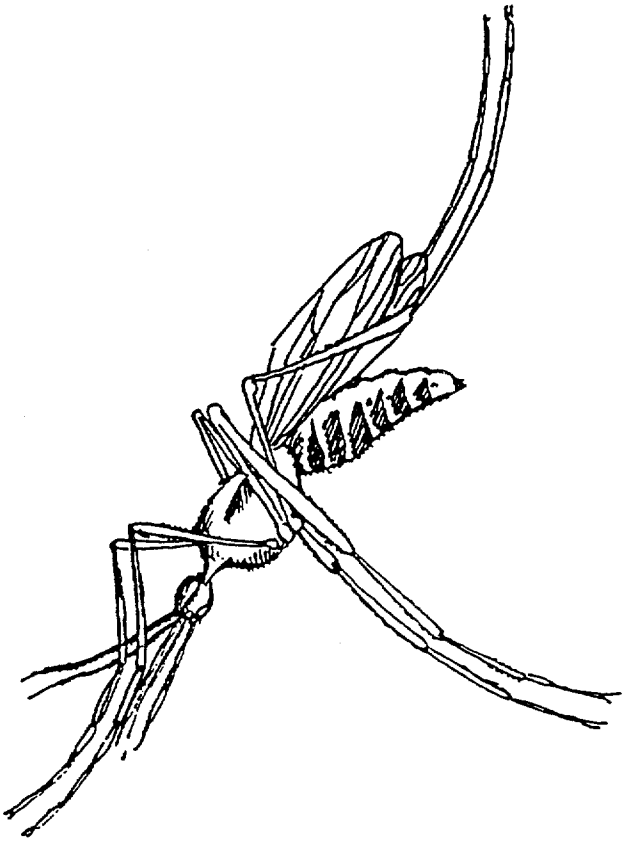
PD-ABP-796

ANNUAL REPORT

OCTOBER 1, 1991 TO OCTOBER 31, 1992

BAGAMOYO BEDNET PROJECT



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Funding for the Bagamoyo Bednet Project is provided by the United States Agency for International Development.

INAUGURATION OF THE PROJECT

Professor Japhet Minjas introduces Minister of Health Dr. Philemon Sarunge and other guests at KEREGE Village, Bagamoyo: 17th October 1992.

COMMUNICATION

"Anopheles" seeks out his victim but is foiled by the treated bed net. a Play presented by Chuo Cha Sanaa to communicate with villagers about IBN use

B

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EXECUTIVE SUMMARY

The Bagamoyo Bed Net Project (BBNP) is a community-based malaria control research project that aims to develop and document a sustainable system for distributing and promoting the use of insecticide-impregnated bed nets (IBNs) in a rural area of coastal Tanzania with a population of approximately 21,000 and to evaluate the impact of the IBNs on the mosquitoes which transmit the disease and on the epidemiology of malaria. The project is a collaborative effort of the Muhimbili College of Health Sciences in Dar es Salaam and The Johns Hopkins University, School of Hygiene and Public Health in Baltimore. There is a permanent staff of 35 persons of whom 14 are scientific and 21 are management and support staff. There are also 4 scientific personnel seconded part time from the Muhimbili College for Health Sciences and 5 similarly seconded from the Johns Hopkins University.

Nets were distributed in 6 of the 13 villages in the study area this year. The process of distribution was designed and carried out to achieve widespread penetration of IBN's into the villages so as to maximize the intervention's potential for reduction of malaria transmission and for long-term sustainability. First a bed net committee was formed in each village. Committee members were chosen following interviews with a number of villagers regarding the suitability of various candidates. The committees attended a seminar in which the objectives and the research findings of the project were explained to them, and then they were asked for their input on how best to implement the intervention. After a village meeting to have the composition of the committee approved by the villagers and the process of implementation explained, committee members made house-to-house visits to assess needs for nets and to encourage people to purchase nets. On planned occasions net sales were undertaken in the selected villages. Village leaders and project staff explained to the villagers about the use of the nets and a play was presented which addressed common misconceptions about nets and promoted their use, then nets were sold and impregnated with insecticide. The project has recovered over 3.6 million Tanzanian shillings (Tsh) from sales of nets, and this money has been banked on behalf of the village mosquito net committees. These funds will be used to sustain the intervention after external funding ends. This success has been achieved in an extremely poor community which has never before paid for medical services and which recently failed to raise the equivalent of less than US $ 1 per family per year to sustain the essential drugs scheme. It constitutes a major breakthrough in the development of sustainable community-based systems for the control of tropical diseases.

Evaluation of the intervention is being carried out at several levels. On one level the immediate impact of the intervention is being measured by assessing levels of net ownership and seasonal and geographic variations in net usage following initial distribution and sales. The duration of insecticidal effect after initial impregnation is measured as is the willingness of the villagers to have the nets re-impregnated after six months. On another level protocols for the evaluation of the effects of the intervention on morbidity and mortality from malaria, densities of mosquito vectors and the proportion infected with malaria parasites, as well as knowledge and beliefs of villagers about malaria and bed nets have been implemented. Among the activities involved in these evaluations have been the operation of fortnightly clinics in 7 villages for a total of 338 infants and young children over a period of five months to assess rates of new

malaria infections. Verbal autopsies for all childhood deaths in the study area are carried out routinely through a network based on the village health workers. Fortnightly collections of mosquito vectors are made using light traps in 80 houses in 8 villages. Finally a survey of 567 households in all 13 villages was conducted to evaluate malaria-related knowledge, beliefs and practices prior to the implementation of a communication plan so that its impact can be assessed at the end of the project.

In October, the project was officially launched at an inaugural ceremony opened by the Minister of Health, although field activities have been going on since March 1991. This well attended ceremony was reported in national newspapers and on Radio Tanzania and received mention in the international media. The Minister was very enthusiastic and has encouraged people in Tanzania to think about incorporating the use of IBNs into malaria control strategies at the national level. Partly as a result of this project, the Government of Tanzania has now waived all taxes and duties on imported mosquito nets and netting. It is relevant and extremely important that at this time in Tanzania the Government is considering increasing community participation and cost sharing in health and moving away from the idea that all health services should be provided free of charge. The successes demonstrated by this project in initial sale of nets will therefore influence the larger debate about how to improve health services in rural Tanzania.

INTRODUCTION

Although malaria is a major public health problem in Latin America, Asia and Africa, it is in sub-Saharan Africa where the disease has the greatest impact. It is estimated, for example, that 95% of the deaths due to malaria globally occur in sub-Saharan Africa, and that between one and two million African children die of malaria every year. In addition, malaria makes a significant contribution to the high rate of mortality found in Africa among pregnant women. Finally, frequent absenteeism from school or work due to acute attacks of malaria, and easy fatigability and poor concentration among workers and students due to anemia resulting from malaria, represent significant barriers to social and economic development.

The enormous scale of the malaria problem is due to several factors. The mosquitoes which transmit malaria in sub-Saharan Africa, primarily members of the *Anopheles gambiae* complex, are exceedingly efficient at transmitting the disease, which means that programs aimed at the mosquito vector must be extremely well-managed for them to have an impact on transmission. On the other hand, low population densities and the dispersed nature of human settlements, the absence of good roads in most rural areas and the high cost of vehicles and insecticides has meant that malaria vector control strategies which have been successful in many parts of Latin America and Asia, such as the application of DDT to house walls, have been not thought to be feasible in rural areas of Africa. Successful malaria vector control programs in Zimbabwe and South Africa are among the few exceptions.

For these reasons, malaria control in sub-Saharan Africa has focussed on the early

treatment of clinical malaria with chloroquine, a drug which due to its low cost and few side effects is ideal for use by village health workers who have little training. Several problems with this strategy have now become apparent. First, varying degrees of resistance to chloroquine and other drugs are now exhibited by the most deadly malaria parasite, *Plasmodium falciparum*, throughout the continent. Alternative drugs are more costly and have more side effects. Second, recent studies of the epidemiology of severe malaria have indicated that early treatment of clinical malaria at the village level may have little impact on the course of many cases of severe malaria, especially cerebral malaria. Finally, early treatment of clinical malaria has no effect on malaria transmission, so the total numbers of people presenting with malaria at clinics and hospitals remains extremely high, sometimes representing one-third or more of all patients. This places a large burden on the entire health system, and makes it extremely difficult to improve the quality of health services or to establish new activities such as AIDS control programs.

The problem of malaria in Africa is receiving considerable attention internationally and was the focus of a meeting of Ministers of Health held in November in Amsterdam under the auspices of the World Health Organization. The need for an effective strategy to deal with chloroquine resistant malaria was the subject of these high level discussions, the outcome of which was to continue with widespread use of chemotherapy but with programs of vector control to be considered when appropriate and affordable. Essentially those concerned with the control of malaria have decided to continue with the same strategies as before in the hope that something new in the way of vaccines or sustainable transmission control will be developed.

Two sets of questions must be answered before most African Ministries of Health will be willing to include IBNs alongside chemotherapy as an integral part of national malaria control strategies. First, there needs to be more information on the magnitude of the effect on malaria transmission in holoendemic areas of Africa where transmission is intense and occurs every month of the year. Once the size of the effect is known, an estimate is needed of the extent of coverage which is necessary for the effect to be seen. Do 75% of people need to be sleeping under nets each night, or does a higher level of usage need to be achieved?

The second set of questions is operational in nature. The same factors which led the World Health Organization to decide that sub-Saharan Africa would not be included in the global malaria eradication program in the 1950s and 1960s are still present today such as dispersed populations, poor quality of roads in rural areas and Ministries of Health with insufficient financial and human resources to meet the health needs of their countries. Can a method of promotion, distribution and reimpregnation of nets be devised which is sustainable with little or no external financing?

The Bagamoyo Bed Net Project aims to address both sets of questions. The following sections will first address the research plan for the operational issues, and then describe the protocols being implemented to evaluate the impact of the intervention.

DESCRIPTION OF THE STUDY AREA

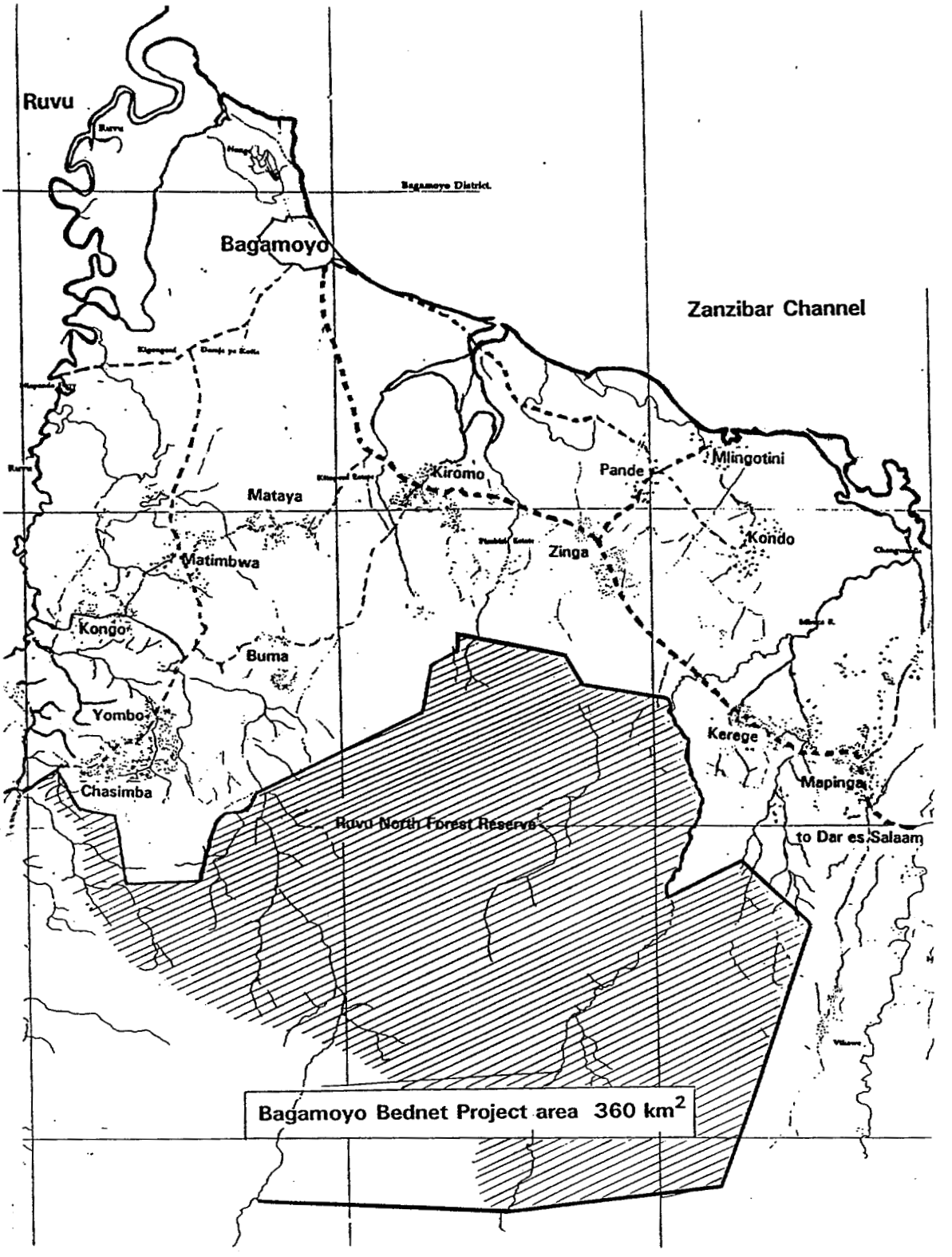
The study is being conducted in 13 villages in Bagamoyo District on the coastal plain of Tanzania, 50 km north of the capital Dar es Salaam. The total population of the study area is 20,996. The predominant ethnic groups are the Zaramo, Kwere and Swahili although 30 other ethnic groups are represented in smaller numbers. Kiswahili is the principal language used, although Kizaramo is also common. The population is almost entirely Muslim. Two of the villages are right on the coast and include large numbers of fishermen. Most of the population are subsistence farmers, the principal crops being rice and cassava. Cash crops grown include cashewnuts, mangoes, coconuts and pineapples.

As elsewhere on the coast of Kenya and Tanzania, there are two rainy seasons, the long rains during the months of March, April and May accounting for approximately 50% of the annual precipitation and the short rains during the months of October, November and December accounting for 25% to 40%. The short rains are unpredictable, starting as early as September or as late as January. Fluctuations in temperature are not great. Mean minimum temperatures show the greatest variation, from 19°C during the months of July and August to 25°C during January and February.

Previous studies have indicated that the principal malaria vectors in coastal Tanzania are *Anopheles gambiae s.s.* and *Anopheles funestus* although the presence of *Anopheles arabiensis* was also suspected. Among the most important larval production sites for these mosquitoes are rice fields which typically are flooded from March to June and a number of small permanent bodies of water found in valleys.

A number of other international organizations have carried out programs in the study area. The Danish aid organization DANIDA had installed piped water supply to the villages. In this project the villagers participated by digging the trenches for the pipes, while the pipes themselves were laid by project staff. The Family Health Project of the German aid organization GTZ (Gemeinschaft für Technische Zusammenarbeit) has been in operation since 1983 in Bagamoyo District. This comprehensive project has included the extensive training for village health workers and supervisory staff and the provision of essential drugs to village health posts.

MAP OF PROJECT AREA
(Grid Lines are 10 Km)



THE FOUR PHASE IMPLEMENTATION (FPI) DESIGN

The most common design used for field trials of bed nets has been to divide the study area into "intervention" and "control" villages, and to distribute nets to all of the intervention villages at one point in time at the beginning of the trial, and then distribute nets to the control villages upon completion of the trial. This design was felt to be inadequate for this project for a number of reasons. First, the process of distribution of nets is far more complex in this project as it involves active community participation including the formation of village bed net committees which help plan and carry out the intervention and the creation of an accounting system for funds collected from sales of nets. Formation and training of these committees takes time, so it was felt to be impossible to work on committee formation in all intervention communities simultaneously. Second, since little is known about how communities respond to this type of intervention, it was thought to be better to carry out distribution in a small number of villages at a time and to learn from mistakes made there before proceeding on to other villages. Finally, there was felt to be a ethical problem in designating some villages as "control" villages since it is clear that the regular use of IBNs conveys some benefits.

The study design settled upon was the Four Phase Implementation (FPI) design. The study area was divided into four groups, the coastal villages of Mlingotini, Kondo and Pande comprising Group 1; Kerege, Mapinga and Zinga in Group II; Kiromo, Buma and Mataya in Group 3; and Matimbwa, Kongo, Chasimba and Yombo, the villages farthest inland, in Group 4. This design enables both research on operational aspects of delivering the intervention and research on the impact of the intervention to proceed simultaneously.

The intervention is being implemented (i.e. nets are being sold, distributed and impregnated) one group at a time, at intervals of six months. After the first round of implementation is complete in each group, a thorough evaluation is carried out of the problems encountered, so that implementation in the next group can proceed more smoothly. In this way, we are achieving a through understanding of the issues involved in implementation. This design is understandable to villagers as they have experience with projects such as the DANIDA water project being implemented in groups.

For logistic purposes assessment of the impact of the intervention is confined almost entirely to Group II and Group IV villages. As nets are distributed to new groups at six month intervals, there will therefore be a period on one entire year, from October 1992 to October 1993 in which group II villages have IBNs, but group IV villages do not yet have them. Three principal types of comparisons will be made using the epidemiology (malariometrics) and entomology data:

1) Group II before October 1992 versus group II after introduction of IBNs in October 1992.
2) Group II versus group IV during the period from October 1992 to October 1993.

3) Group IV before October 1993 versus group IV after introduction of IBNs in October 1994.

In all seven villages in Groups II and IV as well as Mlingotini in Group I, fortnightly light trap collections of mosquito vectors are being made in ten houses in each village. In addition, special clinics are held for five months each year to assess the incidence of new malaria infections for a cohort of children from the seven villages in Groups II and IV. Finally, verbal autopsies are being conducted for all of children under five. More details on these evaluations will be given later in the report. The FPI design is similar to the Stepped Wedge Design, used in The Gambia for evaluating the effectiveness of Hepatitis B vaccine, in operational terms but differs in that intensive monitoring is being conducted in only two of the four groups.

PROJECT ORGANIZATION

For ease of organization the project is divided into four components: Entomology, Malariometrics, Social Science and Administration. The Entomology component is responsible for monitoring changes in mosquito populations as a result of the introduction of IBNs, monitoring the duration of the killing effect of the insecticide after it is applied to the bed nets and testing for insecticide resistance. The Malariometrics component is responsible for monitoring changes in malaria-related morbidity and mortality as a result of the introduction of IBNs and for assessing the degree of resistance to anti-malarial drugs exhibited by malaria parasites found in the study area. The Social Science component conducts qualitative and quantitative research on local beliefs and practices related to mosquitoes, malaria and bed nets, forms and trains village bed nets committees and mobilizes villages for distribution and reimpregnation of nets, and develops, implements and evaluates strategies to educate the population about malaria and IBNs. The Administration component is responsible for payrolls and accounting, resolution of personnel problems, rental and maintenance of facilities, ordering of new supplies and maintaining inventories of project equipment. All components participate in the distribution and reimpregnation with insecticide of nets, and in measurement of net usage, although these activities are coordinated by the Social Science component.

OPERATIONAL RESEARCH

Methods of distribution of bed nets have up to the present taken one of two forms. The first has been to make nets available through commercial channels such as shops and street vendors. While this method requires no commitment of resources on the part of governments, it results in nets primarily being owned by relatively wealthy individuals in urban areas. The other method has been to distribute nets free-of-charge to selected populations. UNICEF has distributed nets free-of-charge to pregnant women and children under five in several areas of Tanzania including Pawaga District, Iringa and Zanzibar. In research projects, nets are typically distributed free-of-charge to all residents of the "intervention" part of the study area, while residents of the "control" part of the study area must wait until the completion of the project

before they too receive nets. The obvious difficulty with this latter method is that there is no mechanism established for ensuring a supply of nets and insecticide once the project is over.

An explicit aim of the Bagamoyo Bed Net Project has been to evaluate the feasibility of a community-based system for the distribution and reimpregnation of nets. It is hoped that if this system functions optimally, although some external input will still be necessary to keep the program going, this support will be limited and its provision will be within the capabilities of the Ministry of Health.

The essential element of the community-based distribution system being established in this project is the village bed net committee. When asked what sort of a committee should be entrusted with the promotion, sales and distribution of nets on behalf on the village, villagers almost unanimously favored the idea of forming a specific bed net committee, as opposed to a malaria committee or a health committee. Nevertheless, the formation of bed net committees must be approached with some caution. Previous experience with health committees in the project area in Bagamoyo District has shown that they are difficult to sustain, especially if they do not enjoy strong support from the local village government. Currently, only two of the health committees originally established in each of the 13 villages several years ago to coordinate village-level primary health care activities are still operating.

In terms of operational research, the three major activities during 1992 were distribution of nets in Group I in June and July 1992, distribution in Group II in October and November 1992, and reimpregnation of nets with insecticide in Group I in December 1992.

Distribution of Nets in Group I in June 1992

Distribution in Group I had been planned for April and May of 1992, but was delayed for a number of reasons, including the unusually heavy rains in the month of May. The process of distribution was designed and carried out so as to maximize the intervention's potential for long-term sustainability. First a bed net committee was formed in each village. Villagers, village leaders and project field staff were all asked to suggest names of persons who might be suitable to serve as committee members. Interviews with villagers were fairly lengthy, so that an accurate assessment could be made as to how trustworthy and respected different individuals were. People were both mentioned frequently as potential committee members and thought to be trustworthy and respected were then approached and asked if they would be interested in serving on the village bed net committee. Once nominated and confirmed in a village meeting, committee members attended a day-long seminar in which they receive information about malaria and its control and discuss how distribution, sales of nets and impregnation should take place. After a village meeting to have the composition of the committee approved by the villagers and the process of implementation explained, committee members made house-to-house visits to assess needs for nets and to encourage people to purchase nets. Several days of net sales were then followed by a day of distribution in which a play was presented which addressed common misconceptions about nets and promoted their use, and nets were sold and impregnated with

insecticide. Separate bank accounts were opened in Bagamoyo for each village bed net committee.

An awareness creation plan was designed and implemented for the group I villages to increase sales and use of IBNs. The Ventura Publisher program was installed on a computer in Dar es Salaam and production was started on educational booklets for bed net committee members and for villagers in general were produced. Posters were also designed and reproduced. The Bagamoyo College of Fine Arts (Chuo cha Sanaa Bagamoyo) was contracted and two plays were written, rehearsed and performed. One play was for the special clinics organized by the malariometrics component. Its purpose was to create awareness about importance of attending malariometrics clinics regularly and to address concerns some people had expressed about the clinics. The second play was to be presented during the distribution of nets in group I villages. Its purpose was to address common misconceptions of nets, explain how the nets were to be used and to emphasize the importance of all members of the family using the nets on a continuous basis.

This first phase of distribution was evaluated in two ways. First, a survey was conducted during August in group I in 176 households to assess levels of net usage and problems people were experiencing with the nets. It was found that side-effects of the insecticide were rare which have been reported elsewhere such as swollen eyes and nasal discharge were rare. Furthermore, people with nets seldom mentioned effects on non-target insects such as bed bugs. Only 36% of the total estimated need for nets was found to have been satisfied, although this can be misleading. Sometimes several people were sleeping under one net, where they would prefer to have two or three nets. The major barrier to the acquisition of nets was said by respondents to have been financial, as nets were sold at a time of the year when people had little money. Other barriers to the acquisition of nets were conflicting responsibilities such as needing to be in the fields to guard the maturing rice from wild pigs or being out at sea fishing.

Other important findings were that only 80% of the nets which had been purchased were in fact in use. One reason for this was that some people bought an extra net in case a guest came to stay at the house, or had bought a net for a family member who was working in Dar es Salaam or Bagamoyo but was expected to return. Other people said that, since mosquitoes were relatively few in number during August, that they did not see the need of using their net yet. This had been expected, based on knowledge of local perceptions of seasonality. This issue is described in detail in the two attached articles on perceptions of seasonality.

The second way the effect of the intervention was evaluated was by organizing a seminar to discuss the problems encountered in the distribution and in the survey. Members of village bed net committees and village government leaders in group I were invited to discuss their impressions of how the process of distribution had gone and to elicit their suggestions for improving the coverage. Many useful recommendations came out of this seminar. For example, the use of receipts during net sales was felt to be a negative factor. Villagers in the area have a long history of handing over their cashew nuts to the cashew nut marketing board, and then being paid many months later or not at all. For that reason it was felt that, instead of issuing

receipts and then receiving the net on the distribution day, that the process should be simultaneous i.e. that people should always receive their nets immediately upon payment. It was also suggested that several distribution points be operated in each village, instead of just one central point. Some people did not buy nets because it was too long a walk to the distribution point and would involve leaving their fields unattended for too long a time.

It was also found that there had been a much lower level of exposure to the health communication messages than had been hoped. Many people had been unable to attend the play performed by actors from the Bagamoyo College of Fine Arts on the day of net distribution. Only those who bought nets were given booklets about how to use the nets, which meant that those who had not bought nets were still missing vital information which might have encouraged them to buy a net. Furthermore, it was found that adults tended to use nets in preference to children, so it was felt necessary not only to expand the dissemination of educational messages, but also to promote the use of nets by children more explicitly. Based on these and other recommendations, a number of changes were made to the distribution plan for the group II villages.

Distribution of Nets in Group II in October 1992

The identification and formation of village bed net committees was carried out in group II villages in a similar way to how it had been done in group I. An attempt was made to form larger committees, as the dispersed nature of the village housing means that each committee member must do a great among of walking. A pre-distribution seminar was organized for group II village government leaders and village bed net committees, in which a number of new strategies were developed.

In group I committee members had gone from house-to-house and asked people what size of net they needed, which resulted in many wrong decisions being made about net sizes, and people frequently needing to exchange small nets for larger ones. In group II, village bed net committee members went from house-to-house with a kit of three nets, and unfolded each net for the householder to see and hold over the beds in the house. In this way more appropriate decisions could be made about what nets to buy.

A much wider distribution of print materials was carried out. Booklets about the use of bed nets were distributed to all households, not just those where nets had been purchased. Posters, instead of just being put up at a few central points were placed widely scattered areas of each village. In order to convey the message concerning the importance of children using nets more effectively, awareness creation plays were performed by the Bagamoyo College of Fine Arts in all primary schools in group I & II. The plays stressed the children in particular should use nets. In addition, an official launching ceremony was organized to attract more attention and stress that officials at all levels of government were supportive of the program.

A number of changes were made to the process of sales and distribution. Instead of

advance sales, nets were sold only on the day of distribution, and people received their nets immediately upon payment. Each village had three widely separated distribution points, instead of one central distribution point, which meant that distribution took three days per village. Finally, committee members were involved more fully in all distribution activities.

Initial distribution in group II yielded encouraging coverage results with an average of 50.6%.

Kerege 55.8%
Mapinga 48.4%
Zinga 47.7%

A further round of distribution is planned for January to bring coverage up to 75%. At that time of the year, people will have just received payment for their cash crops such as cashew nuts and pineapples.

Post distribution seminars were held for village bed net committees in group II villages to assess distribution and find solutions to problems which had occurred. There were meetings in each of the three villages, and then a combined meeting in Kerege. A major problem that was identified was the migration of nets outside of the villages, especially in Mapinga which border the municipality of Dar es Salaam. Village bed net committee members had apprehended a number of people moving out of the village with their nets, and convinced them to return their nets to the village. This is quite a difficult situation, however, as it places the committee members in the role of policemen and women, and may harm the trust they enjoy in their villages. Furthermore, many committee members felt that sales of nets should be on-going, instead of being restricted to distribution days.

Reimpregnation of Nets in Group I in December 1992

The first round of reimpregnation of nets was carried out in group I villages. Special booklets and posters were developed. Further sales of nets also took place, which raised rates of coverage considerably. It was much more difficult than had been anticipated to convince people to bring in their nets to be reimpregnated with insecticide. In other programs in Tanzania which project staff had visited earlier in the year in which nets had been given out free of charge, people apparently had felt that "since these are your nets, we will bring them in for reimpregnation". In the group I reimpregnation exercise we found that many people were of the opinion that "it is my net, I paid for it, so I will reimpregnate it only if I feel like doing so".

It was clear therefore that much more time will need to be spent explaining the rationale for reimpregnating the nets, and the role that the insecticide plays. In retrospect it can been seen that most of the educational messages had focussed on nets, and the insecticide had barely been mentioned.

In a this project distribution of bed nets, promotion of their usage and impregnation with insecticide are all being carried out by members of village bed net committees in collaboration with project staff. The rationale for forming these committees has been to make the intervention more sustainable, but this assumption may not be valid. Factors at both the village and district and national levels will determine whether this program will be sustained when external funding ends. At the village level, major issues are migration of people outside of the study area with their nets, loss of nets due to sales to people outside the village and dissolution of committees due to internal disagreements. During the reimpregnation in group I, it was very apparent that one of the committees is having trouble surviving, and it has proven difficult to recruit new members to strengthen it. It is fortunate that the "three core members" are extremely hard working and dedicated.

In a national program, the problem of dissolution of some committees could become a substantial problem. The formation of a committee with exclusive responsibility for bed nets instead of an integrated health committee has important implications for relations between bed net committees and both villagers and village governments. Furthermore, the method of selecting committee members led to the formation of committees made up predominantly of village elders (wazee). Although these individuals are better known and more trusted by villagers, the work of the committee is frequently too demanding for them, and they have a range of other responsibilities which can prevent them from participating in committee activities. At the district and national levels major issues are periodic supervision of committee activities by the Ministry of Health, the availability of transport for nets and insecticide on "reimpregnation days", and the provision of continuing education and encouragement for committee members.

The project has recovered over 3.6 million Tanzanian shillings from sales of nets, and this money has been banked on behalf of the village mosquito net committees. These funds will be used to sustain the intervention after external funding ends. This success has been achieved in an extremely poor community which has never before paid for medical services and which recently failed to raise the equivalent of less than US $ 1 per family per year to sustain the essential drugs scheme. It constitutes a major breakthrough in the development of sustainable community-based systems for the control of tropical diseases.

EVALUATION OF THE IMPACT OF THE INTERVENTION

The extent of malaria disease in a community is the result of a number of factors which are interrelated in a complex manner and which are difficult to measure. There is also controversy about the relative importance of these factors in the overall picture. To solve this dilemma, the project proposed to monitor morbidity and mortality due to malaria in certain members of the community and also to examine closely the mosquito vector populations and their potential for transmission. These studies are done to see if any changes occur which will indicate a reduction in the level of infection and disease.

Malaria Morbidity

Illness due to malaria presents in many forms. In order to accommodate these variations it was decided to monitor several parameters including parasite densities and species, haemoglobin level, spleen size, temperature, weight, malaria antibody levels and symptoms of common illnesses in the study area. The aim being to assess correctly the extent of the burden of disease due to malaria. The age group that is most vulnerable to succumb to illness in the event of infection, 6-36 months was specifically selected to be monitored. The first morbidity studies, Survey I, were conducted in a series of malaria clinics carried out from June to October in the seven core villages of Group II and Group IV. The studies will be repeated in 1993.

The design and implementation of Survey I was based on a preliminary study carried out for three months (Nov 1991-Jan 1992) in Kondo Village. A total of 338 children were selected randomly from the child census carried out in March and recruitment patterns and attendance are shown in the accompanying text figure. Village Health Workers (VHW) were enlisted to help in the survey. If necessary additional village helpers were recruited and trained by the project staff. Prior to the commencement of the survey a seminar was held for all the personnel involved to ensure that they understood the work plan start, all personnel attended seminars to ensure they understood the work plan. The mothers of the children were mobilized through various channels to participate in he survey. Time was spent explaining the study and the importance of regular attendance was stressed.

The survey was conducted for a total of five months, following a strict protocol (see Appendix A.) On the day of enrollment all children were examined for malaria and treated with fansidar to clear residual infection. Children were seen once a fortnight by project staff as part of the active surveillance system for malaria case detection. In the intervening period, if a child became febrile he/she presented to the VHW who took a blood smear prior to administering chloroquine for a presumptive diagnosis of malaria. In this way records were kept of episodes of fever with proof of infection.

The clinics were extremely popular as reflected by the good attendance (Figure 1) and the gratitude shown by the parents at the final clinic meeting. Such levels of enthusiasm and cooperation are necessary for the successful promotion of community based public health measures such as proposed by this project. A major reason for the good response was the effort made by the project to be concerned with the overall health of the children rather than focusing only on malaria and data collection. Children who attended the clinics were treated for illnesses other than malaria. In addition VHW were supplied with medicines to supplement the essential drugs kit. Children benefited greatly from the regular clinic visits and their health indicators improved greatly during the survey.

All data from the survey were checked, entered into a computer database and rechecked. A preliminary analysis has been done (Appendix A.). The results show that the project study area has very high levels of malaria. On the day of enrollment 86% of the children were infected with malaria at high parasite loads, yet relatively few of the children had clinical manifestations of the disease. The percentage of children infected with significant levels of parasitaemia (> 1,000 trophs/μl blood) was 71% and that with severe infection (>5,000 trophs/μl blood) was 38%. Only 32 (9.5%) of the children had temperatures in excess of 100° F. Approximately 40% of

the children were anaemic.

A good cure was obtained from the initial treatment with fansidar but reinfection rates were rapid with more than half of the children reinfected by week 12 and 84% by week 20. Based on the preliminary analysis, malaria contributes to a significant proportion of poor health. A detailed analysis of the data is being done by an epidemiologist.

The morbidity clinics were extremely successful and show the importance of considering local issues and concerns to ensure good attendance. The role of the social scientists in the project staff, the plays designed and scripted by the Chuo Cha Sanaa staff, and the dedication and support of the malariometric team testify to the level of response and cooperation achieved with the village community. The data collected have shown what the situation is in the BBNP project area. The information is crucial in our measurement of any change which may come about from the use of IBNs. It has also provided new information and insight on this important public health issue in Tanzania.

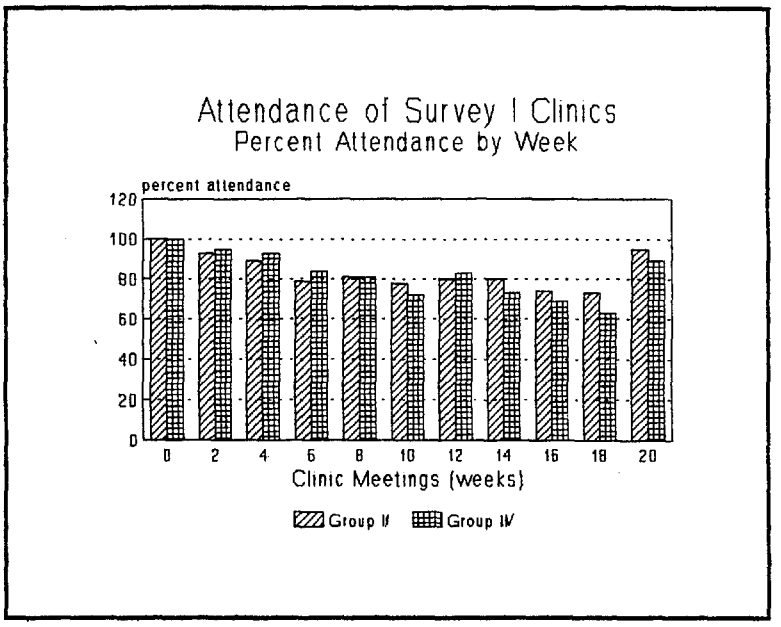


Figure 1 Composite Attendance Rates in Group II and Group IV Villages

Mortality Studies

Evidence from an IBN intervention carried out in the Gambia (Alonso et al 1990) demonstrated a decline in child mortality in children who used IBN's when compared with children who did not. There is considerable interest at WHO to demonstrate this effect elsewhere and the project is attempting to see if this happens in the children in the 13 villages.

The project is monitoring all-cause mortality and disease specific mortality in children under 6 as a parameter to assess the impact of IBN's. As a part of this process, births are being reported as well. In order to provide an initial baseline, a complete census was conducted in

March by the project staff. This was a house to house survey of all children under six and identifies child name, parents, house number, ubalozi and village. A summary of the census information is in Appendix A.

Initially a seminar was convened between the project, the GTZ Family Health Programme which coordinates the primary health care activities in the district and the village health workers (VHW), themselves. This was to develop a common system for reporting births and deaths and to train the VHW on the new mortality surveillance which we needed.

The VHW agreed to complete monthly report forms and were remunerated for this work. Where no VHW existed, a mortality reporter was recruited (a villager who could read and write) with the assistance of the village government. In the large villages, an assistant to the VHW was recruited.

The actual procedure is described in detail in Appendix A.

The mortality surveillance commenced in April and is continuing. The total number of reported deaths by month, with a peak in July and August, at the end of the long rains. A similar peak was reported in the Bagamoyo District as a whole (Mtango and Neuvians, 1986). This peak is due to malaria and pneumonia at a time when food is in short supply, just before the harvest. Figure 2 shows the distribution of deaths by age. More than half of all deaths occurred before six months. The reporting of births was done concurrently with the mortality surveillance. In the period of April to October there were 340 births. An estimate of the infant mortality rate (IMR) for the seven month period is 117 (40 deaths per 340 births). The national IMR from the 1988 census was 105.

The project staff conducted verbal autopsies (VA's) in order to establish cause specific mortality on the deaths which occurred in Aug-Oct. To date 32 VA's have been conducted and the forms are being examined by three physicians for review and determination of cause of death.

Reporting of births was conducted in a similar manner to the mortality surveillance. The total number of births reported from Apr - Oct was 48.

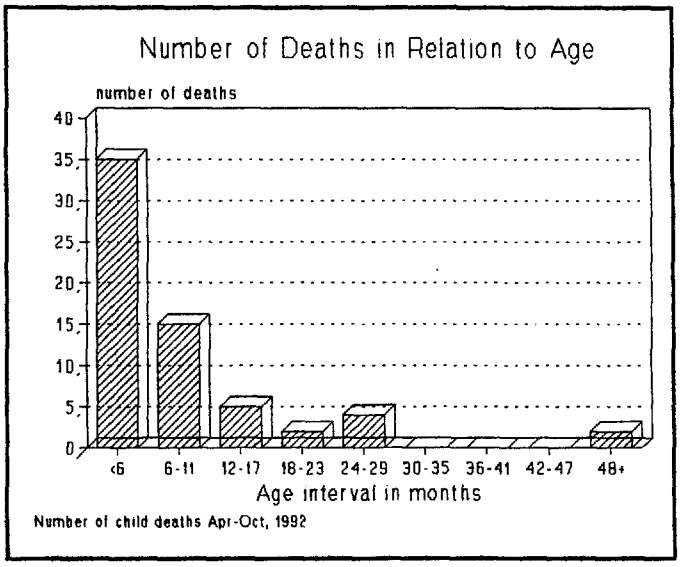


Figure 2
Age specific all cause mortality Bagamoyo District. Under 6 yrs old.

The actual mortality rate in children one year and under, measured in the 13 villages for the six month period April-October 1992 was 50 out of a base population of 1338, giving a six month percentage of 3.74%. This a low mortality rate in this

age group for African rural communities.

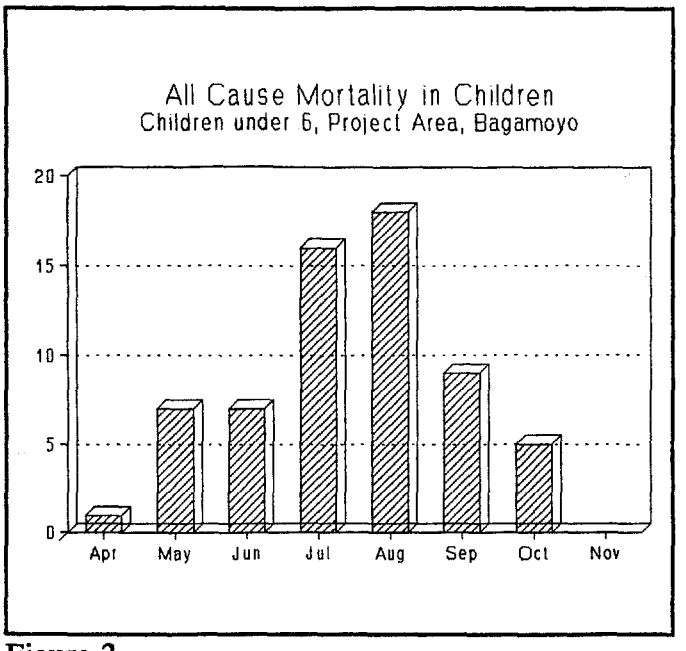


Figure 3
All cause mortality, Bagamoyo District. Under 6 yrs old.

Monitoring the Mosquito Populations (Full Report in Appendix B)

The BBNP is primarily a vector control operation and as such has a direct interest in the status of the vector mosquito population. The target species must be known, their behaviour understood and their role in the transmission of malaria established. This is because there are several species which potentially can transmit malaria in Tanzania. They have different habitats, feeding patterns and may or may not be sensitive to the control strategy. Furthermore, it is essential to know if they are susceptible to the insecticides being used.

There is a second aspect to this study, the actual transmission potential of the mosquitoes themselves. It is important to know the level of malaria infections occurring in the mosquito populations throughout the year and relate this to the infection rate in the people as well as the gametocyte rate in the children. The children are the reservoir of infection in the community and the real target of control. The concept of impregnated bed nets is to break contact between the mosquito population and the source of infective gametocytes which occur predominantly in children. Therefore information which enables us to measure the infection potential of the mosquitoes prior to the intervention will be a sensitive parameter to measure after the introduction of the IBN's in the community.

In order to achieve these objectives the project has established several lines of research. First it was necessary to develop an acceptable sampling method. The use of human night collections is the acceptable method for this. However it is arduous, labour intensive, requires a high level of supervision and is very subjective. It was decided to validate the method of Lines

(1990) which uses CDC miniature light traps to collect mosquitoes at night and compare this with human collections. The data in Appendix B show clearly that there is a relationship, and the traps even collect larger numbers of infected mosquitoes than human collectors sitting out all night. This information has been put into practice and the project is using exclusively the CDC light traps to monitor the mosquito populations and its level of infection. It will also be used in developing a more rational basis for measuring infection potential in the vector population than hitherto.

Mosquito densities have been measured fortnightly in 80 houses, ten per village. The measurements are done in the 7 core villages and Mlingotini. The latter was included to collect information from a sea shore locality. The houses were selected for their potential as good sampling sites and also as a representation of the housing typical for the particular village. Following selection and a discussion with the owner, an agreement was reached and the owner shown how to turn the trap on and off. Then the owner was given an untreated net for each bed in the sample room. The net is the property of the BBNP and can be removed it the owner decides to withdraw from the study. To date no person has done this. Once a fortnight, according to a strict timetable, traps are taken to each village and set up in the respective trap houses. In two villages, outdoor collections are also made. The traps are switched on at 18.00hrs and off at 06.00 the next day when project staff visit the houses to retrieve the traps. At this time, collectors also take alive any blood fed indoor resting mosquitoes they see for cytaxonomic identification.

The mosquitoes are taken to the lab, killed and sorted into vector and non vector species. A sample of the vector species is taken for sporozoite testing by ELISA to determine the infection rate. Identification at this stage is into two main groups, the *Anopheles gambiae* complex (which has at least three species in this area) and *An. funestus* (which also may involve two species here). The three members of the *gambiae* complex found in the coastal regions of Tanzania are *An. arabiensis* which favours drier conditions, is catholic in feeding habits and which may be inclined to feed outdoors; *An. merus* is a brackish water breeder with poorly understood feeding patterns; *An. gambiae* is the most important vector, and because of its indoor resting and feeding preferences is susceptible to insecticide control. Clearly it is vital to know what we are dealing with from month to month if we are going to assess the effectiveness of the intervention thoroughly. This requires exacting work and careful study. The project is fortunate in obtaining as a consultant Dr. Richard Hunt, who is one of the few experts in identification of this species group. For examination, each blood fed mosquito is anaesthetised and identified morphologically. Any members of the *gambiae* complex are placed individually in tubes and kept for approximately 12 hours during which time the ovaries mature. When they reach the proper stage, and there is a window of time here of about one hour, the mosquito is killed and the ovaries removed. They are placed in a preservative made from absolute alcohol (a reagent difficult to keep dry) and later sent to Dr. Hunt who prepares chromosome maps from the material for examination and identification. Dr. Hunt is training two project members in this technique. It is elaborate and time consuming, but essential to understand the dynamic interrelationships of these important anopheline species.

Analyses of the mosquito populations from the 8 villages have been carried out up to October. However sporozoite rates have only been determined until June. These data indicate that

the Group II and Group IV houses are comparable, they also show extraordinary high numbers of vector mosquitoes taken from the houses during June and July.

MEAN DENSITY OF MOSQUITOES COLLECTED PER HOUSE
(10 HOUSES PER VILLAGE USING CDC LIGHT TRAPS)

MONTH/SPECIES	*An. gambiae* complex	proportion infected	*An. funestus*	proportion infected
January (70 Houses)	1.7	18.9	.024	0
February (70)	3.3	7.0	0.30	9.5
March (70)	25.8	4.1	0.41	6.7
April (70)	33.7	4.7	0.28	4.2
May (80)	353	2.2	9.8	2.8
June (80)	183	6.4	15	3.4
July (80)	22.3	not done	17	not done
August (80)	4.6	"	11.2	"
September (80)	3.2	"	8.1	"
October (80)	3.3	"	4.2	"

* = in May an additional village, Mlingotini was added to the sampling to extend collections to a shoreline habitat.

This shows that there extremely high mosquito populations from March to July and that high proportions of these mosquitoes were infected. These data support the elevated parasite loads seen in the morbidity studies. They indicate the importance of monitoring the vector mosquito population throughout the year so that we understand the dynamic of transmission in the absence of any control procedures.

Insecticide Treatment and Susceptibility

In order to determine the actual coverage of insecticide on treated nets and its efficacy in killing mosquitoes which contact the treated surfaces, regular chemical and bioassay is carried out. The actual protocol for this is in Appendix B.

When nets are impregnated with permethrin at specified villages, a small number are marked and set aside for further examination. Each test net is given to a Committee member and asked to hang the net inside the house but not to use it. After two weeks portions of the material

were cut from each net and sent to Roussel Uclaf, U.K. for analysis to determine coverage of technical permethrin.

Initial studies done in Mlingotini showed erratic and sub optimum coverage (See Table). We decided that this was probably due to inaccuracies in measuring out insecticide doses and incorrect dipping techniques. We were able to improve measuring the concentrate by using the 'squeeze and pour' bottle made of high density polyethylene and provided by Roussel Uclaf, Zimbabwe. The apparatus is manufactured in Zimbabwe and is ideal for use in this work. With this bottle it is easy to measure the correct dosage needed for making the working suspension. Using this technique and having excess emulsion for the dipping (see Appendix B), we have achieved a better coverage of insecticide as shown in the Table herewith.

Bioassay was carried out on the experimental nets from Zinga village. The work entails using a lab bred strain of mosquitoes to ensure reproducability. This is a difficult task, but was mastered by project staff and now several strains of local mosquitoes are maintained in the laboratory in Bagamoyo. Bioassay was carried out on each experimental net using the standard WHO test kit. Initial tests using netting one month after impregnation showed 100% mortality in all of eight replicates using test *Anopheles funestus*.

APPENDICES

APPENDIX A: MALARIOMETRICS REPORT
APPENDIX A MALARIOMETRICS

The Malariometric component has two major objectives. First to monitor longitudinally cohorts of young children (6-36 months of age) in each of the core villages in order to define the parameters of transmission from the human standpoint to see if these will change measurably when IBN's are introduced. Secondly to set up means to determine all cause mortality in children under 6 in all the villages and to assess the proportion of these deaths which are related to malaria infection.

These are major activities which are extremely difficult to do. First, there is little agreement among experts which morbidity indices are due to malaria, and which will likely respond to a moderate level of transmission interruption. Secondly, one is working with communities where personal priorities are different from those of the scientists. For long term regular observations to be carried out children must attend clinics regularly. This means that the mothers will be inconvenienced considerably and must feel that there is value in attending.

In the measurement of mortality there are additional problems. First, a census had to be done on the whole study population. Following this it was shown that the number of children was small, probably too small to show a measurable change due to IBN use. Secondly, determining cause of death may be difficult. It is important not to distress the family in collecting the information, and only extremely sensitive personnel can be used in this work. Even then, there is some disagreement among authorities in the validity of the verbal post mortem as a means to determine cause of death.

The successes which project staff have achieved in this work are the results of careful, painstaking interactions with the communities. All members of the staff in the various components have contributed to the success. Much has changed from when we were referred to as "blood suckers" during the first school prevalence survey to the high level of trust and cooperation now existing between project staff and the communities.

A.1. MORBIDITY STUDIES:

A.1.1 Protocol for Morbidity Studies

Prepared by P. Lubega, Z. Premji and E. Chee.

The assessment of malaria morbidity would encompass a series of parameters to be measures to determine the impact of IBN's. Measurements will include: (1) parasite rates, (2) mean parasite densities of positive slides, (3) clinical disease rates defined as fever or fever plus parasitaemia and/or (4) severe clinical disease (fever plus high parasitaemia). Mean packed cell volume (PCV) and percent of children with splenomegaly will also be monitored. A sample for blood serology will also be taken on enrollment and at the final clinic meeting.

Study Population

A census of all children, 5 years of age and younger, residing in the 13 study villages will

form the sampling frame for this morbidity assessment. Only children from 6-36 months will be included in the study. A systematic sample will be drawn and attempts will be made to recruit these children into the study.

This method of selection should yield an unbiased sample of the entire population in this age group. Similar proportions from each village should be recruited initially. Age and sex distributions will be measured and adjustments made in the analysis as necessary. Drop out rates by village will be monitored, but an over-sample will be enrolled initially so that no new subjects will be added. It was decided that longitudinal studies assessing morbidity would be done only in the 7 core villages (group II and group IV), due to logistic reasons. It was suggested that 40 children be followed up in each village; the total cohort of children would be 280.

Study Power Samples were selected based on data from the Kondo clinic to measure a 30% reduction in blood film rates with 80% power and an alpha-level of 0.05. However, since multiple comparisons are proposed, bed net distribution is stratified by village, unequal control and intervention group sizes and to account for a proposed 15% drop out rate, a larger initial sample of 50 per village will be recruited.

Recruitment: Mothers of selected children will be asked to participate in two surveys, 1992 and 1993. An explanation of the tests and rationale for the study will be given by the recruiter. If the mother agrees to participate the child will be enrolled. Data to be collected are on FORM I.

Surveillance: Recruited children will be monitored twice, during the peak transmission periods of 1992 and 1993, beginning in June and extending for 20 week (10 visits). Each child will be examined fortnightly after the initial recruitment (visit 0).

Data collected: The mother will be questioned about febrile episodes and other conditions and any malaria treatment (Clq) received since the last visit. The child's axillary temperature will be taken. Quality control will be performed by staff on the measurements and thermometers monthly. If fever or high temperature is reported by the mother or a temp of 99.5 or higher is recorded, a thick film will be taken and read later that day. In addition VHW's will be instructed to take a thick film from any child fulfilling the above conditions or prior to the administration of chloroquine during the interval between visits.

Noncompliance: Children who have missed a visit will be followed up actively by project staff.

Data management: Survey forms will include the child's name, identification and visit numbers. A code will be used to monitor attendance. If the child is not seen a second code will be used to record the reason (temporarily away/permanently moved/died). Data will be entered as soon as possible, checked and verified. Discrepancies and errors will be checked with the field staff. Reports by visit and cumulative statistics for all visits will be produced to monitor progress and as another means for checking the data. Lab. results will be added to each visit record and checked as soon as they become available.

Data analysis: Several different indices and analyses will be used to study morbidity.

Rates of clinical disease:

(Comparison of children with nets to those without nets)

- o overall rate of fever (no. fevers/child-week)
- o overall rate of fever plus parasitaemia
- o overall rate of fever plus high parasitaemia
- o incidence of fever (first fevers/child week)
- o incidence of fever plus high parasitaemia
- o spleen rates and changes
- o scabies rates and changes
- o PCV profile and changes
- o antibody profiles to select antigens analyzed over time clinical disease experience.

Reinfection: (comparison of intervention and control populations)

- o media (mean) time to reinfection (clinical disease)
- o survival analysis (cox proportional hazard monitoring)

Possible confounders: village, season/year (for comparisons between survey I and survey II) age of child, sex and others?

Correction for malaria case definition: If a child is treated with chloroquine in the 2 weeks between visits but no slide is taken the child will be removed from the analysis until the next visit. I a child gets two episodes of fever plus parasitaemia within 2 weeks of each other, they will be counted as one episode to avoid confusion between reinfection and recrudescence.

Adjunct studies: Other studies will be done if resources and manpower are available.

- o Review of hospital records to monitor severe malaria
- o Localized prevalence studies of specific symptoms or clinical measures.
- o Examination of chloroquine consumption by village using VHW records, dispensary records, distribution records.

A.1.2 **Conduct of morbidity surveillance system**

Introduction:

A surveillance system for determining malaria morbidity in children in the 7 core villages of the project study site was established in May/June 1992. The system is a combination of both passive and active surveillance. Passive surveillance is carried out by the Village Health Worker (VHW) when sick children report to his work station in the village. Active surveillance is undertaken by the project team through fortnightly visits to the villages. By combining both systems it is expected that indicative parameters of malaria morbidity will be obtained in control

and intervention villages in order to assess the impact of Insecticide impregnated bednets (IBNs).

Both passive and active surveillance for malaria morbidity would have flaws when undertaken alone in the project study area given the existing infrastructure of health services, health facility capabilities and health services utilization. A passive surveillance system where a sick person reports to the health facility, in the case of the Bagamoyo rural area, the VHW post or the village dispensary assumes that these facilities exist, are functional and that the community has easy access to and uses them for the disease under surveillance. However this is not always the case. The dispensaries are few and people have to walk long distances to get to them. In the seven core study villages of the Yombo ward comprising of the villages of Matimbwa, Kongo, Yombo, Chasimba with a total population in 1991 of 6,228, and Zinga ward comprising of the villages of Zinga, Kerege and Mapinga with a total population in 1991 of 6,143 there are 3 dispensaries at Kerege, Zinga and Yombo. The facilities are inadequately staffed and equipped and the Essential Drug Kit issued every two months runs out within the first two weeks. Out of the seven village, six have functioning VHWs trained under the Gtz VHW programme that has been operating since 1984, however they face many problems in their work including unavailability of simple drugs, lack of remuneration, inadequate supervision and low morale.

Baseline social science research conducted by the project team reveals that the community do not think malaria is a serious problem, that it manifests as routine generally mild fevers that can be easily treated by bitter medicine obtained from the dispensary or VHW or bought from the local store. High fevers in general are due to spirits or other supernatural forces and when they occur in children, together with convulsions, they are amenable to treatment from the traditional healer and not the contemporary medical setup. Given this background, a passive surveillance system would fail to generate the true statistics of malaria morbidity.

Active surveillance would also be inadequate unless it was done at short intervals for example every two to seven days. Snow et al 1989 showed that monthly and weekly interviews had 19% and 74% sensitivity of detection of fever associated with malaria parasitemia, when compared to daily interviews. The logistics of active surveillance at short intervals are immense, yet surveillance at longer intervals also has its drawbacks. Cases fitting the malaria case definition used in the study (temperature greater than 99.5°F, positive malaria blood smear) would be missed if self-medication with chloroquine is common, especially in a semi immune population like the one in Bagamoyo, where manifestations of the disease are relatively mild. For the above reasons, a system combining active and passive surveillance that is logistically manageable by the project was designed.

Description of morbidity surveillance system

The protocol for the surveillance system has been described in more detail elsewhere (Chee et al, Proposed Morbidity Assessment, Bagamoyo Bednet Project, 9 March 1992). Active surveillance started in the first two weeks of June with recruitment of 346 children of age, 6 months to 3½ years from the seven core study villages. Surveillance is conducted by a field

team comprising of a medical assistant a public health nurse and on occasions a physician and one laboratory technician. The team visit each village at fortnightly intervals and interview mothers of the children in the cohort who assemble at the VHW post which is the CCM (ruling political party) office in the village. The surveillance system is popularly known as the "Special clinic"; to differentiate it from other existing clinics like the Young child clinic (YCC). At visit 0, mothers of children were interviewed regarding the well being of children in the previous two weeks and history of immunization with EPI vaccines. Weight, temperature and spleen size were measured, observations were made regarding the presence of active scabies. The following samples were taken; Packed Cell Volume (PCV) thick and thin malaria blood smears for malaria parasitological identification, and 100 microlitres of blood were blotted on filter paper for immunological assays. All children attending the clinic were given a curative dose of fansidar (500mg sulfadoxine and 25 mg pyrimethamine). Children less than one year were given ¼ tablet and those more than one year ½ tablet. Other ailments that the children had, for example scabies and conjunctivitis were treated.

At the end of the interviews the field team made field checks on the data forms and blood samples. Data forms and blood samples were transported to the project field offices in Bagamoyo town. Data forms were double checked prior to data entry. The thick and thin blood smears were stained with Giemsa and read by an experienced parasitologist. Blood samples for PCV were centrifuged and read immediately after arrival from the field. The blood specimens on filter paper were dried at 37°C overnight and stored in a desiccator with calcium sulphate until immune assays will be performed.

The active surveillance has progressed well and completed the ten clinic studies with little problem. From time to time attendance fell off (see Table in Report body), but this was offset by active follow up where necessary. A play acted by a group from the art school in Bagamoyo emphasizing the importance of regular attendance of the special clinic and highlighting various aspects of malaria transmission and disease was staged. In addition, children were specifically examined for side effects of fansidar. At visit 2 (week 4) a mandatory thick blood smear was taken from all children attending the clinic. The special clinic has incorporated activities of the YCC, for example monthly weighing and nutrition advice, to reduce the inconvenience to the mother and child of attending two different clinics.

In addition to what has been described, the morbidity assessment involves a passive surveillance system. Each working day (Monday to Friday) from 8 am to 12 noon the VHW or an assistant who has been trained by the project attends to children in the cohort who may have complaints in the interval between clinics. The VHWs have been instructed to record the complaints, take the temperature and take thick blood smear if it is indicated due to any of the following reasons; i) temperature greater than 99.5° F, ii) prior to presumptive treatment of malaria with chloroquine. In addition, the VHW have been instructed to take not more than one specimen for each two week period, to avoid constant pricking of children especially when results from the previous specimen may not be available. The VHW has a card for each child where all this information is recorded. Information from the VHW card is incorporated into the child's data form at the fortnightly surveys. VHW are paid 1,500-2,000/- ($US 5-6.6) per

month for this activity in addition to helping the project team on the clinic days. The project has made a provision of the following drugs: panadol, chloroquine tablets, antibiotic eye ointment and will soon provide Oral Rehydration Salts and Benzyl Benzoate Emulsion (BBE), to encourage mothers to report when children are ill. In addition the project team has more specialized drugs like antibiotic syrups that are prescribed on the special clinic days.

Training of VHWs and VHW Assistants

One VHW and one VHW assistant from each village were trained to measure temperature, take thick blood smear to enable them to conduct passive surveillance and to help the project team on the special clinic days. Prior to training, all seven villages had at least one VHW except for Yombo which had none. One VHW assistant was selected in the villages of Matimbwa, Kongo, Chasimba, Zinga and Kerege and two assistants were selected in Yombo. The criteria for selection was that the person had to be a resident of the village, able to read and write and if the VHW was male, then a female was selected. In the case for Yombo, the second VHW assistant is male. The selection was done by the village chairman in consultation with village elders and the VHW.

VHWs and assistants attended a one day seminar. They were given practical demonstrations on measuring temperature with an electronic thermometer (Becton and Dickinson) and made several practices themselves, under supervision of the project staff. In addition, the village team were taught to take thick blood smears and to record the measurements on a form that was similar to the VHW form for measurements and treatment. At the end of the seminar, all participants were able to reliably measure temperature and label glass slides well. The VHW assistants still had difficulty in making good thick blood smears unlike the VHWs who due to their prior experience in the health field mastered the technique quickly. Participants returned to their villages with kits with the necessary items to practice what they had learned. The same kits contain the necessary items for conducting passive surveillance.

Reinforcement of the training was done one week after the seminar through individual sessions with each participant in their own village and has been on-going during the days of the clinics such that the VHWs and assistants now routinely measure temperature and take thick smears under supervision of project staff.

SUMMARY OF RECRUITMENT STATISTICS
Children 6-40 months old enrolled in special clinics

Village	mean weight KG	mean PCV percent	spleen positivity	% febrile >99.5F	% pos malaria
Matimbwa	9.0	29.6	65.9	29.8	74.5
Kongo	9.9	29.8	74	3.9	88.2
Yombo	9.0	29.5	64.9	4.9	92.7
Chasimba	9.7	28.7	71.2	8.8	86.0
Zinga	11.0	28.9	42.6	12.8	89.1
Kerege	10.4	30.0	62.5	5.0	87.5
Mapinga	9.6	29.8	41.5	5.5	74.5

Preparation for Survey I (the present study) was started in April. The design and implementation was based on a preliminary study carried out for three months (Nov1991-Jan1992) in Kondo Village. A total of 346 children were selected from the child census carried out in March The clinics started on 2-6-92 and finished 29-10-92. During this 5 month follow up clinics were held every fortnight. Two children died during the period, from Chasimba and Matimbwa. The Matimbwa child had acute respiratory failure probably due to status asthmaticus. The Chasimba child had fever and convulsions, however the young mother did not take the child to the VHW on the advice of the elders who prescribe traditional healers for this condition. There is strong cultural belief that such cases should not seek hospital treatment.

TABLE SHOWING CLINIC ATTENDANCE RATE.
(Column 1 = recruitment)

Village	% attendance at visit 1-10										
Chasimba	57	97	90	82	78	70	78	80	82	78	96
Yombo	41	90	92	86	74	74	86	68	78	72	80
Zinga	47	90	90	70	78	77	68	68	68	68	96
Kerege	40	98	97	90	76	82	97	97	79	88	98
Mapinga	55	90	81	76	88	75	74	76	74	62	90
Kongo	51	96	94	88	86	72	84	72	58	60	88
Matimbwa	47	98	96	88	86	78	82	70	58	42	92

NB Column 1 represents the actual number recruited at visit 0

In order to boost attendance the following activities were carried out:

1. Plays (drama) performed by actors from the Chuo Cha Sanaa (Bagamoyo Arts Institute). These had health messages particularly about malaria. Plays were performed on visits 2 and 6. Attendance increased after each play.

2. A special effort was made to get people to attend visit 10. Letters were sent to all volunteers through the VHW requesting attendance.
3. Provision of medication for conditions other than malaria.

4. Motivation campaigns through the village government, personal letters to the households, visits to individual families which had poor attendance records.

5. Prior to visit 6 a seminar for the VHW was held to reinforce and motivate them to increase their efficiency.

Reasons for poor attendance:

1. During the rice harvest time most mothers went to their fields, hence could not come.

2. Occasionally due to conflicting religious or other ceremonies or celebrations the turnout was poor. In such cases follow up was done the next day.

3. There was some disappointment because some mothers thought that participating in the clinics would entitle them to obtain IBN's.

4. The society represented in these communities is male orientated, hence the motivation campaign should also involve the fathers, as was done prior to the 10th visit.

On the 10th visit several activities took place that were not routine and which were very gratifying to the teams. First the turnout was extremely high indicating that people remained in the area and that they could be motivated to attend with special effort. Secondly there was a strong positive response from the mothers. Mothers composed and sang songs in tribute to the project staff and village team for having conducted the clinics successfully and expressed gratitude on the improved health status of the children. In Kongo village, a play was performed by the parents and children highlighting the problems of malaria.
In most villages a letter or poem was given to the project staff. In addition in the Group IV villages lunch was prepared by the mothers and served to the project staff. The project reciprocated by providing orange juice and doughnuts for the children.

A.1.3 Morbidity Analyses

Analysis of the data is proceeding and will form the basis of several publications. However, we have performed some analysis on the recruitment data (Time 0) which indicate the

level of malaria infection in the children prior to any intervention. Blood films were made from all children recruited and a summary of counts of trophozoites is given in the table below. The intensity of malaria in this community is extremely high, higher than most published information to date. The significance of this and the interrelationships between intensity of infection and mosquito inoculation rates is to be investigated.

TABLE TO SHOW SEVERE MALARIA
(i.e. parasitemia more than 5,000 trophs per μl blood) in core villages and proportion of children with fever.

Village	No +ve/ tested	Parasite Density as trophozoites per μl of blood.				
Name	00/00	1-1,000	1,001-5,000	5,001-10,000	10,001-40,000	>40,000
Mapinga	42/55	16	13	0	7	5
Kerege	35/40	21	8	0	6	0
Zinga	41/47	14	11	4	4	8
Matimbwa	35/47	4	17	1	4	9
Kongo	45/51	3	19	8	10	5
Chasimba	49/57	14	19	0	5	11
Yombo	38/41	11	6	4	11	6

This work requires very careful investigation as it means that there are significant issues regarding immune response which we are observing. It also throws some doubt on the criterion for severe malaria which is used internationally, a parasite count of 5,000 per μl or above.

Cross tabular analyses between these malaria measurements and symptoms measured will be done on the recruitment data because they contain important information about the state of malaria in the community and may have relevance in the studies of severe malaria and child mortality.

A.1.4. Observations based on preliminary analysis

The malaria indicators observed at the time of recruitment represent an important measurement of the status of malaria in the population of children. Numerous conditions were examined and detailed analysis will take some time, however some conclusions can be made from the data presented here.

- First, malaria is not necessarily a typical febrile disease in this community. There is no correlation between the numbers of children with temperature and those

parasitaemic. However children with high parasite counts are more likely to be febrile.

- Children with fever were more likely to have a low PCV and an enlarged spleen which suggests strong association between malaria and anaemia and malaria and splenomegaly.

- If the malaria positivity is broken down into age groups of 12 months, there does not appear to be any real differences in the proportion infected. All four age groups have an infection rate of approximately 85%.

Clearly malaria is a major cause of anaemia, although 102 of the children who had heavy parasitaemia were not anaemic. The extreme complexity of malaria is evident in these descriptions. The most vulnerable age group for malaria disease in this study group is 6-12 months because maternal antibodies have waned by this time and the children become infected rapidly.

A series of questions were asked of the mothers when children were enrolled and it is interesting to compare the responses with the level of parasitaemia. These responses are subjective, however positive correlations were observed with:

- Any illness in past 2 weeks, $P < 0.05$
- fever in past 2 weeks $P < 0.05$

no correlations were seen with lack of appetite, cough, diarrhoea, body twitching or convulsions.

A series of observations were tested by cross correlations and the following were observed to correlate with **parasitaemia**:-

age. $P < 0.05$; **PCV** < 0.05; **temp** < 0.05;

correlation with **temperature** (> 99.5F)

troph count $P < 0.05$; **PCV** < 0.05; **Spleen** < 0.05

The study of the morbidity of malaria in this community and in the population which attended the clinic in Survey I will go far in helping us to interpret the effects of this infection in communities living in holoendemic regions. It has also laid the basis for us to make comparisons over time in the children in order to detect any changes due to the intervention when it commences.

A.2. PROTOCOL FOR MORTALITY SURVEILLANCE AND REPORTING OF BIRTHS

The measurement of mortality in children under 6 years is one of the parameters that will

be undertaken by the Bagamoyo Bed Project in order to assess the impact of insecticide impregnated bed nets (IBNs). This protocol is more detailed write up of the one prepared by E. Chee, Z. Premji and P. Lubega in January 1992, and focuses on the data collection system and data forms, without emphasis on data analysis and statistical issue.

The target population for the mortality surveillance comprises of all children under 6 years who were enumerated in the child census of March 1992. A yearly re-enumeration will be done to establish the denominator for the year. In addition, the census will be updated regularly as births are reported.

A.2.1 Requirements for mortality surveillance and reporting of births

1) Child census 1992 database
2) Child census 1992 dataform
3) Monthly report form for deaths
4) Verbal autopsy form
5) Code of death
6) Mortality data logbook and database
7) Monthly report form for births
8) Child census update file

Reporting of deaths

All deaths that occur in children under 6 years in the 13 villages of the project study area will be recorded by the village health worker (VHW) in the following manner. The VHW will inquire about deaths in the village from the Balozis, once every fortnight. Once a death is identified, the VHW will interview the mother or guardian of the child and fill the monthly report form for deaths (appendix). All child deaths that occur in the study area, including those of children who are not residents will be reported to avoid omission.

At the beginning of each month, the project mortality supervisor (medical assistant) will collect the death reports of the previous month from all villages and ensure the forms have been filled correctly, especially as regards the Balozi name, which is the key variable by which children are listed and filed for each village. The supervisor will compute totals of deaths of only those children who are residents of the study area, and fill the summary data sheet for the month. All deaths will be traced from either the child census 1992 database, or the birth reports and child census update records in the case of children born after the census enumeration in March 1992, for purposes of child identification and verification of the information on the death report form. In the event that a death cannot be traced to a child on record, a field visit will be made to determine which of the following conditions apply:

i) the child was not enumerated in the census for a number of reasons for example, he/she was temporarily away from the village, or was omitted by the enumerators

ii) the child whose family resides in the study area was born outside the study area after the census enumeration

iii) the family migrated to the study area after the enumeration exercise.

If any of the above reasons apply, the child will be added to the census update records by filling the child census 1992 data form. In the case of iii) above, the date of migration into the study area should be recorded.

Verbal autopsy: A verbal autopsy (VA) will be performed by the medical assistant on all deaths of children who are residents of the study area in the period two to four weeks following death. The VA forms will be copied and distributed at regular intervals to three physicians to review and determine the cause of death based on a code for cause of death (appendix). The original VA form will be filed for reference.

Mortality logbook and database: The listed information pertaining to each death will be entered into a log book and thereafter into a computer database.

Checking of death reports: It is expected that the VHW will get information regarding deaths quite easily since death is a dramatic event. However, a random system of checking under reporting by the VHW will be designed. In addition, at the time on the annual recensus, the degree of under reporting of deaths will be determined.

The information pertaining to each death will be checked by the medical assistant at the time of collection of the reports and if there are uncertainties, a field visit will be made for verification. In addition, at the same time of conducting the VA, the relevant information will be counter checked.

When data are transferred from data forms to the logbook and into the computer, checking by another person will be performed.

A.2.2 Conduct of the child census 1992

A census of children 0-6 years was conducted in all 13 villages of the study area from 5 to 21 March 1992. The objective of the census was to obtain the denominator for determining mortality in children 6 years and under in all 13 villages and secondly, to obtain a sampling frame from which a cohort of children would be selected from the 7 core villages of the study area, for malaria morbidity surveillance.

The census was conducted by 7 enumerators, comprising of 2 malariometrics project staff who were in charge of advance planning, village notification and field logistics, 2 university of Dar es Salaam graduate students in the department of demography who were the overall supervisors and 3 form four leavers who were on holidays awaiting results of final exams. In

preparation for field work, the census data form was pre-tested, guidelines were written for conducting the census (appendix II) the enumerators had a training session on conducting the census. Village maps drawn during the geographical reconnaissance and Balozi (ten cell leader) lists compiled at the time of the general census in July 1991 were used for planning and logistics. Several days prior to enumeration the village chairman, Balozis and village health worker (VHW) were notified verbally and by letter about the objectives of the census and the appointed date of the enumeration. Balozis were told to inform mothers with children 0 - 6 years to stay close to the home until they had been enumerated, and to have ready the children cards for the under five clinic. On the day of enumeration, team members were guided from one house to another by the Balozi. Eligible children were registered eligible children. In some Ubalozis, where there are several houses that are far from each other the mothers were told to assemble at the house of the Balozi to ease the work of enumeration. In general, one village was covered in one day, except for the large villages like Kiromo, Yombo and Chasimba.

At the end of the enumeration exercise, data forms were double checked, corrected, coded and a unique 8 digit number was allocated to each child. Attempts were made to correct identifiable Errors in the enumeration exercise for example omission of some Balozis, by making field checks and re-enumerations. Totals of children were computed by calculator. A computer database was created and data entry was done, commencing on 13 April and ending on 5 June. Significant variables of the data, child's name, child's census number, sex, date of birth, mother's name, Balozi and village codes were checked and corrected.

The total number of children 0 - 6 years for the child census is 2,947 and the number of children 0 - 5 years in the general census 1991 is 3,644. In addition to what has already been mentioned, one cause for the low count in the child census is the inaccuracy in the cutoff date of birth. Some enumerators did not include children born in 1986 in some villages because the supervisors had told them to include children born in 1987 onwards. The accurate cut off date was later confirmed to be 1/March/1986. Hence there is a proportion of children older than 5 years who were omitted. It is not easy to quantitate this error because all enumerators listed children born in 1986 in several of the village. In an attempt to validate the child census every 10th data sheet of the child census was corroborated with the general census. Of the sampled sheets, 75% of the heads of households were listed in the general census. The 25% discrepancy may be attributed to in/out migration or the definition of head of household which may vary depending on which member of the household is interviewed.

Guidelines for conducting child census 1992

1. Introduce yourself to the Balozi

2. Explain to the Balozi the purpose of the census and request him/her to allow you to interview mothers with children whose age is 6 years or below.

3. Use a pencil to fill the data form. The writing should be legible.

4. Fill in information number 1 to 6 on data form.

5. Leave blank question No. 7.

6. Request to see the YCC card of each child.

7. Fill questions 8, 9, 11, 12, 13, 15 and 16, following the information written on the card.

8. Leave blank question number 10.

9. For those children who do not have a YCC card, mother should be interviewed regarding questions 8, 9, 11, 12, 13, 15 and 16.

10. Regarding date of birth, if mother cannot remember the day and month, record a major events that took place at the time of birth of the child or write 99 in the space for day and month.

11. If the birth weight is not available, write 99 in the space for kg and 999 in the space for gm.

12. At the end of the interview, thank the mother.

Reporting of births The VHW will record all births that occur in the 13 villages of the project study area on the monthly report form for births (appendix). At the beginning of each month a medical assistant will collect all the birth reports and check that the forms are filled correctly. The medical assistant will compute totals of births to only those mothers who are residents of the study area and enter the totals in the monthly summary data sheet.

Child census update : The purpose of the child census update will be to keep track of the number of children in the target population on a regular basis, as births occur. This will facilitate the annual recensus exercise and update the sampling frame for the morbidity survey. Field visits for the child census update will be done on a three monthly basis, the child census data form will be filled for each of the listed categories of children and the forms filed in the child census update file. Categories of children to be included in the child census update:

1) children born to mothers who are residents of the study area and whose births were reported by the VHW

2) children born outside the study area to mothers who are residents of the study area (it is a common cultural practice in the project study area for mothers to return to their parents for the birth of a child)

3) children discovered to be residents of the study are through death reports but are not in the child census database or the child census update file

Checking birth reports: The information on births reported by the VHW will be checked by the medical assistant at the time of collecting the reports to ensure that there are no errors in the date of birth, names (the commonly followed naming system is such that the last name of the child is the first name of the father) and other important characteristics like the Balozi name. At the time of the census update, the mothers of children born in the previous three months will be interviewed by the medical assistant who will recheck the information reported by the VHW and register the birth weight. In particular, the child name will be scrutinized, because of the practice of naming the child after 40 days of birth.

Under reporting of births will be checked regularly by comparing the VHW reports with those of the traditional birth attendant (TBA).

A.2.3 Results to date:

The project is monitoring all-cause mortality and disease specific mortality in children under 6 as a parameter to assess the impact of IBN's. As a part of this process, births are being reported as well.

The mortality study is based on a child census carried out by the project staff in March. A summary of the census information is in the Table below.

Initially a seminar was convened between the project, the GTZ Family Health Programme which coordinates the primary health care activities in the district and the village health workers (VHW), themselves. This was to develop a common system for reporting births and deaths and to train the VHW on the new mortality surveillance which we needed.

The VHW agreed to complete monthly report forms and were remunerated for this work. Where no VHW existed, a mortality reporter was recruited (a villager who could read and write) with the assistance of the village government. In the large villages, an assistant to the VHW was recruited.

TABLE SHOWING AGE AND SEX DISTRIBUTION OF UNDER SIX YEAR OLD CHILDREN IN PROJECT AREA

Village	infants	ratio	Year of birth						
		M:F	92	91	90	89	88	87	86
Buma	136	1.2	6	16	27	27	21	34	5
Chasimba	283	0.8	18	39	44	43	61	52	28
Kerege	278	0.9	9	43	51	52	50	49	12
Kiromo	265	0.9	10	63	47	42	46	45	10
Kondo	165	1.2	7	32	32	40	32	21	1
Kongo	218	1.0	10	44	42	33	42	27	20
Mapinga	341	1.4	16	74	55	71	53	33	15
Mataya	104	1.0	2	25	18	23	9	16	9
Matimbwa	244	1.0	11	46	52	42	32	44	17
Mlingotini	238	0.9	6	50	43	58	29	43	9
Pande	175	1.1	11	29	29	30	37	27	12
Yombo	214	1.0	9	39	31	35	45	39	16
Zinga	286	1.3	18	57	51	58	46	46	10

NB: 30 respondents gave no date of birth and are omitted from the body of the table. Subsequent house visits identified a number of children not yet included in this table.
NB: Ratio of males to females is calculated with the number of females as unity.

The mortality surveillance commenced in April and is continuing. The total number of deaths reported from April- October was 63. Figures showing the all cause mortality (age distribution of reported deaths in the district) and the distribution by month, with a peak in July and August, at the end of the long rains are seen in the body of the report.

APPENDIX B: ENTOMOLOGY REPORT
APPENDIX B ANNUAL REPORT/ENTOMOLOGY

This report will cover the following activities of the entomology component from November 1991 to November 1992:

1. Preparations for surveillance and validation studies (November and December 1991)
2. Commencement of surveillance and validation studies (January 1992)
3. Surveillance study (January 1992 to Present)
4. Validation study #1 (January to May 1992)
5. Review of PSC91 study (February to April 1992)
6. Surveillance of gambiae complex by polytene chromosome analysis (June 1992 to Present)
7. Surveillance of vector parity (June 1992 to Present)
8. Establishment of insectary (August 1992)
9. Validation study #2 (September to November 1992)
10. House risk factor study for high densities of vectors (September to November 1992)
11. Bioassay in Kerege village (November 1992)
12. Data management
13. Protocol for treatment of nets.

B.1. Preparations for surveillance and validation studies

In November of 1991 preparations were underway for surveillance and validation studies which would help us to monitor the vector population for infection rates and densities, as well as to determine whether or not CDC mosquito light traps were a suitable substitute for night biting collections (the standard method for collecting vectors for malaria research).

The following activities were performed during this period with the target of January to begin the actual studies:

a) Training of permanent staff to handle equipment and perform duties in the field and lab
b) Testing of equipment in the field
c) Preparing study houses by explaining activities to owners and providing them with untreated bednets
d) Selection and training of village staff to assist us in performing activities in their respective villages
e) Preparation of lab and field data sheets for recording of data
f) Development of computer data base for storage and analysis of all information

B.2. Commencement of surveillance and validation studies

The surveillance and validation studies began on 20 January 1992. There were no initial problems as are often encountered when beginning a major activity for the first time. We did observe, however, that many of the study house owners were apprehensive about handling the light traps to the extent that we wanted them to learn to turn them on and off. This was remedied by project staff demonstrating how to connect and disconnect the trap wires as well as closing the trap collection net. Eventually, almost each house was able to learn this task with the exception of 2 or 3 who still insist that project staff connect the trap at dusk and disconnect it at dawn.

B.3. Surveillance study

The surveillance study using CDC miniature light traps was initially targeted for seven villages (those of Group II Kerege, Mapinga, Zinga and Group IV Chasimba, Kongo, Matimbwa, Yombo), however, an eighth village (coastal Mlingotini of Group I) was added in April to increase the geographic diversity of the study area. In each village there are 10 houses the inhabitants of which are all sleeping under untreated bednets. Additionally, each village (house) is visited once every fortnight.

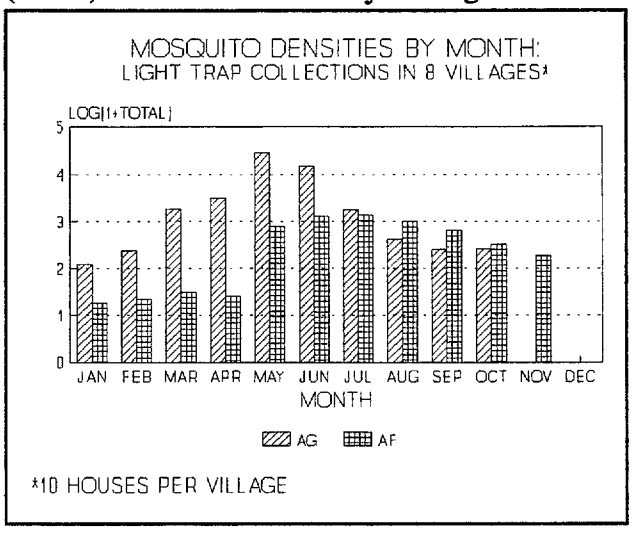


Figure 4 Seasonal fluctuation in anopheline mosquito numbers collected in CDC light traps in houses. Bagamoyo Project Area

Briefly, a CDC miniature light trap is hung beside a bed at a distance of about 0.5m, and about 1.0m from the ground, just before dusk. At 1800 hours, the trap is connected to a 6V rechargeable battery and operates until dawn at 0600 hours when the trap is disconnected and the collection bag closed. This is generally done by the owners of the respective houses and followed up by project staff with random, unannounced checks at 1900 to 2000 hours. In their absence the project staff perform all of these activities with assistance from village aids. To date we have experienced less than 10 occasions when a house was found completely locked, at which time we used an adjacent house previously selected as a back up.

The specimens collected in the traps are sorted, processed and recorded in the lab. The major parameters we are monitoring are sporozoite rate, feeding preferences/habits and household/village density of vector anophelines. Several graphs and tables which accompany this report demonstrate that the vector populations fluctuate in direct proportion to rainfall and temperature throughout the year. Peaks in the sporozoite rate usually follow peaks in vector densities as conditions become favorable for mosquito survival. It appears that A. gambiae sl.

is the dominant vector from January to July, and A. funestus is dominant from August to October. Additionally, the two main study groups II and IV do not appear to be significantly different in sporozoite rates, in vector density per house, or in vector complex (i.e., gambiae and funestus) proportions. This is important since one aspect of the project is to compare a control group (Group IV) to an intervention group (Group II). Graphs for the surveillance study are given below.

The interpretation of these data lead to the following conclusions. First, there is little real difference in the mosquito densities between the two groups of core villages, and that the seasonal fluctuations which occur in one group follow similarly in the other. Secondly, it is interesting to note that as the season progresses, the species which breeds in permanent water, *Anopheles funestus* predominates.

We have collected very large numbers of mosquitoes in these studies, indicative of a heavy transmission potential in the area. When the sporozoite rates are considered (see main report) the severity of this problem can be appreciated.

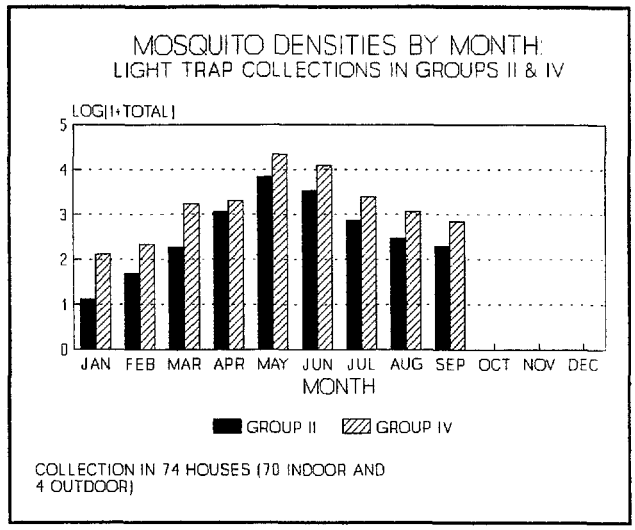


Figure 5 Vector mosquito collections made by light trap in Bagamoyo Project Area. Comparison between collections in Group II and Group IV houses.

B. 4. Validation study #1

This study was begun concurrently with the surveillance study, and ended by the first week of May 1992. Its objective was to assess whether or not light traps are suitable substitutes for night biting collections as a tool to calculate such parameters as inoculation rates.

Two of the seven core study villages were selected to carry out this study, one in Group II and one in Group IV. In each of these villages six of the 10 study houses were selected based on their proximity to a predetermined epicenter used as the main base on the night of collection. Also, two outdoor stations were selected at distances of no more than 50m from two houses being used for indoor collections. The intent here was to provide a comparison between indoor and outdoor collections in and around one house. These collections were performed on consecutive nights in the two villages, with the provision that the night a particular type of collection was done be changed from one fortnight to the next; i.e., light traps preceding and proceeding night biting collections in a consistent and routine manner.

Briefly, on the night of a biting collection pairs of collectors would disperse to the eight locations throughout the village. At 1830 hours they would begin collecting any mosquitoes that came to feed on them. At 1900 hours they would stop and all walk back to the main station where they would hand over their cages to the supervisor who would immediately give them new ones. After having coffee or tea they would return to their respective locations and at 1930 they would begin again and collect for another 30 minutes. This procedure was repeated throughout

the night until dawn at 0600 hours. The previous or following night light traps were placed in these houses (indoor and outdoor) according to the routine established for surveillance.

Analysis of the data indicate that whereas the total number of mosquitoes captured by either sampling method varied by collection method, he relationship between light trap and night biting catches was independent of mosquito density. Confounding variable such as order of sampling method and number of people present at the time of the catch did not affect the relationship between the catch methods. Slight differences in the relative sampling efficiency was detected between villages, however these differences disappeared once the variation in number of mosquitoes collected over time was removed.

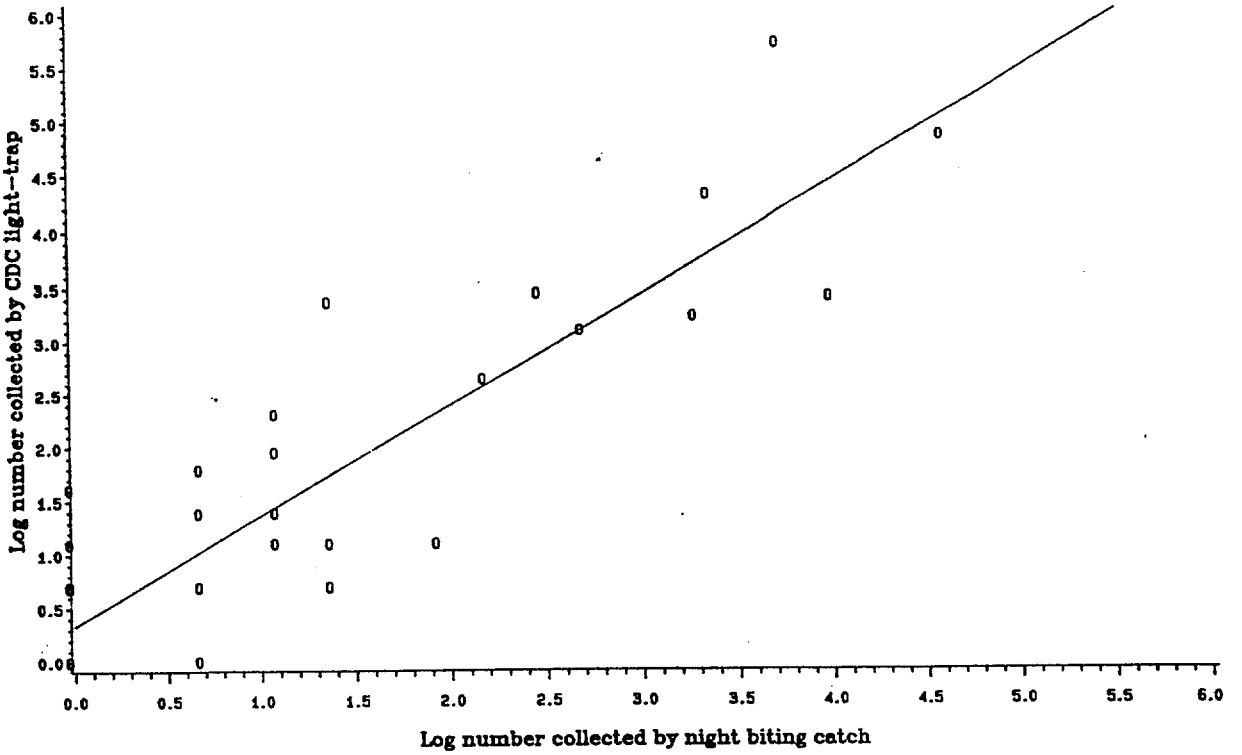
TABLE COMPARING ANOPHELINE MOSQUITO COLLECTIONS MADE BY NIGHT BITING CATCHES AND CDC MINIATURE LIGHT TRAPS IN TWO VILLAGES OVER THE PERIOD MARCH- JUNE 1992.

		CDC Light	trap	night	biting	Village %
Village	species	Total tested	Percent pos.	Total tested	Percent pos.	
Kerege	A.G (sl)	978	4.3	283	2.5	3.9
Kerege	A.F	5	20	0	0	
Matimbwa	A.G. (sl)	1846	4.6	395	1.8	4.1
Matimbwa	A.F.	18	5.7	4	0	
Total		2847	4.5	682	2.1	

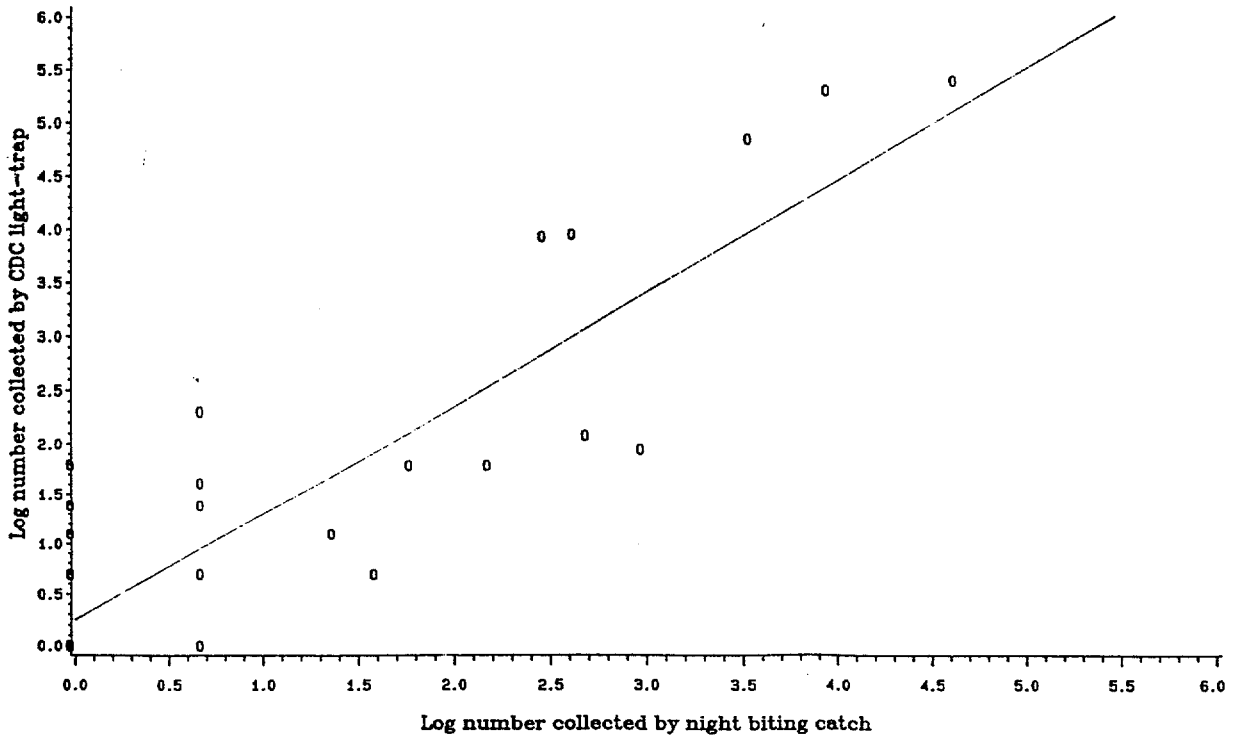
Two conclusions can be drawn from the following two graphs and table included here. First, members of the *Anopheles gambiae* complex can be sampled effectively using light traps. Secondly, light traps appear to be a more sensitive means to capture sporozoite infected mosquitoes. Finally, further work needs to be done to see if *An. funestus* and other members of the complex will respond similarly. Night biting collections cannot be eliminated from the sampling procedures because mosquitoes may respond differently in various seasons, however they are effective and valid for the use we require.

The above material has been prepared for publication.

Number of *Anopheles gambiae* caught in light–traps compared with those caught by night biting catch at the village of Matimbwa



Number of *Anopheles gambiae* caught in light–traps compared with those caught by night biting catch at the village of Kerege



B. 5. Review of Pyrethrum Spray Collection: 91 study

Analysis of the data collected for this study was begun in February and completed in April with the reading of polytene chromosomes. The analysis focused on the following:

a) Sporozoite rates in the vector population
b) Feeding behavior/preferences of the vector population
c) Indoor as opposed to outdoor resting behavior of the vector population
d) Species composition of the gambiae complex

The analysis of these data were incorporated into a larger review of data collected in a survey of school children as well as questionnaires completed in all the 13 study villages. The paper is in draft stage as of now.

B. 6. Surveillance of gambiae complex by polytene chromosome analysis

In order to monitor the various species of the A. gambiae complex in the core study area a study was designed which would permit their proper surveillance throughout the year. The impetus for this was data gathered by Dr. Richard Hunt in outdoor collections from one of the study villages, in which he found several *A. arabiensis*. Given that these tend to be outdoor feeding mosquitoes the need to have information on them over time was made obvious, particularly since bednets target indoor feeding mosquitoes.

B. 7. Surveillance of vector parity

This study was introduced in June of 1992 in order to provide information on the relative age of the vectors in the study area. The reason we want to have an idea of their relative age is because from past studies it is known that the older a mosquito is the more likely it is to have had the chance to become infective: age is directly proportional to number of gonotrophic cycles. In other words, if a mosquito is not parous, meaning that its ovaries have never developed, the inference is that it is not old enough to have taken a blood meal and thus become infected.

Generally, one expects to find larger numbers of parous mosquitoes (mosquitoes which have fed and laid eggs already) during seasons of high survival rate; i.e., just after the long and short rains when temperatures are favorable, and clean, undisturbed breeding sites are abundant.

This study provides another marker to the others being used to monitor the mosquito population over time, and will continue for the duration of the project. Plotted on a graph we should expect it to correlate directly with sporozoite rate, but not densities.

B. 8. Establishment of insectary

In August of 1992 an insectary was established at the office in Bagamoyo. The reasons

for setting one up are as follows:

a) The need for vectors for chromosome studies
b) The need for species specific colonies of vectors for various studies such as bioassays
c) The need for a favorable environment to rear specimens collected during larval surveys
d) The need for vectors for other various studies which have yet been planned.

Initially, there were problems due to dramatic climatic changes within the insectary, particularly at night when the temperature dropped below 20C and the humidity to less than 50%. Once these problems were rectified the colonies began to grow. Currently we have a *gambiae* sl. colony and are trying to develop species specific ones, including *gambiae* ss., *arabiensis*, and perhaps *merus*. *Anopheles funestus* did not do well as we were barely able to get one F1 generation: we have since abandoned rearing this species.

B. 9. Validation study #2

A second round of the validation study was begun in August of 1992 in view of the analysis of data from Validation study #1 which demonstrated that the two study villages selected, Kerege and Matimbwa, were too different to afford easy comparison. It was decided, therefore, that another series of collections should be done with an increased sample size which included the two original villages, but also added two others, Kongo and Zinga. The sampling for this second round will cease at the end of November. The format for collecting data was the same as the one used for Validation study #1.

B. 10. House risk factors for having high densities of vectors

A study was designed in order to investigate the problem associated with neighboring or nearby houses having vastly different sizes of vector populations entering them. Some of the traditional views such as proximity to breeding site and house construction were investigated, but with the intention of looking at them in a detailed and systematic way to see if there are any correlations which may have been previously overlooked. For example, the number of large openings in walls, eaves, vegetation around the compound and proximity to breeding sites as opposed to a thatch roof and proximity to breeding sites only. To get this data questionnaires describing the study houses along with detailed larval surveys were done.

A copy of the protocol is found in Appendix 1, and a copy of the questionnaire is found in Appendix 4. The data collection is currently in its final stages. Analysis will examine correlations, or the lack of them, between different characteristics.

B. 11. Bioassay in Kerege village

A bioassay to test the residual effect of permethrin treated nets on wild collected funestus or laboratory reared, species specific, gambiae complex mosquitoes in Kerege village was

performed, three weeks post impregnation. A total of three nets were tested for residual effect by mosquito exposure and tests of cuttings for quantity of insecticide per area squared (mg/sq-m). This test will be repeated at intervals prescribed in the protocol.

TABLE SHOWING DISTRIBUTION OF PERMETHRIN ON NETS AND TOXICITY TO *Anopheles funestus* using standard WHO bioassay kit (30 min exposure) Analysis carried out 30 days post impregnation.

net ID	top mg/m^2	side 1 mg/m^2	side 2 mg/m^2	Bioassay Dead/Tested	Control Dead/tested
S85	364	163	235	NOT DONE	NOT DONE
S90	248	280	311	86/86 (10 Reps)	2/19
S105	188	309	211	100/100 (10 reps)	1/20

The above data indicate that insecticide coverage is good and the residual insecticide is effective in killing mosquitoes. Observations will be continued for the six months post treatment.

B. 12. Data management

All data collected in the field and sorted/processed in the laboratory is entered into a computer data base depending on the particular study involved. The following is a list of the current data bases being used for data storage:

a) Surveillance study for sporozoite rates, feeding habits,and resting behavior which is time, house and village based.
b) Surveillance study for vector densities which is time, house and village based
c) Surveillance study for species composition of the gambiae complex.
d) House risk factors data base which includes house description, vector densities and breeding site proximity.

B.13. Protocol for treatment of bed nets;

It was decided that the insecticide to be used on the project nets would be permethrin at a dose of 200 mg/m^2. The compound was imported from Roussel Uclaf, U.K. the suppliers of Peripel 55, a 50 % emulsifiable concentrate. Following several trial and error experiments, it was decided that two prerequirements were important. First, the insecticide and water need to be measured accurately. Secondly, there should be an excess of emulsion in the dipping bath to ensure the nets were properly wetted by the mixture.

The project is distributing three sizes of nets, 70 cm, 100cm and 130 cm width. all other dimensions are similar on the 3 sizes. The actual area and dose required are given in the table below. The 70 and 100 cm nets require approximately 400 ml suspension to become saturated, the larger nets require about 450 mls. To achieve proper wetting and distribution of insecticide,

sufficient emulsion to treat 10 nets is made up in a basin. Then five nets are dipped and wetted thoroughly one by one. When five nets have been treated, then more insecticide and water is added to the suspension to make up the volume to treat 10 nets. In this way there is always a surfeit of emulsion with wastage kept to a minimum.

TABLE SHOWING AREA AND PERMETHRIN DOSE FOR MOSQUITO NETS

Net size	area m^2	mg permethrin	mls Peripel
70cm	10	2,000	4.0 ml
100	11.5	2,300	4.5 ml
130	13.6	2,700	5.5 ml

APPENDIX C: SOCIAL SCIENCE REPORT
APPENDIX C

BAGAMOYO BED NET PROJECT - SOCIAL SCIENCE COMPONENT

SUMMARY OF ACTIVITIES FOR 1992

Major activities: December 1991 - March 92

* The team made a visit to Pawaga District, Iringa to observe a program operated by UNICEF in which bed nets are distributed free to pregnant mothers and children under five. The objective of the visit was to observe how the process of reimpregnation of the nets with insecticide was carried out on a mass scale.

* The team made a visit to some villages in Ifakara where a bed net intervention study was being carried out the Swiss Tropical Institute Field Laboratory (STIFL). In one of the study villages a cost recovery scheme with revolving fund had been established. An assessment was made of the applicability of this system to the program in Bagamoyo District.

* Presentations of results of the social science data were made at the annual meeting of the National Institute for Medical Research (NIMR) in Arusha. Two papers were presented:

    i. Why do villagers not think Malaria is as important as doctors do? Findings from Bagamoyo District, Tanzania.

    ii. Community perceptions of biting insects in Bagamoyo District., Tanzania.

* In conjunction with the malariometrics team which was carrying out a malaria surveillance clinic in Kondo village, the social science team held discussions with mothers attending the clinic to explain to them more about malaria, mosquitoes and the need for bed nets, as well as to help them understand the reasons for and results of the clinic.

* A survey instrument was designed and pre-tested to assess knowledge, beliefs and behavior in relation to malaria, mosquitoes, methods of self-protection and to assess several socio-economic variables. Results from this survey can be used to two ways. First, they provide information about local perceptions and beliefs which can be incorporated into the design of educational materials. Second, the survey establishes baseline levels of several key variables such as net ownership and knowledge about malaria. Parts of the survey will be repeated at the end of the intervention after intensive education/communication about malaria and bed nets has occurred. It will

then be possible to detect where gains in knowledge and changes and behavior have taken place as a result of the intervention.

* The pre-intervention survey was conducted in group I villages. A total of 129 interviews completed and the data entered into the computer.

Major Activities: April 1992 - July 1992

This was an extremely busy period.

* One Component staff attended the project meeting with the Bagamoyo District Commissioner and Head of Departments to make a presentation on the achievements of the project.

* The pre-intervention survey was completed in group II, III and IV villages. Preliminary data analysis was conducted after group III had been completed, allowing some questions to be removed and additional questions to be added so that issues which had become apparent during administration of the survey in the first three groups could be addressed in group IV. A total of 438 interviews were completed and data was entered into computer.

* Preliminary data analysis was carried out of the survey results. Detailed analysis was carried out on the data relating to perceptions of seasonality, and drafts of two scientific articles were produced:

    i. A methodology for investigating local perceptions of seasonal occurrence of vector borne diseases.

    ii. Seasonal Variation in the perceived risk of Malaria. Implications for the promotion of insecticide - impregnated bed nets.

* The health communication plan was further elaborated. Communication objectives were made more specific as a result of survey results. The Ventura Publisher program was installed on a computer in Dar es Salaam and production was started on educational booklets for bed net committee members and for villagers in general were produced. Posters were also designed and reproduced. The Bagamoyo College of Fine Arts (Chuo cha Sanaa Bagamoyo) was contracted and two plays were written, rehearsed and performed. One play was for the special clinics organized by the malariometrics component. Its purpose was to create awareness about importance of attending malariometrics clinics regularly and to address concerns some people had expressed about the clinics. The second play was to be presented during the distribution of nets in group I villages. Its purpose was to address common misconceptions of nets, explain how the nets were to be used and to emphasize the

importance of all members of the family using the nets on a continuous basis.

* Village bed net committees were formed in group I villages. This process involved interviewing a number of villagers regarding their suggestions for appropriate committee members, interviewing the committee members to see if they would agree to serve on the committee and presenting the newly formed committees to village-wide meetings to have the composition ratified by the villagers. The mechanism is described in more detail in the committee formation protocol.

* Village bed net committees from group I were invited to a day-long seminar in which the following topics were covered: historical background and objectives of the project; the function of the four major components of the project.; the importance of bed net committees; the internal structure and specific responsibilities of the committees and the establishment of revolving funds and the mechanism for supervising their operation.

* Protocols for the collection of funds from the sale of nets were developed.

* Village bed net committees conducted village-wide surveys to assess needs for nets and to promote net sales. Pre-distribution net sales started.

* Distribution of nets took place in group I villages. The Bagamoyo College of Fine Arts staged a play on each distribution day .

* Visits were made after distributions were held. Complaints were recorded and solutions developed.

Major Activities: July 1992 - November 1992

* A survey was conducted in group I in 176 households to assess levels of net usage and problems people were experiencing with the nets. It was found that side-effects of the insecticide were rare, and that for those who had not yet purchased nets the major barrier had been financial, as nets were sold at a time of the year when people have little money. The overall level of coverage was 36%, and plans were made to increase this.

* Village bed net committees and village government leaders in group I were invited to another seminar to discuss their impressions of how the process of distribution had gone and to elicit their suggestions for improving the process. The problem of low coverage was presented to them and suggestions were elicited. The experience was used to plan a different distribution strategy for group II villages.

* Identification and formation of IBNs committees in group II villages was successfully

done using the mechanism used in group I.

* Pre-Distribution seminar for group II village government leaders and IBNs committees was held. New distribution strategies developed.

    i. Sales promotion house to house (committee members walked from house to house with kit of 3 nets, large, medium and small for family members to choose sizes according to the sizes of their beds.

    ii. Greater use of posters placed in more widely scattered areas.

    iii. To buy nets on distribution day rather than pay money in advance.

    iv. Because of the great size of the villages, it was decided to have three sales locations in different parts of each village to make net sales more convenient for the villagers. Distribution therefore took three days in each village.To take nets to the nearest point. Every village to have 3 Selling points one day to spent in each of three selected points.

    v. Committee members were involved more fully in all distribution activities.

    vi. An official launching ceremony was organized to attract more attention and stress that officials at all levels of government were supportive of the program.

Initial distribution in group II yielded encouraging coverage results with an average of 50.6%. A further round of distribution is planned for January to bring coverage up to 75%.

Kerege 55.8%
Mapinga 48.4%
Zinga 47.7%

* Awareness creation plays were performed by the Bagamoyo College of Fine Arts in all primary schools in groups I & II. The plays stressed the children in particular should use nets.

* Post distribution seminars were held for village bed net committees in group II villages to assess distribution and find solutions to problems which had occurred. There were meetings in each of the three villages, and then a combined meeting in Kerege.

* Personnel from the component advised UNICEF on the design and implementation of a qualitative evaluation of a UNICEF-sponsored community-based nutritional support

program. Field workers from the UNICEF project came to Bagamoyo for a week of training in qualitative data collection methods including writing of field notes and the conduct of key informant interviews and focus groups.

Major Activities: December 1992

* The first round of reimpregnation of nets was carried out in group I villages. Special booklets and posters were developed. Further sales of nets also took place, which raised rates of coverage considerably.

* A system was set up for intensive monitoring of patterns of net usage in group II. In this system, all measurement of patterns of usage is to be conducted in all houses within a 250 meter radius of a house where entomology light trap collections are taking place. Mapping and measurement of usage was completed out in one village.

* One week was spent on writing the first draft of a scientific article which describes the formation and functioning of village bed net committees.

APPENDIX D: ADMINISTRATION REPORT

2.0 MANAGEMENT.

Management of the project is in the hands of the Principal Investigator, Dr. Clive Shiff and the co-Principal Investigator, Prof. Japhet Minjas. They are responsible for all technical and administrative arrangements.

2.1 Technical Issues

Technical Advisory Group:

A major technical change in the direction of the project was effected early in the year when it was decided to include an assessment of mortality among children under six years old in the project area to determine all cause mortality and malaria specific mortality. This would be observed year by year to see whether the use of IBN's reduced all cause and malaria associated mortality. This addition to the project was carried out in response to the WHO/TDR emphasis on this measurement, and as result of a TAG meeting held at the request of the Project Officer. As a result, additional staff were recruited and a new vehicle was purchased. Funds for the vehicle were identified from savings in year 1. The TAG met in Baltimore.

JHU-Muhimbili Medical Center Bagamoyo Bed Net Project (BBNP)
Technical Advisory Group Meeting
20 March 1992

In attendance: A Arata, E Chee, JP Clark, D Clyde, J Davis, D Helitzer-Allen, WH Lyerly Jr, J Marsh, J Minjas, R Morrow, CJ Shiff, P Winch

After introductions, Bill Lyerly and Clive Shiff provided background on the project. We were informed that Mr Lyerly is now Tropical and Infectious Disease Coordinator for AID, and he stressed the Agency's goal of providing analysis, research and technical support (ARTS) and the need to provide guidance to field projects. He had traveled to Geneva with the goal of making the BBNP compatible with the WHO-proposed bed net projects for better comparability. The Bagamoyo project apparently is unique because of the social and behavioral aspects and its potential for sustainability. These aspects make it more than just another bed net project, and was the deciding factor in its funding.

Dr Shiff stressed that former studies have been concentrating on chemotherapy to reduce malaria. Bed net trials (except in China) have been done on a small scale. There is good evidence that vector control projects can work; but when they are vertically controlled, expenses and logistics

are generally prohibitive and as a consequence, they are generally not sustainable. However, with community participation, this project can orientate and motivate the people to use impregnated bed nets (IBNs) when they learn that IBNs are relatively cheap and they do not only kill mosquitoes but are also repellent, the nets provide an immediate benefit to the community.

Professor Minjas referred to a map of Tanzania and explained why the Bagamoyo site was chosen -- the area is holoendemic for malaria and the Muhimbili Medical School already has established connections in the region. Muhimbili Medical Centre has programs in entomology, parasitology, behavioral sciences, community health, epidemiology and biostatistics, which provides a pool of scientists to guide the project. Prof Minjas described the personnel affiliated with the project as being competent and stated that the study was actually underway since May/June 1991.

Dr Helitzer-Allen asked how often the people moved around from site to site. Other than for young men, most people travel little within the country.

Peter Winch described the key issues involved in the social sciences-health communications component of the project. The key issues are 1) proper use of nets, including impregnation and not washing except before impregnation; 2) sustained use of nets; and 3) cost recovery. The methods proposed to achieve these goals are 1) meetings with village leaders; 2) open (key informant) interviews; 3) systematic data collection techniques (card sorting, paired comparisons); 4) focus groups; 5) visits to other projects (UNICEF project in Pawaga, Iringa and the project in Ifakara, Morogoro); and 6) survey on knowledge about malaria, mosquitoes and nets (March 1992). Peter Winch mentioned that an important part of assessing the goals of the project comes from trust of the village leaders by the people.

Dr Helitzer-Allen questioned why the survey instrument was designed to test knowledge when there is no documented evidence that an increase in knowledge leads to a change in behavior.

The preliminary findings of the social sciences component are: 1) nets are a familiar technology, about 5% already have nets, 2) people will pay for nets, if they have trust in those looking after the money, 3) communities do not associate the major complications of malaria with the disease they call malaria; 4) there may be a tendency for use of the nets to be seasonal (May-June). The local people have eight different illness classifications; they think of malaria as mild, intermittent fever.

Dr Winch summarized by saying that effectiveness of the intervention depends on continuous use of the nets. Sustainability depends on our ability to convince people that 1) malaria is a serious problem, 2) use of nets will lead to less malaria, and 3) mosquitoes are important.

Dr Arata requested clarification about the costs for the nets. Currently the nets sell for $10 in Dar; the nets which we are importing will sell for $3.50. The Government of Tanzania is

considering removing the duty on importing the nets. JICA and UNICEF each may also bring in 50,000 nets into the country.

Mr Lyerly asked what the Tanzanian Ministry of Health is doing in terms of malaria control. Prof Minjas responded that the current policy is one of chemotherapy and limited vector control in urban areas.

Peter Winch stressed that many activities of each component in the project present opportunities to communicate the goals of the project: at village meetings, the malaria clinics, regular clinics, entomology data collections, schools, while distributing and impregnating the nets, etc. He feels that all project personnel should take advantage of every opportunity for communication. Some of the ideas being considered to communicate the project goals are 1) plays and skits, 2) leaflet/booklet to be distributed with the nets, 3) various interactive discussion techniques, and 4) a calendar stressing the importance of using nets throughout the year.

Dr Elsbeth Chee presented an overview of the malariometrics component and said that the mortality data collection underway is following the WHO guidelines. The census of children under 6 years is underway and will provide demographic information to assess malaria mortality. A team member will be dedicated for mortality surveillance and approximately 4,000 children will be surveyed for two years. A study by GTZ concluded that there are roughly 20 deaths from malaria per 1,000 children per year (excluding infants). The project has assigned a medical assistant to work with the village health workers and a verbal autopsy form is being developed by project staff.

Mr Lyerly suggested that the survey also include adult deaths from malaria as this information would prove useful as well.

At this point there was discussion as to the approaches to be used to obtain the mortality data. This is probably the single most important issue to be resolved by this TAG. Dr Shiff thinks that the entomology inoculation rate as well as morbidity and incidence measurement are equally important. Peter Winch developed a modification of the Stepped Wedge Design to implement and assess the intervention. It was agreed to pursue the issue of measuring mortality with a small subcommittee to arrive at a strategy which would measure mortality adequately.
Dr Arata stated that permethrin is available in the United States and cautioned about EPA regulations as pertaining to use of insecticides.

Dr Helitzer-Allen considers the WHO/TDR guidelines for bed net studies to be insufficient, especially the lack of background information relevant to the perceived seriousness of malaria, as well as information on the current channels of communication for passing on health information. As to whether this project addresses the major issues expressed in the RFA, Dr Helitzer-Allen feels that it goes far beyond the scope of the RFA. She thinks that more can be done however, especially in behavior change rather than knowledge change. She recommends that a behavior analysis be undertaken in order to understand what steps are required to use nets consistently, and that the plan for communication be strengthened to include material which will

reinforce use of the nets. Dr Winch agrees with Dr Helitzer-Allen's assessment, and feels that distribution of the nets should not begin next month but be delayed until the communication issues are worked out in a coherent manner.

Dr Morrow feels that the real value of this project is the behavioral sciences component, although the mortality issue should be stressed. The study population size is smaller than recommended by WHO guidelines.

2.2 Management Meetings

In order to improve management of the project, a Project Administrator was recruited early in February. The incumbent Mr. G. Rwegasira has assumed the responsibilities extremely well and handles all financial, transport and logistic issues. This is a big responsibility which was originally undertaken by Dr. Lubega, who has now been able to focus on technical issues, management and malariometrics work.

Two types of management meetings are held in Tanzania. A six-monthly planning meeting is held twice yearly to review progress and to plan for the following six months. These meetings are scheduled to coincide with visits of the Principal Investigator. Minutes of these meetings are distributed to all project staff in Tanzania and in Baltimore. The other management meeting is held monthly under the chairmanship of the Field Coordinator. This is to review short term progress and to outline planned activities of all three components of the project.

These meetings are extremely important as a forum for the flow of information in a multi-component project which operates from two bases in Tanzania. The also enable the Field Coordinator to determine areas of concern and to develop strategies for correcting deficiencies.

During the past 12 months these meetings have become very important because of the extremely heavy work load arising from specific activities related to the progress of the project objectives. Management meetings allow all scientific and management staff to realise the implications of the work and develop collaboration to ensure work is done effectively.

Full minutes of these meetings are taken and maintained on file, both in the Project Office at Muhimbili and with the P.I. in Baltimore.

2.2.1 Management Meetings: Specific Components

Each Component is expected to hold regular meetings to plan the work load and to ensure that the project objectives are being addressed. These meetings are at the discretion of the Component Chief, but at least monthly. They are most important when innovative work is planned because they provide opportunity to discuss issues and concerns of the various personnel.

Minutes of these meetings are kept by the component personnel and are submitted to the Field Coordinator. Copies are also sent to the P.I. in Baltimore.

2.3 Coordination Meetings

Weekly Coordination meetings are held in Bagamoyo between the Component Chiefs, the Project Coordinator and the Project Administrator. Each component reports on progress of field activities in the previous week and discusses plans for the upcoming week. Problems, logistic and otherwise are discussed and sharing of manpower and other resources including transport and drivers is coordinated.

2.3.1 Transport Available

All vehicles are under the direct supervision of the Project Administrator and are currently well maintained by the Driver/Mechanics employed by the project. Major service and repair is carried out by the vehicle agents in Dar es Salaam. At present adequate transport facilities are available for project activities.

2.4 Project Accommodation

The main laboratory provided at Muhimbili was completed early in the year and occupied by the project. It provides excellent laboratory facilities and also houses the Project Manager, two IBM-type computers, stores and secretarial services. The laboratory is used for specific analyses, serology and microscopy.

As accommodation needs increased in the field, the project identified a house in Bagamoyo which had potential to be modified into office and laboratory space. A long term lease was negotiated and through the astute organization of Mr. Hall, we took up occupancy in April of this year. Two of the Project air conditioners have been installed, one 286 and one Toshiba laptop and the Okidata printer are installed in the main office. As the electric current frequently surges and drops, these computers and the printer operate through an "uninterruptable power supply". Each component has its own office with desks and filing space. There are toilet facilities and a small air conditioned lab for entomological use. One outhouse has been modified to be an insectary for maintaining mosquitoes and for bioassay work.

The project also maintains a laboratory at the Bagamoyo Teaching Unit where bed nets are stored, numbered and repaired. The polyethylene sealing unit is kept there and insecticide packaging is done in the lab. No insecticide material is allowed at the project house for fear of contaminating the insectary. From time to time the project uses one of the seminar rooms in the Training Unit for discussions or short courses.

The project also rents two houses from Muhimbili College for Health Science. These are used for permanent accommodation for Senior staff, and transient visitors. Overflow visitors are accommodated in the GoGo Hotel, nearby. The project covers these costs in order to reduce the per diem expenses payable to senior staff and visitors.

2.5 Project Assets:

The project received two containers and several shipments of other supplies during the

year. One container included some equipment and supplies, the second was loaded with 28,000 bednets of three sizes. Two shipments of insecticide (Peripel 55) have been received from Roussel Uclaf (UK) for normal use and one shipment of Cyfluthrin from Bayer AG (Germany) for evaluation. These were all cleared by Project staff through the Muhimbili system and landed tax free. However due to local bureaucracy the processes are slow, time consuming and frequently exasperating to the Project Staff.

All assets have been recorded, labelled and the actual location noted. All supplies received are taken into stock and records of use are kept to ensure smooth running of the scientific work.

Modification of nets has become necessary because the demand for large size nets was greater than originally thought. Two tailors are employed on ad hoc basis to convert small 70 cm nets to large 130 cm nets as required.

2.6 Staffing: Salaries and Training

Staff development as a principle of human resource management has been put into consideration by the Project. Thus staff are able to attend short courses to develop skills which will increase the degree of input to research effort. During the year Mrs Mashauri, Administrative Secretary, undertook a two week programme in Lotus 1-2-3 in order to cope administratively with the project expenditures.

Driving instruction (in house) courses have been given to G. Rwegasira, A. Makemba and Y. Hamisi who have now qualified to obtain valid drivers licences. This will assist greatly with movements in the field and obviate the need for drivers all the time. Two Medical Assistants, P. Ndayanga and T. Mwakangale are taking instruction on motorcycles. Y. Hamisi and S. Kamazima both have obtained valid motorcycle licences.

Salaries were increased by 50% in July as a result of devaluation of the shilling and subsequent increase in cost of living. The current monthly expenditure on salaries now runs at approximately 1 million shillings (about $3,030).

Workers Social Security. As the project is a significant employer of staff, it has registered with the National Social Security system, Reg. No. 519456. The project has commenced paying contributions to the appropriate places. This item was never included in the initial budget and will become an additional expenditure which must be accounted for.

2.7 Audit

All project finances are drawn through the Muhimbili Medical Centre accounting system and are subject to monthly report and regular audit. Signed monthly statements showing expenditure are obtained from the University Accountant and submitted to Johns Hopkins University.

The project payroll was audited in October and was found to be proper with the exception of tax payments to the government. This matter is now in hand.

2.8 Overseas visits to and from Tanzania;

To Tanzania

DAVIS, Dr. Jonathan (Entomology)	3-29 Feb.
WINCH, Dr. Peter (Social Science)	10-28 Feb 10 May-15 July 25 Nov-20 Dec.
HUNT, Dr. Richard (Entomology)	31 Mar-29 Apr. 15 Nov-3 Dec.
BARNES, Mrs Frances (inventory)	18 Mar-1 Apr.
SHIFF, Dr. Clive (Supervisory)	12-21 Feb. 29 May-20 June 06-27 Oct.

From Tanzania.

MINJAS, Prof. Japhet	(to JHU)	March 1992
	(to Bangkok)	25 Nov-6 Dec
HALL, Mr Tom	(to JHU)	22-24 July

APPENDIX E: PRESENTATIONS

APPENDIX E.

PRESENTATIONS BY PROJECT PERSONNEL AT INTERNATIONAL CONFERENCES:

G. Lwihula:	"Factors affecting perceptions of febrile disease in communities living in coastal Tanzania" Consultative Research Meeting on Pyrethroid Impregnated Fabrics against Vector Mosquitoes. Arusha Tanzania: 15-17 February 1992.
J.Minjas:	"Large scale trials of Insecticide Impregnated Bed Nets for Malaria Control in Bagamoyo, Tanzania. American Mosquito Control Association, Corpus Christi, Texas March 1992
P. Winch;	"Factors affecting the use of Insecticide impregnated Bed Nets in Bagamoyo, Tanzania". American Mosquito Control Association, Corpus Christi, Texas March 1992.
C. Shiff:	"Local sustainability for insecticide impregnated bed net programs in Tanzania". American Society of Tropical Medicine and Hygiene, Seattle Washington. 15-19 November 1992.
J. Minjas:	"The role of Community Participation in the implementation of an insecticide impregnated bed net intervention to control malaria in coastal Tanzania." XIII International Congress for Tropical Medicine and Malaria. Pattaya Thailand. 29 Nov.- 4 Dec. 1992.

APPENDIX F: PUBLICATIONS
APPENDIX F.

PUBLICATIONS PREPARED OR SUBMITTED

1. P. Winch, S. Kamazima, A.M. Makemba, G.K. Lwihula, P.B. Lubega, J.N. Minjas and C.J. Shiff. 1993. A methodology for investigating local understandings of the seasonality of tropical diseases. Health Policy and Planning (submitted)

2. P. Winch, A.M. Makemba, S.R. Kamazima, G.K. Lwihula, P.Lubega, J.N. Minjas and C.J. Shiff. (1993) Seasonal variations in the perceived risk of malaria: Implications for the promotion of insecticide impregnated bed nets. Social Science and Medicine (submitted)

3. C.J. Shiff, J.N. Minjas, P.Lubega, Z. Premji, T.Hall, A.Majala, R.H. Hunt, J.Beier, P. Winch, A.Makemba and S.R. Kamazima. Studies of malaria prevalence and infection rates in mosquito vectors and socio-economic indicators in the Bagamoyo District, Tanzania, in preparation for a trial of insecticide impregnated bed nets. (in preparation)

4. J.R. Davis, T.Hall, A. Majala, E. Chee, J.N. Minjas, C.J. Shiff and J.C. Beier. (in preparation) Falciparum malaria transmission and validation of anopheline capture by light traps in Bagamoyo, Tanzania.