



Associations of mutillid wasps (Hymenoptera, Mutillidae) with eusocial insects

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Abstract

Although disturbing, this scenario is common within the Mutillidae, as the most striking feature is undoubtedly their marked sexual dimorphism: all known females are wingless and most males are winged, although some species have winged males. Reduced (brachypterous) or apterous. This extreme sexual dimorphism has historically led to numerous descriptions of new species, and even genera, based on a single sex, causing the family to remain poorly studied throughout the world. The objective of this paper is to verify the association of mutillid wasps (Hymenoptera, Mutillidae) with eusocial insects. To this end, a bibliographic survey of Mutillidae was carried out in the years 1937 to 2021. Only complete articles published in scientific journals and expanded abstracts presented at national and international scientific events. Data were also obtained from platforms such as: Academia.edu, Frontiers, Qeios, Pubmed, Biological Abstract, Publons, Dialnet, World, Wide Science, Springer, RefSeek, Microsoft Academic, Science and ERIC.

Keywords: Sexual dimorphism; Defense; Poison; Larva; parasitoid

1. Introduction

1.1. Characteristics

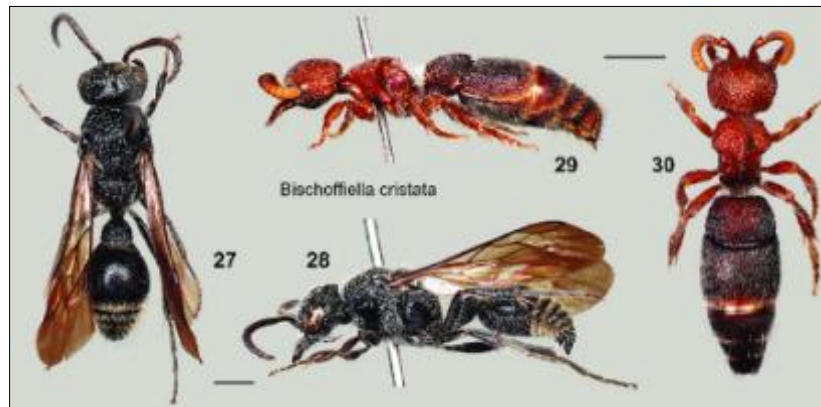
The common name "velvet ant" refers to the dense body hairs, which are often most bright orange or scarlet in color, but can also be black, white, silver, or gold. Black and white specimens are known as panda ants because of their fur coloring reminiscent of China's giant panda. Their bright colors serve the aposematic signs. They are known for their extremely painful bites. The males have wings and are not as hairy as the females (Figures 1 and 2) [1,2,3].

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Source: <https://pt.wikipedia.org/wiki/Formiga-feiticeira>

Figure 1 Specimens of Mutillidae Family



Source: https://www.researchgate.net/figure/Figures-27-30-Bischoffiella-cristata-Bingham-27-28-male-dorsal-lateral-views-29-30_fig5_285233967

Figure 2 *Mutilla cristata* Bingham, 1912. 27-28 male, dorsal & lateral views 29-30 female, lateral & dorsal views 29-32. Scales = 1 mm

As in all other Hymenoptera, only the females have a stinger and can sting. As with other wasps, they can sting repeatedly. They have an organ of stridulation in the metasoma or abdomen. When they are disturbed, they can produce a squeak or high-pitched sound with this organ that serves to prevent or scare away possible predators (Figure 3) [1,2,3].



Source: https://www.researchgate.net/figure/Figures-27-30-Bischoffiella-cristata-Bingham-27-28-male-dorsal-lateral-views-29-30_fig5_285233967

Figure 3 Thorax of the wingless females without distinct segmentation dorsally. Pronotum long, extending back to the tegulae. The spiracle cover lobe of the pronotum margined with close fine hairs. Mesopleuron without a suture. Cenchri absent. Wings present (males), or absent (the ant-like females); not folding longitudinally. Fore-wings with a conspicuous pterostigma; with the venation well developed. Closed fore-wing cells 6–10. Hind-wings with closed cells; of the males without a ‘jugal’ lobe. Fore femur not noticeably dilated. Hind femur without a well-defined trochantellus. Hind tibiae without specialized spurs

The exoskeleton of all the hairy formigants is extraordinarily resistant (to the point that some entomologists have reported difficulty in drilling them with pine trees or trying to mount them for exhibition in museums). This feature allows them to successfully invade the children of their prey and also helps them to stay hidden. Like other species of the Vespoidea family, the males have handles, but the females are uniformly without handles (Figure 4) [1,2,3].



Source: <https://www.sciencedirect.com/science/article/abs/pii/S0306456521001984>

Figure 4 Color lightness of velvet ants (Hymenoptera: Mutillidae) follows an environmental gradient

The abdomen with a marked basal constriction; long petiolate to short-waisted. The ‘waist’ simple. Visible abdominal segments 6 (females), or 7 (males). The gaster colour-patterned; black-and-white or black-and-yellow. Ovipositor of females not visibly protruding; modified as a retractable sting (Figure 5).



Source: <https://www.agefotostock.com/age/en/details-photo/abdomen-and-stinger-of-a-female-wasp-from-the-species-dasymutilla-colored-sem-x-10-wasps-from-the-species-dasymutilla-are-velvet-ants/BSI-1480407>

Figure 5 Abdomen and stinger of a female wasp

The family is best identified by its females because they are the only wingless wasps to have hair-covered grooves on the metasoma and with the mesosomal segments fused on the back. Only one other family of Vespoidea, Bradynobaenidae, has hairy grooves. The females of these are differentiated by having a distinctive prothorax and an elongated petiole similar to that of ants (Figures 6 and 7) [3,4,5].



Source: <https://www.sfzoo.org/velvet-ant/>

Figure 6 Wingless wasps to have hair-covered grooves



Source: <https://paper-pedia.blogspot.com/2018/04/mutillidae-south-carolina-velvet-ant.html>

Figure 7 Female wingless wasps to have hair-covered grooves

1.2. Reproduction and sexual cycle

They are ectoparasites of mature larvae or prepupae of other insects, as with other mutillids. The female ovipositor is used both to insert eggs into host brood cells and to bite (for defense). After mating, the female looks for a terrestrial nest of another insect, such as a bee or a wasp, and lays her eggs in the vicinity of each larva or pupa. After hatching, their young will feed on the remaining defenseless hosts in the nest. Like other mutillids, during mating, the males are assumed to lift the females and proceed to mate while they are in the air [6,7,8].



Source: Photographs by Jason D. Roberts. Waldren GC, Roberts JD, Pitts JP. Phoretic copulation in the velvet ant *Sphaerophthalma pensylvanica* (Lepeletier) (Hymenoptera, Mutillidae): A novel behavior for Sphaerophthalminae with a synthesis of mating strategies in Mutillidae. *Journal of Hymenoptera Research*. 2020; 78: 69-89

Figure 8 MPC-practicing pair of *Sphaerophthalma pensylvanica* (Lepeletier, 1845) in Alabama, USA. Phoretic copulation, a form of phoresy in which a male physically transports a female. All published observations of copulation events in Mutillidae are critically reviewed in the context of mating strategy, and new terminology is proposed for the mating strategies currently known to occur in the family

Contrary to a true ant, velvet ants do not have workers and queens. However, the hairy ants present a haplodiploid sex determination system similar to other members of the Vespoidea superfamily. In the Mutillidae family only the female is able to sting because the stinger itself is a modified female organ called an ovopositor - females have extraordinarily long and maneuverable stingers (Figure 9).



Source: https://www.researchgate.net/figure/Parasitic-biology-of-M-europaea-in-a-B-breviceps-colony-A-Two-eggs-in-a-single-cell_fig3_332393018

Figure 9 (A) Two eggs in a single cell *Mutilla europaea* L. 1758; (B) one hatched egg (downward arrow) and one depauperate egg (upward arrow) in a single cell of a *B. breviceps* pupa; (C) young larva of *M. europaea* sucking the body fluid of a *B. breviceps* pupa; (D) developing *Mutilla europaea* L. 1758, larva and collapsing appendages of the *B. breviceps* pupa; (E) double cocoons; (F) white pupae of *M. europaea*, the dotted circles show the ovipositor of the female (left) and the genitalia of the male

Mature wasps of the Mutillidae family feed on nectar. Although some species are strictly nocturnal, females are often found active during the day. Generally the wasps of this family are stenothermic (they do not support great temperature variation) and thermophilic (active at times of higher luminosity). They cannot avoid light, but are active during temperatures that normally occur only after sunset (Figure 10A).



Source: https://www.researchgate.net/figure/Adult-Mutilla-europaea-A-Female-M-europaea-B-male-M-europaea-and-C-female-M_fig2_332393018

Figure 10A Adult *Mutilla europaea* L. 1758. (A) Female *M. europaea*; (B) male *M. europaea*; and (C) female *M. europaea* inside a *Bombus laticeps* Friese, 1905 nest

The male of the Mutillidae wasps locates the female in flight, and mates with her. The female then enters an insect nest, usually a ground-nesting bee's nest, such as a bumblebee's, or the nest of other wasps, and lays an egg near each larva or pupa. When velvet ant larvae hatch, they consume the host's defenseless larvae or pupae (Figures 10B, 10C, 10D and 10E) [6,7,8].



Source: <https://www.mdpi.com/2075-4450/12/2/100/htm>

Figure 10B Developmental stages of *Oxybelus variegatus* Wesmael, 1852. (A) Egg; (B–H) larva



Source: <https://www.mdpi.com/2075-4450/12/2/100/htm>

Figure 10C Adult of *Oxybelus variegatus* Wesmael, 1852. (A) Male; (B) female in front of the nest entrance; (C–E) female with prey



Source: <https://www.mdpi.com/2075-4450/12/2/100/htm>

Figure 10D Nest of *Oxybelus variegatus* Wesmael, 1852 (A,C,D) Top view of the nest entrance; (B) cross-section of the nest after removing a single paving stone; (E–H) burrow excavation

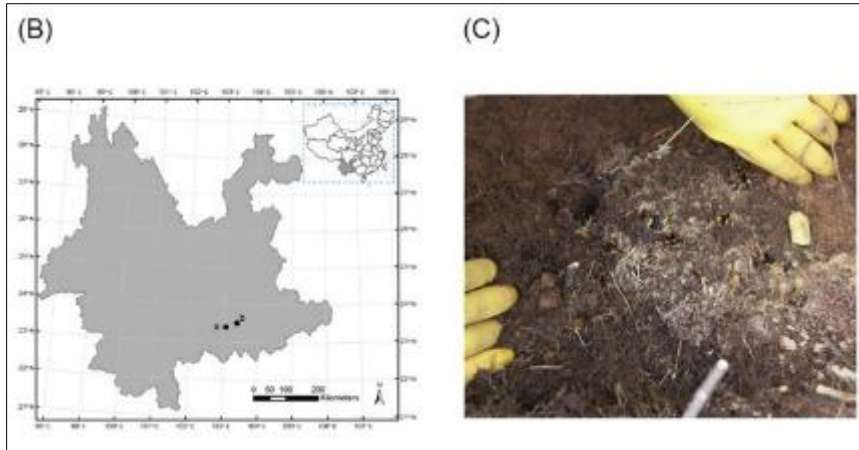


Source: <https://www.mdpi.com/2075-4450/12/2/100/htm>

Figure 10E Kleptoparasites. (A, B) Females of *Metopia argyrocephala* (Meigen, 1824); (C) female *Senotainia conica* (Fallén, 1810)

1.3. Behavior and Habitat

Adult mutilids feed on the nectar of flowers. The larvae are mainly ectoparasitoids of bees and wasps, as well as Diptera, Coleoptera, Lepidoptera and Blattodea (Figure 11A) [8,9].



Source: https://www.researchgate.net/figure/Sampling-and-experimental-site-information-A-Habitat-of-the-first-bumblebee-colony_fig1_332393018

Figure 11A (A) Habitat of the first bumblebee colony collected; (B) points represent the sampling and experiment GPS (Global Positioning System) coordinates: point a is the collection site and point b is the dispersal experiment site; (C) *Bombus breviceps* Smith, 1852 colony in the field

Although some species are strictly nocturnal, females are often active during the day. *Tricholabiodes thisbe* Latreille, 1802 females are sometimes active up to two hours before sunset. Hypothesized that mutilids are generally stenothermic and thermophilic, able to live in light, but active at temperatures that normally occur only after sunset (Figures 11B and 12) [8,9].



Source: Credit Joseph S. Wilson

Figure 11B *Tricholabiodes thisbe* Latreille, 1802

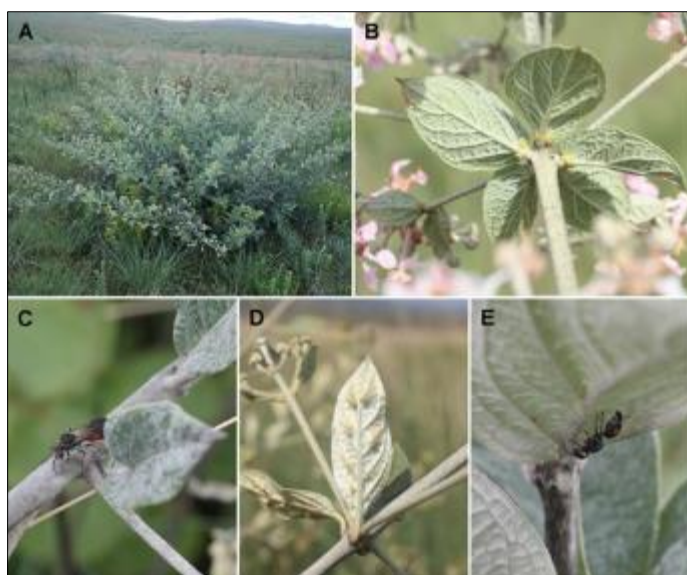


Source: Credit Joseph S. Wilson

Figure 12 *Dasymutilla gloriosa* (Saussure, 1868), a type of wasp confusingly called the thistledown velvet ant, found in the Mojave Desert

1.4. Distribution

There are mutilids throughout the world, about 8,000 species in 230 genera, especially in tropical regions. They are very common in deserts and sandy areas. Most of the American species are found in California, Arizona, Texas, New Mexico, and in adjoining regions of Mexico (Figure 13).



Source: <https://www.scielo.br/j/bjb/a/snjj8LZBWrHVnFzTBn4V8vL/?lang=en>

Figure 13 (A) An overview of the shrub *Banisteriopsis vernoniifolia* (Mart. ex A. Juss.) (Malpighiaceae) (A. Juss.) B. Gates; (B) EFNs of *Banisteriopsis campestris* (Mart. ex A. Juss.) (Malpighiaceae) Little, located at the base of the leaves; (C) Male of *Timulla scoparia* (Gerstaecker, 1874) visiting *B. vernoniifolia*; (D) EFNs located at the leaf blades of *B. vernoniifolia*; (E) Female of *Darditilla vianai* Casal, 1968 visiting *B. vernoniifolia*

They are common in the same types of habitats where their hosts are more varied and abundant. Some species are nocturnal and thus avoid the extreme temperatures of the deserts. Females don't have wings, but males do. Males are more nocturnal while females are more active during the day, especially just after sunrise. They feed mainly on nectar and are not very social [9,10].

1.5. Ecology

It prefers open spaces, sandy or stony, low grass, often close to watercourses in floodplains. Species with diurnal behavior. Females can be seen moving very quickly on the ground looking for nests of solitary bees of the genera *Megachile* sp. and *Anthophora* sp., where they lay their eggs. Larvae are ectoparasites (Figures 14 and 15) [9, 10].



Source: <https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.4123>

Figure 14 Photos of the various species of velvet ants tested with multiple predators in this study. *Dasymutilla occidentalis* Linnaeus, 1758 and *Dasymutilla vesta* (Cresson 1865) occur in the Eastern United States (Eastern mimicry ring), while the remaining species occur in the Western United States and are part of the Western mimicry ring



Source: Photograph by Richard Vaupel

Figure 15 (left) figure of the feeding station with a mockingbird (*Mimus polyglottos* (Linnaeus, 1758) (Aves: Passeriformes: Mimidae) perched on top. (middle) Painted mealworms used to test the role of aposematic coloration found in *Dasymutilla occidentalis* (Linnaeus, 1758) during interactions with free-ranging birds. (right) figure of an aposematically painted mealworm that was struck at by a mockingbird and “decapitated” but not consumed

1.6. Defense

This species produces sound in response to threats from potential predators via stridulation, as from other mutillids, although this species is unusual in having a strong ultrasonic component to the sounds it makes. In addition, as mentioned earlier, they have an extremely painful bite (Figure 16).



Source: Gall BG, Spivey KL, Chapman TL, Delph RJ, Brodie ED Jr5 Wilson JS. The indestructible insect: Velvet ants from across the United States avoid predation by representatives from all major tetrapod clades. *Ecology and Evolution*, 2018; 8(11):5852-5862

Figure 16 keletal structure in Mutillidae sting apparatus, lateral view. AP. brunripes (Myrmosinae). BM. caucasica (Myrmillinae). CN. viduata (Mutillinae). The black thin arrow indicates to anterior. White arrow, sclerotized area of the genital membrane. Scale bar, 0.3 mm

Their larvae are very attractive to predators and even though the females lay about 2,000 eggs a year, this species is almost extinct in the world. If the young survive, it can last up to about 2 years (Figure 17) [11,12,13].



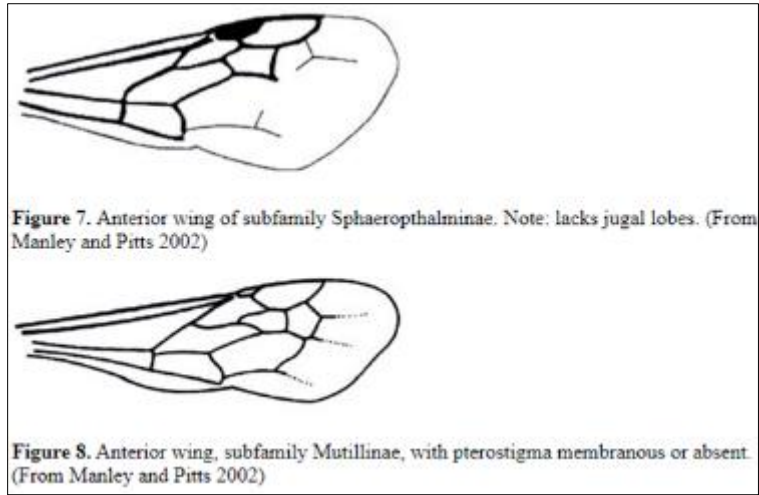
Source: https://www.researchgate.net/figure/Tergum-VIII-T8-in-Mutillidae-Specimens-slide-mounted-The-black-thin-arrow-indicates_fig3_358214946

Figure 17 Tergum VIII (T8) in Mutillidae. Slide mounted samples. The thin black arrow points to previous. AP brunripes (Myrmosinae). BM atra (Myrmosinae). CD. maura (Dasylabrinae). Teacher. caucasica (Myrmillinae).ER. brutia (Mutillinae). Scale bar, 0.3 mm

1.7. Taxonomy

Phylum: Arthropoda, Class: Insecta, Order: Hymenoptera, Suborder: Apocrita, Superfamily: Pompiloidea, Family: Mutillidae, Subfamilies: Mutillinae, Myrmillinae, Pseudophotopsidinae, Rhopalomutillinae, Sphaerophthalminae and Ticoplinae [14,15,16].

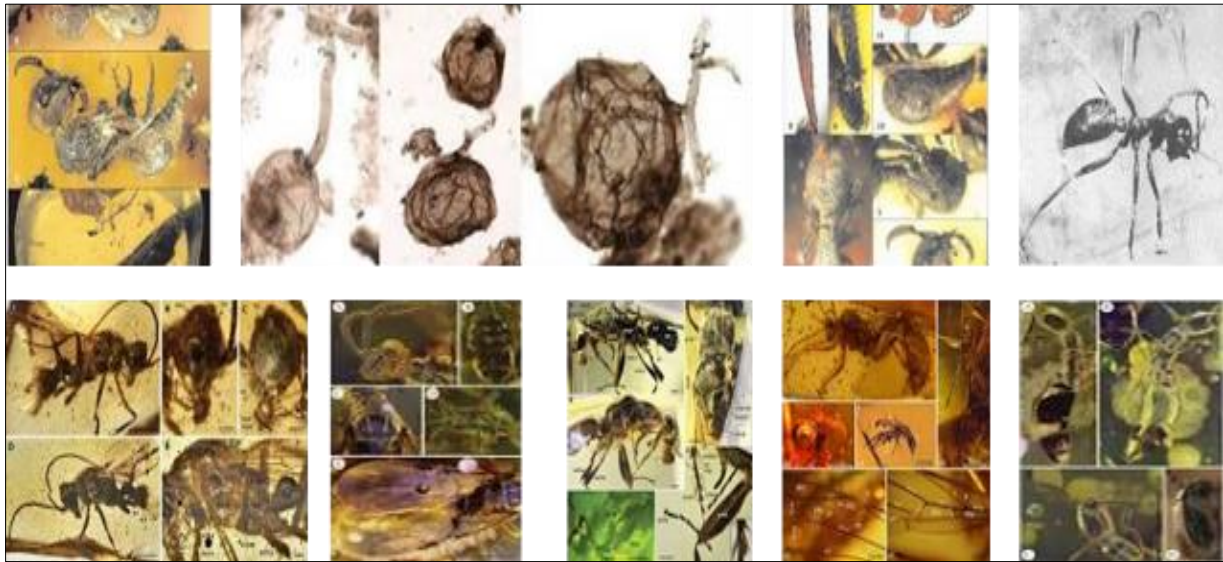
The seven newly recognized subfamilies, Mutillinae and Sphaerophthalminae, occur in the Neotropical region (Figures 18A and 18B).



Source: <https://twitter.com/michelotto8legs/status/1248781384405131264?lang=ar>

Figure 18 A Anterior wing of subfamily Sphaerophthalminae. **Figure 18B** Anterior wing of subfamily Mutillinae

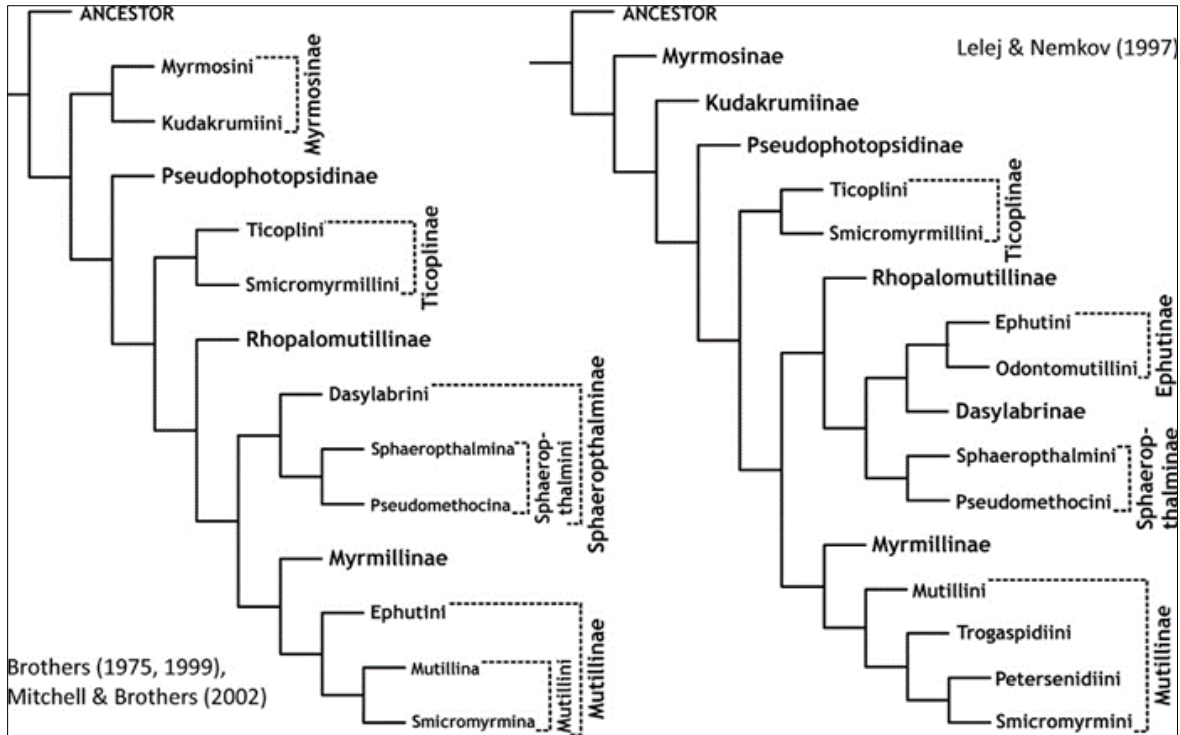
Brazil has the greatest diversity of known witch ants in the world, with 535 named species, more than 10% of the total. But that number may be underestimated. During my preliminary work in Brazil, in nine months studying only females, I found at least 200 more apparently new species that need to be described, reveals the American researcher (Figure 19) [14,15,16].



Source: Lohrmann V, Oh M, Michalik P, Pitts JP, Jeanneau L, Perrichot V. Notes on rhopalosomatid wasps of Dominican and Mexican amber (Hymenoptera: Rhopalosomatidae) with a description of the first fossil species of *Rhopalosoma* Cresson, 1865, *Fossil Record*. 2019; 22: 31–44

Figure 19 *Rhopalosoma hispaniola* sp. nov.: female, holotype, MB. I 5915, Miocene Dominican amber. (a) Overview. (b) Detail of the head in dorsal view. (c) Detail of the tarsal claws. (d) Distal section of mid tibia with tibial spurs. (e–f) Details of the right fore wing. Abbreviations used in (b) and (c): en – eye notch, lo – lateral ocellus, mo – median ocellus, oc – occipital carina, tc – tarsal claw, t5 – tarsomere 5, and pat – preapical tooth

The oldest fossil specimens of Mutillidae are believed to be ones found in amber from the Dominican Republic that are between 25 and 40 million years old. [14,15,16]. The family Mutillidae comprises a monophyletic group of solitary needled wasps (Hymenoptera, Aculeata). (Figure 20) [17,18].



Source: Brothers DJ, Lelej AS (2017) Phylogeny and higher classification of Mutillidae (Hymenoptera) based on morphological reanalyses. Journal of Hymenoptera Research 60: 1-97

Figure 20 Competing current phylogenies and classifications of Mutillidae

Objective

The objective of this paper is to verify the association of mutillid wasps (Hymenoptera, Mutillidae) with eusocial insects.

2. Methods

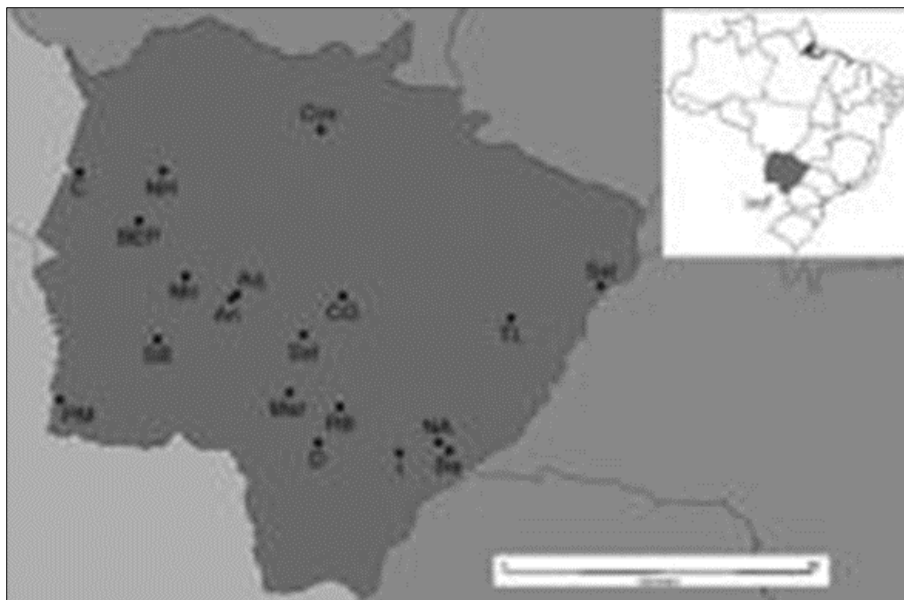
The method used to prepare this mini review was Marchiori 2021 methodology [19].

3. Studies conducted and selected

3.1. Study 1

The objective is to present an updated list of species registered for the state.

114 species (including 22 morphospecies) of Mutillidae are recorded for different localities in the state of Mato Grosso do Sul. The taxa are distributed in 23 genera, three tribes and two subfamilies. In addition to these species, two names incertae sedis described for the municipality of Corumbá by Cresson are reported in the literature: *Mutilla tantula* Cresson, 1902, female, and *Mutilla turnalis* Cresson, 1902, female (Figure 21A) [19].



Source: <https://www.scielo.br/j/isz/a/BpZRC7NYVZwdXdzNVdvzvRG/?lang=pt>

Figure 21A Map with collection locations of Mutillidae species recorded for the state of Mato Grosso do Sul in this study (Na, Anastácio; Aq, Aquidauana; Ba, Batayporã; BEP, Pantanal Study Base (UFMS); C, Corumbá; CG, Campo Grande; Cox, Coxim; D, Dourados; I, Ivinhema; Ma, Maracaju; Mir, Miranda; NA, Nova Andradina; NH, Fazenda Nhumirim (Embrapa Pantanal); PM, Porto Murtinho; RB, Rio Brillhante; SB, Serra da Bodoquena; Sel, Selvíria; Sid, Sidrolândia; TL, Três Lagoas)

The genera with the highest number of species recorded were *Traumatotutilla* André, 1901 (36 species and two subspecies), *Timulla* Ashmead, 1899 (14 spp.), *Ephuta* Say, 1836 (11 spp.) and *Hoplomotilla* Ashmead, 1899 (10 spp.). Only *Timulla terminalis* (Gerst., 1874) is known for both sexes (Figures 21B, 22, and 23) [19].



Source: http://www.waspweb.org/Vespoidea/Mutillidae/Mutillinae/Mutillini/Mutillina/Hadrotilla/Hadrotilla_helle.htm

Figure 21B *Mutilla tantula* Cresson, 1902



Source: https://www.researchgate.net/figure/Habitus-di-Mutilla-europaea-foto-di-Marco-Rastelli_fig34_316923167

Figure 22 *Mutilla turnalis* Cresson, 1902



Source: https://www.ecoregistros.org/site_br/familia.php?id=472

Figure 23 *Traumatotutilla* André, 1901

3.2. Study 2

Traumatotutilla tabapua Couple, 1969

Diagnosis. Female. Posterolateral angles of the head strongly angled; body completely black except for subcircular orange spots on posterior half of T2.

Male. Unknown.

Distribution. Brazil (Amazonas, Pará). These are the first records of this species since its description based only on the holotype.

Host. Unknown.

Traumatotutilla integella (Cresson, 1902)

Diagnosis. Female. Longitudinally striated pygidium; mesosome reddish except the pronotum which is black; T2 with a pair of longitudinal, subtriangular, yellow spots on the posterior half, widely separated from the anterior margin of the segment.

Male. Unknown.

Host. Unknown.



Source: https://www.researchgate.net/figure/Figures-3435-Traumatmutilla-integella-Cresson-1902-34-Habitus-dorsal-view-35_fig11_315807541

Figure 24 *Traumatmutilla integella* (Cresson, 1902). 34) Habitus, dorsal view. 35) Habitus, lateral view. Scale bar: 3 mm

Traumatmutilla verecunda (Cresson, 1902)

Female. Longitudinally striated pygidium; Mesosoma is reddish, except the pronotum which is black; T2 with a pair of longitudinal, subtriangular spots extending from the anterior margin to just before the posterior margin of the segment.

Male. Unknown.

Distribution. (Brazil) Mato Grosso, Goiás.

Host. Unknown [21,22,23,24].

3.3. Study 3

The purpose of the action was to photograph this insect of the order Hymenoptera, 'golden ant' or 'velvet ant', of the family Mutillidae. The interest is focused on the visibility of traditional knowledge, highlighting here the preservation of intangible heritage in the form of knowledge and zootherapeutic use, in addition to the potential for biodiversity conservation, sustainability and technology development (Figure 25).



Source: <https://blog.buson.com.br/conheca-o-vale-do-jequitinhonha/>

Figure 25 Vales of Jequitinhonha and Mucuri

The equipment used was available from the Jequi/UFVJM group and consisted of Sony, Canon EOS Rebel and Nikon D-90 cameras. The photographs were produced by the team in several locations in the region, especially in the Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM) campus in Diamantina, Minas Gerais (Figure 26).



Source: https://www.em.com.br/app/noticia/politica/2012/03/17/interna_politica,283951/aprovada-a-construcao-de-campus-nos-vales.shtml

Figure 26 Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM) campus in Diamantina, Minas Gerais

An interesting observation is about the therapeutic functionality of the 'golden ant', it must be captured for use in the patuá, going down the path where it is, and never going up. Popularly, the use of 'golden ant', against wheezing in children's chests, is justified by the fact that, when we touch the ant, it makes a hiss. The therapeutic use of the ant is structured in a binary logic, in similarity and in contact (Figure 27).



Source: <https://bioone.org/journals/zoosystema/volume-43/issue-1/zoosystema2021v43a1/Revision-of-the-Traumatotutilla-gemella-species-group-Hymenoptera-Mutillidae-with/10.5252/zoosystema2021v43a1.short>

Figure 27 'Golden ants' *Traumatotutilla* (Hymenoptera, Mutillidae)

Binary logic is expressed in the up and down polarity, described in the sense in which the ant was at the moment of its capture (to make the hiss 'go down'). The similarity, that is, the analogy between the ant's wheezing and the child's wheezing, leads us to a homeopathic logic: the like cures like, and it is through contact with the patuá that the child will be treated (Figure 28).



Source: file:///C:/Users/User/Downloads/7538-36650-1-PB%20(1).pdf

Figure 28 The 'gold ant' - Mutilidae in Serra do Espinhaço Meridional, Brazil

Traditional medical systems deserve visibility and prominence, given as well as the National Culture Policy and the National Culture Plan. In this perspective, the fact that we reinforce the forms of traditional therapies refers not only to the possibility of prospective studies, but, above all, to the valorization and protection of that knowledge.

This cultural heritage is almost invisible, not receives due credit and lacks fertile ground for manifestation. The photos of the 'golden ants' sought to bring out a traditional local knowledge, strengthening it through the aesthetics contained in the generated photographs and the charm that everyone manifests when viewing the image of this insect.

The wide geographic distribution and the ethnographic record of the zotherapy phenomenon resulted in the hypothesis of zotherapeutic universality, according to which every culture which presents a developed medical system uses animals as medicine. Valuable information about dyes, oils, dyes, insecticides, natural essences, foods, repellents and various other preparations are transmitted between generations, in communities, and are often not scientifically recorded, due to negligence and/or ignorance of this potential for the sustainability of communities.

These authors warn that the research on zotherapy must be compatible with the welfare of animals and the biological conservation. Traditional animal-based medicine has brought to modern medical science a source of inspiration for pharmaceutical companies such as drug sources [25,26,27,28].

3.4. Study 4

The weevils, also known as weevils, make up a large family of beetles whose main feature is the long snout (curved beak or proboscis) they have. Due to this peculiar characteristic, these insects also receive popular names such as boll weevil and borer. Certain species of these beetles are harmful to agriculture, being relevant pests in plantations of corn (corn weevil), sugarcane cotton, and several species of palm.

Weevils can be preyed upon by bed bugs, spiders and birds and the larvae can be parasitized. Living as scolds or miners can help these larvae not to be preyed on by some natural enemies.

Rare weevil *Ameris* (Curculionidae), mimicking, as a defense, a witch ant from the Mutillidae family, which is actually a wasp (Figure 29).



Source: <https://twitter.com/elfadosinsetos/status/1338551377669328897>

Figure 29 *Ameris* Curculionidae, mimicking, as a defense, a witch ant of the Mutillidae family

Weevils can be preyed upon by bed bugs, spiders, birds, etc. And the larvae can be parasitized. Living as scolds or miners can help these larvae not to be preyed on by some natural enemies (Figure 30).



Source: <https://twitter.com/elfadosinsetos/status/1338551377669328897>

Figure 30 Weevils can be preyed upon by bed bugs, spiders, birds, etc. And the larvae can be parasitized. Living as scolds or miners can help these larvae not to be preyed on by some natural enemies

Here's a really cool cycle of a weevil *Phelypera* beetle, Curculionidae, whose larva makes the silk cocoon. The largest family of beetles in the world is the Curculionidae, made up of beautiful harmless beetles, known as weevils, there are about 60,000 species, so identifying them visually is extremely arduous (Figures 31 and 32). The long structure present in many of them, but not in all, because there are also short-beaked weevils, is nothing more than the rostrum, their mouthparts, through which they feed, and supports a pair of geniculate antennae (Figure 32).



Source: <https://twitter.com/ElfaDosInsetos/status/1338551442949492740>

Figure 31 Genus *Phelypera* Jekel, 1865, beetle Curculionidae (Insecta: Coleoptera)

The larvae (*Phelypera*) are nomadic processionary foragers that punctuate foraging bouts with rosette-shaped resting formations (cycloalexy). Larvae also vibrate or bob their heads rapidly when moving, especially when in contact with conspecifics, and this suggests acoustic or vibrational communication.



Source: <https://twitter.com/ElfaDosInsetos/status/1338551442949492740>

Figure 32 Specimen of Curculionidae (Insecta: Coleoptera)

But what do weevils eat? The habits of weevils are diverse, they can be gallers, eat seeds, be miners, live like borers, eat leaves, eat roots, or feed on flowers, so these are occasional pollinators (Figure 33).



Source: <https://twitter.com/ElfaDosInsetos/status/1338551442949492740>

Figure 33 *Homalinotus coriaceus* Gyllenhal, 1836 (Coleoptera: Curculionidae)

Homalinotus coriaceus Gyllenhal, 1836 (Coleoptera: Curculionidae) is the most recorded weevil in Insetologia. This beetle has, as a defense, strong legs, to cling on and not be caught by predators. The coconut flower peduncle borer, *H. coriaceus*, is a limiting pest to coconut production in Brazil, causing the fall of flowers and immature fruits. A species from the South American continent, which has been observed in coastal regions and inland at altitudes below 800 m (Figure 34).



Source: <https://twitter.com/ElfaDosInsetos/status/1338551442949492740>

Figure 34 Several Curculionidae specimens performing pollination

Are there aquatic weevils? Do not. But there are weevils that occupy niches near the water, feeding only on aquatic plants. How do weevils defend themselves? Weevils are beetles, they have stiff elytra that make them less desirable to predators. They pretend to be dead when disturbed. There are recorded cases of weevils that can jump when they feel threatened (Figure 35).



Source: <https://twitter.com/ElfaDosInsetos/status/1338551442949492740>

Figure 35 Beetle life cycle; egg, larva, pupa and adult (Coleoptera: Curculionidae)

Still in their defenses, weevils can have aposematic colors and patterns, which leave them camouflaged in trunks or that discourage predation, such as spots and macules. Here's a really cool cycle of a weevil/*Phelypera* beetle, Curculionidae, whose larva makes the silk cocoon [29,30,31,32].

3.5. Study 5

The dangerous velvet ant

The velvet ant - actually a velvet wasp - gets its name from the bristles that cover its body and because it resembles an ant. Females are flightless and are often found roaming the land, resembling even more ants. Two common varieties include *Dasymutilla gloriosa* (Saussure, 1868) and *Dasymutilla magnifica* Mickel, 1928 (Figure 36A) [33,34].



Source: <https://beetlesinthebush.com/2012/12/12/the-gloriously-dichromatic-dasymutilla-gloriosa/>

Figure 36A *Dasymutilla gloriosa* (Saussure, 1868), female Brewster Co., Texas

Velvet ants range in size from 1/8 of an inch to an inch, with great variation within species. They look like miniature cotton balls. The variety *Dasymutilla gloriosa*, has been described as a "creosote seed with legs", due to its white color, red, orange, yellow, black or white bristles, and the bristles cover Whole body. Biologists call this type of coloration "aposematic", and they used the term to refer to the conspicuous warning colors of predatory animals that should be avoided. Wings are missing. The integument, which covers the outside of the body, works like an armor and can only be penetrated with great difficulty (Figure 36B).



Source: <http://domescobar.blogspot.com/2010/10/perigosa-formiga-de-veludo.html>

Figure 36B *Dasymutilla gloriosa* (Saussure, 1868), female Brewster Co., Texas

More than 150 velvet ant species occur across the United States, southern Canada and Mexico. There are only about a third of the known species of both sexes, while another third are known only to males, and a final third, only to females. There is a clear possibility that many of these males and females belong to the same species, but because of the marked sexual dimorphism, it is not so evident that males belong to females and vice versa. At least three dozen species inhabit the state of Arizona. They live in all parts of the hot and dry semi-arid desert (Figure 37) [33,34].



Source: <https://www.flickr.com/photos/usgsbiml/28697046314/in/photostream/>

Figure 37 *Dasymutilla gloriosa* (Saussure, 1868)

Like other mutillids, the females of this species can administer a very painful sting as a defense mechanism. Being a mid-sized mutillid, the sting delivered is more powerful than smaller mutillids', but weaker than most larger mutillids (Figure 38) [33,34].



Source: <https://www.flickr.com/photos/usgsbiml/28697046314/in/photostream/>

Figure 38 *Dasymutilla gloriosa* (Saussure, 1868) male | Riverside Co., California

Velvet ants are active during the day, and they may be the first insects to leave in the morning and the last to return to shelter at night. They take refuge from the high midday soil temperatures by digging under rubble or climbing plants. Nectar is their favorite food. Ants are active from April to November, depending on the local climate (Figure 39) [33,34].



Source: <https://kidadl.com/animal-facts/thistledown-velvet-ant-facts>

Figure 39 *Dasymutilla gloriosa* (Saussure, 1868)

Occasionally, agglomerations of ants occur for cutting and mating. One cluster in Arizona contained an estimated 6000 individuals within a 1500 square meter radius. More often, however, ants are solitary with males usually flying low to the ground looking for stray females. Biologists still have no idea how males find females, but they believe vision and pheromones play a big role. After mating, females run in search of wasp or bee pupal chambers. Once found, they will build a nest and use their ovipositor to lay an egg on or near the host (Figure 40) [33,34].



Source: <http://domescobar.blogspot.com/2010/10/perigosa-formiga-de-veludo.html>

Figure 40 *Dasymutilla magnifica* Mickel, 1928

A larva will emerge from the egg, feed on its host, and will grow to full size within a day. The original location will then become a place to build a cocoon for your pupa. Some adults emerge in summer, while others hibernate in the pupal or pre-pupal state (Figure 41) [33,34].



Source: https://a4.pbase.com/o9/94/339594/1/116125496.hD26n4j5.IMG_8415.JPG

Figure 41 *Dasymutilla magnifica* Mickel, 1928

The first known velvet ants were found in a 40-million-year-old amber found in the Dominican Republic. When molested, and during mating, velvet ants produce an audible squeak. They are also known as cow killers or mule killers because of their extremely painful sting. Like all wasps, they can sting multiple times. Because of their armor-like exoskeleton and painful sting, few if any animals feed on these wasps [33,34].

4. Conclusion

Although disturbing, this scenario is common within the Mutillidae, as the most striking feature is undoubtedly their marked sexual dimorphism: all known females are wingless and most males are winged, although some species have winged males. reduced (brachypterous) or apterous. This extreme sexual dimorphism has historically led to numerous descriptions of new species, and even genera, based on a single sex, causing the family to remain poorly studied throughout the world.

Compliance with ethical standards

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