



## Review of *Nilodosis* Kieffer (Diptera: Chironomidae: Chironominae), with description of a new species from South China

HONGQU TANG<sup>1,3</sup> & PETER S. CRANSTON<sup>2</sup>

<sup>1</sup>Jinan University, Institute of Groundwater and Earth Sciences, Guangzhou 510632, P.R. China. E-mail: [townningt@gmail.com](mailto:townningt@gmail.com)

<sup>2</sup>Evolution & Ecology, Australian National University, Canberra, ACT 0200, Australia. E-mail: [pscranston@gmail.com](mailto:pscranston@gmail.com)

<sup>3</sup>Corresponding author

### Abstract

The male, female and pupa of *Nilodosis austrosinensis* Tang & Cranston, **sp. n.**, reared from 2 reservoirs of south China, are described. The male can be separated from congeners by the presence of few squamal setae, a relatively long spur on the mid- and hind legs, a characteristic superior volsella and distinctive pattern of all legs. The female can be separated by features of genitalia, namely the absence of a ventrolateral lobe and the dorsomesal lobe with the apex usually curved. The pupa is separable by a bare tergite VIII and by characteristic spinulation of the sternites. The generic diagnosis is emended and some problems alluded to. This is the first formal record of *Nilodosis* from the Oriental region, indeed the first outside the Afrotropical region.

**Key words:** *Nilodosis*, South China, pupa, new species

### Introduction

The genus *Nilodosis* Kieffer 1921 was erected based on Sudanese (Afrotropical) material with the type species *Nilodosis fusca* Kieffer 1921 as the only originally included species. Later, *Nilodosis grisea* Freeman 1957 from the Belgian Congo (now the Democratic Republic of the Congo) was added to the genus (Freeman 1957a; 1957b). Freeman (*loc. cit.*) also recognised *Endochironomus ituriensis* Goetghebuer 1936, also from the Belgian Congo, as synonymous with *N. fusca*. However, Freeman recognised that the addition of the second species was problematic for the generic concept, recognising that the male hypopygia are appreciably different. Nevertheless, he argued for a relationship based on the absence of pulvilli and presence of a strong anterior tibial spur in both species. The situation remained unaddressed until Cranston & Spies (1999) used associated immature stages and historic material including females to confirm Freeman's proposal that the two species are congeneric. Nevertheless these authors were hesitant since life history associations were incomplete, and variation between the two included species was notable. No further evidence has been brought to bear from Africa. However, recognition that *Fissimentum* Cranston & Nolte 1996 was the sister taxon, allowed discussion of valuable characters in all life stages for relating and distinguishing these two genera.

The larval descriptions allowed Tang & Yamamoto (2012) to recognise larvae from East Asia with the characteristic cleft mentum and long curved mandible with clumped inner teeth as belonging to *Nilodosis* and not to *Fissimentum* as other authors had claimed (Kitagawa 1997, 2001; Ueno *et al.* 2001). On the basis of this generic identification, four unreared larval 'forms' of *Nilodosis* were distinguished from Korea, China and Japan ('East Asia') and the generic diagnosis of larvae was expanded. Until recently the sole evidence for *Nilodosis* in East Asia derived only from these unreared larvae. The larval types previously reported as *N. sp.* 'Guangdong' and *N. sp.* 'Yunnan' typify regional representatives (Tang & Yamamoto 2012) and recently a new larval type, *N. sp.* 'Thailand' has been collected in the Pang River (Sriariyanuwath E.O. *pers. comm.*).

*Nilodosis* can be differentiated in the adult stage by the long arcuate-curved tibial spur on the foreleg, and a characteristic superior volsella. The pupa is characterized by a 6–8 branched thoracic horn, subquadrate spinule

patches on tergites II–VI (V) lacking differentiated anterior transverse bands, the 4 lateral taeniate on T V–VII and vortex located on parasternites IV and V.

Specimens of *Nilodosia* were collected during fieldwork in Guangdong and Macau by the senior author, including the male, female and pupa, with reared material allowing association of the pupa and adult stages. Although size variation, represented by male body length, is evident, so is the variable number of hooklets of pupal tergite II and of taeniae of the anal lobe, evidently there is a single species. Here, we describe the adult and pupa of this new species, modify the generic diagnosis and extend ecological and distributional data.

## Materials and methods

Specimens examined were slide-mounted in Euparal. Morphological terminology and abbreviations follow Sæther (1980): in the pupa, we use spinule/spinulation over the inappropriate terms armament and shagreen. Measurements are given as ranges, with the number of observed specimens in parentheses if different from the number (n) stated at the beginning of the description. Line drawings (by senior author) were aided by use of a drawing tube attached to an Olympus BX43. Material is deposited in the Institute of Groundwater and Earth Sciences, Jinan University, Guangdong, and (one paratype) the Australian National Insect Collection, CSIRO, Canberra, Australia.

## Taxonomy

### *Nilodosia* Kieffer 1921

**Diagnosis.** The specimens examined conform in most diagnostic features to the generic description for adult and pupa (Cranston & Spies 1999). Based on the material described below, the generic diagnosis for *Nilodosia* adult and pupa should be amended as follows.

**Adult male.** AR 1.33–2.60. Acrostichals uniserial or biserial, starting from the anterior scutum. Anal lobe of wing rounded or reduced. Mid and hind tibiae with 2 separated or 1 fused comb; if separated, with 2 short straight spurs, if fused, with curved spur. Foreleg ratio 1.7–2.2, distinctive leg colour pattern in some species. Anal point varied: slightly spatulate with rounded apex (*N. fusca*), parallel-sided (*N. grisea*) or slightly pointed (*N. austrosinensis* **sp. n.**).

**Adult female.** Antenna with 5 or 6 flagellomeres. Gonapophysis VIII simple (*N. austrosinensis* **sp. n.**) or with both dorsomesal and ventrolateral lobes (*N. fusca*). Apodeme lobe visible (*N. fusca*) or reduced (*N. austrosinensis* **sp. n.**).

**Pupa.** Thoracic horn plumose or with several branches. Anteprenotals present or absent. Tergite II–VII with fine spinules, T VIII with or without spinules. Sternites bare or with special pattern on S I–III, and one pair of anterior spinule patches on S VI–VIII.

**Larva.** See Cranston & Spies (1999) and Tang & Yamamoto (2012).

### *Nilodosia austrosinensis* **sp. n.**

urn:lsid:zoobank.org:act:6FAFC229-4060-4106-B76F-44A21CE7678B

*Nilodosia* sp. 'Guangdong', Tang and Yamamoto 2012: 209.

**Material examined. Holotype.** ♂, CHINA: Guangdong Province, Guangzhou City, Conghua, Liuxihe Reservoir, 25.x.2014, light trap, leg. Jun Liu.

**Paratypes:** ♀, Macau SAR, Coloane, Hac-Sa Reservoir, 10.xi.2014, leg. Hongqu Tang; ♀, as previous except 01.xii.2014; 2♂♂, one as holotype, the other with associated pupal exuviae reared in the lab, Macau SAR, Coloane, Hac-Sa Reservoir, 18.viii.2014, leg. Hongqu Tang (30.viii.2014 emerged) (ANIC); Pe, as holotype, 31.x.2014; 2 Pe, Macau SAR, Coloane, Hac-Sa Reservoir, 21.x.2014, leg. Hongqu Tang.

Other examined material, 2 ♂♂, as holotype, 06.vii.2013, leg. Hongqu Tang. 2♂♂ in alcohol, as previous except 15.x.2009; 2♂♂ in alcohol, as previous except 26.vii.2016, leg. Hongqu Tang, Masaru Yamamoto and Nao

Yamamoto; 2 L, as paratypes, one 18.ii.2014, another 21.x.2014; 12 Pe, Guangdong Province, Huazhou City, Hejiang Town, Tangkeng Country, 04.viii.2013, leg. Hongqu Tang; Pe, as previous except Pingding Town, 11.xi.2013; 3 Pe, as previous except Luo River in Huazhou section, 04.viii.2013; 3 Pe, as previous, except Changqi Town, Nan'an Country, 05.viii.2013; Pe, as previous, except 23.xi.2013.

**Description. Adult male** ( $n = 4$ ) total length 3.38–4.15, 3.72 mm (summer population larger, 4.15 mm), and abdomen 2.33–2.87, 2.54 mm. Wing length 1.58–2.00, 1.73 mm (summer average: 2.0 mm, autumn average: 1.6 mm). Ratio total length/wing length 2.06–2.31, 2.18. Ratio wing length/length of profemur 1.88–2.08, 1.97.

Colour. Head and thorax brown to dark brown. Mesonotum with central dark band and 2 lateral dark vittae, central one usually separated into 2 narrow bands by yellowish area bearing acrostichals. Postnotum black. Abdominal tergites dark brown, fainter in intersegmental area, but lacking clear markings. Legs with distinctive pattern (Fig. 1B), coxa usually dark brown, trochanter usually yellow, without dark pigment. Profemur usually with proximal 1/2 whitish, mid-femur largely dark brown, hind-femur usually with 2 whitish areas. All tibiae seem alike, each with 2 whitish bands, one located in the proximal 1/6, the other in sub-apical area. Ta1–2 largely pale yellow, with distal joints area dark brown, ta4–5 usually dark brown, without pale area. Ta3 varies between legs, proximal 1/3 pale on proleg, whole brown on midleg, proximal 4/5 pale on hind leg.

Head. AR 1.33–1.49, 1.43. Segment 1–12 450–480, 458  $\mu\text{m}$  long, ultimate flagellomere 600–715, 655  $\mu\text{m}$  long. Temporal setae 10 including 4–5 inner verticals and 4 outer verticals. Clypeus with 16–20, 18 setae. Tentorium 118–130, 122  $\mu\text{m}$  long, 30–40, 35  $\mu\text{m}$  wide. Palpomere lengths (in  $\mu\text{m}$ ): 40–50, 45; 20–40, 36; 190–200, 195; 130–150, 140; 155–185, 173. Palpomere 4 shorter than 3rd and 5th, 5th/3rd 0.81–0.95, 0.90 (Fig. 1C).

Wing (Fig. 2A). Wing rather smoky, with some faint punctation under high magnification. VR 0.97–1.01, 0.99; R with 8–14, 10,  $R_1$  with 13–18, 15,  $R_{4+5}$  with 20–26, 24 setae. Squama with 2–4, 3 setae.

Thorax (Fig. 1A). Dorsocentrals 10–15, 13, acrostichals 8–12, 10, starting at anteprotum, prealars 3–4. Scutellum with 6–10, 8 setae.

Legs (Fig. 1D–F). Arcuate curved long tibial spur on the tibiae of all legs, of which fore tibia spur is largest, 50–60, 55  $\mu\text{m}$  long, while mid tibial spur relatively small. Combs on mid and hind tibiae fused, occupying about half circumference. Pulvilli vestigial. Lengths (in  $\mu\text{m}$ ) and proportions of legs in Table 1.

**TABLE 1.** Length (in  $\mu\text{m}$ ) and proportion of legs of male *Nilodosis austrosinensis* sp. n. ( $n = 4$ ).

Male	Fe	Ti	Ta <sub>1</sub>	Ta <sub>2</sub>
P1	800–975, 885	430–525, 468	960–965, 963	700–750, 735
P2	680–800, 750	550–700, 632	520–530, 528	220–230, 226
P3	820–1000, 910	610–775, 687	800–820, 810	350–380, 370
	Ta <sub>3</sub>	Ta <sub>4</sub>	Ta <sub>5</sub>	LR
P1	450–510, 487	380–430, 415	120–200, 145	2.08–2.15, 2.11
P2	160–170, 165	115–120, 118	80–90, 85	0.86–0.88, 0.87
P3	290–305, 298	170–200, 188	110–120, 117	1.21–1.29, 1.24

Hypopygium (Fig. 2B). Tergite VIII not constricted at base. Anal point 30–33, 32  $\mu\text{m}$  long, relatively short, tapered from base, and apically slightly pointed (Fig. 2C). Anal tergite bands fused in oval area, with 6–8 median setae in pale area. Phallapodeme 60–65, 63  $\mu\text{m}$  long. Transverse sternapodeme 38–40, 39  $\mu\text{m}$  long, sternapodeme narrow with slight oro-lateral projection. Gonocoxite 95–100, 97  $\mu\text{m}$  long. Superior volsella (Fig. 2D–G) bearing elongate, bare, apically hooked digitus, 40–55, 48  $\mu\text{m}$  long, the basal section widest, with expanded setose and microtrichiose pad, usually bearing 3 strong long setae. Inferior volsella 58–63, 60  $\mu\text{m}$  long, bulbous apically, extending slightly beyond the apex of anal point. Gonostylus 100–125, 110  $\mu\text{m}$  long, with 8–10, 9 long setae along inner margin, apex narrow. HR 1.09–1.45, 1.27. HV 2.30–2.38, 2.33.

**Adult female** ( $n = 2$ ) Medium-sized with abdomen length 2.45–3.25 mm, wing length 1.72–2.15 mm. Color as in male, with same distinctive leg pattern.

Head. Antenna with 6 flagellomeres, lengths (in  $\mu\text{m}$ ): 50–60, 55; 55–65, 57.5; 65–70, 68.8; 65–80, 71.5; 62–70, 65.6; 115–125, 122.5. AR 0.36–0.42, 0.39. Each segment of 1–5 with 2–3 sensilla, pale, distal segment dark brown, with 4–5 pale spots (Fig. 1G). Eye bare, with slight dorsomedial extension. Frontal tubercles absent. Inner

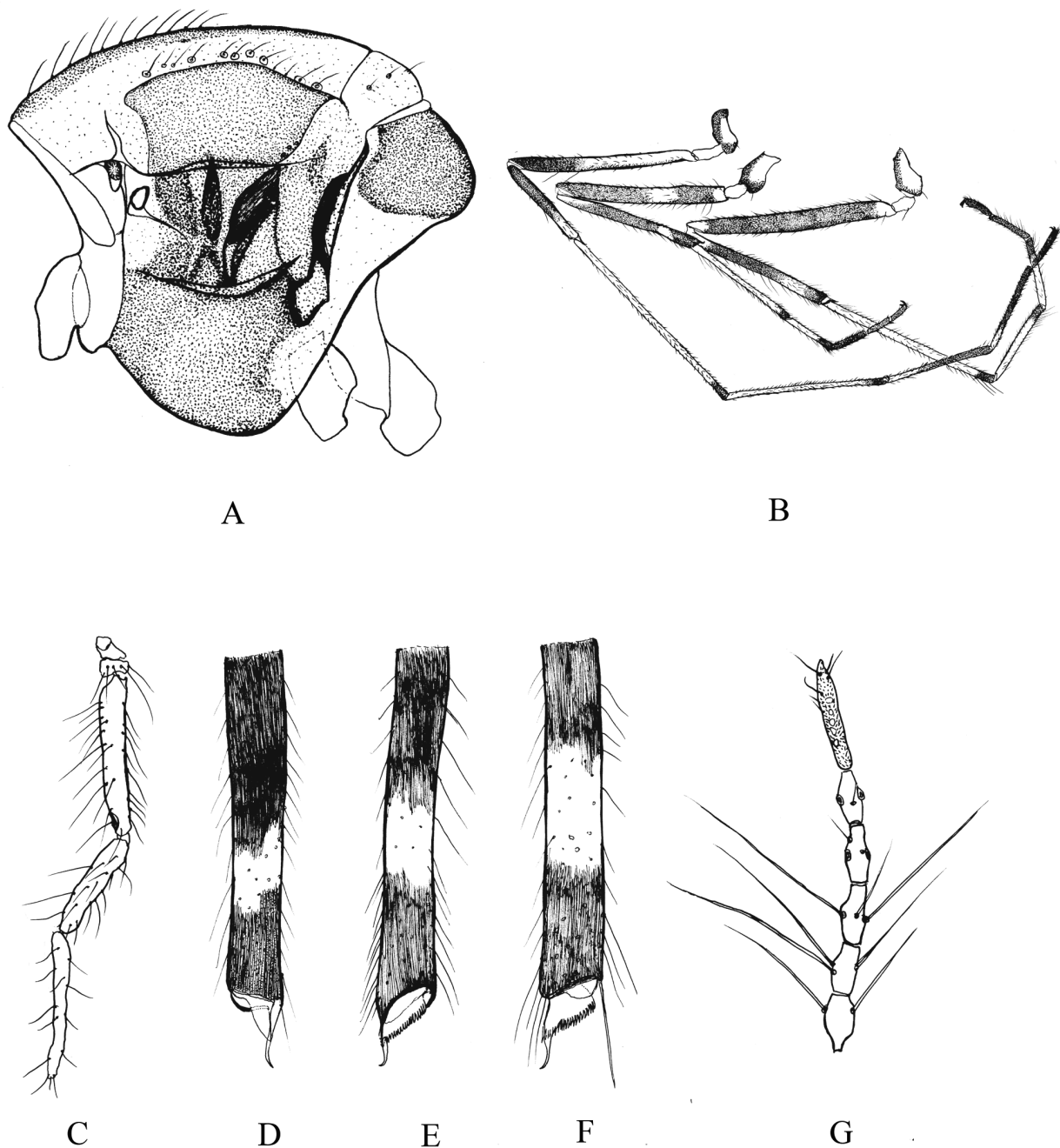
verticals 2–3, outer verticals 4–6, clypeals 24–27. Palp 5-segmented, lengths (in  $\mu\text{m}$ ): 45–50, 46.5; 25–35, 30; 180–245, 211.3; 120–180, 156.3; 210–240, 225; palp 2 rectangular, shorter than wide; palp 3 approximately 6 $\times$  as long as wide; palp 4 slightly shorter, approximately 5 $\times$  as long as wide, palp 5 subequal to 3rd.

Thorax. Anteprenotal lobes medially divided at notch. Acrostichals 10–14, uniserial, dorsocentrals 8–11, prealars 2–3, supraalars 1, scutellars 5–6.

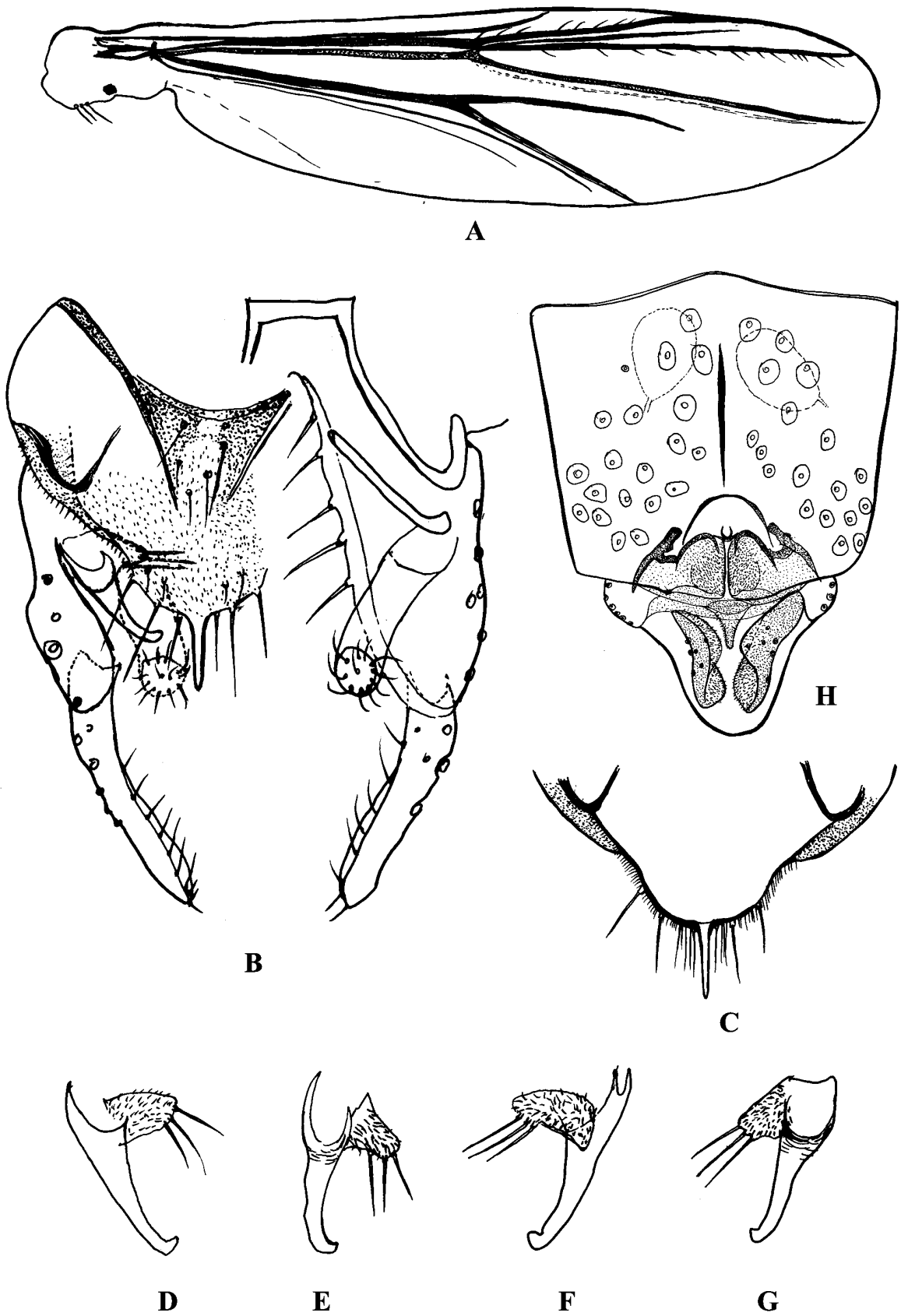
Wing. Grey, with fine to fair punctuation. Anal lobe reduced, costa not extended. R with 18–27 setae,  $R_1$  with 18–30,  $R_{2+3}$  without seta,  $R_{4+5}$  with 36–55. VR around 1.0. Squama with 3–4 setae.

Legs. Similar to males, mensural features in Table 2.

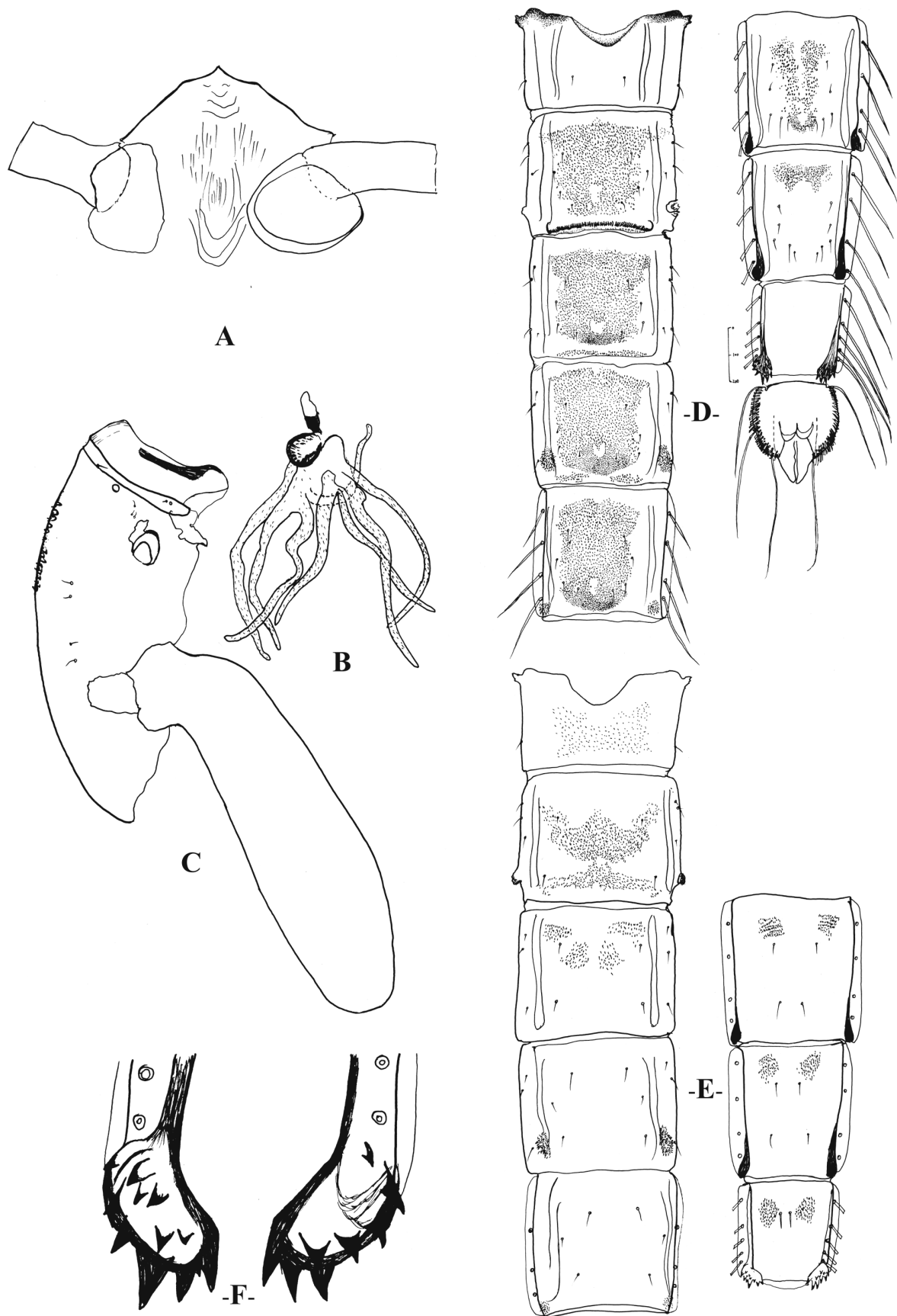
Genitalia (Fig.2H). Gonocoxapodeme gently curved, not fused medially. Gonapophysis VIII with only dorsomesal lobe, covered with some small microtrichia, the apex usually curved. Ventrolateral lobe and apodeme lobe absent. Labium with microtrichia. Gonocoxite IX small, with 4–8 setae. Postgenital plate large, with long setae and fine microtrichia. Seminal capsules oval. Cerci somewhat elongated and spindle shaped.



**FIGURE 1.** *Nilodosia austrosinensis* sp. n., A–F male, G female. A. thorax; B. leg (from left to right, fore, middle and hind); C. maxillary palp; D–F. details of tibial spur and comb (from left to right, fore, middle and hind); G. female antenna.



**FIGURE 2.** *Nilodosia austrosinensis* sp. n., A–G male, H female. A. wing; B. male hypopygium; C. details of anal point; D–G. superior volsella; H. female genitalia.



**FIGURE 3.** *Nilodosis austrosinensis* sp. n., pupa. A. frontal apodome; B. thoracic horn; C. thorax (lateral view); D. abdomen I–IX, dorsal view; E. abdomen I–VIII, ventral view; F. posterolateral comb of segment VIII.

**TABLE 2.** Length (in  $\mu\text{m}$ ) and proportion of legs of female *Nilodosis austrosinensis* sp. n. (n = 2)

Female	Fe	Ti	Ta <sub>1</sub>	Ta <sub>2</sub>
P1	900–1025, 962	510–600, 548	1125–1250, 1188	825–950, 887
P2	790–920, 870	680–790, 750	530–640, 585	210–160, 238
P3	990–1150, 1088	750–870, 815	840–1025, 935	390–500, 450
	Ta <sub>3</sub>	Ta <sub>4</sub>	Ta <sub>5</sub>	LR
P1	540–675, 608	480–550, 515	220–238, 230	2.08–2.21, 2.15
P2	160–180, 175	110–140, 125	80–110, 95	0.75–0.79, 0.78
P3	310–350, 330	190–225, 208	137–142, 140	1.12–1.18, 1.15

**Pupa** (n = 4). Exuviae yellow-grey, apophyses brown. Total length 4.63–5.95, 5.15 mm, abdomen length 3.50–4.80, 3.98 mm.

Cephalic tubercles and frontal setae absent (Fig. 3A). Thoracic horn with 6–8 main branches, basal ring pearl-shaped (Fig. 3B). Mid-thorax with conspicuously large tubercles at median suture (Fig. 3C). Anteprenotum with 1 median and 2 lateral setae. 3 fine precorneals; dorsocentrals: dc1 close to dc2, separated clearly from approximated dc3 and dc4, all subequal and fine, 50–60, 55  $\mu\text{m}$ .

Abdomen: Tergite I bare, II–VII with areas of fine spinules, subquadrate on II–V, with paired longitudinal bands on VI and anterior transverse patch on VII. Tergite VIII (seldom with a few anterolateral spinules) and anal segment bare (Fig. 3D). Tergite II hook row continuous, 400–550, 463  $\mu\text{m}$  long, 0.68–0.74, 0.72 times as wide as corresponding tergite width, comprising 65–100, 82 small hooks. Conjunctions III/IV and IV/V with narrow row of small anteriorly directed spinules, with complete band in the former, and interrupted in the latter. Sternites IV and V bare, VI–VIII with anterior paired spinule patches, I–III with patches strongly developed and extending posterolaterally (Fig. 3E). Vortex present on parasternites IV and V, present only as darkened areas on parasternites VI–VII; pedes spurii B rounded, protruding on segment II. Posterolateral corner of segment VIII with strong multi-spined mace (Fig. 3F). Anal lobe ratio 1.93–2.14, 2.05.

Setation. Segment I with 2 D, 1 V and with 1 L setae; II–VII with 4–5 D, 2–3 V; 3 L on II–IV, V–VII with 4 lateral taeniae, VIII with 0 D, 2 V, 5 lateral taeniae, two V setae rather stoutly taeniate.

Anal lobe rather elongate, with fringe of 45–82, 62 taeniae, biserial over anterior 1/5, mainly uniserial in middle 2/5 and becoming more crowded to biserial in posterior 1/5. Without dorsal taeniate seta. Genital sac of male extending beyond apex of anal lobes, female genital sac shorter than the anal lobe and with a fused hyaline “cercus” extending clearly from the anal lobe.

**Larva.** As described by Tang & Yamamoto (2012) under the name *Nilodosis* sp. 'Guangdong'.

**Etymology.** From Latin, meaning southern China, referring to the type locality.

## Discussion

Body size varied slightly between the summer and autumn populations; usually the former is larger than the latter. The squamal setae is reduced into 2–4 setae in the new species, which is quite different to the previously known species. In the latter, the squama has usually more than 15 setae.

The pupal anteprenotal setae were presumed to be absent in the previous description (Cranston & Spies 1999), but normal anteprenotals can be observed in our material.

The pupa resembles the previously known *N. fusca* considering the pattern of spinules, with some differences on tergites VI–VIII, and the presence of spinule patches on sternite I–III. Except for the mid-thoracic tubercles, the pupa resembles that of *Fissimentum desiccatum* Cranston & Nolte, which can be separated by the tergal patterns (Cranston & Nolte 1996). The pupae of *Conochironomus* and *Skusella* have similar patterns (e.g. Cranston 1966), but can be separated readily from *Nilodosis* and *Fissimentum* by the distribution of lateral taeniate setae (Cranston & Hare 1995; Cranston 1996). The female differs strongly from previously published description, notably in completely lacking a ventrolateral lobe; both ventrolateral and dorsomedian lobes are present in *N. fusca*. Although such differences usually do not occur within a genus, variation in female genitalia can be substantial and certainly

much more than was recognized in Sæther (1977): overall, the female state needs clarification. Since larval exuviae were not obtained from the mass rearing tanks, two larvae from Hac-Sa Reservoir were compared with the published *Nilodosis* sp. 'Guangdong' from Liuxihe Reservoir. They belong to the same species which we assign to *N. austrosinensis* sp. n., since only this larval type is present in both sites.

**Ecology and distribution.** This species is known from 2 relatively clean water-supply reservoirs and the downstream of larger rivers in Guangdong Province. The trophic conditions range from oligotrophic to mesotrophic, with dissolved oxygen from 4.3 to 8.8 mg/l, conductivity from 35 to 88  $\mu$ s/cm, total phosphorus from 0.01 to 0.03 mg/l, and with total nitrogen from 0.40 to 0.82 mg/l. Based on our pupa and adult collection data, adults can emerge from July to December. The larva must inhabit relative deep water since samples by conventional D-frame net contained few larvae. The reservoir bank consists of hard clay. Co-occurring chironomids include several Tanytarsini species, *Polypedilum masudai* (Tokunaga, 1938), *Polypedilum sordens* (van der Wulp, 1874) and (rarely) *Axarus fungorum* (Albu, 1980).

## Acknowledgements

This study was supported by the National Natural Science Foundation of China (NSFC No. U1301235, 41672346) and Foreign Experts Visiting Jinan University Project (No. 2016XJZD-014). The first author thanks Kai-Chin Wong, Hon-Pio Kan, Chi-Ioi Lei and Chok-Him Ng, Department of Gardens and Green Areas, IACM, for assistance with field work in Macau. Special thanks to Mrs. Hong Su and Mrs. Kan-Ting Yuen for transporting slides. We thank two anonymous reviewers.

## References

- Cranston, P.S. (1996) Identification guide to the Chironomidae of New South Wales. *Australian Water Technologies Pty Ltd, West Ryde, NSW. AWT Identification Guide*, 1, 1–376.
- Cranston, P.S. & Hare, L. (1995) *Conochironomus* Freeman: an Afro-Australian Chironomini genus revised (Diptera: Chironomidae). *Systematic Entomology*, 20, 247–264.  
<https://doi.org/10.1111/j.1365-3113.1995.tb00096.x>
- Cranston, P.S. & Nolte, U. (1996) *Fissimentum*, a new genus of drought-tolerant chironomini (Diptera: Chironomidae) from the Americas and Australia. *Entomological News*, 107, 1–15.
- Cranston, P.S., & Spies, M. (1999) The immature stages and phylogenetic position of *Nilodosis* Kieffer, an Afrotropical genus of Chironomini (Diptera: Chironomidae). *African Entomology*, 7, 249–259.
- Freeman, P. (1957a) Chironomidae (Diptera, Nematocera). *Imagines. Résultats Scientifiques. Exploration Hydrobiologique des Lacs Kivu, Édouard et Albert*, 3, 205–221.
- Freeman, P. (1957b) A study of the Chironomidae (Diptera) of Africa south of the Sahara. Part III. *Bulletin of the British Museum Natural History (Entomology)*, 5, 323–426.  
<https://doi.org/10.5962/bhl.part.1515>
- Kieffer, J.J. (1921) Chironomides de l'Afrique Equatoriale (1re partie). *Annales de la Société Entomologique de France*, 90, 1–56.
- Kitagawa, N. (1997) Chironomid larvae from Kiso River – twenty species of larvae collected at near Nohbi Ohashi Bridge. *Tansuiseibutsu (Freshwater Biology)*, 74, 77–99. [In Japanese]
- Kitagawa, N. (2001) Taxonomic studies on Chironomid larvae (3). *Tansuiseibutsu (Freshwater Biology)*, 81, 1–7. [In Japanese]
- Sæther, O.A. (1977) Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys. *Bulletin of the Fisheries Research Board of Canada*, 197, 1–204.
- Sæther, O.A. (1980) Glossary of chironomid morphology terminology (Diptera: Chironomidae). *Entomologica Scandinavica*, Supplement, 16, 1–51.
- Sasa, M. (1989) Chironomid midges of some rivers in Western Japan. Part 5. Chironomid species collected from Naka and Kachiura River, Tokushima. *Research Report of Toyama Prefectural Environment Pollution Research Centre*, 1989, 69–74.
- Tang, H.Q. & Yamamoto, M. (2012) Descriptions of four larval forms of *Nilodosis* Kieffer from East Asia. *Fauna norvegica*, 31, 205–213.  
<https://doi.org/10.5324/fn.v31i0.1406>
- Ueno, R., Nohara, S. & Kato, H. (2001) Distribution of chironomids in the littoral zone of Lake Towada. *Research Report of National Institute Environment Study, Japan*, 167, 99–101.
- Yamamoto, M. (2014) Family Chironomidae. In: Editorial Committee of Catalogue of the Insect of Japan (Ed.), *Catalogue of the Insects of Japan. Vol. 8. Diptera Part 1. Nematocera – Brachycera Aschiza*, The Entomological Society of Japan, Touka Shobo Publisher, Fukuoka, pp. 237–362.