

With Compliment  
to P. M. C. F. 3

NEOTROPICAL NYMPHS OF THE GENUS *HEXAGENIA*  
(EPHEMEROPTERA: EPHEMERIDAE)

W. P. McCAFFERTY<sup>1</sup>

Department of Entomology, University of Georgia, Athens 30601

ABSTRACT

Collections of nymphs of *Hexagenia (Pseudeatonica) albivitta* (Walker) from Costa Rica and Brazil represent the first discovery of Neotropical Ephemeridae in the immature stage, and clarification of the classification of *Hexagenia* is thus possible. Although nymphal morphology is similar in the Nearctic and Neotropical *Hexagenia*, the imagos are distinct, and subgeneric distinction as *Hexagenia* s.s. and *Pseudeatonica* respectively is recognized. Differentiation based on wing venation is discussed. Preliminary habitat and emergence data are also presented for both the Costa Rican and Brazilian material.

Key Words: Ephemeroptera, Neotropical Ephemeridae, *Hexagenia*, *Pseudeatonica* nymphs, subgeneric delineation.

Burrowing mayflies of the family Ephemeridae are presently known to be represented in the Neotropical Realm exclusively by three species of the genus *Hexagenia* Walsh which comprise the subgenus *Pseudeatonica* Spieth. These species are *H. (P.) albivitta* (Walker), *H. (P.) callineura* (Banks), and *H. (P.) mexicana* Eaton. For over a century imagos of Neotropical *Hexagenia* have been known; the nymphal stage, on the other hand, has remained a mystery during this time. Recently, however, and almost simultaneously, extensive series of nymphs were collected both in Costa Rica and Brazil as follows: *H. (P.) albivitta*: Costa Rica, Puntarenas Province, Peninsula de Osa, Rio Rincon at Playa Blanco Road, III-10, 11, 13-1969, W. P. McCafferty, in collector's personal collection; Brazil, Paraná State, Rio dos Patos, 3km. E. of Prudentópolis, 2,300 ft., III-16-1969, W. L. & J. G. Peters, in collection of Florida A & M University, Tallahassee.

<sup>1</sup> Author's address beginning Sept. 8, 1970: Department of Biological Sciences, Dixie College, St. George, Utah 84770.

PRIVATE LIBRARY  
OF WILLIAM L. PETERS

Dr. Peters, although unable to rear to the adult stage the *Hexagenia* nymphs collected in Brazil, was able to associate his nymphal material with imagos of *H. (P.) albivitta* taken from the same locality. The specific identification of the Costa Rican nymphs as *H. (P.) albivitta* is tentative and based entirely on comparison of the dorsal abdominal color patterns, since my attempts to rear or collect imagos at the time were unsuccessful. Dr. Allen M. Young has informed me that he has recently collected imagos of *H. (P.) mexicana* from Costa Rica; however, I have not seen this material. These associations, along with the distribution of these nymphs, leave little doubt that they are actually *Pseudeatonica*. McCafferty (1968) showed evidence that the two subgenera of *Hexagenia* are zoogeographically distinct, *Hexagenia* s.s. ranging no farther south than Nearctic areas of Mexico.

Detailed examination of the exoskeletal morphology of these Central and South American nymphs show them to be indistinguishable on a super-specific level from those of the Nearctic subgenus *Hexagenia* s.s. Mouthparts, cephalic processes, leg structures, and gill morphology are identical in the two (see Fig. 1).

McCafferty (1968) pointed out that knowledge of the nymphal stage of *Pseudeatonica* was necessarily prerequisite to resolving the correct taxonomic ranking of the taxon. On the basis of the morphological similarity between the nymphs of the two groups, full generic status for *Pseudeatonica* as recognized by Kimmins (1960) is not believed justifiable. On the same basis, however, a question remains as to whether or not the Neotropical species should merit being placed in a separate subgenus.

I propose that the subgeneric classification as presented by Spieth (1941) be retained. This recognition of two subgenera is consistent with the criteria for generic and subgeneric status set forth by Edmunds (1962), wherein he states in part that subgeneric status of Ephemeroptera is preferable when two groups of species demonstrate a 'distinct gap' in structure in one stage, but only a weak or absent structural gap in the other stage. In the case of *Hexagenia*, the imagos of the two subgenera are easily differentiated on the basis of several morphological characters, which show *Pseudeatonica* to be a relatively recently derived, monophyletic group. Evidently, little morphological adaptation in the nymphs has occurred since the origin of the subgenera.

For the most part, the diagnostic characters originally designated by Spieth (1941) to separate the two subgenera on the basis of the imagos will readily distinguish the groups. However, his anal venation character should be modified to read as follows: *Hexagenia* s.s. usually with 8-14 veinlets between  $A_1$  and anal margin of fore wings, occasionally fewer but never less than 5. *Pseudeatonica* with 3-6 veinlets between  $A_1$  and anal margin of fore wings. Concerning the above character, it is of interest to note that examination of fore wing pads of the Costa Rican nymphs (Fig. 2) revealed the presence of only three anal veinlets between  $A_1$  and the anal margin, thus corresponding to the character state of *Pseudeatonica* imagos. Wing venation appears fully developed in the late nymphal instars, and is readily discernible in late preultimate nymphal instars. Any correlation of nymphs and imagos, based on comparison of venational systems, would therefore seem to be quite plausible. At the present then, subgeneric identification of the nymphs

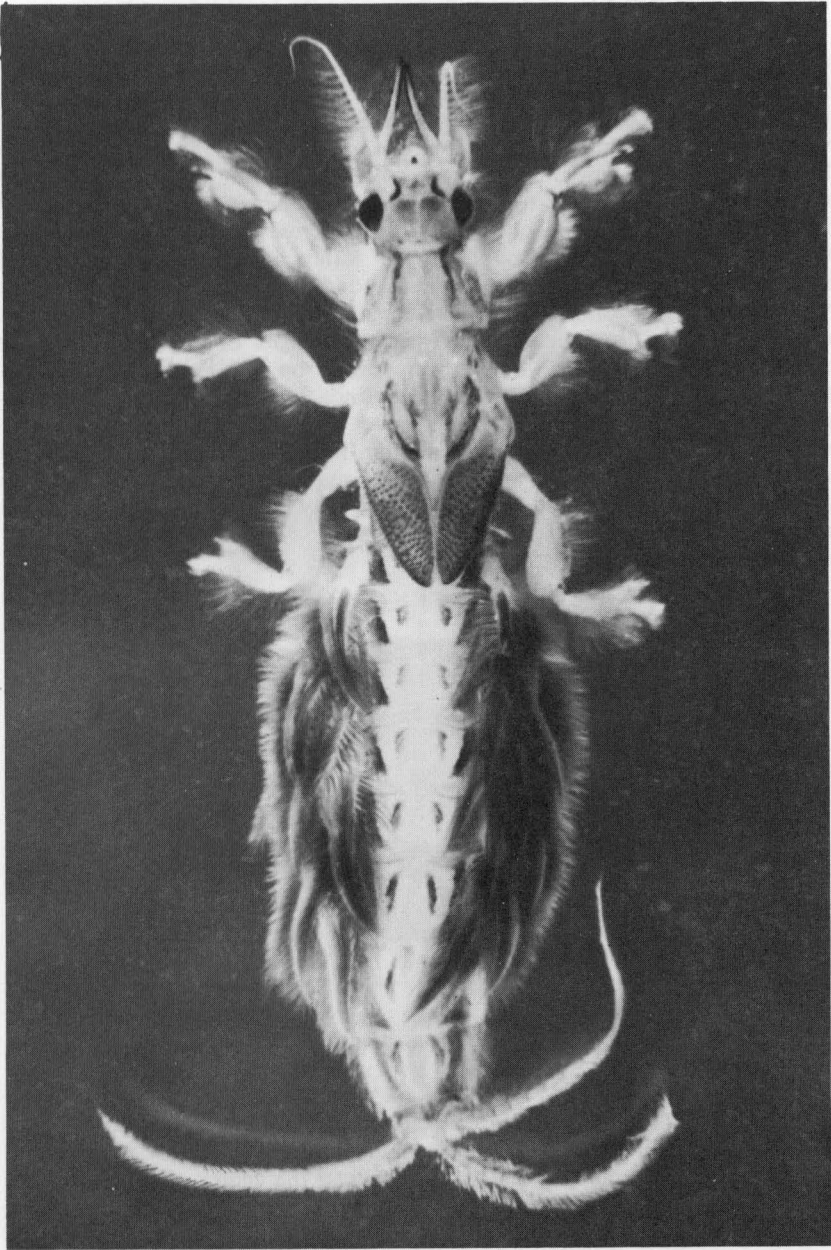


Fig. 1. *H. (P.) albivitta* from Costa Rica, whole nymph, dorsal view.

rests wholly on association with the adult stage; however, predictability based on distributional data would appear to be highly dependable.

The Costa Rican nymphs of *H. (P.) albivitta* were found burrowing in deep silt and marl substrate in slow moving, deep, backwater areas of the Rio Rincon. These areas are known to be least affected by extreme volumetric changes due to wet and dry seasonality. The substrate and current were typical of habitats where Nearctic nymphs of *Hexagenia* s.s. have been taken. At the time the collections were made, early instar nymphs were not found; however, the stage of nymphal development ranged considerably in the specimens found. About 10 per cent of those sampled represented the ultimate or penultimate nymphal instar. A few nymphs were also found burrowing in mud in some very small ponds adjacent to the river. The variation in stage of nymphal development may perhaps suggest several emergence times throughout the year. The imagoes of *H. (P.) mexicana* recently collected by Dr. Young were taken on 21, February, 1970, as follows: Costa Rica, Heredia Province, Finca La Selva, Puerto Viejo. Information on the nymphs of this species is not yet available. The only other aquatic insects found in a similar habitat with *H. (P.) albivitta* nymphs in the Rio Rincon were dragonfly nymphs tentatively identified as *Phyllocycla* sp. (Gomphidae), and these may act as predators on the mayfly nymphs.

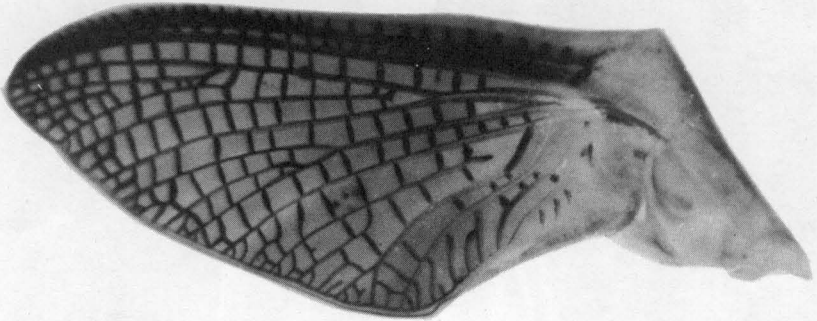


Fig. 2. *H. (P.) albivitta* from Costa Rica, left nymphal fore wing pad, dorsal view.  $\times 150$

Nymphs of *H. (P.) albivitta* collected in Brazil from the Rio dos Patos were found in silt deposits along the muddy banks as well as in small silt deposits in cracks and between rocks. Rocks in the center of the river were washed smooth by the current, but toward the edges of the river nymphs were present wherever the slower current allowed a deposit of silt. Nymphs collected were all about the same size, unlike those taken in Costa Rica. Nymphs of *Campsurus* sp. were frequently collected from the same habitat. On collecting trips to the Rio dos Patos during March, 1969, only three imagoes were collected at light. However, local residents contended that

large hatches occurred during November of each year. This date would approximately correspond to the end of the tropical rainy season. The question as to whether or not there is any direct relationship between tropical seasonality and life cycles of *Hexagenia*, including mass emergences, presents a most interesting area for further research.

#### ACKNOWLEDGEMENTS

I would like to express my gratitude to Dr. William L. Peters of Florida A & M University for the loan of specimens and for supplying me with biological data on his Brazilian collections, and to Dr. Herbert H. Ross of the University of Georgia for his critical review of the manuscript. I would also like to acknowledge the Organization for Tropical Studies in whose program I was participating at the time collections in Costa Rica were made.

#### LITERATURE CITED

- Edmunds, G. F., Jr. 1962. The principles applied in determining the heirarchic level of the higher categories of Ephemeroptera. Syst. Zool. 11:22-31.
- Kimmins, D. E. 1960. The Ephemeroptera types of species described by A. E. Eaton, R. McLachlan, and F. Walker. Bull. Brit. Mus. (Nat. Hist.) Entomol. 9:269-318.
- McCafferty, W. P. 1968. The mayfly genus *Hexagenia* in Mexico. Proc. Entomol. Soc. Wash. 70:358-9.
- Spieth, H. T. 1941. Taxonomic studies on the Ephemeroptera. II. The genus *Hexagenia*. Amer. Midland Natural. 26:233-280.
- J. Georgia Entomol. Soc. 5(4) October, 1970 pp. 224-8.