloperla* are semivoltine. Adults of *A. lenati* were described from Lumber River, Hoke County, within the Sand Hills Level IV ecoregion and is a disjunct population from the mostly mountainous *Alloperla*. *Alloperla lenati* is also listed by NC Natural Heritage Program as Significantly Rare (2010). A recent publication of nymphs of Nearctic *Alloperla* (Stark and Kondratieff, 2010) treats only four of the seven species known to occur in North Carolina.

Taxonomic references:

nymphs:

Stark, B. P. and B. C. Kondratieff. 2010. Larvae of eight eastern Nearctic *Alloperla* species (Plecoptera: Chloroperlidae). *Illiesia*, 6(20): 267-276.

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). *Illinois Biological Monographs* 54: 1-146.

adults:

Kondratieff, B. P. and 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(3):361-363.

Surdick, R. F. 2004. Chloroperlidae (The Sallflies). In B. P. Stark and 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 Number 4. vi + 192 pp.

Haploperla

Genus Diagnosis: Nymphs ~ 7 mm; cerci without dorsal or ventral intercalary hairs, setae at apex of cercal segments only; *pronotum with sparse setae, longest and most numerous at anterior corners; long pronotal fringe hairs are at least 0.3-0.4 times the pronotal width; inner margin of hind wing pads subparallel to body axis;* pronotum and tergites lightly setose; *fore leg with sparse fringe of long setae on tibia;* body light brown, nearly concolorous.

Habitat: Primarily found in gravel and riffle areas of small to medium streams but can also be found in leaf packs. Predacious on chironomid larvae but also facultative collectors and scrapers.

Distribution and Occurrence: Collected from Mountains and Piedmont usually fall through spring. Relatively common.

Species in NC: TAKE TO SPECIES – *brevis*, *fleeki*, (*parkeri*)

H. brevis – fits genus description. Univoltine.

H. fleeki – pronotum with antero- and posterolateral margins dark, contrasting with light brown almost diamond shaped interior; abdominal tergites with transverse banding along posterior margins slightly widening laterally. Adults were described from Lower Little River in Moore County in the Sand Hills.

(*H. parkeri*) – nymphs unknown. Described from Shot Pouch Creek in Macon County and recorded from GSMNP. See notes.

Notes: Mature nymphs collected from Graham, Swain, and Macon Counties (2011) in the Little Tennessee River Basin which key to *Haploperla* have an approximate length of 4.5 mm at maturity and no color pattern. These nymphs also have long hairs on the lateral margins of the winpads. *Haploperla brevis* are larger (up to 7.5 mm) and *H. fleeki* are patterned. These are an unknown species and may possibly be *H. parkeri*. Both *Haploperla fleeki* and *H. parkeri* are listed by NC Natural Heritage Program as Significantly Rare (2010).

Taxonomic references:

nymphs:

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). *Illinois Biological Monographs* 54: 1-146.

adults:

Kondratieff, B. C., River F. Kirchner, and D. L. Lenat. 2005. Two new species of *Haploperla* Navás (Plecoptera: Chloroperlidae) from North Carolina, U.S.A. *Proceedings of the Entomological Society of Washington*. 107(4): 859-863.

Surdick, River F. 2004. Chloroperlidae (The Sallflies). In B. P. Stark and 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 Number 4. vi + 192 pp.

CHLOROPERLIDAE

Rasvena

Genus Diagnosis: *Mature nymphs less than 5.5 mm; mandible lacking ventral submarginal patch of bristles; four faint, longitudinal rows of dots on dorsum of abdomen; long hairs numerous on corners as well as on the anterior and posterior margins of pronotum shorter laterally; inner margin of hind wing pads subparallel to body axis; dark clothing hairs on pronotum, wingpads and abdominal terga.*

Habitat: Unknown. Small streams in the mountains.

Distribution and Occurrence: Nymphs are found in clean mountain streams during the spring. Rarely collected.

Species in NC: MONOTYPIC – *terna*

Notes: Similar to *Haploperla* but smaller with longitudinal, if faint, pigmentation. Recorded from GSMNP. Listed by NC Natural Heritage Program as Significantly Rare (2010). The life cycle of *Rasvena terna* is unknown.

Taxonomic references:

nymphs:

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). Illinois Biological Monographs 54: 1-146.

adults:

Surdick, River F. 2004. Chloroperlidae (The Sallflies). In B. P. Stark and 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 Number 4. vi + 192 pp.

Suwallia

Genus Diagnosis: *Nymphs 8-10 mm; sparse or absent lateral fringe hairs on pronotum; longest fringe hairs no more than 0.2 times the pronotal width; inner margin of hind wing pads divergent; posterior cercal hairs much shorter than cercal segments in apical half of cerci.*

Habitat: Primarily found in gravel and riffle areas of small to medium streams but can also be found in leaf packs. Detritivorous (shredders), herbivorous (scrapers) and facultatively predaceous.

Distribution and Occurrence: Primarily a Mountain species in small to medium rivers. Nymphs are relatively common during the summer but can be found fall through early spring.

Species in NC: TAKE TO SPECIES – *marginata*

Notes: *Suwallia marginata* is the only species in eastern North America. North Carolina is the southern limit for this more northerly-distributed species. Life history studies have not been found for *Suwallia*.

Taxonomic references:

nymphs:

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). Illinois Biological Monographs 54: 1-146.

adults:

Surdick, River F. 2004. Chloroperlidae (The Sallflies). In B. P. Stark and 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 Number 4. vi + 192 pp.

Sweltsa

Genus Diagnosis: *Nymphs 7-8.5 mm; thick depressed black clothing hairs laterally on all thoracic sterna; inner margin of hind wing pads divergent; no intercalary hairs on cercal segments; body typically pale.*

Habitat: Primarily found in gravel and riffle areas of small to medium streams but can also be found in leaf packs. Predaceous on chironomid larvae and facultative collectors.

Distribution and Occurrence: Very common in Mountains, uncommon in the Piedmont. Nymphs are most common in the fall through spring but can be collected year round.

Species in NC: LEAVE AT GENUS – (*holstonensis*), (*lateralis*), (*mediana*), (*urticae*), (*voshelli*)

Notes: Nymphs of most species are undescribed although members of the *Sweltsa mediana* group have a median dorsal abdominal stripe and includes *S. urticae* and *S. voshelli*. Stark *et al.* (2011) published a provisional key to larvae of eastern *Sweltsa*. However, of the ten species currently known to occur in the eastern US only five species are known from NC of which only three are described, therefore the key is of limited usefulness. Nymphs of *Sweltsa holstonensis* and *S. voshelli* remain unknown. At least some *Sweltsa* nymphs are reported to be semivoltine. *Sweltsa holstonensis* is listed by NC Natural Heritage Program as Significantly Rare (2010) and *S. urticae* is “vulnerable to extirpation” per Morse *et al.* (1997).

CHLOROPERLIDAE

Taxonomic references:

nymphs:

Stark, B. P., B. C. Kondratieff, R. F. Kirchner, and K. W. Stewart. 2011. Larvae of Eight Eastern North American *Sweltsa* (Plecoptera: Chloroperlidae). *Illiesia* 7(04):51-64.

Surdick, R. F. 1985. Nearctic genera of Chloroperlinae (Plecoptera: Chloroperlidae). Illinois Biological Monographs 54: 1-146.

adults:

Kondratieff, B. C. and R. F. Kirchner. 1991. New Nearctic Chloroperlidae (Plecoptera). Journal of the New York Entomological Society. 99(2): 199-203.

Kondratieff, B. C. and R. F. Kirchner. 1998. A new species of *Sweltsa* (Plecoptera: Chloroperlidae) from eastern North America. Entomological News 109(4): 293-295.

Surdick, River F. 2004. Chloroperlidae (The Sallflies). In B. P. Stark and 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 Number 4. vi + 192 pp.

PELTOPERLIDAE

(*Peltoperla*)

Genus Diagnosis: Nymphs 8-11 mm; gills absent from prothorax; *thoracic gills double; meso- and metanota with large, solid, dark pigment spots lateral to ecdysial suture; posterior edge of prosternal plate with distinct mesal V-shaped emargination; metasternal plate with short, broad posterior wings.*

Habitat: Collected from leaf packs. Detritivorous (shredders)

Distribution and Occurrence: Nymphs occur late summer through spring in small, cold, mountain springs and seeps.

Species in NC: LEAVE AT GENUS – *arcuata**, (*tarteri*)

Notes: Of the two Nearctic species only the nymph of *P. arcuata* has been reported to be semivoltine while *P. tarteri* has been reported to be univoltine. There is at least one generic key that describes *Peltoperla* as having two pair of circular spots on each side of the pronotal ecdysial line (as pictured in Stewart and Stark, 2002), however this may be an unreliable character as it was removed from later keys and BAU photos of *Peltoperla* do not show any such distinctive light circular dots on the pronotum. There are no published records of *Peltoperla* in North Carolina either of adults or nymphs. However, *Peltoperla arcuata* has been recorded from TN, VA, and WV while *P. tarteri* has been recorded from VA and WV and reared from NC nymphs. Additionally, *Peltoperla* nymphs have been unofficially collected from NC Blue Ridge Parkway seeps.

Taxonomic references:

nymphs:

Stark, B. P. and K. W. Stewart. 1981. The Nearctic Genera of Peltoperlidae (Plecoptera). Journal of the Kansas Entomological Society 54(2): 285-311. (description of *P. arcuata*)

Yokum, K. A., t. R. Angradi and D. C. Tarter. 1995. Ecology of *Peltoperla arcuata* and *Tallaperla maria* (Plecoptera: Peltoperlidae) at the Fernow Experimental Forest, Tucker County, West Virginia. Psyche 102: 151-168.

adults:

Stark B. P. and B. C. Kondratieff. 1987 A new species of *Peltoperla* from eastern North America (Plecoptera: Peltoperlidae). Proceedings of the Entomological Society of Washington 89: 141-146. (description of *P. tarteri*)

Stark, B. P. 2000. Peltoperlidae (The Roachflies). In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 Number 1. vii + 100 pp.

Tallaperla

Genus Diagnosis: Nymphs 7-10 mm; gills absent from prothorax; *thoracic gills double; meso- and metanota without large, solid, dark pigment spots although small indistinct spots may be present on dark forms; posterior edge of prosternal plate mostly straight across although a shallow, broadly curved mesal emargination may be present; metasternal plate with long posterior wings.*

Habitat: Collected from leaf packs particularly in areas of fast flow. Detritivorous (shredders).

Distribution and Occurrence: Common in clean Mountain and Northern Inner Piedmont streams. Collected almost year round.

Species in NC: LEAVE AT GENUS – (*anna*), (*cornelia*), (*elisa*), (*laurie*), (*maiya*), (*maria*)

Notes: Of the six species in NC, only nymphs of *T. maria* have been described. Some species of *Tallaperla* may be semivoltine (*T. maria* for one). Adults of *T. maiya* were described from Wilkes County, NC. *Tallaperla elisa* is listed as “vulnerable to extirpation” by Morse *et al.* (1997) and is listed by NC Natural Heritage Program as Significantly Rare (2010).

Taxonomic references:

nymphs:

Stark, B. P. and K. W. Stewart. 1981. The Nearctic Genera of Peltoperlidae (Plecoptera). Journal of the Kansas Entomological Society 54(2): 285-311.

adults:

Kondratieff, B. C., R. F. Kirchner, R. E. Zuellig, and D. R. Lenat. 2007. A new species of *Tallaperla* (Plecoptera: Peltoperlidae) from North Carolina, U. S. A. Entomological News 118 (1): 81-82. (description of *Tallaperla maiya*)

Stark, B. P. 2000. Peltoperlidae (The Roachflies). In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 Number 1. vii + 100 pp.

PELTOPERLIDAE

Viehoperla

Genus Diagnosis: Nymphs 7-9 mm; *thoracic gills single; small dark spots on meso- and metanota*; posterior edge of prosternal plate mostly straight across; metasternal plate with short, broad posterior wings.

Habitat: Collected from leaf packs. Detritivorous (shredders).

Distribution and Occurrence: Occurs in undisturbed, small, cold streams, springs, and splash zones in Mountains from spring through early fall. Rarely collected.

Species in NC: MONOTYPIC - *ada*

Notes: *Viehoperla* co-occur with *Tallaperla*. The description of *Viehoperla ada* describes nymphs collected from about 1,200 feet to over 5,100 feet above sea level (Stark and Stewart, 1982). All BAU records occur below 3,500 feet; Moore Creek in Macon County (2008) at 3,400 feet, Negro Prong (2009) at 2,400 feet, and UT Cathys Creek (2009) at 2,300 feet. *Viehoperla ada* may be semivoltine but there are no published life history accounts of this species. Recorded from GSMNP. *Viehoperla zipha* was synonymized with *V. ada* in Stark and Stewart (1981).

Taxonomic references:

nymphs:

Stark, B. P. and K. W. Stewart. 1981. The Nearctic Genera of Peltoperlidae (Plecoptera). *Journal of the Kansas Entomological Society* 54(2): 285-311.

Stark, B. P. and K. W. Stewart. 1982. The nymph of *Viehoperla ada* (Plecoptera: Peltoperlidae). *Journal of the Kansas Entomological Society* 55: 494-498.

adults:

Stark, B. P. 2000. Peltoperlidae (The Roachflies). In B. P. Stark and B. J. Armitage (editors). *Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae.* Ohio Biological Survey Bulletin New Series Volume 14 Number 1. vii + 100 pp.

PERLIDAE

Acroneuria

Genus Diagnosis: No setal row or ridge on occiput; postocular fringe with row of several thick setae; cerci with basal fringe of silky setae; anal gills present or absent.

Habitat: Typically collected from hard substrates in well-aerated, fast moving riffles but can also be found in woody debris in slower moving water. Predaceous.

Distribution and Occurrence: Generally widespread during the late spring through fall, though less common in the Coastal Plain. See species accounts.

Species in NC: TAKE TO SPECIES – *abnormis*, *arenosa*, (*arida*), *carolinensis*, *evoluta*, *filicis*, *frisoni*, *internata**, *lycorias*, *perplexa*, *petersi**

- A. abnormis* – male nymphs 15-20 mm, female nymphs 25-30 mm; dorsum of head with a well defined M-shaped head pattern, sometimes with interruptions; posterior margins of abdominal tergites light, dark tergal bands irregular; or dorsum of head without M-shaped head pattern and abdomen uniformly brown; anal gills always absent. Widespread and nymphs occur year round. Semivoltine.
- A. arenosa* – male nymphs 14-17 mm, female nymphs 20-24 mm; dorsum of head with M-shaped pattern, sometimes faint to absent; abdomen uniformly brown; anal gills present. Uncommon but widespread during the spring through fall.
- (*A. arida*) – nymphs unknown. NC adult records are from Haywood County. Also recorded from GA, TN and GSMNP. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).
- A. carolinensis* – male nymphs 17-19 mm, female nymphs 21-23 mm; dorsum of head with light M-shaped pattern; dorsum of abdomen banded, anterior half light and posterior margin of tergites dark; anal gills usually absent. Relatively common in the northeastern Mountains and in the Sand Hills year round but particularly in the early winter.
- A. evoluta* – male nymphs 16-19 mm, female nymphs 21-23 mm; dorsum of head with interrupted M-shaped head pattern, appearing as a transverse row of 3 light spots in front of anterior ocellus; abdomen not banded; anal gills present. Uncommon. Occurs in northeastern Piedmont, Slate Belt, and southern Coastal Plain rivers. Nymphs more common during summer thru late fall. Univoltine (though this may refer to *A. frisoni*) and associated with leaf packs. Keys in Unzicker and McCaskill (1982) to *A. mela* (see notes). Most BAU *A. mela* records are *A. evoluta*.
- A. filicis* – male nymphs 16-18 mm, female nymphs 20-23 mm; dorsum of head with light M-shaped pattern; abdomen banded with posterior margin light; dark tergal bands expanded posteriorly near median line, often reaching posterior margin of tergite; dark bands remain constant in width laterally; anal gills present. Mountains only. Also recorded from GA, SC, TN, VA, WV and GSMNP.
- A. frisoni* – male nymphs 14-17 mm, female nymphs 16-21 mm; dorsum of head with broad light M-shaped pattern; abdomen banded with posterior margins of tergites light and of uniform thickness; posterior margin of tergite 9 dark; anal gills present. Keys in Unzicker and McCaskill (1982) to *A. evoluta* (see notes). BAU records of *A. evoluta* from the eastern Mountains, Northern Inner Piedmont, and Slate Belt, prior to 2008 (23) are *A. frisoni*. Also recorded from GSMNP.
- A. internata** – male nymphs 15-18 mm, female nymphs 21-24 mm; dorsum of head with interrupted M-shaped head pattern, appearing as a transverse row of 3 light spots in front of anterior ocellus; abdomen banded, posterior margins of tergites light and of uniform thickness; anal gills absent. Recorded from VA, WV, and GSMNP.
- A. lycorias* – male nymphs 15-18 mm, female nymphs 17-20 mm; dorsum of head with light well-developed M-shaped pattern; posterior margins of tergites dark; anal gills usually present, sometimes small. Semivoltine. Found in Mountains (mostly the Catawba River basin) and Sand Hills. Though uncommon, nymphs can be collected year round.
- A. perplexa* – male nymphs 15-18 mm, female nymphs 19-23 mm; dorsum of head with light M-shaped pattern of uniform thickness throughout; abdomen banded with posterior tergal margins light; dark tergal bands expanded posteriorly near median line but do not reach posterior margin of tergite; dark bands decrease in width laterally (sometimes not much); anal gills present. Collected mostly from the Mountains, spring through summer. Also recorded from GSMNP.
- A. petersi** – nymph unknown. Recorded from GA, TN and GSMNP. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

PERLIDAE

Notes: It is probable that some nymphs occurring in North Carolina are undescribed or unrecorded species. Additionally, a fair amount of variation exist with color patterns and, therefore, separation of species should be considered provisional. Difficult or immature specimens may best be left at genus. Stark (1991) mentions that old *A. evoluta* descriptions (such as found in Unzicker and McCaskill, 1982) is *A. frisoni*. Additionally, *A. mela* was synonymized with *A. evoluta* (Stark and Brown, 1991).

Taxonomic references:

nymphs:

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp.

Stark, B. P. and L. D. Brown. 1991. What is *Acroneuria evoluta* Klapálek (Plecoptera: Perlidae). Aquatic Insects, 13(1): 29-32.

⇒ Stark, B. P. and A. R. Gaufin. 1976a. The Nearctic species of *Acroneuria* (Plecoptera: Perlidae). Journal of the Kansas Entomological Society, 49(2): 221-253. (nymphal descriptions)

⇒ Unzicker, J. D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A. R. Brigham, W. U. Brigham, and A. Gnilka, editors. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp.

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II.

Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Stark, B. P. and A. R. Gaufin. 1976. The Nearctic species of *Acroneuria* (Plecoptera: Perlidae). Journal of the Kansas Entomological Society, 49(2): 221-253.

Agnentina

Genus Diagnosis: *Occiput* with setal row or ridge complete; basal cercal segments lack fringe of long setae; posterior spinule fringe of abdominal sternum segment 7 complete; body color pattern usually dark brown with contrasting yellow; anal gills present.

Habitat: Nymphs prefer cobble in fast flowing riffles. Predaceous

Distribution and Occurrence: Nymphs occur primarily in the Mountains though can be found in the Piedmont. Uncommon.

Species in NC: TAKE TO SPECIES – *annulipes*, *capitata*, *flavescens*

A. annulipes – nymphs ?? mm; head pattern roughly M-shaped with arms directed posterolaterally, some specimens may have an almost interrupted mask; dorsum of abdomen banded, with dark bands on anterior half of segment, sometimes segments 5 and 6 dark mostly to posterior margin; tergum 10 mostly dark including the apex. Semivoltine. Collected from the Mountains and Slate Belt. Also recorded from SC and VA.

A. capitata – nymphs ?? mm; lateral arms of M-pattern on head directed laterally; dark area between lateral ocelli sometimes lighter to median ocellus; dorsum of abdomen banded, posterior margins dark and with a triangular mesal area anteriorly projecting forming an apparent mid-dorsal longitudinal stripe; apex of tergum 10 light with dark pigmentation faintly continuous mesally, sometimes with a small median projection directed distally. Semivoltine. Collected primarily from the Mountains. Recorded from GSMNP. Listed by NC Natural Heritage Program as Significantly Rare (2010).

A. flavescens – nymphs ?? mm; head pattern roughly M-shaped with arms directed posterolaterally and almost interrupted; a light triangular pale area between lateral ocelli; dorsum of abdomen banded, with dark bands on anterior half of segment, distal segments may have a narrow light band anterior to the dark band; apex of tergite 10 light with narrow dark pigment band interrupted mesally. Semivoltine. Collected primarily from the Mountains during the spring and summer.

Notes: Some *Agnentina* nymphs collected from the Cape Fear River and Surry County do not key well. These nymphs have a head pattern similar to *A. flavescens* (as depicted in Stewart and Stark, 2002) but with tergites 5 and 6 mostly dark. Also, on these specimens, the posterior margin of tergum 10 is narrowly dark with a medial dark longitudinal line from the anterior to posterior margin (thereby dividing the pale area into two suboval spots). Overall, the dorsum of abdomen appears to have one medial and two lateral dark longitudinal stripes. These nymphs may be a variation on *A. annulipes* (the BAU reference specimen closely matches this description but without the light suboval pale areas on tergite 10), although it is entirely possible that they represent an unknown species. Previously known as *Phasganophora*.

Taxonomic references:

nymphs:

⇒ Stark, B. P. 1986. The Nearctic species of *Agnentina* (Plecoptera: Perlidae). Journal of the Kansas Entomological Society 59(3): 437-445.

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II.

Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. Vol. 14 (4). vi + iv p.

PERLIDAE

Attaneuria

Genus Diagnosis: Nymphs 18-30 mm; *occiput with irregular but complete setal row; lateral pronotum and posterior edge of abdominal tergites fringed with long, thin setae; anal gills absent*; body mostly unpatterned but covered with fine, dark clothing hairs.

Habitat: Associated with debris, probably in areas of fast flow. Predaceous.

Distribution and Occurrence: Mountains only, particularly New River basin. Most likely a fall through spring taxon in larger rivers. Rarely collected.

Species in NC: MONOTYPIC – *ruralis*

Notes: One of the largest stoneflies occurring in North Carolina, *Attaneuria ruralis* has been reported as having a semivoltine life cycle. Listed by NC Natural Heritage Program as Significantly Rare (2010).

Taxonomic references:

nymphs:

Stark, B. P. and A. R. Gaufin. 1976b. The Nearctic genera of Perlidae (Plecoptera). Miscellaneous Publications Entomological Society of America, 10. (incomplete)

⇒ Unzicker, J. D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A. R. Brigham, W. U. Brigham, and A. Gnilka, editors. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp.

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Beloneuria

Genus Diagnosis: Head with a well defined M-pattern anterior to median ocellus; *no setal row or ridge on occiput; postocular fringe with scattered setae; no basal silky setae on the cerci; pronotal flange uniformly narrow; anal gills present*; body typically brown with pale yellow pattern and covered with fine, dark clothing hairs.

Habitat: Cobble and coarse woody debris in areas of good flow. Predacious.

Distribution and Occurrence: Nymphs occur year round preferentially in smaller, colder streams and seeps in the Mountains and Foothills. Uncommon.

Species in NC: LEAVE AT GENUS – (*georgiana*), (*stewarti*)

(*B. georgiana*) – nymphs ?? mm; head without two light rectangular dashes anterolateral of the two posterior ocelli; appears to have more spicules on terga 8 than *B. stewarti*. Prefers high elevations. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

(*B. stewarti*) – nymphs ?? mm; head with two light rectangular dashes anterolateral of the two posterior ocelli; appears to have more of a dorsal and ventral intercalary setal fringe on apical segments of cerci than *B. georgiana*. Associated with lower elevations and Piedmont areas. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

Notes: The above species descriptions are based on pictures only. *B. georgiana* is pictured in Stewart and Stark (2002). Stewart and Stark (2008) depicts the head of *B. stewarti*. Also, *B. stewarti* is misidentified as *B. georgiana* in Stark and Gaufin (1976). Because the head patterns on the two species appear to be very similar and thus not a good diagnostic character, it would be best to leave *Beloneuria* specimens at the generic level. Both species have been recorded from GSMNP. *Beloneuria* may be semivoltine.

Taxonomic references:

nymphs:

Stark, B. P. and A. R. Gaufin. 1976. The Nearctic genera of Perlidae (Plecoptera). Miscellaneous Publications of the Entomological Society of America, 10(1): 1-80.

Stark, B. P. and S. W. Szczytko. 1976. The genus *Beloneuria* (Plecoptera: Perlidae). Annals of the Entomological Society of America, 69(6): 1120-1124. (nymphal description of *B. stewarti*. Note: *B. georgiana* was undescribed at time of publication)

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *B. georgiana*)

Stewart, K. W. and B. P. Stark 2007. Chapter 14. Plecoptera. pp 311-384 in R. W. Merritt, K. W. Cummins and M. B. Berg (eds). 2007. An introduction to the aquatic insects of North America. Kendall Hunt Publishing. Dubuque, Iowa. pp 1158. (head of *B. stewarti*)

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Stark, B. P. and S. W. Szczytko. 1976. The genus *Beloneuria* (Plecoptera: Perlidae). Annals of the Entomological Society of America, 69(6): 1120-1124.

PERLIDAE

Eccoptura

Genus Diagnosis: Nymphs 15-22 mm; occiput without transverse row of spinules, setae restricted to postocular fringe; *head with a large, lobed, light yellow area anterior to the median ocellus*; cerci with a sparse basal fringe of silky setae; *anal gills present*; abdominal terga 1-8 often with a pale irregular, submedial transverse band.

Habitat: Typically collected from hard substrates in well-aerated, fast moving riffles. Predaceous.

Distribution and Occurrence: Common in the Mountains and Piedmont. Found in small streams year round but with a summer lull corresponding to emergence.

Species in NC: MONOTYPIC – *xanthenes*

Notes: Smaller specimens may not have a developed color pattern but will have anal gills. Washed out or undeveloped head patterns may still have outline of the developing pale area on head. Semivoltine.

Taxonomic references:

nymphs:

Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp.

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds), Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Hansonoperla

Genus Diagnosis: Nymphs 14-20 mm; eyes set forward from hind margin of head; occiput devoid of spinules; *postocular fringe reduced to 1-2 long setae*; pronotal fringes consist of long setae only at corners; *femora and tibia without ventral setal fringe*; thoracic gills long and feathery; cerci without dorsal fringe; *anal gills absent*; nymph habitus long and slender, brown, with appressed brown clothing hairs, and with pale yellow M-pattern on head, often indistinct.

Habitat: Collected from sand embedded cobbles and woody debris in pools and areas of slower flow including undercut banks or root mats. Most BAU collections occur in cold-water streams in areas up welling. Predacious.

Distribution and Occurrence: occurs in cool, streams and seeps in the Mountains. A fall through winter species. Rarely Collected

Species in NC: TAKE TO SPECIES – *appalachia*

Notes: Only the nymph of *Hansonoperla appalachia* been described and is the only species to occur in North Carolina. It has also been recorded from SC, TN, VA, and GSMNP. *Hansonoperla* has been misidentified as *Perlinella* in some historic BAU samples and may, therefore, be more common than previously noted. The lack of a ventral femoral-tibial fringe of setae on *Hansonoperla* nymphs should separate these two genera. The life history of *Hansonoperla* is unknown.

Taxonomic references:

nymphs:

Kirchner, R. F. and B. C. Kondratieff. 1985. The nymph of *Hansonoperla appalachia* Nelson (Plecoptera: Perlidae). Proceedings of the Entomological Society of Washington 87(3): 593-596.

Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *H. appalachia*)

adults:

Kondratieff, B. C. and R. F. Kirchner. 1996. Two species of *Hansonoperla* (Plecoptera: Perlidae) from eastern North America. Annals of the Entomological Society of America, 89(4): 501-509.

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds), Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Neoperla

Genus Diagnosis: Nymphs 7-12 mm; *head with two large, closely-set lateral ocelli only, anteromedial ocellus lacking*; complete elevated transverse ridge on occiput; *anal gills present*; body dark often with contrasting pattern, with dark clothing hairs.

Habitat: Nymphs prefer detritus in slower water but can be found in riffles as well. Predaceous.

Distribution and Occurrence: Common in the Piedmont and Coastal plain in small streams to large rivers. Uncommon in the Mountains. Nymphs are most abundant during the summer.

Species in NC: LEAVE AT GENUS – (*clymene*), (*carlsoni**, (*catharae*), (*coosa*), (*occipitalis**, (*stewarti*)

PERLIDAE

Notes: Only nymphs of *N. clymene* and *H. carlsoni* have been described. Additionally, several species have light and dark morphs, further hampering species identifications of nymphs. *Neoperla carlsoni* and *N. occipitalis* have been recorded from SC and VA while *N. coosa* has been additionally recorded from GSMNP. *Neoperla* is one of the few perlids that is univoltine.

Taxonomic references:

nymphs:

- Lenat, D.R., R.E. Zuellig, B.C. Kondratieff, & S.R. Beaty. 2009. Distribution of *Neoperla* (Plecoptera: Perlidae) in North Carolina, with new state records for three species. *Illiesia*, 5(15):164-168.
- Stark, B. P. and A. R. Gaufin. 1979. The stoneflies (Plecoptera) of Florida. *Transactions of the American Entomological Society* 104: 391-433. (description of *N. carlsoni*)
- Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *N. clymene*)

adults:

- Stark, B. P. 2004. Perlidae (The Stones). In Stark B.P and B.J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). *Ohio Biological Survey Bulletin, New Series*. 14 (4). vi + iv p.

Paragnetina

Genus Diagnosis: *Occiput* with a complete, closely-set, transverse spinule row; posterior spinule fringe of abdominal sternum segment 7 incomplete; *cerci* with dorsal setal fringe of fine setae; anal gills usually absent; usually distinctly patterned, but sometimes lacking contrasting colors.

Habitat: Nymphs are typically collected from hard substrates in well-aerated, fast moving riffles. Predaceous.

Distribution and Occurrence: Widespread but most common in the Mountains and rare in the Slate Belt. See species accounts.

Species in NC: TAKE TO SPECIES – *fumosa*, *ichusa*, *immarginata*, *kansensis*, *media**

- P. fumosa* – nymphs ?? mm; frons with a pair of yellow spots lateral to the median ocellar spot, median ocellar spot often congruous with pale yellow transverse band near labrum; thoracic nota with complex and extensive pattern of yellow markings; yellow femora with one sometimes two distinctive dark brown transverse bands; abdominal terga 3-4, 5 with a pair of pale markings and 8 and 9 mostly pale; anal gills present or absent. Common and widespread except for Slate Belt and outer Coastal Plain. Usually collected spring through early winter.
- P. ichusa* – nymphs 15-23 mm; head brown with small, light areas around each ocellus and tentoria; femora brown; abdomen brown sometimes with small light mesal areas on tergites 7-9; terga 4-9 without short, thick intercalary setae; anal gills absent. Collected mostly from the Mountains primarily during the summer but can be found year round. Nymphs are inseparable from *Paragnetina media*
- P. immarginata* – nymphs ?? mm; head M-pattern with medial pale line extended anteriorly, often connected to pale frontoclypeal margin; yellow femora distinctively patterned with dark brown longitudinal bar extending about 2/3 the length; abdominal terga banded, anterior half dark; anal gills absent. Common in the Mountains, less common in the Piedmont. Nymphs occur year round.
- P. kansensis* – nymphs ?? mm; dark area of frons without yellow spots near median ocellar spot or with two pair of small spots, one pair anterolateral and one pair posterolateral to the median ocellar spot; thoracic nota with a scattered often diffuse and sometimes obscured pattern of yellow markings; femora variable, some with obscure transverse bars, some brown; abdomen plain brown although segments 7-9 sometimes with lighter markings; terga 4-9 with short, thick intercalary setae; anal gills usually present. Relatively rare. Mostly found in Coastal Plain (with only a few Mountain and Piedmont records) during late spring through summer.
- P. media** – nymphs 15-25 mm; inseparable from *Paragnetina ichusa*. Semivoltine. Adults recorded from VA and further north and west but also recorded from GSMNP.

Notes: Of the five species in the North America, all accounted for in or near North Carolina. While life history studies of *Paragnetina media* suggest it is semivoltine, it is also likely, based on BAU seasonality data, that the other *Paragnetina* species are semivoltine.

Taxonomic references:

nymphs:

- ⇒ Stark, B. P. and S. W. Szczytko. 1981. Contributions to the systematics of *Paragnetina* (Plecoptera: Perlidae). *Journal of the Kansas Entomological Society* 54(3): 625-648.

adults:

- Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). *Ohio Biological Survey Bulletin, New Series*. 14 (4). vi + iv p.
- Stark, B. P. and S. W. Szczytko. 1981. Contributions to the Systematics of *Paragnetina* (Plecoptera: Perlidae). *Journal of the Kansas Entomological Society* 54(3): 625-648.

PERLIDAE

Perlesta

Genus Diagnosis: Nymphs 8-12 mm; *setal row on occiput complete, sinuate, and with irregular gaps; abdomen with numerous short, stout intercalary setae*, often with pigmented bases giving abdomen a speckled appearance; *anal gills present*; body covered with fine, dark clothing hairs.

Habitat: Nymphs occur on cobble in riffles as well as leaf packs in slower flow areas. Early instars are detritivorous and become predacious as they mature.

Distribution and Occurrence: Common and widespread. Nymphs occur spring through mid summer, emerging late July through early August.

Species in NC: LEAVE AT GENUS – (*bjostadi*), *cranshawi**, *decipiens**, (*frisoni*), (*georgiae*), (*leathermani*), (*nelsoni*), *placida*, (*puttmanni*), (*roblei*), (*shawnee*), *shubuta**, *teaysia**

Notes: North Carolina has very high diversity of *Perlesta*, most of which are undescribed at this time. At least five species from NC are currently being associated, a few of which (along with *P. bjostadi* and *P. leathermani*) have been listed by NC Natural Heritage Program as Significantly Rare (2010). *Perlesta georgiae* was described from North Carolina, *Perlesta teaysia* was described from the New River system in southwest Virginia, and *P. cranshawi* was also described from Virginia. *Perlesta decipiens* has been recorded from GSMNP, and *P. shubuta* has been recorded from Congaree N. P. in the South Carolina Coastal Plain. *Perlesta placida* is mostly a Piedmont species. Literature describes *Perlesta* as having a univoltine life cycle. Kondratieff *et al.* are currently revising this genus.

Taxonomic references:

nymphs:

none

adults:

Kondratieff, B. C., R. E. Zuellig, R. F. Kirchner, and D. R. Lenat. 2006. Three new species of *Perlesta* (Plecoptera: Perlidae) from eastern North America and notes on new state records. *Illesia*, 2(5): 31-38.

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). *Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae)*. Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Perlinella

Genus Diagnosis: Nymphs 8-20 mm; eyes set forward from hind margin of head; occiput devoid of spinules; *postocular fringe consists of 1-3 long, slender bristles; 2-5 long setae at pronotal corners; ventral femoral-tibial fringe of silky setae present*; thoracic gills long and feathery; cerci without dorsal fringe; anal gills small or absent; nymph habitus long and slender, brown, with brown clothing hairs, and with a pale yellow M-pattern on head, often interrupted or indistinct.

Habitat: Nymphs occur in gravelly areas and leaf packs. Young nymphs may inhabit the hyporheic. Predaceous.

Distribution and Occurrence: These uncommon nymphs occur primarily in the Sand Hills and southern areas of the Coastal Plain.

Species in NC: TAKE TO SPECIES – *drymo*, *ephyre*, (*zwicki*)

P. drymo – with median ocellus; often with highly contrasting color pattern on thorax (especially pronotum); dorsum of abdomen with faint median longitudinal stripe; small anal gills. Collected during the fall through winter primarily from the southern Coastal Plain and Sand Hills. Relatively rare.

P. ephyre – nymphs 15-23 mm; median ocellus lacking; body color yellowish brown, with no contrasting colors; anal gills present or absent. Collected from Sand Hills and Lumber River typically during the fall through mid-spring. Rare. Listed by NC Natural Heritage Program as Significantly Rare (2010).

(*P. zwicki*) – similar to *P. ephyre*. May be difficult to separate from *P. ephyre* based on body coloration. A Coastal Plain blackwater species. Previously *P. fumipennis* (synonymized by Kondratieff *et al.*, 1988).

Notes: *Perlinella* can be confused with *Hansonoperla*. Nymphs are univoltine.

Taxonomic references:

nymphs:

Kondratieff, B. C., River F. Kirchner and K. W. Stewart. 1988. A review of *Perlinella* Banks (Plecoptera: Perlidae). *Annals of the Entomological Society of America* 89(1): 24-30.

⇒Unzicker, J. D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A. R. Brigham, W. U. Brigham, and A. Gniska, editors. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp.

Zwick, P. 1971. Notes on the genus *Perlinella* and a generic synonymy in North American Perlidae (Plecoptera). *The Florida Entomologist*, 54(4): 315-320.

adults:

Stark, B. P. 2004. Perlidae (The Stones). In Stark B. P and B. J. Armitage (eds). *Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae)*. Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p

PERLODIDAE

Clioperla

Genus Diagnosis: Robust nymph 14-17 mm; *lacinia bidentate and mostly quadrate*; large light area on dorsum of head; dark bar connecting lateral ocelli and eyes; submental gills absent; *pronotum surrounded by a dark border and with lateral edges pale*; dorsum of abdomen with longitudinal stripes sometimes vague and diffuse; *each tergite with up to 4 pale circular dots transversely across the segment, the 2 median dots often most prominent*; cerci with dorsal fringe of short, silky setae on apical segments only.

Habitat: Nymphs are predators of leaf pack invertebrates. They can be also be found in detritus in riffles.

Distribution and Occurrence: Common and widespread in both small streams and larger rivers. Nymphs occur October through April.

Species in NC: MONOTYPIC – *clio*

Notes: The color pattern may be obscured on small, immature nymphs. Univoltine. *Clioperla* nymphs are facultative. Formerly *Isoperla clio*.

Taxonomic references:

nymphs and adults:

Hitchcock, S. W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or Stoneflies of Connecticut. Bulletin of the State Geological and Natural History Survey of Connecticut. 107. vi + 262 pp. (as *Isoperla clio*)

Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *C. clio*)

Cultus

Genus Diagnosis: *Lacinia bidentate*, gradually tapering, and with two marginal hairs below the subapical tooth and a small patch of submarginal hairs near base; submental gills absent; pronotal setae restricted to 2-3 at corner; *mesosternal Y-arms well developed*; *femora with a dorsal fringe of long silky setae*; abdominal tergites dark anteriorly and light posteriorly; *long setal fringe on dorsum of cerci*.

Habitat: Nymphs are found beneath stones in riffles and in leaf packs. Predaceous.

Distribution and Occurrence: Common in the mountains with a few scattered Piedmont records. Primarily a winter through spring taxon. See species accounts.

Species in NC: TAKE TO SPECIES – *decisus* complex, (*verticalis*)

C. decisus complex – nymphs 12-14 mm; subapical tooth of *lacinia* less than 0.5 times the length of the apical tooth (mean 0.43x); median pronotal maculation diamond-shaped and located in the middle. This is a species complex, with *C. decisus isolatus* in NC, GA, and VA, and *C. decisus decisus* farther north. Nymphs occur primarily in moderate streams to moderate rivers in the Mountains.

(*C. verticalis*) – nymphs 12-15 mm; subapical tooth of *lacinia* approximately 0.6 times the length of the apical tooth; median pronotal maculation located near the posterior margin, not diamond-shaped but diffuse. This species may be restricted to small or moderately sized streams in the Mountains. Recorded from GSMNP.

Notes: In smaller specimens, the meso- and sometimes metanotum may be reddish. *Cultus* species are univoltine. *Cultus* can be confused with *Helopicus* or *Diploperla morgani*. The presence of a dorsal setal fringe on the cerci will separate *Cultus* from *Diploperla* while the absence of submental gills on *Cultus* should separate it from *Helopicus*.

Taxonomic references:

nymphs:

⇒ Myers, L. W. and B. C. Kondratieff. 2009. Descriptions of the nymphs of eastern North American species of *Cultus* (Plecoptera: Perlodidae). Entomologica Americana 115(2):109-114.

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P. and B. J. Armitage (eds), Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Stark, B. P., S. W. Szczytko and B. C. Kondratieff. 1988. The *Cultus decisus* complex of Eastern north America (Plecoptera: Perlodidae). Proceedings of the Entomological Society of Washington, 90(1): 91-96.

PERLODIDAE

Diploperla

Genus Diagnosis: Lacinia subtriangular, bidentate with no marginal hairs and a very small patch of submarginal hairs, slender; submental gills present or not; pronotal setae restricted to 2-3 at corner; *fork and stem of mesosternal arms incomplete; femora without a dorsal fringe of long silky setae, although stiff scattered setae present; cerci without long setal fringe but with scattered robust setae.*

Habitat: Nymphs occur in leaf packs. Predaceous.

Distribution and Occurrence: Found in the Mountains and Piedmont in small streams to small rivers during fall through early spring. See species accounts.

Species in NC: TAKE TO SPECIES – *duplicata*, *kanawholensis**, *morgani*, *robusta**

D. duplicata – nymphs 11-14 mm; submental gills absent; light brown in color with no distinct dark markings. A relatively common species collected in the Mountains and Piedmont from October through May.

*D. kanawholensis** – nymphs 14-18 mm; base of lacinia with 1-4 hairs; submental gills present; dark band enclosing ocellar triangle; anterior margin of abdominal terga dark brown. This nymph is very similar to *D. morgani* and may not be reliably separated. Described from WV and recorded from VA and KY, this species may be restricted to more northerly eastern states.

D. morgani – nymphs 14-17 mm; submental gills present; dark longitudinal streak on the femora and dark bands on the abdominal terga occasionally incomplete medially; no dorsal setal fringe on cerci. Mostly found in December through April in the Mountains and Foothills. Relatively rare. Described from VA. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

*D. robusta** – nymphs 12-19 mm; submental gills present; bands on tergites widely interrupted medially; femoral bands absent. Range may be similar to the other species. Recorded from TN, VA, WV, and GSMNP.

Notes: Careful attention should be given to generic characters as *Diploperla* nymphs, particularly those with contrasting color patterns, could be confused with *Cultus* and *Helopicus*.

Taxonomic references:

nymphs:

Kirchner, R. F. and B. C. Kondratieff. 1984. A new *Diploperla* from West Virginia (Plecoptera: Perlodidae). Proceedings of the Entomological Society of Washington 86(3): 648-652. (description of *D. kanawholensis*)

⇒ Kondratieff, B. C., R. F. Kirchner and J. R. Voshell Jr. 1981. Nymphs of *Diploperla*. Annals of the Entomological Society of America 74: 428-430.

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Helopicus

Genus Diagnosis: Lacinia triangular, bidentate sometimes with a small tuft of setae originating on a small knob and with a row of marginal hairs approaching base; *right mandible with five teeth; prominent submental gills, about three times longer than wide; frons with a complete dark transverse band through ocellar triangle; cerci with a dorsal fringe of setae.*

Habitat: Nymphs are associated with leaf packs and submerged logs in high velocity water. Predaceous.

Distribution and Occurrence: Widespread but common only in the Mountains from fall through winter. See species accounts.

Species in NC: TAKE TO SPECIES – *bogaloosa*, *subvarians*

H. bogaloosa – nymphs 17-20 mm; dark transverse band with two dark lobes projecting into anterior light area; occipital spinules typically grouped into a single irregular row. Collected October through March primarily in the Sand Hills and Coastal Plain. Uncommon to rare.

H. subvarians – nymphs 17-20 mm; anterior margin of dark, transverse ocellar band a straight line or mostly so; occipital spinules grouped into broad patch of 2-3 irregular rows. Nymphs occur September through April in the Mountains and Slate Belt (Uwharrie Mountains). Relatively uncommon.

Notes: *Helopicus* nymphs tend towards having a noticeable medial frontal bulge on the clypeus. Although this character is not diagnostic, it may be useful for separating *Helopicus* from *Cultus* and *Diploperla*. It should be noted, however, that *Hydroperla phormidia* also possesses a labrum with a central bulge. Both North Carolina species of *Helopicus* are univoltine.

PERLODIDAE

Taxonomic references:

nymphs:

⇒ Stark, B. P. and D. H. Ray. 1983. A revision of the genus *Helopicus* (Plecoptera: Perlodidae). *Freshwater Invertebrate Biology* 2(1): 16-27.

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). *Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae)*. Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

(*Hydroperla*)

Genus Diagnosis: Nymphs 14-20 mm; lacinia triangular, bidentate sometimes with a small tuft of setae originating on a rudimentary knob and with a row of marginal hairs approaching base; *right mandible with 4 teeth*; distal tooth of mandibles without denticles; *submental gills 2-2.5 times longer than wide*; *transverse dark pigment band of frons interrupted*; mesosternum with no median ridge; cerci with a dorsal fringe of setae.

Habitat: Nymphs are found in leaf packs associated with blue-green algae. Predaceous.

Distribution and Occurrence: Collected from larger brownwater rivers in the Coastal Plain during the late fall through early spring. Rarely collected.

Species in NC: TAKE TO SPECIES – (*phormidia*)

(*H. phormidia*) – nymphs 13-27 mm; labrum with central anteromedial projection; dark pigment band of anterior frontoclypeus absent, instead represented by 4 dark pigment patches; row of 6-8 small dots on anterior half of each abdominal tergite; origins of intercalary bristles of abdomen pigmented giving body a speckled appearance. Listed by NC Natural Heritage Program as Significantly Rare (2010).

Notes: *Hydroperla phormidia* is likely the only species in North Carolina, although the BAU has no nymphal records. Unzicker and McCaskill (1982) records of *H. fugitans* are apparently in error (Kondratieff and Painter, 1986). Carolina Power and Light biologists collected nymphs from the Pee Dee River (origin of BAU reference specimen) and Kondratieff and Kirchner (2004) found adults along Lumber River at Columbus/Robeson county line. *Hydroperla phormidia* is univoltine.

Taxonomic references:

nymphs:

⇒ Nelson, C. H. 1996. Placement of *Helopicus rickeri* Stark in *Hydroperla* Frison (Plecoptera: Perlodidae) with the description of the adult female, nymph, and egg and a cladistics analysis of *Hydroperla*. *Proceedings of the Entomological Society of Washington* 98(2): 237-244.

Ray, D. H. and B. P. Stark. 1981. The Nearctic species of *Hydroperla* (Plecoptera: Perlodidae). *Florida Entomologist* 64: 385-395.

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). *Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae)*. Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Kondratieff, B. C. and 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(3): 361-363. (record for *H. phormidia*)

Kondratieff, B. C. and W. B. Painter. 1986. Two new records of stoneflies (Plecoptera: Perlodidae) from South Carolina. *Entomological News* 97: 17-20.

Nelson, C. H. 1996. Placement of *Helopicus rickeri* Stark in *Hydroperla* Frison (Plecoptera: Perlodidae) with the description of the adult female, nymph, and egg and a cladistics analysis of *Hydroperla*. *Proceedings of the Entomological Society of Washington* 98(2): 237-244

Ray, D. H. and B. P. Stark. 1981. The Nearctic species of *Hydroperla* (Plecoptera: Perlodidae). *Florida Entomologist* 64: 385-395.

Isogenoides

Genus Diagnosis: Lacinia triangular, bidentate with a distinct knob below the subapical tooth and with a row of marginal hairs approaching base; *mesosternum with median longitudinal suture joining fork of mesosternal grooves to transverse anterior suture*; *prominent submental gills, projecting about three times their basal width*; cerci with a dorsal setal fringe; body light brown with contrasting darker brown pattern, covered with clothing hairs.

Habitat: Nymphs occur in cobble riffles and from gravel or cobble areas near banks. Early instars are hyporheic. Predaceous.

Distribution and Occurrence: Primarily collected in small streams to small rivers in the Mountains from late September through April. Relatively uncommon.

Species in NC: TAKE TO SPECIES – *hansoni*, (*varians*)

I. hansoni – nymphs 16-24 mm; large denticles on the ventral mandibular tooth; conspicuous, sharply delineated M-shaped pale mark anterior to median ocellus; ocellar triangle bordered by dark but with pale central spot; dark transverse bands on anterior third to half of terga 1-9 and a dark, transverse band along each posterior margin. Relatively rare. Recorded from GSMNP.

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(*I. varians*) – nymphs 15-21 mm; general body color yellow with indistinct M-head pattern, demarked by dark clothing setae; narrow dark transverse bands on anterior margin of abdominal terga only. One adult male collected by Kondratieff and Kirchner (2004) along Yadkin River at Davie/Davidson county line.

Notes: Nymphs have been documented as inhabiting streams that support trout populations. Unpublished observations (Hanson and Stewart, 2005a) suggest a semivoltine life cycle for some species while some published literature reports both a univoltine cycle and semivoltine cycle for others (Hanson and Stewart, 2005b, *et al.*).

Taxonomic references:

nymphs and adults:

Kondratieff, B. C. and 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(3): 361-363. (record for *I. varians*)

⇒ Sandberg J. B. and K. W. Stewart. 2005a. Holomorphology and systematics of the stonefly genus *Isogenoides* (Plecoptera: Perlodidae). *Transactions of the American Entomological Society* 131(3-4): 269-345.

Sandberg J. B. and K. W. Stewart. 2005b. Life history of the stonefly *Isogenoides zionensis* (Plecoptera: Perlodidae) from the San Miguel River, Colorado *Illiesia*, 1(4):1-12

Isoperla

Genus Diagnosis: *Isoperla* nymphs have a combination of most or all of the following characters: lacinia bidentate with apical tooth shorter than rest of lacinia and typically without low rounded knob; lacinial margin with row or tuft of at least 4-5 long setae, some species with row approaching base; submental gills absent; occiput and prothoracic anterolateral margins usually with rows of short, stout setae; mesosternal Y-arms straight; dorsum of abdomen usually with longitudinal pigment bands (some distinct species with transverse bands); only inner margins of apical segments of cerci fringed with setae or not at all.

Habitat: Nymphs occur under cobbles in riffles and in leaf packs. Omnivorous to predaceous.

Distribution and Occurrence: *Isoperla* nymphs are typically collected during late fall through spring. See species accounts.

Species in NC: PROVISIONALLY TAKE TO SPECIES – see notes below; (*bellona*), *bilineata* gr., *burksi*, (*davisi*), *dicala*, (*distincta* complex), *frisoni*, *holochlora*, nr. *holochlora*, *lata*, *marlynia**, *montana**, nr. *namata*, , *orata*, nr. *richardsoni*, *similis* gr., nr. *slossonae*, *transmarina* gr., *sp. 10*, *sp. A*

Group 1 (Provisional) – Described or distinctive nymphs:

I. bilineata gr. – nymphs 10-14 mm; lacinia receding from base, with row of setae below subapical tooth approaching base; ocellar triangle completely enclosed with a small medial pale spot; 6-8 dark spots on each abdominal tergite. Nymphs of this species may exhibit either a light or dark phase with the dark phase nymphs having the large pale spot anterior to the median ocellus enclosed or mostly so. The nymph is pictured in Stewart and Stark (2002). Widespread but most common in the Mountains. Nymphs commonly occur October through early May. *Isoperla bilineata* is one of the few facultatively tolerant *Isoperla* species. Possibly a species complex.

I. burksi – nymphs ~ 11 mm; lacinia with apical tooth as long as sclerite bearing it, with 1-2 setae below the subapical tooth; large pale area anterior to median ocellus, ocellar spot large and sometimes apparently open behind though narrowly; transverse bands along posterior margins of abdominal terga. Nymphs occur only in the Carolina Slate Belt in the winter. Relatively rare.

I. dicala – nymphs ~ 10; apex of lacinia broad although still narrower than base, with row of setae below subapical tooth; pale marks anterior to median ocellus sometimes indistinct, sometimes with darker border; body and abdomen often speckled, particularly posterior segments; dark longitudinal abdominal stripes with very narrow pale borders. Nymphs are collected from the Mountains and Piedmont during the winter and spring.

I. frisoni – nymphs 10-14 mm; lacinia with low knob below subapical tooth which bears a tuft of setae; dark transverse band on head with backward extensions to lateral ocelli; pro-, meso-, and metanotum pale except for an anterior and posterior pair of dark submedial spots, those on the pronotum usually larger and more irregular; abdomen with 3 dark, thin longitudinal lines; cerci dark basally. There are no BAU records since 1990 as this is primarily a northern species. Recorded from GSMNP. Listed by NC Natural Heritage Program as Significantly Rare (2010).

I. holochlora – nymphs 11-14 mm; apex of lacinia narrower than base, with row of setae below subapical tooth; pale area anterior to median ocellus open to labrum, an oval spot lateral to each side of the ocellar triangle; ocellar spot narrowly, often barely, open behind; dark, abdomen with longitudinal stripes, median stripe narrow and interrupted, often obscured. Nymphs are common and abundant the Mountains and Piedmont from March through August.

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- I. nr. holochlora* – nymphs 9-10; apex of lacinia narrower than base, with row of 5-6 robust setae below subapical tooth and finer setae approaching base; head with a pale M-pattern and with an oval spot lateral to each side of the ocellar triangle; ocellar pale spot absent; lateral abdominal stripes wide and with pale borders, median stripe narrow, sometimes obscured. Relatively common and often abundant primarily in the Mountains. Nymphs are collected from winter into late spring.
- I. lata* – nymphs ~ 13 mm; lacinia distinct, broad, apex as wide as base and covered with a dense brush of setae; head with wide, enclosed pale area anterior to median ocellus; ocellar triangle open behind; pronotum with dark border except extreme lateral margins; abdominal with longitudinal stripes, lateral stripes wide with median stripe narrow and interrupted. Nymphs are relatively rare and are collected from the Mountains only from September through May. Listed by NC Natural Heritage Program as Significantly Rare (2010).
- I. nr. namata* – nymphs ~ 11 mm; apex of lacinia narrower than base, constricted medially, with row of setae below subapical tooth approaching base; North Carolina specimens have a dark transverse band on head usually without backward extensions to lateral ocelli but *sometimes* with extensions and with lighter brown areas behind ecdysial line; abdominal longitudinal lines narrow; abdominal tergites with a transverse row of 6-8 sometimes faint dots. *Isoperla namata* is supposedly geographically restricted to the Ozarks and the midwest (although the 1995 checklist for NC lists this species as occurring here) and, therefore, BAU records for *I. namata* may represent an undescribed species (B. Kondratieff, personal communication). Found in the Mountains and Piedmont during the winter and early spring.
- I. orata* – nymphs 11.5-14.5 mm; lacinia with apical tooth as long as sclerite bearing it, with a tuft of setae below the subapical tooth; head with a dark transverse band through the median ocellus and ocellar triangle enclosed with a large pale spot; dorsum of abdomen with three dark, narrow longitudinal stripes, the central stripe often faint or discontinuous. Nymphs primarily occur in the Mountains in medium to small mid-elevation streams from March through May. Uncommon.
- I. nr. richardsoni* – nymphs 10-13.5 mm; lacinia narrower apically, with large tuft, not row, of hairs below subapical tooth; dark transverse band on head with backward extensions to lateral ocelli and with lateral extensions projection anteriorly to labium enclosing or almost enclosing large anterior pale area; dorsum of abdomen with two dark lateral stripes and one median stripe, all subequal in width; 6-8 dark spots on each abdominal tergite, often indistinct or obscured. To date, *Isoperla nr. richardsoni* has only been collected from Moore County in the Sand Hills in February and April. The true *I. richardsoni* is a northerly species.
- I. similis* gr. – nymphs 12-15 mm; apex of lacinia slightly narrower than base and slightly constricted medially, with row of 4-5 stout setae below subapical tooth; head brown with a pair of pale spots near labral suture, a pale M-shaped mark anterior to median ocellus and pale marks anterolateral to the lateral ocelli; abdomen brown with a light median longitudinal stripe and with a pair of faint submedian pale dots on each segment. Head and body covered with dark clothing hairs. This may be a group of at least two cryptic species. A specimen near this description was collected from Mt. Mitchell by D. Lenat. Collected from headwater Mountain streams and medium rivers during the winter and early spring. Relatively uncommon.
- I. nr. slossonae* – nymphs up to 14 mm; apex of lacinia narrower than base, with row of setae below subapical tooth approaching base; pale quadrate spot anterior to median ocellus and a light, often triangular spot in ocellar triangle; head pale behind ecdysial line except for two short submedial extensions; pronotum with extensive pale areas including lateral margins, wingpads with thick, dark stripes; abdomen brown to dark brown with rows of light spots often confluent with each other giving abdomen a striped appearance, sometimes speckled; posterior margin of tergite ten pale; dark bands near apices of femora and bases of the tibiae. Nymphs are uncommon and found only in the northeastern Blue Ridge, particularly in the New and Watauga River Basins. Formerly called *Isoperla nr. lata* and *I. nr. bilineata* in BAU database. BAU specimens of North Carolina nymphs formerly designated as either “*I. slossonae*” or “nr. *slossonae*” do not match original descriptions, keys, or photos of *I. slossonae* from other areas of the eastern United States. These specimens therefore, may represent an undescribed species and were transferred to *I. sp. A*”.
- I. transmarina* gr. – consists of both *I. davisii* and *I. transmarina*. Nymphs 10-14 mm; apex of lacinia narrower than base and constricted medially, with row of 5-6 stout setae below subapical tooth; pale area anterior to median ocellus enclosed (*davisii*) or not enclosed and open in front (*transmarina*); width of triangular pale spot in ocellar triangle about one half the distance between the lateral ocelli, possibly open behind (*transmarina*) or closed behind (*davisii*); longitudinal abdominal stripes subequal in width, with narrow pale borders. The nymph and adult of *I. davisii* are pictured in Pescador *et al.* (2000). *Isoperla davisii* adults are common in the lower Piedmont and Coastal Plain (B. Kondratieff unpublished data) although there are no BAU records. These two species may have overlapping distributions.

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- I. sp. A* – nymphs ~ 12 mm; apex of lacinia narrower than base, with row of 5-6 stout setae below subapical tooth; pale trident-shaped spot anterior to median ocellus and a small light spot in ocellar triangle; head darker (not pale) behind ecdysial line; body often uniformly brown, sometimes dark, including legs, although very faint longitudinal lines on the abdomen can sometimes be seen. BAU specimens of *I. nr. slossonae* appear to be the same species as specimens designated “*I. slossonae*” as the pigmentation, lacinial morphology, and distributions of the two appear almost identical. Nymphs occur in the Mountains from October to June and are relatively common. Formerly called *Isoperla slossonae* and *I. nr. slossonae* in BAU database.
- I. sp. 10* – nymphs ?? mm; apex of lacinia much narrower than base and with low knob below subapical tooth which bears a tuft of setae; head mostly pale with complex pattern of dark markings; pale area anterior to median ocellus open with two large dark dashes near labral suture; dark markings at base of antennae; ocellar triangle pale, open with dark markings behind on ecdysial line; pronotum mostly pale with large paired anterior and posterior markings; distinctive dark longitudinal markings on meso- and metanotum consisting of paired oblique anterior and paired posterior submedial marks; abdomen with three dark longitudinal lines, median stripe slightly wider than lateral ones. Primarily collected from the Sand Hills. Relatively rare.

Group 2 (Provisional) – Difficult, cryptic, or undescribed nymphs

- (*I. bellona*) – nymph unknown. Adults collected from near high elevation, headwater streams. Recorded from GSMNP. Listed as “vulnerable to extirpation” by Morse *et al.* (1997). Described from Black Mountain, North Carolina.
- (*I. distincta* complex) – nymphs unknown; complex of at least three cryptic species. Collected from high elevation, headwater streams. Rare. Recorded from GSMNP. *Isoperla distincta* is listed as “vulnerable to extirpation” by Morse *et al.* (1997).
- I. marlynia** – nymphs 11.5- 14.5 mm; apex of lacinia slightly narrower than base and somewhat truncate, with several strong setae; nymphs often uniformly brown, some color morphs have posterior transverse dark borders on each tergite and a wide medial longitudinal stripe giving the overall appearance of having pale lateral areas on each abdominal segment. Recorded from SC and VA.
- I. montana** – nymphs unknown although may appear similar to those of *Isoperla richardsoni* (see Hitchcock 1974). Anecdotal records from NC, although it appears to be a northerly-distributed species.

Notes: Lengths above are from Hitchcock (1974) and may represent adults as no reference is given as to the life stage. While color patterns are still the primary way to distinguish between species of nymphs, it appears that there is some variation within a series of specimens and that morphological characters such as the lacinia and setation patterns may prove to be more reliable. Many species occurring in North Carolina are either undescribed, unrecorded, and /or cryptic. Also, there are additional nymphal specimens collected by the BAU that do not fit any description above. In fact, there are at least five new, undescribed species from Caldwell County alone (B. Kondratieff, personal communication). The above species accounts are based mostly on occurrence within the BAU database as the systematics of *Isoperla* nymphs is in disarray. Therefore, separation of species should be provisional. **Leave at genus if a clear diagnosis from Group 1 is not possible.** B. Kondratieff and S. Szczytko are revising the adults of eastern Nearctic *Isoperla* but the manuscript will not treat larvae. Recent rearing attempts have associated some nymphs with adults and will continue. *Isoperla* are typically intolerant as a whole and have a univoltine life cycle.

Taxonomic references:

nymphs:

- Frison, T. H. 1942. Studies of North American Plecoptera with special reference to the fauna of Illinois. Illinois Natural History Bulletin 22(2): 235-355.
- ⇒ Hitchcock, S. W. 1974. Guide to the Insects of Connecticut: Part VII. The Plecoptera or Stoneflies of Connecticut. State Geological and Natural History Survey of Connecticut Bulletin 107: 191-211.
- Pescador, M. L., A. K. Rasmussen, B. A. Richard. 2000. A Guide to the Stoneflies (Plecoptera) of Florida. Florida Department of Environmental Protection, Division of Water Resources Management, Tallahassee. 94 pp. + 72 p. Appendix (picture of *I. davisii*)
- Stewart, K.W. and B.P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *I. bilineata*)
- Unzicker, J. D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A. R. Brigham, W. U. Brigham, and A. Gnilka, editors. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp.

adults:

- Hitchcock, S. W. 1974. Guide to the Insects of Connecticut: Part VII. The Plecoptera or Stoneflies of Connecticut. State Geological and Natural History Survey of Connecticut Bulletin 107: 191-211.

PERLODIDAE

Malirekus

Genus Diagnosis: Nymphs 15-19 mm; *distinctive pale “M” pattern on head*; conical submental gills; *triangular lacinia with low marginal knob bearing a tuft of setae and ventral surface with a cluster of approximately 50 clothing hairs near base*; *single curved row of spinules on back of head, obsolete near midline*; labrum concolorous; cerci with dorsal fringe of short, silky setae.

Habitat: Nymphs most often occur under rocks in riffles. Predaceous.

Distribution and Occurrence: Typically collected from small mountain streams and rivers. Nymphs are most common and abundant from fall thru spring but early instars can be collected during the summer months.

Species in NC: TAKE TO SPECIES – *hastatus*

Notes: *Malirekus hastatus* is the only species to occur in the southeastern United States. Separate *Malirekus* from *Yugus* by the single row of spinules on the occiput. The patch of clothing hairs on the lacinia, a traditional diagnostic feature for separation of these two genera, may be difficult to see (setae be dark or clear) or is not always present as the hairs can fall off. Also, some North Carolina specimens have very small, apparently retracted, submental gills particularly in pre-emergent nymphs. This can lead to confusion with *M. iroquois*, a northeastern species of *Malirekus*, which lacks submental gills entirely (Stewart and Stark 2002). *Malirekus* has a slow univoltine life cycle.

Taxonomic references:

nymphs:

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *M. hastatus*)

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Stark, B. P. and S. W. Szczytko. 1988. A new *Malirekus* species from eastern North America (Plecoptera: Perlodidae). Journal of the Kansas Entomological Society, 61(2): 195-199.

(*Oconoperla*)

Genus Diagnosis: Head with pale shallow M-shaped mark; lacinia bidentate with stout setae on low shoulder below subapical tooth, and with finer marginal setae approaching base; submental gills absent; *posterolateral margins of pronotum notched*; *femoral or tibial setal fringe absent*; cerci without dorsal fringe of short, silky setae but with a sparse circlet of short apical hairs, and with numerous small intercalary spines; habitus hairy, dark brown.

Habitat: Unknown. Nymphs occur under rocks in splash zones and seeps. Predominantly predaceous.

Distribution and Occurrence: Nymphs occur in small seeps and springs in high elevation mountains. Very rare.

Species in NC: MONOTYPIC – (*innubila*)

Notes: *Oconoperla* has been collected from a seep to Little Cataloochee Creek by B. Kondratieff. *Oconoperla* was described from Haywood County, NC and has since been recorded from TN, SC, and GSMNP. There are, however, no BAU records or reference specimens. Listed as “vulnerable to extirpation” by Morse *et al.* (1997).

Taxonomic references:

nymphs:

Stark, B. P. and K.W. Stewart. 1982. *Oconoperla*, a new genus of North American Perlodinae (Plecoptera: Perlodidae). Proceedings of the Entomological Society of Washington 84(4): 747-752.

Stark, B. P. 1985. Notes on *Oconoperla* (Plecoptera: Perlodidae). Entomological News 96(4): 151-155.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *O. innubila*)

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B.P and B.J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Remenus

Genus Diagnosis: Nymph small, less than 10mm; head with faint M-shale pale mark; *lacinia unidentate, with a widely shallow base and with a single, long tooth*; submental gills absent; cerci without dorsal fringe of short, silky setae but with a circlet of long apical hairs; habitus brown, without conspicuous markings.

Habitat: Unknown. Predominantly predaceous.

Distribution and Occurrence: Nymphs are common March through June throughout in small to mid-sized streams in the Mountains and Inner Piedmont.

Species in NC: LEAVE AT GENUS – *bilobatus*, *duffieldi**, *kirchneri**

PERLODIDAE

R. bilobatus – nymph fits genus description. Originally described as *Perla bilobata* from Black Mountain, NC.

*R. duffieldi** – nymphs undescribed, but similar to those of *R. bilobatus*. Occurs in small mountain streams. Described from Towns and Union Counties, GA (Kondratieff and Nelson, 1995), adjacent to Cherokee and Clay Counties, NC.

*R. kirchneri** – nymph unknown. Known from small headwater spring-fed streams in Blue Ridge physiography. Adults are described from Patrick and Floyd Counties, VA (Kondratieff and Nelson, 1995) and recorded from Carter County, TN, adjacent to Avery County, NC.

Notes: So far *Remenus bilobatus* is the only species to be collected from North Carolina as adults. It is possible, however, that nymphs of the other species are unknowingly being collected and, therefore, identifications should be left at genus. There are no life history studies of *Remenus*.

Taxonomic references:

nymphs:

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *R. bilobatus*)

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

Kondratieff, B. C. and C. H. Nelson. 1995. A review of the genus *Remenus* Ricker (Plecoptera: Perlodidae), with descriptions of two new species. Proceedings of the Entomological Society of Washington 97(3): 596-602. (description of *R. kirchneri*)

Yugus

Genus Diagnosis: Pale yellow “M” pattern on head; *lacinia* with sharp knob and marginal setal row that extends from apical tooth to near base; labrum with yellow longitudinal mesal band; double or triple row of setae on back of head; submental gills short or absent; cerci with dorsal fringe of short, silky setae.

Habitat: Unknown but possibly occur in riffles and leaf packs. Predominantly predaceous.

Distribution and Occurrence: Nymphs occur in the Mountains only from late summer through spring. Relatively common. See species accounts.

Species in NC: TAKE TO SPECIES - *arinus*, *bulbosus*, *kirchneri**, (*kondratieffi*)

Y. arinus – nymphs 15-21 mm; mandible with 4 teeth; incomplete M-pattern on head, open anteromedially; lateral margins of frontoclypeus widely dark; pale ocellar spot not enclosed by significantly darker pigmentation posteriorly; coloration of head posterior to epicranial suture pale yellow, without dark pigmentation. Nymphs occur during the winter and spring and are uncommonly collected.

Yugus bulbosus complex – separates from *Y. arinus* by having a complete M-shaped pale mark anterior of median ocellus; mandible with five teeth; occiput between eyes with two enclosed oval areas patterned with indistinct lines.

Y. bulbosus – nymphs 10-13 mm; pale ocellar spot enclosed by dark pigmentation posteriorly; dark pigmentation posterior to epicranial suture stops at setal row, although some dark pigmentation may be present on posterior margin of head. Collected during the winter through spring in the Mountains only. This is the most commonly collected species of *Yugus*.

*Y. kirchneri** – nymphs 12-16 mm; labrum with darker lateral areas barely extending to posterior margin; lateral margins of the frontoclypeus pale and connecting the pale M-shaped mark with the pale transverse frontoclypeal labral suture giving the head the overall appearance of a smaller dark M-shaped mark within a larger pale area; dark pigmentation posterior to epicranial suture continues in some places to posterior margin of head.

(*Y. kondratieffi*) – nymphs 10-13 mm; head pattern similar but slightly different than *Y. bulbosus*.

Notes: The setal row on frons works well to separate *Yugus* nymphs from *Malirekus* nymphs. Use Nelson (2001) to compare head patterns for each species. The head patterns in Nelson (2001) and Stewart and Stark (2002) for *Y. kirchneri* do not completely agree suggesting some variability in head patterns, possibly for all species. Life history studies on any species of *Yugus* have not been found.

Taxonomic references:

nymphs:

⇒ Nelson C. H. 2001. The *Yugus bulbosus* complex, with a comment on the phylogenetic position of *Yugus* within the eastern Perlodini (Plecoptera: Perlodidae: Perlodinae). Proceedings of the Entomological Society of Washington. 103: 601-619.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp. (habitus of *Y. kirchneri*)

adults:

Kondratieff, B. C. 2004. Perlodidae (The Springflies). In Stark B. P and B. J. Armitage (eds). Stoneflies (Plecoptera) of Eastern North America. Volume II. Chloroperlidae, Perlidae, and Perlodidae (Perlodinae). Ohio Biological Survey Bulletin, New Series. 14 (4). vi + iv p.

PTERONARCYIDAE

Pteronarcys

Genus Diagnosis: Large, nymphs 35-50 mm; *branched gills present on thoracic sterna and on abdominal sternites 1 and 2; lateral pronotal margins not convex*; cerci with a weak dorsal fringe of short setae; body typically dark and nymphs of most species have a transverse row of yellow spots on anterior margin of each tergite.

Habitat: Nymphs occur in accumulated detritus under rocks in swift riffles as well as in leaf packs and on woody debris in areas of good flow. Nymphs are primarily detritivorous although they are also facultative predators.

Distribution and Occurrence: Collected year round from small, high elevation streams to larger, warmer rivers. See species accounts for distributions.

Species in NC: TAKE TO SPECIES – *biloba*, *comstocki*, *dorsata*, *proteus*, *scotti*

P. biloba – lateral margin of frontoclypeus with small triangular tubercles adjacent to, and partially obscuring, antennal pedicels; anterolateral angles of pronotum conspicuously produced into hook-like processes, although North Carolina specimens less so; abdominal hooks divergent, often with low knob on the posterior margin of one or more of the pairs, and conspicuous on abdominal segments 7-8; antennae and cerci with a pale yellow medial band; cerci greater than half the length of the abdomen. Nymphs occur year-round in the Mountains from June through February. Semivoltine

P. comstocki – a pair of conspicuous yellow spots lateral to ocellar triangle; frontoclypeus with anterolateral projections and with triangular tubercles adjacent to, and partially obscuring, antennal pedicels; lateral angles of pro-, meso- and metanotum produced into spine-like processes; apices of each femur, tibia and tarsus pale yellow; lateral hooks divergent and conspicuous on abdominal segments 7-8; cerci less than half the length of the abdomen and with yellow submesal band. Collected only recently (2007-2008) from the Catawba River and French Broad River basins. Listed by NC Natural Heritage Program as Significantly Rare (2010).

P. dorsata – frontoclypeus with lateral and somewhat truncate lobes adjacent to antennal pedicels; lateral angles of pronotum produced, anterolateral ones almost hook-like; no lateral projections on abdominal segments; each tergite with anterior and posterior abdominal spots sometimes confluent to give the abdomen a longitudinally striped appearance (3-5 stripes possible). Common and widespread (excluding Slate Belt). Univoltine although BAU data suggests a semivoltine life history with nymphs most abundant from June to October. Associated with *Podostemum ceratophyllum* (riverweed).

P. proteus – lateral margin of frontoclypeus with a low rounded protuberance adjacent to each antennal pedicel; anterolateral projections on pronotum reduced, barely discernible; lateral hooks appressed and not conspicuous on abdominal segments 7-8, the length of those on segment 5, as measured on the posterior surface, one-third to one-fourth the length of the tergite; cerci more than half to three-quarters the length of the abdomen; antennae with a narrow, yellow mesal band. Collected from Mountains and Northern Inner Piedmont. Relatively common although historical data includes *P. scotti*. Merovoltine (3-4 years).

P. scotti – female nymphs up to 45 mm, males somewhat smaller; lateral margin of frontoclypeus with a low rounded protuberance adjacent to each antennal pedicel; anterolateral projections on pronotum easily discernible; lateral hooks appressed and not conspicuous on abdominal segments 6-8, the length of those on segment 5, as measured on the posterior surface, one-fifth to one-sixth the length of the tergite; cerci somewhat reduced, about 0.4 the length of the abdomen; antennae and cerci may be pale with darker medial segments or with a pale medial band. Nymphs occur throughout the year in the Mountains and are more common than BAU records indicate. Probably semivoltine. Recorded from GSMNP.

Notes: *Pteronarcys* species are conspicuously absent from the Carolina Slate Belt. Confusion between the identity of *Pteronarcys proteus* and *P. scotti* has rendered BAU records of *Pteronarcys proteus* suspect. *Pteronarcys pictetii*, the only other eastern species, is apparently inseparable from *P. dorsata* but is restricted to the Midwest. Although some species may be semi- or merovoltine as nymphs, others may have a long diapause as eggs and then nymphal growth up to a year after hatching (still technically semivoltine). Different cohorts coexist within the same stream yielding a range of sizes. Interestingly, some species (and perhaps all) of *Pteronarcys* exhibit thanotosis (freezing and curling into a ball) or autohemorrhaging (reflex bleeding of hemolymph) as defensive behaviors.

Taxonomic references:

nymphs:

Ricker, W. E. 1952. Systematic studies in Plecoptera. Indiana University Publications, Science Ser 18: 1-200.

(key to and description of *P. scotti*)

⇒ Tarter, D. C., M. L. Little, R. F. Kirchner, W.D. Watkins, R. G. Farmer and D. Steele. 1975. Distribution of pteronarcid stoneflies in West Virginia (Insecta: Plecoptera). Proceedings of the West Virginia Academy of Science 47: 79-85.

adult:

Nelson C. H. 2000. Pteronarcyidae (The Salmonflies). In B. P. Stark and B. J. Armitage (editors). Stoneflies (Plecoptera) of Eastern North America. Volume I. Pteronarcyidae, Peltoperlidae, and Taeniopterygidae. Ohio Biological Survey Bulletin New Series Volume 14 Number 1. vii + 100 pp

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- Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. The Caddis Press. Columbus, Ohio, xii + 510pp.
- Stewart, K. W. and B. P. Stark 2008. Chapter 14. Plecoptera. pp 311-384. In R. W. Merritt, K. W. Cummins and M. B. Berg (editors). An Introduction to the Aquatic Insects of North America. Fourth edition. Kendall Hunt Publishing. Dubuque, Iowa. pp 1158.
- Unzicker, J. D. and V. H. McCaskill. 1982. Plecoptera, Chapter 5 (50 pp.). In A. R. Brigham, W. U. Brigham, and A. Gnilka (editors). *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois. 837pp. ** (with checklists) **

Checklists

- DeWalt, R. E. and B. D. Heinold. 2005 Summer emerging Ephemeroptera, Plecoptera, and Trichoptera of Abrams Creek, Great Smoky Mountains National Park. Proceedings of the Entomological Society of Washington 107(1): 34-48.
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- Stark, B. P., S. W. Szczytko and R. W. Baumann. North American stoneflies (Plecoptera): systematics, distribution, and taxonomic references. The Great Basin Naturalist 46(3):383-
- Stark, Bauman and DeWalt, Plecoptera Society of North America web page: <http://plsa.inhs.uiuc.edu/plecoptera/> Valid Names for North American stonefly species.

Current Article

Rare three tailed stone fly discovered in Manhattan sewer



Tags: fossil insect, mayfly, stonefly, entomology

“Scientists claim the below fossil to be that of a rare mayfly.

I think they spent a couple hundred grand of their parent’s hard earned cash on beer drinking and frat parties – more, if they have a Ph.D.

Mayfly, my ass – anyone above the age of six knows that’s a stone fly.

Science. We serve it up so you can hate it all over again.” KBarton10 Aug 28, 2009

2 Comment(s)

Pete | [Sep 30, 2010](#) | [Reply](#)

i don’t want to diassapoint you, but this certainly isn’t a stonefly nymph. sonefly nymphs have only two abdominal appendages. this fossil has three. it really is a mayfly nymph.
at least don’t make idiots from people who have the knowledge. 😊

KBarton10 | [Sep 30, 2010](#) | [Reply](#)

It was a joke Pete. The nymph is encased in stone – making it a “stone fly” ...
My sense of humor is always suspect at best, but I run with it just the same.

Confirmed stonefly genera and species occurring in North Carolina with distributional and tolerance data. M = Mountains, P = Piedmont, CP = Coastal Plain, SB = Slate Belt, SH = Sand Hills. x = found at 2-25 waterbodies, X = 26-50 waterbodies, ⊗ = more than 50 waterbodies (predominate ecoregion). The number "1" indicates that the taxon has been collected from only 1 waterbody in that ecoregion. Taxa without tolerance values have less than 50 records with an associated final bioclassification.

| Taxonomic Hierarchy | | | Ecoregion * | | | | | NCBI Tol. Value | Total No. BAU Records ** | Ref. Spec. Avail. | Notes |
|-----------------------|-------------------|---|-------------|---|----|-------------------|----|-----------------|--------------------------|-------------------|---|
| | | | Level III | | | Selected Level IV | | | | | |
| Family | Genus | Species | M | P | CP | SB | SH | | | | |
| Capniidae | | | | | | | | | | | |
| | <i>Allocapnia</i> | | X | X | x | X | X | 3.3 | 1121 | ✓ | |
| | | <i>aurora</i> Ricker, 1952 | | | | | | | | | |
| | | <i>fumosa</i> Ross, 1964 | | | | | | | | | Vulnerable to extirpation (Morse <i>et al.</i> , 1997) |
| | | <i>nivicola</i> (Fitch, 1847) | | | | | | | | | |
| | | <i>recta</i> (Claassen, 1924) | | | | | | | | | |
| | | <i>rickeri</i> Frison, 1942 | | | | | | | | | |
| | | <i>stannardi</i> Ross, 1964 | | | | | | | | | |
| | | <i>virginiana</i> Frison, 1942 | | | | | | | | | |
| | | <i>wrayi</i> Ross, 1964 | | | | | | | | | |
| | <i>Nemocapnia</i> | | | | | | | | | | |
| | | <i>carolina</i> Banks, 1938 | | | | 1 | | --- | 1 | ✓ | Jackson Cr, Moore Co, 1989 |
| | <i>Paracapnia</i> | | | | | | | | | | |
| | | <i>angulata</i> Hanson, 1961 | ⊗ | | 1 | | | --- | 47 | ✓ | |
| Chloroperlidae | | | | | | | | | | | |
| | <i>Alloperla</i> | | ⊗ | x | | 1 | | 1.0 | 81 | ✓ | |
| | | <i>atlantica</i> Baumann, 1974 | | | | | | | | | |
| | | <i>chloris</i> Frison, 1934 | | | | | | | | | |
| | | <i>lenati</i> Kondratieff and Kirchner, 2004 | | | | | | | | | Significantly Rare (NC NHP 2010), described from NC |
| | | <i>nanina</i> Banks, 1911 | | | | | | | | | described from NC |
| | | <i>neglecta</i> Frison, 1935 | | | | | | | | | |
| | | <i>petasata</i> Surdick, 2004 | | | | | | | | | |
| | | <i>usa</i> Ricker, 1952 | | | | | | | | | |
| | <i>Haploperla</i> | | | | | | | | 5 | | |
| | | <i>brevis</i> (Banks, 1895) | ⊗ | X | 1 | x | x | 1.4 | 221 | ✓ | |
| | | <i>fleeki</i> Kondratieff and Kirchner, 2005 | | | | | 1 | --- | 1 | | Significantly Rare (NC NHP 2010), described from NC, Lower. Little R., Moore Co, 2004 |
| | | <i>parkeri</i> Kondratieff and Kirchner, 2005 | | | | | | | | | Significantly Rare (NC NHP 2010), described from NC |
| | <i>Rasvena</i> | | | | | | | | | | |
| | | <i>terna</i> (Frison, 1942) | x | | | | | --- | 7 | ✓ | Significantly Rare (NC NHP 2010) |
| | <i>Suwallia</i> | | | | | | | | | | |
| | | <i>marginata</i> (Banks, 1897) | ⊗ | x | | 1 | | 2.6 | 209 | ✓ | |

* Records in the Piedmont (distributional data only) do not include Slate Belt or Sand Hills records. ** Total Records are through Oct 2011. † Records are historical.

| Taxonomic Hierarchy | | | Ecoregion * | | | | | NCBI Tol. Value | Total No. BAU Records ** | Ref. Spec. Avail. | Notes |
|---------------------|--------------------|--|-------------|---|----|-------------------|----|-----------------|--------------------------|-------------------|--|
| | | | Level III | | | Selected Level IV | | | | | |
| | | | M | P | CP | SB | SH | | | | |
| Family | Genus | Species | | | | | | | | | |
| | <i>Sweltsa</i> | | ⊗ | x | x | x | x | 0.2 | 469 | ✓ | |
| | | <i>holstonensis</i> Kondratieff and Kirchner, 1998 | | | | | | | | | Vulnerable to extirpation (Morse et al., 1997), Significantly Rare (NC NHP 2010) |
| | | <i>lateralis</i> (Banks, 1911) | | | | | | | | | described from NC |
| | | <i>mediana</i> (Banks, 1911) | | | | | | | | | described from NC |
| | | <i>urticae</i> (Ricker, 1952) | | | | | | | | | Vulnerable to extirpation (Morse et al., 1997) |
| | | <i>voshelli</i> Kondratieff and Kirchner, 1991 | | | | | | | | | |
| Leuctridae | | | | | | | | | | | |
| | <i>Leuctra</i> | | ⊗ | ⊗ | x | X | X | 1.5 | 1620 | ✓ | |
| | | <i>alexanderi</i> Hanson, 1941 | | | | | | | | | |
| | | <i>biloba</i> Claassen, 1923 | | | | | | | | | |
| | | <i>carolinensis</i> Claassen, 1923 | | | | | | | | | described from NC |
| | | <i>ferruginea</i> (Walker, 1851) | | | | | | | | | |
| | | <i>grandis</i> Banks, 1906 | | | | | | | | | described from NC |
| | | <i>mittchellensis</i> Hanson, 1941 | | | | | | | | | |
| | | <i>monticola</i> Hanson, 1941 | | | | | | | | | |
| | | <i>nephophila</i> Hanson, 1941 | | | | | | | | | |
| | | <i>sibleyi</i> Claassen, 1923 | | | | | | | | | |
| | | <i>triloba</i> Claassen, 1923 | | | | | | | | | |
| | <i>Megaleactra</i> | | | | | | | | | | |
| | | <i>williamsae</i> Hanson, 1941 | 1 | | | | | --- | 1 | | Vulnerable to extirpation (Morse et al., 1997) |
| | <i>Paraleuctra</i> | | | | | | | | | | |
| | | <i>sara</i> (Claassen, 1937) | | | | | | | | ✓ | reference specimen from outside agency |
| Nemouridae | | | | | | | | | | | |
| | <i>Amphinemura</i> | | ⊗ | ⊗ | X | ⊗ | x | 3.8 | 911 | ✓ | |
| | | <i>appalachia</i> Baumann, 1996 | | | | | | | | | |
| | | <i>nigritta</i> (Provancher, 1876) | | | | | | | | | |
| | | <i>wui</i> (Claassen, 1936) | | | | | | | | | |
| | <i>Ostrocerca</i> | | | | | | | | | ✓ | reference specimen from D. Lenat |
| | | <i>albidipennis</i> (Walker, 1852) | | | | | | | | | |
| | | <i>truncata</i> (Claassen, 1923) | | | | | | | | | |
| | <i>Paranemoura</i> | | | | | | | | | | |
| | | <i>perfecta</i> (Walker, 1852) | | | | | | | | | |
| | <i>Prostoia</i> | | X | X | x | X | X | 5.2 | 225 | ✓ | |
| | | <i>completa</i> (Walker, 1852) | | | | | | | | | |
| | | <i>hallasi</i> Kondratieff and Kirchner, 1984 | | | | | | | | | described from Great Dismal Swamp |
| | <i>Shipsa</i> | | | | | | | | | | |
| | | <i>rotunda</i> (Claassen, 1923) | x | x | x | x | x | --- | 39 | ✓ | |

| Taxonomic Hierarchy | | | Ecoregion * | | | | | NCBI Tol. Value | Total No. BAU Records ** | Ref. Spec. Avail. | Notes |
|----------------------|-------------------|---|-------------|---|----|-------------------|----|-----------------|--------------------------|-------------------|---|
| | | | Level III | | | Selected Level IV | | | | | |
| Family | Genus | Species | M | P | CP | SB | SH | | | | |
| | <i>Soyedina</i> | | X | x | | | | --- | 27 | ✓ | |
| | | <i>carolinensis</i> (Claassen, 1923) | | | | | | | | | described from NC |
| | | <i>kondratieffi</i> Baumann and Grubbs, 1996 | | | | | | | | | described from NC |
| | | <i>washingtoni</i> (Claassen, 1923) | | | | | | | | | Significantly Rare (NC NHP 2010) |
| | <i>Zapada</i> | | | | | | | | | | |
| | | <i>chila</i> (Ricker, 1952) | x | | | | | --- | 3 | | Vulnerable to extirpation (Morse et al., 1997), Significantly Rare (NC NHP 2010) |
| Peltoperlidae | | | | | | | | | | | |
| | <i>Peltoperla</i> | | | | | | | | | | |
| | | unidentified | | | | | | | | | Blue Ridge Parkway seeps, nymphs not identifiable to species |
| | <i>Tallaperla</i> | | ⊗ | X | | | | 1.3 | 1878 | ✓ | |
| | | <i>anna</i> (Needham and Smith, 1916) | | | | | | | | | |
| | | <i>cornelia</i> (Needham and Smith, 1916) | | | | | | | | | |
| | | <i>elisa</i> Stark, 1983 | | | | | | | | | Vulnerable to extirpation (Morse et al., 1997), Significantly Rare (NC NHP 2010) |
| | | <i>laurie</i> (Ricker, 1952) | | | | | | | | | |
| | | <i>maiya</i> Kondratieff, Kirchner, and Zuellig, 2007 | | | | | | | | | described from NC |
| | | <i>maria</i> (Needham and Smith, 1916) | | | | | | | | | |
| | <i>Viehopera</i> | | | | | | | | | | |
| | | <i>ada</i> (Needham and Smith, 1916) | x | | | | | --- | 4 | ✓ | |
| Perlidae | | | | | | | | | | | |
| | <i>Acroneuria</i> | | | | | | | | | | |
| | | <i>abnormis</i> (Newman, 1838) | ⊗ | ⊗ | ⊗ | ⊗ | x | 2.1 | 3214 | ✓ | |
| | | <i>arenosa</i> (Pictet, 1841) | X | x | x | X | | 2.4 | 119 | ✓ | |
| | | <i>arida</i> (Hagen, 1861) | | | | | | | | | Vulnerable to extirpation (Morse et al., 1997) |
| | | <i>carolinensis</i> (Banks, 1905) | ⊗ | | 1 | | ⊗ | 1.2 | 199 | | described from NC |
| | | <i>evoluta</i> Klapálek, 1909 | x | 1 | X | x | x | 1.7 | 65 | ✓ | |
| | | <i>filicis</i> Frison, 1942 | x | | | | | --- | 7 | ✓ | |
| | | <i>frisoni</i> Stark and Brown, 1991 | x | x | | | x | --- | 24 | ✓ | |
| | | <i>lycorias</i> (Newman, 1839) | x | x | 1 | X | X | 2.1 | 96 | ✓ | |
| | | <i>perplexa</i> Frison, 1937 | x | | | | 1 | --- | 4 | ✓ | |
| | <i>Agnetina</i> | | | | | | | 1.1 | 65 | | |
| | | <i>annulipes</i> (Hagen, 1861) | x | x | 1 | x | | --- | 29 | ✓ | |
| | | <i>capitata</i> (Pictet, 1841) | X | x | | | | --- | 38 | ✓ | Significantly Rare (NC NHP 2010) |
| | | <i>flavescens</i> (Walsh, 1862) | x | x | | | | --- | 31 | ✓ | |
| | <i>Attaneuria</i> | | | | | | | | | | |
| | | <i>ruralis</i> (Hagen, 1861) | x | | | | | --- | 5 | ✓ | Significantly Rare (NC NHP 2010) |

* Records in the Piedmont (distributional data only) do not include Slate Belt or Sand Hills records. ** Total Records are through Oct 2011. † Records are historical.

| Taxonomic Hierarchy | | | Ecoregion * | | | | | NCBI Tol. Value | Total No. BAU Records ** | Ref. Spec. Avail. | Notes |
|---------------------|--------------------|---|-------------|---|----|-------------------|----|-----------------|--------------------------|-------------------|---|
| | | | Level III | | | Selected Level IV | | | | | |
| Family | Genus | Species | M | P | CP | SB | SH | | | | |
| | <i>Diploperla</i> | | | | | | | --- | 15 | | |
| | | <i>duplicata</i> (Banks, 1920) | ⊗ | X | | x | x | 2.8 | 309 | ✓ | |
| | | <i>morgani</i> Kondratieff and Voshell, 1979 | X | x | | | | --- | 35 | ✓ | Vulnerable to extirpation (Morse <i>et al.</i> , 1997) |
| | <i>Helopicus</i> | | | | | | | --- | 15 | | |
| | | <i>bogaloosa</i> Stark and Ray, 1983 | | | x | x | x | --- | 31 | ✓ | |
| | | <i>subvarians</i> (Banks, 1920) | ⊗ | x | | x | | 1.2 | 153 | ✓ | |
| | <i>Hydroperla</i> | | | | | | | | | | |
| | | <i>phormidia</i> Horn, 1970 | | | | | | | | ✓ | Significantly Rare (NC NHP 2010) |
| | <i>Isogenoides</i> | | | | | | | | | | |
| | | <i>hansoni</i> (Ricker, 1952) | X | x | | | | --- | 46 | ✓ | |
| | | <i>varians</i> (Walsh, 1862) | | | | | | | | | |
| | <i>Isoperla</i> | | | | | | | 3.2 | 121 | | at least 4 species undescribed as nymphs, see text |
| | | <i>bellona</i> Banks, 1911 | | | | | | | | | Vulnerable to extirpation (Morse <i>et al.</i> , 1997), described from NC |
| | | <i>bilineata</i> (Say, 1823) | X | x | x | x | x | 5.2 | 146 | ✓ | possibly a group of cryptic species |
| | | <i>burksi</i> Frison, 1942 | | | | x | | --- | 29 | ✓ | |
| | | <i>davisi</i> James, 1974 | | | | | | | | | |
| | | <i>dicala</i> Frison, 1942 | x | x | | 1 | x | --- | 46 | ✓ | |
| | | <i>distincta</i> Nelson, 1976 | | | | | | | | | Vulnerable to extirpation (Morse <i>et al.</i> , 1997), possibly a group of cryptic species |
| | | <i>frisoni</i> Illies, 1966 | x | | | | | --- | 8 | ✓ | Significantly Rare (NC NHP 2010) |
| | | <i>holochlora</i> (Klapálek, 1923) | ⊗ | X | 1 | x | x | 0.7 | 842 | ✓ | does not include <i>nr. holochlora</i> records |
| | | <i>lata</i> Frison, 1942 | X | | | | | --- | 31 | ✓ | Significantly Rare (NC NHP 2010) |
| | | <i>nr. namata</i> Frison, 1942 | ⊗ | X | x | ⊗ | 1 | 2.5 | 464 | ✓ | not true <i>namata</i> |
| | | <i>orata</i> Frison, 1942 | X | x | 1 | | | 0.0 | 78 | | |
| | | <i>richardsoni</i> Frison, 1935 | | | | | x | --- | 4 | ✓ | possibly not the true <i>I. richardsoni</i> |
| | | <i>similis</i> (Hagen, 1861) | ⊗ | x | 1 | | | 0.8 | 98 | ✓ | possibly a group of cryptic species |
| | | <i>slossonae</i> (Banks, 1911) | ⊗ | x | | | | 1.2 | 86 | | all records are suspect |
| | | <i>transmarina</i> (Newman, 1838) | X | ⊗ | x | x | x | 4.8 | 357 | ✓ | records include <i>I. davisi</i> |
| | <i>Malirekus</i> | | | | | | | | | | |
| | | <i>hastatus</i> (Banks, 1920) | ⊗ | x | | 1 | | 1.0 | 713 | ✓ | |
| | <i>Oconoperla</i> | | | | | | | | | | |
| | | <i>innubila</i> (Needham and Claassen, 1925) | | | | | | | | | Vulnerable to extirpation (Morse <i>et al.</i> , 1997), described from NC |
| | <i>Remenus</i> | | | | | | | | | | |
| | | <i>bilobatus</i> (Needham and Claassen, 1925) | ⊗ | x | | | | 0.9 | 310 | ✓ | described from NC, 2 other species possible |

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|-------------------------|----------------------|--|-------------|---|----|-------------------|----|-----------------|--------------------------|-------------------|-------|
| | | | Level III | | | Selected Level IV | | | | | |
| Family | Genus | Species | M | P | CP | SB | SH | | | | |
| | <i>Yugus</i> | | ⊗ | x | | | | | 16 | | |
| | | <i>arinus</i> (Frison, 1942) | X | | | | | | --- | 33 | ✓ |
| | | <i>bulbosus</i> (Frison, 1942) | ⊗ | | | | | | --- | 89 | ✓ |
| | | <i>kondratieffi</i> Nelson, 2001 | | | | | | | | | |
| Pteronarcyidae | | | | | | | | | | | |
| | <i>Pteronarcys</i> | | ⊗ | ⊗ | x | | x | | 1.8 | 1637 | ✓ |
| | | <i>biloba</i> Newman, 1838 | ⊗ | | | | | | 0.0 | 76 | ✓ |
| | | <i>comstocki</i> Smith, 1917 | x | | | | | | --- | 5 | ✓ |
| | | <i>dorsata</i> (Say, 1823) | ⊗ | ⊗ | x | | x | | 2.4 | 473 | ✓ |
| | | <i>proteus</i> Newman, 1838 | ⊗ | X | | | | | 0.4 | 284 | |
| | | <i>scotti</i> Ricker, 1952 | X | | | | | | | 42 | ✓ |
| Taeniopterygidae | | | | | | | | | | | |
| | <i>Bolotoperla</i> | | | | | | | | | | |
| | | <i>rossi</i> (Frison, 1942) | x | | | | | | --- | 8 | ✓ |
| | <i>Oemopteryx</i> | | | | | | | | | | |
| | | <i>contorta</i> (Needham and Claassen, 1925) | | | | | | | | | |
| | <i>Strophopteryx</i> | | ⊗ | X | x | | ⊗ | x | 3.3 | 412 | ✓ |
| | | <i>appalachia</i> Ricker and Ross, 1975 | | | | | | | | | |
| | | <i>fasciata</i> (Burmeister, 1839) | | | | | | | | | |
| | | <i>limata</i> (Frison, 1942) | | | | | | | | | |
| | <i>Taenionema</i> | | | | | | | | | | |
| | | <i>atlanticum</i> Ricker and Ross, 1975 | x | | | | | | --- | 7 | |
| | <i>Taeniopteryx</i> | | ⊗ | X | ⊗ | | X | x | 6.0 | 421 | |
| | | <i>burksi</i> Ricker and Ross, 1968 | | | | | | | n.a. | 82 ⁺ | ✓ |
| | | <i>lita</i> Frison, 1942 | | | | | | | n.a. | 5 ⁺ | |
| | | <i>lonicera</i> Ricker and Ross, 1968 | | | | | | | | | |
| | | <i>maura</i> (Pictet, 1841) | | | | | | | | | |
| | | <i>metequi</i> Ricker and Ross, 1968 | | | | | | | n.a. | 44 ⁺ | ✓ |
| | | <i>parvula</i> Banks, 1918 | | | | | | | n.a. | 2 ⁺ | ✓ |
| | | <i>ugola</i> Ricker and Ross, 1968 | | | | | | | n.a. | 8 ⁺ | |