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### Research article

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## First record of the genus *Alainites* Waltz & McCafferty, 1994 (Ephemeroptera, Baetidae) from India with the description of a new species from the North-western Himalayas

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**Abstract.** A new species *Alainites neeru* sp. nov. is described based on larvae collected from a hill stream in Jammu and Kashmir, India. It is the first report of the genus *Alainites* Waltz & McCafferty, 1994 from India. The new species is closely related to the Palearctic species *A. muticus* (Linnaeus, 1758), but can be distinguished from the latter by the length of the maxillary palp, the reduced number of spine-like setae on the margin between the prostheca and mola of the right mandible, the reduced tracheation in the tergalii, and by a reduced number of spines on the prolongation of the paraprot. With this record, the genus *Alainites* encompasses a total of twenty-two species.

**Keywords.** *Alainites muticus*, mayfly, new species, Palearctic realm.

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## Introduction

The *Baetis muticus* group of species (Müller-Liebenau 1969) was elevated to generic rank as *Alainites* Waltz & McCafferty, 1994 based on laterally compressed body, glossae with dorsal setae, prostheca of right mandible reduced, femoral villopore absent, claws denticulate without any seta, hindwing pads present or absent, tergalium I present or absent, and paraproct with prolongation in the larvae (Waltz *et al.* 1994). After that, different opinions emerged regarding the systematic position of the genus *Alainites* along with the two related genera *Nigrobaetis* Novikova & Kluge, 1987 and *Takobia* Novikova & Kluge, 1987 (Müller-Liebenau 1969; Novikova & Kluge 1987, 1994; Waltz *et al.* 1994; Waltz & McCafferty 1997; Kluge & Novikova 2014). The riddle is mainly due to the lack of strong morphological support, some of the revisions were not based on the type material, and important characters were missing or wrongly interpreted in the original descriptions (Sroka *et al.* 2021; Yanai *et al.* 2022). *Alainites*, *Nigrobaetis*, and *Takobia* were recommended as valid genera based on the most recent investigations by Sroka *et al.* (2021) and Yanai *et al.* (2022) and it was strongly advised to wait until a worldwide phylogeny would be constructed based on genetic and morphological evidence before establishing a final classification.

*Alainites* is characterized in larvae by: i) prostheca of right mandible bifid; ii) femoral villopore absent; iii) posterior margin of the paraproct with a distinct prolongation; iv) body laterally compressed; v) with carina between antennal bases. In imagoes, i) segment III of the forceps is spherical to slightly elongated, and curved; ii) hindwings, when present, with three longitudinal veins, the second of which is bifurcated (Waltz *et al.* 1994; Zrelli *et al.* 2012; Yanai *et al.* 2022).

The genus *Alainites* presently includes 21 species: *Alainites acutulus* Tong & Dudgeon 2000, *A. albinatii* (Sartori & Tomas, 1989), *A. atagonis* (Imanishi, 1937), *A. bengunn* Yanai & Gattolliat, 2022 (in Yanai *et al.* 2022), *A. chocoratus* (Gose, 1980), *A. clivosus* (Chang & Yang, 1994) (in Kang *et al.* 1994), *A. florens* (Imanishi, 1937), *A. gasithi* Yanai & Gattolliat, 2022 (in Yanai *et al.* 2022), *A. kars* (Thomas & Kazanci, 1989) (in Kazanci & Thomas 1989), *A. laetificus* (Müller-Liebenau, 1984), *A. lingulatus* Tong & Dudgeon, 2000, *A. muticus* (Linnaeus, 1758), *A. navasi* (Müller-Liebenau, 1974), *A. oukaimeden* (Thomas & Sartori, 1992) (in Thomas *et al.* 1992), *A. pascalae* Gattolliat, 2011, *A. sadati* Thomas, 1994 (in Thomas & Gagneur 1994), *A. siamensis* Phlai-ngam, Tungpairojwong & Gattolliat, 2022, *A. talasi* (Novikova & Kluge, 1994), *A. yehi* (Kang & Yang, 1994) (in Kang *et al.* 1994), *A. yixiani* (Gui & Lu, 1999), and *A. yoshinensis* (Gose, 1980).

The Indian Baetidae Leach, 1815 comprise about 15 genera and 60 species (Selvakumar *et al.* 2019; Kluge 2020; Kluge & Suttinun 2020; Kubendran *et al.* 2021; Sivaruban *et al.* 2022; Srinivasan *et al.* 2023). Jammu and Kashmir lie in the northwest part of the Himalayas at the intersection of the Palearctic and the Oriental realms, and harbour a rich biodiversity. Yet, the freshwater entomofauna remains poorly known for baetids and other mayflies. A new species of *Acentrella* (*A. isacki* Srinivasan *et al.*, 2023) was recently discovered from a hill stream in the north-western Himalayas and the same batch of samples yielded another new species of the genus *Alainites*, which is also the first record of this genus for the country.

## Material and methods

The larvae of the species were hand-picked from the Neeru stream in Jammu and Kashmir. The specimens were preserved in 80% ethanol. Morphological characters of the new species were studied

using Magnus MSZ stereo zoom and LABOMED Lx400 microscopes, and photos were obtained using an AR 6 Pro digital camera and processed in Adobe Photoshop ver. 7.0. The taxonomical characters are depicted following Yanai *et al.* (2022) and Phlai-ngam *et al.* (2022). The type specimens of the new species are deposited in The American College Museum (AMC), Madurai, Tamil Nadu, India.

## Results

### Taxonomy

Class Insecta Linnaeus, 1758  
Order Ephemeroptera Hyatt & Arms, 1891  
Family Baetidae Leach, 1815  
Genus *Alainites* Waltz & McCafferty, 1994

#### *Alainites neeru* sp. nov.

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Figs 1–36

### Diagnosis

Larval diagnostic characters of *Alainites neeru* sp. nov. are as follows: (1) ventral surface of labrum with eight to ten small, pointed setae, increasing in size towards apex (Fig. 6); (2) right mandible with about four medium stout, pointed spine-like setae between prostheca and mola (Figs 12–13); (3) margin between prostheca and mola of left mandible slightly crenelate near the mola (Fig. 10); (4) labial palp segment III conical, apically slightly pointed (Fig. 16); (5) outer margin of fore tibia with a row of seven to nine stout, spine-like setae only on the distal half (Fig. 23); (6) hindwing pads well-developed (Fig. 28); (7) tergarii present on abdominal segments I–VII, with poorly visible tracheation (Fig. 32) and (8) distal margin of paraproct between prolongation and cercotractor with about 6–8 long, triangular spines (Fig. 36).

### Etymology

The species is named after the type locality Neeru stream, Jammu and Kashmir.

### Material examined

#### Holotype

INDIA • ♀, larva; Jammu and Kashmir, Doda District, Bhaderwah Town, Neeru Stream; 33°01.17' N, 75°39.46' E; 1400 m a.s.l.; 10 Oct. 2020; Asha Sohil leg.; AMC (AMC/ZN/271).

#### Paratypes

INDIA • 3 larvae; same collection data as for holotype; AMC (AMC/ZN/272).

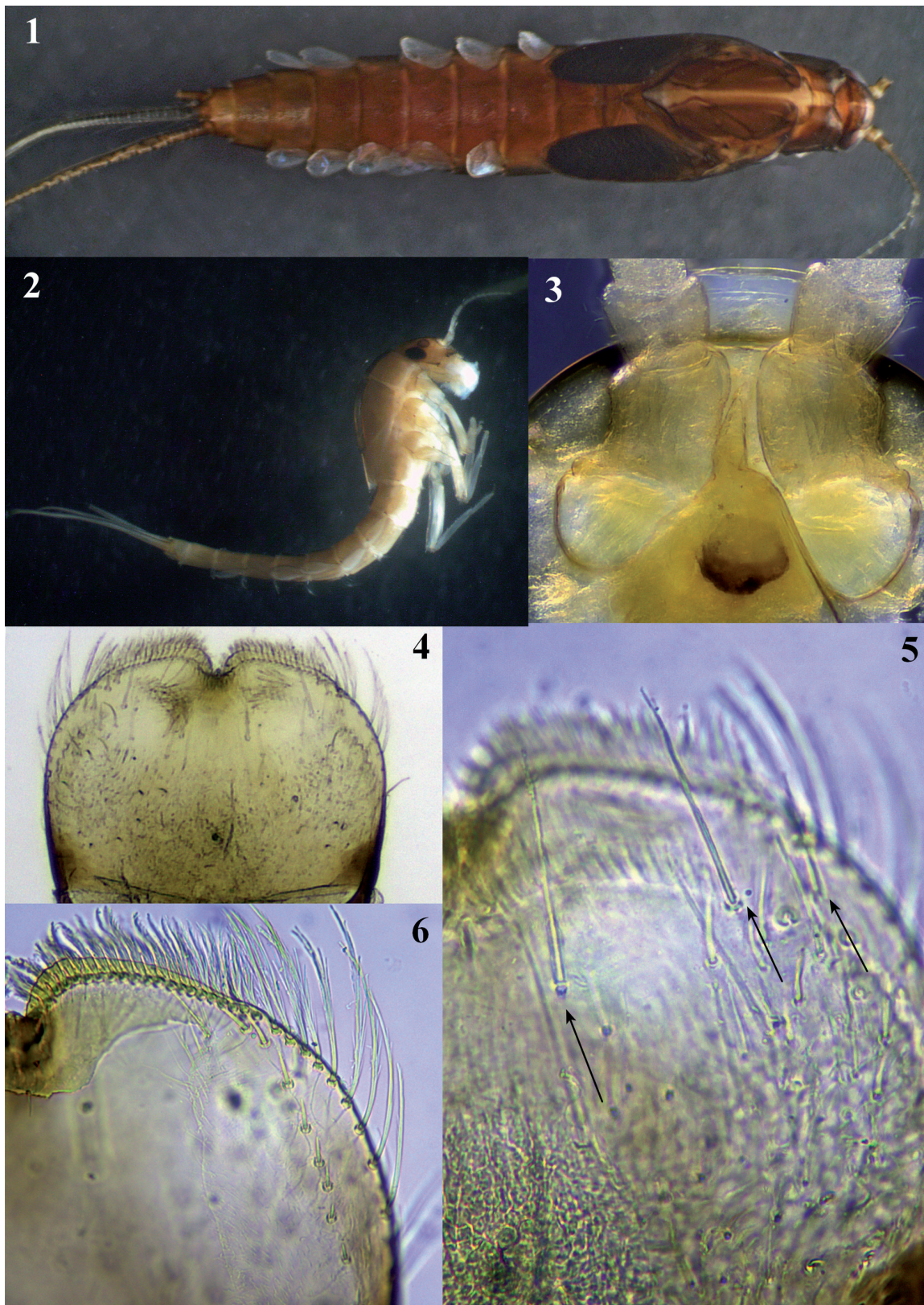
### Description

#### Larva

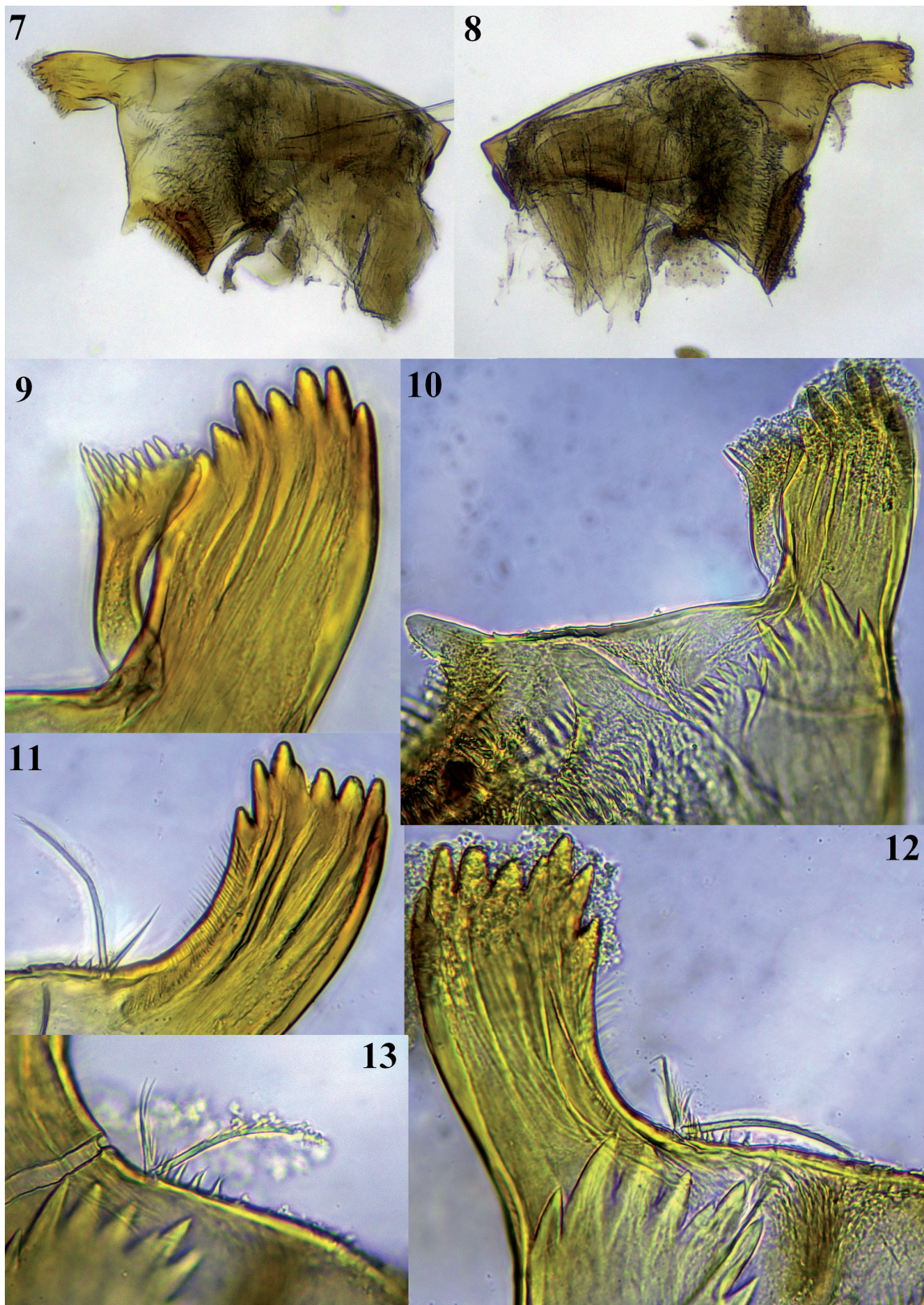
MEASUREMENTS. Body length 4.1–4.3 mm; paracercus length 1.2–1.4 mm; cerci length 1.6–1.7 mm.

COLOURATION. General colouration reddish brown in mature larva and light brown in immature larva (Figs 1–2). Head dark brown. Prothorax and mesothorax dark brown laterally, and pale medially. Legs pale with brownish stripe at distal  $\frac{2}{3}$  area of femora. Abdominal terga unicolor and light brown (Fig. 2). Abdominal sterna light brown. Cerci and paracercus light brown (Fig. 2).

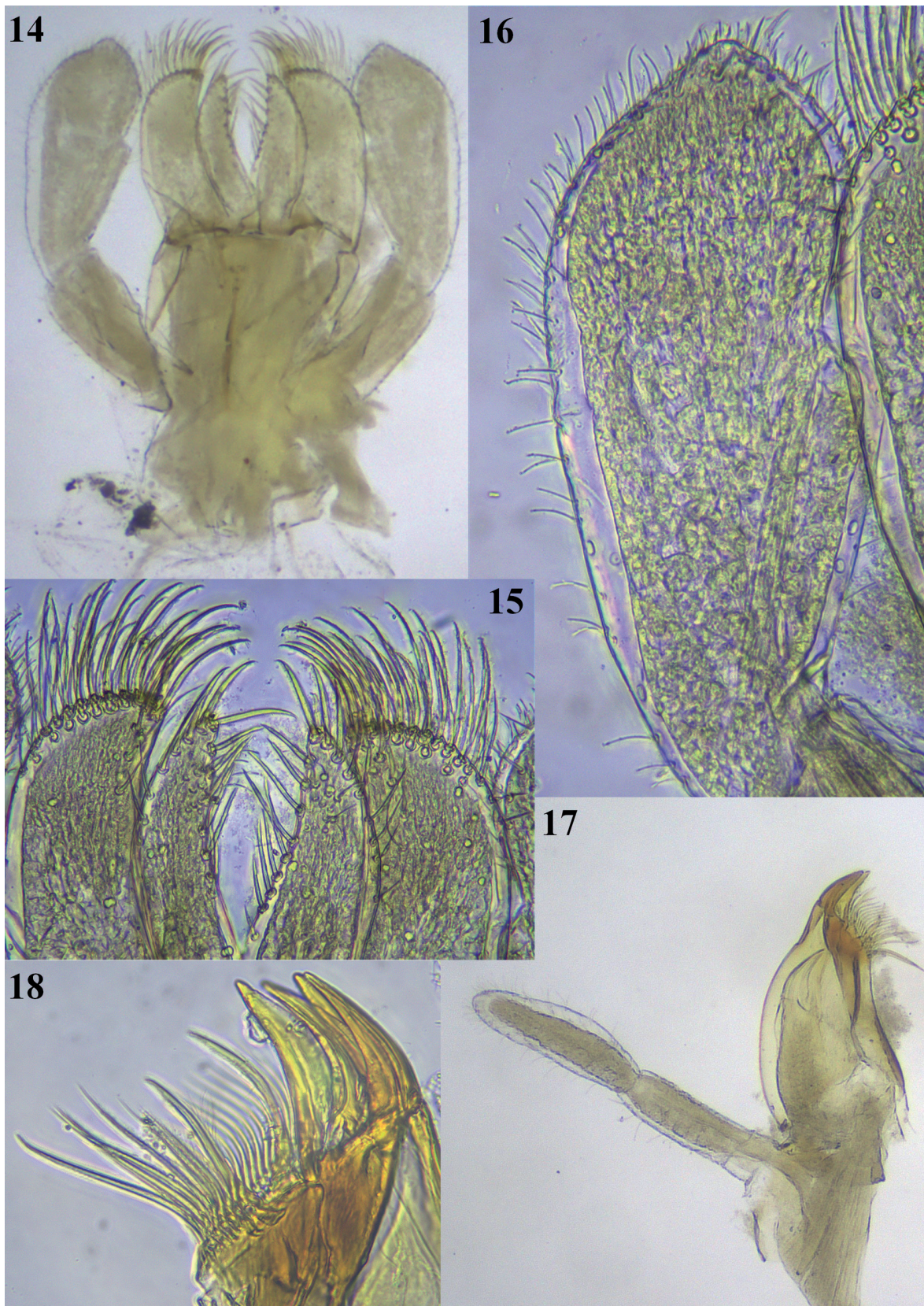
HEAD. Antennae close to each other (Fig. 3). Labrum (Fig. 4): dorsal surface with submarginal arc consisting of central seta, and two lateral setae (Fig. 5). Ventral surface with eight to ten small, pointed



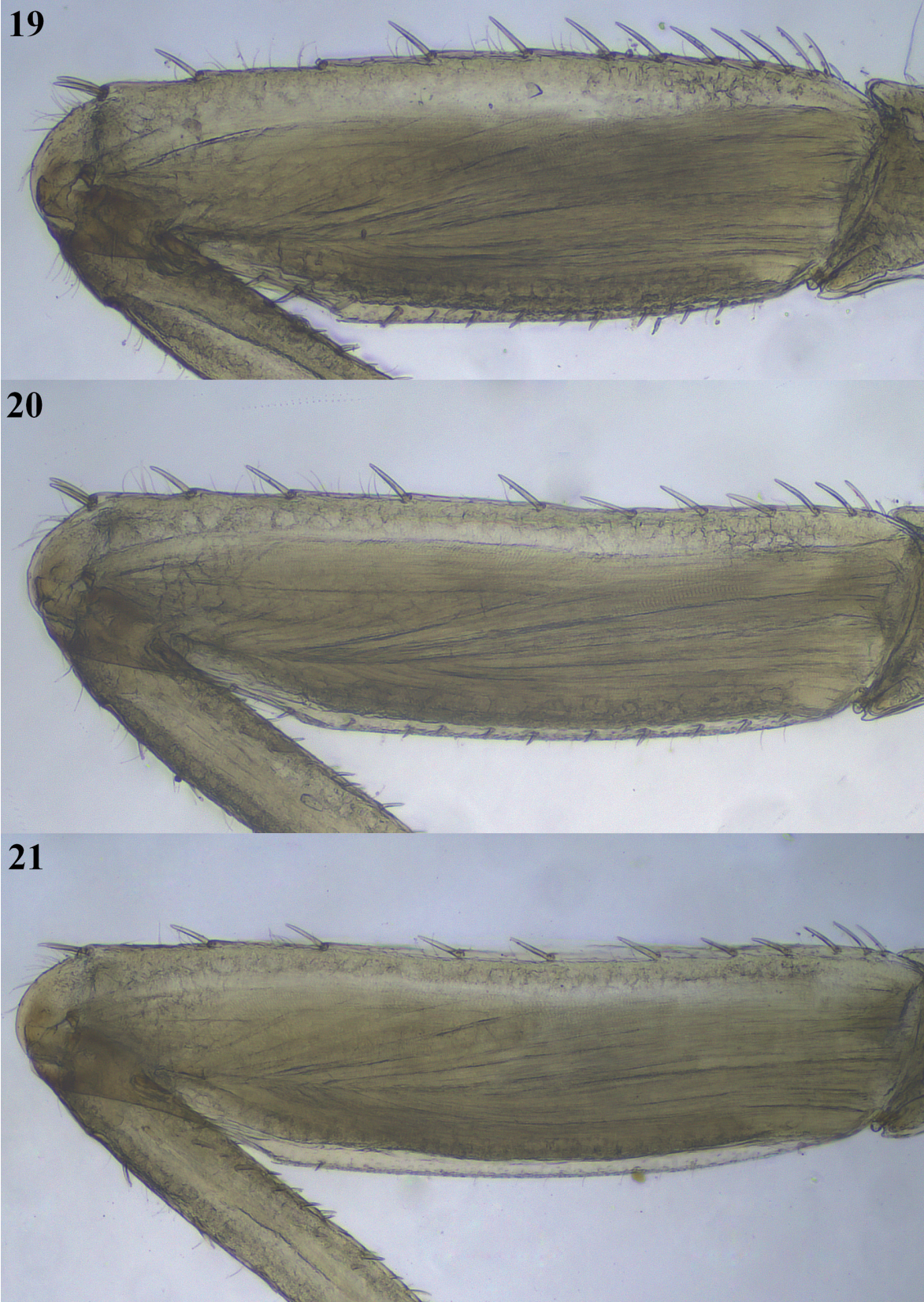
**Figs 1–5.** *Alainites neeru* sp. nov. 1. Holotype, ♀ (AMC), mature larva. 2–6. Paratype (AMC). 2. Immature larva. 3. Antenna. 4. Labrum. 5. Labrum, sub-marginal setae (arrows indicate 1+2 long, simple setae). 6. Setae of the ventral surface of the labrum.



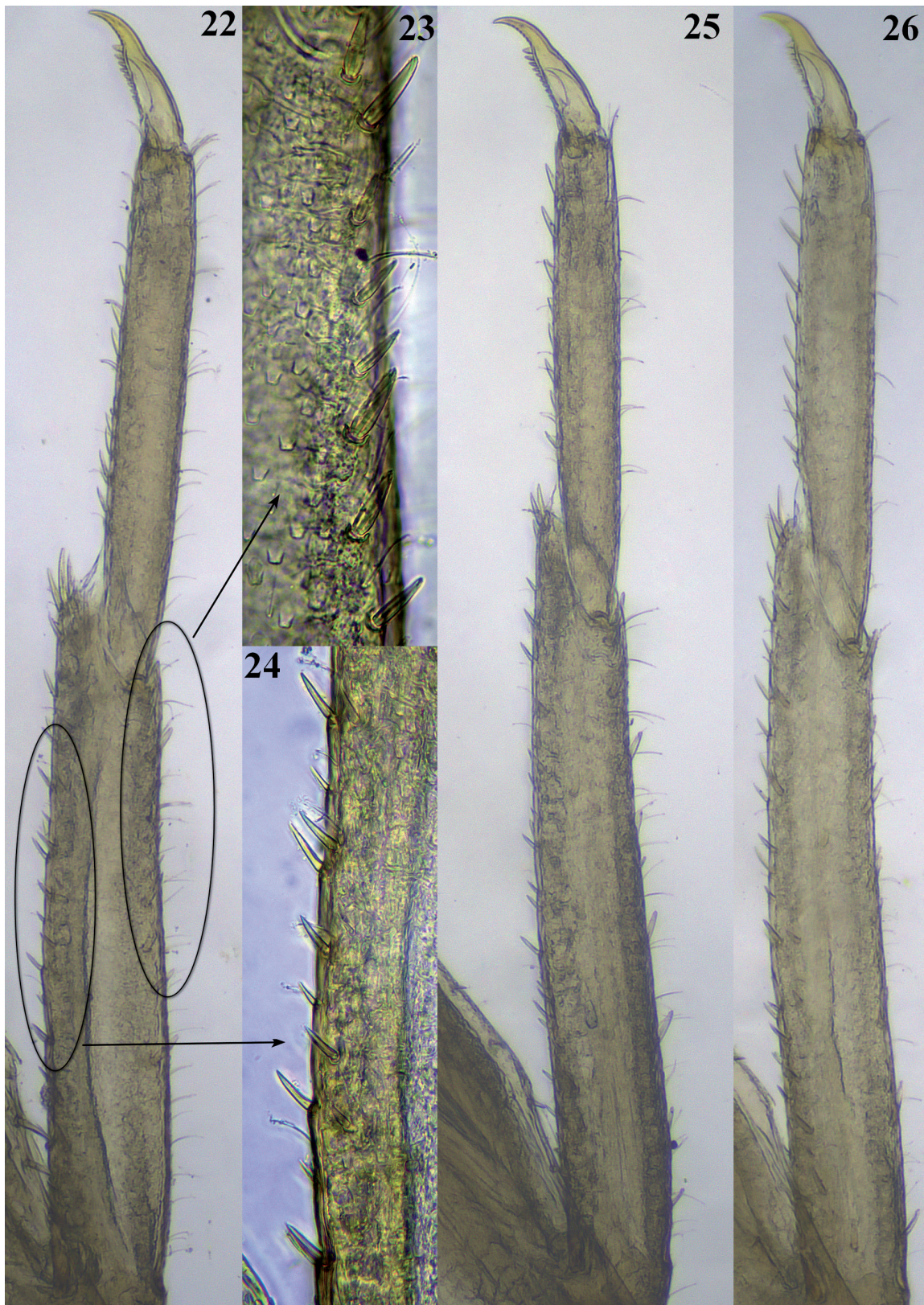
**Figs 7–13.** *Alainites neeru* sp. nov. paratypes (AMC), mouthparts of larva. **7.** Left mandible. **8.** Right mandible. **9.** Prostheca and incisor of left mandible. **10.** Closer view of left mandible. **11–12.** Prostheca and incisor of right mandible. **13.** Prostheca of right mandible.



**Figs 14–18.** *Alainites neeru* sp. nov., paratype (AMC), mouthparts of larva. **14.** Labium. **15.** Glossae and paraglossae. **16.** Closer view of labial palp segment III. **17.** Maxilla. **18.** Closer view of crown of maxilla.

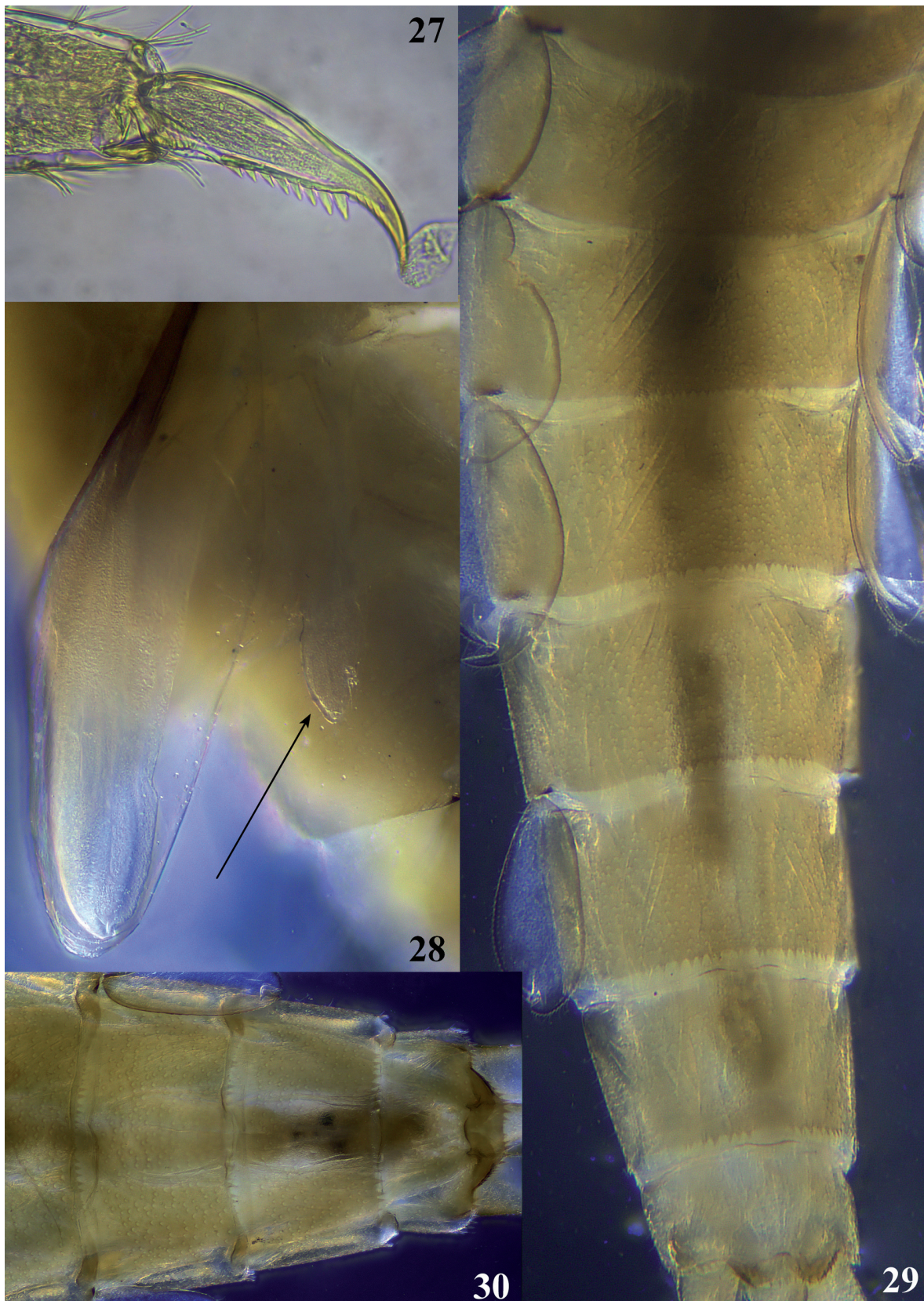


**Figs 19–21.** *Alainites neeru* sp. nov., paratype (AMC), legs of larva. **19.** Forefemur. **20.** Middle femur. **21.** Hind femur.



**Figs 22–26.** *Alainites neeru* sp. nov., paratype (AMC), legs of larva. **22.** Foretibia and foretarsus. **23.** Outer marginal setation of foretibia. **24.** Inner marginal setation of foretibia. **25.** Middle tibia and middle tarsus. **26.** Hind tibia and hind tarsus.





**Figs 27–30.** *Alainites neeru* sp. nov., paratype (AMC), thorax and abdomen of larva. **27.** Foreclaw. **28.** Hindwing pad (pointed by arrow). **29.** Tergal segments III–X. **30.** Tergal segments VIII–X.

setae, increasing in size towards apex, close to lateral margin (Fig. 6); distal margin fringed with two types of setae: laterally with nine to ten long, feathered setae, and medially with twenty to twenty-two shorter, slightly feathered setae. Hypopharynx: lingua rounded, and superlinguae subapically with numerous hair-like setae. Left mandible (Fig. 7): incisor with seven denticles; prostheca with eight small pointed denticles apically (Fig. 9); margin between prostheca and mola, slightly crenelated near the mola (Fig. 10); fine setae present on apex of mola. Right mandible (Fig. 8): incisor with eight denticles (Fig. 11); prostheca bifid and feathered, outer filament half the length of inner filament; margin between prostheca and mola with about four medium stout, pointed, spine-like setae, near prostheca (Figs 12–13); tuft of setae at apex of mola present. Maxilla (Fig. 17): galea-lacinia with three broad teeth and tooth-like dentisetae along with two long, slender, dentisetae (Fig. 18); two, thin setae at base of teeth, row of five long, simple setae at base of lacinia; maxillary palpus two-segmented; segments I and II subequal in length; segment II apically rounded with fine, small, hair-like setae. Labium (Fig. 14): glossa slightly shorter than paraglossa; inner margin of glossae with row of 9–10 setae; paraglossae falcate, dorsally with three long, simple setae near inner margin and three oblique rows of simple setae along apical margin (Fig. 15); labial palpus three-segmented, segment I shorter than segments II and III combined; segment I covered with fine, simple setae; segment II with dorsal oblique row of three long, pointed setae; segment III conical and apex slightly pointed with small to medium, simple setae (Fig. 16).

THORAX. Hindwing pads well developed (Fig. 28).

FORELEG. Femur (Fig. 19): outer margin with a row of twelve to fourteen long, robust setae and with fine, simple setae; inner margin with numerous small, pointed setae; femoral villopore absent. Tibia (Fig. 22): outer margin with row of seven to nine stout, spine-like setae on distal half (Fig. 23); inner margin with three irregular rows of small, pointed setae (Fig. 24); dorsal surface with numerous scale bases, with few short, stout, spine-like setae along tibia-patellar suture. Tarsi, outer margin with few thin setae; inner margin with row of 10 small, pointed setae, increasing in size towards apex; dorsal surface with numerous scale bases. Claws (Fig. 27) with a row of 8–9 denticles, increasing in size towards apex; subapical setae absent.

MIDDLE LEG AND HIND LEG. Similar to foreleg (Figs 20–21, 25–26); except inner margin of hind femur lacks small, pointed setae (Fig. 21); outer margin of middle and hind tibia with row of ca 10 stout spine-like setae (Figs 25–26).

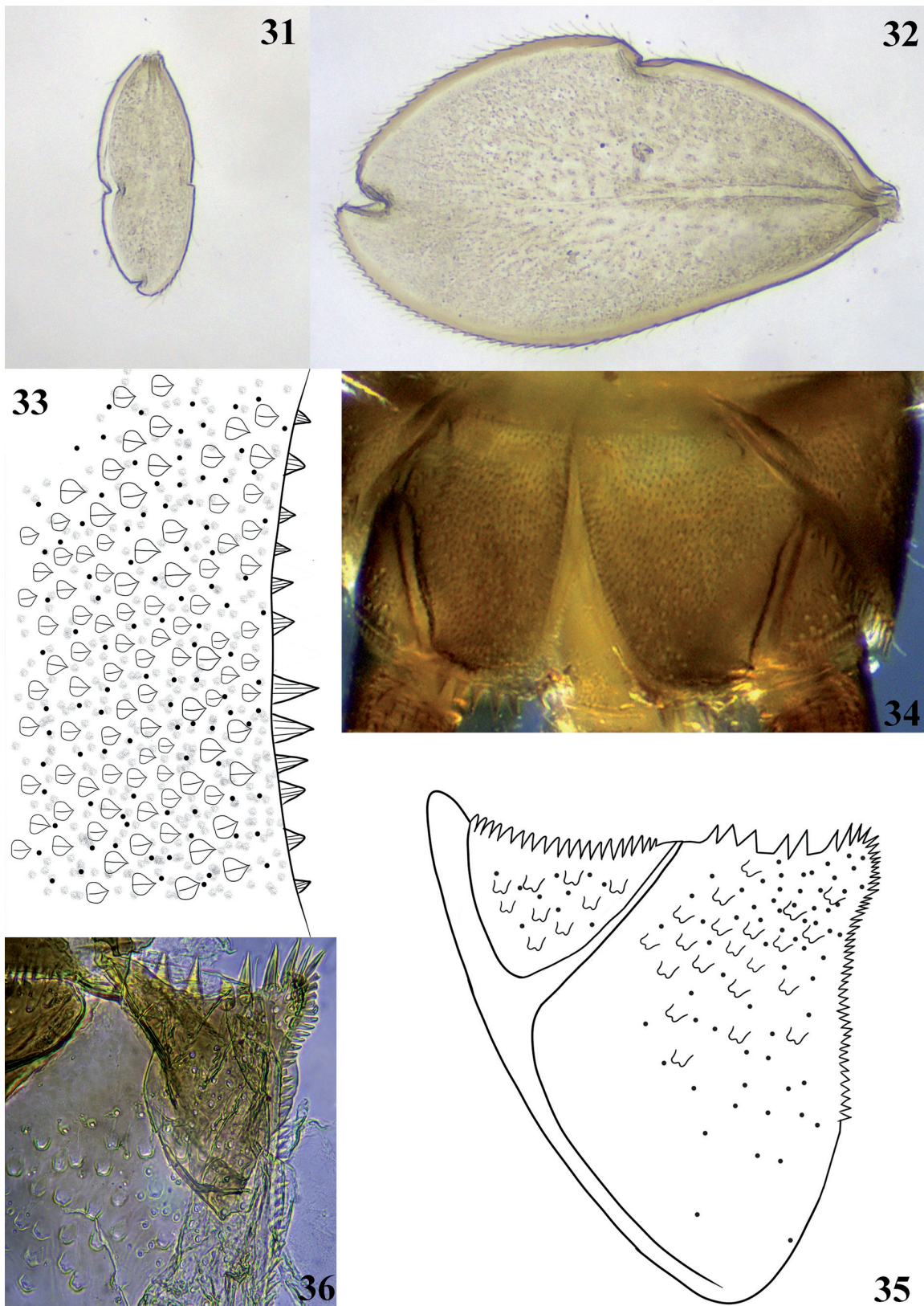
ABDOMEN. Tergites with numerous scale bases (Fig. 29), posterior margin of tergites II–X with triangular spines mainly in middle area (Fig. 33), and absent laterally (Fig. 30). Tergalii (= abdominal gills) present on segments I to VII with poorly visible tracheation; tergalium I elongated and  $\frac{1}{3}$  length of tergalium IV (Fig. 31); tergalia II to VII elliptical with dark brownish band surrounding margins; margins serrated along with long, fine setae (Fig. 32). Paraproct (Figs 34–35) with numerous scale bases and micropores on dorsal surface; well-developed prolongation on distal margin (Fig. 35); distal margin between prolongation and cercotractor with about 6–8 long, triangular spines (Fig. 36); distal margin outside of prolongation with about 40 small, triangular spines; cercotractor with numerous scale bases, distal margin with about 20 spines.

### **Imago**

Unknown.

### **Distribution**

India, Neeru stream (Doda, Jammu and Kashmir).



**Figs 31–36.** *Alainites neeru* sp. nov. **31–32.** Paratype (AMC). **33–36.** Holotype (AMC). **31.** Tergalium I. **32.** Tergalium IV. **33.** Posterior margin of tergum IV denticulation. **34–35.** Paraproct. **36.** Closer view of paraproct.

## Discussion

The newly described species belongs to the genus *Alainites* since it shares all of the synapomorphic characters of the genus, including a laterally compressed body, paraproct with a well-developed prolongation, and right mandible with a bifid feathery prosthema (Waltz *et al.* 1994). It is distinguished from *Alainites albinatii*, *A. bengunn*, *A. gasithi*, *A. kars*, *A. navasi*, *A. oukaimeden*, *A. sadati*, *A. pascalae*, *A. laetificus*, *A. acutulius*, *A. yehei*, *A. talasi*, and *A. yoshinensis* by the presence of seven pairs of tergite. It is distinguished from the species *A. chocoratus* by the absence of a dorsal median brown stripe on the abdomen (Fujitani *et al.* 2017). It is distinguished from *A. florens* at least by the presence of seven denticles in the left mandibular incisor, whereas, in *A. florens*, only six denticles are present in the left mandibular incisor (Gose 1980). It is distinguished from *A. lingulatus* by the well-developed prolongation in the paraproct (Tong & Dudgeon 2000). The new species is further distinguished from *A. yixiani* by the uniform coloration of the abdomen (Phlai-ngam *et al.* 2022). The new species is distinguished from the species *A. clivosus* by the lesser denticulation of the claws (Phlai-ngam *et al.* 2022). It is distinguished from the species *A. siamensis* by the conical shape of the labial palp segment III, whereas, in *A. siamensis*, labial palp segment III is subrectangular (Phlai-ngam *et al.* 2022). The new species is most closely related to the species *A. muticus*. However, it is differentiated by the maxillary palp segments I and II subequal in length, margin between the prosthema and mola of the right mandible with a reduced number of spine-like setae, poorly visible tracheation in the tergite, and by the reduced number of spines in the distal margin of paraproct between prolongation and cercotractor (Müller-Liebenau 1969).

*Alainites* is widely distributed across the Palearctic and Oriental regions. Nearly all species show a limited distribution pattern, as they are known only from that particular country (Phlai-ngam *et al.* 2022) except the type species *Alainites muticus*. With its discovery in India, it is now evident that the genus is prevalent in other areas of the Palearctic and Oriental regions, as the northwest part of the Himalayas is situated at the intersection of the Palearctic and Oriental realms and this discovery is rather expected as some species of *Alainites* are known from the integral mountain system of Central Asia which spreads from Tian-Shan to the Himalayas. The genus is absent from Sri Lanka, and the Western Ghats, and the new species is most similar to the species *Alainites muticus*, suggesting that it could originate from the Palearctic realm. We can also expect more *muticus*-like taxa in this part of the region.

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