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Review of the genus *Pagastia* Oliver (Diptera: Chironomidae: Diamesinae) from North America, with description of *P.* (*P.*) *subletteorum* sp. nov.

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Abstract

Illustrated description of the adult male of *Pagastia* (*P.*) *subletteorum* **sp. nov.**, redescription of the pupa and adult male of *P.* (*P.*) *orthogonia* Oliver and *P.* (*P.*) *partica* (Roback), with redescription of the adult male of *P.* (*Hesperodiamesa*) *sequax* (Garrett) from North America are provided. An emended generic diagnosis and a key to determination of adult males of all known species of *Pagastia* Oliver are also provided.

Key words: Diptera, Chironomidae, Diamesinae, *Pagastia,* new species, key, North America

Introduction

The genus *Pagastia* was described by Oliver (1959) from North America with two included species, *P. orthogonia* (as new, and as the type species for the genus) and *P. partica* (Roback). Sublette (1967) erected the new genus *Hesperodiamesa* for *Prodiamesa sequax* Garrett, but he incorrectly separated the genus from *Pagastia* by "... its...pronotum completely covered by coarse bristles," and Serra-Tosio (1971, 1976) thus synonymized *Hesperodiamesa* with *Pagastia.*

As currently understood, *Pagastia* (*Hesperodiamesa*) includes a single Nearctic species, *P.* (*H.*) *sequax* (Garrett) (known only from Canada), while *Pagastia* s. str. includes six valid species: *P. altaica* Makarchenko, Kerkis *et* Ivanchenko (Altai Mountains, Russia), *P. hidakamontana* Endo (Hokkaido, Japan), *P. lanceolata* (Tokunaga) (Japan, East Siberia, Russian Far East), *P. nivis* (Tokunaga) (Japan, Russian Far East), *P. orientalis* (Tshernovskij) (Siberia, Russian Far East, South Korea, China), *P. orthogonia* Oliver (U.S.A., Japan, Russian Far East), *P. partica* (Roback) (Canada, U.S.A.) (Ashe & Connor 2009) and *P. tianmumontana* Makarchenko *et* Wang (South China) (Makarchenko & Wang 2017). One additional undescribed species, known only from larvae, is recorded from Kirgizstan in Central Asia (Makarchenko & Makarchenko 2000), and two undescribed species are recorded from Nepal (Roback & Coffman 1987).

Reviewing the scanty descriptive works on the genus *Pagastia* Oliver from North America, I can conclude that the descriptions of the adult males don't meet present-day taxonomic standards. Other than the diagnosis in Oliver (1986), there are as yet no published descriptions of the pupae, even though three species have been reared to adults. Three species of larvae, on the other hand, have been described in detail (Oliver & Roussel 1982; Namayandeh & Culp 2016; Namayandeh *et al.* 2016).

Below I present, for the four North American species, a description of the adult male of *Pagastia* (*P.*) *subletteorum* **sp. nov.**, a redescription of the adult male and the pupa of both *P.* (*P.*) *orthogonia* Oliver and *P.* (*P.*) *partica* (Roback), and a redescription of the adult male of *P.* (*Hesperodiamesa*) *sequax* (Garrett). I further present an emended generic diagnosis and a key to the determination of the adult males of all known species of *Pagastia.* Unfortunately, a key to the determination of the larvae and pupae of these species is not yet feasible, due to the very close morphological similarity of most of the species; hopefully, further revisional work will find characters that will enable their eventual discrimination.

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Material and methods

The morphological terminology and abbreviations used below generally follow Sæther (1980). For some structures of the hypopygium, however, the terminology of Hansen & Cook (1976) and Oliver (1989) is used. The material was slide-mounted in either Canada balsam or Euparal®. The photographs were taken using an Axio Lab.A1 (Karl Zeiss) microscope. All the material studied from the collections of Mr C.B.D. Garrett and Drs D.R. Oliver and D. Hansen, including the type specimens, are deposited at the Department of Entomology, University of Minnesota, St. Paul, MN, USA (DEUM) and in the Canadian National Collection, Ottawa (CNC). Some specimens of adult males, pupae, and larvae of *P. orthogonia* and *P. partica*, which were given to me by Drs D. Hansen and V. Teslenko, are placed in the collection of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Vladivostok (FSCEATB FEB RAS).

The holotype and paratypes of the new species are deposited at the Department of Entomology, University of Minnesota, St. Paul, MN, USA (DEUM).

Descriptions

Genus *Pagastia* Oliver

Pagastia Oliver, 1959: 49.
Type species: *Pagastia orthogonia* Oliver, 1959, by original designation.

Diagnosis. As in Oliver (1959, 1983, 1986, 1989), Oliver & Roussel (1982), Makarchenko (1985, 1994, 2006), Makarchenko & Makarchenko (2000), †Sæther & Andersen (2003) and Endo (2004), with the emendations and additions below for the adult male.

Adult male. Medium to large sized species, 4–7 mm long.

Antenna. Pedicel with 3–4 setae. Flagellum with 13 flagellomeres and well developed or slightly reduced setae of plume; flagellomeres 1–4 and 13 with sensilla chaetica. Antennal ratio 1.0–4.2.

Head. Eye hairy, pubescent or naked, strongly extended dorsomedially. Temporal setae numerous, consisting of inner and outer verticals, postorbitals and sometimes orbitals; frontals absent. Tentorium swollen basally, with or without microtrichia. Cornua of cibarial pump with blunt and somewhat irregular tip. Palp with 5 palpomeres; palpomere 3 with sensilla capitata.

Thorax. Antepronotal lobes well developed, separated by wide V- shaped notch; dorsomedial and ventrolateral antepronotals present, or sometimes entire lobe covered with setae. Acrostichals long; dorsocentrals in 1–5 rows; prealars extending anterior to level of median anepistemum II, sometimes almost to parapsidal suture; scutellars multiserial.

Wing. Grayish or gray. Membrane with or without setae on apex. Anal lobe well developed and often protrude forward, angular or rounded. Costa moderately produced; R_{2+3} ending about midway between ends of R_1 and R_{4+5}; FCu proximal to MCu. R_{4+5} with or without setae. M_{1+2}, M_{3+4}, Cu_1 sometimes with setae. Squama with numeroue setae in 2–3 rows. Alula with or without setae.

Legs. Fore leg with or without pseudospurs; mid leg with pseudospurs on tarsomeres 1 and 2; hind leg with pseudospurs on tarsomere 1 and usually on tarsomere 2; sensilla chaetica absent or present on tarsomere 1 of hind leg. Tarsomere 4 cylindrical, equal to or slightly longer than tarsomere 5.

Hypopygium. Tergite IX with or without anal point. When anal point present it is narrow, without setae and with or without apical peg. Phallapodeme moderately sclerotized; aedeagal lobes rarely reduced, but usually moderately to strongly sclerotized; lateral or lateral and median aedeagal lobes present. Gonocoxite with well developed or small basal lobe; transverse sternapodeme broadly arched. Gonostylus with or without short megaseta, simple or with small basal lobe.

Subgenus *Pagastia* s. str.

***Pagastia* (*P.*) *subletteorum* Makarchenko, sp. nov.**
(Figs. 1–6, 19–20)
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Material. Holotype: adult male (slide number 3), Canada: British Columbia Province, St. Mary Lake, roughly 10 miles west of Kimberley (North of Cranbrook), 25.IX.[no year given], leg. C.B.D. Garrett. Paratypes: 7 adult males, same data as holotype.

Derivatio nominis. The species is named in honour and memory of the American chironomid taxonomists Mary F. and James E. Sublette.

Adult male (n = 2).

Total length 4.24 mm. Total length/wing length 1.25–1.31.

Coloration (specimens in Canada balsam). Head, thorax, legs, and abdomen brown to dark brown; antennae light brown; wings greyish.

Head. Eyes slightly pubescent and strongly extended dorsomedially. Temporal setae 29–34, including 4 coronals, 7 preoculars, 14–18 verticals, and 4–5 postorbitals. Clypeus with 17–20 setae. Antenna with 13 flagellomeres and slightly reduced plume, these setae 80–300 μm long; pedicel with 4–5 setae 32–40 μm long; terminal flagellomere with 1–2 subapical setae 54–60 μm long. AR 1.0–1.2. Palpomeres lengths (in μm): 40–48; 76–92; 160–164; 160–176; 260–284. Palpomere 3 in distal part with sensilla capitata (diameter 12–14 μm). Palpomeres 1–5 length/head width 0.82–1.19.

Thorax. Antepronotum with 7–8 dorsomedial and 11–12 ventrolateral setae. Acrostichals 19–20 (32–64 μm long), dorsocentrals 26–32 (in 1–2 rows), prealars 19–20, scutellars 35–36.

Wing. Length 3.24–3.40 mm; width 0.88–1.0 mm. Membrane with setae 32–48 μm long on wing apex. R and R_1 with *ca* 90–100 setae; R_{4+5} with *ca* 60–80 setae; M_{1+2} with 25–29 setae; M_{3+4} with 29–38 setae; Cu_1 with 28–30 setae. Setae on R, R_1, R_{4+5} 36–44 μm long, on other veins 28–36 μm long. Costa extension 80–108 μm long. RM length/MCu length 2.83–3.2. Anal lobe developed, outline angular. Squama with 32–36 setae 72–96 μm long, in 2 rows. Alula with 5 setae 40–64 μm long. VR 0.82–0.90.

Legs. Spur of fore tibia 52–64 μm long; spurs of mid tibia 52–56 μm; of hind tibia 76–88 μm and 52 μm long. Hind tibial comb with 14 setae. Lengths and proportions of leg segments as in Table 1.

TABLE 1. Lengths (in μm) and proportions of leg segments of *Pagastia* (*P.*) *subletteorum* **sp. nov.**, male (n=2)

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	1132–1181	1394–1410	984–1050	525–541	328–344	148–156	148
P_2	1230	1296–1312	574–607	361	230–246	115–131	148
P_3	1361–1394	1325–1788	886–902	476	295	148	164

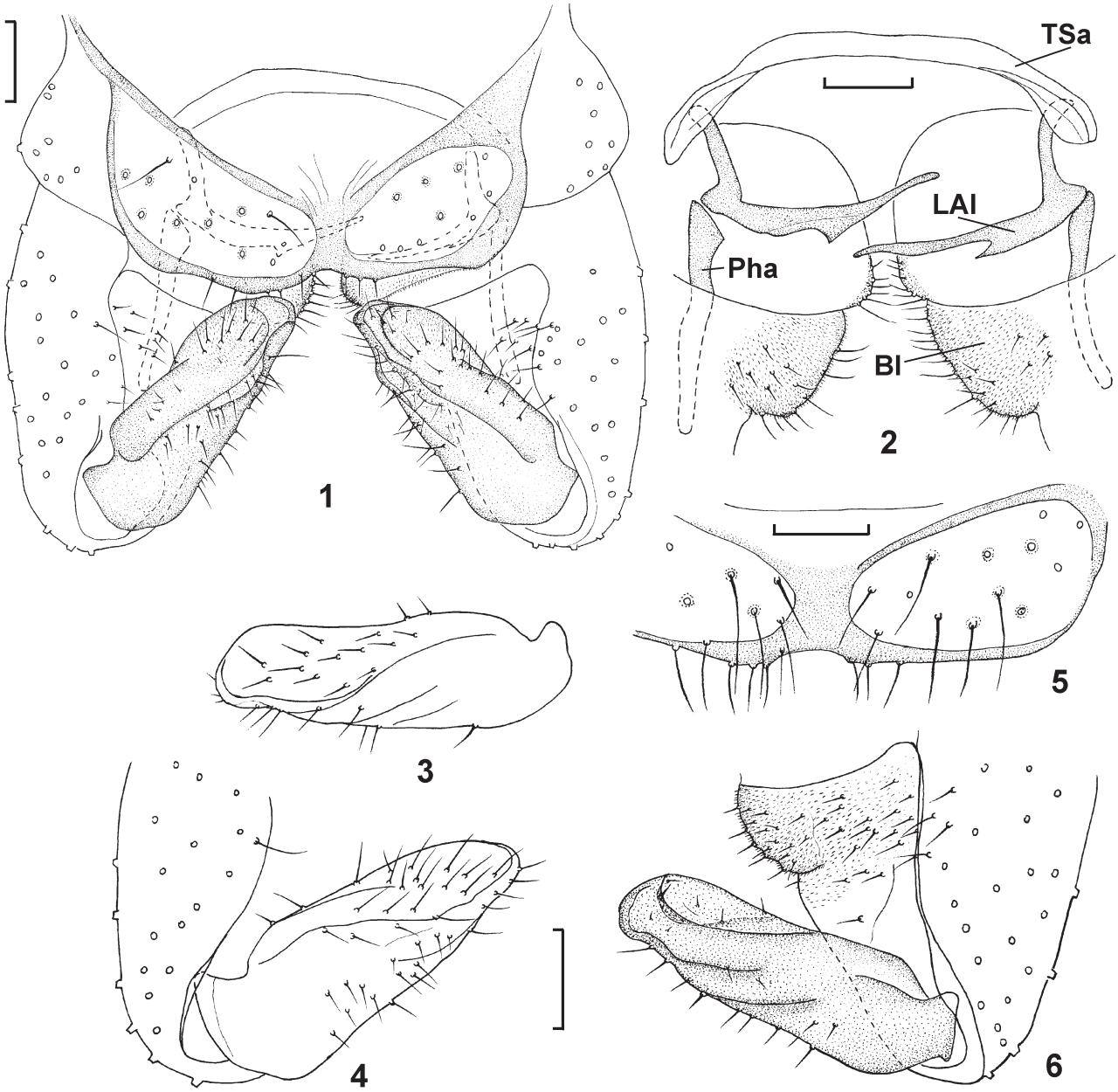
continued

	LR	BV	SV	BR
P_1	0.71–0.74	3.04–3.08	2.42–2.62	0.9–1.0
P_2	0.44–0.47	3.54–3.65	4.16–4.43	1.0–1.9
P_3	0.54–0.56	3.59	3.31–3.42	1.1

Hypopygium (Figs. 1–6, 19–20). Tergite IX without anal point, with 17–21 setae on one side. Laterosternite IX with 20–21 setae. Transverse sternapodeme 200–220 μm long. Phallapodeme 116–128 μm long. Median aedeagal lobe absent; lateral aedeagal lobe 124–128 μm long, with wide basal half and narrow distal portion with a sharply triangular projection on the outer edge. Gonocoxite 236–248 μm long. Gonostylus 164–168 μm long, rugose, scarcely widened in basal part, without megaseta. HR 1.44–1.48.

Pupa and ***larva*** unknown.

Diagnosis. The male of this new species differs from all known species by the absence of an anal point on tergite IX and by the presence of some setae on the alula, M_{1+2}, $M_{3+4,}$ and Cu_1 of the wing, as well as by the low antennal ratio of only 1.0–1.2. See also key below.



FIGURES 1–6. *Pagastia* (*P.*) *subletteorum* **sp. nov.**, male. **1,** hypopygium in dorsal view; **2,** inner structures of hypopygium; **3– 4,** gonostylus in various aspects; **5,** part of tergite IX; **6,** gonocoxite and gonostylus in dorsal view. **Bl**, basal lobe of gonocoxite; **LAl**, lateral aedeagal lobe; **Pha**, phallapodeme; **TSa**, transverse sternapodeme. Scale bars: 50 μm.

Pagastia (*P.*) *orthogonia* Oliver

(Figs. 7–13, 21, 26–32)

Pagastia orthogonia Oliver, 1959: 51; Makarchenko & Makarchenko 2000: 174; Endo 2004: 283; Caldwell 2007: 70; Ashe & O'Connor 2009: 296; Namayandeh & Culp 2016: 206; Namayandeh *et al.* 2016: 58.
Pagastia sp. A Oliver, Roussel 1982: 854.

Material. Holotype: 1 adult male, U.S.A.: Alaska, 163º W, Cold Bay, on tundra, 18.VIII.1952, leg. W.R. Mason, CNC no. 19627. Paratype: 1 adult male, U.S.A., Michigan, Epoufette, 15.V.1955, leg. J.R. Vockeroth. 1 adult male (reared), exuviae of pupa and larval skin, U.S.A., Wisconsin, 11 miles East, 4 miles South of Siren, Burnett County, cold stream (Spring Brook), 22.I.–28.II.1967, leg. D. Hansen, slide DH 69-182; 2 adult males, same location, light trap, 1–2.V.1968, leg. D. Hansen; 2 adult males, same location, 21.IX.1968, leg. D. Hansen; 7 larvae, same

location, Spring Brook, drift trap, 7–8.IX.2014, leg. D. Hansen; 13 larvae, same location, Spring Brook, 24.I.2016, leg. D. Hansen. 1 adult male, 16 pupal exuviae, U.S.A.: South Dakota, Lawrence County, 3 miles West, 10 miles South of Spearfish, Spearfish Creek, alt. 1585 m, 29.IX.1968, leg. D. Hansen. 7 pupal exuviae, U.S.A., Minnesota, Washington County, first order, summer-cool stream, Valley Creek, drift trap, 9–10.V.2015, leg. D. Hansen.

Adult male (n = 5).

Total length 3.8–5.3 mm. Total length/wing length 1.42–1.57.

Coloration. Head, thorax, legs, and abdomen brown to dark brown; antennae light brown or yellowish-brown; wings greyish.

Head. Eyes bare and extended dorsomedially. Temporal setae consisting of 4 coronals, 1–3 orbitals, 8–13 verticals, and 6–12 postorbitals. Clypeus with 11–21 setae. Antenna with 13 flagellomeres and a well developed plume; pedicel with 2 setae 52–60 μm long; terminal flagellomere with 1 subapical setae 20–60 μm long. AR 1.58–1.95. Palpomere lengths (in μm): 40–48; 80–92; 156–196; 148–188; 168–200. Distal part of palpomere 3 with sensilla capitata of 8–12 μm diameter. Palpomeres 1–5 length/head width 0.99–1.04.

Thorax. Antepronotum with 4–5 dorsomedial setae and 5–7 ventrolateral setae. Acrostichals 5–32 (40–68 μm long, in 1–2 rows), dorsocentrals 10–19 (in 1–2 rows), prealars 7–15, scutellars 11–29 (in 2–3 rows).

Wing. Length 2.48–3.60 mm; width 0.72–0.96 mm. Membrane usually without setae, very rarely with several setae near the tip of the wing. R with 16–24 setae, R_1 with 6–14 setae; R_{4+5} with 12–18 setae; other veins without setae. Costa extension 57–115 μm long. RM length/MCu length 2.0–2.2. Anal lobe developed, rounded and slightly protrude. Squama with 42–46 setae in 2–3 rows. Alula without setae. VR 0.90.

Legs. Spur of fore tibia 48–100 μm long; spurs of mid tibia 52–76 μm and 60–80 μm long; spurs of hind tibia 64–80 μm and 72–92 μm long. Hind tibial comb with 10–13 setae. Lengths and proportions of leg segments as in Table 2.

TABLE 2. Lengths (in μm) and proportions of leg segments of *Pagastia* (*P.*) *orthogonia* Oliver, male (n=5)

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	935–1263	1050–1542	836–1164	401–607	279–410	148–180	115–148
P_2	935–1312	951–1460	410–672	262–426	213–279	98–131	115–148
P_3	1017–1132	1197–1738	722–968	361–558	262–361	148–164	115–148

continued

	LR	BV	SV	BR
P_1	0.75–0.84	2.89–2.96	2.24–2.41	1.7–3.9
P_2	0.46–0.55	3.19–3.53	3.59–4.13	1.7–3.6
P_3	0.56–0.63	3.19–3.49	2.98–3.34	3.4–4.4

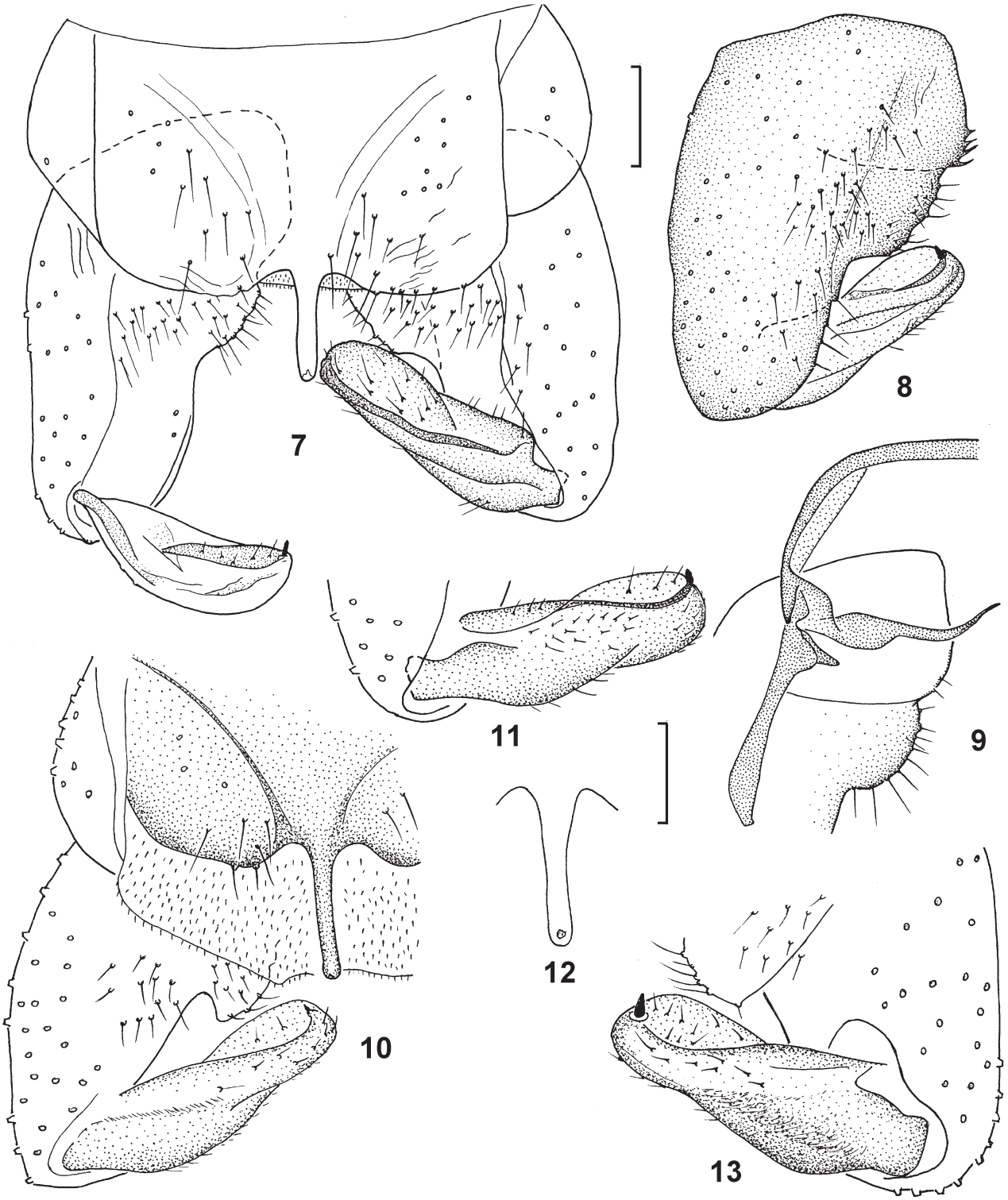
Hypopygium (Figs. 7–13, 21). Tergite IX with 16–26 setae on each side and with an anal point 70–100 μm long, parallel-sided, with rounded apex and sometimes with a pore in apical part (Fig. 12). Laterosternite IX with 7–14 setae. Transverse sternapodeme narrow, arcuate or trapezoidal, 204–252 μm long. Phallapodeme 116–148 μm long. Median aedeagal lobe absent; lateral aedeagal lobe 120–140 μm long. Gonocoxite 260–328 μm long. Gonostylus 168–188 μm long, with megaseta 12–20 μm long. HR 1.50–1.74.

Pupa (n=5). Total length 4.8–5.4 mm. Exuviae range from yellow to grayish to light brown.

Cephalothorax. Frontal apotome with 2 setae 252–260 μm long. Thorax granulated, with 4 dorsocentral setae; anterior Dc_1 and Dc_2 36–40 μm long, Dc_3 12 μm long, Dc_4 44 μm long. Distance between Dc_1 and Dc_2 76 μm; between Dc_2 and Dc_3 72 μm; between Dc_3 and Dc_4 300 μm. Antepronotum with 2 median setae 120–232 μm long and 1 lateral seta 156–168 μm long. Precorneal setae lengths (μm): Pc_1 120–160, Pc_2 168–220, Pc_3 160–188. Bases of the three precorneals form a triangle.

Abdomen. Tergite I without shagreen or with only very fine shagreen of pale spinules along posterior edge. Tergite II with easily visible fine shagreen in anterior ¼ and more extensive shagreen of larger spinules along posterior edge; middle part of tergite with very small and sparsely located spinules. Tergites III–VIII fully covered with shagreen of spinules which become larger near the posterior edge (Fig. 26). Spinules of the shagreen of tergites III–VII along posterior edge are directed anteriorly, and these spinules arise from dark spots (Figs. 27–28). Tergite IX with fine shagreen only anteriorly. Tergites I–VIII with 5 D setae, of which D_3 seta is the longest (116–148 μm)

and is split into 2–3 branches; very rarely the D_3 seta can be simple (Fig. 30). Sternites without shagreen. Segment I with 3 pairs of lateral setae, with L_1 simple, L_3 divided into 2 branches, and L_4 divided into 4–5 branches. Segments II–VIII with 4 pairs of lateral setae, most of which are divided into several branches (Figs. 31–32). Lateral setae of segment VII are located in posterior half (Fig. 27), lateral setae of segment VIII are located in posterior 1/3. More characteristics on abdominal lateral seta are provided in Table 3. Anal lobe 402–426 μm long, with triangular apical tubercle in apical part, and with 3 hair-like anal macrosetae 312–992 μm long and 1–2 simple median setae 64–76 μm long (Fig. 29). Male genital sac not or only slightly extending beyond anal lobe.



FIGURES 7–13. *Pagastia* (*P.*) *orthogonia* Oliver, males from Alaska (holotype) (7–9) and South Dakota (10–13). **7, 10,** hypopygium in dorsal view; **8,** gonocoxite and gonostylus in ventral view; **9,** inner structures of hypopygium; **11,** gonostylus; **12,** anal point; **13,** gonocoxite and gonostylus in dorsal view. Scale bars: 50 μm.

TABLE 3. Characteristics of abdominal lateral setae (L_1–L_4) of the pupa *Pagastia* (*P.*) *orthogonia* Oliver (n=5)

Segments	L_1		L_2		L_3		L_4	
	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm
I	1	48–64	–	–	2	88–104	4–5	100–120
II	1	64–80	2	92–100	1	40–44	2–5	100–112
III	1	60–64	1–3	72–80	1	48–52	4–5	92–100
IV	1	52–68	3–4	64–68	1	28–52	3–5	104–119
V	1–2	48–52	3–6	68–100	1	28–40	5–6	72–84
VI	1–8	60–100	5–6	60–64	1	40–44	5–8	68–72
VII	7–9	60–64	9–10	72–80	5–8	68–80	6–8	60–100
VIII	5	72	6–7	84–92	5–8	84–100	6–8	64–80

Larva was described by Oliver & Roussel (1982), Namayandeh & Culp (2016) and Namayandeh *et al.* (2016).

Remarks. *P. orthogonia* is closely related to the Palaearctic species *P.* (*P.*) *lanceolata* (Tokunaga). Males can be distinguished only by features given in the key below. Pupae and larvae of these two species cannot as yet be distinguished.

Distribution. Japan: Hokkaido; Russian Far East: Amur River basin (lower part); Canada: Nunavut, Prince Edward Island; U.S.A.: Alaska, Georgia, Michigan, Minnesota, North Carolina, North and South Dakota, Ohio, Tennessee, Wisconsin.

Pagastia (*P.*) *partica* (Roback)

(Figs. 14–17, 22–25, 33–38)

Syndiamesa partica Roback, 1957: 4.

Pagastia partica (Roback) Oliver 1959: 52; Oliver & Roussel 1982: 853; Makarchenko & Makarchenko 2000: 174; Ashe & O'Connor 2009: 296.

Material. 1 adult male, 16 pupal exuviae, U.S.A., South Dakota, Lawrence County, 3 miles West, 10 miles South of Spearfish, Spearfish Creek, alt. 1585 m, 29.IX.1968, leg. D. Hansen; 1 adult male, 1 pupa, 1 pupal exuviae, U.S.A., Washington, Yakima River, 26.III.1995, leg. V. Teslenko; 14 larvae, U.S.A., Wyoming, Park County, Beartooth Pass region, small stream feeding Frozen Lake, alt. 3133 m, 11.IX.2002, leg. D. Hansen.

Adult male (n = 2).

Total length 5.6–6.1 mm. Total length/wing length 1.20–1.33.

Coloration. Head, thorax, legs and abdomen brown to dark brown; antennae light brown; wings greyish.

Head. Eyes bare and extended dorsomedially. Temporal setae consisting of 4 coronals, 5 preoculars, 12–14 verticals, and 3–4 postorbitals. Clypeus with 23–40 setae. Antenna with 13 flagellomeres and a well developed plume; pedicel with 1 seta 32–40 μm long; terminal flagellomere with 1–2 subapical setae 36–56 μm long. AR 2.35–3.40. Palpomere lengths (in μm): 60; 129–152; 256–260; 220–276; 208–268. Distal part of palpomere 3 with sensilla capitata 12 μm in diameter. Palpomeres 1–5 length/head width 1.04–1.19.

Thorax. Antepronotum completely covered with 40–63 setae. Acrostichals 14–16 (40–54 μm long, in 1–2 rows), dorsocentrals 26–27 (in 1–2 rows), prealars 31, scutellars ~ 45.

Wing. Length 4.2–5.1 mm; width 1.04–1.2 mm. Membrane without setae. R and R_1 with 32–33 setae; R_{4+5} with 16–18 setae; other veins without setae. Costa extension 115–123 μm long. RM length/MCu length 3.1–3.3. Anal lobe developed, protrudes forward. Squama with ~ 40 setae in 2 rows. Alula without setae. VR 0.89–0.91.

Legs. Spur of fore tibia 96–136 μm long; spurs of mid tibia 60–92 μm and 68–92 μm long; spurs of hind tibia 100–136 μm and 76–92 μm long. Hind tibial comb with 13–14 setae. Lengths and proportions of leg segments as in Table 4.

TABLE 4. Lengths (in μm) and proportions of leg segments of *Pagastia* (*P.*) *partica* (Roback), male (n=2)

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	1427–1600	1607–2000	1230–1320	705–840	459–520	246–280	197–240
P_2	1542–1800	1624–1640	795–880	525–560	328–400	180–240	164–200
P_3	1720–1920	2000–2120	1160–1200	640–760	420–440	220–280	220–240

continued

	LR	BV	SV	BR
P_1	0.66–0.77	2.65–3.51	2.47–2.73	3.0–4.0
P_2	0.43–0.54	3.09–3.31	3.91–3.98	2.5–2.8
P_3	0.57–0.58	3.05–3.25	3.21–3.37	4.3–5.0

Hypopygium (Figs. 14–17, 22–25). Tergite IX with 19–25 setae on each side and with an anal point 132–140 μm long apically with peg 36–38 μm long (Fig. 24). Laterosternite IX with 9–11 setae. Transverse sternapodeme 336–340 μm long. Phallapodeme 152–172 μm long. Median aedeagal lobe 144–180 μm long, widest medially, then tapering abruptly and with the apex forming a sharp hook; lateral aedeagal lobe 168–188 μm long (Figs. 16–17). Gonocoxite 340–400 μm long. Gonostylus 248–280 μm long, with megaseta 10–12 μm long. HR 1.35–1.43.

Pupa (n=5). Total length 6.0–7.1 mm Exuviae yellowish-brown or light brown.

Cephalothorax. Frontal apotome with 2 setae 276–308 μm long. Thorax granulated, with 4 dorsocentral setae: Dc_1 20–44 μm long, divided into 3–7 branches (Fig. 34); Dc_2 52–60 μm long, simple; Dc_3 20–28 μm long, divided into 2–3 branches (Fig. 35); Dc_4 52–58 μm long, simple. Distance between Dc_1 and Dc_2 68–88 μm; between Dc_2 and Dc_3 56–88 μm; between Dc_3 and Dc_4 380–448 μm. Antepronotum with 2 median setae 304–356 μm long and 1 lateral seta 208–264 μm long. Precorneal setae lengths (μm): Pc_1 160–284, Pc_2 348–360, Pc_3 196–210. Bases of the three precorneals usually form a triangle but in some cases form a nearly straight line.

TABLE 5. Characteristics of abdominal lateral setae (L_1–L_4) of the pupa *Pagastia* (*P.*) *partica* (Roback) (n=5)

Segments	L_1		L_2		L_3		L_4	
	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm	Number of seta branches	Maximum length of seta, μm
I	1	116–120	–	–	–	–	2–3	120–124
II	1	108–128	1	52–60	1	40–44	2–3	100–124
III	1	104–108	1	50–56	1	28–52	2	112–120
IV	1	84–140	1	56–60	1	24–28	2	116–128
V	1	84–116	1	28–60	1	40–52	1–4	108–120
VI	1–2	80–108	1	44–52	1	36–56	2–4	112–116
VII	8–10	48–84	10	80–84	6–7	100–104	8–10	84–112
VIII	8	84–196	8–10	88–92	7	104–108	6–7	92–100

Abdomen. Tergite I with fine shagreen of spinules posteriorly. Tergites II–VI with shagreen of spinules in anterior, middle and posterior areas but without shagreen laterally (Fig. 33). Tergites VII–VIII fully covered with shagreen of spinules but shagreen becomes finer in lateral areas (Fig. 36). Tergite IX with fine shagreen only anteriorly. Spinules of shagreen of tergites III–VII along posterior edge are directed anteriorly and are stronger than those of remainder of tergites. Tergites I–VII with 5 D setae, with D_3 seta longest (120–192 μm) and in most cases simple, only occasionally divided into 2 branches. Sternites without shagreen. Segment I with 2 pairs of lateral setae, with L_1 simple and L_4 divided into 2–3 branches. Segments II–VIII with 4 pairs of lateral setae, these setae on more posterior segments are divided into two (Fig. 38) to several branches (Figs. 37, 39). Lateral setae of segment VII are located in posterior half, lateral setae of segment VIII are located in posterior 1/3 (Fig. 36). More detailed characteristics on abdominal lateral seta are provided in Table 5. Anal lobe 607–689 μm long, with triangular apical tubercle, with 3 hair-like anal macrosetae 410–492 μm long and 1 median setae 6–80 μm long, this divided into 3–4 branches (Fig. 40). Male genital sac not or only slightly extending beyond anal lobe.

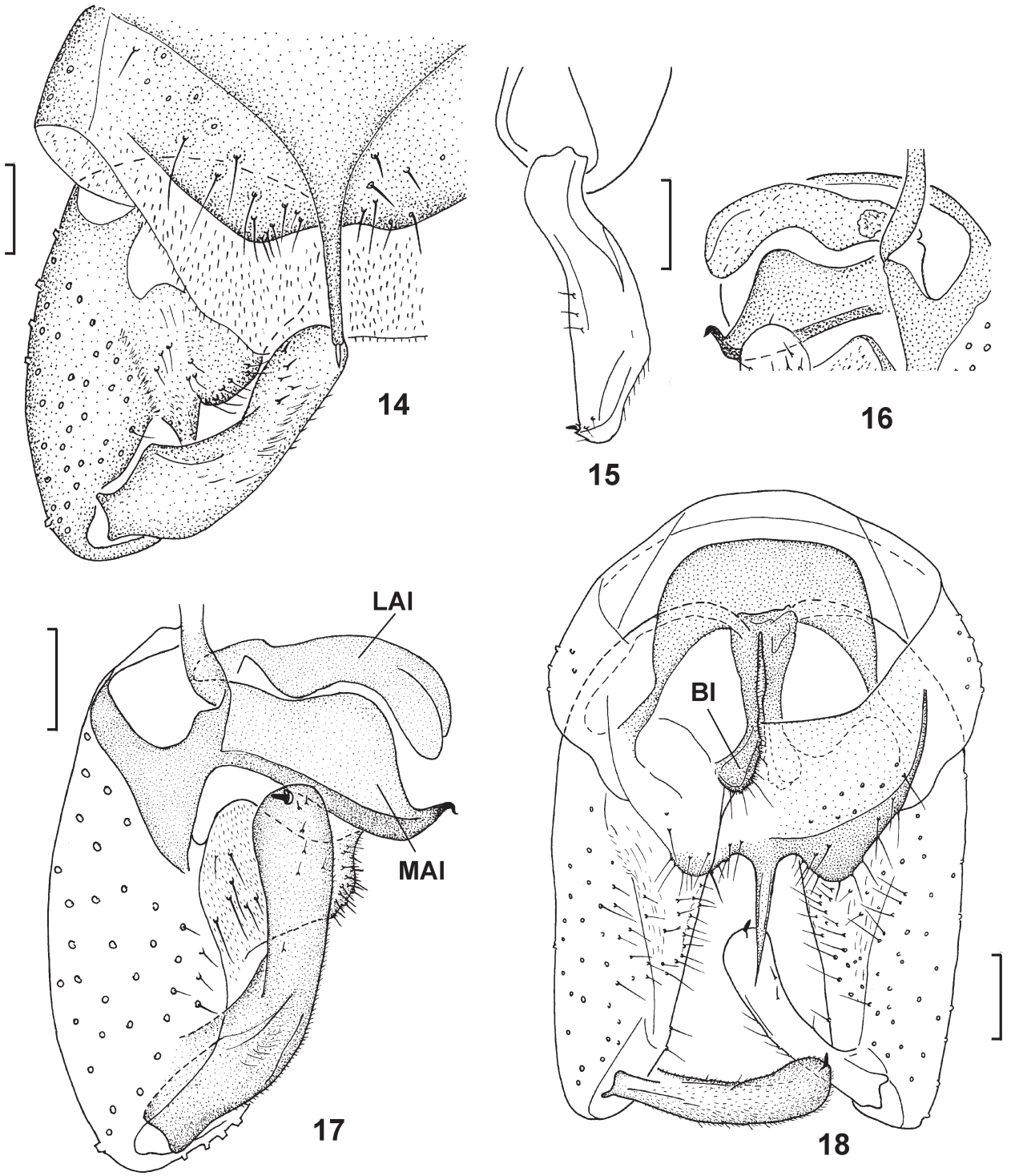
Larva in detail was described by Oliver & Roussel (1982).

Remarks. Pupae and larvae cannot be distinguished from *P. nivis* (Tokunaga) based on the present information.

Distribution. Canada (Yukon Territory), U.S.A. (Alaska, Utah, Wyoming, South Dakota, Washington).

Subgenus *Hesperodiamesa* Sublette

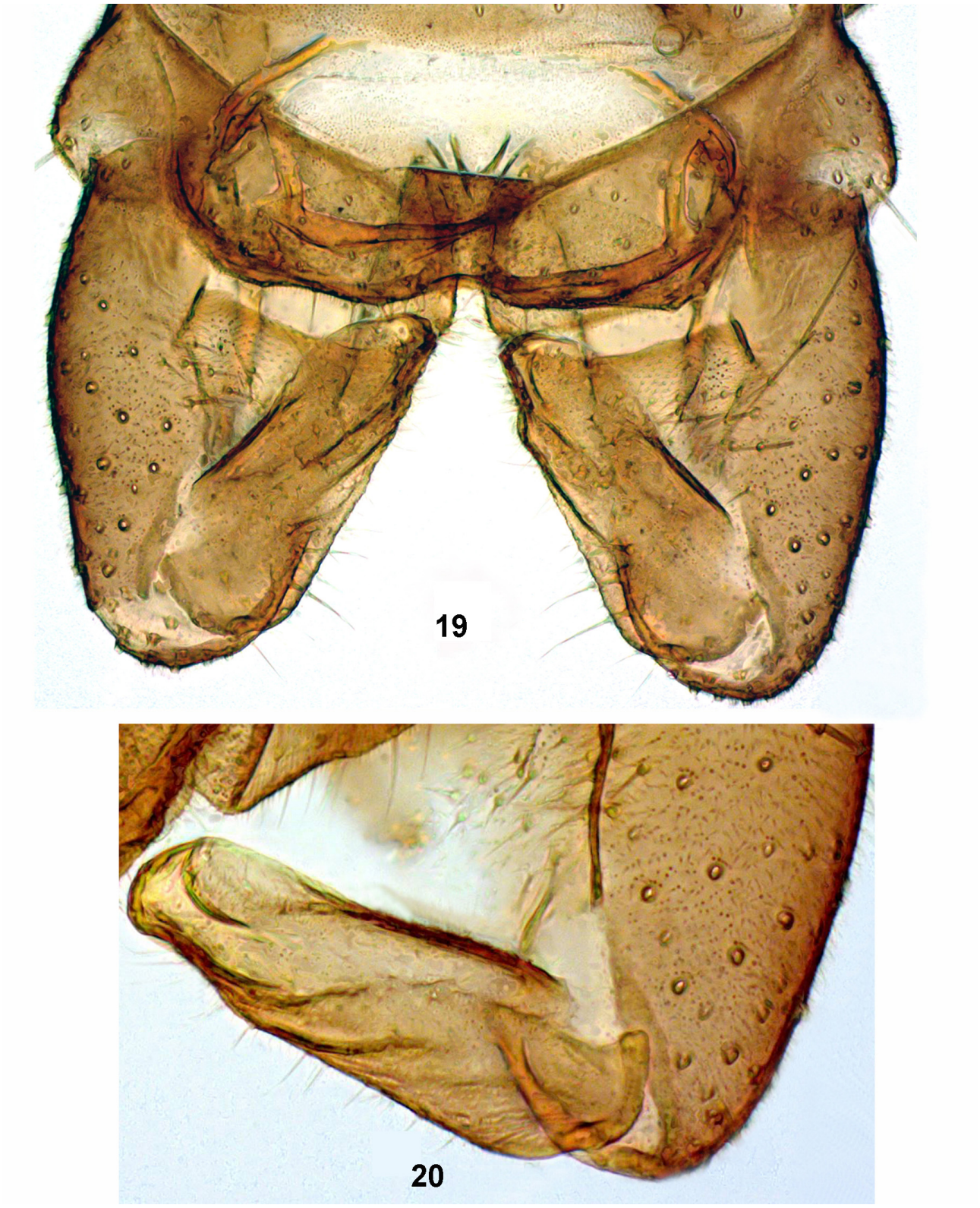
Hesperodiamesa Sublette, 1967: 305 (as genus).



FIGURES 14–18. *Pagastia* (*P.*) *partica* (Roback) (14–17) and *P.* (*H.*) *sequax* (Garrett) (lectotype) (18), males. **14, 18,** hypopygium in dorsal view; **15,** gonostylus; **16,** aedeagal lobes; **17,** part of hypopygium without tergite IX. **MAl**, median aedeagal lobe. Scale bars: 50 μm.

***Pagastia* (*H.*) *sequax* (Garrett)**
(Fig. 18)

Prodiamesa sequax Garrett, 1925: 7.
Hesperodiamesa sequax (Garrett); Sublette, 1967: 305.
Pagastia sequax (Garrett); Serra-Tosio, 1971: 80–81; Serra-Tosio, 1976: 136; Oliver, Roussel, 1982: 853; Makarchenko & Makarchenko 2000: 173.



FIGURES 19–20. *Pagastia* (*P.*) *subletteorum* **sp. nov.**, male. **19,** hypopygium in dorsal view; **20,** gonostylus.

Material. Lectotype (CNC 7919. slide number 1): adult male, Canada, British Columbia Province, Cranbrook, 1.VI.1924, leg. C.B.D. Garrett.

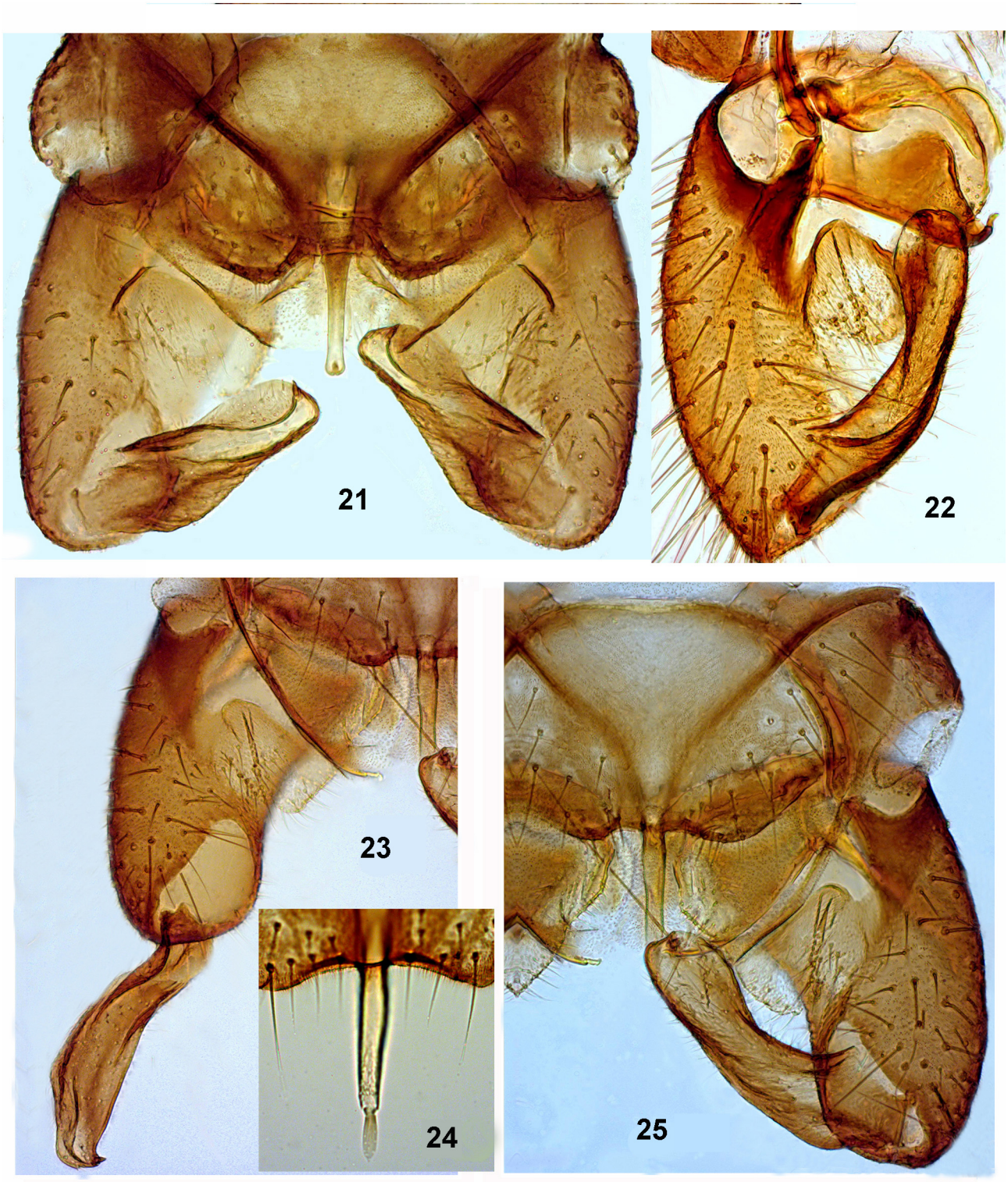
Adult male (n = 1).

Total length ~ 4 mm.

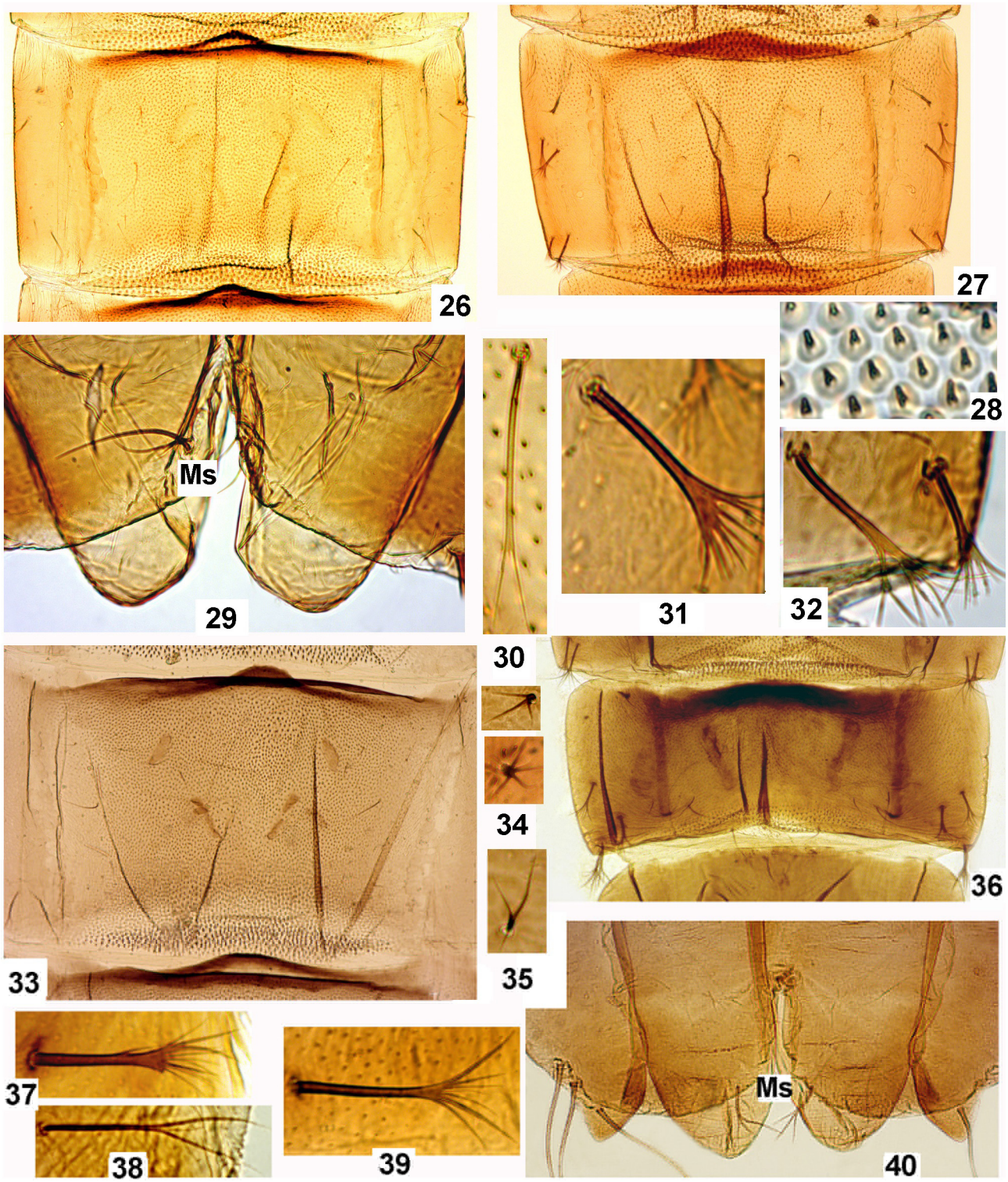
Coloration. Dark brown, blackish.

Head. Eyes hairy and slightly extended dorsomedially. Clypeus with 11 setae. Antennae and palps missing.

Thorax. Antepronotum with 5 dorsomedial and 4–6 ventrolateral setae. Acrostichals present but not clearly visible, dorsocentrals ~ 20 (in 2 rows), prealars 17, scutellars ~ 65.



FIGURES 21–25. *Pagastia* (*P.*) *orthogonia* Oliver from South Dakota (21) and *P.* (*P.*) *partica* (Roback) (22–25), males. **21, 23, 25,** hypopygium in dorsal view; **22,** part of hypopygium without tergite IX; **24,** anal point.



FIGURES 26–40. *Pagastia* (*P.*) *orthogonia* Oliver (26–32) and *P.* (*P.*) *partica* (Roback) (33–40), pupae. **26, 33,** tergite IV; **27,** tergite VII; **28,** spinules of posterior shagreen of tergite IV; **29, 40,** male genital sacs and apex of anal lobes with median setae; **30,** D_3 seta of tergite IV; **31,** L_2 seta of segment VII; **32,** L_3–L_4 setae of segment VIII; **34,** Dc_1 setae of thorax; **35,** Dc_3 seta of thorax; **36,** tergite VIII; **37,** L_1 seta of segment VIII; **38,** L_4 seta of segment IV; **39,** L_2 seta of segment VIII. **Ms**, median setae of anal lobes.

Wings and all tarsi of legs missing.

Hypopygium elongated (Fig. 18). Tergite IX with 23 setae on each side and with a narrow anal point 95.7 µm long, pointed and without apical peg. Laterosternite IX with 8 setae. Transverse sternapodeme 232 µm long. Aedea-

gal lobes reduced. Gonocoxite very long, reaching 508 μm; basal lobe small. Gonostylus 213 μm long, narrowest basally, gradually expanding apically, with megaseta 9 μm long. HR 2.38.

Pupa. Oliver & Roussel (1982) recorded that pupae exuviae, collected by Dr. D.R. Oliver in Alberta (Highwood Pass), were passed to Dr. W.P. Coffman for description. This description, however, was never published.

Larva described by Oliver & Roussel (1982).

Remarks. A rare, at least in collections, and insufficiently studied species. Obviously more specimens, of all three life stages, are sorely needed.

Distribution. Canada: British Columbia, Alberta.

Key to the known species of *Pagastia* Oliver of Holarctic region

Males

1. Eyes hairy. Aedeagal lobes reduced (subgenus *Hesperodiamesa* Sublette). Basal lobe of gonocoxite small. . . . . *P.*(*H.*) *sequax* (Garrett, 1925) (Fig. 18)
- Eyes bare or pubescent. One or two aedeagal lobes present (subgenus *Pagastia* Oliver). Basal lobe of gonocoxite large 2
2. Both median and lateral aedeagal lobes present. AR 2.5-4.2. 3
- Only lateral aedeagal lobe present. AR 1.0–2.42 6
3. Antepronotum with dorsal and lateral setae in widely separated groups. Median aedeagal lobe digitated and widest in distal part 4
- Antepronotum completely covered with setae. Median aedeagal lobe widest medially, then tapering abruptly and with the apex forming a sharp hook . . . . . *P.* (*Pagastia*) *partica* (Roback, 1957) (Figs.16–17)
4. Gonostylus subapical with "heel". . . . . *P.* (*P.*) *nivis* (Tokunaga, 1936) (Makarchenko 2006, Fig. 180, 5–10)
- Gonostylus subapical without "heel" 5
5. Apex of the gonostylus is angled . . . . . *P.* (*P.*) *orientalis* (Tshernovskij, 1949) (Makarchenko 2006, Fig. 181, 1–5)
- Apex of the gonostylus is broadly rounded . . . . . *P.* (*P.*) *altaica* Makarchenko, Kerkis et Ivanchenko, 1997 (Makarchenko *et al.* 1997, Fig. 1)
6. Anal point absent. AR 1.0–1.2. Alula of wing with some setae. . . . . *P.* (*P.*) *subletteorum* **sp. nov.** (Figs. 1–6, 19–20)
- Anal point present. AR 1.54–2.42. Alula without setae. 7
7. Anal point almost parallel-sided in dorsal view; lateral aedeagal lobe tapering to thin apex 8
- Anal point tapering to apex; lateral aedeagal lobe wide in distal part 9
8. Anal point with rounded apex and without apical peg. . . . . *P.* (*P.*) *orthogonia* Oliver, 1959 (Figs. 7–13, 21)
- Anal point with pointed apical peg. AR 1,56–1.75 . . . . . *P.* (*P.*) *hidakamontana* Endo, 2004 (Endo 2004, Figs. 1–6)
9. Anal point narrow, tapering to pointed apex, without apical peg; gonostylus in basal part with outer angle-shaped projection. AR 2.18–2.42 . . . . . *P.* (*P.*) *tianmumontana* Makarchenko *et* Wang, 2017 (Makarchenko &Wang 2017, Figs. 17)
- Anal point widest in basal part and thin apically, pointed and often with apical peg; gonostylus without outer basal projection. AR 1.81–2.10 . . . . . *P.* (*P.*) *lanceolata* (Tokunaga, 1936) (Makarchenko 2006, Fig. 180, 1–4)

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