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MYSTAXIOPS: A NEW GENUS OF SMALL MINNOW MAYFLIES (EPHEMEROPTERA: BAETIDAE) FROM PAPUA NEW GUINEA

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Abstract.—Newly discovered larvae of the mayfly family Baetidae in Papua New Guinea are described as ***Mystaxiops venatoris,* new genus and new species**. The new genus is shown to belong to a monophyletic, predatory subgroup of the *Centroptiloides* complex, which was previously known only from the Afrotropics. The labrum of the new genus is extremely produced into a friction pad, and other mouthpart characteristics also demonstrate adaptations for predation. Labial palps and hypopharynx are distinct from all other related genera. Functional morphology of mouthparts and historical biogeography are hypothesized.

Key Words: mayflies, Papua New Guinea, Baetidae, new genus

An unusual predatory subgroup of the Afrotropical *Centroptiloides* complex of the mayfly family Baetidae has been known to include the genera *Barnumus* McCafferty and Lugo-Ortiz (southern Africa), *Centroptiloides* Demoulin (eastern and southern Africa), *Guloptiloides* Gattolliat and Sartori (Madagascar), *Herbrossus* McCafferty and Lugo-Ortiz (Madagascar), and *Nesoptiloides* Demoulin (Madagascar). The *Centroptiloides* complex and this particular subgroup were first recognized and defined by Lugo-Ortiz and McCafferty (1998). The definition of the complex was more recently modified somewhat by McCafferty (2002). All known species of the subgroup containing the genera mentioned above are apparently predatory at least as mature larvae. Such larvae are all nearly 10 mm or more in body length (relatively large for lotic baetid species) and demonstrate certain specialized characteristics in common that set them apart from other genera of the *Centroptiloides* complex. These characteristics include, for example, a short, broad and thickened labrum; mandibles with more or less lateral convexity together with various degrees of setation in the basal half of the mandible; and heavily sclerotized and well-developed apical spines on the galealaciniae. The presence of highly developed spines of the galealaciniae is a common adaptive trait associated with predatory larvae in Ephemeroptera. The relative sharpness and development of mandibular incisors and reduction of the mola or its modification into a secondary incisor are also adaptive traits commonly associated with predation in Ephemeroptera, but they vary in degree of development among the genera of this predatory subgroup. Raptorial forelegs may or may not be variously developed in predatory mayflies, and this is also the case among this predatory subgroup of the *Centroptiloides* complex.

Recently we identified another member of this subgroup of predatory baetids from Papua New Guinea, which we describe herein. Significantly this discovery expands the known geographic range of the sub-

group and suggests a possible Gondwanan or East Gondwanan origin, with subsequent vicariance giving rise to the present-day, possibly relictual, distribution of the subgroup.

Mystaxiops McCafferty and Sun, new genus
(Figs. 1–10)

Larva.—*Head:* Labrum (Figs. 1, 8–9) broadly V-shaped at distal margin, considerably broader than long, extremely thickened dorsoventrally as best seen in lateral (Fig. 1) or ventral view of hypognathous head; lateral lobes curving somewhat posteriorly; distal expansive area of labrum forming shallow, inverted U-shaped friction pad (Fig. 8) as viewed ventrally; friction pad covered with simple hairlike setae and more marginally with pinnate hairlike setae with very small setules (Fig. 9). Lingua of hypopharynx (Fig. 2) with pronounced, narrow, parallel-sided medioapical lobe. Angulate and planate mandibles (Figs. 3–4) somewhat narrow-elongate, with lateral margins convex and with elongate patch of moderately long setae in basal half of lateral margin, and with only somewhat reduced mola and with one set of broadly based incisors (appearing fused for much of their length); tuft of setae on apical margin between prostheca and mola absent but area roughened with extremely small rudimentary armature detectable only at very high magnification; prostheca somewhat robust, more so on angulate mandible. Maxilla (Figs. 1, 5) with two-segmented maxillary palp extending beyond tip of galealacinia; inner medial subdistal hump of galealacinia with only single small seta. Segment 3 of labial palp (Fig. 6) broadly rounded and nearly as broad as long; segment 2 extremely broadened medially from base, at midlength nearly twice breadth of terminal segment, and with distinct medioapical, thumblike, subacute extension; glossae narrowing distally and considerably smaller than paraglossae. *Thorax:* Pronotum (Fig. 10) without lateral flanges. Forefemur (Fig. 10) broadened mostly in basal half, with smoothly convex ventral margin, and with only short, sparse setae dorsally. Claws with one strong row of denticles and one weaker row of denticles. *Abdomen:* Gills (Fig. 10) large and asymmetrically subovate; tracheation well developed. Caudal filaments with moderately well developed lateral swimming hairs; middle caudal filament nearly as long as cerci.

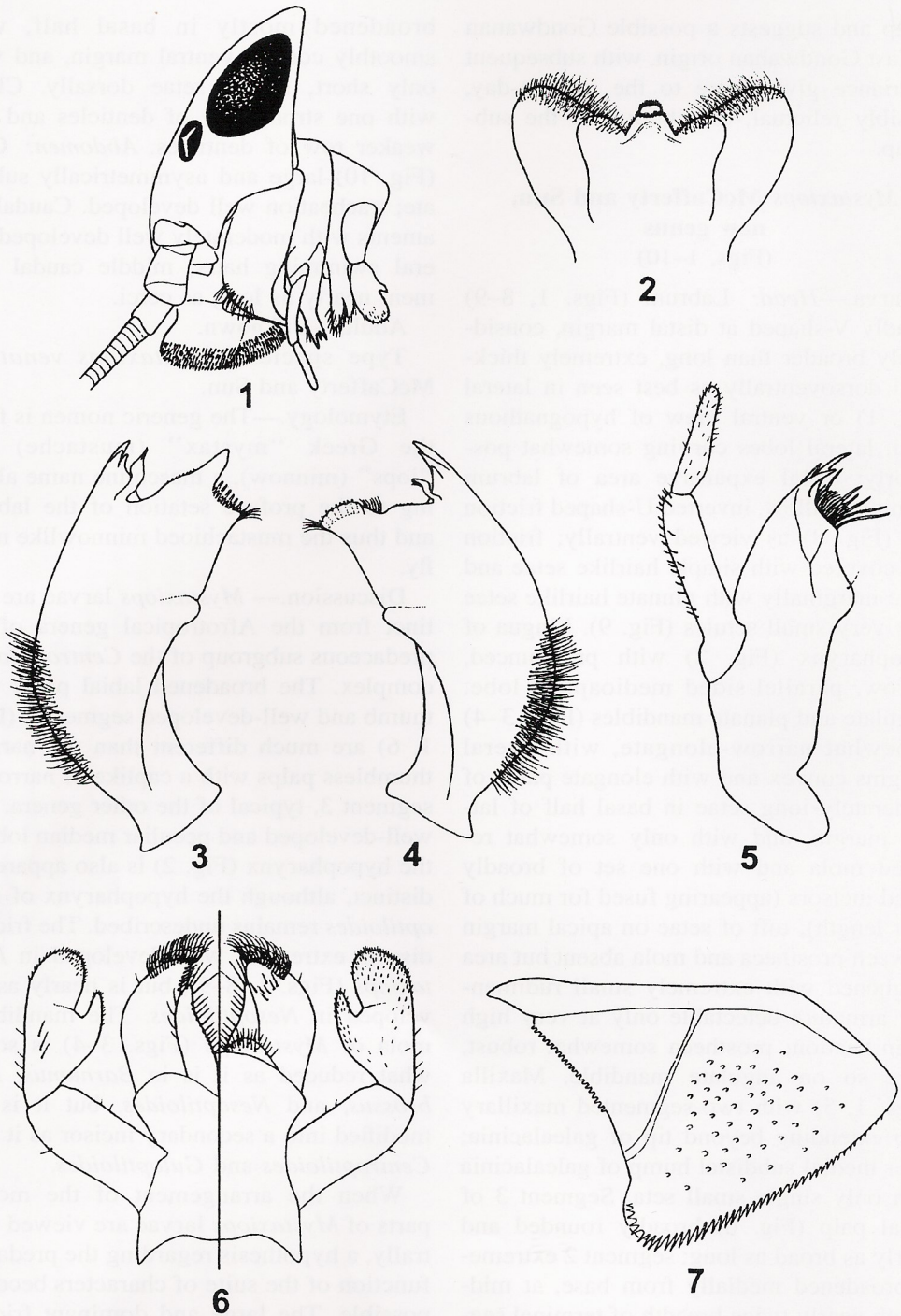
Adult.—Unknown.

Type species.—*Mystaxiops venatoris* McCafferty and Sun.

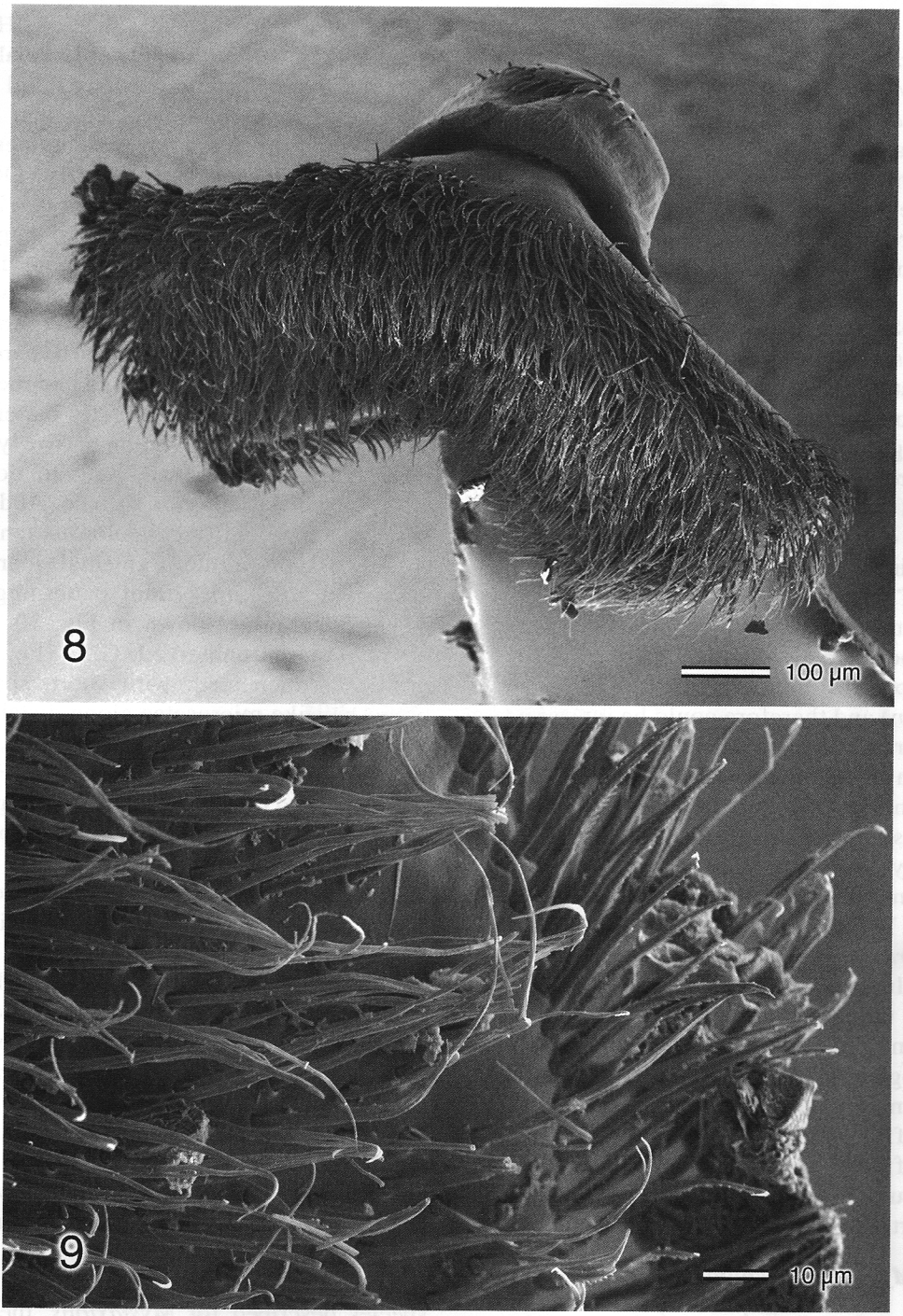
Etymology.—The generic nomen is from the Greek "mystax" (mustache) and "iops" (minnow), a masculine name alluding to the profuse setation of the labrum and thus the mustachioed minnowlike mayfly.

Discussion.— *Mystaxiops* larvae are distinct from the Afrotropical genera of the predaceous subgroup of the *Centroptiloides* complex. The broadened labial palps with thumb and well-developed segment 3 (Figs. 1, 6) are much different than the narrow, thumbless palps with a caplike or narrowed segment 3, typical of the other genera. The well-developed and peculiar median lobe of the hypopharynx (Fig. 2) is also apparently distinct, although the hypopharynx of *Guloptiloides* remains undescribed. The friction disc is extremely well developed in *Mystaxiops* (Figs. 1, 8–9), but is nearly as developed in *Nesoptiloides.* The mandibular mola of *Mystaxiops* (Figs. 3–4) is somewhat reduced as it is in *Barnumus, Herbrossus,* and *Nesoptiloides,* but it is not modified into a secondary incisor as it is in *Centroptiloides* and *Guloptiloides.*

When the arrangement of the mouthparts of *Mystaxiops* larvae are viewed ventrally, a hypothesis regarding the predatory function of the suite of characters becomes possible. The large and dominant friction disc of the labrum could be used to hold prey in place, while at the same time the heavily sclerotized maxillary spines and mandibular incisors could be used to impale and cut the prey, and the intricate la-



Figs. 1–7. *Mystaxiops venatoris,* larva. 1, Head (lateral). 2, Hypopharynx. 3, Angulate mandible. 4, Planate mandible. 5, Maxilla. 6, Labium. 7, Paraproct.



Figs. 8–9. *Mystaxiops venatoris,* larva. 8, Labral friction pad (ventrodistal view). 9, Friction pad setae.

bial palps used to manipulate the prey. The extraordinary, well-developed friction disc may compensate for forelegs that in *Mystaxiops* show no adaptations for being raptorial. *Nesoptiloides,* as another example within the subgroup, does demonstrate forelegs that are both appropriately contoured and fitted with ventral marginal armature to suggest a raptorial function (see fig. 87 in Lugo-Ortiz and McCafferty 1998), in addition to having a cuplike (perhaps suctioning) labrum that could assist in stabilizing prey items. Such differences among the genera of the *Centroptiloides* subgroup of predatory genera could also be related to differences in prey preference and the various degrees to which they rely on carnivory during different phases of their larval development.

The distribution of the predatory subgroup of the *Centroptiloides* complex now appears to be disjunct (part of the Afrotropical Region and Austral-Asian subregion) and therefore could be interpreted as representing a fragmentary relictual pattern remaining from an old East Gondwanan general distribution. These mayflies are not only large and distinctive, they are also relatively easy to collect from riffle areas of streams, as observed by WPM collecting *Centroptiloides* and *Barnumus* in South Africa. If they occur in India and Sri Lanka or other parts of the Oriental Region as might be expected from their known distribution [see e.g., biogeographical analysis of East Gondwanan family Teloganodidae by McCafferty and Wang (1997) and McCafferty and Benstead (2002)], they would have probably been found and reported by now.

Mystaxiops venatoris McCafferty and Sun, new species

(Figs. 1–10)

Late instar larva.—Body (Fig. 10) length 11.5 mm. Cercus length 7.0 mm. Median caudal filament length 5.0 mm. General coloration tan dorsally to cream ventrally, with brown margination. Head capsule (Fig. 10) with white epicranial suture and distinct white border medial and anterior to compound eyes. Segment 1 of maxillary palp (Fig. 5) with numerous short bristlelike setae laterally. Other mouthpart setation as shown in Figs. 2–6. Mandibular incisors and maxillary apical spines heavily sclerotized and more darkly pigmented than other mouthparts when viewing head ventrally. Pronotum sometimes marked as shown in Fig. 10. Femora (Fig. 10) with ventral marginal and medial areas of anterior face distinctly patterned with brown blotch extending narrowly basoventrally, but not extending to dorsal margin or distal anterior surface. Abdominal terga essentially concolorous tan except for brown intersegmental margination and sometimes faint patterning on posterior terga as shown in Fig. 10. Abdominal sterna unmarked. Gills (Fig. 10) profusely tracheated, with short, sparse, blunt, hairlike microsetae along distal and inner margins, and with some sparse, minute spines at outer-distal margin. Paraprocts (Fig. 7) with 33 or more marginal spines and numerous scattered scale bases on surface.

Material examined.—Holotype: Late instar larva, Papua New Guinea, Chimbu Province, Wara Sera Research Station, Crater Mountain Conservation Area, VII-11-2001, Bradler, Jarvis, Svenson (deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana). Other material: Two middle instar larvae, some parts slide-mounted, same data and deposition as holotype.

Etymology.—The specific epithet, venatoris, is a Latin masculine noun meaning "the hunter."

Discussion.—Because this is the first species described for *Mystaxiops,* there is no basis for a diagnosis. The highly distinctive patterning on the femora may prove to be useful for identification of the species, as might the high degree of spination of the paraprocts. It is possible that some charac-

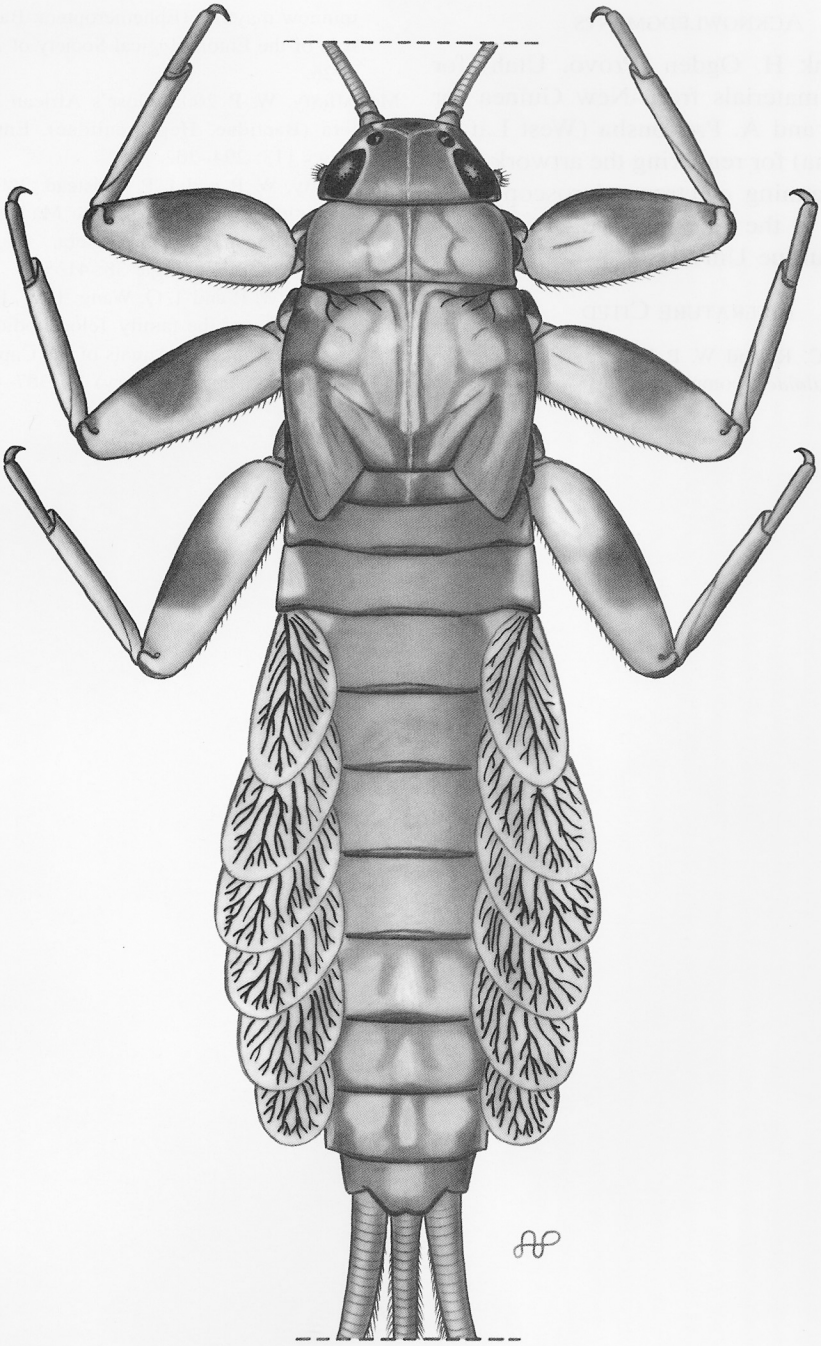


Fig. 10. *Mystaxiops venatoris* larva, dorsal habitus.

teristics given in the generic description may prove to be variable among different species if more species are found. For example, the number of setae on the inner hump of the galealaciniae may vary among species.

No habitat data are available for the new species.

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