Global Scientific JOURNALS

GSJ: Volume 11, Issue 9, September 2023, Online: ISSN 2320-9186
www.globalscientificjournal.com

LARVAL DENSITY OF ANOPHELES IN THE COMMUNE OF LEMBA IN KINSHASA: *qualitative, quantitative and morphological study*

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Summary

Context and objective: The objective of this study was to describe the morphological aspects of the larvae of *Anopheles gambiae* and *Anopheles funestus* in the Mbanza Lemba and Super Lemba districts of Kinshasa.
Methods: Descriptive and analytical observational study with prospective collection. Three hundred and fifty-one (351) larval breeding sites including 200 in Mbanza-Lemba and 151 in super-Lemba were identified and studied from April 15 to June 15, 2019.
Results: A total of 200 breeding grounds for mosquito larvae were identified in Mbanza-Lemba and 151 in Super-Lemba. They were located in stagnant waters in 95% in Mbanza-Lemba and in 98% in Super-Lemba. Wells were represented in 4% and 1.9% respectively.
The larval density of Anopheles ranges from 0 to 293 larvae in Mbanza-Lemba and from 0 to 198 larvae in Super-Lemba while that of Culicines varies from 0 to 10 larvae in Mbanza-Lemba and from 0 to 11 larvae in Super-Lemba.
Conclusion: The larvae develop in stagnant water surfaces, ponds and wells. Stagnant waters are the most productive habitats: the larval population is easy and abundant there. As for the larval density, no significant difference was detected between the two sites, the densities were almost similar.
Keywords: Breeding sites, Anopheles, environmental sites.

Introduction

Female Anopheles mosquitoes are known today as major vectors of malaria and other health problems in sub-Saharan Africa (1, 2). Several authors report that the distribution of mosquito nets impregnated with long-lasting insecticide and indoor residual spraying (IRS) have been instrumental in reducing malaria transmission in sub-Saharan Africa (3, 4). However, these strategies are only effective for adult vectors that are resting indoors. Adult populations that rest or feed outdoors and immature stages that develop in water bodies are not covered by current vector control measures. It is therefore necessary to control the evolutionary stages of these vectors, particularly the aquatic stages, because the protection offered by current tools seems to be hampered by the emergence of resistance to insecticides in our environments (3, 5, 6). The objective of this study was to describe the morphological aspects of the larvae of Anopheles gambiae and Anopheles funestus in the Mbanza Lemba and Super Lemba districts of Kinshasa.

Material and methods

Study site

This study was conducted in the city province of Kinshasa, capital of the Democratic Republic of Congo, precisely in the Commune of Lemba from April 15 to June 15, 2019. Larval surveys were carried out in two sites, namely, super-Lemba and Mbanza- Lemba. The municipality of Lemba is bounded:

To the north : by the intersection of the Matete River with the axis of Kikwit Avenue up to its intersection with the axis of the interchange circle, the axis of the circle in the south and east directions up to its intersection with the axis of the intersection of the Matete River. *To the east* : by the Matete river to its source. And a straight line between the source of the river and the southeast axis of the University of Kinshasa concession. *To the south* : and to the west of this southwest point of the concession of the University of Kinshasa, the axis of the road which surrounds the said concession up to its intersection with By-pass which in turn goes up to the intersection with a straight line connecting the axis with the eastward bifurcation of the Yolo River. The Yolo River to its intersection with the axis of the Kikwit River.

The commune of Lemba is made up of 14 districts, namely: Echangeur, Kimpwanza, Madrandele, Ecole, Masano, Foire, Salongo, Livulu, Mbanza-Lemba, Kemi, Muli, Gombele, Commercial and Kinshasa.

Climatic data of the selected sites

The raw data used come from the N'djili station (Station 64210 of the RVA Aeronautical Meteorology Division, 2013. They cover the period from January 11 to 29, 2019. The N'djili station is located in Kinshasa at coordinates 04°22 ' latitude S, 15°22' longitude East, 310 m of altitude.

Biological material

In order to enable us to carry out our study, the biological material consists of the pre-imaginal forms (larvae and nymphs) of the *Culicidae* taken from the predominantly Anopheline roosts of the selected sites.

Methods

Prospecting of deposits

The prospecting of mosquito larvae sites was done on foot. It first included direct observation of the presence or absence of mosquito larvae (Sy et *al* ., 2016). This method made it possible to collect mosquito larvae in their development environment (lodging). This involves taking the larvae of different stages of development.

Our field observations during sampling drew our attention because we noticed that some sites contained many insects, including mosquitoes. Indeed, the presence of plants in mosquito breeding grounds play a role as a place of fixation or refuge for insects during bad weather, for example sunstroke, wind, precipitation and other movements. The leaves, for example, especially their undersides, play the role of protection against intense insolation and the wind. The abundance of herbs sometimes explains the abundance of mosquitoes and therefore of their larvae.

This is how we took the presence of plants as factors that could justify the abundance of mosquitoes in some gites studied.

Collection of larvae

If these immature stages were present, samples of the larvae and nymphs were taken using the dipping method (Coffinet *et al* ., 2009; Talipouo *et al* ., 2017) and using a 300 ml ladle.

This method consisted in carrying out about ten dipper dives in several places from the point of collection in order to maximize catches (Talipouo *et al.,* 2017). Thus, the pre-imaginal stages of the captured mosquitoes were transferred to trays using transfer pipettes and then transported in coolers to the laboratory. The different larvae collected were then sorted and counted by subfamily (*Anophelinae* or *Culicinae*).

Physico-chemical analyzes of data

Five physicochemical parameters (pH, temperature, conductivity, turbidity and dissolved oxygen) were measured in the laboratory after water sampling at each site (Figure 11). These different parameters of the physicochemical analysis of water were measured using the HI 9812-5 multi-parameter device.

Statistical analyzes of data

The calculation operations were carried out in Microsoft office Excel office professional version 2019 and, on the other hand, most of the statistical calculations as well as the graphs were carried out using Xlstat 2019. The thematic maps were developed using 'Arc Gis 10. All the data analyzed were previously subjected to the Shapiro-Wilk (W) test in order to check whether they follow a normal law or not. Thus, to give credibility to the data from our field observations, we used three types of analyzes and the use of the Chi 2 test. The variability of the larval densities of the different samples was tested by a one-way ANOVA. ANOVAs that proved significant at the threshold of $p < 0.05$ were completed by a Fisher post hoc test.

Results

Types of larval breeding sites studied

A total of 200 breeding grounds for mosquito larvae were identified in Mbanza-Lemba and 151 in Super-Lemba. They were located in stagnant waters in 95% in Mbanza-Lemba and in 98% in Super-Lemba. Wells were represented in 4% and 1.9% respectively.

Table 1. Distribution of mosquito larvae breeding grounds

Nature	**Mbanza-Lemba**		**Super-Lemba**	
	Number	Frequency (%)	Number	Frequency (%)
Backwater	190	95.00	148	98.01
Pond	2	1.00	0	0.00
Well	8	4.00	3	1.99
Total	**200**	**100.00**	**151**	**100.00**

Mosquito larvae density

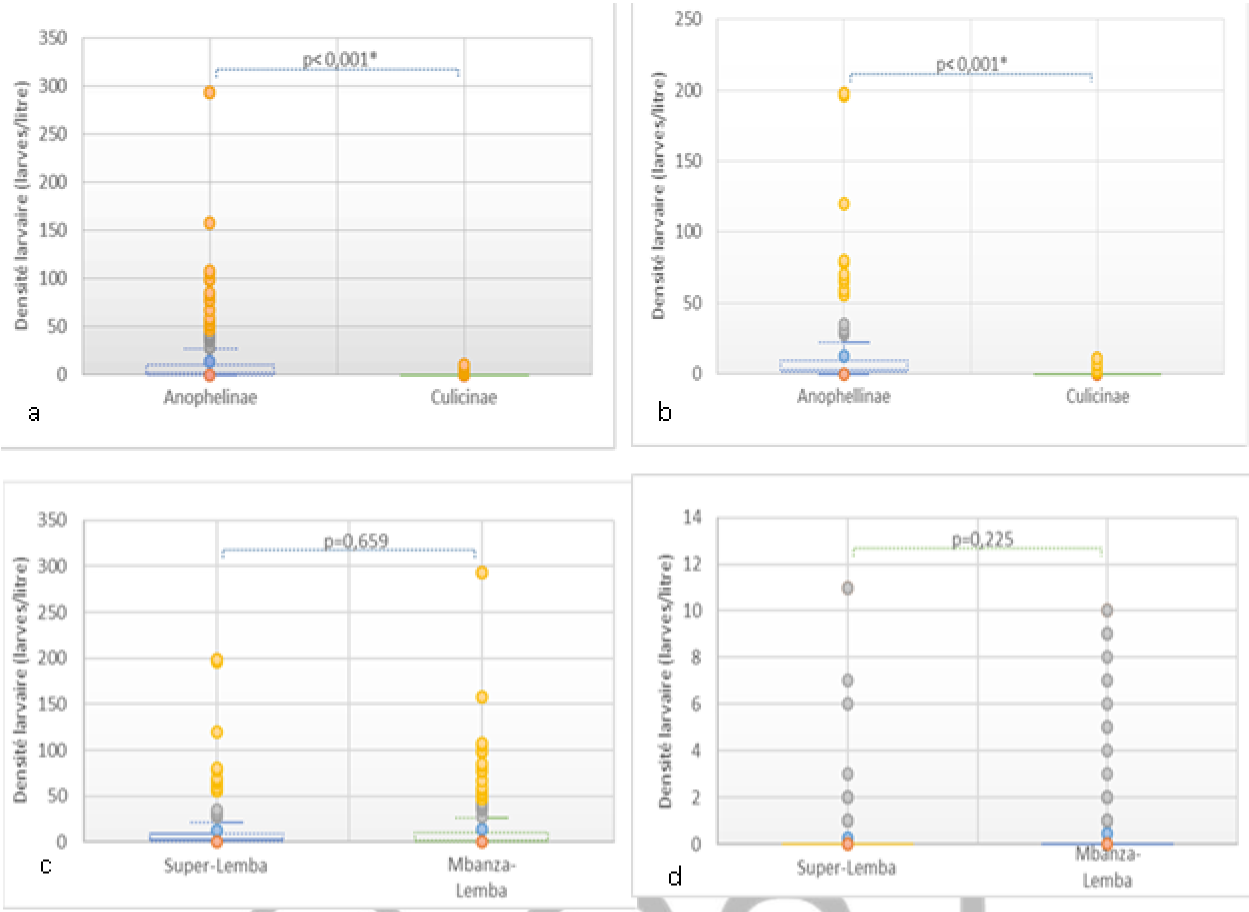

Figure 1. *Density of anophelinae and culicinae larvae recorded in the commune of Lemba: (a) Mbanza-Lemba and (b) super-Lemba. Comparison of the species found (c) anophelidae (d) culinae according to the districts.*

Figure 1 shows that the density of *anopheline larvae* in the roosts identified at Mbanza-Lemba varies considerably from 0 larvae to 293 larvae, with an average of 13.89 ± 1.31 larvae per roost. And that of *culicinae* varies from 0 to 10 larvae, with an average of 0.45 ± 0.01 larvae per roost ($p<0.001$) *Fig. 1a* . The larval density of *anophelinae* in the breeding sites surveyed at Super-Lemba varies from 0 larvae to 198 larvae, with an average of 12.46 ± 0.04 larvae per breeding site and that of the *culicinae* varies from 0 to 11 larvae, with an average of 0.26 ± 0.03 larva per roost ($p<0.001$) *Fig. 1b* . As for the comparison between the density of *anopheline larvae* recorded in Mbanza-Lemba and Super-Lemba, no significant difference was established ($t = 0.44$; $p = 0.659$).

Discussion

The larval surveys carried out in this work have shown that the study area has a high density and diversity of breeding sites. Most of these breeding sites were created by man as a result of his activities (agricultural activities, artificial water surfaces, etc.).

These breeding sites, particularly those with at least one larva, are found in the immediate environment of human populations. In addition, these breeding sites are conducive to the development of Anopheles mosquitoes which are major vectors of numerous pathogens responsible for numerous pathologies including malaria (Rodhain, 2015). Identical results were obtained by Saotoing *et al* . (2011) who noted that the immature stages of *anophelinae* have great ecological elasticity and are capable of colonizing different environments. These results are also similar to those of Karch *et al* . (1992); Tia et al. (2016) and Metelo (2018) who showed the responsibility of residents in establishing conditions conducive to the development and maintenance of mosquitoes through the creation of their larval habitats. Also, the proximity of mosquito development sites to homes could constitute a health risk and nuisance for surrounding human populations. The presence of these larval breeding sites could increase the risks of transmission of other infectious agents by these mosquitoes.

During this study, larval production was higher because the study was conducted in the rainy season. This abundance is probably linked, on the one hand, to the high quantity of permanent larval breeding sites present in the study area and, on the other hand, to the fact that the rainy season offers opportunities for choice of breeding sites for females of different species of mosquitoes both in quality and quantity. The abundance of Anopheles could also be explained by the level of the nature of the larval breeding sites and by the resilience capacity of the larvae. These observations corroborate those made by *Korba et al. (2016*) in Algeria who showed that Anopheles have strong adaptation capacities allowing them to develop in several types of habitats. Identical results were obtained by *Saotoing et al. (2011)* who noted the great ecological elasticity of Anopheles and their ability to colonize different environments. Moreover, the larval breeding sites colonized during this study varied (puddles, ponds, ponds, water storage containers). These breeding sites were mostly characterized by the presence of papers, bottles, plant debris, etc. According to, Alami et al. (2010), the proliferation of mosquito species is conditioned by the nature of the larval habitat. For these authors, the nature of the site favors one or other species depending on the characteristics of the site: stagnant or current, polluted or not, lacking or rich in vegetation.

Conclusion

This study shows that in the two neighborhoods selected, the larvae develop in stagnant water surfaces, ponds and wells. Stagnant waters are the most productive habitats: the larval population is easy and abundant there. As for the larval density, no significant difference was detected between the two sites, the densities were almost similar. The results also showed a proliferation of Anopheles breeding sites in the two sites investigated.

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