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Immature stages of *Culicoides innoxius* Sen & Das Gupta and pupa of *C. huffi* Causey (Diptera: Ceratopogonidae) from India

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Abstract

Both larval and pupal stages of *Culicoides innoxius* Sen & Das Gupta and pupal stages of *C. huffi* Causey are described and illustrated. All specimens were collected from the Lower Gangetic plains of West Bengal. Larvae of *C. innoxius* were obtained from rotten banana stem, while a single pupa of *C. huffi* was collected from an irrigation channel associated with the rice agroecosystem. A pictorial pupal key of the species of the genus reported from India is provided.

Key words: Taxonomy, Clavipalpis group, *Hoffmania*, immature, key, India

Introduction

Culicoides Latreille is one of the most species rich genera of the family Ceratopogonidae with approximately 1368 valid species, 32 subgenera, 38 species group, and 176 unplaced species described worldwide (Borkent & Dominiak 2020), and so far 76 species were reported from India (Chatterjee *et al.* 2020). Most female members of this genus are haematophagous and many species act as important vectors of pathogenic viruses, protozoans and filarial nematodes (Mellor *et al.* 2000; Borkent 2005). These midges are of great concern because they transmit bluetongue (BT), Akabane and other viruses that cause disease in sheep, cattle and wild ruminants (Kettle 1977; Linley *et al.* 1987). Immatures of this genus can be found in a variety of aquatic or semi aquatic habitats, including tree holes, ponds, marshes, streams, various muddy and saturated organic materials, damp or rotting vegetation, and manure (Kettle & Lawson 1952; Jamnback 1965; Borkent 2014; Saha *et al.* 2017; Shults & Borkent 2018). Immature stages of ceratopogonid midges including *Culicoides* are least studied. Only 3% of the larvae and 7% of the pupae are so far described worldwide from the total identified species of the genus (Borkent 2014). Immature stages of only nine species have been described from India. Seven species of *Culicoides* were reported from India which have putative role as a vector of BT virus (Prasad *et al.* 2009). *Culicoides* is a very complex group with many cryptic species, so that the species level identification became sometimes tough. In order to provide additional characters to identify cryptic species, the description of immature characteristics and their habitats may prove to be useful.

This paper aims to redescribe the pupal stage of two species, *Culicoides innoxius* Sen & Das Gupta, 1959 and *C. huffi* Causey, 1938 in light of modern terminologies with a pupal key to the species reported from India of the genus *Culicoides*.

Material and methods

The substrates with both larvae and pupae of *C. innoxius* Sen and Das Gupta, 1959 and only one pupa of *C. huffi* Causey, 1938 were obtained from their habitats. The immature stages were sorted under a stereozoom trinocular microscope