

10

Chapter 7

Three New Species of Baetidae (Ephemeroptera) from the Réserve Naturelle Intégrale d'Andohahela, Madagascar

Jean-Luc Gattolliat,¹ Michel Sartori,¹ and Jean-Marc Elouard²

Abstract

Two new species of *Afroptilum* (Ephemeroptera: Baetidae) are described from the imaginal stage and for one species of *Dabulamanzia* (Ephemeroptera: Baetidae) from the nymphal and imaginal stages from the Réserve Naturelle Intégrale d'Andohahela. Affinities and ecology are discussed.

Résumé

Deux nouvelles espèces d'*Afroptilum* (Ephemeroptera: Baetidae) de la Réserve Naturelle Intégrale d'Andohahela sont décrites à partir des imagos et une espèce de *Dabulamanzia* (Ephemeroptera: Baetidae) à partir de la larve et de l'imago. Leurs affinités et leur écologie sont discutées.

Introduction

Very few taxonomic works have been carried out on Malagasy Baetidae. Eleven species belonging to five genera have been described to date.

Over the course of the past 6 years, a program organized by the Office de la Recherche Scientifique et Technique Outre-mer (ORSTOM) and Centre National de la Recherche Scientifique (CNRE) entitled "Biotypologie et biodiversité des eaux continentales malgaches" has sought to add information on the organisms inhabiting freshwater ecosystems in Madagascar. We currently estimate that 40 baetid species occur on the island.

Three new species from the Réserve Naturelle Intégrale (RNI) d'Andohahela are discussed in this paper. Two of these species are placed in the

genus *Afroptilum* Gillies, 1990, based on the forewing venational pattern, especially the presence of single intercalary veins and two spurs on the hindwings (Gillies, 1990). These two species differ from species of *Centroptilum* Eaton, 1869, in the shape of the second and third segments of the forceps, the second segment becoming narrower at the apex and the third elongated instead of globular, as in *Centroptilum* (Gillies, 1990), and in the lack of a prominent median spine between the gonopod bases (McCafferty & Waltz, 1990). Generic attribution is provisional because knowledge of the nymphal stage is limited; such information might be helpful in understanding the relationships of these two species. The third species is placed in the genus *Dabulamanzia* Lugo-Ortiz and McCafferty, 1996. This generic allocation is justified because the larval stage has a bulbous labial segment 3 and proximal arc setae on the tibia. Furthermore, at the imaginal stage the hindwings have a hooked spur and three longitu-

¹ Musée Cantonal de Zoologie, CP 448, CH-1000, Lausanne 17, Switzerland.

² ORSTOM, BP 434, Antananarivo (101), Madagascar.

GATTOLLIAT ET AL.: BAETIDAE

Fonds Documentaire ORSTOM 115

Cote: Bx 21241 Ex: unique

Fonds Documentaire IRD



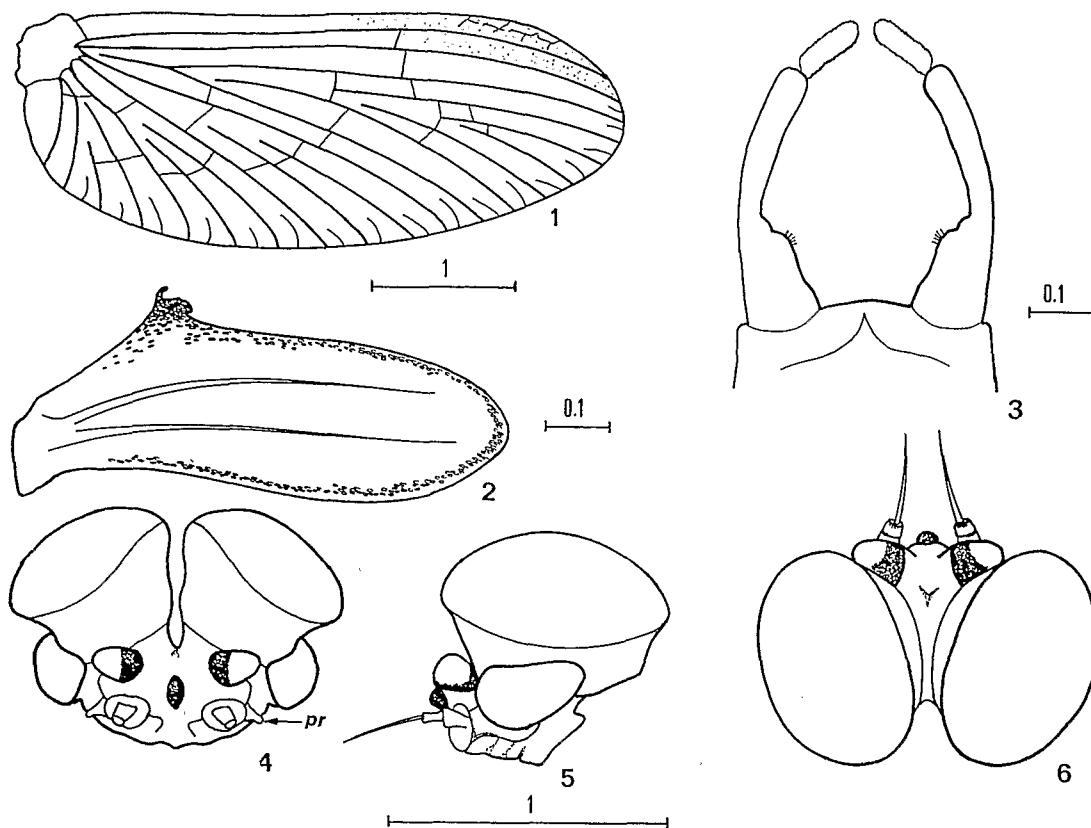
forest are the distribution in the

roboscido- id close to bly due to h provides ic material tes located its imment from the anihy, and anisms are forests of tinued ex-

11 of the des eaux by CNRE ed through oopération oratoire de es et leur and assis- inistère de loppement ble to our t with the tu.

Proboscido- Polymitar- M. Sartori, gy, ecology

OOLOGY



FIGS. 7-1 through 7-6. *Afroptilum mathildae*, new species; male imago. (1) forewing, (2) hindwing, (3) genitalia, (4) head in frontal view (pr = process), (5) head in lateral view, (6) head in dorsal view. Scales are in millimeters.

dinal veins, and the male genitalia gonopods have a basomedial projection on segment 2 (Lugo-Ortiz & McCafferty, 1996). A major systematic revision of African Baetidae is about to be completed (McCafferty, pers. comm.).

The holotypes and part of the paratype series are housed in the Musée Cantonal de Zoologie, Lausanne, Switzerland. Other paratypes are deposited in the Museum National d'Histoire Naturelle (MNHN), Paris, and CNRE, Antananarivo.

Descriptions

Afroptilum mathildae Gattolliat & Sartori, new species (Figs. 7-1 to 7-6)

Male Imago

BODY LENGTH (WITHOUT CAUDAL FILAMENTS)—4.7 mm (4.3–5.2).

HEAD—Width, 1.0 mm. Uniform light brown with a dark brown trapezoid figure between compound eyes (Fig. 7-6). Turbinate eyes uniformly dark brown–purple, well separated and becoming narrower posteriorly (Fig. 7-5). Well-marked process lateral to each antenna (Fig. 7-4). Antennae uniformly pale cream.

THORAX—Light brown with only margins of sclerites darker brown.

FOREWINGS—Mean length, 4.8 mm (4.4–5.4); mean width, 1.9 mm (1.7–2.2); length/width ratio, 2.5. Membrane opaque except distal third of costal area light gray. Pterostigma with four to six horizontal and vertical cross-veins. One intercalary vein between longitudinal veins except between subcostal and first radial veins (Fig. 7-1).

HINDWINGS—Mean length, 0.8 mm (0.7–0.9); mean width, 0.2 mm (0.2–0.3); length/width ratio, 3.2. Fore- to hindwing ratio, 6.2. Membrane hyaline with micropores near margin resembling a black border. Two prominent longitudinal veins

TABLE 7-1
mathildae, new

P1
P2
P3

joined at base of upper clear
LEGS—Lengths a
ABDOMEN
double black
length.

GENITALIA
mentation b
well differ
0.4 mm; the
larger than
apical marg
grooved (F

Examined

HOLOTYPE
April 199
River, loca
STOM sta
47°05'02"E

PARATYPE
405-12, an
Basin, Ant
St89-17, M
m. Fifty m
Antorendri
Belavenok
24°50'18"S

OTHER
gos (nos. 8
re Basin,
46°18'30"N
9), 15 Apr
of Manan
01, Mada
72 m. One
1995, Ma
locality
46°49'19"N
548-8), 25

TABLE 7-1. Measurements (mm) of *Afroptilum mathildae*, new species.

	Femur	Tibia	Tarsus and claw
P1	0.80	1.58	1.21
P2	0.73	0.95	0.42
P3	0.73	0.89	0.42

joined at base. Costal projection with two spurs, upper clearly thinner than lower (Fig. 7-2).

LEGS—Light brown without markings. Measurements are presented in Table 7-1.

ABDOMEN—Pale cream, each segment with a double black lateral line that widens at two-thirds length.

GENITALIA—Three-segmented gonopods, segmentation between first and second segment not well differentiated. Length of segments 1 and 2, 0.4 mm; that of segment 3, 0.1 mm. First segment larger than others with a brush of setae on internal apical margin. Third segment elongated, slightly grooved (Fig. 7-3).

Examined Material

HOLOTYPE—One male imago (no. 405-11), 23 April 1995, Antorendrika Basin, Antorendrika River, locality Belavenoka, St89-17 (LRS/AE/OR-STOM station code; see Chapter 5), Madagascar, 47°05'02"E, 24°50'18"S, 20 m.

PARATYPES—Three male imagos (nos. 405-9, 405-12, and 405-18), 23 April 1995, Antorendrika Basin, Antorendrika River, locality Belavenoka, St89-17, Madagascar, 47°05'02"E, 24°50'18"S, 20 m. Fifty male imagos in alcohol, 23 April 1995, Antorendrika Basin, Antorendrika River, locality Belavenoka, St89-17, Madagascar, 47°05'02"E, 24°50'18"S, 20 m.

OTHER EXAMINED MATERIAL—Two male imagos (nos. 87-4 and 87-5), 13 April 1992, Mandrare Basin, Mandrare River, St12-03, Madagascar, 46°18'30"E, 24°13'18"S. One male imago (no. 91-9), 15 April 1992, Manampanihy Basin, tributary of Manampanihy River, locality Fenoevo, St41-01, Madagascar, 46°53'39"E, 24°41'00"E, altitude 72 m. One male imago (no. 526-6), 21 November 1995, Manampanihy Basin, Manampanihy River, locality Enosiary, St41-06, Madagascar, 46°49'19"E, 24°40'37"S. One male imago (no. 548-8), 29 November 1995, Manampanihy Basin,

Manampanihy River, locality Enosiary, St41-06, Madagascar, 46°49'19"E, 24°40'37"S, 100 m.

Ecology

This species has been found in rivers and streams flowing in woody savannah, steppe, and degraded forest areas. It has been captured with evening light traps, and with morning light traps in stations at low altitude. At one station it was the most abundant mayfly, with more than 200 male imagos caught in one evening.

Afroptilum gilberti Gattolliat & Sartori, new species (Figs. 7-7 to 7-12)

Male Imago

BODY LENGTH (WITHOUT CAUDAL FILAMENTS)—5.0 mm (4.7–5.2).

HEAD—Width, 1.2 mm. Light brown with a dark brown patch between compound eyes (Fig. 7-12) and brown marks on lower margin of carena between antennae (Fig. 7-10). Turbinate eyes light brown except dark brown base. Pale cream antennae with dark brown marks on segments 1, 2, and 3. Well-developed carena prolonged clearly below antennae (Fig. 7-11).

THORAX—Light brown, with only margin of sclerites darker brown.

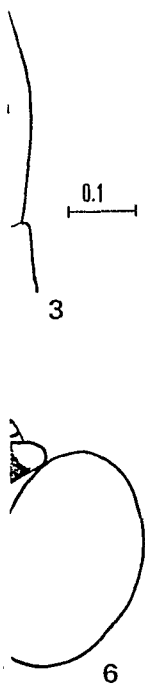
FOREWINGS—Mean length, 5.3 mm (5.1–5.9); mean width, 2.1 mm (2.0–2.1); length/width ratio, 2.5. Membrane opaque except apical third of costal region light gray. Pterostigma with three to seven vertical cross-veins. One intercalary vein between longitudinal veins except sometimes between subcostal, first, second, and third radial veins (Fig. 7-7).

HINDWINGS—Mean length, 0.9 mm (0.8–0.9); mean width, 0.3 mm (0.2–0.3); length/width ratio, 3.2. Fore- to hindwing ratio, 6.0. Membrane hyaline without micropores. Two longitudinal veins well marked and joined at the base. Two spurs clearly distinguishable (Fig. 7-8).

LEGS—Pale cream with brown marks on femora and tibiae. Measurements are presented in Table 7-2.

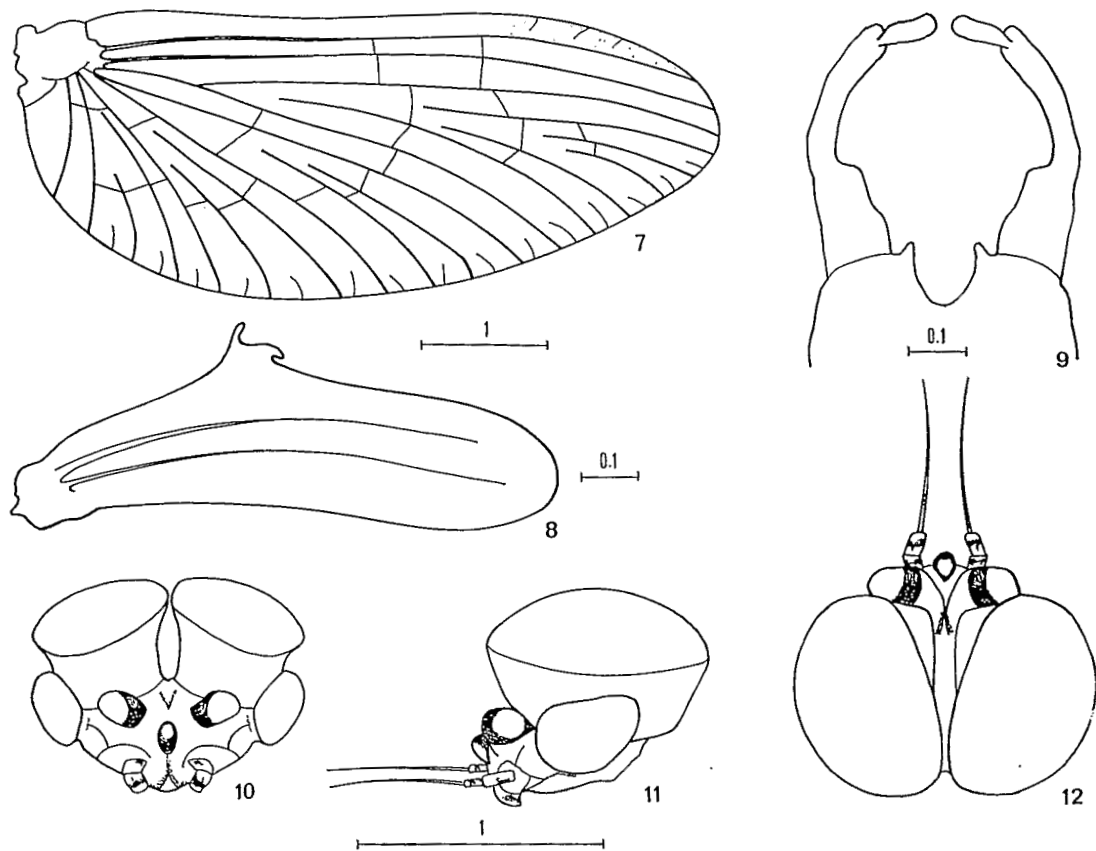
ABDOMEN—Pale cream, with a brown narrow line at distal margin of each segment and a black lateral patch in the middle of each segment.

GENITALIA—Three-segmented gonopods, segmentation between first and second segment bare-



3, (3) genitalia, in millimeters.

light brown between com- es uniformly and becoming -marked pro- 4). Antennae / margins of um (4.4–5.4); h/width ratio, third of cos- h four to six One interca- is except be- s (Fig. 7-1). um (0.7–0.9); h/width ratio, membrane hy- resembling a tudinal veins



FIGS. 7-7 through 7-12. *Afroptilum gilberti*, new species; male imago. (7) forewing, (8) hindwing, (9) genitalia, (10) head in frontal view, (11) head in lateral view, (12) head in dorsal view. Scales are in millimeters.

ly visible. Length of segment 1 and 2, 0.4 mm; segment 3, 0.1 mm. First segment very large becoming narrow only at apex, with an apophysis at base (Fig. 7-9). Third segment elongated, unstreaked.

Examined Material

HOLOTYPE—One male imago (no. 546-3), 27 November 1995, Manampanihy Basin, Andrano-

TABLE 7-2. Measurements (mm) of *Afroptilum gilberti*, new species.

	Femur	Tibia	Tarsus and claw
P1	1.02	2.05	1.84
P2	0.82	1.21	0.53
P3	0.79	1.16	0.49

hela River, locality camp 2 (see Chapter 1), St41-12, Madagascar, 46°44'25"E, 24°35'47"S, 810 m.

PARATYPES—One male imago (no. 91-6), 15 April 1992, Manampanihy Basin, tributary of Manampanihy River, locality Fenoovo, St41-01, Madagascar, 46°53'39"E, 24°41'00"S, 72 m.

OTHER MATERIAL—One male imago (no. 341-13), 3 June 1994, Mandrare Basin, Marotoko River, locality 2 km from Mananara, St12-20, Madagascar, 46°38'50"E, 24°44'02"S, 275 m. One male imago (no. 525-7), 20 November 1995, Efafo Basin, Ambahibe River, locality Isaka-Ivondro, St89-05, Madagascar, 46°51'53"E, 24°46'47"S, 70 m.

Ecology

This species has been found in a variety of ecological settings from flowing streams in intact humid forest to degraded forest, and at mid- to low



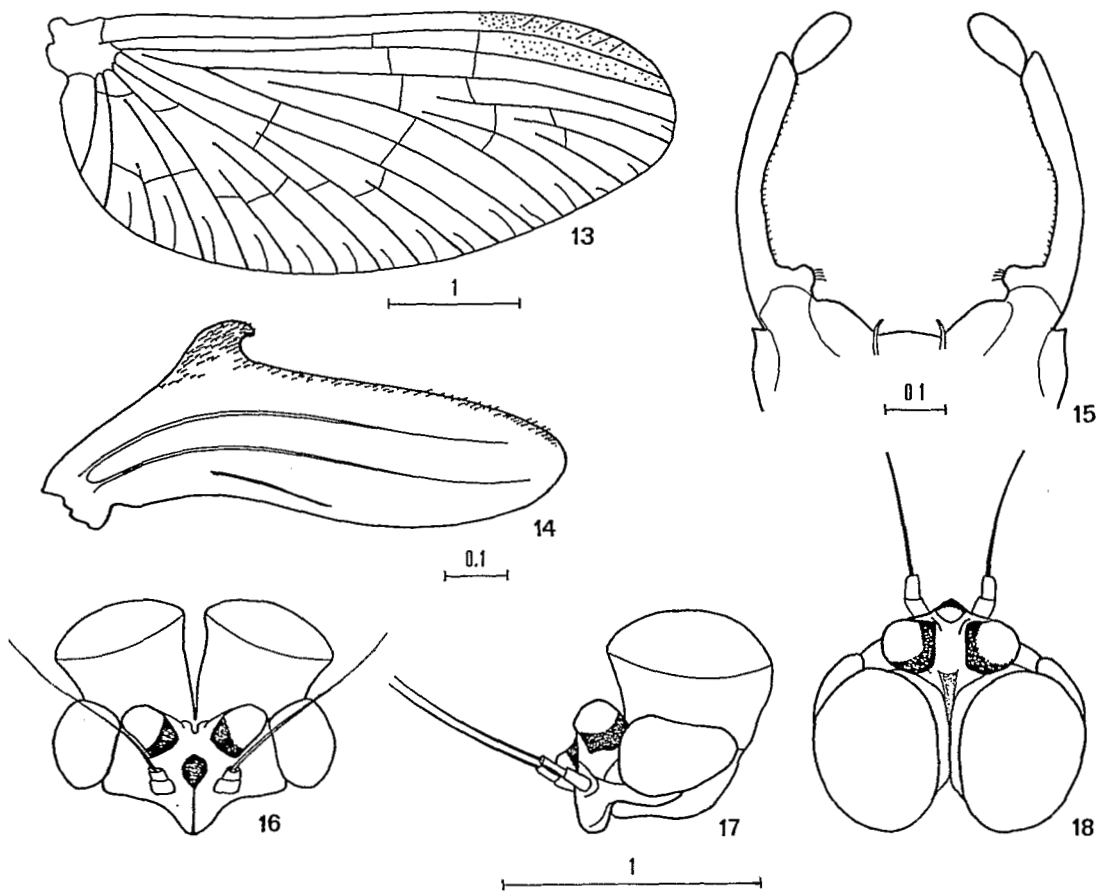
FIGS. 7-1 genitalia, (16)

elevations the eveni: parently r to the RN certainly the ensui ecosystem

Dabular new sp

Male Im

BODY 5.0 mm HEAD- dark br binate e ange (b



FIGS. 7-13 through 7-18. *Dabulamanzia duci* new species; male imago. (13) forewing, (14) hindwing, (15) genitalia, (16) head in frontal view, (17) head in lateral view, (18) head in dorsal view. Scales are in millimeters.

elevations. It was seldomly captured, and only in the evening with light traps. The species is apparently rare and has been found only in or close to the RNI d'Andohahela (Fig. 7-31). It is almost certainly very sensitive to forest destruction and the ensuing ecological changes within the stream ecosystem.

***Dabulamanzia duci* Gattolliat & Elouard, new species (Figs. 7-13 to 7-28)**

Male Imago

BODY LENGTH (WITHOUT CAUDAL FILAMENTS)—5.0 mm (4.8–5.6).

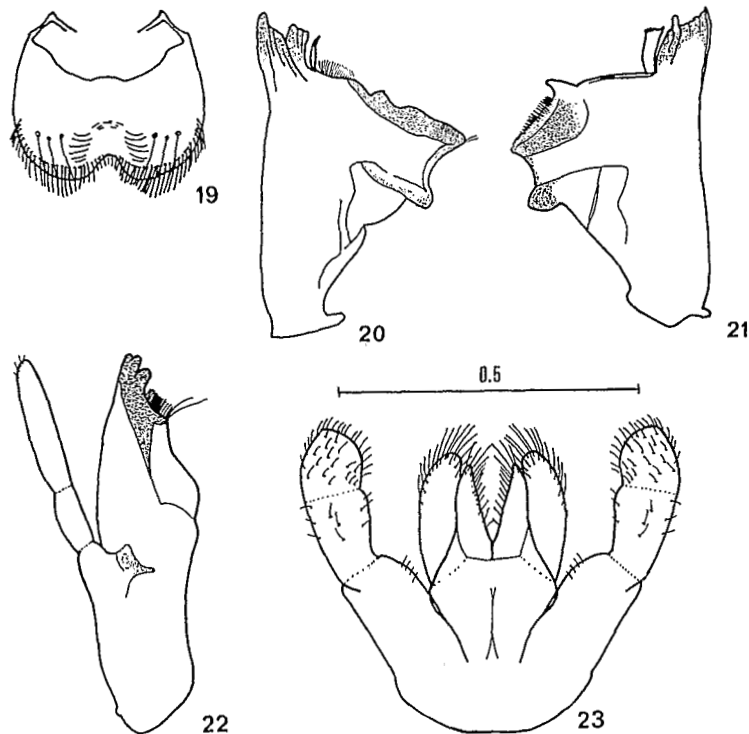
HEAD—Width, 1.1 mm. Light brown with a dark brown patch between lateral ocelli and turbinate eyes (Fig. 7-18). Turbinate eyes deep orange (becoming honey-brown after preservation

and storage in alcohol), subcylindrical. Stout carena between antennae (height of carena equals distance between antennae; Fig. 7-17). Flagella of antennae quite long, but not always as long as shown in Figure 7-16. The peculiar shape of the head and the color of the eyes are typical of this species.

THORAX—Uniformly pale cream.

FOREWINGS—Mean length, 4.6 mm (4.0–5.0); mean width, 1.9 mm (1.6–2.1); length/width ratio, 2.4. Membrane opaque except apical third of costal region light gray. Pterostigma with five to seven vertical cross-veins. One intercalary vein between longitudinal veins except between subcostal and first radial veins and generally also between the second and third radial veins (Fig. 7-13).

HINDWINGS—Mean length, 0.8 mm (0.7–0.9); mean width, 0.2 mm (0.2–0.3); length/width ratio, 3.7. Fore- to hindwing ratio, 5.7. Membrane hy-



FIGS. 7-19 THROUGH 7-23. *Dabulamanzia duci*, new species; male nymph. (19) labrum, (20) right mandible, (21) left mandible, (22) right maxilla, (23) labium. Scale is in millimeters.

aline. Two longitudinal veins well-marked and generally joined at base, distinctly more prominent than the nonintersecting third vein. Costal projection with only one developed spur. Small teeth covering the whole outer margin of wings (Fig. 7-14).

LEGS—Pale cream without mark. Measurements are presented in Table 7-3.

ABDOMEN—Pale cream, with a brown, narrow, transverse line on posterior margin of each segment.

GENITALIA—Three-segmented gonopods, segmentation between first and second segments barely visible. Length of segments 1 and 2, 0.4 mm; segment 3, 0.05 mm. Second segment long, with a stout apophysis bearing a brush of setae, the inner margin covered with small teeth. Third segment ovoid and elongated (Fig. 7-15).

Female Imago

No significant differences in size or color compared to the male imago. The hindwings with their spur on the costal margin and the three longitu-

dinal veins are useful characters by which to recognize females of this species.

Nymph

BODY LENGTH (WITHOUT CAUDAL FILAMENTS)—5.6 mm.

MOUTHPARTS—Dorsal surface of labrum with fine setae along apical margin, three larger setae on each side and reaching the margin (Fig. 7-19). Canines of right mandible not fused, with very small teeth, a large brush of setae between canines and molars (Fig. 7-20). Canines of left mandible not fused (Fig. 7-21). Maxillary palpi two-segmented and as long as galea-lacinia, second segment elongated with a few fine setae at apex. Apical teeth of maxillae broad, brush of setae with two or three longer ones at inner margin, no sensory hair behind apical teeth (Fig. 7-22). Labial palpi stout and composed of three segments partially fused; setae covering third segment, scarce on first and second segments, and inner margin of second segment slightly convex distally. Glossae as long as paraglossae (Fig. 7-23).

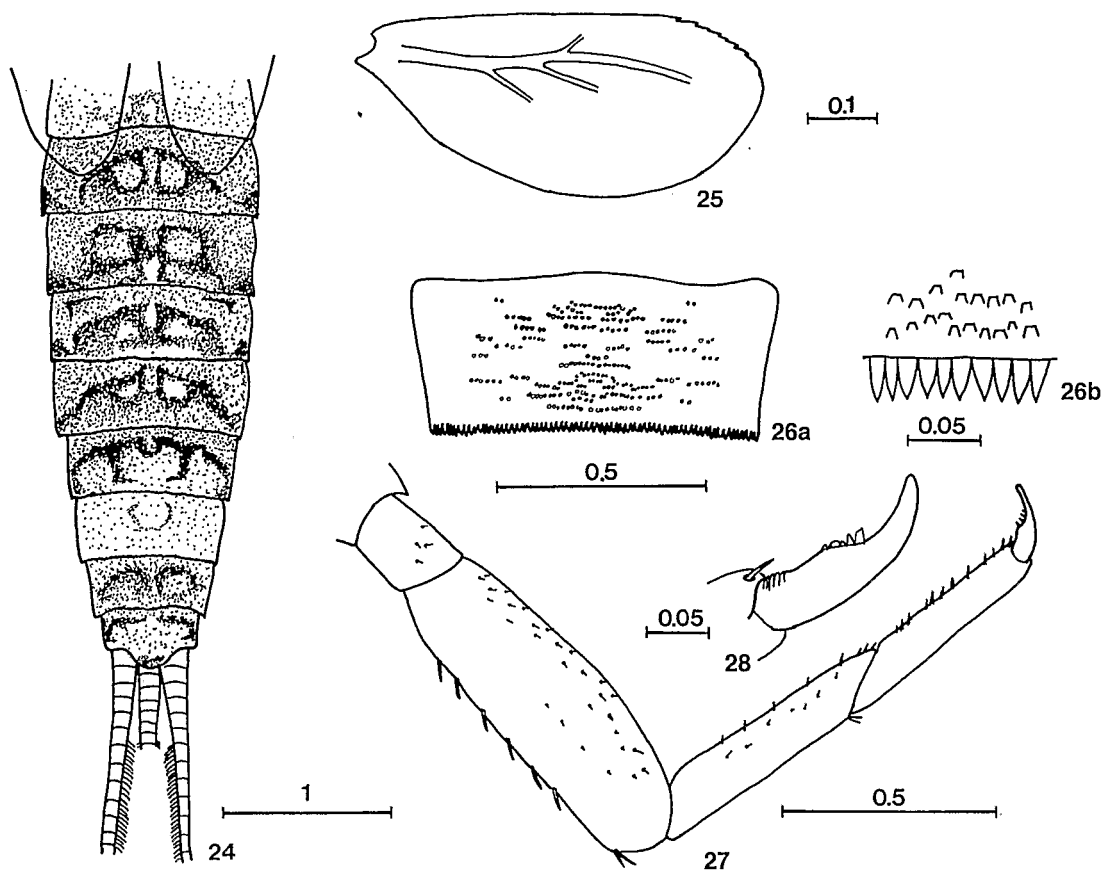


FIGS. 7-2 gill III, (26) (27b) claw

LEGS—margin ar face with patch of s like bristl at apex, ' 7-28c). T: with one ABDOM marks on

TABLE *duci*, new

P1
P2
P3



FIGS. 7-24 through 7-28. *Dabulamanzia duci*, new species; male nymph. (24) abdomen in dorsal view, (25) left gill III, (26a) segment VIII in dorsal view, (26b) posterior margin of segment VIII in dorsal view, (27a) left leg, (27b) claw on the left leg. Scale is in millimeters.

LEGS—Femora with six large bristles on outer margin and a couple of distal bristles, upper surface with scattered spine-like bristles; no femoral patch of setae. Tibiae with sparse scattered spine-like bristles on outer margin, a couple of bristles at apex, without a dorsal line of fine setae (Fig. 7-28c). Tarsi with a line of spine-like setae, claws with one row of about five teeth (Fig. 7-28d).

ABDOMEN—Light brown with dark brown marks on each segment (Fig. 7-24). Each segment

with scale bases and posterior margin with triangular spines longer than wide (Fig. 7-27a, b). Gills present on segments I–VII, asymmetrical and relatively elongated, serrated at apex, tracheation with few ramifications (Fig. 7-25). Presence of cerci and median filament (broken at one-quarter length of cerci), cerci with hair only on interior side, median filament hairs on both sides (Fig. 7-24).

TABLE 7-3. Measurements (mm) of *Dabulamanzia duci*, new species.

	Femur	Tibia	Tarsus and claw
P1	1.13	1.95	2.05
P2	0.84	1.05	0.62
P3	0.79	1.00	0.52

Examined Material

HOLOTYPE—One male imago (no. 525-5), 20 November 1995, Efaho Basin, Ambahibe River, locality Isaka-Ivondro, St89-05, Madagascar, 46°51'53"E, 24°46'47"S, 70 m.

PARATYPES—One male imago (no. 525-6), 20 April 1995, Efaho Basin, Ambahibe River, locality Isaka-Ivondro, St89-05, Madagascar, 46°51'53"E,

24°46'47"S, 70 m. One female imago and four males imagos (nos. 91-10, 91-2, 91-3, 91-4, and 91-5), 15 April 1992, Manampanihy Basin, tributary of Manampanihy River, locality Fenoevo, St41-01, Madagascar, 46°53'39"E, 24°41'00"S, 72 m. One nymphal exuvia with the corresponding male subimago (no. 339-31) and one male imago (no. 339-18), 2 June 1994, Mandrare Basin, Mananara River, locality Hazofotsy, St12-17, Madagascar, 46°35'46"E, 24°48'57"S, 100 m.

OTHER EXAMINED MATERIAL—One male imago (no. 90-8), 14 April 1992, Efaho Basin, Efaho River, locality Ifarantsa, St89-01, Madagascar, 46°52'12"E, 24°55'37"S, 20 m. One male imago (no. 341-12) and seven male individuals, 3 June 1994, Mandrare Basin, Marotoko River, locality 2 km after Mananara, St12-20, Madagascar, 46°38'50"E, 24°44'02"S, 275 m. Three male imagos (nos. 343-5, 343-6, and 343-7), 5 June 1994, Mandrare Basin, Manambolo River, locality 7 km from Berohanga, St12-22, Madagascar, 46°35'11"E, 24°35'07"S, 440 m. One male imago (no. 514-4), 19 October 1995, Rianila Basin, unnamed river, locality road to Lakato, St17-31, Madagascar, 48°21'48"E, 19°02'40"S, 1050 m. One male imago (no. 525-5), 20 November 1995, Efaho Basin, Ambahibe River, locality Isaka-Ivondro, St85-05, Madagascar, 46°51'53"E, 24°46'47"S, 70 m. One male imago (no. 569-1), 2 February 1996, Mandrare Basin, Sakamalio River, locality RNI d'Andohahela, St12-38, Madagascar, 46°40'56"E, 24°32'07"S, 750 m. Three male imagos (nos. 607-1, 607-2, and 607-3), 5 October 1996, Lokoho Basin, unnamed river, locality RNI d'Marojejy (Camp 1), St44-04, Madagascar, 49°46'18"E, 14°25'50"S, 500 m. Three male imagos (nos. 614-1, 614-2, and 614-3), 11 November 1996, Lokoho Basin, Manantenina River, locality RNI d'Marojejy (Camp 1), St44-03, Madagascar, 49°46'20"E, 14°26'02"S, 450 m. Two male imagos (nos. 619-2 and 619-3), one subimago male (no. 619-4), 13 October 1996, Lokoho Basin, Manantenina River, locality RNI d'Marojejy (Camp 1), St44-03, Madagascar, 49°46'20"E, 14°26'02"S, 450 m.

Ecology

Dabulmanzia duci is one of the most common and widespread species of Baetidae in southeastern and eastern Madagascar. It has been found from sea level to above 1000 m, in streams and rivers flowing in all types of vegetation, and in-

side and outside of the RNI d'Andohahela (Fig. 7-32). It was captured with evening and morning light traps, as well as with hand nets during the morning. The males fly in a quite peculiar manner: they apparently wait for the females in horizontal flight a few centimeters above flat stones or rocks.

Affinities

Only one related species has been described from Madagascar: *Afroptilum* (*Centroptilum*) *electropterum* (Demoulin, 1966). *Afroptilum mathildae* and *A. gilberti* differ from *A. electropterum* by the presence of two spurs on the hind wings (instead of one in *A. electropterum*), by the shape of the gonopods, and by the size and color of the turbinate eyes. *Dabulamanzia duci* differs from *A. electropterum* by the presence of three veins in the hindwings (only two in *A. electropterum*), the shape of the genitalia, and the color of the eyes (Demoulin, 1966).

Afroptilum mathildae and *A. gilberti* are much closer to *A. decipiens* subgenus *Afroptilum*, group *sudafricanum* Gillies, 1990, but the shape of the two spurs on the hindwings and especially the shape of the first and second segments of the gonopods are quite different. *Afroptilum gilberti* differs from *A. mathildae* by the color of the turbinate eyes, the presence of a carena between the antennae, and the absence of a brush of setae on the margin of the first segment of the gonopods.

Dabulamanzia duci is closer to *D. tarsale* (Gillies, 1990), previously assigned to the *tarsale* group of *Afroptilum*. However, *D. duci* differs from *D. tarsale* by eye color and by the shape of the third segment of the gonopods, which is shorter and more ovoid in *D. duci*. *Dabulamanzia duci* is also relatively similar in morphology to *D. babaora* (Wuillot & Gillies, 1993), except for differences in the shape and the size of the first segment of the gonopods. The nymph is also very similar to that of *D. babaora*, but the mandibles and the labial palpi are different. *Dabulamanzia duci* is easily distinguished from *D. fica* and *D. helenae* by the shape and number of teeth of the claws (Lugo-Ortiz & McCafferty, 1996). *Dabulamanzia duci* is easily distinguished from *A. mathildae* and *A. gilberti* by the shape of the head, the color of the eyes, the shape of the first segment of the gonopods, and especially by the number of longitudinal veins in the hindwings.

FIGS. 7-29
car. The gray
mathildae, (3

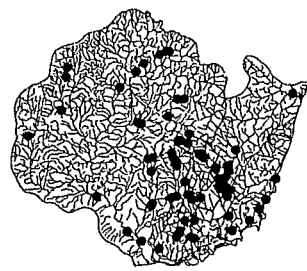
Discussio

The three
herein have
butions. *Af*
cies of low
ers (Fig. 7-
the eastern
opposite e:
in small a
bution is d
and it has
d'Andohal
pends con
tions and
forest. *De*
cies, found
eastern ar
areas with
(Fig. 7-3:
variety of
gered by
cies of 1
years in :

ela (Fig. morning iring the iar man- in hori- at stones

lescribed *optilum*) *roptilum electrop-* the hind-), by the ind color *si* differs of three *electrop-* the color

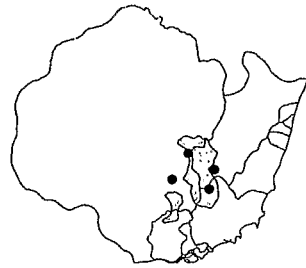
re much *m*, group e of the ally the the gon- *berti* dif- he turbi- between the setae on onopods. *sale* (Gil- *tarsale si* differs shape of is short- *nzia duci* to *D. ba-* t for dif- first seg- also very andibles *lamanzia a* and *D.* th of the). *Dabu-* from *A.* the head, first seg- the num- 5s.



29
Sampled stations



30
Afroptilum mathildae



31
Afroptilum gilberti



32
Dabulamanzia duci

FIGS. 7-29 THROUGH 7-32. Distribution of some *Afroptilum* and *Dabulamanzia* in basins of southeastern Madagascar. The gray area delimits parcels 1 and 2 of the RNI d'Andohahela. (29) sampled stations, (30) distribution of *A. mathildae*, (31) distribution of *A. gilberti*, (32) distribution of *D. duci*.

Discussion

The three new species of Baetidae described herein have different spatial and ecological distributions. *Afroptilum mathildae* is typically a species of low altitude, locally abundant in large rivers (Fig. 7-30). Its presence in other basins along the eastern coast needs to be confirmed. At the opposite extreme is *A. gilberti*, a species that lives in small and well-oxygenated streams; its distribution is directly related to the presence of forest, and it has been found only in or around the RNI d'Andohahela (Fig. 7-31). Its future existence depends completely on these environmental conditions and consequently on the preservation of the forest. *Dabulamanzia duci* is a widespread species, found in large and small streams along the eastern and southeastern coasts. It is known from areas within and outside of the RNI d'Andohahela (Fig. 7-32). Owing to its capacity to thrive in a variety of environments, this species is not endangered by forest degradation. At least 15 new species of Baetidae have been collected in recent years in southeastern Madagascar. Descriptions of

these animals and information on their ecology will be the subject of future articles.

Acknowledgments

This study represents contribution no. 12 of the "Biotypologie et biodiversité des eaux continentales malgaches" project, run jointly by CNRE and ORSTOM. The program is financed through the French Fonds d'Aide et de Coopération (FAC). We thank our colleagues at Laboratoire de Recherche sur les Systèmes Aquatiques et leur Environnement (LRSAE) for their help and assistance. We are deeply indebted to the Ministère de la Recherche Appliquée au Développement (MRAD) for the facilities made available for our research program. The text of a previous version of this chapter was substantially improved by comments by Steve Goodman and an anonymous reviewer.

Literature Cited

- DEMOULIN, G. 1966. Quelques Ephéméroptères nouveaux de Madagascar. *Annales de la Société Entomologique de France, nouv. séries* 2(3): 711-717.
- GILLIES, M. T. 1990. A revision of the African species of *Centroptilum* Eaton (Baetidae, Ephemeroptera). *Aquatic Insects*, 12(2): 97-128.
- LUGO-ORTIZ, C. R., AND W. P. McCAFFERTY. 1996. The composition of *Dabulamanzia*, a new genus of Afrotropical Baetidae (Ephemeroptera), with descriptions of two new species. *Bulletin Société Histoire Naturelle, Toulouse*, 132: 7-13.
- MCCAFFERTY, W. P., AND R. D. WALTZ. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. *Transactions of the American Entomological Society*, 116(4): 769-799.
- WUILLOT, J., AND M. T. GILLIES. 1993. New species of *Afroptilum* (Baetidae, Ephemeroptera) from West Africa. *Revue d'Hydrobiologie Tropicale*, 26(4): 269-277.

Chapt

Aquat
(Dipte
Intégr

Théogèr

Th
insid
were

Le
situé
espè

Introd

The
Madaga
their ori
Naturel
prises fi
the Efa
Manam
region¹
primary
as muc
contain
vegetat
tains is
natural
and hu
and 2)
versan

¹ Lal
tiques
tanana

PILA

FIELDIANA

Zoology

NEW SERIES, NO. 94

**A Floral and Faunal Inventory of the
Réserve Naturelle Intégrale d'Andohahela,
Madagascar: With Reference to
Elevational Variation**

Steven M. Goodman, Editor

June 30, 1999
Publication 1503

PUBLISHED BY FIELD MUSEUM OF NATURAL HISTORY