TRANSMISSION BLOCKING IMMUNITY AND INFECTIVITY OF HUMAN POPULATIONS TO MOSQUITOES DURING MALARIA TRANSMISSION.

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The Papua New Guinea Institute of Medical Research (PNGIMR) has been conducting a multidisciplinary research program on malaria in approximately 70 villages around Madang for the past 5 years. On the basis of information on parasite rates and prevalence of the different species of mosquito vectors in different parts of the Study Area, three villages were selected for intensive study under the proposal. These villages are Maraga, characterised by a very large mosquito population of predominantly _Anopheles farauti_; Mebat, which has an intermediate mosquito population of predominantly _An. koliensis_; and Butelgut, in which the major vector, _An. punctulatus_, is present in very low numbers.

The location of each village is characteristic of the three types of environment found within the heterogeneous environs of Madang, namely swampy coastal lowland (Maraga), well-drained coastal lowland (Mebat) and inland upland (Butelgut). These three villages have been included in longitudinal epidemiological surveys for the past 2 years, the results of which are currently being analysed and will yield detailed information on the parasite rates. An additional survey was carried out in the 3 villages in September 1985 to obtain more detailed information for the present study. Overall, the parasite rate does not differ between the three villages; however, preliminary data from previous surveys indicates a differing age prevalence curve in the 3 villages, with the parasite rate peaking in a younger age group in Butelgut than in Mebat, and at an even later age in Maraga (Fig. 1).

Feasibility studies have indicated the most effective ways to

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collect mosquitoes in the study villages in order to determine the infectious reservoir. The houses are of extremely open construction, and exit-trap collections are not possible. However, it was found that numerous blood-fed mosquitoes could be found resting indoors in the first hour after dawn, after which time they leave the houses. Since a large proportion of houses must be searched in order to obtain a representative sample of mosquitoes, it was found to be most productive to teach the inhabitants to search the walls and mosquito nets of their own houses shortly after arising. This also overcame taboos about outsiders entering houses. These indoor resting collections are being used to determine both the human blood index (using ELISA), and the infectious reservoir, by holding the mosquitoes in the laboratory for five days. These parameters can also be measured in blood-fed mosquitoes caught resting outdoors, but the search for these mosquitoes has proved to be productive only in Maraga, and to a lesser extent in Mebat. This reflects the relative species distributions in the three villages (since An. farauti is easier to find in the bush close to the village) as well as the overall mosquito numbers.

Biting collections are also made in the study villages to obtain mosquitoes for determination of the sporozoite rate (which is done in Madang using ELISA), and also to measure the human biting rate for determination of the vectorial capacity. Despite the fairly similar parasite prevalences in the study villages, the sporozoite rates are markedly different, being considerably lower (0.3%) in Maraga than in Mebat and Butelgut (1.7% and 3.3%

respectively). A large part of this difference appears to be due to an extremely low human blood index in Maraga. However, the inoculation rate in Maraga is much higher than would be expected given such a low sporozoite rate, due to the large biting population of mosquitoes.

Mosquitoes from the biting collection are also used to determine the infectious reservoir. In the time between the submission of this proposal and the start of funding, a mathematical model has been developed by Allan Saul (Queensland Institute of Medical Research) to determine the vectorial capacity using infection rate data from the three types of catch (biting, indoor resting and outdoor resting). This model makes significant modifications to the model formulated by Macdonald which underlay the methods originally given in the proposal for analysis of the data. The essential difference in the Saul model is that it assumes a constant mosquito survival rate per feeding cycle, rather than per day. This assumption approximates more closely to reality, and gives estimates of vectorial capacity differing from those of Macdonald under certain conditions. The data generated in the present study will be of importance in testing the Saul model.

A healthy colony of An. farauti No. 1 is now established in Madang for studies on the infectiousness of individuals. However, the overall proportion of infectious persons in the population, as measured from the uptake of oocysts in wild-caught mosquitoes, appears to be low, i.e. of the order of 5%, and random feeds performed to date on village populations have identified only a few infectious individuals (Table !). A more productive approach may be to conduct feeds on gametocyte carriers and other infected individuals identified at health-care facilities, and relate findings back to the observed prevalences of parasitemic individuals in the village populations. Such studies are being pursued at present.

Table 1: *An. farauti* fed at random on individuals in Madang.

Blood slide result	No. persons	No. batches infected
P. falciparum asexual	41	0
P. vivax	10	0
P. falciparum asexual + P. vivax	10	3
P. falciparum gametocytes	4	1
P. malariae	4	2
Negative	74	0
Total	143	6 (4.2%)

Figure 1.

AGE SPECIFIC PREVALENCE - P FALCIPARUM