



## NEW SPECIES OF *NEOPERLA* NEEDHAM AND *PHANOPERLA* BANKS (PLECOPTERA: PERLIDAE) FROM THE PHILIPPINE ISLANDS

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### ABSTRACT

Five new species of genus *Neoperla* Needham and three new species of genus *Phanoperla* Banks are proposed from specimens collected from Palawan and Mindanao in the Philippine Islands. New taxa include *Neoperla agtouganon* sp. n., *N. andreas* sp. n., *N. palawan* sp. n., *N. sabang* sp. n., *N. salakot* sp. n., *Phanoperla batavica* sp. n., *P. circumspina* sp. n. and *P. magnaspina* sp. n. Additional records are given for *N. dentata* Sivec, 1984, *N. nishidai* Sivec, 1984 and *N. pseudorecta* Sivec, 1984, and one unassociated female is described under informal designation.

**Keywords:** Plecoptera, *Neoperla*, *Phanoperla*, Philippines, New species

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### INTRODUCTION

*Neoperla* Needham and *Phanoperla* Banks are two of the more diverse perlid stonefly genera in Southeast Asia. The former genus currently includes 205 world species and the latter, 46 (DeWalt et al. 2010). Both genera are known to occur on the Philippine Islands with, at least, modest diversity; *Neoperla* currently includes 18 named Philippine species (Sivec 1984; Zwick 1986) and *Phanoperla* includes three (Zwick 1982). The present study is based on a small sample of Neoperlini collected from Palawan in 1995-96 and 1998, and also includes six specimens from Mindanao collected in 1996. Together, these samples include five new species of *Neoperla* and three of *Phanoperla*, suggesting the need for more collecting on the Philippines. Male specimens were prepared for study using the cold maceration technique of Zwick (1983). Specimens are deposited in the Peter Zwick collection, Schlitz, Germany (PZ), the Slovenian Museum of Natural

History, Ljubljana, Slovenia (PMSL) and Zoologisches Museum der Humboldt-Universität, Berlin, Germany (ZMB).

### RESULTS AND DISCUSSION

#### *Neoperla agtouganon* sp. n. (Figs. 1-8)

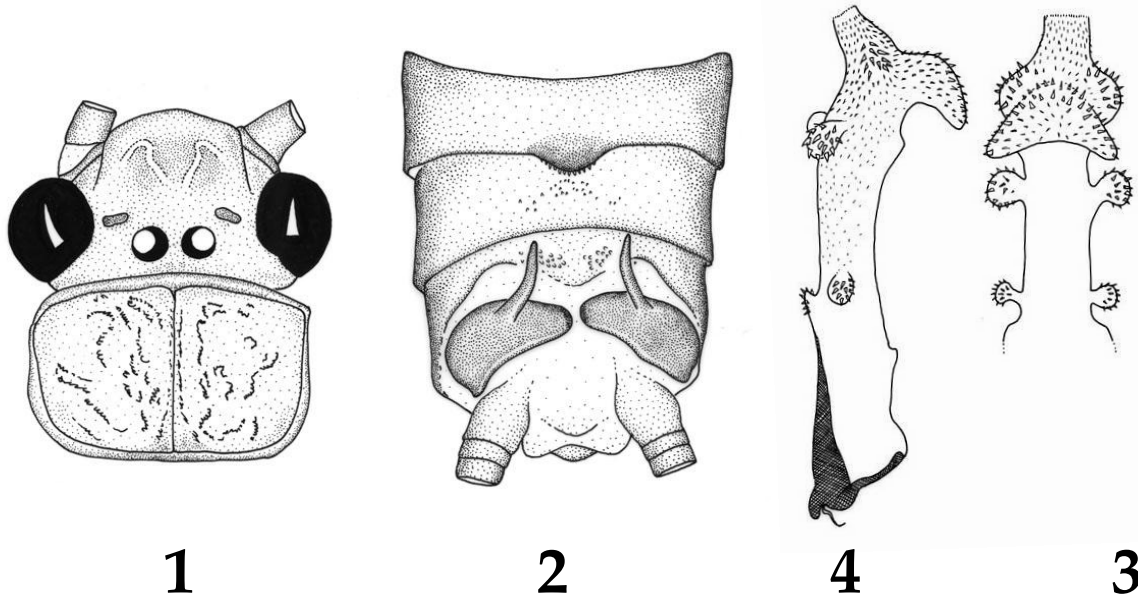
**Material examined.** Holotype ♂, **PHILIPPINE ISLANDS**, Mindanao, Mt. Agtouganon, 1050 m, 28 May-7 June 1996. W. Mey (ZMB). Paratypes 1♂, 4♀, same data as holotype (all specimens deposited in the ZMB).

**Adult habitus.** General color pale brown. Head without distinctive dark pigment patches; pronotum pale with scattered, thin rugosities (Fig. 1).

**Male.** Forewing length 14 mm. Tergum 7 process a small, rounded, median lobe; posterior margin of lobe lined with thick sensilla basiconica. Tergum 8

without lobes, but bearing a sparse mesal patch of sensilla. Tergum 9 with a pair of small median sensilla patches. Hemitergal lobes slender and curved laterad near midlength (Fig. 2). Penis tube short, weakly sclerotized along dorsal margin, and bearing a small spiny, dorsoapical lobe in lateral aspect (Fig. 4). Penis sac longer than tube, bearing

spines along most of length, and curved ventrad into a wide, subapical, spiny lobe, thumb shaped in lateral aspect and somewhat lunate in ventral aspect; sac additionally bearing two basolateral pairs of spiny lobes and a low pair of subapical, spiny outgrowths dorsad to ventral thumb shaped lobe (Figs. 3-4).



Figs. 1-4. *Neoperla agtouganon*. 1. Head and pronotum. 2. Male terminalia. 3. Everted penis sac, dorsal. 4. Penis tube and everted sac, lateral aspect.

**Female.** Forewing length 18-21 mm. Subgenital plate poorly developed, not projecting beyond hind margin of sternum 8.

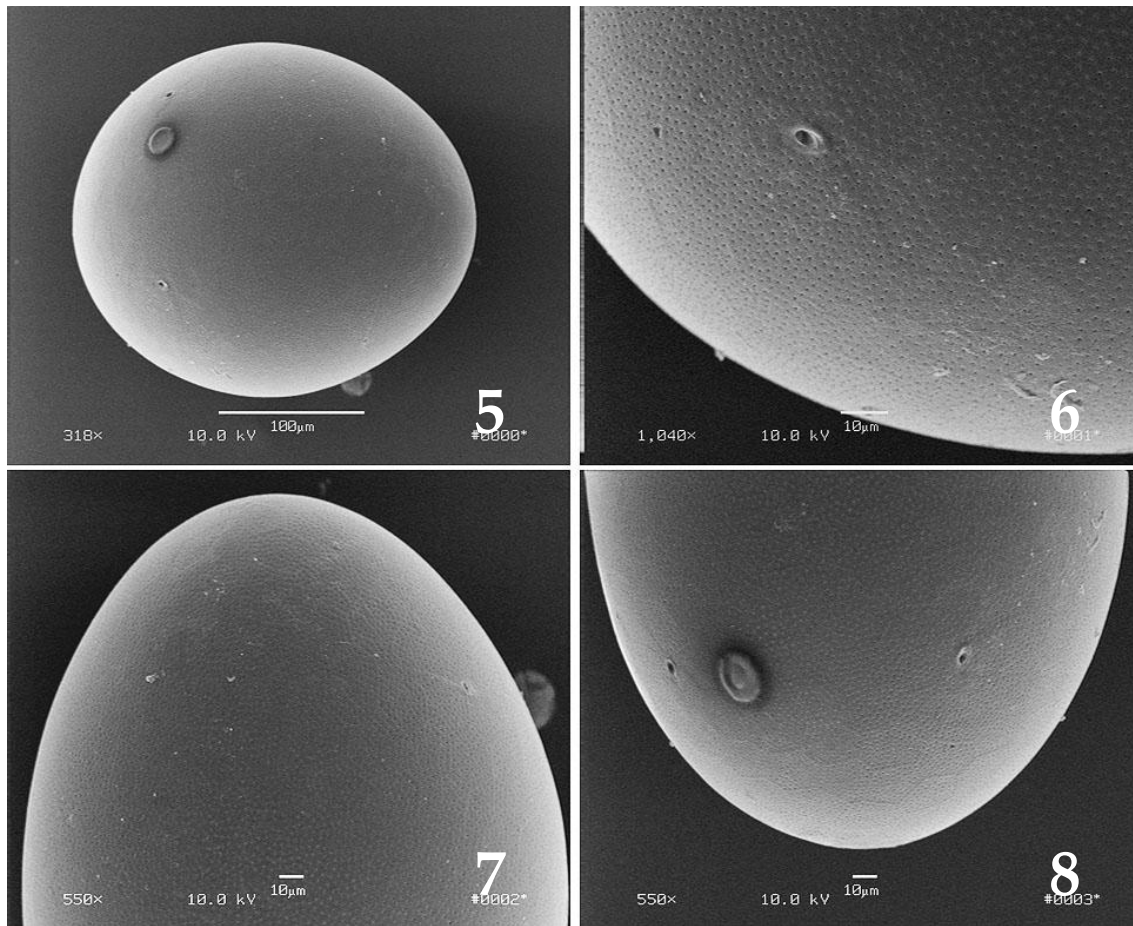
**Egg.** Outline oval, collar absent. Length ca. 280  $\mu$ m, width ca. 240  $\mu$ m. Chorionic surface finely punctate throughout (Figs. 5-8). Micropylar orifices sessile (Fig. 6).

**Larva.** Unknown.

**Etymology.** The species name, used as a noun in apposition, is based on Mt. Agtouganon, the type locality.

**Diagnosis.** This species is a member of the *N. oculata* Banks, 1924 species complex of the *N. montivaga* species group (Sivec 1984; Zwick 1986). Among Philippine members of the complex, the penis of the new species is generally similar to that of *N. pallescens* Banks, 1937 and *N. oculata* in having

multiple pairs of small, dorsolateral lobes and a minor dorsal projection from the penis tube apex. However, the subapical, ventrally hooked, lunate process on the penis sac is unique to *N. agtouganon*. The new species will key to couplet 15 in Sivec (1984) where the ventral lunate process can be interpreted as a single "outgrowth" directing to couplet 16. The presence of at least two pairs of dorsolateral outgrowths on the penis sac directs to couplet 17 where the species is identified either as *N. pallescens* or *N. flinti* Sivec, 1984. However, the lobe positions and general shape of the penis sac are inconsistent with either of these choices. The egg is similar to that of *N. PH D* (Sivec 1984) in lacking a collar and in being finely punctate, however the egg of that species has a fine opercular line.



Figs. 5-8. *Neoperla agtouganan* egg. 5. Entire egg. 6. Micropyle and chorionic detail. 7. Collar end. 8. Anterior end.

***Neoperla andreas* sp. n.**

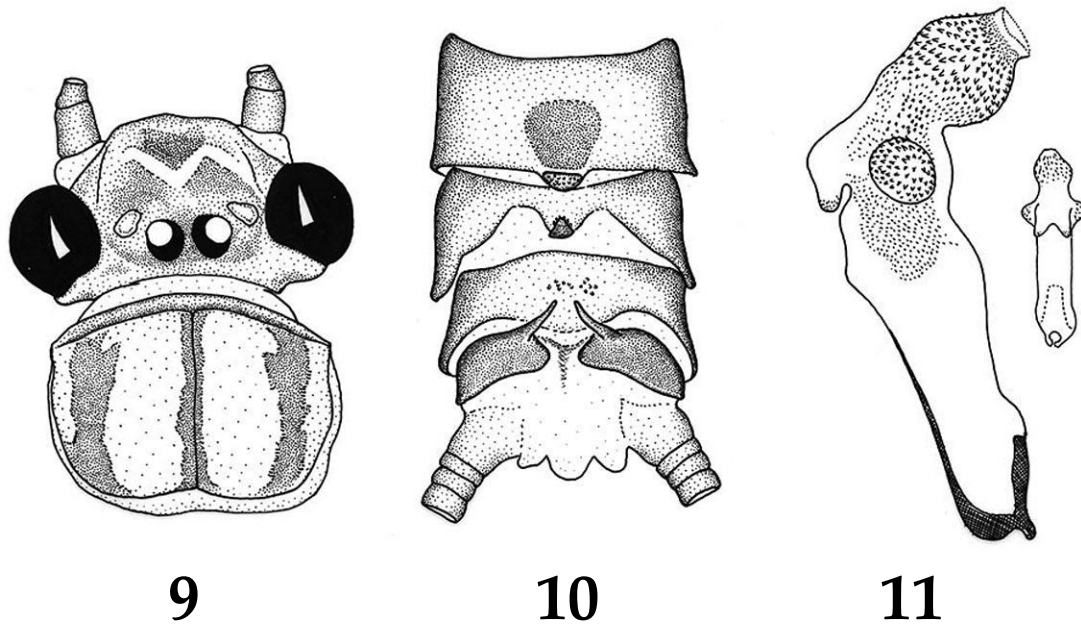
(Figs. 9-11)

**Material examined.** Holotype ♂ and 1♂ paratypes, **PHILIPPINE ISLANDS**, Palawan, Salakot Falls Road, 300 m, 19 March 1996. Additional paratypes: Palawan, Estrella Falls, 3 March 1995, 1♂ (all specimens deposited in the PZ collection).

**Adult habitus.** General color pale brown patterned with yellow. Head pale brown over most of frons, but with a dark spot forward of M-line and a pair of brown spots forward of callosities (Fig. 9). Pronotum with narrow median and sublateral dark bands. Legs, antennae and palpi pale; wings pale brown with darker venation. Ocelli large, about 1 diameter apart.

**Male.** Forewing length 13 mm. Tergum 7 bearing a small posteromedian triangular lobe and a median sclerotized area (Fig. 10). Tergum 8 with a small, median, recurved, tongue-shaped process. Tergum 9 with a small median patch of sensilla. Hemitergal lobes slender, conspicuously narrowed to apex, scarcely bent and directed mesad. Penis tube weakly sclerotized along ventral margin, bare, and subequal to sac in length (Fig. 11). Sac curved dorsad near apex and armed over much of surface with variably sized spines, largest spines form a moderately wide penultimate band; subapex of sac bearing a narrow ring of fine spines; venter of sac bearing near midlength, a large, basally directed, weakly bilobed process, mostly bare but weakly armed on tips;





Figs. 9-11. *Neoperla andreas*. 9. Head and pronotum. 10. Male terminalia. 11. Penis tube and everted sac, lateral aspect, and ventral aspect inset.

dorsolateral of ventral lobe, a pair of spherical, spiny lobes are located.

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name honors Dr. Andreas Zwick, who graciously forwarded this material for our study.

**Diagnosis.** *Neoperla andreas* is a member of the *N. recta* Banks, 1913 complex of the *N. montivaga* species group (Sivec 1984; Zwick 1986). This complex currently includes four Philippine species, *N. nishidai* Sivec, 1984, *N. pseudorecta* Sivec, 1984, *N. recta* and *N. zwicki* Sivec, 1984. The new species is the only one of this group in which the ventral penial lobe is bilobed and at least weakly armed.

#### *Neoperla dentata* Sivec

*Neoperla dentata* Sivec, 1984:37. Holotype ♂ (Bernice P. Bishop Museum), 4 km N San Nicolas, Busuanga Island, Philippine Islands

**Material examined.** PHILIPPINE ISLANDS,

Palawan, Salakot Falls Road, 300 m, 19 March 1996, 4♂. Same locality, 23.-24 March 1996, 1♂. Palawan, Salakot Falls Road to Napsan, 7 March 1998, 1♂. Palawan, San Rafael, Ulanguan, end of February 1996, 9♂, 2♀. Palawan, San Rafael, Ulanguan, Batac village, 10 March 1996, 3♂. Palawan, Bataraza, Tigwayan Falls, 29 March 1996, 1♂. Palawan, PPC, Irawan, 22 February 1996, 1♂, 1♀ (all specimens deposited in the PZ collection).

**Comments.** Sivec (1984) reported this species from two sites on Palawan in addition to the type locality on Busuanga Island and Zwick (1986) reported it from Sarawak. The species was previously known from five male and three female specimens.

#### *Neoperla nishidai* Sivec

*Neoperla nishidai* Sivec, 1984:13. Holotype ♂ (Bernice P. Bishop Museum), 4 km N San Nicolas, Busuanga Island, Philippine Islands

**Material examined.** PHILIPPINE ISLANDS, Palawan, Salakot Falls Road, 300 m, 19 March 1996,

1♂. Same locality, 23-24 March 1996, 1♂. Palawan, San Rafael, Ulanguan, Batac village, 10 March 1996, 1♂. Palawan, PPC, Irawan, 22 February 1996, 1♂ (all specimens deposited in the PZ collection).

**Comments.** Sivec (1984) reported this species from three sites on Palawan in addition to the type locality. The species was previously known from four males and one female specimen, however another similar female with a different egg was collected with these males and is described below as *Neoperla* PA-9. This may be the true female for *N. nishidai*, but in the absence of additional data, no determination can be made.

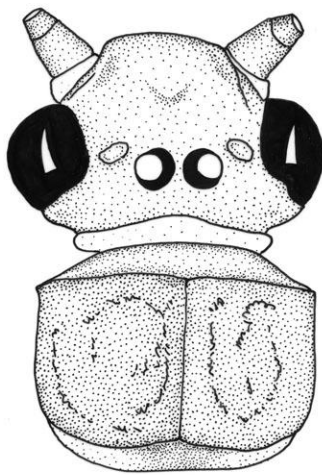
*Neoperla palawan* sp. n.  
(Figs. 12-14)

**Material examined.** Holotype ♂ and 1♂ paratype, PHILIPPINE ISLANDS, Palawan, Salakot Falls Road, 300 m, 19 March 1996. Additional paratypes: Palawan, San Rafael, Ulanguan, end of February 1996, 1♂ (all specimens deposited in the PZ

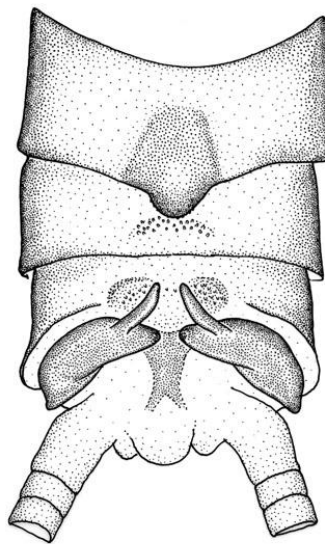
collection).

**Adult habitus.** General color pale brown. Head without distinctive pigment pattern (Fig. 12); pronotum pale brown with slender rugosities looped over disk.

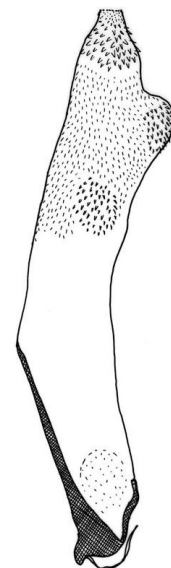
**Male.** Forewing length 12 mm. Tergum 7 bearing a broadly rounded, posteromedian lobe, and a median sclerotized area which extends onto lobe (Fig. 13). Tergum 8 with a small, median patch of sensilla. Tergum 9 with a pair of low, median humps bearing patches of sensilla. Hemitergal lobes curved slightly laterad near midlength, and scarcely narrowed from base to apex. Penis tube unsclerotized along ventral margin, but with a strong dorsal sclerite (Fig. 14); tube unarmed except for minor microtrichia on bulb. Sac slightly longer than tube and armed in apical half with variably sized spines; largest spines in penultimate band near apex and in circular clusters at midlength of armature on ventral margin, and basolaterally in armature band; sac bent slightly ventrad and with only a low, rounded ventral outgrowth.



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13



14

Figs. 12-14. *Neoperla palawan*. 12. Head and pronotum. 13. Male terminalia. 14. Penis tube and everted sac, lateral aspect.

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name, used as a noun in apposition, honors the native Palawan people.

**Diagnosis.** This species is difficult to place but may be another member of the *N. oculata* complex. The absence of distinctive long outgrowths on the penis sac separates it from all but *N. dentata* among Philippine *Neoperla*. That species has a longer, dorsally directed penis sac armed subapically with very large spines along the ventral margin (Sivec 1984), and the two species do not appear to be closely related.

*Neoperla pseudorecta* Sivec

*Neoperla pseudorecta* Sivec, 1984:11. Holotype ♂ (United States National Museum), 25 km W Cebu City, Camp 7, 400 m, Cebu Island, Philippine Islands

**Material examined.** PHILIPPINE ISLANDS, Palawan, Salakot Falls Road, 300 m, 19 March 1996, 1♂ (PMSL).

**Comments.** Sivec (1984) reported ten males of this species from Cebu, Negros, Luzon and Busuanga islands in the Philippines. This specimen represents

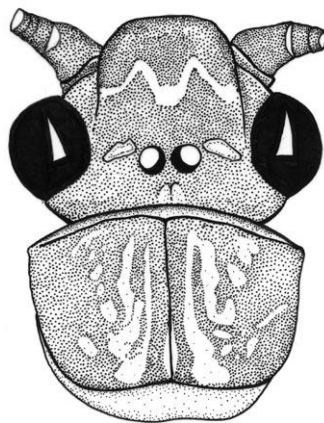
the first record from Palawan; female specimens collected at this site could not definitely be associated with this male.

*Neoperla sabang* sp. n.

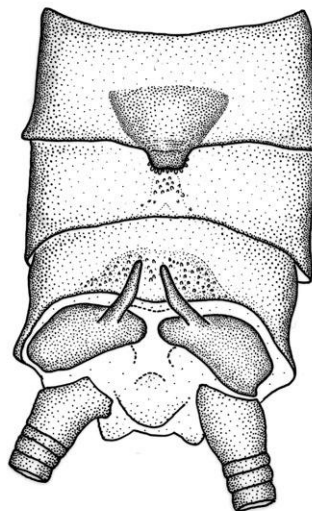
(Figs. 15-23)

**Material examined.** Holotype ♂, PHILIPPINE ISLANDS, Palawan, Sabang, 8 March 1995 (PZ). Paratypes: Palawan: El Nido stream, 19 March 1995, 1♂ (PZ). Palawan, Salakot Falls Road, 300 m, 23-24 March 1996, 1♂, 1♀ (PZ). Palawan, Mt. Salakot Heli-Pad, 720 m, 19 March 1996, 2♀ (PZ). Palawan, San Rafael, Ulanguan, Batac Village, 10 March 1996, 3♂, 1♀ (PZ), 1♂ (PMSL). Specimens deposited in the PZ collection, or the PMSL as indicated.

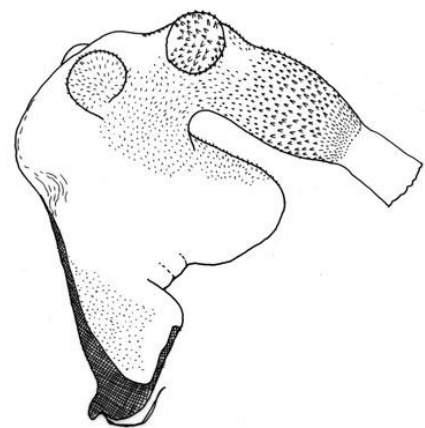
**Adult habitus.** General color dark brown patterned with areas of pale pigment. Head dark brown over most of surface except pale M-line and callosities (Fig. 15). Antennae and palpi brown. Ocelli about 1.5 diameters apart. Pronotum dark brown with pale callosities. Distal third of femora and all of tibia dark brown. Wings brown with darker venation.



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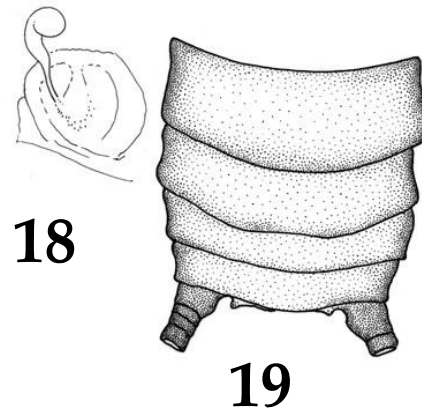
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Figs. 15-19. *Neoperla sabang*. 15. Head and pronotum. 16. Male terminalia. 17. Penis tube and everted sac, lateral aspect.

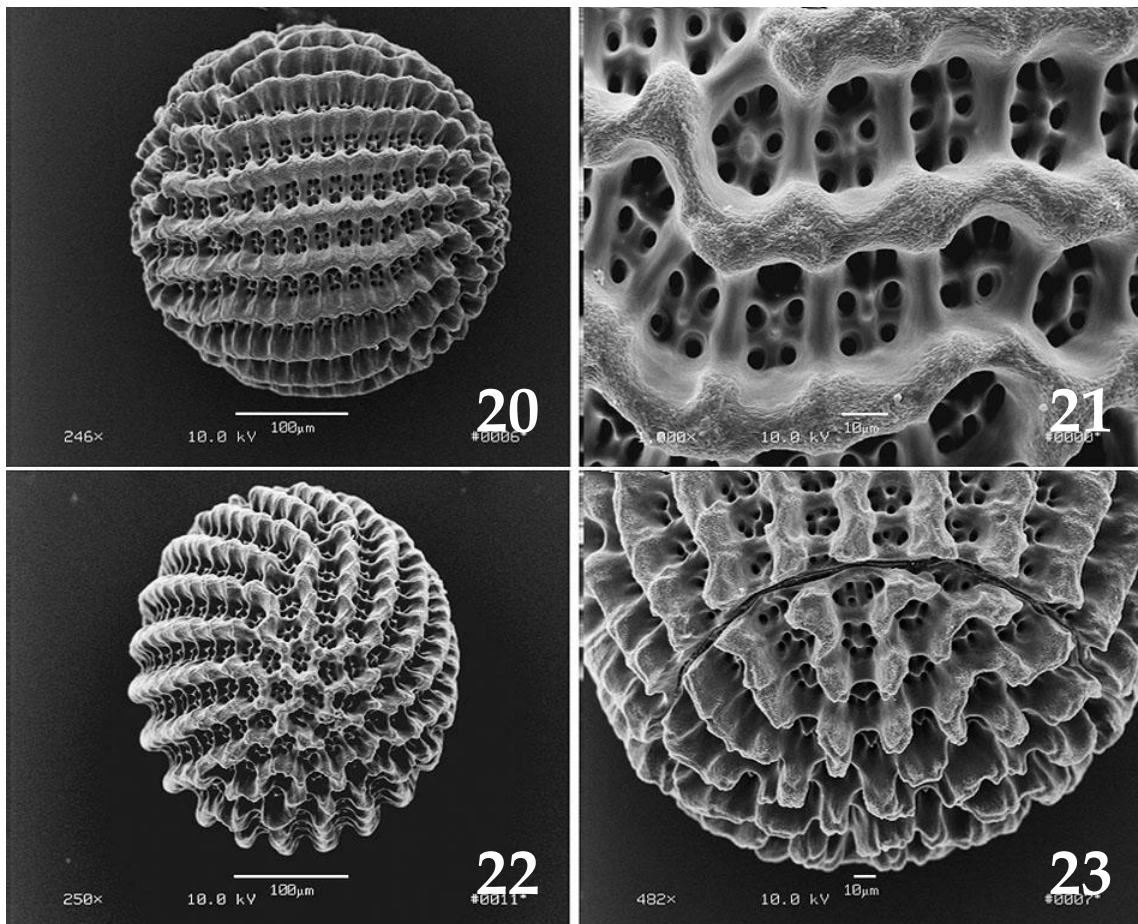


**Male.** Forewing length 14 mm. Tergum 7 bearing a truncate, or slightly notched, median lobe, armed on ventroapical margin with thick, sensilla basiconica (Fig. 16). Tergum 8 with a mesal sclerotized band and a sparse patch of sensilla. Tergum 9 bearing a pair of median humps sparsely covered with sensilla and long hair; sensilla extend into area between humps. Hemitergal lobes slender, tapered to apex, and bent slightly near midlength. Penis tube plump, tube weakly sclerotized along dorsal margin and basally on ventral margin; a sparse patch of fine spinules occurs in bulb region of tube (Fig. 17); sac much distended ventrobasally into a wide projection covered on distal surface with minute spines; apex of sac narrowed, turned sharply ventrad, and bearing two pairs of small, circular, spiny lobes along dorsal margin; largest spines occur in broad, subapical band; apex and dorsal area near lobes free of spines.

**Female.** Forewing length 17 mm. Subgenital plate scarcely developed (Fig. 19), spermatheca short and membranous (Fig. 18).



Figs. 18-19. *Neoperla sabang*. 18. Vagina and spermatheca. 19. Female terminalia.



Figs. 20-23. *Neoperla sabang* egg. 20. Entire egg. 21. Chorionic detail. 22. Apical aspect, collar end. 23. Apical aspect, anterior end.

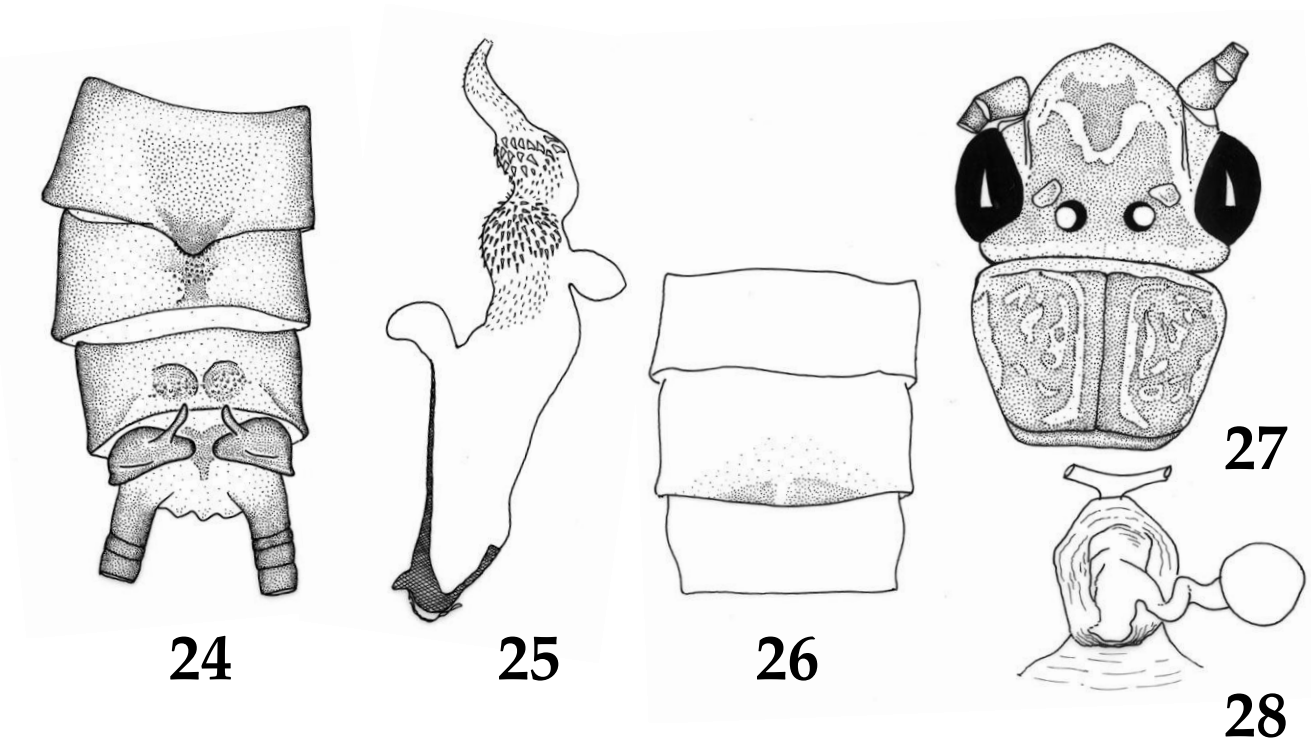
**Egg.** Outline barrel shaped, collar absent. Length ca. 360  $\mu\text{m}$ , width ca. 340  $\mu\text{m}$ . Opercular ring thin. Surface ornate with ca. 21, slightly curved striae extending from operculum to near collar end (Figs. 20-23); sulci with row of rectangular follicle cells each containing 4-6 pores. Collar and opercular ends with irregular follicle cell impressions having thick walls and punctate floors. Micropyles not observed.

**Larva.** Unknown.

**Etymology.** The species name, used as a noun in apposition, is based on the type locality.

**Diagnosis.** This species is a near relative of *N.*

*philippina* Sivec, 1984, a member of the *N. oculata* species group, and shares the small median notch in the process of tergum 7 with that species (Sivec 1984), at least in most specimens at hand. The penis is also quite similar to that species in general shape, but the basoventral lobe on the sac in *N. philippina* is smaller and more finger-like, and the subapical band of spines is narrower and composed of larger spines than in *N. sabang*. In addition, the entire penial sac is covered with spines in *N. philippina*, whereas in *N. sabang* a large area along the dorsal surface between the lobes is bare.



Figs. 24-28. *Neoperla salakot*. 24. Male terminalia. 25. Penis tube and everted sac, lateral aspect. 26. Female abdominal sterna 7-9. 27. Head and pronotum. 28. Vagina and spermatheca.

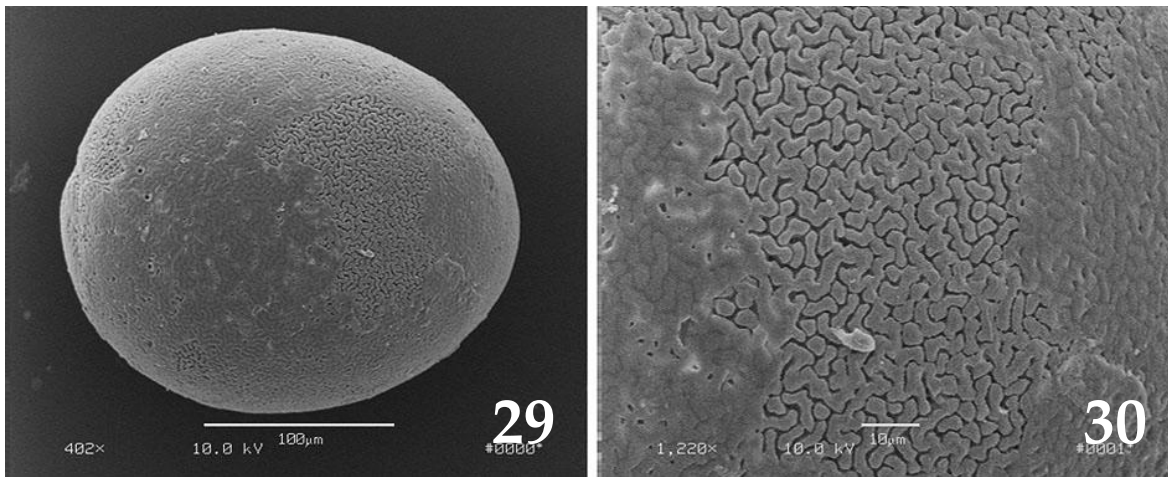
*Neoperla salakot* sp. n.  
(Figs. 24-30)

**Material examined.** Holotype ♂, 1♂ paratypes, **PHILIPPINE ISLANDS**, Palawan, Salakot Falls Road, 300 m, 19 March 1996, (Holotype PZ), 1♂ paratype (PMSL) Additional paratypes: Palawan, type locality but 23-24 March 1996, 2♂, 1♀ (PZ), 1♀ (PMSL). Palawan, Salakot Falls Road to Napsan, 9° 42' 9.6" N, 118° 31' 18" E, 7 March 1998, 1♂, 1♀ (PZ).

Palawan, Mt. Salakot Heli-Pad, 720 m, 18 March 1996, 2♂ (PZ). Palawan, San Rafael, Ulanguan, end of February 1996, 2♂ (PZ). Palawan, Irawan, 22 April 1996, 1♀ (PZ). Specimens deposited in the PZ collection, or the PMSL as indicated.

**Adult habitus.** General color brown with areas of pale pigment. Head mostly brown with pale M-line (Fig. 27). Ocelli about 2 diameters apart. First two antennal segments pale brown, rest dark brown; palpi brown. Pronotum brown with scattered pale





Figs. 29-30. *Neoperla salakot* egg. 29. Entire egg. 30. Chorionic detail.

areas on disc. Femora banded, dark brown in distal half; tibia brown. Wings brown, veins slightly darker.

**Male.** Forewing length 10 mm. Tergum 7 with a rounded, subtriangular, posteromedian lobe, and a median sclerotized area which extends onto lobe (Fig. 24); apex of lobe armed along ventroapical margin with thick sensilla basiconica. Tergum 8 with a small median sensilla patch covering a narrow sclerotized band. Tergum 9 with a pair of low median humps sparsely covered with sensilla. Hemiterga broad at midlength; hemitergal lobes slender, curved slightly laterad and somewhat expanded near apex. Penis tube slender, dorsal sclerite well developed; sac bearing an unarmed, dorsobasal, finger-like lobe, and a more distal, unarmed ventral lobe (Fig. 25). Large spines occur in a dorsolateral band distal to ventral lobe, and a smaller patch of large spines occurs distal to the first. Sac apex very slender and armed along much of length to tip.

**Female.** Forewing length 13-15 mm. Subgenital plate poorly developed, not projecting beyond posterior margin of sternum 8 (Fig. 26). Vagina and spermatheca membranous (Fig. 28).

**Egg.** Outline oval, collar absent. Length ca. 290 μm, width ca. 245 μm. Chorionic surface irregularly vermiculate throughout (Figs. 29-30). Micropyles with large sessile orifices located near anterior end of egg.

**Larva.** Unknown.

**Etymology.** The species name, used as a noun in apposition, is based on the type locality.

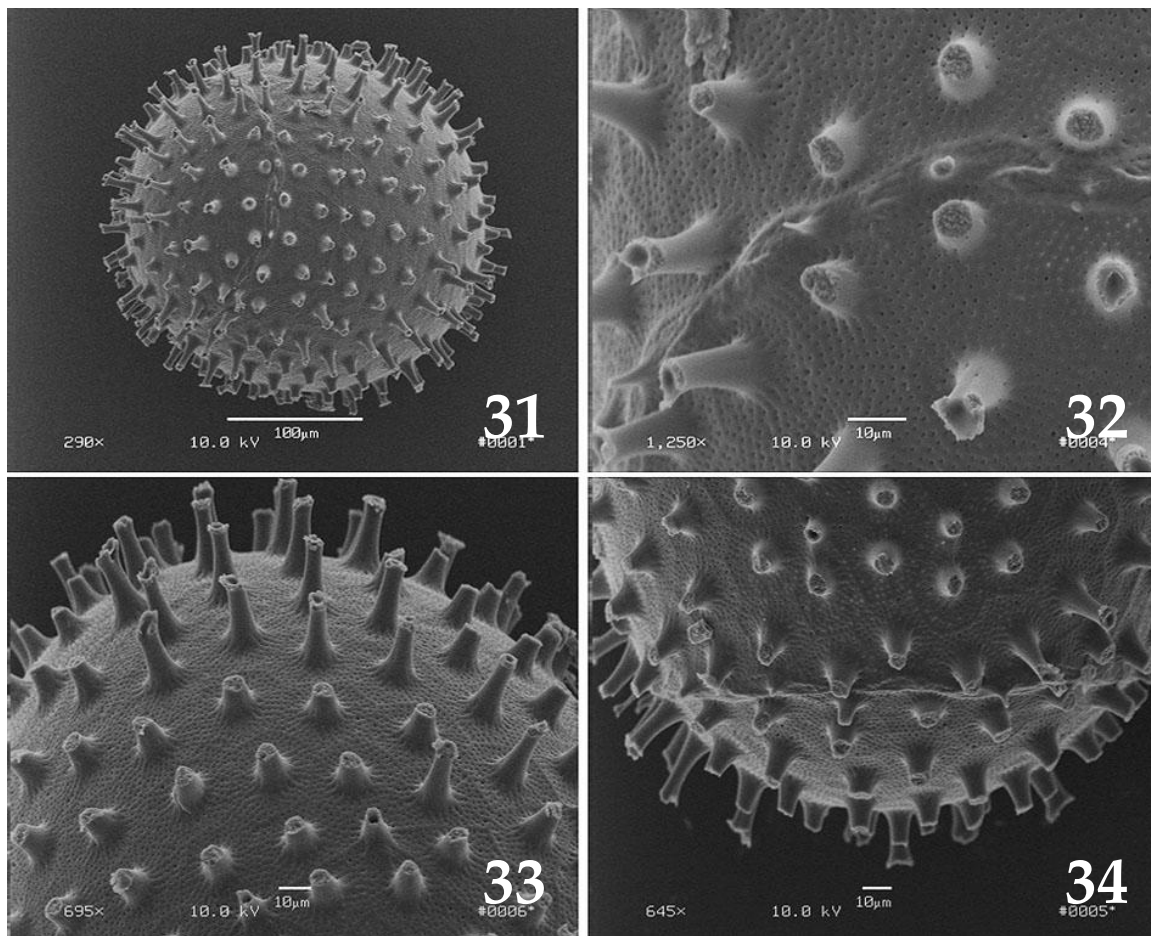
**Diagnosis.** The penis of this species is generally similar in outline to that of *N. atropennis* Banks, 1924. However, in that species a prominent, ventroapical, spiny lobe occurs on the penis sac margin (Sivec 1984), whereas in *N. salakot*, the penial sac lobes lack spines.

#### *Neoperla* PA-9 (Figs. 31-34)

**Material examined.** PHILIPPINE ISLANDS, Palawan, Salakot Falls Road, 300 m, 19 March 1996, 7♀ (PZ), 1♀ (PMSL). Palawan, Salakot Falls Road to Napsan, 9° 42' 9.6" N, 118° 31' 18" E, 7 March 1998, 1♀ (PZ). Palawan, Estrella Falls, 3 March 1995, 2♀ (PZ). Specimens deposited in the PZ collection, or the PMSL as indicated.

**Female.** Length of forewing 17 mm. Subgenital plate slightly produced over base of abdominal sternum 9 and broadly rounded.

**Egg.** Outline broadly oval, collar absent. Length ca. 271 μm, width ca. 256 μm. Chorion finely punctate throughout and bearing long, erect hollow processes scattered in irregular rows over entire chorion (Figs. 31-34). Opercular line thin and obscure, but bearing a series of small, raised spine-like processes.



Figs. 31-34. *Neoperla* species PA-9 egg. 31. Entire egg. 32. Chorionic detail. 33. Collar end. 34. Anterior end.

**Comments.** As indicated in the comments section for *N. nishidai*, this could be the true female of that species.

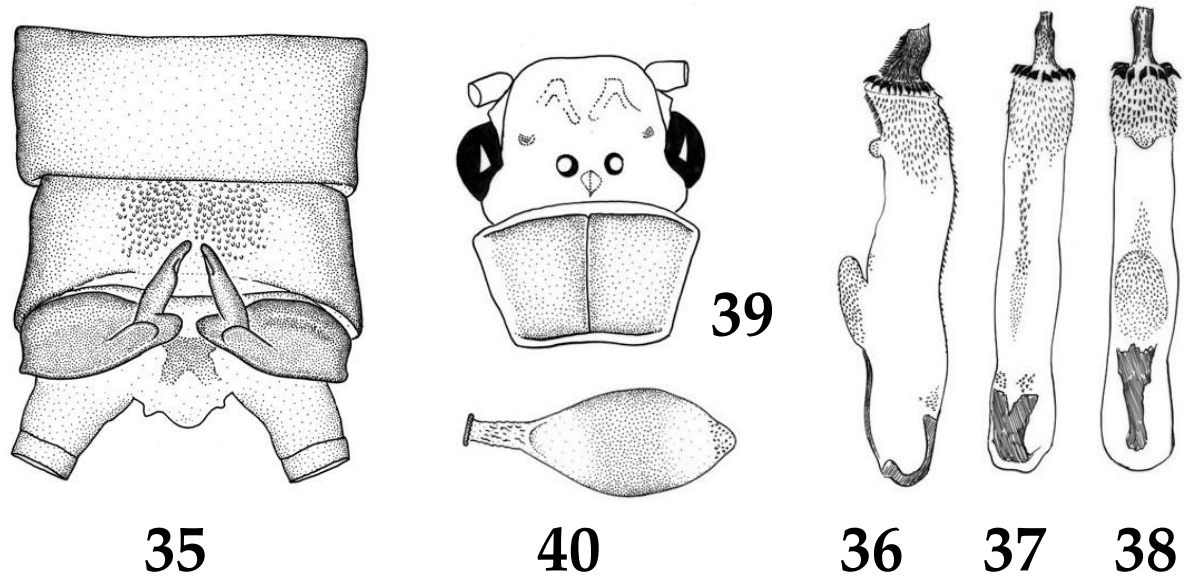
***Phanoperla batavica* sp. n.**  
(Figs. 35-44)

**Material examined.** Holotype ♂ and 1♀ paratypes, **PHILIPPINE ISLANDS**, Palawan, San Rafael, Ulanguan, Batac Village, 10 March 1996, (Holotype PZ), 1♀ paratype (PMSL). Additional paratypes: Palawan, San Rafael, Ulanguan, end of February 1996, 5♂ (PZ), 1♂ (PMSL). Palawan, Salakot Falls Road, 19 March 1996, 4♂, 1♀ (PZ). Palawan, Mt. Salakot, Heli-Pad, 720 m, 19 March 1996, 1♂ (PZ). Specimens deposited in the PZ collection, or the

PMSL as indicated.

**Adult habitus.** General color pale yellow or white. Head uniformly pale, ocelli small, about two diameters apart; callosities and M-line indistinct, antennae and palpi pale but 1<sup>st</sup> antennal segment brownish. Pronotum pale but slightly darker along margins and median suture (Fig. 39). Legs and wings pale.

**Male.** Forewing length 9.5 mm. Tergum 9 bearing a large mesal patch of sensilla narrowly divided on midline (Fig. 35). Hemiterga with a slightly raised, elongate swelling overlapping base of hemitergal lobes; hemitergal lobes excavated along inner margins near apex, relatively straight and directed mesad. Abdominal sterna 4-5 with ventral hair brushes. Penis tube poorly sclerotized but bearing an



Figs. 35-40. *Phanoperla batac*. 35. Male terminalia. 36-38. Penis tube and everted sac. 36. Dorsal aspect. 37. Ventral aspect. 38. Lateral aspect. 39. Head and pronotum. 40. Egg.

irregular dorsal sclerite and a thumb shaped, apically directed spiny lobe; penis sac armed only near apex on lateral and dorsal surface but with a narrow mid-ventral band of spines (Figs. 36-38); subapex bearing an almost complete ring of ca. 14 larger black spines; apex of sac abruptly narrowed beyond spine ring and armed with a dense coating of small black spines; dorsum of sac bearing a small spiny lobe near apex. **Female.** Forewing length 10-12 mm. Subgenital plate poorly developed, not projecting beyond posterior margin of sternum 8.

**Egg.** Outline tear drop shaped with long, slender collar, rugose along surface and with a small flanged rim (Fig. 40-44); chorionic surface with a median zone of fine punctations and a small zone of coarser punctations on lid.

**Etymology.** The species name, used as a noun in apposition, honors the Batac people of Palawan.

**Diagnosis.** The penis tube and sac of this species is generally similar to that of *P. sertispina* Jewett, 1975, an Indian member of the *P. anomala* (Banks, 1939) species group. This species shares a relatively complete apical ring of large black penial spines, other sac armature limited primarily to the apical half, and a tear drop shaped egg with long slender collar with members of the *P. anomala* complex, and

should probably be assigned to that group. The new species differs from these species in having an almost cylindrical and relatively straight penial tube and sac, and in having the dorsal thumb shaped lobe somewhat larger and covered with small spines.

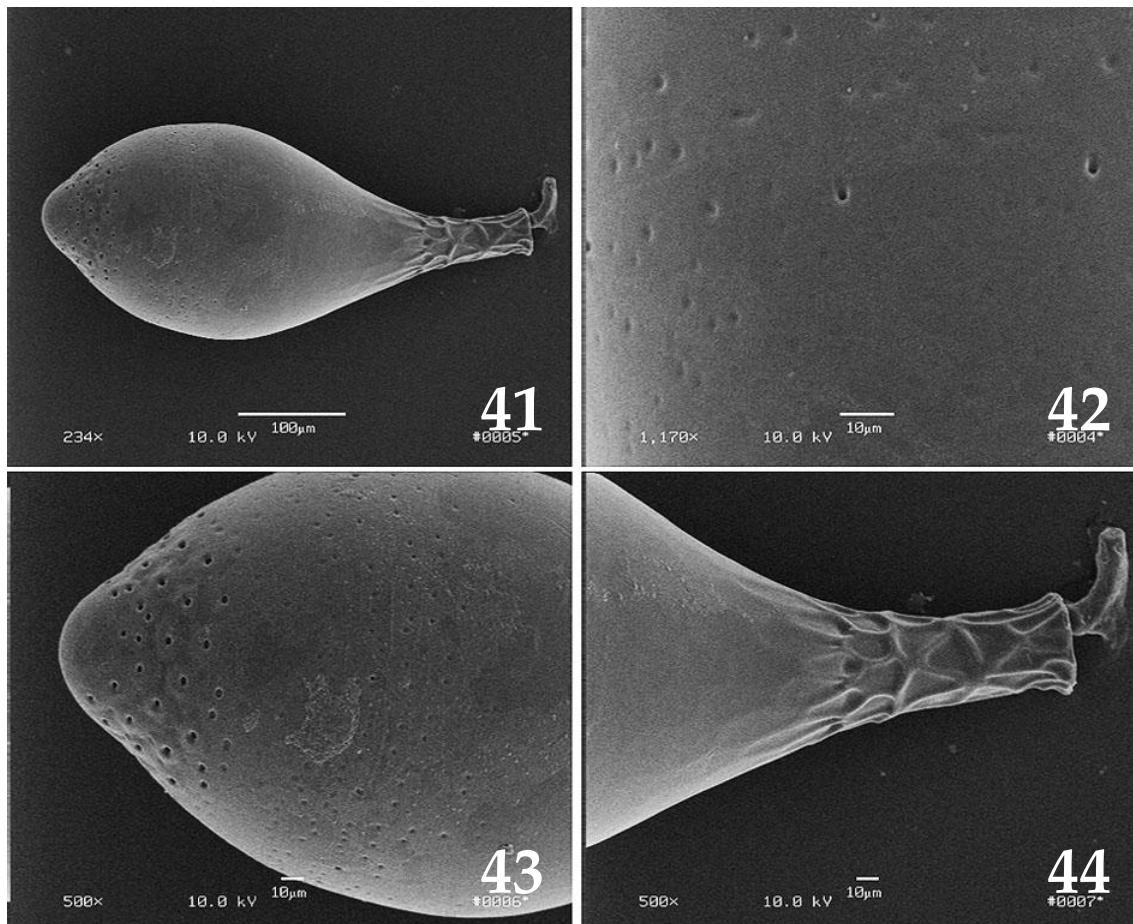
*Phanoperla circumspina* sp. n.  
(Figs. 45-54)

**Material examined.** Holotype ♂ and 14♂, 1♀ paratypes, **PHILIPPINE ISLANDS**, Palawan, Salakot Falls Road, 300 m, 19 March 1996, (PZ). Additional paratypes: Palawan, San Rafael, Ulanguan, end of February 1996, 6♂ (PZ), 1♂, 1♀ (PMSL). Specimens deposited in the PZ collection, or the PMSL as indicated.

**Adult habitus.** General color pale yellow-brown, patterned with pale brown. Head pale brown, slightly darker anterior to M-line (Fig. 45). Pronotum pale with scattered darker rugosities and narrow dark band along median suture. Ocelli almost touching.

**Male.** Forewing length 9 mm. Tergum 9 with a small median and two larger lateral patches of sensilla (Fig. 46). Hemiterga typical, without special modifications, hemitergal lobes short, wide basally,





Figs. 41-44. *Phanoperla batavica* egg. 41. Entire egg. 42. Chorionic detail. 43. Anterior end. 44. Collar end.

pointed at the apex and triangular in outline. Penis tube subequal to sac in length, without lobes or armature (Figs. 47-50); dorsal margin of tube weakly sclerotized, ventral margin membranous. Sac armed near apex with double ring of widely spaced, large black spines, mostly clustered in groups of three; a few small spines located near sac base, and intermingled with large black spines; apex a small cylinder armed over most of surface with small black spines.

**Female.** Forewing length 11 mm. Genitalic structures damaged.

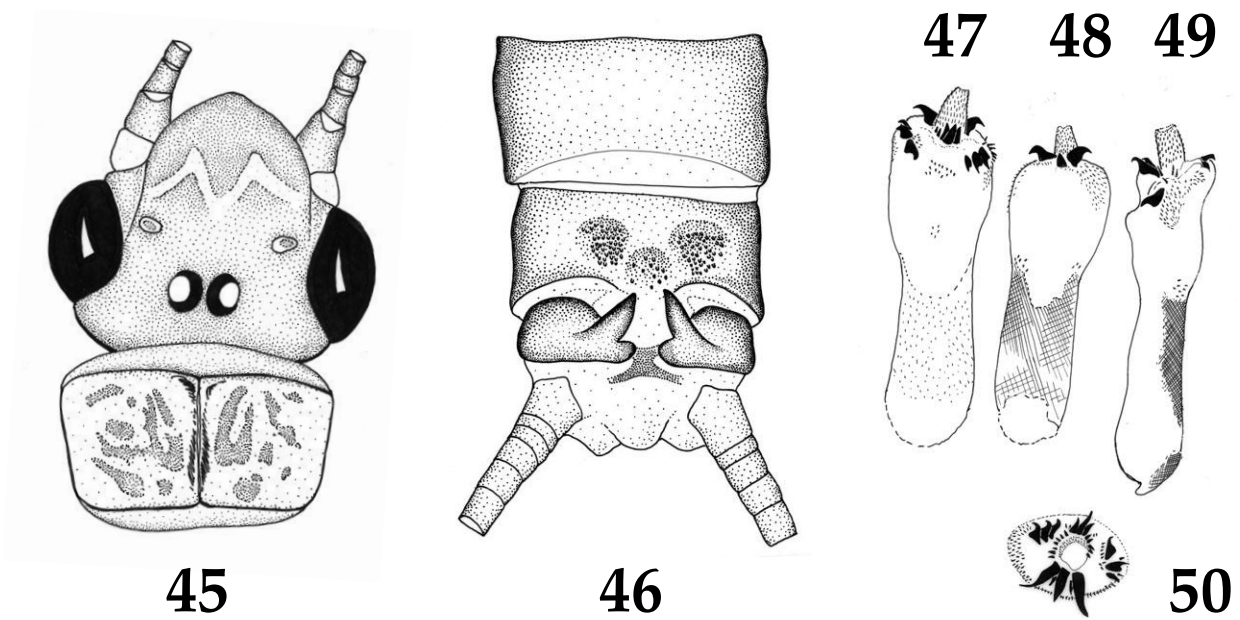
**Egg.** Outline oval with short, wide collar (Fig. 51). Total length ca. 227 µm, equatorial width ca. 176 µm, collar length ca. 23 µm. Chorion covered throughout with coarse, circular punctations, becoming less

abundant on lid (Figs. 52-54). Collar rim scarcely flanged, sides bearing a series of vertical ridges.

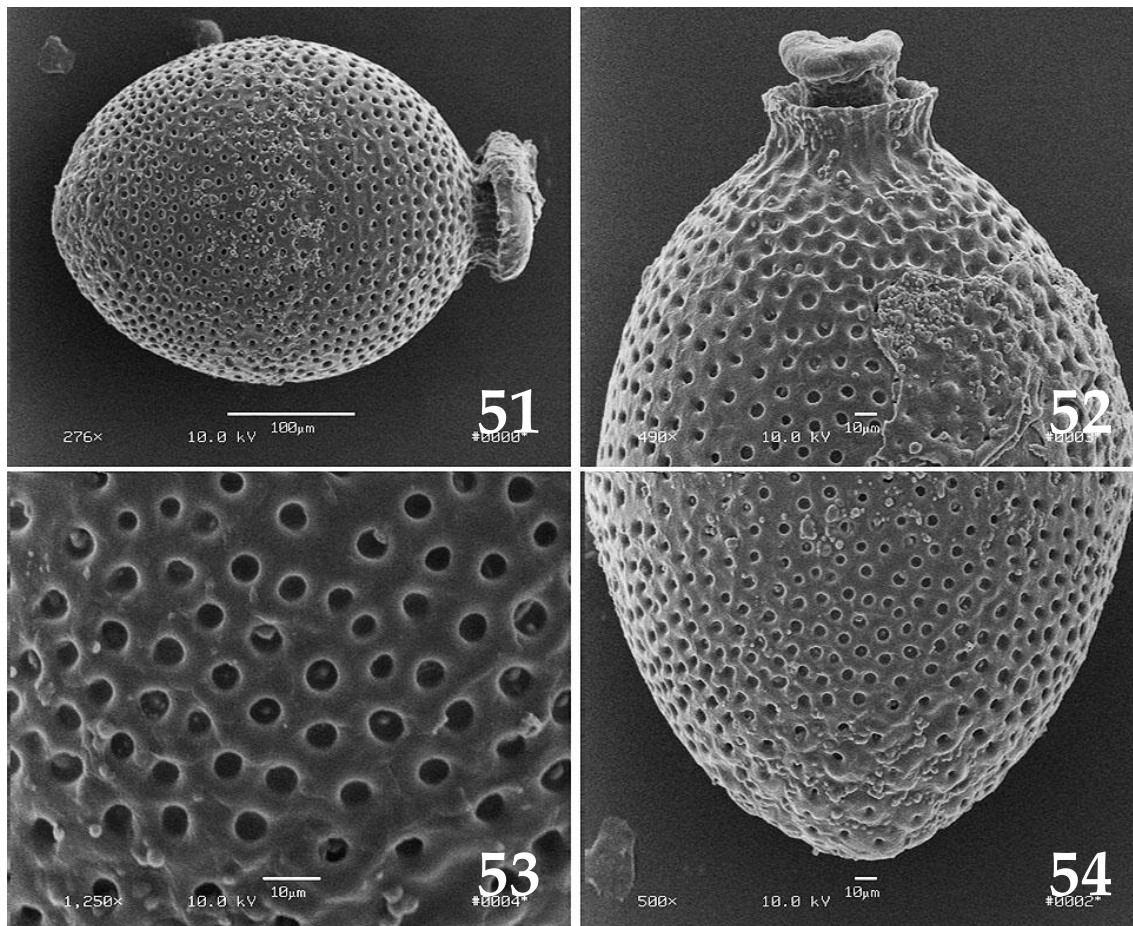
**Larva.** Unknown.

**Etymology.** The species name refers to the circular arrangement of large spines near the penial sac apex.

**Diagnosis.** This species is a member of the *P. flaveola* (Klapálek, 1910) species group and appears to be closely related to *P. flaveola*, a species reported from several of the Philippine islands, including Palawan (Zwick 1982) and to *P. magnaspina* sp. n., described below. Externally, *P. flaveola* differs from the new species in the absence of a median patch of sensilla and small sclerite on tergum 9, and the two differ subtly in details of the penial armature. The distal ring of spines in the new species has three, much larger spines ventrally and small gaps adjacent to the



Figs. 45-50. *Phanoperla circumspina*. 45. Head and pronotum. 46. Male terminalia. 47-50. Penis tube and everted sac. 47. Ventral aspect. 48. Dorsal aspect. 49. Lateral aspect. 50. Apical aspect.



Figs. 51-54. *Phanoperla circumspina* egg. 51. Entire egg. 52. Collar end. 53. Chorionic detail. 54. Anterior end.



larger spines, whereas the distal ring for *P. flaveola* lacks gaps adjacent to the larger spines. In addition, the proximal spine groupings in *P. flaveola* consist of five spines and in *P. circumspina*, they consist of three spines.

***Phanoperla magnaspina* sp. n.**  
(Figs. 55-64)

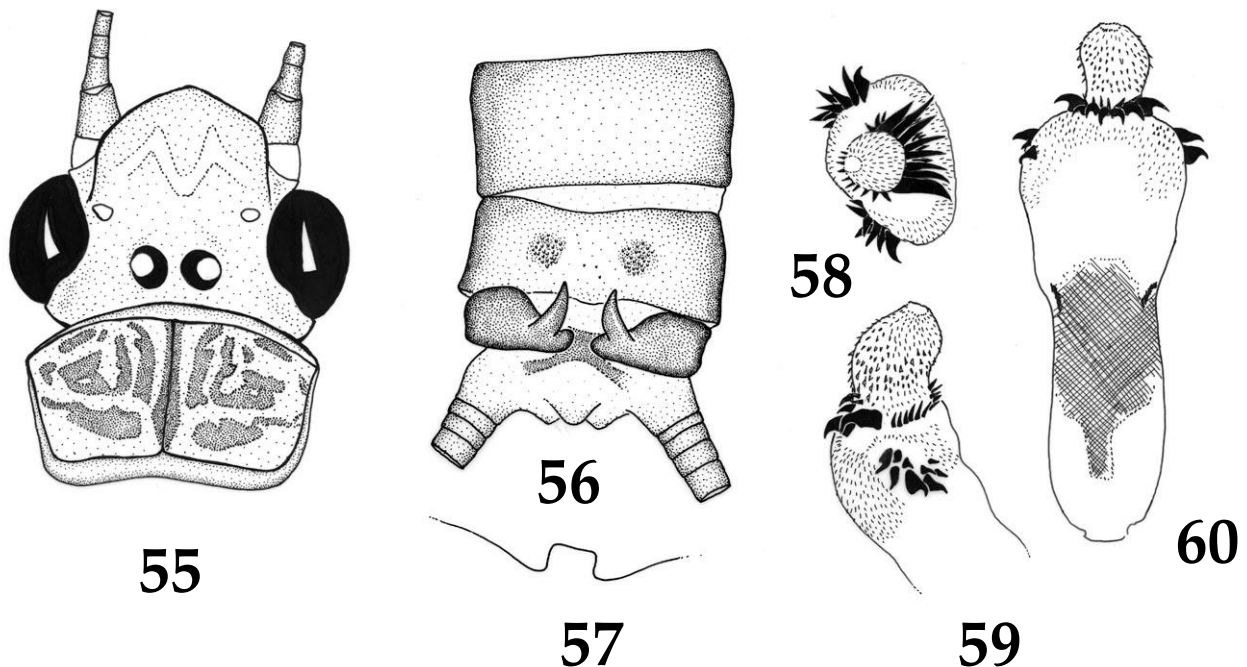
**Material examined.** Holotype ♂ and 21♂, 13♀ paratypes, **PHILIPPINE ISLANDS**, Palawan, Salakot Falls Road, 300 m, 19 March 1996, (holotype and 19 ♂, 11 ♀ paratypes PZ), 2♂, 2♀ (PMSL). Additional paratypes: Palawan, San Rafael, Ulanguan, end of February 1996, 2♂, 3♀ (PZ). Specimens deposited in the PZ collection, or the PMSL as indicated.

**Adult habitus.** General color pale with darker markings on pronotum. Head pale with pale M-line distinct. Ocelli separated by about 0.5 diameters (Fig. 55). Antennae pale brown. Pronotum with pale

narrow band along median suture and scattered dark rugosities on disc.

**Male.** Forewing length 9 mm. Tergum 9 with two sparse patches of sensilla located distal to hemitergal lobe apices (Fig. 56). Hemitergal lobes broad basally, tapered to an acute apex and curved slightly laterad. Penis tube plus sac plump, short and armed with a subapical ring of prominent black spines and a pair of lateral clusters of large dark spines set proximally to subapical ring (Figs. 58-60). Apex of sac cylindrical, much smaller in diameter than median and basal sections of sac, and covered with coarse to fine triangular spines; areas around spine ring and lateral clusters of large spines also bearing numerous small spines. Largest spines located in a cluster of eight along ventral side of subapical ring.

**Female.** Forewing length 11 mm. Subgenital plate slightly produced over base of sternum 9 and bearing a quadrate median notch (Fig. 57).

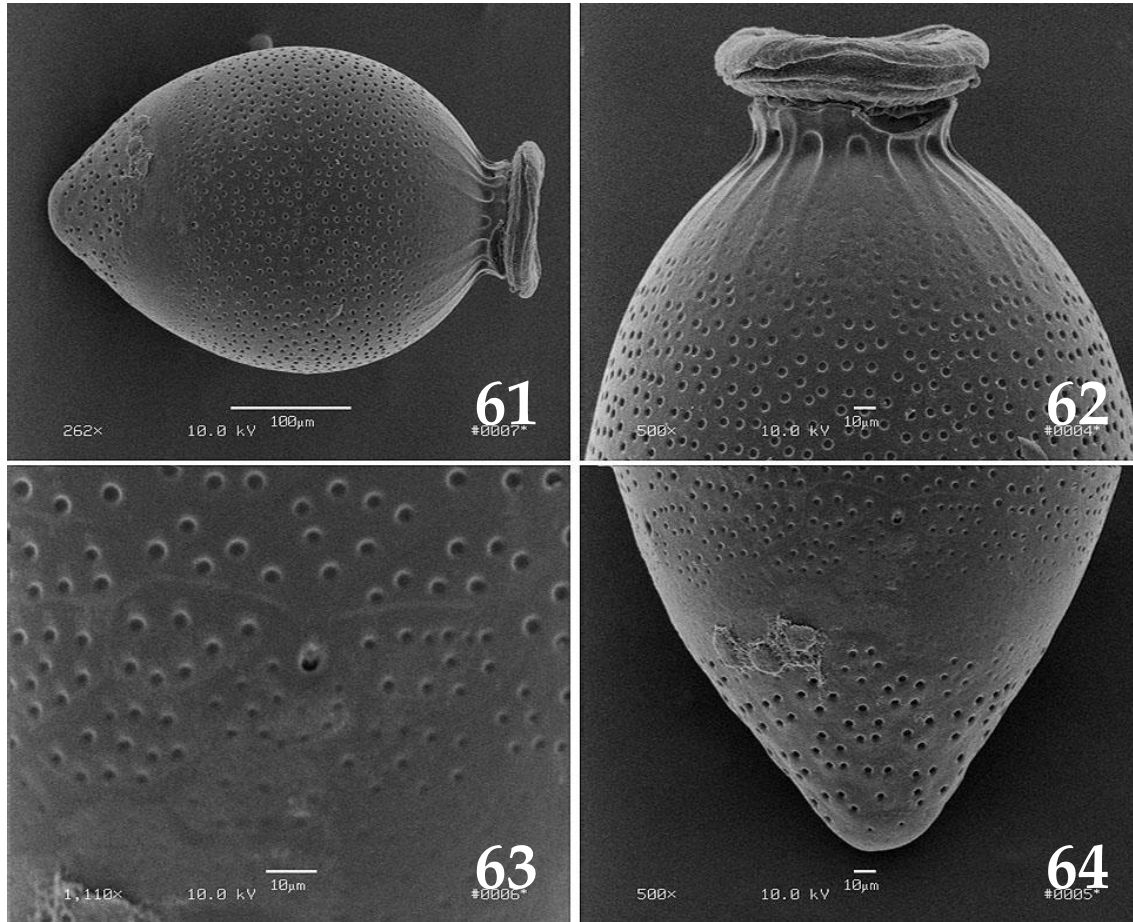


Figs. 55-60. *Phanoperla magnaspina*. 55. Head and pronotum. 56. Male terminalia. 57. Female subgenital plate outline. 58. Everted penis sac, apical aspect. 59. Everted penis sac, lateral aspect. 60. Penis tube and everted sac, dorsal aspect.

**Egg.** General outline spindle shaped with short, wide collar (Fig. 61). Total length ca. 389 µm, equatorial

width ca. 239 µm, collar length ca. 19 µm. Chorion covered over much of surface with coarse





Figs. 61-64. *Phanoperla magnaspina* egg. 61. Entire egg. 62. Collar end. 63. Chorionic detail. 64. Anterior end.

punctations; subequatorial zone and sub collar zones with pits obscure or absent (Figs. 62-64). Micropyles small and sessile. Sides of collar bearing several prominent ridges, which extend onto egg body.

**Larva.** Unknown.

**Etymology.** The species name refers to the enlarged group of spines in the subapical ring of the penis sac.

**Diagnosis.** This species is similar in color pattern and penial armature to *P. circumspina* sp. n., but differs externally from that species in lacking a median patch of sensilla on tergum 9 and in having the ocelli more widely separated. The two also differ in details of penial sac armature, with *P. magnaspina* having a cluster of ca. 8 very large spines in the subapical ring, whereas in *P. circumspina*, only three moderately large spines occur in this position.

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