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Third instar of the myrmecophilous *Italochrysa insignis* (Walker) from Australia (Neuroptera: Chrysopidae: Belonopterygini)

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We dedicate this paper to Professor Maria Matilde Principi, University of Bologna, in recognition of her exemplary studies of *Italochrysa* biology and morphology.

Abstract

The third instar of the Australian green lacewing *Italochrysa insignis* (Walker) is described and compared with that of the European *Italochrysa italica* (Rossi). Larvae of both species are associated with arboreal ant nests. Moreover, they share a substantial number of morphological adaptations that may defend them against ants and that distinguish them from larvae of other chrysopids. The larvae of the two *Italochrysa* Principi species also have distinct differences. The potential systematic value of several of the larval characters at the tribal, generic, and species levels is assessed, and a brief review of myrmecophily in the Belonopterygini is presented.

Key words: Chrysopinae, larval morphology, debris-carrying, defense

Introduction

Italochrysa Principi, with ~75 described species, is the largest and most widespread genus in the green lacewing tribe Belonopterygini (Neuroptera: Chrysopidae) (Brooks 1984, Brooks & Barnard 1990, Hölzel & Ohm 2003, Oswald 2007). It occurs throughout much of the Old World, particularly in tropical and subtropical regions.

Despite the broad geographic distribution of the genus, information on the biology and immature stages of its numerous species is scarce. The first instars of two species were described and illustrated [*Italochrysa insignis* (Walker) from Australia (New 1983) and *Italochrysa stigmatica* (Rambur) from Spain (Díaz-Aranda & Monserrat 1995, Monserrat & Díaz-Aranda 2012)]. Also, images of first instar *Italochrysa italica* (Rossi), previously posted on the internet, are reproduced here (courtesy of C. F. Cesaroni & R. A. Pantaleoni). Despite several attempts, rearing of neonates has proven unsuccessful (New 1983, 1986, Tsukaguchi 1995).

Italochrysa third instars are known for only one species; detailed observations and descriptions of *I. italica* documented a larval association with ant colonies (Principi 1943, 1946, as *Nothochrysa*). The larvae were observed to prey on ant brood, and their specialized debris-carrying behavior was found to provide them a high degree of protection from worker ants. Also, Principi identified many morphological and biological modifications of *I. italica* that previously were unknown from chrysopid larvae and that presumably are related to predation on ant brood. Her findings provide an excellent basis for comparison with other *Italochrysa* species and belonopterygines in general.

Unfortunately, analogous information from other belonopterygine species is very scanty (See Tauber *et al.* 2014). The behavior and morphology of *Nacarina valida* (Erichson) [second or third instar = Semaphorant B, as *Nadiva* Navás] were briefly described and illustrated by Weber (1942). In addition, the first instars in only two other genera have been described, i.e., *Calochrysa extranea* (Esben-Petersen) by New (1986) and *Vieira elegans* (Burmeister) by Tauber *et al.* (2006, transferred from Leucochrysinini). As a result of the limited data, the larval features that distinguish belonopterygine genera and, indeed the tribe, have not been firmly established.

In addition to the above, Principi (1946) reported two behavioral patterns that may implicate chemicals as being important in the *Italochrysa* interaction with ants. First, *I. italica* larvae frequently grasp worker ant adults with their mandibles and bring the ants into contact with their debris packets. The larvae do not appear to feed on the worker ants or to harm them; they are released. The behavior may serve to transfer scent from ants to the debris packets, thus camouflaging the larvae chemically (R. A. Pantaleoni, personal communication). Second, *I. italica* larvae were observed to follow ant trails into and out of the ant nest with precision. It appeared that they perceive the ants' trail pheromone.

In contrast to the mode of myrmecophily described above for *Italochrysa* larvae, the belonopterygine genus *Nacarina* appears to have a very different pattern. Weber (1942) described discovering *N. valida* in a nest of *Camponotus (Myrmotherix) abdominalis* (Fabricius) in South America. His report did not state that the larvae carried debris packets, and Weber's illustration of the mature larva did not depict the enlarged tubercles or large setae that are typically associated with debris-carrying larvae. Like *Italochrysa* larvae, these larvae moved freely among the ants, and they were carried by worker ants as if they were brood. These findings indicate that *N. valida* larvae within the ant nest lack the physical protection of a debris packet, and that protection from host ants is largely through chemical means. [Note: There are anecdotal and unpublished reports that the North American belonopterygine *Abachrysa* has an association with ants. There is no information on the prey associations of the remaining eleven belonopterygine genera.]

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