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EFFICACY OF INSECTICIDE IMPREGNATED BED-NETS TO CONTROL MALARIA IN A RURAL FORESTED AREA IN SOUTHERN CAMEROON

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Due to current spreading of chemoresistant strains of Plasmodium falciparum *malaria control must incorporate vector control programmes. Due to well known constraints house sprayings cannot be performed as before. Personal protection can be developed and a large scale use of insecticide treated bed-nets appeared to be very useful to reduce man-vector contact in Asia, South America and West and East Africa. No trial has been done in forest Central Africa where transmission is permanent. We performed such a trial in the southern part of Cameroon (using deltamethrin, at 25 mg/m²) and obtained similar data to those observed in The Gambia, Burkina Faso and Tanzania with a noteworthy reduction of both transmission and high parasitaemia of* P. falciparum *(respectively 78% and 75%) meaning a drop of malaria morbidity.*

Key words: malaria – insecticide – treated bed-nets – transmission – morbidity

Near the year 2000 malaria is still the number one problem in the world and according to a recent evaluation of WHO more than 40% of total population is still living in endemic areas.

The situation is even worsening with the current spreading of strains of *Plasmodium falciparum* resistant to the usual drugs such as the largely used chloroquine (Desfontaine, 1990).

As malaria is a parasitic disease transmitted by anopheline mosquitoes new vector control programmes are urgently needed for the control of malaria (Carnevale & Mouchet, 1990).

Classical house-sprayings could still be efficient for malaria control but their technical constraints are well known and "Appropriate Technology in Vector Control" has to be developed, and has recently been developed (Curtis, 1989). One of the most promising is the use of impregnated bed-nets (WHO, 1989). This method has already been used in Africa, Asia and South America and has always given very good results in reducing both malaria transmission, malaria morbidity (Carnavale et al., 1988) and even child malaria mortality (Alonso et al., 1991).

This method can easily be developed where bed-nets already used. Actually bed-nets are often used to protect against the nuisance due to mosquitoes: bites and noise (Desfontaine et al., 1989, 1990).

But bed-nets are usually torn and mosquitoes can easily find their way through holes and bite the sleepers. The efficacy of bed-nets to avoid the contact between man and mosquitoes can be restored by impregnating them with a pyrethroid insecticide (permethrin, deltamethrin or lambdacyhalothrin). Such an impregnation can easily be done at individual or at large scale level; actually the technique of impregnation is easy to teach, easy to learn, easy to do.

Two years ago we started a vector control programme with insecticide treated bed-nets in the locality of Mbébé, which is a group of villages located in the forest part of South Cameroon, near the permanently flooding Sanaga River which constitutes a very good breeding site suitable for two main vectors of malaria, *Anopheles nili and An. gambiae. An. nili* breeds among the grass growing near the edge of the river; on the other hand when the river is low the rock pools filled with stagnant water constitute very good breeding sites suitable for *An. gambiae.* A permanent huge anopheline population exists thanks to these good ecological conditions. We developed a programme at village scale and used deltamethrin impregnated bed-nets which were given free to the population and had received a very good acceptance.

MATERIALS AND METHODS

For large scale impregnation it is possible to use two techniques: dipping or spraying (Le Goff et al., 1991). Both were used for impregnating bed-nets in our trial: the first one, in March 1990, by dipping bed-nets with the cut barrel technique; the second one, which was the re-impregnation, in January 1991, was done by spraying.

Dipping can be done with a 200-liter barrel longitudinally cut in two parts: one of the parts receives the right amount of water and insecticide (deltamethrin WP 25 or EC 25); bed-nets are dipped in this half barrel and are wrung above the second half which received the excess amount of insecticide and water which can be used for further impregnation. Then insecticide treated wet bed-nets dry horizontally, on the floor. Spraying is made with an usual knacksack, its flow rate must be known in order to adapt the amount of insecticide and water and the speed of spray to the target concentration as for the classical spraying of a wall. We used a "Solo" sprayer of 14 l with a flow rate of 1,6 l/mn; we filled it with 250 ml of deltamethrin EC 25 and water to obtain a total volume of 10 l. The speed of spray was adapted to the surface of the three sizes of bed nets used: 18 seconds for small bed net (10,2 m^2); 24 s for medium bed net (12,6 m^2); and 28 s for large bed net (15 m^2).

For the spraying the bed-net is hung vertically then we let it dry on the grass to avoid any drop of insecticide. Sprays of bed-nets were done by some of the villagers themselves and their training was very easy because they already used insecticide for cacao plantations.

Entomological evaluation was made with the classical techniques of volunteers catching mosquitoes on their legs and working inside the houses all night long. For parasitological evaluation we performed longitudinal surveys with thin and thick films.

RESULTS

Entomological data - Before the use of treated bed-nets the inhabitans were receiving more than 10.000 bites/man/year mainly due to *An. nili* (8700 bites/man/year) which is present all year round and to *An. gambiae* (1500 bites/man/year) mainly in the dry season (December to March). *An. funestus* is also present but in small amount (Fig. 1).

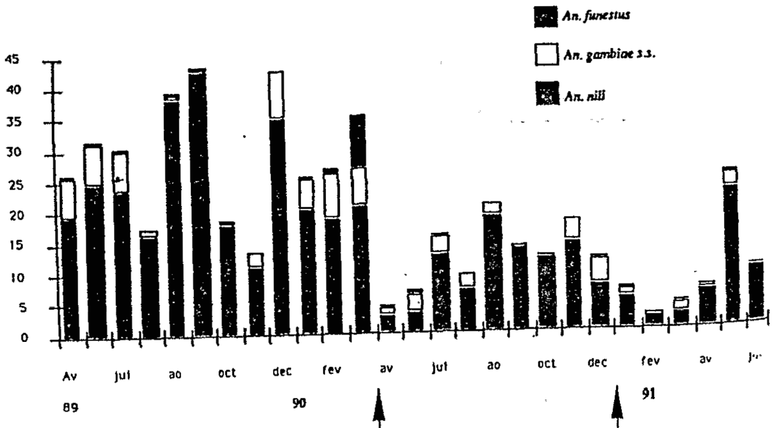

Fig. 1: evolution of agressivity rate of malaria vectors in the village of Mbébé (Cameroon). The arrows show the bed-nets impregnations.

Transmission was permanent with an average of more than 200 infected bites/man/year (ib/m/y) mainly due to *An. nili* (93 ib/m/y) all year round and to *An. gambiae* (78 ib/m/y) mainly when the Sanaga river was at its lowest. After the installation of more than 400 treated bed-nets we noticed a sharp reduction of the main entomological parameters:

For *Anopheles gambiae:*

– the average density decreased: from 4,3 to 1,7 bites/man/night;

– the average inoculation rate decreased: from 0,2 to 0,09 infected bites/man/night;

– the parity rate significantly decreased: from 65 to 56%;

– the sporozoitic index stayed at the same value (about 5%);

– the vectorial capacity decreased from 1 to 0,1.

For *Anopheles nili:*

– the average density decreased: from 24 to 9 bites/man/night;

– the average inoculation rate decreased from 0,3 to 0,02 infected bites/man/night;

– the parity rate decreased from 64 to 32%;

– the sporozoitic index decreased from 1,2 to 0,2%;

– the vectorial capacity decreased from 11 to 0,1.

Hence, after the introduction of treated bed-nets in the villages and for these main vectors the overall reductions were of 62% for the biting rate and 78% for the inoculation rate and during three months (August, September, October) no transmission was noticed (Fig. 2).

These data can be considered as an overestimation because catches of mosquitoes are, of course, outside the bed-nets, therefore sleepers who are well protected under their insecticide treated bed-nets would obviously receive less bites than mosquitoes catchers.

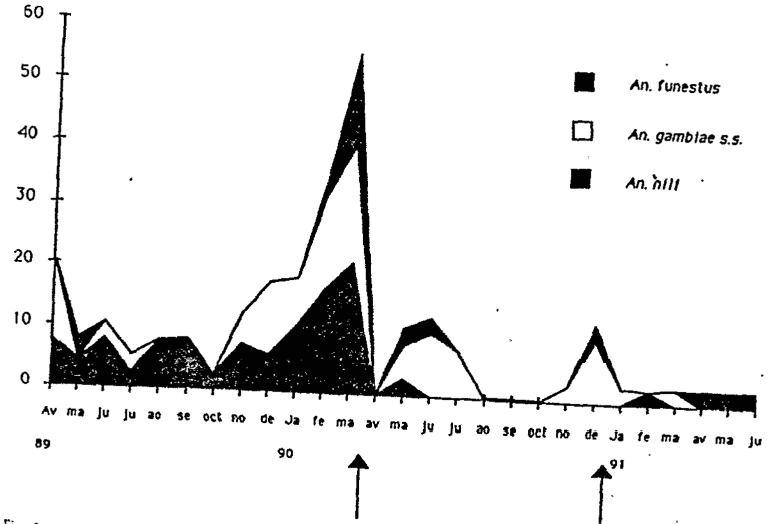

Fig. 2: evolution of the inoculation rate in the village of Mbébé (Cameroon). The arrows show the bed-nets impregnations.

It thus clearly appeared that thanks to the permanent presence of insecticide impregnated bed-nets malaria transmission still occurred (and thus immunity was maintained) but was greatly reduced and the vectorial capacity of the anopheline population was decreased by 98%.

Parasitological data - The first analysis of eight surveys done before and after the installations of treated bed-nets showed that:

- prevalence of *P. falciparum* in children <15 year old remained almost unchanged (about 72% before and after the introduction of impregnated bed nets);

- for children < 15 years and for *P. falciparum:* parasitaemia between 1.000 and 5.000 par/mm^3 were same "before" and after"; but parasitaemia between 5.000 and 10.000 decreased from 10 to 3% and parasitaemia >10.000 which are usually linked to malaria morbidity in these epidemiological situations decreased from 6% to 1.5%. That means a 74.5% decrease of high parasitaemia after the installation of impregnated bed-nets (Fig. 3), a noteworthy result.

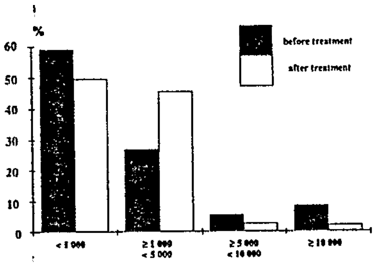

Fig. 3: distribution of the densities of *Plasmodium falciparum* trophozoites among children under 15 year old, before and after insecticide bed-nets impregnation.

DISCUSSION

As in recent trials done in other countries of Africa south of Sahara (Tanzania, The Gambia, Burkina Faso) we noticed that the village scale use of insecticide treated bed-nets induced a decrease in biting rate (60%), a decrease in inoculation rate (78%), no variation in plasmodic index but a sharp decrease of high parasitaemia (66% to 75%) *i.e.* a decrease in malaria morbidity. These data are similar to those obtained in West and East Africa countries (Snow et al., 1988; Lyimo et al., 1991).

Following Ross in 1910 we advocate the large scale use of treated bed-nets which is very easy to use because bed-nets are still largely used to protect people, and mainly babies, against the nuisance to these insects which can give malaria and other vector borne diseases.

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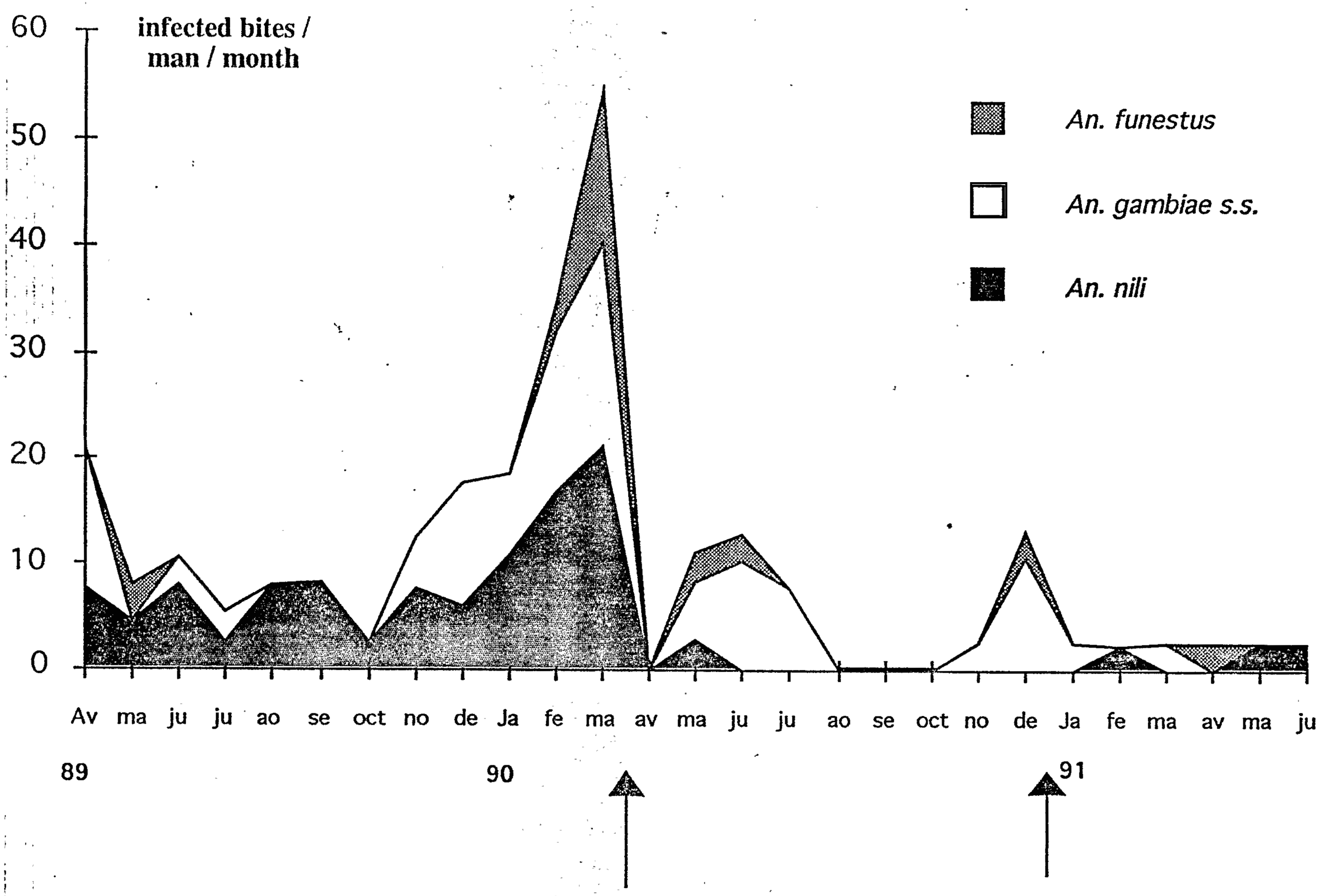
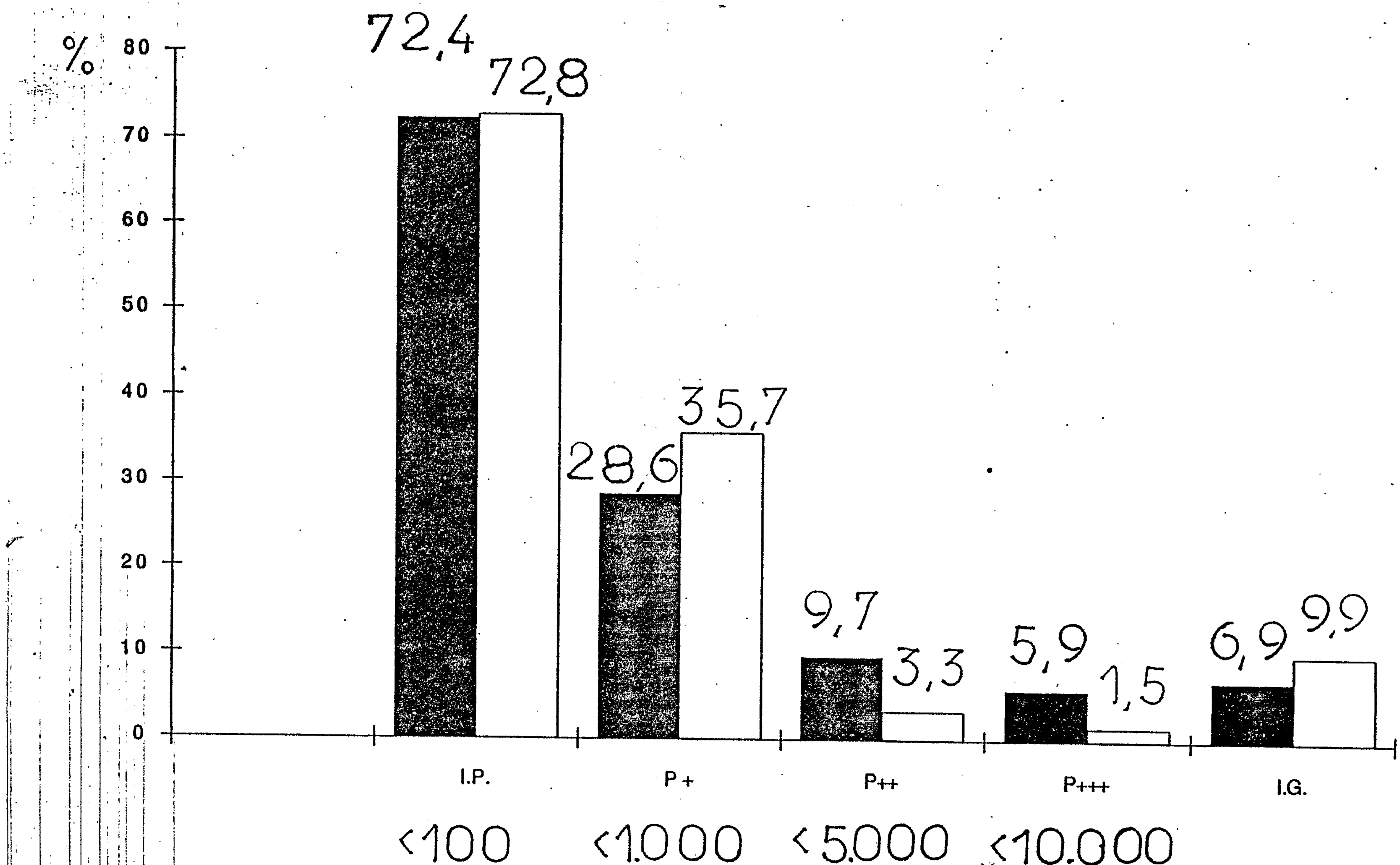


Evolution of the inoculation rate in the village of Mbébé (Cameroon)
The arrows show the bed nets impregnations.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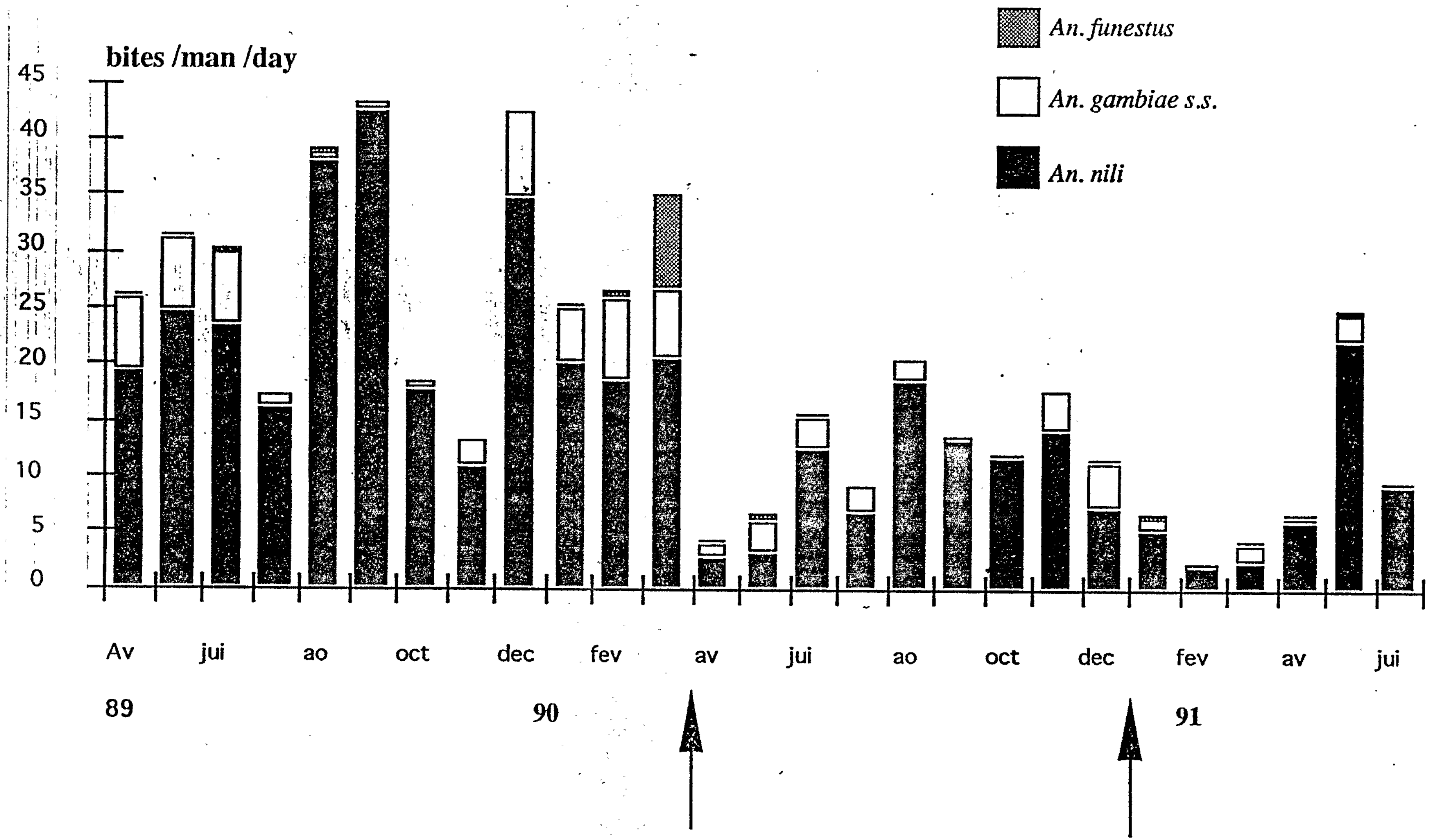

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