Chapter 3

Diseases of Importance at the Wildlife/Livestock Interface in Kenya[1]

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Introduction

Wildlife and livestock contribute significantly to the economies of most sub-Saharan African countries. The wildlife sector in Africa is worth US $7 billion with an annual growth rate of 5%. It is thus a major contributor to the continental gross domestic product (GDP). In East and southern African countries, the consumptive and nonconsumptive utilization of wildlife is a significant foreign exchange earner. In Kenya, tourism accounts for 30% of foreign exchange earnings (Kock *et al*. 2002).

The livestock subsector contributes over 30% of the agricultural GDP and employs more than 50% of the agricultural labor force. Dairy and livestock farming accounts for utilization of 30% of the high-to-medium-potential land and of 81% of the arid and semi-arid lands and is crucial for promoting rural development and reducing poverty (Kock *et al*. 2002).

The rangelands of Kenya comprise 74% of the country's land area and are largely inhabited by nomadic or transhumant pastoralists who comprise 25% of the total population and are principally dependent on livestock (Bourn and Blench 1999). Most of Kenya's livestock and most wildlife are found in the rangeland districts of Kajiado, Laikipia, Narok, and Taita Taveta (Bourn and Blench 1999), and this extensive traditional production system allows a greater interface between domestic and wild animals.

The resurgence of some livestock and wildlife diseases in Kenya that were previously controlled is of serious concern. The recent incursion of rinderpest virus in Kenyan wildlife populations, associated with cattle in the Somali ecosystem, is one example (Wambwa 2002). Major factors in the spread of disease are the uncontrolled or illegal movements of livestock by pastoralists within the country and across national borders in search of grazing or markets, or as a result of cattle rustling. The cross-border livestock trade involves approximately 400,000 head of cattle per year. Seasonal wildlife movements result in frequent interactions with livestock, which also increases the possibility of disease spread across boundaries (Wambwa 2002). In addition, most of these rangelands have a poor infrastructure and are remote, making it difficult to provide adequate veterinary services.

The diseases of major concern to livestock trade presently include contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, African swine fever, foot and mouth disease, Rift Valley fever, rinderpest, and peste des petits ruminants (Grootenhuis 1999). Other diseases of economic and public health importance in Kenya include viral diseases such as malignant catarrhal fever and rabies (Karstad 1986, Kock *et al*. 2002), bacterial diseases such as anthrax and brucellosis (Karstad 1986), protozoal diseases such as trypanosomiasis and theileriosis, and ectoparasite and helminth infestations (Grootenhuis 1986).

The presence of transboundary diseases has greatly reduced Kenya's export of wildlife, livestock, and their products to lucrative international markets as a result of the stringent requirements in sanitary standards for international trade in animals and animal products established by the World Organisation for Animal Health (OIE).

This paper briefly describes the wildlife/livestock interface in Kenya, with emphasis on the important animal diseases at this interface. It suggests measures to enhance disease control and improve trade in wildlife, livestock, and their products.

The wildlife/livestock interface

The wildlife/livestock interface in Kenya is largely influenced by the livestock production systems present in the country. There are two major systems at the interface:

Ranching (cattle/wildlife) system

These are extensive commercial beef or dairy systems in which domestic livestock and wildlife share the same range. They are usually fenced. The management approach aims at selecting livestock breeds that are resistant to disease to establish endemic stability and to regulate stocking densities to ensure optimal nutrition and environmental stability. Income is generated mainly from the sale of livestock and livestock products, and additional income on some ranches is derived from wildlife cropping and tourism. Due to the presence of important diseases such as foot and mouth disease, some export-related income is lost. Disease control measures are specific to the disease in question (Grootenhuis 1999).

Pastoralism and agropastoralism

Nomadic and transhumance pastoralism is found in the rangeland districts of Kenya. Rangelands are treated as

[1]See abstract on p.xx.

common property resources by pastoralists and shelter a great diversity of free-ranging wildlife species that often mix with their livestock (Bourn and Blench 1999). Pastoralists keep indigenous breeds of livestock that are more resistant to pathogens and that are well adapted to these environments. However, land-use pressure and conflict between pastoralists and wildlife have been increasing, resulting in a growing risk of disease transmission between livestock and wildlife and increasing competition for grazing and water resources (Kock *et al*. 2002). Most pastoralists survive at subsistence level and have limited access to veterinary services. Disease control measures usually rely on ethnoveterinary practices, based on traditional knowledge of livestock diseases.

Factors affecting disease trends at the wildlife/livestock interface

Several traders are involved in cross-border trade and sell their cattle all the way from the Somali border to major cities in Kenya, including Nairobi and Mombasa. The dynamic state created by this animal movement results in frequent contact between livestock and wildlife, and a high incidence of pathogen transmission and transboundary diseases (Kock *et al*. 2002). The near cessation of export trade to the lucrative markets of Europe and the Middle East has had a negative impact on livestock production (Grootenhuis 1999).

In Kenya, between 1974 and 1996, wildlife in the rangelands declined by 33% and livestock by approximately 10%, while the human population continued to rise (Bourn and Blench 1999). Pastoralists are becoming more sedentary in the higher-potential rangelands. This has led to the destruction of flora and fauna in these areas due to excessive use of available resources. The resultant ecological changes have created an environment more conducive for development of diseases.

Types of diseases at the wildlife/livestock interface

The most important diseases at the interface are classified by the Office International des Épizooties (OIE) under List A. List A diseases are defined as "transmissible diseases which have a potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products."

At the household level, the effects include inadequate food and income; at the national level, vital export earnings are lost as a result of trade restrictions, and foreign exchange reserves become depleted when livestock food products must be imported (Kock *et al*. 2002). Control needs to be coordinated at both national and international levels. Examples of List A diseases include rinderpest, foot and mouth disease, Rift Valley fever, and African swine fever (Table 1).

Local breeds of livestock and wildlife have developed a degree of endemic stability to some of the pathogens that are constantly present and cycle between livestock and wildlife populations. Many endemic infectious agents do not cause clinical disease in newly infected hosts under normal circum-

Table 1. Transboundary diseases transmitted between wildlife and livestock in Kenya that have national and international importance

Disease and causative agent	Domestic/wildlife association	Status
Rinderpest Morbillivirus	Wide domestic and wild host range in ruminants and suids. Wildlife species are poor maintenance hosts; those most affected are buffalo, kudu, eland, and warthog. Acute disease seen in cattle, wild ruminants, and pigs.	Currently restricted to Somali ecosystem at Kenya/Somali border with occasional epidemics.
Peste des petits ruminants Morbillivirus	Wild/domestic small ruminants are the hosts. Disease cycles endemically in nomadic herds, and transhumance introduces it to native populations.	Serological evidence in sheep and goats in Kenya, 2001. Significant due to importance of sheep and goats for food security.
Rift Valley fever Phlebovirus	Many species of *Culex* and *Aedes* mosquitoes can transmit the disease. No vertebrate reservoir host identified. Reservoir is drought-resistant eggs of *Aedes*.	Disease agent endemic in East Africa and causes sporadic epidemics after long inter-epidemic periods. A pathogenic zoonosis.
Foot and mouth disease Aphthovirus	Wildlife species are not reservoirs except buffalo, which are persistent carriers of SAT1 and SAT2 serotypes. Highly contagious and spreads rapidly. Cattle, pigs, sheep, goats and wildlife (e.g., wildebeest in Serengeti) affected. Types A, O, C, SAT1, and SAT2 have been isolated in Kenya.	Widespread and endemic in cattle and wildlife. Major epizootic potential. Livestock movement control and vaccination are priorities for control.
African swine fever African swine fever virus	Disease of domestic and wild pigs. Maintenance hosts are argasid ticks (*Ornithodorus* spp); secondary role played by free-ranging porcine hosts (warthogs are asymptomatic carriers of the virus).	Has major epizootic potential. First reported in 1921. Reappeared after 30 years and involved movement of pigs.
Contagious bovine pleuropneumonia *Mycoplasma mycoides mycoides* S.c.	Closely associated with livestock movement and not dependent on a wildlife reservoir. Sources of new outbreaks are chronic livestock carriers.	Endemic in northeastern Kenya, newly infected districts in central Kenya. Rest of the country at risk of infection through uncontrolled movement of livestock. Vaccination critical to control spread.

stances of transmission and infection (immunocompetent host exposed to low dose). Disease is most often the result of the disruption of this relationship (e.g., high infectious dose, stressed host, failure of passive transfer). These include vector-borne blood parasites, helminth diseases, enteric bacterial diseases, and a variety of reproductive diseases. The negative impacts of these diseases are mainly experienced at the community level and as such they receive less attention than do epidemic diseases in terms of when control measures are instituted nationally or regionally. However, when the losses at various community levels are consolidated, they are significant enough to result in a national loss. Some endemic diseases have major epizootic potential under certain epidemiological conditions. For example, highly contagious viral diseases such as foot and mouth disease and African swine fever tend to occur as epidemics in livestock but are maintained as stable endemic infections in wildlife. The epizootic potential of a pathogen is related to various epidemiological determinants such as the causative organism, climatic and environmental factors, presence or absence of maintenance hosts, seasonal abundance of vectors, mode of transmission, and presence of a susceptible population (Table 2).

Many zoonotic diseases affect the productivity of both wildlife and livestock. These include diseases such as the meat-borne helminth diseases, and bacterial diseases such as anthrax, brucellosis, tuberculosis, salmonellosis, and clostridial infections. Viral diseases include rabies and Rift Valley fever, and protozoal diseases include toxoplasmosis, sarcosporidiosis, and trypanosomiasis. Both wildlife and livestock could be potential hosts or sources of infection for people. The major concern from zoonotic diseases relates to human disease and suffering (but decreased productivity of animals also has a major impact on livelihoods, welfare, and food security).

Although many diseases can infect wildlife hosts, most wildlife species are generally not involved to any significant extent in the transmission of disease to livestock. However, a few key wildlife species are linked with transmission of major livestock diseases (Table 1). For example, buffalo *(Syncerus caffer)* are a source of a particularly virulent form

Table 2. Diseases transmitted between wildlife and livestock in Kenya that have national and community-level importance

Disease and causative agent	Wildlife/livestock interaction	Status
Malignant catarrhal fever Alcelaphine herpesvirus-1	All wildebeest species are reservoirs. Cattle infected when exposed to cell-free form of the virus from nasal secretions of wildebeest calves. Disease is fatal in cattle and limited to areas where cattle and wildebeest interact (e.g., Maasailand). Cattle are dead-end hosts.	Risk period of contracting this disease is greatest over four months in the wildebeest calving period. Morbidity low but case-fatality rate high, with up to 10% losses of the herd.
African horse sickness Orbivirus	Endemic in zebra, the wild maintenance host, and cycles throughout year. Prevalence rate of antibodies in elephants is high, but role of elephants as maintenance host seems unlikely. An important disease in horses.	Moderate epizootic potential. Transmitted by midges of *Culicoides* species.
Rabies Lyssavirus	Sylvatic rabies has been diagnosed in 33 carnivorous and 23 herbivorous species in sub-Saharan Africa, including jackals, honey badger, mongoose, bat-eared fox, and civet cat in Kenya. Transmitted from wildlife to livestock and vice versa, but domestic dogs thought to be principal reservoir in Kenya. Fatal in all mammalian species. Rabies outbreaks partially responsible for near extinction of endangered wild dogs in the Maasai Mara-Serengeti ecosystem.	Incidence increasing over past 30 years. Most cases reported in domestic dogs and cattle. Better control/vaccination protocol required. Significant zoonotic potential.
Theileriosis or corridor disease *Theileria parva* species	African buffalo is reservoir for *Theileria* parasites, which can cause disease in livestock. Eland and sable transmit *Theileria* spp, which do not cause disease in cattle. Cattle are dead-end hosts and unable to infect intermediate host's vectors.	Moderate epizootic potential. Only *Theileria parva* (corridor disease) derived from buffalo known to have serious economic impact on livestock production. Cattle can be protected by immunization.
Trypanosomiasis *Trypanosoma* species	Wildlife including elephant, rhino, buffalo, warthog, hippo, and various artiodactyls are maintenance hosts and are trypanotolerant, but can show high infection rates with various trypanosome species. Domestic livestock, horses, and dogs affected.	Moderate epizootic potential. Important disease of cattle and horses. Severely hampers livestock industry in tsetse fly endemic belts.
Brucellosis *Brucella* spp	Low prevalence of antibodies in wild bovids in Kenya. Not thought to be major problem in wildlife (although subtle impacts on fertility may be easy to miss). Difficult to eliminate disease from pastoral livestock.	Prevalence and incidence not well documented. Limited epizootic potential. Zoonotic potential. Vaccination of livestock possible.
Anthrax *Bacillus anthracis*	Outbreaks documented in domestic species in absence of wildlife. Anthrax in wildlife reported as both sporadic cases and major epidemics. Links between disease in wildlife and domestic species unclear.	Moderate epizootic potential.

of theileriosis (corridor disease) and a carrier of the SAT (South African Territories) types of foot and mouth disease virus, and wildebeest *(Connochaetes taurinus)* calves are a source of malignant catarrhal fever virus in a form that is lethal to cattle (Grootenhuis 1999).

Current role of the Kenya Wildlife Service in disease control

The Kenya Wildlife Service (KWS) Veterinary Unit supports the Ministry of Livestock by conducting serosurveillance for rinderpest in wildlife to support Kenya's declaration of provisional freedom from the disease. Surveys are conducted in selected wildlife populations, especially in areas adjacent to the Somali border. They include searches for clinical disease by examining wildlife for suspicious signs such as ocular discharges, keratoconjunctivitis, nasal discharges, or diarrhea. Disease outbreak investigations are also performed.

Although disease is an important determinant in the survival of wildlife, the KWS Veterinary Unit has been constrained in expanding its disease-monitoring activities, because the core mandate of KWS is conservation and management of wildlife. Most of KWS' funding is directed towards park management activities, while less goes to disease monitoring. To overcome this, KWS needs to strengthen its institutional linkages with other government departments, nongovernmental organizations, and institutes to expand its capacity and resources to monitor disease. These efforts should include harmonizing the disease control policies between the livestock and wildlife subsectors.

Conclusions

The Ministry of Livestock in Kenya is currently reviewing its legal and policy framework to enhance delivery of animal health services, improve disease control measures, and promote trade of livestock, wildlife, and their products. Some of the key components that Kenya must address during this review include developing an effective national disease surveillance and reporting system to identify and address animal health constraints as required by World Animal Health Codes. Currently, support for epidemiological surveillance is being provided under the Pan African Control of Epizootics (PACE) programme in 27 African countries, including Kenya. The goal is to control major diseases and allow Kenya to regain access to international markets for its live animals and animal products.

Wildlife should remain an integral component of the disease serosurveillance strategy, with a focus on pre-identified groups of key species in areas of importance. Because wild animals are not vaccinated in Kenya, they are valuable sentinels for the monitoring and control of disease, as has been shown with rinderpest. As the statistically valid sample size required is small for rinderpest (Wamwayi *et al*. 2002), wildlife surveillance can provide a feasible and valuable source of information for monitoring disease occurrence.

To improve the delivery of animal health services in the rangelands, the government needs to consider increasing public expenditure for veterinary services in these areas and to devolve some services from the central government to private, public, and community sectors. Community-based animal health workers can provide low-cost services to pastoralists in remote areas (Kock *et al*. 2002).

Livestock movement control should ensure stock inspection at markets, auction yards, stock routes, and entry points into Kenya to limit disease transmission across borders. Clinical disease and serological investigations should be ensured at key points along these routes and at slaughterhouses. Services for local markets should focus on improving productivity and reducing transmission risks for epidemic and zoonotic diseases, without the strict sanitary measures required for export markets. Disease-free zones should be established in designated areas where strict veterinary controls are applied to allow livestock for export to be maintained. Major production areas should be supported by building slaughterhouses that have cooling facilities.

Strategic vaccination, vector-control programmes, and effective management of quarantine are required to reduce infection and prevent transmission of disease in livestock.

Wildlife health management requires a wide range of skills from veterinarians, such as the restraint and capture of wildlife, diagnostic ability in the field, follow-up investigations in the laboratory, and interpretation of epidemiological data. The local undergraduate and postgraduate curricula need to be reviewed to ensure they provide sound knowledge on wildlife disease management.

To succeed in controlling transboundary diseases, Kenya needs to collaborate with East African community states to review and harmonize regional policies, laws, and regulations governing disease surveillance and control. Similar capacities for emergency preparedness and response to epizootic disease outbreaks need to be developed throughout the region.

References

Bourn D, Blench R (eds). *Can Livestock and Wildlife Co-exist? An Interdisciplinary Approach*. Overseas Development Institute (ODI) and The Environment Research Group Oxford (ERGO) Publishers, London, UK; 1999. p.58.

Grootenhuis JG. Viral Diseases. In: Grootenhuis JG (ed). *25 Years of Wildlife Disease Research in Kenya, Nairobi*. Nairobi, Kenya: Kenya Agricultural Research Institute; 1999. pp.61–73.

Grootenhuis JG. Trypanosomiasis, East Coast fever and some other tick-borne diseases at the wildlife/livestock interface. In: Macmillan S (ed). *Wildlife/livestock Interfaces on Rangelands*. Nairobi, Kenya: Interafrican Bureau for Animal Resources; 1986. pp.56–62.

Karstad L. Can livestock and wildlife co-exist? In: Macmillian S (ed). *Wildlife/livestock Interfaces on Rangelands*. Nairobi, Kenya: Interafrican Bureau for Animal Resources; 1986. pp.51–55.

Kock R, Kebkiba B, Heinonen R, Bedane B. Wildlife and pastoral society – shifting paradigms in disease control. *Ann NY Acad Sci*. 2002;969:24–33.

Wambwa E. Transboundary diseases at the wildlife-livestock interface at the Kenya-Somali border, with emphasis on rinderpest. *Proc. 13th Symposium on Tropical Animal Health Production*; 2002 Oct 18; Utrecht, Netherlands. 2002. Utrecht University.

Wamwayi HM, Wambwa E, Orinda G, Injairu RM, Nyariki T, Gakuya F. Pathogenicity and transmission of wildlife-derived lineage II rinderpest virus in cattle and buffaloes. *Proc. East African Workshop on Mild Rinderpest*. Nairobi, Kenya. 2002 Jun 17–19. 2002. African Union/Interafrican Bureau for Animal Resources.