

## Rabies in the Masai Mara, Kenya: preliminary report

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### ABSTRACT

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A serosurvey of rabies antibodies among domestic dogs (*Canis familiaris*, n = 178), spotted hyaenas (*Crocuta crocuta*, n = 72) and African wild dogs (*Lycaon pictus*, n = 18) of the Masai Mara, Kenya, was carried out. Rabies antibodies were found in 9,6% of the domestic dog sera, but all wild dog and hyaena sera were negative.

Rabies has been confirmed in this region among the above species as well as in a domestic cat (*Felis catus*) and a cow (*Bos indicus*) by fluorescent antibody tests (FAT) and/or histopathology. The disease was confirmed in three wild dogs in 1989 and in a fourth dog in early 1991.

In 1992, a spotted hyaena attacked six people, one of whom died; the hyaena brain was positive for rabies. To date, rabies has been confirmed in one domestic cow (n = 22; 4,5%), one domestic cat (n = 9; 11,1%) and five domestic dogs (n = 32; 15,6%). The wild dog cases exhibited paralytic rabies whereas in the hyaena, domestic cat and domestic dogs furious rabies was observed. The dynamics of rabies in this ecosystem is not yet fully understood, but based on these preliminary data it is suspected that domestic dogs play a primary role in its maintenance.

### INTRODUCTION

Rabies is a neurotropic virus to which all mammals are variably susceptible and the disease occurs throughout Africa (Kaplan & Koprowski 1980). Rabies was first reported in Kenya in 1912 (Binepal 1992), at which

time it was thought to have been widespread over much of the country (Davies 1981). However, little is known about the natural history of rabies in Kenya or the relative roles that domestic dogs and wild carnivores play in disease maintenance.

The incidence of rabies has apparently increased dramatically since 1979 (Binepal 1992; Perry 1992). However, as Perry (1992) has pointed out, this increase should be interpreted with care as it may be confounded by factors such as an increased level of surveillance and improved diagnostic capabilities. Of the number of cases confirmed (n = 1058) at the Kabete Veterinary Laboratory from 1987 to 1991, 60% occurred in domestic dogs and only 2,6% in wildlife species including bat-eared fox (*Otocyon megalotis*), honey badger (*Mellivora capensis*), mongoose (several

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species), jackal (several species), bat (species not listed) and African wild dog (Binopal 1992). These data exhibit a very different pattern to those of 1950 to 1987 from Zimbabwe, in which 25% of cases reported occurred in wildlife species and 22% were in jackals (*Canis mesomelas* and *Canis adustus*) alone (Foggini 1988).

It is uncertain if the low number of wildlife rabies cases reported in Kenya is a true reflection of the distribution of rabies among carnivore species or is related to surveillance bias. Such information would be critical to the development of effective control programmes.

In order to better understand the dynamics of rabies and its control in Kenya, a research programme was recently initiated in an area of Masai communal lands bordering the Masai Mara National Reserve. The region is populated by the Masai tribe, their domestic animals and a high density of wildlife species. This allows a unique opportunity to investigate both the ecology of rabies in an ecosystem which supports a diverse population of domestic and wild carnivores and to determine the relative roles of these species in the maintenance of rabies in the ecosystem. We describe progress made to date.

## MATERIALS AND METHODS

### Serology

During 1989 to 1990 blood samples were collected from a randomly selected group of domestic dogs living in association with the Masai tribe in family communities referred to as manyattas. About 20% ( $n = 55$ ) of the manyattas within the study site were selected using a random number table; the study area was largely defined by the home range of a wild dog pack (Fuller & Kat 1990). All the domestic dogs that could be captured in the selected manyattas were sampled from the cephalic vein. None of the wild or domestic canids had known vaccination histories. Spotted hyaenas ( $n = 72$ ) were sampled within this same area from 1990 to 1991 as part of an ongoing behavioural study by Drs Holekamp and Smale. Animals were immobilized with Telazol<sup>R</sup> (A.H. Robins Co., Richmond, Va. 23220 USA) using a remote injection system. Anaesthesia was maintained for 40–60 min with a dose of 3–4 mg/kg.

African wild dogs ( $n = 18$ ) in five radio-collared packs in the Masai Mara, Kenya, were sampled from 1987–1990 as part of an ongoing ecological study (Fuller & Kat 1990). These animals were also immobilized by remote injection with Telazol<sup>R</sup> at dosages of 2–3 mg/kg and anaesthesia was maintained for 35–55 min. Sera were stored at  $-20^{\circ}\text{C}$  until analysed two to three years later.

Rabies virus-neutralizing antibodies were detected using a modified rapid fluorescent focus inhibition

test (RFFIT) (Smith, Fogger & Baer 1973). Titres were expressed in International Units (IU)/ml determined by comparison with a standard serum; a level of  $>0.5\text{IU}$  was considered seropositive based on the standards of the World Health Organization (WHO). Sera were tested at the Centers for Disease Control, (CDC), Atlanta, Georgia, USA.

### Rabies diagnosis and histology

In addition to searches for carcasses by research personnel, a reward system for information about carcasses was instituted among the local villagers, park rangers and tour drivers. This system maximized access to a wide variety of carcasses, which generally are destroyed quickly by scavengers in this ecosystem. Brain tissues were collected as in the method described by Barrat & Blancou (1988). They were tested for rabies viral antigen with a fluorescent antibody test (FAT) (Dean & Abelseth 1973) at the Kabete Veterinary Laboratory, Kenya and at the Central Veterinary Laboratory, Weybridge, UK.

In 1989, seven wild dog carcasses from a rabies outbreak among the Aitong pack were retrieved; three were badly decomposed, but four were suitable for necropsy and histopathology. Tissues collected included the complete brain of one dog and fragments of brain-stem from another. FAT only was performed on the brain of a third dog. Fixed tissues were embedded in paraffin wax, sectioned at  $5\mu\text{m}$  and stained with haematoxylin and eosin (H & E) and Schleifstein's stain.

Histopathological examinations were carried out at the National Zoological Park, Smithsonian Institution.

## RESULTS/OBSERVATIONS

### Domestic species

Of the 178 domestic dog sera tested for rabies antibodies, 9.6% were positive. No other domestic animal species sera have been tested to date.

From November 1992 to July 1993, a total of 68 brain samples collected from domestic animals in the region were tested for rabies by FAT (Table 1a). Five domestic dogs, a cat and a cow were positive; the dogs and the cat died of furious rabies.

### Wildlife species

All hyaenas ( $n = 72$ ) and African wild dogs ( $n = 18$ ) lacked detectable antibodies to rabies virus.

A pack of wild dogs (Aitong pack) ranging to the north of the Masai Mara National Reserve was monitored from 1987 to 1989. During a six-week period (August 1 to September 14, 1989), 21 of 23 members of this pack died. Histological examination of two available

TABLE 1 Rabies FAT diagnoses on brain specimens obtained from the Masai Mara, Kenya

Species	+ ve	- ve	Total
<b>Domestic animals</b>			
Dog	5	27	32
Cat	1	8	9
Cow	1	22	23
Goat	0	2	2
Sheep	0	2	2
<b>Total</b>	<b>7</b>	<b>61</b>	<b>68</b>
<b>Wild animals</b>			
Dwarf mongoose (C)	0	1	1
Banded mongoose (C)	0	4	4
White-tailed mongoose (C)	0	2	2
Black-backed jackal (C)	0	1	1
Spotted hyaena (C)	1	4	5
Wildebeest (U)	0	20	20
Buffalo (U)	0	2	2
Topi (U)	0	5	5
Impala (U)	0	3	3
Blue duiker (U)	0	1	1
Warthog (U)	0	2	2
Giraffe (U)	0	1	1
Zebra (U)	0	2	2
Cape hare (R)	0	7	7
Springhare (R)	0	1	1
Porcupine (R)	0	4	4
<b>Total</b>	<b>1</b>	<b>60</b>	<b>61</b>

(C) = carnivore; (U) = ungulate; (R) = rodent

brain specimens revealed eosinophilic intracytoplasmic inclusions (Negri bodies), supporting the diagnosis of rabies viral encephalitis. Another brain specimen was rabies positive by FAT and in 1991 an additional wild dog brain was also FAT positive. All observed cases exhibited paralytic (dumb) rabies.

In November 1992 an adult spotted hyaena attacked people in two settlements located within the study site. This was the third such attack since 1990 in this area. Six people were severely bitten during the incident and one boy died as a result of his wounds. The hyaena brain was rabies FAT positive (Table 1).

Brain samples from wildlife carcasses of a variety of species found in the area from November 1992 to July 1993 were collected and tested for rabies. With the exception of the hyaena mentioned above, all wild-life specimens ( $n = 61$ ) were negative (Table 1).

## DISCUSSION

The domestic dog population around the Masai Mara is very large and almost entirely unvaccinated against rabies. Domestic dogs are kept primarily to guard livestock from predators and they scavenge

for the majority if not all of their food. They have only a loose association with humans: using the WHO (1988) classification system, these animals would be considered a mixed population of "feral" and "neighbourhood" dogs. Domestic dogs have varying levels of contact with wild carnivores including white-tailed mongooses (*Ichneumia albicauda*), jackals, bat-eared foxes, spotted hyaenas and African wild dogs, which are encountered either when the domestic dogs are travelling with cattle, or when wild carnivores scavenge around manyattas at night. The opportunity thus exists for transmission of infectious diseases between domestic dogs and sympatric wildlife species, and research is in progress to document the scope of this contact and avenues of disease transmission.

This study has documented the occurrence of rabies and humoral antibodies to rabies virus among domestic dogs in the Masai Mara area.

Of the brain samples from domestic dog carcasses tested, five of 32 (15.6%) were positive. Domestic dogs accounted for 62.5% of all positive cases ( $n = 8$ ) from the Masai Mara since November 1992. The predominance of positive cases among domestic dogs in Kenya has also been reported by Kariuki & Ngulo (1985) and Binopal (1992). Seroepidemiological surveys for rabies among other African domestic dog populations have similarly revealed the presence of antibodies: for example, prevalence ranges from 16.1% ( $n = 254$ ; Wosu and Anyanwu 1990) to 31% ( $n = 463$ ; Ogunkoya, Beran, Umoh, Gomwalk & Abdulkadir 1990) among Nigerian dog populations. In our study, 9.6% ( $n = 178$ ) of owned, unvaccinated dogs were positive, but the significance and interpretation of this and other such results in terms of rabies epidemiology remains unclear.

All African wild dogs and spotted hyaenas sampled were seronegative for rabies antibodies. The prevalence of such antibodies among wild carnivores in other studies was generally low or non-existent but again, the significance of seropositivity is unclear. For example, antibodies to rabies virus have been detected among wildlife species such as racoons (6%;  $n = 985$ ; Hill, Beran & Clark 1992), wolves (1%;  $n = 88$ ; Zarnke & Ballard 1987) and jackals in Zimbabwe (3%;  $n = 156$ ; Foggin 1988) and Kenya (3%;  $n = 36$ ; Alexander, Kat, Wayne & Fuller 1993, paper submitted).

While every effort was made to obtain wildlife specimens, it is possible that surveillance would be biased towards domestic animals as carcasses of these species are easier to detect and collect. Although there has been little indication of a sylvatic cycle in this area to date, further investigation will be required to determine the incidence of rabies within wildlife populations. We intend to conduct this research through a continued sampling programme, coupled with an

assessment of the degree of population genetic variation among the rabies virus isolates collected to date from the Masai Mara and elsewhere in Kenya. At this stage, however, it is suspected that the domestic dog plays the primary role in rabies maintenance in the Masai Mara ecosystem.

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