Taxonomy of Some Ants Species Collected in Khartoum State.

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DEDICATION

To my parents and sisters whose love and support sustained me throughout

To my big family

To my teachers everywhere

To all those whom I love.
ACKNOWLEDGEMENTS.

I extend my thanks to my supervisor Dr. El Tigani Mohammed Hassan Allam, for his continuous help and support, for suggesting the project and for giving appreciated advice throughout the project course.

I also want to thank Miss Awaif K.O. El Hag for her help and support.

I would like to express my gratitude to Department of Zoology for providing materials and equipments which were needed in the research.

This project was carried out in the Schistosoma research laboratory at the Department of Zoology, Faculty of Science, University of Khartoum.
ABSTRACT

A survey was carried out to collect ants at different sites in Khartoum State during the hot summer months of May, June and the July. Only seven ant species were found and these were identified, using morphological characteristics, and classified taxonomically into three subfamilies of the Formicidae.

The literature on Sudanese ants was surveyed and it showed only a few patchy studies, therefore, there is need for more research on ants of the Sudan.
الخلاصة

أخبر مسح لجمع أنواع النمل من عدة مناطق من ولاية الخرطوم في شهر مايو، يونيو، ويليو. جمعت فقط سبعة أنواع من النمل صنفت هذه الأنواع تحت ثلاث عوائل من عائلة النمل Formicidae.

أوضح دراسة الأدبيات أن هناك دراسات قليلة عن نمل السودان لذلك يجب إجراء المزيد من الدراسات لأنواع النمل في السودان.
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CHAPTER ONE
INTRODUCTION AND LITERATURE REVIEW

The earliest known specimens of ants were found buried in the Scandinavian Baltic Amber samples which scientists date in upwards of 100 million years old. These primitive samples have evolved into the 5000 to 10000 species known today which vary amongst themselves as widely as the numbers suggest. These remarkably adaptive creatures are found in some form on all continents and all habitats but the extreme arctic. Their success is manifested in the claim that at any time there are at least 1 quadrillion living ants on earth (Holldobler and Wilson 1990).

1.1. Social Organization

All species of ants are social. They live in organized communities or colonies, which may contain anywhere from a few hundred to more than 20 million individuals. These are organized into a complex system which may contain two or more castes and sub castes which can be roughly organized into three groups: queens, males and female workers. (Oster and Wilson 1978):

a) A queen or in some cases a number of queens. A queen is a fertile that lays eggs and controls the colony by producing certain pheromones. The queen is usually, the mother of all individuals in the colony.

b) A few fertile males who fertilize the queen.

c) A large number of infertile wingless female workers and/or soldiers. The number of individuals may reach million in some of the larger colonies and they may be in different size groups known as minor, median and major.
The queen is much larger than the other ants, and has wings. Her primary task is to lay eggs for the colony. Some colonies have one queen, others have many. Queens develop from fertilized ordinary eggs that are given a special diet in the larval stages. Queens have an extended life span of up to twenty-five years and can lay millions of eggs in that time.

Male ants are winged as well; their sole purpose is to mate with the queens. For this reason they are the shortest lived ants in the colony. As in all Hymenoptera, they are formed from non-fertilized eggs.

The majority of the ants in the colony are wingless females who are generally non-reproductive. These workers must perform the tasks of sustaining the colony and all life therein. They are responsible for building, repairing, and defending the nest, and for caring for the queen and the brood.

In polymorphic species, where the workers vary in size, the worker sub casts are most distinguishable. Here there is found a larger or major worker often referred to as a soldier. Her function is often associated with specialization such as guarding the colony, carrying heavy loads, or in species where necessary, foraging for food. While the minima or smaller workers tend the larvae and queen.

1.2. Breeding Season

Once or twice each year, commonly at the beginning of the rainy season, young alates fly out of the colony. The flight of the winged males and females of colonies of the same species are usually synchronized so that pairs are made from males and females of different colonies. This helps with cross breeding. After mating the pair usually dig a small hall where the female lays eggs that hatch into workers that start building the colony and feed their parents.

The morphology of an ant's body is shown in Plate I. The body is divided into three tagmata which are the head, thorax, and abdomen. On the head are antennae, eyes, and mouth parts. The tiny feeler like antennae enables the ant to touch, taste, smell and sense vibrations. These antennae are also used to help the ants communicate with each other.

All worker ants have two compound eyes, these are made of many visual units set close together. Males and queens do not, however, need such a complex system. They have three simple eyes or ocelli on the top of their heads which can distinguish between light and dark.

The head is prognathous with two primary mouth parts the mandibles and the maxillae. The mandibles are used for chewing food, fighting, digging and carrying objects. The smaller maxillae are used for chewing food. On the front of the maxillae is a row of tiny hairs which operate like a comb to clean the legs and antennae.

The thorax has three pairs of legs and wings in allate forms. Two tiny hooks on each leg enable the ant to climb vertically and upside down.

The abdomen is made of three main parts: the waist like petiole, the postpetiole and an enlarged segment which is called the gaster. The petiole is made up of one or two movable segments with humps on top and connects the gaster to the thorax. An ant's gaster contains a crop and intestine. Some varieties may also contain a poison gland, filled with formic acid that can be sprayed at enemies. This substance has proven very useful to people as it may be used as an insecticide, antibiotic, preservative, and disinfectant. Ants were originally the sole industrial source but it can now be artificially produced. Contact with minimal doses of the
ants product is not harmful to humans but the mass doses of thousands can suffocate a person. (Holldobler and Wilson 1990).

1.4. Feeding

Various species feed on plant seeds, nectar, honey-dew secreted by sap-sucking insects, and fungi, but most are general or specialized carnivores that can feed mainly on other invertebrate animals. A few specialized in preying on other ants. Some are scavengers that feed on dead animal and plant material. Various ant species have specialized behavioural adaptations such as culture of fungi, seed harvesting, herding and milking of aphids and other plant sucking bugs and social parasitism or slave making (Awatif Khidir 2005).

1.5. Communication.

Ants need to be able to communicate for an array of reasons (Holldobler and Wilson 1990).

The majority of communication seems to be chemical. Ants also tap each other, feel each other out with their antennae, and straddle each other to give certain messages, and grasp and stroke each other as well. One gland, the pygidial gland on the gastor, is used to lay down trails for the same individual or for others to follow in the same track. It also seems to be used to warn colony members of danger and as a pheromone to attract fellow foragers to food sites. In fire ants, the Dufour's gland is the source of trail-laying chemicals. Some trail pheromones can last several days. In leaf cutter ants, they may create a main trunk trail leading away from the colony only to branch out in several directions a short distance later. They continue to branch out like arteries to capillaries until single ants are foraging for leaf material. When they obtain their
leaf fragment, they turn around follow their pheromone trail back along the path to the main trunk and then the colony (Holldobler and Wilson 1990).

1.6. Family Formicidae:

Formicidae are social Hymenoptera with a wingless female worker caste and winged male and female reproductive castes that live in colonies. (Awatif Khidir 2005)

1.6.1. Main Differential Anatomical Features of Formicidae:

The head is progranulous in female castes (worker and queens).

Antennae have 4 to 12 segments in the female castes and 9 to 13 segments in males. The antennae are elbow shaped bent between the long basal segment and remaining distal segments.

The second abdominal segment is reduced, forming a node or a scale known as the petiole isolated from the alitrunk in front and the remaining abdominal segments behind.

Frequently the third abdominal segments is also reduced an isolated and known as the post-petiole. Wings of queens are deciduous and usually shed after mating. (Bolton 1994)
1.7. Taxonomy

The classification of ants is as follows:

Order: Hymenoptera, Family Formicidae, divided into approximately three hundred known genera and approximately 14000 identified species.

Forel (1878) divided the family Formicidae into five subfamilies, Camponotinae, Dolichoderinae, Dorylinae, Ponerinae and Myrmicinae. These remained unchanged for many years. However, the Camponotinae had its changed later to Formicinae by Wheeler (1920). Bolton (1994) lists 16 subfamilies in the Formicidae. The new eleven subfamilies were based by splitting the original five subfamilies or by the discovery of new species that constitute subfamilies unknown to the early classifiers. Living ants are currently classified into twenty six subfamilies and 439 genera (after Bolton, 2005).

1.7.1 The Classification and Origin

Known living ants are classified into twenty six subfamilies, approximately 439 genera and possibly 11,700 species are described according to Bolton World Catalog. The number of known species is far below the number exist? This is because the number of non described species is enormous especially in the tropics. Overall, it’s quite possible that 20,000 or more species of ants, including as many as 300 genera, exist in the world (Holldobler and Wilson 1990).

The taxonomy of the world ant fauna is still very incomplete. There are a few useful regional monographs such as Creighton’s (1950) review of the ants of North America and North Mexico. Ant larvae have been described by Wheeler and Wheeler (1951, 1986) with a supplementary supplied Picquet (1958).
Plate 1. Morphological Features of a Generalized Ant
<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anochetus traegaordhi</td>
<td>Human houses</td>
</tr>
<tr>
<td>Pachycondyla semaarensis</td>
<td>River bank vegetation</td>
</tr>
<tr>
<td>Lepisiota semenovi</td>
<td>University farms vegetables</td>
</tr>
<tr>
<td>Cataglyphis desetorum</td>
<td>Farm in semi desert area</td>
</tr>
<tr>
<td>Crematogaster mornose</td>
<td>Acacia nilotica</td>
</tr>
<tr>
<td></td>
<td>Forest reserve</td>
</tr>
<tr>
<td>Monomorium biocolor</td>
<td>Acacia nilotica</td>
</tr>
<tr>
<td></td>
<td>Forest reserve</td>
</tr>
<tr>
<td>Paratrechina longicornis</td>
<td>Khartoum university</td>
</tr>
<tr>
<td></td>
<td>Main campus</td>
</tr>
<tr>
<td>Lepisiota gracilicornis</td>
<td>Desert area</td>
</tr>
<tr>
<td>Camponotus (orthonomomyrmex)</td>
<td>University farms vegetables</td>
</tr>
<tr>
<td>sericues</td>
<td></td>
</tr>
<tr>
<td>Camponotus (myrmopiromis)</td>
<td>University farms vegetables</td>
</tr>
<tr>
<td>nvesetosus</td>
<td></td>
</tr>
<tr>
<td>Camponotus sp5</td>
<td>Trees and garden plants from all regions of the Sudan</td>
</tr>
<tr>
<td>Monomorium arenphelium</td>
<td>Khartoum university main campus</td>
</tr>
<tr>
<td>Monomorium destructor</td>
<td>River bank vegetation</td>
</tr>
<tr>
<td>Monomorium mayri</td>
<td>Mix farm (vegetation cattle, furite and cattle farm)</td>
</tr>
<tr>
<td>Teramorium serveventire</td>
<td>Khartoum university</td>
</tr>
<tr>
<td></td>
<td>Main campus</td>
</tr>
<tr>
<td>Pheidole pallidula</td>
<td>University farms vegetables</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pheidole sinatitiva(major worker)</td>
<td>Farm in semi desert area</td>
</tr>
<tr>
<td>Pheidole indica</td>
<td>Mix farm (vegetation cattle, furite and cattle farm)</td>
</tr>
<tr>
<td>Pheidole sinatitica(minor worker)</td>
<td>Desert area</td>
</tr>
<tr>
<td>Cardiocondyla emeryi</td>
<td>Acacia nilotica</td>
</tr>
<tr>
<td></td>
<td>Forest reserve</td>
</tr>
<tr>
<td>Cardiocondyla elegans</td>
<td>Acacia nilotica</td>
</tr>
<tr>
<td></td>
<td>Forest reserve</td>
</tr>
<tr>
<td>Camponotus oasium</td>
<td>Khartoum university main campus</td>
</tr>
<tr>
<td>Cataglyphis lividus</td>
<td>Desert area</td>
</tr>
<tr>
<td><strong>Camponotus (tanaemyrmex) maculatus</strong></td>
<td><strong>River bank</strong></td>
</tr>
<tr>
<td><strong>Camponotus sp6</strong></td>
<td><strong>Khartoum university main campus</strong></td>
</tr>
</tbody>
</table>
CHAPTER TWO
MATERIALS AND METHODS

2.1. Collection Sites.

Samples of ants were collected from different sites in Khartoum state.

The locations were:

1. The Blue Nile River left Bank opposite the University of Khartoum Main Campus.
2. The Khartoum Sunut (Acacia nilotica) Forest on the East bank of the White Nile.
3. Forestry Research Station at Soba.
5. Khartoum North Haj Yosif District.
6. Omdurman, from the family house at Wad Nubawi south of Sheik Gareeballa Mosque.
7. The University of Khartoum Main Campus.

2.2 Specimen Collection.

Ant specimens were collected manually using a paintbrush moistened with 5 % formalin or by using a fine forceps. The collected specimens were dropped and preserved in glass tubes containing 7 % formalin. Then the specimen examined under a microscope. Collection was performed during the daytime usually between 9 a.m. and 5 p.m. The site of collection and the date of collection were recorded for each sample.
Baits consisting of sugar, dry bread, and sweet drops were used for specimen collected at home at Wad Nubawee.

2.3 Key used in identification.

Taxonomic categorization of ant specimen was done following Bolton Key (2005).
CHAPTER THREE
RESULTS

3.1 Ant diversity in Khartoum:

During the current survey, seven species were found in the study areas:

2. *Camponotus maculatus* (Fabricius 1781)
3. *Cataglyphis desertorum* (Forel 1894).
4. *Lepisiota gracilicornis* (Forel 1892).
5. *Paratrechina longicornis* (Latreille 1802).
7. *Monomorium arenophilum* (Santschi 1911).

The small number of species found was possibly due to hot dry conditions at the time of collection during the months of May, June and July. The seven species were classified into three subfamilies:

1. The Myrmicine with 2 species
2. The Formicinae with 4 species
3. The Ponerinae with 1 species.
Table 2: Species of ants found in Khartoum State.

<table>
<thead>
<tr>
<th>Subfamily and species</th>
<th>Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>River Bank</td>
</tr>
<tr>
<td>1. Subfamily: Ponerinae</td>
<td>*</td>
</tr>
<tr>
<td><em>Pachycondyla semnaarenensis</em></td>
<td></td>
</tr>
<tr>
<td>2. Subfamily: Formicinae</td>
<td>*</td>
</tr>
<tr>
<td><em>Camponotus maculatus</em></td>
<td></td>
</tr>
<tr>
<td><em>Cataglyphis desertorum</em></td>
<td></td>
</tr>
<tr>
<td><em>Lepisiota gracillicornis</em></td>
<td></td>
</tr>
<tr>
<td><em>Paratrechina longicornis</em></td>
<td></td>
</tr>
<tr>
<td>3. Subfamily: Myrmicinae</td>
<td>*</td>
</tr>
<tr>
<td><em>Monomorium bicolor</em></td>
<td></td>
</tr>
<tr>
<td><em>Monomorium arenophilum</em></td>
<td></td>
</tr>
</tbody>
</table>
3.2. Geographic distribution of Ant species collected in Khartoum State.

Unlike absolute abundance, the diversity of ant species did not show considerable variation among the different locations surveyed in Khartoum.

3.3. Subfamily: Myrmicinae

3.3.1. Genus: Monomorium

3.3.1.1. Characteristics

1- Antennae eleven or twelve segmented.
2- The median portion of clypeus was distinctly raised.
3- The postpetiole node was less voluminous than the petiolic node in profile and was narrowly attached to the gaster.
4- Propodeum was usually unarmed.

3.3.1.2. Monomorium bicolor (Emery 1877)

The dorsal part of the propodeum had a slight shallow cavity (Plate I). The head and alitrunk were red to bright orange-yellow in color and the gaster was black. This species was very common in houses, stores and farms and considered as a domestic pest.

This species was found in River Bank, Amlak-locality, Haj-yosif and Wad Nubawi.
3.3.1.3. *Monomorium arenophilum* (Santschi 1911)

The ventral aspect of the head had always a few projecting hairs (Plate II). This species had the second largest distribution in Khartoum State and is considered as a pest in houses, stores and farms. This species was found on River Bank, Amlak-locality, Haj-yosif and Wad Nubawi.

3.4. Subfamily: Formicinae

3.4.1. Characteristics

In this subfamily four genera and four species were found:

3.4.1.1. Genus: *Componotus*

3.4.1.2. Characteristics:

Camponotus is a polymorphic genus, which is characterized by the following:

1- Antennae 12 segmented and inserted at a distance behind the posterior clypeal margin.

2- The petiole has a node or a scale which was never armed with teeth or spines.

3- The propodeum was unarmed.

4- The gaster was not capable of reflexion.

3.4.1.3. *Camponotus maculatus* (Fabricius 1781)

Thorax with yellow underside – legs and petiole yellow (Plate III).

Yellow transverse patches on gaster appear as a row of two or three pale spots; subcephalic hairs numerous.

This species was found on the Blue Nile River Bank, Soba and Wad Nubawi.
3.4.2. Genus: Catalaphis

3.4.2.1. Characteristics

1. The metapleura have a distinct wide orifice for the metaplural gland which is situated above the hind coxa and below the level of the propodeal spiracle.

2. Propodeal spiracle an elongate or near-vertical slit.

3. Ocelli present.

4. First gasteral sternite in ventral view with a transverse sulcus immediately behind the helcium.

Members of this genus seemed to prefer dry desert and semi desert localities and were usually found moving on the surface of the ground even in the hot mid-day when the ground temperature was very high. The local name for members of this genus (kalb alhar = sun dog) refers to this habit.

3.4.2.2. Cataglyphis desertorum (Forel 1894).

The workers had long legs and were very dark red in color. They have well-developed spines on the tibiae.

This species was found on the River Bank, Soba and the University Of Khartoum.

3.5.1. Genus: Lepisiota

3.5.1.1. Characteristics

1. Antennae were formed of eleven segments.

2. Propodeum was armed with pair of spines, a pair of teeth, or a pair of tubercles.
3. The dorsal edge of petiole was usually armed with a pair of teeth or pair of spines.

3.5.1.2. *Lepisiota gracilicornis* (Forel 1892).

The propodeal spines were short. Alitrunk was long thin and the antennal scapes were twice as long as the head width (Plate IV).

This species was found on the Blue Nile River Bank, Soba, Haj-Yosif and the University Of Khartoum.

3.5.2. Genus: *Paratrechina*

3.5.2.1. Characteristics

1. Ocelli were absent.
2. First gasteral sternite immediately behind the helicium entire, without a transverse sulcus.
3. Eyes large and very conspicuous.

3.5.2.2. *Paratrechina longricornis* (Latreille 1802).

The antennal scapes were very long, extending as far as the mesonotum. The general body color was brown to black (Plate V). The eyes were large and the legs were long. The petiole was low.

This species was found in Sunt Forest, Soba, Haj-yosif, and University Of Khartoum.
3.6. Subfamily: Ponerine

One genus was recorded from this primitive subfamily.

3.6.1. Genus: Pachycondyla

3.6.1.1. Characteristics

1. The mandible was armed with five or more teeth.

2. Helcium was located very low on the front of the first gasteral segment so that the first gasteral segment had a long vertical anterior face in profile.

3. The tibiae of middle and hind legs had each one large pectinate spur and another small, simple spur.

3.6.1.2. Pachycondyla sennaarensis (Mayr 1862).

The workers of this ant have a deep mesopropdeal furrow and their mandibles have a dorsolateral pit (PlateVI). The eyes were relatively large. The overall body color was black and the appendages had a deep red-brown color. This species is famous for its painful sting especially the winged reproductive females, which were common during the early rainy season. This species was found on all collection sites and is famous for the painful sting of workers and that of the winged females during their reproductive flight at the beginning of the rainy season.
CHAPTER FOUR

Discussion

During the current study, a preliminary survey has been made for ant species in the vicinity of Khartoum. Seven species were identified from the Khartoum area. The species recorded belong to three subfamilies: Myrmicinae with two species, Formicinae with four species, Ponerinae with one species. The survey covered a period of three months (May, June and July), thus, the seasonal variation in Ant diversity and abundance is out of the scope of this study.

Ant diversity in Khartoum has been investigated previously by (Awatif Khidir 2005) who found twenty five species. The larger number of species collected in the previous study compared to the current one is likely to result from the larger scale of sampling in the former, both in time and in space.

When compared to other ant species, the two species Pachycondyl senacaurenis and Monomorium were apparently the most abundant in Khartoum. This is consistent with the finding of the previous study (Awatif Khider, 2005). On the contrary, the previous study reported that Tetramorium was extremely abundant in Khartoum, but it was completely absent from the present collection. The disappearance of this species is, to some extent, mysterious, but it may be related to its seasonal cycle of abundance. Since the abundance of ants follow strong seasonal cycles, it is possible that this collection has missed the peak abundance of the species.

Monomorium species are famous for their ability to form new colonies anywhere they can find a suitable cover such as under a about 20% of every established colony is formed of secondary reproductives or fertile females, which cannot be differentiated externally from ordinary workers.
Pachycondyla senaarensis are very well known because of their painful stings especially those delivered by winged reproductive females when the swarm at the beginning of the rainy season. This species needs further work to investigation the long-lasting painful venom they inject in people.

The species Camponotus malcatus (sugar ant) may transfer diseases through their feeding on sweet food.
Plate I. *Monomorium bicolor* (http://www.antweb.org)

Plate II. *Monomorium arenophilum*. (http://www.antweb.org)
Plate III. *Camponotus maculatus* (http://www.antweb.org)

Plate IV. *Lepisiota gracilicornis* (http://www.antweb.org)
Plate V. *Paratrechina longicornis*  
(http://www.discoverlife.org/20/q?search=Paratrechina+longicornis)

Plate VI. *Pachycondyla sennaarenis* (http://www.antweb.org)
REFERENCES


Websites:

http://www.antweb.org

http://www.discoverlife.org/20/q?search=Paratrechina+longicornis
Appendix

Collection sites of Ants in Khartoum state.

Wad Nubawee

University of Khartoum and Nile Street