Baumann, R.W. & J.J. Lee. 2014. *Neaviperla* is a valid stonefly genus in North America (Plecoptera: Chloroperlidae). *Illiesia*, 10(09):80-87. Available online: http://www2.pms-lj.si/illiesia/Illiesia10-09.pdf

http://zoobank.org/ urn:lsid:zoobank.org:pub:2B06F98F-D1F6-4FB4-8B62-90EE1E780EE2

# *NEAVIPERLA* IS A VALID STONEFLY GENUS IN NORTH AMERICA (PLECOPTERA: CHLOROPERLIDAE)

**Richard W. Baumann[1] and Jonathan J. Lee[2]**

[1] Department of Biology and Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, 84602 U.S.A.
E-mail: richard_baumann@byu.edu

[2] 2337 15th Street, Eureka, California, 95501 U.S.A.
E-mail: jlee@humboldt1.com

## ABSTRACT

*Neaviperla forcipata* is figured as line drawings and scanning electron micrographs and reasons are given why *Neaviperla* Ricker 1943 should be a separate genus rather than a synonym of the genus *Suwallia* Ricker, 1943.

**Keywords:** Plecoptera, Chloroperlidae, *Neaviperla*, new status, western North America

## INTRODUCTION

*Alloperla forcipata* was described by Neave in 1929 in his Jasper Park report. Ricker (1943) found it to be common in his study of southwestern British Columbia stoneflies, and proposed a new subgenus *Neaviperla* Ricker, 1943, stating that it might even be worthy of generic rank. Illies (1966) raised all known Plecoptera subgenera to generic rank. *Neaviperla* remained a genus until Alexander and Stewart (1999) published their revision of the genus *Suwallia* Ricker, 1943 and included *Neaviperla* as a synonym. Stewart and Stark (2002) and Stewart and Stark (2008) considered *Neaviperla* a synonym of *Suwallia*, thus removing it as a genus in their second edition of the nymphs of North American stonefly genera and their chapter in the aquatic insects of North America. This study details why *Neaviperla* is a valid genus and addresses the discussion noted in Alexander & Stewart (1999).

## MATERIALS AND METHODS

Specimens were studied using a Wild M-8 stereomicroscope and scanning electron micrographs were taken at the Brigham Young University Electron Microscope Laboratory using a Philips XL30 ESEM FEG microscope. The figure plates were constructed by Michael Standing. The previously published line drawing figures of *Neaviperla forcipata*, that appeared in Baumann et al. (1977), were used with permission of the American Entomological Society.

## RESULTS

### *Neaviperla forcipata* Ricker

(Figs. 1-18)

*Alloperla forcipata* Neave 1929:160. Holotype ♂ (Canadian National Insect Collection), Lake Edith, Jasper National Park, Canada
*Alloperla (Neaviperla) forcipata*: Ricker, 1943:142.

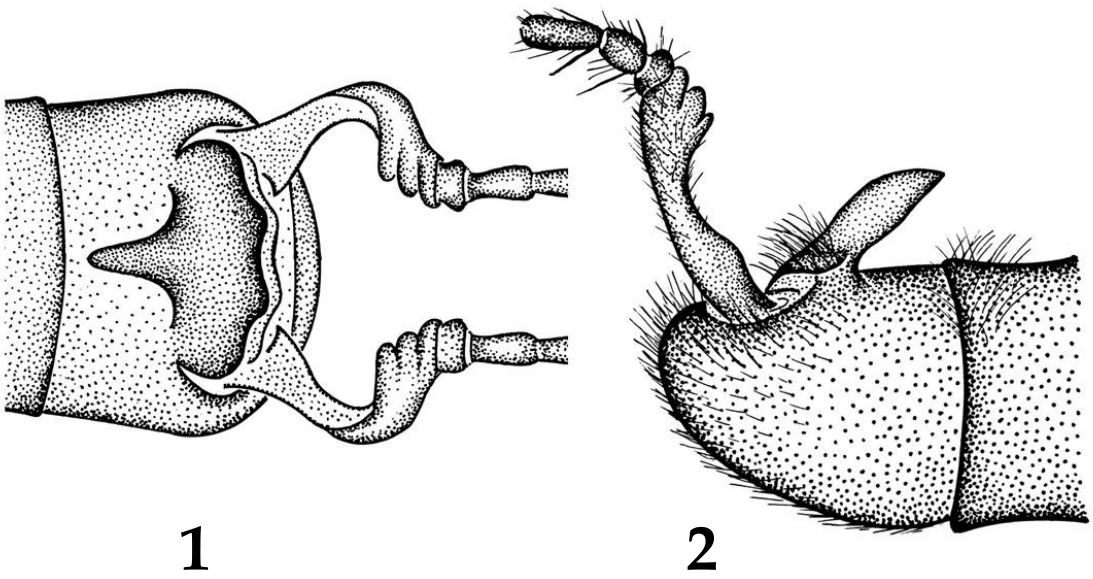
*Neaviperla forcipata*: Illies, 1966:448.
*Suwallia forcipata*: Alexander & Stewart, 1999:202.
*Suwallia forcipata*: Stewart & Stark, 2002:280.
*Suwallia forcipata*: Stark et al. 2012:11.
*Suwallia forcipata*: Stewart and Stark *in* Merritt et al. 2008
*Suwallia forcipata*: DeWalt et al. 2014

**Material examined. CANADA: Alberta,** Minnewanka Creek, passing through lower bank head, Banff National Park, 22 VIII 1969, C.M. Yarmoloy, 1♂, 1♀ (BYUC); Stoney Creek, Banff National Park, 22 VIII 1969, C.M. Yarmoloy, 2♀ (BYUC). **British Columbia,** Babine River, Kisgegas, 21 VIII 1952, W.E. Ricker, 3♂, 6♀ (CNCI); Chilliwack River, Vedder Crossing, 16-IX-4-X-1937, W.E. Ricker, 31♂, 31♀ (CNCI); Chilliwack River, Chilliwack River Provincial Park, 26 VIII 1991, J. Myack, 6♂, 3♀ (CSUC); Frost Creek, Cultus Lake, 22 X 1937, W.E. Ricker, 4♂, 40♀ (CNCI); creek near Garabaldi Station, 27 IX 1964, W.E. Ricker, 1♀ (CNCI); creek at mile 20, N Hazelton, 20 VIII 1952, W.E. Ricker, 4♂ (CNCI); Kitimat River, Hwy 37, 30 km N Kitimat, 1 I 2000, W.N. Mendel, 1♀ (BYUC); Kleanza Creek, near Terrace, 18 VIII 2008, W.M. Jessop, 1♂ (BYUC); Upper Pitt River, Alvin, 23 IX 1938, W.E. Ricker, 1♂, 6♀ (CNCI); Ritchie Creek, Cassiar Hwy, mi 128, 10 IX 1985, R.L. Botorff, 1♂, 7♀ (RLBC); Skeena River, 14 IX 2005, T. Bansak, 2♀ (UMBS); Telegraph Creek, Trapper Lake Horse Camp, 22 VIII 1959, J. Ricker, 1♂ (CNCI); Waukwash River inlet, Owikeno Lake, 12 X 1956, D. Foskett, 1♀ (CNCI). **Yukon,** Blackstone River, km 141, Demster Hwy, 11 VIII 1980, R.J. Cannings, 1♂ (SMDV); Canol Road, km 154, 61° 34′N 133°05′W, 28 VII 1997, B. Marshall, 1♂ (ROME); Rose River, Rose Lake, 61° 35′N 133° 05′W, 28 VII 1981, C.S. Guppy, 1♀ (SMDV); 7 km E Rancheria, 60° 04′N 130° 29′W, 5 VIII 1981, C.S. Guppy, 1♂ (SMDV); Starr Creek, 61° 46′N 131° 51′W, 3 VIII 1981, C.S. Guppy 1♂ (SMDV). **UNITED STATES: Alaska,** Athel Creek, Glenn Hwy, MP 264.5, 11 VIII 1954, C.P. Alexander, 1♀ (USNM); Barr Creek, Seward Peninsula, 70 mi N Nome, 8 VIII 1982, R.L. Newell, 2 larvae, (BYUC); Bear River, Bear Lake, Alaska Peninsula, 4 VIII 1958, J.D. Fiske, 5 larvae (USNM); Same locality, 11 VIII 1958, J.D. Fiske, 1 larva (USNM); creek near Black Lake, Hwy 98, 2 mi N Skagway, 59° 30′N 135°16′W, 21 VIII 2002, Baumann, Huntzinger & Clark, 1♂ (BYUC); Cold Bay, 24 VII 1958, C.H. Lindroth, 2♂, 1♀ (USNM); Granite Creek, Anchorage, 8 IX 1966, K.M. Sommerman, 4♂, 21♀ (USNM); Indian River, near Sitka, 14 IX 2009, G.M. Smith, 1♂, 1♀ (BYUC); Same locality, 13 IX 2010, G.M. Smith, 3♀ (BYUC); Indian River, Sitka National Historic Park, 28 VII 2010, G.M. Smith, 5♂, 5♀ (BYUC); Indian River, Tongass National Forest, 13 VIII 2010, G.M. Smith, 16♂, 10♀ (BYUC); Kwethluk River, Yukon Delta, 17 VIII 2011, Z.J. Crete, 1♂ (ZJCC); Kwethluk River, 22 VIII 2012, Z.J. Crete, 11♂, 9♀ (ZJCC); Same locality, 1 IX 2012, Z.J. Crete, 3♂, 18♀ (ZJCC); Montana Creek, 3 mi N Auke Bay, 21 VIII 2011, R.L. Bottorff, 8♂, 6♀ (RLBC); Montana Creek, near rifle range, Juneau, 10 VIII 1998, J. Hudson, 29♂, 26♀ (BYUC); Same locality, 30 VIII 2011, J. Hudson, 1♀ (BYUC); Mount McKinley Park, 17 VIII 1958, C.H. Lindroth, 1♀ (USNM); Orzenoi Bay, opposite Shumigan Island, 26 VII 1957, J.D. Fiske, 10 larvae (USNM); Same locality, 23 VIII 1957 J.D. Fiske, 10 larvae (USNM); Nome, Seward Peninsula, 13 VIII 1958, C.H. Lindroth, 1♂, 5♀ (USNM); Palmer Creek, Anchorage, 9 IX 1966, K.M. Sommerman, 4♀ (USNM); Paxson, 19 VIII 1958, C.M. Lindroth, 5♂, 9♀, 1 larva (USNM); Pullen Creek, Skagway, 10 VIII 2002, K.T. Huntzinger, 21♂, 4♀ (BYUC); same locality, 18 VIII 2002, Baumann, Huntzinger & Clark, 45♂, 35♀ (BYUC); Reid Creek, Reid Falls, Skagway, 19 VIII 2002, Baumann, Huntzinger & Clark, 2♂, 4♀ (BYUC); Russian River, 0.1 mi above confluence Kenai River, 12 IX 2002, M. Floyd, 3♂, 3♀ (MUIC); Salmon Creek, above jct. Gastineau Channel, Juneau, 27-30 VIII 2002, S.M. Clark, 2♂, 5♀ (BYUC); stream entering Gastineau Channel ¼ mi S Salmon Creek, Juneau, 29 VIII 2002, S.M. Clark, 1♂ (BYUC); Skagway River, Skagway, 59° 28′N 135° 18′W, 18 VIII 2002, R.W. Baumann & S.M. Clark, 107♂, 12♀ (BYUC); Same locality, 21 VIII 2002, Baumann, Huntzinger & Clark, 17♂, 3♀ (BYUC); Steep Creek, near Mendenhall Lake, 15 km N Juneau, 12 VIII 1998, J. Hudson, 11♂, 15♀ (BYUC); Tributary, Surprise Lake, Aniakchak National Monument, Alaska Peninsula, 56° 56′N 158° 06′W, Date?, Collector?, 1♀ (SMDV); Taiya River, Chilkoot Trailhead, Dyea, 19-23 VIII 2002, Baumann, Clark & Huntzinger, 68♂, 19♀ (BYUC); ponds near White Pass, above Skagway, 19 VIII 2002, Baumann, Clark & Huntzinger, 24♂, 6♀ (BYUC). **Montana,** Flathead

Co., Avalanche Creek, Avalanche Campground, Glacier National Park, 10 IX 1968, R.W. Baumann & R.L. Newell, 2♀ (BYUC); South Fork Cut Bank Creek, Schildt Road, 8 VIII 1986, B.C. Kondratieff, 3♂ 5♀ (CSUC); Logan Creek, jct. Mac Donald Creek, Glacier National Park, 10 IX 1968, R.W. Baumann & R.L. Newell, 2♂ (BYUC); Mac Donald Creek, above Mac Donald Lake, Glacier National Park, 10 IX 1968, R.W. Baumann & R.L. Newell, 3♂, 5♀ (BYUC); Park Creek, Lake Isabell Trail, 8 VIII 1986, B.C. Kondratieff, 8♂, 3♀ (CSUC). **Washington,** Jefferson Co., Hoh River, Hoh River Campground, Olympic National Park, 12-IX-2013, J.J. Lee & R.A. Lee, 10♂, 14♀, 57 larvae (BYUC, JJLC); Whatcom Co., Canyon Creek, Mosquito Lake Road, 4 mi E Deming, 12 IX 1993, Kraft & Minakawa, 7♂, 22♀ (BYUC); Devils Creek, Ross Lake, near Newhalem, 2 X 1993, Kraft, Busse & Minakawa, 2♀ (BYUC); Lightning Creek, Ross Lake, near Newhalem, 2 X 1993, Kraft, Moody, Fritz & Kraft, 3♂ 7♀ (BYUC); Middle Fork Nooksack River, 8 mi E Van Zandt, 1 IX 1993, Kraft, Sammeth & Minakawa, 1♂, 1♀, 44 larvae (BYUC); North Fork Nooksack River, 9 X 1966, K. Vander Mey, 1♂, 3♀ (BYUC).

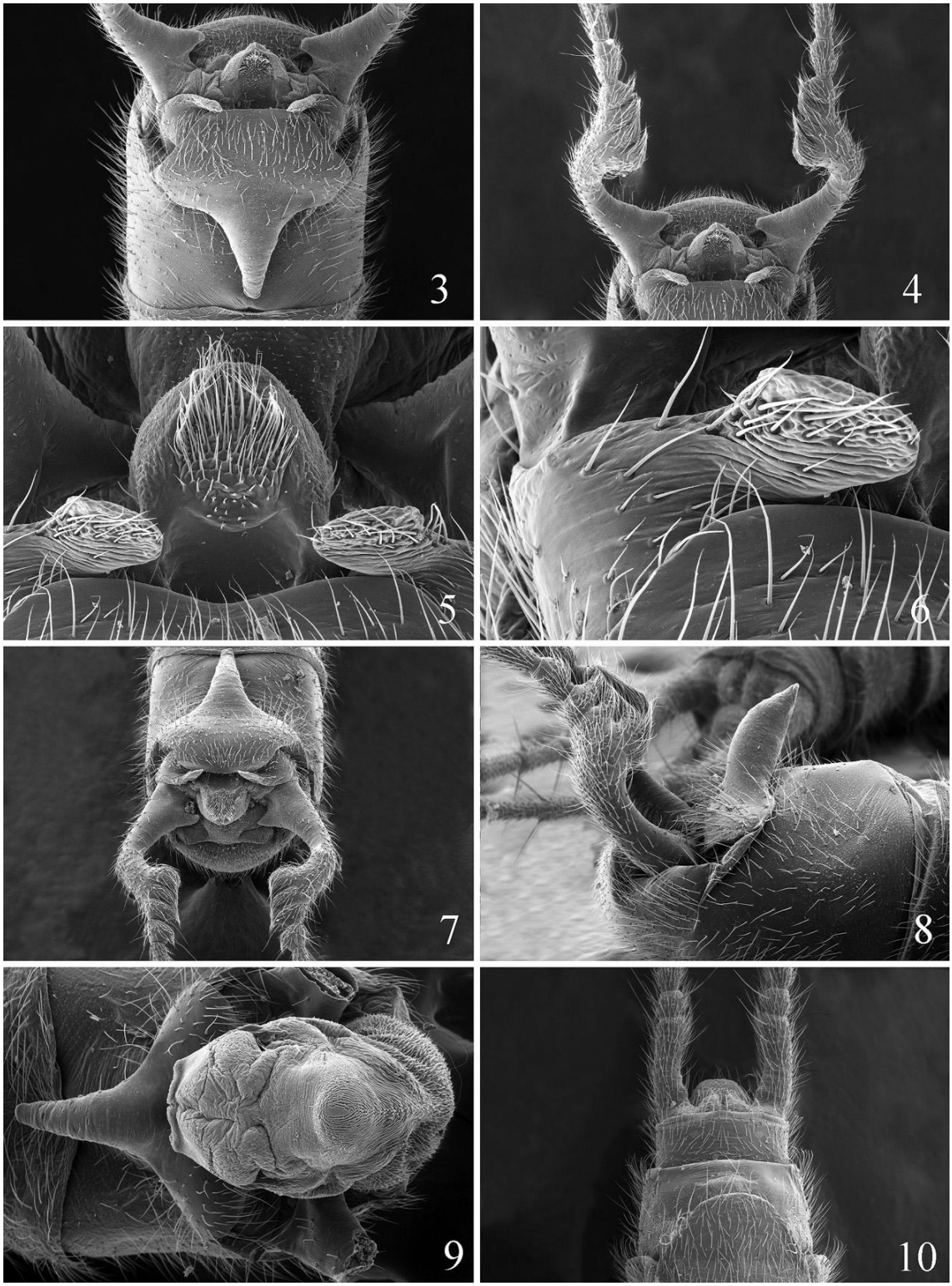
## DISCUSSION

The following characters illustrate the distinctive differences which serve to separate *Neaviperla* as a genus in the family Chloroperlidae and to add characters useful in diagnosis.




Figs. 1-2. *Neaviperla forcipata*, Terminalia: 1. Male, dorsal. 2. Male, lateral.

**Adult.** A distinct sclerotized line is present on the meso and meta thorax that intersects the center of the large U-shaped mark at the base of the segment. This appears as a W in contrast to the U commonly seen in *Suwallia* and makes it easy to separate adults quickly.
**Male.** Five basal segments of cerci modified into clasper-like structures (Figs. 1-4). First segment very large, curved outward and heavily sclerotized (Fig.4), with large inward directed, triangular–shaped process at base (Figs. 4, 7). Segments 2-5 smaller, forming stout inward pointing lobes, sharp apically, and bearing many large setae, which cover irregular grooves (Figs. 4, 7). Ninth segment enlarged, about length of segments 7 and 8, tergum covered by large plate-like structure (Figs. 3, 8), base broadly rounded, tapered to narrow pointed tip, which extends anteriorly to segment 8 (Figs. 3, 7). Lateral margins of tergum 10 formed into inward curved lobes, bluntly




Figs. 3-10. *Neaviperla forcipata*, Alaska. Male: 3. Taiya River, Terminalia, dorsal. 4. Skagway River, Terminalia, cerci, anterior. 5. Indian River, Epiproct and 10th tergal lobes. 6. Indian River, Right Tergal Lobe. 7. Taiya River, Terminalia, posterior. 8. Taiya River, Terminalia, lateral. 9. Indian River, Aedeagus, recurved, dorsal. Female: 10. Taiya River, Terminalia, cerci and subgenital plate, ventral.

truncate apically, with irregular grooves, bearing few long hairs near base, with narrow patch of shorter hairs near apex (Fig. 6).

**Aedeagus.** Stout and capped by dorsal medial hump, when recurved, composed of densely compacted hair-like structures. Aedeagal base with pair of sclerotized hook-like processes that are visible through the ventral cuticle of sternum 9. Processes composed of numerous flat sclerotized tubercles that join together to form a comma-shaped structure (Fig. 9).

**Female.** Cerci with first segment elongate, much longer than remaining segments and slightly concave inwardly (Fig. 10).

**Larvae.** Head and prothorax heavily covered with long hairs (Figs. 11, 12). Basal cercal segment of mature larvae long, with whorl of stout setae that is not associated with segment margins (Fig. 15).

**Egg.** Collar with two layers and chorion smooth.

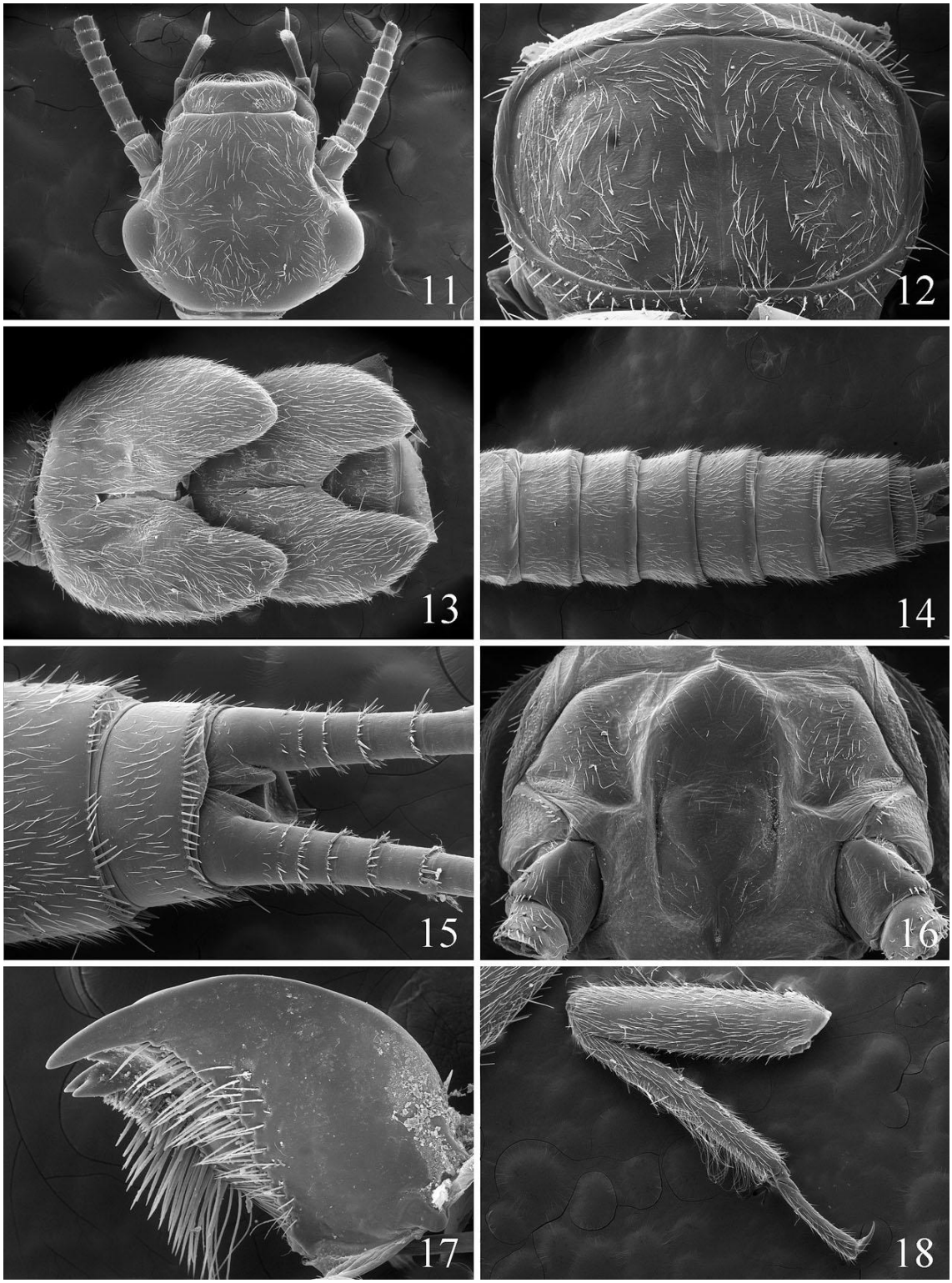
Surdick (1985) constructed a phylogenetic tree that considers the modified cerci of *Neaviperla* as the apomorphic state and also mentions the unique modifications of the ninth tergum. She considers the hemitergal process of *Suwallia* as an apomorphic character with the poorly developed processes of *Neaviperla* as plesiomorphic. Alexander and Stewart (1999) do not address Surdick's phylogenetic tree but instead place *Neaviperla* basally in a clade with four Palearctic species: *Suwallia jezoensis* (Kohno), *S. kerzhneri* Zhiltzova and Zwick, *S. talalajensis* Zhiltzova and *S. teleckojensis* (Samal) based on egg structure, color pattern and hemitergal process shape. However, the exact characters are not given and no phylogeny is included for this clade. The egg of *S. kerzhneri* is unknown. *Neaviperla forcipata* is the only species mentioned in Alexander and Stewart (1999) whose egg has a collar with two layers and a smooth chorion. In addition, based on Alexander and Stewart (1999), *Neaviperla* is distinct from the four Palearctic species mentioned by having a W-shaped rather than simply a U-shaped meso-metanotal mark. *Neaviperla* has a brown head pattern that covers the inter ocellar area and extends forward to the labrum, while the mentioned Asian species exhibit coloration primarily between the ocelli, which is stated to be nearly black.

The larvae of *Neaviperla* and *Suwallia* are indeed similar but that is not surprising given the fact that the family Chloroperlidae is quite conservative in larval characters. The dorsal surface of the pronotum is covered with hairs in both genera but they tend to be larger and thicker in *Neaviperla* (Fig. 12). The mesosternum bears few hairs in each and those on *Neaviperla* are very delicate (Fig. 16). The basal segments of the mature larval cerci show the best diagnostic characters. They are longer in *Neaviperla* and bear a whorl of stout spines located proximal to the first row of cercal spines (Fig. 15). These spines are not associated with the cercal segment divisions and could be related to the extreme modifications of the adult cerci.

## BIOLOGY AND DISTRIBUTION

On 12-IX-2013, the junior author witnessed a large *Neaviperla* emergence on the Hoh River, Olympic National Park, Washington. At approximately two hours before sunset adults could be seen flying from the river. Around thirty minutes later the air between the Hoh River and the campground was full of *Neaviperla* adults. This mass emergence lasted for at least fifteen minutes. Although this genus is relatively rare and not often collected, it can be quite common in habitats that flow into the Pacific Ocean.

*Neaviperla* is found most commonly in the far northern part of western North America (Stewart and Oswood 2006). In Alaska, it has been recorded from as far north as the Seward Peninsula near the Bering Strait and occurs commonly on the Alaska Peninsula at the base of the Aleutian Islands. It has been collected in central Alaska from the Yukon River Delta east to Mount Denali and is very common along the coast in Southeast Alaska. Fewer records are available for Canada but it is known from Yukon (Stewart and Ricker 1997), British Columbia (Ricker and Scudder 1975; Stewart and Osgood 2006) and Alberta (Donald and Anderson 1977). Distribution data for the continental United States are spotty but the genus has been found in Montana (Gaufin et al. 1972; Baumann et al. 1977, Newell, at al. 2008) and Washington (Kondratieff and Lechleitner 2002). There is a questionable record in Koponen and Brinck (1949), indicating that *Neaviperla* might occur in Siberia, based on an illustration of a male that is labeled *Peltoperla* sp. but without any locality data.




Figs. 11-18. *Neaviperla forcipata,* Hoh River, Washington. Larvae: 11. Head, dorsal. 12. Pronotum. 13. Mesnotum and metanotum. 14. Abdomen, dorsal. 15. Cerci and abdominal base. 16. Mesosternum. 17. Mandible. 18. Leg.

Most of the specimens studied in the publication were housed in the Museum of Zoology Collection in Helsinki, Finland. Recently, a series of this species, consisting of 2 males and 2 females, collected by F. Sahlberg near Sitka in the late 1800's, was discovered at the Natural History Central Museum in Helsinki. Thus, there is a good possibility that the specimens studied by the above authors could have come from Alaska and not Siberia.

*Suwallia* remains an enigmatic Holarctic genus with species occurring in both the Nearctic and Palearctic realms. A better understanding of this genus needs to become part of future studies using additional material and more modern techniques. The scope of this contribution was undertaken to understand why and how *Neaviperla* is a valid genus and to learn more about its biology, morphology and distribution.

**ACKNOWLEDGMENTS**

The following individuals and institutions helped improve the quality of this study. Tom Bansak loaned specimens from the Skeena River, British Columbia (UMBS). Richard Bottorff, Placerville, California shared his records from Alaska (RLBC). Shawn Clark, Brigham Young University (BYUC) collected many specimens of this species while nursing the senior author back to health in Juneau, Alaska. Zach Crete, Helena, Montana, let us include some Yukon River Delta records from his collection (ZJCC). Oliver Flint, Smithsonian Institution, loaned specimens from the United States National Museum (USNM). Jerry Freilich, Olympic National Park, helped us obtain a collecting permit and provided guidance in locating collecting localities. Brad Hubley, Royal Ontario Museum (ROME), loaned specimens for study. John Hudson provided specimens from near Juneau, Alaska. Kim Huntzinger allowed us to use the records that were collected as part of her thesis on the aquatic insects of southeastern Alaska (Huntzinger 2003). Boris Kondratieff provided records from the Colorado State University collection (CSUC). Wendy Mendel Jessop, Provo, Utah, obtained specimens from near Terrace, British Columbia. Owen Lonsdale, shared important specimens from the Canadian National Collection of Insects (CNCI). Karen Needham, Spencer Entomology Museum, University of British Columbia, loaned specimens from British Columbia. Bob Newell, Kennewick, Washington donated specimens that he collected in Alaska. Geoff Smith provided valuable collections from near Sitka, Alaska. The Ken Stewart collection of stoneflies from Western North America was donated to Brigham Young University and was useful in this study. Don Tarter, Marshall University, allowed us to list his record from the Kenai Peninsula, Alaska (MUIC). Bob Wisseman, Corvallis, Oregon was instrumental in conveying the valuable Jerry Kraft Washington stonefly collection to Brigham Young University.

**REFERENCES**

Alexander, K.D. & K.W. Stewart. 1999. Revision of the genus *Suwallia* Ricker (Plecoptera: Chloroperlidae). Transactions of the American Entomological Society, 125:185-250.

Baumann, R.W., A.R. Gaufin, and R.F. Surdick. 1977. The stoneflies (Plecoptera) of the Rocky Mountains. Memoirs of the American Entomological Society, 31:1-208.

DeWalt, R.E., M.D. Maehr, U. Neu-Becker, and G. Steuber. 2014. Plecoptera Species File Online. Available from: http://plecoptera.speciesfile.org (accessed 27 August 2014).

Donald, D.B. and R.S. Anderson. 1977. Distribution of the stoneflies (Plecoptera) of the Waterton River drainage, Alberta, Canada. Syesis, 10:111-120.

Gaufin, A.R., W.E. Ricker, M. Miner, P. Milam, and R.A. Hays. 1972. The stoneflies (Plecoptera) of Montana. Transactions of the American Entomological Society, 98:1-161.

Huntzinger, K.T. 2003. Studies on the aquatic insects of southeastern Alaska, with an emphasis on the Skagway area. Unpublished M. S. thesis, Brigham Young University, 67 pp.

Illies, J. 1966. Katalog der rezenten Plecoptera. Das Tierreich 82, Walter de Gruyter & Co., Berlin, 632 pp.

Kondratieff, B.C. and A. Lechleitner. 2002. Stoneflies (Plecoptera) of Mount Rainier National Park, Washington. Western North American Naturalist, 62:385-404.

Koponen, J.S.W. and P. Brinck. 1949. Neue oder wenig bekannte Plecopteren. Annales of entomologici Fennici, 15 (1):1-21.

Neave, F. 1929. Reports of the Jasper Park investigations 1925-26, II. Plecoptera. Contributions to Canadian Biology and Fisheries, being studies from the biological stations of Canada, N. S., IV, 13:159-168 + 3 plate pages.

Newell, R.L., R.W. Baumann, and J.A. Stanford. 2008. Pp 173-185 *in* F.R. Hauer, J. A. Stanford and R.L. Newell (Eds.) International advances in the ecology, zoogeography, and systematics of mayflies and stoneflies. University of California Publications in Entomology 128. University of California Press, Berkeley, California, 412 pp.

Ricker, W.E. 1943. Stoneflies of southwestern British Columbia. Indiana University Publications, Science Series 12, Bloomington, Indiana, 145 pp.

Ricker, W.E. and G.G.E. Scudder. 1975. An annotated checklist of the Plecoptera (Insecta) of British Columbia. Syesis, 8:333-348.

Stark, B.P., K.W. Stewart, S.W. Szczytko, R.W. Baumann, and B.C. Kondratieff. 2012. Scientific and common names of Nearctic stoneflies (Plecoptera), with corrections and additions to the list. Miscellaneous Contributions 1, The Caddis Press, Columbus, Ohio, 20 pp.

Stewart, K.W. and M.K. Oswood. 2006. The stoneflies (Plecoptera) of Alaska and western Canada. The Caddis Press, Columbus, Ohio, 325 pp.

Stewart, K.W. and W.E. Ricker. 1997. Stoneflies (Plecoptera) of the Yukon. Pp 201-222 *in* H.V. Danks and J.A. Downes (Eds.) Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods). Ottawa, Ontario, 1,034 pp.

Stewart, K.W. & B.P. Stark. 2002. Nymphs of North American stonefly genera (Plecoptera), Second Edition. The Caddis Press, Columbus, Ohio, 510 pp.

Stewart, K.W. and B.P. Stark. 2008. Plecoptera. Pp 311-384 *in* Merritt R.W., K.W. Cummins and M.B. Berg (Eds.) An Introduction to the aquatic insects of North America, Fourth Edition. Kendall Hunt Publishing, Dubuque, Iowa. 1158 pp.

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

Received 28 August 2014, Accepted 5 October 2014, Published
9 December 2014