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(REVIEW ARTICLE)

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Bionomic of the Asilidae Family (Insecta: Diptera)

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Abstract

The purpose of this article is to obtain information on the characteristics and taxonomy of the Family Asilidae (Insecta: Diptera). In this article, the bionomy of the Asilidae family will be studied.. A selection of articles published from 1946 to 2021. The mini review was prepared in Goiânia, Goiás, from September to October 2021, through the Online Scientific, internet, ResearchGate, Academia.edu, Frontiers, Biological Abstract, Publons, Qeios, Dialnet, World, Wide Science, Springer, RefSeek, Microsoft Academic, Science, ERIC, Science Research.com, SEEK education, Periodicals CAPES, Google Academic, Bioline International, VADLO, Scopus, Web of Science, LILACS, Medline, LIS and Portal of Scientific Journals in Health Sciences.

Keywords: Predator; *Lampria*; Grassland; Agricultural pests; Bioecological aspects

1 Introduction

The Asilidae family is a group of the Order Diptera (Brachycera: Asiloidea), both adults and larvae are predators especially of phytophagous insects. Although these flies are elements ecosystem, and of practical importance for agriculture, little is known. As with most other groups of entomophagous insects, there are little quantitative data on its impact on prey populations some species occur on the margins of water courses, others occur in reforestation areas, forests, scrub and grassland (Figures 1, 2 and 3) [1,2,3].

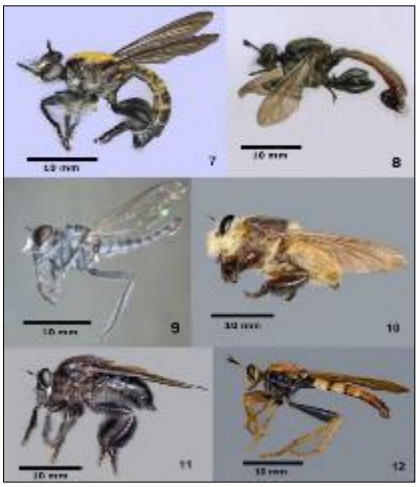

Figure 1 Habitus of Asilidae spp. 7) Male habitus of *Lampria aurifex* Osten Sacken, 1887. Credit: A.E. 8) Male habitus of *Lampria circumdata* Bellardi, 1861. Credit: A.E. 9) Female habitus of *Lissoteles vanduzeei* Cole, 1923. Credit: A.E. 10)

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Female habitus of *Mallophora fautrix* Osten-Sacken, 1887. Credit: A.E. 11) Male habitus of *Mallophora leschenaulti* Macquart, 1838. Credit: A.E. 12) Female habitus of *Ospriocerus tequilae* Martin, 1968; (Source: Martin, 1968. Credit: A.E)

Figure 2 Diptera Asilidae genus *Clephydroneura* Becker; (Source: https://commons.wikimedia.org/wiki/File:Diptera_Asilidae_genus_Clephydroneura_Becker_-_June_2011.jpg)

Highlighted the positive importance of asilides, presenting the result obtained after 16 years of study of the diet of these insects, in which prey analysis revealed the predominance of agricultural pests, among these the leafhoppers from the pastures (Figures 3 and 4A) [3,4,5].

Figure 3 Specimens of Asilidae Family; (Source: https://br.freepik.com/fotos-vetores-gratis/asilidae)

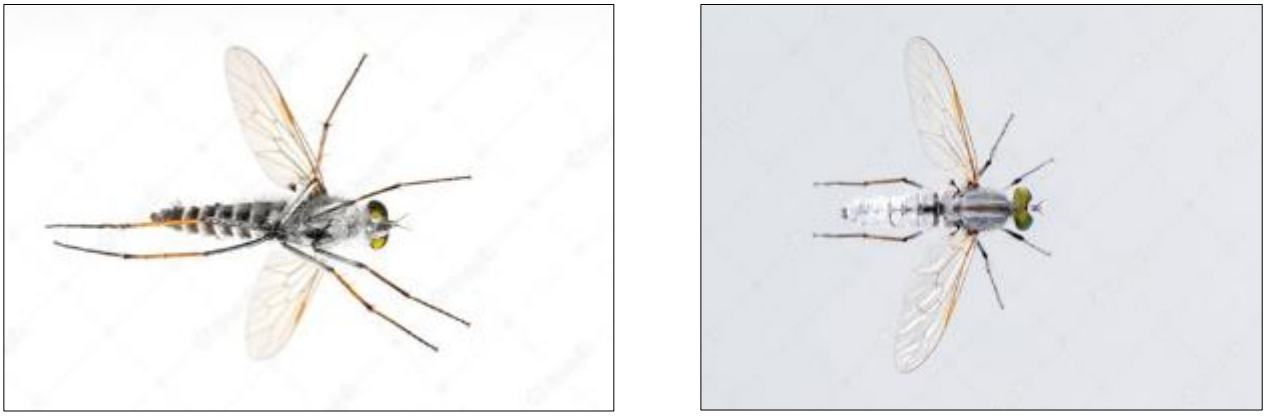

Figure 4 A Asilidae ventral and dorsal; (Source: https://br.freepik.com/fotos-vetores-gratis/asilidae)

Some dipterans belonging to this family are important agents for decreasing density population of phytophagous insects that are recurrent pests in pastures. The *Salpingogaster nigra* Schiner, 1868 (Diptera) fly Syrphidae as the main controller of leafhoppers in sugarcane. However, despite the knowledge of the occurrence of predators as a suppression agent of the population of leafhoppers from pastures, these have not been used in biological control applied (Figure 4B) [5,6,7].

Figure 4B Asilidae performing predatory; (Source: https://www.biodiversity4all.org/taxa/47982-Asilidae)

It is believed that the use of these predators has been limited by the fact that they do not know each other their biological, behavioral and ecological aspects. So, to advance the knowledge, as a step before the indication of the use of predators to control the leafhoppers from pastures, this dissertation was divided into two chapters entitled: associated with the silvopastoral system and monoculture of *Brachiaria decumbens* cv. Basilisk (Graminacee) (Figures 5A and 5B) [7,8,9].

Figure 5A Asilidae pollination; Source: https://www.biodiversity4all.org/taxa/47982-Asilidae

Silvipastoral systems can be attractive to beneficial insects, which play an important role in the natural control of pest populations, such as predatory insects of the Asilidae, making knowledge of their bioecological aspects important. This family has species of predators of the main pests in pastures [9,10,11].

Figure 5B Asilidae: Silvipastoral systems; (Source: esearchgate.net/publication/263890450_Ethology_of_Proctacanthus_brevipennis_Wiedemann_1828_Diptera_Asilidae_in_Northeastern_Florida_USA)

Among the species reported as pests, those belonging to the Cercopidae Family, commonly known as pasture leafhoppers, are registered as the main biotic problem in forage. Leafhopper nymphs cause a physiological disorder as a result of their bites that impair the transport of water and nutrients to the aerial growing points, when they feed on the plant's roots. Adults inject toxins, staining their leaves and reducing their palatability (Figure 6) [10,11,12].

Figure 6 New world spittlebugs (Hemiptera: Cercopidae: Ischnorhininae); (Source: https://www.sciencedirect.com/science/article/abs/pii/S1055790317302257)

This fact is worrying, because more than 90% of cattle use pasture for food, as they represent one of the most economical food resources. Thus, for the implementation of the control of these pests using predators, the initial step is to know the bioecology of these natural enemies in the different pasture conduction systems (monoculture and/or silvopastoral) (Figure 7) [13,14,15].

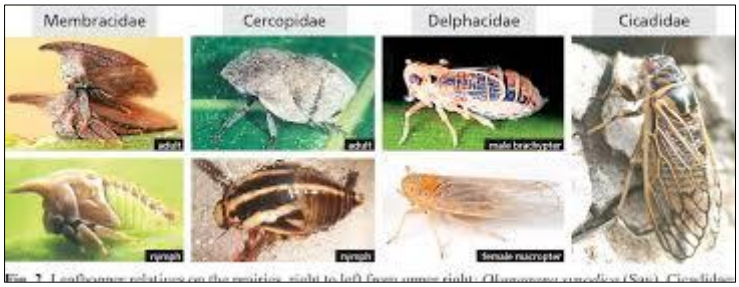

Figure 7 Leafhopper relatives on the prairies, right to left from upper right: *Okanagana synodica* (Say, 1825), Cicadidae; *Muirodelphax arvensis* (Fitch, 1963), Delphacidae; *Lepyronia gibbosa* Ball, 1899, Cercopidae; *Campylenchia rugosa*

(Fowler,1884), Membracidae; (Source: Photographs courtesy of Dan Johnson, Tyler C. Christensen, University of Minnesota, Bill Johnson andy Daun, and Lynette Schimming)

Asilids are particularly abundant in arid and sunny habitats, which are ideal conditions to observe their various morphologies and behaviors are insects diurnal, in which the adults are usually active flies of considerable size, which prey on various arthropods (waps, bees, dragonflies, grasshoppers, other flies and some spiders) [14,15].

2 Morphology

Morphologically, they are characterized by their large eyes, piercing mouthparts and strong sucking mouths, in addition to strong spiny legs. The relatively stout legs, armed with bristles and thorns, are designed to capture and hold prey such as: *Apis mellifera* Linnaeus, 1758; *Cicindela punctulata* Olivier, 1790; *Bombus* sp. among other insects. Per have a highly developed predatory apparatus, many species have no difficulty in feeding bees and sometimes causing significant damage to colonies (Figures 8A, 8B and 8C) [16,17].

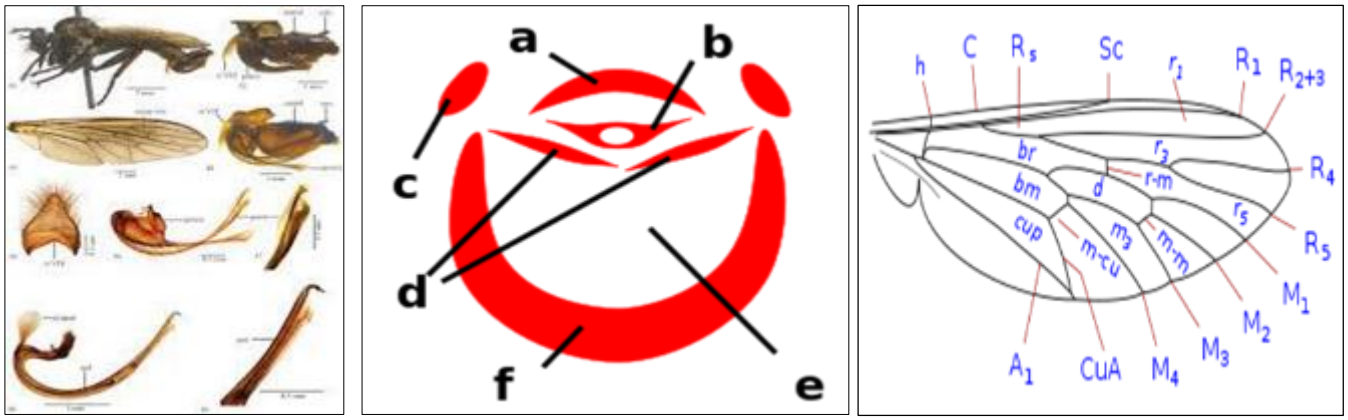

Figure 8A Holotype male. 1 Habitus, lateral view 2 Terminalia, lateral view 3 Wing. Obs. The small crosssvein connecting stump vein with R_{2+3} is an anomaly 4 Terminalia, lateral view treated in hot 10% KOH 5 Sternite VIII 6 Gonocoxite and gonostylus 7 Apex of gonostylus 8 Aedeagus 9 Apex of aedeagus. Abbreviations: aed: aedeagus; cerc: cercus; ej apod: ejaculatory apodeme; epand: epandrium; goncx: gonocoxite; gonst: gonostylus; hypd: hypandrium; st VIII: sternite VIII. Figure 8B Section of Asilidae mouthparts a: labrum; b: hypopharynx; c: maxillary palp; d: maxillae; e: food channel; f: labium. Figure C Basal plan of the wing venation. Longitudinal veins: C: coast; Sc: subcoast; R: radius; M: average; Cu: cubitus; A: anal. Crossveins: h: humeral; r-m: radio-medial; m-m: medial; m-cu: medium-cubital Cells: d: dial; br: 1st basal; bm: 2nd basal; r1: marginal; r3: 1st submarginal; r5: 1st later; m3: 4th posterior; cup: cell cup; (Source: https://www.biodiversity4all.org/taxa/47982-Asilidae)

Figure 9 larvae, pupa and adult of Asilidae; (Source: https://www.google.com/search?q=egg,+pupa+larva+and+adult+of+Asilidae&sxsrf=AOaemvJzEJ15t4Y6Tmxf8k32-fnfSHy6gg:1640121697923&source=lnms&tbm=isch&sa=X&ved=2ahUKEwi1hsW56fX0AhU2pZUCHUSHAkUQ_AUoAXoECAIQAw&biw=1366&bih=625&dpr=1)

Another factor that favors the predation of hymenoptera is the fact that some asilids have mimetic characteristics of other insects, including some bees. Bees are models for several mimetic dipterans, since the vast majority of bee species use the stinger to protect themselves from possible predators, in addition to warding them off because of their inpalatibility Foraging and flight are described in the literature as similar between these two groups of insects, increasing the success rate of mimicry (Figure 9) [17,18].

2.1 Egg

The egg is hyaline or pigmented and of variable shape from spherical to oval and up to 2 mm in length. The surface is smooth or bears microsculptures, which are generally polygonal and visible only in the electron microscope (Figure 10).

Figure 10 Egg of Asilidae; (Source: https://sites.google.com/site/australianasilidae/introduction-2/biology/eggs)

2.2 Larva

The larva is apodous, cylindrical, and elongated, more or less flattened dorsoventrally and tapered at the cephalic and caudal ends. The color is white or yellowish. The head is small, rugged, dark-pigmented and hypognathous, the abdomen is composed of eight apparent urites, with the last two often fused and more or less reduced. The respiratory system is amphineustic, with two pairs of spiracles, one thoracic and one abdominal. Also, rudimentary and nonfunctional stigmata occur in other abdominal segments.

2.3 Pupa

The pupa is naked, as in the majority of the Orthorrhapha, exarate and therefore able to move.

2.4 Biology

The lifecycle takes place in 1–3 years. The postembryonic development consists of four larval stages (instars) and one pupa. The larvae of the first instar differ from other stages in both ethology and trophic regimen. The larvae of most known asilids live in the soil or in the case of some taxonomic groups, in rotting organic material, usually wood and the bark of dead trees. With regard to feeding behavior, most of the literature gives the larvae of the Asilidae as entomophagous, but doubts remain about the real nature of the trophic regimen and its mechanisms (Figure 11) [17,18].

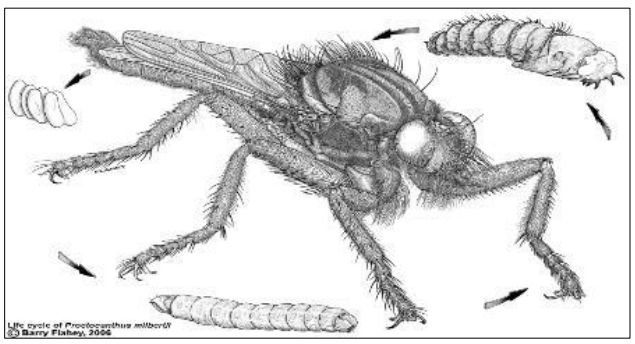

Figure 11 Asilidae life cycle; (Source: http://www.geller-grimm.de/genera06.htm)

The entomophagy of some species had indeed been hypothesized by some authors of the 19th century, based on the findings of larvae of asilids associated with larvae of other insects, predation was occasional and secondary to the plant-based diet. More recent studies have confirmed the entomophagy of some asilids without extending this species' feeding behavior for the whole family. Less certain, however, is the mechanism of implementing entomophagy: in general, the behavior is cited as predation, but for some species may be ectoparasitoids (Figure 12) [18,19].

Figure 12 Specimens of Asilidae previous view; (Source: https://br.pinterest.com/pin/776730266982143991/)

The feeding behavior of the larvae of *Machimus rusticus* (Meigen, 1820) and its evolution during postembryonic development: in particular, the larvae of the first instar does not feed on insects, those of the second instar feed on secretions by larvae of beetles (and may cause death), while the larvae of the third and fourth instars actually behave like predators. In short, the feeding behavior of larval asilids can configure as intermediate between predation and ectoparasitism [18,19].

2.5 Habitat and ecology

The Causse du Larzac is a limestone karst plateau, a typical habitat of those favored by many species of Asilidae generally occur in habitats that are open, sunny, and dry, even arid. They favor open or scattered vegetation, and some species even frequent bare ground. Typical habitats include savannah, forest steppe, open steppe, semidesert, maquis shrubland, and related shrubland types such as fynbos and chaparral. Their biodiversity is lower in forested ecosystems, and where the asilids of occur in such environments, they tend to concentrate in the glades and margins. In those conditions, the interrupted canopy leaves space for various species of shrubs and herbaceous plants suited to asilid styles of predation (Figure 13) [18,19].

Figure 13 Previous view robberflies as adults are aerial predators that wait in ambush until an insect flies past and then fly up, grab hold of it and tumble to the ground where the fly subdues the prey by penetrating the body with its stout proboscis and injecting saliva that contains neurotoxins that kill as well as proteolytic enzymes that break down the body contents. It then sucks out the contents. The life cycles of robberflies are poorly known - the larvae are known to live in soil, leaf litter or rotten wood and evidently are also predatory. There are over 7000 species of robberflies worldwide with 790 species recorded from South Africa; (Source: http://www.biodiversityexplorer.info/flies/asilidae/index.htm)

2.6 Distribution

Asilidae occur in all zoogeographical regions except Antarctica. In the Northern Hemisphere, some species are even adapted to tundra. Alpine species occur at altitudes exceeding 4000 meters/13,000 feet. However, the highest levels of biodiversity are in warm climates; tropical or subtropical and arid or semi-arid regions tend to have the greatest variety of species, followed by areas where rainfall is highly seasonal [18,19].

2.7 Systematics

The Asilidae currently include over 7500 described species in about 556 genera. Their taxonomy is still under study in the light of new specimens and cladistic analysis. The 14 accepted subfamilies are: Asilinae, Bathypogoninae, Brachyrhopalinae, Dasypogoninae, Dioctriinae, Laphriinae, Leptogastrinae, Ommatiinae, Phellinae, Stenopogoninae, Stichopogoninae, Tillobromatinae, Trigonomiminae and Willistonininae [18,19].

2.8 Phylogeny

The phylogenetic relationships of taxa within the monophyletic Asilidae are still very poorly known. The Asilidae received much attention from dipterists and many revisionary projects and ecological studies were undertaken. Despite this interest a comprehensive understanding of major evolutionary events during the phylogenetic history of the Asilidae are not known. This page will provide an overview of what is known so far and point out recent studies that have incorporated morphological as well as DNA-sequence data to reconstruct the phylogeny of the Asilidae or subtaxa within it (Figure 14) [19].

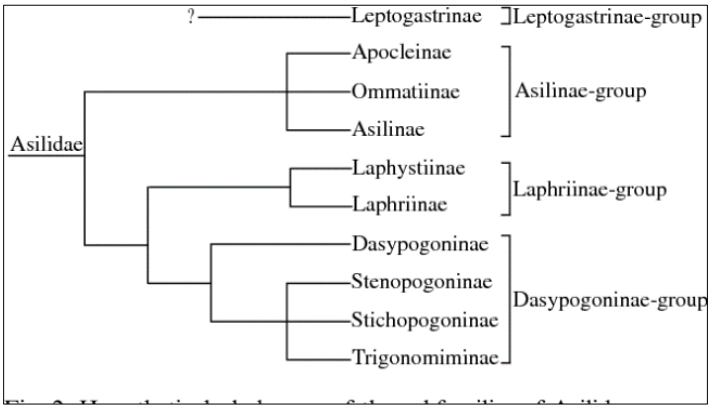

Figure 14 Sensitivity analysis mapped on the topology for the hypothetical laphriinae-group as proposed by Papavero (1973). This relationship is recovered in the maximum likelihood tree and for a subset of cost parameter values in the optimization alignment tree; (Source: https://www.semanticscholar.org/paper/A-phylogeny-of-robber-flies-(Diptera%3A-Asilidae)-at-Bybee-Taylor/9e165fa829d3caef126a4578d36b7941b966c6de/figure/6)

Objective

In this article, the bionomy of the Asilidae family will be studied (Insecta: Diptera).

3 Methods

The method used to prepare this mini review was Marchiori 2021 methodology [20].

4 Studies conducted and selected

4.1 Study 1

The list of species likely to occur in Mato Grosso do Sul, but not yet registered, was inferred from the distribution information cited by Papavero (2009) [21].

List of species recorded for Mato Grosso from the South. There are recorded in the literature 32 species of 17 genera of Asilidae occurring in the state of Mato Grosso do Sul. This number corresponds to 7% of the species known from Brazil. In an inventory carried out for the species from Bahia, 18 species of Asilidae were registered a priori, based on literature

data. After collections carried out and examination of material in collections, this number rose to 69 species, an increase of almost 300% (Figures 15, 16, 17, 18 and 19).

Figure 15 Specimen of Alisinae; (Source: https://bugguide.net/node/view/1543606)

Figure 16 Specimen of Dasypogoninae; (Source: https://bugguide.net/node/view/1543606)

The Cerrado is home to the vast majority of taxa recorded in Mato Grosso do Sul, 22 species, 17 of which unique to that biome. The Pantanal has nine species, seven of which only occur in this biome. The Atlantic Forest of Mato Grosso do Sul has the lowest richness among the state's biomes (five species, three of which are exclusive). Although the result is compatible with what is known about the group's biology, and also with the extent of the biomes in Mato Grosso do Sul, the collection events are insufficient to affirm that this reflects the real richness of species in the state.

Figure 17 Specimen of Laphriinae; (Source: https://en.wikipedia.org/wiki/Laphriinae)

Listed below are 27 species with distribution recorded in the surroundings of Mato Grosso do Sul (Papavero, 2009) [21], but so far not registered in the state: **Asilinae** [*Amblyonychus substitulus* (Walker, 1851), *Eccritosia barbata*

(Fabricius, 1787), *Eicherax macularis* (Wiedemann, 1821), *Mallophora barbipes* (Wiedemann, 1819), *Mallophora dureti* Artigas & Angulo, 1980, *Mallophora emiliae* Carrera, 1960, *Mallophora nigritarsis* (Fabricius, 1805), *Mallophora ruficauda* (Wiedemann, 1828), *Mallophora sylveirii* Macquart, 1838, *Mallophora zita* Curran, 1941, T*aurhynchus rubricornis* (Macquart, 1838), *Wygodasilus ulchripes* (Bromley, 1928)]; **Dasypogoninae** [*Amorimius bicolor* (Carrera, 1949), *Cleptomyia tripartita* (Walker, 1854), *Diogmites lindigii* (Schiner, 1868), *Pseudorus distendens* (Wiedemann, 1828), *Senobasis lenkoi* Papavero, 1975)]; **Laphriinae** [*Aphestia annulipes* (Macquart, 1838), *Cerotainia lynchii* (Williston, 1889)]; **Ommatiinae** [*Ommatius arginellus* (Fabricius, 1781)]; **Stenopogoninae** [*Archilestris capnoptera* (Wiedemann, 1828), *Cylicomera rubrofasciata.*

Figure 18 Specimen of Ommatiinae; (Source: https://pt.dreamstime.com/foto-de-stock-royalty-free-mosca-de-abelha-bombyliidae-image32094345)

Lynch Arribálzaga, 1881, *Dicranus schrottkyi* Bezzi, 1910, *Enigmomorphus paradoxus* Hermann, 1912, *Plesiomma caedens* (Wiedemann, 1828), *Prolepsis fenestrata* (Macquart, 1838)]; *Stichopogoninae* [*Townsendia fiebrigii* Bezzi, 1909] [22,23].

Figure 19 Specimen of Stenopogoninae; (Source: https://www.flickr.com/photos/itchydogimages/34172139512)

4.2 Study 2

In this context, the present study reports a case of mimicry between Asilidae flies from genus *Aphamartania* Schiner, 1866 and bees of the species *Eulaema (Apeulaema) nigrita* Lepeletier, 1841 (Hymenoptera, Anthophila, Apidae), which occur in sympatry in Salvador, Bahia (Figure 20).

Figure 20 Mimetic species deposited in the Entomological collection of the Natural History Museum of the Federal University of Bahia (MHNBA-UFBA), in Salvador, Bahia. A-B- Specimen of sp. (Diptera, Asilidae); C-D - Male specimen *of Eulaema (Apeulaema) nigrita* Lepeletier, 1841 (Hymenoptera, Anthophila, Apidae). A and C- Body in dorsal view; B and D- Body in side view; (Source: http://web.unijorge.edu.br/sites/candomba/teste/pdf/artigos/2018/moscas.pdf)

Another factor that favors the predation of hymenoptera is the fact that some asilids have mimetic characteristics of other insects, including some bees.

The Asilidae *Aphamartania* are similar to the *E. (A.) nigrite* bees in their size, shape, color pattern and flight. The wings of these Asilidae flies resemble the wings of the *Eulaema* bees, despite having only one pair of wings. The fly's body is hairy, making it look quite similar to the bee's body the hind legs of the females of *E. (A.) nigrita* have a wider apical half of the tibia, with a concave outer surface and surrounded by thick bristles (corbicula), a structure that works as a basket used by bees to transport the pollen they collect in the flowers. Male bees do not have the pollen basket, but it is swollen, and as *Aphamartania* has long bristles on the hind tibia that visually looks like an enlargement of the tibia, it facilitates even more the mimicry of Asilidae flies with *E. (A.) nigrite* (Figure 21).

Figure 21 *Aphamartania* Schiner, 1866; (Source: https://www.researchgate.net/publication/283508690_Revision_of_the_genus_Paraphamartania_Engel_with_description_of_two_new_species_and_comments_on_the_related_Nearctic_genus_Cophura_Osten_Sacken_DipteraAsilidae)

Although flies have a morphologically different head when compared to the bee's head, the hair color pattern (with some pale yellowish bristles) and the integument color (predominantly blackened) reinforce the mimicry, since the males of *E. (A.) nigrite* have yellowish stripes on the clypeus and area parocular, which together form a very similar image for the two insects.

The observed specimen of *Aphamartania* (Asilidae) had been deposited with the MHNBA (The specimens studied are deposited in the Entomological collection of the Museum of Natural History of the Biology Institute of the Federal

University of Bahia) since 1996, and had been identified at that time in the MHNBA collection as if it were a specimen of the *E. (A.) nigritta* bee, probably due to its similarity in color, size and shape of the abdomen, in addition to its area of occurrence, having been collected together with the bees, in the same collection in flowers of plants from the restinga of Lagoa do Abaeté (10.I.1996, Plant 05, 4:30 pm), using an entomological network.

Based on the morphological characters observed in both species, there is strong evidence that flies of the genus Aphamartania are using the morphological and behavioral mimicry of bees (completely black color, large size and fixed stinger) as an advantage in avoiding their predators. (Batesian) and possibly also to get closer to their possible prey (Peckhamian mimicry) [24].

4.3 Study 3

Within the order of flies (Diptera), there is the family of assassin flies (also called robber flies, robber flies, or "killer flies"), which is formally known as Asilidae. Adults can be found in many habitats, but generally each species lives in a specific location. These flies are predatory and attack a wide variety of insects, including wasps, bees, dragonflies, grasshoppers, and other flies. It is common for insects of the same size to attack or even some larger than themselves. Most assolids catch their prey in flight, and some of the larger species can cause a painful bite if handled carelessly. Killer flies have a peculiar body shape. The pair of huge eyes they have gives them the appearance that the upper part of their head is sunken and that makes them stand out from other flies. The thorax is somewhat stout and its long and strong legs emerge from it. Although the abdomen is generally somewhat elongated and somewhat conical, there are some killer flies that are more like bumblebees because their abdomen is plumper (Figure 22).

Figure 22 Asilinae (Diptera, Asilidae); (Source: https://www.scielo.br/j/rbent/a/xWjrhzrB9MgKQpbnPvWfctk/?lang=en)

On the other hand, the larvae live in the soil, among decomposing matter, where they feed on the larvae of other insects. An efficient flying predator Regarding their predatory behavior, these flies may assess the suitability of their prey before going out to capture it. The explanation for this behavior in a small insect (like this fly) may revolve around the energy cost it would take to dominate a larger prey. That is, attempting to capture a larger prey where there is little possibility of energy gain (in case you cannot capture and eat it), would mean a substantial loss caused by muscle fatigue. In addition, evaluating whether the hunt would be adequate is also more favorable, since when chasing its prey it breaks its camouflage and is exposed to its own predators. In larger insects, such as dragonflies, its wide eyes give them a relatively high visual resolution. This allows them to estimate the size of their prey before chasing them and makes them efficient predators.

However, due to the size of assassin flies, it is impressive that they can also visualize and chase their prey. Its small size could limit its neural capacity and the spatial resolution that its compound eyes provide. However, assassin flies have proven that they are also efficient persecutors. Finally, there is still much research in this field of assassin flies, but there is no doubt that with what is already known about them they occupy a prominent and deserved place among the fascinating, efficient and voracious flying insects [25,26].

4.4 Study 4

Mimicry can be defined as an evolutionary adaptation to which it is possible morphological characteristics similar to the other, or confused with individuals of different taxa and just bringing it advantages for the predator. The most common characteristics of mimicry pointed out in many definitions are: 1) similarity between colors, signs or species; two) Confusion or incapable of discriminating, or ability to deceive a participant; 3) increase or decrease in the fitness of two participants.

Generally, or mimicry evolved from a need for protection against predators. Being a form of mutualism, where the advantage can be attributed to organisms that share a certain characteristic, or it can be a disadvantage, when it transforms you or individual in business. Cases of interspecific mimicry are not uncommon in nature. Among the known models, the most common are called Batesiano, Mülleriano and Peckhamiano (Figure 23).

Figure 23 Mimicry in adult robber fly of the Subfamily Asilinae; (Source: https://www.freepik.com/premium-photo/adult-robber-fly-subfamily-asilinae_20233728.htm)

In Batesian mimicry, the palatable species evolved to resemble an unpalatable conspicuous species, thus gaining protection from predation. In the same way, various species of Diptera are described in the literature by mimicking wasps and bees, characterizing or Müllerian mimicry, by presenting similar signs of warning or aposematic, acquiring protection against its predators. Conversely, or Peckhamian mimicry or aggressive mimicry, occur in Situations of a mimetic species or predator, or which deceives its prey in order to an unsuspecting approach the same.

Among the Insecta, Asilidae (Diptera: Brachycera: Asiloidea) is very important family of predator flies, composed by bout 7,500 species and distributed throughout the world. The diversity of the group can be attributed to its wide distribution, even if it is more Each species tends to occupy a selective niche. Being strong aerial predators, dipterous species end up predating a wide variety of insects in more diverse orders [27,28,29,30,31].

4.5 Study 5

Laphria is a genus of flies of the family Asilidae, subfamily Laphriinae, described by Meigen1803. It is a genus with holartic distribution. They feed on all kinds of insects, flies, bees, wasps and escarabajos. As with other solids, they use their proboscis to pierce the body of their prey, inject enzymes and feed on the broken tissue (Figure 24).

They are large flies, between 15 and 25 mm in length. The majority are vellosas and generally black in color. Some have mimetic designs of bees or bees with black and yellow bands [32].

Figure 24 *Laphria* is a genus of flies of the family Asilidae, subfamily Laphriinae; (Source: https://commons.wikimedia.org/wiki/File:Laphria_ephippium_bl.JPG)

4.6 Study 6

The flies of the genus *Smerynolaphria* Hermann, 1912 they belong to Asilidae, whose members are commonly known as "robber flies", being one of the groups with the greatest species richness within the Diptera order, with 555 genera and more than 7500 described specie. The asílidos are insect predator flies and other arthropods, which are characterized by having a cut proboscis. It is protected by a group of bristles that receive the name of "mystax" in its set.

For the Neotropical region, 217 genera and 1576 species of asílides have been reported, however, studies for Peru in this group are scarce. Fifty-three genera have been reported and 113 species for the country have added new records and reported 97 species of soil asilids for the Tambopata National Reserve in Madre de Dios, many of these possibly new to science, suggesting that much of Peru's diversity is still needs to be discovered. The genus *Smerynolaphria* was created to include three Neotropical species previously listed in the genus *Laphria* (Figure 25).

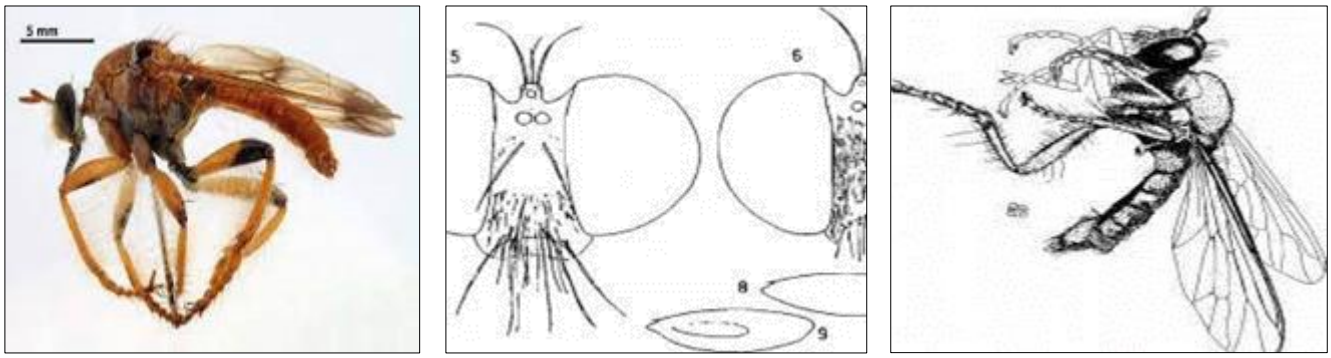

Figure 25 *Smeryngolaphria gorayebi* Artigas, Papavero & Pimentel, 1988; (Source: https://www.mindat.org/taxon-1659052.html)

The subfamily distinguishes itself from other members of Laprhriinae by lacking a ventral facial hump. Furthermore, it includes flies of medium size, oxidized yellow color and with bands or black marks, especially in the abdomen. Currently, the genus comprises 10 described species, system of which are of Neotropical distribution and three of Afrotropical distribution, only of questioned status, although the diagnostic characteristics of the genus are of smaller size and presentan anatergito setoso, an important apomorphy that would justify the separation of the species described for the Neotropical In the Neotrópico, the genus is reported for the countries of Bolivia, Brazil, French Guayana, Nicaragua and Panama. The present work is reported for the first time to Peru, expanding the range of distribution of the four neotropical species registered in the literature. The present work has the objective of contributing to the awareness of Asilidae flies in Peru (Figure 26).

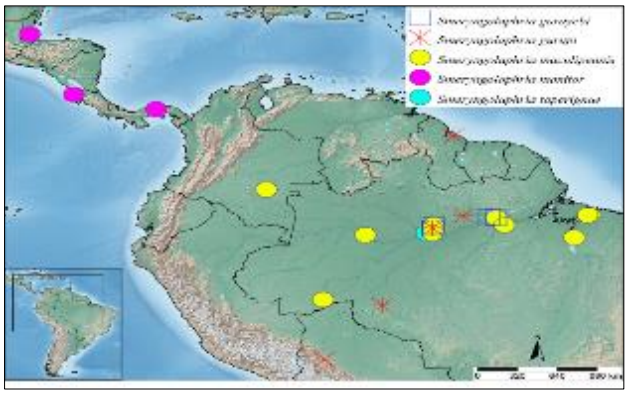

Figure 26 New records of distribution of Artigas, Papavero & Pimentel, 1988, *Smeryngolaphria gurupi* Hermann, 1912, *Smeryngolaphria maculipennis* (Macquart, 1846), *Smeryngolaphria numitor* (Osten Sacken, 1887) and *Smeryngolaphria taperignae* Artigas, Papavero & Pimentel, 1988; (Source: https://www.semanticscholar.org/paper/Contribution-to-the-knowledge-of-the-Neotropical-of-Camargo-Vieira/034b758d31de15659cf653c5d3abfa1582c74f4b)

This work is based on the review of specimens from the collection of the Natural History Museum of the Universidad Nacional Mayor de San Marcos, Lima, Peru-MUSM) collection has four specimens belonging to the genus *Smeryngolaphria*, comprising two species already described: *Smeryngolaphria gorayebi* Artigas, Papavero & Pimentel, 1988, and *Smeryngolaphria maculipennis* (Macquart, 1846). Three of the specimens examined were collected in the Tambopata National Reserve [33].

5 Conclusion

The Asilidae family belongs to the order Diptera and are predators popularly known as killer flies, with more than 100 species taking place in Brazil. All species in the family have predatory habits and constitute an important population control mechanism for their prey.

References

[1] Bromley SW. The robber flies of Brazil (Asilidae: Diptera). 1th ed. São Paulo: Imprensa Oficial do Estado. 1946.

[2] Weinberg M. Catalogue of díptera types from the Museum of Natural History. 1th ed. London: Museum of Natural History. 1973.

[3] Bisby F. Species 2000 & ITIS Catalogue of Life. 2012; 5(3): 34-36.

[4] Burel F. Comparative biodiversity along a gradient of agricultural landscapes. Acta Oecologica. 1998; 19(1): 47–60.

[5] Bybee SM, Taylor SD, Nelson CR, Whiting MF. A phylogeny of robber flies (Diptera: Asilidae) at the subfamilial level: molecular evidence. Molecular Phylogenetics and Evolution. 2004; 30(3): 789-797.

[6] Campbell JW, Hanula JL. Efficiency of malaise traps and colored pan traps for collecting flower visiting insects from three forested ecosystems. Journal of Insect Conservation. 2007; 11(3): 399–408.

[7] Dikow T. A phylogenetic hypothesis for Asilidae based on a total evidence analysis of morphological and DNA sequence data (Insecta: Diptera: Brachycera: Asiloidea). Organisms, Diversity and Evolution. 2009; 9(3): 165-188.

[8] Fisher EM, Brown BV, Borkent JM. Manual of Central American Diptera. 1th ed. Ottawa: NRC Research Press 1989.

[9] Giraldo C, Escobar F, Chara JD, Calle Z. The adoption of silvopastoral systems promotes the recovery of ecological processes regulated by dung beetles in the Colombian Andes. Insect Conservation and Diversity. 2001; 4(3): 115–122.

[10] Vieira RM, Castro I, Almeida D, Alvim E, Bravo F. Asilidae (Diptera) da Bahia, Brasil: Sinopse das espécies e chave de identificação. Sitientibus Série Ciências Biológicas. 2006; 6: 243-256.

[11] Van DRG, Bellows TS. Steps in classical arthropod biological control. 1th ed. College Park: Entomological Society of America. 1993.

[12] Wood GC. Manual of Nearctic Diptera. 1th ed. Quebec: Canadian Government Publishing Centre. 1981.

[13] Wood DM. Manual of Nearctic Diptera. 1th ed. Quebec: Canadian Government Publishing Centre. 1989.

[14] Lopes EJM, Passos FP, Oliveira FF. Moscas *Aphamartania* Schiner, 1866 (Diptera: Asilidae) X Abelhas *Eulaema* Candombá. Revista Virtual. 2018; 14(1): 1-8.

[15] Charles J. Biological nomenclature. 1th ed. London: Edward Arnold. 1973.

[16] Dennis D, Barnes S, Jeffrey K, Knutson L. Review and analysis of information on the biology and morphology of immature stages of robber flies (Diptera: Asilidae). Zootaxa. 2013; 3673(1): 1–64.

[17] Dennis D, Lavigne S, Robert J. Comparative behavior of Wyoming robber flies II (Diptera: Asilidae). 1th ed. Laramie: Agricultural Experiment Station, University of Wyoming. 1975.

[18] Oldroyd H. An introduction to the robber flies (Diptera: Asilidae) of South Africa. Annals of the Natal Museum. 1974; 22: 1-171.

[19] Papavero N. Studies of Asilidae (Diptera) systematics and evolution: I. A preliminary classification in subfamilies. Arquivos de Zoologia. 1973; 23(3): 217-274.

[20] Marchiori CH. Biology and feeding behavior of ceratopogonid adult (Diptera: Ceratopogonidae). International Journal of Frontiers in Science and Technology Research. 2021; 1(2): 007–024.

[21] Papavero N. Catalogue of Neotropical Diptera. Asilidae. Neotropical Diptera. 2009; 17: 1-179.

[22] Papavero N. Neotropical *Acronyches* (Diptera, Asilidae), new or otherwise. Papéis Avulsos de Zoologia. 1971; 23: 145-151.

[23] Cezar LS. Checklist das moscas Asilidae (Diptera) no Mato Grosso do Sul, Brasil. Iheringia, Série Zoologia. 2017; 107(supl.): e2017134.

[24] Artigas JN, Papavero N. The American genera of Asilidae (Diptera): Keys for identification with an atlas of female spermathecae and other morphological details. IX.10. Subfamily Asilinae Leach - Lecania-group, with a catalogue of the Neotropical species. Theoria. 1995; 4: 33-56.

[25] Wardill TJ, et al. The killer fly hunger games: Target size and speed predict decision to pursuit. Behavior and Evolution. 2015; 86(1): 28-37.

[26] Borror DJ, DeLong DM. Introduction to the Study of Insects. 7th ed. Belmont: California: Thomson Brooks. 2019.

[27] Timo M. Semiotic interpretations of biological mimicry. Semiotica. 2007; 167: 223-248.

[28] Arash R, Thomas NS. Mimicry in hoverflies (Diptera: Syrphidae): a field test of the competitive mimicry hypothesis. Behavioral Ecology. 2006; 18(2): 337-344.

[29] Smith J, Mayna HD. Animal signals. 1th ed. Oxford: Oxford University Press. 2003.

[30] Wolfgang W. Mimicry and the evolution of animal communication. Nature. 1965; 208(5010): 519.

[31] Zhi-Qiang Z. Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. 1th ed. Auckland: Magnolia Press. 2011.

[32] Myers P, Espinosa R, Parr CS, Jones T, Hammond GS, Dewey TA. The Animal Diversity Web (online). 1th ed. Detroit: University of Michigan. 2021.

[33] Flores SP. Primer registro del género *Smeryngolaphria* Hermann, 1912 (Diptera: Asilidae: Laphriinae) en Perú. Revista Peruana de Biología. 2017; 24(2): 223-226.