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CONTRIBUTION TO THE FALL STONEFLY (PLECOPTERA) FAUNA OF KOREA

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ABSTRACT

The Plecoptera material collected during a fall visit to the Republic of Korea was studied. *Nemoura aquila* Murányi sp. n. is described from both sexes. The unknown female of *Despaxia asiatica* Zwick and the unknown larva of *Nemoura geei* Wu are described. The male and the larva of *Protonemura villosa* Ham & Lee are redescribed and the female is described for the first time, and the species is transferred to the *P. towadensis* group sensu Shimizu. The internal female genital sclerites of *Amphinemura steinmanni* Zwick are also described.

Keywords: Republic of Korea, Plecoptera, *Amphinemura*, *Protonemura*, *Nemoura*, *Despaxia*, new species, female description, larval description, redescription

INTRODUCTION

The Plecoptera fauna of the Korean Peninsula was essentially unknown until the seventies (Zwick 1973a, 1973b), and remained poorly studied even at the turn of the millennium (Kim et al. 1998). Significant studies of Korean materials were recently done and twenty species, one third of the whole, were described or first reported during the last two years (Ham 2009, Stark 2010, Zwick 2010). However, all of the new material originated from the Republic of Korea, and the stonefly fauna of the People's Republic of Korea remains still relatively poorly known with only 23 species reported (Ham 2008).

During a collecting tour in the Republic of Korea in September 2010, we collected additional valuable material from the northern Thebek (Seorak and Hwaak Mts.) and the southern Soebek (Deokyu and Jiri Mts.) mountain ranges. This collection contains a new species of *Nemoura* bringing the number of species known from the Republic of Korea to 60 (Stark 2010, Zwick 2010). In addition, we describe the hitherto unknown female and/or larva, respectively, of a further three species, redescribe and clarify the classification of one, and complement the description of one more species. We also present ecological and distributional notes on these autumnal species.

MATERIAL AND METHODS

The material was caught by hand, dipnet and by beating sheet. All specimens were stored in 70% ethanol, slide preparations were fixed in glycerin-gelatine. Type specimens are deposited in the National Institute of Biological Resources, Incheon, Republic of Korea (NIBR) and in the Hungarian Natural History Museum, Budapest, Hungary (HNHM). Examined comparative material from the People's Republic of Korea is also housed in the HNHM.

Where necessary, terminalia were cleared by boiling in 10% KOH. Examination of internal female

genital sclerites were done with the method of Zwick (2010). SEM photos were made using gold-palladium coating after critical point drying. Specimens used for illustrations are indicated in the material examined.

Terminology of the terminalia follows Baumann (1975) in case of *Protonemura,* Zwick (2010) in case of *Amphinemura* and *Nemoura*.

RESULTS AND DISCUSSION

Nemouridae

Amphinemura steinmanni Zwick 1973
(Figs. 1-2)

Amphinemura steinmanni Zwick 1973 — Zwick 1973a:158. (original description of the male and the female from People's Republic of Korea); Zhiltzova 2003:181. (monograph, with the original figures); Teslenko & Zhiltzova 2009:113. (key, with the original figures).

Material examined. PEOPLE'S REPUBLIC OF KOREA: Kanwon Province, Diamond Range, Hotel Go-song, 29.05.1970, leg. Sándor Mahunka, Henrik Steinmann: holotype ♂, 1♀ paratype (HNHM); same locality and collectors, 01.06.1970: 2♀ paratypes (HNHM). REPUBLIC OF KOREA: Gangwon Province, Yangyang-gun, Seorak Mts., Hangae-ryeong Pass, 1.5km S of the rest area, brook in deciduous forest, 875m, N38°05.481′ E128°24.267′, 09.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon: 1♂; Jeollabuk Province, Muju-gun, Deokyu Mts., Sugyeongdae, 1km S of the settlement, clearing edge above a road, 640m, N35°53.888′ E127°46.378′, 13.09.2010, leg. Hye Woo Byeon, Tae Woo Kim, György Makranczy, Dávid Murányi: 4♂ 2♀; Jeollabuk Province, Muju-gun, Deokyu Mts., Baekryeon Temple, towards Osujagul Cave, tributary of Gucheondong Stream in deciduous forest, 985m, N35°51.069′ E127°46.169′, 14.09.2010, leg. Hye Woo Byeon, Tae Woo Kim, György Makranczy, Dávid Murányi: 2♀; Jeollanam Province, Gurye-gun, Jiri Mts., Mt. Nogodan, at Nogodan shelter, brook in bamboo-mixed deciduous forest, 1350m, N35°17.740′ E127°31.574′, 15.09.2010, leg. Tae Woo Kim, Dávid Murányi: 1♂ 1♀; Gyeongsangnam Province, Sancheong-gun, Jiri Mts., Ogeok Valley, 3km NW of Daewon Temple, N branch of Yup-yeong, open spring and its outlet at forest edge, 675m, N35°22.926′ E127°47.112′, 16.09.2010, leg. Hye Woo Byeon, László Forró, Tae Woo Kim, György Makranczy, Dávid Murányi: 8♂ 7♀ (one female terminalia prepared on slide, used for drawings Figs. 1-2).

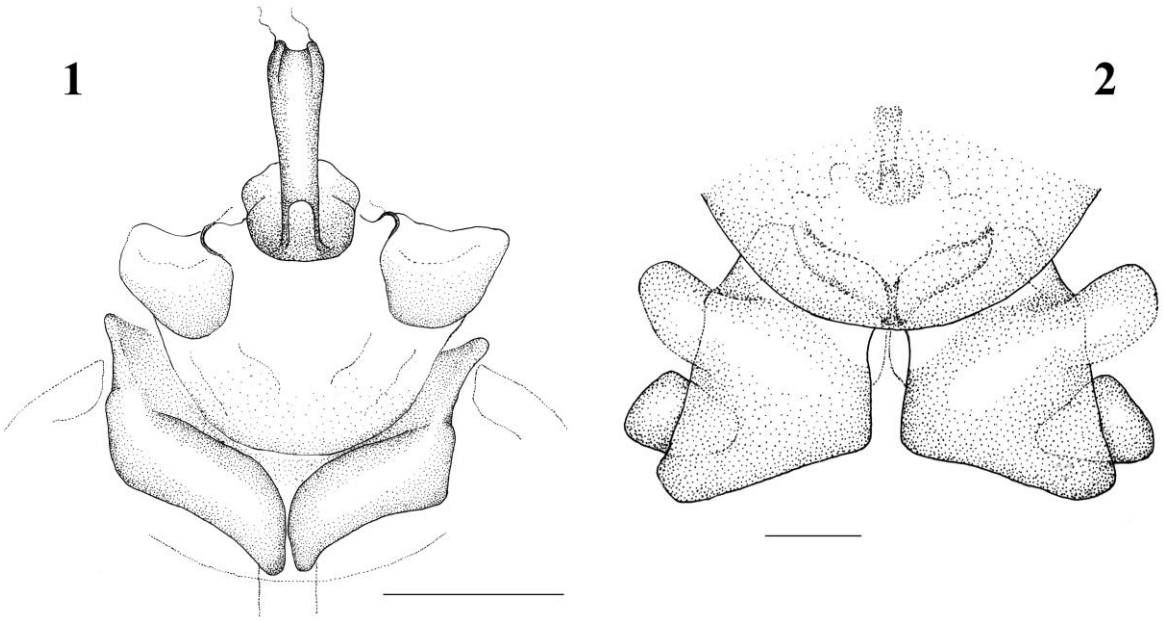
Female internal genital sclerites (Figs. 1-2). Anterior shield small and rounded, with large sclerotized tube which leads into the membraneous spermatheca. The tube is barely anteriorly widened, and has two short fingers posteriorly. Laterally to the anterior shield, lightly sclerotized folded hemispheres are ventrally attached to a large medial, spherical membranous area. Posteriorly to this spherical membrane, a caudally flattened wide sclerite is attached. Dorsal part of this sclerite has two folded arms that are weakly divergent posteriorly. Posteriomedially, from the meeting point of the dorsal arms, a strongly sclerotized crest leads to the ventral end of the sclerite, and its ventral tip is undivided and attached to the anterior end of the narrow notch in the subgenital plate.

Affinities. Internal sclerites are similar to those of *A. denstigris* Zwick 2010, but differ by the smaller anterior shield and the shape of its tube and by the posterior sclerite having weakly divergent dorsal arms. Neither the size nor the position of components was changed when the specimen was flattened by slide mounting, but remained as seen in a three dimensional aspect after clearing in KOH.

Notes. The female used for the illustrations was collected in copula, and its internal structures agree with the female paratypes. The description of inner structures of this species was not possible (Zwick 2010) because at that time the HNHM allowed no loans of type specimens. Fortunately, the museum returned to loaning types in 2011.

Geographical distribution and ecology. The species is known from the entire Korean Peninsula and the South of the Russian Far East (Zwick 2010). Adults were reported to occur from May to August (Zhiltzova 2003). Our specimens found in September were all fully pigmented and probably represented the latest adults of the season. They were found at small forest brooks and a spring outlet, all with slow or moderately fast flow and with stony or gravelly

substrate mixed with sand or even silt. Specimens were found in association with up to five species, but also as the single stonefly of a particular habitat (Table 1).



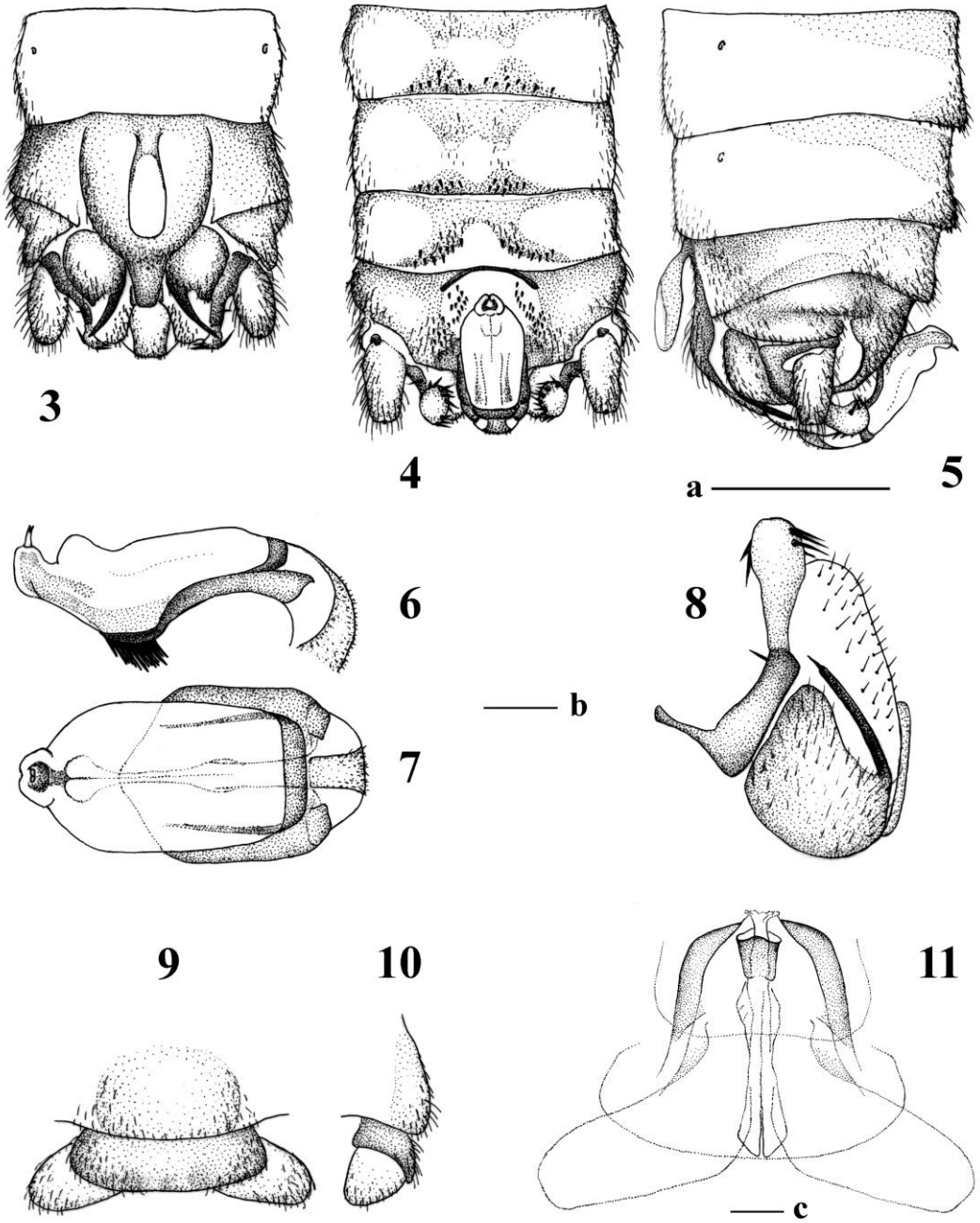
Figs. 1-2. Female genitalia of *Amphinemura steinmanni* Zwick 1973. 1: internal genital sclerites, dorsal view; 2: pregenital, subgenital and paragenital plates, with transparency of internal sclerites, ventral view (scales 0.1 mm).

Protonemura villosa Ham & Lee 1999
(Figs. 3-19, 29)

Protonemura villosa Ham & Lee 1999 — Ham & Lee 1999:122. (original description of the male and larva from Republic of Korea).

Material examined. REPUBLIC OF KOREA: Jeollanam Province, Gurye-gun, Jiri Mts., Mt. Nogodan, at Nogodan shelter, brook in bamboo-mixed deciduous forest, 1350m, N35°17.740′ E127°31.574′, 15.09.2010, leg. Tae Woo Kim, Dávid Murányi: 2♂ 2♀ (one female used for drawings Figs. 9-11), 6 larvae (one matured female used for drawings Figs. 18-19, another matured female used for SEMs Figs. 12-17); Jeollanam Province, Gurye-gun, Jiri Mts., Mt. Nogodan, beneath Nogodan shelter, rocky stream in deciduous forest, 1280m, N35°17.738′ E127°31.430′, 15.09.2010, leg. Hye Woo Byeon, Tae Woo Kim, Dávid Murányi: 1♂ (used for drawings Figs. 3-8).

Male terminalia (Figs. 3-8). Hypoproct rounded, longer than wide, tip shorter than the vesicle. Vesicle three times as long as wide. Inner paraproctal lobe small. Median lobe with large, rounded base and long, dark blade-shaped expansion that is curving outward, membranous part hardly separated. Outer lobe strongly sclerotized in its curved basal half, apical part weakly sclerotized and globular at the apex; the lobe bears an outward directed spine at the end of the strongly sclerotized section, and 8-9 strong spines arranged in a row on the inner part of the apex. Terga VII-IX dark coloured in their anterior and posterior medial part, and bearing numerous black spines posteriorly; tergite IX emarginated posterio-medially. Tergite X with a strongly sclerotized, curved medial arch in the anterior margin, delimiting a medial membranous field reaching beyond the apical part of the epiproct; the tergite bears numerous black spines in two diverging



Figs. 3-11. Terminalia of the adult of *Protonemura villosa* Ham & Lee 1999. 3: male terminalia, ventral view; 4: male terminalia, dorsal view; 5: male terminalia, lateral view; 6: male epiproct, lateral view; 7: male epiproct, dorsal view; 8: male paraproct, ventrolateral view; 9: female pregenital and subgenital plates, and vaginal lobes, ventral view; 10: female pregenital and subgenital plates, and vaginal lobes, lateral view; 11: female internal genital sclerites, dorsal view (scale a 0.5 mm (for Figs. 3-5, 9-10), scales b-c 0.1 mm (b for Figs. 6-8)).

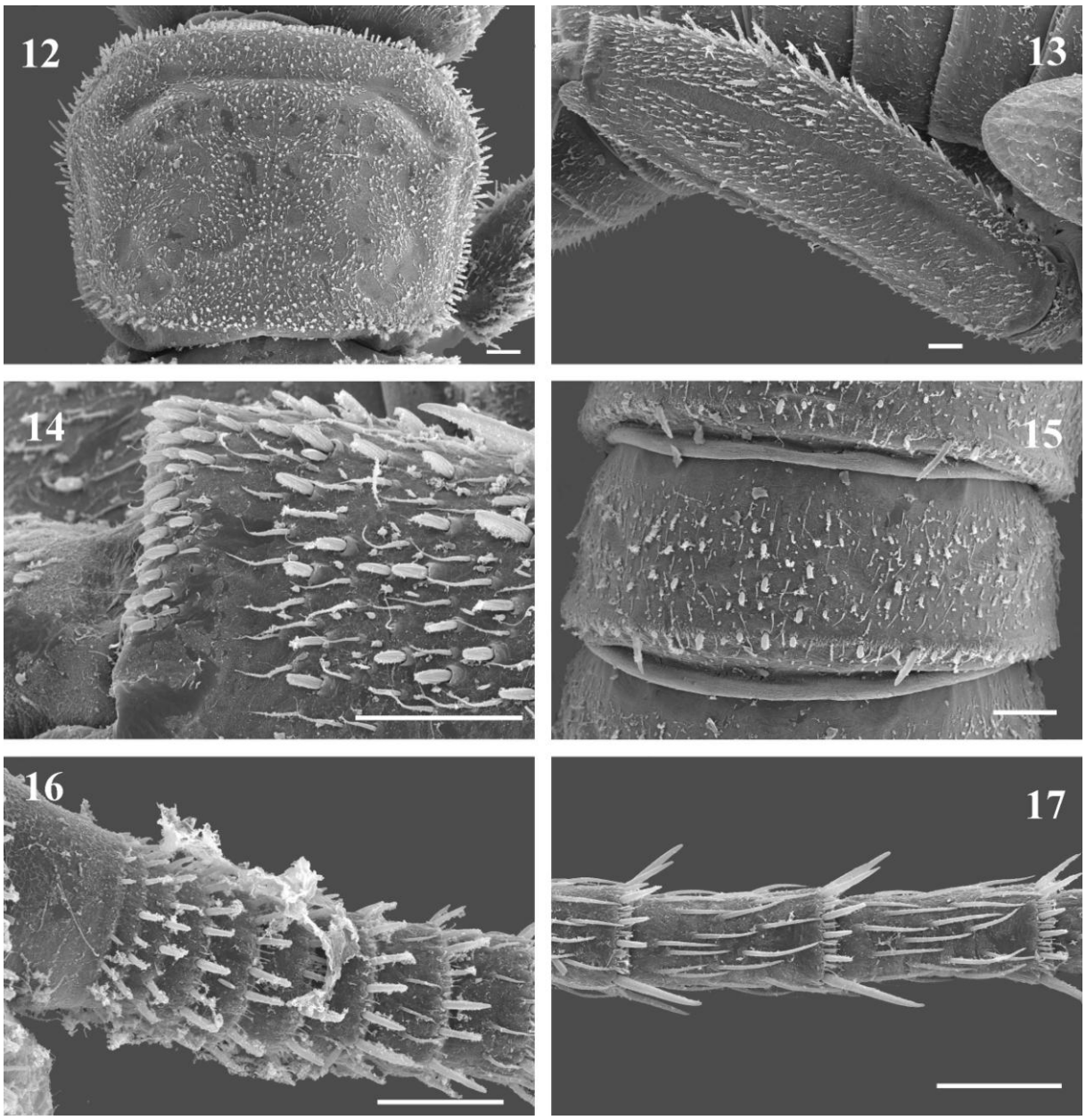
longitudinal stripes, originating from the anterior arch. Epiproct stout, its sides nearly parallel in dorsal view, ending in an upcurved tip with a small, sometimes barely visible bifid terminal filament. Before the upcurved apex, a conspicuous hump present in the dorsal midline. Lateral sclerite thin, forming a U-shaped ring above the large and wide ventral sclerite. Ventral sclerite half as long as the epiproct, but nearly as wide as its length, sides parallel; apical end V-shaped, bulging and with numerous moderately long spines in the apical fourth of the sclerite. Sides of the sclerite upturned before the apical bulge. Cerci short, normal.

Female genitalia (Figs. 9-11). Pregenital plate large but pale, rounded. Subgenital plate large slightly rounded and without indentation, brown coloured. Vaginal lobes large and rounded, extending nearly over all of the segment's width. Internal genital sclerites are forming a large plate beneath the origin of the vaginal lobes; this plate ends before the posterior end of pregenital plate. Besides this plate, an elongated, sclerotized ring can be seen below the spermatheca, and two pale, elongated and pointed plates at the genital opening.

Mature larva (Figs. 12-19). Body relatively slender, body length 7.0–8.5 mm. General colour brown, with dark brown pattern on head and thorax. Pilosity distinct. Head stout, brown with dark patches. The pronotum subtrapezoidal with distinct granules and rounded corners; slightly narrowing towards the posterior margin and its length is three fourth of its maximum width. Cervical gills simple, bald, and relatively long. Wing pads of typical length for macropterous species, meso- and metanotum with marmorated dark brown pattern. Legs typical of the genus, tibia slightly longer than femur; width of hind femur less than one third of its length. Abdomen relatively slender and uniformly brown coloured, integument light and matt, first 4 abdominal segments divided by pleura. Genital opening well visible on the mature female larva, and placed under the anterior half of sternite VIII; paraprocts not pointed. Terminalia of the mature male larva unknown. Cercus long, with more than 30 segments; segment sides nearly parallel, the width of segments 14–16 is half of their length.

Pilosity: Head with dense, stout bristles and thin hairs; eye bear small setae between the ocelli. Antennal segments with short pilosity. Pronotum with dense, stout and blunt bristles, and thin hairs. Margin of the pronotum bearing blunt bristles, the length of the longest less than 1/15 of the pronotum width. The bristles on the anterior corners of the meso- and metanotum are as long as the marginal bristles of the pronotum. The setae placed in lines on the wing pads are relatively long and acute. Legs with dense setation. All femora bear both short and long, acute bristles and thin hairs. Long bristles occur mostly on the outer surface; on hind femur they are placed in the apical half. Bristles not in a regular arrangement; the longest ones reach two fifths of the femur's width on the first, one third on the hind leg. A bald median line is conspicuous on the dorsal surface of all femora and is covered with rounded scales. Tarsi relatively slender, covered with thin hairs and bristles; apical spikes of tibiae short. Tergal segments with blunt bristles and thin hairs, acute spines occur only in the row of the posterior margin. Paired spines on the posterior margin acute, moderately long; on tergite V they reach less than one third of the segment's length. Distal margin with tiny triangular spikes around the row of bristles. Cercal segments with acute bristles, a few blunt ones occur only in the apical whorl. The apical whorl on segments 14-16 is a set of 13–15 strong, acute spikes mixed with short, blunt spikes and thin setae. Longest bristles reach half of the segment's length on segments 14–16.

Affinities. In the original description, the male was compared to *P. hotakana* (Uéno 1931) as its closest relative. However, the upturned apex of the epiproct clearly indicates that the species belongs to the *P. towadensis* group sensu Shimizu (1998), instead of the *P. hotakana* group sensu Shimizu (1998). The male differs from all the three other members of the group (*P. towadensis* (Kawai 1954), *P. kohnoae* Shimizu 1997 and *P. ermolenkoi* Zhiltzova 1982) with the hump in the dorsal midline of the epiproct, wide ventral sclerite of the epiproct with spines arranged only in its apical fourth, and the long blade-shaped expansion of the median paraproct lobe. The subgenital plate of the female is distinctive lacking an anterior emargination. The shape of the subgenital plate has been shown to be variable in related groups (Shimizu 1998). As no additional Far Eastern *Protonemura* larvae have been described, its



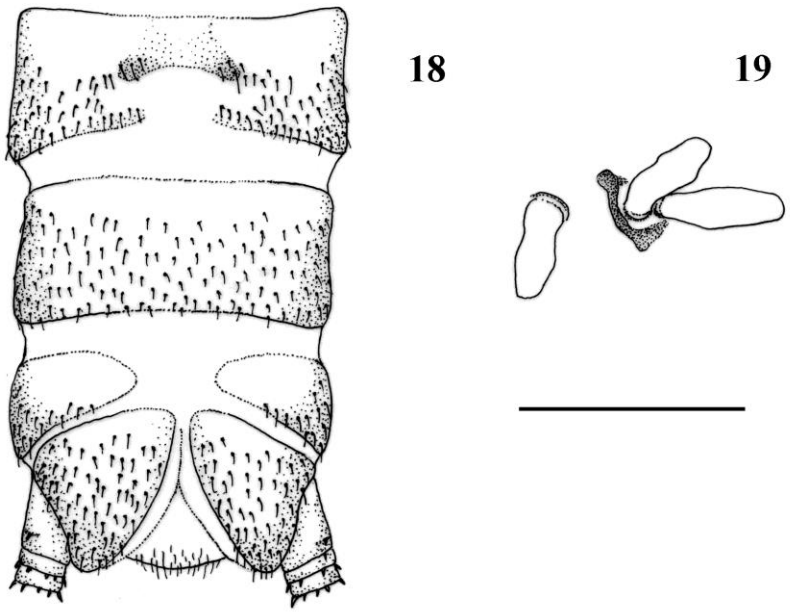
Figs. 12-17. Larva of *Protonemura villosa* Ham & Lee 1999. 12: pronotum; 13: hind femur; 14: outer apical part of the femur; 15: 5th tergal segment; 16: basal segments of the cercus; 17: 15-16th segment of the cercus (scales 0.1 mm).

distinctive characters cannot be discussed.

Notes. *Protonemura villosa* is the only species of the genus reported from Korea (Stark 2010, Zwick 2010). During our tour we found young larvae of an additional species both in the Seorak and the Deokyu Mts.

Geographical distribution and ecology (Fig. 29). The species was known only from the type material from Jeollanam Province, where the species was collected from May to October (Ham & Lee 1999). Our specimens were found in the same province at

two different sections of a forest stream. The upper section (type locality of *Scopura jiri* Jin & Bae 2005) has moderately fast flow and stony substrate mixed with sandy patches, while the lower section has fast flow and rocky-stony substrate with few sandy patches. Specimens were found in common with seven additional taxa (Table 1).



Figs. 18-19. Larva of *Protonemura villosa* Ham & Lee, 1999. 18: mature female, terminalia, ventral view; 19: left gills, ventral view (scale 0.5 mm).

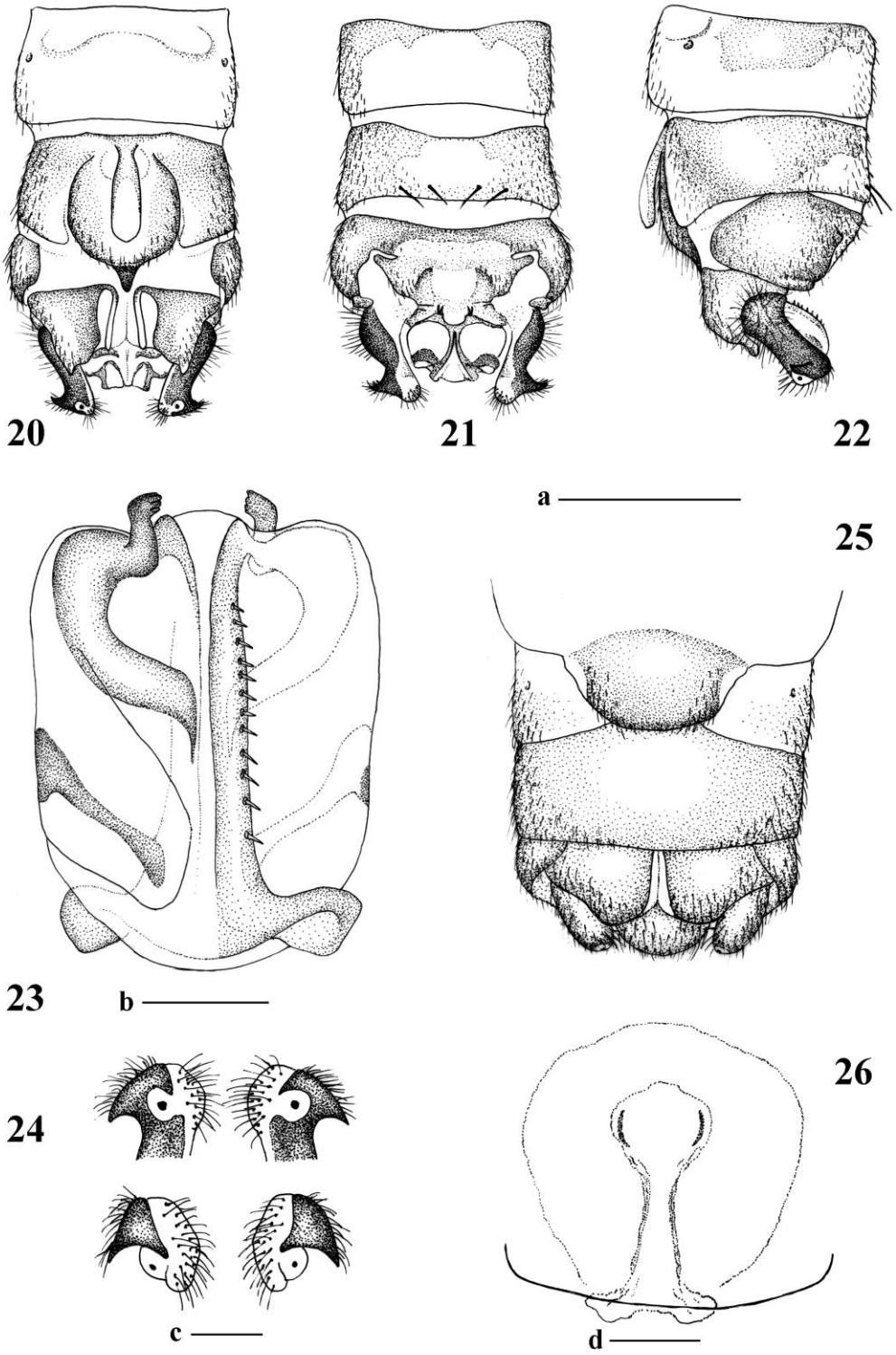
***Nemoura aquila* Murányi sp. n.**
(Fig. 20-29)

Type material. REPUBLIC OF KOREA: Holotype male: Gangwon Province, Yangyang-gun, Seorak Mts., Hangae-ryeong Pass, 1.5km S of the rest area, brook in deciduous forest, 875m, N38°05.481' E128°24.267', 09.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon (HNHM; epiproct prepared on slide, used for drawings Figs. 20-24). Allotype female: same locality and data (NIBR; caught in copula with the holotype, used for drawing Fig. 25). Paratype: same locality and data: 1♀ (HNHM; terminalia prepared on slide, used for drawing Fig. 26).

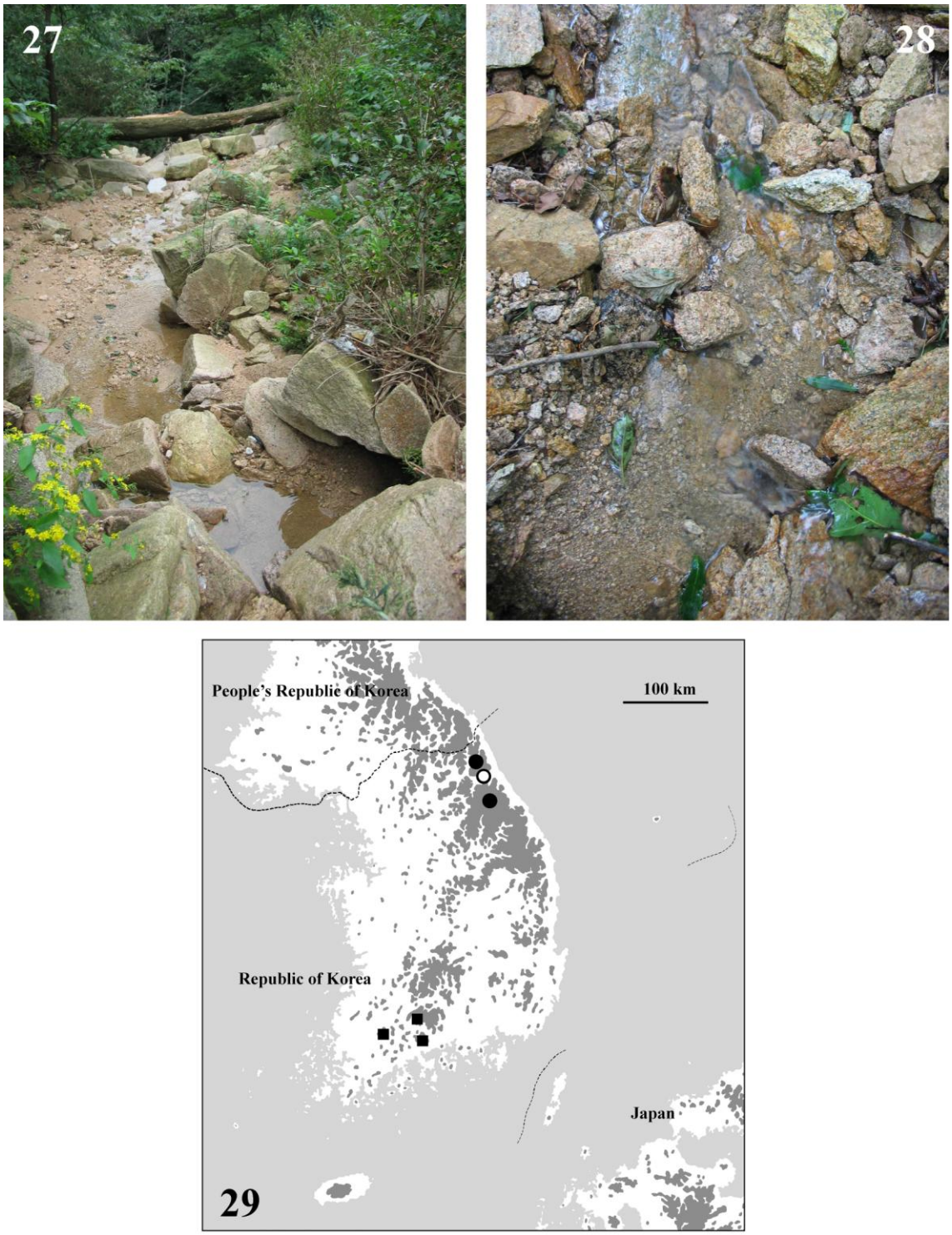
Diagnosis. Male: Cercus straight and stout with strong apical hook, sclerotization forming an open ring around the prominent vestigial second segment. Paraproct with a pronounced outer tip. Apical sclerites of the epiproct erect, long and slender, tip with four finger-like parts.

Description. Medium sized species, macropterous in both sexes. Body length: ♂ holotype 7.0 mm, ♀ allotype 8.0 mm, paratype 7.5 mm; forewing length: ♂ holotype 6.5 mm, ♀ allotype 8.5 mm, paratype 8.0 mm. Head and basal half of the antenna black, rest of the antenna dark brown, palpi yellowish. Pronotum trapezoidal with rounded corners, dark brown. Legs yellow, distal end of tibiae and tarsal segments darkened. Wings brownish, venation dark brown. Abdomen reddish brown except for terminal segments, which are dark brown.

Male terminalia (Figs. 20-24). Hypoproct rounded, as long as wide, tip short, darker than the rest of the plate. Vesicle more than three times as long as wide. Paraproct: inner margin of the outer lobe slightly convex with a prominence in the distal third, outer margin curved. Apical part of the lobe with a small



Figs. 20-26. Terminalia of the adult of *Nemoura aquila* Murányi. 20: male terminalia, dorsal view; 21: male terminalia, ventral view; 22: male terminalia, lateral view; 23: male epiproct, left side dorsal, right side ventral view; 24: head of male cerci, ventrocaudal and caudal views; 25: female terminalia, ventral view; 26: vaginal complex (scale a 0.5 mm (for Figs. 20-22, 25), scales b-d 0.1 mm).



Figs. 27-29. Type locality of *Nemoura aquila* Murányi and the distribution of the Korean endemics included in this paper. 27: type locality: Seorak Mts., Hangae-ryeong Pass; 28: substrate of the type locality brook; 29: known occurrences of *Protonemura villosa* Ham & Lee 1999 (■), *Despaxia asiatica* Zwick 2010 and *N. aquila* Murányi (○), and *D. asiatica* (●) (dark grey areas are above 500 m).

but pronounced offset outer tip. Inner paraproct lobe yellowish. Cercus straight, stout and strongly sclerotized, being membranous only at the apex around the vestigial segment, and on the inner side. Base slightly wider than the rest of the cerci. Vestigial second segment prominent, placed on the ventral part of the head of cerci, sclerotization forming an open ring around it. Apical hook strong, curved ventrolaterally; the inner tooth forming the ring around the vestigial second segment is downcurved in caudal view. Tergite IX bearing four strong spines dorsomedially, and a medial light area. Tergite X medially bearing two small, diverging ridges under the tip of the epiproct. Epiproct stout, subtrapezoidal. Ventral sclerite narrow, with parallel ridges bearing 12 spines ventrally. Arms of the ventral sclerite forming a wide and strong, heart-shaped ring. Apical sclerites long, relatively slender and erect (directed forward when flattened on slide), their tip slightly bent inward, and hardly separated into four finger-like parts. Sclerotized parts of the lateral arms dark, long and narrow.

Female terminalia (Figs. 25-26). Pregenital plate small, its width is half the width of sternite VII, overhanging the whole length of sternite VIII. Posterior edge rounded, most of the plate dark brown but lateral edges light. Sternite VIII with brown patches laterally. Vaginal complex with membranous receptaculum seminis bearing two small, elongate lateral sclerites, and with slightly sclerotized edges of the narrowing central section. Cerci, epiproct and paraprocts normal, dark brown.

Larva. unknown.

Table 1. Plecoptera found at the localities of the species included in this paper (1: Inje-gun, Naerincheon River tributary; 2: Seorak Mts., Hangae-ryeong Pass; 3: Seorak Mts., Misi-ryeong Pass; 4: Hwaak Mts., Hwaak Pass; 5: Deokyu Mts., Sugyeongdae; 6: Deokyu Mts., Gucheondong Stream tributary; 7: Jiri Mts., Hwagaecheon Stream tributary; 8: Jiri Mts., brook at Nogodan shelter; 9: Jiri Mts., stream beneath Nogodan shelter; 10: Jiri Mts., spring in Ogeok Valley; A: adult; L: larva)

Locality / Taxon	1	2	3	4	5	6	7	8	9	10
Scopura jiri Jin & Bae								L	L	
Scopura sp.						L				
***Amphinemura steinmanni* Zwick**		A			A	A		A		A
A. denstigris Zwick	I									
Amphinemura sp.							L			
***Protonemura villosa* Ham & Lee**								A,L	A	
***Nemoura aquila* Murányi sp. n.**		A								
***N. geei* Wu**	A	A	A	A,L		L	L	A		
Nemoura sp.					A			A	A	
***Despaxia asiatica* Zwick**		A,L	A							
Arcynopteryx sp.									L	
Megarcys sp.									L	
Sweltsa sp.								L	L	
Kiotina decorata (Zwick)							L			
Kamimuria sp.									L	

Affinities. The species cannot be placed into an existing species group. It appears closely related to *N. ussuriensis* Zhiltzova 1997 (in Teslenko & Zhiltzova 1997), *N. espera* Ham & Lee 1999 and *N. tripotini* Zwick 2010. The male differs from these species by the erect and relatively slender apical sclerites of the epiproct, ending in finger-like parts that bear no spines, by the pronounced outer tip of

the paraprocts, and by the more strongly sclerotized head of cerci, with the inner tooth forming a ring around the vestigial segment. The ventral sclerite of the epiproct also distinguishes *N. aquila* from *N. ussuriensis* and *N. espera*, being narrow and armed with numerous spines in the new species. The female cannot be distinguished with certainty from the other Far East *Nemoura*.

Geographical distribution and ecology (Figs. 27-29). The species was found at a single locality in the Seorak Mts. in September. All three specimens were fully pigmented, and the holotype male was found in copula with the allotype female. The type locality is a small (width 0.5-1 m) forest brook with cold water and gravel substrate mixed with a few sandy patches. The section where the specimens were caught has moderately fast flow, while most of the brook has fast flow in a steep bed. Specimens were found associated with adults of *A. steinmanni*, *N. geei* Wu 1929 and adults and larva of *D. asiatica* Zwick 2010 (Table 1).

Etymology. The name *aquila* (meaning eagle in Latin) refers to the shape of the cerci that look like eagle heads. This method of naming is frequently used in the genus (e.g. *N. avicularis* Morton, *N. sciurus* Aubert and *N. anas* Murányi). Used as a noun, gender feminine.

Nemoura geei Wu 1929
(Figs. 30-36)

Nemoura geei Wu 1929 — Wu 1929:200. (original description of the male from China); Shimizu 1997:211. (redescription of male and female); Zhiltzova 2003:292. (monograph, with the original figures of *N. brevicerca*); Teslenko & Zhiltzova 2009:150. (key, with the original figures of *N. brevicercia*).
Nemoura pekinensis Claassen 1929 — Claassen 1929:511. (original description of the male and the female from China); Wu 1938:120. (syn. fide).
Nemoura brevicercia Zhiltzova 1982 — Zhiltzova 1982:37. (original description of the male from Russia); Shimizu 1997:211. (syn. fide).

Material examined. REPUBLIC OF KOREA: Gangwon Province, Inje-gun, Inje, 2km E of the city, tributary of Naerincheon River, 200m, N38°04.021′ E128°11.468′, 08.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon: 3♂; Gangwon Province, Yangyang-gun, Seorak Mts., Hangae-ryeong Pass, 1.5km S of the rest area, brook in deciduous forest, 875m, N38°05.481′ E128°24.267′, 09.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon: 3♂ 7♀; Gangwon Province, Inje-gun, Seorak Mts., Misi-ryeong Pass, beneath the rest area, brook in deciduous rocky forest, 745m, N38°12.963′ E128°26.189′, 10.09.2010, leg. Dávid Murányi: 1♀; Gyeonggi Province, Gapyeong-gun, Hwaak Mts., Hwaak pass, 4.5km S of the tunnel, spring and its outlet, 280m, N37°57.376′ E127°31.718′, 11.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon: 1♂ 4 larvae; Jeollabuk Province, Muju-gun, Deokyu Mts., Baekryeon Temple, towards Osujagul Cave, sidebrook of Gucheondong Stream in deciduous forest, 985m, N35°51.069′ E127°46.169′, 14.09.2010, leg. Hye Woo Byeon, Tae Woo Kim, György Makranczy, Dávid Murányi: 2 larvae; Gyeongsangnam Province, Hadong-gun, Jiri Mts., Ssanggyesa Valley, parking lot beneath Daesung Camp, tributary of Hwagaecheon Stream in deciduous forest, 270m, N35°16.523′ E127°39.131′, 14.09.2010, leg. Hye Woo Byeon, László Forró, Tae Woo Kim, György Makranczy, Dávid Murányi: 1pharate ♂ 6 larvae (one matured male used for drawing Fig. 30, one matured female used for SEMs Figs. 31-36); Jeollanam Province, Gurye-gun, Jiri Mts., Mt. Nogodan, at Nogodan shelter, brook in bamboo-mixed deciduous forest, 1350m, N35°17.740′ E127°31.574′, 15.09.2010, leg. Tae Woo Kim, Dávid Murányi: 1♂.

Mature larva (Figs. 30-36). Body relatively slender, body length 6.0-7.5 mm. General colour pale brown, with conspicuous dark brown pattern. Pilosity strong and distinct. Head stout, dark brown with black tentorial callosities and light brown patches on the occiput. Antenna light brown, but scape and pedicel dark brown. Pronotum subtrapezoidal, corners rounded, it is slightly narrowing towards the posterior margin; light brown with a few dark granules. Its length equals two thirds of its maximum width. Wing pads of typical length for macropterous species, meso- and metanotum dark brown with light patches and distinct, finger-like ornamentation. Legs typical of the genus, tibia as long as or slightly shorter than femur; width of hind femur two fifth of

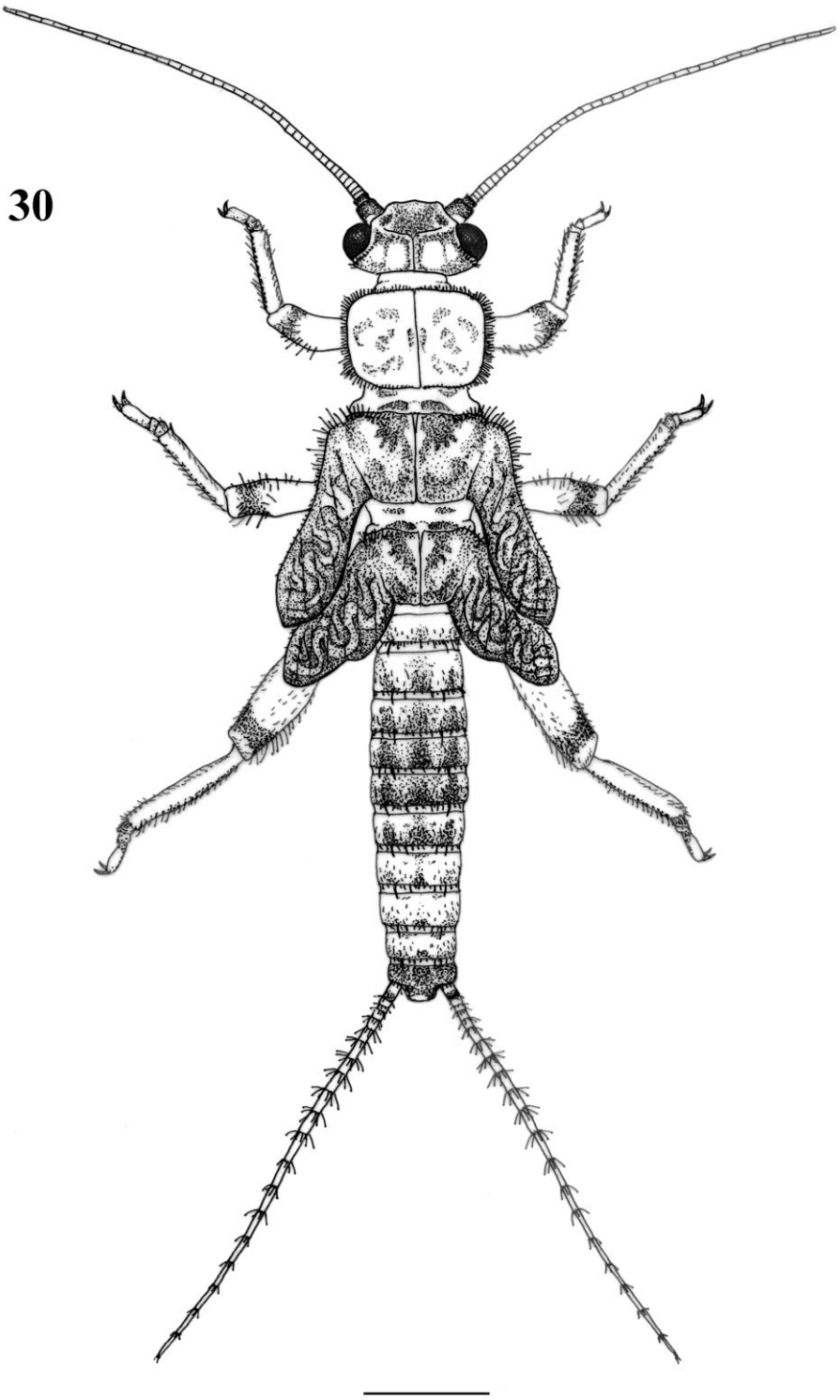
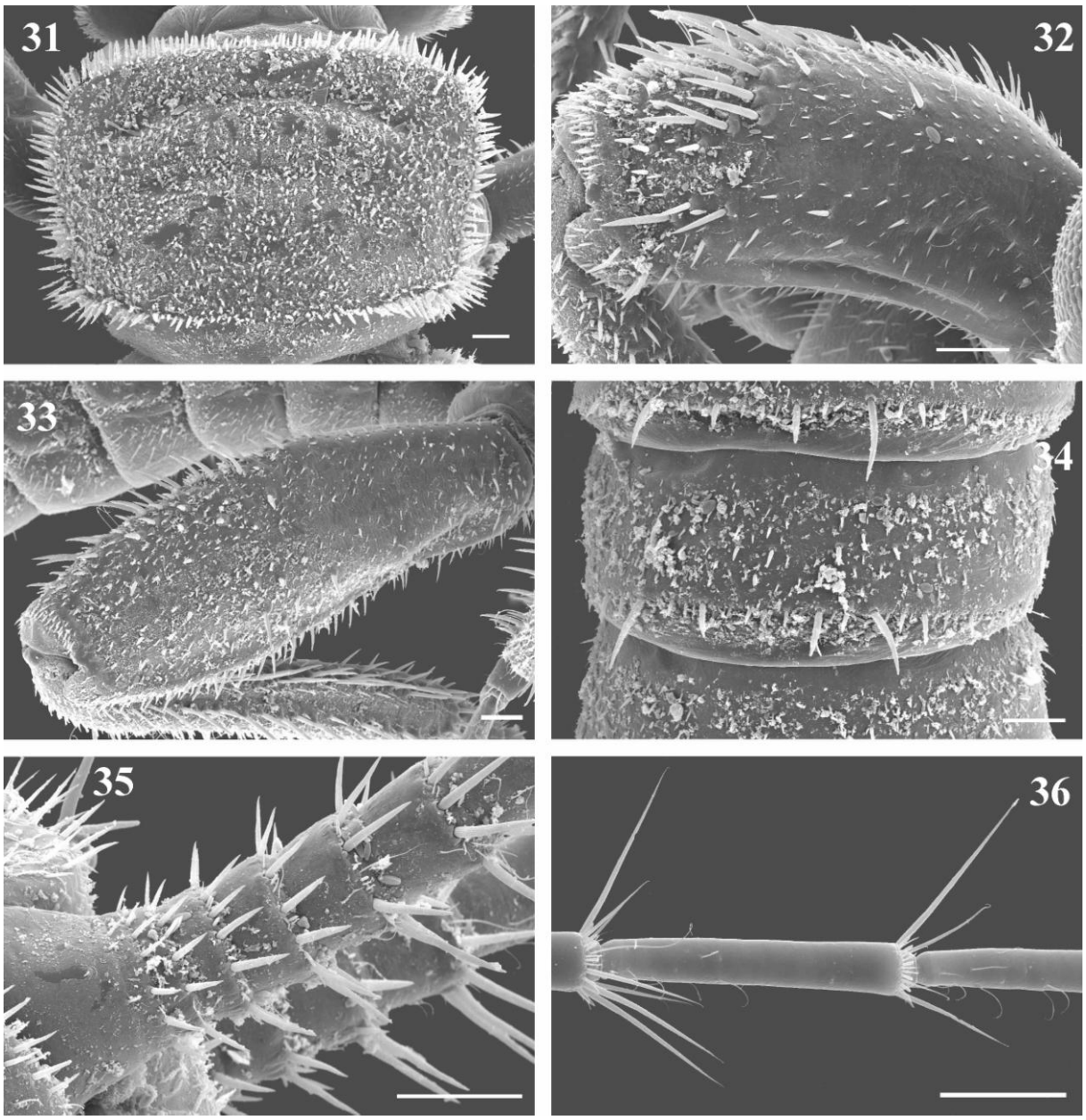


Fig. 30. Habitus of a mature larva of *Nemoura geei* Wu 1929, dorsal view (scale 1 mm).



Figs. 31-36. Larva of *Nemoura geei* Wu 1929. 31: pronotum; 32: fore femur; 33: hind femur; 34: 5th tergal segment; 35: basal segments of the cercus; 36: 15th segment of the cercus (scales 0.1 mm).

its length. Femora light brown with an apical dark brown ring, tibiae and tarsi light brown to brown. Abdomen relatively slender, integument light and matt. Ground colour light brown, but with three longitudinal dark brown patches on most of the segments; these are missing or small on terga I-II and VII-IX, and most intensive on terga V-VI. Tergite X entirely dark brown, mostly with a well delimited central patch. Ventral surface of the body light brown, with dark brown lines on the segment

margins. Cercus light brown and long, with about 20 segments; segment sides nearly parallel, the width of segments 14-16 is one sixth of their length.
Pilosity: Head with dense, stout bristles and a few thin hairs; acute bristles occur only in the anterior third and around the compound eyes. Eye bear small setae between the ocelli. Antennal segments with short pilosity. Pronotum with short, stout bristles. Margin of the pronotum bearing stout, sharp bristles, the length of the longest ones is less than 1/10 of the pronotum's width. The bristles on the anterior corners of the meso- and metanotum are longer than the marginal bristles of the pronotum. The setae placed in lines on the wing pads are short and blunt. Legs with dense setation. All femora bear both short and long, acute bristles and thin hairs. Long bristles occur on the apical half of the fore and mid femora, and on the apical two thirds of the hind femur. Bristles not in a regular arrangement; the longest ones reach half of the femur's width on the first, one third on the hind legs. A bald median line is conspicuous on the dorsal surface of all femora and is covered with rounded scales. Apical row of short bristles present on all femora. Tarsi relatively stout, covered with thin hairs; apical spikes of tibiae short. Terga covered with short, acute bristles. Distal row with bristles of variable length; the longest ones on tergite V reach nearly half the segment's length. Distal margin with very few tiny triangular spikes around the row of bristles. Cercal segments with a few thin hairs besides the apical whorl of bristles. The apical whorl on segments 14-16 is a set of short, clubbed bristles and 3-5 long, acute bristles mixed with thin hairs. Longest bristles reach two thirds of the segment's length on segments 14-16.
Affinities. The larva can be easily distinguished from all known Far East *Nemoura* larvae on the basis of its distinctive dark brown and light brown pattern.
Geographical distribution and ecology. The species is known from Northeast China, the whole Korean Peninsula, the Russian Far East and Japan (Shimizu 1997, Zwick 2010). Adults hitherto reported to occur from March to June (Shimizu 1997, Zhiltzova 2003, Zwick 2010) and from September to October (Shimizu 1997). In September we found both fully pigmented adults and immature larvae, suggesting a flight period even more extended towards autumn. Specimens were found at forest streams and springs, both with fast and slow flow and with stony, rocky or gravelly substrate mixed with sand. *Nemoura geei* proved to be the most frequent autumnal species of the smaller waterflows during our tour. Specimens were found associated with up to five species, but also the only stonefly collected at a particular habitat (Table 1).

Leuctridae

Despaxia asiatica Zwick 2010
(Figs. 29, 37-38)

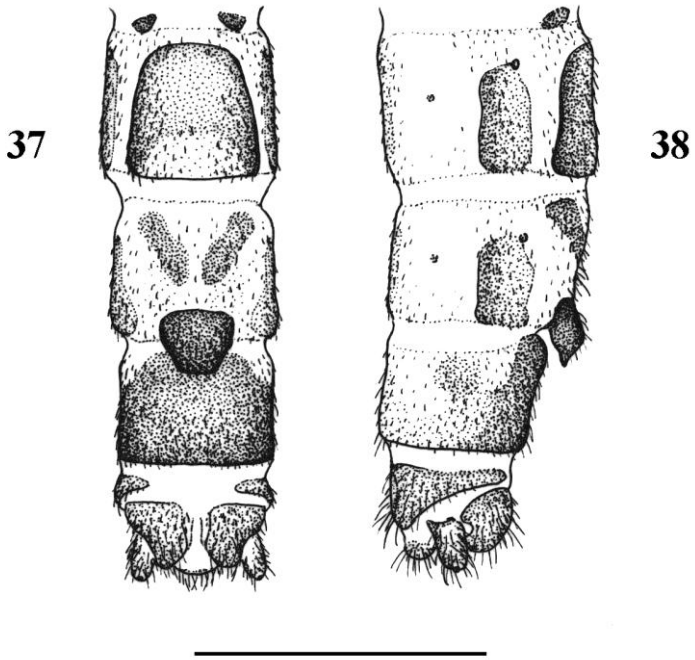
Despaxia asiatica Zwick 2010 — Zwick 2010:90. (original description of the male from Republic of Korea).

Material examined: REPUBLIC OF KOREA: Gangwon Province, Yangyang-gun, Seorak Mts., Hangae-ryeong Pass, 1.5km S of the rest area, brook in deciduous forest, 875m, N38°05.481′ E128°24.267′, 09.09.2010, leg. László Forró, György Makranczy, Dávid Murányi, Sun Jae Park, Jung Do Yoon: 2♂ 1 larva; Gangwon Province, Inje-gun, Seorak Mts., Misi-ryeong Pass, beneath the rest area, brook in deciduous rocky forest, 745m, N38°12.963′ E128°26.189′, 10.09.2010, leg. Dávid Murányi: 5♂ 2♀ (one female used for drawings Figs. 37-38).
Female terminalia (Figs. 37-38). Terga I-VIII mostly membranous but with transverse row of four pigmented spots, and terga IV-VIII bear a pale and narrow longitudinal medial sclerite. Tergite IX sclerotized medially and posteriorly, tergite X completely sclerotized. Lateral sclerites present on segments II-VIII. Sterna I-VII simple with subrectangular median sclerite and two small anterior sclerites. Sternite VII median sclerite with pale posterior margin, indented in the middle. Sternite VIII with two converging sclerotized stripes on the anterior half, posterior fourth bears a small, dark brown subgenital plate overhanging on sternite IX. The subgenital plate is trapezoidal, sides converging towards the linear posterior margin; its width is more than one third of the segment's width, length half of the segment's length. Sternite IX dark with a straight anterior line and two lateral unpigmented areas. Paraproct, epiproct and cercus normal.
Affinities. The female can be easily distinguished

from the other known species of the genus, the West Nearctic *D. augusta* (Banks 1907), on the basis of the presence of a subgenital plate and pale mid-dorsal sclerites. The subgenital plate of *D. augusta* is not developed (see Baumann et al. 1977, Fig. 339), a character that is not diagnostic for the genus.

Notes. The single larva caught together with adults at the Hangae-ryeong Pass is not in the final instar, thus, it is not described herein.

Geographical distribution and ecology (Fig. 29). The species was recently described on the basis of a single male from the same province, caught with a Malaise trap between 1st of October and 11th of November (Zwick 2010). Thus, it seems to be restricted to the Thebek mountain ranges of Korea. As some of the adults that we caught in September are teneral, and the presence of a young larva in September suggests that imagos can occur also quite late in autumn. *Despaxia asiatica* inhabits small forest brooks, our specimens were caught at fast sections with gravel and stony substrate mixed with few sandy patches. Specimens were found in association one to three species (Table 1).



Figs. 37-38. Terminalia of the female adult of *Despaxia asiatica* Zwick 2010. 37: ventral view; 38: lateral view (scale 0.5 mm).

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