



Prevalence, disease description and epidemiological factors of a novel skin disease in Giraffes (*Giraffa camelopardalis*) in Ruaha National Park, Tanzania

Epaphras Alex Muse¹, Karimuribo Esron Daniel², Mpanduji Donald Gregory³ and Meing'ataki Godwell Elias¹

¹Ruaha National Park, P.O. Box 369, Iringa, Tanzania; ²Department of Veterinary Medicine and Public Health, Faculty of Veterinary Medicine, Sokoine University of Agriculture, P. O. Box 3020, Morogoro, Tanzania;

³Department of Veterinary Surgery and Theriogenology, Faculty of Veterinary Medicine, Sokoine University of Agriculture, P. O. Box 3021, Morogoro, Tanzania

Abstract

A study was conducted to examine the prevalence and epidemiological factors of a novel skin disease in giraffes inhabiting the Ruaha National Park (RNP). A cross-sectional drive-transect survey was conducted. Animals were observed using binoculars from the car. Potential epidemiological risk factors assessment included disease status, age, sex, disease severity, body condition, herd size, location, park zone, vegetation types, other wild animal species and presence of oxpeckers. The results showed that the prevalence of the skin disease was 79.8% and all areas of the park were affected. Adults animals were significantly more affected than sub-adults and young ($P=0.001$). Skin lesions were located on the forelimb of 98.6% ($n=91$) and nearly all (99%) of the skin lesions on affected giraffes appeared severe and chronic. Examination of other wild animal species in vicinity indicated that the disease is exclusive to giraffes animals. Grossly, lesions in affected animals comprised scabs, wrinkled skin and encrustations and dry or oozing blood. The study proposes to call the disease Giraffe Skin Disease (GSD). It was further recommended carrying out more and elaborate studies to determine the aetiological agent (s) and identify the risk factors associated with the GSD as well as assessment of long-term population impact and design mitigation measures.

Key words: Giraffe, Skin disease, risk factors, Ruaha, Tanzania

Introduction

The range of giraffes (*Giraffa camelopardalis*), once covered most of Africa, but is presently patchy and discontinuous as a result of the rinderpest pandemic and anthropogenic activities such as poaching, increased human settlement and expansion of agriculture (TANAPA, 2000). The remaining isolated populations are more vulnerable to stochastic factors such as diseases, which could negatively impact on giraffes populations and adversely affect economic revenues derived from tourism in Tanzania. Being one of the largest intact ecosystems in Africa, Ruaha National Park (RNP) and its surrounding wildlife protected areas supports a large population of giraffes and other wildlife species; including the highest antelope diversity of any park in Tanzania.

In November 2000, debilitated giraffes with skin lesions were observed in the northeastern section (Lunda) of RNP. The extent of the skin lesions on the

affected individuals suggested that the disease had been present for some time. Surveys conducted in 2002-03 found that 85% of the giraffes sighted were affected (Mlengeya and Lyaruu, Unpublished data). Another survey conducted in 2005 reported the variation in the prevalence of the disease in different months and seasons of the year (Mlengeya and Lyaruu, Unpublished data). It was reported that in the wet season (February), 82% of the giraffes sighted were affected, while in the dry season (October), 63% were affected; suggesting the prevalence of the disease to be high during the rainy season and subsides during dry months. Although the giraffes often occur in close proximity to other ungulates like zebra and impala, to date similar skin lesions have not been observed in other species; suggesting the disease to specifically affect giraffes.

Based on the distribution and appearance of lesions in affected giraffes, it was initially suspected that *Dermatophilus congolensis* infection could be involved.

Corresponding author: Epaphras Alex Muse, Ruaha National Park, P.O. Box 369, Iringa, Tanzania

In domestic animals, *D. congolensis* affects the skin of the fore and hind limbs, the chest region and sometimes the neck. In Eastern Tanzania, the prevalence of *D. congolensis* infection in goats was reported to be 1.6% (Msami et al., 2001). The most important epidemiological factor in dermatophilosis infection is the presence of predisposing factors causing skin damage e.g. prolonged wetting during the rainy season, thorny bushes and other objects likely to cause trauma which make transmission of *D. congolensis* from carriers to susceptible animals a likely consequence. Other factors that cause skin damage include biting flies and ticks especially *Amblyomma variegatum*, may also predispose animals to dermatophilosis. Dermatophilosis in wild animals has been described in a woodchuck (*Marmota monax*) and a striped skunk (*Mephitis mephitis*) (Ira et al., 1981).

The emergence of a highly prevalent skin disease in Ruaha's giraffes may impact their populations directly through increased mortality, or indirectly via increased losses from predation on lame giraffes or increased vulnerability to other environmental stressors such as drought and fire. For example, bovine tuberculosis (BTB) infected buffaloes are more susceptible to drought or BTB infection in lions is associated with altered social dynamics (De Vos et al., 2001; Keet et al., 1996).

The overall objective of this study was to systematically examine the prevalence and spatial distribution of the giraffe's skin disease and assess potential disease risk factors in RNP. Specifically, the objectives were 1) to examine the prevalence and spatial distribution of skin disease in giraffes inhabiting RNP 2) to characterize the appearance, location and severity of lesions on affected giraffes and 3) to examine the associations of the skin disease with potential risk factors.

Materials and Methods

Study area

The study was conducted in Ruaha National Park (RNP) which is located in Iringa region, Southern highlands of Tanzania. The park is geographically situated between latitudes 7°30'S and 8°00'S and; longitudes 33°50'E and 35°25'E. It is the only park in the country with flora and fauna characteristic of the dry East African savannah and the Southern African (Zambezian) miombo woodland. The park has species associated with the unique wildlife habitat represented by *Acacia*, *Combretum*, *Commiphora* and *Brachystegia* (miombo) woodland and perennial grasses. The wildlife species in RNP include the rare Greater and lesser Kudu, the roan and sable antelope.

Estimation of the prevalence and spatial distribution of the disease and potential risk factors

A cross-sectional survey was adopted to measure the prevalence and spatial distribution of diseased giraffes. Driving transect routes were established utilizing the road networks in the park. Observational data was collected by trained observers seated inside the vehicle using binoculars. Only animals clearly seen at a distance of 50 m or less were described. In order to avoid bias, a systematic random selection of study animals was adopted. Each day, the first giraffe to be observed was randomly selected using a sampling frame of the 10 first animals to be encountered. Subsequently, the 4th giraffe encountered was examined and details recorded on a standardized data collection sheet. If the 4th giraffe could not be examined due to distance from the observer or lack of visibility, the 5th giraffe was examined. For each selected animal, disease status (presence or absence of skin lesions); demographic data (age category, sex, herd size); ecological variables (ecological zone, type of vegetation); presence and number of oxpeckers (*Buphagus erythrorhynchus*), animal behaviour (necking behaviour) and spatial location (recorded using a handheld Global Positioning System (GPS) unit; GPSmap® 60SC model, Calorina, USA) were recorded. The severity of lesions were categorized as mild (small skin nodules of about 2-3 cm in diameter with raised hair, and then become small alopecic lesions); moderate (large round or oval alopecic patch of 10-16 cm in diameter); or severe (skin wrinkles, scabs, scales, cracks with raw fissures).

The survey was conducted in three consecutive days to ensure that our target sample size was reached within the shortest period of time and to avoid double-counting the same individuals. It was assumed that giraffes studied would not move to uncounted ecological zones during this study period.

Statistical Analysis

Survey data were entered into an Excel spreadsheet, and summary and descriptive statistics computed for various potential risk factors. The prevalence of skin disease was calculated as the proportion of giraffes with skin lesions divided by the total number of giraffes examined during the cross-sectional study. Statistical difference for the prevalence of giraffes skin disease stratified by risk factors was assessed using Chi square tests. Statistical analysis was conducted using EpiInfo software (Version 5.01, CDC, Atlanta, USA). Disease status (i.e. presence or absence of skin lesions) was the outcome variable and the risk factors included age category (young, sub-adult and adult), sex, location, vegetation types and body condition (assessed visually based on the extent of protrusions of pelvic bone, ribs, and back bone).

Although giraffes were observed in close proximity to other wild animal species including impala, zebra, elephants, warthogs and dikdik in 17.1% of the groups; no other species exhibited skin lesions. Opecker birds were observed on 20.3% of the giraffes examined. No other bird species were present or moving among giraffes.

Characterization and classification of skin lesions

Skin lesions were located on the forelimb of 98.6% of giraffes examined. Involvement of both forelimbs (bilateral lesions) was common (90.7%, n=91). Lesions were less commonly observed on the brisket (11%), and rarely observed on the hindlimbs, hindquarters, vulva area and a lesion involving coffin and pastern joints (5.5% in total). A small proportion (14.5%) of giraffes with forelimb lesions also had lesions involving the brisket area. Observed skin lesions were mainly localized to the ventral carpal joints.

Nearly all (99%) (n=91) of the lesions on the examined giraffes appeared chronic. The extent of the

Group	Number observed (N)	Number diseased	Prevalence (%)
All giraffes	109	87	79.8 (71.5-86.6)
Sex*			
Male	44	41	93.2 (82.6-98.2)
Female	47	43	91.5 (80.7-97.2)
Age			
Young	5	0	0.0 (0.0-45.1)
Sub-adult	13	3	23.1 (6.2-50.9)
Adult	91	84	92.3 (85.4-96.6)
Body condition			
Good	97	74	76.3 (67.1-83.9)
Fair	9	9	100.0 (66.3-100.0)
Poor	3	3	100.0 (36.8-100.0)

Prevalence, spatial distribution and risk factors for skin disease

The skin disease in the park was generally very high (>80.0 %) in all zones except the Eastern zone which had only 37.5% of animals affected by the disease (Table 2). The type of vegetation did not influence magnitude of disease problem in animals examined.

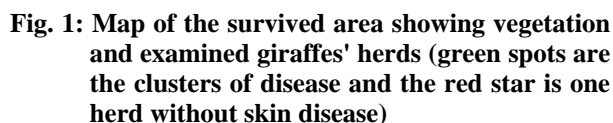
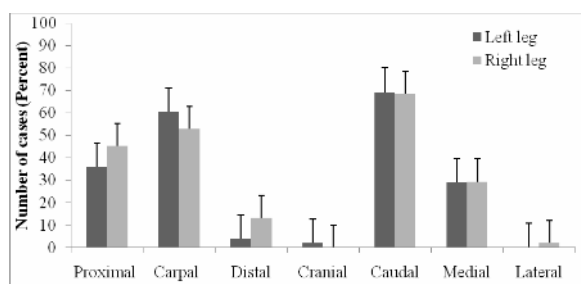
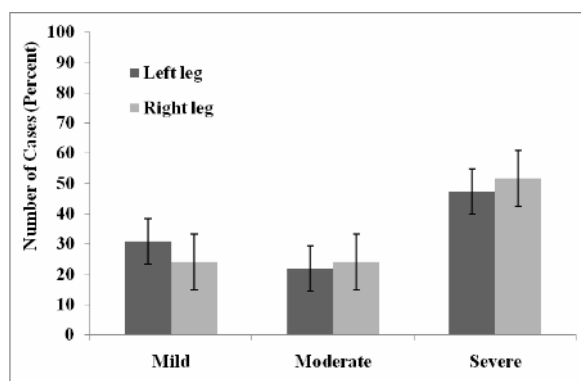


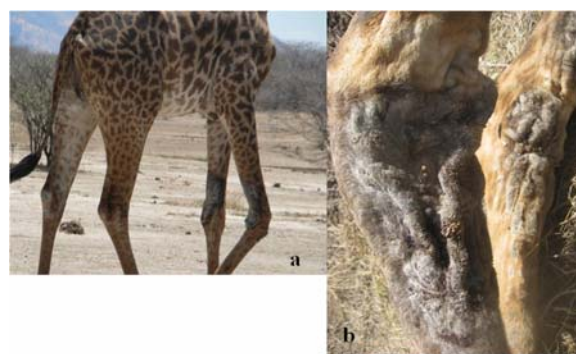
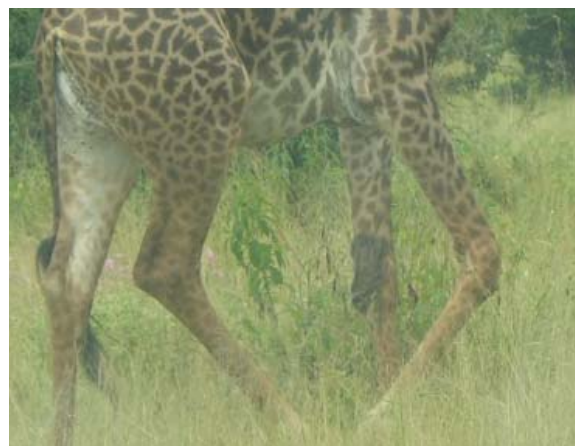
Table 2: Prevalence of skin Disease by spatial zones and vegetation types of RNP

Group	Total number of giraffes observed	Prevalence (% diseased animals out of total animals)	Number of herds observed	Herd prevalence (% of herds with infected animals)
Park zone				
Central	86	82.6 (71)	25	100.0 (25)
Eastern	8	37.5 (3)	3	66.7 (2)
Northern	5	80.0 (4)	4	100.0 (4)
Western	10	90.0 (9)	4	100.0 (4)
Total	109	79.8 (87)	36	97.2 (35)
Vegetation type				
Combretum – Acacia	68	77.9 (53)	21	100.0 (21)
Combretum mixed	13	69.2 (9)	7	100.0 (7)
Combretum -Commiphora	17	88.2 (15)	5	100.0 (5)
Miombo	0	-	0	-
Riverine	0	-	0	-
Others (Baobab, Bushland)	11	90.9 (10)	3	66.7 (2)
Total	109	79.8 (87)	36	97.2 (35)

**Fig. 2: Lesions distribution between left and right legs with reference to the carpal joint (n=91)****Fig. 3: Severity extent of lesions between left and right legs (n=91)**

lesions showed that more than half (51.7%) of the animals were severely affected (Fig 3). Most of the animals (89.7%) had normal gait and few animals were walking either carefully, stiff or lame (2.9%, 4.4% and 2.9%, respectively).

Lesions distribution on the forelimbs showed that carpal joint was more affected (53.6%), followed by proximal and then distal parts (38.4% and 8%, respectively). Also lesions were mostly located on the caudal aspects (68.9%) followed by medial aspects

**Fig. 4: Alopecic lesions on the carpal joints of both forelimbs (a); close up view of severe lesions with encrustation and wrinkled skin on both left and right forelimbs (b)****Fig. 5: Skin flap on the left leg seen on either side of the carpal joint**

(29.1%) of the carpal joint. When lesions distribution was stratified between left and right legs, it was noted that only carpal joint was frequently more involved (60.4% and 52.8%, respectively) (Fig. 2). The other

body part affected was proximal to carpal joint which was an extension from the carpal joint in most cases (13.7%), while 9.4% of the extension from carpal joint involved distal aspects of the carpal joint. The brisket areas were involved in few cases (3.8%). Two cases for each of both left and right legs extended from proximal through carpal to distal parts of the carpal joint.

The gross lesions observed included scabs, wrinkled skin, encrustations. Dried or oozing blood was noted on some lesions. In addition, 15.7% of the wrinkled skin lesions had also scabs while 13.7% of these wrinkled skin lesions were also encrusted (Fig. 4b). Alopecia was recorded in 15.7% of the cases (Fig. 4a) with some alopecic skin raised while others flat. Other lesions noticed include skin flaps, pendulous skin and cracking of the skin with exudates due to presumed secondary infection. One affected animal had a noticeably swollen carpal joint.

Discussion

This study confirmed that skin disease in giraffes is highly prevalent and is present throughout RNP. The distribution of the lesions, extent of the disease, and description of gross lesions reveal that the skin disease is often severe and at an advanced stage (chronic), hence it is thought that this disease has potential to cause population level impacts on giraffes. Adult giraffes were more affected when compared to sub-adult and young, supporting the idea that lesions were chronic. The composition of the giraffes' herds had few sub-adults and young animals. Although most giraffes observed had a normal gait, lameness was noticed in a small proportion of the affected animals, and may be under observations as it would be a normal behavior for a wild animal to conceal signs of weakness until they are severe to avoid being spotted by predators.

The mechanism of transmission of skin disease in giraffes' population is unknown. It is speculated that the disease might be transmitted by contact with other affected animals, spores in grass, oxpeckers, biting flies or other insects. During dry season animals have been observed to congregate together at the remaining water holes (Epaphras et al., 2008), the behaviour which is likely to increase chances of contact among animals and may thereby increase disease transmission if a direct transmission route is involved.

Oxpeckers have been suspected to play a role in the occurrence of Giraffes Ear Disease (GED) in other areas of Tanzania (Mlengeya et al., 2002; Kagaruki et al., 2003, 2005). The presence of oxpeckers calls for further studies to ascertain the role of these birds in the transmission of the infection. As opposed to GED there were no flies observed on the skin lesions in RNP. Even though giraffes were found in close proximity with other animal species, those were not affected by this condition.

Free mixing and necking behaviour may aid transmission of the disease between herds and within the group. Necking behaviour and mixing of giraffes have been observed to contribute to the increased magnitude of the diseases within and between herds (Estes, 1991); however, the current study did not observe necking behaviour.

The presence of giraffes browsing vegetation in the habitat influences giraffes' distribution in the park. High numbers of animals in one area may increase the rate of disease transmission in animals (Curtis et al., 2001). Many of the giraffes' herds were sighted in combretum-acacia and combretum mixed vegetation types because these animals do not prefer dense vegetation types for security reasons against predators. Giraffes have a very good hearing and eyesight and so can communicate easily in short bushes and sparse trees, the habitat provided by combretum – acacia type and combretum mixed with other short trees.

Although this study did not examine the causative agent of the condition, it is suggested that the disease can be called Giraffes Skin Disease (GSD), based on the description of lesions observed. Further study is urgently needed to determine the aetiology of GSD, and to evaluate the disease impact on Ruaha's giraffes population through direct mortality or indirectly through alterations of predation risk, behaviour or reproduction. Determination of GSD aetiology, associated risk factors, and transmission routes will allow managers to consider possible intervention strategies. Given that GSD is now present and highly prevalent throughout RNP, surveys in other protected areas are needed. This is essential to determine the geographic distribution of GSD and to identify GSD-free giraffes populations that could serve as refugia and comparison populations for population studies.

Acknowledgements

The authors wish to thank the Tanzania National Parks (TANAPA) for sponsoring the study. The authors are very grateful to Dr. Deana Clifford for the major review of the manuscript. The appreciations are extended to former Ruaha Chief Park warden, Mr. Hando Justin for his moral support and Ruaha Park staff for their invaluable support and contributions.

References

- Curtis, V., Cairncross, S. and Yonli, R. 2001. Domestic hygiene and diarrhea-pinpointing the problem. *Journal for Tropical Medicine and International Health*, 5(1): 22-32.
- De Vos, V., Bengis R.G., Kriek N.P., Michel, A., Keet D.F., Raath J.P. and Huchzermeyer, H.F. 2001. The epidemiology of tuberculosis in free-ranging African buffalo (*Syncerus caffer*) in the Kruger

- National Park, South Africa. *Onderstepoort Journal of Veterinary Research*, 68(2):119-30.
- Epaphras, A.M., Gereta, E., Lejora, I.A., Ole Meing'ataki, G.E., Ng'umbi, G., Kiwango, Y., Mwangomo, E., Semanini, F., Vitalis, L., Balizi, J. and Mtahiko, M.G.G. 2008. Wildlife water utilization and importance of artificial waterholes during dry season at Ruaha National Park, Tanzania. *Wetlands Ecology and Management*, 16: 183-188.
- Estes, R. 1991. The Behavior Guide to African Mammals. University of California Press, California, Pp: 386.
- Ira J.S., Ward B.S. and Morris A.G. 1981. *Dermatophilus congolensis* Infections in Wildlife in New York State. *Journal of Clinical Microbiology*, 14 (6): 604-606.
- Kagaruki, L.K., Fyumagwa, R., E. K. Batamuzi, T. Mlengeya, Lyaruu, V.H. and Mofulu, F. 2005. Giraffe ear disease problem in Mikumi National Park, TANZANIA: Tick and fly association in Proceedings of the 5th TAWIRI, scientific conference; Arusha, Tanzania. J.D. Keyyu, S.A.R. Mduma and A.L. Lobora(Eds). 1-3 December. Pp: 309-319.
- Kagaruki, L.K., Fyumagwa, R., Mofulu, F. and Lyaruu, V.H. 2003. A study of giraffe ear problems in Mikumi National Park: Tick and fly survey in: Proceedings of the 4th annual scientific conference; TAWIRI, Arusha, Tanzania. J.D. Keyyu, E.K.Batamuzi, B.M. Mutayoba and D.G. Mpanduji(Eds), December 4-6. Pp:178-180.
- Keet D.F., Kriek N.P., Penrith, M.L., Michel, A. and Huchzermeyer H. 1996. Tuberculosis in buffaloes (*Syncerus caffer*) in the Kruger National Park: spread of the disease to other species. *Onderstepoort Journal of Veterinary Research*, 63(3):239-44.
- Mlengeya, T.D.K., Mtambo, M.M.A., Msola, P.M., Batamuzi, E.K., Fyumagwa, R., Morkel, P., Lyaruu, V., Mofulu, F., Semuguruka, W.D., Maselle, R.M., Kilewo, M.K., Moronda, M., Silayo, R.S., Minga, U.M. and Kambarge, D.M. 2002. Severe infectious otitis in giraffes in Mikumi National Park and Selous Game Reserve; Tanzania in: Proceedings of the 3rd annual scientific conference; TAWIRI, (W.D. Semnguruka, M.N. Mgasia and L.J.M. Kusiluka) December 3-5, Arusha, Tanzania, Pp: 283-290.
- Msami, H.M., Khaschabi, D., Schöpf, K., Kapaga, A.M. and Shibahara, T. 2001. *Dermatophilus congolensis* infection in goats in Tanzania. *Tropical Animal Health and Production*, 33: 367-377.
- TANAPA, Tanzania National Parks. 2000. Mikumi Pub: African Publishing Group.