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Soumeya Chahed
Mouloud Mammeri University of Tizi-Ouzou, Algeria, soumeyachahed26@gmail.com

Hania Belkacem
Mouloud Mammeri University of Tizi-Ouzou, Algeria, haniabelkacem@gmail.com

Lynda Boukhari
Mouloud Mammeri University of Tizi-Ouzou, Algeria, lyndaboukhari1996@gmail.com

Karima Brahmi
Mouloud Mammeri University of Tizi-Ouzou, Algeria, karib20032002@yahoo.fr

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Cover Page Footnote

We would like to thank Dr. Nabti Ismahane of the Ahmed Zabana University of Relizane (Algeria) for his help in confirming the Coquillettidia genus.

MOSQUITO SURVEY IN TIZI-OUZOU (ALGERIA NORTHERN): UPDATED INVENTORY WITH NEW REPORTS

SOUMEYA CHAHED[1], HANIA BELKACEM[1], LYNDA BOUKHARI[1], AND KARIMA BRAHMI[1]

[1]*Mouloud Mammeri University of Tizi-Ouzou, Algeria.*

Corresponding Author's email : soumeyachahed26@gmail.com

ABSTARCT

Mosquitoes play an important role in public health, they are responsible for the transmission of pathogens that cause infectious diseases to both humans and animals. The study of this fauna biodiversity is necessary to determine the vector species of diseases. Our inventory of mosquitoes in Tizi-Ouzou province has been updated in this study, it was carried out from April to September, 2021 at 43 breeding sites, spread over ten different communes. The inventory was based on the sampling of larvae and the capture of adults on human bait. The identification of Culicidae inventoried revealed the presence of 14 species belonging to five genera and two subfamilies. We report the first citation of four species for this region, these are *Culex (Culex) laticinctus* Edwards, 1913, *Culex (Culex) mimeticus* Noe, 1899, *Aedes (Ochlerotatus) berlandi* (Seguy, 1921) and *Coquillettidia (Coquillettidia) richiardii* (Ficalbi, 1889). The genus *Coquillettidia* was cited for the first time in Tizi-Ouzou. The data of this study was exploited by the ecological indices in order to have the relative abundance and the frequency of occurrence.

Keywords: Inventory, Mosquitoes, Tizi-Ouzou, Coquillettidia, Algeria.

INTRODUCTION

Mosquitoes are the most important arthropods of medical importance, because of their possibility of transmitting diseases, such as malaria, encephalitis and filariasis. These diseases are caused by pathogens and parasites that they transmit to humans (Azari-Hamidian et al., 2019). Several species of mosquitoes are vectors of zoonotic diseases. *Aedes (Stegomyia) albopictus* (Skuse, 1894) can transmit several viruses that cause serious human diseases (Wang et al., 2021), In particular Dengue, Chikungunya, yellow fever and Zika fever (Ducheyne et al., 2018).

A good knowledge of the Culicidian fauna, by studying its taxonomy and abundance, is very important before carrying out mosquito control. Larval surveys continued to be important for assessing population size and the impact of control measures. A good knowledge of pre-imaginal ecology is essential for understanding mosquito population dynamics (Service, 1993).

The present work aim to make a more extensive inventory of the Culicidae fauna in various stations in Tizi-Ouzou. It was being carried out as part of an updated inventory to deepen our knowledge of the faunal richness of the Culicidae, which can include disease vectors.The results of this study can be used for planning control strategies in this region for future work.

MATERIALS AND METHODS

Presentation of the Study Area

Tizi-Ouzou is located in Algeria Northern (36.70°N/4.05°E, altitude 195m), it is situated in the heart of the Djurdjura massif with a surface area of 2957.94 km2. It is bounded to the North by the Mediterranean Sea basin, to the South by Bouira, to the East by Bejaia and to the

West by Boumerdes. The geographical location of our study area is shown in Figure 1. This location has allowed it to have a variety of landscapes, dominated by mountainous regions and a very important coastal area. The climate of Tizi-Ouzou is warm temperate Mediterranean, with more precipitation in winter than in summer.It is considered as Csa (warm temperature, dry and hot summer) according to the classification of Koppen et al., (2011).

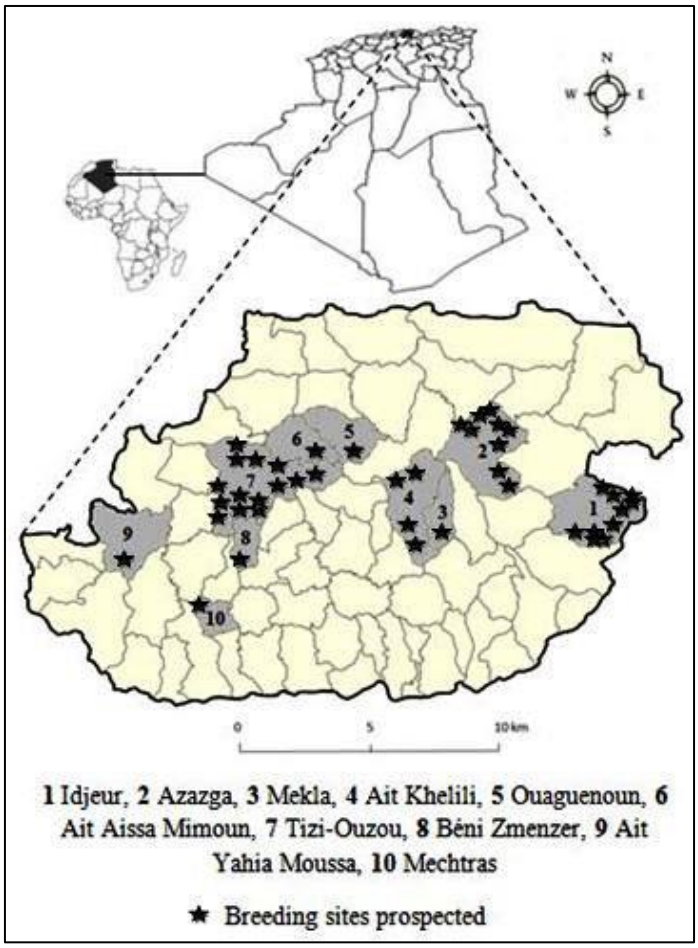

Figure 1 : Geographical location of the study area.

Sampling

Our sampling was carried out depending on the accessibility of the breeding sites and the availability of Culicidae larvae. It was carried out bimonthly from April to September, 2021 in 43 breeding sites distributed over ten stations (Idjeur, Azazga, Mekla, Ait Khelili, Mechtras, Tizi-Ouzou, Ait Aissa Mimoun, Ouaguenoun, Beni Zmenzer and Ait Yahia Moussa).

This inventory was based primarily on sampling of larvae using the standard 'dipping' method cited by Croset et al., (1976); Service (1993); Silver (2008) and Becker et al., (2020) using a 500ml dipper. Adults captured on human bait were also conducted in our study, it was carried out at the time of mosquito activity in search of a blood meal. We accidentally trapped the adults on a human body (Becker et al., 2003) using a dry tube.

Larvae Rearing

The inventoried 1st, 2nd and 3rd instar larvae were reared in the laboratory under ambient conditions, near the window to have a natural photoperiod. They were

placed in containers containing 300ml of dichlorinated water and covered with fine mesh of 0,5mmnetting. The containers containing Pupae were placed inside cubic cages of different sizes, consisting of a wooden frame with a fine mesh and a sleeve in the middle to suck up the adults after their emergence. A food composed bya mixture of biscuit and yeast, was given to the larvae every three days.The changing of water is very important to avoid the death of the individuals by asphyxiation, following the decomposition of the food in the water (Rehimi and Soltani, 1999).

The 4th instar larvae were mounted after clarification. They are placed in a heating bath of 10% KOH for ten minutes, then rinsed in three baths of distilled water of 3 minutes each to get rid of the KOH, then one minute in absolute ethanol. Samples were preserved in 70% diluted ethanol until they are fixed between the slide and the coverglasses in a drop of Faure's liquid.

Adults were aspirated after emergence using a mouth aspirator, frozen directly after emergence to prevent movement, and then stored in a dry, protected from humidity in Petri dishes.

Morphological Identification

In order to identify our samples, we used the standard method of morphological study of larvae and adults. We used a Novex microscope (10 to 100 x magnification) and a binocular magnifying glass of Optika WF10X/21, based on the dichotomous keys of Becker et al., (2010). Confirmation of our identification was made on the basis of the latest version of the MosKeyTool identification software of Gunay et al., (2020).

Data Analysis

The results of this study were exploited by ecological indices, we used composition indices, to show relative abundance and frequencies of occurrence and structure indices, to show Shannon Weaver and equitability indices. We also considered the distribution of Culicidae species in the different stations surveyed.

RESULTS AND DISCUSSIONS

Biodiversity of mosquitoes in Tizi-Ouzou

The inventory of mosquitoes carried out in this study revealed the presence of 14 species divided into six genera and two subfamilies. The genus *Culex* was the most dominant with eight species, these are *Culex pipiens* s.l., *Culex impudicus, Culex territans, Culex perexiguus, Culex hortensis, Culex theileri, Culex laticinctus and Culex mimeticus*. The genus *Anopheles* was represented by two species, *Anopheles claviger* and the complex *Anopheles maculipennis* s.l. The other four genera were represented by one species each, the genus *Culiseta* by *Culiseta longiareolata*, the genus *Aedes* by *Aedes berlandi*, the genus *Uranotaenia* by *Uranotaenia unguiculata* and the genus *Coquillettidia* by *Coquillettidia richiardii*. Capture on human bait allowed us to find two new species for this area: *Ae. berlandi* and *Cq. richiardii*.

The genus *Culex* has also taken the first position in the work carried out by Hafsi et al., (2021) in Souk Ahras and Arroussi et al., (2021) in Annaba. The highest number of species found in this study wasexplained by the large number of breeding sites inventoried, 43 breeding sites spread over ten stations. The list of species found in the present work clarified in Table 1.

Among the species found, four were cited for the first time in Tizi-Ouzou, namely *Culex laticinctus, Culex mimeticus, Aedes berlandi* and *Coquillettidia richiardii*.

This first citation was probably caused by the lack of study on Culicidae in this region, our study is among the first inventories of Culicidae carried out in this

region. It may also be caused by the variety of sampling methods carried out, as capture on human bait allowed us to find two new species: *Ae. berlandi* and *Cq. richiardii*.

The genus *Coquillettidia* was cited for the first time in this area, it has already been found in Setif (North-East Algeria) by Nabti and Bounechada (2020), which confirms its presence in Algeria Northern. *Cq. richiardii* is characterised by wings with broad scales of a dense, light colour and a light proboscis in its half (Figure 2).It was also found in Germany in 2007 and 2008 by Timmermann and Becker (2010).

Six genera of Culicidae are present in Algeria, these are *Culex, Anopheles, Aedes, Culiseta, Orthopodomyia* and *Uranotaenia*. In this study, we add the genus *Coquillettidia* to the genera present.

Lafri et al., (2014) found three species in Tizi-Ouzou in common with our study, namely *Cx. pipiens* s.l., *Cx. territans* and *Cs. longiareolata*, which confirms their presence in this region.

The biodiversity survey of Culicidae in Algeria has been carried out by several authors in different Algerian regions. In this work, we present 13 works carried out from 2011 to 2021 on culicidial diversity in 26 different district (table 2).

Table 2 shows that Algeria has a very high culicidial diversity, with a total of 45 species cited. According the chart of mosquito species distribution in the western Palaearctic region of Robert et al., (2019), 61 species are known in Algeria. This richness is due to its large surface area of 2.382 million km^2 and its geographical location (North Africa), which gives it a very rich landscape, characterised by a large coastal area, high plateaus and a very vast Sahara.

The richness of landscape is perhaps the main cause of the presence of native species, as it can allow the installation of invasive species, such as *Aedes albopictus* which was reported for the first time in this country in 2010 by Izri et al., (2011) in the village of Larbaa Nath Irathen in Tizi-Ouzou.

Number of Individuals and Relative Abundance of Culicidae Species Collected from Tizi-Ouzou during the Study Period.

In our study, two species were very abundant, *Culiseta longiareolata* with a total of 1176 individuals and a relative abundance of 40.78 % and *Culex pipiens* s.l. with a total of 1132 specimens and an abundance of 39.25 %. The species *Culex hortensis* has a higher or lower number of individuals than the other species, 363 individuals with a relative frequency of 12.59 %.

The dominance of *Cs. longiareolata* over the other species was probably due to the nature of the breeding sites surveyed and their location, which were for the most part rural anthropic sites.

Culiseta longiareolata is frequently observed in association with *Cx. pipiens* s.l. In the urban environment of Annaba, Arroussi et al., (2021) found *Cx. pipiens* as the most dominant species with a relative abundance of 55.23 % followed by *Cs. longiareolata* with a frequency of 20.21 %.

Two species were classified as regular species (frequency of occurrence between 50 % and 74 %), namely *Cs. longiareolata* and *Cx. pipiens* s.l. These species were found in almost all the samples taken.

Structural indices

One species was classified as incidental (index between 25 % and 50 %), it was *Cx. hortensis*. Another species was classified as accidental; *Cx. territans* (index between 5 % and 25 %), the other species were considered as rare species (index below 4 %).

Table 1: List of Culicidae species collected in Tizi-Ouzou during the study period.

Genus	Species
Culex	*Culex (Culex) pipiens*s.l.Linnaeus, 1758
	Culex (Neoculex) impudicus Ficalbi, 1890
	Culex (Neoculex) territans Walker, 1856
	Culex (Culex) perexiguus (Theobald, 1903)
	Culex (Maillotia) hortensis Ficalbi, 1889
	Culex (Culex) theileri Theobald, 1903
	Culex (Culex) laticinctus Edwards, 1913
	Culex (Culex) mimeticus Noe, 1899
Culiseta	*Culiseta (Allotheobaldia) longiareolata* (Macquart, 1838)
Uranotaenia	*Uranotaenia (Pseudoficalbia) unguiculata* Edwards, 1913
Aedes	*Aedes (Ochlerotatus) berlandi* (Seguy, 1921)
Coquillettidia	*Coquillettidia (Coquillettidia) richiardii* (Ficalbi,1889)
Anopheles	*Anopheles (Anopheles) maculipennis* s.l. Meigen, 1818
	Anopheles (Anopheles) claviger (Meigen, 1804)

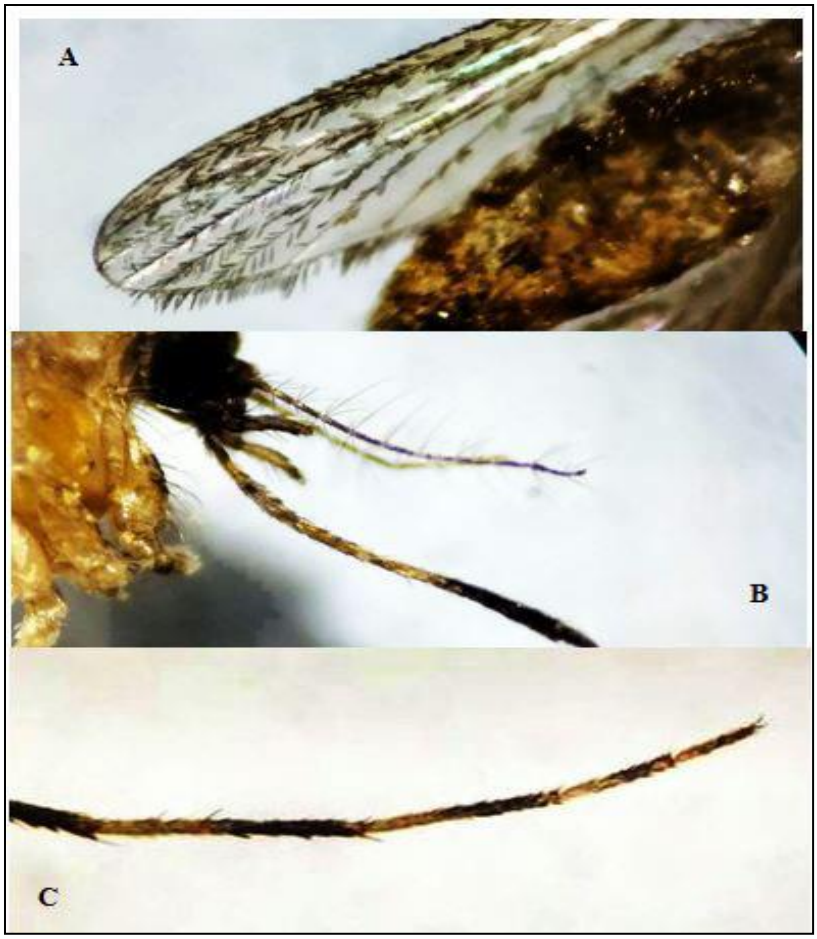

Figure 2: *Coquillettidia richiardii* adulte female. A Veins with a mixture of pale and dark scales, wing scales usually broad and conspicuous and abdomen almost coered with pale scales; B Proboscis is pale in the median area ; CTarsomere 5 with two coloured (©ChahedS.).

Table 2: Culicidae species presented in Algeria ; E East, W West, N North, S South, C Center, sp One species, spp Several species.

Species	District	Authors
19 spp: *Cx. pipiens, Cx. theileri, Cx. hortensis, Cx. simpsoni, Cx. antennatus, Cx. martini, Cx. adairi, Cx. territans, Cx. arbieeni, Cx. quinquefasciatus, Cx. laticinctus, Cs. morsitans, Cs. annulata, Cs. longiareolata, An. labranchiae, An. claviger, An. marteri, Ae. flavescens, Ur. unguiculata*	Souk Ahras (E)	Hafsi et al., (2021)
1 sp: *Ae. albopictus*	//	Hamaidia and Soltani (2021)
8 spp: *Cx. pipiens, Cx. theileri, Cx. modestus, Cs. longiareolata, An. labranchiae, An. claviger, Ae. aegypti, Ae. albopictus*	Annaba (E)	Arroussi et al., (2021)
2 spp: *Cx. pipiens, Cs. longiareolata*	//	Lafri et al., (2014)
9 spp: *Cs. longiareolata, C. richiardii, Cx. simpsoni, Cx. theileri, Cx. pipiens* s.l., *An. labranchiae, Cx. hortensis, Ae. caspius, An. cinereus hispaniola*	Setif (E)	Nabti and Bounechad (2020)
9 spp : *Cx. pipiens, Cx. theileri, Cx. hortensis, Cx. deserticola, Cs. longiareolata, Cs. subochrea, Ae. caspius, An. labranchiae, An. cinereus*	Batna (E)	Belkhiri et al., (2021)
1 sp: *Cx. pipiens*	Saida (W)	Lafri et al., (2014)
5 spp: *Ae. albopictus, An. labranchiae, Cx. pipiens, Cx. territans, Cs. longiareolata*	Tizi-Ouzou (C)	Lafri et al., (2014)
1 sp: *Ae. albopictus*	//	Izri et al., (2011)
2 spp: *Cx. pipiens, Cs. longiareolata*	Medea (C)	Lafri et al., (2014)
6 spp: *An. labranchiae, Cx. pipiens, Cx. deserticola, Cx. hortensis, Cs. longiareolata, Ur. unguiculata*	Blida (C)	Lafri et al., (2014)
2 spp: *Cx. pipiens, Cs. longiareolata*	Mostaganem (W)	Lafri et al., (2014)
1 sp: *Cs. longiareolata*	Bechar (S)	Lafri et al., (2014)
5 spp: *Cx. pipiens, Cs. longiareolata, Ae. flavescens, Ae. coluzzii, Ae. detritus*	Tipaza (C)	Lafri et al., (2014)
1 sp: *Ae. geniculatus*	Boumerdes (C)	Lafri et al., (2014)
1 sp: *Ae. albopictus*	Algiers (C)	Benallal et al., (2019)
7 spp: *Cx. pipiens, Cx. theileri, Cx. deserticola, Cx. hortensis, Cs. longiareolata, Cs. litorea, Ur. unguiculata*	//	Lafri et al., (2014)
7 spp: *Ae. dorsalis, Ae. detritus, Ae. caspius, Ae. vexans, Ae. mariae, An. sergenti, Cs.longiareolata*	Oum El Bouaghi (E)	Messai et al., (2016)
14 spp: *An. cinereus, An. sergentii, An. multicolor, Cx. brumpti, Cx. deserticola, Cx. hortensis, Cx. impudicus, Cx. laticinctus, Cx. martinii, Cx. modestus, Cx. perexiguus, Cx. pipiens, Cx. theileri, Cs. longiareolata*	M'Sila (S)	Asloum et al., (2021)
11 spp: *Cx. pipiens, Cx. hortensis, Cx. univittatus, Cx. brumpti, Cx. modestus, Cs. subochrea, Cs. annulata, Cs. moristans, Ae. pullatus, Ae. vexans, An. coustani*	El Tarf (E)	Houmani et al., (2017)
7 spp: *Ur. unguiculata, Cx. pipiens, Cx. laticinctus, Cx. impudicus, Cx. hortensis, Cx. theileri, Cs. longiareolata*	//	Boudemagh et al., (2013)
2 spp: *Cx. pipiens, Cs. longiareolata*	//	Lafri et al., (2014)
13 spp: *Ae. berlandi, Ae. vexans, An. plumbeus, An. labranchiae, Cx.*		Amara Korba

pipiens s.l., *Cx. perexiguus, Cx. theileri, Cx. pusillus, Cx. modestus, Cx. impudicus, Cs. longiareolata, Cs. annulata, Ur. unguiculata*		et al., (2015)
1 sp: *An. multicolor*	Tamanrasset (S)	Lafri et al., (2014)
3 spp: *An. multicolor, Cx. hortensis, Cs. longiareolata*	Tindouf (S)	Lafri et al., (2014)
3 spp: *Ae. vexans, Ae. dorsalis, An. multicolor*	Ghardaia (S)	Lafri et al., (2014)
1 sp: *An. multicolor*	Naama (S)	Lafri et al., (2014)

Table 3: Number of individuals recorded in Tizi-Ouzou during the study period.

Species	Larvae	Adults		Total number
		Male	Females	
Cx. pipiens s.l.	873	134	125	1132
Cx. hortensis	224	78	61	363
Cx. mimeticus	13	2	4	19
Cx. territans	64	6	17	87
Cx. laticinctus	14	2	1	17
Cx. theileri	3	0	0	3
Cx. perexiguus	30	0	0	30
Cx. impudicus	9	0	1	10
Cs. longiareolata	814	183	179	1176
An. maculipennis s.l.	3	0	2	5
An. claviger	13	1	0	14
Ur. unguiculata	26	0	0	26
Cq. richiardii	0	0	1	1
Ae. berlandi	0	0	1	1
Total	2086	406	392	2884

Frequency of Occurrence

Table 4: Structural indices

Shannon Weaver diversity index	Maximum diversity H'max	Equi-Distribution index
0,529 bits	3,807	0,498

Shannon Weaver diversity index is close to the equitability index found, which means that our study area wasvery diverse. The equitability index tends to 0, which means that the numbers of individuals collected werenot in balance with each other.

Distribution of Mosquitoes in the Surveyed Areas

The distribution of Culicidae species in Tizi-Ouzou was influenced by several factors: the nature of the breeding site surveyed, the number of collections carried out, which influences of the number of individuals collected and the durability of the breeding sites, which determines the number of collections.

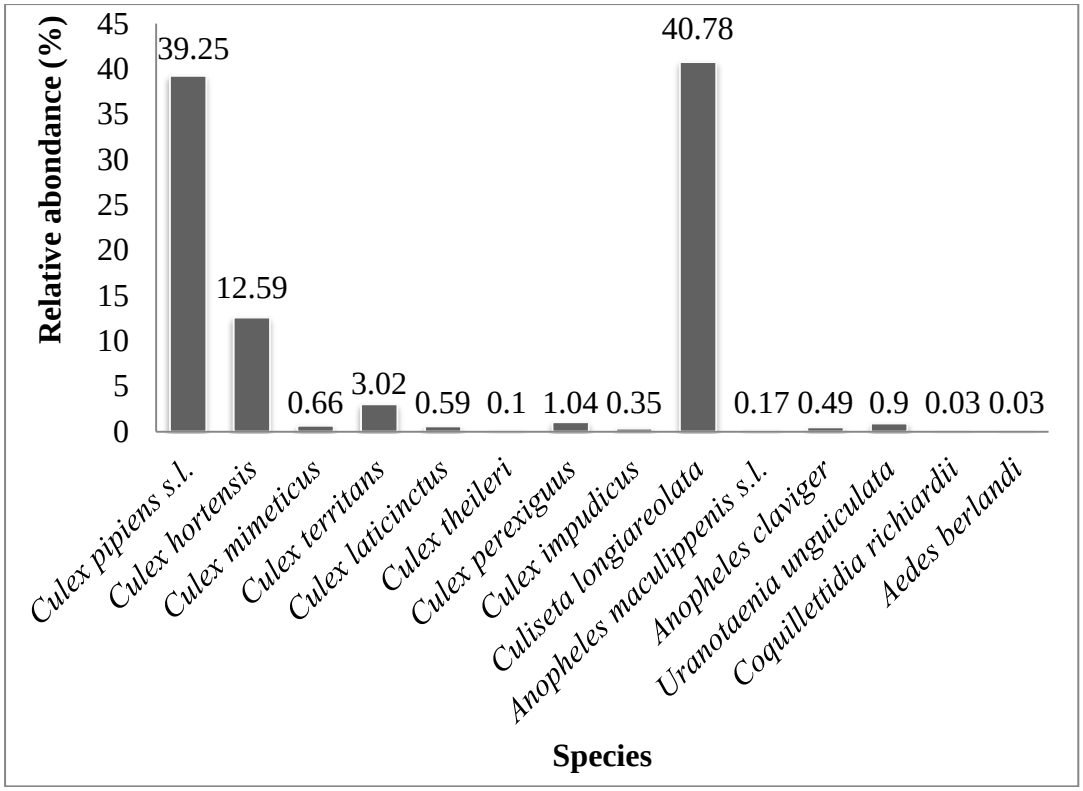

Figure 3: Relative abundance of species surveyed Tizi-Ouzou during the study period.

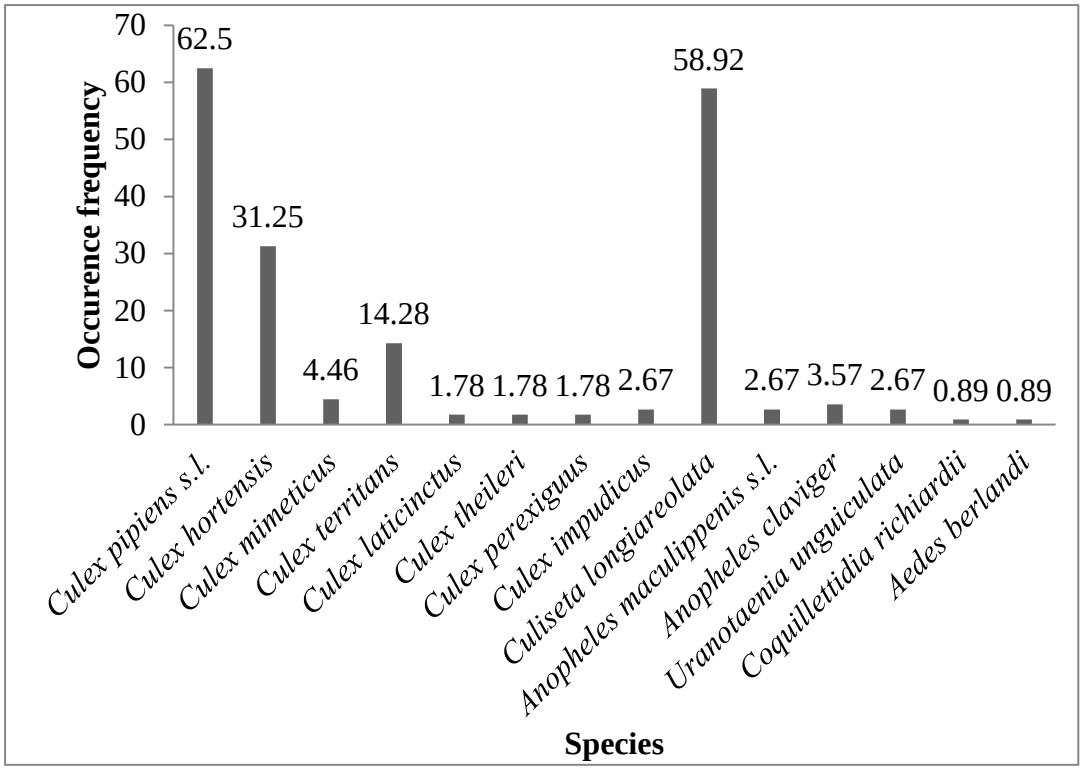

Figure 4: Frequencyof occurrence of Culicidae species found in Tizi-Ouzou during the study period.

Table 5: Distribution of Culicidae species in Tizi-Ouzou district.

Stations	Sites	Breeding sites	Nature of the breeding site	Species found
Tizi-Ouzou	The city	Metal barrel	Anthropogenic	*Cx. pipiens* s.l. *Cs. longiareolata* *Cx. hortensis*
		Basin	//	*Cx. territans* *Cs. longiareolata* *Cx. hortensis*
		Capture on human bait in an open space		*Cq. richiardii*
	Azib Ahmed	Barrel	Anthropogenic	*Cx. pipiens* s.l. *Cs. longiareolata*
		Barrel	//	*Cs. longiareolata*
		Pit	//	*Cs. longiareolata* *Cx. pipiens* s.l. *An. claviger*
		Water reservoir	Natural	*Cx. pipiens* s.l. *Cs. longiareolata*
	Betrouna	Pit	Anthropogenic	*Cs. longiareolata* *Cx. pipiens* s.l.
		Bucket	//	*Cs. longiareolata* *Cx. pipiens* s.l. *Cx. hortensis* *Cx. territans*
	Oued Aissi	Pond	//	*Cx. hortensis* *Cx. mimeticus* *Cx. pipiens* s.l. *Cx. territans*
		Dam	//	*Cx. pipiens* s.l *Cx. territans* *Ur. unguiculata* *Cx. perexiguus* *Cx. theileri*
		Dam	//	*Cx. pipiens* s.l. *Cs. longiareolata* *Cx. territans*
		Cement tube	//	*Cx. pipiens* s.l. *Cs. longiareolata*
		Wadi	Natural	*Cx. pipiens* s.l. *Cs. longiareolata* *Cx. mimeticus* *Cx. territans* *Cx. hortensis*
Ait Khelili	Megheira	Well	Anthropogenic	*Cx. pipiens* s.l. *Cs. longiareolata*
		Mountain reservoir	Natural	*Cs. longiareolata* *Cx. territans*
	Agoulmim	Metal barrel	Anthropogenic	*Cx. pipiens* s.l. *Cs. longiareolata*
		Fontain	//	*Cx. pipiens* s.l. *Cs. longiareolata*
Idjeur	Tifrit Ait Oumalek	Well	//	*Cx. hortensis*
		Basin	//	*Cx. pipiens* s.l. *Cx. hortensis* *Cs. longiareolata*
		Basin	//	*Cx. hortensis*

				Cs. longiareolata *Cx. pipiens* s.l.
		Basin	//	*Cx. pipiens* s.l. *Cs. longiareolata* *An. maculipennis* s.l. *An. claviger* *Cx. mimeticus* *Cx. territans* *Cx. hortensis* *Cx. laticinctus*
		Metal barrel	//	*Cx. hortensis* *Cx. mimeticus* *Cs. longiareolata* *Cx. territans*
		Pools of water	Natural	*Cx. hortensis* *Cx. pipiens* s.l. *Cs. longiareolata*
		Pools of water	//	*Cx. pipiens* s.l. *Cx. territans* *Cx. hortensis* *Cs. longiareolata*
		Pools of water	//	*Cx. hortensis* *Cx. pipiens* s.l. *Cs. longiareolata* *Cx. territans*
		Water reservoir	//	*Cx. pipiens* s.l. *Cx. hortensis* *Cs. longiareolata*
		Water reservoir	//	*Cx. pipiens* s.l. *Cx. hortensis* *Cs. longiareolata*
Azazga	Cheurfa N'Bahloul	Well	Anthropogenic	*Cs. longiareolata* *Cx. pipiens* s.l. *Cx. hortensis*
		Well	//	*Cs. longiareolata*
		Well	//	*Cs. longiareolata*
		Well	//	*Cs. longiareolata* *Cx. pipiens* s.l. *Cx. hortensis*
		Pond	//	*Cs. longiareolata* *Cx. pipiens* s.l. *Cx. hortensis*
		Pond	//	*Cs. longiareolata* *Cx. hortensis*
		Pond	//	*Cx. hortensis* *Cx. impudicus* *Cx. pipiens* s.l.
		Basin	//	*Cx. pipiens* s.l. *Cx. impudicus*
		Barrel	//	*Cs. longiareolata* *Cx. pipiens* s.l.
Ait Aissa Mimoun	Akaoudj	Barrel	//	*Cs. longiareolata*
Mechtras	Ait Imghour	Container	//	*Cx. pipiens* s.l. *Cs. longiareolata* *Cx. hortensis*
Ait Yahia Moussa	Ighil Vir	Jar	//	*Cx. pipiens* s.l. *Cs. longiareolata*
Ouaguenoun	Tamda	Sewage leak	//	*An. maculipennis* s.l.

				Cx. laticinctus *Cx. theileri* *Cx. territans* *Cx. perexiguus*
Beni Zmenzer	Ath Ouanech e	Water source	Natural	*Cx. pipiens* s.l. *Cs. longiareolata* *Cx. hortensis*
Mekla	The city	Captured on human bait in an open space		*Ae. berlandi*

Table 5 shows the distribution of species recorded in the different study stations. The station of Tizi-Ouzou was very rich in culicid species (10 species) followed by the station of Idjeur (8 species). This is explained by the high number of breeding sites surveyed, Tizi-Ouzou with 13 breeding sites distributed over four sites and an open space in which we conducted human bait sampling. Idjeur with 10 breeding sites. This high number of surveyed breeding sites increased the possibility of finding a significant biodiversity.

The station of Azazga, Ait Khelili, Ouaguenoun, Beni Zmenzer and Mechtras showed an average biodiversity. It is due on the one hand to the presence of an important vegetation cover, which favoured the presence of an important diversity and on the other hand, to the drying up of the temporary breeding sites, which decreased the number of collections.

The stations with the lowest number of culicid species were Mekla and Ait Yahia Moussa, probably due to the number of samples taken. One sample was taken at both stations, which reduced the possibility of finding other species.

Culiseta longiareolata was found in 8 stations, namely Idjeur, Azazga, Ait Khelili, Ait Aissa Mimoun, Tizi-Ouzou, Beni Zmenzer, Ait Yahia Moussa and Mechtras. It has also been found in several studies carried out on culicidial diversity in Algeria, in Souk Ahras (Hafsi et al., 2021), Sétif (Nabti and Bounechada, 2020), Tizi-Ouzou (Lafri et al., 2014), El Tarf (Boudemagh et al., 2013; Amara Korba et al., 2015) and Medea, Blida, Mostaganem, Bechar, Tipaza, Algiers and Tindouf (Lafri et al., 2014). It is a cosmopolitan species (Khaligh et al., 2020) with a great capacity to colonise different breeding sites. It was first found in Germany in 2011 by Becker and Hoffmann (2011), in Malta by Schaffner et al., (2010), in Croatia by Merdic et al., (2020). It was also found in Iran by Moosa-Kazemi et al., (2010) and Keshavarzi et al., (2017). It is an intermediate host of avian *Plasmodium* that can transmit Malta fever (Hazratian et al., 2019). It can also cause Tularemia and arboviral diseases (Soltanbeiglu et al., 2020).

The *Culex pipiens* s.l. complex was found in 7 stations, namely Idjeur, Azazga, Ait Khelili, Tizi-Ouzou, Beni Zmenzer, Ait Yahia Moussa and Mechtras. In Algeria, several authors have reported its presence, Hafsi et al., (2021) in Souk-Ahras, Arroussi et al., (2021) in Annaba, Nabti and Bounechada (2020) in Setif and Larfi et al., (2014) in Saida, Medea, Blida, Mostaganem, Tizi-Ouzou, Tipaza, Algiers and El Tarf. It has a strong ecological suitability that shows annual seasonal dynamics. It is well known as a cosmopolitan, hardy and resistant species, able to adapt to the most diverse environments. In the Maghreb region, during the summer of 2010, it was found infected with West Nile and Rift Valley viruses by Amraoui et al., (2012).

The *Anopheles maculipennis* s.l. complex has been found in two stations, Tizi-Ouzou and Ouaguenoun. It is composed of morphologically similar species, which can only be identified by

molecular techniques (Laboudi et al., 2014). *Anopheles labranchiae* is the only representative of this complex in Algeria (Nabti and Bounechada, 2020). It is considered the main vector of malaria in Europe and the Palaearctic region (Ghavami, 2005).

Culex theileri was found in two stations, Ouaguenoun and Tizi-Ouzou. It was also found by Hafsi et al., (2021) in Souk-Ahras, also by Arroussi et al., (2021) in Annaba, Boudemagh et al., (2013) and Amara Korba et al., (2015) in El Tarf, Nabti and Bounechada (2020) in Setif. It was first found in Malta in 2009 by Schaffner et al., (2010), as it was found in the work of Moosa-Kazemi et al., (2010) and Keshavarzi et al., (2017) in Iran. According to Brunhes et al., (1999), the species was found naturally infected with West Nile and Sindbis viruses in South Africa.

Culex perexiguus was found in two stations, Ouaguenoun and Tizi-Ouzou, it was also found by other authors, including Amara Korba et al., (2015) in Lake Tonga (El Tarf) and in the Oases of the Sahara, where it was reported to carry West Nile virus by Benbetka et al., (2018). According to Brunhes et al., (1999), *Cx. perexiguus* has transmitted West Nile and Sindbis viruses in Egypt and several Middle Eastern countries. Recently, in 2017, this species is present in Egypt (Elhawary et al., 2020).

Aedes berlandi, Culex laticinctus, Culex mimeticus, Culex hortensis, Culex territans and *Culex impudicus* have no known vector role, whereas *Ur. unguiculata* can transmit parasites to amphibians and reptiles (Brunhes et al., 1999).

CONCLUSION AND PERSPECTIVES

Although preliminary, the results of this work contribute to the knowledge of new species of Culicidae for the region of Tizi-Ouzou. Our updated inventory of mosquitoes in Tizi-Ouzou has revealed the presence of 14 species distributed over six genera and two subfamilies. We report the first citation of the genus *Coquillettidia* in this district, which confirms its presence in Algeria. Among the six genera found in this study, three are known for their role in the transmission of pathogens, namely *Culex, Aedes* and *Anopheles*. A survey of the diversité species in other area and during the big perdiode should be continued.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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