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Description of larva, redescription of adults and biology of *Mortogenesia mesopotamica* (Morton, 1921) (Ephemeroptera: Palingeniidae)

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Abstract

All life stages of *Mortogenesia mesopotamica* (Morton, 1921) are described, on the basis of material collected in the lower Euphrates–Tigris River basin. Adults are redescribed, and larvae are described for the first time, based on sets of larval exuviae. The monotypic genus *Mortogenesia* Lestage, 1923 is redefined using both adult and larval characteristics: eyes not contiguous, distinctly separated by a wide gap; vestigial mandibular tusks present, with 3–4 rounded lateral projections; forewing veins MP_1 and iMP not brought together; CuA furcation absent on forewing; both claws similarly shaped in males; hind tarsi five-segmented; penes with roughly triangular, apically rounded and divergent lobes (*in adults*); seven conspicuous stout teeth on outer margin of mandibular tusk, with no apical spine-like setae; maxillary palps two-segmented; distal segment of labial palps asymmetric and bulbous; basal segment of labial palps densely pilose; forelegs with relatively short, triangular claws that are basally wider than tarsi; foretibiae with stout spines only; and a simple, leaf-like gill 1 (*in larvae*). The burrowing larvae of *M. mesopotamica* occur solely in large permanent lowland rivers, in clayey or muddy sediments, with particles exceeding 0.025–0.075 mm. Based on observations of their burrows, larval density is approximately 100–200 individuals per square meter. Various evidence suggests a unique phenomenon of male neoteny in *Mortogenesia*. Preliminary results of male dissections suggests a missing teneral adult cuticle, and male "subimagoes" and females occur simultaneously after oviposition. *Mortogenesia mesopotamica* is known currently from the Euphrates–Tigris basin in Iraq and from the Karkheh River in Iran.

Key words: morphology, differential diagnosis, metamorphic stages, distribution, life cycle, Middle East

Introduction

The mayfly *Mortogenesia mesopotamica* (Morton, 1921) is probably one of the earliest insect known to man. According to Soldán (1997), it was regarded by ancient literates as "water locust" after the occurrence in extremely large swarms on water and banks of large rivers resembling true "terrestrial" locusts (Orthoptera) in Mesopotamia (cf. Bodenheimer 1960; Harpaz 1973). Water locusts were mentioned under the item No. 234 in the 14th Tablets of bilingual Sumero-Akkadian cuneiform dictionary discovered in the royal library of the Assyrian king Ashurbanipal (669–629 B.C.) (now deposited in the Natural History Museum, London). Sumerian name of water locusts was "buru.id.da" and Akkadian name "ku-li-lum" (Landsberger 1934). The native people of Euphrates–Tigris oases have been familiar with this conspicuous mayfly and also the English mentioned the huge swarms many times in the 18th and 19th centuries.

Despite the species is probably known for more than four thousand years, there are no detailed information on its morphology, phylogeny and biology, except for a short description of adults by Morton (1921), a single record on its occurrence in the Tigris River (Al-Zubaidi *et al.* 1987) and a short treatment by Kluge (2004). Either Lestage (1923) establishing the genus *Mortogenesia* or Demoulin (1965) revising the Palingeniidae of the world worked only with literature data and illustrations of the adults by Morton (1921). The larvae have remained unknown for a

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The unique phenomenon in *Mortogenesia* seems to be possible reduction of imaginal stage. The only (subimaginal) winged instar is known to occur in *Palingenia* (Edmunds & McCafferty 1988; Kluge 2004), but solely in females. Also Kluge (2004: 254) noted that "some specimens [of males of *Anagenesia*] do not moult at all"; on the other hand for all species of *Chankagenesia* the presence of male imago is confirmed (Buldovsky 1935a: 834; 1935b: 160; 1935c: 124; Tshernova 1952: 243–246). Preliminary dissection of some male body parts (wings, legs, cerci and forceps) of *Mortogenesia* seems to indicate that teneral adult cuticle is missing. Neoteny of males is documented also by simultaneous occurrence of male "subimagoes" and females (with no or only several eggs in abdominal cavity) after oviposition, which never occurs in related genus *Palingenia* (Soldán & Landa 1986; Russev 1987; Bauerfeind & Soldán 2012). This hypothesis should be verified by electron micrographs of transversal sections through male subimaginal cuticle.

The early daily and seasonal emergence, and neoteny could be explained as an adaptation to extreme climatic conditions (arid or even desert abiotic factors) and/or protection from predators. While the aquatic environment is relatively constant and comparable to that of other Palingeniidae, "terrestrial" conditions, where mating and compensatory flight is realized, exert a very strong environmental pressure of extreme temperatures (even more than 45°C) and extremely low humidity which can be tolerated by adult mayflies only for several minutes. Moreover, most predators (including fish and birds) are active after the sunset. These would be the reasons for the general elimination of subimaginal instar and shift of emergence to the morning and to early spring months. Similar tendency to reduce a subimaginal stage was documented in *Cloeon* species in arid areas (Soldán 1987).

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