Bryelmis Barr (Coleoptera: Elmidae: Elminae), a New Genus of Riffle Beetle with Three New Species from the Pacific Northwest, U.S.A.

Author(s) :Cheryl B. Barr
Source: The Coleopterists Bulletin, 65(3):197-212. 2011.
Published By: The Coleopterists Society
DOI: 10.1649/072.065.0301
URL: http://www.bioone.org/doi/full/10.1649/072.065.0301

The Coleopterists Bulletin, 65(3): 197–212. 2011.

Bryelmis Barr (Coleoptera: Elmidae: Elminae), a New Genus of Riffle Beetle with Three New Species from the Pacific Northwest, U.S.A.

Cheryl B. Barr
Essig Museum of Entomology
1101 Valley Life Sciences Bldg., #4780
University of California
Berkeley, CA 94720-4780, U.S.A.

Abstract

Bryelmis Barr, a **new genus** of elmid, and three **new species**, *Bryelmis idahoensis* Barr, *Bryelmis rivularis* Barr, and *Bryelmis siskiyou* Barr, are described from streams and springs in Washington, Oregon, California, and Idaho. Drawings or photographs of the adult habitus and male genitalia of each species, and of the larval habitus of the genus, are included, as well as a key to the adults of the species and revised couplets for insertion into existing adult and larval keys to the Elmidae. The biogeography, habitat, and microhabitat of the species are discussed. Aquatic liverworts are the unusual primary microhabitat of all three species of *Bryelmis*.

Key Words: aquatic beetles, aquatic liverwort, *Chiloscyphus*, glacial refugium, Nearctic

---

The Elmidae of North America, excluding Mexico, were reviewed in depth by Sanderson (1953, 1954) and Brown (1972), who included keys to species. Recent keys by White and Roughley (2008) and Shepard (2002) are to the generic level only. There are nearly 100 described species in 27 genera currently known from North America. The last new genus described from the continent was *Huleechius* Brown (1981) from Arizona and Mexico.

In his multi-volume treatment of the beetles of the Pacific Northwest (British Columbia, Washington, Oregon, Idaho), Hatch (1965) listed and provided keys for 10 genera and 16 species of elmids. Since then, *Atractelmis wawona* Chandler (1954), described from California, was reported from Oregon and Idaho (Shepard and Barr 1991), and a new species, *Zaitzevia* (*Susevia*) *posthonia* Brown (2001) was described from British Columbia, Washington, Oregon, Idaho, and northern California.

Until fairly recently, the new genus described herein was only rarely collected, perhaps because its specific microhabitat would likely be missed in typical stream substrate kick sampling. In addition, it superficially resembles the very common *Cleptelmis* Sanderson, which may contribute to it being overlooked in the field and in museum collections. After discovering that my 1985 collections of elmids from Washington and Oregon contained an unknown genus and species of elmid, I focused subsequent collecting efforts on aquatic bryophytes, the suspected microhabitat. Identification of the inhabited bryophyte from several collection localities revealed it to be an aquatic liverwort rather than a moss. Examination of specimens I later collected in northern California revealed a second species. Subsequently, additional specimens were obtained from laboratories and collectors engaged in water quality monitoring who became aware of the existence of this new elmid and its particular microhabitat. More recently, specimens from northern Idaho, sent to me for examination, turned out to be a distinct third species.

Aquatic bryophytes are not a common microhabitat for elmids, with only three species in North America frequently associated with aquatic mosses or liverworts: *Promoresia tardella* (Fall) in the East, and *A. wawona* and *Cleptelmis addenda* (Fall) in the West (Brown 1972; Shepard and Barr 1991). Unlike members of the new genus described here, the bodies of the first two species are spindle-shaped, *i.e.*, narrowed anteriorly and posteriorly; *Cleptelmis* is quadrate, similar to the new genus in general shape.

Material and Methods

The following observations are based on the examination of 652 adult and over 200 larval specimens. Larvae are treated at the generic level only, and are excluded from the species treatments and range map. Photographs of the adult specimens were taken with a Visionary Digital BK Plus Lab System and line drawings were executed using a Zeiss Stemi SV6 dissecting microscope with camera lucida, and a Leica DM LS2 compound microscope with camera lucida. Specimens will be deposited in the following institutions and private collections as designated in Material Examined:

ABAC: Aquatic Biology Associates, Inc., Corvallis, OR, USA

BNHM: The Natural History Museum, London, UK

CASC: California Academy of Sciences, San Francisco, CA, USA

CNCI: Canadian National Collection of Insects, Ottawa, Ontario, Canada

EMEC: Essig Museum of Entomology, University of California, Berkeley, CA, USA

CIDA: Orma J. Smith Museum of Natural History, Albertson College, Caldwell, ID, USA

JJLC: Jon J. Lee, Eureka, CA, USA

LSAM: Louisiana State Arthropod Museum, Louisiana State University, Baton Rouge, LA, USA

MCZC: Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA

MTEC: Montana Entomology Collection, Montana State University, Bozeman, MT, USA

OMNH: Sam Noble Oklahoma Museum of Natural History, University of Oklahoma, Norman, OK, USA

OSAC: Oregon State Arthropod Collection, Oregon State University, Corvallis, OR, USA

SMDV: George J. Spencer Entomological Museum, University of British Columbia, Vancouver, BC, Canada

USNM: U. S. National Museum of Natural History, Washington, DC, USA

WDSC: William D. Shepard, Pinole, CA, USA

WFBM: W. F. Barr Entomological Collection, University of Idaho, Moscow, ID, USA

WSUC: James Entomological Collection, Washington State University, Pullman, WA, USA

Aquatic bryophytes associated with the new genus were identified by specialists William Buck of The New York Botanical Garden, Bronx, NY and Daniel Norris of the University and Jepson Herbaria, University of California, Berkeley, CA. These samples will be deposited as vouchers in the latter collection.

Bryelmis Barr, new genus
(Figs. 1–9)

Type Species. *Bryelmis rivularis* Barr, **new species**, here designated.

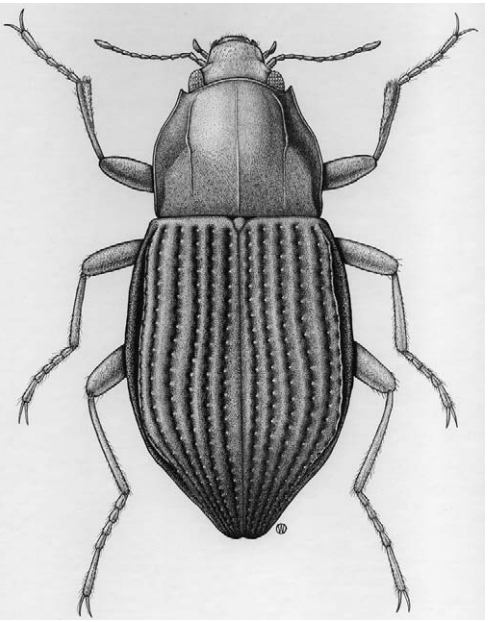


Fig. 1. Dorsal habitus of *Bryelmis rivularis*, type species.

Adult Description. Male. Body elongate-ovoid, approximately twice as long as wide, robust, convex dorsally and ventrally, well-sclerotized (Figs. 1, 3–4, 8–9). **Head**: Prognathus, punctate with moderately long, pale setae. Antenna filiform, with 11 antennomeres; basal antennomere 1/3X longer than antennomere 2; antennomeres 3–10 about the same length as antennomere 2 but narrower, about 1/2X width of first 2, size slightly increasing distally; ultimate antennomere fusiform, 2X as long as the penultimate, bearing a cluster of short, dense setae at tip. Eye ovoid, well-developed. Clypeus rectangular, extending basally beneath antennal insertions, anterior angles broadly rounded. Mandible dark basally, lighter apically, with 3 long, slender teeth, tips narrowly rounded; prostheca transparent with 4 fine apical teeth. Maxillary palpus 3-segmented; apical segment fusiform, slightly asymmetrical, longer than previous two segments; basal segment 1/2 the length of the second segment. Labrum rectangular, narrower than clypeus; apicolateral, and occasionally mediolateral, margins with dense fringe of pale, stout setae. Labial palpus 3-segmented, apical segment subovoid, as long as basal 2 segments and 2X as wide. Gena and gula with dense, yellow plastron. **Pronotum**: Generally trapezoidal, convex, carinate, and sulcate. Wider than long, widest about 1/3 distance from base, narrowest at apex. Lateral margins entire, margined and faintly crenate,

weakly sinuate; anterior margin smooth and shiny, arcuate over base of head, apicolateral angles acute; basal margin weakly sinuate, basolateral angles more or less right angled. Disc moderately convex with narrow, median, longitudinal carina extending from near apical margin to base; margined by two distinct subparallel, sublateral carinae extending from near apical margin to base, often obscured at basal 1/3–1/2 by deep, closely-spaced punctures; distance between sublateral carinae at apex less than head width. Sublateral carinae each bordered laterally at basal 1/3 by a shelf-like area extending nearly to lateral margin, area margined by an obscure to distinct carina; carinae together having an "h"-shaped, forked appearance. A deep, granulate sulcus at lateral margin, widest anteriorly, abruptly narrowed at basal 1/3; a pair of broad, shallow foveae present near basal margin, mesal to bases of main sublateral carinae. Disc of pronotum with small, sparse to moderately dense punctures accompanied by long, fine setae; basolateral shelf-like area rugose with deep, closely-spaced punctures. **Elytron**: Elongate, convex, laterally marginate; disk carinate and sulcate, depressed at base; together wider than base of pronotum. Lateral margin slightly arcuate to apical 1/4, then abruptly narrowed to rounded tip. Sublateral carinae at intervals 7 and 8, bordering striae 6 and 7, joined at the umbone; the more medial stria ends at about 1/5 the distance from the elytral apex, most distinct in apical 1/3; the more lateral stria is shorter. Longitudinal sulcus 3 intervals wide, extending from carina at interval 8 to lateral margin, deepest adjacent to metasternum. Nine punctate striae. **Scutellum**: Small, longer than wide. **Metathoracic wings**: Present or absent. **Legs**: Prothoracic leg shortest, metathoracic leg longest. Femur with basal patch of pale yellow setae on medial/inner surface, at basal 2/3 of profemur and metafemur and basal 1/2 of metafemur. Protibia with dense cleaning fringe of long, pale yellow setae on distal 2/3–3/4 of medial/inner surface; fringe of setae present but sparse on mesotibia and metatibia. Tarsus including claw nearly as long as tibia, with tarsomere 5 as long as tarsomeres 1–4 combined. Tarsal formula 5–5–5. Claws long and slender, without teeth. **Venter**: Glabrous medially, dense silver to golden plastron present laterally. Prosternal disc roughly triangular, emarginate; disc concave anteriorly, convex between procoxae, concave posteriorly near apex; anterior margin straight beneath head, apex bluntly rounded and inserted into a deep mesosternal fossa. Mesosternal disc concave between mesocoxae. Metasternal disc roughly cordate with a median, longitudinal sulcus, partly margined with a carina extending from between mesocoxae posteriorly nearly to metacoxae; each metacoxa with a small, posteriorly-projecting lobe. Abdomen with 5 sterna, most convex medially; sternum 1 with a pair of arcuate, divergent carinae extending from mesal margin of metacoxae to posterior margin of sternum, forming an approximate triangle; sternum 5 broadly triangular with a bluntly rounded apex. Plastron present on gena, gula, prosternal epimeron and hypomeron, metasternal episternum and lateral to carinae, elytral epipleura (hypomeron) except for base, laterally on all abdominal sterna, and on bases of all coxae. **Genitalia** (Figs. 5–7): Typical for an elmine and with no features unique to the genus.

Adult Diagnosis. Adults of *Bryelmis* superficially resemble those of *Cleptelmis*, and can be mistaken for this genus because of basally forked sublateral pronotal carinae and similar size, shape, and coloration. *Bryelmis* is distinguished by a median longitudinal pronotal carina and distinct elytral sublateral carinae, and the often-indistinct forks of the sublateral pronotal carinae and basal areas between are more or less "h"-shaped. *Cleptelmis* lacks a median pronotal carina and elytral sublateral carinae, and the basal forks of the distinct sublateral pronotal carinae form an upside-down "Y." The genera *Rhizelmis* Chandler and *Ampumixis* Sanderson both have a median pronotal carina like *Bryelmis*, but lack elytral carinae.

Bryelmis keys to *Cleptelmis* in White and Roughley (2008), couplet 11; Shepard (2002), couplet 11; and Brown (1972), couplet 46. To include *Bryelmis*, the following substitutions should be made:

Pronotal carinae appearing forked at basal third ..... A

A Pronotum with median longitudinal carina, at least anteriorly; elytra with sublateral carinae... ..... ***Bryelmis***

A′ Pronotum without median longitudinal carina; elytra without sublateral elytral carinae..... .....***Cleptelmis***

I find the character "pronotal carinae forked at base or not forked at base" to be problematic and subject to misinterpretation, and think that existing generic keys need revision.

Larval Description. Mature larva (Fig. 2) approximately 4.5 mm long, 0.7 mm wide at metathorax; elateriform, tapering posteriorly, subtriangular in cross-section; red brown with pale middorsal suture, head darker; moderately to densely tuberculate, with flattened setae. **Head**: Highly sclerotized, darker dorsally than ventrally, normally partly concealed by pronotum. Antenna cylindrical, 3-segmented; basal segment stout, as wide as long, 1/3 length of segment 2; segment 2 longest, 3X as long as wide, bearing apical seta as long as apical segment; apical segment minute, 1/2 width and 1/4 length of segment 2. Stemmata well-developed, grouped in

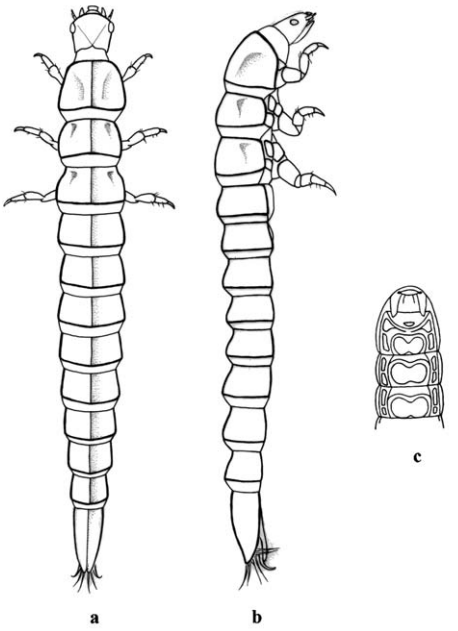


Fig. 2. Larva of *Bryelmis*. a) Dorsal view, b) Lateral view, c) Sternum.

an oval cluster. Frontal sutures together narrowly U-shaped and meeting near base of head, epicranial stem very short; frons dorsolaterally flattened. Clypeus fused to frons. Labrum transverse, 4X longer than wide, truncate with rounded apicolateral margins, margins setose. Mandible with 3 stout, blunt, apical teeth; the middle one largest. Maxilla with galea and lacinia distinct and apically setose; maxillary palpus transparent, 4-segmented, with a long seta laterally adjacent. Labium rectangular, 2X longer than wide; labial palpus transparent, 2-segmented. **Thorax**: Prothorax nearly as long as meso- and metathorax together, with 2 irregularly-shaped mesolateral depressions on each side; prosternum with cervical sclerites configured like a "V," postpleurite with a single, undivided sclerite, posterior sternum absent (procoxal cavities open posteriorly). Mesothorax and metathorax of similar size and shape, with 2 anterolateral depressions; mesothorax with a pair of lateral, tuberculate spiracles; meso- and metasternum each with 2 pairs of pleural sclerites. Notal margins rounded laterally. Legs 5-segmented, terminal segment a tarsungulus. **Abdomen**: Nine-segmented; segments 1–7 with separate tergites, pleurites, and sternites; segments 8 and 9 each united into a ring. Pale middorsal suture on tergites 1–7; each tergite with a middorsal, hump-like protuberance on posterior tergal margin becoming more prominent on posterior segments, together appearing bluntly saw-toothed in lateral view (Fig. 2b). Dorsal, anterolateral spiracles near margins of segments 1–8. All segments except 9 with apical fringe of peg-like setae. Segment 9 narrow, elongate, with emarginate apex; dorsal longitudinal carina convex in lateral view except near apex; tip acuminate in lateral view; ventral operculum ovate, broadly rounded anteriorly and narrowly rounded posteriorly; opercular chamber with 2 retractile anal hooks.

Larval Diagnosis. *Bryelmis* larvae (Fig. 2) most resemble those of *Ampumixis* in general shape and sclerite characteristics. They differ in that *Ampumixis* has prominent dorsal clusters of pale, spatulate setae on the middorsal and mediolateral protuberances and lateral margins, whereas *Bryelmis* at most has small numbers of pale, flattened setae. In *Ampumixis*, all abdominal tergites have pronounced, rounded middorsal protuberances; in *Bryelmis*, they are less developed and usually most noticeable on the posterior segments. Although the larvae of *Optioservus* Sanderson and *Heterlimnius* Hinton are subtriangular in cross-section like *Bryelmis*, unlike *Bryelmis* (Fig. 2c) their prothoracic postpleurites are composed of two parts. In addition, the lateral margins of the thorax are explanate in the former genera, while those of *Bryelmis* are not. The larvae of *Cleptelmis* and *Atractelmis* are hemicylindrical and do not have dorsomedial hump-like protuberances.

Bryelmis larvae key to *Ampumixis* in White and Roughley (2008), couplet 18, and Brown (1972), couplet 26. To include *Bryelmis*, the following substitution should be made:

Body robust and broad, subtriangular in cross section; with or without spatulate spines along lateral margins and middorsal line ..... A

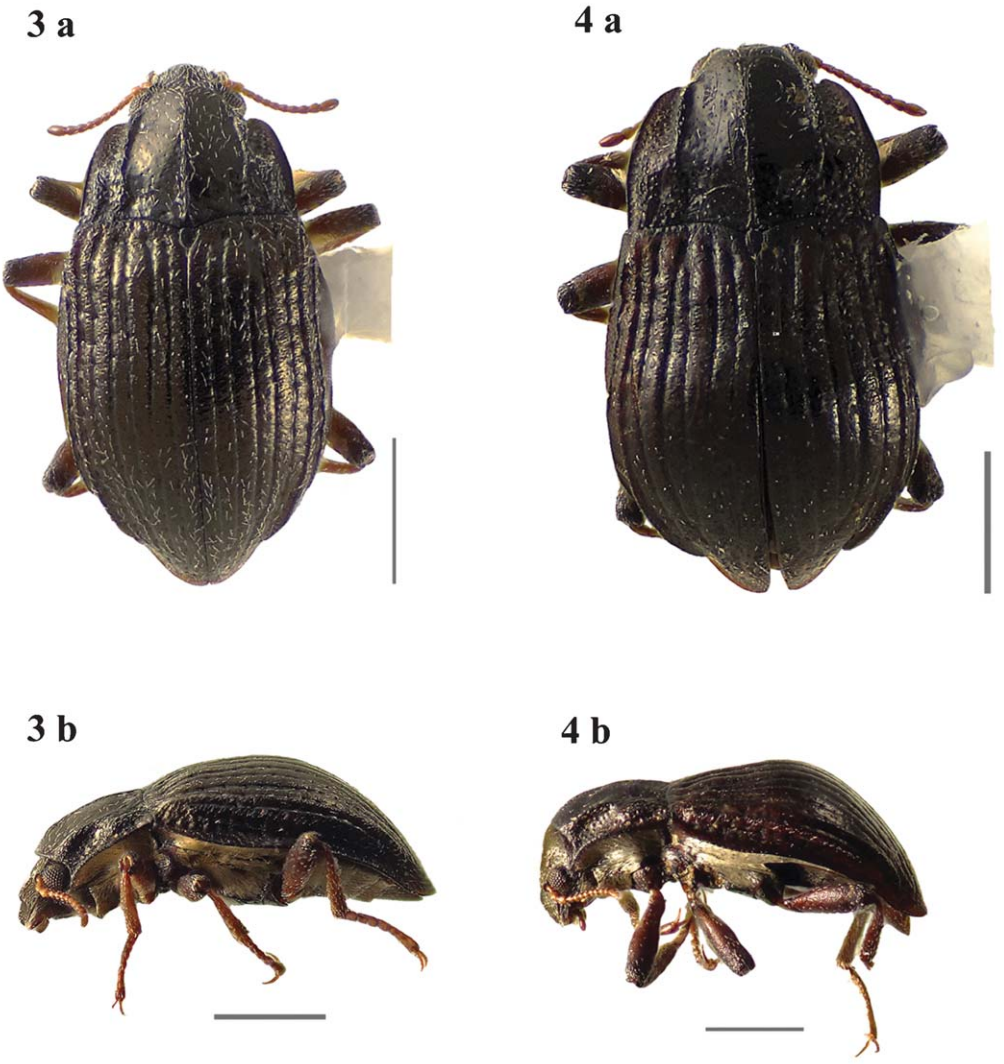
A With prominent clusters of spatulate spines along lateral margins and middorsal line....***Ampumixis***

A′ Without prominent clusters of spatulate spines ..... ***Bryelmis***

Etymology. The generic name combines *bry-*, from the Greek *bryon*, meaning moss, plus *elmis*, from the nominate genus of the family, *Elmis*. Gender: feminine.

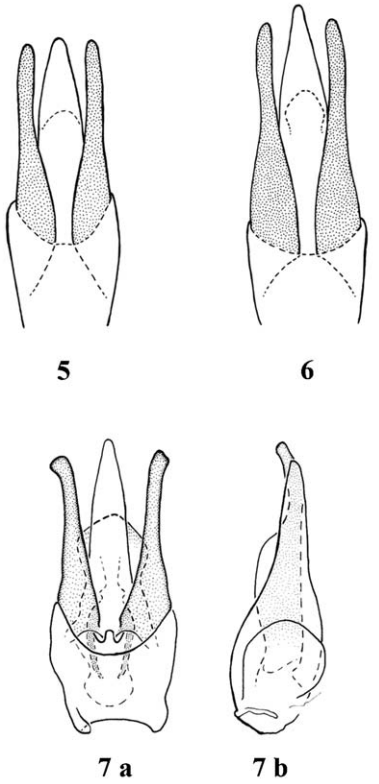
Bryelmis idahoensis Barr, new species
(Figs. 3–5, 10, 11)

Description. Length 2.00–2.34 mm; width 1.04–1.18 mm. Body color dark brown to black; rugose and sculptured with prominent carinae, sulci, striae, and punctures. **Antenna**: Testaceous, often darker at tip. **Head**: Dark brown to black. Eyes strongly protuberant. Frons finely rugose with moderately coarse punctures and long, pale setae; epicranial sutures prominent. Clypeus with fine punctures, evenly spaced more than 2X their



Figs. 3–4. Habitus of *Bryelmis idahoensis*. a) Dorsal, b) Lateral. Scale bars = 0.5 mm.

diameters apart, integument between punctures smooth; setae moderately long, sparse except at lateral margins. Labrum with evenly spaced fine punctures bearing sparse, moderately long setae; apico-lateral margins with dense clusters of setae. **Pronotum**: Dark brown to black, shiny. Distinctly wider than long, widest about 1/3 distance from base or occasionally at base; length 0.60–0.70 mm, width at widest point 0.84–0.96 mm. Basalolateral angles right-angled to slightly obtuse, occasionally slightly acute. Disc smooth, with small, sparse punctures accompanied by fine setae distributed mostly along midline and near lateral margins; longitudinal, central elevation bearing a narrow, median, longitudinal carina extending from near apical margin to basal margin. Sublateral carinae prominent, narrow or broad but not sharply carinate; each bordered medially by a rounded basal and an elongate apical fossa, both moderately deep. **Elytron**: Convex; shiny with short, sparse setae; dark brown to black, occasionally red brown, often with a slight metallic sheen. Length 1.50–1.78 mm, width 0.50–0.58 mm. Disk usually flattened at basal 1/3 with broad, shallow depression present laterad of suture, distinctly humped at middle, angled downward at apical 1/2; sometimes not flattened at base and without depression, and more evenly rounded from base to apex. Two distinct sublateral carinae at intervals 7 and 8; the



Figs. 5–7. Male genitalia of *Bryelmis* spp. **5)** *B. idahoensis*, dorsal view; **6)** *B. siskiyou*, dorsal view; **7)** *B. rivularis*, a) Dorsal view, b) Lateral view.

more medial stria ending abruptly at about 1/5 the distance from the elytral apex; the more lateral stria slightly shorter. Deep longitudinal sulcus bordering lateral margin, with deeper fovea adjacent to metasternum. Nine, often deeply-impressed striae with moderately deep punctures separated by 1X their diameters. **Leg**: Shiny, red brown except for distal 1/4–1/3 of femur which is dark brown; visible portion of femur dark in dorsal habitus view. Femur with closely spaced, minute punctures and sparse setae. **Venter**: Shiny, red brown to dark brown medially, prosternum darkest; dense silver to golden plastron present laterally. Apex of prosternum broadly rounded. Mesosternal disc deeply concave between mesocoxae. Metasternal disc convex. **Male genitalia**: In dorsal view (Fig. 5), parameres with outer margins more or less parallel, tips narrowly rounded. Penis slightly longer than parameres, widest near middle then abruptly narrowed to a blunt tip which is about as wide as that of a paramere.

Variation. There is notable individual variation in this species, even within a single population. All specimens examined were strongly sculptured and striate, but varied in the degree of pronotal and elytral convexity, the presence or absence of basal elytral depressions, the presence or absence of metathoracic wings, and the width of the pronotum at the apical margin behind the head (Figs. 3, 4). Figure 4 illustrates an unusually stocky and sculptured specimen with deep elytral striae. Body size and color, ranging from occasionally red brown to more common dark brown and black, are other variables. Females (n = 5) were slightly longer than males (n = 5) in a comparison of the length measurements of the longest and shortest specimens, with the longest specimen a female and the shortest a male.

Comparative and Diagnostic Comments. *Bryelmis idahoensis* (Figs. 3, 4) is black or dark brown with a body that is generally rugose and sculptured with prominent carinae, sulci, striae, and punctures. The median pronotal carina is produced and ridge-like, the pronotal disc is relatively smooth with few punctures and setae, and the lateral elytral sulcus is deep and trench-like. Its overall appearance is broad, stocky, and "tank-like". *Bryelmis rivularis* (Fig. 8) and *B. siskiyou* (Fig. 9) are much less rugose with elytra not as deeply striate, shallow lateral elytral sulci, less prominent median longitudinal pronotal carinae, and more punctation and setation on the pronotal discs. The male genitalia of *B. idahoensis* (Fig. 5) is somewhat similar to that of *B. siskiyou* (Fig. 6), but differs from that of *B. rivularis* (Fig. 7) which has the paramere tips angled outward.

Material Examined. 458 specimens. **HOLOTYPE** ♂ in EMEC, labeled "IDAHO: Clearwater Co., Clearwater NF, Fern Creek at FS Rd. 700 N of Isabella Landing, 14-VII-2007, C. B. Barr // trib. Isabella Creek, 46°51.703′ N, 115°37.379′ W, elevation 1980 ft. // HOLOTYPE *Bryelmis idahoensis* Barr" [red label]. Two hundred two paratypes (P) [yellow labels] and 255 non-paratypes (NP) were examined from the following localities: Same data as holotype (4 P, BNHM; 4 P, CASC; 2 P, CNCI; 22 P, 3 NP, EMEC; 4 P, USNM). **IDAHO:** Clearwater Co.: Clearwater NF, Deadhorse Creek along FS Rd. 246 nr. Sheep Mtn. Work Ctr., 19-VIII-1999, M.Wolfe // trib. N. Fk. Clearwater R. ~13 mi. NE Headquarters, T39N R07E S08 NW SE NE, elev. 3480 ft. (2 P, CIDA; 2 P, 2 NP, EMEC; 2 P, WFBM); Clearwater NF, Deadhorse Creek at FS Rd. 246, 14-VII-2007, C. B. Barr // trib. N. Fk. Clearwater River, SE Sheep Mtn. Saddle, elev. 3517 ft., 46°44.499′ N, 115°35.983′ W (6 P, EMEC); data same, except W. D. Shepard (9 NP, WDSC); Clearwater NF, Fern Creek at FS Rd. 700 ~20 mi. NE Headquarters, 31-VIII-1999, M.Wolfe // tributary Isabella Cr., N. Fk.Clearwater R., T41N R07E S30 SW SE SE, elev. 2000 ft. (3 P, 1 NP, CIDA; 2 P, WFBM); Fern Cr. -Isabella

Cr., -115.6220, 46.8618, 28 JUL 2003, D.L. Gustafson, W1889 (8 P, MTEC); 1 mi N Isabella Landing, 14 VII 07, 1980′, Fern Creek // William D. Shepard, leg. (6 P, 58 NP, WDSC); Gorman Cr. mid Br., 115.0780, 46.6722, 03 JUL 2002, 1158 m, D.L. Gustafson, W1660 (2 P, MTEC); Isabella Creek, IX-15/X-22-2005, pitfall trap in moist old growth cedar forest, F.W. Merickel (2 P, WFBM); Clearwater NF, tributary Isabella Cr. at FS Rd. 700 0.9 mi. N Isabella Landing , 14-VII-2007, C. B. Barr // 46°51.593′ N, 115°37.379′ W, elevation 1980 ft. (16 P, 1 NP, EMEC); 0.9 mi N Isabella Landing, 14 VII 07, 1980′, unnamed stream // William D. Shepard, leg. (3 P, 22 NP, WDSC); Clearwater Natl. For., Laundry Cr. at FS Rd. 737, 28-VII-1997, coll. A. Stonesifer // down ridge from FS Rd. 737 mi. marker 6, elevation 3840 ft., 46°46′12″N, 115°03′42″W (1 NP, EMEC); Clearwater NF, Little Washington Cr. at FS Rd. 246 ~15 mi. NE Headquarters, 30-VIII-1999, M. Wolfe // trib. N. Fk. Clearwater R., T40N R07E S34 SE NE NW, elev. 3620 ft. (1 P, WFBM); Clearwater NF, Little Washington Creek at FS Rd. 246, 14-VII-2007, C. B. Barr // trib. N. Fk. Clearwater R., elev. 3653 ft., 46°46.222′ N, 115°33.964′ W (2 P, CNCI; 19 P, 4 NP, EMEC; 2 P, LSAM; 2 P, OMNH); 4.7 mi NE FS 680 X FS 246, 14 VII 07, Little Washington Cr // William D. Shepard, leg. (5 P, 122 NP, WDSC); Clearwater NF, trib. Little Washington Creek at FS Rd. 246, 14-VII-2007, C. B. Barr // trib. N. Fk. Clearwater R., elev. 3637 ft., 46°45.787′ N, 115°34.365′ W (3 P, EMEC); Orofino Cr. -Thompson Gulch, 02 JUL 2002, 1038 m, D.L. Gustafson, W1653 (1 P, MTEC); Orogrande Cr. -Mill Cr., -115.5067, 46.6127, 27 JUL 2003, 0763 m, D.L. Gustafson, W1885 (1 P, MTEC); Clearwater NF, Pete Ott Creek at FS Rd. 250 N of Kelly Forks RS, 21-VII-1998, T. Apel // trib. N. Fk. Clearwater R. .25 mi. above confl., T39N R10E S6 NW NE NE, elev.1036m (1 P, EMEC). Idaho Co.: Ashpile Creek .25 mi. upstream from Hwy. 12, T36N. R11E.,S14 SE.,NW.SE, 890m, 1998SLEW A0006, VI-29-1998, M. Rayton coll. // larvae in ETOH collection, specimen received from EcoAnalysts, Inc., J.J. Pfeiffer (6 P, WFBM); Ashpile Cr. -low, -115.0636, 46.4602, 29 JUN 1998, 976 m, M. Rayton colr. (2 P, MTEC); Nez Perce NF, Ballinger Cr. ca. 22 mi. E of Lowell, 11-VIII-1998, M. Rayton // tributary Selway R. 400m above bridge, T32N R10E S25 NE NE SW, elev. 585m (1 P, EMEC); Clearwater NF, Bridge Creek at US Hwy. 12 ca. 3 rd. mi. W Lowell, 14-VII-2007, C. B. Barr // trib. Mid. Fk. Clearwater R., elevation 1445 ft., 46°08.467′ N, 115°39.432′ W (1 P, EMEC); Rt 12, Canyon Creek, ca 6.4 mi. NE of Lowell, 26 Sept 1991, R. S. Zack collector (1 P, WSUC); Nez Perce NF, Fall Creek at Hwy. 14 1.8 rd. mi. E Golden, 12-VII-2007, C. B. Barr // trib. S. Fk. Clearwater R., elev. 3555 ft., 45°48.672′ N, 115°38.978′ W (1 NP, EMEC); Nez Perce NF, lower Huddleson Creek ca. 17 mi. ESE Grangeville, 30-VII-1999, M. Rayton // trib. S. Fk. Clearwater R. just above confluence, T28N R05E S35 NW SW NW, elev. 2900 ft. (1 P, EMEC); Nez Perce NF, trib. Meadow Creek at FS Rd. 443 nr. Selway Falls Cgd., 15-VII-2007, C. B. Barr // trib. Selway River, 46°02.521′ N, 115°17.738′ W, elevation 1683 ft. (9 P, EMEC); S of FS 223 X 443, 15 VII 07, 1683', unnamed stream // William D. Shepard, leg. (2 P, 6 NP, WDSC); Rainy Day Cr. -mouth, -115.6940, 45.8030, 01 JUL 2002, 1041 m, D.L. Gustafson, W1651 (3 P, MTEC); Nez Perce NF, trib. Selway R. at FS Rd. 223 ca.12.5 rd. mi. SE Lowell, 15-VII-2007, C. B. Barr // 46°04.563′ N, 115°24.694′ W, elevation 1695 ft. (3 P, EMEC); Sheep Creek at US Hwy. 95 nr. Sheep Creek Rest Area, 6.1 rd. mi. S Riggins, 11-VII-2007, C. B. Barr // trib. Little Salmon R., elevation 2157 ft., 45°20.558′ N, 116°21.000′ W (7 P, EMEC); data same, except W. D. Shepard (4 NP, WDSC); Nez Perce NF, Simmons Cr. 11 mi. ENE Elk City, 24-IX-1999, M. Rayton // above confl. Sable Cr., trib. Meadow Creek, T29N R10E S09 SE SE NE, elev. 3360 ft. (1 P, CIDA; 1 P, EMEC; 1 P, WFBM); Nez Perce NF, Surveyor Cr. at Hwy. 14 nr. mm 27, 4.5 rd. mi. W Golden, 12-VII-2007, C. B. Barr // trib. S. Fk. Clearwater R., elev. 3186 ft., 45°47.691′ N, 115°45.563′ W (16 P, 2 NP, EMEC); 4.5 mi W Golden, 12 VII 07, 3186′, Surveyor Creek // William D. Shepard, leg. (4 P, 16 NP, WDSC). Lemhi Co.: Salmon NF, Bear Basin Cr. above FS Rd. 030, 29-VII-1996, C. Fischer // trib. Salmon River, elev. 3000 ft., T23N R13E S13 NEQ (2 NP, CIDA; 1 P, EMEC; 1 P, WFBM); Salmon Natl. Forest, Elk Creek 20 m above Hwy. 93, elev. 5060′, 14-VII-1997, Overfield // trib. N.Fk. Salmon R., 45°36′08.98″N, 113°57′53.35″W (1 P, EMEC). Shoshone Co.: St. Joe Natl. Forest, Engstrum Creek, trib. Mica Creek, 2-VII-1992, J. White (1 NP, EMEC); Hammond-Kyle mid trib, -115.7689, 47.3121, 05 JUL 2002, 0915 m, D.L. Gustafson, W1673 (1 P, MTEC); trib. Merry Cr. at FS Rd. 226/758 nr. Davies Pass, 8.6 rd. mi. NE Clarkia, 13-VII-2007, C. B. Barr // elevation 3552 ft., 47°04.704′ N, 116°09.128′ W (4 P, EMEC); 8.6 mi. NE Clarkia, 13 VII 07, 3852′, trib of Merry Cr // William D. Shepard, leg. (2 P, WDSC); 9 mi NE Clarkia, 13 VII 07, 3553′, trib of Merry Cr // William D. Shepard, leg. (6 P, WDSC).

Distribution, Habitat, and Biology. Based on collection records, the range of this species extends from the lower "panhandle region" of northern Idaho, in an area from the St. Joe River in Shoshone County, southeast to the Salmon River in Lemhi County (Fig. 10). This mountainous area includes the three main forks of the Clearwater

River in the counties of Clearwater and Idaho. In July 2007, I went to Idaho, along with Bill Shepard, to collect additional specimens and examine the habitat of *B. idahoensis*. We collected specimens at 13 localities, all of which are low-order, closed-canopy streams with cool to cold water, the largest at 1.5–3.0 m wide being Fern Creek, the type locality (Fig. 11). Most of the sites are cold, high-gradient, first-order rivulets that are completely concealed from the road by plant cover. Sampling was also done in larger streams which lacked aquatic bryophytes, but these were unproductive for *Bryelmis*. When found at a site, specimens of *B. idahoensis* were often present in large numbers.

The majority of specimens were collected in association with aquatic bryophytes attached to rocks, although in some cases the beetles were also found on waterlogged wood. Bryophyte samples from eight sites yielded one species of liverwort and four species of moss. The liverwort *Chiloscyphus polyanthos rivularis* (Schrad.) Nees (Geocalycaceae) was present in six of the eight samples, and was exclusive in three. The most common moss, *Platyhypnidium riparioides* (Hedwig) Dixon (Brachytheciaceae), was present in two samples, and the other three moss species were present in one sample each. *Bryelmis idahoensis* specimens were collected from waterlogged wood at four localities and were common at two; aquatic bryophytes also occurred at three of these sites. Two specimens borrowed for this study were collected in a "pitfall trap in moist old growth cedar forest". . ."in a very damp area within several meters of running water" (Isabella Creek) (F. Merickel, *in litt.*).

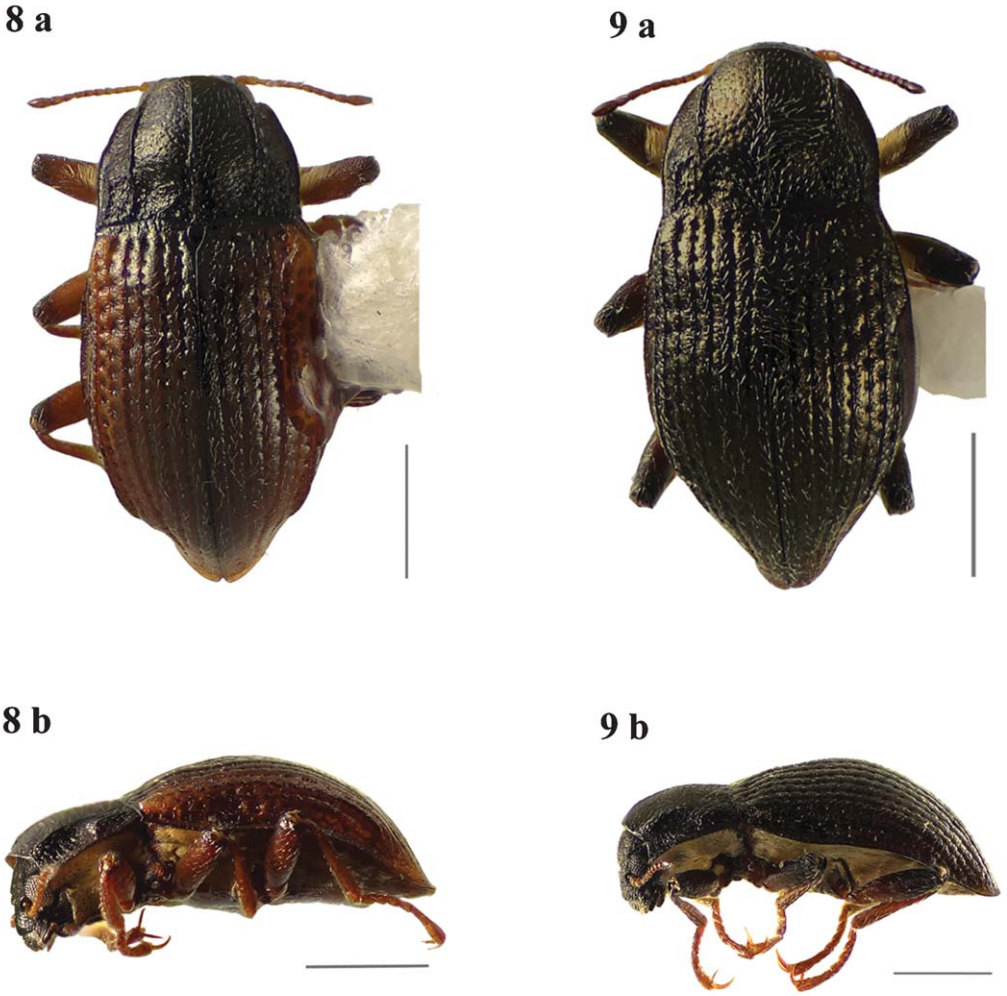
I recorded the following elmid species co-occurring with *B. idahoensis* at one or more of the collecting localities: *C. addenda*, *Heterlimnius corpulentus* (LeConte), *Lara avara* LeConte, *Narpus concolor* LeConte, *Optioservus quadrimaculatus* (Horn), and *Z. posthonia*. In the smaller streams, *B. idahoensis* was usually the only elmine present, but was sometimes accompanied by *L. avara*, a laraine elmid that is typically associated with wood and woody debris (Brown 1972).

Etymology. The species is named for the state in which it occurs, *Idaho*, plus *–ensis*, a suffix denoting place or locality. The origin of the name *Idaho* is contested.

Bryelmis rivularis Barr, new species
(Figs. 7, 8, 10, 13)

Description. Length 1.84–2.36 mm, width 0.9–1.2 mm. Body color dark brown to black, or bicolored with broad orange to red-brown elytral vittae; carinae, sulci, striae, and punctures distinct. **Antenna**: Testaceous, often darker at tip. **Head**: Dark brown to black. Eyes weakly protuberant. Frons finely rugose with scattered small punctures bearing fine setae. Clypeus sparsely punctate with small punctures spaced more than 2X their diameters apart, bearing moderately long setae; integument between punctures smooth medially, finely rugose laterally. Labrum smooth with evenly spaced fine punctures bearing setae, apico-lateral margins with dense clusters of setae. **Pronotum**: Dark brown to black, shiny. Slightly wider than long, widest about 1/3 distance from base; length 0.56–0.72 mm, width at widest point 0.7–0.9 mm. Basolateral angles more or less forming right angles. Disc finely rugose with small, shallow, widely spaced punctures accompanied by fine setae; narrow, low, median longitudinal carina extending from near apical margin to basal margin. Sublateral carinae narrow but not sharply carinate; each bordered medially by a shallow, broad basal and a sulcate apical fossa. **Elytron**: Convex; shiny with short, sparse setae; color medium orange, red-brown or black, sometimes bicolored, dark medially with broad, red-brown, variably wide lateral vitta extending to lateral margin. Length 1.38–1.74 mm, width at widest point 0.44–0.62 mm. Disk lateral to suture with a shallow depression about 1/3 distance from base. A low sublateral carina present at interval 7, most developed at apical 1/3, abruptly ending at about 1/5 of the distance from the elytral apex; less distinct carina present at interval 8 ending about 1/3 the distance from the apex. Shallow longitudinal sulcus with deeper fovea containing enlarged punctures adjacent to metasternum. **Leg**: Shiny red-brown except for distal 1/4–1/3 of femur which is dark brown; visible portion of femur dark in dorsal habitus view. Femur with closely spaced, small punctures and sparse setae. **Venter**: Shiny, red-brown to dark brown medially, prosternum darkest; dense silver to golden plastron present laterally. Apex of prosternum broadly rounded. Mesosternal disc shallowly concave between mesocoxae. Metasternal disc flat to slightly convex. **Male genitalia** (Fig. 7): Parameres narrowed medially, then flared laterally at tips, each producing an obtuse angle. Penis slightly longer than parameres, more or less parallel-sided to apical third, then narrowed to acuminate tip.

Variation. The most conspicuous variable among individuals is the color of the elytra, which can range from orange to black, or be more or less vittate with orange or red-brown laterally and a black stripe at the suture. Less noticeable are differences in the size and depth of the elytral depression at the basal 1/3. Metathoracic wings may be present or absent. Measurements of the length of the longest and shortest specimens showed size overlap between males (n = 4) and females (n = 4), with both the longest and shortest being males.



Figs. 8–9. Habitus of *Bryelmis* spp. **8)** *B. rivularis*, a) Dorsal, b) Lateral; **9)** *B. siskiyou*, a) Dorsal, b) Lateral. Scale bars = 0.5 mm.

Comparative and Diagnostic Comments. *Bryelmis rivularis* is unique among the three species in having male genitalia with the paramere tips angled outward (Fig. 7). In addition, some individuals are bicolored, having broad, red-brown elytral vittae lateral to the midline (Fig. 8). Externally, this species most resembles *B. siskiyou* (Fig. 9), but differs in that the median pronotal carina is distinct, the sublateral pronotal carinae are often more pronounced, and the elytra are more deeply striate with larger punctures. In *B. siskiyou*, the median pronotal carina is reduced, the sublateral pronotal carinae are distinct but less prominent, and the elytra are not as deeply striate and punctate, giving the body a smoother appearance. *Bryelmis idahoensis* (Figs. 3, 4) is more rugose and sculptured with prominent carinae, sulci, striae, and punctures. Unlike *B. rivularis and B. siskiyou*, the median pronotal carina is produced and ridge-like, the pronotal disc is smooth with few punctures and setae, the lateral elytral sulcus is deep and trench-like, and the male genitalia have the tips of the parameres unbent (Fig. 5).

Material Examined. 139 specimens. **HOLOTYPE** ♂ in EMEC, labeled "WA: Jefferson Co., Hell Roaring Cr. at Upper Hoh Rd. just NE jct. US Hwy. 101, ~13 rd. mi. SSE Forks, 1-VI-1992, coll. C.B. Barr // HOLOTYPE *Bryelmis rivularis*

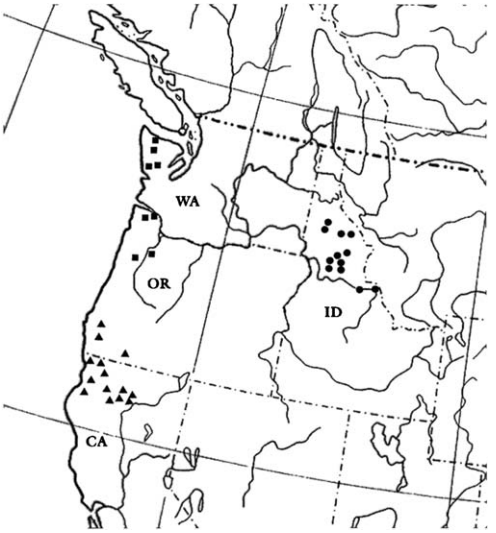


Fig. 10. Known distribution of *Bryelmis* spp. in North America: *B. idahoensis* (circles), *B. rivularis* (squares), and *B. siskiyou* (triangles).

Barr" [red label]. Ninety-six paratypes (P) [yellow labels] and 42 non-paratypes (NP) were examined from the following localities: Same data as holotype (4 P, BNHM; 4 P, CASC; 4P, CNCI; 25 P, 17 NP, EMEC; 2 P, LSAM; 4 P, OSAC); **OREGON:** Benton Co.: Siuslaw NF, trib. Crooked Cr. along Marys Peak Rd. 0.3 mi. W jct. Hwy. 34, 28-VI-1985, C. B. Barr (2 P, EMEC); Siuslaw NF, Marys Peak Campgrd., Parker Cr., el. 3600′, 9-VIII-1983, R.W. Wisseman coll. // extracted from moss on margin of stream with berlese funnel (2 P, EMEC; 1 NP, ABAC); Mary's Peak, 85/6/28, H.P.B. [Harley P. Brown] (1 P, OMNH); Siuslaw NF, Marys Peak Rd., day use area, 23-VI-2004, coll. R. E. Roughley & R. D. Kenner // elev. ca. 930 m, 44° 30′15.60″N, 123° 33′43.10″W (1 P, SMDV). Clatsop Co.: Lewis & Clark R., 85/7/1, H. P. Brown (1 P, OMNH); Lewis & Clark River, Saddle Mtn. S.P. road., 1-VII-1985, C. B. Barr // small tributary (4 P, EMEC); Lewis & Clark R. at Saddle Mtn. Rd., 8 km. N jct. Hwy. 26, 23-VI-2004, coll. R. E. Roughley & R. D. Kenner (1 P, SMDV). Columbia Co.: Fall Creek along Hwy. 47, 2.7 mi. WSW Clatskanie, 3-VI-1992, C. B. Barr (8 P, 2 NP, EMEC). Marion Co.: Silver Falls SP, S fork Silver Crk. ca 16 mi SE Salem, 26 Oct 1985, R S & V L Zack collectors (1 P, WSUC). **WASHINGTON:** Clallam Co.: Beaver Crk., ca 2 mi N of Sappho, R12W T30N Sec 20, 24 June 1992, R. S. Zack collector (1 P, WSUC). Grays Harbor Co.: Olympic NF boundary, Donkey Cr. at FS Rd. 22, ~10 air mi. NE Humptulips, 2-VI-1992, coll. C.B. Barr (3 P, EMEC); Moclips, Moclips Riv., T20N R12W Sec 8, 23 June 1992, R. S. Zack (1 P, EMEC; 2 P, WSUC). Jefferson Co.: Hell Roaring Cr. at Upper Hoh Rd. just NE jct. US Hwy. 101, ~13 rd. mi. SSE Forks, 2-VII-1985, C. B. Barr (12 P, 6 NP, EMEC); Forks (7 mi SE), 12 July 1988, P.J. & R.E. Spangler, P.D. Perkins // collected in Hell Roaring Creek, colln. #10, (2 P, MCZC; 8 P, 15 NP, USNM); Hell Roaring Crk. ca. 12 mi SSE Forks, T27N R12W Sec 21, 23 June 1992, R. S. Zack collector (4 P, WSUC).

Distribution, Habitat, and Biology. Based on collection records, *B. rivularis* inhabits the Coast Ranges from the Olympic Mountains of northwestern Washington, south to northwestern Oregon where it also occurs in the western Cascades (Fig. 10).

The type locality, Hell Roaring Creek (Fig. 13), is near the Hoh Rainforest area of Olympic National Park in Washington. This is the only known locality to yield more than a few specimens of the species. The water is tea-colored due to tannins in the allocthonous input from the surrounding coniferous forest, and much coarse, woody debris is present in the stream. In the areas where specimens were collected, the stream bed ranges from 3–6 m wide and the water depth is generally less than 0.3 m. The substrate is sandy gravel and cobbles less than 30 cm in diameter, and occasional larger boulders. A series of 54 specimens of *B. rivularis* collected in June 1992 had a sex ratio of 28 females to 26 males.

Microhabitat preference for bryophytes was examined during a second visit to Hell Roaring Creek, and was found to be the aquatic liverworts *C. polyanthos rivularis* and *Scapania undulata* (L.) Dumort (Scapaniaceae). A more in-depth look at microhabitat preference at this locality is contained in the Discussion section.

The four other streams where I have collected *B. rivularis* ranged from small (1.5–3.0 m wide) with cobbles and sandy gravel, to large (>7.5 m) with swift water, bedrock ledges, and small waterfalls. Despite the dissimilarities in stream type, in all cases *B. rivularis* was found among aquatic bryophytes attached to rocks. Several species of Elminae inhabit three of the streams, including the type locality, but only *B. rivularis* occurs in the two smaller streams. I have recorded the following elmid species co-occurring with *B. rivularis* at one or more of the collecting localities: *C. addenda*, *Heterlimnius koebeli* (Martin), *L. avara*, *Narpus angustus* Casey, *N. concolor*, *O. quadrimaculatus*, *Zaitzevia parvula* (Horn), and *Z. posthonia*.

Etymology. The specific epithet, *rivularis*, from the Latin *rivulus* or *rivalis*, meaning "stream or brook", is taken from the name of the aquatic liverwort with which it has been most commonly associated, *C. polyanthos rivularis*.

Bryelmis siskiyou Barr, new species
(Figs. 6, 9, 10, 12)

Description. Length 1.8–2.3 mm, width 0.92–1.14 mm. Body color dark brown to black; appearing smooth, with elytral carinae, striae, and punctures not prominent. **Antenna**: Testaceous, often darker at tip. **Head**: Black. Eyes weakly protuberant. Frons with scattered small punctures bearing fine setae. Clypeus with fine, evenly spaced punctures more than 2X their diameters apart, integument between punctures smooth. Labrum faintly emarginate, smooth, with fine, evenly spaced punctures bearing setae; apico-lateral, and occasionally mediolateral, margins with dense clusters of setae. **Pronotum**: Dark brown to black, shiny. Slightly wider than long, widest about 1/3 distance from base; length 0.58–0.70 mm, width at widest point 0.7–0.9 mm. Basolateral angles nearly forming right angles, lateral margin often slightly sinuate near base. Disc shiny, with small, widely spaced punctures accompanied by fine setae; narrow, often indistinct median longitudinal carina extending from near apical margin to near base where it becomes faint or absent. Sublateral carinae usually narrow but not sharply carinate; each bordered medially by a shallow, broad basal and an indistinct apical fossa. **Elytron**: Convex; shiny with short, sparse setae, medium brown to black. Length 1.3–1.6 mm, width 0.44–0.56 mm. Disk lateral to suture usually slightly depressed at basal 1/3. A low, sublateral carina present at interval 7, most developed at apical 1/3, abruptly ending at about 1/5 of the distance from the elytral apex; a slightly shorter carina present at interval 8; both carinae often indistinct. Shallow longitudinal sulcus with deeper fovea containing enlarged punctures adjacent to metasternum. Nine striae with shallow to moderately deep punctures separated by 1X their diameters. **Leg**: Shiny red-brown, except for distal 1/4–1/3 of femur which is dark brown, or entirely dark brown; visible portion of femur dark in dorsal habitus view. Femur with closely spaced, minute punctures and sparse setae. **Venter**: Shiny, red-brown to dark brown medially, prosternum darkest; dense silver to golden plastron present laterally. Apex of prosternum narrowly to broadly rounded. Mesosternal disc shallowly concave between mesocoxae. Metasternal disc slightly convex. **Male genitalia**: In dorsal view (Fig. 6), parameres with outer margins constricted medially, tips narrowly rounded. Penis slightly longer than parameres, slender, and nearly parallel-sided in basal two-thirds, then gradually narrowed to a tip which is not as wide as that of a paramere.

Variation. In *B. siskiyou*, the development of the longitudinal median pronotal carina and the sublateral elytral carinae varies from fairly visible to low and indistinct. An elytral depression at the basal 1/3, normally present in *Bryelmis*, may not be evident in some individuals. Metathoracic wings may be present or absent. Females (n = 3) were slightly longer than males (n = 3) in a comparison of the length measurements of the longest and shortest specimens, with the longest specimen a female and the shortest a male.

Comparative and Diagnostic Comments. Externally, *B. siskiyou* (Fig. 9) most closely resembles *B. rivularis*, but differs in that the median pronotal carina is reduced, the sublateral elytral carinae are usually not as prominent, and the elytra are not deeply striate and punctate, giving the body a smooth appearance. Conversely, in *B. rivularis* (Fig. 8) the median pronotal carina is distinct, the sublateral elytral carinae are prominent, and the elytra are deeply striate with large punctures. In addition, the male genitalia of *B. siskiyou* (Fig. 6) have parameres which are straight at the tips, whereas *B. rivularis* (Fig. 7) has the paramere tips angled outward. *Bryelmis idahoensis* (Figs. 3, 4) is more rugose and sculptured with prominent carinae, sulci, striae, and punctures; unlike *B. siskiyou and B. rivularis*, the median pronotal carina is produced and ridge-like, the pronotal disc is smooth with few punctures and setae, and the lateral elytral sulcus is deep and trench-like.

Material Examined. 59 specimens. **HOLOTYPE** ♂ in EMEC, labeled: "CA: Shasta Co., Shasta NF, trib. Castle Cr., spring run at FS Rd. 25 5.4 rd. mi. W jct. I-5, 17-IX-1994, C. B. Barr // HOLOTYPE *Bryelmis siskiyou* Barr" [red label]. Forty-two paratypes (P) [yellow labels] and 16 non-paratypes (NP) were examined from the following localities: Same data as holotype (2 P, BNHM; 1 P, CASC; 7 P, 1 NP, EMEC; 1 P, OSAC; 2 P, USNM); **CALIFORNIA:** Del Norte Co.: Six Rivers NF, trib. N. Fk. Smith R. at Cooper Flat, Hwy.199 4 mi.W Gasquet, 10-VI-2008, coll. C. B. Barr (2 P, EMEC). Humboldt Co.: Six Rivers Natl. Forest, Dragsaw Spring at FS Rd. 13N01, VII-29-2007, coll. J. J. Lee (2 NP, JJLC); Six Rivers Natl. Forest, Dragsaw Spring at F.S. Rd. 13N01, 14-VI-2008, C. B. Barr // 41.24789° N, 123.69340° W, elevation 784m (7 P, EMEC); data same, except W. D. Shepard (1 NP, WDSC); Six Rivers Natl. Forest, Red Mountain Creek at FS Rd. 10N12, V-30-02, coll. J. J. Lee (1 NP, JJLC); data same, except VI-6-03 (2 NP, JJLC); data same, except VIII-27-06 (1 NP, JJLC); data same, except 23-VIII-2007 (1 NP, JJLC); Six Rivers Natl. Forest, Red Mountain Creek at F.S. Rd. 10N12, 14-VI-2008, C. B. Barr // 41.24697° N, 123.68943° W, elevation 722m (2 P, EMEC); data same, except W. D. Shepard (2 NP, WDSC); Redwood Creek trib. 10.6 km E Maple Creek, 7-VIII-2001 // 40°45′17″N, 123°44′23″W, elev. ~1050 m // California Dept. of Fish & Game,

ML#7063 E-Map (1 P, EMEC). Shasta Co.: Shasta NF, Castle Creek at FS Rd. 25, 7.7 rd. mi. W jct. I-5, 17-IX-1994, C. B. Barr // collected from seep at creek margin (1 P, EMEC); Shasta NF, trib. Damnation Creek at Dog Cr. Rd. // FS 8G012 1 rd. mi. E Clear Cr. Cgd., 30-V-1994, coll. C.B. Barr (3 P, 2 NP, EMEC); Shasta NF, tributary Dog Creek at Dog Cr. Rd. // FS 8G012 6 rd. mi. W of I-5/Vollmers, 30-V-1994, coll. C. B. Barr (1 P, 1 NP, EMEC). Siskiyou Co.: Buckhorn Creek ~16 mi. SE Happy Camp, 2-X-2001 // 41°39′48″N, 123°16′36″W, elev. ~430 m // California Dept. of Fish & Game, ML#7304 E-Map (1 P, EMEC); Head of W. Branch Indian creek at Poker Flat 5040′, 14.VIII.1966 // collector Hugh B. Leech (1 P, CASC); 3 mi SE Cecilville, 21-VII-1990, S Fk Salmon River // William D. Shepard, leg. (2 P, WDSC). Trinity Co.: 12 mi N Trinity Ctr, 20-VII-1990, Eagle Creek // William D. Shepard, leg. (1 P, WDSC); 10 mi N Weaverville, 18-VII-1990, Stuart Fork // William D. Shepard, leg. (1 P, WDSC); 5.8 mi SW Trinity Center, 18-VII-1990, E Fk Stuart Fork // William D. Shepard, leg. (1 P, WDSC). **OREGON:** Douglas Co.: mouth W. Fk. Bobby Cr. 16 mi. WNW Glendale, elev. 1924 ft., 12-X-1993, R.W. Wisseman // 42°48′03.99″N, 123°43′38.13″W, BLM Medford Dist. monitoring site (1 P, EMEC). Jackson Co.: Lake Creek at mouth, 14 mi. NE of Medford nr. Hwy. 140, X-1994, R.W. Wisseman collr. // 42°25′16.58″N, 122°37′14.63″W, elev.1620′, BLM Medford District monitoring site (1 P, EMEC). Josephine Co.: Siskiyou NF, Phillips Cr. 24 mi. W Grants Pass, elev. 3479 ft., 24-IX-1992, A. Haspiel // off FS Rd. 2512-663, 42°26′13.93″N, 123°48′15.46″W (4 P, EMEC; 1 NP, ABAC).

Distribution, Habitat, and Biology. *Bryelmis siskiyou* occurs in the coastal mountain ranges of northwestern California and in extreme southwestern Oregon. It has been collected as far east as the western Cascades (Fig. 10).

The type locality, an unnamed tributary of Castle Creek west of Castle Crags State Park, CA, is a small, less than 0.5 m wide, incised spring run with clear, cold water in a heavily forested area. I collected a series of 15 adult specimens from *C. polyanthos rivularis*, which was growing in abundance a short distance downstream from the spring source. The additional six localities where I have collected the species were likewise forested, with habitats ranging from tiny spring runs (Fig. 12) to small streams, all with clear, cold water. At none of these sites, except for the type locality, was the species abundant. Adults and larvae of *B. siskiyou* were found inhabiting aquatic bryophytes in these waters as well, and at Red Mountain Creek (Humboldt Co., CA), *C. polyanthos rivularis* was verified as the microhabitat. I have recorded the following elmid species co-occurring with *B. siskiyou* at one or more of the collecting localities: *Ampumixis dispar* (Fall), *A. wawona*, *C. addenda*, *H. koebeli*, *L. avara*, *N. concolor*, *O. quadrimaculatus*, *Ordobrevia nubifera* (Fall), *Rhizelmis nigra* Chandler, and *Z. parvula*.

Etymology. The specific epithet, *siskiyou*, refers to the mountain range, national forest, and county of the same name, all within the geographic range of the species. The origin of the word is unknown, but has been speculated to have been derived in the mid-1800s from Chinook or French names.

Key to the Species of *Bryelmis*

1. Pronotal median longitudinal carina prominent; pronotal sublateral carinae explanate and ridge-like, bordered by deep antero-medial depressions; pronotum distinctly wider than long (Figs. 3, 4). Idaho (Fig. 10) .... ***B. idahoensis***

1′. Pronotal median longitudinal carina not as prominent, may be distinct or indistinct; pronotal sublateral carinae bordered by indistinct or shallow antero-medial depressions; pronotum about as wide as long (Figs. 8, 9).....2

2. Male genitalia with tips of parameres flared to produce an obtuse angle (Fig. 7); pronotal median longitudinal carina distinct to base; elytra moderately to deeply striate with large punctures, sublateral carinae prominent (Fig. 8). Washington to Oregon (Fig. 10)..... ***B. rivularis***

2′. Male genitalia with tips of parameres narrowly rounded, not obtusely angled (Fig. 6); pronotal median longitudinal carina low, often indistinct, more visible anteriorly; elytra lightly to moderately striate and punctate, sublateral carinae not prominent (Fig. 9). Oregon to northern California (Fig. 10)..... .....***B. siskiyou***

Discussion

Geographic Distribution. The genus *Bryelmis* exhibits an interesting pattern of geographic distribution consisting of a coastal Pacific Northwest element, comprising two species, and a disjunct northern Rocky Mountain element in central Idaho. Collection records indicate that *B. siskiyou* and *B. rivularis* occur in the Coast Ranges, the former ranging from northern California to southern Oregon and the latter from northern Oregon to the Olympic Mountains of Washington, and that *B. idahoensis* occurs in northern and central Idaho primarily in the Clearwater River drainage (Fig. 10). Distribution records imply that the geographic ranges of the three species are allopatric, and while this is probably true of *B. idahoensis*, it would not be surprising if the ranges of *B. rivularis* and

B. siskiyou are found to overlap in the Coast Ranges of west-central Oregon.

Early in the study I collected throughout Washington and Oregon specifically in search of additional records and failed to find *Bryelmis* in the dry Columbia Basin/Plateau region which occupies the eastern part of the states. Likewise, despite much sampling by me and others in streams of the Sierra Nevada Mountains of California, no specimens have been found there. The most eastern record of the coastal species *B. rivularis* is from the western Cascade Mountains near Salem, OR. *Bryelmis siskiyou*, also coastal, has been found as far east as the western Cascades near Medford, OR, and in the Trinity Mountains which are located in the eastern Coast Ranges of northern California. Additional collecting in the Cascades will possibly reveal further eastern occurrences of these species. The northern range of *B. rivularis* may extend into British Columbia, although examination of museum specimens from the area yielded no members of the species. I did not collect north of the Olympic Mountains of Washington.

Although two records of *B. idahoensis* are from very close to the Montana state line, the species has not been found in Montana and may not occur there. The border in that area is a barrier formed by the crest of the Bitterroot Range and the Continental Divide, with the terrain on the western side much lower and wetter than that of the east, which is in a rain shadow. As a result, many organisms are restricted to one side of the mountains or the other (M. A. Ivie, *in litt.*).

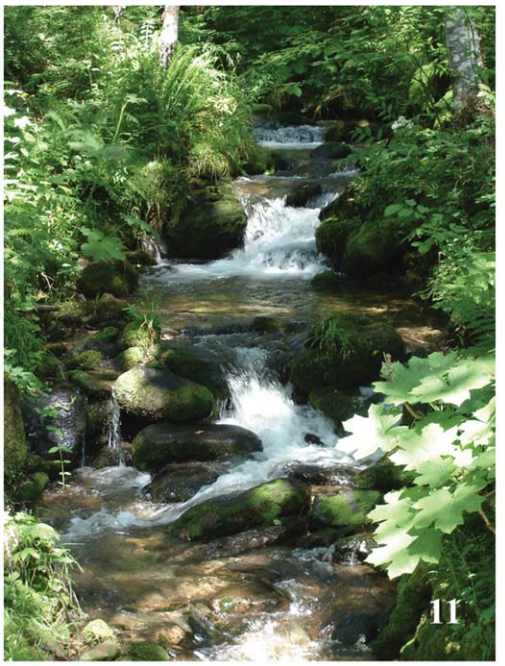
This peculiar disjunct distribution exhibited by many plant and animal taxa, and its origins, has been the subject of numerous research publications. The Clearwater River drainage in Idaho, containing the southernmost extension of the mesic coniferous forest in the northern Rocky Mountains, is an area that has long been hypothesized to be a glacial refugium due to the presence of species with coastal forest affinities (Daubenmire 1975). Subsequent studies involving plant distributions (Brunsfeld *et al.* 2001, 2007; Brunsfeld and Sullivan 2005; Carstens *et al.* 2005; Gavin 2009) have formally proposed and tested this hypothesis. McCune (1984) used the term "maritime extension" to refer to this area while discussing lichens with oceanic affinities, and it was called the Columbia Plateau Maritime Faunal Incursion Zone by Kavanaugh (1988) in a paper on the patterns, affinities, and origins of the Pacific Northwest insect fauna. Most recently, Björk (2010) discussed similarities between what he termed the Interior Wetbelt and the similar climate of the Northwest Pacific coast, and noted the greatest concentrations of disjunct coastal taxa occur in the Clearwater region.

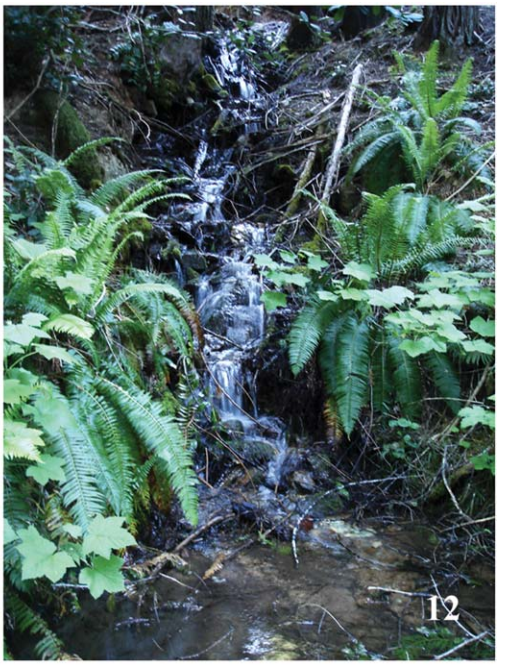
Although *B. idahoensis* occurs in a hypothesized glacial refugium, I found that not to be the case for *B. rivularis*, the northernmost species. Comparison of records of continental and alpine glaciation with the known geographic distribution of the species revealed that the most northern locality from Clallam County, WA was covered by the continental ice sheet at its maximum (Thackray 2001).

Habitat and Microhabitat. The following habitat observations and summarizations are based on personal field notes and collections. *Bryelmis idahoensis* (13 observations) was found only in low-order, likely spring-fed, clear, cool to cold streams (Fig. 11), whereas the two coastal species also occur in larger streams. *Bryelmis siskiyou* (11 observations) inhabits clear, cold waters ranging from tiny spring runs to small streams (Fig. 12), while *B. rivularis* (5 observations) occurs in small to large (>7.5 m wide) streams which ranged from clear to tannin-stained (Fig. 13). One common feature of all of the sites was the presence of coniferous forest canopy cover and apparent high water quality.

The most striking similarity among collection localities was the presence of aquatic bryophytes. Qualitative collecting of microhabitats in streams where *Bryelmis* is present revealed that the adults almost exclusively occurred in conjunction with aquatic bryophytes, particularly liverworts, rather than other substrates; an exception was the additional utilization of waterlogged wood by *B. idahoensis*. The larvae of at least two of the three species are sometimes found in root masses as well as bryophytes. Quantitative sampling of *B. rivularis* from Hell Roaring Creek, WA yielded 53 adults and 17 larvae from bryophytes, 2 adults and 1 larva from substrate kick samples, and 2 adults and 16 larvae from roots. Another collector captured adult beetles in a pitfall trap set in a moist forest within several meters of a stream. Adult beetles in the subfamily Elminae are not known to leave the water, so it is likely that these individuals had recently emerged from pupation, which occurs terrestrially.

Samples of bryophytes associated with all three species of *Bryelmis* were collected for identification by specialists. Several samples taken from two Washington localities (Donkey and Hell Roaring Creeks), some of which had yielded *B. rivularis* and some not, indicated that the preferred bryophytes were the aquatic liverworts *C. polyanthos rivularis* and *S. undulata*, whereas the non-preferred bryophytes were aquatic mosses, *Fontinalis neomexicana* Sull. and Lesq. (Fontinalaceae) and *P. riparioides*. Subsequent to this revelation, I targeted aquatic liverworts while searching for *Bryelmis* and discovered a second species, *B. siskiyou*, associated with *C. polyanthos rivularis* in northern California. Of eight bryophyte samples collected in Idaho in association with the third species, *B. idahoensis*, six contained *C. polyanthos rivularis*; at two sites the species was associated





Figs. 11–13. 11) Fern Creek, Clearwater Co., ID, type locality of *Bryelmis idahoensis*; **12)** Dragsaw Spring, Humboldt Co., CA, habitat of *Bryelmis siskiyou*; **13)** Hell Roaring Creek, Jefferson Co., WA, type locality of *Bryelmis rivularis.*

with aquatic mosses. Other bryophytes present in the samples included the mosses *Brachythecium asperrimum* (C. Müller Hal.) Sullivant and *Kindbergia praelonga* (Hedwig) Ochyra (both Brachytheciaceae), *P. riparioides*, and *Plagiomnium rostratum* (Schrader) T. Koponen (Mniaceae).

The liverwort *Chiloscyphus polyanthos* (L.) Corda, with two subspecies, is widely distributed in western and northeastern North America and western Europe (Global Biological Information Facility data.gbif.org/species/13725423). In a study of the distribution and habitat demands of riparian bryophytes in the western Cascades of Oregon, Jonsson (1996) found *C. polyanthos* to be commonly and abundantly submerged on rocks and boulders in streams, and considered the species characteristic of medium-sized, low-elevation streams at 420–1,250 m. Sites at which I collected both

Chiloscyphus and *Bryelmis* ranged from 722–1,072 m in elevation.

Phylogeny and Relationships. A phylogeny of the Elmidae has yet to be proposed, although research is currently underway using molecular and morphological tools. On the basis of adult and larval morphology, *Bryelmis* appears to be most closely related to the genera *Ampumixis* and *Cleptelmis*, sharing common features with each, although this supposition warrants further examination. Adults of *Bryelmis* and *Cleptelmis* have indistinctly or distinctly forked sublateral carinae on the pronotum, whereas *Bryelmis* and *Ampumixis* both have a median carina on the pronotum. The larva of *Bryelmis* most closely resembles that of *Ampumixis*, both having similar sclerite characters.

Larvae. Although it may be possible to find morphological characters to separate the larvae of the three species, I have not attempted to do so. Larvae may be tentatively assigned to species based on association with adults and/or the collection locality.

Acknowledgments

The following people contributed important information or specimens from their field collections for this study: Eric Dinger, The BugLab, BLM/USU National Aquatic Monitoring Center, Logan, UT; Daniel Gustafson, Montana State University, Bozeman; Rex Kenner (late), Spencer Museum, University of British Columbia, Vancouver, Canada; Jon Lee, Eureka, CA; Frank Merickel, University of Idaho, Moscow; Kate Parkin, Kalispell, MT; Austin Brady Richards, California Dept. of Fish and Game, Chico; Rob Roughley (late), University of Manitoba, Winnipeg, Canada; William Shepard, University of California, Berkeley; Paul Spangler, U. S. National Museum of Natural History, Washington, DC; Robert Wisseman, Aquatic Biology Associates, Inc., Corvallis, OR; and Richard Zack, Washington State University, Pullman. I am especially grateful to Gary Lester, John Pfeiffer, and Jody White of EcoAnalysts, Inc., Moscow, ID for bringing the existence of *B. idahoensis* to my attention and for generously sharing their knowledge and specimens with me, and to Chris Fishel, formerly of EcoAnalysts, for discovering and introducing me to an unexpected microhabitat. Museum specimens were loaned by Roberta Brett and David Kavanaugh of the California Academy of Sciences, Michael Ivie of Montana State University, and Frank Merickel of the University of Idaho. The late Harley Brown, University of Oklahoma, Norman, provided me with sage advice, tutelage, and fellowship in the field, and alerted me to new collection records. In addition to providing many specimens from his collection, Bill Shepard, my husband and frequent field partner, deserves an award of merit for his patience, encouragement, and guidance through what became an excruciatingly slow study. Aquatic bryophyte samples were identified by William R. Buck of The New York Botanical Garden and Daniel Norris of the University and Jepson Herbaria at the University of California, Berkeley. Lastly, I am grateful to Kevin Wiseman of Richmond, CA, for the scientific illustrations, and to Traci Grzymala, PhD student at the University of California, Berkeley, for the specimen photographs.

References Cited

Björk, C. R. 2010. Distribution patterns of disjunct and endemic vascular plants in the interior wetbelt of northwest North America. Botany 88: 409–428.

Brown, H. P. 1972. Aquatic dryopoid beetles (Coleoptera) of the United States. Biota of Freshwater Ecosystems Identification Manual No. 6. Water Pollution Control Research Series. U.S. Environmental Protection Agency, Washington, DC.

Brown, H. P. 1981. *Huleechius*, a new genus of riffle beetles from Mexico and Arizona (Coleoptera, Dryopoidea, Elmidae). The Pan-Pacific Entomologist 57: 228–244.

Brown, H. P. 2001. Synopsis of the riffle beetle genus *Zaitzevia* (Coleoptera: Elmidae) in North America, with description of a new subgenus and species. Entomological News 112: 201–211.

Brunsfeld, S. J., T. R. Miller, and B. C. Carstens. 2007. Insights into the biogeography of the Pacific Northwest of North America: evidence from the phylogeography of *Salix melanopsis*. Systematic Botany 32(1): 129–139.

Brunsfeld, S. J., and J. Sullivan. 2005. A multicompartmented glacial refugium in the northern Rocky Mountains: evidence from the phylogeography of *Cardamine constancei* (Brassicaceae). Conservation Genetics 6(6): 895–904.

Brunsfeld, S. J., J. Sullivan, D. E. Soltis, and P. S. Soltis. 2001. Comparative phylogeography of northwestern North America: a synthesis [pp. 319–339]. *In*: Integrating Ecology and Evolution in a Spatial Context (J. Silvertown and J. Antonovics, editors). Blackwell Publishing, Williston, VT.

Carstens, B. C., S. J. Brunsfeld, J. R. Demboski, J. M. Good, and J. Sullivan. 2005. Investigating the evolutionary history of the Pacific Northwest mesic forest ecosystem: hypothesis testing within a comparative phylogeographic framework. Evolution 59(8): 1639–1652.

Chandler, H. P. 1954. New genera and species of Elmidae (Coleoptera) from California. The Pan-Pacific Entomologist 30: 125–131.

Daubenmire, R. 1975. Floristic plant geography of eastern Washington and northern Idaho. Journal of Biogeography 2: 1–18.

Gavin, D. G. 2009. The coastal-disjunct mesic flora in the inland Pacific Northwest of USA and Canada: refugia, dispersal and disequilibrium. Diversity and Distributions 15: 972–982.

Hatch, M. H. 1965. The Beetles of the Pacific Northwest, Part IV: Macrodactyles, Palpicornes, and Heteromera. University of Washington Publications in Biology, Vol 16. University of Washington Press, Seattle, WA.

Jonsson, B. G. 1996. Riparian bryophytes of the H. J. Andrews Experimental Forest in the western Cascades, Oregon. The Bryologist 99(2): 226–235.

Kavanaugh, D. H. 1988. The insect fauna of the Pacific Northwest coast of North America: present patterns and affinities and their origins. Memoirs of the Entomological Society of Canada 144: 125–149.

McCune, B. 1984. Lichens with oceanic affinities in the Bitterroot Mountains of Montana and Idaho. The Bryologist 87(1): 44–50.

Sanderson, M. W. 1953. A revision of the Nearctic genera of Elmidae (Coleoptera). Journal of the Kansas Entomological Society 26: 148–163.

Sanderson, M. W. 1954. A revision of the Nearctic genera of Elmidae (Coleoptera). Journal of the Kansas Entomological Society 27: 1–13.

Shepard, W. D. 2002. Elmidae Curtis 1830 [pp. 117–120]. *In*: American Beetles Polyphaga: Scarabaeoidea through Curculionoidea, Volume 2 (R. H. Arnett, Jr., M. C. Thomas, P. E. Skelley, and J. H. Frank, editors). CRC Press, Boca Raton, FL.

Shepard, W. D., and C. B. Barr. 1991. Description of the larva of *Atractelmis* (Coleoptera: Elmidae) and new information on the morphology, distribution, and habitat of *Atractelmis wawona* Chandler. The Pan-Pacific Entomologist 67: 195–199.

Thackray, G. D. 2001. Extensive early and middle Wisconsin glaciation on the western Olympic Peninsula, Washington, and the variability of Pacific moisture delivery to the northwestern United States. Quaternary Research 55(3): 257–270.

White, D. S., and R. E. Roughley. 2008. Aquatic Coleoptera [pp. 571–671]. *In*: An Introduction to the Aquatic Insects of North America (R.W. Merritt, K. W. Cummins, and M. B. Berg, editors). 4th Edition. Kendall/Hunt Publishing Co., Dubuque, IA.

(Received 25 January 2011; accepted 10 May 2011. Publication date 20 September 2011.)