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Classification of Cuban ants (Hymenoptera: Formicidae) into functional groups

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Abstract: Classification of organisms into functional groups allows reliable comparisons among environments under different conditions. This constitutes a generalized practice in local and regional ants studies. In this contribution, a functional group classification for the Cuban ant fauna is proposed. Two main criteria were taken into account: prevalent foraging and nesting behavior. In order to make a comparable system, we adapted the terminology from literature sources. On this basis, we distinguish 11 functional groups: ground and vegetation dominant omnivores, ground and vegetation opportunists, ground omnivores and scavengers, "poneroids" specialist predators, myrmicine specialist predators, large ponerine epigaeic predators, open-habitat specialists, arboreal specialists, leaf-cutting fungus-growers, non-leaf cutting fungus growers and limestone-dwelling specialists. This classification should prove to be useful as a tool for environmental assessment and ant diversity monitoring in Cuban ecosystems, either natural or human-modified.

Keywords: Assemblages, Cuba, habitats, monitoring, myrmecofauna.

Resumen: *CLASIFICACIÓN DE LAS HORMIGAS CUBANAS (HYMENOPTERA: FORMICIDAE) EN GRUPOS FUNCIONALES*. La clasificación de los organismos en grupos funcionales permite comparaciones confiables entre diferentes condiciones ambientales. Esto constituye una práctica generalizada en estudios locales y regionales sobre hormigas. En este estudio se propone una clasificación en grupos funcionales para la mirmecofauna cubana. Para ello, se tuvieron en cuenta dos criterios fundamentales: conducta prevalente de forrajeo y nidificación. Para hacer comparable esta clasificación, se adaptó la terminología de la literatura existente. Sobre esta base, se distinguieron 11 grupos funcionales: omnívoras dominantes de suelo y vegetación, oportunistas de suelo y vegetación, omnívoras y carroñeras de suelo, "poneroides" depredadores especialistas, mirmicinos depredadores especialistas, ponerinos depredadores epigéicos grandes, especialistas de hábitats abiertos, arborícolas, cortadoras de hojas cultivadoras de hongos, no cortadoras de hojascultivadoras de hongos, carsifílicas. Esta clasificación debe ser una herramienta útil para evaluaciones ambientales y monitoreo de la diversidad de hormigas en ecosistemas de Cuba, tanto naturales como modificados por la acción humana.

Palabras clave: Cuba, ensambles, hábitats, mirmecofauna, monitoreo.

INTRODUCCIÓN

The ants constitute one of the most successful groups of insects (Hölldobler and Wilson, 1990). These organisms can be considered important components of biodiversity, because of their high abundance and species richness, with more than 12 700 known species and about 21 000 estimated species (Pall *et al*., 2014). The ants contribute to crucial ecological functions like nutrient cycling, mixing of organic matter, and soil enrichment and aeration (Forgarait, 1998; Jurzenski *et al*., 2012; Rivas *et al*., 2014). Moreover, they also play important roles as predators, defoliators, scavengers, decomposers, seed dispersers, pollen collectors (Brandão *et al*., 2012; Kwon *et al*., 2014), and also sustain mutualistic relationships with a great diversity of organisms, such as plants, bacteria, fungi and other arthropods (Rivas *et al*., 2014; Lange *et al*., 2015).

In summary, ants can act as ecological engineers, keystone or invasive species (Castracani *et al*., 2007; Lach *et al*., 2010), being responsible for multiple ecosystem services and processes (Del Toro *et al*., 2012, 2015). Thus, ants interact with ecological assemblages in a general way, influencing the population dynamics of a great number of organisms, including ants themselves (Rivas *et al*., 2014; Lange *et al*., 2015).

Ants are also considered suitable bioindicators of habitat quality and environmental change (Rivas *et al*., 2014; Bharti *et al*., 2016). Related to this subject, there is the issue about grouping ants into guilds or functional groups

(Mustafa *et al*., 2011; Gómez and Abril, 2011; Jurzenski *et al*., 2012). The guilds/functional groups concepts are usually considered synonyms (Silvestre *et al*., 2003; Medeiro *et al*., 2011). Functional groups might be seen as groups of species that are similar in life strategies and ecological traits, influencing in a similar way the structure of the community (Blondel, 2003; Brandão *et al*., 2012; Pla *et al*., 2012).

It is expected that functional groups should have equivalent responses to environmental changes (Blaum *et al*., 2011); changes in their species composition should reflect habitat differences,and be comparable with the patterns observed in similar contexts in different areas (Brandão*et al*., 2009). For instance, Croc *et al*. (2014) espoused that species richness alone cannot appropriately describe the differences in community structure. These authors remarked the importance of the functional diversity perspective, which can be estimated by the functional group number in the community.

Core studies about classifying ant species into guilds/ functional groups are those of Andersen (1995, 1997) for Australia and North America, respectively, and Brown (2000) and Philpott *et al*. (2010) for a general perspective on ant genera. Lange *et al*. (2015) noticed that composition and abundance of ant assemblages are associated with floristic and climatic characteristics of each region. This pattern implies the necessity to generate functional group classifications appropriated to local conditions.

Local classifications have been created, among others, for ants from Italy (Castracani *et al*., 2010), the Iberian Peninsula and the Balearic Islands (Roig and Espalader, 2010), temperate North America (Jurzenkski *et al*., 2012), the Korean Peninsula (Kwon *et al*., 2014), and Neotropical mainland (Delabie *et al*., 2000; Silvestre *et al*., 2003; Medeiro *et al*., 2011; Brandão *et al*., 2012; Leal *et al*., 2012; Croc *et al*., 2014; García-Martínez *et al*., 2015). Croc *et al*. (2014) asserted that there is a little current literature dealing with the functional structure of Neotropical ant communities. Such assertion is especially true for the Caribbean insular ant fauna. Accordingly, the goal of this study is to propose a classification of Cuban ant species into functional groups. There have been no previous attempts of conducting this task for this insular territory.

The Cuban archipelago is the largest territory of the insular Caribbean, with a total area of 110 994 km^2. It includes the mainland of Cuba, the Isle of Pines and about 4 195 smaller islands (keys and islets). The relief is mainly flat and calcareous, with four principal mountainous systems, which support the best preserved forests: the Guaniguanico Mountain Range in the west, Guamuhaya Massif in the central region, and the two more extensive mountainous groups are located in the eastern region: the Sierra Maestra Mountain Range in the South, and the Nipe-Sagua-Baracoa Massif in the north. The highest elevation above sea level is the Pico Real del Turquino (1 974 m), located in the Sierra Maestra.

The Cuban ant fauna comprises nine subfamilies, 46 genera and 168 species (based on Fontenla, 1997a, b, 1998, 2000a; Baroni-Urbani and Andrade, 2003a, b; Wilson, 2003; La Polla *et al*., 2010; Sarnat *et al*., 2015). About 43% of Cuban ant species are local endemics. This endemism is especially high in the genera *Temnothorax* (33 endemic species), *Camponotus* (11), *Pheidole* (7) and *Thaumatomyrmex* (4).

In Cuba, the genus *Temnothorax* has evolved into three species groups that segregate by nesting habitat. There is a group of small ground nesting species with generalized morphology; a group of arboreal species that nest on trees and epiphytes, and a third group comprised by species associated with limestone formations. All of the species in the last two groups exhibit remarkable behavioral and morphological diversity, and display the following combined traits: slow or "frozen" motions, stylized silhouettes, inflated legs, long spines and shining or iridescent integuments (Fontenla 2000b). Cuba is also the only island in the Greater Antilles with leaf-cutting ants, belonging to *Atta* and *Acromyrmex* genera.

Another important component of the Cuban ant fauna is the subset of 30 cosmopolitan or widespread species (*sensu* Wetterer, 2015 and Sarnat *et al*., 2015). Some of these species are pests, mainly in agricultural systems and urban localities; such is the case for *Wasmannia auropunctata*, *Pheidolemegacephala, Solenopsis geminata, Nylanderia fulva, Paratrechina longicornis* and *Tapinoma melanocephalum* (Fontenla and Matienzo, 2011).

MATERIAL AND METHODS

We created a functional group classification for Cuban ants, taking into account two main criteria related to apparent functional role: prevalent foraging behavior and nesting behavior. In order to make our system comparable to other published functional group classifications, we adopted the terminology below, which is adapted from Brandão *et al*. (2012), Del Toro *et al*. (2015) and González-Salazar *et al*. (2015).

Omnivorous: generalist scavengers and opportunist predators of injured or disabled little animals. Some of them also collect small seeds or a variety of organic matter, including hemipteran (aphids, scale insects) honeydew and flower nectar. *Specialist predators*: predators specialized in hunting some specific groups of small arthropods or their immature stages. They usually exhibit modified morphologies, includingremarkable changesin the shape and length of mandibles. *Nesting habitats*: referring to the building of colonies in open sites, urban places (indoors, gardens, parks, forested avenues and streets), agricultural systems, arboreal substrates, vegetation, ground (soil, litter, rotting trunks and logs) and limestone substrates. *Cryptic species*: species that build their nests within the soil, litter, under stones, rotting logs or other hidden places; and forage in the ground. *Epigaeic species*: medium- to large-size species that forage on ground or exposed surfaces like trees or shrubs trunks and branches.

The names of the functional groups were primarily inferred from our field observations and adapted from the classifications in Delabie *et al*. (2000), Silvestre *et al*. (2003), Leal *et al*. (2012) and Croc *et al*. (2014) for different ecological situations in the Neotropical mainland. In contrast to the mainland groups, we distinguished an open-habitat species group and devised a new ant functional group, the limestone-dwelling species group. We followed Baccaro *et al*. (2015), Ward *et al*. (2015) and Borowiec (2016) for subfamily and generic-level taxonomy of Neotropical ants, and reviewed ant world on line catalog (Bolton, 2018).

RESULTS AND DISCUSSION

We distinguished the following eleven functional groups (Appendix 1):

1. Ground and vegetation dominant omnivores. 2. Ground and vegetation opportunists. 3. Ground omnivores and scavengers. 4. "Poneroids" specialist predators. 5. Myrmicines specialist predators. 6. Large ponerines epigaeic predators. 7. Open-habitat specialists. 8. Arboreal specialists. 9. Leaf-cutting fungus-growers. 10. Non leaf-cutting fungus-growers. 11. Limestone-dwelling specialists.

Brief description and generic composition of functional groups:

1. Ground and vegetation dominant omnivores.

Omnivorous foragers on soil, litter, vegetation and trees.These species have cosmopolitan distribution and can be found in disturbed places, agricultural systems, urban habitats, indoors, and even in well forested sites, especially in the cases of *Solenopsis geminata* and *Wasmannia auropunctata*. They exhibit aggressive and invasive behavior, tending to exclude each other. Usually, they live in large colonies.

Generic composition: *Pheidole* (in part), *Solenopsis* (in part), *Wasmannia*.

2. Ground and vegetation opportunists.

Omnivorous foragers on soil, litter and vegetation, including trees. Most are cosmopolitan or widespread species, characteristic of disturbed sites, agroecosystems, urban habitats, indoors and other environments with low ant diversity. The exception to this plasticity of habitats are the *Zatania* species, which live in large colonies in forested places, mainly located in the mountainous ranges.

Generic composition: *Brachymyrmex*, *Camponotus* (in part), *Cardiocondyla*, *Monomorium*, *Nylanderia* (in part), *Paratrechina*, *Plagiolepis*, *Tapinoma*, *Tetramorium*, *Trichomyrmex*, *Zatania* (in part).

3. Ground omnivores and scavengers.

Small to medium-size species mostly found in well forested sites, where they forage mainly in soil and litter. Some species of *Crematogaster* also forage on trees.

Generic composition: *Camponotus* (in part), *Crematogaster*, *Pheidole* (in part), *Rogeria*, *Solenopsis* (in part), *Nylanderia* (in part), *Stenamma*, *Temnothorax* (in part).

4. "Poneroids" specialist predators.

Composed by species in Amblyoponinae, Dorylinae, Ectatomminae, Ponerinae, Proceratiinae cryptic species that live in small colonies and nest primarily within the soil, litter and rotting logs, where they capture small arthropods as well as their larvae or their eggs. Some of these considered former "poneroids" (Dorylinae, Ectatomminae) belong actually to the Formicoid clade (Brady *et al*., 2014), but we keep this denomination because of a general "resemblance" in appearance and life style.

Generic composition: *Anochetus*, *Cerapachys*, *Cylindromyrmex*, *Discothyrea*, *Gnamptogenys*, *Hypoponera*, *Prionopelta*, *Pseudoponera* (in part), *Proceratium*, *Stigmatomma*, *Thaumatomyrmex*.

5. Myrmicine specialist predators.

Small and cryptic species that are more frequent in places with rich and humid soil and litter. All of them have modified mandibles that can be enlarged, or short and triangular, and hunt mainly collembola and myriapods.

Genera composition: *Carebara*, *Eurhopalothrix*, *Strumigenys*.

6. Large ponerine epigaeic predators.

Ponerines showing relatively large body size (1 cm or more) and long linear, sickle-like, or triangular mandibles. They forage on soil or litter surface and also on trees, in the case of *Platythyrea*. They are mostly solitary hunters.

Generic composition: *Leptogenys*, *Odontomachus*, *Platythyrea*, *Pseudoponera* (in part).

7. Open-habitat specialists.

These species build their nests in open and sunny places of forest paths, disturbed sites, agricultural systems, city parks, gardens, and other urban environments. *Dorymyrmex* and *Forelius* are also common in coastal habitats. They are generalized and opportunist foragers in soil and vegetation. Members of *Dorymyrmex* forage on trees, and *Pheidole fallax* is characterized by collecting small seeds.

Generic composition: *Dorymyrmex*, *Forelius*, *Pheidole* (in part).

8. Arboreal specialists.

These ants build their nests and forage in shrubs, trees, palm trees or mangroves. This is a group of generalized foragers or opportunist predators. Occasionally, some individuals of *Camponotus* and *Pseudomyrmex* can be seen in the ground.

Generic composition: *Camponotus* (in part), *Cephalotes*, *Myrmelachista*, *Pseudomyrmex*, *Temnothorax* (in part), *Xenomyrmex*.

9. Leaf-cutting fungus-growers.

Polymorphic Attini species that cut fresh leaves from shrubs or trees to carry them as substrate for their symbiotic fungus. They also pick fallen flowers and even vegetable organic material of different origin, like bread crumbs. These ants are able to prosper in a diversity of habitats, including city parks and gardens. *Atta insularis* can become a pest in agricultural systems and gardens. *Acromyrmex* is able to live in coastal zones practically devoid of trees.

Generic composition: *Atta*, *Acromyrmex*.

10. Non leaf-cutting fungus-growers.

Monomorphic Attini species that collect in the soil a variety of organic material as substrate for their symbiotic fungus, such as small leaves, fruits, flowers or their fragments, as well as lichens, mosses, and feces, carcasses or body pieces of arthropods. *Cyphomyrmex minutus* forages also on trees.

Generic composition: *Cyphomyrmex*, *Mycocepurus*, *Trachymyrmex*.

11. Limestone-dwelling.

These species forage on the limestone substrates that occur mainly within Cubas' mountains, and build their nests into crevices and under stones, making a tubular entrance to the nest of cartoon material. *Camponotus macromischoides* dwells mixed with *Temnothorax poeyi* and can be considered its mimic, because of its general resemblance and behavior.

Generic composition: *Camponotus* (in part), *Temnothorax* (in part), *Zatania* (in part).

Most of our functional groups are congruent with those in Silvestre *et al*. (2003) (Our functional groups 1, 2, 4, 5, 6, 9, 10) and Leal *et al*. (2012) (Our functional groups 1, 3, 6, 8, 9, 10). We created for *Dorymyrmex piramicus* and *Forelius pruinosus* a separate functional group (open-habitats specialists), because of their remarkable preference for generalized environmental conditions or habitat patches exposed to sun radiation and relatively naked soil surface to build their nests. The novel functional group, the limestone-dwelling specialists, is justified by the strong associations of these species to that kind of environment.

The functional groups with the highest number of species were ground omnivores and scavengers (35 species), arboreal specialists (33 species) and ground and vegetation opportunists (31 species). These three functional groups account for 60% of all Cuban species. The endemic species only have members in seven of the eleven functional groups. This segment of Cuban ants is concentrated in the arboreal specialists (23 species: 31% of total endemic species), limestone-dwelling specialists (17 species: 23%), and ground omnivorous and scavengers (17 species: 23%) functional groups (Table 1).

The cosmopolitan species also have members in only seven functional groups, with 50% of their species (15 species) belonging to the ground and vegetation opportunists functional group. The dominant omnivorous of ground and vegetation functional group are exclusively integrated by cosmopolitan species.

In short, the endemic species prevail in more specific habitats, like forest and limestone formations of well-preserved regions, and the cosmopolitan group is represented by tipically opportunists and invasive species. This classification should prove to be useful as a tool for environmental assessment and biodiversity monitoring in Cuban ecosystems, either natural or human-modified.

Table 1. Number of species of Cuban ants within each recognized functional group. Ground and vegetation dominant omnivores (DOM), ground and vegetation opportunists (GVO), ground omnivorous and scavengers (GOS), poneroids specialist predators (PSP), myrmicines specialist predators (MSP), ponerines epigaeic predators (PEP), open-habitat specialists (OHS), arboreal specialists (ARB), leaf-cutting fungus-growers (LCF), non leaf-cutting fungus growers (NCF), limestone-dwelling specialists (LDS).

Tabla 1. Número de especies de hormigas cubanas en cada grupo funcional. Omnívoras dominantes de suelo y vegetación (DOM) oportunistas de suelo y vegetación (GVO), omnívoras y carroñeras de suelo (GOS), poneroides depredadores especialistas (PSP), mirmicinos depredadores especialistas (MSP), ponerinos depredadores epigéicos (PEP), especialistas de hábitats abiertos (OHS), arborícolas (ARB), cortadoras de hojas cultivadoras de hongos (LCF), no cortadoras de hojas cultivadoras de hongos (NCF), carsifílicas (LDS).

Functional group	Total species	Endemic	Cosmopolitan
DOM	3	0	3
GVO	31	2	15
GOS	35	17	2
PSP	18	10	3
MSP	15	3	4
PEP	7	0	2
OHS	3	0	0
ARB	33	23	0
LCF	3	2	0
NCF	3	0	1
LDS	17	17	0
Total	171	74	30

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Appendix 1. Cuban ant species and their functional groups. Ground and vegetation dominant omnivores (DOM), ground and vegetation opportunists (GVO), ground omnivorous and scavengers (GOS), "poneroids" specialist predators (PSP), myrmicines specialist predators (MSP), large ponerines epigaeic predators (PEP), open-habitat specialists (OHS), arboreal specialists (ARB), leaf-cutting fungus-growers (LCF), non-leaf-cutting fungus growers (NCF), limestone-dwelling specialists (LDS). Endemic species (E).Cosmopolitan species (C).

Anexo 1. Especies cubanas de hormigas y sus grupos funcionales. Omnívoras dominantes de suelo y vegetación (DOM) oportunistas de suelo y vegetación (GVO), omnívoras y carroñeras de suelo (GOS), "poneroides" depredadores especialistas (PSP), mirmicinos depredadores especialistas (MSP), ponerinos depredadores epigéicos (PEP), especialistas de hábitats abiertos (OHS), arborícolas (ARB), cortadoras de hojas cultivadoras de hongos (LCF), no cortadoras de hojas cultivadoras de hongos (NCF), carsifílicas (LDS). Especies endémicas (E). Especies cosmopolitas (C).

Subfamily	**Species**	**FG**	**E**	**C**
Amblyoponinae	*Prionopelta antillana* Forel	PSP		
	Stigmatomma bierigi (Santschi)	PSP	X	
Dolichoderinae	*Dorymyrmex pyramicus* Roger	OHS		
	Forelius pruinosus (Roger)	OHS		
	Tapinoma litorale Wheeler	GVO		
	Tapinoma melanocephalum (Fabricius)	GVO		X
Dorylinae	*Ooceraea biroi* (Forel)	PSP		X
	Cylyndromyrmex darlingtoni (Wheeler)	PSP	X	
Ectatomminae	*Gnamptogenys rumba* Lattke	PSP	X	
Formicinae	*Brachymyrmex flavidulus* (Roger)	GVO		
	Brachymyrmex heeri Forel	GVO		
	Brachymyrmex minutus Forel	GVO		
	Brachymyrmex obscurior Forel	GVO		
	Camponotus bermudezi Aguayo	GVO	X	
	Camponotus conspicuus (Smith)	GVO		

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Subfamily	Species	FG	E	C
Formicinae	*Camponotus gilgiventris* Roger	ARB	X	
	Camponotus gundlachi Mann	ARB	X	
	Camponotus kutterianus Baroni	GOS	X	
	Camponotus micrositus Wheeler	GOS	X	
	Camponotus macromischoides Fontenla	LDS	X	
	Camponotus planatus Roger	ARB		
	Camponotus ramulorum Wheeler	GVO		
	Camponotus riehli Roger	ARB		
	Camponotus santosi Forel	GVO	X	
	Camponotus sphaeralis Roger	ARB	X	
	Camponotus sphaericus Mann	ARB	X	
	Camponotus taino Fontenla	LDS	X	
	Camponotus thysanopus Wheeler	ARB	X	
	Myrmelachista kraatzi Mann	ARB	X	
	Myrmelachista rogerii André	ARB	X	
	Nylanderia steinheili Forel	GVO		X
	Nylanderia bourbonica Forel	GVO		X
	Nylanderia fulva Mayr	GVO		
	Nylanderia myops Mann	GOS		
	Nylanderia pubens Forel	GVO		
	Nylanderia vividula Nylander	GVO		
	Paratrechina longicornis (Latreille)	GVO		X
	Plagiolepis allaudi Emery	GVO		X
	Zatania albimaculata (Santschi)	GVO	X	
	Zatania gibberosa (Roger)	GVO		
	Zatania karstica (Fontenla)	LDS	X	
Myrmicinae	*Acromyrmex octospinosus* Wheeler	LCF		
	Atta cubana Fontenla	LCF	X	
	Atta insularis Guérin	LCF	X	
	Cardiocondyla emeryi Forel	GVO		X
	Cardiocondyla venustula Wheeler	GVO		X
	Cardiocondyla wroughtoni (Forel)	GVO		X
	Carebar aurichi (Wheeler)	MSP		
	Cephalotes varians (Smith)	ARB		
	Crematogaster barbouri Weber	GOS	X	
	Crematogaster manni Buren	GOS		
	Crematogaster sanguínea Roger	GOS	X	
	Crematogaster steinheili Forel	GOS		
	Crematogaster victima Smith	GOS		
	Cyphomyrmex minutus Mayr	NCF		X

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Anexo 1. Continuación

Subfamily	**Species**	**FG**	**E**	**C**
Myrmicinae	*Eurhopalotryx weberi* (Brown &Kempf)	MSP	X	
	Monomorium ebeninum Forel	GVO		
	Monomorium florícola (Jerdon)	GVO		X
	Monomorium pharaonis (Linnaeus)	GVO		X
	Monomorium salomonis (Linnaeus)	GVO		X
	Mycocepurus smithi Forel	NCF		
	Pheidole alayoi Wilson	GOS	X	
	Pheidole bakeri Forel	GOS	X	
	Pheidole bilimeki Mayr	GOS		
	Pheidole cubaensis Mayr	GOS	X	
	Pheidole exigua Mayr	GOS		
	Pheidole fallax Mayr	OHS		
	Pheidole flavens Roger	GOS		
	Pheidole indica Forel	GOS		X
	Pheidole macromischoides Wilson	GOS	X	
	Pheidole megacephala (Fabricius)	DOM		X
	Pheidole naylae Wilson	GOS	X	
	Pheidole neolongiceps Brown	GOS	X	
	Pheidole punctatissima Mayr	GOS		
	Pheidole similigena Wheeler	GOS	X	
	Pheidole subarmata Mayr	GOS		
	Rogeria brunnea Santschi	GOS		
	Rogeria carinata Kluger	GOS		
	Rogeria curvipubens Santschi	GOS		
	Solenopsis corticalis Forel	GOS		
	Solenopsis geminata (Fabricius)	DOM		X
	Solenopsis globularia Forel	GOS		X
	Solenopsis picea Emeryi	GOS		
	Stenamma sp	GOS		
	Strumigenys albertii Forel	MSP		
	Strumigenys convexiceps (Santschi)	MSP		
	Strumigenys eggersi Mann	MSP		
	Strumigenys emmae (Emeryi)	MSP		X
	Strumigenys gundlachi (Roger)	MSP		
	Strumigenys lanuginosa Wheeler	MSP		
	Strumigenys louisiana Roger	MSP		
	Strumigenys margaritae (Forel)	MSP		
	Strumigenys membranifera (Emeryi)	MSP		X
	Strumigenys nitens (Santschi)	MSP	X	
	Strumigeny srogerii Emeryi	MSP		X

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Subfamily	Species	FG	E	C
	Strumigenys silvestrii Emeryi	MSP		X
	Strumigenys simulans (Santschi)	MSP	X	
	Temmnothorax abeli (Fontenla)	ARB	X	
	Temmnothorax alayoi (Baroni)	ARB	X	
	Temmnothorax androsanus (Wheeler)	GOS		
	Temmnothorax banao (Fontenla)	LDS	X	
	Temmnothorax barbouri (Aguayo)	ARB	X	
	Temmnothorax barroi (Aguayo)	LDS	X	
	Temmnothorax bermudezi (Wheeler)	LDS	X	
	Temmnothorax bruneri (Mann)	ARB	X	
	Temmnothorax cuyaguateje (Fontenla)	GOS	X	
	Temmnothorax darlingtoni (Wheeler)	ARB	X	
	Temmnothorax dissimilis (Aguayo)	ARB	X	
	Temmnothorax creightoni (Mann)	ARB	X	
	Temmnothorax gibbifer (Baroni)	ARB	X	
	Temmnothorax gundlachi (Wheeler)	LDS	X	
	Temmnothorax imias (Fontenla)	GOS	X	
	Temmnothorax iris (Roger)	LDS	X	
	Temmnothorax laetus (Wheeler)	ARB	X	
	Temmnothorax mortoni (Aguayo)	LDS	X	
	Temmnothorax myersi (Wheeler)	LDS	X	
	Temmnothorax nigricans (Wheeler)	GOS	X	
	Temmnothorax nipensis (Fontenla)	LDS	X	
	Temmnothorax pastinifer (Emeryi)	GOS		
	Temmnothorax platycnemis (Wheeler)	ARB	X	
	Temmnothorax poeyi (Wheeler)	LDS	X	
	Temmnothorax porphyritis (Roger)	LDS	X	
	Temmnothorax punicans (Roger)	ARB	X	
	Temmnothorax purpuratus (Roger)	ARB	X	
	Temmnothorax schwarzi (Mann)	GOS	X	
	Temmnothorax senectutis (Baroni)	LDS	X	
	Temmnothorax splendens (Wheeler)	ARB		
	Temmnothorax squamifer (Roger)	ARB	X	
	Temmnothorax terricolus (Mann)	GOS	X	
	Temmnothorax torrei (Aguayo)	GOS		
	Temmnothorax versicolor (Roger)	LDS	X	
	Temmnothorax villarensis (Aguayo)	LDS	X	
	Temmnothorax violaceus (Mann)	ARB	X	
	Temmnothorax wheeleri (Mann)	LDS	X	
	Tetramorium bicarinatum (Nylander)	GVO		X

Appendix 1. Continuation

Anexo 1. Continuación

Subfamily	**Species**	**FG**	**E**	**C**
Myrmicinae	*Tetramoriuml ucayanum* Wheeler	GVO		X
	Tetramorium similimum (Nylander)	GVO		X
	Trachymyrmex jamaicensis Wheeler	NCF		
	Trichomyrmex destructor (Jerdon)	GVO		X
	Xenomyrmex floridanus Wheeler	ARB		
	Wasmannia auropunctata (Roger)	DOM		X
Ponerinae	*Anochetus mayri* Emeryi	PSP		
	Gnamptogenys sp	PSP		
	Hypoponera ergatandria (Forel)	PSP		
	Hypoponera opaciceps (Mayr)	PSP		X
	Hypoponera opacior (Forel)	PSP		
	Hypoponera punctatissima (Roger)	PSP		X
	Leptogenys maxillosa Roger	PEP		X
	Leptogenys pubiceps Emeryi	PEP		
	Leptogenys punctaticeps Emeryi	PEP		
	Odontomachus insularis Guerin	PEP		
	Odontomachus ruginodes Wheeler	PEP		
	Platythyrea punctata (Smith)	PEP		
	Pseudoponera succedanea (Roger)	PSP	X	
	Pseudoponera stigma (Fabricius)	PEP		X
	Thaumatomyrmex baryai Fontenla	PSP	X	
	Thaumatomyrmex cochlearis Creighton	PSP	X	
	Thaumatomyrmex mandibularis Baroni Urbani & de Andrade	PSP	X	
	Thaumatomyrmex nageli Baroni Urbani & de Andrade	PSP	X	
Proceratinae	*Discothyrea testacea* Roger	PSP	X	
	Proceratium cubanum Baroni Urbani & de Andrade	PSP	X	
Pseudomyrmicinae	*Pseudomyrmex cubaensis* (Forel)	ARB		
	Pseudomyrmex opacior Forel	ARB	X	
	Pseudomyrmex pallidus (Smith)	ARB		
	Pseudomyrmex pazosi Santschi	ARB	X	
	Pseudomyrmex seminole Ward	ARB		
	Pseudomyrmex simplex (Smith)	ARB		
	Pseudomyrmex subater Wheeler& Mann	ARB		

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