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Gratia narumonae n. sp., a new mayfly from Thailand [Ephemeroptera, Baetidae]

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Keywords : *Gratia*, new species, Ephemeroptera, Baetidae, larva, last instar, Thailand.

A detailed description of the larval structures (last instar) of *Gratia narumonae*, new species from Thailand, in comparison with the type-species of the genus : *G. sororculaenadinae* Thomas, 1992. Labium, vestigial wingpads, gills, scales on sternites, and paraprocts mainly distinguish the two species. The combination of characters defining the genus *Gratia* is slightly reduced. Both species live on rocks in waterfalls.

***Gratia narumonae* n. sp., éphéméroptère nouveau de Thaïlande [Ephemeroptera, Baetidae]**

Mots-clés : *Gratia*, espèce nouvelle, Ephemeroptera, Baetidae, larve, dernier stade, Thaïlande.

Description détaillée de la larve au dernier stade de *Gratia narumonae*, espèce nouvelle de Thaïlande, comparativement à l'espèce-type du genre : *G. sororculaenadinae* Thomas, 1992. Le labium, les fourreaux alaires vestigiaux, les branchies, les écailles des sternites et les paraproctes fournissent les principaux caractères discriminants entre les deux espèces. La combinaison de caractères définissant le genre *Gratia* est légèrement restreinte. Les deux espèces vivent sur les rochers de chutes d'eau.

Introduction

Publications dealing with the Ephemeroptera of Thailand are quite scarce. Early informations on Thai mayflies were published by UENO (1961) and GOSE (1969). Recently, WANG & SITES (1999) described a new species of Ephemerellidae, and SITES et al. (2001) provided a key for 13 families of southern Thailand. New records of Behningiidae and two species of Potamanthidae and Prosopistomatidae were reported by PARNRONG et al. (2002); two genera of Heptageniidae were also recorded (as mature larvae) by SANGPRADUB et al. (2002). This brings the total of presently known Thai mayflies to 14 families.

The genus *Gratia* was erected by THOMAS (1992) for the species *sororculaenadinae*, discovered in Thailand during a field prospecting carried out by biologists of Paul Sabatier University, Toulouse, under the leadership of both Dr L. Deharveng and Dr N. Giani. In the present work, the spe-

cimen collection is a part of study supported by the TRF/BIOTEC Special Program for Biodiversity Research and Training grant BTR 141006. Study of this recent material allowed the discovery of a new species of *Gratia*, described herebelow. Informations on methods and collecting sites are given in SANGPRADUB et al. (2002).

***Gratia narumonae* Boonsoong & Thomas n. sp. : description**

Last-instar larva.

Short diagnosis

Uniform medium to dark brown species. A row of strong mediodorsal processes on abdomen; vestigial terminal filament and hind wingpads.

HEAD

General shape similar to *sororculaenadinae* (see THOMAS 1992, fig. 1). Frontal surface with numerous fine setae and pores.

Antennae (Fig. 1). Relatively short : length less than twice (1.6 in female) the width of the head. Scape and pedicel with scattered fine setae, and with 5-6 and 2-3 scales respectively, e.g. much less than in *sororculaenadinae* (about 30 scales on both segments : THOMAS 1992, fig. 2). Flagellum with 29-33 segments.

Labrum (Fig. 2). Rather broad, with a strong keel developing towards the clypeus ; medial indentation conspicuous. Anterior marginal fringe similar to *sororculaenadinae*, with bifid feathered setae (2a). Number of great dorsal setae : 1 + 10-12 (generally 11) ; the parasagittal seta and the two innermost lateral setae are simple, the other ones (2b) being branched (however in *sororculaenadinae* these setae are more ramified, clearly fimbriate : see THOMAS 1992, fig. 3a left).

Mandibles (Fig. 3). Similar to *sororculaenadinae* (see THOMAS 1992, fig. 4) regarding left and right prosthecas, clearly asymmetrical, and with respect to the quite prominent transverse ridges on molar area of left mandible (3L). Nevertheless the strong tooth adjacent to this area is nearly rectilinear and symmetrical in shape, whereas it is more curved in *sororculaenadinae*. Moreover, incisors are fused on both mandibules (they appear slightly separated in the right mandible of *sororculaenadinae*).

Maxillae. Similar to *sororculaenadinae* (general shape, apex of galealacinia, and palpi : see THOMAS 1992 fig. 5, 5a and 5c); palpi short and thick, with one denticle at apex on a small excrescence.

Hypopharynx (Fig. 4).

Labium (Fig. 5, 5a, b and c) small sized (labrum is slightly broader than labium), and easily distinguishable from *sororculaenadinae*. Glossae (5a) clearly shorter than paraglossae (subequal in length in *sororculaenadinae* : THOMAS 1992, fig. 6d). Paraglossae (5b) similarly shaped in both species; two strong dorsal setae in distal third, as in *sororculaenadinae* (N. b. : fig. 6c in THOMAS 1992 corresponds to *ventral* side); but innermost ventral setae at apex are shorter and stouter in *sororculaenadinae*. Labial palps (5c) clearly different from *sororculaenadinae* (see THOMAS 1992, fig. 6a and d), their morphology being much more classical within Baetidae : in particular segments 2+3 do not incurve outside of glossae ; segment 3, rounded and with a conical projection at apex, appears dark brown. Segment 1 with numerous chloride cells on dorsal side in both species.

THORAX

Pronotum. Surface with four small blunt tubercles, the two anterior bigger and at wider interval than the two posterior ones, parasagittal. Pattern of muscular insertions similar to *sororculaenadinae* (see THOMAS 1992, fig. 7).

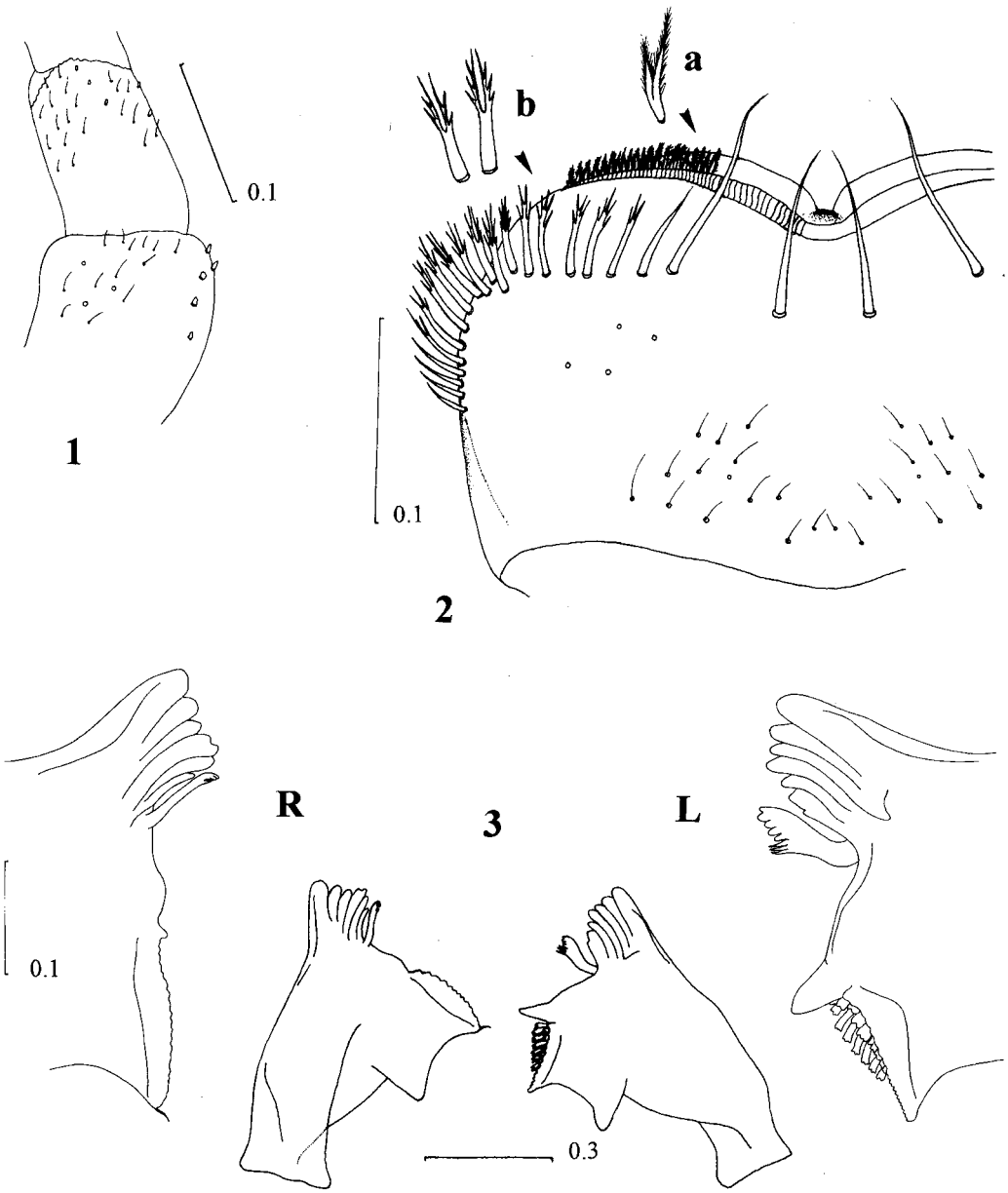

Plate 1. Larval structures (last-instar) of *Gratia narumonae* n. sp. Scale in mm.
1 : antennal scape and pedicel. 2 : labrum; a : setae of anterior marginal fringe;
b : great branched dorsal setae. 3 : mandibles (R : right; L : left).

Planché 1. Structures larvaires au dernier stade de *Gratia narumonae* n. sp. Echelle en mm.
1 : scape et pédicelle antennaires. 2 : labre ; a : soies de la frange marginale antérieure ;
b : grandes soies dorsales ramifiées. 3 : mandibules (R : droite ; L : gauche)

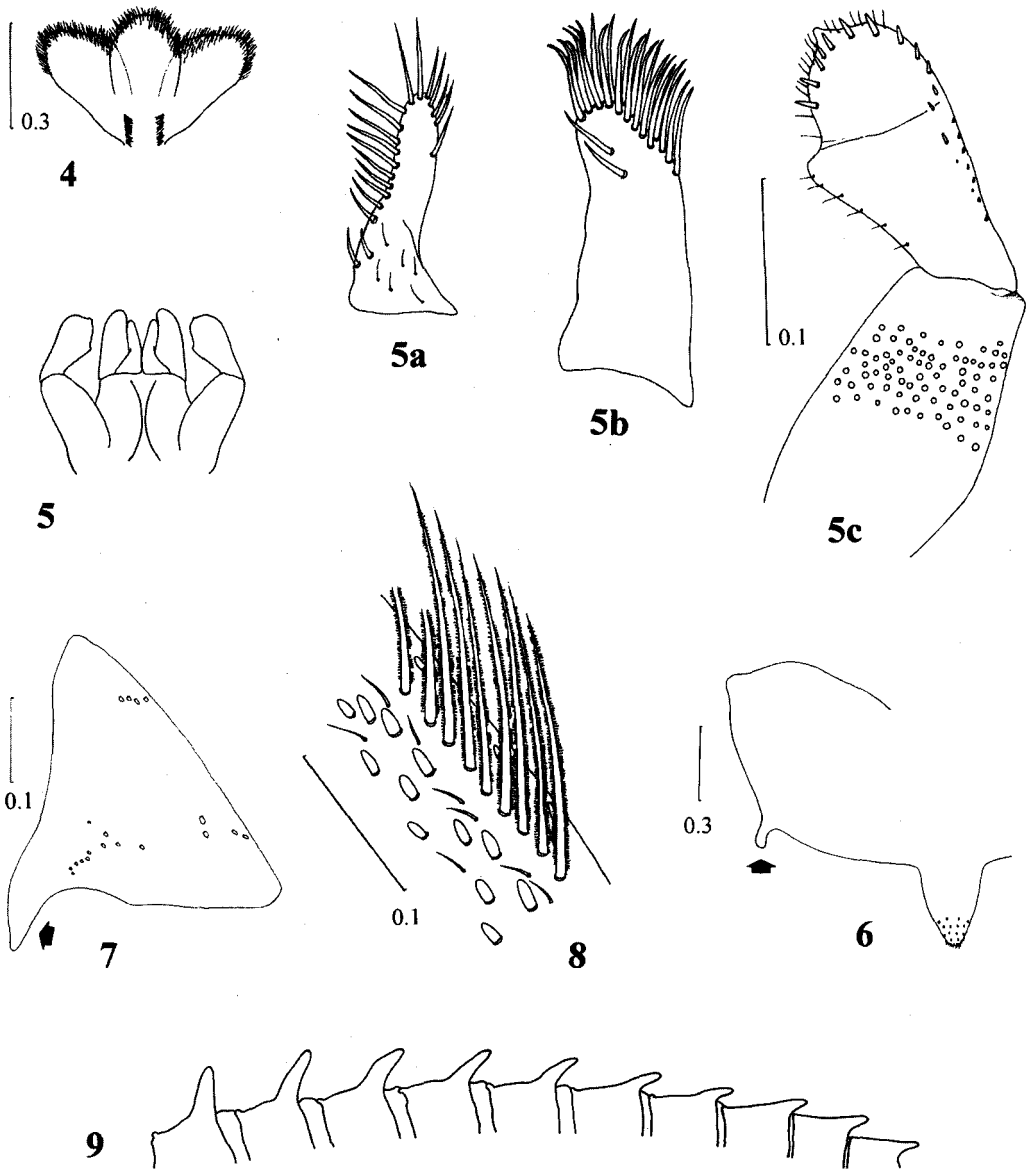

Plate 2. Larval structures (last-instar) of *Gratia narumonae* n. sp. Scale in mm.
4 : hypopharynx. 5 : labium, ventral ; 5a : glossa (dorsal) ; 5b : paraglossa (dorsal); 5c : palpus (dorsal).
6 : left hind wingpad (arrow) and metathoracic tubercle. 7 : trochanter III and inner distal process (arrow).
8 : posterior margin of forefemur, with pectinate bristles. 9 : series of dorsoabdominal processes (lateral view).

Planche 2. Structures larvaires au dernier stade de *Gratia narumonae* n. sp. Echelle en mm.
4 : hypopharynx. 5 : labium, vue ventrale ; 5a : glosse (vue dorsale) ; 5b : paraglosse (vue dorsale);
5c : palpe (vue dorsale). 6 : fourreau alaire postérieur gauche (flèche) et tubercule métathoracique. 7 : trochanter III et son processus distal interne (flèche). 8 : bord postérieur du fémur antérieur, avec soies pectinées.
9 : série des processus dorsoabdominaux (vue de profil).

Metathorax (Fig. 6) with a strong medial process, finger-like and as long as the corresponding tergum in the sagittal plane, and perpendicular to this latter. This process lies in the bottom of the notch separating fore wingpads. Hind wingpads quite vestigial in both sexes ; ratio of hind wingpads length / metathoracic process length is about 1/3 versus 3/1 in *sororculaenadinae* (see THOMAS 1992, fig. 8) : so, it can be assumed that hind wings are probably totally absent in adults of *G. narumonae* (imagos and subimagos are still unknown). In other potential new species of *Gratia* to be discovered, hind wingpads (last-instar larvae) may be absent. Indeed discrimination between highly reduced hindwings and totally absent hindwings is by no mean a generic character in Baetidae, as shown several times, in particular recently regarding the well defined and clearly isolated genus *Camelobaetidius* Demoulin (see THOMAS et al. 2003).

Legs. Ratio of tibia length / femur length : P1 = 1,09 ; P2 = 1,04 ; P3 = 0,98. Ratio of tibia length / tarsus length : P1 = 2,45 ; P2 = 2,51 ; P3 = 2,59. In comparison with *sororculaenadinae*, tibiae are longer with respect to femora, and shorter with respect to tarsi. Ratio of maximal width / length of femur : P1 = 0,37 ; P2 = 0,35 ; P3 = 0,34. Ratio of maximal diameter / length of tibia : P1 = 0,11; P2 = 0,12; P3 = 0,13. Thus, legs are proportionally stronger in *narumonae* than in *sororculaenadinae*.

Coxae 1, 2 and 3 with numerous chloride cells.

Trochanters 1, 2 and 3 (Fig. 7) with a conspicuous inner distal process.

Femora with a strong posterior row of feathered bristles (Fig. 8), quite similar to *Jubabaetis pescadori* Müller-Liebenau, 1980, but contrary to this latter species, the posterior edge of tibiae and tarsi are fringed with very fine hairs, finer than in *sororculaenadinae*. Upper surface with short rounded scales, shagreen and scattered small setae. Ventral femoral patch of setae sensu WALTZ & MCCAFFERTY (1987) (become classical as «femoral villopore» : see for instance EDMUNDS & WALTZ 1996) present.

Tibia and tarsi with a posterior longitudinal row of very fine simple setae.

Claws robust, strongly bent, nearly identical to *sororculaenadinae* (THOMAS 1992, fig. 11), with two subapical setae and one row of 9 (sometimes 10, seldom 8) denticles, the two outermost clearly longer than the others. This row of denticles is concave, then convex from apex to tarsus.

ABDOMEN

Colour of dorsal pattern rather uniform, medium to dark brown.

Tergites each with a strong mediodorsal posterior process (Fig. 9) shortening from I to IX : length of process equal to about tergite length (e.g. 0,2 mm) on segments I-III, equal to about half the length of tergite on segments VI-VII, and inferior beyond. Also the angle of processes with the body axis lessens from segment I (nearly orthogonal) to segment IX. On tergite X, the process is very reduced, parallel to the tergite, and superposed on terminal filament.

Segments not posterolaterally developed.

Tergites (Fig. 10) with scattered fine setae, scale bases, and short thin scales, more numerous and bigger near to the mediodorsal processes; on these latter the scales are conspicuous (Fig. 11). Posterior tergal edge with short, largely rounded denticles and fine setae.

Gills : seven pairs well developed (Fig. 12.I to VII) and more largely rounded at apex than in *sororculaenadinae*; margin devoid of scales (contrary to *sororculaenadinae*), only with fine setae.

Ventral surface (Fig. 13) with rounded scales and scattered fine setae. Scales are bigger and more numerous on sternites VI, and in particular VII, VIII and IX (between 70 and 100 scales, including a posterior marginal row of 25-30 scales always present on VII, VIII, IX, and sometimes on VI).

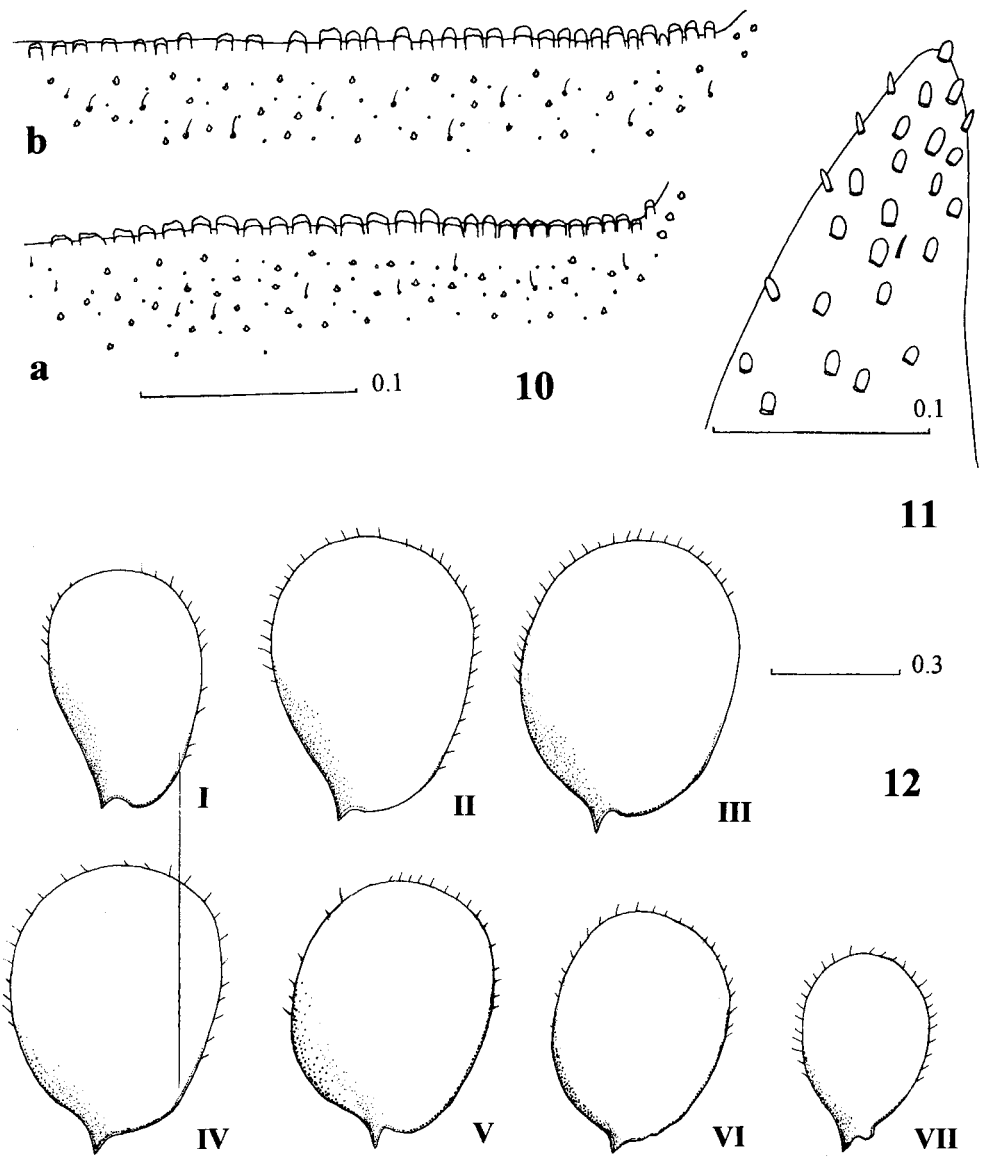

Plate 3. Larval structures (last-instar) of *Gratia narumonae* n. sp. Scale in mm.
10 : posterior margin and surface of the 4th (a) and 5th (b) abdominal tergites, near to tubercles.
11 : 5th tubercle and scales. 12 : gills I to VII.

Planche 3. Structures larvaires au dernier stade de *Gratia narumonae* n. sp. Echelle en mm.
10 : bord postérieur et surface des 4e (a) et 5e (b) tergites abdominaux, près des tubercules.
11 : 5e tubercule et ses écailles. 12 : branchies I à VII.

Contrary to *sororculaenadinae*, scales are not differenciated into several clearly distinct types; in particular there are no long and flexuous bifid setae under distal half of abdomen. Anterolateral parts of each sternite with a small shagreen area. Many chloride cells on sternite II, less numerous and laterally only on other segments.

Paraprocts (Fig. 14) with 11-16 strong rounded scales (most of them marginal/submarginal), e.g., less than in *sororculaenadinae*. Surface with more than 200 chloride cells, intermixed with small separated spines (Fig. 14a) rather than a multipointed shagreen, and visible at a magnification as low as 200 through a good phase contrast (Nikon for instance). Porous plates of the thoracic sternites in *Coloburiscoides* nymps (Oligoneuriidae) show a rather similar surface structure (FILSCHIE & CAMPBELL 1984, photo 9). Density of chloride cells on paraprocts of *G. narumonae* reaches about 12,000 per mm^2, in comparison with the classical high number of 3,000 in *Perla marginata* (see KOMNICK 1977) : it is an adaptation to low conductivity of the water. But our measures (see below : study material) also show that it is an adaptation to short term important variations in conductivity.

Cerci without hairlike setae along inner margin.

Terminal filament vestigial (Fig. 15), cone shaped with segments largely fused (apparently between one and three segments) ; length subequal or inferior to the basal diameter of cerci.

SIZE (last-instar)

Body length : male = 6,4 mm; female = 6,4 mm.

Cerci length : male = 6,3 mm; female = 5,5 mm.

So, *G. narumonae* is a species larger than *sororculaenadinae*, but its cerci appear to be proportionately shorter.

ETYMOLOGIE

G. narumonae is named after Dr Narumon Sangpradub, advisor of the senior author. Dr Sangpradub collected the material and initiated the present study.

Study material

Collecting site : Tarn Sawan (Mae Kong river basin), 17°28'N, 101°03'E, 510 m elevation, Na Haeo district, Loei province, dry evergreen forest, Thailand, 12/02/1999.

The species is locally abundant : 2,090 larvae in all (including 82 last-instar individuals) were collected. Holotype is a male last-instar larva, preserved in alcohol with parts mounted on three slides in DPX medium (DePeX mounting medium, BDH Laboratory Supplies, Poole, England); it is deposited at the Natural History Museum of Chulalongkorm University, Bangkok, Thailand, together with 10 paratypes (in alcohol). 68 paratypes preserved in alcohol are deposited at the collection of the Department of Biology, Khon Kaen University, Thailand. Moreover, three paratypes, mounted each on six slides in Canada Balsam, are deposited as follows : two at the Naturhistorisches Museum, Wien, Austria, and one at the National Museum of Natural History (Smithsonian Institution), Washington D.C., USA.

The larvae were found clinging on rocks of cascades in undisturbed hillstreams. They feed rather on detritus, and are more abundant in February. G. *sororculaenadinae* lives in similar biotope but is more limimadicolous. At the collecting site of *G. narumonae*, conductivity of the water varies from 1 to 2.5 within three months, being higher in dry season. The following values were measured : range in February = 136-250 µS/cm; in March = 114-212 µS/cm; in April = 105-111 µS/cm.

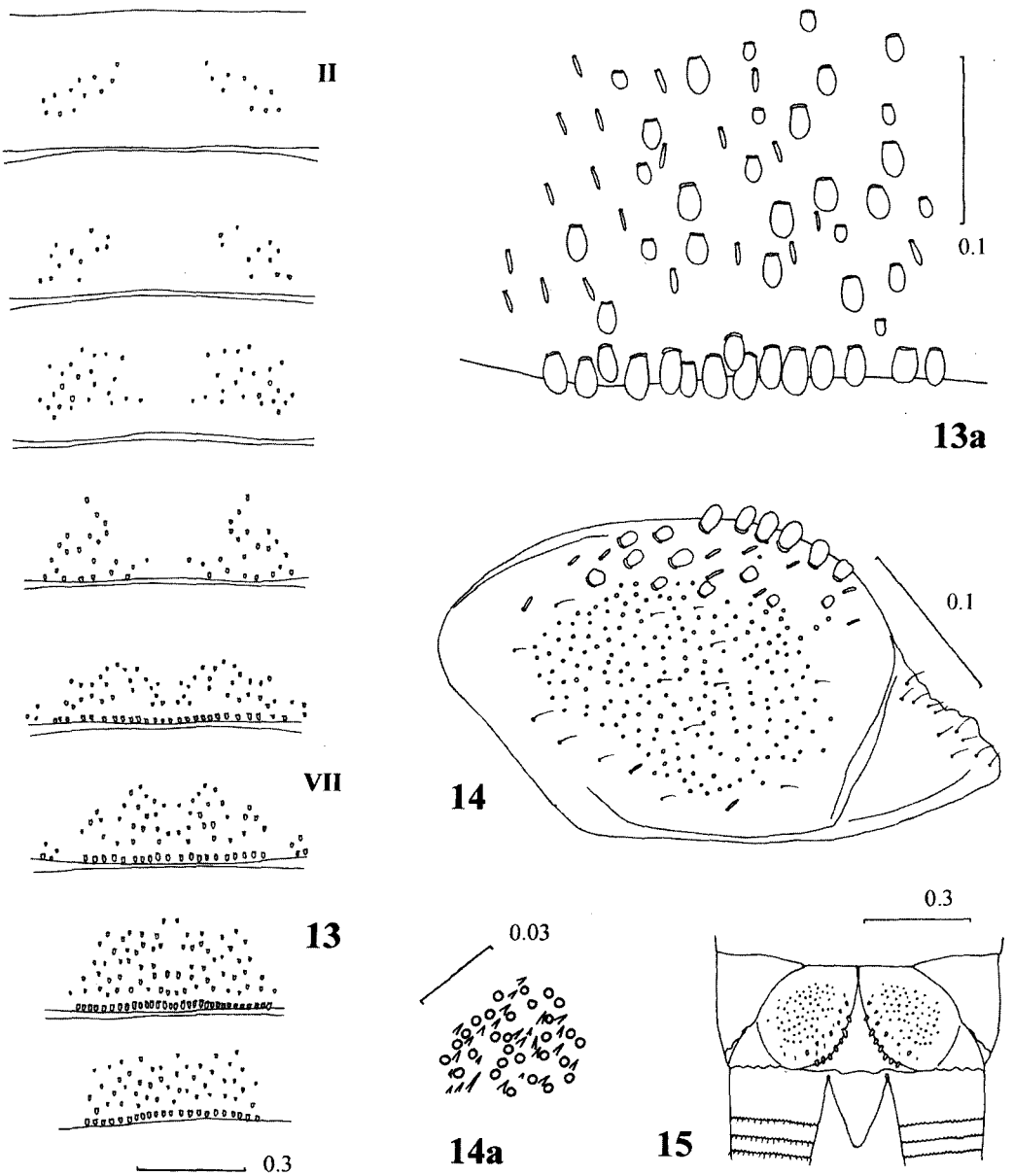

Plate 4. Larval structures (last-instar) of *Gratia narumonae* n. sp. Scale in mm.
13 : series of abdominal sternites II to IX, and scales; 13a : detail of sternite IX. 14 : paraproct; 14a : detail of central area. 15 : last segment (ventral view) and terminal filament.

Planche 4. Structures larvaires au dernier stade de *Gratia narumonae* n. sp. Echelle en mm.
13 : série des tergites abdominaux II à IX et leurs écailles; 13a : détail du sternite IX. 14 : paraprocte ; 14a : détail de la région centrale. 15 : dernier segment (en vue ventrale) et filament terminal.

Discussion

G. narumonae is not really closely related to G. *sororculaenadinae*. So, the discovery of this new species allows a more precise definition of the genus, according to the following combination of characters :

- great dorsal setae of labrum branched or fimbriate (with the exception of the parasagittal seta and of the two innermost lateral setae) ;
- hind wingpads present, reduced or vestigial (possibly absent in other potential species);
- femora with a strong posterior row of feathered bristles; tibiae and tarsi with a posterior row of single bristles;
- femoral villopore present ;
- claws with one row of denticles and two subapical setae;
- tergites of metathorax and abdomen (I-IX) each with a strong mediodorsal process;
- abdominal sternites with conspicuous scales ;
- cerci devoid of setae ;
- terminal filament vestigial, cone shaped; length subequal or inferior to the basal diameter of cerci.

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