

# **RABIES SURVEILLANCE IN WILDLIFE POPULATIONS AT THE WILDLIFE/DOMESTIC ANIMAL INTERFACE; A CASE STUDY IN KIBWEZI, KENYA**

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## **1 INTRODUCTION.**

Dog rabies has been the dominant type of rabies observed in Kenya since the first case was diagnosed in 1912. However, there has been a low but consistent number of positive cases from wildlife species over the years (Kariuki *et al.*, 1985; Binepal *et al.*, 1991). Although rabies (and canine distemper) have been suspected to be the major killers of the endangered wild dog in the Maasai Mara (Alexander *et al.*, 1993), surveillance for the disease in wildlife has never been well developed.

A wildlife reservoir of rabies has been suspected to be the cause of the persistence of rabies in localities in Kenya even during periods when the disease was well controlled in the rest of the country. Kibwezi Division in Makueni District (formerly under Machakos District) has reported a consistently high number of rabies cases even in the early 1970's, a period when rabies was best controlled in Kenya. The role that wildlife played in the maintenance of the disease at that time has always been suspected but never seriously studied, and this study was established with the aim of investigating its present role.

Because the study was limited in time and resources we relied on quick, cheap and robust surveillance methods. We used four different methods. The first method was to continue an active surveillance method established by Kitala *et al.* (1994) in this area and specifically note all reported wildlife cases captured by that programme. Secondly, to maximise the number of wildlife samples for rabies diagnosis, we collected animals killed by vehicles along the Nairobi-Mombasa highway. The third method was to conduct a survey of randomly selected households to establish the presence and relative abundance of wildlife in the study area and their contacts with humans and domestic animals. This also allowed for information on the wildlife species observed to be in closest contact with dogs. Finally, we trapped wildlife near homesteads to further determine which wildlife species had close contact with dogs and humans and to obtain samples from these for rabies diagnosis.

## **2 MATERIALS AND METHODS.**

### **2.1 Study area.**

The study was conducted in Kibwezi Division of Makueni District. Kibwezi Division covers approximately 3400 km<sup>2</sup> and lies between longitudes 37°55" and 38°5" East and between latitudes 0°20" and 0°30" South. The elevation averages approximately 900m above sea level. The area has a bi-modal pattern of rainfall with most rain falling in the months of March - April and November - December. Annual rainfall usually ranges between 500-1000 mm. The primary vegetation consists of wooded bushland with baobab trees being a common and noticeable feature. The population density is 49 people per km<sup>2</sup> (1989 census). Most people live on small holdings of about 5 - 10 hectares (Jaetzold and Schmidt, 1983). The principal livestock species raised are goats, sheep, zebu cattle and local free-ranging chickens. The average herd size of grazing livestock is between 5 and 10 livestock units per household. The principal crops grown are millet, sorghum and maize. There is a large sisal estate in

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the area but none is grown by the smallholders. Tobacco and cotton are grown for local consumption. The dog density in the area is 10 dogs per km<sup>2</sup> with 35% of the households having at least one dog and an average of 2.12 dogs per dog owning household (Kitala *et al.*, 1994).

The area borders the Chyulu National Reserve to the west, Tsavo West National Park to the south, and Tsavo East National Park to the south-west across a tributary of Athi river. Thus, the division is surrounded on 3 sides by wildlife reserves. Formerly, Kibwezi Division was largely unsettled and wildlife roamed freely in the area. But in the last 20 years, many new human settlements have been established and the larger wildlife species have almost been completely displaced. However, small wild carnivora still remain and there are quite large populations of genets, various mongoose species and the African civet. Occasionally, large wild animals migrate through the area as they move between the parks adjacent to the area.

This study was conducted in four sub-locations, Mukaange, Utithi, Mbui Nzau, and Mikuyuni. These sub-locations were chosen because of their proximity to the Nairobi - Mombasa highway, so that information gathered in the questionnaire would approximate the wildlife population from which road-kill carcasses were collected.

## **2.2 Retrieval of samples from households and road kills.**

Four rabies workers were locally recruited in consultation with community leaders. Each worker was vaccinated against rabies (Vero - Rab, Rhone-Merieux) and given training on obtaining and recording information on suspected rabies cases in humans and animals. The rabies workers were given forms to record all wildlife killed in homesteads and to submit samples collected for rabies testing.

The rabies workers patrolled the Mombasa - Nairobi highway daily between 6.00 am and 7.00 am to collect heads of any animals killed by vehicles over the previous 24 hours. A 30 km section of road between Mbui Nzau and Machinery markets was checked each day. In cases where heads were crushed completely an attempt was made to collect brain or spinal cord material and place them in transport media from WHO kits. Intact heads were collected in polythene bags and stored in a freezer at the Kibwezi veterinary office until they could be transported to the Veterinary Research Laboratory, Kabete, for diagnosis by FAT.

## **2.3 Household questionnaire survey.**

In each sub-location, a list of all the households was compiled through village elders (each sub-location is divided into villages, whose number differ per sub-location, each headed by a village elder). These village lists were combined and 50 households were randomly selected from each of the sub-locations for inclusion in the survey. At each selected household, the household head or other adult present was interviewed. In most households, children, who were usually with dogs and thus observed most wildlife contacts, were also present and were questioned on the presence and relative frequency of encounters with different wildlife species. The questionnaire consisted of a Table of different wildlife species with their Kikamba names and indicating the frequency of sightings, estimated number seen and the time-of-day and the season most frequently seen.

## **2.4 Wildlife trapping.**

Ten of the surveyed households in each sub-location were randomly selected for live trapping of wildlife. Cage traps, made according to specification given by National Live TrapR (Wildlife restraint series, 1991) were used. The dimensions were determined by the general sizes of the animals expected to be trapped. All traps used were 100 x 40 x 40 cm. Traps were set for 3 to 4 nights on each selected household. Initially, the number of traps varied between 1 and 3. With experience it was found that one trap per household was adequate after trapping success was found not to vary with number of traps per household. The location of the trap was varied on different nights with the trap usually in close proximity (not more than 300 m) to the homesteads. Initial trappings were most successful when the owner advised on the trap locations. Thus, in subsequent trappings householders determined the trap locations, usually on paths leading to the homestead. This maximised the trapping of animals that were most likely to contact domestic animals and humans. Different baits were used initially, but it quickly became evident that most species trapped were small carnivores, attracted by chickens in the homesteads. Thus, fresh pieces of chicken were used as bait for most trappings.

Once trapped, the animals were anaesthetised using ketamine (Ketaset, Fort Dodge USA) alone or in combination with xylazine (RompunR, Bayer, Leverkusen, Germany). The doses were varied to determine the most suitable regime for each species using guideline reference values given by the Wildlife Restraint Series (1991) (Miscellaneous small mammals, Ketamine HCl (Ketaset, Fort Dodge USA) 2.5-5 mg/kg). After anaesthesia the animals were bled and their body measurements taken, and then euthanased with 150 mg pentobarbitone sodium (J. M. Loveridge plc Southampton, England). Initially, every 3rd animal trapped was to be released after marking to estimate a rate of recapture but this was later abandoned due to low trapping successes. The head was either carried whole in ice to the laboratory or a brain sample taken using the straw method and samples placed in WHO kits for sample transportation under room temperature.

### **3 RESULTS.**

#### **3.1 Active surveillance in households.**

Samples from all animal species were collected as part of an active surveillance programme over a 9 month period. Wildlife constituted 15% (9 of 57) of the samples. The species of wildlife involved were the genet (*Genetta genetta*), common mongoose (*Herpestes* sp.), bushbaby (*Galago senegalensis*), jackal (unspecified sp), honeybadger (*Mellivora capensis*), canerat (*Lophiomys imhause*) and porcupine (*Hystrix galeata*). Each species was represented by one or two samples. None of these samples tested positive for rabies by FAT.

#### **3.2 Retrieval of samples from road-kills.**

A total of 151 wildlife carcasses were found on the section of road surveyed over the 9 month period of the study. Of these, 66 yielded brain samples which could be submitted for rabies diagnosis. Three of these samples were positive under FAT. Fifteen different wildlife species were identified among the 151 wildlife carcasses found.

#### **3.3 Household questionnaire survey.**

The white tailed mongoose (*Ischeumia albicauda*), the common mongoose, the squirrel (*Paraxerus* sp.) and the genet were the most common species of wildlife sighted by people in the study area. Domestic cats (*Felis catus*) which had gone wild were also very commonly sighted. Larger carnivores like jackals, hyenas, lions and leopards were said to be only rarely sighted though there were reports of occasional movement of these animals from the surrounding National Parks and Reserves. The civet (*Viverra civetta*) had a frequency of sighting intermediate between that of the small and the large carnivores.

#### **3.4 Wildlife behaviour patterns.**

The white tailed mongoose, civet, genet, hyena (unspecified sp), and lion (*Panthera leo*) were all considered to be nocturnal. Most respondents said they saw the leopard (*Panthera pardus*) and the squirrel only during the day while the common mongoose, caracal and wild cats were generally thought to be seen at any time of day or night. Only the hyena and the lion were thought by the majority of respondents to be sighted on a seasonal basis with the majority of people saying that they sighted them during the wet season. Other species were sighted year round (Table 1).

A total of 114 households (56% of all households) reported sighting animals with "abnormal" behaviour. The white tailed mongoose was the most common species reported as exhibiting abnormal behaviour, with 80% of households reporting encounters with a white tailed mongoose showing at least one category of abnormal behaviour. The majority of these reports described aggressive behaviour towards people. Only 7 (6.7%) of all animals showing abnormal behaviour had signs of mania, a category of behaviour that could be closely associated with the furious type of rabies. Of these, 3 were white tailed mongoose.

**Table 1 : Summary of frequency, time and season of sighting of wildlife species observed in 200 randomly selected homesteads in Kibwezi Division, Makuani District, Kenya, June 1995**

Species	Frequency of sighting <sup>a</sup>	Mainly seen at <sup>b</sup>	Main season <sup>c</sup>
White tailed mongoose	High	Night	All
Common mongoose	High	Any	All
Squirrel	High	Day	All
Civet	Low	Night	All
Genet	High	Night	All
Hyena	Low	Night	Seasonal
Jackal	Low	Night	All
Lion	Low	Night	Seasonal
Leopard	Low	Day	Any
Caracal	High	Any	Any
Wildcat	Low	Any	Any

<sup>a</sup> High if more than 50% of the respondents said they saw the animal either daily or weekly

<sup>b</sup> A specific time is listed if more than 50% of the respondents felt that the animal was seen during a particular time that was considered to be the main time the animal was seen

<sup>c</sup> If 50% said they saw the animal in a particular season that animal was considered to be seasonal

### **3.5 Wildlife/ domestic animal contact.**

Seventy-one percent (143 of 202) of the households reported having heard or witnessed dogs fighting with unspecified wild animal species. Seventy percent of these reported having heard these fights at least weekly. The majority of the respondents could not positively identify the species of wildlife that fought with their dogs though many assumed that it was the white tailed mongoose or the honey-badger, which are known to frequent the households and are naturally aggressive.

### **3.6 Wildlife trapping.**

A total of 23 animals were trapped in 21 households from 79 attempts. Twenty four trapping attempts were made in Utithi sub-location, 21 in Mukaange and 24 in Mbuinzau and Mikuyuni combined. Nine animals were trapped in Utithi, 5 in Mukaange and 9 in Mikuyuni and Mbuinzau combined. This gives a trap success rate of 9%. Eleven of the animals were white tailed mongoose, 11 were genet and 1 was a common mongoose. All were FAT negative.

## **4 DISCUSSION.**

Retrieval of samples from households using the active surveillance method

The number of samples collected from wildlife in the active surveillance programme was small and in our opinion this type of active surveillance in communities would need to be supplemented with other methods for a satisfactory estimation of rabies incidence in wildlife populations. However, the method can provide specific evidence of rabies transmission between wildlife and human and animal populations, particularly if outbreaks of rabies occur and has shown efficacy as a system for monitoring dog rabies (Kitala *et al.*, 1994). Thus any wildlife cases uncovered would be secondary to this primary benefit. Parameter estimates of importance in this respect would be the relative timing of increased case reports in domestic animal and wildlife populations and the average number of secondary contacts made by an initial rabid wild or domestic animal and other animals.

### **4.1 Retrieval of samples from road-kills.**

The number of wildlife samples collected from road-killed animals indicates that along a busy highway, this could be a useful method for relatively easily obtaining wildlife species for disease surveillance. The yield of samples obtained during the study period varied mainly by the availability of bicycles and time of day the road was searched. To cover sufficient distances bicycles were essential. Bicycles allow increased distances to be covered while allowing for closer investigation of road-sides as well as the main road surface. We found that the time in the morning when the workers went out determined the state in which the carcasses would be found. Most animals are hit on the road at night. When workers began searching between 5.30 and 6.00 am the number of carcasses from which brain material could be recovered for rabies diagnosis was much higher than when they began searching at 7.00am or later. This is because many vehicles drive after first light and completely crush carcasses killed during the previous night and early morning.

This form of opportunistic sample collection is very well suited for assessing trends in disease incidence over time, in agreement with findings from elsewhere (Woolf *et al.*, 1986). We think it would be very well suited to monitoring both endemic and epidemic rabies and to estimate the relative timing of the percentage of rabies (or other disease) positives in different wild and domestic animal species, a potential indicator of the inter-species transmission of rabies.

## **4.2 Household questionnaire survey.**

### **4.2.1 Frequency of sighting of wildlife.**

Although somewhat subjective, the questionnaire method of estimating relative density of animals appeared to us to provide a useful indicator of the relative abundance of species of animals difficult to count due to their size and behaviour patterns. The species of wildlife trapped on homesteads corresponded well with those species said to be most commonly sighted by local people.

By this method it was also possible to identify the species of wildlife in closest contact with the domestic dogs and thus indicate the most likely species which could act as a reservoir of rabies given the right conditions (as for example for jackal rabies in Zimbabwe (Bingham (1997) in this volume)). Based on this study, the species of wildlife with greatest potential to act as reservoirs include white tailed mongoose, the common mongoose and the genet. These species are also in closest contact with the dogs and occur in population densities which might support transmission. However, more detailed ecological studies of these species would be required to estimate parameters for rabies transmission modelling.

From a more general wildlife conservation and management perspective, household questionnaires also provide other benefits. They could be particularly useful in initiating dialogue between communities and wildlife personnel. They provide information for wildlife staff to understand community perceptions of wildlife in their area and can be an important guide for community discussion and education efforts.

### **4.2.2 Wildlife behaviour patterns.**

The questionnaire also provide useful information on the common patterns of behaviour of wildlife in closest contact with domestic animal and human populations. Because the observations are subjective, we have used them as relative rather than absolute indices. From their responses, it was convincing to us that local people observed wildlife closely and did notice the behaviour of wildlife. We see two potential applications for this local knowledge. The first is to help refine the design of ecological studies relative to rabies transmission and the second is to help in the assessment of post-exposure rabies treatment based on the contact species usual behaviour pattern.

While local knowledge of wildlife behaviour could be informative, most people were not experts and would invariably use their observation of the behaviour of domestic animals as a basis of comparison for wildlife behaviour. Thus, when they described a wild animal's behaviour as "abnormal" this was usually relative to behaviour of their dogs. However, they did note species-to-species differences, identifying white-tailed mongooses and honey badgers as particularly aggressive species.

Local residents also concurred on the hunting behaviour of wildlife species most likely to contact them. This further points to the white tailed mongoose and other small carnivores which hunt for chickens in

the households as species which come into constant contact with domestic dogs. The frequent fights between these carnivores and the dog probably provide more-than-sufficient contact for rabies transmission between dogs and these species.

### **4.3 Wildlife trapping.**

Wildlife trapping was a very labour intensive exercise that yielded only modest results. The success rate of trapping depended on the position of the trap and the bait used. The paths leading to the homestead were found to be good locations to position traps. After trying out different types of meat from butcheries, it was found that pieces of freshly killed chicken were most preferred by the white tailed mongoose and the genet. It would be possible to use traps to estimate the population of wildlife in the area using capture - mark - release-recapture methods but based on our experience this would need to be done in a relatively small area for a sufficient length of time. Initially, we attempted to mark and release animals that had been trapped. Three animals, one white tailed mongoose and 2 genets, were marked by tattoos and with transponders but none were re-trapped. The low success rate of trapping, within the resource and time limitations faced, made us abandon attempts to estimate population sizes.

The types of bait used need further refining depending on the species one is interested in. Chicken meat was continued as the bait throughout this trapping study because it gave good results in trapping the white tailed mongoose and the genet but apparently it is not ideal for other species, as none other were trapped. A few attempts to use maize grains to attract squirrels were unsuccessful (a guinea fowl was caught instead). Also the type of trap used was probably not ideal for trapping squirrels. Local people are quite successful (P.M. Kitala, personal communication) in trapping squirrels but we had insufficient time to pursue this.

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