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Second Annual Report, January to December 2004.

RatZooMan, Prevention of sanitary risks linked to rodents at the rural/peri-urban interface

http://www.nri.org/ratzooman

Keywords: zoonosis, infectious disease, rodent, peri-urban, epidemiology

Table of Contents

Scientific report

Summary of content

WP1 Retrospective and prospective investigation of human sera for zoonotics
Problems with gaining ethical clearance to collect human blood samples continued through the second year of the project. These problems of access have been largely resolved in all four DC partner countries, and samples, although limited in some countries, are now being collected for analysis. Of those human samples already serologically analysed for leptospirosis, percent prevalence ranges up to 23% in Tanzania (for particular serovars by MAT) and 13% in Mozambique (all pathogenic serovars). No leptospire isolates have been obtained from human blood cultures so far, but a total of 400 cultures are still under incubation. Antibodies to plague have been detected in 2% of human samples analysed in Mozambique. Toxoplasmosis prevalence is greater than 70% in Mozambique and 19% in Tanzania of those samples analysed. Further details can be found in the SPMC, NHLS, and INS partner reports in the annex.

WP2 Taxonomic identification of rodent species found in rural and peri-urban habitats
Approximately 3,500 individual samples out of a total of 4,800 individuals collected so far have been processed. The large majority of these specimens have had the skull removed and cleaned for taxonomic investigation. For large series of specimens of the same species from a locality (typically in the genera *Rattus, Mus, Mastomys*) only a sub-sample of the specimens was dissected, the rest were kept for later reference. Removed skulls were measured with 19 different measurements for multivariate analysis. This has indicated the presence of species from more than 20 rodent genera from the four African countries surveyed. So far 11,584 tissue samples (representing 4572 individuals) have been received and catalogued. These samples are used for molecular identification of specimens that cannot be reliably identified morphologically. Further details can be found in the RUCA partner report in the annex.

WP3 Isolation and identification of zoonotics from rodents and domestic animals
Rodent sera are being tested against six serovars of *Leptospira interrogans* by MAT namely, Icterohaemorrhagiae, Gripotyphosa, Ballum, Canicola, Hardjo and Pomona. In Tanzanian samples, the highest MAT titre obtained was above 1:10240 with serovar Icterohaemorrhagiae. General serological tests for pathogenic leptospires have shown prevalence of 16% in Mozambique and X in South Africa. Leptospires have been successfully isolated from three small mammal species, *M. natalensis*, *Crocidura* spp. And *C. gambianus*; whereas specimens from other species (*Arvicanthis*, *Nannomys, Tatera*, *Lemniscomis*, *Grammomys*, *Dasymys, Steatomys*, *Rattus* and *Mus*) have yielded no isolates. Analysis for antibody to *Toxoplasma* antibody using the latex agglutination Bio-Rad Pastorex Toxo® kit showed negative results for all samples collected in Tanzania, while greater than 74% of samples from Mozambique were positive. More than 300 serum samples have been collected from dogs, cats, pigs and small ruminants, and these will be analysed soon. A total of 300 serum samples, each, were collected from of dogs, cats, pigs (each 300 samples) and small ruminants (goats and sheep – total 300) from urban and periurban Morogoro, however, no further collection were made in 2004. The serology of these samples is yet to be carried out. Further details can be found in the SPMC, NHLS, and INS partner reports in the annex.

WP4 Rodent ecology in rural/peri-urban Africa
Studies on rodent movements in peri-urban/urban environments were carried out using marked baits. These studies showed that, in general, all rodent species caught in these environments are unlikely to be moving distances greater than 200 m under most circumstances. After a late start, studies on rodent population dynamics and breeding are ongoing in all four African countries. Preliminary analyses show that although several small mammal genuses are represented at the study sites in both Tanzania and South Africa, by far the greater part of the animals is *Mastomys* sp. A small amount of *Crocidura* sp. is also found in two of the study sites in Tanzania, whereas a small amount of *Rhabdomys* sp. and *Aethomys* sp. are represented at the study sites in South Africa. Generally speaking the population dynamic patterns and reproduction of both *Mastomys* sp. and *Rhabdomys* sp. show seasonality, and may relate to the rainfall pattern, although more data are needed for proper interpretation. Furthermore, *Mastomys* sp. may interact with *Rhabdomys* sp., the population dynamics of the latter species thus being shaped, at least to some degree, by the presence of the former

species. A fair degree of parallelism between replicates within the same locality indicates the robustness of the obtained information. Further details can be found in the DPIL partner report in the annex.

WP5 Impact of environmental factors, water management and land use strategies upon zoonotics

The main frustration of the year has been the difficulty in obtaining satellite imagery from the South African Receiving Station. This has delayed the production of satellite maps for the study sites. A start has been made on the land use interpretation for the main focal sites, but again this cannot be competed until all the imagery is received. The image processing component of the project is divided into two parts: 1). Providing up to date map coverage for all the sites (nominally two sites per country. However, Durban has a very good digital map coverage already so this site was not covered, Work is progressing on six of the remaining sites. Some extra imagery is required to cover the sites adequately and this has been requested. 2). Land use in the focal sites over the last ten years. Imagery has been obtained and work is in progress. The Thematic Mapper imagery is proving difficult to analyse without any ground truth data for the sites, but we are hoping that using the recent SPOT imagery acquired will provide a better recent analysis. Further details can be found in the NRI partner report.

WP6 Socio-economic impact and livelihood constraints of disease

Data from three sites (Lushoto, Cato Crest and Mapate) have been analysed and reported. Data have been collected for another site (Morrumbala), with ongoing collections from a further two sites (Maputo, Harare). The current analysis highlights the socio-economic differences between rural/urban situations, between different countries, and the common problems faced by rodents. Awareness about rodent disease problems is relatively high in areas where plague is endemic, while outside these areas knowledge about rodent-transmitted diseases is virtually nil. Further details can be found in the NRI partner report.

WP7 Measuring factors of anthropogenic change upon rodent ecology, epidemiology and natural capital

Reports have been finalised and published for three sites: Lushoto, Tanzania; Cato Crest, South Africa and Mapate, South Africa. Data has been collected for the site of Morrumbala, Mozambique with a report currently being drafted. Data is expected to be collected from two further sites, Harare, Zimbabwe and Maputo, Mozambique. Further details can be found in the NRI partner report.

WP8 Geographic Information System

Good progress has been made to develop a database that can hold a lot of the data generated by the project as well as complementary data for the GIS displays. A GIS prototype has been developed to enable easy and quick access to the project data in map form. Database design was finalised and developed after discussions with project members and the tables are comparable with the datasets being developed by the individual work packages. The database has been programmed using VBA and the Access database. There are import programs to enable rapid input of the project data, especially important for the large number of rat catches. A number of queries and pivot tables have been developed to help analyse the data, especially related to spatial representation. Filters can be applied to this table to refine the data as required. Further details can be found in the NRI partner report.

WP9 Predictive modelling tools for assessing zoonotic transmission risks

Good progress has been made in developing a mathematical model that explains the transmission of leptospirosis through different pathways (environmental, sexual, maternal) within a rodent population over time. The general approach has been to devise a model combining a rodent population model with an epidemiological model of leptospira infection in the rodents. The latter is entirely novel as no previous attempt to model the dynamics of the disease has been found in the literature. Validation is planned by comparison of model output with rodent population data, and to the extent that it is available, leptospira prevalence data in the rodents. The model will then be used to investigate the potential effects of management interventions affecting rodent populations, and some potential scenarios can be found detailed in the NRI partner report. The objective is to help guide policy and strategy for leptospirosis control. The evaluation of historical patient-level data on plague cases in Tanzania have been gathered and analysed to explain the variation in incidence by means of variation in demographic, temporal and spatial criteria. This analysis of cases has indicated that there are three villages which are exceptional with higher incidence and frequency rates for plague. The three exceptional villages lie close to one another in western Mlalo of Lushoto District, though they are not entirely adjacent. Plague cases are also seasonally and inter-annually variable, and this variability can also be correlated with the higher number of cases found in the Division of Mlalo. Sex and age are also important variables where the data show that for adults aged between 30 and 60, the incidence among women is 3 to 4 times higher than that among men. Incidence among children aged between 5 and 14 is twice as high as that among adult women. Further WP details can be found in the NRI and RUCA partner reports.

WP10 Development of sustainable control strategies for the management of rodent-borne disease
Due to start in month 24

WP11 Analysis of policy issues
Due to start in month 26

WP12 Stakeholder workshop
Due to start in month 28

WP13 Output dissemination and project co-ordination
Efforts to advertise and disseminate the project have been made as described under publications. The consortia partners meet twice per year, and this has helped ensure that the project operates efficiently as a team.

Problems

Very serious problems have been created for DC partners by the failure of the EC to swiftly provide the second year advance of funds. The project is now officially in its third year and funding for the second year has still not arrived. Communication with the EC on this matter has been very unsatisfactory, it taking several months to receive responses from EC officials, and with supporting materials that had been posted being subsequently lost and re-requested by EC officials. As the lead partner, NRI has made some advances from it's own funds to DC partners on several occasions to assist in the delivery of activities, but this has generally been inadequate for activities to continue at the anticipated rate planned for in the project cycle. The lack of funds has inevitably caused slippage in the delivery of the project outputs.

Problems continued throughout the second year of the project in gaining ethical clearance to take human blood samples. Although this problem has been recently resolved, its effects coupled with lack of funds cited above led to an official request to extend the project activities for a further six months. The EC has officially agreed to a final project end date of 31 June 2006. It is hoped that funding from the EC will arrive soon so that the project's initial objectives can be achieved by the revised project end date.

Publications

Invited lecture at the 19th International Zoological Congress, Beijing, China, 23-27 August 2004: LEIRS, H. & BELMAIN, S.. Prevention of sanitary risks linked to rodents at the rural/peri-urban interface in South-eastern Africa.

Ratzooman website

Article in International Rodent Research Newsletter

Article appearing in The Mercury, 9 February 2004, Durban, South African newspaper

Outline plans for next year

Coordination meetings are scheduled for April 2005 (KIT, Netherlands) and September 2005 (SZ, Zimbabwe). As the project has been officially extended for six months, the final project workshop is now scheduled to take place in early May 2006 (NHLS, South Africa) in time for the project completion at the end of June 2006. Systems are working well for the collection and processing of animal samples. The collection and analysis of human sera has gone well in Tanzania, but not so well in South Africa (largely due to ethical clearance procedures) and in Mozambique and Zimbabwe (largely due to funds not being made available by the EC). Financial constraints are now severely affecting all DC partners. Although financial problems have been somewhat mitigated by DC partners borrowing funds from other research projects and by the lead partner advancing some funds on an ad hoc basis from their own funds, the financial crisis caused by delays in issuing advance funds from the EC will increasingly affect the quantity and quality of research that can be done by the DC partners.

Bearing in mind the above, project activities are more or less on track. The notable exceptions are with regard to WP1 (collection/analysis of human sera is now active in all four African countries); WP4 (capture-mark-release studies were delayed in their start and will now continue until December 2005); WP5 (receipt of satellite imagery was delayed, but analysis is now going ahead); and WPs 6 and 7 (outstanding site reports are still required for Mozambique and Zimbabwe).

The third year of the project will see new WP activities commence, particularly with regard to WPs 10, 11 and 12. Work has already started on these, and they are expected to deliver their outputs within the timeframe of the project. The additional six months of time given in the extension will help ensure that the project is able to deliver it outputs; however, the main constraint affecting delivery remains the availability of funds to finance activities in DC countries caused by delays in receiving funds from the EC.

Management report

Organisation

Project organisation has gone smoothly with most communication among partners relying on email. The technical coordinator has had to remind partners that they must copy communication so that activities and progress can be monitored and to send regular updates of activities and data to work package leaders and the technical coordinator. Generally, cooperation has been very good among partners and their subcontractors.

Meetings

Representatives from each consortium partner, and subcontractors when relevant, have been present at all meetings. Two meetings were held during 2004: one in February hosted by Mozambican colleagues and one in September hosted by Danish colleagues. Minutes of each meeting can be found in the Annex. Frequent meetings have been essential for the ratzooman project to keep activities on track and keep all partners informed of progress on different activities.

Dates of next consortium meetings:
Week of 25 April 2005 at KIT, Netherlands
Week of 5 September 2005 at SZ, Zimbabwe
Week of 1 May 2006 at NHLS, South Africa for final project workshop

In explanation for the timing of the final workshop in May 2006, it was agreed during planning discussions at the September coordination meeting through a consortium partner vote to request an extension to the project timeframe of six months. The official request put forward by the technical co-ordinator to the EC was accepted, and the project is now officially due to end on the 31st June 2006.

Exchanges

Staff exchanges have occurred independent of coordination meetings for individual work package activities as follows:

For WPs 1 to 4, INS staff have visited NHLS in July 2004

For WP5 NRI staff have visited KIT in June 2004

For WP6, NRI staff have visited NHLS, SPMC, INS and SZ and their relevant subcontractors in January and February 2004

For WP7, NRI staff have visited NHLS, SPMC, and INS and their relevant subcontractors in January and February 2004.

For WP8, NRI and INS staff have visited NHLS in July 2004

For WP9, NRI and RUCA staff have visited KIT in January 2004

For WP13, NRI staff have visited NHLS in February 2004.

Problems

Very serious problems have been created for DC partners by the failure of the EC to swiftly provide the second year advance of funds. The project is now officially in its third year and funding for the second year has still not arrived. Communication with the EC on this matter has been very unsatisfactory, it taking several months to receive responses from EC officials, and with supporting materials that had been posted being subsequently lost and re-requested by EC officials. As the lead partner, NRI has made small advances from it's own funds to DC partners on several occasions to assist in the delivery of activities, but this has generally been inadequate for activities to continue at the anticipated rate planned for in the project cycle. The lack of funds has inevitably caused slippage in the delivery of the project outputs.

Problems continued throughout the second year of the project in gaining ethical clearance to take human blood samples. Although this problem has been recently resolved, its effects coupled with lack of funds cited above led to an official request to extend the project activities for a further six months. The EC has officially agreed to a final project end date of 31 June 2006. It is hoped that funding from the EC will arrive soon so that the project's initial objectives can be achieved by the revised project end date.

Annexes

Meeting reports

Minutes of RATZOOMAN meeting held at the National Institute of Health, Maputo, Mozambique, 11-13 February 2004.

The following people were in attendance:-
Lorraine Arntzen, National Health Laboratory Service, South Africa
Steve Belmain, Natural Resources Institute, UK
Aida Cala, National Veterinary Research Institute, Mozambique
Nan Chalmers, Syngenta, Zimbabwe
Godfrey Chikwenhere, Plant Protection Research Institute, Zimbabwe
Venancio Cluiba, National Veterinary Research Institute, Mozambique
Rudy Hartskeerl, Royal Tropical Institute, the Netherlands
Malcolm Iles, Natural Resources Institute, UK
Monica Janowski, Natural Resources Institute, UK
Herwig Leirs, Danish Pest Infestation Laboratory, Denmark and University of Antwerp, Belgium
Robert Machang'u, Sokoine Pest Management Centre, Tanzania
Anabela Manhica, National Veterinary Research Institute, Mozambique
Adrian Meyer, Natural Resources Institute, UK
Rassul Nala, National Institute of Health, Mozambique
Judith Pender, Natural Resources Institute, UK
Malodi Setshedi, National Health Laboratory Service, South Africa
Manuel Sumila, National Institute of Health, Mozambique
Peter Taylor, Durban Natural Science Museum, South Africa

Meeting opened with welcome by the Director of National Institute of Health. Each consortium partner gave a presentation of the activities which took place over the first year of the project, based on their first year technical report.

SB report on NRI with particular reference to activities in WP 5, 6, 7, 9 and 13. MJ elaborated anthropological survey, but interpretation is difficult without other rodent data that is in the process of being collected.

HL report on DPIL with particular reference to WP4 and preparation of CMR protocol for all primary sites and movements of rodents between habitats using marked bait and telemetry studies in Tanzania. It is important that CMR field selection is for two sites that are in the peri-urban interface as near to the urban area as possible. All sites need to collect weather data, which has not yet been sent to HL. Data must be regularly sent to DPIL on a monthly basis, and this will help to correct problems before they are repeated in the next census.

HL report on RUCA with particular reference to WP2 reporting on preparation of protocol and manual for the studies and the taxonomic identification of rodents collected. Not all data that had been collected had been received. Rodents had been trapped in many places but little site information has been provided to interpret the data. Ecological information required to further analysis.

LA report on NHLS. There was delay in sample analysis due to problems in getting kits and reagents ordered and sent to South Africa, but all consumables are now available and analysis is moving along. Preliminary results of serological analysis of rodent samples has not shown any samples plague positive. From Venda 39 samples were tested, from Durban 232 samples, 10 of which were positive for leptospirosis (10%), and 4 samples were positive for toxoplasmosis. Sera from Port Elizabeth showed 63 samples out of 587 to be lepto positive (20%). Rodent sera were analysed with the DriDot test, and RH raised the issue that this test will be unreliable for animal sera, emphasising that MAT must be done to confirm. Human sera have not yet been sourced and there are problems obtaining ethical clearance. The serovars used for lepto MAT need to be approved by RH.

RM on SPMC activities. Human sera were obtained through assistance from on going projects involving HIV and schistosomiasis and from routine malaria and typhoid diagnosis. Sources of the serum specimens included AghaKhan Hospital, Upendo Medical Laboratory and Mikumi Health Centre, with other sera obtained from two referral hospitals. A total of 1702 samples from 5 different locations. Samples will be screened soon. Captured rodent species, trapping from February to December in human residences, preliminary identifications were done to Genus with further taxonomic identification at RUCA. The total number of rodents and shrews captured was 2065 in Morogoro. First recorded case of Norway rats in Morogoro. Sera and tissues have been collected with opportunistic sampling from Mbeya, Kilimanjaro, Dodoma. Samples have also been collected from domestic animals, i.e. dogs, pigs, cats, sheep and goats in Morogoro. Isolations of lepto from urine and kidneys and samples cultured, isolated 1029 cultures of which 25 were positive for lepto or 2.4% of sample population. RM referred to socio economic data from Lushoto – trouble of funding for social studies, and will have difficulty in funding further socio-economic studies, could probably do studies easily in Morogoro but unlikely to do Masasi.

RH report on KIT. WP1 human sera has not really started except in Tanzania, retrospective analysis, selection of sites has occurred. Culturing is the most important aspect of this work package and must occur. RH raised the question on how do we do this???? WP3 analysis of animals and improved methods for diagnosis of leptospirosis. Isolation can be difficult from kidneys – helps if you centrifuge and concentrate the leptospires with an initial low speed for 5 minute at 150 g and then a high speed spin for 10 min at 6500 g. RH developed new media of bilayer with a bottom layer of charcoal and then a liquid of rabbit sera on top. Some partners will try to use the new media, but agreed to stick with the traditional protocol to ensure comparability with existing data.

RN report on INS. National veterinary research institute has been subcontracted and they had a meeting in August to identify sites and develop the protocols with a second meeting in November with local authorities. Field work started on 1st December. There was real difficulty in sourcing materials and importing them into Mozambique, both traps and reagents; however everything is now happening. Primary site consists of the Maxaquene A, T3 and Tsalala areas of Maputo. It was proposed that a more flexible protocol would be required to obtain data from secondary sites in Central Mozambique because of the costs and difficulties in reaching the area. RN to set up a visit to Morrumbala that will pull in overseas staff for a longer trapping period to happen around May 2004. For GIS, details of study sites have been collected with agreement on the database structures and GIS requirements identified.

GC report on SZ. Rodent trapping and sample collection going well in Mbari, no human sera yet collected. Some problems with one urban site (Hatcliffe) where high numbers of traps went missing and, therefore, had to change the site. Problem of funding raised, as advance is coming from Syngenta headquarters in Switzerland who will not advance any further funds until the EC reimburses their first year expenses. This is effecting their ability to deliver activities.

Various group discussions and resolutions took place regarding the standardisation of data for input to GIS, data tables for WP2 and habitat descriptions, ph water analysis, changes to the socioeconomic questionnaire.

Agreed Actions & Points of Discussion

1. **Data and communication** - Steve will provide common access to all data within the Ratzooman website. To be useful and productive it will be essential that all collaborators provide up-to-date data for inclusion in the database. Everyone must make a greater effort to copy SB in on correspondence and keep him informed of activities!!

2. **Socioeconomic & Anthropological -** It was suggested that it was more appropriate to undertake survey work in Morogoro than other sites in Tanzania to facilitate activities and reduce costs. Firstly there was a great deal more data on rodent populations at Morogoro and secondly much of the work relating to the dynamics of plague at Lushoto had already been undertaken. The importance of undertaking work on the human populations in areas where there were positive indications of disease presence was discussed. The potential to do work on the rodent eating area in Mozambique was discussed and that if appropriate collaborators can be identified the work can occur at the same time

as the team visit to Zambezia. Questionnaires circulated for everyone to comment so that Malcolm and Monica can revise as necessary.

3. **Sample collection** - Herwig stressed the need to send data to DPIL and RUCA as soon as possible once collected. This would facilitate more rapid analysis of data. In addition, this early analysis of initial data would identify errors in the data and data collection and recording at an early stage in time for wider correction. Need to trap in open areas outside towns and outside houses but also in peri urban areas. This sample size was currently rather low. Looking for interface between domestic rodents and rodents around outside of town. In recording trapped rodents it is important that the point at which the rodent was trapped is recorded so that the point can be re-visited at a future date. If a code is used it is important that another data file is set up containing the details relating to the codes. Great care should be taken in recording these data. It is worth setting up a file that will cross check that the data on the record sheet matches to data in the locality file. There is no need to record units in each record, for instance no need to include g when recording in the weight column. It was agreed that further questions be inserted into the record sheets relating to the construction and hygiene standards around the individual houses. Adrian designed these as follows:

DEFINITIONS OF HOUSING CATEGORIES - Proofing
CATEGORY 1 Very poor quality housing - about as bad as it gets! Provides very easy access for rodents.
CATEGORY 2 Poor housing and worse than average. Access for rodents relatively easy.
CATEGORY 3 Better than average. Fairly good housing that provides more limited access for rodents.
CATEGORY 4 Good housing, access for rodents is difficult.

DEFINITIONS OF HOUSING CATEGORIES - Internal Harbourage
CATEGORY 1 Extensive availability of harbourage and cover inside the property. Plenty of places for rodents to hide. Very untidy.
CATEGORY 2 Harbourage and cover available but not in very large quantities. More harbourage than average.
CATEGORY 3 Limited harbourage available. Less harbourage than average.
CATEGORY 4 Almost no places for the rodents to live, a clean and very tidy house.
NB:
1. The presence of an enclosed roof space should be seen as one factor that contributes to the availability of potential harbourage.
2. The presence of a grass roof, because it provides potentially good harbourage, would probably place the house into categories 1 or 2.

DEFINITIONS OF HOUSING CATEGORIES - External Hygiene
NB: All assessments to be taken within 5 meters of the building.
CATEGORY 1 Very extensive availability of harbourage and cover. Generally a very untidy area around the building.
CATEGORY 2 Area is generally untidy and provides cover for rodents and is worse than average, but could be worse.
CATEGORY 3 Some cover but better than average.
CATEGORY 4 Very tidy and clean environment that provides no or almost no cover for rodents.

4. **Leptospirosis Screening** - Rudy confirmed that the DriDot test is not appropriate for animals, but that existing analysis in comparison to MAT may prove useful to show efficacy of DriDot for animal samples.

5. **GIS** - Judith Pender said that partners must do in country searches for large scale digital maps to obtain all roads and streams. Data must be sent to Judith for input as it comes in. Recoding of Longitude and Latitude must be recorded in a standard way.

6. **Sample analysis** – This will be done separately in Zimbabwe, Tanzania and South Africa (with Mozambique samples sent to South Africa for analysis, with the prospect of eventually doing some analysis in Mozambique). Emphasised need to communicate and establish standard analysis protocols.

Next Meetings
Week of 20 September 2004 at DPIL
Week of 11 April 2004 at KIT
Week of 5 September at SZ
Week of 7 November at NHLS

Minutes of RATZOOMAN meeting held at the Danish Pest Infestation Laboratory, Kings Lyngby, Denmark, 22-24 September 2004

The following people were in attendance:-
Lorraine Arntzen, National Health Laboratory Service, South Africa
Steve Belmain, Natural Resources Institute, UK
Stephen Davis, University of Antwerp, Belgium
Rudy Hartskeerl, Royal Tropical Institute, the Netherlands
Ann-Charlotte Heiberg, Pest Infestation Laboratory, Denmark
John Holt, Natural Resources Institute, UK
Malcolm Iles, Natural Resources Institute, UK
Monica Janowski, Natural Resources Institute, UK
Jorgen Jespersen, Danish Pest Infestation Laboratory, Denmark
Herwig Leirs, Danish Pest Infestation Laboratory, Denmark and University of Antwerp, Belgium
Jens Lodal, Pest Infestation Laboratory, Denmark
Robert Machang'u, Sokoine University of Agriculture, Tanzania
Anabela Manhica, National Veterinary Research Institute, Mozambique
Adrian Meyer, Natural Resources Institute, UK
Rassul Nala, National Institute of Health, Mozambique
Judith Pender, Natural Resources Institute, UK
Linda Ritchie, Natural Resources Institute, UK
Ricardo Thompson, National Institute of Health, Mozambique
Solveig Vibe-Petersen, Danish Pest Infestation Laboratory, Denmark
Peter Weile, Ministry of the Environment, Denmark
Moses Zimba, Harare City Health, Zimbabwe

Meeting opened with welcome by the Director of the DPIL, Jorgen Jespersen. Format of meeting was to discuss activities for each work package, receiving reports from each partner involved followed by a summary presented by the work package coordinator.

WP1 Retrospective and prospective investigation of human sera for zoonotics.
RM reported on progress in Tanzania. Human samples (1702) have been collected from a number of clinics and serologically screened for leptospirosis using MAT against five serovars. Details can be found in his presentation linked to this text.

LA reported progress from South Africa. No blood samples have yet to be obtained. Problems with ethics, witchcraft and HIV are making it difficult to obtain samples from hospitals and targeted communities. Consent forms must be translated into all local languages which makes particular problems for multi-ethnic communities as found in Cato Crest. Partners will continue to work towards collecting human samples but no firm deadline can be set for when this might occur.

MM reported on progress from Zimbabwe. Some human samples have been collected but not yet analysed. Collection and analysis have been constrained by lack of project money. Samples can be collected, but requires payment to those collecting samples. Analysis kits are very expensive and it was agreed that samples should be sent to LA for analysis in South Africa.

RT reported progress in Mozambique. Samples have been collected in Maputo and Zambezia and analysed in South Africa through LA. Toxoplasmosis was found to be very high in both Zambezia (rodent eaters) and in Maputo (HIV patients), generating concern over the lack of diagnosis and treatment in cerebro-reactivation in AIDS patients.

As work package coordinator, RH commented on the problems faced in this work package, and he is not optimistic that we will deliver the promised outputs in time. Sample sizes collected so far are small and unlikely to provide representative prevalence data. Not all samples have been evaluated against all three diseases using the tests previously agreed. Rudy also reminded everybody that human isolates are required to confirm the serovars responsible to establish linkage with results in WP3. Collecting human isolates will be difficult without strong relationships and communication with clinical staff involved. Tanzania has the best chance of succeeding in human isolation, but other countries should try to develop the appropriate linkages to achieve this aim.
Action: Everyone to try harder to get human samples collected from the target communities and/or local clinics, hospitals, blood banks, other clinical surveys.

WP2 Taxonomic Identification of rodent species found in rural and peri-urban habitats.

RM reported that approximately 3000 rodents and shrews have been caught to date in Tanzania. Samples have been given preliminary identifications and sent to Antwerp for confirmation. Data showed some temporal variation for both sylvatic and commensal species.

LA reported that samples in Limpopo Province, South Africa have been limited due to a period of draught. As the drought has now ended, rodent captures have increased. It was decided to repeat the collection again in Oct/Nov to collect a larger sample size. Sample sizes collected in Durban have been higher and reliably identified locally by Peter Taylor. Sample collection in Port Elisabeth has not occurred.

MM reported some sampling has occurred in Zimbabwe, but again activities are limited by availability of money. Financial problems were discussed separately later on.

RT reported that samples have been collected in both Maputo and Zambezia, Mozambique, and all samples have been sent for identification in Antwerp. It is planned to carry out more sampling in both sites.

As work package coordinator, HL presented a summary of the data collected and analysed so far. Please see the summary to establish what samples and information has been received for each African country. What is still missing from the work package is the need to link rodent trapping site information and human sero-positives.

Action: Ensure that data is entered into standard forms. This ensures that no data entry errors are made. Contact HL if unsure how to do this. HL will send each country the most recent version and partners should continue to work with this one for all future input.

Action: Collect missing site data for sites in Tanzania, Zimbabwe and Mozambique and enter into standard form. The data is useless without the site information so this must be done.

Action: Send all collected specimens and livers to Antwerp asap. These are urgently needed to carry out identification work.

Action: Lorraine will ask Peter Taylor for information on rodent identification and circulate the relevant pages to all African partners plus Monica and Malcolm.

WP3 Isolation and identification of zoonotics from rodents and domestic animals.

LA reported that Port Elizabeth rodent sera samples are plentiful but not much known about sources or methods of capture. No other tissues are provided for other tests and rodent species identification can not be confirmed beyond that reported by the collectors in Port Elisabeth. All samples have been screened for leptospirosis using the human dri-dot test. Positive leptospirosis samples have been sent for MATs. The negatives will be sent after the positive samples have been analysed. All samples so far have been plague negative, and toxoplasmosis ranges from 5 to 26% sero-positives at the different sites. No samples from domestic animals have yet to be collected.

Rodent samples have not been analysed in Zimbabwe due to financial problems. It was agreed that samples will be sent to South Africa for analysis.

AM reported that rodent samples have been serologically analysed for Mozambique through South Africa, awaiting results of MAT and PCR. AM wants to try to do some of the analysis in Mozambique, and it was suggested that

RM reported on leptospirosis serological and isolation tests from Tanzania. Samples from domestic animals have been collected but have yet to be analysed. Six serovars were tested in MAT. RH suggested that a larger panel should be done with a sub-sample to see whether these are the correct serovars to use. However, it was suggested that the six serovars should be used to promote standardisation and comparability of results obtained in different countries and with human and domestic animals. It was, therefore, agreed to leave panels as they are but to appreciate their limitations and that it is likely that sero-positive samples will go undetected. RH emphasised that different areas/countries may need different panels of serovars in the MAT because having the same panel in all countries for standardization only makes sense if you use a large, generally applicable panel. Some titre levels of leptospirosis in rodents were remarkably high, but the total percentage of positives was disappointingly low.

RM then summarised the work package status so far. HL stressed the importance of using the standard files for inputting data from the WP3 tests. These files need to be finalised by RH, LA and RM. It was agreed that it would be necessary to identify the precise living place of sero-positive patients.

Action: Rudy to finalise the record sheet for human positives in discussion with Robert and Lorraine. Sheet needs to be circulated to African partners for data input, ensuring everyone uses the standard form.

Action: Herwig will produce labels for human and domestic animal samples

Action: African partners to increase efforts to collect domestic animal samples.
Action: Herwig will add a list of domestic animals to the existing rodent data sheet so that all non-human samples appear within the same spreadsheet.

WP4 Rodent Ecology in rural/peri-urban Africa
HL summarised what information has been collected so far. Research using marked baits to assess likely rodent movement distances in urban areas has been completed and provides good data on likely distances moved by rodents in urban areas. There have been several problems in the collection of CMR data in Zimbabwe and Mozambique where it was misunderstood that data must be collected from the CMR study sites on a monthly basis. Partners now understand why this must be done and will continue the study on a monthly basis. Data from South Africa has not been input using the standard form and software, and it is essential that this occurs to minimise data entry errors and reduce future workload.
Action: Solveig will go through all data she currently has and input it into the correct CMR programme. This will then be sent to the African partners who must then use the standard form for all future CMR data input. It is essential that the standard CMR data entry package is used for all future data collection.
Action: African partners must send area description information about the CMR sites to Solveig on local habitat, environment, climate and the distance between the different CMR plots.
Action: African partners to send through the toe clippings obtained from marked animals to Antwerp. This is used to confirm the rodent species.
Action: African partners must obtain climatic data from the nearest weather stations to the CMR study sites and provide temperature and rainfall data (broken down on a daily basis) for the duration of the CMR study period as well as 3 months before the trial started.

WP5 Impact of environmental factors, water management and land use strategies upon zoonotics.
SB reported that NRI is looking at survival of pathogens on food. Initial work by a PhD student has started with using salmonella and will then be extended to leptospirosis based on a recent visit to KIT by NRI staff to determine the requirements for handling leptospires. Reports should be available for next meeting. JP presented work related to establishment of GIS and analysis of land use changes. Difficulties in procuring all the maps required have had a major impact on analysing change as recent maps for all sites are still missing.
Action: get the missing images and complete land use categorisation for change analysis.

WP6 Socio-economic impact and livelihood constraints of disease
MI presented a consolidated report for results collected so far. It was agreed to try to incorporate a question on the degree to which people slept in the same room as food stored. Agreed to work on development of risk scores for certain behaviours and habitat aspects and will discuss further with John Holt and Stephen Davis on how the modellers can help with this. Surveys have still not yet occurred in Morogoro, Mozambique and Zimbabwe. It was agreed that the work should definitely be done in Morogoro and that funding existed to do this. Surveys in Zimbabwe and Mozambique should go ahead, and it was stressed that these must happen within the next three months in order for the result to be of use to the project. Ricardo and Rassul will do the data collection themselves on their next visit to Morrumbala.
Action: MI to liaise with SB over correlating socio-economic factors with questionnaire parameters.
Action: MI to liaise with JH and SD over potential models that could be used to assess potential risks associated with certain questionnaire responses.
Action: Further studies in Tanzania, Zimbabwe and Mozambique must be completed as a matter of urgency.

WP7 Measuring factors of anthropogenic change upon rodent ecology
MJ presented a consolidated report of the surveys conducted in Lushoto, Limpopo and Durban. It was agreed that comparable surveys will not be undertaken in Morogoro due to lack of sufficient funds. It was agreed that surveys in Mozambique (Zambezia already done but further revisions and translation required before deciding whether to also do Maputo) and in Zimbabwe (staff for survey in Harare are identified and awaiting financial resolutions before work can be carried out). It should be possible to get these surveys done in time with data and reports handed to Monica by end of 2004.

WP8 Geographic Information System

JP presented existing database structure for comment by all partners. It was agreed that all spreadsheets should be sent to JP immediately so that preliminary analyses can be done. Revised spreadsheets will automatically update any changed data as further information is collected. It was agreed that all partners should have access to the database component of the GIS and further buttons to facilitate the user interface will be added.
Action: All partners to tell Judith details of required analyses as soon as possible.
Action: African partners to obtain climatic data, particularly rainfall and temperature for study sites.
Action: RT, RN, SB, JP and possibly LA to work out the financial problems associated with obtaining the final satellite images required.
Action: All partners to send new data, spreadsheets and photos to Judith asap.
Action: All partners to send Judith a list of keywords, references (for a bibliography) and reports they wish to be associated with the GIS database.
Action: All partners to establish whether they have access to Access 2000. Earlier versions of Access 2000 will not work with the GIS database. Anyone without Access 2000 should notify SB and JP immediately.

WP9 Predictive Modelling for assessing zoonotic transmission risks.
JH and SD presented a summary of the current mathematical model developed for leptospirosis. The model does not yet incorporate any potential stochasticity, and is based on many theoretical parameter values for which we do not yet have real evidence. However, it will allow us to vary parameters and understand how changes in rodent or disease ecology will effect transmission risks. Work will continue to develop the model as more data from other work packages is generated.

WP10 Development of Sustainable Control Strategies
This work package is due to start in January 2005. The delays in collecting and analysing information from the other work packages will influence what can be achieved in this WP. It was agreed that it will be possible to make some analysis of data collected so far, leading to reporting potential intervention strategies, recommendations and trialling limited activities through demonstration.
Action: HL, SVP, ACH and JL will summarise our existing knowledge and draft a report that highlights potential interventions and recommendations which will then be circulated to all partners for comment. It will then be decided how to proceed with this work package.

WP11 Analysis of Policy Issues
MM reported that will be necessary to involve government at all levels (local, national, agriculture, health, women). Activities in WP10 such as demonstration sites in each country will be essential for raising awareness and influencing policy makers.
Action: Martha will develop a brief report on the current policies in different SADC countries with regard to zoonotic diseases, particularly leptospirosis, plague and toxoplasmosis, but also more widely about neglected communicable diseases where rodents may be involved in their transmission. This report about existing policies should be completed by the time of our next meeting in April.
Action: In addition to contacting key government policy makers in each country Martha will also contact WHO and FAO to find out about their current recommendations and ask for their assistance in revising policies relevant to the SADC.

WP12 Stakeholder Workshop
LA presented to partners issues that need to be clarified with regard to the timing, location and audience for the workshop. It was suggested that the meeting takes place away from Johannesburg and Pretoria in a place such as Kruger National Park to encourage people to come and stay focussed on the workshop agenda. It was suggested that the workshop should then be two days with allowances for safari. Participant numbers should be limited to approximately 100 – based on Kruger limitations.
Action: All partners to send lists of potential participants to Lorraine and Steve. Ideally the list should contain names, and addresses of key VIPs to whom invitations should be sent. Participants should be drawn from different categories of stakeholders, e.g. Ministers of Health, Environmental Health Officers, Directors of Research Institutes, Disease Surveillance Boards, charitable organisations involved in health care delivery, Councillors/representatives from communities involved, WHO representatives, officers from key donors particularly the EU and, DANIDA, DFID offices in each country.
Action: Lorraine and John Frean to investigate getting a VVIP (such as Nelson Mandela) committed to the workshop for inclusion on the invitations to be sent out.

Action: Steve and Herwig to discuss asap additional funding through the CTA or as an EC Accompanying Measure to cover the travel and subsistence of a limited number of delegates and other workshop costs.
Action: A variety of materials should be ready for distribution at the meeting, including a brief report of the project's findings and recommendations, a policy document for discussion, and shorter leaflets and handouts that highlight the problems with rodent-transmitted diseases and existing/proposed interventions.

WP13 Output Dissemination
The only output since our last meeting has been by Herwig who gave a conference presentation at the International Congress of Zoology in Beijing in August 2004 where the ratzooman activities were summarised to date. Herwig's presentation can be found on the ratzooman website (http://www.nri.org/ratzooman/publications.htm) as a PowerPoint presentation (that contains the animations) and as a smaller PDF file (where the animations are lost).
Action: Every effort should now be made to complete reports as soon as possible so that peer-reviewed publications can be developed and submitted.

Administration / Financial Issues
We have still not had the 2nd payment from the EC. We have responded to all their queries raised in our first cost statements and can only hope that the money arrives soon. NRI will send the money out as soon as we get it. Please remember the queries raised by the EC and try to avoid them with the next round of cost statements.

NRI has already advanced some money to needy partners, and hopes that everyone can find alternative sources of cash to keep project activities going until the money arrives from the EC. **It is imperative that partners contact NRI if they are suffering financial problems so that something can be sorted out.**

The dates of the next meetings are as follows:
Meeting in Amsterdam arranged for **27 to 29 April 2005 -** with people arriving on the 26th
Meeting in Harare for **7 to 9 September 2005**, with people arriving on the 6th.
Stakeholder workshop in South Africa for the **week starting 7 November 2005**. This would be a two day workshop on the Thursday and Friday with ratzooman partners meeting on the Tuesday and Wednesday, therefore partners need to arrive in Jo'burg/Kruger on the 7th Nov.

All consortium partners requested that we ask the EC for the project time period to be extended by six months. This would give everyone more time to complete the analysis and integration of data sets and prepare materials for the stakeholder workshop that would then take place a few months into 2006. SB said he would raise the prospect of an extension with the NRI administration, and if agreed, he would contact the EC and make arrangements for the extension. SB will contact everyone once he has a better idea of what will happen. **In the meantime everyone should continue planning as if the project will end December 31st 2005**.

Publications

Invited lecture at the 19th International Zoological Congress, Beijing, China, 23-27 August 2004: LEIRS, H. & BELMAIN, S.. Prevention of sanitary risks linked to rodents at the rural/peri-urban interface in South-eastern Africa.

Ratzooman website

Article in International Rodent Research Newsletter

Article appearing in The Mercury, 9 February 2004, Durban, South African newspaper

Consortium partner reports

NRI

RATZOOMAN
Prevention of sanitary risks linked to rodents at the rural/peri-urban interface

INCO-DEV contract number ICA4-2002-10056

ANNUAL SCIENTIFIC REPORT

Participant:	NRI
Period:	Jan to Dec 2004

Scientific achievements

Land and water WP5 – NRI staff visited KIT staff to learn about leptospire culturing and maintenance. Three serovars of leptospire have been obtained for maintenance at NRI. Food challenge protocols have been developed to infect different African food types to assess their susceptibility to keep leptospires alive, with experiments ongoing.
Socio-economic activities WP6 – Data from three sites has been analysed and reported. Data has been collected for another site, with plans to collect from a further two sites. The current analysis highlights the socio-economic differences between rural/urban situations, between different countries, and the common problems faced by rodents. Awareness about rodent disease problems is relatively high in areas where plague is endemic, while outside these areas knowledge about rodent-transmitted diseases is virtually nil.
Anthropological activities WP7 – Reports have been finalised and published for three sites: Lushoto, Tanzania; Cato Crest, South Africa and Mapate, South Africa. Data has been collected for the site of Morrumbala, Mozambique with a report currently being drafted. Data is expected to be collected from two further sites, Harare, Zimbabwe and Maputo, Mozambique.
GIS activities WP8 – A database system to house all project data sets has been developed and shared with all project partners. Imagery of rural and urban study sites (paper maps, SPOT, Landsat) has been acquired, and land use change analysis is nearly complete.
Modelling activities WP9 – Stochastic mathematical models have been developed in collaboration with staff from RUCA that will account for the different modes of leptospirosis transmission within a rodent population. The model is being revised and evaluated as new data become available.

Scientific problems encountered

None

Publications or presentations

Various updates to project website: http://www.nri.org/ratzooman

Invited lecture at the 19th International Zoological Congress, Beijing, China, 23-27 August 2004: LEIRS, H. & BELMAIN, S.. Prevention of sanitary risks linked to rodents at the rural/peri-urban interface in South-eastern Africa.

Progress on WP6 Socio-economic impact and livelihood constraints of disease

Overview
Field visits to Mozambique (planning), South Africa (review and planning), Tanzania (review) and Zimbabwe (planning). Close collaboration during the development of methodology and preparatory field visits with anthropogenic WP7. Field survey and data entry completed for Cato Crest, South Africa. First stage and secondary analysis of data of three completed surveys, preparation of draft technical report and circulation to all collaborators for comment.

Specifics
South Africa - Visit February 2004 to finalise data queries and finalise survey analysis for the Mapate study area (Limpopo Province) and make preparations for an additional survey (KwaZulu Natal Province). Collaborators identified for additional site. Urban /squatter site selected and also visited, questionnaire and training material prepared, and enumerators trained. Work programme agreed with Project collaborators. Household survey completed with 90 urban/squatter households, data entered on computer spreadsheet by collaborators (July/August). First stage of analysis of data and secondary analysis to key identify socio-economic factors and draft report completed.
Tanzania - Visit February 2004 to finalise data queries for Lushoto survey data (endemic plague area). Discussions with Project collaborators on an additional study area under consideration and visited (Morogoro; urban, extensively surveyed by the Project and others for information on rodents).
Mozambique - Peri-urban and plague survey areas selected. Questionnaire, selection procedure and training material prepared. Collaborator selection and training. Monitoring and follow-up with collaborators on progress.
Zimbabwe - Peri-urban, plague and market survey areas selected. Questionnaire, selection procedure and training material prepared. Collaborator selection and training. Monitoring and follow-up with collaborators on progress.

Socio-Economic Factors relevant to rodent-borne diseases:
Provisional results from surveys at three field sites

South Africa:	Mapate, Limpopo Province and
	Cato Crest, KwaZulu Natal.
Tanzania:	Lushoto District, Tanga Province.

By Malcolm Iles, based on surveys conducted by: Takalani Takhani of the University of Venda (Thohoyandou); Peter Taylor of the National History Museum (Durban) and Philip Damian of Sokoine Agricultural University (Morogoro).

1. Introduction

This is a consolidated report of activities undertaken for the socio-economic component of the Project. Three surveys have been completed thus far. The analysis of the data presented is of key socio-economic factors potentially influencing zoonosis transmission.

The report is divided into 5 sections:
Introduction
Methodology; which sets out the methods used for gathering data.
Analysis; which presents the basic data and has begun the process of establishing relationships between human perceptions and activities that may influence their exposure to rodent-borne diseases.
Review and discussion of results; summarises the outputs thus far and discusses possible relationships. The contribution of existing and additional data is reviewed in the context of the different sites.
Some Initial Observations/Conclusions; makes an attempt at drawing preliminary conclusions.

Further data collection in the Project countries of southern Africa is ongoing/planned.

2. Methodology

Survey approach
The survey was set up in consultation with Project collaborators in the country concerned.

The approach adopted has two important features:
Survey sites were selected that are common to the technical components of the Project in order to enhance the interdisciplinary understanding of the various factors operating, and
Close collaboration on methodology and conduct between the socio-economic and social-anthropological components of the Project. In all survey and case studies, households selected for research were drawn either from common areas or samples.

Although some fine-tuning was necessary to accommodate a few essential local differences, the basic structure of the questionnaire used in each survey was the same in order to facilitate comparison between sites (See: Annex 1).

Sample selection

Site selection
In order to facilitate cross-referencing with zoonosis data being generated by Project collaborators, the site selected for the socio-economic survey is common for the zoological and anthropological components.

About the sites

Mapate: A rural (close to a major urban centre), low-density site in, Limpopo Province in the northern highveld of South Africa.
Cato Crest: An urban, high density, site in Durban, KwaZulu Natal Province, near the coast in eastern South Africa.
Lushoto: Three sub-sites; rural, low density, partly urban (small town), squatter. There is an ongoing history of plague in one of the sites (Mlalo). Lushoto is a rural district situated in Tanga province in Tanzania's hilly northeast.

Survey conduct and data management
A draft questionnaire was prepared and enumerators identified in consultation with in-country collaborators. The Questionnaire was finalised together with enumerator guidelines and supplied by NRI. In-country collaborators finalised recruitment and trained the enumerators, conducted the survey and entered data on computer spreadsheets. It was then analysed in the UK and draft reports prepared.

Household selection for survey
Villages were thought to be broadly representative of the socio-economic characteristics prevalent in areas previously selected for Project technical Work Programmes.

Household sampling lists were obtained through local politico-administrative structures or drawn up together with the village chairs, from which households were selected at random. Where household lists were not available, other methods were identified to ensure randomness. In Cato Crest, for example, the transect approach was used whereby transects were drawn through a map of the site and houses along those lines were visited at random; every 3rd house was systematically selected, with the starting point chosen at random. Contingency arrangements were made for the selection of a similar replacement in cases were a house was unoccupied at the time of the enumerator's visit.

Surveys were completed by interviewing the head, or a key informant, of each selected household.

Enumerators and Guidelines

(see: Enumerator guidelines).

Data collection and entry

Sample source and size

The size of each survey sample was intended to be large enough to give sufficient data in the anticipated social sub-groups.

Table 1: Numbers of households interviewed

Country/site	Number of households	Total sample size
South Africa:		
Mapate	120	120
Cato Crest	90	90
Tanzania:		
Lushoto, of which		102
Lushoto	45	
Mlalo	31	
Soni	26	

Table 2: Density and location of households interviewed

Country/site	Housing density				Location	
	Squatter	Low	Medium	High	Valley	Hill
South Africa;						
Mapate	25	74	19	-	39	79
Cato Crest	90	-	-	90	17	83
Lushoto	23	54	21	2	29	73

3. Analysis

Analysis of the data has been undertaken in two stages. Firstly, descriptive statistics based on simple averages, and secondly, by calculating the correlations between household socio-economic variables and human behaviour, with particular reference to factors which may predispose to zoonosis transfer. Two types of socio-economic variables have been used; firstly, household biodata and land use, and secondly livestock ownership, important both as an indicator of wealth and as alternative carriers to rodents.

The correlation analyses were run separately for each group of variable, i.e. livestock, housing, sanitation, storage of staples, rodents, etc.

The correlation analyses were made using XLSTAT 7.1. The calculations are made by crossing columns using the Pearson correlation coefficient (similarity within the interval [-1,+1]).

Presentation

In the correlation tables only relationships which were significant at the 0.05 level are presented (see: following para for the few exceptions). Correlations around 0.2 are low, but are still significant.

In almost all correlation tables, bold text is used, whether the correlations were positive or negative. This format is modified in a few cases, where:
there are a large number of correlations; positives have been presented in bold and negatives in italics.
what were expected to be important relationships have not resulted in significance, the correlations have been presented in normal text.
Wherever these occur, the reader is alerted to the change in format.

Each sub-section of text deals with a specific socio-economic issue potentially relevant to human vulnerability to rodent-borne diseases. At the end of key sections there is a short overview summary comparing the sites.

Where a table cell is blacked out, this means no data was generated because the question was not asked.

A. Socio-economic status

The data are analysed for head of households whose performance is seen as a key indicator of household socio-economic

Socio-economic status of other H/H members. Considerable additional data has been gathered on the socio-economic status of all members of interviewed households: gender, age, education level and economic indicators. Further analyses of this data could be undertaken.

Age and education

As heads of household are the most senior members of the family, this overall age structure seen in Table 3 would be expected. However there are some notable differences between the villages for: Lushoto, higher average age; Lushoto, much lower levels of education, and the relative importance of men or women as HoH; the h/holds headed by men and women were reciprocals in Mapate and Cat Crest, whereas in Lushoto, relatively few h/holds were headed by women.

Table 3: Age and education status

Country/ site	Age				Education
	Average	Range	Males %	Females %	Average years
South Africa					
Mapate	45.2	17 - 91	56	44	7.2
Cato Crest	42.0	20 - 75	57	43	7.3
Tanzania					
Lushoto	51.8	20 - 86	86	14	4.7

There were no strong positive correlations between the different socio-economic indicators within families. Age and education status were negatively correlated for Mapate: -0.531, presumably resulting from the improved access to education for those younger.

Employment status

The key member of the household for employment is thought to be the head of household. The following table presents the employment status for heads of household.

Table 4: Employment status

Country/ site	Employment status								Stays at home			
	Unemployed		Employed		Pensioner		Others		Yes		No	
	Nos.	%	Nos.	%	Nos.	%	Nos	%	Nos	%	Nos	%
South Africa												
Mapate	77	64	30	25	12	10	-		107	90	12	10
Cato Crest	15	23	58[1]	66	13[2]	15	2[3]	2	84	93	6	7
Tanzania												
Lushoto	5	5	93	91	4	4	-		101		1	

[1] Includes 24 classed as ‘informal earning’
[2] Includes those on grants and 1 classed as ‘retired’
[3] Housewives

The employment status for the entire sample of the sample is considered in Table 5 below. As expected, given the importance of the head of household, the average level of employment declines.

Table 5: Employment status of HoH

Status	Numbers	%
Unemployed	414	83
Employed	66	13
Pensioner	19	4
Scholar	1	-

Biodata/social indicators

Table 6: Correlations between socio-economic indicators

		Education	Occupation	Land area
Lushoto	Age	-0.367		0.390
	Education		-0.217	
Mapate	Age	-0.531	0.541	
	Stays at home		0.201	

Only correlations significant at the 5% level are shown.

Household heads in Mapate and Cato Crest (South Africa) were fairly evenly divided between men and women, whereas Lushoto (Tanzania) was dominated by men. Mapate and Cato Crest were fairly close in average age and years of education, whereas in Lushoto, average age was higher than in the other sites and education years notably lower.

Age is negatively correlated with education, presumably because education is now generally available to younger family members. Age and occupation are positively correlated in Mapate with most of the older heads of household being involved in agriculture. In Lushoto, age is positively correlated with land area for the same reason.

Generally however, age and education did not exhibit strong correlations with other variables.

Overview of socio-economic status

Although there were differences between sites, the general economic status of the sample households was low, characterised by low levels of employment and dependency on the head of household (HoH). Apart from Lushoto, where animals are an important asset, further indication of low economic status are the number of animals kept in Mapate and Cato Crest (although as a squatter area, this is to be expected), and the quality of housing.

Mapate and Lushoto are both rural locations and so provide a useful comparison. A major difference is that the Lushoto is far from an urban centre whereas Mapate is close to a major urban centre and is linked by cheap and readily available public transport.

There is a much higher level of employment amongst HoH in Lushoto than in Mapate, although this is masked because farming was not considered ‘employment’ in Mapate. The nature of employment also differs markedly, with a much higher proportion of the employed HoHs staying at home in Lushoto; partly because they are mainly farming. It may also be because of the propensity to migrate in search of paid employment in South Africa.

This would appear to indicate a relatively high level of unemployment in Mapate, and that most HoHs remain at home. It is thought that those who don’t stay at home are employed outside the village.

Land. The scale is important for the rural sites; Mapate and Lushoto. Farm size is small. (Note: Land can be a key indicator of wealth, but the surveys did not gather land ownership data).

Cultivation

Crops are important in Mapate and Lushoto. Maize is the most important crop; grown by all households and positively correlated with bean production in Lushoto. Vegetables are also important and fruit trees are grown by all farmers in Mapate. Cassava and bananas are also important in Lushoto. In Cato Crest the only crop is vegetables; grown by a few households. The different crops grown and areas are shown in Table 7.

Table 7: Crops grown, numbers of farmers growing and average areas in Square metres

Country/ site	What crops do you grow?											
	Vegetables		Fruit		Maize		Beans		Cassava		Bananas	
	Nos.	Area	Nos.	Area	Nos.	Area	Nos	Area	Nos	Area	Nos	Area
South Africa												
Mapate	47	94	100	32	107	1632					3	1343
Cato Crest	4	2.5[1]	9	2[1]								
Tanzania												
Lushoto[1]	66	0.7[2]	22	0.6[2]	100	2.0[2]	69	1.6[2]	57	0.9[2]	25	1.3[2]

[1] Also grown are Irish potatoes (which would be well suited because of the altitude) by 30 farmers on an average of 1.6 acres.
[2] In acres

It would appear likely that when in season, these crop areas provide a significant food source for rodents.

Table 8: Correlations between socio-economic indicators and crop areas: Lushoto

	Vegetables	Fruit	Maize	Beans	Cassava	Bananas	Irish potatoes
Age			0.387	0.293	0.277	0.269	
Education (yrs)		0.204			-0.225		
Land area	0.380		0.851	0.865	0.315	0.205	0.688
Vegetables				0.280			
Maize				0.616	0.348		0.478
Beans							0.658
Cassava							-0.201

The relationship between age and education could be complex; for example, younger farmers might have had more opportunities to stay longer in education. The positive correlations between age and: maize, beans, cassava and bananas suggests that these crops are grown increasingly with age. The correlations involving education are interesting: positively, with fruit, and negatively, with cassava. This might have been expected as awareness increases of the healthy benefits of fruit and that cassava is a ‘poor man’s crop’.

Land area is positively correlated with the growing of beans, maize, Irish potatoes, vegetables and cassava. Age of HoH is positively correlated with maize, beans, cassava and bananas.

Animals and livestock

Animals. Household keeping differs markedly for each site. Those kept on any scale are (in order of importance):
Cattle, at Lushoto and, with notably fewer animals, Mapate.
Goats at Lushoto and, with notably fewer animals, Mapate.
Sheep at Lushoto only
Cats at Lushoto and, with notably fewer animals, Cato Crest.
Dogs at Mapate and, with notably fewer animals, Lushoto and Cato Crest.
Pigs a few at Mapate only.

Table 9: Animal keeping

Country/ site	What animals do you keep?											
	Cattle		Goats		Sheep		Pigs		Dogs		Cats	
	Nos.	/HH	Nos.	/HH	Nos.	/HH	Nos	H/H	Nos	/HH	Nos	/HH
South Africa												
Mapate[1]	4	2.5	4	6.3	-		4	2.8	39	2.8	2	2.5
Cato Crest[2]	-		-		-		-		6	1.5	6	1.7
Tanzania												
Lushoto[3]	59	2.2	34	3.1	37	2.9	-	-	12	1.6	23	1.6

Other animals were kept by:
[1] 12 HH and an average of 5.7 (donkeys, chickens and ducks).
[2] 2 HH have 13 chickens.
[3] 60 HH and an average of 4.7.

Lushoto, compared with Mapate. Many more households keep animals. Cats are markedly more important numerically, dogs less so. There are very few animals in Cato Crest and no farm livestock, apart from chickens.

Animals sleeping in the house
Households were asked if animals sleep in the house. Animals are usually kept close to the house. Cats appear to move freely around compounds. In Cato Crest, almost half said that cats owned by others came into the house. Cats sleep in the house in almost ¼ of households in Lushoto and a few houses in Mapate and Cato Crest. The following tables give the responses.

Table 10: Animals sleeping in the house

Country/ site	What animals sleep in the house?											
	Cattle		Goats		Sheep		Pigs		Dogs		Cats	
	Nos.	%	Nos.	%	Nos.	%	Nos	%	Nos	%	Nos	%
South Africa												
Mapate[1]											2	100
Cato Crest	[redacted]											
Tanzania												
Lushoto[2]	59	100	33	97	35	95	-	-	12	100	23	100

Blocked out cells signifies question not asked/relevant

This question was intended to find out which animals slept close to household members. These responses suggests that the question was interpreted differently; Lushoto responses refer to animals living near the house.

A review of the data generated during the Mapate and Lushoto surveys indicated the need for more information in respect of cats, because of their importance as a primary host for toxoplasmosis. It was thought likely that not only the households' own cats might enter houses, particularly in urban areas. So, for Cato Crest households were asked; 'Do other cats come into your house?' and specifically whether cats 'slept in the house'. [1]

[1] A summary of the relevant discussion can be found in the Project Meeting Report, Maputo, February 2004.

Table 11: Presence of cats In percentages

Country/ site	Do other cats come into your house?		Do cats sleep in the house?	
	Yes	No	Yes	No
South Africa				
Cato Crest	40	50	4	86

Table12: Correlations between socio-economic indicators and livestock

	Education (yrs)	Goats keeping	Pigs keeping	Dogs	Cats keeping
Mapate					
Age	-0.531				
Cattle keeping		0.313		0.211	0.321
Dogs keeping			0.411		0.482
Lushoto					
Land area cultivated		0.198			
Cattle keeping		0.223			0.212
Dogs keeping		0.225			
Other animals		0.231			

In Mapate, cattle are positively correlated with: keeping cats, goats and dogs. In Lushoto, goats are positively correlated with: land area and keeping cattle, dogs and other animals.

Although there were also no strong positive correlations between ownership of different types of livestock in Mapate, households keeping cattle were more likely to also keep goats, dogs and cats. Because of the higher value of cattle, this may be an extension of economic well-being. There was also a positive correlation between households keeping pigs and dogs, and dogs and cats, although the reasons for this are not clear.

Housing

The type of housing lived in by the interviewees is presented in Table 13 and provides an indication of economic status. The use of 'improved' materials may reduce rodent access. *Note: for subsequent comparison with household type rodent catch.*

Table 13: Type of housing Percentages of respondents in each

Country/ site	Type of housing			
	Traditional	Improved	Brick and tile/sheet	Recycled materials
South Africa				
Mapate	13	41.8	44	
Cato Crest			53	47
Tanzania				
Lushoto	33	47	19	

Blocked out cells signifies question not asked/relevant

Rodent access to housing

The experience generated during the Mapate and Lushoto surveys indicated the need for more accurate information in respect of the access of rodents to houses and the areas surrounding. In essence, although status was still based on enumerator assessment, the refinements (explained below) addressed the different components of houses and compounds. These refinements were made to the questionnaire after these surveys were completed in time for the Cato Crest survey and beyond[2].

Table 14: Is the house rodent-proof? In percentages

Country/site	House is rodent-proof					
	Doorways		Eaves		Walls	
	Yes	No	Yes	No	Yes	No
South Africa						
Mapate						
Cato Crest	35	65	30	70	50	50
Tanzania						
Lushoto						

Blocked out cells signifies question not asked/relevant

Assessment of interviewee property for ease of rodent access.

Living accommodation.
Enumerators assessed the interviewee's house where the family sleeps for how rodent-proof the house is; checking the walls, the roof and the doors (when closed) to see if rodents can gain access. One of the categories below was chosen for each household interviewed.

Category 1
Very poor quality housing (poor quality building materials, gaps between building materials - about as bad as housing can be. Provides very easy access for rodents.

Category 2
Poor housing and worse than average. Access for rodents is relatively easy but not as bad as Category 1.

Category 3
Better than average. Quite good housing that could only provide limited access for rodents. Not as good as Category 4.

Category 4
Good housing, access for rodents is very difficult.

Table 15: Ease of rodent access: living accommodation

Country/site	Ease of rodent access category							
	1		2		3		4	
	Nos	%	Nos	%	Nos	%	Nos	%
South Africa								
Cato Crest?	9	24	12	32	15	39	2	5

Does not include non-responses.

Table 16: House ownership

Country/ site	House ownership			
	Do you own your own house?		How many years have you lived in this house?	
	Yes	%	Range	Average
South Africa				
Cato Crest	31	34	1 – 14	8.4

Does not include non-responses.

The rest of the household compound (excluding living accommodation)

2 A summary of the relevant discussions can be found in the Project Meeting Report, Maputo, February 2004.

Enumerators assessed how rodent-free the interviewee's compound of the household is. After checking all buildings (kitchen, toilet, poultry houses, etc.) and possible sites where rodents could hide (apart from the living accommodation) to see if rodents can gain access, one of the categories below was chosen for each household interviewed.

CATEGORY 1
There is very extensive availability of harbourage and cover (such as household waste, other rubbish, building rubble, timber stacks, etc.). Generally, there is very easy access to rodents to any buildings within the compound (poor quality building materials, gaps between building materials) and evidence of rodents (rodents' holes, etc.).

CATEGORY 2
The area could provide cover and harbourage for rodents. It is worse than average, but not as bad as Category 1.

CATEGORY 3
There is some cover but it is better than average. Not as good as Category 4.

CATEGORY 4
It is a very tidy and clean environment that provides almost no cover, or none, for rodents. Generally there is no access to rodents within the compound and no evidence of rodents

Table 17: Ease of rodent access: rest of the household compound

Country/site	Availability of rodent cover							
	1		2		3		4	
	Nos	%	Nos	%	Nos	%	Nos	%
South Africa								
Cato Crest?	9	24	18	47	9	24	2	5

Does not include non-responses.

South Africa Mapate
The closeness of houses to cultivated and uncultivated land (Table 18) confirms visual assessment; that cultivated land is quite close, and that most houses are quite close to bush areas. 'Bush' refers to uncultivated land full of trees, grass and other plant material, possible harbourage for rodents.

Table 18: Closeness of house to cultivated and uncultivated land Average distances per household in metres.

Country/ site	Type of land					
	Land used to grow vegetables		Land used to grow maize		Uncultivated land (bush)	
	HH	Dist	HH	Dist	HH	Dist
South Africa						
Mapate		9		75		114
Cato Crest						
Tanzania						
Lushoto[1]	70		100		57	

Blocked out cells signifies question not asked/relevant

Table 19: Correlations between socio-economic indicators and housing: Mapate

	Type of housing	Closeness of house to Vegetables	Closeness of house to Maize
Age			-0.211
Area land	0.302	0.228	
Goats keeping		O.548	

Table 20: Correlations between socio-economic indicators and housing: Cato Crest

	Type of housing		Rodent proof			Quality of accommodation	Home owner	Number years in home	Quality of compound
	Recycled	Br + tile	Doorways	Eaves	Walls				
Age			0.217						
Stay at home									-0.273
Housing recycled		-0.889	-0.448	-0.465	-0.511				
Housing Br + tile			0.464	0.432	0.622				
R-proof doors				0.554	0.587	-0.288	-0.245		-0.287
R-proof eaves					0.513	-0.397	-0.386	-0.336	-0.409
R-proof walls						-0.229	-0.227		-0.283
Quality of accommodation							0.752	0.706	0.928
Home owner								0.881	0.709
Number years in home									0.640

Table 21: Correlations between socio-economic indicators and housing

	General condition	Type of housing			Closeness of house to		
		Traditional	Improved	Br + tile	Vegetables	Maize	Bush
Lushoto							
Stay at home							0.239
Traditional housing			-0.639	-0.331	0.400	0.210	
Improved housing				-0.442	-0.272		
Vegetables						0.203	
Mapate							
Age						-0.211	
Area of land	0.302				0.288		

Overview

There is a lack of data for comparison of the type of housing and access to rodents. The experience generated during the Mapate and Lushoto surveys indicated the need for more accurate information in respect of the access of rodents to houses and the areas surrounding. Status was still based on enumerator assessment, the refinements addressed the different components of houses and compounds. These refinements were made to the questionnaire for the Cato Crest survey and subsequent surveys.

Socio-economic and housing factors where there is correlation for Cato Crest.
Positive correlations:
Home owner with quality of accommodation
Home owner with number of years occupancy
Quality of compound with quality of accommodation, home-owner and number of years in the house.
Brick and tile housing with rodent-proof walls, doors and eaves.
Rodent-proof eaves with rodent-proof walls.
Negative correlations:
Recycled housing with rodent-proof doors, eaves and walls.
Rodent-proof eaves with quality of accommodation, home-ownership, number of years in house and quality of compound.

Socio-economic and housing factors where there is correlation for Mapate.
Positive correlations:
Area of land with whether washing water is covered
Negative correlations
Age with drinking and washing water sources
Occupation with washing water source.

B. Human behaviour

Water

Drinking water sources. Rural sources are fairly evenly divided between piped and open (streams) and washing water comes mainly from open sources. Urban water sources are only piped. The source of water for families without their own piped water source is shown in Table 22.

Table 22: Family water sources: without own piped water source, In percentages

Country/ site	Drinking water source			Washing water source		
	Open	Piped	Purchased from a source outside the area	Open	Piped	Purchased from a source outside the area
South Africa						
Mapate	43	38		72	7	
Cato Crest		100			100	
Tanzania						
Lushoto	44	49		46	49	

Overview
As might be expected, given that water resources are shared, responses from adjoining households/families are consistent with one another.

Some households get water from more than one source: local springs, rivers and boreholes. Families appear to take more care with their drinking water than their washing water; with a larger number obtaining water from a piped source. The piped water is metered and paid to the local municipality, whereas river and spring water are a free resource.

Water storage is common for both drinking and washing water. Fewer households store in Cato Crest, where all water is piped. Covering water is commonplace with drinking water (up to 1/5th uncovered), less so for washing water. Boiling and filtering water is only practised in rural Lushoto where households have insufficient and have to purchase. In Mapate, drinking water is generally stored because is only available during restricted periods, whereas washing water is carried in larger containers which act as store until depleted.

Storage practice (the following tables) varies widely. Again more care is taken with drinking water than washing water, although 18 per cent of households do not cover.

Although families store water, the periods it is covered varies. Approximately half of the households cover most of the time or except when in use, whereas half of the households only cover occasionally or never.

Table 23: Families storing their water

Country/ site	Storing	
	Yes	No
South Africa		
Mapate		
Cato Crest	58	42
Tanzania		
Lushoto		

Table 24: Types of family water storage For those that store water, was it kept covered? In percentages

Country/ site	Drinking water		Washing water	
	Covered	Not Covered	Covered	Not Covered
South Africa				
Mapate	78	18	23	65
Cato Crest	87	13	9	91
Tanzania				
Lushoto	99	1	56	44

Table 25: Covering of stored water In percentages

Country/ site	Stored water is kept covered			
	Except when in use	Mostly	Occasionally	Never
South Africa				
Mapate	17	35	28	20
Cato Crest	88	-	6	6
Tanzania				
Lushoto	33	65	-	1

Table 26: Families boiling and filtering drinking water

Country/ site	Boiling	Filtering
South Africa		
Mapate	3	1
Cato Crest	[redacted]	
Tanzania		
Lushoto	85	38

Blocked out cells signifies question not asked/relevant

Overall

Most people boil their drinking water in Lushoto and many also filter it. In Mapate very few families boiled or filtered drinking water, probably because it is treated.

The types of water storage used in the different sites were: bucket; large clay pot and drum.

Sanitation

Type and location of toilet

Most families, over 90 per cent for all sites, have their own toilet.

Table 27: Does your family have its own toilet? Numbers

Country/ site	Own toilet	
	Yes	No
South Africa		
Mapate	100	19
Cato Crest	93	7
Tanzania		
Lushoto	95	3

Toilet construction. In the rural sites, households are fairly evenly divided between traditional and 'improved', with the remainder as brick/tile/sheet. In Mapate, the majority have a toilet that is improved or brick with tile/sheet type and few families a traditional type (Table 28) and a few families have two toilets. Some families are thought to have flushing toilets, using outside latrines when there is insufficient water for flushing. In Lushoto, the majority have traditional toilets.

Table 28: Type of toilet In percentages

Country/ site	Type of toilet		
	Traditional	Improved	Brick and tile/sheet
South Africa			
Mapate	14	49	34
Cato Crest			
Tanzania			
Lushoto	55	32	12

Blocked out cells signifies question not asked/relevant

The closeness of the toilet to sites of possible rodent habitation is shown in Table 29.

Table 29: Closeness of the toilet to sites of possible rodent habitation In metres

Country/site	Closeness of the toilet to sites of possible rodent habitation							
	The house		Land used for vegetable growing		Land used for growing maize		Uncultivated land (bush)	
	Range	Average	Range	Average	Range	Average	Range	Average
South Africa								
Mapate	6 - 35	17	2 - 70	17	1 – 2500	29	1 - 800	117
Cato Crest								
Tanzania								
Lushoto								

Blocked out cells signifies question not asked/relevant

Disposal of waste

In the rural sites, household practices are fairly evenly divided between burning waste and through ways such that it could remain a food source for rodents: discarded or in covered or uncovered pits. In Lushoto waste is mainly buried in a pit. In the urban site (Cato Crest) almost all waste is collected by the council.

Households use more than one method.

South Africa Mapate

Almost half of families burnt their waste. Disposal by the majority of the remaining households is through ways such that it could remain a food source for rodents.

Table 30: Family disposal of waste In percentages

Country/site	Method of disposal					
	Burnt	Thrown anywhere	Pit in garden and cover	Pit not covered	Collected by council	Other
South Africa						
Mapate	48	23	15	14	1	3[1]
Cato Crest	-	-	-	-	94	3
Tanzania						
Lushoto	11		85			6

[1] one place which is not covered, at the back of the house, as compost.

Table 31: Correlations between socio-economic indicators and sanitation: Mapate

			Closeness of toilet to				Waste disposal	
	Own toilet	Quality of toilet construction	House	Vegetable land	Maize land	Bush	Burnt	Other
Area land		0.366					0.334	
Occupation					-0.972			
Own toilet			-0.608					
Quality of toilet construction	-0.694		0.405			0.304	0.454	-0.279
Close to house	-0.608	0.405	0.266					
Close to veg	-0.246							
Close to maize								
Close to bush		0.304						
Waste burnt		0.454						
Waste other		-0.279					-0.549	

For Mapate, the correlation between occupation and distance from toilet to maize land is highly negative because many heads of households are farmers and the distances to the maize are far. The distance to the toilet from the house increases when it is not owned, so the correlation is highly negative.

For Lushoto, there was:
Positive correlation between
gender and brick and tile toilet and closeness of the toilet to the house.
Improved toilet with ‘council collection of waste’.
Strong negative correlation between
traditional toilets and improved and brick and tile toilets.

There are a number of unexpected cross-correlations which are difficult to explain. For example, traditional toilet was negatively correlated with ‘council collection of waste’, whereas with ‘waste is burnt’ it was positively correlated.

There were no positive or negative correlations between socio-economic indicators and sanitation for Cato Crest.

Table 32: Correlations between socio-economic indicators and sanitation: Lushoto

	Own toilet	Quality of toilet construction			Closeness of toilet to				Waste disposal		
		Trad	Impr	Br+tile	House	Vegetable land	Maize land	Bush	Pit	Council	Burnt
Head of h/h		-0.219		0.397	0.486						
Gender				0.208	0.256						
Stay at home						0.207		0.264			
Trad toilet			-0.731	-0.395		0.265				-0.249	0.231
Improved toilet				-0.247						0.310	
Close to house	-0.439										
Close to veg							0.392				
Waste pit										-0.391	-0.602

Table 33: Correlations between livestock and sanitation: Lushoto

Livestock numbers	Own toilet	Quality of toilet construction			Closeness of toilet to				Waste disposal		
		Trad	Impr	Br+tile	House	Vegetable land	Maize land	Bush	Pit	Council	Burnt
Cattle				0.205							
Goats								0.311			
Sheep											0.217
Dogs					0.340			0.275			
Cats											0.330
Other animals	-0.249					0.331					

Table 34: Correlations between livestock keeping and sanitation: Mapate

	Own toilet	Quality of toilet construction	Closeness of toilet to				Waste disposal		
			House	Vegetable land	Maize land	Bush	Council	Burnt	Other
Cattle							0.334		
Goats				0.279					
Pigs									
Dogs									
Cats									
Other livestock	-0.184								
Own toilet		-0.694	-0.608	-0.246					
Close to house		0.405		0.266					
Close to maize									
Close to bush		0.304						0.336	
Waste burnt		0.454							-0.549
Waste other		-0.279							

Correlations between livestock keeping and sanitation were:
Positive for Mapate:
Cattle with council collecting waste which may be related to increasing wealth and power.
Goats with closeness of the toilet to vegetable areas
Negative correlation
between type of toilet construction and other livestock (mainly poultry), but numbers are small.

Positive for Lushoto:
Dogs with closeness of the toilet to the house and with the bush.
Goats with closeness of the toilet to the bush.
Cattle with brick and tile toilet.
Sheep and cats with burnt waste disposal.

The reasons for a positive correlation between ‘the toilet is near to vegetables’ with goat-keeping, are not clear.

Staple food storage

Most of the households interviewed store their staple foods. The types of stores used by families for storing maize, and whether they are rodent-proof, are shown in Table 35. The majority use sacks. Households considered that more than a third of the stores are not rodent-proof.

Types of store used for staples

Table 35: Types of store used for staples In percentages

Country/site	Households storing	Type of store				
		Sacks	Traditional store (open)	Traditional store (closed)	Purchased store	Other
South Africa						
Mapate	86	62	-	2	-	2[2]
Cato Crest	84	14	84[1]	-	-	-
Tanzania						
Lushoto	100	98	12	88	7	-

[1] Drums
[2] Bucket and tins

For those storing staple food, less than half sleep in the same room as where staple food is stored and the majority do not (Table 36). Usually, bags of maize are put in the corner of the room.

Table 36: Do you store food on or off the floor? In percentages

Country/site	Store food	
	On the floor	Off the floor
South Africa		
Mapate		
Cato Crest	30	69
Tanzania		
Lushoto		

Blocked out cells signifies question not asked/relevant

Table 37: Families sleeping in the place where staple food is stored In percentages

Country/site	Families sleeping where staple food is stored	
	Yes	No
South Africa		
Mapate	42	58
Cato Crest		
Tanzania		
Lushoto	90	10

For Mapate there was:
Positive correlation between
sleeping with stored staples with storing staples in sacks with land area, and.
storing in sacks with storing staples and storing in sacks.

Table 38: Correlations between area of land cultivated and staple storage: Mapate

	Store in sacks	Family sleeps in same room as staples
Area land	0.222	0.199
Store staples	0.182	0.295
Store in sacks		0.238

For Lushoto there was:
Positive correlation between storing staples in sacks with traditional open store, and with the family sleeps in same room as staples.
Storing in traditional open store is positively correlated with the family sleeps in same room as staples but negatively correlated with traditional closed store .

Table 39: Correlations between socio-economic indicators and staple storage: Lushoto

	Store in				Family sleeps in same room as staples
	Sacks	Traditional open	Traditional closed	Other	
Age	0.207				
Education	-0.298				
Store staples		0.387			0.429
Store trad open			-0.743		0.289
Store other					-0.302

There were no positive or negative correlations between livestock keeping and staple storage in Mapate.

C. Rodents

Observation

Families were asked a number of questions dealing directly with rodents. The responses indicate that most people have seen rats in the village(Table 40).

The majority of h/holds in all sites, have seen rats in the village.

Table 40: Families seeing rats in their village In percentages

Country/ site	Families seeing rats in their village	
	Yes	No
South Africa		
Mapate	91	9
Cato Crest	86	14
Tanzania		
Lushoto	89	11

Of these, it most likely they were seen in the house or the bush/surrounding areas. Being seen in crops was only important in Lushoto. There is a lot of variation in respect of frequency of observation (seldom, 1/month, 1/week, 1/day and >1/day) for the 'Yes' families:
Mapate; a decline in scores as the frequency of observation increases; the most common frequency being once a month, and the least common - more than once a day.
Cato Crest; daily or more frequent observations account for the majority.
Lushoto; would appear to be bimodal – observations either not at all or frequent (to be checked)

In respect of frequency of observation. Those seeing rats in their village indicated (Table 41). For Mapate there appears to be a decline in scores as the frequency of observation increases; the most common frequency being once a month, and the least common - more than once a day. The daily observations do appear to be an important factor, accounting for at least 15% of the 'Yes' families. For Lushoto, there appears to be a bimodal distribution with peaks of 'seldom seeing rats' and the more frequent observations. The locations were people see rats are fairly evenly distributed.

Table 41: Location and frequency of seeing rats in their village Mapate

Frequency Where	Seldom	Once a month	Once a week	Once a day	> once a day	Total scores for this location
In the house	17	28	15	16	10	*86*
In crops	0	11	2	2	1	*16*
In the bush	34	24	13	1	6	*78*
Elsewhere	3	0	0	0	0	*3*
Total scores for this frequency	*54*	*63*	*30*	*19*	*17*	

Cato Crest

Frequency Where	Seldom	Once a month	Once a week	Once a day	> once a day	Total scores for this location
In the house	9	7	9	20	19	*64*
In crops	0	0	0	1	0	*1*
In the bush	6	4	7	19	27	*63*
Elsewhere	0	0	0	0	0	*0*
Total scores for this frequency	*15*	*11*	*16*	*40*	*46*	

Lushoto

Frequency Where	Seldom	Once a month	Once a week	Once a day	> once a day	Total scores for this location
In the house	52	2	4	7	18	*82*
In crops	38	1	13	20	9	*81*
In the bush	27	2	15	18	7	*69*
Elsewhere	-	-	-	-	-	
Total scores for this frequency	*107*	*5*	*32*	*45*	*34*	

Rats as a problem

To try and translate these frequencies into importance, interviewees were asked if rats are seen as a problem in their village (Table 42). Rats are seen as a problem by most h/h, except Lushoto, which is evenly divided. When asked specifically if rats carried disease, the majority response was 'Yes' for Lushoto and less than half for Mapate and Cato Crest. Bitten by rats, Mapate 5%, Cato Crest 14% and Lushoto 7%. None of which became infected.

Table 42: Rats are seen as a problem in their village In percentages

Country/ site	Rats are seen as a problem in their village	
	Yes	No
South Africa		
Mapate	84	16
Cato Crest	76	24
Tanzania		
Lushoto	52	48

Table 43: What problems do rats cause? Numbers of responses

Problem rats cause	Country/site	
	Cato Crest	
Eat food	30	
Eat clothes	21	
Make mess/dirty/holes	6	
Destroy furniture/other	6	
Destroy everything/ belongings	5	
Noise/disturbing	4	
Flies/health	2	

Table 44: What can be done about problems do rats cause? Numbers of responses

What can be done	Country/site	
	Cato Crest	
Nothing	19	
Poisoning/traps/kill them	17	
Keep yard cleaner	3	
Cover food	1	
Change behaviour	1	
City Council will come	1	

Table 45: Families that say rats carry disease In percentages

Country/ site	Families that say rats carry disease	
	Yes	No
South Africa		
Mapate	43	57
Cato Crest[1]	33	67
Tanzania		
Lushoto	64	36

[1] This question was only put to families not mentioning disease-related problems

From the views expressed in Tables 40 to 45 above, it could be concluded that concerns amongst interviewed families are less about disease than about other factors. In this, we could speculate that families might have concerns about food loss and nuisance value.

Family members which have been bitten by rats

South Africa Mapate
A small number of families say that family members have been bitten by rats. The members of the family most likely to be bitten were: granddaughter, grandson and mother. None of these people became infected.

Table 46: Families in which members have been bitten by rats In percentages

Country/ site	Families in which members have been bitten by rats	
	Yes	No
South Africa		
Mapate	5	95
Cato Crest	14	86
Tanzania		
Lushoto	7	93

Cato Crest
Of those bitten, the family members most affected were: daughter (4 families); spouse (3 families), and head of household (2).

Do you eat rodents?
Two families in Cato Crest said they ate rats.

Rat control
The majority of families say they undertake rat control (Table 47). Attributing this level of importance compares with Table 42 (above) in which a higher proportion of families considered rats a problem.

Table 47: Families that undertake rat control In percentages

Country/ site	Families that undertake rat control	
	Yes	No
South Africa		
Mapate	74	26
Cato Crest	21	79
Tanzania		
Lushoto	91	9

A range of methods are used to control rats; the most important being chemical, followed by mechanical, biological and other (Table 48). Because of the presence in Mapate village of another rodent-related project, we can expect some influence to have been exerted on these responses, particularly those assessing awareness.

Table 48: Control methods used by family members for rat control In percentages

Country/site	Control methods used by family members for rat control			
	Mechanical means	Chemical means	Biological means	Other
South Africa				
Mapate	13	34	4	7[1]
Cato Crest	11	52	8	-
Tanzania				
Lushoto	35	63	32	-

Households use more than one method.

Comments

South Africa Cato Crest
Some families expressed concern about using chemicals to control rats because there are young children around.
Cats are not a control option for some families because of religion.
Some families have sent their children away because of the rat problem.
Some used to control with chemicals, but felt it was ineffective.
Others stopped using because they felt it had been effective.
Some used to eat rodents in their farm villages but not here in squatter conditions (for health reasons?)
When there a lot of rats, people trap them, but when there are few they don't.

For Mapate
gender has a negative correlation with undertaking rodent control although positive with family members have been bitten, with which there is a positive relationship with education.
There is a positive relationship between thinking rats are a problem with think rats carry disease, family members bitten and undertake rodent control.
Similarly there is a positive relationship between thinking rats carry disease with family members bitten, undertake rodent control and chemical means of control.

Table 49 Correlations between socio-economic indicators and rodents: Mapate

	Think rats carry disease	Family members bitten	Undertake rodent control	Means of control	
				Chemical	Biological
Age (years)					0.246
Education (years)		0.228			
Area land				-0.232	
Think rats are a problem	0.490	0.297	0.241		
Think rats carry disease		0.296	0.333	0.247	

Households make a connection between rats being a problem and carrying disease, which are positively correlated, similarly between carrying disease and undertaking rodent control.

For Cato Crest
there is a positive correlation between seeing rats, undertaking control for which chemicals are used.

Table 50: Correlations between seeing and controlling rodents: Cato Crest

	Undertake rodent control	Chemical control
See rodents	0.213	
Undertake rodent control		0.222

For Lushoto, which has an endemic plague problem, many variables demonstrate positive correlations with one another (as might be expected), including:
Think rats are a problem with all the following: think rats carry disease; Family members bitten; Undertake rodent control, and chemical, mechanical, biological and other methods of control.
Think rats carry disease with all the following: Family members bitten; Undertake rodent control, and chemical, mechanical, biological and other methods of control.
Family members bitten with all the following: Think rats are a problem; Think rats carry disease; Undertake rat control; Mechanical and chemical, mechanical, biological and other methods of control.

Interestingly, seeing rats is negatively correlated with all the following: Family members bitten; Undertake rodent control, and biological and other methods of control. Also, land area is negatively correlated with think rats carry disease; and undertake rodent control

Also, where there is cross-livestock correlation they are negative except for other animals with think rats are a problem, which is positive.

Table 51: Correlations between socio-economic indicators and rodents: Lushoto

	See rats	Think rats are a problem	Think rats carry disease	Family members bitten	Undertake rodent control	Means of control			
						Mech	Chemical	Biological	Other
Land area			-0.228		-0.242				
See rats			-0.342	-0.363	-0.224			-0.282	-0.338
Think rats are a problem			0.540	0.489	0.298	0.231	0.388	0.298	0.436
Think rats carry disease				0.580	0.394	0.357	0.486	0.335	0.461
Undertake rat control				0.640		0.593	0.569	0.572	0.755
Mechanical	0.255			0.603			0.336	0.529	0.694
Chemical				0.555				0.294	0.644
Biological				0.581					0.729
Other				0.821					

As might be expected, there is a positive correlation between keeping cats and using non-chemical methods to control rats.

For Lushoto, there are strong positive correlations between the different methods of flea control and families affected by plague. The only socio-economic indicator with a correlation with and fleas/plague management is land area which is negative.

Any correlations between livestock with methods of flea control and with households affected by plague, are all negative.

For Mapate for livestock: rodent control relationships, there are positive some correlations.

Table 52: Correlations between livestock and rodents

	See rats	Think rats are a problem	Think rats carry disease	Family members bitten	Undertake rodent control	Means of control			
						Mechanical	Chemical	Biological	Other
Lushoto									
Cattle					-0.198			-0.246	
Goats				-0.276	-0.245				-0.211
Cats				-0.288		-0.241		-0.412	
Other animals		0.225				-0.234			
Mapate									
Goats	0.212								
Cats						0.248			
Other animals								0.264	

Although there is a negative correlation between seeing rats and family members being bitten, there are strong positive correlations between being bitten and: thinking rats are a problem, that they carry disease and attempting to control rats; with all methods of control.

There are negative correlations between owning cats (and owning goats) with being bitten and with mechanical and biological control.

D. Plague

This section focuses on areas thought to experience or be predisposed to outbreaks of plague.

There are positive correlations between frequency of observation and whether seen in crops and bush (Table 53).

Table 53: Correlations frequency of rat observation: Lushoto survey sub-sites

	Frequency rats seen in house				Frequency rats seen in crops				Frequency rats seen in bush			
	Seldom	1/week	1/day	1/day plus	Seldom	1/week	1/day	1/day plus	Seldom	1/week	1/day	1/day plus
Division		*-0.205*						*-0.315*				*-0.275*
Village		*-0.205*						*-0.315*				*-0.275*
Ward		*-0.205*						*-0.315*				*-0.275*
See rats	-0.291				*-0.268*				*-0.209*			
Rats seen in house												
Seldom		*-0.206*	*-0.199*	*-0.472*	0.228	0.198						*-0.199*
1/week	*-0.206*						0.282				0.436	
1/day	*-0.199*											
1/day plus	*-0.472*							0.491				0.485
Rats seen in crops												
Seldom	0.228					*-0.294*	*-0.329*	*-0.240*	0.457		*-0.357*	*-0.209*
1/week	0.198				*-0.294*				*-0.229*	0.837		
1/day		0.282			*-0.329*				*-0.240*	*-0.205*	0.808	
1/day plus				0.491	*-0.240*							0.873
Rats seen in bush												
Seldom					0.457	*-0.229*	*-0.240*			*-0.249*	*-0.278*	
1/week						0.837	*-0.205*		*-0.249*			
1/day		0.436			*-0.357*		0.808		*-0.278*			
1/day plus	*-0.199*			0.485	*-0.209*			0.873				

Only values significant at the level of significance alpha=0.050 (two-tailed test) are shown.
Positive correlations shown in bold, negative correlations shown in *italics*

It is not clear why only three of the frequencies that rats are observed exhibit a negative correlation: 1/week, house; more than 1/day, crops and more than 1/day bush. In each case, these correlations are common for division, village and ward.

Seeing rats is negatively correlated with 'seldom'.

Table 54: Household undertaking flea control In percentages

Country/ site	Household members undertaking flea control	
	Yes	No
Tanzania		
Lushoto	46	54

Table 55: Methods used for flea control Households can use more than one method. In percentages

Country/site	Methods used for flea control				
	Plaster floor	Put hot water on floor	Use insecticides	Use traditional insecticides	Other
Tanzania					
Lushoto	13	15	31	8	1

Table 56: Households affected by plague In percentages

Country/ site	Affected by plague	
	Yes	No
Tanzania		
Lushoto	5	95

Table 57: Differences between your household and those affected by plague

Country/site	Reasons given	Number
Tanzania		
Lushoto	There are rats	5
	There are rats with fleas	2
	They are not following health directives from health officers	3
	Dirty environment	3
	Dirty environment, poor disposal of dead rat	2
	There is a presence of fleas that cause the disease	2
	They are surrounded by bushes	1
	They are surrounded by bushes and rats that carry plague	1
	Sleep on Dry banana leaves	1
	People sleep on the floor	1
	Not healthy	1
	Unclean	1
Additional comments?		
	Lack of land	3
	The village has no plague cases	3
	No/ Few crops grown by respondent due to poor health	2
	Misuse of chemicals for rats control has caused some poisoning problems	1
	Rats might not be that many due to empty stores	1

The correlations are weak between the survey sub-sites in Lushoto for the control of rats and fleas (Table 58). The correlations are mainly not significant, and in the case of ‘rats carry disease’, there is a negative correlation. NOTE: secondary data for the survey sites are being checked for further information on plague incidence.

However, all correlations between all the rodent-related variables are positive and many are exceptionally highly positive. This suggests that:
rats are seen as a problem,
they are thought to carry disease
and that as a result:
households undertake rodent control, and
households undertake flea control.
There are also very strong correlations between these perceptions and actions and the subsequent methods used; all of which are also positively correlated with one another.

Also, there are very strong positive correlations between both family members being bitten by rats and the incidence of plague in a family, with all the other variables listed above.

Table 58: Correlations between perceptions control of rats and fleas: Lushoto

	Rodents			Fleas						Plague Incidence
	Rats carry disease	H/h member bitten	Under-take control	lea control	Control methods					
					Plaster	H/water	I/cides	Trad'nl	Other	
Rats are a problem	0.540	0.489	0.298	0.510	0.471	0.417	0.515	0.432	0.363	0.444
Carry disease		0.580	0.394	0.581	0.489	0.451	0.514	0.406	0.432	0.454
H/h member bitten	0.580		0.640	0.612	0.683	0.717	0.616	0.734	0.759	0.756
Undertake control	0.394	0.640		0.534	0.686	0.637	0.536	0.709	0.713	0.721
Mechanical control	0.357	0.603	0.593	0.496	0.585	0.541	0.496	0.568	0.668	0.601
Chemical control	0.486	0.555	0.569	0.590	0.641	0.651	0.563	0.600	0.575	0.623
Biological control	0.335	0.581	0.572	0.492	0.603	0.537	0.597	0.656	0.705	0.715
Other control	0.461	0.821	0.755	0.682	0.856	0.829	0.735	0.908	0.931	0.932
Flea control										
Undertake control	0.581	0.612	0.534		0.675	0.743	0.854	0.667	0.627	0.707
Plaster floors	0.489	0.683	0.686	0.675		0.838	0.660	0.806	0.787	0.834
Hot water floors	0.451	0.717	0.637	0.743	0.838		0.713	0.776	0.785	0.804
Use insecticides	0.514	0.616	0.536	0.854	0.660	0.713		0.687	0.685	0.746
Trad'nl insecticides	0.406	0.734	0.709	0.667	0.806	0.776	0.687		0.866	0.836
Other control	0.432	0.759	0.713	0.627	0.787	0.785	0.685	0.866		0.863
Plague incidence	0.454	0.756	0.721	0.707	0.834	0.804	0.746	0.836	0.863	

In bold, significant values (except diagonal) at the level of significance alpha=0.050 (two-tailed test)

There are strong correlations for all perceptions of rodents with resulting actions against rodents, including with the particular control methods used (not shown). Similarly

Table 59: Correlations between livestock and fleas/plague: Lushoto

	Methods of flea control		H/hold affected by plague
	Traditional insecticides	Other	
Cattle		-0.207	
Goats	-0.205	-0.238	-0.208
Cats		-0.197	-0.243

4. Review and discussion of results

Summary of outcomes

The three sites were:
Mapate; rural (close to a major urban centre), low-density
Cato Crest; urban, high density, and

Lushoto; mainly rural, low density, partly urban (small town), squatter and has an ongoing history of plague.

A Socio-economic status

Social characteristics.
Head of household is positively correlated with gender. Household heads in Mapate and Cato Crest (South Africa) were fairly evenly divided between men and women, whereas Lushoto (Tanzania) was dominated by men. Mapate and Cato Crest were fairly close in average age and years of education, whereas in Lushoto, average age was notably higher and education years notably lower.

Age is negatively correlated with education, presumably because education is now generally available to younger family members. Age and occupation are positively correlated in Mapate with most of the older heads of household being involved in agriculture. In Lushoto, age is positively correlated with land area for the same reason.

Although there were differences between sites, the general economic status of the sample households was low, characterised by low levels of employment and dependency on the head of household (HoH). Apart from Lushoto, where animals are an important asset, further indication of low economic status are the number of animals kept in Mapate and Cato Crest (although as a squatter area, this is to be expected), and the quality of housing.

Land. The scale is important for the rural sites; Mapate and Lushoto. Farm size is small. (Land can be a key indicator of wealth, but the surveys did not gather land ownership data).

Crops are important in Mapate and Lushoto. Maize is the most important crop; grown by all households and positively correlated with bean production in Lushoto. Vegetables are also important and fruit trees are grown by all farmers in Mapate. Cassava and bananas are also important in Lushoto. In Cato Crest the only crop is vegetables; grown by a few households.

Land area is positively correlated with the growing of beans, maize, Irish potatoes, vegetables and cassava. Age of HoH is positively correlated with maize, beans, cassava and bananas. Education is negatively correlated with growing cassava.

Animals. Household ownership differs markedly for each site. Those kept on any scale are (in order of importance):
Cattle, at Lushoto and, with notably fewer animals, Mapate.
Goats at Lushoto and, with notably fewer animals, Mapate.
Sheep at Lushoto only
Cats at Lushoto and, with notably fewer animals, Cato Crest.
Dogs at Mapate and, with notably fewer animals, Lushoto and Cato Crest.
Pigs a few at Mapate only.

Cattle are positively correlated with: keeping cats, goats and dogs in Mapate. Goats are positively correlated with: land area and keeping cattle, dogs and other animals in Lushoto.

Animals are usually kept close to the house. Cats appear to move freely around compounds. In Cato Crest, almost half said that cats owned by others came into the house. Cats sleep in the house in almost ¼ of households in Lushoto and a few houses in Mapate and Cato Crest.

The question about animals sleeping at the house was interpreted differently by different households.

There is a lack of data for comparison of the type of housing and access to rodents. The experience generated during the Mapate and Lushoto surveys indicated the need for more accurate information in respect of the access of rodents to houses and the areas surrounding. Status was still based on enumerator assessment, the refinements addressed the different components of houses and compounds. These refinements were made to the questionnaire for the Cato Crest survey and subsequent surveys.

Socio-economic and housing factors where there is correlation for Cato Crest.

Positive correlations:
Home owner with quality of accommodation
Home owner with number of years occupancy
Quality of compound with quality of accommodation, home-owner and number of years in the house.
Brick and tile housing with rodent-proof walls, doors and eaves.
Rodent-proof eaves with rodent-proof walls.
Negative correlations:
Recycled housing with rodent-proof doors, eaves and walls.
Rodent-proof eaves with quality of accommodation, home-ownership, number of years in house and quality of compound.

B. Human behaviour

Drinking water sources. Rural sources are fairly evenly divided between piped and open (streams) and washing water comes mainly from open sources. Urban water sources are only piped.

Water storage is common for both drinking and washing water. Fewer households store in Cato Crest, where all water is piped. Covering water is commonplace with drinking water (up to 1/5th uncovered), less so for washing water. Boiling and filtering water is only practised in rural Lushoto where households have insufficient and have to purchase.

Although there are many strong correlations between water source, storage and whether or not water is covered for each of the three sites, there is nevertheless variation between sites. It is not clear what causes this variation.

For example there is strong correlation between the types of store used for drinking water and washing water in Mapate. These two variables are also correlated for Cato Crest.

Socio-economic and housing factors where there is correlation for Mapate.
Positive correlations:
Area of land with whether washing water is covered
Negative correlations
Age with drinking and washing water sources
Occupation with washing water source.

Livestock keeping is correlated with a number of water management practices:
Positive correlations:
Dogs with storing water; Lushoto
Pigs and dogs with water is covered except when in use; Mapate
Negative correlations for Lushoto:
Goat numbers with washing water source, and
Dog numbers with whether water is stored.

There are a number of unexpected cross-correlations which are difficult to explain. For example, for Lushoto and how frequently water is covered; keeping cats is positively correlated with covered ‘except when in use’ but negatively with ‘mostly’ covered.

Toilet construction. In the rural sites they are fairly evenly divided between traditional and ‘improved’, with the remainder as brick/tile/sheet.

Waste disposal. In the rural sites, household practices are fairly evenly divided between burning waste and through ways such that it could remain a food source for rodents: discarded or in covered or uncovered pits. In Lushoto waste is mainly buried in a pit. In the urban site (Cato Crest) almost all waste is collected by the council.

For Mapate, the correlation between occupation and distance from toilet to maize land is highly negative because many heads of households are farmers and the distances to the maize are far. The distance to the toilet from the house increases when it is not owned, so the correlation is highly negative.

For Lushoto, there was:
Positive correlation between
gender and brick and tile toilet and closeness of the toilet to the house.
Improved toilet with 'council collection of waste'.
Strong negative correlation between
traditional toilets and improved and brick and tile toilets.

There are a number of unexpected cross-correlations which are difficult to explain. For example, traditional toilet was negatively correlated with 'council collection of waste', whereas with 'waste is burnt' it was positively correlated.

There were no positive or negative correlations between socio-economic indicators and sanitation for Cato Crest.

Correlations between livestock keeping and sanitation were:
Positive for Mapate:
Cattle with council collecting waste which may be related to increasing wealth and power.
Goats with closeness of the toilet to vegetable areas
Negative correlation
between type of toilet construction and other livestock (mainly poultry), but numbers are small.

Positive for Lushoto:
Dogs with closeness of the toilet to the house and with the bush.
Goats with closeness of the toilet to the bush.
Cattle with brick and tile toilet.
Sheep and cats with burnt waste disposal.

Most households store their staple foods: Mapate, 86%; Cato Crest 84%, Lushoto 100%. Most use sacks or a traditional open type of store. In Cato Crest, storage location is 30% (on the floor) and 69% (off the floor) Sleeping in the room where staples are stored, Mapate; 42% and Lushoto 90%.

For Mapate there was:
Positive correlation between
sleeping with stored staples with storing staples in sacks with land area, and.
storing in sacks with storing staples and storing in sacks.

For Cato Crest there was:
Positive correlation between
storing in drums with storing staples and
gender with storing on the floor.
Strong negative correlation between:
storing in drums with storing in sacks.

For Lushoto there was:
Positive correlation between storing staples in sacks with traditional open store, and with the family sleeps in same room as staples.
Storing in traditional open store is positively correlated with the family sleeps in same room as staples but negatively correlated with traditional closed store .

C. Rodents

The majority of h/holds in all sites, have seen rats in the village. Of these, it most likely they were seen in the house or the bush/surrounding areas. Being seen in crops was only important in Lushoto. There is a lot of variation in respect of frequency of observation (seldom, 1/month, 1/week, 1/day and >1/day) for the 'Yes' families:
Mapate; a decline in scores as the frequency of observation increases; the most common frequency being once a month, and the least common - more than once a day.
Cato Crest; daily or more frequent observations account for the majority.
Lushoto; would appear to be bimodal – observations either not at all or frequent (to be checked)

Rats are seen as a problem by most h/h, except Lushoto, which is evenly divided.
When asked specifically if rats carried disease, the majority response was ‘Yes’ for Lushoto and less than half for Mapate and Cato Crest. Bitten by rats, Mapate 5%, Cato Crest 14% and Lushoto 7%. None of which became infected.

For Mapate
gender has a negative correlation with undertaking rodent control although positive with family members have been bitten, with which there is a positive relationship with education.
There is a positive relationship between thinking rats are a problem with think rats carry disease, family members bitten and undertake rodent control.
Similarly there is a positive relationship between thinking rats carry disease with family members bitten, undertake rodent control and chemical means of control.

For Cato Crest
there is a positive correlation between seeing rats, undertaking control for which chemicals are used.

For Lushoto, which has an endemic plague problem, many variables demonstrate positive correlations with one another (as might be expected), including:
Think rats are a problem with all the following: think rats carry disease; Family members bitten; Undertake rodent control, and chemical, mechanical, biological and other methods of control.
Think rats carry disease with all the following: Family members bitten; Undertake rodent control, and chemical, mechanical, biological and other methods of control.
Family members bitten with all the following: Think rats are a problem; Think rats carry disease; Undertake rat control; Mechanical and chemical, mechanical, biological and other methods of control.

Interestingly, seeing rats is negatively correlated with all the following: Family members bitten; Undertake rodent control, and biological and other methods of control. Also, land area is negatively correlated with think rats carry disease; and undertake rodent control

Also, where there is cross-livestock correlation they are negative except for other animals with think rats are a problem, which is positive.

Questions on plague were added to the questionnaire for Lushoto, an endemic plague area. Household members undertaking flea control? Yes – 46%, No – 54%

Methods used by households for flea control Plaster floor, 13 %; Put hot water on floor 15 %; Use insecticides, 13 %; Use traditional insecticides 8 % Other 1%.

For Lushoto, there are strong positive correlations between the different methods of flea control and families affected by plague. The only socio-economic indicator with a correlation with and fleas/plague management is land area which is negative.

Any correlations between livestock with methods of flea control and with households affected by plague, are all negative.

Has anyone been affected by plague? Yes – 5%, No – 95%.

The correlations are weak between the survey sub-sites in Lushoto for the control of rats and fleas. The correlations are mainly not significant, and in the case of ‘rats carry disease’, there is a negative correlation.

However, all correlations between all the rodent-related variables are positive and many are exceptionally highly positive. This suggests that:
rats are seen as a problem,
they are thought to carry disease
and that as a result:
households undertake rodent control, and
households undertake flea control.
There are also very strong correlations between these perceptions and actions and the subsequent methods used; all of which are also positively correlated with one another.

Also, there are very strong positive correlations between both family members being bitten by rats and the incidence of plague in a family, with all the other variables listed above.

Overall the communities surveyed have a moderate to high (?) exposure to rodents:
Food source availability for rodents is 'high'
Rodent access to human buildings and land is 'high' and there is good availability of cover for rodents.
Close contact with alternative (to humans) hosts for rodent diseases is limited apart from cats.
Rodent access to human drinking water is 'moderate to high' – source, or while it is covered.
Rodent access to household waste is 'moderate to high'
Rodent access to stored food is 'high'
Frequency of observation of rats is 'medium to high' Awareness of the importance of rodents is 'low' although it becomes higher when diseases are specifically asked

Further research

The status of the ongoing research, in terms of sites, is reviewed below in Table 60.
Table 60: Socio-Economic Component. Regional matrix: representativeness.

Criteria	Mozambique	South Africa	Tanzania	Zimbabwe	Comments
Plague					
Existence of plague (*historic*)	✓ (Matara)	?	✓		
Consumption of rodents	✓		✓		
Leptospirosis	✓ (Mbala)		✓		High prevalence rates have been found where work has been done in Mozambique and Tanzania.
Widespread – probably everywhere. Not sure on prevalence.					
Toxoplasmosis					
Widespread – probably everywhere. Not sure on prevalence.					
Socio-economic partners contacted,	✓	✓	✓	✓	Areas and enumerators selected. Questionnaires, guidance and entry sheets provided.
Socio-economic survey					
Rural area	✓ ?	✓ [1]	✓ [3]	✓	
Peri-urban	✓		✓	✓	
Urban area	✓	✓ [2]	✓ ?	✓	
Market survey				✓	
Anthropometric study					
Rural area		✓ [1]	✓ [3]		
Urban area					

Key: ✓ indicates confirmation. *?* Indicates historical evidence

[1] Mapate, Limpopo province: 120 households, from 4 Blocks selected purposively according to observed economic status and proximity to bush areas in one village. Questionnaires for 30 households selected at random from each selected Block.

[2] Cato Crest, Durban, KwaZulu Natal province.

[3] Lushoto district, Tanga Province 102 households interviewed from 3 villages purposively selected on basis of historic assessment of their propensity to plague epidemic: (1) propensity to plague; (2) 'No' plague, (3) plague history but no plague since 1990. 34 questionnaires from households selected at random from each selected village.

The table shows the relative contribution of both those sites that have already been surveyed, and those where further surveys are planned (using slightly modified questionnaires).

Further socio-economic surveys planned.
–Mozambique, Maputo, urban surveys planned to complete 12/04
–Zimbabwe, Harare, urban surveys planned to complete 03/05
–Tanzania, Morogoro urban under consideration
–Mozambique, Zambezia, rural, plague under consideration

Areas where additional data will assist the identification of relationships:
Type of housing and access to rodents

Exploration of this data for relationships between socio-economic factors and family responses to possible exposure to rodent-borne diseases is being undertaken with simplified/combined groupings for: age; employment status and education.

This research output will be explored further to establish relationships with information emerging from other Project work packages.

5. Some Initial Observations/Conclusions

Comments on the analysis
There are differences between and within sites for all the social, economic, behaviour and rodent-related variables measured.

There are many cross-correlations within groups of variables. Some are strongly negatively correlated because they are mutually exclusive; if the toilets are of a traditional construction, they can't also be improved and brick and tile toilets.

Others, for example, drinking and washing water sources, storage vessels and practices, mostly positive, which at first sight are difficult to explain. However, this may be due to commonality; there are no significant differences between drinking and washing water; what applies for one, applies for the other. Also, piped water tends to remove possibilities for variation; less need to store, etc.. Except from the point of view of Leptospirosis, where there is wastage around common standpoints.

For some variables; e.g. accessibility of rodents to houses and availability of harbour in compounds, the method of assessment was changed during the sequence of surveys. In these cases we do not yet have enough data to assess links with socio-economic status.

Livestock are an important indicator of wealth in the rural surveys and are positively correlated with other indicators of wealth. However, positive and negative correlations with the human behaviour and rodent-related variables appear to be limited or coincidental. It is difficult to understand why, for example, there is a positive correlation between dogs with storing water and a negative correlation for goat numbers with washing water source (both in Lushoto)

There appears to be some positive relationship between wealth and rodent-related practices that are less risky.

Some relationships are evident between awareness of the importance of rodents and human responses. However, all the sites so far surveyed are also supporting zoonosis research and so there may be some influence on respondents' replies to questions.

Similar remarks apply to the one plague site surveyed so far, Lushoto, in respect of relationships and influence. Lushoto also has the influence of government programmes which are trying to help families deal with plague, so could be particularly significant in terms of influence on respondents' replies to questions.

Overview
The analysis reveals that the data basically consistent.

The "tentative conclusions", reported on during the Maputo and Copenhagen meetings, appear to hold. The communities surveyed have a moderate to high (?) exposure to rodents:

Food source availability for rodents is ‘high’
Rodent access to human buildings and land is ‘high’ and there is good availability of cover for rodents.
Close contact with alternative (to humans) hosts for rodent diseases is limited apart from cats.
Rodent access to human drinking water is ‘moderate to high’ – source, or while it is covered.
Rodent access to household waste is ‘moderate to high’
Rodent access to stored food is ‘high’
Frequency of observation of rats is ‘medium to high’. Awareness of the importance of rodents is ‘low’ although it becomes higher when diseases are specifically asked.

Next steps

Explore this research output with other WPs.
This report will be circulated for comment by other collaborators. Comments:
Would be considered for incorporation in the text;
Could influence further analysis of existing data and
Could influence further research.

Further research
Although there are some strong correlations discussed above, which appear to be significant, they are limited. This could mean that there are weak linkages between the social and behavioural aspects studied, or that we have insufficient data to verify relationships. Either way, the other surveys already planned should help to confirm which is the case for the different factors.

The uncompleted surveys would add:
Rodent access to houses and compounds: any additional survey.
Plague; Mozambique Zambezia and/or Zimbabwe Nkayi (also lack of influence from other research).
Urban; Mozambique Maputo and/or Tanzania Morogoro.
Lack of influence with zoonosis research: Mozambique Zambezia and Zimbabwe Hatcliffe and Nkayi.

Exploration of existing and additional data for relationships between socio-economic factors and family responses to possible exposure to rodent-borne diseases

This has been started with simplified/combined groupings for: age; employment status and education.

Annex 1: Household survey questionnaire Cato Crest, South Africa
Location, enumerator, interviewee

Name of enumerator: ________Date of interview: _________ GPS Code: _______

Location: Country South Africa Province: KwaZulu/Natal Urban: Durban/Cato Crest

Area/Block _______________________Density: Squatter/High density

Site (Tick one) Valley: _______Hill ________ Household number: ______________

Name of Household Head _______________Who is interviewed if different ___________

A. Socio-economic status

Biodata/social indicators

Code ↓	Household members occupation					Office use ↓
	* Write in the number code for these categories					
	Relation to family head	Age	Gender	*Years completed in school*	*Occupation*	*Stays at home*
101						
102						
103						
104						
105						
106						
107						
108						
109						
110						
111						
112						

Cultivation
Do you grow any crops near the house? Yes No
If 'Yes', what crops do you grow?

		Square metres	Office use
201	Vegetables		
202	Fruit		
203	Maize		
204	Other staples (specify)		

Animals
What animals or livestock do you keep? Yes No

		Numbers			Numbers	Office use
301	Chickens		303	Dogs		
302	Pigs		304	Cats		
305	Other animals (specify)					

		Tick if 'Yes'	Office use
310	Do other cats come into your house?		
311	Do cats sleep in the house?		

Housing

What type of house does the family live in? Tick

401	Recycled materials		Brick/cement walls and tile/sheet		

Is the house rodent-proof?

405	Doorways	Yes	No	
406	Eaves	Yes	No	
407	Walls	Yes	No	

Assess the quality of the living accommodation

Refer to the categories and tick one of the following

410	1	2	3	4	

		Tick if 'Yes'	
420	Do you own your own house?		

		No. of years		
430	How many years have you lived in this house?			

Assess the quality of the rest of the household compound (excluding accommodation)

Refer to the categories and tick one of the following

440	1	2	3	4	

B. Human behaviour

Water Tick

Where does your family obtain its drinking water from?

501	Open water source	
502	Piped water source	
503	Purchased from a source outside the area/village	

Where does your family obtain its washing water from?

504	Open water source	
505	Piped water source	
506	Purchased from a source outside the area/village	

507	Does your family store its water?	Yes:	No:	

Enumerator: if the answer if YES, continue to Question 508, if NO, to Question 512

If Yes, in what does your family store its water? Specify / tick

508	Drinking water	Type: ___			
509		Covered?	Yes:	No:	
510	Washing water	Type: ___			
511		Covered?	Yes:	No:	

	Is the stored water kept covered? Tick		
512	Except when in use		
513	Mostly		
514	Occasionally		
515	Never		

Sanitation Tick

601	Does your family have its own toilet?	Yes:	No:	

	How do you dispose of waste:	If 'Yes,' tick	
610	Pit in garden		
611	Collected by council		
612	Burnt		
613	Canals		
614	Other (specify)		

Staple food storage Tick

701	Does your family store staple food?	Yes:	No:	

Enumerator: if the answer if YES, continue to Question 702, if NO, to Question 801

702 What type of store do you use? Is it rat-proof? Tick those applicable

Is it rat-proof?

		Used	Yes	No	
710	Sacks				
711	Drums				
712	Tins				
713	Other (specify) ___________________________				

Where do you store food? If 'Yes,' tick

720	On the floor		Off the floor			
721	Does the family sleep in the house with stored food?		Yes:		No:	
722	Does the family sleep in the same room as stored food?		Yes:		No:	

C. Rodents

Observation Tick

801	Do you see rodents in your area?	Yes:	No:	

Enumerator: if the answer if YES, continue to Question 802, if NO, to Question 806

Where and how frequently do you see rodents in your area? Tick those applicable

	Frequency Where	Seldom	Once a month	Once a week	Once a day	More than once a day	
802	In the house						
803	In crops						
804	In the bush						
805	Specify						

806	Are rodents a problem in your area?	Yes:	No:	
807	If so, in what way (Specify)?			
808	If they are a problem, what can you do to overcome problems?			

If ´they carry disease´ was not mentioned, please ask Question 809

809	Do rodents carry disease?	Yes:	No:	

810	Have any of your family members been bitten by rodents during the past year?	Yes:	No:	

Enumerator: if the answer if YES, continue to Question 820, if NO, the questionnaire is complete

Which family members have been bitten by rodents? One Tick for each member bitten

Family members in questions 820 - 821 are the same as filled in for questions 101 - 112

	Relation to family head	Which family members been bitten by rodents? Tick	Were any family members infected by these bites? Tick		
			Yes	No	
820					
821					
822					
823					
824					
825					
826					
827					
828					
829					
830					
831					

840	Do you eat rodents?	Yes:	No:	

845	Do any family members undertake rodent control?	Yes:	No:	

	If yes, what do family members use to for rodent control?	Yes:	No:	
850	Mechanical means			
851	Chemical means			
852	Biological means			
853	Other (specify)			

Notes: Any additional information relevant to the study which was observed, or took place during the interview.

Progress on WP 7, Measuring factors of anthropogenic change upon rodent ecology, epidemiology and natural capital

Reports have been finalised and published for three sites: Lushoto, Tanzania; Cato Crest, South Africa and Mapate, South Africa.

Mapate, Limpopo Province, S. Africa – report finalized and final draft ready July. Map still awaited from Pfarelo Matshidze, the anthropologist from the University of Venda who carried out the fieldwork (three copies got lost in the post). After some effort, this arrived electronically via Frikkie Kirsten. The report has now been printed and distributed with a cover and the map.

Cato Crest, Durban, S. Africa – fieldwork carried out by Suzanne Leclerc-Madlala February – May. Report edited and finalized by Monica Janowski, printed and distributed June 2004.

Lushoto, Tanzania – first draft produced Feb 04 by Flavianus Magayane of Sokoine University, using data gathered by himself, Edmund Kayombo and Devota Mosha. After comments and revisions by Dr. Magayane, editing and finalization by Monica Janowski, final version printed and distributed October/November 2004.

Zambezia Province, Mozambique – a study was carried out in late 2004 by a sociologist identified through Ricardo Thompson, and a first draft of the report is currently in the process of being written. The work package coordinator, Monica Janowski, is not yet in receipt of this.

Maputo, Mozambique and **Harare, Zimbabwe** – discussions have been held about studies to be held in these two sites, and in principle they are to go ahead. However these have not started yet. In Maputo, this is because Ricardo Thompson felt that it would be best to get the draft report on the study in Zambezia province written first. It is not clear why the study in Harare has not yet started. A sociologist who is able to do the work has been identified but she has not yet been contracted through Syngenta although it was agreed that this would happen.

GIS – Preliminary discussions have been held with Judith Pender about inputting the anthropological data and copies of the reports on Cato Crest, Mapate and Lushoto have been sent to her.

Progress on WP8, Geographic Information System and Remote sensing

General

Good progress has been made to developing a database that can hold a lot of the data generated by the project as well as complementary data for the GIS displays. A GIS prototype has been developed to enable easy and quick access to the project data in map form.

The main frustration of the year has been the difficulty in obtaining satellite imagery from the South African Receiving Station. This has delayed the production of satellite maps for the study sites.

A start has been made on the land use interpretation for the main focal sites, but again this cannot be competed until all the imagery is received.

Database development

Database design was finalised and developed after discussions with project members and the tables are comparable with the datasets being developed by the individual work packages. The database has been programmed using VBA and the Access database. There are import programs to enable rapid input of the project data, especially important for the large number of rat catches. A number of queries and pivot tables have been developed to help analyse the data, especially related to spatial representation. For example, the pivot table below shows the rat catches. Filters can be applied to this table to refine the data as required.

Rodent Capture Pivot Table

Sex: All | TrapType: All

Species	MO Rodents caught	SA Rodents caught	TE Rodents caught	ZI Rodents caught	Grand Total Rodents caught
(Blank)	128				128
Aethomys		44			44
Arvicanthis			111		111
Cricetomys			139		139
Crocidura			274		274
Dasymys		3	6		9
Grammomys			20		20
Lemniscomys		11	13		24
Mastomys	2	318	1714	13	2047
Mus	111	24	393		528
Mus (Leggada, Nannomys)		1	12		13
Otomys		2			2
otomys ango.		1			1
Praomys			2		2
rattus		8			8
Rattus norvegicus	26	235	35		296
Rattus rattus		21	397	15	433
Rattus sp.		5			5
Rhabdomys		7			7
Saccostomys		1			1
Shrew			1		1
Steatomys		1	1		2
Tatera	2		44		46
Grand Total	269	682	3162	28	4141

The database is also being used to store other project data and meta data about the maps and images gathered for the GIS as well as the climatic data supplied by project partners. The database has been distributed to partners for comments.

GIS

A GIS has been developed based on the Arcview 3.x. The interface developed allows rapid access to map and interpreted data as well as to the data generated by other work packages. Several queries for display have been developed and work is ongoing to refine the display and develop meaningful queries, analyses and displays.

A map of the total rodent catches for Mapate in September 2003 is shown below as an example. The base is an aerial photograph supplied by South African Collaborators.

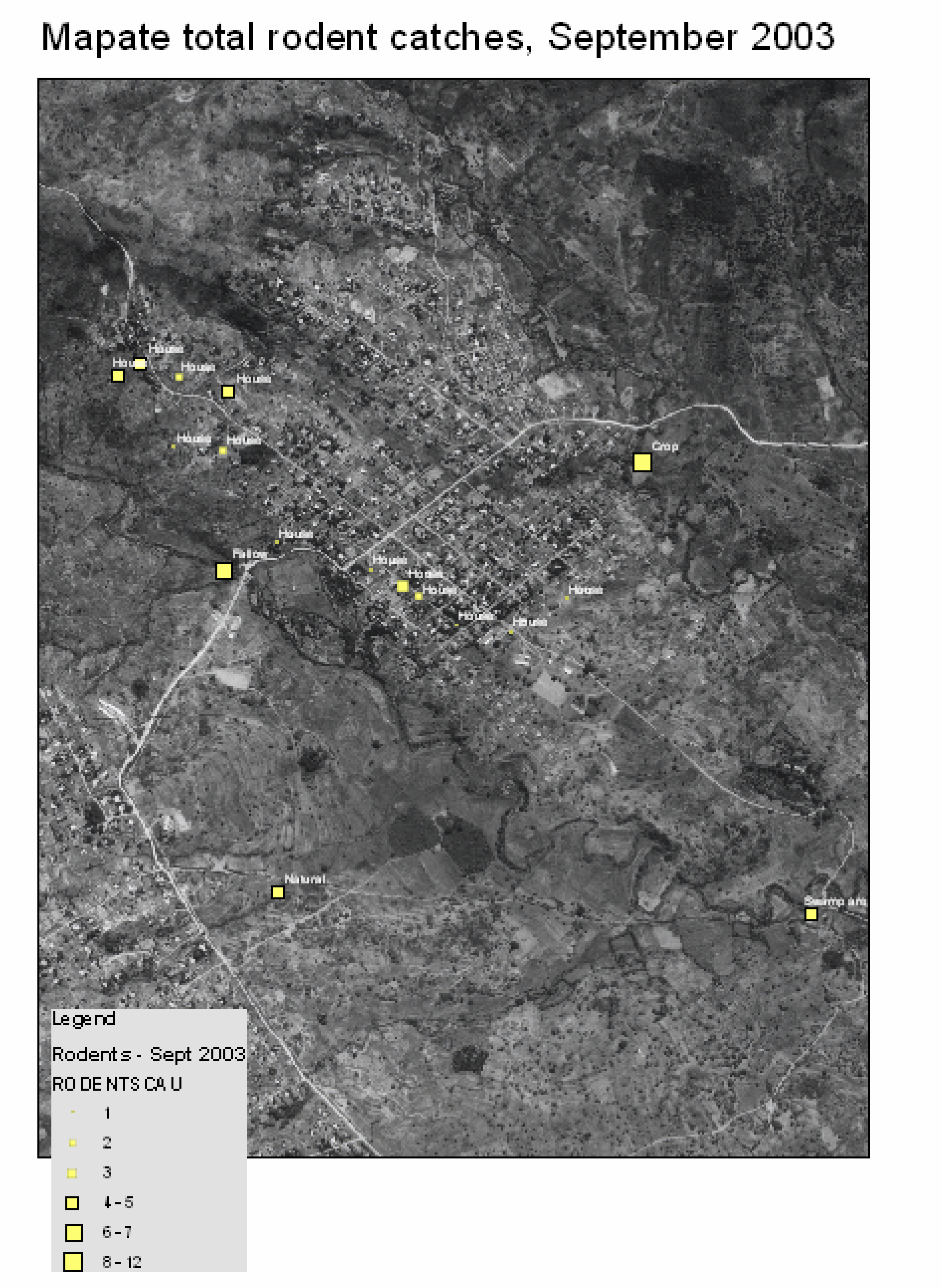


Image Processing

The image processing component of the project is divided into two parts

1. Providing up to date map coverage for all the sites (nominally two sites per country. However, Durban has a very good digital map coverage already so this site was not covered, Work is progressing on six of the remaining sites. Some extra imagery is required to cover the sites adequately and this has been requested. We are also not absolutely certain of the location of the Zimbabwe secondary site and have not ordered imagery for that site yet. This work is using SPOT imagery.
2. Land use in the focal sites over the last ten years. Imagery has been obtained and work is in progress. The Thematic Mapper imagery is proving difficult to analyse without any ground truth data for the sites, but we are hoping that using the recent SPOT imagery acquired will provide a better recent analysis.

In addition collaborators have provided aerial photography for Morogoro (Tanzania) and Mapate (South Africa).

Next few months

Tasks for JP and RT

1. Finalise GIS design and manual
2. Produce analyses for April meeting
3. Complete map production
4. Complete satellite maps
5. Continue to refine database
6. Hand over to RT (after April meeting).

Required from collaborators

Sites information
Continued supply of rat and serology data
Climatology data
Photos
References and keywords for bibliography

Status of Tasks identified in January 2004 and progress

Tasks for Maputo

Task	Status
1. Order hardware and software and install	Complete
2. Install prototype GIS –	Awaiting RT visit to UK
3. Source TM sub-scenes and purchase (for focal sites)	partially done
4. Copy TM scenes onto cds and DHL to Pender –	images delivered directly to UK
5. Source high resolution data for all study sites (SPOT or aerial imagery or existing coverages)	done
6. Purchase data identified in 5 –	partly done
7. Prepare high resolution background coverages and place in \Rats\GIS\TOPO	Being done in UK
8. Add meta details to map data base in Raztzooman.mdb	Done in UK
9. Prepare and distribute topo maps to collaborators for use in the field	Being done in UK
10. Send coverages and updated database to Pender	Not necessary
11. Source water information	Not done
12. Source climatic data for the study sites	Being done by collaborators
13. Input climatic data into data base	Being done in UK
14. Input land use change coverages (see 3,4 above and 2 below	Being done in UK
15. Input Socio-economic data????	Being done in UK
16. Input rats data ?????	Being done in UK
17. Input disease data	Being done in UK

Tasks for Pender

Task	Status
1. Continue to source remote sensing and other background data as above Continuing – but I would appreciate knowing what has been accomplished by RT	Done
2. Send budget	Done
3. Analyse the land use change from the TM scenes. Provide coverages for the GIS and send to Maputo. Write report	In progress

for collaborators. Unable to achieve – no data received from Maputo.	
4. Obtain database structure from Herwig, incorporate the database structure into Ratzooman.mdb. Send new database to Maputo. Database under construction – further details on structure requested from Herwig, but will be sorted out in Maputo	Done Later done
5. Reply to Herwig	done
6. Input rats data ?????? Future task – will be sorted out after Maputo	Done and continuing
7. Structure database for climatic and water resources data In hand – design partially complete – Need feedback from collaborators	Done for climate No water data to work on
8. Structure database for disease data Need further discussion with collaborators	done
9. Program extraction of data into GIS Future task	done
10. Up date manual Future task	Not done
11. Consult the socio economic scientists over relationships between data and GIS Meeting held with socio economic scientists	done
12. Consult with Modellers over use of GIS and database data Need more data into GIS	Not done yet
13. Contact Tony Palmer & aerial photography suppliers in RSA	Done, passed to RT
14. Send and copy all documentation to Ricardo	done
15. Ask AL/Anne about Tanzania data sources used in Lake Tan Gef project	Done – no suitable data

Progress on WP9, Predictive and simulation modelling tools for assessing zoonotic transmission risks in rural and peri-urban areas of Africa

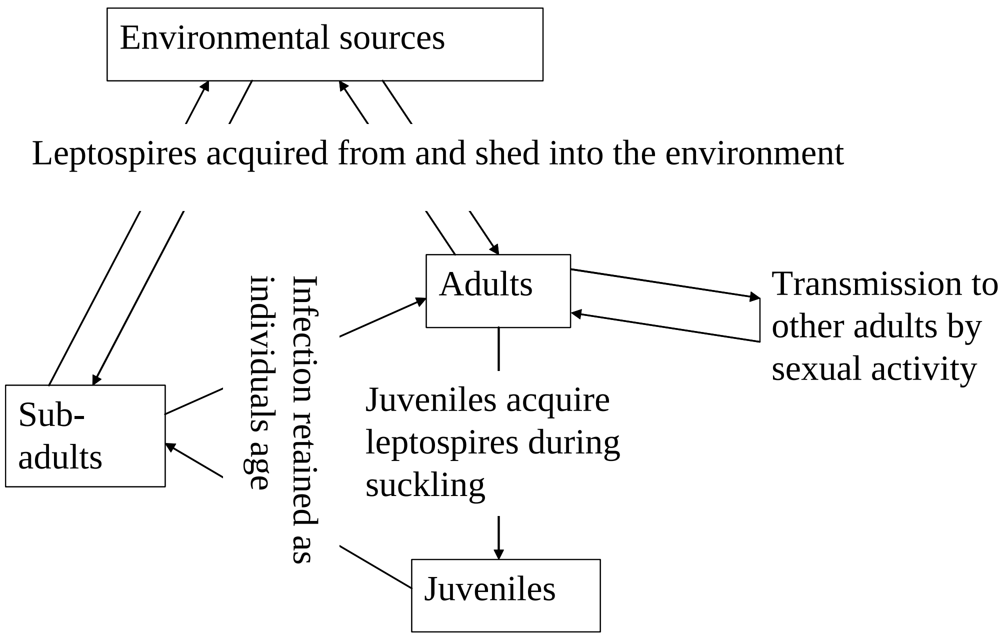
Work has focussed on the further development of an epidemiological model of leptospirosis. The general approach has been to devise a model combining a rodent population model (Mastomys model, Leirs et al) with an epidemiological model of leptospira infection in the rodents. The latter is entirely novel as no previous attempt to model the dynamics of the disease has been found in the literature. Validation is planned by comparison of model output with rodent population data, and to the extent that it is available, leptospira prevalence data in the rodents. The model will then be used to investigate the potential effects of management interventions affecting rodent populations. The objective is to help guide policy and strategy for leptospirosis control.

In developing the new model various issues were addressed. Leptospirosis in rodents is highly complex and careful consideration was given to the extent to which this complexity should be incorporated to provide a model which had greatest utility. One important aspect of this complexity is the existence of three transmission routes: sexual transmission, mother to offspring transmission and infection from environmental sources.

Sexual transmission has been postulated by some to be ‘the major transmission route in rodent disease reservoirs’ but evidence also exists that that Leptospirosis fails to persist in rodent populations in absence of other infection sources (reference). Mother to offspring transmission can occur through mother’s milk, probably in most mammals, including rodents. Juveniles acquire passive immunity from carrier mothers which may be active for more than one month. Juveniles are however more susceptible to infection than older animals. Sensitivity analysis was used to begin to gain an understanding of the importance of both the sexual and the mother-to-offspring transmission routes.

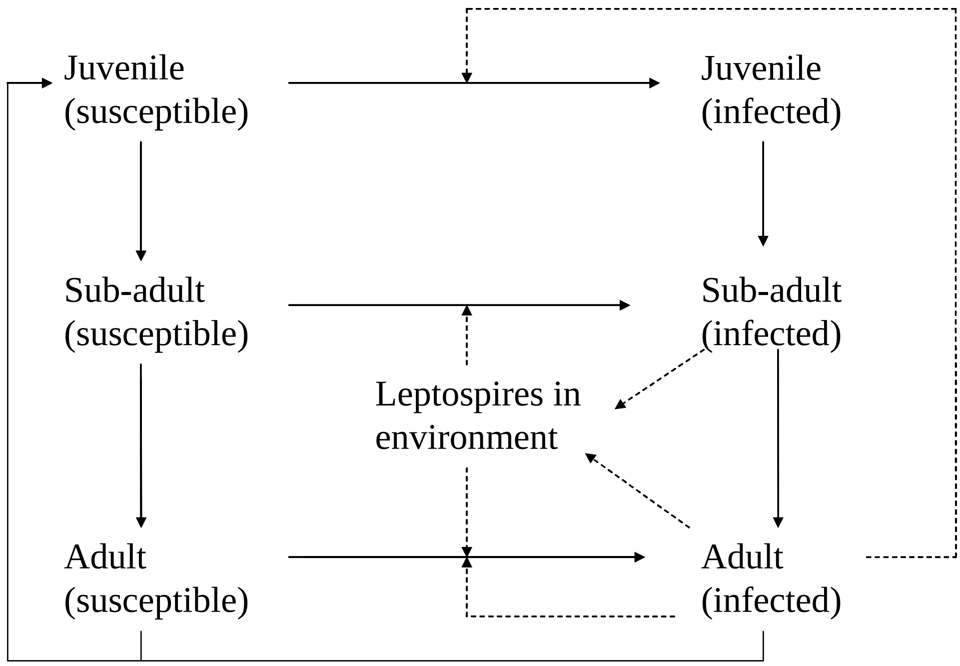
Infection from environmental sources is thought to be the most important transmission route but how this is affected by seasonal fluctuations required consideration. In the wet season, leptospire survival was expected to be better as moisture & humidity are greater and water bodies would usually be fresher and cleaner. Leptospire concentration may be lower due to dilution, so the risk of rodents acquiring infection may be lower. In the dry season, initial leptospire survival is likely to be poor as most rodent urine would be shed on dry ground. Leptospire concentration in dry-season water bodies my be high, however, as rodents visit and contaminate the few remaining water sources, so risk of infection may be higher. Survival of leptospires would be expected to decline as water quality deteriorates. Seasonal effects on rodent (Mastomys) population dynamics are better understood and some simulations incorporating seasonal processes were run to compare model output with existing Mastomys data. Model predictions about fluctuations in leptospira infection in the rodent population cannot be tested until project data become available.

Fig. 1 Various leptospire transmission routes in a rodent host



In the development of the model it was clear that the importance of the different transmission routes was related to the life-stage of the rodent. From the perspectives of both leptospirosis epidemiology and rodent population dynamics it was convenient to consider three rodent life stages: juveniles, sub-adults and adults. Accordingly the model has six variables representing the rodents and one variable, leptospires in the environment.

Fig. 2. Model variables and relationships (solid arrows indicating variable changes and dashed arrows infection routes).



The mathematical details of the model are given elsewhere in this report. Some initial analysis of the model is discussed below.

Various types of management intervention are possible which might be expected to have some effect on leptospira infection in the rodent population.

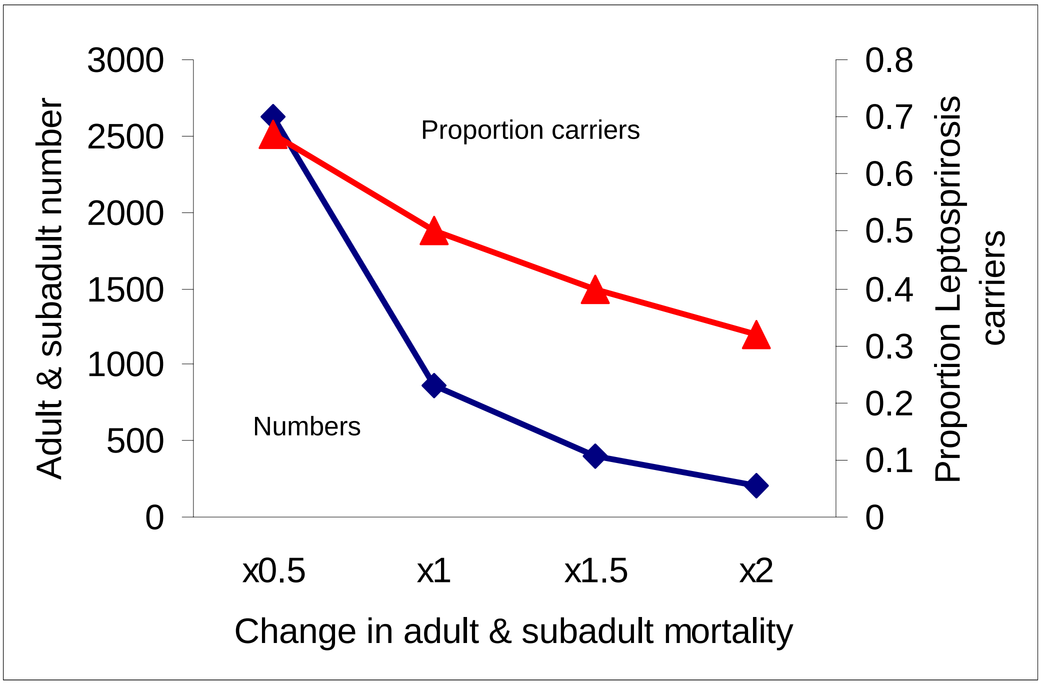
- Trapping – increase in mortality, change in age structure
- Reduce rodent habitats – decrease in environment carrying capacity
- Separate rodents and humans - so reduce decrease in leptospire shedding into water sources (but possibly not rat contact with leptospires)
- Chemosterilants – reduce breeding, change age structure

The different management interventions correspond to different model parameters. For example, trapping corresponds to a decrease in the survival of sub-adults and adults (parameters s_1 and s_2, respectively). In contrast, actions to reduce rodent habitat correspond to a reduction in the rodent carrying capacity of the environment (represented by the parameter c, which controls the strength of the density dependence in rodent maturation). By varying the values of the relevant parameters in the model it is possible to examine the impact that might be expected from the corresponding management intervention.

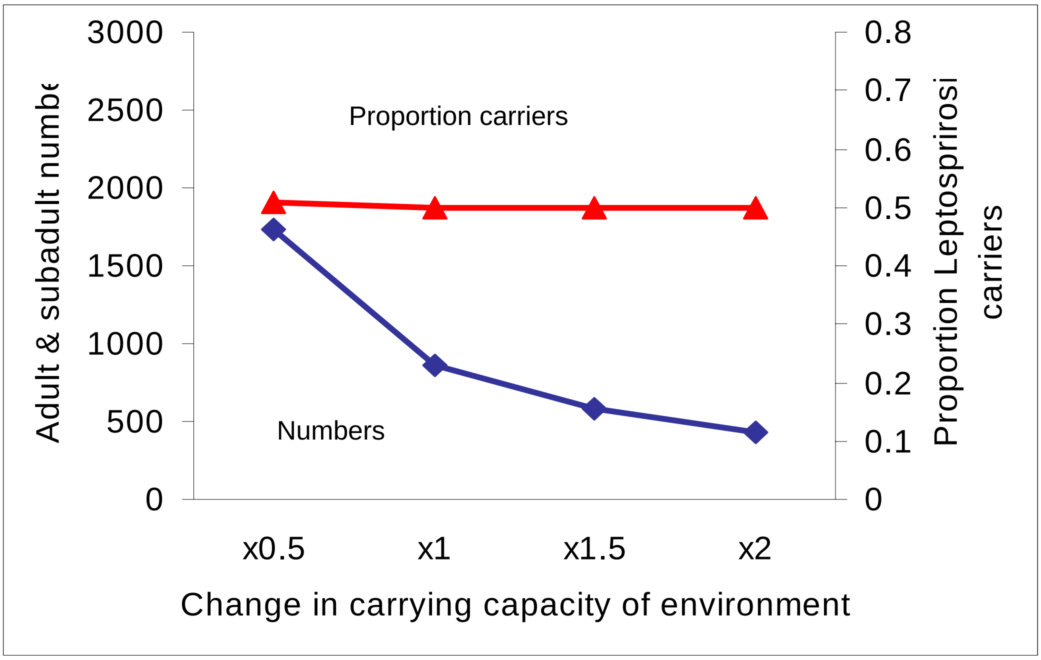
The effects of trapping and habitat reduction proved to be rather different. In both cases the parameters were varied over a four-fold range, i.e. from half to double their estimated values (Fig.3). In both cases there was an effect on rodent abundance but only trapping had any substantial effect on the proportion of rodents which were carriers.

Fig. 3 The effects of a) trapping, and b) reduced rodent habitats, on adult and sub-adult number and on leptospira infection rate in the rodents

a)



b)



A two-fold reduction in survival reduced rodent abundance from approximately 900 to 200 and reduced the proportion of carriers from 0.5 to 0.3. A two-fold reduction in available rodent habitats reduced abundance to 500 but had little effect on infection. Thus, the trapping option had the effect of reducing the number of *carrier* rodents by 87% but the habitat option by only 50%. The immediate suggestion therefore is that trapping rather than habitat reduction might be expected to have more impact on human infection.

The result does depend on other parameter values however, in particular the ease with which rodents acquire infection from environmental sources. If the acquisition rate was very high (e.g. 0.1 per day) then increased mortality had very little impact on the carrier status of the population (Fig. 4). In contrast, if the rate was very low (0.001 per day) then the proportion of carriers could be reduced dramatically by trapping.

Sensitivity of model outcomes to the three different infection routes, 'maternal', sexual and environmental was examined by comparing model outcomes under different combinations of the relevant transmission parameters (v_1, v_2 and v_3 , for 'maternal', sexual and environmental transmission, respectively). When infection rate from environmental sources was set to an intermediate value (0.01 per day) then the other two transmission routes had relatively little effect on the overall disease outcome (Fig. 5a). In particular, sexual transmission had almost no effect on disease prevalence in the rodent population. Only when infection from environmental sources was quite low could prevalence be sensitive to the other transmission routes (Fig. 5b). It may be, therefore, that the model could be simplified by including on the environmental route of transmission.

Fig. 4 Sensitivity to the acquisition rate of leptospirosis from environmental sources

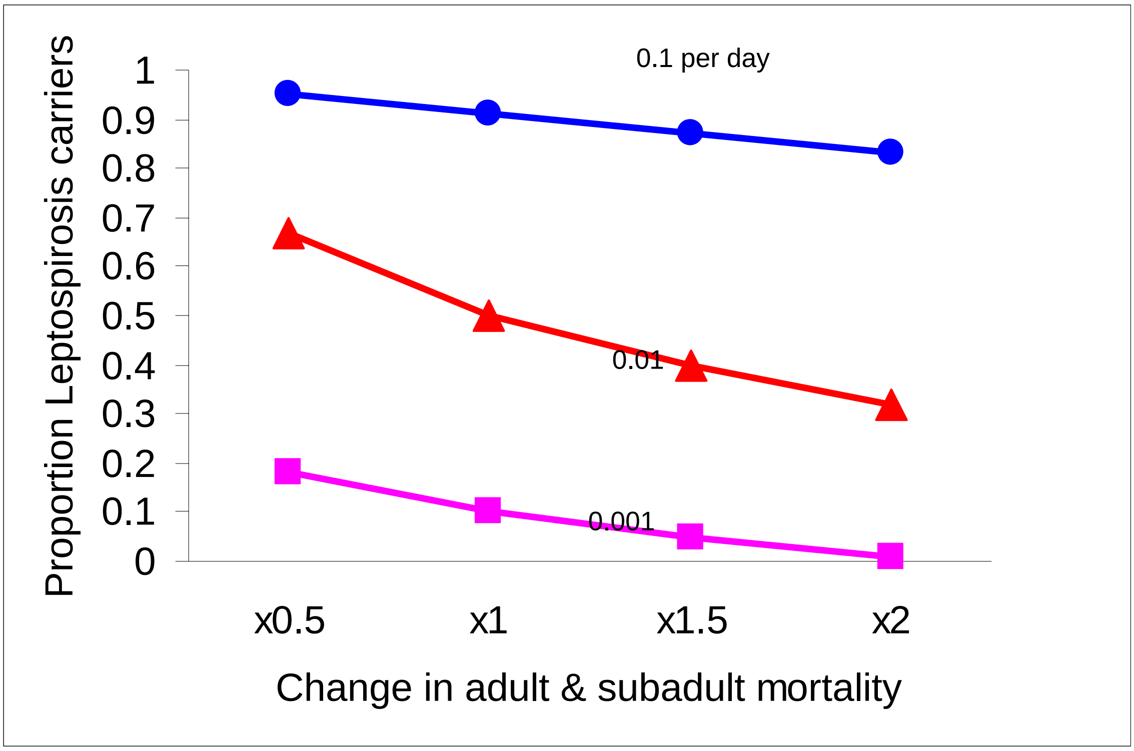
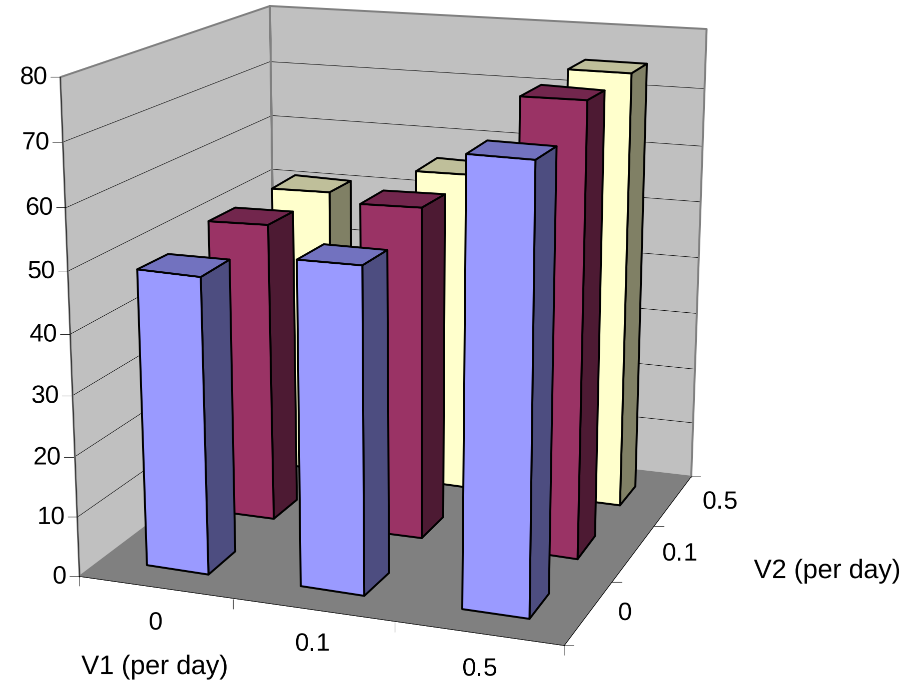
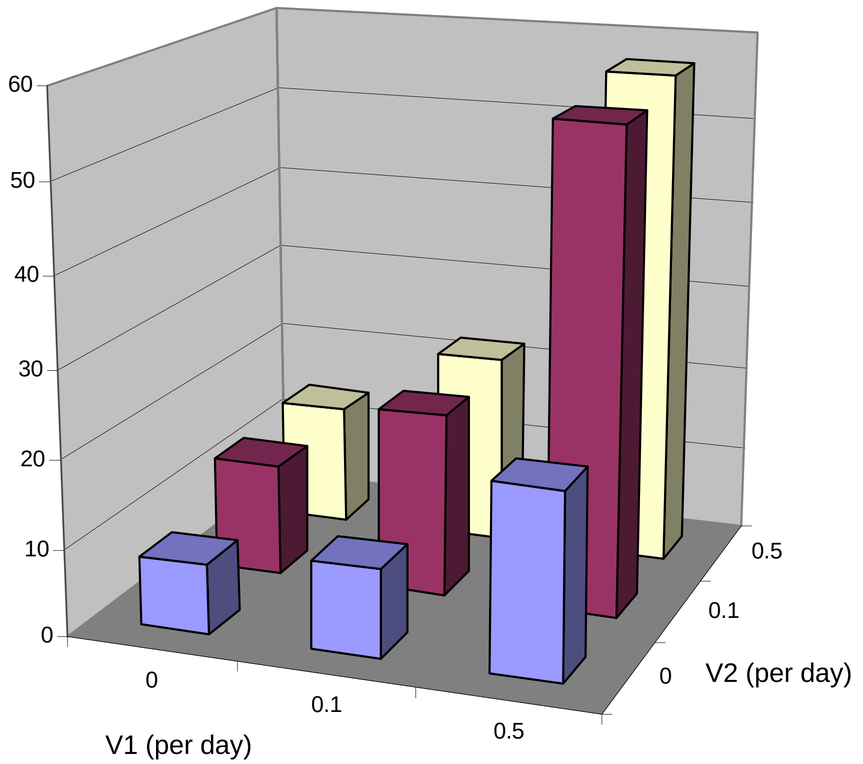


Fig. 5. Effect of transmission via milk (v1) and sexual transmission (v2) on prevalence in non-juveniles, when infection rate from environment sources is a) 0.01 per day and b) 0.001 per day

a)



b)



In the results discussed so far, all parameter values have been kept constant. This may be sufficient to provide an indication of the general or long-term outcomes expected under different circumstances. As mentioned earlier, however, seasonal processes are important in leptospirosis epidemiology and some initial work has been done to incorporate season cycles into the Mastomys/leptospirosis model. Seasonality was introduced with a switch in both rodent reproduction and leptospirosis survival. All other parameters were constant. Model output was compared with the 10-year mean of the Mastomys population cycle derived from published data (Leirs et al).

The initial assumption was that rodent reproduction should start in April/May and finish in September. This resulted in a simulated population cycle which was about one month too early compared to the data. When instead, reproduction was initiated in mid June and continued until mid October, the fit was much better. Fig. 6 shows the results.

With the initial parameter estimates, the amplitude of the rodent population cycle was also too small compared to the data. An increase in both mortality (of adults & sub adults) and fecundity increased both the height of the peak and the depth of the trough of simulated population size (Table 1).

Table 1. Parameter values used in the simulations

Parameter	**Value**	**Notes**
B	0.28 or 0	Reproduction between days 161 – 292 only. Original value was 0.2
β	10^5	
c	0.04	
k	10^3	
μ	0.2 or 0.05	Leptospire mortality high days 219 – 312, low otherwise. Original value was 0.1
Ψ_0	0.04	
Ψ_1	0.01	
s_0	0.01	
s_1 (& s_2)	0.013	Original value was 0.01
v_1	0	Original value was 0.01
v_2	0	Original value was 0.01
v_3	0.005	Gives prevalence in range 0.1 to 0.6

The survival of leptospires in the environment was assumed to depend on the period of the rainy season, mortality being lower in wet conditions and higher in dry conditions. The wet season was assumed to last from the beginning of October to May. A time lag was assumed such that mean leptospire survival was assumed to be higher (20 days = 1/0.05) between mid November and early July and lower (5 days =1/0.2) at other times (Table 1).

With these assumptions about leptospire survival, the peaks of the susceptible and carrier rodent populations occurred at different times, early November and late December, respectively (Fig. 7). Indeed, the cycle in disease prevalence in the rodent population was quite dramatic ranging from about 0.1 at the end of September to 0.6 in May (Fig. 8). These results were obtained with a single disease transmission route only – indirect, from the environment (i.e. $v_1 = v_2 = 0$); with v_1 and v_2 set to their original values the timing of the cycle was the same but whole graph was slightly higher on the y-axis (i.e. there was a small overall increase in prevalence throughout the year). It is interesting that simulated disease prevalence in the rodents reached a peak at a time of year, at the start of the breeding season, when the population is near its lowest. Potentially, if transmission route v_1 were more important, its effect would be expected to be enhanced by the prevalence cycle.

Leptospire abundance in the environment (Fig. 9), followed the abundance of infected rodents with lag of about one month. Presumably, if different assumptions were made about the duration of leptospire survival, the lag would change but this has not yet been examined. Peak environmental leptospires occurred at the end of January and the trough occurred at the end of August.

Fig. 6. Model output (line) compared with the 10-year mean of the Mastomys annual population cycle (± 1 se) derived from published data (Leirs et al).

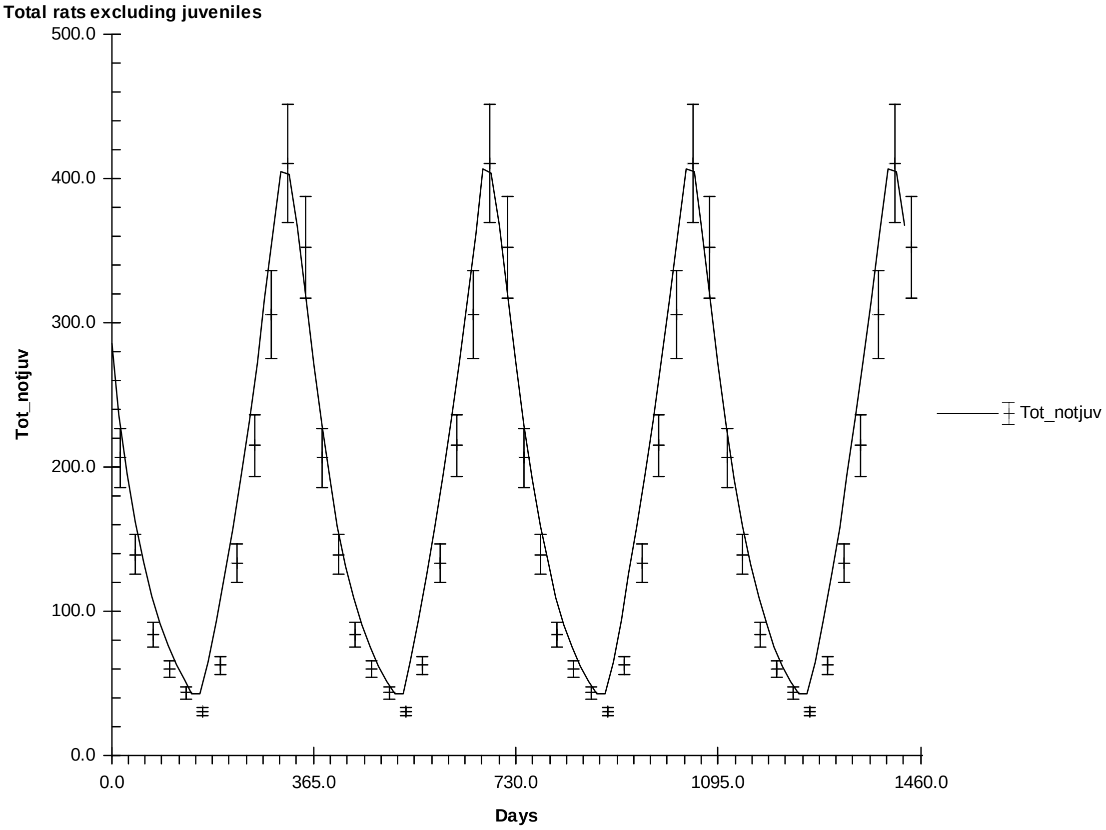


Fig. 7. Susceptible and carrier rodent numbers shown separately

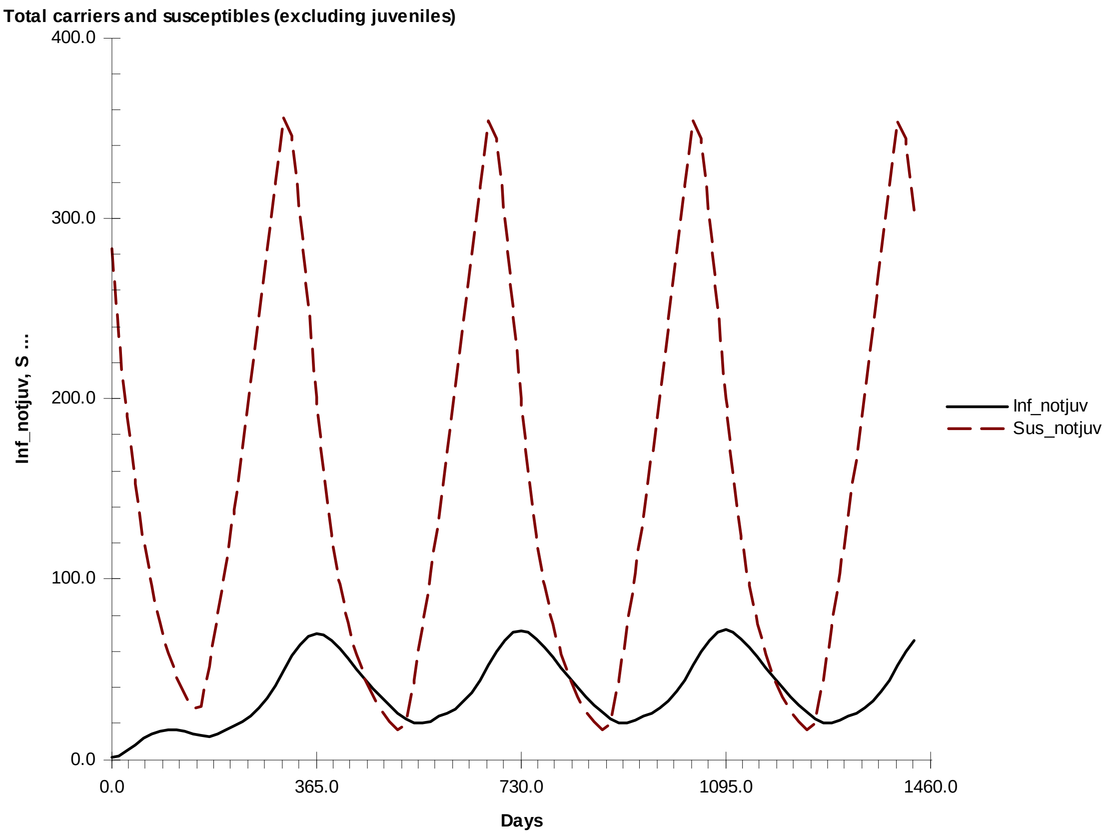


Fig. 8 Annual cycles in disease prevalence in the rodent population

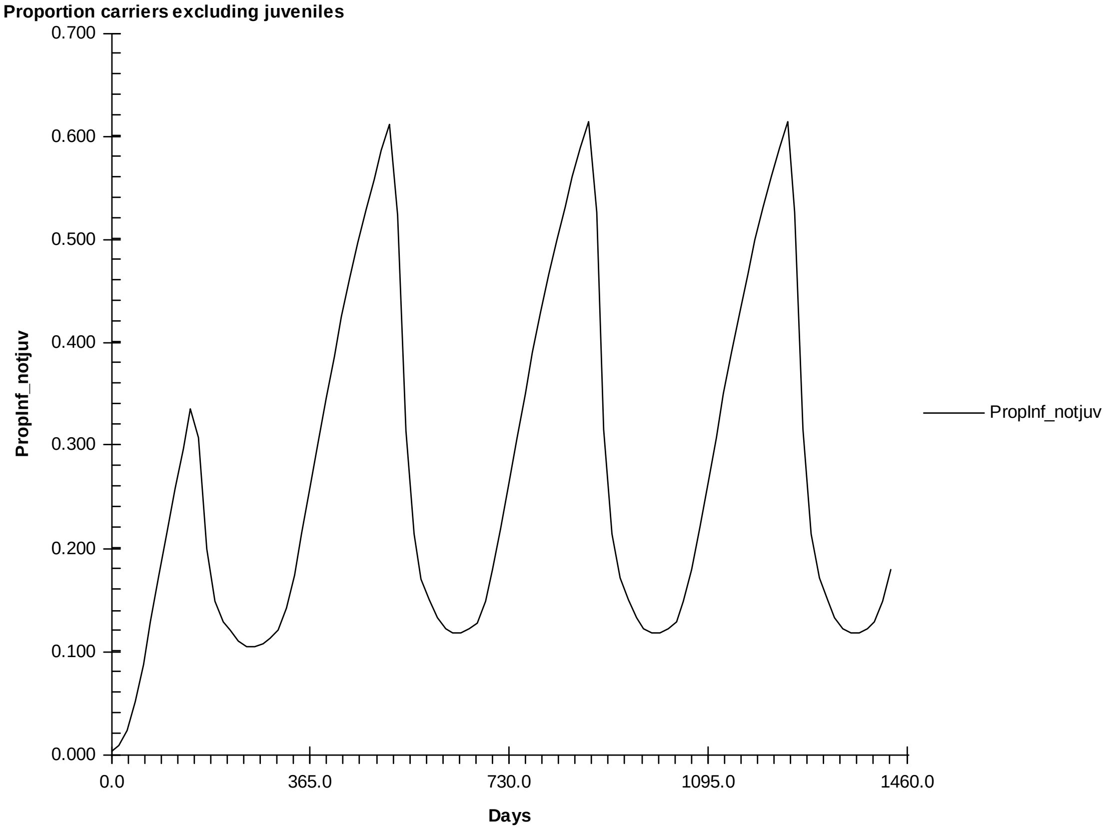
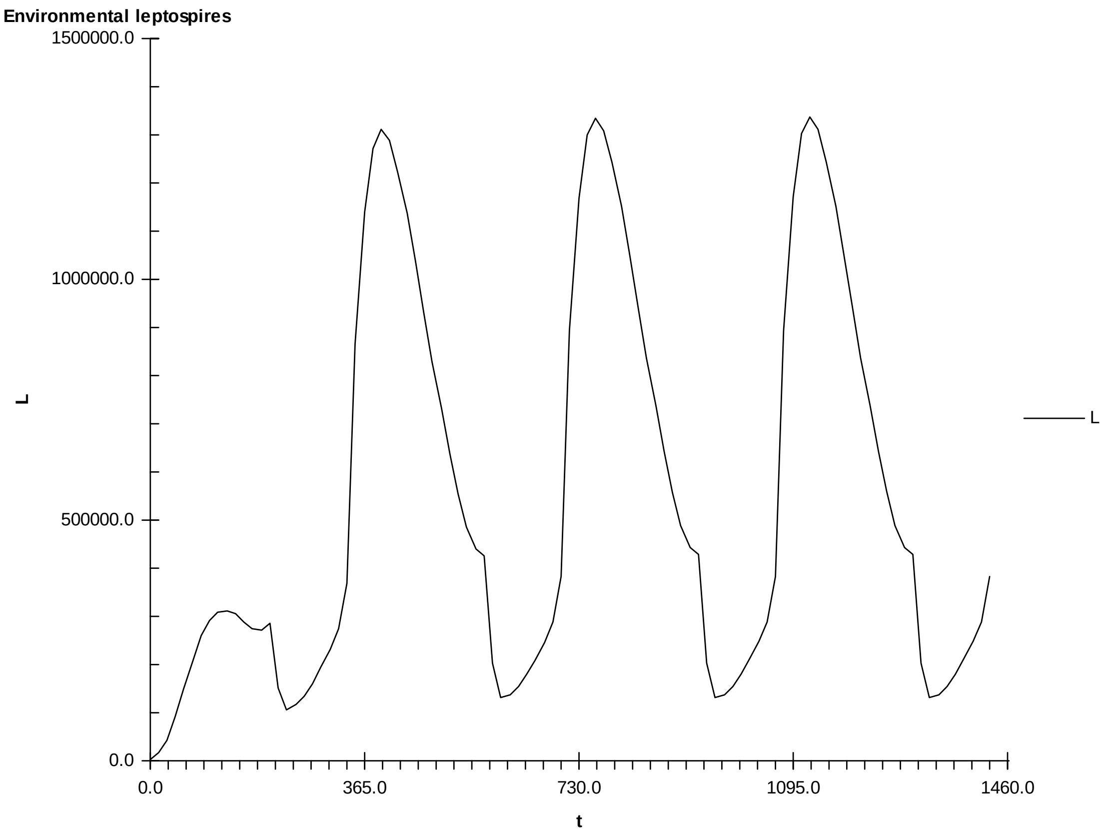


Fig. 9. Annual cycles of Leptospire abundance in the environment



RUCA

RATZOOMAN
Prevention of sanitary risks linked to rodents at the rural/peri-urban interface

INCO-DC contract number ICA4-2001-10125

ANNUAL SCIENTIFIC REPORT

Participant:	RUCA
Period:	Jan 2004-Dec 2004

Scientific achievements

- Data file formats for rodent specimen collection improved and consolidated. Processing of specimens for taxonomic identification started.
- Additional work (outside Ratzooman) on specimens collected in the project, discovered several mycobacteria (in collaboration with the Institute of Tropical medicine in Antwerp, Belgium) and a new arena virus in rodents from Morogoro, Tanzania (in collaboration with the Bernhard Nocht Institute of Tropical Medicine in Hamburg, Germany).
- Preliminary analysis of plague hospital data completed; analysis of bubonic plague incidence by village, sex and age revealed that there is a plague "hotspot" within the Lushoto plague focus, and within this focus particular people groups are becoming infected.
- A basic mathematical model for the spread of leptospirosis among rodents has been formulated.

Scientific problems encountered

- We do not yet have accurate geographical information (latitudes and longitudes) for the villages specified in the human case data (the village of each patient was recorded). This has held up formal analysis of the hospital data on human cases of plague.
- We could not obtain basic parameter values for leptospirosis infection from the literature; no estimates of leptospirosis prevalence rates in rodents have been made available.

Publications or presentations

Invited lecture at the 19th International Zoological Congress, Beijing, China, 23-27 August 2004: LEIRS, H. & BELMAIN, S.. Prevention of sanitary risks linked to rodents at the rural/peri-urban interface in South-eastern Africa.

Work Package 2: Taxonomic identification of rodent species found in rural and peri-urban habitats

Objectives
To ascertain the rodent and insectivore species found among different habitats in SADC communities

Activities
RUCA assisted the team in Mozambique to set up the study, and trained team members there in the collection protocol and data recording. Furthermore, RUCA also actively participated in the collection of samples from Tanzania. Specimens (preserved carcasses, organ tissues in ethanol) from all four countries have been received at RUCA and have been prepared for taxonomic investigation. The taxonomic investigations, morphometrically and with molecular techniques, are ongoing.

The data files for recording information about the collected animals, have been modified and a more elaborate (but also more strict) use interface was designed in order to avoid the errors and lacks of information that occurred during the earlier stages of the project.
RUCA also developed similar file formats for use in other WPs, for storing information about pathogen test results of rodent specimens, human and cattle samples.

Encountered problems and solutions
Collecting rodents in Mozambique and Zimbabwe started late and the collected material is still limited. For a part of the collection from these countries, RUCA has not yet received the specimens, the information or both.

Preliminary analysis of the collected data indicated a lack of seasonal replication of trapping at the same sites. During the coordination meeting in September, the need for such replications was stressed again, and plans were adjusted for the different countries in order to ensure replicated trapping sessions.

Preliminary results
In total, RUCA received information and/or material for 4800 individuals. About 3500 of these have arrived already at Antwerp and have gone through a first triage and species identification. The large majority of these specimens have had the skull removed and cleaned for taxonomic investigation. For large series of specimens of the same species from a locality (typically in the genera *Rattus, Mus, Mastomys*) only a sub-sample of the specimens was dissected, the rest were kept for later reference.

Removed skulls were measured, and this work is ongoing. On each skull, 19 skull measurements are taken for later multivariate analysis, and if needed comparison with type material.

So far 11584 tissue samples (representing 4572 individuals) have been received and catalogued at RUCA. These samples are used for molecular identification of specimens that cannot be reliably identified morphologically. For such molecular identification, DNA is extracted from the samples, and the cytochrome B gene of the mitochondrial DNA is sequenced and compared with known DNA sequences.

The table below gives a preliminary overview of the different species collected in all four countries. It should be noted however, that not all these identifications have been confirmed, and that within some genera, more than one species is represented in the collections.

Genus (Field-Id)	Mozambique	South Africa	Tanzania	Zimbabwe	Total
Aethomys		45			45
Arvicanthis			111		111
Cricetomys			139		139
Crocidura			308		308
Dasymys		4	6		10
Grammomys			20		20
Lemniscomys		13	13	2	28
Malacomys		1			1
Mastomys	2	479	2000	82	2563
Mus	111	25	393		529
Mus (Leggada, Nannomys)		1	14		15
Otomys		4			4
Praomys			2		2
Rattus norvegicus	26	236	35		297
Rattus rattus		21	407	39	467
Rattus sp.		14			14
Rhabdomys		27		1	28
Saccostomus		1		1	2
Steatomys		1	1		2
Tatera	2		47		49
yet unspecified	130		41		171
Total	271	872	3537	125	4805

Further work is ongoing to identify all specimens, as well as including the Ratzooman information in more general taxonomic reviews.

Work Package 9: Predictive and simulatory modelling

Objectives
To develop modelling tools that are capable of providing accurate simulations and predictions of when zoonotic diseases may outbreak and to determine particular areas that are or will become increasingly susceptible to zoonosis.

Activities
Meetings between University of Antwerp, NRI and KIT have continued and our basic model for leptospirosis in a rodent host is formulated (see below) and analysed (see report from NRI). Model development continued throughout the year. Presentation of the model and the chosen parameter values provoked lively discussion at the annual meeting in Copenhagen, Denmark.

Model of rodent population with leptospire infection
This is a differential equation model with six classes of rodents (juveniles, sub-adults and adults all of whom may either be susceptible or infected). Maturation rates of sub-adults is sensitive to the abundance of adults and this limits total abundance.

This is a compartment model where individuals are either susceptible or infectious. Once infected, individuals are chronically infected for their lifetime, continually shedding leptospires in their urine. There are ongoing discussions over the accuracy of these assumptions. Future modelling may include a recovery term where individuals recover but only to become susceptible again.

Infectious juveniles are assumed not to shed leptospires into the environment since they are generally confined to the nest.

The equations are…

$$\frac{dJ_S}{dt} = B\left(A_S + (1-v_1)A_I\right) - \psi_0 J_S - s_0 J_S$$

$$\frac{dJ_I}{dt} = Bv_1 A_I - \psi_0 J_I - s_0 J_I$$

$$\frac{dU_S}{dt} = \psi_0 J_S - \psi_1 \exp(-c(A_s + A_I))U_S - s_1 U_S - \frac{v_3 L}{L+h} U_S$$

$$\frac{dU_I}{dt} = \psi_0 J_I + \frac{v_3 L}{L+h} U_S - \psi_1 \exp(-c(A_s + A_I))U_I - s_1 U_I$$

$$\frac{dA_S}{dt} = \psi_1 \exp(-c(A_s + A_I))U_S - s_2 A_S - \frac{v_2 A_S A_I}{A_I + A_S} - \frac{v_3 L}{L+h} A_S$$

$$\frac{dA_I}{dt} = \psi_1 \exp(-c(A_s + A_I))U_I + \frac{v_2 A_S A_I}{A_I + A_S} + \frac{v_3 L}{L+h} A_S - s_2 A_I$$

$$\frac{dL}{dt} = k\left(U_I + A_I\right) - \mu L$$

J_S, U_S, A_S = numbers of susceptible juveniles, sub-adults & adults
J_I, U_I, A_I = numbers of susceptible juveniles, sub-adults & adults
L = number of leptospires in environment
B = per capita birth rate
s_i = stage-specific death rates
□$_i$ = stage-specific maturation rate
c = shape-parameter for density-dependence in maturation of sub-adults
k = number of leptospires shed per day per infected individual
□= survival rate of leptospires in the environment
v_1 = proportion of pups infected from suckling

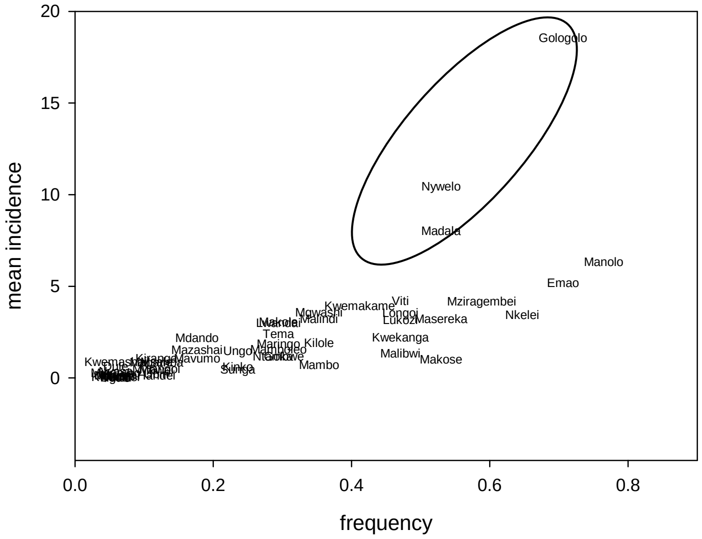
v_2 = transmission co-efficient for sexual transmission
v_3 = transmission co-efficient for indirect transmission (via the environment)
h = number of leptospires at which transmission rate from the environment is $0.5v_3$

Analysis of hospital data on plague

Data on human plague cases were obtained from hospital records throughout the Lushoto district of Tanzania. The data are the month of onset of disease, the village where the patient lived, the patient's age and gender, the type of plague disease (bubonic, pneumonic or systemic) and whether the patient survived.

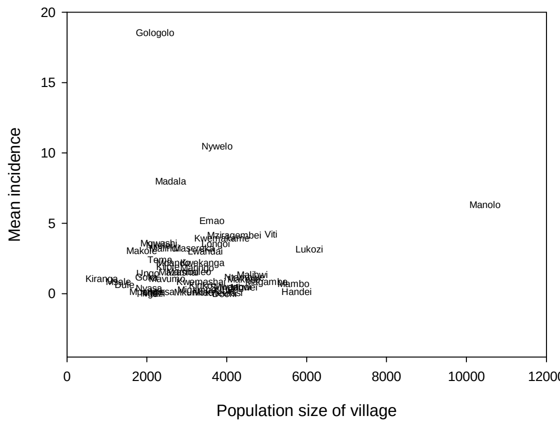
Incidence was calculated for 51 villages using demographic data collected during the 2002 population census. A further 54 villages were ascribed a constant incidence of 0.

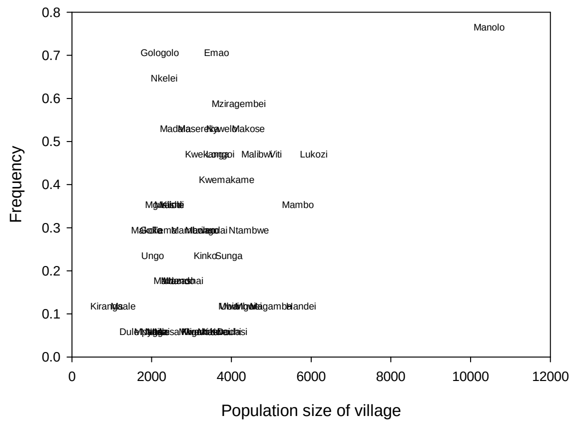
For those villages recording at least one plague case, a mean incidence and frequency (proportion of years in which there was at least one plague case) were calculated.



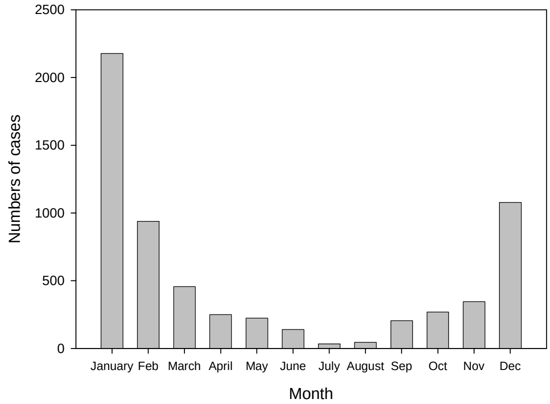
The plot suggests that three of the villages are exceptional and for the remaining villages there is a linear correlation between frequency and mean incidence. The three exceptional villages lie close to one another, though they are not entirely adjacent.

Population size does not seem to explain either variation in mean incidence or frequency although the population size of Manolo (the good hinge point) is unusually high.

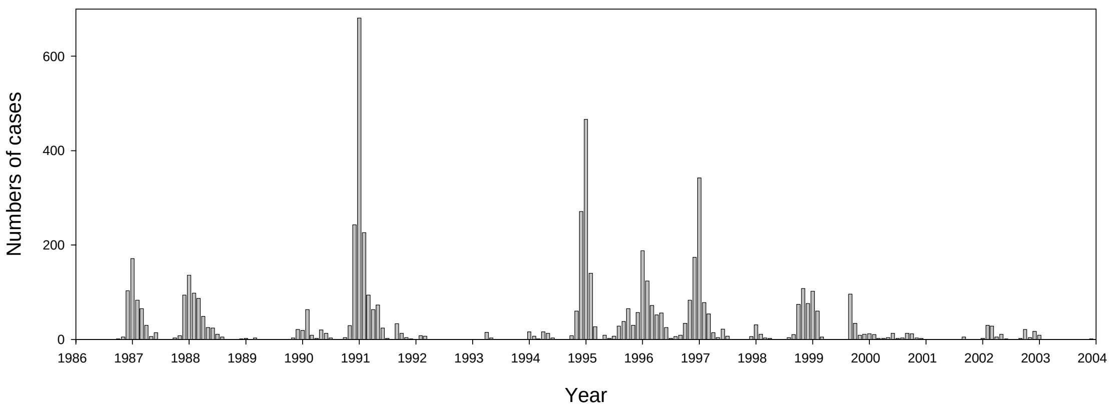




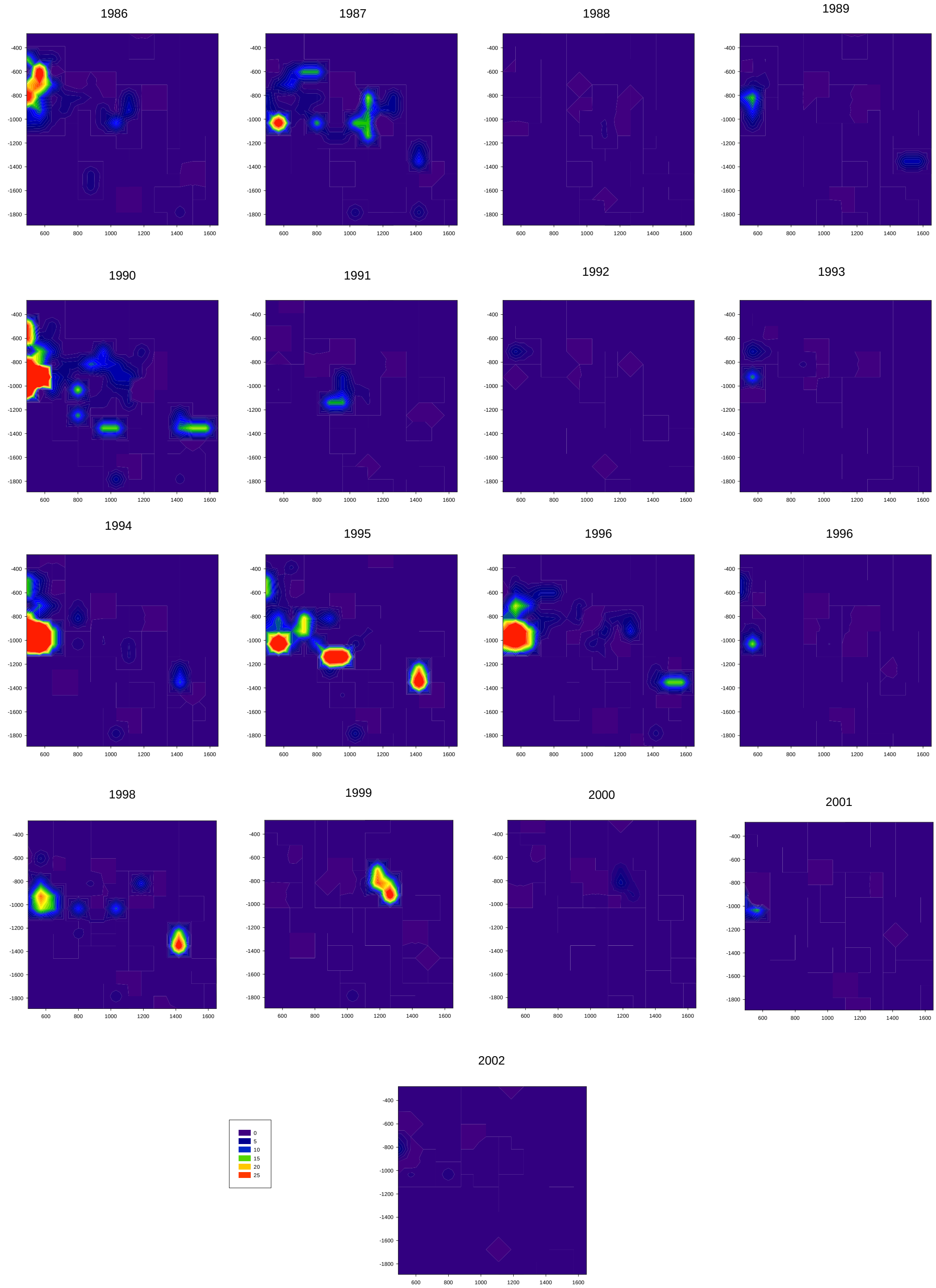
A plot of the total number of plague cases each month reveals a distinct seasonality in when cases have occurred. On this basis a plague "season" was defined as the 12 month period beginning in July of one year and ending in June of the next year. While this seasonal pattern appears very strongly when plotting total or mean number of cases each month, for individual years and individual villages the seasonal variation can be, and is often, quite different (see the section on spatio-temporal variation below).



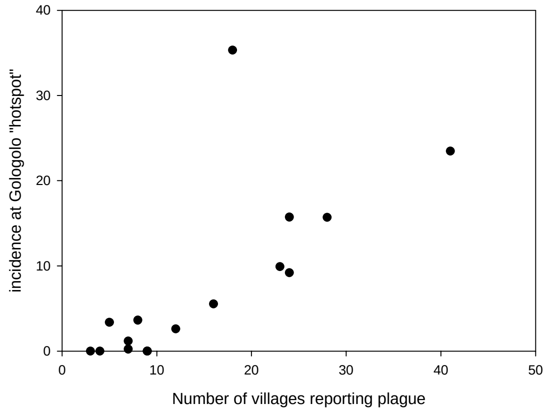
The interannual variation is extreme. When comparing between years the variance in numbers of cases is higher than the mean for each of the 12 months. A time series plot of monthly cases identifies the 1990/91 season and 1994-97 as periods in which many people were infected.



The following set of “heat-maps” illustrate the how the distribution of plague cases over the Lushoto district varies between years. The maps are based on point estimates of incidence in 105 villages with an estimate of incidence for each plague year. Note that the label 1986 indicates an incidence based on numbers of cases in the 12 months beginning July 1986 and ending June 1987.

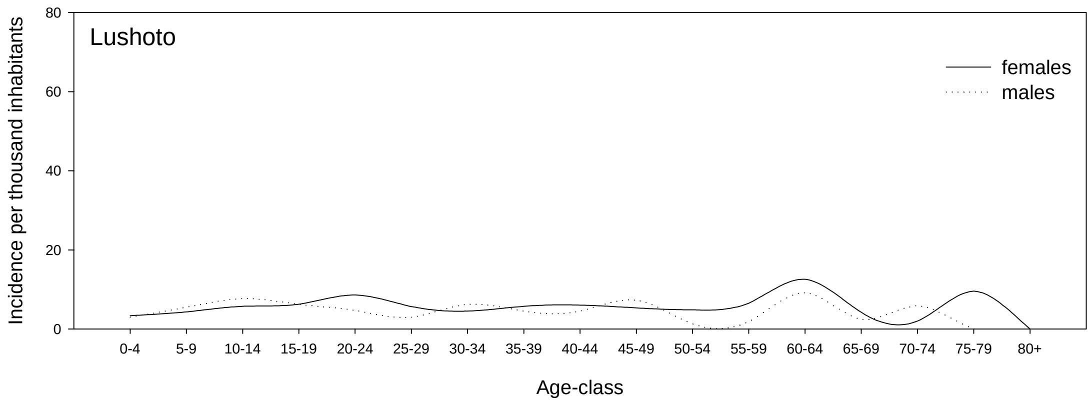


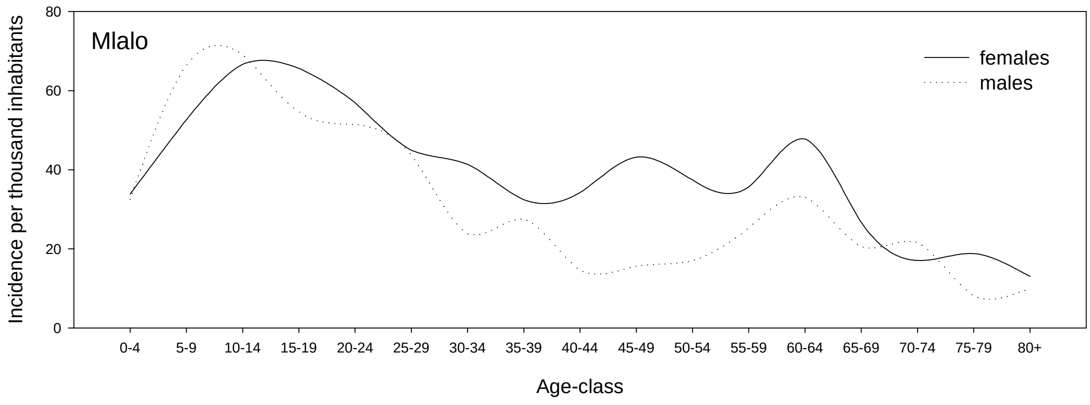
The heat-maps indicate that there is a focus of plague cases in western Mlalo and this is the location of the three villages with an unusually high incidence (see fig 1). The mean incidence over a plague season at these three villages is correlated with the number of villages reporting one or more plague cases. The single obvious outlier – if this is not an outlier then nothing is (analysis of studentized residuals, Vinsent Sluydts, pers. com.) – is 1994 when there was unusually high numbers of plague cases in the Gologolo area but absent everywhere else.

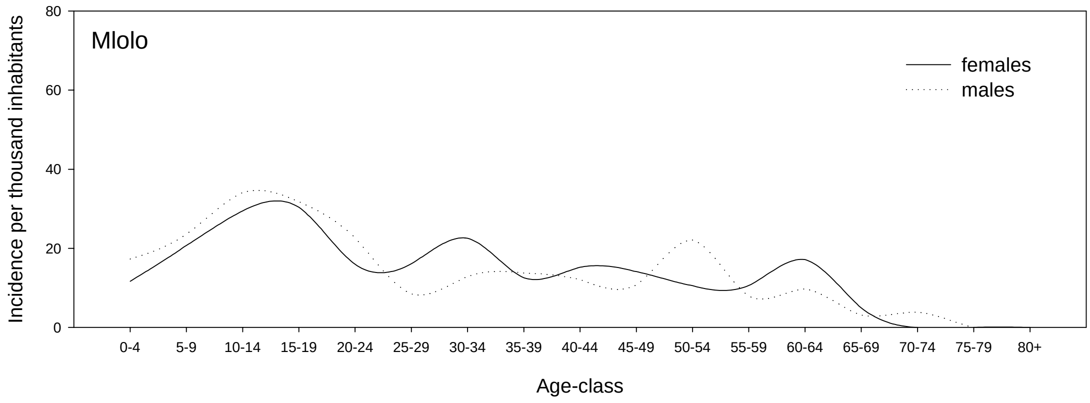


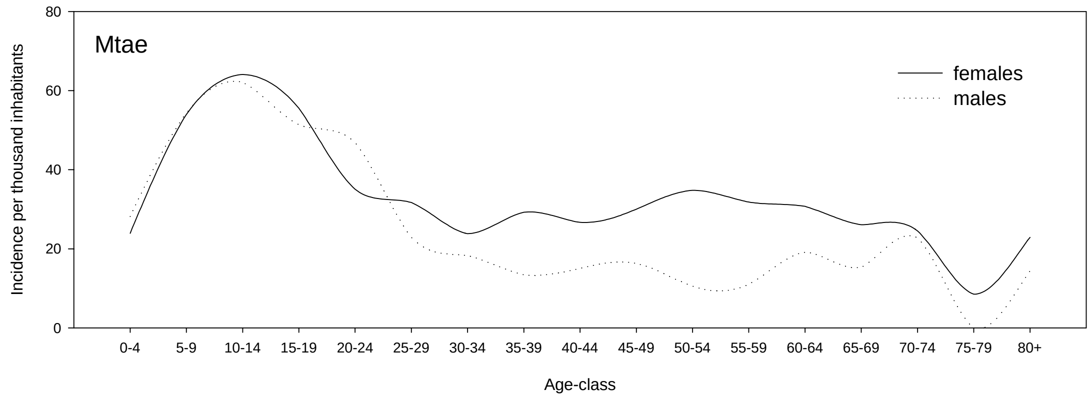
Demographic variation

Census data taken in 2002 throughout Tanzania was used to calculate incidence profiles for plague in four Divisions within the Lushoto district. An age distribution of patients with any of the three types of plague was formed by pooling the human case data across the period 1986 to 2002. All of the incidence profiles shown below assume that the 2002 data on the human population size and age distribution applies to the whole of the time period over which human cases were recorded. This is a somewhat coarse assumption since the human population in Lushoto is known to be an increasing population. For this reason incidence is likely to be here underestimated.


Lushoto
females
males
Incidence per thousand inhabitants
0
20
40
60
80
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80+
Age-class


Mlalo
females
males
Incidence per thousand inhabitants
0
20
40
60
80
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80+
Age-class

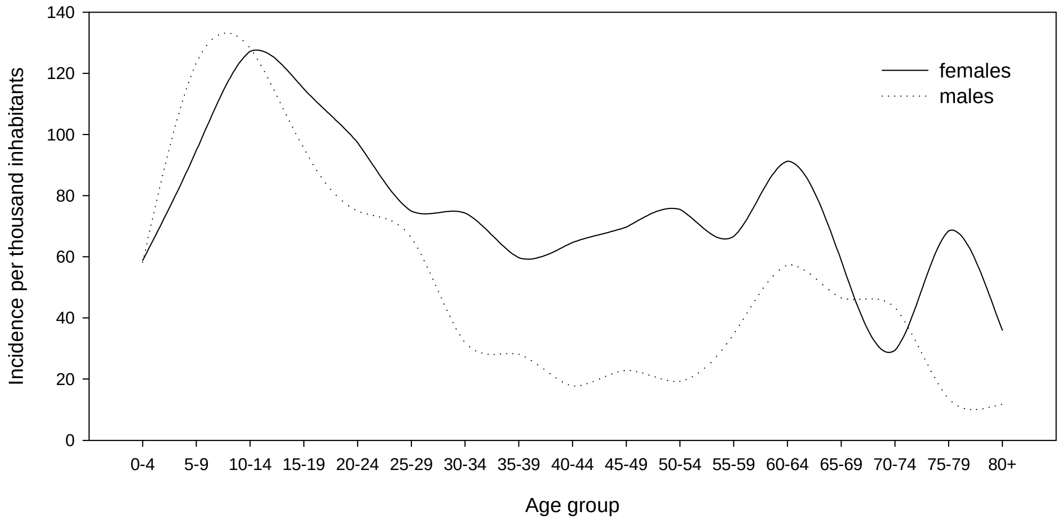

Mlolo
females
males
Incidence per thousand inhabitants
0
20
40
60
80
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80+
Age-class


Mtae
females
males
Incidence per thousand inhabitants
0
20
40
60
80
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80+
Age-class

Both Mlalo and Mtae show differences in incidence between adults and children (less than 15 years of age) and between adult men and women.

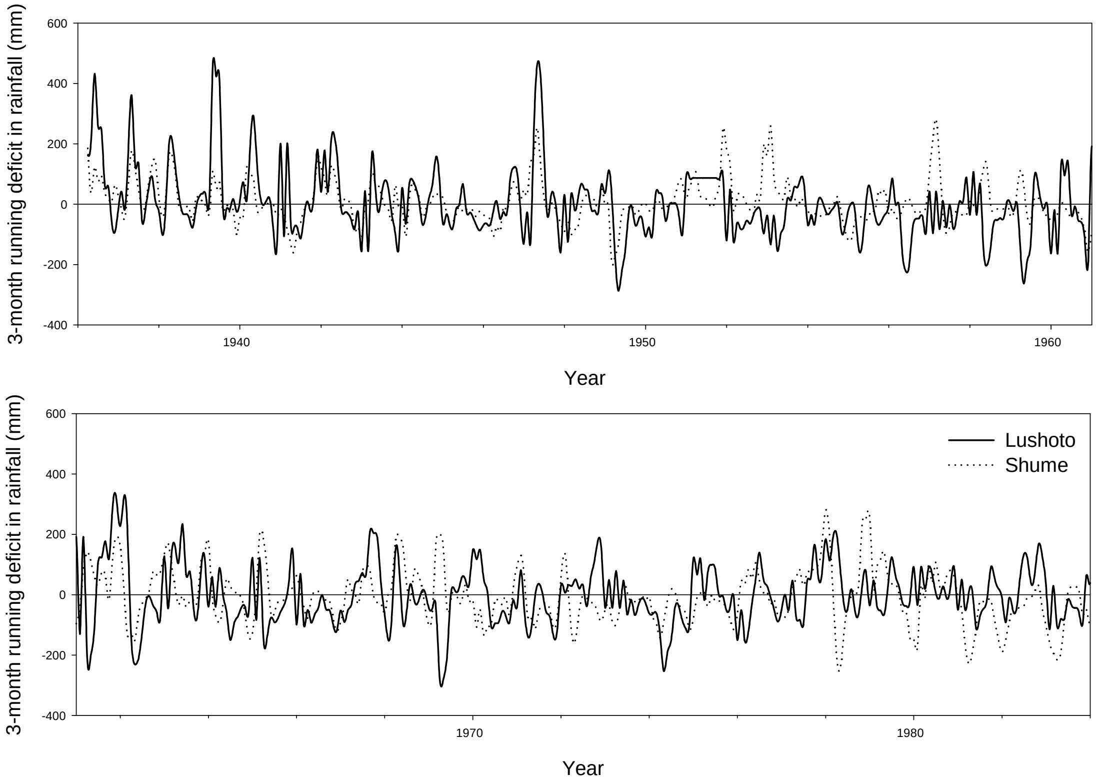
If we look more closely at bubonic cases in the Shume ward, within the division of Mlalo, then these sex and age differences are easier to see. This subset of villages includes the three identified in figure 1 as having exceptionally high levels of incidence and frequency. For adults aged between 30 and 60, the incidence among women is 3 to 4 times higher than that among men. Incidence among children aged between 5 and 14 is twice as high as that among adult women.

Bubonic plague cases in Shume



Explanatory variables: Rainfall

There are two sources of climatic data (weather stations) in the region. One is the weather station at the township of Lushoto and the other is the weather station that used to operate at the forestry research station at Shume. The research station at Shume was closed down at about the same time as plague cases began to be recorded (1984). The relationship between rainfall at Shume and rainfall at Lushoto is not consistent. The following figure shows a time series of the 3 month running deficit of rainfall at both sites during the overlapping time period (1936-1984). In general, wet and dry periods are not concurrent.



Explanatory variables: Plague control activities

The first outbreak of human plague in the Lushoto district occurred in 1980 and this was the very first indication of its presence in the area. There were 49 cases and 11 deaths distributed between two villages. Recurring outbreaks prompted control measures such as removal of rodents and fleas during and immediately after each outbreak. Steps were also taken to improve health education and sanitary conditions. Beginning in 1983 spraying of houses with DDT was carried out in the affected villages irrespective of whether an outbreak had occurred or was occurring. A special flea operation, also using DDT, was carried out in April 1987 with no discernible effect.

Human cases of plague continued to occur with alarming frequency and in July 1987 a Permanent Plague Control Team (PPCT) was formed in an attempt to insure plague control measures were promptly and properly implemented.

During 1988-89, there was a desperate need for an effective insecticide that could be used to replace the use of DDT dust, which was viewed hazardous to health. Increasingly, the donor for several developmental programmes in the Lushoto District, whose programmes included promotion of health in the district, could no longer justify the use of donor funds to purchase a banned chemical in his country (Germany). The use of DDT, however, was not legally banned in Tanzania and in fact it was being locally formulated. In 1988-89 therefore, another insecticide, not hitherto tested for efficacy against fleas in Tanzania, was introduced. The insecticide, 1% cyfluthrin, is a synthetic pyrethroid, which was widely uses to control agricultural pests, and was already available in Tanzania for control of cotton pests, but in a different formulation. This insecticide was applied in houses in Lushoto until 1991, when there were reports that it was ineffective. However, these claims were not based on field tests. The dust formulation of the insecticide was being imported from Germany and was generally expensive. Therefore, in the 1991-1992 plague season, a new insecticide, Actellic Super Dust, a cocktail mixture of pirimiphos methyl (organophosphate) and permethrin (synthetic pyrethroid) was introduced for dusting houses. The recommendation from the Ministry of Health was based on two premises (i) that it was safe to use in houses since it was recommended for use against stored product pests (ii) it was widely available, cheap and effective. The efficacy tests, however, were based on laboratory experiments and it had not been tested in houses in Lushoto before the recommendation. Actellic Super Dust continued to be used against fleas until 1996, when it was reported that many people were complaining that it was not effective at all. In 1996 it was again recommended that an alternative insecticide, carbaryl (a carbamate) be introduced for fleas control. This was based on the fact that carbaryl had been tested in various other places in the world and was a commonly used insecticide against fleas. Therefore, in the 1996-1997 plague season carbaryl was introduced and continues to be used to-date.

The control of rodents in Lushoto has largely depended on the use of anticoagulant rodenticides. Initially, brodifacoum, formulated as wax blocks, pellets or mixed in cereals, was used until 1990. Beginning 1991, Another rodenticide, bromadiolone, a second generation anticoagulant, also mixed in cereals, was introduced in the district. Due to the large area where rodents are found in the wild, the rodenticides were recommended for use in houses and a limited area around houses. The costs for supplying rodenticides to be used on a wide area outside living premises would have been enormous and could not be affordable by the Ministry of Health or the donor. The recommendation was to apply the insecticides several days before the rodenticides in order to kill the fleas before killing the host. However, it was obvious that the rodent population density in Lushoto, particularly of *Mastomys natalensis*, was low between October and February, where as in the same period, there are more plague cases occurring. These observations were made during the 1998-1999 plague season (See Makundi et al 2002 in Rats, Mice and People, p 20-24). In this respect, we advised the Lushoto District to put more emphasis on fleas control within houses since this was more manageable with available resources, than a wide scale rodent control approach. To-date, rodent control is limited to in house rodenticide application, which targets *Rattus rattus*. More resources are being used to purchase the insecticide, distribute and apply it.

DPIL

RATZOOMAN
Prevention of sanitary risks linked to rodents at the rural/peri-urban interface

INCO-DC contract number ICA4-2001-10125

ANNUAL SCIENTIFIC REPORT

Participant:	DPIL
Period:	Jan 2004-Dec 2004

Scientific achievements

- Preliminary analyses of CMR data from Tanzania and South Africa indicate similar seasonal population dynamics patterns and reproductive patterns in peri-urban populations as in agricultural areas.
- Last years' pilot study on foraging movements of rodents in an African city was replicated and found movements of up to almost 200 m, although the large majority of animals forage over much smaller distances.

Scientific problems encountered

Publications or presentations

Invited lecture at the 19th International Zoological Congress, Beijing, China, 23-27 August 2004: LEIRS, H. & BELMAIN, S.. Prevention of sanitary risks linked to rodents at the rural/peri-urban interface in South-eastern Africa.

Work Package 4: Rodent ecology in rural/peri-urban Africa

Objectives

- To establish rodent population dynamics for the major rodent and small mammal species identified in targeted areas of the SADC
- To understand the interactions among different small mammal communities in these areas
- To analyse the roles of the different species identified in WP 2 in relation to human populations and zoonosis
- To discover potential factors influencing small mammal species prevalence

Activities

4.1. Capture-Mark-Recapture study

Briefly, in Tanzania, South Africa and Zimbabwe a replicated CMR-study was set up in two fields at the peri-urban/rural interface in the main focal site (the locality where the Ratzooman studies are concentrated in each country). In Mozambique the CMR-study was only set up in one field.
Monthly CMR trapping sessions were carried out, during which animals were marked and released (see the appendix in the first annual report for a full detail of the WP protocol). The CMR-work at the sites in Mozambique and Zimbabwe, however, did not start until 2004 and were not carried out regularly until October 2004.

In Morogoro, Tanzania, SUA continued the already ongoing CMR study in a field-fallow mosaic in order to provide a background for the interpretation of the other studies.

Monthly rainfall data were obtained from weather stations near the study sites in each of the African countries. The rainfall data were sent from Tanzania and South Africa to DPIL, but still remain to be sent from Mozambique and Zimbabwe.

CMR-data was sent from Tanzania and South Africa to DPIL, in order to be analysed and compared, but data from Mozambique and Zimbabwe still remain to be received at DPIL and hence cannot yet be presented in this report.

CMR-data files were adapted when needed in order to obtain the right format to match the software used for analysing the data.

Analyses of rodent population dynamics and demographic processes started for the sites in South Africa and Tanzania. Data analysing for the sites in Mozambique and Zimbabwe await receipt of the CMR data.

4.2. Movements of rodents in towns

In 2003, a pilot study was carried out to study the movements of individual rodents in a town environment, using a colour-marked bait. As the results of that study were surprising and could be due to aspecific staining, the study was repeated more extensively in 2004. Basically, baits (based on peanut butter and maize scraps) were mixed with 0.15 % Rhodamin B (RB), and laid out at focal points in town. After ingestion by the rodents, they attempt to clear this compound from their body by depositing it in inert tissues, mainly fur. Since rodent whiskers grow very fast, they are a prime site for deposition of excretory products. Animals were afterwards captured at sites at a different distance from the baiting points and the presence of the pigment in their whiskers was noted. In this way, this techniques provides information about the minimal distances that can be covered by rodents in these environments.

In May-June-July 2004, the field study was carried out in Morogoro, Tanzania. The same RB-bait was placed at 3 types of sites in the city of Morogoro: Markets, slaughterhouses/butcheries, and grain stores/mills. For each type of site 3 different focal sites were identified (9 sites in total). The 3 markets were: Soko Kuu, Mwemsesongo Market, and Saba Saba Market. Butcheries were: Chamwino butchery, Kilakala butchery, and Msamvu Central Slaughterhouse, and mills were: Misufini mill, Msamvu mill, and Tanesco mill.

50 g of marked bait were put in emptied halved coconut shells and placed within an 25-35 m2 area, where rodents were thought most likely to feed or hide. Every morning, consumption was checked in each feeding station and replenished. This was repeated for four consecutive nights. The location of bait stations was recorded by reading co-ordinates from a handheld GPS.

Five days after the last feeding night, traps pre-baited with a peanut butter and maize scraps mix were placed at 5 distances from the feeding site: 0 m, 20 m, 50 m, 100 m, and 200 m. At each distance, we placed 12 traps in sites where most rodent activity was expected. Those places were identified either from local people's observations of rodent activity or from signs of rodents; e.g. faeces or footprints.
Traps were put relatively close to each other, approximately every 2-5 meter in lines or clusters. The trapping locations closest to the baiting points (0 – 20 m) mostly consisted of habitat similar to the chosen bait locations (i.e. market areas, butcheries, and grain stores) whereas the trapping locations further away (50 – 200 m) could vary from dense building areas to fallow land. This means that the habitat between the trapping locations varied considerably. However, roads crossing between trapping locations were avoided where possible. Traps were placed inside or around houses as well as in uncultivated surroundings.

Every morning the traps were checked and captured animals were collected. Rodents were trapped by removal trapping and trappings were repeated for four consecutive nights. For the trapping we used Sherman LFA live traps, home made wooden box live traps, large wire cage traps, traditional funnel traps and snap traps in order to catch various species of rodents. We used 60 traps per day on each location adding up to 180 traps per night. Total number of trapping nights was 12; thus, all in all 1260 traps were used. GPS was used to measure the distance between trapping locations and the placement of traps was recorded by reading co-ordinates from a handheld GPS.
.
Trapped rodents were anaesthetised and put to death by putting them in a glass jar containing a cotton wool ball with isoflurane. Following anaesthesia, at least 6 guard hairs including the follicle were removed with tweezers from both sides of the snout..

Encountered problems and solutions

Delays in the delivery of traps caused CMR-field work (not only for WP4) to be considerably delayed in most countries, as reported last year, with the studies in Zimbabwe and Mozambique not even starting in 2003. CMR trappings were then initiated in 2004 in these countries, but until October, trapping sessions were not regular, thus further delaying retrieval of useful data. Trapping is going on regularly now, but it means that the CMR trappings will be done monthly in all African countries as scheduled but it means that for two of the African countries it is only possible to carry out one full year of CMR-work within the project. In addition CMR-data have only been sent from two of the four African countries to DPIL. As a result data analysis are still rather preliminary and for two of the African countries yet have to be done. The general delays also means that analyses will only be finished after the project has come to an end. This further means that modelling work later in the project, will be hampered by an incomplete understanding of the demography, and that models and control strategies may have to be revised several times when new data are coming in.

Preliminary results

4.1. Capture-Mark-Recapture study

CMR trappings started very late in all countries (see first annual report) and were not carried out regularly in two of the four countries. Furthermore, data still remain to be sent from Mozambique and Zimbabwe to DPIL in order to be analysed. Therefore analyses are still rather limited, and results can only be presented for the sites in Tanzania and South Africa.

CMR-data files were closely examined for identification and typing errors before closed-model population estimates for the monthly capture-mark-recapture sessions on rodents were calculated with the software program CAPTURE (White *et al*. 1982) using the jack-knife model for heterogeneous capture probability (M_h). Numbers of reproducing females were calculated at each trapping session by an add-on software program developed for the purpose. Subsequently the proportions of reproducing females (i.e. females that either had perforated vagina, were lactating or were pregnant or had a combination of those stages) were calculated at each trapping session as the number of reproducing females divided by the total number of females (adults as subadults).

The following is a short summary on study fields and of the data obtained for each study site in Tanzania and South Africa. For those two countries there is further a brief description of the dynamics- and reproductive patterns and the relationship of these parameters with rainfall. Our knowledge of rainfall and population dynamics relationships of *Mastomys natalensis* in the Morogoro region, Tanzania will be used as reference, and we therefore begin here.

Morogoro, Tanzania:

The ecology of *M. natalensis* has been studied for years in Morogoro (e.g. see Telford, 1989; Christensen, 1993; Leirs, 1995) providing a well-supported scientific knowledge about the relationship between rainfall and population dynamics and reproduction of this rodent species. We know that the population dynamics of *M. natalensis* in this region fluctuates seasonally, but also that the fluctuations vary in magnitude between years, occasionally leading to outbreaks. Reproduction is seasonal and strictly related to the rainfall patterns (Leirs *et al*., 1994). Rainfall patterns are bimodal with a first peak appearing around December (in the short wet season) and a second peak appearing around April (in the long wet season). The amount of rain that falls during the short wet season is highly variable. Usually reproduction first begin after the second rainfall peak soon after abundant rain has fallen in the long wet season, but if much rain falls already during the short wet season, reproduction may begin considerably earlier (Leirs *et al*., 1989) with a possibility that high increase in rodent numbers follow.

The background CMR-study of *M. natalensis* in a 3 ha field-fallow mosaic (MOSA) carried on as planned. *M. natalensis* population estimates are shown from June 2000 until December 2004 (Figure 1) and proportion of reproducing females (Figure 2) are shown from March 2000 until December 2004. Rainfall patterns are presented back from October 1999. Table 1 shows the amount of rainfall during the long- and short wet season in the different study years. The population dynamics (Figure 1) show clear seasonality and follow the general pattern of densities building up from the beginning of the dry season (June) following the main reproductive season (April – September) reaching a peak towards the end of the short wet season (October – December) and thus declining again during the long wet season (March – May). When the rain is abundant during the short wet season as in 2000 and 2002 (3.1 and 3.5 times more rain in 2000 and 2002, respectively than during the short wet season in 2001) the decline phase decreases much slower and reaches a minimum towards the end of the following long wet season (i.e. in 2001 and 2003, respectively). Population peaks in 2000 and 2003 are substantial lower in comparison to the population peaks in the remaining study years and may be due to low amount of rainfall during the long wet season ahead of the population increase (Table 1). Likewise, the high population peaks in 2002 and 2004 may be due to “wet years” with large amount of rainfall both during the long wet season *ahead* of the population increase and during the short wet season *while* the population increases. Breeding also shows clear seasonality (Figure 2). Females generally start breeding March/April, but in 2003 breeding first begins in May, whereas in 2004 breeding already begins in February (Figure 2). Very little rain, however, fell during the long wet season in 2003 (Table 1), which may have delayed onset of reproduction slightly. On the contrary, much rain fell during the long wet season in 2004 (Table 1), which may have hastened onset of reproduction. Further, in 2001 and 2002, where population peaks are high, the breeding period is extended until late December and late October, respectively, whereas breeding terminates early September in 2000 and 2003. The long wet seasons were rather wet in those two years (Table 1), which perhaps have improved the environmental conditions for reproduction to continue. Thus abundant rainfall in general may extend the breeding period.

Table 1. Total amount of rainfall (mm) during the long- and short wet seasons in Morogoro, Tanzania since 1999.

Wet seasons	Long (Jan-May) (mm)	Short (Oct-Dec) (mm)	Long/Short
1999		95.7	Dry
2000	457.2	260.0	Dry/Wet
2001	691.5	83.0	Wet/Dry
2002	623.0	294.0	Wet/Wet
2003	343.2	83.6	Dry/Dry
2004	696.9	217.4	Wet/Wet

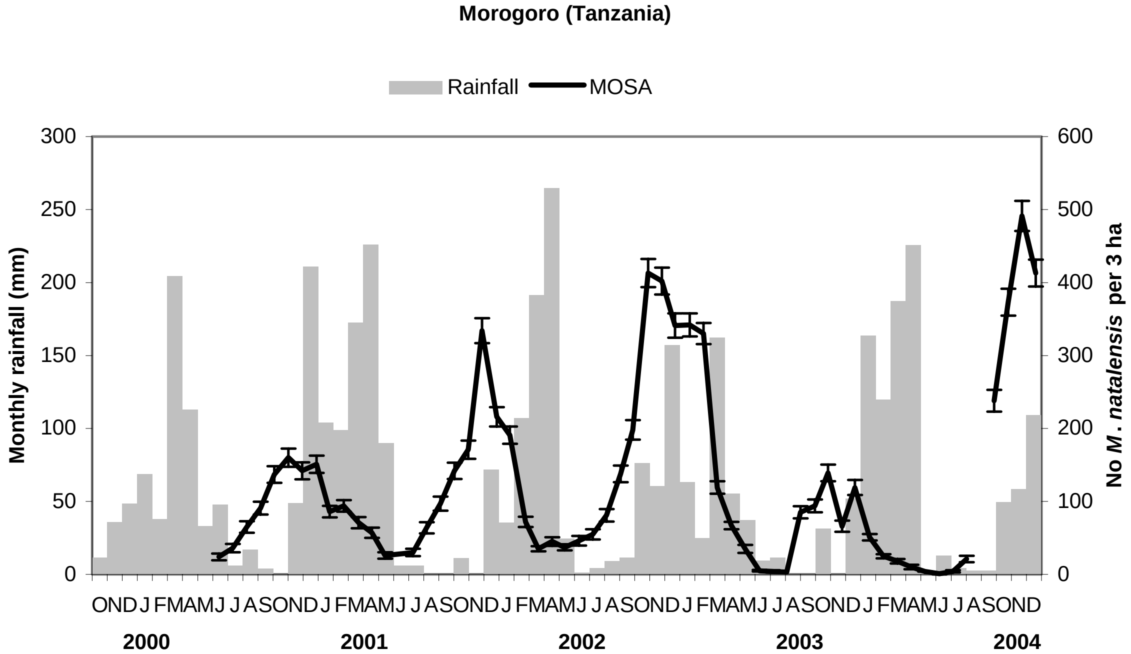


Figure 1. Population dynamics of *Mastomys natalensis* in MOSA site

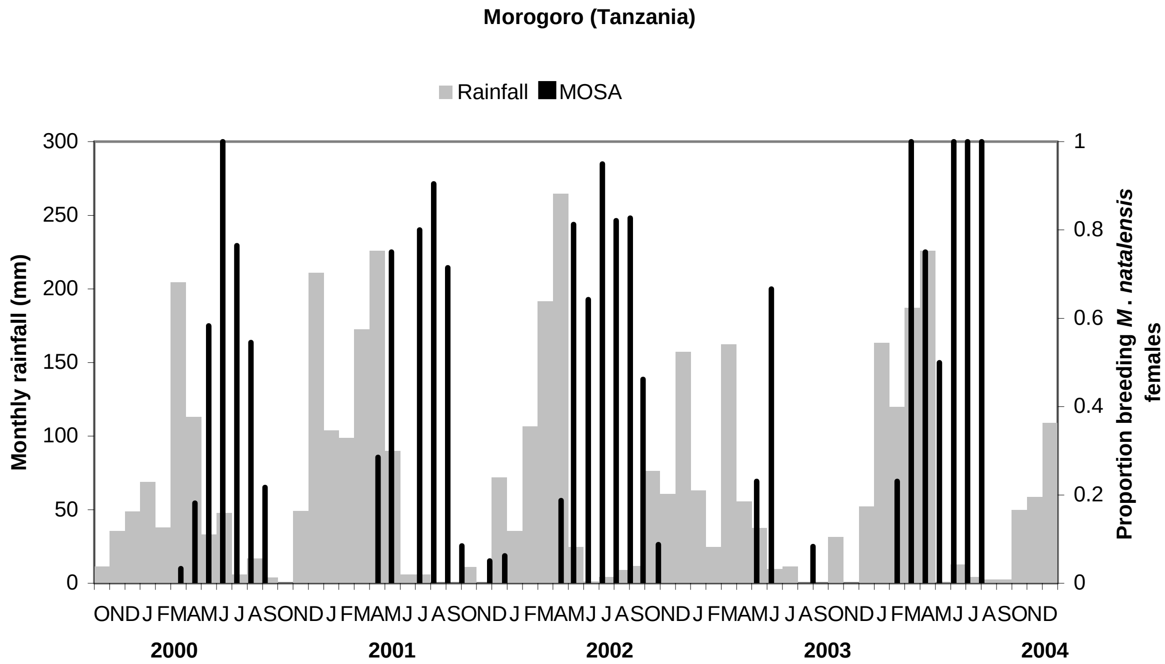


Figure 2. Breeding of *Mastomys natalensis* females in MOSA site

CMR-studies at two 1 ha sites (AB and CH) in peri-urban interface began in March 2004 and data have been received at DPIL up until December 2004. Captured species involved are *Mastomys natalensis*, *Lemniscomys rosalia*, *Rattus rattus*, *Tatera swaythlingi*, *Cricetomys gambianus*, *Saccostomys* sp. and *Crocidura* sp.

In AB there is at present a total of 505 captures of 393 individual animals. Of those individuals, 365 were *Mastomys natalensis* (approx. 93%) and 16 were *Crocidura* sp. (approx. 4%). In CH there is at present a total of 379 captures of 299 individual animals. Of those individuals, 273 were *Mastomys natalensis* (approx. 91%) and 19 were *Crocidura* sp. (approx. 6%). Because populations of *Crocidura* sp. at a maximum consist of 5 animals, we only present the data for *M. natalensis*.

Because we have not yet covered an entire trapping year, interpretation of results will naturally be restricted. Population dynamics of *Mastomys* sp., however, seem to fluctuate seasonally in both study sites, starting to increase from March, peaking around September in AB and November in CH, followed by a decrease again (Figure 3). Also breeding seems to be seasonal (Figure 4). Breeding females are found from the onset of the study (i.e. March) and terminates in September in both AB and CH. Rainfall is identical to the MOSA site because the sites are near to each other, and rainfall data therefore comes from the same weather station. Population dynamics and reproduction thus compares with that for *M. natalensis* in MOSA site, except that population size start increasing some months earlier in both AB and CH, and that the population in CH peaks substantial earlier in AB (already in September compared to November for the population in MOSA site).

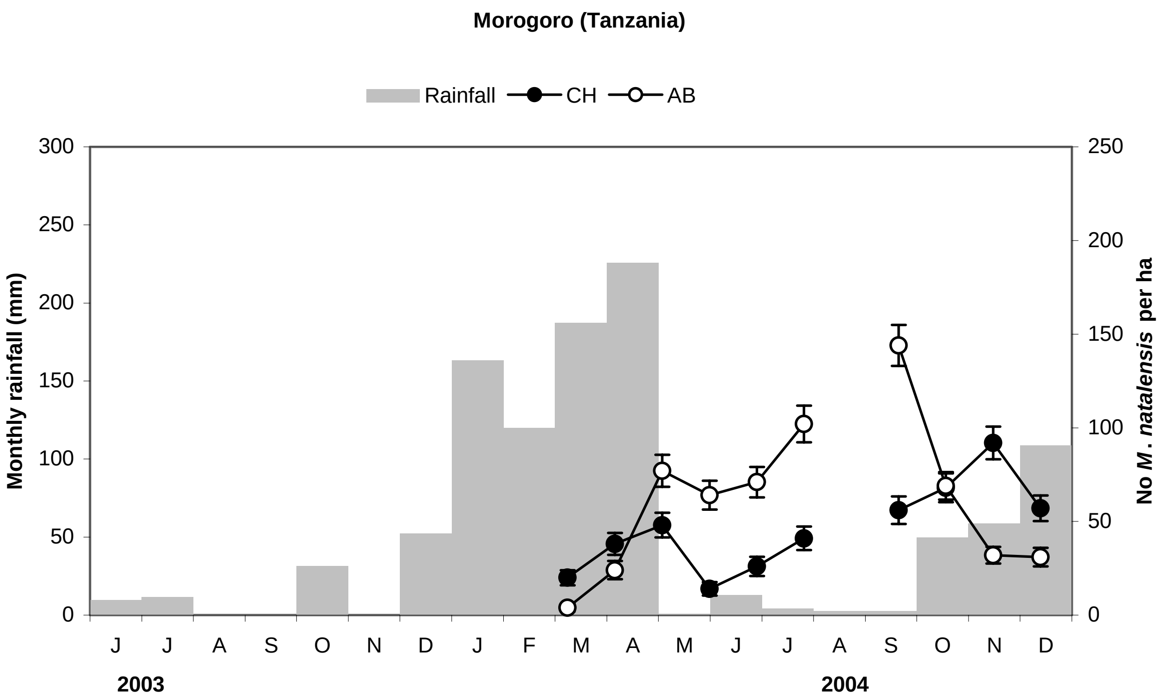


Figure 3. Population dynamics of *Mastomys natalensis* in AB and CH sites

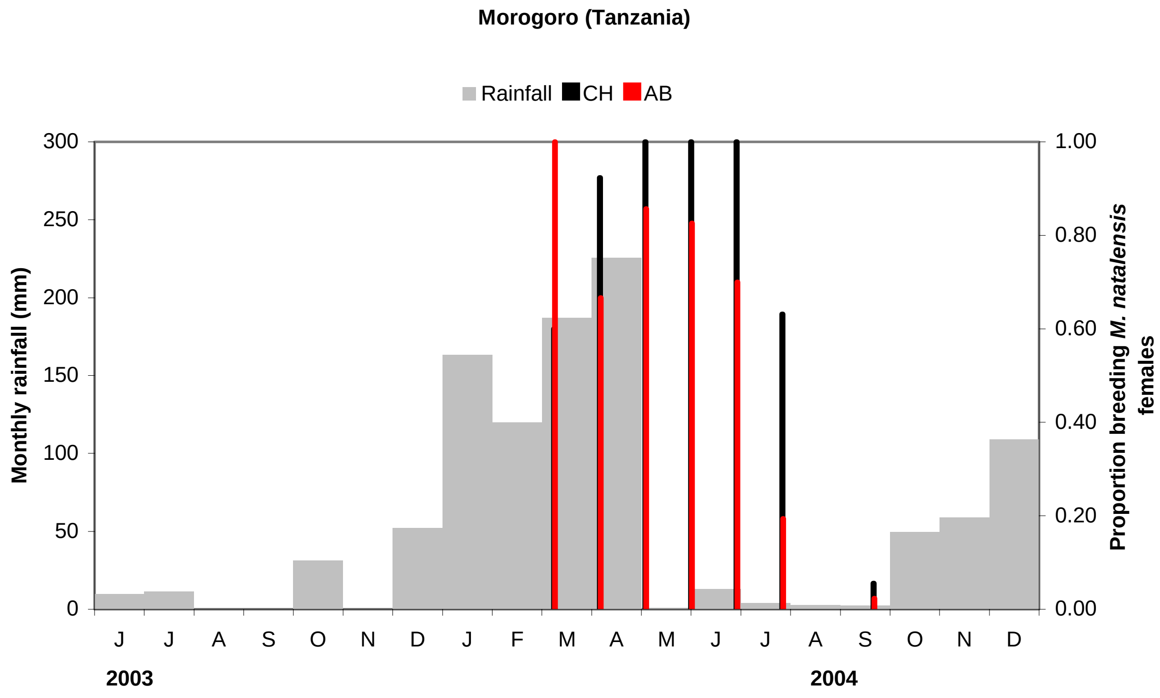


Figure 4. Breeding of *Mastomys natalensis* females in AB and CH sites

Mapate, South Africa:

CMR-studies at two 1 ha sites (CMR2 and CMR3) in peri-urban setting began in September 2003 and data have been received at DPIL up until December 2004. Captured species involved are *Mastomys* sp., *Rhabdomys* sp., *Aethomys* sp., *Otomys* sp., *Mus* sp., *Tatera* sp., *Lemniscomys rosalia* and *Saccostomys campestris*.

In CMR2 there is at present a total of 759 captures of 634 individual animals. Of those individuals, 542 were *Mastomys* sp. (approx. 85%), 53 were *Rhabdomys* sp. (approx. 8%) and 21 were *Aethomys* sp. (approx. 3%). In CMR3 there is at present a total of 363 captures of 303 individual animals. Of those individuals, 278 were *Mastomys* sp. (approx. 92%) and 18 were *Aethomys* sp. (approx. 6%). Due to the very small amount of *Aethomys* sp. in both sites, we only present the data for *Mastomys* sp. and *Rhabdomys* sp.

Population dynamics for *Mastomys* sp. also fluctuates seasonally in the sites in South Africa (Figure 5). From the beginning of the study (i.e. September 2003), population size is low in both CMR2 and CMR3 until late March 2004. Then the populations increase fast and peak already late July, followed by a decline extending until the latest trapping session at present (i.e. November). Rainfall pattern seems to resemble that in Morogoro, thus at least in the observed period being bimodal with a short wet season from September/October to October/November and a long wet season from December to April. Thus *Mastomys* sp. begin population rise during the dry season following the long wet season just like in Morogoro. Breeding start few months before populations begin to rise (i.e. in February) and continue through the population rise, peak and decline period (Figure 6). There is only few months yet where the rodents do not breed. Thus from the data it is still too early to interpret the pattern of seasonality in breeding.

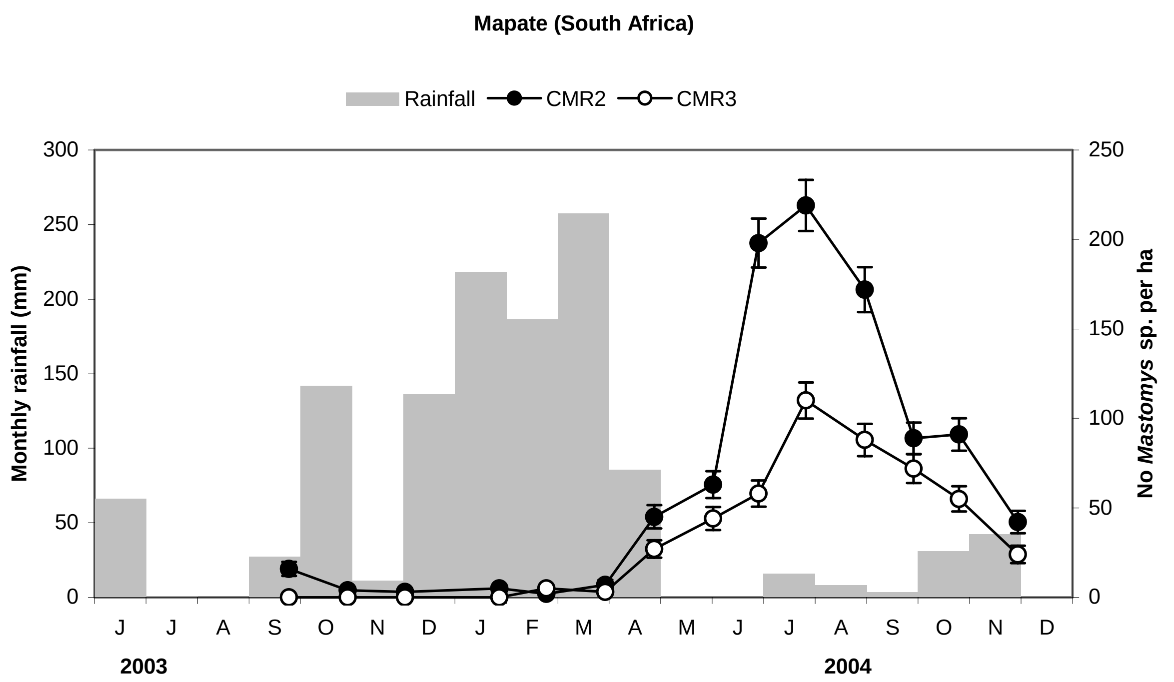


Figure 5. Population dynamics of *Mastomys* sp. in CMR2 and CMR3 sites

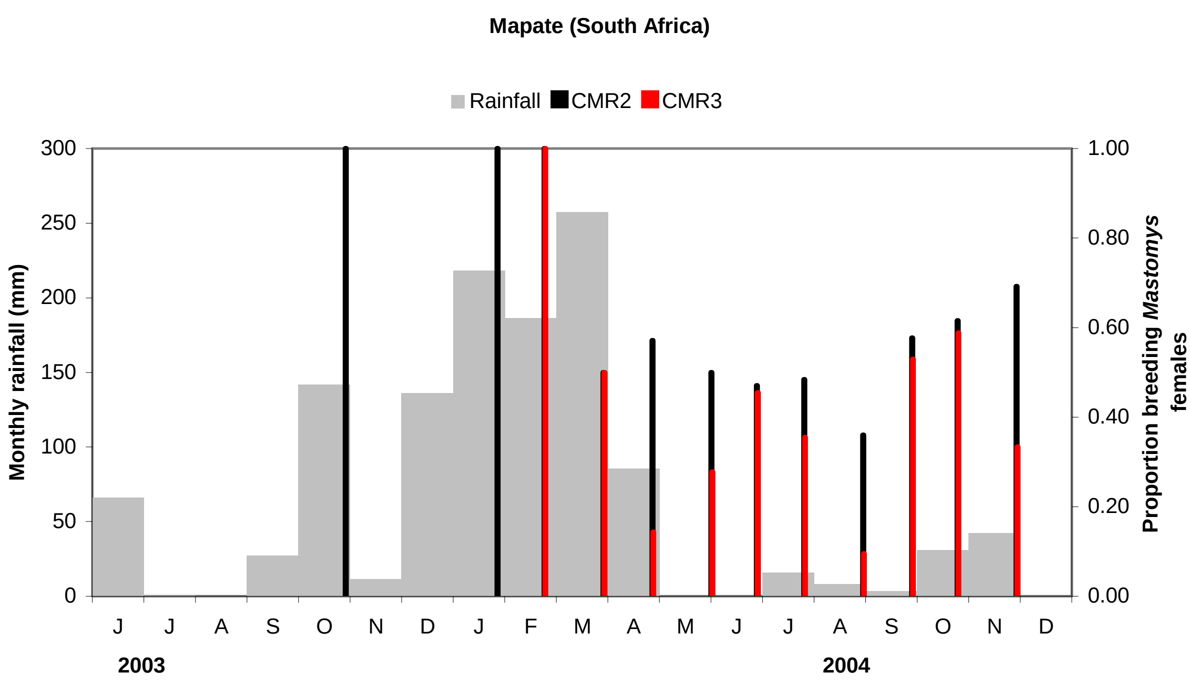


Figure 6. Breeding of *Mastomys* females in CMR2 and CMR3 sites

Rhabdomys sp. is only presented in CMR2, and is completely absent from CMR3. Population size in general, however, is substantial smaller than that of *Mastomys* sp. The Population dynamics of *Rhabdomys* sp. peaks twice during the study year (i.e. late February and late August) (Figure 7). Before the first peak and after the second peak, the population decreases to zero individuals, but between peaks the population, although declining, remain at a certain size. Breeding seems to be seasonal, and begins January and terminates September (Figure 8). Perhaps interspecific competition acts for *Mastomys* sp. and *Rhabdomys* sp. Because *Mastomys* sp. population rises in between the population peaks of *Rhabdomys* sp., it seems possible that *Mastomys* sp. restrict the number of *Rhabdomys* sp. in the site, thus participating in shaping their population dynamics pattern.

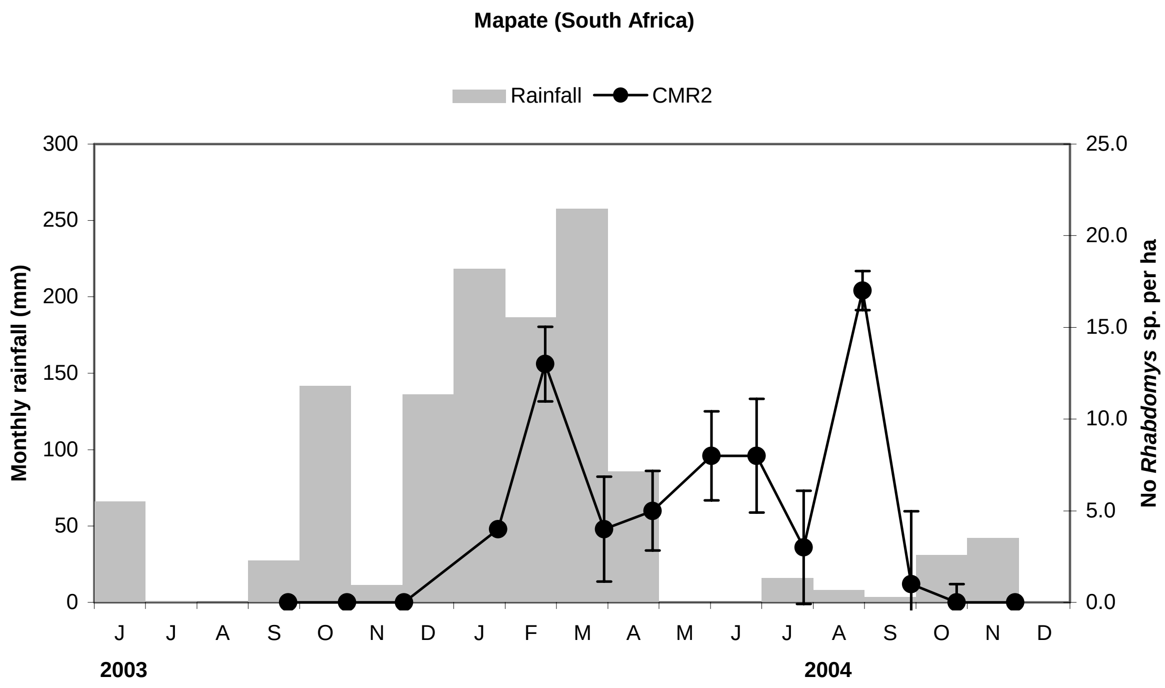


Figure 7. Population dynamics of *Rhabdomys* sp. in CMR2 site

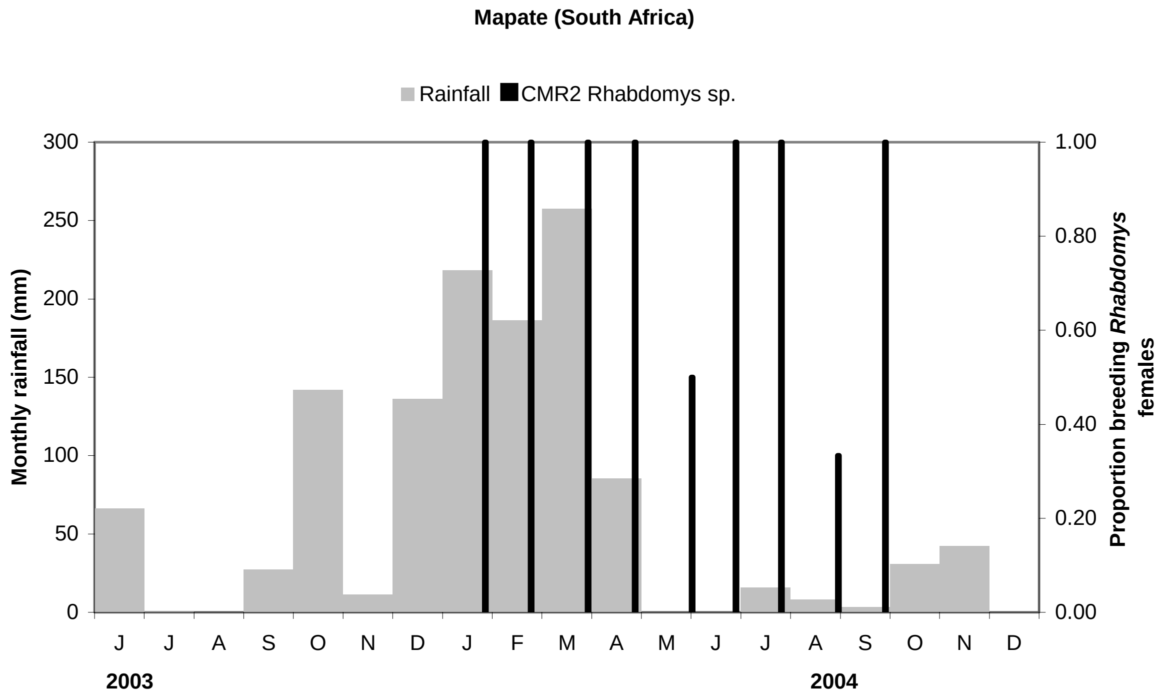


Figure 8. Breeding in *Rhabdomys* females in CMR2 site

Zimbabwe:

CMR-studies at two 1 ha sites (HAT1 and HAT2) started in June 2004, but initial captures were not carried out regularly. At present only data from the first trapping sessions have been received and therefore analyses are yet to be done.

Mozambique:

CMR-studies at one 1 ha site started in February 2004, but initial captures were not carried out regularly. Monthly trappings were only obtained from October 2004. Because at present no data have yet been received, analyses are yet to be done.

In summary: Although several small mammal genuses are represented at the study sites in both Tanzania and South Africa, by far the greater part of the animals is *Mastomys* sp. A small amount of *Crocidura* sp., however, is also found in two of the study sites in Tanzania, whereas a small amount of *Rhabdomys* sp. and *Aethomys* sp. are represented at the study sites in South Africa (see percentages above). Generally speaking the population dynamic patterns and reproduction of both *Mastomys* sp. and *Rhabdomys* sp. show seasonality, and may relate to the rainfall pattern, although more data are needed for proper interpretation. Furthermore, *Mastomys* sp. may interact with *Rhabdomys* sp., the population dynamics of the latter species thus being shaped, at least to some degree, by the presence of the former species. A fair degree of parallelism between replicates within the same locality indicates the robustness of the obtained information.

4.2. Movements of rodents in towns

In total 131 rodents were captured during the field study. Of these, 17 individuals (12.98%) showed RB fluorescent marking in the whiskers when observed under UV illumination. None of the rodents showed any external signs of RB bait consumption.

Table 1 shows the 7 different species trapped per distance, and the number of RB positive individuals among them. The percentage of animals showing positive RB marking decreases as the distance from the bait point increases. At 0 m 32% of the trapped rodents were found positive with regard to presence of RB in the whiskers and thus showed evidence of marked bait consumption whereas only 3.7% of the rodents, trapped 200 m away from the bait point, showed RB fluorescence in the whiskers. The two species dominating the trapped species were *Rattus rattus* (n=46) and Mus sp. (n=36). Together these two species make up 62.6% of the total number of rodents trapped. However, most *Rattus rattus* were trapped close to the baiting points (0-50 m) whereas the number of Mus slightly increased with the distance. About 15% of the animals trapped were shrews (n=20), followed by *Mastomys natalensis* (n=14) which accounts for 10.68% of the total. These two species were both mainly trapped in a 100 m distance. *Cricetomys gambianus* (n=11) make up 8.40% and *Rattus norvegicus* (n=3) 2.29% of the total. A single *Grammomys dolichurus* was trapped.

Table 1 shows per species and per trapping distance, the number of individuals with a positive Rhodamine B signal/the total number of individuals trapped at that distance.

Species/Distance	0m	20m	50m	100m	200m	Total
Cricetomys gambianus	2/2	2/3	0/0	0/1	0/5	4/11
Crocidura sp.	1/1	0/0	0/5	0/10	1/4	2/20
Rattus rattus	2/20	1/2	2/14	0/7	0/3	5/46
Rattus norvegicus	1/2	0/0	0/0	0/0	0/1	1/3
Mastomys natalensis	0/0	0/0	0/1	1/12	0/1	1/14
Mus sp.	3/3	1/9	0/1	0/10	0/13	4/36
Grammomys dolichurus	0/0	0/0	0/1	0/0	0/0	0/1
Total	9/28	4/14	2/22	1/40	1/27	17/131
	32.14%	28.57%	9.09%	2.5%	3.7%	

The number of rodents trapped varied between foci: Mills/grain stores: Tanesco (n=16), Msamvu mill (n=24), Misufini (n=11); Markets: Mwembesongo (n=22), Saba saba (n=1), Soko kuu (n=2); Butcheries/slaughterhouse: Msamvu Slaughterhouse (n=16), Kilakala (n=25), and Chamwino (n=14).

Figure 5 shows the number of rodents with positive RB signals in the whiskers, plotted against distance from bait point to trapping point. A linear regression indicates an intersection with the X-axis at 181.45 m, i.e. the distance from bait point where no rodents with positive RB signals are expected to be found based on our results.

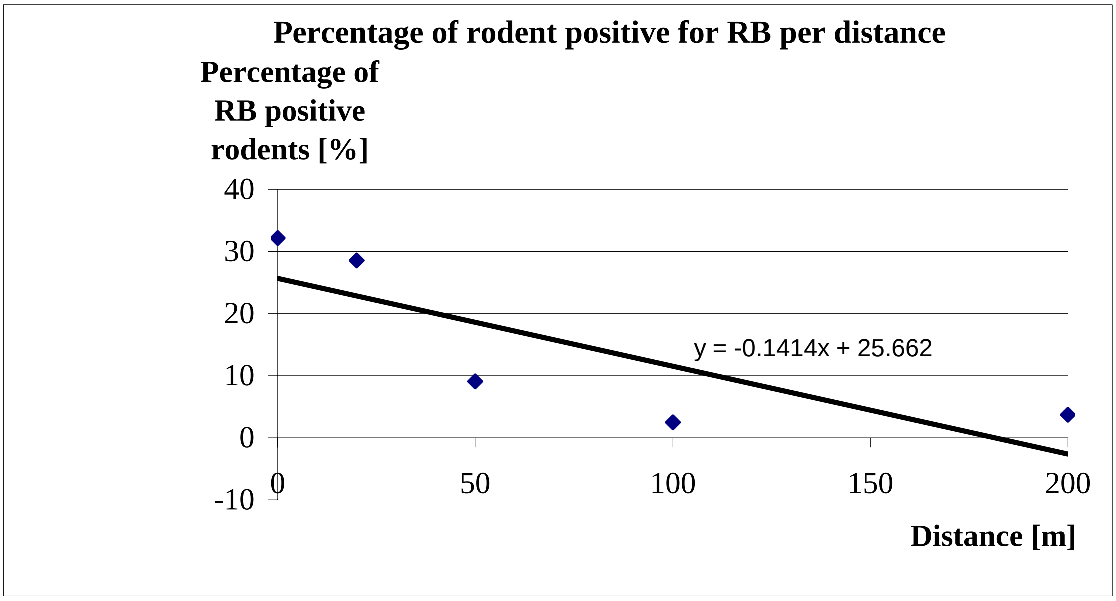


Figure 5. Percentage of rodents positive for Rhodamine B trapped per distance.

Figure 6 shows the percentage of RB positive individuals of the most abundant species *Rattus rattus* and *Mus* sp.. The proportion of *Mus* positive for RB reaches 0 at a distance of 50 m. RB positive *Rattus rattus* were found at a distance of up to 100 m from the baiting point.

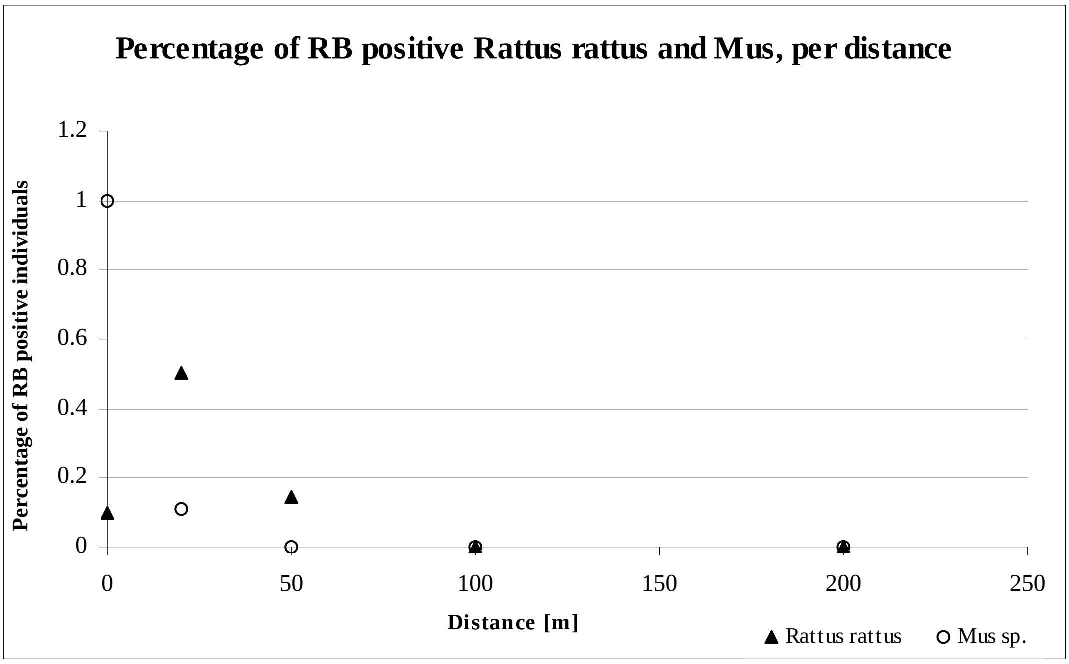


Figure 6 shows percentage of *Rattus rattus* and *Mus* sp. positive for Rhodamine B per trapping distance.

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KIT

Partner 3, Department of Biomedical Research, KIT (Koninklijk Instituut v.d. Tropen/Royal Tropical Institute Contract # ICA4-CT-2002-10056

Report for January to December 2004

Work package 1: Retrospective and prospective investigation of human sera for the presence of antibodies against Leptospira, Toxoplasma, and Yersinia antigens

For this work package, a plan was formulated at the inception meeting in UK in March 2003. The availability of sera, the analysis techniques to be used, and the collection of samples and data were discussed and now partly implemented: (1) For the retrospective analyses, DC partners should identify all sources of sera that could be used for testing and find ways to facilitate their analysis for leptospirosis, toxoplasmosis and plague. (2) DC partners should select one major and two minor focal towns for project activities in each country, also to be used for all other work package activities. DC partners need to contact local hospitals in focal areas for involvement in prospective serological analysis. (3) Tests: DriDot will be used as screening tests for human leptospirosis. MAT will be used for leptospirosis in rodents and other animals and for confirmation of human samples. Toxoplasmosis will be established through serology and by thick blood smear. The toxoplasmosis kit can possibly be adapted for use in (other) animals. PCR could serve as an alternative. For plague, ELISA is available for humans and can be adapted for rodents and other animals. Culturing of leptospires will be done where possible.

There are problems in this WP and care should be taken to deliver the promised outputs in time. Sample sizes collected so far are small and unlikely to provide representative prevalence data. Not all samples have been evaluated against all three diseases. Human leptospires isolates required to determine the causative serovars for linkage to infection reservoirs (WP3) are lacking. Collecting human isolates (and even sera) will be difficult without strong relationships and communication with clinical staff involved. Tanzania has the best chance of succeeding in human isolation. However, other countries should try to achieve the same.

Work package 3: Analysis of rodents, insectivores and domestic animals for the presence of leptospirosis, toxoplasmosis and plague

Leptospira should be routinely cultured (see WP1). Advice on serology and culturing has been given. Considering the low success rate of isolations from rodents done in Tanzania, it might better to fully focus on a selected number of isolates and doing them well than to spread attention to large numbers of isolates.

In 2003 and 2004 excel files and a questionnaire for EPI-Info have been constructed together with partners Danish Pest Infestation Laboratory, Denmark and University of Antwerp, Belgium, to collect all data obtained from the investigation of rodents, domestic animals and humans. These data are to be inserted into GIS.

Work package 4 : Rodent ecology in rural/peri-urban Africa

Participation in the discussions only.

Work package 5: Impact of water management and land use strategies upon rodent zoonotics

KIT further provided all information on leptospirosis (dynamics) that may be required for GIS (WP 8) and modelling (WP 9) purposes and for optimal sampling and testing from environment and food.

Work package 11: Analysis of policy issues

The start month of this work package is month 26.

Work package 13 : Output dissemination and project co-ordination

Rudy Hartskeerl of KIT visited the project coordination meetings in Mozambique and Denmark, 2004.

Rudy Hartskeerl, December 2004

SPMC

Project title: Prevention of Sanitary Risks linked Rodents at the Rural/Periurban Interface (RATZOOMAN). Contract No ICA4-2001-10125.

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1.0 REPORT SUMMARY

The project activities effectively took off in the middle of February, 2004 amidst uncertainty of advancement of funds by the EU as it was in 2003. This necessitated funds to be borrowed from other objects. Thanks to additional advance of funds from the Natural Research Institute through which activities planned for this year were to a great extent accomplished. Activities carried out continued to address the work packages (WP) charted out at the project's semi annual progress report held in Morogoro, July 2003.

The project study areas were Morogoro urban/periurban, which constituted the major study area, Lushoto rural/periurban and Masasi/Mtwara, which were the second and third minor study areas respectively.
This work packages addressed include:
WP1: Retrospective and prospective investigations of human sera for zoonotics
WP2: Taxonomic identification of rodent species in the study areas
WP3: Isolation of zoonotics from rodents and domestic animals from the study areas
WP6: Socio-economic impact of rodent transmitted disease (plague)
WP7: Socio-anthropogenic change upon rodent ecology

Generally speaking the activities that had started the previous year (2003) were performed satisfactorily. A copy of the final report on activity in WP7 (Socio-anthropogenic change upon rodent ecology) was received.
Future activities shall include:
i) Socio-economic impact of rodent transmitted disease
ii) Further analysis of the sera obtained through WPs 1,2 and 3 in 2003/2004
iii) Further characterization of isolated pathogens and their vector rodent vectors.
iv) Population dynamics of rodents of major and minor areas of study.

2.0 DETAILED REPORT OF PROJECT ACTIVITIES

2.1 Retrospective and prospective investigation of human sera for zoonotics (WP1).

Human sera were obtained (starting 2003) from ongoing epidemiological research, elsewhere, or from routine diagnostic procedures (e.g. HIV, schistosomiasis, malaria and PUOs were used. Sera were also kindly provided from serum banks of two major referral hospitals. Additional sera were obtained in year 2004 from two hospitals from Masasi and Mtwara, in the southern Tanzania Region of Mtwara. People in this region relish rodent meat. Wherever possible the clinical-epidemiological information related to the donor of the serum was recorded, however, without disclosing the identity of the donors. The amounts and origin (locality) of the serum samples were as shown in Table 1. Representative samples of these sera were screened for antibodies to *Leptospira spp* and *Toxoplasma spp.* using the micro agglutination test (MAT), and the Bio-Rad Pastorex Toxo® latex agglutination kit respectively. The results are shown in Tables 2a-c and Table 3.

Table 1: -Human serum collections by locality from 2003 to 2004*

Period (year)	**Region**	**Locality**	**No of Samples**
May-June (2003)	Morogoro	Aga Khan Hospital	336
May (2003)	Morogoro	Upendo Medical Laboratory	325
May-July (2003)	Morogoro	Mikumi Health Centre	290
May-July (2003)	Kilimanjaro	KCMC - Referral hospital	352
uly-Sept (2003)	Dar Es Salaam	MUCHS - Referral hospital	399
Oct-Nov (2004)	Mtwara	Mtwara District Hospital	**200***
Oct-Nov (2004)	Mtwara	Ndanda Mission Hospital	**200***
Oct-Nov (2004)	Mtwara	Mtwara Regio. Hospital	**100***
	TOTAL		**2102**

*** Blue indicates activity done in 2004 additional to 2003**

Table 2a: - Human sera (n = 150) tested for leptospira antibodies by MAT from Agha Khan Hospital, Morogoro

Titres of tested samples	Serovars tested					
	Grippo.	Ictero.	Hardjo	Pomona	Canicola	Ballum
1:20		1	1	1		1
1:40		1		1		
1:80			2			
1:160		1				1
1:320						
1:640		1				
1:1280		1	1			
Total (%)	**0**	**5 (3.33)**	**4 (2.67)**	**2 (1.33)**	**0**	**2 (1.33)**

Table 2b: - Human sera (n = 150) tested for leptospira antibodies by MAT from Upendo Medical Laboratory, Morogoro

Titres of tested samples	Serovars tested					
	Grippo.	Ictero.	Hardjo	Pomona	Canicola	Ballum
1:20		7				
1:40	1	4	2			
1:80		2				
1:160	1	2				
1:320			1			
1:640						
1:1280						
Total (%)	**2(1.3)**	**15 (10)**	**3 (2)**	**0**	**0**	**0**

Table 2c: - Human sera (n = 100) tested for leptospira antibodies by MAT from Mikumi Health Centre

Titres of tested samples	Serovars tested					
	Grippo.	Icterro.	Hardjo	Pomona	Canicola	Ballum
1:20		4	2	2	1	
1:40		5			1	
1:80		9	1		4	
1:160		2			1	
1:320		3				
1:640			1			
1:2560			1			
Total (%)	**0**	**23 (23)**	**5 (5)**	**2 (2)**	**7 (7)**	**0**

Table. 3 HUMAN TOXOPLASMOSIS SEROLOGICAL RESULTS

Source of sample	Sera collected	Sera tested	No of positive sera	% Positive
Masasi district hospital	200	60	13	21.7
Ndanda hospital	100*	30	3	10
Mtwara regional hospital	100	30	7	23.3
TOTAL	**400**	**120**	**23**	**19.2**

* Sera got haemolysed and this could have interfered with the reading of the agglutination titres

2.2 Identification of predominant rodent and shrew species in study areas (WP 2)

Rodent and shrews were trapped between February and December, 2003 using procedures described by Leirs and others. During the Months of February, March, July and August, 2003 trapping was done weekly, while for the remaining months trapping was done once per month. Areas sampled included human residences, peridomestic sites, home gardens and fallow lands in the vicinity of human settlements primarily in the Morogoro area. A limited number of rodents from other areas were kindly provided by colleague-researchers during their trapping expeditions outside Morogoro. In 2004, additional trapping was carried out in a few houses and swamps in Morogoro to complement trappings done in 2003. Also captures made in Masasi and Mtwara districts, once in the month of October 2004, have been included in the inventory. In total 1284 rodents and shrews were captured over this period of time (Tables 4, 5). Identification of the captured rodents was preliminarily done to the genus/species levels at SUA. Where applicable, further in depth identification shall be done by Partner 3 (RUCA) and reported accordingly.

Table 4: Rodent species captured in urban and peri-urban Morogoro (February-December 2003)

Species	**Months of collection**										
	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	**Tot.**
Mastomys	213	32	0	0	0	183	328	177	40	10	29	**1012**
Crocidura	59	17	4	0	4	13	16	22	0	4	5	**144**
Rattus rattus	104	14	37	38	22	29	21	7	30	10	1	**313**
Rattus Norv.	10	4	5	0	2	6	2	4	0	0	0	**33**
Mus	154	111	20	15	17	24	21	4	2	0	0	**368**
Cricetomys	1	20	23	9	18	21	5	9	14	1	0	**121**
Tatera	5	3	0	0	0	3	12	4	2	3	3	**38**
Lemniscomys	5	3	0	0	0	0	3	0	0	0	0	**11**
Grammomys	0	0	0	0	0	0	5	1	1	2	1	**10**
Leggada	0	0	0	0	0	3	1	1	1	1	2	**9**
Dasymis	0	0	0	0	0	0	2	2	0	0	0	**4**
Praomys	2	0	0	0	0	0	0	0	0	0	0	**2**
Steatomys	1	0	0	0	0	0	0	0	0	0	0	**1**
Arvicanthis	0	0	0	0	0	0	1	0	0	0	0	**1**
Total	**554**	**204**	**89**	**62**	**63**	**290**	**422**	**227**	**88**	**28**	**38**	**2065**

Table 5: Rodent captured in urban and peri-urban Morogoro (January –December 2004)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
M. natalensis	39	0	45	NT	48	30	214	187	105	NT	154	131	953
Crocidura spp	4	0	15	“	24	13	18	37	6	“	6	27	150
R. rattus	23	0	0	“	8	47	2	0	2	“	10	0	92
R. norvegicus	0	0	0	“	0	2	0	0	0	“	0	0	2
Mus spp	2	0	0	“	0	36	0	0	0	“	0	0	38
C. gambianus	2	4	0	“	0	9	2	0	0	“	0	0	17
Tatera spp	5	0	1	“	0	0	1	1	0	“	3	0	11
Lemniscomys spp	2	0	0	“	0	0	0	0	0	“	1	0	3
Grammomys spp	0	0	0	“	0	0	1	2	8	“	0	0	11
Leggada spp	0	0	0	“	1	0	0	1	1	“	1	1	5
Dasymis spp	0	0	0	“	0	0	0	2	0	“	0	0	2
Total	**77**	**4**	**61**	**“**	**81**	**137**	**238**	**230**	**122**	**“**	**175**	**159**	**1284**

NT = Not trapped

2.3 Collection of rodent and shrew sera for zoonotic screening (WP3)

Subsequent to trapping (WP 2) sera from the captured rodents and shrews were analysed for antibody to zoonotic agents infections. The total amounts of sera collected in the Morogoro area (2003-2004) were 2151. Out of these 500 randomly selected sera were tested against six serovars of the *Leptospira interrogans* by MAT namely, Icterohaemorrhagiae, Gripotyphosa, Ballum, Canicola, Hardjo and Pomona (Table 6). For serovars Icterohaemorrhagiae and Gripotyphosa local isolates RM1 and RM4. The highest MAT titre obtained was above 1:10240 with serovar Icterohaemorrhagiae The results were as shown in Table 6. Analysis for antibody to *Toxoplasma spp* antibody was carried out on 110 out of 170 sera collected in Masasi and Mtwara districts. All these sera were negative by the latex agglutination Bio-Rad Pastorex Toxo® kit.

Table 6: - Rodents and shrew sera (n = 500) tested for leptospira antibodies by MAT

Titres of tested samples	Serovars tested					
	Ictero.	**Hardjo**	**Pomona**	**Canicola**	**Ballum**	Gripo.
1:20	9			4		**5**
1:40	**2**		**1**	**1**		**3**
1:80	**1**			**4**		**1**
1:160	**1**			**1**		**1**
1:320	**2**					
1:640	**3**			**3**		
1:1280	**3**			**1**		
1:2560	**2**					
1:20480	**2**					
Total (%)	25 (5)	0	1 (0.2)	14 (2.8)	0	10 (2)

2.4 Studies of sera from domestic animals for analysis of zoonotics

A total of 300 serum samples, each, were collected from of dogs, cats, pigs (each 300 samples) and small ruminants (goats and sheep – total 300) from urban and periurban Morogoro, however, no further collection were made in 2004. The serology of these samples is yet to be carried out.

2.5 Isolation of zoonotic agents from rodents shrews and humans

Primary isolation of leptospira spp. was carried out from urinary bladders and kidney tissues of the rodents and shrews obtained in WP2, isolations were also attempted from freshly obtained human blood and urine. Specimens were inoculated in Fletcher's medium and incubated at room temperature

(24-28^0 C) under a regular weekly screening for bacterial growth over a maximum period of 4 months. Secondary cultures were grown in EMJH medium. Spirochetal isolates were obtained from *Cricetomys spp., Mastomys spp*, and *Crocidura spp* (Table 7).

Table 7: Leptospira isolates from rodents and shrews

Rodent and shrew species	**Total cultures**	**Positive**	**% Positive**	Locality
M. natalensis	1296	7	0.54	Morogoro, Mtwara (n=97)
Crocidura spp	221	11	4.98	Morogoro Mtwara (1)
C. gambianus	190	9	4.74	Morogoro

Specimens from other species of rodents yielded no isolates. These include: *Arvicanthis spp* (n=22), *Nannomys spp* (8) *Tatera spp* (11), *Lemniscomis spp* (5), *Grammomys spp* (13), *Dasymys spp* (6) *Steatomys spp* (1), *Rattus spp* (278) and *Mus spp* (137). Also, no isolates have been obtained from human blood cultures so far. A total of 400 cultures are still under incubation.

2.5.1 Characterization of isolates

Primary characterization of these isolates is on going using antibodies prepared in hyperimmune rabbit sera to reference strains. Initially MAT of the isolates shall be carried out against reference antisera followed by cross agglutination - absorption for indecisive cases. Cultures of the isolates shall confirmed in collaboration with KIT and reported accordingly.

2.6. Socio-economic and socio - anthropogenic studies in Lushoto district (WP6, 7)

These studies focused on selected villages the plague endemic areas of rural Lushoto District in Tanga Region, effective 2003. The final report on the Socio – anthropogenic component of the study has been received. Further report shall be given by NRI colleagues

3.0 GENERAL COMMENTS

The activities carried out went on smoothly after some initial period of preliminaries. Technical problems encountered were minimal and collaboration with other partners was good. It is yet to be decided on the most appropriate The engagement of a research assistant dedicated to this project has proven to be very valuable. Additional assistance was through students (MSc) and students who spent some of their school break times in trapping rats and in the preparation of specimens in 2003. It is anticipated that the exposure of these young persons to the project shall stimulate interest in related research in the future. For 2004 activities continued, not so smoothly due to frequent shortage of funds. It was anticipated that the EU would disburse some funds earlier in the year but this did not happen. Nonetheless, funds advanced to the Ratzooman projects by colleagues (projects) at SUA, and especially by NRI are highly appreciated. Without these, activities of this year (2004) would have been severely impaired if not left out altogether..

It is suggested that the component involving identification of rodent species in Lushoto (WP2) and studies on zoonotics in the same area utilize already existing materials/data obtained from previous studies, and available, at SPMC. This is due to public health reasons and the general feeling that any further expeditions in Lushoto may not bring any new knowledge, given the extensive studies carried out in the past in Lushoto.

A manuscript titled “Rodent and shrews as carriers of potentially zoonotic spirochetes in rural and periurban Tanzania shall be finalized upon completion of the isolation and characterization of the isolates. to be published in a relevant journal, such as the East African Journal of Public Health.

4.0 FUTURE ACTIVITIES

Future activities shall complement the preliminary works carried out so far, namely:

(i) Serological analyses of human, rodent and domestic animal sera for rodent transmitted zoonotic infections (Leptospirosis, toxoplasmosis)
(ii) Further identification of the rodents /shrews predominant in the study areas.
(iii) Characterization of the leptospira isolates obtained from this study.
(iv) Socio economic studies in leptospirosis prone in the major study area
(v) Further analysis of the sera obtained through WPs 1, 2 and 3 in 2003/2004.

NHLS

ANNUAL PROJECT PROGRESS REPORT (Jan. – Dec. 2004) YEAR TWO

Project title: Prevention of sanitary risks linked to rodents at the rural / peri- urban interface – RATZOOMAN

PRIME CONTRACTOR:
Partner No 7

National Health Laboratory Service
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SOUTH AFRICA
(John Frean, Lorraine Arntzen, Malodi Setshedi & Chantel le Roux)

INSTITUTIONAL SUBCONTRACTORS:

PPRI/ARC, Pretoria
(Frikkie Kirsten, Emil von Maltitz and Fanie Phanuel S Malebana)

Natural Science Museum, Durban
(Dr Peter Taylor)

INDIVIDUAL SUBCONTRACTORS:
(Pfarelo Matshidze and Takalani Thakani – Thohoyando)
(Prof S Leclerc Madlala - Duban)

REPORT SUMMARY:

The project started off very slowly. It took a long time to contact the sub contractors and for them to set up the trapping schedules. Once that was sorted out, the project moved forward much faster. The one major problem that we experienced, was with obtaining ethics clearance to collect human blood samples. The ethics clearance has now been granted and we will collect human samples from the respective areas. Another problem has been with delay of transfer of funds by the EU.

The project study areas were Mapate in Limpopo Province, Durban in KwaZulu Natal and Port Elizabeth in the Eastern Cape.

Trapping was undertaken in the urban/periurban of Mapate, which constituted the major study area, Durban and Port Elizabeth were the second and third minor study areas respectively.

The work packages for these areas include:

WP1: Retrospective and prospective testing of human sera from the same trapping areas, for the same three zoonotic diseases.
WP2: Taxonomic identification of rodents and insectivores from the study areas
WP3: To ascertain the prevalence of three rodent-borne zoonotic diseases among different rodents and insectivores.
WP4: To establish rodent population dynamics for the major rodent and small mammal species identified in targeted areas.
WP6: Socio-economic impact of rodent transmitted diseases
WP7: Socio-anthropogenic factors which promote or reduce the chance of contracting zoonotic diseases.

WP12: Project workshop. The date for this workshop is booked for 2 & 3rd May 2006 for a pre conference meeting and the conference dates are 4 & 5th May 2006. The conference will be held at Berg & Dal in the Kruger National Park in South Africa.

Activities for 2005

Completion of analysis of sera obtained through WPs 1,2 and 3 in 2003/2004 & 2005.
Completion of isolation and characterization of zoonotic pathogens
Assisting Mozambique and Zimbabwe with some of their testing.
Assist Tanzania with acquiring reagents for the plague serology tests

B. DETAILED REPORT OF WORKPACKAGES

Retrospective and prospective investigation of human sera for the three zoonotic diseases. (WP1)

We experienced a delay in obtaining ethics clearance to obtain human blood samples. This was due to the ethics committee requiring written consent and we had suggested verbal consent. It was also suggested that we have the consent forms translated into the language of the area. Ethics clearance has been granted and we will collect blood samples from the population in the respective trapping areas. No samples have been received to date.

Identification of predominant rodent species in the study areas (WP2)

Rodents were trapped in the three areas using universal trapping methods. Trapping was done during the all four seasons throughout the year at the prescribed intervals. Trapping areas included human houses, home gardens, peridomestic sites, fallow lands.
Identification of the captured rodents was preliminarily done to the genus/species levels at the different sites. Further identification will be done by Partner 3 (RUCA).

Collection of rodent sera for zoonotic screening (WP3)

Sera from captured rodents were analyzed for antibodies to the three zoonotic diseases. The total number of rodent sera collected in all three sites (2003-2004) was 1329.
Plague testing: The Enzyme-Linked Immunoassay (EIA) was used to test the sera for antibody to F1 (*Yersinia pestis*). Reagents kindly supplied by CDC.
Leptospirosis testing: The Lepto Tek Dri-Dot immunoassay (Biomerieux) was used as a screening test on 1329 rodent sera and 500 randomly selected sera were sent to Onderstepoort Vet. Institute, to be tested against six serovars of Leptospira interrogans by the MAT test, namely, Icterohaemorrhagiae, Gripotyphosa, Ballum, canicola, Hardjo and Pomona (Results still to follow)
(The Leptospirosis Dri Dot kit was also used as a screen on all the rodent sera.) The results will be compared to the MAT results, when the MAT results are available.
Toxoplasma testing: Pastorex Toxo latex particle agglutination (BIO-RAD)was used. Analysis for antibody to Toxoplasma spp antibody was carried out on 1329 rodent sera collected in all three provinces.

Isolation of zoonotic agents from rodents (WP4)

Primary isolation of Leptospira spp. Was carried out from kidney tissues of rodents obtained in WP2. Samples were ground up in a pestle and mortar and inoculated into Fletcher's medium and incubated at room temperature (24-28°C) with weekly screening for bacterial contamination for a maximum period of 4 months. These cultures have been sent to Onderstepoort Vet Institute for processing and results to follow.

Rodent samples tested: TABLE 1

AREA	Mapate – Limpopo Province			Durban – KwaZulu Natal			Port Elizabeth – Eastern Cape		
TEST	Plague	Lepto	Toxo	Plague	Lepto	Toxo	Plague	Lepto	Toxo
NO. RECEIVED	202	202	202	184	184	184	943	943	943
NO. TESTED	178 24 insuf	193 9 insuf	201 1 insuf	157 27 insuf	170 14 insuf	179 5 insuf	914 29 insuf	942 1 insuf	938 5 insuf
NO. POSITIVE (%)	0 %	13 6.74%	37 18.40%	0 %	22 12.94%	8 4.47%	0 %	226 23.99%	147 15.67%

Socio-economic and socio-anthropogenic studies in Mapate and Durban.
These studies focused on areas in the different trapping sites in Mapate and Durban. The studies are completed and the final report are being written up.

GENERAL COMMENTS

The project activities went well, once all the initial delays had been dealt with. Technical problems encountered at the beginning of the project have been solved and collaboration with other partners was good. It was anticipated that the EU would disburse some funds earlier in the year but this did not happen and we had to "borrow" funds from other unrelated research funds. This is not always possible and could cause difficulties with getting the project testing done in the specified time period.

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TECHNICAL REPORT – PROGRESS AND CHALLENGES

WORK PACKAGE 1

RETROPSPECTIVE AND PROSPECTIVE INVESTIGATION OF HUMANISERA FOR ZOONOTICS

Delayed release of projects funds resulted in delays in taking action by The Blood Transfusion Services. It was like we were starting all over again. The programme is on course as assurance was given that they will start soon.

WORK PACKAGE 2

Carcasses and internal organs collected the previous year were sent to Belgium. In October rodents were collected in Nkayi and could not be processed due to unpaid Bench Fees.

Trapping of rodents in Mbare, Hatcliff and Nkayi resumed in February and processing is in progress.

WORK PACKAGE 3

ISOLATION AND IDENTIFICATION OF ZOONOTICS FROM RODENTS AND DOMESTIC ANIMALS.

Rodents

Rodent sera collected from the beginning of the project were taken to South Africa by Martha who was travelling to S.A. on a separate business assignment (to save on freight costs).

Domestic animals

Bureaucratic problems faced with the Department of Veterinary Services (Ministry of Agriculture) coupled with late release of funds severely affected the progress. However, discussions with the relevant authorities were finalized at the end of February 2005 and we were assured that collection of animal blood sera from Nkayi would start March/April 2005.

WORK PACKAGE 4

RODENT ECOLOGY IN RURAL AND / PERI URBAN AGRICULTURE

CMR experiments were resumed in Hatcliff second week of February 2005 and were repeated second week of March and will be continued in the second week of April to give 3 date capture points.

WORK PACKAGE 5

IMPACT OF ENVIRONMENT FACTORS, WATERS MANAGEMENT AND LAND USE STRATEGIES UPON ZOONOTICS.

Rural agriculture (Nkayi–Dhakamela)

Dhakamela is a rural agricultural village in Nkayi District and has been hard hit by plague outbreaks in 1974, 1982 and 1996, with the highest victims of more than seven dead and over 60 clinical cases.

Rodent trap catches obtained in Nkayi between October 2004 and February 2005 were very low and a total of only 46 rodents were caught during the two visits to that area. One of the possible reasons why they experienced such low catches could have been the scarcity of vegetation due to land use for cropping, building space coupled with draughts. Vegetation normally provides food and shelter/refuge for field rodents.

WORK PACKAGE 6 AND WORK PACKAGE 7

SOCIO ECONOMIC IMPACT AND LIVLIHOOD, CONTRAINTS OF DISEASE/MEASURING FACTORS OF ANTHROPOGENIS CHANGE UPON RODENT ECOLOGY, EPIDIMIOLOGY AND NATURAL CAPITAL

The information will be available at the end of April 2005 meeting in the Netherlands since the Socio-Scientist started this month to collect the required data. So far, data from 20 houses at Mbare and 70 houses at Hatcliff has been collected. Plans to visit Nkayi during the third week of March 2005 were finalized last week.

WORK PACKAGE 8

GEOGRAPHIC INFORMATION SYSTEMS

Weather data from the Zimbabwe Metrological Department in Harare for all the study areas is now available and the logistical arrangements have been sorted out. The Ratzooman Project Zimbabwe need to get the details of the aspects of weather components required and that will be made available by the weather station before April.

WORK PACKAGE 9

POLICY ISSUES

Background research on current understanding of Zoonosis in SADC countries is in process. Full Report to be available in April 2005.

INS

Introduction

RATZOOMAN project activities are undertaken by the National Health Institute and National Veterinary Research Institute in Mozambique, according to the protocols defined. The activities involved to achieve the main objective include various Work Packages, called WP 1, 2, 3, 4, 6, 7 and 8

The main activities carried out so far involves human serum sample collection, rodents and small mammals collection and processing, capture and recapture of rodents and small mammals, socio-anthropologic study, socio-economic study from Morrumbala and Mutarara which data is still being entered in the statistical program EpinInfo 2002.

Project objectives:

- To identify and describe the Yersinia, Leptospira and Toxoplasma species prevalence in four geographically clustered southern African countries in human, rodents and domestic animal population in Mozambique;
- To undertake a livelihood constraint and impact study of zoon tic diseases;
- To identify epidemiological determinants of rodent borne zoonotic diseases at the rural/peri-urban interface
- To investigate the impact of anthropogenic factors which affect disease transmission risk;
- To develop and test sustainable control strategies that reduce sanitary risks associated with rodent-borne diseases

Methodology and Results

Site Identification:

- Maputo, Zambézia and Tete were identified as the sites to work on, being Maputo Maxaquene (sub-urban area), T3 (peri-urban area) and Tsalala (rural area), while in Zambézia the district of Morrumbala at Megaza administrative post (Megaza and Pinda localities) and for Tete the district of Mutarara administrative post of Charre (Mandua and Mpane localities) were defined as rural area. The sites were identified as recommended in the project protocol.

WP 1

Human serum sample in a total of 550 were collected from the sites according to the WP1 protocol. The samples were collected from the Hospitals and from the household within the working area. Because of difficulties on getting the sample from some involved individuals in the areas, the collection was not undertaken in the way it should be done. It was supposed to collect blood samples from the all individuals in the household, but unfortunately they refuse to donate blood, to avoid to be tested on HIV/AIDS.

Trapping and processing of animals (WP 2, 3,and 4):

The activities started in February 2004 and consisted of trapping of rodents and small mammals in a variety of peri-urban and rural areas of Maputo province in the southeast part of Mozambique, Zambézia and Tete in the northern part of the country in order to achieve the objectives of the project.

From the mentioned sites, 475 rodents were trapped processed according to WP 2 protocol. Some of the processed animals were locally identified, R. Norvegicus, Mus spp, Mastomys, Tatera and Crocidura. From those animals, 301animals were sent to Belgium for taxonomical identification, and 78 samples of organs sent to South Africa in May 2004 for laboratory diagnosis according to the manual. So far the team is still testing the remaining samples.

From the samples tested in South Africa the results are:

Leptospira	16.6% (n=78)
Toxoplasma	74.4% (n=78)
Yersinia	0% (n=78)

The results presented are still being processed by the Laboratory as they were sent in a crude way, which do not identify the sites from were the positive cases come from.

Concerning capture and recapture, 68 animals were captured and recaptured from Tsalala according to the WP 4. From these animals 7 were recaptured so far and 11 died while processing or found dad in the traps. The amount of sample mentioned includes those captured while the team was not aware of the correct procedure for capture and recapture.
Because of lack of information capture and recapture did not follow the protocol and was carried out each tree months. The mistake was identified in Denmark during the last coordination meeting and agreed to be carried out monthly from October 2004 for a year period.

WP 6
Concerning socio-economic study, questionnaires were carried out in Morrumbala and Mutarara districts. A total of 60 household families were involved, and 30 questionnaires from each district were made. It is planned to undertake questionnaire in Maputo province during February in a total of 30 households. The data being introduced to a data base using a statistical program EpinInfo 2002. As we have agreed the analyses is going to be done by Malcolm Iles from NRI. The Mozambican team only gathered the information from the field.

WP 7
A socio-anthropologist was hired to conduct the study in Morrumbala district of Zambézia and a report produced. The study was carried out, making in-depth interviews to the population, to find out their attitudes knowledge and their behaviour with Rats. Mutarara was not involved in the study due to the similarity in living habits of both populations.

WP 8

Spot scenes and TM images for the main site in each country were purchased from the Satellite Applications Centre, South Africa. The images are currently processed and analyzed in order to get a digital of each site and also to evaluate land use changes that could be potentially related to rodent data.

All the data already colleted will be integrated in a Geographic Information System (GIS) showing the spatial relation between the different variable being studied.

Other Work package

The Mozambican team was not working on that wok package.

Main Constraints

The Mozambican team was facing a lot of problems.

Problems related with the accessibility of the areas where we were working on. In the rain season the accessibility become worst.

To flight always the rat traps up to the North, makes it so expensive.

Sometimes to access to the peoples houses, and get their permission is difficulty. There is other individual, who agree on participating on the project, and they just receive the traps, and don't do anything with them and on the end, the return it to us the way we gave to them.

Budget constraints

The team is facing money problems. To carry on the project, is being so hard, due to the lack of money. We could manage to make activities up to December 2004, and still waiting for the budget to carry on the 2005 activities. Otherwise, the team is going to stop their activities.

For the work package 8 the team is having a lot of problems, buying the spot images in South Africa. The company where we are buying the images are not responding on time the orders. Apart of that the Mozambican central bank doesn't allow the institution to transfer hug amount of money in the some time, and to delay the process they ask a lot of documents, and in the main time we cannot take the money with us to South Africa to make direct payment.

Planned activities for 2005

-Trapping on different sites according to the protocol. Maputo, Morrumbala, Mutarara.

Capture and recapture in Tsalala site

To process and analyses of the existing samples (Rats and Human samples)

The team is writing scientific articles

Note: Apart of writing scientific articles, the other activities depend mainly on the 2005 budget.