

Book chapter 9: Parasitoids of dipterous of forensic importance in Brazil

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Abstract

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The largest superfamily among parasitoid Hymenoptera is Ichneumonoidea that occurs in all habitats, being easily collected. Its hosts are mainly larvae and pupae of holometabolous insects, excluding Megaloptera and Siphonaptera, occurring rarely on individual eggs and are subdivided into Ichneumonidae and Braconidae.

Many Braconidae parasitise hemimetabola nymphs (Homoptera, Heteroptera, Isoptera and Psocoptera) and some adult parasites of Coleoptera and Hymenoptera. Some species may be phytophages (Matthews, 1984; Wahl & Sharkey in Goulet & Huber, 1993).

Askew & Shaw (1986) distinguished the Ichneumonoidea in idiobionts, those who permanently paralyze the host and in koinobionts, those who temporarily paralyze, allowing the development of the post-posture host.

Ichneumonoidea are among the most diverse neotropical superfamilies with more than 40,000 described species distributed in 694 genera and together with Chalcidoidea correspond to 48% of all neotropical Hymenoptera (Grissell & Schauff, 1990).

Among the Braconidae, the Subfamily Alysiinae is cosmopolitan with more than 1000 species described worldwide; of the 41 genera of the New World, 20 occur in the Neotropical region (Wharton et al. 1997).

Alysiinae are koinobiont and endoparasitoids of brachicerous dipterans; Alysiini are

associated with more than 20 Families of Diptera (Wharton, 1984). Many of its hosts occur associated with manure, fungi or decaying plant and animal matter; few parasites Tephritidae larvae. Pupation of the parasitoid occurs within the host's pupary. Most are solitary parasitoid; some species of *Aphaereta* sp. are gregarious.

The main function of exodont jaws seems to be to allow the adult to break the host's pupary to leave him (Griffiths, 1964). These jaws could also serve to break the substrate where the host's pupary is located.

Some of the best studied Alysinae are the paleatic species *Alysia manducator* and the nearctic species *Aphaereta pallipes*. The Alysinae of the genera *Gnathopleura* Wharton, *Aphaereta* and *Alysia* Latreille have been created and used for biological control of caliphorids and muscids, but without much success (Legner, 1978; Wharton, 1984).

In Brazil, studies on Parasinae alysid species of muscoid dipterans refer mainly to species of the genera *Aphaereta* and *Gnathopleura*. *Aphaereta* sp. was one of the predominant parasitoids on muscoid dipterans collected on various substrates in the states of Goiás and Minas Gerais (Marchiori et al., 2002; Marchiori & Silva Filho, 2004; Silva, 2007).

Gnathopleura quadridentate, Wharton 1986 was recorded in several studies conducted in Brazil, associated with species of *Oxysarcodexia*, *Sarcodexia* and *Peckia* (Diptera, Sarcophagidae) on various substrates, occurring in areas of mesophilic forest and urban environments (Marchiori et al., 2004; Marchiori & Silva Filho, 2004; 2006; Bonani et al., 2006; Marchiori, 2007).

Chalcididae are usually endoparasitoid, primary and solitary mainly of mature Diptera larvae (including aquatic as in Stratiomyidae) and Lepidoptera pupae (Grissell & Schauff, 1997; Tavares, 2007), but are also registered as Coleoptera parasitoids (including the supposed primitive hosts whose larvae develop in wood), Neuroptera, Hymenoptera, Strepsiptera and as hyperparasitoids (Naumann, 1991).

There are also gregarious and ectoparasitoid species (Noyes, 2003). Species of the genus *Brachymeria* Westwood are important primary parasitoids of couscoid dipterans, such as those of the family Sarcophagidae (Burks, 1960; Habu, 1960; Grissell & Schauff, 1990; Marchiori, 2001) and Calliphoridae (Bishop et al., 1996).

Some species are of economic importance because they attack insect pests and others

of forensic importance (Gauld & Bolton, 1988; Santana et al.2008). The species *Brachymeria podagrica* (Fabricius) was found parasitising the following species of dipterans of forensic importance: *Chrysomya* sp., *Chrysomya albiceps* (Wiedemann), *Chrysomya megacephala* (Fabricius) (Calliphoridae), *Hemilucilia flavifacies* (Calliphoridae) Erderlein, *Ophyra aenescens* (Wiedemann) (Muscidae), *Oxysarcodexia thornax* (Walker) (Sarcophagidae), *Peckia chrysostoma* (Wiedemann) (Sarcophagidae), *Peckia intermutnas* (Walker) (Diptera: Sarcophagidae), *Sarcodexia lambens* (Wiedemann) and *Squamatois trivittatus* (Curran, 1927) (Diptera: Sarcophagidae) (Silva, 1999; Marchiori et al., 2001a; Marchiori et al., 2002a; Marchiori et al., 2003a; b; c; Silva et al., 2005).

Granato & Oliveira Costa (2008) collected from immature specimens of dipterans of forensic importance *Brachymeria* sp. and *Conura* sp.

The family Diapriidae (Hymenoptera: Proctotrupeoidea) has many common species, little is known about the biology of these parasitoids. Oviposition can occur in the host larva or pupa. Most Diapriidae are parasitoids of Calliphoridae, Muscidae, Sarcophagidae, Sphaercoeridae and Tachinidae (Silva, 1991).

Species of the genus *Trichopria* are usually of immature stages of Diptera (Legner et al., 1976). *Trichopria* sp. is cited in the literature as parasitoid of some Sarcophagidae, Sepsidae, Muscidae and Calliphoridae (Figg et al., 1983; Blume, 1984; Silva, 1991).

Trichopria sp. was found parasitizing the following species of dipterans of forensic importance: *C. albiceps*, *Chrysomya putoria* (Wiedemann), *Fannia canicularis* (L.), *H. flavifacies*, *Ophyra* sp., *Palaeosepsis* spp., *Phaenicia eximia* (Wiedemann), *P. chrysostoma*, *P. intermutnas*, *P. eximia* and *Synthesiomyia nudiseta* (Wulp) (Muscidae) (Silva, 1991; Monteiro & Prado, 2000; Marchiori et al., 2000a; Marchiori et al., 2001; Bonani et al., 2004; Marchiori et al., 2002; Marchiori et al., 2004)

The Family Encyrtidae and a general form are endoparasitoids of eggs, immature and adults or egg predators mainly of cochineals (Hemiptera: Coccidae and Pseudococcidae), although several hosts have already been registered in several groups of Arthropoda (Tachikawa, 1981), as well as hyperparasitoids and polyembryonic parasitoids (Noyes, 1995).

Most egg and pupae parasitoids have idiobiont strategy, while larval parasitoids have koinobiont strategy. Several particularities are noted in the biology of Encyrtidae. The

phenomenon of polyembryonic consists of the development of multiple larvae from a single egg placed in the host (Noyes, 1985; 1987; 1988; 1990a; b; 1996; 2000; Noyes & Valentini, 1989; Trjapitzin, 1973a; b).

The species *Tachinaephagus zealandicus* Ashmead was found parasitizing the following species of dipterans of forensic importance: *C. megacephala*, *C. putoria*, *Musca domestica* (L.) (Muscidae) and *S. lambens* (Monteiro, 1995; Sereno & Neves, 2003; Costa et al., 2004; Morretti & Ribeiro, 2006) and the species *Hemencrytus herbertii* parasitoids the species: *C. albiceps*, *Euboettcheria colusor* (Curran et Walley) (Sarcophagidae), *Hemilucilia flavifacies* (Calliphoridae), *M. domestica*, *Ophrya* sp., *O. thornax*, *P. eximia*, *P. chrysosotma*, *P. intermutnas* and *S. nudiseta* (Silva, 1991; Noyes & Wodley, 1994; Marchiori et al., 2003b; d; Marchiori et al., 2004).

The Eulophidae family, as you would expect in such a large group, various habits of life occur as parasitoids of eggs, larvae and pupae of more than 10 orders of insects can be solitary, gregarious, idiobionts, koinobionts, ectoparasitoids and endoparasitoids, including aquatic, predators of Arachnida oothetes and even Nematoda (LaSalle & Suffcha, 1995).

However, there is a pattern among hosts, predominantly those whose immature larvae are housed in gallhouses, mines or stems, especially of Lepidoptera, Coleoptera, Diptera and Hymenoptera orders. *Tachinobia* species behave like gregarious parasitoids of Lepidoptera and Diptera pupae (Boucek, 1977; La Salle, 1994). *Tachinobia* spp. parasitised the following species of dipterans of forensic importance: *C. albiceps*, *P. eximia*, *Megaselia scalaris* (Loew) (Phoridae) *O. aenescens*, *O. thornax*, parasitoid *C. albiceps*, *P. eximia*, *Oxysarcodexia* sp. and *P. intermutnas* and *S. nudiseta* (Silva, 1991; Marchiori et al., 2005a; Marchiori et al., 2006a).

The Eurytomidae family are mostly parasitoids of usually endophytic immature insects tenants or phytophages. Tenants can feed on the galley material and also from the gallant. Phytophages can be galleys, blowers or feed on seeds from a wide variety of plants. There are several types of idiobiont parasitoids, koinobionts, solitary or gregarious, kleptoparasitoids, facultative hyperparasitoids or not (Noyes, 2003) and these occur in several orders, such as Diptera, Coleoptera, Hymenoptera, Lepidoptera, Heteroptera eggs and Orthoptera.

Eurytoma sp. parasitized the following species of dipterans of forensic importance:

Fannia pusio (Wiedemann) (Fanniidae) (Marchiori, 2007a) and *M. domestica* (Bruno et al., 1992; Costa, et al., 2004).

The Figitidae family are parasitoids of Neuroptera and Diptera (Gauld & Bolton, 1988). They behave like primary parasitoids of dipteran larvae (Díaz & Gallardo, 1995; 1996). Eucoilinae are koinobionts and endoparasitoids that ovipose in the larval stage of Diptera Cyclorhapha and emerge as adults of their host's pupary (Wharton et al., 1998), which remains alive until the pupa stage (Ovruski, 1994).

They are the largest group of Cynipoidea presenting a wide geographical distribution (Gauld & Bolton, 1988). Several species of eucoilines have been reported as important natural enemies of different groups of dipterans (Wharton et al., 1998).

The species *Acantheucoela* sp. was found parasitizing *Oxysarcodexia* sp. *Kleidotoma nigra* (Hartig) *Palaeosepsis* spp: *Paraganapis egeria* Díaz, Gallardo Walsh parasitizing *Cyrtoneurine paraescita* Couri (Muscidae), *Palaeosepsis* spp., and *F. pusio*; *Triplasta artocoxalis* Ashmead *C. paraescita*, *Palaeosepsis* spp., and Sphaeroceridae spp.; *Triplasta coxalis* Ashmead parasitizing *Palaeosepsis* spp.; *Trybliographa* sp. parasitizing *O. thornax* (Silva, 1991; Marchiori et al., 2006) (Marchiori & Linhares, 1999; Marchiori et al., 1999; Marchiori et al., 200b;c;d; Marchiori et al., 2001b; Marchiori et al., 2001c; Marchiori et al., 2002b; Marchiori et al., 2005;b;c;d;e; Marchiori et al., 2007b) and *Neralsia esplendens* (Borgmeier) parasitizing *O. thornax* (Marchiori et al., 2006b).

The Pteromalidae family (Hymenoptera, Chalcidoidea) includes a large number of parasitoid species, many of which are important in biological control of synanthropic muscoids (Cardoso & Milward-De-Azevedo, 1996). They can be solitary or gregarious, ectoparasitoids or endoparasitoids, primary or secondary parasitoids, koinobionts or idiobionts. Most are idiobiont and many develop as ectoparasitoids in larvae or puparies of Diptera, Coleoptera, Hymenoptera, Lepidoptera and Siphonaptera (Ioriatti, 1995).

The main species of parasitoids and their hosts are: *Muscidifurax raptor* Girault & Sanders: *M. domestica* and *Palaeosepsis* spp. *Muscidifurax raptoroides* (Kogan & Legner): *M. domestica* and *C. putoria*. *Nasonia vitripennis* (Walker) *Cochliomyia hominivorax* (Coquerel) (Diptera: Calliphoridae), *C. albiceps*, *C. megacephala*, *C. putoria*, *H. flavifacies*, *M. domestica*, *O. thornax*, *P. chrysostoma*, *P. intermutans* e *Synthesiomyia nudiseta* (Diptera: Muscidae). *Pachycrepoideus vindemmiae* (Rondani): *C. albiceps*, *C. megacephala*, *C. putoria*, *F. pusio*, *H. flavifacies*, *M. scalaris*, *M domestica*, *O. thornax*,

Ophyra sp. (Diptera: Muscidae), *Poeciolosomella* sp. (Diptera: Sphaeroceridae), *O. thornax*, *P. chrysostoma* and *Sarcodexia lambens* (Diptera: Sarcophagidae). *Spalangia cameroni* Perkins: *C. putoria*, *C. parescita*, *M. domestica*, *Palaeosepsis* spp., *R. belforti* and *Stomoxys calcitrans* L. (Diptera: Muscidae). *Spalangia drosophilae* (Ashmead): *F. pusio*, *O. thornax*, *Palaeosepsis* spp. and *P. chrysostoma*. *Spalangia endius* Walker: *C. putoria*, *C. parescita*, *F. pusio*, *M. domestica*, *O. thornax*, *Palaeosepsis* spp., *P. chrysostoma*, *S. lambens*. and *S. calcitrans*. *Spalangia gemina* Boucek: *M. domestica*, *C. putoria* and *S. calcitrans*. *Spalangia nigra* Latrielle: *C. parescita*, *F. pusio*, *M. domestica*, *O. thornax*, *Palaeosepsis* spp. and *R. belforti*. *Spalangia nigroaenae* Curtis: *C. parescita*, *M. domestica*, *O. thornax*, *Palaeosepsis* spp., *R. belforti* and *S. calcitrans*. *Spalangia* sp.: *O. thornax* and *P. intermutans* (Silveira et al., 1980; Silva, 1991; Sereno & Neves, 1993a; 1993b; Monteiro, 1995; Almeida, 1996; Marchiori & Linhares, 1999; Marchiori et al., 1999; Marchiori et al., 2000b;c;d; Marchiori et al., 2001b; Marchiori et al., 2001c; Marchiori et al., 2002b; Carvalho et al., 2003; Carvalho et al., 2003b; Carvalho et al., 2004; Marchiori et al., 2005;b;c;d;e; Marchiori et al., 2007b) (Marchiori et al., 2006a; Marchiori et al., 2006b, Rodrigues-Guimarães, 2006).

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