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THE ROLE PLAYED BY WILDLIFE IN THE EPIZOOTIOLOGY OF RABIES IN SOUTH AFRICA AND SOUTH-WEST AFRICA

B. J. H. BARNARD, Veterinary Research Institute, Onderstepoort 0110

ABSTRACT

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The role played by wildlife in the perpetuation of rabies is discussed in the light of information obtained during a routine examination of specimens at the Veterinary Research Institute, Onderstepoort, during the 10-year period, 1967–1976. In the course of the investigation, 9 additional hosts of rabies were confirmed and 4 rabies areas identified. The chief disseminators in 2 of these areas were found to be the dog (*Canis familiaris*) and the black-backed jackal (*C. mesomelas*); in the third area, the yellow mongoose (*Cynictis penicillata*), and in the fourth *Genetta* and *Felis* spp., including the domestic cat (*Felis catis*). It was noted that the domestic cat is of less importance in those areas where dogs and jackals are the chief disseminators.

Résumé

RÔLE DE LA FAUNE SAUVAGE DANS L'ÉPIZOOTIOLOGIE DE LA RAGE EN AFRIQUE DU SUD ET AU SUD-OUEST AFRICAIN

On discute le rôle joué par les animaux sauvages dans la perpétuation de la rage, à la lumière des renseignements recueillis pendant la décennie 1967–1976 *lors des examens de routine effectués sur des spécimens à l'Institut de Recherche Vétérinaire d'Onderstepoort. En cours de l'enquête l'existence de* 9 *hôtes additionnels pour la rage a été confirmée et* 4 *zones enzootiques ont été identifiées. Dans* 2 *de celles-ci les principaux propagateurs se sont avérés être le chien* (Canis familiaris) *et le chacal à dos noir* (C. mesomelas); *dans la troisième la mangouste jaune* (Cynictis penicillata) *et dans la quatrième diverses espèces de* Genetta *et* Felis, *y compris le chat domestique* (Felis catis). *On a remarqué que le chat domestique a moins d'importance dans les régions où chiens et chacals sont les principaux propagateurs.*

INTRODUCTION

Rabies exists in 2 epidemiological forms: urban rabies, propagated principally in dogs, and wildlife rabies. Within a given area there are apparently only 1 or 2 species responsible for the perpetuation of the disease (WHO, 1973); for example, the red fox (*Vulpes vulpes*) in Central and Western Europe and the red fox and the racoon dog (*Nyctereutes procyonoides*) in Eastern Europe. More or less independent epidemics are perpetuated in various parts of North America by foxes (*Vulpes fulva* and *Urocyon cinereoargenteus*), skunks (*Mepthitis mephitis*) and racoons (*Procyon lotor*). In the Arctic region the Arctic fox (*Alopex lagopus*) is the chief disseminator. In parts of Europe rabies virus of low virulence is commonly isolated from wild rodents such as *Microtinae* and *Muridae*. This form of rabies does not seem to be associated with fox rabies and its epidemiological significance has not yet been assessed (WHO, 1973).

In parts of South America, where rabies occurs mainly in cattle, certain species of vampire bats (*Phyllostoma superciliatum* and *Desmodus rotundus*) (Pawan, 1936) are the chief vectors. Outbreaks in these countries are remarkable for the small number of dogs and the large number of cattle involved.

In South Africa and South-West Africa rabies, though widespread, is more or less confined to certain areas, the most important of which is the central plateau, embracing practically the whole of the Orange Free State, the Western Transvaal and the Northern Cape. In this area the yellow mongoose is regarded as the chief disseminator (Snyman, 1940; Zumpt, 1976). Two other areas are recognized, one being in the Northern and Eastern Transvaal and Natal and the other in the northern part of South-West Africa.

In this paper the behaviour of rabid wild animals, the distribution of rabies and some aspects of the role played by the different wild animals in the perpetuation of the disease will be discussed in the light of information obtained during a routine examination of specimens for the 10-years period, 1967–1976. Some of the results will be compared with data obtained before 1965.

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MATERIALS AND METHODS

Diagnostic procedures

Brain specimens, collected by veterinarians, Stock Inspectors and Medical Health officers, together with case reports, were submitted to Onderstepoort for examination. One part of the brain of these specimens was preserved in 50% aqueous glycerine solution for the fluorescent antibody test for rabies and for biological tests in 3-week-old mice. The other part was preserved in 10% formalin for histological examination. A positive diagnosis was made when 1 or more of the 3 diagnostic methods proved positive.

Host list

Animals from which specimens were submitted for examination were identified, where possible, and newly identified hosts were added to the host list for rabies.

Grouping

As vernacular names were used in many instances, the precise identification of some species was sometimes not possible. To eliminate confusion, the different species were therefore grouped in a convenient way.

Behaviour of rabid animals

1. *Aggressiveness*

Aggressiveness was assessed by counting the attacks reported on humans and farm animals. Attacks on dogs and cats were excluded because of the inherent fighting nature of these carnivores. In many instances they and not the rabid vector were the attacking animals.

2. *Bite wounds*

The possibility of virus transmission was assumed where bite wounds were inflicted and this was assessed by counting the cases in which bite wounds were described. Bite wounds resulting from fights with dogs or cats were also counted.

3. *Unusual tameness*

For the purpose of this paper an animal was classified as "unusually tame" when its behaviour was such and when it did not show any inclination to bite or to attack.

Cases excluded

Cases of rabies in *Canis mesomelas* in the Etosha Game Reserve are not included in the list to determine behaviour because of their different habitat. They were included, however, in the total number of cases mentioned.

Results and Discussion

Host list

Since the publication of an addendum by Van der Westhuizen & Meredith (1967) to "A check-list and host-list of zoonoses occurring in mammals and birds in South and South-West Africa" (Neitz, 1956), 9 additional hosts of rabies have been confirmed. All the known wild animal hosts of rabies in South Africa and South-West Africa are listed in Table 1.

Grouping

Single or only a few specimens were presented for examination from certain species and, in some instances, the correct identification of species was not feasible. To avoid confusion the different species were therefore conveniently grouped as follows:

Group	*Species in Group*
Cynictis	*C. penicillata*
Canis	*C. mesomelas*
Felis	Wild *Felis* spp.
Suricata	*S. suricatta*
Genetta	*Genetta* spp.
Otocyon	*O. megalotis*
Herpestes	*Herpestes, Mungos* and *Ichneumia* spp.
Ictonyx	*Ictonyx* and *Poecilogale* spp.
Xerus	*Xerus* and *Paraxerus* spp.
Mellivora	*M. capensis*
Rodentia	Mice, rats, mole rats and moles
Other	Species not mentioned

TABLE 1 Wildlife host-list of rabies in the Republic of South Africa and South-West Africa

Class, order and family	Genus and species	Vernacular names	
		English	Afrikaans
Mammalia Primates Cercopithecidae	*Cercopithecus aethiops* (Linnaeus, 1758)	Vervet monkey	Blouaap
Carnivora	*Viverra civetta* (Schreber, 1778)	East African civet	Siwetkat
Viverridae	*Genetta rubigionsa* (Pucheran, 1855)	Rusty-spooted genet	Muskeljaatkat
	Genetta tigrina (Schreber, 1778)	Large-spotted genet	Grootkolmuskeljaatkat
	Genetta genetta (Linnaeus, 1758)	Small-spotted gent	Kleinkolmuskeljaatkat
	Herpestes ichneumon (Linnaeus, 1758)	Cape ichneumon	Grootgrysmuishond
	Herpestes pulverulentus (Wagner, 1839)	Cape grey mongoose	Kleingrysmuishond
	Herpestes sanguineus (Rüppell, 1835)	Slender mongoose	Rooimuishond
	Ichneumia albicauda (G. Cuvier, 1829)	White-tailed mongoose	Witstertmuishod
	Paracynictis selousi (de Winton, 1896)	Selous' mongoose	Kleinwitstertmuishond
	Cynictis penicillata (G. Cuvier, 1829)	Yellow mongoose	Rooimeerkat
	Atilax paludinosus (G. Cuvier, 1777)	Water mongoose	Kommetjiesgatmuishond
	Mungos mungo (Gmelin, 1788)	Banded mongoose	Gebandemuishond
	Suricata suricatta (Schreber, 1777)	Suricate	Stokstertmeerkat
Hyaenidae	*Crocuta crocuta* (Erxleben, 1777)	Spotted hyena	Gevlektehiëna
Protelidea	*Proteles cristatus* (Sparrman, 1783)	Aardwolf	Maanhaarjakkals
Felidae	*Felis serval* (Schreber, 1776)	Serval cat	Tierboskat
	Felis nigripes (Burchell, 1824)	Black-footed cat	Swartpootkat
	Felis caracal (Schreber, 1776)	Caracal	Rooikat
	Felis lybica (Forster, 1780)	Cape wild cat	Vaalboskat
	Panthera pardus (Linnaeus, 1758)	Leopard	Luiperd
Canidae	*Canis mesomelas* (Schreber, 1775)	Black-backed jackal	Rooijakkals
	Canis adustus (Sundevall, 1846)	Side-striped jackal	Witkwasjakkals
	Vulpes chama (A. Smith, 1833)	Chama fox	Silwerjakkals
	Otocyon megalotis (Desmarest, 1822)	Bat-eared fox	Bakoorjakkals
Mustelidae	*Mellivora capensis* (Schreber, 1776)	Honey badger	Ratel
	Ictonyx striatus (Perry, 1810)	Cape pole cat (skunk)	Stinkmuishond
	Poecilogale albinucha (Gray, 1864)	Snake mongoose	Slangmuishond
Hyracoidea Procaviidae	*Procavia capensis* (Pallas, 1766)	Rock dassie	Klipdas
Artiodactyla	*Redunca fulvorufula* (Afzelius, 1815)	Mountain reedbuck	Rooiribbok
Bovidae	*Tragelaphus strepsiceros* (Pallas, 1766)	Kudu	Koedoe
	Sylvicapra grimmia (Linnaeus, 1758)	Grey duiker	Duiker
	Raphicerus campestris (Thunberg, 1811)	Steenbok	Steenbok
Rodentia	*Xerus inauris* (Zimmermann, 1780)	Ground squirrel	Waaierstertmeerkat
Sciuridae	*Paraxerus cepapi* (A. Smith, 1836)	Yellow-footed squirrel	Geelpooteekhoring

TABLE 2 Confirmed cases of rabies in the Republic of South Africa and South-West Africa for the period 1967–1976

Hosts of rabies	Confirmed cases				Percentage of:			
					Wildlife vectors	Dogs & cats	All vectors	All rabies cases
Wildlife vectors:								
Cynictis	699				67		47	37
Canis	105				10		7	5
Felis	51				5		4	2
Suricata	47				5		4	2
Genetta	41				4		3	2
Otocyon	39				3		2	2
Herpestes	18				2		1	1
Ictonyx	15				1		1	<1
Xerus	8				<1		<1	<1
Mellivora	7				<1		<1	<1
Other	9				<1		<1	<1
		1 039					79	56
Domestic vectors:								
Dogs	194					70	14	10
Cats	86					30	6	5
		280					21	15
			1 319					72
Antelope:								
Grey duiker	5							<1
Kudu	3							<1
Steenbok	2							<1
Mountain reedbuck	1							<1
		11						<1
Farm animals:								
Cattle	456							25
Sheep	31							1
Coat	17							<1
Horse and donkey	9							<1
		513						28
			524					28
Total				1 843				

Confirmed cases

During the periods 1916–1949 and 1953–1961, 417 and 908 cases of rabies were recorded, respectively, (Maré, 1962), while in the 10 years 1967–1976, 1843 diagnoses of rabies were made. Admittedly, better knowledge of the disease, public awareness and improved diagnostic methods all contributed to the higher number of cases diagnosed in the latter period, but nevertheless the increase is so spectacular that one must conclude that rabies is on the increase in South Africa and South-West Africa. However, because of improved control measures, rabies in dogs is an exception. During the period 1953–1961, 321 cases in dogs were recorded (Maré, 1962), while in the period under investigation only 194 diagnoses were made. This decrease may certainly be attributed to control measures such as registration, licensing and taxation of dogs, elimination of stray animals and mass vaccination of dogs free of charge. Nevertheless, dogs still play an important role in the epizootiology of rabies in this country. They were the victims in 388 out of 516 (75%) cases where bite wounds were inflicted by wild animals (Table 6).

During the period 1953–1961, instances of rabies in wildlife comprised 22% of the total number of cases, while, in the period 1967–1976, 56% of the diagnoses made were in wildlife (Table 2). Although the figures reflect not only greater public awareness but also a decrease in canine cases, the increase in wildlife involvement emphasizes the increasing importance of wildlife in the epizootiology of rabies in this country.

Transmission

The mode of transmission in most cases, especially in cattle, could not be determined unambiguously but it can be reasonably assumed that the recognized vectors in the relevant area were responsible. In 60% of the cases in the Northern Transvaal where rabies was confirmed in cattle, rabid jackals or jackals with an abnormal behavioural pattern were seen prior to the onset of symptoms in cattle (Brückner, Hurter & Boshoff, 1978). In the present investigation, jackals were shown to be responsible for 8 of the 38 recorded cases of transmission of rabies to domestic animals (Table 3).

Numerous occasions where dogs were bitten by different wild animals are known, but, as a rule, such dogs were destroyed and the outcome is unknown.

TABLE 3 Confirmed transmissions of rabies to domestic animals for the period 1967–1976

Vector	Victim			
	Cattle	Sheep and goat	Dogs	Total
Cynictis.....	5	1	4	10
Canis.....	5	2	1	8
Felis.....	2	1	1	4
Herpestes....	3	0	1	4
Genetta.....	0	1	0	1
Dog.....	1	1	7	9
Cat.....	0	1	1	2
	16	7	15	38

Behavioural pattern of the different groups

The behavioural patterns of both normal and rabid wild animals show a wide variation. Some species are very aggressive and dangerous while others are less so, depending *inter alia* on whether they are nocturnal or diurnal, large or small. These differences may play an important role in their effectiveness as disseminators of rabies virus.

1. *Cynictis penicillata*

The yellow mongoose is widely distributed in South Africa, but it is most prevalent in the central plateau, which includes almost the whole of the Orange Free State, the Western Transvaal and the Northern Cape (Meredith, Smith & Smith, 1974; Snyman, 1937). The yellow mongoose is diurnal and rarely nocturnal. It is a solitary hunter and takes both vertebrate and invertebrate prey (Rautenbach & Nel, 1978). In many parts it occurs in close association with *S. suricatta* and *X. inauris* (Zumpt, 1976). Yellow mongooses have a symbiotic relationship in which *X. inauris* is the builder of a burrow system, *Cynictis* the defender of the mutual colony, while *S. suricatta* very often invades such a burrow and expels the other inhabitants, thereby promoting the spread of rabies. *S. suricatta* remains in the burrow system until all the food supplies are depleted and then moves on to the next colony. In other parts the yellow mongoose, in the absence of *X. inauris,* has different living habits and is thus less dangerous as a disseminator of the disease.

TABLE 4 Behaviour of rabid wild animals in the Republic of South Africa and South-West Africa

Group	Visit buildings, as percentage of group	Unusually tame, as percentage of group
Cynictis.....	89	20
Xerus.....	87	0
Genetta.....	82	5
Felis.....	80	0
Herpestes.....	80	17
Ictonyx.....	77	33
Suricata.....	75	4
Canis.....	60	23
Otocyon.....	46	13
Mellivora.....	29	0

Sixty-seven per cent (Table 2) of all the cases of wild animals encountered were *Cynictis,* and 89% (Table 4) of them were encountered in or at farm buildings such as homesteads, stores, stables and kraals. Being one of the smallest disseminators and having an average mass of only 0,8 kg (Rautenbach & Nel, 1978), the rabid mongoose is a relatively easy animal to cope with. Only 38% (Table 5) were described as aggressive and 52% (Table 6) bit humans, farm animals, dogs or cats. The majority of cases where bite wounds were inflicted resulted from dogs attacking and killing a rabid mongoose. Successful attempts by mongoose to attack humans were rare. Only 10 known outbreaks of rabies in domestic animals could definitely be traced to the yellow mongoose (Table 3).

2. *C. mesomelas* (black-backed jackal)

The second most commonly involved wild animal is the black-backed jackal (*C. mesomelas*). It is a hardy, resourceful and very cunning animal, which wanders over great expanses of country when in search of food (Roberts, 1951), and, having an average mass of 7,8 kg, is one of the larger disseminators of rabies (Rautenbach & Nel, 1978). It is regarded as one of the major pests by the sheep farmer on account of its having developed the habit of attacking sheep.

Rabies in jackals seems to be most prevalent during the months July–November (Brückner, Hurter & Boshoff, 1978). This coincides with their mating and whelping season as well as the shortage of natural food resources during this period (Bueler, 1969).

Seventy-five and 30 cases, respectively, were recorded in jackals in the farming areas and the Etosha Game Reserve (Table 2). In farming areas, 60% of the jackals were encountered at or in farm buildings (Table 4). Almost 50% were aggressive and 37% (Table 5) attacked humans or farm animals.

Rabid jackals were often encountered at watering places where they attacked cattle. Cases where a so-called "tame" jackal was seen wandering aimlessly around, later becoming aggressive and even killing domestic animals or attacking humans without provocation, were also described.

3. *Felis* and *Genetta* spp.

Although from different families, wild *Felis* and *Genetta* spp. are similar in habit. *F. libyca,* the most commonly encountered species, is widely distributed and has a wide habitat tolerance. *G. tigrina* usually prefers a habitat close to water, whereas *G. genetta* exists away from it (Rautenbach & Nel, 1978). Both *Felis* and *Genetta* spp. are nocturnal animals which prey upon any small animal they can capture, and not infrequently raid poultry yards. They are fierce animals when trapped or cornered (Roberts, 1951). Unlike the yellow mongoose, which adapts itself to close existence with farming activities, *Felis* and *Genetta* spp. prefer to keep away from such activities (Rautenbach, personal communication 1978) Notwithstanding this fact, more than 80% (Table 4) of the *Felis* and *Genetta* cases were encountered at or in farm buildings, and 87% and 62% respectively were aggressive (Table 5). Except for *M. capensis* apart, they were responsible for the highest percentages of bite wounds inflicted, 76% for the *Genetta* spp., and 90% for the *Felis* spp., respectively (Table 6).

Being nocturnal animals, rabid individuals enter buildings at night and have been known to attack people whilst they are asleep. When rabid, they are very dangerous animals and furious fighters, but this is not always the case. In one instance, a rabid *Genetta* spent the night with a man in bed without trying to bite him. Several cases have been recorded

where a wild cat entered a dwelling and successfuly attacked several people before it could be killed. They have also attacked people in the veld. In 2 particular cases they could not be removed from their victims and had to be killed before their jaws could be opened.

4. *Mellivora capensis*

Badgers prey to some extent upon small animals and, when attacked, put up a fierce fight, usually being more than a match for their prey, partly on account of the toughness of their hides, and partly because of their claws and fairly strong canine teeth (Roberts, 1951). Shone (1962) mentioned that badgers were involved in a number of outbreaks of rabies amongst cattle and sheep in Rhodesia, and Darbyshire (1953) reported on the death of 47 sheep in one flock in Rhodesia, where it was suspected that a rabid badger was involved.

According to the case reports accompanying the 7 badger cases, the badger is one of the most dangerous rabid animals to deal with. Only 2 (29%) visited farm buildings (Table 4), but all of them were very aggressive (Table 5). Two bit humans and the other 5 bit farm animals (Table 6). In 4 cases more than 1 victim was involved. Dogs were not involved.

5. *Suricatta, O. megalotis, Herpestes* and *Ictonyx*

Suricatta and *Herpestes* are diurnal, while *O. megalotis,* though diurnal in undisturbed areas, especially during winter (Rautenbach & Nel, 1978), becomes exclusively nocturnal in settled areas. *Ictonyx* is strictly nocturnal.

None of these animals is really regarded as dangerous. As a matter of fact, they are sometimes kept as pets. *Suricatta* being of a mild and sociable disposition is easily tamed, *Ictonyx* is docile and friendly, while *Otocyon* is described as a harmless insectivorous fox (Roberts, 1951).

Information obtained in this investigation indicated that these animals, even when rabid, are relatively easy to cope with. They were neither very aggressive (Table 5) nor successful in their attacks on humans or animals (Table 6). Except for *Suricatta,* 45% or less were in contact with humans or domestic animals and in the vast majority of cases these contacts took place when they were attacked by dogs. There were only 6 cases where *Otocyon,* 2 where *Herpestes* and 10 where *Suricatta* tried to attack humans or farm animals. They were as a rule easily killed either by dogs or by man.

TABLE 5 Aggressiveness in the different groups of rabid animals

Vector		Aggressiveness against:				Aggression	
Group	Cases	Man	%	Farm animals*	%	Total	%
Mellivora	7	2	29	5	71	7	100
Felis	51	36	71	8	16	44	87
Xerus	8	6	75	0	0	6	75
Genetta	41	25	62	0	0	25	62
Cynictis	622	223	36	11	—2	234	38
Suricata	47	13	28	5	11	18	38
Canis	75	20	26	8	11	28	37
Otocyon	39	9	23	4	10	13	33
Herpestes	18	2	11	1	5	3	16
Ictonyx	15	0	0	0	0	0	0
Cat	86	74	86	1**	1	75	87
Dog	194	107	64	14**	7	162	83

* Dogs and cats excluded
** Including dogs and cats

TABLE 6 Bite wounds inflicted by the different groups of rabid animals

Vectors		Victims							
Group	No.	Dogs		Man		Farm animals		Total	
		No.	%	No.	%	No.	%	No.	%
Mellivora	7	7	0	2	29	5	71	7	100
Felis	51	10	20	27	54	8	16	45	90
Genetta	41	10	24	21	51	0	0	21	76
Suricata	47	21	45	5	10	5	10	31	66
Canis	75	24	32	9	12	8	10	41	66
Cynictis	622	296	48	14	3	11	2	326	52
Otocyon	39	13	33	2	5	4	10	19	45
Herpestes	18	6	33	1	6	1	6	8	44
Xerus	8	3	37	0	0	0	0	3	37
Ictonyx	15	5	33	0	0	0	0	5	33
Total	923	388	40	86	9	42	4	516	56
Cats	86	12	14	60	70	1	1	73	85
Dogs	194	33	17	90	47	14	7	137	71

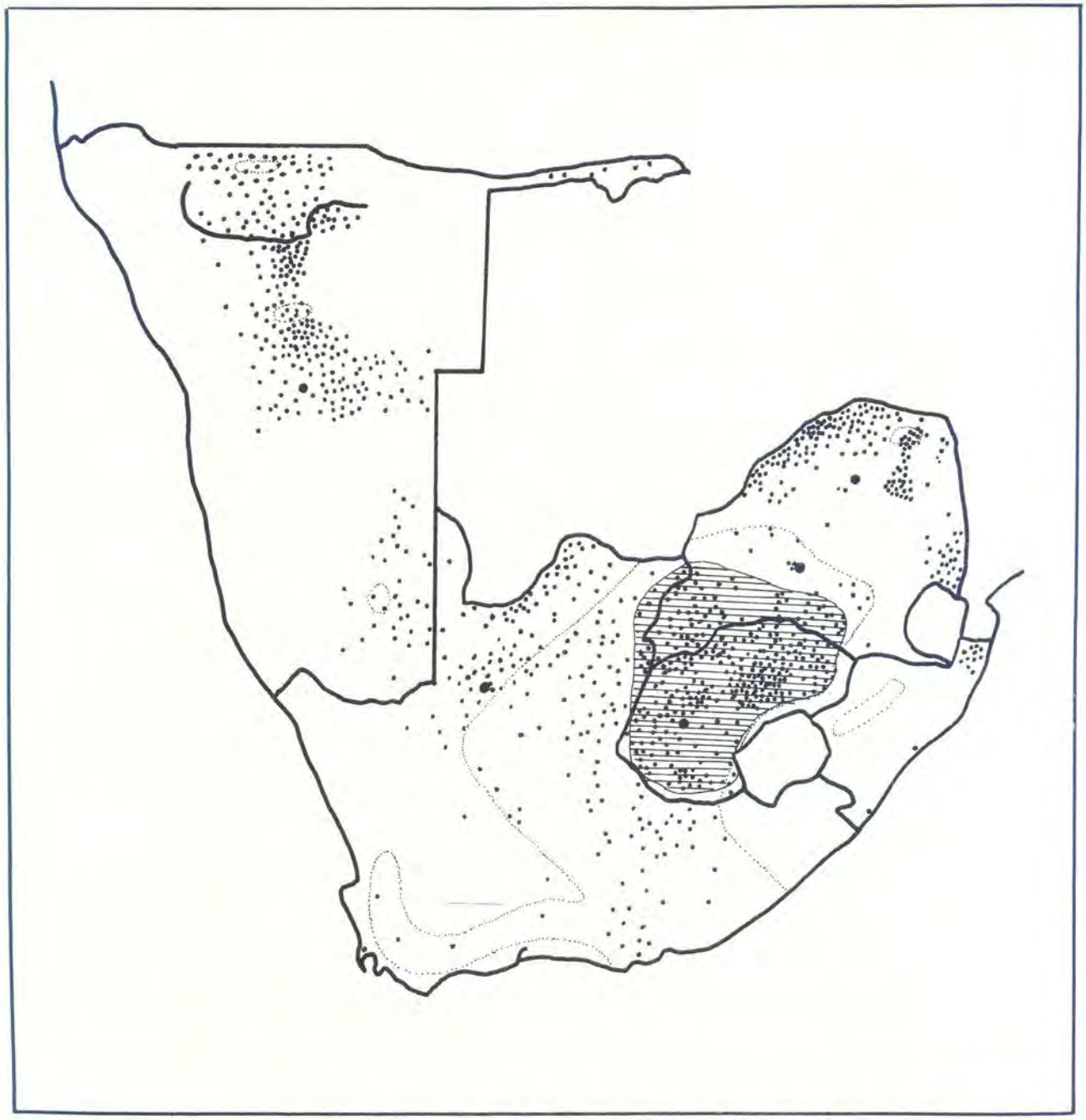

FIG. 1 Distribution of rabies cases in South Africa and South-West Africa during the 10-year period, 1967–1976

6. *Rodentia*

Except for *Xerus* and *Paraxerus,* 375 specimens from rats, moles and mole rats were examined with negative results. It can therefore be concluded that it is very unlikely that they play a significant role in the disemination of rabies in this country.

Rabies areas

Reports on the existence of rabies in South Africa prior to the first authentic outbreaks at Port Elizabeth in 1893 are scanty (Hutcheon, 1894; Snyman, 1940). Following that outbreak, the incidence rate fluctuated from year to year.

Reviews on rabies in this country by Neitz & Thomas (1934) and Snyman (1940) stress that it occurs mainly in the Orange Free State, the Western Transvaal and the Northern Cape. They also observed that the incidence of the disease is related to the regional population density of various species of the family *Viverridae*. This area became known as the viverrid rabies area. Prior to 1957, only a few sporadic cases of rabies had been reported from the Northern Transvaal. Subsequently, the disease spread within a few years throughout the Northern and Eastern Transvaal and, during 1961, into Natal (Maré, 1962). In this area, typical "dog rabies" was recognized, and 50 out of the 66 cases diagnosed were in dogs (Maré, 1962).

In South-West Africa suspected cases have been reported from Ovamboland since 1926, but the first diagnosis was made only during 1938 (Snyman, 1940).

A comparison of the distribution of rabies in 1976 (Fig. 1) and 1962 (Maré) shows that there is little change in the distribution of the disease. Only a few cases have been recorded in new districts.

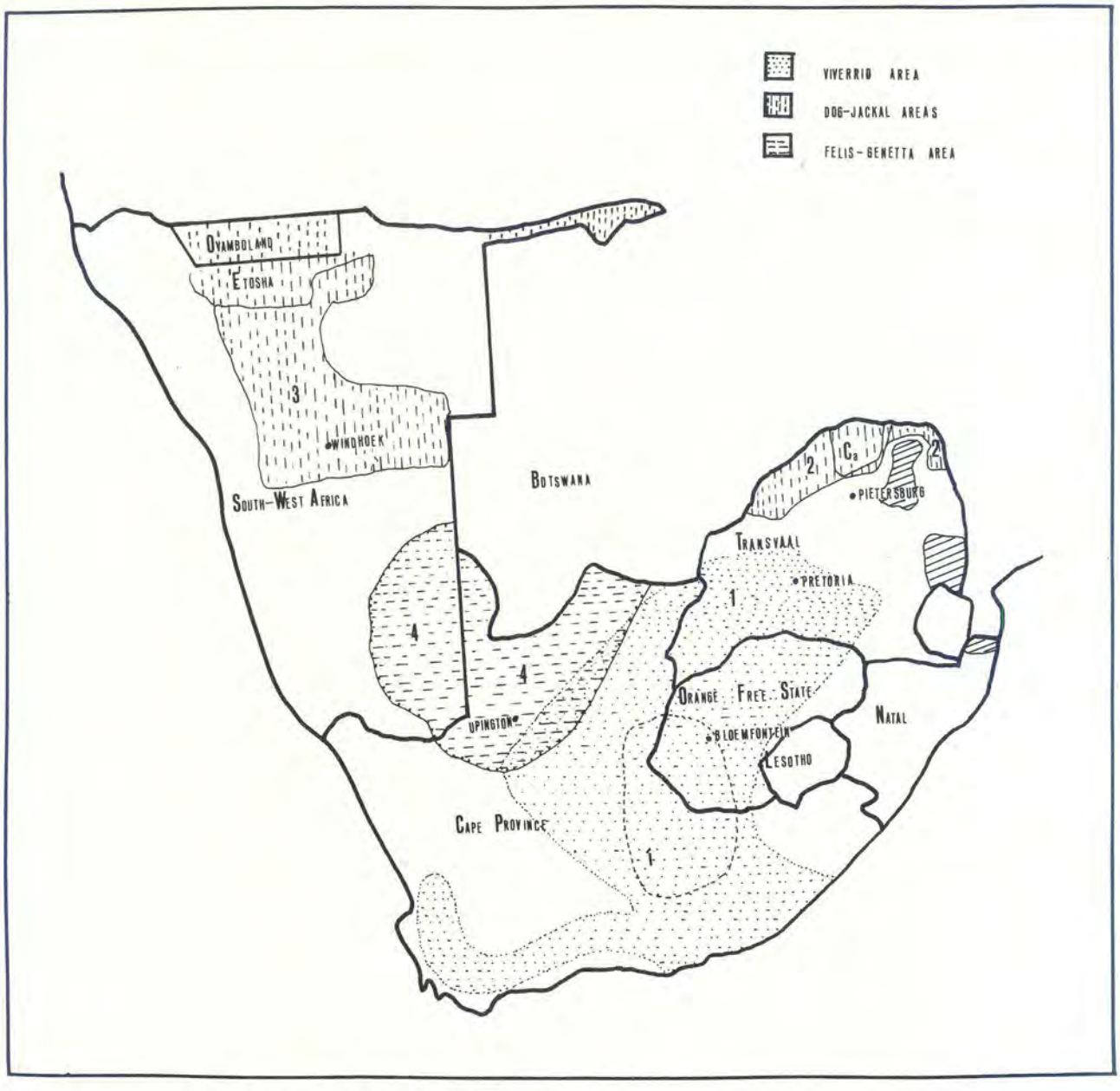

FIG. 2 Rabies areas in South Africa and South-West Africa

Rabies areas according to the distribution of wild vectors

Although the density of the different species involved in the different areas is unknown, their distribution is reasonably well known (Rautenbach, 1978, personal communication). *Cynictis* is, with a few exceptions, confined to the central plateau, but the other important vectors, including *Felis, Canis, Herpestes, Genetta, Otocyon* and *Suricatta* spp., are widely distributed. It is assumed, however, that the Northern Transvaal and the coastal regions may have a denser population of at least some of the species concerned.

The distribution of the wild vector cases encountered indicates 4 recognizable rabies areas (Table 7 and Fig. 2). In all these areas, cases of the chief vectors comprise 73% or more of the total number of vector cases in that area. In Area 1, known as the viverrid rabies area, *Cynictis* is the most common vector (75%). Apart from *Cynictis,* cases of all the other wild vectors except *M. capensis* were encountered in this area. Cases of the second most important vector (5%) in this area, *Suricatta,* was to a large extent concentrated in the southern Orange Free State and the north-eastern Cape.

In Areas 2 and 3 in the Northern Transvaal and the northern part of South-West Africa, respectively, *C. mesomelas* and dogs are the most common vectors, while *Felis* and *Genetta* spp. dominate the picture in the 4th area in the southern part of South-West Africa and the north-western Cape. No cases of the black-backed jackal were encountered in this area, while *Cynictis* comprised less than 1% of the vectors in this area which overlaps the *viverrid area.*

Vector: victim ratio

The different vectors, as described above, whether noctural or diurnal, differ in behavioural pattern, body size and habits. It was seen that *Felis* and *Genetta* spp., the chief vectors in the southern South-West Africa and Northern Cape area, are much more

TABLE 7 The distribution of chief vectors in the different rabies areas

Species	Area							
	Northern Transvaal	%*	Northern South-West Africa	%	Central Plateau	%	Southern South-West Africa Northern Cape	%
C. mesomelas	12	88	55	73	8		0	
Dogs	11		24		53		11	
C. penicillata	2		2		692	75	2	
Felis and *Genetta*	0		2		29		58	
Cat	1		3		48		24	75
Other vectors	0		24		70		13	
Total	26		110		910		108	

* Chief vector as a percentage of total vectors

aggressive and successful in their attacks on humans and farm animals than either the black-backed jackal or the yellow mongoose, the 2 chief vectors in the other areas. One would thus expect more victim cases per vector in this area than in the other areas, especially in the Northern Transvaal, where no *Felis* or *Genetta* cases were encountered. Interestingly enough, this was not the case.

TABLE 8 The ratio between rabies cases in vectors and domestic animals in the different areas

Area	Cases in:		Ratio
	Vectors	Farm animals	
Northern Transvaal	26	92	1:3,5
Northern South-West Africa	110	167	1:1,5
Central plateau	910	224	1:0,24
Southern South-West Africa and Northern Cape	108	17	1:0,16

In the Northern Transvaal and the northern part of South-West Africa, where *C. mesomelas* and dogs are the chief vectors, one vector case was encountered for every 3,5 and 1,5 cases, respectively, in farm animals (Table 8), while in the southern South West Africa and the northern Cape area and the viverrid area, where *C. mesomelas* is of very little importance, the ratio is 1:0,16 and 1:0,24, respectively. This difference in ratio may indicate less efficient transmission of the virus by the relatively small *C. penicillata, Genetta* and *Felis* spp. The ratio can also be influenced by the relative density of both vectors and victims in the different areas. Unfortunately, this is not known.

TABLE 9 The distribution of cases in dogs and cats in the different areas

Area	Case in:		Ratio
	Dogs	Cats	
Northern Transvaal	12	1	10:1
Northern South-West Africa	24	3	10:1
Central Plateau	53	48	10:10
Southern South-West Africa and Northern Cape	11	24	10:20

Another interesting observation is the difference in ratio between dog and cat cases in the different areas (Table 9). Both being domesticated animals, one would expect no marked difference between the numbers kept as pets in the different areas, so that the difference in the ratio of rabies cases in dogs and cats in the different areas is difficult to explain. In the Northern Transvaal, where mainly jackals are involved, 1 case in dogs is recorded for every 0,09 cases in cats, while in the southern part of South-West Africa and the Northern Cape, where no jackal cases were encountered, the ratio between dogs and cats is 1:2,2. In the other areas where jackal and other species are involved, the ratio lies somewhere between the 2 extremes with northern South-West Africa, where mainly jackals are involved very close to the Northern Transvaal.

From these results it is clear that 4 different rabies areas can be identified. They differ in locality, in the vectors chiefly involved, the ratio between vectors and victims and the ratio between dogs and domestic cats.

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