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The description of immature stages of *Linevitshia* Makarchenko and *Sasayusurika* Makarchenko (Diptera, Chironomidae, Diamesinae), with some remarks on taxonomy and systematics of these genera

Описание преимагинальных стадий развития *Linevitshia* Makarchenko и *Sasayusurika* Makarchenko (Diptera, Chironomidae, Diamesinae) с замечаниями по таксономии и систематике этих родов

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Key words: Diptera, Chironomidae, Diamesinae, *Linevitshia*, *Sasayusurika*, immature stages, taxonomy, Japan.

Ключевые слова: Diptera, Chironomidae, Diamesinae, *Linevitshia*, *Sasayusurika*, преимагинальные стадии, таксономия, Япония.

Abstract. Diagnoses of *Linevitshia* Makarchenko and *Sasayusurika* Makarchenko are emended and after investigation of immature stages are added. Type species *Sasayusurika aenigmata* Makarchenko, 1993, is synonymized with *S. nigatana* (Tokunaga, 1936), **comb. nov.** Descriptions of pupae for *L. yezoensis* Endo and *S. nigatana* (Tokunaga), and description of larva for *S. nigatana* by materials from Japan are adduced for the first time. After receiving of a new data on features of pupae and larva relationships of *Linevitshia* and *Sasayusurika* with other members of Diamesinae subfamily are discussed.

Резюме. Уточнены и после изучения преимагинальных стадий развития расширены диагнозы родов *Linevitshia* Makarchenko и *Sasayusurika* Makarchenko. Типовой вид рода *Sasayusurika aenigmata* Makarchenko, 1993 сведён в синоним к *S. nigatana* (Tokunaga, 1936), **comb. nov.** Впервые приведены описания куколок *L. yezoensis* Endo и *S. nigatana* (Tokunaga), а также личинки *S. nigatana* по материалам из Японии. На основании новых данных, полученных в процессе изучения куколок и личинки, обсуждаются возможные родственные связи родов *Linevitshi*a и *Sasyusurika* с другими представителями подсемейства Diamesinae.

Introduction

The genus *Linevitshia* Makarchenko was established with the description of *L. prima* Makarchenko by male imagines from Primorye Territory of the Russian Far East [Makarchenko, 1987]. Makarchenko placed *Linevitshia* in the subfamily Podonominae, partly because vein R_{2+3} seemed to be missing in the original specimens that had just emerged from the pupal exuviae before capture. However, Endo later collected in Hokkaido similar midges in which R_{2+3} is distinct, described second species *L. yezoensis* Endo by male and female and was reconsidered the placement of *Linevitshia* in the light of a new morphological evidence in the subfamily Diamesinae [Endo et al., 2007]. Authors of this paper recorded about similarity of *Linevitshia* by some features of thorax and wing to *Protanypus* Kieffer but was anticipated new evidence coming from immature stages of this genus and hopefully from emerging DNA studies on the phylogeny of Chironomidae. Similar situation was with determination of systematic position of the monotypical genus *Sasayusurika* which was described from two males of *S. aenigmata* collected in Nikko National Park on the Honhu, Japan [Makarchenko, 1993]. Later, Willassen [2007] redescribed this species by male and for the first time described female from the Indian Himalaya, and emended generic diagnosis. This author noted that the genus cannot easy be absorbed into one of the already named northern tribes of Diamesinae. The closest candidate may be Diamesini but some features of female may be similar to *Paraheptagyia* Brundin and *Archaeochlus* Brundin. And as result of his discussion was also recommendation for understanding of Diamesinae systematics to study molecular data and immature stages of *Sasayusurika* [Willassen, 2007].

Here we describe pupae of *Linevitshia yezoensis* Endo and *Sasayusurika nigatana* (Tokunaga), and also larva of *S. nigatana*, add the generic diagnosis and discuss about similarities of both genera with some other members of Diamesinae but not include these rare and unique genera in any known tribes and not erect new tribes for these ones. We believe for this purpose we need additional molecular data which will get in near future Dr. E. Willassen. After that we hope to find worthy place for *Linevitshia* and *Sasyusurika* in Diamesinae system.

Material and methods

Pupae and larvae were fixed in 70 % ethanol. The specimens were mounted in either Euparal or Fora-Berleze solutions. The morphological nomenclature follows Sæther [1980].

Material is deposited in the Institute of Biology and Soil Sciences, Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia (IBSS FEBRAS) and in the Laboratory of Entomology, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido, Japan (LEOU).

Linevitshia Makarchenko, 1987

Linevitshia Makarchenko, 1987: 205, ♂; Brundin, 1989: 27, Fig. 4.3, ♂; Sæther et al., 2000: 134, Fig. 144, ♂.

Type species**:** *Linevitshia prima* Makarchenko, 1987, by original designation.

Other included species: *Linevitshia yezoensis* Endo, 2007.

Diagnosis (emended). **Male imagines.** Small sized. Antenna with 13 flagellomeres. AR about 1. Eyes reniform, bare. Clypeus without setae. Antepronotum with U-shaped notch in frontal view. Antepronotals are in separate median and lateral clusters, the acrostichal and dorsocentral stripes are connected posteriorly. Posterior anepisternum II and epimeron II with setae. Wing with setae on squama, alula and R, R_1, R_{4+5}; membrane without macrotrichia; R_{2+3} weak, but distinct; costa extends beyond R_{4+5}. Tergite IX without anal point. Gonocoxite simple, inferior and superioe volsellae reduced. Sternapodeme broadly arched; phallapodeme long; aedeagal lobe large, forked distally. Gonostylus in distal part with long and strong setae and apical megasetae.

Female imagines. Antenna with 6 flagellomeres. AR about 0.5. Clypeus without setae. Antepronotum with dorsal and lateral setae. Posterior anepisternum II and epimeron II with setae. Costa produced well beyond R_{4+5}. R_{2+3} occasionally faint but usually distinct from base to margin of costa. Alula and squama with setae. Gonapophyses VIII jointed mesally to form a «floor» at the anterior of genital chamber, caudolaterally with narrow flap covering base of ventrolateral lobe and gonocoxite. Seminal capsules surface with weak granulation. Gonocoxite IX broad and rounded. Tergite IX undivided. Segment X long, devoid of setae. Postgenital plate present. Cerci small.

Pupa. Small sized. Exuviae yellow or brownish-yellow.

Cephalothorax. Frontal short hair-like setae present on frontal apotome. Frontal apotome slightly granulated or smooth, without tubercles or warts. Antepronotum with 3 median and 2 lateral antepronotals. Thoracic horn absent. Four precorneals present.

Abdomen. Tergites and sternites I–VIII with slender shagreen which more visible in lateral parts. Tergites III–VII and sternites III–VII with posterior transverse row of large and more dark thorn-like spines; size of these spines on tergites and sternites subequal. Tergite VIII also with posterior row but small spines. Posterior margin of sternite VIII with long, triangular, apically rounded caudal lobe (male) or with 2 long, small rounded caudal lobes (female). Abdominal setation: Tergites I–VII with 5 D setae, some setae moved to lateral part; VIII with 2 D setae. Segments I with 2 L setae, II–VIII with 4 L setae. Sometimes dorsal and lateral setae are very difficult separated.

Anal lobe with 3 strong needle-shaped anal macrosetae and two very short and hair-like lateral setae which sometimes not so good visible; median setae and apical tubercle absent. Male genital sac not extended beyond anal lobe.

Larva unknown.

Linevitshia yezoensis Endo, 2007

Figs 1–14.

Linevitshia yezoensis Endo in Endo, Makarchenko et Willassen, 2007: 93, Figs 1–4, 7–13.

Material examined. 3 pupae, 4 pupae exuviae, Nuppuku River, Taisho, Obihiro, Hokkaido, Japan, 12.X.2005, drift net, leg. K. Endo.

Description. **Male.** Description is presented by Endo et al. [2007].

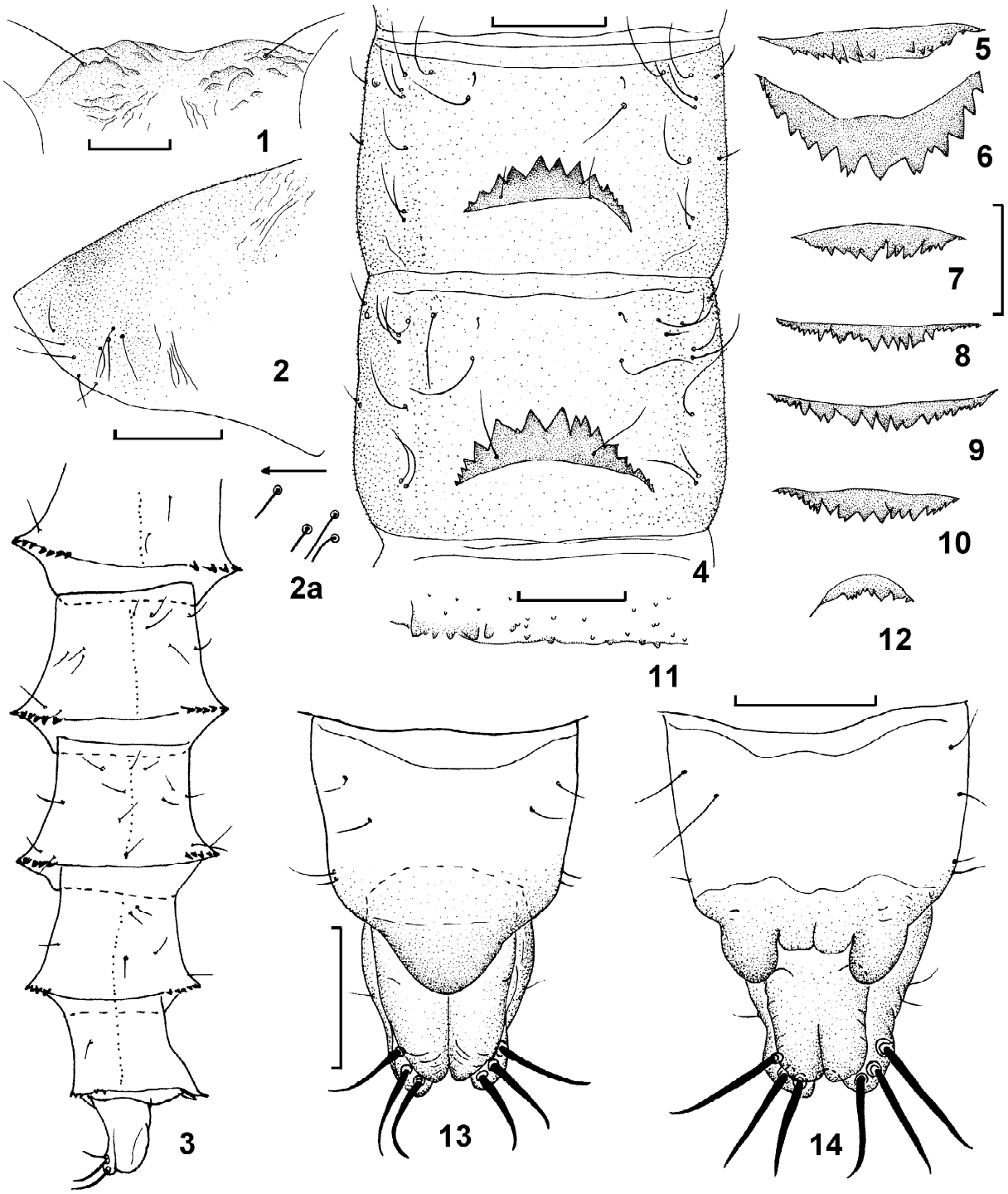
Pupa (n=5). Total length 3.5–4.5 mm. Coloration brown or dark brown. Exuviae yellow or brownish-yellow.

Cephalothorax. Frontal apotoma with 2 setae 56–60 μm long (Fig. 1). Thorax granulated in anterodorsal part and smooth in middle and posteriodorsal parts (Fig. 2). Precorneal setae lengths (μm): Pc_1 — 84–96, Pc_2 — 100–116, Pc_3 — 100–108, Pc_4 — 84–104. Base of three precorneals make up triangle and distance between fourth precorneal seta and nearest precorneals 20–28 μm (Fig. 2a). Antepronotum with 3 median and 2 lateral antepronotals (Fig. 2). Dorsocentrals 2, metanotals 2–3, supraalars 2.

Abdomen. Tergites and sternites I–VIII with slender shagreen which more visible in lateral parts. Tergites I–II without posterior transverse row of large and thorn-like spines, but tergite II very often with posterior striae or row of 8–25 small spines; size of these spines is little more than size of shagreen spines (Fig. 11). Tergites and sterites III–VII with posterior transverse row of large and more dark thorn-like spines (Fig. 3). Number of these spines on tergites III–VII accordingly — 21–28 : 21–25 : 26–28 : 26–28 : 23–24 (Fig. 4). Tergite VIII also with posterior row of 10–14 but small spines (Fig. 12). Number of thorn-like spines on sternites III–VII accordingly — 21–26 : 22–23 : 18–23 : 18–25 : 22–25 (Figs 5–10). Size of spines on tergites and sternites subequal. Posterior margin of sternite VIII with caudal lobe 148–168 μm long and 328–336 μm wide (male) (Fig. 13) or with 2 small caudal lobes 88 μm long and 160–164 μm wide (female) (Fig. 14). Segment I with 2 pairs of lateral setae 56–88 μm long. Segments II–VIII with 4 pairs of lateral setae 56–120 μm long. Dorsal setae length 68–128 μm. Anal lobe with 2 short lateral setae 44–52 μm long and with 3 strong and straight (sometimes slightly curved in distal part), needle-shaped anal macrosetae 112–168 μm long (Figs 13–14).

Distribution. Known only from type locality — Hokkaido Island, Japan.

Comments. In our previous paper on systematics of *Linevitshia* [Endo et al., 2007] we reported that «placement of this genus in Diamesinae must be regarded as provisional because the immature stages are as yet unknown and pupal and larval character states are important in the present un-



Figs 1–14. Pupa of *Linevitshia yezoensis* Endo: 1 — frontal apotoma; 2 — anterior part of thorax; 2a — precorneal setae; 3 — segments IV–VIII and anal segment, from one side; 4 — tergites III–IV; 5 — posterior transverse row of sternite III, male; 6 — the same of sternite IV, male; 7 — the same of sternite VII, male; 8 — the same of sternite III, female ; 9 — the same of sternite IV, female; 10 — the same of sternite VII female; 11 — the same of tergite II, male; 12 — the same of tergite VIII, male; 13 — sternite VIII and anal segment from above, male; 14 — sternite VIII and anal segment from above, female. Scale bars are as follows: Fig. 1 — 50 μm, Figs 2–14 — 200 μm.

Рис. 1–14. Куколка *Linevitshia yezoensis* Endo: 1 — фронтальная апотома; 2 — передняя часть груди; 2а — прекорнеальные щетинки; 3 — сегменты IV–VIII и анальный сегмент, сбоку; 4 — тергиты III–IV; 5 — шипы заднего ряда стернита III самца; 6 — то же, стернита IV самца; 7 — то же, стернита VII самца; 8 — то же, стернита III самки; 9 — то же, стернита IV самки; 10 — то же, стернита VII самки; 11 — то же, тергита II самца; 12 — шипы заднего ряда тергита VIII; 13 — стернит VIII и анальный сегмент самца снизу; 14 — стернит VIII и анальный сегмент самки снизу. Масштабные линейки для рис. 1 — 50 мкм, рис. 2–14 — 200 мкм.

derstanding of chironomid systematics». It is truth and investigation of pupal characters of *L. yezoensis* is demonstrated that placement of *Linevitshia* in Diamesinae is competence. Some features of pupae, namely presence of posterior rows of large spines on tergites and sternites III–VII, are the same as in genera *Diamesa* and *Syndiamesa*, and the existence on sternite VIII of caudal lobe (male) or 2 small caudal lobes (female) is the same as in *Protanypus* Kieffer. We did not find any features which are typical for subfamilies Podonominae or Tanypodinae. Availability of four precorneals, presence of 2 short hair-like lateral setae on anal lobe, finding of posterior rows of large spines on tergites and sternites in complex with presence of caudal lobe (lobes) on sternite VII are specific for genus *Linevitshia* and did not record for other genera and known tribes of Diamesinae.

Sasayusurika Makarchenko, 1993

Sasayusurika Makarchenko, 1993: 118, ♂; Sæther et al., 2000: 149, Fig. 216, ♂; Willassen, 2007: 315, ♂.

Type species**:** *Sasayusurika aenigmata* Makarchenko, 1993 = *Diamesa* (*Psilodiamesa*) *nigatana* Tokunaga, 1936, by original designation and monotypy.

Diagnosis (emended). Diagnostic characters of the genus for the male and female are presented by Makarchenko [1993] and Willassen [2007].

Pupa. Medium sized. Exuviae brownish-grey or brown.

Cephalothorax. Frontal apotome without setae but with pair of low tubercles. Antepronotum with 1 median and 1 lateral antepronotals. Dorsocentrals reduced. Thoracic horn candle-shaped and consists of two parts: basal part large and wide, not sclerotizated and semitransparent, apical part short, well sclerotizated and finger-shaped. Three precorneals present.

Abdomen. Tergites and sternites I–VIII and anal lobes uniformly covered by shagreen of small spinules. Tergites and sternites without posterior transverse row of large spines.

Segment I with 2 pairs of short hair-like lateral setae; segments II–VIII with 4 pairs of short hair-like lateral setae. Dorsal muscle marks bare. Anal lobe with 3 strong and long anal macrosetae which situated in anal-lateral angles of lobe and in distal part declinated; median setae and apical tubercle absent. Male genital sac extended beyond anal lobe, female genital sac not reaching apex of lobe.

Larva. Large sized, up to 10.7 mm.

Antenna. With 5 segments; 3rd annulated segment at least in 3 times longer than 2nd, 4th and 5th segments very short. Style less than 1/3 length of segment 3.

Labrum. $S_{I–IV}$ setae simple and seta-like. Pair of labral lamellae narrow and long. Pecten epipharyngis consisting of 5 long rounded scales. Premandible wide in distal part, with 1 tooth and simple lateral spine.

Mandible. Apical tooth shorter than combined width of 4 inner teeth. Seta subdentalis narrow and long. Seta interna absent. In outer margin in middle part situated small sensilla.

Mentum. With 1 median and 6 pairs of lateral teeth; median tooth in 4 times as wide as first lateral tooth; median tooth little lighter in color than dark brown lateral teeth. Ventromental plate elongate and narrow. Setae submenti strong and arising closer to mentum than to postoccipital margin.

Maxilla. Palp longer than wide. Setae maxillaries simple. Both sides of maxilla with numerous long fantail situated setae.

Abdomen. Anterior and posterior parapods separate, each bearing an apical crown of long narrow claws. Procercus not longer than wide, bearing 10 anal setae, without lateral setae; lateral setae situate near procercus on the body cover. Supraanal setae strong. Body setae dark and good visible.

Sasayusurika nigatana (Tokunaga, 1936), **comb. nov.**

Figs 15–39.

Diamesa (*Psilodiamesa*) *nigatana* Tokunaga, 1936: 537, ♂ (holotype — ♂; head, legs, wings and hypopygium mounted in euparal; Sasagamine, Niigata Prefecture, Honshu, Japan, March 9, 1932; leg. K. Imanishi; deposited in Kyoto Prefectural University, examined by K. Endo).

Sasayusurika aenigmata Makarchenko, 1993: 119–121, ♂ (holotype — ♂, head, legs, wings and hypopygium mounted in euparal; Okunikko, Nikko City, Nikko National Park, Toyamazawa River, 1450 m in altitude, Tochigi Prefecture, Honshu, Japan, September 21, 1988, leg. R. Ueno; deposited in the collection of the National Science Museum of Natural History, Tokyo, Japan, examined by E.A. Makarchenko), **syn. nov.**; Willassen, 2007: 316.

Material examined. 2 pupae, 2 pupae exuviae, 4 larvae, Maibara, Ryozen Mount, Urushi-ga-daki, Shiga Prefecture, Honshu, Japan, 6.IV.2004, leg. K. Endo; 1 pupa exuviae, the same data as before, 24.V.2003, leg. K. Endo.

Description. **Male.** Description is presented by Makarchenko [1993] and Willassen [2007].

Pupa (n=3). Total length 6.7–6.8 mm. Coloration: cephalothorax from dark brown to black, abdomen brown, dark brown or grayish-brown. Exuviae brownish-grey or brown.

Cephalothorax. Frontal apotoma without setae, with pair low tubercles (Fig. 15). Thorax intensive granulated by small spines in anterodorsal part, smooth in anterolateral part and not so intensive granulated in middle and posteriodorsal parts (Fig. 16). Thoracic horn candle-shaped and consists of basal and apical parts (Figs 17–19). Basal part not sclerotizated, grayish color and semitransparent, 364–420 μm long and 136–158 μm wide (near base). Apical part well sclerotizated, brown or dark brown color, finger-shaped, 276–296 μm long (Figs 20–23). Precorneal setae lengths (μm): Pc_1 — 76–88, Pc_2 — 156–188, Pc_3 — 120–140 (Fig. 16). Antepronotum with 1 median and 1 lateral antepronotals 68–108 μm long (Fig. 16).

Abdomen. Tergites and sternites I–VIII and anal lobes uniformly covered by shagreen of small spines (Fig. 24). Without shagreen only anteriomedian part of tergite I and dorsal muscle markes (MD_1–MD_3). Apex of all shagreen spines is directed to back. Tergites and sternites without posterior transverse row of large spines. Tergites with 5 pairs of dorsal setae 24–44 μm long. Segment I with 2 pairs of short hair-like lateral setae; segments II–VII with 4 pairs of short hair-like lateral setae, 24–40 μm long. Segment VIII with 3–4 pairs of lateral setae, which displaced in anal-lateral angles (Fig. 25); length of 2 pairs setae 50–52 μm and 1–2 pairs 26–28 μm. Anal lobe with 3 strong and dark brown to black anal macrosetae 264–312 μm long, which situated in anal-lateral angles of lobe and which in distal part declinated (Fig. 27). Sometimes anal macrosetae are lost during fixation of material (Fig. 26). Male genital sac extended beyond anal lobe, female genital sac not reaching apex of lobe (Figs 26–27).

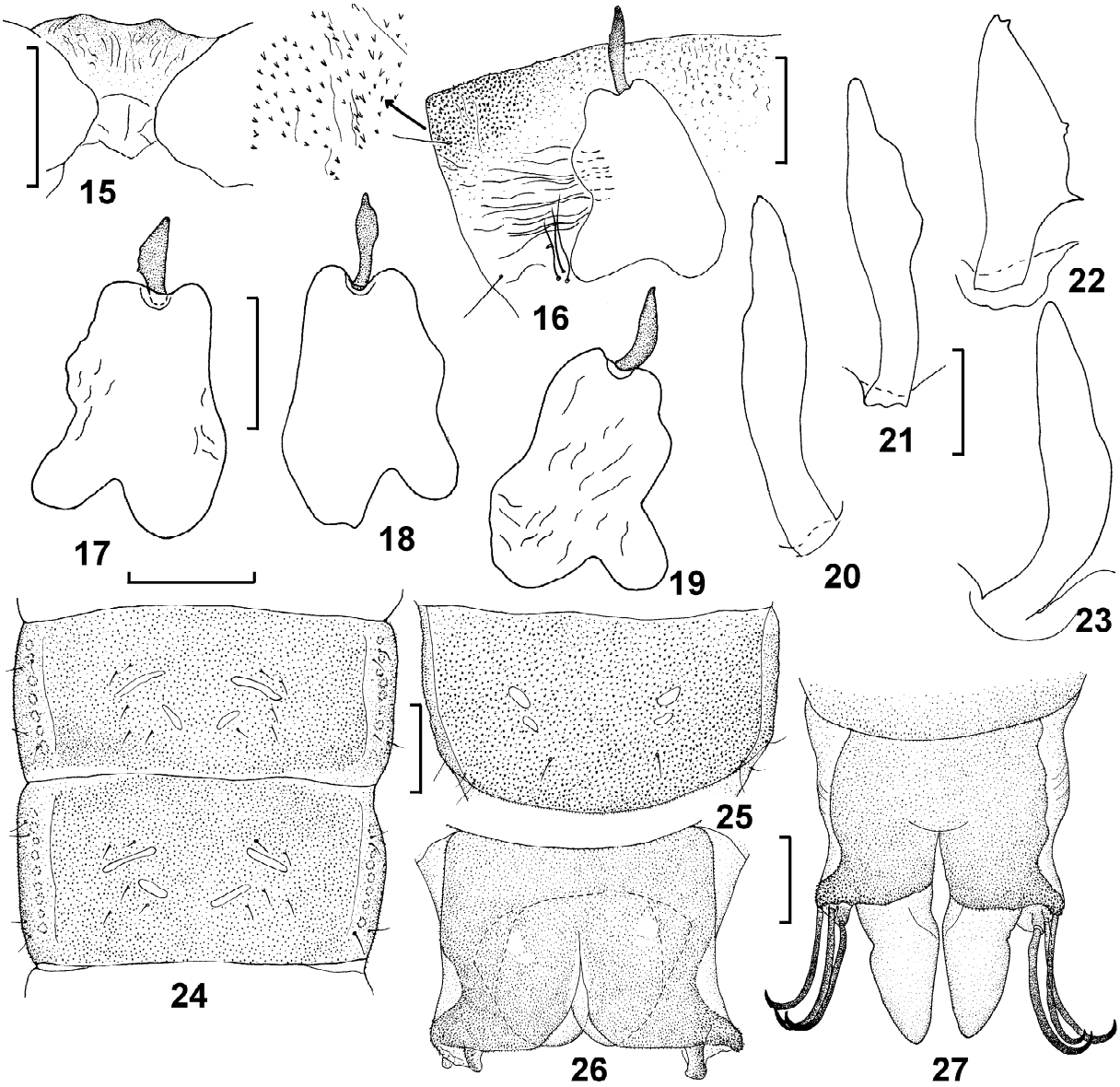
Fourth instar larva (n=4). Coloration: head from dark brown to black, abdomen dark green or greenish brown. Total length 8.5–10.7 mm.

Head. Head capsule 0.75–0.88 mm long and 0.56–0.63 mm wide. Labrum with simple and seta-like $S_{I–IV}$ setae. Pair of labral lamellae narrow and long. Pecten epipharyngis consisting of 5 long and rounded scales (Fig. 28). Premandible with 1 tooth and simple lateral spine (Fig. 33). Antenna with 5 segments; large ring organ situates in basal quarter of

1st segment; antennal blade ending at least near base of 5th segment (Figs 29–30). Lengths (μm) of antennal segments 1–3 : 88 : 24–28 : 52–56. Segments 4–5 very short. Style length 10 μm. AR 1.0. Mandible dark brown to black; apical tooth shorter than combined width of 4 inner teeth; seta subdentalis narrow, 20–28 μm long, ending near apex of 3rd tooth; seta interna absent; outer margin in middle part with small sensilla, basal part with 3 setae (Fig. 36). Mentum with 1 median and 6 pairs of lateral teeth; median tooth in 4 times broader than 1st lateral tooth; median tooth little lighter in color than dark brown lateral teeth. Ventromental plates elongate and narrow, 120–124 μm long. Setae submenti strong, about 120 μm long (Figs 31–32). Maxilla in both parts with numerous long fantail situated setae; palp length 40 μm, width 24 μm; ring organ situates in middle part of palp or little proximal. Setae maxillaries simple; SM_1 length 48 μm, SM_2 length 20 μm.

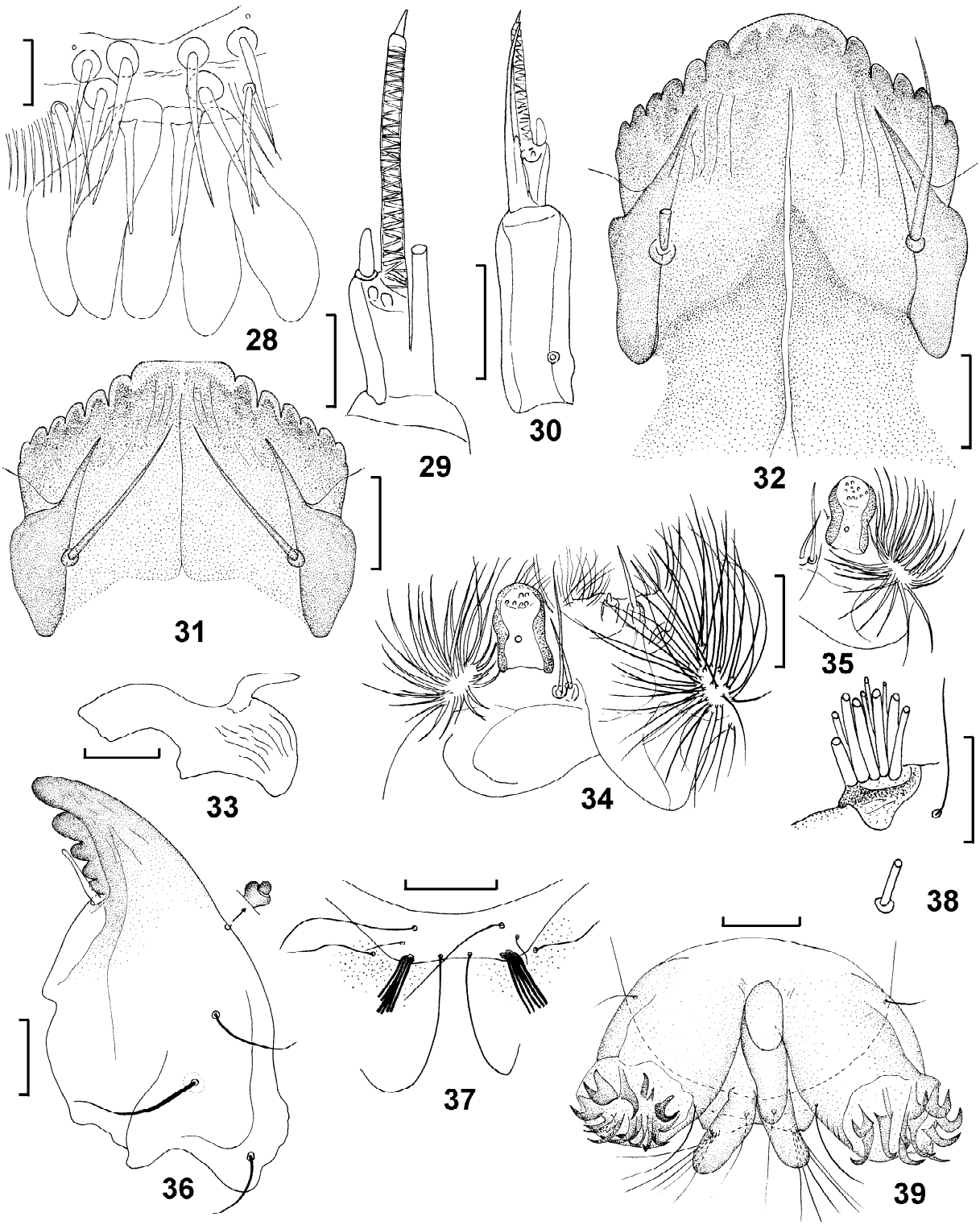
Abdomen. Anterior and posterior parapods separate, each bearing an apical crown of long narrow claws. Procercus not longer than wide, bearing 10 anal dark brown or black setae, 396–420 μm long, without lateral setae; lateral setae staying near procercus on the body cover: one seta strong, 246–308 μm long, another seta hair-like, 52 μm long (Fig. 37). Supraanal setae strong, 51–75 μm long. Body setae dark, good visible, 48–200 μm long. Dorsal pair of anal tubules length 220–280 μm, ventral pair of anal tubules length 240–288 μm; one ventral anal tubules situated under other and very often one of them invisible (Fig. 39).

Distribution. Known from Honshu Island of Japan and from the Indian Himalaya.



Figs 15–27. Pupa of *Sasayusurika nigatana* (Tokunaga): 15 — frontal apotoma; 16 — anterior part of thorax with thoracic horn; 17–19 — total view of thoracic horn; 20–23 — apical part of thoracic horn; 24 — tergites II–III; 25 — tergite VIII; 26 — anal segment of female; 27 — the same of male. Scale bars are as follows: Figs 15–19, 24–27 — 200 μm, Figs 20–23 — 50 μm.

Рис. 15–27. Куколка *Sasayusurika nigatana* (Tokunaga): 15 — фронтальная апотома; 16 — передняя часть груди с торальным рогом; 17–19 — общий вид торакального рога; 20–23 — апикальная часть торакального рога; 24 — тергиты II–III; 25 — тергит VIII; 26 — анальный сегмент самки; 27 — то же, самца. Масштабные линейки для рис. 15–19, 24–27 — 200 мкм, рис. 20–23 — 50 мкм.



Figs 28–39. Larva of *Sasayusurika nigatana* (Tokunaga): 28 — part of labrum; 29 — distal part of antenna; 30 — antenna; 31–32 — mentum; 33 — premandible; 34 — maxilla; 35 — part of maxilla with palp; 36 — mandible; 37 — part of anal segment, from above; 38 — procercus and lateral setae; 39 — anal segment with posterior parapods and anal papillae, from below. Scale bars are as follows: Figs 28–29 — 20 μm, Figs 30–36, 38 — 50 μm, Figs 37, 39 — 200 μm.

Рис. 28–39. Личинка *Sasayusurika nigatana* (Tokunaga): 28 — часть лабрума; 29 — дистальная часть антенны; 30 — антенна; 31–32 — ментум; 33 — премандибула; 34 — максилла; 35 — часть максиллы со щупиком; 36 — мандибула; 37 — часть анального сегмента, сверху; 38 — подставка преанальной кисточки и латеральные щетинки; 39 — анальный сегмент с задними подталкивателями и анальными жабрами, снизу. Масштабные линейки для рис. 28–29 — 20 мкм, рис. 30–36, 38 — 50 мкм, рис. 37, 39 — 200 мкм.

Comments. The investigation of immature stages of *S. nigatana* is supported of preliminary opinion about originality of *Sasayusurika*. From one side, some features of pupa, namely shagreenation of tergites and sternites, characters of thorax of *S. nigatana,* are similar to *Pseudodiamesa* Goetghebuer and *Pagastia* Oliver. Antenna of larva, subdental seta of mandible and long ventromental plates are similar to such of *Boreoheptagyia* Brundin, and absence of seta interna of mandible is typical for *Protanypus*. But from another side, we did not find any pupae in Diamesinae or other subfamilies with resembling thoracic horn as in *S. nigatana*. Also, some other characters, namely absence setae on frontal apotoma, anal macrosetae situated in anal-lateral angles of anal lobe and anal lobe very thickly covered by small spines of shagreen, are not typical for most pupae of Diamesinae. Larva of *S. nigatana* is good separated from other members of Diamesinae by relatively long maxillar palp and presence in both parts of maxilla numerous long fantail situated setae. Procercus partly reduced, not longer than wide, bearing 10 anal setae. Lateral setae staying near procercus on the body cover.

Acknowledgments

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