SciMedCentral
Annals of Community Medicine and Practice

Short Communication

Habitat Characterization and Spatial Distribution of *Anopheles Sp* Mosquito Larvae in Luanda, Angola

María del Carmen Marquetti Fernández[1]*, Yoenys Hidalgo Flores[2], and Duniarliz Lamothe Nuviola[2]

[1]*Department Vector Control, Instituto de Medicina Tropical Pedro Kourí, Cuba*
[2]*Cuban Control Programanti-Larval Malaria Vectors with Biolarvicides in Angola, Cuba*

***Corresponding author**

María del Carmen Marquetti Fernández, Department Vector Control, Institute of Tropical Medicine Pedro Kourí, La Habana, Cuba. Cuban Medical Cooperation in Angola, Email: marquetti@ipk.sld.cu; nanibisset2@gmail.com

Submitted: 07 December 2016

Accepted: 30 December 2016

Published: 02 January 2017

Keywords

- *Anopheles sp*
- Habitat characterization
- Malaria
- Luanda
- Angola

Abstract

Anophelesgambiae and *Anophelesfunestus* are the main vectors of malaria in Angola. The objective of this work was to obtain information about the habitat characterization of *Anopheles sp.* Mosquito larvae in Luanda. Mosquito larvae sampling was conducted to determine the presence or absence of *Anopheles* mosquito larvae during January and March 2015. A total of 512 potential mosquito breeding sites were sampled, 437 (85,3%) were productive for mosquitos About 135 of 179 (75,4%) of all available *Anopheles sp.* habitats were man-made. *Anopheles sp.* Larvae presence was much more likely to found in ground drains, concrete drains, puddles, ground wells and concrete wells than other habitats. Breeding sites with sunlit presence and semi-polluted and clear water were more likely to contain *Anopheles sp.* larvae than others. This results combined with improved knowledge of mosquito ecology and their interactions with humans, is crucial to understand the epidemiology of urban malaria in the capital of Angola.

INTRODUCTION

In the Afro tropical Region, where Malaria is transmitted mainly by *Anopheles funestus* and members of the *Anopheles gambiae* complex, gaps in information on larval ecology and the ability of *An. gambiaes.l.* To exploit a wide variety of larval habitats have discouraged efforts to develop and implement larval control strategies [1].

In recent years there is increasing interest in the Implementation of the reduction and management of larval populations of mosquito vectors of Malariain Africa, highlighting the use of two bacteria *Bacillus thuringiensis* and *Bacillussphaericus* because these are highly effective against mosquito larvae [2,3].

In Angola Malaria vector control is directed primarily to the anti-larval fight using these larvicides (*Bacillusthuringiensis* (Bactivec®) and *Bacillussphaericus* (Griselesf®), which are applied by brigades anti larval struggle, at the level of municipalities, created to support Cuban cooperation, which has been developing this activity within the Program of National Malaria Control since 2009, in addition limited actions of intra household spraying with use of pyrethroids and more over since 2006 has increased the distribution of impregnated mosquito net sare made in the populational though to date coverage is insufficient (Plano Estrategico Nacionalpara o Control da Malaria em Angola 2015 to 2020).

Anophelesgambiae and *Anophelesfunestus* are the main vectors of malaria in Angola, but other species such as *Anophelesarabiensis*, *Anopheles nili*, *Anophelesmelas* and *Anophelespharoensis* are also reported [4].

Studies carried out in Luanda founded low Malaria parasitaemia (5.5%) in children under5 years compared with 29% in neighboring provinces [5], while a low prevalence of confirmed cases reported with Malariain Luanda, which increased with distance from the city center [6]. However, the province of Luanda was the most cases of Malaria reported in the country with over 30% and 3% mortality during 2013, although most of these cases were clinically diagnosed and no information is available on where they were acquired.

The objective of this work was to obtain information about the habitat characterization of *Anopheles sp.* Mosquito larvae in Luanda, Angola. This work was carried out in order to collect base line information for to improve the larval control mosquito through the biolarvicides application implemented in Luanda.

The study was carried out in Luanda, the capital of Angola, as a population estimated of 6 542 944 inhabitants (National Census data conducted from 15-31of May, 2014; National Institute of Statistics). A large proportion of the residents of Luanda live in densely populated urban slums. The city is divided in 7 municipalities Belas, Cacuaco, Cazenga, Icolo de Bengo, Quissama, Viana and Luanda municipality which has the same name as the province and conformed by Ingombota, Maianga, Rangel, Samba, Sambizanga and Kilamba Kiaxi districts respectively. Each municipality is divided into comunes and these in neighborhoods. The rainy season is between November-May but the most accumulation of rain in Luanda occurs in March- April. Luanda had an annual rainfall of 323 millimeters during 2013 with values of 27,9 millimeters for November and 12,7 millimeters in April with a peak of rainfall in April 116,8 millimeters (Average Climatic Conditions Luanda, Angola; BBC Weather, 2013). The data collection was conducted from January to March 2015 belonging to rainy season. Each area was visited only once time of breeding sites in all municipalities of Luanda. Open natural and artificial water bodies were selected randomly in all municipalities for to sampling with the mainly objective to determine the presence or absence of *Anopheles* mosquito larvae using standard procedures. A total of 512 were selected; 185 in Luanda municipality conformed by Ingombota, Maianga, Rangel, Samba, Sambizanga and Kilamba Kiaxi districts; 95 for Cacuaco y Vianaperi urban municipalities; 52 for Belas coastal municipality; 30 for Icolo de Bengo and Quissama the most rural municipalities of the province and 25 for Cazenga situated in the center of the province. From every potential breeding site up to 5 dips were taken with a standard white 350 ml dipper (WHO 1992). Habitat characterization only was carried out in the breeding sites with *Anopheles* mosquito's presence.

The staff (5 persons) that performed the sampling belongs to the malaria program established in the province and trained for the activity by Cuban specialist in vector control. All sample included different parameters: location of breeding sites; man–made or not breeding sites; presence/absence of *Anopheles* larvae*;* presence/absence of sunlit; partly sunny (sun receives only part of the day) and shaded*;* presence/absence of any vegetation*,* water turbidity (pollute, semi-pollute or clear water) (qualitative appreciation) and the classification in permanent or semi permanent breeding sites. The sampled mosquito larvae was transferred to small labelled vials and sent to the entomology laboratory belonging to Malaria Control Program at the Ministry of Health in Luanda for the identification only at genus level. Pupae were not recorded as they cannot be differentiated from non-*Anopheles* species in the field.

Each site was categorized as one of the following habitat type: concrete drains, ground drains, flooded yards, flooded houses, natural lagoons, cisterns, tanks, swampy areas, puddles, ground wells, concrete wells, wells covered with tires of used cars and sewerage.

A total of 512 potential mosquito breeding sites were sampled, 75 (14,6%) were negative to mosquito larvae at the time of visit. Of the 512 sites 258 (50,4%) were productive for only culicines, 143 (27,9%) were productive for culicine and *Anopheles sp.* larvae and 36 (7,1%) were productive only for *Anopheles sp*. mosquitoes.

The majority of the breeding sites with *Anopheles sp.* larvae presence were founded in the most urban municipality (Luanda) 100 (55,9%) of the total. Icolo de Bengo and Quissama showed the most low percentages (4,5%) and (5,6%). The rest of the municipalities Viana, Cacuaco, Cazenga y Belas showed percentages between 7,2% to 9,5%.

Presence/absence of *Anopheles sp.* Larvae

Ground drains, concrete drains, puddles, ground wells and concrete wells were much more likely to contain *Anopheles sp.* larvae than other habitats, (Figure 1). Breeding sites with sunlit presence and semi-polluted water and clear water were more likely to contain *Anopheles sp*. larvae. However *Anopheles* larvae presence not showed predilection for presence or absence of vegetation at the breeding sites. Despite the study was carried out in rainy season 148 (82,7%) of the total of *Anopheles sp* breeding sites were classifies as permanent breeding sites. About 135 of 179 (75,4%) of all available habitats were man-made, of them 48 (35,5%) for drainages and 66 (48,8%) for water storage purposes (Table 1).

Breeding sites of *Anopheles* mosquitoes in general can be natural or artificial permanently or semi-permanent prominent among them the lagoons, streams, back waters of rivers, irrigation

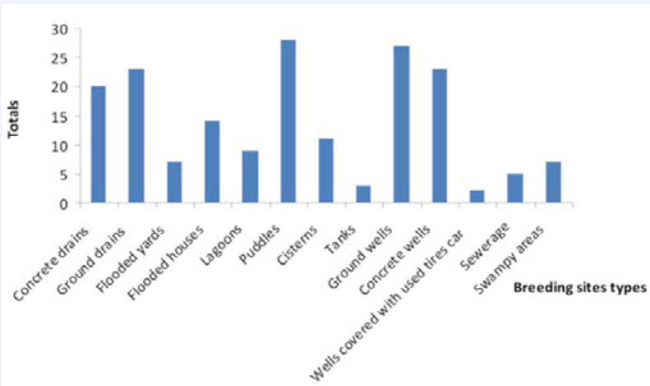

Figure 1 Totals of *Anopheles sp* larvae presence in different breeding sites in Luanda, January- March 2015.

Table 1: Number and percentage of different parameters analyzed in *Anopheles sp.* breeding sites in Luanda, January-March 2015.

Parameters	Total (N= 179)	% del total
Sunlit	136	75,9
Partially sunlit	34	19,1
Shaded	9	5,0
Any vegetation presence	86	49,1
No vegetation presence	93	51,9
Clear water	72	40,2
Semi-polluted water	80	44,7
Polluted water	27	15,1
Permanent breeding sites	148	82,7
Semi- permanent breeding sites	31	17,3
Man-made breeding sites	135	75,4
Natural breeding sites	44	24,6

canals, animal foot prints, small holes in the ground associated with the presence of vegetation. Recently studies in urban areas of some cities in Africa and America have also reported the presence of *Anophelessp.* In water with high organic pollution content [7-13]. It is possible, however, that these habitats have always been capable of supporting larvae, if not to the same frequency as 'cleaner' sites. Indeed, the definition of 'clean', 'dirty' and 'polluted' water itself is unclear when examining the original literature.

The ecological processes associated with urbanization should, in theory, limit Malaria transmission by reducing the opportunities for vector breeding and the degree of contact between humans and vectors. Improved access to health care and Malaria control measures also should contribute to a reduced burden of Malaria disease. Evidence from the field largely bears out this theory but also suggests that the existence of diverse epidemiological situation in most urban areas makes generalization difficult. In most cases, a human settlement initially favours the multiplication of breeding sites and the perennial presence of high densities of *Anopheles sp.* [14].

Man-made larval habitats in close vicinity to human habitation are known to play an important role in *Anopheles* proliferation [15,16], especially in the dry season when supported by human activity [17]. The very common ground and concrete drains and wells provide excellent conditions for both *Anopheles* and culicine larvae as they keep water for considerably longer time than natural habitats. Furthermore, they are often re-filled with water from human activities and waste so that the number of available habitats is artificially kept higher than rain alone would support

Coexistence ofanophelines and culicinesmosquito was found at sites during the study. Researchers about setting *Anophelessp*. In these hábitats would be necessary for a better understanding of the distribution of breeding sites of the vectors of malaria in Luanda.

Main limitations of the study

This study represents the first results carried out in urban area for to obtain information about the habitat characterization of *Anopheles sp*. mosquito larvae in Luanda (Angola). More intensive studies are currently being undertaken to complement these results. The study was implemented only during rainy season. It's recommended to repeat in dry season when the selectivity of mosquitoes for ovi position sites can be greatly diminished. Very small breeding sites could not be selected and were, therefore, largely excluded from the study and *Anopheles sp*. mosquitoes were not classified down to species level.

The goal of the study was to characterize important breeding sites of *Anopheles sp*. mosquitoes and, consequently, potential foci of malaria transmission, regardless of the species. This is because in the context of sustainable operations in a routine mosquito control programs municipal staff cannot be expected to identify all *Anopheles* larvae samples to species level without rendering sampling procedures prohibitively laborious and expensive. To achieve a satisfactory impact, exhaustive targeting of all potential vector species is necessary anyway. Furthermore, community acceptance of vector control programs in Luanda has been shown to require suppression of all mosquito species, rather than only malaria vectors.

In conclusion, all potential breeding sites need to be considered as sources of malaria risk and exhaustively targeted in any larval control intervention. These finding about malaria vectors breeding sites provides an approach to the understanding of vector distribution and ecology about the malaria vectors in Luanda that is essential for the malaria larval control programs strategies and for to malaria control in the Angola capital. On the other hand mapping of malaria risk on the basis of breeding sites plays an important role for urban malaria control programs. Also, initial risk mapping of breeding sites, combined with improved knowledge of mosquito ecology and their interactions with humans, is crucial to understand the epidemiology of urban malaria in the country.

ACKNOWLEDGMENTS

The authors wish thanks to Ministry of Health, Dr. Filomeno Fortes Chief of National Malaria Control Program in Angola, all Heads of Health at the municipalities and districts levels; Angolan brigades vector control staff; Cuban specialists belonging to Control Programm anti-larval against malaria (LABIOFAM) and the population of the province of Luanda for his contribution to the realization of this work.

REFERENCES

1. Walker K, Lynch M. Contributions of *Anopheles* larval control to malaria suppression in tropical Africa: review of achievements and potential. Cochrane Database Syst Rev. 2013.

2. Minakawa N, Sonye G, Futami K, Kaneko S, Moushinzimana E, Fillinger U. A large-scale field trial to evaluate the efficacy of bacillus larvicides for controlling malaria in western Kenya. Study design and methods. Trop Med Health. 2007; 35: 41-45.

3. Fillinger U, Ndenga B, Githeko A, Lindsay SN. Integrated malaria vector control with microbial larvicides and insecticide –treated nets in western Kenya: a controlled trial. Bull World Health Organ. 2009; 87: 9.

4. Cuamba N, Kwang Shik C, Townson H. Malaria vectors in Angola: distribution of species and molecular forms of the *Anopheles gambiae* complex, their pyretroid insecticide knockdown resistance (kdr) status and *Plasmodium falciparums* porozoite rates. Malar J. 2006; 5: 2.

5. Cosep Consultoria, Consaúde, and ICF International. *Angola* Malaria Indicator Survey 2011. Calverton, Maryland. 2011.

6. Thwing JI, Mihigo J, Fernandes A, Sante F, Ferreira C, Fortes F, et al. How much malaria occurs in urban Luanda, Angola? A health facility-base assessment. Am J Trop Med Hyg. 2009; 3: 487-491.

7. Minakawa N, Sonye G, Mogi M, Yan G. Habitat characteristics of *Anopheles gambiaes.s.* larvae in a Kenyan highland. Med Vet Entomol. 2004; 18: 3: 301-305.

8. Sattler MA, Mtasiwa D, Kiama M, Premji Z, Tanner M, Killeen GF, et al. Habitat characterization and spatial distribution of *Anopheles sp.* Mosquito larvae in Dar es Salaam (Tanzania) during an extended dry period. Malar J. 2005; 4: 4.

9. Sogoba N, Vounatsou P, Bagayoko MM, Doumbia S, Dolo G, Gasoniu L, et al. The spatial distribution of *Anopheles gambiaesensustricto* and *An. arabiensis* (Diptera: Culicidae) in Mali. Geospat Health. 2007; 2: 213-222.

10. Marquetti MC, Rojas L, Birniwa MM, Sulaiman HU, Adamu HH.

Identificación de los sitios de cría de *Anophelessp.* durante parte de la estación seca en el estado de Jigawa, Nigeria. Rev Cubana Med Trop. 2007; 59: 166-168.

11. Marquetti MC, Rojas L, Pomier O. Asesoría cubana en el control de los vectores de malaria durante un brote epidémico en Jamaica y en dos países endémicos de África. Rev Biomédica. 2008 ; 19: 1.
12. Oyewole IO, Momoh OO, Anyasor GN, Ogunnowo AA, Ibidapo CA, Oduola OA, et al. Physico-chemical characteristics of *Anopheles* breeding sites: impact on fecundity and progeny development. African J Environm Science and Technology. 2009; 3: 12: 447-452.
13. Gouagna LC, Dehecq JB, Girod R, Boyer S, Lempérière G, Fontenille D. Spatial and temporal distribution patterns of *Anopheles arabiensis* breeding sites in La Reunión island-multi-year trend analysis of historical records from 1996-2009. Parasites Vectors. 2011; 4: 121.
14. Casman E, Dowlatabadi H. The contextual determinants of Malaria. Resources for the future Washington, DC. 2002; 381.
15. Holstein MH. Biology of *Anopheles gambiae*. World Health Organization, Geneva, Switzerland. 1954.
16. Minakawa N, Seda P, Yan G. Influence of host and larval habitat distribution on the abundance of African malaria vectors in western Kenya. Amer J of Trop Med and Hyg. 2002; 67, 32-38.
17. Fillinger U, Sonye G, Killeen GF, Knols BG, Becker N. The practical importance of permanent and semi permanent habitats for controlling aquatic stages of *Anopheles gambiae* sensulato mosquitoes: operational observations from a rural town in western Kenya. Trop Med Int Health. 2004; 9: 1274-1289.

Cite this article

del Carmen Marquetti Fernández M, Flores YH, Nuviola DL (2017) Habitat Characterization and Spatial Distribution of Anopheles Sp Mosquito Larvae in Luanda, Angola. Ann Community Med Pract 3(1): 1016.