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STUDY OF SOME PHYSICOCHEMICAL PARAMETERS ON THE ABUNDANCE AND DISTRIBUTION OF MOSQUITO LARVAE IN RIVER ANTAU, KEFFI, NASARAWA STATE, NIGERIA

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ABSTRACT

Aquatic life is influenced by physicochemical parameters which enabled organisms to develop different adaptations that may improve and sustain the productivity of the ecosystem. Changes in the water quality may affect biotic community structure with the most vulnerable species dying while the most sensitive ones act as bio- indicators of environmental health. This paper assessed some physicochemical parameters on the abundance and distribution of mosquito larvae in River Antau conducted between April and July, 2021. The samples were collected from three selected points (A, B and C) monthly using dipper and larvae bowl and transported to the Entomology and Insectary Laboratory for analysis. Temperature, pH and DO across the sampling points were equally analyzed**.** A total of one thousand and three (1003) mosquito larvae including *Anopheles sp* 562(56.0%) and *Culex sp* 441(44.0%) were collected. The results showed that the highest number of *Anopheles sp* 386(68.7%) were recorded in May and the lowest 34(6.1%) in June, while the highest number of *Culex sp*152 (34.5%) were encountered in April and the lowest 40 (9.1%) occurred in the month of July. Physicochemical parameters were found to influence the distribution and abundance of mosquito larvae in River Antau. This study recommends for public health awareness on the mosquito's management and control to reduce transmission of malaria in the area.

Keywords: River Antau, physicochemical parameters, abundance, distribution, mosquito larvae

INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem required by all living organisms for survival. It is mainly used for industrial, domestic, agricultural and other purposes, lack of water is considered as a limiting factor of socio-economic development of a country. The quality of water in an aquatic ecosystem is largely dependent on its physical, chemical and biological characteristics (Sargaonkar and Deshpande, 2003).

Globally, water resources are increasingly under severe threats of pollution from human activities and inappropriate agricultural drainage from rivers (Jin *et al*., 2020a, 2020b). Anthropogenic activities such as untreated industrial effluents, improperly disposed domestic wastes, and agricultural runoff are largely responsible to surface water pollution and water quality deterioration (UN, 2016; Uddin and Jeong, 2021; Hasan *et al*., 2019). Therefore, monitoring of physicochemical parameters play key roles in assessing the water environment, ecosystem, hydrochemistry, ecology, and restoring water quality (Whitehead *et al*., 2018; Sarkar *et al*., 2016; Islam *et al*., 2019).

Aquatic organisms need a healthy environment to live and adequate nutrients for their survival and development. The productivity of the water bodies are largely influenced by physicochemical parameters such as temperature, rainfall, pH, salinity, dissolved oxygen, carbon dioxide, total suspended and dissolved solids, total alkalinity and acidity and heavy metal contaminants. Any change of these properties due to discharge of liquid, gaseous or solid substance is likely to create detrimental or injurious effect to aquatic life and consequently public health could be termed water pollution (Pandey *et al*., 1993).

The physicochemical parameters and mosquito larvae abundance and distribution of a river indicate its quality and suitability for both human use and survival of the living organisms within it. McCrae (2005) reported that larval habitat and the type of water plays key roles in determining mosquito site selection of oviposition, productivity of such habitats as well as the adult mosquito emergence which is critical in determining the vectorial capacity of mosquitoes. Mosquito larvae are also known to show preference to water with suitable pH, optimum temperature, dissolved oxygen, concentration of ammonia, and nitrate (Afolabi *et al*., 2013). Olayemi, *et al.*, (2010) reported that strong correlation exits between certain physicochemical parameters, mosquito larval abundance, distribution as well as their breeding sits. Therefore, this research was conducted to assess some physicochemical parameters on the abundance and distribution of mosquito larvae species in the study area.

MATERIALS AND METHODOLOGY

Study Area

This study was carried out at River Antau in Keffi Local Government Area of Nasarawa State, Nigeria within the period of April - July, 2021. Keffi Town lies within 8° 50′ 47" N latitude and 7° 52′ 24" E longitude and is about 50Km from the Federal Capital Territory, Abuja. The population of the area is about 92,664 as at 2006 census. The river bank has a concentration of residential populations and mainly used for domestic, bricklaying works and irrigation purpose.

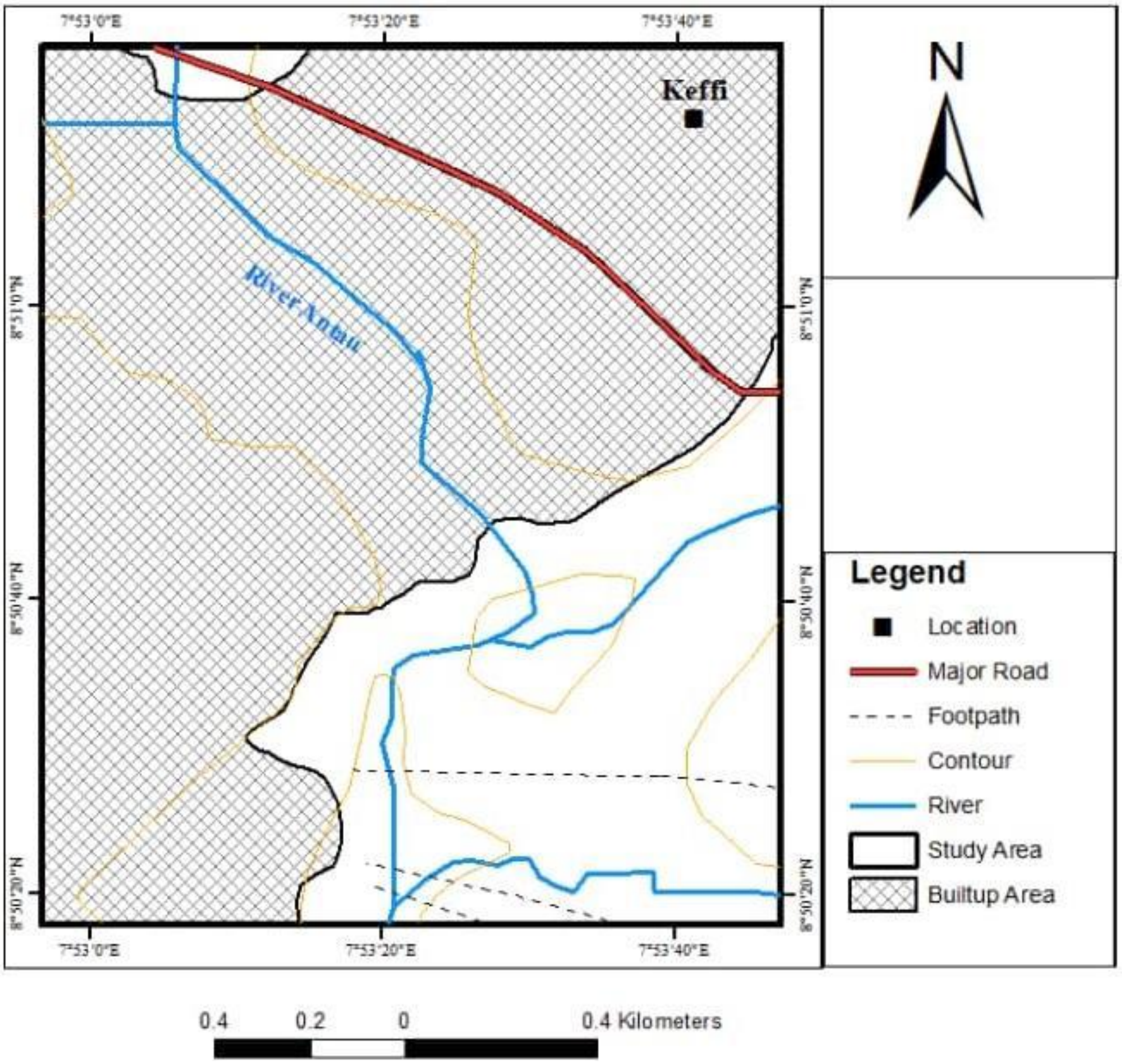

Figure 1: Map of River Antau

Determination of physicochemical parameters
Physicochemical parameters such as temperature, pH and dissolved oxygen of River Antau were analyzed by standard method (APHA, 2012) and guided manual (Manivaskam, 2011). Water samples were collected from the selected three points (A, B and C) usually in the morning hours between 7 to 10am at the approximate depth of 10-20 cm by dipping in a cleaned labelled glass bottles (2Litre) and airtight. The water samples were immediately taken to the chemistry laboratory for analysis. The samples were protected from heat and direct sunlight during transportation and the equipment used were thoroughly checked and calibrated according to the manufacturer's specifications and instructions. The water temperature and pH were directly recorded *in situ* while the dissolved oxygen was analyzed in the laboratory.

Temperature (°C)
Temperature is one of the most important factors in the aquatic environment (Dwivedi and Pandey, 2002). It affects the physical and chemical properties of water body and also affects the aquatic vegetation, organisms and their biological activities. The temperature of the water was measured *in situ* by dipping a mercury thermometer with range of 0 °C to 100 °C into the water at each point for about 2-5 minutes and readings were recorded (APAH,2012).

pH
The pH is the concentrations of hydrogen ions (H+) present in water and is a measure of acidity or alkalinity. Most of the aquatic organisms are very sensitive to pH change and pH can alter various metabolic activities of aquatic organisms**.** The pH of water sample was measured by electronic pH meter (APHA, 2012). The electrode of the pH meter was dipped into the water sample for 2-5 minutes and the pH readings of the water samples were immediately taken *in situ***.**

Dissolved Oxygen (DO)
The dissolved oxygen measures the amount of life sustaining oxygen present in the water. To establish an accurate reading of DO in the samples, Winkler titration method was used. About 200 mL of the water sample was carefully transferred into a 300 ml biochemical oxygen demand (BOD) bottle and brought to the laboratory for analysis. 1mL each of Manganese Sulphate (MnSO4) and Alkali-iodate azide (KI reagent was added. The precipitates formed was dissolved by adding 2 ml. of concentrated Sulphuric acid (H_2SO_4). The

resulting mixture was titrated against 0.025 N sodium thiosulphate ($Na_2S_2O_3$) and the point at which the color changes is the "endpoint" which is equivalent to the amount of oxygen dissolved in the sample. The DO content was determined using the following formula (Winkler's method – APHA, 2012).

$$\text{Dissolved oxygen (mg/L)} = \frac{\text{B.R x N x1 000}}{\text{Amount of sample taken (ml)}}$$

Where, B. R. = Burette Reading (Amount of titrant used)
N = Normality of Sodium thiosulphate.

Mosquito Larvae Collection

Mosquito larvae were collected by standard dipping method (Olayemi and Ande. 2009; Jacob and Joao 2012) usually between the hours of 7.00 - 10.00am monthly. The larvae in each dip (2–15dips) were transferred into clean labelled vials using the larval bowl and brought to the Entomology and Insectary Laboratory of Nasarawa State University, Keffi for analysis.

Sorting and Identification of Mosquito Larvae

The mosquito larvae sampled were decanted in a white plastic tray and sorted out to species level with the help of magnifying glass, counted and preserved in a vial of 70% ethanol. Morphologically identification was done with × 20 magnification of a dissecting microscope and identification keys (Sallum *et al*., 2020).

Data analysis

Chi square test was used to analyze the variation in physicochemical parameters and mosquito's larvae abundance across the sampling points. Significant difference was observed at 5% probability ($P < 0.05$).

RESULTS AND DISCUSSION

In the present study, a total number of one thousand and three (1003) mosquito larvae inc *Anopheles sp* 562(56.03%) and *Culex sp* 441(43.97%) were collected (Table1). The highest number of *Anopheles sp* 386(68.7%) were recorded in May while the lowest number 34(6.1%) occurred in June. In April, 441(43.97%) of *Culex* mosquito were recorded, while 40(9.1%) occurred in July 40(9.1%). Table 2 showed the results of various physiochemical parameters with respect to sampling points. The temperature ranges from 27.8°C to 28.3°C. The highest value was recorded in point C (28.3°C) followed by B (28.0) while point A had the lowest value (27.8°C). The pH of the water with respect to location ranged from 6.9 to 7.0 as shown in Table 2. Point A had the lowest value (6.9), while B has the highest pH value (7.2). The dissolved oxygen values recorded in points A and C fluctuates between 6.61 mg/L and 6.76 mg/L respectively as observed in Table 2. The results of the study indicate that abundance and distribution of the mosquito larvae in relation to physicochemical parameters varied significantly ($p < 0.05$).

Table 1: Monthly abundance of mosquito larvae at River Antau (April - July, 2021**)**

Mosquito Larvae	**Month**				
	April	**May**	**June**	**July**	**% Composition**
Anopheles sp	93(16.5%)	386(68.7%)	34(6.1%)	49(8.7%)	562(56.03%)
Culex sp	152(34.5%)	151(34.2%)	98(22.2%)	40(9.1%)	441(43.97%)
Total	**245(24.5%)**	**537(53.5%)**	**132(13.2%)**	**89(8.9%)**	**1003(100)**

$\chi 2$ = P < 0.05(*)

Table2: Physicochemical parameters at the sampling points of River Antau (April- June, 2021)

Parameters	**Sampling points**		
	A	**B**	**C**
Temperature (^{O}C)	27.8	28.0	28.3
pH	6.9	7.2	7.0
Dissolve oxygen (mg/L)	6.76	6.61	6.67

DISCUSSION

Generally, different aquatic habitats play an important role in mosquito breeding which provide basic information and knowledge for the effective control of their larvae (Killeen *et al*., 2012). However, variation in physicochemical parameters of the water indicate different environmental conditions which may be related to the patterns of water use, temperature and rainfall (Ayoade *et al*., 2006; Atobatele and Ugwumba, 2008; Oso and Fagbenro, 2008; Abolude, 2007). It was observed that the water temperature (28.3°C) of the river recorded was optimal for the breeding of mosquitoes which indicates positive correlation with other parameters and mosquito larvae abundance in the study area. A recent study conducted at Akure North by Afolabi and Aladesanmi (2018) also shows that the optimal temperature (28 °C) favored breeding of mosquitoes which is not likely to occur at temperature below 25°C. The pH of water is an important parameters because many biological activities occurs only within a narrow range. Thus, any variation beyond acceptable range could be fatal to aquatic organisms. The pH range 6.9 - 7.2 recorded in this study corroborated with the works of Adebote, Oniye, Ndams, & Nache, 2006; Afolabi *et al*, 2010) who reported that pH range (6.8 –7.2 and 7.0–7.4) were suitable for the weakening of the mosquito egg shells for the emergence of its first instar larvae and that pH less than 5.0 and higher than 7.4 have fatal effects on the survival of mosquito species**.** The dissolved oxygen (DO) is also a very important key parameter for the survival of aquatic organisms. It measures the degree of pollution by organic matter and the destruction of organic substances, as well as the self-purification capacity of the water body. The low concentration of DO in the fresh water aquatic system indicates the presence of high organic load (Yayyntas *et al*., 2007). Dissolved oxygen also indicate the changes occur in the biological parameters due to aerobic or anaerobic phenomenon and signifies the condition of the river/streams for the purpose of the aquatic as well as human life (Chang, 2005). Sufficient supply of dissolved oxygen (DO) is vital for aquatic life and is a good indicator of water quality (Bahadori and Vuthaluru, 2010) and Andrews *et al*. (2011).

CONCLUSION

The findings of this study showed variations in temperature, pH and dissolved oxygen levels as the most important factors suitable for breeding of mosquito larvae in the water bodies which favored the abundance and distribution of *Anopheles,* and *Culex* species in River Antau. Therefore, physicochemical, biological and microbiological parameters of the river were optimal for the breeding of *Anopheles* and *Culex* mosquito larvae species which also reflects the biotic and abiotic status of the ecosystem.

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