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Community- And Road-Kill Rabies Surveillance In Kibwezi, Kenya

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Summary

We investigated the possibility of cross-infection by rabies between domestic animals and wild mammalian carnivores at a wild-domestic animal interface. The area was known to have a domestic-dog rabies but the involvement of wildlife was unknown. Four sublocations within a transect of approximately 20 km along the Nairobi-Mombasa highway were selected as the study area. A total of 202 households within the area were randomly selected and visited to collect information on wildlife abundance and habits, and for wildlife-domestic dog interactions. Forty of the 202 households were randomly selected for wildlife trapping. An eight-month long community-and road-kill-based rabies surveillance was implemented in the 4 sublocations.The white-tailed mongoose (Ischeumia albicauda), the genet cat (Genetta genetta), the common mongoose (Herpestes spp), the civet cat (Viverra civetta) and the bush squirrel (Paraxerus spp), were identified as the most prevalent species of wildlife in the area.Seventy-one percent (143/202) of the households reported having heard or witnessed their dogs fighting with unspecified wild animal species. White-tailed mongooses (11) and genet cats (11) were the species of wild carnivores trapped within the precincts of the households.The domestic dog accounted for 91% (20/22) of the rabies positive animal brain specimens collected in the community-based rabies surveillance. Only 6.2% (5/ 81) of the specimens from road-kills were

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positive for rabies including a domestic cat, a goat, a common mongoose (Herpestes spp), a genet cat, and an unidentified wildlife species.

This study has revealed that small wild carnivores are frequent in Kibwezi and interact with dogs. Dogs are currently the main species for transmission of rabies but there is some rabies in wildlife. The potential for wildlife to act as a reservoir for rabies as in other areas where dog rabies has been controlled needs further investigation

Keywords: Rabies; Surveillance; Community-based; road-kills; Kenya

1. Introduction

Rabies has been reported in Kenya since 1912 (Hudson, 1944). As in other developing countries, the domestic dog is the most important reservoir. During 1991-1996, 999 rabies cases were confirmed: 523 dogs, 314 other domestic animals, 127 humans, and 35 wild animals (Karugah, 1995). However, it is widely suspected that the officially reported incidence is a gross underestimation of the true rabies incidence in Kenya-- particularly because the main incentive for reporting rabies cases (government-supported diagnosis linked to post-exposure treatment of confirmed exposures) has become ineffective (Kitala et al., 2000).

Major constraints in improving understanding of rabies in wildlife in developing countries (including Kenya) are the lack of data on the populations at risk and effective reporting systems on rabies incidence by species. Disease surveillance in free-ranging wildlife is difficult due to inaccessibility of the animals. Non-traditional or novel methods of data collection have to be used (although it often is difficulty to draw conclusions from the data).

In Makueni/Machakos Districts (Kenya), the persistence of rabies despite relatively good control of the disease in the rest of the country has led to a suspicion of wildlife involvement in rabies maintenance.The district is surrounded by wildlife-protected areas and rabies has been diagnosed in wildlife in the district (Kariuki and Ngulo, 1985). During 1983-1992, Makueni/Machakos Districts accounted for 29% (623/2149) of the confirmed animal rabies cases countrywide (Chong, 1993). Although a relatively large, poorly supervised and inadequately vaccinated dog population in the district might be the major cause of rabies persistence (Kitala et al., 2001), the role of wildlife has not been investigated.

The present study was carried out with the following specific objectives: describe prevalence of rabies between domestic animals and local wildlife species; determine the abundance of local wildlife species; and to investigate interaction between wild carnivores and domestic dogs. Currently rabies is considered as one of the major zoonotic diseases of that impacts lives of both humans and livestock and other domestic animals.

2. Materials and methods

2.1 Study area

The study was conducted in the Kibwezi Division of Makueni District. The division covers an area of approximately 3,400 km^2 and lies between longitudes 370 55" and 380 5" east and between latitudes 00 20" and 00 30" south. According to the 1999 national census, Kibwezi Division had a human population density of 84,931 people. The division borders the Chyulu National Reserve to the west, Tsavo West National Park to the south, and Tsavo East National Park to the southeast. Over the last 20 years, new human settlements in the division have been established in previous wildlife areas (Jaetzold and Schmidt, 1983).

2.2 Survey for local perceptions on wildlife

A 20-km transect was selected along the Mombasa-Nairobi highway as the study area. The area has both well established villages and newer ones. Four administrative sublocations within the transect were purposively selected because of their proximity to the Mombasa-Nairobi highway for household survey of wildlife occurrence and habits, wildlife trapping and for community-based surveillance for rabies. In the four selected sublocations, a list of all households (total 1209) was compiled by village elders and 202 households were selected using a random-number table for inclusion in the survey. Questionnaires were designed based on the World Health Organization Guidelines for Dog Rabies Control (WHO, 1987) (with minor modifications). Data were collected by administering the questionnaires via personal interviews of household heads or any other adult relative present. A subsequent visit was made if any of these people were not at home at the time of the first visit. The interviews were conducted in the local language (Kikamba). In addition, schoolboys who usually spend most time with household dogs and are therefore more likely to observe dog-wildlife contacts, were also interviewed. The questionnaires consisted of a list of different wildlife species with their local names (Kikamba).The information sought included the

frequency of sighting of the animals, their estimated number, time of day seen, and season of the year when most frequently seen. In addition, respondents were questioned about abnormal behaviour they may have noticed exhibited by the wild animals they saw such as aggression and loss of fear towards humans manifested by animals wandering into homesteads.

2.3. Wildlife trapping

To supplement the information from the household survey, 10 of the survey households in each sublocation were selected randomly using a random number-table for subsequent live trapping of wildlife within their precincts. Cage traps, made according to specifications given by the National Live Trap (Wildlife Restraint Series, 1991) were used. All the traps were 100 x 40 x 40 cm. The traps were set on paths leading to the households for 3 to 4 nights; one trap was used per household. The paths were selected to maximize the trapping of animals that were most likely to contact domestic animals and humans. Pieces of fresh chicken meat were used as baits to lure the animals into the baits. The trapped animals were anaesthetized using ketamine (KetasetR, 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 2.5 - 5 mg /kg).

2.4. Active-surveillance system

One resident field assistant (rabies worker) for each sublocation was recruited in consultation with community leaders. The assistants received pre-exposure immunization against rabies using a purified vero cell rabies vaccine (Pasteur Merieux, Lyon, France) on days 0, 7 and 28 according to the manufacturer's recommendations. In addition, they were trained in rabies and data collection. With the assistance of the local leaders, public meetings were held in the study area to introduce the rabies workers, increase rabies awareness and explain objectives of the study.

Rabies surveillance was conducted via a community approach in the 4 selected sublocations over an eight-month period between October 1994 and May 1995.The public would report all rabies suspect animals either seen or killed, to the field assistants. A rabies-suspect was any animal showing signs consistent with rabies and any animal that they exposed. The field assistants collected heads of any rabies-suspect animal killed by the public. In addition, the field assistants patrolled the Mombasa-Nairobi highway daily using bicycles between 0600 hours and 0700 hours to collect heads of any animals killed by vehicles over the previous 24 hours. Approximately, a 30 kilometre stretch of the highway was checked daily. In cases where heads were crushed completely, an attempt was made to collect brain or spinal cord material. The collected head specimens from rabies-suspect animals and road-kills were placed in a polythene bag and stored in a freezer at the Kibwezi Divisional Veterinary Office before transportation, in transport kits provided by the WHO, to the Central Veterinary Laboratory in Kabete, Nairobi, for rabies diagnosis using the fluorescent antibody test (FAT) according to the method described by Kissling (1975); the FAT has a reported sensitivity of 97.1% (Kissling, 1975) and a specificity of 99.9% (Charlton et al., 1986).

3. Results

3.1. Frequency of wildlife sightings

Ten different wild carnivore species were reported to have been sighted.The white- tailed mongoose (Ischeumia albicauda), the common mongoose (Herpestes spp), the squirrel (Paraxerus spp), the genet (Genetta genetta), and the civet cat (Viverra civetta) were the most common species of wildlife sighted by people in the study area (Table 1). In addition, feral domestic cats (Felis cati) were also commonly sighted. Larger carnivores like jackals, hyenas, lions and leopards rarely were sighted--- although there were reports of occasional movements of these animals from the surrounding national parks and reserves onto farms.

3.2. Wildlife with "abnormal" behaviour

A total of 114 (56%) households reported sighting wild animals exhibiting what was perceived as abnormal behavior; 80% of households reported having encountered a white-tailed mongoose showing abnormal behavior. Most of these reports described aggressive behavior towards people. Only 7 (6.7%) of all animals showing abnormal behavior had signs of mania (similar to the furious type of rabies); 3 were white-tailed mongooses.

3.3. Wildlife-dog interactions

Seventy-one percent (143 of 202) of the households reported having heard or witnessed dogs fighting with unspecified wild animal species; 70% reported having heard the fights at least weekly. Many considered the white-tailed mongoose as the most likely wild animal

Table 1: Frequency of sighting of wild carnivores by respondents in 202 randomly selected households in Kibwezi Division, Makueni District, Kenya (June 1995).

Species	Frequency of sighting (% of households)				
	Daily	Weekly	Monthly	Yearly	Never
White-tailed mongoose (*Ischeumia albicauda*)	55	23	14	5	3
Mongoose (*Herpestes* spp)	83	11	4	1	1
Squirrel (*Paraxerus* spp)	100	0	0	0	0
Civet (*Viverra civetta*)	8	35	17	20	20
Genet (*Genetta genetta*)	18	30	24	10	18
Hyena (unspecified spp)	4	2	2	7	85
Jackal (unspecified spp)	2	2	5	12	79
Lion (*Panthera leo*)	0	0	2	20	78
Leopard (*Panthera pardus*)	2	2	5	11	80
Caracal (unspecified spp)	23	42	18	3	14
Wildcat (*Felis cati*)	66	13	9	1	10

Table 2: Fluorescent antibody test results by species of specimens collected during a community-based active surveillance for rabies in Kibwezi Division, Makueni District, Kenya, October 1994- May 1995

Species	Fluorescent antibody test results		
	Positive	Negative	Total
Domestic			
Dog	20	21	41
Cat	1	3	4
Goat	1	2	3
Wild			
Genet (*Genetta genetta*)	0	2	2
Mongoose (*Herpestes* spp)	0	2	2
Bush baby (*Galago senegalensis*)	0	1	1
Jackal (*Mesomelas* spp)	0	1	1
Honey badger (*Mellivora capensis*)	0	1	1
Cane rat (*Lophiomys imhause*)	0	1	1
Porcupine (Hystrix galeata)	0	1	1
Total	22	35	57

involved. The white-tailed mongoose, other nonspecified mongooses and the genets apparently have adapted to living near houses and prey on domestic chicken. Thus, they are more likely to come into contact with the domestic dog.

3.4. Wildlife trapped

A total of 23 wild carnivores were trapped within the precincts of 21 of the 40 households selected for the exercise. They included 11 white-tailed mongooses, 11 genet cats, and a common mongoose.

3.5. Rabies cases detected by active surveillance

Fifty-seven animal specimens were collected during the community-based active surveillance for rabies (Table 2). Of these, forty-one (72%) were from domestic dog (Canis familiaris). Domestic cats (Felis cati) and goats (Caprine) were the only other domestic animal species whose samples were collected. Nine specimens from 7 different wildlife species were collected during the same period representing 16% of the total specimens collected. Twenty-two (39%) of the collected specimens were

Table 3: Species and fluorescent antibody test results of animal specimens collected from road-kills along the Nairobi-Mombasa highway in Kibwezi Division, Makueni District, Kenya, October 1994- May 1995

Species	No. observed	No. brain specimens collected	Fluorescent antibody test results	
			Positive	Negative
Domestic				
Cat	9	7	1	6
Dog	22	11	0	11
Sheep	3	2	0	2
Goat	4	4	1	3
Wild				
Bush baby (*Galago senegalensis*)	14	4	0	4
African civet (*Viverra civetta*)	11	6	0	6
Squirrel (Bush; *Paraxerus* spp)	12	5	0	5
Wild rodents (unspecified spp)	40	24	0	24
Bat (unspecified spp)	5	2	0	2
Mongoose (*Herpestes* spp)	12	4	1	3
Hedgehog (*Atelerix albiventris*)	27	2	0	2
Genet (*Genetta genetta)*	4	2	1	1
Baboon (*Papio anubis*)	1	1	0	1
Bushbuck (*Tragelaphus* spp)	2	1	0	1
Jackal (unspecified spp)	2	1	0	1
Porcupine (*Hystrix galeata*)	5	0	0	0
Hyrax (rock; *Procavia* spp)	1	0	0	0
Hare *(Lepus* spp)	6	1	0	1
Cane rat (*Thyronomys* spp)	3	3	0	3
Unidentified spp	2	1	1	0
Total	185	81	5	76

positive for rabies on FAT out of which 91% were from domestic dogs (Table 2). None of the 9 wildlife specimens were positive for rabies.

3.6. Rabies cases detected by road-kill surveillance

A total of 185 road-kills were observed but only 81 had sufficient brain material remaining for sampling (Table 3). Five of the 81 (6%) specimens were positive for rabies including 1 cat, 1 goat, 1 mongoose, 1 genet and 1 unidentified wildlife species (Table 3). It was interesting to us that none of the domestic-dog samples collected from the road-kills tested positive for rabies.

4. Discussion

Like in other African countries, our study shows that the domestic dog plays a central role in the maintenance and transmission of rabies (Tierkel, 1975; Acha, 1981; Bogel et al., 1982; Fekadu, 1982; WHO, 1992; Randal, 2004). This survey suggests that there are frequent contacts between dogs and smaller wild mammalian carnivores. Mongooses, which prey on domestic chicken are the species most likely to be infected with rabies. Whether the population ecology of these species could allow for the establishment of an independent rabies wildlife reservoir remains unclear. Rabies in wildlife has previously been reported in Kenya (Chong, 1993). The potential role of wildlife in rabies deserves consideration, because in North America and Europe, wildlife rabies predominated after canine rabies was controlled (Acha and Arambulo, 1985). In Southern Africa, independent rabies cycles have been shown to occur in the yellow mongoose (Cynictis penicillata) and in the black-backed jackal (Canis Mesomelas) in Zimbabwe (Thomson and Meredith, 1992). It was not clear in this study whether

the rabies virus isolates from the mongoose and the genet cat were a spill-over from domestic dogs or had adapted to these wildlife species. Further investigations are required to elucidate this by extensive monoclonal antibody studies on local virus isolates and/or sequence analysis of viral genomes.

We tried to get information from primary-school children (especially boys, who spend the most time with the dogs) with mixed results. Such an information-collection programme depended on the personal interest of at least one teacher in the school, and experience was that many teachers felt the study was an extra burden on an already-busy school schedule. Kitala et al. (2000) have demonstrated the central role young schoolboys could play in dog ecology studies as well in uncovering suspected rabies cases.

This was the first time road-kills have been used for rabies surveillance in Kenya. The results indicate that the wildlife populations in areas of endemic rabies do get infected. The method can be refined to cover a longer period of time to detect dynamics of rabies infections in wildlife populations. The drawback of the method is the opportunistic nature of sample collection making it difficult to extrapolate the results to the wildlife populations to give reliable indices of disease occurrence.

Although subjective, our questionnaire seemed to offer ideas of the potential for dog-wildlife (or even human-wildlife) contact. We speculate that the wildlife carnivores with greatest potential to act as reservoirs include the white-tailed mongoose (Ischeumia albicauda), the common mongoose (Herpestes spp), and the genet (Genetta genetta).

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Comparative Assessment Of Innate Humoral And Cellular Immunity Of Exotic And Nigerian Indigenous Breeds Of Chickens

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Innate humoral and cellular immunity of the Nigerian indigenous and exotic breeds of chickens were assessed and compared for degree of immunocompetence. Natural antibodies and complement levels of Arbor acres broilers, Nera pullets, Nera cockerels and Nigerian indigenous chickens were assessed using haemolysis-haemagglutination assay. Delayed footpad reaction was also assessed. Results obtained from pullets and cockerels were pooled to constitute the mixed types group.

Natural antibodies and complement titers of indigenous chickens and pullets (7.5 Ø 0.62; 3.3 Ø 0.21 and 7.5 Ø 0.75; 3.0 Ø 0.0 respectively) were significantly higher ($p<0.05$) than those of cockerels and broilers (5.6 Ø 0.88; 2.7 Ø 0.15 and 4.2 Ø 0.17; 2.8 Ø 0.09 respectively). Titers in the mixed type group (6.6 Ø 0.61; 2.9 Ø 0.07) were lower than those of IC ($p<0.05$). Delayed footpad reaction showed maximum response at 24 hours post challenge in indigenous chickens and broilers and 48 hours post challenge in pullets, cockerels and mixed type groups with indigenous chickens recording the highest delayed footpad reaction value at peak (1.96 Ø 0.13 mm).

The study showed higher levels of natural antibodies and complement as well as faster and more intense delayed type hypersensitivity reaction in indigenous chickens than exotic Nera breed both of which are reared for meat and egg.

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Key words: Cellular immunity; exotic chickens; humoral immunity; Innate immunity; Nigerian indigenous chickens.

Abbreviations

IC	Indigenous chickens
DFR	Delayed footpad reaction
DTH	Delayed-type hypersensitivity reaction
MT	Mixed type
NAbs	Natural antibodies
IBD	Infectious bursal disease
PEG	Polyethylene glycol

Introduction

The Nigerian indigenous chickens which constitute majority (84%) of chickens reared in Nigeria (FDLPCS, 1992) have been able to thrive for centuries in the harsh tropical environment. They are more adapted to tropical conditions like high environmental temperature and humidity as well as poor nutrition than the introduced exotic breeds which perform sub-optimally in the tropics (Marks et al., 1969) since they were not bred to be reared in the tropics. The indigenous chickens are scavengers making them less competitive with humans for grains; they are self-breeding and are produced very economically by rural dwellers with little or no housing, feeding and veterinary care (Okoye and Aba-Adulugba, 1998). They are however characterized by small body size, slow