Ephemera, 2000, Vol. **2** (2) : 105-111

The first mayfly taken from the island of Mauritius [Ephemeroptera, Baetidae]

by W. Patrick McCAFFERTY*[1] & John R. MAUREMOOTOO**

* Department of Entomology, Purdue University, West Lafayette, IN 47907 USA
** Mauritian Wildlife Foundation, Ken Lee Building, Port Louis, Mauritius

1. Correspondent : pat_mccafferty@entm.purdue.edu

Keywords : Mauritius, *Cloeon*, new species.

Cloeon madhouae n. sp. represents the first mayfly to be collected on the Indian Ocean island of Mauritius. The species is based on larvae taken at one locality from a low-elevation, small drainage stream in the Mare Chicose region. The new species is shown to be highly distinctive from its known congener on Madagascar. The relative vagility of *Cloeon* along with the theoretical biogeography of Ephemeroptera as it may apply to the southern Mascarene islands of Mauritius and Reunion are discussed.

Le premier éphémère signalé de l'Ile Maurice (Ephemeroptera, Baetidae)

Mots-clés : Ile Maurice, *Cloeon,* espèce nouvelle.

Cloeon madhouae n. sp. est le premier éphémère récolté à l'Ile Maurice, Océan Indien. La description de l'espèce est basée sur des larves provenant d'une localité de basse altitude : un petit canal de drainage dans la région de Mare Chicose. Cette espèce nouvelle diffère considérablement de celle du même genre déjà connue de Madagascar. Le potentiel de dispersion de *Cloeon* de pair avec la biogéographie théorique des Ephemeroptera telle qu'elle peut s'appliquer aux Iles Mascareignes méridionales de Maurice et La Réunion sont discutés.

1. Introduction

STARMÜHLNER (1979) stated that, "Absolutely absent on Mauritius are the Ephemerida and never found by others or by our mission!". In April of 1998, however, Madhvee Madhou collected two larvae of the genus *Cloeon* Leach from a small stream in the southeast region of the Indian Ocean island of Mauritius. We are honored to describe this first mayfly from Mauritius and name it after Ms. Madhou herein. The new species will be shown below to differ considerably from the Madagascar species *Cloeon emmanueli* Lugo-Ortiz & McCafferty, the only species of *Cloeon* now known from any relatively nearby landmass. In addition, we discuss theoretical biogeography of Ephemeroptera, as it may be applicable to *Cloeon*, Baetidae, and the southern Mascarene islands of Mauritius and Reunion.

2. *Cloeon madhouae* n. sp.

Description

Larva

Body : Length 5.8 mm. General coloration cream with few light brown and medium brown markings.

Head : Head capsule pale, with small, light brown infusions anterior to compound eyes and lateral ocelli, and medium brown patches medial to compound eyes. Antennae pale, three times length of dorsal head. Dorsal surface of labrum (Fig. 1) with one pair of moderately long medial setae submarginally, and two more lateral additional pairs in anterior aspect, with sparse setal row continuing submarginally and laterally in anterior half of labrum. Angulate mandible (Fig. 2) with incisors somewhat distinct (not quite completely fused) ; outer incisor with four denticles ; inner incisor with four denticles ; tuft of fine, short setae on apical margin between incisors and mola extending from base of prostheca to slightly over one-half length of that margin ; mola with rake armature subapically dentate. Planate mandible (Fig. 3) with incisors fused in basal half only ; outer incisors with four denticles ; inner incisors with three denticles ; tuft of short, fine setae along apical margin between incisors and mola extending from base of prostheca to over three-fourths length of that margin. Maxillae (Fig. 4) with galealaciniae with irregular row of fine setae submedially in midregion ; palps three segmented ; relative lengths of palp segments as shown in Figure 4. Lingua of hypopharynx (Fig. 5) truncate apically ; superlinguae extending subequally with lingua and bluntly pointed on rounded apical margins. Labium (Fig. 6) with glossae and paraglossae subequal in length ; glossae abruptly narrowing apically ; paraglossae broadly rounded apically ; medial marginal length of palp segment 1 and palp segments 2 and 3 combined subequal ; palp segment 2 distinctly broadened distally ; palp segment 3 relatively broad, obliquely truncate apically-apicolaterally short-pointed and apicomedially rounded.

Thorax : Notum generally unmarked. Medium brown patches dorsal of coxa of each leg. Hindwingpads absent. Legs unmarked except for diffuse light brown shading subdistally on femora. Forelegs with armature as shown in Figure 7. Tarsal claws (Fig. 8) with two rows of denticles, with denticles more developed distally.

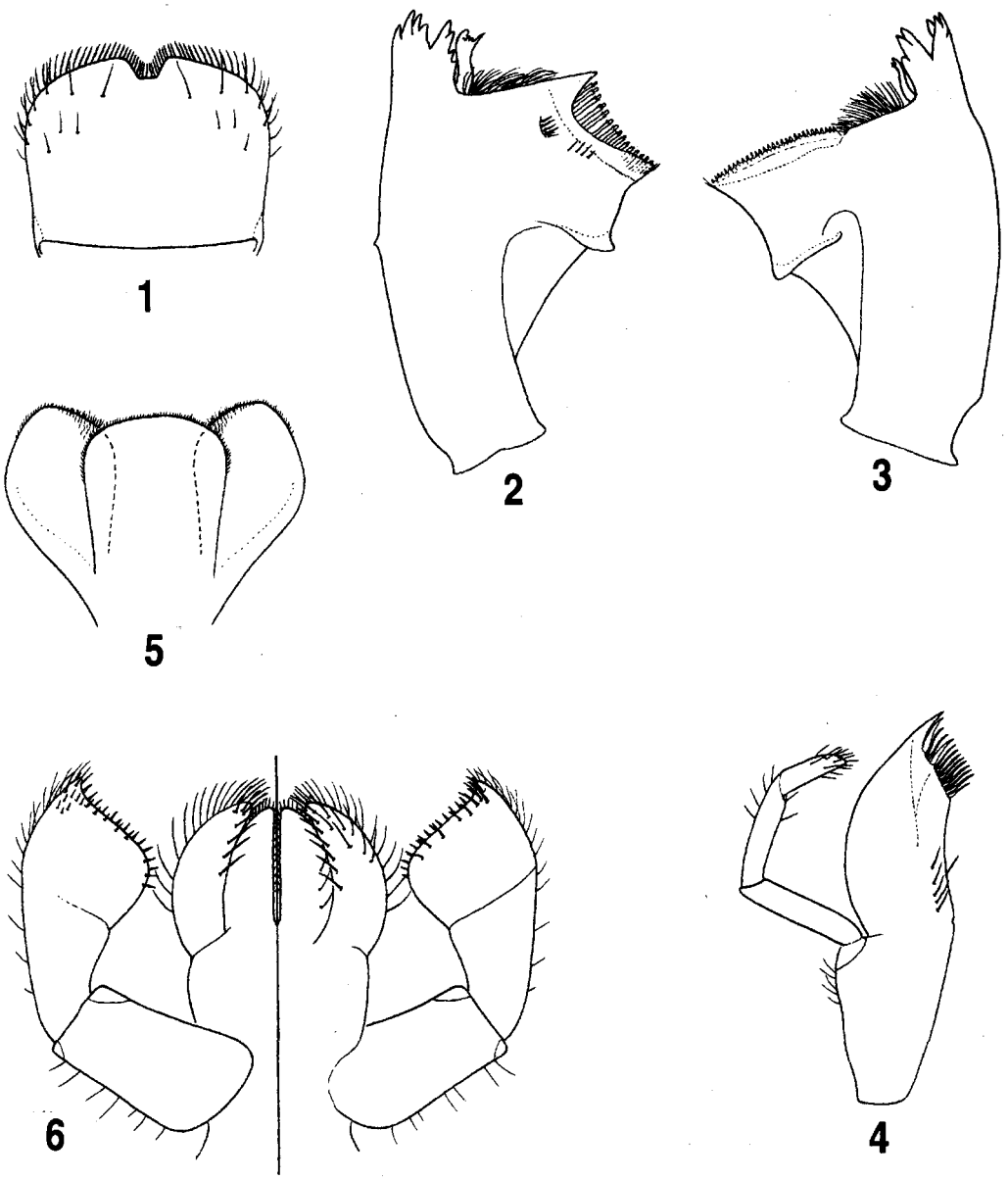
Abdomen : Tergal markings as in Figure 9 ; terga 1-9 with lateral brown patches on lateral shelves near posterior margin ; tergum 2 dark brown over entire width, with pigment narrowing laterally to posterior ; tergum 3 brown laterally, leaving semicircular pale area medially ; tergum 4 pale ; tergum 5 dark brown medially in posterior half, with light brown, sublateral, somewhat semi-elliptical markings ; terga 6 lightly shaded nearly throughout, becoming light brown sublaterally ; terga 7-9 pale except for some far lateral shading in 8 and 9 ; tergum 10 only lightly shaded. Sterna pale, with some lateral shading on sterna 8 and 9. Gill 6 with lower lamella subcircular and upper lamella well-developed (other gills not available). Caudal filaments pale.

Adult

Unknown.

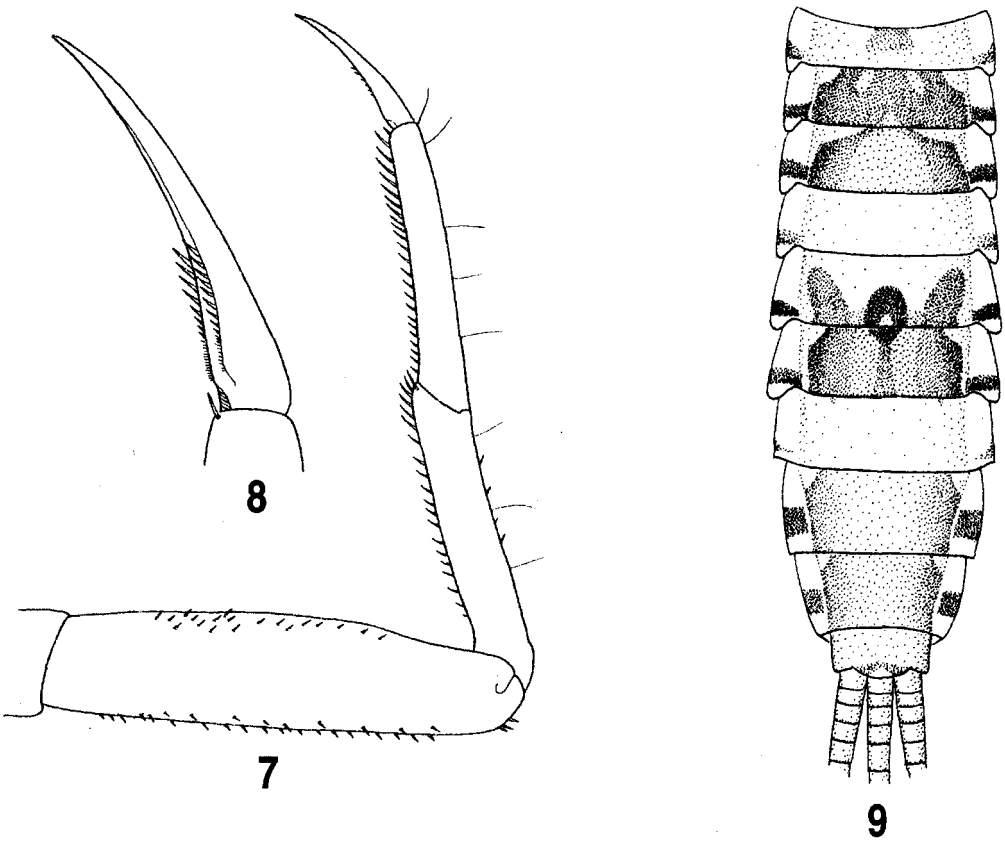
Material examined

Holotype : Male larva, Mauritius, Mare Chicose, Feeder Tibere, 30-IV-1998, M. Madhou (mouthparts and foreleg slide-mounted in Euparol), deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana, USA. There is an additional poorly preserved larva (same data as holotype) in the possession of JRM.



Pl. 1. larval structures of *C. madhouae* n. sp.
1 : labrum (dorsal). 2 : angulate mandible. 3 : planate mandible. 4 : maxilla. 5 : hypopharynx. 6: labium.

Pl. 1 : structures larvaires de *C. madhouae* n. sp.
1 : labre (vue dorsale). 2 : mandibule angulée. 3 : mandibule plane. 4 : maxille. 5 : hypopharynx. 6 : labium.



Pl. 2. larval structures of *C. madhouae* n. sp.
7 : foreleg. 8 : foreclaw. 9 : abdomen (dorsal).

Pl. 2. structures larvaires de *C. madhouae* n. sp.
7 : patte antérieure. 8 : griffe antérieure. 9 : abdomen (vue dorsale).

Diagnosis

The larvae of *Cloeon emmanueli* were described from Madagascar (LUGO-ORTIZ & MCCAFFERTY 1998) and provide some basis of comparison with *C. madhouae*. Dorsal labral setation of *C. madhouae* differs significantly from that of *C. emmanueli* in that there is a definite submarginal setal pattern rather than just a sparse scattering of setae. The incisors of the angulate mandible of *C. emmanueli* are completely fused, whereas those of *C. madhouae* are partially divided ; and the apical marginal setal tuft of the planate mandible in *C. madhouae* covers a longer area of the mandibular margin than that of *C. emmanueli*. The labium of *C. madhouae* differs significantly from that of *C. emmanueli* in that palp segment 2 broadens distally and segment 3 is relatively broad. The apex of labial palp segment 3, however, is pointed apicolaterally and rounded apicomedially in both species, but in *C. emmanueli* is narrower and appears much more oblique and falcate. The more distal denticles in the claws of *C. madhouae* are more triangular shaped and shar-

per appearing than those of *C. emmanueli*. Finally, the abdominal terga of *C. madhouae* have a much more distinctive color pattern than those of *C. emmanueli*.

Habitat

The larvae of *C. madhouae* were taken with a pond net (2.5 mm mesh size) from a small drainage stream that is bordered by sugarcane plantations in the southeast part of the island of Mauritius. The current was slow and substrate generally consisted of mud and silt at the collection site.

3. Discussion

Mauritius is a small and remote volcanic island in the Mascarene Archipelago in the southern Indian Ocean. The nearest large land mass is Madagascar (about 1000 km to the west) ; however, the nearest landfall is represented by the also small volcanic island of Reunion (about 200 km to the southwest). Reunion lies between Mauritius and southern Madagascar (nearly 800 km from Madagascar). Both Mauritius and Reunion are relatively very young islands along the Mascarene Ridge, which is perhaps 35 million years old ; Mauritius dates to 7.8 million years and Mauritius dates only to about 2 million years (THOMSON 1991). Given the young age of these islands, it is unlikely that they have ever been significantly closer to Madagascar than they are presently.

Whereas mayflies have never been reported in any manner from Mauritius, there have been both published and oral reports of mayflies on Reunion. STARMÜHLNER (1979) reported "Baetidae gen. spec." from two stream habitats in Reunion. An anecdotal treatment of the order Ephemeroptera, including a limited and unspecific reference to Baetidae, was also given in a review of freshwater macroinvertebrates of Reunion in FARITIET (1996). George Edmunds (Salt Lake City, Utah) and Alain Thomas (Toulouse, France) have also indicated to WPM that they have seen, or heard of, Baetidae on Reunion, but neither had access to any more details at this time.

Although mayflies are either not present or not well represented on remote, volcanic islands in general (EDMUNDS 1972, MCCAFFERTY 1998), presumably because of generally low vagility and thus poor overseas colonization capabilities, baetid mayflies and *Cloeon* in particular are often the only mayflies represented when mayflies are present on remote oceanic islands. In the South Pacific, for example, *Cloeon* is known from the Vanuatu, Yap, and Samoan Islands (KIMMINS 1936, EDMUNDS 1972).

The European species *Cloeon cognatum* Stephens is known from the eastern and midwestern USA (FLOWERS 1978) and is considered an adventive species (e.g. RANDOLPH & MCCAFFERTY 1998) because it does not show a distribution pattern typical of the several circumpolar species in North America (see MCCAFFERTY & RANDOLPH 1998). The exotic nature of *C. cognatum* suggests that *Cloeon*, in addition to being a good disperser relative to many other mayflies, also has a capacity for being introduced into new environments by man, possibly due to its relatively tolerant ecological requirements compared to many other mayflies. It should also be noted that there are indeed documented occurrences of other mayflies on islands as a result of being transported there by man (see ZIMMERMAN 1957, BAE & MCCAFFERTY 1991).

The occurrence of *Cloeon* on Mauritius and the documented occurrence of the genus on Madagascar, however, suggests that random overseas dispersal in the past 7.8 million years accounts for the presence of *Cloeon* on Mauritius at this time. Furthermore, *Cloeon madhouae* presumably evolved from a dispersed seed population on Mauritius, as evidenced by the distinctiveness of the species. *Cloeon* may certainly also occur on Reunion for all of the reasons related to its transportability as reviewed above ; and if so, it could possibly be represented there by *C. madhouae* or a closely related species. It is apparent from the surveys of STARMÜHLNER (1979) that several spe-

cies of freshwater macroinvertebrates are shared by Reunion and Mauritius. Any interchange between Mauritius and Reunion with respect to *Cloeon*, however, would have to have taken place in the past 2 million years ; and contrary to what may be surmised from the sparse information that exists, there is no real evidence that *Cloeon* represents the Baetidae that has been alluded to on Reunion.

Two pieces of evidence suggest that *Cloeon* was not the genus being referred to from Reunion by either STARMÜHLNER (1979) or FARITIET (1996). First, in the former reference, the Baetidae in Reunion were taken from upper to middle elevation, high-gradient streams in currents ranging from 30 cm to >1 m/sec. This is clearly not a predictable habitat for *Cloeon*, which is inclined to slow or lentic waters, and more typical of the habitat described for it in Mauritius (see above). Secondly, in FARITIET (1996), the Baetidae referred to were mentioned as having only two developed caudal filaments. Thus, the combination of the moderate - to swift-current habitat, the two - tailed morphological feature, and the biogeography noted above strongly suggests that the Réunion baetids alluded to involve a genus that meets all of these particular ecological, morphological, and biogeographic criteria. Thus, a strong candidate would be the somewhat speciose Afrotropical genus *Acanthiops* Waltz & McCafferty (historically sometimes incorrectly referred to by its junior synonym *Afroptiloides* Gillies*). A somewhat less likely candidate would be *Afrobaetodes* Demoulin. Both of these baetid genera have recently been confirmed to occur on Madagascar (see GATTOLLIAT & SARTORI 1999, GATTOLLIAT 2000, LUGO-ORTIZ et al. 2001, JACOBUS & MCCAFFERTY 2001).

Acknowledgements

We thank Geneviève Guiraud and Alain Thomas (Toulouse, France) for assisting with some pertinent literature and the French translation of the abstract, Arwin Provonsha (West Lafayette, Indiana) for figures, and Madhvee Madhou (Quatre Bornes, Mauritius) for collecting the material and providing other information. This paper has been assigned Purdue ARP Journal No. 16497.

References

BAE, Y.J. & W.P. MCCAFFERTY. 1991. Phylogenetic systematics of the Potamanthidae (Ephemeroptera). *Transactions of the American Entomological Society*, **117** : 1-143.

EDMUNDS, G.F. 1972. Biogeography and evolution of Ephemeroptera. *Annual Review of Entomology*, **17** : 21-42.

FARITIET, E. 1996. *Inventaire des macro-invertébrés d'eau douce*. Azalées Editions, Saint-Denis, La Réunion.

FLOWERS, R.W. 1978. Occurrence of *Cloeon cognatum* Stephens in the United States (Ephemeroptera, Baetidae). *Entomological News*, **89** : 79-80.

GATTOLIAT, J.-L. & M. SARTORI. 1999. A new species of *Afrobaetodes* (Ephemeroptera : Baetidae) and first report of the genus from Madagascar. *Annales de Limnologie*, **35** : 179-184.

GATTOLIAT, J.-L. 2000. Three new species of *Afroptiloides* (Insecta : Ephemeroptera) and first report of this genus from Madagascar. *Bulletin de la Société Entomologique Suisse*, **72** : 305-315.

JACOBUS, L. M. & W. P. MCCAFFERTY. 2001. Contribution to the systematics of *Afrobaetodes* Demoulin (Ephemeroptera : Baetidae). *African Entomology* in press.

KIMMINS, D. E. 1936. Odonata, Ephemeroptera, and Neuroptera of the New Hebrides and Banks Islands. *Annals and Magazine of Natural History*, **18** : 68-89.

---

* At the time being this opinion is controversial. Ephemera.

* Dans l'état des connaissances actuelles, cette opinion est controversée. Ephemera.

LUGO-ORTIZ, C.R. & W.P. MCCAFFERTY. 1998. New species of *Cloeon* and *Demoulinia* (Ephemeroptera : Baetidae) from Madagascar. *Entomological News*, **109** : 357-362.

LUGO-ORTIZ, C.R., H.M. BARBER, W.P. MCCAFFERTY & F.C. DE MOOR. 2001. A non-paraphyletic classification of the Afrotropical genus *Acanthiops* Waltz & McCafferty (Ephemeroptera : Baetidae). *African Entomology*, **9** : in press.

MCCAFFERTY, W.P. 1998. Ephemeroptera and the great American interchange. *Journal of the North American Benthological Society*, **17** : 1-20.

MCCAFFERTY, W.P. & R.P. RANDOLPH. 1998. Canada mayflies : a faunistic compendium. *Proceedings of the Entomological Society of Ontario*, **129** : 47-97.

RANDOLPH, R.P. & W.P. MCCAFFERTY. 1998. Diversity and distribution of the mayflies (Ephemeroptera) of Illinois, Indiana, Kentucky, Michigan, and Wisconsin. *Ohio Biological Survey Bulletin, NS*, **13 (1)** : vii + 1-188.

STARMÜHLNER, F. 1979. Results of the Austrian hydrobiological mission, 1974, to the Seychelles-, Comores- and Mascarene Archipelagos. *Annalen des naturhistorisches Museums in Wien*, **82** (1978) : 621-742.

THOMSON, K.S. 1991. *Living fossil*. W.W. Norton & Company, 1-252, New York.

ZIMMERMAN, E.C. 1957. *Insects of Hawaii*, Volume 6. University of Hawaii Press, vi + 1-209, Honolulu.