Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(3): 1030-1037

Received: 04-03-2019
Accepted: 06-04-2019

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# Household and home garden infesting arthropods (Ants and Myriapods) in the city of Yaoundé, Cameroon

**Mbenoun Masse Paul Serge, Ebangue Titti Giovani and Ruth Mony**

**Abstract**
Terrestrial arthropods are particularly species rich in urban area due to a high degree of resource and microhabitat heterogeneity. Here, we investigated the community structure of ants and myriapods which occur in the urban habitats (house and garden) in the city of Yaoundé. Samples were collected in 2011 and 2017 in ten urban districts using baits and visual catch as sampling methods. A total of 836 occurrences in 53 species (32 species in house and 48 in garden), 26 genera and 12 families or subfamilies were identified. The most common species found in and out of human habitats were *Pheidole megacephala* (ant) and *Haplothysanus chappellei* (myriapod). Five species occurred in all part of house and in garden were known as ''Tramp species'', *Wasmannia auropunctata, P. megacephala, Monomorium pharaonis, Paratrechina longicornis* and *Haplothysanus chapellei*, and noxious to human food conservation and cultivated fields.

**Keywords:** Ant, myriapod, *Pheidole megacephala, Haplothysanus chappellei*, Cameroon

## Introduction
Since decades, urban growth is recognized as one of the most lasting types of habitat loss and fragmentation than other human disturbances [1-5]. Urbanization reduces and fragments the suitable habitats for many species (plants and animals). Most of these endemic and threatened species are restricted sometimes in urban environnements [6]. Amongst these threatened species, the poorly mobile ones (e.g Arthropoda) are assumed to be more affected by habitat fragmentation than mobiles species. With regard to Arthropoda, urbanization can either promote the loss of species which are more sensitive to narrow environmental change [7] or increase the diversity of urban adapted species which are able to exploit the wide variety of habitats and support viable populations than urban specialist [8, 9]. Yet well adapted to urban environment become often harmfull and invasives, threatining human health and native ecosystems [10, 11].
Ants (Insecta) and myriapods (Myriapoda) are two groups of special importance in tropical ecosystems. Ants act as predators, scavengers, herbivores, detritivores, and granivores [12], while in myriapods except centipedes that are predators, the vast majority (millipedes, pauropods and symphylans) are detritivores, eating decaying plant material [13, 14]. Both groups are distributed in all continents except Antartica [12, 15]. Currently there are more than 12,500 described species of ants in 290 genera belonging to 21 extant subfamilies, whereas about 15000 species or morphospecies of myriapods in 160 families have already been described [13].
With the increasing loss of their natural habitats, ants and myriapods have colonized urban areas worldwide. Although urban environment conditions affect drastically some sensitive species, they offer more possibilities for nest sites [16] and food availability than surrounding areas [17]. Many studies have documented the community structure of house infesting ants in tropical regions of South America [18-20], but little is known about ant and myriapod structure in urban habitats in afrotropical regions. Thus, this study was to investigate the diversity of ant and myriapod species occur in human habitats in order to point out the potential invasive and harmful species.

## Materials and Methods
### Study area
This study was carried out between 2011 and 2017 in the city of Yaoundé (3°56'N; 11°10'E; 750 a.s.l.) in southern camerounian plateau.

Yaoundé's built-up urban area extends over 256 km$^2$, and is home to an estimated 2.5 million inhabitants, which makes it the second-largest city in the country after Douala, the economical capital. The region is characterized by a bimodal rainfall pattern with the major wet season from March to June, followed with a short dry season from July to the end of August, and the short wet season from September to mid-November followed with a long dry season from mid-November to February [21]. Average annual rainfall is about 1.576 mm and the mean annual temperature is 25 °C. The mean annual relative humidity is 79.5%. The vegetation in the Yaounde belongs to the semi-deciduous forest type, but currently is a mixture of forest relics on hill summits and garden crops (urban agriculture) along river and inland valleys.

**Sampling methods**

Ten district were chosen from the periphery toward the center of the urban area (Figure 1). Ten houses were randomly selected within each district. Samples were collected in each room (bedroom, livingroom, bathroom, kitchen) [20] and home garden. Two standard methods for measuring and monitoring biodiversity (Baiting and Hand collection in quadrat) were selected for ants and myriapods [22]. In each room, small glass tubes (length : 68 cm ;Ø : 33cm) containing a mixture of honey 30%, tuna 50% and soya oil 20% as bait were placed on the ground and collected after 6 to 10 hours. In addition, ants and myripods were searched in dark corners and wetter places in room (e.g. cracks in the wall, under cooking tools). In home garden, plant containers, stones, fallen branches, rotten tree limbs, crumps grass were carefully checked. All samples were stored in 70% ethanol and transported to the Laboratory of Zoology where specimens were identified to the genus or species level with relevant dichotomic keys.

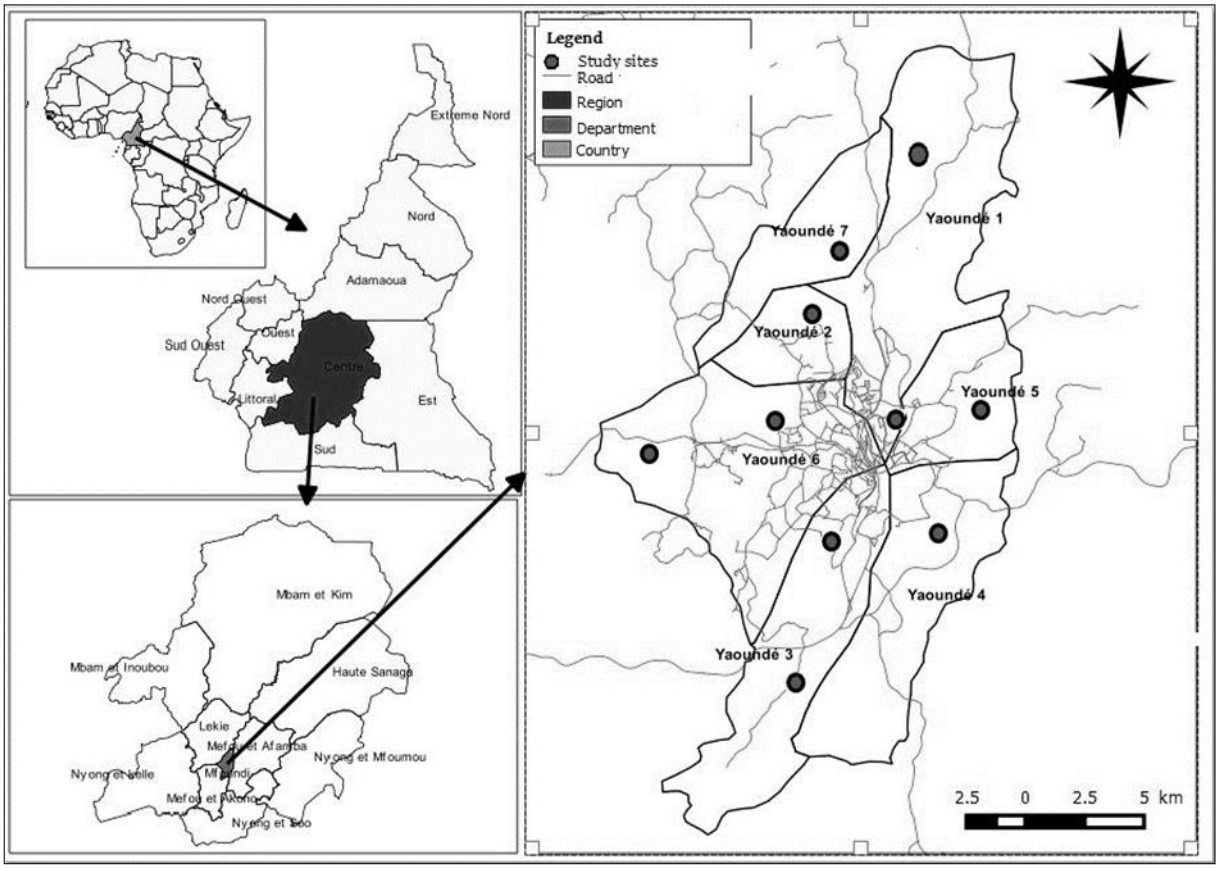


**Fig 1:** Map of study sites in the city of Yaoundé, Cameroon

**Data analysis**

To analyse the species occurrence and species number in home and garden, data was analysed on the basis of presence/absence of species at each emplacement using software ''EstimateSWin 8.0.0.'' The percentage of the total occurrence of a species in all the samples was used as relative abundance. To measure the diversity and similarity between among different emplacements alpha diversity (Shannon-Weaver and Simpson Evenness) and Chekanovsky-Sorensen's index ($S_S$ = 2a/(2a +b+c), where a = number of species common in both area, b = number of species unique to the first area, and c= number of species unique to the second area) were calculated. Correspondence factor analysis was used to detect associations and oppositions existing between species at each emplacement.

**Results**

**Overall taxonomic composition**

A total of 836 occurrences specimens belonging to 53 species (32 species in house and 48 in garden), 26 genera and 12 subfamilies or families were identified (Appendix 1). Myrmicinae was the dominant subfamily with 24 species in 6 genera, followed by Formicinae (10 species in 4 genera) and Dolichoderinae (4 species in 2 genera). The most species-rich genus was *Tetramorium* (10 species) followed by *Pheidole* (6 species) and *Monomorium* (5 species). Myrmicinae were most abundant subfamilies (417 occurrences), followed by Odontopygidae (248) and Formicinae (81). *Haplothysanus chapellei* was the most common species (244 occurrences; 29.19%), followed by *Pheidole megacephala* (85 occurrences; 10.17%), *Pheidole tenuinodis* (55 occurrences; 6.58%),

*Wasmannia auropunctata* (44 occurrences; 5.26%) and *Paratrechina longicornis* (42 occurrences; 5.02%) (Table 1). Among the 53 species collected, 46 species belong to the ants and 7 belong to myriapods (3 Centipedes and 4 millipedes). In the ants, Myrmicinae was the most abundant subfamilies (72.90%) followed by Formicinae (14.16%), Dolichoderinae (7.70%) and Ponerinae (3.67%). The most common ant species were *Pheidole megacephala* (14.86%), followed by *Pheidole tenuinodis* (9.62%), *Wasmannia auropunctata* (7.69%) and *Monomorium* sp.6 (5.59%). In the myriapods, Odontopygidae is the most abundant families with 93.94% of the total of occurrence, followed by Scolopendridae (2.27%), Mecistocephalidae (1.52%), Oxydesmidae (1.52%) and Cryptopidae (0.76%). The most common myriapod species was *H. chapellei* (92.42%).

**Table 1:** Occurrence of most abundant ant and myriapod species living in both house and home garden in the city of Yaoundé.

| Taxon | n | % |
|---|---|---|
| **Ant** | | |
| **Dolichoderinae** | | |
| *Tapinoma carininotum* | 36 | 4.31 |
| **Formicinae** | | |
| *Paratrechina longicornis* | 42 | 5.02 |
| **Myrmicinae** | | |
| *Monomorium Bicolor* | 27 | 3.23 |
| *Monomorium guineense* | 10 | 1.20 |
| *Monomorium pharaonis* | 16 | 1.91 |
| *Monomorium* sp.1 | 18 | 2.15 |
| *Monomorium* sp.6 | 32 | 3.83 |
| *Pheidole megacephala* | 85 | 10.17 |
| *Pheidole* sp.4 | 18 | 2.15 |
| *Pheidole tenuinodis* | 55 | 6.58 |
| *Tetramorium pylacum* | 16 | 1.91 |
| Tetramorium sp2 | 18 | 2.15 |
| *Wasmannia auropunctata* | 44 | 5.26 |
| **Ponerinae** | | |
| *Pachycondyla* sp. | 15 | 1.79 |
| **Myriapod** | | |
| **Odontopygidae** | | |
| *Haplothysanus chapellei* | 244 | 29.19 |

**Appendix 1:** Occurrence of ant and myriapod species recorded in house and home garden in the city of Yaoundé in 2007 and 2017.

| Taxon | House | Garden |
|---|---|---|
| **Ant** | | |
| **Aenictinae** | | |
| *Aenictus decolor* | 1 | 0 |
| **Cerapachyinae** | | |
| *Cerapachys coxalis* | 0 | 1 |
| **Dolichoderinae** | | |
| *Tapinoma carininotum* | 29 | 7 |
| *Tapinoma* sp.1 | 1 | 5 |
| *Technomyrmex albipes* | 0 | 2 |
| **Dorylinae** | | |
| *Dorylus (Anomma )nigricans* | 1 | 1 |
| *Dorylus (Dorylus)* sp. | 0 | 4 |
| **Formicinae** | | |
| *Camponotus (Myrmotrema )* sp.2 | 1 | 0 |
| *Camponotus (Myrmotrema)* sp.1 | 1 | 8 |
| *Camponotus (Tanaemyrmex) brutus* | 2 | 5 |
| *Camponotus (Tanaemyrmex)maculatus* | 0 | 1 |
| *Lepisiota* sp.1 | 0 | 2 |
| *Lepisiota* sp.2 | 0 | 6 |
| *Lepisiota* sp.3 | 1 | 5 |
| *Paratrechina longicornis* | 19 | 23 |
| *Paratrechina* sp.2 | 0 | 6 |
| *Polyrachis laboriosa* | 0 | 1 |
| **Myrmicinae** | | |
| *Crematogaster clariventris* | 2 | 4 |
| *Monomorium bicolor* | 3 | 24 |
| *Monomorium guineense* | 4 | 6 |
| *Monomorium pharaonis* | 14 | 2 |
| *Monomorium* sp.1 | 2 | 16 |
| *Monomorium* sp.6 | 24 | 8 |

| | | |
|---|---|---|
| *Myrmicaria opaciventris* | 0 | 26 |
| *Pheidole megacephala* | 49 | 36 |
| *Pheidole* sp.2 | 4 | 3 |
| *Pheidole* sp.4 | 1 | 17 |
| *Pheidole* sp.6 | 2 | 7 |
| *Pheidole speculifera* | 1 | 0 |
| *Pheidole tenuinodis* | 30 | 25 |
| *Tetramorium colorium* | 0 | 1 |
| *Tetramorium longicorne* | 0 | 10 |
| *Tetramorium magnificum* | 1 | 0 |
| *Tetramorium pylacum* | 2 | 14 |
| *Tetramorium simillimum* | 1 | 8 |
| *Tetramorium* sp.10 | 1 | 0 |
| *Tetramorium* sp.2 | 3 | 15 |
| *Tetramorium* sp.4 | 1 | 3 |
| *Tetramorium* sp.5 | 0 | 1 |
| *Tetramorium* sp.7 | 0 | 2 |
| *Wasmannia auropunctata* | 29 | 15 |
| **Ponerinae** | | |
| *Odontomachus troglodytes* | 0 | 1 |
| *Oligomyrmex* sp. | 0 | 2 |
| *Pachycondyla* sp. | 0 | 15 |
| *Pachycondyla tarsata* | 0 | 1 |
| *Proceratium* sp. | 0 | 2 |
| **Myriapod** | | |
| **Chilopoda** | | |
| **Cryptopidae** | | |
| *Cryptos (cryptos) hortensis* | 1 | 1 |
| **Mecistocephalidae** | | |
| *Mecistocephalus punctifrons* | 2 | 2 |
| **Scolopendridae** | 4 | **2** |
| *Scolopendra morsitans* | 4 | 2 |
| **Diplopoda** | | |
| **Odontopygidae** | | |
| *Coenobothrus detruncatus* | 0 | 2 |
| *Haplothysanus chapellei* | 49 | 195 |
| *Peridontopyge trauni* | 0 | 2 |
| **Oxydesmidae** | | |
| *Coromus* sp. | 0 | 4 |
| Total | 287 | 549 |

**Species turnover and occurrence between emplacements**

Three species were unique in house (11.53%), *Aenictus decolour*, *Camponotus (Myrmotrema)* sp.2, *Phedole speculifera*, and *Tetramorium* sp.10, whilst twenty-one species were found in Garden (43.75%), *Cerapachys coxalis*, *Technomyrmex albipes*, *Dorylus (Dorylus)* sp., *Camponotus (Tanaemyrmex)maculatus*, *Lepisiota* sp. 1, *L*.sp. 2, *L.* sp. 3, *Paratrechina* sp.*2*, *Polyrachis laboriosa*, *Myrmicaria opaciventris*, *Tetramorium colorium*, *T. longicorne*, *T.* sp.5, *T.* sp.7, *Odontomachus troglodytes*, *Oligomyrmes* sp., *Pachychondyla tarsata*, *P.* s*p.*, *Proceratium* sp., *Coenobothrus detruncatus*, *Peridontopyge trauni* and *Coromus* sp. Twenty one species (51%) were common in both emplacements.

Eight species, 84.67% of the total number of occurrences, *Tapinoma carininotum*, *Paratrechina longicornis*, *Monomorium pharaonis*, *Monomorium* sp.6, *Pheidole megacephala*, *Pheidole tenuinodis*, *Wasmannia auropunctata*, and *Haplothysanus chapellei*, were collected in all part of house and in garden (Table 2). Among these species, five are known as ‘’Tranp species’’, *W. auropunctata*, *P. megacephala*, *M. pharaonis*, *P. longicornis*, *H. chapellei* while three are regarded as ‘’harmfull’’, *T. carininotum*, *M.* sp.6 and *P. tenuinodis.*

**Table 2:** Relative frequence of ant and myriapod species encountered in different part of the house in the city of Yaoundé, Cameroon. $^{T}$=Tramp species; * = harmful species

| | Taxon | bathroom | Bedroom | kitchen | Livingroom |
|---|---|---|---|---|---|
| **Ant** | **Aenictinae** | | | | |
| | *Aenictus decolor* | 1.18 | 0 | 0 | 0 |
| | **Dolichoderinae** | | | | |
| | *Tapinoma carininotum** | 5.88 | 12.50 | 11.65 | 11.76 |
| | *Tapinoma* sp.1 | 0 | 2.08 | 0 | 0 |
| | **Dorylinae** | | | | |
| | *Dorylus (Anomma )nigricans* | 1.18 | 0 | 0 | 0 |
| | **Formicinae** | | | | |
| | *Camponotus (Myrmotrema )* sp.2 | 0 | 0 | 0.97 | 0 |
| | *Camponotus (Myrmotrema)* sp.1 | 1.18 | 0 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| | *Camponotus (Tanaemyrmex) brutus* | 1.18 | 0 | 0 | 1.96 |
| | *Lepisiota* sp.3 | 0 | 0 | 0 | 1.96 |
| | *Paratrechina longicornis**T* | 4.71 | 10.42 | 6.80 | 5.88 |
| | **Myrmicinae** | | | | |
| | *Crematogaster clariventris* | 2.35 | 0 | 0 | 0 |
| | *Monomorium bicolor* | 2.35 | 0 | 0.97 | 0 |
| | *Monomorium guineense* | 2.35 | 0 | 1.94 | 0 |
| | *Monomorium pharaonis**T* | 3.53 | 8.33 | 3.88 | 5.88 |
| | *Monomorium* sp.1 | 0 | 0 | 1.94 | 0 |
| | *Monomorium* sp.6* | 10.59 | 10.42 | 4.85 | 9.80 |
| | *Pheidole megacephala**T* | 12.94 | 20.83 | 16.50 | 21.57 |
| | *Pheidole* sp.2 | 2.35 | 2.08 | 0 | 1.96 |
| | *Pheidole* sp.4 | 0 | 0 | 0.97 | 0 |
| | *Pheidole* sp.6 | 1.18 | 0 | 0.97 | 0 |
| | *Pheidole speculifera* | 1.18 | 0 | 0 | 0 |
| | *Pheidole tenuinodis** | 8.24 | 8.33 | 11.65 | 13.73 |
| | *Tetramorium magnificum* | 0 | 2.08 | 0 | 0 |
| | *Tetramorium pylacum* | 1.18 | 2.08 | 0 | 0 |
| | *Tetramorium simillimum* | 0 | 0 | 0.97 | 0 |
| | *Tetramorium* sp.10 | 0 | 0 | 0.97 | 0 |
| | *Tetramorium* sp.2 | 2.35 | 0 | 0.97 | 0 |
| | *Tetramorium* sp.4 | 1.18 | 0 | 0 | 0 |
| | *Wasmannia auropunctata**T* | 10.59 | 12.50 | 7.77 | 11.76 |
| **Myriapod** | **Chilopoda** | | | | |
| | **Cryptopidae** | | | | |
| | *Cryptos (cryptos) hortensis* | 1.18 | 0 | 0 | 0 |
| | **Mecistocephalidae** | | | | |
| | *Mecistocephalus punctifrons* | 2.35 | 0 | 0 | 0 |
| | **Scolopendridae** | | | | |
| | *Scolopendra morsitans* | 3.53 | 0 | 0.97 | 0 |
| | **Diplopoda** | | | | |
| | **Odontopygidae** | | | | |
| | *Haplothysanus chapellei** | 15.29 | 8.33 | 24.27 | 13.73 |

**Distribution patterns, diversity and similarity**

As regard Myriapods, species occurrence was higher in kitchen (46.43%) than in bedroom (19.05%) while the richest part of house was bathroom (4 species) and the poorest were bedroom and livingroom with 1 species each (Figure 2a).

In the Ants, the highest number of species was found in bathroom (20 species) and the lowest in livingroom (10 species) (Figure 2b). The similar pattern was observed in species occurrence (bathroom; 28.57% and livingroom; 19.48%). *Pheidole megacephala* occurs in all house's emplacement, while *T. carininotum* rather prefers bedroom, *W. auropunctata* and *M. pharaonis* bathroom, and *P. longicornis* kitchen (Fig.3). Shannon-weaver was greatest in bathroom (Table 3). This value reflected the high number of species recorded at this emplacement. Simpson evenness was less than 0.50 and showed the absence of dominance among ant species. The similarity index of Sorensen indicated that the emplacements shared more than 50% and the most similar pairs of species were found between bedroom and livingroom (77%), and between bedroom and bathroom (60%) (Table 4).

**Table 3:** Alpha diversity measurements for different part of house. Given is emplacement, species richness S, Shannon Index H', Pielou index, and Simpson Evenness.

| Emplacement | S | Shannon (H') | H'/$H_{max}$ | Simpson (D) |
|---|---|---|---|---|
| Kitchen | 16 | 1,73 | 0,43 | 0,33 |
| Bedroom | 11 | 0,65 | 0,20 | 0,35 |
| Livingroom | 10 | 0,71 | 0,22 | 0, 32 |
| Bathroom | 20 | 2,42 | 1,32 | 0,41 |

**Table 4:** Sorensen quantitative index among different emplacements.

| | Emplacement | | | |
|---|---|---|---|---|
| | **Bathroom** | **Bedroom** | **Kitchen** | **Livingroom** |
| Bathroom | - | 0.60 | 0.50 | 0.55 |
| Bedroom | | - | 0.56 | 0.77 |
| Kitchen | | | - | 0.56 |
| Livingroom | | | | - |

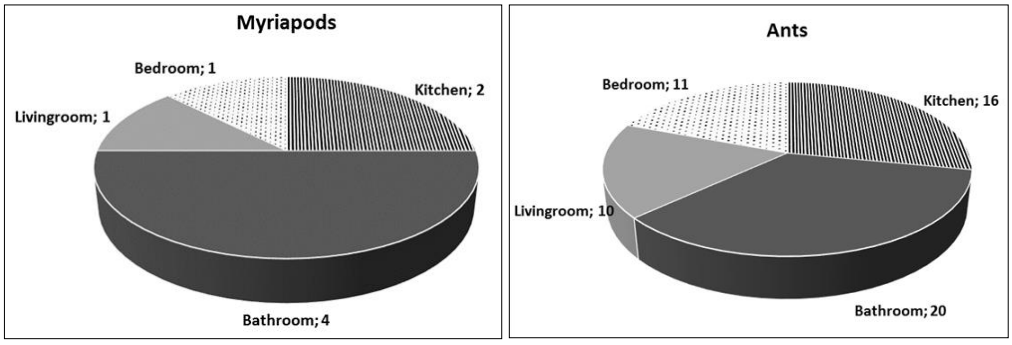


**Fig 2:** Species richness in myriapods (a) and ants (b) at different part of house

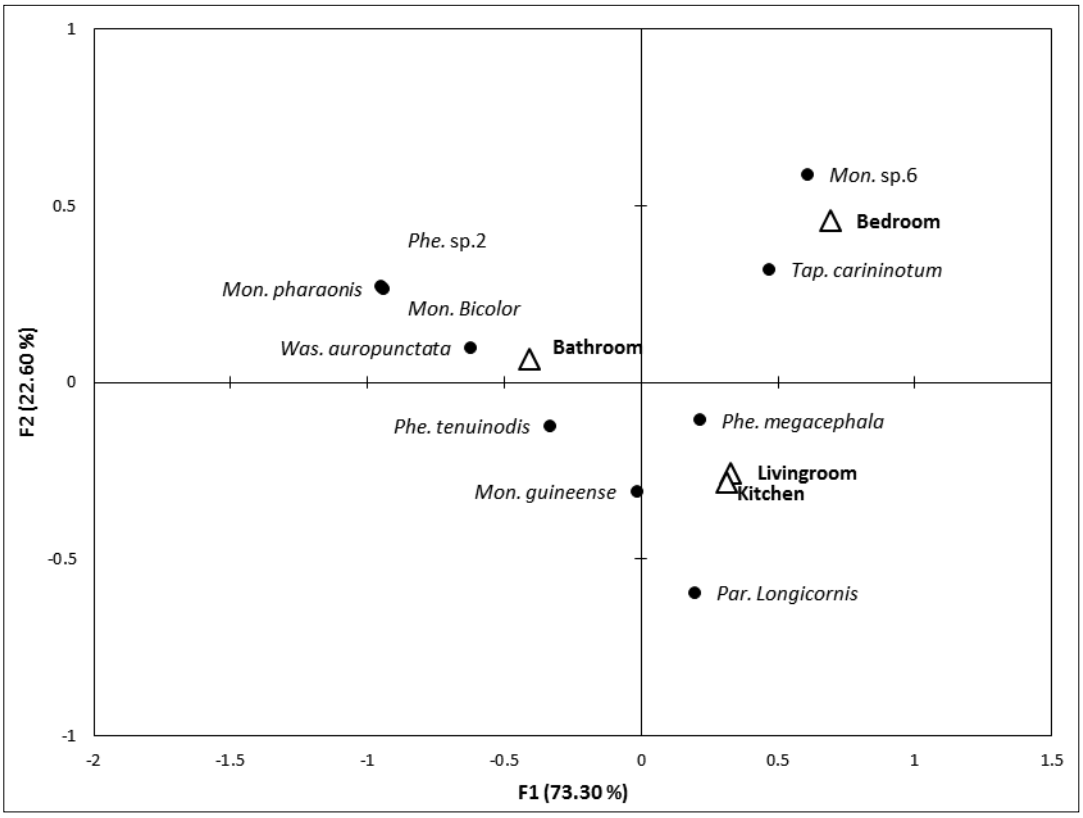


**Fig 3:** Correspondence factor analysis of 10 most abundant ant species found in house in the city of Yaoundé. Legends: *Phe =Pheidole, Par = Paratrechina, Mon = Monomorium, Was= Wasmannia, Tap = Tapinoma.*

## Discussion

Our result show that species richness was higher in ant than myriapod both in and out of human habitats. Unlike myriapods, ant species are one of the most ubiquitous, widespread, and represented groups of animals in most terrestrial ecosystems [12, 23]. As the most species-rich and biologically eclectic of all social insects, ants occur in any terrestrial environment including forest leaf litter, rotten wood, under the bark of dead trees, near water, on the seashore, under stones, in the soil, in buildings etc. They widespread success of ants stems in large part from their elaborate social behaviour [24, 25].

A significant difference in species richness was observed between garden and house. Although house offer more possibilities for food availability (e.g. food residue in the kitchen), most of species occur in garden which offers nest sites, food availability, vegetation and abiotic factor required for the development and survival of many species. In the other hand, the biggest ants belonging to Ponerinae subfamily (*Pachycondyla, Odontomachus, Oligomyrmex, Proceratium*) and some Myrmicinae (*Myrmicaria opaciventris*) were absent in house. These species are mainly predateous and hunt other arthropods and termites [26]. They nest in the soil, the leaf litter or in rotten logs [27].

In the ants, the big-Headed ant *Pheidole megacephala* was the most common species found in all part of house. This is consistent with other studies conducted in Brazil [20, 28]. This species was also more common in garden than other species. *Pheidole megacephala* was the only species infesting more than 80% of house and garden surveyed. This big-Headed ant is native to sub-Saharan Africa and recent reports showed that it dominates the ant community both in its native range [29, 30] and in introduced range [31].

In the myriapods, *Haplothysanus chapellei* was the most frequent species recorded in and out of house. This small myriapod species has already been reported in Tchad republic and Senegal recognized as noxious and detrimental to cultivated fields [32, 33]. Thus, this study is the first one underlying the presence of this species in the houses in which it represents more than half of the myriapod populations.

In Yaoundé city, the greatest number of ant and myriapod species was observed in bathroom. Out of the 100 houses sampled, more than 60% belonged to low-income people and had bathroom located out of house. These bathrooms are generally wet and built with temporary materials (e.g. rotten wood, boards, old sheet metal), and offer ideal conditions for moisture and shelter for myriapods and ants.

During this study, we identified four Tramp or invasive species namely, *W. auropunctata, P. megacephala, M. pharaonis* and *P. longicornis* [34] occur in houses. *W. auropunctata* was found in two sites whereas the other ones were found at different sites. The impact of invasive species on invertebrates and vertebrate have been widely reported in the literature [30, 35-43]. With respect to human being, the stings of invasive ant such as *W. auropunctata* can be very painful and numerous stings over a short period can be anaphylactic stress [44, 45]. In the other hand, among domestic dogs and cats, *W. auropunctata* stings can cause blindness [46].

## Conclusion

This study shows the household and home garden infesting arthropod assemblages in the city Yaoundé. Many ant and myriapod species occur in urban habitat where they are often endemic. Unfortunately, amongst species recorded both in and out the house, five are known as tramp species and can be detrimental to human health, food conservation and cultivated fields. Therefore, local authorities should take measures to eradicate or reduce populations of these harmful and invasive species in the urban habitats.

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