International Journal of Tropical Medicine 1(2) : 77-80, 2006

Dynamics of Malaria Transmission in a Forest-savannah Transition Zone, Bini-Dang, Ngaoundere, Cameroon

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Abstract: The aim of this study was to study the transmission of human malaria in the transition region between forest and savannah (Bini-Dang), during a year. We first of all, had to collect data field: To catch living mosquitoes ; then, in the laboratory after identifying and dissecting them, we had to look for, at the level of salivary glands, the presence of sporozoïts and also, at the level of ovaries, the parity of this anopheles after analysing insects caught. We arrived at the following conclusions : the carrier of transmission of malaria within the homes in this zone was *Anopheles gambiae*. The average of aggressive rate is 12,14 bites per human per night (bhn). The analysis of different results allowed us to note that the human bites rates for the main vector of transmission (*Anopheles gambiae*) varied depending on the season. The little presence of *Anopheles coustani* was traduced by the fact its exophile pronounced. But the transmission was independent for different seasons. So we had the maximum and minimum of transmission during the dry season (January and December, respectively).

Key words: Bini-Dang, malaria transmission

INTRODUCTION

Malaria is one of the major public health problems in Africa. It is the number one cause of morbidity and mortality in Cameroon[1]. This author further stated that, in Cameroon, the disease accounts for 38-40% of all cases of hospital consultations, 22-23% of all cases of hospitalisation, about 40% of deaths in children under 5 years and 40% of the health budgets of households. Malaria control could be achieved by three complementary methods: drugs, vaccines and vector control, using spraying, mosquito nets or future use of transgenic mosquitoes[2]. More and more resistance to anti-malarial drugs has appeared in recent years and a vaccine unfortunately will not be available for some years to come[2]. Therefore, mosquito control remains a priority method of malaria control. Insecticides cause environmental degradation and health hazards to humans, as well as the development of insecticide resistance in mosquitoes[3]. Integrated Vector Management (IVM) which combines different control tools (Chemical, physical, environmental, biological and genetic), while minimising the use of insecticides appears promising for malaria control and may be also eradication[3].

In Cameroon, the major vector of malaria is *Anopheles gambiae s.s.* with at least five other species as secondary or local vectors[4,5]. In most parts of Africa, several vectors transmit malaria in each location, in some cases at the same time in other cases during different seasons[6]. Much variation can be observed between years, or between villages a few kilometres apart. Transmission can occur throughout the year or only during 2 or 3 months. Entomological inoculation rates may vary from less than 0.01 to more than 1000 infective bites per man per year[2]. This heterogeneity in the malaria vectorial system and transmission in Africa, indicates that the successful control of malaria in the continent requires the development of IVM programmes per region or locality. In turn, detailed knowledge of the vector species present and the dynamics of malaria transmission in each region or locality are indispensable for the development of viable IVM programmes.

In the village of Bini-Dang, Cameroon, where the University of Ngaoundere is located, little or no studies on malaria transmission nor the vectors involved have been carried out. The construction and development of the university, as well as the increase in the number of students at the university from 1993 to date have resulted in serious environmental modifications. This study was therefore undertaken to determine the species composition of malaria vectors and the transmission of the *Plasmodium* parasites at Bini-Dang during a 12-month-period, with a view to developing a viable IVM programme.

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MATERIALS AND METHODS

Study site: The study was conducted in the university community of Bini-Dang (7°25N, 13°32E; 1128 masl). This village is situated 15 Km north of the city of Ngaoundere, the capital of Adamawa province. The only University in northern Cameroon is located in Bini-Dang. The village location around a stream and lake permits the persistence of anopheline larvae throughout the year. The vegetation is of the Sudano-Guinean type. The rainfall pattern is monomodal and the rainy season lasts from April to October with an annual rainfall of 1600 mm.

Mosquito collections: From April 2000 to March 2001, collection of adult mosquitoes were carried out during 4 consecutive nights, twice a month in four houses. The houses were chosen with respect to their distance from a permanent stream (Bidou). The first, second, third and forth house was located at a distance of 20, 70, 130 and 250 m (Fig. 1) from the stream. Mosquitoes were captured when they settled on the leg of a voluntary human bait[3,7]. Two teams of four capturers worked inside the four houses. The first team captured mosquitoes between 20.00 and 1.00 hrs, while the second team did same between 1.00 and 6.00 hrs. The Human baits were rotated between teams and night fractions as well as among houses.

Laboratory processing of anophelines: The mosquitoes captured were grouped on hourly basis and kept in separate sacs, then counted and identified[8,9]. The *Anopheles* mosquitoes were dissected and the salivary glands examined for malaria sporozoïtes, while the ovaries were examined a day after, to determine parity[10].

RESULTS

Mosquito capture: From April 2000 to March 2001, 1939 Culicidae were collected during 24 nights (96 person-nights) on human volunteers. Among the specimens captured, *Anopheles gambiae*, *Anopheles coustani*, *Culex* sp. and *Mansonia* sp. accounted for 59,88, 0,72, 27,18. and 12,22% of the mosquitoes captured, respectively (Table 1). *Anopheles gambiae* represented the most aggressive Culicidae with a human biting rate of 12,14 bites per human per night (bhn) against 0,15 bhn for *Anopheles coustani*, 2,47 bhn for *Mansonia* sp. and 5,37 bhn for *Culex* sp.

Seasonality and biting cycles: The human biting rate for *An. gambiae* varied with season, generally being higher in the rainy than in the dry season Figure 2. All the other Culicidae did not show any variation that was linked to seasons (Table 2 and Fig. 2). *Anopheles gambiae* was

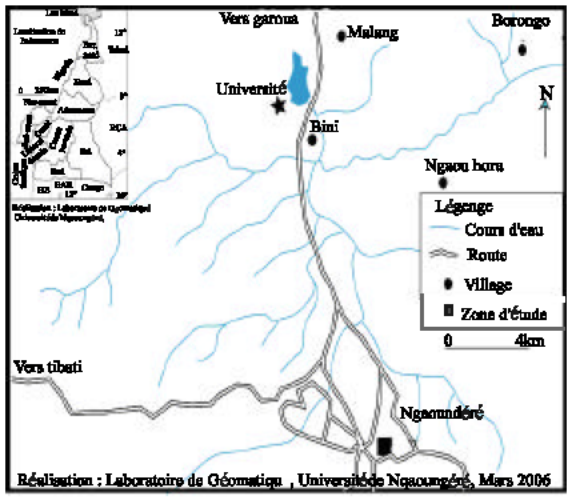

Fig. 1: Representation of locality of Ngaoundere (Cameroon)

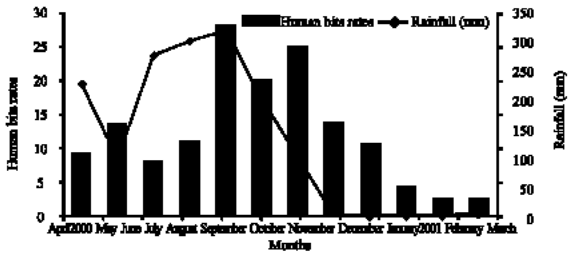

Fig. 2: Monthly human bites rates and rainfall for anopheles gambiae in Bini-Dang from April 2000 to March 2001

Table 1: Human bites rates and number of different culicidae caught from April 2000 to March 2001 after 24 collections on human volunteers at Bini-Dang

Species	N0. of culicidae	Human bites rate
Anopheles gambiae	1161	12,09
Anopheles coustani	14	0,14
Culex sp.	527	5,48
Mansonia sp.	237	2,46
Total	1939	20,19

present year round with an average human biting rate of 12,14 bhn. A maximum human biting rate of 27.75 bhn occurred in August, the peak period of the rainy season for *Anopheles gambiae* with a minimum of 2.5 bhn in the months of February and March in the dry season. Considering these variations, the annual aggressive rate of *Anopheles gambiae* at Bini-Dang is 4431,10 bites per man and per year.

In the other hand, the period of human bites rates of *Culex* sp. and *Mansonia* sp. its also highly present in the rainy season with 0,79 bhn in June and 0,71 bhn on July, respectively for *Culex* sp. and *Mansonia* sp. (Table 2).

Table 2: Annual human bites rates for culicidae, parity rates and entomological inoculation, caught from April 2000 to March 2001 after 24 collections on human volunteers at Bini-Dang

Months	Human per night	*Anopheles gambiae* HBR	*Anopheles gambiae* Parity (%)	h	*Anopheles coustani* (HBR)	*Culex* sp. (HBR)	*Mansonia* sp. (HBR)
April 2000	8	9	52,77	0,9	0,125	0,19	0,12
May	8	13,25	50,94	1,24	0	0,58	0
June	8	7,87	41,27	0,4	0	0,79	0,02
July	8	10,87	42,52	0,9	0,625	0,64	0,71
August	8	27,75	45,49	0,9	0,25	0,47	0,27
September	8	19,75	48,10	1,01	0	0,45	0,39
October	8	24,62	55,17	0,4	0,375	0,67	0,31
November	8	13,77	50,46	0,5	0	0,48	0,24
December	8	10,25	53,65	0,25	0,125	0,46	0,16
January 2001	8	3,87	54,84	2,25	0	0,32	0,08
February	8	2,25	50	0,45	0	0,18	0,09
March	8	2,25	61,11	0,75	0,25	0,125	0,07

HBR = Human bites rates (bites per human per night)

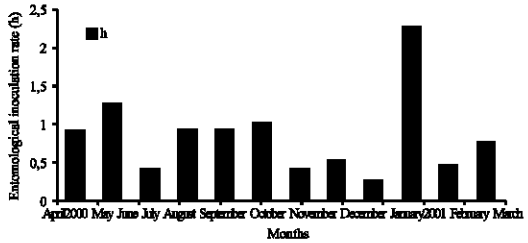

Fig. 3: Monthly entomological inoculation rates for anopheles gambiae in bini-dang, from April 2000 to March 2001

Parity rates of vector: During the year of study, the parity rate was 49,87% for *Anopheles gambiae*. Generally, the parity rate did not differ between the rainy season (March to October) and the dry season (November to February) (Z = 0,50) (Table 2). Both the maximum (March, 61,11%) and minimum parity rates were in the wet season (June, 41,27%).

Entomological inoculation rates: At the time of the dissection of 1161 *Anopheles gambiae*, we obtained 67 females with sporozoïtes; the sporozoïtic index is 0.052 (5,2%), an average human aggressive rates of 12,14 bhn, the average entomological inoculation rate is 0.63 infected bites per man and per night. This rate shows considerable seasonal variation with a maximum of 2.25 infected bites/man/night (ibhn) in January (Fig. 3) and a minimum of 0,25 ibhn in December. These variations were independent for seasonal variation. The annual entomological inoculation rate of this species is 229,95 infected bites/man with a remarkable constance of transmission all the year. *Anopheles gambiae* ensure the permanent transmission of human malaria.

DISCUSSION

The study shows the annual and seasonal variations of malaria transmission in Bini-Dang. This transmission was assured only by *Anopheles gambiae*. The Culicidae were present throughout the year because of the permanent stream (bidou) and the presence of different kinds of Culicidae. The aggressive mosquitoes were represented by *Anopheles*, *Culex* and *Mansonia*. These values were similarly like those observed, except the presence of *Aedes*. The absence of *Aedes* in this study was bound at the fact of exophil insect[11]. The maximum of human bites rates was observed in April (rainy season) in fact of existence of many larval resting places due to the precipitations.

Aggressive rates of female's anopheles are superior the one of the other Culicidae during this study. These data are different of those recorded by certain authors[12,13,4]. This difference would explain himself by the fact that the permanent larval resting place of Bini-Dang was oxygenated well during the rainy seasons. What encourages the development of anopheles larval, whereas the present resting places at the time of the other studies were close by some very dirty water courses, encouraging so the development of the Culicinae. The apparition of *Mansonia* sp. toward the end of the rain season, is bound to the apparition of the aquatic vegetation of as much more that the siphon was adapted to the drilling of aquatic plant stems and the taking of the intracellular oxygen. The parity rate of the population of *Anopheles gambiae* present of weak oscillations bound to the presence of a permanent resting place. This resting place permits to maintain a more constant larval productivity. This productivity translates himself by a permanent emergence of imago. These results are similar those observed in particular by many authors in Cameroon[12,13,4,14]. The rate of inoculation entomological means is of about 0,63 infected bites by man and per night with a permanent transmission of the human malaria in the zone of Bini-Dang. *Anopheles gambiae* is inside the main vector responsible for the transmission of the malaria. *Anopheles coustani* is very rare in houses of the fact its

exophile pronounced. However the presence of some species of *Anopheles coustani*, watch that this species exists in this zone of study, as attests it the works of[11]. We can think therefore outside about the existence of a transmission of dwellings by this anopheles or others.

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