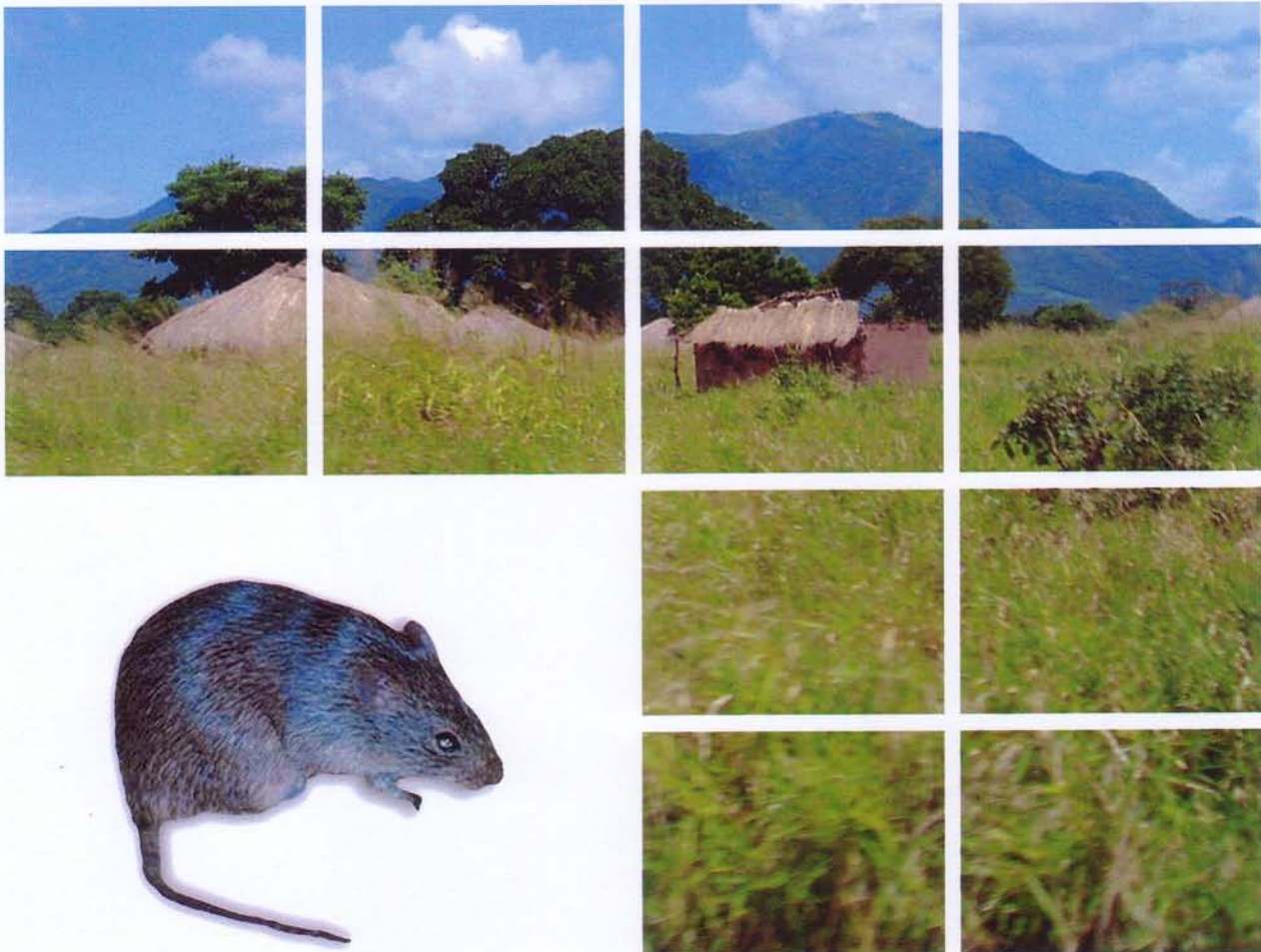


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Perceptions and Practices relevant to the Transmission of Plague, Leptospirosis and Toxoplasmosis

Morrumbala, Mozambique

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1. Introduction

The study on which this report is based forms part of a research project funded by the European Union, RATZOOMAN, which focuses upon the prevalence among rats and humans, and transmission from rats to humans, of plague, toxoplasmosis and leptospirosis. As part of this project, studies of various kinds, including social anthropological studies like this one, have been carried out in Tanzania, Mozambique, South Africa and Zimbabwe.

While some field sites have been selected to reflect different types of ecosystem or settlement pattern which could be relevant to understanding the prevalence or persistence of these three illnesses, Morrumbala, like one of the other field sites, Lushoto in Tanzania, was selected because it is a place where plague is currently a problem. In addition, it is known that rats are regularly eaten in Morrumbala and surrounding areas (not only in Mozambique but also in parts of Malawi, Zimbabwe and Zambia, where wild rats which are eaten are described using the same term, *mbeua*), and this is an important risk factor for transmitting plague.

Because of the presence of plague, the main aim of this study was to investigate local practices and perceptions relating to rats and to plague, in order to better understand how these relate to the way in which plague has presented and spread in the district, as well as to make some recommendations regarding changes in behaviour which would have the potential to reduce transmission of plague.

Some information was also gathered on practices relating to the transmission of toxoplasmosis and leptospirosis.

1.1 Plague in Morrumbala

There is a possibility that plague has been present in the area for many years (see section 4.4 below). However, the first registered cases of plague surfaced at the District Health Centre in Morrumbala in September 1997. At this time the residents of various parts of the town reported deaths associated with abscesses within the community. The abscesses were located in the armpits and/or in the facial ganglia of the victims, and were accompanied by high fever and by general malaise. In October of the same year, more people developed abscesses, not only in Morrumbala town but in other parts of the district including Boroma, Mepinha and Cumbabo.

The national health and plague surveillance authorities, the DPCZ/RS, were alerted. They responded promptly, sending doctors and technicians to the districts to get first-hand information on the situation, working with the District Health Directorate. It was through this intervention that the first research was done in the main affected zones. The research revealed the presence of *Yersinia pestis*, the plague bacillus. From this point on, the district was declared a zone affected by plague. All cases of illness which manifested clinically with abscesses in the armpit or jaw were immediately assumed to be cases of plague. The same approach was taken in Mutarara nearby, where cases of illness with similar symptoms were also being reported.

The district authorities began through various measures to try to control the situation. Patients were treated, members of households to which they belonged were given

prophylactic treatment, their houses were sprayed with insecticide and sanitary education programmes were implemented in areas where plague cases were occurring. Despite this, however, from 1998 to 2005 the number of cases of plague shot up, particularly in the areas of Pinda and Magaza, local and administrative posts which border with Malawi. In this context sanitary health measures were intensified in the hope of sensitising the population on the dangers of the disease and on measures to be taken in dealing with rats and rodents that come into contact with humans and their homes. Currently the situation seems to be improving, with a reduction of the number of cases since 2004; in that year only one case was diagnosed.

YEAR	CASES	DEATHS
1997	712	72
1998	404	0
1999	194	0
2000	105	0
2001	56	0
2002	117	0
2003	49	0
2004	1	0

Table 1: Cases of plague in Morrumbala (Source: Zambézia Health Provincial Directorate)

A distinctive feature of the relationship between humans and rodents in this part of Mozambique (and in neighbouring parts of Malawi) is that certain species of rodents are considered good to eat, and are hunted for food. This is a risk factor in relation to the transmission of plague, since when a rat dies its fleas will jump on to the nearest warm-blooded host. Methods of handling and cooking the meat of the animal are also potential risk factors; if the fresh blood of an infected animal is ingested or comes into contact with a skin lesion the plague bacillus can be transmitted from the animal to the person.

2. Morrumbala: Location and characteristics

Morrumbala is one of the 17 districts of Zambezia province, which is situated in the central region of Mozambique. In the north it borders the provinces of Nampula and Niassa, in the south Sofala and the Indian Ocean, in the east Malawi and Tete province, Mutarara district as well as the districts of Milange, Mocuba, Nicoadala and Mopeia, which are in the province of Zambezia. The district of Morrumbala has a surface area of 12 823 Km². It has four administrative posts: Morrumbala town, Chire, Megaza and Derre.

Topographically Morrumbala is situated in a mountainous zone, forming the mid part of Zambezia. The dominant vegetation is humid forest, with a high level of biodiversity. One of the most important rivers of the province, the river Chire, flows through the district. It is through this river that Morrumbala is linked to Mutarara district in Tete. The river extends into Malawi.

In Zambezia there are two distinct seasons: a hot wet season from December to March and a colder dry season from May to November.



Partial view of Pinda Administrative Post. The mountain which gives the district its name (Morrumbala) can be seen in the background.

2.1 The people of Morrumbala and their livelihoods

The district has a population of 311,627. It is the second most populous district in the province. The population density is estimated at 20-22 people per km².

The majority of the population belong to the same ethnic group, Sena, and speak the same language, and they have very similar – and distinctive – habits and customs. The Sena occupy a continuous swathe of land from Mutarara up to Luabo, Chinde. However, they are not politically or administratively unified.

Between the mountains and the plains, interspersed between forested areas and savannah areas, and between the rivers Chire and Zambezia which flow through the district, maize, sorghum, beans and sweet potatoes are the most important crops. However, productivity is not high and what is grown is usually only enough for eight months a year. Because there is limited access to other sources of income, the area is poor and hunger is not unknown.

Traditionally, agriculture is the responsibility of women, while men are responsible for fishing and hunting. Fishing is the traditional occupation of men. However, there has been a long period of drought recently, followed by floods in 2000, which meant that part of the population of Morrumbala was forced to move to higher areas and it has been difficult to continue to fish. This has also meant that men have increasingly become involved in agriculture, rather than fishing.

Lately there have been cattle and goat health programmes in the district. The district is a tsetse fly infested area.

During the colonial period the Zambezia Company created employment in the area and at present a company called AGRIMO provides some employment in cotton growing and picking. Despite this, however, most people do not have access to employment and depend on subsistence agriculture, fishing and forest products, very little of which they are able to sell. The area is therefore very cash-poor.

Like most of the country, this area suffered devastation resulting from the war which lasted from 1974 to 1994. Many basic services were destroyed and landmines were widely planted. The town of Morrumbala bears clear scars in the shape of ruined buildings.



A ruined building in the town of Morrumbala.

Despite having a relatively high population, the district has the third worst education network in the province: 51 EP1 schools (grades 1-5) and 1 EP2 school (grades 1-8). This explains the low level of education within the population; few people have gone beyond the fourth grade.

3. Methodology used in the study

Fieldwork was carried out over a 5-day period in March 2005, with participant observation as the main methodology. Semi-structured individual interviews and focus group discussions were also used, both with local people engaged in subsistence agriculture and with local opinion leaders and local government staff.

The reason for involving a variety of government departments is that understanding – as well as tackling – plague as a disease requires an integrated approach, involving different government departments at district level. The health department at district level has trained and employs community health agents, whose responsibility it is to sensitize local people about plague. These agents also serve as a link between the health department and the communities, with the aim of achieving control of the disease and an effective follow-up when a case of plague is identified. Agricultural practices, and the way in which local people relate to the natural environment, are relevant to the transmission of plague; staff of the agriculture department in fact showed a great deal of knowledge about plague. Focus group discussions and individual interviews were held with the district directors for health, education, agriculture, culture, women's affairs and social welfare, and their staff. A document search was also carried out at the district health centre on rat-borne diseases and the history of these in the district.

3.1 Field sites and selection of key informant households

The research was carried out in three sites within the district; Morrumbala town centre; Pinda; and Sapinda cluster (Iimpinha). In all of these places there is a community health technician with experience of plague. Households which had experienced plague were identified through the records in the health post at Pinda and at the district hospital. Information held on patients includes the patient's name and sex, the diagnosis, day of admission, place of residence, type of treatment administered, course of the disease and the type of hospital and home care. These registers include information on individuals admitted to the hospital or health post during the critical period of the recent outbreak, both confirmed cases of plague and suspected cases of plague, without positive test results. Through the registers, we were able to identify and locate individuals who had suffered from plague, had been cured and were residing in Morrumbala town centre and in Pinda.

Households chosen for the study which had not had plague were selected among neighbours of households which had had a member with plague, because this would allow a consideration of differences between households which shared, broadly, the same habits and customs and lived in the same area.

The selection of key informant households was done through the local health staff, both through the staff of the district health posts and through the community health agents. The health posts had the registers of individuals who have had plague and the location of the households to which they belong, while community health agents know the exact location of these households.

15 key informant households were selected, 6 of which had a member who had suffered from the plague and 9 of which had never suffered plague. Of the 15 households, 4 lived in Morrumbala town centre and 11 in Pinda, which is a more rural area. All of the 6 households which had suffered plague were in Pinda. Pinda is situated between an area of secondary forest and the river Chire. During the colonial and immediate post-colonial period it was a grazing area, together with nearby Megaza, for the now-extinct Zambezia Company. During the civil war (1976-1992) the population of Pinda sought refuge in neighbouring Malawi. In 2001, because of the floods, the population moved to higher areas, leaving the lower ones for farming. The administrative post covering Pinda and Sapinda has a population of 15,814 distributed in 14 clusters: Moni, Mecaúla

1 and 2, Bocage centre, Nhatangalanga, Chipaluo, Ndamuenda, Jossene, Gardace, Suzi, Sapinda, Npanha, Kembo, Gera, Gera 2 and Roque.



One of the households participating in the study, that headed by Joao Xavier in Pinda.

4. Rats in Morrumbala

4.1 Types of rat

As already mentioned, a distinctive feature of the relationship between humans and rats in this area is that rats are eaten. They are an important source of protein in Morrumbala, in the context of lack of access to alternative sources. With the drought and the lack of fish, there has been an even greater reliance on hunting rats for meat. Other domestic animals are not eaten on a regular basis but are slaughtered only for important occasions, such as welcoming an important visitor, as well as being sold for cash. However, rats are not viewed as an undesirable ‘famine’ food, but as a tasty and valuable food. It appears that the consumption of rat meat has a long history in the area.

There are two types of rat identified by the people of Morrumbala: the house rat, known as *matchiro*, and the field rat, known as *mbeua*. There are said to be different types of *mbeua*, some of which are considered tastier than others. While *mbeua* are eaten, *matchiro* are not. People are very clear that they never eat rats which live in their houses (*matchiro*), and consider them to be disgusting and dirty. They consider them to be a completely different animal from the rats which they hunt and eat in the fields (*mbeua*).

Despite local beliefs that *matchiro* and *mbeua* are quite different, in terms of biological classification there is an overlap between *matchiro* and *mbeua*, and it is very possible that people are actually eating rats which have been in their houses. Rats which are hunted include a high proportion of *Mastomys* species (this has been ascertained through an analysis of *mbeua* for sale in local markets), which the RATZOOMAN project's trapping programme trapped inside people's houses as well as in the fields.

The people of Morrumbala have very different attitudes to *matchiro* and *mbeua*. The former are bad and undesirable, while the latter are good. While local people want to see *matchiro* controlled and preferably eliminated, they do not want to eliminate *mbeua*, since these are an important food source. Clearly, given the biological overlap between the two local categories, the elimination of *matchiro* cannot be achieved without a reduction in *mbeua*. In practice, because they do not see *matchiro* and *mbeua* as overlapping, local people would be happy to have *matchiro* eliminated through control measures. However, they do not undertake any consistent control measures themselves to reduce the population of *matchiro* rats in their houses, relying on government control measures and campaigns. This may well be because they have little faith in the prospect of successfully and sustainably eliminating *matchiro*, which have always entered their houses.

Pinda and Morrumbala have high rat populations in the fields and in the forest. This is both a blessing and a curse, since rats are a source of food but also a source of disease. A recognition of the high level of rats in the area, particularly since 1997 when the recent outbreak of plague began, has led to Pinda and Morrumbala being considered by the local health authorities to be areas with a high level of disease caused by rats.

4.2 Rat access to houses

Rats enter local households in two ways: as hunted meat, and of their own accord, in search of food. Access to houses is relatively easy in the area, where most are made of simple materials. In Morrumbala households are made up of a number of houses made of wooden poles with mud walls and thatched roofs. These are about 15 metres apart. Toilets are about the same distance from the houses. Storage silos may either be inside the houses or a few metres from the main house.

The interior of the house is often not divided at all. Sometimes it is divided into two areas. If it is, then one area is the sleeping area and the other is a living area with a cooking hearth, a grain storage area and storage for pots, plates and water. The male head of the family and his wife sleep in a bed made of wooden poles, while the children and other family members sleep on mats on the floor. Even if there is a separate sleeping area for their parents, children may sleep in the living area.

Rats enter houses through the numerous gaps, especially between the walls and the roofs. Once inside, they have easy access to household members' bodies at night, to leftover food and to stored grain. At night in particular they run around the house, circulating in different areas in search of food. Informants said that they often bite people at night, on the face as well as on the feet and hands. People often have remnants of food on their hands and mouths, because they have not washed after eating.



The inside of a house in Pinda, showing the storage of maize in the main living room near the cooking area.

4.3 Rat hunting and cooking

Rat hunting is a long-standing practice in the Morrumbala area, occurring mainly during the period from May to July. Although anyone may go rat hunting, and rats are often hunted opportunistically in the fields when people are working there, a good deal of rat hunting is by young boys, often in groups. Rat hunting is part of initiation rites for young boys, which have the purpose of preparing them for their lives as adult men. During the rat-hunting season, boys often fail to attend school in order to go rat hunting.

Rats are hunted through two main methods: traps and smoking them out of their underground nests. *Mastomys* is a social animal which lives in large groups, so a large number of rats can be caught through smoking them out. Traps are made of a bucket, grass, wire, thread and some grain. The rats are attracted by the smell of food, which is hung by a thread on top of a bucket of water buried under the surface of the ground and covered by thin layer of grass. When the rat attempts to get the food it falls into the bucket and drowns. Such traps are set up at night either in the fields or in houses. We were told that maize meal is put on the trap for two days for the rats to get used to it and then on the third day up to 100-200 rats may be found in the trap.



Boys in a local market in Morrumbala with a hunted rat.

Once caught, rats are killed and carried home, often on the head, so that the dead rats are in close contact with the body. This means that the rat fleas are able to transfer to the human body with ease.

Rats may be eaten fresh or they may be boiled and then dried, like other meat, for consumption later or for sale in the market. If a large number are caught then they can be a lucrative source of income since they are sold at good prices in local markets.

Women prepare rats for consumption fresh or dry them for household consumption later. However, where large numbers have been caught and they are to be sold, then men often prepare them for sale by boiling and drying them. Thus both men and women are likely to be exposed to the possibility of transmission of the plague bacillus through rat fleas or rat blood.

4.4 Local perceptions of rats and disease

It is noteworthy that the local population appears to be aware that consumption of rats can cause disease. Rats are mainly eaten during the months of May and June and are not eaten between the months of August and February, because their consumption during this period is said to cause a disease called *mabunkwe*, characterized by bleeding, painful ganglions in the armpits and a high fever. *Mabunkwe* is considered potentially fatal. Elders told the research team that this disease has existed since colonial times.



Six rats trapped by one of the women involved as an informant in the study.

It is not clear whether the disease described locally as *mabunkwe* is the same as plague or how long it has been present in the area. However, the similarities between the symptoms of plague and those said to be characteristic of *mabunkwe* are striking. In order to understand better the history of plague in the area, and to understand the epidemiology of plague historically, it would be very valuable to do a more detailed study of *mabunkwe*.

Until the local government health post became aware of the presence of plague and began to sensitize the local population about the dangers of this disease, it would appear that *mabunkwe* was seen as being a disease like any other, equivalent to malaria, fever or diarrhoea. The families or the patients do not tell dramatic stories about the disease. They only talk of the appearance of abscesses and fever and the need to seek treatment at the health post. The families only became aware of the gravity of the disease after they had gone to the hospital for treatment, and when sensitising and insecticide-spraying campaigns commenced.

It seems that there is some confusion in terms of local perception of the nature and source of plague. It is likely that they are not sure whether this disease is a new one or is simply *mabunkwe*. One informant told us: “Well, they say that there is a disease you get from *matchiro*, it seems that you get a kind of sore. When you get this on the hand or the face, that is the disease you get from *matchiro* and you have to go to the hospital”. Thus it seems that some people believe that the disease can only be caught from *matchiro* rats and not from *mbeua* rats.

The implication of this is that people may not be careful in their handling of *mbeua* rats which they have hunted for food, and may be exposed to fleas from these rats which can transmit plague. They do not realize that their hunting and consumption of rats is a risk factor for transmission of plague, as well as toxoplasmosis.

It is common in most traditional rural Mozambican societies to attribute the causes of disease to third parties; in other words to spiritual, supernatural and obscure causes like witchcraft. Even once they are made aware of the fact that rats can transmit disease, they may well believe that it is witchcraft which causes one person rather than another to pick up the disease from a rat. Thus, even when they have been sensitized to the importance of handling rats carefully so as not to be bitten by their fleas, and of the importance of cooking rat meat thoroughly in order to avoid transmission of plague or toxoplasmosis through the blood of the rat, they will not necessarily follow the recommendations, since they may believe that the disease is in fact transmitted through witchcraft.

5. Rats and disease

5.1 The epidemiology of plague in the area

The reasons for the sudden outbreak of plague in 1997 and the reduction in the years after that are still not properly understood. It is possible that there is natural cycle involved, especially if plague has a long history in the area, as may be the case (see section ? above). There has been an accelerated rate of deforestation in the area, due in part to the recent drought which drove people away from the rivers and to higher ground, as well as to a greater reliance on agriculture. It is possible that this has led to a heightened contact with a reservoir species in the wild, leading to the outbreak.

Regular annual bush-burning as part of farming may also be related to an increased level of contact with rats or other rodents on a cyclical basis, when these flee the burnt area. Rats carrying plague may, in these conditions, be more likely to enter fields and houses, and may come into increased contact with humans. An analysis of the time of year when cases have occurred might be appropriate in order to understand the potential relationship between bush-burning and plague cases.

On the other hand, it may be that the sensitization, prophylactic treatment and insecticide spraying campaigns undertaken by the health authorities may have been effective in reducing incidence of the disease. This is made more likely by the fact that these campaigns were carried out in a coordinated manner by the authorities in Morrumbala, Mutarara and also in neighbouring Malawi.

It must be noted that in 2002 there was a sharp rise in the levels of infection, with cases reported from previously unaffected parts of the district and from Malawi. This was explained by the health authorities as a result of delays in insecticide spraying, but could be due to other factors.

5.2 Leptospirosis and toxoplasmosis

We have no figures at present on the incidence of leptospirosis or toxoplasmosis in the area, and can only identify practices which may be relevant to the transmission of these diseases.

Leptospirosis, a serious disease involving a high fever which is often confused with other fevers, particularly malaria, is transmitted through leptospires excreted in the urine of infected animals, whether rats or other animals, including domestic animals. This is

very frequently via water, in which the leptospire can survive longest, and which is often taken into the human body or is in contact with places through which it can enter the body such as cuts, the eye or the nose. Toxoplasmosis is caused by an organism which is transmitted through the faeces of cats and through the blood of other animals. It presents as a serious illness in those whose immune systems are compromised and it causes birth defects in pregnant women.

5.2.1 Water and leptospirosis

There is a serious shortage of water in the area, both in Morrumbala town and in rural areas like Pinda. In Morrumbala town there are a few boreholes in the outlying parts of the town but a shortage of water in the centre of town. In Pinda there are at least five boreholes, but there are still shortages of clean water for drinking and washing. Households very rarely have taps of their own, but depend on communal taps, if indeed they are near a borehole. Many people in the area rely on water from the river.

Communal taps are associated with pools and rivulets of standing water and where there are rats in the vicinity these may very well urinate in these, and children in particular may pick up leptospire from the water when playing in the area. River water is often contaminated with leptospire since rats and other animals are likely to urinate on river banks. Children, who often play on river banks, are more likely to be exposed to leptospire because of this.

In Morrumbala it is women's job to bring water to the house for drinking, washing and cooking. Once or twice a week, instead of going to the fields, women go to fetch water to fill up the household storage containers, waking early and often walking long distances in search of the precious liquid. Because of this, women, and children who accompany them to get water, are more likely to be exposed to leptospire, because they have more contact with water and with places where water is obtained.

Because of the way in which water is stored, rats are likely to have access to the containers, with a resulting danger of the transmission of leptospirosis to all members of the household. Water is traditionally stored in an earthenware container. It is also stored nowadays in plastic or metal buckets, drums or cans. In theory, all of these containers have lids, but these are often inadequate, with gaps between the lid and the container rim. Water containers are kept adjacent to the hearth, to food stores and to domestic utensils, so that rats run around near them.

Generally speaking, there is a low level of hygiene within households in Morrumbala. People – especially children – rarely wash their hands before or after eating. They often share plates and cups with others. This means that there is a danger that leptospirosis could be transmitted from hand to mouth, if someone has touched water or something on which a rat has urinated, or from person to person.

Not only are people in Morrumbala in regular contact with rats, but also with their own domestic animals, and this also poses the threat of transmission of leptospirosis. In Morrumbala, there is very intimate contact between domestic animals and people. Goats and chickens are often brought into the houses at night, since theft is said to be common. Dogs are also allowed inside the house, being put outside only at night to act as guard dogs. Domestic animals are allowed to eat from plates and pots, lick people,

step on them, roll on their clothes and on cereal crops while these are being dried in the sun. Since any of these animals could be carrying the disease, humans risk picking it up through these habits.



The inside of a house in Pinda, showing the presence of cats in the house and their intimate contact with stored maize.

5.2.2 Toxoplasmosis

The methods of handling and cooking rat meat which have been identified as risk factors for the transmission of plague are also risk factors for the transmission of toxoplasmosis, since this can also be transmitted through blood.

Toxoplasmosis is also transmitted through contact with cat faeces. This may well be a route through which some individuals, probably particularly children, pick up this illness from time to time.

6. Conclusions and recommendations

Morrumbala is an area with a high rat population relative to many other parts of Mozambique. This is due to the fact that it is an agricultural area producing cereals of various kinds; and to the fact that there has recently been a rapid rate of deforestation, which has flushed rats out of the bush and into areas inhabited by humans.

Rats in this area, as in neighbouring areas including parts of Tanzania, Zambia, Zimbabwe and Malawi, are hunted and eaten. The hunting of rats is associated with initiation of boys and it appears to be boys who do a good deal of the regular rat-hunting. Boys are proud of their ability to hunt rats. However it is also clear that other members of households also hunt rats, mainly when they are in the fields for agricultural purposes.

There are no records relating to levels of infection among humans of leptospirosis or toxoplasmosis, but it is very likely that these diseases are present, given local practices. One of the means of transmission of toxoplasmosis is contact with and particularly consumption of meat which is not fully cooked, and this is also one means through which plague is transmitted. Plague is present in the area, and this could suggest that toxoplasmosis is also present, transmitted through the same means.

Plague is present in the area, and may have been present for many years, since local people talk of an illness associated with eating rats called *mabunkwe* which has been a problem for an undetermined time. It is not yet known whether the source of plague is to be attributed to contact with hunted rats or to contact with rats which enter the house. Once this is known, it will be possible to concentrate more on developing ways of effectively sensitizing local people to the known mode of transmission of the plague and to necessary changes in behaviour.

It is also not clear why the level of infection with plague has fallen in the past few years after a peak in 1997 and 1998. The response of the local population to sensitization campaigns has not been properly analysed as yet. It is difficult to be sure whether they have been persuaded to accept that hunted rats, which they categorise as *mbeua*, are a source of plague; it has been noted that some informants stated explicitly that they see the disease as one coming from *matchiro*, which are seen as dirty pests. *Mbeua* rats, which are seen as a clean, good source of food, may not easily be viewed as sources of disease. This is likely to reduce the likelihood that recommendations relating to the handling of hunted rats are followed.

The patterns of hunting are not entirely clear and need to be investigated further. Although it seems clear that the period May-July is the peak rat-hunting season, it is only the period August to October, considered the reproductive period, when they are not hunted at all. Levels and patterns of rat-hunting during other months need to be further studied, and related to the incidence of plague. The incidence of plague among different age-groups and between the two genders needs to be studied further, to see what relationship there is between hunting and incidence of plague, since plague may be caught via rat fleas from dead rats during the time immediately after the rat has been killed.

The relationship between the preparation and cooking of rats and the incidence of plague is also one which needs to be analysed further. Plague can be caught during the preparation and cooking of rats, from fleas remaining on the rat and from contact with the blood of an infected rat. Is it predominantly women who prepare rats for conservation and cooking, and who cook them? Or do the hunters themselves involve themselves in this? Where rats are being prepared for sale it appears to be the (male) hunters who prepare and dry the rats. Where rats are eaten at home, what relative role do men and women play in preparing and cooking them?

Although the rat does not have a specific magical function in this area, there is a belief that disease is caused by magical means, by sorcery. A straightforward material explanation of disease, particularly one as nasty and virulent as plague, and with such a complex and indirect means of transmission (via fleas as well as via blood), is not necessarily going to be easily accepted. Therefore it is very possible that sensitization campaigns aimed at getting people change their behaviour in handling rats may not be effective. It has been found in a parallel study carried out for the RATZOOMAN project in Lushoto in Tanzania, an area where plague is also present (although people do not eat rats), that it is difficult to demonstrate and persuade people of the need to change their behaviour in order to avoid catching plague. There, plague is seen as a punishment from leaders, those with power to send diseases, and even if it is accepted that it comes through rats, the fact that one individual comes into contact with an infected rat and another does not is often attributed to witchcraft. This does not mean that it is not possible to persuade people; after a long campaign in Lushoto, people are beginning to change their habits. But it is a challenge.

It must be recognized, in this area, that rats are an important source of protein in an area where there is limited access to protein, particularly with the drop in fishing in recent years due to cycles of drought and flood, which have led to people moving away from fishing. It would probably not be possible, even if it were right, to persuade people to stop eating rats. Sensitization has to be done in the context of an acceptance that people will continue to eat rats. Ways of killing, transporting, preparing and cooking rats need to be developed which prevent the transmission of the plague bacteria to humans. These need to be developed in the context of an understanding of local practices. They need to be introduced together with a careful campaign to show people what plague is, how it is transmitted and how to avoid catching it. This in turn needs to be done in the context of a better understanding (yet to be developed) of local concepts of disease, particularly of the illness known as *mabunkwe*.

Sensitization of the local population about plague and the way it is transmitted needs to be done using appropriate media. This could include posters; radio; community theatre; and video. A survey of ways in which different media have been used so far in the area for development purposes, and the availability of different media (such as the presence and nature of local theatre groups and local radio stations) needs to be carried out before deciding on appropriate combinations of media.



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