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ANT (HYMENOPTERA: FORMICIDAE) DIVERSITY AND BIOINDICATORS IN THE LANDS WITH DIFFERENT ANTHROPOGENIC ACTIVITIES IN NEW DAMIETTA, EGYPT

[ab]Mohammed M. El Bokl*, [c]Fayez M. Semida, [de]Mahmoud S. Abdel-Dayem, [a]Eman I. El Surtasi

[a] *Department of Zoology, Faculty of Science, Damietta University, Egypt.*

[b] *Department of Zoology, Faculty of Science, Al-Bayda, Omar Al-Mukhtar university, Libya.*

[c] *Department of Zoology, Faculty of Science, Suez Canal University, Ismalia, Egypt.*

[d] *Department of Entomology, Faculty of Science, Cairo University, Giza, Egypt.*

[e] *Plant Protection Department, College of Food and Agricultural Sciences, King Saud University, Riyadh, Saudi Arabia.*

A B S T R A C T

Ant diversity and bioindication are the main issues in myrmecological studies worldwide for their role in detection habitat characteristics and any ecosystem with sensitive finger printing the correlating changes. New Damietta is a city located along coastal Mediterranean Sea. Husbandry and urbanization impacts were the main anthropogenic activities at six study sites, but three control sites were free from such practices from marsh 2007 to February 2009. Within each site, 20 pitfall traps were simultaneously set in grid arrangement for two consecutive days each month. A total of 28 species were identified. Significant differences in species diversity, richness and abundance were apparent among the sites. The spatial variation among the study sites recorded the highest percent of species number and abundance (25 species of 5570individuals) at control sites. Meanwhile, the husbandry sites were a highly abundant impact and concomitantly recorded reduction of the value of species richness, Simpson diversity index and evenness. Ant species and composition succeed in differentiation the impacted sites far away their control throughout clustering, while five indicative ant species and the abundance level of certain ant species were significantly correlated with the status of study sites. In brief, environmental factors indicated their importance which reflects the changes of habitat characteristics, ant species and species biodiversity in study sites.

Keywords: Ant composition, urbanization, abundance, species richness, Egypt.

INTRODUCTION

Damietta is a province in the North part of Egypt covering about 1.029 km^2 on the extreme of Damietta branch of the Nile River, about 5% of the Delta's area and about 1% of the Egypt area. New Damietta city is a recently reclaimed city along coastal Mediterranean Sea in Egypt. Its locality is at 31°26'20.0972''N, 31°42'55.6898''E. It is characterized by san dy sheets and dunes, special flora and temperate to dry climate. Anthropogenic disturbances are among the most important factors that are shaping ecosystem diversity and structure (Murray *et al*., 2006). A particular change in environmental conditions may increase the diversity of one subset of organisms within a community, while decreasing the diversity of a different group of organisms (Semida *et a*l., 2001). Thus, a great concern for modern ecologists is to have the tools at hand that allow them to quickly evaluate the diversity of focal taxa, to easily pinpoint local changes in ecosystems caused by human activities, and also to rapidly and precisely answer on the state of conservation (Delabie *et al*., 2009 ; Uehara-Prado *et al*., 2009). Ants have been used as a powerful tool in several ecological studies (Folgarait, 1998; Lach *et al*., 2010). This group has useful characteristics for successful indication and monitoring of environmental impacts, including widespread distribution, high abundance, importance in ecosystem functioning, ease of sampling, and relatively well-known taxonomy and ecology (Agosti *et al*., 2000). Areas of the Mediterranean basin have been profoundly transformed by human activity and led to

* Corresponding Author:
Email: elbokl@yahoo.com

profound changes in the landscape (Geri *et al*., 2010). New Damietta is a recently reclaimed city along coastal Mediterranean Sea in Egypt that has witnessed major development and anthropogenic activities during the latest decades. Thus, this study fills the lacuna with the following objectives: (i) to assess ant diversity, Abundance and species richness across sites with different degrees of anthropogenic activities in and around New Damietta, Egypt, (ii) to identify the influence of ecological determinants such as soil parameters and vegetation cover on ant distribution, and (iii) to identify species that can be used as effective indicators of disturbance.

MATERIALS AND METHODS

Study sites: New Damietta is renowned for its guava farms and palm trees over its land in addition to some famous agricultural products such as tomatoes, vegetables, wheat and others. Nevertheless, salt wild herbs and shrubs such as *Inula crithmoides* (Golden samphire), *Zygophyllum aegyptium* (Ratrayt), *Alhagi graecerum* (Aquoul), and *Juncus rigidus* (Samaar Morrr) characterize the other wild regions. The climate of the study area is almost semi-arid with a short rainy winter season and a long dry summer season. Husbandry (3 different habitat sites) and urbanization (3 different habitat sites) were chosen as main activities in six study sites with three control sites. The coordinates of each site were recorded using a hand-held Global Positioning System (GPS), Garmin, GPS III plus as shown in (Table 1).

Table 1. Types of study sites and their coordination.

Study Site	Location	Coordinate
Urbanized sites	A	E 31º 40' 10.4", N 31º 27' 23"
	B	E 31º 40' 45", N 31º 26' 20.3"
	C	E 31º 40' 37.6", N 31º 26' 28.8"
Husbandry sites	A	E 31º 41' 50.6", N 31º 26' 20.1"
	B	E 31º 41' 50.4", N 31º 26' 13.8"
	C	E 31º 46' 6", N 31º 25' 6''
Control sites	A	E 31º 41' 40.3", N 31º 26' 27.8"
	B	E 31º 41' 40.6", N 31º 26' 32.6"
	C	E 31º 39' 46.8", N 31º 27' 20.6"

Ant collection: Each pitfall trap consisted of a rounded plastic bottle 13 cm deep with an opening of 5.7cm diameter and was filled of water with a little colorless detergent. Twenty traps were fixed per site at five-meter intervals in a regular distribution. The collected specimens were identified to the lowest possible taxonomic level. Soil samples were air dried and physical/chemical properties of the soil were analyzed. The portion finer than 2 mm was kept for physical and chemical analysis. Soil Texture was analyzed by sifting through the sieves of: 0.59 mm for coarse sand, 0.25 mm for medium sand, 0.063 mm for fine sand, and < 0.063 mm for silt and clay fraction. Soil moisture, calcium carbonate ($CaCO3$), Cl- ion, bicarbonates ($H2CO3-$), and the organic carbon content, following the procedures of United States Salinity Laboratory (Anon 1954; Piper 1947; Jackson 1962). Electric conductivity (EC) and soil Hydrogen ion (pH) were evaluated in 1:5 soil–water extract using digital conductivity meter (YSI Model 35) and a glass electrode pH-meter (model 80), respectively. Concentrations of the cations, Na +, K +, Mg+2 and Ca+2 were determined using a Corning 410 Flame Photometer (Model Jenway PFP7) (Rowell 1994). Moreover, the samples of plants (whole plant) in each site were identified in the Botany Department, Faculty of Science, Damietta University, Egypt. The relative vegetation cover of each plant was estimated according to the method described in (Barbour *et al*., 1999).

Data analysis

Ant diversity: Ant diversity was expressed as species richness, relative abundance, evenness and Simpson/Shannon diversity index. All estimates of ant diversity were calculated by PC-ORD program 4.14 (McCune & Mefford, 1999). Whenever, analyses of variance (ANOVA) were used to test for differences in spatial and temporal values of diversity indices between the different study sites. Detrended Correspondence Analysis (DCA), an indirect gradient analysis technique, plots sites against axes based on species composition and abundance (Ter Braak 1994). Sites that are more similar in environmental conditions are depicted as being closer together in the diagram. Correlation and Regression analysis were performed to assess the relation between diversity parameters and habitat characteristics. Indicator Species Analysis was carried out using PC-ORD (McCune and Mefford, 1999). The strength of these relationships has been determinate by correlation coefficient value (r), more than 0.4 refers to presence the relationship, up to 0.7 medium, and when to be 0.9 means strong relationship. These analyses were run using Win STAT® for Excel (Fitch, 2009).

RESULTS

Sampling efficiency: As shown in Fig.1, the number of recorded species gradually increased with the increasing the number of traps to an asymptote, nearly from trap 18 to trap 20 in all sites. From these curve, it could be concluded that the sampling was enough to catch all the species available in our study area and the present data are will reveal the species diversity of the sampling sites.

Faunistic composition: Ant fauna of the study sites in New Damietta city consisted of three subfamilies, 10 genera, 28 species (Appendix 1) and 11573 individuals. The control sites had the highest number of species (25 species=89.2%). Meanwhile, 18 species (64.5%) was recorded from urbanized sites and 15 species (53.7%) recorded from husbandry sites. *Cardiocondyla israelica* Seifert, 2003, *Pheidole teneriffana* Forel, 1893, *Messor niloticus* Santschi, 1938 and *Paratrechina jaegerkioeldi* Mayr, 1904 were the common formicid species at the study area in New Damietta region. On the other hand, *Monomorium salomonis* Linnaeus, 1758 was restricted only to the two coastal sites (control site C and urbanized site A). *Camponotus fellah* Dalla Torre, 1893 was recorded only at both control sites A and B while, *Cataglyphis lividus* André, 1881 was detected in all study sites except husbandry sites (A&B). It was highly abundant at urbanized site C. Furthermore, animal rearing site was the only site that has been characterized throughout the study period with the presence of *Monomorium areniphilum* Santschi, 1911, the absence of *Messor aegyptiacus* Emery 1878, and a highly relative abundance of *Cataglyphis savignyi* (Dufour, 1862). Finally, both agricultural sites showed a highly abundance of Paratrechina sp. in a contrary less abundance of *Pheidole teneriffana* Forel 1893, while Tapinoma sp. was restricted only to agriculture B.

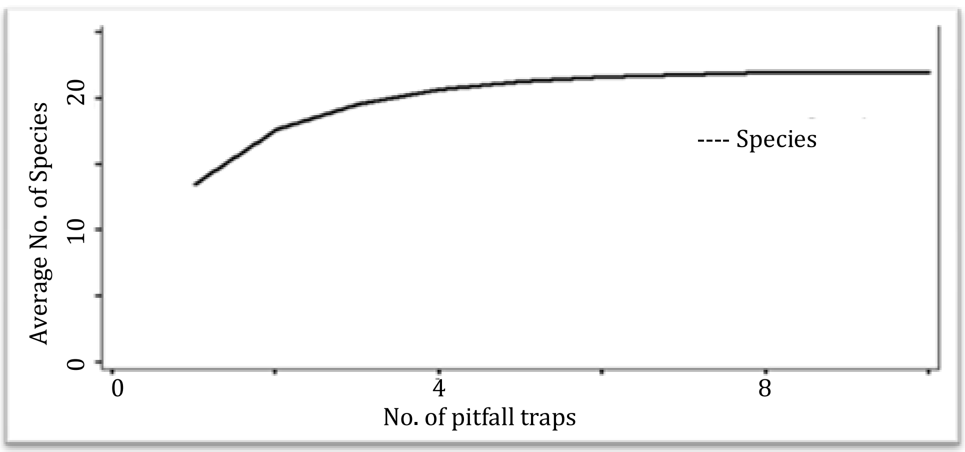

Figure 1. Species effort curve of formicid species during the study period 2007-2009 (24 repeated trips) in New Damietta region, Mediterranean Coast, Egypt.

Overall Ant diversity: A total of 11,573 formicid individuals (28 spp.) were sampled throughout the study period. Species evenness was 0.65, while, the overall pattern of diversity was (0.84 & 2.67 in Simpson and Shannon diversity index, respectively). The spatial variation was stated in the current study throughout four parameters: species abundance, species richness, evenness, and Simpson diversity. Fig. 2 indicates the spatial variation of formicid species with highly significant differences among the different study sites in species richness ($F_{(8,119)} = 13.988$, $P< 0.0001$), abundance ($F_{(8, 119)} = 10.53$, $P< 0.0001$), and Formicidae diversity ($F_{(8,119)} = 15.497$, $P< 0.0001$), but no significant differences was in the species evenness ($F_{(8,119)} = 1.03$, $P>0.44$).The highest values of species richness (25 species), individual abundance (5570 individuals), and diversity (0.84) were in the control sites. Meanwhile, husbandry impact recorded a higher impact in abundance than urbanization and concomitantly with decreasing of species richness (15 species), species diversity (0.64) and evenness (0.28).

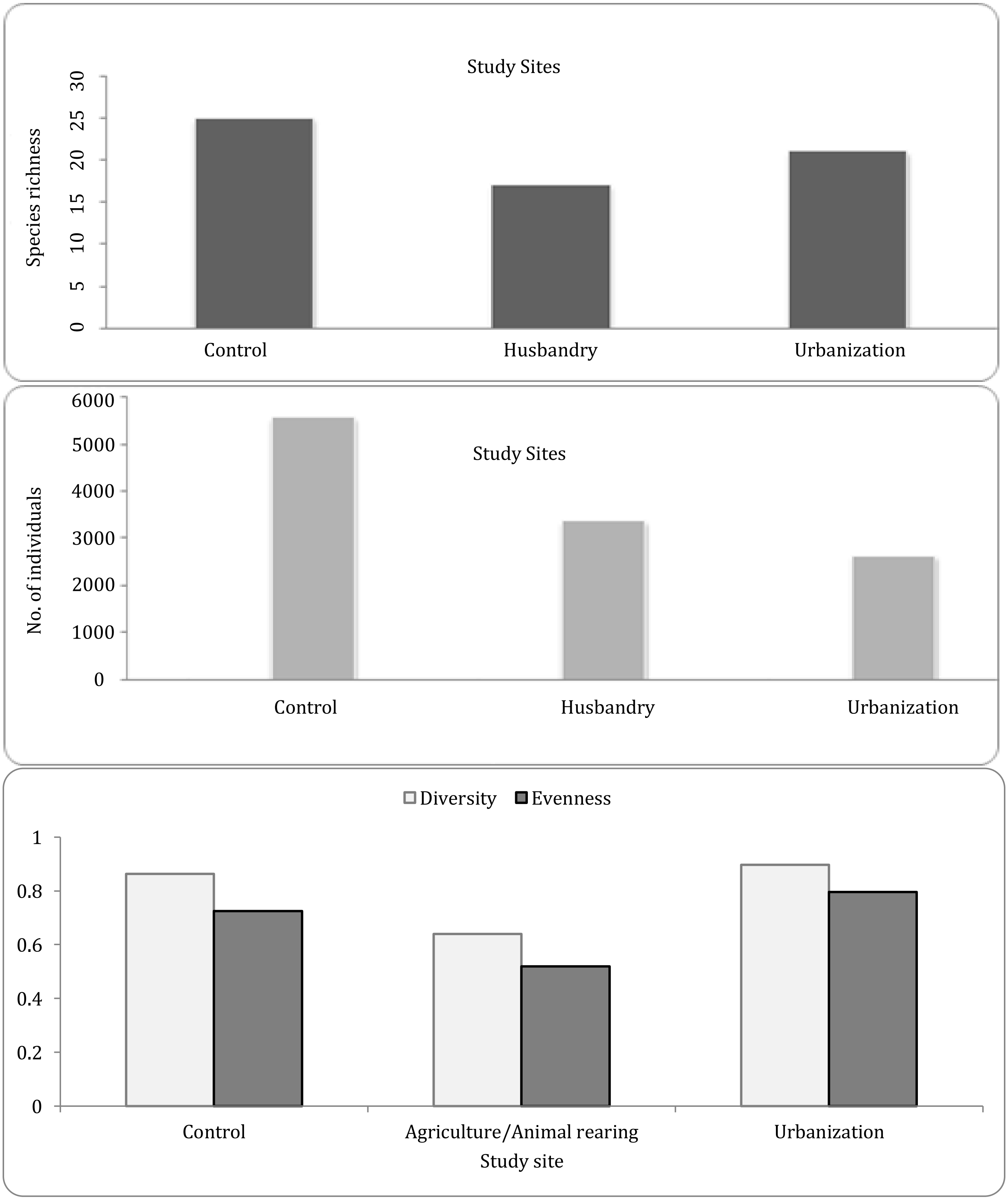

Figure 2. Spatial variation of formicid species at different sites of study area in a) species richness (F (8,119) = 13.988, P< 0.0001), b) abundance (F (8,119) = 10.53, P< 0.0001), and c) Simpson diversity index (F (8,119) = 15.497, P< 0.0001) and species evenness (F (8,119)= 1.013, P> 0.44).

Data analyses

Similarity: Cluster analysis (Fig. 3) visualizes five distinct groups by four different phases. At the first phase, animals rearing site and both agricultural sites (A & B) separated far away the other study sites. The next phase clustered both agricultural sites far away animal farm. Both control sites (A & B) differentiated as separate clad at the third phase. Meanwhile, the fourth phase characterized three sites of urbanized impact. Finally, coastal urbanized site (A) differentiated from both city urbanized sites (B & C) and clarified that urbanized A is more closely to control A, while the others are closely to control A and B at the fifth stage.

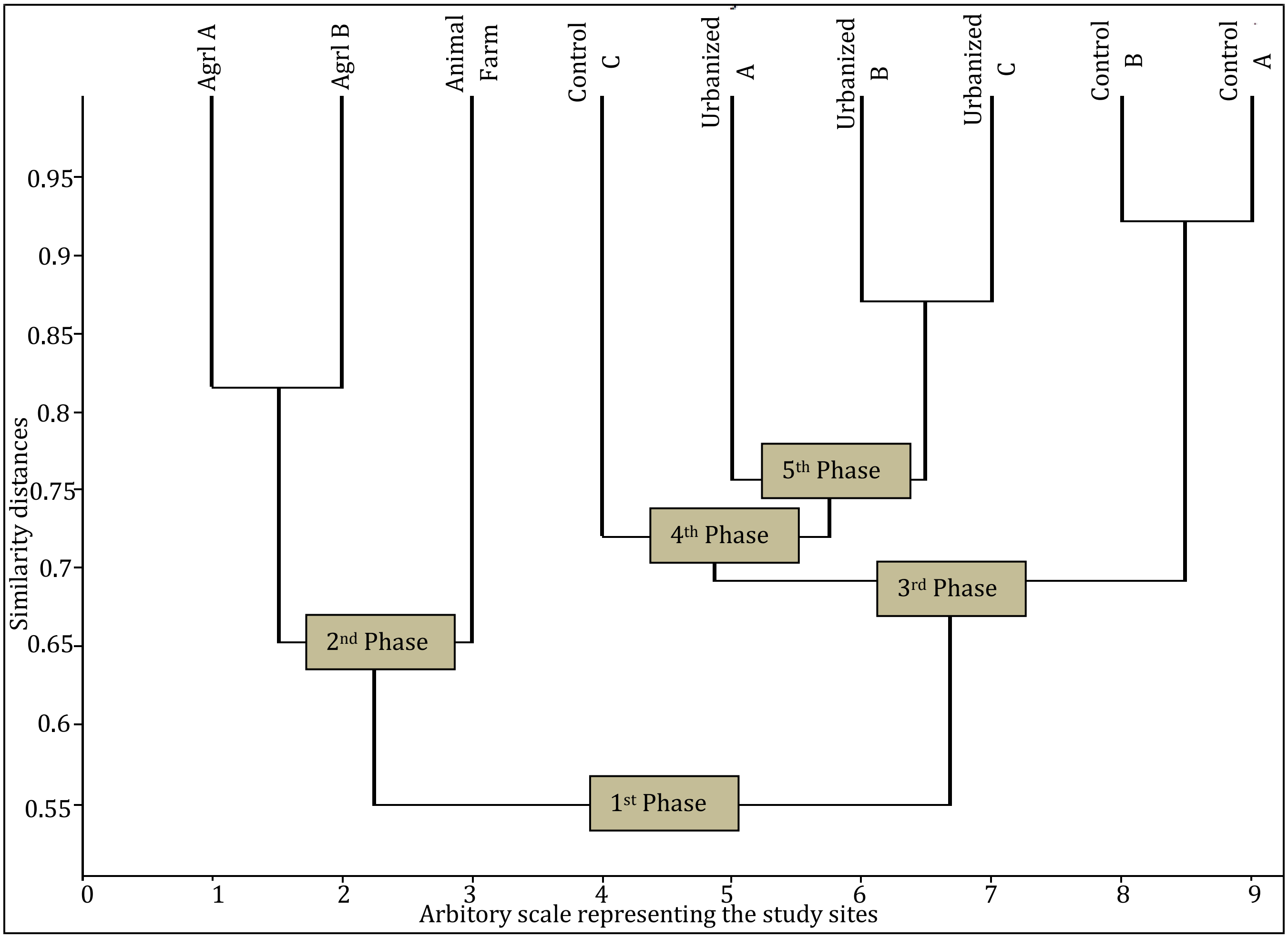

Figure 3. Hierarchical Cluster analysis of formicid species using Dice similarity with linkage method (Paired group Algorithm) grouping sites depending up on the similarity distances. The length of each node in the dendrogram is the similarity between the pair of clusters whose fusion corresponds with the node.

Ordination study sites: The Detrended Correspondence Analysis (DCA) of ant species shows the ordination study sites Fig. 4. The study sites are spread out along axis 1 (Eigen-value= 0.795) and axis 2 (Eigen-value= 0.513). Both axes differentiated the nine study sites Fig. 4 into four groups: animal rearing site, both agricultural sites (A & B), the coastal sites (control C and urbanized A site) and four sites inside the city (both of control sites A & B and urbanized sites B& C). Soil parameters and vegetation cover of plant species reflected the correlation between ant species and the studied sites. A strong correlation was associated total organic matter and carbon (r= 0.65), clay\ silt content (r= 0.75), and the relative cover of *Conyza liuifolia* were correlated with axis 1 (r= 0.75) to axis 1, while the weak correlation was to axis 2. These previous soil and relative vegetation parameters increased toward the animal rearing site. While, chlorides ions (Cl-) and the relative cover of *Halocnemum strobilaceum* increased toward both coastal control and urbanized site A and correlated strongly with axis 1 (r= -0.78& -0.76 respectively) but a weak correlation to axis 2 (r= 0.05& -0.064 respectively). On the other hand, the plant species richness increased toward the two control sites (A & B) that recorded a correlation with axis2 (r= -0.56) and weak correlation with axis 1 (r= 0.06). Toward agricultural sites (A), soil moisture content and the relative vegetation cover of planned species: *Psidium guajava* and *Phoenix dactylifera* increased with strong correlation to axis 2 (r= 0.66, r= 0.91 & 0.89 respectively) and weak correlation to axis 1 (r= 0.123, 0.005 & r= -0.007 respectively).

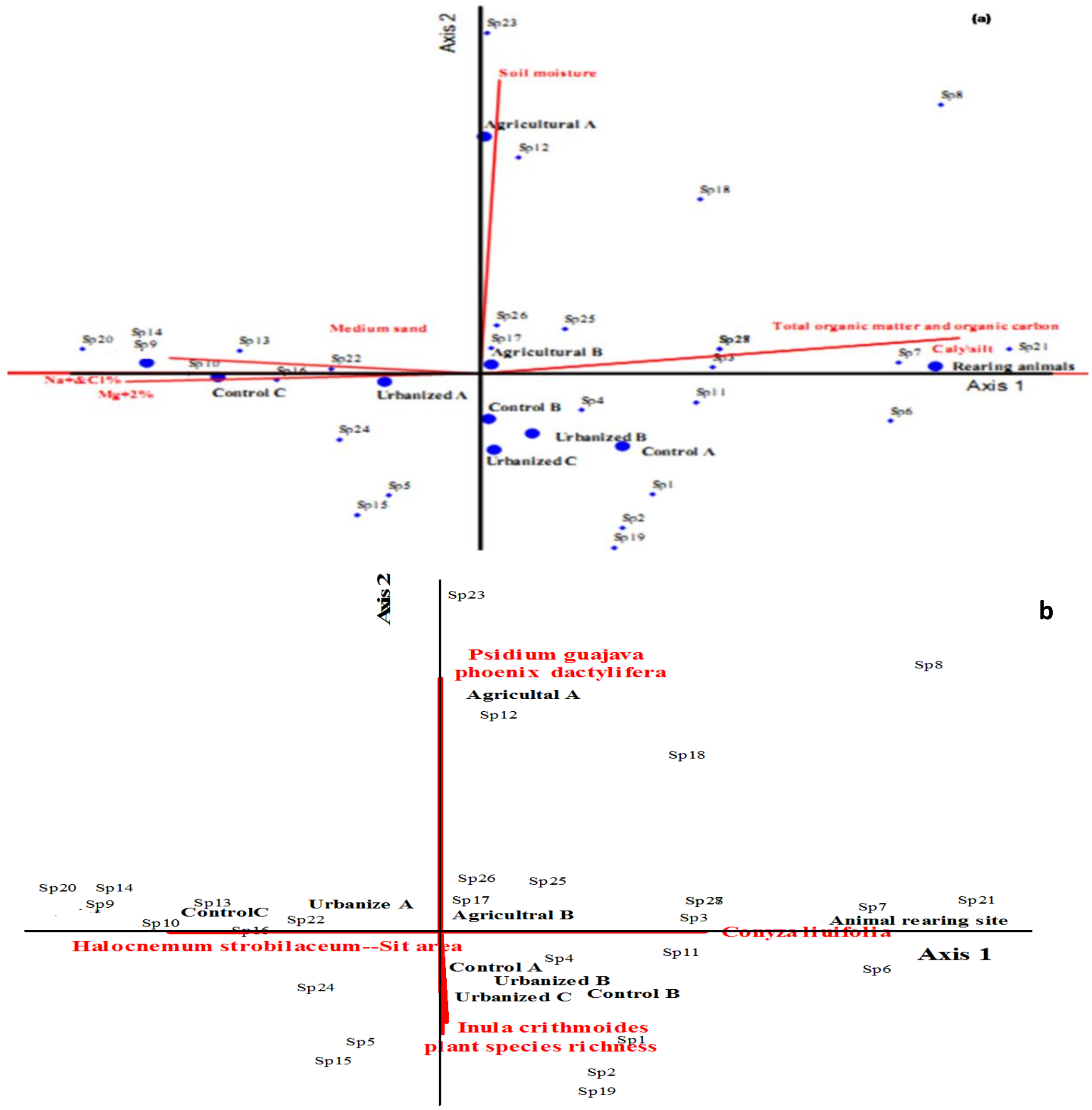

Figure 4. DCA ordination of formicid species composition, in relative to a) soil parameters, and b) relative cover of plant species for study area dependent on formicid species in New Damietta region, Mediterranean Coast, Egypt during 2007-2009. Sp (1-28), formicid species identified in Appendix 1.

Indicator Species Analysis: Five ant species clarified significantly correlated with the study sites. The occurrence of three ant species: *Camponotus cognatocompressus* (Sp2) (IV= 60, P< 0.01), *Camponotus aegyptiacus* (Sp1) (IV= 75.5, P< 0.01) and *Cataglyphis lividus* Sp5 (IV= 40, P< 0.05) were associated with the study sites' group {both the control sites (A & B) and the urbanized sites (B&C)}. However, both coastal sites (control C and urbanized A) were characterized with an indicative species, *Monomorium salomonis* (Sp20) (IV=

100, P< 0.01). Moreover, the abundance of Cataglyphis sp2 (Sp8), (IV= 44.1, P< 0.05) was significantly correlated with both agricultural sites, while *Monomorium areniphilum* (Sp21), (IV= 100, P< 0.01)was an indicative species at animals rearing site.

Relative abundance of major ant species: Figure 5. indicated the spatial variation in the relative abundance of ant species: *Cardiocondyla israelica*, *Pheidole teneriffana*, *Messor niloticus* and *Paratrechina jaegerkioeldi*, which have been the main ant species in New Damietta region. Highly significant difference was indicated among the study sites in these species abundance (F (8, 39) = 2.56, P< 0.01), where agricultural site A had the lowest site in the abundance of three antspecies (*Cardiocondyla israelica*, *Pheidole teneriffana*, *Messor niloticus*), and the lowest site in the abundance of *Paratrechina jaegerkioeldi* was at rearing animal farm.

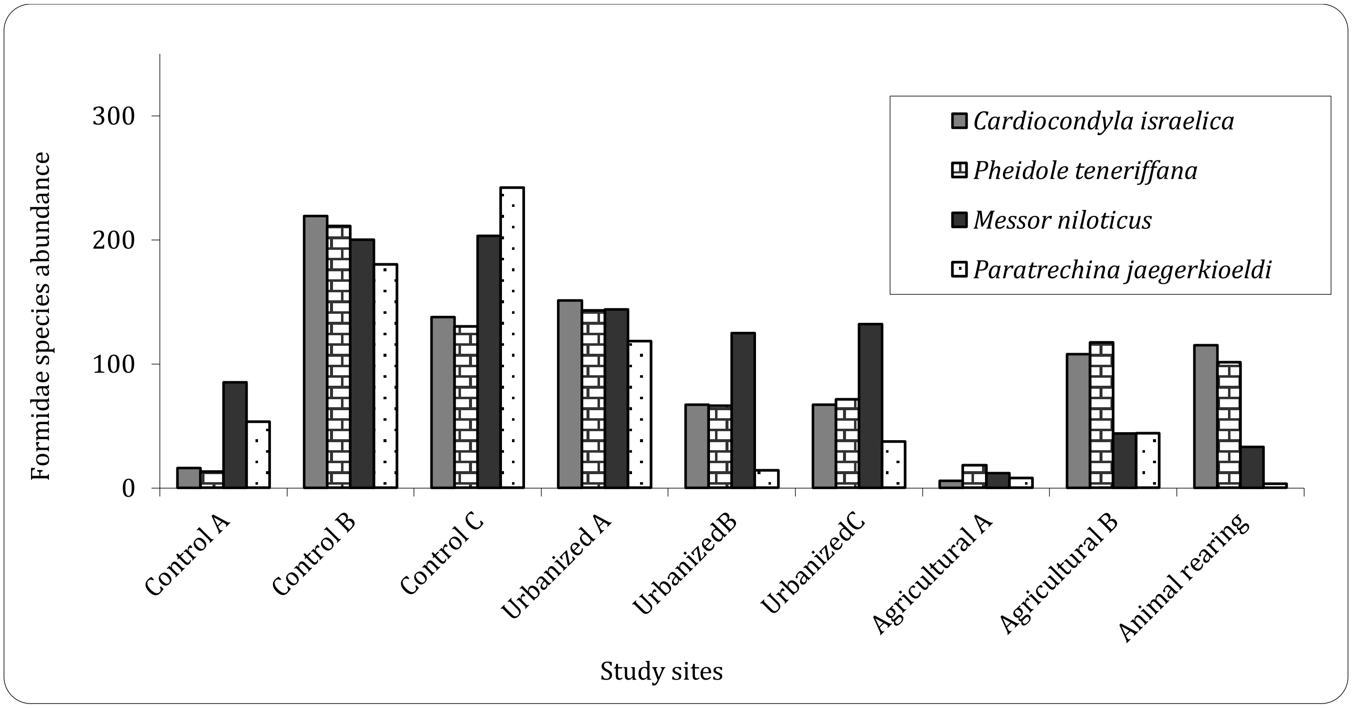

Figure 5. Spatial variation in abundance of main formicid species at different sites of study area (F (8,32) = 1.072, P< 0.01).

Ant diversity and Environmental factors

- **Diversity:** Soil parameters showed significant correlations with species diversity index Table 2. The diversity index of ant species had a positive correlation with the percentage of vegetation cover (r= 0.63, P< 0.01). Moreover, the relative cover of *Alhagi graecerum*, *Inula crithmoides*, *Juncus rigidus*, *Tamarix tetragyae* and *Zygophyllum aegypteium* had positive correlations with Simpson diversity index of ants. The most positive one was with the relative cover of *Inula crithmoides* (r= 0.82, P< 0.0001).
- **Abundance:** The abundance of ant species was correlated positively Table 2 with the concentration of the cations (Na+, K+ & Cl-), the electric conductivity (µs/cm), pH, the percentage of fine sand and clay\ silt content, barren area (m2) and the relative plant cover of *Halocnemum strobilaceum*. However, their abundance exhibited negative correlations with the percentage of vegetation cover, moisture content of soil, and medium sand content. A strong positive correlation was recorded between the abundance of ant species with the concentration of chloride (Cl-) (r= 0.77, P< 0.01& r= 0.79, P< 0.001, respectively) and negatively with the percentage of vegetation cover (r= -0.72, P< 0.01& r = -0.71, P< 0.01, respectively).
- **Species richness:** As shown in Table 2, the percentage of coarse sand and moisture content of soil was correlated negatively with the species richness of ant species, while the relative cover of *Alhagi graecerum*, calcium cation (Ca+2), plant species number and the relative cover of some wild plants such as *Alhagi graecerum*, *Zygophyllum aegypteium* & *Juncus rigidus*. The most positive one was with the plant species number (r= 0.73, P< 0.01).

Table 2. The correlation coefficient values (r) between soil and flora factors and abundance, richness and diversity trend at the study area from March 2007 to February 2009 in the study sites, New Damietta region, Mediterranean Coast, Egypt.

Environmental factors	Abundance	Richness	Diversity
Coarse sand %	-0.2	-0.63*	0.1
Medium sand%	-0.67*	0.3	-0.3
Fine sand%	0.65*	0.36	-0.50
Clay\silt%	0.74*	0.4	-0.4
Electric conductivity (μs/cm)	0.64*	0.4	0.3
M.S.%	-0.67*	-0.56*	-0.13
Na^+ ($megl^{-1}$)	0.67*	0.4	0.4
K^+ ($megl^{-1}$)	0.67*	0.3	0.4
Cl^- ($megl^{-1}$)	0.79**	0.3	0.4
Ca^{+2} ($megl^{-1}$)	0.22	0.60*	0.1
Vegetation Cover%	-0.71*	0.5	0.63*
Barren area%	0.64*	0.2	-0.28
Plant richness	0.4	0.73*	0.790*
Halocnemum strobilaceum%	0.57*	0.2	0.3
Tamarix tetragyae%	-0.14	0.4	0.57*
Inula crithmoides %	0.2	0.52*	0.82**
Alhagi graecerum %	0.1	0.64*	0.54*
Zygophyllum aegypteium %	0.34	0.60*	0.64*
Juncus rigidus %	0.4	0.67*	0.72*

(M.S. %= moisture content of soil %)

Star (*) is significant when P< 0.01, (**) is highly significant when P<0.001

DISCUSSION

Areas of the Mediterranean basin have been witnessed profoundly transformed by human activity and led to profound changes in the landscape (Geri *et al.*, 2010). New Damietta region is a recently reclaimed and developed region along coastal Mediterranean Sea. The importance of this region is attributed to holding projects such as industry, fish cultures, resorts and tourism, urbanization, port, animal rearing and agricultural activities. Based upon the anthropogenic activities, ant diversity and ant bioindicators were investigated to find out the impact of anthropogenic activities in this region. Ant community can better reflect the response of biodiversity to habitat disturbance status (Vargas *et al.*, 2007; Schmidt and Diehl, 2008). Spatially, the present results indicated the ant species richness and abundance at natural habitat (control sites) compared to the impacted sites. This come in accordance with several research studies of Gomez *et al.*, 2003 in Spain ; Andersen 1995 in Australia ; Bestelmeyer; Wiens, 1996 in Argentina, Graham *et al.*, 2009 in the Southeastern United States; Castracani *et al.*, 2010 in Italy and attributed such results to microhabitat complexity and a positive relationship between its richness and available net primary productivity.

Different spatial distribution of species abundance during the current study and further recording of certain species dominance, the increase of ant abundance, and concomitantly affected with reduction the value of its diversity and evenness as clarified in agricultural/ animal rearing impact. These results may simply explained by Semida *et al.* (2001) who stated that environment conditions shaped the diversity of community and a particular change in it may increase the diversity of one subset of organisms within a community, while decrease the diversity of a different group of organisms. Otherwise, the dominance of ant species pre-adapted to the post-disturbance conditions and causes a decrease in ant community diversity is supported by the study of Farji-Brener *et al.* (2002) who attributed their results to increasing habitat favorability for these dominant ants.

On the other hand, the lowest species number and abundance of ant recorded at husbandry sites may be due to changes in main microenvironmental factors [area, vegetation, chemical (nutrients) and physical (soil texture and structure)]. Similar to those recorded by Folgarait (1998), Wang *et al*. (2001), Matlock & Dela Cruz (2003) and Hernandez-Ruiz et al. (2009) and they attributed their results to agricultural practices such as irrigation, increase soil moisture and pesticide which have a negative effect upon species richness, biodiversity, reduction ant biomass and colony densities of epiedaphic ants sequentially affects the structure of the ant community.

Soil characteristics are well known with their strong effects on spatial distribution of soil communities (Bardgett *et al*., 2005). In the present study, some soil properties recorded significant correlations with the species richness, abundance and diversity by Pearson relationships. The relationship between ant community and habitat factors is consistent with the finding of Boulton *et al*. (2005) who concluded that overall ant species richness and abundance are more consistently associated with soil chemistry and texture than plants. Meanwhile, Majer *et al*. (1984) pointed to plant species richness and diversity, percentage of plant cover and litter cover as well as lower soil moisture (Wang *et al*., 2001), while Morrison (1998) who stated that ant community increase with increasing habitat divergence. Moreover, Shaban (2009) found that soil cation K+, the soil alkalinity value and the percent of sand in the soil are the most important factors for Hymenoptera fauna by the CCA result in Port Said, Egypt. Additionally, Parr *et al*. (2002) attributed the positive correlation between barren area and the abundance of ants to increasing of spacing reduces the competition between ant nesting sites and root zones.

The current results of the grouping of the ant species might be reflect differentiation between control and impact sites, which depend upon ant species and habitat characteristics. Clustering analysis pronounced dissimilarity in ant inhabitants and differentiated between the disturbed sites (husbandry and urbanized sites) and their natural site. This differentiation has been attributed to the similarity degree in the main environmental factors, degree of the impact and recolonization ability of species after disturbance. This explanation is supported throughout the results of DCA analysis in the relative to the environmental factors and habitat characteristics (soil and vegetation) which the habitat characteristics of natural sites differentiated from the disturbed sites. Similar to those corresponded by Orabi, (2006) who concluded that the differences in vegetation characteristics between disturbed and undisturbed sites reflected in differences in ant community composition. On the other hand, Fitzpatrick *et al*. (2001) have highlighted on the co-variation between natural landscape features and anthropogenic factors that can make assessing the biotic integrity of ecosystems difficult. This difficulty attributed to the re-colonization process of ant species not limited by resource availability (Campos *et al*., 2007).

Ant Species Indicator Analysis currently showed that the closely urbanized sites (B&C) to control (A&B) was in their indicator species, *Cataglyphis lividus*, *Camponotus cognatocompressus* and *Camponotus aegyptiacus*, where were known as city sites. Moreover, the abundance of Cataglyphis sp-2 is significantly correlated with both agricultural sites. In the comparable results in Mediterranean region, Andersen and Spain (1996) recorded that Camponotus, Messor and Cataglyphis preferred habitats of arid and semi-arid areas. Collingwood, (1985) registered *Camponotus aegyptiacus* as the common ant species in Northeast Africa, and in Egypt (Ali et al., 1988). Additionally, the absence of *Messor aegyptiacus* from the present animal rearing impact is a good indicator. This is consistent with the view of Mercier and Lenoir (1999) who pointed to the genus Messor, which is very sensitive to resource density with high abundance of natural resources, recruiting down one or another trunk-trail only when seeds are aggregated. Otherwise, both studied coastal sites characterized with an indicative species: *Monomorium salomonis*, while *Monomorium areniphilum* is an indicative species at animals rearing site. Monomorium is one of the most abundant and frequent genera and occupies environments with different conditions, and their populations are not so highly affected by micro weather changes (Hernández-Ruiz and Castaño-Meneses, 2006). *Monomorium salomonis* is recorded in sandy places along seaboard and widely distributed in Mediterranean Africa (Comin and Espadaler, 1984).

The key question on the studied ant community is being a functional indicator to anthropogenic activities. In brief, spatially results reflect the response of biodiversity to impacts, which there is a significant impact on diversity, species richness and abundance of ant community at two types of anthropogenic activities (husbandry and urbanization) in comparing with the natural sites as the result of changes in the environmental characteristics. Otherwise, grouping analyses and Indicator Analysis reflect the changes of habitat characteristics in impacted sites far away their natural habitat mirroring with ant community. These changes throughout landscape opening are induced a shift in species composition and potentially constitute a threat for species diversity (De la Peña *et al*., 2003; Dullinger *et al*., 2003).

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Appendix 1. Collected formicid species from March 2007 to February 2009 in the study sites, New Damietta region, Mediterranean coast, Egypt.

Subfamily	Scientific name	% abundance	Code
Formicinae	*Camponotus aegyptiacus* Emery, 1915	0.518448	Sp1
Formicinae	*Camponotus cognatocompressus* Forel, 1904	0.198738	Sp2
Formicinae	*Camponotus fellah* Dalla Torre, 1893	2.635445	Sp3
Myrmicinae	*Cardiocondyla israelica* Seifert, 2003	0.241942	Sp4
Formicinae	*Cataglyphis lividus* (André, 1881)	7.664391	Sp5
Formicinae	*Cataglyphis savignyi* (Dufour, 1862)	7.517498	Sp6
Formicinae	*Cataglyphis* sp.1	8.450704	Sp7
Formicinae	*Cataglyphis* sp.2	6.039921	Sp8
Formicinae	*Cataglyphis* sp.3	7.923615	Sp9
Myrmicinae	*Crematogaster inermis* Mayr, 1862	11.10343	Sp10
Myrmicinae	*Crematogaster* sp.	5.651084	Sp11
Formicinae	Formica. sp.1	1.226994	Sp12
Formicinae	Formica. sp.2	0.336991	Sp13
Formicinae	Formica. sp.3	1.019615	Sp14
Myrmicinae	*Messor aegyptiacus* (Emery, 1878)	0.414758	Sp15
Myrmicinae	*Messor niloticus* Santschi, 1937	0.017282	Sp16
Myrmicinae	*Messor* sp.1	0.034563	Sp17
Myrmicinae	*Messor* sp.2	0.285146	Sp18
Myrmicinae	*Messor* sp.3	0.077767	Sp19
Myrmicinae	*Monomorium salomonis* (Linnaeus, 1758)	0.604856	Sp20
Myrmicinae	*Monomorium areniphilum* Santschi, 1911	0.025922	Sp21
Formicinae	*Paratrechina jaegerskioeldi* (Mayr, 1904)	15.10412	Sp22
Formicinae	*Paratrechina* sp.	1.261557	Sp23
Myrmicinae	*Pheidole megacephala* (Fabricius, 1793)	0.025922	Sp24
Myrmicinae	*Pheidole teneriffana* Forel, 1893	5.314093	Sp25
Dolichoderinae	*Tapinoma* sp.	0.025922	Sp26
Myrmicinae	*Tetramorium* sp.1	0.034563	Sp27
Myrmicinae	*Tetramorium* sp.2	16.24471	Sp28