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Short communication: New report of *Aedes albopictus* in Souk Ahras, Northeast Algeria

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Abstract. *Hamaidia K, Soltani N. 2021. Short communication: New report of* Aedes albopictus *in Souk Ahras, Northeast Algeria. Biodiversitas 22: 2901-2906.* The present paper reports the occurrence of *Aedes albopictus* (Skuse), an aggressive Asian tiger mosquito in the city of Souk-Ahras (Northeast of Algeria). A "26 April" estate' inhabitants (Souk-Ahras province) have reported unusual daytime bites by a striped mosquito. On early September 2020, an intensive field inspection was carried out for potential mosquito breeding sites in the locations around the city. A total of 105 specimens (8 larvae, 24 pupae and 73 adults) of *Ae. albopictus* were collected in a pile of old tyres in a residential garden. After previous records of this species in Algeria, this is the first evidence of its presence in Souk-Ahras province, and the findings enhance combined public participation with professional validation in surveillance of vector borne-diseases programs with emphasis on the need for sensitising citizens about controlling this important vector.

Keywords: *Aedes albopictus*, Algeria, first record, invasive mosquito, Souk-Ahras

INTRODUCTION

The Asian tiger mosquito, *Aedes albopictus* (Skuse) (Diptera: Culicidae), is an invasive mosquito geographically restricted to parts of the Asia-Pacific region (Medlock et al. 2015). However, the high tolerance to this relatively thermophilic mosquito species showed an important spread possibility in several climatically different regions (Kamal et al. 2018; Tippel et al. 2019) showing survival suitability for European and American countries. Climate change represents along with urbanization and globalization, the major guiding for this geographic expansion (Poinsignon et al. 2019; Lwande et al. 2020).

Apart from causing discomfort with its daytime bites, the major concern of *Ae. albopictus* emergence is its ability to transmit several viruses (Amraoui et al. 2019; Bohers et al. 2020). This species has been implicated as a vector of chikungunya (Honório et al. 2019), dengue (Ferreira-de-Lima et al. 2020), yellow fever (Kamgang et al. 2019) and Zika (McKenzie et al. 2019; Bohers et al. 2020) viruses. Many southern European countries suffered from several vector borne diseases with *Aedes albopictus* as a main vector. Recently, native chikungunya was reported in France (Calba et al. 2017; Franke et al. 2019) and Italy (Venturi et al. 2017). Moreover, the dengue and Zika virus (Calba et al. 2017; Vasqueza et al. 2018) infection outbreak was detected in southern France, fortunately with low to medium-low risk perception (Le Tyrant et al. 2019).

Huge efforts to mitigate the viruses' emerging public health threat have been made at different levels (individual, environmental and household), especially by improving biomedical research to prevent infectious vector-borne diseases (Chan et al. 2020). Unfortunately, the dynamics of arbovirus vectors such as *Ae. albopictus* are weakly understood (Tedjou et al. 2020).

The focus of most researches was on pathogens (viruses, etc.) and their effects on humans, much less on their arthropod host, while the spread of these diseases strongly depends on the spatiotemporal evolution of vector populations. In medical entomology, the domestication phenomenon of vector borne-diseases was reported as an adaptation throughout their history with humans (Powell and Tabachnick 2013). Recently, it has been proven that the spread of *Ae. albopictus* in new areas following its introduction could be explained in relation with human movement models (Kraemer et al. 2019) and classified as potential bridge vectors of arboviruses (Pereira-dos-Santos et al. 2020). Adaptation of *Ae. albopictus* for urban areas was recently reported (Muhammad et al. 2020).

Although several studies have been undertaken over the past two decades on the biodiversity of the eastern Algerian mosquito-fauna (Messai et al. 2010; Bouabida et al. 2012; Benhissen et al. 2014; Lounaci et al. 2014; Hamaidia et al. 2016; Merabti et al. 2017; Benmalek et al. 2018; Hamaidia and Bershi 2018; Hafsi et al. 2021), there was no report on *Ae. albopictus*, while it was previously listed in a few Central Algeria regions (Benallal et al. 2019).

In order to carry out an effective monitoring program including the ordering of mosquito vector species, we suggest integrated surveillance tools, based on novel community-implication such as Mosquito Alert System (Eritja et al. 2019). At University of Souk-Ahras, a new project (No. D01N01UN410120210001) has been established not only for the surveillance of indigenous and newly emerged mosquito species, but the exploration of potential human and environmental pressures affecting

their distribution and dynamics as well. The main objective was to create an efficient combination between citizen-sourced data and traditional epidemiological resources and perform effective control operations on the one hand. On the other hand, new sustainable control strategies will be performed against mosquitoes with botanical products (Bouzidi et al. 2020; Draouet et al. 2020).

MATERIALS AND METHODS

Study area

The region of Souk-Ahras (Northeast Algeria) is a mountainous region known for its agricultural nature, its dense forest cover and several rivers flowing through it (Figure 1). It contains rural, peri-urban and urban areas. According to its climatic conditions, this area is characterised by a sub-humid climate with a long wet season (Tlidjane et al. 2019; Derdous et al. 2020) with a mean temperature of 15.33°C and an annual rainfall of 114.62 mm. '26 April' estate inhabitants in Souk-Ahras province (36°17'24.2"N 7°56'33.6"E 653m) (Figure 2) have reported through phone calling unusual daytime bites during the past three months (since June 2020) by a nontypical striped mosquito.

After obtaining verbal consent from householders in some locations around this city, an intensive field examination from September 10th to 20th, 2020 was carried out for potential mosquito breeding sites. The target garden has displayed distinct characteristics; it is shady, well vegetated and wet, and it is located within an urban area, far about 500 m from a 30,000 m^2 forest cover.

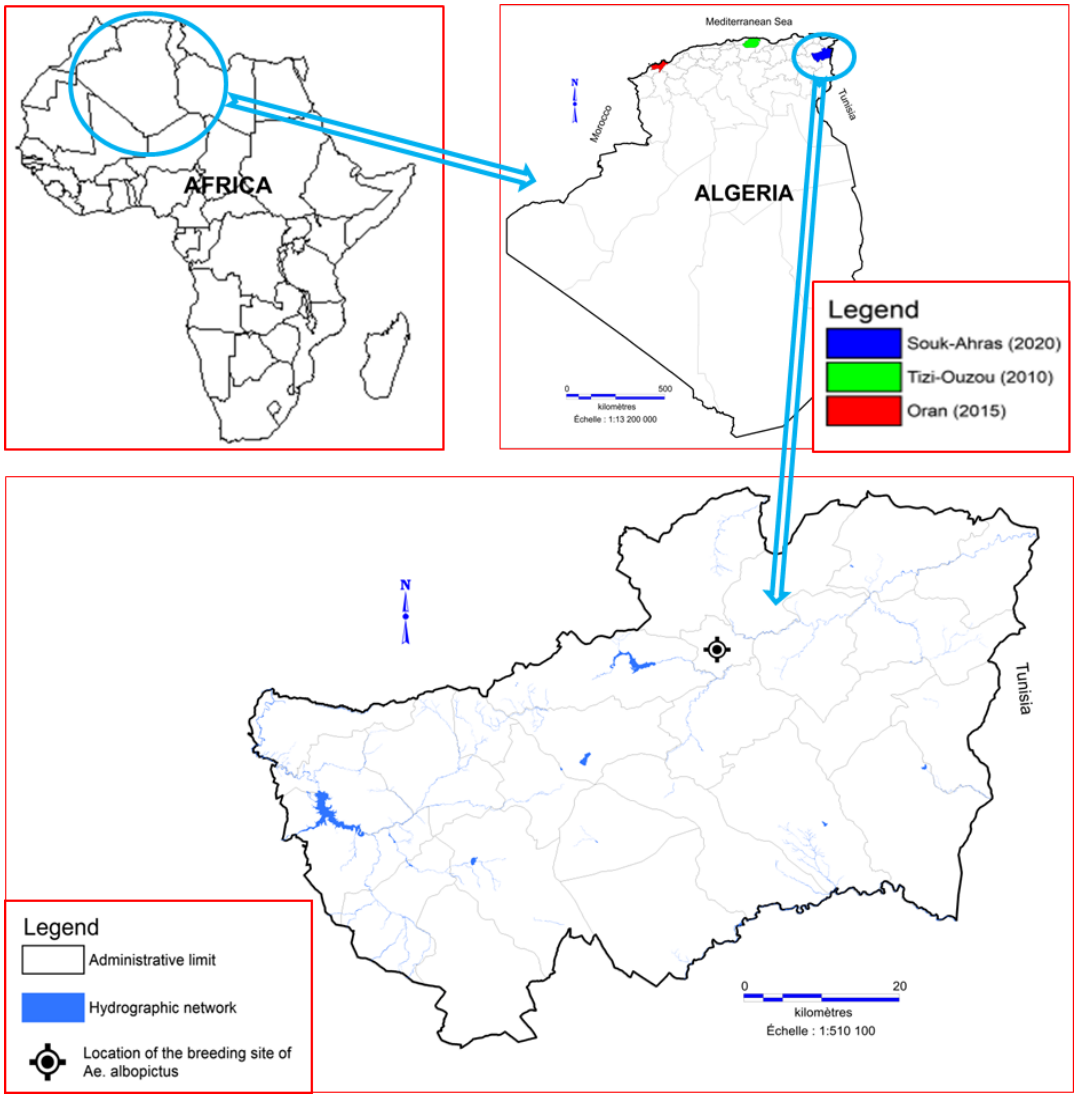

Figure 1. Location of *Ae. albopictus* first detections in Mediterranean coast (realized with Mapinfo Pro 12.0, 2021)

Figure 2. Breeding site of *Ae. albopictus* in Souk-Ahras (Algeria): A. Google-Earth; B. Residential garden

Mosquito collection

Twenty residential properties were checked during this survey where all kinds of artificial water containers, flowerpots, reservoirs, basements, wheelbarrows and construction containers have been surveyed. Immature stages (larvae and pupae) were collected using a dipper, while sampling of resting adults was carried out with manual aspirator consisting of a silicone tube, a mouth piece, a mesh and a glass tube. A total of 105 individuals (8 larvae, 24 pupa and 73 adults) were collected. The immature stages (larvae and pupae) were maintained in their breeding water site in the insectarium of laboratory of Applied Animal Biology (Faculty of Sciences, Department of Biology, University Badji Mokhtar, Annaba) until emergence of the adults. The rearing cage (40 cm^3) with a wooden frame was covered with mesh allowing excellent transparency, and allowed access through the 15cm sleeve opening. Adults were then identified using the morphological key by Schaffner et al. (2001).

RESULTS AND DISCUSSION

Aedes albopictus (Skuse, 1894) (Diptera: Culicidae) is an invasive mosquito native from Southeast Asia (Lizuain et al. 2019). It is best known as a vector of several viruses of public health significance (Bohers et al. 2020; Ferreira-de-Lima et al. 2020; Vega-Rúa et al. 2020; Vega-Rúa et al. 2020) such as dengue, chikungunya, and Zika. There were a recent series of outbreaks of these diseases around the world (Calba et al. 2017; Venturi et al. 2017; Vasqueza et al. 2018; Franke et al. 2019). *Aedes albopictus* is well-established in southern European countries (Balaska et al. 2020). Italy seems to be the origin of its recent spread increasing rate in Europe (Kraemer et al. 2019). Also, recent arboviral outbreaks were more concentrated in urban areas in West Africa (Buchwald et al. 2020).

This remarkable invasion was due in the first place to its great ecological plasticity (Benelli et al. 2020; Kramer et al. 2021), especially by dry-resistant eggs easily transportable through used tires and other containers (Kamal et al. 2018). Especially that high invasion of *Aedes* mosquitoes in these artificial habitats was reported (Bennett et al. 2019; Lizuain et al. 2019; Malla et al. 2019; Wilke et al. 2019; Dallimore et al. 2020). Moreover, expansion of suitable vector habitats was probably the key factor caused by climate changes (Khan et al. 2020; Echeverry-Cárdenas et al. 2021). It was reported that this invasive vector appeared to have a high cold tolerance (Tippelt et al. 2019). In Algeria, the establishment and distribution of the *Ae. albopictus* is still unknown. This lack of information about its dynamic distribution restricted establishment of risk maps (Ducheyne et al. 2018; Monaghan et al. 2019). Thus, it is crucial to better understand the current distributions for effective surveillance programs and diseases risk management. So, this emergency plan needs to make more collections in other surrounding regions in both indoor and outdoor places.

Only few occasional detections of *Ae. albopictus* in the Algerian coast have been mentioned previously. In 2010, one invasive mosquito female had initially been captured in a stable in Tizi-Ouzou (Larabaa Nath Irathen locality) (Izri et al. 2011). However, this species had not been found again until 2014 through an updated mosquito list in Illoula Oumalou village (Tizi-Ouzou province), where two adult specimens of this same species were recorded (Lafri et al. 2014). This second locality is situated 40 km to the east of the first village.

In 2015, *Ae. albopictus* reappeared in the west of the country, in Oran in the seaside resort of Ain Turk, where all developmental stages (from egg to adult) were found during two consecutive years, which means that this species has settled well (Benallal et al. 2016). In addition to these occasional records in the Mediterranean coast,

Ae. albopictus larvae and adults were first collected in Rabat (Morocco) on early September 2015 (Bennouna et al. 2017) and in Tunisia in 2018 (Bouattour et al. 2019). Unlike these three detections of *Ae. albopictus* between 2010 to 2015, there has been no record in eastern Algeria until now, suggesting that it has recently successfully invaded several new Algerian areas (Benallal et al. 2019). With these sightings of *Ae. albopictus* in various regions of Algeria, there would be a necessity to use ecological niche models as potential identifiers of invasion in new areas and therefore, subsequently, identification and collections in those new areas.

Citizens play a key role in detection of this mosquito, as well as in its spread and control. A report of unusual daytime bites by a striped mosquito was made by residents from Souk-Ahras province (eastern Algeria). On early September 2020, a total of 105 specimens of different development instars of *Ae. albopictus* were collected after an intensive field inspection in twenty residential properties from a residential shady vegetated garden in a pile of old tyres (Figure 2). After specimens identification as *Ae. albopictus* (Figure 3), all artificial containers were inspected as potential larval sites and they were immediately eliminated in order to avoid the further spreading of this mosquito.

Aedes albopictus adults are distinguished by a black scutum with a continuing median longitudinal white stripe along the thorax (Figure 3-B). They are also recognized by their black legs with distinct white basal scales on each tarsal segment (Figure 3-D). Our findings suggest the presence of *Ae. albopictus* in Souk-Ahras. *Aedes albopictus* was caught in three habitat types; rural, peri-urban and urban areas (Mayi et al. 2020).

Aedes albopictus prefers shady areas where it rests in shrubs near the ground (Kamgang et al. 2019). Several recent studies revealed a high infestation of invasive *Aedes* mosquitoes in used tires in several countries (Bennett et al. 2019; Lizuain et al. 2019; Malla et al. 2019; Wilke et al. 2019; Dallimore et al. 2020). Tires represent a perfect refuge of immature mosquitoes from predators and the rubber guarantees efficient thermal insulation (Wilke et al. 2019). *Aedes albopictus* is characterized by its eclectic feeding behavior, and its ecological preference to urban and peri-urban vegetated settings for feeding and resting (Lounibos and Kramer 2016). This kind of habitats was found to improve adult fitness and reproductive success (Muhammad et al. 2020).

Unlike *Ae. aegypti* spread which is characterized by long distance importations, *Ae. albopictus* has expanded more along the fringes of its distribution (Kraemer et al. 2019). Known that the Asian tiger mosquito is well established in Tunisia (Bouattour et al. 2019), it was expected to detect it in Souk-Ahras (Tunisian border). Especially since Souk-Ahras province is considered as a transit point for various export traffic. Alarmingly, it was demonstrated experimentally that *Ae. albopictus* Tunisian strain was competent to transmit chikungunya, Zika and dengue viruses (Bohers et al. 2020). *Aedes albopictus* is well adapted for specific urban settings. Urbanization increases adult survivorship and fecundity (Muhammad et al. 2020). The most reliable method to predict the spread and establishment of new mosquito species is the systematic surveillance (Schoener et al. 2019). Fortunately, the low abundance of *Ae. aegypti* in our study area could make it easier to control. But, first record could probably mean its establishment anywhere, so monitoring of this species is recommended even at this level. Newly emerged vector distribution and spread maps are required to carry out effective surveillance strategies and to improve current vector control and surveillance.

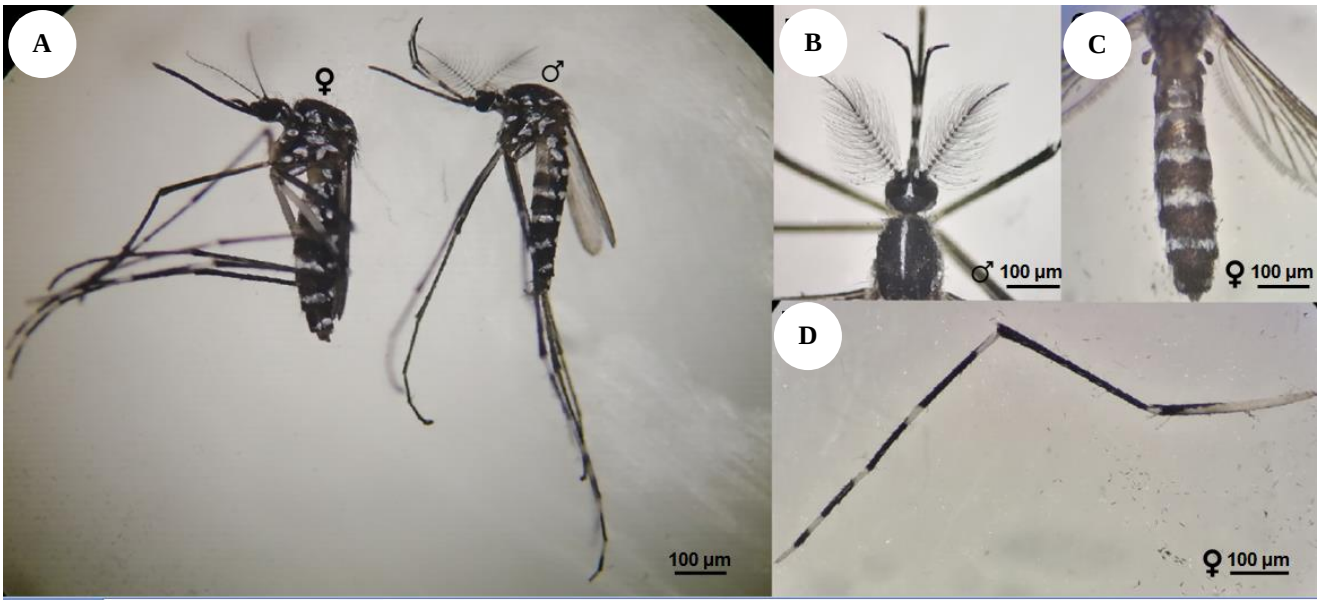

Figure 3. *Aedes albopictus*. A. Adults; B. Thorax; C. Abdomen; D. Third leg

Our results highlight the effectiveness of 'passive surveillance' for tracking invasive mosquitoes involving citizens. In response to this new detection in northeastern Algeria of *Ae. albopictus*, it is strongly recommended to inform the public about preventive procedures to delay its spread and development, especially because of its quick adaptation in urban areas (Muhammad et al. 2020). Further investigations are requested to assess the capacity of *Ae. albopictus* in Arbovirus transmission to more focus on preventive strategies by national public health authorities.

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