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## VIRAL DISEASES OF LIVESTOCK IN ZAMBIA

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### ABSTRACT

This review is to provide information on viral diseases of livestock in Zambia. The distribution of the diseases as well as the control measures and limited research that has been done, are described. Foot and mouth disease (FMD) causes serious economic losses in the cattle industry. So far five serotypes (SAT1, SAT2, SAT3, O and A) of FMD virus have been isolated in Zambia. Other notifiable viral diseases are rabies, Rift Valley fever, lumpy skin disease, African horse sickness, bluetongue, African swine fever, Newcastle disease, Marek's disease, fowlpox and infectious bursal disease. Based on the reports of clinical and/or serological diagnoses, these are widespread in the country, although their precise incidence rates are not known. With the establishment of a veterinary school equipped with modern diagnostic facilities and the increasing number of qualified veterinary personnel, this review would stimulate surveillance study on the viral diseases for the ultimate goal of achieving effective disease control measures.

Key Words: Viral diseases, Livestock, Control, Review, Zambia

### INTRODUCTION

Zambia, with an area of 751,000 square kilometers and a population of over nine million, lies 10–18 degrees south of the equator in South Central Africa. The livestock industry in Zambia consists of approximately 2.3 million cattle (1.8 million in the traditional sector and the remainder in the commercial sector), 63,000 sheep, 633,000 goats, 286,000 pigs and 14 million poultry<sup>17)</sup>. Cattle have traditionally been considered as a symbol of family wealth. Despite the large domestic animal popula-

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tion, the country has had a critical shortage of qualified veterinary personnel. This has affected the accurate recognition and documentation of the disease status in the sub-Saharan state. In 1983, the University of Zambia with the cooperation of the Government of Japan established the School of Veterinary Medicine whose aim was to provide veterinary training.

The Department of Veterinary and Tsetse Control Services of Zambia publishes annual reports on the disease situation in the country. However, diagnoses of most of these diseases are based only on clinical or postmortem observation. Thus definite incidence and prevalence rates of the diseases are not known. This review is to provide information on the viral diseases of livestock presently prevailing in Zambia. Each disease is briefly described below. Occurrence of viral diseases and their distribution in Zambia are shown in Table 1. Figure 1 has the map of Zambia showing its regional divisions.

#### FOOT AND MOUTH DISEASE

FMD is one of the most contagious diseases of animals and the most important viral disease of cattle in Zambia. It is an acute febrile disease that affects cloven-footed animals characterized by vesicle formation on the tongue, lips and feet. In Zambia, FMD was first recorded in the Western province in 1933<sup>77)</sup> and since then there have been repeated outbreaks of the disease in Southern, Central and Western provinces every one to two years. These outbreaks of the disease, confounded by the high cost of vaccines during periods of ailing economy, have always caused considerable economic losses to the livestock industry. There is reduced animal traction power leading to poor crop production and overall reduction in total national agricultural output. The country is also denied access to the beef export market notably that of the European Union<sup>51,76)</sup>. So far five serotypes of the virus have been isolated, namely SAT1, SAT2, SAT3, O and A with SAT2 being the most prevalent followed by SAT1<sup>51,77)</sup>. The other three serotypes of the virus are rare. The disease has always been mild in indigenous cattle often causing only transient lameness. Occasional deaths of calves have been reported particularly when outbreaks have occurred late in the dry season. There is notable absence on record of FMD in pigs, sheep and goats except for a passing reference to natural cases of FMD in pigs in 1935<sup>51)</sup> and an outbreak in Southern province in 1979<sup>4)</sup>. FMD virus isolates in Zambia were not serotyped until SAT immunological type of FMD virus was recognized and isolates from outbreaks in Mazabuka district were identified as SAT2 for the first time by the Animal Virus Research Institute, Pirbright, England, in 1948. In 1976, an outbreak due to type O was confirmed in Mbala district of Northern province near Nakonde on the border with Tanzania. In 1995, SAT3 outbreak occurred in cattle in Sesheke district of Western province for the first time<sup>42)</sup> and is assumed to have been a spill over from the Caprivi strip in Namibia.

Table 1. Viral diseases of livestock in Zambia and their distribution

Foot and mouth disease	Bovine	Southern, Lusaka, Central, Northern, Western	(42, 51, 71, 77)
	Porcine	Southern	(4, 51)
Rift Valley fever	Human	Central, Lusaka Southern	(44, 74)
	Bovine/ovine	Southern, Central	(25, 33, 34, 67)
	Human/bovine	Countrywide	(13, 28)
	Bovine	Countrywide	(57)
Rabies	Bovine	Countrywide	(3, 59, 61)
	Canine	Western	(63, 70)
	Canine/bovine	Countrywide	(30)
	Canine(jackal)	Countrywide	(55)
Bovine viral diarrhoea	Bovine	Countrywide	(21)
		Southern	(25)
Lumpy skin disease	Bovine	Eastern, Northern, Central, Copperbelt, Western	(37) (16)
		A threat in the North	(54)
		Lusaka	(58)
Parainfluenza 3	Bovine	Southern	(25)
Bovine adenovirus 3	Bovine	Southern	(25)
Pseudo lumpy skin disease	Bovine	Countrywide	(31)
Balanoposthitis	Bovine	Lusaka	(40)
Infectious bovine rhinotrache- itis/Infections pustular vulvo- vaginitis	Bovine	Southern	(25)
Newcastle disease	Poultry	Countrywide	(7, 8, 32, 62)
Infectious bursal disease	Poultry	Lusaka, Southern, Central	(60)
Fowl pox	Poultry	Countrywide	(16)
Marek's disease	Poultry	Countrywide	(16)
African swine fever	Porcine	Eastern	(16)
Porcine parvovirus	Porcine	Lusaka	(69)
Bluetongue	Ovine	Lusaka, Southern, Northern, Central	(68)
		Countrywide	(64)
Orf	Ovine/caprine	Countrywide	(64)
African horse sickness	Equine	Countrywide	(16)
Molluscum contagiosum	Equine	Copperbelt	(35)

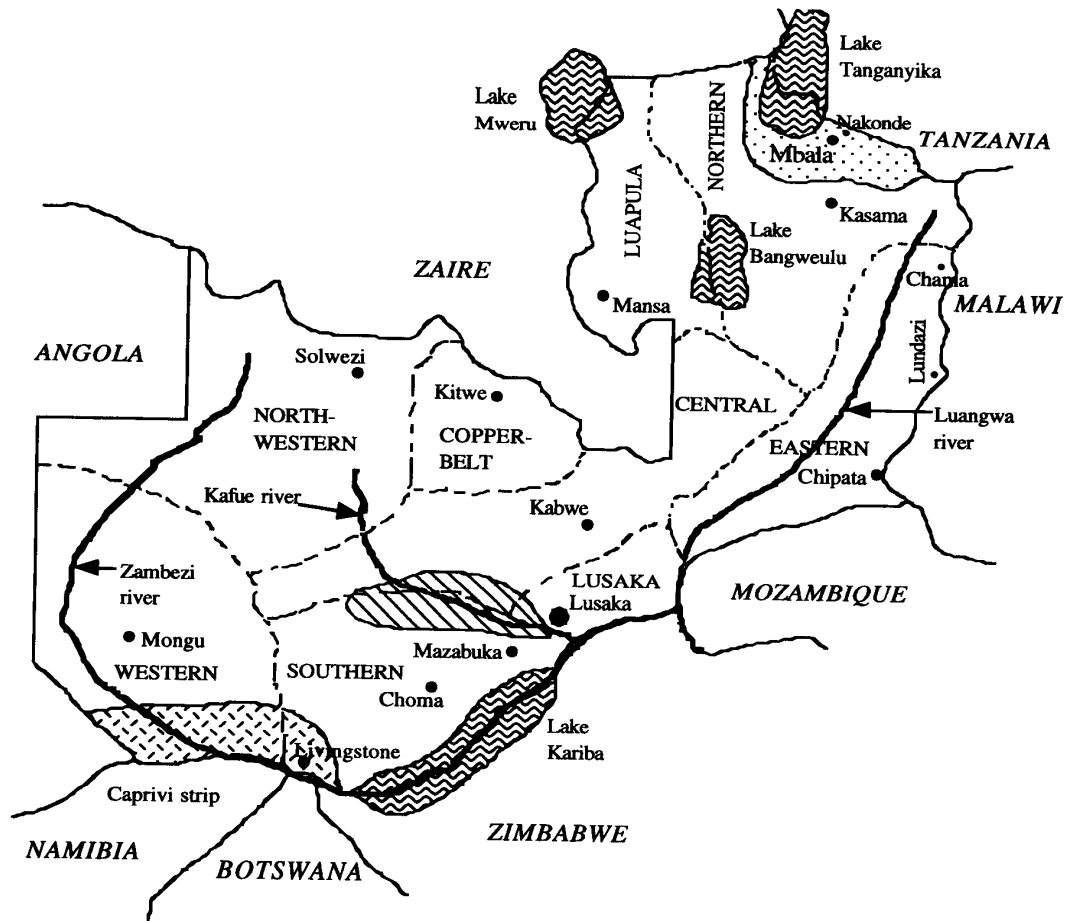






Fig. 1. Map of Zambia showing the nine provinces (plain uppercase), FMD high-risk area (i) , area (ii)  and area (iii) , major rivers and lakes . Provincial boundaries are shown by dashed lines. Neighbouring countries are shown in Italic.

Although wildlife has been incriminated as a source of FMD outbreaks in livestock, especially those in Southern province, no apparent disease has been confirmed. Albl & Hedge<sup>5)</sup> carried out a series of surveillance studies on specimens from wildlife in Luangwa National Park and isolated SAT1, SAT2 and SAT3 viruses from apparently healthy buffaloes. Thomson<sup>71)</sup> isolated FMD virus from some buffaloes in the Kafue National Park (Nanzhila area) and found two strains each of SAT1 and SAT2 and three strains of SAT3. Comparison of the partial nucleotide sequences of the 1D genes of these viruses showed that they were similar to those of other isolates from Southern Africa, indicating a common source of origin.

Zyambo<sup>77)</sup> and Perry & Hedger<sup>51)</sup> suggested three FMD high risk areas in Zambia (Fig. 1), namely; (i) Southern part of Western and Southern provinces bordering on

the Caprivi Strip and Botswana, with extensions principally northwards into Western province, (ii) the border of Central and Southern provinces on the Kafue Flats in Namwala, Mazabuka, Monze district with extensions to Central, Lusaka and Southern provinces and (iii) Mbala district and Nakonde in Northern province on the border with Tanzania. Outbreaks of disease in area (i) have been associated with the movement of cattle along the stock route in the 'busy' region where Botswana, Namibia, Zambia and Zimbabwe have their common border. The Central Veterinary Research Institute in Lusaka serotyped the recent FMD virus as SAT3<sup>42)</sup>. Those in area (ii) may have originated from wildlife (buffalo) in the Kafue National Park and Kafue Flats. The area (iii) is actually geographically isolated from the other two in the country and the outbreaks were probably introduced from neighboring Tanzania.

#### RIFT VALLEY FEVER

Rift Valley fever (RVF) is one of the most important zoonotic diseases in sub-Saharan Africa and is assumed to have originated from the Rift Valley of Kenya, spread to other regions causing serious disease in man and animals. Outbreaks of the disease in cattle and sheep are usually followed by those in man<sup>38)</sup>. In Zambia the disease was first reported in cattle and sheep in Central (Chisamba), Southern (Mazabuka, Livingstone) and some parts of the Copperbelt province. Some unexplained abortions were reported in March, 1974. It was also found that aborted foetuses were such as to preclude the possibility of contagious abortion<sup>14)</sup>. Watts et al.<sup>74)</sup> described an outbreak of RVF in farm workers in Kabwe rural district of Zambia. A 20-year-old farmer died due to RVF in January, 1984. Eighty six serum samples from humans in the same area were tested and 10 had antibodies against RVF virus. All those found positive had previous contact with animals or animal products, suggesting the possible transmission of RVF virus by direct contact. Another epizootic of the disease in Zambia has been reported by Hussein et al.<sup>33,34)</sup> in which some cattle and sheep aborted and neonatal lambs became ill. Nineteen sera from the affected sheep in herds with signs of disease were examined by the hemagglutination-inhibition (HI) test and 14 had HI antibodies against RVF virus. They tested bovine sera for neutralizing antibodies by plaque reduction assay using BHK-21 clone 15 cells and found that some were positive to the virus in Mazabuka (67%), Monze (50%) and Lusaka (52%) districts. However, the sera collected from cattle in Chisamba were negative although the disease was first reported in the area. Using the indirect immunofluorescent antibody (IFA) test, Morita<sup>41)</sup> found that five out of 53 workers in cattle abattoirs in Lusaka and Mazabuka were IFA antibody positive to the virus. In Mazabuka district, a cattle farming area, 19 out of 167 residents tested had IFA antibodies to RVF virus. Of those, 13 had no previous contact with cattle, suggesting other means of transmission like through mosquito bites. Hasebe et al.<sup>28)</sup> reported using the IFA test that cattle did not seem to play a significant role as amplifiers of

the virus in humans. Ghirelli et al.<sup>25)</sup> found the prevalence of RVF in cattle in the Kafue Flats to be 14%. Stafford & Hansson<sup>68)</sup> discovered that bluetongue and RVF were considered "common" by more than 10% of the farmers they interviewed. In Zambia, greater sero-conversion activity was found to be associated with vegetational changes<sup>13)</sup>. There is need for continued research to elucidate the mechanisms of transmission and perpetuation of the virus in nature.

#### RABIES

Rabies is a disease of all warm blooded vertebrates, including human beings, but wild raccoons, foxes, skunks and bats are the most common carriers of the disease. It is caused by a virus that is generally transmitted by the bite of diseased animals, most commonly dogs and other carnivores. In Zambia rabies was apparently present in the 19th Century and in 1901 Chief Lewanika of the Barotse in the Western province of the country ordered destruction of all the dogs in the area in an attempt to control a serious outbreak of the disease<sup>63,70)</sup>. In the mid 1900, rabies was recognized among domestic animals in scattered foci throughout Zambia<sup>3)</sup>. It appears that these foci served as starting points for intermittent epizootics resulting in countrywide distribution and establishment of the disease among domestic dogs. Hayles et al.<sup>30)</sup>, examined the presence of Negri bodies on direct smears of brain tissues of animals showing dramatic clinical signs of rabies and found that dogs accounted for 80% while cattle 10% of the total rabies cases. As of 1976, rabies was present in all provinces of Zambia and most prevalent in the Central, Southern, Copperbelt and Eastern provinces. The dog was the main carrier of the infection and was responsible for 82.7% of all positive cases<sup>20)</sup>. The disease has been confirmed in dogs, cattle, cats, horses, goats, sheep, pigs, jackals, honey badgers, velvet monkeys, antibears, thick-tailed bush babies, wilddogs and humans<sup>30,53)</sup>. Rottcher et al.<sup>55)</sup> found out that wildlife species made up 26 of 1,304 positive rabies cases between 1969 and 1976 and pointed out the jackal (*Canis adustus*) as the predominate wildlife species involved (69%) in the epidemiology of bovine rabies in remote farm areas in Zambia. They, however, observed that rabies could die out naturally in the wild populations as long as the balanced biotype was kept intact. Shandomo & Raninga<sup>59)</sup> and Sharma & Chiba<sup>61)</sup> have also described outbreaks of rabies in cattle. The highest incidence occurred along the line of rail that extends from Livingstone in the Southern province through Lusaka and Kabwe in Central province and through Ndola to Kitwe in the Copperbelt province. From time to time work on rabies mostly on epidemiology and public health significance has been published<sup>65,72)</sup>. Raman et al.<sup>53)</sup> reported a case of rabies acquired in Zambia by a 45-year-old woman, that eventually led to brain death 14 days after patient admission to a hospital. There is need to strengthen the knowledge through research on isolation and characterization of rabies and rabies related viruses in the country. Further research to determine the extent of spread of

the virus among wild animals in Zambia is required to enable implementation of effective control measures.

#### AFRICAN SWINE FEVER

African swine fever (ASF) is an acute contagious disease of domestic pigs caused by an unclassified virus originating from wild species of suidae in Africa. ASF has been enzootic in the Eastern province of Zambia since 1912. The disease emerged in East Africa between 1900 and 1910 in domestic pigs originally imported from Europe and has since then occurred sporadically in various countries throughout the continent<sup>39)</sup>. It spread to Southwest Europe in 1964, the West Indies in 1971 and South America in 1978 and at present it constitutes a major threat to swine production industry throughout the world<sup>52)</sup>. The existence of ASF is one of the major limiting factors of swine production in Zambia in which the first officially recorded outbreak was in 1965 in Chipata and Katete districts of Eastern province in exotic pigs<sup>9)</sup>. The whole province except Lundazi and Chama districts is an endemic zone at present<sup>43)</sup>. The province supports over 60% of the pig population in Zambia.

Samui et al.<sup>56)</sup> reported for the first time an outbreak of ASF outside the Eastern province in Zambia. The outbreak occurred 14 km North of Kabwe in Central province in 1989. The origin of this outbreak was suspected to be contaminated pork or pork products from Eastern province. Another outbreak of ASF covering a wider area outside the Eastern province was reported in Lusaka district<sup>12)</sup>. More than 10,000 pigs, exotic and indigenous were at risk. All pigs within the radius of 5 km from the outbreak zone were closed off or slaughtered and compensation given. Quarantine, restriction of movement of pigs, closure of slaughter house and ban on import of pig and pig products were done. These measures effectively prevented the spread of the virus.

Wilkinson et al.<sup>75)</sup> isolated the ASF virus from ticks (*Ornithodoros moubata*) collected from animal burrows in national parks and game management areas in Northern, Eastern, Central and Southern provinces. Restriction enzyme site mapping of the genomes of the isolates from soft ticks inhabiting warthog burrows from different areas in Zambia showed considerable genetic diversity. The genomes of the isolates from neighboring warthog burrows were more familiar to each other than to those from different areas, although a number of differences were observed even between genomes of isolates from the same warthog burrows<sup>18)</sup>. Haresnape et al.<sup>27)</sup> isolated ASF viruses from ticks of the *Ornithodoros moubata* complex (Ixodoidea: Argasidae) collected within the ASF enzootic area of Malawi. ASF viruses were also isolated from ticks collected in both domestic pig sties and houses in certain villages in Mchinji district where there had been recent ASF outbreaks. Mchinji district is in the center of a large ASF enzootic area which stretches into other districts of Malawi and also into Zambia and Mozambique. Research should be done to further determine the



role played by *Ornithodoros moubata* as a virus reservoir and potential vector of the disease in the field situation in Zambia.

#### BOVINE HERPESVIRUS INFECTIONS

Infectious bovine rhinotracheitis is caused by bovine herpesvirus-1 (BHV-1) infection and is manifested by respiratory and genital infections and also ocular and neurologic diseases in cattle<sup>24</sup>). The prevalence of BHV-1 infections was found to be 42.1% in the cattle of the Kafue Flats<sup>25</sup>). Balanoposthitis is a disease of the reproductive tract of male cattle caused by BHV-1 infection. In Zambia, Moorthy<sup>40</sup>) reported an outbreak of balanoposthitis in breeding boran bulls on a ranch and 25 of 105 bulls aged 7–8 years were affected. Diagnosis was based on demonstration of intranuclear inclusion bodies of Cowdry type A in the epithelial cells of the preputial mucosa. However, no attempt for virus isolation so far has been done in Zambia. Pseudo lumpy skin disease, caused by bovine herpesvirus-2, is characterized by multiple skin nodules and plaques and ulcers on the teats and mammary glands of cows. Virus isolation of bovine herpesvirus-2 has been made from cattle in Zambia<sup>31</sup>). The virus was isolated from an oesophageal/pharyngeal sample from a clinically normal three-year-old heifer, on monolayer cultures of primary bovine thyroid cells. Electron microscopy revealed agents typical of herpesvirus group. The isolated virus was identified by neutralization tests against a standard BHV-2 specific antiserum produced in rabbits. The prevalence of neutralizing antibodies ranging from 1:4 to 128 in sera from cattle in each of the three widely separated areas; Kazungula in 45/50 cattle (93%), the Kafue Flats in 112/121 cattle (90%) and Mbala in 35/54 cattle (65%) indicated that the infection was widespread in Zambia. Research on isolation and characterization of the virus as well as determining the precise distribution of the infections in the country is required.

#### BOVINE VIRAL DIARRHOEA

Bovine viral diarrhoea (BVD) is an endemic infection of cattle which is caused by BVD virus infection. It is characterized by congenital and enteric disease with a wide range of clinical manifestations and has a worldwide distribution<sup>46</sup>). In Zambian cattle, Giangaspero et al.<sup>21</sup>) did not find significant differences in prevalence between traditionally managed and commercial farms and between imported and indigenous breeds. The percentage of animals seropositive varied between provinces. The highest percentage was found in Lusaka province being 63.9%, in Western, Copperbelt and Southern provinces 59.4%, 54.5% and 29.5%, respectively. The lowest percentage was found in Eastern province being only 2.6%. Despite the high serological prevalence no clinical case of BVD infection has been reported in Zambia. Ghirotti et al.<sup>25</sup>) found the sero-prevalence of antibodies to BVD-mucosal disease virus to be 76.2% in cattle of the Kafue Flats. The precise distribution and impact on the livestock

industry of this disease in the country should be determined.

#### LUMPY SKIN DISEASE

Lumpy skin disease (LSD) is an acute, subacute or inapparent viral disease of cattle, characterized by fever, multiple firm, circumscribed skin nodules, necrotic plaques in the mucous membranes and swelling of the peripheral lymph nodes. The disease is caused by a Capripox virus. In 1929, a disease presumably LSD termed pseudourticaria was first encountered in Zambia<sup>37</sup>). In 1987, 33 outbreaks, involving 990 cases were confirmed. The majority of the outbreaks were in Eastern province (30) followed by Northern (2) and lastly Central province (1). The disease could be controlled by vaccination<sup>16</sup>), however, this is insufficiently done due to lack of funds to purchase the vaccines. LSD is thought to have a countrywide distribution. More information is required to enable implementation of effective control measures.

#### ORF

Orf is localized, vesiculo pustular exanthema of sheep, goats and other small wild ruminants caused by a parapox virus. Because of the economic losses it causes, Orf is regarded as one of the important viral diseases of sheep and goats. The disease has been confirmed in sheep and goats in Zambia by electron microscopic demonstration of typical parapox virions in negatively stained preparations from crust lesions<sup>64</sup>). This disease has not been investigated except for a few reports based on clinical symptoms of its occurrence mainly during the rainy season<sup>11</sup>).

#### NEWCASTLE DISEASE

As regards the viral diseases of poultry in Zambia, very limited research work has been done. Newcastle disease (ND) among viral diseases is still the number one killer of large numbers of birds every year despite the fact that vaccines are available. ND was first reported in Zambia in native fowls in Mazabuka in 1952 and been known to occur throughout the country since that time. Hussein et al.<sup>32</sup>) reported ND outbreaks caused by viscerotropic velogenic virus strains. Sharma et al.<sup>62</sup>) gave an account of ND outbreaks and its distribution from 1975–1984 in Zambia. Alders et al.<sup>7,8</sup>) found an average of 36.9% of 2,000 blood samples to be anti-ND virus antibody positive in HI tests in a countrywide surveillance study. The sero-prevalence varied between provinces, ranging from 29.2% in Northern province to 51.3% in the Copper-belt province. Vaccination is the major means of control.

#### OTHER VIRAL DISEASES

Other viral diseases which have been diagnosed and confirmed include infectious bursal disease<sup>60</sup>). Hasegawa et al.<sup>29</sup>) in an epidemiological survey of poultry diseases in commercial breeding farms in Zambia reported 5.6% prevalence of antibodies against

egg drop syndrome 76 virus. The economic impact of this disease on the poultry industry is not well known due to lack of adequate data.

Cases of suspected Akabane virus infections have been reported<sup>56)</sup>. In three newborn Holstein-friesian calves, hydranencephaly with arthrogryposis was observed. Akabane virus infection was suspected based on pathological findings, though the exact causative agent could not be determined. They also reported a single case of antibodies to Wesselsbron virus in the sera of one of the affected calves. Further serological survey on a 100 dairy cows from the farm where the cases were found, and 90 cows from the neighboring farm showed that 43% and 30%, respectively, of the cows had antibodies to Akabane virus. There is need for a countrywide survey to determine the distribution of this disease. Prevalence rates of parainfluenza 3 and bovine adenovirus 3 were 94.4% and 87.4%, respectively, in cattle in the Kafue Flats<sup>25)</sup>. There is an obvious need to establish whether these high prevalence rates are common in cattle throughout the country.

Suspected molluscum contagiosum in three horses in Zambia was reported by Lange et al.<sup>35)</sup>, who found the horses suffering from a slow progressive skin disease with lesions on the chest, shoulders, inner and lateral surfaces of the fore- and hindlimbs, the face, fetlocks, pasterns and on the lateral surfaces of the body. Cytoplasmic inclusions containing many pox virions were identified electron microscopically. Molluscum contagiosum is caused by a yet unclassified virus that has not even been cultivated. It is a disease of humans with a worldwide distribution and may be spread by close contact including sexual intercourse<sup>45)</sup>.

Poxvirus infection in the Nile crocodiles (*Crocodylus niloticus*) has been reported<sup>48)</sup> in which there was an outbreak of numerous yellowish cutaneous nodules in one-to two-year-old farmed Nile crocodiles at a crocodile farm at Lake Tanganyika during 1988. Stafford et al.<sup>69)</sup> tested blood samples from swine on some commercial piggeries in Lusaka and found these to be negative for antibodies to Aujeszky's disease, transmissible gastroenteritis (TGE), swine influenza and hog cholera viruses. Some, however, had antibodies to porcine parvovirus. Papilloma, fibropapilloma and lymphosarcoma have been reported in cattle based on histopathological examination<sup>47)</sup>. African horse sickness, fowlpox and Marek's disease are endemic in Zambia<sup>16)</sup>.

There is a continuing presence of rinderpest virus as a threat in East Africa as well as in Zambia. Rossiter et al.<sup>54)</sup> observed that subsequent massive emergency vaccination campaigns have been successful in eliminating clinical rinderpest in Tanzania and preventing its spread southwards to countries including Zambia. The last outbreak of rinderpest in Zambia was recorded in 1898<sup>4)</sup>. In Zambia, from time to time, there is a rinderpest vaccination campaign along the border with Tanzania (Mbala, Nakonde).

## DISEASE CONTROL

Precise data concerning the distribution of the diseases in the country is lacking. The disease control strategies in Zambia include vaccination, zoo sanitary measures<sup>10)</sup>, slaughter, stock movement restriction, import restriction, quarantine and surveillance. In times of outbreaks, livestock and their products are subjected to restriction of movement and zoo sanitary measures are enforced. In order to prevent the introduction of infected animals during the incubation period into outbreak-free herds, farms or areas with confirmed or suspected cases of the concerned disease are banned from trade. These measures are similar to some of those taken during the eradication campaign of infectious bovine rhinotracheitis in Switzerland<sup>1)</sup>. Due to the high prevalence of ASF in Eastern province and the geographical characteristics of the area, swine and their products are not allowed to leave this area. There are several checkpoints to enforce this measure. When found necessary, compulsory slaughter of all susceptible stock is done and farmers are compensated.

Vaccination is the most important means of controlling viral infections of livestock in Zambia. During a study of the ecology of dogs in an urban and a semi-rural area of Zambia De Balogh et al.<sup>15)</sup> found that there was a need for better coordination between different services involved in rabies control in Zambia to enhance sustainability of vaccination programs and improve the treatment of persons bitten by dogs. The Veterinary Research Institute at Balmoral in Lusaka produces rabies vaccine but the rest are imported.

The disease control efforts are complicated by the fact that Zambia is a land-locked country (Fig. 1). Therefore, to combat viral disease problems effectively regional rather than local disease control programs need to be implemented. Simple, specific and sensitive diagnostic methods which could be utilized in the field surveillance research should be developed.

## DISCUSSION

One major obstacle hindering efficient disease control measures is the lack of sufficient specialized veterinary personnel. There are only a few laboratories which are able to diagnose suspected cases of viral diseases of livestock in Zambia. This has led to the lack of sufficient data for the evaluation of the epidemiological situation of viral infections in animals. Some wild animals like buffaloes and lechwe are in contact with cattle when they graze together on the fresh grass which grows as the flood recedes. Cattle may have as a result introduced diseases such as tuberculosis into the Kafue lechwe population when in contact at the common grazing grounds<sup>67)</sup>. Ghiretti et al.<sup>25)</sup> noted that the high concentration of wild and domestic ruminants grazing together in the flood plains during the early dry season may be a major determinant of the high values of the disease prevalence rates among the cattle in the

Kafue Flats. This observation is similar to that made by Pandey et al.<sup>49)</sup> when they reported the presence of cutaneous streptothricosis in Kafue lechwe and indicated that this was because of contact with infected cattle.

When the animals are killed for meat, there is a potential public health problem since diseases like RVF may be transmitted to man<sup>36,41,73)</sup>. Giangaspero et al.<sup>22)</sup> made serological findings indicating pestivirus in man and speculated this could have a relationship with a pestivirus of animal origin. Anti-BVD virus antibodies were detected in adult Zambian patients infected with the human immunodeficiency virus (HIV). It was also noted that the anti-HIV antibody positive patients with chronic diarrhoea or associated illnesses appeared to have significantly increased prevalence of anti-BVD virus antibodies<sup>23)</sup>.

Research should be encouraged and directed towards examining the accuracy and feasibility of the viral diseases testing of livestock in Zambia. This is the approach proposed by Stafford<sup>67)</sup> suggesting the tuberculosis testing of the lechwe in the wild, transit and on game farms. There has been a limited number of serological surveys conducted and as a result there is a pressing need to evaluate further the prevalence of antibodies to viral diseases in the livestock population. With the growing number of game-farms (which also stock domestic animals) now in Zambia, it is important that possible transmission of disease from the wild animals to the livestock and vice versa is strictly monitored. Development and establishment of simple, highly sensitive and specific methods of diagnosis applicable to the surveillance study of viral diseases is underway<sup>44)</sup>.

To achieve the goals there is great need for increased government funding for research into animal disease control projects. With the establishment of a veterinary school equipped with modern diagnostic facilities the number of qualified veterinary personnel is now increasing. With proper coordination between veterinarians, government and farmers the problem of viral infections of livestock in Zambia could be minimized.

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