Acta Biologica Sibirica
Vol 10 (2024): Acta Biologica Sibirica, 291–302
Articles

On the genus Arrup Chamberlin, 1912 (Chilopoda: Geophilomorpha: Mecistocephalidae) from Russia, with a key to the members of the family Mecistocephalidae from Russia

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The members of the genus *Arrup* Chamberlin, 1912 from Russia are reviewed: *A. mamaevi* (Titova, 1975) is re-described based on type and new material; *A.* cf. *dentatus* (Takakuwa, 1934) is also described based on the material from Russia, differences from specimens from Japan are shown. All the records are mapped. A key to the members of the family Mecistocephalidae known from Russia is provided.

Acta Biologica Sibirica 10: 291–302 (2024)

doi: 10.5281/zenodo.11096418

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Academic editor: R. Yakovlev | Received 28 March 2024 | Accepted 15 April 2024 | Published 1 May 2024

http://zoobank.org/6C40305D-E49C-454C-A01E-FB446D15D3C9

Citation: Dyachkov YuD (2024) On the genus *Arrup* Chamberlin, 1912 (Chilopoda: Geophilomorpha: Mecistocephalidae) from Russia, with a key to the members of the family Mecistocephalidae from Russia. Acta Biologica Sibirica 10: 291–302. https://doi.org/10.5281/zenodo.11096418

Keywords

Biodiversity, Far East, identification key, re-description, new records, Siberia, types

Introduction

The genus *Arrup* Chamberlin, 1912 is mainly spread in East Asia, with some species are also known from Central Asia and the southwest part of North America (Bonato 2011; Dyachkov 2019). The first record of this genus from Russia was provided by Titova (1969), who recorded a single specimen of *Prolamnonyx holstii* from the Maritime Krai. Later, she described a new species, *P. mamaevi*, based on this specimen (Titova 1975); she also recorded *Arrup dentatus* Takakuwa, 1934 (under the name *Prolamnonyx dentatus*) from Sakhalin, the Kuril Islands and the Maritime Krai. The latter species was placed in the genus *Arrup* by Crabill (1964). Foddai et al. (2003) provided a

new combination, *A. mamaevi* (Titova, 1975) for *Prolamnonyx mamaevi*.

This paper contributes a redescription of *A. mamaevi*, a description of specimens of *A.* cf. *dentatus* from Russia and their differences from the specimens from Japan. Descriptions are based on the available type and new materials.

Materials and methods

The type specimen of *A. mamaevi* from ZMMU (abbreviations below) and specimens originally assumed to be *A. dentatus* by Titova (1975) from the Maritime krai and Kunashir Island were examined. Additional materials from ASU, IBSS, and PSU were also studied.

The specimens were examined with Olympus stereo microscopes: SZX16 and BX51. Some specimens of each species were dissected, and their cephalic capsule, forcipular segment, mandibles, maxillary complex, and remaining body were boiled in 10% KOH and mounted in permanent slides using euparal. Photographs were taken using an Olympus DP74 or XC50 digital cameras attached to the microscopes.

The terminology follows Bonato et al. (2010b). Identification key prepared using Titova (1975), Uliana et al. (2007), Bonato & Minelli (2010), Bonato et al. (2010a), Dyachkov & Bonato (2024). Localities are indicated as in the original labels or publications. Additional information is in square brackets. Localities were mapped (Fig. 1) with SimpleMappr (Shorthouse 2010).

Abbreviations: AF – A.A. Fomichev, ASU – Altai State University (Barnaul, Russia), BM – B.M. Mamaev, coll. – collector, juv. – juvenile, IBSS – Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences (Vladivostok, Russia), K – Kurochkina, MS – M.E. Sergeev, PSU – Perm State University (Perm, Russia), YD – Yu.V. Dyachkov, ZMMU – Zoological Museum of the Moscow State University (Moscow, Russia).

Result

Genus *Arrup* Chamberlin, 1912

***Arrup mamaevi* (Titova, 1975)**

Figs 1–16

Type locality: «Primorsky Kray, zapovednik Kedrovaya Pad» [Nature Reserve, ca. N43°6', E131°28'] (Titova 1975).

Prolamnonyx mamaevi Titova 1975: 44 (original description).

Prolamnonyx holstii – Titova 1969: 165 (see Remarks).

Prolamnonyx mamaevi – Ganin 1997: 121.

Arrup mamaevi – Foddai et al. 2003: 1262; Dyachkov, Bonato 2024: 35.

Material. Holotype: female (ZMMU Rc 8443), [Russia], D.V. [Far East], Kedrovaya Pad, under tree bark and in wood of *Chosenia*, 6.IX.[19]64, coll. BM. Other material: Russia, Maritime Province, Ussuriysky District, Krounovka River Valley: 2 males, 7 juv. (ASU No. 673), N43°40'47", E131°34'53", *Querqus* forest, in soil and litter, 190 m, 10–11.VII.2022, coll. YD; 1 female (ASU No. 569), N43°40'47", E131°34'37", 180 m, 9–11.VII.2022, coll. AF; 1 female (IBSS No. 35), [Khassan District], Ostrovok Falshiviy Cape [N42°27'8", E130°47'8"], 16.VI.2021, coll. MS.

Diagnosis. An *Arrup* species with body length up to 32 mm; second maxillary pretarsi absent; forcipular trochanteroprefemur with a large distal denticle, tibia with small bulge, and tarsungulum with pointed basal denticle.

Figure 1. *Distribution of the genus Arrup Chamberlin, 1912 known in Russia: triangle, A. cf. dentatus (Takakuwa, 1934); star, A. mamaevi (Titova, 1975). Green color indicates type locality.*

Redescription. Holotype is in poor condition (Fig. 16).

Head. Anterior markedly areolate part of the clypeus extending medially for 80% of the total clypeal length. Clypeal setae: 43 (based on the original description, 33 setae recognizable on slide). Each cephalic pleurite with 2 setae.

Forcipular segment. Coxosternite 1.1 as wide as long, with a pair of small anterior denticles. Trochanteroprefemur 1.4 × as long as wide; tarsungulum 2.5 × as long as wide. Trochanteroprefemur with a large obtuse distal denticle and tarsungulum with a large basal denticle.

Ultimate leg-bearing segment. Metasternite sub trapezoidal, ca. 1.2 × as long as wide, the anterior margin usually ca. 2 times wider than the posterior one. Each coxopleuron with 27–33 pores scattered on ventral and lateral sides. Legs densely setose, without pretarsus.

Intraspecific variations. Body length up to 24 mm and width up to 2 mm. Color (in ethanol 70%) usually yellow, with head, forcipular segment (except forcipular tergite), and antennae slightly darker (Figs 2–7).

Head. Cephalic plate ca. 1.6 × as long as wide, hexagonal, slightly widening on the anterior third; posterior margin slightly concave anteriorly. Transverse suture distinct. Antennae ca. 4 × longer as the head maximum width.

Anterior markedly areolate part of the clypeus extending medially for 80% of the total clypeal length (Figs 8–9). Clypeal setae: 15–32 (Figs 8–9). Cephalic pleurites with 2–3 setae. Each mandible (Fig. 15) usually with 7 lamellae, with 6–11 teeth in each lamella. Second maxillae (Figs 10–11):

distal part of 2nd article usually with 1–3 setae, distal part of 3rd article with up to 6 setae, pretarsus absent.

Forcipular segment. Tergite sub-trapezoid, ca. 1.9 × as wide as long. Coxosternite 1.1 × as wide as long, with a pair of small anterior denticles. Trochanteroprefemur 1.4 × as long as wide; tarsungulum 2.7 × as long as wide. Forcipules, when closed, do not surpassing the anterior margin of the cephalic plate (Figs 2–3). Trochanteroprefemur with a large obtuse distal denticle, tibia with a small bulge, and tarsungulum with a large basal denticle (Figs 2, 12). Calyx of poison gland usually reaching distal part of the trochanteroprefemur in both sexes (Fig. 12).

Leg-bearing segments (Fig. 4). Tergites 1–37 with a pair of paramedian sulci. Metasternites 2–9 with a median longitudinal sulcus. 41 leg-bearing segments. Legs 1 slightly smaller than following legs; pretarsi with two minute accessory spines. Segments sparsely setose, legs more densely setose.

Ultimate leg-bearing segment (Figs 5–6, 13–14). Metatergite shield-shaped, 0.8 × as long as wide, and 1.2 × as wide as the pretergite (Fig. 6). Metasternite sub trapezoidal, its length to width varying between 1:1 and 1:1.1, and the anterior margin usually ca. 2 times wider than the posterior one. Up to 35 pores on each coxopleuron, scattered on ventral and lateral sides. Legs densely setose.

Postpedal segments densely setose (Figs 13–14). Intermediate sternite and first genital sternite well-developed. Male gonopods bi-articulate and separated by a conic projection in between. Female gonopods bi-articulate, subtriangular. Anal pores present (Fig. 13).

Distribution. Maritime krai, Russia (Titova 1975; Ganin 1997; Dyachkov & Bonato 2024).

Remarks. This species was described (Titova 1975) based on a sole female from the “Primorsky Krai, zapovednik Kedrovaya Pad” collected on the 6.IX.1964; the holotype had been previously assigned to *A. holstii* (Pocock, 1895) (Titova 1969). This specimen is expected to be at the ZMMU, but I did not find the holotype. Nevertheless, I detected slide that can be recognized as holotype according to the locality, date, and collector reported on the label (ZMMU Rc 8443). Unfortunately, slide is in poor condition (Fig. 16).

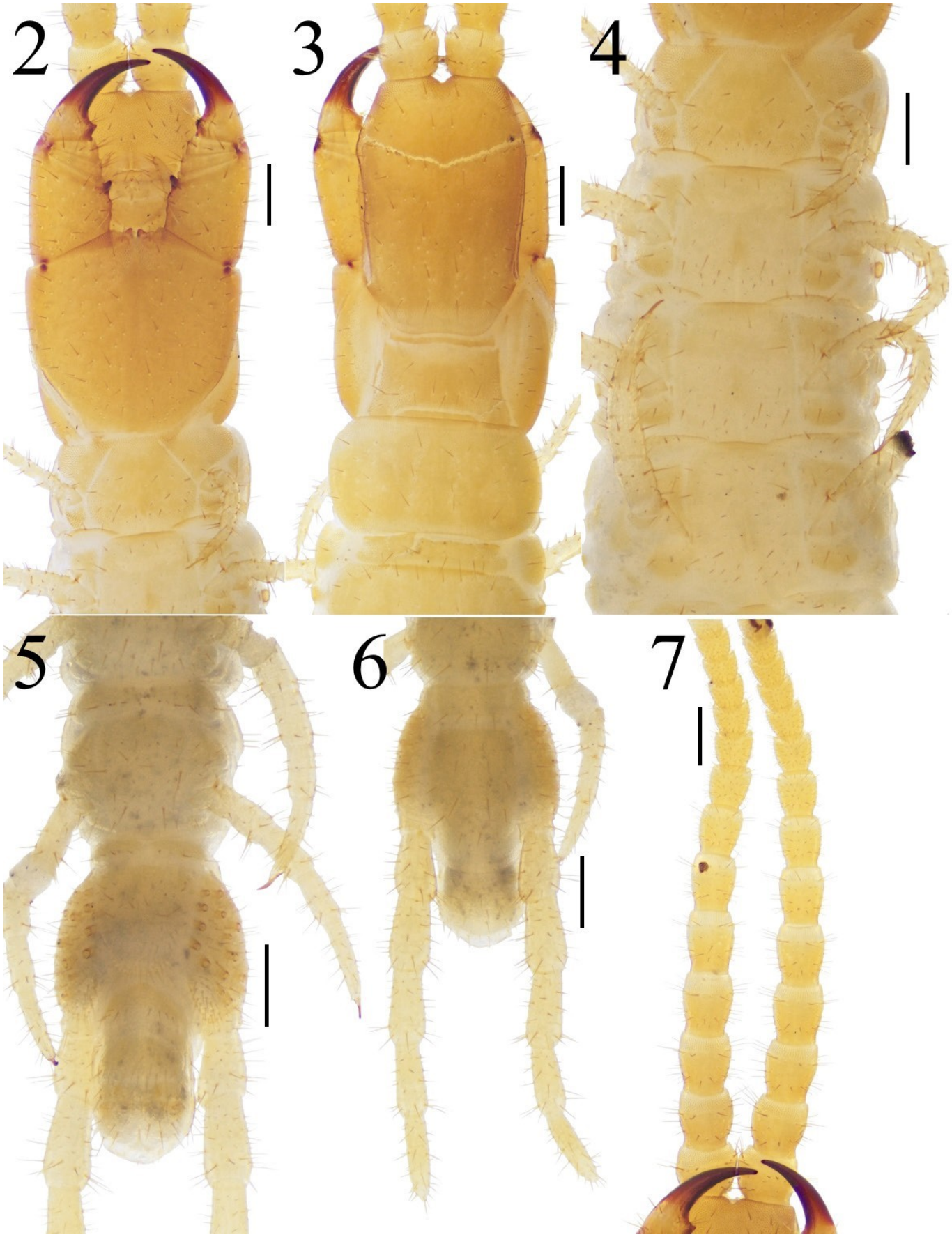

Figure 2. ***Figures 2–7.*** *Arrup mamaevi (Titova, 1975) (ASU No. 673): 2, 3, front body fragment, ventral and dorsal views; 4, 1–4 leg-bearing segments, ventral view; 5, 6, rear body fragment, ventral and dorsal views; 7 – antennae, ventral view.*

Scale: 0.2 mm.

Arrup cf. *dentatus* (Takakuwa, 1934)

Figs 17–31

Type locality: “Zyôzankei (bei Sapporo)” [Japan, Hokkaido Isl.] (Takakuwa 1934).

Prolamnonyx dentatus Takakuwa 1934: 359 (original description).

Prolamnonyx dentatus – Shinohara 1972: 66; Titova 1975: 45; Ganin 1997: 134.

Arrup dentatus – Crabill 1964: 166; Foddai et al. 2003: 1261; Dyachkov, Bonato 2024: 35.

Material. 1 female (PSU No. 1565), Russia, Primorsky Krai, Lazovsky Nature Reserve, bay near Petrov Island, N42°52', E133°47', 01.VIII.2009, coll. K; 12 males, 4 females, 2 juv. (ASU No. 670), 11.5 km Kishinevka Village, Lisaya Mt., N43°14'45", E133°43'02", stony mixed forest, under stones, in litter, 620 m, 21.VII.2022, coll. YD; 5 males (ASU No. 671), N43°15'06", E133°42'54", *Populus* forest among screes, under stones, 600–1000 m, 22.VII.2022, coll. YD; Sudzukhinskiy [Lazovsky] Nature Reserve, Tachingauz [bay, ca. N43°1', E134°8']: 7 males, 6 females (ZMMU Rc 8205; identified by Titova), mixed forest, in soil, IX.1971, coll. unknown; 2 males, 4 females, 1 juv. (ZMMU Rc 8203; identified by Titova), *Pinus* forest, in soil, IX.1971 coll. unknown; 1 male (ZMMU Rc 8442; identified by Titova), Kunashur [Island, ca. N44°6', E145°49'], coll. unknown.

Intraspecific variations. Body length up to 22 mm and width up to 1 mm in ♂♂, length up to 18 mm and width up to 0.95 mm in ♀♀. Color (in 70% ethanol) usually dark yellow, with head, forcipular segment (except forcipular tergite), and antennae light brown (Figs 17–19).

Head. Cephalic plate ca. 1.3 × as long as wide, sub-rectangular, its posterior margin almost straight. Transverse suture distinct. Antennae ca. 3.75 × longer as the head maximum width.

Anterior markedly areolate part of the clypeus extending medially for 70% of the total length of the clypeus (Fig. 23). Clypeal setae usually 18–19 on the markedly areolate part. Labral mid-piece usually pointed and projecting backwards beyond the posterior margins of the labral lateral ones. Each mandible (Figs 30–31) usually with five lamellae, with 5–12 teeth in each lamella.

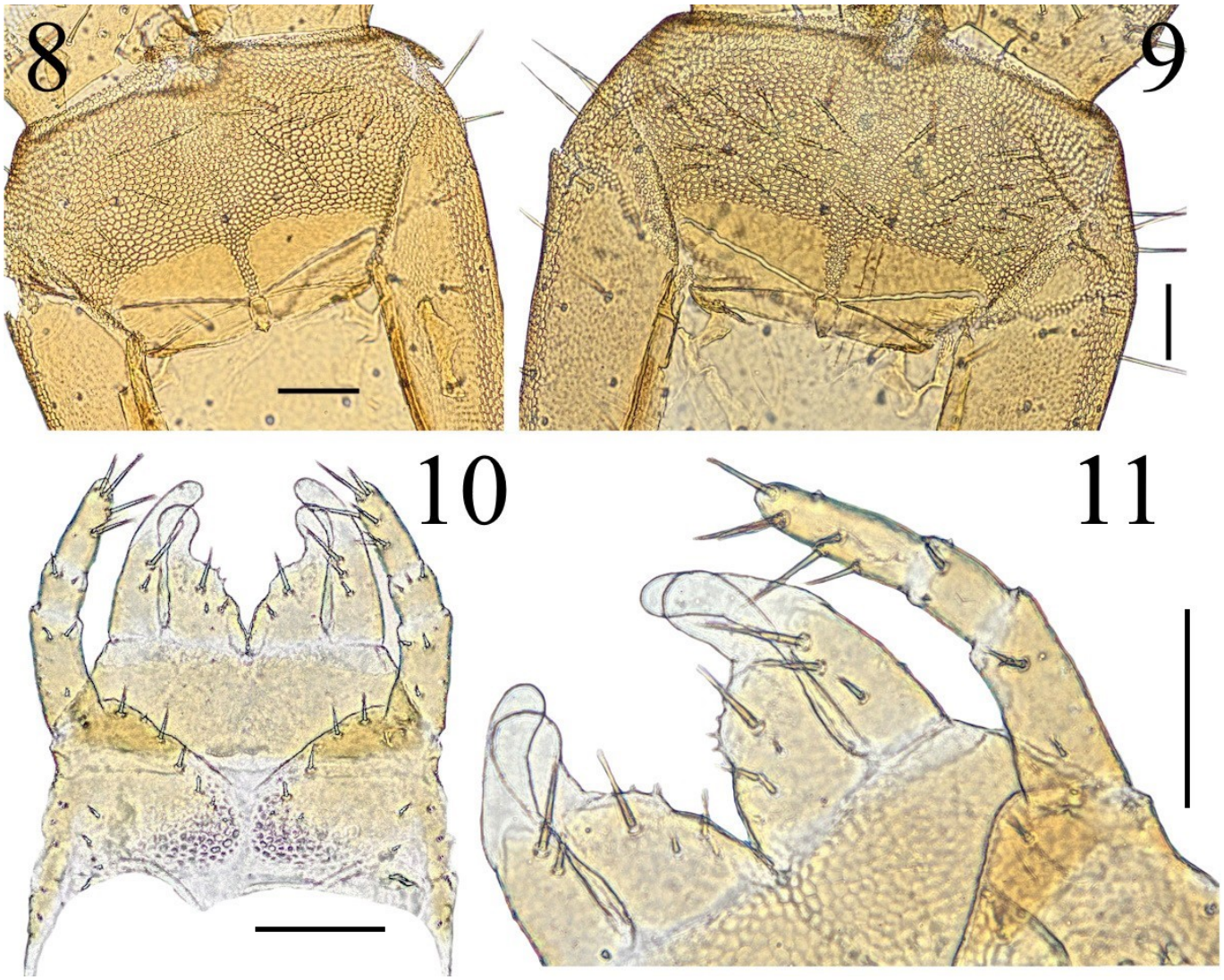

Figure 3. *Figures 8–11. Arrup mamaevi (Titova, 1975) (IBSS No. 35: 8, 11; ASU No. 673: 9; ASU No. 569: 10), ventral view: 8, 9, clypeus and labrum; 10, maxillary complex; 11, first maxillae and second maxillary telopodite. Scale: 0.1 mm.*

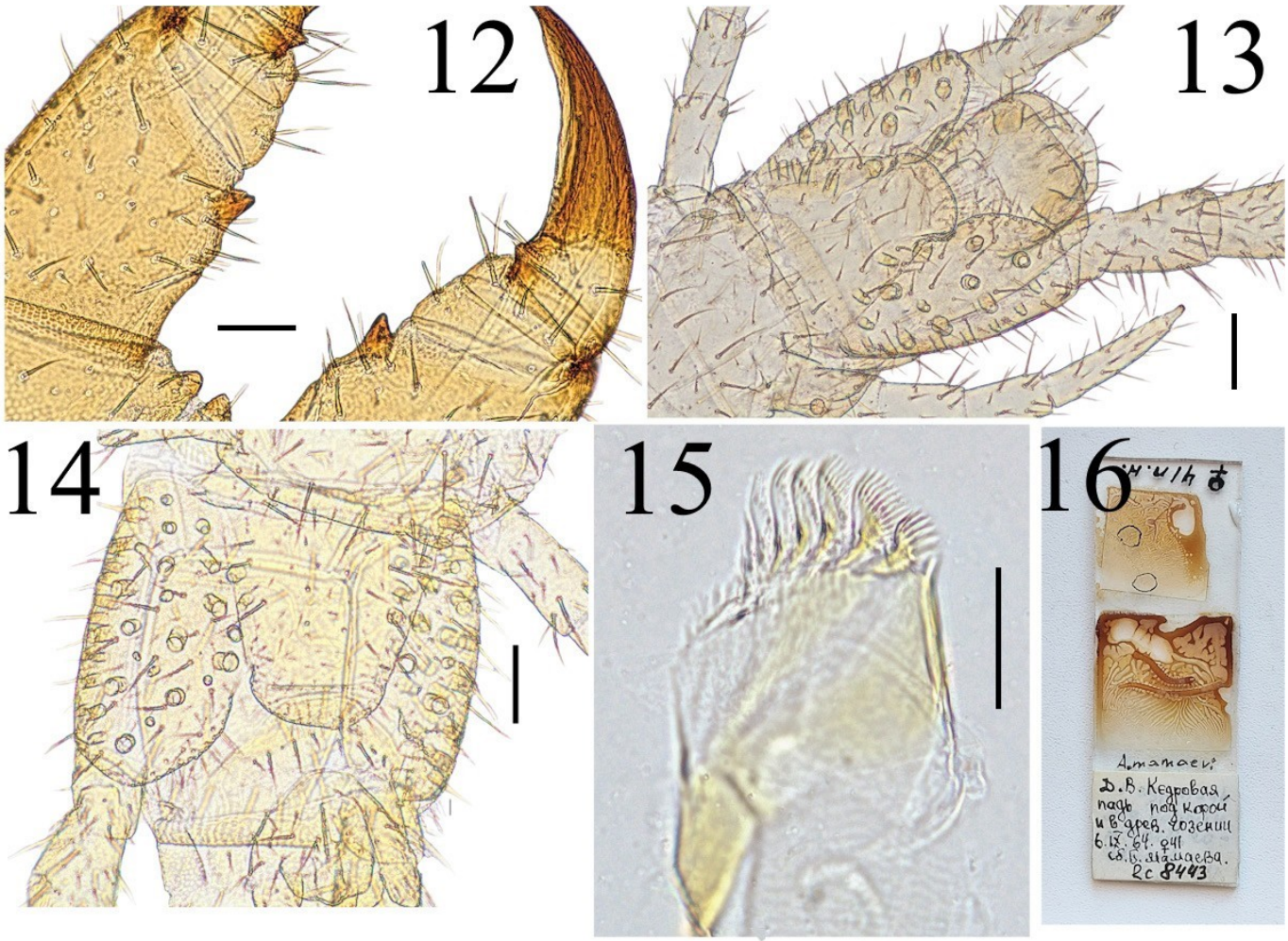

Figure 4. *Figures 12–16. Arrup mamaevi (Titova, 1975) (IBSS No. 35: 12, 14; ASU No. 569: 13, 15; ZMMU Rc 8443: 16), ventral view: 12, forcipules; 13, 14, ultimate leg-bearing segment; 15, mandible; 16, slide in poor condition. Scale: 0.1 mm (12–14), 0.05 mm (15).*

Second maxillae (Figs 27–29): distal part of 2nd article usually with up to 3 setae, distal part of 3rd article with up to 6 setae, pretarsus absent (see Remarks).

Forcipular segment. Tergite usually partially covered by tergite 1 (Fig. 18), subtrapezoid, ca. 2 × as wide as long. Coxosternite 1.1 × as wide as long, with a pair of small anterior denticles. Forcipules usually do not surpassing the anterior margin of the cephalic plate (Figs 17–19). Trochanteroprefemur 1.4 × as long as wide; tarsungulum 2.4 × as long as wide. Trochanteroprefemur with a large obtuse distal denticle, femur without denticle, tibia with a large denticle, and tarsungulum with a basal denticle (Figs 17, 25). A sole female specimen has a denticle on the right femur (collected together with other specimens with usual morphology, in the sample ASU No. 670, Fig. 19). Calyx of poison gland usually reaching the trochanteroprefemur in both sexes.

Leg-bearing segments. Tergites from 1st to penultimate with a pair of paramedian sulci. Metasternites from 2–3 to 10–11 with a median longitudinal sulcus (Fig. 17). Legs 1 slightly smaller than following legs; pretarsi with two minute accessory spines.

Ultimate leg-bearing segment. Almost similar in both sexes (Figs 20–22, 26): metatergite shield-shaped, about as long as wide, and 1.2 × as wide as the pretergite. Metasternite sub-triangle, 1.1 × as wide as long. Up to 17 pores on each coxopleuron, scattered on ventral and lateral sides. Legs slender in females and slightly incrassate in males (trochanter, prefemur and femur more

incrassate than tibia and both tarsi; Fig. 20), densely setose.

Postpedal segments densely setose in both sexes (Figs 20–21). Both intermediate sternite and first genital sternite well-developed. Male gonopods bi-articulate, triangle, narrow, and separated by a conic projection in between (Fig. 20). Female gonopods bi-articulate, subtriangular (Figs 21, 26). Anal pores present (Fig. 26).

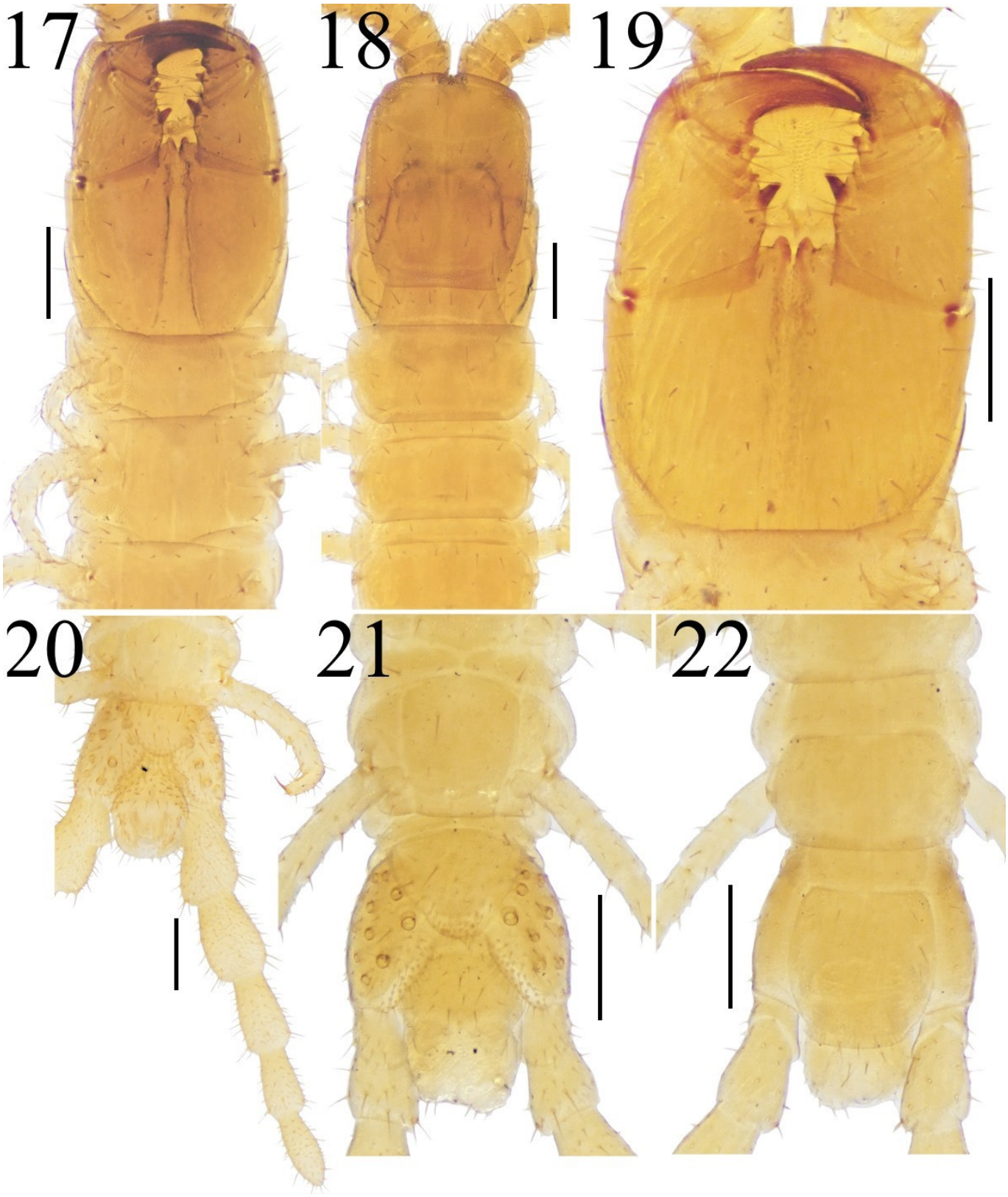

Figure 5. *Figures 17–22. Arrup cf. dentatus (Takakuwa, 1934) (ZMMU Rc 8205: 17–18; ASU No. 670: 19–22): 17, 18, front body fragment, ventral and dorsal views; 19, forcipular segment, ventral view; 20, ultimate leg-bearing segment of male, ventral view; 21–22, rear body part of female, ventral and dorsal views. Scale: 0.2 mm.*

Distribution. Russia: Maritime krai and Sakhalin oblast (Sakhalin and Kuril Islands: Kunashir and Shikotan) (Titova 1975; Ganin 1997; Dyachkov & Bonato 2024) and Japan (Takakuwa 1934;

Shinohara 1972).

Remarks. The type material is probably lost. Uliana et al. (2007) studied 3 specimens (1 male and 2 females) considered to be *A. dentatus* from Hokkaido Isl., Mt. Soranuma-dake (close to the type locality). These specimens have the second maxillary pretarsi. According to the original description (Takakuwa 1934), the second maxillary pretarsi are absent in *A. dentatus*. Titova (1975) also indicated absence of this character in the specimens of *A. dentatus* from the Russian Far East. I studied both Titova's (ZMMU Rc 8203, Rc 8205, and Rc 8442) and additional fresh materials. These specimens from Russia do not have the second maxillary pretarsi (Figs 27–29). Therefore, additional studies are necessary to clarify the taxonomic status of these populations because there are significant differences between specimens from Russia and Japan. Thus, I regarded the specimens studied here as *A.* cf. *dentatus*.

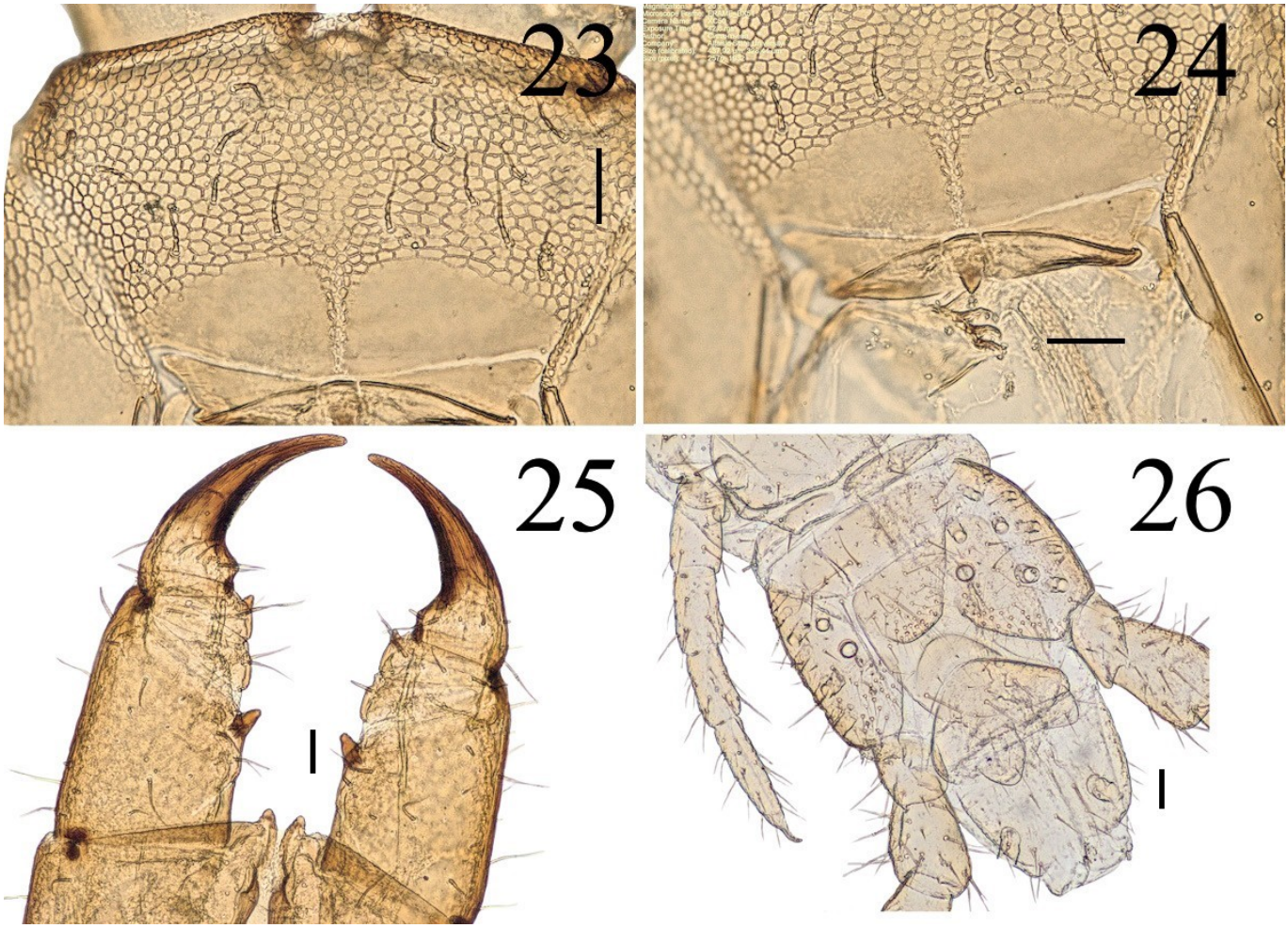

Figure 6. ***Figures 23–26.*** *Arrup cf. dentatus (Takakuwa, 1934) (ZMMU Rc 8205), ventral view: 23, clypeus; 24, clypeal plagulae and labrum; 25, forcipules; 26, rear body fragment of female. Scale: 0.05 mm.*

Conclusion

To date, the family Mecistocephalidae is represented by 5 species in 4 genera, *Agnostrup* Foddai et al., 2003, *Arrup*, *Dicellophilus* Cook, 1896, and *Tygarrup* Chamberlin, 1914, in Russia: *Dicellophilus carniolensis* (C.L. Koch, 1847) is known from the Caucasus, Krasnodar Krai (Volkova 2016), while *Agnostrup striganovae*, *Arrup* cf. *dentatus*, *A. mamaevi*, and *Tygarrup javanicus* (Attems, 1907) are recorded from Asian part of Russia (Titova 1969, 1975; Nefediev 2019; Dyachkov & Bonato 2024). *T. javanicus* is an anthropochore introduction known from hothouses in Western Siberia (Nefediev 2019), while the other species are known from Far East only.

A specimen of *Krateraspis meinerti* (Sseliwanoff, 1881) was reported by Izotova (1960) from the Tatarstan (European Russia), but this record was questioned by Dyachkov & Bonato (2022). According to the illustrations of the specimen's morphology provided by Izotova (1960), this specimen belongs to the genus *Arctogeophilus* Attems, 1909, family Geophilidae.

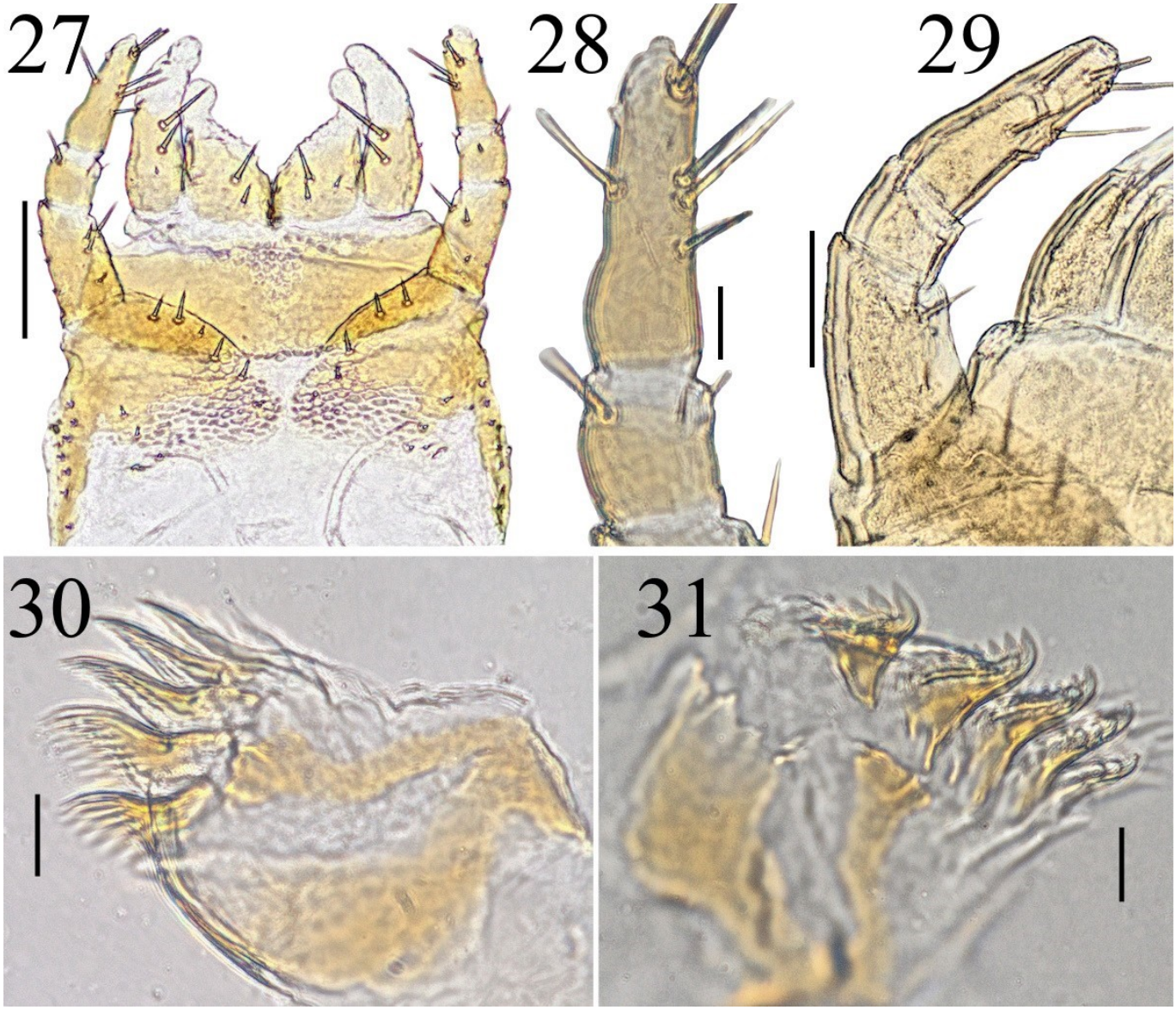

Figure 7. *Figures 27–31. Arrup cf. dentatus (Takakuwa, 1934) (ASU No. 671: 27–28, 30–31; ZMMU Rc 8205 – 29): 27, maxillary complex, ventral view; 28, 29, right telopodite of second maxillae, ventral view; 30, 31, mandible, lateral view. Scale: 0.02 mm (28, 30, 31), 0.05 mm (29), 0.1 mm (27).*

A key to a members of the family Mecistocephalidae known from Russia

1 Hair-like projections on a posterior alae present, 43 leg-bearing segments

.....*Dicellophilus carniolensis*

– Hair-like projections on posterior alae absent, 41 or 45 leg-bearing segments **2**

2 Clypeus with a pair of plagulae, separated by a mid-longitudinal areolate stripe, invariably 41 leg-bearing segments..... 3

– Clypeus with a single entire plagulae, invariably 45 leg-bearing segments**.**

.....*Tygarrup javanicus*

3 First maxillary coxosternite entire..... 4

– First maxillary coxosternite divided, with a distinct mid-longitudinal suture *Agnostrup striganovae*

4 Forcipular trochanteroprefemur with a large distal denticle, tibia with large denticle, tarsungulum with pointed one..... *Arrup* cf. *dentatus*

– Forcipular trochanteroprefemur with a large distal denticle, tibia with small bulge, and tarsungulum with pointed denticle..... *A. mamaevi*.

Acknowledgements

I am grateful to A.A. Schileyko (ZMMU), E.V. Mikhaljova (IBSS), and G.Sh. Farzalieva (PSU) who loaned material. I am also thankful to A.A. Fomichev (ASU) for his help during field work. I also wish to and N.J. Speranskaya (ASU) who provided access to Olympus BX51 stereo microscope.

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