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Preliminary report of mosquitoes survey at Tonga Lake (North-East Algeria)

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ABSTRACT

Background: Mosquitoes are transmitters of several human diseases including, malaria, filariasis, West Nile virus and Rift Valley fever virus. To planified and succeful any mosquito vector control, a good understanding of the occurrence of specific important vector species, their abundance and distribution are needed. **Objectives:** The present study aimed to identify the mosquito potential vectors distributed throughout Tonga Lake region, a part of National Park of El-Kala situated in northeastern Algeria and to discuss the epidemiological importance of these insects. **Results:** Thirteen species representing five genera were identified: *Ae. brelandi*, *Ae. vexans*, *An. plumbeus*, *An. labranchiae*, *Cx. pipiens s. l.*, *Cx. perexiguus*, *Cx. theileri*, *Cx. pusillus*, *Cx. modestus*, *Cx. impudicus*, *Cs. longiareolata*, *Cs. annulata*, *Ur. unguiculata*. The dominant species was *Cx. pipiens s. l.* with more than 70%. **Conclusion:** The occurrence of *Aedes*, *Anopheles* and *Culex* is suggestive of the presence of a risk for vector-borne diseases such as malaria, West Nile fever, Rift Valley Fever and filariasis in the area. In this study, results on species diversity may help in the future planning of vector control measures.

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INTRODUCTION

Mosquitoes (family; Culicidae) are at the center of worldwide entomological research because of their importance as vectors of a wide range of debilitating viral and parasitic pathogens affecting both humans and animals [1]. Several of the world's most prevalent infectious diseases notably malaria, lymphatic filariasis and dengue, as well as less common diseases such as Japanese encephalitis, chikungunya, Rift Valley fever and West Nile virus, are transmitted by mosquitoes [2].

Within the Mediterranean, wetlands constitute a remarkable natural heritage, occupying a transition zone between terrestrial and aquatic systems [3]. All mosquitoes have an intimate relationship with wetlands because water is an essential requirement for the larval stages [4]. In north Algeria, the hot and humid coastal climate of Mediterranean, lakes, marshes, small water pools and drains provide these conditions.

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The knowledge of mosquito communities is important in the assessment of risks of transmission and control of several arboviruses, especially in wetlands where migratory, non-migrating bird and mosquitoes species congregate [5]. There has been little recently published work regarding mosquito species occurring in Algeria [6, 7, 8, 9, 10, 11, 12, 13].

Tonga Lake within National Park of El-Kala is classified among the North Africa's top biodiversity hotspots [14]. However, no attempt has been made to study mosquito's diversity in this region. The present study describes results of a preliminary survey to detect mosquito vectors diversity in National Park of El-Kala. To our knowledge, this report constitute the first step to knowing the association between wetlands and mosquito species in this region. Considering the fact that the Asian tiger mosquito *Aedes albopictus* has the most important ability of invading new biotopes as its occurring worldwide, we kept in mind this possibility while performing our investigations.

MATERIAL AND METHODS

Study area

The survey was conducted in surrounding area of Tonga Lake (Figure 1), which is situated in the extreme north east of Algeria (36°52′ N, 8°31′ E) (Figure 2). A freshwater Lake of 2 400 ha with a maximum depth of 2.5 m. This Lake have an international importance under the Ramsar Convention in 1983 and a part of the larger El-Kala wetland system, which is generally, recognized as one of the four major wetland complexes in the Western Mediterranean, this seasonal freshwater Lake is linked to the Mediterranean Sea [15; 16]. The Tonga Lake area was investigated in part because of the high diversity of potential breeding areas for mosquitoes (many wetland types) and proximity of these breeding sites to relatively dense human populations and other hosts including migratory birds.

Figure 1. Tonga Lake, a freshwater marsh within the El-Kala National Park, Algeria. Photo © Amara Korba R.

Specimen collection

Surveys were carried out in summer 2012 at peridomestic sites, generally near habitations and located a few meters from the Lake in which humans and other hosts such as horse and livestock were readily available to mosquitoes. Adult specimens were collected using CDC miniature light traps (John W. Hock Company®) and Co2-baited traps (Mosquito Magnet Liberty Plus®) during June and July. After collection, all adults were anesthetized in the freezer, counted and preserved with silica gel in Eppendorf tubes. Immature stages were sampled using a classical dipping method [17]; a dipper (ca. 1000 ml) with an extendable handle was used for collection at most sites. The breeding sites were variable, ranging from temporary to permanent. Ponds, Sewerage basin, marshes, puddles, and artificial water filled containers, drainage ditches and tires were sampled. Early

instars were reared to either late instars or adults. All pupae were allowed to emerge as adults and the resultant adults were preserved as mentioned earlier. Late instars (3rd and 4th) were killed and fixed in 75% ethanol. Mosquito larvae and adults were identified as possible to species level using X40 dissecting microscope with two identification software [18, 19] and illustrated keys of Becker et al. [1].

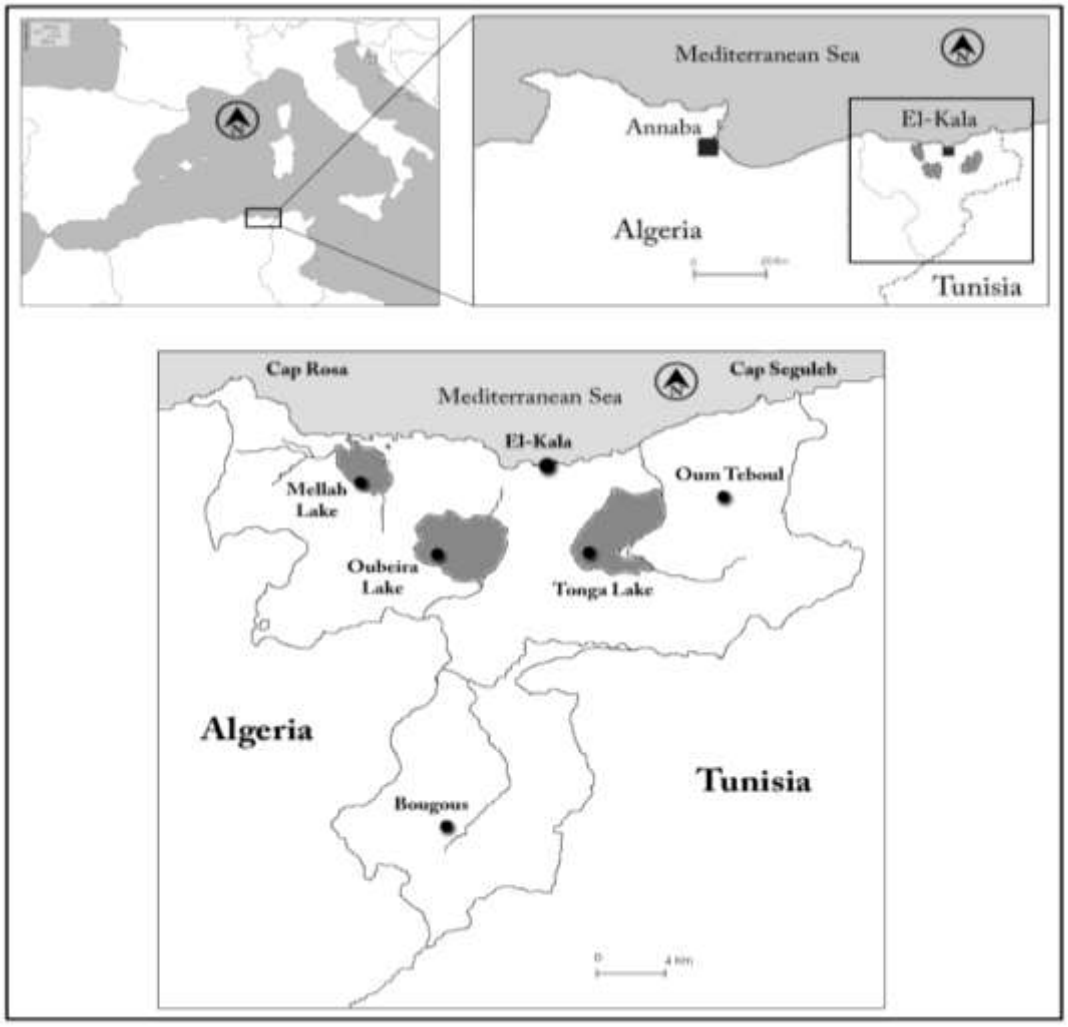

Figure 2. Map showing Geographic location of Tonga Lake.

RESULTS

A total of 4633 mosquito (1137 Adult and 3496 larvae) were collected between June and July 2012 in the surrounding area of Tonga Lake. Of these, 75.4% of the total mosquitoes (n=3496) were collected using dipping method, 15.5% (n=719) by CDC Light Traps and 9% (n=418) were collected using the Mosquito Magnet. 4510 (97,3%) of specimens were identified to species level showed 13 confirmed taxa representing two subfamilies: (*Culicinae* and *Anophelinae*) with five genera which included: Two *Aedes* spp : *Ae. brelandi* and *Ae. vexans*, Two *Anopheles* spp : *An. plumbeus* and *An. labranchiae* ; six *Culex* species namely : *Cx. pipiens, Cx. perexiguus, Cx. theileri, Cx. pusillus, Cx. modestus* and *Cx. impudicus* ; Two Culiseta spp: *Cs. longiareolata* and *Cs. annulata* ; and one *Uranotaenia* : *Ur. unguiculata*. Identification of 123 (2,7%) specimens became indecisive because there are not classified in Algerian mosquitoes checklist suggesting that there need confirmation. The list of collected mosquitoes is shown on (Table 1). Data for each species and methods of collection is presented in (Table 2). The relative abundance of *Culicinae* (65.59%) was higher than the *Anophelinae* (34.40%). *Culex pipiens sensu lato* was the predominant species accounting for more than 70% of the collected specimens, followed by *Culex theileri* (9,30%), *Anopheles labranchiae* (6,41%), *Culex perexiguus* (6,41%), other species are uncommon such as *Cx. impudicus* (0,06%), *Ae. berlandi* (0,01%) and *An. plumbeus* (0,01%).

Table 1. List of collected mosquitoes in Tonga Lake (northeast Algeria).

Familly	Sub-familly	Genus (subgenus) species
Culicidae	*Anophelinae*	*Anopheles (Anopheles) plumbeus* (Stephens, 1828) *Anopheles (Anopheles) labranchiae* (Falleroni, 1926)
	Culicinae	*Aedes (Ochlerotatus) berlandi* (Seguy, 1921) *Aedes (Aedimorphus) vexans* (Meigen, 1830)
		Culex (Culex) pipiens (Linnaeus, 1758) *Culex (Culex) perexiguus* (Theobald, 1901) *Culex (Culex) theileri* (Theobald, 1903) *Culex (Barraudius) pusillus* (Macquart, 1850) *Culex (Barraudius) modestus* (Ficalbi, 1890) *Culex (Neoculex) impudicus* (Ficalbi, 1890)
		Culiseta (Allotheobaldia) longiareolata (Macquart, 1838) *Culiseta (Culiseta) annulata* (Schrank, 1776)
		Uranotaenia (Pseudoficalbia) unguiculata (Edwards, 1913)

Table 2. Mosquito densities according to the methods of capture collected in summer 2012.

	Sampling Methods				
Species	Mosquito Magnet	CDC miniature light traps	Dipping	*Total*	*%*
Cx. pipiens s. l.	160	113	2992	3265	70,47
Cx. theileri	0	201	230	431	9,30
An. labranchiae	68	211	18	297	6,41
Cx. perexiguus	49	23	198	270	5,83
Cx. modestus	1	103	0	104	2,24
Uncertain species 1	77	3	0	80	1,73
Cx. pusillus	36	26	0	62	1,34
Ae. vexans	0	31	0	31	0,67
Cx. sp	22	0	0	22	0,47
Cs, longiareolata	0	0	21	21	0,45
Ur. Unguiculata	0	0	19	19	0,41
Ur. sp	0	3	15	18	0,39
Cs. annulata	1	4	0	5	0,11
Uncertain species 2	3	0	0	3	0,06
Cx. impudicus	0	0	3	3	0,06
Ae. berlandi	0	1	0	1	0,02
An. plumbeus	1	0	0	1	0,02
Total	418	719	3496	4633	

DISCUSSION

A checklist and keys of Algerian Culicidae were provided by [18, 20] listing 48 species based on data mainly collected between 1920 and 1999. After that an online taxonomic catalog in the website of the Walter Reed Biosystematics Unit (WRBU) www.mosquitocatalog.org (accessed 22 Jan. 2014), listed a total of 42 species expected in Algeria based on literature data. Recently identified *An. gambiae* and *Cx. quinquefasciatus* as new to

the Algerian mosquito fauna [7, 21], also Izri et al. [8] reported the presence of the Asian tiger mosquito *Ae. albopictus* and Lafri et al. [13] detect the presence of *Cx. territans* and confirmed the presence of *Ae. albopictus* in the country. Based on this works, the mosquito fauna of Algeria includes 6 genera, 52 species.

Our survey revealed the prevalence of 13 mosquito species, belonging to 5 genera in extreme northeast of Algeria. This species had previously been reported from other northeastern department. Berchi, [11] reported from (Constantine) department 7 species including *Cx. mimeticus, An. maculipenis s.l.* Messai et al. [10] detect 11 species from (Mila) department, *Cx. antennatus* and *Cx. hortensis* are either species. In addition, Bouabida et al. [12] found 9 species in (Tebessa) department with *Cx. perexiguus* and *Cs. annulata.* Moreover, missing species can be mainly linked to differences between environmental location types and the duration of the study, others escape attention because they are not attracted to used traps.

The most common species *Cx. pipiens s. l.* is widely distributed in different regions of Algeria, in agreement with these findings references cited previously such as western district, as well as in the eastern. Evidently, *Cx. pipiens s. l.* oviposits in many artificial and natural containers. Amara Korba et al. [22] describes, for the first time in Algeria, the genetic composition of *Culex pipiens pipiens* form pipiens, molestus and hybrids pipiens/molestus. The large feeding preference including human, and their capacity to transmit WNV and RVF [23] make them a potential vector for this arbovirus in the country and North Africa.

The use of multiple traps to collect mosquitoes proved to be a good sampling technics to study the biodiversity of Culicidae and collected large number of species, which can capture specimens in the larva and adult form. These technics allowed us to detect for the first time the presence of both *Ae. berlandi* and *An. plumbeus* as breeders in extreme North-East Algeria, and other generalists as *Cx. pipiens s. l.* and *Cx. theileri* which are the prevalent species in studied area. Take apart the identified species, we have counted 123 specimens without confirmation of statute because most of the discriminating characteristics suggests that these are new species in the country, which does not exist in the current checklist of Algerian mosquitoes, and need profoundly identification to be confirmed. Of the 13 mosquito species reported for Tonga Lake region, almost half (*An. labranchiae*, *Ae. vexans, Cx. modestus, Cx. pipiens s.l., Cx. theileri* and *Cx. perexiguus*) are considered major vectors of parasites (e.g., plasmodia) and viruses (e.g., dengue, Rift Valley Fever,West Nile) [24, 25, 1].

Our study aimed to understand mosquito species composition in Tonga Lake region; which would reflect the presence of different potential vectors in this environment. The presence of *Aedes*, *Anopheles* and *Culex* mosquitoes in this region exposes the people to a risk of mosquito-borne diseases including malaria, bancroftian filariasis, and arboviruses. Especially as Algeria was an endemic malaria country [26, 7], major epidemic in the north of the country were attributed to *Plasmodium vivax* [27]. Many factors appear to contribute to resurgence and spread of malaria one of them, the movement of infected people from areas where malaria was still endemic to areas where the disease had been eradicated led to resurgence of this disease [28]. The West Nile (WN) fever and Rift Valley fever (RVF) are two emerging arboviruses against which Algeria is at risk [22]. Indeed, the city of Tinerkouk (Adrar department) experienced West Nile Virus outbreak in 1994, with 50 human cases reported and 8 deaths [29]. Moreover, a common border with Mauritania where RVF are endemic, hydraulic works to supply potable water in the Sahara increase the risk of virus introduction in the country.

The Asian tiger mosquito *Aedes albopictus* shows an explosive worldwide spreading, being currently the most invasive mosquito in the world and is the major vector of dengue and chikungunya viruses [30]. The presence of this mosquito in the northern country present a real risk of human infection and shows the need for implementation of close surveillance the spreading of this species. Climate change, the rise in temperature over recent year, development of transport facilities, water distribution, irrigation and agriculture, illegal transport of livestock, wars. These factors created and ideal environment for establishment of many population vectors, which could be resulted increase the risk of mosquito-borne diseases.

CONCLUSION

This study being the first contribution to the knowledge of mosquitos fauna in the region and National Park of El-kala, it's appear that; *Cx. pipiens s. l. , Cx. theileri, An. labranchiae* and *Cx. perexiguus* were the most abundant and widespread mosquitoes. These species are known vectors already identified in many region in the world. Further surveillance, however, are needed to continuously monitor the diversity of both *Anopheline* and *Culicine* vectors in the region and more extensive survey large wetlands complex of the National Park of El-Kala are needed.

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Competing Interests:

The authors declare that they have no competing interests.

Author Contributions:

Conceived and designed the experiments: RAK, SB, and SCB - Fieldwork: RAK, SB, MSA, and MLB - Identification: RAK and SB - Supervising/contributed/materials: ZB, FF and SCB - Wrote the paper: RAK, SB, MLB, and SCB. All authors read and approved the final version of the manuscript.

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