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A new species of *Pseudogaurax* Malloch (Diptera: Chloropidae) reared from dobsonfly egg-masses (Megaloptera: Corydalidae) in Brazil

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Abstract

Pseudogaurax idiogenes Wheeler **sp. n.** (type locality: Iporanga, São Paulo, Brazil) is described from specimens reared from the egg masses of dobsonflies (Corydalidae) in southern Brazil. This is only the second record of *Pseudogaurax* larvae feeding on Megaloptera eggs (first from the Neotropical region). Larvae of most species of *Pseudogaurax* are predators of spider eggs.

Key Words: Chloropidae, Neotropical, Megaloptera, ecology, aquatic insects, stream, egg predation

Introduction

Flies in the family Chloropidae have a broader range of larval ecological roles than almost any other family of Diptera; chloropids whose larval habits are known include species that are phytophagous, mycetophagous, saprophagous, predaceous or parasitic, sometimes showing great ecological specialization (Ferrar 1987). *Pseudogaurax* Malloch is one of the few genera of Chloropidae whose larval habits have been studied in some detail, and probably as many specimens have been obtained by rearing as by general collecting. Larvae of *Pseudogaurax* species are predators, usually in the egg sacs of spiders (Ferrar 1987; Barnes *et al*. 1992). This known association with spider egg masses has led to studies of the life history of selected species of *Pseudogaurax* dating back more than 100 years (e.g., Davidson 1896; Barnes *et al*. 1992). Although most rearing records of larval *Pseudogaurax* are from spider egg masses, there are scattered records from egg masses or cocoons of insects in multiple orders including Mantodea, Lepidoptera and Rhaphidioptera (Kanmiya 1983; Ferrar 1987; Barnes *et al*. 1992). All the previously mentioned records are from terrestrial arthropods, but Coquillett (1898) reared one adult of *Pseudogaurax anchora* (Loew) from "egg shells" of *Corydalus cornutus* (L.) (Megaloptera: Corydalidae) in Washington DC, USA. This appears to be the only record to date of *Pseudogaurax* (or any predaceous chloropid) associated with aquatic insects (although the eggs are deposited outside water).

Megalopterans are large insects, usually 20–90 mm long. The order is divided in two families, Sialidae and Corydalidae. Both families occur in the Neotropical Region, although only a few individuals of a few species of Sialidae are known. Corydalidae, in contrast, are quite common and comprise two subfamilies, Corydalinae and Chauliodinae. Larvae of Corydalinae are easily found in streams, particularly those with rocky bottoms and clear water. Larvae are predators and feed on a variety of aquatic invertebrates. Mature larvae leave the stream and search for a protected place where they pupate. Adults are highly seasonal, being commonly collected at lights close to streams during warm summer nights (Contreras-Ramos 1998). Egg-masses,

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covered with a protective layer, are laid on objects overhanging streams. Bridges seem to be particularly attractive sites. Newly-hatched larvae cut the layer covering the egg-mass and fall into the water. Specimens of unidentified Chloropidae were reared from megalopteran egg-masses in southern Brazil. In this paper we describe a new species of *Pseudogaurax* associated with Corydalidae egg-masses and provide notes on its natural history.

Materials and methods

Genitalic preparations of flies were made by removing the abdomen and heating it in 85% lactic acid in a microwave oven for 2–3 periods of 20–30 seconds each, separated by a cooling period of 1–2 minutes. Cleared abdomens were then transferred to glycerin for further dissection and examination. Cleared abdomens and genitalia were stored in glycerin in microvials pinned beneath the specimen.

Types of Chloropidae have been deposited in the Museu de Zoologia, Universidade de São Paulo, Brazil (MZSP) and the Lyman Entomological Museum, McGill University, Ste-Anne-de-Bellevue, Quebec, Canada (LEM).

Results

Pseudogaurax idiogenes Wheeler, sp. n.

(Figs. 1–3)

Description: Total length 3.0–3.5 mm. Frons yellow, subequal in width to eye in dorsal view; frontal triangle half as long as frons, shining yellow, ocellar tubercle shining black; 8–10 long, pale fronto-orbital setae; several pale interfrontal setae almost as long as fronto-orbital setae; ocellar bristles short, reclinate; vertical and postocellar bristles long, pale; eye large, densely hairy; gena yellow, genal height 0.1 times eye height; vibrissa and subvibrissal setae long, pale; postgena yellow, narrow; occiput yellow; face flat, pale yellow; pedicel yellow, first flagellomere yellow, reniform, higher than long; arista long pubescent, dark brown; proboscis small, pale; palpus yellow, with long, pale distal and ventral setulae.

Thorax with pronotum distinct in dorsal view, pale yellow; scutum yellow with dark yellow to orange longitudinal median and intra-alar stripes, median stripe with narrow, darker orange stripe on either side of midline in some specimens, small, dark, medial spot anterior to scutellum; scutal setae pale, postpronotal and notopleural setae slightly darker; 1 anterior and 2 posterior notopleural setae; row of prescutellar setae slightly longer than other scutal setulae; scutellum yellow, rugose, with long pale setulae; apical scutellar bristles pale, divergent, strong, lateral scutellar setae weak, pale; thoracic pleurites yellow except for dark shining anteroventral spot on anepisternum. Legs pale yellow except for brown band on middle third of hind tibia; femoral organ absent; tibial organ large, oval, pale, interrupting brown tibial band on posterior surface of hind tibia. Wing typical of the genus; second costal sector 1.7–2.0 times as long as third, cell c broad; halter yellow.

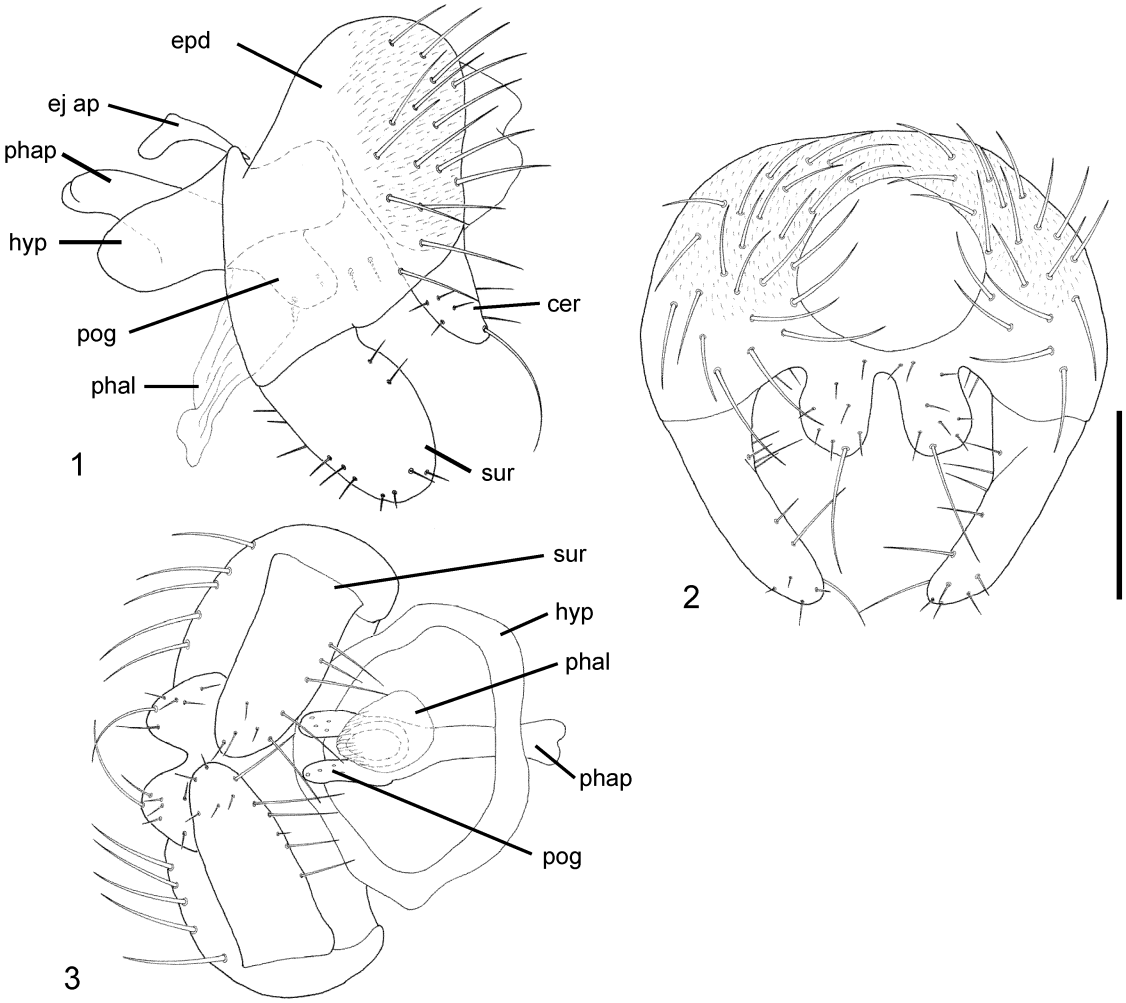
Abdominal syntergite 1+2 yellow with brown posterolateral corners, tergites 3–5 brown, tergite 3 sometimes paler medially; tergites with long weak setae, especially laterally.

Male postabdomen (Figs. 1–3): epandrium pale yellow, broader than high in posterior view; surstylus straight, slightly clavate, setose and setulose; hypandrium short and broad in ventral view; postgonites well-sclerotized, broad and quadrate in lateral view; distiphallus long, pale, membranous; cerci long, quadrate, well-sclerotized, diverging apically and separated by deep U-shaped ventral cleft, each cercus with long ventral seta and shorter setae and setulae; subepandrial sclerite simple, pale.

Female postabdomen: tergite 6 well-sclerotized, with posteromedial dark spot; other tergites and sternites of segments 6–8 reduced; tergite 10 triangular, shining; cerci well-sclerotized, elongate, narrow in dorsal

view, with long setulae.

Type material: Holotype ♂. BRAZIL: São Paulo, Iporanga, Parque Estadual Intervales, (24°17'36"S, 48°25'06"W), 600–700m, ex corydalid egg masses, 26.i.2002, A. S. Melo (MZSP). Paratypes. Same data as holotype (1♂, 4♀, MZSP, 1♂, 1♀, LEM).



FIGURES 1–3. *Pseudogaurax idiogenes*. 1. Male genitalia, lateral. 2. Male genitalia, posterior. 3. Male genitalia, ventral. Abbreviations: cer – cercus; ej ap – ejaculatory apodeme; epd – epandrium; hyp – hypandrium; phal – phallus; phap – phallapodeme; pog – postgonite; sur – surstylus. Scale bar = 0.5 mm.

Etymology: The species name is from the Greek *idiogenes* (distinctive, peculiar), referring to the habits of the larvae, feeding on eggs of Megaloptera instead of spider egg masses like most species of this genus.

Comments: This species will not key out in Sabrosky's (1966; 1990) keys to New World *Pseudogaurax*. It runs to couplet 13 in Sabrosky (1966) but does not key to either half of that couplet because of the color pattern of the legs. We have not included revised couplets to Sabrosky's keys to species because the large number of undescribed Neotropical species of *Pseudogaurax* would make any effort premature pending a complete revision of the fauna. Specimens of *P. idiogenes* may be distinguished from other described New World species of *Pseudogaurax* by the combination of the scutal colour pattern, the yellow scutellum and the extensively yellow legs with a dark band on the hind tibia.

Natural history of *Pseudogaurax idiogenes*

Pseudogaurax idiogenes specimens were obtained from Megaloptera egg-masses collected in Parque

Estadual Intervales, Iporanga, São Paulo, Brazil (24º17'36" S, 48º25'06"W, 600–700 m el.), on 26-I-2002. Egg-masses were located on a small wooden bridge with a foundation of sedimentary rocks vertical to the stream. Four egg-masses (~18 mm diameter each) were obtained from the bridge foundation. They were removed using a screwdriver and included a small piece of rock to which they were attached, thus preventing damage to the egg-masses. Two pieces of rock, each containing two egg-masses (~5 mm apart in each case) were collected. The white covering material of all egg-masses was homogenous and did not contain any sign of oviposition by Chloropidae. It is thus likely that female flies attacked the megalopteran egg-masses during or immediately after oviposition.

It is not certain to which species of Megaloptera the egg-masses belonged. No description of Megaloptera larvae is available for the species occurring in the region. However, adults of *Chloronia corripiens* (Walker) and *Corydalus diasi* Navás have been collected at the same site. A third species, *Corydalus hecate* MacLachlan, has been collected from two streams in the same watershed, ca. 10 km from the study site. Azevedo (2003) provides photographs of egg-masses of *Corydalus* sp. and *Chloronia hieroglyphica* (Rambur) from the central Amazon. Egg-masses of *Corydalus* are white, while those of *Chloronia hieroglyphica* are pale-brown. If coloration is diagnostic at the genus level, egg-masses from the study site probably belong to *Corydalus diasi* or *Corydalus hecate* (Fig. 4).

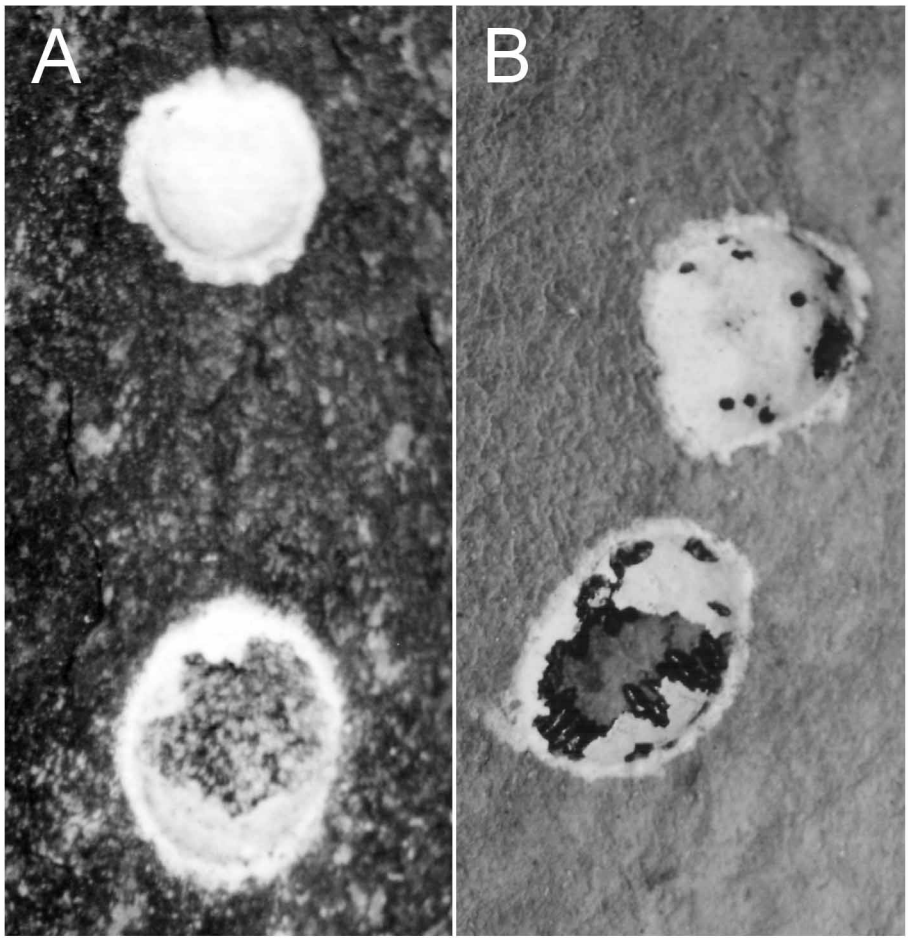


FIGURE 4. A. Intact (top) and ecloded (bottom) egg-masses of Corydalidae (not attacked by parasites). B. Egg-masses attacked by *Pseudogaurax idiogenes* showing emergence holes of adult flies (top) and remaining fly puparia (bottom, protective layer of egg mass partially removed).

Because the initial objective was to obtain megalopteran larvae, egg-masses were not separated in individual containers. On 31-I-2002 five flies emerged from one egg-mass. Flies were first seen at 06:50 am and it is likely that they emerged minutes before, as they were close to the egg-mass and the wings of one individual

were not yet expanded. It was possible to identify the five small holes in the egg-mass from which they emerged. Two flies escaped during transfer between vials; the three remaining specimens were females. On 01-II-2002 2 males and 6 females emerged between 06:40 and 06:50 am from the same egg-mass. On 06-II-2002 2 males and 3 females emerged between 07:50 and 08:25 am from the second egg-mass on the same piece of rock. On 07-II-2002 around 07:50 am, two further individuals (2 females) were obtained, likely from the second egg-mass. The last fly (1 female) emerged on 22-II-2002. It was not possible to determine its exact emergence time, although it was first sighted around 09:30 am. The puparia of reared flies remained inside the megalopteran egg-mass.

The two egg-masses on the second piece of rock produced no flies. Megalopteran larvae emerged from one of them in the night of 06-07-II-2002. The second egg-mass remained intact.

A second visit was made to the sample site on 09-III-2004 to assess the proportion of attacked egg-masses and the number of puparia per egg-mass. A total of 126 egg-masses was recorded. Nine were in poor condition, indicating that they were likely from the previous year. One intact egg-mass (no Megaloptera or Chloropidae emergence) was partially covered by the nest of a wasp, and one showed signs of fungal infection. Another egg-mass was damaged. From the remaining 114 egg-masses, two (1.8%) were pre-emergence, 24 (21.0%) showed signs of megalopteran emergence, and 88 (77.2%) contained fly puparia or small holes (sign of Chloropidae emergence) (Fig. 4B). Twenty egg-masses showing signs of Chloropidae attack were removed from the substrate, fixed in alcohol and returned to the laboratory to estimate the number of flies developing per egg-mass. The mean number of Chloropidae puparia per egg-mass was 26.65 (n = 20, min = 4, max = 77, sd = 20.62). Some of the egg-masses were attached to the lower surface of the substrate, and as the fly puparia are only loosely attached to the substrate, it is possible that some of them fell down before collection. Additionally, egg-masses revealed saprophagous invertebrates such as Acari and Psocoptera (Insecta), which may have destroyed part of the material. Thus the numbers provided above may be underestimates.

Five out of the 20 examined egg-masses contained dipteran larvae, likely from Chloropidae. In three egg-masses there were well-developed pupae and adults of small wasps. Each fly puparium was parasitized by a single wasp. One megalopteran egg-mass contained two adult wasps and 20 pupae of wasps. Additionally, in four egg-masses some fly puparia (1 of 18, 3 of 11, 2 of 50, and 60 of 77 puparia, respectively) were completely filled by small larvae, probably parasitoid Hymenoptera.

Although data are available only from a single locality in southeast Brazil, it is likely that this Chloropidae-Corydalidae host association occurs elsewhere. Some egg-masses of Corydalidae observed during a casual visit to a stream site in southern Brazil (Maquiné, Rio Grande do Sul, 29°31’33”S, 50°18’56”W, XII-2004), ~700 km from the study site, contained small holes similar to those observed in this study.

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