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Research Article

A new species of the genus *Rhyacophila* Pictet, 1834 (Insecta, Trichoptera, Rhyacophilidae), from India*

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Abstract

Rhyacophila masudi **sp. nov.** from Northwest Himalaya of India is described and illustrated. The species mostly occurs in the Pir Panjal Region of Jammu and Kashmir, India. With this new addition, the genus *Rhyacophila* is represented by 166 valid species from India.

Key Words

Asia, caddisflies, India, lactic acid, macerated

Introduction

The family Rhyacophilidae is one of the Basal Lineages of suborder Integripalpia (Morse et al. 2019) and holds significant biogeographical interest due to its primitive nature. Ross (1956) and Schmid (1970) updated the taxonomy for this family in India. These caddisflies occur primarily in north-temperate regions like North America, Europe, and northern Asia, but they can also be found in India and the tropical zones of southeastern Asia (Holzenthal et al. 2007).

In India, there are two rhyacophilid genera: *Rhyacophila* Pictet, 1834, and *Himalopsyche* Banks, 1940. *Rhyacophila* is the largest genus in the family and has more than 800 described species (Schmid 1970; Oláh 2010; Kiss 2011, 2013; Holzenthal et al. 2015; Oláh and Beshkov 2016; Valladolid et al. 2020, 2021, 2023; Morse 2023). To date, the genus *Rhyacophila* comprises 165 species and seven subspecies in India (Ali et al. 2020; Parey et al. 2023). While some species of this genus have a wide distribution in various freshwater habitats, others have a more limited range. Larvae of *Rhyacophila* species do not build cases and can move freely in the stream riverbeds. Most species have predatory larvae (Holzenthal et al. 2007), although a few feed on tiny organic particles and living vascular and nonvascular plant material (Merritt et al. 2019). The species of *Rhyacophila* occupy diverse habitats, ranging from near sea level to over 3500 m above mean sea level (AMSL), and can be found in water with different flow velocities. The majority of the Indian species of *Rhyacophila* are endemic to the Himalayan region. They prefer clean, fast-flowing fresh waters that are not affected by organic pollution. The Himalayan region in India, Pakistan, and Nepal provides a suitable environment for this genus (Parey et al. 2023).

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Methods

Sampling area

The adults of this species were collected from Jammu and Kashmir and adjoining localities in Himachal Pradesh, northwestern Himalaya. It has been noted from the study that the species is predominant in the Pir Panjal region of Jammu and Kashmir Himalaya. A total of 14 male specimens were collected from sites at 1770–3680 m AMSL (Figs 1, 2, Table 1).

Morphological study

Samples were collected from streams and waterfalls at high altitudes using a 15-watt ultraviolet light (BioQuip Products Inc.), powered by a sealed rechargeable 12-volt battery, and hand-picked from a white sheet and nearby stones for 1–3 hours after dusk. The collected specimens were preserved in 96% ethanol. The male genitalia were carefully extracted using fine-tipped forceps and macerated using the lactic acid technique described by Blahnik et al. (2007) and, for better visualization, we placed them in 70% ethanol with a drop of glycerine. The nomenclature for the genitalia follows that of Schmid (1970). The type specimens are stored in the Museum of the Department of Zoology, Baba Ghulam Shah Badshah University, Rajouri, Jammu & Kashmir, India (BGSBU). Variations of the morphological characteristics of the genitalia of the newly discovered species, *Rhyacophila masudi* sp. nov., were examined by using 14 male specimens. Illustrations were created using Adobe Illustrator (ADOBE CREATIVE CLOUD, version 2021) based on photographs captured with a Realme 6 Pro camera mounted on a stereozoom microscope (Olympus SZX10). The photographs and plates were assembled using Adobe Photoshop.

Results

Species description

***Rhyacophila masudi* sp. nov.**

https://zoobank.org/9E4E0165-737F-44F4-89CB-6054EFEB793E

Diagnosis. The new species resembles *Rhyacophila obscura* Martynov, 1927, in the *R. obscura* Species Group. The characters that place the new species in the

Table 1. Sampling sites, their coordinates, and elevations (m a.s.l.) for *Rhyacophila masudi* sp. nov.

Sampling Site	Region	GPS coordinates (Latitude, Longitude)	Altitude	Date of Collection
Buffliaz	Jammu & Kashmir	33.5937, 74.3647	1850 m	15.vi.2019
Kandra	Jammu & Kashmir	33.3845, 74.5976	1820 m	17.ix.2020
Kousernag	Jammu & Kashmir	33.5008, 74.8347	3680 m	12.viii.2020
Thajawas	Jammu & Kashmir	34.2921, 75.2686	2770 m	2.vii.2021
Panchpulla	Hiamchal Pradesh	32.5261, 75.9894	2000 m	28.v.2022
Bhagsunag	Hiamchal Pradesh	32.2461, 76.3369	1770 m	30.v.2022

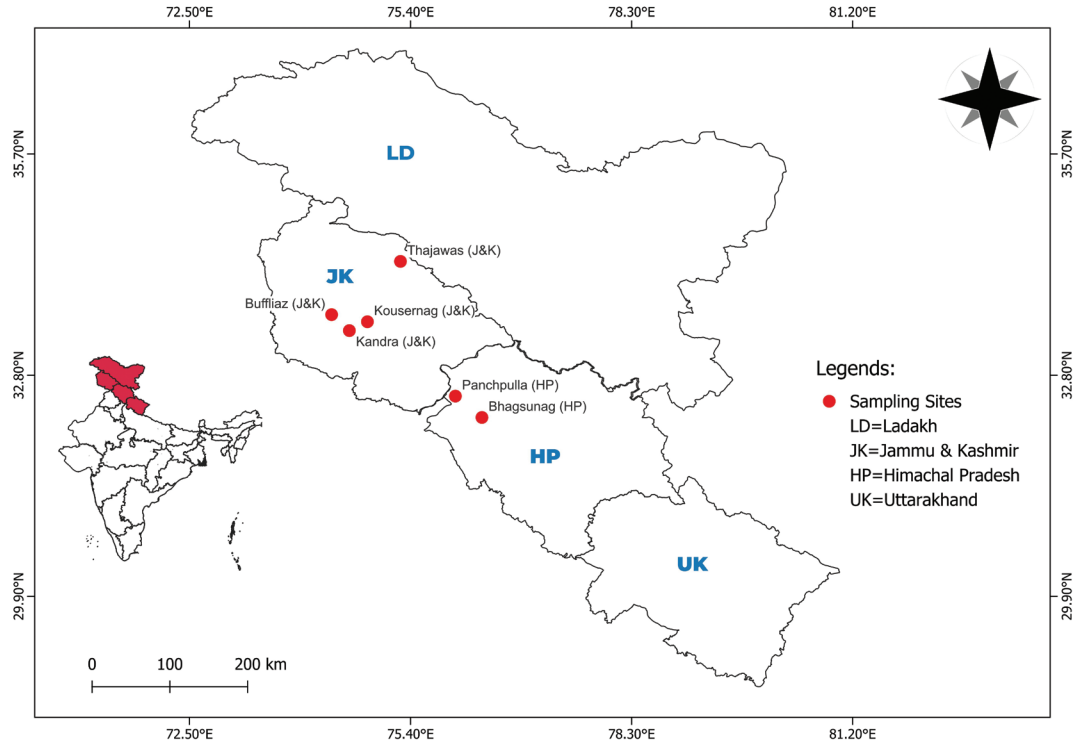

Figure 1. Map showing the collection sites of *Rhyacophila masudi* sp. nov.

Figure 2. Pictures showing some localities of *Rhyacophila masudi* sp. nov. across different locations in the Indian Himalaya. (Abbreviations**:** J&K = Jammu and Kashmir, HP = Himachal Pradesh).

R. obscura Group are features of segment X, the aedeagus, parameres, ventral lobes of the aedeagus, and the second segment of each inferior appendage. In lateral view, segment X is short and bent downwards in *R. masudi* sp. nov. but in *R. obscura*, it is long and directed posterad. The phallotheca is crescentic in the former and rectangular in the latter species. The excision between the two lobes of the second segment of the inferior appendages is wider in *R. masudi* sp. nov. but it is shallow in *R. obscura*. In *R. masudi* sp. nov. parameres are apically rounded but oval in the latter (Fig. 4A).

Description. Adult (male): Head, thorax, and legs yellowish brown; general body pale brown and antennae with alternating light and dark brown bands. Abdomen dark brown and genitalia pale brown. Length of each antenna 4.3 mm and of each forewing 6.79 mm (n = 14). In forewings, fork II arises slightly more nearly basal than fork I (Fig. 3A–C).

Genitalia (♂) (Fig. 4). In lateral view, tergum of segment IX slightly longer than its sternum. In dorsal view, segment X trilobed, outer lobes much broader than median lobe and apicolaterally round, tiny middle lobe triangular; in lateral view bent downwards, with blunt apex. Pair of dark anal

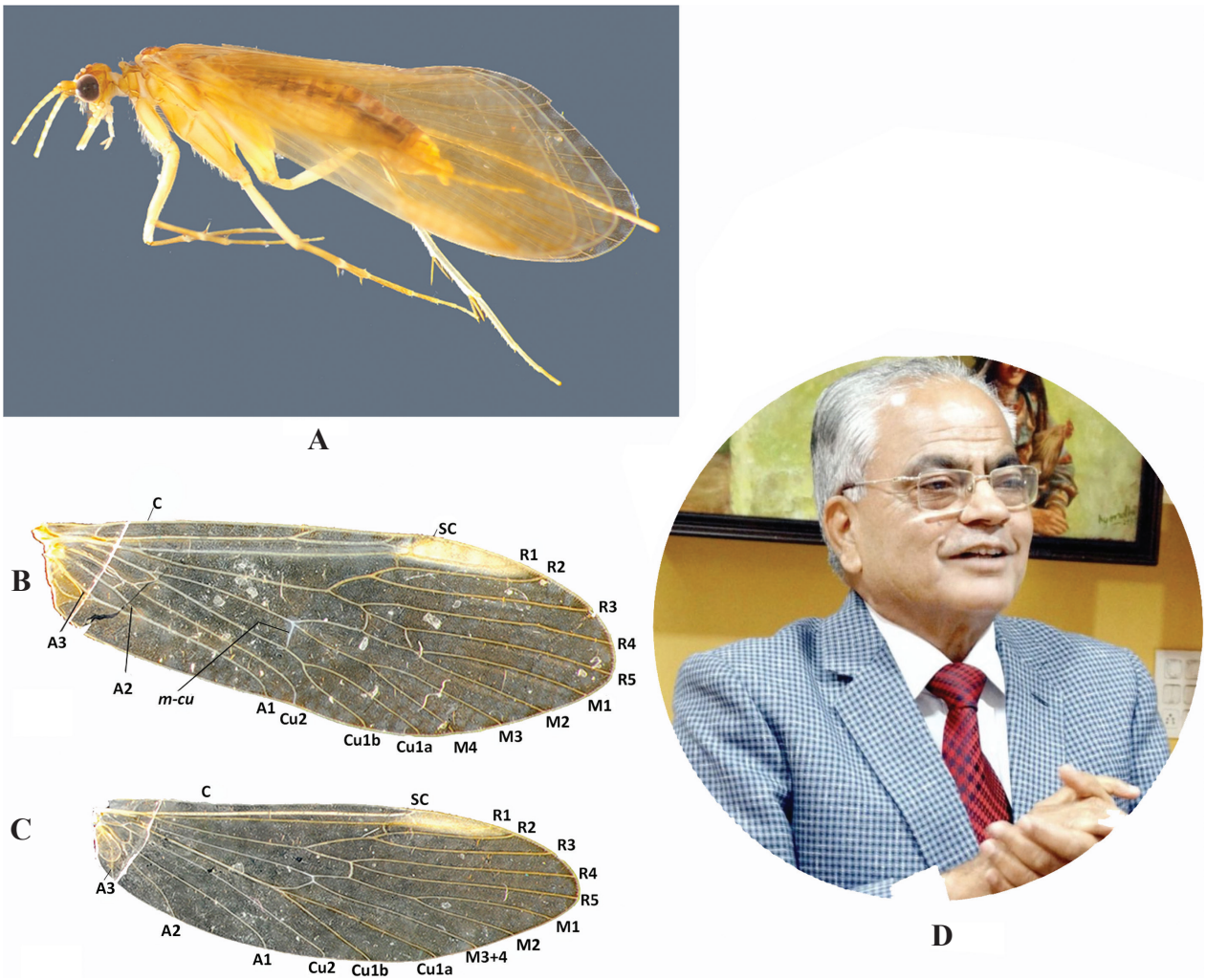

Figure 3. Adult male of *Rhyacophila masudi* sp. nov. and picture of M. Choudhary. **A.** *R. masudi*, habitus, left lateral; **B.** *R. masudi*, right forewing, dorsal; **C.** right hind wing, dorsal; **D.** picture of the late Masud Choudhary.

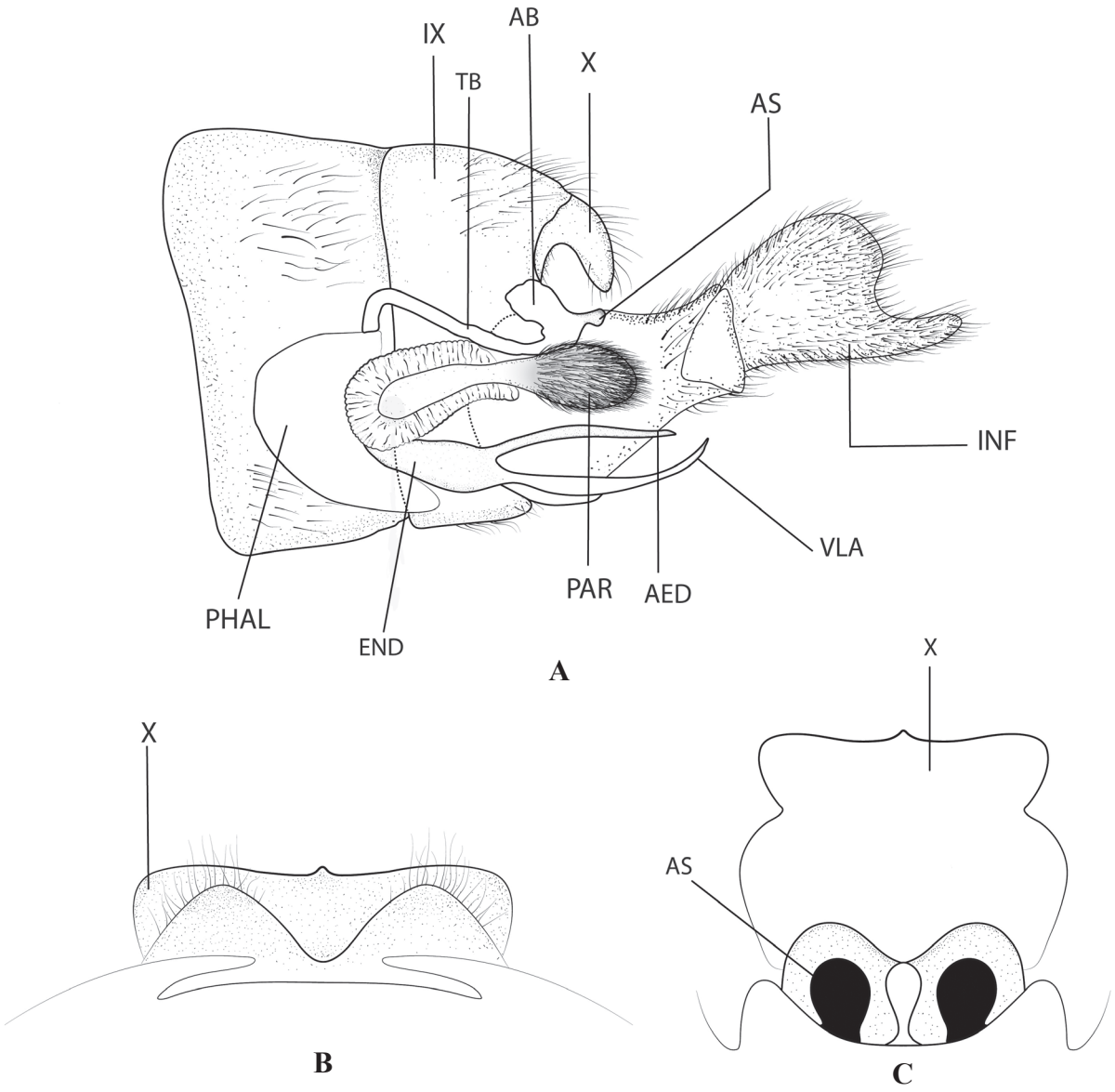

Figure 4. *Rhyacophila masudi* sp. nov. male genitalia. **A.** Left lateral; **B.** Segment X, dorsal; **C.** Segment X and anal sclerites, ventral. Abbreviations: AB = apical band; AED = aedeagus; AS = anal sclerite (paired); END = endotheca; INF = inferior appendage (paired); IX = abdominal segment IX; PAR = paramere (paired); PHAL = phallotheca; TB = tergal band; VLA = ventral lobe of aedeagus; X = abdominal segment X.

sclerites elliptical in ventral view. Phallotheca crescentic in lateral view, with convex anterior margin and concave posterior margin; endotheca shorter, tubular; aedeagus slender, tubular, acute distally; ventral lobe longer than aedeagus, apically acute, directed posterodorsad; parameres elliptical, round apically, clothed with dense setae. Inferior appendages each with first segment longer than second; second segment with dorsal lobe apically round and elevated, ventral lobe slender and projecting beyond dorsal lobe, with tall, deep excision between lobes. In ventral view first segment of inferior appendage with mesal concavity.

Female. Unknown.

Type material. ***Holotype*.** ♂, INDIA: Jammu and Kashmir, Buffliaz, DKG forest, 33.5937°N, 74.3646°E, 1850 m, 15.vi.2019, Coll. Tabraq Ali, Zahid Hussain, Aquib Majeed, and Osman Javid.

***Paratypes*.** INDIA: (2♂) same locality and collection data as holotype except 2.ix.2019; (2♂) Jammu and Kashmir, Rajouri, Kandra, 33.3844°N, 74.5975°E, 1820 m, 17.ix.2020; (2♂) Jammu and Kashmir, Kousernag, 33.5007°N, 74.8347°E, 3680 m, 12.viii.2020; (3♂) Jammu and Kashmir, Thajawas Glacier, 34.2920°N, 75.2686°E, 2780 m, 2.vii.2021; (3♂) Himachal Pradesh, Panchpulla waterfall, 32.5260°N, 75.9893°E, 2000 m, 28.v.2022; (1♂) Himachal Pradesh, Bhagsunag waterfall, 32.2460°N, 76.3369°E, 1770 m, 30.v.2022. **Collectors:** Tabraq Ali, Zahid Hussain, Aquib Majeed, and Sajad H. Parey.

Holotype and paratypes depository. Holotype and paratypes are deposited in the museum of the Department of Zoology, BGSB University, Rajouri, India.

Distribution. India: Jammu and Kashmir region, Himachal Pradesh state.

Etymology. This species is named in honor of the late Masud Choudhary (Fig. 3D), founding Vice Chancellor of Baba Ghulam Shah Badshah University, Rajouri, J&K, India, for his great contributions towards making the university a hub of excellence in teaching and research and for his excellent services to improve social and educational opportunities for the people of the Pirpanjal Range of Jammu and Kashmir.

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