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Mini Review of Parasitoids Collected from Dipterans (Flies) in the Brazilian Cerrado Biome

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Abstract

These dipterans use decaying organic matter for food and ovi/ larviposition, so the species of these families easily adapt to anthropic environments, which makes them insects considered to be synanthropic cosmopolitans of importance for public health. The collection was built from articles (describing the objective and results) from 1999 and 2010 with the theme: dipterous parasitoids elaborated from 2000 to 2021 in the cerrado biome of the states of Goiás and Minas Gerais. The most used parasitoids in biological control are in the Hymenoptera. Within Hymenoptera Parasitic and the most used families are Braconidae, Ichneumonidae, Trichogrammatidae, Eulophidae and the superfamily Chalcidoidea (Pteromalidae, Encyrtidae and Aphelinidae) and Coleoptera parasitoids of the Staphilinidae family.

Keywords: Insecta; Hymenptera; Coleoptera; Collection; Brazil.

1. Introduction

Some Diptera (Figure 1) families have ecological importance in nutrient cycling, as is the case of saprophagous species. Among these, stand out the muscoid dipterans of the families Calliphoridae, Muscidae, Fannidae and Sarcophagidae. These dipterans use decaying organic material for feeding and ovi/larviposition, for this fact the species of these families easily adapt to anthropic environments, which makes them insects considered to be synanthropic cosmopolitans of importance to public health (Figure 2) [1].

For the Neotropical region, according to Carvalho and Mello-Patiu [2], there are about 850 species of Muscidae, 800 of Sarcophagidae, 130 of Calliphoridae and 60 of Fanniidae, although some other authors stipulate similar values for more or less It is estimated that these families affect about 15% of the world's fauna [2].

This last aspect supports Forensic Entomology, which has three sub-areas of application: urban of stocked products; and medical-legal, an area that studies insects and other arthropods, mainly associated with crime scenes and corpses. Among the objectives studied in this science is the determination of how, where and, in particular, when death occurred based on information taken from insects found on or near the corpse [3].

2. Parasitoids

In a simple way, biological control can be divided into natural or applied. Natural biological control refers to the population of natural enemies that occur naturally in the field, as an example we can cite predatory beetles, Chrysopidae and earwigs. Applied biological control, on the other hand, refers to the manipulation of the cultivation environment or the release of organisms for pest management, as an example we can cite the parasitoid (Figures 3, 4 and 5) wasp *Cotesia flavipes* (Cameron) (Hymenoptera: Braconidae) [4].

The parasitoids most used in biological control are in the order Hymenoptera and Diptera. Within Hymenoptera Parasitic (Figure 6) and the most used families are Braconidae, Ichneumonidae, Trichogrammatidae, Eulophidae and the superfamily Chalcidoidea (Pteromalidae, Encyrtidae and Aphelinidae) and parasitoids fo Order Coleoptera da family Staphilinidae [4].

3. Methods Used to Collect parasitoids in this Article. According to Marchiori [5].

1- Metal Container traps: 5.1 Study 1, 5.3. Study 3, 5.4. Study 4, 5.5. study 5 and 5.8. Study 8 (Figure 7).
2- Method with animal carcasses in rural areas using two pig carcasses: 5.10 Study 10,
3- Method for collecting feces: 5.2. Study 2, 5.6. Study 6, 5.7. Study 7, 5.9. Study 9, 5.11 Study 11.

4. Methods

The methodology used in this study was that of Marchiori [6]. The collection was built from articles (describing the objective and results) from 1999 and 2010 with the theme: dipterous parasitoids elaborated from 2000 to 2021 in the cerrado biome (Figure 6) of the states. of Goiás and Minas Gerais, Brazil (Figure 8). The most used parasitoids in biological control are in the Hymenoptera

5. Studies Carried Out

5.1. Study 1

This study determined the species of parasitoids of Diptera present in forest, rural, and urban areas in the municipality of Monte Alegre, MG.

A total of 372 dipteran puparia were collected, 91 in the forest area, 217 in the rural area and 64 in the urban area, from which 49 parasitoids emerged, 13 in the forest area, 24 in the rural area and 12 in the urban area. *Triplasta atrocoxalis* (Ashmead) (Hymenoptera: Figitidae) was the most frequent species, 34.7% (17/49).

The percentage of parasitism was 14.3%, 11.0% and 18.8% in forest, rural and urban areas, respectively, higher in urban areas [7].

5.2. Study 2

The objective of this work was to verify the degree of synanthropy of the species of parasitoids of dipterans collected in cattle feces in Monte Alegre, MG.

The synanthropy index was calculated from the formula:

$$IS = \frac{2a + b - 2c}{2}$$

where: a= percentage of a certain species captured in the urban area in relation to this same species, captured in the rural and forested areas; b= percentage of the same species captured in the rural area; c= percentage of the same species captured in the forested zone. The synanthropy index ranges from +100 to -100; the first value represents the highest degree of association with man, and negative values indicate an aversion to anthropodized environments.

Forty-nine parasitoids were collected, 13 in the forest area, 24 in the rural area and 12 in the urban area. The species *Kleidotoma nigra* (Hartig) (Hymenoptera: Figitidae), *Paraganaspis egeria* Díaz, Gallardo & Walsh (Hymenoptera: Figitidae), *Spalangia cameroni* Perkins (Hymenoptera: Pteromalidae), *Trichopria* sp. (Hymenoptera: Diapriidae), *Triplasta atrocoxalis* (Ashmead) (Hymenoptera: Figitidae) and *Triplasta coxalis* (Ashmead) (Hymenoptera: Figitidae) had synanthropy indices of +0.1, -100, +50, +100, -3, -100, respectively [8].

5.3. Study 3

The objective of this work was to detect the species of *Fannia pusio* (Wiedemann) (Diptera: Fannidae) parasitoids collected in human feces, bovine liver and fish, in Caldas Novas, Goiás, Brazil.

They were obtained 325 *F. pusio* pupae, from 24 of which 24 parasitoids emerged, being 03 specimens of *Paraganaspis egeria* Díaz, Gallardo & Walsh (Hymenoptera: Figitidae), 14 specimens of *Pachycrepoideus vindemmiae* (Rondani) Pteromalidae), 02 specimens of *Spalangia drosophilae* Ashmead, (Hymenoptera: Pteromalidaee) and 05 specimens of *Spalangia nigra* Latrielle, (Hymenoptera: Pteromalidae). The percentage of parasitism obtained was 7,4%.

The percentage of parasitism presented by *P. vindemmiae*, *S. nigra*, *P. egeria*, and *S. drosophilae* was 4.3%, 1.5%, 0.9% and 0.6%, respectively. The species with the highest occurrence was *P. vindemmiae* representing 58.3% of the individuals collected and also the one present in all attracting baits.

The species *S. nigra* was the second most abundant, representing 20.8% of the individuals collected and had the highest frequency of parasitism with 7.7%.

Regarding the preference of parasitoids for substrates, it was found that: *P. vindemmiae* showed preference for *F. pusio* collected from bovine liver; *P. egeria* occurred only in *F. pusio* collected from human feces; *S. drosophilae* and *S nigra* also showed preferences for *F. pusio* collected in bovine liver, however, they were collected only in this substrate (X^2=14,78; GL=6; P<0,05) [9].

5.4. Study 4

The aim of this study was to re-late the parasitoids associated with flies collected in the Alvorada slaughterhouse in Itumbiara, Goiás.

A total of 1,411 fly pupae were collected, from which 960 parasitoids emerged from 216 positive pupae. The total percentage of parasitism was 15.3%. The percentage of parasitism presented by the hymenopteran parasitoids *Aphaereta* sp. (Braconidae), *Brachymeria podagrica* (Fabricius) (Chalcididae, *Nasonia vitripennis* (Walker) (Pteromalidae), *Pachycrepoideus vindemmiae* (Rodani) (Pteromalidae), *Spalangia* sp. (Pteromalidae) and *Trybliographa* sp (Figitidae) was 0.4%, 12.3%, 2.4%, 0.1%, 0.1% and 0.1%, respectively. The absolute frequency, percentage of parasitized pupae and parasitoid species collected were: 205 specimens (2.3%) of *Aphaereta* sp., 173 specimens (80.0%) of *B. podagrica*, 578 specimens (15.7%) from *N, vitripennis*, one (0.5%) from *P. vindemmiae*, two (0.9%) from *Spalangia* sp. and one specimen (0.5%) of *Trybliographa* sp.

Regarding the preference of parasitoids for species of dipterans, it was found that: *Aphaereta* sp. preferred *Sarcodexia lambens* (Wiedemann) (Diptera: Sarcophagidae); *B. podagrica* by *Oxysarcodexy thornax* Walker and *S. lambens*; *N. vitripennis* by *Chrysomya albiceps* (Wiedemann) (Diptera: Calliphoridae) and *Chrysomya megacephala* (Fabricius) (Diptera: Calliphoridae) ; *P. vindemmiae* by *S. lambens*; *Spalangia* sp. by *Musca domestica* L. (Diptera: Muscidae) and *Trybliographa* sp. by *O. thornax* ((X^2= 1897,17; GL=68; P<0,05) [10].

5.5. Study 5

The aim of this study was to know the species of parasitoids associated with *Musca domestica* L. (Diptera: Muscidae) in various substrates.

A total of 11403 pupae of *M. domestica* were collected from July 1999 to July 2003, of which 74 pupae were parasitized with 113 parasitoids. The prevalence of parasitism by the percentage 0.7% (74/11403). Chicken feces was the substrate in which the highest number of fly pupae was collected (68.2%).

Pachycrepoideus vindemmiae (Rondani) (Hymenoptera: Pteromalidae) was the most abundant species in puparia of *M. domestica* with 35.4%.

The percentage of parasitism in chicken feces, human feces, bovine liver, chicken viscera, food waste and bovine feces was 0.6%, 0.9%, 6.3%, 2.2%, 20.0% and 0.5%, respectively [11].

5.6. Study 6

The aim of this study was to study constancy, dominance, and monthly frequency of muscoid dipterans and their parasitoids (Hymenoptera and Coleoptera), associated with fresh cattle feces, in Uberlândia, MG.

A total of 6,292 dipterans were collected, represented by 5 families and 15 species of the order Diptera, in 120 fecal plaques, with an average of 52.4% individuals per fecal plaque. In the Sepsidae family, the most abundant species were: *Palaeosepsis insularis* Williston with 43.2% and *Palaeosepsis pusio* Schiner with 24.9%. In the family Sarcophagidae, *Sarcophagula* sp. represented 16.8% of the individuals collected. Among the Muscidae, *Brontaea quadristigma* by **(**Thomson) was the most abundant with 3.2%.

One thousand three hundred and six (1306) parasitoids belonging to 2 orders, 6 families and 14 species were obtained. The Pteromalidae family, with 6 species, was the one that showed the highest species richness among all studied parasitoid groups. The most abundant species within the families *were*: Figitidae with morphospecies 3 (54%), Pteromalidae with *Spalangia drosophilae* Ashmed (6.5%), Figitidae with morphospecies sp. (6.4%), Diapriidae with *Trichopria* sp. (6.1%) and Braconidae with *Aphaereta* sp. (1.6%).

These 1,306 parasitoids came from 6,292 pupae, corresponding to 4.8% of parasitism. A total of 989 specimens from 4,400 pupae of *Palaeosepsis* sp. (22.5% parasitism), 289 specimens from 1060 pupae of *Sarcophagula* sp. (27.3%), 11 specimens of 204 pupae of *B. quadristigma* (5.4%), 16 specimens of 147 pupae of *Brontaea debilis* Williston (10.9%) and 1 specimen of 397 pupae of Sphaeroceridae (0.3 %).

The parasitoid that presented the highest percentage of parasitism was Figitidae sp.2, which, together with *Spalangia cameroni* Perkins, was also found in a greater variety of hosts. Regarding the dominance of the studied species, only *P. insularis* and Figitidae sp.3 were dominant. The indices for *Sarcophagula* sp. The parasitoids that were non-dominant and constant in relation to this dipteran were: Figitidae sp. and Figitidae sp.2; non-dominant and accessory: *Aleochara notula* Erichson (Coleoptera: Staphylinidae), *S. drosophilae, S. cameroni* and *Trichopria* sp.; non-dominant and accidental: Figitidae sp.1, Figitidae sp.3, *S. endius*, *Spalangia nigroaenea* Curtis and *Spalangia nigra* (Letraille). All parastoids of *B. quadristigma*: Figitidae sp.2, *S. cameroni*, *S. nigroaenea* and *Trichopria* sp., were non-dominant and accidental [12].

5.7. Study 7

Thus, this study aims to contribute to the knowledge of these fly parasitoids that occur in cattle feces and in areas of native vegetation close to the studied pastures.

A total of 5,786 dipterans were collected: Muscidae: *Brontaea quadristigma* (Thomson) with 720 specimens, *Brontaea debilis* Williston with 452 specimens, *Cyrtoneurina pararecista* Couri with 2,362 specimens and *Musca domestica* L. with 1 specimen. Sarcophagidae: *Hybopygia terminalis* Wiedemann with 3 specimens, *Sarcophagula occidua* Fabricius with 2006 specimens, *Oxysarcodexy diana* Lopes with 2 specimens and *Oxysarcodexy thornax* Walker with 1 specimen and *Ravinia belforti* Prado & Fonseca with 1 espécimen;; Sepsidae: *Archisepsis scabra* Loew with 34 specimens, *Palaeosepsis insular* Williston with 131 specimens and *Palaeosepsis pusio* Schiner with 26 specimens; Sphaeroceridae: Sphaeroceridae sp. with 27 specimens.

Regarding the parasitoids 104 individuals belonging to the Eucoilinae and one individual from the Figitinae sub-family were collected. The percentage of parasitism was 1.81%.

The most abundant species of parasitoids were: *Triplasta* sp. (Figitidae) with 68.6% and *Paraganaspis egeria* Díaz, Gallardo and Wash (Figitidae) with 30.4%. The results suggest that *Triplasta* sp. they are the most abundant figitids in bovine feces with eight days of exposure.

Triplasta sp. showed a preference for *Palaeosepsis* sp. and *P. egeria* by *Sarcophagula occidua* Fabricius (Diptera: Sarcophagidae) pupae (X^2= 5.49; GL= 1; p=3.84), at a 5% probability level [12].

5.8. Study 8

The objective of this work was to identify the community of flies of medical and veterinary importance and their natural enemies in a cerrado region, located on the outskirts of the city of Itumbiara, GO.

In the present study 5825 muscoid dipterans belonging to four families were obtained. Of the individuals collected, the species *Fannia pusio* (Wiedemann) was the most abundant. *F. pusio* was the most frequent species, with (1698) 29.9%. The absence of species of the genus *Phaenicia* was noted in this work. *Atherigona orientalis* Schiner (Diptera: Muscidae) was the second most collected species among muscoids, being the first among muscidae.

With respect to parasitoids, the total percentage of parasitism was 6.8%. *Nasonia vitripennis* (Walker) (Pteromalidae) was the most frequent specimen, followed by *Brachymeria* sp. (Chalcididae); *Hememcyrtus* sp. (Hymenoptera: Encyrtidae) showed preference for pupae of *Euboettcheria* sp. (Diptera: Sarcophagidae) and *Synthesiomyia nudiseta* (Wulp) (Diptera: Muscidae), *N. vitripennis* for pupae of *C. albiceps* and *Oxysarcodexia thornax* (Walker), *Brachymeria* sp. for pupae of *Peckia chrysostoma* (Wiedemann) and for pupae de *F. pusio* (X^2= 1084,09; GL=20; P= 31,41).

Peckia chrysostoma was the specie that presented the highest rate of parasitism by *Brachymeria* sp. and *Pachycrepoideus vindemmiae* (Rondani) was the least frequent species [13].

5.9. Study 9

Thus, the objective of this work was to verify the parasitoid species found in *Cyrtoneurina pararescita* Couri (Diptera: Muscidae) pupae in bovine feces.

Of the 5758 flies collected, 2362 were represented by the species *C. pararescita*. The species of muscidae made up 61.3% of the flies and 41.8% of all individuals collected.

Four species of *Spalangia* were collected, totaling 15 individuals: one specimen of *Spalangia cameroni* Perkins, 1910 (6.7%), two specimens of *Spalangia endius* Walker, 1830 (13.3%), 10 specimens of *Spalangia nigroaenea* Curtis, 1839 (66.7%) and two specimens of *Spalangia* sp. (13.3%). The total percentage of parasitism was 0.63%. *Spalangia nigroaenea* was the most common parasitoid in *C. pararescita* pupae. No other type of parasitoid was found in pupae of this Diptera. These results suggest that *Spalangia* can be considered the most important natural enemy of *C. pararescita* in southern Goiás [14].

5.10. Study 10

This research aimed to study the fauna of arthropods associated with animal carcasses and collect possible natural enemies of flies that colonize this environment.

A total of 4395 arthropod specimens were collected from pig carcasses: 69.0% from exposed carcass in the forest and 31.0% from pasture. In the forest, a greater number of individuals and species were obtained.

Five specimens of *Paraganapis egeria* Diaz, Gallardo & Wash (Hymenoptera: Figitidae) and 7 of *Spalangia endius* Walker (Hymenoptera: Pteromalidae) were collected from puparia of *Chrysomya albiceps* (Wiedemann) (Diptera: Calliphoridae) and 6 specimens of *Pachycrepoideus vindemmiae* (Rondani) (Hymenoptera: Pteromalidae) *Ophyra aenecens* L. (Diptera: Muscidae). The total percentage of parasitism was 0.4%. In puparia of *C. albiceps* and *O. aenecens* it was, respectively, 0.3% and 2.0%. *P. vindemmiae, P. egeria and S. endius* showed, respectively, a percentage of parasitism of 0.1%, 0.1% and 0.2% [15].

5.11. Study 11

The aim of this study was to verify the species of parasitoids of the Pteromalidae family associated with muscoid dipteran pupae deposited in cattle feces in the municipality of Panamá, Goiás.

Of the total, 43 were parasitized, each by a single parasitoid. Five specimens of *Pachycrepoideus vindemmiae* (Rondani), four specimens of *Spalangia cameroni* Perkins, seven specimens of *Spalangia drosophilae* Ashmead, two specimens of *Spalangia endius* Walker, seven specimens of *Spalangia nigra* Latrielle and 18 specimens of *Spalangia nigroaenea* Curtis were collected. The total percentage of parasitism observed was 14.7% (43/293).

The percentages of parasitism of *P. vindemmiae*, *S. cameroni*, *S. drosophilae*, *S. endius*, *S. nigra* and *S nigroaenea* were 1.7% (5/293), 1.4% (4/293), 2 .4% (7/293), 0.7% (2/293), 2.4% (7/293) and 6.1% (18/293), respectively.

Spalangia nigroaenea was the most collected species with 41.9% (18/43) and showed the highest percentage of parasitism in pupae of *Brontaea quadristigma* (Thomson) (Diptera: Muscidae), with 16.1% [16].

References

[1] Linhares, A. X., 1981. "Synanthropy of Calliphoridae e Sarcophagidae (Diptera) in the city of Campinas, São Paulo, Brazil." *Rev. Bras. Entomol.*, vol. 25, pp. 231-243.

[2] Carvalho, C. J. B. and Mello-Patiu, C. A., 2008. "Key to the adults of the most common forensic species of Diptera in South America." *Rev. Bras. Entomol.*, vol. 52, pp. 390-406.

[3] Oliveira, T. C. and Vasconcelos, S. D., 2010. "Insects (Diptera) associated with cadavers at the Institute of Legal Medicine in Pernambuco, Brazil: Implications for forensic." *Entomol. For Sci. Int.*, vol. 198, pp. 97–102.

[4] Carmo, D., Neves, D., Arcanjo, L., and Arcanjo. "Inimigos naturais de pragas agrícolas." Available: www.museudeentomologia.ufv.br/inimigos-naturais-de-pragas-agricolas/

[5] Marchiori, C. H., 2016. "Armadilhas para coleta de espécimes de inseto no Brasil." *Biológico*, vol. 78, pp. 1-5.

[6] Marchiori, C. H., 2021. "Parasitoids of agricultural importance collected at Atlantic forest. biomes in Brazil: A bibliographic summar." *J. Agri. Scie.*, vol. 3, pp. 28-32.

[7] Marchiori, C. H., Barbaresco, L. F., and Ferreira, M. E., 2008. "Parasitoides de Diptera coletados em áreas florestal, rural e urbana em Monte Alegre, MG." *Arq Bras Med Vet Zootec*, vol. 60, pp. 570-1572.

[8] Marchiori, C. H., 2011. "Sinantropia de parasitoides de dípteros coletados em fezes bovinas." *Arq. Bras. Med. Vet. Zootec.*, vol. 63, pp. 492-494.

[9] Marchiori, C. H., Silva, F. O. M., Fortes, F. C. A., Brunes, R. R. B., Borges, R. F., Gonçalves, P. L. P., and Laurindo, J. F., 2005. "Parasitoides de *Fannia pusio* (Wiedemann, 1830) (Diptera: Fanniidae) coletados em Caldas Novas, Goiás, Brasil." *Cienc. Agrotec.*, vol. 29, pp. 1288-1291.

[10] Marchiori, C. H., Leles, A. S., Carvalho, S. A., and Rodrigues, R. F., 2007. "Parasitoides de dípteros muscóides coletados no matadouro vorada em Itumbiara, sul de Goiás Brasil." *Rev Bras Parasitol Vet*, vol. 16, pp. 235-237.

[11] Marchiori, C. H., 2006. "Microhimenópteros de *Musca domestica* L. (Diptera: Muscidae) coletados em diferentes substratos em Itumbiara, Goiás." *Arq. Bras. Med. Vet. Zootec.*, vol. 58, pp. 447-449.

[12] Marchiori, C. H. and Linhares, A. X., 2000. "Constância, dominância e freqüência mensal de dípteros muscóides e seus parasitoides (Hymenoptera e Coleoptera), associados a fezes frescas de bovinos, em Uberlândia, MG." *Neotrop Entomol*, vol. 28, pp. 375-387.

[13] Marchiori, C. H., Castro, M. E., Paiva, V. T., Teixeira, F. F., and Silva, C. G., 2000. "Dípteros muscóides de importância médica e veterinária e seus parasitóides em Goiás." *Arq. Bras. Med. Vet. Zootec*, vol. 52, pp. 350-353.

[14] Marchiori, C. H., Oliveira, A. T., and Linhares, A. X., 1999. "Espécies de *Spalangia* (Hymenoptera: Pteromalidae) como inimigos naturais de *Cyrtoneurina pararecista* Couri (Diptera: Muscidae) em fezes bovinas no Sul Goiano." *Arq. Bras. Med. Vet. Zootec*, vol. 51, pp. 401-402.

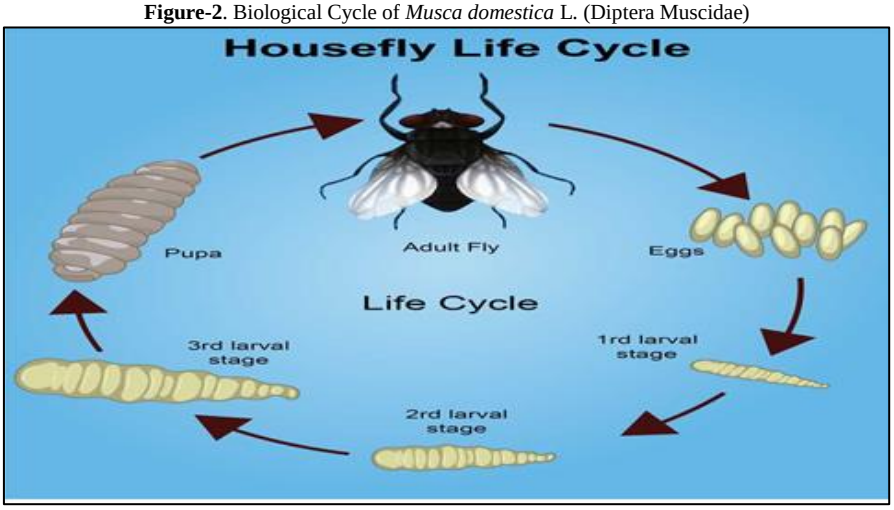
[15] Marchiori, C. H., Silva, C. G., Caldas, E. R., Vieira, C. I. S., Almeida, K. G. S., Linhares, A. X., and Teixeira, F. F., 2000. "Dípteros muscóides associados com carcaça de suíno e seus parasitóides em área de pastagem e de mata em Goiás." *Arq. Bras. Med. Vet. Zootec.*, vol. 52, pp. 459 – 460.

[16] Marchiori, C. H., Silva, F. O., Borges, M. P. M., and Melo, M., 2005. "Parasitóides da família Pteromalidae (Hymenoptera: Pteromalidae) coletados em fezes de gado bovino em uma propriedade rural do município de Panamá, Goiás." *Arq. Bras. Med. Vet. Zootec*, vol. 57, pp. 270–272.

Figure-1. *Chrysomya megacephala* (Fabricius) (Diptera: Calliphoridae)

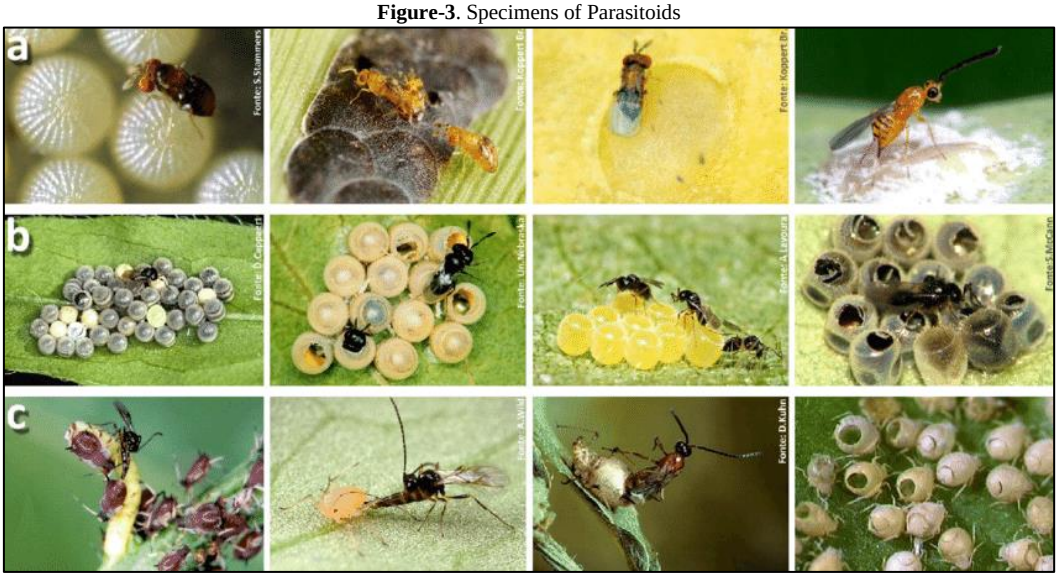
Source: https://www.shutterstock.com/pt/search/diptera

Figure-2. Biological Cycle of *Musca domestica* L. (Diptera Muscidae)



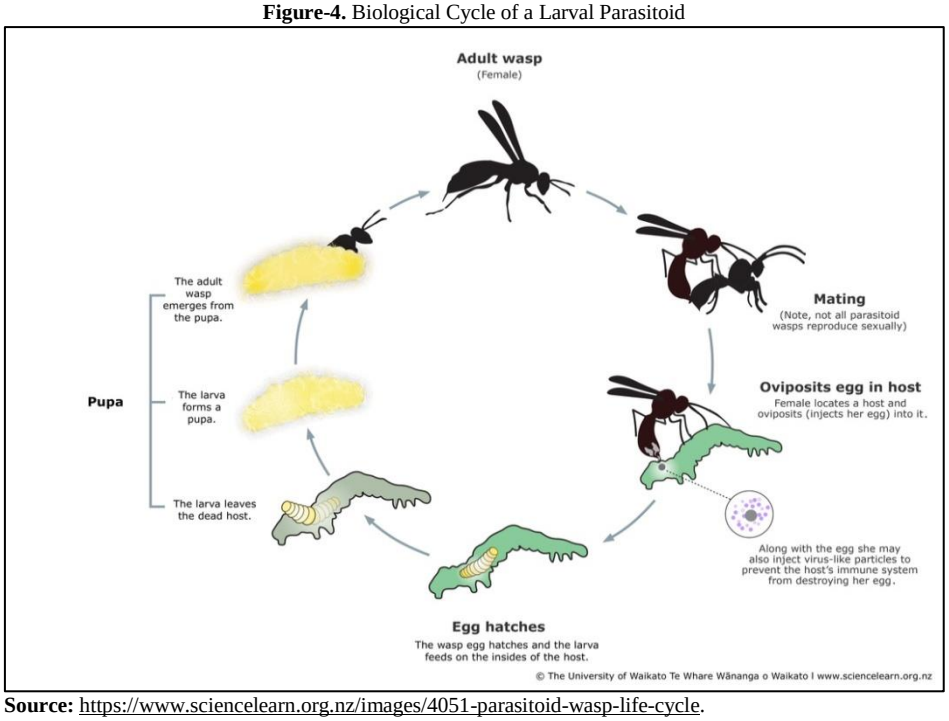
Source: https://pestremovalwarrior.com/housefly-life-cycle-various-stages-of-development/

Figure-3. Specimens of Parasitoids



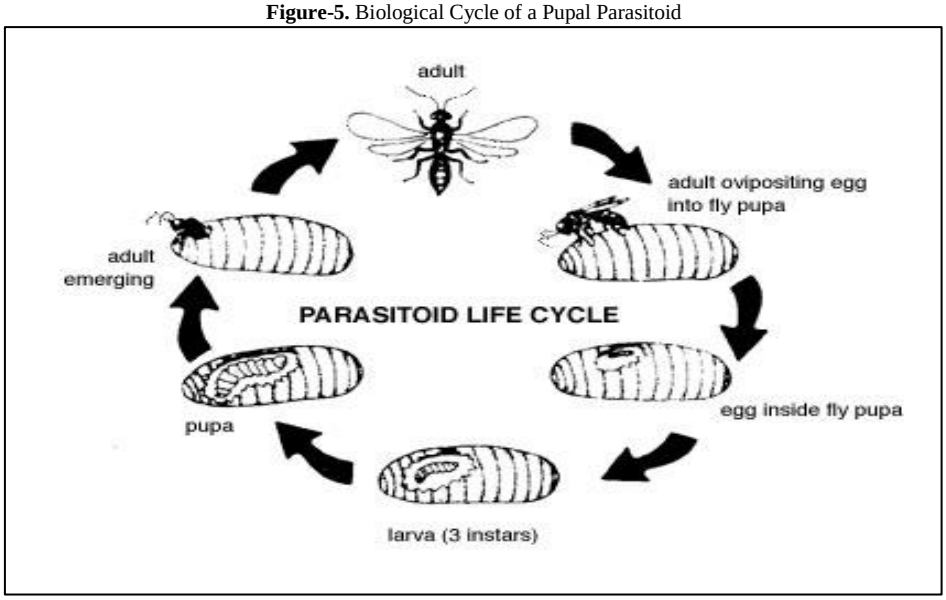
Source: https://www.researchgate.net/figure/Figura-1-Inimigos-naturais-das-pragas-a-micro-vespas-parasitoides-de-ovos-de-lagartas_fig1_347977792.

Figure-4. Biological Cycle of a Larval Parasitoid



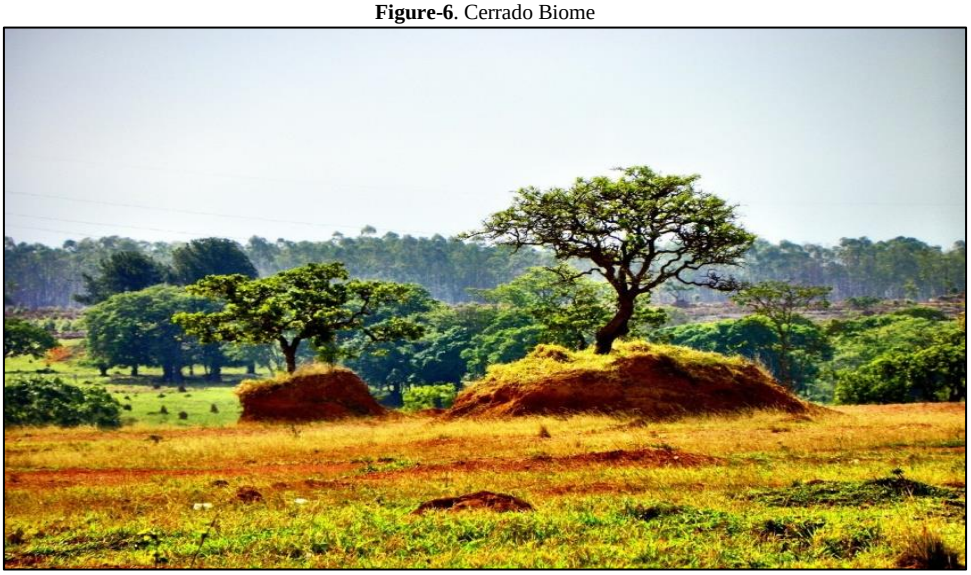
Source: https://www.sciencelearn.org.nz/images/4051-parasitoid-wasp-life-cycle.

Figure-5. Biological Cycle of a Pupal Parasitoid



Source: https://biocontrol.entomology.cornell.edu/parasitoids/muscidifurax.php.

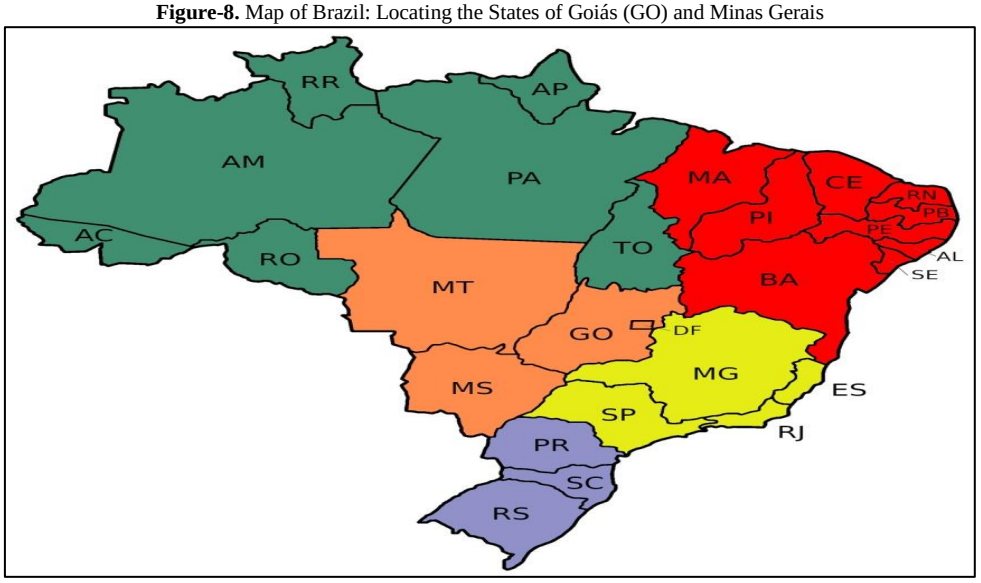
Figure-6. Cerrado Biome



Source: https://www.infoescola.com/geografia/cerrados/.

Figure-7. Metal Container Traps

Figure-8. Map of Brazil: Locating the States of Goiás (GO) and Minas Gerais



Source: https://www.infoescola.com/geografia/mapa-do-brasil/