

Two unusual species of *Polypedilum* Kieffer (Diptera: Chironomidae) from Oriental China

RUILEI ZHANG^{1,2}, XINHUA WANG^{2*} & OLE A. SÆTHER³

¹College of Life Sciences, Nankai University, 300071 Tianjin, China

²College of Aqua-life Science and Technology, Shanghai Fisheries University, Shanghai, China

³The Natural History Collections, Bergen Museum, University of Bergen, Muséplass 3, N-5020 Bergen, Norway

*Corresponding author. E-mail: xhwang@nankai.edu.cn

Abstract

Polypedilum (*Cerobregma*) *paucisetum* sp. n. and *P.* (*Tripodura*) *nudiprostatum* sp. n., with peculiar superior volsellae are described as male imagines from Oriental China. *P.* (*C.*) *paucisetum* has an *Uresipedilum*-like superior volsella. The superior volsella of *P.* (*T.*) *nudiprostatum* is slender and non-clavate with 11–13 apical setae. A phylogenetic analysis places *P.* (*C.*) *paucisetum* as the sister species of the remaining members of the subgenus. *P.* (*T.*) *nudiprostatum* apparently belongs to the *pullum* group of *Tripodura*.

Key words: Chironomidae, *Polypedilum*, *Cerobregma*, *Tripodura*, new species, Oriental China

Introduction

The genus *Polypedilum* was erected by Kieffer (1912), and has a cosmopolitan distribution with about 430 described species. It is a heterogeneous group and the larvae occur in almost all lentic and lotic waters, except at high altitude and latitude. The males of the genus can be recognized by the combination of deeply bifid pulvilli and abdominal segment VIII constricted basally giving it a triangular appearance.

The genus is split in six subgenera: *Polypedilum* s. str. Kieffer, 1912; *Pentapedilum* Kieffer, 1913; *Tripodura* Townes, 1945; *Asheum* Sublette and Sublette, 1983; *Uresipedilum* Oyewo and Sæther, 1998; and *Cerobregma* Sæther and Sundal, 1999.

The subgenus *Cerobregma* contains 11 species known as male imagines and 4 species known as pupae. The males of *Cerobregma* are characterized by strong anal tergal bands; bulb-like, extended gonocoxites, with a deep incision between gonocoxite and gonostylus; and usually with conspicuously strong, apically split setae along inner margin of

gonostylus. The larvae are ectoparasitic on caddis flies (Kobayashi *et al.* 2003).

The subgenus *Tripodura* was established by Townes (1945). To date, 140 species are described worldwide. The subgenus is characterized by having a trifid anal point or at least shoulders to each side of the anal point and / or superior volsella without apical extension. In this paper, we describe two unusual species of the genus *Polypedilum* from Oriental China.

Material and methods

The material examined was mounted on slides following the procedure outlined by Sæther (1969). The morphological nomenclature follows Sæther (1980) with the additions and corrections given by Sæther (1990). Measurements are given as ranges followed by a mean when three or more specimens were measured, followed by the number measured (n) in parentheses.

All material examined is deposited in the Department of Biology, Nankai University, China (BDN).

Polypedilum (Cerobregma) paucisetum sp. n.

(Figs. 1–7)

Type material

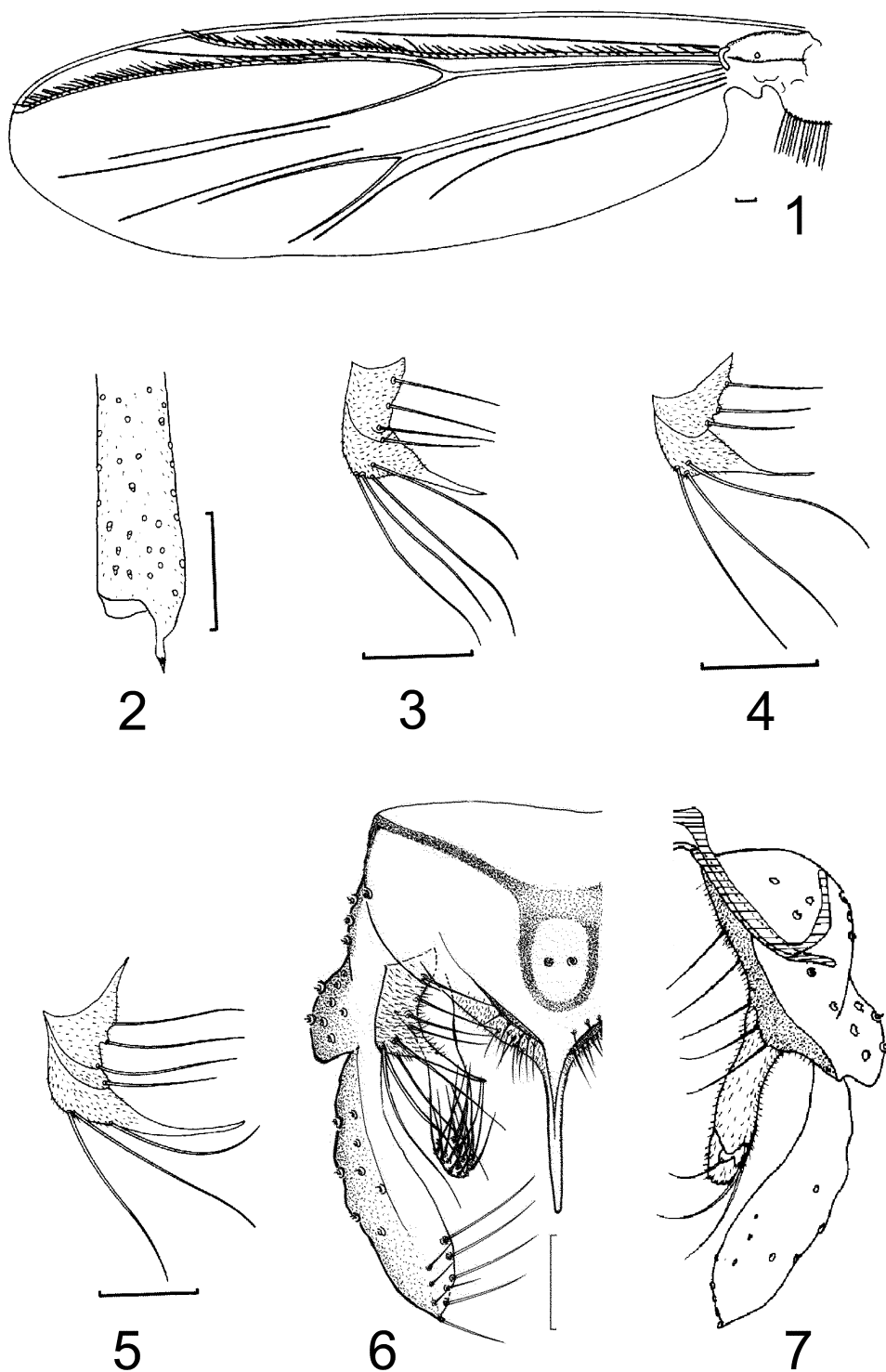
Holotype male, CHINA: Guangdong Province, Fengkai County, Heishiding Natural Reserve, 20.iv.1988, light trap, X. Wang (BDN No.: 05921). Paratypes: 9 males as holotype; 2 males, Guizhou Province, Fanjing Mountain Natural Reserve, Huoguo Temple, 3.viii.2001, light trap, R. Zhang; 3 males, Guizhou Province, Jiangkou County, 27.vii.2001, light trap, R. Zhang; 1 male, Guizhou Province, Luodian County, 420 m a.s.l., 7.viii.1995, light trap, W. Bu; 1 male, Yunnan Province, Mengla County, Menglun Township, 12.iv.1987, H. Zou.

Etymology

From Latin *paucus*, few and *seta*, hair, referring to the low number of setae on the anal tergite.

Diagnostic characters

The species has an *Uresipedilum*-like superior volsella, which is unique in the subgenus *Cerobregma*. The low number of anal tergite setae and the setae along inner margin of the gonostylus being not-split, will separate the species from other members of the subgenus.



FIGURES 1–7. *Polypedilum (Cerobregma) paucisetum* sp. n., male. 1. Wing. 2. Fore tibial scale. 3–5. Superior volsella. 6. Hypopygium, dorsal view. 7. Hypopygium, ventral view. Scales = 50 μ m.

Description

Male (n = 10 except when otherwise stated). Total length 2.59–3.38, 2.99 mm. Wing length 1.62–2.13, 1.93 mm. Total length / wing length 1.43–1.67, 1.55. Wing length / length of profemur 1.95–2.21, 2.11.

Coloration. Head brown. Thorax brown with darker vittae, postnotum and preepisternum. Abdominal segments entirely brown or tergites II–V brown with pale posterior margins. Legs and wings uniformly brown.

Head. AR 0.54–0.91, 0.72. Ultimate flagellomere 368–525, 441 μm long. Temporal setae 11–18, 16; including 3–10, 7 inner verticals; 4–9, 7 outer verticals and 1–3, 2 postorbitals. Clypeus with 16–30, 22 setae. Tentorium 107–143, 117 μm long, 36–52, 43 μm wide. Palpomere lengths (in μm): 31–47, 39; 49–57, 52; 104–146, 121; 109–151, 130; 177–252, 211.

Wing (Fig. 1). VR 1.14–1.32, 1.23. Brachiolum with 1 seta; R with 18–29, 23; R_1 with 20–35, 29; R_{4+5} with 34–67, 50; RM with 0–3; M with 0–2 setae. Squama with 11–19, 16(8) setae.

Thorax. Anteprenotals and scutal tubercle absent. Dorsocentrals 12–23, 18; acrostichals 9–19, 14; prealars 5–11, 8. Scutellum with 11–19, 15 setae.

Legs. Terminal scale (Fig. 2) of front tibia triangular, 44–70, 57 μm long with small spine; spur on median tibiae 52–68, 62 μm long including 23–34, 30 μm long comb, un-spurred comb 18–34, 25 μm long; spur on posterior tibia 57–78, 67 μm long including 29–52, 37 μm long comb, un-spurred comb 23–36, 29 μm long. Width at apex of front tibia 49–65, 56 μm ; of mid tibia 52–68, 58 μm ; of hind tibia 55–73, 65 μm . Lengths (in μm) and proportions of legs as in Table 1.

TABLE 1. Lengths (in μm) and proportions of legs of *Polypedilum (Cerobregma) paucisetum* sp. n., male (n = 8–14).

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR
p ₁	830–1040, 917	546–630, 592	956–1215, 1097	641–783, 712	441–525, 483	368–473, 423	179–221, 196	1.75–1.93, 1.85
p ₂	977–1242, 1096	777–972, 875	399–515, 451	242–326, 284	189–242, 220	133–186, 155	80–106, 94	0.48–0.56, 0.51
p ₃	987–1323, 1159	830–1053, 942	578–756, 644	336–441, 391	315–410, 354	221–273, 219	95–137, 113	0.64–0.72, 0.69

Hypopygium (Figs. 3–7). Anal tergite bands strongly developed, fused basally and apically, completely surrounding 1–5, 3 strong median anal tergite setae. Laterosternite with 2–3, 3 setae. Anal point 62–100, 79 μm long, tapering. Phallapodeme 81–108, 97 μm long; transverse sternapodeme 26–55, 37 μm long. Gonocoxite 130–168, 152 μm long with bulb-like apicolateral extension. Superior volsella (Figs. 3–5) not projecting posteriorly, base with 2–4 inner and 2–4 apical setae, with microtrichiae; apicomedial

projection long, slender, with sharply pointed apex. Inferior volsella apically split in 3 lobes with 20–27 not-split subapical setae and an apical seta. Gonostylus 120–165, 139 μm long, with long, not-split setae along inner margin. HR 0.98–1.20, 1.09. HV 1.88–2.29, 2.14.

Distribution

The specimens were collected in light traps in the Guandong, Guizhan and Yunnan provinces in Oriental China.

Remarks

In this new species, the basal portion of the superior volsella is low and broad, the apical processes arise from the inner margin of its base and are directed inwards, which are typical in the subgenus *Uresipedilum* Oyewo and Sæther. The superior volsella is somewhat similar to the volsellae of *P. (C.) bulbocaudatum* Sæther and Sundal, *P. (C.) subulatum* Sæther and Sundal (Sæther & Sundal 1999: Figs. 43–44) and *P. (C.) okigrandis* Sasa (Sasa 1993: Fig. 10.5). However, in these three species the apical process of the superior volsella arise from the outer margin of its base. In the new species neither the setae along the inner margin of the gonostylus nor any setae of the inferior volsella are split, which separate it from most other members of the subgenus *Cerobregma*. However, according to the descriptions both *P. (C.) kamotertium* Sasa (Sasa 1989: 64) and *P. (C.) okigrandis* lack split setae. Sæther and Sundal (1999), however, assumed that the branching of the setae had been overlooked. Kobayashi *et al.* (2003) showed that this is indeed the case at least in *P. (C.) kamotertium*.

***Polypedilum (Tripodura) nudiprostatum* sp. n.**

(Figs. 8–12)

Type material

Holotype male, CHINA: Guangxi Autonomous Region, Longsheng County, Sanmen Town, 26.v.1990, light trap, X. Wang (BDN No.: 01560). Paratype: 1 male, Fujian Province, Jianning County, 26.ix. 2002, light trap, Z. Liu.

Etymology

From Latin, *nudus*, bare and *prosto*, project, referring to the long, naked lateral projections of the anal point.

Diagnostic characters

The species differs from other species of *Tripodura* in the shape of the straight superior volsella and the trifid anal point with long lateral processes.

Description

Male (n = 1–2). Total length 1.89 mm. Wing length 1.08–1.24 mm. Total length / wing length 1.75. Wing length / length of profemur 2.37–2.45.

Coloration. Head brown except palpomere yellow. Thorax brown with darker vittae, postnotum and preepisternum. Abdominal segments entirely brown. Fore legs with femora yellow at distal 1/4, other parts brown; mid and hind legs with femora yellow at distal 1/5, others parts brown.

Head. AR 0.58–0.59. Ultimate flagellomere 242–273 μm long. Temporal setae 8–9. Clypeus with 13–14 setae. Tentorium 78–94 μm long, 20–31 μm wide. Palpomere lengths (in μm): 25–36, 26–28, 49–55, 65–75, 114–123.

Wing (Fig. 8). VR 1.30–1.33. Brachiolum with 1 setae, R with 12–14, R₁ with 8–9, R₄₊₅ with 14–15 setae. Squama with 5–6 setae.

Thorax. Dorsocentrals 13–16, acrostichals 11–14, prealars 3–4. Scutellum with 9–10 setae.

Legs. Terminal scale (Fig. 9) of front tibia 23–26 μm long with small spine; spur on mid tibiae 34–42 μm long including 18–20 μm long comb, un-spurred comb 16–18 μm long; spur on posterior tibia 39–42 μm long including 21–23 μm long comb, un-spurred comb 18–21 μm long. Width at apex of front tibia 34–36 μm , of mid tibia 46–57 μm , of hind tibia 39–42 μm . Lengths (in μm) and proportions of legs as in Table 2.

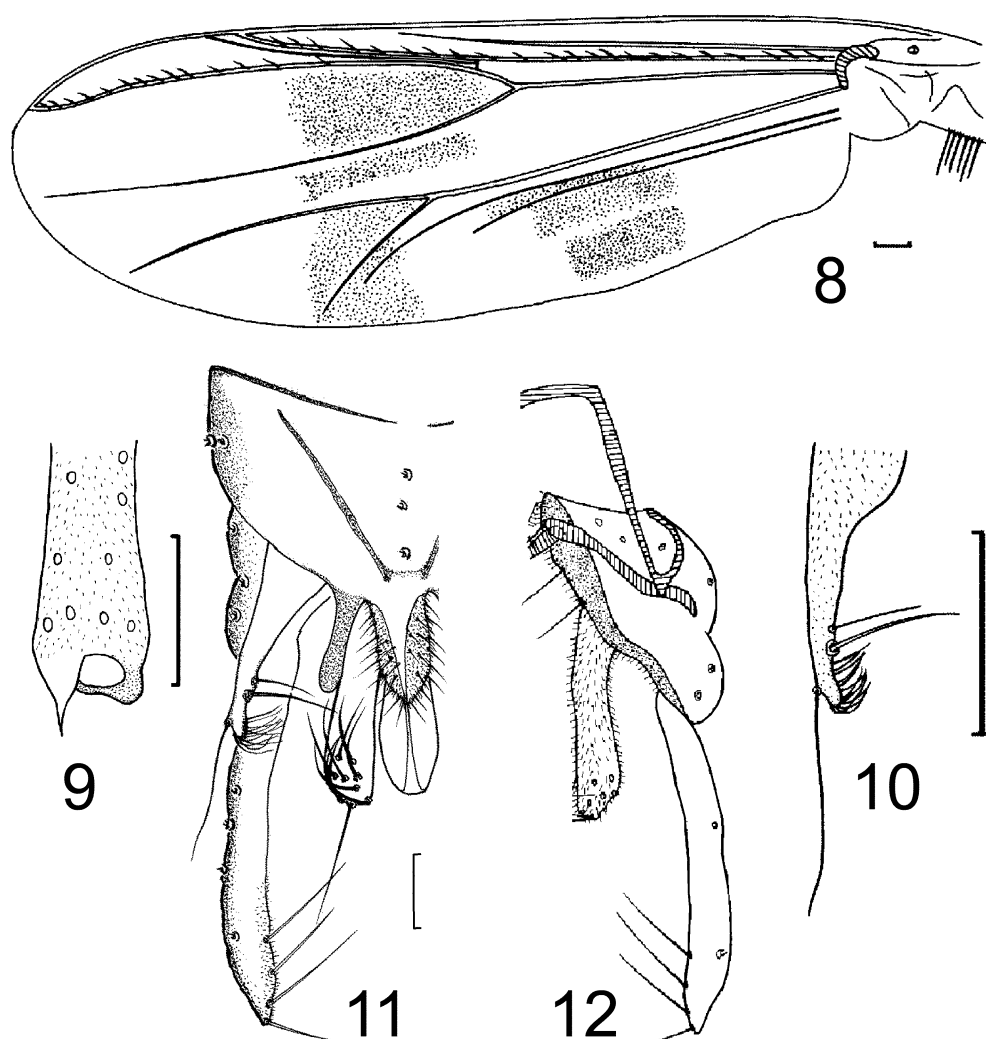
TABLE 2. Lengths (in μm) and proportions of legs of *Polypedilum (Tripodura) nudiprostatum* sp. n., male (n = 1–2).

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR
p ₁	441–525	297–347	651	399	315	242	126	1.88
p ₂	546–630	389–441	191	106	73	47	42	0.49
p ₃	578–630	462–546	305–378	168–196	147–175	95–106	58–64	0.66–0.69

Hypopygium (Figs. 10–12). Anal tergite bands not fused basally, with 2–3 median setae. Laterosternite with 2 setae. Anal point broad, 63–68 μm long, lateral projections very long, strongly sclerotized, without setae, with slightly spatulate apex. Phallapodeme 55–65 μm long; transverse sternapodeme 29–34 μm long. Gonocoxite 86–101 μm long. Superior volsella (Fig. 10) 52–60 μm long, with 2 strong inner setae in apical 1/4, 1 outer subapical setae, and about 11–13 slender setae apically. Inferior volsella 65–72 μm long, with 6 setae. Gonostylus 94–130 μm long, with 3–4 long setae along inner margin and 1 apical seta. HR 0.78–0.91. HV 2.01.

Distribution

The species was collected in Guangxi and Fujian provinces in Oriental China.



FIGURES 8–12. *Polypedilum (Tripodura) nudiprostatum* sp. n., male. 8. Wing. 9. Fore tibial scale. 10. Superior volsella. 11. Hypopygium, dorsal view. 12. Hypopygium, ventral view. Scales = 50 μ m.

Remarks

The superior volsellae of *Tripodura* either have a base and an apical extension as in other members of *Polypedilum* or are more or less pad-like or clavate without apical extension. However, there is a large variation within both types. In *P. (T.) chelum* Vårdal (Vårdal *et al.* 2002: Fig. 9 C, D) the base is strongly reduced, while other species have a superior volsella practically inseparable from typical *Polypedilum s. str.* Among the species without extension many are club-shaped and have secondary apical expansions

almost appearing as lateral extensions. The superior volsella of *P. (T.) abyssiniae* Kieffer (Vårdal *et al.* 2002: Fig. 17 I), for instance approaches the type found in *Uresipedilum*. Other species have a slender and even non-clavate superior volsella without a clear apical extension (Type B₂ in Bidawid & Fittkau 1995: Fig. 15). Examples are *P. (T.) patulum* Bjørlo (Vårdal *et al.* 2002: Figs. 13 H, I) and *P. (T.) albosignatum* Kieffer (Vårdal *et al.* 2002: Fig. 14 D). The superior volsella of the present species best can be interpreted as an extreme form of the last type, i. e. without apical extension. The lateral projections of the anal point are narrow, parallel-sided, strongly sclerotized and without setae, i.e. different from nearly all other known species in the subgenus with trifold anal point and similar to that figured by Albu (1980: Fig. 151) for *P. (T.) pullum* (Zetterstedt).

Systematics

Although quite heterogeneous, the genus *Polypedilum* in the widest sense is one of the better defined genera of the family Chironomidae. At least the male imagines are recognizable by the combination of deeply bifid pulvilli and abdominal segment VIII constricted basally giving a triangular appearance.

Among the subgenera presently recognized *Uresipedilum*, *Tripodura* and *Cerobregma* are shown to be monophyletic (Oyewo & Sæther 1998; Sæther & Sundal 1999; Vårdal *et al.* 2002) while the remaining subgenera (*Asheum*, *Polypedilum s. str.* and *Pentapedilum*) all are in need of revision and redefinition. Only *Cerobregma* shows synapomorphies in all stages. *Uresipedilum* is well defined in the adult and larval stage, while some pupae have a dorsal seta on the anal lobe like in *Tripodura* and *P. nubifer* Skuse. *Tripodura* can be defined by a combination of synapomorphies in the adult and larval stages.

P. (C.) paucisetum has a superior volsella essentially of the *Uresipedilum* type. It was thus interesting to see if it would change the position of *Cerobregma* in the cladograms presented in Sæther and Sundal (1999). *P. (C.) paucisetum* was added to the data matrix in Sæther and Sundal (1999) and the same procedures followed. The strict consensus tree when all trends were unordered and unweighted had *P. (C.) paucisetum* in a trichotomy with the remaining *Cerobregma* and *Asheum* plus *Collartomyia* Goetghebuer. However, the majority rule tree showed that in 85 % of the trees *P. (C.) paucisetum* was part of *Cerobregma*. All other procedures, reweighting, ordering of all or some characters, weighting of same characters etc. gave *P. (C.) paucisetum* as part of *Cerobregma*. However, when some trends were ordered and weighted as in Sæther and Sundal (1999: Fig. 5) none of the shortest trees had *Polypedilum* monophyletic. When the constraint that the genus should be monophyletic is followed there is just one shortest tree with *Cerobregma* monophyletic and *Tripodura* as its sister group.

The placement of *P. (C.) paucisetum* within *Cerobregma* was also tested using the data matrix in Sæther and Sundal (1999: Table 2) with corrections for the Japanese species and

the same procedures. All cladograms had *P. (C.) paucisetum* as the sister species to the remaining species of the subgenus.

The placement of *P. (T.) nudiprostatum* within the subgenus *Tripodura* is quite clear. Without knowledge of the pupa it makes no sense trying to include the species in the large data matrix in Vårdal *et al.* (2002). However, based on the male imago the combination of conspicuous wing markings without discrete spots in cell m basal of crossvein RM, projections to each side of the anal point, and apically broadened anal point without distal transparent lobes place the species in the *pullum* group sensu Vårdal *et al.* (2002). The projection to each side of the anal point is quite similar to the specimen tentatively placed in *P. (T.) pullum* (Zetterstedt) by Albu (1980: Fig.151).

Acknowledgements

The authors are grateful to Mr. Bingchun Ji. Mrs. Yufen Li for making the slides preparations. Financial support from the National Natural Science Foundation of China (NSFC) and China National Education Committee (NEC) are acknowledged.

References

- Albu, P. (1980) Diptera Fam. Chironomidae—Subfam. Chironominae. *Fauna Republicii Socialiste Romania Insecta*, 11, 193–228.
- Bidawid, N. & Fittkau, E.J. (1995) Zur Kenntnis der neotropischen Arten der Gattung *Polypedilum* Kieffer, 1912 Teil I (Diptera: Chironomidae). *Entomofauna*, 16, 465–536.
- Kieffer, J.J. (1912) H. Sauter's Formosa Ausbeute. Tendipedidae (Chironomidae) (Dipt.). *Supplementa entomologica*, 1, 27–43.
- Kobayashi, T., Ohtaka, A. & Takahashi, T. (2003) The second record of ectoparasitic Chironomidae on Trichoptera from Japan, *Polypedilum (Cerobregma) kamotertium* Sasa, 1989. *Spixiana*, 26, 83–93.
- Oyewo, E.A. & Sæther, O.A. (1998) Revision of Afrotropical *Polypedilum* Kieffer subgen. *Uresipedilum* Sasa et Kikuchi, 1995 (Diptera: Chironomidae), with a review of the subgenus. *Annals of Limnology*, 34, 315–362.
- Sæther, O.A. (1969) Some Nearctic Podonominae, Diamesinae and Orthocladiinae (Diptera: Chironomidae). *Bulletin of the Fisheries Research Board of Canada*, 170, 1–154.
- Sæther, O.A. (1980) Glossary of chironomid morphology terminology (Diptera: Chironomidae). *Entomologica scandinavica, Supplement*, 14, 1–55.
- Sæther, O.A. (1990) A review of the genus *Limnophyes* Eaton from the Holarctic and Afrotropical regions (Diptera: Chironomidae, Orthocladiinae). *Entomologica scandinavica, Supplement*, 35, 1–139.
- Sæther, O.A. & Sundal, A. (1999) *Cerobregma*, a new subgenus of *Polypedilum* Kieffer, with a tentative phylogeny of subgenera and species groups within *Polypedilum* (Diptera: Chironomidae). *Journal of the Kansas Entomological Society*, 71, 315–382.
- Sasa, M. (1989) Studies on the chironomid midges (Diptera, Chironomidae) of Shou River. Annex. Chironomid midges of some rivers in western Japan. *Research Report from Toyama Prefectural Environmental Pollution Research Center*, 1989, 46–110.

- Sasa, M. (1993) Studies on the chironomid midges (Yusurika) collected in Toyama and other areas of Japan, 1993. Part 10. Additional records of Chironomidae from Okinawa Island. *Research Report from Toyama Prefectural Environmental Pollution Research Center*, 1993, 125–139.
- Townes, H.K., Jr. (1945) The Nearctic species of Tendipedini (Diptera, Tendipedidae) (= Chironomidae). *American Midland Naturalist*, 34, 1–206.
- Vårdal, H., Bjørlo, A. & Sæther, O.A. (2002) Afrotropical *Polypedilum* subgenus *Tripodura*, with a review of the subgenus (Diptera: Chironomidae). *Zoologica Scripta*, 31, 331–402.