

## Rabies in bat-eared foxes in South Africa

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### ABSTRACT

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Rabies in bat-eared foxes was first recognized in South Africa in 1955 and is likely to have been derived from canine rabies introduced to South Africa in 1950. Since then it has become established in this species in the drier western half of the country and the south-western Cape so that rabies now occurs in bat-eared foxes adjacent to the peri-urban canine population of Cape Town. Peak incidence was recorded in the early 1980s and the incidence is seasonal with most cases occurring in winter.

### INTRODUCTION

Apart from an isolated outbreak of rabies in the vicinity of Port Elizabeth in 1893 which resulted from the importation of a rabid dog from Britain (Hutcheon 1894), rabies prevalent in South Africa prior to 1950 is presumed to have been maintained by free-living viverrids—principally yellow mongooses, *Cynictis penicillata* (Snyman 1940). In 1950 canine rabies entered South Africa from Botswana and spread through the northern and eastern Transvaal into Mozambique and down the east coast of the subcontinent into Natal which was reached in 1961. This pandemic continues to move down the east coast of South Africa and has now passed through Natal and the Transkei and its front is presently in the Eastern Cape.

Between 1928, when indigenous rabies was first conclusively diagnosed in South Africa (Snyman 1940) and 1954, rabies was diagnosed in a wide variety of wildlife species but not in bat-eared foxes, *Otocyon*

*megalotis* (Thomson & Meredith 1992). The first two cases diagnosed in bat-eared foxes occurred in 1955/1956 in the northern Transvaal close to the Zimbabwe border and it was presumed that these were derived from the rabies epidemic current, particularly in dogs and black-backed jackals (*Canis mesomelas*), in the border regions of South Africa, Zimbabwe and Botswana at that time. Subsequently, based on the presumably unbiased submission of specimens from the field for rabies diagnosis, rabies has become established in bat-eared foxes in South Africa (Thomson & Meredith 1992).

Bat-eared foxes, which despite their name are not true foxes, have a discontinuous distribution in Africa. The southern African distribution covers a large area of semi-arid and arid, short grass habitat in South Africa, Namibia, Botswana and south-western Angola. This population is separated by about 1 200 km from the subspecies (*O. m. virgatus*, Miller 1909) which occurs in East Africa (Mackie & Nel 1989; Skinner & Smithers 1990; Maas 1993).

The relative abundance or otherwise of rainfall appears to have a marked influence on the distribution of bat-eared foxes in southern Africa (Crawford & Macdonald 1988), probably because of the effect

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rainfall has on the abundance of their prey which are predominantly insects—particularly harvester termites, *Hodotermes mossombicus* and *Microhodotermes victor* (Mackie & Nel 1989).

In both southern and East Africa, marked fluctuations in the sizes of bat-eared fox populations have been observed (Leaky 1969; Lamprecht 1979; Nel, Mills & Van Aarde 1984; Mackie 1992, personal communication). Explanations for this phenomenon have varied: in the south-western Kalahari, rainfall, through its effect on the availability of food, has been shown to have a large influence on group size and total numbers of bat-eared foxes (Nel *et al.* 1984), whereas in East Africa, disease (Leaky 1969) and migration between habitats (Lamprecht 1979) have been advanced as possible explanations. More recently, rabies has been shown to be involved in the problem at least in the Serengeti National Park (Maas 1993).

This paper documents the incidence and distribution of cases of rabies in bat-eared foxes in South Africa between 1955 and the present and indicates the potential danger this poses to the domestic dog population in the Western Cape. It also points out the deficiencies and consequences of the hitherto inadequate documentation of some specimen submissions in South Africa.

## MATERIALS AND METHODS

The data presented here was obtained from the records of rabies diagnosis of the Onderstepoort Veterinary Institute. Positive cases were confirmed by direct immunofluorescence on brain impression smears.

## RESULTS

The location of individual cases in bat-eared foxes between 1955 and 1992 is shown in five-year periods in Fig. 1a–h. The first two cases in the Northern Transvaal (Fig. 1a) appear to have been isolated events because no other case of rabies in bat-eared foxes in that region has been detected since. Between 1960 and 1969 four cases were diagnosed in the Karoo (Fig. 1b and c). In the decade 1970–1979, 32 diagnoses were made, mostly in the north-western Cape close to the border with Namibia (Fig. 1d and e). A clear increase in rabies cases in bat-eared foxes occurred in the following decade (1980–1989) when the main focus was the north-eastern Cape with a number of cases clustered on the border with Botswana (Fig. 1f and g). In that period cases in the south-western Cape and along the west coast of South Africa occurred for the first time. Since 1990 the number of rabies cases in this species appears to have diminished although the focus in the south-western Cape seems established and there also appears to be an eastwardly extension into the western Orange Free State and the Eastern Cape (Fig. 1h).

The monthly incidence of rabies in bat-eared foxes over the period 1980–1992 is shown in Fig. 2. This demonstrates clearly that cases are most numerous in the dry winter months, viz. May–October.

## DISCUSSION

It has recently been shown that rabies in South Africa is caused by at least two variants of rabies virus (Lyssavirus serogroup 1) which can be distinguished both antigenically (King, Meredith & Thomson 1993; King, Meredith & Thomson, in press) and by nucleotide sequencing (Nel, Von Teichman & Thomson 1993). One of these variants has been isolated predominantly from wild and domestic Canidae (including bat-eared foxes) while the other, more heterogeneous group, has largely been recovered from free-living Viverridae, predominantly mongooses (King *et al.*, in press). On this basis, the two groups of variants have provisionally been designated "canid" and "viverrid". These findings support historical accounts which tend to indicate that indigenous, mostly viverrid-related, rabies has been present in South Africa for at least 100 years (Snyman 1940). The advent of canine rabies, i.e. a form of the disease which propagated easily in domestic dogs, was only introduced in 1950 (Alexander 1952).

In studies so far conducted the isolates of "canid" virus, in contrast to "viverrid" viruses, have shown little antigenic variation with the monoclonal antibody panels employed (King *et al.* 1993; King *et al.*, in press; Wandeler 1993, personal communication). It is tempting to presume on this basis that the rabies isolates obtained from black-backed jackals, bat-eared foxes and domestic dogs (the only canids from which a significant number of specimens are available) are biologically similar and therefore easily transmissible between these species. On the other hand, field data on this point is ambiguous: dog-jackal associations in the context of rabies have been observed in both South Africa and Zimbabwe (Cumming 1982). In Zimbabwe jackal rabies can reliably be presumed to have derived from the introduction of canine rabies in 1950 since endemic rabies almost certainly did not occur in Zimbabwe between 1913 and 1950 (Edmonds 1922; Bingham 1992). Conversely there have been epizootics of rabies in black-backed jackals in the north-western Transvaal (South Africa) which did not spread to or propagate in adjacent susceptible domestic dog populations (Van der Pypekamp 1993, personal communication).

At present in South Africa, active epizootics in Canidae are largely confined to the Natal coastal belt (dogs), the northern Transvaal (black-backed jackals) and localities depicted in Fig. 1a–h for bat-eared foxes; i.e. different canids are more or less exclusively involved in each of these localities. In the context of



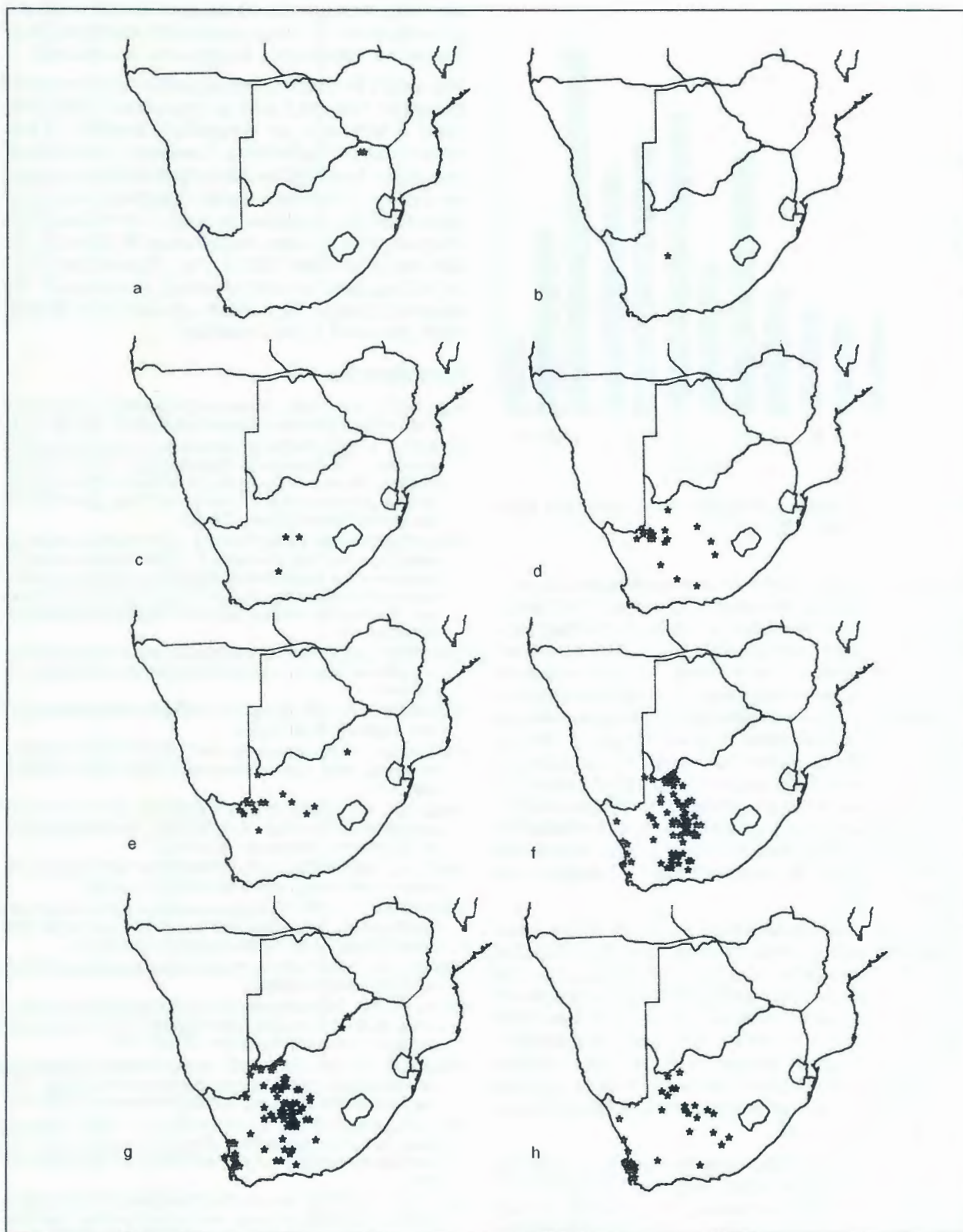


FIG. 1 The distribution of rabies cases diagnosed in bat-eared foxes in South Africa: 1955–1992

a: 1955–1959; b: 1960–1964; c: 1965–1969; d: 1970–1974; e: 1975–1979; f: 1980–1984; g: 1985–1989; h: 1990–1992

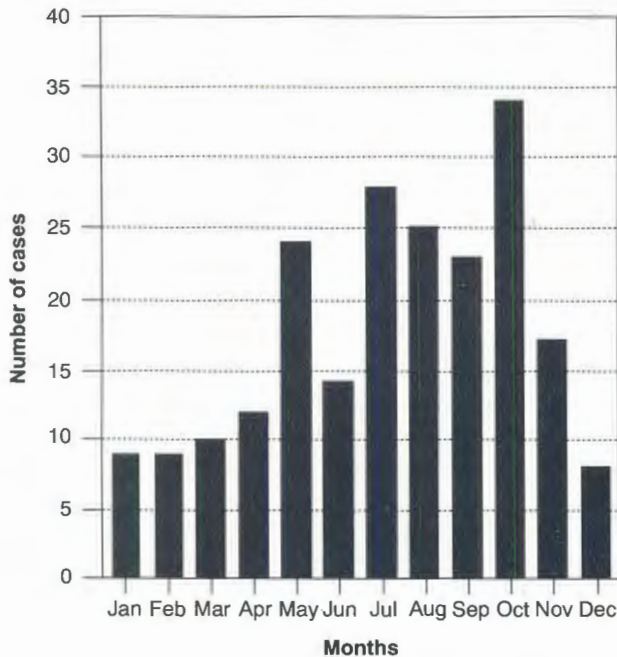


FIG. 2 Monthly incidence of rabies in bat-eared foxes in South Africa (1980–1992)

the distribution of rabies in bat-eared foxes, its persistence in the south-western Cape (Fig. 1f–h) raises the question of the threat of rabies to the dog population of Cape Town and surrounds, the second largest urban area in South Africa. To date, rabies in dogs has not been diagnosed in the south-western Cape and the question therefore arises as to whether this should be ascribed to good fortune or the inability of the "bat-eared fox virus" to propagate in dogs. However, there are no comparative studies on the dog populations of Natal and the Western Cape, both with regard to population size and interaction with humans and other animals that may explain the failure of rabies to establish itself in dogs in the Western Cape.

Most rabid bat-eared foxes in South Africa have been detected in winter months, viz. May–October (Fig. 2). Why that is, and the relationship it has to the social behaviour of bat-eared foxes, is at present not clear. However, it should be borne in mind that rabies in almost all animals, both wild and domestic, which are regularly infected in South Africa, shows an apparent increase in incidence in winter months (Swanepoel 1992, personal communication; Thomson & Meredith 1992).

Unfortunately, the data submitted with bat-eared fox brain specimens for rabies diagnosis provide no information on either the sexes of the animals or their ages. Hence it is impossible at present to determine whether the female bias in rabies cases amongst bat-eared foxes in the Serengeti (Maas 1993) applies in southern Africa or not. This is a clear demon-

stration of how important it is that specimen submission from suspect rabies cases in wild animals are accompanied not only by accurate identification of the animal species but its age and sex as well.

The extent to which rabies regulates the numbers of bat-eared foxes can only be speculated upon since there is little data on population densities of bat-eared foxes in South Africa. However, it is known that population densities fluctuate markedly and that food availability is the major factor affecting changes in population density (Nel *et al.* 1984). It is nevertheless intriguing that the rise in incidence of rabies in this species in the early 1980's (Fig. 1f) co-incident with an appreciable population crash observed in the western Orange Free State at that time (Mackie 1992, personal communication).

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