

## THE BITING MIDGES OF THE BATU CAVES, MALAYSIA (DIPTERA: CERATOPOGONIDAE)

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*Abstract.* Nine species of Ceratopogonidae were identified from collections made in the Batu Caves, Kuala Lumpur, Malaysia between 1959 and 1961 by H. E. McClure and associates. Two species, *Atrichopogon jacobsoni* and *Forcipomyia subpallida*, were taken in large numbers and are considered an established part of the cave fauna. *A. jacobsoni* larvae were found breeding in the bat guano on the floor of the caves. *F. subpallida* immatures were not found, but this species probably breeds in the older and drier collections of guano. The other species, belonging to the genera *Forcipomyia*, *Dasyhelea*, *Culicoides*, and *Stilobezzia*, are probably chance visitors to the caves.

When McClure et al. (1967) published their comprehensive review of the fauna of the Batu Caves, Kuala Lumpur, Malaysia, only a preliminary report was made on the Ceratopogonidae because of my inability to determine all the species. Since that time I have given their material additional study and am now able to offer a more nearly complete list of species. Of the 9 species of Ceratopogonidae represented in the collections made by Dr McClure and his associates, I have been able to name 7; the others, all in difficult genera in which species are best determined by male genitalia, are each represented by a single female.

McClure et al. (1967) gave a good map of the Batu Caves on which are marked the locations of the various caverns, rooms, and other features listed below for the specimens examined.

Two species, *Atrichopogon jacobsoni* (de Meijere) and *Forcipomyia subpallida* Tokunaga, appear to be well adapted to cave life and were taken in large numbers throughout the study and virtually throughout the caves. The larvae of *A. jacobsoni* were found living in bat guano, as had previously been suspected (Edwards 1924). The immature stages of *F. subpallida* were not found, but other species of the genus breed in or under manure, especially in older piles where the midge larvae feed on fungal mycelia. Older and drier portions of bat guano are probably utilized by *Forcipomyia* larvae. The remaining genera have aquatic larvae, and they may breed in pools in the brighter portions of the caves, or the adults more likely have sought refuge from outside in the lower temperatures and higher humidities of the caves. The *Culicoides* females may possibly have sought blood meals from the bats.

To my knowledge similar studies of the ceratopogonid inhabitants of caves have been made only by Edwards (1924) for the Siju Cave in India and by Vattier & Adam (1966a, 1966b) for caves in the Congo (Brazzaville) and Gabon. Edwards reported only one species, *Atrichopogon jacobsoni* (as *A. cavernarum* Edwards) from Siju Cave.

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He also reported the same species from the Batu Caves from collections by Ridley (1898), and stated that the midges were taken in the dark zone of the cave, about 1.6 km (1 mi) from the entrance, and apparently bred in the guano of the fruit bats.

In the Congo (Brazzaville) Vattier & Adam (1966a) found 27 species of Ceratopogonidae belonging to 12 genera in their intensive cave studies. One species, *Dasyhelea adami* Vattier, is a true troglobite (known only from inside caves) and its larvae feed on the wet guano of the fruit-eating bats. Three other species are troglaphiles, *Dasyhelea flava* Carter, Ingram & Macfie (common), *Stilobezzia vandeli* Vattier & Adam (rare), and *Nilobezzia trogliphila* Vattier & Adam (rare). The remaining 23 species are troglaxenes. The 17 new species described from the Congo caves by these authors are all apparently different from their congeners found outside the caves, but the authors were of the opinion that the adults had emerged inside the caves from larvae and/or pupae that had been carried into the caves in floodwaters of streams draining from the outside. By contrast, Vattier & Adam (1966b) found only 3 species of Ceratopogonidae in 2 caves in the Gabon Republic: the troglobite *Dasyhelea adami* already described from the Congo; a common troglobite, *Culicoides brosetti* Vattier & Adam; and a troglaxene, *Forcipomyia (Euprojoannisia) marsalae* Vattier & Adam. No floodwaters penetrated the Gabon caves and the guano consisted mainly of the drier deposits of the insectivorous bats, perhaps accounting for the lesser number of species found there.

All collections listed below are from the Batu Caves, Kuala Lumpur, Malaysia.

#### ***Atrichopogon jacobsoni* (de Meijere)**

*Ceratopogon jacobsoni* de Meijere, 1907: 212 (♀,♂; Java; fig. wings).

*Atrichopogon jacobsoni* (de Meijere): Edwards, 1928: 52 (combination; Samoa; synonym *cavernarum*).—Esaki, 1940: 186 (habits).—Tokunaga & Murachi, 1959: 120 (re-described; Micronesia; figs.).—Drake, 1971: 63 (immature stages; figs.; Hawaii).

*Atrichopogon cavernarum* Edwards, 1924: 107 (♂,♀; India; caves, larvae probably breeding in bat guano).

This species is readily identified from the excellent redescription and figures of the adult by Tokunaga & Murachi (1959), and the description of the larva and pupa by Drake (1971). The immature stages taken from bat droppings in Cavern A agree with Drake's description and figures from laboratory colonies in Hawaii.

According to McClure et al. (1967), "*Atrichopogon jacobsoni* (de Meijere), Table 17, is probably synonymous with *A. cavernarum* Edwards which both Ridley (1898) and Dover (1929) noted as being abundant 240–600 m in the caverns. In this study the species was found mainly in Cavern C with a population ratio: A-9; B-4.5, C-85.8. It was most abundant when the Cavern was wet."

*Specimens examined.* Cavern A: 24.XI.1959, 1 adult; 27.XII.1960, larvae; 3.I.1961, adults; from fresh bat droppings, 50 larvae, 25 pupae, 20 adults. Cavern B: 21.XII.1959, 1 adult. Cavern C: 4.VIII.1959, 1♀; 27.X.1959, 1 adult; 10.XI.1959,

15 adults; 17.XI.1959, 4 adults; location 3 (Penny Room), 10.V.1960, light trap, 25 ♀; on walls, 28.VII.1959, 9 ♀; location 3, light trap, 24 adults; location 4, light trap, 8.XII.1959, 3 adults; location 5, light trap, 9.XII.1959, 26 adults; location 9, 11.VIII.1959, 11 adults; location 9, 5.IX.1959, 1 ♂; location 10, 5.IX.1959, 18 ♀.

**Forcipomyia (Forcipomyia) subpallida** Tokunaga

*Forcipomyia* (Subgenus D) *subpallida* Tokunaga, 1962: 181 (♂, ♀; Ryukyu Is; fig. ♂ genitalia).

*Forcipomyia* (Subgenus D) *pallida* (Winnertz) of Tokunaga, 1962: 180 (Ryukyu Is; records and description).

Previously reported only from the Ryukyu Is. I have studied the types of *F. subpallida* which are in the U.S. National Museum of Natural History. I have also studied the specimens reported by Tokunaga (1962) as *F. pallida* (Winnertz) and believe that they are conspecific with *subpallida* Tokunaga. They are clearly not Winnertz' Palearctic species, which does not occur in the Oriental Region.

McClure et al. (1967) reported "*Forcipomyia* spp., Table 17, less common than the foregoing species this population was distributed in the Caverns: A-1.6, B-18.1, C-80.3. It appeared in the collections sporadically." These remarks may be interpreted as applying essentially to *F. subpallida*.

*Specimens examined.* Cavern A: location 1, 19.II.1960, 1 ♀. Cavern B: 1.III.1960, 1 ♂; 8.III.1960, 10 adults; 29.III.1960, 1 ♂; 19.IV.1960, 2 ♂, 1 ♀; Onyx Tower, 22.II.1960, 1 ♂, 2 ♀; location 3, 3.IX.1959, 1 ♂; location 11, 14.XII.1959, 2 ♀. Cavern C: Black Cascade, 15.III.1960, 2 ♂, 6 ♀; 22.III.1960, 1 ♀; Black Onyx, 22.II.1960, 2 ♂; location 3 (Penny Room), light trap, 8.XII.1959, 28 adults; location 4, light trap, 8.XII.1959, 16 adults; location 5, 2.IX.1959, 1 ♀; 9.XII.1959, 32 adults; location 9, light trap, 11.VIII.1959, 1 ♀, 5 ♂; location 10, 5.IX.1959, 4 adults. Cavern D: location 5, 2.IX.1959, 1 ♀; location 6, 3.IX.1959, 1 ♀; location 7, 4.IX.1959, 3 ♀.

**Forcipomyia** (subgenus near *Lepidohelea*) sp.

*Specimens examined.* Cavern C: 10.VI.1960, 1 ♀.

**Forcipomyia (Thyridomyia)** sp.

*Specimens examined.* Cavern B: location 4, 3.IX.1960, 1 ♀.

**Dasyhelea claviculifera** Tokunaga

*Dasyhelea claviculifera* Tokunaga, 1962: 202 (♂, ♀; Okinawa; fig. ♂ genitalia).

This species is readily identified by the characteristic ♂ genitalia, which were figured by Tokunaga (1962).

*Specimens examined.* Cavern C: location 4, light trap, 8.XII.1959, 1 ♂.

**Culicoides huffi** Causey

*Specimens examined.* Cavern A (Bat Room): location 2, 1.IX.1959, 2♂, 1♀.

**Culicoides arakawai** (Arakawa)

*Specimens examined.* Cavern A (Bat Room): location 2, 1.IX.1959, 1♂.

**Culicoides peregrinus** Kieffer

*Specimens examined.* Cavern B: Onyx Tower, light trap, 22.II.1960, 1♀.

**Stilobezzia notata** (de Meijere)

*Ceratopogon notatus* de Meijere, 1907: 210 (♂, ♀; Java; fig. wing).

*Stilobezzia notata* (de Meijere): Kieffer, 1919: 192 (combination).—Das Gupta & Wirth, 1968: 86 (redescribed; figs.; distribution).

This widespread Oriental species was redescribed by Das Gupta & Wirth (1968), who included detailed figures. The Batu Caves specimens were included in their locality records.

*Specimens examined.* Cavern C: Dinosaur Jaws, light trap, 16.VIII.1960, 2♀.

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