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MORPHOLOGICAL IDENTIFICATION AND PREVALENCE OF ANTS IN KUCHLAK, BALOCHISTAN

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Abstract

This field study was conducted for morphological identification of ant species and to explore the indoor and outdoor ant species prevalence in the Kuchlak area, a town near Quetta, Balochistan province of Pakistan, which helps us to know which species have become more abundant or which species are dominant now. This research was carried out in April 2021 to March 2022. Quantitative collections were made on both indoor and outdoor Ant species of Kuchlak. Ants were gathered from different collection sites of Kuchlak randomly from indoor (kitchen, rooms, washrooms, stores and apartments) and outdoor (grassy fields, forest, footpaths, streets, barren ground, butcher shops and graveyards) sites by hand-pick method. Their identification has been done on the basis of their colour, absence or presence of nodes on petiole, antennal segments, shapes of thorax and abdomen. All the observations were based on the worker caste. A total of 1056 samples were collected from different areas of Kuchlak in which total 10 species were identified i.e. Tetramorium caespitum 20.8%, Monomorium pharaonis 14.2%, Paraterchinia longicornis 14%, Tapinoma sessile 11.6%, Messor instabilis 10.9%, Pheidole megacephala 8.5%, Crematogaster subnuda 7.6%, Monomorium indicum 5.2%, Camponotus modoc 4.8% and Cataglyphis bellicose 2.4% which are belonging to three subfamilies i.e. Myrmicinae, Formicinae and Dolichodenae. Tetramorium caespitum species was most dominant, while Cataglyphis bellicosa was the least abundant species. Shannon diversity index (H), evenness EH and Margalef's index for species richness of outdoor ant species are as follows: 1.99, 0.90 and 1.23, respectively, are greater than the indoor ant species 1.55, 0.86 and 0.84, respectively. All the species were first recorded in this study.

Keywords: *Hymenoptera, Formicidae, Species, Indoor, Outdoor.*

INTRODUCTION

On earth Arthropods are most successful phylum representing (1,302,809 species) or about 78.5% of the living species. Insecta is the largest class under Arthropod phylum. Class Insecta is the most successful group with (1,070,781 species) and over 80% it accounts for of all arthropods (1). Members of this group identified by three body segments, three pairs of jointed legs, an exoskeleton, usually two pairs of wings and one pair of antennae (2). Ants are diverse group among many types of insects present on earth (3).

Ants are universally known, dominant group and widely distributed individuals from class Insecta under family Formicidae, superfamily Vespoidea and order Hymenoptera. On a global scale Ants have become major keystone species making up 30% of faunal biomass in the land environment (4). They are thought to have lived on Earth about 120 million years before (5).

Ants are Hemimetabolic insect (6). Ants are separated from the other members of order Hymenoptera via node which consist of one or two segments and it join the mesosoma with gaster, consistently present metapleural gland and geniculate antennae (7).

Around 22000 different ant species have been identified (8). They are divided between 20 subfamilies. These subfamilies are amblyoponinae, agroecomyrmecinae, aneuretinae, brownimecia, apomyrminae, dolichoderine, norylinae, myrmeciinae, myrmicinae, ponerinae, paraponerinae proceratiinae, spheomyminae, pseudomyrmecinae, actaeomminae, formicinae, formiciinae, heteroponerinae,martialinae and leptanillinae. The species have become extinct are brownimecia, spheomyminae and formiciinae (9). Ants help in maintaining the balance in the ecosystem. Ants have both positive and negative effects on the ecosystem (10). Ants are referred to as ecosystem engineers since they have a significant impact on soil quality and the decomposition process (11). In South Africa they are used

to gather the seeds for herbal tea (12). In Africa and South America army ants serve as surgical sutures (13). Many ant species provide essential ecosystem services like food and medication, in many areas of the world formicidae also used in entomo therapy or as alternative medicine. Ants contain well developed immune system and anti-microbial chemicals which ants are used for pathogen defense that can be used to cure human diseases. As a source of medications for the expanding global population this taxon could benefit to mankind in the future (14). Because of their biological characteristics ants are increasingly being used as the focal taxon for ecological and conservation studies (15). Ants have both beneficial and harmful effects on the ecosystem (16). They are dangerous to human health because they can spread diseases including dysentery, typhoid fever and tuberculosis (17). Because of their stinging or biting habits ants are also annoying numerous human fatalities occur in the United States each year as a result of ant stings (18). On their morphological basis ant can be easily identified and classified in different parts of the world (19). The aim of this study was to identify Ant species morphologically and their prevalence in Kuchlak.

METHODOLOGY

STUDY AREA

This study was conducted in Kuchlak. Kuchlak is a town near to Quetta city in Balochistan province of Pakistan. Kuchlak has arid and continental climate. In Kuchlak the main source of precipitation is snowfall during the winter months; unlike most of Pakistan. Kuchlak is famous for its summer fruits such as apples and peaches, but soil aridity is an issue. In the Kuchlak valley vegetables like tomatoes, potatoes, onions, and turnips are grown.

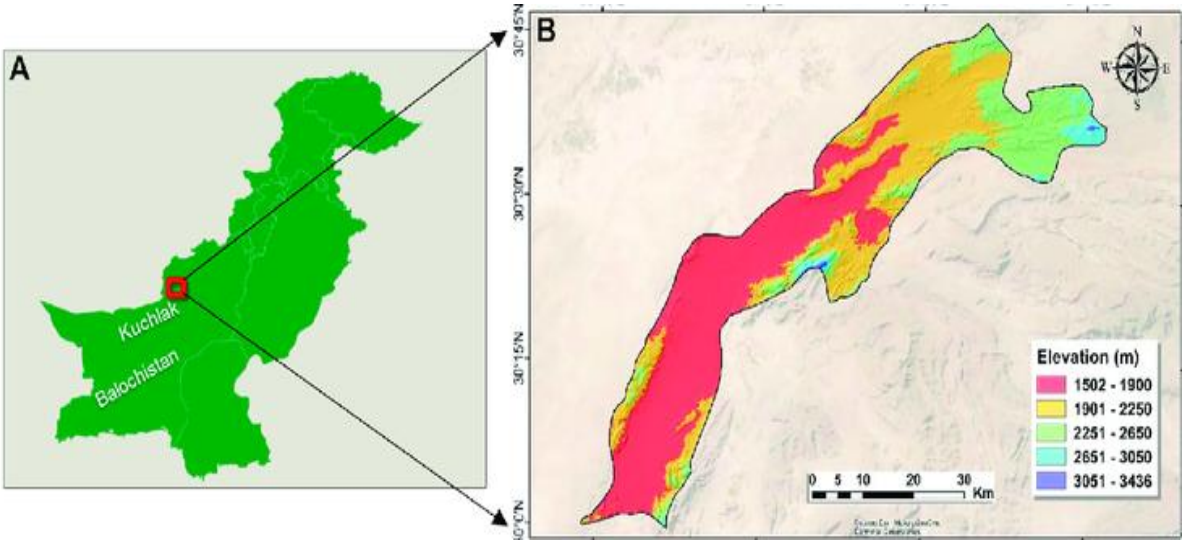


Fig 1. Map of Kuchlak, Quetta District

DURATION OF STUDY AND SAMPLE COLLECTION

This study completed within one year from April 2021 to March 2022, Ants were sampled randomly from different collection sites, indoor (kitchen, rooms, washrooms, stores and apartments) and outdoor (grassy fields, barren ground, forest, butcher shops, streets, parks and grave yards) of Kuchlak area. Hand collection method was used. Collection was made both during day and night time.

PRESERVATION METHOD

The captured ants were first killed and temporarily preserved in 70% ethanol and 30% water filled Eppendorf tubes.

SLIDE PREPARATION

Both full extent and separate slides were prepared to identify the species. The material used in slides preparation were alcohol with different concentration (30%, 50%, 70%, 90% and 100%), glass slide, coverslips, dissection box, candabalsam and microscope. First the specimen were taken out from the test

tube and were put in alcohol of different conc. i.e 50%, 70%, 90% and in last 100% alcohol then dipped into clove oil for one minute and then dipped into xylol for few seconds after that ants were put on slides with a drop of candablalsam and were arranged with the help of dissecting needle and microscope, coverslips were carefully put on the slides.

IDENTIFICATION AND PHOTOGRAPHS

The specimens were then identified using the morphological characters such as color, absence or presence of nodes on petiole, antennal segments, shape of thorax and abdomen under light microscope. The ants were classified into subfamilies, genera and then species by using keys described in "Urban ants Identification" and "The Ants" by Bert Holldobler, Wilson. Identified specimens were also matched to pictures found online on ant wiki (www.antwiki.org) and ant web (www.antweb.org). Microscopic pictures of ant's different body parts were taken by Samsung A10 camera mobile

SPECIES DIVERSITY INDICES

To calculate the species diversity indices of ants, living indoor and outdoor habitats of Kuchlak study area, Shannon Wiener diversity index (1949) is used as follow.

$$H= -\sum[(pi)\times\ln(pi)]$$

H = Species diversity index, Σ = sum of the calculations, Pi = proportion of each species in the sample, ln= natural log

RESULTS

A total 1056 ants were collected from the study area. All the species were based on the worker caste and reported for the first time in Kuchlak area.

Table I showing the collected ants were classified in to 10 species within 9 genera which belonged to 3 subfamilies (Myrmicinae, Formicinae and Dolichodenae) from family Formicidae. These species were identified on the bases of their color, size, segments and type of antennae and number of nodes on the petiole.

Table I. Classification of ant species with common names sampled in Kuchlak

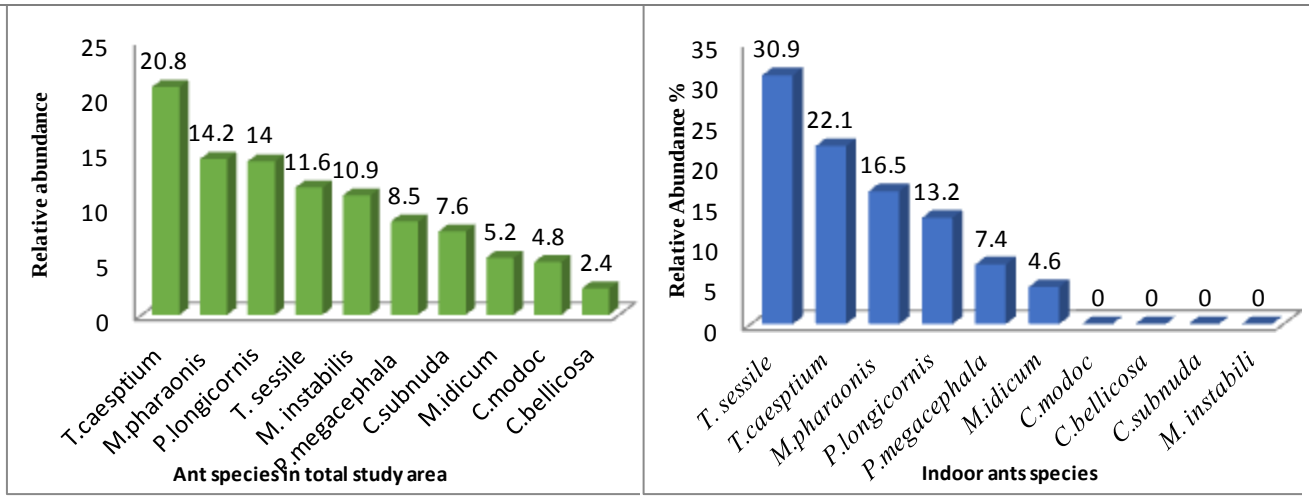
S. no.	Class	Order	Family	Sub families	Genus	Species	Common name
1	Insecta	Hymenoptera	Formicidae	Myrmicinae	Tetramorium	Caesptium	Pavement ant
2					Monomorium	Pharaonis	Pharaoh ant
3					Pheidole	megacephala	Bid headed ant
4					Messor	instabilis	Harvester ant
5					Crematogaster	subnuda	Broad acrobat ant
6					Monomorium	indicum	Unknown
7				Formicinae	Paratrechina	longicornis	Crazy ant
8					Camponotus	modoc	Western Carpenter ant
9					Cataglyphis	bellicosa	Desert ant
10				Dolichoderinae	Tapinoma	Sessile	Odorous ant
Total	1	1	1	3	9	10	10

The total percentage values of species were collected from the study area (Table II). The richest subfamily that was found during the study is Myrmicinae (67.2%) with 6 species followed by subfamily Formicinae (21.2%) with 3 species and the least abundant was Dolichoderinae (11.6%) with single species. The overall percentage of Ants species was (100%) as follow.

Relative abundance of ant species represents the evenness of distribution of individuals among the species in total study area. Relative abundance of *Tetramorium Caesptium* (20.4%) was high while the other species are more or less even in study area (Fig. 2a).

Table II. Abundance values of ant species with their subfamilies in total study area

S. no.	Sub families	Species	No. of individual collected	Percentage	Abundance
1	Myrmicinae	Tetramorium Caesptium	220	20.8%	67.2%
2		Monomorium pharaonis	150	14.2%	
3		Pheidole megacephala	90	8.5%	
4		Messor instabilis	115	10.9%	
5		Crematogaster subnuda	80	7.6%	
6		Monomorium indicum	55	5.2%	
7	Formicinae	Paraterchinia longicornis	148	14%	21.2%
8		Camponotus modoc	51	4.8%	
9		Cataglyphis bellicosa	25	2.4%	
10	Dolichoderinae	Tapinoma sessile	122	11.6%	11.6%
Total	3	10	1056	100%	100%



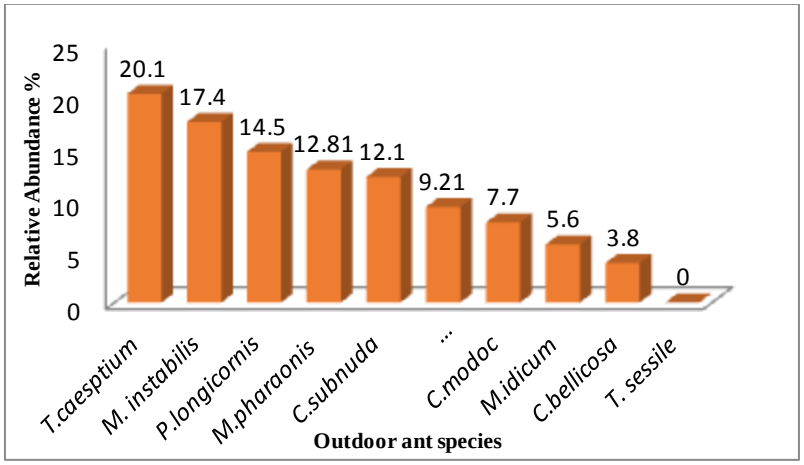


Fig. 2 (a). Relative abundance of ant species distributed in total study area;. **(b).** Relative abundance of indoor ant species; **(c).** Relative abundance of outdoor ant species

Relative abundance of indoor and outdoor ant species to know their endemic nature related to each habitat. We found that Tapinoma sessile (30.9%) was most dominant within indoor ant species followed by Tetramorium Caesptium (22.1%) while Camponotus modoc, Cataglyphis bellicose, Messor instabili and Crematogaster sbnuda were completely absent. Among the outdoor species Tetramorium Caesptium (20.1%) was the most dominant followed by Messor instabilis (17.4%) while Tapinoma sessile is completely absent (Fig. 2b and Fig. 2c). Ant species are listed and the complete counts of indoor and outdoor ant species numbers are presented in Table III.

Table III. Shannon diversity index calculations

	Species	Frequencies		Pi1	Pi2	InPi1	InPi2	Pi1 x InPi1	Pi2 x InPi2
		indoor	outdoor						
1	T.caesptium	87	133	0.23	0.19	-1.46	-1.66	-0.33	-0.31
2	M.pharaonis	65	85	0.17	0.12	-1.77	-2.12	-0.30	-0.25
3	P.megacephala	29	61	0.07	0.08	-2.6	-2.52	-0.18	-0.20
4	M. instabilis	0	115	0	0.16	0	-1.83	0	-0.29
5	C.subnuda	0	80	0	0.12	0	-2.12	0	-0.25
6	M.idicum	18	37	0.04	0.05	-3.21	-2.9	-0.12	-0.14
7	P.longicornis	52	96	0.13	0.14	-2.04	-1.96	-0.26	-0.27
8	C.modoc	0	51	0	0.07	0	-2.65	0	-0.18
9	C.bellicosa	0	25	0	0.03	0	-3.50	0	-0.10
10	T. sessile	122	0	0.32	0	-1.13	0	-0.36	0
Total		373	683					-1.55	-1.99

Result is H_1= 1.55 < H_2= 1.99 shows that outdoor ant species diversity is higher than the indoor. To calculate the species diversity indices of ants living indoor and outdoor habitats, Shannon Wiener diversity index (1949) is used as follow:

Species evenness will tell us how evenly Ant species are distributed in a designated sites or the relative abundance of each Ant species in an area. We calculate the ant species evenness for both type indoor and outdoor habitats by using Shannon Equitability Index as follow.

i. $E_H = H / ln(S)$

H=Shannon diversity index, *ln*= natural log, S=Total number of species

E_{H1} = 1.55/ ln (6) = 1.55/1.79 = 0.86

E_{H2} = 1.99/ ln (9) = 1.99/2.19 = .0.90

Result is E_{H1} = 0.86 < E_{H2} = *0.90* shows that outdoor ants species evenness is greater than the indoor ant species evenness.

Margalef's index (Margalef, 1958) is used to measure species richness. Calculation for indoor and outdoor Ant species richness is as follow.

ii. Margalef's index = S-1/ ln (N)

S= Number of species, ln= natural log, N= Total number of individual

Margalef's index$_1$ = 6-1/ln (373) = 5/5.92 =0.84

Margalef's index$_2$ = 9-1/ln (683) = 8/6.5 = 1.23

Result is 0.84 <1.23 so outdoor ant species richness is greater than the indoor.

Fig. 3 showing rank abundance curve of ant species and their distribution pattern in the total study area. Single species (Tetramorium Caesptium pi= 0.21) is most dominant and apart from that other ant species that present in the study area are more or less even. More equally species are in proportion to each other means greater the evenness of the site.

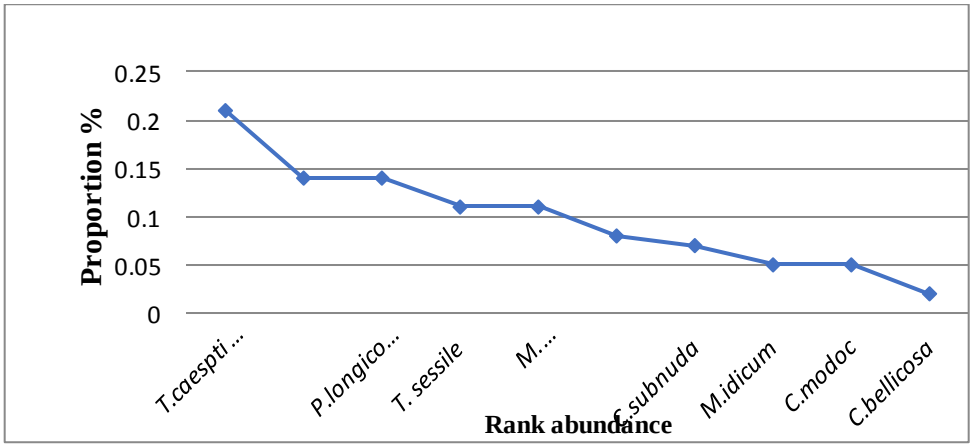


Fig. 3. Rank abundance curve of ant species present in Kuchlak.

Illustration of the evenness of Ant species distribution for indoor and outdoor collection sites (Fig. 4). The Ant diversity is more even in outdoor sites and less even within indoor sites. Collected ant species are shown in Fig. 5.

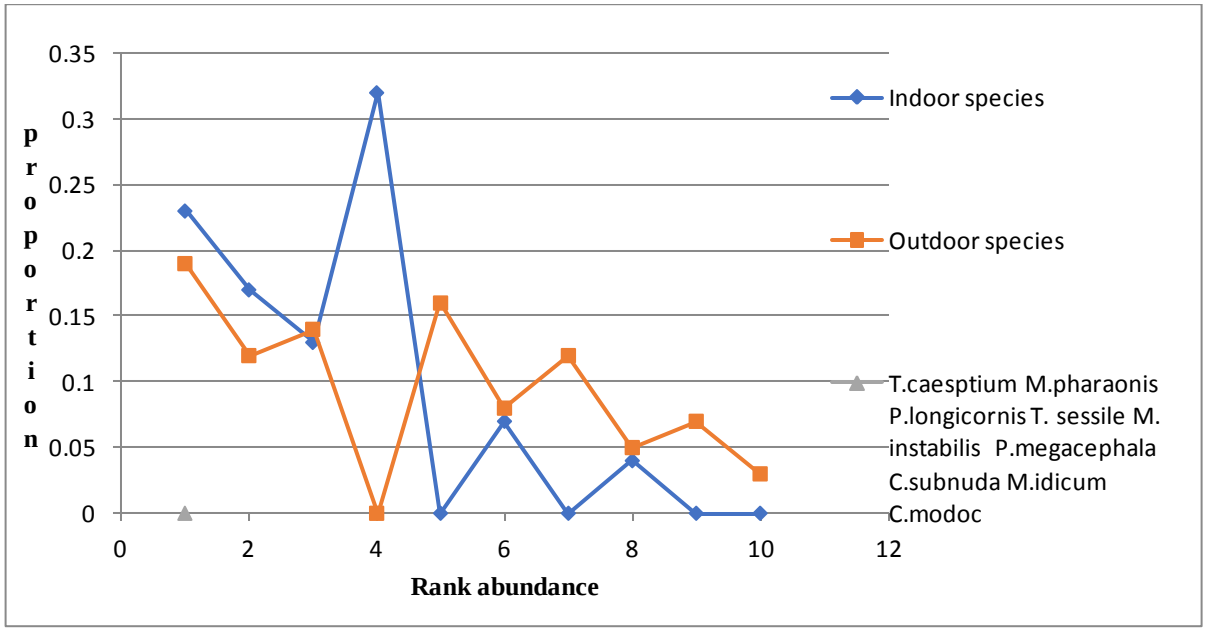


Fig. 4. Rank abundance curve of indoor and outdoor ant species

DISCUSSION

The current study examined small town kuchlak with small number of habitat where the ant species might found this could be the probable reason for reporting only total 10 ant species that belonging to 9 genera within 3 subfamilies as shown in (Table I). All of the ant species were first time recorded from the current research area and highlighting a moderate level of ant species richness in this region. Among the 10 ant species *Tetramorium Caesptium* was the most dominant species in Kuchlak with relative abundance of (20.8%), followed by *Monomorium pharaonis* with (14.2%) and *Paratrechina longicornis* with (14%) while *Cataglyphis bellicose* with (2.4%) is the least common species hardly found in Kuchlak area as shown in (Table. II). Out of 10 ant species reported in our study five of them i.e. Tetramorium Caesptium, *Monomorium pharaonis, Paratrechina longicornis, Camponotus modoc* and Tapinoma sessile were also previously reported by (Ahmed et al., 2013) from Quetta, Pakistan this similarity in species richness is due to same climate and same type of habitat of both study areas. This support the notion that environmental conditions such as humidity, temperature, vegetation play an important role in shaping ants distribution. Distribution patterns of ant species between indoor and outdoor sites revealed notable differences. In this study Indoor habitats were predominantly colonized by Tetramorium Caesptium, Monomorium pharaonis, Pheidole megacephala, Monomorium indicum, and Paratrechina longicornis while Tapinoma sessile present only in indoor collection sites usually these species found from kitchens because these ants usually come indoors seeking of food and sugar. Among them 3 species i.e. Paratrechina longicornis, Monomorium pharaonis, Pheidole megacephala were also reported by (Haji 2008) as indoor species in house ants of Karachi (20) while four ant species in this study included Crematogaster subnuda, Messor instabilis, Camponotus modoc and Cataglyphis bellicose only present in outdoor collection sites, consistent with previous records from similar environment by (Rasheed *et al.,* 2021) (21). In Checklist of Ants in Pakistan listed total 103 ant species under 35 genera within 7 subfamilies (Rasheed *et al.,* 2019) (22).The three subfamilies found from our study area i.e. Myrmicinae, Formicinae and Dolichoderinae (Table I) also listed in Checklist of Ants in Pakistan. Shannon diversity index (H), evenness EH and Margalef's index for species richness of outdoor ant species are as follow 1.99, 0.90 and 1.23 respectively are greater than the indoor ant species 1.55, 0.86 and 0.84 respectively, these values are comparable slightly lower to diversity metrics reported in other parts of Pakistan that are forested or agriculturally richer region such as Punjab and Khyber Pakhtunkhwa.

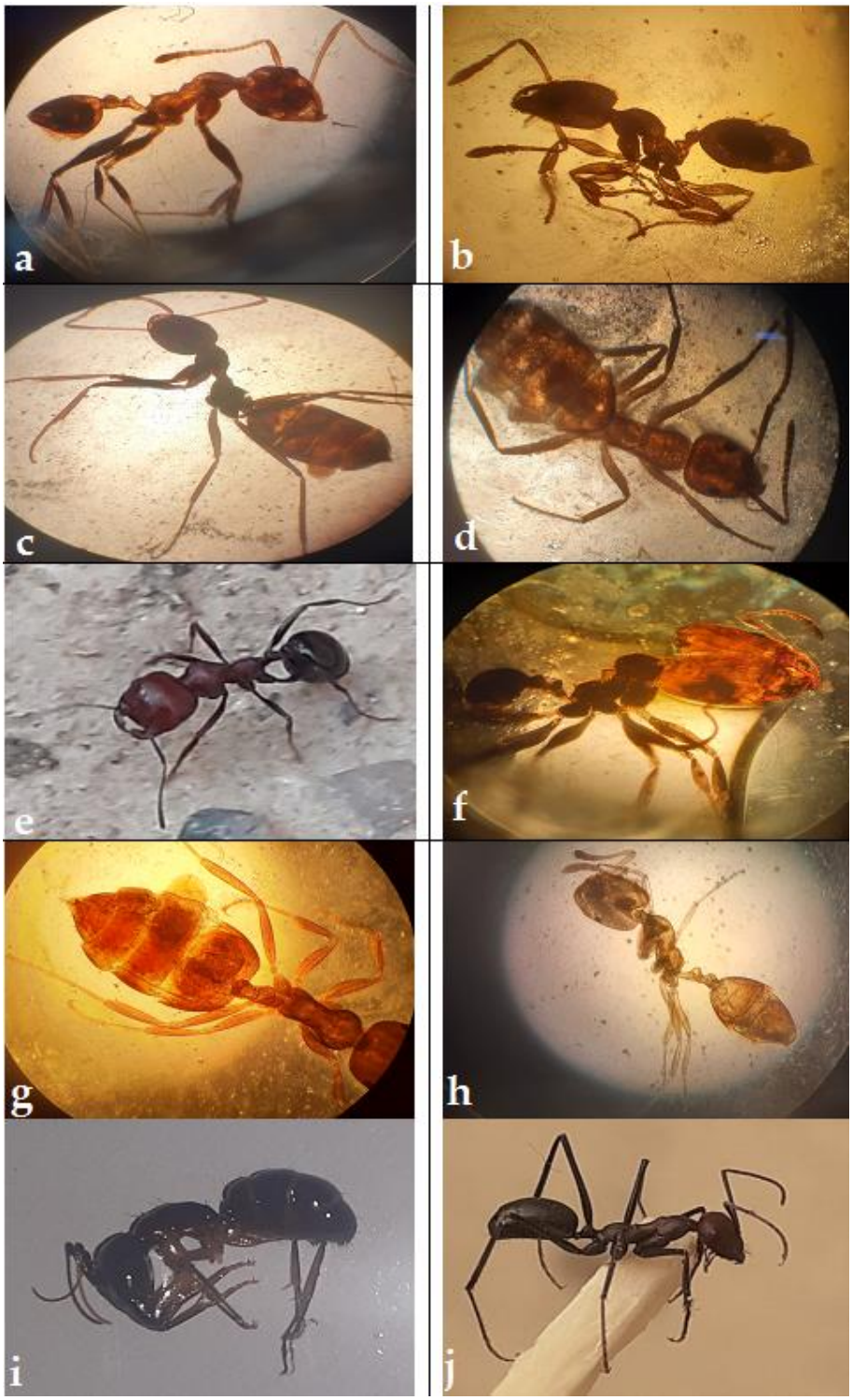


Fig. 5 (a). *Tetramorium Caesptium* (b). *Monomorium pharaonis* (c). *Paraterchinia longicornis* (d). *Tapinoma sessile* (e). *Messor instabilis* (f). *Pheidole megacephala* (g). *Crematogaster subnuda* (h). *Monomorium indicum* (i). *Camponotus modoc* (j). *Cataglyphis bellicosa*

Throughout the country many ant species have been reported as a new country record in ant fauna of Pakistan reported by different scientists (24, 25). Description shows that these species collected from the forest and agricultural area while our study area mostly consist of arid and semiarid habitats so these species were not reported in our study area, due to the differences in habitat and ecological conditions from which the collections were made in.

CONCLUSION

Present research clearly showed the ant diversity in Kuchlak not just highlights the field potential as well as emphasizes the necessity to fully investigate this vital insects group of Pakistan. In the study area Kuchlak ant diversity is extremely high and highly sensitive to human effects. By comparing ant species

diversity indices to indoor and outdoor areas we came to the conclusion that in Kuchlak area the outdoor ant species diversity greater, stable and more evenly distributed than the indoor ant species diversity which is lower, unstable and less evenly distributed. This study indicates that the green grasses, bushes and trees help to maintain ant's niche and ecology to some extent thus generally species richness increases as vegetation increase and decrease as disturbances increase. Present study shows that diversity of the ant species resist with human interferences. This research can be helpful for understanding the ant diversity that not only has ecological significance but can also aid in pest management and conservation planning in rapidly urbanizing regions.

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