**UNIVERSIDADE ESTADUAL PAULISTA - UNESP FACULDADE DE CIÊNCIAS AGRÁRIAS E VETERINÁRIAS CÂMPUS DE JABOTICABAL**

# ALTERATION OF THE FAUNISTIC COMPOSITION OF EDAFIC MITES ACCORDING TO LAND USE IN THE CENTRAL-SOUTHERN REGION OF BRAZIL

**Jorge Luís M. Marticorena**

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**Jorge Luis M. Marticorena**

**Advisor: Prof. Dr. Gilberto José de Moraes**

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## CERTIFICADO DE APROVAÇÃO

TÍTULO DA TESE: ALTERATION OF THE FAUNISTIC COMPOSITION OF EDAFIC MITES ACCORDING TO LAND USE IN THE CENTRAL-SOUTHERN REGION OF BRAZIL

**AUTOR: JORGE LUIS MUÑOZ MARTICORENA**
**ORIENTADOR: GILBERTO JOSÉ DE MORAES**

Aprovado como parte das exigências para obtenção do Título de Doutor em AGRONOMIA (ENTOMOLOGIA AGRÍCOLA), pela Comissão Examinadora:

Prof. Dr. GILBERTO JOSÉ DE MORAES
Departamento de Entomologia e Acaralogia / ESALQ - USP / Piracicaba/SP

Raphael C. Castilho
Prof. Dr. RAPHAEL DE CAMPOS CASTILHO
Departamento de Fitossanidade / FCAV / UNESP - Jaboticabal

Prof. Dr. DANIEL JUNIOR DE ANDRADE
Departamento de Fitossanidade / FCAV / UNESP - Jaboticabal

Prof. Dr. ANTONIO CARLOS LOFEGO
Instituto de Biociencias Letras e Ciencias Exatas / UNESP - São José do rio Preto/SP

Peterson Rodrigo Demite
Prof. Dr. PETERSON RODRIGO DEMITE
Instituto Federal Goiano- / Câmpus de Urutai/GO

Jaboticabal, 07 de abril de 2017

## CURRICULAR DATA OF THE AUTHOR

**JORGE LUIS MUNOZ MARTICORENA** – Son of Maria E. Marticorena, born in Chincha Alta, Peru on April 6, 1970. Graduated in Agricultural Sciences at San Luis Gonzaga University (Peru) in 1995. MS in Agronomy-Entomology at Universidade Agraria “La Molina” (Peru) in August 2013. He started his Doctorate in Agronomy-Entomology at the Universidade Estadual Paulista (UNESP) “Julio de Mesquita Filho”, Campus of Jaboticabal, supervised by Prof. Dr. Gilberto José de Moraes. He conducted part of his Doctorate research at Departamento de Entomologia e Acarologia, Escola Superior de Agricultura ``Luiz de Queiroz´´ Universidade de São Paulo, Piracicaba, São Paulo state, Brazil. During the doctorate he had a scholarship provided by Programa de apoio a Estudantes de Doutorado do Exterior (PAEDEX)/ Associação Ibero-americana Universitária de Pós-graduação (AUIP).

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## SUMMARY

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# ALTERAÇÃO DA COMPOSIÇÃO FAUNÍSTICA DE ÁCAROS EDÁFICOS DE ACORDO COM O USO DA TERRA NA REGIÃO CENTRO SUL DO BRASIL

**RESUMO** - O ecossistema natural da Região Centro Sul do Brasil é formado em grande parte pelos Biomas Cerrado e Floresta Atlântica, que hoje se encontram fragmentados como resultado da transformação das áreas para a realização de atividades agrícolas e pecuárias ao longo do tempo. Esses fragmentos ainda são habitados por uma rica fauna e flora endêmica, que em seu conjunto constituem um complexo sistema trófico formado por artrópodes, nematoides, microrganismos e plantas. O objetivo deste trabalho foi estimar a abundância e a diversidade de ácaros edáficos em áreas com diferentes usos da terra no município de Jataí no estado de Goiás, e nos municípios de Valparaíso e Ipaussu no estado de São Paulo. Duas amostragens foram feitas durante este estudo, a primeira entre Dezembro de 2013 e Janeiro de 2014 e a segunda entre Dezembro de 2014 e Janeiro do 2015. Em cada data de amostragem foram tomadas 12 amostras de serapilheira, 12 amostras de solo a 0-5 cm de profundidade e 12 amostras de solo a 5-10 cm em cada unidade de estudo, cada uma correspondendo a um uso da terra em cada município: vegetação natural, cana-de-açúcar ou pastagem. Os ácaros foram extraídos utilizando-se uma modificação do método de Berlese-Tullgren. Os resultados mostraram a existência de novas constatações de ácaros para o Brasil, incluindo algumas espécies ainda não descritas. Cita-se a ocorrência de uma nova espécie de *Zercoseius* Walter & Lindquist (Blattisociidae), três novas espécies de *Asca* von Heyden (Ascidae) e um novo gênero de Ologamasidae. Laelapidae foi a família com maior número de espécies, incluindo 19 espécies de *Gaeolaelaps* Evans & Till, oito de *Cosmolaelaps* Berlese, uma de *Stratiolaelaps* Berlese e uma de *Pseudoparasitus* Oudemans. O numero de gêneros e especies observados após do uso da terra foram vistos reduzidos. Isto foi mais evidente em Ipaussu.

**Palavras-chave:** Complexo trófico, ácaros edáficos, *Gaeolaelaps*

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**ABSTRACT** – The natural ecosystem of the Central South Region of Brazil is formed in large part by the Cerrado and Atlantic Forest Biomes, which today are fragmented as a result of the transformation of the areas for the carrying out of agricultural and livestock activities over time. These fragments are still inhabited by a rich endemic fauna and flora, which together constitute a complex trophic system formed by arthropods, nematodes, microorganisms and plants. The objective of this work was to estimate both, the abundance and diversity of edaphic mites in areas with different land uses located in the municipality of Jataí in the state of Goiás and in the municipalities of Valparaíso and Ipaussu in the state of São Paulo. Two samplings were taken during this study, the first between December 2013 and January 2014 and the second between December 2014 and January 2015. At each sampling date 12 litter samples were taken, 12 soil samples at 0-5 cm depth and 12 soil samples at 5-10 cm of each study unit, each corresponding to one land use in each municipality: natural vegetation, sugarcane or pasture. The mites were extracted using a modification of the Berlese-Tullgren method. The results showed the existence of new mite findings for Brazil, including some species not yet described. The occurrence of a new species of *Zercoseius* Walter & Lindquist (Blattisociidae), three new species of *Asca* von Heyden (Ascidae) and a new genus of Ologamasidae are mentioned. Laelapidae was the family with the highest number of species, including 19 species of *Gaeolaelaps* Evans & Till, eight of *Cosmolaelaps* Berlese, one of *Stratiolaelaps* Berlese and one of *Pseudoparasitus* Oudemans. The number of genera and species observed after land use was reduced. This was most evident in Ipaussu.

**Keywords:** Complex trophic, edaphic mites, *Gaeolaelaps*

# **CHAPTER 1 –** GENERAL CONSIDERATION

## 1. Introduction

### **1.1.** Soil mite diversity

Soil mites are a very diverse group within the microarthropodes that colonize secluded habitats due to their small size. They inhabit undisturbed niches in the superficial soil layers, as well as organic residues and fallen fruits (Remen, 2010). They feed on organisms as nematodes, other mites, inmature insect and soil fungi (Carrillo et al., 2015), and show differential vertical distribution in the soil profile that varies according to the species. Predatory mites of the families such as Ascidae, Blattisociidae, Melicharidae and Phytoseiidae feed of small arthropods on the surface of the ground, others such as Macrochelidae and Parasitidae feed on nematodes, eggs and first instar larvae of insects in compost and manure (Koehler, 1999). Euedaphics mites as Rhodacaridae are frequently encountered inhabiting soil pores, feeding of nematodes and small wormlike organisms (Walter & Proctor, 1999).

Mites differ from other arthropods by having the following combination of characteristics: body formed by two main regions (gnathosoma and idiosoma), four pairs of legs, absence of wings and no body segmentation. They are divided into the superorders Acariformes and Parasitiformes. The latter are also called Anactinotríchida, composed of four orders (Walter & Proctor, 1999, Linquist et al., 2009a). Soil predators are very diverse and mainly represented by the order Mesostigmata; other orders within Parasitiformes are Opilioacarida, Holothyrida and Ixodida (Lindquist et al, 2009b). The Mesotigmata contains about 70 families, with more than 10,000 species; about half of which are edaphic predators. Most species of the mesostigmatid family Laelapidae are aggressive predators on the ground, some of which having been considered biological control agents of pests, especially those of the genera *Gaeolaelaps* and *Stratriolaelaps* (Walter & Proctor, 1999).

Predatory soil mites are small (ranging from 0.1 mm to 3 mm in length (Evans et al., 1961). This feature allows them to move freely in the soil interstices (Crossley, 1991). These mites are included mainly in the families Ascidae, Blattisociidae, Laelapidae, Mellicharidae, Ologamasidae and Rhodacaridae (Walter et al., 1988). Soils of areas of natural vegetation are inhabited by a complex trophic group, which are integrated by diverse classes of organisms, that directly or indirectly have been related with the dynamics of populations of edaphic mites (McFee & Kelly, 1995).

The structure and faunistic composition of the soil mites are determined by various factors related to features of the ecosystem they inhabit (climatic condition, plant faunistic composition, food sources, etc). Santos (2013) studied the diversity of biological control agents of three regions (Atlantic Forest, Caatinga and Agreste) of Alagoas state, reporting that mesostigmatid species were the second most abundant soil mites, after Oribatida, in the three sites. The Atlantic Forest biome was more diverse than the other two ecosystems. The litter on the soil surface had more morphospecies (44-62%) than the subjacent soil layers (9-26%). The most abundant families in this niche were Ologamasidae, Laelapidae and Rhodacaridae. *Multidentorhodacarus squamosus* (Karg) was the most common in all sites. In the southern region of São Paulo, 11 species of edaphic mites were reported by Mineiro et al. (2009), including the family Ascidae collected in litter and subjacent soil layers. The following species were reported: *Proctoalelaps diffisus* Karg, *Asca garmani* Hurlbutt, *Blattisocius tarsalis* (Berlese), *Protogamasellus mica* (Athias-Henriot) and five native species, including *Cheiroseius neophalangiodes* Mineiro, Lindquist & Moraes, 2009, *Gamasellodes magnaventris* Mineiro, Lindquist & Moraes, 2009, *Lasioseius latinoamericanus* Mineiro, Lindquist & Moraes.

The negative effects of conventional cultivation on mite distribution in Rio Grande do Sul was shown by Gimenes et al. (2010). In that study, the mean densities were low in soil samples of conventional cultivation in comparison to non-tillage areas and areas of natural vegetation. Soil of areas with deciduous trees in Canada have small mite abundance and richness in comparison with soil from conifers and mixed stands (Diaz-Aguilar et al., 2013). The effects of two semi - arid sheeps grazing intensities applied to chenopodium shrublands in good and poor condition were analized on soil mites in Western Australiam where it was observed that heavily grazed sites had reduzed abundance and richness of the soil mites (Kinnear & Tongway, 2004). The effects of three diferent land management practices on soil mites density was evaluated in temperate areas of Cordoba, Argentina; observing that total mite density decreased as soil cultivation increased. It was also observed that Mesostigmata were more sensitive to the agricultural practice than

Prostigmata and Astigmatina (Bedano et al, 2006). Anthropogenic disturbances in forest areas were analyzed in various European sites (Bedano & Ruf, 2010). Differences between communities of soil mites inhabiting grassland and arable land were not detected.

### 1.2. Atlantic Forest and Cerrado fragments

Many fragments of both Cerrado and Atlantic Forest are found in the central-southern region of Brazil (Viana, 1995; Walter, 2007). These are inhabited by a diverse endemic fauna and flora (Sano & Almeida, 2008; Lagos & Muller, 2007). Fragmentation in this region is the result of the process of incorporation of natural areas into agricultural and livestock producing farms, occurring for many years due to the rapid economic development. Each fragment is represented by a certain type of physiognomy formation, which evolved over the years associated with temporal and spatio-physical variables predominant at each environment (Ribeiro & Walter, 1998; Sano & Almeida, 2008). The Cerrado biome is located in the Brazilian central plateau. It is the second largest Brazilian biome, after the Amazon Forest, with an extension corresponding aproximately to 23% the contry´s territory (Klink and Machado, 2005). Altitude in this biome varies between 300 and 1600 m above sea level, and it has a predominance of Latossolo soil type (Lopes, 1984). The Atlantic Forest biome occupies the eastern front of Brazil and a large portion of Paraná. This biome was exploited and destroyed by more the 500 years and replaced by crops as coffee (XVIII and XIX century), pasture (XIX and XX century) and more recently, by eucalyptus forests (Colombo & Joly, 2010)

The fragmentation process evolved due to several factors, such as the occupation by native people, Portuguese settlers, demographic growth and most recently by advanced agricultural technology, that transformed a high percentage of the natural vegetation on temporary crops and exotic pastures (Silva et al., 1996; Klink & Machado, 2005). In 2002, the number of Cerrado fragments in São Paulo state was estimated at 7,000 (Kouka et al., 2005).

Remaining areas of the standing Atlantic Forest biome are estimated to correspond only to 8 % of the area in the state, being considered as secondary vegetation remainder, and only 50 percent are protected in conservation units, included intermedials secondary forest and small fragments (Colombo & Joly 2010).

## 1.3. Role of the natural vegetation in the economic development of the central-southern region of Brazil

In the early 1970´s, the expansion of sugarcane (*Saccharum officinarum* L.) cultivation increased considerably, due particularly to the success of the national ethanol production program (Rosillo-Calle et al., 2005). With this event, a new process of land use and intensity began, and large pasture areas were replaced by sugarcane plantations (Klink & Machado, 2005). Both Atlantic Forest and Cerrado biomes were most affected during the intensive agriculture growth, important in the economic development of São Paulo, Goiás and other states. Change in land use occurred in parallel with the use of larger amounts of fertilizers and pesticides, and intensive use of agricultural implements for tillage (Silva et al., 1996). This was followed by a drastic reduction in the diversity of plant communities, animals and microorganisms, including predatory soil mites (Walter, 2007; Franco et al., 2016).

Preservation of those ecosystems may play an important role in the climatic stability, and the preservation of both endemic fauna and flora, which are in danger of extinction (Turbé et al., 2010). Edaphic mites have been mentioned as important in both the preservation of the physico-chemical characteristics of the soil (Hulsmann & Wolters, 1996) and the stability of soil inhabiting pest organisms (Koehler, 1999; Diaz-Aguilar et al., 2013). Health and/or quality of soil are two essential conditions in food security (Stonea et al., 2016), and monitoring these characteristic is the base to study biodiversity as indicators (Pereira e Silva et al., 2012). In Brazil, preservation of undisturbed natural vegetation, including fragments or secondary vegetation, are monitored and protected by state governments or by laws established in the Brazilian forest code. From the ecological point of view, it is considered that this vegetation has important role in climate stability and soil conservation.

## 1.4. Characteristics of the areas where the present study was conducted

### 1.4.1. Cerrado

Most of this biome is located in Goiás, Tocantins, Mato Grosso do Sul, Minas Gerais, Piaui and the Federal District (Goedert, 1989). The climate of this ecosystem is classified as Aw Koppen (rainy tropical), with an average annual rainfall of 1500 mm; it has two well defined seasons, the first a 5-6 month dry winter and the second a rainy summer (Adámoli et al., 1985). Thermal gradient is very variable along the wide range of both latitudes and altitudes.

The Cerrado is formed by various vegetation physiognomies, ranging from forest areas with predominance of arboreal species to savannah areas with scattered trees and shrubs. Temporal (geological and ecological) and spatial factors as well as major climatic and geomorphological changes were responsible for the occurrence of forest and savannahs formations in this biome. Their floristic diversity is estimated to be above 7,000 plant species, of which 44% would be endemic (Mendonça et al., 1998). Many of these species are mostly herbaceous plants included in Poaceae and Favaceae, very numerous and with wide geographical distribution (Almeida et al., 2008). However, the forest physiognomy has been less studied. Some researches consider that the south central forest is mostly semi-deciduous (Oliveira Filho & Rather, 1995).

At least 11 types of physiognomies are known. Forest areas are grouped as Ciliar forest, Gallery forest, Dry forest and Cerradão, whereas savannah areas are grouped as Cerrado restricted sense, Cerrado park, Palm tree and meadow (dirty field, rocky field, clean field). Several of them have subtypes.

### 1.4.2. Atlantic Forest

The Atlantic Forest has various formations and forest ecosystems, with highest differentiated floristic structures and composition according to the climatic and geographic characteristics, support a high degrees of species ritchness and endemism including soil mites (Ribeiro et al., 2009). However it has undergone a forest loss by effects of the land use. Some studies revealed that more than 80% of the fragments are < 50 ha, while the distance between fragments exceeds 1440 km

(Ribeiro et al, 2009). One of the factors that most influence the variation of physiognomies of this vegetation is its extension, reaching areas up to 38 $^{o}$S latitude.

The Atlantic Forest was, at the time of discovery, the second largest Tropical forest of South America, covering a continuous area of little more than one million square km (1,290,692.46 $km^2$), 15% of the Brazilian territory. Altitudinal variations are another important factor that contributes to the occurrence of high biological diversity, given that it is found from sea level to 1,800 m above sea level. As a result of the economic development of Brazil, this biome was greatly altered, and it is now almost totally restricted to fragments.

### 1.5 Sugarcane crop (*Sacharum officinarum* L.)

The center of origin of sugarcane is uncertain, but possibly it is in the Polynesian Islands, New Guinea or India (Roach & Daniels, 1987). It has been reported from India since ancient times (about 6,000 years BC), in Assam and Bengal regions (Lippman, 1942). However, most varietal diversity of this species has been found in New Guinea and China (Daniels & Roach, 1987). The word sugar derives from the Sanskrit, an old Hindu language (Azzi, 1938). This plant was taken to Europe and other parts of the world in the trips of the Genovese, Venetians and the Arabs (Stevenson,1965). It is believed that sugarcane was introduced to Brazil in 1502, with the expeditions of Fernando de Noronha (Correa, 1926). At the beginning, development of the sugarcane agroindustry was slow (Deer,1949), but now it covers extensive areas in Brazil, especially in the southeast and northeast areas.

### 1.6. Pasture

The center of origin of *Brachiara* grasses is probably the African continent, from where it was introduced to Latin America with great economic success (Lascano & Euclides, 1994). In São Paulo it quickly occupied large areas, establishing in acidic and poor soils of the Atlantic Forest and the Cerrado biomes. This occurred as a consequence of its easy propagation by seeds and its characteristic dominance. It has allowed good animal performance in comparison with native pasture species, which explains the great interest on these plants for cattle raising and its consequent expansion in the tropics.

## 2. Hypotheses

The abundance, richness and diversity of soil mites decrease with deforestation along time. This reduction is correlated with changes of various geophysical parameters (organic matter, temperature, texture, humidity etc.) of the soil and biophysical changes of the ecosystem (biomass).

## 3. Objectives

1.- To determine the effects of change in land use on predatory mites, estimating parameters of diversity and abundance, using various ecological indexes, in the evaluation of areas occupied by natural vegetation, pasture or sugarcane.

2.- To analyze the vertical distribution of genera soil mites of three stratas (litter, 0-5 cm from depth and 5-10 cm from depth) according to land use .

3.- To perform the determination of species of *Gaeolaelaps* found in this work.

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**CHAPTER 2 –** EFFECT OF LAND USE ON THE DIVERSITY OF SOIL MITES, WITH EMPHASIS ON THE ORDER MESOSTIGMATA, IN THE CENTRAL-SOUTHERN REGION OF BRAZIL

**ABSTRACT** - This study consisted of the evaluation of the mite fauna present in three types of habitats [natural vegetation (NV), pasture (PA) and sugarcane fields (SC)] in three sites of the Centro-Southern Region of Brazil (Jataí, Goiás state, and Valparaíso and Ipaussu, São Paulo state). These were evaluated in the litter layer and at two soil strata: 0-5 and 5-10 cm from the surface of the mineral fraction. Eight-nine mesostigmatid species were found, belonging to 14 families. Laelapidae was the most diverse. In a sampling conducted in December 2013/ January 2014, the highest population densities in this study were found in the NV. In a sampling conducte in December 2014/ January 2015, the same was observed in Ipaussu, but in the other sites, the density in the NV was about the same as in SC, both of which were higher than in PA. The effects of land use change on abundance, taxa richness, shannon, dominance and evenness indexes were not significantly different among sites. Our study established that there are species that showed more relative dominance (*DV'*) than others within the NV, the same species showed a great dominance and capacity to re ($p<0.05$). The structure of the soil mites community (at the genus level) was affected by both land use and site. The interaction shows that effects of land use change on community composition varied colonize disturbed areas as SC and PA anteriorly ocuped by NV, these species were *Multidentorhodacarus triramulus* (Karg), which was observed in two of three locaties, *Asca garmani, Asca* sp1 (Hurlbutt), *Gaeolaelaps isodentis* (Karg) and *Protogamasellus similis* (Genis, Loots & Ryke) observed in the three locaties; *Stratiolaelaps ornatissima (*Aswegen & loots), found only in NV from Ipaussu. Many species with relativy dominance were registered and others considered as rare.

## 2.1 INTRODUCTION

The effects of the change in land use in soil mite fauna has not been studied in Brazil. When natural areas are incorporated into land for agriculture or livestock production, loss of biodiversity may occur, leading to loss of the predatory mite population and their capacity to regulate soil pests (Robinson & Sutherland, 2002). High species richness occur in natural areas, usually occupied by multitrophic groups, which often have strong positive effect on ecosystem services (Soliveres et al., 2016).

The control of prey population (top down) is affected by predator density and plant community composition, as reported for collembolan population, which decreases under high predatory mite density in natural ecosystems. Collembolan population increases under simple plant communities (monoculture) and soil microbial community biomass (bottom-up) (Prakash & Eisenhauer, 2015).

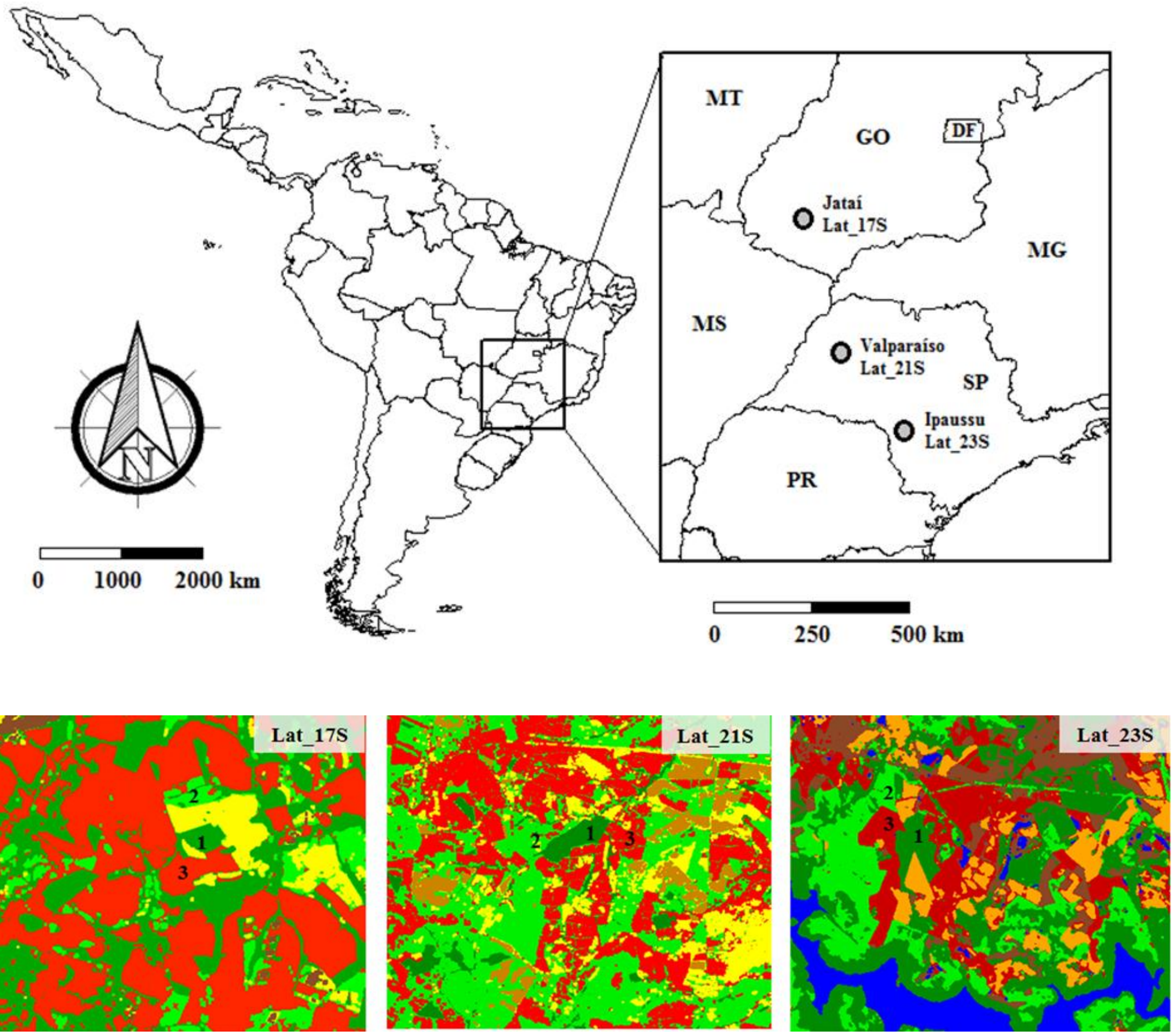
In a dryland system of Australia, the effect of soil mites was studied under two sheep-grazing intensities in chenopod shrublands for 10 years. It was shown that heavily grazed sites had reduced abundance and diversity of soil mites (Kinnear & Tongway, 2004). Soil structure and biodiversity are always strongly associated and the structure stability (aggregated) is influenced directly by biological activity. Cultivated soils have reduced biodiversity compared to uncultivated soils (Benckiser, 1997), while soil cultivated by conservation tillage can be situated between those two extremes, their function as reservoir of predatory soil mites depends on various factors, as organic and inorganic fertilizers, pesticides and crop rotation (Rusch et al., 2010). Soil mites also play a part in the nutrient cycling but this mainly occurs when inorganic fertilizers are replaced by organic manures that favor their preferred fungal food (Rusek, 1998; Moore et al., 1984). Diverse mite assemblages can occur in areas with plant species communities of different ages while fewer mite species are associated with less diverse plant communities (Wissuva et al., 2012). Predatory mites are considered good indicators among the sensitive soil organisms for detecting impacts of airborne pollutants in the soil (Rufa & Beck, 2005). In undisturbed grassland, predatory mite communities are usually formed by 10-15 species. Due to their abundance, species richness, distribution and position in the food web in agroecosystem, predatory mites of the order Mesostigmata are considered good indicators of soil condition and ecologyical disturbance (Koehler, 1997).

## 2.2 MATERIALS AND METHODS

### 2.2.1. Study area

This study was conducted in three sites of the central-southern region of Brazil: Jataí, in Goiás state, and Valparaíso and Ipaussu, São Paulo state. These municipalities are respectively located about 685, 372 and 206 km from the Acarology Laboratory of Escola Superior de Agricultura ´´Luiz de Queiroz´´ (ESALQ), where the samples collected were processed. Two samplings were conducted, between December 2013 and January 2014 and December 2014 and January 2015. The collection sites (Fig. 1) are located between 17° and 23° south latitude, in the Neotropical region (Burnham & Graham,1999).

In each municipality, three habitats were sampled, as subsequently detailed: Jataí, 17°54'59''S, 51°35°47''W (patch of disturbed Cerrado biome, constituted by sclerophyllous and xeromorphic plants); 17°54'26''S, 51°35°56''W (sugarcane *Saccharum officinarum* (Linnaeus) cultivar RB 855453; hereafter SC); 17°54'20''S, 51°35°46''W (grassland, with dominance of *Brachiaria decumbens* Stapf, *B. brizantha* (Hochst) Stapf, *B. ruzizientis* (Germain & Evrard); hereafter, PA); Valparaíso, 21°14'13''S, 50°46°38''W (patch of disturbed Atlantic Forest biome, constituted by seasonal semideciduous and xeromorphic plants); 21°14'11''S, 50°47'06''W (SC, cultivar sp.791011); 21°14'17''S, 50°47'27''W (PA with dominance of *Brachiaria* sp.); Ipaussu, 23°5'43''S, 49°37°27''W (patch of disturbed Atlantic Forest biome), 23°5'13''S, 49°36°53''W (SC, cultivar CTC6); 23°4'45''S, 49°38°11''W (PA, with a dominance of *Cynodon* sp.).




Jataí - Goiás Valparaíso – São Paulo Ipaussu – São Paulo

**Figure 1.** Geographic location of the sampling sites in the central-southern region of Brazil. Three bottom pictures: colors refer to: dark green – Natural vegetation, light green – Pasture, red – sugarcane and yellow – Rest of culture; numbers refer to: 1 – natural vegetation, 2 – pasture and 3 – sugarcane field.

### 2.2.2. Description of the study sites

Changes in land use occur continously in the central-southern region of Brazil due in particular to the expansion of sugarcane destined for the production of ethanol in the South-Central Region of Brazil (Cherubin et al., 2014). SC crop replaces especially areas of PA and annual crops and in a more restricted way the NV (Walter, et al, 2014). Cerrado sensu latu is the predominant ecosystem in this region (Ratter, et al 1997). Until the beginning of the 1970´s, areas of the natural vegetation were converted into agriculture and livestock production areas, in spite of the low soil fertility. The three land use are located adjacent to each to minimize the effects of climatic, topography and soil variation.

**2.2.2.a Jataí**

Located in the “planalto meridional”, dominated by ancient sediments and bands of basaltic spills. Altitudes of Jataí vary from 700 to 1,100 m. The clime is Awa type (Köppen classification) mesothermal tropical (Cherubin et al., 2015), with two well defined seasons, with higher rainfall between October and April and a dry season between May and September. The mean winter temperature varies between 10 and 27 ° C, but the minimum can be as low as 5 °C. In the summer, temperature varies between 18 and 35 ° C, with peaks of up to 38 ° C.

The place chosen for this study is characterized for presenting many small fragments of natural vegetation and both large pasture lands and agricultural crops. The NV is represented by Cerradão Forest formation with xeromorphic aspects, with presence of species that occur in Cerrado *sensu stricto* and also of forest species; the soils are deep, with good drainage and medium to low fertility, lightly acid. The pasture lands are formed by grasses of the genus *Brachiaria* established in 1980, while sucarcane plantation was established in part of previous pasture land in 2009 with the RB 855453 cultivar, before the soil land was plowed and treated with limestone (1.6 ton/ ha). The change in land use between 2003 and 2014 was intense with an increase in sugarcane cultivation (Fig 2 A, B).

**2.2.2.b Valparaíso**

Altitudes in this municipality vary from 449 to 500 m. The clime is classified as Awa type (Köppen- classification), humid tropical with dry winter. The mean annual temperature is about 23,4 ºC and the annual precipitation, about 1240 mm. This is an important municipality in the state as sugarcane and alcohol producer.The natural plant composition of this site is formed by seasonal semideciduous forest, comprising a transition between the Atlantic Forest and the Cerrado. The study in this site was done in a fragment of natural vegetation converted into pasture land in 1980. The pasture comprises of *Brachiaria* grasses, fertilized with 120 kg/ ha/ year of the formula 20-05-19. Sugarcane plantation replaced part of pasture areas in 2010, using the cultivar sp.791011. Harvest is done mechanically, with no burning.

**2.2.2.c Ipaussu**

This municipality is located in the confluence of the rivers Paranapanema and Pardo, formerly covered by the Atlantic Forest. Most of this area was converted into farms, especially for coffee production. Today many fragments can still be seen in the area; these are characterized by presenting many secondary fragments formed by seasonal semidecidous forest (Franco, 2016). The climate is classified as Cw type (Köppen classification) tropical with annual mean temperature of 21,7 ºC and annual precipitation of 1470 mm. The soil is classified as Rhodic Apludox. Conversion from natural vegetation to pasture occurred in 1979. Pasture is composed of tropical grasses of the genus *Cynodon* spp. established in 1990, by the same soil management described for the others sites. Annually, sugarcane fertilization was 200 $m^3$/ ha of vinasse, 25 ton/ ha of filter cake and boiler ash, and 100 kg/ ha of ureia. Sugarcane plantation replaced part of pasture areas in 1990, according to the soil management described for the other sites. Sugarcane is mechanically harvested, with no burning since 2003. Change in land use between 2003 and 2014 was intense, with an increase in sugarcane cultivation (Figure 2 B, C).

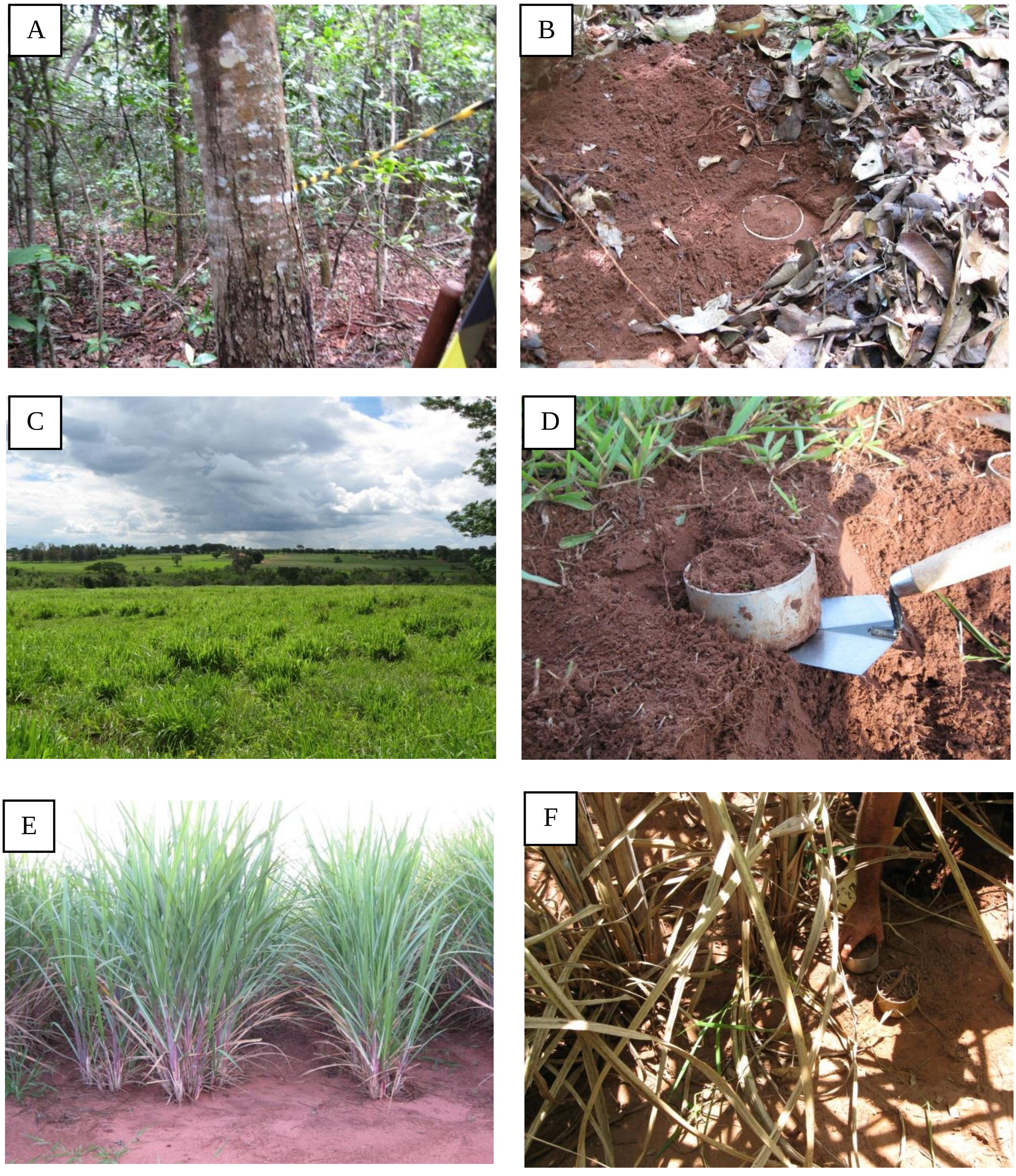



**Figure 2.** Plots of the study sites and sampling techniques; A) Atlantic Forest; B) sampling in the natural vegetation; C) pasture land; D) sampling the surface layer of pasture land; E) sugarcane plantation; F) sampling sugarcane plantation.

### 2.2.3. Field sampling

Two samplings were carried out, betwen December 2013 and January 2014 and between December 2014 and January 2015, in the three sites. In each site three ecosystems were selected: one natural ecosystem (natural vegetation) and two agroecosystems (pasture and sugarcane plantation). In each ecosystem five plots distributed randomly in a square of about 0.5 ha each were selected. From each plot, nine samples were collected at each sampling date: three each of surface litter, soil at 0-5 cm and and soil at 5-10 cm from the surface. Each sample was extracted with a cylinder (9.5 cm diameter and 5 cm heigh, approximately 284 $cm^3$). Thus, the 45 samples was collected from each habitat (135 samples from each site) were taken to the Laboratory of Acarology at ESALQ - USP.

### 2.2.4. Description of climatic parameters

Between November 2013 and January 2014, average climatic parameters in the study sites were: Jataí – T° max= 31.8, T° mim= 20.0, T° mean= 24.6; cumulativy rainfall (mm)= 421; Valparaíso – T° max= 33.7, T° mim= 20.8, T° mean= 24.9, cumulativy rainfall (mm)= 353; Ipaussu – T° max= 31.7; T° mim= 19.3; T° mean= 25.5; cumulativy rainfall (mm)= 266.

Between November 2014 and Janurary 2015, average climatic parameters in the study sites were: Jataí – T° max= 31.7, T° mim= 20.1, T° mean= 24.6, cumulativy rainfall (mm)= 628; Valparaíso –T° max= 33.1, T° mim= 20.8, T° mean= 26.9, cumulativy rainfall (mm)= 330; Ipaussu – T° max= 31.4, T° mim= 19.7, T° mean= 25.6, cumulativy rainfall (mm)= 453.

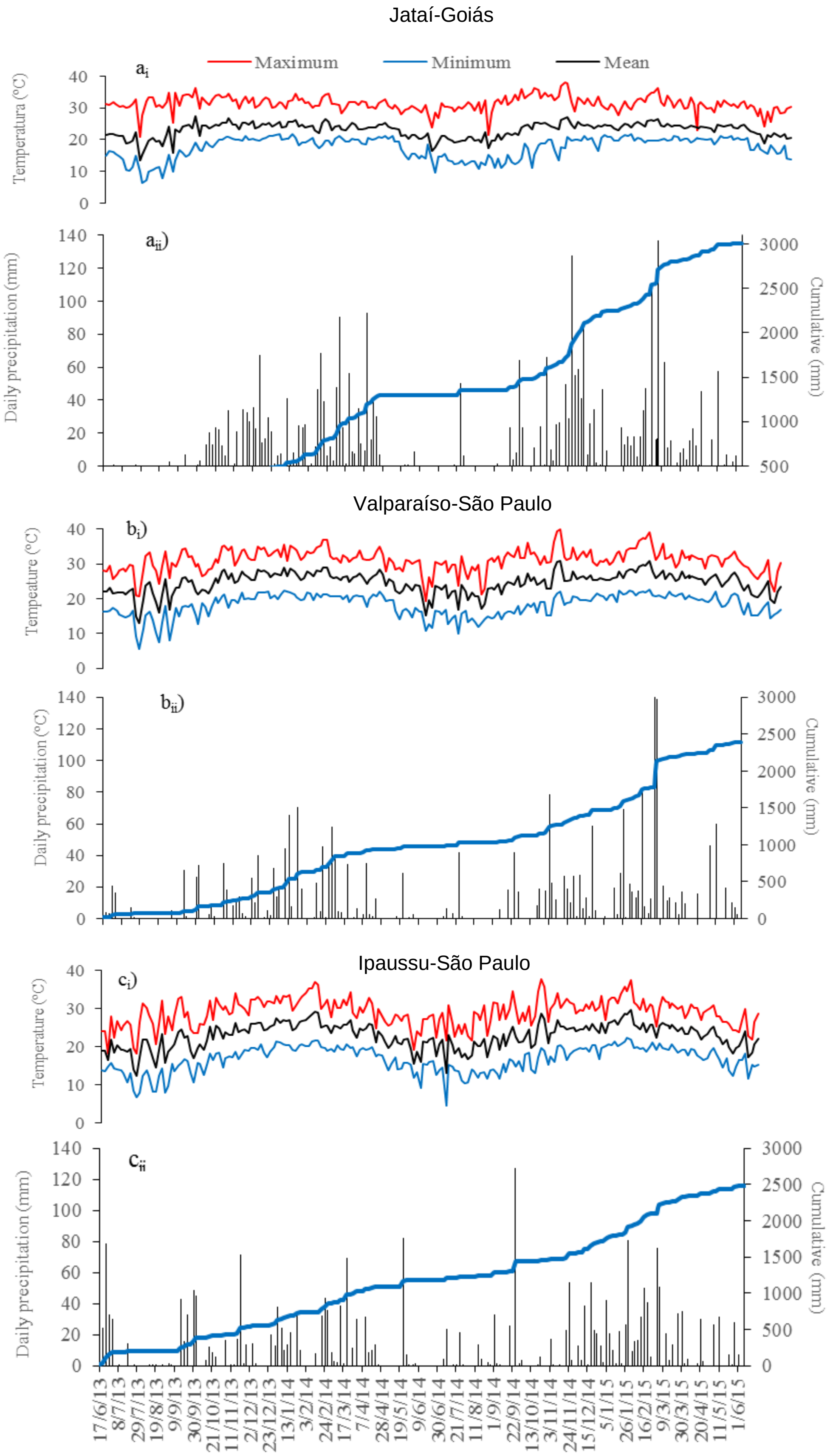



**Figure 3.** Average daily maximum, minimum and mean temperature (i) and daily and cumulative rainfall (ii) during soil sampling in the three sites in central–southern, Brazil

### 2.2.5. Laboratory procedure

#### 2.2.5.a Mite extraction

An active and dynamic system was used for the extraction of the mites (Fig. 5). This system is basically characterized by a gradient of temperature and humidity due to the heat produced by the incandescent lamps maintained above the samples, inducing mite migration to the bottom of the samples, causing them to fall into a 70% ethanol reservoir (McSorley & Walter 1991). This method is called Berlese-Tullgren funnels (Crossley & Blair 1991), invented by Berlese (1905) and modified by Tullgren (1918). However, the efficiency of the extraction varies with soil characteristics, being more efficient for forest ecosystems, with high content of organic matter (Sandler et al., 2010).

#### 2.2.5.b Screening

The container holding the mites extracted from each sample was properly coded and stored temporarily. All mites collected were then examined under a stereomicroscope, separated by morphotypes and mounted on microscope slides (except Oribatida) using Hoyer's medium. The slides were subsequently dried at about 50 °C for 5 to 10 days. Very dark mites were clarified in lactic acid before mounting. The Oribatida were separated from the rest of mites and preserved in alcohol for later identification by specialists.

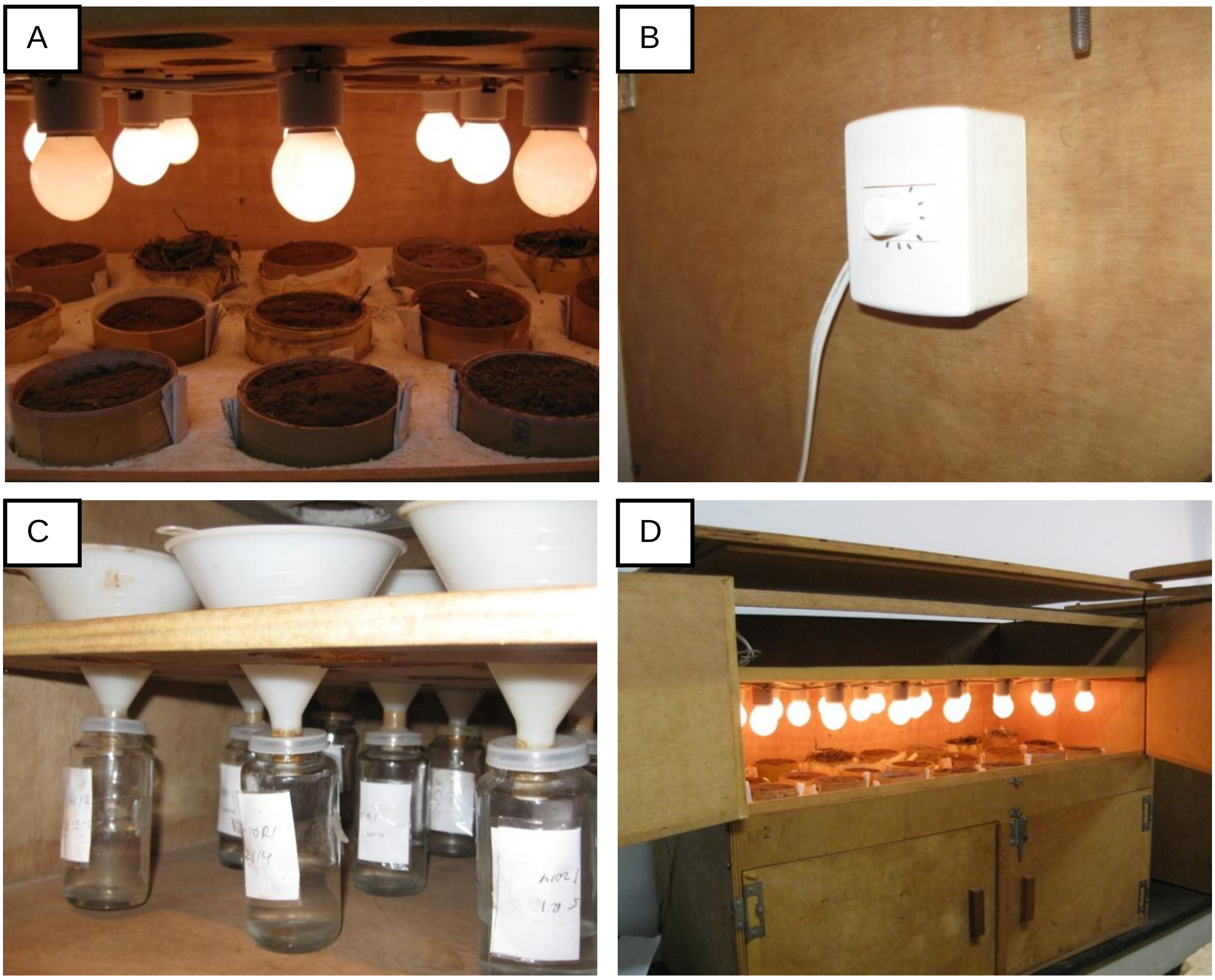



**Figure 4.** Modified Tullgren funnels methods. A) cylinder with soil sample B) Dimmer C) traps contained alcohol 70% D) extraction of the soil mites.

### 2.2.5.c Mite Identification

Identification at supraordinal level was made possible with the help of keys to the superorders, orders, and suborders (Lindquist et al., 2009). In addition, various keys to identify families were used, as Mesostigmata (Lindquist et al., 2009), Prostigmata (Walter et al., 2009) and Endeostigmata (Walter, 2009). A key by Zacharda (1980) was used to identify genera of Rhagididae. Also used were an artificial key to the families of terrestrial endeostigmatid and prostigmatid mites (Kethley, 1990) and a key to *Blattisocius* species of the world (Britto et al., 2012).

Relevant information resources about taxonomic studies was facilitate by using various catalogues: for the families Ascidae Voigts & Oudemans, Blattisociidae Garman and Melicharidae Hirschmann (Moraes et al., 2016); Ologamasidae Ryke (Castilho et al., 2016), Rhodacaridae Oudemans (Castilho et al., 2012); and Laelapidae (Moreira et al., 2014).

The morphological characterization of mesostigmatid mites is mainly based on the description of their chaetotaxy, the dorsal and ventral shield dimensions, chelicera format (Lindquist et al., 2009), leg chaetotaxy, characteristics of the peritreme etc. For the identification of genera of Trombidiformes, the main characteristics considered are leg chaetotaxy, shape of empodiun, presence and absence of trichobotria, shape and location of peritreme etc (Lindquist et al., 2009).

The identification was done with the use of a phase contrast microscope (Leica, DMLB) and a differential interference contrast microscope (Nikon, Eclipse 80i). All identified specimens were deposited in the mite reference collection of Department of Entomology and Acarology, Escola Superior de Agriculture “Luiz de Quieroz”, Universidade de São Paulo.

### 2.2.6. Diversity analysis.

The study of biodiversity is related to species richness (Moreno & Halffer, 2001) and can be composed of three components: the α diversity (mean species reachness), β diversity (degree of replacement of species among habitats in the landscape) and ɣ diversity (the species richness on the total landscape as the results of both α and β diversities). These components can be useful for measuring and monitoring the effects of the land use change (Halffter, 1998).

The data obtained from two sampling periods in each site, each with a different chronological sequence of land use, were compared using more than one index of diversity (Magurram, 1988). In total five index values were used: Relative abundance, Margalef, Shannon-Wiener, Simpson and Pieolou.

Margalef index determines species richness considering the numerical distribution of individuals of different species ($S$-1) and the logarithm of the total number of species (Marrugan, 2011). Higher index implies higher diversity of the sampled community.

$$D_{mg} = \frac{(S-1)}{LnN}$$

$D_{mg}$ = diversidade
$S$ = Total number of species
$N$ = Total number of all individuals
$Ln$ = Naperian logarithm

Shannon index measures heterogeneity and take into account the degree of evenness in species abundances. The maximum diversity ($H_{max}$) that could possibly occur in a habitat can be determined in a situation, where all species have equal abundance (Magurran, 2004).

$$H' = \sum_{i=1}^{S} pi \times Lnpi$$

$pi = ni / N$
$ni$ = number of individuals of the species $i$
$N$ = total number of individuals in the sample

Simpson index take in a determined species (in our case genera) number, which are presents in the habitat and is derived of their relative abundance. Simpson index represents the probability for two individuals from the same habitat, when randomly selected, to belong to the same species. If the index value is about 1 there is a high probability that the species was dominant and when the index value is about 0, biodiversity is high in the habitat.

$$D = \sum_{i=1}^{S} pi^2$$

$pi$ = relative abundance (proportion) of the specie $i$ in the sample
$pi = ni / N$

Pielou index proposed by Pielou (1975) measures the proportion of the observed diversity in relation to maximum expected diversity (Marrugan, 2011).

$$J = \frac{H'}{LnS}$$

$H'$ = number derived from of Shannon index
$LnS$ = Naperian logarithm of the total number of species

Relative dominant index ($DV'$) assesses the effect of change in land change (NV-PA-SC) in the dominance structure of predaceous soil mites (Mesostigmata) (Pinzo'n & Spence, 2010; Aguilar, 2013). This indicator takes into account the overall proportional abundance of a given species weighted by its overall frequency.

$$DV' = \frac{DVi}{\sum_{i=1}^{S} DVi} \times 100$$

Where: $DVi = wi \times APi$

$wi = Ki / K$

$APi = ni / N$

$N$ = Total number of individual
$K$ = Total number of sites
$Ni$ = Total abundance of ith species
$Ki$ = number of sites

**2.2.7. Statistic Analysis**

We analized the mixed linear effects of the relationship between biological variables (Index values: abundance, richness, diversity, dominance and evenness) and type of land use performed.

$$y = X\beta + Z\gamma + e$$

${}_{n}y_{1}$ = vector of observations
${}_{n}X_{p+1}$ = matrix of incidence of fixed effects
${}_{p+1}\beta_{1}$ = vector of unknown fixed effects
${}_{n}Z_{q}$ = incidence matrix of random effects
${}_{q}\gamma_{1}$ = vector of unknown random effects
${}_{n}e_{1}$= Vector of random errors

Land use and soil type depth were used as fixed effects in the model including their interaction. Study sites were included as random effects. P values were obtained by means of probability rates of the model. To test the effects of land use and habitat, non metric analysis of multivariate variance was performed (np-MANOVA). The analysis was performed in software R, version 3.2.2 trough the vegan packages (Dixon, 2003), Im4 (Bates et al., 2015) and ggplot 2 (Wickhan, 2005).

## 2.3. RESULTS

### 2.3.1. Faunistic composition

In total 2,944 adult mites, mostly predators, were collected and examined in this study, belonging to Mesostigmata (33 genera of 13 families), Trombidiformes (20 genera of 10 families) and Sarcoptiformes (one genus of Astigmatina and one genus of Endeostigmata). Aproximatelly 78 species of Mesostigmata and 31 of Trombidiformes were found determined.

### 2.3.2. Mite densities

In Valparaíso, total density in the first sampling ranged from 0 to 17,119 mites/m². The range in the natural vegetation (NV) was 0 – 8,528, in pasture (PA) 0 – 2,186 and in sugarcane (SC) plantation 0 – 6,405. In the second sampling, total density was only 0 – 9,809, with 0 – 1,687 in NV; 0 – 1,061 in PA and 0 – 7,061 in SC.

In Jataí, total density in the first sampling ranged from 0 to 3,385 mites/m², with 0 – 2,562 in NV, 0 – 511 in PA and 0 – 312 in SC. In the second sampling, densities were higher, 0 – 7,623 in total, with 0 – 500 in NV, 0 – 4,374 in PA and 0 – 2,749 in SC.

In Ipaussu, total density in the first sampling ranged from 0 to 37.962 mites/m², with 0 – 20,153 in NV, 0 – 8,186 in PA and 0 – 9,623 in SC. In the second sampling, densities were 0 – 11,820 in total, with 0 – 4,248 in NV, 0 – 2,406 in PA and 0 – 5,166 in SC.

### 2.3.3. Ecological parameters

Figures 6 and 7 show the diversity indexes calculated in this work, as subsequently detailed.

**Margalef index of genus richness**

Considering the samples of different depth together in the first sampling period in NV, the highest values were observed for Valparaiso and Ipaussu, especially in the letter place. In both the index value was higher on the litter layer, however it was higher in Ipaussu, with 3.80. The exception ocurred in Jatai where the richness valeus were lowest and < 2.00. (Tab. 1). While that, in the second sampling in NV, the indexes decreased in Valparaiso and Ipaussu being the richness valeus < 2.00, similarity is the situation of Jatai. Its observed also that in Valparaiso and Ipaussu the ritchness valeus for sugarcane are similarities = 2.00, especially in litter layer, while in other layers the values are even lower. (Tab. 2).

**Shannon diversity index**

As for the previous index, the highest indexes were observed for Valparaiso and Ipaussu, respectively with 0.80 and 0.90 in the first sampling in NV and slightly low in PA and SC, always being greater these indices in litter layer. However in Jataí these Shannon valeus were very low in all the soil profile (Tab. 1). In the second sampling, the indexes decreased slightly in Ipaussu to 0.60 in NV, but is higher that other places, with relation to PA, no was observed differences between the three places; while that the same was observed as the anterior case (Tab. 2).

**Pielou (J) evenness index**

The highest indexes were observed in Valparaiso and Ipaussu, respectively 0.09 and 0.10 in the first sampling in NV, but in the case of Jataí the values were low. The same was observed for the results obtained in PA and SC as above mencioned for Valparaíso and Ipaussu, being the valeus again low in Jataí. As to the soil profile, the highest indexes were observed in the litter layer in the three ecosystems of the three sites (Tab. 1). The indexes in the second sampling mantaining similarity as in the first sampling in NV from the three places (0.10), while that with relation to PA the highest valeus was observed in Ipaussu and Jataí with 0.10, contrary was observed a reduction this valeu in Valparaíso 0.04. In SC the values are similarities on the three places, with the diference that in Jataí ocurred an increasing, while that in the others places no ocurred changes.With relation to the soil profile, the indexes at 0-5 and 5-10 cm layers were also low (Tab. 2).

**Simpson dominance indexes (D)**

The highest indexes were observed in Valparaiso and Ipaussu, with respectively 0.3 and 0.4 in the first sampling period, the first in NV and the second in PA and SC. In relation to the soil profile, the highest indexes were observed at 0-5 cm layer in Valparaíso (0.5 in NV and 0.4 in PA), and the litter layer in Ipaussu (0.5 in NV) (Table 1). In the second sampling, the indexes were lower in Jataí (0.4 in NV and PA) and the same values in NV in Ipaussu being considered the highest value in this sample. In the soil profile, again, the highest indexes were found for the litter layer (Tab. 2).

**Simpson diversity index (1-D)**

In the first sampling, this index was high for most combination of ecosystems and sampling sites, but lowest in PA and SC in Ipaussu (Tab. 1). Similar values were obtained in the second sampling (Tab. 2). The abundance estimated for each genus is shown in Tables 3 and 4.

**Table 1.** Ecological parameters of the mite communities in areas of different land use in three regions of central-southern Brazil (January 2014).

| Ecological parameters | layer | Jataí-Goiás | | | Valparaíso-São Paulo | | | Ipaussu-São Paulo | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Nat-veg | Pasture | Sugarcane | Nat-veg | Pasture | Sugarcane | Nat-veg | Pasture | Sugarcane |
| **Abundancy mites/m²** | Litter | 2437 | 448 | 281 | 7248 | 2030 | 5905 | 15436 | 250 | 6249 |
| | 0-5 cm | 31 | 62 | 31 | 9994 | 156 | 470 | 4436 | 2187 | 3155 |
| | 5-10 cm | 62 | 0 | 0 | 281 | 0 | 31 | 530 | 5750 | 218 |
| | Total | 2562 | 511 | 312 | 8528 | 2186 | 6405 | 20153 | 8186 | 9623 |
| **taxa** | Litter | 3 | 2 | 2 | 13 | 7 | 9 | 17 | 1 | 9 |
| | 0-5 cm | 1 | 1 | 1 | 3 | 2 | 1 | 8 | 5 | 7 |
| | 5-10 cm | 1 | 0 | 0 | 2 | 1 | 1 | 3 | 6 | 2 |
| | Total | 4 | 2 | 2 | 15 | 8 | 9 | 19 | 7 | 12 |
| **Margalef-Richness** | Litter | 0.78 | 0.49 | 0.42 | 3.02 | 1.71 | 2.09 | 3.80 | 0.13 | 2.00 |
| | 0-5 cm | 0.00 | 0.08 | 0.00 | 0.71 | 0.29 | 0.26 | 1.82 | 1.03 | 1.67 |
| | 5-10 cm | 0.08 | 0.00 | 0.00 | 0.39 | 0.08 | 0.00 | 0.64 | 1.23 | 0.33 |
| | Total | 0.83 | 0.60 | 0.41 | 3.35 | 1.79 | 2.07 | 4.02 | 1.48 | 2.55 |
| **Shannon-Diversity** | Litter | 0.24 | 0.18 | 0.23 | 0.78 | 0.50 | 0.55 | 0.87 | 0.10 | 0.51 |
| | 0-5 cm | 0.00 | 0.06 | 0.00 | 0.25 | 0.18 | 0.17 | 0.59 | 0.42 | 0.58 |
| | 5-10 cm | 0.06 | 0.00 | 0.00 | 0.17 | 0.06 | 0.00 | 0.23 | 0.47 | 0.07 |
| | Total | 0.24 | 0.20 | 0.23 | 0.82 | 0.53 | 0.55 | 0.93 | 0.57 | 0.63 |
| **Pielou-Evenness** | Litter | 0.03 | 0.02 | 0.04 | 0.09 | 0.06 | 0.06 | 0.09 | 0.01 | 0.06 |
| | 0-5 cm | 0.00 | 0.01 | 0.00 | 0.03 | 0.03 | 0.02 | 0.07 | 0.05 | 0.07 |
| | 5-10 cm | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.03 | 0.05 | 0.01 |
| | Total | 0.03 | 0.03 | 0.03 | 0.09 | 0.06 | 0.06 | 0.10 | 0.06 | 0.07 |
| **Dominancy-Simpson** | Litter | 0.15 | 0.23 | 0.12 | 0.31 | 0.32 | 0.31 | 0.21 | 0.47 | 0.34 |
| | 0-5 cm | 0.20 | 0.10 | 0.20 | 0.53 | 0.36 | 0.17 | 0.20 | 0.53 | 0.42 |
| | 5-10 cm | 0.10 | 0.00 | 0.00 | 0.23 | 0.30 | 0.20 | 0.28 | 0.25 | 0.04 |
| | Total | 0.11 | 0.22 | 0.12 | 0.29 | 0.31 | 0.31 | 0.20 | 0.40 | 0.42 |
| **Diversity-Simpson** | Litter | 0.85 | 0.77 | 0.89 | 0.69 | 0.68 | 0.69 | 0.79 | 0.53 | 0.66 |
| | 0-5 cm | 0.80 | 0.90 | 0.80 | 0.47 | 0.64 | 0.83 | 0.80 | 0.47 | 0.58 |
| | 5-10 cm | 0.90 | 1.00 | 1.00 | 0.77 | 0.70 | 0.80 | 0.72 | 0.75 | 0.96 |
| | Total | 0.85 | 0.78 | 0.88 | 0.71 | 0.69 | 0.69 | 0.80 | 0.60 | 0.58 |

**Table 2.** Ecological parameters of the mite communities in areas of different land use in three regions of central-southern Brazil (January 2015).

| Ecological parameters | layer | Jataí-Goiás | | | Valparaíso-São Paulo | | | Ipaussu-São Paulo | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Nat-veg | Pasture | Sugarcane | Nat-veg | Pasture | Sugarcane | Nat-veg | Pasture | Sugarcane |
| **Abundancy mites/m²** | Litter | 468 | 4093 | 2624 | 1687 | 562 | 6749 | 3062 | 94 | 3324 |
| | 0-5 cm | 0 | 312 | 0 | 62 | 375 | 125 | 656 | 375 | 1468 |
| | 5-10 cm | 31 | 0 | 125 | 31 | 125 | 188 | 624 | 1937 | 406 |
| | Total | 500 | 4374 | 2749 | 1687 | 1061 | 7061 | 4248 | 2406 | 5166 |
| **taxa** | Litter | 2 | 7 | 5 | 6 | 2 | 9 | 6 | 1 | 7 |
| | 0-5 cm | 0 | 2 | 0 | 1 | 1 | 1 | 3 | 1 | 4 |
| | 5-10 cm | 1 | 0 | 1 | 1 | 1 | 1 | 3 | 2 | 2 |
| | Total | 2 | 7 | 6 | 4 | 3 | 9 | 7 | 3 | 9 |
| **Margalef-Richness** | Litter | 0.26 | 1.48 | 1.31 | 1.54 | 0.61 | 2.03 | 1.34 | 0.15 | 1.67 |
| | 0-5 cm | 0.00 | 0.48 | 0.00 | 0.08 | 0.25 | 0.14 | 0.71 | 0.27 | 1.03 |
| | 5-10 cm | 0.00 | 0.00 | 0.21 | 0.00 | 0.21 | 0.13 | 0.68 | 0.27 | 0.60 |
| | Total | 0.32 | 1.53 | 1.35 | 0.96 | 0.80 | 2.12 | 1.49 | 0.57 | 1.99 |
| **Shannon-Diversity** | Litter | 0.15 | 0.44 | 0.54 | 0.38 | 0.24 | 0.61 | 0.50 | 0.10 | 0.35 |
| | 0-5 cm | 0.00 | 0.25 | 0.00 | 0.06 | 0.11 | 0.09 | 0.35 | 0.15 | 0.20 |
| | 5-10 cm | 0.00 | 0.00 | 0.12 | 0.00 | 0.12 | 0.08 | 0.25 | 0.07 | 0.20 |
| | Total | 0.16 | 0.45 | 0.39 | 0.38 | 0.30 | 0.53 | 0.56 | 0.16 | 0.59 |
| **Pielou-Evenness** | Litter | 0.02 | 0.05 | 0.07 | 0.05 | 0.03 | 0.07 | 0.06 | 0.02 | 0.05 |
| | 0-5 cm | 0.00 | 0.04 | 0.00 | 0.01 | 0.02 | 0.01 | 0.05 | 0.02 | 0.02 |
| | 5-10 cm | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.01 | 0.03 | 0.01 | 0.03 |
| | Total | 0.02 | 0.05 | 0.05 | 0.05 | 0.04 | 0.06 | 0.07 | 0.02 | 0.07 |
| **Dominancy-Simpson** | Folhedo | 0.40 | 0.38 | 0.23 | 0.21 | 0.13 | 0.23 | 0.23 | 0.07 | 0.25 |
| | 0-5 cm | 0.00 | 0.10 | 0.00 | 0.10 | 0.27 | 0.08 | 0.18 | 0.18 | 0.21 |
| | 5-10 cm | 0.20 | 0.00 | 0.05 | 0.20 | 0.05 | 0.10 | 0.32 | 0.33 | 0.02 |
| | Total | 0.38 | 0.37 | 0.23 | 0.22 | 0.09 | 0.22 | 0.40 | 0.24 | 0.23 |
| **Diversity-Simpson** | Folhedo | 0.60 | 0.62 | 0.77 | 0.79 | 0.87 | 0.77 | 0.77 | 0.93 | 0.75 |
| | 0-5 cm | 1.00 | 0.90 | 1.00 | 0.90 | 0.73 | 0.93 | 0.82 | 0.82 | 0.79 |
| | 5-10 cm | 0.80 | 1.00 | 0.95 | 0.80 | 0.95 | 0.90 | 0.68 | 0.67 | 0.98 |
| | Total | 0.62 | 0.63 | 0.77 | 0.78 | 0.91 | 0.78 | 0.60 | 0.76 | 0.77 |

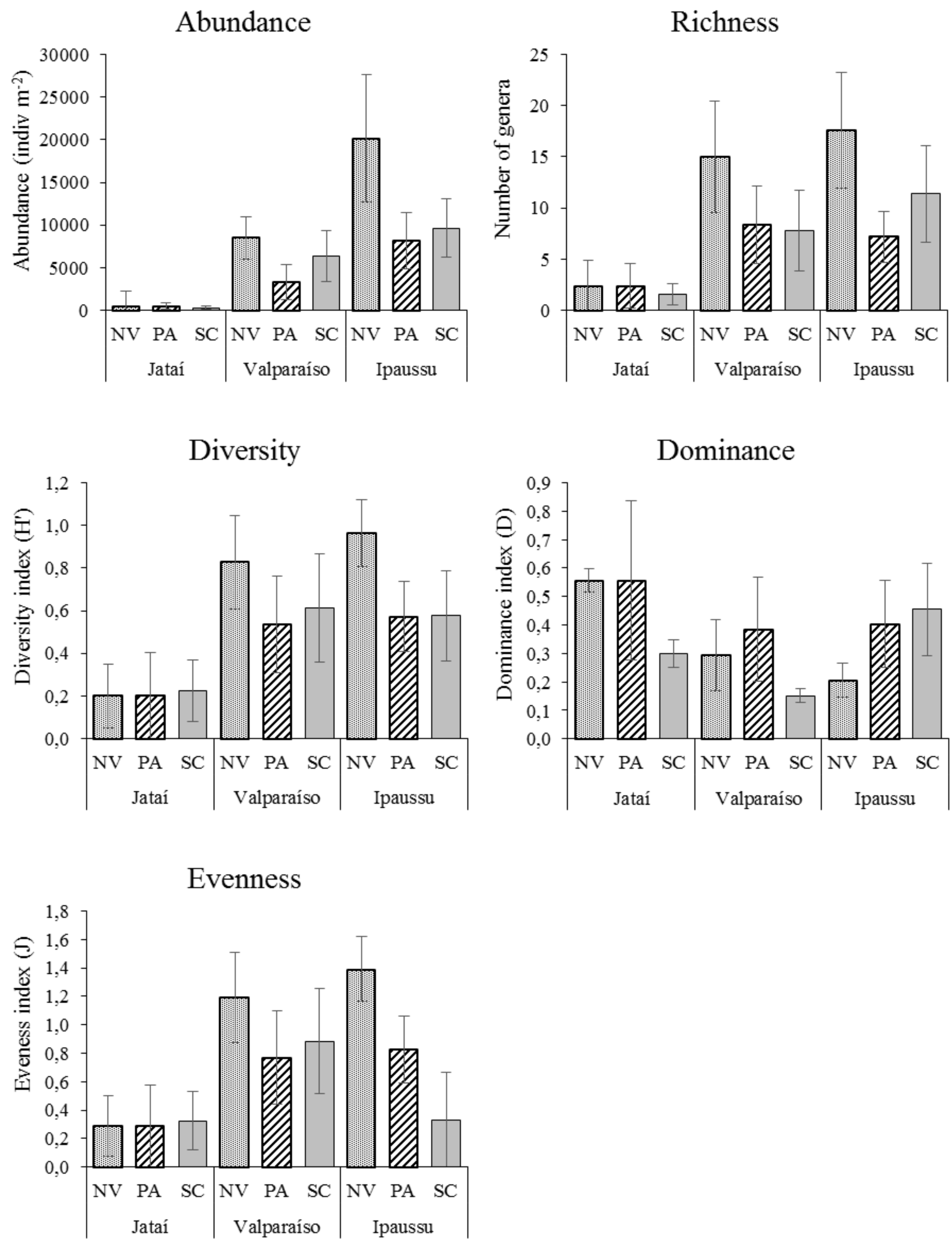



**Figure 5.** Mite abundance, number of genera (Margalef index richness), diversity (Shannon's index), dominance (Simpson's index) and eveness (Pielou's Index) in the 0 -10 cm soil layer (including litter) as a function of the land use change, i.e., natural vegetation (NV), pasture (PA) or sugarcane (SC) in three sites in central-southernBrazil; n= 5; error bars denote standard error of the mean. Period: 2013 – 2014.

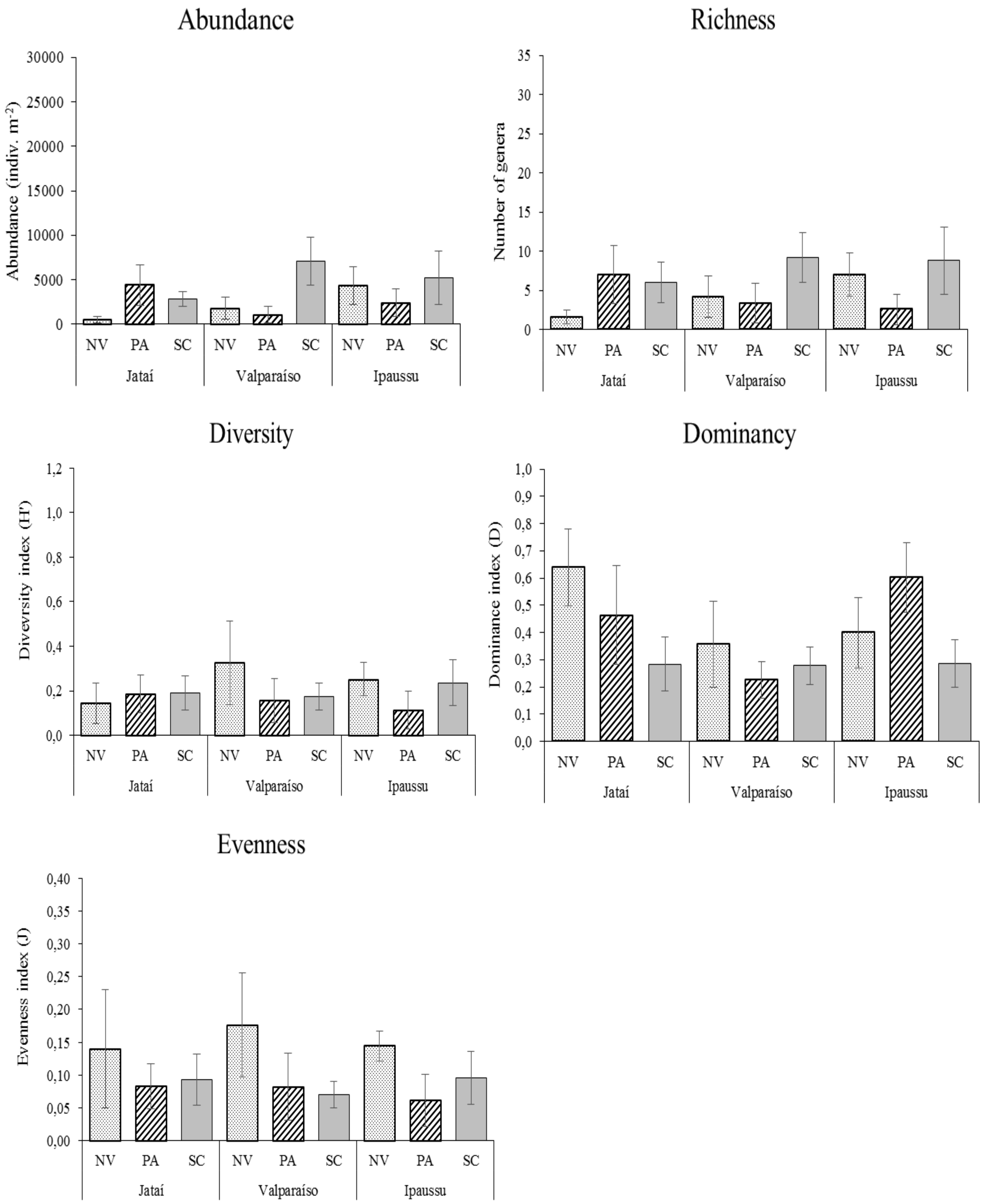



**Figure 6.** Mite abundance, number of genera (Margalef index richness), diversity (Shannon's index), dominance (Simpson's index) and eveness (Pielou's Index) in the 0 -10 cm soil layer (including litter) as a function of the land use change, i.e., natural vegetation (NV), pasture (PA) or sugarcane (SC) in three sites in central-southern Brazil; n= 5; error bars denote standard error of the mean. Period: 2014 – 2015.

**Table 3.** Abundance (individuals/$m^{-2}$) and standard error of soil mite genera found in native vegetation (NV), pasture (PA) and sugarcane (SC) in three sites of central-southern Brazil. Year 2014 (n=5).

| Genus | | Jataí | | | Valparaíso | | | Ipaussu | |
|---|---|---|---|---|---|---|---|---|---|
| | NV | PA | SC | NV | PA | SC | NV | PA | SC |
| **Laelapidae** | | ind/$m^{-2}$ | | | ind/$m^{-2}$ | | | ind/$m^{-2}$ | |
| *Gaeolaelaps* | 31.2(±28) | 0(±0) | 468.6(±108) | 718.6(±314) | 312.4(±171) | 343.8(±274) | 593.6(±255) | 62.4(±56) | 343.6(±168) |
| *Cosmolaelaps* | 0(±0) | 0(±0) | 0(±0) | 218.6(±84) | 93.6(±56) | 125(±112) | 0(±0) | 0(±0) | 0(±0) |
| *Pseudoparasitus* | 62.4(±56) | 0(±0) | 250(±224) | 31.2(±28) | 0(±0) | 62.4(±34) | 843.8(±344) | 0(±0) | 1499.8(±458) |
| *Stratriolaelaps* | 0(±0) | 0(±0) | 0(±0) | 31.2(±6) | 0(±0) | 687.4(±392) | 0(±0) | 0(±0) | 0(±0) |
| **Ascidae** | | | | | | | | | |
| *Asca* | 0(±0) | 0(±0) | 0(±0) | 1844(±605) | 1437.4(±846) | 1625.2(±766) | 31.2(±28) | 0(±0) | 0(±0) |
| *Protogamasellus* | 0(±0) | 0(±0) | 0(±0) | 1093.8(±692) | 31.2(±28) | 281(±81) | 0(±0) | 0(±0) | 156.2(±77) |
| *Gamasellodes* | 187.6(±82) | 31.2(±28) | 812.6(±447) | 62.4(±56) | 31.2(±28) | 31.2(±28) | 31.2(±28) | 62.4(±34) | 1969 |
| **Blattisociidae** | | | | | | | | | |
| *Lasioseius* | 249.6(±95) | 31.2(±28) | 2031.2(±620) | 93.8(±84) | 0(±0) | 31.2(±28) | 93.6(±34) | 0(±0) | 0(±0) |
| *Zercoseius* | 499.8(±314) | 31.2(±28) | 249.6(±129) | 31.2(±28) | 0(±0) | 3156.6(±942) | 281.2(±184) | 62.4(±34) | 124.8(±52) |
| *Cheiroseius* | 62.4(±56) | 31.2(±28) | 124.8(±112) | 62.4(±56) | 0(±0) | 1750(±782) | 218.6(±137) | 93.6(±56) | 374.8(±180) |
| *Blattisocius* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 124.8(±68) | 0(±0) | 0(±0) | 0(±0) |
| **Scutacaridae** | | | | | | | | | |
| *Scutacarus* | 0(±0) | 0(±0) | 1718.8(±948) | 93.8(±84) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 1562.4(±767) |
| **Mellicharidae** | | | | | | | | | |
| *Proctolaelaps* | 0(±0) | 0(±0) | 62.4(±56) | 656.4(±190) | 218.8(±196) | 62.4(±56) | 0(±0) | 0(±0) | 31.2(±28) |
| *Tropicoseius* | 187.2(±112) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Rhodacaridae** | | | | | | | | | |
| *Multidentorhodacarus* | 31.2(±28) | 0(±0) | 0(±0) | 93.8(±84) | 0(±0) | 2156.2(±921) | 62.4(±56) | 0(±0) | 62.4(±34) |
| *Protogamasellopsis* | 0(±0) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Afrodacarellus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 156.2(±77) |
| *Binodacarus* | 62.4(±56) | 0(±0) | 62.4(±56) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) |
| ***Podocinidae*** | | | | | | | | | |
| *Podocinum* | 62.4(±56) | 31.2(±28) | 31.2(±28) | 0(±0) | 0(±0) | 656.2(±227) | 0(±0) | 0(±0) | 62.4(±34) |
| **Macrochellidae** | | | | | | | | | |
| *Holostaspella* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Macrochelles* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 93.8(±84) |
| **Parasitidae** | | | | | | | | | |
| *Eugamasus* | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 218.6(±71) | 31.2(±28) | 0(±0) | 125(±112) |
| **Veiigaidae** | | | | | | | | | |
| *Gamasolaelaps* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 312.4(±217) | 0(±0) | 31.2(±28) | 0(±0) |
| **Digamasellidae** | | | | | | | | | |
| *Dendrolaelaspis* | 31.2(±28) | 0(±0) | 1250.2(±424) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 500.2(±136) |
| *Digamasellus* | 0(±0) | 0(±0) | 0(±0) | 156.2(±108) | 31.2(±28) | 62.4(±56) | 0(±0) | 0(±0) | 31.2(±28) |
| **Ologamasidae** | | | | | | | | | |
| *Neogamasellevans* | 0(±0) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 702.5(±2400 | 0(±0) | 0(±0) | 0(±0) |
| *Gamasiphoides* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 499.8(±317) | 0(±0) | 0(±0) | 0(±0) |
| *Gamasiphis* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 62.4(±34) |
| *Gamasellevans* | 62.4(±56) | 198.8(±109) | 0(±0) | 0(±0) | 0(±0) | 62.4(±56) | 62.4(±34) | 0(±0) | 0(±0) |
| *Ologamasus* | 31.2(±28) | 0(±0) | 718.6(±275) | 0(±0) | 0(±0) | 156.2(±108) | 250(±163) | 0(±0) | 406.2(±298) |
| *Rykellus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 374.8(±144) | 0(±0) | 0(±0) | 0(±0) |
| **Phytoseiidae** | | | | | | | | | |
| *Proprioseiopsis* | 0(±0) | 0(±0) | 0(±0) | 93.6(±56) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) |
| **Cunaxidae** | | | | | | | | | |
| *Neocunaxoides* | 0(±0) | 0(±0) | 0(±0) | 62.4(±56) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) |
| *Coleoscirus* | 95.20(±31) | 0(±0) | 0(±0) | 124.8(±68) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) | 93.8(±84) |
| *Armascirus* | 312.4(±147) | 0(±0) | 31.2(±28) | 218.8(±122) | 0(±0) | 31.2(±28) | 562.6(±371) | 0(±0) | 31.2(±28) |
| *Neoscirula* | 0(±0) | 0(±0) | 0(±0) | 281(±56) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) |
| *Lupaeus* | 0(±0) | 31.2(±28) | 0(±0) | 93.8(±19) | 0(±0) | 312.4(±99) | 218.6(±84) | 0(±0) | 31.2(±28) |
| *Pulaeus* | 0(±0) | 0(±0) | 0(±0) | 93.6(±56) | 0(±0) | 906.2(±307) | 31.2(±28) | 0(±0) | 0(±0) |
| *Scutopalus* | 0(±0) | 0(±0) | 0(±0) | 62.4(±56) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 62.4(±56) |
| **Stigmaeidae** | | | | | | | | | |
| *Eustigmaeus* | 93.8(±84) | 0(±0) | 0(±0) | 406.2(±274) | 0(±0) | 687.4(±389) | 500(±227) | 0(±0) | 156.2(±140) |
| *Stigmaeus* | 31.2(±28) | 31.2(±28) | 93.6(±84) | 93.6(±56) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Bdellidae** | | | | | | | | | |
| *Bdellodes* | 0(±0) | 31.2(±28) | 0(±0) | 31.2(±28) | 31.2(±28) | 468.8(±419) | 31.2(±28) | 0(±0) | 31.2(±28) |
| **Rhagididae** | | | | | | | | | |
| *Rhagidia* | 0(±0) | 31.2(±28) | 0(±0) | 499.8(±162) | 62.4(±34) | 1156.2(±799) | 0(±0) | 0(±0) | 31.2(±28) |
| *Coccorhagidia* | 31.2(±28) | 31.2(±28) | 0(±0) | 0(±0) | 31.2(±28) | 1406.4(±1258) | 0(±0) | 0(±0) | 0(±0) |
| **Pseudocheyllidae** | | | | | | | | | |
| *Anaplocheyllus* | 0(±0) | 0(±0) | 93.8(±84) | 156(±140) | 0(±0) | 2063.0(±862.6) | 218.6(±105) | 0(±0) | 93.6(±56) |
| **Cheylletidae** | | | | | | | | | |
| *Cheylletus* | 0(±0) | 0(±0) | 0(±0) | 249.6(±137) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) |
| *Caudachelles* | 0(±0) | 0(±0) | 0(±0) | 31.2(±28) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Hemicheyletia* | 126.4(±53) | 0(±0) | 0(±0) | 62.4(±56) | 0(±0) | 0(±0) | 62.4(±56) | 0(±0) | 0(±0) |
| **Eupodidae** | | | | | | | | | |
| *Eupodes* | 0(±0) | 0(±0) | 0(±0) | 31.2(±28) | 31.2(±28) | 62.4(±56) | 0(±0) | 0(±0) | 0(±0) |
| *Benoynissus* | 0(±0) | 0(±0) | 0(±0) | 625(±398) | 31.2(±28) | 187.4(±112) | 31.2(±28) | 0(±0) | 0(±0) |
| **Tarsonemidae** | | | | | | | | | |
| *Tarsonemus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Anystidae** | | | | | | | | | |
| *Chaureseria* | 31.2(±28) | 0(±0) | 0(±0) | 218.4(±44) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 93.6(±56) |
| **Pyrosejidae** | | | | | | | | | |
| *Pyrosejus* | 62.4(±56) | 0(±0) | 93.6(±56) | 0(±0) | 0(±0) | 156.2(±880 | 62.4(±34) | 0(±0) | 187.2(±81) |

**Table 4.** Abundance (individuals/$m^{-2}$) and standard error of soil mite genera found in native vegetation (NV), pasture (PA) and sugarcane (SC) in three sites of central-southern Brazil, year 2015 (n=5).

| Genus | Jatai | | | Valparaiso | | | Ipaussu | | |
|---|---|---|---|---|---|---|---|---|---|
| | NV | PA | SC | NV | PA | SC | NV | PA | SC |
| **Laelapidae** | | ind/$m^{-2}$ se | | | ind/$m^{-2}$ se | | | ind/$m^{-2}$ se | |
| *Gaeolaelaps* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Cosmolaelaps* | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Pseudoparasitus* | 0(±0) | 31.2(±32) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) |
| *Stratriolaelaps* | 0(±0) | 0(±0) | 0(±0) | 125.0(±125) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Ascidae** | | | | | | | | | |
| *Asca* | 0(±0) | 562.4(±250) | 31.2(±31) | 468.8(±262) | 0(±0) | 0(±0) | 156.2(±15) | 0(±0) | 0(±0) |
| *Protogamasellus* | 0(±0) | 124.8(±125) | 968.8(±459) | 93.6(±62) | 0(±0) | 593.8(±234) | 0(±0) | 187.6(±188) | 62.4(±62) |
| *Gamasellodes* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Blattisociidae** | | | | | | | | | |
| *Lasioseius* | 31,2(±31) | 312.4(±178) | 156.0(±99) | 93.6(±94) | 93.6(±94) | 93.6(±38) | 93.6(±22) | 62.4(±62) | 0(±0) |
| *Zercoseius* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 374.8(16) | 0(±0) | 0(±0) |
| *Cheiroseius* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 718.8(±1060 | 0(±0) |
| *Blattisocius* | 0(±0) | 62.4(±62) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Scutacaridae** | | | | | | | | | |
| *Scutacarus* | 0(±0) | 62.4(±62) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) |
| **Macrochellidae** | | | | | | | | | |
| *Proctolaelaps* | 93.6(±62) | 125(±91) | 187.4(±91) | 187.4(±115) | 31.2(±31) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) |
| *Tropicoseius* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 125.0(±125) | 0(±0) | 0(±0) | 0(±0) |
| **Rhodacaridae** | | | | | | | | | |
| *Multidentorhodacarus* | 250.0(±250) | 0(±0) | 31.2(±31) | 31.2(±31) | 31.2(±31) | 31.2(±31) | 31.2(±12) | 0(±0) | 62.4(±62) |
| *Protogamasellopsis* | 0(±0) | 31.2(±31) | 250.0(±106) | 0(±0) | 62.4(±62) | 156.2(±156) | 31.2(±12) | 0(±0) | 0(±0) |
| *Afrodacarellus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 31.2(±12) | 0(±0) | 31.2(±31) |
| *Binodacarus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Veiigaidae** | | | | | | | | | |
| *Gamasolaelaps* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 124.8(±76) |
| **Digamasellidae** | | | | | | | | | |
| *Dendrolaelaspis* | 0(±0) | 0(±0) | 0(±0) | 156.2(±99) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Podocinidae** | | | | | | | | | |
| *Podocinum* | 0(±0) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 31.2(±12) | 0(±0) | 0(±0) |
| **Macrochellidae** | | | | | | | | | |
| *Holostaspella* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Macrochelles* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Parasitidae** | | | | | | | | | |
| *Eugamasus* | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 93.6(±62) | 0(±0) |
| **Ologamasidae** | | | | | | | | | |
| *Neogamasellevans* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 62.4(±62) |
| *Gamasiphoides* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Gamasiphis* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 62.4(±62) | 406.2(±295) | 62.4(±18) | 0(±0) | 0(±0) |
| *Ologamasus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 93.6(±14) | 0(±0) | 0(±0) |
| *Rykellus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Phytoseiidae** | | | | | | | | | |
| *Proprioseiopsis* | 0(±0) | 187.4(±125) | 0(±0) | 0(±0) | 93.6(±62) | 125.0(±125) | 0(±0) | 62.4(±62) | 62.4(±62) |
| **Cunaxidae** | | | | | | | | | |
| *Neocunaxoides* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 31.2(±31) | 218.6(±80) | 0(±0) | 0(±0) | 0(±0) |
| *Coleoscirus* | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Armascirus* | 0(±0) | 62.4(±38) | 0(±0) | 93.8(±94) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) |
| *Scutascirus* | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Neoscirula* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Lupaeus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 62.4(±62) | 0(±0) | 0(±0) | 0(±0) |
| *Pulaeus* | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 406.2(±168) | 0(±0) | 0(±0) | 31.2(±31) |
| *Scutapalus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Stigmaeidae** | | | | | | | | | |
| *Eustigmaeus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Stigmaeus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Bdellidae** | | | | | | | | | |
| *Bdellodes* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Rhagididae** | | | | | | | | | |
| *Ragidia* | 93.6(±38) | 31.2(±31) | 0(±0) | 156.2(±99) | 31.2(±31) | 531.0(±381) | 0(±0) | 0(±0) | 0(±0) |
| *Coccoragidia* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Pseudocheyllidae** | | | | | | | | | |
| *Anaplocheyllus* | 0(±0) | 93.8(±94) | 0(±0) | 62.4(±62) | 187.4(±151) | 0(±0) | 31.2(±12) | 31.2(±31) | 93.6(±62) |
| **Cheylletidae** | | | | | | | | | |
| *Cheylletus* | 0(±0) | 0(±0) | 62.4(±62) | 0(±0) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 62.4(±62) |
| *Caudachelles* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Eupodidae** | | | | | | | | | |
| *Eupodes* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Benoynissus* | 0(±0) | 0(±0) | 62.4(±62) | 0(±0) | 31.2(±31) | 0(±0) | 0(±0) | 0(±0) | 31.2(±31) |
| **Tydeidae** | | | | | | | | | |
| *Tydeus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| *Lorryia* | 0(±0) | 0(±0) | 64(±64) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Tarsonemidae** | | | | | | | | | |
| *Tarsonemus* | 0(±0) | 0(±0) | 124.8(±76) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Anystidae** | | | | | | | | | |
| *Chaureseria* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |
| **Pyrosejidae** | | | | | | | | | |
| *Pyrosejus* | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) | 0(±0) |

### 2.3.4. Relative dominance of predatory mites at genus level

The degree of dominance of predatory mite genera [dominant (D), localy dominant (LD), subdominant (SD), common (C) and uncommon (UC)] varied according to the community composition and the large number of uncommon species (Table 5). A few genera were considered dominant, specially for having great abundance and frequency. In the presentation of the results in the subsequent figures, the mite genera located in the upper right quadrant were both the most frequent and most abundant and have the status of dominant (D). Genera located in the lower right quadrant have the status of subdominant (SD), which are also frequently collected but at low abundance. Locally dominant genera were those positioned in the upper left quadrant and these are infrequently collected, but they were present in high abundances. The highest number of genera are present in the lower left quadrant, in which a subdivision occurs, uncommon species being located in the left subdivision and common species in the right subdivision.

During the first sampling (2013/2014) conducted in NV (Fig. 8), *Asca* and *Zercoseius* were dominant (D) genera; *Neogamasellevans*, *Cheiroseius*, *Benoynissus*, *Gaeolaelaps*, *Protogamasellus*, *Rhagidia*, *Proctolaelaps* and *Cosmolaelaps* were considered subdominant (SD). For PA, *Eugamasus* and *Protogamasellus* were considered dominant (D); *Asca*, *Gamasiphis*, *Gamasellodes*, *Gaeolaelaps* and *Neocunaxoides* were considered subdominant (SD); *Cheiroseius* was found to be locality dominant (LD). In SC, three genera were considered dominant (D): *Cheiroseius*, *Asca*, and *Cosmolaelaps*; *Gaeolaelaps*, *Lasioseius*, *Gamasolaelaps*, *Gamasiphis*, *Neocunaxoides*, *Eugamasus*, *Benoynissus*, *Rhagidia* and *Armascirus* were considered subdominant (SD)

During the second sampling (2014/2015), conducted in NV, the following genera were determined as dominant (Fig. 9): *Gamasellodes*, *Cheiroseius* and *Protogamasellus*; while *Eustigmaeus*, *Gamasiphis*, *Lasioseius*, *Coleoscirus*, *Gaeolaelaps*, *Pulaeus* and *Proctolaelaps* were determined subdominant (SD). In PA only *Cheiroseius* was considered dominant (D); *Asca*, *Stratriolaelaps*, *Zercoseius*, *Proctolaelaps*, *Rhagidia*, *Rykellus*, *Multidentorhodacarus*, *Gaeolaelaps* and *Lasioseius* were found subdominant (SD). In SC, two genera were considered dominants (D), *Gaeolaelaps* and *Gamasellodes*; only one genus was considered localy dominant (LD), *Cheiroseius*; *Asca*, *Lasioseius*, *Anaplocheyllus*, *Proprioseiopsis* and *Proctolaelaps* were considered subdominant (SD).

### 2.3.5. Relative dominance of mesostigmatid mite species

In Jataí, the dominant mesostigmatid mites in the first sampling period (Table 6) were *Neogamasellevans* sp (42.9), *Asca* sp. 1 (11.2) and *A. garmani* (12.2) in NV and *Proprioseiopsis* sp. (41.7) in SC. In PA, all the species were estimated as subdominant (SD). In the second sampling, the dominant species were *G. magnaventris* (24.4), *G. invictianus* (14.8), *Asca* sp. 3 (13.0) and *Gaeolaelaps* n.sp. 3 (10.4) in NV; *A. garmani* (23.9), *P. diffisus* (13.0) and *Proprioseiopsis* sp (13.0) in SC and *P. diffisus* in PA.

In Valparaíso (Table 7), the dominant species in the first sampling were *M. trirramulus* (26.1) in NV; *Zercoseius* sp (54.5). and *C. pugiuncullus* (15.0) in SC and *P. similis* (29.3) and *G. invictianus* (18.9) in PA. In the second sampling, the dominant species were *A. garmani* (23.9) and *Proprioseiopsis* sp (13.0) in NV; *G. magnaventris* (50.4) and *P. similis* (16.8) in SC and *Gaeolaelaps* n.sp 3. (38.1) and *Proprioseiopsis* sp (14.3) in PA.

In Ipaussu (Table 8) the dominant species in the first sampling were *M. trirramulus* (32.1), *Gaeolaelaps* sp.n 1 (32.1), *S. ornatissima* (16.3) and *G. isodentis* (16.3) in NV; *A. garmani* (21.0), *C. pugiunculus* (13.3), *P. similis* (12.3) and *C. barbatus* (12.0) in SC and *P. sigillophorus* (23.9), *C. pugiunculus* (23.1), *Eugamasus sp* (14.5) and *A. garmani* (11.6) in PA. In the second sampling, the dominant species were *S. ornatissima* (16.7), *G. isodentis* (16.7), *Rykellus* sp (13.3) and *Zercoseius* sp (12.2) in NV; *C. pugiuncullus* (18.3), *G. queenslandicus* (16.9) and *P. sigillophorus* (14.9) in SC and *P. sigilophorus* (66.7) and *G. queenslandicus* (16.9) in PA.

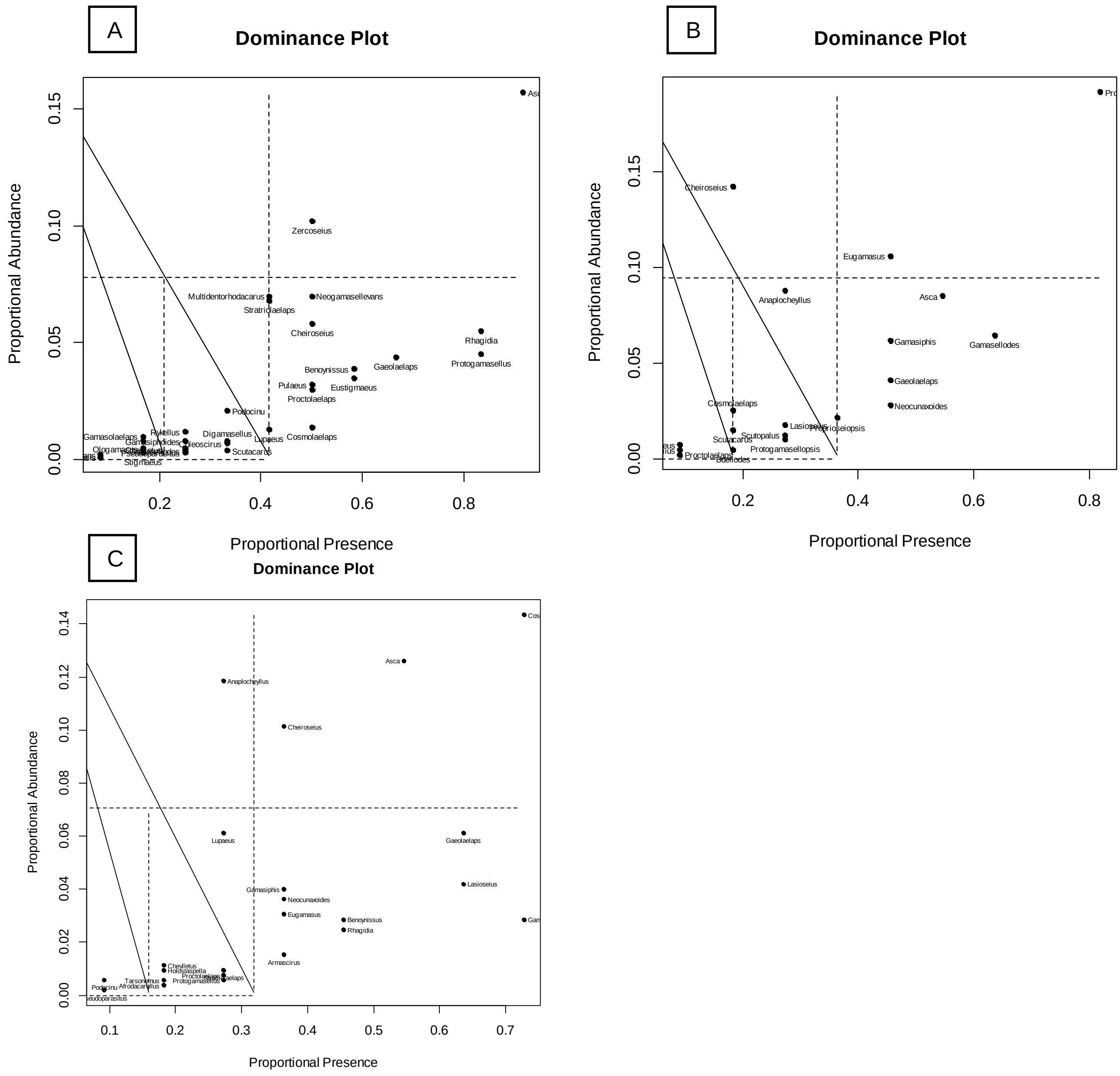



**Figure 7**. Dominance plot of mite genera in assemblages of diferent land use in the regions of central-sourthern Brazil (December 2013/January 2014). A) Natural Vegetation, B) Pasture, C) Sugarcane.

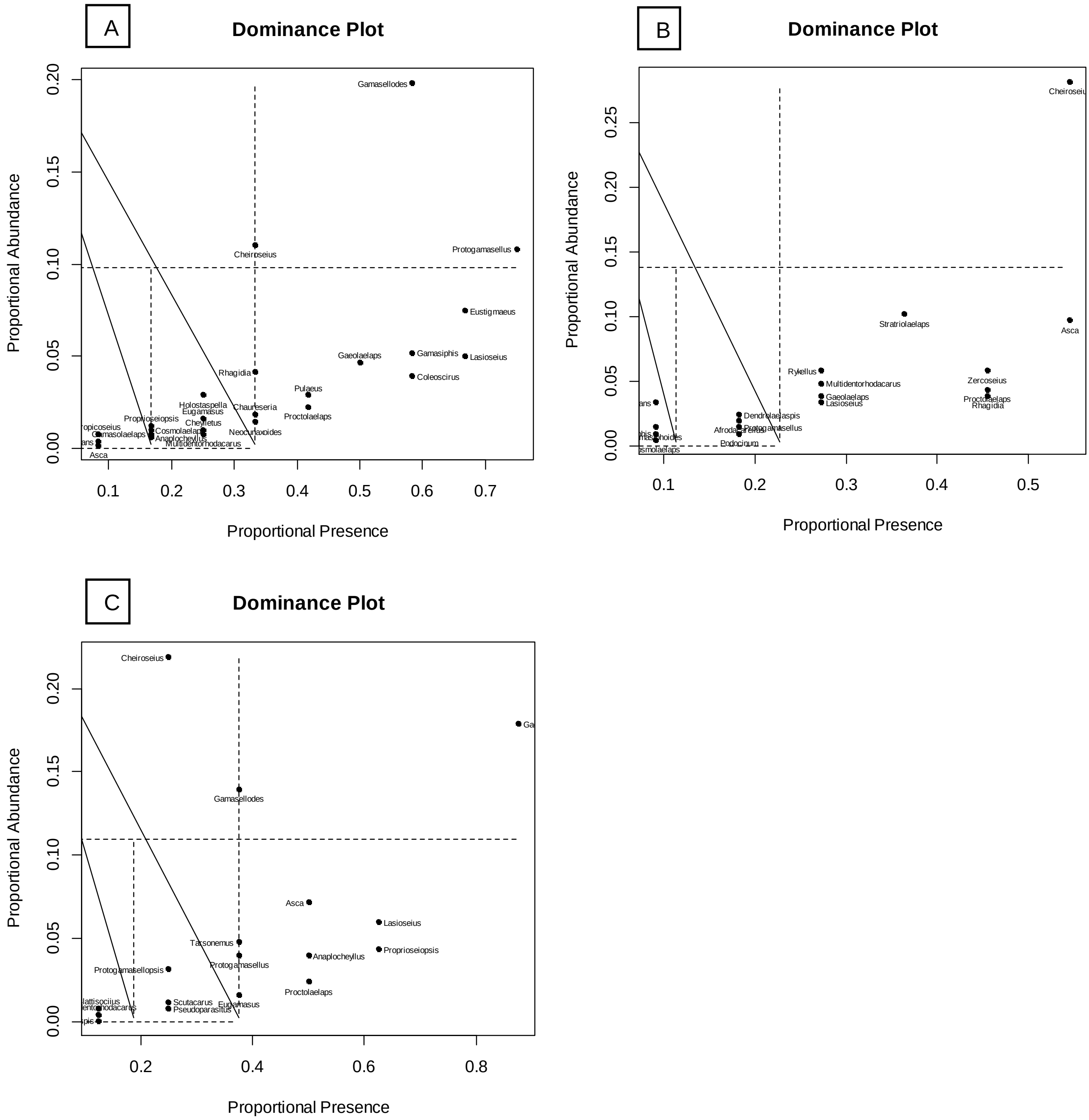



**Figure 8**. Dominance plot of mite genera in assemblages of diferent land use in the regions of central-sourthern Brazil (December 2014/January 2015). A) Natural Vegetation, B) Pasture, C) Sugarcane.

**Table 5.** Relative dominance value (*DV '*) of mite genera in different types of land use (Natural Vegetation-Pasture-Sugarcane) in Centro-southern Brasil.

| | Dec 2013/Jan 2014 | | | Dec 2014/Jan 2015 | | |
|---|---|---|---|---|---|---|
| | **NV** | **PA** | **SC** | **NV** | **PA** | **SC** |
| ***Genu*** | **DVp** | **DVp** | **DVp** | **DVp** | **DVp** | **DVp** |
| ***Asca*** | 25.8 D | 10.5 D | 15.4 D | 13.6 D | 7.8 SD | 0.04 UC |
| ***Zercoseius*** | 9.2 D | | | 6.8 SD | | |
| ***Multidentorhodacarus*** | 5.2 SD | | 0.6 C | 3.4 SD | 0.1 UC | 0.4 C |
| ***Neogamasellevans*** | 6.2 SD | | | 0.8 C | | 0.1 C |
| ***Stratriolaelaps*** | 5.1 SD | | 0.6 C | 9.5 D | | |
| ***Cheiroseius*** | 5.2 SD | 5.8 SD | 8.2 D | 39.3 D | 11.9 D | 7.5 SD |
| ***Rhagidia*** | 8.2 SD | 0.6 C | 2.5 SD | 4.5 SD | 0.4 C | 2.8 SD |
| ***Protogamasellus*** | 6.7 SD | 35.2 D | 0.3 C | 0.7 C | 3.2 SD | 16.5 D |
| ***Gaeolaelaps*** | 5.2 SD | 4.2 SD | 8.7 D | 2.7 SD | 34.0 D | 4.7 SD |
| ***Benoynissus*** | 4.1 SD | 0.8 C | 2.9 SD | | 0.1 UC | 0.2 C |
| ***Eustigmaeus*** | 3.7 SD | 0.1 UC | 0.2 C | | 0.7 C | 10.1 D |
| ***Pulaeus*** | 2.9 SD | 0.2 C | 3.3 SD | | 0.1 UC | 2.5 SD |
| ***Proctolaelaps*** | 2.7 SD | 0.1 UC | 0.5 C | 5.1 SD | 2.6 SD | 1.9 SD |
| ***Podocinum*** | 1.3 SD | | 0.1 UC | 0.5 C | | |
| ***Cosmolaelaps*** | 1.3 SD | 1.1 SD | 23.3 D | 0.1 UC | | 0.4 C |
| ***Lupaeus*** | 0.9 C | | 3.7 SD | | | 0.8 C |
| ***Rykellus*** | 0.5 C | | 0.1 UC | 4.1 SD | | |
| ***Gamasolaelaps*** | 0.3 C | | 0.04 UC | | | 0.3 C |
| ***Gamasiphoides*** | 0.4 C | | 0.2 C | 0.3 C | | |
| ***Armascirus*** | 0.4 C | 0.1 UC | 1.2 SD | | 0.4 C | 0.04 UC |
| ***Digamasellus*** | 0.5 C | | | | | |
| ***Cheylletus*** | 0.2 C | 0.6 C | 0.5 C | | | 0.5 C |
| ***Eugamasus*** | 0.4 C | 10.8 D | 2.5 SD | | 1.3 SD | 0.8 C |
| ***Coleoscirus*** | 0.4 C | | | | 0.4 C | 4.7 SD |
| ***Neoscirula*** | 0.4 C | | 0.04 UC | | | |
| ***Chaureseria*** | 0.4 C | | | | | 1.3 SD |
| ***Ologamasus*** | 0.2 C | | | | | |
| ***Pyrosejus*** | 0.2 C | | | | | |
| ***Bdellodes*** | 0.2 C | 0.2 C | | | | |
| ***Lasioseius*** | 0.1 UC | 1.1 SD | 6.0 D | 2.4 C | 8.1 SD | 6.7 SD |
| ***Gamasellodes*** | 0.2 C | 9.3 D | 4.7 SD | 11.3 D | | 23.4 D |
| ***Blattisociius*** | 0.1 UC | 0.1 UC | 0.04 UC | | 0.2 C | |
| ***Scutacarus*** | 0.2 C | 0.6 C | | | 0.7 C | |
| ***Proprioseiopsis*** | 0.2 C | 1.8 SD | 0.2 C | | 5.9 SD | 0.4 C |
| ***Coccorhagidia*** | 0.1 UC | | 0.04 UC | | | |
| ***Eupodes*** | 0.2 C | | 0.04 UC | | | |
| ***Pseudoparasitus*** | 0.1 UC | | 0.04 UC | 3,4 SD | 0.4 C | |
| ***Neocunaxoides*** | 0.1 UC | 2.9 SD | 3.0 SD | | 0.1 UC | 1.0 C |
| ***Stigmaeus*** | 0.1 UC | 0.1 UC | 0.04 UC | | | |
| ***Anaplocheyllus*** | 0.1 UC | 5.4 SD | 7.2 D | 0.7 C | 4.3 SD | 0.2 C |
| ***Gamasellevans*** | 0.03 UC | | | | | |
| ***Scutopalus*** | 0.03 UC | 0.8 C | | | | |
| ***Hemicheyletia*** | 0.03 UC | | | | | |
| ***Protogamasellopsis*** | 0.02 UC | 0.6 C | | 0.1 UC | 1.7 SD | 4.7 SD |
| ***Afrodacarellus*** | 0.02 UC | | 0.2 C | 0.9 C | | |
| ***Binodacarus*** | 0.02 UC | | | | | |
| ***Caudachelles*** | 0.02 UC | | | | | |
| ***Gamasiphis*** | | 6.4 SD | 3.3 SD | 0.2 C | 0.2 C | 6.2 SD |
| ***Afrodacarellus*** | | 0.6 C | | | | 0.04 UC |
| ***Holostaspella*** | | 0.1 UC | 0.4 C | | | 1.5 SD |
| ***Tarsonemus*** | | 0.1 UC | 0.2 C | | 3.9 SD | 0.3 C |
| ***Macrochelles*** | | | 0.04 UC | | | |
| ***Dendrolaelaspis*** | | | | 1.1 SD | 0.02 UC | |
| ***Tropicoseius*** | | | | | | 0.1 C |

**Table 6**. Relative dominance value (*DV* ') of mite species in different types of land uses (Natural Vegetation-Pasture-Sugarcane) Jataí (Goiás).

| | Dec 2013/Jan 2014 | | | Dec 2014/Jan 2015 | | |
|---|---|---|---|---|---|---|
| | NV | PA | SC | NV | PA | SC |
| **Species** | % DVp Cat. | % DVp Cat. | % DVp Cat. | % DVp Cat. | % DVp Cat. | % DVp Cat. |
| ***Neogamasellevans* sp** | 42.9 (0.34) D | | | | | |
| ***Asca* sp 1** | 16.2 (0.13) D | | | | | 6.5 (0.03) SD |
| ***Asca garmani* Hurlbutt** | 12.2 (0.10) D | | 8.3 (0.02) SD | 1.7 (0.004) C | | 23.9 (0.14) D |
| ***Multidentorhodacarus triramulus* Hurlbutt** | 5.8 (0.04) SD | | 8.3 (0.02) SD | 7.0 (0.03) SD | 2.5 (0.005) C | 2.2 (0.004) C |
| ***Proctolaelaps diffisus* Karg** | 5.8 (0.04) SD | | | 2.6 (0.01) SD | 12.5 (0.05) D | 13.0 (0.05) D |
| ***Gaeolaelaps* n. sp. *2*** | 5.1 (0.004) C | 6.7 (0.01) SD | 8.3 (0.02) SD | 2.6 (0.01) SD | | |
| ***Eugamasus* n.sp.** | 3.9 (0.02) SD | | | 0.9 (0.002) C | | |
| ***Cosmolaelaps* sp4** | 2.6 (0.01) SD | | | | | |
| ***Gaeolaelaps brevipellis* Karg** | 1.3 (0.003) C | | | 0.9 (0.002) C | | |
| ***Gaeolaelaps círcularis* Karg** | 1.3 (0.003) C | | | | | |
| ***Gaeolaelaps* n. sp. 9** | 1.3 (0.003) C | | | | | |
| ***Protogamasellus similis* Genis, Loots & Ryke** | 0.6 (0.001) UC | 6.7 (0.01) SD | | 4.4 (0.02) SD | 60.0 (0.36) D | 4.4 (0.01) SD |
| ***Gaeolaelaps verticis* Karg** | 0.6 (0.001) UC | | | | | |
| ***Cosmolaelaps barbatus* Moreira, Klompen & Moraes** | 0.6 (0.001) UC | | | | | |
| ***Proprioseiopsis* sp** | | 46.7 (0.09) SD | 41.7 (0.20) D | | | 13.0 (0.05) D |
| ***Gaeolaelaps* n. sp. 3** | | 20.0 (0.08) SD | | 10.4 (0.06) D | | |
| ***Asca* sp3** | | 6.7 (0.01) SD | 8.3 (0.02) SD | 13.0 (0.05) D | | |
| ***Gaeolaelaps invictianus* Walter & Moser** | | 6.7 (0.01) SD | | 14.8 (0.10) D | | |
| ***Gaeolaelaps* n. sp. 1** | | 6.7 (0.01) SD | | 3.5 (0.01) SD | | |
| ***Cosmolaelaps* sp2** | | | 8.3 (0.02) SD | | | |
| ***Gaeolaelaps aguape* n. sp. 7** | | | 8.3 (0.02) SD | | | |
| ***Lasioseius latinoamericanus* Mineiro, Lindquist & Moraes** | | | 8.3 (0.02) SD | | | |
| ***Gaeolaelaps queenslandicus* Womerley** | | | | | | |
| ***Gaeolaelaps isodentis* Karg** | | | | | | 6.5 (0.03) SD |
| ***Gaeolaelaps n. sp.* 4** | | | | | | |
| ***Gaeolaelaps* n. sp. 5** | | | | | | |
| ***Gaeolaelaps* n. sp. 6** | | | | | | |
| ***Gaeolaelaps* n. sp. 8** | | | | | | |
| ***Gaeolaelaps* n. sp. 10** | | | | | | |
| ***Gaeolaelaps n. sp.* 11** | | | | | | |
| ***Gaeolaelaps n. sp.* 12** | | | | | | 2.2 (0.004) C |
| ***Cosmolaelaps confinisetarum* Moreira, Klompen & Moraes** | | | | | | |
| ***Cosmolaelaps* n.sp.1** | | | | | | |
| ***Cosmolaelaps aff. oliveirai* Moreira, Klompen & Moraes** | | | | | | |
| ***Cosmolaelaps* sp3** | | | | | | |
| ***Cosmolaelaps* sp5** | | | | | | |
| ***Pseudoparasitus* sp1** | | | | | | |
| ***Pseudoparasitus* sp2** | | | | 0.9 (0.002) C | | |
| ***Pseudoparasitus* sp3** | | | | | | |
| ***Pseudoparasitus* sp4** | | | | | | |
| ***Stratriolaelaps ornatissima* Aswegen & Loots** | | | | | | 8.7 (0.04) C |
| ***Binodacarus aceguensis* Castilho & Moraes** | | | | | | |
| ***Protogamasellopsis zaheri* Abo-Shnaf, Castilho & Moraes** | | | | | 20.0 (0.08) D | 2.2 (0.004) C |
| ***Afrodacarellus aff. minutus* Hurlbutt** | | | | | | 6.5 (0.03) SD |
| ***Asca* sp2** | | | | | | |
| ***Gamasellodes magnaventris* Mineiro, Lindquist & Moraes** | | | | 24.4 (0.15) D | | |
| ***Gamasellodes* sp1** | | | | | | |
| ***Gamasellodes* sp2** | | | | | | |
| ***Protogamasellus sigilophorus* Mineiro, Lindquist & Moraes** | | | | | | |
| ***Protogamasellus aff. Sigillophorus* Mineiro, Lindquist & Moraes** | | | | | | |
| ***Cheiroseius pugiunculus* Karg** | | | | 0.9 (0.002) C | | |
| ***Cheiroseius neophalangiodes* Mineiro, Lindquist & Moraes** | | | | | | |
| ***Lasioseius aff. barbiensis* Faraji & Karg** | | | | | | |
| ***Lasioseius quinisetosus* Lindquist & Karg** | | | | | | |
| ***Lasioseius n.sp.*** | | | | 8.7 (0.05) SD | | |
| ***Zercoseius* sp1** | | | | | | |
| ***Zigoseius* n.sp.** | | | | | | 2.2 (0.004) C |
| ***Blatissocius keegani* Fox** | | | | 1.7 (0.007) C | | |
| ***Gamasolaelaps* sp** | | | | | | |
| ***Tropicoseius* sp** | | | | | | |
| ***Dendrolaelaspis* sp** | | | | | | 8.7 (0.04) SD |
| ***Holostaspella* sp** | | | | | 2.5 (0.005) C | |
| ***Podocinum* sp** | | | | | 2.5 (0.005) C | |
| ***Criptopnatus* sp** | | | | 1.7 (0.007) C | | |
| ***Pirosejus* sp** | | | | | | |
| ***Gamasiphoides* sp** | | | | | | |
| ***Ologamasus* sp** | | | | | | |
| ***Rykellus* sp** | | | | | | |

**Table 7.** Relative dominance value (*DV* ') of mite species in different types of land use (Natural Vegetation-Pasture-Sugarcane) Valparaíso (São Paulo).

| | Dec 2013/Jan 2014 | | | Dec 2014/Jan 2015 | | |
|---|---|---|---|---|---|---|
| | NV | PA | SC | NV | PA | SC |
| Species | % DV Cat. | % DV Cat. | % DV Cat. | % DV Cat. | % DV Cat. | % DV Cat. |
| *Multidentorhodacarus triramulus* Hurlbutt | 26.1 (0.21) D | 3.4 (0.01) SD | 0.9 (0.02) C | 2.2 (0.004) C | | |
| *Proctolaelaps diffisus* Karg | 1.8 (0.11) SD | 3.5 (0.01) SD | 1.4 (0.01) SD | 13.0 (0.05) SD | | |
| *Protogamasellus similis* Genis, Loots & Ryke | 15.1 (0.10) SD | 29.3 (0.18) D | 4.7 (0.01) SD | 4.4 (0.01) SD | 4.8(0.01) SD | 16.8 (0.1) D |
| *Asca garmani* Hurlbutt | 14.7 (0.10) SD | 6.9 (0.03) SD | 0.5 (0.001) C | 23.9 (0.14) D | | |
| *Asca* sp. 1 | 11.5 (0.10) SD | 1.7 (0.003) C | | 6.5 (0.03) SD | | |
| *Gaeolaelaps isodentis* Karg | 2.3 (0.01) C | | | 6.5 (0.03) SD | | |
| *Gaeolaelaps círcularis* Karg | 1.8 (0.01) C | | 0.5 (0.001) C | | | |
| *Neogamasellevans* sp | 1.8 (0.004) UC | | | | | |
| *Proprioseiopsis* sp | 1.4 (0.003) UC | 5.2 (0.05) SD | 1.4 (0.01) SD | 13.0 (0.05) D | 14.3(0.03) D | 1.5 (0.01) SD |
| *Gaeolaelaps verticis* Karg | 0.9 (0.002) UC | | | | | |
| *Gaeolaelaps* n. sp. 6 | 0.9 (0.002) UC | | | | | |
| *Lasioseius quinisetosus* Lindquist & Karg | 0.9 (0.002) C | | | | | |
| *Zercoseius* n.sp. | 0.5 (0.001)C | 1.7 (0.003) C | 54.5 (0.44) D | | | |
| *Cheiroseius pugiunculus* Karg | 0.5 (0.001) C | 3.5 (0.01) SD | 15.0 (0.09) D | | | |
| *Gamasellodes magnaventris* Mineiro, Lindquist & Moraes | 0.5 (0.001) C | 3.5 (0.01) SD | 3.3 (0.01) SD | | 4.8(0.01) SD | 50.4 (0.40) D |
| *Cosmolaelaps barbatus* Moreira, Klompen & Moraes | 0.5 (0.001) C | 3.5 (0.01) SD | 7.5 (0.05) SD | | 4.8 (0.01) SD | |
| *Asca* sp. 2 | 0.5 (0.001) C | 1.7 (0.003) C | | | | |
| *Pseudoparasitus* sp. 2 | 0.5 (0.001) C | | | | | |
| *Stratriolaelaps ornatissima* Aswegen & Loots | 0.5 (0.001) C | | | 8.7 (0.04) SD | | |
| *Protogamasellus sigilophorus* Mineiro, Lindquist & Moraes | 0.5 (0.001) C | | | | | 1.5 (0.01) SD |
| *Protogamasellus aff. Sigillophorus* Mineiro, Lindquist & Moraes | 0.5 (0.001) C | | | | | |
| *Gaeolaelaps invictianus* Walter & Moser | | 18.9(0.11) D | 5.2 (0.02) SD | | 19.1 (0.08) D | 1.5 (0.01) SD |
| *Lasioseius latinoamericanus* Mineiro, Lindquist & Moraes | | 6.9(0.03) SD | 0.9 (0.02) C | | | |
| *Gaeolaelaps* n. sp. 8 | | 3.5(0.01) SD | | | | |
| *Holostaspella* sp. | | 1.7(0.003) C | 0.5 (0.001) C | | | 10.7 (0.10) D |
| *Gamasellodes* sp. 1 | | 1.7(0.003) C | | | | |
| *Gamasellodes* sp. 2 | | 1.7(0.003) C | | | | |
| *Eugamasus* n.sp. | | 1.7(0.003) C | | | | |
| *Lasioseius aff. barbiensis* Faraji & Karg | | | 0.9 (0.02) C | | | |
| *Gaeolaelaps n. sp.* 4 | | | 0.5 (0.001) C | | | |
| *Gaeolaelaps* n. sp. 7 | | | 0.5 (0.001) C | | | |
| *Cosmolaelaps* sp. 4 | | | 0.5 (0.001) C | | | |
| *Cosmolaelaps* sp. 5 | | | 0.5 (0.001) C | | | |
| *Pseudoparasitus* sp. 1 | | | 0.5 (0.001) C | | | |
| *Gaeolaelaps queenslandicus* Womerley | | | 0.5 (0.001) C | | | |
| *Gaeolaelaps* n. sp. 1 | | | | | | 0.8 (0.002) C |
| *Gaeolaelaps* n. sp. 2 | | | | 2.2 (0.004) C | | 4.6 (0.02) SD |
| *Gaeolaelaps* n. sp. 3 | | | | 2.2 (0.004) C | 38.1 (0.23) D | 6.9 (0.04) SD |
| *Gaeolaelaps brevipellis* Karg | | | | 6.5 (0.03) SD | | |
| *Gaeolaelaps* n. sp. 5 | | | | | 14.3 (0.03) D | |
| *Gaeolaelaps* n. sp. 9 | | | | 2.2 (0.004) C | | |
| *Gaeolaelaps* n. sp. 10 | | | | | | 5.3 (0.02) SD |
| *Gaeolaelaps* n. sp. 11 | | | | 8.7 (0.04) SD | | |
| *Gaeolaelaps* n. sp. 12 | | | | 2.2 (0.004) C | | 4.6 (0.02) SD |
| *Cosmolaelaps confinisetarum* Moreira, Klompen & Moraes | | | | | | |
| *Cosmolaelaps* n.sp.1 | | | | | | |
| *Cosmolaelaps aff. oliveirai* Moreira, Klompen & Moraes | | | | | | |
| *Cosmolaelaps* sp. 2 | | | | | | |
| *Cosmolaelaps* sp. 3 | | | | | | |
| *Pseudoparasitus* sp. 3 | | | | | | |
| *Pseudoparasitus* sp. 4 | | | | | | |
| *Binodacarus aceguensis* Castilho & Moraes | | | | | | |
| *Protogamasellopsis zaheri* Abo-Shnaf, Castilho & Moraes | | | | 2.2 (0.004) C | 38.1 (0.23) D | 6.9 (0.04) SD |
| *Afrodacarellus aff. minutus* Hurlbutt | | | | 6.5 (0.03) SD | | |
| *Asca* sp. 3 | | | | | | |
| *Cheiroseius neophalangiodes* Mineiro, Lindquist & Moraes | | | | | | |
| *Lasioseius* n.sp. | | | | | 14.3 (0.03) D | |
| *Zigoseius* n.sp. | | | | 2.2 (0.004) C | | |
| *Blatissocius keegani* Fox | | | | | | |
| *Gamasolaelaps* sp. | | | | | | |
| *Tropicoseius* sp. | | | | | | 5.3 (0.02) SD |
| *Dendrolaelaspis* sp. | | | | 8.7 (0.04) SD | | |
| *Podocinum* sp. | | | | | | |
| *Criptopnatus* sp. | | | | | | |
| *Pirosejus* sp. | | | | | | |
| *Gamasiphoides* sp. | | | | | | |
| *Ologamasus* sp. | | | | | | |
| *Rykellus* sp. | | | | | | |

**Table 8.** Relative dominance value (*DV* ') of mite species in different types of land uses (Natural Vegetation-Pasture-Sugarcane) Ipaussu (São Paulo).

| | Dec 2013/Jan 2014 | | | Dec 2014/Jan 2015 | | |
|---|---|---|---|---|---|---|
| | NV | PA | SC | NV | PA | SC |
| **Species** | **% DV Cat.** | **% DV Cat.** | **% DV Cat.** | **% DV Cat.** | **% DV Cat.** | **% DV Cat.** |
| ***Multidentorhodacarus triramulus*** **Hurlbutt** | 32.1 (0.26) D | 2.1 (0.008) C | 2.9 (0.02) SD | 1.1 (0.002) SD | 3.7 (0.01) SD | 2.8 (0.01) SD |
| ***Stratriolaelaps ornatissima*** **Aswegen & Loots** | 16.3 (0.13) D | | 1.3 (0.005) SD | 16.7 (0.1) D | | |
| ***Asca garmani*** **Hurlbutt** | 9.1 (0.07) SD | 11.6 (0.07) D | 21.0 (0.17) D | 7.8 (0.03) SD | | |
| ***Cheiroseius neophalangiodes*** **Mineiro, Lindquist & Moraes** | 8.1 (0.07) SD | | 3.2 (0.01) SD | 2.2 (0.04) SD | | |
| ***Cheiroseius pugiunculus*** **Karg** | 5.3 (0.04) SD | 23.1 (0.19) D | 13.3 (0.11) D | | 3.7 (0.01) SD | 18.3 (0.11) D |
| ***Podocinum*** **sp.** | 4.6 (0.03) SD | | 1.3 (0.01) SD | 1.1 (0.002) SD | | |
| ***Gamasolaelaps*** **sp.** | 4.6 (0.03) SD | | 0.3 (0.0006) UC | | | 5.6 (0.02) SD |
| ***Asca*** **sp. 1** | 3.8 (0.02) SD | | | | | |
| ***Protogamasellus similis*** **Genis, Loots & Ryke** | 2.2 (0.009) C | 6.2 (0.04) SD | 12.3 (0.10) D | | | 4.2 (0.02) SD |
| ***Criptopnatus*** **sp.** | 1.9 (0.01) SD | | 9.1 (0.10) SD | | 3.7 (0.01) SD | |
| ***Rykellus*** **sp.** | 1.7 (0.01) SD | | 1.0 (0.004) C | 13.3 (0.08) D | | |
| ***Gamasiphoides*** **sp.** | 1.9 (0.01) SD | | 0.7 (0.001) C | 1.1 (0.002) SD | | 1.4 (0.003) SD |
| ***Pirosejus*** **sp.** | 1.2 (0.005) C | | | | | |
| ***Ologamasus*** **sp.** | 1.2 (0.005) C | | | 3.3 (0.01) SD | | |
| ***Proctolaelaps diffisus*** **Karg** | 0.7 (0.003) C | 0.4 (0.0008) UC | 1.3 (0.01) SD | | | 1.4 (0.003) SD |
| ***Gaeolaelaps verticis*** **Karg** | 0.7 (0.003) C | | | 1.1 (0.002) SD | | |
| ***Cosmolaelaps confinisetarum*** **Moreira, Klompen & Moraes** | 0.7 (0.003) C | | | 1.1 (0.002) SD | | |
| ***Gaeolaelaps*** **n. sp. 11** | 0.5 (0.002) C | | | | | |
| ***Blatissocius keegani*** **Fox** | 0.5 (0.001) C | 0.4 (0.008) C | 1.0 (0.004) C | | | |
| ***Protogamasellus sigilophorus*** **Mineiro, Lindquist & Moraes** | 0.5 (0.001) C | 23.9 (0.19) D | | | 66.7 (0.4) D | 14.19 (0.10) D |
| ***Gaeolaelaps queenslandicus*** **Womerley** | 0.2 (0.0004) UC | 4.1 (0.03) SD | 4.9 (0.03) SD | | 14.8 (0.06) D | 16.9 (0.1) D |
| ***Cosmolaelaps barbatus*** **Moreira, Klompen & Moraes** | 0.2 (0.0004) UC | 1.7 (0.007) SD | 12.0 (0.07) D | | | 7.0 (0.03) SD |
| ***Gamasellodes magnaventris*** **Mineiro, Lindquist & Moraes** | 0.2 (0.0004) UC | 1.7 (0.007) SD | 0.3 (0.0006) UC | | | 1.4 (0.003) C |
| ***Lasioseius latinoamericanus*** **Mineiro, Lindquist & Moraes** | 0.2 (0.0004) UC | 0.8 (0.002) C | 2.6 (0.01) SD | | | |
| ***Proprioseiopsis*** **sp.** | 0.2 (0.0004) UC | 0.4 (0.0008) UC | 0.7 (0.001) C | 4.4 (0.02) SD | | 2.8 (0.01) SD |
| ***Holostaspella*** **sp.** | 0.2 (0.0004) UC | | 1.3 (0.01) SD | 1.1 (0.002) C | | 4.2 (0.02) SD |
| ***Gaeolaelaps*** **n. sp. 6** | 0.2 (0.0004) UC | | | | | |
| ***Cosmolaelaps*** **n.sp.1** | 0.2 (0.0004) UC | | | | | |
| ***Cosmolaelaps aff. oliveirai*** **Moreira, Klompen & Moraes** | 0.2 (0.0004) UC | | | | | |
| ***Pseudoparasitus*** **sp. 2** | 0.2 (0.0004) UC | | | 6.7 (0.03) SD | | |
| ***Binodacarus aceguensis*** **Castilho & Moraes** | 0.2 (0.0004) UC | | | | | |
| ***Eugamasus*** **n.sp.** | | 14.5 (0.10) D | 0.1 (0.10) C | | 7.4 (0.02) SD | 8.5 (0.03) SD |
| ***Zercoseius*** **sp. 1** | | 4.9 (0.03) SD | | 12.2 (0.07) D | | |
| ***Cosmolaelaps*** **sp. 3** | | 1.7 (0.007) SD | | | | |
| ***Gaeolaelaps*** **n. sp. 5** | | 1.2 (0.005) SD | | | | |
| ***Cosmolaelaps*** **sp. 5** | | 0.4 (0.0008) UC | 0.3 (0.0006) UC | | | |
| ***Gaeolaelaps invictianus*** **Walter & Moser** | | 0.4 (0.0008) UC | | | | |
| ***Pseudoparasitus*** **sp. 1** | | 0.4 (0.0008) UC | | | | |
| ***Gaeolaelaps*** **n. sp. 8** | | | 0.3 (0.0006) UC | 3.3 (0.01) SD | | |
| ***Cosmolaelaps*** **sp. 2** | | | 0.7 (0.001) C | | | |
| ***Gaeolaelaps*** **n. sp. 1** | 32.1 (0.26) D | 2.1 (0.008) SD | 2.9 (0.02) SD | 1.1 (0.002) C | 3.7 (0.01) SD | 2.8 (0.01) SD |
| ***Gaeolaelaps isodentis*** **Karg** | 16.3 (0.13) D | | 1.3 (0.005) SD | 16.7 (0.1) D | | |
| ***Gaeolaelaps*** **n. sp. 2** | 9.1 (0.07) SD | 11.6 (0.07) D | 21.0 (0.17) D | 7.8 (0.03) SD | | |
| ***Gaeolaelaps*** **n. sp. 3** | 8.1 (0.07) SD | | 3.2 (0.01) SD | 2.2 (0.04) SD | | |
| ***Gaeolaelaps brevipellis*** **Karg 1978** | 5.3 (0.04) SD | 23.1 (0.19) D | 13.3 (0.11) D | | 3.7 (0.01) SD | 18.3 (0.11) D |
| ***Gaeolaelaps*** **n. sp. 4** | 4.6 (0.03) SD | | 1.3 (0.01) SD | 1.1 (0.002) C | | |
| ***Gaeolaelaps*** **n. sp. 7** | 4.6 (0.03) SD | | 0.3 (0.0006) UC | | | 5.6 (0.02) SD |
| ***Gaeolaelaps círcularis*** **Karg** | 3.8 (0.02) SD | | | | | |
| ***Gaeolaelaps*** **n. sp. 9** | | | | | | |
| ***Gaeolaelaps*** **n. sp. 10** | | | | | | |
| ***Gaeolaelaps*** **n. sp. 12** | | | | | | |
| ***Cosmolaelaps*** **sp. 4** | | | | | | |
| ***Pseudoparasitus*** **sp. 3** | | | | | | |
| ***Pseudoparasitus*** **sp. 4** | | | | | | |
| ***Protogamasellopsis zaheri*** **Abo-Shnaf, Castilho & Moraes** | | | | | | |
| ***Afrodacarellus aff. minutus*** **Hurlbutt** | | | | | | |
| ***Asca*** **sp. 2** | | | | | | |
| ***Asca*** **sp. 3** | | | | | | |
| ***Gamasellodes*** **sp. 1** | | | | | | |
| ***Gamasellodes*** **sp. 2** | | | | | | |
| ***Protogamasellus aff. sigillophorus*** **Mineiro, Lindquist & Moraes** | 32.2 (0.26) D | 2.1 (0.008) SD | 2.9 (0.02) SD | 1.1 (0.002) C | 3.7 (0.01) SD | 2.8 (0.01) SD |
| ***Lasioseius aff. barbiensis*** **Faraji & Karg** | 16.3 (0.13) D | | 1.3 (0.005) SD | 16.7 (0.1) D | | |
| ***Lasioseius quinisetosus*** **Lindquist & Karg** | 9.1 (0.07) SD | 11.57 (0.07) D | 21.0 (0.17) D | 7.8 (0.03) SD | | |
| ***Lasioseius*** **n.sp.** | 8,1 (0,07) SD | | 3.2 (0.01) SD | 2.2 (0.04) SD | | |
| ***Zigoseius*** **n.sp.** | 5.3 (0.04) SD | 23.14 (0.19) D | 13.3 (0.11) D | | 3.7 (0.01) SD | 18.3 (0.11) SD |
| ***Tropicoseius*** **sp.** | 4.6 (0.03) SD | | 1.3 (0.01) SD | 1.1 (0.002) C | | |
| ***Dendrolaelaspis*** **sp.** | 4.6 (0.03) SD | | 0.3 (0.0006) UC | | | 5.6 (0.02) SD |
| ***Neogamasellevans*** **sp.** | 3.8 (0.02) SD | | | | | |

## 2.3.6. Vertical distribution of soil mites.

In the first sampling, the highest mean number of mites was found in NV, especialy in the litter layer, with 8,374 mites/m², the density reducing at deaper soil layers (see Fig. 9). In the second sampling, population density reduced to 1,739 mites/m² in NV and increased in sugarcane with 4,254 mites/m² (Fig. 10).

In Goiás-Jataí, the greatest abundance of mites were observed in litter layer specially in NV with 2,436 mites/m². The genera most frequently observed were *Gaeolaelaps*, *Asca*, *Proctolaelaps* (Mesostigmata), *Coleoscirus* and *Rhagidia* (Trombidiformes), while that to 0-5 cm layer, a single genus was found, *Rhagidia.* To 5-10 cm depth was observed soma generas as *Gaeolaelaps* and *Asca* (Fig. 11). In the second sampling (2015), mite density and diversity were again low in natural environment. Most abundant genera were found on pasture, like to first sample the highest abundance and diversity is reported in the litter layer, with a total density of 4,093 mites/m². The genera identified were *Gaeolaelaps*, *Asca*, *Gamasellodes*, *Lasioseius*, *Proctolaelaps*, *Proprioseiopsis* (Mesostigmata), *Armascirus*, *Anaplocheyllus*, *Eustigmaeus* and *Tarsonemus* (Trombidiformes) (Fig. 12).

While that in São Paulo-Valparaíso (2014 year), in this site the highest numbers of mites, is found in the litter layer in NV with a total density about of 7,248 mites/m². The genera most frequently observed were *Gaeolaelaps*, *Asca*, *Protogamasellus*, *Proctolaelaps* (Mesostigmata), *Armascirus*, *Neoscirula*, *Eustigmaeus*, *Rhagidia* and *Benoynissus* (Trombidiformes). However at greater depth occurred a low the abundance and diversity as was observed to 0-5 cm depth where was found as most abundant, *Gaeolaelaps*, *Cosmolaelaps* (Mesostigmata), *Rhagidia* and *Cheylletus* (Trombidiformes), being the total density this layer about of 999 mites/m². But still was possivel found soil mites to 5-10 cm depth, where a total density was only 280 mites/m². The genera commonly found in this layer were *Gaeolaelaps*, *Cosmolaelpas*, *Protogamasellopsis*, *Neogamasellevans* (Mesostigmata), *Bdellodes* and *Cheylletus* (Trombidiformes) (Fig. 13). In the second monitoring (2015 year), the populational density and diversity was have been low, in this same plot, which was calculated in 1687 mites/m², also with the predominance of the genera *Asca*, *Proctolaelaps*, *Gaeolaelaps*, *Afrodacarellus*, *Dendrolaelaspis* (Mesostigmata), *Armascirus*, *Rhagidia* and *Anaplocheyllus* (Trombidiformes). Two genera was reported to 0-5 from depth, with a total density of 62 mites/m², this genera were *Gaeolaelaps* and *Cheiroseius*. To 5-10 cm from depth only was found to *Afrodacarellus* with a density of 32 mites/m². In this plot two genera were characterized by their abundance and capacity to mobilize at greater depths, which were *Gaeolaelaps* and *Cosmolaelaps*. The highest abundance and diversity occurred in the litter layer of SC, which was increase slightly with respect to anteriorly year with 6749 mites/m², also were identifying some genera as *Gaeolaelaps*, *Protogamasellus*, *Gamasellodes*, *Lasioseius*, *Cheiroseius*, *Tropicoseius*, *Holostaspella*, *Protogamasellopsis*, *Gamasiphis* (Mesostigmata), *Neocunaxoides*, *Coleoscirus*, *Pulaeus*, *Eustigmaeus* and *Rhagidia* (Trombidiformes). To 0-5 from depth the total density was 125 mites/m² and the genera most commonly found were *Gamasellodes*, *Cheiroseius* and *Holostaspella* all Mesostigmata; while that the total density to 5-10 cm were found the genera *Multidentorhodacarus*, *Proprioseiopsis* and *Coleoscirus* (Fig 14).

Finally in São Paulo-Ipaussu (2014), in this site the highest numbers of mites, was found in the litter layer of NV, with a total density about of 15,436 mites/m². The genera most frequently observed were *Gaeolaelaps*, *Stratriolaelaps*, *Asca*, *Lasioseius*, *Zercoseius*, *Cheiroseius*, *Multidentorhodacarus*, *Podocinum*, *Neogamasellevans*, *Gamasiphis* (Mesostigmata), *Pulaeus*, *Eustigmaeus*, *Rhagidia* and *Benoynissus* (Trombidiformes). However at greater depth occurred a low the abundance and diversity as was observed to 0-5 cm depth where was found as most abundant, *Gaeolaelaps*, *Stratriolaelaps*, *Zercoseius*, *Cheiroseius*, *Multidentorhodacarus*, *Podocinum*, *Eugamasus*, *Neogamasellevans*, *Gamasiphis*, *Rykellus* (Mesostigmata), *Pulaeus*, *Rhagidia* and *Benoynissus* (Trombidiformes), being the total density this layer about of 4,436 mites/m². It was also possible to find soil mites at 5-10 cm depth, where a total density was only 530 mites/m². The genera commonly found in this layer were *Stratriolaelaps*, *Multidentorhodacarus*, *Neogamasellevans*, *Rykellus* (Mesostigmata), *Rhagidia* and *Eupodes* (Trombidiformes) (Fig. 15). In the second monitoring (2015), the populational density and diversity was low, calculated at 3,062 mites/m² in NV, with predominance of the genera *Gaeolaelaps*, *Pseudoparasitus*, *Stratriolaelaps*, *Asca*, *Lasioseius*, *Zercoseius*, *Cheiroseius*, *Neogamasellevans*, *Gamasiphis*, *Rykellus* (Mesostigmata) and

*Anaplocheyllus* (Trombidiformes). Various genera were reported at 0-5 depth, with a total density of 656 mites/m², the genera collected were *Gaeolaelaps*, *Pseudoparasitus*, *Stratriolaelaps,* *Lasioseius*, *Zercoseius*, *Cheiroseius*, *Neogamasellevans*, *Gamasiphis* and *Rykellus* all Mesostigmata. At 5-10 cm from from the soil surface, the following genera of Mesostigmata were found: *Pseudoparasitus*, *Stratriolaelaps*, *Lasioseius*, *Protogamasellus*, *Afrodacarellus*, *Neogamasellevans*, *Gamasiphis*, *Ologamasus* and *Rykellus*, with a total density of 624 mites/m². In the ecosystem PA and SC, few mites were observed, although with greater abundance in litter layer, except in PA, where the highest soil mites was reported to 5-10 cm from depth (Fig. 16).

For the sampling conducted in 2014, all the factors significantly impacted community composition np-MANOVA: Land use (df=2, F=4.1438, $r^2$=0,1562, p=0.001): site (df=2, F=4.7377, $r^2$=0.1786, p=0.001) interaction land use * site (df=4, F=3.0730, $r^2$=0,2316, p=0.001. (Fig. 17). While that to sampling 2015 again the factors significantly impacted community composition np-MANOVA: Land use Land use (df=2, F=4.15, $r^2$=0,15903, p=0.001): site (df=2, F=5.2819, $r^2$=0.2024, p=0.001) interaction land use per site (df=4, F=2.8316, $r^2$=0,2170, p=0.001. (Fig. 18). The points collected in different uses of the earth (different colors) are grouped in such a way that it is possible to differentiate them. The same occurs when the factor is area (different symbols). This differentiated grouping indicates that the composition of the mite community differs between land uses as well as between areas. These "clues" are then confirmed by npMANOVA (Fig. 19).

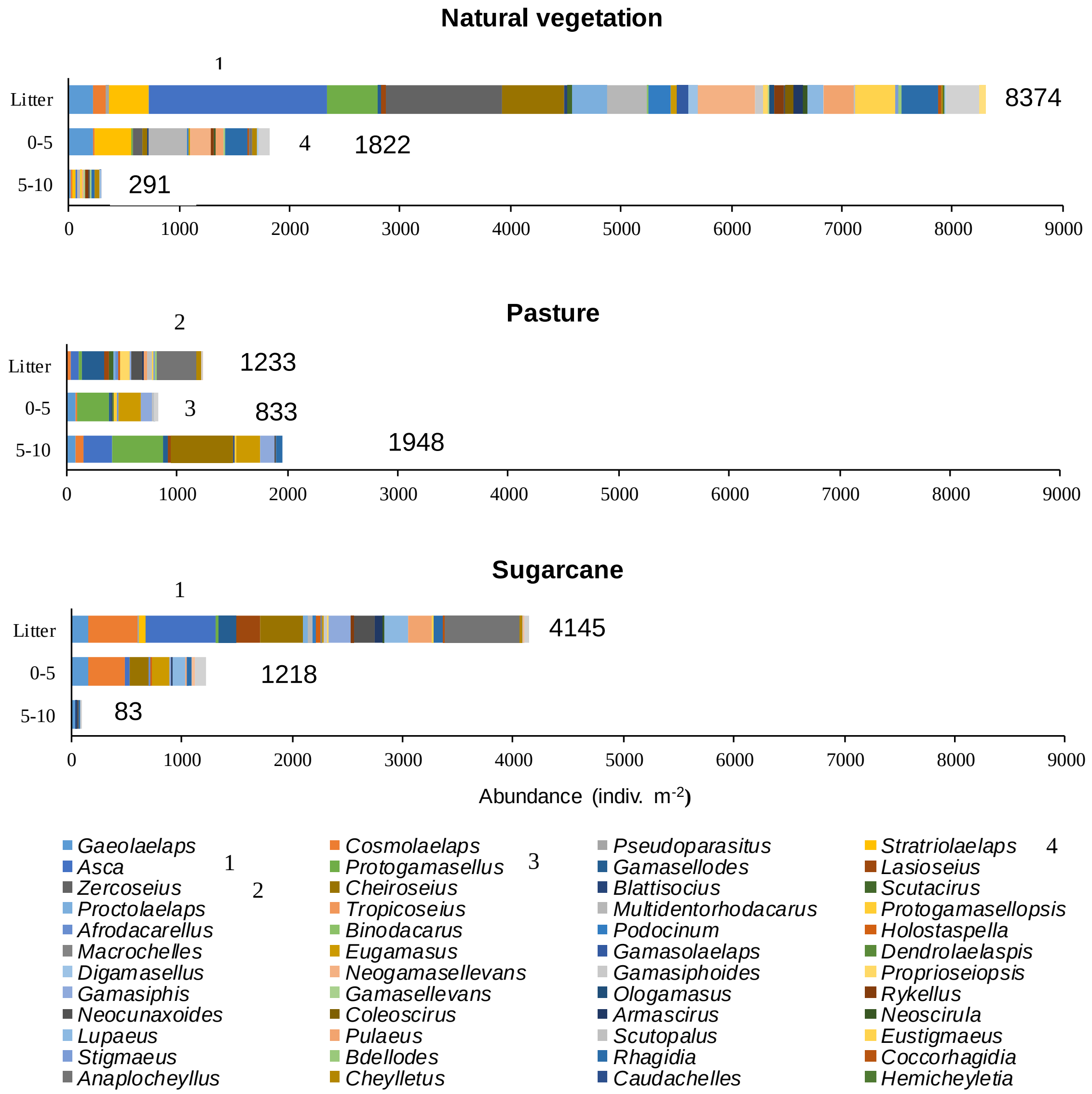



**Figure 9.** Average vertical distribuition and genera composition of soil mites as a function of the land use change (i.e., native vegetation – pasture – sugarcane) in central-southern Brazil, year 2014.

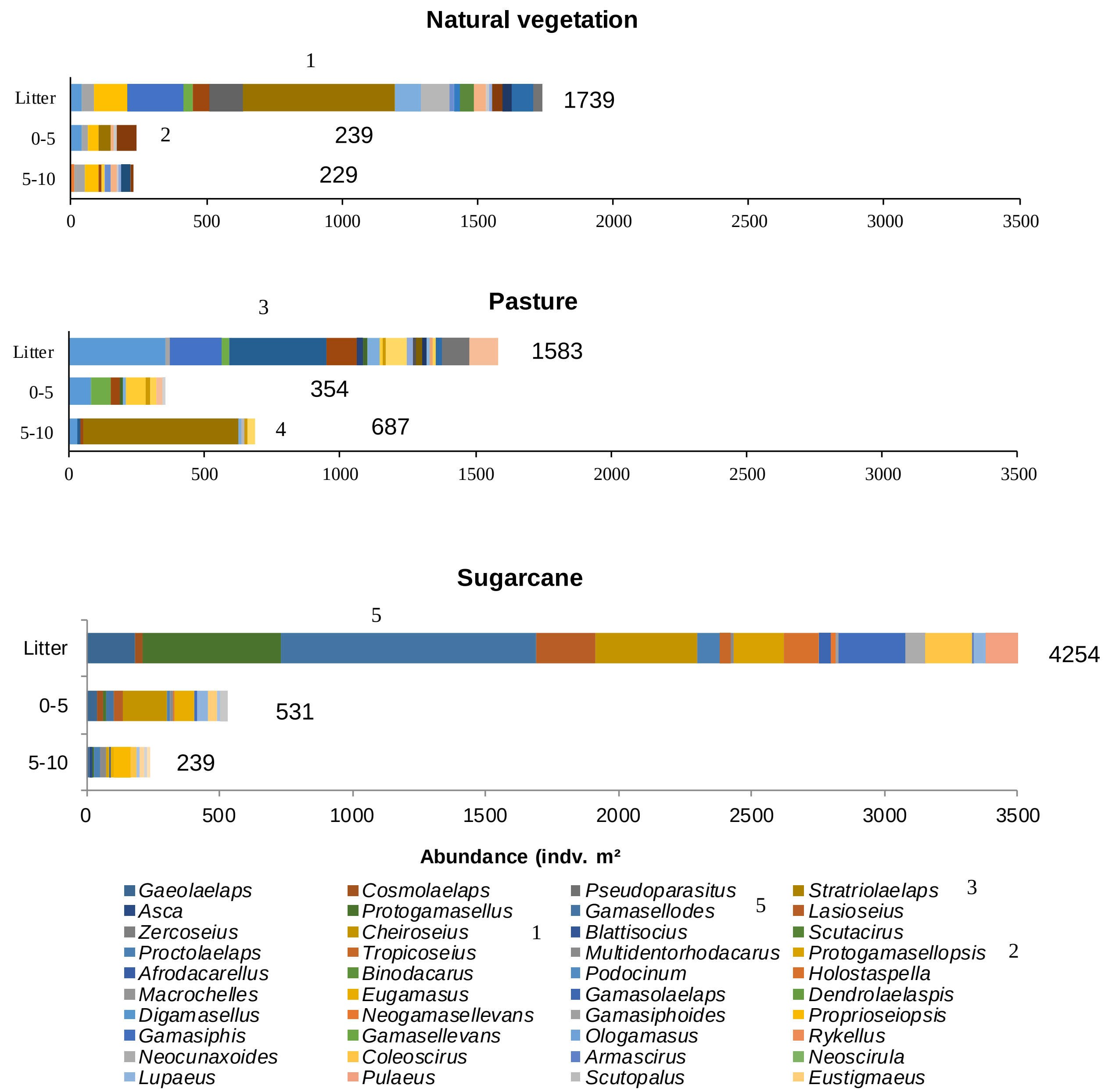



**Figure 10.** Average vertical distribuition and genera composition of soil mites as a function of the land use change (i.e., native vegetation – pasture – sugarcane) in central-southern Brazil, year 2015

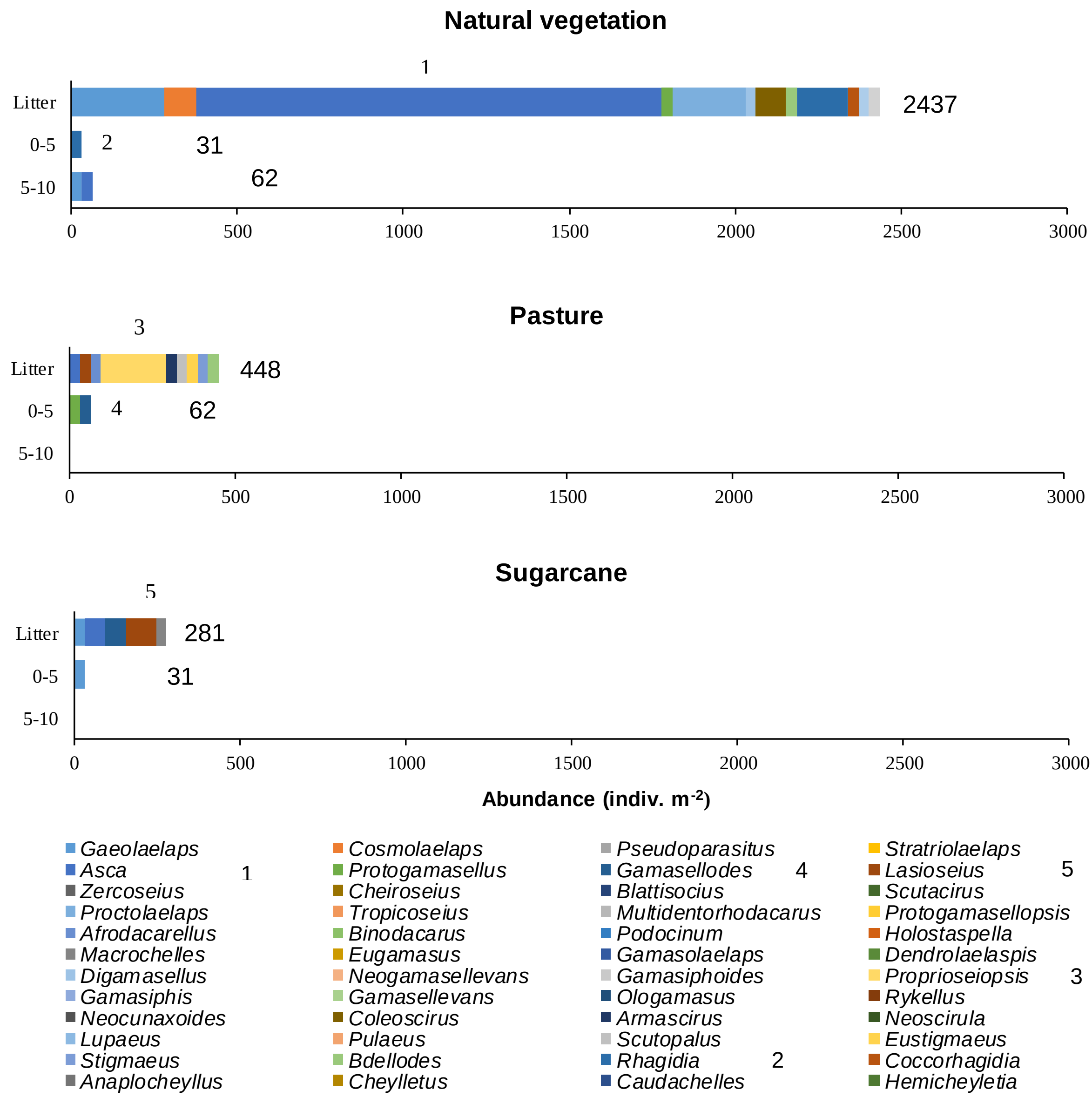



**Figure 11.** Vertical distribution and genera composition of soil mites as a function of the land use change (i.e., natural vegetation, pasture and sugarcane) at Jataí Goiás sisite, 2014.

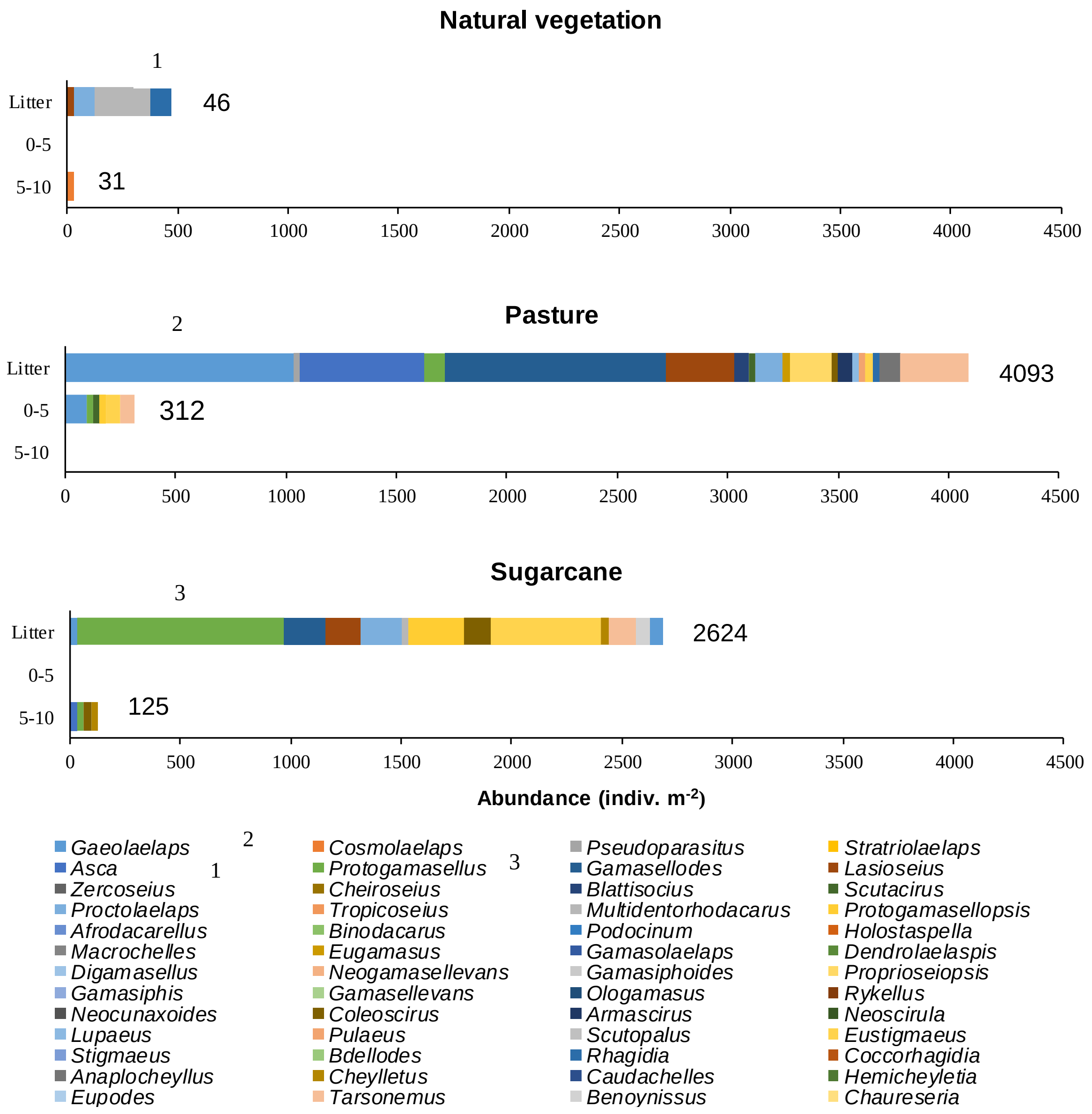



**Figure 12.** Vertical distribution and genera composition of soil mites as a function of the land use change (i.e., natural vegetation, pasture and sugarcane) at Jataí Goiás site, 2015.

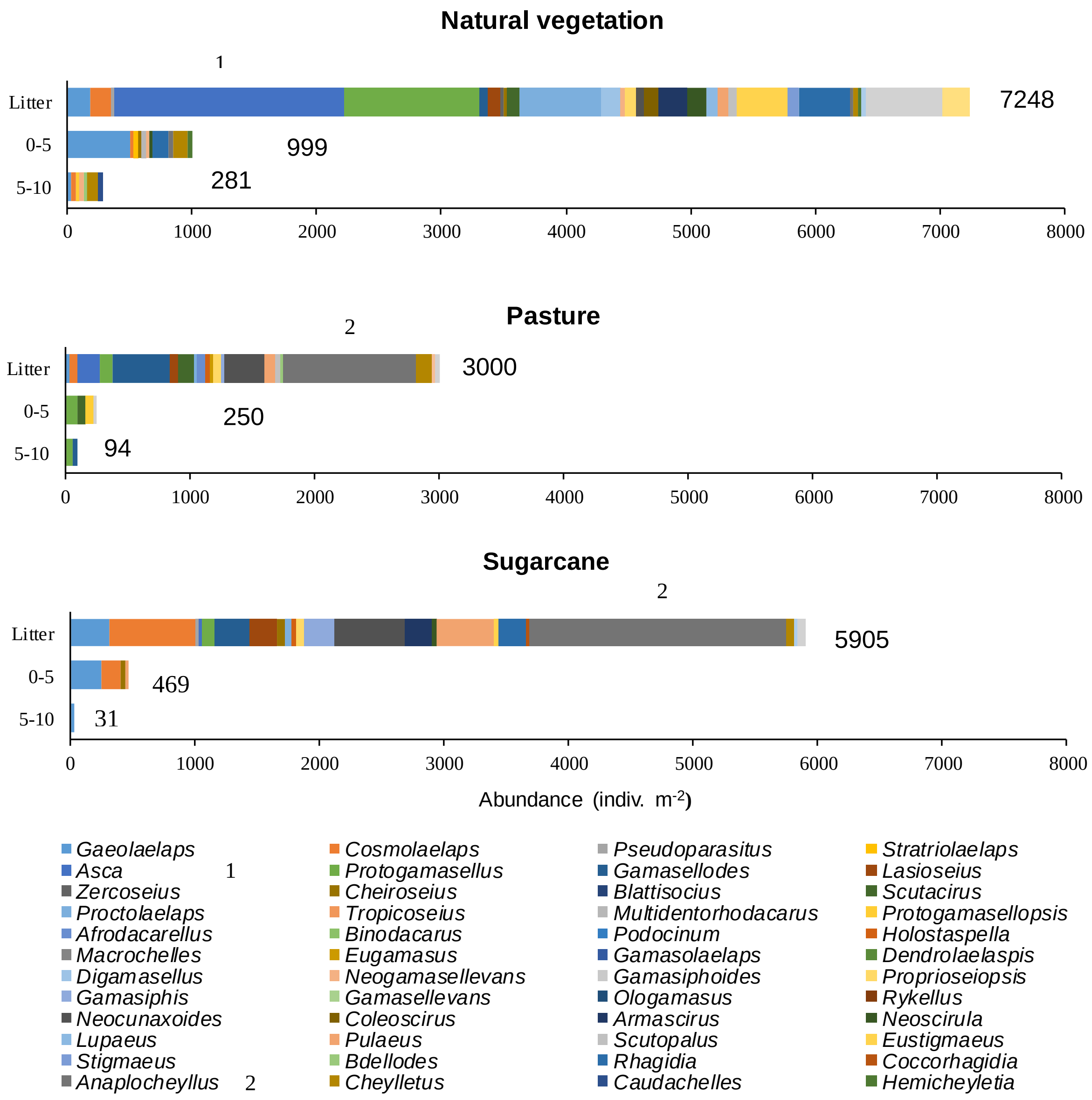



**Figure 13.** Vertical distribution and genera composition of soil mites as a function of the land use (i.e., natural vegetation, pasture and sugarcane) at Valparaíso-São Paulo site, 2014.

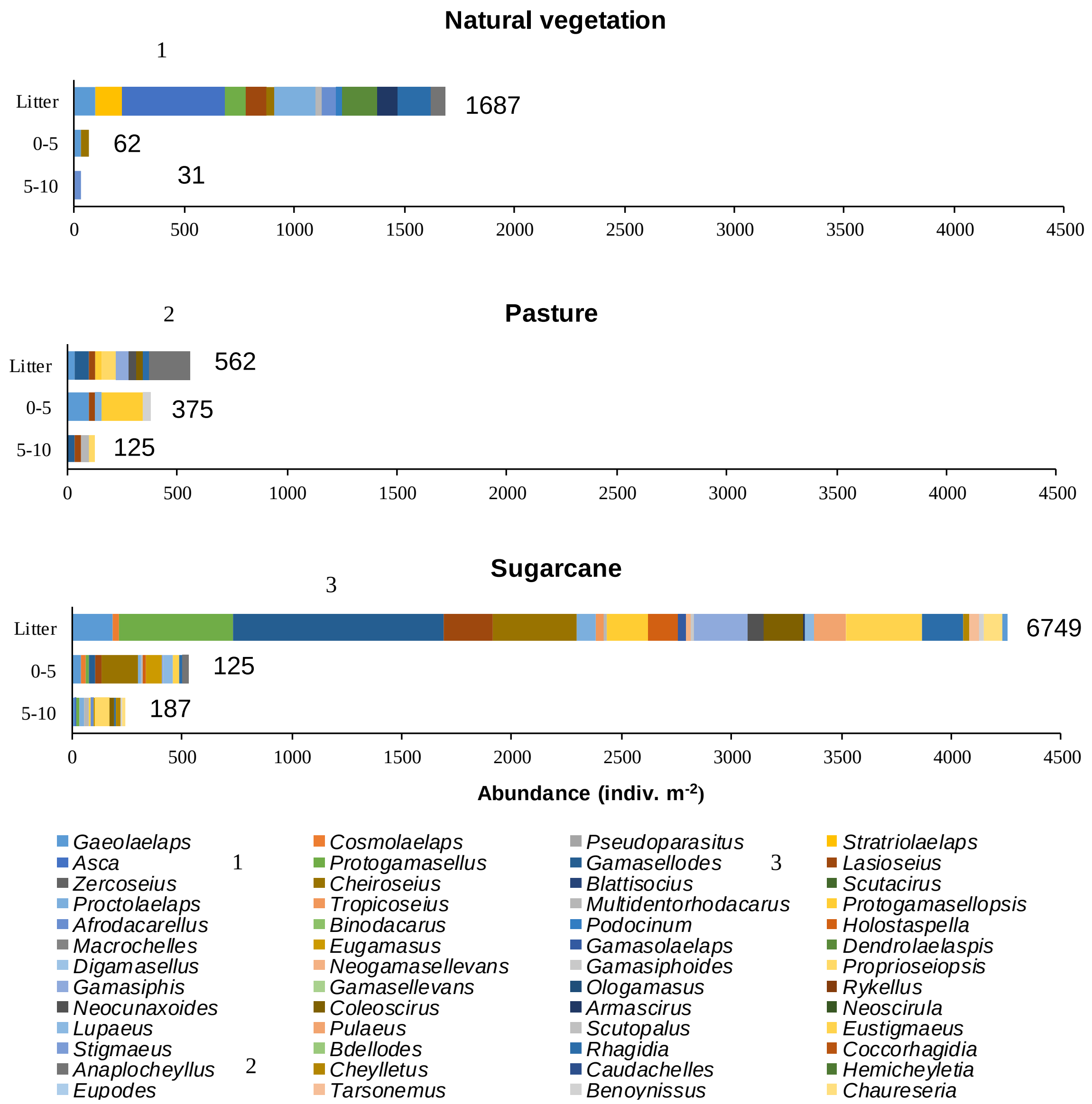



**Figure 14**. Vertical distribution and genera composition of soil mites as a function of the land use (i.e., natural vegetation, pasture and sugarcane) at Valparaíso-São Paulo site, 2015.

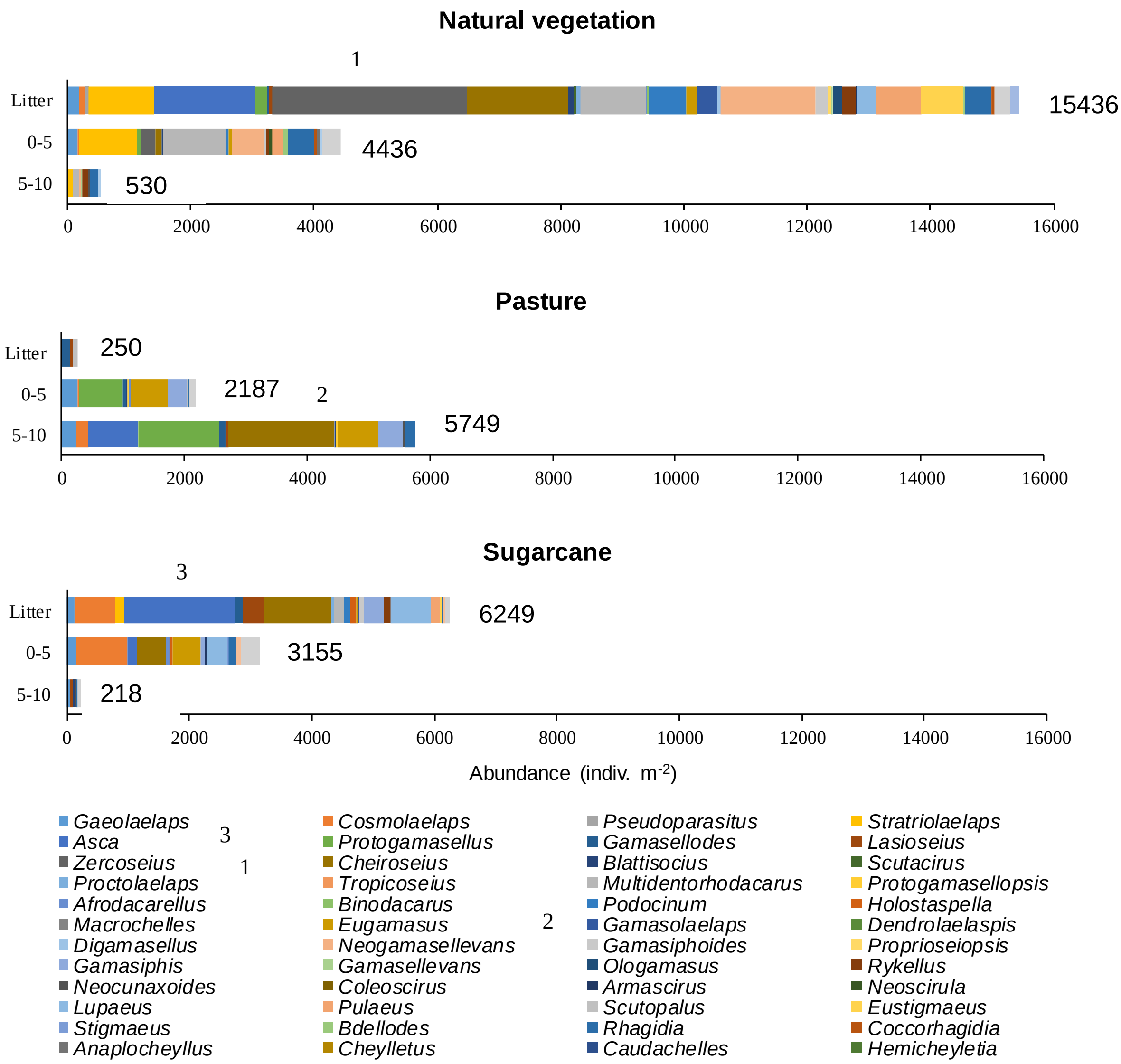



**Figure 15.** Vertical distribution and genera composition of soil mites as a function of the land use (i.e., natural vegetation, pasture and sugarcane) at Ipaussu-São Paulo site, 2014.

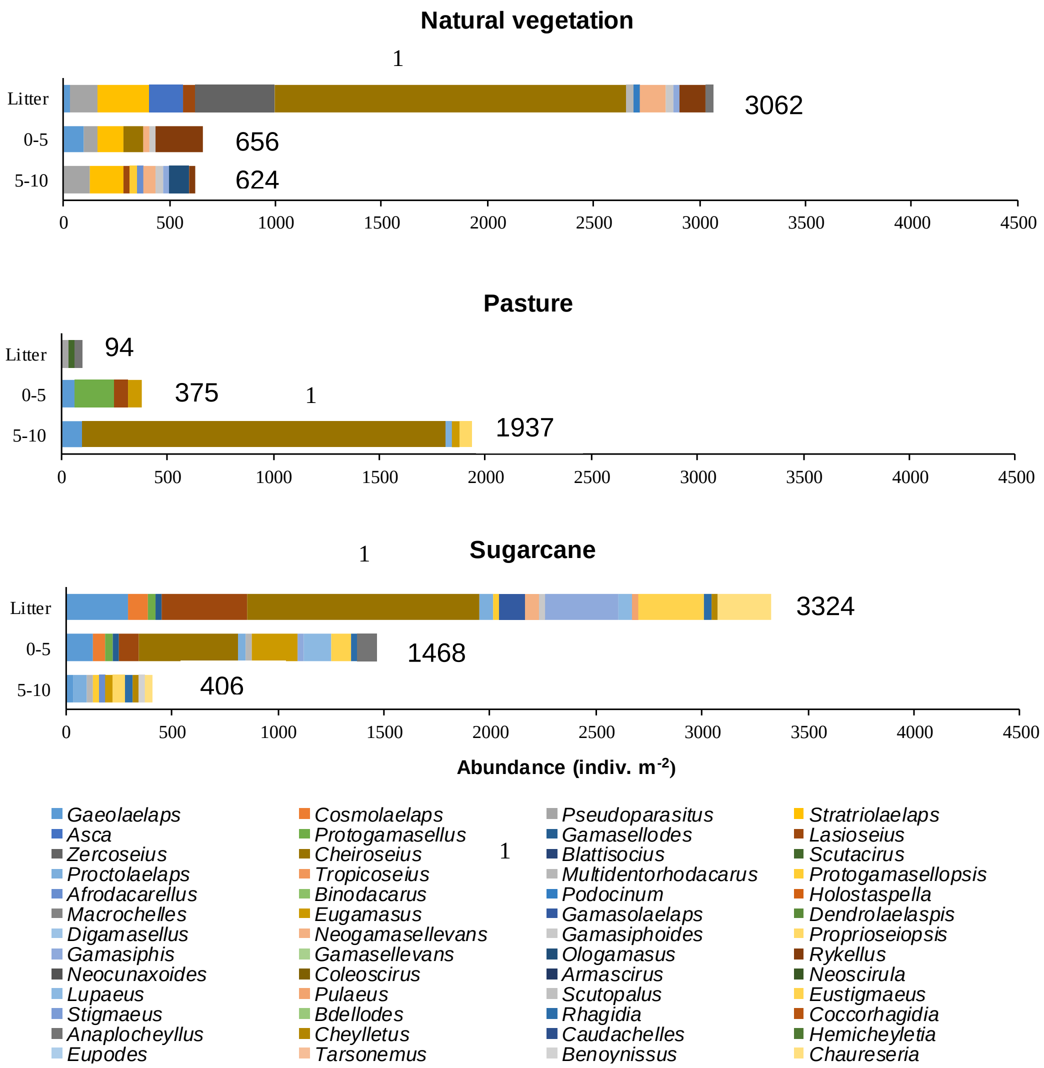



**Figure 16.** Vertical distribution and genera composition of soil mites as a function of the land use (i.e., natural vegetation, pasture and sugarcane) at Ipaussu-São Paulo site, 2015.

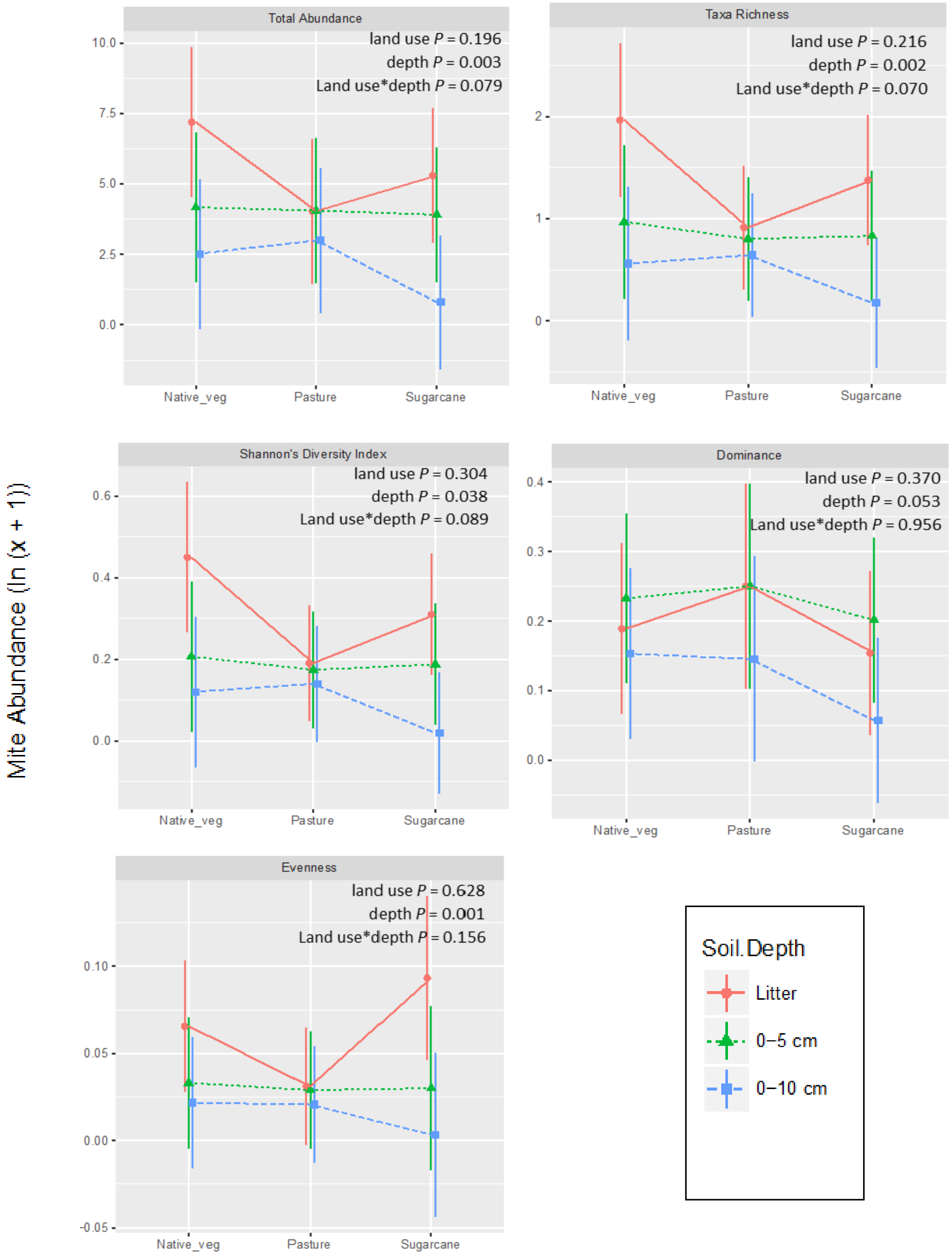



**Figure 17.** Effects of land use change and soil depth on abundance, taxa richness, shannon, dominance and evenness (2014 year).

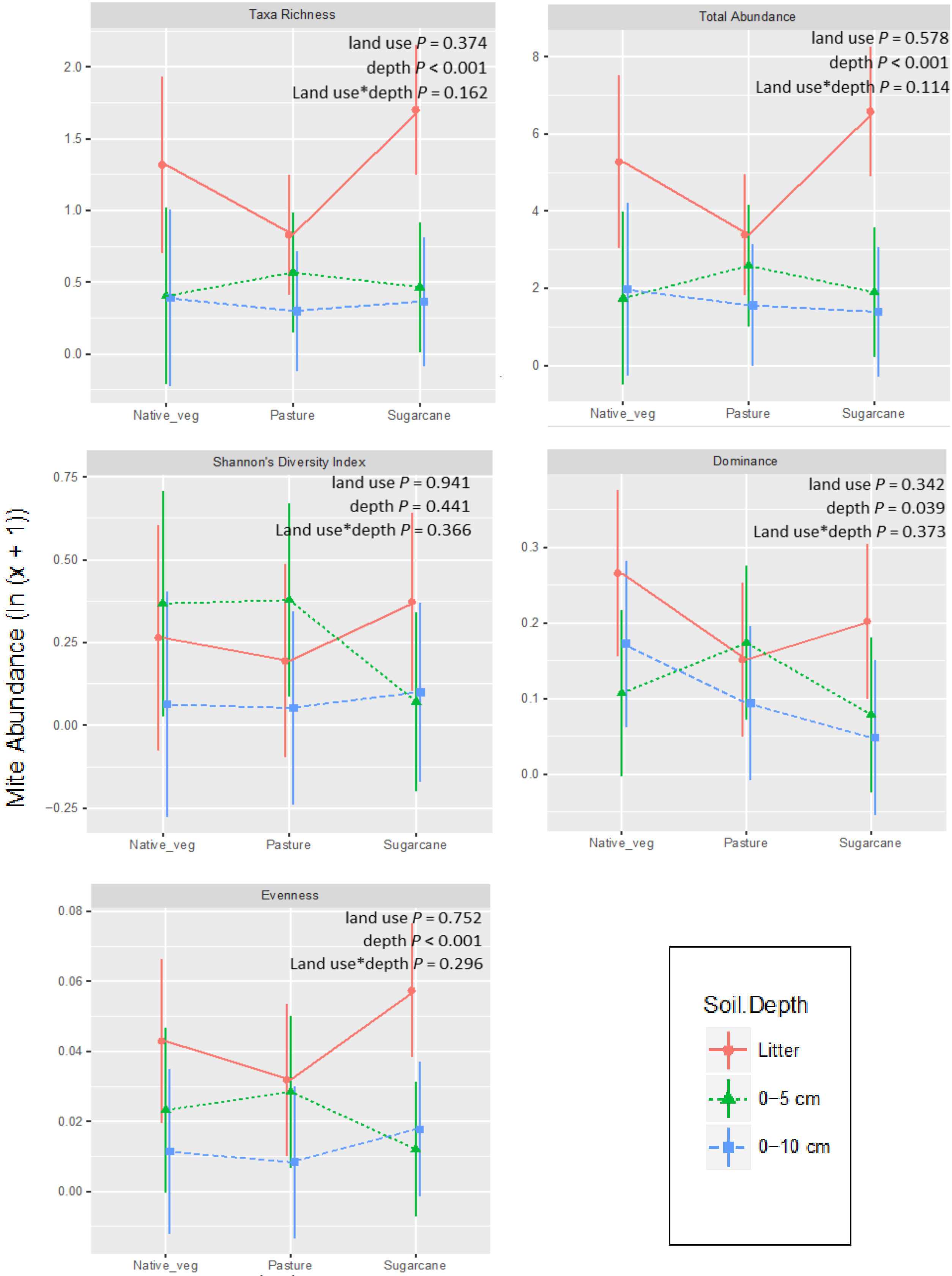



**Figure 18.** Effects of land use change and soil depth on abundance, taxa richness, shannon, dominance and evenness (2015 year).

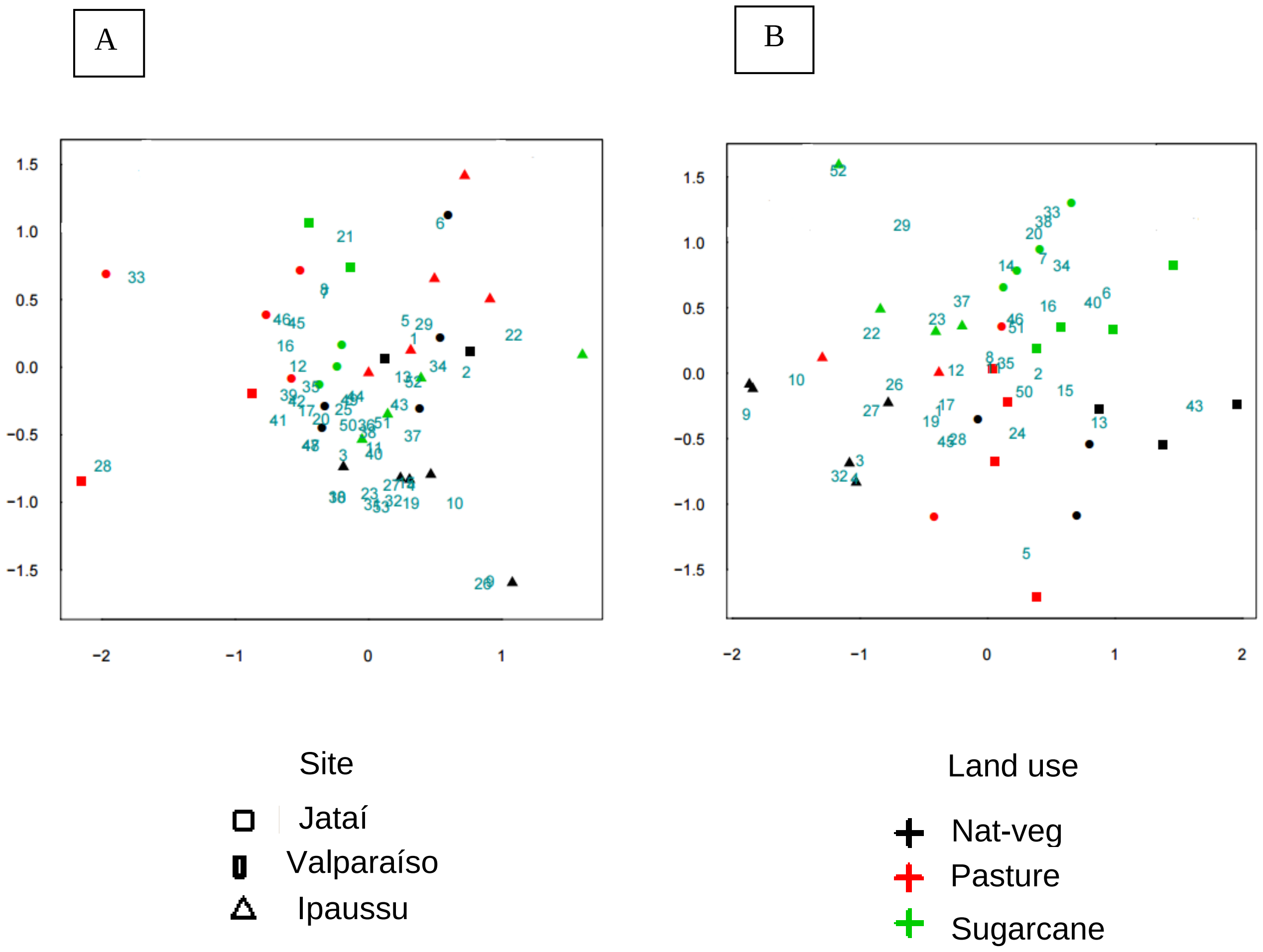



**Figure 19.** Effects the land use Community composition (at the genus level). (native vegetation – pasture – sugarcane) in central-southern Brazil, year 2014 (A) and year 2015 (B).

1. *Gaeolaelaps*, 2. *Cosmolaelaps*, 3. *Pseudoparasitus*, 4. *Stratriolaelaps*, 5. *Asca*, 6. *Protogamasellus*, 7. *Gamasellodes*, 8. *Lasioseius*, 9. *Zercoseius*, *Cheiroseius*, 10. *Blattisociius*, 11. *Scutacarus*, 12. *Proctolaelaps*, 13. *Tropicoseius*, 14. *Multidentorhodacarus*, 15. *Protogamasellopsis*, 16. *Afrodacarellus*, 17. *Binodacarus*, 18. *Podocinum*, 19. *Holostaspella*, 20. *Macrocheles*, 21. *Eugamasus*, 22. *Gamasolaelaps*, 23. *Dendrolaelaspis*, 24. *Digamasellus*, 25. Neogamasellevans, 26. Gamasiphoides, 27. *Proprioseiopsis*, 28. *Gamasiphis,* 29. *Gamasellevans*, 30. *Ologamasus,* 31. *Rykellus,* 32. *Neocunaxoides,* 33. *Coleoscirus*, 34. *Armascirus,* 35. *Neoscirula*, 36. *Lupaeus,* 37. *Pulaeus*, 38. *Scutopalus,* 39. *Eustigmaeus,* 40. *Stigmaeus,* 41. *Bdellodes,* 42. *Rhagidia,* 43. *Coccorhagidia,* 44. *Anaplocheyllus.* 45. *Cheylletus*

### 2.3.7. Dissimilarity analysis of soil mite genera according to land use.

The analysis of dissimilarity of the first sampling showed the presence of three groups (Fig. 21). The most distinct group was constituted only by the NV of Ipaussu; the second, only by the NV of Valparaíso; and the third by the remaining combinations of sites and ecosystems. Each group is characterized by their homogeneity, the first group formed by generas established in NV from Valparaiso which also may be present in NV, PA and SC of Jataí or in PA and SC of Ipaussu (second group).

The analysis of the second sampling also showed the presence of three groups (Figure 22). The most distinct group was again constituted by only one combination of sites and ecosystems, namely SC in Valparaíso; the second, by SC in Jataí; and the third by the remaining combinations of sites and ecosystems. In this opportunity we having that the third group determined in the first collection is grouped with NV, PA of Valparaiso, NV and PA of Jatai, SC of Valparaiso and SC of Ipaussu.

A listed of generas with their distribution established for two sampled was sample indicating absent and present (table 9 and 10).

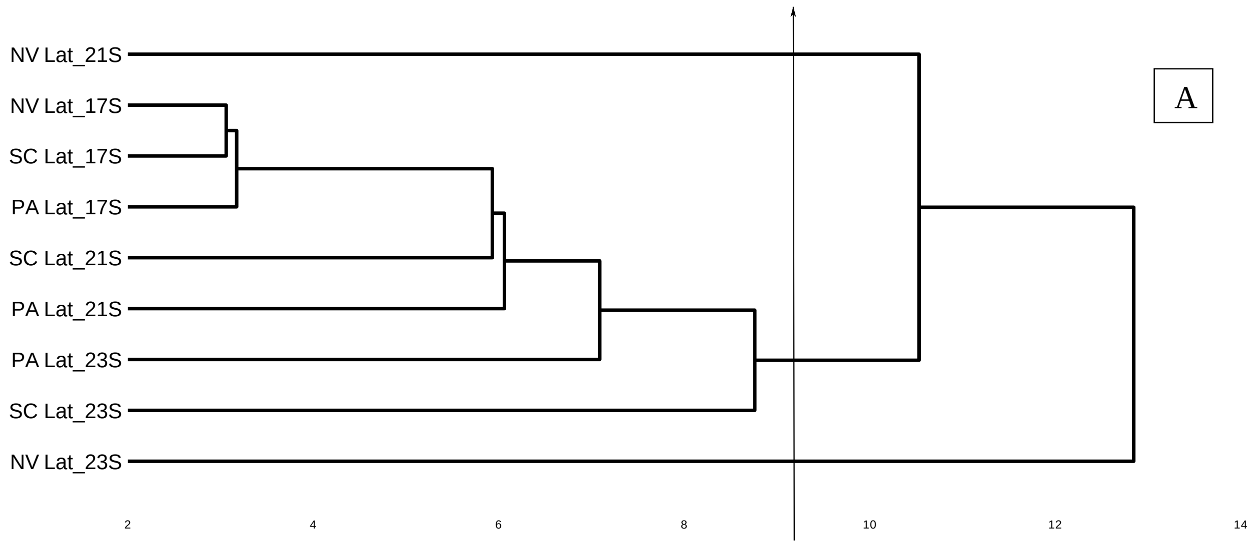



**Figure 20.** Dissimilarity of faunistic composition of soil mites according to land-use (i.e., native vegetation, pasture, sugarcane) in three sites (Lat_17S, Lat_21S and Lat_23S) in central-southern, Brazil, year 2014 (A).

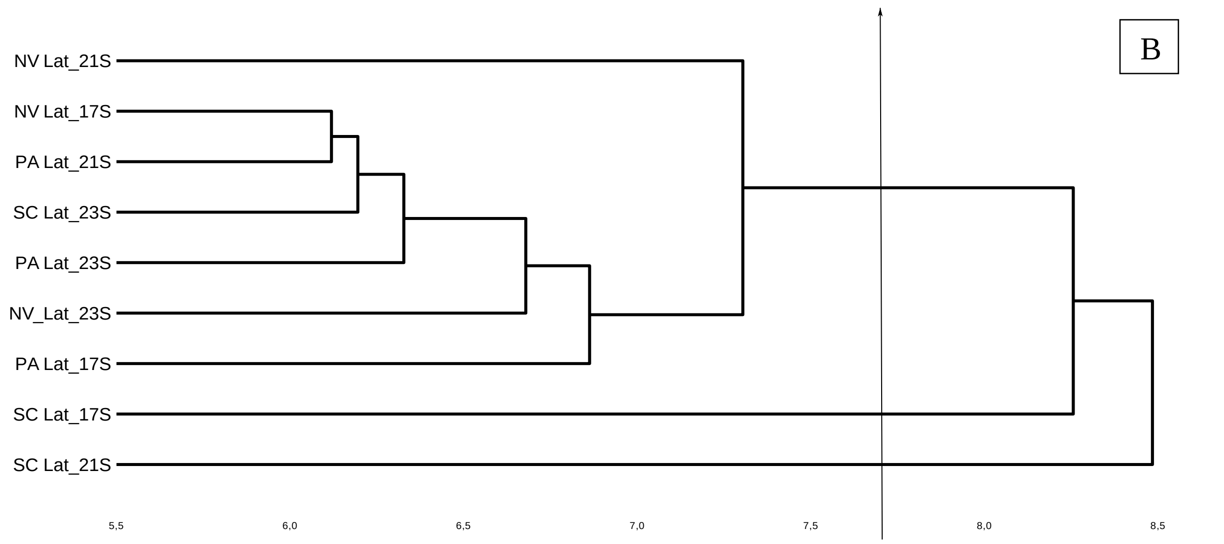



**Figure 21.** Dissimilarity of faunistic composition of soil mites according to land-use (i.e., native vegetation, pasture, sugarcane) in three sites (Lat_17S, Lat_21S and Lat_23S) in central-southern, Brazil, year 2015 (B).

## 2.4. DISCUSSION

### 2.4.1. Faunistic composition and mite densities

Despite the relatively small sampling effort in the present work, we were able to identify a total of 114 morpho-species of 52 genera, belonging to 26 families of two orders (15 Mesostigmata and 11 Trombidiformes) in the three sampling sites. Within Mesostigmata order, representatives of Pyrosejidae are reported for the first time in Brazil. However, several Trombidiformes families were also common. The only family of Sarcoptiformes-Endeostigmata found in this study, Nanorchestidae, is uncommon in the Neotropical region, but actualy had been reported two generas in São Paulo state (Mineiro et al., 2010).

The results of the present study confirmed the hypothesis that the convertion of the natural vegetation areas into pasture or agricultural land affects the diversity and abundance of edaphic mites, especially rarer groups. The dominant species seem to have greater capacity of adaptation to adverse condition, being found in both natural vegetation as well as in pasture and sugarcane. Some genera as *Asca*, *Protogamasellus*, *Proctolaelaps*, and *Rhagidia*, were showed higher ability to survive habitats alteration resulting from changed land use, quickly recolonizing new habitats.

In the first sampling, the highest density of predatory mites in the NV in Valparaisso and Ipaussu but not in Jatai is intriguing, given the similarity in floristic characteristics and meteorological conditions of the three sites, especially in relation to rainfall, a main factor for the role it plays in Al+ concentration and pH level (Xu et al., 2012).

### 2.4.2 Vertical distribution of soil mites.

An analyzis of the vertical distribution of predatory mites in Jatai showed a high abundance in the litter. These mites have been a great capacity to move through tiny spaces in the soil (Walter & Proctor, 1999). In PA was observed a low diversity of genera and populations. Genera reported in NV, were again observed in this plot, but in low population, such as *Asca*, *Lasioseius*, *Afrodacarellus*, *Proprioseiopsis*, and others no reported as *Scutopallus*, *Eustigmaeus*, *Stigmaeus* and *Bdellodes,* these mites are a good incators the effects of the land use. Other predatory genera, as *Gamasellodes*, *Armascirus* and *Anaplocheyllus* were found in the second sample (2015 year). The abundance and diversity at 0-5 and 5-10 cm from depth were also very low. But genera with great capacity to recolonize habitats with continuous anthropogenic disturbances are detected in this plot being *Gaeolaelaps*, *Eustigmaeus* and *Tarsonemus* those with a great capacity to move until 0-10 cm from depth. *Tarsonemus* is a mite genera considered omnivore and in this work four species were identified. SC is the plot with greater anthropic activity, here it was observed that after the change in land use (from NV to PA and then to SC), genera that were reported in NV and PA were also observed in SC, suchs as *Gaeolaelaps*, *Asca*, *Gamasellodes*, and *Lasioseius.* However the abundance was very low and the dominance of some genera was high. However, in the second sampling, an increase in number of genera was detected, with the appearance of some Rhodacaridae, Tydeidae and Cunaxidae, especially in the litter layer. We think that the increased biomass and plant waste on the ground increased the population of dominant species.

Predators is a great group formed by many species, which have been mentioned as important as regulartors of soil pests (Koehler, 1997). *Armascirus*, *Neoscirula* and *Coleoscirus*, included in Cunaxidae, have not been adequately studied, despite their diversity in the soil (Gomes de Castro, 2008). As mencioned above, these genera have great capacity to move through small speces in the soil, but they are usually found in the litter layer (Santos, 2013). The laelapid *Cosmolaelaps* was found in the 0-5 and 5-10 cm layers. SC culture is characterized by have a greater anthropic activity, here was observed that after of the land use change, NV to PA and after PA to SC; the genera suchs as *Gaeolaelaps*, *Cosmolaelaps*, *Gamasellodes*, *Lasioseius*, *Asca*, *Gamasellodes*, and *Lasioseius* have been present. However the abundance these generas was very low and the dominance of some genera was high.

In the second sampling, an increase in the number of genera occurred, with especially in the litter layer with a exception of PA in Ipaussu where the abundance was highest to 5-10 cm from depth. We thinking that the increase the biomass and plant waste on the ground increase the population of dominat species due better conditions for their life cycle but its no occurred in PA and the mites have been tendency to moved to highest depths.

The same groups were found in the 0-5 layer, but at low population levels. Also genera reported in NV were again observed in Ipaussu, but in low population, suchs as *Asca*, *Protogamasellus*, *Gamasellodes*, *Anaplocheyllus*. However the abundance was very low and the dominance of some genera was high. But in the second sampling, an increase in the number of genera occurred, appearing some Rhodacaridae, Tydeidae and Cunaxidae, especially in the litter layer. *Asca garmani*, *C. barbatus*, *M. trirramulus*, *P. diffisus* and *P. similis* were shown to be good bioindicators of environmental changes, because have dominance and abundance. In contrast, pasture land showed low diversity and predominance of few species, as *G invictianus*, *G. vicentei*, *M. trirramulus*, *G. magnaventris*, *P. similis*, *Zercoseius* sp. and *Eugamasus* sp. On the other hand, sugarcane plantation showed an increase in abundance and a slight increase in diversity in relation to pasture land, being reported to *C. barbatus*, *C. sp5*, *M. trirramulus*, *A. garmani*, *Zercoseius sp.*those with highest dominance and both *L*. *latinoamericanus* and *C. pugiuncullus* with a low dominance.

The highest mite densities were observed in the litter, as expected from other works. Lower densities at 0-5 cm from the soil surface and even lower in the layer 5-10 cm from the soil surface probably refers to progressively less diverse and less abundant food availability at increasing depth. Exceptions were few species as *Eugamasus* sp. (Parasitidae) and *Gamasiphis* sp. (Ologamasidae) which were observed especially at 0-5 and 5-10 cm depth.

The diversity of soil mites of the natural vegetation (NV) of Ipaussu was reduced in 67%, after that these areas were converted into pasture land. As many natural areas of Goiás and São Paulo states have been incorporated into agricultural and livestock areas in the last decades, the conservation of fragments of the natural vegetation seems important to preserve different mite groups. Finally dominant species in all sites were *M. trirramulus*, *A. garmani* and *P. diffisus*. Three genera were outstanding for their abundance at greater depths *Gaeolaelaps*, *Asca* and *Rhagidia.*

Acording to np-MANOVA program the effects the land use change on abundance, taxa richness, Shannon, dominance and evenness are not significan ($p<0.05$). Community composition (at the genus level) was affected by both land use and site. The interaction shows that effects of land use change on community composition varies among sites. Land use change did not change the trophic structure of mite community, although being this classification only two trophics groups.

## 2.5. CONCLUSIONS

The soil of natural vegetation fragments is the habitat of a large predatory mite community, including species of Mesostigmata and Trombidiformes. The first comprise a large number of genera, as *Gaeolaelaps*, *Cosmolaelaps, Asca*, *Protogamasellus*, *Lasioseius*, which were the most abundant soil mites observed in three ecosystems (natural vegetation, pasture and sugarcane) of each of the three places where this study was conducted (Jataí, Ipaussu and Valparaíso). The second comprise a smaller number of genera, as *Anaplocheyllus*, *Rhagidia*, *Lupaeus* and others.

The land use change shown a great diference with relation to a faunistic composition abundance between each plots and site but no betwwen sites according the results obtained from idex values, especially Margalef which were high in Ipaussu in NV and litter layer, however the index values were lowest to 0-5 and 5-10 cm layers, except in PA at Ipaussu where the abundance was highest in the 5-10 cm layer.

Two functional groups are recognized in each ecosystem of each site, including a larger proportion of Mesostigmata (mainly predators, except *Tropicoseius*, which is nectivorous) and a minor proportion of Trombidiformes, except *Tarsonemus*, *Eupodes* and *Benoynissus*, which are omnivores.

Some predators had great capacity to explore deep layers of soil until 5-10 cm from depth as *Gaelaelaps*, *Cosmolaelaps*, *Protogamasellus*, *Lasioseius*

(Mesostigmata), likewise as *Rhagidia*, *Anaplocheyllus* and *Benoynissus* (Trombidiformes). Others only were observed exploring litter layers of soil in a single plot as *Stratiolaelaps* which very dominat in Ipaussu. Various species of predatory mites, namely *Multidentorhodacarus triramulus*, *Neogamasellevans* sp.and *Asca garmani*, were characyerized by having a great dominance and adaptation capacity to change in land use. These quickly recolonized the new habitats.

**Table 9.** Mites species collected in three ecological situations of three locaties in central sourthern Brazil.

| | 2014 | | | | | | | | | 2015 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lat_17 | | | Lat_21 | | | Lat_23 | | | Lat_17 | | | Lat_21 | | | Lat_23 | | |
| | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC |
| **Laelapidae** | | | | | | | | | | | | | | | | | | |
| *Gaeolaelaps queenslandicus* Womerley | | | | | | | X | | X | | | | | | X | X | X | X |
| *Gaeolaelaps invictianus* Walter & Moser | | | | | X | X | X | X | | | X | | | X | | | | |
| *Gaeolaelaps* n. sp. 1 | | X | | | | | X | | X | | | | | | | | X | X |
| *Gaeolaelaps verticis* Karg | | | | X | | | X | | | | | | | | | | X | |
| *Gaeolaelaps isodentis* Karg | | | | X | | | | | | | | | X | | | | | |
| *Gaeolaelaps bandeirantes* n. sp. 2 | | | | | | | | | X | | X | | | | | X | | |
| *Gaeolaelaps vicentei* n. sp. 3 | X | | X | | | | | | | | X | | | | | | | |
| *Gaeolaelaps brevipellis* Karg | X | | | | | | | | | | | | | | | | | |
| *Gaeolaelaps rioparana* n. sp. 4 | | X | | | | | | | | | | | | | | | | |
| *Gaeolaelaps ipaussuensis* n. sp. 5 | | | | | | | | X | | | | | | | | | | |
| *Gaeolaelaps goianus* n. sp. 6 | | | | X | | | X | | | | | | | | | | | |
| *Gaeolaelaps aguape* n. sp. 7 | | | | | | X | | | | | | | | | | | | |
| *Gaeolaelaps círcularis* Karg | | | | X | | | | | | | | | | | | | | |
| *Gaeolaelaps paulista* n. sp. 8 | | | | X | | | | | X | | | | | | | X | | |
| *Gaeolaelaps parablattae* n. sp. 9 | X | | | | | | | | | | | | | | | | | |
| *Gaeolaelaps parasimilisetae* n. sp. 10 | | | | | | X | | | | | | | | | | | | |
| *Gaeolaelaps brasiliensis* n. sp. 11 | | | | | | | X | | | | | | | | | | | |
| *Gaeolaelaps flechtmanni* n. sp. 12 | | | | | | | X | | | | | | | | X | | | |
| *Gaeolaelaps bauruensis* n. sp. 13 | | | | | | | | | | | | | | | | | | |
| *Cosmolaelaps barbatus* Moreira, Klompen & Moraes | X | | | | X | X | X | X | X | | | | | X | | | | X |
| *Cosmolaelaps cofinesetarum* Moreira, Klompen & Moraes | X | | | | | | X | | | | | | | | | | | |
| *Cosmolaelaps* sp.1 | | | | X | | | | | | | | | | | | | | |
| *Cosmolaelaps* sp.2 | | | | | | | X | | | | | | | | | | | |
| *Cosmolaelaps* sp.3 | X | | X | | | | | X | X | | | | | | | | | |
| *Cosmolaelaps* sp.4 | | | | | | | | X | | | | | | | | | | |
| *Cosmolaelaps* sp.5 | | | | | | X | | | X | | | | | | | | | |
| *Cosmolaelaps* sp.6 | X | | | | | X | | | | | | | | | | | | |
| *Pseudoparasitus* sp.1 | | | | | X | | | X | | | | | | | | | | |
| *Pseudoparasitus* sp.2 | | | | | | | X | | | | | | | | | | | |
| *Pseudoparasitus* sp.3 | | | | X | | X | X | | | | | | | | | | | |
| *Pseudoparasitus* sp.4 | | | | | | | | | | | | | | | | | | |
| *Stratriolaelaps ornatissima* Aswegen & Loots | | | | X | | | X | | X | | | | X | | | X | | |
| **Rhodacaridae** | | | | | | | | | | | | | | | | | | |
| *Multidentorhodacarus triramulus* Hurlbutt | X | | X | X | X | X | X | X | X | X | | X | X | X | X | | | X |
| *Binodacarus aceguensis* Castilho & Moraes | | | | | X | | X | | | | | | | | | | | |
| *Protogamasellopsis zaheri* Abo-Shnaf, Castilho & Moraes | X | X | X | X | X | X | X | X | X | | | X | | X | X | X | | X |
| *Afrodacarellus citri* Loots | | | | | | | | | X | | | | | | | | | |
| *Afrodacarellus aff. Minutus* Hurlbutt | | | | | | | | | X | | | | X | X | | | | X |
| **Ascidae** | | | | | | | | | | | | | | | | | | |
| *Asca garmani* Hurlbutt | X | | X | X | X | X | X | X | X | | X | | X | | | X | | |
| *Asca* sp. 1 | X | | | X | X | | | | | | X | | X | | | X | | |
| *Asca* sp. 2 | | | | X | X | | | | | | | | | | | | | |
| *Asca* sp. 3 | | X | X | | | | | | | | X | | | | | | | |
| *Gamasellodes magnaventris* Mineiro, Lindquist & Moraes | | | | X | X | X | | X | | | X | X | | | X | | | X |
| *Gamasellodes* sp. 1 | | | | | | X | | | | | | | | | | | | |
| *Gamasellodes* sp. 2 | | | | | X | | | | | | | | | | | | | |
| *Protogamasellus similis* Genis, Loots & Ryke | | | | X | X | X | | | | | X | X | X | | X | | X | X |
| *Protogamasellus sigilophorus* Mineiro, Lindquist & Moraes | | | | X | | | X | X | | | | | | | | | X | X |
| *Protogamasellus* sp. | | | | X | | | | | | | | | | | | | | |
| **Blattisociidae** | | | | X | X | X | | | | | | | | | | | | |
| *Cheiroseius pugiunculus* Karg | | | | X | X | X | X | X | X | | X | X | X | | | X | X | X |
| *Cheiroseius neophalangiodes* Mineiro, Lindquist & Moraes | | | | | | | X | X | | | | | | | | X | | |
| *Lasioseius* aff. *barbiensis* Faraji & Karg | | | | | | X | | | | | | | | | | | | |
| *Lasioseius latinoamericanus* Mineiro, Lindquist & Moraes | | | X | | | | | | X | X | | X | X | | X | | X | X |
| *Lasioseius quinisetosus* Lindquist & Karg | | | | X | | | | | | | | | | | | | | |
| *Zercoseius* sp. 1 | | | | X | | X | X | | X | | | | | | | | | |
| *Blatissocius keegani* Fox | | | | | | | X | | | | | | | | | | | |
| **Mellicharidae** | | | | | | | | | | | | | | | | | | |
| *Proctolaelaps diffissus* Karg | X | | | X | X | X | | | X | | X | X | X | X | | | | X |
| *Proctolaelaps paulista* Mineiro, Lindquist & Moraes | | | | | | | | | | | | X | | | | | | |
| *Proctolaelaps* sp. 1 | | | | X | | | | | | | | | | | | | | |
| *Proctolaelaps* sp. 2 | X | | | | | | | | | | | | | | | | | |
| *Tropicoseius* sp. | | | | | | | | | | | | | | | | | | |

Abbreviations; NV: Natural vegetation, PA: Pasture, SC: Sugarcane

**Table 10. (Continue....).** Mites species collected in three ecological situations of three locaties in central-southern of Brazil.

| | 2014 | | | | | | | | | 2015 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lat_17 | | | Lat_21 | | | Lat_23 | | | Lat_17 | | | Lat_21 | | | Lat_23 | | |
| | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC |
| **Macrochellidae** | | | | | | | | | | | | | | | | | | |
| *Holostaspella* sp. | | | | | X | X | | | X | | | | | | X | | | |
| **Cryptopnatidae** | | | | | | | | | | | | | | | | | | |
| *Cryptognatus* sp. | | | | | | | X | | X | | X | | | X | | | | |
| **Veiigaidae** | | | | | | | | | | | | | | | | | | |
| *Gamasolaelaps* sp. | | | | | | | X | | | | | | | | | | | X |
| **Parasitidae** | | | | | | | | | | | | | | | | | | |
| *Eugamasus* sp. | | | | | X | | X | X | X | | X | | | | | | X | X |
| **Podocinidae** | | | | | | | | | | | | | | | | | | |
| *Podocinum sagax* Berlese | | | | | | | X | | | | | | X | | | X | | |
| *Podocinum pacificum* Berlese | | | | | | | | | | | | | | | | | | |
| *Podocinella* sp. | | | | | | | X | | X | | | | | | | | | |
| **Phytoseiidae** | | | | | | | X | | | | | | | | | | | |
| *Proprioseiopsis* sp. | | | | | | | X | | | | X | X | | X | X | | | X |
| **Digamasellidae** | | | | | | | | | | | | | | | | | | |
| *Digamasellus* sp. | | | | X | X | X | X | | | | | | | | | | | |
| *Dendrolaeplaspis* sp. | | | | X | | | | | | | | | X | | | | | |
| **Pyrosejidae** | | | | | | | | | | | | | | | | | | |
| *Pyrosejus* sp. | | | | | | | X | | | | | | | | | | | |
| **Ologamasidae** | | | | | | | | | | | | | | | | | | |
| *Neogamasellevans* sp. | | | | X | | | X | | | | | | | | | X | | |
| *Gamasiphoides* sp. | | | | | | | X | | X | | | | | | | X | | X |
| *Gamasiphis* sp. | | | | | X | X | | | | | | | | | | | | |
| *Gamasellevans* sp. | | | | | | | X | | | | | | | | | | | |
| *Rykellus* sp. | | | | | | | X | | X | | | | | | | X | | |
| *Ologamasus* sp. | | | | | | | | | X | | | | | | | | | |
| **Uropodina** | | | | | | | | | | | | | | | | | | |
| *Dynichus* sp. | | | | | | | X | | | | | | | | | | | |
| *Deraiophorus* sp. | | | | | | | X | | | | | | | | | | | |
| *Oplitis* sp. | | | | | | | X | | | | | | | | | | | |
| *Trichouropodella* sp. | | | | | | | X | | | | | | | | | | | |
| **Cunaxidae** | | | | | | | | | | | | | | | | | | |
| *Neocunaxoides* aff. *rykei* Den Heyer | | | | | X | X | | | | | | | | | | | | |
| *Neocunaxoides rykei* Den Heyer | | | | | X | X | | | | | | | | X | X | | | |
| *Lupaeus clarae* Den Heyer | | | | | | | | | X | | X | | | | X | | | X |
| *Lupaeus* aff. *Martini* Den Heyer | X | | | | | | | | X | | | | | | | | | |
| *Pulaeus* sp. n. a | | | | X | X | X | | | X | | | | | | X | | | X |
| *Pulaeus* sp. n. b | | | | | | | | | X | | | | | | | | | |
| *Pulaeus* sp. n. c | | | | | | X | X | | | | | | | | | | | |
| *Neoscirula* sp. n.a | | | | X | | | | | | | | | | | | | | |
| *Coleoscirus breslauensis* Den Heyer | X | | | X | | X | | | | | | | | | X | | | |
| *Coleoscirus simplex* Ewing | | X | | | X | | | | | | X | X | | X | X | | | |
| *Coleoscirus tuberculatus* Den Heyer | | | | | | X | | | | | | | | | | | | |
| *Armascirus* aff. *brasiliensis* Den Heyer & Castro | | X | | | | X | | | | | X | | X | | X | | | |
| *Scutopalus* sp n.1 | | | | | | | | | | | | | | | | | | |
| *Scutopalus* sp n.2 | | X | | X | | | X | X | | | | | | | | | | |
| *Pseudobonzia* sp | | | | | | | | | | | | X | | | | | X | |
| **Stigmaeidae** | | | | | | | | | | | | | | | | | | |
| *Eustigmaeus oliverai sp. n.* Paktinat-Saeij & Bagheri | | | | X | | | X | | X | | X | X | | | X | | | X |
| *Stigmaeus brasiliensis* sp. n. Paktinat, Moraes & Munoz | | X | | X | | | | | X | | | | | | | | | |
| **Bdellidae** | | | | | | | | | | | | | | | | | | |
| Bdellodes sp. | X | X | | X | | | X | | | | X | | | | X | | | |
| **Rhagididae** | | | | | | | | | | | | | | | | | | |
| *Rhagidia* sp. | X | | | X | X | X | X | X | X | X | X | | X | X | X | | | X |
| *Coccorhagidia* sp. | | X | X | | | | X | | | | | | | | | | | |
| **Pseudocheyllidae** | | | | | | | | | | | | | | | | | | |
| *Anaplocheyllus* sp. | X | | | X | | | X | | | | X | | X | X | | X | X | X |
| **Cheylletidae** | | | | | | | | | | | | | | | | | | |
| *Cheylletus* sp. | X | | | X | | | X | | | | | X | | | X | | | X |
| *Caudachelles* sp. | | | | X | | | | | | | | | | | | | | |
| *Hemicheylletia* sp. | | | | X | | | | | | | | | | | | | | |

Abbreviations; NV: Natural vegetation, PA: Pasture, SC: Sugarcane

**Table 11. (Continue....).** Mites species collected in three ecological situations of three locaties in central-southern of Brazil.

| | 2014 | | | | | | | | | 2015 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lat_17 | | | Lat_21 | | | Lat_23 | | | Lat_17 | | | Lat_21 | | | Lat_23 | | |
| | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC | NV | PA | SC |
| **Eupodidae** | | | | | | | | | | | | | | | | | | |
| *Eupodes* sp. | | | | | | | X | | | | | | | | | | | |
| *Benoynissus* sp. | X | | | X | | X | X | | X | | X | X | | X | X | X | X | X |
| **Tarsonemidae** | | | | | | | | | | | | | | | | | | |
| *Tarsonemus* sp. 1 | X | | | | | | X | | | | X | X | | | | | | |
| *Tarsonemus* sp. 2 | | | | | | | | | | | | | | | | | | |
| *Tarsonemus* sp. 3 | | | | | | | | | | | | | | | | | | |
| *Tarsonemus* sp. 4 | | | | | | | | | | | | | | | | | | |
| **Anystidae** | | | X | | | | | | | | | | | | | | | |
| *Chaureseria* sp. | X | X | | | | | X | | | | | | | | | | | X |
| **Tydeiidae** | | | | | | | | | | | | | | | | | | |
| *Llorryia* sp. | | | | | X | | | | | | X | | | | | | | |
| *Tydeus* sp. | | | | | | | | | | | X | X | | X | X | | X | |
| **Erythraeidae** | | | | | | | | | | | | | | | | | | |
| *Leptus* sp. | | | | X | | | | | | | | | | | | | | |

Abbreviations; NV: Natural vegetation, P: Pasture, SC: Sugarcane

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## CHAPTER 3 – *Gaeolaelaps* (Mesostigmata: Laelapidae) species from centro-southern Brazil

### Abstract

*Gaeolaelaps* Evans & Till is a laelapid genus composed of free living mites of the order Mesostigmata, some of which have been produced commercially for use as biological control agents of pest organisms. They are edaphic and have been reported from many different countries, but they are poorly known in Brazil. The objective of this paper is to report the results of a taxonomic study of *Gaeolaelaps* species extracted from litter and soil samples collected from areas of natural vegetation, grassland (*Brachiaria brizantha* and *Cynodon dactylum*) and sugarcane (*Saccharum officinarum*), in areas of the states of Goiás (municipality of Jataí) and São Paulo (mainly municipalities of Ipaussu and Valparaíso). Nineteen species were found, 14 of which are new to science, namely *G. azul* n.sp., *G. bandeirantes* n.sp., *G. bauruensis* n.sp., *G. brachyperitremata* n.sp., *G. brasiliensis* n.sp., *G. flechtmanni* n.sp., *G. goianus* n.sp., *G. ipaussuensis* n.sp., *G. longisetosus* n.sp., *G. parablattae* n.sp., *G. paraclarensis* n.sp., *G. paulista* n.sp., *G. rioparana* n.sp. and *G. vicentei* n.sp.. *Gaeolaelaps invictianus* Walter & Moser, 2010 was the most numerous and *G. queenslandicus* (Womersley, 1956) the most frequent species collected.

**Key words**: predatory, bioindicator, biological control predatory mite.

### 3.1. Introduction

Laelapidae is a very diverse mite family of the order Mesostigmata composed of species with widely variable feeding habits, ranging from hematophagous to free living (Moreira & Moraes, 2015). *Gaeolaelaps* Evans & Till is one of the free living laelapid species found in edaphic habitats, where they have been reported to feed on small arthropods (Moreira & Moraes, 2015). Some laelapid species have been commercially produced for use as biological control agents, including *Gaeolaelaps aculeifer* (Canestrini), which has been recommended for the control of insect larvae (Prischmann-Voldseth & Dashiell, 2013). Mites of this genus have been mentioned to be important pest control agents (Krebs, 1978; Koehler, 1991; Saito & Brownbridge, 2016). They have also been considered appropriate bioindicators of soil quality (Koehler, 1999; Ruf & Beck, 2005; Coja & Bruckner, 2006; Beaulieu & Weeks, 2007).

*Gaeolaelaps* was initially proposed as a subgenus of *Hypoaspis* Canestrini, being first mentioned at the genus level by Rosario (1981). It has been considered to belong to Hypoaspidinae (Casanueva, 1993), a group mentioned as one of the most primitive mesostigmatids, for having no specialized structures (Evans & Till, 1966). Beaulieu (2009) reviewed *Gaeolaelaps*, providing a diagnosis of the genus. About 100 described species seem to belong to this genus (Kazemi et al., 1999).

An effort has recently been initiated to determine the laelapid species from Brazil, envisioning the discovery of new candidates for practical use as biological control agents. Little is known about the free living laelapids from Brazil. Only 42 species of this family have so far been reported from this country (G.F. Moreira, unpublished information, 2014). Among these, the only *Gaeolaelaps* species reported were *G. queenslandicus* (Womersleyer) and a species identified as *G*. aff. *brevipellis* (Karg) (Freire & Moraes, 2007). The objective of this paper was report the results of a taxonomic study of *Gaeolaelaps* species extracted from litter and soil samples collected from centro-southern Brazil.

## 3.2. Materials and methods

Most litter and soil samples were collected from the following localities and respective types of habitats: Valparaiso, São Paulo state: 21°14 13'' S, 50°46'38'' W (patch of disturbed Atlantic Forest biome, constituted by seasonal semidecidous and xeromorphic plants); 21°14'11'' S, 50°47'06'' W (sugarcane, *Saccharum officinarum* Linnaeus, plantation, cultivar SP 791011); 21°14'17'' S, 50°47'27'' W (grassland with dominance of *Brachiaria* sp.); Ipaussu, São Paulo state: 23°5'43'' S, 49°37'27'' W (patch of disturbed Atlantic Forest biome), 23°5'13'' S, 49°36'53'' W (sugarcane plantation, cultivar CTC6); 23°4'45'' S, 49°38'11'' W (grassland, with a dominance of *Cynodon* sp.); Jataí, Goiás state: 17°54'59'' S, 51°35'47'' W (patch of disturbed Cerrado biome, constituted by sclerophyllous and xeromorphic plants); 17°54'26'' S, 51°35'56'' W (sugarcane plantation, cultivar RB 855453); 17°54'20'' S, 51°35'46' W (grassland, with dominance of *Brachiara decumbens* Stapf, *B. brizantha* (Hochst) Stapf, *B. ruziziensis* (Germain & Evrard) ). The only exception referred to a soil sample collected at the municipality of Bauru, São Paulo state, about 100 km northwest of Ipaussu municipality, São Paulo state.

Twelve samples of each substrate (litter; soil at two depths: 0–5 and 5–10 cm from the surface) were taken from each sampling site and respective vegetation type between December 2013 to January 2014 and December 2014 to January 2015. Each sample was collected with a cylinder (8 cm diameter x 5 cm height). After collected, each sample was sealed and stored in a cool box for transport to the laboratory, where the mites were extracted using modified Berlese-Tullgren funnels (Oliveira et al, 2001). All samples were collected by the first author of this publication. Extracted mites were mounted on slides in Hoyer´s medium for examination under phase and interference contrast microscopes (respectively Leica, DMLB and Nikon, Eclipse 80i). Complementary descriptions of previously described species are based on specimens collected in this study.

Illustrations were done with the help of a drawing tube connected to the phase contrast microscope. Pencil illustrations were then processed with a digital tablet, using the Adobe Illustrator® program. Measurements were taken with a graded ocular attached to the phase contrast microscope. In the text, for each character, the average measurement followed (in parentheses) by the minimum and the maximum measurements are given in micrometers. Length of corniculus corresponded to the distance from the tip to the median region of the basal line; width of the same structure refers to the maximal width. For both fixed and movable digits, indicated number of teeth does not include the apical tooth. Setal nomenclature is that of Evans (1963), Evans & Till (1966) and Lindquist (1994) respectively for legs, dorsal idiosoma and opisthogastric region. All types and representatives of the described species were deposited at the mite reference collection of Departamento de Entomologia e Acarologia, Escola Superior de Agricultura “Luiz de Queiroz”, Piracicaba, São Paulo state, Brazil.

## 3.3. RESULTS

***Gaeolaelaps* Evans & Till**

*Geolaelaps* Berlese, 1923: 254, *nomen nudum* (as detailed by Halliday & Lindquist 2007: 65).
*Gaeolaelaps* Trägårdh, 1952: 66, *nomen nudum*.
*Gaeolaelaps* Evans & Till, 1966: 159, correction of original spelling given by Halliday & Lindquist (2007); Beaulieu, 2009: 35.
*Hypoaspis* (*Geolaelaps*).— Bregetova, 1977: 499; Karg, 1979: 79, 1982: 237, 1993: 136.
*Gaeolaelaps*.— Walter & Oliver, 1990: 295; Casanueva, 1993: 40; Beaulieu, 2009: 35.
*Geolaelaps*.— Rosario, 1981: 46; Hunter, 1993: 23; Karg & Schorlemmer, 2013: 203.
Type species: *Laelaps aculeifer* Canestrini, 1884: 698, by original designation.

**Remark:** a detailed characterization of this genus was given by Beaulieu (2009: 35).

***Gaeolaelaps* n.sp. 1**

**Adult female (Figures 1-10)** (four specimens measured)

**Dorsal idiosomal (Fig. 1).** Dorsal shield reticulate, posteriorly constricted, but lobed between *S3* and *S4*, 419 (400-435) long and 156 (143-170) wide; with 36 pairs of setae: *j1–j6*; *z1*, *z2, z4–z6*; *s1–s6*; *r2–r5*; *J1–J5*; *Z1–Z5*; *S1–S5*; setae smooth and pointed; with eight pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*R1*). Setal length: *j1* 26 (22-30), *j2* 31 (30-35), *j3* 33 (30-36), *j4* 32 (31-33), *j5* 26 (24-28), *j6* 28 (26-30); *z1* 19 (17-21), *z2* 31 (30-33), *z4* 32 (31-32), *z5* 35 (34-35), *z6* 28 (25-30); *s1* 24 (22-28), *s2* 25 (22-28); *s3* 32 (30-35), *s4* 32 (30-35), *s5* 28 (27-30), *s6* 30 (29-30); *r2* 28 (23-30), *r3* 32 (30-35), *r4* 27 (25-30), *r5* 26 (25-27), *R1* 24 (22-25); *J1* 25 (22-27), *J2* 26 (25-27), *J3* 27 (25-28), *J4* 26 (25-27), *J5* 25; *Z1* 29 (26-31), *Z2* 29 (27-30), *Z3* 31 (30-32), *Z4* 32 (30-35), *Z5* 37 (35-37); *S1* 27 (25-28), *S2* 26 (25-28), *S3* 28 (25-30), *S4* 29 (27-30), *S5* 32 (30-34).

**Ventral idiosoma (Figs. 2, 3).** Base of tritosternum 33 (30-36) long and 13 (12-14) wide basally; laciniae 91 (85-100), separated by about 93% of their total length. With a pair punctate and reticulate presternal platelets. Sternal shield with lateral reticulation; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*);

posterior margin centrally truncate to slightly concave; distance between *st1* and posterior margin of sternal shield 119 (117-120), *st1*–*st1* 73 (66-76), *st2*–*st2* 87 (85-91), *st3*–*st3* 88 (75-95). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; posterior region represented by an undulate platelet between coxae III–IV, with anterior extension of some specimens apparently fused with anterior region. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 143 (135-150) long, 59 (55-61) of maximal width; distance *st5*–*st5* 57 (53-61). Genital lyrifissure (*iv5*) on unsclerotized cuticle laterad of *st5*; with a pair of slender paragenital platelets close to a pair of lateral notches of genital shield, posteriad of *st5*, and a pair of ellipsoidal platelets anterolaterad of *Zv1*. Anal shield subtriangular, with paranal cribral extensions (*sensu* Krantz & Redmond, 1986); reticulate. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv5*) and two pairs of lyrifissures. Setal length: *st1* 33 (30-35), *st2* 31(28-35), *st3* 31 (29-33), *st4* 26 (24-28), *st5* 22 (20-24), Jv*1* 23 (21-25), *Jv2* 24 (22-25), *Jv3* 24 (20-26), *Jv4* 25 (22-28), *Jv5* 37 (35-40), *Zv1* 21(20-24), *Zv2* 25 (23-26), *Zv5* 26, paranal 25 (23-30), postanal 25 (23-27).

**Gnathosoma (Figs. 4-6).** Epistome convex and with anterior margin denticulate. Deustosternum with seven transverse lines, the most distal smooth, others with 9-22 denticles each. Corniculi parallel to each other, 41 (40-45) long and 15 (13-17) wide, reaching median region of palp femur; *h3* slightly anterolaterad of *h2*. Chelicera with dorsal lyrifissure and dorsal seta distinct; fixed cheliceral digit 52 (45-55), with five teeth; movable digit 70 (67-74), with two teeth. Palp 172 (160-190) long. Setal length: *h1* 33 (28-36), *h2* 22 (20-25), *h3* 25 (20-30), *pc* 26 (22-30).

**Peritreme (Figs. 1, 3).** 178 (175-180) long, extending anteriorly to level of *s1*; peritrematic plate fused with dorsal shield near *z1*, with a pair of lyrifissures and a pore behind stigma.

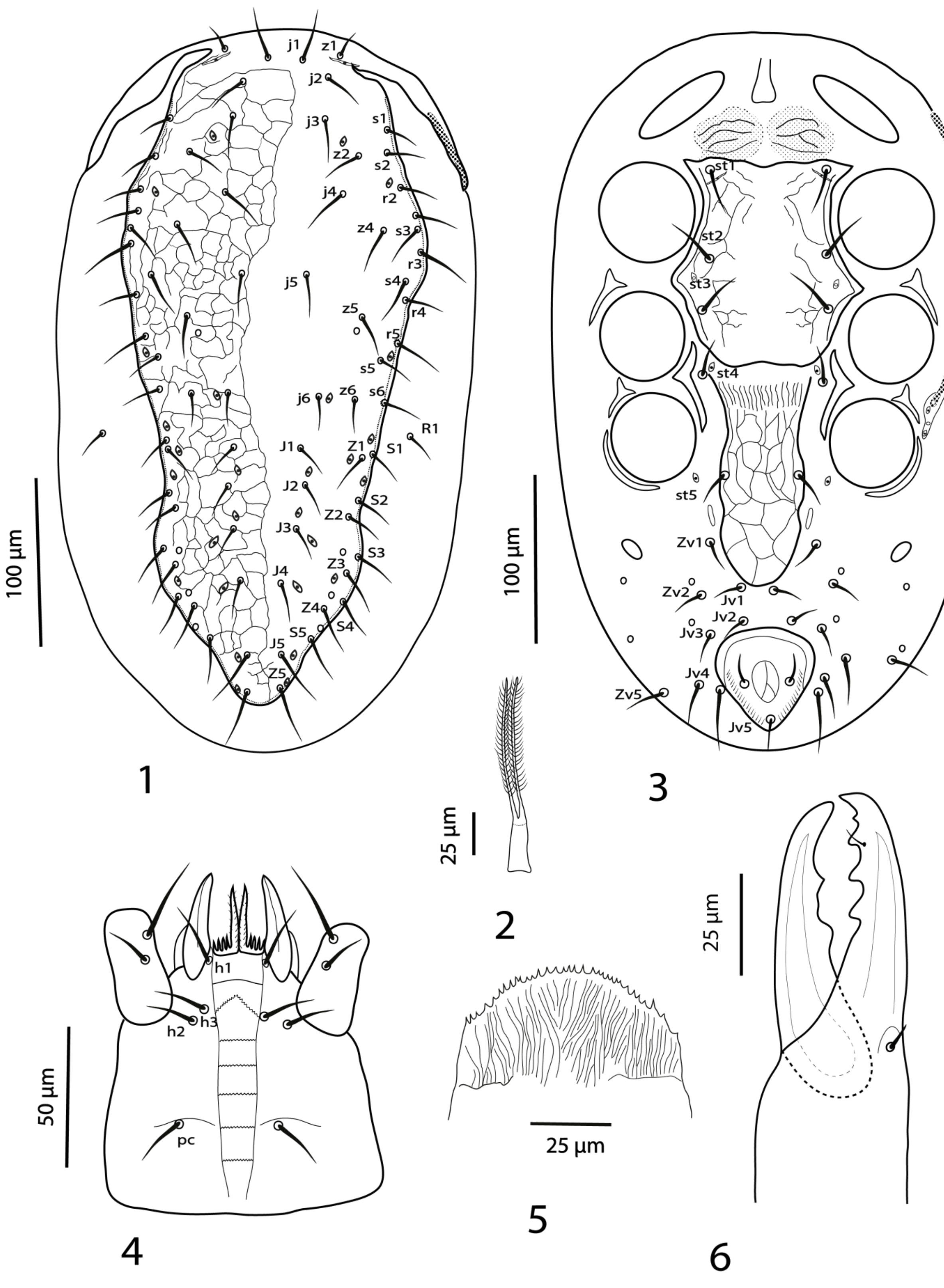
**Legs (Figs. 7-10).** Length (not including ambulacra): I, 472 (465-480); II, 336 (322-345); III, 295 (280-305); IV, 458 (445-470). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1.0/1-0; 1-0/1, 0/2-1; 2-3/1-2/2-

1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *av* of genu, *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *md*, *av1* and *pv1* of tarsus; leg III: *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *av2* and *pv2*, *av1* and *pv1* of tarsus; leg IV: *av* of genu, *av* and *pv* of tibia, *mv*, *av2* and *pv2*.

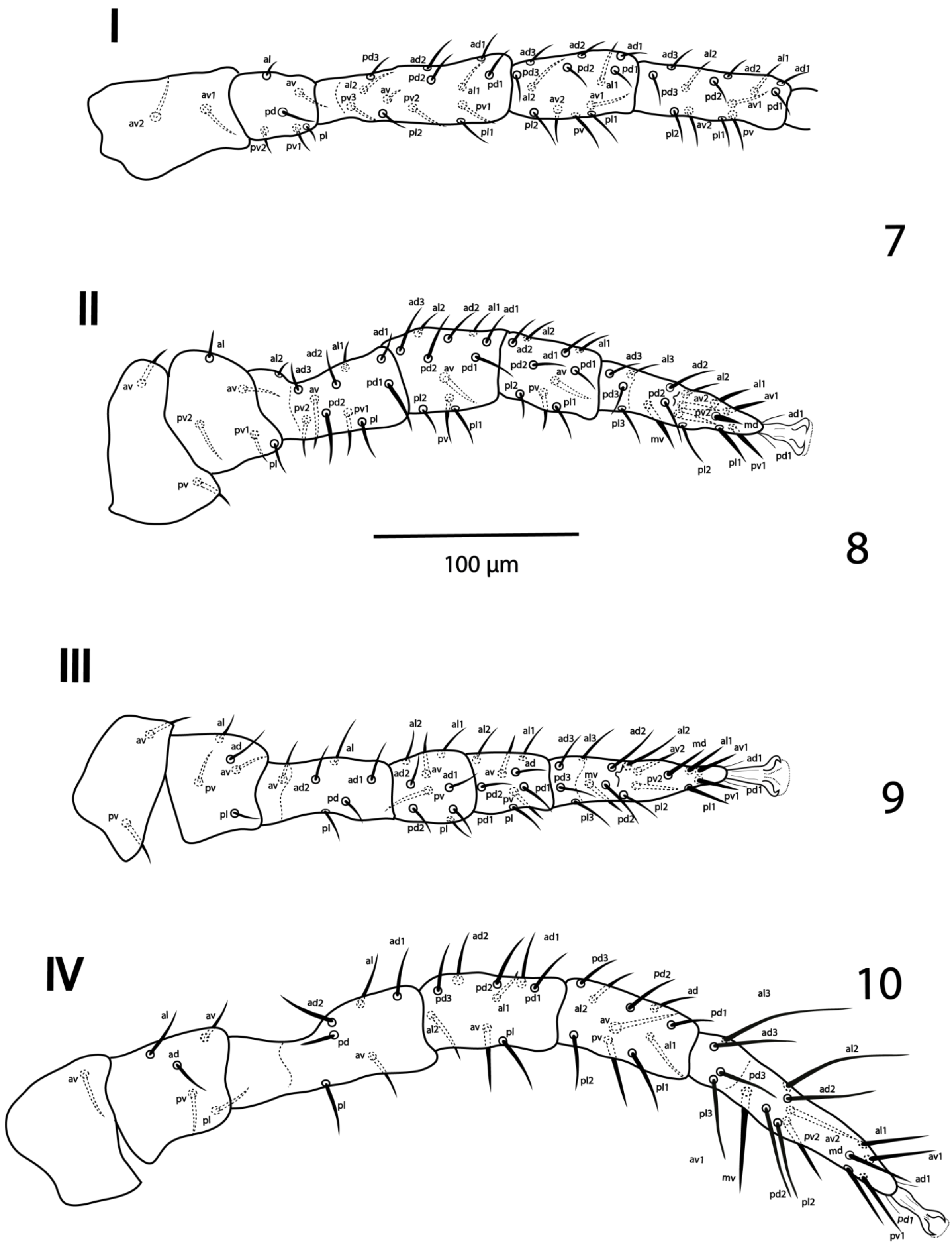
**Adult male**: unknown.

**Material examined.** Holotype female collected in Jataí, Goiás state, Brazil, on 26/II/2014, from litter of sugarcane field. Three paratype females collected in Valparaíso, São Paulo state on 16/XII/2014 from soil (0-5 cm deep) of a sugarcane field.

**Remarks.** This species is most similar to *G. queenslandicus* Womersley, 1956, but the latter has spur-like setae on femur, tibia and tarsus of leg II, tarsus of leg III and trochanter–tarsus of leg IV.




**FIGURES 1-6**. ***Gaeolaelaps* n.sp. 1**; Female: 1, dorsal view of idiosoma; 2, tritosternum; 3, ventral view of idiosoma; 4, gnathosoma; 5, tectum; 6, anti-axial view of chelicera.




**FIGURES 7-10**. ***Gaeolaelaps* n.sp. 1**; Female: 7, leg I; 8, leg II; 9, leg III; 10, leg IV.

## *Gaeolaelaps* n.sp. 2

**Adult female (Figures 11-20)** (six specimens measured)

**Dorsal idiosomal (Fig. 11).** Dorsal shield mostly smooth, except for scant striae parallel to anterolateral margins and for diagonal striae in region between *S1* and *S4*, posteriorly rounded, 404 (400–410) long and 220 (215–225) of maximal width; with 38 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*, *z2, z4–z6*, *s1–s6*, *r2–r5*, *J1–J5*; *Px2*, *Px3*, *Z1–Z5*, *S1–S5*; setae smooth and pointed; with 16 pairs of lyrifissures and four pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*r6*). Setal length: *j1* 22 (20–25), *j2* 26 (24–30), *j3* 33 (30–36), *j4* 37 (35–40), *j5* 33 (30–35), *j6* 35 (34–36), *z1* 20 (18–23), *z2* 36 (33–38), *z4* 40 (39–42), *z5* 37 (36–40), *z6* 38 (36–41), *s1* 29 (25–33), *s2* 28 (25–31), *s3* 35 (30–37), *s4* 37 (33–40), *s5* 45 (44–47), *s6* 37 (35–40), *r2* 36 (35–37), *r3* 33 (32–35), *r4* 34 (32–35), *r5* 33 (32–34), *r6* 18 (16–20), *J1* 34 (30–38), *J2* 35 (29–40), *J3* 36 (30–40), *J4* 42 (40–46), *J5* 42 (38–44), *Px2* 39 (36–39), *Px3* 42 (40–45), *Z1* 46 (41–50), *Z2* 35 (26–42), *Z3* 47 (45–50), *Z4* 49 (45–52), *Z5* 50 (48–50), *S1* 30 (27–32), *S2* 36 (34–38), *S3* 36 (35–38), *S4* 40 (40–42), *S5* 44 (41–46).

**Ventral idiosoma (Figs. 12, 13).** Tritosternum 95 (91-98) long, line separating base remaining of tritosternum not distinguishable. Separate section of laciniae correspond to about 64% of total length of tritosternum. With a pair of punctate and reticulate presternal platelets. Sternal shield lightly reticulate, except for smooth central area ; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin about straight; distance between st1 and posterior margin of sternal shield 96 (95-98), *st1–st1* 60 (59–60), *st2–st2* 77 (75–80), *st3–st3* 79 (78–80). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield, projecting as a long extension between coxae I-II which bears a dital pore; region behind sternal shield represented by a curved platelet. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 140 (130–156) long, 70 (68–75) of maximal width; distance *st5–st5* 60 (56–65). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of slender paragenital platelets close to a pair of lateral notches of genital shield posteriad of *st5* and a pair of ellipsoidal platelets anterolaterad of *Zv1*. Anal shield subtriangular, without distinct marginal pores. Two pairs of ellipsoidal metapodal platelets, the inner tiny. Opisthogaster with eight pairs of simple setae (*Jv*1–*Jv5*, *Zv*1, *Zv2* and *Zv5*) and four pairs of lyrifissures. Setal length: *st1* 27 (26-30), *st2* 30 (27-32), *st3* 28 (26-30), *st4* 26 (25–28), *st5* 24 (23–25), *Jv1* 22 (20–24), *Jv2* 24 (21–28), *Jv3* 24 (22–25), *Jv4* 25 (22–26), *Jv5* 34 (30–35), *Zv1* 20 (20–21), *Zv2* 25 (22–27), *Zv3* 35 (30–37), paranal 24 (2–28), postanal 28 (25–30).

**Gnathosoma (Figs. 14-16).** Epistome convex and with anterior margin denticulate. Deustosternum with eight transverse lines, the first and the last smooth, others with 13–17 denticles each. Corniculi subparallel to each other, 37 (35–38) long and 12 (10–14) wide, reaching basal end of palp femur; *h3* mesad and lightly posteriad of. Chelicera with dorsal lyrifissure distinct; anti-axial lyrifissure indistinguishable because of orientation of specimen; dorsal seta stout. Fixed cheliceral digit 39 (38–40) long, with six teeth in addition apical tooth (most distal and most proximal off line in relation to others); movable digit 35 (34–37) long, with two teeth. Palp 152 (140–158) long. Setal length: *h1* 26 (24–29), *h2* 18 (15–20), *h3* 29 (24–32), *pc* 19 (17–21).

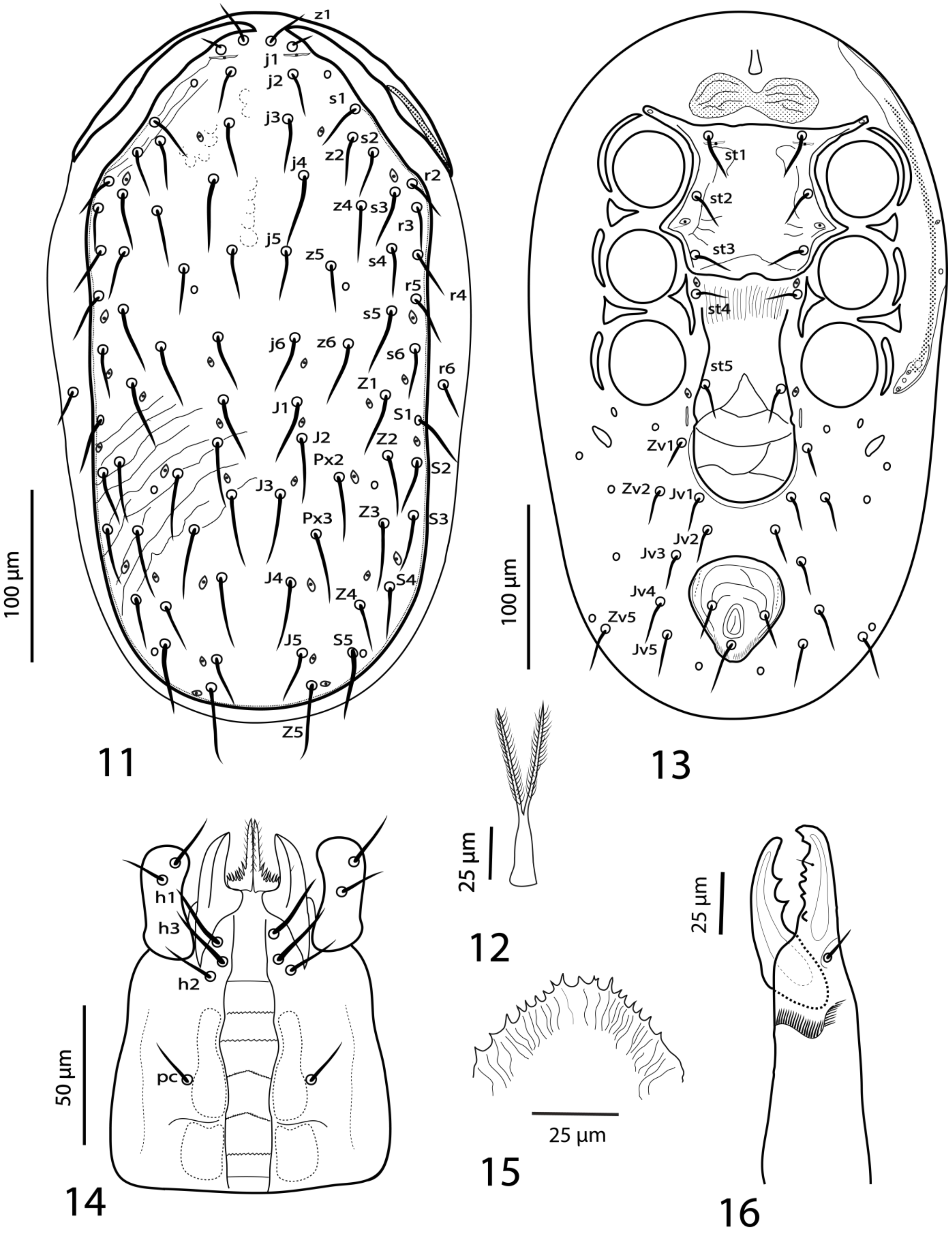
**Peritreme (Figs. 11, 13).** 176 (170–180) long, extending anteriorly to level slightly anteriad of s1; peritrematic plate fused with dorsal shield near *z1*, with a lyrifissure in region between coxae II–III and a pore and a pair of lyrifissures behind stigma.

**Legs (Figs. 17-20).** Length (not including ambulacra): I, 396 (380–405); II, 266 (250-275); III, 242 (235–250); IV, 350 (335–360). Chaetotaxy (coxa–tibia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-3/1,2/3-2; 2-3/2,3/1-2; 2-3/1,3/2-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg I: *ad3* of femur, *pv* of genu, *av2* of tibia; leg II: *av* of femur, *pv* of tibia, *mv, pv2 and av1* of tarsus; leg III: *pv* of trochanter, *pv* of tibia; leg IV: *pd* of femur, *av* of genu; *av* and *pv* of tibia. Setae *pd2* 56 and *pd3* 50 on tarsi IV longer than other setae.

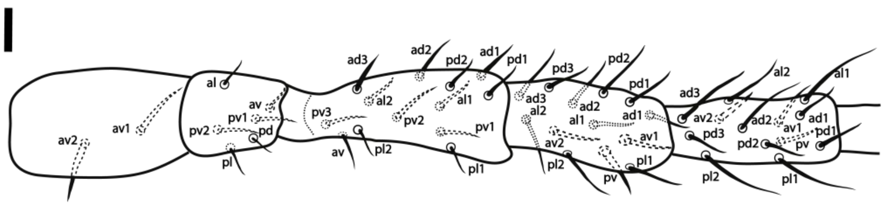
**Adult male**: unknown.

**Material examined.** Holotype female collected in Ipaussu, São Paulo state, Brazil, on 30/I/2014, from litter of natural vegetation. Five paratype females collected in the same locality and on same date, of which: three from litter and one from soil (0-5 cm deep) of natural vegetation, and one from litter of a sugarcane field.

**Remarks.** This species is most similar to *Gaeolaelaps* n.sp 11., but the latter lacks *J2* and its anal shield has a pair of distinct marginal pores anterolaterad of para-anal setae.




**FIGURES 11-16.** ***Gaeolaelaps*** **n.sp. 2**; Female: 11, dorsal view of idiosoma; 12, tritosternum; 13, ventral view of idiosoma; 14, gnathosoma; 15, tectum; 16, anti-axial view of chelicera.

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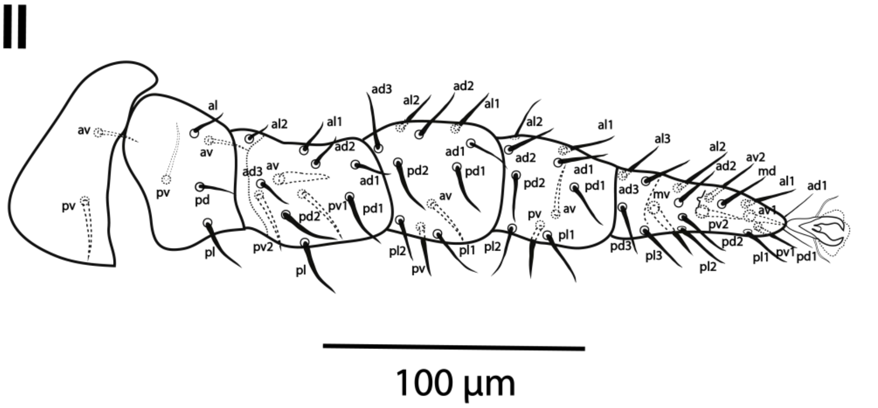


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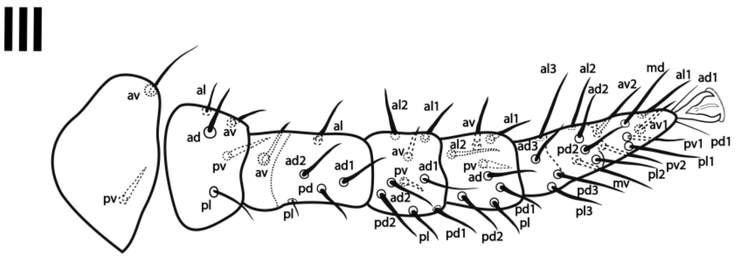


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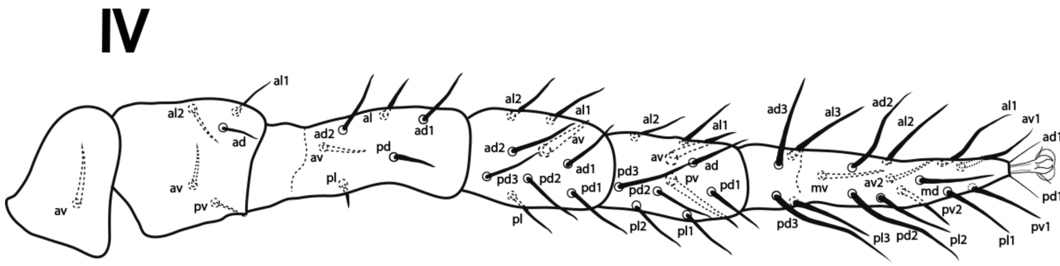


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**FIGURES 17-20.** ***Gaeolaelaps* n.sp. 2**; Female: 17, leg I; 18, leg II; 19, leg III; 20, leg IV.

***Gaeolaelaps* n.sp. 3**

**Adult female (Figures 21-30)** (two specimens measured)

**Dorsal idiosomal (Fig. 21).** Podonotal region of dorsal shield smooth; opisthonotal region reticulate, tapering posteriorly, 572-600 long and 324-340 of maximal width; with 39 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6* ; *z1–z6*; *s1–s6*; *r2–r5*; *J1–J5*; *Z1–Z5*; *S1–S5*; *Jx2* and *Jx3*; with five pairs of pores and 15 pairs of lyrifissures. Unsclerotized cuticle laterad of dorsal shield with six pairs of setae (*r6*, *R1*-*R6*, *UR*). Setal length: *j1* 51-55, *j2* 62-68, *j3* 72-77, *j4* 49-68, *j5* 64-71, *j6* 49-55; *z1* 59-64, *z2* 63-70, *z3* 60-70, *z4* 71-75, *z5* 56-67, *z6* 51-53; *s1* 50-52, *s2* 61-65, *s3* 70-73, *s4* 70-73, *s5* 68 57-70, *s6* 55-65; *r2* 60-65, *r3* 75-80, *r4* 61-67, *r*5 61-64*, r6* 41-44; *J1* 45-50, *J2* 45-50, *J*3 44-49, *J4* 46-51, *J5* 38-40; *Jx2* 46-50, *Jx3* 42-50; *Z1* 59-60, *Z2* 51-57, *Z3* 55-59, *Z4* 39-60, *Z5* 67-70; *S1* 56-59, *S2* 56-60, *S3* 57-60, *S4* 58-62, *S5* 61-69, *R1* 45-47, *R2* 40-47, *R3* 45-50, *R4* 48-51, *R5* 50-58, *R6* 55-60.

**Ventral idiosoma (Figs. 22, 23).** Tritosternum without distinct line separating base from laciniae or with two lines at variable orientations; divided for about 90% of its total length. With a pair of punctate and reticulate presternal platelets. Sternal shield reticulate along lateral and anterior margins, smooth elsewhere; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin convex; distance between *st1* and posterior margin of sternal shield 174-185, *st1–st1* 86-93, *st2–st2* 101-103, *st3–st3* 122-132. Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV, fused by a narrow bridge with anterior region. Genital shield tongue-shaped, reticulate, 180 (175-190) long, 85 (80-91) of maximal width; distance *st5–st5* 33-38. Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of elongate paragenital platelets. Anal shield pear-shaped, reticulate, whithout marginal pores, with paranal cribral extensions (sensu Krantz & Redmond, 1989). With two pairs of elongate metapodal platelets, the outer distinctly smaller and away from the inner.

Opisthogaster with nine pairs setae (*Jv*1-*Jv5*, *Zv1*, *Zv3*-*Zv5*) and three pairs of lyrifissures. Setal length: *st1* 43-50, *st2* 49-52, *st3* 40-46, *st4* 35-40, *st5* 33-38, *Jv1* 36-43, *Jv2* 39-42, *Jv3* 40-48, *Jv4* 40-46, *Jv5* 65-70, *Zv1* 34-37, *Zv3* 41-45, *Zv4* 38-42, *Zv5* 37-50; paranal 40-45, postanal 50-54.

**Gnathosoma (Figs. 24-26).** Epistome convex and with anterior margin with denticles of variable sizes. Deustosternum with seven transverse lines, the most distal smooth, others with 30-45 denticles each; with a constriction at level of second most proximal line. Corniculi subparallel to each other, 64-75 long and 22-24 wide, reaching median region of palp femur; *h3* anteriad of *h2*. Internal malae bifurcate basally, frimbriate. Chelicera with dorsal lyrifissure and dorsal seta distinct; fixed cheliceral digit 78-80 long, with 12-15 denticles (the first and the last distinctly longer than others and a setiform *pilus dentilis*; movable digit 98-108 long, with two teeth. Palp 233-246 long. Setal length: *h1* 50 (45-55), *h2* 28 (25-31), *h3* 58 (50-65), *pc* 38 (31-45).

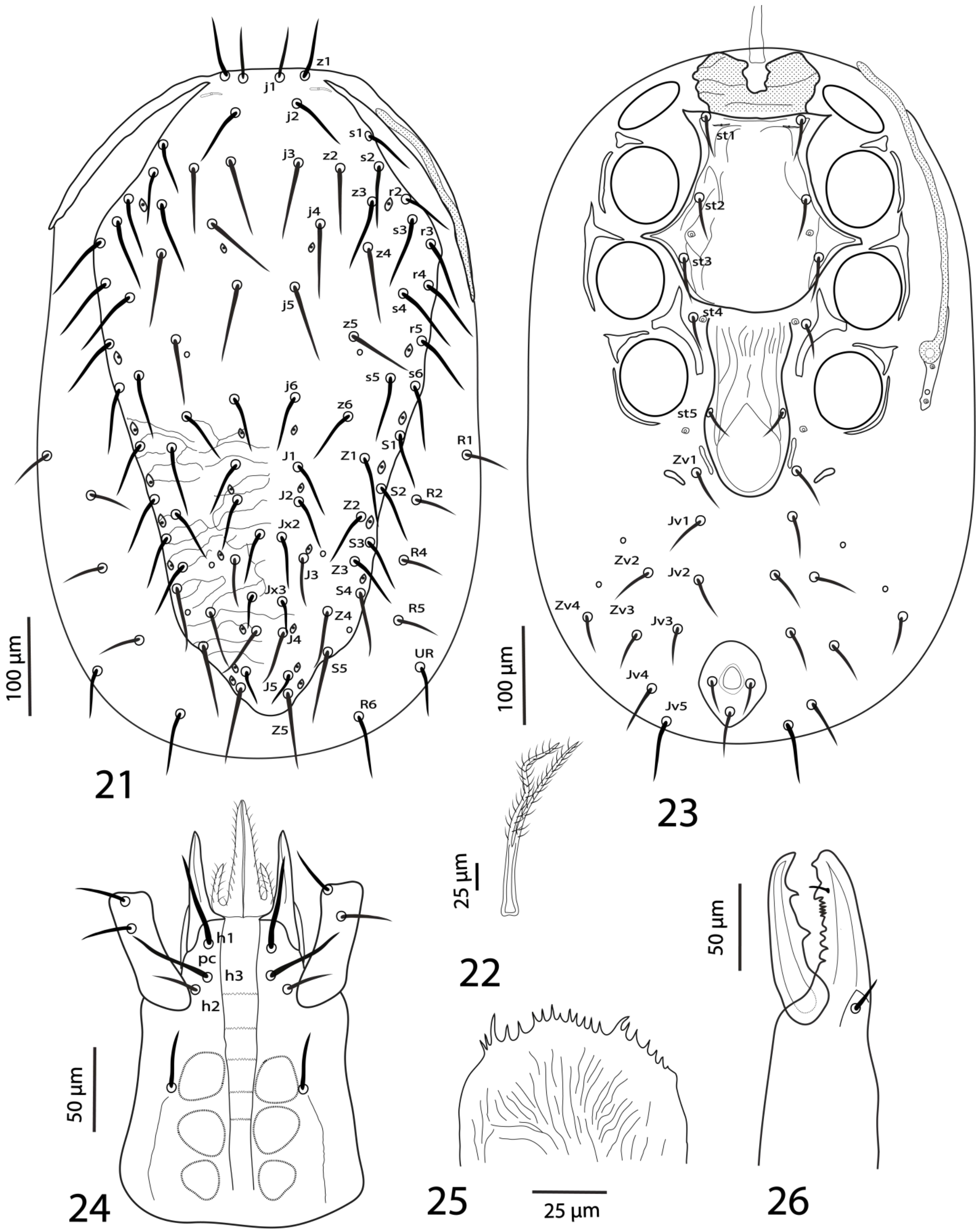
**Peritreme (Figs. 21, 23).** 324-350 long, extending anteriorly slightly beyond level of *s1*. Peritrematic plate barely fused with dorsal shield by a narrow bridge , with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

**Legs (Figs. 27-30).** Length (not including ambulacra): I, 712-726; II, 525-560; III, 505-526; IV, 775-804. Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2, 3/1-2; II, 0-0/1.0/1-0; 1- 0/1,0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *pl* of trochanter, *al1, pv1* and *pv2* of femur, *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *av2*, *md*, *al1*, *av1* and *pv1* of tarsus; leg III: *av* of femur, *av* and *pv* of genu, *pv* of tibia, *mv*, *pd2*, *av2*, *pv2*, *md*, *al1*, *pl1*, *av1* and *pv1* of tarsus; leg IV: *ad* of trochanter, av and *pd* of femur, *av* and *pl* of genu, *av*, *pv* and *pl1* of tibia, *pl3*, *mv*, *pl2*, *av2*, *pv2*, *al1*, av and *pv1* of tarsus.

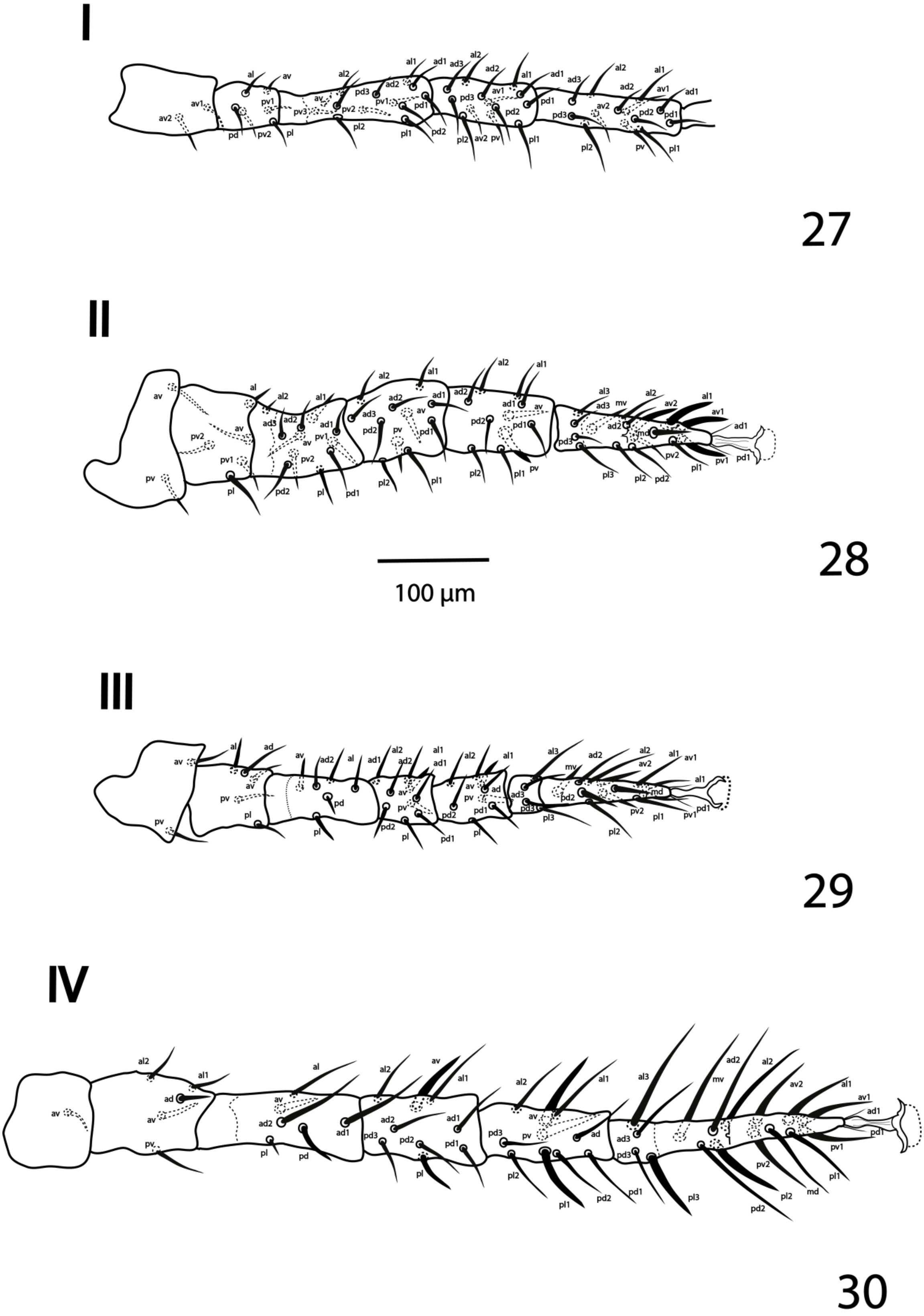
**Adult male**: unknown.

**Material examined.** Holotype and paratype females collected in Bauru, São Paulo state, Brazil, on 26/III/2016, from litter.

**Remarks.** This species is most similar to *G. queenslandicus*, but the latter does not have supernumerary setae on dorsal shield.




**FIGURES 21-26**. ***Gaeolaelaps* n.sp. 3**; Female: 21, dorsal view of idiosoma; 22, tritosternum; 23, ventral view of idiosoma; 24, gnathosoma; 25, tectum; 26, anti-axial view of chelicera.




**FIGURES 27-30. *Gaeolaelaps* n.sp. 3**; Female: 27, leg I; 28, leg II; 29, leg III; 30, leg IV.

***Gaeolaelaps* n.sp. 4**

**Adult female (Figures 31-40)** (five specimens measured)

**Dorsal idiosomal (Fig. 31).** Dorsal shield reticulate (light reticulation in central area of podonotal region posteriorly rounded, 395 (385–400) long and 238 (230–243) wide; with a slender punctate marginal band, most clearly discernible posteriad of r3; with 38 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1, z2, z4–z6*; *s1–s6*; *r2–r5*, *J1–J5*; *Px2*, *Px3*; *Z1–Z5*; *S1–S5*; setae smooth and pointed; with 17 pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*r6*). Setal length: *j1* 15 (15–16), *j2* 10 (9–10), *j3* 10 (9–11), *j4* 11 (10–12), *j5* 10 (9–11), *j6* 10 (9–10); *z1* 8 (7–9), *z2* 10, *z4* 10 (9–11), *z5* 9 (8–10), *z6* 9; *s1* 10 (9–10), *s2* 10 (10–11); *s3* 10, *s4* 10 (10-11), *s5* 9 (8-10), *s6* 9; r2 10, *r3* 10 (9-11), *r4* 10 (10-11), *r5* 10 (9-10), r6 10 (9–10); *J1* 10 (9–10), *J2* 10, *J3* 9 (8–10), *J4* 10 (9–10), *J5* 10 (10–11); *Px2* 9 (8–9), *Px3* 7 (6–7); *Z1* 9 (8–10), *Z2* 10, *Z3* 10, *Z4* 10 (9–10), *Z5* 10 (10–11); *S1* 10 (9–11), *S2* 9 (8–10), *S3* 10 (9–10), *S4* 10 (9–10), *S5* 10 (10–11).

**Ventral idiosoma (Figs. 32, 33).** Base of tritosternum 27 (24-30) long; and 13 (12-13) basally, laciniae 68 (65-70) long, separated by about 72% of their total length. With a pair of punctate and transversely striate presternal platelets. Sternal shield smooth centrally and reticulate along margins; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin convex; distance between st1 and posterior margin of sternal shield 106 (104–107), *st1–st1* 55 (50–58), *st2–st2* 78 (78), *st3–st3* 78 (77–80). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; posterior region represented by an undulate platelet between coxae III–IV (in some specimens fused with anterior region). Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 126 (122–128) long, 62 (60–63) of maximal width; distance *st5–st5* 53 (52–55). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*; with two pairs of similar sized paragenital platelets. Anal shield subtriangular, reticulate, with a pair of marginal pores laterad of paranal setae. Two pairs of metapodal platelets, the outer slender and the inner rounded and smaller. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv5*) and two pairs of lyrifissures. Setal length: *h1* 28 (25–30), *h2* 17 (15–20), *h3* 19 (16–20), *pc* 20 (20–21), st1 27 (25–29), *st2* 27 (26–28), *st3* 23, *st4* 20, *st5* 17 (16–18), *Jv1* 17 (16–17), *Jv2* 17 (16–17), *Jv3* 18 (17–18), *Jv4* 19 (18–20), *Jv5* 20, *Zv1* 16 (15–17), *Zv2* 17 (16–18), *Zv5* 16, paranal 20, postanal 16 (15–16).

**Gnathosoma (Figs. 34-36).** Epistome convex and with anterior margin denticulate. Deustosternum with seven transverse lines, the most distal smooth, the following with 10-16 denticles each. Corniculi subparallel to each other, 34 (30–37) long and 10 (8-11) wide, reaching proximal region of palp femur; *h3* posteromesad of *h2*. Fixed cheliceral digit 38 (36–40), with seven teeth and a short setiform *pilus dentilis*; movable digit 49 (47–50) long, with two teeth. Palp 155 (150–160) long. Setal length: *h1* 28 (25–30), *h2* 17 (15–20), *h3* 19 (16–20), *pc* 20 (20–21).

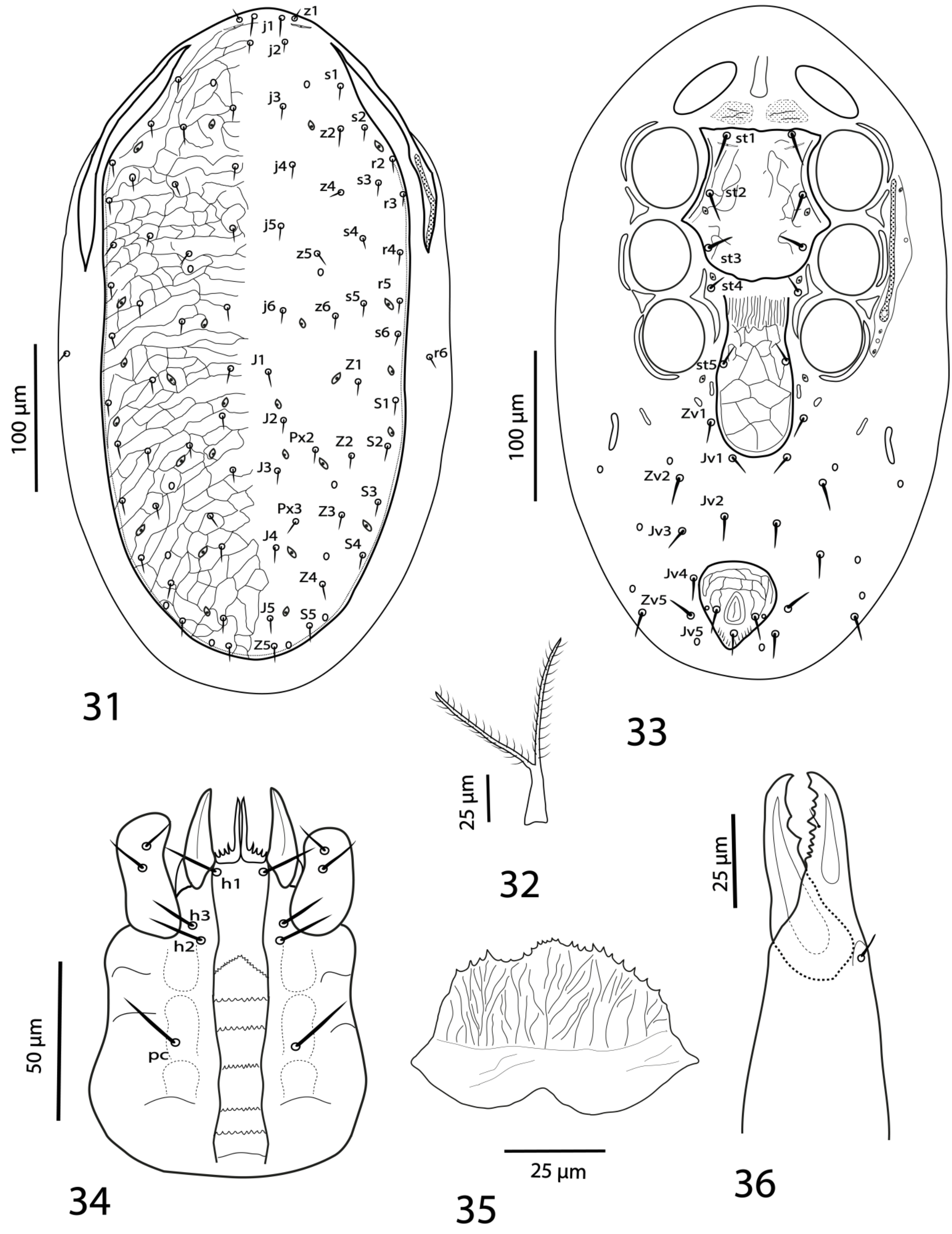
**Peritreme (Figs. 31, 33).** 102 (100-104) long, extending anteriorly to level of *r2*. Peritrematic plate fused with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III and two lyrifissures and a pore behind stigma.

**Legs (Fig. 37-40).** Length (not including ambulacra): I, 403 (400–405); II, 299 (292-306); III, 252 (250–255); IV, 391 (386–395). Chaetotaxy (coxa–tíbia): I, 0-0/2, 0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2, 3/1-2; 2-3/2, 3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1, 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1, 1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg I: *pv1* of tibia; leg II: *av* and *pv* of genu, *av* and *pv* of tibia, *mv* and *av2* of tarsus; leg III: *av* of genu, *av* of tibia, *mv* and *pv2* of tarsus; leg IV: *av* and *pv* of tibia, *mv* of tarsus.

**Adult male**: unknown.

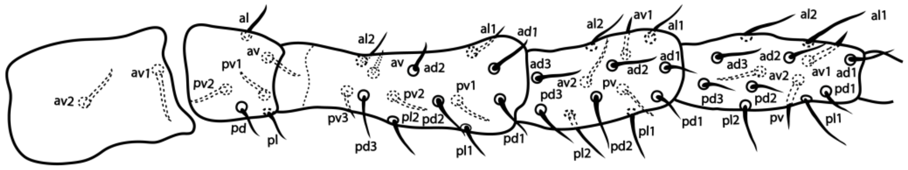
**Material examined.** Holotype female collected in Jataí, Goiás state, Brazil, on 15/II/2014, from litter of natural vegetation. Five paratype females collected in thye same locality and substrate on 30/I/2014.

**Remarks.** This species is most similar to *G. brevipellis* (Karg, 1979), but an examination of the holotype of the latter species showed that it has longer peritreme, reaching the level of *s1*. It is also similar to *Gaeolaelaps* n.sp 9., but the latter has long peritreme (reaching only level of *s1*).




**FIGURES 31-36.** ***Gaeolaelaps*** **n.sp. 4;** Female: 31, dorsal view of idiosoma; 32, tritosternum; 33, ventral view of idiosoma; 34, gnathosoma; 35, tectum; 36, anti-axial view of chelicera.

I



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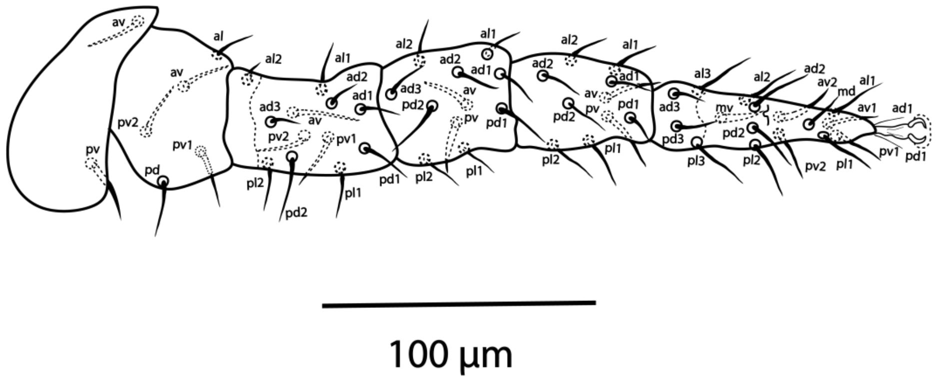
II

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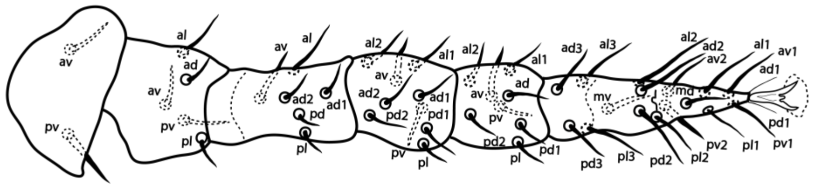
III



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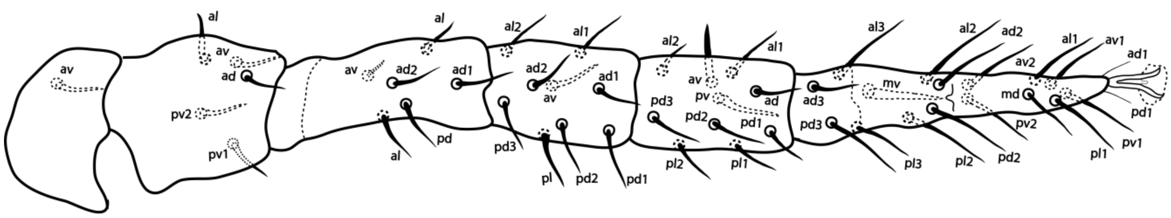
IV



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**FIGURES 37-40**. ***Gaeolaelaps* n.sp. 4;** Female: 37, leg I; 38, leg II; 39, leg III; 40, leg IV.

***Gaeolaelaps* n.sp. 5**

**Adult female (Figures 41-51)** (two specimens measured)

**Dorsal idiosomal (Fig. 41).** Dorsal shield smooth, posteriorly rounded, 703 (690-715) long and 460 (440-480) of maximal width; with 38 pairs of setae, including two pairs of extra opisthonotal setae, and a one unpaired extra setae: *j1–j6*, *z2–z6*, *s1–s6*, *r2–r5*, *J1–J5*, *Jx2*, *Px2*, *Px3*, Z1–Z5, S1–S5; whith 15 pairs of lyrifissures and 5 pairs of pores. Setal length: *j1* 44 (43-45), *j2* 42, *j3* 53 (52-54), *j4* 57 (53-60), *j5* 50, *j6* 47, *z2* 58 (55-60), *z3* 55, *z4* 53 (50-55), *z5* 54, *z6* 53, *s1* 40, *s2* 40 (38-42), *s3* 60, *s4* 56 (52-60), *s5* 56, *s6* 48 (46-50), *r2* 45 (40-49), *r3* 47 (46-48), *r4* 45 (44-45), *r5* 48 (45-50), *J1* 48, *J2* 37 (33-41), *J3* 45, *J4* 46 (45-47), *J5* 44 (41-46), *Px2* 52, *Px3* 48, *Z1* 55 (54-55), *Z2* 72, *Z3* 39, *Z4* 95, *Z5* 100, *S1* 51, *S2* 25, *S3* 80, *S4* 60, *S5* 96.

**Ventral idiosoma (Figs. 42, 44).** Base of tritosternum 45 (42-47) long and 20 (19-21) wide basally; laciniae 112 (103-122), totally separated from each other. With a pair of punctate and reticulate presternal platelets. Sternal shield with scant reticulation along anterior and lateral margins, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin concave; distance between *st1* and posterior margin of sternal shield 179 (170-188), *st1–st1* 104 (98-110), *st2–st2* 138 (125-150), *st3–st3* 148 (140-155). Seta *st4* and lyrifissure iv3 on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate plate between coxae III–IV distinctly fused with anterior region. Exopodal plate a complete, slender structure, with elongate extensions between neighboring coxae, or fragmented near coxa IV. Genital shield tongue-shaped, smooth, except for a slender punctate marginal strip, 280 (275-285) long, 123 (112-133) of maximal width; distance *st5–st5* 109 (98-120); genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of rounded paragenital platelets, widely separated from genital shield. Anal shield oval, without marginal pores, smooth. Two pairs of metapodal platelets, the anterior rounded and smaller. Opisthogaster with eight pairs of setae (*Jv1-Jv4*, *Zv1-Zv4*) and two pairs of lyrifissures. Setal length: *st1* 64 (62-65), *st2* 58 (55-60), *st3* 71 (70-71), *st4* 58 (57-

59), *st5* 45 (40-50), *Jv1* 44 (41-46), *Jv2* 48 (46-50), *Jv3* 43 (42-44), *Jv4* 39 (35-42), *Jv5* 48 (45-50), *Zv1* 40, *Zv2* 47 (45-48), *Zv3* 37(34-40), *Zv4* 20, *Zv5* 20; paranal 35 (34-36), postanal 33 (30-36).

**Spermathecal apparatus (Fig. 43).** Tubulus a seemingly complex structure, apparently slightly wider and with an associate saccular structure near solenostome, annulate throughout; rami distinct, with longitudinal lines, seemingly attached to sacculus away from each other and apparently with an additional associated slender duct.

**Gnathosoma (Figs. 45-47).** Epistome convex and with anterior margin denticulate. Deustosternum apparently with seven transverse lines, the most distal smooth and others with 8-23 denticles. Corniculi subparallel to each other, 84 (80-88) long and 33 (30-35) wide, extending slightly beyond median region of palp femur; *h3* slightly anteriad of *h2*. Internal malae with three fringed tines. Chelicera with dorsal lyrifissure and dorsal seta distinct; fixed digit 125 long, with 11 teeth and a setiform *pilus dentilis*; movable digit 118 (116-120) long, with two relatively large teeth. Palp 245 (240-250) long. Setal length: *h1*70, *h2* 32, *h3* 64 (63-65), *pc* 40.

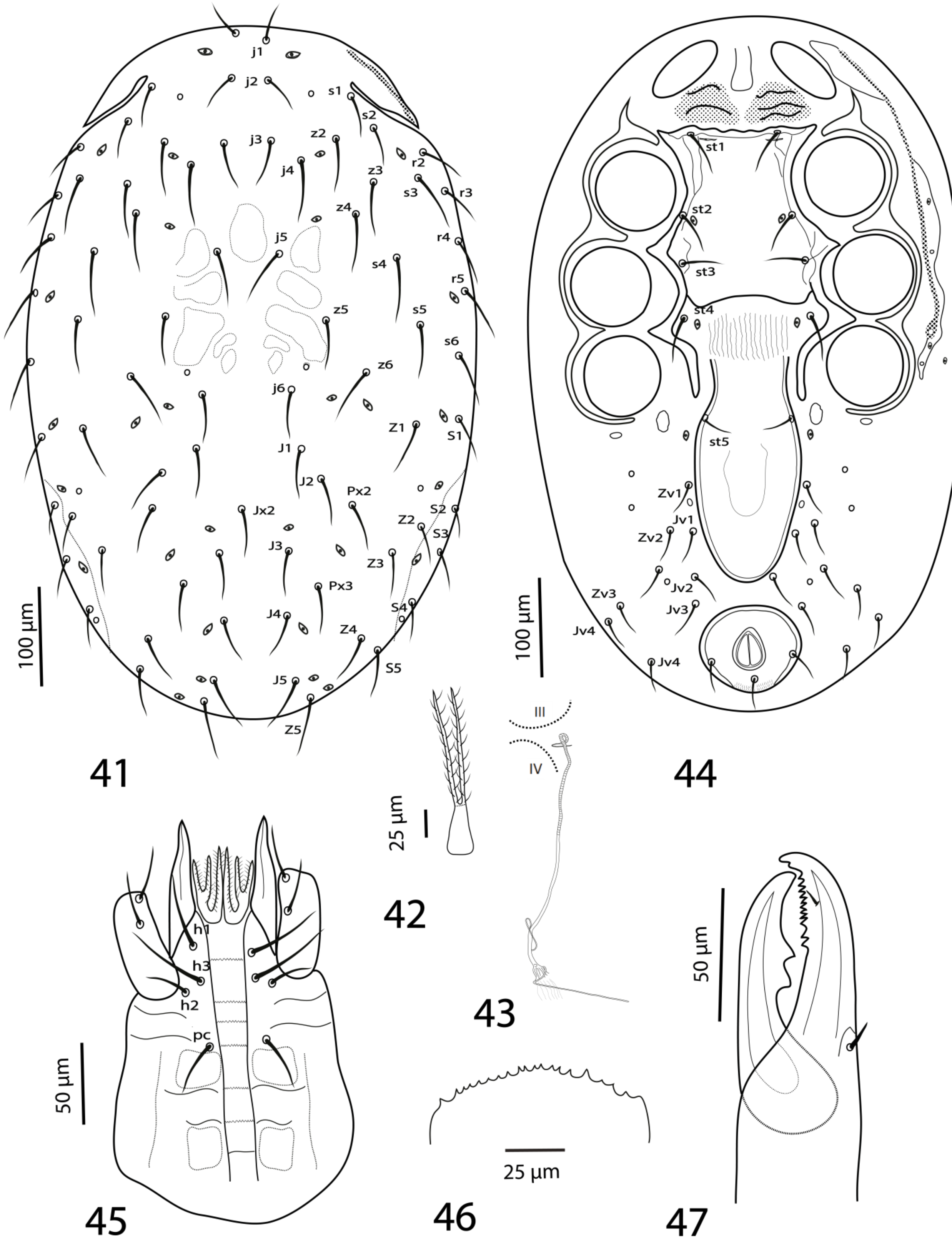
**Peritreme (Figs. 41, 44).** 355 (350-360) long, extending anteriorly to level between *j1* and *s1*; peritrematic plate broadly fused with dorsal shield near *s1*, with a lyrifissure and a pore in region between coxae II–III and with a pair of lyrifissures and a pore behind stigma.

**Legs (Figs. 48-51).** Length (not including ambulacra): I, 366 (357-374); II, 250 (240-260); III, 245 (235-255); IV, 397 (395-398). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1-0/1, 0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-1; tarsi II-IV with 18 setae each. Femur II with thick and short seteae; seta *pd2* on tarsus IV 105 (94-115) longer; with the following setae stouter than other setae of same segments: leg II: *av* of femur, *av* and *pv* of genu, *av* and *pv* of tibia, *mv* of tarsus; leg III: *pd1* of femur, *av* and *pv* of genus, *av* and *pv* of tibia; leg IV: *pd* of femur, *av* of genu, *av* and *pv* of tibia.

**Adult male**: unknown.

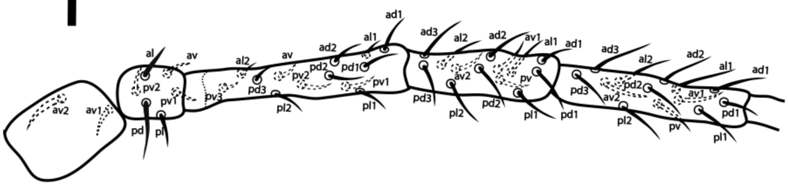
**Material examined.** Holotype female collected in Ipaussu, São Paulo state, Brazil, on 16/XII/2014, from litter of natural vegetation. Paratype female collected in the same locality and substrate, on 3/XII/2014.

**Remarks.** This species is similar to *Gaeolaelaps* n.sp 8., but the latter has no *Jx* setae. It is also similar to *G. blattae* (Strong & Halliday, 1994) and *Gaeolaelaps* n.sp 12., both of which differ from the new species by having seta *z1*.




**FIGURES 41-47.** ***Gaeolaelaps* n.sp. 5;** Female: 41, dorsal view of idiosoma; 42, tritosternum; 43, spermathecae; 44, ventral view of idiosoma; 45, gnathosoma; 46, tectum; 47, anti-axial view of chelicera.

I



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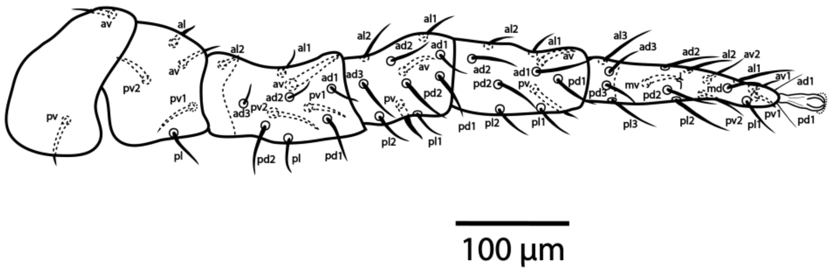
II

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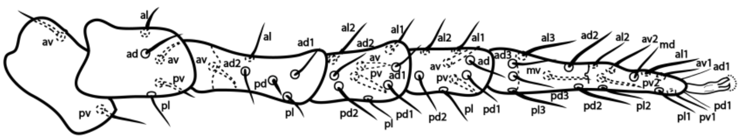
III



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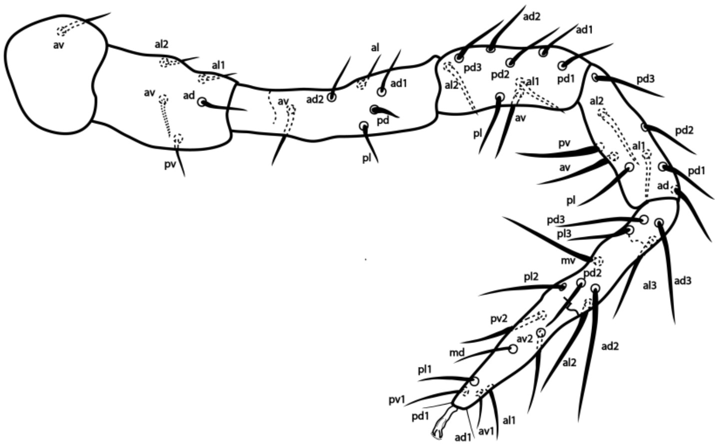
IV



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**FIGURES 48-51.** ***Gaeolaelaps* n.sp. 5;** Female: 48, leg I; 49, leg II; 50, leg III; 51, leg IV.

***Gaeolaelaps* n.sp. 6**

**Adult female (Figures 52-62)** (six specimens measured)

**Dorsal idiosomal (Fig. 52).** Dorsal shield reticulate along anterolateral margins and on opisthonotal region laterad of setae of the *J* series, posteriorly truncate, 489 (485-495) long and 301 (290-314) wide; with a slender punctate marginal band, most clearly discernible posteriad of *r3*; with 33 pairs of setae: *j1–j6*, *z1–z5*; *s1–s6*; *r2–r5*; *J1*, *J3–J5*; *Z1*, *Z3–Z5*; *S1*, *S3–S5*; all setae smooth and pointed; with 15 pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*R1*). Setal length**:** *j1* 28 (27-28), *j2* 41, *j3* 52 (49-55), *j4* 51, *j5* 39 (37-40), *j6* 31 (30-32); *z1* 15 (15-16), *z2* 50 (50-51), *z3* 52 (52-53), *z4* 56, *z5* 35 (33-38); *s1* 33 (31-34), *s2* 33 (31-35); *s3* 52 (52-53), *s4* 56 (55-57), *s5* 50 (50-51), *s6* 39 (37-41); *r2* 37 (36-38), *r3* 42 (41-43), *r4* 30 (30-31), *r5* 30, *r6* 20; *J1* 27 (26-28), *J3* 23 (22-25), *J4* 20 (20-21), *J5* 20 (20-21); *Z1* 48 (46-50), *Z3* 41 (40-42), *Z4* 41 (40-41), *Z5* 42 (41-42); *S1* 25 (25-26), *S3* 31 (30-33), *S4* 27 (27-28), *S5* 31 (30-32).

**Ventral idiosoma (Figs. 53, 55).** Base of tritosternum 21 (18-23) long and 11 (10-12) wide basally; laciniae 72 (70-73), separated for about 90% of their total length. With a pair of punctate and reticulate presternal platelets. Sternal shield reticulate, with reticulation light posteromesally, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin convex; distance between *st1* and posterior margin of sternal shield 130 (130-131), *st1–st1* 61 (60-62), *st2–st2* 87 (85-90), *st3–st3* 88 (87-90). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV, fused by a broad or narrow bridge with anterior region, or not fused. Exopodal plate fragmented. Genital shield drop-shaped, reticulate, 157 (155-160) long, 105 (103-110) of maximal width; distance *st5–st5* 73 (68-80). Genital lyrifissure (*iv5*) on unsclerotized cuticle, varying from anterolerad to posterolaterad of *st5*. Anal shield pear-shaped, with paranal cribral extensions; puntate, with punctation most distinct along anterior margin. With a pair of elongate metapodal platelets. Opisthogaster with nine pairs of simple setae (*Jv1-Jv5*, *Zv1-Zv3* and *Zv5*) and two pairs of lyrifissures. Setal length**:** *st1* 43 (41-46), *st2* 50, *st3* 46 (45-

47), *st4* 36 (35-39), *st5* 36 (35-37), Jv*1* 39 (38-40), *Jv2* 38 (36-39), *Jv3* 34 (32-36), *Jv4* 21 (20-21), *Jv5* 38 (35-40), *Zv1* 22 (21-23), *Zv2* 33 (32-35), *Zv3* 20, *Zv5* 23 (21-24), paranal 36 (35-37), postanal 21 (18-22).

**Spermathecal apparatus (Fig. 54).** Tubulus slender; rami distinct, attached to sacculus far away from each other.

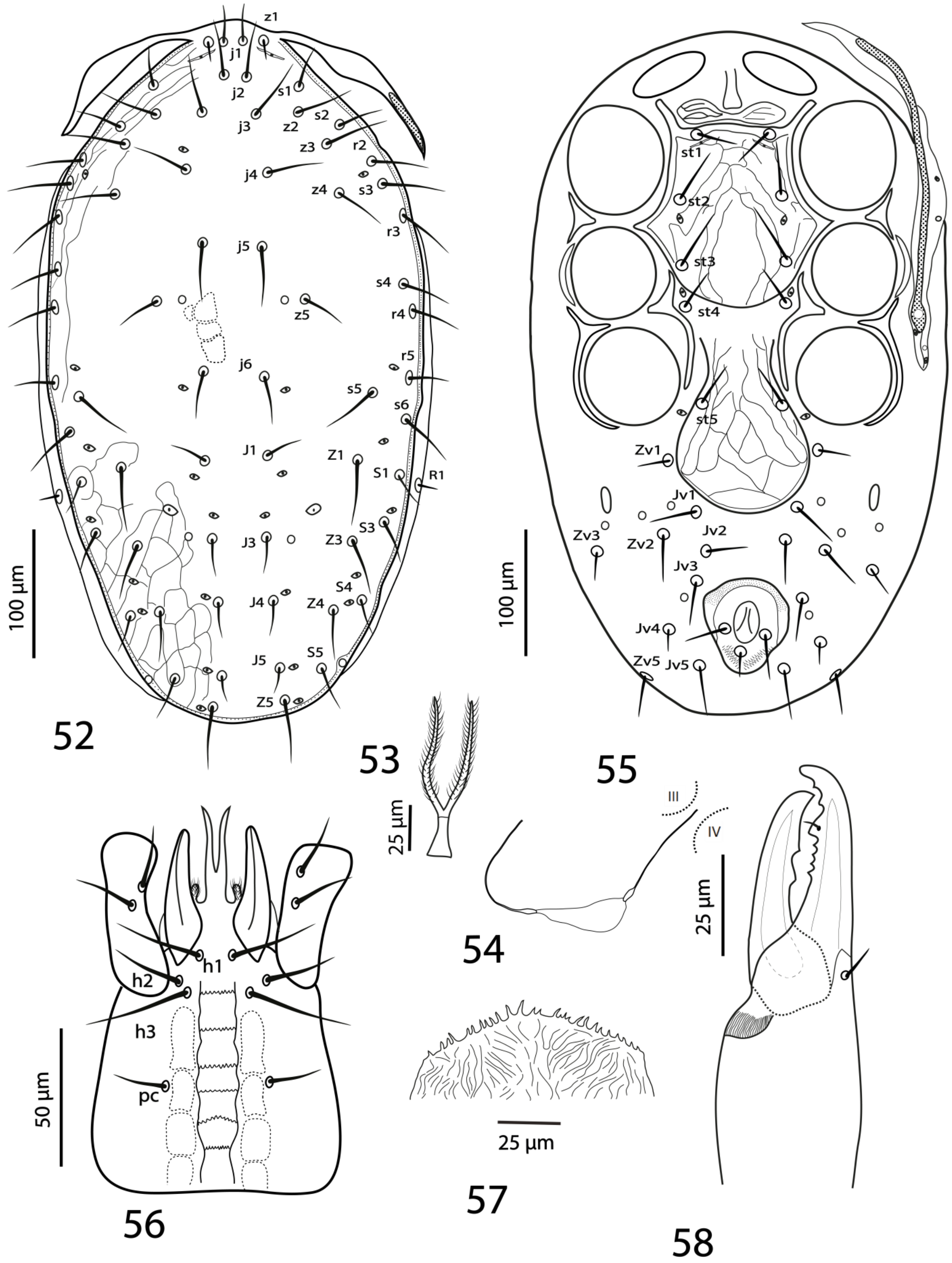
**Gnathosoma (Figs. 56-58).** Epistome convex and with anterior margin denticulate. Deustosternum with eight transverse lines, the most distal and the most proximal smooth, others with 12–19 denticles each. Corniculi subparallel to each other, 36 (35-37) long and 14 (12-16) wide, reaching proximal part of palp femur; *h3* slightly posterolaterad of *h2*. Chelicera with distinct dorsal lyrifissure and dorsal seta; fixed digit 51 (50-53) long, with 8 teeth (most basal and second most distal denticle distinctly larger than others) and a large *pilus dentilis*; movable digit 61 (59-62) with two teeth, large teeth. Palp 161 (160-165) long. Setal length: *h1* 39 (36-42), *h2* 32 (31-33), *h3* 51 (48-53), *pc* 36 (34-39).

**Peritreme (Figs. 52, 55).** 236 (230-242) long, extending anteriorly to level of *s1*; peritrematic plate fused with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

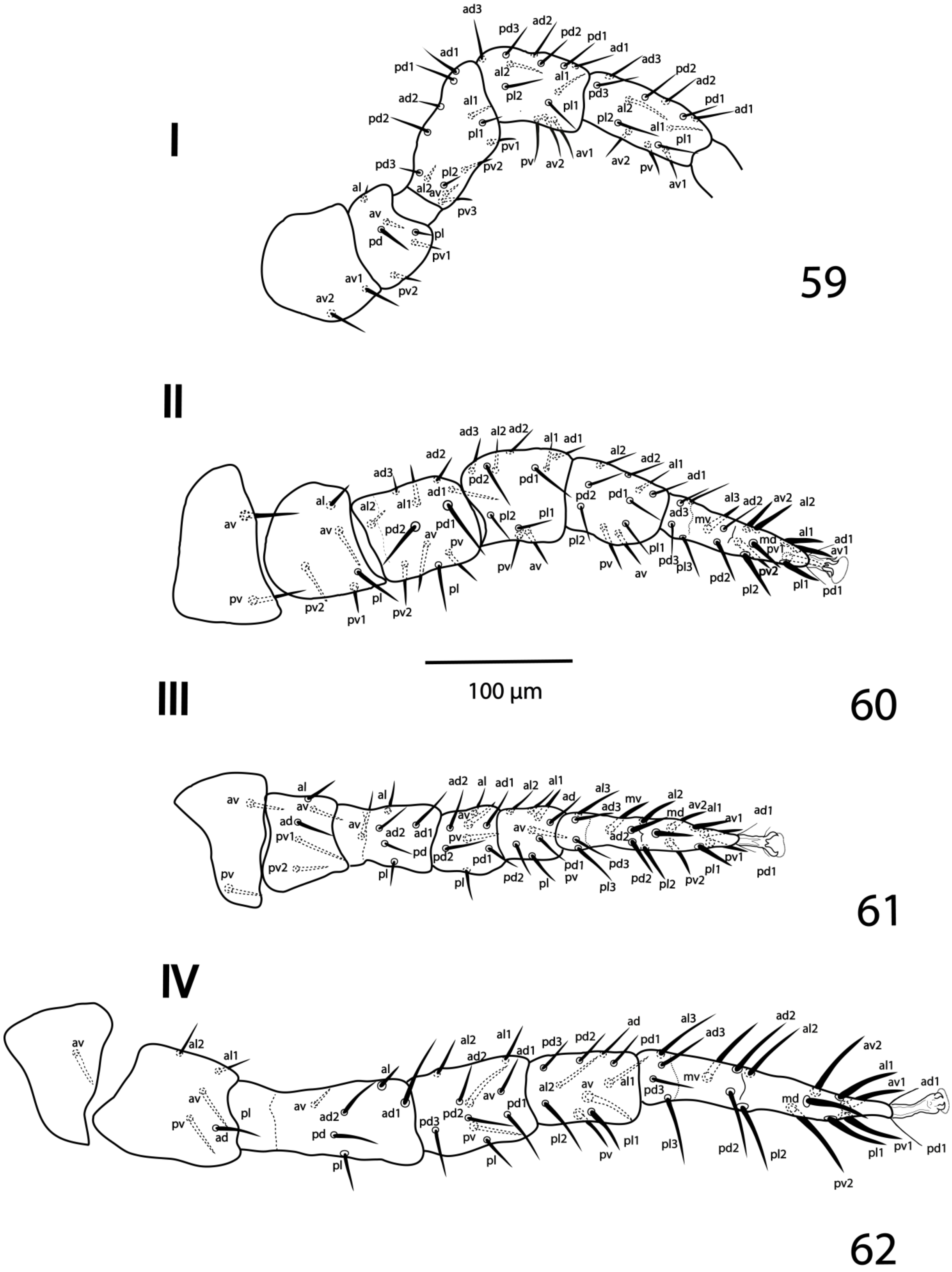
**Legs (Fig. 59-62).** Length (not including ambulacra): I, 452 (440-466); II, 394 (390-397); III, 360 (355-365); IV, 524 (518-535). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2, 3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1, 1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each; Seta *pl2* of tarsus IV 92 (90-93) and *pd1* femur IV 70 long; with the following setae stouter than other setae of same segments: leg II: *av* and *pv* of tibia, *ad2*, *al2*, *pl2*, *al1*, *pl1*, *av1* and *pv1*of tarsu; leg III: *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *ad2*, *pl2*, *al1*, *pl1*, *av1* and *pv1* of tarsus; leg IV: *av*, *pv* and *al1* of tibia, *pv2*, *md*, *pl1*, *pl2*, *av1* and *pv1* of tarsus.

**Material examined.** Valparaiso: five females from soil (0-5 cm deep) and one female from soil (5-10 cm deep) of natural vegetation, collected in 16/XII/2014.

**Remarks.** This species is most similar to *Gaeolaelaps circularis* Hyatt, 1964, but the latter has longer peritreme (extending anteriorly beyond coxa I) and metapodal plates extremely minute.




**FIGURES 52-58.** ***Gaeolaelaps* n.sp. 6**; Female: 52, dorsal view of idiosoma; 53, tritosternum; 54, spermatecae; 55, ventral view of idiosoma; 56, gnathosoma; 57, tectum; 58, anti-axial view of chelicera.




**FIGURES 59-62**. ***Gaeolaelaps* n.sp. 6**; Female: 59, leg I; 60, leg II; 61, leg III; 62, leg IV.

***Gaeolaelaps* n.sp. 7**

**Adult female (Figures 63-71)** (three specimen measured)

**Dorsal idiosomal (Fig. 63).** Dorsal shield reticulate, posteriorly rounded, 430 (425-435) long and 257 (253-260) wide; with 38 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*,z2, *z4–z6*, *s1–s6*, *r2–r5*, *J1–J5*, *Px2*, *Px3*, *Z1–Z5*, *S1–S5*; with 18 pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*r6*). Setal length: *j1* 17 (15-19), *j2* 11 (10-11), *j3* 12 (10-13), *j4* 11 (10-11), *j5* (10-11), *j6* 11 (10-11); *z1* 13 (12-13), *z2* 13 (11-14), *z4* 11 (10-12), *z5* 11 (10-11), *z6* 11 (10-12); *s1* 12 (11-12), *s2* 12 (10-13); *s3* 12 (11-12), *s4* 11 (10-12), *s5* 11 (10-11), *s6* 13 (11-15); *r2* 12 (10-13), *r3* 12 (11-13), *r4* 14 (12-15), *r5* 13 (11-14), *r6* 15 (13-16); *J1* 11 (10-11), *J2* 11(10-11), *J3* 11 (10-11), *J4* 11 (10-12), *J5* 13 (12-14); *Px2* 11 (10-12), *Px3* 12 (11-12); *Z1* 12 (11-13), *Z2* 13 (12-14), *Z3* 12 (11-12), *Z4* 15 (14-16), *Z5* 21 (20-21); *S1* 13 (12-14), *S2* 14 (13-14), *S3* 16 (15-17), *S4* 18 (16-20), *S5* 19 (18-20). Setae smooth and pointed.

**Ventral idiosoma (Figs. 64, 65).** Tritosternum 100 (96-102) long, line separating base remaining of tritosternum not distinguishable. Separate section of laciniae correspond to about 74% of total length of tritosternum. With a pair of punctate and reticulate presternal platelets. Sternal shield reticulate, except for a narrow longitudinal central band; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin concave; distance between *st1* and posterior margin of sternal shield 107 (106-108), *st1–st1* 64 (63–65), *st2–st2* 74 (73-75), *st3–st3* 76 (75–76). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sterna shield represented by an undulate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 153 (150–155) long, 67 (66–68) of maximal width; distance *st5–st5* 61 (60–62). Genital lyrifissure (iv5) on unsclerotized cuticle posterolaterad of *st5*; with two pairs of paragenital platelets, the inner slightly larger. Anal shield subtriangular, striate, with a pair of marginal pores laterad of paranal setae. Two pairs of slender metapodal platelets, the inner smaller. Opisthogaster with ten pairs of simple setae (*Jv1-Jv5*, *Zv1- Zv5*) and three pairs of lyrifissures. Setal length: *st1* 31 (29-33), *st2* 28 (26-29), *st3* 26 (25-27), *st4* 23 (21-25), *st5* 22 (20-24), *Jv1* 23 (20-25), *Jv2* 24 (22-26), *Jv3* 22 (21-23), *Jv4* 24 (21-26), *Jv5* 27 (26-27), *Zv1* 22 (20-23), *Zv2* 25 (23-26), *Zv5* 22 (21-23), paranal 24 (22-26), postanal 22 (21-23).

**Gnathosoma (Figs. 66-68).** Epistome convex and with anterior margin denticulate. Deustosternum delimited by subparallel lateral; with eight transverse lines, the most distal and the most proximal smooth, others with 18-21 denticles each. Corniculi subparallel to each other, 32 (30-33) long and 13 (12-14) wide, reaching proximal region of palp femur; *h3* in transverse line with *h2*. Fixed cheliceral digit 42 (40-43) long, with eight teeth and a short setiform *pilus dentilis*; movable digit 38 (37-39) long, with two teeth. Palp 168 (165-170) long. Setal length: *h1* 24 (22-25), *h2* 16 (15-17), *h3* 20 (19-20), pc 21 (20-22).

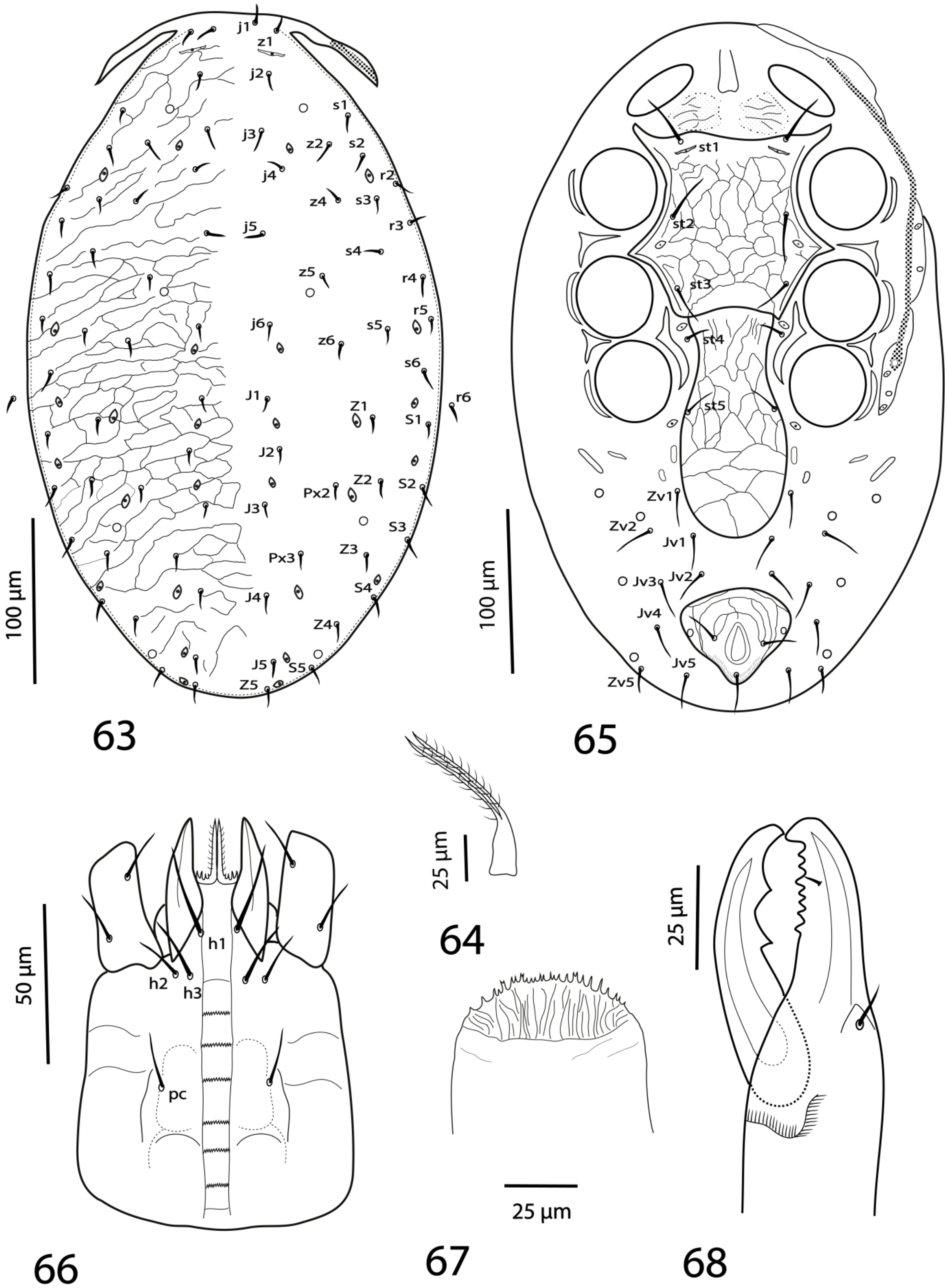
**Peritreme (Figs. 63, 65).** 229 (222-235) long, extending anteriorly to level between *z1* and *s1*. Peritrematic plate fused with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III and two lyrifissures and a pore behind stigma.

**Legs (Fig. 69-72).** Length (not including ambulacra): I, 424 (420-428); II, 328 (320-335); III, 295 (290-300); IV, 428 (420-435). Chetotaxy (coxa–tibia): I, 0-0/2,0/0-0; 1-0/1,1-1/2; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/2-2/1-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 1-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/1-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *pv* of tibia, *av2* and *pv2* of tarsus; leg III: mv, av2 and pv2 of tarsus; leg IV: *ad* of trochanter, *pv* of tibia, *mv* and md of tarsus.

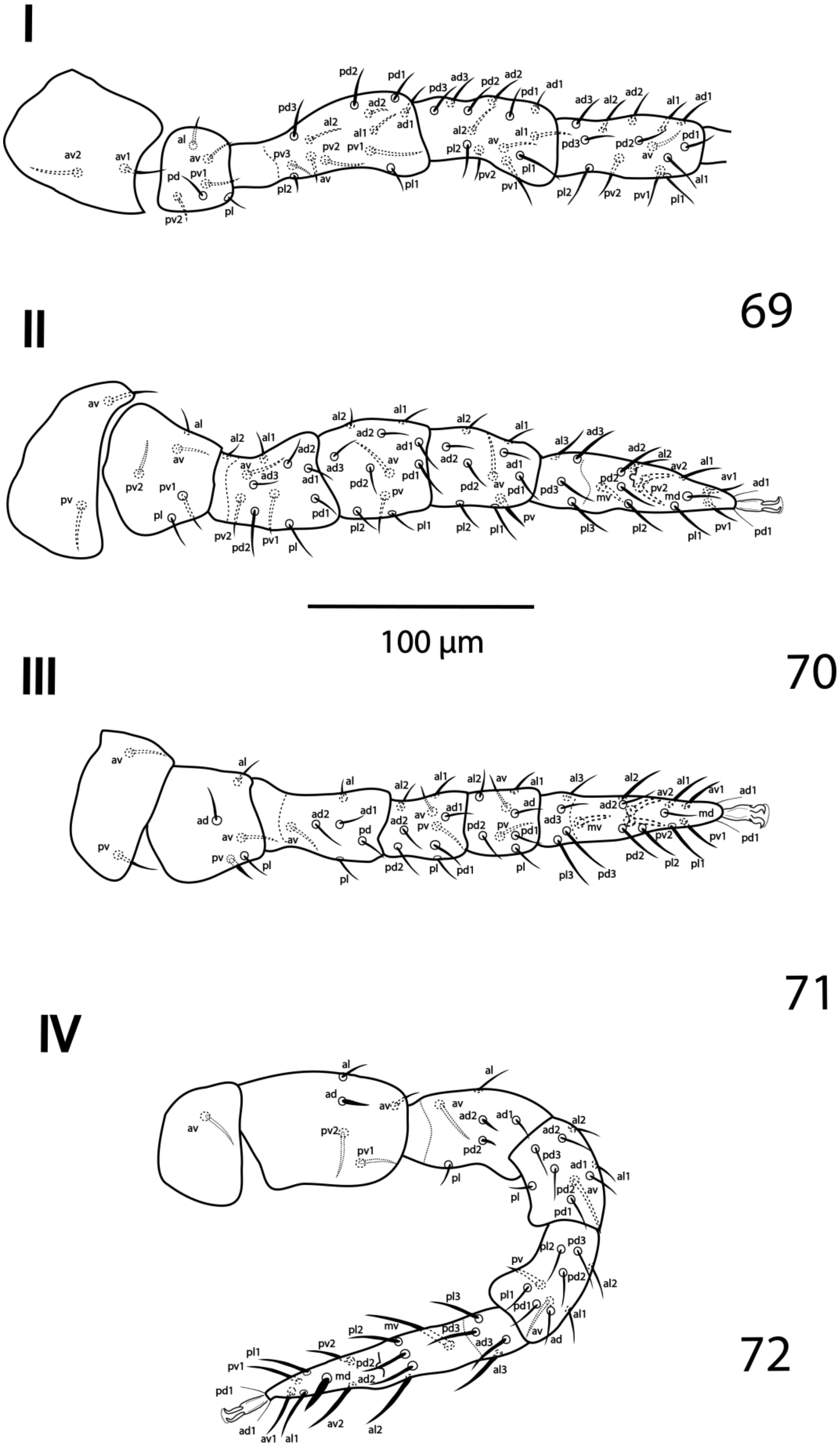
**Adult male**: unknown.

**Material examined.** Holotype female collected in Jataí, São Paulo state, Brazil, on 15/II/2014, from litter of a grassland.

**Remarks.** This species is most similar to *G. brevipellis* (Karg, 1979), but the latter has *j1* distinctly shorter, and *j3*, *j4*, *j5*, *j6*, *z4*, *z5*, *z6*, *s3*, *s4* and *s5* distinctly longer; additionally, the latter species has the posterior border of the sternal shield convex. This new species is also similar to *Gaeolaelaps* n.sp. 13 and *G. verticis* (Karg, 1978), both of which differ from the new species by having short peritreme (reaching only level of *r2*).




**FIGURES 63-68**. ***Gaeolaelaps* n.sp. 7**; Female: 63, dorsal view of idiosoma; 64, tritosternum; 65, ventral view of idiosoma; 66, gnathosoma; 67, tectum; 68, anti-axial view of chelicera.




**FIGURES 69-72**. ***Gaeolaelaps* n.sp. 7**; Female: 69, leg I; 70, leg II; 71, leg III; 72, leg IV.

***Gaeolaelaps* n.sp. 8**

**Adult female (Figures 73-83)** (two specimens measured)

**Dorsal idiosomal (Fig. 73).** Dorsal shield smooth, posteriorly rounded, 610-650 long and 408-436 of maximal width; with 37 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*; *z2–z6*; *s1–s6*; *r2–r5*; *J1–J5*; *Z1–Z5*; *S1*, *S3–S5*; *Px2* and *Px3*; whith 15 pairs of lyrifissures and 5 pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*R2*). Setal length: *j1* 25-34, *j2* 30-35, *j3* 31-38, *j4* 33-37, *j5* 32-35, *j6* 24-30; *z2* 34-37, *z3* 30-35, *z4* 31-36, *z5* 30-34, *z6* 27-30; *s1* 26-30, *s2* 24-29, *s3* 33-37, *s4* 32-36, *s5* 27-35, *s6* 28-31; *r2* 29-31, *r3* 30-31, *r4* 27-30, *r5* 24-29; *J1* 25-30, *J2* 23-26, *J3* 25-30, *J4* 27-30, *J5* 29-30; *Px2* 26-29, *Px3* 26-28; *Z1* 27-33, *Z2* 25-26, *Z3* 29-31, *Z4* 30-32, *Z5* 31-51; *S1* 28-31, *S2* 15-27 S3 34-35, *S4* 26-31, *S5* 20-28, *R2* 15.

**Ventral idiosoma (Figs. 74, 76).** Base of tritosternum 47-57 long and 18-20 wide basally; laciniae 105-115, totally separated from each other. With a pair of punctate and reticulate presternal platelets. Sternal shield with scant reticulation along lateral margins, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin truncate, with a pair of short spine-like projections; distance between *st1* and posterior margin of sternal shield 160-168, *st1–st1* 96-100, *st2–st2* 144-151, *st3–st3* 140-145. Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV, fused with anterior region. Exopodal plate slender, interrupted near anterior margin of coxa III. Genital shield tongue-shaped, smooth, 242-255 long, 118-123 of maximal width; distance *st5–st5* 102-110. Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*; with a pair of rod-shaped paragenital platelets. Anal shield oval, smooth, whith a pair of marginal pores laterad to paranal setae. Two pairs of rod-shaped metapodal platelets, the inner slightly smaller. Opisthogaster with ten pairs of setae (*Jv1*-*Jv5*, *Zv1*-*Zv5*). and two pairs of lyrifissures. Setal length: *st1* 58-63, *st2* 56-80, *st3* 65-67, *st4* 50-80, *st5* 38-44, *Jv1* 30-42, *Jv2* 35-41, *Jv3* 30-36, *Jv4* 27-32, *Jv5* 21-35, *Zv1* 31-43, *Zv2* 38-41, *Zv3* 21-27, *Zv4* 15, *Zv5* 22; paranal 24-35, postanal 31-37.

**Spermathecal apparatus (Fig. 75).** Tubulus a seemingly complex structure, apparently smooth throughout; ramus shaped as a short cylinder, attached to a saccular structure apparently separate from a similar structure on the opposite side and with a slender duct leaving each ramus.

**Gnathosoma (Figs. 77-79).** Epistome convex and with anterior margin denticulate. Deustosternum apparently with seven barely distinguishable transverse lines, whose denticles could not be counted. Corniculi subparallel to each other, 58 (55-63) long and 18 (16-20) wide, extending beyond median region of palp femur; *h3* slightly anteriad of *h2*. Chelicera with dorsal lyrifissure and dorsal seta distinct; fixed cheliceral digit 78-86 long, with 12 teeth (the first and the last distinctly longer than others) and a setiform *pilus dentilis*; movable digit 116-120 long, with two relatively large teeth. Palp 208-234 long. Setal length: *h1* 38-66, *h2* 27-32, *h3* 40-62, *pc* 42-46.

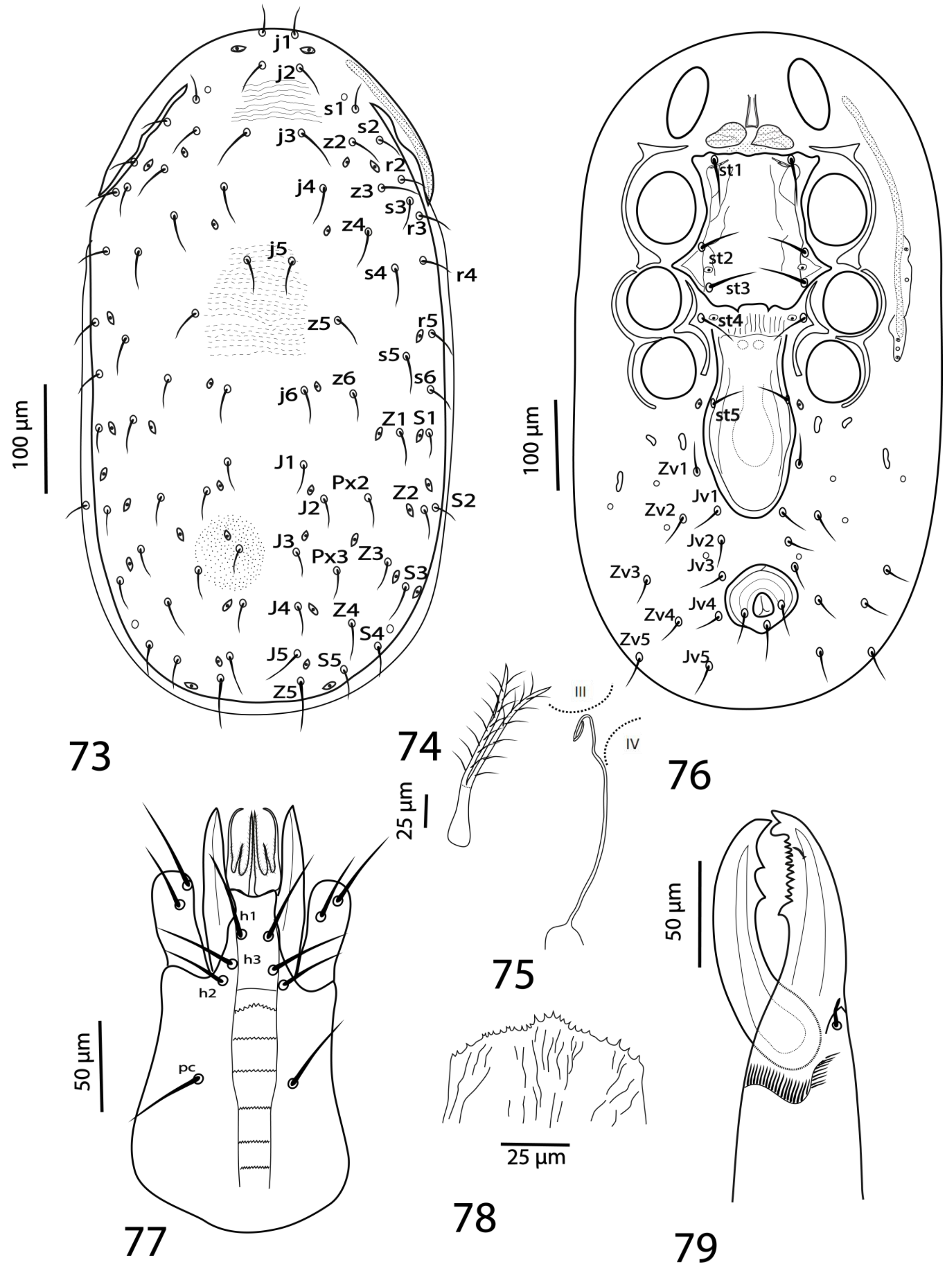
**Peritreme (Figs. 73, 76).** 322-353 long, extending anteriorly to level between *j1* and *s1*. Peritrematic plate fused with dorsal shield near *s1*, with a lyrifissure and a pore in region between coxae and a pair of lyrifissures and a pore behind stigma with sharp posterior end extending well behing posteriormost lyrifissure.

**Legs (Figs. 80-83).** Length (not including ambulacra): I, 735-785; II, 550-590; III, 495-534; IV, 726-780. Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2, 3/1-2; II, 0-0/1.0/1-0; 1-0/1,0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1, 1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *av* of femur, *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *md*, *al1, pl1, av1 and pv1* of tarsus; leg III: *av* and *pv* of genu, *mv* of tarsus; leg IV: *av* of genu, *av* of tibia, *mv* and *av2* of tarsus.

**Adult male**: unknown.

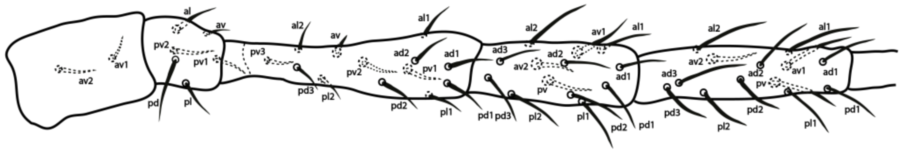
**Material examined**. Holotype and paratype females collected in Ipaussu, São Paulo state, Brazil, on 16/XII/2014, from litter of natural vegetation.

**Remarks.** This species is most similar to *Gaeolaelaps* n.sp. 5 and *Gaeolaelaps* n.sp. 12, but both differ from this new species by having no *Jx* setae.




**FIGURES 73-79.** ***Gaeolaelaps*** **n.sp. 8**; Female: 73, dorsal view of idiosoma; 74, tritosternum; 75, spermathecae; 76, ventral view of idiosoma; 77, gnathosoma; 78, tectum; 79, anti-axial view of chelicera.

I



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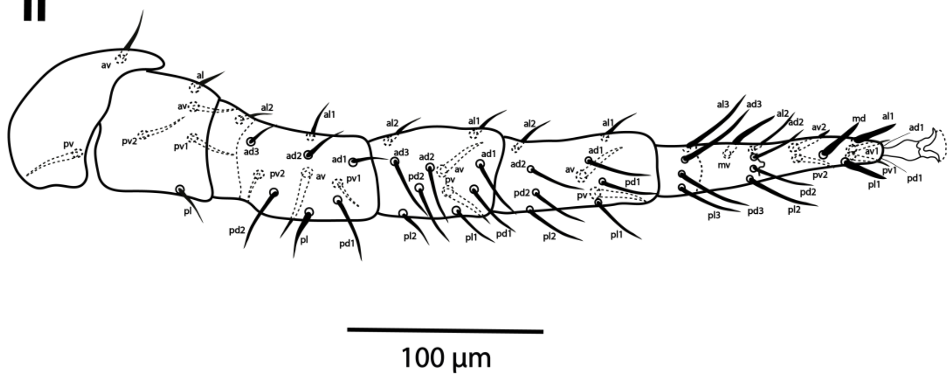
II

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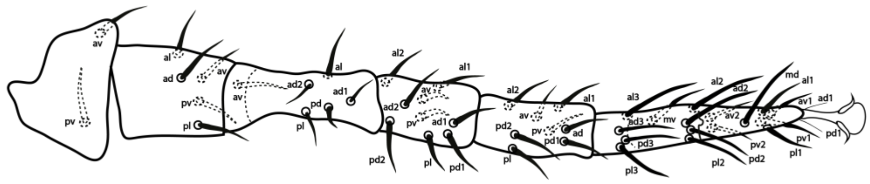
III



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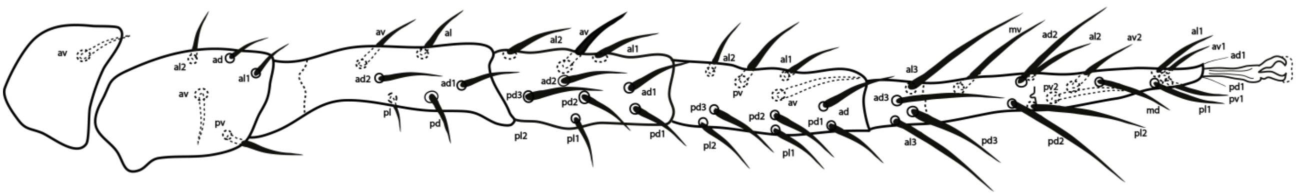
IV



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**FIGURES 80-83.** ***Gaeolaelaps* n.sp. 8**; Female: 80, leg I; 81, leg II; 82, leg III; 83, leg IV.

## *Gaeolaelaps* n.sp. 9

**Adult female (Figures 84-93)** (three specimens measured)

**Dorsal idiosomal (Fig. 84).** Dorsal shield reticulate, posteriorly rounded, 343 (333-353) long and 189 (185-195) wide; with 39 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*,*z2*, *z4–z6*; *s1*–s6; *r2–r5*, *J1–J5*; *Px2*, *Px3*; *Z1–Z5*; *S1–S5*; setae smooth and pointed, with 16 pairs lyrifissures and four pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*r6*). Setal length: *j1* 13 (12-14), *j2* 13 (12-13), *j3* 16 (14-17), *j4* 13 (12-14), *j5* 13 (12-14), *j6* 11 (10-11); *z1* 7 (6-8), *z2* 13 (12-14), *z4* 15, *z5* 13 (12-13), *z6* 13 (12-14); *s1* 14 (13-14), *s2* 13 (12-14); *s3* 13, *s4* 15 (14-15), *s5* 14, *s6* 14 (13-14); *r2* 14 (13-14), *r3* 15, *r4* 13, *r5* 13 (12-13), *r6* 11 (10-11); *J1* 11 (10-11), *J2* 12 (11-13), *J3* 12 (11-12), *J4* 14, *J5* 15; *Px2* 12 (11-12), *Px3* 13 (12-13); *Z1* 14 (13-15), *Z2* 16 (15-16), *Z3* 16 (15-16), *Z4* 18 (17-18), *Z5* 16 (15-16); *S1* 14 (13-14), *S2* 15, *S3* 16 (14-18), *S4* 18 (17-18), *S5* 17 (16-17).

**Ventral idiosoma (Figs. 85, 86).** Base of tritosternum 23 (22-24) long and 10 (9-10) wide basally; laciniae 62 (61-63), separated by about 92% of their total length. With a pair of punctate and reticulate presternal platelets. Sternal shield smooth centrally and reticulate along lateral margins; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin of sternal shield convex; distance between *st1* and posterior margin of sternal shield 93 (90-96), *st1–st1* 46 (45-46*), st2–st2* 65 (65), *st3–st3* 66 (65-66). Seta *st*4 and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; posterior region represented by an undulate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 111 (108-113) long, 53 (50-55) of maximal width; distance *st5–st5* 47 (45-48). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. Anal shield subtriangular, reticulate, with a pair of marginal pores anterolaterad of paranal setae. Two metapodal platelets, the inner slender, the outer ellipsoidal and larger. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv5*) and four pairs of lyrifissures. Setal length: *st1* 20, *st2* 23 (22-23), *st3* 22 (21-22), *st4* 17 (16-17), *st5* 16 (15-16), Jv*1* 16 (15-16), *Jv2* 17 (16-17), *Jv3* 15, *Jv4* 16 (15-16), *Jv5* 19 (17-20), *Zv1* 16 (15-16), *Zv2* 17 (16-18), *Zv3* 16, paranal 14 (12-16), post anal 11 (9-13).

**Gnathosoma (Figs. 87-89).** Epistome convex and with anterior margin denticulate. Deustosternum with eight transverse lines, the most distal and the most proximal smooth, others with 11-15 denticles each. Corniculi subparallel to each other, 26 (25-26) long and 15 (14-15) wide, reaching proximal region of palp femur; *h3* about in transverse line with *h2*. Fixed cheliceral digit 48 (46-50) long, apparently with five teeth in a paraxial line and two teeth in an antiaxial line and a short setiform *pilus dentilis*; movable digit 44 (43-45) long, with two teeth. Palp 132 (122-142) long. Setal length: *h1* 20 (17-22), *h2* 17 (16-18), *h3* 20 (17-22), *pc* 16.

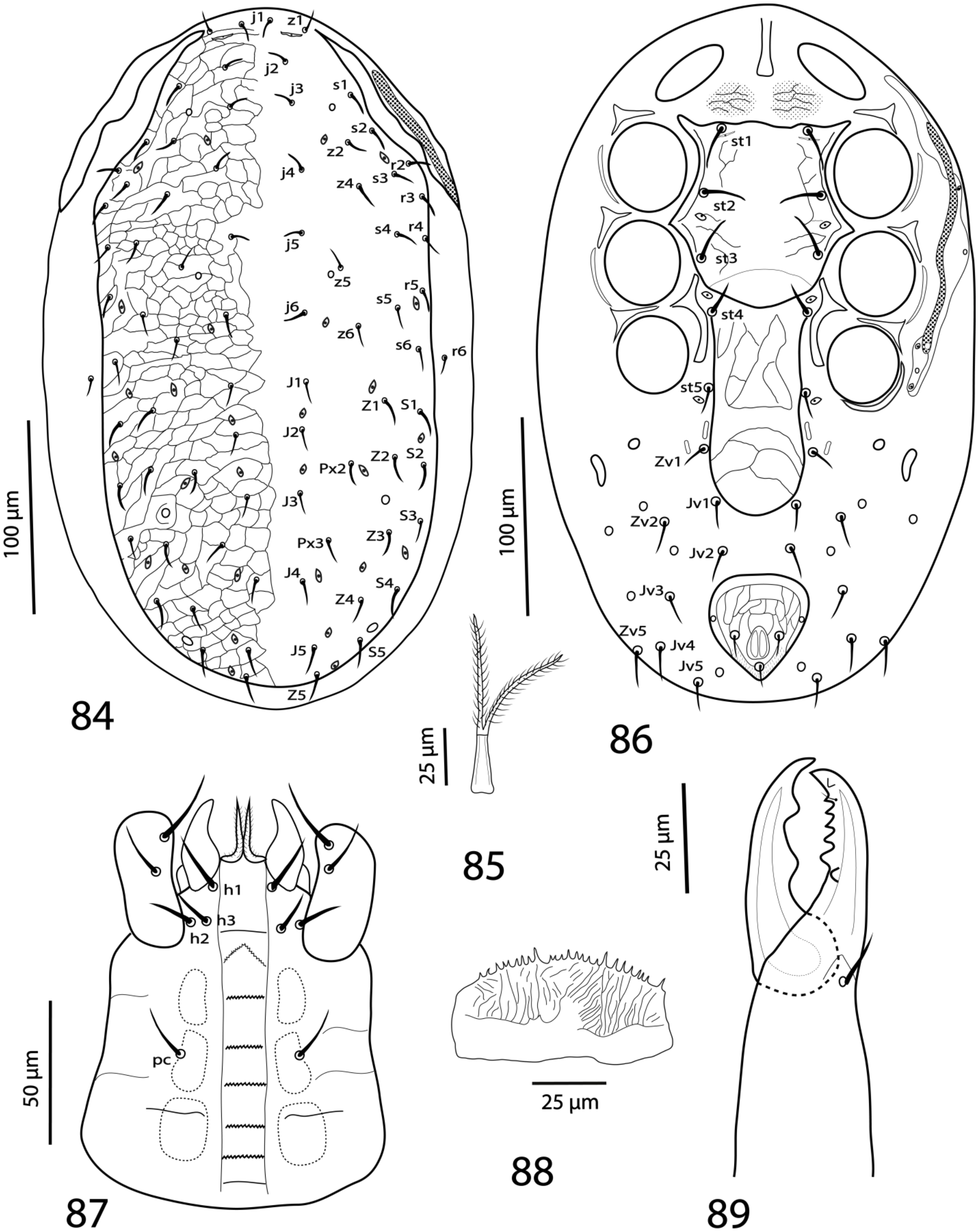
**Peritreme (Figs. 84, 86).** 152 (147-156) long, extending anteriorly to level between *z1* and *s1*; peritrematic plate fused with dorsal shield near z1; with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

**Legs (Figs. 90-93).** Length (not including ambulacra): I, 337 (320-353); II, 244 (235-252); III, 204 (195-213); IV, 285 (270-300). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-3/1,2/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1-0/1, 0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg I: *pv* of tibia; leg II: *av* of femur; leg III: *al3* and *mv* of tarsus; leg IV: *av2*, *pv2*, *md*, *av1* and *pv1* of femur.

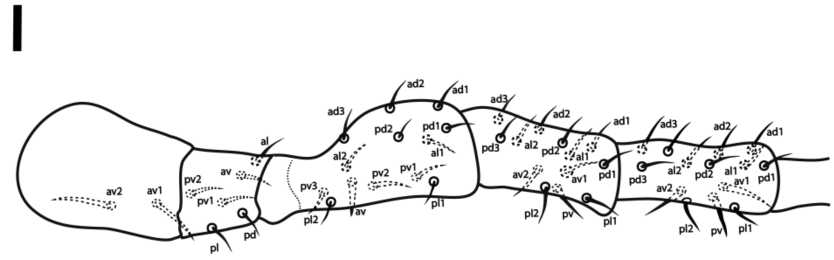
**Adult male**: unknown.

**Material examined.** Holotype female and a paratype female collected in Ipaussu, São Paulo state, Brazil, on 3/XII/2014, from soil (0-5 cm deep) of natural vegetation. and one paratype female collected in Valparaíso, São Paulo state, on 9/XII/2014 from soil (0-5 cm deep) of natural vegetation.

**Remarks.** This species is similar to *G. brevipellis* (Karg, 1979) and *G. farajii* Nemati & Mohseni, 2013, but both of these have seta *z3*. The first of those species further differ from the new species by having and sternal shield totally reticulate. It is also similar to *Gaeolaelaps* n.sp 4., but the latter has short peritreme (reaching only level of *r2*).




**FIGURES 84-89.** ***Gaeolaelaps*** **n.sp**. **9**; Female: 84, dorsal view of idiosoma; 85, tritosternum; 86, ventral view of idiosoma; 87, gnathosoma; 88, tectum; 89, anti-axial view of chelicera.

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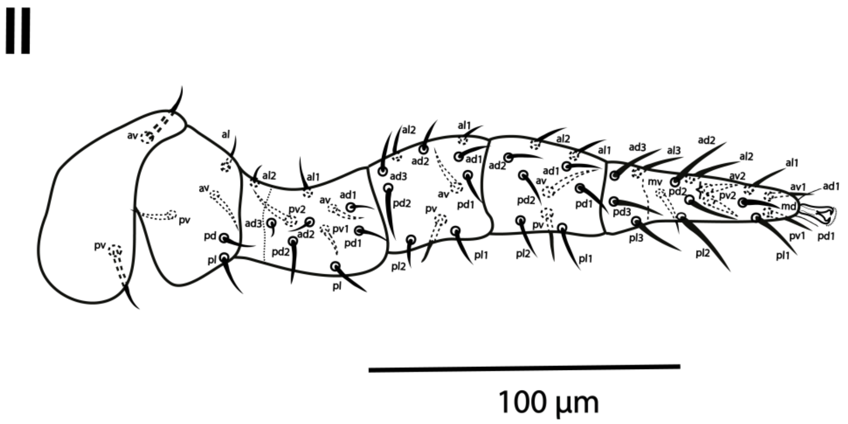


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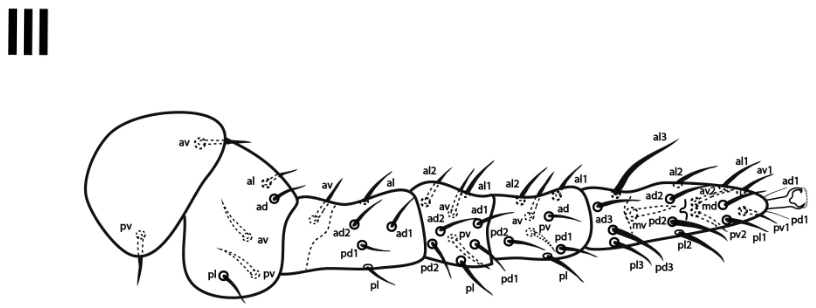


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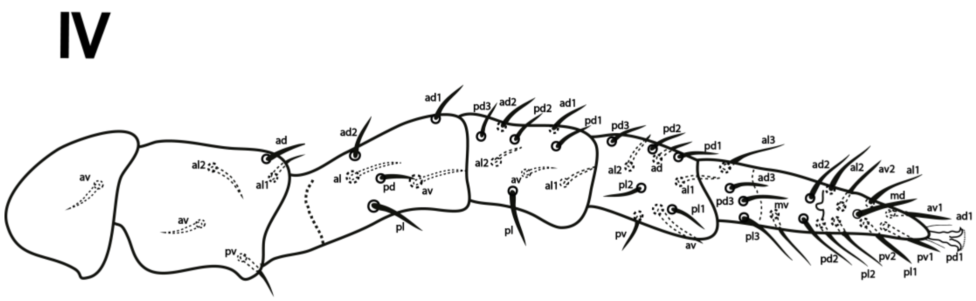


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**FIGURES 90-93**. ***Gaeolaelaps* n.sp. 9**; Female: 90, leg I; 91, leg II; 92, leg III; 93, leg IV.

***Gaeolaelaps* aff. *invictianus* Walter & Moser**

*Gaeolaelaps invictianus* Walter & Moser, 2010: 400.

**Adult female (Figures 94-103)** (eight specimens measured)

**Dorsal idiosoma (Fig. 94).** Podonotal region of dorsal shield smooth and opisthonotal region reticulate and posteriorly rounded, 408 (395–432) long and 210 (198–220) wide; with 37 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*,*z2*, *z4–z6*, *s1–s6*, *r2–r5* (*r3* absent on one side in some specimens), *J1*, *J3–J5*, *Px2*, *Px3*, *Z1–Z5*, *S1–S5*; setae *Z2* about equidistant to *J1* and *J3*; setae smooth and pointed; with 14 pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*R1*). Measurement of setae: *j1* 25 (23–28), *j2* 25 (24–30), *j3* 32 (28–35), *j4* 30 (27–33), *j5* 26 (22–29), *j6* 23 (22–25); *z1* 27 (22–30), *z2* 32 (28–36), *z4* 35 (35–36), *z5* 30 (28–30), *z6* 29 (23–31); *s1* 23 (19–25), *s2* 25 (23–26); *s3* 32 (30–33), *s4* 31 (30–35), *s5* 28 (25–31), *s6* 29 (26–32); *r2* 31 (28–34), *r3* 30 (28–32), *r4* 26 (24–29), *r5* 29 (26–30); *J1* 23 (21–25), *J3* 21 (20–23), *J4* 32 (30–34), *J5* 32 (30–35); *Px*2 21 (20–24) *Px*3 25 (23–26); *Z1* 34 (32–36), *Z2* 27 (25–28), *Z3* 31 (30–35), *Z4* 40 (38–40), *Z5* 50 (47–53); *S1* 26 (22–30), *S2* 25 (22–27), *S3* 26 (22–28), *S4* 30 (29–33), *S5* 37 (34–40); *R1* 17 (15–20).

**Ventral idiosoma (Fig. 95, 96).** Tritosternum 89 (84-99) long, line separating base remaining of tritosternum not distinguishable; separate section of laciniae correspond to about 70% of total length of tritosternum. With a pair of punctuate and transversely striate presternal platelets. Sternal shield smooth, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin slightly convex; distance between st1 and posterior margin of sternal shield 98 (80–104), *st1–st1* 63 (60–65), *st2–st2* 84 (80–89), *st3–st3* 84 (82–85). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped and with scant lines, 148 (157–168) long, 75 (68–81) of maximal width; distance *st5–st5* 70 (66–72). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of slender paragenital platelets close to a pair of lateral notches of genital shield posteriad of *st5* and a pair of ellipsoidal platelets posteriad of *Zv1*. Anal shield subtriangular, without marginal pores. With two pairs of rounded metapodal platelets, the inner ill-defined, smaller. Opisthogaster with eight pairs of simple setae (*Jv1–Jv5*, *Zv1*, *Zv2* and *Zv4*) and five pairs of lyrifissures. Setal length: *st1* 27 (25–30), *st2* 29 (23–31), *st3* 28 (25–31), *st4* 24 (20–26), *st5* 21 (19–25), Jv*1* 20 (19–21), *Jv2* 22 (19–24), *Jv3* 23 (22–26), *Jv4* 23 (20–26), *Jv5* 34 (30–38), *Zv1* 19 (16–20), *Zv2* 23 (20–25), *Zv3* 23 (21–25), paranal 24 (21–25), postanal 27 (23–30).

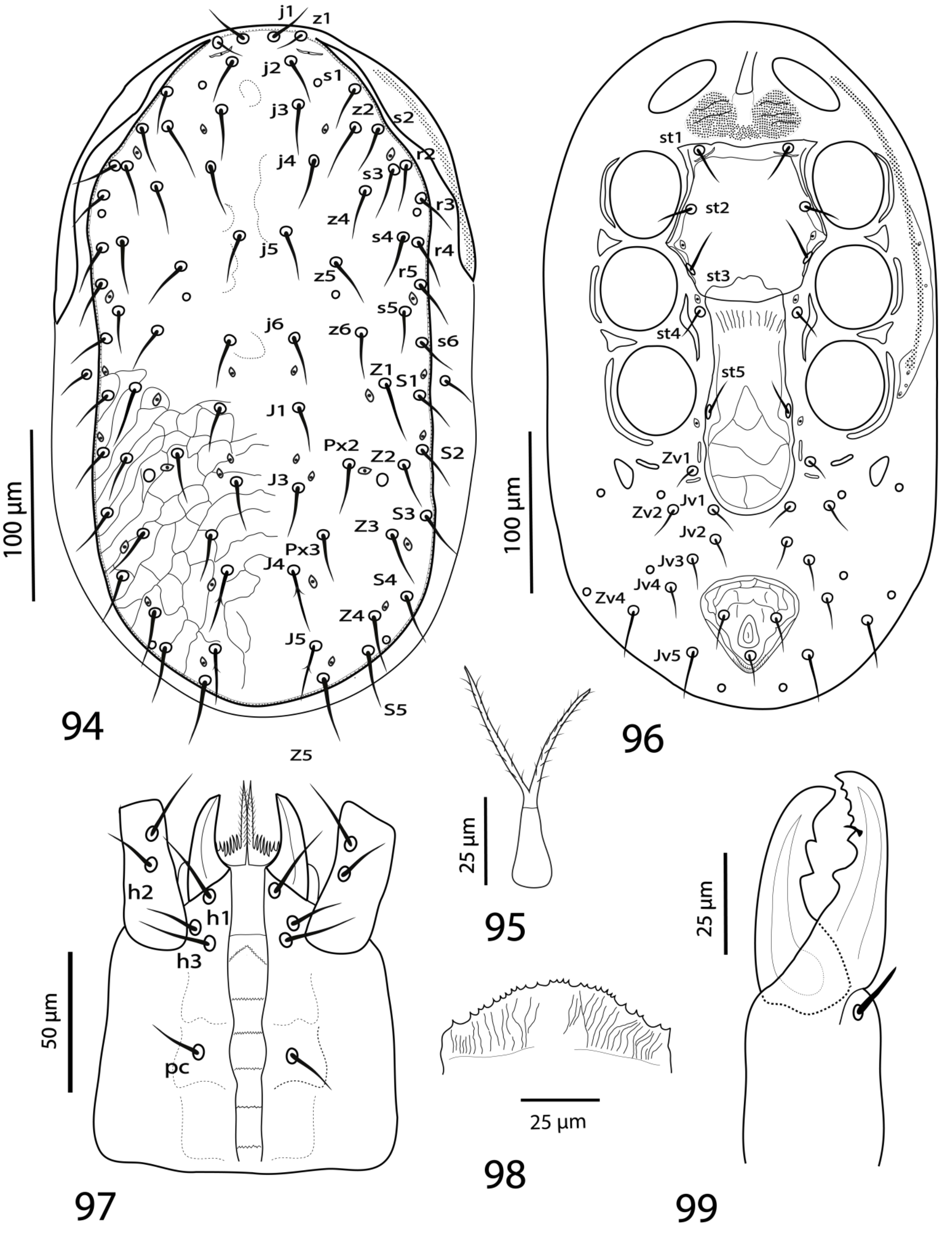
**Gnathosoma (Figs. 97-99).** Epistome slightly convex and with anterior margin denticulate. Deustosternum with a barely discernible distal smooth transverse line followed by six lines containing 10–12 denticles each. Corniculi subparallel to each other, 37 (35–40) long and 12 (11–14) wide, reaching distal end of palp trochanter; *h3* slightly posteriad and mediad of *h2*. Chelicera with dorsal lyrifissure distinct; anti-axial lyrifissure indistinguishable; dorsal seta stout. Fixed cheliceral digit 43 (41–45) long, with seven teeth and a short setiform *pilus dentilis*; movable digit 59 (55–60), with two teeth. Palp 156 (154–160) long. Setal length: *h1* 25 (22–30), *h2* 14 (11–16), *h3* 29 (26–30), *pc* 18 (16–20).

**Peritreme (Figs. 94, 96).** 198 (191–203) long, extending anteriorly to level between *z1* and *s1*; peritrematic plate fused by a narrow bridge to dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III; a pair of lyrifissures and a pore behind stigma.

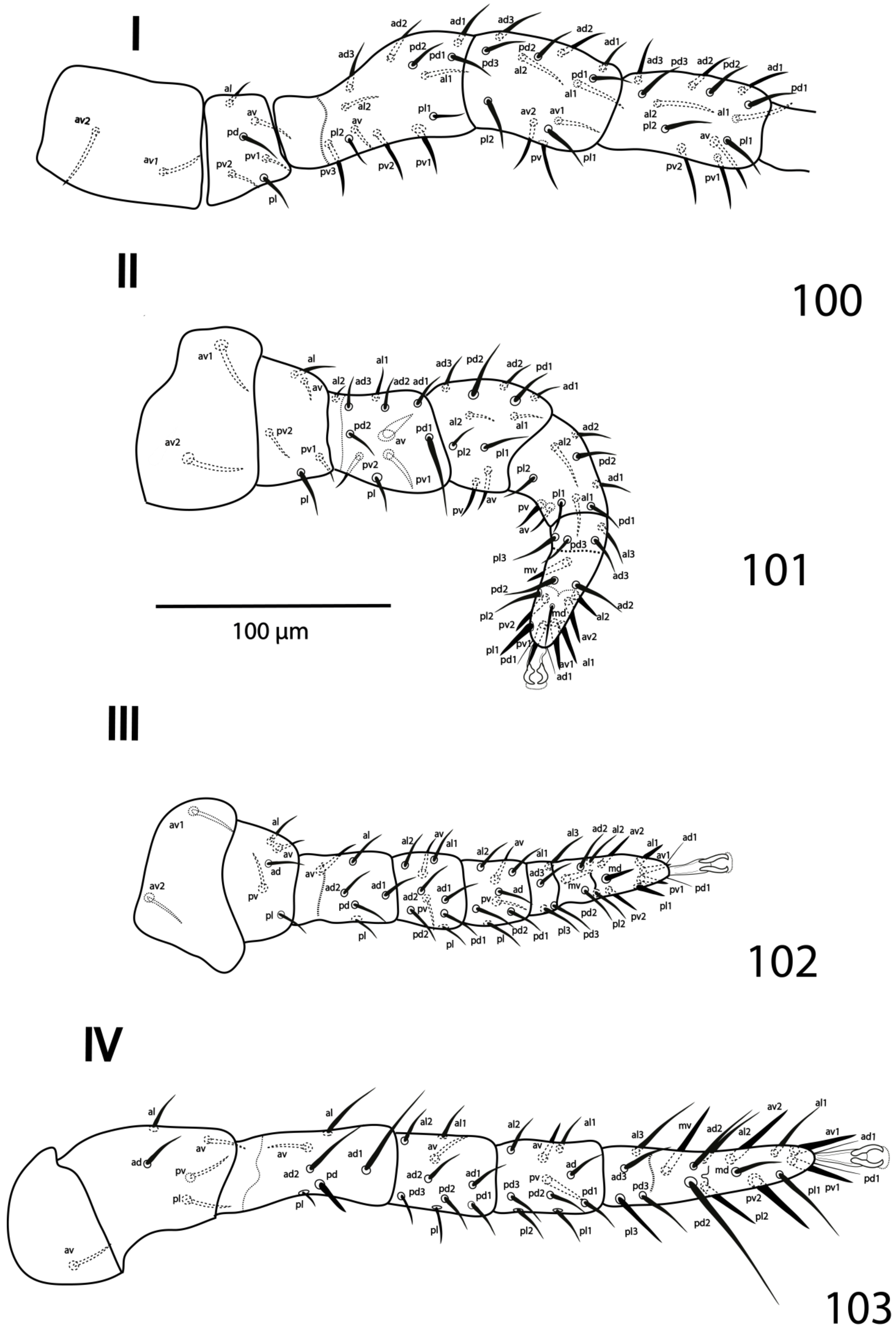
**Legs (Figs. 100-103).** Length (not including ambulacra): I, 384 (365–400); II, 279 (268-290); III, 243 (230–250); IV, 353 (320–375). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. Seta *ad1* of femur IV [51(50–53)] and *pd2* of tarsus IV [72 (70–74)] distinctly longer than other setae. With the following setae stouter than other setae of same segments: leg I: *pv1* of femur; leg II: *av* of femur, *mv*, *md*, *pl2*, *av2*, *pv2*, *av1* and *pv1* of tarsus; leg III: *av* of femur, *av* of genu, *av* of tibia, *mv*, *md*, *av2*, *pv2*, *av1*and *pv1* of tarsus; leg IV: *av* of genu, *av* and *pv* of tibia, *av1*, *pv1*, *av2* and *pv2* of tarsus.

**Material examined.** Ipaussu: two females from soil (0-5 cm deep) of a grassland; Jatai: twenty two females from litter of a grassland; Valparaiso: three females from litter and ten females from grassland soil (0-5 cm deep); ten females from litter, two females from soil (0-5 cm deep) and two females from soil (5-10 cm deep) of a sugarcane field. All collected between 8 and 16/XII/2014.

**Remarks.** The specimens examined have the general facies of *G. invictianus*, described from specimens found in phoretic association with the fire ant *Solenopsis invicta* Bruen from southern USA. The main differences refer to the smaller sizes of the specimens collected in this study and the concurrently shorter body and leg setae and, more outstandingly, the presence of the post-anal seta in those specimens. Our first reasoning was to consider the specimens to be a new species. However, this is not done because it could represent a case of adult female dimorphism, apparently not previously reported in Laelapidae. *Solenopsis invicta* is found from São Paulo state (Pesquero & Dias, 2011), where the mites were collected in this study. Future collections in that region may indicate whether typical *G. invictianus* are found in association with those ants, further supporting the assumption that the specimens reported in this paper belong to that species. Biological observations or molecular analysis should be helpful in revealing the true identity of the specimens collected. Female dimorphism in Mesostigmata has rarely been proven. Experimental confirmation of adult female dimorphism has only been reported for *Antennoseius* (*Vitzthumia*) *janus* Lindquist & Walter, 1989 by Lindquist & Walter (1989) and for *Antennoseius* (*Vitzthumia*) *perseus* Beaulieu, Déchêne & Walter (Ascidae) by Beaulieu et al. (2008).




**FIGURES 94-99.** ***Gaeolaelaps*** **aff.** ***invictianus*** **Walter & Moser**; Female: 94, dorsal view of idiosoma; 95, tritosternum; 96, ventral view of idiosoma; 97, gnathosoma; 98, tectum; 99, anti-axial view of chelicera.




**FIGURES 100-103.** ***Gaeolaelaps* aff. *invictianus* Walter & Moser**; Female: 100, leg I; 101, leg II; 102, leg III; 103, leg IV.

***Gaeolaelaps* n.sp. 10**

**Adult female (Figures 104-113)** (five specimens measured)

**Dorsal idiosomal (Fig. 104).** Dorsal shield smooth, posteriorly pointed, with transverse line in the region of fusion of podonotal and opisthonotal shields, 286 (274-295) long and 127 (120-135) wide; with 37 pairs of setae: *j1–j6*, *z1–z6*, *s1–s6*, *r2–r5*, *J1–J5*, *Z1–Z5*, *S1–S5*; with eight pairs of lyrifissures and two pairs of pores. Unsclerotized cuticle laterad of dorsal shield with two pairs of setae (*r6* and *R3*). Setal length: *j1* 18 (16–20), *j2* 16 (14–17), *j3* 21 (19–23), *j4* 20 (19–22), *j5* 19 (19–20), j6 20; z1 19 (18–20), z3 20 (18–21), z4 21 (20–22), z5 22 (20–23), z6 21 (19–22); *s1* 16 (12–18), *s2* 19 (17–20); *s3* 21 (20–22), *s4* 20 (19–22), *s5* 20 (18–21), *s6* 17 (14–20); *r2* 20 (17–24), *r3* 26, *r4* 21 (20–23), *r5* 24 (22–25), *r6* 29 (24–33); *J1* 17 (16–18), *J2* 17, *J3* 16 (15–16), *J4* 16 (16–17), *J5* 16 (15–18); *Z1* 18 (17–20), *Z2* 18 (17–19), *Z3* 17 (16–18), *Z4* 18 (16–20), *Z5* 18 (17–21); *S1* 19 (17–20), *S2* 19 (18–20), *S3* 17 (15–18), *S4* 15 (14–16), *S5* 14 (11–18), *R3* 63 (62–64).

**Ventral idiosoma (Figs. 105, 106).** Base of tritosternum 22 (21-22) long and 11 (10-11) wide basally; laciniae 71 (67-74) long, line separating base from laciniae not distinguishable; divided section of laciniae about 76% of total length of tritosternum. With presternal area lightly sclerotized, with few striae but without punctation, fused with sternal shield, but with distinct constriction behind *st1*. Sternal shield broad, smooth, with two pairs of setae (*st2–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); seta *st1* inserted on presternal region; posterior margin slightly convex; distance between *st1* and posterior margin of sternal shield 96 (90–100), *st1–st1* 47 (45–48), *st2–st2* 72 (70–74), *st3–st3* 69 (66–71). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by a narrow and boomerang-shaped platelet around coxa IV, occasionally interrupted near mid-length. Exopodal plate indistinct. Genital shield tongue-shaped, with scant longitudinal lines, 95 (90–100) long, 37 (36–38) maximal width; distance st5–st5 36 (32–38). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of st5. Without discrete paragenital plates. Anal shield oval, without marginal pores. Metapodal platelets indistinct. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv5*) and two pairs of lyrifissures. Setal length: *st1* 20 (20–21), *st2* 25 (25–26), *st3* 25 (25–26), *st4* 20, *st5* 15 (14-15), Jv*1* 16 (16–17), *Jv2* 18 (16–20), *Jv3* 35 (35–36), *Jv4* 40 (35–50), *Jv5* 36 (32–40), *Zv1* 17 (15–18), *Zv2* 18 (16–20), *Zv5* 45 (40–51), paranal 15, postanal 20 (19–20).

**Gnathosoma (Figs. 107-109).** Epistome truncate and with anterior margin denticulate. Deustosternum delimited by lateral lines that converge slightly posteriorly; with seven transverse lines, the most distal smooth, others ranging from 8 (proximally) to 11 (distally) denticles each. Corniculi subparallel to each other, 37 (36–38) long and 11 (10–11) wide, almost reaching median region of palp femur; *h3* anteromesad of *h2*. Chelicera with distinct dorsal lyrifissure and dorsal seta; fixed cheliceral digit 37 (35–38) long, with seven teeth; movable digit 44 (40–48) long, with two teeth. Palp 112 (109–116) long. Setal length: *h1* 29 (27–30), *h2* 15 (13–16), *h3* 24 (23–25), *pc* 16 (15–17).

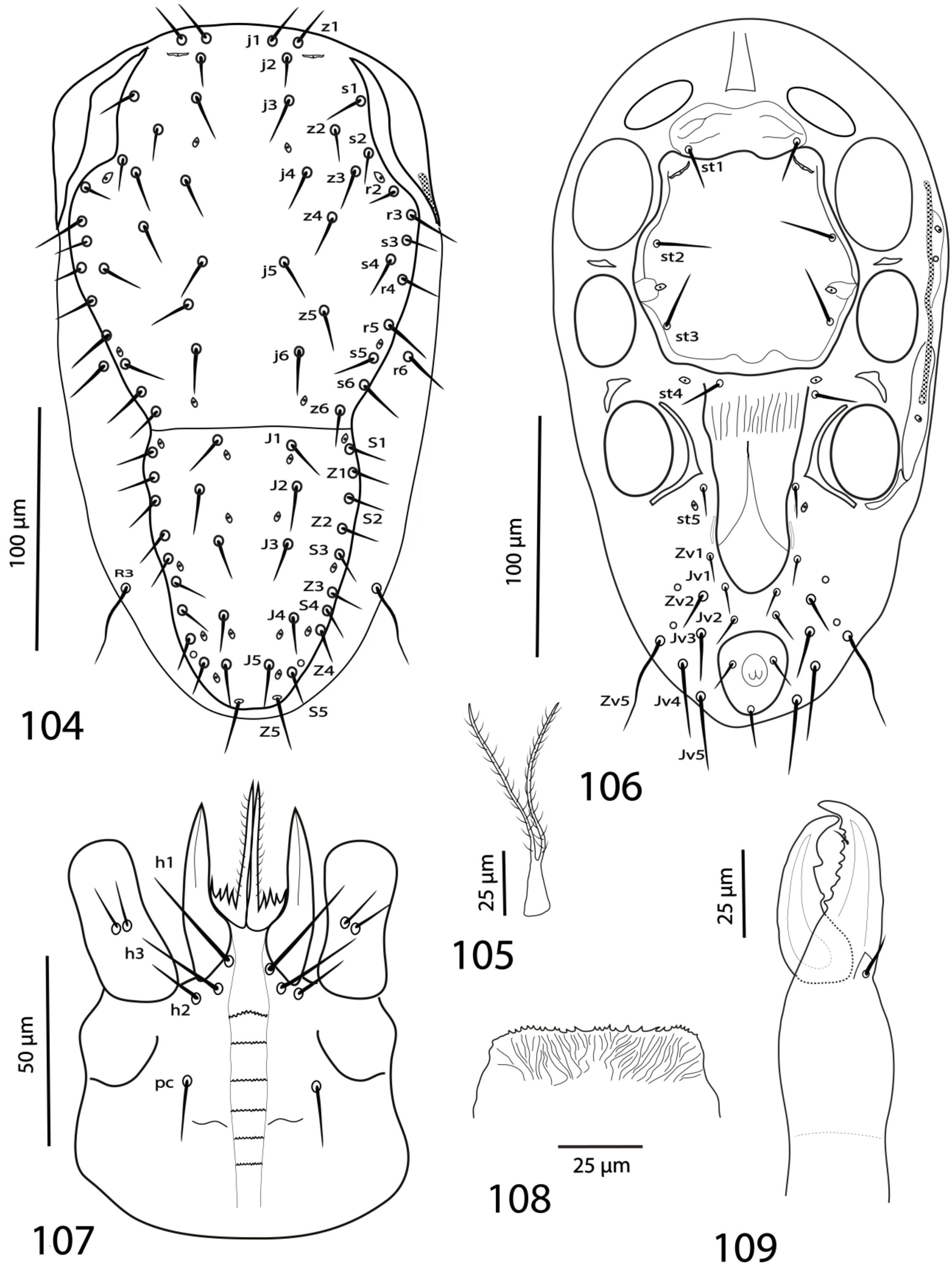
**Peritreme (Figs. 104, 106).** 115 (108-117) long, extending anteriorly to level of *r2*. Peritrematic plate fused with dorsal shield in region between *z1* and *s1*, with a lyrifissure and a pore in region between coxae II–III and with a distinct lyrifissure behind stigma.

**Legs (Figs. 110-113).** Length (not including ambulacra): I, 333 (325–338); II, 217 (200-230); III, 190 (180–200); IV, 293 (290–295). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1.0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. Tarsus IV: *pd2* 30 (31-33) and *md* 25 (24-25) longer than other setae of same segment. With the following setae stouter than other setae of same segments: leg II: *pv* of genu, *pv* of tibia, *mv*, *av2* and *pv2* of tarsus; leg III: *av* of genu, *av* and *pv* of tibia, *mv* and *av2* of tarsus; leg IV: *pv* of tibia, *pl3*, *mv*, *av2*, *pv2*, *av1* and *pv1* of tarsus.

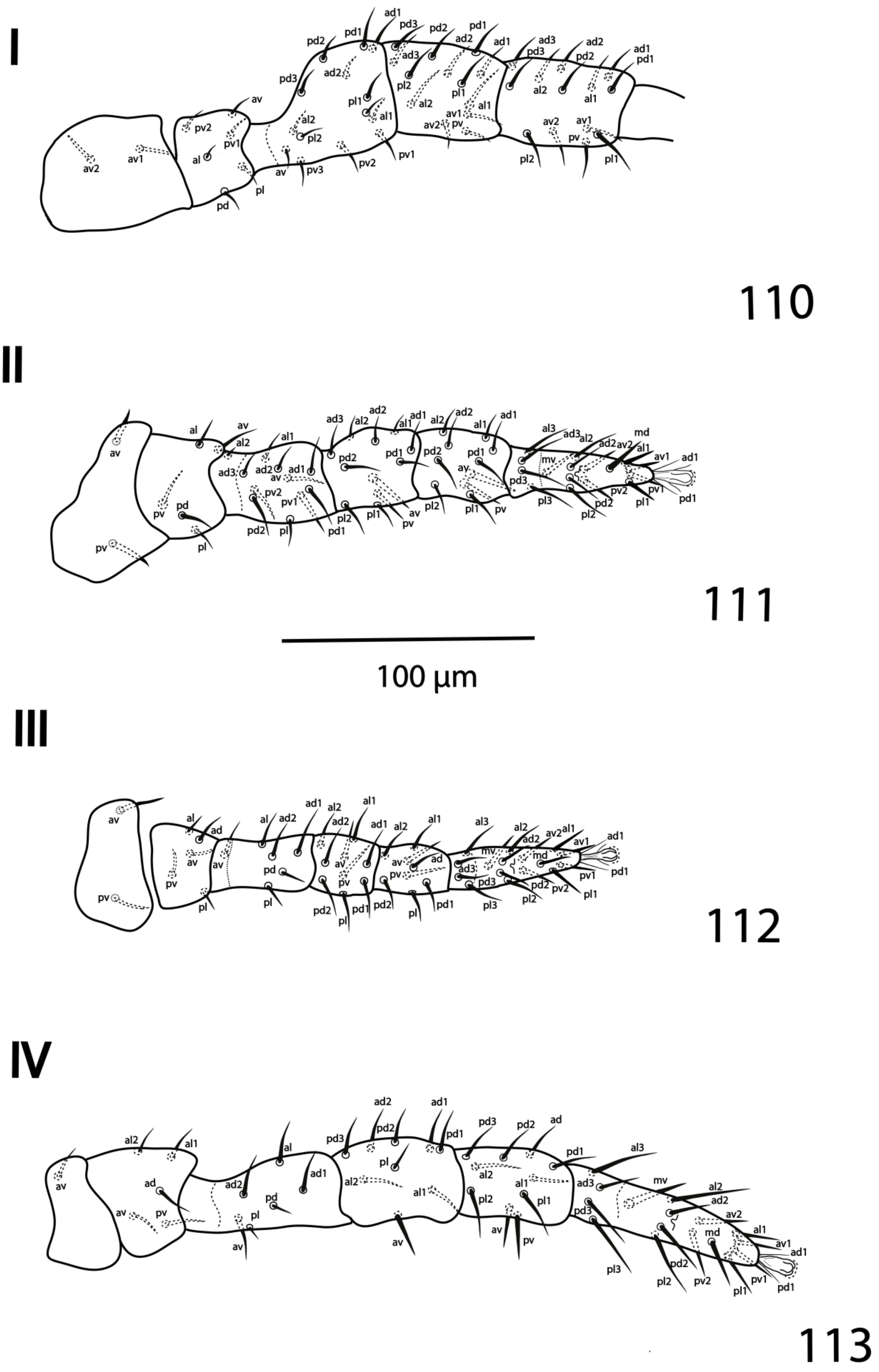
**Adult male**: unknown.

**Material examined.** Holotype female and four paratype females collected in Ipaussu, São Paulo state, Brazil, on 3/XII/2014, from soil (0-5 cm deep) of a grassland.

**Remarks.** This species is different from all other *Gaeolaelaps* species by having a transverse line in the region of fusion of podonotal and opisthonotal shields.




**FIGURES 104-109**. ***Gaeolaelaps* n.sp. 10**; Female: 104, dorsal view of idiosoma; 105, tritosternum; 106, ventral view of idiosoma; 107, gnathosoma; 108, tectum; 109, anti-axial view of chelicera.




**FIGURES 110-113**. ***Gaeolaelaps* n.sp. 10**; Female: 110, leg and tarsi I; 111, leg II; 112, leg III; 113, leg IV.

***Gaeolaelaps isodentis*** **(Karg)**
*Hypoaspis* (*Geolaelaps*) *isodentis* Karg, 1989b: 121.
*Hypoaspis* (*Gaeolaelaps*) *isodentis*. — Karg, 2000: 247.

**Adult female (Figures 114-123)** (eight specimens measured)

**Dorsal idiosomal (Fig. 114).** Dorsal shield reticulate and posteriorly rounded, 400 (380–417) long and 238 (220–252) wide; with 38 pairs of setae including two pairs of extra opisthonotal setae: *j1*–j6, *z1*,*z2*, z4–z6; *s1–s6*; *r2–r5*, *J1–J5*; *Px*2, *Px3*; *Z1–Z5*; *S1–S5*; setae smooth and pointed; with 14 pairs of lyrifissures and six pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a single pair of setae (*R1*). Setal length: *j1* 13 (10–15), *j2* 14 (12–15), *j3* 16 (14–17), *j4* 18 (14–20), *j5* 12 (12–19), *j6* 14 (12–15); *z1* 10 (6–-14), *z2* 17 (14–20), *z4* 15 (14–16), *z5* 16 (13–20), *z6* 14 (12–16); *s1* 15 (14–16), *s2* 15(12–16); *s3* 15(13–16), *s4* 16(14–17), *s5* 15(14–17), *s6* 15(13–17); *r2* 15(13–16), *r3* 15 (15–16), *r4* 14 (13–15), *r5* 16 (13–17); *J1* 13 (11–15), *J2* 12 (9–13), *J3* 13 (10–14), *J4* 16 (14–17), *J5* 18 (15–20); *Px2* 13 (11–14), *Px3* 14 (13–15); *Z1* 15 (13–17), *Z2* 16 (14–17), *Z3* 16 (14–17), *Z4* 16 (15–18), *Z5* 19 (16–22); *S1* 15 (14–17), *S2* 15 (14–17), *S3* 16 (14–18), *S4* 18 (15–19), *S5* 18 (16–20).

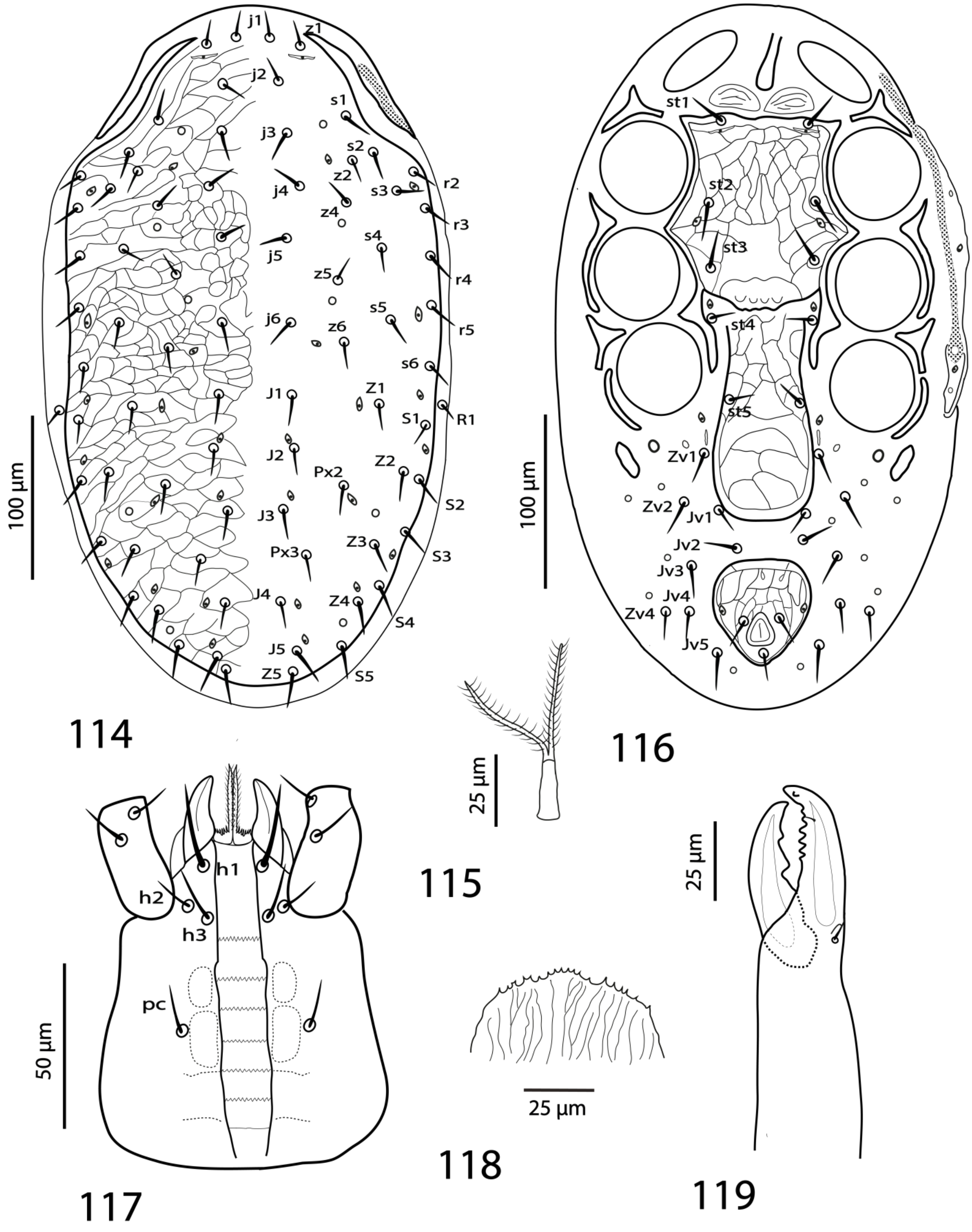
**Ventral idiosoma (Figs. 115, 116).** Tritosternum 99 (97-101) long, line separating base remaining of tritosternum not distinguishable. Separate section of laciniae correspond to about 77% of total length of tritosternum. With a pair of reticulate presternal platelets. Sternal shield reticulate (reticles at central area between *st3* setae barely distinguishable); with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin convex, with two pairs of depressions next to central region of margin; distance between st1 and posterior margin of sternal shield 112 (110–112), *st1–st1* 52 (50–55), *st2–st2* 71 (70–73), *st3–st3* 75 (74–75). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by a v-shaped platelet between coxae III–IV, distinctly fused by a broad or a narrow bridge with anterior region or not fused. Exopodal plate fragmented. Genital shield tongue-shaped and reticulate, 121 (114–125) long, 64 (60–66) of maximal width; distance *st5–st5* 55 (50–59). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. Anal shield subtriangular, reticulate, with a pair of marginal pores anterolaterad of paranal setae. Two pairs of metapodal platelets the external ellipsoidal and the internal rounded and smaller. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv4*) and three pairs of lyrifissures. Setal length: *st1* 24 (20-26), *st2* 25 (22-27), *st3* 24 (21-26), *st4* 20 (16-22), *st5* 18 (16-20), *Jv1* 18 (16-20), *Jv2* 20 (16-21), *Jv3* 19 (15-20), *Jv4* 20 (15-21), *Jv5* 22 (17-24), *Zv1* 16 (14-19), *Zv2* 18 (16-20), *Zv4* 19 (16-20), paranal 17 (12-20), postanal 12 (9-14).

**Gnathosoma (Figs. 117-119).** Epistome convex and with anterior margin denticulate. Deustosternum with a distal smooth transverse line followed by six lines containing 12–14 denticles (only five lines in some specimens) each and a proximalmost smooth line. Corniculi subparallel to each other, 41 (40–41) long and 11 (10-11) wide, reaching distal end of palp trochanter; *h3* slightly posteriad of *h2*. Fixed cheliceral digit 37 (36-38) long, apparently with 7–8 teeth and a short setiform *pilus dentilis*; movable digit 50 (46–52) long, with apparently two teeth. Palp 144 (130–162) long. Setal length: *h1* 24 (17–30), *h2* 17 (15–18), *h*3 20 (16–22), *pc* 18 (16–20).

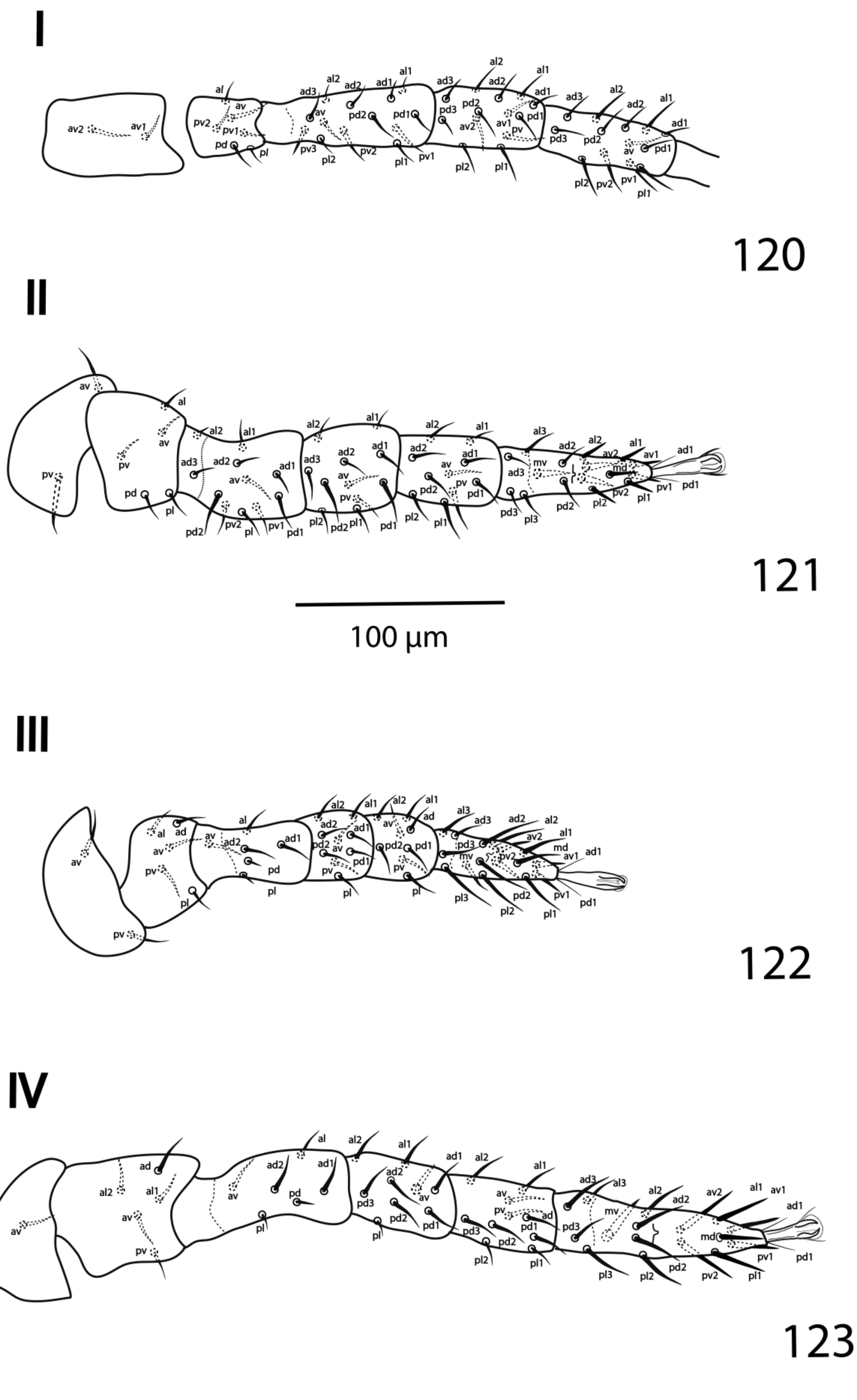
**Peritreme (Figs. 114, 116).** 119 (113–126) long, extending anteriorly to level between *z1* and *s1*; peritrematic plate fused by a narrow bridge with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

**Legs (Fig. 120-123).** Length (not including ambulacra): I, 389 (380–400); II, 290 (285–305); III, 229 (210–240); IV, 357 (350–360). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. Seta *mv* of tarsi IV longer than other setae of the same segment [43 (35-50)]. With the following setae stouter than other setae of same segments: leg II: mv, av2 and pv2 of tarsus; leg III: av of genu, av of tibia, mv and pv2 of tarsus; leg IV: av of genu, av of tibia, mv, av1 and pv1of tarsus.

**Material examined.** Valparaiso: four females from litter and two females from soil (0-5 cm deep) of natural vegetation. All collected on 12/XII/2014.




**FIGURES 114-119. *Gaeolaelaps isodentis* Karg;** Female: 114, dorsal view of idiosoma; 115, tritosternum; 116, ventral view of idiosoma; 117, gnathosoma; 118, tectum; 119, anti-axial view of chelicera.




**FIGURES 120-123.** ***Gaeolaelaps isodentis*** **Karg**; Female: 120, leg I; 121, leg II; 122, leg III; 123, leg IV.

***Gaeolaeplas* n.sp. 11**

**Adult female (Figures 124-133)** (eight specimens measured)

**Dorsal idiosomal (Fig. 124)**. Podonotal region of dorsal shield smooth; opisthonotal region reticulate and posteriorly rounded, 483 (475–495) long and 271 (258–280) wide; with 37 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1, z2*, *z4–z6*, *s1–s6*, *r2–r5*, *J1*, *J3–J5*, *Px2*, *Px3*, *Z1–Z5*, *S1–S5*; setae *Z2* distinctly closer to *J1* than to *J3*; setae smooth and pointed; with 15 pairs of lyrifissures and 5 pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a single pair of setae (*r6*). Setal length: *j1* 25 (23–28), *j2* 35 (33–36), *j3* 41, *j4* 43, *j5* 31, *j6* 50 (49–50); *z1* 34 (30–37), *z2* 45 (44–47), *z4* 51 (50–52), *z5* 43 (42–43), *z6* 51; *s1* 28 (26–30), *s2* 30 (29–30); *s3* 45 (41–47), *s4* 51 (50–52), *s5* 50 (59–50), *s6* 47 (45-–0); *r2* 42 (40–43), *r3* 41 (40–43), *r4* 37 (35–39), *r5* 39 (36–41), *r6* 20 (19–20); *J1* 51, *J3* 52, *J4* 66 (64–68), *J5* 66 (64–68); *Px2* 53(52–54), *Px3* 62 (58–66); *Z1* 54 (53–55), *Z2* 53 (52–55), *Z3* 63 (60–66), *Z4* 80 (77–82), *Z5* 81 (80–83); *S1* 38 (35–40), *S2* 39 (38–40), *S3* 42 (40–44), *S4* 44 (40–47), *S5* 67 (65–68).

**Ventral idiosoma (Fig. 125, 126).** Base of tritosternum 25 (24-26) long and 13 (12-13) wide basally; laciniae 72 (71-72) long, separated for about 99% of their total length. With a pair of punctate and striate presternal platelets. Sternal shield smooth, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin about truncate; distance between *st1* and posterior margin of sternal shield 96 (95–97), *st1–st1* 67 (66–68), *st2–st2* 93 (92–95), *st3–st3* 93 (92–95). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped and with scant lines, 174 (171–177) long, 78 (75–80) of maximal width; distance *st5–st5* 71 (69–73). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of slender paragenital platelets close to a pair of lateral notches of genital shield posteriad of *st5* and a pair of ellipsoidal platelets laterad of *Zv1*. Anal shield subtriangular, with marginal pores ill-defided, anterolaterad of paranal setae. Two pairs of rounded metapodal platelets, the inner ill-defined, smaller. Opisthogaster with eight pairs of simple setae (*Jv1–Jv5*, *Zv1*, *Zv2* and *Zv4*) and five pairs of lyrifissures. Setal length: *st1* 31 (30–32), *st2* 29 (25–32), *st3* 31 (31–32), *st4* 27 (25–28), *st5* 25 (23–27), Jv*1* 25 (24–26), *Jv2* 28 (27–30), *Jv3* 32 (30–33), *Jv4* 37 (35–40), *Jv5* 66 (64–68), *Zv1* 20 (18–22), *Zv2* 28 (28–29), *Zv5* 36 (35–37), paranal 28 (26–30), postanal 36 (35–37).

**Gnathosoma (Figs. 127-129).** Epistome truncate and with anterior margin denticulate. Deustosternum with a barely discernible distal smooth transverse line followed by six lines containing 10–12 denticles each. Corniculi subparallel to each other, 42 (38–45) long and 13 (12–13) wide, reaching distal end of palp trochanter; *h3* about in line with *h2*. Chelicera with dorsal lyrifissure distinct; anti-axial lyrifissure indistinguishable because of orientation; dorsal seta stout; fixed cheliceral digit 43 (41–44) long, apparently with five teeth and a short setiform *pilus dentilis*; movable digit 59 (58–60) long, with two teeth. Palp 169 (162–175) long. Setal length: *h1* 27 (24–28), *h2* 19 (18–20), *h3* 31 (30–33), *pc* 23 (22–23).

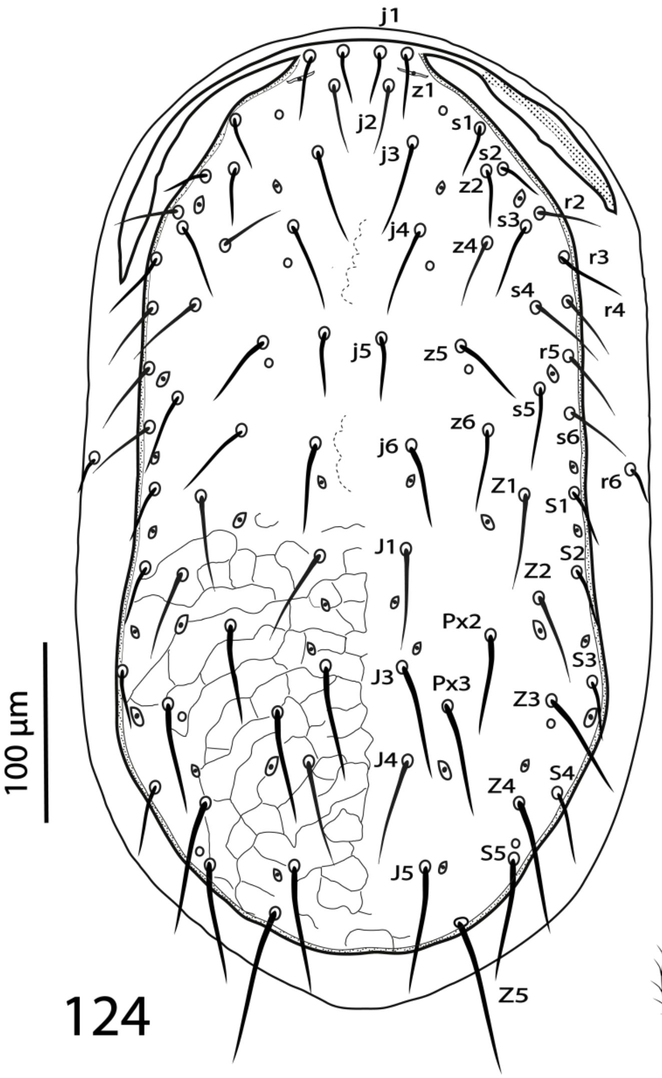
**Peritreme (Fig. 124, 126).** 219 (212–224) long, extending anteriorly to level between *z1* and *s1*; peritrematic plate fused by a narrow bridge with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III, and with a pair of lyrifissures and a pore behind stigma.

**Legs (130-133).** Length (not including ambulacra): I, 426 (418–437); II, 308 (300-314); III, 289 (263–273); IV, 378 (370–395). Chaetotaxy coxa–tibia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/1,3/2-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2. Seta *pd*1 of femur II distinctly longer than others of the same segment and seta *av* of femur II spur-like; *pd2* of tarsus IV 76 (73–79) distinctly longer than other setae of the same segment. With the following setae stouter than other setae of same segments: leg I: *av* of femur , *av1* and *pv1* of genu; leg II: *pv* of genu, *av* of femur, *av* and *pv* tibia, *mv*, *av2*, *pv2*, md and *av1* of tarsus; leg III: *av* and *pv* of coxae, *av* of femur, *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *md*, *al1*, *av1* and *pv1* of tarsus of genu, *av* of tibia, *mv*, *av1* and *pv1*of tarsus; leg IV: *av* of coxae, *av1* of femur, *av* of genu, *av* and *pv* of tibia, *mv*, *pd3*, *av2*, *pv2*, *md*, *av1* and *pv1* of tarsus.

**Adult male**: unknown.

**Material examined.** Holotype female collected in Ipaussu, São Paulo state, Brazil, on 3/XII/2014, from litter of a sugarcane field. Four paratype females collected in Jataí, Sao Paulo state on 16/XII/2014, from litter of a grassland.

**Remarks.** This species is most similar to *G.* aff. *invictianus* Walter & Moser, 2010, but the latter has most dorsal shield setae distinctly shorter, epistome convex and anal shield without marginal pores. Is is also similar to *Gaeolaelaps* n.sp 2., but the latter has epistome convex, seta *J2* and anal shield without marginal pores.

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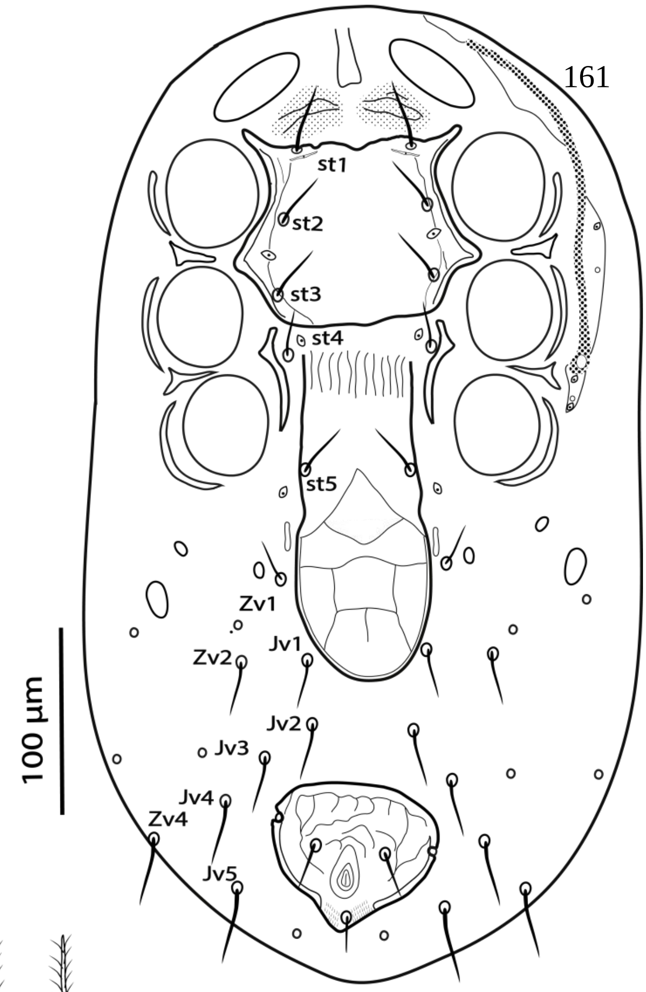


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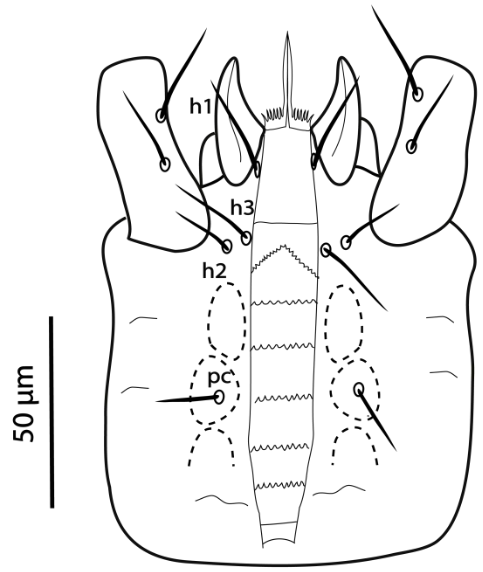


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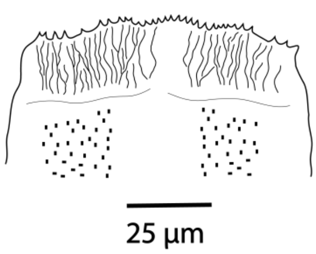


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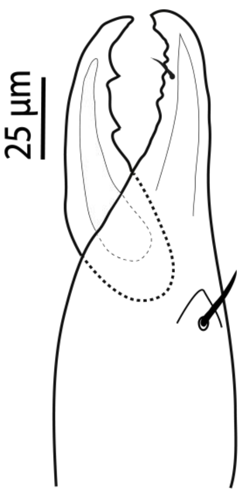


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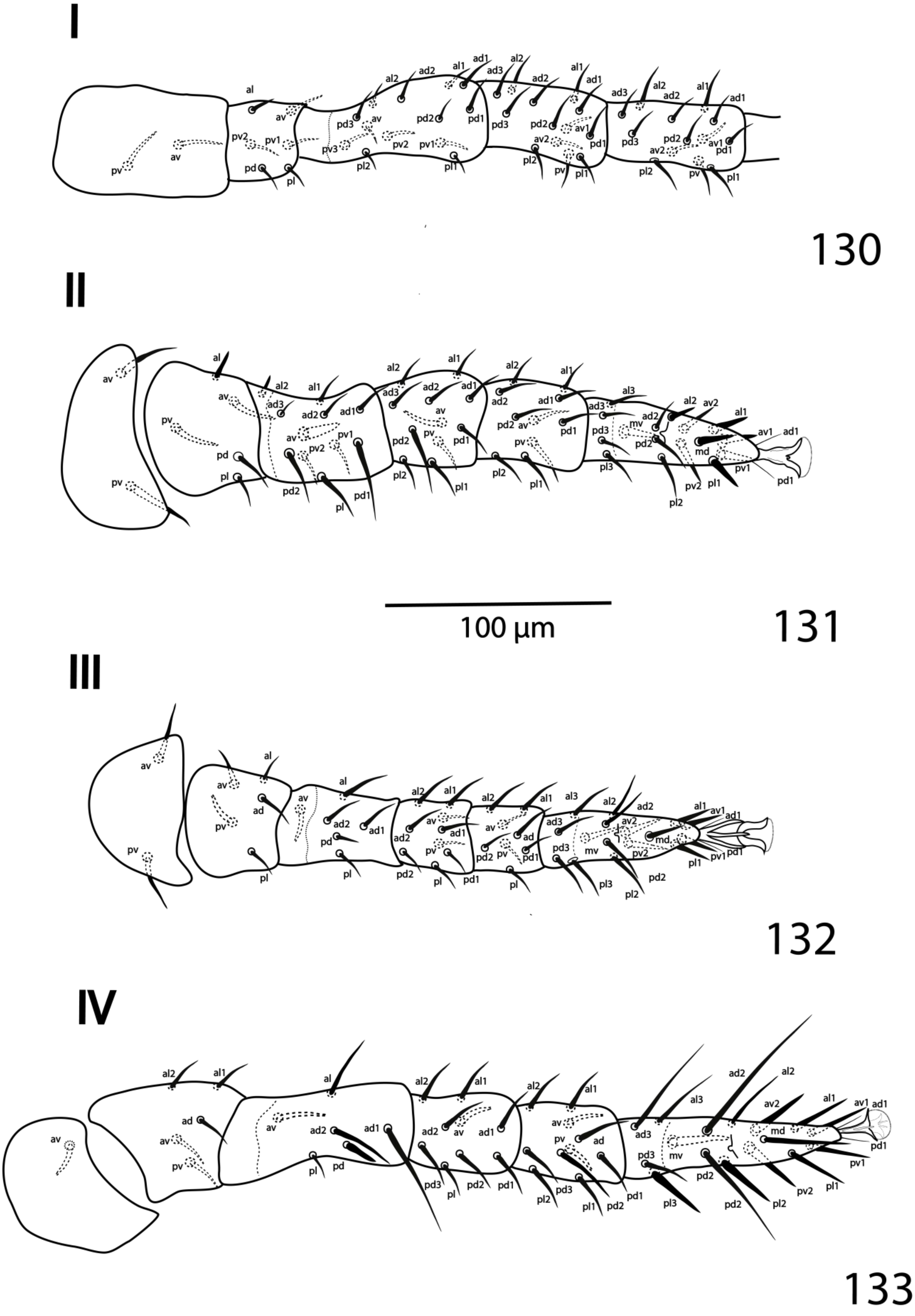
**FIGURES 124-129.** ***Gaeolaelaps*** **n.sp. 11**; Female: Female: 124, dorsal view of idiosoma; 125, tritosternum; 126, ventral view of idiosoma; 127, gnathosoma; 128, tectum; 129, anti-axial view of chelicera.




**FIGURES 130-133. *Gaeolaelaps* n.sp 11;** Female: 130, leg I; 131, leg II; 132, leg III; 133, leg IV.

***Gaeolaelaps* n.sp. 12**

**Adult female (Figures 134-144)** (two specimen measured)

**Dorsal idiosomal (Fig. 134).** Dorsal shield smooth, except for scant lines anteriad of *s1* and for a narrow marginal punctate strip posteriad of *s1*, posteriorly rounded, 675-713 long and 440 wide; with 39 pairs of setae, including two pairs of extra setae, and one unpaired extra setae: *j1–j6*; *z1–z6*; *s1–s6*; *r2–r5*, *J1, J3–J5*; *Z1–Z5*; *S1–S5*; *Px2* and *Px3*, *Jx2*; setae smooth and pointed; with 13 pairs of lyrifissures and 4 pairs of pores. Setal length: *j1* 56-52, *j2* 50-63, *j3* 74-103, *j4* 82-100, *j5* 98 90-113, *j6* 83; *z1* 26-22, *z2* 66-90, *z3* 72-75, *z4* 81, *z5* 86, *z6* 77; *s1* 60 50-70, *s2* 54-60; *s3* 68-90, *s4* 85, *s5* 82, *s6* 63; *r2* 45-64, *r3* 50-66, *r4* 55-77, *r5* 41-48, *r6* 22; *J1* 80, *Jx2* 75, *J3* 78, *J4* 83-99, *J5* 82-93; *Px2* 80-115, *Px3* 85-121; *Z1* 92-118, *Z3* 88-113, *Z4* 98-115, *Z5* 100-104; *S1* 51-71, *S2* 34 (25-43), *S3* 78 (75-102), *S4* 78 (60-100), *S5* 103 (96-117).

**Ventral idiosoma (Figs. 135-137).** Base of tritosternum 53 long and 21 wide basally; laciniae 140, totally separated from each other. With a pair of reticulate and punctate presternal platelets. Sternal shield with scant reticulation along anterior and lateral margins; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); distance between *st1* and posterior margin of sternal shield 103, *st1–st1* 65, *st2–st2* 77, *st3–st3* 78. Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate plate, distinctly fused by a narrow bridge with anterior region. Exopodal plate apparently a single slender plate with distinct projections between neighboring coxae. Genital shield tongue-shaped, smooth except for a line along lateral margins, 138 long, 61 of maximal width; with a marked constriction midway between insertion of *st5* and posterior margin; distance *st5–st5* 56. Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*; with a pair of rounded to ellipsoidal paragenital platelets. Anal shield pear-shaped, with scant striae anteriad of anal opening, without distinct marginal pores. Two pairs of metapodal platelets, the inner ellipsoidal, the outer elongate. Opisthogaster with eight pairs of setae (*Jv1*-*Jv5*, *Zv1*-*Zv3*), and four pairs of lyrifissures, *Zv1* adjacent to margin of genital shield. Setal length**:** *st1* 76 (72-80), *st2* 68 (64-72), *st3* 74 (70-77), *st4* 63 (60-65), *st5* 46, Jv*1* 52 (50-54), *Jv2* 56 (52-60), *Jv3* 52 (51-52), *Jv4* 63 (45-80), *Jv5* 75, *Zv1* 58 (55-60), *Zv2* 54 (48-60); paranal 38 (36-40), postanal 40 (40-41).

**Spermathecal apparatus (Fig. 136).** Infundibulum apparently large; tubulus seemingly annulate; rami distinct.

**Gnathosoma (Figs. 138-140).** Epistome slightly convex and with anterior margin denticulate. Deustosternum with seven transverse lines, the distal most smooth, others with 16-22 denticles each. Corniculi subparallel to each other, 64 long and 22 wide, almost reaching median level of palp trochanter; *h3* anteriad of *h2*. Chelicera with dorsal lyrifissure and dorsal seta distinct; fixed cheliceral digit 76 long, with eleven teeth; movable digit 114 long, with two teeth. Palp 154 long. Setal length: *h1* 53 (50-55), *h2* 33 (32-33), *h3* 62 (58-66), *pc* 62 (50-74).

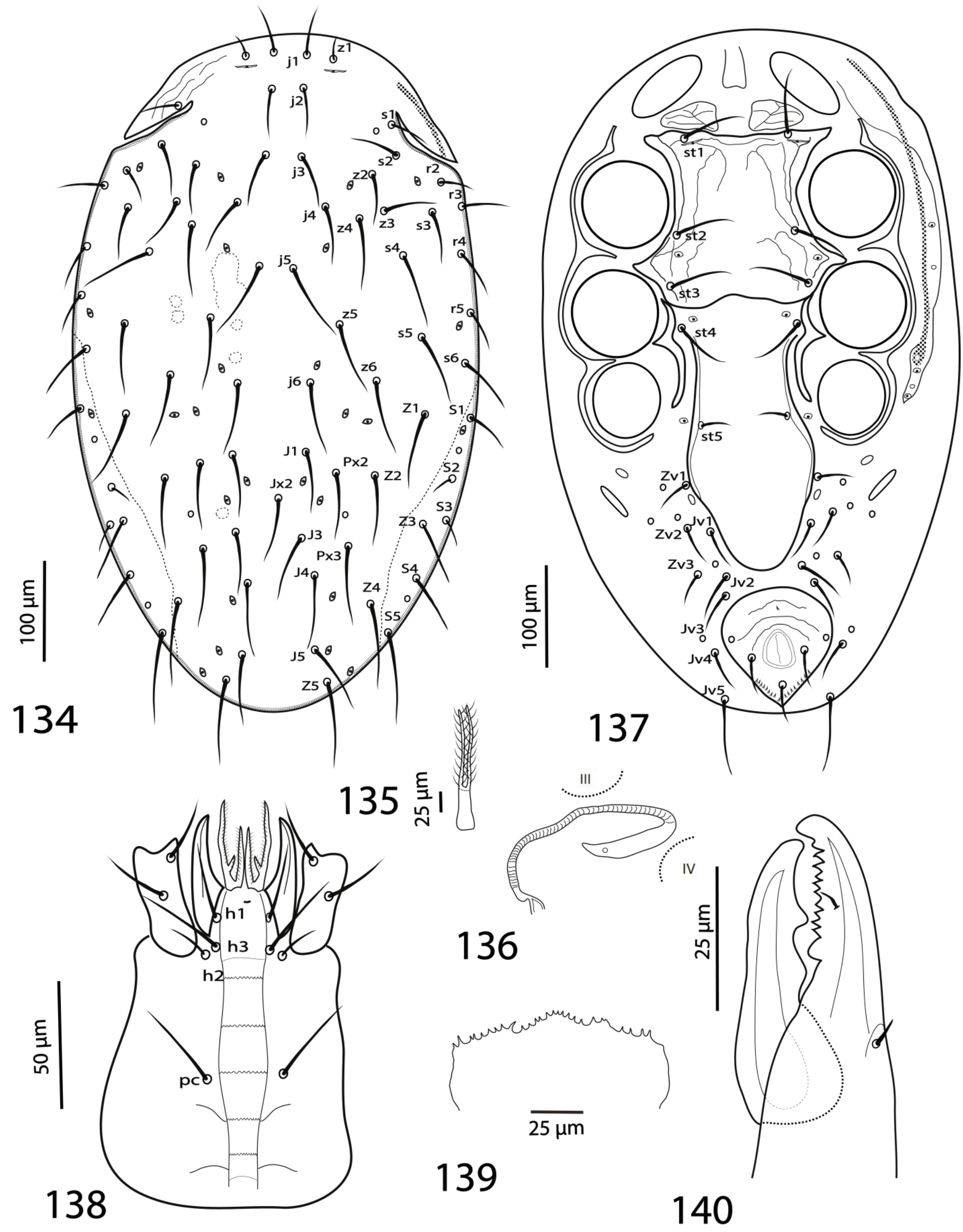
**Peritreme (Figs. 135, 138).** 169 long, extending anteriorly to level of *s1*; peritrematic plate fused with dorsal shield near *s1*, with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

**Legs (Figs. 141-144).** Length (not including ambulacra): I, 433 (433); II, 310 (310); III, 255 (255); IV, 395 (395). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2, 3/1-2; 2-3/2, 3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1, 3/1-2; ; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *av* of femur, *av* and *pv* of tibia, *mv*, *av2* and *pv2* of tarsus; leg III: *av* and *pv* of genu, md and av2 of tarsus.

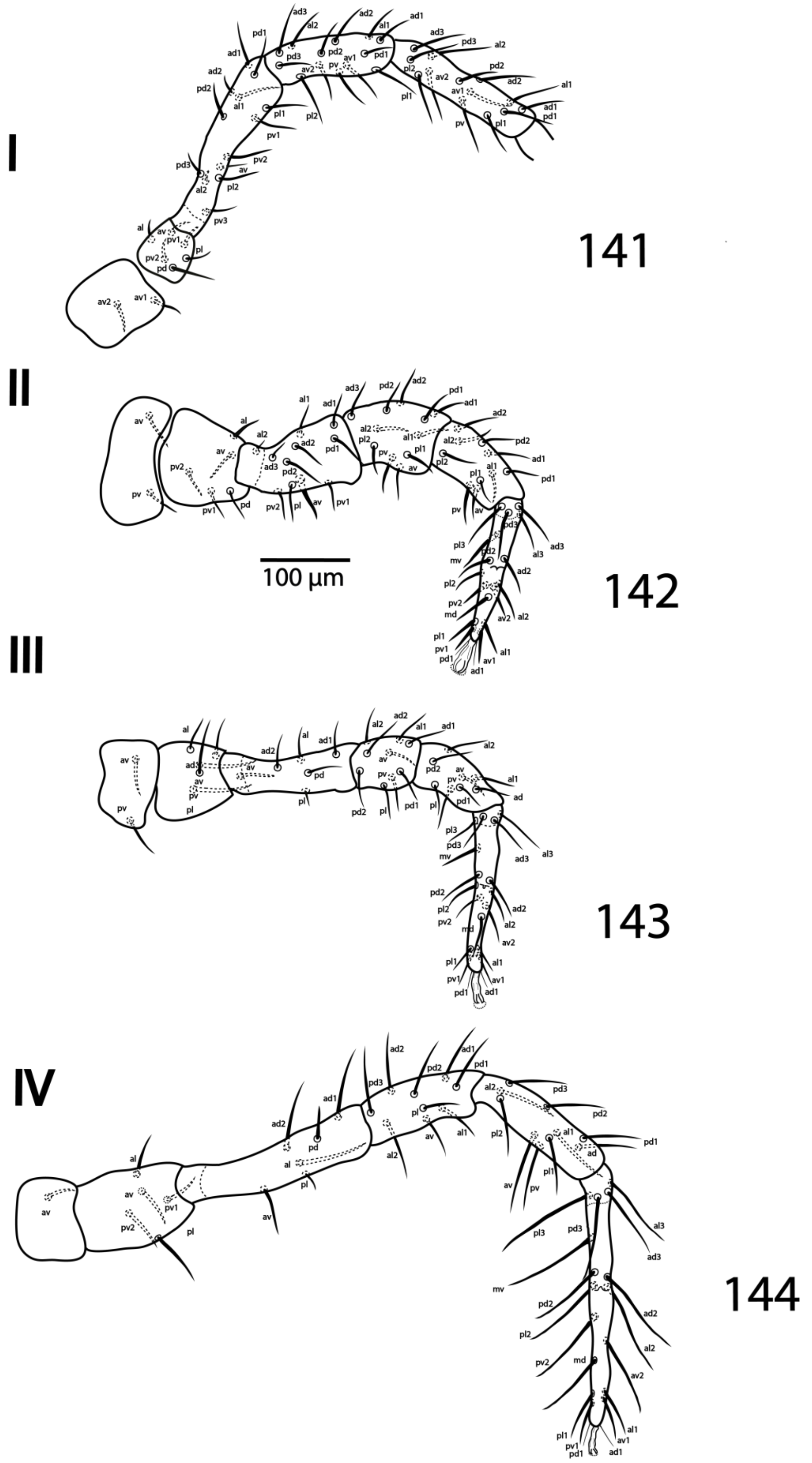
**Adult male**: unknown.

**Material examined.** Holotype female collected in Jataí, Goiás state, Brazil, on 16/XII/2014, from soil (0-5 cm deep) of natural vegetation.

**Remarks.** This species is most similar to *G. blattae* (Strong & Halliday, 1994), but the latter has weak polygonal ornamentation on the dorsal shield (very indistinct in some specimens) and setae of femur–tarsus of legs II–IV thicker than dorsal setae (only *av* of femur II distinctly thicker than other setae in the new species). It is also similar to *Gaeolaelaps* n.sp 5., but the latter does not have seta *z1*.




**FIGURES 134-140.** ***Gaeolaelaps* n.sp. 12**; Female: 134, dorsal view of idiosoma; 135, tritosternum; 136, spermathecae; 137, ventral view of idiosoma; 138, gnathosoma; 139, tectum; 140, anti-axial view of chelicera.




**FIGURES 141-144. *Gaeolaelaps* n.sp. 12**; Female: 141, leg I; 142, leg II; 143, leg III; 144, leg IV.

### *Gaeolaelaps* n.sp. 13

**Adult female (Figures 145-154)** (one specimen measured)

**Dorsal idiosomal (Fig. 145).** Dorsal shield mostly reticulate except for smooth central area between j5-j6, posteriorly rounded, 400 long and 231 wide; with 38 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*, *z2*, *z4–z6*; *s1–s6*; *r2–r5*, *J1–J5*; *Z1–Z5*; *S1–S5*; *Px2* and *Px3*; R5 on unsclerotized cuticle; setae smooth and pointed; with 15 pairs of lyrifissures and 3 pairs of pores. Setal length: *j1* 24, *j2* 16, *j3* 17, *j4* 15, *j5* 12, *j6* 12; *z1* 12, *z2* 16, *z4* 16, *z5* 13, *z6* 12; *s1* 12, *s2* 16; *s3* 19, *s4* 16, *s5* 16, *s6* 16; *r2* 20, *r3* 20, *r4* 15, *r5* 17, *r6* 12; *J1* 10, *J2* and *J3*, *J4* 12, *J5* 12; *Px2* 10, *Px3* 10; *Z1* 13, *Z2* 12, *Z3* 13, *Z4* 14, *Z5* 17; *S1* 14, *S2* 15, *S3* 13, *S4* 14, *S5* 15, *R5* 15.

**Ventral idiosoma (Figs. 146, 147).** Base of tritosternum 25 long and 12 wide basally; laciniae 71, separated by about 97% of their total length. With a pair of punctate and reticulate presternal platelets. Sternal shield with scant reticulation along anterior and lateral margins; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin slightly undulate; distance between *st1* and posterior margin of sternal shield 113, *st1–st1* 60, *st2–st2* 80, *st3–st3* 83. Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by an undulate platelet between coxae III–IV, fused by a narrow line with anterior region. Exopodal plate fragmented. Genital shield tongue-shaped and reticulate, 133 long, 72 of maximal width; distance *st5–st5* 62. Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. Anal shield subtriangular, reticulate, with a pair of marginal pores laterad of para anal setae. With two pairs of metapodal platelets, the outer elongate and the internal rounded and smaller. Opisthogaster with nine pairs of setae (*Jv1*-*Jv5*, *Zv1*-*Zv3* and *Zv5*). Setal length: *st1* 25, *st2* 27, *st3* 23, *st4* 16, *st5* 19, *Jv1* 19, *Jv2* 20, *Jv3* 20, *Jv4* 17, *Jv5* 25, *Zv1* 20, *Zv2* 20, *Zv5* 18; paranal 20, postanal 20.

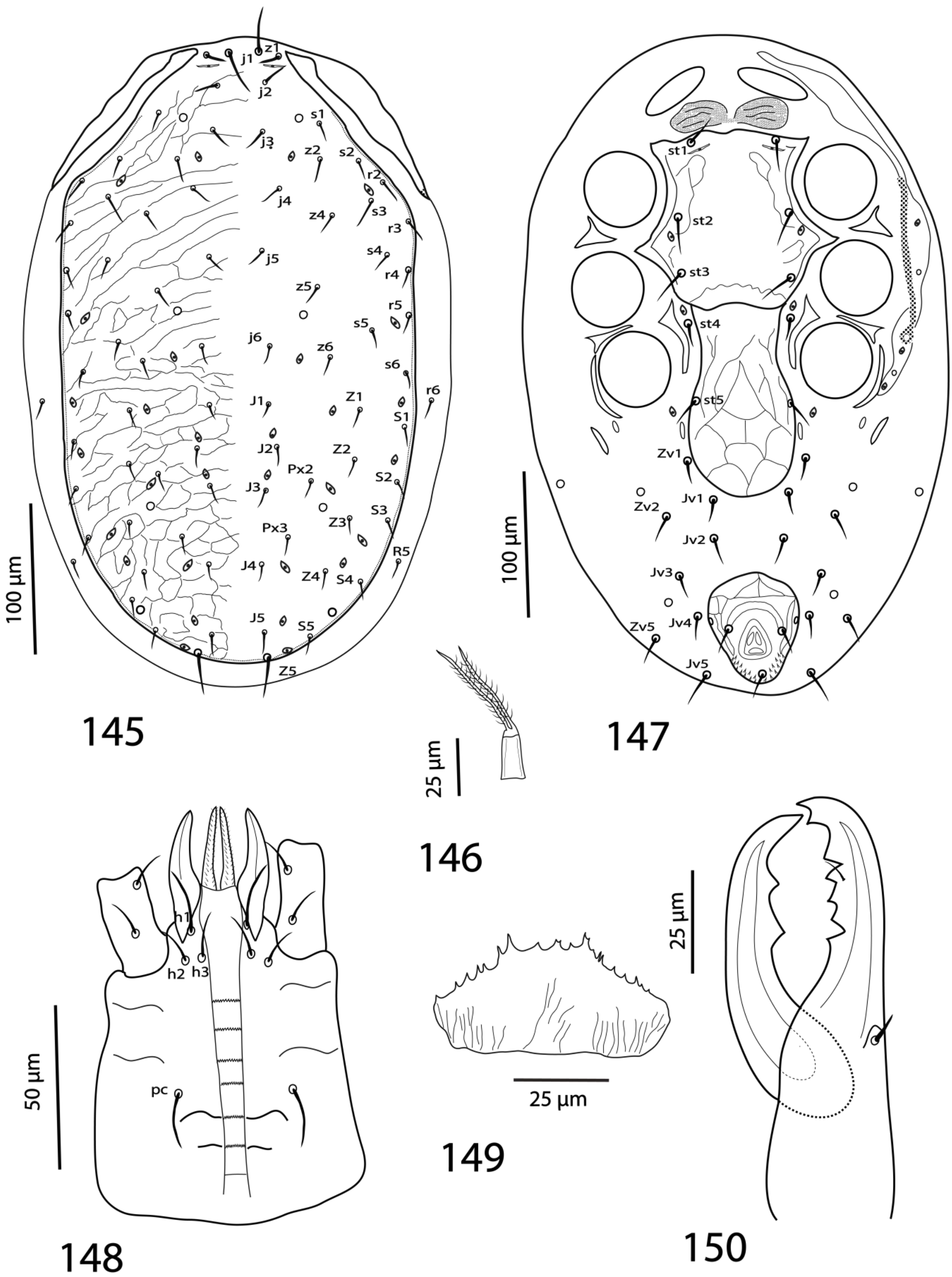
**Gnathosoma (Figs. 148-150).** Epistome convex and with anterior margin denticulate. Deustosternum delimited by lateral lines that converge slightly posteriorly; with eight transverse lines, the most distal and the most proximal smooth, others with 7-17 denticles each. Corniculi subparallel to each other, 25 long and 12 wide, reaching basal end of palp femur; *h3* slightly anteriad of *h2*. Chelicera with dorsal lyrifisure distinct; dorsal seta stout; anti-axial lyrifissure indistinct because of orientation; fixed cheliceral digit 39 long, with six teeth and a setiform *pilus dintilis*; movable digit 56 long, with two teeth. Palp 158 long. Setal length: *h1* 27, *h2* 18, *h3* 23, *pc* 24.

**Peritreme (Figs. 145, 147).** 104 long, extending anteriorly to level between *r2-r3*; Peritrematic plate fused with dorsal shield near *z1*, with a lyrifissure and a pore in region between coxae II–III and two pairs of lyrifissures and a pore behind stigma, abutting exopodal plate.

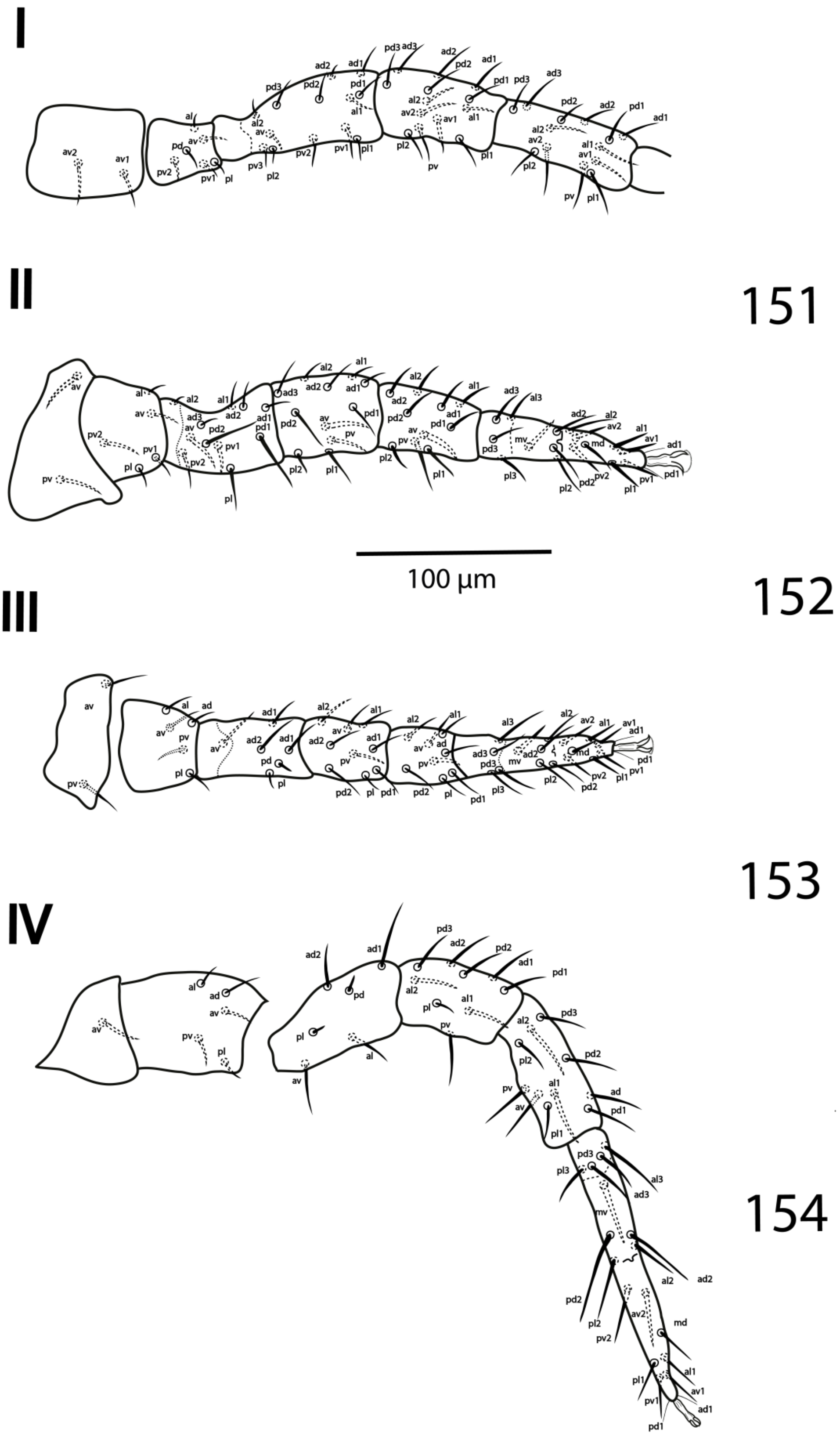
**Legs (Fig. 151-154).** Length (not including ambulacra): I, 410 (410); II, 325 (325); III, 270 (270); IV, 460 (460). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2, 3/1-2; 2-3/2, 3/1-2; II, 0-0/1,0/1-0; 1-0/1,0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1; 2-2/1,3/0-1; 2-1/1, 3/1-2; tarsi II-IV with 18 setae each**.** With the following setae stouter than other setae of same segments: leg II: *av* and *pv* of genu, *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *av1* and *pv1* of tarsus; leg III: *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *av1* and *pv1* of tarsus; leg IV: *av* and *pv* of tibia.

**Adult male**: unknown.

**Remarks.** This species is similar to *Gaeolaelaps* n.sp 7., but the latter has long peritreme (reaching level between *r2-r3*). It is also similar to *G. verticis* (Karg, 1978) and *G. vertisimilis*, but the original descriptions of those species are not sufficiently detailed for a final conclusion.




**FIGURES 145-150.** ***Gaeolaelaps*** **n.sp. 13**; Female: 145, dorsal view of idiosoma; 146, tritosternum; 147, ventral view of idiosoma; 148, gnathosoma; 149, tectum; 150, anti-axial view of chelicera.




**FIGURES 151-154. *Gaeolaelaps* n.sp. 13**; Female: 151, leg I; 152, leg II; 153, leg III; 154, leg IV.

***Gaeolaelaps* n.sp. 14**

**Adult female (Figures 155-165)** (four specimens measured)

**Dorsal idiosomal (Fig. 155).** Dorsal shield reticulate and posteriorly rounded, 488 (485-490) long and 293 (280-305) wide; with 39 pairs of setae, including two pairs of extra opisthonotal setae: *j1–j6*, *z1–z6*; *s1–s6*; *r2–r5*, *J1–J5*; *Px2*, *Px*3; *Z1–Z5*; *S1–S5*; setae smooth and pointed; with 15 pairs of lyrifissures and three pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a six pairs of setae (*R1, R2*, *R5, R6* and *UR*). Setal length: *j1* 26 (22-30*), j2* 34 (32-36), *j3* 35 (32-40), *j4* 30 (28-32), *j5* 29 (28-30), *j6* 25 (22-27); *z1* 24 (22-28), *z2* 36 (32-40), *z3* 35 (33-37), *z4* 35 (34-36), *z5* 28 (24-30), *z6* 28 (25-31); *s1* 30 (25-33), *s2* 30 (28-34); *s3* 37 (35-40), *s4* 33 (28-34), *s5* 31 (30-32), *s6* 28 (26-31); *r2* 29 (25-31), *r3* 30 (26-34), *r4* 29 (27-30), *r5* 29 (26-32), *r6* 21 (18-26); *J1* 20 (19-20), *J2* 21 (20-22), *J3* 21 (17-23), *J4* 24 (24-25), *J5* 24 (21-26); *Px*2 21 (21-22), *Px*3 23 (21-26), *Z1* 24 (22-25), *Z2* 23 (20-26), *Z3* 22 (20-24), *Z4* 24-29), *Z5* 44 (39-47); *S1* 25 (20-28), *S2* 26 (22-30), *S3* 24 (21-28), *S4* 22 (21-23), *S5* 24 (22-25); *R1* 21 (20-24), R2 (20), *R4* 21 (20-21), *R5* 21 (20-22), *R6* 23 (20-25), *UR* 17 (16-17).

**Ventral idiosoma (Figs. 156-158).** Base of tritosternum 24 (20-30) long and 14 (12-15) wide basally; laciniae 78 (65-86), separated by about 66% of their total length. With a pair of punctate and reticulate presternal platelets. Sternal shield reticulate, with two pairs of setae (*st2–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); seta *st1* inserted on presternal region; posterior margin of sternal shield varying from slightly convex to slightly concave; distance between *st1* and posterior margin of sternal shield 117 (105-126), *st1–st1* 59 (55-63), *st2–st2* 80 (71-90), *st3–st3* 87 (78-95). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; posterior region represented by an undulate plate between coxae III–IV, whose slender anterior end abuts posterolateral margin of sternal shield. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate , 177 (170-182) long, 87 (70-96) of maximal width; with a marked constriction midway between insertion of st5 and posterior margin; distance *st5–st5* 78 (70-84). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. Anal shield subtriangular, with a pair of marginal pores near anterolateral corners. With a pair of subtriangular metapodal platelets. Opisthogaster with ten pairs of setae (*Jv1*-*Jv5*, *Zv1*-*Zv5*) and three pairs of lyrifissures. Setal length: *st1* 36 (30-40), *st2* 43 (37-46), *st3* 45 (43-47), *st4* 47 (45-48), *st5* 33 (27-38), Jv*1* 33 (27-37), *Jv2* 35 (30-40), *Jv3* 32 (30-35), *Jv4* 23 (21-26), *Jv5* 37 (30-41), *Zv1* 26 (21-30), *Zv2* 33 (30-36), *Zv3* 20 (18-22), *Zv4* 17 (15-20), *Zv5* 20 (19-22), paranal 36 (30-42), post anal 20 (19-22).

**Spermathecal apparatus (Fig. 157).** Tubulus slender; rami indistinct, attached to sacculus far away from each other.

**Gnathosoma (Figs. 159-161).** Epistome slightly convex and with anterior margin denticulate. Deustosternum with seven transverse lines, the most distal smooth, others with 6-11 denticles. Corniculi varying from subparallel to each other to distally convergent, 34 (30-35) long and 12 (11-14) wide, reaching basal region of palp femur; seta *h3* slightly anteriad of *h3*. Chelicera with dorsal and anti-axial lyrifissures distinct; dorsal seta stout; fixed cheliceral digit 43 (40-47) apparently with nine teeth in addition apical tooth and setiform *pilus dentilis*; movable digit bidentate. Palp 144 (143-145) long. Setal length: *h1* 30 (29-32), *h2* 20 (20-21), *h3* 36 (30-47), *pc* 32 (31-33).

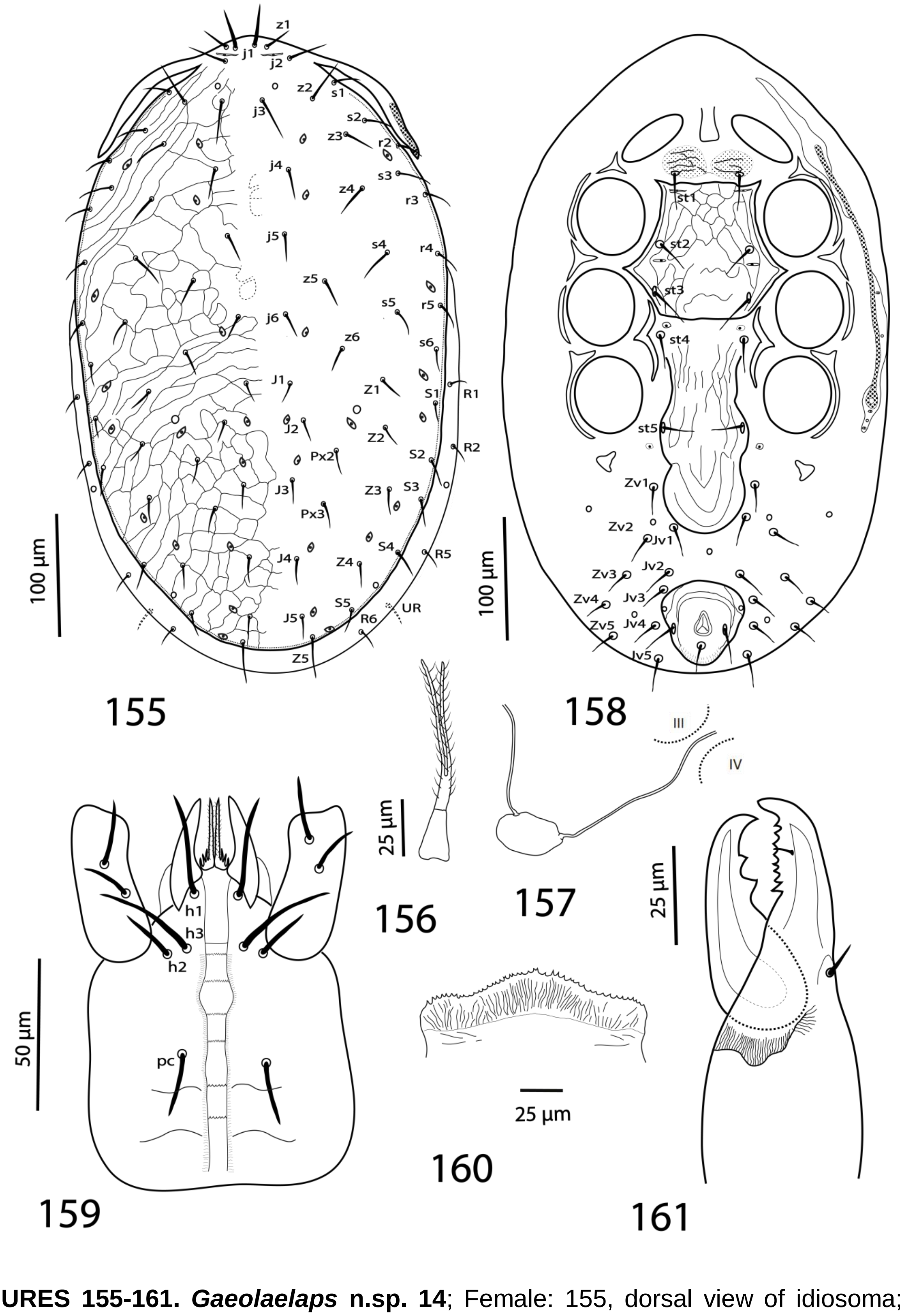
**Peritreme (Figs. 155, 158).** 221 (215-225) long, extending anteriorly to level of *s2*; peritrematic plate fused with dorsal shield near z1, with a lyrifissure and a pore in region between coxae II–III and a pair of lyrifissures and a pore behind stigma.

**Legs (Fig. 162-165).** Length (not including ambulacra): I, 403 (380-435); II, 349 (336-360); III, 305 (285-318); IV, 471 (444-488). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1, 1/0-1; 2-2/1,3/0-1; 2-1/1. 3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *av* of femur, *av* and pv of genu, *av and pv of tibia, mv, al2, pl2, av2, pv2, pl2,md, al1, pl1, av1 and av2* of tarsus; leg III: al of trochanter, av and pv of genu, av and pv of tibia, al2, pl2, mv, av2, pv2, md, al1, pl1, av1, pv1 of tarsu; leg IV: *ad* of trochanter, *av1* and *av2* of genu, *av* and *pv* of tibia, *mv*, *al2*, *pl2*, *av2*, *pv2*, *md*, *al1*, *pl1*, *av1* and *pv1* of the tarsus. Setae ad1 of femur IV most longer than other setae of same segment.

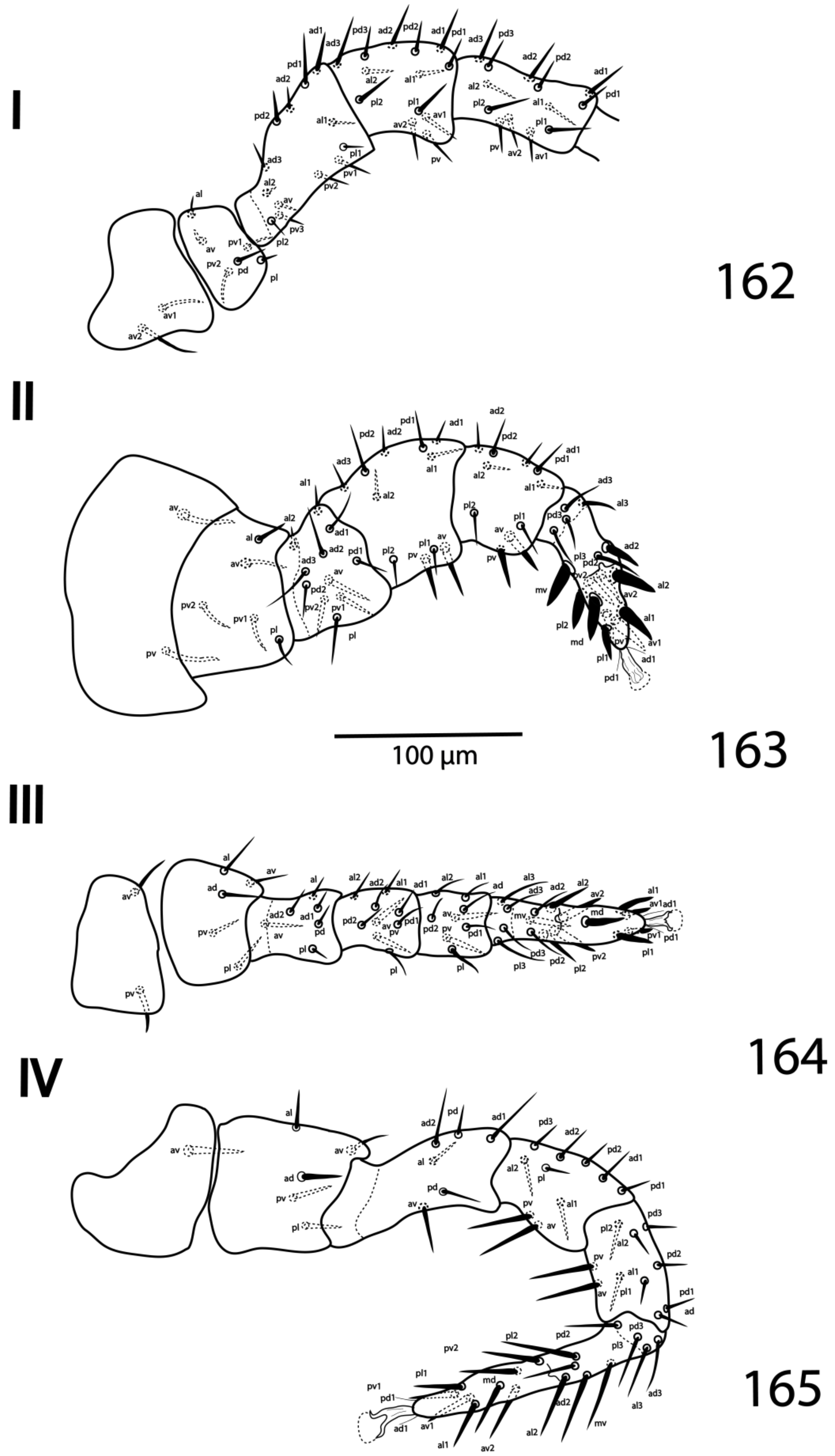
**Adult male**: unknown.

**Material examined.** Holotype female and two paratype females collected in Valparaíso, São Paulo state, Brazil, on 9/XII/2014, from soil (0-5 cm deep) of natural vegetation. One paratype female collected in Ipaussu, São Paulo state on 3/XII/2014, from soil (0-5 cm deep) of a sugarcane field.

**Remarks.** This species differs from other *Gaeolaelaps* species by having genital shield with a marked constriction midway between insertion of st5 and posterior margin and three ventral setae (*pv2* present) on femur II.




**FIGURES 155-161. *Gaeolaelaps* n.sp. 14**; Female: 155, dorsal view of idiosoma; 156, tritosternum; 157, spermatecae; 158, ventral view of idiosoma; 159, gnathosoma; 160, tectum; 161, anti-axial view of chelicera.




**FIGURES 162-165.** ***Gaeolaelaps*** **n.sp. 14**; Female: 162, leg I; 163, leg II; 164, leg III; 165, leg IV.

***Gaeolaelaps queenslandicus* (Womersley)**
*Androlaelaps queenslandicus* Womersley 1956: 577.
*Geolaelaps queenslandicus* .—Ryke, 1963: 13.
*Gaeolaelaps queenslandicus*.—Hyatt, 1964: 472
*Hypoaspis queenslandicus*.—Costa, 1966: 141
*Hypoaspis* (*Hypoaspis*) *queenslandicus*.— Aswegen & Loots, 1970: 190
*Hypoaspis* (*Geolaelaps*) *queenslandica*.— Karg, 1979: 81
*Hypoaspis* (*Gaeolaelaps*) *queenslandica.*— Faraji et al., 2008: 207
*Gaeolaelaps queenslandica*. — Trach, 2012: 162

**Adult female (Figures 166-175)** (eight specimens measured)

**Dorsal idiosoma (Fig. 166).** Dorsal shield tapering posteriorly, 493 (446–540) long and 273 (240–305) of maximal width, with light to barely distinguishable reticulation; with 37 pairs of setae: *j1–j6*, *z1–z6*; *s1–s6*; *r2–r5*, *J1–J5*; *Z1–Z5*; *S1–S5*; setae smooth and pointed; with 17 pairs of lyrifissures and 6 pairs of pores. Unsclerotized cuticle laterad of dorsal shield with seven pairs of setae (*r6*, *R1, R2, R3*, *R4*, *R5, R6* and *UR*). Measurement of setae: *j1* 35 (33–36), *j2* 46 (44–50), *j3* 49 (45–50), *j4* 46 (40–48), *j5* 42 (43–45), *j6* 41 (40–43); *z1* 35 (29–38), *z2* 48 (46–50), *z3* 51 (48-53), *z4* 50 (47–51), *z5* 52 (48–55), *z6* 36 (35–40); *s1* 34 (33–35), *s2* 48 (47–50); *s3* 50 (49–51), *s4* 52 (50–55), *s5* 53 (51–55), *s6* 46 (43–50); *r2* 51 (50–55), *r3* 61 (58–65), *r4* 64 (61–67), *r5* 47 (45–51), *r6* 46 (44–47); *J1* 32 (30–35), *J2* 41 (40–43), *J3* 30 (29–33), *J4* 29 (27–31), *J5* 20 (19–22); *Z1* 43 (40–50), *Z2* 41 (37–45), *Z3* 43 (39–45), *Z4* 48 (45–50), *Z5* 46 (40–48); *S1* 42 (39–44), *S2* 43 (40–45), *S3* 41 (40–42), *S4* 43 (39–47), *S5* 40 (41–47); *r6* 30, *R1* 30 (26–31), *R2* 31 (29–33), *R3* 31 (30–32), *R4* 32 (30–32), *R5* 34 (31–36), *R6* 42 (40–45); *UR* 25 (21–27).

**Ventral idiosoma (Figs. 167, 168).** Tritosternum 143 (133-152) long, line separating base remaining of tritosternum not distinguishable; separate section of laciniae correspond to about 70% of total length of tritosternum. With a pair of punctuate presternal platelets (with additional scant striae in some specimens). Sternal shield reticulate, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin slightly convex; distance between *st1* and posterior margin of sternal shield 164 (157–168), *st1–st1* 78 (75–80), *st2–st2* 81 (80–85), *st3–st3* 101 (98–106). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by a tri-radiate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 148 (157–168) long, 75 (68–81) of maximal width; distance *st5*–*st5* 70 (66–72). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. Anal shield pear-shaped, reticulate, without marginal pores. With a pair of slender paragenital platelets and a pair of slender metapodal platelets. Opisthogaster with nine pairs of simple setae (*Jv1*-*Jv5*, *Zv1*-*Zv3* and *Zv5*) and four pairs of lyrifissures. Setal length: *st1* 44 (40–46), *st2* 41 (40–42), *st3* 38 (36–40), *st4* 30 (29–32), *st5* 27 (24–30), *Jv1* 29 (26–31), *Jv2* 25 (23–30), *Jv3* 30 (27–32), *Jv4* 28 (25–30), *Jv5* 40 (35–45), *Zv1* 29 (27–31), *Zv2* 30 (28–32), *Zv3* 24 (22–25), *Zv5* 24 (20–28); paranal 19 (15–20), postanal 31 (30–32).

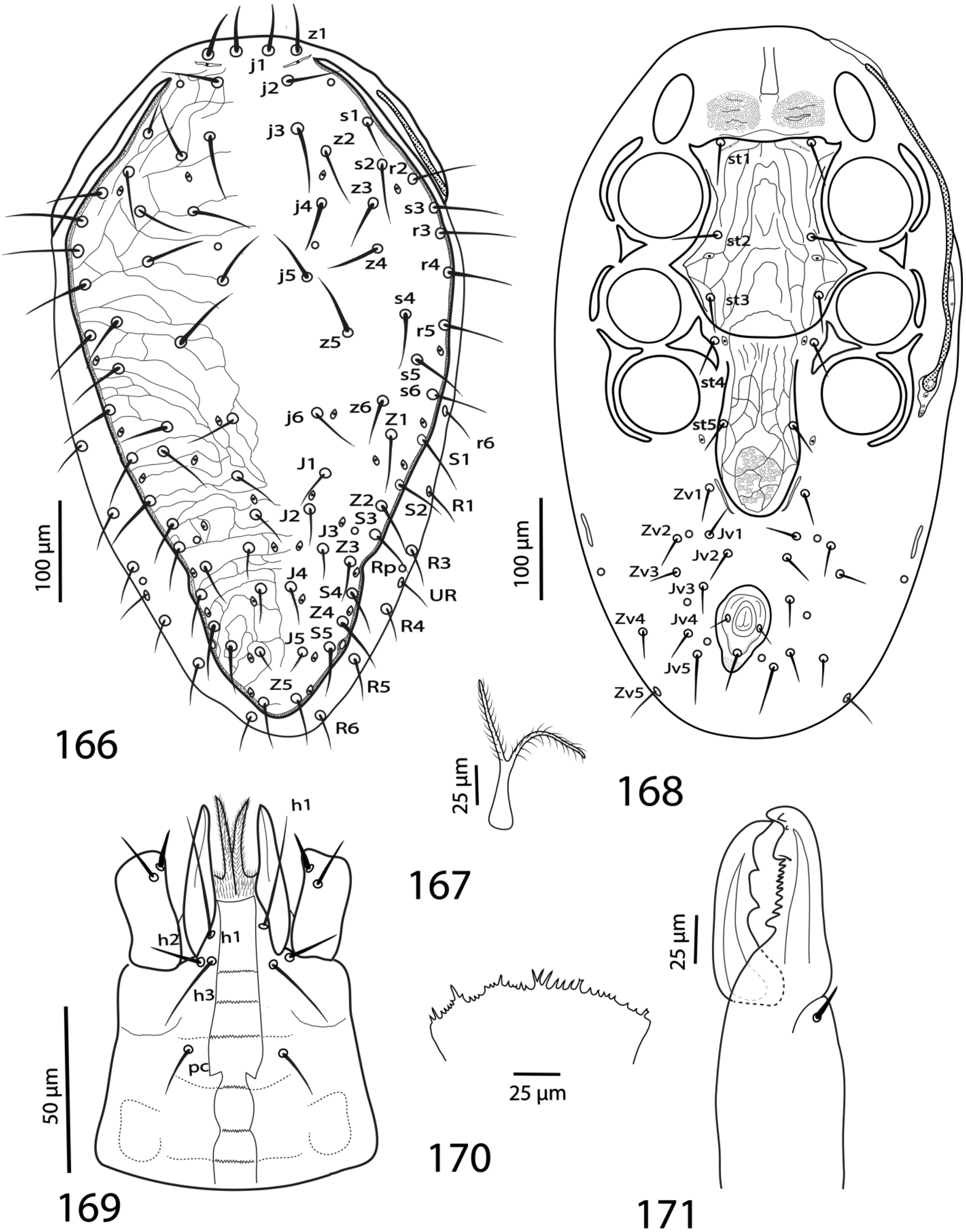
**Gnathosoma (Figs. 169-171).** Epistome distally truncate and with denticles of various lengths. Deustosternum with seven transverse lines, the distal most smooth, the following three with 20-30 denticles and the remaining with 10-15 denticles each. Corniculi subparallel to each other, 73 (63–80) long and 21 (20–21) wide, reaching median region of palp femur; *h3* in transverse line with *h2*. Chelicera with dorsal lyrifissure and dorsal seta distinct, the latter stout; anti-axial lyrifisure indistinct; fixed digit 76 (73–81) long, with 10-12 teeth and a short setiform *pilus dentilis*; second distalmost denticle distinctly larger than others; subsequent denticles increasing progressively backward; movable digit 94 (85–97) long, with two relatively large teeth. Palp 191 (188–195) long. Setal length: *h1* 56 (50–60), *h2* 30 (28–31), *h3* 43 (40–47), *pc* 29 (25–30).

**Peritreme (Figs. 166, 168).** 261 (250–270) long, extending anteriorly slightly beyond base of *s1*. Peritrematic plate fused with dorsal shield near base of *z1*, with a lyrifissure and a pore in region between coxae II–III; a pair of lyrifissures and a pore behind stigma.

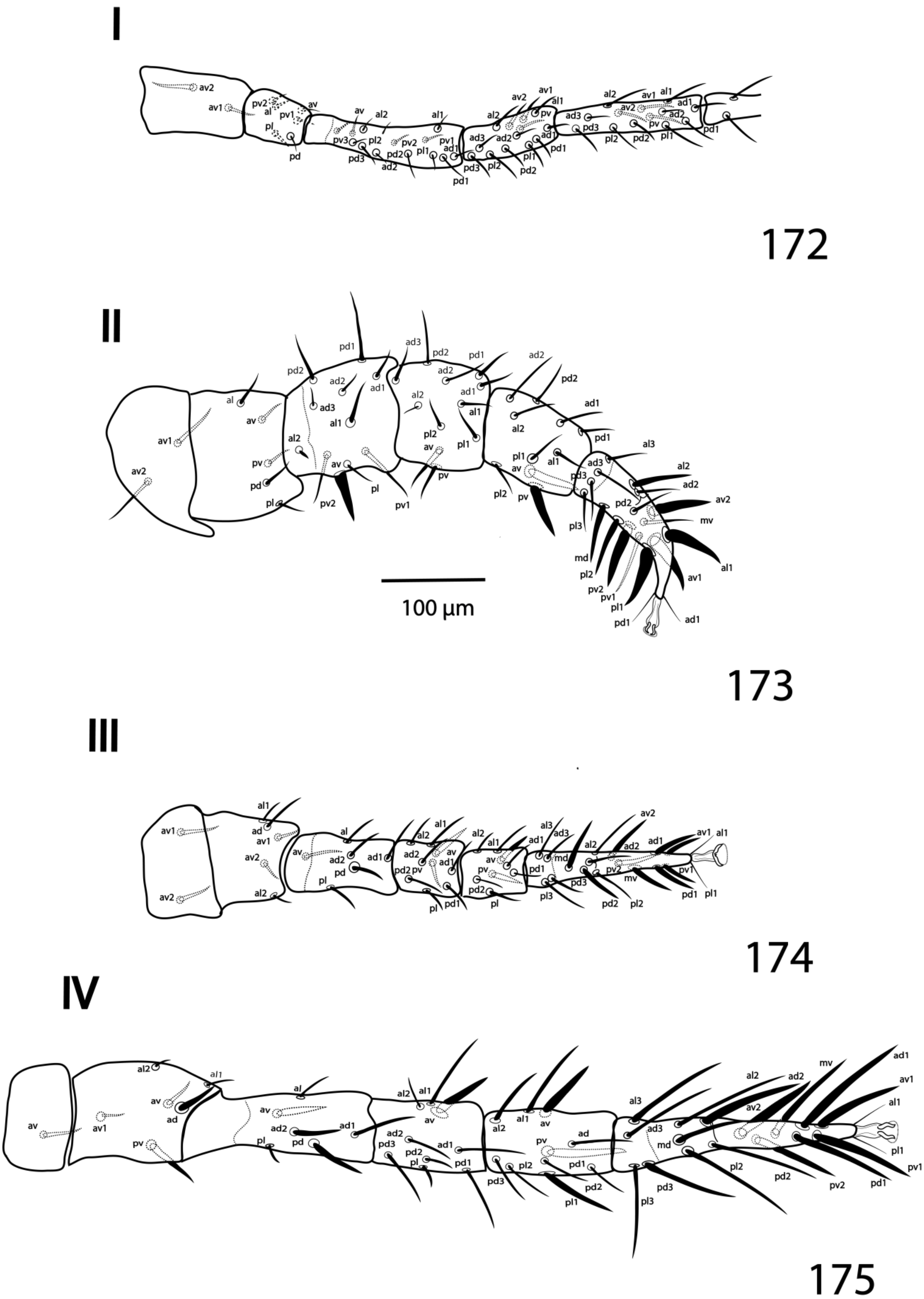
**Legs (Figs. 172-175).** Leg II much stouter than others. Length (not including ambulacra): I, 646 (500–615); II, 448 (380–440); III, 438 (345–445); IV, 665 (560–685). Chaetotaxy (coxa–tibia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/1,3/2-2; II, 0-0/1,0/1-0; 1-0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-

0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1, 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg II: *av* and *al2* of femur, *pl1* and *pv* of tibia, *ad, av1, av2, mv, pd1, pl2, pv1,* and *pv2* of tarsus; leg III: *pd1* of femur, *ad1, av2, md, mv, pl2* and *pv2* of tarsus; leg IV: *ad* of trochanter, *ad2* and *pd* of femur, *av* of genu, *av*, *pv* and *pl1* of tibia, *ad1*, *ad2*, *av1*, *av2*, *mv*, *pd1*, *pv1* and *pv2* of tarsus.

**Material examined.** Collected in Ipaussu on 30/I/2014, as follows: one female from litter of natural vegetation; six females from soil (0-5 cm deep) and two females from soil (5-10 cm deep) of a sugarcane field; five females from soil (0-5 cm deep) and five females from soil (5-10 cm deep) of a grassland.




**FIGURES 166-171.** ***Gaeolaelaps queenslandicus*** **Womersley;** Female: 166, dorsal view of idiosoma; 167, tritosternum; 168, ventral view of idiosoma; 169, gnathosoma; 170, tectum; 171, anti-axial view of chelicera.




**FIGURES 172-175.** ***Gaeolaelaps queenslandicus*** Womersley; Female: 172, leg I; 173, leg II; 174, leg III; 175, leg IV.

***Gaeolaelaps verticis* (Karg)**
*Hypoaspis* (*Hypoaspis*) *verticis* Karg, 1978: 16.
*Hypoaspis* (*Gaeolaelaps*) *verticis* Karg, 1979: 80 (objective synonym).
*Hypoaspis* (*Gaelaelaps*) *verticis*.—Karg, 1982: 239, 1994: 184, 2006: 147.
*Gaeolaelaps verticis*.— Nemati & Mohseni, 2013: 80.

**Adult female (Figures 176-185)** (seven specimens measured)

**Dorsal idiosomal (Fig. 176).** Dorsal shield reticulate, except for a central area of podonotal region, smooth; posteriorly rounded, 421 (398–455) long and 273 (243–290) wide; with 38 pairs of setae, including two pairs of extra opisthonotal setae: *j1–j6*; *z1*, *z2, z4*–z6; *s1–s6*; *r2–r5*; *J1–J5*; *px2*, *px3*; *Z1–Z5*; *S1–S5*, all setae smooth and pointed; with 13 pairs of lyrifissures and four pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a three pair of setae (*R1*, *R3* and *R4*). Setal length: *j1* 33 (31–35), *j2* 6 (5–7), *j3* 8 (5–10), *j4* 9 (6–10), *j5* 7 (6–8), *j6* 6 (5–6); *z1* 8 (7–10), *z2* 7 (5–8), *z4* 6 (6–10), *z5* 6 (5–8), *z6* 6 (5–7); *s1* 6 (5–8), *s2* 5 (5–6); *s3* 8 (6–10), *s4* 7 (5–9), *s5* 7 (5–7), *s6* 7 (5–9); *r2* 6 (5–9), *r3* 7 (5–8), *r4* 6 (5–8), *r5* 6 (5–8), *r6* 7 (6–10); *J1* 5 (4–6), *J2* 5 (5–6), *J3* 5 (4–6), *J4* 5 (4–6), *J5* 6 (5–6); *px*2 5 (4–6), *px3* 5 (4–6); *Z1* 6 (5–6), *Z2* 6 (5–6), *Z3* 5 (5–7), *Z4* 5 (5–6), *Z5* 18 (17–20); *S1* 6 (5–8), *S2* 6 (4–8), *S3* 6 (5–6), *S4* 6 (5–6), *S5* 6 (6–7); *R1* 8 (7–9), *R3* 6 (5–6), *R4* 8 (7–8).

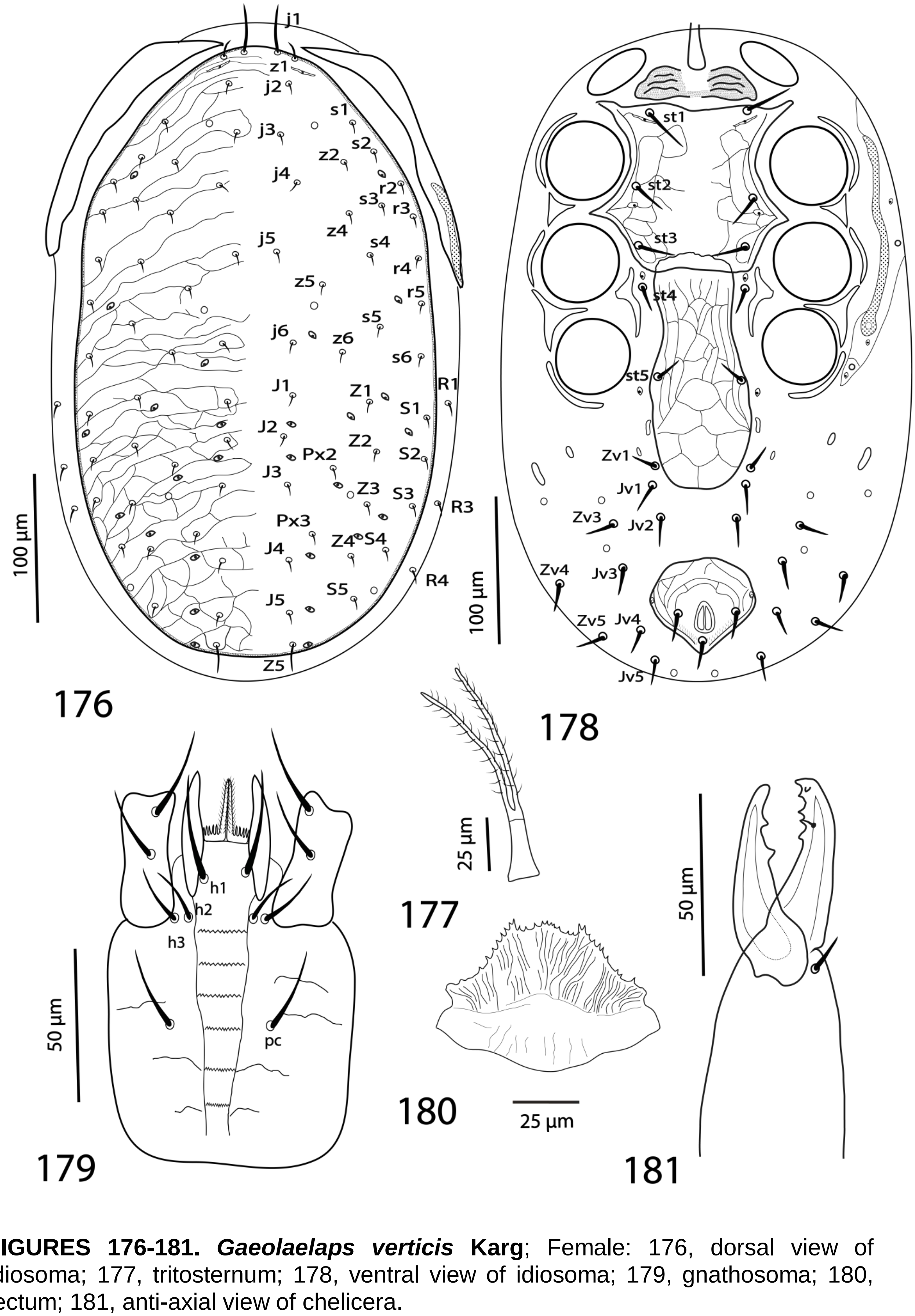
**Ventral idiosoma (Figs. 177, 178).** Base of tritosternum 25 (23-27) long and 11 (10-11) wide basally; laciniae 73 (72-76), separated by about 96% of their total length. With a pair of punctate and striate presternal platelets. Sternal shield reticulate laterally, smooth centrally, with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin truncate; distance between *st1* and posterior margin of sternal shield 113 (105–120), *st1–st1* 69 (66–73), *st2–st2* 87 (82–90), *st3–st3* 87 (82–90). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sternal shield represented by a v-shaped platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped and reticulate, 144 (130–160) long, 79 (74–85) of maximal width; distance *st5–st5* 69 (62–75). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*. With a pair of slender paragenital platelets close to a pair of lateral notches of genital shield posteriad of *st5* Anal shield subtriangular, reticulate, with a pair of marginal pores anterolaterad of paranal setae. Two pairs of ellipsoidal metapodal platelets, the inner smaller. Opisthogaster with nine pairs of simple setae (*Jv1*-Jv*5*, *Zv1*, *Zv3*-*Zv5*; some specimens without *Zv4*) and three pair of lyrifissures. Setal length: *st1* 35 (32–37), *st2* 32 (30–34), *st3* 27 (25–28), *st4* 23 (20–25), *st5* 22 (20–23), Jv*1* 22 (20–23), *Jv2* 20 (18–21), *Jv3* 18 (14–20), *Jv4* 12 (10–14), *Jv5* 18 (14–20), *Zv1* 18 (17–21), *Zv3* 20 (18–21), *Zv4* 10 (7–11), *Zv5* 13 (10–17), paranal 19 (17–21), postanal 20 (18–23).

**Gnathosoma (Figs. 179-181).** Epistome denticulate, convex, but with central region truncate. Deustosternum with a smooth distal transverse line followed by six lines containing 14–22 denticles each, and a proximal most smooth line. Corniculi subparallel to each other, 31 (31–32) long and 10 (9–11) wide, extending anteriorly to basal section of palp femur; *h3* in about transverse line with *h2*. Fixed cheliceral digit 39 (37–41) long, with five teeth and a short setiform *pilus dentilis*; movable digit 53 (52–55) long, with two teeth. Palp 168 (162–170) long. Setal length: *h1* 30 (23–33), *h2* 19 (17–20), *h3* 19 (17–21), *pc* 27 (26–28).

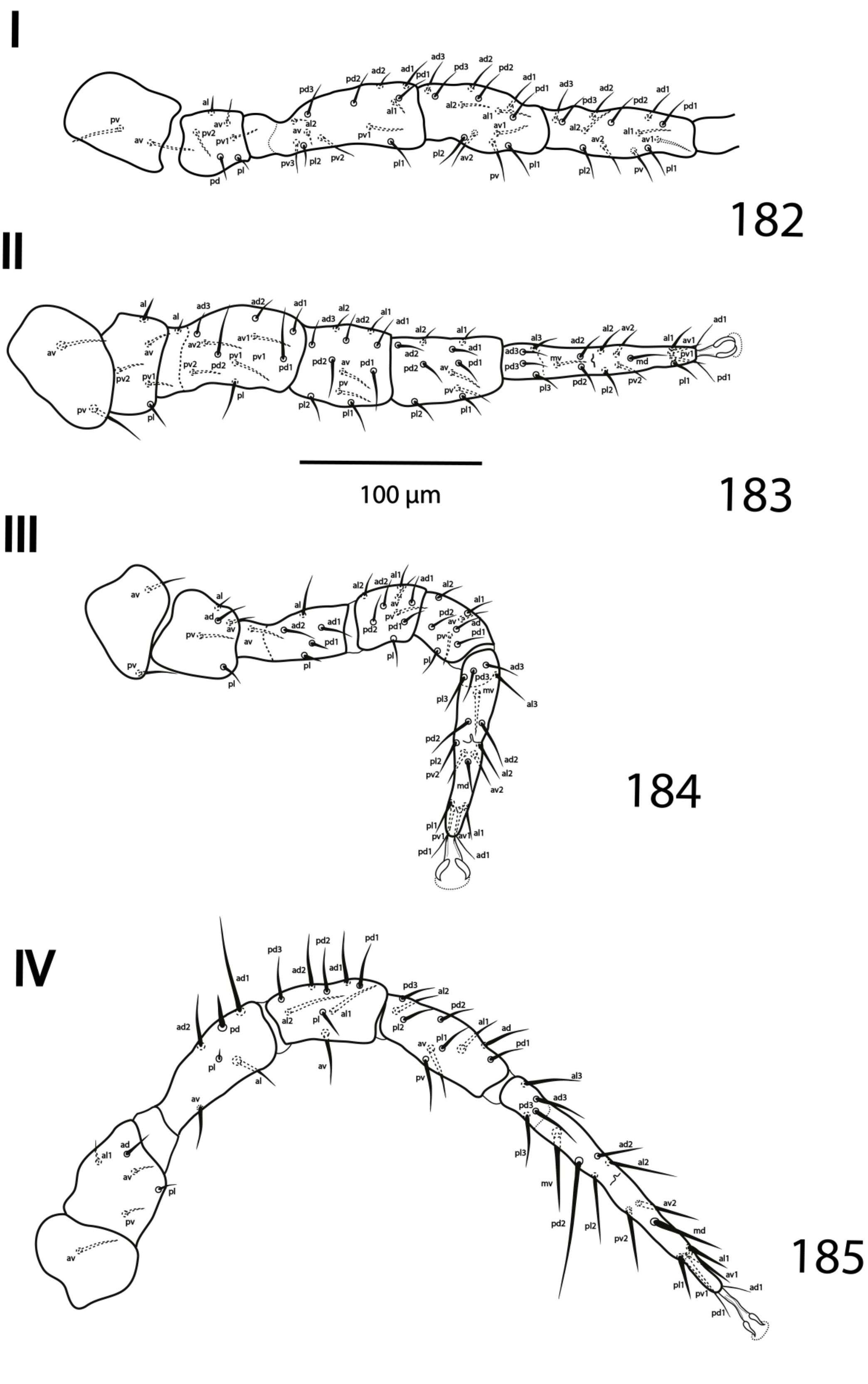
**Peritreme (Figs. 176, 178).** 119 (113–126) long, extending anteriorly to level of *r2*; peritrematic plate fused with dorsal shield by a narrow bridge near *z1*, with a lyrifissure and a pore in region between coxae II–III and with a pair of lyrifissures and a pore behind stigma.

**Legs (Figs. 182-185).** Length (not including ambulacra): I, 481 (460–510); II, 379 (360–398); III, 335 (330–345); IV, 519 (512–525). Chaetotaxy (coxa–tíbia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1-0/1,0/2-1; 2-3/1-2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1, 1/0-1; 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. Seta *ad1* 61 (57-65) of femur IV and *ad2* 102 (101-103) of tarsus IV distinctly longer than others of the same segment, *pd* of femur IV thornlike. With the following setae slightly stouter than other setae of same segments: leg IV: *pd* of femur, *pv* of genu, *av* and *pv* of tibia of tarsus.

**Material examined.** Collected on 8 and 15/XII/2014, as follows: Ipaussu - three females from soil (0-5 cm deep) of natural vegetation and two females from litter of natural vegetation; Valparaiso - two females from soil (0-5 cm deep) of natural vegetation.




**FIGURES 176-181.** ***Gaeolaelaps verticis*** **Karg**; Female: 176, dorsal view of idiosoma; 177, tritosternum; 178, ventral view of idiosoma; 179, gnathosoma; 180, tectum; 181, anti-axial view of chelicera.




**FIGURES 182-185**. ***Gaeolaelaps verticis*** (Karg); Female: 181, leg I; 182, leg II; 183, leg III; 184, leg IV.

***Gaeolaelaps* n.sp. 15**

**Adult female (Figures 186-195)** (five specimens measured)

**Dorsal idiosomal (Fig. 186).** Dorsal shield reticulate (reticulation light in central area of podonotal region), posteriorly rounded, 421 (408–430) long and 192 (180–210) of maximal width; with a slender punctate marginal band, most clearly discernible posteriad of r3; with 39 pairs of setae including two pairs of extra opisthonotal setae: *j1–j6*, *z1*, *z3–z6*; *s1–s6*; *r2–r5*, *J1–J5*; *Px2*, *Px3*; *Z1–Z5*, *S1–S5*. Setae smooth and pointed; with 14 pairs of lyrifissures and four pairs of pores. Unsclerotized cuticle laterad of dorsal shield with a pair of setae (*r6*). Setal length: *j1* 25 (23–26), *j2* 23 (22–25), *j3* 28 (25-31), *j4* 28 (26-30), *j5* 27 (25-31), *j6* 25 (22-28); *z1* 19 (18-21), *z3* 27 (25-30), *z4* 28 (26–31), *z5* 28 (26–30), *z6* 25 (24–27); *s1* 22 (20–24), *s2* 22 (20–23), *s3* 29 (25–31), *s4* 29 (26–32), *s5* 27 (25–30), *s6* 28 (26–30); *r2* 23 (21–24), *r3* 27 (25–30), *r4* 24 (21–30), *r5* 27 (25–30), *r6* 25 (23–28); *J1* 24 (22–26), *J2* 26 (24–30), *J3* 25 (23–27), *J4* 31 (28–33), *J5* 30 (28–32); *Px2* 27 (26–30), *Px3* 27 (27–28); *Z1* 28 (26–30), *Z2* 28 (25–30), *Z3* 29 (27–30), *Z4* 30 (27–32), *Z5* 38 (30–40); *S1* 26 (23–33), *S2* 28 (25–30), *S3* 29 (28–30), *S4* 31 (30–33), *S5* 33 (31–35).

**Ventral idiosoma (Figs. 187, 188).** Base of tritosternum 28 (26-30) long and 15 (15-14) wide basally, laciniae 68 (67-70) long, separated for about 99% of their total length. With a pair of punctate and reticulate presternal platelets. Sternal shield smooth centrally and reticulate along lateral margins; with three pairs of setae (*st1–st3*) and two pairs of lyrifissures (*iv1*, *iv2*); posterior margin truncate; distance between *st1* and posterior margin of sternal shield 105 (100–115), *st1–st1* 65 (63–67), *st2–st2* 77 (75–82), *st3–st3* 78 (75–82). Seta *st4* and lyrifissure *iv3* on unsclerotized cuticle. Anterior region of endopodal plate fused with sternal shield; region behind sterna shield represented by an undulate platelet between coxae III–IV. Exopodal plate fragmented. Genital shield tongue-shaped, reticulate, 138 (130–142) long, 61 (55–70) of maximal width; distance *st5–st5* 56 (53–65). Genital lyrifissure (*iv5*) on unsclerotized cuticle posterolaterad of *st5*; with two pairs of paragenital platelets, the inner slender, the other shorter and slightly wider. Anal shield pear-shaped, reticulate, with a pair of marginal pores laterad of paranal setae. Two pairs of ellipsoidal metapodal platelets, the inner distinctly smaller. Opisthogaster with eight pairs of simple setae (*Jv1*-*Jv5*, *Zv1*, *Zv2* and *Zv5*) and two pairs of lyrifissures. Setal length: *st1* 31 (28–34), *st2* 31 (30–35), *st3* 29 (26–31), *st4* 24 (20–31), *st5* 21 (19–25), *Jv1* 23 (21–25), *Jv2* 25 (24–27), *Jv3* 26 (25–28), *Jv4* 30 (30–31), *Jv5* 36 (35–38), *Zv1* 22 (22–24), *Zv2* 28 (25–30), *Zv4* 30 (29–30), paranal 26 (25–27), postanal 28 (25–31).

**Gnathosoma (Figs. 189-191).** Epistome convex and with anterior margin denticulate. Deustosternum with seven transverse lines, the most distal smooth, the following with 10-16 denticles each. Corniculi subparallel to each other, 38 (35–40) long and 11 (10-11) wide, reaching proximal region of palp femur; *h3* about in transverse line with *h2*. Fixed cheliceral digit 39 (38–40) long, with seven teeth; movable digit 58 (55–60) long, with two teeth. Palp 154 (145–160) long. Setal length: *h1* 28 (25–30), *h2* 19 (17–20), *h3* 23 (21–26), *pc* 22 (22–24).

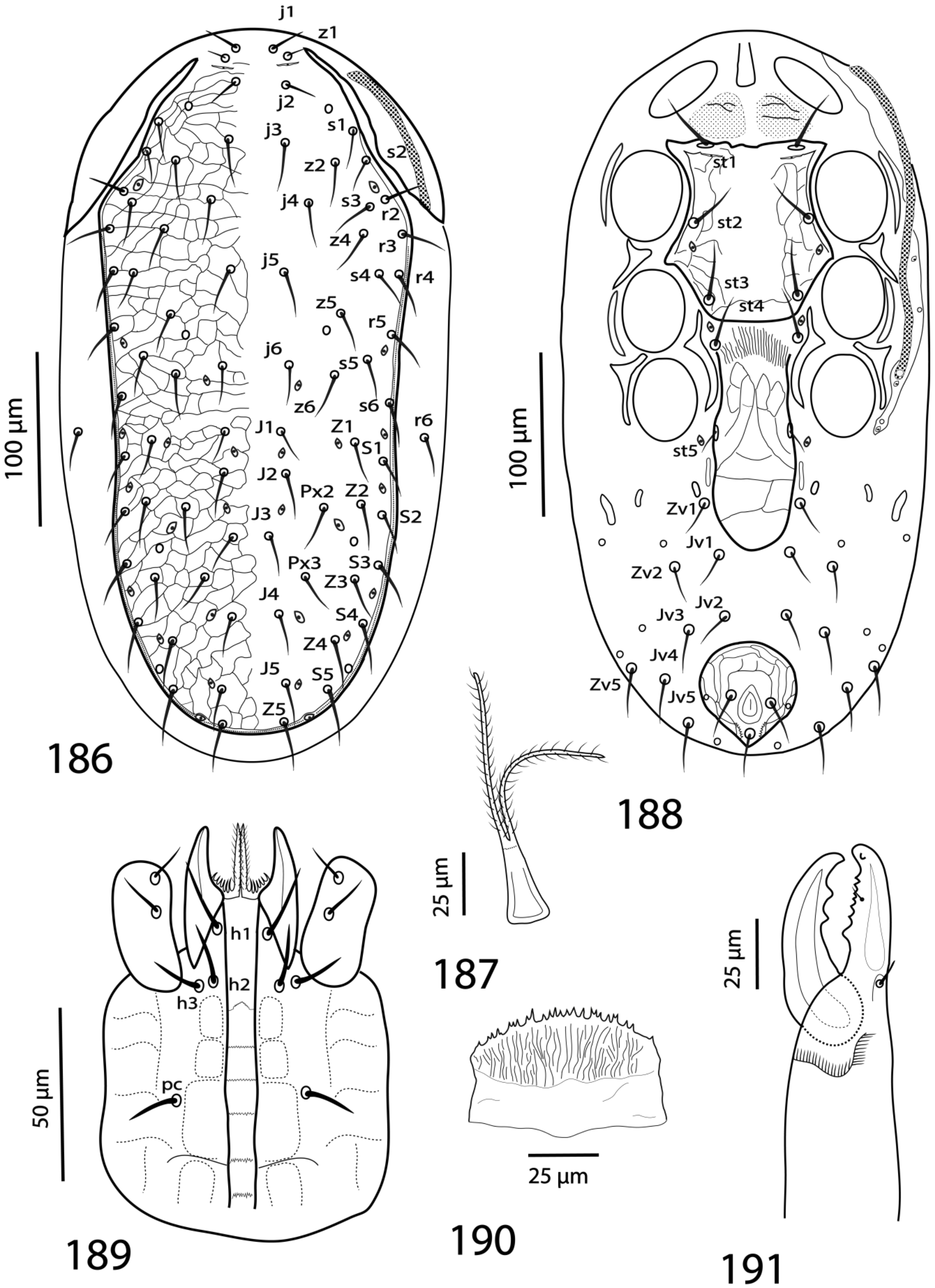
**Peritreme (Figs. 186, 188).** 205 (195–215) long, extending anteriorly to level between *z1* and *s1*. Peritrematic plate fused with dorsal shield near *z1*; with a lyrifissure and a pore in region between coxae II–III and two lyrifissures and a pore behind stigma.

**Legs (Figs. 192-195).** Length (not including ambulacra): I, 430 (410–450); II, 310 (295-325); III, 271 (260–280); IV, 397 (380–415). Chaetotaxy (coxa–tibia): I, 0-0/2,0/0-0; 1-0/1,1/2-1; 2-2/1,3/3-2; 2-3/2,3/1-2; 2-3/2,3/1-2; II, 0-0/1,0/1-0; 1- 0/1,0/2-1; 2-3/1,2/2-1; 2-3/1,2/1-2; 2-2/1,2/1-2; III, 0-0/1,0/1-0; 1-1/1,0/1-1; 1-2/1,1/0-1; 2-2/1,2/1-1; 2-1/1,2/1-1; IV, 0-0/1,0/0-0; 2-1/1,0/1-0; 1-2/1,1/0-1, 2-2/1,3/0-1; 2-1/1,3/1-2; tarsi II-IV with 18 setae each. With the following setae stouter than other setae of same segments: leg I: *av1*, *pv1* and *av2* of genu, *av2*, *av1* and *pv1* of tibia; leg II: *av* of trochanter, *av* and *pv2* of femur, *av* and *pv* of genu, *pv* of tibia, *mv* and *pv2* of tarsus; *av* of trochanter, *av* of genu; leg IV: *av* of genu, *av* and *pv* of tibia, *mv*, *av2*, *pv2*, *md*, *av1*, and *pv1* of tarsus.

**Adult male**: unknown.

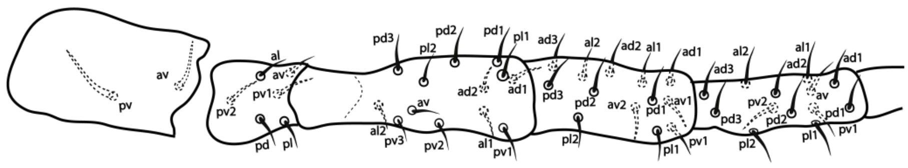
**Material examined.** Holotype female and four paratype females collected in Jataí, Goiás state, Brazil, on 16/XII/2014, from soil (0-5 cm deep) of natural vegetation.

**Remarks.** This species is most similar to *G. farajii* Nemati & Mohseni, 2013, but the latter has dorsal shield with shorter setae and does not have a seta of the *z* series (*z3*).



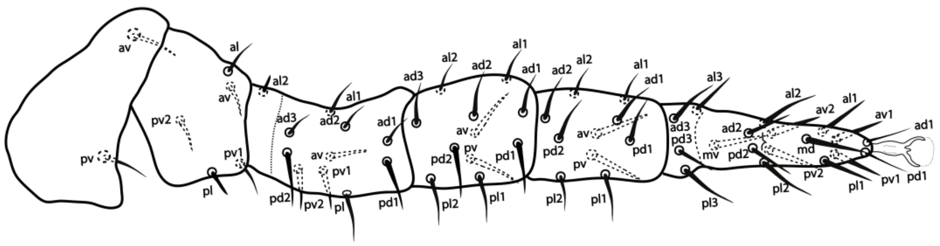

**FIGURES 186-191. *Gaeolaelaps* n.sp. 15**; Female: 186, dorsal view of idiosoma; 187, tritosternum; 188, ventral view of idiosoma; 189, gnathosoma; 190, tectum; 191, anti-axial view of chelicera.

I



192

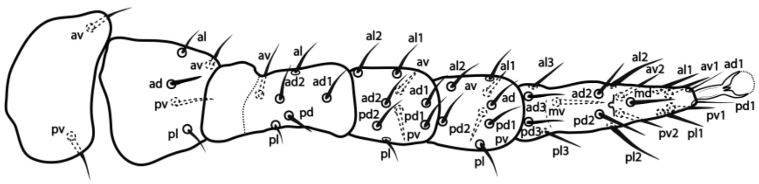
II



100 µm

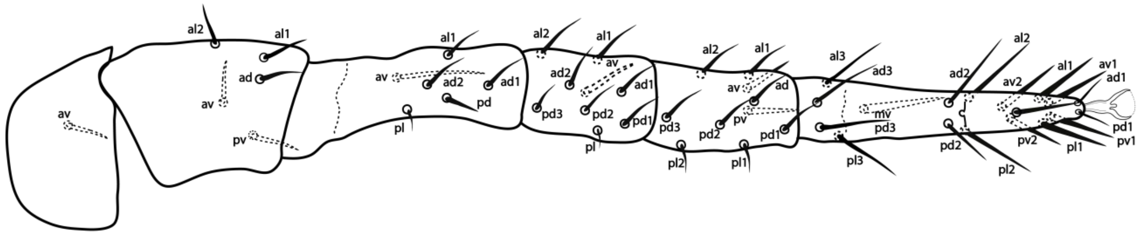
193

III



194

IV



195

**FIGURES 192-195.** ***Gaeolaelaps*** **n.sp. 15**; Female: 192, leg I; 193, leg II; 194, leg III; 195, leg IV.

**Key for the separation of adult females of *Gaeolaelaps* species reported from centro-southern Brazil**

The following key contains only the *Gaeolaelaps* species collected in this study, given that those are the only species of this genus reported from centro-southern Brazil.

**1.** Dorsal shield with a transverse line in the region of fusion of podonotal and opisthonotal shields; sternal shield broad ………………..***Gaeolaelaps* n.sp. 10**
**1´**. Dorsal shield without that line; sternal shield normal ……………..…..……….. **2**
**2.** With one unpaired dorsal seta (*Jx2*) ...……….…………..….…………..……. **3**
**2´**. Without unpaired dorsal seta …..……………….……………..…....…………... **4**
**3.** Without *z1* ……………………………………………..……. ***Gaeolaelaps* n.sp. 5**
**3´.** With *z1* ………………………..……………....……...... ***Gaeolaelaps* n.sp. 12**
**4.** Seta *J2* present …...…………..….……..……………………….….……….…… **5**
**4´.** Setae *J2* absent ……………..…………………..…………….……...…….……. **17**
**5.** Without extra paired setae ……...………..………………………………..……... **6**
**5´.** With extra paired setae (*Jx2*, *Jx3*, *Px2* or *Px3*) ……….....………..……..……. **7**
**6.** Legs II and IV with several spur-like setae; anal shield pear-shaped and without a pair of marginal pores and paranal cribal ………………….. ***G. queenslandicus***
**6´.** Legs II and IV with at some setae slightly thicker than others; anal shield subtriangular with a pair of marginal pores and paranal cribal extension and reticulate ……………………………………………..………… ***Gaeolaelaps* n.sp. 1**
**7.** Peritreme short, extending at most to level of *r2* ………................................... **8**
**7´.** Peritreme large, extending at least to level of *s2* ………………...…………….. **10**
**8.** Epistome truncate; mid-dorsal seta of tarsus IV longer than other setae of the same segment ……………..…………………………………………….. ***G. verticis***
**8´.** Epistome convex, mid-dorsal seta of tarsus IV only slightly longer than other seta of the same segment ............................................................................... **9**
**9**. Setae *j1* and *Z5* longer than distance to *j2* and *J5*, respectively; peritrematic plate abutting exopodal plate ………………………….……… ***Gaeolaelaps* n.sp. 13**
**9´.** Setae *j1* and *Z5* shorter than distance to *j2* and *J5*, respectively; peritrematic plate no abutting exopodal plate ……………………………… ***Gaeolaelaps* n.sp. 4**
**10.** Dorsal shield smooth or only reticulate in opisthonotal region ……………..….. **11**
**10´.** Dorsal shield reticulate at least in part of podonotal and opisthonotal regions ………………………………………………………………………………………….. **13**
11. Dorsal shield smooth; with most opisthonotal setae distinctly shorter than distance to respective subsequent setae …...........……….... ***Gaeolaelaps* n.sp 8**
**11´.** At least part of opisthonotal region striate or reticulate; with opistonothal setae distinctly longer than distance to respective subsequent setae …………. **12**
**12.** Opisthonotal region of dorsal shield totally reticulate; unsclerotized region laterad of dorsal shield with six of setae (*R1*, *R2*, *R4-R6*, *UR*); central region of tectum slightly convex; fixed cheliceral digit with 12-15 teeth ............................................................................................... ***Gaeolaelaps* n.sp. 4**
**12´.** Opisthonotal region with diagonal striae anteriad of *J3*, *Px3* and *S4*, smooth elsewhere; central, denticulate region of tectum distinctly convex; fixed cheliceral digit with six teeth ……………………..……………….……. ***Gaeolaelaps* n.sp.*2***

**13.** Genital shield with marked constriction mid-way between insertion of *st5* and posterior shield margin ………………………...…………. ***Gaeolaelaps* n.sp. 14**
**13´**. Genital shield without marked constriction ……………..……..……………….. **14**
**14.** Posterior margin of sternal shield convex, with two pairs of depressions next to median region of the margin ..…………..………………..…………. ***G. isodentis***
**14´.** Posterior margin of sternal shield concave or convex, without depressions next to median region of the margin ………………………………………….……. **15**
**15**. Posterior margin of sternal shield concave …………...…. ***Gaeolaelaps* n.sp. 7**
**15´**. Posterior margin of sternal shield convex ………..…………..…..…………... **16**
**16.** Most dorsal shield setae at least half as long as distance between their bases and the bases of the respective subsequent setae …………***Gaeolaelaps* n.sp. 15**
**16´**. Most dorsal shield setae less than half as long as distance between their bases and the bases of the respective subsequent setae ……………………………………………………………….. ***Gaeolaelaps* n.sp. 9**
**17.** Dorsal seta *S3*, *Px2* and *Px3* absent …...………………..….. ***Gaeolaelaps* n.sp. 6**
**17´**. Dorsal seta *S3*, *Px2* and *Px3* present …………………….…………….…. **18**
**18** Setae *J3* and *Px2* longer than distance between their bases and the bases of *J4* and *Px3* respectively; seta *z1* about 1.3 times as long as *j1* ……………………………………………………..………..***Gaeolaelaps* n.sp. 11**
**18´.** Setae *J3* and *Px2* shorter than distance between their bases and the bases of *J4* and *Px3* respectively; seta *z1* about as long as *j1* ………………………………………………………………. ***G. invictianus***

## 3.4. DISCUSSION

Nineteen species of *Gaeolaelaps* were found in this study, of which 14 are new to science. This seems a high number of species, given that they were collected in just two occasions, and in relatively few samples. It is expected that many other *Gaeolaelaps* species could be found in a more extensive survey. *G. invictianus* was the most numerous and *G. queenslandicus* the most frequent species collected in this study. The maximum number of species that were collected from samples taken from patches of natural vegetation were 13 more than half the number found in pasture and sugarcane field.

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