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Gaufinia wasatchensis
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**Gauffinia**, a new stonefly genus (Plecoptera: Chloroperlidae), with the description of six new species from western North America

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ABSTRACT.—*Gauffinia* is proposed as a new genus for the *Sweltsa lamba* (Needham and Claassen 1925) species group, and 5 current and 6 new species are recognized based primarily on scanning electron microscopy of the male epiproct. Males of the new genus are distinguished from all other Chloroperlidae by the presence of a distinctive leaf-like aedeagal lamella. A preliminary key for males of the 11 currently recognized species is presented to assist in identification.

RESUMEN.—Se propone *Gauffinia* como un nuevo género del grupo de especies *Sweltsa lamba* (Needham y Claassen 1925) y se reconocen 5 especies actuales y 6 nuevas basándose principalmente en microscopía electrónica de barrido del epiprocto masculino. Los machos del nuevo género se distinguen de todos los demás Chloroperlidae por la presencia de una distintiva lamínilla aedeagal en forma de hoja. Se presenta una clave preliminar de los machos de las 11 especies actualmente reconocidas para ayudar en la identificación.

*Sweltsa* was proposed by Ricker (1943) as a subgenus of *Alloperla* and given generic status by Illies (1966). The subgenus originally included 9 species, with *Alloperla oregonensis* Frison 1935 selected as subgenotype (Ricker 1943). Ricker (1952) listed 5 additional species in the group, including 3 from the eastern Nearctic region, and other western Nearctic species were proposed by Baumann (1973), Baumann and Jacobi (1984), Gaufin (1964b), Jewett (1955, 1959, 1960, 1965), Baumann and Bottorff (1997), and Surdick (1995). More recently, a few species have been described by Kondratieff and Baumann (2009), Lee and Baumann (2010), and Stark and Baumann (2007, 2018), and scanning electron microscopy has previously been used to document epiproct structure for 16 currently recognized western Nearctic *Sweltsa* (Table 1). For much of its history, the genus was thought to be a moderately sized Nearctic endemic but several species from eastern Asia were recognized by Zwick (1971, 1973), and the genus currently includes 26 western Nearctic, 10 eastern Nearctic, and 18 eastern Palearctic/Oriental species (Stark and Sivec 2009, Chen and Du 2017, DeWalt et al. 2018, Dong et al. 2018).

Currently only 3 *Sweltsa* species groups—the *S. borealis* (Banks 1895) group, the *S. lamba* (Needham and Claassen 1925) group, and the *S. tamalpa* (Ricker 1952) group—have gained formal recognition (Surdick 1995, Stark and Baumann 2007). Surdick (1995) proposed keys for the 5 Nearctic species whose males have a “sclerotized leaflet on the aedeagus” and referred to these species as the “*Sweltsa lamba* group.” She also referred to 7 Nearctic species whose females have the “subgenital plate … emarginate” as the “*Sweltsa borealis* group,” although she noted that 2 of these (*S. californica* [Jewett 1965] and *S. continua* [Banks 1911]) “…are more distantly related.” Tentative species groups among western Nearctic *Sweltsa* are listed in Table 1.

Needham and Claassen (1925) provided the first details of the unique aedeagal lamella (= “chitinized lobe”) in their descriptions of male *Alloperla lamba* and *A. albertensis* Needham

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*BPS* orcid.org/0000-0002-8579-3016  
*RWB* orcid.org/0000-0003-0838-4080

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TABLE 1. Tentative species groups, current species composition, and sources of SEM epiproct data among western Nearctic *Sweltsa*.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>SEM Study</th>
</tr>
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<tbody>
<tr>
<td>Borealis group</td>
<td></td>
</tr>
<tr>
<td><em>S. adamanthea</em> Surdick 1995</td>
<td>None</td>
</tr>
<tr>
<td><em>S. borealis</em> (Banks 1895)</td>
<td>None</td>
</tr>
<tr>
<td><em>S. fidelis</em> (Banks 1920)</td>
<td>Delk et al. 1998</td>
</tr>
<tr>
<td><em>S. revelstoka</em> (Jewett 1955)</td>
<td>Delk et al. 1998</td>
</tr>
<tr>
<td><em>S. umbonata</em> Surdick 1995</td>
<td>None</td>
</tr>
<tr>
<td>Californica group</td>
<td></td>
</tr>
<tr>
<td><em>S. californica</em> (Jewett 1965)</td>
<td>None</td>
</tr>
<tr>
<td><em>S. continua</em> (Banks 1911)</td>
<td>None</td>
</tr>
<tr>
<td>Coloradensis group</td>
<td></td>
</tr>
<tr>
<td><em>S. coloradensis</em> (Banks 1898)</td>
<td>Stark and Baumann 2018</td>
</tr>
<tr>
<td><em>S. lyrata</em> Stark &amp; Baumann 2018</td>
<td>Stark and Baumann 2018</td>
</tr>
<tr>
<td><em>S. mogollonica</em> Stark &amp; Baumann 2018</td>
<td>Stark and Baumann 2018</td>
</tr>
<tr>
<td>Exquisita group</td>
<td></td>
</tr>
<tr>
<td><em>S. exquisita</em> (Frison 1935)</td>
<td>Kondratieff and Baumann 2009</td>
</tr>
<tr>
<td>Lamba group</td>
<td></td>
</tr>
<tr>
<td><em>S. albertensis</em> (Needham &amp; Claassen 1925)</td>
<td>Current study</td>
</tr>
<tr>
<td><em>S. cristata</em> Surdick 1995</td>
<td>Current study</td>
</tr>
<tr>
<td><em>S. gaufini</em> Baumann 1973</td>
<td>Current study</td>
</tr>
<tr>
<td><em>S. hondo</em> Baumann &amp; Jacobi 1984</td>
<td>Current study</td>
</tr>
<tr>
<td><em>S. lamba</em> (Needham &amp; Claassen 1925)</td>
<td>Current study</td>
</tr>
<tr>
<td>Occidens group</td>
<td></td>
</tr>
<tr>
<td><em>S. durfeei</em> Kondratieff &amp; Baumann 2009</td>
<td>Kondratieff and Baumann 2009</td>
</tr>
<tr>
<td><em>S. occidens</em> (Frison 1937)</td>
<td>Kondratieff and Baumann 2009</td>
</tr>
<tr>
<td>Oregonensis group</td>
<td></td>
</tr>
<tr>
<td><em>S. oregoneusis</em> (Frison 1935)</td>
<td>Nye and Stark 2010</td>
</tr>
<tr>
<td>Pacifica group</td>
<td></td>
</tr>
<tr>
<td><em>S. pacifica</em> (Banks 1895)</td>
<td>Nye and Stark 2010</td>
</tr>
<tr>
<td>Tamalpa group</td>
<td></td>
</tr>
<tr>
<td><em>S. pisteri</em> Baumann &amp; Bottorff 1977</td>
<td>Stark and Baumann 2007</td>
</tr>
<tr>
<td><em>S. tanalpa</em> (Ricker 1952)</td>
<td>Stark and Baumann 2007</td>
</tr>
<tr>
<td><em>S. yurok</em> Stark &amp; Baumann 2007</td>
<td>Stark and Baumann 2007</td>
</tr>
<tr>
<td>Townesi group</td>
<td></td>
</tr>
<tr>
<td><em>S. resina</em> Surdick 1995</td>
<td>Nye and Stark 2010</td>
</tr>
<tr>
<td><em>S. saltix</em> Lee &amp; Baumann 2010</td>
<td>Lee and Baumann 2010</td>
</tr>
<tr>
<td><em>S. townesi</em> (Ricker 1952)</td>
<td>Lee and Baumann 2010, Nye and Stark 2010</td>
</tr>
</tbody>
</table>

and Claassen 1925. Baumann (1973) provided additional details of the structure (= “leaf-like structure”) for 3 species of *Sweltsa* (*S. albertensis*, *S. gaufini* Baumann 1973, and *S. lamba*). Baumann and Jacobi (1984) later observed the same structure (= “leaf-like appendage”) on the aedeagus of *S. hondo* Baumann and Jacobi 1984, and Surdick (1995) confirmed its presence (= “leaflet” = “sclerotized lamella”) in *S. cristata* Surdick 1995 and indicated that this structure is unique to the related species of the *S. lamba* group. In the present study, we used scanning electron microscopy to examine males from throughout the known range of the *S. lamba* group. These data support recognition of 6 previously undescribed species and suggest that the *S. lamba* species group should be recognized as a genus distinct from *Sweltsa*.

METHODS

Specimens from the following collections were examined during the study: Bill P. Stark Collection, Mississippi College, Clinton, Mississippi (BPSC); Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, Shawn M. Clark (BYU); Canadian National Collection of Insects, Ottawa, Ontario, Owen Lonsdale (CNC); C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado, Boris C. Kondratieff (CSUIC); Illinois Natural History Survey, Champaign, Illinois, R. Edward DeWalt (INHS); Spencer Entomological Collection, University of British Columbia, Vancouver, BC, Karen Needham (UBCV); and United States National Museum of Natural History, Washington, DC, Oliver S. Flint Jr.
(USNM). Holotypes of new species are deposited at the Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah (BYU). Registered codens used for institutional collections were obtained from the GBIF Registry of Scientific Collections (https://www.gbif.org/grscicoll).

Wings were removed from male specimens, and the bodies of specimens were placed in an ultrasonic cleaner for 10–15 s. Specimens were inspected using an Olympus SZH10 or Wild M8 stereomicroscope and dehydrated through a series of 90%, 95%, and 100% ethanol for 10 min each before transfer to hexamethyldisilizane for 30 min to an hour. Dehydrated specimens were studied with a Philips XL30 ESCM FEG scanning electron microscope or a Thermo Fisher Scientific Apreo C scanning electron microscope at Brigham Young University, or with an Amray 1810 scanning electron microscope at Mississippi College. Terms used for epiproct structures are illustrated in Fig. 1.

**SPECIES ACCOUNTS**

*Gaufinia*, new genus

**Type species.**—*Alloperla lamba* Needham and Claassen, 1925 = *Gaufinia lamba* (Needham and Claassen), original designation. The virtual tautonomy formed by *Sweltsa gaufini* Baumann, 1973 = *Gaufinia gaufini* (Baumann) is contraindicated as type species because *Gaufinia lamba* is more common, better known, and more widely distributed, and it is part of the more diverse clade of the new genus.

**Adult body color.**—Body yellow to brown patterned with darker markings on head and pronotum; meso and metathoracic U-shaped sutures dark, abdomen with a median, dark, longitudinal band.

**Male aedeagus.**—A membranous, bilobed sac that bears a sclerotized, bilobed or trilobed anterior lamella. The membranous sac bears sparse clusters of fine setae.

**Male epiproct.**—A moderately wide structure which extends forward over much of
tergum 9, constricting subapically to a narrow neck and terminating in a relatively long, upturned hook. Densely hirsute over most of surface with non-appressed, long, thin setae. A single, or sometimes double, dorsal carina extends along much of the epiproct length (Fig. 1).

Tergal process.—A single transverse, dorsally notched process occurs near the anterior margin of tergum 9.

Female subgenital plate.—Posterior margin entire, truncate or rounded, and usually reaching the anterior margin of sternum 9.


Larva.—None described (Stewart and Stark 2002).

Etymology.—The genus name honors the late Dr. Arden R. Gaufin, our major professor for doctoral work at the University of Utah. Dr. Gaufin was an enthusiastic collector of chloroperlid adults, and he published an early synopsis of the Nearctic species (Gaufin 1964a).

Distribution.—Canada: AB, BC. USA: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY. The genus is presently considered endemic to western North America. Northernmost records are from the Waterton Lakes area of southern Alberta (Needham and Claassen 1925), and southernmost records are from northern New Mexico (Baumann and Jacobi 1984) and central Arizona (this paper). No records are listed for British Columbia by Baumann and Stark (2010), Ricker (1939, 1943), Ricker and Scudder (1975), or Stewart and Oswood (2006), but Surdick (1985) includes a record of G. albertensis from “Vancouver Isl.” No records are known from California (Jewett 1960, Surdick 1985) or Alaska.

Diagnosis.—Adults of the new genus share a distinctive reticulate head and pronotal color pattern with some members of *Sweltsa* (e.g., *S. borealis, S. coloradensis*, and *S. revelstoka*). Males are distinguished from all known chloroperlid genera by the presence of an aedeagal lamella and by details of the epiproct. The epiproct always terminates in a slender, upturned hook connected to a sclerite that often bears marginal spines. Apical hooks on the epiproct are also known in most species of eastern Nearctic *Sweltsa* (e.g., *S. lateralis* (Banks 1911)) and in *S. californica* (Jewett 1965), *S. coloradensis* (Banks 1898), and *S. continua* (Banks 1911) in western North America. All these species have appressed hair covering the epiproct surface, and the epiproct hook lacks the spine-bearing basal sclerite. They also lack extensive development of a dorsal carina; only in *S. coloradensis* does this feature occur as a small structure near the hook. Females and larvae are more difficult to distinguish from other chloroperlid genera, but some groups (e.g., the *Sweltsa borealis* group females) are distinct on the basis of their lobed subgenital plates. *Gaufinia* females share hair brushes on the posterolateral margins of segment 8 with *Sweltsa* and *Alloperla* species and can usually be distinguished from these by combinations of color pattern and subgenital plate shape (Surdick 1985). Presently, none of the *Gaufinia* larvae have been described, although a few have been associated (Stewart and Stark 2002).

*Gaufinia albertensis* (Needham and Claassen), new combination

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:3562

(Figs. 2–7)


**DISTRIBUTION.**—**CANADA:** AB, BC. **USA:** ID, MT, WA, WY. Stark et al. (1973) and Baumann et al. (1977) list a few Colorado sites for

**Figs. 2–7. Gaufinia albertensis** epiproct and aedeagal structure. 2. Epiproct, lateral, Hyalite Creek, Montana. 3–4. Rattlesnake Creek, Montana. 3. Epiproct dorsal. 4. Epiproct, oblique dorsolateral aspect. 5. Epiproct apex, dorsal, Hyalite Creek, Montana. 6. Aedeagal body and lamella, caudal aspect in situ recurved over abdomen, Boulder Creek, Montana. 7. Aedeagal lamella, anterior aspect, erect over abdomen, Cutbank Creek, Montana.
G. albertensis. These specimens were misidentified by W.E. Ricker, who stated the following in a February 1972 letter to B.R. Oblad: “The collections that contained males were certainly albertensis or some closely-allied undescribed species.” We found 8 vials of specimens from Colorado in the CNC collection that were labeled S. albertensis by W.E. Ricker. These proved to be S. lamba and are probably the material that resulted in the incorrect Colorado records in the past literature.

ADULT HABITUS.—Head and pronotum with typical pattern of dark reticulations on a pale background. Abdomen with a prominent dark median longitudinal stripe on segments 1–8.

MALE.—Forewing length ca. 6.5–7.0 mm. Epiproct length from base to apex of neck ca. 3.18 × greatest width of epiproct body. Shoulders converge gradually to neck; neck not constricted and not clearly defined, but lateral margins convergent to apex (Figs. 2–4). Neck apex projects slightly over base of hook; hilt obscure, without marginal spines and terminating in a short and almost straight or spatulate hook (Figs. 3–5). Notch of 9th tergal process shallow and narrow. Aedeagal lamella narrowed from base to tip, bilobed with rounded apices (Figs. 6–7).

FEMALE.—Forewing length ca. 7.5–8.0 mm. Posterior margin of subgenital plate entire and generally reaching posterior margin of sternum 9.

LARVA.—Undescribed.

COMMENTS.—The epiproct of G. albertensis is markedly more slender, and bears a shorter and less upturned hook, than other members of the genus, except for G. gaufini, which shares both features. Males of these 2 species are most readily distinguished on the basis of the epiproct carina. Among specimens of G. albertensis, the dorsal carina is a single, relatively low ridge, whereas among specimens of G. gaufini, the carina is a double ridge whose margins are flared away from a median suture. In addition, the aedeagal lamella of G. albertensis has 2 lobes; however, this structure in males of G. gaufini bears an additional small median lobe. Although the epiprocts for both species are slender, the widest point on the epiproct is located near the apex in G. albertensis and nearer the base in G. gaufini. Gaufinia albertensis females are not considered reliably distinct from other members of the genus.

Gaufinia cristata (Surdick),
new combination
http://lsid.speciesfile.org/urn:lsid:Plecoptera .speciesfile.org:TaxonName:3569
(Figs. 8–13)


ADULT HABITUS.—Typical of genus, with pale yellow body marked with scattered, dark hieroglyphic-like spots on the head and pronotum, and with a prominent dark median abdominal stripe extending over segment 8.

MALE.—Forewing length ca. 7.5 mm. Lateral margins of epiproct body almost parallel for most of length but constricted near base and with margins strongly convergent apically (Fig. 8); neck short, with parallel sides (no basal constriction), and with head not expanded (Fig. 10). Carina conspicuous and extending almost to apex of neck (Fig. 9). Hook very slender and without basal hilt (Fig. 12) (see Surdick 1995).

FEMALE.—Forewing length ca. 8 mm. Posterior subgenital plate margin entire, extending over most of sternum 9; lateral margins slightly concave.

LARVA.—Unknown.

COMMENTS.—This species was previously known only from the holotype and allotype specimens collected in San Juan County, Utah.
Gaufinia gaufini (Baumann),
new combination
http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:3498 (Figs. 14–19)


Distribution.—USA: ID, UT.

Adult habitus.—Typical of genus, with scattered, dark hieroglyphic-like markings on head and pronotum, and with a median dorsal abdominal stripe composed of a series of dusky spots, each enclosing a pair of pale spots on abdominal terga 1–8.

Male.—Forewing length ca. 8–9 mm. Epiproct length from base to apex of neck ca. 2.75–3.15 × width of epiproct at midlength of epiproct body. Epiproct body somewhat oval with greatest width at ca. 45% of distance from base (Fig. 14). Neck short and wide, length ca. 0.87–0.96 × width at midlength. Hilt indistinct, entire hook short, somewhat spatulate, wide basally, upturned, acute at apex and without marginal spines (Figs. 15–16). Carina double with panels constricted at ca. 25% of epiproct body length, flared outward for most of length and divided by a prominent groove on the basal half; carina ending short of neck (Figs. 14, 17). Aedeagal lamella bearing 3 apical lobes; lateral lobes somewhat scoop shaped, wide at midlength and narrowed to a rounded apex; mid lobe much narrower, slightly shorter than outer lobes and apically acute (Fig. 19); length of aedeagal lamella ca. 1.28 × basal width; lateral margins concave; posterior membranous section of aedeagus bulging at midlength and bearing a pair of small rabbit ear–like apical lobes (Fig. 18).

Female.—Forewing length ca. 9–10 mm. Posterior margin of subgenital plate entire, forming a triangular outline with rounded apex extending beyond posterior margin of sternum 9.

Larva.—Unknown.

Comments.—Males of this species are distinct from other members of the genus by virtue of the double carina on the epiproct, and the trilobed aedeagal lamella.

Gaufinia hondo (Baumann and Jacobi),
new combination
http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:3547 (Figs. 20–25)


Material examined.—New Mexico: Colfax Co., Agua Fria Creek, Fish Campground, Philmont Scout Ranch, 28 June 1987, R.C.


DISTRIBUTION.—USA: NM, UT.

ADULT HABITUS.—Typical of genus, with scattered, dark hieroglyphic-like markings on head and pronotum; abdomen bearing a median stripe composed of dusky brown spots on segments 1–8; spots become progressively smaller on posterior segments.

MALE.—Forewing length ca. 7–8 mm. Epiproct length from base to apex of neck ca. 1.6–1.9 × width of epiproct body at midlength (Figs. 20–22); base much narrower than width at shoulders. Shoulders of epiproct body conspicuously bulging (Figs. 20–21); width of body across shoulders ca. 0.55 × epiproct length; epiproct margins forward of shoulders converge abruptly to base of neck. Neck ca. 1.4 × long as width at midlength; lateral margins of neck converge basally with greatest width near apex. Hilt well defined, forming a circular scoop-shaped disc and bearing a short keel (Fig. 23); lateral margins with obscure scalloping. Hook slender, forming a curved cylinder arising from hilt. Carina extends beyond constricted portion of neck. Aedeagal lamella about as wide as long, bilobed with apex narrow and rounded (Figs. 24–25).

FEMALE.—Forewing length ca. 9–10 mm. Posterior margin of subgenital plate entire; lateral margins convergent from midlength to slightly pointed apex; apex extends over about two thirds of sternum 9.

COMMENTS.—Male epiprocts of this species are very similar in most respects to G. lamba but differ in having much more prominent shoulders on the epiproct body. The 2 species exhibit scarcely any differences in details of the epiproct neck, hilt, and hook. The aedeagal lamellae for both species are also similar in length and width, but the posterior aspect of the G. lamba lobes are more nearly truncate at the apical margin.

Gaufinia jarbidge n. sp.

(Figs. 26–31)


ADULT HABITUS.—Ocellar triangle encloses a butterfly-shaped pale brown area; anterior to lateral ocelli, a small brown, knob-like extension directed toward anterior margin of eye occurs, and forward of the ocellar triangle, a pair of bar-shaped pigmented areas occur. Most of occiput and lateral area of frons are pale. Pronotum bears a pair of longitudinal brown bars on either side of median suture, and a few (ca. 3–4) obscure sublateral dusky spots are present on the disk. Median stripe consists of ca. 5–7 dorsal pigment spots on...
abdominal terga. Legs, cerci and antennae pale. Wings hyaline, veins pale.

**Male.**—Forewing length ca. 4.5–5.0 mm. Epiproct length from base to apex of neck ca. 2.07× width of epiproct body at midlength. Anterolateral margins of epiproct body form a straight line which angles from shoulders to base of neck (Fig. 28). Neck margins parallel (Figs. 26, 28), apex truncate or slightly rounded; neck ca. 1.12–1.19× long as width at midlength. Hilt becomes gradually wider from hook base to near neck apex (Figs. 27–29), then is abruptly constricted; lateral margins bear an irregular row of spiny projections (Fig. 29), dorsum bears a low median keel. Carina extends to near neck apex (Fig. 28).

Aedeagal lamella bilobed; apical margin almost truncate from anterior aspect (Fig. 31) and narrowed to a rounded margin in caudal aspect (Fig. 30). Lobes of membranous sac bear numerous minute pores along basolateral surfaces (Fig. 30).

**FEMALE.**—Forewing length ca. 5.0–6.0 mm. Posterior margin of subgenital plate entire, rounded to slightly pointed; apex extends over about half of sternum 9.

**LARVA.**—Unknown.

**ETYMOLOGY.**—The species name is based on the Jarbidge Mountain Range of eastern Nevada and is used as a noun in apposition.

**DIAGNOSIS.**—The neck of this species is similar to those of *G. kaibabensis* and *G.*
wasatchensis in being relatively slender and short, but the hook and hilt are slightly more prominent and the neck is slightly larger than in those species. The lateral margins of the epiproct body from shoulders to neck form straight lines rather than the curved profile of the *G. kaibabensis* epiproct. *Gaufinia jarbridge* is also a smaller species with male forewing lengths of about 5 mm or less and female forewing lengths of about 6 mm or less.

**Distribution.**—Known only from the Jarbridge Mountains, Nevada.

*Gaufinia kaibabensis* n. sp. (Figs. 32–37)


**Adult habitus.**—Body pale with brown markings on dorsum of head, thoracic nota, and abdomen. Wings, cerci, and legs pale, antennae pale basally but brown on apical two thirds. Abdominal terga 2–7 with dark blotch forming median stripe. Head mostly pale but with small brown markings forward of median ocellus; occipital area pale except for obscure brown posterolateral spots and a dark linear spot on either side of epicranial suture. Pronotum with 2 irregular linear patches of brown on either side of median suture, and additional pigmented areas scattered on disc; pronotum dark brown along most of lateral and posterior margins.

**Male.**—Forewing length ca. 7.5–8.0 mm. Epiproct length from base to apex of neck ca. 1.20× long as width at midlength, with lateral margins slightly convergent apically (Figs. 32–34). Hilt sclerite only slightly wider in dorsal aspect near base than near hook, but distinctly thicker in lateral aspect at base and bearing an obscure dorsal keel; lateral margins of hilt irregularly scalloped forming a few broad, triangular spines, and hook surface bearing scattered irregular tubercles (Figs. 33, 35–36). Carina extends to neck apex, or nearly so; carina bare along dorsal margin (Figs. 32–33, 37). Lateral aspect of epiproct neck apex strongly slanted from carina for more than half the distance to hilt base. Aedeagal lamella similar to that of *G. lamba*; apical margins truncate in caudal aspect, rounded in anterior aspect; anterior surface with fine, reticulate, chain-like pattern.

**Female.**—Forewing length ca. 8.5–9.2 mm. Subgenital plate extends over ca. three fourths of sternum 9. Lateral margins slightly convex forming a rounded apex.

**Larva.**—Unknown.

**Etymology.**—The species name refers to the type locality on the Kaibab Plateau.

**Diagnosis.**—*Gaufinia kaibabensis* is one of several species in which the neck region is relatively slender and not constricted at the base. The hilt is obscure and the slender hook bears irregular spiny projections scattered over the surface. The neck and hook for *G. cristata* are similar (Surdick 1995), but the lateral margins of the epiproct body for that species are not smoothly rounded and gradually convergent as in this species (Fig. 32). *Gaufinia wasatchensis* is also similar (see below), but in that species, the neck is longer and the hilt is distinct and clearly defined from the hook.

**Distribution.**—Known only from North Canyon Spring on the Kaibab Plateau, Arizona.

*Gaufinia lamba* (Needham and Claassen), new combination

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:3545
(Figs. 38–43)


**Material examined.**—**Colorado:** Boulder Co., Long Lake, outlet, 31 July 2008, Ruiter &

**DISTRIBUTION.**—USA: CO, WY.

**ADULT HABITUS.**—Head with dark, somewhat butterfly-shaped marking over ocellar triangle and extending with swallowtail-like markings over anterolateral frons; 2 additional

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small dark spots occur near anterior margin of head. Occiput with a transverse row of irregular brown spots near posterior margin of head. Antennal scape brown, segments 2–6 pale and additional segments brown. Pronotum with ca. 6 brown hieroglyphic-like markings on each side of median suture. Median abdominal stripe consists of dark spot on ca. terga 1–8. Legs brown, cerci and wings pale; veins amber.

**Male.**—Forewing length ca. 7.5–8.0 mm. Epiproct length from base to apex of neck ca. 2.2–2.5× width of epiproct body at mid-length. Shoulders not conspicuously bulging and anterolateral margins of epiproct body gradually convergent in slanted lines to base of neck (Figs. 38–40). Length of neck ca. 1.0–1.2× neck width at midlength; lateral margins of neck constricted basally and widest near or beyond anterior margin of carina (Figs. 38–39). Hilt forming a circular disc at base of hook; lateral margins of hilt and surface of hook with minute, irregular spiny projections (Fig. 41). Carina extends to apical third of neck. Aedeagal lamella bilobed; apical margins of lobes truncate in anterior aspect (Fig. 43), but narrowly rounded in caudal aspect (Fig. 42).

**Female.**—Forewing length ca. 8.5–9.0 mm. Subgenital plate entire; posterior margin essentially truncate with convergent lateral margins. Apex of plate covers sternum 9.

**Larva.**—Undescribed.

*Gaufinia shivwitsa* n. sp.

(Figs. 44–49)


**Adult habitus.**—Head with dusky brown X-shaped pattern that extends from lateral ocelli through anterior ocellus and terminates on the frontoclypeus; small lateral extensions to the X-pattern occur midway between lateral and anterior ocelli and on the anterobasal part of the X-pattern; 2 additional small pale brown spots occur near the anterior margin of the head and more obscure ones occur on the occiput. Pronotum with ca. 7 elongate dusky brown hieroglyphic-like markings on either side of median suture. Median abdominal stripe consists of dark brown rings on ca. 5 basal terga and obscure markings on distal segments through tergum 8.

**Male.**—Forewing length ca. 7.5–8.1 mm. Epiproct length from base of apex of neck ca. 2.59× width of epiproct body at midlength. Shoulders converge strongly to neck from epiproct midlength (Figs. 44–45); neck ca. 2.8× long as width at midlength, and conspicuously constricted near midlength (Figs. 44–45, 48). Carina extends to near neck apex (Figs. 46–47). Hilt sclerite ellipsoid with marginal spines and a median longitudinal dorsal keel (Figs. 48–49); hook short and slightly widened at apex. Aedeagal lamella not examined.

**Female.**—Forewing length ca. 8.5–9.0 mm. Subgenital plate entire, broadly rounded to almost truncate across posterior margin, and extending over ca. two thirds of sternum 9.

**Larva.**—Unknown.

**Etymology.**—The species name, used as a noun in apposition, honors the Native American Shiviwits Band of Southern Paiutes of southwestern Utah.

**Diagnosis.**—The neck of the epiproct of *G. shivwitsa* is distinctive in being slender, strongly constricted at roughly midlength, and in becoming much wider across the head region of the epiproct tip.

**Distribution.**—Presently known from southwestern Utah and from one site in southeastern Nevada.
**Gaufinia shoshone** n. sp.

(Figs. 50–55)


ADULT HABITUS.—Head with pale brown X-pattern extending from lateral ocelli, through anterior ocellus, to frontoclypeus; small pigmented spots located adjacent to anterior ocellus and connected to anterior base of X-pattern. More prominent dusky markings occur along the posterior occiput and adjacent to the compound eye. The pronotum bears ca. 6 hieroglyphic-like markings on either side of median suture. The median abdominal stripe is composed of brown rings located on the posterior margin of terga 1–8. Legs, wings and veins and cerci pale; antennae pale in posterior margins of terga 1–8. Legs, wings, and veins and cerci pale; antennae pale in basal third, but brown beyond.

MALE.—Forewing length ca. 6.0–6.5 mm. Epiproct length from base to apex of neck ca. 2.3–2.6× width of epiproct body at midlength. Shoulders usually converge gradually to base of neck (Fig. 50), but some specimens exhibit a slight constriction of the lateral margins in the apical half of the epiproct body; neck about as long as wide or slightly wider at midlength than long (Fig. 50); base narrow and neck apex wider and slightly notched in most specimens. Hilt slender, with dorsal ridge and irregular projections along lateral margins (Figs. 52–53). Carina reaches almost to midlength of neck (Figs. 50–51). Aedeagal lamella bilobed; lobes narrowly rounded in caudal aspect (Fig. 55); membranous aedeagal body typical of genus (Fig. 54).

FEMALE.—Forewing length ca. 7.5–8.2 mm. Subgenital plate extends beyond posterior margin of sternum 9; lateral margins slightly concave.

LARVA.—Unknown.

ETYMOLOGY.—The species name, used as a noun in apposition, honors the Native American Shoshone people of northwestern Utah.

DIAGNOSIS.—The epiproct of G. shoshone is similar to that of G. lamba in dorsal aspect, but the hilt and hook (Figs. 50–53) are more slender than in the latter species, and the apical notch on the neck of the new species appears distinctive.

DISTRIBUTION.—Known only from the Raft River Mountains of northwestern Utah.

**Gaunisia wallowa n. sp.**

(Figs. 56–61)


MALE.—Forewing length ca. 6.0–6.5 mm. Epiproct length from base to apex of neck ca. 1.85–1.95× width of epiproct at midlength. Epiproct body with swollen shoulders and short length, appearing almost circular in outline; shoulders converge strongly on sides of neck, attaching at an almost 90° angle (Figs. 56, 60–61). Neck length ca. 1.8–2.0× neck width at midlength; base narrow, apex wider and projecting along median line (Fig. 60). Hilt short, narrow at base and expanded apically into a prominent disc-like structure; lateral margins of disc irregularly scalloped with small spine-like projections (Figs. 57–59). Anterolateral shelf sclerites project ventrally from epiproct body at about midwidth of shoulders (Figs. 56, 60–61). Carina reaches about midlength on neck (Fig. 57). Aedeagal lamella not examined.

FEMALE.—Forewing length ca. 8.5–9.0 mm.

LARVA.—Unknown.

ETYMOLOGY.—The species name, used as a noun in apposition, is based on the Wallowa Mountains of northeastern Oregon.

DIAGNOSIS.—The neck region of this species is suggestive of G. lamba; however, the neck is longer than in typical G. lamba (Figs. 56, 60).

DISTRIBUTION.—Presently known from eastern Oregon and southeastern Washington.
Gaufinia wasatchensis n. sp.

(Figs. 62–67)


ADULT HABITUS.—Head almost completely pale, but with small brown spots over lateral ocelli and anterior ocellus, small bars near antennal bases, and obscure brownish spots near front margin of head. Occiput pale. Pronotum with 2 major brown markings adjacent to median suture, each separated into a cluster of 2–4 smaller brown spots by intervening pale
areas; generally with ca. 4 additional brown spots near anterolateral margins. Median abdominal stripe consists of dark pigment spots on terga 2–8; brown spots less conspicuous on terga 2–4. Legs, wings, wing veins, and cerci pale; antennae pale in basal third but brown beyond.

**MALE.**—Forewing length ca. 7.5–8.0 mm. Epiproct length from base to apex of neck ca. 2× width of epiproct body at midlength. Shoulders converge gradually to neck; neck ca. 2.25× long as width at midlength, head rounded and narrow, with lateral margins almost parallel (Figs. 62–63). Hilt sclerite

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expanded in basal half to about midlength, then narrowed to near base of hook (Figs. 64–65); lateral margins of hilt bear an irregular row of narrow spines. Carina extends almost to apex of neck (Figs. 62–64). Aedeagal lamella bilobed; caudal aspect of lobes narrowed apically and rounded along apical margins (Fig. 67); membranous caudal lobes of aedeagus typical of genus.

**FEMALE.**—Forewing length ca. 8.5–9.0 mm. Subgenital plate extends to posterior margin of sternum 9. Lateral margins slightly concave.

**LARVA.**—Unknown.

**ETYMOLOGY.**—The species name, used as a noun in apposition, is based on the Wasatch Mountains where most of the known specimens were collected.

**DIAGNOSIS.**—Males of this species are similar to those of *G. lamba*, but in that species the epiproct head is broad, with an angular apex (Figs. 39, 40).

**DISTRIBUTION.**—Presently known from the Wasatch Mountain Range in northern Utah, in southern Idaho, and at scattered sites in Wyoming.

**ECOLOGY**

*Gaufinia* species live mostly in spring-fed habitats (Fig. 68). Some of these springs can be very large like the following springs from Utah: Big Springs, Utah Co.; Cascade Springs, Wasatch Co.; Thousand Springs, Salt Lake Co.; Ricks Spring, Cache Co.; and Spring Hollow Spring, Cache Co. However, *Gaufinia* also occurs in small headwater tributaries of larger creeks and rivers, and for this reason the collection information data are sometimes too general, such as “Snake River, Yellowstone National Park.”

**DISTRIBUTION**

This genus occurs primarily in the Rocky Mountains in the United States and the Canadian Rockies in Canada. Needham and Claassen (1925) described the first 2 species that now occur in the genus: *Gaufinia lamba* from Colorado and *Gaufinia albertensis* from Alberta. In addition, *Gaufinia* is sometimes found in lower-elevation regions where ideal spring-fed habitats occur. For example, *Gaufinia kaibabensis* is found in North Canyon Spring on the Kaibab Plateau in Arizona.

Since 1925, several publications have included citations of distribution records of species that presently occur in the genus *Gaufinia*. The most-often-cited works are “Systematic List of Plecoptera of Intermountain Region” (Gaufin 1964b) and The Stoneflies (Plecoptera) of the Rocky Mountains (Baumann et al. 1977). These publications were not always supported by careful research but often relied on the published literature. Consequently, we will explain the history involved and attempt to resolve any problems that might exist. Each province and state will be covered separately.

**Canada**

**ALBERTA.**—The holotype ♂ and 3 ♀ paratypes of *Gaufinia albertensis* from Waterton Lakes National Park (CNC) and a collection from Livingston Creek (BYU) are the only confirmed specimens of *Gaufinia* from this province.

**BRITISH COLUMBIA.**—Three records from British Columbia were confirmed: North of Cowichan Lake (CNC), Golden Dreams River, near Whistler (BYU), and North Fork Flathead River, SE of Fernie (INHS).

**United States**

**ARIZONA.**—The distribution and past dispersal of southwestern United States Plecoptera (Stewart et al. 1974) lists *Sweltsa lamba* from Arizona. This record gives a reference to Gaufin (1964b). All *Sweltsa* specimens in the BYU collection, which was once at the University of Utah, were studied, and no confirmation was made. However, several specimens labeled as *Sweltsa coloradensis* were present that could have contributed to the misidentification. The specimens noted were found to represent 2 *Sweltsa* species: *S. coloradensis* and *S. mogollonica* (Stark and Baumann 2018). These specimens were from small streams but not large springs like North Canyon Spring, the type locality of *Gaufinia kaibabensis* on the Kaibab Plateau. Consequently, the only *Gaufinia* species known from Arizona is *G. kaibabensis*.

**COLORADO.**—The type locality of *Gaufinia lamba* is Fern Lake, Estes Park, Colorado. The holotype is in the Cornell University Collection. The original description lists 33 ♂ 34 ♀ paratypes that are to be shared with several colleagues. We studied specimens from this
Fig. 68. Big Springs, Utah Co., Utah. Photo credit: Alan R. Myrup.
series that were from the Illinois Natural History Collection. This species has been widely collected in Colorado and was included in the thesis studies of 2 students of Arden Gaufin from the University of Utah: Alan W. Knight, Gunnison River, and Bryant R. Oblad, Yampa River. Their results are included in Stark et al. (1973) as Sweltsa lamba. This species was also listed more recently in Kondratieff and Baumann (2002).

In addition, both papers also list Sweltsa albertensis incorrectly as occurring in Colorado. The reason for the incorrect Gaufinia albortensis records stems from the fact that William E. Ricker identified 8 vials of Colorado specimens that were in the CNC collection as Sweltsa albortensis. Workers went with his identifications, but they were not correct.

Our conclusion, based on specimens studied in this revision, is that Gaufinia lamba is the only Gaufinia species in Colorado.

IDAHO.—Nebeker and Gaufin (1966) list 2 species that are now included in the genus Gaufinia: albortensis and lamba. The first species, G. albortensis, does indeed occur in Idaho, but the second one, G. lamba, does not. In total, we found that 3 species of Gaufinia presently occur in Idaho: albortensis, gaufini, and wasatchensis. Gaufinia albortensis is widespread in south central Idaho and as far east as Teton County. Gaufinia gaufini occurs only in the Cub River drainage in Franklin County, in the extreme southeastern corner of the state. Finally, Gaufinia wasatchensis extends north from Utah into several southeastern Idaho counties.

MONTANA.—This state likely has the most ideal habitats for Gaufinia species. Large numbers of stoneflies were collected over the years in studies by Arden Gaufin, students, and colleagues at the University of Montana Flathead Lake Biological Station. Add their efforts to the work by Andy Sheldon, Jack Stanford, Bob Newell, Kenneth Stewart, and others and the volume of specimens is enormous. Still only one species of Gaufinia was found in Montana, and that is Gaufinia albortensis.


NEVADA.—Only one species was listed from Nevada when Baumann et al. (2017) recorded Gaufinia wasatchensis. This species turned out to be Gaufinia jarbidge, which occurs in the Jarbidge Mountains in the northern part of Elko County. However, a single female with an odd subgenital plate was collected at Bottle Creek in the Jackson Range, Humboldt County, that could belong to Gaufinia. In addition, a small series of specimens was collected in Lincoln County near Panaca by Andy Sheldon. These resemble Gaufinia shivwitsa and have been lumped under G. shivwitsa in this paper. Future collecting in this area could yield another new Gaufinia species.

NEW MEXICO.—The first Gaufinia species to be listed from New Mexico was Sweltsa lamba. In the mid-1970s, Stark et al. (1975) listed S. lamba in a paper on new records of stoneflies from the state. And then in 2005, it was included again in an updated list by (Jacobi et al. 2005).

During this time, a second species that belonged to the genus, Sweltsa hondo, was described (Baumann and Jacobi 1984). As part of our study, many specimens from throughout the state were studied. The present study included 5 counties in north-central New Mexico. The results showed that only Gaufinia hondo was present.

OREGON.—Gaufinia is not well represented in Oregon. This result is surprising because ideal spring-fed habitats are common. However, since the genus does not occur near the Pacific Coast, the only species present in Oregon is in the Blue or Wallowa Mountains in the northeast corner of the state. This new species, Gaufinia wallowa, also occurs southwest into the headwaters of the John Day River in Wallowa–Whitman National Forest.

UTAH.—Gaufinia is broadly distributed in Utah, where 6 species are represented. Originally, the only species recorded from the state was Gaufinia lamba. However, now we know that this species, which was named from Colorado, is not found in Utah. What was called G. lamba is really our new species, Gaufinia wasatchensis. This species is distributed in the Wasatch Mountains from north central Utah to southern Idaho (Gaufin et al. 1966, Baumann and Gaufin 1969).
Historically, the second species named in what is now Gaufinia was Stenoltsa gaufini from Ricks Spring in upper Logan Canyon (Baumann 1973). Then Baumann and Jacobi (1984) described a new species from New Mexico, Stenoltsa hondo. Another species, Stenoltsa cristata, was later named from the Abajo Mountains near Blanding, Utah. (Surdick 1995).

In this paper, we now describe 2 additional species of Gaufinia from Utah: G. shoshone and G. shivwitsa.

The Raft River Mountains of northwestern Utah is the home of Gaufinia shoshone. The Raft River originally flowed into the Snake River in Idaho. Now, it usually dries up, except in abundant water years (Houseman and Baumann 1997).

Gaufinia shivwitsa is found in southwestern Utah, from Beaver south to the Pine Valley Mountains near St. George (Call and Baumann 1997).

Finally, during this study, we discovered that specimens collected in the extreme southeastern corner of Utah belong to the species Gaufinia hondo. If a straight line is drawn, New Mexico in the Four Corners area is very close to southeastern Utah.

Thus, there are 6 species of Gaufinia presently recorded from Utah: cristata, gaufini, hondo, shoshone, shivwitsa, and wasatchensis.

WASHINGTON.—Two species of Gaufinia have been recorded from Washington: G. albertensis and G. wallowa.

Gaufinia albertensis was found at Flodell Creek in the Little Pend Oreille River drainage. This locality is in Stevens County in the Selkirk Mountains.

Gaufinia wallowa specimens were collected from the Tucannon River, junction Punjab Creek, in Columbia County in Umatilla National Forest.

PRELIMINARY KEY TO MALE GAUFINIA

1. Dorsal aspect of epiproct with 2 median longitudinal carinae (Figs. 14–17); aedeagal lamella trilobed (Fig. 19) ....................... G. gaufini
   Dorsal aspect of epiproct with a single median longitudinal carina (Fig. 38); aedeagal lamella bilobed (Fig. 7) .......................... 2
2. Median longitudinal carina of epiproct usually incomplete in a short section between shoul-
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CONTENTS

Gaufinia, a new stonefly genus (Plecoptera: Chloroperlidae), with the description of six new species from western North America

Bill P. Stark and Richard W. Baumann