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Research Article

# An updated checklist of the Culicinae (Dip., Culicidae) in north-eastern Morocco, with new distribution data

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**Abstract.** Several species of mosquitoes from the subfamily Culicinae play a significant role in public health as vectors of arboviruses. Of the over 3000 recorded Culicinae species worldwide, 43 are present in Morocco. Of these, 14 are recognized as potential vectors of viruses such as West Nile (WNV), Zika (ZIKV), yellow fever (YFV), and chikungunya (CHIKV). This study aims to update the distribution of mosquito species in north-eastern Morocco. Larval surveys conducted at 20 sites yielded the collection and identification of 13 species across four genera. *Culex* was the dominant genus with eight species and the widest distribution. Aedes followed *this* with three species. The genera *Culiseta* and *Uranotaenia* were each represented by a single species. Five of these species are potential arbovirus vectors, and seven are new records for the study region. This updated inventory of the culicid fauna, including new reports and data on ecological distribution, greatly enhances our understanding of the Culicinae community composition in north-eastern Morocco. These results provide a vital basis for assessing arboviral risks and implementing targeted vector control strategies, thereby helping to improve public health measures in the region.

**Keywords**: *Aedes*, *Culex*, *Culiseta*, *Uranotaenia*, Rif Morocco

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## Introduction

Mosquitoes (Diptera: Culicidae) are a globally important group of arthropods, comprising over 3,729 species found worldwide (Harbach, 2026), from tropical to temperate regions. They have a considerable impact on public and veterinary health, particularly the hematophagous species of the Culicinae subfamily, which act as competent vectors for a multitude of pathogens. These insects transmit parasites that cause malaria and filariasis. Still, they are most notable for transmitting emerging or re-emerging arboviruses, including dengue virus (DENV), Zika virus (ZIKV), chikungunya virus (CHIKV), yellow fever virus (YFV), West Nile virus (WNV), and Rift Valley fever virus (RVFV) (Trari & Dakki, 2017). Morocco is recognised as a high-risk area for the emergence of vector-borne diseases, given its strategic geographical location, climatic diversity, and increased exposure to international trade, particularly with Europe and sub-Saharan Africa. This also promotes the rapid spread of insect vectors, thereby exposing a large proportion of the population to these health threats (Guimerà *et al.*, 2005; Perrings *et al.*, 2005).

To date, 43 mosquito species have been recorded in the country (Trari & Dakki, 2017). Of these, at least 14 species, belonging to the subfamily Culicinae, have been confirmed as potential vectors of human and animal pathogens (Trari *et al.*, 2017). These insects have been extensively studied worldwide, including in our country. However, there is a significant knowledge gap in the Eastern Rif region of northeastern Morocco. Systematic entomological inventories are sorely lacking in this region, leaving the local species diversity, species distribution,

and vector potential largely unknown. This study aims to address this issue. An inventory of mosquito species in this region is an essential preliminary step for any accurate assessment of arboviral risk. By mapping species diversity and distribution and identifying potential vectors, this work provides an indispensable scientific basis. These data are essential for implementing targeted epidemiological surveillance programs and appropriate vector control strategies, thereby actively contributing to the protection of public health in northeastern Morocco and beyond.

## Materials and methods

### Study area and sampling sites

This study was conducted in the Eastern Rif region of northeastern Morocco. The study area encompasses the provinces of Al Hoceïma, Nador, and Driouch and forms the eastern extension of the Rif mountains range. Geographically, the Eastern Rif is bordered by the Mediterranean Sea to the north, the Central Rif to the west, the Algerian border to the east, and the Taza-Oujda corridor to the south. The region has a Mediterranean climate, ranging from semi-arid to arid, with an average annual rainfall of 200-400 mm. Targeted sampling was conducted within this area, with a specific focus on the coastal province of Al Hoceïma. This province exhibits a more pronounced maritime-influenced Mediterranean climate, with generally higher rainfall than the broader region. For this study, twenty sites were selected; their geographical location within the study area is presented in Fig. 1. A sampling campaign was conducted across 20 distinct sites in Morocco, particularly in the Eastern Rif region, due to the lack of data on arbovirus vector mosquitoes. This three-year study (February 2021 to December 2023) targeted 20 larval breeding sites of various types, including both natural and artificial habitats (Table 1).

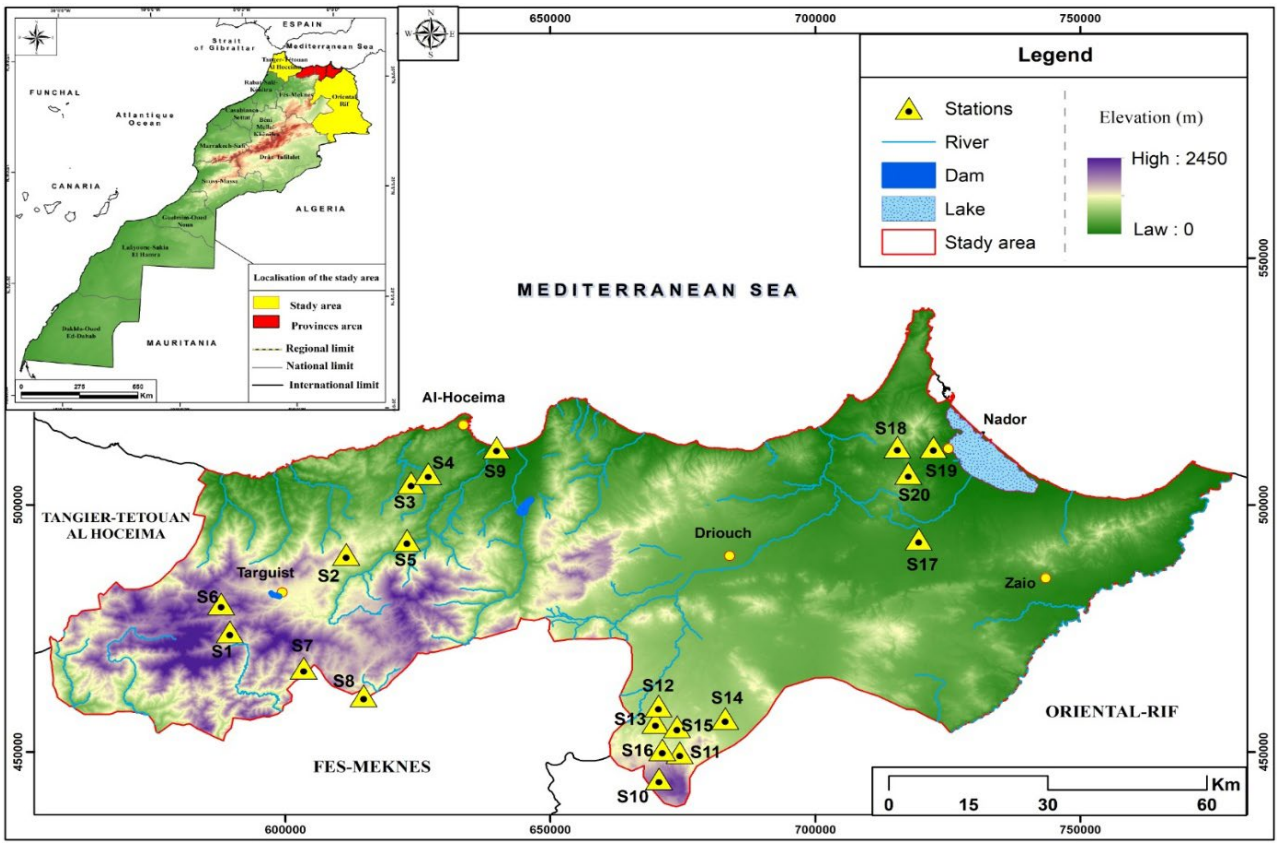


Fig.1. Distribution map of the study area showing the investigated sites

Table 1. Sampling sites in the Oriental Rif Region, Northeastern Morocco

| Code | Stations | Localities | Altitude | Latitude | Longitude |
|---|---|---|---|---|---|
| S1 | Bni bounsar | Al Hociema | 1250 | 34°50'32.85"N | 4°25'17.63"W |
| S2 | Tigart | Bni Hdifa | 1205 | 35° 0'27.90" N | 4°11'30.96"W |
| S3 | Oued Merika | Bni Hdifa | 246 | 35° 8'11.09"N | 4° 5'3.14"W |
| S4 | Oued Bouham | Ait Kamra | 244 | 35° 8'26.70"N | 4° 0'40.37"W |
| S5 | Bni Abdelah | Al Hociema | 747 | 35° 3'14.96"N | 4° 5'17.37"W |
| S6 | Oued Taghzout | Tabrant | 1070 | 34°46'22.31"N | 4°31'43.32"W |
| S7 | Oued Sra1 | Al Hociema | 284 | 34°31'33.79"N | 4°37'1.46"W |
| S8 | Oued Sra 2 | Al Hociema | 290 | 34°31'32.38"N | 4°38'2.50"W |
| S9 | Oued Boukidan | Plage Souani | 278 | 35°11'49.62"N | 3°51'47.11"W |
| S10 | Ain Lahssan | Driouch | 525 | 34°22'38.46"N | 3°31'33.83"W |
| S11 | Zaouia | Driouch | 690 | 34°37'56.2"N | 3°29'49.6"W |
| S12 | Ain Zohra 1 | Driouch | 822 | 34°39'36.42"N | 3°32'23.96"W |
| S13 | Ain Zohra 2 | Driouch | 834 | 34°39'20.24"N | 3°33'16.34"W |
| S14 | Taouima | Nador | 290 | 35° 6'46.08"N | 2°55'37.44"W |
| S15 | Khouilaf 1 | Driouch | 587 | 34°38'43.51"N | 3°20'55.71"W |
| S16 | Khouilaf 2 | Driouch | 764 | 34°39'58.64"N | 3°31'34.13"W |
| S17 | Ain Ayad | Driouch | 862 | 34°38'41.37"N | 3°32'21.79"W |
| S18 | Zeghanghane | Nador | 124 | 35°08'42.2"N | 3°00'56.6"W |
| S19 | Bouarouro 1 | Nador | 249 | 35° 9'27.73"N | 2°54'22.00"W |
| S20 | Bouarouro 2 | Nador | 250 | 35° 9'16.67"N | 2°54'20.82"W |

### Sampling Method

Monthly sampling was conducted based on two main criteria: the presence of mosquito larvae at a given breeding site and the site accessibility. Larvae were collected using the dipping technique (Coffinet *et al.*, 2009). Semi-quantitative larval sampling was performed using a Langeron net. The number of dips taken varied according to the size (surface area) of each breeding site and the apparent larval density. During each collection event, Pasteur pipettes were used to capture the larvae collected. All samples were meticulously labelled with the date, location, and breeding site identification number. Finally, the fauna samples were preserved in 70% alcohol for subsequent analysis.

### Laboratory Analysis

The collected mosquitoes were identified at the species level using morphological criteria and the Moroccan identification key (Himmi *et al.*, 1995)as well as the CD-ROM key by (Brunhes *et al.*, 2000). Morphological identification was conducted at two facilities: The Laboratory of Ecology, Systematics, and Conservation of Biodiversity (LESCB), Faculty of Sciences, Abdelmalek Essaâdi University, Tetouan, Morocco, and the National Institute of Hygiene (NIH), Rabat, Morocco.

## Results

We identified 13 species (Fig. 2), members of four genera (*Aedes*, *Culex*, *Culiseta*, and *Uranotaenia*) of the subfamily Culicinae, collected in north-eastern Morocco. Five of these species are potential arbovirus vectors, and seven are new records for the study region.

### *Ae. (Och.) pulcritarsis* (Rondani, 1872)

*Aedes pulcritarsis* exhibits specialized larval ecology, developing exclusively in dendrolimnic habitats characterized by tannin-rich waters containing decomposing plant matter. The species shows a marked preference for oak tree cavities. Within our study area, the species was identified in similar habitats within an *Eucalyptus* plantation, where larvae were collected in plant detritus-rich water, alongside *Uranotaenia unguiculata*. From a vector perspective, *Ae. pulcritarsis* is not considered a significant nuisance and is not implicated in the transmission of known human pathogens. This study reports the first occurrence of this species in the study area.

### *Ae.* (*Och.*) *caspius* (Pallas, 1771)

At the Bouarouro site, we identified *Aedes caspius*. *Aedes detritus* s.l. and *Cx. pipiens* were also found. These species were primarily located in large larval habitats characterized by fresh to slightly brackish water. These habitats were characterized by aquatic vegetation and a notable abundance of algae, creating favourable ecological conditions for larval development.

### *Ae.* (*Och.*) *detritus* (Haliday, 1833)

*Aedes detritus* has been observed at three sites (Bouarouro 1, Bouarouro 2, and Oued Boukidan), where it occasionally co-occurs with *Aedes caspius*, particularly at Bouarouro. This strictly halophilic species primarily develops in large, brackish larval habitats such as estuaries, coastal marshes, semi-permanent ponds, and stagnant lagoons. The larvae develop specifically in habitats with high salinity.

### *Cx. (Cux.) brumpti* Galliard, 1931

*Culex brumpti* were identified in a larval habitat characteristic of the Oued Sra station. This site is characterized by small collections of stagnant water with a rocky, shallow bottom. This study reports the first occurrence of this species in the study area.

### *Cx.(Cux.) laticinctus* Edwards, 1913

Larvae were collected in a wide variety of biotopes, including both polluted and clean freshwater habitats. They were found in both natural habitats (rock pools, springs) and artificial habitats (cisterns, barrels, water storage basins, and irrigation canals). This ecological plasticity explains its abundance in the region.

### *Cx. (Cux.) mimeticus* Noè, 1899

*Culex mimeticus* has been recorded in several localities within the study area, including Zeghanghane, Ain Lahssan, Tigart, Bni Bounssar, Taghzout, Ain Zohra, Ain Ayad, Khouilaf, and Taouima. This wide distribution indicates notable adaptability to diverse lentic environments. The larval stages of *Cx. mimeticus* were primarily observed in natural habitats with stagnant or slow-flowing water.

### *Cx. (Cux.) perexiguus* Theobald, 1903

The *Culex perexiguus* was identified in several localities within the study area, notably in Bni Bounssar, Oued Sra, Khouilaf 2, and Zeghanghane. Its larval ecology is characterized by high plasticity, with development observed in various freshwater habitats.

### *Cx. (Cux.) pipiens* Linnaeus, 1758

In our study area, *Cx. pipiens* was identified in the majority of surveyed sites (Oued SRA, Khouilaf, Tigart, Zeghanghane, Oued Merika, Taghzout, Khouilaf 2, Zaouia, Ain Lahssan, Bni Bounssar, Bouarouro), confirming its status as the most abundant species. It was found in a variety of breeding sites, including organically rich, polluted waters, wastewater, streams (wadis), and natural and artificial habitats ranging from permanent to temporary.

### *Cx. (Cux.) theileri* Theobald, 1903

*Culex theileri* was identified in several localities within the study area (Oued SRA, Zeghanghane, Ain Lahssan, Bni Bounssar, Taghzout, Ain Ayad). Its larval habitat varied from small collections (rock pools) to larger ditches. A common feature of all positive breeding sites was the presence of organic matter, in the form of plant debris or pollution, indicating a marked preference for freshwater.

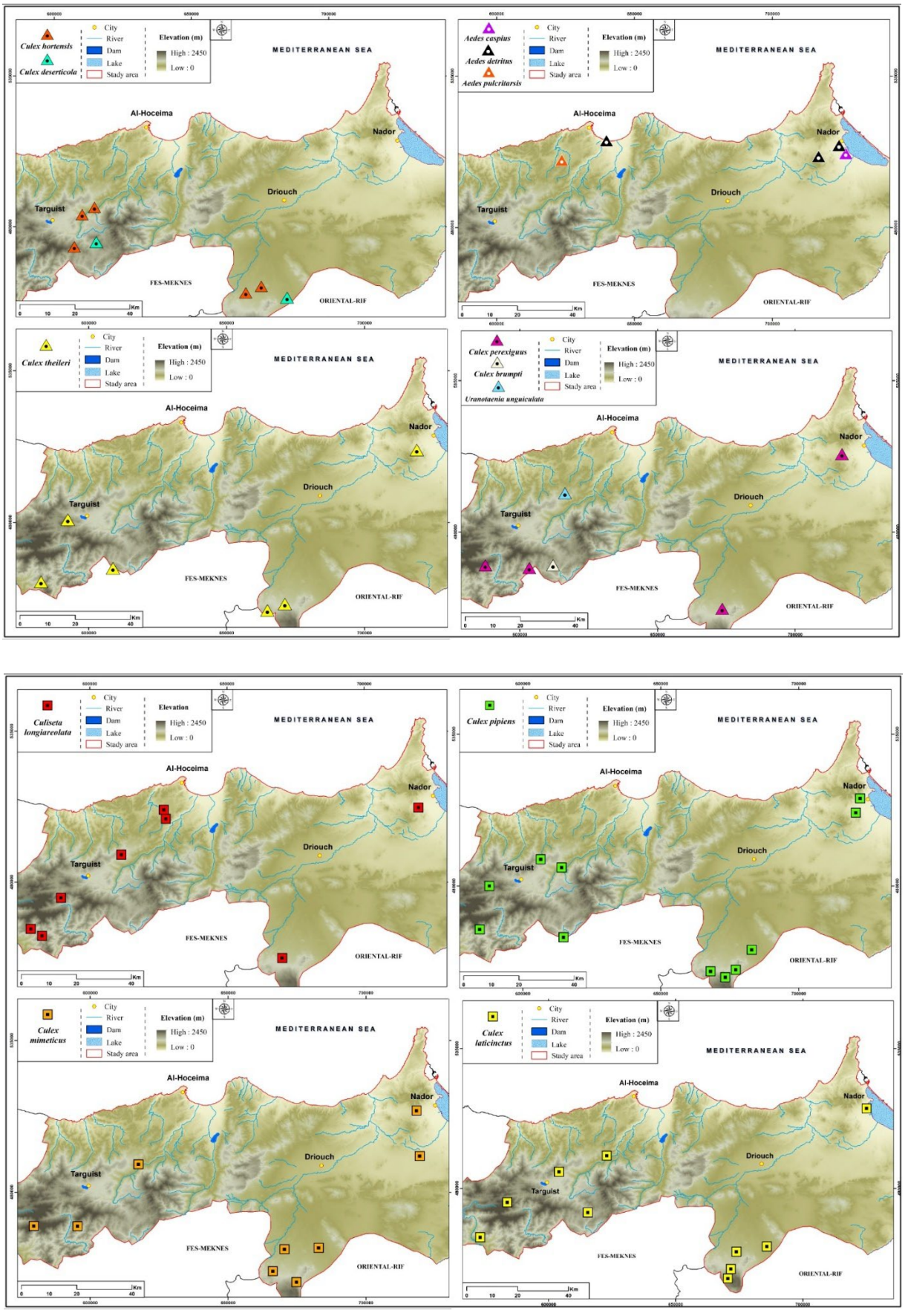


Fig.2. Spatial distribution of Culicinae species in the study area

### *Cx.* (*Mai.*) *deserticola* Kirkpatrick, 1925

*Culex deserticola* was identified in our study area, specifically in the Oued Sra and Khouilaf. Localities. It was found in rocky-larval habitats characterized by fresh, stagnant water. This is the first time it has been recorded in the study area.

### *Cx. (Mai.) hortensis* Ficalbi, 1889

*Culex hortensis* was identified in three distinct localities within the study area: Oued Sra1, Tigart, Bni Bounssar Ain Zohra1 and Ain Zohra 2. Collections revealed larval development of this species in natural stagnant freshwater habitats as well as in anthropogenic water storage basins. This observation constitutes the first confirmed record of *Culex hortensis* in this region.

### *Cs. (All.) longiareolata* (Macquart, 1838)

*Culiseta longiareolata* was recorded at several sites in the study area, including Oued Sra 1, Oued Sra 2, Oued Bouham, Ain Zohra, Zeghanghane, Bni Bounssar, Taghzout, Bni Abdelah, and Tigart. This ubiquitous species, known for its high ecological plasticity, was collected in a wide variety of freshwater larval habitats. Its preferred habitats included natural features such as temporary pools and rock holes, as well as artificial structures like water storage basins. These sites often had stagnant water. This study reports the first confirmed occurrence of *Cs. longiareolata* in the study area.

### *Ur. (Pfc.) unguiculata* Edwards, 1913

*Uranotaenia unguiculata* develops mainly in shallow marshes with abundant vegetation. Its larvae adopt a position parallel to the water surface, similar to Anopheles, while adults exhibit specialized zoophilic behavior, targeting amphibians and reptiles. In our study area, the presence of *Ur. unguiculata* larvae was confirmed in freshwater collections rich in plant detritus within an eucalyptus plantation, where the species was found alongside *Aedes pulcritarsis*. This observation constitutes the first record for this species in the geographical area under consideration.

## Discussion

*Aedes (Ochlerotatus) pulcritarsis* and *Uranotaenia unguiculata* were collected together in dendrolimnetic habitats (tannin-rich waters with plant debris) within a eucalyptus plantation. This ecological association has not been previously documented in Morocco. *Aedes pulcritarsis*, a Palearctic species closely related to *Ae. berlandi* (Severini *et al.*, 2009), has been recorded in Italy (Severini *et al.*, 2009), Spain (Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012), France (Moussiegt, 1991; Schaffner, 1998), and Maghreb countries, including Tunisia (Sicart, 1942; Moussiegt, 1983; Bouattour, 2013), Algeria (Bettioui, 2008), Austria (Bakran-Lebl *et al.*, 2022), and Morocco (Trari *et al.*, 2002; Trari & Dakki, 2017). It remains relatively uncommon in Morocco (Trari, 2017). Our observation confirms its presence in a previously unreported area and specifies its preferred habitat (tree holes with tannic waters).

*Uranotaenia unguiculata*, a species native to Palestine and the only tropical representative of its genus in the Mediterranean (Senevet & Andarelli, 1959), is widespread in southern Eurasia (Šebesta *et al.*, 2010) and has been reported in southern Europe (Schaffner, 1998; Almeida *et al.*, 2005; Severini *et al.*, 2009; Bueno-Marí *et al.*, 2012). In North Africa, it has been recorded from Egypt to Morocco (Harbach *et al.*, 1988; Trari, 2017), with a more marked presence on the Moroccan Atlantic coast. Our study extends its distribution to a new locality and confirms its development in freshwater rich in decomposing vegetation. *Culex brumpti*, recorded for the first time in our study area (Oued Sra), was originally described in Corsica (Galliard, 1931) and later found in Sardinia (Aitken, 1954), Italy (Severini *et al.*, 2009), and France, exclusively in Corsica (Schaffner, 1998), but not in Spain (Bueno-Marí *et al.*, 2012). In Morocco, it was first identified in the Gharb North Atlantic coastal plain (Bailly-Choumara, 1968, 1972) and the Marrakesh region (Bailly-Choumara, 1968), and confirmed near Fez (El Ouali

Lalami *et al.*, 2010). Its presence in small, stagnant bodies of water with a rocky, shallow bottom aligns with its known ecology.

*Aedes caspius* and *Aedes detritus* co-occurred at Bouarouro in large larval habitats characterized by fresh to slightly brackish water with aquatic vegetation and abundant algae. *Ae. caspius* has a broad Palearctic distribution, ranging from Europe to Central Asia and North Africa, including Morocco and Egypt (Robert *et al.*, 2019). It is particularly abundant in the Mediterranean basin, reported in Italy, Belgium, France (Balenghien *et al.*, 2008; Carron *et al.*, 2008), Spain (Gutierrez-Lopez *et al.*, 2019), and North African countries (Egypt, Libya, Algeria, Tunisia, and Morocco). In Morocco, this species, first described as *Aedes punctatus* (Séguy, 1930), is prevalent in both coastal and inland wetlands, particularly at low altitudes (Trari, 2017). Our study confirms its ecological plasticity. *Aedes detritus* is a Palearctic species primarily found in coastal areas of Europe and North Africa. In Europe, it is well-documented along the coastlines of the United Kingdom (Blagrove *et al.*, 2016), Italy (Mancini *et al.*, 2017), Belgium (Boukraa *et al.*, 2015), France (Brengues *et al.*, 2014), and Spain (Ruiz-Arrondo *et al.*, 2019). In North Africa, it has been reported in Egypt (Abdel-Hamid *et al.*, 2011), Tunisia (Ben Ayed *et al.*, 2019), Algeria (Metge & Hassaïne, 1998), and Morocco (Trari, 2017). In Morocco, *Ae. detritus* is strictly limited to Atlantic (Tanger-Tantan) and Mediterranean (Tanger-Saïdia) coastal zones due to its dependence on saline larval habitats (Trari, 2017). Its presence in three of our sites corresponds to this distribution.

Both species are competent vectors for several arboviruses: *Ae. caspius* for Tahyna virus (Pilaski & Mackenstein, 1985), West Nile virus (Orshan *et al.*, 2008; Ergunay *et al.*, 2014), Rift Valley fever virus (Turell *et al.*, 1996; Tantely *et al.*, 2015), Sindbis virus (Lundström, 1999), and Usutu virus (Cook *et al.*, 2018). *Aedes detritus* is a competent vector for Zika, chikungunya, Japanese encephalitis, West Nile virus and Rift Valley fever (Balenghien *et al.*, 2008; Mackenzie-Impoinvil *et al.*, 2015; Tantely *et al.*, 2015; Lumley *et al.*, 2018; Blagrove *et al.*, 2020). *Culex pipiens* was the dominant species in our sampling (11 localities), confirming its status as the most abundant and ubiquitous species in Morocco (Amraoui *et al.*, 2012a). This cosmopolitan species is widely distributed across temperate regions, particularly in the Mediterranean basin (Amraoui *et al.*, 2012a; Brugman *et al.*, 2018), and is found in Europe, North Africa, Asia, Australia, and the Americas. It exists in two morphologically identical but ecologically distinct biotypes: the *pipiens* form (anautogenous, eurygamous, heterodynamic) and the *molestus* form (autogenous, stenogamous, homodynamic) (Farajollahi *et al.*, 2011). In Morocco, *Cx. pipiens* comprises two main forms (urban *pipiens* and rural *molestus*), as well as hybrids, which coexist in regions such as Marrakech and Casablanca (Amraoui *et al.*, 2012b). Its presence in polluted waters, wastewater, wadis, and natural and artificial habitats demonstrates remarkable adaptation to anthropized environments. This ubiquity is concerning because *Cx. pipiens* is a major vector of West Nile virus (Amraoui *et al.*, 2012a), Usutu virus (Calzolari *et al.*, 2010), and Rift Valley fever virus (Meegan *et al.*, 1980).

*Culex laticinctus*, found in 10 very diverse localities (rock pools, springs, cisterns, irrigation canals, polluted or clean waters), shows rare ecological plasticity for a species primarily associated with desert regions of the Mediterranean basin. It is widespread in Africa and Mediterranean regions, ranging from the Canary Islands to the Middle East (Gutsevich *et al.*, 1974; Becker *et al.*, 2010). It is present in Europe, particularly in Italy, Spain (Severini *et al.*, 2009) (Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012), Portugal (Ribeiro *et al.*, 1988; Almeida *et al.*, 2005), Malta, Greece, Romania, Turkey (Snow & Ramsdale, 1999), and Croatia (Zitko & Merdic, 2006). In North Africa, it has been reported in Egypt (Harbach *et al.*, 1988), Libya (Goodwin, 1961), Tunisia(Moussiegt, 1983; Bouattour, 2013), Algeria (Messai *et al.*, 2011; Bouabida *et al.*, 2012; Boudemagh *et al.*, 2013), and Morocco (Trari *et al.*, 2002; Trari *et al.*, 2017). First reported in northern Morocco (Himmi, 2007), our study confirms its presence in several new localities.

*Culex perexiguus* identified at four localities (Fig. 2), exhibits great adaptability to various freshwater habitats. This species is widely distributed across North Africa and Southwest Asia, extending as far as India (Harbach *et al.*, 1988). It has been reported in Italy (Severini *et al.*, 2009), Spain (Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012), Albania, Bulgaria, Greece, Portugal (Snow & Ramsdale, 2004), Malta (Gratt, 2009), Saudi Arabia (Al Ahmad *et al.*, 2011), and North African countries including Egypt (Harbach *et al.*, 1988), Mauritania (Hamon *et al.*, 1966), Libya (Goodwin, 1961), Tunisia(Moussiegt, 1983; Bouattour, 2013), Algeria (Tine-Djebbar *et al.*, 2011; Bouabida *et al.*, 2012), and Morocco (Trari *et al.*, 2002; Trari *et al.*, 2017). It is a confirmed vector of West Nile virus (Cornel *et al.*, 1993; Miller *et al.*, 2000; Jupp, 2001). *Culex mimeticus* observed in nine localities (Fig. 2),

prefers stagnant or slow-flowing waters in natural habitats. This species is widely distributed across the Far East, the Middle East, and the Mediterranean basin. In Europe, it has been recorded in Italy (Severini *et al.*, 2009), France (Schaffner, 1998), and Spain (Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012; Bueno-Marí *et al.*, 2014). In North Africa, it is primarily found in mountainous regions such as the Algerian Tell and in steppes (Senevet & Andarelli, 1959). Records also exist from Egypt (Harbach *et al.*, 1988), Algeria (Sergent, 1909; Bouabida *et al.*, 2012), Tunisia(Sicart, 1942; Moussiegt, 1991; Bouattour, 2013), and Morocco (Trari *et al.*, 2002; Trari *et al.*, 2017). In Morocco, although common, it shows a preference for mid- to high-altitude regions (Trari, 2017).

*Culex theileri* presents in six localities (Fig. 2), was consistently found in freshwater rich in organic matter (plant debris or pollution). This species is widely distributed throughout the Mediterranean region, the Canary Islands, Iraq, Yemen, Aden, India, and southern and eastern Africa (Senevet & Andarelli, 1959). In Europe, it has been found in Spain(Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012), including the Canary Islands (Martínez-De La Puente *et al.*, 2012), France (Schaffner, 1998), Italy (Severini *et al.*, 2009), and more recently Malta (Schaffner *et al.*, 2010). In North Africa, it has been reported in Egypt (Harbach *et al.*, 1988), Algeria (Messai *et al.*, 2011; Tine-Djebbar *et al.*, 2011; Bouabida *et al.*, 2012; Benhissen *et al.*, 2014), Tunisia (Moussiegt, 1983; Bouattour, 2013), and Morocco (Trari *et al.*, 2002; Trari *et al.*, 2017), where it occupies a broad distribution range (Trari, 2017). *Culex theileri* is a confirmed vector of West Nile virus in Morocco (Amraoui *et al.*, 2012a). *Culex deserticola*, a Saharan species originally described in Egypt (Kirkpatrick, 1925), was found at Oued Sra and Khouilaf. This species is widely distributed across the southern Mediterranean region, from Morocco to Southwest Asia. It has recently been observed in Spain (Ramos *et al.*, 2002) and northern Algeria (Messai *et al.*, 2011), showing signs of northward expansion, including in Morocco, where it has now exceeded its historical limits (Gaud, 1947). These observations suggest adaptation to environmental changes. Its presence in our area represents the first record for the study area.

*Culex hortensis*, often confused with *Cx. deserticola* in the past (Callot, 1942; Senevet, 1947), was formally identified in five localities (Fig. 2). This species is primarily found in southern Europe, North Africa, and the Atlantic islands. In Europe, it has been reported in Italy (Severini *et al.*, 2009), Spain (Aranda *et al.*, 2000; Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012; Bueno-Marí *et al.*, 2014), France (Schaffner, 1998), and Belgium (Boukraa *et al.*, 2015). In North Africa, it has been identified in Algeria (Messai *et al.*, 2011; Bouabida *et al.*, 2012), Tunisia (Moussiegt, 1983; Bouattour, 2013), and Morocco(Trari *et al.*, 2002; Trari *et al.*, 2017), where it remains widely distributed, particularly in high-altitude areas. This is the first confirmed record for our region. *Culiseta longiareolata* was recorded in nine sites (Fig. 2), demonstrating a strong capacity to colonize stagnant freshwater habitats. This species is widely distributed across the Palearctic region, India, eastern and southern Africa, as well as the Canary and Azores archipelagos. In Europe, it is present in Greece (Linton *et al.*, 2007), France (Rageau *et al.*, 1970), Spain (Aranda *et al.*, 2000; Eritja *et al.*, 2000; Bueno-Marí *et al.*, 2012; Bueno-Marí *et al.*, 2014), Italy (Severini *et al.*, 2009), the Canary Islands (Martínez-De La Puente *et al.*, 2012), Austria, Slovenia (Seidel *et al.*, 2013), and Germany (Becker & Hoffmann, 2011). Its presence has been documented in several North African countries, including Egypt (Harbach *et al.*, 1988), Mauritania (Hamon *et al.*, 1966), Libya (Vermeil, 1953; Goodwin, 1961), Tunisia (Moussiegt, 1983; Bouattour, 2013), Algeria (Messai *et al.*, 2011; Tine-Djebbar *et al.*, 2011; Bouabida *et al.*, 2012; Boudemagh *et al.*, 2013; Benhissen *et al.*, 2014; Dahchar *et al.*, 2016), and Morocco (Trari *et al.*, 2002; Trari *et al.*, 2017).

## Conclusion

Due to the high competence of certain species in transmitting pathogens to humans and animals, mosquitoes represent the most significant group of vectors in public health. Therefore, characterizing the culicid fauna and its geographical distribution is essential for assessing potential transmission risks and anticipating epidemic outbreaks. Our inventory identified 13 species of mosquito in the eastern Rif region, divided into four genera: *Culex*, *Aedes*, *Culiseta*, and *Uranotaenia*. Five of these species are recognized as potential vectors of arboviruses: *Aedes caspius, Aedes detritus, Culex pipiens, Culex theileri,* and *Culex perexiguus*. Notably, *Aedes detritus*, a major arbovirus vector in Morocco, has been reported for the first time. In addition, seven species are new records for the study area: *Aedes detritus, Aedes pulcritarsis, Culex brumpti, Culex deserticola, Culex hortensis, Culiseta longiareolata*,

and *Uranotaenia unguiculata*. Accurate mapping of species presence and ecological distribution is essential for estimating the true Culicinae diversity and accurately assessing vector risk. This fundamental knowledge is a prerequisite for designing and implementing targeted and effective control strategies. The rapid detection of changes in local biodiversity provides health authorities with crucial information, enabling them to respond proactively and mitigate the impact of vector populations on public health

## Author's Contributions

**Samya Jdiaa** Conceptualizing, writing and review; **Hanan Hazyoun**: writing and review; **Moulay Anass Louah**: Supervision, Writing - Review and Editing, Project administration, Resources; **Oumnia Himmi**: Supervision, Conceptualization, Writing - Review and Editing.

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All data generated or analyzed during this study, including detailed methodology, are available from the corresponding author upon reasonable request.

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Insects were used in this study. All applicable international, national, and institutional guidelines for the care and use of animals were followed. This article does not contain any studies with human participants performed by the authors.

## Consent for Publication

Non applicable

## Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

## Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

# REFERENCES

Abdel-Hamid, Y. M., Soliman, M. I. & Kenawy, M. A. (2011) Mosquitoes (Diptera: Culicidae) in relation to the risk of disease transmission in El Ismailia Governorate, Egypt. *Journal of the Egyptian Society of Parasitology*, *41*(2), 347-356 .

Aitken, T. H .G. (1954) The Culicidae of Sardinia and Corsica (Diptera). *Bulletin of Entomological Research*, *45*(3), 437-494 .

Al Ahmad, A. M., Sallam, M. F., Khuriji, M. A., Kheir, S. M. & Azari-Hamidian, S. (2011) Checklist and pictorial key to fourth-instar larvae of mosquitoes (Diptera: Culicidae) of Saudi Arabia. *Journal of Medical Entomology*, *48*(4), 717-737. https://doi.org/https://doi.org/10.1603/me10146

Almeida, A. P. G., Galão, R. P., Novo, M. T., Sousa, C. A., Parreira, R., Rodrigues, J. C., Pinto, J. & Carvalho, L. (2005) Update on the distribution of some mosquito (Diptera: Culicidae) species in Portugal. *European Mosquito Bulletin (Journal of the European Mosquito Control Association)*, *19*, 20-25 .

Amraoui, F., Krida, G., Bouattour, A., Rhim, A ,.Daaboub, J., Harrat, Z., Boubidi, S. C., Tijane, M., Sarih, M. & Failloux, A. B. (2012a) *Culex pipiens*, an experimental efficient vector of West Nile and Rift Valley Fever Viruses in the Maghreb region. *PLOS One*, *7*(5), e36757. https://doi.org/10.1371/journal.pone.0036757 .

Amraoui, F., Tijane, M., Sarih, M., & Failloux, A. B. (2012b) Molecular evidence of *Culex pipiens* form molestus and hybrids pipiens/molestus in Morocco, North Africa. *Parasites & Vectors*, *5*(1), 83-86. https://doi.org/10.1186/1756-3305-5-83 .

Aranda, C., Eritja, R., Schaffner, F. & Escosa, R. (2000) *Culex* (*Culex*) *torrentium* Martini (Diptera: Culicidae) a new species from Spain. *European Mosquito Bulletin*, *8*, 7-9 .

Bailly-Choumara, H. (1968) Contribution à l'étude des Moustiques du Maroc (Diptera: Culicidae). Six espèces nouvelles pour le pays. *Cahiers de l'ORSTOM, Série Entomologie Médicale*, *VI*, 139-144 .

Bailly-Choumara, H. (1972) Detailed study of a collection of *Anopheles labranchiae* using portable C.D.C. light traps (4.5 volts), with an examination of the residual fauna, conducted in Larache, Morocco. Report No. I0/72, Entomology Laboratory, Cherifian Scientific Institute, Rabat, 18 pp.

Bakran-Lebl, K., Pree, S., Brenner, T., Daroglou, E., Eigner, B., Griesbacher, A., Gunczy ,J., Hufnagl, P., Jäger, S., Jerrentrup, H., Klocker, L., Paill, W., Petermann, J. S., Barogh, B. S., Schwerte, T., Suchentrunk, C., Wieser, C., Wortha, L. N., Zechmeister, T., Fuehrer, H. P. (2022) First nationwide monitoring program for the detection of potentially invasive mosquito species in Austria. *Insects*, *13*(3). https://doi.org/10.3390/insects13030276

Balenghien, T., Vazeille, M., Grandadam, M., Schaffner, F., Zeller, H., Reiter, P., Sabatier, P., Fouque, F. & Bicout, D. J. (2008) Vector competence of some French *Culex* and *Aedes* mosquitoes for West Nile Virus. *Vector-Borne and Zoonotic Diseases*, *8*(5), 589-596. https://doi.org/https://doi.org/10.1089/vbz.2007.0266

Becker, N. & Hoffmann, D. (2011) First record of *Culiseta longiareolata* (Macquart) for Germany. *European Mosquito Bulletin*, *29*, 143-150 .

Becker, N., Petric, D., Zgomba, M., Boase, C., Madon, M., Dahl, C. & Kaiser, A. (2010) *Mosquitoes and Their Control, Second Edition*. 2nd edn. Berlin: Springer , 577 p.

Ben Ayed, W., Amraoui, F., M'Ghirbi, Y., Schaffner, F., Rhaim, A., Failloux, A. B. & Bouattour, A. (2019) A survey of Aedes (Diptera: Culicidae) mosquitoes in Tunisia and the potential role of *Aedes detritus* and *Aedes caspius* in the transmission of Zika Virus. *Journal of Medical Entomology*, *56*(5), 1377-1383. https://doi.org/10.1093/jme/tjz067

Benhissen, S., Habbachi, W., Masna, F., Mecheri, H., Ouakid, M. L., & Bairi, A. (2014) Inventory of Culicidae in arid regions: The case of the Ouled-Djellal Oasis (Biskra, Algeria). *ElWahat Journal of Research and Studies*, 7(2), 86–91.

Bettioui, R. A. (2008) A demographic and ecological study of dendrotelmus mosquitoes (Diptera, Culicidae) in the Tlemcen region, Far Western Algeria Abou Bekr Belkaïd University, Tlemcen, 135 pp.

Blagrove, M. S. C ,.Caminade, C., Diggle, P. J., Patterson, E. I., Sherlock, K., Chapman, G. E., Hesson, J., Metelmann, S., McCall, P. J., Lycett, G., Medlock, J., Hughes, G. L., Della Torre, A., & Baylis, M. (2020) Potential for Zika virus transmission by mosquitoes in temperate climates.*Proceedings of the Royal Society B: Biological Sciences*, *287*(1930), 20200119. https://doi.org/10.1098/rspb.2020.0119

Blagrove, M. S. C., Sherlock, K., Chapman, G. E., Impoinvil, D. E., McCall, P. J., Medlock, J. M., Lycett, G., Solomon, T. & Baylis, M. (2016) Evaluation of the vector competence of a native UK mosquito *Ochlerotatus detritus* (*Aedes detritus*) for dengue, chikungunya and West Nile viruses. *Parasites & Vectors*, *9*, 452. https://doi.org/10.1186/s13071-016-1739-3

Bouabida, H., Djebbar, F., & Soltani, N. (2012) A systematic and ecological study of mosquitoes (Diptera: Culicidae) in the Tébessa region (Algeria).*Entomologie Faunistique*, *65*, 99-103 .

Bouattour, A. (2013) *Bio-écologie des moustiques vecteurs du Virus West-Nile en Tunisie.* In: Atelier surveillance et lutte contre le Virus West-Nile en Tunisie, Institut Pasteur de Tunis, Tunis, 4-5 avril 2013 .

Boudemagh, N., Bendali-Saoudi, F. & Soltani, N. (2013) Inventory of Culicidae (Diptera: Nematocera) in the region of Collo (North-East Algeria). *Annals of Biological Research*, *4*(2), 94-99 .

Boukraa, S., Dekoninck, W., Versteirt, V., Schaffner, F., Coosemans, M., Haubruge, E. & Francis, F. (2015) Updated checklist of the mosquitoes (Diptera: Culicidae) of Belgium. *Journal of Vector Ecology*, 40(2), 398-407. https://doi.org/10.1111/jvec.12180

Brengues, C., Ferré, J. B., Le Goff, G., Lami, P., Pratlong, F., Pasteur, N., Lagneau, C., Simard, F. & Robert, V. (2014) A multiplex PCR to differentiate the two sibling species of mosquitoes *Ochlerotatus detritus* and *Oc. coluzzii* and evidence for further genetic heterogeneity within the Detritus complex. *Infection, Genetics and Evolution*, *28*, 676-680. https://doi.org/10.1016/j.meegid.2014.07.010

Brugman, V. A., Hernández-Triana, L. M., Medlock, J. M ,.Fooks, A. R., Carpenter, S. & Johnson, N. (2018) The role of *Culex pipiens* L. (Diptera: Culicidae) in virus transmission in Europe. *International Journal of Environmental Research and Public Health*, *15*(2), 389. https://doi.org/10.3390/ijerph15020389

Bueno-Marí, R., Bernués-Bañeres, A. & Jiménez-Peydró, R. (2014) Biodiversity and larval habitat heterogeneity of mosquitoes (Diptera: Culicidae) in northern Spain. *Acta Zoologica Bulgarica*, *66*(4), 547-554 .

Bueno-Marí, R., Bernués Bañeres, A. & Jiménez-Peydró, R. (2012) Updated checklist and distribution maps of mosquitoes (Diptera: Culicidae) of Spain. *European Mosquito Bulletin*, *30*, 91-126 .

Callot, J. (1942) Sur *Culex hortensis* et *Culex apicalis* à Richelieu (Inde-et-Loire). *Annales de Parasitologie*, *XIX*(4-5-6), 129-141 .

Calzolari, M., Bonilauri, P., Bellini, R., Albieri, A., Defilippo, F., Maioli, G., Galletti, G., Gelati, A., Barbieri, I., Tamba, M., Lelli, D., Carra, E., Cordioli, P., Angelini, P. & Dottori, M. (2010) Evidence of simultaneous circulation of West Nile and Usutu viruses in mosquitoes sampled in Emilia-Romagna region (Italy) in 2009. *PLOS One*, *5*(12), e14324 .

Carron, A., Bichaud, L., Platz, N. & Bicout, D. J. (2008) Survivorship characteristics of the mosquito *Aedes caspius* adults from southern France under laboratory conditions. *Medical and Veterinary Entomology*, *22*(1), 70-73. https://doi.org/10.1111/j.1365-2915.2008.00718.x .

Coffinet, T., Rogier, C., & Pages, F. (2009)Assessment of Anopheles mosquito aggressiveness and the risk of malaria transmission: methods used by the French Armed Forces . *Medecine Tropicale*, *69*(2), 109-122 .

Cook, C. L., Huang, Y. S., Lyons, A. C., Alto, B. W., Unlu, I., Higgs, S. & Vanlandingham, D. L. (2018) North American *Culex pipiens* and *Culex quinquefasciatus* are competent vectors for Usutu virus. *PLOS Neglected Tropical Diseases*, *12*(8), e0006732. https://doi.org/10.1371/journal.pntd.0006732 .

Cornel, A. J., Jupp, P. G. & Blackburn, N. K. (1993) Environmental temperature on the vector competence of *Culex univittatus* (Diptera: Culicidae) for West Nile virus. *Journal of Medical Entomology*, *30*(2), 449-456. https://doi.org/10.1093/jmedent/30.2.449.

Dahchar, Z., Bendali-Saoudi, F. & Soltani, N. (2016) Larvicidal activity of some plant extracts against two mosquito species *Culex pipiens* and *Culiseta longiareolata*. *Journal of Entomology and Zoology Studies*, *4*(4), 346-350 .

El Ouali Lalami, A., Hindi, T., Azzouzi, A., Elghadraoui, L., Maniar, S., Faraj, C., Adlaoui, E., Ameur, I., & Ibnsouda Koraichi, S. (2010) Inventory and seasonal distribution of culicidae in central Morocco . *Entomologie Faunistique*, *62*(4), 131-138 .

Ergunay, K., Gunay, F., Erisoz Kasap, O., Oter, K., Gargari, S., Karaoglu, T., Tezcan, S., Cabalar, M., Yildirim, Y., Emekdas, G., Alten, B. & Ozkul, A. (2014) Serological, molecular and entomological surveillance demonstrates widespread circulation of West Nile virus in Turkey. *PLOS Neglected Tropical Diseases*, *8*(7), e3028. https://doi.org/10.1371/journal.pntd.0003028 .

Eritja, R ,.Aranda, C., Padrós, J., Goula, M., Lucientes, J., Escosa, R., Marquez, E. & Caseres, F. (2000) An annotated checklist and bibliography of the Spanish mosquitoes (Diptera, Culicidae). *European Mosquito Bulletin*, *8*, 10-18 .

Farajollahi, A., Fonseca, D .M., Kramer, L. D., & Marm Kilpatrick, A. (2011) Bird biting mosquitoes and human disease: a review of the role of *Culex pipiens* complex mosquitoes in epidemiology. *Infection, Genetics and Evolution*, *11*(11), 1577-1585. https://doi.org/10.1016/j.meegid.2011.08.013 .

Galliard, H. (1931) *Culex brumpti,* n. sp. New mosquito species discovered in Corsica. *Annals of Human and Comparative Parasitology*, *9*(1-2), 134-139 .

Gaud, J. (1947)A Contribution to the study of Culicidae in Morocco: four new species for the local fauna. *Bulletin of the Moroccan Society of Natural Sciences* , *25-27*, 204-206 .

Goodwin, W. J. (1961) A list of the mosquitoes of Lybia. *Mosquito News*, *21*(2), 106-109 .

Gratt, P. (2009) *Culex* (Culex) *perexiguus* Theobald (Diptera: Culicidae) ,a mosquito species new to the Maltese fauna. *European Mosquito Bulletin*, *27*, 7-9 .

Guimerà, R., Mossa, S., Turtschi, A. & Amaral, L. A. (2005) The worldwide air transportation network: Anomalous centrality, community structure, and cities' global roles. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(22), 7794-7799. https://doi.org/10.1073/pnas.0407994102

Gutierrez-Lopez, R., Bialosuknia, S. M., Ciota, A. T., Montalvo, T., Martinez-de la Puente, J., Gangoso, L ,.Figuerola, J. & Kramer, L. D. (2019) Vector competence of *Aedes caspius* and *Ae. albopictus* mosquitoes for Zika virus, Spain. *Emerging Infectious Diseases*, *25*(2), 346-348. https://doi.org/10.3201/eid2502.171123 .

Gutsevich, A. V., Monchadskii, A. S. & Shtakelberg, A. A. (1974) *Fauna of the U.S.S.R. Diptera, Mosquitoes, Family Culicidae* (Vol. 100). Academy of Sciences of the USSR, Zoological Institute, Leningrad .

Hamon, J., Maffi, M., Grenier, Y., Coz, J., Ouedraogo, C. S., & Djimé, D. (1966) Notes on the mosquitoes of the Islamic Republic of Mauritania (Family Culicidae) (Part I). *Annals of the Entomological Society of France (New Series)* , *II*(2), 371-383 .

Harbach, R. E. (2026) *Valid Species* https://mosquitotaxonomic-inventory.myspecies.info/valid-species-list

Harbach, R. E., Harrison, B. A., Gad, A., Kenawy, M. A. & El Said, S. (1988) Records and notes on mosquitoes (Diptera: Culicidae) collected in Egypt. *Mosquito Systematics*, *20*(3), 317-342 .

Himmi, O. (2007) Culicidae (Insects, Diptera) in Morocco: Systematics, Ecology, and Pilot Epidemiological Studies.

Himmi, O., Dakki, M., Trari, B., & El Agbani, M. A. (1995)The Culicidae of Morocco: identification keys, with biological and ecological data. *Proceedings of the Scientific Institute, Zoology Series*, Rabat.

Jupp, P. G. (2001) The ecology of West Nile virus in South Africa and the occurrence of outbreaks in humans. *Annals of the New York Academy of Sciences*, *951*, 143-152. https://doi.org/10.1111/j.1749-6632.2001.tb02692.x .

Kirkpatrick, B. A. F. E. S. (1925) The mosquitoes of Egypt. *Government Press*, Cairo, 224 pp, 144 figures, 1 carte.

Linton, Y. M., Smith, L. & Koliopoulos, G. (2007) Contribution to the mosquito fauna of the Greek island of Samos. *European Mosquito Bulletin*, *22*, 1-4 .

Lumley, S., Hernández-Triana, L. M., Horton, D. L., Fernández de Marco, M. D. M., Medlock, J. M., Hewson, R., Fooks, A. R. & Johnson, N. (2018) Competence of mosquitoes native to the United Kingdom to support replication and transmission of Rift Valley fever virus. *Parasites & Vectors*, *11*(1), 308. https://doi.org/10.1186/s13071-018-2884-7

Lundström, J. O. (1999) Mosquito-borne viruses in western Europe: a review. *Journal of Vector Ecology*, *24*, 1-39 .

Mackenzie-Impoinvil, L., Impoinvil, D. E., Galbraith, S. E., Dillon, R. J., Ranson, H., Johnson, N., Fooks, A. R., Solomon, T., & Baylis, M. (2015). Evaluation of a temperate climate mosquito, *Ochlerotatus detritus* (=*Aedes detritus*), as a potential vector of Japanese encephalitis virus. *Medical and Veterinary Entomology*, *29*(1), 1–9. https://doi.org/10.1111/mve.12083

Mancini, G., Montarsi, F., Calzolari, M., Capelli, G., Dottori, M., Ravagnan, S., Lelli, D., Chiari, M., Santilli, A., Quaglia, M., Federici, V., Monaco, F., Goffredo, M. & Savini, G. (2017) Mosquito species involved in the circulation of West Nile and Usutu viruses in Italy. *Veterinaria Italiana*, *53*(2), 97-110. https://doi.org/10.1371/journal.pone.0014324 .

Martínez-De La Puente, J., Moreno-Indias, I., Hernández-Castellano, L. E., Argüello, A., Ruiz, S., Soriguer, R. & Figuerola, J. (2012) Host-feeding pattern of *Culex theileri* (Diptera: Culicidae), potential vector of *Dirofilaria immitis* in the Canary Islands, Spain. *Journal of Medical Entomology*, 49( 6), 1419–1423.https://doi.org/10.1603/me12081 .

Meegan, J. M., Khalil, G. M., Hoogstraal, H. & Adham, F. K. (1980) Experimental transmission and field isolation studies implicating *Culex pipiens* as a vector of Rift Valley fever virus in Egypt. *The American Journal of Tropical Medicine and Hygiene*, *29*(6), 1405-1410. https://doi.org/10.4269/ajtmh.1980.29.1405 .

Messai, N., Berchi, S., Boulknafd, F. & Louadi, K. (2011) Inventaire systématique et diversité biologique des Culicidae (Diptera: Nematocera) dans la région de Mila (Algérie). *Entomologie Faunistique*, *63*(3), 203-206 .

Metge, G. & Hassaïne, K. (1998). Study of the environmental factors associated with oviposition by Aedes caspius and Aedes detritus along a transect in Algeria. *Journal of the American Mosquito Control Association*, *14*(3), 283-288 .

Miller, B. R., Nassi, R. S., Godsey, M. S., Savage, H. M., Lutwama, J. J., Lanciotti, R. S. & Petters, S. (2000) First field evidence for natural vertical transmission of West Nile Virus in *Culex univittatus* complex mosquitoes from Rift Valley province, Kenya. *The American Journal of Tropical Medicine and Hygiene*, *62*(2), 240-246. https://doi.org/10.4269/ajtmh.2000.62.240 .

Moussiegt, O. (1983) Les moustiques de Tunisie, leur répartition, bibliographie. *Documents EID, Montpellier, France*, *47*, 3-29 .

Moussiegt, O. (1991) Les espèces françaises de moustiques des creux d'arbres. Bibliographie. *Document EID, Montpellier, France*, *60*, 145 .

Orshan, L., Bin, H., Schnur, H., Kaufman, A., Valinsky ,A., Shulman, L., Weiss, L., Mendelson, E. & Pener, H. (2008) Mosquito vectors of West Nile Fever in Israel. *Journal of Medical Entomology*, *45*(5), 939-947. https://doi.org/10.1603/0022-2585(2008)45[939:mvownf]2.0.co;2 .

Perrings, C., Dehnen-Schmutz ,K., Touza, J. & Williamson, M. (2005) How to manage biological invasions under globalization. *Trends in Ecology & Evolution*, *20*(5), 212-215. https://doi.org/10.1016/j.tree.2005.02.011

Pilaski, J. & Mackenstein, H. (1985) Isolation of Tahyna virus from mosquitoes in 2 different European natural foci. *Bakteriologie, Mikrobiologie und Hygiene*, *180*, 394-420 .

Rageau, J., Mouchet, J., & Abonnenc, C. (1970)Geographical distribution of Mosquitoes (Diptera: Culicidae) in France. *ORSTOM Papers, Medical Entomology and Parasitology Series*, *8*(3), 289-315 .

Ramos, H. C., Lucientes, J., Blasco-Zumeta, J., Oscar, J. J. & Ribeiro, H. (2002) Some morphological characteristics of *Culex deserticola*, a recent addition to the Spanish fauna (Diptera: Culicidae .(*European Mosquito Bulletin*, *12*, 27-29 .

Ribeiro, H., Ramos, H. C., Pires, C. A. & Capela, R. A. (1988) An annotated checklist of the mosquitoes of continental Portugal (Diptera Culicidae). *Actas III Congreso Iberico de Entomologia*, 233-254 .

Robert, V., Gunay, F., Le Goff, G., Philippe, B., Sulesco, T., Khalin, A., Medlock, J., Kampen, H., Petrić, D. & Schaffner, F. (2019) Distribution chart for Euro-Mediterranean mosquitoes (western Palaearctic region). *Journal of the European Mosquito Control Association*, *37*, 1-28 .

Ruiz-Arrondo, I., McMahon, B. J., Hernández-Triana, L. M., Santibañez, P., Portillo, A. & Oteo, J. A. (2019) Surveillance of mosquitoes (Diptera, Culicidae) in a Northern Central Region of Spain: Implications for the medical community. *Frontiers in Veterinary Science*, *6*, 86. https://doi.org/10.3389/fvets.2019.00086

Schaffner, F. (1998) A revised checklist of the French Culicidae. *European Mosquito Bulletin*, *2*, 1-9 .

Schaffner, F., Gatt, P., Mall, S., Marolia, M., Spiteri ,G., Melillos, T. & Zeller, H. (2010) Mosquitoes in Malta: Preliminary entomological investigation and risk assessment for vector-borne diseases (Diptera: Culicidae). *Bulletin of the Entomological Society of Malta*, *3*, 41-54 .

Šebesta, O., Halouzka, J ,.Hubálek, Z., Juřicová, Z., Rudolf, I., Šikutová, S., Svobodová, P. & Reiter, P. (2010) Mosquito (Diptera: Culicidae) Fauna in an Area Endemic for West Nile Virus. *Journal of Vector Ecology*, *35*(1), 156-162. https://doi.org/10.1111/j.1948-7134.2010.00072.x

Séguy, E. (1930) Notes on mosquitoes III (1): *Anopheles costalis* in Southern Europe. Entomological Encyclopedia Diptera, 5, 177-178.

Seidel, B., Nowotny, N., Duh, D., Indra, A., Hufnagl, P. & Allerberger, F. (2013) First records of the thermophilic mosquito *Culiseta longiareolata* (Macquart, 1838) in Austria, 2012, and in Slovenia, 2013. *Journal of the European Mosquito Control Association*, *31*, 17-20 .

Senevet, G. (1947) The *Culex* genus in North Africa. I. The larvae. *Archives of the Pasteur Institute of Algeria*, *25*, 107-136 .

Senevet, G., & Andarelli, L. (1959) Mosquitoes of North Africa and the Mediterranean Basin. The genera *Culex*, *Uranotaenia*, *Theobaldia*, *Orthopodomyia*, and *Mansonia* (Vol. XXXVII). *Encyclopédie Entomologique, Paul Lechevalier Editions*, *Paris*.

Sergent, E. (1909) List of Mosquitoes in North Africa (Part 1). *Annals of the Entomological Society of France*, *28*, 440-448 .

Severini, F., Toma, L., Di Luca, M. & Romi, R. (2009) Identification of the adult stages of the Italian mosquitoes. *Fragmenta Entomologica*, *41*(2), 213-372 .

Sicart, M. (1942). Note on the Presence of *Aedes pulchritarsis* in Tunisia. *Archives of the Pasteur Institute of Tunis*, *31*, 132 .

Snow, K. R. & Ramsdale, C. D. (1999) Distribution chart for European mosquitoes. *European Mosquito Bulletin*, *3*, 14-31 .

Snow, K. R. & Ramsdale, C. D. (2004) *Fauna Europaea: Culicidae*. http://www.faunaeur.org

Tantely, L. M., Boyer, S. & Fontenille, D. (2015) A review of mosquitoes associated with Rift Valley fever virus in Madagascar. *The American Journal of Tropical Medicine and Hygiene*, *92*(4), 722-729. https://doi.org/10.4269/ajtmh.14-0421 .

Tine-Djebbar, F., Bouabida, H., & Soltani, N. (2011) Morphometric and Biochemical Characterization of Certain Mosquito Species Recorded in the Tébessa Region. *Bulletin of the Zoological Society of France*, *136*(1-4), 177-185 .

Trari, B. (2017) Mosquitoes (insects, Diptera) of Morocco: distribution atlas and epidemiological studies. *Mohammed V University, Faculty of Sciences, Rabat*.

Trari, B., & Dakki, M. (2017) Atlas of mosquitoes (Diptera Culicidae) of Morocco. *Research Institute of Sciences, Zoology Series, Rabat, Morocco* .

Trari, B., Dakki, M., & Harbach, R. E. (2017) An updated checklist of the Culicidae (Diptera) of Morocco, with notes on species of historical and current medical importance. *Journal of Vector Ecology*, *42*(1), 94-104. https://doi.org/10.1111/jvec.12243

Trari, B., Dakki, M., Himmi, O., & El Agbani, M. A. (2002) Mosquitoes (Diptera Culicidae) of Morocco: A Literature Review (1916–2001) and species inventory. *Bulletin of the Society for Exotic Pathology*, *96*(4), 329-334 .

Turell, M. J., Presley, S. M., Gad, A. M., Cope, S. E., Dohm, D. J., Morrill, J. C. & Arthur, R. R. (1996) Vector competence of Egyptian mosquitoes for Rift Valley fever virus. *The American Journal of Tropical Medicine and Hygiene*, *54*(2), 136-139. https://doi.org/10.4269/ajtmh.1996.54.136 .

Vermeil, C. (1953) Contribution to the Study of Culicidae in Fezzan, Libya: Presence of Anopheles broussesi E. in El Barka, Rhat District. *Bulletin of the Society for Exotic Pathology*, *46*(3), 445-454 .

Zitko, T. & Merdic, E. (2006) *Culex laticinctus* Edwards, a mosquito species new to the Croatian fauna. *European Mosquito Bulletin*, *21*, 11-13 .

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Research Article

# چک لیست به‌روز شده از پشه های (Dip., Culicidae) در شمال شرقی مراکش، با داده‌های جدید پراکنش

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**چکیده:** چندین گونه پشه از زیرخانواده Culicinae به عنوان ناقل آربوویروس‌ها (ویروس‌های بندپازاد)، نقش مهمی در سلامت عمومی دارند. از بیش از ۳۰۰۰ گونه Culicinae ثبت شده در سراسر جهان، ۴۳ گونه در مراکش وجود دارند. از این تعداد، ۱۴ گونه به عنوان ناقلان بالقوه ویروس‌هایی مانند ویروس نیل غربی (WNV)، زیکا (ZIKV)، تب زرد (YFV) و چیکونگونیا (CHIKV) شناخته می‌شوند. هدف از این مطالعه، به‌روزرسانی پراکنش گونه‌های پشه در شمال شرقی مراکش است. بررسی‌های لاروی انجام شده در ۲۰ مکان منجر به جمع‌آوری و شناسایی ۱۳ گونه متعلق به چهار جنس شد. *Culex* با هشت گونه و وسیع‌ترین پراکندگی، جنس غالب بود. پس از آن *Aedes* با سه گونه قرار داشت. جنس‌های *Culiseta* و*Uranotaenia* هر کدام با یک گونه نشان داده شدند. پنج گونه از این گونه‌ها ناقلان بالقوه آربوویروس هستند و هفت گونه رکوردهای جدید برای منطقه مورد مطالعه هستند. این فهرست به‌روز شده از گونه های کولیسید، شامل گزارش‌ها و داده‌های جدید در مورد توزیع اکولوژیکی، درک ما از ترکیب جامعه کولیسینه در شمال شرقی مراکش را تا حد زیادی افزایش می‌دهد. این نتایج مبنای حیاتی برای ارزیابی خطرات آربوویروسی و اجرای استراتژی‌های کنترل ناقل هدفمند فراهم می‌کند و در نتیجه به بهبود اقدامات بهداشت عمومی در منطقه کمک می‌کند.

**کلمات کلیدی:** آئدس، کولکس، کولیستا، اورانوتانیا، ریف مراکش

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