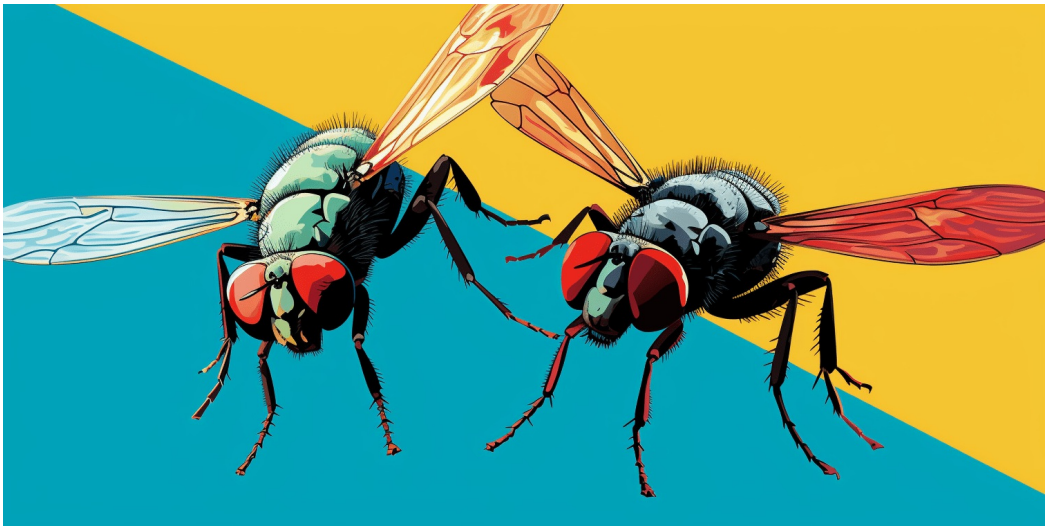

Investigation of the families Asteiidae, Lauxaniidae, Mydidae, and Neriidae (Insecta: Diptera)

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Abstract

Adults of the Asteiidae family can be captured with Malaise traps set within the forest, but the best way to obtain specimens is when they are found congregating. At these sites, one can easily capture the adults with a vacuum cleaner. The larvae may be scavengers on the excrement of other insects. Adult Lauxiniidae are sedentary and like shaded places. They can be found in a wide variety of environments such as grasses, flowers, compost capitula, and low foliage, mainly in humid forests near streams and swamps. It was observed that they are more active at the end of the afternoon and, therefore, are easier to collect during this period. Many adults are scraper fungi found on leaves. Larvae in this family are primarily saprophagous, commonly found in fallen leaves, rotting wood or straw, decaying vegetation, and bird nests. Mydidae is a relatively small group of Asiloidea (Diptera) that comprises the largest flies in the world, and little is known about the nature of adults; males visit flowers occasionally, and females are unlikely to feed. The Mydidae constitute a family of orthorrhaph flies, which includes the largest known dipterans. Larvae of several species of Mydidae feed on immatures of Coleoptera and can be found in nests of *Atta* spp., and *Acromyrmex* spp. ants. All other Neriidae probably feed on other decaying plant organic tissues, such as plant resins and fruit secretions, and more rarely on animal manure and organic matter. Some species of *Glyphidops* Enderlein, Sepúlveda et al. (2014) and *Nerius* Fabricius, 1805 were observed on freshly felled trunks and branches, in galleries of wood saw

beetles (Coleoptera, Cerambycidae), while others may be associated with human crops, such as squash, cotton, banana, gourd, and papaya. Some species have high rates of synanthropy, being attracted by cooking odors and becoming common inside homes. Some species are used for behavioral and sexual selection studies. The mini-review aims to verify the themes of the Asteiidae, Lauxiniidae, Mydidae, and Neriidae families such as morphology, biology, and systematics. In terms of the type of research source, we worked with scientific articles published in national and international journals. This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, and Hall. Considering only this section constitutes a limitation of the study since articles belonging to journals that integrate other sections of the aforementioned electronic library could also contribute to the discussion of knowledge production and the writing of interpretative syntheses of each theme.

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1. Introduction

Some dipterans are of fundamental medical and veterinary importance since they can produce myiasis and act in the transmission of pathogens to humans and other animals. Diptera is valuable for Forensic Entomology, larval therapy, pollination, decomposition of organic, necrophagous, matter, predators, parasitoids, ectoparasitic mammals, and vectors of pathogens. The occurrence, distribution, and predominance of these flies in metropolitan areas are factors of great importance in public health. In rural areas, they can lead to a decrease in egg production and animal diseases, in addition to causing discomfort to the population neighboring the creations [1].

1.1. Objective

The mini-review aims to verify the themes of the Asteiidae, Lauxiniidae, Mydidae, and Neriidae families such as morphology, biology, and systematics.

2. Methods

In terms of the type of research source, we worked with scientific articles published in national and international journals. This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, and Hall. Considering only this section constitutes a limitation of the study since articles belonging to journals that integrate other sections of the aforementioned electronic library could also contribute to the discussion of knowledge production and the writing of interpretative syntheses of each theme.

3. Family Asteiidae

This is a worldwide family of approximately 100 described species of very small acalyptrates grouped into 10 genera. A few species have been bred from fungi, and many species are associated with trees; few are collected using generalized methods like Malaise traps. Although all but two of the 10 genera occur in the Indo-Pacific region, Fiji's known fauna has five species of just the genus *Asteia* Meigen, all but one of which are new[1][2].

3.1. Description

They are very small (2 mm or more) and inconspicuous flies with several particular characteristics, especially in terms of wing venation. Identification of these flies at the family level requires a stereoscope or a good hand lens. The wings are transparent and have only two longitudinal veins (2 and 3; the first vein is very short and bends towards the costal vein). This feature is unique to this family [1][2].

A similar, but not identical, feature is found in some Chloropidae. Other features of members of this family include a thorax that is generally black or light brown and highly polished, and an abdomen with slender, dark-spotted tergites arranged in pairs. Males have headbands across the forehead [3][4].

3.2. Biology

Adults can be captured with Malaise traps set within the forest, but the best way to obtain specimens is when they are found congregating. At these sites, one can easily capture the adults with a vacuum cleaner. Adults are often found on flowers and low vegetation but have been collected from indoor windowsills and tree wounds. In one genus *Leiomyza* Macquart, 1835, adults are found on mushrooms and bracket fungi[5][6].

Adults of the species *Astiosoma rufifrons* Duda, 1927 are attracted to wood ash after bonfires, especially at dusk. The biologies of the larvae are unknown, but adults have been reared from fungi (*Leiomyza*), *Cannabis sativa* L. (Cannabaceae) stems, flower buds, and dried cane stems. The larvae may be scavengers on the excrement of other insects [7][8].

3.3. Taxonomy

There are only 2 genera and 8 species reported for Costa Rica (antenna, expanse, and spinosa). The asteíids, like most of the small groups of calyptrate flies with delicate individuals, have been taxonomically neglected, and it is difficult to estimate their true diversity in Costa Rica [9][10][11].

Subfamilies: Asteiinae and Sigaloessinae.

4. Selected Manuscripts

4.1. Study 1

Occurrence of Asteiidae in the Gemer area, listing 5 species. No additional species have been found during fieldwork in the Muránska planina in 2013; only additional records of 3 species are presented below.

Asteia amoena Meigen, 1830.

Remarks: A common species recorded from an additional locality in the Muránska planina NP, here surprisingly found in the forest undergrowth.

Leiomyza dudai Sabrosky, 1956.

Remarks: Although this mycophagous species is common in Slovakia, it has previously only once been recorded from the Muránska planina NP (Roháček 1986: Muráň).

Leiomyza scatophagina (Fallén, 1823).

Remarks: There were only two records of this uncommon species from Gemer. The above specimen confirmed the contemporary occurrence in the Muránska planina NP [12][13][14].

4.2. Study 2

Asteiidae Flies Facts

There are six species in Holland. Two species of *Asteia* and four species of Leiomyza. *Asteia* Meigen, 1830, species have ocher-yellow colors with dark patterns. *Leiomyza* species are shiny black.

The flies are called 'zigzag flies' because of the characteristic arista has a typical zigzag pattern with many lateral branches. Also typical are the long wings that project beyond the abdomen. The wings are clear and iridescent. Asteia species have only one r-n crossvein. *Leiomyza* species also have a dm-cu cross vein.

Asteia concinna Meigen, 1830 is mostly found in brackish water areas, but we also find it in bogs in the Hoge Veluwe. *Asteia amoena* Meigen, 1830 the most common species within the family.

Leiomya species are observed in various types of mushrooms, especially in decaying oyster mushrooms. They have an elaborate mating ritual in which they flap their wings and exchange a drop of moisture as a nuptial gift ("tropholaxia"). Tropholaxis also occurs in other types of flies, including the beautiful Platystomatidae flies.

They exhibit typical flight behavior. They hover over a seat and do a sudden vertical deflection when startled, followed by a slow descent to the seat [15].

4.3. Study 3

A parasitological examination of sturgeons of the family At the external examination of an Amur sturgeon*Acipenser schrenckii* Brandt, 1869 (Pisces: Acipenseriformes; Acipenseridae) with a body length of 40 cm by Smith a small wound closed with skin was found on the ventral side of the body at the base of the 8th scute of the ventral row. After dissecting the wound an imago *Leiomyza scatophagina* (Fallen, 1823) was extracted. Fish were examined live right after they had been caught which excluded the probability of getting flies into tissues during the procedure. Moreover, growing into the adult stage one hour is impossible. Most likely, the invasion and laying took place in the aquatic environment.

According to unpublished information from ichthyologists and fishermen, juvenile sturgeons, to which this specimen belonged, typically keep in shallow waters, unlike adults. A slight injury of soft tissue was seen at the base of the scute that could allow the fly to put its egg. This is most probably a case of facultative myiasis, a disease caused by the invasion and activity of larval and adult arthropods in the tissues and cavities of human or animal organisms.

Larvae’s ability to exist in decomposing organic materials predetermined the development of larval parasitism in flies. Many species, for which necrophagy is more or less typical, can use not only meat and corpses but also festering wounds on a human or animal’s body as a substrate for oviposition. In most cases, larvae do not come out of the boundaries of the wound and do not damage the intact tissues of the host animal.

They consume purulent exudate and dead tissues and actually do not differ much from their free-living congeners. The family Asteiidae includes about 100 species of 11 genera described in the world fauna. These are minute to small (1.0-3.0 mm), delicate, often weakly sclerotized flies. Three genera and about 10 species are recorded from Russia. Two species of the genus *Asteia* are known from the Russian Far East. Biology is poorly known. The European species of Asteiidae belong to two, ecologically different groups. *Asteia* species are considered to be (phyto-)saprophagous as larvae. *Leiomyza* species have mycetophagous larvae developing in the sporocarps of fungi and occur chiefly in woodland [16][17].

5. Familia Lauxaniidae

The Lauxanioidea are a superfamily of flies that includes the two large families, the Lauxaniidae and Chamaemyiidae, and the small family Celyphidae. Generally, they are small to medium, densely populated, colored flies. The Chamaemyiidae live as parasites on insects. The family Celyphidae looks like beetles. Larvae of most Lauxaniidae and Celyphidae feed on

decaying vegetation. Some species of Lauxaniidae only occur in bird nests. Adult lauxaniids may visit flowers. Larvae of all known Chamaemyiidae have a rather different lifestyle: they are predators of aphids and scale insects. The Lauxaniidae constitute one of the largest families of Diptera Schizophora, with worldwide distribution, very abundant in tropical areas, and absent in the Antarctic region [18][19][20].

5.1. Description

Lauxaniids range from small to medium in size, 1.5 to 8.0 mm. Their bodies are variously marked and colored, varying from pale yellow to brown, gray, or black, sometimes with mingling or dark spots. The wings are usually yellowish, but there may be spots or dark areas. The head is spherical, but very projecting anteriorly in the species of some genera. Some species have impressively colored eyes in life [21][22][23].

The antennae are normally short, but a group of genera has very long antennae. The thorax is normally matte. The abdomen is ovoid, rarely thin. The family can be recognized by the convergence of the postocellar setae, the presence of 2 front orbital setae, the absence of vibrissae, and wing venation with a complete costal vein, a complete subcostal vein, and a short anal vein, not extending to the wing margin [24][25][26].

5.2. Biology

Adult Lauxiniidae is sedentary and likes shaded places. They can be found in a wide variety of environments such as grasses, flowers, compost capitula, and low foliage, mainly in humid forests near streams and swamps. It was observed that they are more active at the end of the afternoon and, therefore, are easier to collect during this period. Many adults are saprophagous fungi found on leaves [27][28][29].

The larvae of the family feed on decaying plant matter. In the temperate region, larvae of most species are saprophagous, living on fallen leaves and other decaying plant material. There are few records regarding the biology of Neotropical Lauxaniids, and immature stages have not been described [30][31][32].

Larvae in this family are primarily saprophagous, commonly found in fallen leaves, rotting wood or straw, decaying vegetation, and bird nests. Some species are known to be phytophagous and have been reported on roots, stems, and leaves of clover, on galls on the ovaries of violets, and on pseudo-leaves of cacti [33][34][35].

5.3. Biological cycle

The complete cycle from egg to adult can take from 16 to 96 days in the Nearctic region. Eggs are laid on individual leaves among the fallen leaves of the mulch. The eggs hatch in 2-3 days into first-instar larvae. There are 3 larval instars, and generally, the younger instars penetrate the leaf tissues and burrow as leafminers. The more advanced stages can do the same but are more often found outside the leaves. The formation of the puparium can occur inside the leaf, or the same larva can be covered with a calcareous secretion before forming the puparium; the secretion appears to originate from the Malpighian tubules [36][37][38].

5.4. Habitat and Distribution Geographic

Adults of most species prefer moist, shady habitats. Many species can be found visiting flowers. They are commonly found on low vegetation and become increasingly active in the late afternoon and early morning. Some species are attracted to light, to baits with decaying fruit or meat. They can be reared using a jar covered with nylon cloth and with honey and brewer's yeast as food for the adults. Leaves from mulch, decaying lettuce, and tree leaves can be used for larvae [39][40][41].

The Lauxiniidae have distribution in all the main biogeographical regions of the world. The neotropical Lauxiniidae are ten shared with the Nearctic region, and four are widely distributed and found in other regions. This review of the Neotropical genera indicated the existence of this region [42][43].

5.5. Taxonomy

The family of Acalyptrate dipterans, Lauxaniidae, is one of the largest of the division Schizophora. The Lauxaniidae is composed of about 142 genera and approximately 1550 species, with distribution in all the main biogeographical regions of the world. The neotropical Lauxaniidae is composed of 32 endemic genera, shared with the Nearctic region, and four widely distributed in other regions. The family comprises three subfamilies, Lauxaniinae, Homoneurinae, and Eurychoromyiinae [44][45][46][47].

6. Selected Studies

6.1. Study 1

The objective was to characterize the Diptera fauna in the upland fragment of the 1st Infantry Battalion in the Jungle - Manaus, Amazonas, in the dry and rainy periods.

The collections were made in September and October 2017, comprising the least rainy period in this region, and also in February and March 2018, comprising the rainiest period. The specimens were collected in in-flight interception traps (passive collections: two Malaise and two Suspended (1m)) that remained in the field for seven days of each month.

During the dry and rainy seasons, 1379 dipterans of the Brachycera suborder were captured and divided into 28 families, which are: Agromyzidae (1), Calliphoridae (2), Chloropidae (14), Clusiidae (5), Drosophilidae (138), Dolichopodidae (203), Ephydridae (25), Hybotidae (10), Lauxaniidae (32), Lonchaeidae (5), Micropezidae (27), Milichiidae (39), Muscidae (20), Neriidae (3), Periscelididae (10), Phoridae (463), Richardiidae (9), Ropalomeridae (4), Sarcophagidae (45), Sepsidae (8), Syrphidae (11), Sphaeroceridae (175), Stratiomyidae (64), Tabanidae (12), Tachinidae (25), Ulidiidae (26), Xylomyidae (3).

The collections in the dry period were less abundant in relation to the rainy period (455 and 920, respectively), possibly

due to the increase in rainfall, which caused a greater presence of wild fruits in the process of fermentation, with the most abundant families in traps decomposing organic matter such as Phoridae, Sphaeroceridae, and Drosophilidae.

Lauxaniidae is one of the largest families of Diptera Schizophora, with a very abundant distribution in tropical areas, and is composed of about 1,550 species, but the Brazilian fauna comprises a smaller number of species, about 106, divided between 39 genera. Adults have a small to relatively large body (2-11 mm), with varying coloration, often with markings, spots, stripes, or reticulated patterns. The larvae of these families are known as saprophages, feeding on a variety of decaying plant matter and even on flower heads. Adults are leaf fungus scrapers [48][49].

6.2. Study 2

The general objective of this study was to generate scientific knowledge about the pest and beneficial insects associated with guava in Honduras; this information may be used by national producers in the design of a better agronomic and phytosanitary management plan for this crop.

The total abundance of insects in the three sampling methods was 13,568 insects, with the Pitfall trap capturing the highest number of insects at 5,670, followed by the McPhail trap with 5,413 insects, and finally the observation method with 2,485 insects. Pitfall and McPhail traps are effective for capturing insects, since a good number of them were caught using this type of trapping; it is reported that visual observation is not as effective for stopping a number of insects.

Quarantine families were collected of insects associated with guava; in addition, 10 types of feeding habits of insects were reported. The most abundant families were Muscidae, Lauxaniidae, Tephritidae, Apidae, and Formicidae. The Shannon-Weaver diversity index, a diverse fauna is considered when it is above an index of 2 upwards with a maximum of 5. In this study, low diversity indices resulted in an average of 1.061, which indicates that the entomofauna in guava is low [50].

6.3. Study 3

The Acalyptrated Diptera, although they do not form a natural group, share some characteristics, such as the reduction or absence of the calyptra, the absence of the longitudinal suture in the pedicel, and the incomplete suture of the thorax. Within the Muscomorpha, they were once considered a sister group to the Calyptrates; however, more recent evidence has indicated their paraphyly.

The “acalyptrates” have a worldwide distribution and a great diversity of habits and forms. There are a total of approximately 80 families in the world, with many species. Some families are very numerous, such as Agromyzidae, Chloropidae, Drosophilidae, Ephydridae, Lauxaniidae, and Tephritidae, which together represent more than 50% of the species in this group. The biology and ecology of these dipterans are quite varied and can be miners, gallers, aquatic, predators, and saprophages.

As a result, a total of 10 families were found, with the following diversity: Agromyzidae, Chloropidae, Drosophilidae, Ephydridae, Lauxaniidae, Neriidae, Milichiidae, Sepsidae, Chyromyidae, and Sphaeroceridae. The most numerous in

terms of the number of specimens collected were Chloropidae and Drosophilidae. Some families collected have great economic, agricultural, medical, and veterinary importance.

The Agromyzidae, for example, for having the biology of their immature phase related to plants, being miners of leaves, stems, and fruits, are considered pests, since they interfere with the development of the plant, compromising its commercial interest. The larvae of most species of Chloropidae feed on grass stems and are serious pests of cereals. Some chloropids, which grow in decaying vegetation and droppings, are attracted to animal secretions, particularly the eyes. That's why they are called "eye-lickers." They can act as vectors of yaws and conjunctivitis.

Drosophilidae is known as vinegar flies and are often domestic pests on fruit present, and some species are ectoparasites. The Ephydridae family has aquatic or semiaquatic habits; they are found in rivers, water collections, and seas. The Lauxaniidae have saprophagous larvae and are possible consumers of microorganisms, fungi, bacteria, and yeasts. About the Neriidae family, there is no knowledge of the immature stage; it is only known that the adults feed on tree excrement and rotten fruits.

The Milichiidae have some species that are kleptoparasites and therefore steal food captured by other animals. Sepsidae is called "black cleaner flies" and some species can be found on the face of mammals; the larvae feed on various decaying materials. Chyronomyidae larvae are apparently saprophagous, occurring in a series of substrates. They are found in vegetation of saline areas, mainly beaches. The larvae of the Sphaeroceridae family are microbial herbivores, found in environments rich in bacteria [51].

7. Family Mydidae

Mydidae is a relatively small group of Asiloidea (Diptera) that comprise the largest flies in the world and little is known about the nature of adults; males visit flowers occasionally and females are unlikely to feed. The Mydidae constitute a family of orthorrhaph flies, which includes the largest known dipterans. These are dipterans medium to large size (9 – 60 mm). Its orange, black, and white colors shimmered in the rays of sunlight [52][53].

7.1. Description

The Mydidae family presents the following apomorphic characters: simple subgenera or with a wide median projection, maxillary palp with a segment, commonly reduced and without pit, which differs from Anomalomydas Papavero & Wilcox, proprecoxal bridge present, reduced macrosetae on the shield and escutcheon or absent, males with tergum 8 with deeply concave posterior margin (except in *Syllegomydas* Becker, 1906), hypandrium fused to the gonocoxytes or absent, gonostyles absent, aedeagal apodemes absent, and tergum 9 of females extending ventrally to the middle of the acanthophorites.

The proboscis is little developed or even vestigial and the antennae are long, ending in the shape of a club. They have an elongated body, sparsely hairy, generally dark, dull, brown to blackish in color. The bristles are developed only on the

paws. In the wings, the veins end before reaching the tip, with which, in general, the posterior alar margin does not or almost does not present veins [54][55][56][57].

7.2. Biology

Larvae of several species of Mydidae feed on immatures of Coleoptera and can be found in nests of *Atta* spp. (Zikán, 1942) and *Acromyrmex* spp. ants. Adults are suggested as being flower visitors, but the biology of most species is still unknown. *Gauromydas heros* (Perty, 1833) males visit flowers, but adult females were not recorded visiting flowers and might not feed. Mydidae species are rarely sampled and seen in the field.

Most adults live in open, generally hot, arid, sandy habitats. The measured ones move quickly over the sand, running backward so easily like forwards, and they are fast fliers. The males feed on nectar, while the females, it seems, feed on body reserves. The belief that they are predators does not seem to be true, since the mouthparts seem to be indicated to suck nectar from flowers and not for predation. The larvae, meanwhile, are predators of beetle (Coleoptera) larvae in stumps and ants (Hymenoptera).

Floral-visiting Diptera family and food adaptations. The proboscis structure is short and thick, some stunted and others elongated. Adult feeding: Most of them feed obligatorily on flowers. Feeding of the larvae: predators of the soil [58][59][60][61].

7.3. Habitat and Geographic Distribution

They are found in desert or semi-desert areas, with some species in forests; the richest in Afrotropical species, followed by Nearctic, Neotropical, Palearctic, Australian, and Eastern, in that order of richness. Cuba, Venezuela, Colombia, Chile, Argentina, Brazil, Mexico, North Africa, specifically from Morocco, Algeria, Tunisia, Egypt, and Europe [62][63]

7.4. Taxonomy

With more than 360 species, this family is known from all biogeographical regions, with South Africa and South America being the areas with greater diversity. As for Europe, until now, only six species were known, of which two have been cited from the Iberian Peninsula, specifically two from Spain and one from Portugal. Mydidae is divided into nine subfamilies, three of them occurring in Brazil: Apiophorinae, Rhopaliinae, and Mydinae.

Familia Mydidae: Subfamilia Leptomydinae and Syllegomydinae. [64][65][66][67].

8. The following studies were selected

8.1. Study 1

Messiasia notospila (Wiedemann, 1830). Brazil: Mato Grosso do Sul (Porto Murtinho, arredores do Hotel Camalotes) 1

male. *Messiasia zikani* D'Andretta, 1951. Brazil: Mato Grosso do Sul (Corumbá, Serra do Urucum).

Gauromydas autuorii (D'Andretta). Maracajú, Mato Grosso, Brasil; female.

Syllegomydas algericus (Gerstaecker, 1868)

The genus *Syllegomydas* Becker, 1906 comprises 17 species distributed throughout Africa and Asia, while the species*S. algericus* was only known from North Africa, specifically from.

Morocco, Algeria, Tunisia, and Egypt, Europe. Thus, the number of known species in the Iberian Peninsula (in Spain) and in Europe, respectively, rises to three and seven. We estimate that nearly 20 species are likely to occur in the state.

Nemomydas sponsor (Sacken, 1886).

Leptomidas sponsor Sacken, 1886.

Distribution: Guatemala, Nicaragua, and Granada.

This shows the lack of information available for the group in Brazil, especially in some states where collecting and sampling efforts were limited up to now. Regardless of their ecological importance as endoparasitoids and their potential relevance for pollination, studies and sampling in Acroceridae are still scarce. This evidences the necessity of sampling in Brazil, as in the Mato Grosso do Sul area, for instance [68][69].

8.2. Study 2

The Mydidae Family in Antofagasta, Chile

It is a family related to the robber flies (Asilidae), but of older lineage.

The Mydidae are a small family of flies, which has about 470 described species around the world. They are flies typical of arid zones or -at least- poor in vegetation. They prefer warm climates and the hottest times of the year. None of its species is small, but they range from medium to large, so much so that the largest fly in the world (6 centimeters) belongs to this family.

Mitrodetus dentitarsis (Macquart, 1850)

Since deserts are not scarce in our country, it is understandable that we have a good number of species of Mididae, all of which are endemic, that is, exclusive to our country. Of the 14 known species, most have been recorded from the third region to the south, but this is surely due to how little studied the great North has been over the years. Considering that the desert is our main - if not only - regional landscape, it is obvious to assume that there are more species in our environment than the two that we have been able to observe on our tours, a short distance from the city.

Mitrodetus dimidiatus Philippi, 1865.

These flies, as is often the case, have different eating habits in their larval state than in their imago state (*adult insect). As flies, to be clearer, it is known that many feed on the nectar of flowers, constituting a valuable contribution to the pollination of our plants, although research carried out in other countries indicates that in certain species only the males feed on this form, maintaining their females' predatory behaviors.

In its larval state, meanwhile, it has been proven that they effectively play a predatory role on other larvae, of multiple species of insects - such as bees, wasps, and beetles - that develop under the ground and up to about 10 cm deep. Insects that dig caves abound in our area, in which they hide their larvae so that they can develop, accompanied by paralyzed spiders or orthoptera, to serve them as food, as various genera of wasps do, or simply to protect them, as some bees do. These could be good food for the larvae of the middle, as well as the larvae of Coleoptera, which feed on the roots of the plants.

Mitrodetus microgloss sp. nov.

The underground development of the Mididae lasts between two and three years, after which the adult emerges from the ground, climbing onto a plant or rock where it can expose its wings to dry them. Shortly after this, the female can reproduce and start a new cycle.

Little is known about these flies, since most of their life is spent underground, and their imago period is short and takes place in desert areas, often far from man. Even the aforementioned largest fly in the world is little known, for the same reasons. This leads us to believe that, if serious and complete studies were made of our entomological fauna, we would find that our country has more than 14 species of Mididae.

Mitrodetus ovilaying sp. nov.

He has 70% of his body inside the arena[70][71][72][73].

8.3. Study 3

Biology of the Family Mydidae

Little is known about their biology, although Zikan reported that *Gauromydas heros* (Perty, 1833) larvae live in subterranean "trays" of *Atta* sp. ant detritus in southern Brazil, where they appear to feed on detritivorous larvae of Dynastinae (*Coelosis* spp.). In the United States, *Mydas brunneus* Johnson, 1926, *Mydas clavatus* (Drury, 1773), and *Mydas tibialis* Wiedemann, 1831, larvae are predators of beetle larvae (*Osmoderma* spp.) which feed on dead wood and can be found on standing and fallen trees with extensive heart rot. Others *Mydas maculiventris* (Westwood, 1835) are subterranean and feed on "white grubs" Scarabaeidae: genus *Phyllophaga* Harris 1827), that attack grass roots and could be potential biological control agents for white grubs in turf production areas).

The larvae usually take two to three years to mature. Adults of several species are avid visitors to flowers and act as pollinators. Rattlesnake master *Eryngium yuccifolium* (Rattlesnake Master) (Apiaceae) is a favorite nectar source in the

Midwest. They are found infrequently as the adult life expectancy can be quite short [74].

8.4. Study 4

Mydidae Family

The larvae usually live in loose, dry soil, sometimes in decaying wood, and develop by attacking juvenile stages of other insects, usually beetles. Pupation takes place below the surface of the soil, and at the end of the nymph stage, the adult, in the farata phase, emerges to the surface to seek the warmest hours. Adult males are glyciphagous and feed by sucking nectar from flowers, or do not feed due to atrophy of the mouthparts. Females do not feed and, to perform reproductive functions, exploit the adipose reserves accumulated in the abdomen during post-embryonic development. The typical habitat is represented by open ecosystems with a hot and arid climate; therefore, Mydidae are mainly found in the deserts and steppes of tropical and subtropical regions. Several species have adapted in every way to colonize wetter environments, such as the rainforest.

Farata phase

Stage of post-embryonic development between molt and cuticle detachment. The individual in the farata form has already completed its development but remains within the cuticle of the previous stage. In Diptera, there are farata forms:

1. The first-age larva during the end of incubation, surrounded by the embryonic cuticle.
2. The larvae of the penultimate and last stage, surrounded by the cuticle of the previous stages.
3. In Cyclorrhapha, the pupa, enclosed in the puparium, formed by the sclerification of the cuticle of the last larval stage.
4. In some primitive groups, the adult during the completion of the pupal phase, surrounded by the pupal cuticle.

Note: The farata phase, which is a kind of “mobile pupa,” and, after exiting the cocoon, attaches to the substrate and performs the last ecdysis, giving rise to the adult insect [75][76].

9. Family Neriidae

9.1. Nerioidea is a superfamily of Acalyptratae flies

As flies, Nerioidea undergo complete metamorphosis with the four life stages of egg, larva, pupa, and adult. The adult stage has three body segments (head, thorax, and abdomen), three pairs of legs, and one pair of wings.

Some features that distinguish adult Nerioidea from other flies are a face that's usually weakly sclerotized (except in Fergusoninidae), antenna usually porrect or slightly deflexed (elbowed in Tanypezidae), wing veins R2+3 and R4+5 usually convergent, and the wing anal cell usually much smaller than the subcostal cell.

Most Nerioidea is associated with dead and decaying organic matter such as dead wood, rotting fruit, and bat dung. On

the other hand, Fergusoninidae form galls in plants of the family Myrtaceae, and some Micropezidae have larvae that are predatory or agricultural pests [77][78][79].

9.2. Description

Morphologically, the Neriidae are medium to large-sized flies (5-20 mm) with a peculiar appearance. They can be distinguished from others by the following characteristics: head flattened dorso-ventrally, generally longer than wide; anteriorly projected forehead and face; absence of ocellar bristles; absence or reduction of vibrissa; antenna extended forward; pedicel [80][81][82][83][84].

with a finger-like process on the inner face, extending through the flagellum; apical or dorso-apical arista; reduced thoracic chaetotaxy and bristles, when present, always short (except for some Old-World genera); wing elongated, with R4+5 and M converging; legs long and thin, commonly with rigid bristly spines on the ventral region of the femur; epandrium elongated and flexed under the abdomen [85][86][87][88].

9.3. Biology

The biology of the Neriidae family is little known, but it occurs in arid areas of the Nearctic and Neotropical regions, with adults and larvae commonly found in cacti of various genera and species (hence deriving the popular name 'cactus flies'). The larvae develop in the necrotic tissues of cacti, probably feeding on fungi responsible for organic decomposition.

Larvae reared in nutrient-rich substrates exhibit greater body size as adults, and males have more elongated bodies compared to flies reared in nutrient-poor substrates. The expression of male secondary sexual traits is particularly sensitive to the protein content of the larval.

All other Neriidae probably feed on other decaying plant organic tissues, such as plant resins and fruit secretions, and more rarely on animal manure and organic matter. Some species were observed on freshly felled trunks and branches, in galleries of wood saw beetles (Coleoptera, Cerambycidae), while others may be associated with human crops, such as squash, cotton, banana, gourd, and papaya. Some species have high rates of synanthropy, being attracted by cooking odors and becoming common inside homes. Some species are used for behavioral and sexual selection studies.

Males of some species engage in spectacular fights over territory or access to females. Rivals raise their bodies to an almost vertical posture and hit each other with the ventral surfaces of their heads, hit each other with their front paws, or attempt to get each other into a headlock.

Males of *Derocephalus angusticollis* Enderlein, 1922, participate in fights over territories and females and guard favorable locations for oviposition, with females laying eggs. Adult neriids try to stay close to plants constantly, avoiding open places, and are reluctant to fly, preferring to run with their long legs through the expanses of vegetation in which they shelter. Observed specimens of *Odontoloxozus longicornis* (Coquillett, 1904) in phoretic association with pseudoscorpions were common in cacti [89][90][91][92][93][94][95][96]

9.4. Taxonomy

Neriidae comprises 106 species distributed in 19 genera, distributed throughout all tropical regions of the world, with few exceptions.

The subfamilies: Gymnonerinae and Neriinae

Tribes: Indonesicesini, Paranerini, Telostylini, and Neriini.

Genera: *Cerantichir* Enderlein, 1922, *Derocephalus* Enderlein, 1922, *Glyphidops* Enderlein, 1922, *Nerius* Fabricius, 1805, *Odontoloxozus* Enderlein, 1922, and *Telostylinus* Enderlein, 1922.

Species of Neriidae: *Glyphidops filosus* (Fabricius, 1805); *Glyphidops ocherus* Henning, 1937; *Glyphidops etele* Aczél, 1961; *Glyphidops carrerai* Aczél, 1961; *Glyphidops dubia* Henning, 1937; *Glyphidops limbata* (Enderlein, 1922); *Glyphidops neutra* Henning, 1937; *Glyphidops dura* (Cresson, 1926); *Glyphidops falvifrons* (Bigot, 1886); *Nerius czernyi* Aczél, 1961; *Nerius wool* Aczél, 1961; *Nerius pilifer* Fabricius, 1805 [97][98][99][100][101].

10. Manuscript Selected

10.1. Study 1

Two Neriidae species are known in Australia:

Telostylinus angusticollis Enderlein, 1922 (also known as *Derocephalus angusticollis* Enderlein, 1922) is native to NSW and southern Queensland. These large flies (up to 2 cm in length) aggregate and breed on rotting trunks of Acacia longifolia and other trees. Using these flies in research on diet, aging, developmental plasticity, and non-genetic inheritance.

T. angusticollis individuals that are reared on a nutrient-poor larval diet develop into adults with little or no sexual dimorphism in body size or shape. In contrast, when provided with abundant nutrients as larvae, males develop into adults with extremely elongated legs, heads, and antennae. The four flies pictured below are full siblings (males on the left, females on the right) that were reared on nutrient-rich (top) or nutrient-poor (bottom) larval diets [102][103][104][105].

10.2. Study 2

In Brazil, the genera *Cerantichir, Eoneria* Aczél, 1951, *Glyphidops, Longina* Wiedemann, 1830, and *Nerius* are known, with a total of 17 registered species. The Amazonian species that presented new records and a key to the species in that region were cataloged. For the Northeast region, two species were recorded, one for the Caatinga of Bahia and another for Alagoas (Maceió) and Bahia.

Glyphidops Enderlein, 1922

Distribution. Argentina (Tucumán), Brazil (Acre, Amapá, Amazonas, Bahia, Espirito Santo, Mato Grosso, Minas Gerais, Pará, Paraíba, Paraná, Rio de Janeiro, Rondônia, Roraima, Santa Catarina, São Paulo), Bolivia, Colombia, Costa Rica, Ecuador, USA (Arizona, Florida), Guatemala, Guyana, Honduras, Mexico, Panama, Peru, Suriname, Trinidad Tobago, and Venezuela.

Glyphidops carrerai Aczél, 1961

Distribution. Brazil (Amazonas, São Paulo, Pará, Paraíba), Colombia, and Guyana.

Glyphidops filosus (Fabricius, 1805)

Distribution. Argentina (Chaco, Corrientes, Jujuy, La Rioja) and Brazil (Bahia, Paraíba)..

Nerius Fabricius, 1805

Distribution. Argentina, Bolivia, Brazil (Acre, Amazonas, Bahia, Goiás, Mato Grosso, Pará, Paraíba, Rio Grande do Sul, Rondônia, São Paulo, Tocantins), Colombia, Costa Rica, El Salvador, Ecuador, Guyana, Mexico, Panama, Paraguay, Peru, Dominican Republic, Suriname, Trinidad, and Venezuela.

Nerius pilifer Fabricius, 1805

Distribution. Argentina (Chaco, Corrientes, Jujuy, Misiones, Tucumán), Bolivia, Brazil (Acre, Amazonas, Bahia, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Rio de Janeiro, Rondônia, São Paulo, Tocantins), Colombia, Costa Rica, Ecuador, Guyana, Haiti, Mexico (Tabasco), Nicaragua, Panama, Paraguay, Peru, Suriname, and Venezue [106][107][108][109][110][111].

10.3. Study 3

Update of the species present in the state of Chiapas-Colombia

In total, 322 specimens of the Neriidae family were reviewed, corresponding to six species of the genera *Cerantichir*, *Glyphidops*, *Nerius*, and *Odontoloxozus*. Four of the species represent new records for the state of Chiapas, while two species are recorded for the first time in Mexico. The data for each of the species found are indicated below.

Cerantichir enderleini Henning, 1937

Diagnosis: Yellowish-brown color, shiny, partly yellow head; pleuron shiny yellowish-brown and bare; thorax with two yellowish brown longitudinal lines, as wide as the scutellum.

Distribution: Costa Rica. It is registered for the first time in Mexico.

Glyphidops filosus (Fabricius, 1805).

Diagnosis: Yellow front line with a well-defined black oval spot on the posterior third and covering the ocellar triangle; first

flagellomere lanceolate with apical ridge; back of shield with two white pruinous lines, separated by a broad brown line that tapers after the transverse suture; supra-wing seta absent.

Distribution: Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, Guyana, Suriname, Ecuador, Peru, Brazil, Bolivia, Montserrat, Trinidad. It is registered for the first time in Mexico.

Glyphidops flavifrons (Bigot,1886)

Diagnosis: Frontal yellow line; first flagellomere oblong with apical ridge; ocellar triangle dark brown, contrasting with a front line; back of shield with two white pruinous lines, separated by a broad brown line that.

Distribution: United States, Mexico (Baja California, Sonora, Tabasco, Veracruz), Honduras, Nicaragua, Costa Rica, Panama, Trinidad and Tobago, Colombia, Guyana, Ecuador, Brazil, and Bolivia. It is reported for the first time in the state of Chiapas.

Nerius pilifer Fabricius, 1805

Diagnosis: Escape and pedicel brown, the base of antenna shiny dark brown; frontal vein dark red, with a central brown band that goes from the middle region to the posterior region; occiput shiny; thorax brown with pale luminescence; thorax (in dorsal view) with a broad gray stripe, separated in the middle by a very thin brown stripe; anterior notopleural seta reduced; basicosta with a small seta; a dorsocentral seta; dark brown legs; anterior femur with protruding anteroventral row of spines.

Distribution: Mexico (Tabasco), Nicaragua, Costa Rica, Panama, Guyana, Suriname, Haiti, Colombia, Venezuela, Ecuador, Paraguay, Peru, Bolivia, Brazil and Argentina. It is reported for the first time in the state of Chiapas.

Nerius plurivittatus Bigot, 1886

Diagnosis: Antenna base bright; distal margin slightly concave in dorsal view; occiput dull with a yellow median band; thorax (dorsal view) with a broad gray stripe, divided by a brown stripe and by an intra-wing line on the postsutural scute; slightly pruinous frontal orbital plate, with the anterior half yellow and the posterior half brown

Distribution: Mexico (Veracruz), El Salvador, Panama, the Dominican Republic, Trinidad, Guyana, Venezuela, Colombia, Brazil, Peru, Bolivia, and Argentina. It is reported for the first time in the state of Chiapas.

Odontoloxozus longicornis (Coquillet, 1904)

Diagnosis: Third antennal segment broad at its apex, with white pubescent ridge; thorax with numerous stout spinules located in brown spots, giving an irrorated appearance; femur armed with strong ventral spines; posterior cross vein highly oblique, subparallel with inner margin.

Distribution: United States, Mexico (Baja California, Baja California Sur, Guanajuato, Morelos, Oaxaca, Puebla, Querétaro, San Luis Potosí, Sinaloa, Sonora), and Costa Rica. It is reported for the first time in the state of Chiapas [107][108][109][110][111].

10.4. Study 4

Entomology Forensic

In this paper, we report four families of Diptera (Micropezidae, Neriidae, Sepsidae, and Ulidiidae) and one family of Coleoptera (Hydrophilidae) as insects associated with pig carcasses for the first time in Peninsular Malaysia.

A total of three pig carcasses, each weighing about 10kg, were used in simulating different manners of death, including burnt, hanged, and placed on the ground (as control). The first day of placement was counted as Day 1, and the observation was continued until Day 14. Along the decomposition process, we counted and collected some dipterans in the family Micropezidae, *Mimegralla albimana* Doleschall, 1856; Neriidae, *Telostylinus lineolatus* (Wiedemann, 1830); Sepsidae, *Allosepsis indica* Wiedemann, 1824; and Ulidiidae (*Physiphora* sp.).

The Neriidae adults are usually found on certain cacti, flowers, and rotting vegetables, and the larvae breed in decaying cacti or fruits. In our study, *T. lineolatus* was found on decaying pig carcasses, and the population increased during the early decay stage and the dry stage of decomposition. They have a large labellum and licked on fluid that remained on the pig's bones. We also noticed these insects were attracted to decaying fruit such as papaya *Carica papaya* L. (Caricaceae). However, no Neriidae larvae were discovered from carcasses [112][113][114].

11. Conclusion

The Acalyptrates Diptera, although they do not form a natural group, share some characteristics, such as the reduction or absence of the calyptra, the absence of the longitudinal suture in the pedicel, and the incomplete suture of the thorax. Within the Muscomorpha, they were once considered a sister group to the Calyptrates; however, more recent evidence has indicated their paraphyly. The arthropods associated with corpses are divided into four categories: necrophagous, predator, omnivore, and adventive. All four Diptera families mentioned above fit into the adventive group as they came to the carcasses as visitors and fed on oozing fluid. In this paper, we highlight the presence of opportunistic insects associated with pig carcasses. The arthropods associated with corpses are divided into four categories: necrophagous, predator, omnivore, and adventive.

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