A new family, Coryphoridae (Ephemeroptera: Ephemerelloidea),
and description of the winged and egg stages of Coryphorus

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ABSTRACT. A new family Coryphoridae is proposed in the superfamily Ephemerelloidea for the monotypic genus Coryphorus. Characters that distinguish Coryphoridae from all other Ephemerelloidea are discussed. The male imago, male subimago, female imago, and egg of Coryphorus aquilus Peters are described for the first time.

RESUMEN. Se propone a Coryphoridae como una nueva familia de Ephemerelloidea para el género monotípico Coryphorus. Se discuten los caracteres que distinguen a Coryphoridae del resto de los Ephemerelloidea. Se describen por primera vez el imago macho, subimago macho, imago hembra y huevo de Coryphorus aquilus Peters.

Key words. Coryphorus, Coryphoridae, Leptohyphidae, Ephemerelloidea, Ephemeroptera, South America

Introduction

The genus Coryphorus was originally described by Peters (1981) in the Machadorythinae (Tricorythidae) for the type species C. aquilus Peters which was known only from the nymph. Machadorythinae were, at this time, a monotypic African subfamily of Tricorythidae, known from the nymphs of Machadorthus palanquim Demoulin (1959). Coryphorus was associated with Machadorthus by the following characters: eyes large and elevated above vertex, pedicel of antennae thick and long, and pronotum with a posteromedian tubercle. Further, the fusion of glossae and paraglossae in Coryphorus also occurred in Machadorythinae.

In 1989 Elouard and Gillies reported that Tricorythus maculatus Kimmins, 1949, was the adult of Machadorthus palanquim, creating a new combination Machadorthus maculatus. Because the adults of Machadorthus had the derived wing character of Tricorythidae and developing wings in nymphs of Coryphorus lacked this character, Peters and Peters (1993) transferred Coryphorus to Leptohyphidae based on other nymphal characters of mouthparts, although the taxonomic position of Coryphorus could only be clarified when the adult was known (Peters and Peters 1993, McCafferty and Wang 2000).

We recently collected three specimens of the winged stages of Coryphorus aquilus in Colombia. Although not reared, the specimens were associated with Coryphorus based on the unique wing venation, the color patterns of wings and legs, and the position of the gill bases: remnants of gill bases 2-5 matching the position of those on the Coryphorus nymph are visible on the male subimago and to a lesser degree on the imago (Fig. 9). In addition, the posterior margin of the prothorax of the male is elevated and a possible remnant of the nymphal dorsal ridge on tergum 6 is visible in the female. In this paper, we describe the male imago, female imago, male subimago, and egg of Coryphorus.

McCafferty and Wang (2000) suggested that Coryphorus might be treated as a separate subfamily within the Leptohyphidae. However, these authors could not find autapomorphies exclusive to Leptohyphidae (without Coryphorus) based only on the described nymph. The discovery of the imago
Coryphoridae NEW FAMILY is established for the monotypic genus Coryphorus. We establish Coryphoridae because of several autapomorphies which include the loss of cubital intercalaries in male and female adults, the reduced, desclerotized forceps located near the apex of a small distally produced male styliger plate, and the extreme reduction of labial palpal segments two and three in the nymph. The claw condition of the male imago is plesiomorphic. Members of the Leptohyphidae from North and Central America were recently divided into two subfamilies, Leptohyphinae and Tricorythodinae by Wiersema and McCafferty (2000). All species of both subfamilies of Leptohyphidae have similar foreclaws on male imagos.

The foreclaw character needs further explanation. Dissimilar foreclaws occur in imagos of all Ephemerelloidea except Leptohyphidae, all subimagos of the superfamily, and possibly some species of Ephemerithys. Although Gillies (1960) reported similar foreclaws for Ephemerithys, examined male imagos of E. pictus Gillies and E. kiboensis Gillies have dissimilar foreclaws. In all Leptohyphidae, male subimagos with dissimilar foreclaws molt to male imagos with similar foreclaws. Some confusion exists in the literature, as Traver (1959) reported dissimilar foreclaws for the holotype subimago of Tricorythodes arequita Traver, and Domínguez (1984) reported dissimilar foreclaws for the holotype subimago of Haplohyphes baritu Domínguez (erroneously listed as an imago in publication). Imagos of these species examined by the senior author have similar claws.

Apomorphic characters such as the fused penes and 2-segmented forceps are found throughout the superfamily, as are many plesiomorphic characters (for example 4-segmented tarsi). The undivided eyes are probably apomorphic as they are characteristic of most Leptohyphidae, Diceromyzonidae, Ephemerithyidae, and Tricorythidae. Nymphs of Coryphorus have a “gill basket” composed of dorsally expanded abdominal terga as do nympha of Machadorythus, but this structure is composed of abdominal terga 3-6 in Coryphorus and terga 3-7 in Machadorythus, and the gill structure is different (Peters 1981, Elouard and Gillies 1989). This and other characters cited by Peters 1981 (elevated eyes and antennae, tubercles on the head) are presumed homoplasies for Coryphorus and Machadorythus as they reoccur in different forms in both genera (and in many families of Ephemeroptera). The fusion of the glossae and paraglossae is also considered to be independently evolved in Coryphorus and Machadorythus because of the different shape of the fused labium (Kluge 2000).
Figures 1-9. Male imago of *Coryphorus aquilus*. 1-3, legs: 1, foreleg; 2, foreclaw; 3, tarsi of metathoracic leg. 4-6, genitalia: 4, lateral; 5, detail of forceps; 6, ventral. 7, dorsal view of head and prothorax. 8, forewing (concave veins stippled). 9, abdominal terga 1-10.
**Egg.** Length 240-310 μm; width 80-100 μm; with small, basal polar cap. Chorion as in Fig. 10-12; micropyle under chorionic ridge near base of egg.

**Discussion.** The longitudinal suture of the latero-postnotum is straight as described by Kluge (1992) for *Tricorythodes cubensis* Kluge and Naranjo, the posterior notal protuberances are slightly divergent posteriorly, and the medioparapsidal and lateroparapsidal sutures do not meet anterior to the transverse interscutal suture. The ventral nerve cord is visible in the male subimago as one ganglion in the mesothorax and 6 ganglia in abdominal sterna 1-5, but in the male imago these ganglia are fused in sterna 1-5 into a single undefined nerve band without visible connectives (nerve cord not visible in female).

Both forefemora of the male are curved (Fig. 1), apparently to fit around the enlarged eyes. In the male subimago, the forefemora are straight. Because only one male imago is available, we do not know if this character occurs in other specimens. For the same reason, we cannot be sure if the structure at the apex of the foretibia (Fig. 1) represents a modification of the tibia or partial fusion of a tarsal segment.

Imagos of *Coryphorus* can be distinguished from all genera of the Ephemerelloidea by the following combination of characters: 1) absence of intercalaries in the cubital field of forewing (Fig. 8); 2) setae present on posterior margin of forewing (Fig. 8); 3) male with large, fused, distally broadened penes and short desclerotized forceps (Figs. 4-6); 4) styliger plate of male produced distally, about as long as wide (Fig. 6); 5) ninth sternum of female broad, not extended; 6) eyes of male undivided, separated, greatly enlarged (Fig. 7). *Coryphorus* is distinguished from Neotropical Leptohyphidae by the same characters (except for wing setae and undivided male eyes) and by the dissimilar foreclaws of the male imago.

Within the Neotropics, *Leptohyphodes inanis* (Pictet), originally described from two specimens, is reported to have large eyes nearly meeting on the meson of head (Ulmer 1921) so the character “large eyes” is frequently used in keys to imagos (for example Traver 1958, Dominguez et al. 1992). *Coryphorus* is easily distinguished from *Leptohyphodes* by the lateral position of the large eyes in *Coryphorus* and other characters given above; also, the eyes of *Leptohyphodes* are divided into dorsal and ventral portions and those of *Coryphorus* are not.

**Coryphorus aquilus** Peters (Figures 1-12)

*Coryphorus aquilus* Peters, 1981:211.

**Description.** Male imago (in alcohol). Body length (head to apex of tergum 10) 5.5 mm; forewing 5.3 mm; (caudal filaments broken and missing). Total width of eyes and head 1.85 mm; head pale yellowish-brown, with dark brown marks on meson of head between eyes (Fig. 7); eyes black; base of lateral ocelli black, antennae hyaline (Fig. 7). Prothorax pale yellowish-brown, with darker brown marks dorsally as in Fig. 7; mesothorax light brown, darker dorsally, with blackish-brown mark between posterior scutal protuberances and a pair of lateral blackish marks on mesoscutum near base of wing. Longitudinal and cross veins of forewings deep gray, except apically hyaline in vein MP, and veins of cubital and anal area; forewing membrane dark gray basally and in cells C and Sc, faded in stigmatic area, lighter gray in radial cells, and pale gray.
fading to hyaline in posterior half of wing (Fig. 8). Legs: measurements (in mm) of femur, tibia, tarsus: leg I -- 0.96, 1.44, 0.67; leg II -- 0.96, 0.80, 0.53; leg III -- 1.12, 0.83, 0.48; coxae and trochanters of all legs pale yellowish-brown; femora whitish with heavy blackish marks near apex and with smaller blackish streaks dorsally as in Fig. 1 (also as in Peters 1981, Fig. 29-31, legs of nymph); all tibiae whitish with a fine blackish streaks at base and middle, and prothoracic tibiae with yellowish-brown apex (possible fused 1st tarsal segment); tarsi and claws pale with hooked portion of claws brownish and with blackish mark on basal segment of tarsi of meso- and metathoracic legs. Abdominal terga (Fig. 9) whitish, terga 1-3 and 6-8 with submedian blackish-brown marks dorsally, marks small on terga 3, 6-8; terga 4-5 without marks; posterior portion of tergum 8, 9 and middle of tergum 10 washed with reddish-brown; no visible spiracular marks but lateral margins of terga lightly washed with gray; sterna whitish, sterna with small narrow median grayish line posteriorly, sterna 5-8 reddish-brown at lateral margins. Bases of cerci and terminal filament hyaline.

Male subimago. Body length 5.1 mm; forewing 5.3 mm; cerci 3.0 mm; terminal filament 2.5 mm. Characters of male imago, except forelegs short, head and thorax paler, marks of abdomen less extensive and distinct and small blackish sublateral marks on tergum 9; sterna 2-9 with small paired anterosubmedian pale gray marks. Cerci showing developing imaginal cerci under exuviae, cerci hyaline at base and apex with median 2/3 dark gray; terminal filament similar but pale gray.

Female imago (in alcohol). Body length 3.7 mm (body somewhat shrunken); wing 6.4 mm, cercus 3.0 mm [other caudal filaments broken and missing]. Coloration of head and thorax as in male imago. Legs: measurements (in mm) of femur, tibia, tarsus: leg I broken and missing; leg II -- 1.12, 0.72, 0.43; leg III -- 1.20, 0.96, 0.56; marks on femora of all legs heavier and more extensive than in male, tibiae as in male, no marks on tarsi. Wing coloration as in male except gray color of membrane reduced; basal third of cells C and Sc dark gray, membrane at base of other longitudinal veins gray, color faded apically and posteriorly. Abdominal terga whitish washed with black, marks more extensive than in male but abdominal segments compressed so details not visible; abdominal sterna completely washed with gray, with darker poster-omedian mark on sterna 1-9; sterna 2-8 blackish-brown laterally. Cercus hyaline.

Egg (in alcohol). Yellowish-brown. All eggs were in a single clump with eggs extruded along the long axis and joined laterally.


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