



Article

urn:lsid:zoobank.org:pub:31CC9B59-447E-4005-99B1-84D9232DB97E

Two Eocene species of *Culiseta* (Diptera: Culicidae) from the Kishenehn Formation in Montana

RALPH E. HARBACH¹ & DALE GREENWALT²

¹Department of Life Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, U.K. E-mail: r.harbach@nhm.ac.uk

²Paleobiology Department, National Museum of Natural History, Washington, DC, 20013, USA. E-mail: GreenwaltD@si.edu

Abstract

Culiseta kishenehn, **sp. n.** and *Cs. lemniscata*, **sp. n.** (Diptera: Culicidae: Culisetini) are described from compression fossils from the 46 million year old Kishenehn shale deposits in Montana, USA. The new species appear to share features with extant species of subgenera *Climacura* and *Culicella*, respectively. The antiquity of *Culiseta* is examined and previously described Eocene fossil species are discussed. *Eoaedes* **gen. n.** and *Aetheapnomyia* **gen. n.** are established for *Aedes damzeni* Podénas and *Ae. hoffeinsorum* Szadziewski, two Eocene fossil species in Baltic amber.

Key words: *Aetheapnomyia* gen. n., compression fossils, *Culiseta kishenehn* sp. n., *Cs. lemniscata* sp. n., *Eoaedes* gen. n., mosquitoes

Introduction

Family Culicidae (Diptera) includes 3,523 extant species classified in 111 genera (including the 80 genera of tribe Aedini recognized in the phylogenetic classification of Reinert *et al.*, 2009) (Harbach, 2012). Fossil Culicidae have been described from amber inclusions (11 species) and compression/impressions (12 species) from localities in Canada, Dominican Republic, England, Germany, France, Mexico, Myanmar, Poland and the United States. Twenty-one of the fossil species are from the Tertiary, including species of *Anopheles* Meigen, *Culex* Linnaeus, *Mansonia* Blanchard, *Toxorhynchites* Theobald and two extinct genera, and two are from the Cretaceous. The discovery of the two Cretaceous species confirms Edwards' (1923) view that Culicidae must have originated in the Mesozoic. The oldest fossil, *Burmaculex antiquus* Borkent & Grimaldi, is in Burmese amber from the mid-Cretaceous (89.3–99.6 million years ago, Mya) and the second oldest fossil, *Paleoculicis minutus* Poinar, Zavortink, Pike & Johnston, is in Canadian amber from the Late (Upper) Cretaceous (66.0–100.5 Mya). Ten of the Tertiary species are from the Oligocene (23.0–33.9 Mya; 5 Late Oligocene 23.0–28.1 Mya), nine from the Eocene (33.9–58.0 Mya; 2 Late Eocene 33.9–41.3 Mya, 2 Early Eocene 41.3–56.0 Mya), one from the Early Miocene to Late Eocene (13.8–41.3 Mya) and one from the Early Miocene to Late Oligocene (13.8–33.9 Mya). The Eocene fossil species are placed in two or three extant genera, *Anopheles* (1 species), *Culex* (4 species) and perhaps *Toxorhynchites* (1 species), and four species that are doubtfully assigned to the extant genus *Aedes* Meigen (Harbach, 2012).

Two Eocene species of genus *Culiseta* Felt are described here from compression fossils discovered in shale deposits of the Kishenehn Basin (46.2 ±0.4 Mya) in North America. The depositional environment of the Kishenehn Basin 46 Mya was a large shallow body of water, both lacustrine and paludal. Data from several studies suggest that the climate of the Kishenehn Basin 46 Mya was wet subtropical to tropical: (1) Approximately 10 million years after the higher temperatures of the Paleocene-Eocene Thermal Maximum, the mean annual temperature for what is now northern Montana was approximately 15°C higher than it is now (Wolfe, 1995). (2) The early arboreal primate *Tarkadectes montanensis*, originally described from the Coal Creek member (McKenna, 1990), was recently assigned to the extinct family Omomyidae (Ni *et al.*, 2010). Most closely related to the Omomyidae are the insectivorous Tarsiidae, extant species of which are restricted to islands of Southeast Asia