

## AN OUTBREAK OF DERMATOPHILOSIS IN SABLE *HIPPOTRAGUS NIGER* AND ROAN *HIPPOTRAGUS EQUINUS* IN THE KRUGER NATIONAL PARK\*

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*Abstract* – A severe skin disease diagnosed as dermatophilosis took on alarming proportions in roan antelope *Hippotragus equinus* and sable antelope *Hippotragus niger* herds, which were kept in a 256 ha enclosure in the Kruger National Park, Republic of South Africa. Only calves were effected. Numerous *Dermatophilus* organisms were identified in skin biopsies taken from affected areas and examined histologically. Complete recovery followed a single treatment of intramuscular injections of a combination of a long-acting penicillin and streptomycin and the topical application of a preparation which included copper sulphate and benzene hexachloride. Factors which probably contributed to the outbreak included prolonged wetness, flies, a high density of susceptible animals and playful butting behaviour of the calves.

This is the first report of the occurrence of dermatophilosis as a disease entity in wildlife species in southern Africa.

\* *The views expressed herein are those of the authors and are not to be construed as official or as reflecting the views of the U.S. Air Force or the Department of Defence.*

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## Introduction

The distribution of the disease entity known as dermatophilosis (cutaneous streptothricosis, senkobo disease, mycotic dermatitis) among domestic animals such as cattle, sheep and horses is world-wide (Plowright 1956; Austwick 1969; Searcy and Hulland 1968). The disease was initially reported in South Africa during 1928 from sheep (Bekker 1928). Since then it has been found that the disease is widespread in South Africa among cattle and sheep (Steyn 1931; Schulz 1956), particularly along the eastern escarpment with its high summer rainfall and greater humidity (Rossiter 1969). This area lies adjacent to South Africa's greatest wildlife concentration and largest wildlife sanctuaries. Yet so far as we are aware the disease has not hitherto been described in southern African wildlife species. The position is very much the same elsewhere. Austwick (1969) commented on this phenomenon by pointing out that the actinomycete *Dermatophilus congolensis* causes one of the commonest skin diseases of domestic animals and yet few cases have been reported in wild animals. Vague reports from tropical Africa indicate that the giraffe *Giraffa camelopardalis*, Thomson's gazelle *Gazelle thomsoni* (MacKenzie and Simpson 1964) and a zebra *Equus* sp. (Green 1960) have been found to be mildly infected. In temperate regions the disease has been reported from the white-tailed deer *Odocoileus virginianus* (Dean, Gordon, Severinghaus, Kroll and Reilly 1961; Kistner, Shotts and Green 1970), a cottontail rabbit *Sylvilagus floridanus* (Shotts and Kistner 1970), young chamois *Rupicapra rupicapra* (Nicolet, Klinger and Fey 1967), polar bears *Thalarctos maritimus* (Smith and Cordes 1972), owl monkeys *Aotus trivirgatus* (King, Fraser, Garcia, Wolf and Williamson 1971), a fox *Vulpes vulpes* (Austwick 1969) and sea lions *Otaria bryonia* (Fresè and Weber 1971). According to Stewart (1972) Kusel'tan reported infection in hares, hedgehogs and gerbils. The disease is zoonotic and was experimentally produced in man by Memery and Thiery (according to Stewart 1972). Natural infection occurred in four men who skinned and handled an infected deer carcass (Dean *et al.* 1961) and one of us (G.D.I.) had a focal, self limiting skin lesion on a finger from careless handling of infectious material. Rubel (1972) strongly implicated *D. congolensis* as the cause of pitted keratolysis, a skin condition affecting the foot soles of people in Zaïre.

## History

The roan antelope *Hippotragus equinus* is comparatively rare throughout its range in Africa. This is especially true for the Kruger National Park (K.N.P.) where there is a small population of 250 to 300 animals causing considerable concern for their chances of survival (Joubert 1970). It was, therefore, decided to launch an intensive investigation into the bio-ecology of this rare species. To provide realistic study opportunities and simultaneously build up a population from which

groups could be released periodically to augment the natural population, it was decided to erect an inviolate enclosure of 256 ha in the most favourable roan habitat in the northern district of the K.N.P. This enclosure is hereafter referred to as the Camp. A nucleus herd of 10 roan were released in the Camp without mishap in 1967 (Pienaar 1968; Joubert 1970).

After promising results were achieved initially, 13 sable antelope *Hippotragus niger*, also a rare species in South Africa, were placed in the same enclosure during August 1969 and May 1970.

The respective nucleus herds did exceedingly well initially. The roan antelope herd, however, suffered a severe setback in 1970 when 15 out of a total of 27 animals died from anthrax (unpublished data, de Vos).

In spite of mortality of unknown aetiology which the young calves of both species suffered sporadically, the numbers again increased to 48 for sable and 26 for roan antelope at the beginning of March 1974. Shortly thereafter, however, two deaths among young sable antelope calves occurred but due to interference by scavenger birds no worthwhile specimens for diagnosis were available. It was decided to thoroughly examine remaining animals in the Camp in an attempt to determine the causes of the unexplained deaths.

#### *Materials and Methods*

##### *Operational*

The enclosure was entered and the roan and sable herds approached by means of a vehicle. Preliminary observations of the animals on hoof were made from the vehicle. A pair of 10 x 50 binoculars aided in the closer examination of individuals. Affected animals were subsequently caught by the drug immobilization technique. A Palmer Cap-Chur gas-powered rifle was used to propel two ml capacity darts or projectile syringes.

To lessen the disturbance factor the recumbent animals were taken by vehicle to a properly equipped point of operations on the periphery of the Camp for closer examination, sampling and treatment.

Skin biopsies were taken from the worst affected areas of each individual and preserved in Millonig's 10% buffered formalin. In addition deep skin scrapings were collected in a 50% glycerine/alcohol solution. These specimens were processed and examined at a later date. The formalin-fixed tissues were prepared in a routine manner for light microscopy and stained with haematoxylin and eosin (HE), Giemsa's and Gram's stains and the periodic acid Schiff (PAS) reaction.

Treated animals were marked by hairclipping, every individual having its own distinct and easily recognizable identification mark for future reference. After resuscitation the animals were released in the immediate vicinity of the herd. During 15 to 20 April 1974 12 affected animals were caught and treated in this manner.

In order to assess the course of the disease without chemotherapeutic

interference, the least infected individual was omitted from the initial treatment, but was treated on the second visit to the Camp 10 days afterwards. At the same time one of the previously treated individuals was caught and re-examined to determine the reaction to therapy.

To determine whether infection occurred in the immediate surroundings of the Camp, the area was surveyed intensively by means of binoculars.

The comparative abundance of ticks inside and outside the Camp was subjectively assessed by merely walking through the veld in the respective areas. The amount of ticks attached to the person was taken as an indication of abundance.

#### *Climate*

Data were obtained from the meteorological station at the Shingwedzi Rest Camp, situated 40 km to the south of the enclosure.

#### *Drugs*

The immobilizing drugs and antidote used were:

*Etorphine hydrochloride*, M99<sup>1</sup> was used as the basic immobilizing agent (Pienaar 1974). *Azaperone*, R1929<sup>2</sup> was used as a neuroleptic together with the M99 in the dart combinations (Pienaar 1974). *Nalorphine hydrobromide*, *Lethidrone*<sup>3</sup> was used for its<sup>4</sup> properties to antagonize the narcotic effects of morphine or a morphine derivative such as M99 (Pienaar 1974).

For therapy of the skin condition, associated debility and stress, a series of drugs and combinations were used. The faculties for which the drug was chosen, are mentioned briefly in each case.

*Thioctic acid* (Tioctan)<sup>4</sup> was administered for liver invigoration, detoxification and metabolic improvement. *Procaine penicillin G* and *benethamine penicillin* (Compropen)<sup>5</sup> was administered in combination with *dihydrostreptomycin* (Distrep)<sup>6</sup> for its known synergistic action against *D. congolensis* (Roberts 1967; Smith and Cordes 1972). *Selenium-Vitamin E* (BO-SE)<sup>7</sup> was administered for its beneficial effect on capture myopahty as claimed by Basson and Hofmeyr (1973).

*Hydroxycobalamin* (*Vit. B12b*) (Neo Cytamen)<sup>8</sup> with its prolonged blood level was used for its known beneficial effects in debilitated cases. *Benzene*

<sup>1</sup>Reckitt and Sons Ltd.

<sup>2</sup>Janssen Pharmaceutica.

<sup>3</sup>Burroughs Wellcome and Company.

<sup>4</sup>Fujisawa Pharmaceutical Co. Ltd.

<sup>5</sup>Glaxo-Allenburys S.A. (Pty) Ltd.

<sup>6</sup>A.S. Ruffel (Pty) Ltd.

<sup>7</sup>S.A. Cyanamide Ltd.

<sup>8</sup>Glaxo-Allenburys S.A. (Pty) Ltd.

hexachloride, B.H.C. diluted in water to a concentration of 0,03% of the gamma isomer was used as a wash for its known paracitidal effects and its claimed beneficial effects on the course of dermatophilosis (Plowright 1956). A dermatological preparation, applied topically was made up of: "Healing oil"<sup>9</sup>, containing 33,3% vegetable oil, 58,9% oleo resins and 0,5% germicidal agent as the basis with copper sulphate B.P. added to make 5% of the final solution. Copper sulphate was used for its useful antiseptic and potent fungicidal properties. It has been found beneficial in the treatment of dermatophilosis in sheep (Moule 1948; Rossiter 1956; Roberts 1957). Finally B.H.C. was added to two concentrations of about 0,025% of the gamma isomer.

<sup>9</sup>Cooper and Nephews S.A. (Pty) Ltd.

## Results

### Environmental

Geographically the Camp is situated in the northern region of the K.N.P. and occupies a 1,6 km area to the north and south of the 22°47' latitude south and 31°15' longitude east lines respectively. As is typical for the rest of the region the area is rather flat, with an altitude of about 390 m above sea level. The area consists mainly of a heavy

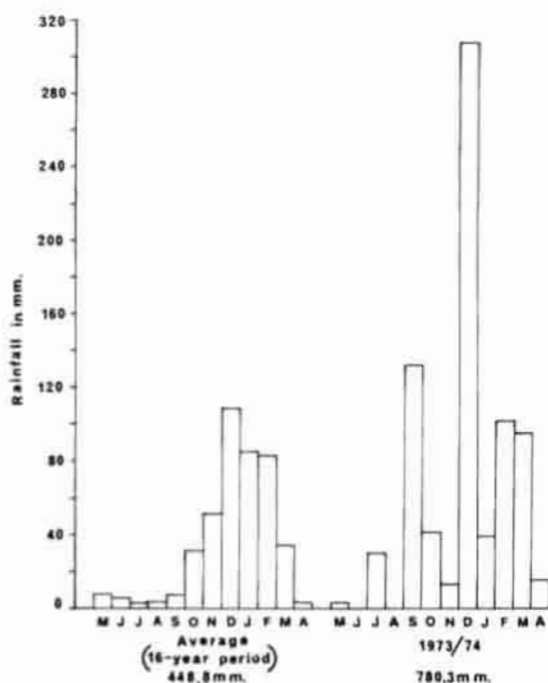


Fig. 1. Histogram of the monthly rainfall distribution for Shingwedzi Rest Camp, Kruger National Park, during the period of and directly preceding the outbreak of dermatophilosis. Yearly rainfall figures are included for comparative purposes.

black basaltic soil type and the savannah vegetation type is dominated by the tree and shrub form of the mopane (*Colophospermum mopane*), hence the designation of this vegetation type as "mopane scrub and tree savannah" (Pienaar 1963). Other important tree and shrub species include *Combretum imberbe*, *Sclerocarya caffra*, *Lonchocarpus capassa*, *Dalbergia melanoxylon* and *Grewia* spp. The grass stratum is mainly comprised of *Themeda triandra*, *Panicum coloratum*, *Schmidtia pappophoroides*, *Cenchrus ciliaris*, *Heteropogon contortus*, *Digitaria* spp. and *Aristida* spp. giving an overall "tall grass" appearance. Being at its peak stage of growth and as a result of exceptionally good rains (Fig. 1), the green grass cover was especially lush during the time of the disease outbreak. For the greater part of the Camp the grass exceeded the shoulder height of the younger, or affected animals. As depicted by Fig. 1, exceptionally heavy rains were experienced during the season preceding the disease outbreak. Precipitation in the form of heavy dew further intensified and prolonged exposure to moisture.

The biting fly *Lipoptena paradoxa* was particularly abundant and when working with the calves these flies would swarm from them and settle on the handlers. A subjective assessment of tick infestation indicated that there were greater numbers on the vegetation inside than there was outside the Camp.

#### *Initial Examination*

Familiar to the occasional proximity of a vehicle within the Camp, it was possible to approach the animals with some caution to within 20 metres. At this distance and with the aid of 10 x 50 binoculars it was clear that some debilitating skin disease existed which affected the total calf crop, at the time consisting of seven sable and six roan calves. The ages ranged from about 2-4 months. They were variably infected, some being obviously in the early and others in more advanced stages of the disease. Debilitation clearly paralleled the progressive stages of infection. The more severely infected individuals showed a droopiness of the head and ears and frequently shook their heads as if the lesions were irritant. They often lagged behind the rest of the herd. Mild lachrymation was shown by the most severely infected individuals.

Binocular examination of animals outside the Camp for infection was also carried out, the immediate surrounding area being covered more intensively. No affected animals were detected.

#### *Immobilization*

On 1974.04.16 catching operations commenced and by 1974.04.19 12 of the 13 affected calves were caught for close examination, sampling of the skin lesions and treatment. The animals were of uniform size and age and a dosage rate of 2 mg M99 and 40 mg Azaperone was used throughout. Animals went down in three to nine minutes after intramuscular deposition of the drugs by Cap-Chur dart. This was, however,

only executed with the utmost caution and patience. With too much activity around them, or when hard pressed, the calves often resorted to hiding or laying up behaviour for long periods or even the rest of the day.

Effective counteraction of the immobilizing drugs was achieved with the administration of 100 mg Lethidrone (60 mg intravenous and 40 mg intramuscular). The calves invariably got up within two minutes and joined the herd shortly afterwards. No fatalities occurred.



Fig. 2. Dermatophilosis, sable calf. Patchy lesions around eyes and base of ear. Encrusted hair in lesions over the withers. Note capture dart in right hip.

Fig. 3. Dermatophilosis, sable calf. Patchy lesions on ears and heavy encrustation of mane down to withers.

### Gross Appearance

The skin condition was an exudative dermatitis characterized by the formation of crusts. Lesions ranged in size from small nodule-like formations to large patches (Fig. 2) and in the more advanced stages whole regions of skin were covered with heavy encrustations of dry exudate admixed with hair (Fig. 3). In the more severe cases a purulent serous exudate exuded through cracks in the crust. In the early stages the crusts were tenacious and on removal the skin beneath would appear moist and hyperaemic with minor haemorrhages in some cases. In the later stages the crusts could be removed more easily and in some instances were only held in place by penetrating hairs.

The variety of lesions, or various stages of infectivity, made it possible to follow the sequence of development of the lesions. In the earliest stage

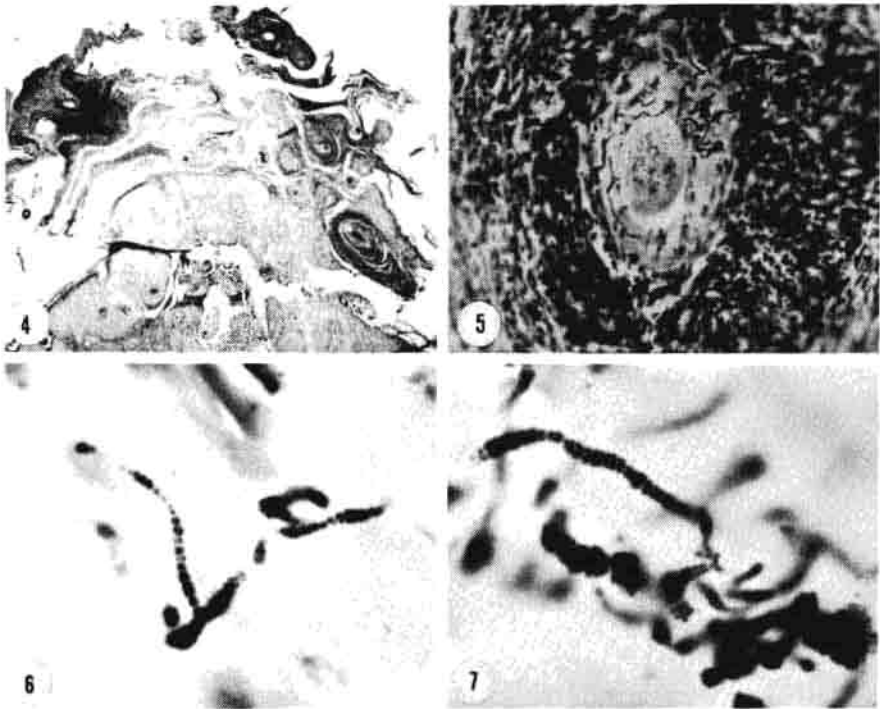


Fig. 4. Dermatophilosis. Low magnification showing layered exudate and acanthosis of epidermis. HE x 30.

Fig. 5. Dermatophilosis. Concentration of organisms around hair shaft in exudate. Giemsa stain x 500.

Fig. 6. *D. congolexis*. Branching and horizontal divisions. Giemsa stain x 1200.

Fig. 7. *D. congolexis*. Horizontal and transverse divisions forming coccoid spores. Giemsa stain x 1200.



only the forehead and immediate vicinity of the eyes were affected. Lesions then appeared on the dorsal aspects of the head, neck, thorax and lumbar regions. From there it appeared to spread down the sides of the body and on the legs. The most severe case showed heavy coalesced encrustations of the dorsal aspects of the body, the lateral rib cage behind the elbow, the sternal aspect and lower parts of the legs. In this case the hair of the rest of the body were unnaturally erect and on palpation revealed roughening of the skin surface due to numerous small (pea-size) isolated wart-like elevations.

Numerous immature stages of *Boophilus* ticks were found on the animals, some even being imbedded in the lesion encrustations. A few *Amblyomma* and *Rhipicephalus* ticks were also found, mostly confined to the anal region.

#### *Histopathological findings and Definitive Diagnosis*

Pathological changes were primarily in the epidermis and consisted of acanthosis and piling of cornified epithelium and exudate on the epidermal surfaces in a layered fashion (Fig. 4, 5, 6 and 7). This layered material contained neutrophils, which in some foci were concentrated in a pustular-like formation. Within the exudate organisms were easily seen in HE stained sections. They were most plentiful around, but not invading hair shafts (Fig. 5) and in foci containing large numbers of inflammatory cells. Organisms grew in a mycelia-like fashion (Fig. 6) and the growth formation was divided both horizontally and longitudinally forming coccoid bodies up to 6 or 8 organisms across in the widest portions (Fig. 7). They stained well with Giemsa's and Gram's stains but PAS reaction was negative. Morphologically and histologically they were identified as *D. congolensis*.

The underlying dermis was infiltrated by neutrophils and small mononuclear cells and there was some fibroblastic proliferation.

#### *Therapy*

Ten days after treatment (*vide supra*) a binocular re-examination revealed drastic and a clearcut improvement of previously affected individuals. This was further borne out by catching and closely examining one of the calves which was judged to be severely infected prior to treatment 12 days earlier. Scab formation had stopped and the skin was dry and pliable. The overall impression which was gained was that the animal was on its way to full recovery.

The disease in the untreated control calf had progressed from a limited infection on the forehead and around the eyes to a severe stage with crustformation on the head, ears, back, sides, sternum and legs. Treatment was instituted at this time. As witnessed a month later all animals showed a complete clinical recovery.

### Discussion and Conclusions

The gross skin lesions of dermatophilosis are essentially the same in all animal species (Smith, Jones and Hunt 1972) and those seen in the roan and sable calves of this report conform with those which have been described. The constant finding of *Dermatophilus* organisms in skin lesions therefore warranted a diagnosis of dermatophilosis.

The fungal-like appearance of *D. congolensis* has led to names for the disease such as mycotic dermatitis and cutaneous streptothricosis. Gordon (1964) disproved its relationship with fungi and regarded the above names as misleading implying treatment should be antifungal instead of antibacterial. Roberts (1967) suggested "dermatophilus infections" be used for the disease and Stewart (1972) states the term "dermatophilosis" is equally explicable. Jubb and Kennedy (1970) expressed the opinion that the older entrenched names, i.e. cutaneous streptothricosis in cattle, mycotic dermatitis in sheep and strawberry footrot in sheep be retained but recent reports of the disease have favoured dermatophilosis.

Although the epizootiologic pattern of dermatophilosis is not completely understood, some factors contributing to dissemination of this disease are known. Organisms of the genus *Dermatophilus* undergo fragmentation of the mycelia as a result of multidimensional division and give rise to motile zoospores (Gordon and Edwards 1963; Gordon 1964; Roberts 1967). The reservoir of *D. congolensis* in nature is, however, unknown. Attempts to isolate it from soil have been unsuccessful (Roberts 1963a; Kaplan and Johnston 1966). Roberts (1967) maintains that chronically affected individuals are probably the organism's chief means of survival within a flock or herd during dormant periods. There is also evidence that the micro-organism concerned leads a saprophytic life on the skin and that it is not until the equilibrium between the parasite and host is disturbed by extraneous factors that it becomes a true pathogen (Gordon 1964). The micro-organism which gave rise to the present outbreak must therefore have originated from a biological carrier within the Camp.

There has been a rather consistent association between wet conditions or humidity and infection (Chodnik 1956; Plowright 1956; Scarnell 1961; le Riche 1968). In addition Richard and Pier (1966) found that flies, contaminated with *D. congolensis*, infected rabbits more readily if their skin was first wetted. Intense or prolonged wetting of the skin apparently results in emulsification and disruption of the sebaceous film (Roberts 1963b; Roberts and Graham 1966) as well as maceration of the stratum corneum, which then becomes more permeable to irritant substances (Suskind and Ishihara 1965) and probably more susceptible to disturbance by mechanical agents (Roberts 1967).

As depicted by Figure 1 exceptionally heavy rains were experienced during the season preceding the disease outbreak. Wet conditions were further augmented by a high humidity with regular nightly precipitations in the form of heavy dew which not only dampened individuals

close to the ground but also thoroughly moistened the tall grass cover. This provided almost continuous moist conditions for the young animals and must be considered partially responsible for the dramatic differential morbidity in which the calves were exclusively affected. However, in Australia young animals appear more susceptible to infection than older sheep (Nesbit and Bannatyne 1955) and in Kansas, U.S.A. calves accounted for 33 of 39 cases reported in cattle (Kelly, Huston, Imes and Weide 1964). Roberts (1963b) maintains that sheep lambs are born with an incomplete sebaceous film that does not become fully protective for a period varying from a few days to five or six weeks. This should not be a factor in the present outbreak as the youngest roan and sable calves were at least two months old.

The lesions of the infection are usually distributed in either of two quite different patterns – over the face, ears and body suggesting transfer by insects, or on the lips and legs suggesting transfer via the pasture (Roberts 1967). In cattle in Africa the disease is closely associated with tick infestation, and the lesions develop mainly in those ventral areas of the body most heavily infested with ticks (Plowright 1956; MacAdam 1964b). Ticks of the genera *Amblyomma*, *Boophilus*, *Haemaphysalis*, *Hyalomma*, *Ixodes* and *Rhipicephalus* have been incriminated as mechanical vectors of this disease entity (Plowright 1956; Vandemaele 1961; MacAdam 1964a). The transmission of zoospores by flies has also been shown to occur (Roberts 1963a; MacAdam 1964a; Richard and Pier 1966; Roberts and Graham 1966). In experiments with rabbits both *Musca domestica* and *Stomoxys calcitrans* were implicated (Richard and Pier 1966).

In this case three Ixodidae parasites were recovered. Since *Boophilus* which was the most abundant, is a one-host tick, its potential as a vector would be limited. The three-host ticks, *Amblyomma* and *Rhipicephalus* were not present in large enough numbers as to be significant in the dissemination of the disease. The distribution of the initial lesions, being dorsally over the muzzle, head and neck also indicates the importance of a flying vector rather than ticks. By virtue of their abundance the biting flies *Lipoptena paradoxa* must be considered important vectors and one of the most significant epizootiological factors of this outbreak.

A well-known epizootiological concept is that disease transmission is usually in direct proportion to the density of susceptible individuals. The 26 roan antelope inside the Camp provided a density figure of one animal per 0,1 km<sup>2</sup> as opposed to one animal per 14,5 km<sup>2</sup> for comparable habitat outside. The position for the sable antelope is even more dramatic, there being one animal per 0,05 km<sup>2</sup> within the Camp and very few sedentary animals in that particular habitat outside. Even the most favourable sable antelope habitat in the K.N.P. does not exceed more than one animal per 3,6 km<sup>2</sup> (S. C. J. Joubert, *pers. commun.*). This means that both species are lumped together in a restricted space (2,56 km<sup>2</sup>) in densities which far exceed those for their free-ranging conspecifics in the K.N.P. and must therefore, under the specific circumstances, be re-

garded as abnormally high densities. Density and probably an associated higher arthropod incidence are some factors at variance between the two populations in the same habitat inside and outside the Camp. Free-roaming individuals (particularly calves) are also in a better position to seek out areas of short grass during periods of heavy precipitation, and thus escape from conditions which are favourable for the development of this disease. The failure of finding infection outside might therefore be regarded as significant in this context.

The importance of density as an epizootiological factor is further stressed by findings to the effect that the transmission of dermatophilosis can occur by contact between sheep, especially if they are wet (le Riche 1968). The behaviour pattern of young roan and sable calves also afford ample opportunity of contact between members of a herd. On this aspect Joubert (1970) wrote: "Certainly one of the major characteristics in the composition of the roan herd is the close relationship between the young animals and especially those of the same age group. Young roan generally associated together in a closely knit unit or nursery in the close proximity of one or more of the adult cows, or at times even seek the company of the herd bull". "Quite frequently even the very young calves interlude the wild running by confronting one another on their knees and after a few seconds of playful butting with their foreheads and pushing they again jump up and commence running around. These play-fights may be repeated several times between different members during each 'play-session'." This butting behaviour should provide ideal opportunity for transmission of zoospores to take place. This theory is further corroborated by the fact that the earliest lesions were seen on the forehead and around the eyes.

Disease manifestations in roan and sable calves were very similar to that which is frequently seen in domesticated stock. Without chemotherapeutic interference death would undoubtedly have occurred in a high percentage of affected animals and probably was the cause of death of two calves, an occurrence which initiated the investigation. The efficacy of therapy, as instituted, was further proven by a complete cure after a single treatment.

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