

The larvae of the Madagascar genus *Cheirogenesia* Demoulin (Ephemeroptera: Palingeniidae)

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Abstract

Generic characteristics of the larval stage of *Cheirogenesia* Demoulin are described and illustrated in detail for the first time. *Fontainica josettae* McCafferty is shown to be a junior synonym of *Cheirogenesia decaryi* (Navas) **syn.n.**, and a specific description of the larvae is given. Notes on the probable relationships of this Madagascar genus and on the biology and habitat of the larvae are included.

Introduction

McCafferty (1968) described a new genus and species from Madagascar, *Fontainica josettae* McCafferty, based on a larval specimen collected and reported on by Mme J. Fontaine (1968). The genera of the family Ephemeridae (including *Pentagenia* Walsh) were being comprehensively studied by the first author at that time. In order to help elucidate generic relationships in the family Ephemeridae, the larva was named as new on the basis of (1) its striking morphological similarity (even though the larva was relatively young) to the genus *Pentagenia* which is known only from North America, and (2) the prediction that the then unknown larvae of Ephemeridae would prove to be very different in generic characterization from *Pentagenia*, according to hypothesized phylogeny.

Demoulin (1969) assumed that Fontaine's specimen was an ephemerid, as had Fontaine (1968), and so argued that it could just as well be the unknown larva of *Eatonica josettae* Demoulin from Madagascar. It is interesting to note, however, that the

generic larval characteristics of *Eatonica*, which were first presented by Demoulin (1968), are totally unlike those of Fontaine's specimen. Furthermore, characteristics of the then unknown larvae of *Pseudeatonia* Spieth and *Eatonigenia* Ulmer, which were subsequently described by McCafferty (1970 and 1973, respectively), have proven to be totally unlike those of Fontaine's larva. The relationships of *Eatonica* and the latter groups are discussed briefly by McCafferty (1971, 1973).

More recent evolutionary studies by McCafferty (1972) and Edmunds (1972) have indicated that *Pentagenia* is very closely related to the Palingeniidae genera. Consequently, McCafferty (1972) suggested the possibility that *Fontainica* might indeed represent the unknown larval stage of the monotypic palingeniid genus *Cheirogenesia* Demoulin from Madagascar, since the larvae of *Pentagenia* (and hence *Fontainica*) were essentially palingeniid-like.

We have examined the young larva described by Fontaine. Furthermore, several larvae, including some that were well developed, were collected from Madagascar as follows: MALAGASY REPUBLIC, PROV. Tananarive, Fleuve Mangoro at Rte. National 2, 18.x.1971 (G. F. and C. H. Edmunds, F. Emmanuel) (University of Utah, Salt Lake City). The obvious palingeniid characteristics of these specimens, and also the fact that they were in essence like Fontaine's larval specimen, led to the conclusion that they were probably *F.josettae*. Examination of the more mature male larvae further revealed that the developing genitalia were of the type described for the adults of *Cheirogenesia decaryi* (Navas) (Demoulin, 1952). From these observations it is apparent that *Fontainica* represents the larva of *Cheirogenesia*.

The descriptions and discussions below represent the first detailed treatment of the larvae of *Cheirogenesia* and are important to understanding relationships within the Palingeniidae.

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***Cheirogenesisia* Demoulin**

Cheirogenesisia Demoulin, 1952, 10. Type-species
Anagenesia decaryi Navas, by original designation.
Fontainica McCafferty, 1968, 293. Type-species
F. josettae McCafferty, by monotypy. **syn.n.**

Larva

Head. Frontal process (Figs. 1 and 2) approximately twice as wide as long; lateral margins slightly divergent from base; anterior margin nearly straight, sometimes appearing slightly emarginate, with lateral processes projecting strongly anteriorly and four to seven smaller medial spines (in mature larvae); giving appearance of subtruncate, crenulate frontal process. Supra-antennal processes (Figs. 1 and 2) oriented anterolaterally with each having large anteriorly pointed process immediately above base of antenna and smaller lateral process situated approximately midway between base of antenna and anterior margin of compound eye. Antennae (Figs. 1 and 2) with pedicels and scapes approximately same length. Labrum (Fig. 3) with distal margin slightly convex. Mandibular tusks (Figs. 2 and 4) broad, tapering in distal third to heavily sclerotized apices; lateral carina of each tusk (Fig. 4) with regular row of armature, in mature larvae as follows: eleven to fifteen socketed spurs in distal two-thirds, progressing from long spurs originating in carina basally to progressively shorter, more heavily sclerotized spurs originating at apices of progressively longer spines distally. Distal margin of median lingua of hypopharynx (Fig. 5) straight in lateral two-thirds and triangularly produced in median third. Maxillary palpi (Fig. 6) two-segmented with distal segment

twice length of basal segment. Labium as in Fig. 7.

Thorax. Tibiae of fore legs (Figs. 1 and 8) strongly and truncately excavated, each with large prominent process anterior to tarsus and somewhat less prominent process posterior to tarsus; anterolateral margin of each fore tibia straight with dense rows of spurs extending for entire length. Tibiae of hind legs (Figs. 1 and 9) with tibial processes rounded and spuriferous apically, extending well beyond bases of tarsi.

Abdomen. Gill 1 (Fig. 10) minute, single, and somewhat oval. Gills 2-7 (Figs. 1 and 11) with anterior lamellar branch much longer and more fimbriate than posterior lamellar branch; gill filaments dense and brush-like along dorsal margin and consisting of single row along ventral margin. Lateral abdominal lobes (Fig. 1) well developed on segments 3-7, one-third to one-half as long as anterior lamellar branch of corresponding gills.

Discussion

Morphological variation correlated with size class of the larvae can be seen in the armature of the frontal process and mandibular tusks in *Cheirogenesisia*. The number of medial spines along the anterior margin of the frontal process appears to increase with age, since in intermediate sized larvae (approximately 10 mm in length) there are from three to five spines and only one distinct spine is present in the young larva collected by Fontaine (1968), although the anterior margin is quite rough in her specimen. The lateral carina of the mandibular tusks becomes more spiniferous and the spurs arising on spinal bases become more numerous with age. The total number of spurs along the carina also increases somewhat

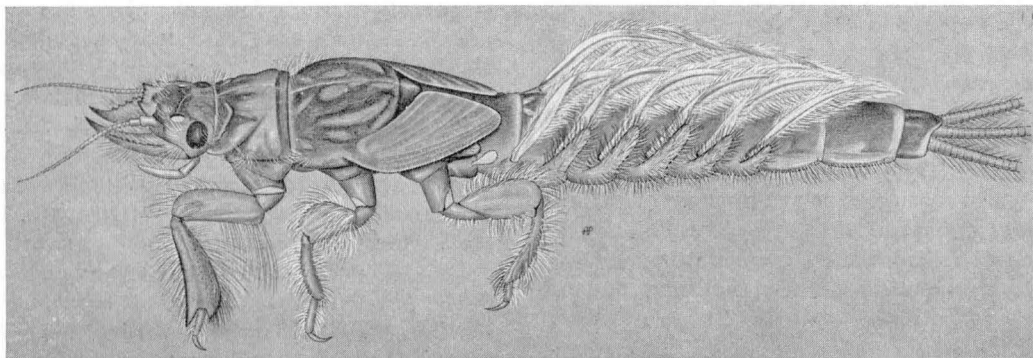
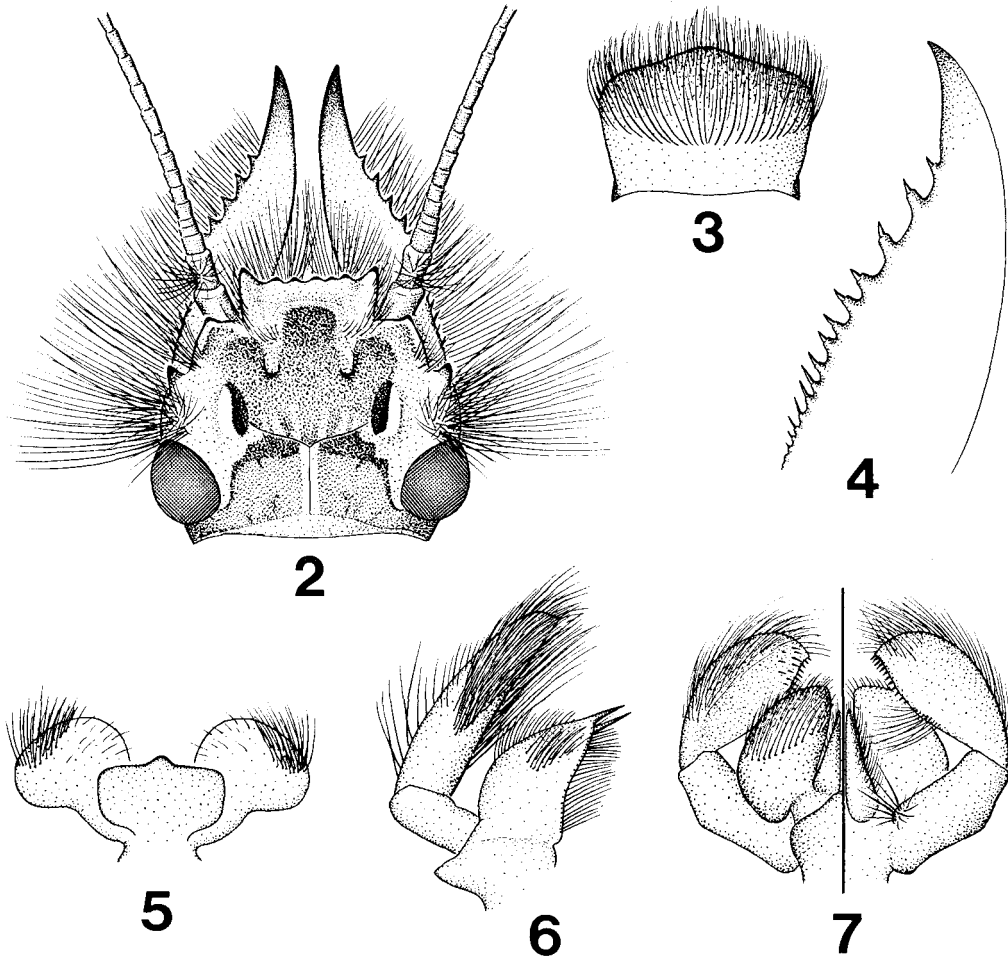


Fig. 1. Larva, *Cheirogenesisia decaryi* (Navas).



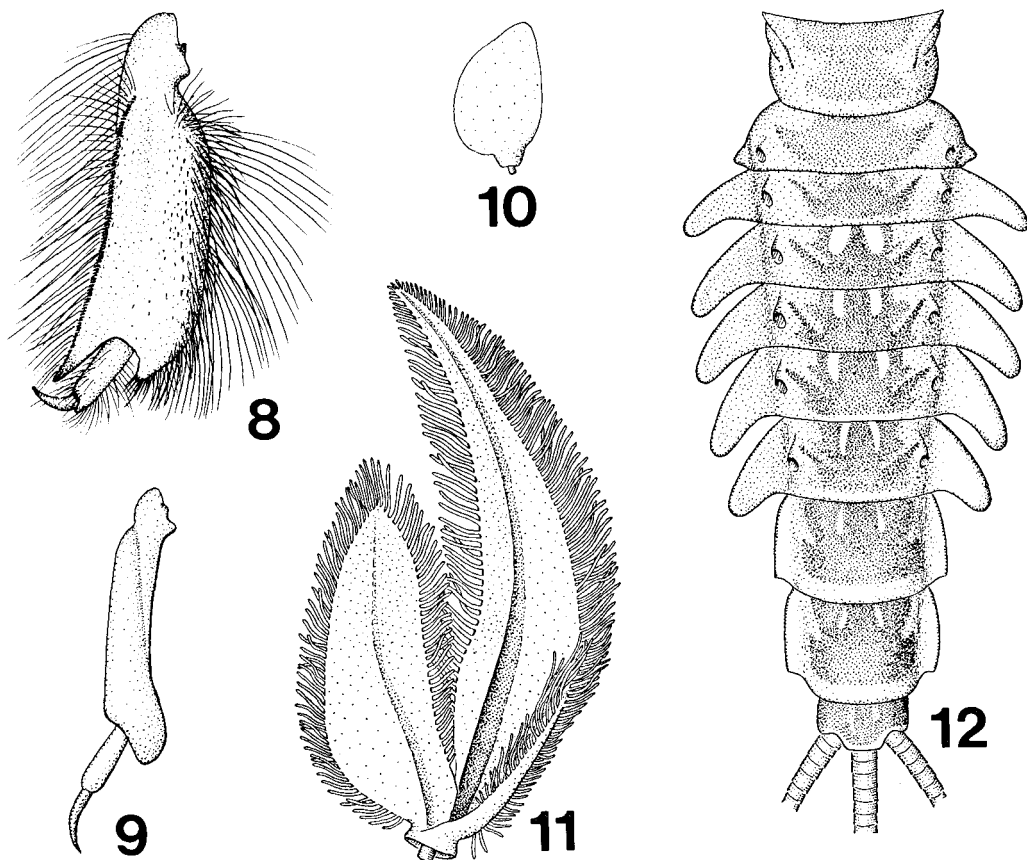
Figs. 2-7. *Cheirogenesis decaryi* (Navas): (2) head; (3) labrum; (4) tusk (without setae); (5) hypopharynx; (6) maxilla; (7) labium.

with age. There are eight distinct carinal spurs, none of which have spinal bases in Fontaine's early instar specimen; there are approximately eleven carinal spurs with four or five having spinal bases distally in intermediate sized larvae; and there are eleven to fifteen carinal spurs with at least eight having spinal bases distally in mature larvae.

Palingeniid larvae are generally poorly known. Data concerning their morphological characterization are fragmentary, and the larval stage of *Mortogenesis* Lestage remains unknown to date. Any morphological comparison of the larvae of the genera must therefore be considered tentative and is reliant to a great extent on sketchy characterization reported in the literature. The presently most complete treatments of larvae are found in Landa

(1969) and Gravelly (1920) for *Palingenia* Burmeister; Tshernova (1952) for *Chankagenesia* Buldovskij; Ulmer (1939) for *Plethogenesis* Ulmer; and Gravelly (1920) and Tshernova (1952) for *Anagenesia* Eaton.

The following combination of characteristics will apparently distinguish *Cheirogenesis* larvae from other presently known palingeniid larvae: (1) the frontal process is nearly truncate with little anterior emargination (Fig. 2), (2) the supra-antennal processes are not broadly produced on the head (Fig. 2), (3) the mandibular tusks do not have the lateral carina modified into large crenulations but instead possess a rather uniform series of small spurs and spines (Fig. 4), (4) the tibiae of the fore legs have well developed posterior and anterior distal processes and no large crenulations or large processes along the



Figs. 8-12. *Cheirogenesia decaryi* (Navas); (8) tibia and tarsus of fore leg; (9) tibia and tarsus of hind leg (without setae and spurs); (10) gill 1; (11) gill 4; (12) abdominal terga.

anterior margin (Fig. 8), and (5) the tibial processes of the hind legs are well developed but distinctly rounded apically (Fig. 9).

Some preliminary inferences about generic relationships can be drawn. On the basis of the larval stage, *Cheirogenesia* is evidently most closely related to *Anagenesia* and *Plethogenesia*, and more distantly related to *Palingenia*. Its relationship to *Chankagenesia* is unclear because of the lack of morphological information on this latter genus. *Cheirogenesia*, *Anagenesia*, and *Plethogenesia* possess two-segmented maxillary palpi, and all have some development of the posterodistal angle of each tibiae of the fore legs into a distal process. Gill 1 is single in at least *Plethogenesia* and *Cheirogenesia*, and the tibial process of the hind legs is rounded apically

in these genera. The general facies of *Chankagenesia*, *Anagenesia*, *Cheirogenesia* and *Plethogenesia* are similar, particularly regarding cephalic and fore leg armature.

More definitive theories of evolutionary inter-relationships are not possible until adequate comparative material is available for study, and is further dependent on the consideration of adult characterization among palingeniid genera. Moreover, the study of *Pentagenia* in relation to the other genera will be an important key to understanding phylogeny since it ties the Palingeniidae directly to an evolutionary origin within the Ephemeridae (McCafferty, 1973, 1976). Consideration of the classificatory status of *Pentagenia* within the Palingeniidae will be taken up by us elsewhere.

Cheirogenesia decaryi (Navas)

Anagenesia decaryi Navas, 1926, 99. Holotype-male adult, Madagascar (other locality data not known), (Paris Museum) [not examined].

Cheirogenesia decaryi (Navas) Demoulin, 1952, 6.

Fontainica josettae McCafferty, 1968, 293. Holotype-larva, Madagascar, Antsampandrano, 150 km au sud de Tananarive, 2000 m d'altitude, 25.vii.58, F. Starmühlner (Paris Museum) [examined].
syn.n.

Larva (Fig. 1)

Length. Body 20–23 mm, caudal filaments 6.8–7.5 mm. General body colour ash brown patterned dorsally, pale ventrally, with pale yellow to burnt gold setae and spurs. Frontal process (Figs. 1 and 2) pale with dark brown anterior spines, sparsely setiferous below primarily in lateral two-thirds. Head capsule (Figs. 1 and 2) densely setiferous anterior to compound eyes and sparsely setiferous anterior to epicranial arms and posterior to base of frontal process; distinct colour pattern dorsally consisting of brown area between compound eyes and extending anteriorly to base of frontal process, lighter brown posteriorly and dark brown anteriorly with dark spot medially at base of frontal process, dorsal areas in front of compound eyes pale.

Pronotum (Fig. 1) constricted in anterior third, approximately width of head, setiferous laterally, bordered with light brown laterally and ash brown posteriorly, brown anteriorly with pair of indented, pale, semi-circular streaks; anterior pigmented area continuing posteriorly as pair of short attenuated marks sublaterally and pair of longer attenuated marks submedially. Mesonotum with complex pattern of ash brown on pale background as in Fig. 1. Legs (Figs. 1, 8 and 9) without distinct colour patterns, generally heavily setiferous laterally.

Dorsal abdominal colour pattern as in Fig. 12, generally ash brown with distinct submedian pair of pale, longitudinally oriented dashes on terga 4–9 (also on terga 1–3 in younger larvae); brown becoming faint to absent at anterolateral corners of terga 3–7. Anterior lamellar branches of gills 2–7 (Figs. 1 and 11) with thick, dark tracheal streak in basal third and continuing distally to apices as only thin dark line.

Discussion

The paucity of information on palingeniid species in the larval stage precludes any comparative

specific diagnosis. We expect, however, that colour pattern will be of some importance as it is in most mayfly species. It should be noted that Fontaine (1968) studied a male imago of *Cheirogenesia* from Madagascar but could not positively confirm its identity as *C. decaryi*, and suggested that it may represent an additional species of *Cheirogenesia*. Demoulin (1970) in his treatment of Ethiopian and Madagascar Ephemeroptera continued to treat *Cheirogenesia* as monospecific. Because of Fontaine's observations, however, there remains the remote possibility that the species described herein may be assignable to a *Cheirogenesia* species other than *C. decaryi*.

Bionomics

Cheirogenesia were found at only a single locality, at the bridge where the highway from Tananarive to Tamatave (R.N. 2) crosses the Mangoro (or Mongoro) River. The larvae were collected by stirring up rather soft silt near the river margin where the current was very slow. All of the suitable habitat available had to be worked carefully to secure the twelve specimens. The water temperature was 26°C. The Mangoro is a large silty river with a number of very large boulders forming a partial dike at the bridge site. The only other mayflies found in the river at the site were the ubiquitous larvae of *Elassoneuria* and *Tricorythus* which were found on the boulders. The larva described by Fontaine (1968) was collected with larvae of *Probosciodplocia* in the same type of habitat where we collected *Probosciodplocia* at eight separate stations. The Mangoro site was strikingly different from the type of habitat where we found *Probosciodplocia*, however.

None of the specimens were in the last larval instar, although two of them showed well developed convoluted wings within the wing pads. The known emergence dates for *Cheirogenesia* are April and February. Severe rain prevented any attempt to collect adults at the time larvae were taken. Mr Emmanuel has promised to return to the site to seek more mature larvae and the adults. Between 10 October and 8 November we collected and reared mayflies at thirty localities in Tananarive, Tamatave, Diego Suarez and Fianarantsoa Provinces of Madagascar. At least two other localities appeared suitable for *Cheirogenesia* but we failed to find larvae.

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