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Seasonal pattern of Bancroftian Filariasis transmission in Ebonyi State, Nigeria

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Bancroftian filariasis in Nigeria is endemic with 22.1% of the population thought to be infected. The main mosquito genera implicated with *Wuchereria bancrofti* transmission are *Anopheles* and *Culex*. The study was carried out to compare the infectivity rates of the vectors between the high transmission (rainy) and the low transmission (dry) seasons. Mosquitoes were sampled from houses and compared from six sentinel villages (3 each from Ohaukwu and Abakiliki Local Government Areas) of Ebonyi State, Nigeria. Day resting indoor collection (DRI) by Aspirator and Pyrethrum Spray Catch (PSC) were used to collect mosquitoes between 7:00 and 11:00am. After morphological identification, female parous mosquitoes were dissected in search for infective (L_3) larvae of *W. bancrofti*. A total of 4,840 female mosquitoes were dissected. More mosquitoes were caught in the rainy season than in the dry season. Infectivity rates of vectors in Ohaukwu villages were 3.54 and 5.41% in the rainy and dry seasons, respectively, whereas in Abakiliki villages these were 1.85 and 1.19%, respectively. There was no significant difference in the overall infectivity rates between the two seasons in both Ohaukwu and Abakiliki villages (p>0.05). Similarly, no significant difference in the total/average transmission potentials were found between the seasons (p>0.05). *Anopheles gambiae* sl was the main vector in both study sites followed by an *Anopheles funestus* and *Culex quinquefasciatus*. There was a difference in infectivity rates of *Anopheles* species between the wet and dry seasons (p<0.05), whereas no significant difference exist in infectivity rates of *Anopheles* species and *Cx. quinquefasciatus* (p>0.05). Findings were discussed in the context of on-going plans to eliminate filariasis and the transmitting vectors.

Key words: Bancroftian filariasis, rainy season, dry season, *Wuchereria bancrofti*.

INTRODUCTION

Wuchereria bancrofti which causes bancroftian filariasis is the only etiologic agent in Africa (Michael and Bundy, 1997).The disease is prevalent and widespread in Nigeria which is the third most endemic country in the world (after India and Indonesia) and estimated 22.1% of the population is thought to be infected (Eigege et al., 2003). The epidemiology of the disease regarding the abundance of the proven vectors (*Anopheles* and Culicine species) is somewhat different when compared with other ecological zones of the world.

In Nigeria, the prevalence of bancroftian filariasis or (filariasis index) between the northern parts with lowest

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rainfall and southern parts with highest rainfall parts vary considerably (Nwoke, pers. Communication, 2007). However, no explanation was offered to these findings regarding vector infectivity or infection rates. Studies elsewhere have revealed that the peak transmission of filariasis was during the long rains and after the short rains in Mambru and Jaribuni villages of Kenya (Wijers and Kinyanjui, 1977). The hot dry season transmission was interrupted in Mambru, but was rather low in Jaribuni. Wijers and Kaleli (1984) in related study concluded that transmission season coincides with the long rain during which filariasis vectors were in abundance. However, no clear reports on comparison between vector infectivity rates between the seasons were shown.

Clearly, further work is urgently needed to evaluate the exact importance of both the vector capacities and seasonal filariasis transmission in parts of Africa. In Nigeria limited works exist on vector infectivity infection rates both natural and experimental (Anosike et al., 2003; Mbah, 2010; Awolola et al., 2006; Amaechi, 2009). Infectivity and infection studies of mosquitoes on filariasis between the dry and wet seasons are lacking. The present study therefore examines the seasonal infection/infectivity rates in rural endemic areas of Ebonyi State, Nigeria.

MATERIALS AND METHODS

Study sites

The study was conducted in six (6) sentinel villages, three (3) each from Ohaukwu (Orijiriafor, Okpochiri and Ndiagu Obu) Abakiliki (Mgbabeluzor, Okarie Echida and Okpochiri) Ebonyi State, Nigeria ($7°31^1$ -$8°\ 18^1$N- $50\ 36^1$ - $6°\ 15^1$E) Figure 1. The ecology of the area has been described in details (Amaechi et al., 2010; Richards et al., 2013). The inhabitants are Igbos who mainly live in mud walled and thatched houses. Houses with block walls and or iron sheets roofing are extremely rare. They are peasants growing mainly maize, rice, yam and cassava. Livestock kept includes cattle and goats with some animals tethered inside human dwellings. The sites were selected based on preliminary ICT-survey (Carter Center, 2009. Unpublished data) indicating the presence of bancroftian filariasis in the area.

ETHICAL CONSIDERATION

Ethical clearance and permission was approved by the Post Graduate Research Board of the Zoology Department of Imo State, University of Owerri, Nigeria and Ebonyi State Ministry of Health. Team members were trained on entomological survey methods. Informed verbal consent was obtained from residents of household on mosquito collections.

Mosquito sampling technique/laboratory processing

The prevalence of infective mosquitoes was assessed in households. Houses were visited twice monthly during the mornings and indoor resting mosquitoes were collected by pyrethrum spray catch (PSC) and mechanical aspirator (WHO, 2002). The time and period of collection were chosen to catch fully engorged vectors and reflected the seasons (rainy and dry) of the areas. As much as possible houses were of similar construction to avoid the effect of variability. Indoor resting mosquitoes were collected in 20 selected houses and at least one sleeping room in each house was used for mosquito collection (Mboera et al., 2006). Mosquitoes caught were taken to a temporary dissection center as time allowed. Visual identification (for morphology) was made using different keys and characteristics (Nwoke, 2007, unpublished). Blood fed females were dissected to determine parity by observing the degree of ovarian trachioles (Detinova, 1962). The body parts (head and mouth parts, thorax and abdomen) were macerated and examined for the presence of living filarial larvae. For more exact identification of filarial larvae stages and species, the preparations were stained with haematoxyline (Nelson, 1959) and examined with microscope. Recovery of larval stages of *W. bancrofti* was done according to Nelson and Pester (1962); larval stages were categorized by sizes rather than by appearances (Nathan, 1981).

Statistical analysis

Data were analyzed by chi square using Epi Info 6 computer software statistical analysis programme to compare the infectivity rates of the vectors between the rainy and dry seasons. Yates correction was also used to compare infectivity rates of the vectors; the sentinel villages and the mosquito vector species.

RESULTS

Cumulatively, 4,840 blood fed mosquitoes were dissected. Table 1 shows that infection and infectivity rates of the vectors were (8.82% versus 15.22%) and (3.54% versus 5.41%) in the rainy and dry seasons, respectively. Table 2 shows the infection and infectivity rates of LF vectors in Abakiliki. Infection and infectivity rates were found to be 2.30% versus 1.62% and 1.85% versus 1.19% for rainy and dry seasons. Infectivity rates differed significantly between the rainy and dry seasons in Ohaukwu ($p>0.05$) but not in Abakiliki ($p<0.05$). In both seasons and study sites, *Anopheles gambiae* was the predominantly species (Tables 1 and 2).

Considering the infectivity rates of the vectors independently, the order of vector importance of the three main vectors in Ohaukwu and Abakiliki was *A. gambiae, Anopheles funestus* and *Culex quinquefasciatus* (Tables 1 and 2). This was the same trend in both seasons. Statistical significant difference in infectivity rates were found between *Anopheles* species ($p<0.05$). However, no significant difference existed between infectivity rates of *Anopheles* spp. and *Cx. quinquefasciatus* (Table 3). The highest number of infective larvae (L_3) per mosquito in Ohaukwu was 5 with an average of 5 which occurred in the rainy season. In Abakiliki, the highest number of infective larvae per mosquito was 4 (*An. gambiae*) with an average of 2 during the rainy season. There was only one infective larva of *Cx. quinquefasciatus* which

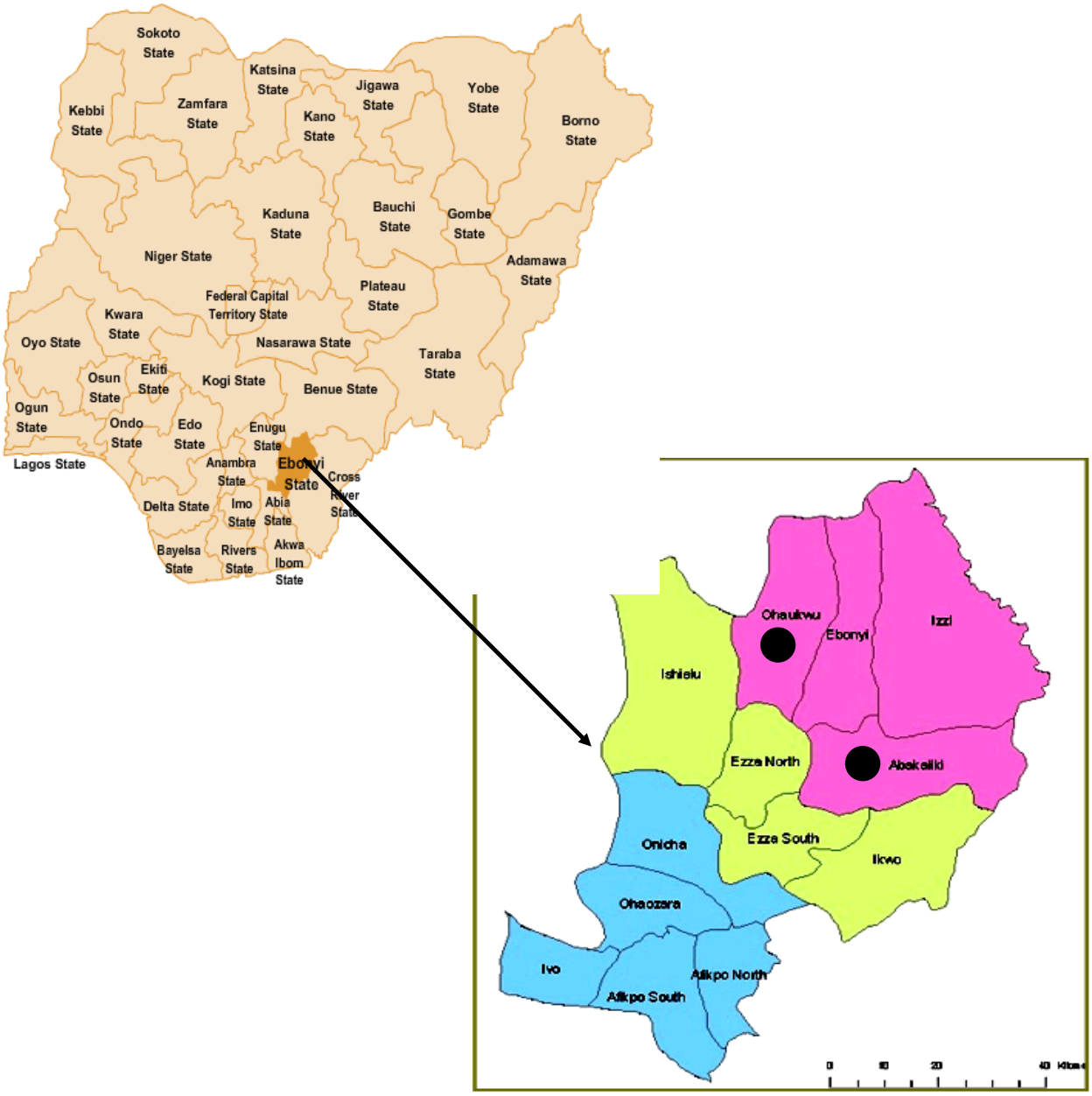

Figure 1: Map of Ebonyi State showing the study areas.

occurred during the dry season. No significant difference in the total/average transmission potential (TP^{+}) were observed between the seasons ($p<0.05$).

DISCUSSION

Although the Pyrethrum Spray Catch (PSC) and Mechanical Aspirator (MA) method records only the mosquitoes that rest indoors, it is widely used for estimating the abundance, seasonal densities, host preference and vector infection status as in this study. Previous study has shown that mosquito infectivity rates are low during the dry season and high in the rainy season. However, this was not the case for both study sites: Orijiriafor, Okpochiri, Ndiagu Obu rural villages in Ohaukwu and Mgbabeluzor, Okarie Echida and Obeagu Ibom villages towns in Abakiliki. This observation contradicted those of Kasili et al. (2009) in Kenyan Coast and in Philippines (Valeza and Grove, 1979) and could

Table 1. Overall infection and infectivity rates of LF vectors during the transmission (July - September) and non-transmission (October - December) 2013 seasons in Ohaukwu.

Mosquitoes species	Number			No. containing larvae stages			Rates %			TP^+
	Parous	Infection	Infective	Diss	Parous	Infected	L_1	L_2	L_3	
Rainy season										
An. gambiae sl	1,348	1,085	44	24	64	57	3.26	10.76	4.23	65
An. funestus sl	363	243	4	6	0	6	1.10	3.31	1.65	11
Cx. quinquefasciatus	66	31	0	0	0	0	0.00	0.00	0.00	0
Mn. africana	2	2	0	0	0	0	0.00	0.00	0.00	0
Ae. aegypti	1	0	0	0	0	0	0.00	0.00	0.00	0
Total	1,780	1,361	48	30	64	63	2.70	8.82	3.54	176/59
Dry Season										
An. gambiae sl	731	699	26	19	45	48	3.56	15.32	6.57	48
An. funestus sl	168	146	13	13	21	6	7.74	23.81	3.57	20
Cx. quinquefasciatus	99	58	0	0	0	0	0.00	0.00	0.00	0
Mn.africana	1	1	0	0	0	1	0.00	0.00	0.00	0
Ae. aegypti	0	0	0	0	0	0	0.00	0.00	0.00	0
Total	999	904	39	32	66	54	3.90	15.22	5.41	68/23

Table 2. Overall infection and infectivity rates of LF vectors during the transmission (July - September) and non-transmission (October - December) 2013 seasons in Abakiliki.

Mosquitoes species	Number			No. containing larvae stages			Rates (%)			TP^+
	Parous	Infection	Infective	Diss	Parous	Infected	L_1	L_2	L_3	
Rainy season										
An. gambiae sl	782	742	5	0	3	12	0.64	1.92	1.5	12
An. funestus sl	227	198	7	1	0	9	3.08	4.41	3.96	9
Cx. quinquefasciatus	49	34	0	0	0	0	0.00	0.00	0.00	0
Mn. africana	77	59	1	0	1	0	1.30	1.30	0.00	0
Total	1,135	1,033	13	1	4	21	1.15	2.30	1.85	21/7
Dry season										
An. gambiae sl	601	527	6	3	0	7	0.99	1.66	1.16	7
An. funestus sl	152	138	3	1	0	3	1.97	2.63	1.97	3
Cx. quinquefasciatus	92	49	1	0	0	1	1.09	1.09	1.09	1
Mn.africana	81	69	0	0	0	0	0.00	0.00	0.00	0
Total	926	783	10	4	0	11	1.08	1.62	1.19	11/4

be attributed to human behavior and difference in ecological settings. Abakiliki, though not urbanized settlement has had resulting sanitary conditions due to shift in ecology/gradual modified ecology from rural to rural/urban. The state capital is few kilometer away from these villages resulting in improved economic status through trading and rapid transportation of farm products. These could explain the parity in infectivity rates.

The only significant difference in infectivity rates of vectors was between *Anopheles* species (*An. gambiae* sl and *An. funestus* sl) in both seasons. Similar observation have been observed elsewhere by Manyi et al, (2016). These observations probably depicted *Anopheles* spp. as the most important bancrofti filariasis vectors in terms of infectivity rates. Similar findings were reported at other sentinel sites of Nigeria (Amadi and Udonsi, 2004; Mbah, 2010; Awolola et al., 2006). Thus, confirmation of evidence that their infectivity status has not changed in rural African communities in the last seven decades (Taylor, 1930; Kuhlow, 1987). The increase in number of *Anopheles* spp. in both Ohaukwu and Abakiliki accounted for infectivity rates in the seasons. Previous reports has

Table 3. Comparison of filarial infectivity rates between LF vectors.

Species	Filarial infectivities		
	-ve	+ve	P*
An. gambiae sl	3,303	159	S
An. funestus sl	870	40	-
Cx. quinquefasciatus	305	1	NS
An. gambiae sl	3,303	159	-
An. funestus sl	870	40	NS
Cx. quinquefasciatus	305	1	-

P*= Chi square with Yate's correction ; NS = not significant, P> 0.05; S = significant, P< 0.05.

shown that *An. gambiae* ss mosquito predominate in rainy season whereas *Anopheles arabiensis* in the dry season. The predominant status of *An. gambiae* in both seasons demands for identification beyond morphological criteria to ascertain the contribution of sibling species in filariasis transmission.

Cx. quinquefasciatus when compared with *An. gambiae, An. funestus* was few in number with low infectivity rate(1.09%) found only in the dry season. Wijers (1977) have found them to have reduced longevity. By implication, even if the number could be high as observed herein, very few may live to support *W. bancrofti* larvae. This could account for its low contribution to infectivity rates. Previous works have posited that it is an urban vector Manyi et al (2014) in Makurdi (North Central, Nigeria) found high infectivity rates in Anopheles and its involvement together with *Anopheles* spp. in Abakiliki further supports changed sanitary condition of the area. There has been large population movement in the South Eastern part of Nigeria as a result of human workforce (labour). Ebonyi population has been actively involved in this process. Therefore, the introduction of *W. bancrofti* into other areas is possible and because of the abundance and compatibility of the parasite and vectors the infection might well become established in the local population that is not at present a focus for bancrofti filariasis.

In both Ohaukwu and Abakiliki, *A. gambiae* was more abundant in the rainy season than in the dry season. The number of *A. funestus* in Ohaukwu and Abakiliki declined during dry season because their breeding sites were mainly clear water and vegetation near the water sources which were rare in the dry season. The observed proportions of *Culex* in both sites and seasons were due to open polluted water trenches which ramify throughout the area (foul water bodies for cassava fermentation and local sponge making from palm oil heads). In the dry months, they are filled with larvae and pupae of *Culex* mosquitoes whereas pit latrine became water-logged in the rainy seasons thus providing excellent breeding sites for *Culex* mosquitoes.

Apparently, the abundance of these vectors was due to prevailing weather conditions; rains with large numbers appearing during the long rains and very few during the drier months. In both sites, *Culex* was present though not the most important in the transmission of *W. bancrofti*. Therefore, it appears that the great risk of infection from infective mosquitoes in both Ohaukwu and Abakiliki is due to the bites of *An. gambiae* and *An. funestus*. Though, it has been noted that *Culex* is an urban vector and could serve as a potential vector for urban cities (Onwuliri and Anosike, 1989). Results of this study have shown *Culex* to be a contributing vector of filariasis transmission.

Mansonia africana (non-filarial vector in Nigeria) and *Aedes aegypti* were encountered, indicative of the level of nuisance, the inhabitants of the area got from these mosquitoes. Their dissection results probably reflected feeding habit and anatomical variation rather than absence of *W. bancrofti*.

The transmission potentials (TP^+) were comparable for both seasons and clearly indicated no changes in vector-contact rates with infected people. The difference in vector infectivity rates between the seasons is independent on vector abundance but the actual species of the mosquito vector. The results of this study therefore revealed that there is a difference between the rainy and dry seasons and the abundance of *An. gambiae* sl and *An. funestus* sl in rainy seasons could be the main reasons for this. The implication of these findings to the Nigerian Lymphatic Filariasis Elimination Programme in vector control cannot be overemphasized.

CONFLICT OF INTEREST

The authors have not declared any conflict of interest

REFERENCES

Amadi EC, Udonsi JK (2004). Studies of the influence of climatic factors on the transmission potentials of mosquito vectors of LF in Khana LGA Rivers State Nigeria. Nigerian Journal of Parasitology Book of Abstract Annual Conference, Sept. 22-24th IMSU, 90.

Amaechi AA (2009). Studies on ITN for control of mosquito vectors of Human lymphatic filariasis in parts of Ebonyi State, Nigeria. Ph.D Thesis of IMSU, Nigeria.

Amaechi AA, Nwoke BE, Ukaga CN, Uduji H, Emukah EC, Prince TO, Eneanya CI, Onyeka PI, Okere AN (2010). Seasonal variations in human lymphatic filariasis transmission by mosquitoes in parts of Ebonyi State, Nigeria. International Science Research Journal 2(1):56-61.

Anosike JC, Onwuliri CO, Nwoke BE, Dozie IN (2003). Laboratory investigation of the infection rate of *Anopheles gambiae* and *Anopheles funestus* in the transmission of Wuchereria bancrofti. Nigerian Journal of Parasitology 24(1):143-148.

Awolola TS, Idowu ET, Adeneye AK, Mafe MA, Oduola AO, Ogunrinade A, Appelt B, Coetzee M (2006). Entomological survey and infection rates of *Plasmodium falciparum* and *Wuchereria bancrofti* in mosquito populations in the Kainji Lake Area, Nigeria. Nigerian Journal of Parasitology 27(1):58-61.

Carter Center (2009). Survey of bancrofti filariasis in Imo and Ebonyi States (unpublished).

Detinova TS (1962). Age-grading methods in Diptera of medical importance. World Health Organization Monograph Series 47:1-216.

Eigege A, Richards Jr FO, Blaney DD, Miri ES, Gontor I, Ogah G, Umaru J, Jinadu MY, Mathai W, Amadiegwu S, Hopkins DR (2003). Rapid assessment for lymphatic filariasis in central Nigeria: a comparison of the immunochromatographic card test and hydrocele rates in an area of high endemicity. The American Journal of Tropical Medicine and Hygiene 68(6):643-646.

Kasili S, Oyieke F, Wamae C, Mbogo C (2009). Seasonal changes of infectivity rates of *Bancroftian filariasis* vectors in coast province, Kenya. Journal of Vector and Bone Disease 46(3):219-224.

Kuhlow F (1987). Observations and experiments on *Culex-Antennatus* (Becker) as a potential vector of Bancroftian-Filariasis in West-Africa. In Tropical Medicine and Parasitology 38(4):349-349.

Manyi MM, Dechi A, Kwaghbo AI (2016). Studies on the Incrimination rates of two minor vectors *Anopheles gambiae* and *Anopheles funestus* complexes in the transmission of *Bancroftain filariasis* in Markudi North Central Nigeria. International Journal of Science 5:2-9. Available at: https://www.researchgate.net/profile/Mm_Manyi/publication/303714724_Studies_on_the_Incrimination_Rates_of_Two_Minor_Vectors_-_Anopheles_Gambiae_and_Anopheles_Funestus_Complexes_in_the_Transmission_of_Bancroftian_Filariasis_in_Makurdi_North_Central_Nigeria/links/5afd2c4baca272b5d87084f3/Studies-on-the-Incrimination-Rates-of-Two-Minor-Vectors-Anopheles-Gambiae-and-Anopheles-Funestus-Complexes-in-the-Transmission-of-Bancroftian-Filariasis-in-Makurdi-North-Central-Nigeria.pdf

Manyi MM, Imandeh GN, Azua ET (2014). Vectorial Potential of *Anopheles* and *Culex* species in the Transmission of Bancroftian Filariasis in the Localities of Makurdi, North Central Nigeria. Journal of Entomology and Zoology Studies 2(5):171-177.

Mbah DC (2010). Vectors of lymphatic filariasis in Anambra State, South Eastern, Nigeria. Multidisciplinary Journal of Empirical Research 8(1):82-85.

Mboera LEG, Magesa SM, Moten F (2006). Indoors man-biting mosquitoes and their implication on malaria transmission in Mpwapwa and Iringa District, Tanzania. Tanzania Journal of Health Research 8(3):141-144.

Michael PE, Bundy DAP (1997). Global mapping of lymphatic filariasis. Parasitology Today 13(12):472-476.

Nathan NB (1981). Bancroftian filariasis in Coastal North Trinidad West Indies: Intensity of transmission by *Culex quinquefasciatus*. Transactions of the Royal Society of Tropical Medicine and Hygiene 75(5):721-730.

Nelson G (1959). The identification of the infection filarial larvae in mosquitoes: with a note on the species found in wild mosquitoes on the Kenyan Coast. Journal of Helminthology 33(2-3):233-256.

Nelson GS, Pester FRN (1962). The identification of infective filarial larvae in simulidae. Bulletin of the World Health Organization 27(4-5):473.

Nwoke BEB (2007). Atlas of mosquitoes of medical importance (unpublished data).

Onwuliri COE, Anosike JC (1989). Filariasis in some parts of Bauchi State of Nigeria. In Proceedings of International Epidemiological Association African Regional Conference pp. 91-98.

Richards FO, Emukah E, Graves PM, Nkwocha O, Nwankwo L, Rakers L, Mosher A, Patterson A, Ozaki M, Nwoke BE, Ukaga CN (2013). Community-wide distribution of long-lasting insecticidal nets can halt transmission of lymphatic filariasis in southeastern Nigeria. The American Journal of Tropical Medicine and Hygiene 89(3):578-587.

Taylor AW (1930). The domestic Mosquitos of Gadau, Northern Nigeria, and their relation to malaria and filariasis. Annals of Tropical Medicine and Parasitology 24(3):425-435.

Valeza FS, Grove DI (1979). Bancroftian filariasis in a Philippine village: entomological findings. The Southeast Asian Journal of Tropical Medicine and Public Health 10(1):51-61.

Wijers DJB (1977). Bancroftian filariasis in Kenya: IV. Disease distribution and transmission dynamics. Annals of Tropical Medicine and Parasitology 71(4):451-463.

Wijers DJB, Kaleli N (1984). Bancroftian filariasis in Kenya V. Mass treatment given by members of the local community. Annals of Tropical Medicine and Parasitology 78(4):383-394.

Wijers DJB, Kinyanjui H (1977). Bancroftian filariasis in Kenya: II. Clinical and parasitological investigations in Mambrui, a small coastal town, and Jaribuni, a rural area more inland (Coast Province). Annals of Tropical Medicine and Parasitology 71(3):333-345.

World Health Organization (WHO) (2000). Science and activities relating to the detection assessment, understanding and prevention of adverse effect on disease.