

***Deuterophlebia* Edwards, 1922 (Diptera: Deuterophlebiidae) an Enigmatic Primitive Diptera (Insecta) from Kashmir Himalaya**

Mohd Sharjeel Sofi¹, Sami Ullah Bhat¹, K.A. Subramanian^{2*}, Inam Sabha¹, Irfan Rashid³ and J.C. Kuniyal⁴

¹*Aquatic Ecology Lab, Department of Environmental Science, School of Earth and Environmental Sciences, University of Kashmir, Srinagar-190006, India.*

²*Southern Regional Centre, Zoological Survey of India, #130, Santhome High Road, Chennai-670028, India.*

³*Department of Botany, School of Biological Sciences, University of Kashmir, Jammu and Kashmir, Pin-190006, India.*

⁴*G.B. Pant Institute of Himalayan Environment & Development, Kosi-Katarmal, Almora, Uttarakhand, Pin-263643, India.*

(Email: subbuka.zsi@gmail.com)

Abstract

Mountain midges (Deuterophlebiidae) are cold water hill stream insects restricted to Nearctic and Palaearctic regions. Deuterophlebiidae is believed to be a primitive lineage of Diptera and so elicits a considerable degree of interest in aquatic entomologists. Due to their restricted geographic distribution and specialized habitats, very little information is available on these primitive enigmatic insects from India. Here we report the discovery of a larva of mountain midge from Kashmir Himalaya after a time gap of forty nine years.

Keywords: *Deuterophlebia, Diptera, Mountain midges, Hill stream, Kashmir Himalaya.*

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Introduction

Diptera is one among the world's four most diverse group of insects eminently acclimatized for life at higher elevations. The group is one of the most commonly recognized and widespread insects all over the world (Sarwar, 2020). Out of 158 families of Diptera 41 have aquatic representatives with about 46,000 aquatic species representing about 30% of all formally described species of Diptera (Alder and Courtney, 2019). Every single dipteran fly has its own biological distinctiveness and ecological importance and some aquatic Diptera are regarded as "ecosystem engineers" as these species can considerably change the abiotic habitat and thus affect the ecology of other organisms and associated ecosystem processes (Wotton *et al.*, 1998; Alder and Courtney, 2019). One such case is presented by a cryptic monotypic family of Mountain Midges (Diptera: Deuterophlebiidae: *Deuterophlebia*) that are highly specialized hill stream insects. Mountain midges are mysterious nematocer-

ous flies currently represented by a single genus with 15 species restricted to Nearctic and Palaearctic regions (Wiegmann and Yeates, 2017; Pape and Thompson, 2019). *Deuterophlebia* is evoking considerable interest in both dipterists and aquatic entomologists, not only for their morphological and ecological distinctiveness, but also for its primeval lineage (McAlpine, 1981).

The immature stages are highly specialized to inhabit cold fast flowing torrential streams. The larvae have distinct eversible crochet-tipped prolegs and streamlined pupae. The prolegs have elongate setae both anteriorly as well as posteriorly. The mouth parts of adults are atrophied (Courtney, 1994). All larvae are grazers, noshing on the delicate film of periphyton on submerged rocks in streams. Head capsule is eucephalous. Antenna is elongated and split widely. Abdomen eight segmented with segments I-VII with paired, crochet-tipped,

lateral prolegs (Edwards, 1922). Segments IV and V are broadest. Thorax is dorsoventrally flattened, with three discrete divisions separated by lateral incisions. Adult longevity is brief, under two hours in males and not more than 24 hours in females. Aerial mating is presumed, as no case of mating is observed. Fecundity is low (Courtney, 1991).

The Family Deuterophlebiidae and genus *Deuterophlebia* was erected by F.W. Edwards (1922) based on specimens collected by F.J. Mitchell from Srinagar, Kashmir, India. The Palearctic species of *Deuterophlebia* is represented by eight species viz., *D. mirabilis* Edwards, 1922; *D. nipponica* Kitakami, 1938; *D. tyosenensis* Kitakami, 1938; *D. sajanica* Jedlicka & Halgos, 1981; *D. bicarinata* Courtney, 1994; *D. blepharis* Courtney, 1994; *D. brachyrhina* Courtney, 1994; *D. oporina* Courtney, 1994 (Courtney, 1994; Pape and Thompson, 2019). Among these, *D. mirabilis* (Kashmir, Sikkim); *D. blepharis* (Sikkim); *D. brachyrhina* (Arunachal Pradesh); *D. oporina* (Arunachal Pradesh) and an undescribed species of *Deuterophlebia* sp. (Courtney, 1994) have been reported from the Indian Himalaya. Overlooking the revision of Palearctic *Deuterophlebia* by Courtney (1994), Banerjee *et al.* (2018) reported only one species *D. mirabilis* from the Indian Himalaya. Courtney's (1994) revision and descriptions of new species from Himalaya were based on adult materials collected and deposited by Schmid in National Museum of Natural History, Washington, USA and Biosystematics Research Centre, Ottawa Canada. Larvae of 'an apparently undescribed species' were found in melt water streams of the northern Pir Panjal Range and the south slope of the Himalaya (Courtney, 1994), and additional observations were recorded by Dubey and Kaul (1971). All the species descriptions of *Deuterophlebia* from Indian Himalaya were based on adults and definite larvae-pupa-adult relationship were never established including for the widespread species *D. mirabilis* hence, definite species level identification of immature stages are difficult at present. Since 1971, there was no report of this rare family of Diptera from Indian Himalaya. During a recent field study in Kashmir, a single larva of *Deuterophlebia* was collected and reported

here after forty nine years.

Materials and Methods

The larva was collected by using D-net (30 cm wide base and 30 cm long) with 0.5 mm mesh size (Ligeiro *et al.*, 2020). The sampling net was placed on stream bed at downstream end of the reach, so that the natural flow that directs organisms into the net (Sabha *et al.*, 2020). The bottom substrate was disturbed for at least 1 minute by kicking method to dislodge the upper layer of cobbles or gravel and to scrape the underlying bed (Ilmonen and Paasivirta, 2005).

One larva mounted with Hoyer's medium on slide and was photographed (Figure 2) using Leica M205A stereo zoom microscope.

Material examined: One larva mounted with Hoyer's medium on slide. Locality: Thajwas stream, Thajwas, Kashmir, India. Longitude: 75° 16' 10.5" N; Latitude: 34° 17' 25.6" E; Altitude: 2798 m. Date: 12 October 2018. The specimen is deposited at Zoological Survey of India, Southern Regional Centre, Chennai, India.

Results and Discussion

Single larva of *Deuterophlebia* was found in a riffle of Thajwas stream originating from famous Thajwas Glacier. The glacier lies on the great flank of Kashmir Himalayas surrounded by picturesque plateaus and snow field. The temperature of the melt water was 4°C when the larva was discovered. The larva occurred in a riffle with rocky substrata covered with thick layer of periphyton. The average depth of the stream cross-section was about 9.5 inches and current velocity of the stream was 3 m/s the day larva was found.

The collected specimen was chocolate brown in colour which turned into white in alcohol. The larva is not identified up to species level due to non-availability of larval descriptions. The length of larva was 6mm; prolegs tipped with 13 rows of crochet rows, indicating the 4th instar stage (Fig. 2). Earlier collection of the larvae of *Deuterophlebia* from the Western Himalaya was from the headwaters of Alhni River (Himachal Pradesh) below snow fields and glaciers at 4000m (Dubey and Kaul, 1971).



Figure 1: Thajwas stream, collection locality of the larva.

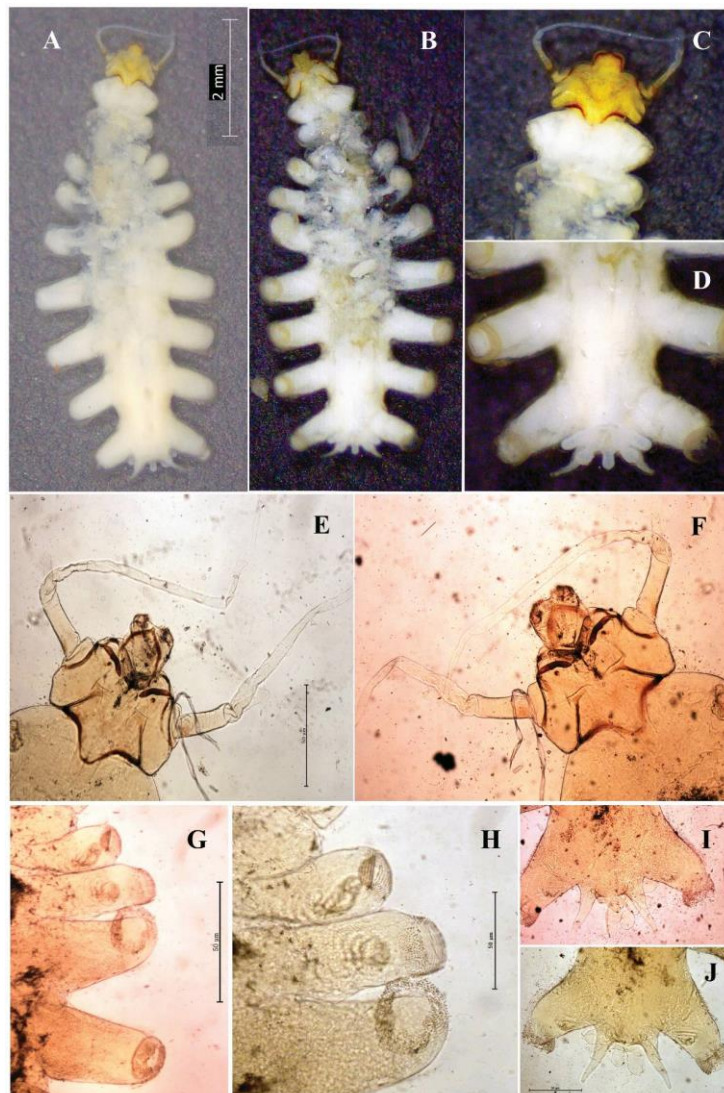


Figure 2 (A-J): *Deuterophlebia*, instar IV, ventral view of head, thorax, and abdominal segments.

They observed gregarious association of *Deuterophlebia* to algae-covered stones along with Chironomidae, Simuliidae and Blepharoceridae.

Rediscovery of *Deuterophlebia* sp. indicate the pristine nature of the streams in the basin. Extensive survey of Himalaya and collection of more larvae and adults coupled

with DNA analysis will reveal the correct species identity, diversity, ecology and distribution of *Deuterophlebia* in Kashmir Himalaya.

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