

RatZooMan:

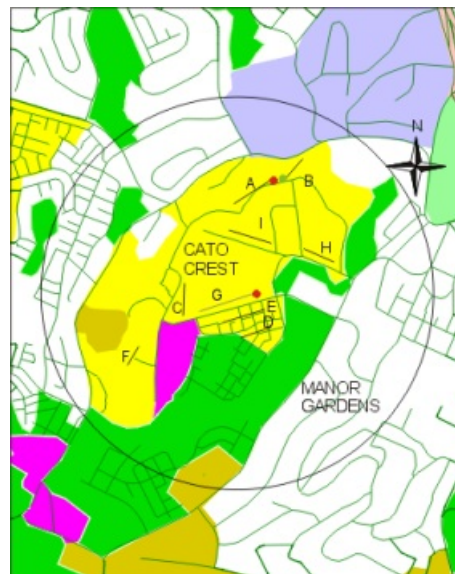
Durban's Sharpshooter in the Rat War



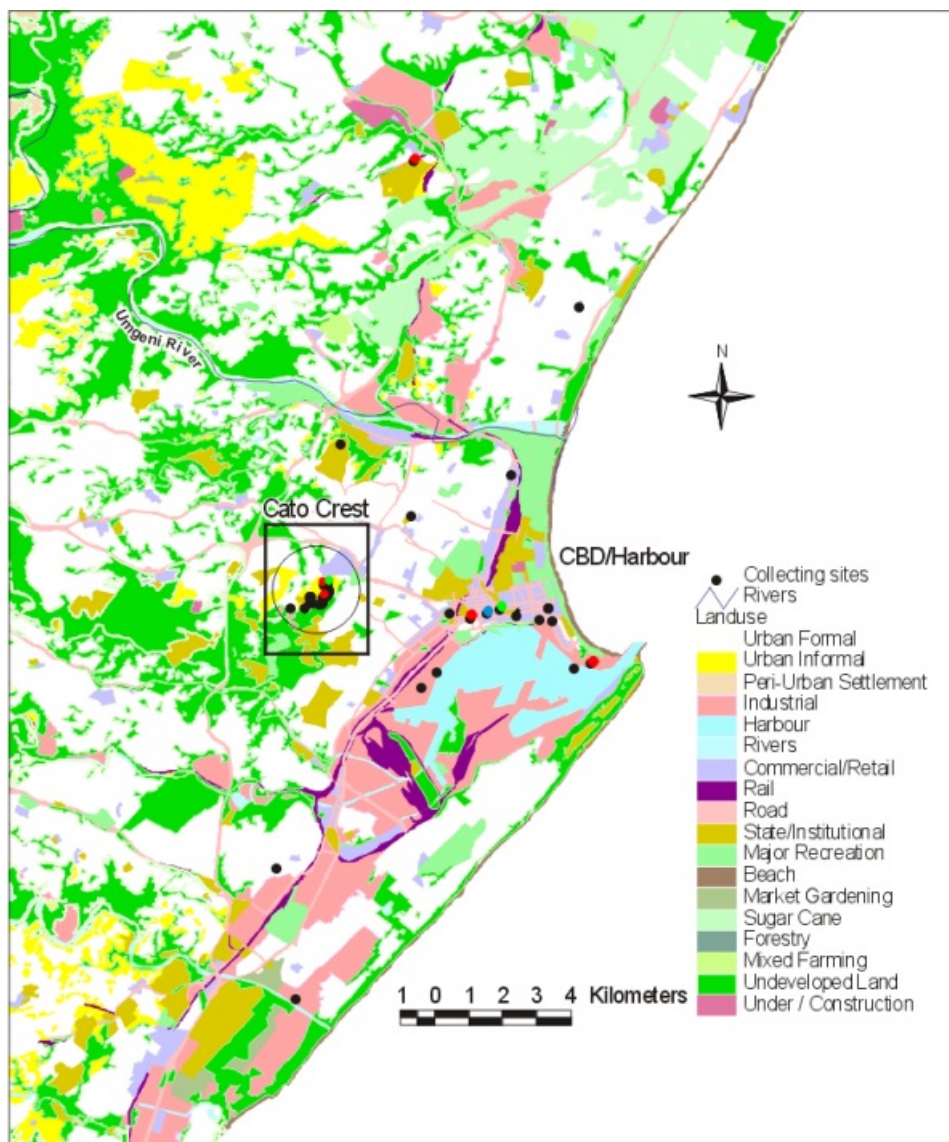
Early results from the RatZooMan Project in Durban show that, by identifying rodent disease 'hotspots' and their environmental and socio-economic correlates, disease-bearing rodents can be controlled more effectively and inexpensively, as well as in an environment-friendly manner. This 'sharpshooter' approach works much better than the alternative 'shotgun' approach.

RatZooMan (Rodent Zoonosis Management) is an international European-Union funded project involving four African countries, South Africa, Zimbabwe, Tanzania and Mozambique, and four European countries, United Kingdom, Belgium, Netherlands and Denmark. As a contracted partner in this

project, the Natural Science Museum (NSM) has teamed up with the City Health Vector Control department to test a cross section of Durban's rodent population for three rodent-borne diseases which affect humans, namely leptospirosis, toxoplasmosis and plague. Blood and tissue samples of rodents obtained by NSM staff and interns (see related article in this issue by AR Ali, page 17) are sent to the National Health Laboratory in Johannesburg. Rodents of three species have been tested, the brown or Norway rat (*Rattus norvegicus*), the house mouse (*Mus musculus*), and the multimammate mouse (*Mastomys natalensis*). Recently collected samples of a fourth species, the black rat (*Rattus rattus*), remain to be tested.



Larger scale map of the Cato Crest informal settlement with locations of positive samples indicated as for larger map. Transects A to I were used to indicate positions of houses whose occupants were interviewed for the socioeconomic survey.

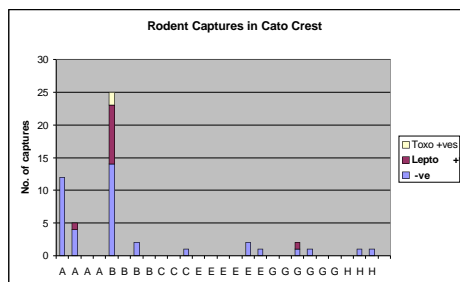


Map of landuse in Ethekwini Municipal Area showing collecting points of rodents. Red dots indicate location of samples positive for leptospirosis, blue represent toxoplasmosis infections and green represent locations where samples tested positive for both diseases.

Samples originated from a wide variety of sites, from Merebank in the south to KwaMashu in the north, and as far inland as Shongweni. However, most came from the harbour and commercial district of Durban and the Cato Crest informal settlement. Out of 248 rodents collected, 154 were tested for plague, 203 for toxoplasmosis and 185 for leptospirosis. The tests showed that while no rodents tested positive for plague, five Norway rats (2.5% of sample tested) were positive for toxoplasmosis, and 19 Norway rats (10.3% of sample tested) were positive for leptospirosis. The distribution of infected rats was not random but was highly concentrated in two major foci: a localised area of Cato Crest where prevalence of leptospirosis and toxoplasmosis was 39% and 8% respectively in a single dwelling, and the CBD of Durban, where prevalence of leptospirosis and toxoplasmosis was 38% and 12.5% respectively.

Based on this information, Vector Control was able to conduct pro-active and targeted baiting campaigns in the affected area of Cato Crest, using multi-dose rodenticide bait for human safety reasons. Health notices were also served on affected food outlets in town that were found to harbour infected rats.

It was gratifying to find no cases of plague, a disease which is spread by



Graph showing number of rodents captured in houses sampled across transects A – I, indicating disease infections.

certain flea species which live on rats. This disease killed one quarter of Europe's population in the Middle Ages, and the last pandemic during the time of the Boer War resulted in a high mortality of South Africans. Being a major port, the threat of plague reaching our city is a constant one, with ships from plague-endemic countries arriving at the port frequently. City Health and SA Ports authorities co-operate to ensure that maximum vigilance is kept up to prevent rats leaving docked ships from plague-endemic countries and to step up baiting campaigns to kill any possibly infected rodents leaving ships.

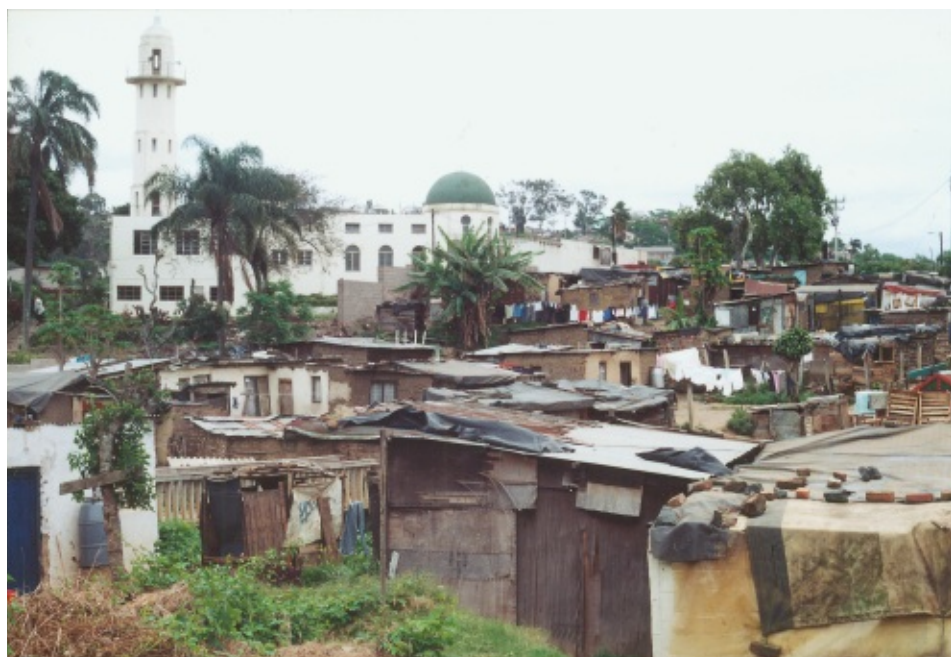
Leptospirosis is spread in the contaminated urine of infected rodents and can be transmitted to humans through cuts, abrasions, sores, the eyes and mouth. Leptospirosis can be picked up by playing in or drinking contaminated water and by eating contaminated food. The disease is

spread by bacteria of the genus *Leptospira* and can be treated effectively by antibiotics. However, the symptoms are similar to those of many other tropical diseases, such as malaria, and therefore the disease often goes undiagnosed and untreated. In immune-suppressed individuals, such as those with AIDS, the disease can be fatal if untreated. The bacteria can survive for a short period outside the host in damp soils with pH between 6.5 and 8. The optimum pH for the bacterium is 7.2. Toxoplasmosis is a protozoan disease caused by the organism *Toxoplasma gondii*. The main host is the domestic cat where the organism is able to reproduce sexually. Cysts are shed in cat faeces, which are then consumed by other animals such as rodents. The cysts become encapsulated in the secondary host and the life cycle is completed when the cat eats rodents with encapsulated cysts, which then become reactivated. Toxoplasmosis can be spread to humans through contact with infected cat faeces (e.g. by cuddling and stroking domestic cats), or by eating incompletely cooked, infected rodents. Although the disease is usually benign in humans, individuals with AIDS cannot encapsulate the cysts which can then be reactivated and continue to multiply, causing death.

In order to attempt determination of environmental and socio-economic risk factors for leptospirosis and toxoplasmosis in Cato Crest, intensive trapping of rodents along nine transects in Cato Crest was accompanied by parallel

studies of soil pH (acidity) and socio-economic and anthropological factors. The socio-economic study, co-ordinated by NSM staff and interns under the guidance of Dr Malcom Iles of the Natural Resources institute in Greenwich, England, involved surveys of 90 households, 10 from each of nine transects. The same transects were used for the socio-economic surveys, soil tests and rodent trapping so as to allow direct correlation of the different results. Under the leadership of Professor Leclerc-Madlala of the University of KZN's Anthropology Department, three students conducted in-depth interviews with 10 families represented in the socio-economic study.

The soil results showed that soil pH conditions for persistence of leptospire bacteria were ideal throughout the informal settlement (i.e., falling close to the optimum value of 7.2). Tests were performed on soil samples of two types (Dwyka tillite and Berea sand), which were taken some distance from dwellings, as well as from soil samples taken in the proximity of houses in each of the nine transects. While average values obtained for each transect fell close to the values for undisturbed soil samples, it was noted that readings as low as pH 5 were recorded. These were attributed to detergents and bleaches, which were used for cleaning and then thrown from the houses onto the nearby soil. Although unintentional, the practice of 'treating' household soils in this way becomes an effective means of reducing the threat of leptospirosis by eliminating any bacteria that may persist in the soil.



Dwellings and Divinity. This picture shows the proximity of the shacks to each other. In the background is the Ahmedia Mosque along Bellair Road.

Although pH conditions are therefore ideal for leptospirosis throughout the settlement, the soils are usually dry, except for numerous pools which often form around stand pipes. Indeed, the hotspot of leptospirosis found in rodents at Cato Crest was in a valley floor area (transects A and B) near a river and where a broken water pipe ensured that the soil remained constantly damp, creating ideal conditions for the spread of leptospirosis. In this same area, several socio-economic factors contributed to a very high density of rodents (reflected in the number of rodents caught as well as the rate of 'take-up' of bait). These included the poor construction of the houses in the area (mostly from recycled materials), which facilitated rodent access, the presence of adequate harbourage for rodents in burrows beneath the houses and the presence of a tuck shop, which afforded a plentiful supply of food for rodents in the form of fresh produce. Our results were



Akhooli R. Ali

Photograph of shacks in vicinity of Transects A and B which represented a disease hotspot.

able to direct the Vector Control Department to this specific area, where repeated baiting campaigns have since been carried out. The Department's budget does not extend to being able to bait the entire settlement, still less other settlements, but the success of the RatZooMan project lies in being able to direct control efforts to the seat of the problem. Hopefully, as time goes on, these results will allow us to build predictive GIS (Geographic Information System) models incorporating environmental and demographic data, such that maps of high disease risk can be generated for the entire Durban region. Such maps will be useful tools to allow more targeted and cost effective rodent control methods.

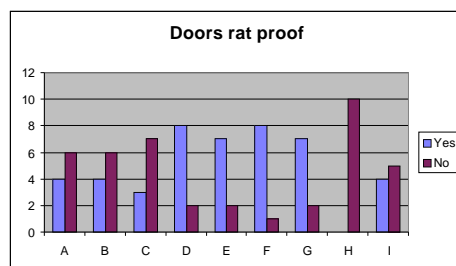
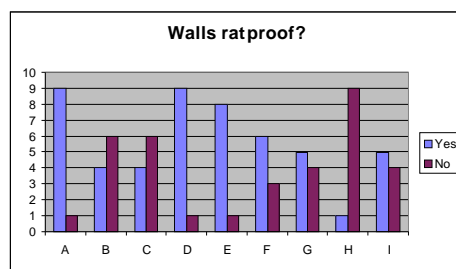
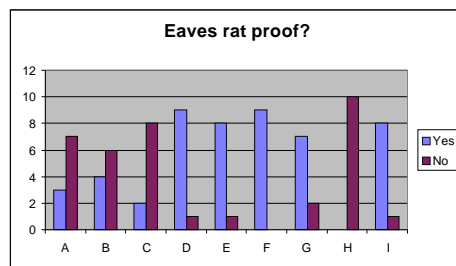
The socio-economic and anthropological studies in Cato Crest revealed that residents appear resigned to living with rats, which they view as primary competitors for scarce resources. There are many tales of rats performing amazing and brazen thefts of food, such as opening lids on food sources. Residents are generally unaware of the disease risks associated with rodents. Between 0 and 30% of residents interviewed across the



Peter Taylor

Photograph showing electrified 'smartie houses' constructed to accommodate all Cato Crest residents ultimately, in accordance with a slum clearance programme.

nine transects reported rat bites and most residents admitted to sighting rats on a daily basis. Two of the nine transects (D and E) fell within the area of so-called 'smartie houses' which are properly constructed and supplied with electricity. Residents living in shacks are gradually being moved into the smartie houses, with concomitant and progressive shack clearance. Smartie houses are generally inaccessible to rats, but the smaller house mice can gain access and were abundant. Although a relatively small number of



Graphs showing subjective scoring of rodent access (through eaves, walls and doors) in dwellings from nine different transects in Cato Crest.

mice were collected in smartie houses, all of them tested negative for all three diseases. Nevertheless, house mice are known to harbour a wide range of diseases and a larger sample should be tested. Whilst residents no longer use the local river for washing and drinking (fresh water is supplied to all residents by means of standing pipes), children often play in the water and use the mud to construct clay animals, thus exposing them to leptospirosis. Residents of Cato Crest interviewed during our study expressed disgust at the idea of eating rodents, thus preventing exposure to toxoplasmosis. However, semi-feral cats abound in the settlement, where several households may share the services of a cat as an aid in rodent control. Although not encouraged by parents, children were observed cuddling and playing with cats, so increasing their risk of exposure to toxoplasmosis.

Recent newspaper articles have dramatised the apparent increase in Durban's rodent populations, often exaggerating their physical size and spreading panic. On the other hand, environmentalists have complained about so-called 'indiscriminate' poisoning campaigns which may harm non-target animals. RatZooMan offers a rational response to both of these valid concerns. Not only is it proactively testing rodent populations in known problem areas where rodents congregate (informal markets and settlements, hostels, the harbour and food outlets), thus allowing predictive models to be made. These will ultimately allow scientists to map high risk areas for diseases, but the approach also guides Vector Control staff to specific high-risk areas where baiting can be carried out in a precisely targeted, safe and effective manner.

The next step is to gain community support for testing communities at risk for leptospirosis and toxoplasmosis. This will allow health authorities to be informed about the problem and to include, at the primary health level, appropriate diagnostic tests and treatment. By fighting rats using a smarter, 'sharpshooter' approach, this project can ultimately save many human lives within the constraints of limited available resources, which just goes to show that science and technology are key components in improving the quality of life for Durbanites, South Africans and all humankind.

Viva RatZooMan!



Dr Peter Taylor
Curator: Mammalogy
Natural Science Museum

Rat-Race at the NSM



Just 10 minutes' drive from the high-rise buildings of central Durban lies an informal settlement called Cato Crest. In essence, Cato Crest can be considered to be the closest squatter camp to the inner city. This under-developed area is bound by Cato Manor Road to the east and Francois Road to the south. To the west it borders along Bellair Road and on the north it encroaches into Bonella, with its more formal dwellings, and the Jan Smuts Highway.

This is an area covering approximately 2.5 km² and comprises high-density, informal dwellings. The *imijondolo* (shacks) here are constructed from any material available such as recycled corrugated iron, wood, plastic sheeting, tarpaulins, packed mud, etc. Due to their proximity to each other and method of construction, the interiors of these shacks are dark, even during the day, and ventilation is poor. Toilets, if available, are of the pit-system type and usually double as a washroom.

Communal taps erected at intervals along the roadside are the only source of clean water. It is a common sight to notice items of clothing, kitchen utensils and even children being washed at these taps. These watering sites lack proper drainage and puddles of water collect, while refuse bags lie at the side of the roads awaiting the arrival of collection trucks.

One may pose the question: "What scientific interest can an environment of this nature hold for the Museum?"

The Mammal Department of the Natural Science Museum (NSM) has been undertaking a local survey of rodent species to ascertain how these mammalian vectors are instrumental in the spread of rodent-borne diseases in and around the eThekweni Metropolitan Area. On a larger scale, similar surveys are being undertaken by other scientific organisations in the southern African Zoogeographical Region.

The RatZooMan (Rodent Zoonosis Management) Project has been an ongoing study for over a year. Staff of the Mammal Department at the NSM have been collaborating with the Vector Control Division of eThekweni Health to collect various species from Cato Crest. Although rodents were collected from diverse habitats, such as the harbour areas, the city centre and places of



Some of the material used in constructing dwellings. The wooden structure to the left is the makeshift toilet. An ideal breeding ground for rodents.

relatively high concentration of food storage, such as the bulk sales hall in Clairwood and the fresh vegetable market in Warwick Avenue, Cato Crest was earmarked as an ideal environment to study rodents co-habiting with humans in an informal situation.

During collecting trips staff interview householders to ascertain whether any rodents have been observed. Traps are then baited and set up at strategic spots indoors. Although the trapped animals are not injured in any way, these traps must be examined within 24 hours of their being set. Despite monitoring frequency, there have been a fair number of resourceful escapees from these traps.

The captive animals are brought to the Museum where, through various procedures, the species are identified. Further research is undertaken to identify potential diseases and vectors. All scientific data are then carefully recorded and collated.

Three mammal species have been identified from this area. The brown rat, *Rattus norvegicus*, has been the most

abundant; it can reach a length of almost 375 cm (including tail) and adults weigh up to 255 grams. The black rat, *Rattus rattus* and the house mouse, *Mus musculus*, a relatively smaller rodent, have also been found. All three of these are of medical importance as disease vectors.

Soil sampling, which is an important aspect of this survey, has also been undertaken at Cato Crest to test the soil pH values (acidity/alkalinity). A number of brown rats collected from this area were found to be positive for leptospirosis and toxoplasmosis. It has been established that the *Leptospira* bacterium and the *Toxoplasma* protozoan require moist soil and a suitable pH to complete their life-cycles - and this environment is aplenty in Cato Crest. (RatZooMan article page 14 in this issue refers).

The NSM is thus intimately involved in undertaking investigations that ultimately affect the health of all citizens of the eThekweni Municipality. This is only one of the many ways in which the Museum and its staff serve the people of our community.

Abdool R. Ali
Technician: Mammalogy
Natural Science Museum

