African Journal of Biological Sciences

Systematics and biometrics Study on the *Culicidian fauna* (Diptera: Culicidae) in the region of Ain Touila, northeast Algeria

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Abstract: the present study aimed to deepen our knowledge of the specific diversity of the *Culicidian fauna* on the outskirts of Ain Touila, district of Khenchela (Northeast of Algeria), over a very limited period, using a light trap sampling method to capture adult mosquitoes.

The identification of the targeted species was conducted via observation under a microscope in addition to the use of the software of the Culicidae of Mediterranean Africa established by the IRD of Montpellier, France. Several morphometric variables were considered for adult females. Biometrics was evaluated using length and width measurements based on specific criteria: antennae, wing, paw1, and abdomen and compared the studied species. This inventory revealed the existence of 51 individuals belonging to 9 species of the Culicidae family:

- One common species: *Culiseta longiareolata* (15 individuals)

- Six rare species: *Orthopodomiya pulcripalpis* (5 individuals), *Aedes esoensis rossicus* (8 individuals), *Aedes aegypti* (6 individuals), *Culiseta ochroptrea* (6 individuals), *Uranotaenia unguiculata* (4 individuals), *Aedes vexans* (3 individuals),

- Two very rare species: *Culiseta morsitans* (2 individuals) and *Culex brumpti* (2 individuals).

Keywords: Systematics; Biometrics; morphometric*; Culicidian fauna*

Introduction

Conservation of biodiversity requires authentic knowledge of the distribution of fauna and flora. Among this fauna, insects, which belong to the arthropods branch and represent more than 50% of the diversity of the planet (Wilson, 1988) and nearly 60% of the animal kingdom (Pavan, 1986), are receiving increasing research importance.

The Culicidae are probably the best known and most feared among the various groups of blood-sucking insects for a variety of reasons, such as disease transmission and the nuisance generated by their proliferation in touristic areas. These reasons, among others, make it crucial to conduct campaigns to fight these threating species (Schaffner et al., 2001).

The fierce fight against diseases transmitted by mosquitoes in both terrestrial and aquatic media sheds light on these arthropods, making them an important study material for biologists.

Mosquitoes are ubiquitous insects that can be found in almost every type of climatic region worldwide, from the Arctic to the tropics. They survive harsh winters or dry seasons depending on their habitat. According to the species, they can thrive in all types of puddles, from heavily polluted lakes to clean rivers, and from small accumulations of water in tin cans to ponds and streams. Their distribution is amplified and eased by air travel and the introduction of non-native species into new territories. Infected mosquitoes have been transported to temperate climates, transmitting tropical diseases.

Culicidae's systematics can be studied using dichotomous keys that allow the identification of species based on a very precise set of criteria and microscopic descriptors.

The region of Khenchela is unexploited on the whole as far as fauna is concerned and in particular from an entomological viewpoint. Our objective focuses on remediation, at least in part, of this deficiency by first attempting to compile an inventory of mosquitoes in certain stations in the Wilaya of Khenchela. The morphometric study involved all sampled species, including four structures, characterizing adult females. A comparison was made between all harvested species.

1. Materials and methods

1.1. Geographical location

The wilaya of Khenchela is located in northeastern Algeria in the Aures region. It occupies a geographical position between the steppe chain and the highlands, which gives it an agro-pastoral and Saharian forest character. It is surrounded by the districts of Oum El Bouaghi in the east, Batna and Biskra in the west, El Oued in the south, and Tebessa in the east. It occupies an area estimated to be 971,000 hectares. The Khenchela region has GPS coordinates of 35°26′08″ North and 7°08′35″ East with an altitude of 1128 m. It involves 21 municipalities and eight departments (Boubelli, 2009).

1.2. Climate

The Khenchela region is part of the Constantine highlands and is characterized by a semi-arid climate with a cold winter and a dry and hot summer with annual rainfall between 300 and 450 mm and an average annual temperature of 14° C (Lamy, 1997).

1.3. Study station:

Ain Touila covers an area of 34,000 ha. It is named in relation to a source of water located in Jabal Awlad Tamrabet, in the north of the commune. This source has a long split stream flowing toward most of the villages. It is the main source that comes from the region of Ras Moussa in the place called "Shu'ba Lakhira". It is characterized by valleys and forests in the high mountains, which contain many types of mosquitoes.

The preliminary study was conducted using documentation collected from forest and municipality services.

1.4. Collection technique

Collection was conducted using CDC (Center for Diseases Control) type light traps. Many Diptera are attracted to artificial light (Matile, 1993)

A miniature light trap of personal manufacture inspired by the CDC-type model (Alexander 2000) but modified and adapted to the conditions of the field was installed inside a small forest full of trees in the presence of water. This place is considered a gathering spot for many types of

adult mosquitoes; hence, it aids the capture of a large number of mosquitoes at night. The

trapping period depends on the objective of the study and the climatic conditions (wind, rain, etc.). According to Seguy (1923), the preparation of adults intended for systematic study is done waterlessly, given that their identification is based mainly on external morphological characters. All organs offer useful characteristics for identification (Seguy, 1951).

To confirm the identification of the species, we placed the mosquitoes on the ventral side under a microscope, and using a pin, we spread the wings and legs to make the observation and identification thanks to the Culicidae identification software of Mediterranean Africa established by IRD Montpellier (Brunhes et al., 2000). Several morphometric parameters were considered for adult males and females: such as the length and width of antennae, wing, legs, and abdomen. (Used Image Tool software).

2. Results and discussion

2.1. Systematic inventory of species recorded in the Ain Touila region:

The adopted capture method allowed us to collect 51 adults of Culicidae. A systematic list of recorded species has been established according to the taxonomic order of Brunhes et al. (2000). It includes nine species belonging to the Culicidae family. The results relating to the numbers of species trapped and the centesimal frequency and abundance are presented in table 1.

Table 1: Number of individuals and percentage frequency of the species

Gender	Species	Number	frequency %	Abundance
	Aedes aegypti	06	11.76	rare species
Aedes	*Aedes esoensis rossicus*	08	15.68	rare species
	Aedes vexans	03	5.89	rare species
	Culiseta longiareolata	15	29.41	common species
Culiseta	*Culiseta morsitans*	02	3.93	very rare species
	Culiseta ochroptrea	06	11.76	rare species
Orthopodomyia	*Orthopodomyia pulcripalpis*	05	9.80	rare species
Uranotaenia	*Uranotaenia unguiculata*	04	7.84	rare species
Culex	*Culex brumpti*	02	3.93	very rare species
	Total	51	100	

The cumulative results in Table 2 show that the species of *Culiseta longiareolata* is the most abundant species with a rate of 29.41%, followed by *Aedes esoensis rossicus* with 15.68 %, *Aedes aegypti* and *Culiseta ochroptera* with 11.76% each and *Uranotaenia unguiculata* with 7.84%.

Table 2: Biometrics of the measurements of female adults of some species (Tool image software)

Species	Kind	Length (µm)	Width (µm)
Culesita longiareolata	Antenna	1810	100
	Leg1	8220	19
	Wing	4440	1340
	Abdomen	4070	650
Orthopodomyia pulcripalpis	Antenna	4310	100
	Leg 1	9600	290
	Wing	4730	1370
	Abdomen	3560	750
Aedes esoensis rossicus	Antenna	4080	100
	Leg1	10690	180
	Wing	7620	1900
	Abdomen	8310	1680
Aedes aegypti	Antenna	2540	90
	Leg1	7810	18
	Wing	4850	1220
	Abdomen	9090	1020
Culiseta ochroptera	Antenna	2970	70
	Leg1	15230	350
	Wing	9560	2450
	Abdomen	5070	880
Uranotaenia unguiculata	Antenna	1830	60
	Leg1	3920	950
	Wing	8270	895
	Abdomen	34709	390
Aedes vexans	Antenna	2930	90
	Leg1	7010	150
	Wing	3860	870
	Abdomen	6020	700
Culiseta morsitans	Antenna	3330	60
	Leg1	19270	370
	Wing	11130	2590
	Abdomen	5450	700
Culex brumpti	Antenna	2130	50
	Leg1	11690	220
	Wing	7380	2070
	Abdomen	3670	800

The other species are represented by small amounts, *Aedes vexans* with 5.89%, followed by *Culiseta morsitans* and *Culex brumpti* with 3.93%.

The inventory highlighted the total and clear dominance of the species *Culiseta longiareolata* (29.4% with 15 individuals) as a widely distributed species (Brunhes et al., 2000); In fact, Boukraa (2009) reported its existence in polluted lodgings, permanent lodgings with stagnant water rich or poor in vegetation, and temporary lodgings with water or running water with or without vegetation. Mahdi et al. (2019) showed that the species *Culiseta longiareolata* is relatively abundant with a rate of 98.50% in the region of Chechar (wilaya of Khenchela). Moreover, Hassaine (2002) found that *Cs. longeoreolata* is considered to be a species with a very wide distribution in Mediterranean Africa with a relative abundance of 24.4%. On the other hand the work of Brunhes et al. (1999); Berchi (2000); Haissaine (2002), and Lounaci (2003) have shown that *Culex pipiens* is the most popular species in Mediterranean Africa.

Ur. unguiculata as a rare species, was encountered in May in a small grassy stretch of water in the urban environment with a frequency of 4.5%. Rebhi (2015) caught these species in Djelfa with an abundance of 0.74%. Boukraa (2009) reported these species in the Ghardaïa region with a relative abundance of 0.58%. Djamai and Touatoua (2017) captured 16 individuals of this species in the Babar region (khenchela).

These results are attributed to the climatic and geographical conditions of the study region:

The average abundance of a stand corresponds to the average number of species found in a region. This parameter has the advantage of being statistically interpretable (Blondel, 1979) and greatly reducing the share taken, in a stand, by rare or accidental species. some inventories have been undertaken in the arid zones of the South, as reported by Bebba (2004) in Oued Righ (Touggourt and Djamâa) and Merabeti (2011) in Biskra, who mentioned 22 species of Culicidae belonging to the six genera (Aedes , Anopheles, Culex, Culiseta, Uranotenia, Orthopodomya).

The analysis of the structure of the Culicidian population in our study region reveals that all living organisms (animals, plants) play a role in the life of Culicidae larvae by providing them with the organic matter essential for their development. These materials can be considered as a

factor stimulating the development of the preimaginal stages, but according to these qualities, they could be harmful and favor the parasitism of certain larval stages (Benkhalfate, 1991).

The number of species individuals depends on the state of health of the female, the food abundance, the climatic conditions and the hatching of the eggs. Culicidae are conditioned by temperature and biological or chemical composition of water. The physicochemical components of water can play an essential role not only in the biology of a species but also in the structure and dynamics of the entire biocenosis (Berchi, 2000). *Cx. pipiens* and *Cs. longiareolata* develop in all types of lodgings, whether artificial or natural. the probability of their presence is high and their power of dispersal is considerable. Their small number can be explained by the location of their breeding sites because they were isolated from human movements.

2.2. Morphometric study

Culicidae generally show distinct morphological characteristics, leading to easy identification of this family. However, their grouping into subfamilies, genus, or subgenus is much more difficult. Only several characteristics determine subspecies and sibling species. Faced with the impossibility of using the morphological criteria used in the key, one must have recourse to other more elaborate techniques. Biometrics is the only way to solve this problem. Our biometric study focused on adult females of all species inventoried in the region and concerned different morphological descriptors like the abdomen, antennae, wings, and paw1.

This biometric study of the harvested species is simple and preliminary compared with the biometric work done due to the time and working conditions. Dahchar (2017) focused on larvae and adult males and females of all the species inventoried in the western region of Annaba on the basis of different morphological descriptors such as the head, antennae, palpi, thorax, abdomen, and three legs with all the segments.

A comparative study of the biometrics of two species harvested from two ecologically and climatically different regions namely Annaba (humid) and Oum El Bouaghi (semi-arid), using statistical analysis by multivariate variance, showed a significant difference in the measurements of adult males and females of *Orthopodomyia pulcripalpis* and a significant difference between adult females and larvae of *Culex laticinctus* (Oudainia 2015).

The biometry carried out by Boudemag (2015) on male and female adults of three species of the genus Culiseta: *Culiseta longiareolata, Culiseta ochroptera*, and *Culiseta glaphyroptera*, showed significant, highly and very highly differences.

3. Conclusion

Algeria is home to a diverse flora and fauna, rich in endemic species thanks to the presence of wetlands, which are very favorable places for the proliferation of many species of mosquito vectors of viral diseases, parasitic or simply generating nuisance.

In the present work, we have attempted to inventory and highlight the species of Culicidae present in the Ain Touila region; for capturing adults using light traps of the CDC (Center for Diseases Control) type

Our study highlighted the presence of nine species and 51 individuals belonging to four genera. The Culicinae subfamily is represented by the genus Culesita with three species, *Culesita longiareolata; Culiseta morsitont, Culiseta ochroptrea* and the genus Aedes with 3 species: *Aedes esoensis rossicus, Aedes vexans, Aedes aegypti* and the genus Culex has only one species *Culex brumpti*. The genus *Orthpodomyia*, has only one species *Orthpodomyia pulcripalpis* and Uranotaenia with one species: *Uranotaenia unguiculatar*.

The morphometric study concerned all the species sampled, including four structures, characterizing male and female adults. A comparison was performed on the collected species. These results can be attributed to the climatic and geographical conditions of the study regions. This information, which would obviously deserve to be reinforced by new field investigations, is important to deepen the studies on the inventory, taxonomy, and biometrics of these organisms, in particular the species at risk of transmission or at the origin of an intense nuisance, to help those in charge to develop a strategy to fight against injurious mosquitoes while always protecting humans.

No conflicts of interests

"We certify that we have no affiliation with or financial involvement with any organization or entity with a direct financial or any other interest in the subject matter or materials discussed in the manuscript."

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