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Biosystematic study of culicidae (Diptera, Nematocera) nuisance source in Tébessa (Algeria)

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Abstract
In order to better understand the systematic and the biodiversity of mosquitoes in Tébessa (north-eastern Algeria), we proceeded to harvest Culicidae larvae using the "dipping" method in five different biotopes, 3 urban and 2 rural with diffèrent characteristics, these biotopes were located in 5 stations. This study was conducted over a nine-month period extending from September 2014 to May 2015. Nine species of Culicidae are identified belonging to two subfamily Anophelinae and Culicinae and to four genera (*Culex*, *Culiseta*, *Aedes* and *Anopheles*), *Culex* (*Culex*) *pipiens* Linné 1758 was the most dominant species by their abundance and frequency (64%, 42,58%) followed by *Culiseta (Allotheobaldia) longiareolata* Macquart 1838 whose relative abundance was 18,6% and the occurrence frequency was 21,43%. The culicidian population found was moderately diverse and moderately balanced (H'= 1, 53 bits, H'max=3, 17 bits, E=0, 48). Results also found that *Culiseta longiareolata* was the most appeared species in the Sidi Yahia location, and the species of *Culex pipiens*, *Culex theileri* and *Culiseta longiareolata* were found in association with all inventoried species.

Keywords: Culicidae, inventory, phenology, faunistic association, Tébessa (Algeria)

1. Introduction
Arthropods are the most successful branch on our planet. They are found in all habitats, from snowy mountain peaks to abyssal pits, and deserts to tropical forests. The biodiversity of Arthropods gives them a considerable place in the animal world. There are 1,025 million species of arthropods described in the biosphere. The estimated number is 8, 750 million, of which 9/10 are insects [4]. This class of insects has succeeded in colonizing almost all natural environments and adapting to many ways of life [30]. A number of insects are bloodsucking, which interact in a regular way with vertebrates. These interactions have led them to become, as the pathogen vectors evolve.

Mosquitoes are insects belonging to the family Culicidae, classified in the order Diptera and suborder Nematocera. The Culicidae family is divided into three subfamilies, Toxorhynchitinae, Anophelinae and Culicinae [23]. The culicidian fauna, by its wide distribution and its abundances is responsible for the nuisance (painful and troublesome bites) and are also involved in the transmission of several human and veterinary diseases [16]. Such as malaria and filariasis through its wide distribution and abundance, these characteristics make Culicidae importance in medical and veterinary fields [21]. The fight against mosquitoes has always been a major concern to protect against these blood-sucking insects. In order to better know Culicidae and the environments in which these insects develop, lots of researches have been carried outlike those that are focused on taxonomy, inventory and ecology, such as in the studies of [11, 33, 17] and mosquito control and distribution, such as in [34, 27]. In Algeria, the studies conducted on Culicidae date back to the last century, including those of [13, 2, 10, 26, 7, 5, 18, 19] This study on Culicidae in the Tebessa region aims to make inventory the Culicidae species, determine the ecological indices of structure and composition of the culicidian population, and to establish a phenological study of Culicidae species.

2. Materials and Methods
2.1 Study area
Tebessa is located in the northeast of Algeria (35°20' N, 8°6' E, Altitude: 960 m). It is 13878 km^2 large, limited to the north by the province Souk-Ahras, to the south by the province of El Oued, to the west by the province of Oum El Bouaghi and Khenchla, and to the east by the Algerian-Tunisian borders. It belongs to a semi-arid bioclimatic stage with an aridity index 14.26.

2.2 Study site

In this study, 5 breeding sites located in five stations were selected. Ecologically speaking, these deposits were different. To better know the culicidian diversity, rural and other urban lodgings were chosen: 3 rural lodgings in Boulhef-Dyr (G01), Sidi Yahia (G03) and El-Merdja (G02) and 2 urban lodgings (The University Campus of Tébessa (G05) and the university residence of Tébessa Mille 2 (G04). The characteristics of the deposits are shown in Table 1.

Table 1: Principal characteristics of the prospect larval biotopes cm: centimetre

	Nature of the deposit	Water-borne	Vegetation	Length	Width	Depth
G01	Permanent	Rainwater	Very abundant	300 cm	200cm	50 cm
G02	Permanent	rainwater + natural water + waste water	Very abundant	400 cm	200cm	100cm
G03	Permanent	Rainwater + ground water	Abundant	250 cm	150cm	70 cm
G04	Temporary	Waste water	Without vegetation	120 cm	50 cm	100cm
G05	Permanent	Rainwater + sewage water	Scarce	500 cm	150cm	150cm

G01: Boulhef-Dyr deposit G02: El Merdja deposit G03: Sidi Yahia deposit G04: University Residence Mille 2 deposit, G05: Tébessa University Campus deposit.

2.3 Sampling Technique

The mosquito larvae sampling periods were spread over a 9-month period from September 2014 to May 2015. Samples were taken monthly. For the mosquito larvae sampling, "dipping" method has been used [29, 32, 14]. This method involves harvesting in several locations of the deposit and without repetition a 1-litre ladle of water (*c*). Using this method, we performed a series of 5 samples and then calculated the average number (*n*) of larvae per sample. This number is an estimate of the average larval density per liter. The Culicidae larvae were identified using [28], and confirmation was made using the Mediterranean Africa's mosquito identification software of Brunhes *et al.* [12].

2.4 Statistical analysis

To better understand the obtained results, ecological indices of composition (species richness, relative abundance and frequency of occurrence) and ecological structural indices (Shannon index and equitability index) have been used.

3. Results

3.1 Inventory Culicidae

The systematic inventory of Culicidae mosquitoes collected to Tebessa in the sampling stations revealed after identification the presence of nine species belonging to two subfamilly Culicinae appeared the most species-rich, it is divided between three genera : the *Culex* genera with three species **(***Culex (Culex) pipiens* Linné, 1758; *Culex (Culex) theileri* Theobald, 1903 and *Culex (Culex) mimeticus* Noe, 1899); the *Culiseta* genera represented by two species **(***Culiseta (Culiseta) annulata* Schrank, 1776 and *Culiseta* (*Allotheobaldia*) *longiareolata* Macquart 1838) and the *Aedes* genera with two species (*Aedes (Ochlerotatus) coluzzii* Rioux, Guilvard et Pasteur, 1998, *Aedes (Ochlerotatus) dorsalis* Meigen, 1830).

The subfamilly Anophelinae is represented by one genera, *Anopheles* with two species: *Anopheles (Anopheles) labranchiae* Falleroni, 1926 and *Anopheles (Anopheles) claviger* Meigen, 1804. (Table 2)

Table 2: List of Culicidae species harvested in the prospected deposits (September 2014 - May 2015).

Sub-family	Anophelinae	Culicinae		
Genera	*Anopheles*	*Aedes*	*Culex*	*Culiseta*
	Anopheles (Anopheles) labranchiae Falleroni, 1926. *Anopheles (Anopheles) claviger* Meigen, 1804.	*Aedes (Ochlerotatus) coluzzii* Rioux, Guilvard et Pasteur, 1998. *Aedes (Ochlerotatus) dorsalis* Meigen, 1830.	*Culex (Culex) pipiens* Linné, 1758. *Culex (Culex) theileri* Theobald, 1903. *Culex (Culex) mimeticus* Noe, 1899.	*Culiseta (Culiseta) annulata* Schrank, 1776. *Culiseta (Allotheobaldia) longiareolata* Macquart 1838

3.2 Statistical study of the culicidian fauna

For all the deposits, the statistical study of the data revealed that the most abundant and most frequent species was represented by *Culex pipiens* with abundance and a frequency of 64% and 42, 85% respectively. This species is considered as an accessory, then the species: *Culiseta longiareolata*, *Culex theileri*, *Culex mimeticus*, *Culiseta annulata*, *Aedes dorsalis*, *Aedes coluzzii*, *Anopheles labranchiae* and *Anopheles claviger* are classified. These species are qualified accidental (Table 3) (Fig. 1and 2).

Table 3: Values of statistical indices applied to Culicidae species.

Species	Ni	C (%)	F	Cate.
Culex pipiens	840	64	42,58	Acce
Culex theileri	170	13	12,5	Accid
Culex mimeticus	20	1,5	1,78	Accid
Culiseta annulata	13	01	10,71	Accid
Culiseta longiareolata	243	18.6	21,43	Accid
Aedes dorsalis	8	0,61	3,57	Accid
Aedes coluzzii	12	0,92	3,57	Accid
Anopheles claviger	2	0,15	1,78	Accid
Anopheles labranchiae	1	0,08	1,78	Accid
Total	1309	100	100	
H'				-1,53
H'max				3,17
E				0,48

ni: number of species, C (%): relative abundance, F: frequency of occurrence, Cat. : category, Acce: accessory; Accid.: accidental, H': Schannon index, H'max: maximum diversity, E: equitability.

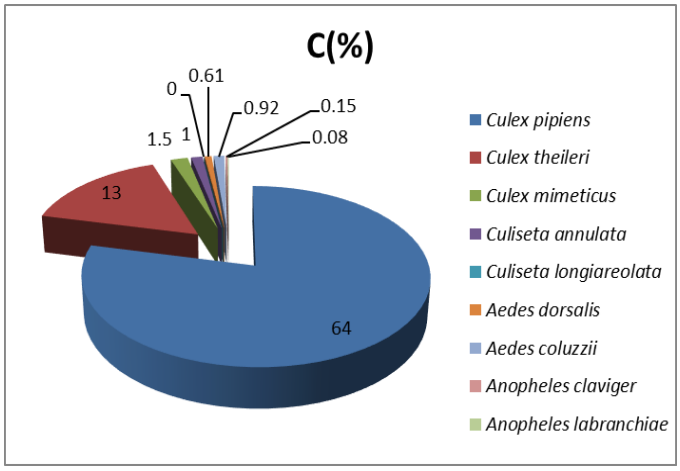

Fig 1: Abundance relative of Culicidae species in Tebessa area (2014-2015).

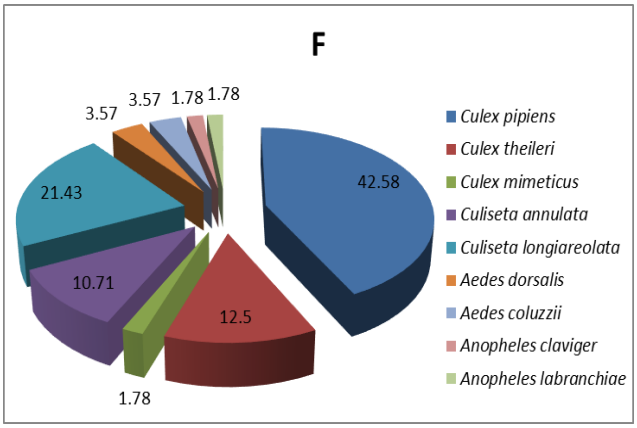

Fig 2: Frequency of occurrence of Culicidae species in Tebessa area (2014-2015).

The diversity of the Culicidae species is calculated by the H' Shannon index with a value of 1.53 bit; this value was lower than the maximum diversity (H'max = 3.17) which means that the culicidiae fauna is moderately diversified. The equitability value was 0.48 or 48%, which explains that the Culicidae population was moderately balanced.

3.3 Phenological study of Culicidiae species in Sidi Yahia deposit

The phenology of Culicidae species in Sidi Yahia deposit showed that Culicidae species appear intermittently. As an example, it is worth mentioning the species *Culiseta longiareolata*, which appeared for five months during the research period (December, November, March, April and May). We also noticed species that appear two to three months such as the species *Aedes coluzzii* which appears in November and December and the species *Culex pipiens* which appears during the months of December, April and May. On the other hand, the species which appeared only one month during the period of this study are presented by: *Culex theiler* and *Culex mimeticus* which appeared in October and *Culiseta annulata* which appeared in May (Table 4).

Table 4: Phenogram of culicidiae species in the Sidi Yahia G04 deposit.

month / species	October	November	December	January	February	March	April	May
Culiseta longiareolata								
Aedes coluzzii								
Culex mimitucus								
Culex theileri								
Culex pipiens								
Culiseta annulata								

3.4 Faunistic associations of the Culicidian species

For a better exploitation of the results, we also studied associations of the Culicidiae fauna which allows defining the different groups of associated species according to the ecological requirements of their environments.

According to Table 5, *Culex pipiens*, *Culex theileri*, *Culiseta longiareolata* and *Culiseta annulata* species were found in association with all species inventoried in exploited deposits. However, *Culex mimeticus*, *Aedes dorsalis*, *Aedes coluzzii*, *Anopheles labranchiae* and *Anopheles claviger* were present and associated with some inventoried species.

Table 5: Faunistic Associations of Culicidae.

Species / Species	*Culex pipiens*	*Culex theileri*	*Culex mimeticus*	*Culiseta annulata*	*Culiseta longiareolata*	*Aedes coluzzii*	*Anopheles labranchiae*	*Aedes dorsalis*	*Anopheles claviger*
Culex pipiens		+	+	+	+	+	+	+	+
Culex theileri	+		+	+	+	+	+	+	+
Culex mimeticus	+	+		+	+	-	-	+	-
Culiseta annulata	+	+	+		+	+	+	+	+
Culiseta longiareolata	+	+	+	+		+	+	+	+
Aedes dorsalis	+	+	-	+	+		-	-	+
Anopheles labranchiae	+	+	-	+	+	-		+	+
Aedes coluzzii	+	+	+	+	+	-	-		+
Anopheles claviger	+	+	-	+	+	+	-	-	

+: Presence**, -:** Absence.

4. Discussion

This study enables us identify nine species of Culicidae belonging to two subfamily and to four genera: *Culex*, *Culiseta*, *Aedes* and *Anopheles*. 3 species belonging to the *Culex* genera, 2 species belonging to the *Culiseta* genera, 2 species belonging to the *Aedes* genera and 2 species belonging to the *Anopheles genera*. in the Smir marsh in Morocco, El-joubari [15] identified 14 Culicidae species (5 *Culiseta* species, 2 *Culex* species, 5 *Ochlerotatus* species and 2 *Anopheles* species) and in the region of Constantine in Algeria Berchi *et al.* [8] collected 6 species, belonging to the four genera, *Culex*, *Culiseta*, *Anopheles* and *Uranotaenia.* Also Lounaci [22] declared that the subfamily Anophelinae is represented by only one species in the eastern region of Algiers. Andarelli [3] reports the absence of the *Aedes* genera in the northern region of Aures although *Culiseta longiareoloata* species has been reported by Abbed [1] in the region of Oum El-Bouaghi.

The species *Culex pipiens* was the most abundant. Indeed it is present in all the deposits at a frequency of 42, 58%, followed by the species *Culiseta longiareolata* with 21, 43% of frequency. These two species are very abundant in the region of Tebessa. Bouabida *et al.* [9] revealed that *Culiseta longiareolata* and *Culex pipiens* have 43, 52% and 38, 82% occurrence frequency respectively.

In this study, these two species are found in biotops with different characteristics whether permanent or temporary, rich or poor in vegetation, in rainwater, polluted or underground water. The abundance of both *Culex pipiens* and *Culiseta longiareolata* is related to their ubiquity and plasticity. Brunhes *et al.* [12] and Hassain [20] have shown that both *Culex pipiens* and *Culiseta longiareolata* are widely spread species that are common throughout Mediterranean Africa and can be found in several biotope types.

Messai *et al.* [25] also found that both species *Culex pipiens* and *Culiseta longiareolata* with a high abundance in the region of Mila. The studies by the ecological indices of structure (H'= 1, 53 bits, E = 48%) show an average diversified and moderately balanced stand. The diversity of the Culicidea stand can be ascribed to the ecological characteristics of the deposit as the richness of the vegetation medium which constitutes a thermal and humid microclimate favorable to the Culicidae development, because the Culicidae species prefer vegetation rich environments much more. Seguy [31] states that the species abundance of Culicidae decreases as the plant cover and shade created by the trees decrease. Regarding the phenological study of Culicidae species, this study is necessary to estimate the number of annual generation and the periods of presence of larvae and adults of Cilicidae according to Merabeti & Ouakid [24].

In Sdi Yahia deposit, Culicidiae species show month-to-month appearance fluctuations of which the most common species is *Culiseta longiareolata*, it appears during the last month of autumn and the beginning of the winter and throughout the spring season, this occurrence can be explained by variations in climatic factors in the region or the bio ecological characteristics of the species such as impoundment during November and December and the temperatures of the spring season. Merabeti & Ouakid [24] found that *Culex pipiens* is the most common species in the region of Biskra, is the most common species, while *Culiseta longiareolata* appear sonly in late autumn and at the end of spring. Concerning the faunistic association of the culicidian species, it is marked by the four species: *Culex pipiens*, *Culiseta longiareolata*, *Cilex theileri* and *Culiseta annulata* which are found with all inventoried species. The association of the *Culex pipiens* and *Culex theileri* species with all Culicidae species recorded is also reported by Benhissen *et al.* [6] in the region of Biskra.

5. Conclusion

In our study, there were four genera of Culicidae (*Culex*, *Aedes*, *Culiseta*, *Anopheles*) belonging to two subfamilly in Tebessa region. The result showed that *Culex pipiens* species was the most dominant and *Culiseta longiareolata* species was the most appeared. The analyses reveales also that some species of Culicidae can live in association.

This study is one of the first biotypical attempts in the region of Tebessa, it deserves to be enriched by new methods (genetics, enzymology, molecular biology) that might be able to solve some problems caused by the Culicidae one of the harmful insects of the region.

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7. Références

1. Abbed A. Contribution à étude d'un inventaire systématique des moustiques (Culicidae - Diptera) de la

région d'Oum el Bouaghi et ses abords, Mem. DES. Univ. Constantine. 2001, 20.
2. Abouzeitoune MH. Evaluation de la lutte biologiquedes larves de Culex *pipiens* (Dipteres : Culicidae) à l'aide de *Gambusia affinis* (poisson téléostéen). Edition Dunod, Paris, 1991, 32-36.
3. AndarelIi L. Les Anophelinés et Culicinés de L'Aurès, la lutte antipaludique en Algérie (Campagne 1953). Alger, Gouvernement générale de l'Algérie. Direction de santé publique, 133-141. Parasit. (Paris). 1954; 45(3):385-386.
4. Beaumont A, Cassier P. Animal Biology of Protozoa to Epithelioneuric Metazoa, Dunod University, 1973.
5. Bendali F, Djebbar F, Soltani N. Efficacité compare de quelques espèces de poisson à l'égard de divers stades de *Culex pipiens* L. dans des conditions de laboratoire. Parasitica. 2001; 57(4):255-265.
6. Benhissen S, Habbachi W, Masna F, Mechri H, Ouakid ML. Et Bairi AM. Inventaire des Culicidae des zones arides : cas des Oasis d'Oued Djellel (Biskra, Algerie) revue El Wehat pour les recherches et les études. 2014; 7(2):86-91 ISSN : 1112-7163
7. Berchi S. Résistance des certaines populations de *Culex pipiens*L. au malation à constantine (Algérie). Bull. Soc. Ent. France. 2000; 105(2):125-129.
8. Berchi S, Aouati A, Louadi K. Typologie des gîtes propices au développement larvaire de *Culex pipiens* L. 1758 (Diptera-Culicidae), source de nuisance à Constantine (Algérie), Ecologia mediterranea. 2012; 38(2):5-16.
9. Bouabida H, Djebbar F, Soltani N. Etude systématique et écologique des Moustiques (Diptera: Culicidae) dans la région de Tébessa (Algérie). Entomologie faunistique. 2012; 65:99-103.
10. Boudjelida H, Bouaziz A, Soin T, Smagghe G, Soltani N. Effects of ecdysone agonist halofenozide against Culexpipiens. Pestic. Biochem. Physiol. 2005; 83:115-123
11. Boussaa S, Boumezzough A. Identification et caractérisation des gîtes larvaires de phlébotomes (Diptera: Psychodidae) à Marrakech (Maroc). Entomologie Faunistique-Faunistic Entomology. 2014; 67:193-201
12. Brunhes J, Rhaim A, Geoffroy B, Angel G, Hervy JP. Les moustiques de l'Afrique méditerranéenne. Logiciel d'identification et d'enseignement. Montpellier, France, IRD & IPT.CD-Rom collection didactique. Editions IRD. 2000, 105-109
13. Clastrier J. La présence en Algérie d'*Orthopodomiya pulchipalpis.* Rodani. Arch. Inst. Pasteur Alg. 1941; 19(4):443-446.
14. Croset H, Papierok B, Rioux JA, Gabinaud A, Cousserans J, Arnaud D. Estimates of larval population of culicid mosquitoes: comparison of capture-recapture, removal and Dipping methods. Ecolog. Ent. 1976; 1:251-256.
15. El-joubari M, Louah A, Himmi O. Les moustiques des marais de Smir (Nord-ouest du Maroc): inventaire de biotypologie, Société de Pathologie et Springer-Verlag. France. 2014; 107:48-59.
16. El lalami A, Cherigui M, Ibnsouda Koraichi S, Maniar S, EL Maimouni N, Rhajaoui M. Malaria imported in the Northern Center of Morocco between 1997 and 2007. Cah. Health. 2009; 19(1):43-47.
17. El Ouali Lalami AB, Hindi T, Azzouzi A, Elghadraoui L, Maniar S, Faraj C *et al*. Inventaire et répartition saisonnière des Culicidae dans le centre du Maroc. Entomologie faunistique-Faunistic Entomology. 2010; 62(4):131-138.
18. Hamaidia K, Soltani N. Laboratory Evaluation of a Biorational Insecticide, Kinoprene, against *Culex pipiens* Larvae: Effects on Growth and Development. Annual Research & Review in Biology. 2014; 4(14):2263-2273.
19. Hamaidia K, Soltani N. Ovicidal activity of an insect growth disruptor (Methoxyfenozide) against *Culex pipiens* L. and delayed effect on development. Journal of Entomology and Zoology Studies. JEZS. 2016; 4(4):1202-1207
20. Hassain K. Biogéographie et biotypologie des Culicides (Diptera – Nématocera) de l'Afrique méditerranéenne. Bio écologie des espèces les plus vulnérantes (*Aedes caspius, Aedes détritus, Aedes mariae et Culex pipiens*) de la région occidentale d'Algérie. Thèse de doctorat es Sciences, Université de Tlemcen. 2002, 191.
21. Louah A, Ramdani M, Saoud Y, Mahjour J. Biotypologie de la faune Culicidiennes de la péninsule tingitane. Bull. inst. Sci., Rabat. 1995; 19:93-102.
22. Lounaci Z. Biosystématique et bioécologie des Culicidae (Diptra, Nematocera) en milieux rural et agricole. Thèse doc. I.N.A, El-harrach, 2003.
23. Matile L. The Dipteres of Western Europe. Introduction, study techniques and morphologies. Nematoceres, Bracchycera, Orthorraphs and Aschizes. Ed. Boubee. Paris, 1993.
24. Merabeti I, Ouakid ML. Contribution à l'étude des moustiques (*Diptera*: *Culicidae*) dans les oasis de la région de Biskra (nord-est d'Algérie). Actes Du Séminaire International Sur La Biodiversité Faunistique En Zones Arides Et Semi- Arides. 2010, 185-189.
25. Messai N, Berchi S, Boulknafd F, Louadi K. Inventaire systématique et diversité biologique de Culicidae (Diptera: Nematocera) dans la région de Mila (Algérie). Entomologie faunistique. 2010; 63(3):203-206.
26. Metge G, Hassaine K. Study of the environmental factors associated with oviposition by *Aedes detritus* along atransect in Algeria. J AMCA. 1998; 14(3):213-244.
27. Pradel J, Rey D, Foussadier R, Bicout D. Etude écologique des Moustiques (Diptera, Culicidae) – Vecteurs potentiels d'Arboviroses dans la région Rhone-Alpes. Epidémiol et santé animal. 2007; 51:81-94.
28. Rioux JA. Les Culicides du « midi méditerranéen». Paris, Le Chevalier, 1958, 303.
29. Rioux JA, Juminer B, Kchouk M, Croset H. Présence du caractère autogène chez *Culex pipiens pipiens* L. dans un biotope épigé de l'île de Djerba. Archives de l'Institut Pasteur de Tunis. 1965; 42:1-8.
30. Rhodain F, Perez C. Precis of medical and veterinary entomology. Maloine. S A Editor 27, Street of the school medicine 75006, Paris. 1985, 443.
31. Seguy E. les Culicidae de l'Afrique mineure, de l'Egypte et de la Syrie. Encyclopedie entomologique I. Ed. Paul Lechevalier, Paris. 1924, 257.
32. Subra R. Études écologiques sur *Culex pipiensfatigans* Wiedmann, 1828 (Diptera, Culicidae) dans une zone urbaine de savane soudanienne ouest-africaine. Dynamique des populations préimaginales. Cahier ORSTOM, Service entomologie médicale et parasitologie. 1971; 9:73-102.
33. Tia E, Gbalégba NG C, M'BraK R, Kaba A, Boby OAM, Koné M *et al*. Étude du niveau de production larvaire d'*Anopheles gambiaes* L. (Diptera: Culicidae) dans

différents types de gîtes à Oussou-yaokro au Centre-Ouest et à Korhogo, au Nord (Côte d'Ivoire). Journal of Applied Biosciences. 2016; 105:10170-10182. ISSN 1997-5902

34. Toto JC, Besnard P, LEMIRE J, Almeida DSI, Dos Santos MA, Fortes F *et al.* Premiers tests OMS d'évaluation de la sensibilité aux insecticides chez *Anopheles gambiae* et *Culex quinquefasciatus* à Lobito, Angola. Bull. Soc. Pathol. Exot. 2011; 104:307-312.