

*Full Length Research Paper*

# Assessment of Entomological and Parasitological Parameters of Malaria Transmission in Gwagwalada Area Council Abuja Nigeria

GIMBA, U.N.

Department of Biological Sciences, University of Abuja, Nigeria, P.M.B 117, Gwagwalada Abuja, Nigeria  
Corresponding Email Address: [usnaji@yahoo.com](mailto:usnaji@yahoo.com); Tel: 08036381509

Abstract

***A total of 867 mosquitoes were collected and identified: 420(48.44%) from Dukpa and 447(51.55%) from Kutunku. The collected mosquitoes were subsequently dissected for parity (egg laying status) and sporozoite rates using standard procedures. The results obtained indicates that Anopheles mosquitoes had a relative abundance of 542(62.51) with the females constituting 380(70.11%) and the males 162(29.88%). Kutunku had the higher number of Anopheles mosquitoes of 287(52.95%) compared to Dukpa with 55(47.04%). Out of the 380 females dissected, 210(55.26%) were positive for both sporozoites and parity rates, while 170(44.73%) were negative for both. Also, a total of 425 blood samples were collected and examined for malaria parasites from both locations. On the whole 277(65.20%) of the samples were positive while 148(34.80%) were negative at both locations with Dukpa having 70.00% infection rate compared to Kutunku with 60.10% respectively. Generally, there was no significant difference in the distribution of the mosquito vectors and the malaria parasites within the study areas ( $P>0.05$ ). The heavy burden exerted by mosquito-borne diseases was the reason for this study to evaluate the entomological and parasitological indices of malaria disease transmission in Kutunku and Dukpa, FCT, Abuja, Nigeria. This is a survey type study conducted in two selected communities in Gwagwalada Town, FCT, Abuja, North Central Nigeria. Mosquitoes were sampled using Pyrethrum Spray Catches (PSC). The population indoors was sampled by covering the floor with a white cloth of 5m x 5m each edge being held to the wall by a masking tape. The room was spread with an insecticide a pyrethroid and then left for 10 minutes, with every opening being shut. This study therefore will be useful as a baseline data to help in designing strategies for the control of mosquito-borne diseases in Gwagwalada, Abuja and its environs.***

***Keywords:*** Assessment, Entomological, Parasitological, Parameters, Malaria Transmission.

## INTRODUCTION

Despite advances in treatment and prevention over the past decades, malaria still threatens the lives of millions in tropical countries. Over the years, increasing use of control measures such as insecticide treated nets, indoor residual spraying, and early treatment with Artemisinin - based Combination Therapies (ACT's) has led to a reduction in morbidity and mortality caused by malaria in some African countries. In Africa, more than \$12 billion is lost to malaria annually thus reducing the Gross Domestic Product (GDP) and contributes to a great extent to the poverty situation in Africa, as it exerts an impediment to this progress is the ability of the

parasite to develop resistance to anti-malarial and increasing insecticide resistance of the mosquito vector.

Malaria is transmitted by female mosquitoes of the genus *Anopheles* because they support the sporogonic development of human malaria parasites. There are over 2,500 species of *Anopheles* mosquitoes, but less than 50 are capable of transmitting malaria (Ahmed, 2014). In some cases, different forms are found in varying ecological regions, thus the need to identify the prevalent malaria vectors in the study locations.

According to the World Health Organization (2014), malaria is the world's most important parasitic disease

with estimated 247 million cases resulting in 881,000 deaths most of them children under the ages of five (World Health Organization, 2013). It poses a major threat to over 2.4 billion people which is about 4% of the world population. Indeed malaria is a major public health problem worldwide (Angerilli, 1980).

And it is a persistent ailment in tropical Africa especially among under five children due to their low level of resistance to the disease and mortality to it amounts to millions (Appawu et al., 2011).

Malaria transmission in these African communities is enhanced by environmental conditions such as high humidity and warmth which accelerates mosquito development. Poor quality housing also facilitates malaria transmission as the populations are continually exposed to mosquito bites. Treated nets offer protection from the mosquitoes, although bites can still occur outside the house (Awolola et al., 2014).

Nigeria accounts for a quarter of all malaria cases in Africa (Coetzee et al., 2002). It is endemic throughout Nigeria with a high percentage of the population at risk. In the southern part of the country, transmission occurs all year round while in the north it is more seasonal. Almost all malaria cases in the country are caused by *Plasmodium falciparum*, considered to be the leading cause of death worldwide in 2004, from a single infections agent (Angerilli, 1980). Malaria is the most common disease in Nigeria and according to the Federal Ministry of Health [8], half of its population will have one or more malaria attacks annually. It also reported that malaria accounts for 25 percent of infant mortality and 30 percent of childhood mortality in Nigeria (Coetzee et al., 2002).

The importance of detailed knowledge of local determinants of malaria is of primary importance in the development of area-specific control interventions that will effectively lead to the control of the disease. Presently, there is a little information on these drivers of malaria transmission in Gwagwalada, FCT-Abuja, Nigeria (Fradin, 2002), thus the aim of this study is to determine the entomological and parasitological indices of malaria transmission of this two communities for effective control measures of malaria in the study area.

## MATERIALS AND METHODS

The study was undertaken in two selected sites in some parts of Gwagwalada, an Area Council in Abuja, Nigeria. These sites are:- Kutunku and Dukpa, Gwagwalada Area Council is located about 55km away from Federal Capital City. It lies on latitude 8° 55', North and 9° 00' North and longitude east and 7°.05' east (Ishaya, 2013). The area covers a total of 65sq kilometer located at center of very fertile area with abundance of grasses (Ishaya, 2013).

This study area falls in to the guinea savanna vegetation zone of the country which is the vegetation types, constituting about 50% of the land area of Nigeria. There are two seasons within this vegetational zone, dry season that lasts between four to seven months and a rainy season that lasts between four to five months. The rainfall ranges between 1016mm and 1524mm with relative humidity of between 60% and 80%. The guinea savanna is divided into two vegetation zones: - the northern and the southern guinea savanna (Ishaya, 2013). Common trees, such as *Daniella Oliveri*, *Azelia africanus* among other species, are common. The temperature of this area is highly influenced by the Niger-Benue trough where heat is trapped. The highest diurnal temperature ranges between 27°C and 37°C in the months of November-April (dry season). The rainy season comes between the months of April to October with temperature range of 23°C and 36°C. It is pertinent to observe that, this area has a higher temperature than any other Area Council in the Federal Capital Territory throughout the year (Ishaya, 2013) (Figure 1).

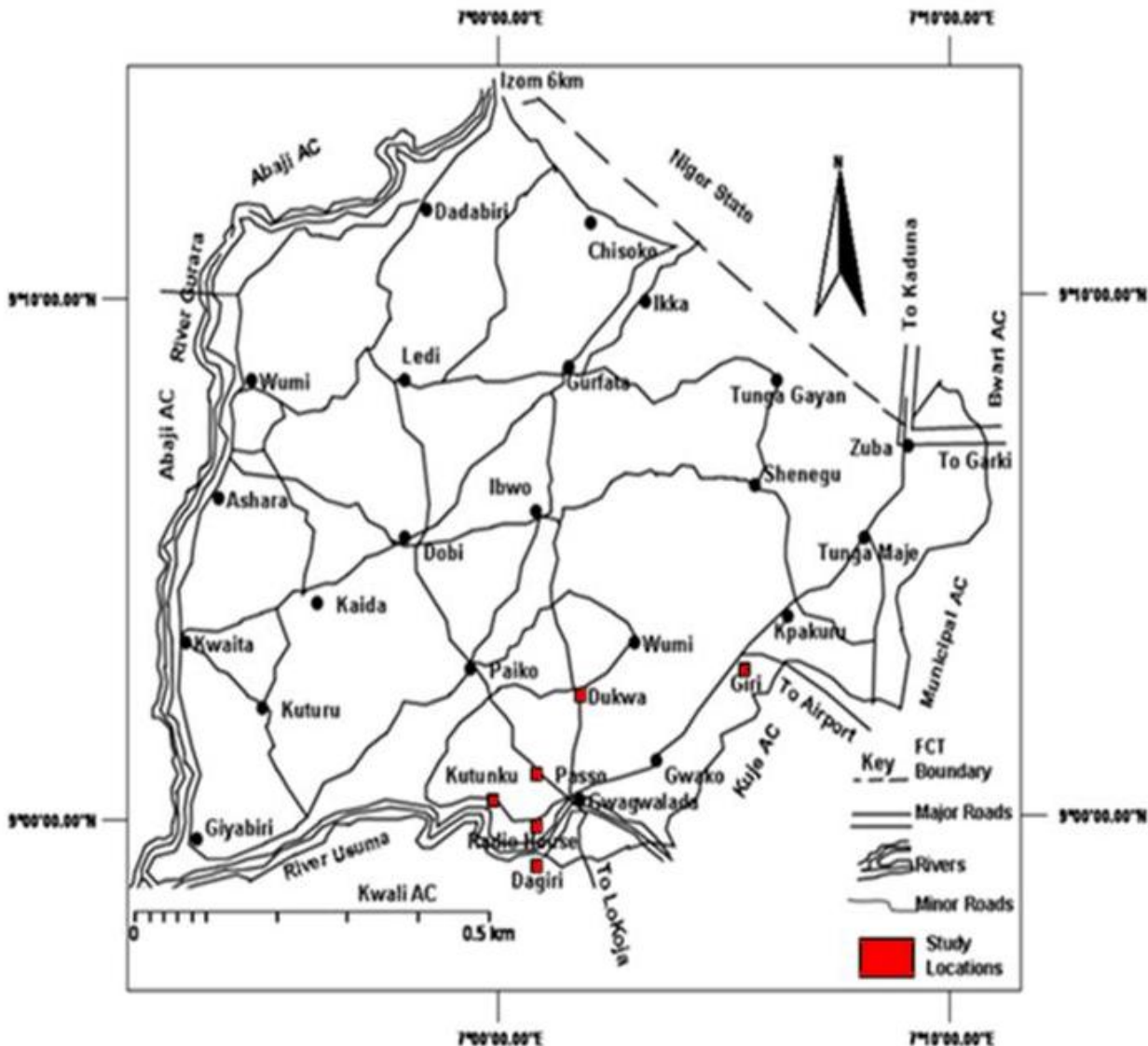
### **Mosquito Collection, Preservation and Identification**

Collection of mosquito was carried out using Pyrethrum Spray Catches (Federal Ministry of Health, 2014; 2005). The population indoors was sampled by covering the floor with a white sheet of 5m x 5m each edge held to the wall by a masking tape. The room was spread with an insecticide a pyrethroid and then left for 10 minutes, with every opening being shut.

### **Specimen Collection, Processing and Dissection**

Peripheral blood was collected from the right thumb of children five years and above. *Anopheles* mosquitoes were collected weekly using Pyrethrum spray Method between 06:00hrs - 07:00hrs from August to October, 2013 and 2014 respectively Mosquito collection were carried out on two sampling sites representing the general ecotype of the area. Captured mosquitoes were sorted according to the sites of collection, and were then conveyed to laboratory for further identification using the keys of (Gillies and De Meillon, 1968). Also Dissection of the salivary glands for sporozoites and ovary for parity was carried out according to the techniques of Olayemi et al. (2009) and World Health Organization (2013).

The adult sampled mosquitoes were examined for *Plasmodium* sporozoites by investigating the salivary glands following the techniques of World Health Organization (2013) and Olayemi et al. (2009), the ovaries were dissected out of the abdomen at the region of 6<sup>th</sup> and 7<sup>th</sup> under a dissecting microscope using x40



Source: Abuja Geographical Information System

Figure 1. Map of Gwagwalada Area Council F.C.T. Abuja Showing the Study Sites.

and x200 objectives of Zeiss light microscope in the Laboratory and at the National Veterinary Research Institute laboratory in Vom, using the method of Holstein (1954), these ovaries which the terminal skeins of the tracheoles were found to be uncoiled were considered as parous while ones with coiled skein were considered Nulliparous.

**Parasitological Analysis**

Blood samples that were collected from children of 0 - 5 years old by pricking gently of their thumb and the blood droplet was examined using a direct thin and thick blood smear preparation stained with Giemsa as demonstrated

by Munga et al. (2006), for the presence of the ring form stages of the parasites in the blood of the individuals in the laboratory.

**Plasmodium Sporozoite Infection Rate**

This is the number of sporozoites found in the salivary gland of dissected Anopheline mosquitoes and it was calculated by dividing the number of sporozoites positive mosquitoes by the number of mosquitoes dissected.

$$S.R. = \frac{\text{Number of sporozoites positive mosquitoes}}{\text{Number of dissected mosquitoes}}$$

### Parous Rate

This was determined by the dissection of the ovary of the collected specimen and was calculated by dividing the number of parous females by the number of dissected mosquitoes. This will show the cycle of oviposition.

$$P.R.= \frac{\text{Number of parous females mosquitoes}}{\text{Number of dissected mosquitoes}}$$

### Scope and Limitation

The study was restricted to two selected communities in Gwagwalada, FCT-Abuja and these selected communities are Dukpa and Kutunku respectively and among 0-5 years of human populations while the vector collection was in-door.

### RESULTS

The relative abundance of mosquito species within the study areas, with 867 mosquitoes collected at both locations are shown in Table 1. A total of 420 mosquitoes were collected at Dukpa comprising 255 *Anopheles gambiae* with 78 (30.60%) males and 177 (30.20%) females while 165 were *Culex pipiens pipiens* with 65 (39.40%) males and 100 (60.6%) females. At Kutunku, a total of 447 mosquitoes species were collected, of these 287 were *Anopheles gambiae* with 84(29.3%) males and 203 (70.7%) females. And 160 were *Culex* species with 108 (67.5%) males and 52 (32.5%) females. Out of 542 *Anopheles gambiae* females, 380 were dissected for both parity and sporozoite rates respectively.

Positive rate of sporozoite in *Anopheles gambiae* in the study areas showed that of 177 mosquitoes dissected 95(53%) were positive for the sporozoites while 82 (46%) were negative out of the total number dissected at Dukpa. At Kutunku out of the 203 mosquitoes dissected for sporozoites 115 (56%) were positive while 88 (43.3%) were negative. Chi-square analysis showed that there is no significant difference ( $P>0.05$ ) in the sporozoite infection rates among the individual mosquito species in the study. Therefore malaria parasites transmission within the study areas i.e. Dukpa and Kutunku in Gwagwalada, FCT-Abuja were stable as shown in Table 2.

Table 3 below showed the prevalence of malaria parasites infection among the under five (0-5) years of children population at Dukpa and Kutunku in Gwagwalada, FCT, Abuja. Of the 425 children examined for the malaria parasites at both locations 152

(70%) were infected with *P. falciparum*. At Dukpa 152 (70.00%) were infected out of 217 examined while at Kutunku out of 208 children 125 (60.10%) were infected. There was no significant difference ( $p>0.05$ ) in the malaria infection rates between the two areas.

### DISCUSSION

This study showed high abundance of mosquito species and the prevalence of malaria parasites among the under five children within the study areas as indicators of malaria transmission.

*Anopheles* mosquitoes' relative abundance was very high though the use of some insecticides and usage of long lasting insecticide treated nets can reduce vector infectivity as well as vector survival rate and the length of the sporogonic cycle (Molta et al., 2004). Both Kutunku and Dukpa had high *Anopheles* mosquitoes which may be due to the availability of temporary breeding sites as reported by Angerilli (1980) and some of the environmental practices within the study areas which include disposing of containers, receptacles, water storage jars, unused tyres, abandoned cans etc., also the *Anopheles* species found in this study areas were also reported by Coluzzi et al. (2002) which is the most important vector of the malaria parasites in the Sub-Saharan Africa, in connection with certain climatic factors most especially the annual precipitation appears to influence the range and the relative abundance of the mosquito species.

Malaria parasites prevalence was high indicating a high rate of Plasmodium parasitaemia among the under five children which is in line with the high relative abundance *Anopheles* vectors sampled within the study areas which agrees with the previous work reported by Molta et al. (2004) and Service (1993) in Jos North Central Nigeria and Ahmed, 2014 in the malaria endemic village of Erunmu in southwest Nigeria. For the sporozoites and parity rates determination of 55% is relatively high compare to the work and findings of Olayemi and Ande, (2008) in Ilorin, which was also similar to the findings of Fradin (2002) in Senegal with 25% prevalence of sporozoites and parity rates determination and higher than the 7.1% reported in Ghana by Appawu et al. (2011), also in south west Nigeria by Awolola et al. (2014), that reported the prevalence of sporozoites rates of *Anopheles* mosquitoes as 5.6%, 2.9% and 1.8% respectively. However, findings in this study showed that all parous *Anopheles* mosquitoes were infected, since they were all carrying sporozoites unlike in other studies in Senegal and Ghana and even Lagos State in South West Nigeria (Olayemi and Ande, 2008; Olayemi et al., 2009, World Health Organization, 2014). It showed that *Anopheles* mosquitoes in selected study areas are

**Table 1.** Relative abundance of Mosquito species at Kutunku and Dukpa in Gwagwalada, FCT Abuja, Nigeria

Site	No. of mosquitoes collected	<i>Anopheles gambiae</i>		<i>Culex pipiens pipiens</i>	
		Males No. (%)	Females No. (%)	Males No. (%)	Females No. (%)
Kutunku	420	78(30.6%)	177(30.2%)	65(39.4%)	100(60.6%)
Dukpa	447	84(29.3%)	203(70.7%)	108(67.5%)	52(32.5%)
<b>TOTAL</b>	<b>867</b>	<b>162(29.9%)</b>	<b>380(70.1%)</b>	<b>173 (53.2%)</b>	<b>152 (46.8)</b>

**Table 2.** Sporozoites infection rate of *Anopheles gambiae* at Kutunku and Dukpa in Gwagwalada, FCT Abuja, Nigeria

Collection sites	No. of mosquitoes collected	No. dissected	No. positive (%)	No. negative (%)
Kutunku	255	177	95(53%)	82(46%)
Dukpa	287	203	115(56.7%)	88(43.3%)
<b>TOTAL</b>	<b>542</b>	<b>380</b>	<b>210(55.3%)</b>	<b>170(44.7%)</b>

**Table 3.** Prevalence of malaria parasite among under five children at Kutunku and Dukpa in Gwagwalada, FCT Abuja, Nigeria

Collection sites	No examined	No positive (%)	No. negative (%)
Kutunku	217	152(70%)	65(29.9%)
Dukpa	208	125(60.1%)	83(39.9%)
<b>TOTAL</b>	<b>425</b>	<b>277(65.2%)</b>	<b>148(34.8%)</b>

effective vectors of malaria transmission.

The results obtained from the parasitological examination of blood samples of the under five children is in line with the presence and relative abundance of the adult female *Anopheles* mosquitoes as the principal vector of malaria transmission (Holstein, 1954, the relative abundance of the *Anopheles* mosquito species within the study areas also agrees with the findings of (Bockarie et al., 1994) who reported that *Anopheles* species tends to occur regularly throughout the wet and dry seasons in west Africa mostly with the peak at the rainy seasons which is in line with the period the study was carried out. The relative abundance of the mosquito species within the study areas was also associated with the availability of suitable breeding habitats within the locations as described by Minakawa and Jam (2005). The breeding sites ranges across the various types of water bodies such as temporary ground pools to large permanent water bodies found within the study areas. More so the high rate of malaria infection within the study area could be attributed to the fact that the infection is already a looming endemic problem in Nigeria, including Federal Capital Territory as the sampling and surveying period coincided with the peak of raining season when mosquitoes are breeding due to the amount of rainfall from July to September. Moreover Gwagwalada and its environs including the study areas are relatively water logged and poorly drained areas,

gutters and other drainages are also routinely clogged with wastes as a result of an inefficient public waste disposal system. All these provide good breeding sites for mosquitoes which help to fuel stable and continuous malaria transmission, even beyond the peak rainy season in the months of November and December respectively.

## CONCLUSION

The findings of this study indicates that both the entomological and parasitological indices of malaria transmission which includes the sporozoites found in the salivary glands of the female *Anopheles* as well as their parous nature and the *Plasmodium* parasites found in the blood samples of the children are well established in the study areas, thus explaining the endemicity of malaria in Gwagwalada and its environs.

## REFERENCES

- Ahmed AM (2014). A dual effect for the black seed oil on the malaria vector *Anopheles gambiae*. Enhances immunity and reduce the concomitant reproductive cost. *Journal of Entomology*.4:1-19.
- Angerilli NDP (1980). Influences of extracts of vegetation on the survival and oviposition by *Aedes aegypti* (Diptera: Culicidae) *Can. Entomology*.112:1249-1252.
- Appawu MS, Owusu - Agyesi S, Dadzie V, Asoala F, Anto F (2011). *Malaria Transmission Dynamics at a site In northern Ghana*

- proposed for testing malaria vaccines. *Trop. Med. Int. Health*;9:164-170.
- Awolola ST, Ibrahim K, Okorie T, Koekemoer LL, Hunt RH, Coetzee M (2014). Species composition and biting activities of anthropophilic Anopheles mosquitoes and their role in malaria transmission in a holo-endemic area of south western Nigeria. *African Entomology*. 11:227- 232.
- Bockarie MJ, Service MW, Barnish G, Maude GH, Greenwood BM (1994). Malaria in a rural area of Sierra Leone. III. Vector ecology and disease transmission. *Annals of Tropical Medicine and Parasitology*.88(3):251-62.
- Coetzee M, Craig M, Le-Seur D (2002). Distribution of Africa malaria mosquitoes belonging to the Anopheles *gambiae* complex. *Parasitology Today*;16:74- 77.
- Coluzzi M, Sabbatini A, Della-Torre Di Deco MA, Petrarca V (2002). Apolythene Chromosome Analysis of the Anopheles *gambiae* species complex. *Parasitologia*.35:23-9.
- El-Badry AA, Al-Ali KH (2010). Prevalence and Seasonal distribution of deuce mosquito *Aedes aegypti*. (Diptera. Culicidae) in Al-Madinah Al-Munawwarah. *Saudi Arabia Journal of Entomology*;7:80-88.
- Federal Ministry of Health (2005). Federal Republic of Nigeria. National *Anti-malarial Treatment Policy*. Abuja: Federal Ministry of Health, National Malaria and Vector Control Division.
- Federal Ministry of Health, Nigeria (FMOH) (2014). *A road map for malaria control in Nigeria - Strategic plan*.12.
- Fradin MS (2002). Mosquitoes and mosquito repellents: A clinician's guide. *Annals of Internal Medicine*;128(11):931-940.
- Gillies MT, De Meillon B (1968). *The Anophelinae of Africa south of the Sahara (Ethiopian Zoogeographical Region)*. Publications of the South African Institute for Medical Research.54.
- Gulleko CH, Coluzzi M (2013). *Advances in the study of Afro-typical malaria vectors*. *Parasitologia*.35:23-9.
- Holstein MH (1954). *Biology of Anopheles gambiae: Research in Western Africa*. WHO. Geneva, Swiss.
- Ishaya S (2013). Analysis of Growing Season Rainfall and Temperature Variability in the Federal Capital Territory of Nigeria. *Nigeria Journal of Tropical Geography*. Vol. 4(2) pp 471-490. Nasarawa State University.
- Minakawa NG, Jam G (2005). *Relationship between occurrence of Anopheles S.l. (Diptera: culicidae) and size and stability of larvae habitat* *Medical Journal of Entomology*. 42:295-300.
- Molta NB, Omalu ICJ, Oguche S, Pam SD, Afolabi BM, Mosanya ME (2004). Declining efficacies of chloroquine and sulfadoxine-pyrimethamine combination against Plasmodium falciparum in the North Central Plateau, Nigeria: Parasitological performance of the drugs. *Nigerian Journal of Parasitology*.25:57-63.
- Munga S, Minakawa N, Zhou G, Mushinzimana E, Barrack O, Gilheko AK, Yam G (2006). *Association between land cover and habitat productivity of malaria vectors in western Kenya in highlands*. A. M. J. Trop. Med. Hgg.7A:67-75.
- Munga S, Minakawa N, Zhou G, Mushinzimana E, Barrack O, Gilheko AK, Yam G (2006). *Association between land cover and habitat productivity of malaria vectors in western Kenya in highlands*. A. M. J. Trop. Med. Hgg.;7A:67-75.
- Olayemi IK, Ande AT (2008). Species composition and larval habitats of mosquitoes (Diptera: Culicidae) in Borin, Nigeria. *The Zoologist*;6:7-15.
- Olayemi IK, Ande, AT, Isah B, Idris AR (2009). Epidemiology of malaria in relation to climatic variables in Minna, Nigeria; *African Journal of Medical Sciences*.;2(1):5- 10.
- Service MW (1993). *Mosquito Ecology: Field Sampling methods*, 2nd ed. Chapman and Hall, London, United Kingdom.
- World Health Organization (2013). *The Africa malaria Report*.125-130.
- World Health Organization (2014). *World Malaria World Health Organization*. World Malaria Report. Geneva.
- World Health Organizations (2014). *Malaria entomology and vector control, learner's Guide. Social mobilization and training control, prevention and eradication department, communicable diseases cluster, World Health Organization, Geneva*.

How to cite this article: GIMBA UN (2014). Assessment of Entomological and Parasitological Parameters of Malaria Transmission in Gwagwalada Area Council Abuja Nigeria. *Int. J. Environ. Sci. Toxic. Res.* Vol. 2(11):217-222