

A TAXONOMIC DESCRIPTION ON THREE NEW RECORDS OF GENUS *CULICOIDES* (DIPTERA: CERATOPOGONIDAE) FROM THE SUB-HIMALAYAN FOOTHILLS OF WEST BENGAL

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ABSTRACT: The study describes three new records of species of genus *Culicoides* from Alipurduar, Cooch Behar and Jalpaiguri districts located in the Sub Himalayan Terai zone of West Bengal. They are small in size, popularly known as 'biting midges' mostly found in moist tropical regions of the world. *Culicoides* midges are vectors of harmful microorganisms feeding on blood of livestock animals and spreading diseases. Very few instances of cattle diseases are reported from West Bengal, that too from the southern region of the State. Animal rearing and dairy farming are important sources of livelihood for villagers at high altitude. This manuscript is a brief taxonomic account of *Culicoides* midges from the Terai region of West Bengal abetting in species documentation and identification. This study is of value in helping to recognize disease occurrence vectored by biting midges, spread awareness and develop safety measures on cattle management in various high altitude regions of West Bengal and India.

KEY WORDS: *Culicoides*, Terai zone, West Bengal, Vector

Culicoides, a genus of family Ceratopogonidae, known as 'biting midges' are very small in size (1-3mm), haemtophagous and vector of transmittable pathogens like Blue tongue virus (BTV), Epizootic hemorrhagic disease virus (EHDV), African horse sickness virus (AHSV), Akabane, Aino, Equine encephalitis virus (EEV) causing diseases to livestock animals, equines, birds and human beings (Mellor et al., 2000; Meiswinkel et al., 2004).

Culicoides midges are distributed all over the world preferring regions with tropical and subtropical climate. Eleven of the thirteen known *Culicoides* vectors from India are reported from West Bengal with a total of 57 species from the genus (Mukhopadhyay et al., 2016). For the last two centuries a number of disease outbreaks have been reported from various parts of India where *Culicoides* species have been found to be the vector (Sodhi et al., 1981; Bandopadhyay & Mullick, 1983; Jankiraman et al., 1991; Kulkarni et al., 1992; Mehrotra et al., 1995; Sreenivasulu et al., 2004; Ravishankar et al., 2005; Illango, 2006; Chand et al., 2015). Recently instances of cattle diseases are reported from various southern districts of West Bengal in the new alluvial, red laterite and coastal parts (Mandal et al., 2011; Halder et al., 2013, 2016; Joardar et al., 2014; Harsh et al., 2015), but no evidences from the northern part of the State. Agriculture of the Sub Himalayan landscape of West Bengal provides only a small percentage to the economy, practicable only near the alluvial patches of the riverside when there is sufficient rainfall at moderate temperature. Therefore, animal rearing and dairy farming are the only unswerving methods of income for the villagers in this high altitude region with twenty eight percent of the Indian

dairy farms being located in the state of West Bengal (19th Livestock Census, 2012).

This study has been intended to find the distribution sites of *Culicoides* midges in various districts of Terai zone of West Bengal and take required protective measures to save the livestock and dairy farming industries of the concerned area for future.

MATERIALS AND METHODS

Study Area. This study area is based on the Terai region of West Bengal. The region covers an area of 0.17 m. ha., occupying about 1.9 per cent of the total area of the State. It is located at the Sub-Himalayas, at the foothills of the Himalayan Mountains. The region comprises of major parts of Alipurduar, about half of Jalpaiguri and entire Cooch Behar districts. It is composed of young alluvium on alluvial fans of the foothills, shallow to moderately deep with medium to fine texture. The soil has low water holding capacity resulting in severe flood and runoff with high amount of undecomposed organic matter. The region has warm summer, cool winter with high rainfall. January is the coldest month and winter starts from the end of November and extends to February with a mean winter temperature ranging from 9°C to 14°C. The summer season begins from the month of March and temperature starts rising up to June. May is the hottest month with summer temperature varying from 21-31°C. July marks the beginning of monsoon season which lasts till September with an annual rainfall of ≥3000 mm (Census 2011-Jalpaiguri, Census 2011- Kochbihar).

Insects were collected from cattle sheds in Dawaguri in Cooch Behar, Majhiali in Jalpaiguri and Mahakalguri in Alipurduar and the locations were geo-referenced by GPS handset GARMIN Oregon 550. A distribution map (Fig. 1) of *Culicoides* in Terai region of West Bengal was created using ArcGIS 10.5.

Sample Collection, Preservation and Identification. Sample collection was made using sweep nets in early morning, afternoon and just before sunset for a period of one year in 2015 based on three seasons (pre monsoon, monsoon and post monsoon) for 90 days. After collection, they were preserved in 70% ethanol. In the laboratory, different parts of the specimens of *Culicoides* species were mounted on glass slides in phenol-balsam mixture and identified through Leica DFC 295 binocular light microscope with the aid of morphological descriptions of different authors (Sen & Das Gupta, 1959; Wirth et al., 1985; Wirth & Hubert, 1989; Nandi & Mazumdar, 2014). All the measurements are in micrometers.

RESULTS

SYSTEMATIC LIST

Order Diptera

Suborder Nematocera

Superfamily Chironomoidea

Family Ceratopogonidae

Subfamily Ceratopogoninae

Tribe Culicoidini

Genus *Culicoides* Latreille, 1809

Subgenus *Trithecoides* Wirth and Hubert, 1959

Anophelis species group

Culicoides anophelis Edwards, 1922

Subgenus Unplaced

Chaetophthalmus species group*Culicoides majorinus* Chu, 1977*Culicoides yadongensis* Chu, 1984**SYSTEMATIC ACCOUNT****Genus *Culicoides*** Latreille, 18091809. *Culicoides* Latreille, Paris and Strasbourg, 4: 399 pp.Type species: *Culicoides punctatus* Latreille 1809 (= *Ceratopogon punctatus* Meigen 1804)**Key to Species group of Genus *Culicoides***

1. Second radial cell of wing is included in a pale spot.....*Anophelis* species group
 --. Second radial cell of wing forming a dark brown stigma...*Chaetophthalmus* species group

Subgenus *Trithecoides* Wirth and Hubert, 19591959. *Trithecoides* Wirth and Hubert, Pacific Insects, 1: 1-38.Type species: *Culicoides flaviscutatus* Wirth & Hubert, 1959***Anophelis* species Group**

Diagnosis. Eyes broadly contiguous. Second radial cell of wing is included in a pale spot. Wing markings consisting of 2 anterior pale areas, 1 over R-M crossvein; second over apex of second radial cell. Hind tibial comb with 4 spines, second from spur longest. Three well-developed, sclerotized spermathecae always present (Plate 1).

***Culicoides anophelis* Edwards, 1922**1922. *Culicoides anophelis* Edwards, Bulletin of Entomological Research, 13: 161-167.

Material examined. 2♀♀, collected from cow shed, 26.3187° N, 89.5131° E, Dawaguri, Coochbehar, 20.i.2015, Coll. E. Mukhopadhyay. 1♀, collected from cow shed, 26.5440° N, 86.0800° E, Majhiali, Jalpaiguri, 10.v.2015, Coll. E. Mukhopadhyay. 1♀, collected from cow shed, 26.5459° N, 89.6887° E, Mahakalguri, Alipurduar, 23.vii.2015, Coll. S. Hazra.

Diagnosis. Wings generally with dark streaks along veins and moderately pale areas in cells; 2 large, very pale spots, one centering on R-M crossvein and other on apex of second radial cell; apex of wing narrowly pale (Plate 2).

Distribution: India: West Bengal: Alipurduar: Mahakalguri, Coochbehar: Dawaguri, Jalpaiguri: Majhiali, Kolkata: Thakurpukur, Gobra, Kestopur; South 24 Parganas: Port Canning, Nikarighata, North 24 Parganas: Dumdum; Andhra Pradesh : Chittoor, Parakasma; Assam: Golaghat; Bihar; Karnataka; Kerala; Madhya Pradesh; Tamil Nadu.

Type locality: Malaysia.

Subgenus unplaced***Chaetophthalmus* species group**

Diagnosis. Eyes broadly to narrowly separated. Wing light in colour with very few or no pale spots, when present not following specific pattern; first radial cell equal in length to 2nd radial cell; Hind tibial comb with 5 spines, second from spur longest; Two functional spermathecae ovoid to pyriform in shape, with short necks, third spermatheca rudimentary (Plate 3).

Key to species

1. Win with dark brown stigma formed by deep infuscation of second radial cell and caudal to cell r_5*C. majorinus*
 --. Wing with dark stigma over cell r_2 formed by deep infuscation at extreme end of costal cell.....*C. yadongensis*

***Culicoides majorinus* Chu, 1977**

1977. *Culicoides majorinus* Chu, Acta Entomologica Sinica, 20: 99-105.

Material examined. 1♀, collected from cow shed, 26.3150° N, 89.5300°E, Mahakalguri, Alipurduar, 24.vii.2015, Coll. S. Hazra.

Diagnosis. Wing with deep infuscations along veins; a small pale spot on anterior wing margin distal to second radial cell; a dark area on anterior margin of midlength of cell r_5 ; two dark areas of cell r_2 and r_5 enclosing a rounded pale area between (Plate 4).

Distribution: India: West Bengal: Alipurduar: Mahakalguri, Darjeeling: Darjeeling Govt., College campus.

Type locality: China.

***Culicoides yadongensis* Chu, 1984**

1984. *Culicoides yadongensis* Chu, Entomotaxonomia, 6: 24.

1977. *Culicoides spinulosus* Chu, Acta Entomologica Sinica, 20: 99-105.

Material examined. 1♀, collected from cow shed, 26.3200° N, 89.4920°E, Mahakalguri, Alipurduar, 24.vii.2015, Coll. S. Hazra.

Diagnosis. Wings with oval and prominent cells r_1 and r_2 ; darkened outlines of R-M crossvein and veins R_{2+3} , R_{4+5} veins, M_2 , Cu_1 and Cu_2 (Plate 5).

Distribution: India: West Bengal: Alipurduar: Mahakalguri, Darjeeling.

Type locality: China.

DISCUSSION

The current study abridges three species of genus *Culicoides* under two species group: Subgenus *Trithecooides*- *Anophelis* species group: *C. anophelis* and Subgenus unplaced-*Chaetophthalmus* species group: *C. majorinus* and *C. yadongensis* from Terai zone in the Sub Himalayan foothills of West Bengal. These three species are restricted to the Oriental region and are invasive to India. Fortunately, there are no reports on spread of diseases by these species to livestock animals from anywhere in the world. Their distribution pattern based on seasonal collection in 2015 from West Bengal shows two records of *C. anophelis* in pre-monsoon from Coochbehar, one record of it in monsoon from Jalpaiguri and one in post-monsoon from Alipurduar, one record of *C. majorinus* in post-monsoon from Alipurduar and one record of *C. yadongensis* in post-monsoon from Alipurduar. The distribution trend in the sampling sites for a period of one year study shows maximum distribution from Alipurduar, followed by Coochbehar and Jalpaiguri. Such high altitude region distribution is an instance of rare occurrence for this insect which prefers moist tropical climate with medium temperature and rainfall. Nevertheless, recent researches on global warming and climate change show dispersal of such hematophagous insects to more suitable warmer regions of the world for their survival (Kulkarni et al., 2016). Moreover, the phenomenon of invasion by these insects to other parts of the world from their homeland also supports the above mentioned scenario. Further our study can be extended to the unexplored areas of terai zone in West Bengal and the expected outcomes are much higher based on the present circumstances of climate change which would aid in evolving a comparative study on taxonomy, habitat and ecology of this insect from the past and in present.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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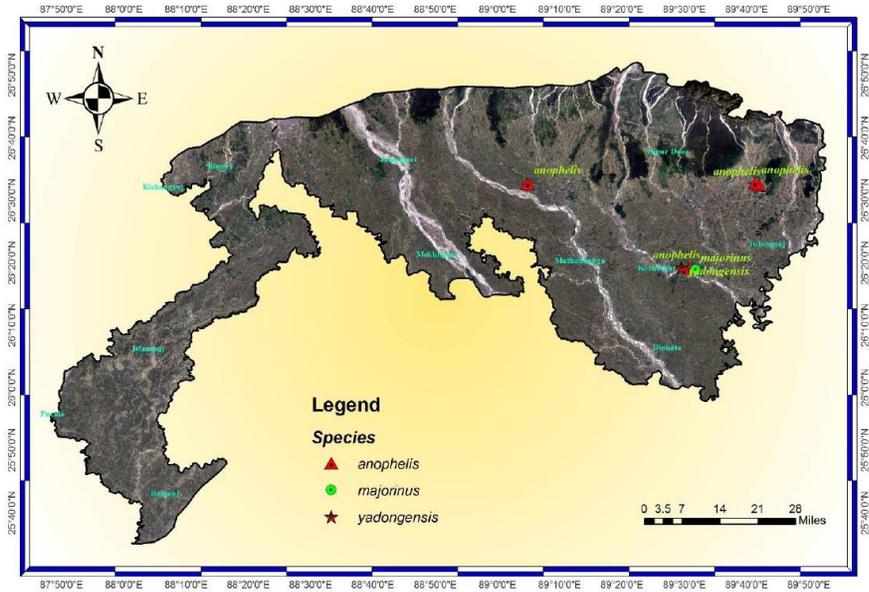


Figure 1. Distribution map showing three species of genus *Culicoides* from Terai zone of West Bengal.

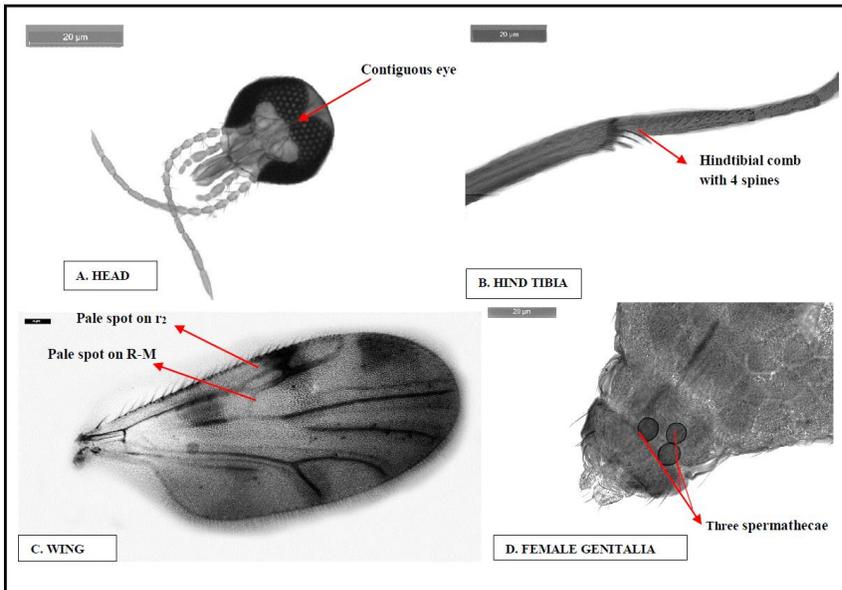


Plate 1. *Anophelis* species group.

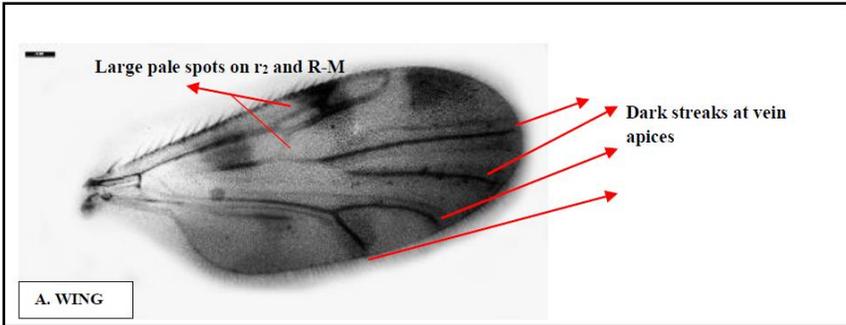


Plate 2. *Culicoides anophelis* Edwards, 1922.

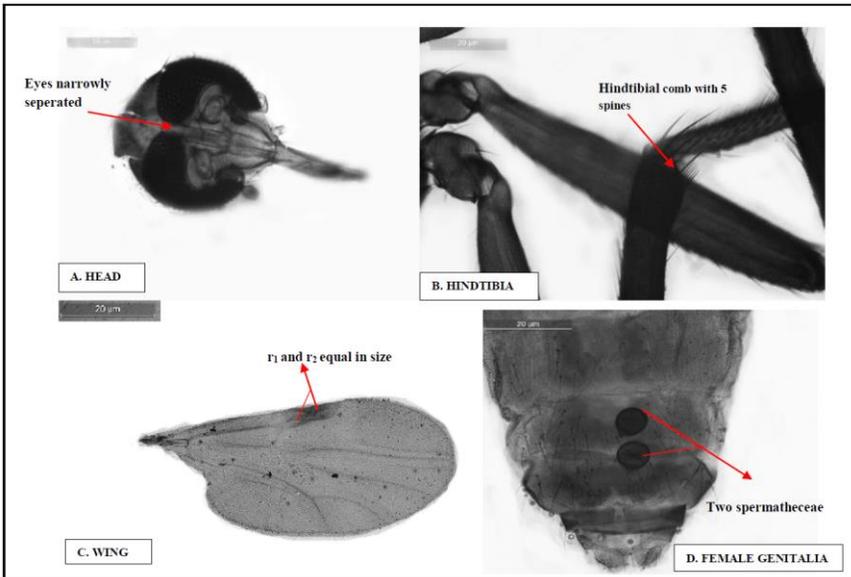


Plate 3. *Chaetophthalmus* species group.

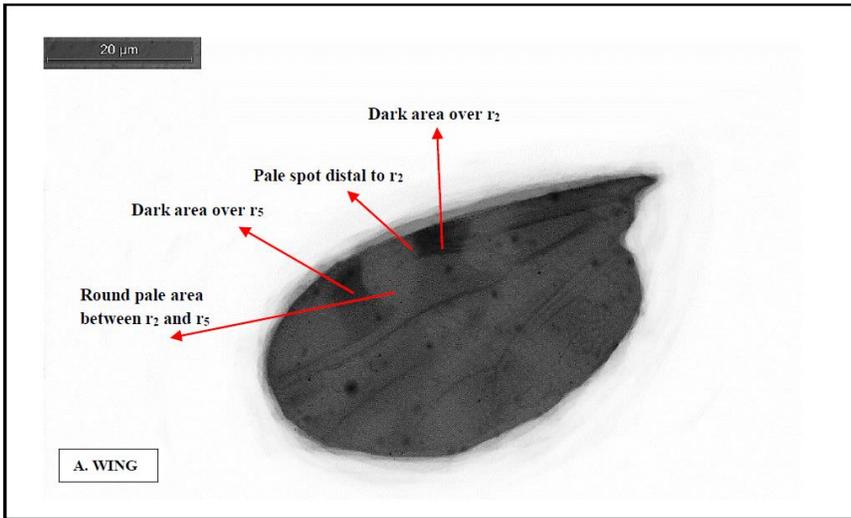


Plate 4. *Culicoides majorinus* Chu, 1977.

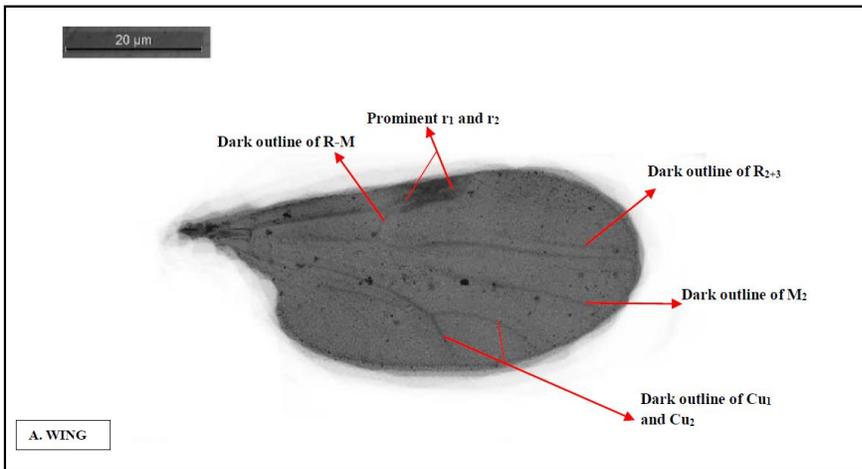


Plate 5. *Culicoides yadongensis* Chu, 1984.