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Baetiella muchei (Braasch, 1978) (Ephemeroptera: Baetidae) new to India, with reference to the morphological variability of the larvae

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ABSTRACT. *Baetiella muchei* (Braasch, 1978) is recorded for the first time from the Neeru stream of Jammu and Kashmir, India. The variability in larval characters such as size, the shape of the labrum, and the number of the sub-marginal arc of setae in the labrum differs from 12 to 22, degree of fusion of the mandibular incisors, spines on the distal margin of the tergites, distal margin of the paraproct, and the length of cerci are observed from the Indian population when compared to the type specimens. The species number of *Baetiella* Uéno, 1931 has now increased to six in India. A distributional map of this species is also provided.

Key words: Himalayas, mayflies, new record, Oriental, Palaearctic

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INTRODUCTION

Baetiella Uéno, 1931 is a small genus of the family Baetidae limited to the East Palaearctic and Oriental regions (Waltz & McCafferty, 1987; Tong & Dudgeon, 2000; Ishiwata, 2001). The genus is distributed in Russia, Mongolia, Tajikistan, China, Vietnam, Japan, Korea, Nepal, and India (Vasanth et al., 2020). The genus was first established by Uéno (1931) based on *Acentrella japonica* Imanishi, 1931. Since there were uncertainties in the taxonomical position of the genus, *Baetiella* was previously classified as a subgenus of *Pseudocloeon* Klapálek, 1905 (Kazlauskas, 1963; Braasch, 1978; Kluge, 1983; Tong & Dudgeon, 2000)

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and even considered as a subgenus of *Baetis* Leach, 1815 (Müller-Liebenau, 1985; Tshernova et al., 1986). Presently, sixteen species were assigned to this genus, of which eleven were known from the larval stage, one from the imaginal stage, and four from both larval and imaginal stages. In addition, Shi & Tong (2015) described diagnostic features with a larval key for fourteen species of *Baetiella*.

Jammu & Kashmir lies in the northwest part of the Himalayas at the intersection of two biogeographic regions of the world, the Palaearctic and the Oriental realms, and harbours rich biodiversity. Yet the freshwater entomofauna remains poorly understood for baetids as well as other mayflies, especially for genus *Baetiella*, confined to East Palaearctic and Oriental realms. Before 2020, *B. ladakae* Traver, 1939 was the sole species described based on a single male imago from Ladakh, India (Traver, 1939). Vasanth et al. (2020) reported a new species *B. subansiri* Vasanth, Selvakumar & Subramanian, 2020 and new records of five additional species *B. armata* Braasch, 1983; *B. ausobskyi* Braasch, 1983; *B. imanishii* Braasch, 1983; *B. marginata* Braasch, 1983 and *B. spathae* Shi & Tong, 2015 of this genus from eastern Himalayas, Arunachal Pradesh, India. In this article, *Baetiella muchei* (Braasch, 1978) is recorded for the first time from the northwest part of the Himalayas based on the larval specimens.

MATERIAL AND METHODS

The larvae of the new record were collected during October 2020 by hand picking from the Neeru stream at Nalthi, Bhaderwah in Jammu & Kashmir. The specimens were preserved in 80% ethanol. The morphological characters were observed using Magnus® MSZ stereo zoom and LABOMED® Lx400 microscopes. Photographs were taken with a MiaCam® CMOS AR 6 pro microscope camera and measurements were acquired using Capture 2.2.1 software and further processed in Adobe® Photoshop 7.0. The distributional map was done with the help of the software SimpleMappr (Shorthouse, 2010). The species identification is based on the original description and keys of Braasch (1978) and Shi & Tong (2015) respectively, and the derivation of terminology is mostly based on Shi & Tong (2015) and Vasanth et al. (2020). The materials are deposited in The American College Museum (AMC), Madurai, Tamil Nadu, India.

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1758

Order Ephemeroptera Hyatt & Arms, 1891

Family Baetidae Leach, 1815

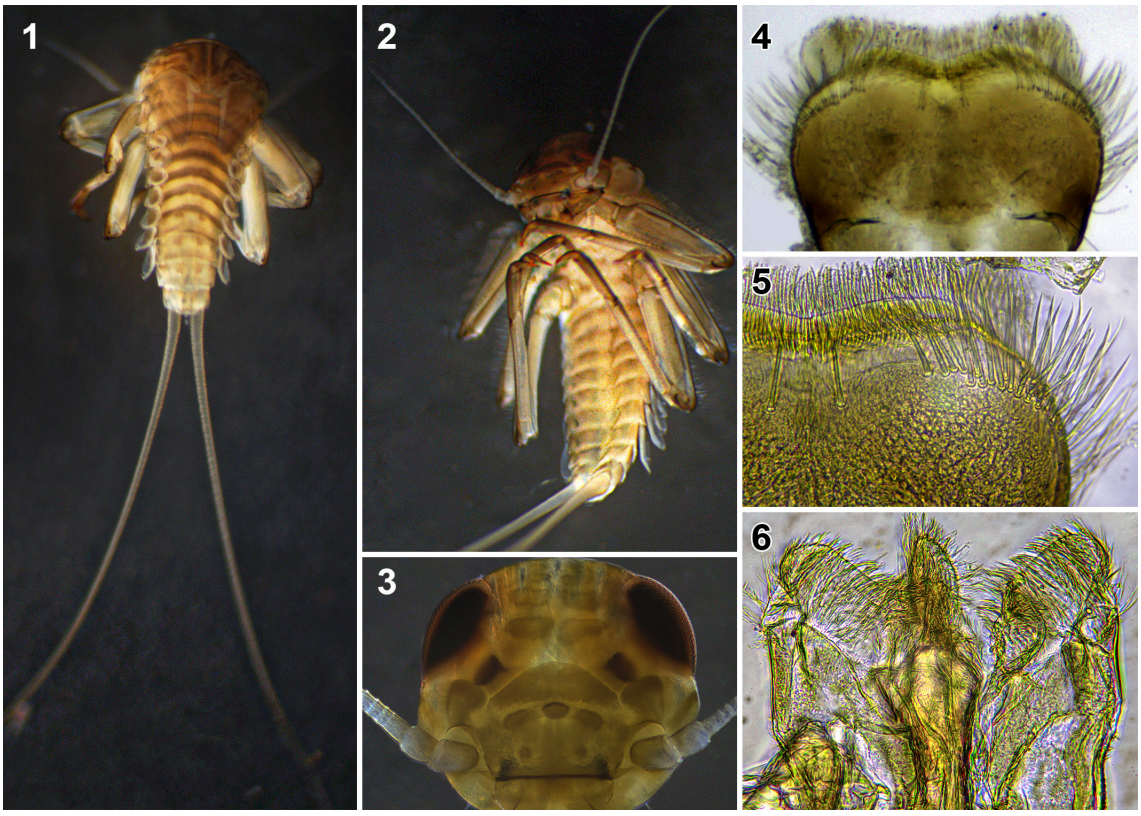
Genus *Baetiella* Uéno, 1931

***Baetiella muchei* (Braasch, 1978)** (Figs 1–25)

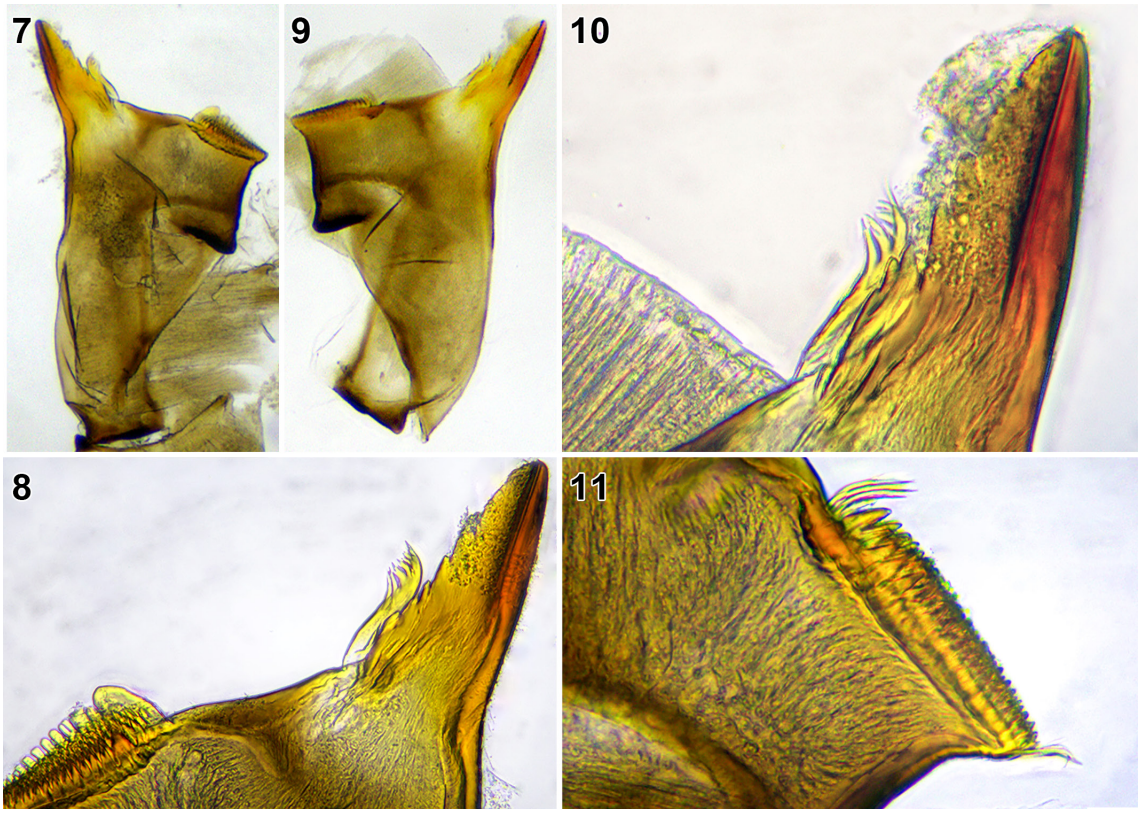
Material examined. 1♂ larva (AMC/ZN/276) and 1♀ larva (AMC/ZN/277), India, Jammu & Kashmir, Doda district, Bhaderwah, Neeru stream, 32°57'08"N, 75°43'15"E; 1800 m. a.s.l., October 2020, leg. Asha Sohil.

Distribution. Tajikistan, Uzbekistan, and North India (**new record**) (Fig. 25).

Diagnosis. Larval diagnostic characters of *Baetiella muchei* (Braasch, 1978) are as follows: ***i.*** Dorsal surface of the labrum with a pair of submedian long, simple setae and an irregular row of 12–22 simple setae in the submarginal arc (Fig. 5); ***ii.*** Outer denticle of both mandibular incisors blade-like (Figs 7–10); ***iii.*** Prostheca of both mandibles stick-like (Figs 7–10); ***iv.*** Labial palp segment II without inner apical lobe on the distal margin (Fig. 15); ***v.*** Prothorax and mesothorax without any tubercles; ***vi.*** foretibia larger than the forefemur (Fig. 16); ***vii.*** Posterior margin of terga without any posteromedian protuberance (Fig. 1) and ***viii.*** Tergalii with a longitudinal dark brownish band in the main trunk (Fig. 20).



Figures 1–6. *Baetiella muchei* (Braasch, 1978): **1.** Female larval habitus, dorsal view; **2.** Female larval habitus, ventral view; **3.** Head capsule; **4.** Labrum; **5.** Labrum, sub-marginal setae; **6.** Hypopharynx.



Figures 7–11. *Baetiella muchei* (Braasch, 1978). **7.** Left mandible; **8.** Left mandibular prostheca; **9.** Right mandible; **10.** Right mandibular prostheca; **11.** Right mandibular mola.

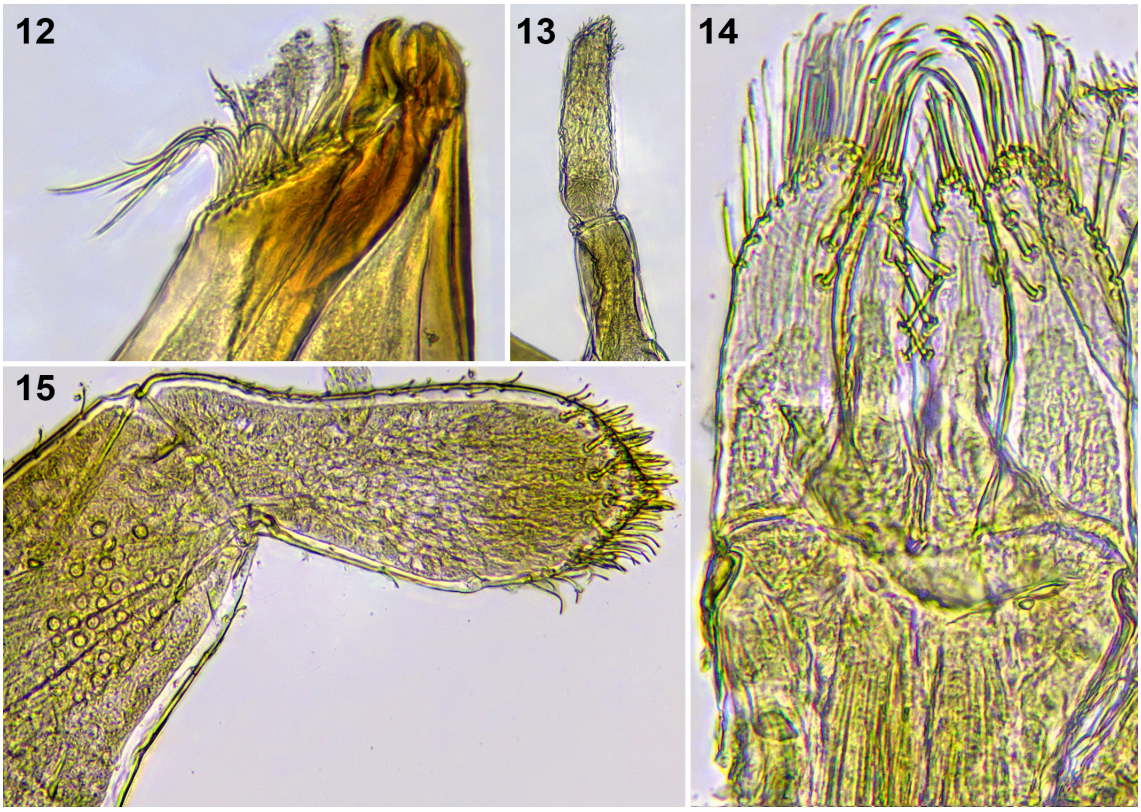
Redescription. — **Mature Female larva** (in alcohol).

Body: *Acentrella*-like (Fig. 1). Length: Body 2.8–2.9 mm; paracercus 3.7–3.9 mm; antenna 1.4 mm. Coloration (Fig. 1): Head and thorax dorsally dark brownish; abdomen dorsally light brownish and posterior margin of tergal segments I–VI with dark brownish band; head, thorax, and abdomen ventrally pale (Fig. 2); cerci pale.

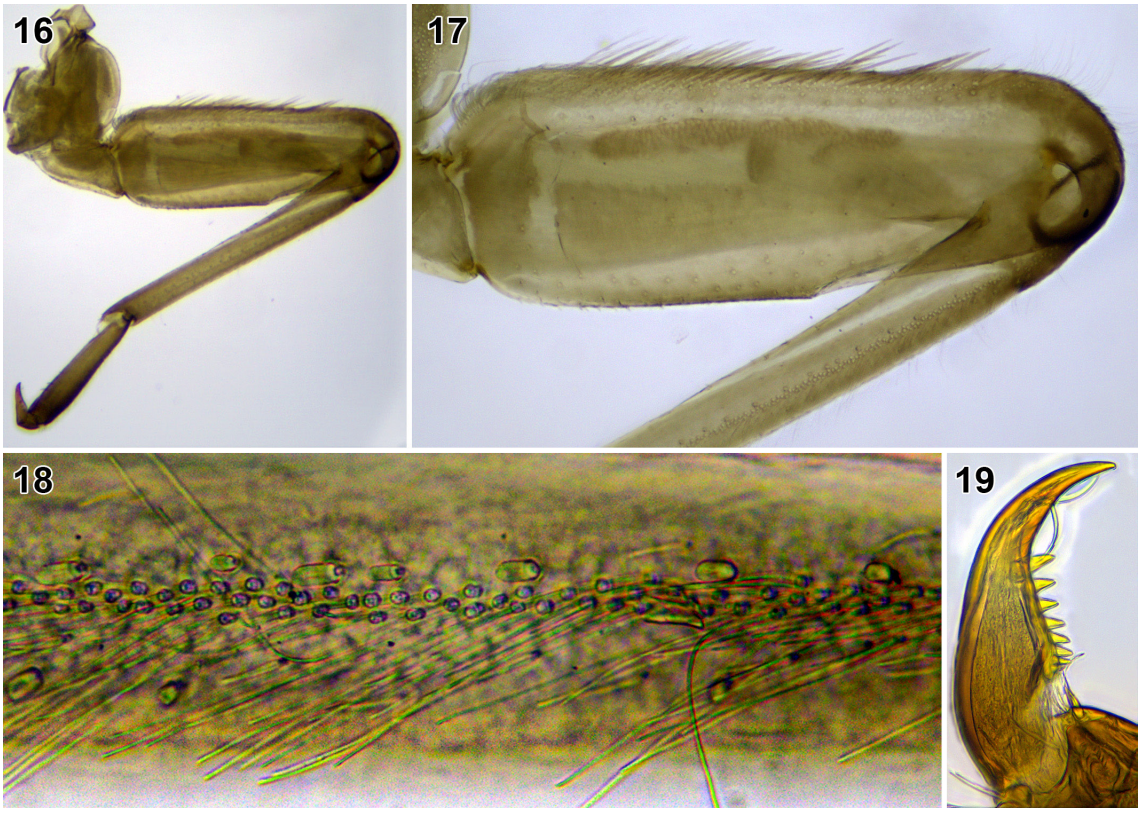
Head. Scape subequal in the length of the pedicel (Fig. 3); dorsal surface of scape and pedicel with fine scattered simple setae. Labrum (Fig. 4): Sub-rectangular, length 0.65× maximum width; medial emargination with nearly straight margin, dorsal surface with numerous fine, simple setae; submarginal arc with a pair of submedian long, simple setae and irregular row of 12–22 simple setae in the submarginal arc (Fig. 5); ventral surface with 4–6 short, spine-like setae laterally. Hypopharynx (Fig. 6): Lingua rounded and superlinguae broadly truncated with scattered fine, simple setae. Left mandible (Fig. 7): Incisor and kinetodontium fused; incisor with two denticles, outer denticle blade-like and enlarged; kinetodontium with three denticles; prostheca stick-like, apicolaterally with small denticles (Fig. 8); medial margin with two minute spine-like setae; molar apex without any setae. Right mandible (Fig. 9): Incisor and kinetodontium fused; incisor with two denticles, outer denticle blade-like and enlarged; kinetodontium with three denticles; prostheca stick-like and denticulate apically (Fig. 10); medial margin without any processes; molar apex with few simple setae (Fig. 11). Maxilla: Galea-lacinia with two simple setae under the crown; inner dorsal row consists of one tooth-like denti-seta (Fig. 12); medially with a simple seta dorsally and four long, simple setae ventrally. Maxillary palp two-segmented, segment II slightly smaller than segment I (Fig. 13); segment II with a pointed tip at the apex. Labium: Glossa subequal in the length of paraglossa (Fig. 14); inner margin of glossa with six spine-like setae; three long setae on the apex; outer margin with four long, simple setae. Paraglossa with three rows of long setae on the apex with three long, simple setae near the inner margin. Labial palp three-segmented; segment I subequal in length to segments II and III combined. Segment I with small micropores dorsally and fine, simple setae ventrally; segment II without any inner apical lobe on the distal margin (Fig. 15); both inner and outer margins with small fine, simple setae; dorsal surface with 4 spine-like setae near the outer margin; segment III conical with a pointed tip at the apex; apical margin with scattered short, stout setae.

Thorax. Prothorax and mesothorax without any tubercles. Hind protoptera reduced. Foreleg (Fig. 16): ratio of length of femur/tibia/tarsus/claw 0.8:1.0:0.5:0.2. Femur (Fig. 17). Length ca. 2.7× maximum width; outer margin with a row of long, simple setae up to ¾ of the outer margin and row of long thin, hair-like setae along entire margin; inner margin with small spines on the proximal half, distal half mostly bare; inner marginal surface with a scattered row of spatulate setae; femoral villopore reduced; tibiae with a row of small spine-like setae on both the margins; dorsal surface with a stripe of densely and irregularly situated long thin setae along with a longitudinal row of minute, stout setae (Fig. 18); tarsi with a row of long thin setae on the outer margin and a row of five to six spine-like setae increasing in size distally on the inner margin; claw with a row of seven to eight denticles and two subapical setae present (Fig. 19). Legs without any coxal gill.

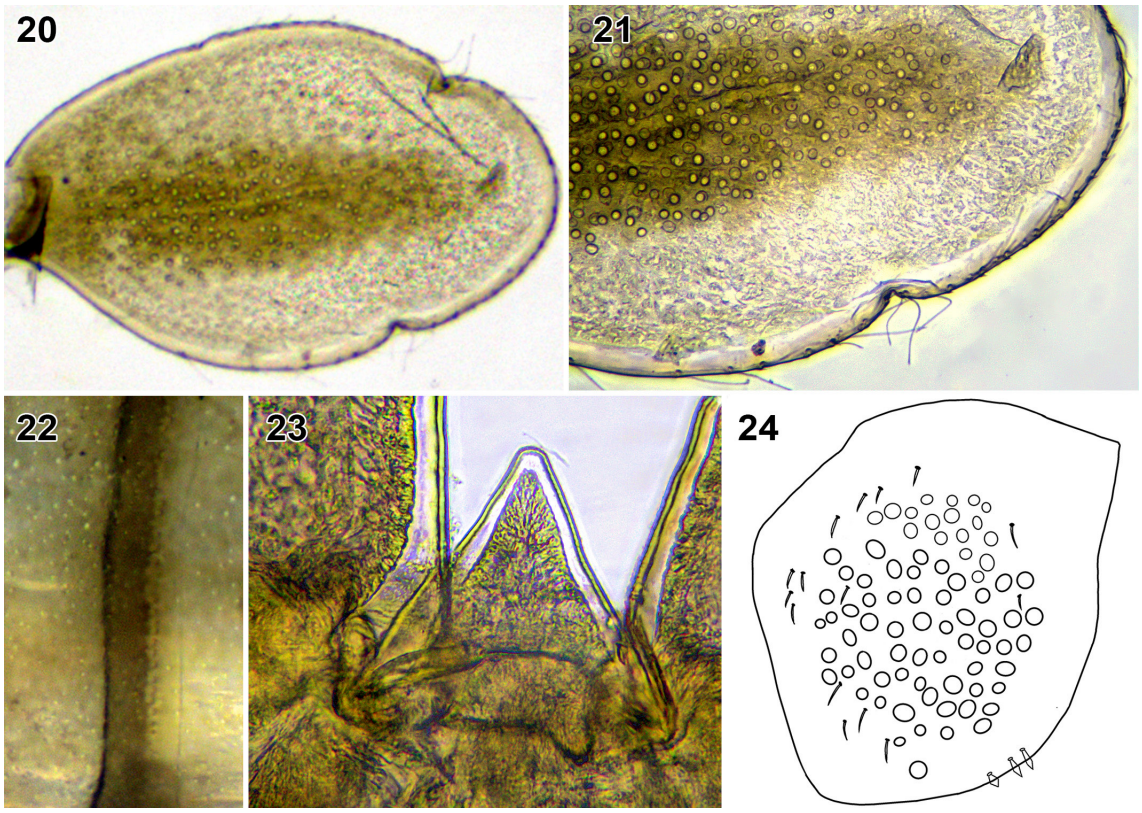
Abdomen. Tergalii present on abdominal segments I–VII. Tergalius I smaller than other tergalii (Fig. 1); tergalius IV semi-elliptical with poorly developed tracheation and longitudinal dark brownish band in the main trunk (Fig. 20); dorsal surface scattered with numerous pores, margin smooth with fine, long simple setae and short, stout setae (Fig. 21). Posterior margin of terga without any median protuberance; tergal surface without any setation, posterior margin of terga V–IX with rounded denticles, longer than wide (Fig. 22). Posterior margin of sterna smooth, without any denticles or setae. Paraproct with numerous pores along with simple setae and stout setae on dorsal surface and 2–3 small, spatulate setae along inner margin (Fig. 24). Paracercus reduced to one segment (Fig. 23).



Figures 12–15. *Baetiella muchei* (Braasch, 1978). **12.** Closer view of galea-lacinia; **13.** Maxillary palp; **14.** Glossa and paraglossa; **15.** Labial palp.



Figures 16–19. *Baetiella muchei* (Braasch, 1978). **16.** Foreleg; **17.** Forefemur; **18.** Closer view of setation in foretibia; **19.** Foreclaw.



Figures 20–24. *Baetiella muchei* (Braasch, 1978). **20.** Tergalius IV; **21.** Marginal setation in tergalius IV; **22.** Posterior margin of tergum IV denticulation; **23.** Paracercus; **24.** Paraproct.

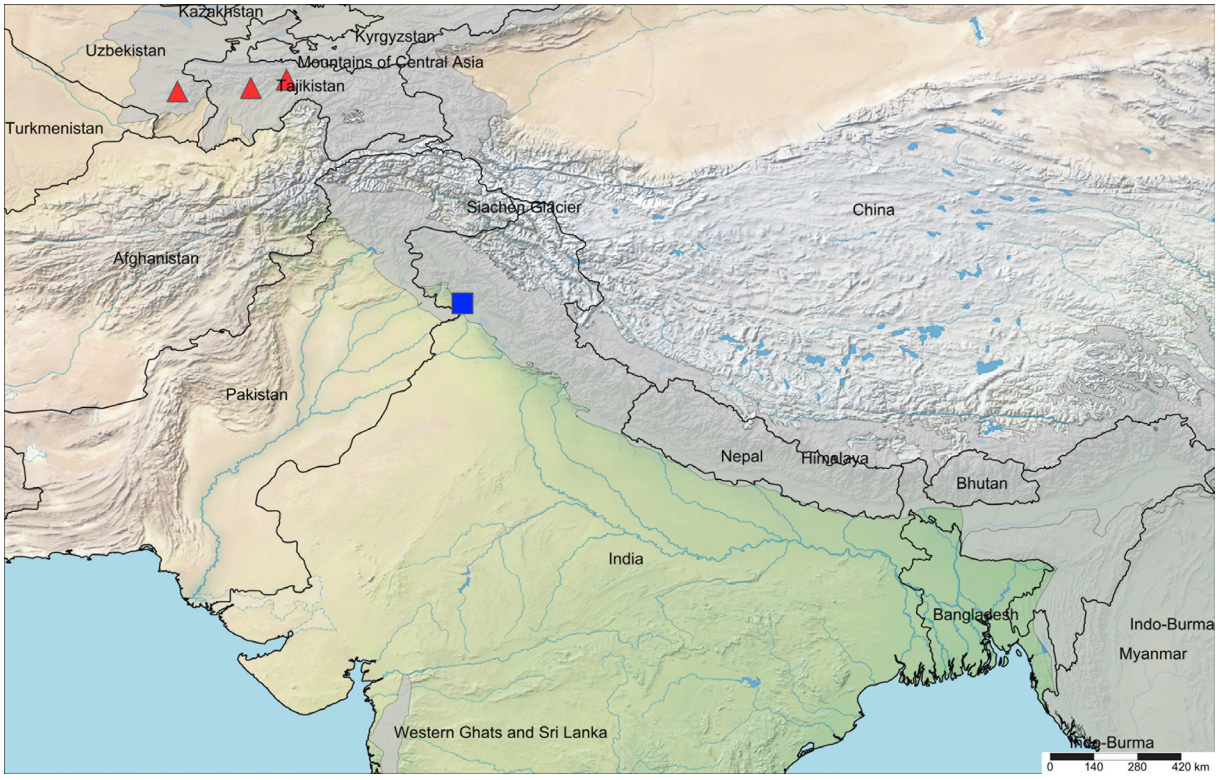


Figure 25. Distribution map of *Baetiella muchei* (Braasch, 1978). Red triangles indicate distribution in Tajikistan and Uzbekistan and blue square indicates its distribution in India.

DISCUSSION

Baetiella muchei (Braasch, 1978) was first described based on the larval characters in Tajikistan. Later, Novikova & Kluge (1987) described the male and female imaginal characters of *B. muchei*. Here, we provide an improved larval description of *B. muchei*, based on fresh material collected from the northwest part of the Himalayas and this is the first record of this species from India. There are few significant differences were observed in the Indian population when compared to the type specimen: the size of the larva, the shape of the labrum and the number of setae on each side of the labrum vary from 12 to 22 among specimens from the same locality, degree of fusion of the incisors of the two mandibles, spines on the distal margin of the tergites, distal margin of the paraproct, and the length of cerci vary from equal to the body length to 1.5 times the body (Dr N.J. Kluge, pers. Comm.). The significant differences observed in several individuals within the same locality, both in India and Tajikistan, may be potentially influenced by temperature and altitude, which fits with the concept of phenotypic plasticity (Peckarsky et al., 2001). Additionally, we also suspect that larvae in various instars show variability in the mouthparts, which is common in all mayfly taxa. Considering the distribution pattern of *Baetiella muchei* in Tajikistan, Uzbekistan, and the northwestern part of the Himalayas (Fig. 25), there is a suspicion that this species may have spread from the Tian-Shan region to the Himalayas. This hypothesis is supported by the observation that both mountain systems are integral and share common mayfly taxa (Sohil et al., 2023).

Baetiella muchei can be distinguished from other known species of *Baetiella* except *B. marginata*, *B. innotata* (Braasch, 1978), and *B. japonica* by the absence of posteromedian protuberances in the tergum. *Baetiella muchei* is further distinguished from *B. marginata* and *B. innotata* by the paracercus reduced to a single segment. *Baetiella muchei* can be separated from another closely related species *B. japonica*, by tergalii with the longitudinal dark brownish band in the main trunk, whereas, in *B. japonica*, tergalii without any peculiar colouration in the main trunk (Uéno, 1931:fig. 31). It is further distinguished from Indian species *B. subansiri* by the absence of protuberances in the posterior margin of the tergum.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: T. Sivaruban: Manuscript preparation, taxonomical expertise and revising the manuscript; A. Sohil: Collecting the specimens in the field and technical review of manuscript; P. Srinivasan: Manuscript preparation, taxonomic identification and revising the manuscript; S. Barathy: Conceptualization of work and technical review of manuscript; N. Sharma: Writing the manuscript and correspondence; R. Isack: Taxonomic identification and revising the manuscript. All authors read and approved the final version of the manuscript.

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This research received no specific grant from any funding agencies.

AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the American College Museum (AMC), Madurai, Tamil Nadu, India, and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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گونهٔ *Baetiella muchei* (Braasch, 1978) (Ephemeroptera: Baetidae) گزارش جدید برای هند، و اشاره به تنوع ریخت‌شناسی لاروها

تامبیراتنام سیواروبان[1]، آشا سهیل[2]، پاندیاراجان سرینیواسان[1]، سیواروبان باراتی[3]، نیراج شارما[4*]، راجاسکاران ایسک[1]

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چکیده: یک گونه یک‌روزه به نام *Baetiella muchei* (Braasch, 1978) برای اولین بار از رودخانه نیرو در جامو و کشمیر، هند گزارش شد. تنوع ریختی در خصوصیات لاروی مانند اندازه، شکل لب بالا و تعداد کمان‌های متشکل از موهای زیر حاشیه‌ای روی لب‌بالا بین ۱۲ تا ۲۲ متغیر بود. میزان الحاق مفاصل آرواره‌ای، خارهای حاشیه عقبی بندهای شکمی، حاشیه عقبی پاراپروکت و طول سرسی‌ها در نمونه‌های جمع‌آوری شده از هند با نمونه‌های مرجع مقایسه شد. تعداد گونه‌های جنس *Baetiella* Uéno, 1931 در هند به شش عدد افزایش یافت. نقشه پراکنش این گونه نیز تهیه و ارایه شد.

واژگان کلیدی: هیمالیا، یک‌روزه‌ها، گزارش جدید، شرق اوراسیایی، پالئارکتیک