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Formicidae (Hymenoptera) from the Humid Chaco ecoregion: inventory of species, new records, and pictorial keys for subfamilies and genera identification

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Abstract: This is the first study that analyzes the ant fauna of the Humid Chaco ecoregion. We produced an inventory based on a) sampling at different locations in the provinces of Chaco and Corrientes, Argentina, and b) bibliographic records. This inventory comprises 10 subfamilies, 77 genera, and 462 species. Eight of these species are new records for the Humid Chaco ecoregion, and six species are registered for the first time in Argentina. *Acanthostichus longinodis*, *Camponotus fiebrigi*, *Crematogaster thalia*, *Eciton mexicanum argentinum*, *Mycetomoellerius fiebrigi*, *Strumigenys insolita* and *Strumigenys siagodens* are registered as endemic species of the Humid Chaco ecoregion. Pictorial keys are provided for the 10 subfamilies and 77 genera that inhabit this ecoregion.

Keywords: ants, check list, Neotropical region, new records

Resumen: Este es el primer estudio que analiza la fauna de hormigas exclusivamente en la ecorregión del Chaco Húmedo. Elaboramos un inventario basado en a) muestreo en diferentes localidades de las provincias de Chaco y Corrientes, Argentina, y b) registros bibliográficos. Este inventario comprende 10 subfamilias, 77 géneros y 462 especies. Ocho de estas especies son nuevos registros para la ecorregión del Chaco Húmedo y seis especies son registradas por primera vez en Argentina. *Acanthostichus longinodis*, *Camponotus fiebrigi*, *Crematogaster thalia*, *Eciton mexicanum argentinum*, *Mycetomoellerius fiebrigi*, *Strumigenys insolita* y *Strumigenys siagodens* están registradas como especies endémicas de la ecorregión del Chaco Húmedo. Se proporcionan claves pictóricas para las 10 subfamilias y los 77 géneros que habitan en esta ecorregión.

Palabras clave: hormigas, lista de especies, región Neotropical, nuevos registros

INTRODUCTION

Formicidae (Hymenoptera) is one of the most abundant groups of insects in terrestrial ecosystems (Mason *et al.,* 2006; Schultheiss *et al.*, 2022). They are distributed in practically all environments, from arid deserts to riverside forests subjected to long periods of flooding (Fernández, 2003) and from sea level to an altitude that exceeds 4,000 meters (Beutel *et al.,* 2013).

The Neotropical region is recognized for harboring high species richness of ants, with around 3,400 taxa (Fernández *et al.*, 2021), representing about 23% of the total number of current species registered worldwide. In addition to their biological diversity, ants exhibit a wide variety of behaviors, food habits, and interactions with other organisms, intervening in important processes such as seed dispersal and soil dynamics (Arcila & Lozano-Zambrano, 2003; Kaspari, 2003).

Due to its geographical location, longitudinal extension, and topography, Argentina has a great variety of ecoregions, from the extensive Patagonian Steppes to the high rain forests of the Yungas (Matteucci, 2007; Arana *et al.*, 2017, 2021). These conditions favor the establishment of rich ant fauna, with a total of 697 species distributed among 82 genera and 10 subfamilies recognized in the country, many of which are endemic (Cuezzo & Larrea, 2022). The richness of

ant species in Argentina has intermediate values if compared with those of other countries in the region, such as Chile (84 species), Uruguay (104 species), Bolivia (441 species), Paraguay (445 species), Colombia (1,200 species), and Brazil (1,521 species) (Fernández & Sendoya, 2004; Wild, 2007a; Baccaro *et al.*, 2015; Fernández *et al.*, 2019, 2021). However, several areas, such as the Chaco Region, are poorly inventoried.

The Humid Chaco is one of the three ecoregions into which the Chaco region is divided (Arana *et al.*, 2021). This ecoregion comprises central Paraguay, northeast Argentina, and a small area of Brazil (Morrone 2014). The vegetation unit of this ecoregion is characterized by a mosaic composed of various plant communities, namely mesophyte forest, semi-open xerophyte forest, riverside forest, *Copernicia alba* palm savanna, tall hygrophyte grassland, and marshy herbaceous formations (Oyarzabal *et al.,* 2018). Argentina is one of the ten countries in the world with the highest loss of forest extensions (FAO, 2016), the Humid Chaco being one of the most deforested ecoregions in the last three decades (Zak *et al.*, 2008; Hoyos *et al.*, 2012). The ecosystems of this ecoregion are threatened by conversion processes caused by anthropic activities (Dinerstein *et al.*, 1995; Volante & Seghezzo, 2018). These processes reduce the recovery capacity of the environments and cause irreversible effects on the biodiversity of the flora and fauna, affecting the provision of ecosystem services (Sanderson *et al.*, 2002; Pavlacky *et al.*, 2012; Correa Ayram *et al.*, 2017). There is no accurate data on the diversity of ants in this ecoregion because many species inventories are made using political divisions (i.e., country/province/state) that lack biological meaning (Whittaker *et al.*, 2005; Diniz-Filho *et al.*, 2010). Therefore, the distribution range of most insect species in the tropical and subtropical ecoregions of Asia, America, and Africa is unknown (Diniz-Filho *et al.*, 2010).

Given the limited knowledge of ant assemblages in many ecosystems of the Humid Chaco ecoregion, it is essential to conduct studies that make it possible to inventory and map the biodiversity in this area and evaluate the crucial role that these insects play in the structure and function of these terrestrial ecosystems (Cuezzo, 1998; Calcaterra *et al.*, 2021). Inventories provide valuable information on the biodiversity, structure, and function of the different hierarchical levels of species in different environments, and such information is essential for decision-making in ecosystem management and conservation programs (Villarreal *et al.*, 2006). This study aimed to inventory the ants inhabiting the Humid Chaco ecoregion and update the species distribution for this area given new records. In addition, pictorial keys are included to aid in the taxonomic identification of subfamilies and genera of Formicidae occurring in this ecoregion of South America.

MATERIAL AND METHODS

Inventory and data sources

This inventory was created based on a) censuses carried out in gallery forests in the provinces of Chaco and Corrientes (Argentina) and b) bibliographic records corresponding to specimens collected in different environments of the Humid Chaco ecoregion. All localities providing a reference are included and detailed in Figure 1 and Table 1.

The bibliographic information was obtained and georeferenced using the antmaps.org page (Janicki *et al.*, 2016), which displays the information from the GABI database (Guénard *et al.*, 2017). This database is an important tool and represents a starting point for characterizing and understanding the geographic distribution of a species or group of ants. The georeferenced data in this system were verified by searching for the scientific articles referenced in the database for each point and species and by corroborating the coordinates provided by the antmap website.

Study area

New material was collected from gallery forests located in the following departments of the province of Chaco, Argentina: Primero de Mayo (Antequera, Los Chaguares), Bermejo (El Bagual, San Carlos, Vedia), General San Martín (Pampa del Indio Provincial Park) and Sargento Cabral (Quintana, and Chaco National Park). In addition, new material was collected from gallery forests, grasslands (Larrea *et al*., 2022), and palm forests located in the following departments of the province of Corrientes, Argentina: Mburucuyá (Mburucuyá National Park), San Miguel (San Miguel, San Nicolás), Santo Tome (Galarza), and Ituzaingó (Cambyreta).

Trapping methodology

Ant censuses were taken by following the recommendations of the ALL protocol, developed as a proposal for a rapid and standardized survey of ants in a humid and wooded environment (Agosti *et al.*, 2000). Censuses in Chaco were carried out

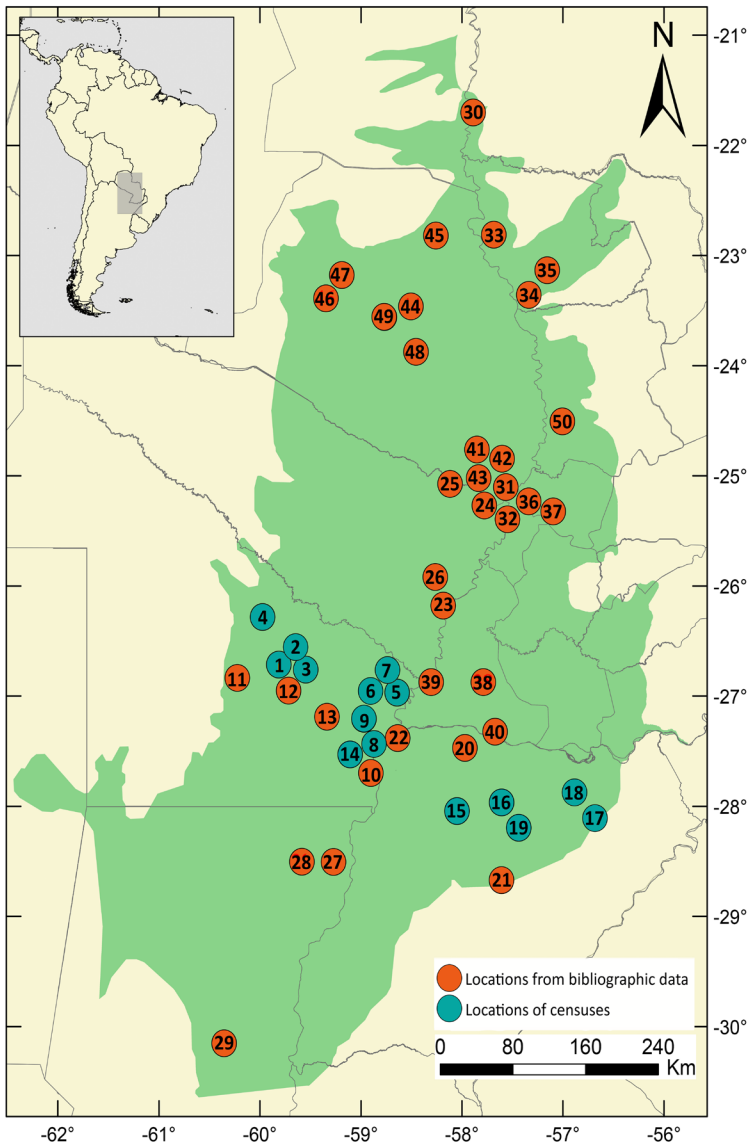

Fig. 1. Map of the Humid Chaco ecoregion and localities where Formicidae species are registered (for references see Table 1).

from October to March in 2017 and 2018, whereas in Corrientes they were conducted from October to March in 2013, 2014, and 2017. At each site, two transects (200 m long) were drawn, 100 m apart from each other. In each transect, 20 points separated by 10 m were selected. The following census methods were used: a) collection of 1 m^2 of litter, b) foliage pattering, c) manual catch, and d) pitfall.

All the captured specimens were kept in plastic containers with 70% alcohol, labeled with information on the locality, date, collector, and capture technique, until their subsequent purification and taxonomic identification.

Inventory format

To organize the inventory, the classification of subfamilies and genera proposed in AntCat (www.antcat.org) was followed. This website compiles all the changes in the relationships between the different groups of Formicidae (Bolton, 2022). The subfamilies, genera, and species were placed in alphabetical order, with their valid name, author, and year of publication.

Table 1. Localities in the Humid Chaco ecoregion where species of Formicidae were registered. Abbreviations: a, censuses; b, bibliographic record.

Country	Province/State/ Department	Locality	Geographical coordinates	Source of data	Ref. in Fig. 1
Argentina	Chaco	Chaco National Park 1	26°48’14.8”S 59°36’28.4”W	a, b	1
		Chaco National Park 2	26°47’1.67”S 59°36’18.4”W	a	2
		Estancia Quintana	26°48’01.7”S 59°36’00.4”W	a	3
		Pampa del Indio Provincial Park	26°16’40.2”S 59°58’06.2”W	a	4
		Estancia San Carlos	26°57’46.1”S 58°38’12.0”W	a	5
		Vedia	26°56’01.4”S 58°38’52.7”W	a	6
		Estancia El Bagual	26°47’33.6”S 58°44’02.2”W	a	7
		Puerto Antequera	27°25’41.9”S 58°51’58.8”W	a	8
		Reserva Los Chaguares	27°20’01.5”S 58°58’01.5”W	a	9
		Reserva Natural Colonia Benítez	27°19’06.4”S 58°56’58.3”W	a, b	10
		Presidencia Roque Sáenz Peña	26°29’11.5”S 60°08’11.3”W	a	11
		Colonia Elisa	26°56’42.0”S 59°42’35.0”W	b	12
		Ruta 16 (km 61)	27°10’58.8”S 59°19’58.8”W	b	13
		Estancia San Francisco	27°30’30.2”S 59°04’53.2”W	a	14
	Corrientes	Mburucuyá National Park	28°02’25.1”S 58°02’36.2”W	a	15
		San Miguel	28°01’03.8”S 57°34’34.4”W	a	16
		Galarza	28°06’07.4”S 56°40’24.9”W	a	17
		Cambyreta	27°52’06.9”S 56°52’49.6”W	a	18
		San Nicolás	28°09’32.2”S 57°26’42.1”W	a	19
		Laguna Vallejos	27°26’12.8”S 58°03’39.7”W	b	20
		Rincón de Socorro	28°38’16.2”S 57°25’06.5”W	a	21
		Corrientes	27°33’00.0”S 58°40’58.8”W	b	22
	Formosa	Formosa	26°10’15.8”S 58°08’26.0”W	b	23
		Clorinda	25°14’49.8”S 57°44’50.2”W	b	24
		Pilcomayo National Park	25°04’55.3”S 58°04’01.0”W	b	25
		Mojón de Fierro	26°02’28.5”S 58°02’40.2”W	b	26
	Santa Fe	Villa Ocampo	29°07’59.2”S 59°39’11.6”W	b	27
		Villa Ana	28°30’00.0”S 59°34’48.0”W	b	28
		Vera y Pintado	30°09’00.0”S 60°21’00.0”W	b	29
Brazil	Mato Grosso do Sul	Porto Murtinho	21°41’39.8”S 57°52’59.9”W	b	30
Paraguay	Central	San Lorenzo	25°16’00.0”S 57°19’00.0”W	b	31
		Villa Elisa	25°23’54.5”S 57°34’15.7”W	b	32
	Concepción	Puerto Max	22°43’30.6”S 57°43’45.9”W	b	33
		Kurusu Isabel	23°21’24.3”S 57°20’19.9”W	b	34
		Concepción	23°23’17.8”S 57°24’18.2”W	b	35
	Cordillera	Caacupé	25°23’00.0”S 57°09’00.0”W	b	36
		San Bernardino	25°21’00.0”S 57°20’00.0”W	b	37
	Ñeembucú	Ñeembucú	26°49’30.6”S 57°42’53.5”W	b	38
		Pilar	26°52’00.0”S 58°18’00.0”W	b	39
		Cerrito	27°19’01.2”S 57°40’01.2”W	b	40
	Presidente Hayes	Benjamín Aceval	25°00’00.6”S 57°32’43.5”W	b	41
		Rio Confuso	25°09’48.5”S 57°35’20.0”W	b	42
		Villa Hayes	25°16’00.0”S 57°40’00.0”W	b	43
		Pozo Colorado	23°33’07.7”S 58°45’51.2”W	b	44
		Estancia San Pedro	22°48’35.6”S 58°15’14.0”W	b	45
		Estancia Yatamasit	23°22’00.0”S 59°20’00.0”W	b	46
		Rio Verde 1	23°13’04.3”S 59°12’10.6”W	b	47
		Monte Lindo	23°54’19.2”S 58°25’09.9”W	b	48
		Rio Verde 2	23°33’07.7”S 58°45’51.2”W	b	49
	San Pedro	Puerto Rosario	22°45’27.4”S 58°16’33.9”W	b	50

For new records in the Humid Chaco ecoregion and Argentina, the inventory was prepared according to this structure: family, subfamily, valid species name with author and year of publication, country, province, department, locality in brackets, date of collection, collector, number and caste of specimens, and depository with collection number in brackets of the pinned specimens and/or glass vials (for specimens of the same species from the same locality). For departments in the same province, information is separated by semicolons. General species distribution at the country level for the Neotropical region is presented according to Cuezzo (1998), Lattke (2003), De Andrade (2004), Fernández & Sendoya (2004), Wild (2007b), Vittar & Cuezzo (2008), Lattke (2012), and Longino (2013). Detailed information for species distribution in the Humid Chaco ecoregion is also provided as follows: country and province, department, and locality in brackets. Localities in the same province are separated by a comma.

Pictorial keys for subfamily and genera of ants inhabiting the Humid Chaco ecoregion

The pictorial keys presented are based on Bolton (1994), Palacio & Fernández (2003), and Baccaro *et al*. (2015). We followed the classification proposed by Ward (2005, 2007), Brady *et al*. (2014), Schmidt & Shattuck (2014), Ward *et al*. (2014), Camacho *et al*. (2022), and Hanisch *et al*. (2022). Illustrations were made on a Wacom Intuos Art tablet and Adobe Photoshop editing software.

RESULTS

Herein we present the inventory of Formicidae species recorded in the Humid Chaco ecoregion. Ten subfamilies distributed among 77 genera and 462 species are listed (supp. Table 1). Eight species have been recorded for the first time in this ecoregion. In addition, and six species have been recorded for the first time in Argentina. We highlight out seven species that could be endemic species of Humid Chaco (Table S1).

New records for the Humid Chaco ecoregion

Family Formicidae (Latreille, 1809)
Subfamily Ectatomminae Emery, 1895

Acanthoponera mucronata (Roger, 1860)

Material examined. Argentina, Chaco, Sargento Cabral (Estancia El Bagual), 20-III-2018, Larrea leg, 15 Workers, (CARTROUNNE 9603); Primero de Mayo (Reserva Los Chaguares), 21-X-2017, Larrea leg, 4 Workers, (CARTROUNNE 9604).
Distribution. Neotropical: Argentina, Brazil, Bolivia, Colombia, Ecuador, Paraguay, Peru and Venezuela.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Sargento Cabral, Primero de Mayo).
Comments. Workers were collected in galleries forests. These ants were found nesting in the trees with nocturnal habits.

Subfamily Myrmicinae Lepeletier de Saint-Fargeau, 1835

Pheidole capillata Emery, 1906

Material examined. Argentina, Chaco, Primero de Mayo (Reserva Los Chaguares), 21-X-2017, Larrea leg, 8 Workers (CARTROUNNE 9684).
Distribution. Neotropical: Argentina, Brazil and Peru.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Primero de Mayo).
Comments. Wilson (2003) mentions that this species forage on cloudy days at dawn or dusk.

Pheidole synarmata Wilson, 2003

Material examined. Argentina, Chaco, Bermejo (Estancia San Carlos), 20-III-2018, Larrea leg, 5 Workers, (CARTROUNNE 9654).
Distribution. Neotropical: Argentina, Brazil, Colombia, Costa Rica, El Salvador, French Guiana, Guyana, Honduras, Nicaragua, Panama, Peru and Venezuela.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Bermejo).
Comments. This species was reported as associated with pig carcasses (Andrade-Silva et al. 2015).

Procryptocerus goeldii Forel 1899.

Material examined. Argentina, Chaco, Bermejo (Estancia San Carlos), 15-XI-2013, Larrea leg, 11 Workers, (CARTROUNNE 9656); Sargento Cabral (Chaco National Park 1), 10-II-2018, Larrea leg, 7 Workers, (CARTROUNNE 9684).
Distribution. Neotropical: Argentina, Brazil, French Guiana, Guyana and Paraguay.

Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Bermejo, Capitán Solari).

Procryptocerus hylaeus Kempf 1951.

Material examined. Argentina, Chaco, Primero de Mayo (Puerto Antequera), 30-X-2017, Larrea leg, 3 Workers, (CARTROUNNE 9685).
Distribution. Neotropical: Argentina, Brazil, Bolivia, Colombia, Costa Rica, French Guiana, Guyana, Panama, Paraguay, Peru and Venezuela.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Primero de Mayo).
Comments. Longino & Snelling (2002) reported to *P. goeldii* and *P. hylaeus* as species with sympatric distribution.

Strumigenys dyseides Bolton, 2000.

Material examined. Argentina, Chaco, Sargento Cabral (Estancia El Bagual), 20-III-2018, Larrea leg, 19 Workers, (CARTROUNNE 9686); Sargento Cabral (Chaco National Park 1), 14-II-2018, Larrea leg, 7 Workers, (CARTROUNNE 9687).
Distribution. Neotropical: Argentina, Brazil, Colombia, French Guiana and Guyana.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Sargento Cabral, Capitán Solario).

Strumigenys lilloana (Brown, 1950)

Material examined. Argentina, Chaco, Sargento Cabral (Estancia El Bagual), 20-III-2018, Larrea leg, 2 Workers, (CARTROUNNE 9661).
Distribution. Neotropical: Argentina, Brazil.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Sargento Cabral).

Subfamily Ponerinae Lepeletier de Saint-Fargeau, 1835

Leptogenys pusilla (Emery, 1890)

Material examined. Argentina, Chaco, Sargento Cabral (Estancia El Bagual), 20-III-2018, Larrea leg, 6 Workers, (CARTROUNNE 9675).
Distribution. Neotropical: Argentina, Brazil, Colombia, Costa Rica, Lesser Antilles, Mexico, Panama.
Distribution in the Humid Chaco ecoregion. Argentina (Chaco: Sargento Cabral).

Pictorial keys for Formicidae ants from the Humid Chaco ecoregion

To assist researchers who wish to perform the taxonomic identification of ants, we prepared relatively simple pictorial keys for identification to the subfamilies (Fig. 2, see Fig. S1 for the Spanish version) and genera for each subfamily inhabiting the Humid Chaco ecoregion: Amblyoponinae (Fig. 3), Dolichoderinae (Fig. 4), Dorylinae (Fig. 5), Ectatomminae (Fig. 6), Formicinae (Fig. 7), Myrmicinae (Figs. 8–11), Paraponerinae (Fig. 2), Ponerinae (Figs. 12–13), Proceratiinae (Fig. 2), and Pseudomyrmecinae (Fig. 2).

DISCUSSION

This inventory provides valuable information for understanding the distribution of one of the most conspicuous groups of arthropods in the Humid Chaco. This information, added to previous studies on other invertebrate taxa (Laffont *et al.*, 2007; Rubio e*t al.*, 2008; Dufek *et al.*, 2020), will allow the evaluation of patterns of endemism of arthropods in the region.

Ten subfamilies of ants were recorded for the Humid Chaco ecoregion: Amblyoponinae, Dolichoderinae, Dorylinae, Ectatomminae, Formicinae, Myrmicinae, Paraponerinae, Ponerinae, Proceratiinae, and Pseudomyrmecinae. This represents 77% (10/13) of the total subfamilies registered in the Neotropical region (Fernández & Sendoya, 2004; Guénard *et al.*, 2017; Fernández *et al.*, 2021).

Of the 462 species included in this inventory, 56 were obtained from censuses whereas 398 were only recorded from bibliographical sources. Eight species are new records for the Humid Chaco ecoregion. These species were exclusively obtained from census events carried out in the provinces of Chaco and Corrientes, Argentina.

The most diverse genera recorded in the Humid Chaco ecoregion were *Camponotus* Mayr, 1961 (46 species) and *Pheidole* Westwood, 1839 (38 species). These ants represent the most common groups in the Neotropical region and are the most hyperdiverse genera of ants worldwide (Wilson, 2003; Pérez-Sánchez et al., 2018).

The species with the most widespread distribution (five or more localities) were *Crematogaster crinosa* Mayr, 1862, *Dorymyrmex thoracicus* Gallardo 1916, *Ectatomma brunneum* Smith 1858, *Linepithema humile* (Mayr, 1868), *Nesomyrmex spininodis* (Mayr, 1887), *Nylanderia*

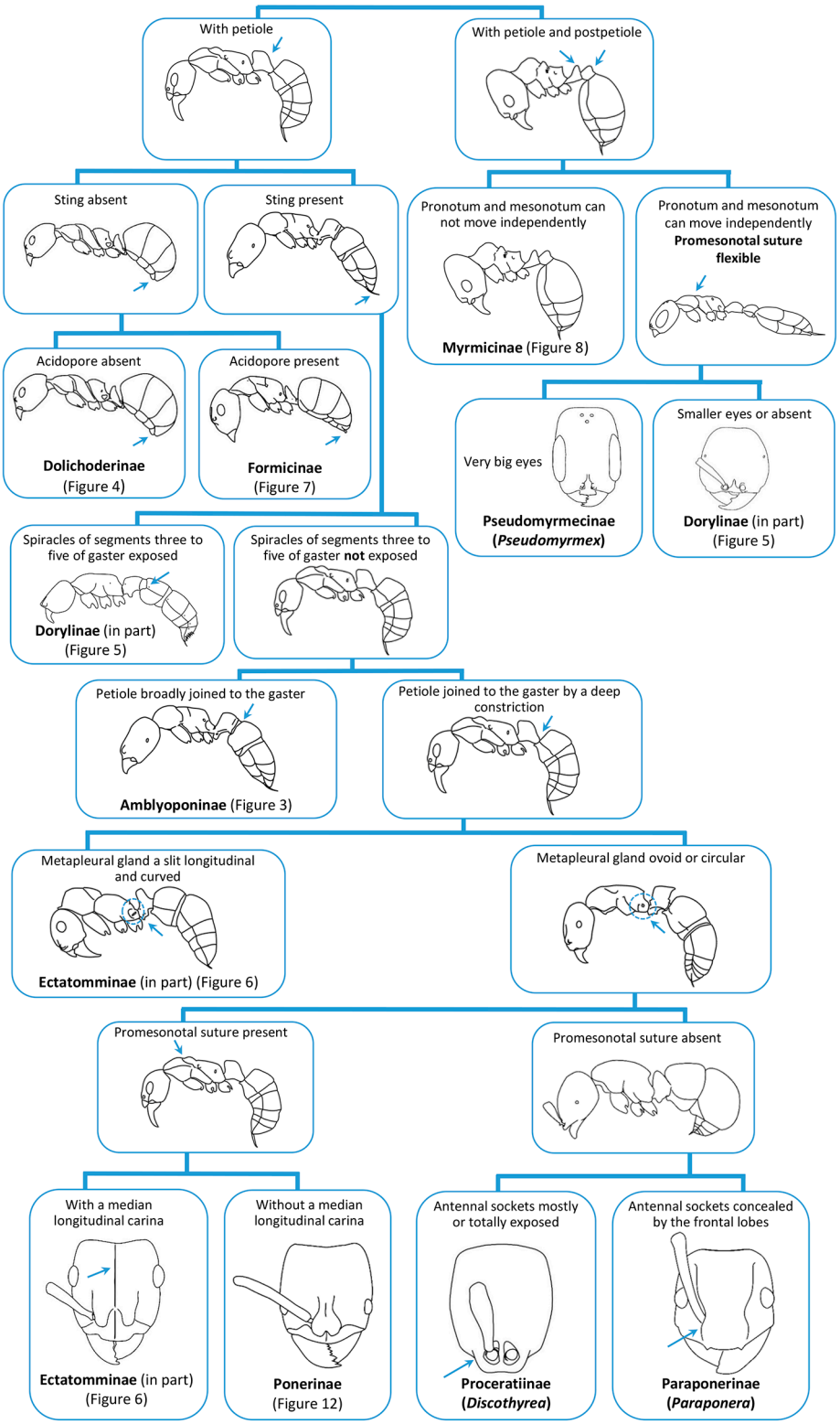

Fig. 2. Pictorial key to the subfamilies of Formicidae (Hymenoptera) from the Humid Chaco ecoregion.

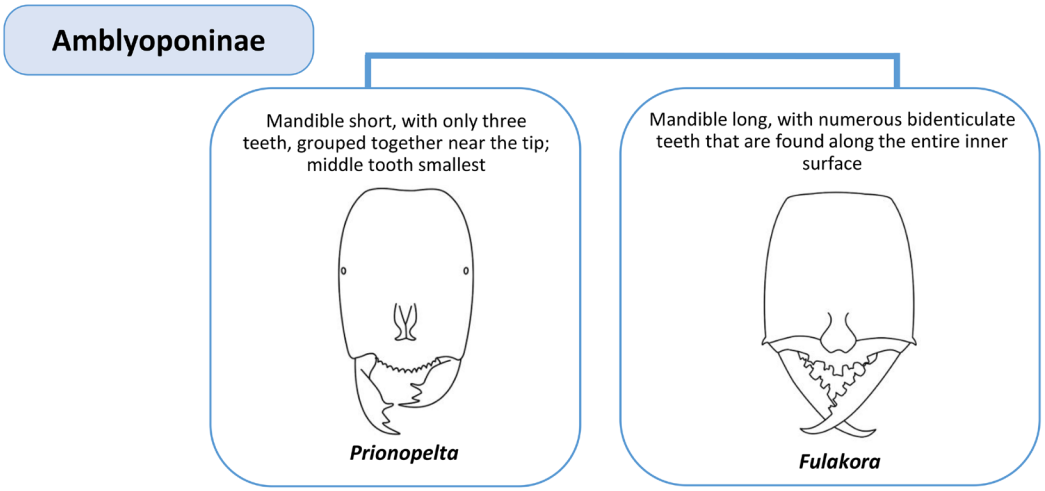

Fig. 3. Pictorial key to the genera of Amblyoponinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

fulva (Mayr, 1862), *Octostruma balzani* (Emery, 1894), *Pseudomyrmex gracilis* (Fabricius, 1804), *Solenopsis invicta* Buren, 1972, *Strumigenys eggersi* Emery, 1890, and *Wasmannia auropunctata* (Roger, 1863). Many of these species (e.g., *Solenopsis invicta*, *Linepithema humile*, *Nylanderia fulva* and *Wasmannia auropunctata*) are organisms with great adaptation capacity, considered exotic (introduced) species of economic importance in other regions of the planet (Della, 2003).

Several species of this inventory collected in censuses stand out in a forensic and economic context. The species *Camponotus blandus* (Smith, 1858), *Camponotus punctulatus* Mayr, 1868, *Camponotus rufipes* (Fabricius, 1775), *Ectatomma brunneum*, *Pheidole radoszkowskii* Mayr, 1884, *Pheidole synarmata*, *Pseudomyrmex gracilis*, and *Solenopsis saevissi* were collected associated with pig carcasses in Brazil (Andrade-Silva *et al.*, 2015; Viana *et al.*, 2022). Regarding its economic importance, the genera *Acromyrmex* spp. Mayr, 1863 and *Atta* Fabricius, 1804 include several species which are pest for a variety of crops (Nickele *et al.*, 2012; Montoya-Lerma *et al.*, 2012; Diaz Napal *et al.*, 2015). In addition, species like *Linepithema humile*, *Wasmannia auropunctata*, *Nylanderia fulva* are recognized as household pest (Ness & Bronstein, 2004).The following seven taxa were recorded as endemic species for the Humid Chaco ecoregion: *Acanthostichus longinodis* Mackay, 2004, *Camponotus fiebrigi* Forel, 1906, *Crematogaster thalia* Forel, 1911, *Eciton mexicanum argentinum* Borgmeier, 1955, *Mycetomoellerius fiebrigi* (Santschi, 1916), *Strumigenys insolita* Bolton, 2000 and *Strumigenys siagodens* (Bolton, 2000). This contribution provides new groups of useful insects to characterize the biographical ecoregion of the Humid Chaco, which to date has no reported endemic ant species (Morrone, 2000; Arana *et al.*, 2021). It is important to mention that there are few records available for many of these species. This implies that future studies could extend the distribution area of these organisms beyond the Humid Chaco ecoregion. Therefore, new surveys may help to better understand the distribution of some of these species.

CONCLUSIONS

Species inventory, new records, endemic species, and taxonomic keys presented herein represent a significant contribution to the knowledge of Formicidae from the Humid Chaco ecoregion. This will allow for a better understanding of the biological value of this ecoregion of South America which is being greatly transformed by human activity. Furthermore, the inventory approach with a biogeographical perspective is essential because it presents true biological implications on organisms, unlike the traditional approaches using political boundaries (i.e., countries, states/provinces, departments).

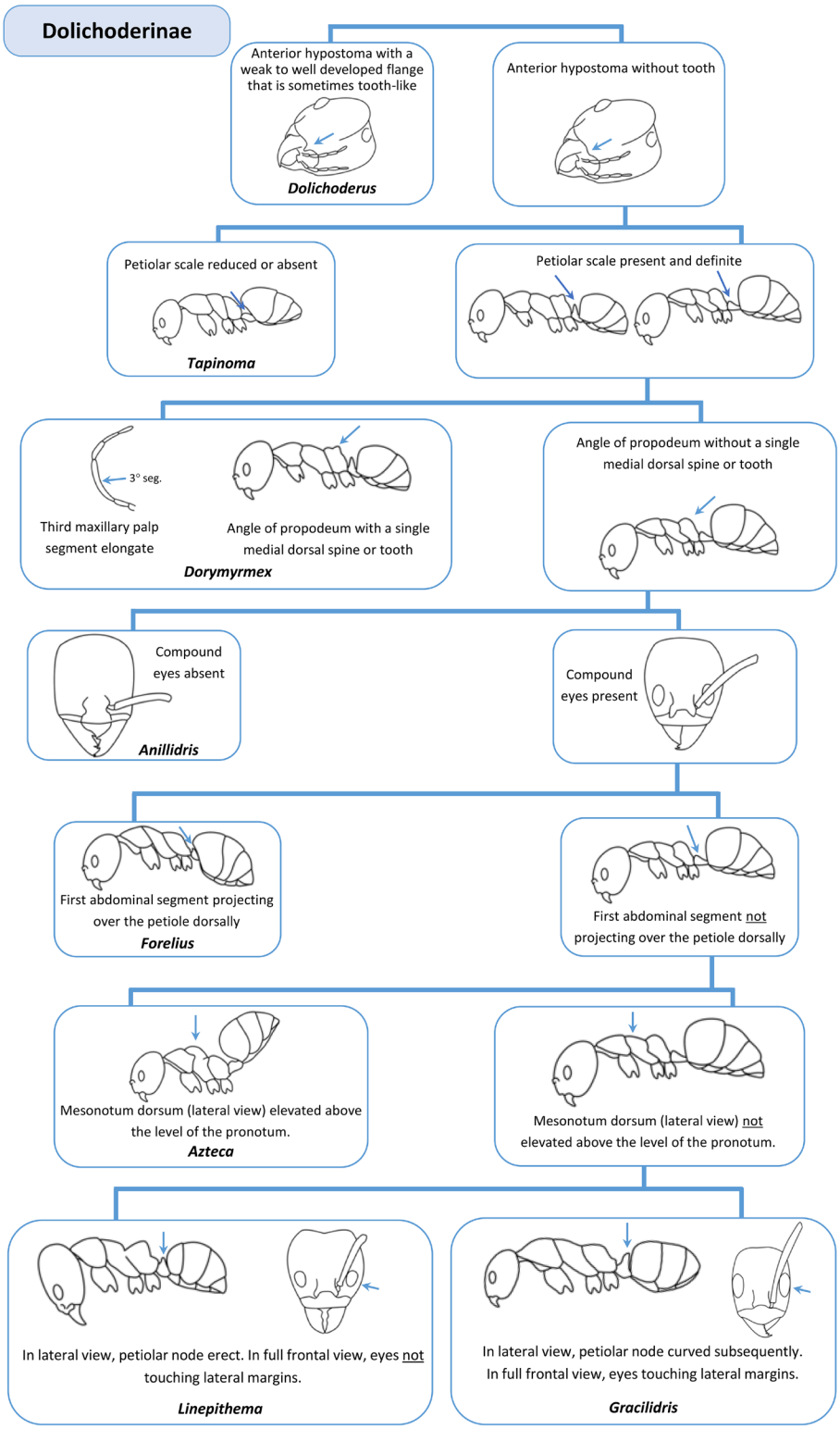

Fig. 4. Pictorial key to the genera of Dolichoderinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

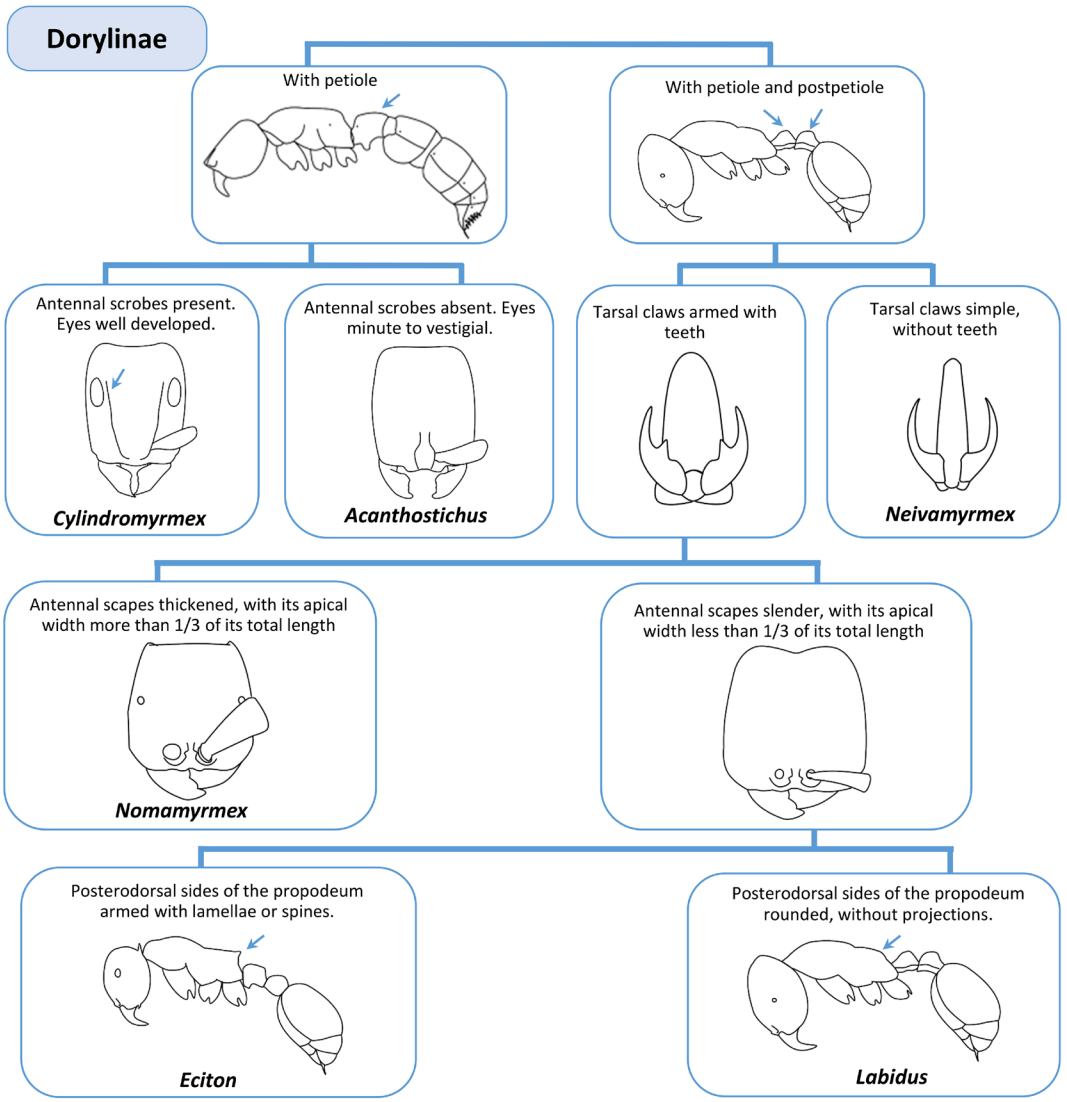

Fig. 5. Pictorial key to the genera of Dorylinae (Hymenoptera) from the Humid Chaco ecoregion.

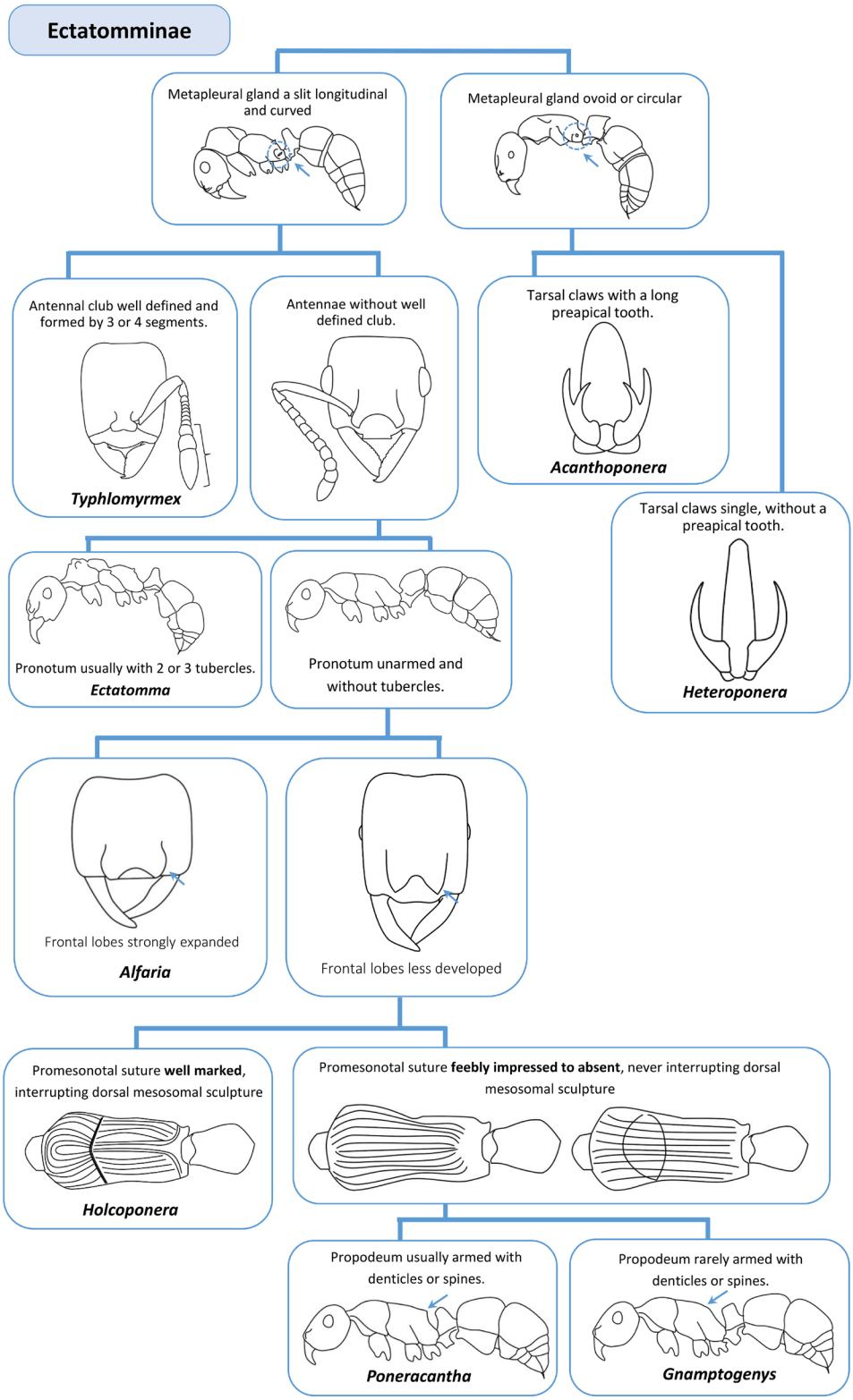

Fig. 6. Pictorial key to the genera of Ectatomminae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

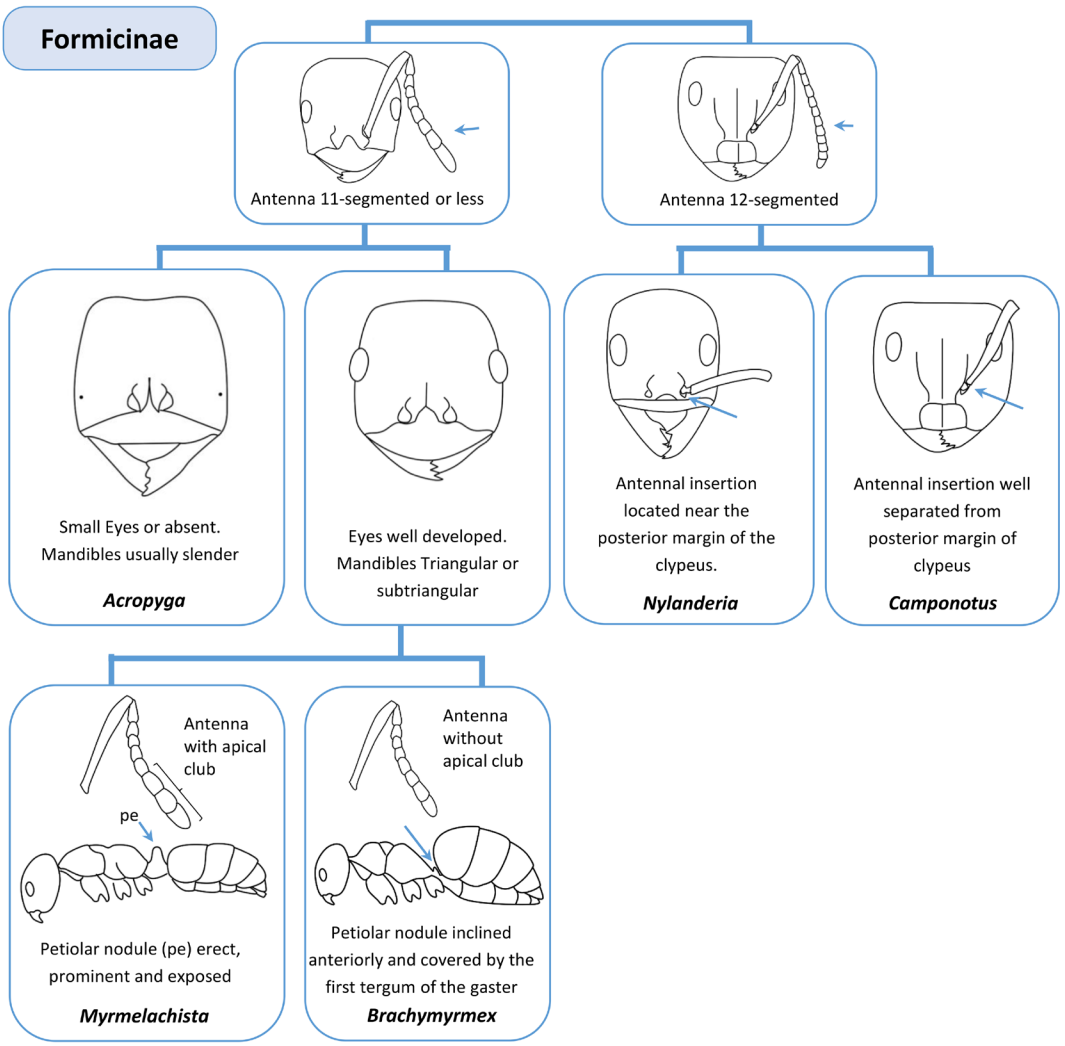

Fig. 7. Pictorial key to the genera of Formicinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

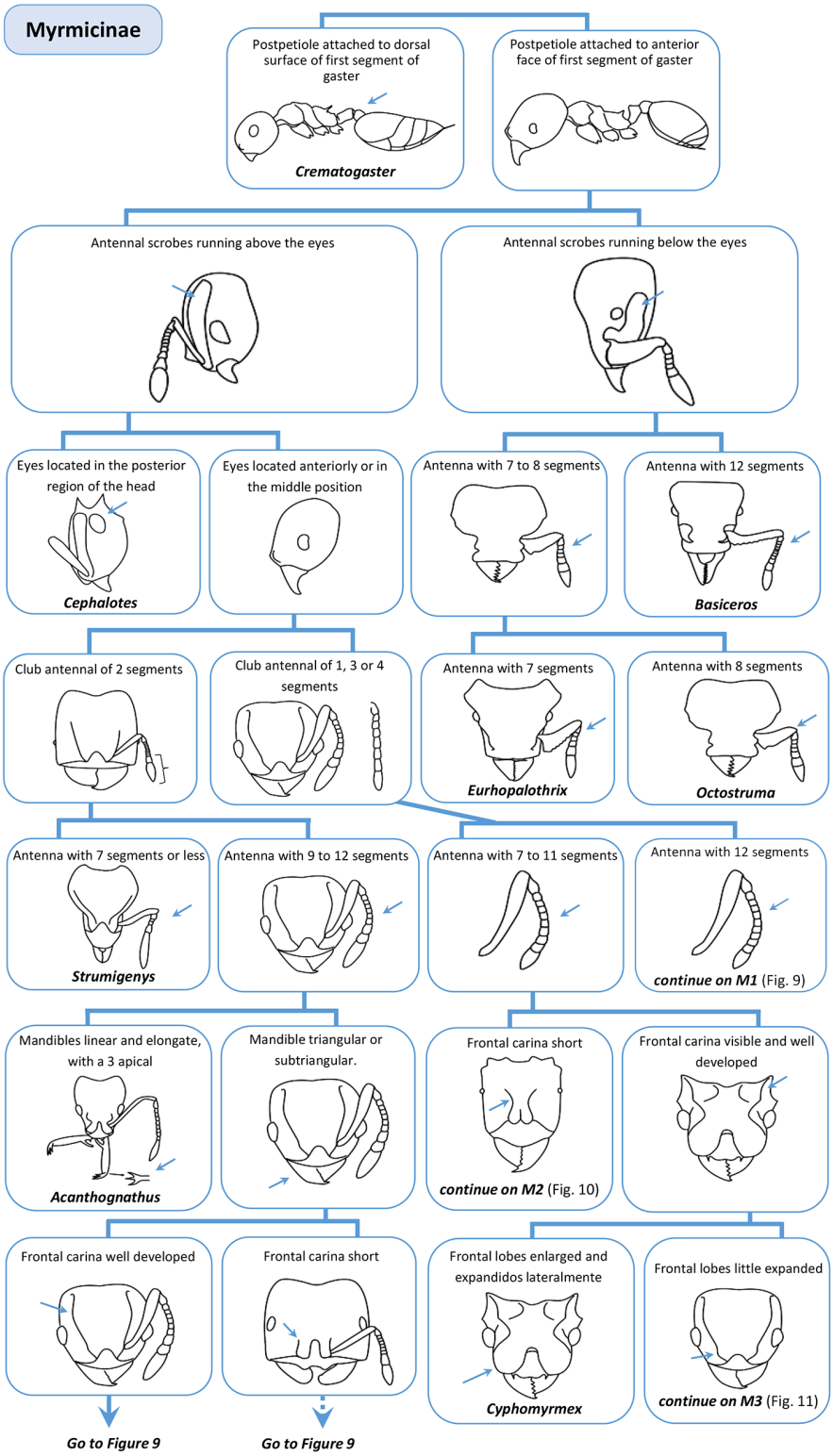

Fig. 8. First part of the pictorial key to the genera of Myrmicinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

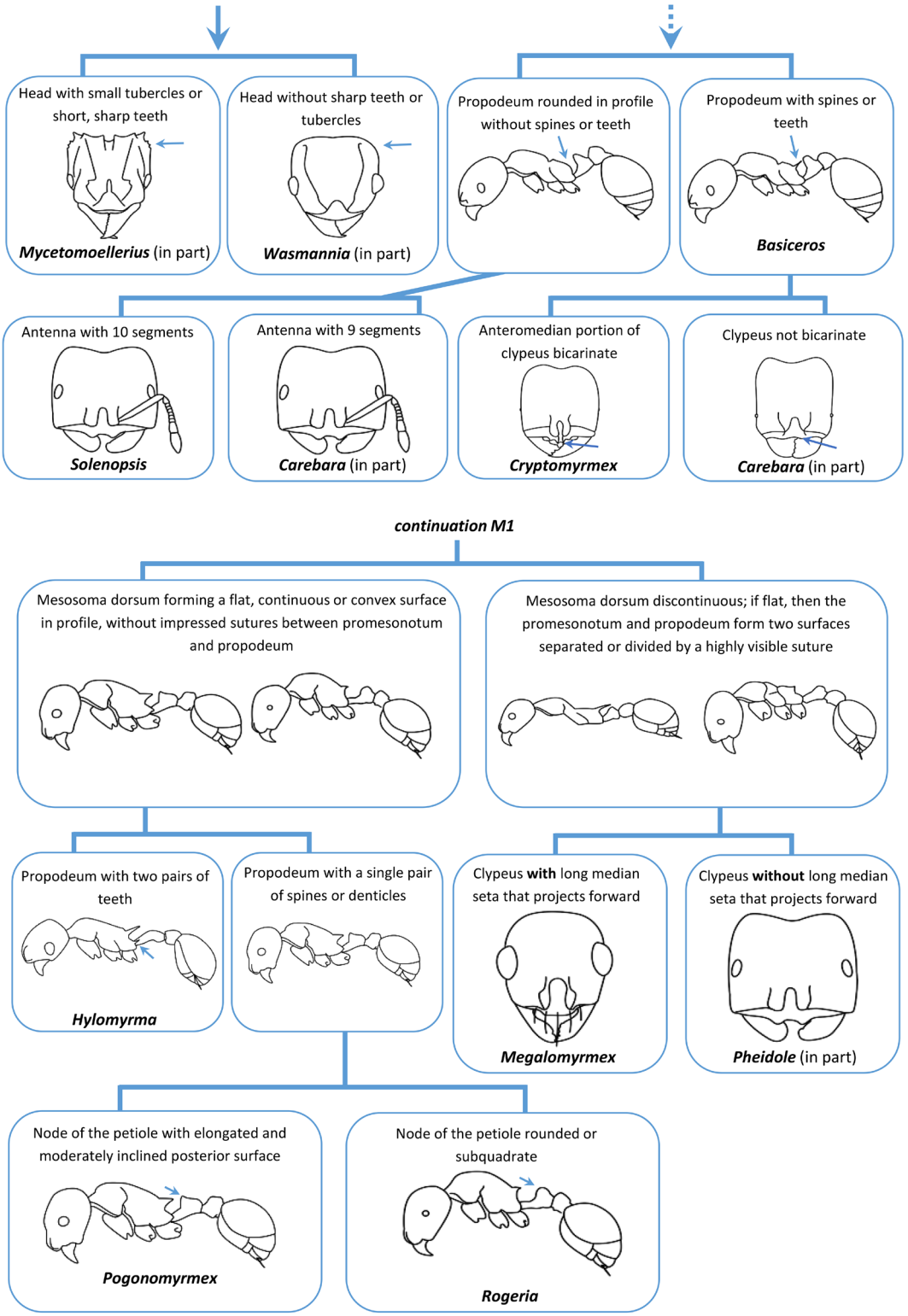

Fig. 9. Second part of the pictorial key to the genera of Myrmicinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

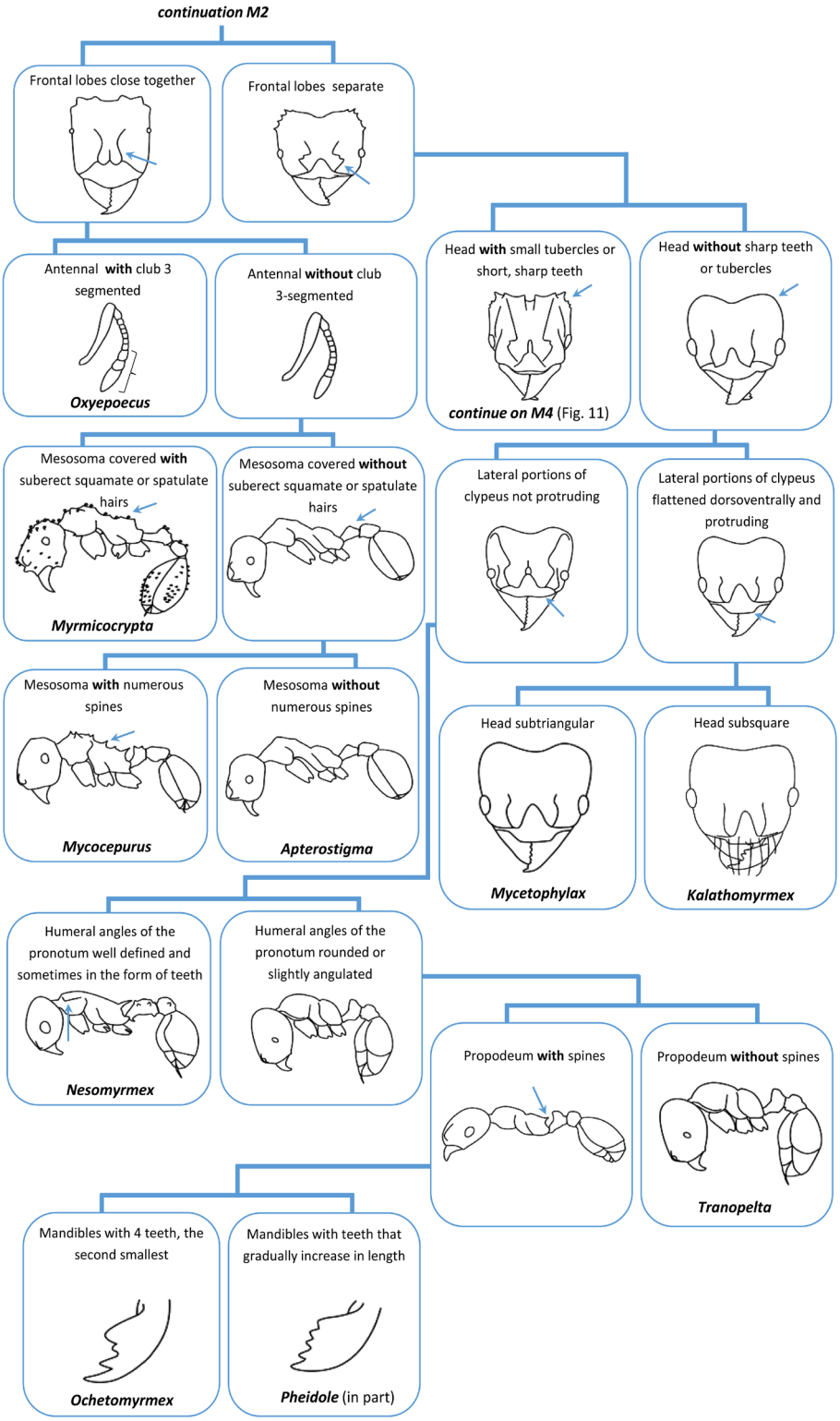

Fig. 10. Third part of the pictorial key to the genera of Myrmicinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

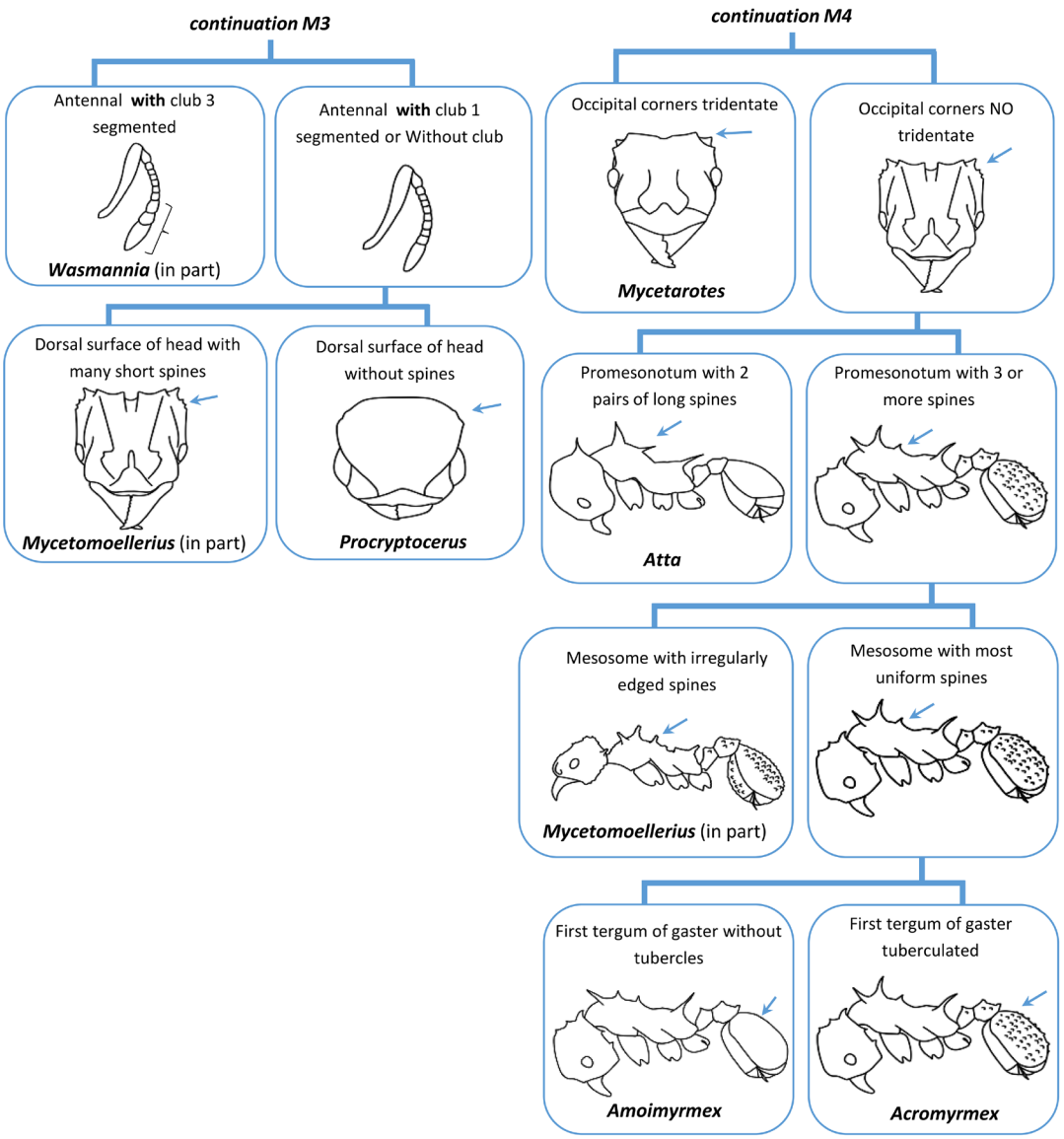

Fig. 11. Fourth part of the pictorial key to the genera of Myrmicinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

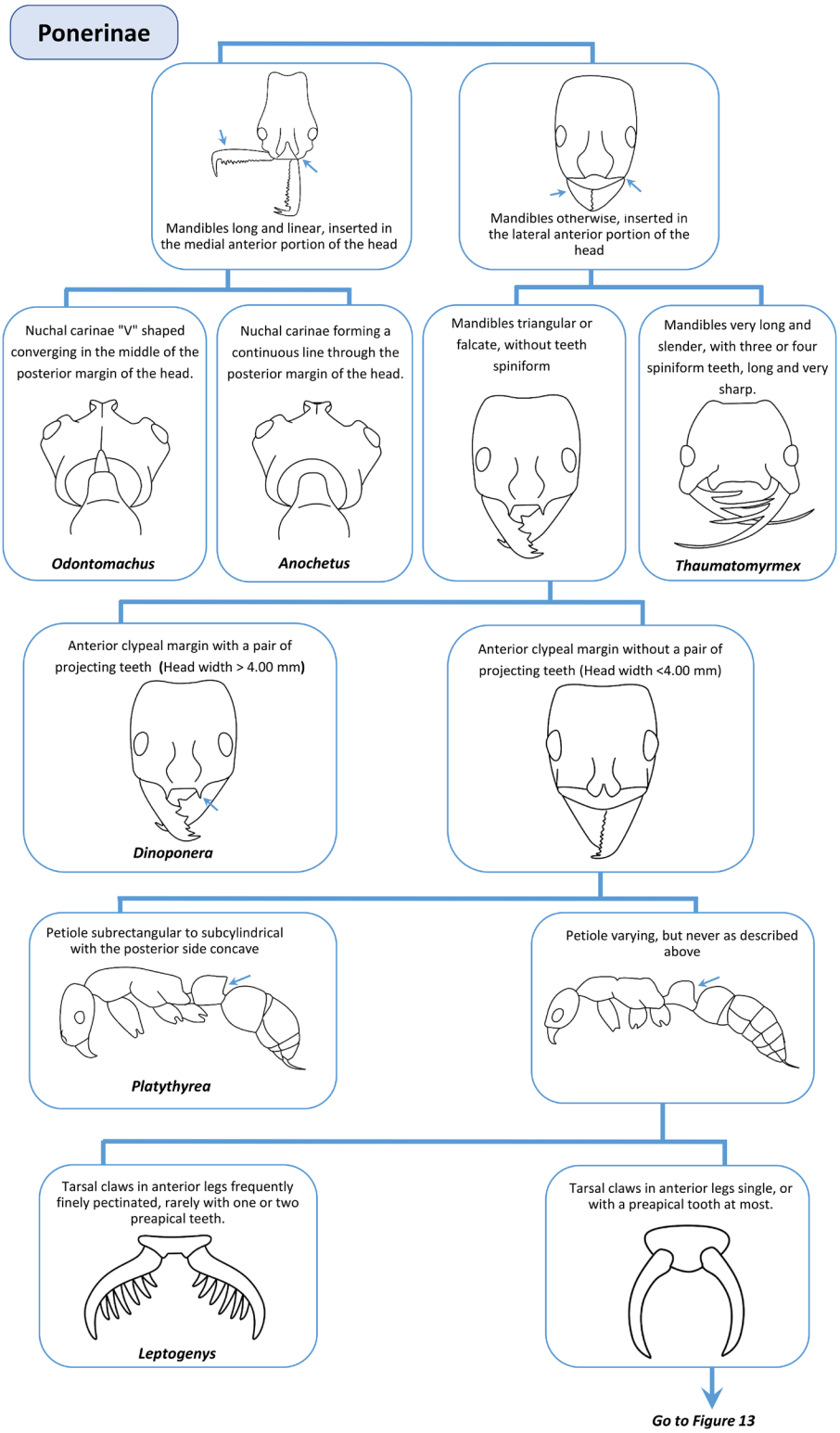

Fig. 12. First part of the pictorial key to the genera of Ponerinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

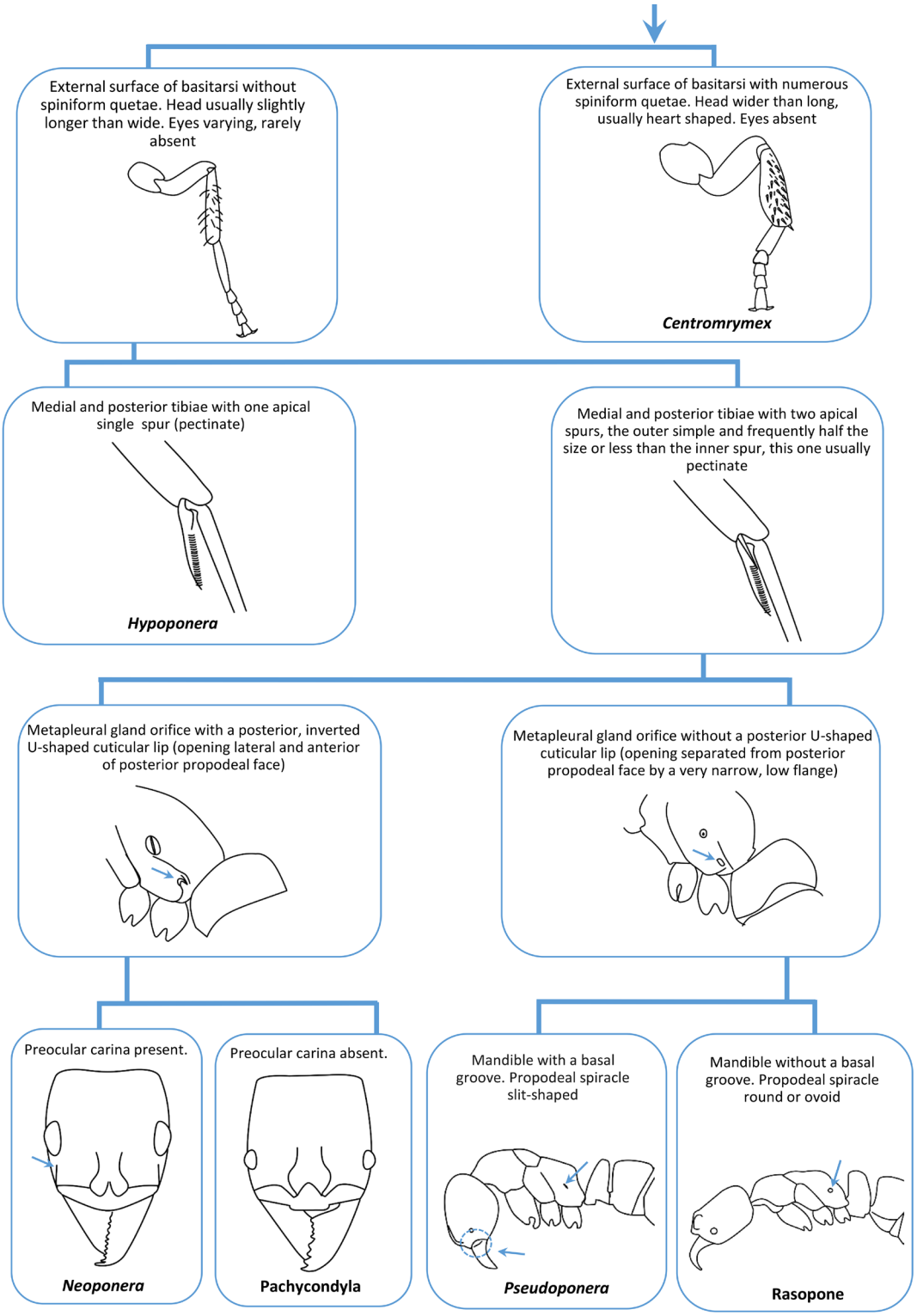

Fig. 13. Second part of the pictorial key to the genera of Ponerinae (Hymenoptera: Formicidae) from the Humid Chaco ecoregion.

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