

## **The Holarctic winter stonefly genus *Isocapnia*, with an emphasis on the North American fauna (Plecoptera: Capniidae)**

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Source: Monographs of the Western North American Naturalist, 2(1) : 65-95

Published By: Monte L. Bean Life Science Museum, Brigham Young University

URL: <https://doi.org/10.3398/1545-0228-2.1.65>

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THE HOLARCTIC WINTER STONEFLY GENUS *ISOCAPNIA*,  
WITH AN EMPHASIS ON THE NORTH AMERICAN FAUNA  
(PLECOPTERA: CAPNIIDAE)

J.T. Zenger<sup>1</sup> and R.W. Baumann<sup>2</sup>

**ABSTRACT.**—This paper presents descriptions, diagnoses, figures, and keys for 12 western North American species of the Holarctic genus *Isocapnia* Banks. Complete known distributional records and a cladistic analysis are included for the Nearctic species. *Isocapnia fraseri* and *I. missouri* are synonymized with *I. integra*, and 3 new species are described: *I. eichlini* n. sp., *I. palousa* n. sp., and *I. rickeri* n. sp. Representatives of 5 of the 7 known Palearctic species of *Isocapnia* were examined and are compared with the Nearctic species. Type localities and distributional data are listed for all 7 Palearctic species.

*Key words:* stoneflies, Plecoptera, *Isocapnia*, North America, Holarctic.

The previous revision of *Isocapnia* (Ricker 1959) was based on a rather limited number of specimens, primarily restricted to the Pacific Northwest and Northern Rockies. Since 1959 extensive new information and material from throughout the western United States have been obtained, greatly adding to the knowledge of *Isocapnia* and resulting in this study.

The genus *Isocapnia* was proposed in 1938 by Nathan Banks, with *Arsapnia grandis* Banks (1907) designated as the genotype, based on characters that included the following: radius straight at base of radial sector vein, 5 or more costal cross veins, and long setae covering the body. Originally included in the genus were *Capnia crinita* Needham and Claassen (1925) and *I. fumosa* Banks (1938). Additional work on the genus was done by Frison (1942), who provided additional generic characters for *Isocapnia* and included a new species, *I. abbreviata*. Hanson (1943) synonymized *I. fumosa* and *C. fumigata* Claassen (1937) with *I. grandis* and described a new species, *I. integra*. He later provided detailed descriptions of generic characters, including use of adult sternal characters (Hanson 1946). Two new species, *I. agassizi* and *I. spenceri*, and a new variety, *I. spenceri thujae*, were added to the genus by Ricker (1943), who also considered *I. fumigata* a synonym of *I. grandis*. Ricker (1959) published a revision of *Isocapnia*, including descriptions of 4 new Nearctic species: *I. fraseri*, *I. hyalita*, *I.*

*missouri*, *I. mogila*, and *I. kudia* from Siberia. He also synonymized his subspecies *I. s. thujae* under *I. spenceri* (Ricker 1959); then he later added *Eucapnopsis vedderensis* Ricker to the genus, bringing the number of North American species to 11 (Ricker 1965).

Three new species of *Isocapnia* are described in this paper: *I. eichlini* n. sp., a species similar to *I. abbreviata* and found in the Coast Range of California; *I. palousa* n. sp., a species related to *I. agassizi* and distributed in the eastern panhandle region of Idaho and in eastern Oregon and Washington; and *I. rickeri* n. sp., a sister species of *I. grandis*, known from southeastern Washington and northeastern Oregon. In addition, 2 species, *I. fraseri* and *I. missouri*, are synonymized with *I. integra*.

Twelve species are now recognized from western North America and 7 from eastern Asia (Zhiltzova et al. 1975). Nymphs are rarely collected, due in part to their hyporheic habitat (Stanford and Gaufin 1974). Stewart and Stark (2002) indicate a probable semivoltine life cycle.

Members of the genus are unique among the Capniidae because of their relatively large size and the regular occurrence of micropterous, often dwarfed, males in populations containing fully macropterous males. Micropterous males are known for 7 North American species and 5 Asian species. Two North American species, *I. integra* and *I. spenceri*, exhibit brachypterous

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females, but all other species have long-winged females, with the exception of *I. aptera* Zhiltzova, which is completely wingless.

Species in the genus *Isocapnia* can be divided into 5 groups based on the phylogeny of the genus: the Grandis Group: *I. grandis* and *I. rickeri* n. sp., characterized by the lack of micropterous males and by an S-shaped epiproct (Figs. 1, 3); the Crinita Group: *I. crinita*, *I. agassizi*, and *I. palousa* n. sp., characterized by the presence of micropterous males and by forward or upward curving epiproct (Figs. 5, 7, 9); the Hyalita Group: *I. hyalita*, *I. integra*, and *I. spenceri*, characterized by the occurrence of micropterous males and by protuberances on the posterior edge of the 9th tergum of males (Figs. 11–16); the Abbreviata Group: *I. abbreviata*, *I. eichlini* n. sp., and *I. mogila*, characterized by a very short epiproct and lack of micropterous males (Figs. 17–22); and finally, the Vedderensis Group: *I. vedderensis*, characterized by short cerci, a lack of micropterous males, and an unsclerotized female subgenital plate (Figs. 23–24).

We based the phylogenetic analysis on the methodology of Hennig (1966), including the use of Swofford's Phylogenetic Analysis Using Parsimony (PAUP) (1991) and Maddison and Maddison's (1992) MacClade, phylogenetic analysis computer programs.

Specimens were examined using a Wild M8 dissecting microscope. Body and wing length measurements were rounded to the nearest 0.5 mm. Drawings were made using a camera lucida attachment on a Wild M7 dissecting microscope.

#### *Isocapnia* Banks

*Isocapnia* Banks, 1938: 73. Frison, 1942: 68. Hanson, 1946: 235. Ricker, 1959: 639. Baumann et al. 1977: 77.

DESCRIPTION.—Male, body length 4–15 mm, length of forewing micropterous 0.5–1.5 mm, macropterous 5–14 mm; female, body length 5–19 mm, length of forewing 5–16 mm;  $R_1$  straight at base of  $R_s$ ; sternum broadly fused to basisternum; postalar bridge present on both pterothoracic segments; transverse dark band on mesepiron; mesothoracic furcasternum united with postfurcasternal plates; vesicle extending from separate anterior sternite of the 9th sternum (Fig. 1); medial narrow light membranous stripe along terga 2–8.

DIAGNOSIS.—Large-sized individuals of the

Grandis, Crinita, and Hyalita Groups can be distinguished easily by the numerous, 3 or more, costal cross veins before the Sc. All species can be identified as having  $R_1$  straight at the base of  $R_s$ ; sternum broadly fused to basisternum; mesothoracic furcasternum united with postfurcasternal plates. Males can be distinguished from most genera of Capniidae by the presence of the vesicle on the 9th sternum. Only *Eucapnopsis* and *Bolshecapnia* have similar vesicles.

DISTRIBUTION.—Members of this genus occur in North America from the northern coast of Alaska, south to San Luis Obispo County in southern California, west to central Alaska, east to Saskatchewan and South Dakota, and south along the Rocky Mountains to north central New Mexico (Jewett 1959, 1960, Gaufin et al. 1966, 1972, Ricker and Scudder 1975, Baumann et al. 1977, Donald and Anderson 1977, Dosdall and Lemkuhl 1979, Stewart and Ricker 1997, Huntsman et al. 1999, Kondratieff and Baumann 2002).

Generally, species of *Isocapnia* are associated with relatively pristine, gravel-based streams and rivers that have a well-developed hyporheic zone. Adults have been found from sea level to elevations above 3000 m and in systems ranging from small 2nd-order streams to large rivers, such as the lower Fraser River in southern British Columbia (Ricker and Scudder 1975, Scudder 1994).

Noted large-scale, western dispersal barriers, such as the Snake River plain, Great Basin, and Colorado River (Nebeker and Gaufin 1967), appear to have greatly affected the distribution of *Isocapnia*. A vivid example of this is the complete absence of *Isocapnia* in Nevada and Arizona, both of which have suitable mountain stream habitats but are isolated by natural barriers. Nevada is isolated by the Snake River plain to the northeast and internally by the basins between the various ranges, while Arizona is isolated from southern migration by the Colorado River.

The distribution of the Grandis Group demonstrates the 2 extremes in *Isocapnia* distribution. *Isocapnia grandis* is found from the North Slope of Alaska south to Utah and west to the northern Sierra Nevada. *Isocapnia rickeri* n. sp., on the other hand, is limited to an isolated area, one in which it likely evolved, south of the Snake River in southeastern Washington and northeastern Oregon.

In the Crinita Group, *I. crinita* extends from near Fairbanks, Alaska, south along the Rocky Mountains into Utah, Colorado, and northern New Mexico. *Isocapnia agassizi* has a coastal distribution extending from western Oregon north to southeastern Alaska. The range of *I. palousa* n. sp. is limited to the southeastern panhandle region of Idaho and to eastern Oregon and Washington. This range is similar to that of *I. rickeri* n. sp., which indicates a possible past refugium in this area.

*Isocapnia hyalita*, of the Hyalita Group, has a range limited to the Rocky Mountains, from central Utah in the south to Alberta in the north. In contrast, *I. spenceri* has a distribution that extends from the Sierra Nevada and Coast Mountains of California to southeastern Alaska. The range of *I. integra* overlaps that of *I. spenceri* and extends north to the northeastern coast of Alaska, west into Alberta, and east to western South Dakota.

The Abbreviata Group is limited to the Coast Range in western North America. *Isocapnia abbreviata* occurs along the Coast Range from California to British Columbia. The extremely rare species *I. mogila* has a smaller range, having been found in the Coast Range in northern California and in southwestern Oregon. *Isocapnia eichlini* n. sp. is limited to the California Coast Range.

*Isocapnia vedderensis* is widely distributed, with specimens examined from central Alaska to north central New Mexico and as far west as California.

#### Males of Nearctic *Isocapnia* Species

1. Body length of macropterous specimens less than 7 mm; epiproct shorter than length of tergum 8 (Figs. 17, 19, 21, 23) ..... 2  
Body length of macropterous specimens greater than 7 mm (micropterous males may be shorter); epiproct longer than length of tergum 8 (Figs. 1, 3, 5, 7, 9, 11, 13, 15) ..... 5
- 2(1). Venation of forewing irregular (Fig. 26); spine at base of epiproct (Fig. 19) ..... *mogila*  
Venation normal (Fig. 25); no spine at base of epiproct ..... 3
- 3(2). Cerci short, 9 or fewer cercal segments; dark-edged ridge along anterior margin of epiproct base, peaking medially; paraprocts short, not easily visible from above (Fig. 24) ..... *vedderensis*  
Cerci long, more than 9 cercal segments; ridge on epiproct base absent; paraprocts visible from above ..... 4

- 4(3). Large, round medial hump on posterior portion of tergum 9 (Fig. 17); paraprocts divergent, almost 90° (Fig. 18) ..... *eichlini* n. sp.  
Hump on tergum 9 absent (Fig. 21); paraprocts divergent, approximately 45° (Fig. 22) ..... *abbreviata*
- 5(1). Large, chisel-shaped protuberance on posterior margin of tergum 9 (Figs. 11–16) ..... 6  
Chisel-shaped protuberance lacking (Figs. 1–10) ..... 8
- 6(5). Epiproct roughly duck-head shaped, very broad from lateral view, striated along its length posteriorly (Figs. 13–14) ..... *spenceri*  
Epiproct narrow and elongate ..... 7
- 7(6). Epiproct curved forward along entire length, rounded hook on end with small, downward-facing anterior spine near apex (Fig. 11) ..... *hyalita*  
Epiproct slender, curving forward slightly, tapering to apex (Fig. 15) ..... *integra*
- 8(5). Epiproct at least 2 times length of tergum 8 (Figs. 7, 9) ..... 9  
Epiproct shorter than twice the length of tergum 8 (Figs. 1, 3, 5) ..... 10
- 9(8). Fine hairs spaced along epiproct; small, round knob imbedded in posterior cleft near tip of epiproct (Figs. 9–10) ..... *palousa* n. sp.  
Epiproct lacking hairs and knob absent (Figs. 7–8) ..... *agassizi*
- 10(8). Body covered with long, dense, conspicuous hairs; epiproct strongly curved forward (Fig. 5) ..... *crinita*  
Body hairs short and inconspicuous; epiproct straight to slightly S-shaped (Figs. 1, 3) ..... 11
11. Epiproct slightly S-shaped, approximately the same length as tergum 8 (Fig. 3); apex broad (Fig. 4) ..... *rickeri* n. sp.  
Epiproct S-shaped, approximately 1.5 times as long as tergum 8 (Fig. 1); apex narrow (Fig. 2) ..... *grandis*

#### Females of Nearctic *Isocapnia* Species

1. Cerci short, 9 or fewer cercal segments; subgenital plate of 8th sternum medially unsclerotized (Fig. 38) ..... *vedderensis*  
Cerci long, more than 9 cercal segments; subgenital plate sclerotized medially (Figs. 27–37) ..... 2
- 2(1). Wing venation irregular (Fig. 26) ..... *mogila*  
Wing venation regular (Fig. 25) ..... 3
- 3(2). Body length less than 7.5 mm ..... *abbreviata*  
Body length greater than 7.5 mm ..... 4
- 4(3). Four or fewer costal crossveins before Sc ..... 5  
Five or more costal crossveins before Sc ..... 8
- 5(4). Posterior half of subgenital plate mushroom shaped, anterior half bearing large, V-shaped

- indentation (Fig. 35); Coast Range of California ..... *eichlini* n. sp.  
Subgenital plate and distribution not as above . . . 6
- 6(5). Posterior margin of subgenital plate generally flush with edge of sternum (Fig. 34). . . . . *integra*  
Posterior margin of subgenital plate broadly recessed (Fig. 32–33) . . . . . 7
- 7(6). Alberta south to Utah . . . . . *hyalita*  
Western British Columbia to California . . *spenceri*
- 8(4). Posterior margin of subgenital plate even with or extending slightly beyond edge of sternum (Fig. 30) . . . . . *palousa* n. sp.  
Posterior margin of subgenital plate recessed (Figs. 27–29, 31) . . . . . 9
- 9(8). Body hairs short and inconspicuous; anterior margin of subgenital plate recessed medially (Figs. 27–28, 31) . . . . . 10  
Body covered with long, dense, conspicuous hairs; anterior margin of subgenital plate not recessed (Fig. 29) . . . . . *crinita*
- 10(9). Anterior portion of dark sclerotized area of subgenital plate bordered by light membrane (Figs. 27, 31) . . . . . 11  
Anterior portion of dark sclerotized area of subgenital plate not bordered, or only slightly bordered, by light membrane (Fig. 28) . . . . . *rickeri* n. sp.
- 11(10). Subgenital plate between anterior and posterior recessed areas and lateral light membranous areas longer than wide (Fig. 31) . . . . . *agassizi*  
Subgenital plate between anterior and posterior recessed areas and lateral light membranous areas wider than long (Fig. 27) . . . . . *grandis*

### *Isocapnia abbreviata* Frison

(Figs. 21–22, 37)

*Isocapnia abbreviata* Frison, 1942: 71–72 (INHS). Hanson, 1946: 239. Jewett, 1954: 548. Jewett, 1959: 51. Ricker, 1959: 642.

TYPE LOCALITY.—Oak Creek, Benton County, Oregon.

MALE.—Body length 4.5–6 mm; length of forewing 5.5–7 mm; 2 to 3 costal cross veins before Sc, 0 to 1 beyond; body light brown; thin, dark line broken medially along anterior margin of terga 2–9; 4 to 6 muscle attachment marks across terga 2–9; darker, bare patches along lateral edges of terga, sometimes broad and irregularly shaped and extending along anterior edge; darker, bare anterior and medial border along 10th tergum; epiproct slightly shorter than length of 8th tergum, gently curved, tapering abruptly to a narrow point with a very small anterior hook; rounded hump on anterior basal plate of epiproct; paraprocts visible from

above, elongate and divergent; vesicle heart shaped (Figs. 21–22).

FEMALE.—Body length 5.5–7.5 mm; length of forewing 7–8 mm; 3 to 4 subcostal cross veins before Sc, 1 beyond; body light brown; terga 1–9 similar to male; margin of subgenital plate of sternum 8 recessed both anteriorly and posteriorly (Fig. 37).

DISCUSSION.—*Isocapnia abbreviata* can be distinguished from others in the Abbreviata Group by its smaller size and lack of a hump on the 9th tergum (Fig. 17) or spine on the base of the epiproct (Fig. 19); it can be distinguished from *I. vedderensis* by its long cerci and in females by the presence of a sclerotized subgenital plate on the 8th sternum. The female was described in Jewett (1954) from the Rogue River, Oregon.

SPECIMENS EXAMINED.—**Canada:** BRITISH COLUMBIA: Chemainus River, Hwy 1, Vancouver Island, 20-III-1970, R.A. Haick, 5♂, 2♀ (USNM). **USA:** ALASKA: Noatak River, 26-VI-1973, E. Holsten, 1♀ (UWBM). CALIFORNIA: Contra Costa Co., San Leandro Creek, Canyon, 19-III-1980, D.G. Denning, 1♀ (BYUC). Del Norte Co., Klamath, 20-III-1967, M. Orewien, 1♂ (CASC); Smith River, Hwy 199, Panther Flat Campground, 29-III-1967, Vertrees & Schuh, 1♂ (USNM). Humboldt Co., Eel River, 11 miles S Weott, 31-III-1967, Schuh & Vertrees, 1♂ (USNM). Marin Co., Arroyo Nicasio, Nicasio, 6-II-1955, S.W. Hitchcock, 1♂, 1♀ (USNM). Mendocino Co., South Fork Eel River, Coast Range Preserve, 31-I-1984, L.E. Serpa, 13♂, 1♀ (BYUC); 17-II-1985, 2♂, 1♀ (BYUC). Navarro River, Hendy Woods State Park, 18-II-1985, Baumann & Nelson, 3♂, 4♀ (BYUC). Napa Co., Capell Creek, road to Spanish Flat, off Hwy 128, 2-II-1993, Eichlin & Andrews, 2♂ (BYUC). San Luis Obispo Co., Santa Rosa Creek, 1 mile W Cambria, 22-I-1989, T.D. Eichlin & F.G. Andrews, 1♂, 1♀ (BYUC). OREGON: Benton Co., Oak Creek, 26-II-1938, S.G. Jewett, Jr., 1♂ (holotype INHS). Curry Co., mouth of Rogue River, Agness, 30-III-1949, S.G. Jewett, Jr., 4♂, 4♀ (BYUC, CNIC); 2-IV-1949, 2♂, 2♀ (BYUC); 2-V-1971, W.E. Ricker, 1♂ (CNIC). Douglas Co., South Umpqua River, 1 mile SSE Winston, 25-II-1985, M.N. Stansbury, 1♀ (BYUC). Josephine Co., Applegate River, 7 miles S Grants Pass, 23-II-1968, S.G. Jewett, Jr., 1♂ (BYUC). Lane Co., Eugene, ?-II-1947, B. Malkin, 1♂ (CASC). Willamette River, Eugene, 4-III-1948, S.G.



Jewett, Jr., 6 ♀ (CASC). Row River, 3-III-2003, C. Kerst, 1 ♂ (CSUC). Marion Co., Santiam River, near Jefferson, 4-II-1950, S.G. Jewett, Jr., 2 ♂ (CASC); 5-IV-1950, 1 ♂, 4 ♀ (CASC). Yamhill Co., South Fork Yamhill River, 24-II-1974, S.G. Jewett, Jr., 5 ♂, 6 ♀ (PMNH). WASHINGTON: Lewis Co., Cowlitz River, Mayfield Dam, 1-III-1965, S.G. Jewett, Jr., 1 ♂ (USNM).

*Isocapnia agassizi* Ricker

(Figs. 7–8, 31)

*Isocapnia* sp. Frison, 1942: 68.

*Isocapnia agassizi* Ricker, 1943: 90 (CUIC). Ricker, 1959: 642. Jewett, 1959: 52.

TYPE LOCALITY.—Fraser River, Agassiz, British Columbia.

MALE.—Body length, micropterous 5–8.5 mm, macropterous 7–12 mm; length of forewing, micropterous 0.5–1.5 mm, macropterous 6–10.5 mm; 4 to 7 costal cross veins before Sc, 0 to 3 beyond; body brown; bare, dark band along plural edge of terga 2–8, tergum 9 bearing a round, bare, dark patch; 4 to 6 muscle attachment marks on terga 1–9; 9th tergum divided medially by a sclerotized, I-shaped mark, the posterior end of the I-mark being enlarged; epiproct long and slender, held upright with gentle forward curve; tip of epiproct angled forward, laterally flattened and indented posteriorly; length of epiproct twice length of tergum 8; vesicle oblong (Figs. 7–8).

FEMALE.—Body length 8–17 mm; length of forewing 8–13 mm; 4 to 9 costal cross veins before Sc, 1 to 3 beyond; bare, darker band along lateral edge of tergum 2–9; 4 to 6 faint muscle attachment marks across terga 1–9; 2 bare, heavily sclerotized regions on anterior edge of sterna 2–9; lateral anterior corners of sternum 8 rounded; subgenital plate indented posteriorly with membrane extending anteriorly a short distance on each side of central sclerotization; 2 close, medial, small indentations on anterior edge of subgenital plate (Fig. 31).

DISCUSSION.—Male *I. agassizi* are distinguished from *I. crinita* by the much longer epiproct, which is more than twice the length of tergum 8, and distinguished from *I. palousa* n. sp. by the absence of pubescence on the epiproct shaft and absence of a small knob in the posterior cleft near the epiproct tip. Females can be distinguished from the others in the Crinta Group by both the anterior and posterior margins of the subgenital plate being recessed.

SPECIMENS EXAMINED.—**Canada:** ALBERTA: North Saskatchewan River, Edmonton, 27-IV-1992, E. Fuller, 1 ♀ (BYUC); 8-VI-1992, 1 ♀ (BYUC). Saskatchewan River, Edmonton, 10-V-1979, D.B. Donald, 2 ♂, 1 ♀, 3 micropterous ♂ (DBDC). BRITISH COLUMBIA: Cameron Creek, above Cameron Lake, Vancouver Island, 9-V-1954, W.E. Ricker, 12 ♂, 4 ♀ (CNIC); 19-VI-1955, 1 ♂, 2 ♀ (CNIC); 10-IV-1956, 1 ♀ (CNIC); 15-IV-1956, 1 ♀ (CNIC); 15-VI-1956, 6 ♂, 2 ♀ (CNIC). Chilliwack River, Vedder Crossing, 24-IV-1938, S. Spencer, 1 ♀ (CNIC). Fraser River, Agassiz, 24-IV-1938, W.E. Ricker, 1 ♀, 1 ♂ micropterous (holotype ♂ and allotype ♀) (INHS); same data, 3 ♂, 1 ♀, 9 micropterous ♂ (CNIC, INHS); 17-III-1957, 1 ♂, 1 ♀, 2 micropterous ♂ (CNIC); 17-IV-1957, 9 ♂, 2 ♀, 18 micropterous ♂, 1 nymph (BYUC, CNIC); 24-IV-1957, 28 ♂, 19 ♀, 20 micropterous ♂ (BYUC, CNIC); I-V-1957, 22 ♂, 22 ♀, 6 micropterous ♂ (BYUC, CNIC); 26-II-1960, 2 ♂, 1 ♀, 5 micropterous ♂ (CNIC); 15-IV-1988, K.W. Stewart, 2 ♂, 4 micropterous ♂ (UNTC). Harrison River, Chehalis Indian Reserve, 17-IV-1957, W.E. Ricker, 1 ♀ (CNIC). Sumas River, near Chilliwack, 6-V-1937, W.E. Ricker, 1 ♀ (CNIC). Three Valley Lake, Hwy 1, 17-IV-1981, D.B. Donald, 1 micropterous ♂ (DBDC). Tunjony Lake, 10-VII-1960, W.W. Moss, 1 ♀ (CNIC). YUKON: Kluane River, Alaska Highway, mile 117, NW Burwash Landing, 28-VI-1996, Stewart & Abbott, 1 ♂ (UNTC). **USA:** ALASKA: Eagle River, 14 miles NW Juneau, 19-V-1974, S.T. Elliott, 1 micropterous ♂ (BYUC). Katze-hin River, near Chilkoot Inlet, 59°12'N 135°26'W, 16-VI-2002, K.T. Huntzinger, 1 ♂ (BYUC). Keta River, near Hill Creek, 50 miles SE Ketchikan, 4-V-1979, R.N. Vineyard, 1 ♂, 1 ♀ (BYUC). Kowee Creek, 40 miles N Juneau, 26-V-1985, R.L. Bottorff, 2 ♀, micropterous ♂ (RLBC). OREGON: Jackson Co., Rogue River, Gold Hill, 2-III-1950, S.G. Jewett, Jr., 1 ♂ (BYUC). Rogue River, Savage Rapids Dam, 17-III-1960, S.G. Jewett, Jr., 1 ♀ (USNM). Linn Co., Willamette River, Harrisburg, 4-III-1948, S.G. Jewett, Jr., 3 ♂, 1 ♀ (BYUC). Marion Co., Santiam River, near Jefferson, 4-III-1948, S.G. Jewett, Jr., 6 ♂, 2 ♀ (BYUC, CNIC, ROME). WASHINGTON: Clallam Co., Olympic National Park, 22-V-1971, D. Loreth, 1 ♂ (WCFC). King Co., Snoqualmie River, Snoqualmie, 7-V-1932, G.N. Hoppe, 1 micropterous ♂ (INHS). Snoqualmie River, 11-V-1972, R.A. Haick, 4 ♀ (USNM). Lewis Co., Cowlitz River, Mayfield

Dam, 5-III-1963, D. Greenland, 1♂ (USNM); 18-III-1963, 1♂, 2♀ (ROME, USNM); 2-IV-1963, 10♂, 6♀ (OSUO, ROME); 5-IV-1963, 11♂, 2♀ (USNM); 9-IV-1963, 1 micropterous ♂ (BYUC); 11-IV-1963, 2♂, 4♀ (BYUC, USNM); 15-IV-1963, 1♂ (ROME); 17-IV-1963, 1♂, 1♀ (USNM); 7-V-1963, 1♂ (ROME). Pierce Co., White River, Rt. 410, Mount Rainier National Park, 29-V-1997, B.C. Kondratieff, 1♂ (CSUC); 14-16-V-2001, B.C. Kondratieff, 3♂, 4♀, 2 micropterous ♂ (CSUC). Tahoma Creek, Paradise Road, Mount Rainier National Park, 30-V-1997, B.C. Kondratieff, 1♀ (CSUC). Whatcom Co., North Fork Nooksack River, 23-V-1937, W.E. Ricker, 2♀ (CNIC); 15-IV-1989, R.I. Pollock 1♂, 2 micropterous ♂ (BYUC).

*Isocapnia crinita*  
(Needham and Claassen 1925)  
(Figs. 5-6, 29)

*Capnia crinita* Needham and Claassen, 1925: 269, 357 (CUIC).

*Isocapnia crinita* Claassen, 1940: 96. Frison, 1942: 69. Hanson, 1943: 160. Ricker, 1959: 643. Baumann et al., 1977: 78.

*Isocapnia* sp. Frison, 1942: 70.

TYPE LOCALITY.—Bozeman, Gallatin County, Montana.

MALE.—Body length, micropterous 5–10 mm, macropterous 7–10 mm; length of forewing, micropterous 0.5–1.5 mm, macropterous 7–10 mm; 4 to 8 costal cross veins before Sc, 1 to 3 beyond; body covered with long, dense, conspicuous hairs; body brown to dark brown; thin, dark band along anterior margin of terga 1–9; 4 to 6 muscle attachment marks across middle of terga 2–9; dark, bare bands along plural edges of terga 2–9; dark, bordered, hourglass-shaped mark on 9th tergum; epiproct curved gently forward, narrowing abruptly toward the apex, with tip angled forward; length of epiproct 1.6 times the length of tergum 9; paraprocts visible from above; vesicle round, covered with fine, dense pubescence (Figs. 5–6).

FEMALE.—Body length 8–15 mm; length of forewing 8–12 mm; 4 to 9 costal cross veins before Sc, 1 to 4 beyond; body covered with long, dense, conspicuous hairs; body brown to dark brown; dark, bare bands along plural margins of terga 2–9; 4 to 6 small muscle attachment marks on terga 2–9; 2 separate sclerotized patches along anterior margin of sterna 2–6; subgenital plate with posterior

margin recessed, posterior half mushroom-shaped, bordered laterally by light membrane (Fig. 29).

DISCUSSION.—*Isocapnia crinita* males can be distinguished from both *I. agassizi* and *I. palousa* n. sp. by the shorter epiproct, which is less than twice the length of tergum 8 in *I. crinita* (Fig. 5). Females can be distinguished by the subgenital character combination: anterior margin not recessed medially, posterior margin recessed, and posterior half of plate being mushroom shaped, with light, lateral membranous border and by its heavy pubescence (Fig. 29).

SPECIMENS EXAMINED.—**Canada:** ALBERTA: Battle Creek, Ressor Lake, Cypress Hills Provincial Park, 20 miles S Walsh, 3-VI-1975, L.A. Dosdall, 1♀ (USIK); 19-V-1976, 12♀, 1 micropterous ♂ (USIK). Bow River, Canmore, 29-IV-1978, 2♂, 1♀ (DBDC). **USA:** ALASKA: Chena River, C-800, 23-V-1972, Schallock & Jinkinson, 1 micropterous ♂ (UNTC); 8-V-1973, 2♂, 13♀, 3 micropterous ♂, 4 nymphs (UNTC, BYUC). Noatak River, 27-VI-1973, E. Holsten, 1♀ (UWBM). COLORADO: Gunnison Co., Gunnison River, Gunnison, 18-IV-1954, W.E. Ricker, 1♂, 1♀ (CNIC). Routt Co., Yampa River, Hwy 40, E Hayden, 9-V-1997, R.W. & W. Baumann, 1 micropterous ♂ (BYUC). Saguache Co., Tomichi Creek, Hwy 50, W Sargents, 7-V-1992, Kondratieff, Zenger, & Baumann, 1♂, 1♀, 1 micropterous ♂ (BYUC, CSUC). IDAHO: Blaine Co., Big Wood River, Stanton Crossing, 22-II-2003, D.C. Gustafson, 1♀, 1 micropterous ♂ (DLGC). Lemhi Co., Salmon River above Deadwater, 2 miles W North Fork, 21-V-1977, D.H. Funk, 1♂ (DHFC). MONTANA: Flathead Co., Middle Fork Flathead River, West Glacier, 25-IV-1973, J.A. Stanford, 1♂, 4♀, 9 micropterous ♂ (FLBS); 5-24-IV-1974, J.A. Stanford, 1♂, 1♀, 1 micropterous ♂ (FLBS). Flathead River, Kalispell, 5-IV-1969, R.L. Newell, 1 micropterous ♂ (USNM); 23-IV-1972, J.A. Stanford, 1 micropterous ♂ (UNTC); 28-IV-1972, A.R. Gaufin, 1♀, 1 micropterous ♂ (BYUC); 4-IV-1973, J.A. Stanford, 2♂, 1♀, 2 micropterous ♂ (UNTC); 14-IV-1973, Stanford, Haick, & McAuliffe, 2♂, 2♀, 1 micropterous ♂ (BYUC, USNM); 21-IV-1973, J.A. Stanford, 4♂, 3♀, 2 micropterous ♂ (BYUC); 2-IV-1989, J.A. Stanford, 21♂, 8♀, 29 micropterous ♂ (FLBS); 8-IV-1996, D.L. Gustafson, 7♂, 9♀, 5 micropterous ♂ (BYUC, DLGC). Gallatin Co., East Gallatin River, Bozeman, 19-IV-1988, D.L.

Gustafson, 1 micropterous ♂ (DLGC). Gallatin River, Hwy I-90, 14-IV-1984, D.L. Gustafson, 5♂, 3♀ (DLGC). Grayling Creek, Hwy 287, 27-IV-1997, D.L. Gustafson, 4♂, 4♀, 8 micropterous ♂, 2 nymphs (BYUC, DLGC). Montana Experiment Station, Bozeman, 12-V-1917, R.A. Cooley (holotype ♀) (CUIC). Lincoln Co., Fisher River, 5 miles above junction Kootenai River, 25-IV-1969, Baumann & Miner, 1 micropterous ♂ (USNM). Fisher River, Hwy 2, 11-IV-1997, D.L. Gustafson, 2♀ (DLGC). Kootenai River, Libby, 7-IV-1988, D.L. Gustafson, 1♂ (DLGC). Lake Creek, 6-IV-1988, D.L. Gustafson, 1♂, 4♀ (DLGC). Libby Dam Area, 8-IV-1973, Haick & McAuliffe, 1♂ (USNM). Tobacco River, Eureka, 24-IV-1974, J.A. Stanford, 1♀ (BYUC). Missoula Co., Bitterroot River, Buckhouse Bridge, 19-V-1970, R.A. Haick, 1♀ (USNM). Park Co., Shields River, E Livingston, 15-IV-1973, G. Roemhild, 2♂, 1♀, 2 micropterous ♂ (MTEC). Ravalli Co., Bitterroot River, Hwy 93, 1 mile N Hamilton, 17-V-1969, R.L. Newell, 1 micropterous ♂ (USNM). Bitterroot River, Stevensville, 23-IV-1973, Haick & McAuliffe, 1♀ (USNM). NEW MEXICO: Colfax Co., Vermejo River, Vermejo Park, 23-IV-1986, Baumann, Kondratieff, & Wells, 3♂, 7♀, 4 micropterous ♂ (BYUC, CSUC). UTAH: Cache Co., Logan Canyon, 20-IV-1937, Knowlton & Harmston, 1♂ (INHS). Blacksmith Fork, Logan River, 24-IV-1955, Gaufin & Jewett, 3♂, 3♀ (BYUC, CNIC); 24-III-1988, C.R. Nelson, 1 micropterous ♂ (BYUC). Little Bear River, Hwy 89-91, Wellsville, 14-IV-1954, A.R. Gaufin, 1♂, 4♀ (BYUC). Emery Co., Huntington River between North and South Hughes Canyons, 2-V-1971, Winget & Devenport, 2♀ (BYUC). Left Fork Huntington River, 4-V-1971, Winget & Devenport, 1♀, 2 micropterous ♂ (BYUC). Huntington River, Stuart Ranger Station, 14-IV-1977, Baumann & Winget, 1♂, 1♀, 4 micropterous ♂, 1 nymph (BYUC); 4-V-1978, 7♀, 6 micropterous ♂ (BYUC). Sevier Co., Clear Creek, Hwy 89, Sevier, 5-IV-1968, R.W. Baumann, 1♀, 1 micropterous ♂ (BYUC); 28-III-1987, Baumann & Zwick, 1♀, 1 micropterous ♂ (BYUC). Summit Co., Weber River, Hwy 196, Peoa, 25-IV-1968, A.R. Gaufin, 2♀ (BYUC). Utah Co., Diamond Fork, N Thistle, 19-IV-1954, W.E. Ricker, 1♂ (CNIC); 3-V-1976, Baumann & Vigos, 1♀, 54 micropterous ♂ (BYUC); 8-IV-1981, Clark & Stanger, 4♂, 4♀, 70 micropterous ♂ (BYUC); 28-IV-1984, S.A. Wells, 1♀ (BYUC); 14-IV-1987, Nelson &

Wells, 3♀, 17 micropterous ♂ (BYUC); 18-IV-1987, C.R. & J.R. Nelson, 2♀, 5 micropterous ♂ (BYUC). Wasatch Co., Provo River, Jordanelle, I-V-1948, A.R. Gaufin, 1♀ (BYUC). Weber Co., Ogden River, 17-IV-1937, M.C. Tanner, 1♀ (BYUC). WYOMING: Park Co., Gallatin River, Yellowstone National Park, 28-IV-1979, G. Roemhild, 1♂ (MTEC).

*Isocapnia eichlini*, new species

(Figs. 17–18, 35)

MALE.—Body length 5.5–7 mm; length of forewing 6.5–7.5 mm; 2 to 3 subcostal cross veins before Sc, 1 beyond; body color dark brown; dark, narrow border along anterior margin of terga 2–10; 4 to 6 muscle attachment marks across terga 2–9; irregularly shaped, dark, bare patch along lateral edge of terga 1–9; median posterior portion of tergum 9 expanding to form a large hump; smaller, round hump on basal portion of epiproct; epiproct slightly shorter than tergum 8; paraprocts easily visible from above and widely divergent, almost pointing laterally; broad, oval-shaped vesicle (Figs. 17–18).

FEMALE.—Body length 7.5–10.5 mm; length of forewing 7.5–9 mm; 2 to 3 subcostal cross veins before Sc, 1 beyond; body color dark brown; posterior half of subgenital plate mushroom shaped, bordered laterally by light membrane, anterior half bearing a wide, V-shaped indentation (Fig. 35).

TYPES.—Holotype ♂ and allotype ♀, USA: CALIFORNIA: San Luis Obispo Co., Atascadero Creek, 2.8 miles S Atascadero, 22-I-1989, T.D. Eichlin & E.G. Andrews (CASC). Paratypes: CALIFORNIA: same data as holotype, 3♂, 5♀ (BYUC). Napa Co., Eticuera Creek, 8 miles S Knoxville, 21-II-1975, Eichlin & Kono, 5♂ (BYUC). Eticuera Creek, 6–10 miles above Lake Berryessa, 2-III-1988, Stanger & Bottonoff, 2♀ (BYUC). Zin Zin Creek, 5 miles N Lake Berryessa, 2-III-1988, Stanger & Bottonoff, 1♀ (BYUC). Additional specimens: OREGON: Polk Co., Rickreal Creek, Hwy 99W, N Monmouth, 16-III-2004, Baumann & Clark 2♀ (BYUC). These 2 specimens appear to belong to this species, but males are needed for final confirmation.

DIAGNOSIS.—Male *I. eichlini* can be distinguished from others in the Abbreviata Group by the bulbous hump on the posterior portion of tergum 9 (Fig. 17). Females can be identified



by the mushroom shape of the posterior half of the subgenital plate, bordered laterally by an unsclerotized membrane and large, V-shaped indentation along the anterior margin (Fig. 35).

ETYMOLOGY.—This species is named after Thomas D. Eichlin, California Department of Agriculture, who has been an avid stonefly collector for many years and collected the first specimens of this species, including the only males.

*Isocapnia grandis* (Banks)

(Figs. 1–2, 25, 27)

*Arsapnia grandis* Banks, 1907: 329 (MCZC).

*Capnia grandis* Needham and Claassen, 1925: 259, 387.

*Capnia fumigata* Claassen, 1937: 79 (CUIC).

*Isocapnia grandis* (Banks) 1938: 73. Claassen, 1940: 93, 96. Frison, 1942: 69. Ricker, 1943: 89. Hanson, 1943: 158. Ricker, 1959: 647. Jewett, 1959: 52. Baumann et al., 1977: 78.

*Isocapnia fumosa* Banks, 1938: 74 (MCZC).

*Isocapnia fumigata* (Claassen) 1942: 70.

TYPE LOCALITY.—Victoria, British Columbia.

MALE.—Body length 11–15 mm; length of forewing 10–14 mm; 4 to 8 costal cross veins before Sc, 1 to 3 beyond; body dark brown; anterior margin of tergum 8 indented medially 1/8 the length of tergum; tergum 9 indented medially 1/5 the length of tergum; smooth, pubescent-free, dark band near plural margins of terga 1–8, each angled upward anteriorly; circular, dark patches on sides of terga 9 and 10; up to 6 small muscle attachment marks visible across each tergum, becoming more prominent posteriorly; epiproct long, slender, S-shaped in side view, with minute hook on anterior side of apex; length of epiproct approximately 1.5 times the length of tergum 9; paraprocts generally not visible from above; round vesicle covered with dense, fine pubescence, on narrow stalk extending from separate anterior portion of 9th sternum (Figs. 1–2).

FEMALE.—Body length 13–19 mm; length of forewing 11–16 mm; 4 to 9 costal cross veins before Sc, 1 to 3 beyond; body dark brown; bare, dark, or darkly bordered band along edges of sterna 8 and 9; subgenital plate W-shaped, recessed posteriorly 1/3 the length of sternum; anterior medial portion pointed and recessed 1/5 the length of sternum; both posterior and anterior 1/3 of median heavily sclerotized region bordered by lighter membranous region (Figs. 25–27).

DISCUSSION.—Males of this species can be distinguished from *I. rickeri* n. sp. by the longer

epiproct, 1.5 times the length of tergum 8 (Fig. 1) and by the lack of complete sclerotized bisection of the 9th tergum (Fig. 2). Females can be distinguished by the W-shaped 8th sternum, with both anterior and posterior margins of the subgenital plate recessed.

SPECIMENS EXAMINED.—**Canada:** ALBERTA: Banff, 26-V-1960, W.W. Moss, 1♂ (CNIC). 15 miles NW Beaton River, 8-VI-1950, P. Rubtsoff, 1♂, 1♀ (CASC). Bow River, Canmore, 2-VI-1976, D.B. Donald, 1♀ (DBDC). BRITISH COLUMBIA: Victoria, 12-IV-1907, (lectotype ♂) (MCZC). Cameron Creek, above Cameron Lake, Vancouver Island, 9-V-1954, W.E. Ricker, 1♀ (CNIC); 15-IV-1956, 1♀ (CNIC). Capilano River, N Vancouver, 18-IV-1959, W.E. Ricker, 4♂, 4♀ (CNIC). Chilliwack River, Vedder Crossing, 25-IV-1937, Ricker & Spencer, 4♂, 8♀ (CNIC, USNM); 28-IV-1937, S. Spencer, 1♀ (BYUC); 16-IV-1988, K.W. Stewart, 1♂ (UNTC). Cultus Lake, 25-IV-1937, W.E. Ricker, 1♂, 1♀ (USNM); II-V-1937, 1♂, 1♀ (CNIC). Fraser River, Agassiz, 24-IV-1938, 10♂, 11♀ (INHS); 17-IV-1957, 5♂, 1♀ (CNIC); 24-IV-1957, 10♂, 3♀ (CNIC); I-V-1957, 11♂, 4♀ (CNIC, BYUC); 26-III-1960, 1♂ (CNIC). Haslam Creek, Cassidy, near Nanaimo, 16-III-5-IV-1952, W.E. Ricker, 28♂, 4♀ (CNIC). Alaska Highway, mile 413, 26-VI-1954, M.E. Smith, 1♀ (USNM). Muncho Lake, Alaska Highway, mile 455, 27–28-VI-1952, Alexander & Smith, 2♂, 4♀ (USNM). Six miles W Terrace, 20-IV-1960, J.G. Chillcott, 1♂ (CNIC). Tetsa River, 19-VI-1958, C.H. Lindroth, 1♀ (USNM). NORTHWEST TERRITORIES: James Creek, Demster Highway, 22-VI-1996, Abbott & Stewart, 1♀ (UNTC). YUKON TERRITORY: Cornwall Creek, Richardson Mountains, 16-VI-1980, R.J. Cannings, 2♀ (SMDV). North Fork Crossing, mile 43, Aklavik Road, Ogilvie Mountains, 6-VII-1962, R.E. Leech, 1♀ (CNIC). **USA:** ALASKA: Richardson Highway, mile 206, 18-VII-1962, P.J. Skitsko, 1♀ (CNIC). Canning River, North Slope, 16-VI-1972, Alaska Pipeline Survey, 1♀ (UNTC). Chena River, 23-V-1972, Schallock & Jinkinson, 3♂, 5♀ (UNTC). East Fork Chulitna River, 28-VI-1981, S. Sonnichsen, 1♂ (UNTC). Wiseman, 2–13-VI-1948, M.W. Johnson, 3♀ (CNIC). CALIFORNIA: Butte Co., Butte Creek above Hwy 99, 27-III-1988, J.A. Stanger, 1♀ (BYUC). Middle Fork Feather River, 22-II-1966, S.G. Jewett, Jr., 1♂, 3♀ (USNM). El Dorado Co., North Fork Cosumes River, Sweeneys Somerset, 24-IV-1982, 1♀ (RLBC); 6-IV-1983,

- 1 ♀ (RLBC). Plumas Co., North Fork Feather River, Chester, 23-VIII-1955, W.E. Ricker, 1 ♂ (dried) (CNIC); 6-IV-1968, S.G. Jewett, Jr., 1 ♀ (USNM). Rice Creek, Feather River Meadows, 30-V-1991, Baumann & Stark, 1 ♂ (BYUC). IDAHO: Custer Co., East Fork Salmon River, 23 miles NW Ketchum, 18-VII-1978, D.H. Funk, 1 ♀ (DHFC). Shoshone Co., Coeur d'Alene River, Prichard, 26-IV-2001, D.L. Gustafson, 2 ♀ (DLGC). MONTANA: Flathead Co., 3 miles SE Creston, 28-IV-1969, L. Sonstelie, 1 ♀ (USNM). Flathead River, Kalispell, 4-10-IV-1973, J.A. Stanford, 5 ♂, 2 ♀ (UNTC); 14-IV-1973, Haick & McAuliffe, 3 ♂, 5 ♀ (USNM); 28-IV-1973, J.A. Stanford, 3 ♂, (BYUC); 14-V-1973, J.A. Stanford, 1 ♂ (FLBS). Middle Fork Flathead River, Walton Ranger Station, 9-V-1969, P. Milam, 1 ♂, 1 ♀ (USNM); 22-IV-1972, J.A. Stanford, 1 ♀ (UNTC); 5-24-IV-1974, J.A. Stanford, 1 ♂ (FLBS); 29-IV-1974, 1 ♂, 4 ♀, (FLBS). Gallatin Co., Gallatin River, Bozeman, 13-VI-1984, D.L. Gustafson, 3 ♂, 9 ♀, 4 nymphs (BYUC, DLGC); 13-VI-1987, 12 nymphs (DLGC). Lake Co., Jocko River, Hwy 93, below Arlee, 4-VI-1973, Haick & McAuliffe, 3 ♂, 7 ♀ (BYUC, USNM); 26-V-1977, D.H. Funk, 1 ♀ (DHFC). Lincoln Co., Fisher River, Hwy 2, 7-IV-1988, D.L. Gustafson, 2 ♂ (DLGC). Tobacco River, Eureka, 24-IV-1974, J.A. Stanford, 1 ♀ (BYUC). Missoula Co., Bitterroot River, Missoula, 1-V-1965, D.M. Lehmkuhl, 1 ♀ (USNM); 7-V-1965, 1 ♀ (USNM). Sweetgrass Co., creek, Hwy 10, 5 miles E Big Timber, 14-V-1967, M.L. Miner, 2 ♂, 6 ♀ (USNM). OREGON: Junction Canyon, 7-IV-1919, A.C. Burrill, 1 ♀ (MCZC). Herman, 18-IV-1920, A.C. Burrill, 1 ♀ (*Isocapnia fumosa* holotype) (MCZC). Benton Co., Alsea, 21-III-1929, J.E. Davis, 1 ♂ 1 ♀ (*Capnia fumigata* holotype ♂ and allotype ♀) (CUIC). Clackamas Co., Eagle Creek, 3-IV-1940, S.G. Jewett, Jr., 1 ♂ (OSUO). Clatsop Co., Big Creek, 19-II-1939, S.G. Jewett, Jr., 2 ♂, 1 ♀ (BYUC, INHS); 10-IV-1940, 1 ♀ (OSUO); 12-IV-1947, 3 ♀ (OSUO); Necanicum River, 27-III-1943, S.G. Jewett, Jr., 1 ♀ (OSUO); 12-IV-1947, 2 ♂ (OSUO). Curry Co., mouth of Rogue River, 30-III-1949, S.G. Jewett, Jr., 8 ♂ (OSUO). Douglas Co., Cow Creek, tributary Umpqua River, 1-III-1950, S.G. Jewett, Jr., 1 ♂, 1 ♀ (BYUC); 8-IV-1968, 1 ♀ (USNM). Quines Creek at mouth, 22-II-1968, 1 ♂, S.G. Jewett, Jr. (USNM). Hood River Co., Herman Creek, 2-III-1948, S.G. Jewett, Jr., 1 ♂, 2 ♀ (OSUO). East Fork Illinois River, Selma, 23-II-1968, S.G. Jewett, Jr., 1 ♀ (USNM). Josephine Co., Grave Creek, 20-III-1985, S.G. Jewett, Jr., 1 ♂, 1 ♀ (OSUO). Lane Co., Eugene, ?-III-1947, B. Malkin, 2 ♂, 2 ♀ (CNIC, OSUO). Linn Co., Willamette River, Harrisburg, 4-III-1948, 10 ♂, 3 ♀ (BYUC, USNM). Marion Co., Santiam River near Jefferson, 30-III-1940, S.G. Jewett, Jr., 1 ♂, 1 ♀ (BYUC); 4-III-1948, 24 ♂, 11 ♀, (BYUC, CNIC, OSUO, USNM); 5-IV-1950, 6 ♂, 2 ♀ (CASC); 2-IV-1966, 1 ♂ (USNM); 23-II-1974, 1 ♀ (PMNH); 9-IV-1975, 1 ♀ (PMNH). Multnomah Co., Multnomah Falls, 8-IV-1939, S.G. Jewett, Jr., 1 ♂ (INHS). Washington Co., Wolf Creek, 12-IV-1947, S.G. Jewett, Jr., 1 ♀ (OSUO). UTAH: Utah Co., Provo River, Murdock Diverson, 30-VI-1963, A.V. Nebeker, 3 ♂, 5 ♀ (BYUC). WASHINGTON: Jefferson Co., Hoh River, Olympic National Park, 28-V-1983, Stewart & Szczytko, 3 ♀ (UNTC). King Co., Cedar River, Maple Valley, 18-V-1931, G. Hoppe, 1 ♂ (INHS); 22-IV-1933, 1 ♂ (INHS). Snoqualmie River, 11-V-1972, R.A. Haick, 1 ♂, 2 ♀ (CNIC, USNM). Kittitas Co., Yakima River, Hwy 90, Cle Elum, 11-V-1972, R.A. Haick, 2 ♂, 1 ♀ (USNM); 6-V-1982, Baumann & Smith, 2 ♂, 4 ♀ (BYUC). Lewis Co., Cowlitz River, Mayfield Dam, 2-30-IV-1963, D. Greenland, 7 ♂, 1 ♀ (BYUC, ROME). Hall Creek, Hwy 12, W Packwood, 17-III-1970, R.A. Haick, 1 ♂ (BYUC). Pierce Co., Kautz Creek, Hwy 706, Mount Rainier National Park, 13-V-2001, B.C. Kondratieff, 1 ♂ (CSUC). Tahoma Creek, Westside Road, Mount Rainier National Park, 22-V-2003, Kondratieff & Schmidt, 1 ♀ (CSUC). White River, Mount Rainier National Park, Hwy 410, 22-VII-1936, E.C. Van Dyke, 1 ♀ (CASC); 20-V-1997, B.C. Kondratieff, 1 ♀ (CSUC); 14-16-V-2001, B.C. Kondratieff, 4 ♂, 2 ♀ (CSUC). Yakima Co., Yakima River, 16-IV-1952, S.G. Jewett, Jr., 1 ♀ (CASC). WYOMING: Teton Co., Gros Ventre River, Hwy 26, 7 miles N Jackson, Grand Teton National Park, 23-VI-1964, Richardson & Jensen, 1 ♀ (BYUC). Snake River, Hwy 22, 4 miles W Jackson, 8-VI-1987, B.C. Kondratieff, 2 ♂ (CSUC).
- Isocapnia hyalita* Ricker  
(Figs. 11-12, 32)
- Isocapnia hyalita* Ricker, 1959: 648 (CNIC). Baumann et al., 1977: 80.
- TYPE LOCALITY.—Hyalite Creek, Gallatin County, Montana.

**MALE.**—Body length, micropterous 8–12 mm, macropterous 8–14 mm; length of forewing, micropterous 1 mm, macropterous 8–12.5 mm; 2 to 6 costal cross veins before Sc, 0 to 1 beyond; body color, head, and pronotum dark brown to black, with lighter margin around pronotum; mesothorax and metathorax brown to dark brown; 4 to 6 small, dark muscle attachment marks on terga 2–9; very thin, dark band near anterior margin of terga 2–9, often broken medially; anterior margin of tergum 9 broadly indented medially; sides of tergum 9 dark brown to black, extending broadly along anterior indentation; tergum 8 raised medially near posterior margin; large, chisel-shaped protuberance, divided medially, near posterior edge of tergum 8; epiproct 1.3 times length of tergum 9, strongly curved forward, forming half circle in profile; small, anterior, downward-pointing spine near rounded, posteriorly bent tip; medial groove running along posterior edge of epiproct; vesicle round and heavily pubescent (Figs. 11–12).

**FEMALE.**—Body length 11–18 mm; length of forewing 11–16 mm; 3 to 4 costal cross veins before Sc, 0 to 2 beyond; body color same as male; posterior margin of subgenital plate recessed approximately 1/5 the length of segment (Fig. 32).

**DISCUSSION.**—Males of this species can be distinguished from others in the *Hyalita* Group by the strongly curved epiproct, compared to the straight epiproct of *I. integra* and the duck-head-shaped epiproct of *I. spenceri*. Females of the *Hyalita* Group are extremely difficult to separate. The more southern Rocky Mountain distribution of *I. hyalita* usually distinguishes it from the other *Hyalita* Group species.

**SPECIMENS EXAMINED.**—**Canada:** ALBERTA: Evelin Creek, Jasper National Park, 21-VII-1979, D.B. Donald, 1 ♀ (DBDC). Rowe Brook, near Cameron Creek, Waterton Lakes National Park, 12-V-1979, D.B. Donald, 2 ♂ (DBDC). **USA:** COLORADO: Mineral Co., Treasure Falls, Hwy 160, 7 miles S Wolf Creek Pass, 6-V-1997, R.W. & W. Baumann, 1 ♂ (BYUC). Summit Co., seeps near Solitude Station, Copper Mountain, 5-VII-1997, B.C. Kondratieff, 1 ♀ (CSUC). IDAHO: Fourth of July Creek, tributary of Salmon River, 9-V-1977, D.H. Funk, 2 ♂, 2 micropterous ♂ (DHFC); 24-V-1977, 1 ♂, 1 ♀, 1 micropterous ♂ (DHFC). Lemhi Co., Salmon River at Spring Creek, 5 miles E Shoup, 15-IV-1977, D.H. Funk, 1 ♀, 1 micropterous

♂ (DHFC). MONTANA: Flathead Co., Middle Fork Dickey Creek, 25-IV-1966, P. Milam, 3 ♂ (BYUC). McDonald Creek, Avalanche Campground, Glacier National Park, 2-V-1972, A.R. Gaufin, 1 ♂, 5 ♀ (BYUC). Riverside Creek, near Hungry Horse Reservoir, 2-V-1969, Baumann & Miner, 1 ♀ (USNM). Gallatin Co., West Gallatin River, Squaw Creek Bridge, 6-V-1951, Hays & Alvord, 1 ♀ (CNIC). Grayling Creek, Hwy 287, 27-IV-1997, D.L. Gustafson, 4 ♂, 2 ♀, 10 micropterous ♂ (BYUC, DLGC). Hell Roaring Creek, Hwy 191, 13-V-1951, Hays & Alvord, 1 ♀ (CNIC). Hyalite Creek, 6-V-1950, R. Hays, 1 ♂ (CNIC); 10-V-1951, 1 micropterous ♂ (CNIC); 8-V-1952, 2 ♂, 1 ♀, 5 micropterous ♂ (includes holotype and allotype) (CNIC); 9-V-1952, 2 ♂, 1 ♀, 3 micropterous ♂ (BYUC); 11-V-1952, 1 ♀ (CNIC). Lincoln Co., Fisher River, Hwy 2, 11-IV-1997, D.L. Gustafson, 1 ♂ (DLGC). Granite Creek, Hwy 2, 6-IV-1988, D.L. Gustafson, 6 ♂, 12 ♀, 4 micropterous ♂ (BYUC, DLGC); 11-IV-1997, 10 ♂, 9 ♀, 31 micropterous ♂ (BYUC, DLGC). Grave Creek, 21-V-1969, P. Milam, 1 ♀ (USNM); 29-III-1970, 2 micropterous ♂ (BYUC). Lake Creek, 6-IV-1998, D.L. Gustafson, 3 ♀, 1 micropterous ♂ (DLGC). Libby Creek, Hwy 2, 11-IV-1997, D.L. Gustafson, 1 ♂, 7 ♀, 2 micropterous ♂ (DLGC). Libby Dam, 8-IV-1973, Haick & McAuliffe, 1 ♂, 7 ♀, 3 micropterous ♂ (USNM). Pipe Creek, 7-IV-1988, D.L. Gustafson, 1 ♀ (DLGC). Missoula Co., Bitterroot River, Buckhouse Bridge, 3-IV-1972, R.A. Haick, 1 micropterous ♂ (USNM). Grant Creek, near Missoula, 26-IV-1972, 1 ♀ (USNM). Rattlesnake Creek, Greenough Park, 14-16-IV-1969, Baumann & Oblad, 3 ♀ (BYUC, USNM); 14-V-1969, M.L. Miner, 1 micropterous ♂ (USNM). OREGON: Grant Co., Canyon Creek, S John Day, 14-IV-1984, G.R. Fiala, 1 ♀ (BYUC). Union Co., Five Points Creek, Hwy I-84, Hilgard, junction Grande Ronde River, 25-IV-1985, Baumann & Nelson, 1 ♂ (BYUC). UTAH: Box Elder Co., Brigham Canyon, 1-V-1937, Knowlton & Harmston, 1 ♀ (INHS); Knowlton & Bischoff, 1 ♀ (BYUC). Salt Lake Co., Big Cottonwood Canyon, 15-VI-1937, G.F. Knowlton, 1 ♀ (BYUC). Salt Lake Co., Big Cottonwood Canyon, 15-VI-1937, G.F. Knowlton, 1 ♀ (BYUC). Utah Co., American Fork Canyon, 22-IV-1972, D.C. Cox, 1 ♀ (BYUC). American Fork River, 8-IV-1967, C.D. Bjork, 2 ♂, 1 ♀ (BYUC); 10-IV-1967, Bjork & Oblad, 2 ♂, 1 ♀, 2 micropterous ♂ (BYUC); 12-IV-1967, C.D. Bjork, 1 ♀, 1 micropterous ♂ (BYUC);



10-IV-1986, Christman & Nelson, 1 ♀, 1 micropterous ♂ (BYUC); 18-IV-1986, Huish & Nelson, 1 ♂, 1 ♀, 3 micropterous ♂ (BYUC). Summit Creek, Santaquin Canyon, E Santaquin, 3-V-2002, D.J. Ozment, 7 ♂, 3 ♀, 10 micropterous ♂ (BYUC). Timponeke Campground, South Fork American Fork Canyon, 29-IV-1992, R.L. Johnson, 2 ♀ (BYUC); I-V-1992, J.T. Zenger, 1 micropterous ♂ (BYUC). Tooele Co., South Willow Creek, Upper Narrows, Stansbury Mountains, 15-V-1967, Baumann & Oblad, 5 ♂, 3 ♀, 6 micropterous ♂ (BYUC). Wasatch Co., Deer Creek, 5-V-1949, A.R. Gaufin, 1 ♀ (BYUC). WASHINGTON: Columbia Co., Touchet River, Hwy 12 near Dayton, 5-III-1984, G.R. Fiala, 2 ♂, 1 ♀ (BYUC); 25-IV-1985, Baumann & Nelson, 1 micropterous ♂ (BYUC); 14-IV-1998, R.L. Newell, 2 micropterous ♂ (BYUC, RLNC). Walla Walla Co., Mill Creek, 18 miles SE Walla Walla, 16-IV-2000, R.L. Newell, 1 ♂, 2 ♀ (RLNC). WYOMING: Bighorn Co., Brindle Creek, Rt. 264, 6 miles NE Shell, 9-V-1998, S.A. Grubbs, 1 micropterous ♂ (SAGC).

*Isocapnia integra* Hanson

(Figs. 15–16, 34)

*Arsapnia grandis* Banks, 1907: 329 (in part).

*Isocapnia integra* Hanson, 1943: 160 (MCZC). Hanson, 1946: 239. Ricker, 1959: 649. Baumann et al., 1977: 80.

*Isocapnia fraseri* Ricker 1959: 645 (CNIC). New synonymy.

*Isocapnia missouri* Ricker 1959: 651 (INHS). New synonymy.

TYPE LOCALITY.—Banff, Alberta.

MALE.—Body length, micropterous 4.5–7.5 mm, macropterous 7–10.5 mm; forewing length, micropterous 0.3–1 mm, macropterous 7–9 mm; 4 costal crossveins before Sc, 1 to 2 beyond; dark border along anterior margin of terga 2–10, divided medially on anterior terga; 4 to 6 small muscle attachment marks across terga 1–8; V-shaped anterior indentation with broad, dark border on tergum 9; large, medially divided, chisel-shaped protuberance along posterior margin of tergum 9, angled posteriorly; posterior margin of tergum 9 dark; epiproct nearly straight, tapering near apex; length of epiproct approximately twice the length of tergum 8; vesicle small and oblong (Figs. 15–16).

FEMALE.—Body length 10.5–12 mm; length of forewing 8.5–10 mm; 1 to 3 costal crossveins before Sc, 0 or 1 beyond; anterior margin of subgenital plate slightly recessed from posterior margin (Fig. 34).

DISCUSSION.—Males of this species can be distinguished from others in the *Hyalita* Group by the thin, straight epiproct and the chisel-shaped protuberance on the 9th tergum. Females are not easily distinguished. The best characters are that the posterior margin of the subgenital plate is either not recessed or only slightly recessed and that the species comes from the more northern range, from Wyoming to Alaska. *Isocapnia fraseri* and *I. missouri* are considered synonyms. These 2 species were distinguished on the basis of small differences in the depth of the medial division of the chisel-shaped protuberance on the 9th tergum, the width along different portions of the epiproct, and the size of the lobe on the 9th sternum. After examining many specimens from throughout the range, we found the differences to vary between populations at different altitudes and in different stream sizes.

SPECIMENS EXAMINED.—**Canada:** ALBERTA: Alderson Lake, Waterton Lakes National Park, 27-VIII-1975, D.B. Donald, 3 ♀, 2 micropterous ♂, (DBDC); 15-VII-1989, D.J. Larson, 5 ♀ (MUNC). Banff, 17-VI-1901, ?, 1 ♀ (holotype, MCZC); 22-VI-1908, J.C. Bradley, 1 ♀ (CUIC); 11-VI-1922, C.B.D. Garrett, 1 ♀ (CNIC). Battle Creek, Reesor Lake, 19-V-1976, L.M. Dosdall, 4 ♀ (USIK). Berland River, 75 km N Hinton, 30-IV–2-VI-1994, E. Fuller, 1 ♀ (BYUC). Bow River, Arrowhead, 29-IV-1976, D.B. Donald, 4 brachypterous ♀, 1 micropterous ♂ (DBDC). Upper Cavell Lake, Jasper National Park, 16-VII-1978, D.B. Donald, 3 ♀, 3 micropterous ♂ (DBDC). Cirque lake, tributary of Wolverine Creek, Banff National Park, 28-VI-1956, K. Ricker, 10 ♀ (CNIC). Consolation Lake, Banff National Park, 1-VI-1958, W.E. Ricker, 1 ♀ (CNIC); 8-VIII-1981, D.B. Donald, 3 ♀, 4 micropterous ♂ (DBDC). Floe Lake, Banff National Park, 5-VI-1957, W.E. Ricker, 3 ♀, 1 micropterous ♂ (CNIC); 28-V-1958, 1 ♂, 1 ♀ (CNIC). Waiparous Creek, North Ghost Campground, 24-V-1993, Baumann, Campora & Liu, 1 ♀, 2 micropterous ♂ (BYUC). BRITISH COLUMBIA: Atlin, 3-IV-1955, H. Huckel, 1 ♀ (CNIC). Floe Lake, Kootenay National Park, 21-VIII-1981, D.B. Donald, 1 ♂, 15 ♀ (DBDC). Fraser River, Agassiz, 24-IV-1938, ?, 2 ♀, 2 micropterous ♂ (CNIC); 17-IV-1957, W.E. Ricker, 10 ♂, 14 ♀, 57 micropterous ♂ (includes *Isocapnia fraseri* holotype ♂) (BYUC, CNIC, INHS); 24-IV-1957, 4 ♂, 14 ♀, 25 micropterous ♂ (BYUC, CNIC); 1-V-1957, 2 ♀, 2



micropterous ♂ (CNIC); 14-III-1958, 1 micropterous ♂ (CNIC); 26-III-1960, 2♂, 1♀, 5 micropterous ♂ (CNIC); 15-16-IV-1988, K.W. Stewart, 1♀, 4 micropterous ♂ (UNTC). YUKON: North Fork Pass, Ogilvie Mountains, 26-VI-1962, ?, 1 micropterous ♂ (CNIC). USA: ALASKA: Chena River, 8-V-1972, Schallock & Jinkinson, 5♀, 3 micropterous ♂, 1 nymph (UNTC); 23-V-1972, 5 micropterous ♂ (UNTC); 8-V-1973, 7♂, 39♀, 21 micropterous ♂ (BYUC, UNTC). North Fork Chena River, Chena Hot Springs Road, 21-V-1984, W.C. Fields, 4 micropterous ♂ (WCFC). Honolulu Creek, Parks Hwy, mile 178, 1-VI-1982, E. Fuller, 8 micropterous ♂, 1 nymph (ROME). IDAHO: Coeur d'Alene River, Prichard, 26-IV-2001, D.L. Gustafson, 2♀ (DLGC). MONTANA: Broadwater Co., Missouri River, Toston, 4-IV-1952, R. Hays, 1 micropterous ♂ (*Isocapnia missourii* holotype) (INHS). Casade Co., Smith River, Eden Bridge, 6-IV-1996, D.L. Gustafson, 2♂ nymphs (BYUC, DLGC). Flathead Co., Flathead River, Kalispell, 24-IV-1973, J.A. Stanford, 46♂, 34♀, 20 micropterous ♂ (BYUC, UNTC); 29-IV-1974, 2♂, 6♀, 1 micropterous ♂ (FLBS). Middle Fork Flathead River, Essex, 12-IV-1968, P. Milam, 1♂, 1♀, 3 micropterous ♂ (USNM); 12-IV-9-V-1969, Gaufin & Milam, 16♂, 20♀, 11 micropterous ♂ (USNM). North Fork Flathead River, Polebridge, 20-V-1993, D.L. Gustafson, 1♂ (DLGC); 7-VI-1996, Flint & Ruiter, 3♀ (CSUC, USNM). Gallatin Co., Gallatin River, Bozeman, 14-IV-1984, D.L. Gustafson, 20♀ (BYUC, DLGC); 3-IV-1990, 3♀, 3 micropterous ♂ (BYUC, DLGC). Gallatin River, Logan, 13-IV-1985, D.L. Gustafson, 6♀, 1 micropterous ♂ (DLGC). Glacier Co., Middle Fork Flathead River (groundwater spring), near West Glacier, 10-II-2003, B.L. Reid, 2 brachypterous ♀, 2 micropterous ♂ (FLBS). Lincoln Co., Fisher River, Hwy 2, 11-IV-1997, D.L. Gustafson, 4♂, 3♀ (BYUC, DLGC). Fisher River, near junction Kootenai River, 25-IV-1969, Baumann & Miner, 3♀, 3 micropterous ♂ (BYUC, USNM). Lake Creek, 6-IV-1988, D.L. Gustafson, 1 micropterous ♂ (DLGC). Tobacco River, Eureka, 24-IV-1974, J.A. Stanford, 1♂, 1 micropterous ♂ (BYUC). Mineral Co., Denna Mora Creek, Denna Mora, Rt. 10, W Saltese, 16-IV-1966, Wiggins & Yamamoto, 1♀ (ROME). Yellowstone Co., Yellowstone River, Buffalo Mirage, 17-III-2000, D.L. Gustafson, 1 micropterous ♂ (DLGC). SOUTH DAKOTA: Lawrence Co., Spearfish Creek, above confluence Red-

water Creek, 24-III-1982, Baumann & Winget, 1 brachypterous ♀ (BYUC). WYOMING: Teton Co., Snake River, Hwy 22, Wilson, 11-III-2003, D.L. Gustafson, 1♀ (DLGC).

*Isocapnia mogila* Ricker

(Figs. 19–20, 26, 36)

*Isocapnia mogila* Ricker, 1959: 652 (CASC).

TYPE LOCALITY.—Cow Creek, Douglas County, Oregon.

MALE.—Body length 6–6.5 mm; length of forewing 7–7.5 mm; unusual wing venation with many incomplete cross veins; body color dark brown; thin, dark border along anterior margin of terga 2–10; 4 to 6 muscle attachment marks across terga 2–9; dark, bare patch along lateral edge of terga 1–9; broad, rounded, V-shaped indentation of anterior edge of tergum 9; small median spine arising from basal plate of epiproct; epiproct approximately 3/4 the length of tergum 8, with anterior hook extending from tip; vesicle triangular in shape (Figs. 19–20).

FEMALE.—Body length 9–9.5 mm; length of forewing 7.5–8 mm; 3 subcostal cross veins before Sc, 1 beyond; wings and terga similar to male, with peculiar wing venation; posterior margin of subgenital plate recessed, with a short, membranous border on each side; anterior portion broadly recessed, with a light-colored, central extension covering center of the plate (Figs. 26, 36).

DISCUSSION.—This species is easily distinguished by its irregular wing venation and short, narrow epiproct (Fig. 26). It is quite rare, with only 3 males known.

SPECIMENS EXAMINED.—USA: CALIFORNIA: Marin Co., Lagunitas Creek, 1-II-1972, 1♂ (CASC). San Luis Obispo Co., Santa Rosa Creek, near Cambria, 22-I-1988, T.D. Eichlin, 1♀ (BYUC). OREGON: Douglas Co., Cow Creek, Hwy 99, 22-XI-1955, S.G. Jewett, Jr., 2♂ (includes holotype) (BYUC, CASC). Josephine Co., Grave Creek, tributary of the Rogue River, 1-III-1950, S.G. Jewett, Jr., 10♀ (includes allotype) (CASC).

*Isocapnia palousa*, new species

(Figs. 9–10, 30)

MALE.—Body length, micropterous 6–9 mm; forewing length less than 1 mm, only micropterous males known; body color brown; narrow,

dark band along anterior margin of terga 1–10; bare, dark band along lateral margin of terga 1–9; 4 to 6 muscle attachment marks across terga 1–9; tergum 9 broadly indented medially both anteriorly and posteriorly, line joining indentations; epiproct approximately 2.5 times the length of tergum 8, held upright, bending forward gently, with small knob arising from groove on posterior side of tip; epiproct covered with short, lateral, sparse hairs; vesicle round, covered with dense, fine pubescence; posterior of 9th sternum with large, rounded, V-shaped anterior indentation so that area behind vesicle is completely membranous (Figs. 9–10).

**FEMALE.**—Body length 11–11.5 mm; length of forewing 8.5–9 mm; 7 costal cross veins before Sc, 2 beyond; body color brown; 4 to 6 muscle attachment marks across terga 1–10; darker, bare band along plural edge of terga 2–9; subgenital plate rounded and extending to posterior edge of sternum; medial portion of anterior half of subgenital plate light-colored and almost membranous (Fig. 30).

**TYPES.**—Holotype ♂, allotype ♀, **USA:** WASHINGTON: Columbia Co., Touchet River, Hwy 12, Dayton, 5-III-1984, G.R. Fiala (CASC). Paratypes: IDAHO: Latah Co., Bear Creek, Hwy 3, junction Potlach River, 25-III-1969, Baumann & Oblad, 1♀, 1 micropterous ♂ (BYUC); Big Bear Creek, near Kendrick, 8-III-1969, G.R. Fiala, 2 micropterous ♂ (BYUC). Middle Fork Potlach Creek, Hwy 3, Juliaetta, 25-III-1969, Baumann & Oblad, 1♀, 1 micropterous ♂ (BYUC); 7-III-1984, G.R. Fiala, 1 micropterous ♂ (BYUC). OREGON: Umatilla Co., Umatilla River, Echo, 22-II-1998, R.L. Newell, 2♂, 2♀, 2 micropterous ♂ (BYUC); 16-II-1999, R.L. Newell, 1♂, 1♀, 1 micropterous ♂ (RLNC); 18-III-2000, 2♀ (RLNC). WASHINGTON: Columbia Co., Touchet River, 5 miles W Dayton, 24-II-1998, R.L. Newell, 1♀, 3 micropterous ♂ (BYUC). Touchet River, Dayton, 4-IV-1998, R.L. Newell, 1♀ (RLNC). Tucannon River, Hwy 126, 5-III-1984, G.R. Fiala, 1♂ (BYUC). Tucannon River, Hwy 12 bridge, 24-II-1998, R.L. Newell, 6♂, 7♀, 19 micropterous ♂ (BYUC, RLNC). Tucannon River, 3 miles S Hwy 12, 24-II-1998, R.L. Newell, 1♂, 7♀, 2 micropterous ♂ (BYUC). Tucannon River, Starbuck, 24-II-1998, R.L. Newell, 1 micropterous ♂ (BYUC).

**DIAGNOSIS.**—Males of this species can be distinguished from others in the Crinita Group

by the small hairs along the epiproct and the small knob embedded in the groove near the tip of the epiproct (Figs. 9–10). Females can be identified by the nonrecessed posterior margin of the subgenital plate (Fig. 30).

**ETYMOLOGY.**—This species is named after the Palouse Hills of northwestern Idaho and southeastern Washington, north of the Snake River, where most of the specimens have been found. Palouse is the name of an Indian tribe native to this area that bred the famous Appaloosa horses.

*Isocapnia rickeri*, new species

(Figs. 3–4, 28)

**MALE.**—Body length 9–12 mm; length of forewing 8.5–11.5 mm; 4 to 7 costal cross veins before Sc, 1 to 4 beyond; body very dark brown; dark band and medial, V-shaped indentation along anterior margin of terga 1–10, darkness of band and depth of indentation increasing posteriorly; tergum 9 bisected almost completely; sides of dark anterior margin of tergum 9 meeting medially, forming small ridge; V-shaped indentation on posterior edge of tergum 8, also faintly present on terga 6–7; smooth, pubescent-free, generally dark band near lateral margins of terga 1–9; 4 to 6 small muscle attachment marks visible across terga 1–9; epiproct short, roughly equal to length of tergum 8, slightly S-shaped in lateral view, held upright, with small hook on anterior side of tip; posterior side of epiproct slightly flattened, with medial groove along basal 1/3; paraprocts visible from above; vesicle round, covered with dense, fine pubescence, on narrow stalk extending from separate anterior portion of 9th sternum; 2 round muscle attachment marks on each sternum (Figs. 3–4).

**FEMALE.**—Body length 12–18 mm; length of forewing 12–14 mm; 4 to 9 costal cross veins before Sc, 1 to 4 beyond; body very dark brown; posterior margin of subgenital plate recessed posteriorly 1/3 the width of the sternite and 1/4 the length (Fig. 28).

**TYPES.**—Holotype ♂ and allotype ♀, **USA:** OREGON: Umatilla Co., Umatilla River at Mission, 5 miles E Pendleton, 25-IV-1985, R.W. Baumann & C.R. Nelson (CAS). Paratypes: OREGON: Umatilla Co., Umatilla River, Cayuse, 15-IV-1952, S.G. Jewett, Jr., 3♂, 7♀ (BYUC, CNIC). Same data as holotype, 4♂, 9♀ (BYUC). Umatilla River, Pendleton, 15-IV-1952, S.G.

Jewett, Jr., 4♂ (BYUC, CNIC). WASHINGTON: Asotin Co., Asotin Creek, 5 miles above Asotin, 27-IV-1985, Baumann & Nelson, 1♂ (BYUC). Columbia Co., Touchet River, 4 miles SW Dayton, 25-IV-1985, Baumann & Nelson, 4♂, 7♀ (BYUC). Touchet River, Dayton, 13-III-1999, R.L. Newell, 1♀ (RLNC). Tucannon River, Hwy 12, S Delancy, 25-IV-1985, Baumann & Nelson 1♂, 1♀ (BYUC). King Co., Cedar River, G. Hoppe, 9-IV-1932, 1♀ (INHS). Umatilla Co., Mill Creek, 10 miles SE Walla Walla, 4-IV-1998, R.L. Newell, 1♂ (RLNC).

ETYMOLOGY.—This species is named after the late William E. Ricker, the eminent plecopterologist who named many of the species in the genus, did a revision of the genus in 1959, and provided many of the specimens examined for this paper.

DIAGNOSIS.—*Isocapnia rickeri* differs in the male from *I. grandis* by its shorter, more angular epiproct, which bears a hook on the tip. In addition, it has a sclerotized ridge on the medial part of tergum 9. The female subgenital plate has a much broader sclerotized medial area than *I. grandis*.

*Isocapnia spenceri* Ricker

(Figs. 13–14, 33)

*Isocapnia spenceri* Ricker, 1943: 91 (INHS). Ricker, 1959: 652. Jewett, 1959: 652. Jewett, 1960: 148.

*Isocapnia spenceri thujae* Ricker, 1943: 92 (INHS). Ricker, 1959: 653.

TYPE LOCALITY.—Chilliwack River, Vedder Crossing, British Columbia.

MALE.—Body length, micropterous 7–10 mm, macropterous 9–11.5 mm; length of forewing, micropterous 0.5–1 mm, macropterous 9.5–11 mm; 2 to 4 costal cross veins before Sc, 0 to 1 beyond; head and pronotum dark brown to black, with light edge around pronotum; meso- and metathorax dark brown; abdominal segments lighter than thorax; 4 to 6 dark muscle attachment marks across terga 2–8; narrow, dark band near anterior edge of terga 2–9; thick, dark, bare band along lateral edge of terga 2–8; thin, dark, sometimes faint, medial line running length of tergum 8, faintly visible on previous terga; large, bare, dark patch completely covering lateral sides of tergum 9 and extending along posterior edge; V-shaped anterior indentation on tergum 9, with dark line extending from tip of V to near middle of the tergum; large, medially separated protuberance arising from the posterior edge of tergum

9, tilting medially and posteriorly, ending in dark, lateral-running ridge descending on each side of protuberance; epiproct duck-head shaped both from lateral and dorsal view, furrowed along its length and thickest posteriorly, which is the back of the neck and head of the duck, with groove running along entire posterior length; length of epiproct approximately equal to length of tergum 8; vesicle round, covered with dense pubescence (Figs. 13–14).

FEMALE.—Body length 10–14 mm; length of forewing 9.5–14 mm; 2 to 5 costal cross veins before Sc, 0 to 2 beyond; head and thorax coloration same as male; 4 to 6 muscle attachment marks across terga and a long and short lateral dark bare mark on each side of terga 2–9; sterna 8 and 9 both sclerotized medially with lateral indentations; posterior margin of subgenital plate recessed approximately 1/5 the length of sternum (Fig. 33).

DISCUSSION.—Males of this species are easily discernible from Hyalita Group species and from all other named *Isocapnia* by their duck-head-shaped epiproct. Females are much more difficult to differentiate. However, they often have an extremely dark head and pronotum, darker than *I. integra*, and are not found in the Rocky Mountains, as is *I. hyalita*.

SPECIMENS EXAMINED.—**Canada:** BRITISH COLUMBIA: Cameron Creek above Cameron Lake, Vancouver Island, 8-IV-1955, W.E. Ricker, 2 micropterous ♂ (CNIC); 15-IV-1956, 2♀, 1 micropterous ♂ (CNIC). Capilano River, Vancouver Island, 18-IV-1957, W.E. Ricker, 2♀, 10 micropterous ♂ (CNIC). Chehalis River, near Harrison Mills, 17-IV-1957, W.E. Ricker, 1♀ (CNIC). Chilliwack River, Vedder Crossing, 25-IV-1937, S. Spencer, 1♂ (holotype, INHS); 20-V-1937, W.E. Ricker, 1♀ (CNIC); 24-IV-1938, W.E. Ricker, 1♀, 1 micropterous ♂ (*Isocapnia spenceri thujae* holotype ♂ and allotype ♀, INHS). Haslam Creek, Cassidy, S Nanaimo, Vancouver Island, 16-III–5-IV-1952, W.E. Ricker, 4♂, 15♀, 11 micropterous ♂ (BYUC, CNIC). Lakelse River, near Terrace, 15-VI-1950, F. Neave, 1♀ (CNIC). Seymour Creek, North Vancouver, 18-IV-1957, W.E. Ricker, 1♀ (CNIC). **USA:** ALASKA: Keta River, below Cabin Slough, Misty Fiords National Monument, 26-IV-1979, R.M. Vineyard, 1♀ (BYUC). Keta River, below Hill Creek, 27-IV-1979, R.N. Vineyard, 2♀ (BYUC). CALIFORNIA: Placer Co., Bear Creek, below Alpine Meadows Ski Area, 21-IV-1987, Baumann, Nelson, & Wells, 1♂



(BYUC). Plumas Co., North Fork Feather River, Chester, 6-IV-1968, S.G. Jewett, Jr., 1 micropterous ♂ (USNM). Sierra Co., Little Truckee River, Hwy 89, near Truckee Pass, 10-V-1983, Baumann & Mower, 14♂, 3♀, 17 micropterous ♂ (BYUC). Trinity Co., Trinity River, 7 miles S Trinity Center, 2-III-1955, Black & Jewett, 1 micropterous ♂ (BYUC). OREGON: Benton Co., Corvallis, 25-III-1938, D. Coons, 1♀ (INHS). Clackamas Co., Eagle Creek, S Eagle Creek, 3-IV-1940, S.G. Jewett, Jr., 1♀ (BYUC). Clatsop Co., Necanicum River, 14-III-1953, S.G. Jewett, Jr., 3 micropterous ♂ (BYUC). Lane Co., Eugene, B. Malkin, ?-IV-1947, 1♂, 2♀ (BYUC, CASC). Willamette River, Eugene, 4-III-1948, S.G. Jewett, Jr., 2♀ (BYUC). Linn Co., Willamette River, Harrisburg, 4-III-1948, S.G. Jewett, Jr., 5♂, 26♀ (BYUC, USNM). Marion Co., Santiam River, near Jefferson, 4-III-1948, 2♂, 13♀ (BYUC, CASC, OSUO). Washington Co., Hillsboro, 19-III-1936, Coray & Schuh, 1♀ (INHS). WASHINGTON: Jefferson Co., Hoh River Campground, Olympic National Park, 12-IV-1975, D.M. Jackson, 2♂ (WSUC). Lewis Co., Berwick Creek, E Mary McKranks, 16-II-1987, G.R. Fiala, 1♂ (BYUC). Cowlitz River, Mayfield Dam, S.G. Jewett, Jr., 1 micropterous ♂ (BYUC). Ohanapecosh River, Ohanapecosh Campground, Mount Rainier National Park, 28-V-1997, B.C. Kondratieff, 1♀ (CSUC). Pierce Co., White River, Hwy 410, Mount Rainier National Park, 14-V-2001, B.C. Kondratieff, 1 brachypterous ♀, 1 micropterous ♂ (CSUC). Whatcom Co., North Fork Nooksack River, E Deming, 15-IV-1989, R.I. Pollock, 1 micropterous ♂ (BYUC).

*Isocapnia vedderensis* (Ricker)

(Figs. 23–24, 38)

*Eucapnopsis vedderensis* (Ricker), 1943: 86–87 (INHS). Jewett, 1959: 50.

*Isocapnia vedderensis* (Ricker), 1965: 488. Baumann et al., 1977: 82.

TYPE LOCALITY.—Chilliwack River, Vedder Crossing, British Columbia.

MALE.—Body length 4–6.5 mm; length of forewing 5–6 mm; 0 to 2 subcostal cross veins before Sc, 0 to 1 beyond; thin, dark line along anterior margin of terga 2–9; 4 to 6 muscle attachment marks across terga 2–9; entire edge of basal portion of epiproct raised, often to a dark-edged ridge that peaks at the anterior corner of base; epiproct 1/2 length of tergum 8, broad at base, immediately narrowing

to a sharp, anteriorly hooked tip; fusion plate long and prominent; vesicle round, extending from sternum 9; cerci with 6–9 segments (Figs. 23–24).

FEMALE.—Body length 5–7.5 mm; length of forewing 5.5–7.5 mm; 1 to 3 subcostal cross veins before Sc, 0 to 2 beyond; subgenital plate of 8th sternum almost membranous, or unsclerotized, not easily distinguishable in older preserved specimens; 6–9 cercal segments (Fig. 38).

DIAGNOSIS.—Both the male and female can be distinguished by their short, less than 9 segmented, cerci. Females can be further identified by their nearly unsclerotized subgenital plate (Fig. 38).

DISCUSSION.—*Isocapnia vedderensis* appears not to be closely related to other species of the genus and superficially resembles *Eucapnopsis*. However, phylogenetically, *I. vedderensis* is a distinct clade of *Isocapnia* (Fig. 39).

SPECIMENS EXAMINED.—**Canada:** ALBERTA: Tributary Bow Lake, Banff National Park, 30-V-1958, W.E. Ricker, 1♂ (CNIC). Tributary Bow River, 5 miles below Bow Lake, Banff National Park, 31-V-1958, W.E. Ricker, 1♂ (CNIC). Spray River, Banff, 5-VI-1957, W.E. Ricker, 1♀ (CNIC). Sulphur Creek, Jasper National Park, 26-V-1976, D.B. Donald, 1♂ (DBDC). BRITISH COLUMBIA: Chilliwack River, Vedder Crossing, 25–26-IV-1937, W.E. Ricker, 6♂, 3♀ (CNIC, INHS); 12-V-1937, 1♂, 1♀ (holotype and allotype, INHS); 16-IV-1939, S.D. Spencer, 1♀ (CNIC). Fraser River, Agassiz, 24-IV-1938, W.E. Ricker, 2♂, 1♀ (CNIC); 17-IV-1938, 3♂, 1♀ (CNIC); 24-IV-1957, 3♂, 3♀ (CNIC); 15-IV-1988, K.W. Stewart, 2♂ (UNTC). Kootenay River, Hwy 3, 7-IV-1973, Haick & McAuliffe, 1♂, 1♀ (USNM). Three Valley Lake, Hwy 1, 17-IV-1981, D.B. Donald, 1♂ (DBDC). **USA:** ALASKA: Chena River, 25-V-1972, Schallock & Jinkinson, 15♂, 7♀ (UNTC); 8-V-1973, 3♂, 2♀ (UNTC). West Fork Chena River, Chena Hot Springs Road, 20-V-1984, W.C. Fields, 4♂ (WCFC). Honolulu Creek, Parks Highway, mile 178, 1-V-1982, E. Fuller, 3♀ (ROME). CALIFORNIA: Alpine Co., West Fork Carson River, Hwy 88, 6 miles E Carson Pass, 12-VII-1995, Alexander & Bottorff, 1♂ (KDAC). COLORADO: Archuleta Co., San Juan River, Rt. 160, 1-V-1992, B.C. Kondratieff, 1♂ (CSUC). Dolores Co., Dolores River, Rt. 145, S Rico, 1-V-1995, B.C. Kondratieff, 1♂, 1♀ (CSUC). Grande Co.,



Williams Fork, Rt. 138, 3-VI-1995, B.C. Kondratieff, 1♂ (CSUC). IDAHO: Lemhi Co., Salmon River, Spring Creek, 5 miles E Shoup, 15-IV-1977, D.N. Funk, 13♂, 5♀ (DHFC). North Fork Salmon River, 0.5 mile N North Fork, 25-V-1977, D.N. Funk, 1♀ (DHFC). Owyhee Co., East Fork Jarbridge River, Murphy Hot Springs, Baumann & Zenger, 3♂, 3♀ (BYUC). MONTANA: Flathead Co., Flathead River, Kalispell, 10-IV-1973, J.A. Stanford, 2♂, 2♀ (BYUC); 14-IV-1973, Haick & McAuliffe, 36♂, 44♀ (BYUC, USNM); 28-IV-1973, J.A. Stanford, 3♂, 4♀ (BYUC); 14-IV-1974, 2♂, 2♀ (BYUC); 29-IV-1974, 1♂, 2♀ (FLBS); 2-IV-1989, 2♂, 1♀ (FLBS). Middle Fork Flathead River, Essex, 21-IV-1968, P. Milam, 1♂, 2♀ (BYUC, USNM). Middle Fork Flathead River, Walton Ranger Station, 9-IV-1969, P. Milam, 10♂, 7♀ (BYUC). Middle Fork Flathead River, West Glacier, 9-V-1969, A.R. Gauvin, 1♀ (USNM). McDonald Creek, Avalanche Campground, Glacier National Park, 2-V-1972, A.R. Gauvin, 1♂ (BYUC). Gallatin Co., Hyalite Creek, 17-V-1951, R. Hays, 1♀ (USNM); 9-V-1952, 1♂, 1♀ (OSUO). Middle Creek, 16-V-1952, R. Hays, 3♀ (USNM). Spanish Creek, Hwy 191, 6-V-1951, Hays & Alvord, 1♂, 1♀ (CNIC). Lincoln Co., Fisher River, 5 miles above junction Kootenai River, 25-IV-1969, Baumann & Miner, 5♂, 5♀ (BYUC, USNM). NEW MEXICO: Colfax Co., Vermejo River, Vermejo Park, 23-IV-1986, Baumann, Kondratieff, and Wells, 1♂, 3♀ (BYUC). UTAH: Cache Co., Blacksmith Fork, below junction Rock Creek, 5-III-1983, Baumann & Nelson, 1♀ (BYUC). Indian Canyon, near summit, 23-IV-1943, Knowlton & Wood, 4♂, 1♀ (INHS). Logan River, Logan Canyon, 15-V-1938, D.E. Hardy, 1♀ (BYUC). Logan Canyon, Spring Hollow, 12-IV-1979, C.R. Nelson, 6♀ (BYUC). Emery Co., Huntington River, Race Horse Flat, 16-IV-1971, Winget & Devenport, 2♂ (BYUC). Huntington River, Stuart Ranger Station, 4-V-1978, Baumann & Winget, 4♂, 1♀ (BYUC). Utah Co., American Fork River, 15-IV-1967, B.R. Oblad, 3♂, 2♀ (BYUC). American Fork River, Timpanogos Cave National Monument, 18-26-IV-1967, C.D. Bjork, 8♂, 6♀ (BYUC). Diamond Fork, 3 miles above junction Spanish Fork River, 8-IV-1981, Clark & Stanger, 29♂, 13♀ (BYUC). Diamond Fork, junction Little Diamond Creek, 14-15-IV-1987, Nelson & Wells, 34♂, 11♀ (BYUC). Provo River, ?, L. Miller, 1♂ (BYUC). Wayne Co., Fremont River, junction Sulphur Creek, Capitol

Reef National Park, 18-III-1989, R.W. Baumann, 8♂, 5♀ (BYUC). Pleasant Creek, Lower Canyon, Capitol Reef National Park, 4-IV-1994, Brammer & MacDonald, 1♀ (BYUC). WASHINGTON: Chelan Co., Nanson Creek, Lake Wenatchee State Park, 27-IV-1963, W.E. Ricker, 3♀ (CNIC). Pierce Co., White River, Hwy 410, Mount Rainier National Park, 16-V-2001, B.C. Kondratieff, 2♂, 5♀ (CSUC); 23-V-2004, 5♂, 3♀ (CSUC). Whatcom Co., North Fork Nooksack River, E Deming, 15-IV-1963, R.I. Pollock, 1♂, 1♀ (BYUC).

#### Palearctic *Isocapnia* Species

Representatives of 5 of the 7 known Palearctic species of *Isocapnia* were examined, and all 7 are briefly compared with the Nearctic species. These Palearctic species each fall into either the *Isocapnia* Crinita or Grandis Groups, except for *I. aptera*, which is only known in the female. All are easily distinguished from their Nearctic relatives. What follows is a brief comparison of the diagnostic traits of the Palearctic and Nearctic species. For an excellent and complete description of the Palearctic species, see Zhiltzova et al. (1975), Palearctic Species of the Genus *Isocapnia*. Some additional references for *Isocapnia* in the Palearctic are useful to better understand this Holarctic genus: Zhiltzova and Zapekina-Dulkeit 1986 and Zhiltzova 2003.

#### *Isocapnia arcuata* Zhiltzova

*Isocapnia arcuata* Zhiltzova et al., 1975: 566–568.

TYPE LOCALITY.—Komarovka River, south Primorye, Russia.

DISTRIBUTION.—Amur Basin, coast of Okhotsk Sea, Primorye and Sakhalin Island.

DESCRIPTION.—The 3 male *I. arcuata* examined were micropterous and 6.5–8 mm in length. The epiproct is long, slender, and curved forward, which is similar to *I. crinita*, *I. palousa* n. sp., and *I. agassizi*, but the *I. agassizi* epiproct is held more horizontally than the other species, causing the curve to be upward rather than forward. The length of the epiproct is longer than in *I. crinita* but shorter than in *I. palousa* n. sp. or *I. agassizi*, approximately 1.5 times the length of tergum 8. The forward curve of the epiproct is also more pronounced, making it appear more rounded in profile than *I.*

*crinita*, *I. palousa* n. sp., or *I. agassizi*. The paraprocts are visible from above, as in *I. crinita*, and tergum 9 is divided medially, as in *I. crinita* and *I. agassizi*. The body is not heavily pubescent like *I. crinita*.

*Isocapnia aptera*  
Zhiltzova

*Isocapnia aptera* Zhiltzova, 1969: 604–606.

TYPE LOCALITY.—Aksu Jabaglinsk National Park, Tien Shan Mountains, Kirgizstan.

DISTRIBUTION.—This species is known only from the type locality in the Tien Shan Mountains. The single, female type specimen was not examined.

*Isocapnia guentheri*  
(Joost)

*Capnia guentheri* Joost, 1970: 38.

TYPE LOCALITY.—Tamir River, Archangai, Mongolia.

DISTRIBUTION.—Mongolia, Russian Far East, and Sakhalin Island.

DESCRIPTION.—This species is similar in appearance to *I. grandis* but much smaller. The 4 micropterous males examined were 7.5–8.5 mm long, compared to *I. grandis*, which ranges in length from 11 to 15 mm. Similarities with *I. grandis* include a slender, S-shaped epiproct and an undivided tergum 9. Beyond size, the other notable differences between *I. guentheri* and *I. grandis* include the presence of micropterous males in *I. guentheri* and a relatively narrower vesicle. Joost (1970) described this interesting species from Mongolia, not realizing that it was really an *Isocapnia*.

*Isocapnia japonica*  
Kohno

*Isocapnia japonica* Kohno, 1953: 203.

TYPE LOCALITY.—Takada Bridge, Honshu, Japan.

DISTRIBUTION.—Honshu Island, Sakhalin Island, and the Kurile Islands of Japan and the Russian Far East.

DESCRIPTION.—Specimens of this species were not examined but were compared based on the excellent illustrations of Kohno (1953); this species is similar to *I. grandis*. However, the epiproct is very strongly recurved, and micropterous males are present. Kawai (1967)

states that it seems to be restricted to northern Honshu, but Zhiltzova et al. (1975) list it as also occurring in Sakhalin and the Kurile Islands.

*Isocapnia kudia* Ricker

*Isocapnia kudia* Ricker, 1959: 650.

TYPE LOCALITY.—Kudia River, Amgu, Russia.

DISTRIBUTION.—Baikal region, south Primorye, and coast of Okhotsk Sea.

DESCRIPTION.—The single macropterous male that was examined was 12 mm long. The epiproct of *I. kudia* is distinctively narrow near the base yet broad in the middle. It is also angular in cross section and has 2 prominent hooks at the tip, traits that distinguish it from other *Isocapnia*. The 9th tergum is divided. The female *I. kudia* exhibits a distinctive pattern of sclerotization on its subgenital plate.

*Isocapnia orientalis*  
Zhiltzova

*Isocapnia orientalis* Zhiltzova et al., 1975: 571–573.

TYPE LOCALITY.—Khor River, Amur Basin, Russia.

DISTRIBUTION.—Amur Basin, Kolyma Basin, Primorye, coast of the Okhotsk Sea, and Sakhalin Island.

DESCRIPTION.—One male and 1 female paratype were studied. The male was micropterous and 8 mm long, and the female was macropterous and 11 mm long. The epiproct of *I. orientalis* is long and slender, with a gentle upward curve very similar to *I. agassizi*. The epiproct length is approximately 1.5 times the length of tergum 9, which is shorter than *I. agassizi* and more similar in relative length to that of *I. crinita*. However, the epiproct has a prominent hook at the tip that is much more pronounced than the suggestion of a hook found on either *I. agassizi* or *I. crinita*. The 9th tergum is undivided, unlike both *I. agassizi* and *I. crinita*. *Isocapnia orientalis* can be distinguished from *I. palousa* n. sp. by the more horizontal position of the epiproct, the shorter length of the epiproct, and the lack of the lateral sparse hairs and terminal knob on the epiproct.

*Isocapnia sibirica*  
(Zapekina-Dulkeit)

*Capnia nigra sibirica* Zapekina-Dulkeit, 1955: 15–18.

TYPE LOCALITY.—Teletskoye Lake, Altai Mountains, Russia.

DISTRIBUTION.—Altai Mountains, Sayan Mountains, Baikal Region, and Mongolia.

DESCRIPTION.—The epiproct of *I. sibirica* is slender, S-shaped, and similar to *I. grandis*. The single micropterous male examined was 9 mm long and, unlike *I. grandis*, was strikingly pubescent, as much as or more so than *I. crinita*. The 9th tergum is not divided, and the paraprocts are not visible from above, as with *I. grandis*. The female subgenital plate is indistinctive and only shallowly recessed, unlike the *I. grandis* female, which has a distinctively sclerotized and deeply recessed subgenital plate.

#### Phylogenetic Analysis of Nearctic *Isocapnia* Species

Table 1 shows the characters used in the phylogenetic analysis, along with their status in the various species. Two outgroups were chosen, *Eucapnopsis* and *Bolshecapnia*, from among other Capniidae genera. These were selected because males in both genera possess a vesicle on sternum 9, a character found in all *Isocapnia*. Comparison results with either outgroup were very similar (results from *Eucapnopsis* are presented). Analysis was limited to synapomorphies, first on a generic level, then a species level, resulting in the isolation of the genus and then the species groups used throughout this paper. The phylogenetic tree depicted in Figure 39 shows those results and indicates how species within the groups are related.

The following descriptions of characters are used for Table 1: 1. Prothoracic presternum broadly fused with basisternum. 2. Mesothoracic furcasternum fused to mesosternum. 3. Tips of paraprocts divergent. 4. Metathoracic furcasternum fused to and poorly demarked from 1st abdominal sternite. 5. Female subgenital plate at least partially sclerotized. 6. Length of epiproct greater than length of 8th tergum. 7. Body length of macropterous male greater than 7 mm. 8. Dark line along anterior margin of female tergum. 9. Body length of females 10–13 mm. 10. Male epiproct recurved or S-shaped. 11. Body length of female greater than 14 mm. 12. Micropterous males known to occur. 13. Male 9th tergum divided medially by V-shaped or I-shaped, dark sclerotized mark. 14. Chisel-shaped protuberance on male 9th

tergum. 15. Length of male epiproct twice the length of tergum 8. 16. Male epiproct longer than length of tergum 8 and curved forward.

The following guide indicates how the characters in Table 1 were used to identify the species groups, based on the results of the phylogenetic tree in Figure 39. Characters 1–3 separate *Isocapnia* from the outgroup. Characters 4–5 isolate *I. vedderensis* from the rest of the genus. Characters 6–8 divide the Abbreviata Group from the Grandis, Crinita, and Hyalita Groups. Character 9 splits *I. eichlini* n. sp. and *I. mogila* from *I. abbreviata*. Characters 10–12 divide the Grandis Group from the Crinita and Hyalita Groups. Characters 13–15 separate the Crinita Group from the Hyalita Group. Character 16 splits *I. crinita* from *I. agassizi* and *I. palousa* n. sp. Character 23 separates *I. hyalita* from *I. integra* and *I. spenceri*.

#### MATERIAL EXAMINED

Specimens were provided by the following individuals and institutions: Kevin D. Alexander, Western State College of Colorado, Gunnison, Colorado (KDAC); Richard L. Bottorff, South Lake Tahoe California (RLBC); Brigham Young University, Provo, Utah, Shawn M. Clark (BYUC); University of British Columbia, Vancouver, British Columbia, Syd G. Cannings (SMDV); Burke Museum, University of Washington–Seattle, Washington, Rodney L. Crawford (UWBM); California Academy of Sciences, San Francisco, California, Vincent F. Lee and Norman D. Penny (CASC); California Department of Agriculture, Sacramento, California, Fred G. Andrews and Thomas D. Eichlin; Canadian National Collection, Ottawa, Ontario, Edward C. Becker and Donald E. Bright (CNIC); Colorado State University, Fort Collins, Colorado, Boris C. Kondratieff (CSUC); Cornell University, Ithaca, New York, E. Richard Hoebeke (CUIC); David B. Donald, Regina, Saskatchewan (DBDC); Gene R. Fiala, Gresham, Oregon; Wayne C. Fields, Jr., Newcastle, California (WCFC); Flathead Lake Biological Station, Polson, Montana, Jack A. Stanford (FLBS); Edward R. Fuller, Edmonton, Alberta; David H. Funk, Stroud Water Research Center, Avondale, Pennsylvania (DHFC); Scott A. Grubbs, Western Kentucky University, Bowling Green, Kentucky (SAGC); Daniel L. Gustafson, Bozeman, Montana (DLGC); Kimberly T. Huntzinger, Seattle, Washington; Illinois Natural

Survey, Champaign, Illinois, Edward R. DeWalt and Donald W. Webb (INHS); Stanley G. Jewett, Jr. (deceased), West Linn, Oregon; Robert L. Johnson, Holden, Utah; John F. MacDonald, Purdue University, West Lafayette, Indiana; Memorial University of Newfoundland, St. Johns, Newfoundland, David J. Larson (MUNC); Michael J. Mitchell, Longmont, Colorado; Montana State University, Bozeman, Montana, Michael A. Ivie (MTEC); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, Philip D. Perkins (MCZC); Robert L. Newell, Polson, Montana (RLNC); University of North Texas, Denton, Texas, Kenneth W. Stewart (UNTC); Oregon State University, Corvallis, Oregon, Norman H. Anderson and John D. Lattin (OSUO); Derrick J. Ozment, Provo, Utah; Royal Ontario Museum, Toronto, Ontario, Glenn B. Wiggins (ROME); Peabody Museum of Natural History, Yale University, New Haven, Connecticut, Raymond J. Pupedis (PMNH); Richard I. Pollock, Pullman, Washington; William E. Ricker (deceased), Nanaimo, British Columbia; University of Saskatchewan, Saskatoon, Saskatchewan, Lloyd M. Dosdall and Dennis M. Lemkuhl (USIK); Larry E. Serpa, Tiburon, California; Jean A. Stanger-Leavitt, Lincoln, Nebraska; Michael J. Stansbury, Roseburg, Oregon; United States National Museum, Smithsonian Institution, Washington, D.C., Nancy Adams and Oliver S. Flint, Jr. (USNM); Richard N. Vineyard, Sparks, Nevada; and Washington State University, Pullman, Washington, Richard S. Zack (WSUC).

#### ACKNOWLEDGMENTS

The excellent illustrations were made by Jean Stanger-Leavitt. Randal V. Baker helped organize and improve the final plates. Specimens of Palearctic *Isocapnia* species were provided by L.A. Zhiltzova of St. Petersburg, Russia, with the help of Peter Zwick of Schlitz, Germany. Special thanks are given to Boris Kondratieff for helping us collect in the field, finding specimens to borrow, and improving the final manuscript. We are grateful to Kenneth Stewart and Brian Armitage for allowing us to use the stylized habitus illustration of an *Isocapnia* nymph from Stewart and Stark (2002) as the frontispiece and on the cover of the reprints. Finally, credit is given to our 2 deceased colleagues Stanley Jewett and Bill Ricker for

their help and encouragement and especially for the many specimens of *Isocapnia* they collected.

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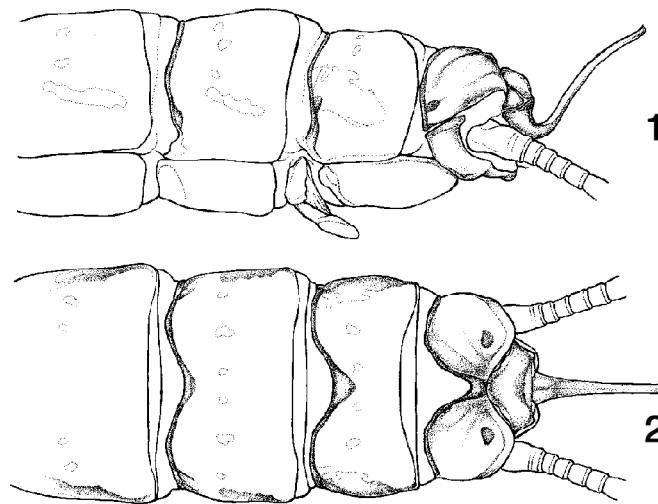
Received 20 November 2002

Accepted 11 January 2004

TABLE 1. Nearctic *Isocapnia* species.

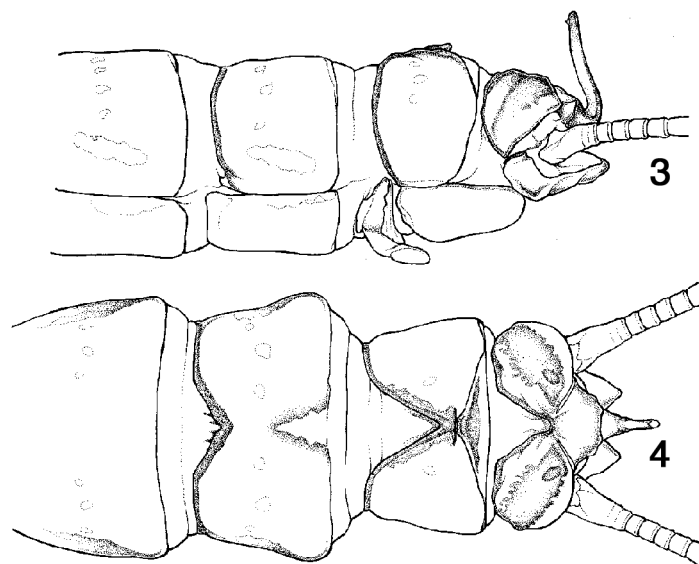
Character state	<i>Eucapniopsis breviceauda</i>	<i>I. grandis</i>	<i>I. rickerti</i> n. sp.	<i>I. crinita</i>	<i>I. palousa</i> n. sp.	<i>I. agassizi</i>	<i>I. hydulta</i>	<i>I. integra</i>	<i>I. spenceri</i>	<i>I. abbreviata</i>	<i>I. etchlini</i> n. sp.	<i>I. mogila</i>	<i>I. vedderensis</i>
1. Presternum fused to basisternum	O	X	X	X	X	X	X	X	X	X	X	X	X
2. Mesosternum fused to furcasternum	O	X	X	X	X	X	X	X	X	X	X	X	X
3. Paraprocts divergent	O	X	X	X	X	X	X	X	X	X	X	X	X
4. Furcasternum fused to first sternum	O	X	X	X	X	X	X	X	X	X	X	X	O
5. Female subgenital plate sclerotized	O	X	X	X	X	X	X	X	X	X	X	X	O
6. Epiproct longer than 8th tergum	O	X	X	X	X	X	X	X	X	O	O	O	O
7. Males longer than 7 mm	O	X	X	X	X	X	X	X	X	O	O	O	O
8. Dark anterior margin female terga	O	O	O	O	O	O	O	O	O	X	X	X	X
9. Females 10–13 mm long	O	O	O	O	O	O	O	X	O	O	X	X	O
10. Epiproct S-shaped	O	X	X	O	O	O	O	O	O	O	O	O	O
11. Females longer than 14 mm	O	X	X	X	O	X	X	O	X	O	O	O	O
12. Micropterous males	O	O	O	X	X	X	X	X	X	O	O	O	O
13. Male 9th tergum divided medially	O	O	X	X	X	X	O	O	O	O	O	O	O
14. Protuberance on male 9th tergum	O	O	O	O	O	O	X	X	X	O	O	O	O
15. Epiproct twice length of 8th tergum	O	O	O	O	X	X	O	O	O	O	O	O	O
16. Epiproct curved forward	O	O	O	X	X	X	X	O	O	O	O	O	O

X = apomorphy, O = pleistomorphy



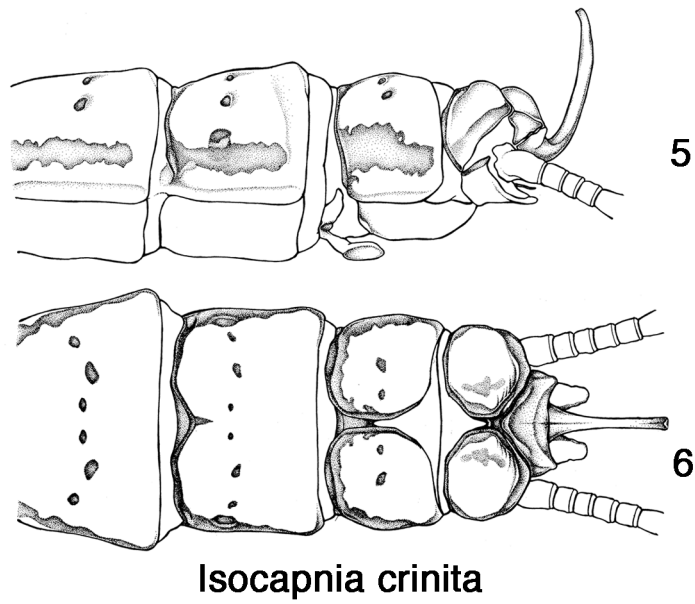
### ***Isocapnia grandis***

Figs. 1–2. *I. grandis*: 1, male terminalia (lateral); 2, male terminalia (dorsal).

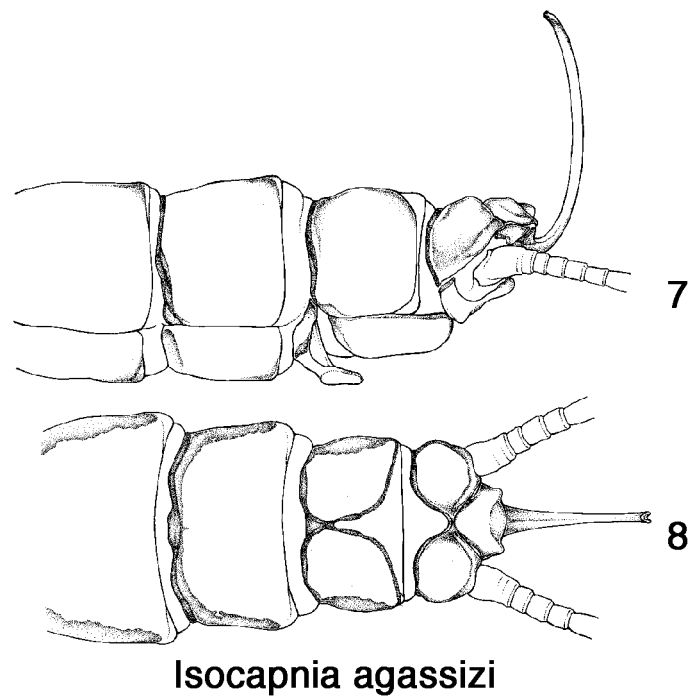


### ***Isocapnia rickeri***

Figs. 3–4. *I. rickeri* n. sp.: 3, male terminalia (lateral); 4, male terminalia (dorsal).

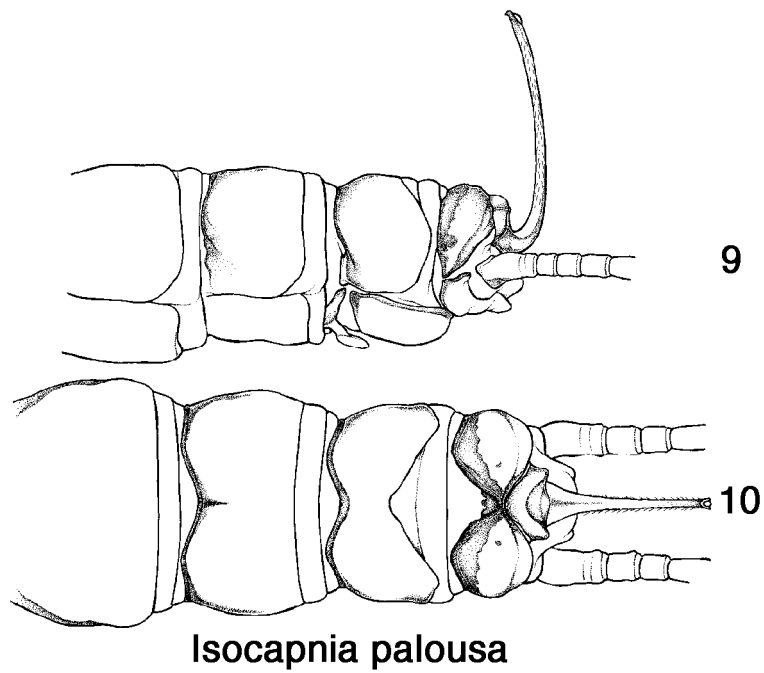


Figs. 5–6. *I. crinita*: 5, male terminalia (lateral); 6, male terminalia (dorsal).

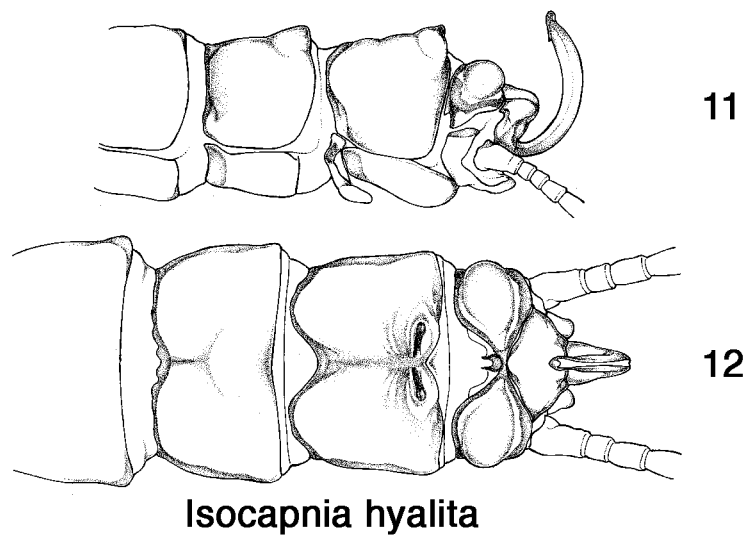


Figs. 7–8. *I. agassizi*: 7, male terminalia (lateral); 8, male terminalia (dorsal).

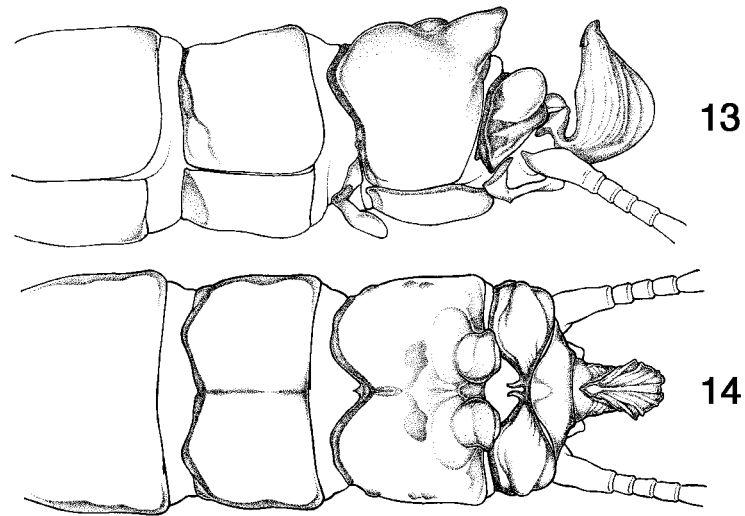




Figs. 9–10. *I. palouza* n. sp.: 9, male terminalia (lateral); 10, male terminalia (dorsal).

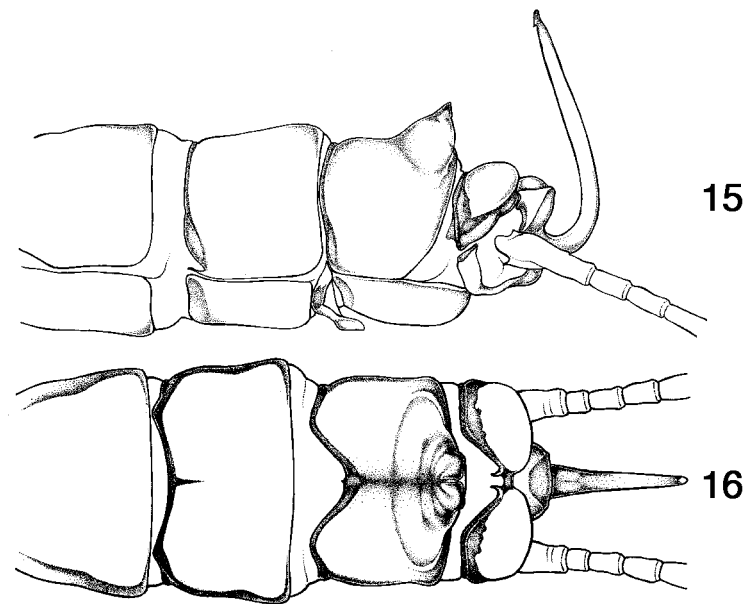


Figs. 11–12. *I. hyalita*: 11, male terminalia (lateral); 12, male terminalia (dorsal).



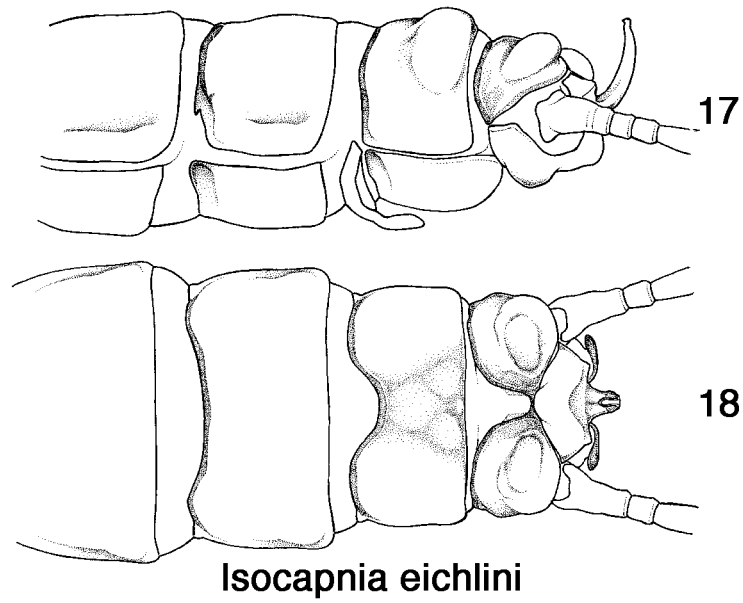
***Isocapnia spenceri***

Figs. 13–14. *I. spenceri*: 13, male terminalia (lateral); 14, male terminalia (dorsal).

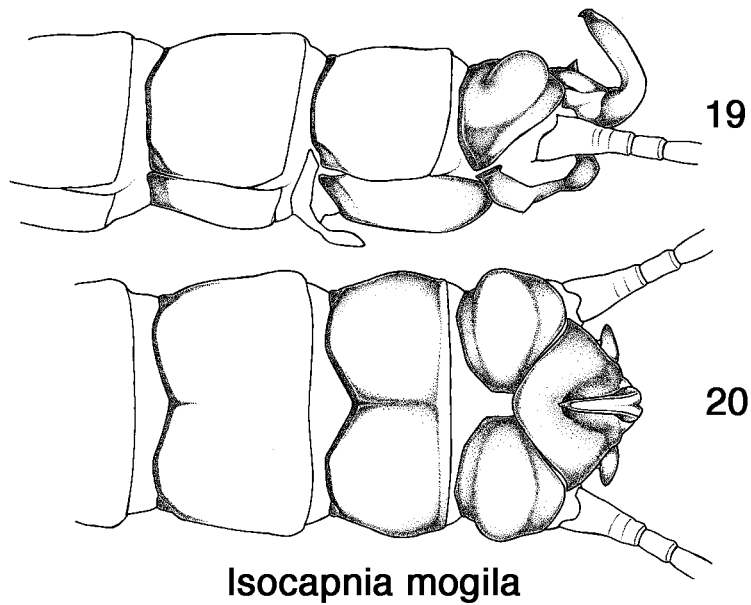


***Isocapnia integra***

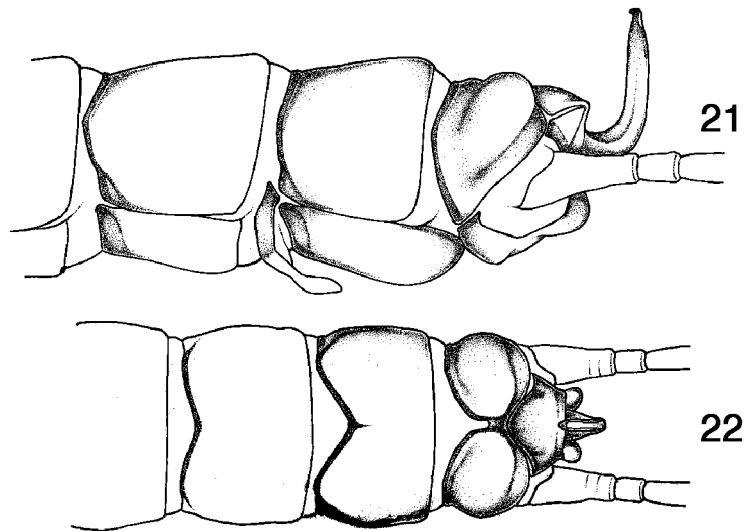
Figs. 15–16. *I. integra*: 15, male terminalia (lateral); 16, male terminalia (dorsal).



Figs. 17–18. *I. eichlini* n. sp.: 17, male terminalia (lateral); 18, male terminalia (dorsal).

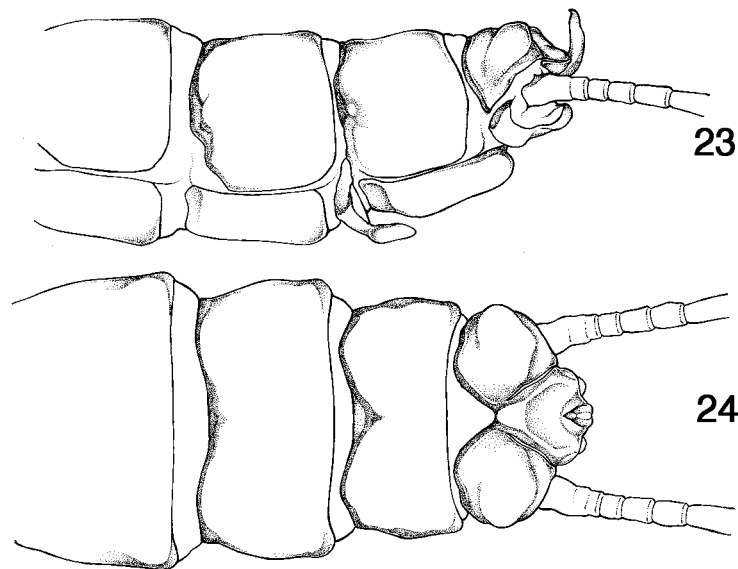


Figs. 19–20. *I. mogila*: 19, male terminalia (lateral); 20, male terminalia (dorsal).



### *Isocapnia abbreviata*

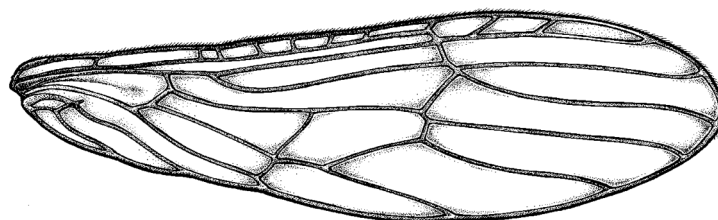
Figs. 21–22. *I. abbreviata*: 21, male terminalia (lateral); 22, male terminalia (dorsal).



### *Isocapnia vedderensis*

Figs. 23–24. *I. vedderensis*: 23, male terminalia (lateral); 24, male terminalia (dorsal).

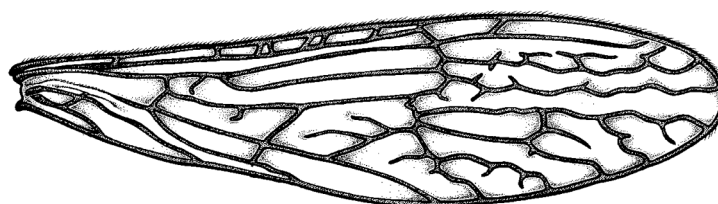




25

*Isocapnia grandis*

Fig. 25. *I. grandis* female right forewing.



26

*Isocapnia mogila*

Fig. 26. *I. mogila* female right forewing.

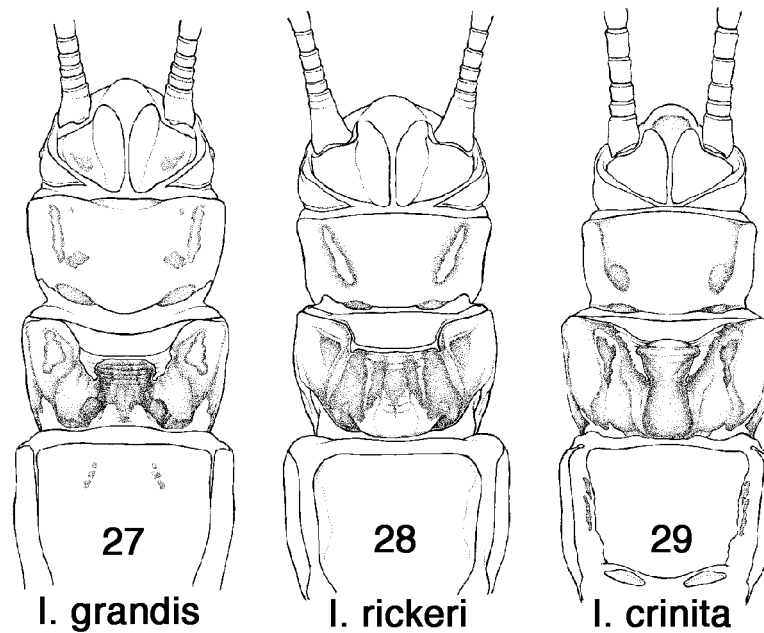


Fig. 27. *I. grandis* female terminalia (ventral). Fig. 28. *I. rickeri* n. sp. female terminalia (ventral). Fig. 29. *I. crinita* female terminalia (ventral).

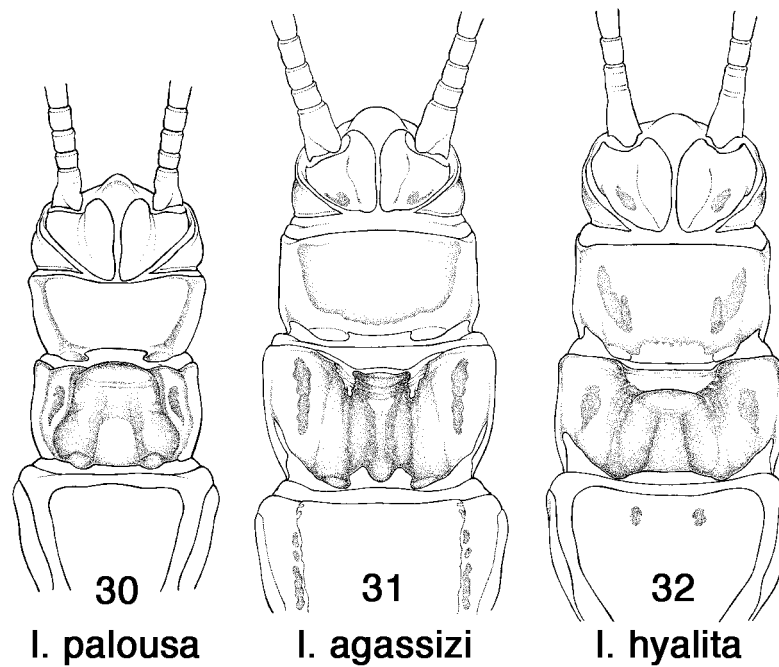


Fig. 30. *I. palousa* n. sp. female terminalia (ventral). Fig. 31. *I. agassizi* female terminalia (ventral). Fig. 32. *I. hyalita* female terminalia (ventral).

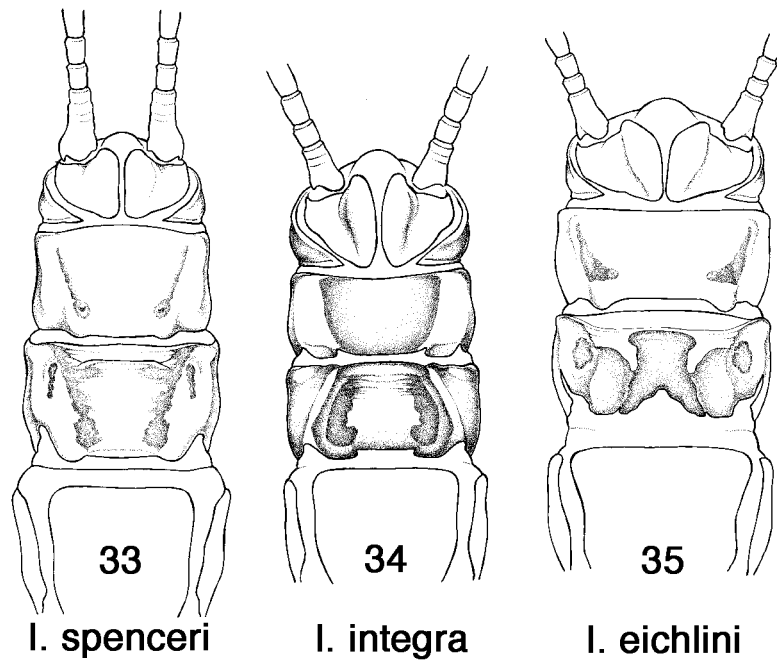


Fig. 33. *I. spenceri* female terminalia (ventral). Fig. 34. *I. integra* female terminalia (ventral). Fig. 35. *I. eichlini* n. sp. female terminalia (ventral).

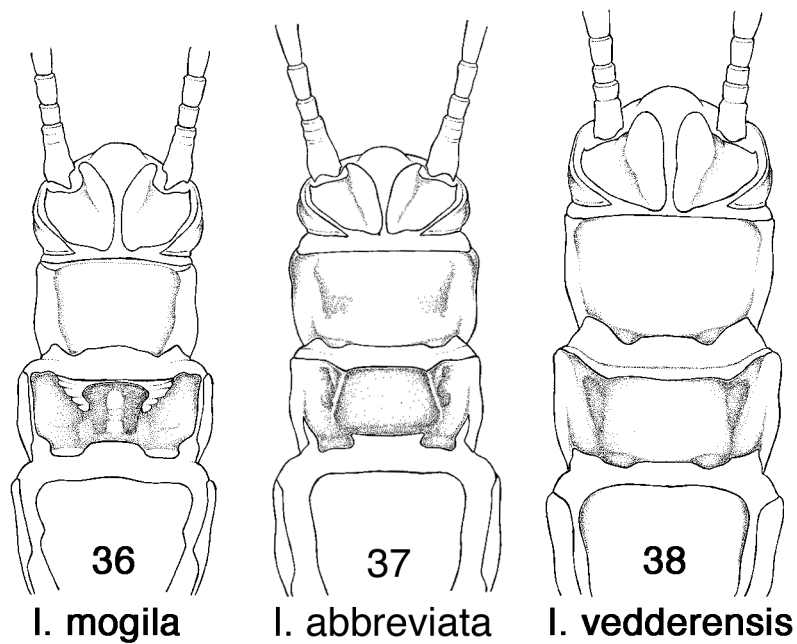


Fig. 36. *I. mogila* female terminalia (ventral). Fig. 37. *I. abbreviata* female terminalia (ventral). Fig. 38. *I. vedderensis* female terminalia (ventral).

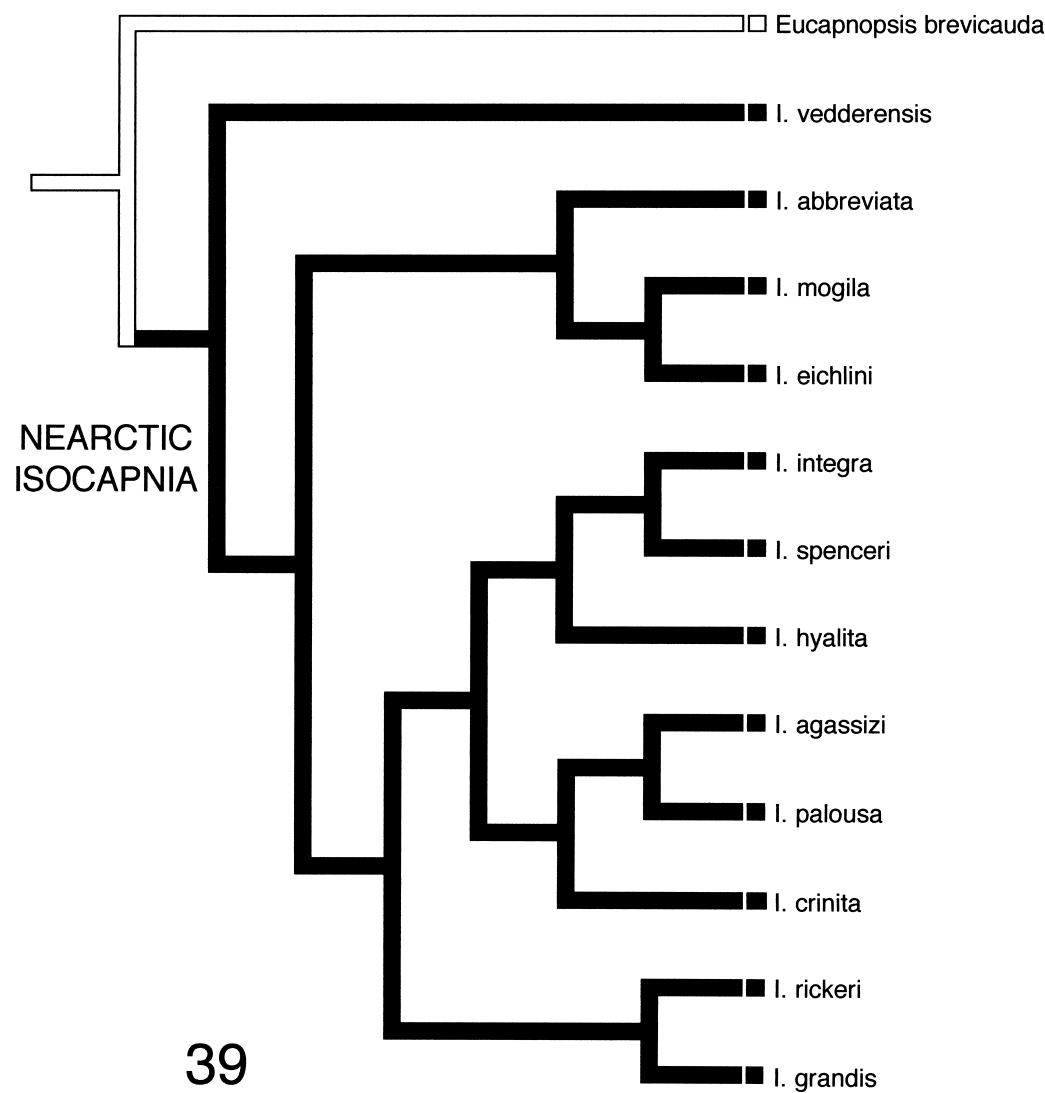


Fig. 39. Phylogenetic tree of the Nearctic species in the genus *Isocapnia*, based on characters from Table 1.