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A new milliped of the genus *Stenozonium* Shelley 1998 from Washington State, U. S. A.: first record of the genus and family from North of the Columbia River (Polyzoniida: Polyzoniidae)

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Abstract

The new species, *Stenozonium leonardi*, the northernmost representative of the Polyzoniidae in western North America and the only one north of the Columbia River, is described from the Olympic Peninsula of Washington; it is isolated by some 180 mi (288 km) from *S. benedictae* Shelley, 1998, in coastal Oregon. *Stenozonium* alone among the four polyzoniidan genera in western North America consists of entirely allopatric and widely separated species, with one apiece in California, Oregon, and Washington-- evidence that it diversified earlier than its ordinal counterparts.

Key words: *Stenozonium*, Polyzoniida, Polyzoniidae, Hirudisomatidae, Washington, Olympic Peninsula, allopatry

Introduction

The milliped order Polyzoniida comprises three families (Shelley, 2003*a*) Polyzoniidae Newport, 1844; Hirudisomatidae Silvestri, 1896; and Siphonotidae Cook, 1895, all of which occur in North America and the continental United States (US) (Hoffman, 1999). The last is represented only by the tropical species, *Rhinotus purpureus* (Pocock, 1894), which has been introduced into Florida and Louisiana (Causey, 1953, 1965; Chamberlin & Hoffman, 1958; Hoffman, 1999; Shelley, 2001), but the first two are indigenous and represented in the US east of the Central Plains and along the Pacific Coast; both families extend northward into Canada. The Hirudisomatidae is represented by one genus, *Octoglena* Wood, 1864, and five species, one in Alabama, Georgia, Tennessee, and the

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Carolinas, and four in the West, one of which, *O. anura* (Cook, 1904), ranges from southern Oregon to the southwestern corner of mainland British Columbia (Shelley, 1995).

With different subfamilies in both general areas, the Polyzoniidae is the most diverse North American polyzoniidan family. The eastern components, comprising the endemic tribe Petaserpetini Shelley, 1998, belong to the nominate subfamily that also occurs in Europe and the Palaearctic part of Asia; there is only one genus, *Petaserpes* Cope, 1870, and six species, two of which, *P. cryptocephalus* (McNeill, 1887) and *P. mutabile* (Causey, 1951), range northward into Canada (Ontario and Québec). The western components comprise the endemic subfamily Buzoniinae Shelley, 1998, which is divided into two tribes that occur in both California and Oregon: Buzoniini, with one genus and species (*Buzonium crassipes* Cook & Loomis, 1928), and Bdellozoniini Shelley, 1998, with two genera (*Bdellozonium* Cook & Loomis, 1928, and *Stenozonium* Shelley, 1998), each with two species. *Stenozonium* is distinguished by its distinctly narrower body, light yellowish coloration, and aspects of the gonopods; *S. exile* Shelley, 1998, the type species, occurs in Humboldt County, California, around 255 mi (408 km) south of *S. benedictae* Shelley, 1998, in Benton, Lane, Lincoln, and Linn counties, Oregon. The Lincoln County record of the latter, lying ca. 90 mi (144 km) south of the Columbia River that forms the border between Oregon and Washington, is the northern-most of the Polyzoniidae in western North America, so the only ordinal representative from there northward is the hirudisomatid, *O. anura*. In February 2005, William P. Leonard and Casey Richart discovered a new species of *Stenozonium* in the Olympic Peninsula of Washington, approximately 90 mi (144 km) north of the Columbia River, which constitutes the first records of the genus and the Polyzoniidae north of this water-course. We describe and illustrate this species herein, naming it for Mr. Leonard, who has collected extensively in the northwestern US and supplied us with a host of new species and genera, most still undescribed. His discoveries include the new family, Microlympiidae Shear & Leonard, 2003 (Chordeumatida), and the first Nearctic representative of the Palearctic chordeumatid family Anthroleucosomatidae (Shear & Leonard 2003, 2004).

The Polyzoniidae and Hirudisomatidae overlap broadly in the contiguous coastal regions of California and Oregon, and both expand eastward to the Cascade Mountains in the latter state (Fig. 1). Except for the new species (Fig. 1, square), the Hirudisomatidae occurs alone from northwestern Oregon northward, and it is the lone ordinal component around San Francisco Bay, extending southward along the coast to Santa Cruz County (Shelley 1995). Likewise, the Polyzoniidae is the lone representative in the Cascades and Sierra Nevada of California, and associated foothills, except for *O. sierra* Shelley, 1998, in Placer County, which is narrowly segregated from *O. bivirgata* Wood, 1864, in Colusa County and, for convenience, is shown as continuous in fig. 1. There is also an allopatric population of *Bdellozonium cerviculatum* Cook & Loomis, 1928 (Polyzoniidae), in southern Monterey County (Fig. 1, dot), which lies well outside the general ranges of both families. Thus, while they occur sympatrically in the coastal border regions of California

and Oregon, the polyzoniidan families also occupy sizeable areas alone or nearly so. The only representation of the Polyzoniidae south of San Francisco Bay is the allopatric population of *B. cerviculatum*, and the only one north of the Columbia River is the allopatric species, *S. leonardi*.

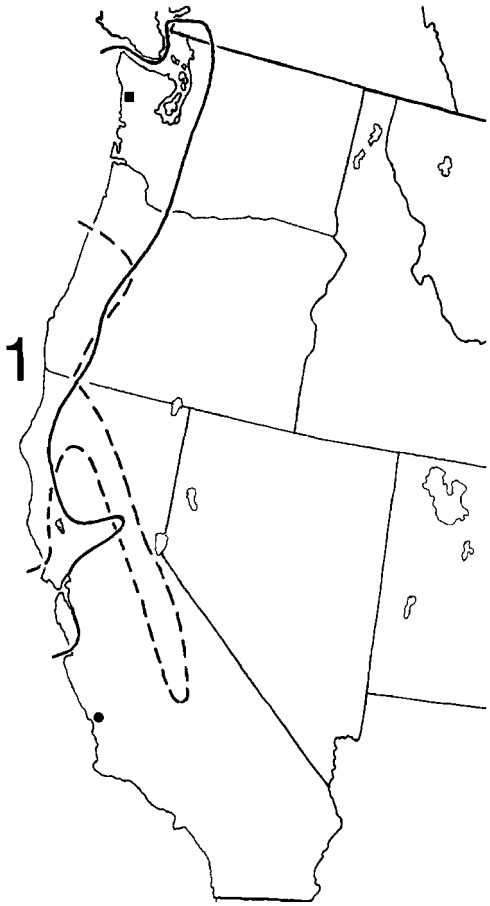


FIGURE 1. Comparative distributions of the Polyzoniidae (dashed line) and Hirudisomatidae (solid line) in western North America. Square, known locality of *S. leonardi*; dot, allopatric population of *Bdellozonium cerviculatum* in Monterey County, California (both Polyzoniidae).

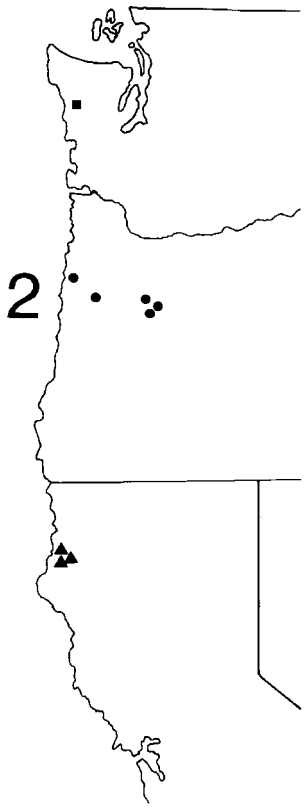


FIGURE 2. Distribution of *Stenozonium*. Triangles, *S. exile*; dots, *S. benedictae*; square, *S. leonardi*.

Genus *Stenozonium* Shelley, 1998

Stenozonium Shelley, 1998:12. Hoffman, 1999:32. Shelley, 2002:92.

Type species. *Stenozonium exile* Shelley, 1998, by original designation.

Diagnosis. As presented by Shelley (1998).

Components. Three allopatric species are known; others may exist in moist coastal environments north of San Francisco Bay.

Distribution. Occupying widely segregated areas in the Coast Range of northern California, central Oregon, and the Olympic Peninsula of Washington; the Oregon species also ranges eastward onto the western slope of the Cascades (Fig. 2).

Remarks. While additional species of *Stenozonium* may yet be encountered and the ranges of the known ones will surely expand with additional samples, the lacunae between the three components will surely never be completely filled because of their sizes (180 & 235 mi (288 & 376 km)). We therefore suspect that *Stenozonium* truly consists of allopatric species, in contrast to the continuous distributions of species and populations in the other Pacific polyzoniid genera, excepting the Monterey County, California, population of *Bdellozonium cerviculatum*, and in contrast to the continuous pattern in the Pacific species of *Octoglena* (Shelley 1995, 1998). Allopatry patterns are indicators of age, evidence that a taxon has existed long enough for extinctions to generate anatomical and geographical discontinuities and isolate populations and species from each other. That *Stenozonium* alone among west-Nearctic polyzoniidan genera exhibits allopatry suggests greater age and that it antedates the other genera. We cannot hypothesize time periods, but the geographic evidence suggests that *Stenozonium* is a product of an early dichotomy in the Polyzoniidae and that both *Bdellozonium* and *Buzonium*/Buzoniini are comparatively "young" taxa.

***Stenozonium leonardi*, new species**

Figs. 2–4.

Type specimens. ♂ holotype and juvenile paratype (North Carolina State Museum of Natural Sciences [NCSM]) collected by W. P. Leonard and C. Richart, 5 March 2005, along Queets River Rd. ca. 6 mi (9.6 km) NE jct. US hwy. 101, in Olympic National Park, Jefferson County, Washington (N 47º 34.330', W 124º 08.206'). One ♂ and one ♀ paratypes (Field Museum of Natural History) and another ♀ paratype (NCSM) taken by same collectors on 13 February 2005 on Queets River Rd. ca. 5.8 mi (9.3 km) NE jct. US hwy. 101 (N 47° 39.34', W 124° 8.16'). These sites are in the southwestern corner of Jefferson County approximately 9.2 mi (14.7 km) ENE of the town of Queets.

Etymology. We are pleased to name this species for our colleague Bill Leonard, who has, by his assiduous collecting, more than doubled the number of milliped species known from the state of Washington.

Diagnosis. Ocelli 3 or 4 pairs; sternum of anterior gonopods elevated in midline, with two short lobes; anterior gonopod coxa without sclerotized flap, with flattened, medial extension; ultimate podomere complex, hirsute basally and narrowly rounded apically, with spiniform projections and a trapezoidal prolongation on anterior surface, and a quadrate flange on caudal margin.

Color in life (Fig. 3). Dorsum generally light yellowish with mottled brownish patterns, tergites becoming progressively fainter and more indistinct caudad; collum and succeeding 3–4 tergites with strongest mottling but depigmented, without yellowish base color; venter pale.

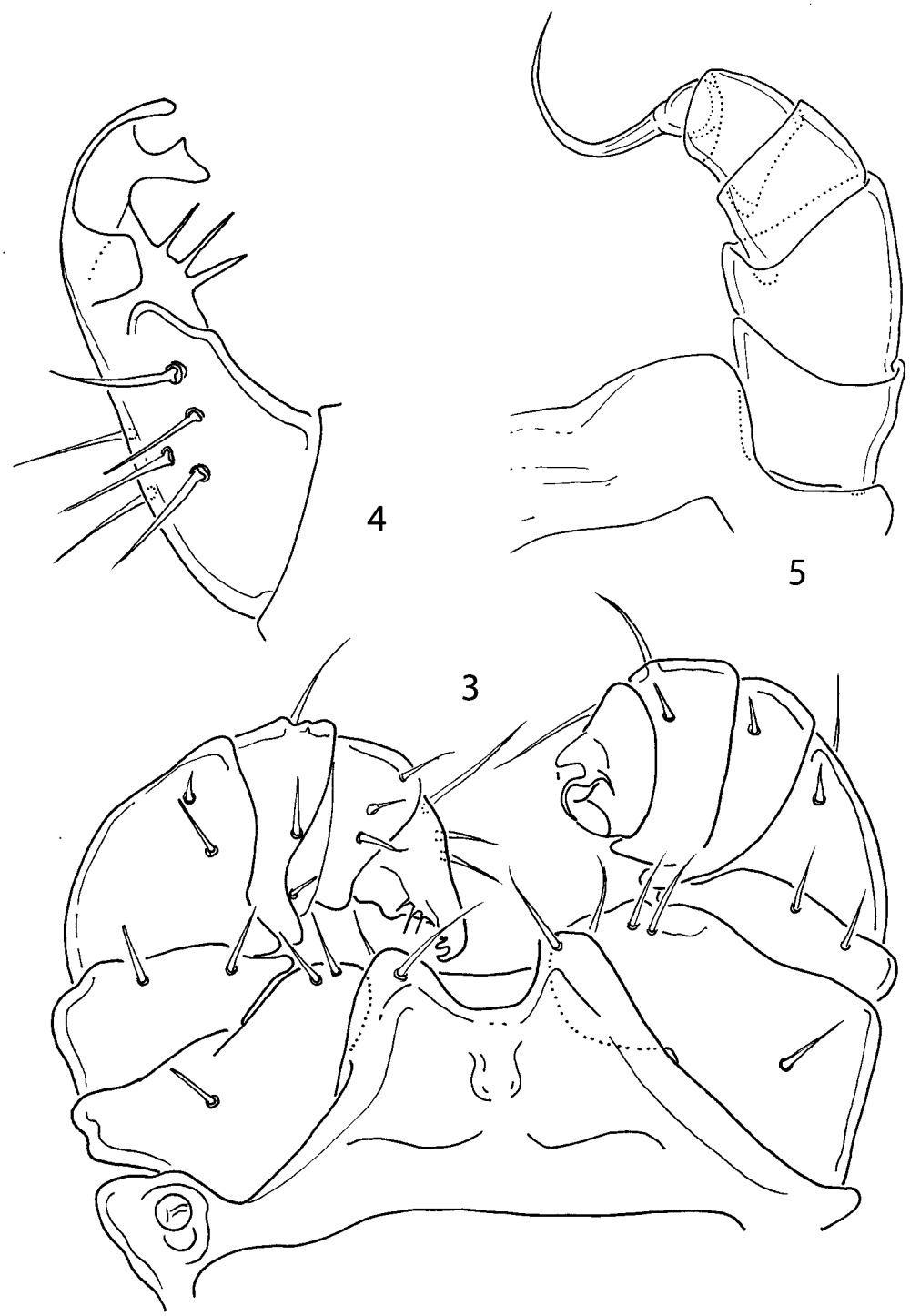
FIGURE 3. *S. leonardi* holotype, photo of live individual at time of collection.

Description. Body form normal for genus, long, narrow, and tapering at both ends, more strongly so on anterior end; dimensions of available specimens as follows: Holotype (36 segments including epiproct), 7.4 mm long (L), 1.4 mm wide (W), W/L ratio 18.9%; ♂ paratype (33 segs.), 6.0 mm L, 1.0 mm W, W/L ratio 16.7%; ♀ paratype (38 segs.), 9.5 mm L, 1.6 mm (W), W/L 16.8%; ♀ paratype (48 segs.), 15.8 mm L, 1.9 mm W, W/L 12.0%; juvenile paratype (29 segs,), 3.8 mm L, 0.9 mm W, W/L 23.7%.

Head subpyriform, smoothly continuing anterior tapering, labrum narrowly rounded. Ocelli darkly pigmented, either 3 pairs arranged linearly in slanted rows or 4 pairs with second ocellus (counting caudad from interantennal region) displaced slightly laterad. Antennae extending backwards to anterior margin of 5th tergite, composed of seven articles, 2–5 clavate, relative lengths of antennomeres 6>5>3>4>2>1>7.

Midbody tergites normal for genus, with faint ozopores at caudolateral corners; epiproct rounded, protruding slightly caudad. Opposing legs separated by relatively broad sterna, legs extending laterad and terminating short of lateral segmental margins, invisible in dorsal perspective.

Sternum of anterior gonopods (Figs. 4–5) elevated in midline and expanding into two short, subquadrate lobes. Anterior gonopod coxa with flattened medial extension, podomeres 2–4 with narrow, elongate, medial lobes; ultimate podomere elongate and complex, directed anteriad, hirsute basally and glabrous thereafter, hirsute basal part terminating in rounded shoulder proximal to quadrate flange on caudal surface, with three slender, spiniform projections on anterior margin opposite flange, middle one longest, podomere curving slightly laterad distally with narrowly rounded tip overhanging shallowly bifurcate, trapezoidal prolongation on anterior margin distal to spines. Posterior gonopod sternum (Fig. 6) broad, expanding slightly laterad, ultimate gonopodal podomere strongly falcate with suggestion of subapical barbs (difficult to discern clearly even at 400x).



FIGURES 4–6. *S. leonardi* paratype. 4, anterior gonopods, anterior view, left gonopod displaced slightly caudad during dissection, thereby providing a profile of the ultimate podomere that normally projects directly anteriad. 5, ultimate podomere of left anterior gonopod, caudal view. 6, left posterior gonopod, caudal view. Figs. 3–4 drawn at 400x magnification; fig. 5 shown at ~1,200x (drawn at 400x and enlarged 3 fold).

Ecology. The specimens were encountered in winter in leaf litter and under woody debris and rocks in second-growth rainforest approximately 40m south of the Queets River. The canopy was nearly closed and dominated by western hemlock (*Tsuga heterophyla*), western red-cedar (*Thuja plicata*), red alder (*Alnus rubra*), and sword fern (*Polystichum munitum*). Mr. Leonard's diplopod discoveries have generally come in winter or early spring (Shelley, 2003*b*; Shear & Leonard 2003, 2004), a time that past collectors avoided because of the inevitable cold, damp weather. Consequently, he has unearthed an entirely unknown fauna in this part of the continent.

Distribution. Known only from the type locality, which is approximately 180 mi (288 km) north of *S. benedictae* Shelley in Lincoln County, Oregon, and 90 mi (144 km) north of the Columbia River.

Remarks. *Stenozonium leonardi* exhibits the light yellowish coloration and long narrow body form of the congeneric species in Oregon and California, so these features truly diagnose the genus. However, the absence of the base color on the anteriormost segments in *S. leonardi*, photographed alive in fig. 2, is striking, and these segments also exhibit the heaviest mottling. Whether this depigmentation exists in *S. exile* and *benedictae* is unknown, as all the available material had been preserved in alcohol for at least 21 years when Shelley (1998) described them.

The W/L ratio drops noticeably with age, as the millipeds add segments and grow longer but do not become proportionally broader.

Stenozonium leonardi appears to be closely related to *S. benedictae*, the more proximate species, with which it shares a flattened, medially extended anterior gonopod coxa; the sclerotized coxal flap readily distinguishes *S. exile* from both of these species. The new species differs from *S. benedictae* in the shape of the sternal plates, which can be ascertained by comparing the figures in Shelley (1998) with ours. In proposing the genus and the two original species, Shelley (1998) did not closely examine the ultimate anterior gonopod podomeres for fine structure as we show in our figures of *S. leonardi*. His drawings (Shelley 1998, figs. 22–25), done at high magnification under a compound microscope, do not reveal complexities necessitating closer examination, but now that such has been found in *S. leonardi*, the other species need to be re-examined in this regard.

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