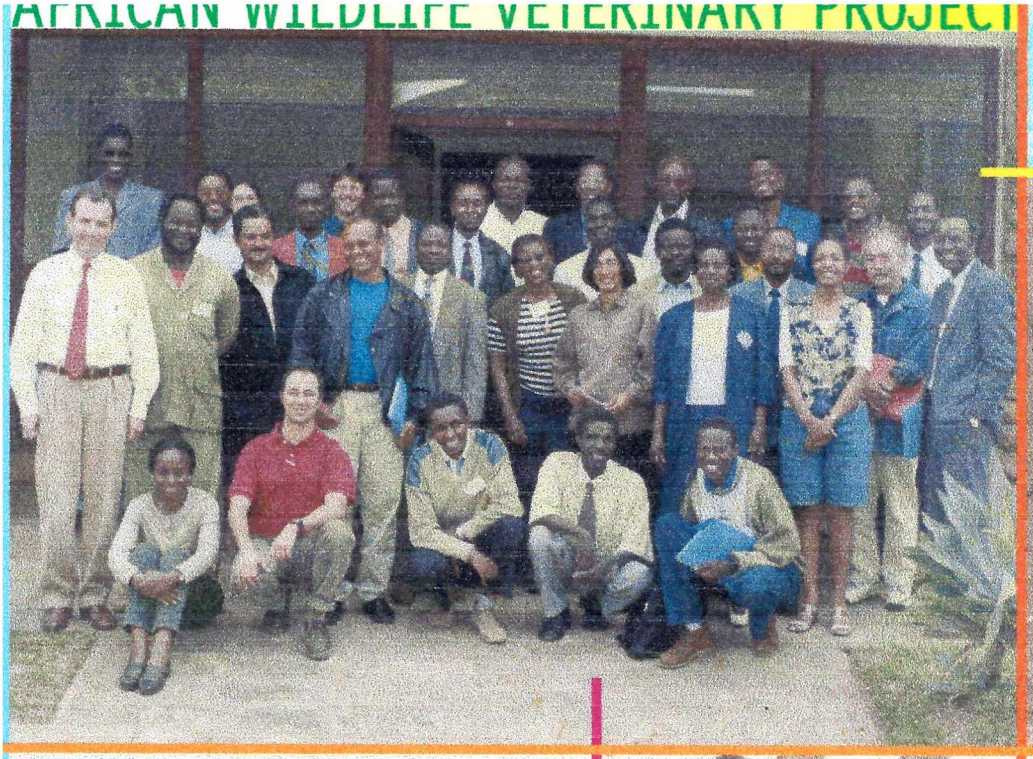
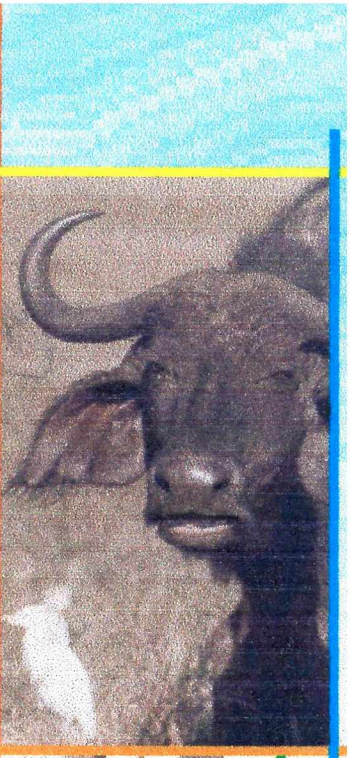
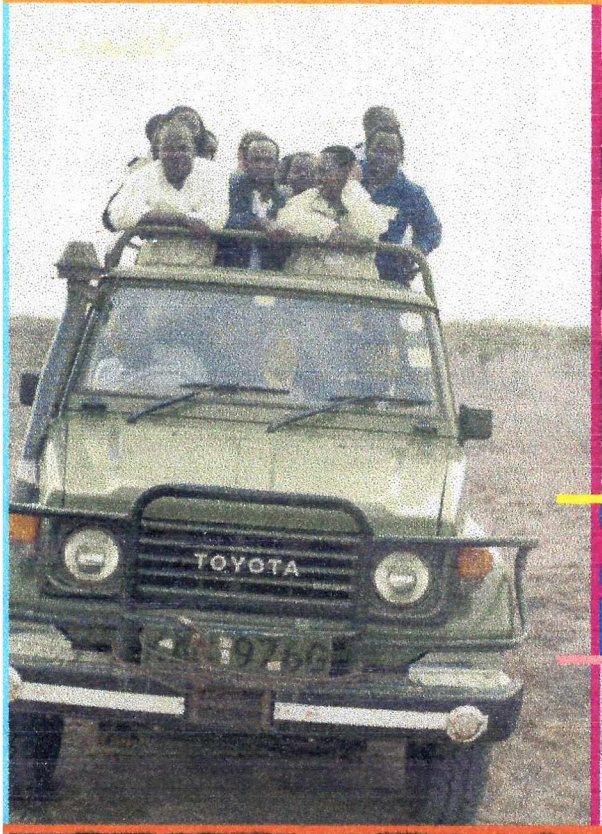
AFRICAN WILDLIFE VETERINARY PROJECT







OAU/IBAR/AWVP TRAINING WORKSHOP

ORGANISATION OF AFRICAN UNITY
INTERAFRICA BUREAU OF ANIMAL RESOURCES

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OAU/IBAR/AWVP TRAINING WORKSHOP held at Kenya Wildlife Service - Veterinary Unit, Langata, Nairobi, Kenya *6 – 12 June 1999*

OPENING CEREMONY

The Director OAU/IBAR, Dr Walter Masiga opened the meeting.

Summary of speech by Dr Masiga:

Ladies and gentlemen, veterinary colleagues and wildlife specialists welcome to Kenya and Nairobi.

We are privileged to be gathered together for this technical workshop on rinderpest at the Kenya Wildlife Services Veterinary Unit facilities in Langata.

I would like to thank the Director KWS, Dr Richard Leakey and his staff for providing the venue for this meeting . Secondly I would like to thank the European Union for providing the finance for the workshop under the Wildlife programme. Finally I would like to thank my colleagues from OAU IBAR and others for giving their time and input into the workshop.

I am in addition to being a Director of OAU, a veterinarian. So I can truly participate in this meeting in a meaningful way. Indeed my involvement in Rinderpest some years back was new to me then (my specialty was in fact in another disease) so have courage in tackling this area of wildlife disease. I am happy that issues, which affect not only livestock but also wildlife in Africa, are increasingly receiving attention.

We can no longer ignore the complex interactions that exist between all organisms on the planet in relation to disease. The experience in Tsavo West National Park when rinderpest devastated wild animals, buffalo, kudu and so on is pertinent to this. Very few cattle were affected but as the reservoir of the disease was a major threat to the wildlife. On this continent; environment, animals, health are more closely interlinked than probably any other continent on earth. If we examine only one disease; rinderpest, we soon recognise the importance in understanding these relationships. It is through this improved knowledge of the epidemiology of rinderpest in different domestic and wild species that we hope to finally eradicate the virus with all the resultant benefits to livestock economy and wildlife resources. Do not forget that wildlife and tourism was the most important foreign exchange earner to Kenya over recent years.

So this meeting is an opportunity to learn. Anyone who thinks they know it all please leave! The objectives include

- establishing a network in Africa under OAU IBAR to investigate diseases affecting wildlife particularly those also affecting livestock and human populations.
- to build local institutions to support national disease control programs at various levels including wildlife disease.
- to disseminate knowledge which will empower communities in each country to improve animal and wildlife health and in effect human welfare.

This wildlife project on rinderpest is a catalyst for future activities in this field and as our own OAU/IBAR projects are expanding under the successor to PARC the Pan African programme for the Control of Epizootic disease PACE, it is opportune. The details and rational of these developments will be explained to you during the workshop.

Although you will be given information focused on rinderpest and wildlife please take the opportunity to discuss and develop ideas for the future, not only for rinderpest eradication but for other diseases which are familiar to us in the veterinary community - MCF, ASF, FMD, PPR,CBPP,TB etc. Also remember the importance of information gathering, storage and management - this will be important to the continuity and sustainability of programmes. A recent loss in my family of an Uncle reminded me of his words - the faintest ink will outlive the longest memory.

I look forward to hearing about and reading your discussions. Please accept my best wishes for the week in Nairobi and for your field trip to Meru National Park - beware of buffaloes.

HISTORY OF PARC - OVERVIEW
Dr. Solomon Haile Mariam, OAU/IBAR

From 1986

- Development of projects started with a political discussion:

- Current population growth - 3%
- Projected population by 2025 - 1.3 billion
- Current food production - 2%
- Optimal food growth rate to meet demand by 2025 - 4%

Politicians will only support projects if they address the key issues.

- Legislative Authorities of OAU/IBAR

- Member states

- Role of indigenous livestock in Africa

- Source of food, farm energy, etc.

- OAU/IBAR PARC

36 partner countries sub - saharan Africa

Objectives :

- eradicate Rinderpest from Africa.
- revitalize the vet services and delivery of sustainable vet services in Africa.

Donors EU - 130 million ECU

Life: 1986 - 1998

Problems - phasing of each country into the programme - delays in synchronization. Each country needed to agree to objectives and principles before entering the project. Many discussions were necessary. In many countries it has been very difficult to implement in others considerable progress has been made.

- PARC projects in Africa

Recent developments are concentrating on the remaining foci of infection in Eastern Africa, with disease apparently controlled in Western Africa.

East Africa 11 countries 250 million people large population of pastoral cattle systems and wildlife.

1993-4 new strategy

- create a sanitary cordon (buffer zone - continue vaccination - increase surveillance etc.) with focus on Sudan as disease was believed to be isolated in that area. (only problem was in the RDC(previously Zaire) but this was a lower risk area due to geography and other factors discouraging livestock movement).

Increase:
- cost recovery on disease control programmes
- liberalization of veterinary policy e.g. drug and pharmaceutical importation and distribution.

PARC influenced Governments in the change of policy.

- privatization of animal health services. Encouraged by PARC through provision of credit lines to private veterinarians - small changes are seen in many countries.
- community mobilization. Initial resistance but increased acceptance of local management of health services and cost burden.

The PARC input has been catalytic - small in scale at present but results encouraging the process.

An economic unit was established to assess the progress and impact of disease control. Results are now becoming available.

- Major achievements of PARC

- border harmonization - annual meeting for each region.
- rinderpest eradicated from West central Africa
- intensive eradication ongoing in East Africa
- Veterinary Services revitalized
- Cooperation among African Veterinary Services
- Vaccine quality improved
- Countries diagnostic and disease surveillance capacity improved
- Private vets

Finance for a future programme established - PACE. **P**an **A**frican for the **C**ontrol of **E**pizootic diseases, e.g. - diseases like trypanosomiasis remain a major problem affecting 37 countries in Africa with vast areas of land unsuitable for food production losses estimated at $1 billion etc.

Discussion
Dr Mlengeya (Tanzania National Parks Chief Vet) - commends and encourages the involvement of wildlife specialists in animal health programmes - too often ignored.

Dr Kock (OAU/IBAR) - an holistic approach to disease management is critical - disease involves environment - animals - people etc. and all need to be considered - also multi - disciplinary teams are needed to ensure a rationale programme.

Dr Wambua (Kenya Wildlife Service - Chief Vet) asked how long the programmes will run for - Dr Solomon advised that this depends on results. If the present programme is a success and is taken seriously it will grow and continue for many years. The participants of this workshop are critical to this success in Wildlife.

PARC/IBAR EAST AND WEST AFRICA: THE WAY FORWARD

Dr Rene Bessin OAU IBAR

BACKGROUND

OAU/IBAR Structure and Function

The functions of IBAR are as follows:

- to coordinate the activities of OAU Member States in the field of Animal Health and Production;
- to collect, collate and disseminate information on all aspects of Animal Health and Production amongst Member States;
- to initiate, execute and develop projects n the field of Animal Health and Production;
- to liaise with the appropriate Authorities of Member States, Regional groups, International and inter-Governmental organisations.

The Pan African Rinderpest Campaign

BACKGROUND

The Pan African Rinderpest Campaign is a Livestock Sector Promotion Program implemented through National Programmes. Those National Programmes are coordinated under the aegis of the Interafrican Bureau for Animal Resources under two Regional Coordinations:

- The Coordination Unit for West and Central Africa based in Bamako (Mali)
- The Coordination Unit for Eastern Africa based in Nairobi (Kenya)
- The two major objectives of PARC are:
- Eradication of Rinderpest from the African continent;
- Improvement of Animal Health Services by making provisions for future funding of such services through sector resources.

PARC in Eastern Africa

Rinderpest is currently confined to a few East African countries, nevertheless, there have been notable improvements recently; Rinderpest has not been reported from Uganda since 1994,from Ethiopia since November 1995,from Kenya since 1997 and Tanzania in 1997.

The virus is still believed to be present in Southern Sudan and in Somalia and present a major threat to the neighboring countries. PARC in collaboration with European Union, Unicef and NGOs are currently actively involved in disease searching and vaccinations.

The decrease in the number of official reports in the past few years is some indications that the overall distribution and incidence of the disease is continuing to decrease in Eastern Africa.

A PARC in West and Central Africa

The PARC program whose main objective is to eradicate Rinderpest in Africa may be considered as having largely reached its objectives in West and Central Africa. As a matter of fact, for almost eleven years now, no outbreak of rinderpest has ever been reported in the area. The various

research activities on the presence of the rinderpest virus among goats have shown a low if not zero probability of presence of the virus.

One may therefore reasonably think that the virus has been practically eliminated from West and Central African countries.

In fact it is probable that outbreaks would occur if the virus were present for whoever knows about the major mingling of transhuming herds in West and Central Africa and the mode of transmission of the pathogen agent by close contact.

Following the different technical meetings and global evaluation of the PARC programme, it has been decided that all PARC activities should be focused on eradicating rinderpest, before fighting against any other priority disease 'such as CBPP.

THE OIE PATHWAY

The West African countries that are part of the same epidemiological set are invited to stop vaccinating and to start the OIE Pathway of declaring the country immune from rinderpest.

To do so the reinforcement of the efficiency of the sanitary cordon in Central Africa is considered as a major strategic objective. Risks of outbreaks of the disease exist particularly at the level of the sanitary cordon currently constituted of Eastern Chad, Southern Sudan and the Central African Republic.

THE SANITARY CORDON

Vaccination needs to be reinforced in the cordon through involvement of the sanitary mandate holders. Cameroon, the Central African Republic and Chad do not have any pest foci but must maintain the sanitary cordon as a shield to protect West Africa.

For the other West and Central African countries, one needs to prove the absence of the virus through cessation of vaccination and establishment of a strong surveillance system in cattle, goats and particularly wildlife.

EPIDEMIOSURVEILLANCE

The 11 Regional Conference held in N'Djamena decided:

- that, the establishment of national epidemiosurveillance and epidemiovigilance networks is a priority for all countries engaged or about to engage on the OIE pathway and has expressed the wish that:
  - the correct management of such networks takes into account the performance indicators;
  - It has decided that the national laboratories constitute the mainspring of epidemiosurveillance and epidemiovigilance and must be supported.
  - the countries that have declared provisional freedom from rinderpest should be supported in addition to the establishment of epidemiosurveillance networks, the cost of active clinical and serological research as well as the procedures of verification specific to rinderpest as provided for by the OIE pathway.

For three years most West African countries have stopped vaccinating.

Table 1: Provisional declaration and stopping vaccination

Country	Date of provisional declaration Of freedom from rinderpest	Year when vaccination against rinderpest was stopped
Gambia		1990
Guinea	1996	1996
Senegal	January 1997	1996
Cote d'Ivoire	January 1997	1996
Mali	December 1997	1997
Ghana	February 1997	1996
Niger	November 1997	1997
Burkina Faso	December 1997	1997
Mauritania	Decision to stop made	1998
Benin	Decision to stop made	1999
Togo	Decision to stop made	1999
Chad		1999

The cessation of vaccination against rinderpest in West Africa therefore leads to the establishment of and epidemiovigilance activity for that disease. The epidemiovigilance structure will serve in the epidemiosurveillance of priority diseases in the region, which number 3 or 4 infections.

EPIDEMIOSURVEILLANCE NETWORKS

In West Africa, established Epidemiosurveillance Networks will make possible an objective evaluation not only of the status of rinderpest, but other major pathologies. West and Central African countries can be divided into two major categories:

- the first category includes countries, which have truly started epidemiosurveillance activities Guinea, Senegal, Gambia, Chad, and Central African Republic;
- the second group includes countries where epidemiosurveillance activities will be operational in a very near future: Mali, Mauritania, Ghana, Niger, Togo, Benin and Cameroon.
- National Epidemiosurveillance Networks are moving very fast in the Region.

PRIORITY DISEASES UNDER SURVEILLANCE

Diseases under surveillance can be prioritised as follows:

- Priority 1= Rinderpest, Contagious Bovine Pleuro Pneumonia, Peste des Petits Ruminants
- Priority 2= Foot and Mouth Disease, Contagious Caprice Pleuropneumonia, African Hog Pest, Nodular Skin Diseases, Poxviroses
- Priority 3= Aviar Diseases, Zoonoses, Rift Valley Fever, Parasitoses

POLICY REFORMS AND PRIVATIZATION OF THE LIVESTOCK SECTOR

The policy reform and privatization of the livestock sector can be considered as a success in West and Central Africa. The achievements are presented as follows:

- generalised cost recovery for services rendered all over the Region;
- largely privatised import and distribution of drugs;
- modification of laws and regulations everywhere;
- private clienteles firmly established in many countries;
- sanitary mandates accepted in all countries.

PARTICULAR ISSUES TO BE EXAMINED FURTHER DURING THE IMPLEMENTATION OF PARC

The following issues need special attention:
- organisation of a steering scheme of the privatisation program
- technical support to private promoters in the field of training
- adequate use and consideration of the role of communication and sensitisation
- extension of activities to others than the sale of drugs and vaccination.

The epidemiological surveillance of diseases however supposes the availability of:
- surveillance in an efficient manner and to warn the diagnostic teams of laboratories and central veterinary services as soon as an outbreak of the disease occurs;
- diagnostic structures capable of rapidly identifying the disease;
- a unit of service specialised in the management of the surveillance network capable of animating the work of all agents involved, collecting the data, analysing them and diffusing the results.
- It is therefore evident that the association between field services and laboratories must be very close.

THE WESTERN SANITARY CORDON

In Central Africa, for the buffer zone, also called «Western Cordon<~the intervention will make possible the reasoned, coordinated and limited pursuit of vaccinations. It will mostly tend toward active research of the disease.

The common approach is based on the maximum resort of private veterinarians, the development and use of livestock auxiliaries as vaccinators in remote areas and to the wide use of thermostable vaccines for these regions. This principle has been accepted by the main states involved (CAR, Chad and Sudan).

The precise definition of sanitary cordon, both from geographical standpoint and from the standpoint of actions to carry out, has also been admitted.

EMERGENCY ACTIONS

An emergency fund« for the purpose of facing eventual resurgence of rinderpest in disease free zones has been set up. The continuation of regional stocks of vaccines will be considered on these funds.

In order to complete all this arrangements, the guidelines for the preparation of national rapid reaction strategies and plans for unforeseen events have been prepared by FAO jointly with OAU/IBAR/PARC.

The regional Coordination Unit for West and Central Africa has been strengthened by making available and epidemiologist, funded by the French Cooperation.

THE AFRICAN WILDLIFE VETERINARY PROJECT (AWVP)

BACKGROUND

The AWVP is a component of PARC, a well-established veterinary programme. It aims at eradicating rinderpest virus from Africa.

The project will establish systems to monitor rinderpest at the interface between wild and domestic animals. Samples from wild animal populations in endemic, cordon sanitaire and epidemic areas can provide data to clearly establish the status of rinderpest in the region. Recent and historical epidemics can thus be identified and mapped since the wildlife populations act as sentinels of the disease.

The information gained will add to the understanding of the present epidemiology and distribution of the virus remaining in Africa.

The absence of antibodies in wild ruminants will assist countries on the OIE pathway and be the final confirmation of the final eradication of rinderpest virus from Africa.

An additional and important aspect is capacity building through the training of in country professionals and establishment of a wildlife component of the PARC and future PACE epidemiology network.

Through this project considerable progress will be made in promoting better management of rinderpest and assist OAU in the ultimate eradication of rinderpest virus.

SURVEILLANCE OF RINDERPEST USING WILDLIFE AS SENTINELS

The specific objectives of this surveillance in East, West and Central Africa are:
- to collect samples from wildlife species susceptible to rinderpest in the Sanitary Cordon zone in and previously known endemic and epidemic zones;
- to train national staff in the field of specialised veterinary techniques regarding wildlife.

The study will cover four west and central African and four east African countries and will focus on west Africa, two countries in the cordon sanitaire namely Chad and CAR. Priority will be given to two other countries that are Burkina Faso and Democratic Republic of Congo. In E. Africa, Ethiopia, Uganda, Kenya, Tanzania, are priorities.

The sera will be analysed in four different laboratories using c-Elisa.

THE SOLUTION: PACE

Following twelve years of implementation, the PARC programme concluded on 31" March 1999. OAU/IBAR and the European Commission have developed detailed proposals for a new programme,

Pan- African Programme for the Control of Epizootics (PACE). The European Commission on 24 April has approved the PACE programme 1999,and project activities are expected to take off early in the year 2000.

OBJECTIVES

The programme's overall objective is to contribute to rural development and poverty alleviation by improving animal production with the help of and adequate framework to place animal health in a more secure footing. The programme will take advantage of the present stage of rinderpest eradication in order to put in place national and continental epidemiology networks for animal diseases, to provide country with the capacity to organise disease control programmes that are technically and economically sound and finally, to develop effective and sustainable distribution of veterinary products and veterinary services to enable this long term programme to be self financing. The programme in particular sets out to:

- strengthen the capacity to control animal diseases at all level and;
- set up national and Pan-African information systems on animal health

RESULTS

The results anticipated are:

- the reinforcement of national and Pan-African services to improve technical knowledge of animal diseases and their economic impact assessment, and to produce the most appropriate programmes for disease control;
- improvement of distribution of veterinary services and drugs to livestock producers through improved organisation of the privatisation of the veterinary services and the strengthening of public sector capabilities;
- eradication of rinderpest from Africa;
- improved targeting and more economically and technically efficient organisation of sustainable control of major epizootics and particularly CBPP;
- the setting up of a Pan-African Centre for the exchange of data on epidemiology and the economic of animal health.

COSTS

The programme is designed to start early in the year 2000,for a period of five years, and will cost 72 million EURO.

CONCLUSION

Rinderpest in Africa has not been reported from West and Central Africa for virtually twelve years. The strategy of the Pan African Rinderpest Campaign of the Organisation of African Unity-Inter African Bureau for Animal Resources is to support West African Member States to cease vaccination and join the OIE Pathway leading to a final eradication and freedom from rinderpest infection; to assist in the institution of effective cordon sanitaire; and for active disease searching. In effect, the whole of West Africa appears to be rinderpest free and has stopped vaccination. East Africa remains with 2 foci's – Sudan and Somali and vaccination will continue in this area with adjacent countries maintaining vigilance as they confirm eradication through epidemiosurveillance.

THE EPIDEMIOLOGY OF RINDERPEST IN WILDLIFE

Dr P. Rossiter, OAU/IBAR/PARC (FAO)

Introduction

Rinderpest has probably had more impact on man and his domestic livestock than any other animal disease. In its worst and most devastating form, "cattle plague", it can de-stock whole areas of cattle, impoverishing the owners and creating great hardship in rural communities. The causative virus can probably infect all cloven - hoofed animals and where it occurs can be the cause of serious disease in wildlife.

Etiology

The causative virus is a member of the genus Morbilliviridae in the Family Paramyxoviridae. Recent molecular studies have determined the entire nucleotide sequence of the virus (Baron and Barrett, 1995) and indicate that it may be the oldest morbillivirus from which the other members of the genus evolved (Norrby and others, 1985; Chamberlain and others, 1993).

Epidemiology

Infected animals excrete virus in all secretions and excretions from 24-48 hours before the onset of clinical signs until either death or after the development of high titres of antibody some 7 to 10 days later (Scott, 1964; Plowright, 1968). The virus is fragile and highly susceptible to inactivation by physical and chemical means and usually survives for only a few hours outside the host. Transmission, therefore, requires close contact between infected and susceptible animals. Airborne spread, other than for a few metres inside animal pens, has never been proven to occur over long distances outdoors; recovered animals are solidly immune for the rest of their life and never re-excrete the virus; indirect transfer of virus by vehicles, fodder, veterinarians etc. is rare, and arthropod-borne transmission is unknown.

Therefore, rinderpest is maintained and spread by the mixing of infected with susceptible stock. Virtually all new outbreaks can be traced to the introduction of unvaccinated stock especially trade animals, as several recent outbreaks in Africa and Asia have shown. The last confirmed outbreak of rinderpest in Western Europe was in Rome zoo following the importation of infected wildlife from Somalia.

At present it is generally accepted that the virus is maintained by continuous cycles of infection in domestic cattle and buffaloes. Earlier concerns about the role of small ruminants in southern India have been answered by the successful eradication of rinderpest from India through a programme based solely on the control of the disease in bovines. Wildlife become infected through contact with infected cattle as the result of abnormally close contact along the borders of wildlife preserves or at water points and grazing areas. This is more common in times of drought. It is well recognised that infected wildlife transmit the disease amongst themselves and can carry it over significant distances to re-infect cattle not epidemiologically linked to the original source of the infection (Carmichael, 1938; Plowright, 1968; Woodford, 1984). However, the main epidemiological question concerning wildlife and rinderpest is whether or not they are permanent reservoirs for the virus?

The role of wildlife in maintaining rinderpest was a long running debate in eastern Africa from the establishment of veterinary services at the turn of the 20th century until the widespread use of cell-

culture attenuated vaccine in the early 1960s. The current and generally accepted view of specialists who have worked on this subject is that wildlife are incapable of persistently maintaining the virus. The evidence for this comes from two sources; empirical observation and serology. The empirical evidence is that rinderpest has been eradicated from areas with significant wildlife populations in which the disease was often seen. For instance, wildlife did not prevent the eradication of rinderpest from Europe and Southern Africa over a hundred years ago, or from India and West and Central Africa during the past decade, though, admittedly, the wildlife numbers in these regions are much lower than in East Africa. (Although initially high, the wildlife population in Southern Africa crashed during the Great Pandemic of 1887-1896, probably to levels which could not sustain the virus, and they only recovered after the infection had been eradicated from cattle). In East Africa the debate focused mainly on one unique area - the Maasai grasslands of northern Tanzania and southern Kenya where high numbers of pastoral cattle range freely amongst the highest number of species of wild ruminants and pigs in the world, and the largest population sizes of such species in the continent. Rinderpest was endemic there from at least the 1930s to the early 1960s (Cornell and Reid, 1934; Branagan and Hammond, 1965). Mortality with clinical disease was noted annually or biannually in both wild and domestic stock and acted as a severe constraint on the population size of susceptible species especially buffalo and wildebeest in which the disease was referred to as "yearling disease". When effective immunization of cattle was carried out in the early 1960s with the newly developed cell-culture attenuated rinderpest vaccine (Plowright & Ferris, 1962) the virus was eradicated from cattle in the Maasailands. Simultaneously, the disease also disappeared from wildlife even though they were not vaccinated, and their populations began to increase in size immediately until finally checked by other limiting factors such as predation and food supply. Conclusive evidence came when serological surveys proved that all wildebeest and buffaloes born after 1963 were antibody negative (Plowright & McCullough, 1967; Taylor & Watson, 1967). Thus the virus had been eradicated from both cattle and wildlife in the Maasailands by the immunization of cattle alone and this excellent proof is the main evidence that East Africa's wild animals are not a permanent reservoir of infection with rinderpest virus. If the variety and numbers of susceptible species that exist in the Serengeti/Mara ecosytem cannot maintain the infection then, almost certainly, nor can the increasingly isolated and small wildlife populations elsewhere in Africa. To prove the point, this first eradication of rinderpest from the Serengeti was repeated again in 1982 when rinderpest was re-introduced to the buffaloes and other highly susceptible species such as eland and giraffe (Rossiter and others, 1983, 1987; Anderson and others 1990). Thus rinderpest has died out twice in Africa's largest wildlife concentrations following eradication of the disease in cattle through vaccination.

Modest prevalences of antibody to rinderpest in localised wildlife populations in Kenya were reported after the eradication of clinical disease from the Serengeti (Wafula and others, 1983; Rossiter and others, 1984, Plowright, 1987) but these, together with significant prevalences of antibody in sheep and goats, are now thought to represent unrecognised extensions of infection from nearby domestic cattle that did not cause epidemic outbreaks in the wildlife.

How long wildlife populations can remain infected after an epidemic is uncertain but evidence from the populations of several hundred thousand wildebeest and up to 60,000 buffalo in the Serengeti Mara suggests that even in these large populations the maximum the infection can probably last before dying out is only one or two years (Rossiter and others, 1987; Anderson and others, 1990).

The apparent absence of disease in cattle during the recent series of outbreaks of rinderpest in wildlife in Kenya, in the Tsavo National Parks during 1994-1995 and Nairobi National Park in late 1996 (Kock and others, 1999) re-opened the debate on the role of wildlife in the epidemiology of rinderpest. However, detailed investigation of the Nairobi outbreak found evidence of mild rinderpest existing in the cattle surrounding the park for one to two months before it was

confirmed in eland and buffaloes, and laboratory confirmed mild clinical disease was eventually found to be widespread in cattle throughout a large part of Southern Kenya between the Tsavo and Nairobi National Parks in late 1996. Both outbreaks affected animals of all ages in the prime target species of buffaloes, lesser kudu and eland (Scott, 1963, Plowright, 1968) and very high prevalences of animals with clinical signs were clearly visible in infected herds at the peak of infection. A survey of 23 buffaloes in Nairobi National Park in 1993 had not detected antibody to the virus (Rossiter and others, unpublished information) whereas serology carried out immediately after the 1994-1996 outbreaks revealed high titres of antibody in all animals sampled from affected herds but no antibodies in unaffected healthy herds ahead of the epidemic wave. Thus the outbreaks had all the hallmarks of epidemic and not endemic infection.

Molecular typing (Barrett and others, 1998) indicates that the virus responsible for these two outbreaks in wildlife is unique amongst the strains circulating in East Africa today and is extremely closely related to the RGK/1 strain isolated from a sick giraffe in eastern Kenya in 1962 (Leiss and Plowright, 1964). Currently, the search for the reservoir of this virus is focusing on the cattle of Somali speaking pastoralists in north-eastern Africa. Surveillance is difficult because the disease in zebu cattle, which has been confirmed in experimental studies (Wamwayi, unpublished), is much milder than that caused by other circulating strains of the virus. As a result, cattle keepers are insufficiently perturbed about the disease to report it to veterinary authorities. This is not a new phenomenon since strains isolated in the past from sick eland (Robson and others, 1958) and buffalo (Plowright, 1963) in the Maasailands were also shown to cause equally mild disease in cattle. Fortunately, these mild strains were eradicated from Maasailand when cattle populations were thoroughly immunised but it would appear than at least one strain survived in the more inaccessible pastoral-ecosystems of Northeast Africa.

One poorly understood aspect of rinderpest is interspecies transmission. In some wildlife outbreaks most of the highly susceptible species are involved either simultaneously or sequentially whilst in other outbreaks only some or perhaps one species is affected. Clearly factors influencing both the virulence of the strain and the contact rate between different species are involved.) Computer aided epidemiological modelling investigated the latter factor with a view to possibly predicting rinderpest epidemics and their progress in wildlife (Dobson,1995). This study hinged upon observations of the distances regularly measured between different species, and the logical assumption that transmission would be most likely to occur between susceptible species that were in close contact with each other. The measurements were made on apparently healthy populations but during the recent outbreaks in Kenya it was quickly apparent that sick animals had altered behaviour which would facilitate transmission to other species. Sick eland lagged behind or dropped out of their herds often becoming objects of curiosity to other species. On one occasion a herd of wildebeest grazed within a few feet of a severely affected eland and one wildebeest actually walked up to the eland and sniffed at its nose and discharges from less than a foot away (Rossiter, personal observations). Blind kudu left their groups and wandered away from their preferred habitat of confining bush into clearings such as roads and tracks, where they were very accessible to other curious animals. It had been frequently reported in the past that sick buffaloes remain around water holes increasing the chance of transmission to other animals that were forced to drink at the same point (Carmichael, 1938; Branagan, 1966; Plowright and others, 1964). So the altered behavior of the infected host may influence the probability of interspecies transmission. Almost certainly, intrinsic resilience of some species against the virus is also involved.

The virus also plays a role. In many parts of East Africa livestock owners and veterinarians know that outbreaks of mortality in warthogs are frequently due to rinderpest. The corollary of this has been that abundant healthy warthog populations have often been assumed to mean the absence of the disease. However, this assumption may have to be revised since healthy warthogs were seen

running through infected buffalo herds on more than one occasion in the recent Kenyan outbreaks but no affected warthogs were seen at any time. Since it is probable that warthogs are still highly susceptible to many strains of rinderpest virus it would seem that the lineage 2 virus circulating in East Africa at present is not particularly pathogenic for warthogs.

Another aspect of wildlife rinderpest that needs further clarification is the tendency to regard outbreaks of the disease involving several wild species as one epidemic though this may not be strictly the case. Once the virus has successfully crossed into a new species then the transmission dynamics and subsequent progress of the virus is determined by the population dynamics and distribution of that particular host species, as well as the ability of the virus to cause disease and to be shed by that species. For instance, when the virus becomes established in lesser kudu, it causes an epidemic in lesser kudu the geographical limitations of which are the geographical distribution of the lesser kudu, or at least of that density of lesser kudus which allows transmission, and is independent of re-introduction from other sources. An "epidemic" involving several species may in fact be a cascade of epidemics, which may have a common origin but are all moving entirely independently of each other. During the recent outbreak in Tsavo National Parks the distribution and sequence of cases in lesser kudus and in buffaloes suggested two separate epidemics. The buffalo epidemic was highly visible and spread very rapidly whereas the lesser kudu epidemic moved much more slowly and at times in different directions to the buffalo epidemic. Similar observations for buffalo and how they spread the disease to warthog and bushbuck were made by Carmichael, (1938). In contrast to the very obvious disease in buffaloes, the low-key way in which the disease can spread in lesser kudu suggests that epidemic disease in this species could spread through large areas without being recognised. Needless to say, when a severe epidemic in one species occurs in a conservation area where densities of many wildlife are high and contact between them frequent, the chances for interspecies transmission are highest and several species may become affected at that time and place giving the impression of a single "wildlife" epidemic.

Summary

Africa's wild ungulates can be affected by rinderpest and as recently as 1996 in Kenya have suffered severe losses from this disease. Infected wild animals spread infection amongst their own species and to other species including domestic livestock especially cattle. However, the virus rapidly dies out in these species following epidemics and there is no evidence that wildlife maintain the infection. Clinical evidence for this is supported by over 35years of serological observations from wildlife in East Africa. These show that antibodies to rinderpest virus are only found in recently infected wildlife and that antibody negative susceptibles soon begin to build up in herds following epidemics. There is no serological evidence of wildlife populations with high prevalences of antibodies in animals of all but the youngest ages which would be expected if they were maintaining the virus within their populations. Rather than being incriminated in the persistence of rinderpest in East Africa wildlife are valuable sentinels of disease that may be clinically unrecognizable in cattle, and because of this are making an important contribution to the eradication of rinderpest from Africa .

References

1. **ANDERSON, E. C., JAGO, M., MLEMGYA, T., TIMMS, C, PAYNE, A.. and HIRJI, K.** (1990) A serological survey of rinderpest in wildlife, sheep and goats in Northern Tanzania. Epidemiology and Infection, 105, 203-214.

2. **BARON M. D. & BARRETT, T.** (1995) The sequence of the N and L genes of rinderpest virus, and the 5' and 3' extra-genic sequences: the completion of the genome sequence of the virus. Veterinary Microbiology 44, 175-186.

3. **BARRETT, T., ROSSITER, P.B., WAMWAYI, H.M., KOCK, R. D., WAMBUA, J., and MWANZIA, J.** (1998). Rediscovery of the second African linege of rinderpest virus. Veterinary Record, 142: 24, 669-671

4. **BRANAGAN, D., 1966.** Behaviour of buffalo infected with rinderpest. *Bulletin of Epizootic Diseases of Africa*, 14, 341-342.

5. **BRANAGAN, D. & HAMMOND, J.A., 1965.** Rinderpest in Tanganyika: A review. *Bulletin of Epizootic Diseases of Africa*, 13, 225-246.

6. **CARMICHAEL, J.,** 1938. Rinderpest in African game. *Journal of Comparative Pathology*, 51, 264-268

7. **CHAMBERLAIN, R. W., WAMWAYI, H. W., HOCKLEY, E., SHAILA, M. S. , GOATLEY, L., KNOWLES, N, J. & BARRETT, T.** (1993) Evidence for different lineages of rinderpest virus reflecting their geographic isolation. Journal of General Virology, 74, 2775-2780.

8. **CORNELL, R.L. & REID, N.R., 1934.** Rinderpest in wildebeest. *Annual report of the Department of Veterinary Science and Animal Husbandry, Tanganyika Territory, 1933.* Dar-es-Salaam : Government Printer.

9. **DOBSON, A.** , (1995) The ecology and epidemiology of rinderpest virus in Serengeti and Ngorongoro conservation area. In: A.R.E. Sinclair and P. A "Serengeti II. Dynamics, Management and Conservation of an Ecosystem" pp485-505. Chicago, University of Chicago Press.

10. **KOCK, R. A., WAMBUA, J., MWANZIA, J., BARRETT, T., WAMWAYI, H. M., KOCK,N. & ROSSITER, P.** (1998). Rinderpest epidemics in wild ruminants in Kenya, 1993-1997. 145: 275-283

11. **LEISS, B. & PLOWRIGHT, W.,** 1964. Studies on the pathogenesis of rinderpest in experimentally infected cattle. I. Correlation of clinical signs, viraemia and virus excretion by various routes. Journal of Hygiene, 62, 81-100.

12. **NORRBY, E., SHESBERADARAN, H., McCULLOUGH, K.C., CARPENTER, W. C. & ORVELL, C.,** 1985. Is rinderpest the archevirus of the morbillivirus genus? Intervirology, **23**, 228-232.

13. **PLOWRIGHT, W.,** 1963b. Some properties of strains of rinderpest recently isolated in East Africa. Research in Veterinary Science, 4, 96-108.

14. **PLOWRIGHT, W.,** 1968. Rinderpest virus. Monographs in Virology, 3, 25-110

15. **PLOWRIGHT, W.**, 1987. Investigations of rinderpest antibody in East African wildlife, 1967-1971. Revue Scientifique et Technique de L'Office des Epizooties, 6, 497-513.

16. **PLOWRIGHT, W. & FERRIS, R.D.**, 1962. Studies with rinderpest virus in tissue culture. The use of attenuated virus as a vaccine for cattle. Research in Veterinary Science, 3, 172-182.

17. **PLOWRIGHT, W., LAWS, R.M. & RAMPTON, C.S.**, 1964. Serological evidence for the susceptibility of the hippopotamus (Hippopotamus amphibius Linnaeus) to natural infection with rinderpest virus. Journal of Hygiene, Cambridge, 62, 329-336

18. **PLOWRIGHT, W. & McCULLOUGH, B.**, 1967. Investigations on the incidence of rinderpest virus infection in game animals of N. Tanganyika and S. Kenya 1960/1963. Journal of Hygiene, Cambridge, 65, 343-358.

19. **ROBSON, J., ARNOLD, R.M., PLOWRIGHT, W. & SCOTT, G.R.**, 1959. The isolation from an eland of a strain of virus attenuated for cattle. Bulletin of Epizootic Diseases of Africa, 7, 97-102.

20. **ROSSITER, P.B., JESSETT, D.M., WAFULA, J.S., KARSTAD, L., CHEMA, S., TAYLOR, W.P., ROWE, L., NYANGE, J.C., OTARU, M., MUMBALA, M. & SCOTT, G.R.**, (1983). Re-emergence of rinderpest as a threat in East Africa since 1979. The Veterinary Record, **113**, 459-461.

21. **ROSSITER, P.B., TAYLOR, W.P., BWANGAMOI, B., NGEREZA, A.R.H., MOORHOUSE, P.D.S., HARESNAPE, J.M., WAFULA, J.S., NYANGE, J.F.C. & GUMM, I.D.**, 1987. Continuing presence of rinderpest virus as a threat in East Africa 1983-1985. The Veterinary Record, **120**, 59-62.

22. **ROSSITER, P.B., KARSTAD, L., JESSETT, D.M., YAMAMOTO, T., DARDIRI, A.H. & MUSHI, E.Z.**, (1982). Neutralising antibodies to rinderpest virus in wild animal sera collected in Kenya between 1970 and 1981. Preventive Veterinary Medicine, **1**, 257-264.

23. **SCOTT, G.R.** 1964 Rinderpest. Advances in Veterianry Science, **9**, 113-224

24. **TAYLOR, W.P. & WATSON, R.M.**, (1967). Studies of the epizootiology of rinderpest in blue wildebeest and other game species of Northern Tanzania and Southern Kenya, 1965-1967. Journal of Hygiene, Cambridge, **65**, 537-545.

25. **WAFULA, J. S., MUSHI, E. Z. & KARSTAD, L.** (1983) Antibodies to rinderpest virus in the sera of some wildlife in Kenya. Bulletin of Animal Health and Production, **30**, 363-365.

26. **WOODFORD, M. H.** (1984) Rinderpest in wildlife in sub-sahelian Africa. Consultancy report, pp 60. Rome, Food and Agriculture Organisation.

WRITTEN PRESENTATIONS

RINDERPEST IN WILD RUMINANTS

Dr Richard Kock OAU/IBAR AWVP

Clinical and pathological features of RINDERPEST epidemics in wildlife with reference to lineage II strains

The disease in wild ruminants is epidemic in nature - there is no reservoir status. If a high proportion of animals in a wild ruminant herd are ill or dying, rinderpest must be suspected in the differential diagnosis.

Buffalo

The initial signs include; malaise and diarrhoea. In remote areas usually shy animals are more approachable and even aggressive. On physical examination of early cases, the animals are found to be febrile (40° - 41°C) and dehydrated. There are shallow erosions of one to two centimeter (cm) diameter on the margins of the nares, lips, tongue and on the buccal mucosa. In more chronic cases erosions are less discrete, with fissuring of mucosa, necrosis and a fetid smell. Leucopaenia, lymphopaenia and neutropaenia are recorded from early cases progressing to leucocytosis (with in certain cases lymphopaenia or anaemia).

As the disease progresses, the herd looks in poor coat and body condition, with marked weakness and emaciation. Dermatoses are sometimes severe and extensive in young animals, tenesmus and projectile, watery diarrhoea, nasal discharge and crusting of the nares were common. In a number of animals, discrete skin lesions can be seen, one to two cm in diameter, plaque like with some verrucose and keratinized. Abortion may occur. Peripheral lymph nodes in chronic cases are noticeably enlarged and in the eyes; keratoconjunctivitis, corneal ulcers, uveitis, iritis and cataract can be seen In herds recovering from the infection, fresh or healing wounds, probably from lion are frequently seen on the backs of the animals.

Post-mortem examination shows in many cases, severe dehydration, emaciation, oral erosions, gastroenteritis with intestinal mucosal haemorrhages, ulceration of the abomasal mucosa along folds of the fundus, and at the ileocaecal junction; with lymphadenopathy. A number of animals during recovery from the initial virus infection have chronic skin and ocular lesions as observed clinically.

Lesser Kudu

The most consistent clinical sign in the lesser kudu is blindness and marked tear staining of the face. Kudu usually are extremely secretive and difficult to observe, but when affected are seen standing segregated from others, clearly disoriented and bumping into objects. Animals may even have swellings around the knee and hock joints. Animals may be in good body and coat condition but febrile (41 - 42°C) and dehydrated. Oral lip and buccal erosions are recorded on a few occasions but diarrhoea is rare. Morbidity and mortality are high, so most groups in an epidemic area are affected over a period of weeks and many carcasses and more usually skeletons are seen. Haematology includes lymphopaenia or mild to moderate lymphocytosis. High packed cell volume of up to 75% can be recorded due to severe dehydration.

At post-mortem examination; epiphora, severe ulcerative keratoconjunctivitis, corneal opacity, uveitis in one or more usually both eyes, synovitis and tenosynovitis around the radial and tarsal joints can be recorded. Grossly there can be; pneumonia, lymphadenopathy, gastro-enteritis and

congestion ("zebra striping") in the colon; the liver and gall bladder enlarged and the kidneys hyperaemic.

Eland

Affected eland tend to hang back from the herd, are depressed and inappetant. There can be marked tearing from both eyes and opacity with staining and crusting of the facial hair. Diarrhoea can be present in a few cases but not obvious as with buffalo. Severely affected animals are dehydrated, emaciated and unable to move far. Erosion and necrosis of the buccal mucosa are evident with a cheese like appearance.

At post-mortem examination, the oral erosions can extend into the oesophagus in some cases. Lymph nodes are enlarged, congested and oedematous. There is usually mild to severe gastro-enteritis with abomasal ulcers of approximately one cm diameter, congestion and petechiation of intestinal mucosae especially around the peyers patches which were enlarged. Faeces are usually soft even if diarrhoea is absence. Gall bladder, liver and splenic enlargement and congestion can be recorded. The lungs were emphysematous and with patchy consolidation in some cases.

Histopathology

Histopathology is useful in diagnosis. Single cell necrosis is found regularly among epithelial cells in many tissues in buffalo, kudu, and eland, with striking syncytia in kudu, and occasionally in eland. The most striking histopathological lesions occur in the lesser kudu, where individual epithelial cell necrosis can be found in renal tubules, abomasum, small and large intestine, lung, conjunctiva, and salivary, pancreatic and bile ducts, often with the formation of syncytial cells. The most chronic lesions were present in the conjunctiva, possibly indicating the point of viral entry. Single cell necrosis can also be found in renal tubules, salivary ducts, abomasum, small and large intestine and conjunctiva in buffalo, but typically without syncytia. Epithelial cell necrosis is present in oesophagus, abomasum, and small and large intestine in eland, with syncytia only found in the small intestine. Lymph nodes and spleen in all three species often has haemosiderin deposits, suggesting prior hemorrhage, either in the lymph nodes, themselves, or in the tissues of drainage. lymphoid necrosis typical for rinderpest in cattle is not been reported.

Other species can be affected and they will show a variety of lesions and pathology as described above.

The clinicopathological picture of rinderpest in buffalo appears similar to cattle with commonly corneal opacity; keratoconjunctivitis, corneal ulceration, uveitis, cataract (significant features also in kudu and other species) and a range of skin lesions. The skin disease is probably associated with the immunosuppression caused by the virus exacerbating latent infections.
The eye pathology in buffalo and kudu is particularly significant as even in animals recovering from the acute phase, the effect of the blindness resulted in abnormal behavior, physical trauma (e.g. joint swellings in kudu) and death through inanition, predation and even from drowning in mud pools. Data from kudu with more chronic lesions in the eyes, suggests that in this species, the conjunctiva is the point of viral entry.

From gross and histopathology, it is suggested that the pathogenesis in all species which have died from the disease (i.e. examined post-mortem) is short, with frequently severe and life threatening pathology and few chronic changes.

Mortality

This can vary according to species, density and stage of the epidemic. Buffalo mortality can vary from as little as 25% (at the end or with small herd sizes) to as much as 60% (with herds of 300 or more and at the height of the epidemic). Lesser kudu mortality appears higher up to 80% where there is a contiguos population. Solitary animals or populations at low density and with a small herd size are likely to suffer lower mortalities at the population level. There is also evidence of resistance to infection by certain species and this may be true for e.g. gazelle but in fact this may relate more to likely contact rates between infected individuals; a factor of individual species social organisation.

Problems of diagnosis

Delay in diagnosing rinderpest virus infection in wildlife is a result of a number of factors.

- The epidemic nature of the disease may not immediately be apparent with the inherent difficulties of observing sick wild animals, insidious spread with sporadic mortality and a lack of reported involvement in vaccinated domestic cattle populations, with lineage II strains.
- The epidemics appear to occur with drought which is associated with increased invasion of wildlife areas by cattle, contact at pasture and at scarce water resources. With high ambient temperatures (~35°C) carcasses are often too putrefied for useful diagnostics or little is left to examine, after scavengers had eaten their fill within hours of death.
- Sick animals if sampled, are usually moribund, euthanased or in the recovery phase of the disease and probably no longer shedding virus.
- The problem only comes to people's attention where large numbers of animals have died, scavengers were satiated and rapid decomposition had led to a stench especially concentrated around water holes. Dehydration is a clinical feature and sick buffalo tend to stay near the water. This is not the case with kudu or eland. Kudu and eland obtain much of their water requirements from browse.
- In species other than buffalo lesions may not immediately suggest rinderpest.
- As the disease may spread in different species at different rates there may not be coincident mortality.

Standard diagnostic tests can be applied with wild ruminants including serology - VNT, Elisa and c-ELISA; antigen tests, AGID; virus isolation; immunohistochemistry and PCR. Due to the difficulty in obtaining fresh samples i.e. antigen in wild ruminants and the relative insensitivity of ELISA to lineage II virus antibody; VNT is probably the best routine test on live animals and histopathology/electron microscopy on dead animal tissues fixed in buffered formal saline.

Epidemiology and surveillance

There appears to be distinct phases of infection in each species during an epidemic, suggesting the virus enters each population and spreads at a rate determined by the respective density, social structure and behavior. Buffaloes congregate in herds of mixed sex, in tens to several hundreds of animals. Aged bulls are usually solitary or in small bachelor herds. The tendency to congregate has a seasonal basis with increased concentration of animals before the rains around water sources. After rain and the resultant vegetational flush the animals tend to disperse over a wide area in suitable habitat. Besides the seasonal patterns of movement, buffalo are considered to be resident to a particular area from year to year and in some areas they hardly move at all. This explains the more explosive pattern of disease in buffalo, followed some months later in kudu. Kudu are a highly residential, non territorial species and animals from different family groups meet casually, with

males more likely to move between groups. They live in small family groups of perhaps 5-7 individuals and older males are usually solitary. Densities in optimum habitat are approximately one per 50 Ha. There is minimal seasonal movement from high to low ground during the rains. The low population density and lower contact rate between individuals probably slows the spread of infection. Eland in contrast are highly mobile with home ranges of 1-2000 km^2 and might be significant in the spread between concentrations of other more resident wildlife and cattle. Herd sizes vary and mix freely with concentrations of hundreds of animals usually during rains. Eland are often seen in association with other species.

Other species may be affected in an epidemic e.g. giraffe, bushbuck and impala but are likely to be dead end hosts with little impact on the spread of disease. Lineage I is known to impact warthog and this may be a good indicator of disease for these strains but lineage II virus does not appear to favour pigs. The families Alcelaphinae, Gazellinae, Reduncinae and Hippotraginae were not apparently affected during the outbreaks with lineage II in 1962 nor 1994.

There is a risk of virus transmission between wild ruminants and cattle (and between different species) but interspecific transmission may be the exception due to extreme circumstances such as drought. The insidious spread of the virus over more than a year recorded in outbreaks confirms the importance of species like buffalo, eland and kudu in the epidemiology of rinderpest in Africa.

Serology is critical to understanding the epidemiology of the disease in wildlife. Retrospective serosurveillance after an epidemic provides the likely point of entry into wildlife populations and other important information on the spatial and temporal aspects of the epidemiology. The usual approach is purposive sampling (age stratified). Surveillance of populations in general provides important information on past epidemics and local disease status. Samples from animals born after epidemics and which are seronegative, supports claims that wild animals do not act as a reservoir.

Control measures need to be applied vigorously and strategically using surveillance techniques to monitor and map the spread of infection and identify enzootic foci. Wild animal populations act as sentinels of the disease which will assist in developing strategies for and confirming the eradication of the virus from Africa. This is the basis for developing a network of competent persons and institutions in Africa to tackle these issues. The AWVP is an initial phase in this process.

RECOMMENDED PROCEDURES FOR DISEASE AND SEROLOGICAL SURVEILLANCE AS PART OF GLOBAL RINDERPEST ERADICATION PROGRAMME

Dr Roland Geiger, OAU/IBAR

Rinderpest eradication strategy

Different areas:

- Where vaccine stopped - any foci remaining?
- Where vaccination intensified - is the vaccine cover adequate?
- Infected areas - which pops affected is vaccination being carried out properly?

In relation to wildlife we want to know if the disease is present or absent (or has been present during the life of the population)

OIE Pathway : a series of steps to follow for being declared officially free of rinderpest.

How to detect rinderpest?
- after the incubation period, starts with fever, follows with symptoms
- after infection, we get antibodies (Ab) which last the whole life. These Ab will allow to detect the disease.

We do make the difference between Ab from the infection and Ab from the vaccination. With livestock we must stop the vaccination to know if the Ab are from the disease. With wildlife, as it is not vaccinated, we do not have this problem. But the offspring of cattle do not have vaccination Ab. However, if we find young cattle with Ab, it means the disease is still present.

The probability of detecting the disease increases with time during the 5 year OIE pathway.

Disease surveillance :

a) Disease reporting

- clinical signs reported
- persons involved
- monitoring and evaluation
- incentives and penalties

b) Random sample survey

- Survey sensitive enough to detect disease with a probability of 95% if the disease is present in 1% of sampling units. A certain % of samples is necessary, according with the prevalence rate of the disease: 300 herds must be sampled in a given country for 1% prevalence, 50 herds for 5% prevalence. We are talking of herds, not individuals.
- Inside a particular herd, we have the same kind of sampling consideration. In a herd, we sample 20% of the animals for 1% prev and 95%CL.
- With 1% prevalence, for 95% confidence, we need to sample 300 herds, (nearly) independently of the global size of the population, because the probability of detection is nearly the same for

1000 or 5000 animals.

c) Purposive sample survey

It is very difficult to have a statistical confirmation of the absence of the disease

The clinical diagnosis must always be confirmed by the lab.:
- detection of antigens (Ag)
- detection of the Ab
- isolation of the virus.

Outbreak investigation :
- epidemiological investigation
- clinical examination
- sample collection
- lab testing

"SURVEILLANCE IS DATA FOR ACTION!" = no need of surveillance if there is no action afterward.

FIELD AND LABORATORY PROCEDURES FOR WILDLIFE DISEASE DIAGNOSIS

D. Mudakha, KWS

Field laboratory set up: checklist of equipment and chemicals needed

Haematology: need of standardization, taking into account if the animal has been shot or drug immobilized.

Biochemistry: careful preparation of samples, including anticoagulant, centrifugation, cold storage, etc

Parasitology: collection, preservation and examination of samples (take to the field 5% formalin)

Bacteriology: sampling, staining after fixing smears

BACTERIOLOGY

INTRODUCTION

Pathogenic Bacteria can only cause disease if they have the right conditions. The organisms must be in the right part of the body to cause disease. The organisms must enter the body in sufficient numbers and must be virulent i.e. multiply quickly producing toxins. The ability of different organisms to either varies greatly. Provided these conditions are fulfilled, pathogenic bacteria cause diseases in two stages:

- Incubation period: There is invasion of the organisms multiplication and spread in the body. This may last a few days or weeks. During the incubation period the animal will show signs of illness.

- Secondly there is a release of bacterial toxins that often spread in the body. At this stage the disease becomes evident. Often there is fever, pain and inflammation depending on the actual disease

In some chronic diseases this second stage may not be well defined. In some cases it may take a long time before the animals start showing signs or the animal may be overcome by the disease in the end.

LABORATORY IDENTIFICATION OF BACTERIA

The following are the main ways in which bacteria are usually identified in the laboratory.

- By examining the bacteria directly under the microscope and other characteristics which include shape, size and movement and others are characteristics such as tendency to form chains or pairs. Phase contrasts and dark ground illumination are of value for this
- By examining the bacteria in a stained specimen for their structure and their reaction to different stains
- By culturing the growing organisms using culture media each different medium encouraging the growth of special organisms and so identifying them by growth characteristics or cultural reactions.
- By testing the antibodies which may be found in the patient's serum, these having been produced in response to bacterial invasion.

NATURE OF SPECIMENS

The following are the kind of specimens, which may be taken to the laboratory for their examination:

- **Urine:** This is for organisms which may cause urinary tract infections
- **Faecal:** For organisms that cause intestinal infections
- **Cerebrospinal fluid:** For organisms affecting the spinal cord and the brain
- **Blood:** For organisms causing bacteraemia
- **Aspirates:** Aspirates are collected by using a needle and a syringe from abcessses, cysts, thoracic and abdominal and joint cavities.
- **Skin scrappings:** For culture of fungi

Specimen containers

In the field the recommended types of containers are for different specimens and may not always be available. However containers used should be suitable and properly labeled and sterile if the specimen is for culturing. The containers must be securely closed by screw caps or well fitting stoppers so that the specimens can neither leak nor allow other organisms to enter

BACTERIOLOGICAL TECHNIQUE

The handling of bacterial specimens requires special techniques and it is important that laboratory workers ore well trained to avoid transferring bacteria from one specimen to another and to prevent infection of themselves or others. Bacterial contamination of specimens can be avoided if the following general rules are followed:

- That the cotton wool plugs or the lids removed are not placed on the bench, but kept between the last two fingers and the rims of the tubes or bottles are sterilised by flaming before the lids are replaced.

- That wire loops or needles or forceps or scalpel blades are sterilised by flaming before and after being used for innoculating or touching culture media.
- That all pipettes are plugged with non-absorbent cotton wool and sterilised before use.
- All petri dishes and articles used in preparing culture media are properly washed and sterilised.
- Laboratory staff should wear protective clothing such as laboratory caps, gloves and wash their hands after handling infected specimens.
- Do not eat, smoke or drink in the laboratory.
- Any infectious material accidentally spilt on the bench or on the table should be wiped with a disinfectant
- All bacterial cultures and infected glassware after use should be discarded into a suitable disinfectant container and autoclaved before being washed up.
- Laboratory benches and equipment used in the work should be wiped with a suitable disinfectant by the end of each day's work.
- Laboratory staff should be vaccinated against rabies and tuberculosis if possible

PREPARATION OF SPECIMENS FOR STAINING

Before being stained bacterial smears must be fixed. This is usually done by passing the slide smear upwards three times through the bunsen flame. The smear must be allowed to cool before being stained.

Methylene blue staining method

Methylene blue stains bacteria blue showing their morphology. It demonstrates well the bi-polar staining of the organisms.

Procedure

- Cover the fixed smear with methylene blue for 3 minutes.
- Wash off with tap water and stand the slide on the need in a draining rack to dry.

Results

Organisms stain blue

GRAMS STAINING METHOD

Those organisms which, after being washed with acetone remain stained dark blue with the crystal violet or methylene violet are called gram positive. Those which are decolourised by acetone are coloured red with the counter stain arid are called gram negative.

Procedure

- Cover the fixed smear with crystal violet for 30 seconds to 1 minute.
- Replace the Stain lugols iodine for 30 seconds to 1 minute without washing in water.

- Wash off with acetone for a few seconds until there is no more colour running off the smear.
- Wash the smear with water.
- Cover with neutral red for 2 minutes.
- Wash off with water and Stand the slide on a draining rack to dry.

Results

- Gram positive organisms stain dark blue.
- Gram negative organisms stain red.
- Nuclei of WBC stain red.
- Epithelial cells slain rod.

Reporting of the gram smear

Whether the bacteria art gram negative or positive.
The numbers of bacteria present are reported as moderate or few.
The morphology of the bacteria
Whether WBC's present contain intracellular bacteria

BIOCHEMISTRY

INTRODUCTION

It is essential to have good quality samples. Poor samples may give rise to inaccurate or misleading results or even to no results at all. The most important factors are:

- Good sampling technique to minimise stress to the animal and to avoid hemolysis. Both can significantly alter the level of certain constituents in the samples.
- Thorough mixing of the blood with an adequate amount of an anticoagulant such as lithium heparin in inhibit fibrin production.
- Lithium heparin bead tubes may work better than the more common 'coated' green top tubes. The beads allow a better mixture of the heparin through out the sample.
- Prompt centrifugation to avoid sample deterioration and changes in certain blood constituents
- Minimum delay between analysis and centrifugation, fibrin can continue to form in the sample despite the presence of an anti coagulant and can lead to the blockage of the micro bore tube of the pipette tip.
- Analysis must always be carried out on freshly centrifuged samples.

USE OF PLASMA OR SERUM

The use of plasma or serum is recommended in biochemistry but it should be remembered that the time taken for blood to clot and retraction to take place may exceed one hour and hemolysis is more likely to occur.

Certain analytes may pass from red cells to the serum during the clotting process e.g. lactate dehydrogenase and inorganic phosphate. Also an acceptable degree of glycolysis may occur.

ANIMAL PREPARARTION

Fasting

Blood samples should be taken from animals, which have been fasted for at least 5 hours. However, it is difficult to be sure when animals, cats in particular last ingested food.

The effect of feeding on most test results will be small compared with changes seen in disease unless a large meal has been ingested within 5 hours of testing.

The tests which are most likely to show important increases after ingestion of food are:

- Cholesterol
- Glucose
- Inorganic phosphate
- Triglycerides
- Urea

STRESS

An animal should be in a calm environment. Significant changes attributable to stress may be seen in the concentration of plasma glucose and those tests, which are affected by hemolysis.

Tests that show increases are:
- Aspartate amino transferase (AST or SGOT)
- Creatinine kinase (CK)
- Glucose (GLU)
- Lactae dehydrogenase (LDH)
- Inorganic phosphate (PHOS)
- Magnesium(Mg)

NB: At present there is no evidence to show that the time of the day at which a sample is taken has a significant effect on the result of any test.

SAMPLE PREPARATION

It is very important to maintain consistency for a good sampling technique in order to yield good quality samples for testing. The procedure should be straight forward, fast and cost effective.

Anticoagulants

Use only lithium heparin. Other anticoagulants may interfere significantly with test results. Note that the relationship between the amount of anticoagulant in the blood tube and the volume of

blood contained is an important factor. It is recommended that blood tubes should be no more than half filled to ensure there is adequate anticoagulant.

Taking the sample

Venous blood should be drawn smoothly but quickly to minimize stress and the risk of hemolysis. Remove the needle flow the syringe and dispose of carefully. Gently dispense the blood without delay into a tube containing lithium heparin, pro-marked patient identification i.e. date and the time sample was taken. Cap the tube tightly. Gently invert the tube continuously for 15 seconds. The anti coagulant must mix with the blood. During the mixing check that the air bubbles or blood

are not trapped at the end of the tube.

NB: Never shake the tube. Vigorous agitation will cause hemolysis, which may interfere with the analysis.

It is recommended that blood samples are centrifuged immediately after collection. However if this is not possible, then store between 4°C and 8°C in the dark and centrifuge within an hour. For some of the tests blood must be centrifuged immediately.

SAMPLE HANDLING AFTER CENTRIFUGATION

Aspartate amino transferase (AST)

Blood samples must be centrifuged immediately after collection. Slight hemolysis can cause a marked increase in plasma AST activity.

Calcium

Avoid exposure of the sample to air.

Creatinine kinase (CK)

Blood samples must be centrifuged immediately after collection. Slight hemolysis can cause marked increases in plasma CK activity.

Glucose(GLU)

Blood samples must be centrifuged immediately after collection. In lithium heparin glycolysis occurs in the presence of red cells. The glucose content can diminish at the rate of 10% an hour at 20°C.

Lactate dehydrogenase (LDH)

Blood samples must be centrifuged immediately after collection. Slight hemolysis can cause a marked increase in plasma LDH activity.

Magnesium (Mg)

Blood samples must be centrifuged and analysed immediately. Hemolysed samples can give erroneously high magnesium concentrations.

Ammonia (NH3)

Blood samples must be centrifuged and analysed immediately after collection. Avoid exposure of the sample to air. All sample containers should be capped unless sample is being withdrawn. This is to ensure that loss of ammonia or contamination does not occur.

Inorganic phosphate (PHOS)

Blood samples must be centrifuged immediately after collection as phosphates art released quickly from the red cells. Hemolysed samples can give erroneously high phosphate concentrations.

Total bilirubin (TBIL)

Blood samples must be centrifuged immediately after collection. If immediate analysis is not possible the plasma must be removed and stored in the dark as bilirubin degrades fast in the light

Total protein (TP)

Hemolysed samples can result in raised plasma protein concentrations.

CENTRIFUGATION

Correct centrifugation is a vital step in sample preparation. A high spin speed e.g. 12000 - 16000 rpm and a spin length of 1 - 2 minutes is recommended for the proper sedimentation of fibrin. Do not centrifuge blood until it has thoroughly mixed with the anticoagulant. When you are ready to centrifuge the blood sample transfer it by means of a disposable pipette into a centrifuge tube. Draw the blood carefully into a pipette. Transfer it gently to avoid hemolysis. Following centrifugation, the sample should be visually inspected. Care should be taken not to disturb the red cells. It is essential that there should be minimum delay between centrifugation and analysis. If there is any delay of even 5-10 minutes fibrin may begin to form and precipitate. It is then vital to recentrifuge immediately before the analysis.

CENTRIFUGED SAMPLE INSPECTION

It is important to examine the sample carefully following centrifugation. Visual inspection of the sample may provide guidance as to the choice of tests to be performed.

Hemolysed sample

Sample has a transparent reddish hue. This colour may range from pink to deep red. Hemolysis indicates damage to the red cells during sample preparation or intravascular hemolysis. Total bilirubin and hematocrit tests should be considered.

Icteric sample

Plasma has a transparent yellow to opaque brown colour. Icterus indicates obstructive or toxic liver disease, intravascular hemolysis. Liver enzyme and total bilirubin tests should be performed.

Lipaemic sample

Sample has a pale milky appearance possibly with floating fat globules. Lipaemia indicates recent ingestion of a fatty meal, dysfunction of lipid metabolism. Lipid and liver enzyme tests should be performed.

Buffy coat

A layer of white blood cells at the interface of plasma and packed red cells. A thick buffy coat suggests the presence of a large number of white cells in the sample.

SAMPLE STORAGE

It is recommended that blood samples are centrifuged and analysed immediately after collection.

Storing blood

If h is not possible to centrifuge and analyse immediately then it should be stored between 4°C to 8 °C in the dark and centrifuged within one hour but for some tests the blood must be centrifuged immediately.

Storing plasma

If it is not possible to analyse immediately the plasma must be removed from the red cells. Do not pour off the plasma. When you are ready to transfer the plasma transfer it by means of a disposable pipette to a fresh centrifuge tube. Take care not to draw up white or red cells. Avoid frothing at any stage as this damages plasma proteins. Transfer plasma in cryo-vials of at least 2mls for storage premarked with patient identification and date. A plasma sample may be stored for upto 6 hours between 4 °C to 8°C for long term storage freeze from - 18 °C to -86°C.

ANALYSIS OF STORED PLASMA SAMPLES

This applies to all samples stored between 4°C to -18°C. Allow the sample to come to room temperature. Mix gently but thoroughly by inversion. Do not shake. Centrifuge the sample at room temperature. This is because during storage fibrin particles may have formed.

PARASITOLOGY

Parasites inhabiting the digestive tract and the biliary and urinary systems produce eggs, larvae or cysts that leave the body of the host by way of the faeces or urine. Occasionally even adult parasites may be seen in the faeces, especially when the host has enteritis. Parasitic worm eggs or larvae from the lower respiratory system are usually coughed into the pharynx and swallowed after

which they appear in the faeces. Many parasitic forms seen in faeces have characteristic morphology that is diagnostic for a particular species of parasite.

On the other hand certain worm parasites produce eggs that may be recognised as those of nematodes, flukes or from tapeworms but cannot easily be separated as to that extent of species origin. Mange or scab mites may be licked or imbibed from the skin, thus accounting for their appearance in the faeces. Faecal examination may also reveal to a limited extent the status of digestion as shown by the presence of undigested musle, starch or fat globules. Animals may swallow certain objects that may resemble parasite forms. These are known as pseudoparasites and they include such things like pollen grains, plant hairs & grain mites Mould spores and a variety of harmless plant and animal debris. Parasite eggs and cysts from one species of host may be found in faeces of a scavenger or a predator host as a result of coprophagy.

COLLECTION OF FAECAL SAMPLES

Fresh samples should be used whenever possible. Old samples may become dehydrated making suspension difficult. Also worm eggs or coccidia oocysts may undergo development like hatching or disintegration to such an extent as to interfere with diagnosis. Faecal samples should be collected in suitable containers. It is suggested that the containers should be clean, wide mouthed, screw-capped or stoppered jars of at leant 60ml capacity.

Spatulas are suitable for picking up samples but a sample taken directly from the rectum is the best especially during immobilisation of animals. If faecal material is to be transported for more than a few hours it must be preserved. A 10% buffered formalin solution may be added to saturate the sample. Refrigeration at 4°C to 8°C will also keep samples in good condition for several days.

Cool boxes packed with ice packs are also used to preserve a sample for a couple of days. Faecal samples to be shipped by postal services or other means should be preserved and enclosed in leak proof containers. Proper identification of each sample using a label or tag is necessary.

GROSS EXAMINATION

Gross examination should always be done for the detection of living or dead worms or for the detection of segments of tapeworms. Oily or soapy substances in samples will indicate that microscopic examination will be difficult or even impossible.

MICROSCOPIC EXAMINATION

Many techniques for microscopic examination have been described before:

The Simple Smear Technique

This technique is better than examination at all, but it has disadvantages. It should be used only

when very small samples are available or when lack of equipment or time prevents the use of a more accurate technique.

Procedure

- Place a microslide on a small piece of newspaper
- Place a drop of water on the centre of the slide
- With a toothpick or any other simple instrument detach from the faecal sample a small sample of about 3mm diameter.
- Mix the sample with a drop of water on the slide until the suspension is cloudy but not so much that the newsprint cannot be read through it. Using fine pointed forceps remove any larger bits of debris that may be present.
- Gently lower the coverslip onto the slide.
- Examine systematically under low and high magnification for details.

QUANTITATIVE CONCENTRATION METHODS

These are of greater value in routine clinical diagnosis. They will detect most alimentary canal parasites and some of those from the respiratory tract as well. They also aid in the diagnosis of certain manges of canines and felines.

Qualitative methods are reasonably rapid and are of value for the detection of certain parasites of most animals. Faecal examination methods can and should be conducted in such a manner as to avoid any contamination of the laboratory.

To prevent the dissemination of odours the samples should be kept covered as much as possible. Concentration of parasite eggs or oocysts from maybe accompanied in a number of ways. All methods depend on mixing a faecal sample with a liquid whose specific gravity is greater than that of most such forms but less than most of the faecal debris. Thus the parasite forms vise to the top of the floatation fluid by gravity a process that may be hastened by centrifugation

Floatation fluids may be of various compositions. Those most commonly recommended include heavy solutions of sodium chloride or sucrose, glycerine, zinc sulphate, zinc acetate, sodium nitrate, sodium acetate or magnesium sulphate. None of these solutions are ideal for these purposes. Glycerine has too high viscosity, but tend to dehydrate and thus distort parasite forms.

They also crystalise rather quickly on the microslide. Solutions with a high specific gravity (sp. gr. 1.400) will float too much debris defeating the purpose for which they are intended.

SUGAR FLOATATION TECHNIQUE

Our experience has shown that sugar solution with a specific gravity of 1.200 to 1.300 is

the most satisfactory floatation fluid available for routine qualitative clinical faecal examinations and employing centrifugation. This solution will fail to float operculated eggs tapeworms, flukes. This is not a serious objection because tapeworms usually leave the host within the worms proglottids which may be seen grossly in the faeces.

MATERIALS

- Centrifuge
- Coverslips
- Forceps
- Floatation fluid
- Glass marking pencil
- Spatula
- Paper towel
- Waste container
- Wire loop
- Microscope
- Microslide
- Paper cups
- Strainer
- Test tubes
- Test tube brushes
- Test tube rack

Procedure

- The faecal sample should be fresh and moist. If not, add enough saline to soften it
- Place the paper cups on the table or the bench. Number them identifying the source of the sample.
- Using a spatula transfer 1-2 g of the sample to a paper cup.
- Add 15 ml of the sugar solution using a measuring cylinder.
- Using a spatula stir gently until the faeces are thoroughly suspended in the sugar solution. Excess vigor introduces air bubbles making observation of eggs and cysts difficult
- Pour the contents of the cup through a strainer into the second cup. Discard the debris into the waste container and clean the strainer at once in running tap water.
- Using a marker pen identify a test lube with the source of the sample.
- Gently pour the mixture into a labeled test lube filling almost 10 the brim.
- Place the test tube into a centrifuge if necessary add a balancing tube containing water. Spin at 1500rpm for 3 minutes.

NB: If a centrifuge is not available gravity floatation may accomplish by allowing the test tube to remain undisturbed in the rack for a couple of minutes.

- Transfer the test tube from the centrifuge by holding the tube at the top. This avoids agitation of the contents.
- Using a wire loop or a glass rod transfer a drop of sample from the surface of the sample.
- Place the drop on a clean microslide and cover with a coverslip. The fluid should spread out evenly under the coverslip. Too rapid application of the coverslip may introduce air bubbles

which may interfere with microscopic examination.
- Avoid pressure on die coverslip because parasitic forms arc easily mutilated.
- Place the slide under the microscope and examine under low and high power for parasites.

MODIFIED FLUKE EGG TECHNIQUE

A small piece of faecal sample is mixed with a saline in a test tube. Sieve through a strainer. The sieved contents art centrifuged and the supernatant fluid poured off. The deposit is resuspended in more saline, mixed and centrifuged. Repeat this until the supernatant fluid is clear. The deposit is examined directly on a slide. By this simple sedimentation method parasitic eggs cysts and free living parasites can be concentrated and retain their morphology'.

FORMAL SALINE ETHER SEDIMENTATION METHOD

This method gives a good concentration of parasitic contents and is recommended for routine work. However, this method cannot be used to concentrate free living forms and the formalin kills the parasite.

- 10% formal saline
- Saline 450 ml
- Concentrated formaldehyde solution 50ml
- 40% w/v

Procedure
- Mix a small piece of faecal in 10ml of 10% formal saline in a test tube.
- Sieve the suspension into a beaker through a strainer.
- Pour 6ml of the sieved suspension into a centrifuge tube.
- Add 3ml of ether
- Mix well and centrifuge at 3000rpm for 1 minute.

When centrifuging, contents of the tube divide into 4 layers as follows:
- An upper layer of ether
- A middle layer of faecal particles or debris
- A lower layer of formal saline
- It is the deposit in which the parasites will be found.

- Using an applicator stick separate the middle layer from the sides of the tube and pour this away together with the ether and formal saline.
- Re-suspend the deposit by tapping the bottom of the tube with the finger
- Transfer the deposit to a slide using a pasteur pipette.
- Examine under low and high power magnification.

OCCULT BLOOD IN FAECES

When occult blood is found in faeces the specimen is brown to black. Occult blood is hidden and altered blood which can be found when there is bleeding in the upper alimentary canal or stomach either due to parasites and ingested sharp objects.

Detection

Methods for detecting occult blood in faeces are usually based on peroxidase reactions using reagent tablets called Haematest or a mixture of Orthototidine peroxidase.

- Using a clean applicator stick, smear the faeces on the small square of filter paper.
- Place one Haematest tablet in the middle of the square.
- Using a pastuer pipette place one drop of water onto the tablet and wait for 5-10 seconds.
- Pipette a second drop of water so that it runs down the side of the tablet onto the filter paper.
- Exactly 2 minutes later examine for any change of colour around the tablet

Results

A blue colour appearing around the tablet means that occult blood is present and the test reported as positive. If there is no colour change the test is negative. The intensity of the colour is proportional to the amount of occult blood present.

QUANTITATIVE METHODS

The eggs per gram of faeces are correlated to the worm burden of an individual. However the worm burden of an individual depends on:

The bulk and water content of the faeces.
The proportion of adult egg laying females to males in the host
The resistance of an individual to infection

MCMASTER EGG COUNT

This is a quantitative method in diagnostic parasitology.

Principal

A known weight of faeces is mixed with a known volume of a floatation fluid. A sample of the mixture is placed in a counting chamber of known volume and all eggs are counted. Arithmetic

conversion of the number of eggs yield the number of eggs per gram of faeces (e.p.g.)

Procedure

- Fill the measuring cylinder with saturated magnesium sulphate salt 28ml.
- Finish filling the measuring cylinder upto the 30ml mark with faeces approximately 2gms by displacement
- Mix thoroughly
- Sieve
- Fill the counting chamber. Note that both sides should not be filled from the same dropper
- Let the chamber stand for a few minutes to allow the eggs to rise to the top
- Place chamber under low power of the microscope and count eggs in cm of the slide
- Count in both the chambers. Take the sum of the two and multiply by 100

NB: The ruled area is 1cm by 1cm. The depth of one chamber is 0.15cm and for the two chambers is 0.3cm. The faecal mixture is 30mls
Therefore by arithmetic conversion - (30/0.3) = 100

PRESERVATION AND STAINING OF HELMINTHS

Preservation of nematodes

The cuticle of these worms is very thick and therefore it is preferable to use hot fluids for fixation. 70% alcohol or a 3-5% formalin solution should be heated to 70 - 80°C. After thoroughly washing the worms by shaking them in two or three changes of physiological saline they should be thrown into the hot fixing fluid. After the liquid has cooled they should be stored in clean fluid the same kind. For most purposes a fixative of 2% formaldehyde and 5% acetic acid is suitable. This is made by adding 5ml glacial acetic acid 90ml water. This solution at half strength is perfectly adequate for storage of helminths. Formaldehyde is an extreme irritant and prolonged exposure to the fumes should be avoided under all circumstances.

Preservation of trematodes

These may be vigorously in 1% NaCl solution and then fixed in 5% formalin, by replacing the saline with formal saline and continually shaking. This, if vigorously done, prevents contraction of worms. Another useful fixative of 85 parts of 85% ethyl alcohol, 10 parts of 40 % formalin and 5 parts of glacial acetic acid.

Preservation of cestodes

Wash them in 1% NaCl solution, care being taken not to break them or allow them to become badly tangled. They should then be fixed in 5% formal saline, either between two pieces of glass or while being drawn through the fixing liquid with a pair of forceps, or dipped several times into the liquid and allowed to hang between dipping, suspended by the posterior end from the forceps. The slight traction maintains them in a favourable stretched position and facilitates the subsequent examination.

SAMPLING EQUIPMENT

During field operations whenever an animal is immobilised, we take a variety of samples for both immediate analysis to help in confirming diagnosis and for future reference. These samples include:

- Clotted blood for serum collection
- EDTA blood for haematology, heparinised blood for biochemistry.
- Tissues for pathology are stored in frozen conditions or are fixed in 10% buffered formalin.
- Tissues for genetics collected and stored in DMSO.
- Parasites collected and stored in 70% alcohol.
- Swabs either for bacteriology or viral culture depending on the type of transport media.

For the above samples to be collected and delivered to the laboratory with minimum contamination the following items are necessary:

- EDTA tubes for whole blood
- Vacutainer tubes for sera
- Heparinised tubes for plasma
- Syringes and hypodermic needles of varying sizes depending on the animal species.
- Cool box with ice bags
- Glass slides for smears
- Pastuer pipettes for separating sera and plasma
- Cryo vials for sera and plasma storage
- Swabs for collection and transport media for bacterial and viral samples.
- 70% alcohol for parasites
- Fecal pots
- 10% buffered formalin.
- Portable centrifuge
- Sterile and unsterile gloves
- Weighing balance
- Liquid nitrogen cylinders for keeping samples frozen at -196 C.
- Post mortem kit
- Field centrifuge
- Immobilisation forms for proper record keeping
- Post mortem forms
- 50% glycerol
- DMSO vials
- Marker pen

RECORD KEEPING

As part of diagnosis, field and laboratory recording is very important as it helps in referring to both the present and the past clinical findings. This has helped in establishing a data base for each species e.g. immobilisation dose rates, pathological lesions etc

Among the records kept are:

Sample record which covers

- Species
- Age
- Sex
- Sample identification e.g. sera, plasma etc
- KWS laboratory number
- Collection date
- In lab date
- Animal location
-

Immobilisation form which covers

- Species
- Age
- Sex
- Dose rate and observation from darting time to full recovery
- Restraint method
- Approximate weight
- Investigators

Haematology report form

- Species
- Age
- Sex
- Weight
- Location
- PCV%
- Hb gm/dl
- Platelets x 103/l
- RBC x 103/l
- WBC x 103/l
- Differential count

Post mortem form

- Post mortem number
- Species
- Location
- Age
- Weight
- Death date

- Post mortem date
- Visual marks seen
- Histology samples taken
- Physical condition
- Carcass condition
- Necropsy report commenting on individual system and organs
- Remarks on the tentative diagnosis made

BASIC EPIDEMIOLOGY

Dr. Kamau, KWS

Introduction

Epidemiology can be defined as the study of the patterns of disease that exist in field conditions. It is the study of the frequency, distribution, and determinants of health and disease in populations. [Logos (study) epi (upon) demos (populations)]. It is an analogue of pathogenesis of disease in individuals. It is therefore a fundamental science for medicine in populations (Martin et.aI. 1987). Wildlife management is about conservation of species and is of necessity focused on populations. In the management of wildlife health, only rarely is the individual the focus of investigation especially in free-ranging situations. The major focus of a wildlife veterinarian is therefore epidemiological.

The major purpose of epidemiology is to provide data on which rational decisions for the prevention and/or control of disease in animal populations can be based. The data may describe the disease characteristics within the population (descriptive epidemiology) or it may be on the factors that might cause the disease of concern (analytic epidemiology). In descriptive epidemiology, the primary purpose is to describe what the syndrome is, who is affected, where the disease occurs and when it occurs. In analytic epidemiology, the main purpose is collection and analysis of data to test hypothesis, answering the question on why the disease occurred.

Most epidemiologic work is based on four principles or concepts about health and disease. The first is that disease occurrence is related to the environment of the species being studied. This includes physical, biological and sociological aspects of the environment. Weather is a good example and the effect of weather as a determinant of many parasitic diseases and vector borne diseases is well documented. Associating the type of environment to disease occurrence in many instances may describe the cause of the disease.

The second principle of epidemiologic work is to count the occurrence of natural events such as births, deaths and disease. This kind of quantification demands that the veterinarian needs to have basic knowledge on demographic and statistical techniques. The approach is based on the fact that biological phenomena when taken in mass is quite predictable. Veterinarians use this predictability implicitly and explicitly. For example, in clinical diagnosis, knowing that certain diseases such as milk fever and reticulo-peritonitis occur more frequently at ~r near parturition. It is this predictability that leads one to inquire why certain diseases occur in certain circumstances e.g. why does wildlife rabies occur more frequently near relatively urbanized areas than in more isolated rural areas?

The third concept in epidemiology is to utilize as much as possible nature's experiments whenever possible with the epidemiologist acting as an observer. Such studies are therefore called observational studies. For example in studying the effect of fencing on worm loads in grazing wildlife, one can identify sufficient number of wildlife found in fenced areas and sufficient number of wildlife found in non4enced situations, assess the e.p.gs and compare the results statistically. Observational studies such as these are alternatives to the often impractical experimental studies. Classic historical epidemiologic observational studies showed that knowing the natural history of a

disease could sometimes be used to control the disease even before the causal agent and its pathogenesis was known. E.g. eradication of CBPP in the United states occurred 6 years before the causal agent was identified by careful observation that the disease pattern followed shipments from Europe.

The fourth basic concept of epidemiology is that controlled field experiments should be performed whenever possible in the species of interest and in its natural environment. Such experiments are called field trials. In field trials, the type, timing and level of challenge are left to nature. E.g. field trials for effectiveness of vaccines.

In general, epidemiologic studies follow the general scientific method where hypotheses are derived and then tested. Three different approaches are used to test hypotheses. These are observational studies, controlled experiments, and theoretical studies. Theoretical approach to hypothesis testing is a product of the computer age. In this approach, some form of a model is used to mimic reality. Its advantage is that a large number of hypotheses can be tested in a short time without having to go through expensive and time consuming field experiments.

Causal reasoning

Since observational studies are central to epidemiologic work, the reasoning behind them should be understood. The sequence of causal reasoning is a three stage process. First, it is necessary to ascertain whether the independent variable (Exposure factor) is statistically associated with the dependant variable (outcome). Second, if the variables are associated statistically, there is a set of criteria used to assess whether the variables are likely to be causally associated. Finally the nature and consequence of the causal association may be elaborated using actual experimentation, path models or simulation models.

Association in epidemiology means more than two events occurring together in the same individual. The two events must be tested to find out whether they occur together more or less frequently than would be expected by chance alone.

SAMPLING METHODS

Collection of information about the population is an essential component of epidemiologic studies. A good sample design is critical for the information to be useful for making decisions about the population.

Because you cannot take specimen for testing from every individual in a population, a representative subset (called sample) is needed to make references about characteristics of the population. Formal sampling methods are necessary if accurate conclusions are to be drawn from the sample.

There are 2 reasons for taking a planned sample of the population:

- One is to describe characteristics (e.g. frequency and/or distribution of disease or production level of a population. Descriptive studies are called surveys e.g. selecting a sample of buffalo in Nairobi NP to estimate percentage exposed to rinderpest. This is usually descriptive of the population and is called descriptive epidemiology.
- The second is to assess specific associations e.g. to test hypothesis between events and/or

- factors in the population. These are called analytic studies - and the process of collating, analyzing and interpretation of the information is called analytical epidemiology. In practice, the difference between the two is often nebulous and hypothesis testing could be done from data collected from surveys but it is to be noted that the main emphasis of surveys differs from hypothesis testing.

Regardless of the reason for taking the sample, the method used for selecting the study members from the population will determine the precision and nature of extrapolation from the sample to the population. Planning the sampling strategy is a major component of survey design and it's of central importance in design of analytic studies.

Steps

1) The objective of the sampling must be stated clearly and concisely. The statement should include the parameters being estimated and the unit of concern. The investigator must be clear about the reference or target population. This is the aggregate of individuals whose characteristics will be elucidated by the study. The most important thing is to have the sampled population being representative of the target population e.g. It would be inappropriate to make references about occurrence of rinderpest in the buffalo population of the whole country based on a sample of a few large herds in Nairobi NP.

2) Explicit definitions of the outcome must be considered e.g. sero- positivity for canine distemper with a defined cut-point. This increases the validity of the study and allows other workers to compare the results of the survey.

3) Because the results of samples are subject to uncertainty due to sampling variation, it is important to consider how precise (quantitatively) the answer needs to be. The results of different samples of the same population will in general not be equal. The greater the precision required (small sample variation) the larger the sample must be.

4) Sampling frame - The sampled population must be divided into sampling units prior to selecting the sample. The size of the unit can vary from an individual to aggregate of individuals - herds, prides, family units etc. The list of all sampling units is called the sampling frame. The unit of concern may sometimes be different from the sampling unit for practical considerations e.g. Although the objective may be estimate the prevalence of brucella antibodies in a herd of cattle - one may sample herds instead of individuals.

5) Pre-testing there should be significantly rigorous pre-testing of the procedures to detect deficiencies in study design - sample selection, clarity of questionnaires, and acceptability and performance of screening tests. The pre-testing should also be used to evaluate whether data to be collected in the actual study are appropriate to answer the original objectives.

ESTIMATING POPULATION CHARACTERISTICS IN SURVEYS

Non-Probability Sampling

A collection of methods that do not rely on formal random techniques to identify units to be

included in the sample, e.g.:

- Judgement sampling
- Convenience sampling
- Purposive sampling

Judgement sampling - representative units of population selected by the investigator. This depends on the investigator's experience and knowledge of the population. It is often biased.

Convenience sampling - sampling is done depending on the how easy it is to obtain the sample. It also lead to biased results

Purposive sampling - selection of units based on known exposure or disease status - often used in analytic observational studies - inadequate for obtaining data to estimate population parameters.

PROBABILITY SAMPLING

Simple random sampling - a fixed percentage of the population selected using a formal random process e.g. flipping a coin, random number generators, or random number tables.

A formal random selection procedure is required for the investigator to calculate precision of sample estimate as measured by the standard error of the mean. It gives the investigator assurance about the sample's representativeness of the population being investigated. Confidence intervals are calculated based on this premise - SRS is often difficult to use in the field.

Systematic random sampling
Sampling units (n) are selected from sampling frame at regular intervals e.g. every 5th farm or every 3rd animal - the interval (k) = 5 or 3.

If k is fixed, n will vary with total population number N If n is fixed, k becomes the integer nearest to N/n

3) Stratified random sampling
In stratified sampling, prior to selection, the sampling frame is divided into strata based on factors likely to influence the level of the characteristic (e.g. prevalence of antibodies) being estimated.

Then a simple random or systematic random sample is selected within each stratum.
Advantages: It is more flexible than simple random sampling because a different sampling percentage can be used in the various strata e.g. 2% in one stratum and 5% in another. The precision of sample estimate may be improved because only the within stratum variation contributes to the variation (standard error) of the mean. In simple random sampling both within and between stratum variation are present. Std error = std deviation of a mean.

Disadvantage One needs to know the status of all sampling units with respect to the factors forming the strata prior to drawing the sample. The number of factors used for stratification should be limited to those most likely to have the greatest impact on the characteristic in question.

Proportional weighting - number of samples per strata should be related to the relative size in comparison to other strata.

4) Cluster Sampling

In cluster sampling the initial unit is larger than the unit of concern. Clusters will often arise naturally e.g. herds, pens, prides, geographically administrative etc. The clusters (sampling units) can be selected by systematic, simple or stratified random methods. All individuals in a cluster are tested - if the individual is the unit of concern.

The sampling frame consists of all cluster found in the population, where clusters to be tested are randomly selected. Sometimes the herd is pen, etc the unit of concern and is therefore is therefore not considered to be a cluster.

5) Multi-Stage Sampling

Similar to cluster sampling except sampling takes place at all levels - selecting a sample of primary units e.g. herds listed in the sampling frame. Then within the primary unit a sample of secondary units e.g. animals.

Advantages: It has more practical advantages and flexibility i.e. The number of primary (n_1) and secondary units (n2) may be varied to account for different cost of sampling primary versus secondary units as well as variability of the characteristics of the factor being estimated.

SAMPLE SIZE CONSIDERATIONS

In order to determine the sample size (n) to be used to estimate the prevalence of reactor P (T+) in a population, and is often impractical to test every animal, a certain sample of the population has to be used. But what sample size is sufficient in order to draw a conclusion on the absence or presence of disease? An investigator must first determine what level of confidence he wants when ruling out the disease. The level of confidence or precision is the amount of error that one considers allowable. To be 100% confident that the disease is absent one has to test every single individual, which is often impractical. The question is phrased as "what sample size is required so that the veterinarian can be 95% or 99% confident that the herd is unexposed given that no animal in the sample give a positive test result?

The sample size is a function of the confidence level, the total size of the herd and the number of diseased animals within the population and it is given by the formula

$n = [1-(1-a)^{1/D}]\ [N-(D-1)/2]$

Where

N = sample size

ID = number of diseased animals

a = Probability(Confidence level) of observing at least one diseased animal in a sample when the disease affects at least D/N in the population

N = population size

Using the formula the sample sizes required to be 95/99% confident disease is present at or below the specified prevalence *DIN* if no diseased animals are observed is as follows

Prevalence of disease D/N) x 100

Population size	1 %	5%	10%	50%
30	29/30	23/27	19/23	5/7
60	57/60	38/47	23/31	5/7
100	95/99	45/59	25/36	5/7
300	189/235	54/78	28/41	5/7
500	225/300	56/83	28/42	5/7
1000	258/367	58/86	29/43	5/7
10,000	294/448	59/90	29/44	5/7

The formula could as well be solved for D, the diseased animals in the population given the sample size n

$D = [1-(1-a)^{1/n}]\ [N-(D-1)/2]$

It is useful to provide the maximum number of diseased animals D expected in the population with the confidence a when n individuals are examined and found free of disease

Example
If 20 randomly selected buffaloes are examined and found to be sero negative for brucellosis, the maximum number of infected animals would be

$D = [1-(1-0.95)^{0.05}]\ [5000 - (19/2)]$

$= 0.139 \times 4990.5 = 694$

giving a maximum prevalence of 13.9%

ANALYTIC EPIDEMIOLOGY

Hypothesis testing

There are three types of studies used for testing hypothesis and are named according to the type sampling used to collect samples from the population

1) CROSS -SECTIONAL STUDIES
2) COHORT STUDIES
3) CASE CONTROL STUDIES

They differ in the amount of information they provide about the target population. Cross sectional studies are based on a single sample of the population. Cohort and case control studies are based on the two separate often purposive samples. They are used to test association between factors, usually between disease occurrence and exposure to certain factors.

The status of the population can be summarised as follows depending on exposure to factor and occurrence of disease.

	Diseased (D+)	not diseased (D-)	
Exposed (F+)	A	B	A+B
Not exposed (F-)	C	D	C+D
	A+C	B+D	N=A+B+C+D

Major population parameters can then be calculated as

Parameter	Notation	Calculation
Exposed	P(F+)	A+B/N
Diseased	P(D+)	A+C/N
Diseased and exposed	P(F+ & D+)	A/N
Diseased in exposed group	P(D+IF+)	A/(A+B)
Diseased in non exposed group	P(D+IF-)	C/(C+D)
Exposed in diseased	P(F+ID+)	A/(A+C)
Exposed in non diseased group	P(F+ID-)	B/(B+D)

Cross-sectional sampling

A sample usually obtained by one of the probability methods is selected from the population then, each sampling unit is classified according to its current status for factor and disease.

- All disease rate in the population can be estimated
- The method allows the investigator to learn about the population structure as well as to test the null hypothesis that the factor and disease are independent events in the population.
- Impractical when disease frequency is low because a large sample size is required to get sufficient number of cases

Cohort sampling

Two samples are obtained based on a known factor and tested for disease. It tests the null hypothesis that the disease rates and factor rates are independent events in the population.

The two cohorts should be as similar to one another as possible except for the factor

Case control sampling

Samples of diseased and non-diseased individuals are selected and the proportion of each that has been exposed to factor is used to estimate the corresponding population proportion. Testing whether these two sample proportions are equal evaluates the null hypothesis that the factor and the disease are independent events in the population.

- formal random sampling not always done. Usually purposive selection according to status of disease the two samples must be as similar as possible except for the disease status

Examples

Suppose one wanted to test the effect of vaccination on the occurrence of pneumonia in impala caught and shipped to a certain locality. Assume the total population of all the impala that have been shipped have the following characteristics

	Pneumonia (D+)	No pneumonia (D-)	Total
Vaccinated (F+)	12,000	48,000	60,000
Not vaccinated (F-)	18000	22,000	40,000
	30,000	70,000	100,000

1000 animals were sampled from this population using cross-sectional methods, the anticipated results, ignoring sampling error would be;

	D+	D-	p(D+/F)
Vaccinated (F+)	120	480	600 (20%)
Not vaccinated (F-)	180	220	400 (45%)
	300	700	1000
p(F+/D)	(40%)	(69%)	

All the population parameters can be estimated from these data

If cohort sampling were used with 500 individuals per group, the results would be as follows;

	D+	D-	p(D+/F)
Vaccinated F+	100	400	500 (20%)
Not vaccinated (F-)	225	275	500 (45%)

Only two characteristics (shown in parenthesis) of the population can be estimated from the these data

If case control sampling were used with 500 individuals per group, the results would be;

	D+	D-
Vaccinated (F+)	200	343
Non vaccinated (F-)	300	157
	500	500
p(F+/D)	(40%)	(69%)

Again only the parameters in the parenthesis can be estimated about the population.

DISEASE CAUSATION

Proving causation of disease in observational studies is very difficult. Inferring the cause and effect in based on results of observational studies is a matter of judgement. A set of accepted criteria have been set in place to ensure a common basis for making inference about causation.

- The currently accepted ones are;
- The incidence and prevalence of disease should be higher in individuals exposed to the putative cause than non-exposed individuals.
- The exposure should be more common in cases than in those without disease
- Exposure must precede the disease
- There should be a spectrum of measurable host responses to the agent
- Elimination of the putative cause should result in lower incidence of disease
- Preventing, or modifying the host response should decrease or eliminate the expression of disease.
- The disease should be reproducible experimentally

Statistical association

To prove that the incidence or prevalence of disease are actually higher in exposed than non-exposed individuals, a simple comparison between the rates may not prove much as any differences seen may come from sampling error. To evaluate the probability that sampling error might account for the observed differences, a formal statistical test is required.

To select a statistical test consider the type of data (qualitative or quantitative), and the study design. Qualitative data involves rates and proportions while quantitative data are based on measurements and are summarized by means, standard deviations and standard errors.

For rates and proportions(Qualitative data), the chi-square test provides the probability that a difference as large or larger than the observed in the sample would arise due to chance alone, if there were no association (no real chance) in the population. By convention, if this probability is less than 5% one may say the rates are significantly different and hence the factor and the disease are statistically associated. The result of the chi-square test is influenced by the magnitude of the difference as well as the sample size.

In general the statistic is derived from:

$$X^2 = E[(\text{observed} - \text{expected} - 0.5)^2/\text{expected}$$

or in the two by two table introduced before,

$$X^2 = \frac{[(a \times d) - b \times c) - 0.5n)^2 \times n}{(a + b) \times (c + d) \times (a + c) \times (b + d)}$$

when used on 2 x2 tables the chi square statistics have I degree of freedom, hence the critical value is 3.84 at 5% level

for quantitative data the students test provides the information about differences between two means that is similar to the chi square statistic.

EPIDEMIOLOGY IN WILDLIFE POPULATIONS

In wildlife populations, the investigator often does not know most parameters of the population.

Obtaining specimen from the animals for testing is difficult and expensive.

- Innovativeness in methods of obtaining specimen required. e.g. use of road kills, involvement of non-medical personnel who come in contact with wildlife more frequently etc.

Always be careful about extrapolating results from the sample to the population in the absence of formal sampling methods

- Knowledge of the biology of the species of interest always useful in interpreting results e.g. one positive rabies case in wild dog *(Lycaon pictus)* can be used to assume the whole pack is infected.

Other considerations such as whether the species of interest is endangered or not, social organisation of the species and the effect of the disturbance on social structure and herd cohesion

and therefore survival need to be taken into account

Concepts of disease prevention and control different from those in domestic animal medicine
- Natural processes of disease and immunity in populations emphasised

Major goals of epidemiological investigations in wildlife medicine are
- assessment of the effect of disease on the population and its impact on the survival of the species
- wildlife as indicator species for certain diseases in the ecosystem and ecosystem healthiness e.g. rinderpest, effects of pollution
- effect of reduced habitat on wildlife health and cross-transmission of diseases to and from domestic animals.
- effects of human interventions on wildlife health e.g. translocations, fencing etc.
- New infectious diseases?
- Understanding of mechanisms of resistance to various diseases

INVESTIGATING EPIDEMICS IN WILDLIFE

Epidemic refers to the unexpected increase in disease or death to a level clearly greater than normal. If ongoing monitoring programs exist, an epidemic occurs when disease or death exceeds 2 standard deviations above the mean.

In free ranging wildlife, epidemics could often go unnoticed due to inaccessibility of the species affected or lack of awareness on the part of wildlife managers. (The opposite often occurs if the animal populations are near tourist circuits or if the species easily arouse emotions)

The major objectives of epidemic investigations are determining the causes, understanding the implications or consequences, instituting corrective measures where possible and recommending procedures to reduce risk of future outbreaks

There are two general approaches to investigating outbreaks each dictated by the rate of spread of the problem

Slowly spreading propagative type

Rapidly spreading common source type

Steps

Note the temporal pattern of the outbreak and determine whether it is likely to be a point (common) source or a propagated epidemic (examine the epidemic curve)

Propagated epidemics

Is it a propagated epidemic?

Examine the first few animals that became sick
(does this explain the epidemic? Are they the source)?
If the source is not found

Examine any additions to the populations (not always practical in wildlife)
e.g. cattle grazing in the area

Examine recent occurrences
e.g. encroachment by human activity or animals going to human habitations
If source not found
A more detailed study, including laboratory analysis of appropriate samples

When source is found, one should institute trace-back procedures to identify the problem and prevent further spread of the problem
Is it a point source?

Point epidemics

Is it a point source?

Is it an emergency -------- no ---------- diagnosis
No Yes

YES

Obtain a general history (determine the animals involved, general setting, temporal aspects)

One syndrome?
(Examine animals and collect samples and controls)

date of median case

Incubation period Likely time of exposure

Obtain specific details
- feed (composition and distribution of components)
- water (source(s), distribution)
- environment (pollution)

Investigate association of factors and disease Make attack rate table
- (consider unit of concern?, nature of sample?, statistical analysis)
- relative risk (odds ratio) Remove risk factors and obtain appropriate samples

If no factors obvious refine questions and begin again

If solved, make appropriate recommendations and suggestions for future prevention

Techniques of taking specimen in wildlife
Conservative/non-invasive

Preferable where possible.
- Faecal material - Intestinal parasites
- Faecal cortisol levels for stress
- Nutritional analysis
- Biopsy darts - genetics

Invasive techniques
Darting - haematology, serology, bacteriology, virology
Post mortems - more conclusive
- sometimes better to sacrifice the individual for the sake of the population
- use individuals who are clinically sick, both acute and chronic stages
- be clear on the differential diagnosis beforehand. It
- determines specimen collection, storage and transport.
- Care should be taken on specimen collection because of the difficulty of obtaining them
- Collect as much material as possible. Store for future reference

A well equipped laboratory with personnel experienced in handling and interpretation of results from wildlife specimen can be extremely useful.

CONTROL OF RINDERPEST

B. M. Mugenyo, Vet. Labs., Kabete

GENERAL PERSPECTIVE

Eradication of rinderpest is easily possible considering that;

- Rinderpest virus is fragile to environmental conditions and chemicals.
- Short incubation period (3-9 days)
- There are no insect vectors and the disease is easily spread through contact.
- High mortality in susceptible animals, making it easy to recognise.
- There is no carrier state and vaccinated or recovered animals are immune for life.
- The virus has one serotype and a single life vaccine is effective against all known strains.

However, eradication may be complicated by presence of endemic forci sustained by;

- Existence of mild strains of the virus.
- Low grade infection in wild game
- Inaccessibility due to natural barriers or conflict areas.

CONTROL OF RINDERPEST CAN BE BY STAMPING OUT POLICY OR VACCINATION.

Stamping out

Stamping out is used to eradicate the disease in non-endemic areas. Define infected zone. All cattle in this zone are placed under strict quarantine and movement restrictions imposed. The affected and in contact herds are slaughtered and carcasses burnt or buried. The owners are suitably compensated. Define surveillance zone surrounding infected zone. Active disease surveillance is carried out daily for three weeks in the surveillance zone. Define security zone surrounding the surveillance zone. Active disease surveillance is carried out weekly and should continue for 21 days after the last clinical case in the infected zone. Epidemiological investigation to determine the source of infection.

Vaccination (Prophylactic)

For Social-economic reasons, stamping out policy is sometimes impractical especially in the parts of Africa where rinderpest persists. Control of rinderpest in these areas then can be achieved by vaccination.

MASS VACCINATION

Ideally, in susceptible livestock populations in high risk areas, all cattle should be vaccinated annually for three years and there after vaccination be confined to the yearly calf crops. Vaccination should be followed with seromonitoring to ascertain attainment of required antibody prevalence. The attenuated tissue culture rinderpest vaccine is the most preferred. The vaccine is safe, stable, and highly immunogenic and confers life long immunity. However, it is heat labile but a heat stable version has been produced and has been useful in, inaccessible, conflict areas where

rinderpest persists in Africa. There is need for regional cooperation in rinderpest control.

QUARANTINE AND VACCINATION

However, mass vaccination can be avoided in favour of quarantine and vaccination in countries free from rinderpest or where the disease is contained in specified areas. The quarantine and vaccination strategy entails;

(i) Cessation of mass vaccination except in known endemic forci in inaccessible, conflict areas, where by, Community Animal Health Workers (CAHW) can be used and in sanitary cordon areas surrounding the known endemic forci within country or International borders. The status of no vaccination will enhance population of susceptible cattle. This will enable early detection of the disease.

(ii) In case of an outbreak in an area formerly free of rinderpest, then;

a) Define a control zone (the zone containing the infected herds) and quarantine it.
b) Stop movement of susceptible species and close livestock markets and slaughterhouses. For a minimum of 56 days after vaccination.
c) Vaccinate all cattle in the zone after sensitisation of the communities. Carcasses dying of rinderpest should be burnt or buried. Vaccinating teams should work from the outside to the inside.
d) Cattle should be examined daily for at least 28 days after last clinical case.
e) Define a surveillance zone surrounding control zone. All premises with cattle in this zone should be visited daily to examine cattle for clinical disease. This should continue for at least 28 days after the last clinical case in the control zone or end of the vaccination.
f) Define a security zone surrounding the surveillance zone. Cattle in this zone should be examined weekly for clinical disease. The examination should continue for at least 28 days after the last clinical case in control zone.
g) Epidemiological investigation to determine the source of infection and detect other possible spreads.

Emergency Preparedness

For countries free of rinderpest or where disease is contained in specified areas, it is demanded that;

(i) The expertise to recognise rinderpest in the field is sustained.
(ii) Disease surveillance is sustained at levels for early detection of the disease and appropriate reporting (effective veterinary service).
(iii) Diagnostic capability is maintained at level to provide rapid and accurate diagnostic results.
(iv) There is adequate legislative provision for enforcement of infectious disease regulations.
(v) The necessary resources are maintained in readiness for immediate action.

(vi) There is an upto date emergency preparedness plan to guide response to rinderpest suspicion or outbreak.

OIE Pathway

The goal of rinderpest control is to achieve freedom from rinderpest and ultimately achieving eradication, which will eventually enhance trade in livestock and livestock products.

The OIE have therefore instituted a system for verifying the steps towards the referred aims. The system is referred to as OW Pathway. The steps in the pathway are as follows:

a) Provisional freedom from rinderpest. A country declares itself or a zone to be provisionally free from rinderpest after fulfilling the conditions set by OIE i.e.

- No disease for two years
- Cease vaccination by date of declaration
- There is effective veterinary service
- A disease surveillance system is in place
- There are effective measures to prevent re-introduction

b) Freedom from rinderpest disease in zones of a country. A country that has declared itself provisionally free from rinderpest may apply to the OIE to be declared free from rinderpest disease in zones, on meeting the OIE set criteria i.e.

- No vaccination for three years
- No clinical disease for five years
- Disease surveillance is done in area (documented) There are effective measures in place to prevent re4ntroduction

c) Freedom from rinderpest infection. A country that has not vaccinated against rinderpest for ten years and has not had rinderpest virus infection, may be declared free from infection by OW provided the country has maintained adequate disease reporting system. Declaration freedom from infection can only be made for a whole country.

Or

Where a country has had rinderpest or vaccinated within the last ten years

1) There should be effective surveillance for at least two years. The surveillance must include other susceptible domestic stock.
2) Where susceptible game populations are present.

Disease surveillance data from wild game is required to supplement the surveillance data from domestic stock for OIE declaration of freedom from disease and infection.

RINDERPEST CONTROL - KENYAN PERSPECTIVE

B.M. Mugenyo, Vet. Labs., Kabete

JP 15 ERA

Rinderpest has been occurring in Kenya since the 1890s after it was introduced from the North. From oral reports, the early rinderpest occurred with devastating loss of livestock and the susceptible wildlife species.

Before 1964, control was done through vaccination with the caprinised vaccine - Kabete attenuated Goat vaccine (KAG). This vaccine was replaced with the tissue culture vaccine in 1964.

During the 1 960s and 1 970s, a multi donor project - Joint Project 15 (JP 15) succeeded in eliminating rinderpest from most of Africa, except for two forci Mali/Mauritania in west Africa and Ethiopia/Sudan in East Africa. In Kenya, the project was carried out from 1969 to 1974.

Rinderpest occurrence in Kenya was eliminated for a decade after JP 15 campaign. Annual vaccination against rinderpest continued after JP 15. However vaccination coverage dropped gradually due to inefficient funding. Also, there was no system in place to monitor herd immunity levels and subsequent surveillance.

Clinical rinderpest re-emerged in Kenya from 1985 i.e. ten years after end of JP 15. Sporadic rinderpest outbreaks continued to be reported from mid 1980s and1990s especially in West Pokot and Turkana districts, which neighbours the endemic forci in Southern Sudan. Devastating rinderpest outbreaks were kept at bay in the greater part of the country through annual vaccination campaigns, strict movement control and quarantines.

After re-emergence of rinderpest in mid 1980s, a donor funded regional rinderpest control programme - the Pan African Rinderpest Campaign was launched. Kenya benefited from the PARC funding especially after recurrent rinderpest outbreak in wildlife in 1995 and 1996.

WILDLIFE RINDERPEST OUTBREAK

Rinderpest outbreak occurred in Tsavo East National Park in mid 1994 where it killed buffalo and kudu populations however, the disease was not immediately diagnosed. In December 1994, a clear-cut rinderpest epidemic decimated buffalo population in Tsavo West National Park. The causative virus was characterised to be rinderpest lineage II strain.

Cattle in the adjoining areas were never reported with the disease. During 1995/96 period, a joint wildlife/livestock project was financed by EU under OAU/IBAR PARC, to be executed by KWS and Ministry of Livestock Development. The KWS carried serosurvey of susceptible wildlife and investigated the virus source. While Veterinary Department carried active disease search to unearth the disease source and emergency vaccination to forestall spread of the disease to the cattle herds at risk.

The causative virus was finally characterised as lineage II strain, which had not been diagnosed for

30 years. The source of the virus was geographically defined to be the districts to the east of Tsavo National Park.

In late 1996, rinderpest outbreak occurred in Nairobi National Park where it affected buffalo and eland. The disease was also diagnosed by AGID test in cattle in areas south of the Nairobi National Park. The virus was found to be similar to the Tsavo rinderpest virus. Active disease search and emergency vaccination was done in cattle populations in areas bordering Nairobi National Park. The disease did not spread within cattle population due to timely intervention. However, the disease was diagnosed in Northern Tanzania in early 1997 in cattle and is assumed to have spread from Southern Kenya. An emergency programme for eradication of rinderpest in Kenya (PARC/EPERK) was planned.

EMERGENCY VACCINATION PROGRAMME (PARC/EPERK)

The programme was financed by EU for two years (1997 to 1998). The programme aimed to contain spread of rinderpest in the short term through emergency vaccination. The programme was further supposed to put in place the process to ensure eventual eradication of the virus from Kenya.

In the first round of the programme in 1997, 3.6m head of cattle were vaccinated in 24 of 29 selected districts. Another 3.7m head of cattle were vaccinated during the second round in 25 districts in 1998. Both rounds were followed with seromonitoring.

Purposive disease surveillance was also carried out during the two rounds of the programme implementation. There has been no clinical rinderpest diagnosis either in. livestock or wildlife, since December 1996 (The Nairobi National Park -outbreak). The programme therefore has achieved the main objective of containing spread of rinderpest in Kenya.

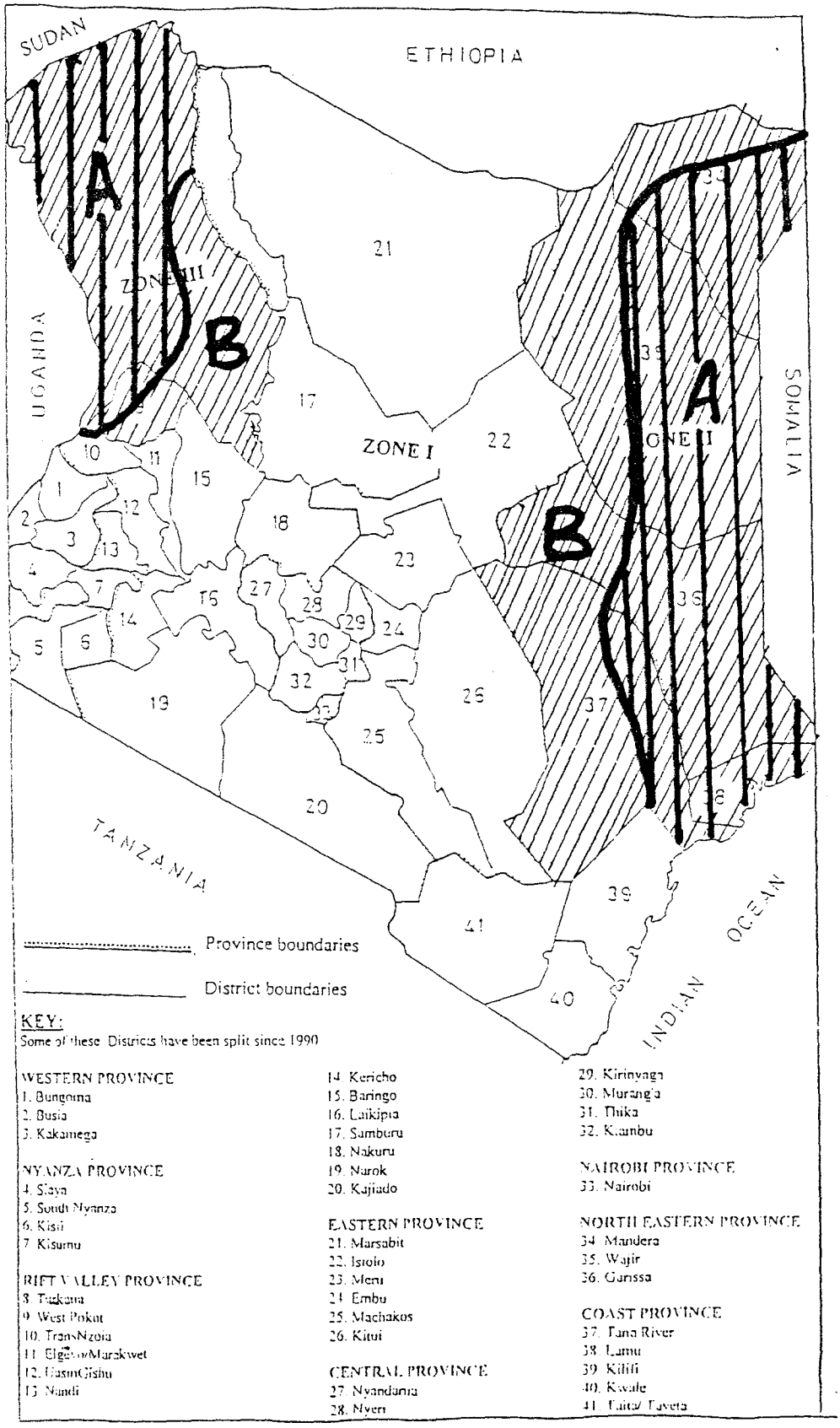
SURVEILLANCE STAGE

The mass emergency vaccination has managed to contain spread of rinderpest in Kenya. Through surveillance work and information from OAU/IBAR office's we have defined the high rinderpest risk areas of the country. The high risk areas are;

(i) The North eastern Kenya region. The area borders Somalia where the rinderpest situation is unclear.
(ii) The North western Kenya region. The area borders southern Sudan where there is a known rinderpest endemic forci.

Accordingly, the country has been zoned according to prevailing rinderpest epidemiology. The zoning is per the following map of Kenya;

ZONING IN THE RINDERPEST ERADICATION PROCESS: A – VACCINATION AREAS; **B** – SURVEILLANCE AREAS



KEY:
Some of these Districts have been split since 1990

WESTERN PROVINCE
1. Bungoma
2. Busia
3. Kakamega

NYANZA PROVINCE
4. Siaya
5. South Nyanza
6. Kisii
7. Kisumu

RIFT VALLEY PROVINCE
8. Trakana
9. West Pokot
10. TransNzoia
11. Elgeyo/Marakwet
12. Nasm Gishu
13. Nandi
14. Kericho
15. Baringo
16. Laikipia
17. Samburu
18. Nakuru
19. Narok
20. Kajiado

EASTERN PROVINCE
21. Marsabit
22. Isiolo
23. Meru
24. Embu
25. Machakos
26. Kitui

CENTRAL PROVINCE
27. Nyandarua
28. Nyeri
29. Kirinyaga
30. Murang'a
31. Thika
32. Kiambu

NAIROBI PROVINCE
33. Nairobi

NORTH EASTERN PROVINCE
34. Mandera
35. Wajir
36. Garissa

COAST PROVINCE
37. Tana River
38. Lamu
39. Kilifi
40. Kwale
41. Taita/ Taveta

(a) Zone I

The zone comprises of the bulk of the country.

Activities

- Cessation of vaccination from January, 1999. Provisionally declared free from rinderpest from January 1999.
- Surveillance activities to prove absence of infection to enhance progression down OIE pathway.
-

(b) Zone II

The zone comprises of the districts neighbouring Somalia.

Activities

- Surveillance activities to prove absence of infection and enter OIE pathway, depending on rinderpest situation in Somalia.
- The zone will serve as a sanitary cordon between Kenya and Somalia.
- The sanitary cordon will comprise of;
  - (i) An immune buffer zone of vaccinated cattle adject to Somalia border.
  - (ii) An active disease surveillance areas of unvaccinated cattle between the vaccinated cattle in the immune buffer and the rinderpest free zone (zone I).

(c) Zone III

The zone comprises the districts neighbouring the rinderpest endemic southern Sudan.

Activities

- The zone will serve as a sanitary cordon between Kenya and the endemic rinderpest forci in southern Sudan.
- Surveillance activities to prove absence of infection and enter OW pathway depending on the status of the endemic forci in southern Sudan.
- The sanitary cordon comprises of two sections as in Zone II.

EMERGENCY PREPAREDNESS

1) There is a veterinary department with a direct chain of command from the DVS to the frontline staff
2) There is a surveillance unit under Coordination Unit of PARC/PACE. A country wide surveillance system is in the process of being established.
3) Frontline staff and livestock owners in high rinderpest risk areas have been sensitized to surveillance system. The sensitisation will be extended to the rest of the country.
4) There are five regional laboratories and one central laboratory with the capacity to carry out rinderpest disease diagnosis and investigation of reported rinderpest outbreaks. The central laboratory is equipped to carry the necessary serology work. The regional rinderpest reference laboratory (NVRC- Muguga) is available for advanced rinderpest diagnosis technology.
5) There is a rinderpest vaccine bank (500,000 doses) and vaccination; camping equipment, cold

chain and vehicles for emergency vaccination.

6) There is a fund under DVS control for emergency financial provision.
7) There is enabling legislation.

The ultimate objective is to have OW declaration of freedom from infection by 2007. However, the attainment of this status will depend on the rinderpest situation in the rinderpest forci in the neighbouring countries (Sudan and Somalia).

SAFETY AT WORK

Dr. Kock, OAU/IBAR/AWVP

When working in wildlife areas on foot these are the rules you should abide by:

1. Confirm the presence of any potentially dangerous species and their usual behavior - e.g. animals in hunting areas or areas with high levels of poaching will have more shy and possibly aggressive individuals.
2. Equip yourself and the team properly - tracker, security officer with an appropriate calibre rifle and experience, water and emergency food, compass gps as required, proper clothing, binoculars.
3. When in the bush use knowledge of animal behaviour to avoid confrontation - note habitats, game routes, rivers etc. Certain species use certain areas more frequently e.g. hippo and buffalo - riverine zones.
4. Note time of day and probable activity of animals.
5. USE EYES EARS AND NOSE whilst walking - note vegetation, terrain, tracks/dung and their freshness, recent disturbance of vegetation, feeding signs, vultures etc. If you walk quietly, as is usually the case, you may stumble on a resting animal so if you want to avoid trouble take a trumpet!
6. In the event of confrontation DO NOT PANIC. The animal will usually wait for your move before deciding on what to do if it hasn't run off or attacked immediately (in which case there really is nothing you can do any case). Keep aware of what the animal (s) are doing as you move away. Do not run if at all possible - seek shelter, trees as you proceed in case of a charge etc. Be aware of the wind, animals tend to run into wind.

MEDICAL ATTENTION AND PROPHYLAXIS

Dr. Chardonnet, CIRAD

In working in bush areas with wild animals in tropical countries you are exposed to a variety of disease risks as well as work hazards:

- Environmental e.g. dehydration, heat stroke, sun burn.
- Trauma - e.g. walking running injuries, animal related handling injures
- Tick born disease - tick fever
- Water born disease - e.g. bilharzia
- Food born disease - e.g. salmonella
- Insect born disease - e.g. malaria, arboviruses
- Zoonoses - e.g. rabies, anthrax.

Avoid these through careful planning of work and prevention - use prophylaxis as desired - vaccines, palliatives etc.

Ensure medical first aid kit is properly stocked and maintain a written list which should be checked against stock prior to departure.

DRUG SAFETY

Dr. Kock, OAU/IBAR/AWVP

As the main drugs used are etorphine, xylazine and zolatil be aware that:

Etorphine can be absorbed through mucous membranes but not intact skin. To avoid fatalities with accidental injection/absorption; NARCAN (naloxone) should be carried on personnel **at all times** minimum 6 x 2 ml vials with at least 60 vials in a central accessible point within 15 minutes of operational area. Diprenorphine can be used in emergency but is not ideal. Use naltrexone which is preferable if available but NARCAN is optional.

Xylazine and teletamine - accidental injection is unlikely to be fatal except at high doses but symptoms can be distressing and knowledge/information of these and their control should be available.

There are many texts on drug use and safety and these should be consulted or kept handy during operations.

ZOONOTIC DISEASES OF WILDLIFE

Dr. G. Muchemi, KWS

It is estimated that over (175) infections and diseases of animals are transmissible to (Human)

MODES OF ZOONOTIC DISEASE TRANSMISSION

1. Direct contact
   - Bites scratches
   - Handling Tissues
2. Indirect contact
   - Secretions
   - Excretions - urine
     - faeces
   - Blood
   - Aerosols
   - Contaminated soil
   - Fomites - bedding
     - feed troughs
     - restraining equipment

MOST COMMON ZOONOSES IN WILDLIFE

A) VIRAL DISEASES:

	Disease	Etiology	Mode of Transmission
1.	Rabies	Lyssa virus	Bite wounds
2.	African Green Monkey Disease	Marbug Virus	Handling tissues
3.	Ebola	Ebola virus	Handling tissues
4.	Lassa fever	Arena virus	Urine, dust
5.	Rift Valley Fever	Bunyavirus	Mosquitoes, hanlng meat
6.	Yellow fever	Flavivirus	Mosquitoes (Aedes sp.)

B) BACTERIAL DISEASES:

7.	Anthrax	B.anthracis	Skin aerosol, ingestion

B) BACTERIAL DISEASES *(cont'd):*

	Disease	Etiology	Mode of Transmission
8.	Brucellosis	Brucella spp.	Contact with excretions, secretions, ingestion
9.	Tetanus	C. tetani	Wound infections from soil, faeces
10.	Plague	Y. pestis	Fleas, contact, aerosol
11.	Salmonellosis	Salmonella	Fecal oral spp.
12.	Tuberculosis	M. bovis M.tuberculosis	Ingestion, aerosol
C. FUNGAL DISEASES:			
13.	Ringworm	Microsporum Trichophyton spp.	Contact, fomites
D)	**PARASITIC DISEASES:** **PROTOZOA:**		
14.	Trypanosomiasis	T. brucei	Tsetse fly bite
15.	Toxoplasma	T. gondii	Ingestion oocysts, meat
	TREMATODES:		
16.	Schistosomiasis	S. mansoni) S. haematobium) S. bovis)	Cercarie in snails
	CESTODES:		
17.	Taeniasis	Taeniaspp.)	
18.	Echinococcosis	E.granulosus	Ingestion of ova
19.	Sparganosis	Spirometra spp.	Ingestion of raw crustaceans (cyclops)
	NEMATODES:		
20.	Trichinellosis	T. spiralis	Ingestion, undercooked meat

HOW TO MINIMIZE/REDUCE ZOONOTIC DISEASE HAZARDS:

(i) IN THE FIELD:

a) Proper Restraint methods
- Physical) Prevent Bites
- Chemical)

b) Protective Clothing
- Gloves
- Face masks
- Overalls

(ii) IN THE ZOO

a) Vaccination of Zoo keepers

- MMR - (Measles, Mumps Rabies)
- Polio
- Tetanus
- Hepatitis A

b) Strict 30 -90 days quarantine

DEVELOPMENT OF CAPTURE TEAMS IN EASTERN AFRICA

G.J. Kanyingi, KWS

INTRODUCTION

Throughout history, many different spp. of animals have been captured by human beings and moved from one location to another. In most cases, the motivation to move these animals was sentimentalism, curiosity or the desire to establish populations of wild animals that could be hunted, trapped or utilized in other ways. Some of these early translocations were successful but failures were common. With the introduction of modern capture techniques, combined with increased knowledge and experience, capture and translocation of animals may be a viable option for today's wildlife manager. It however remains an option that is controversial, expensive and difficult. Due to the risks involved, a wildlife manager must not only consider the ecological and biological viability but also the most productive use of the available resources. This paper gives you a brief background on how the present capture team was established and the steps it has taken to ensure that it plays a vital role in the management of wildlife in the Republic of Kenya.

BACKGROUND

The idea to create a capture team within the then Game Department for management purposes were hatched in 1974 by the former head of the research division Mr. Simon W. Taiti. The task to establish this team was laid on Dr. I. A. Chawdhry who in 1975 engaged in this noble task. The pioneer staff included a Veterinarian, and Assistant Game Warden, one ranger and two drivers. Through observation and participation in capture of wild animals with the already established private capture teams in Kenya, we were able to get the exposure and the training that we seriously required. These private capture teams included big names like Ken Randall, Carr Hartley, John Seago and Don Hunt. They were capturing wild animals for commercial purposes until 1978 when through a Parliamentary Act No.5 of 1978 trade in wildlife and wildlife products were prohibited. All the above teams were employing a combination of both Mechanical and chemical capture and the species targeted included Black Rhinoceros - ***Diceros bicornis,*** African Elephants - ***Loxodonte africana,*** Fringe eared Oryx - ***Oryx beisa***, African Buffalo - ***Syricenis caffer*** and other free ranging species. After acquiring the necessary training and exposure, we were able to establish the present capture team in 1975. Our first major challenge was in 1978 when we were assigned the task of translocating Rothschild Giraffes - ***Giraffa cameropardails rothschildi*** which was an endangered spp. from Soy -Eldoret to Lake Nakuru National Park. We engaged casual labour to facilitate the operation to take off as planned. Despite all these constraints, we were able to translocate twenty-four animals and nineteen survived. The population has grown to over one hundred and fifty animals which is a good indicator to the success of the translocation. The team has since then been able to conduct several translocation exercises including rescue of injured, snared, abandoned animals and to assist in disease intervention by capturing animals for sampling.

We have also been involved in the restocking of various conservation areas within the republic with various spp. of animals especially the endangered spp. like black rhinos.

ESTABLISHING A CAPTURE TEAM:

For an organization or an individual to be able to establish an effective capture team, there are some basic requirements which are very crucial. This includes trained personnel, capture equipment, capture vehicles, plants, a store and a workshop. The team should be composed of a minimum of twelve strong men who should be multiskilled. The members of the current capture team in Kenya have undergone the paramilitary training primarily to instill self-discipline and to be able to protect themselves whilst in field. During this training, the members undergo a weapon handling and maintenance course, first aid, bush craft skills, survival techniques and behaviour of various spp. of wild animals. They are also conversant with basic animal husbandry of captive animals, identification of plants, behaviour of different spp. of animals and also stalking of wild animals. We are able to construct temporary and permanent holding bomas, translocation as well as export crates. The present team has been together for the past eighteen years and has always worked together as a team. To enhance productivity, discipline and team work within the unit, the department gives incentives in form of allowances, protective clothing e.g. overalls, gumboots, leather hand gloves, commendations, promotions and appraisals to the members of the team. The present team is made up of eight rangers, two Cpl. rangers and one Sgt. ranger. As the officer in-charge of the team, I have not had any major complaint that could affect the day to day activities of the Unit. I however, receive normal complaints, which are amicably solved. The team has however been seriously affected by the retrenchments in the past two years 1997 - 1998, during which we have lost four rangers and two drivers. This calls up for introduction of new blood into the team.

PLANNING AND PREPARATION FOR A CAPTURE OPERATION:

For the success of any capture operation, careful planning is required, preparation, professional expertise, experienced personnel, technology and appropriate funding. The first consideration is the amount of resources required for the operation. The available resources must be utilised efficiently as the conservation agencies do not have unlimited resources. The resources should be utilised in accordance with the goals and objectives of the general wildlife management plan. The personnel to be involved in a capture operation are alerted in advance. This enables them to ensure that all the equipment required for the operation are in place and in good working condition.

DRAWBACKS:

There are various drawbacks that could force an operation to be called off or cancelled. They include in adequate funds, lack of the necessary resources, bad weather and insecurity within an operation area.

CAMPING SITE:

It should be within the vicinity of the operation area and various factors should be considered.

(i) Drainage system
(ii) Accessibility by road
(iii) Availability of water
(iv) It should be away from towns
(v) It should be away from noisy human activities

CAPTURE OF ANIMALS:

The method of capture is dictated by the reason of capture, number of animals to be captured and the terrain.

There are mainly two methods that could be employed in the capture of wild animals namely individual and mass capture.

Individual Capture: Involves capturing an individual animal. This can be executed by use of a net gun, or individual darting.

Mass Capture: Mass capture involves capture of many individual animals at the same time. This can be accomplished by use of the fixed net system, plastic capture boma, drop net system plastic corrals and also linear net system.

Dangers of wild animals: If you hope to get involved in wildlife capture, remember the prime concern is safety to the individual carrying out the restraint. Many animals both small and large can inflict major injuries within a short time. Some injuries may be fatal. Never try to take unnecessary risks and ensure an animal is fully immobilised before approaching it.

Rope work: All individuals capturing animals by physical or chemical methods must become familiar with the rope work.

HOLDING FACILITIES:

The holding facilities are determined by the following factors and they should be able to efficiently handle the captive animals with the minimum amount of stress.

i. Reason for confining the animal
ii. Species of the animal
iii. Number of the animals to be handled
iv. Duration of confinement.

The following factors must be considered:

i. Safety and adaptation. Ensure safety and well being of the animals in captivity by preventing their escape.

ii. Site - no noisy activities and should be easily accessible.

iii. Size - must be large enough to be able to accommodate all animals. This is based roughly on the formula of $1.5m^2$ for every 50-kg. of live mass.

vi. Drainage - The drainage must be good to prevent muddy unhygienic conditions.

v. Ventilation - The facilities should have a free air flow.

vi. Protection against sun and rain.

CARE AND MAINTENANCE OF CAPTURE EQUIPMENTS:

Equipment is a very crucial component in a capture operation. Most of the equipment are very expensive and therefore calls for a need to maintain and take care of them, i.e.

- The tents should be washed and dried before being taken back for storage.
- The capture nets if rained on should also be dried before storage.
- The nets do collect sticky materials in form of seeds, twigs and thorns. They should be stretched and all these foreign bodies removed before storage.
- The vehicles should be properly serviced after every major operation.
- Chain saws and generators should also be serviced after the operation.
- The transportation crates and cages should be checked and rectified after every major operation.

FUTURE OF THE UNIT:

To ensure it continues playing it's important role within the organization by adding new blood into the team and acquiring some essential captive equipment.

ESTABLISHING A CAPTURE TEAM IN EASTERN AFRICA

G.J. Kanyingi, KWS

Capture team in Kenya

- Background.
- Personnel

Training

- Behaviour of animals
- Plant identification
- Paramilitary
- First aid
- Bush craft skills
- Handling and care of firearms
- Identification of different spp. of wild animals
- Stalking of wild animals
- Precautions while handling wild animal
- Care of captive animals

Requirements to start the team:

- Personnel
- Equipment
- Vehicles
- Tractors and Trailers
- Generator/welding machine
- Store
- Work shop
- Holding facilities

Capture Operation:

- Requires careful planning
- Preparation
- Professional expertise
- Experienced personnel
- Appropriate funding

NB: The first consideration is the amount of resources required for the Operation.

Capture Methodology:

- Individual capture
- Mass capture

Hirola translocatlon:

- Why translocate?
- Personnel
- Methodology:
  - A fixed it U net system
  - Loose chain of freely hung nets
  - Darting

- Observations
- Comparisons Red hartebeest Vs Hirola

Holding facilities:

Dictated by:-

- Reason for confinement
- Spp. of animal
- Number of animals to be handled
- Duration of confinement

Types - Holding bomas (Pens)

- Permanent
- Temporary
- Mobile
- Cages > Squeeze
  > Normal
- Traps

NB: The facilities should be able to efficiently handle the captive animals with minimum stress.

Factors that can make a capture operation to be cancelled or called off.

- Inadequate funds
- Lack of the necessary resources
- Bad weather
- In security in opps area

Camping Site:

- Proximity to opps. area
- Drainage
- Accessibility
- Away from towns
- A way from noises

Care and maintenance of capture equipment:

- Tents
- Nets
- Crates
- Containers
- Vehicles
- Generators
- Chain Saws
- Other accessories

Future of the Unit:

Ensure it continues playing its role within the organization by adding new blood into the team and acquiring essential equipment

INDIVIDUAL ANIMAL IMMOBILISATION TECHNIQUES

Eland

Key problems: highly tolerant to etorphine. Underdosing leads to persistent running and exhaustion, overheating myopathy and death.

Solution: high dose etorphine with addition of high dose of xylazine

Minimum : Adult male 12 mg Etorphine 200 mg xylazine, female 10 mg etorphine 150 mg xylazine

Use : 3-4 ml palmer/pneudart with 40 mm needles so require concentrated etorphine 4.9 mg/ml and xylazine
100 mg/ml

Ensure reversal with both diprenorphine and alpha antagonist and availability of doxapram.

Giraffe

Key problems: physiologically maladapted to immobilisation: sensitive to changes in blood pressure and respiratory depression (large respiratory deadspace and brain far from heart) also poor muscle stress tolerance.

Solution: high dose pure etorphine and rope restraint with immediate reversal on recumbency with control of the head on the ground and blindfolding blockage of the ears as necessary.

Minimum: adult male 12 mg etorphine female 10 mg etorphine

Use: palmer/pneudart 60mm needles minimum 2 persons on the ground for rope work but better 4-6 in case of complications.

Wild pigs

Key problem: high tolerance of drugs and poor tolerance of respiratory depression

Solution: use combinations of etorphine, xylazine and or tiletamine/zolasepam.

et 5 mg + xy 20 mg
et 3mg + xy 20 mg + tiletamine/z 200 mg
tiletamine/z 500 mg

Use doxopram and reverse xylazine as necessary

Care of animals like warthog disappearing down holes semi immobilised.

Use netting techniques if available.

IMMOBILISATION OF CARNIVORES

Dr. Wambua

This article is an overview of some current drugs, dosages and methods used in the immobilisation of individual wild carnivores. Special precautions that need to be taken during immobilisation are mentioned. The article applies to both captive and free-ranging situations. It is compiled from individual experiences as well as a review of published scientific literature. It should serve as a general guide and not an exhaustive review. It is divided into 3 parts:

- Immobilising and sedative agents
- Delivery systems and special precautions
- Suggested drug dosages

IMMOBILISING AND SEDATIVE AGENTS:

CYCLOHEXAMINES (DISSOCIATIVE ANAESTHETICS)

Examples: Ketamine Hydrochloride (Ketaset®, Ketalar®, Vetalar®)
Tiletamine Hydrochloride + Zolazepam (Telazol®, Zoletil®)
Phencyclidine Hydrochloride (Sernylan®) No longer available for veterinary use

They are the drugs of choice for the immobilisation of carnivores. They are injectable general anaesthetics that are used alone or in combination with other Central Nervous System (CNS) drugs. They are referred to as dissociative anaesthetics because they induce anaesthesia by interrupting the flow of information from the unconscious to the conscious parts of the brain rather than by generalised depression of brain centers. The animal appears to be awake but are unaware of their surroundings. Phencyclidine is the parent compound of this group, but is no longer available for veterinary use. The relative potencies of Phencyclidine: Tiletamine: Ketamine is 5:2.5:1

Properties/Effects:
Cause profound anaesthesia and analgesia

Thought to be amnestic (animal has little or no recollection of the anaesthetic event)

The coughing and swallowing reflex are retained. This is beneficial since it helps prevent inhalation of saliva and gut contents.

Stimulates the cardiovascular system causing an increase in heart rate, cardiac output and arterial pressure.

Respiration is depressed, but remains within the physiological limits. Adequate respiration rate is maintained at a surgical level of anaesthesia.

Cause poor muscle relaxation, muscle tremors, and convulsive seizures when the anaesthetics are used on their own and at times when combined with sedatives. Diazepam injections are recommended for treatment of these convulsions.

Eyelids remain open during the entire period of anaesthesia with intact corneal and light reflexes. Corneal ulceration may occur, and prolonged exposure to the sun can result in retinal damage. A bland ointment should be used to prevent drying of the cornea and a blindfold to shield them from

direct sunlight. This also helps to calm the animal.

Cause excessive salivation. This can be reduced by giving Atropine (0.04mg/kg)

Excessive stimulation of the animal can delay induction, and hasten recovery. There should be minimal disturbance. Quiet, dark environments allow smoother recovery.

Depth of anaesthesia can be evaluated by the animal's response to painful stimuli.

There is no complete antagonist for cyclohexamines. Their specific receptor sites in the CNS have not been identified therefore no competitive antagonist has been developed. Recovery can be prolonged and associated with excitement. Partial antagonists include; Yohimbine, Tolazoline, and Naloxone.

They may cause stimulation of certain areas of the brain. This may cause emergence reactions and hallucinatory behaviour during recovery unlike the sleepy recoveries in most other agents. Reactions include ataxia, increased motor activity, sensitivity to touch. Hallucinatory behaviour includes staring in space, and moving in slow motion after invisible objects. The use of Xylazine minimises side effects.

Ketamine Hcl
Is probably the most widely used in this group. Induction time is 3-10 mins. Duration of action 1-3 hours

- Has a wide safety margin
- Thought to have little effect on visceral pain and thus is a poor choice for major abdominal surgery
- The major drawback is that when used to capture large wild carnivores, you need a large volume therefore have to use 1&ge darts that need more delivery force or repeated darting is required.

Tiletamine Hel:
Tiletamine used alone causes severe convulsions therefore. It is only available in combination with a diazpenone sedative, zolazepam hydrochloride.

- Highly soluble combination and can form a highly concentrated solution to make up small darts, but once in solution it is unstable.
- It is an extremely safe combination
- Occasionally an animal may undergo re-sedation within 24-36 hours after complete recovery from anaesthesia. This is reported in Siberian tiger ***Panthera tigris altaica,*** Bengal tiger ***Panthera tigris tigris.***

OPIOIDS:

Examples:
- Fentanyl (R4263, Sublimase®, Innovar Vet® = Fentanyl + Droperidol)
- Etorphine (M99, Large Animal Immobilon® = M99 + Acetylpromazine)
- Carfentanil (R33799, Wildnil, Super-fentanyl)

Opicids have morphine like action. They bind to receptors all over the body but prevalent in the

CNS. They are the most potent drugs available for animal immobilisation. The 3 most commonly used opioids are Fentanyl, Etorphine and Carfentanil. They are used in large carnivores excluding felids but are generally not preferred. 2 dangerous side effects that occur with opioids are induced excitement and respiratory depression. Excitement is extreme in cats and opioids must never be used in this group. The more potent opioids Etorphine and Carfentanil often result in severe respiratory depression or arrest in canids. Fentanyl or combinations with Fentanyl have been successfiilly used on smaller eanids e.g. Wild dogs, and have a short induction time (2-3 mins). Etotphine/Xylazine combination has been used in Hyaena. Useful because complete reversal of both anaesthetic and sedative are possible. Narcotic antagonists that have higher affinity for the narcotic receptor sites can rapidly reverse the effects of opioids. Renarcotisation can occur on some occasions.

TRANQUILLISERS/SEDATIVES
They have been used extensively in canid immobilisations. They act as adjuncts to the primary immobilising agent (cyclohexamine or opioid) and produce a smooth anaesthetic induction, anaesthesia and recovery. They reduce the amount of general anaesthetic required. On their own, they are capable of heavily sedating canids, however with stimulation these animals can be aroused and are capable of directed attack.

Alpha2-adrenergic agonists:

Examples
- Xylazine Hydrochloride (Rompun®)
- Meditomidine (Dormitor®)

They act by depressing the CNS functions and cause a sleep-like state. Their sedative and analgesic properties are the basis of their clinical use. This however is inseparable from other undesirable alpha 2-agonist effects.

Properties/Effects:
Potent sedative (1-2 hrs) and analgesics (15-30 mins)

Reduce the amount of general anaesthetic required and deepen the level of anaesthesia

Cause muscle relaxation

Cause depression of respiration

Can cause severe bradycardia

Causes salivation This is controlled by the use of Atropine (0.02mg/kg)

Reduce gut-motility and secretion

Reduce body temperature.

Causes prolonged recovery from anaesthesia. Giving an alpha 2-adrenergic antagonist e.g. Yohimbine® (A synthetic alpha adrenergic blocker) can shorten this time. Waiting at least 20-45 minutes after last Ketamine injection before administering Yohimbine or any other alpha 2-antagonist, to allow a smoother recovery. Atipamazolee® antagonises the behavioural, cardiovascular, gastrointestinal, neurochemical and hypothermic effects of Meditomidine.

NB. The use of Xylazine alone in carnivores is contraindicated. Although the animals appear anaesthetised after administration of the drug, the sedation induced by Xylazine can be overcome if the animal is stimulated, and it may react aggressively

Ihe Hellabraun mixture (Ketamine/Xylazine mixture)
This is an anaesthetic combination of lyophilised Xyiazine Hcl with aqueous Ketamine Hcl used in many mammalian species. The ratio of mixture is 125mg Xyaline: 100mg Ketamine per ml. With this combination, small volumes are required to anaesthetise large carnivores.

Ketamlne/Meditomidine mixture
This combination induces a safe and reliable immobilisation in a variety of carnivore species. Inductions are calm. Myorelaxation is good to excellent and immobilisation lasts approximately 45 minutes. Recommended dosage rate is 80-100 ug/kg Meditotiudine and 3.0 mg/kg Ketamine.

Other Tranquillisers

Phenothiazines e.g. Acetylpromazine
Has been used in wild canid immobilisation

Butyrophenones: e.g. Azaperone
No reports of it's use in wild canids. Used in other species to counter narcotic respiratory depression

Benzodiazepines e.g. Diazepam. Zolazepam
Diazepam is primarily used in canid immobilisation to counter convulsions and muscle rigidity produced by cyclohexamines. Their disadvantage is that when used in combination with cyclohexamines to immobilise large canids, the total drug volume required is greater than practical as compared to a sedative such as Xylazine which is capable of producing the effect in a relatively small amount. Flumazenil is a benzodiazepine antagonist which can reduce recovery times when Diazepam has been used.

Small Carnivores	Delivery Systems	Special presentations
Serval Cat *Fells serval* Caracal *Felis caracal* Side stripped jackal *Canis adustus* Bat eared fox *Otocyon meglotis*	BlowPipe Blow gun Pole syringe (trapped animal) Physical restraint & hand inject	Free-living small carnivores are not easy to approach, dart and keep in sight once darted Should not be darted over 5-10m distances. High velocities are required for the dart to reach the animal and severe injury can result because of lack of muscling. In most cases, small carnivores have to be trapped first, then darted or hand injected. Only adjustable, air powered projectors should be used on small carnivores with lightweight darts and needles to avoid injury.

Small Carnivores	Delivery Systems	Special presentations
		Although fatal wounds from small carnivores are unlikely, they still have the potential to cause severe injury. Take Care when handling them.

Medium/large Carnivores	Delivery Systems	Special presentations
Lion *Panthera leo* Leopard *Panthera pardus* Cheetah *Acinonyx jabatus* Spotted hyena *Crocuta crocuta*	Dart rifle (CO_2 or gun pwder) Blow pipe Blow gun Pole syringe	They are capable of inflicting injury with their teeth and claws. With large carnivores, injuries can be fatal. With dangerous animals it is important to assess at what point it is safe to handle the animal. Test the animals response to stimuli with an object like a pole. With experience one gets better. Keep assessing the animal during anaesthesia for the need to give additional drug. Be aware of the possibility of regurgitation if the animal is at a bait or a kill. A heavy calibre firearm should be kept at hand. Minimise panic when approaching an animal in a trap by reducing noise and making use of available cover. Move out of sight once darted.

Precautions with Immobilised Carnivores:
Always retrieve the dart and check for complete discharge of the drug.

Be wary of a semi-immobilised carnivore. Approach it cautiously

Place the immobilised animal on its side with its head extended and angled downwards and tongue pulled out on one side. Should regurgitation occur, the vomitus would flow out of the mouth.

Apply a bland ointment to the eyes and blindfold the animal to prevent permanent damage of the retina by direct sunlight or put it in the shade.

Noise should be minimised especially with dissociative anaesthetics, as the animals can still perceive loud noise that can cause unnecessary stress and reduce the depth of anaesthesia.

Recovery is also smoother in quiet, dark environments.

All canids should be given antibiotics after immobilisation because abscesses can occur and are debilitating in free-ranging animals

The animals vital parameters (Heart rate, Respiration and Temperature) should be monitored throughout the procedure

For species that live in groups, prolonged separation of an immobilised group member should be avoided, as reintroduction to the group may result in extensive fighting.

Do not allow carnivores to recover unattended. Other predators may attack them.

Suggested Drug Dosages:
Below are some suggested drug doses for selected canid species. If the animal is not anaesthetised within 10 - 15 minutes, give an additional dose, that is a half of the original anaesthetising dose. Do not give additional tranquilliser.

ANIMAL	DOSAGES (mg/kg)					DARTING SITES
	Zoletil	Ketamine	Xylazine	Fentanyl	Etorphine	
Serval Cat	3-5					
Felis serval		9-15				Hindquarters
Caracal	3-4					
Felis caracal		10	1			Hindquarters
Side stripped	3-4					Hindquarters
Jackal						
Canis adustus		5-10	0.5-1			
Civet cat	4-5					
Civettictis civetta		8-10	0.5-1			Hindquarters
Wild dog	2-3					
Lycaon pictus		4-11	1			Upper hind leg
			1	0.1		
Spotted Hyaena	5-6					Shoulder
Crocuta crocuta		10	1-2			Neck
			0.05		0.63	Hindquarters
Cheetah	3-4					
Acinonyx jabatus		8-10	1			Hindquarters
Leopard	5-10					Shoulder
Panthera pardus		8-10	1			Hindquarters
Lion	4-5					Neck
Panthera leo		7-8				Shoulder
			3-4			Hindquarters

Reviewed Literature

Bush M., 1996. Methods of Capture, Handling and Anaesthesia In Wild Mammals in Captivity-Principles and Tecimiques. Ed. Devra G. Kleiman et 21, The Chicago University Press. Pp 25 **40**

Jalanka H. H., and Roeken B. O., 1990. The use of Meditomidine, Meditornidine-Ketamine combinations, and Atipamazole in non-domestic mammals: A review. Journal of Zoo and Wildlife Medicine (21)3:259-282

Kreeger T. 3., 1992. A review of chemical immobilisation of wild canids. Proceedings of Joint Conference. American Association of Zoo Veterinarians and the American Association of Wildlife Veterinarians. pp 271-283

Mckenzie A. A., Burroughs R. E. J., 1993. The Chemical Capture of Carnivores. In The Capture and Care Manual. Ed. Andrew A. Mcenzie. Published by Wildlife Decision Support Services and The South AfricanVeterinary Foundation. Pp 223-250.

Wright, M. 1982. Pharniocologic effects of ketamine and its use in veterinary medicine. Journal of American Veterinary Medical Association. 180: 1462-1471.

INDIVIDUAL ANIMAL CAPTURE TECHNIQUES: GAZELLES AND LARGE HORNED ANTELOPES

Dr. Mwanzia, UAE

INTRODUCTION

Classification

Gazelles and large horned antelopes are in the order of even toed ungulates (artiodactyla) and the suborder ruminants (Ruminantia).

There are 12 Subfamilies in the order comprising 44 genera with a total of over 100 species.

Of interest in this talk will be: -

Subfamily Tragelaphinae that includes among others the following: -
- Greater Kudu-*Tragelaphus strepsiceros*
- Lesser Kudu- *Tragelaphus imberbis*
- Bushbuck- *Tragelaphus scriptus*
- Bongo -*Tragelaphus euryceros*
- Common Eland- *Tragelaphus (Taurotragus) oryx*

Sub family Hippotraginae that includes among others the following: -
- Roan antelope- *Hippotragus equinus*
- Sable antelope - *Hippotragus niger*
- Addax- *Addax nasomaculatus*
- Gemsbok- *Oryx gazella gemsbok*
- Beisa oryx- *Oryx gezella beisa*
- Arabian oryx -*Oryx leucoryx*
- Scimitar horned oryx- *Oryx damah*
- Fringe eared oryx- *Oryx gezella callotis*

Subfamily Antilopinae- gazelles and related species which include among others the following: -
- Impala- *Aepyceros melampus*
- Grant's gazelle- *Gazella granti*
- Thomson's gazelle- *Gazella thomsoni*
- Gerenuk- *Litocranius walleri*
- Dorcas gazelle- *Gazella dorcas*

Application of various modern capture methods to capture the above named animals requires a certain amount of expertise, experience and some knowledge of the anatomy, physiology and the habits of the animals to be captured. These animals can be captured for various reasons and is always very important those involved are clear as to what the purpose of the operation is (translocation, research studies, collection of samples, clinical treatment or surgical purposes).

For the purpose of this workshop I will dwell on individual capture techniques in which there are two main ways: -

IMMOBILIZATION

Net gun

I will talk on the immobilization and net gun techniques in general and eventually I will talk about some individual species capture in details. I will also briefly mention hand capture of impala.
An overview of drugs used in capture of these animals has already been given and I will mention in passing the drugs of choice when I speak of the individual antelopes and gazelles.

IMMOBILIZATION OF ANTELOPES AND GAZELLES

General principles

Immobilization of antelopes and gazelles just like any other species can be divided broadly in five main categories: -

- Planning
- Approach
- Darting
- Induction
- Recovery

Planning

Before catching any antelope/gazelle the objective should be clear and the target animal well defined. Specific terrain and circumstances must be evaluated and a plan of action drawn. This plan of action should be discussed with all concerned so that each and every ones responsibility is clear. The purpose of capture will dictate the actions to be taken for example a catch and release operation can usually be done with a minimum back up. Sometimes only one vehicle, or helicopter and crew are needed. On the other hand, when transportation has to be done proper back up should be provided.

The specific antelope/gazelle to be darted is an important consideration. Variations in behavioral and physiological response to a particular drug or drug combinations exist among different species, requiring different approaches and drug combinations. Some species such as Kudu, Gemsbok are easily excitable and higher drug dosages and heavier sedation may be required. When an off road approach, with the associated disturbance and a chase is contemplated, pre or post darting a higher dose is recommended. Animals adapted to captive conditions require a dramatically lower dose compared to there free - ranging counterparts.

Considering all these variables, it is advisable before any catching operation, to scan the literature and previous records for the best possible drug dosages and technique for a particular gazelle/antelope.

The health state of the gazelle/antelope to be immobilized is also an important consideration. Sick and debilitated animals require less dosage and the same applies to animals in poor condition. Fat animals on the other hand seem to have a higher resistance to immobilizing drugs.

Terrain where immobilization is going to take place is also a very important consideration in deciding the dose of the immobilizing agents. In flat open country where pursuit and observation is easy post darting lower doses can be used however in dense bush habitats or mountains terrain where follow up is difficult and hazardous short induction time and hence higher doses are recommended

Circumstances such as very hot weather must be taken in account in order to expose the gazelle/antelope to minimal exertional stress and overheating. Thus it is advisable whenever possible to limit your immobilization's to cooler parts of the day. Drugs that interfere with temperature regulation like the phenothiazine derivatives should also not be used in very hot weather.

In the planning phase equipment like dart guns, dart syringes, vehicles, radios, ropes etc is also checked to see if in order. The drug box is also packed with all the necessary material for the project at hand including emergency treatment packs.

In case the species, sex and age of the specific antelope/gazelle is known, it is preferably to load before going out for the capture operation so that opportunities that present themselves along the way can be taken.

Approach and darting

This is a very important step in the immobilization procedure. Considering the availability of potent morphine analgesics, a successful approach and a well-placed dart will virtually ensure success.

Approach could be on foot, vehicle or helicopter.

Free ranging antelopes/gazelles are wary of people approaching on foot and will maintain a long flight distance, usually out of range of the dart gun. This need a great deal of bushcraft and can be dangerous to the operator. However this can be done sometimes under emergency situations.
Approach by vehicle with the objective of remaining on the road as far as possible before the dart is fired in nature reserves is a suitable method. A smooth and slow approach, preferably without changing speed or sudden lurches, and preferably without stops near the animal are made. Always try to drive at angle that will take the vehicle at a tangent past the animal at a distance within firing range but outside their flight distance. This technique may not always be feasible and sometimes a fast approach and firing the dart from the moving car while passing the animal is successful.

With the vehicle approach, patience is the greatest virtue an operator can have. Impatience often results in taking chances on bad terrain, risking shots over a near impossible distance or bad angle; thereby increasing your chances of losing the animal from factors such as heat stress, broken limbs or bad reaction sometimes from a misplaced dart.

The preferred method of approach of free ranging large horned antelopes is from a helicopter. The helicopter is used to locate the animal and then bring the operator within firing range.

A well-placed dart is a dart, which hits a well-muscled area with intramuscular deposition of the drug resulting. Th neck region is suitable for adult antelopes with heavy necks like Sable, Kudu and Roan. The shoulder is a good target place for remote injection if the scapular crest can be avoided because it provides a wide flat target, which is perpendicular to the line of flight of the dart when working on ground level.

The hindquarters are the most common site of injection. Well-fleshed antelope may be injected from any angle provided the dart is perpendicular to the surface.

Induction

The time interval between injection (darting) and the point where the animal is rendered immobile is called the induction time. Induction period typically follows a progression from an alarm reaction through various stages to recumbency. These stages can be well defined or could be rather arbitrary with stages merging into each other. These are very important because they determine when to handle the antelope/gazelle with minimum risks. Briefly this can be classified as follows: -

Alarm reaction-Reaction to darting include alarm wariness

Aberrant behavior-Reaction to drug includes locomotory changes, agitation and disorientation.

Immobilization- Include standing, swaying or leaning, recumbent able to stand or recumbent unable to stand.

If the habitats permits it always advisable to stay put after darting the antelope until it has clamed down after the initial alarm reaction.
The first outward signs and symptoms of the onset of immobilization are usually a slight disorientation or aberrant behavior. The animal may move away from the herd or walk in an aimless fashion.
The drugged animal going down characterizes the terminal phase of the induction period. The animal sometimes may rise spontaneously shortly afterwards, or when disturbed quickly hence it always important for an animal to be watched for a while to ensure that it has reached a satisfactory plane of anesthesia, before handling it.

Handling

During this period the animal can be handled without the risk to both man and the animal. In gazelles/antelopes the preferred position is the sternal one to avoid bloat. The head should be down to allow any material that may have regurgitated to flow freely out through the mouth and not into the respiratory tract.
Once down it is always very important to determine the depth of anesthesia. The eyes should be protected by use of eye ointment and a blind should be used. It is also very important to ensure the animal does not overheat by closely monitoring the temperature and were possible keep it cool by dosing with cold water.

Recovery

Use of reversible compounds has greatly facilitated the capture handling of gazelles and antelopes. Depression of the respiratory system with anoxia and shock is prevented. It is always very important prior to administering the antidote all possible external stimuli is removed. This includes vehicles and people, with only the person administering the antidote and somebody to keep the animal upright, allowed near by. Noise should always be kept at a minimum. Only when an antelope has retained his righting reflexes and control over his neck is the blindfold removed and the animal allowed to make an attempt to stand. When an animal is stimulated before he is ready to get up, he will attempt it but may fall around and sustain injuries. Once up allow the animal to wonder undisturbed

Briefly I will go over the selected subfamilies mentioned earlier with some species being mentioned.

TRAGELAPHINAE: -

Etorphine is most suitable opiod mixed with a neuroleptic (xylazine, azaperone or detomidine). Darting can be from a hide, vehicle or helicopter. Helicopter is the preferred method though expensive.

Kudu

Etorphine most suitable opiod-Adult bull 5-6 mg total dose; adult cow 4-5mg total dose. Mix with neuroleptic 40-50mg xylazine or 100mg azaperone or 10mg detomidine. 3000iu hylase can be used to speed induction

Use of helicopter most effective. A 50-60 mm long needle preferably collared should be used.

Bush buck

Etorphine most suitable opiod- Adult ram 1.5-2 mg total dose; adult ewe 1-1.5 mg total dose. Mix with 60-80 mg Azaperone.

Darting best done from a hide. Needles should be 20-30mm long and preferably collared.

Lesser Kudu

Etorphine most suitable opiod. Adult ram 2-3 mg total dose; adult ewe 2-3mg. Mix with 10-20 mg Xylazine, 50-60 mg Azaperone, or 5 mg Detomidine.

Darting from vehicle can be done. 20-30mm needle collared is suitable.

Eland

Covered in another paper.

HIPPOTRAGINAE: -

Etorphine most suitable opiod mixed with a neuroleptic(xylazine, azaperone, detomidine).

Darting can be from vehicle helicopter or hide.

It is important to remember that hippotraginae are difficult and dangerous to restrain manually due to their aggressive tendencies and can inflict serious injuries.

Roan antelope

Etorphine most suitable opiod: Adult bull 4-5mg; adult cow 3-4 mg. Mix this with 15-20mg xylazine, or 100 mg azaperone, or 10 mg detomidine.
Preferably use 50-60 mm collared needles.

Darting can be from the vehicle, hide or helicopter.

Sable antelope

Etorphine most suitable opiod-Adult bull 4-5 mg total dose; adult cow 3-4mg total dose. Mix with neuroleptic 15-20mg xylazine or 100mg Azaperone or 10mg detomidine. 3000iu hylase can be used to speed induction

Use of helicopter most effective. A 50-60 mm long needle preferably collared should be used.

Gemsbok

Etorphine most suitable opiod. Adult bull 4-5 mg total dose; adult cow 3-4mg. Mix with 15-20 mg Xylazine, 100 mg Azaperone, or 10 mg detomidine.

Darting from vehicle and helicopter can be done. 40-50mm needle collared is suitable.

Beisa and Fringe eared oryx

Etorphine opiod of choice. Etorphine at range of 3- 6-mg total dose mixed with 20-40 mg xylazine for adult animals is suitable.
Darting can be from the vehicle, hide or helicopter. A 40-50mm needle can be used.

Arabian oryx

Etorphine most suitable opiod. Adult bull 3.5-4.5 mg total dose; adult cow 1.5-3.5mg. Mix with 10-45 mg xylazine.

Darting from vehicle and helicopter can be done. 40-50mm needle collared is suitable.

Scimitar horned oryx

Etorphine most suitable opiod. Adult bull 3-4 mg total dose; adult cow 2-3mg. Mix with 10-40 mg xylazine.

Darting from vehicle or helicopter can be done. 40-50mm needle collared is suitable.

ANTILOPINAE

Impala

Both hand and chemical capture can be done.

Fentanyl opiod of choice since impala are sensitive to etorphine.

Adult ram 10-15 mg fentanyl; adult ewe 10 mg fentanyl. Mix with 2-3 mg xylazine, or 50 mg azaperone.

Darting can be from a hide or a vehicle.

Needles should be 20-30 mm with or without collars.

Hand capture of Impala by temporarily blinding them with spotlights on dark moonless nights can

be done.

GAZELLES

Grant's gazelle, Thomson's gazelle, Gerenuk, Dorcas gazelle can be captured using Ketamine/xylazine mixture (Hellabrum mixture) at a ratio of 1:1. When used together ketamine and xylazine exhibit a marked synergistic effect.

For adult Thomson's gazelle, Grant's gazelle and Dorcas gazelle 1 ml of the above mixture (100mg xylazine +100 ketamine) is adequate to bring about an adequate immobilization with the xylazine being reversed with an alpha-2 -adrenergic blocker.

For Gerenuk 1.5 ml of the above mixture can be used.

Darting can be from a vehicle or a hide. Needle size should be 20-25 mm long and thin (2.5mm) and preferably non-collared.

NET GUN

The net gun is a hand held physical restrain device that uses an explosive charge to project a net over an animal. When fired over and in front of the animal it can effectively tangle the animal. It is preferably used from a helicopter though it can also be used from a vehicle. For individual capture of antelopes it can be safe and least expensive especially if the animals are scattered. The other advantages of the net gun include; it is less stressful to animal because there is less exertion prior to restrain, dangerous drugs are not required and the area where the animal is to be captured can be selected.

Some of the antelopes that can be caught with a net include Impala, Thomson gazelles, Grant's gazelle, Gerenuk and the young of Gemsbok, Beisa and •Eland.

Technique

This requires experience and usually the idea is to aim to net the animal from the area of the withers to the head. Always ensure there is enough personnel to restrain the animal before netting it.

Wrong use of a net gun and especially from a helicopter is potentially very dangerous and inexperienced user is advised to ensure adequate ground practice before attempting this.

In conclusion I would say Individual capture of gazelles and antelopes can be successfully done using the techniques discussed in this paper provided specific protocols are adhered to. It is always important before embarking on a capture operation to refresh your Knowledge on the specific antelope/gazelle to be captured and especially on the dosages of the drugs to be used.

References

Wildlife Restrain Series, 1991. International Wildlife Veterinary services, Inc
1850 North Main street, Salinas, California, 90906 USA

Capture and care manual, 1993 1st Edition edited by Andrew A. Mckenzie.

Kock, R.A. 1987 Remote injection systems: Science and art. Vet. Rec. 121: 76-80

Pienaar, U. de V. 1968. Recent advances in the field of wildlife immobilization and restrain of wild ungulates in South African National Parks. Antwerp Zoo.J. 46:17-38.

INDIVIDUAL CAPTURE METHODS - AFRICAN BUFFALO

Dr. J. Wambua, KWS

African buffalo ***(Syncerus caffer)***
This is a massive animal with a short neck and short sturdy legs.

Occur in two main races:

Cape Buffalo: Largest of all other races with males weighing up to 700kg. This is primarily a savanna species but could also be found in open bushes.

Distribution: Eastern, Central and Southern Africa.

Forest Buffalo: Smaller race with males weighing up to 320 kg. This is primarily a forest species.

Distribution: Mainly western Africa.

Characteristics

- Both sexes are horned. In males the horns are larger and the base broadens into a boss, while in females the horns are shorter and thinner with incomplete boss.
- Form herds of upto several thousand animals that pack together and often lie touching.
- They co-operatively protect herd members especially calves and will immediately respond to distress calls from one of their members by charging en masse. When the herd is frightened bulls always stay at the rear of the herd. Some mature bulls and old cows live solitary or sometimes in pairs.
- When approached with vehicle the youngsters/subadults tend to approach (curiosity?) closely enough to allow for easy observation and/or darting.
- When disturbed the herd will easily abandon an immobilized member of the group.
- Will easily flee from humans but are capable of laying a quick ambush for anybody approaching on foot

Capture Techniques Mass capture
Plastic boma system is possible with this species but the boma must be reinforced with nets to prevent easy breakout. The animals are driven into a boma (without a loading ramp) from where they are darted.

Individual capture:

The best technique is chemical immobilization (darting).

Buffaloes have large muscle masses of neck, shoulder, hindquarters that can be darted into, but one should be aware of horns and ears if aiming at the neck. The hide is thick therefore you need to use a suitable needle and charge.

Darting could be done from a vehicle on foot (from a hide) or from a helicopter. When using a vehicle you need to be cautious in your approach

Use of radio tracking darts is essential if working in bush/ forested areas.

Drugs:

Bulls: 10-12mg M99 + 50 - 80mg Xylazine or 200mg azaperone

Cows: 8-10mg M99 + 40 - 60mg Xylazine or 150mg azaperone

Sub-adult: 5-6mg + 30mg Xylazine or 100mg azaperone. Reverse with Diprenorphine + $_2$ agonist antiagonist e.g. Tolagoline anticedon

Safety Procedures when Tracking Buffalo

Buffalo should be regarded dangerous at all times.

Whenever tracking darted buffalo;

- Have only the most essential persons, i.e. the veterinarian and at least two well-trained and appropriately armed rangers.
- While walking through thickets/bushes, always look through to inspect bushes around you before moving forward.
- Never allow any other persons to scatter into the bushes.
- Do not capture at night unless you know the terrain very well, and have good spotlights (e.g. several maglite torches).

Considerations when Handling Immobilized Buffalo

- Once immobilized, the buffalo often bloats.
- They are prone to regurgitation especially if immobilized shortly after having consumed large volumes of water. This may lead to aspiration of rumen contents.
- They generate considerable heat through fermentation and can easily develop hyperthermia.

Precautions

One should avoid:

- Darting during hot hours of the day i.e. Midday
- Capture of heavily pregnant animals.
- Chasing the animals too far.
- Once immobilized and the problem regurgitation occurs, maintain the animal on sternal recumbency and keep the head high.

Age Determination of African Buffalo

Points to Note:

- Female: Sexually mature at about 3 years. Male: 5-6 years
- Gestation Period: 11 – 11 1/2 months
- First parturition at 4-6 years.
- Life Expectancy in the wild 20 years

Age determination could be done by considering (either or both) the following;

- Size and shape of the horns (see the attachment)
- Teeth eruption

Deciduous/milk teeth:

Incisors and Premolars erupt within I week of life. Eruption of canine teeth may delay and appear at 4 months.

Permanent teeth:

More reliable (than using size/shape of horns) in determining individuals whose age falls in 2-5 years bracket The eruption of permanent teeth occur as follows:

Incisor Teeth

1st Pair - erupt by 2 years 9 months

2nd Pair - erupt by 3 years 8 months

3rd Pair - erupt by 4 years

Canine teeth;

May erupt at 5 years though not reliable

Premolar

2nd Pair – by 4 years

3rd Pair – by 4 years

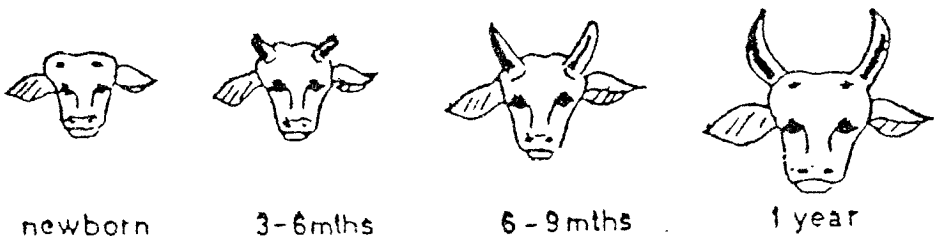
Molar

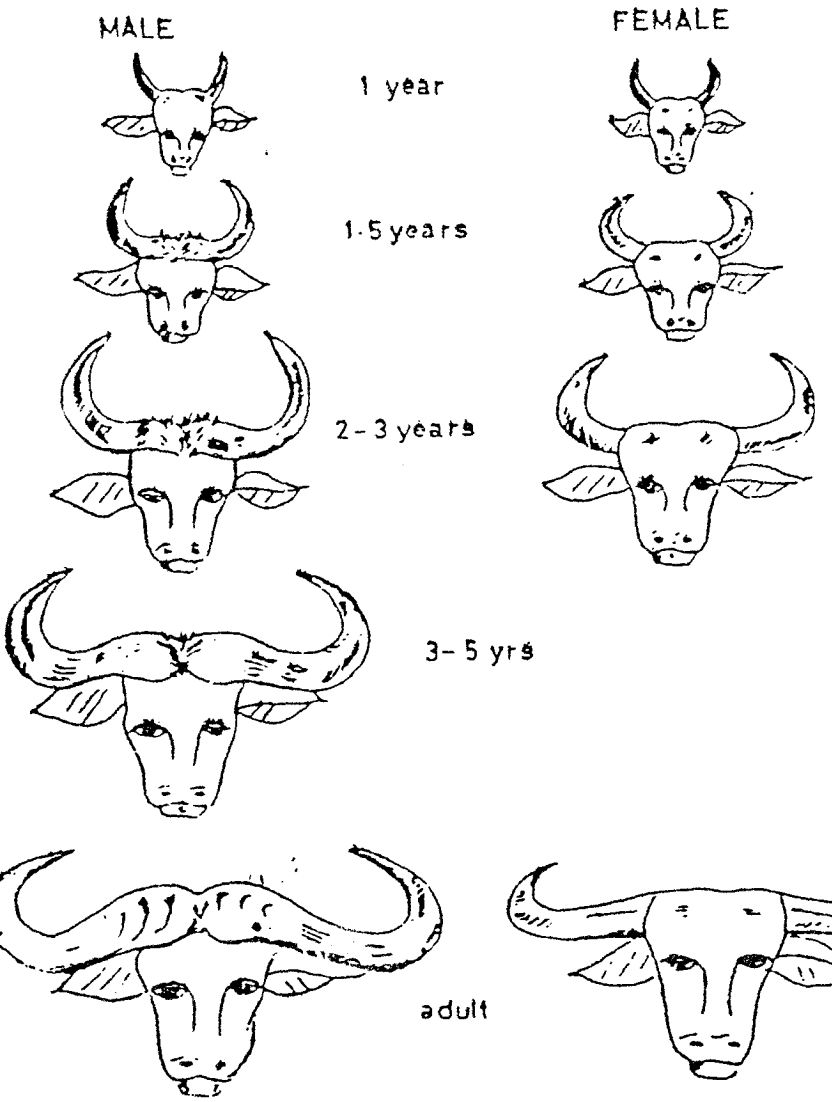
1st Pair - erupt by 1 year

2nd Pair - erupt by 2 years.

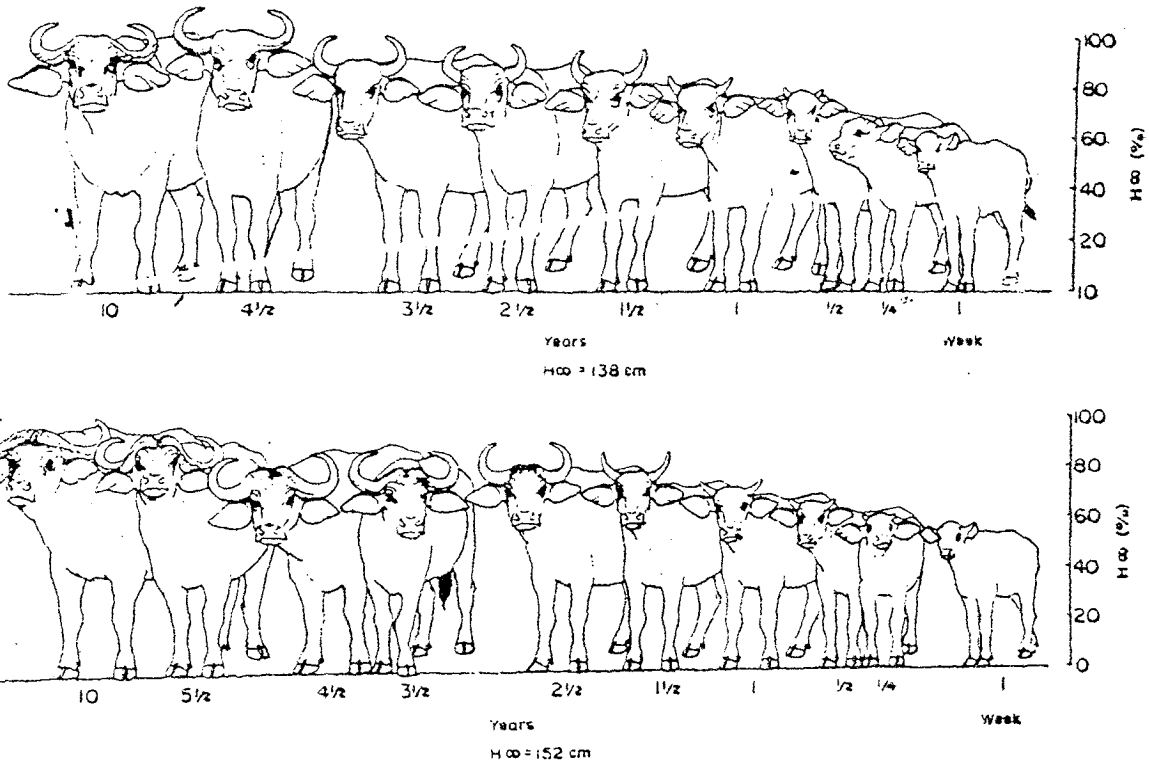
3rd Pair - erupt by 3 years

THE SHAPE AND SIZE OF HORNS IN THE VARIOUS AGE AND SEX CLASSES OF AFRICAN BUFFALO





DRAWINGS OF FEMALE (UPPER) AND MALE (BELOW) BUFFALOES OF VARIOUS AGES, TAKEN FROM PHOTOGRAPHS OF ANIMALS WHOSE APPROXIMATE AGE WAS KNOWN; DRAWN TO A RELATIVE SCALE BASED ON THE ATTAINMENT OF ASYMPTOPIC SHOULDER HEIGHT



Comparison of tooth eruption times in African buffalo with times recorded for the Asian buffalo and domestic cattle

Dentition	African buffalo	Asian buffalo	[2]Asian buffalo	[3]Zebu cattle	[4]European cattle	[5]European cattle
Deciduous teeth						
I_1		3 days (0-9 days)	3-7 days	-		
I_2	within 1 week	11 days (1-31 days)	4-7 days	-		
I_3		18 days (5-38 days)	9-14 days	-	Birth 2 weeks	At birth
C	by 4 mths.	4 mths. (1-11 mths.)	4-6 mths.	-		
pm_2		-	4-7 days	-		
pm_3	within 1 week	-	5-8 days	-	Birth	
Permanent teeth						
I_1	by 2yrs. 9mths.	2yrs. 10mths. (2yrs. 8mths.- 3yrs. 2mths.)	2yrs. 9mths.	2yrs. 3mths.- 2years 8mths.	1.5-2yrs.	2years
I_2	by 3yrs. 8mths.	3yrs 5mths. (3yrs 5mths. - 3yrs 9mths.)	3yrs. 9mths.	2yrs. 8mths.- 3yrs. 4mths.	2-2.5yrs	2yrs.9mth.
I_3	by 4yrs +	4yrs. 3mths. (3yrs. 10mths. 4yrs. 11mths.)	4yrs. 0mths.	3yrs. 4mths.- 4yrs. 6mths.	3yrs.	3yrs. 4mths.

Dentition	African buffalo	Asian buffalo	[2]Asian buffalo	[3]Zebu cattle	[4]European cattle	[5]European cattle
C	by 5 years	4yrs 10mths. (4yrs. 6mths.-5yrs. 9mths.)	4yrs. 9mths.	3yrs. 11mths-6yrs. 0mths.	3.5-4yrs	4yrs.4mths.-4yrs.9mths.
PM_2	by 4yrs.	-	2yrs. 10mths.		2-2.5yrs.	
PM_3	by 4yrs.	-	3yrs. 11mths.		1.5-2.5yrs.	
PM_4	?	-	4yrs. 0mths.		2.5-3yrs	
M_1	by 1yr.	-	1yr. 3mths.		5-6mths	
M_2	by 2yrs.	-	1yr. 5mths.		1-1.5yrs	
M_3	by 3yrs	-	2yrs. 8mths.		2-2.5yrs	

Authorities
1. Villegas (1929). Average age and range (in brackets) from 39 animals
2. MacGregor (1939). Average age from 18 animals
3. Kikule (1953). Age ranges from 187 cattle
4. Sisson & Grossman (1956). Average figures of improved breeds under favourable conditions
5. Cornevin & Lesbre (1894). Taken from illustrations of incisor eruption.

General Safety Procedures when Handling Wildlife

Whenever you are working with wildlife you cannot afford to be careless; you must always have a sober mind.

- All Wild animals should always be regarded, as potentially dangerous and appropriate precautions should be taken to prevent injury and/or death.
- You should only have essential personnel who must include at least two appropriately armed, well-trained Wildlife rangers.
- Make use of a cover when approaching wild animal for any procedure and make minimal noise.
- Approach closely enough only when fully prepared to conduct the procedure.
- Treat all antelopes with respect and do not subdue small, young weak or semi-immobilized animals by force.
- For immobilized antelopes always grab the horns first and do not let the head swing around, the animal may still be capable of doing damage.
- Always approach any immobilized animal with caution, the animal may still be strong on its feet and difficult to control especially if under dosed.
- Wild animals carry a number of diseases that are transferable to man. You must be cautious especially in cases of suspected disease outbreaks. Some of the wildlife zoonosis includes: Anthrax, brucellosis, Rift valley fever, hydatid disease etc.

CONSTRUCTION OF TEMPORARY HOLDING PENS

J.G. Kanyingi

INTRODUCTION

REASONS FOR ACCOMODATING CAPTIVE ANIMALS.

- Gathering of animals before transportation to other destinations.
- Acclimatisation and adaptation of animals before they are released into a new habitat.
- Quarantine of animals for disease control and veterinary inspections.
- Conditioning and taming of animals before export especially to the conditions involved with air travel.
- Treatment of injured arid sick animals.
- Supplementary feeding of debilitated or undernourished animals
- Research purposes.

Types of accommodation

- Determined by the reasons for confining the animal, the species o{ animals, arid the number of the animals and the duration of confinement
- The main function of a temporary holding facility is to hold and handle the animals efficiently arid with the minimum amount of stress.
- The design and construction of holding pens for most antelope spp. is relatively simple.
- If they have to be kept for several hours to a few days, a simply constructed round or oval field boma of capture plastic material is sufficient.

GUIDELINES AND BASIC STANDARDS

When accommodating captive animals, the following factors are considered.

Safety and adaptation

- Wild animals that have recently been captured, transported and placed in captivity instinctively try to escape.
- They are under stress, fear captivity and are anxious on their safety
- In the attempt to escape, they run around, jump out of pens and injure themselves and other animals in the pen.
- Ensuring the safety and well being of the animals in captivity by preventing their escape is very essential.

Site

- Must be away from areas of noisy human activity, i.e., homesteads, farm buildings, main roads, railway lines, barking dogs, etc.
- Holding pens should be conveniently situated arid should, be easily accessible

- Holding pens should not be built near perimeter fences, otherwise the animals will run into or jump over the fences into property upon release.

Material

- Sturdy, durable material such as wooden planks or poles recommended for construction of holding pens.
- Material must be strong enough to restrain or control any animals attempting to escape by forcing their way through the walls.

Height of pens

- Must be high enough to discourage animals from jumping over, i.e. impalas, waterbuck, and elands.
- Walls should be raised to over 3 m and/or placing wire netting or shade clothing over the top of the pens.
- It is recommended that holding pens for kudus and elands be completely roofed and thus partially darkened to discourage jumping.

Injurious material

- To obviate injury to 'animals in captivity, thorough inspection must be undertaken.
- All sharp or protruding objects such as nails, bolts, wires, etc. must be removed before any animals are moved into the holding pens.

Bedding

- A thick layer of straw should cover a section of the floor to provide bedding for the animals.
- This should be preferably under the shaded part of the pen and away from the passageway.

Additional security

- During first three to six days of captivity, the sides of the pens should be covered to restrict the view to the outside.
- This will make animals less aware of people and other animals and helps to reduce stress.
- Materials that could be used for this purpose includes thatching grass, reeds or hessian cloth to allow free flow of air through the pens.

Size

- Size of holding pens recommended for most of medium to large antelope is based roughly on the formula of 1.5 m^2 for every 50 kg of live body mass.
- Depending on the mass and the number of animals to be accommodated, the recommended size for housing small groups of medium sized antelope is between 3 x 5 m and 5 x 5 m. For accommodating groups of ten large antelopes, pens of 10 x 6m are recommended.

- The smallest single pens for housing individual animals should not be less than 3 x 2m.

- Number the pens clearly for convenience and easy management.

Drainage

- Pens must be built in a location that will ensure good drainage and run off of rain.
- Good drainage essential to prevent development of muddy, unhygienic conditions that could contribute to stress, respiratory diseases and foot rot.

Passages and doors

- In case of multiple pens, passageways of 1-2 m wide are recommended to allow free movement of wheelbarrows carting feed and removing old feed.
- Incorporation of a crush with two sliding gates at the end of the passage near the loading ramp is advisable.
- Useful for sorting out and sexing animals for the examination and treatment of animals.
- Wooden ladders to allow a quiet escape by staff must be fixed at regular and strategic places along the passage way walls as a precaution.

Ventilation

- A free airflow ensuring good ventilation through the pens is essential for the well being of the animals.'
- Holding pens with solid walls or sides that inhibit airflow are not recommended.
- If wood is used, 20 mm gaps between the poles or planks will provide sufficient ventilation.
- If split poles with uneven edges are used, they should be covered with a layer of hessian cloth from 100 mm, above the ground to a height of 2 m.

Protection against sun and rain

- Naturally, most animals seek for shade under the trees for shelter during hottest part of the day.
- One third of the holding pen should be roofed to provide shade.
- A solid roof must be provided to give full protection against rain.
- Wet, rain, soaked animals standing in a cold, wet, muddy pen are liable to get respiratory infection, foot rot and coccidiosis.

Ramps for loading and offloading

- Well constructed, sturdy ramps for offloading and loading of captive animals are fundamental component of the holding pens.

Offloading ramp

- Should be 2- 2.5 m wide and should be wide enough to encourage animals to move rapidly and freely out of the transport vehicle.

Loading ramp

- should be narrow to prevent animals from turning around while being loaded.

Sliding gate

- For sorting, sexing and handling a large number of animals, it is necessary to have about two or three sliding gates in the passage leading to the loading ramp.

Loading and offloading

- Should always be done with minimum noise and no shouting. Shouting only causes panic and confusion to the animals.
- There must be ample space in front of the loading area for turning and maneuvering large transport vehicles.

Food containers and feeding hatches

- Hayracks are unnecessary as most grazing animals feed at a near ground level except for animals such as giraffes.
- Hayracks can be hazardous; fatal injuries can result when animals rush into the pens soon after capture.
- Feed should be placed on the ground provided the ground is not wet or muddy.
- In large pens, food should be placed in the middle of the enclosure to enable animals stand around the food and eat.
- When there are many juveniles -in the group, food should be placed in several different areas to prevent victimisation.
- If feed containers are used, the sides and corners must be smooth or protected with rubber to protect injuries. Wooden or concrete feed containers are preferable to metal ones.

Water troughs

- Not advisable to use free standing water troughs. Animals move them around and they cause injuries when animals collide with them.
- If plastic or rubber containers are used, they should be secured to a corner and cleaned regularly.
- Troughs should hold a minimum of 50l of water and must be cleaned and refilled regularly.
- Round cement water troughs sunk into the ground and extending under the outer wall of the pen are recommended. Easy to clean and to refill.
- Water troughs must not have sharp sides or corners against which animals could injure themselves. Cut' metal drums with sharp edges should never be used.

Feed and water provision

- Must be fed regularly with fresh food that is suitable for the species.
- Replenishing of feed and water must be done quickly without any loud noise or shouting.
- Most animals do not feed or drink during the first few days of captivity. Due to unacceptance of their captive state and are still anxious and restless.
- Feeding should be done by trust worthy and reliable people.

Sanitation

- Captive animals should never be allowed to stand or lie on dung.
- Soiled bedding and left fodder must be removed every second day.
- There must be service pens to temporarily accommodate the captive animals while their pens are being cleaned.
- Water troughs should never run over while being filled, as this will create dampness that could predispose the animals to foot rot and coccidiosis.

Crush

- Enables the injection of tranquilisers, vaccines and antibiotics.
- Application of an acaricide for tick control.
- Administration of remedies for the control of internal parasites.
- The fitting or removal of pipes from the animals horns.

Treatment of wood

- All wood structures should be treated with creosote or a similar chemical to prevent weathering and termite damage.
- This should be done before the animals are put into the enclosures as creosote has a bad smell.

Inspections and observations

- Should be done twice per day by a competent person.
- Should be done with the least disturbance.
- Inspection or peep holes covered with a rubber or canvas flap are used for
- observation

Noise

- Noises at or near the pens is forbidden.
- Banging and shouting upsets and unsettles the animals.
- Loading and unloading of animals should be conducted quietly with minimal use of electric prodders. Shouting at the animals and staff assisting with the procedures causes confusion and panic and makes the animals fearful, anxious and aggressive.

MATERIALS

- The main objective is to create an impression of solid walls through which the animals cannot see by using game capture sheeting or hessian. The opaque sheeting appears as a solid barrier to the animals.

- The height of the walls depends on the species of the animals that have to be confined.
- For noted jumpers such as impalas, elands, etc. the height of the walls should not be less than 3 m.
- Walls should be strengthened by use of a wire mesh on the outside or capture nets.
- Poles to support walls must be firmly placed at 5 m intervals.
- Steel cables or ropes at ground level, middle and top are tensioned to support the material. The material is secured to the cables with baling wire or twine.

Boma size

- The boma can be square, circular or oval.
- The diameter of a circular boma is normally between 30 and 40m, oval bomas are usually 50 x 30m.
- Boma size dependent on the number of captive animals to be held.

Shade

- If there are no shade trees inside the boma, artificial shade should be supplied.

Water provision

- Dig a shallow circular dam, approximately 200mm deep arid 2m in diameter.
- Line it with canvas or a strong plastic material covered with soil.
- Should be constructed in the middle of the enclosure and filled through an underground hosepipe from a water supply point outside the boma.

Loading and offloading ramps

- Use mobile loading and offloading ramps.
- Must be sturdy and safe to prevent Injury to the animals.
- An easy and inexpensive method is to use soil filled grain bags placed in step formation from the top or back of the ramp to ground level.
- Cover the bags with soil.

Gates

- A wide gate covered with material similar to that on the boma walls provides access for feeding and cleaning.
- Also serves as an exit for removing or releasing the animals.

Single holding pens

- Mature males or aggressive individuals should be kept in holding pens for the sake of the safety of the rest of the group.
- Small pens can be built inside or outside the main boma.

NB: The welfare and comfort of animals should always be a priority for all participants in the game industry.

TRANSPORTATION OF WILD ANIMALS

J.G. Kanyingi, KWS

INTRODUCTION

There are mainly three ways of transportation of wild animals which includes:

- Road transportation.
- Sea transportation.
- Air transportation.

Selection on the mode of transportation is dictated by the following factors:

- Number of animals to be transported.
- Distance to the destination.
- Value of the animals.

Direct transportation is advisable if animals are to be released into a similar habitat to that they were captured from. This eliminates unnecessary loading and reloading.

TIPS TO DRIVERS

An interesting and strange phenomenon is that wild animals tend to calm down after the transportation truck has started and the engine is idling.

The following factors must be observed to the successful transportation of game animals:

- Truck must depart immediately the animals have been loaded.
- The truck should start slowly, accelerate smoothly and be driven cautiously over rough roads.
- Curves must be negotiated carefully.
- Breaking must be done smoothly.

CRATES, VEHICLES AND ACCESSORIES

Too often, a container that is unsuitable is utilised because it is available. This is a short cut to disaster and should be avoided. The size and strength of the crate should be appropriate. Too large a crate is as bad as a small one. The floor must allow drainage of urine and spilt water. The ventilation should allow an inflow of air horizontally and vertically. It should riot allow escape of animals. The most recommenced vehicles are 4 x 4 trucks. The vehicles should be serviced and checked prior to departure. It should be accompanied by a mechanic who should carry the back up spare parts and tools. There should be standing by transportation truck in case of a major breakdown.

NB: The engine should be left idling during any stops and while choosing the route to be followed, avoid cities, towns and noisy areas. Inquisitive onlookers should be kept away and a good spotlight and ropes should be carried to cover crates in case of rain or cold weather. The tarpaulin must be properly fitted to avoid flapping which could frighten animals.

MORTALITY

Transportation is one of the most traumatic events a wild animal can be exposed to. More animals die during transportation due to injuries or infections sustained than during capture. Most of these deaths go unnoticed because animals die in the field after release. This is caused by stress, extreme temperatures and injuries. Stress is mainly caused by excessive muscular exertion or fear during capture and transportation. Many unfamiliar events that occur during capture and subsequent transportation lead to both psychological and physical stress which leads to capture myopathy or white muscle disease. This can be alleviated by use of tranquilisers.

ROAD TRANSPORTA TION

Road transportation in mass crates is the 'most common form for wild herbivores. Individual crates can be used when handling a small number of animals or aggressive individuals. The crate to be used must be strong enough to with hold the weight and strength of the animal and must be of the correct size. When designing a crate, the following tips can be used:

- The crate must be strong enough to accommodate and restrain the animals from escape.
- The animal must be able to comfortably stand and lie down.
- The floor should not be slippery.
- Ample ventilation is required.
- Consider animals with long horns.
- The doors at both ends must be of vertical sliding.

GENERAL PRINCIPLES TO BE FOLLOWED DURING TRANSPORTATION INCLUDES:

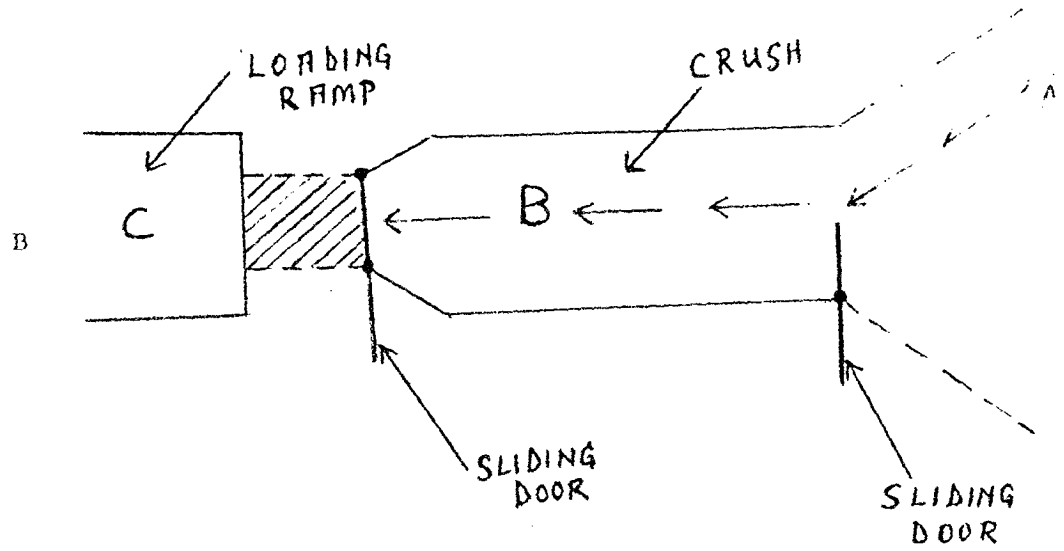
- Wild animals should only be transported by experienced persons using suitable equipment.
- The welfare of the animals must be taken into account.
- The optimal time for transportation must be taken into account considering road condition, distance and the traffic flow.
- Consider the telephone and electrical overhead cables.
- Animals with sharp horns are often nervous and aggressive when confined. Put rubber or plastic pipes on their horns.

BOMA TRAINING

If herbivores are to be transported for long distances or to a different habitat, they should be boma trained. This takes 4-8 weeks and it minimises stress factors. The wounds should be treated and the individuals fed on concentrates to improve their bodies. Boma trained animals suffers less from stress and the mortality rate is very low or non-existent.

LOADING AND OFFLOADING

A mass crate is used for transporting animals caught in capture corrals. Animals are loaded directly and if they have to be sorted out into age groups or sexed, it should be done before loading. Most of the pressure is inside the crush and therefore, it must be strong enough. Smoking is prohibited at the loading area. As soon as the last animal has been loaded, the engine should be started as it has a calming effect. Never force the animals out during offloading. They should leave the crates as calmly as possible.



A.- Loading Passage
B.- Crush
C.- Loading Ramp

AIR TRANSPORTATION

Wild animals are traditionally transported overland or by sea. The journey is often arduous. and long. The mortality could be high especially if the climatic conditions are not conducive. An option to avoid such dangers is transportation by air.

CRATES

Must be secure and covered at the top and must be well ventilated. The animals must be loaded into the crates five days before departure.

LOADING

In most cases, the animals have to be tranquilised. Therefore, the attendant must be having a sound knowledge of tranquilising drugs. Loading is conducted under the supervision of a veterinarian and the stipulation of a five-day period is so that the animals can get used to the crates.

TRANSPORTATION TO AIRPORT

Requires careful planning and tarpaulins must be carried in all vehicles to cover animals in case of rain.

OFFLOADING AT AIRPORT

One should have a sound knowledge of the offloading procedure on the positioning of the crates on pallets.

All ventilation and inspection openings should be covered to stress due to the spectators at the airport.

LOADING AND INFLIGHT CARE

Positioning of the crates should be decided by the attendant in consultation with the agent, loadmaster and the flight engineer. Ventilation and accessibility to animals must be a priority.

OFFLOADING AND TRANSPORTATION

Should be co-ordinated by the attendant and transportation requires assessment of weather conditions.

RELEASE IN FINAL DESTINATION

Should also be co-ordinated by the attendant and he should tell the recipient on the nutritional requirements of the animals as well as on care and handling during the settling period.

CONTAINER REQUIREMENTS

All transportation crates and containers should be constructed as per the I.A.T.A. (International Air Transport Association).

- Should be suitably constructed, clean, leak proof and escape proof.
- Attendant should be able to give necessary attention to animals.
- Animals will only be carried in closed crates and containers.
- Carrying in open stalls should be arranged with the carriers.
- Adequate litter must be carried to absorb excreta.
- Before constructing the crates, check with the forwarding agents on the door size and the height.
- Access doors must be secure to avoid accidental opening
- If timber is used, the joints should be such that animal cannot bore or bite.
- Should not have any protruding objects like nails, bolts, etc.
- Should have adequate air vents.
- Should have troughs for water and food.
- Large animal crates must offer spaces for fork lifting.

TRANSPORTATION BY SEA

Transportation by sea is applicable when a large number of animals is to be moved from one country to another. The costs are not as prohibitive as the air transportation.

CRATES

Should be properly designed to make the work easier and enhance the survival rate by contributing to the comfort of the animals and its management. Rhinos and Elephants must always be crated individually.

VENTILATION

It can be hot and humid at sea. Therefore, adequate flow of air through crates must be ensured. The floors must have stoppers and the roof must be solid.

TRANSPORTATION TO DOCKS

This is a very stressful part of the operation due to noise, movement and disruption. Establish the expected time of arrival of the ship and the actual docking site. On departure, confirm departure time with the dockmaster. Loading should be done in the shortest time possible to minimise stress to the animals.

OFFLOADING AND TRANSPORTATION TO FINAL DESTINATION

Animals must be well fed and crates cleaned before offloading. The recipient must be informed as this is a long process. The offloading should be conducted within the shortest time possible.

RELEASE AND ADAPTATION

The attendant should by now have known the temperament of each animal. New animals should never be mixed with the existing population. There should only be visual contact and if possible physical contact through a fence.

CARE OF ANTELOPES IN CAPTIVITY

J.G. Kanyingi, KWS

GENERAL PRINCIPLES

- Are difficult to care for adequately during the initial stages.
- Are very stress susceptible and do not easily show clinical symptoms until the problem is well advanced.
- Are prone to problems of intra and interspecific aggression and malnutrition. The effects of capture may persist for some time.

BOMA MANAGEMENT

PREPLANNING

- Decide the objectives of boma confinement.
- Are the animals going to be confined briefly or are they going to be confined for a longer period for quarantine or for other purposes?
- The length of confinement will influence the management of the animals in pens significantly.
- The behaviour of different species of animals varies and therefore, the approach that is adopted will also vary.

PRINCIPLES OF HANDLING

- The boma construction and management must be of such a standard that the animals can adapt to their new conditions quickly and without pain
- Be aware that the animals that are coming into the boma are wild and that they have been subjected to the rigours of capture, transportation and offloading. Most species are susceptible to stress and must be handled carefully.
- Most antelopes will be stressed by the exertion of capture although they may look good but are not physically fit. They may have injuries, muscle pain or fatigue and are likely to be hyperthermic, dehydrated and hypoglycaemic. Such animals should be handled carefully as further stress will exacerbate the problems they already have.
- The animals will assess the situation and try to escape which results to more stress, injuries which may lead to death. Ensure that the animals are not tempted to escape by shoddy construction of the holding boma.

SOCIAL ORGANISATION

Appreciate that each species has its own particular way of organising its social groupings. Therefore, mixing of incompatible sexes, groups, or numbers can lead to fighting resulting in injuries and even mortalities.

FEEDING

- The kind of feed for each species is critical and it must be provided *ad libitum*. Adequate and appropriate food supplies must be procured in advance.
- Remember that you have taken a wild animal away from its normal feed and are now expecting it to adapt to a totally unfamiliar diet. The microflora of the rumen will take approximately six weeks to adjust to a change in diet. This is a severe stress to the animal, which leads to a drop in condition over the first 7-10 days.
- Sufficient feed containers must be placed out at least one per every 2-3 animals. This will prevent dominant animals from pushing out subordinates. Water troughs can be placed inside the boma if large enough or along sides with facilities for cleaning.
- Teff or lucerne is put in racks either inside the pen or along the walls of the pen.
- Most animals are fed at least once per day but twice per day in the beginning as they may take time to accept the feed. This will reduce wastage, trampling and soiling of the feed and the animals will not sleep on the food as it is offered once per day.
- Some species such as bushbucks, steenbok and grysbok are nocturnal or crepuscular. For such species put out small amounts of feed in the early morning and late afternoon.
- Specialised feeders such as kudu, nyala and impala should be fed in browse. This should be cut daily and different trees must be selected each time.
- If animals are to be held for more than three weeks, supply them with rock salt licks.

CLEANING OF PENS

- Dung accumulates rapidly in pens and it should be removed daily. Old feed must also be removed daily.
- Pens should have two compartments to facilitate feeding and cleaning. Such compartments could also be used to contain aggressive individuals.
- Water containers must be cleaned and drained once per day. If the pen is muddy, the containers should be cleaned twice per day.
- If the captive animals will not be in pens for three or less days, they should not be disturbed. The pens can be cleaned once they have been removed.

PARASITE CONTROL

- Manure should be damped at least 500 metres from the holding pens and this should be controlled with a suitable insecticide.
- Ticks must be controlled. Spray the animals with a suitable acaricide before introducing the animals into the pens or once they have settled down.
- There is a chance that animals in pens will be ingested with internal parasites at much higher rates than normal. These should be treated with antihelminths if the animals are going to be confined for more than three weeks.

TREATMENT OF WOUNDS

- Wounds should be assessed and treated as soon as possible with the appropriate antibiotics. Treat in crushes and in severe cases, immobilise the animals.
- Foot baths can be used to control footrot problems but if incorrectly sited or filled, they can cause severe injuries.

REMOVAL OF PROBLEM ANIMALS

- Certain individual animals may be aggressive or injured and may have to be removed. This can be achieved in two ways:
- Head the individuals through a door into a passage or into an adjacent pen; isolate the individual animals through judicious manipulation.
- The alternative would be to immobilise the individual in the pen and once it is down, chase the other individuals away.

DISADVANTAGES

- The immobilised individual may be attacked by more dominant or aggressive individuals.
- More stubborn species especially gemsbok will refuse to move out of the pen which will hinder accessibility to the immobilised animal.
- Some of the highly excitable species especially if not tranquilised may injure themselves.

INTRODUCTION OF ANIMALS TO CONFINEMENT

- **Check conditions of walls.** There should be no sharp objects or protrusions. Check gaps between posts. Should not be large enough to enable animals to escape or that horns can become snagged in them.
- **Check condition of floor.** Must be clean and free of lot manure and feed. Stumps, unnecessary poles and pieces of wire must be removed. The slope of the floor should enable proper drainage.
- **Check operation of doors.** Must be solid and must close and open with ease. Must have a fast working latching or locking system.
- **Check availability of shelter.**
- **Check condition of spare pens.**
- **Check water containers.** Should be clean, have smooth edges and contain clean fresh water. A constant supply is ideal.
- **Check the feed containers.** Sufficient number should be availed. Must be of a suitable size, clean, filled with fresh feed and should be distributed around the pen. Hays racks must be filled with lucerne, teff or any other quality hay.
- **Check the feed.** Ensure right kind of feed is in the pen before the animals are introduced. Check for moulds. Do not use mouldy feed. Ensure strings and wire on bales are removed.

WILDLIFE CONSERVATION AND DISEASE IN ETHIOPIA

Dr. Fekadu

INTRODUCTION

In Ethiopia, wildlife products have long history Civet musk, ivory, leopard skin were exported from the country for a long time. However despite the long history efforts towards the conservation of wildlife began relatively recently. This was with the 1909 decree Emperor Merelik II, which was meant to regulate hunting, mainly of elephants. The Ethiopian wildlife conservation organisation (EWCO) was formed in 1964. Since then nine national parks (two gazetted), four sanctuaries, nine wildlife reserves and 18 controlled hunting areas have been established. They totally cover an area of 194,000 km^2 (Fekadu S. 1991 unpublished).

DISTRIBUTION AND RESOURCE POTENTIAL

Ethiopia has a diverse wildlife resource although the density is becoming historical. Its distribution is mainly south. South western parts of the country. The country's ecological, (climatic and altitudinal) variations have contributed to the existence of diverse flora and fauna. The wildlife areas are distributed in the country representing different ecosystems: alpine, afro - alpine, aquatic and arid. There are 277 species of mammals, out of which 31 are endemic, and 861 species of birds out of which 28 are endemic.

Table 1: Summary of Wildlife Species in Ethiopia

	No. of spp.	No. of endemic	%
Terrestrial mammal	277	31	11.2
Birds	861	28	3.3
Reptile	201	9	4.5
Amphibians	63	24	38.1
Fresh water fish	150	4	2.7
Butterflies	324	7	2.2

Source: Compendum of wildlife resource information (Hillman, 1922a)

bovine pleuropneumonia, as in East Africa. The mortality in ruminants had another implication, the knock on effect, that the population of *G. Morsitans* was severely reduced or died due to lack of suitable hosts on which to feed (Walter Plowright 1982). This was also important for wildlife conservation. It is possible to conclude from this fact that prevalence of Glossira species in the wildlife range can prohibit the encroachment of domestic, grazing and browsing animals in to the area. The disease literally burned itself out in southern Africa, aided by vaccination movement controls, and by 1903 confirmed in south West Africa (Walter Plowright). See Table 1.

Table 2: Wild ungulates of higher susceptibility to rinderpest virus infection

Level of susceptibility	Common name	Scientific name
Very high	Buffalo	*Syncerus caffer*
	Warthog	*Phacocoerus aethiopicus*
	Eland	*Taurotragus oryx*
	Kudu	*Trageluphus strepsiceros*
		T. imberbis
High	Giraffe	*Giraffa camelopardalis and G.reticulate*
	Bushbuck	*Tragelaphus scriptus*
	Bushpig	*Potamochoerus porcus*
	Sitatunga	*Tragelaphus spetei*
	Uganda kob	*Adenota kob*
	Giant forest	*Hylochoerus meinertzhageni*
	Bongo	*Boocercus euryceros*
	Wildebeest	*Connochaetes spp.*

Table 3: Wild ungulates of lower susceptibility to rinderpest virus infection

Level of susceptibility	Common name	Scientific name
Moderate	Reedbuck	*Redunca spp.*
	Topi	*Dumaliscus korrigum*
	Blesbok and	*Damailcus albitrous* and
	Bontbok	*D. pygargus*
	Gemsbok	*Oryx gazeHa*
	Roan and Sable	*Hippofra gus equinus*
	Antelope	*H. niger*
	Oribi	*Ourebia ourebi*
	Impala	*Aepyceros melampus*
	Springbok	*Antidorcas marsupialis*
Low	Waterbuck	*Kobus ellipsiprymnus* and *K. detassa*
	Duiker	*Cephalophus spp*
	Oryx	*Oryx beisa*
	Grant's gazelle	*Gazelle granti*
	Dikdik	*Rhyncotragus Kirki*

Level of susceptibility	Common name	Scientific name
	Hartbeest	*Alcelaphus spp.*
Very low	Thomson's gazelle	*Gazelle thomsoni*
	Hippopotamus	*Hippopotamus amphibus*
	Gerenuk	*Litocranius walleri*

Source - Walter Plowright (1982)

RINDERPEST IN WILDLIFE IN EAST AFRICA AND OTHER PARTS OF THE WORLD

Members of other artiodactyla are thought to be susceptible, but the manifestations vary from species to species, from a cute lethal disease, in warthog to undetectable such as Thomson's gazelle.

Corneal opacity or blindness, which does not occur in domestic animals with rinderpest, has been seen several times in wild species including giraffe, as in the 1960-61 out break in Kenya. Some species such as hippopotamus and Thomson's gazelle, which have been shown by serological means, to have been infected frequently, have never been observed to be affected clinically.

Wildlife losses have occurred in recent years and the epidemic of 1968 affected eland, buffaloes and warthogs in the Central African Republic, the probable source being trade cattle from Chad. (Scott G.R.1976).

Transfer of rinderpest infection such as rinderpest can obviously take place more easily as population density increases.

There is less transmission in smaller communities due to low contact. Density is important for the maintenance to the disease. In the areas where cattle - game contact were frequent, it is possible that feed back mechanism of cattle to game and game to cattle transmission and maintain the virus continuously.

A syndrome simulating rinderpest occurred among captive wild animals at Calcutta Zoo in 1969. It first affected Nilgai ***(Buselaphus tragocemelus)*** spread to Gayal ***(Bibos frontalis)*** and other hog deer ***(Axis porcinus),*** and in the forests of Tarmil Nadu in affected bison. The wild ruminants most commonly observed clinically sick are in Africa, the buffalo, eland, giraffe, kudu, and wildebeest and in Asia, the bartery, gaur nilgai and sambur. (Scott. G.R). Rinderpest has also been reported in Zebra, Asian elephant (Wallach ***etal,*** 1982).

CONTROL

Rinderpest or cattle plague is without doubt the most lethal and potentially dangerous infectious disease which affect wild Artiodactyla; although its terrors for domestic animals are now much reduced by effective vaccines. (Walter Plowright 1982).

One of the ways controlling rinderpest has been separation of the game animals of the National

parks from the cattle population by fencing ditching and controlling contact with cattle. However this is an expensive method to apply.

Vaccination - vaccination in domestic animal as steadily eroded the geographical boundaries of the disease strains of rinderpest virus are immunologically homogenous and a vaccine prepared from one strain protects against all strains. However they differ in their virulence for and ability to infect specific hosts, this is due to variations in innate resistance in hosts.

This implies an epidemic of rinderpest does not always involve all susceptible species at risk.

Control also depends (based) on prevention or banning imports of livestock from the endemic areas.

Captured antelopes, shipped from east Africa introduced to the Rome Zoo and all artiodactyla were slaughtered. Control of rinderpest in high (endemic) risk areas (comprises) involves vaccinating domestic cattle and domestic buffaloes as controlling their movement. Outbreaks can be controlled by quarantine measures and revaccination around the focus. But mass vaccination of wildlife is logistically difficult (Scott, G.R 1976).

Conflict of ideas - There has been a conflict of ideas between the domestic animal veterinarians and Game Wardens, that the veterinarians claim that the game were reservoirs and disseminators of infections for their charges. Wardens assort that without cattle the rinderpest would disappear from game.

There has also been a conflict of ideas between domestic animal veterinarians and wildlife veterinarians. Wildlife veterinarians suggest that disease is only one of many and often minor risk and efforts to eradicate is extremely costly and it is a natural process which under go natural selection thus important for the evolution of the species. It is also not possible to eliminate diseases. It is only advisable to vaccinate only when the basic reproductive rate (Ro > 1) is greater than one (which means the disease or infection has established in the population). If it is less than one (R<-1) it will die by itself without intervention (Ballou, 1993).

From the domestic animal point of view, the loss of one animal is uneconomical thus at any cost loss is evaluated in terms of economy and vaccination is extremely important even in sporadic cases and on the other hand it is the survival or viability of the species (population) considered by wildlife veterinarians (not single individuals).

Development of Vaccine for wildlife - Still the question remains to develop or not to develop vaccines? There is an argument that vaccination should be avoided and natural selection allowed to eliminate certain animals.

The objectives of vaccination:

- Control anthropogenesis
- Control Zoonoses
- Protection of endangered species

The objectives should take into account the cost of production and profitability of vaccine. Vaccination should consider population demography and structure i.e. the proportion to be immunised, overage age, pregnant animals, herd situation or individuals (Akini, 1999, unpublished).

An infectious disease can maintain itself in a population only the reproductive rate – R > 1. Thus immunisation reduce the proportion of susceptible in population reducing R.

The most promising method of vaccination of wildlife thought to be through bait. These vaccines must produce immunity when given by oral route a most retain immunogenesity under adverse environmental conditions, must be a fracture nonpathozoniz to target species.

However due to financial, technical and commercial reasons may hinder production.

REFERENCES

Akyini, N. (1999) MSc wild animal health assistant (London) unpublished.

Ballou, J. D. (1993) Assessing the risks of infectious diseases in captive breeding and reintroduction programmes. Journal of Zoo and wildlife medicine 24(3): 327-335

Fekadu S. (1996) Ethiopian wildlife conservation - a review in environment and social change in Wollo Pessie. Work shop 24-27 May Ethiopia PP. 10-13.

Scott, G. R. (1976), wildlife rinderpest. In wildlife diseases plenum press, New York and London PP 245 - 255.

Walter Plowright (1982) - The effects of rinderpest and rinderpest control on wildlife in Africa. In symposia of zoological society of London No 50.1-28.

ESTABLISHMENT AND DEVELOPMENT OF WILDLIFE VETERINARY UNIT - TANAPA EXPERIENCE

Dr. Mlengeya

Background-why

1992 - Disease monitoring and investigation project

1996 - Serengeti wildlife veterinary project.

Objectives

- disease monitoring/control
- endangered spps. management
- research support
- community based activities
- emergence animal support
- problem animal control
- local/international liaising
- develop tissue bank
- develop veterinary policies

Structure

Plan of Action

- Awareness campaign
- Development of AHIS
- Liaising (local/international)
- Building local capacity
- Soliciting funding

TANAPA WITH RINDERPEST

Long time involvement

1989
1993 - 96

Rinderpest outbreak - 1996 in NNP later to Northern Tanzania

AWVP Feasibility study

- **Local counterpart**
- **Agreement**
- **Implementation**

Sample collection

- Zones
- Team
- Use of hunting companies
- Achievement
- Sample submission

WILDLIFE HEALTH TRAINING: A UNIQUE OPPORTUNITY IN UGANDA.

C. Dranzoa, Makerere University

INTRODUCTION

The health of wildlife populations and individuals within those populations, cannot be fully understood, successfully managed, properly studied, or ultimately conserved without direct consideration of the habitats and ecosystems in which they live. Ecosystems, in turn cannot be properly considered in isolation from the impact of the human activity. The health of wild animals and their habitats cannot be understood without some insight into the social, ethical, political systems and the economic forces that influence conservation policies.

Many ecological, social and economic issues influence the outcome of efforts to maintain or conserve wild animal health globally, but these issues are currently viewed, in most veterinary curricula, as tangential or unrelated to veterinary medicine itself Issues such as the larger socio-political and environmental landscape within which these problems exist, resource utilisation by local communities, land tenure, ecotourism, and the contributions by professionals in other conservation fields have enormous impact on wildlife health, welfare, and conservation. But are not explored in traditional veterinary programs.

Most veterinary curricula are providing the modern technical training necessary to deliver clinical care to domestic animals. But there are few opportunities available in the veterinary curriculum world over for students to learn about wildlife (in the wilderness) and the larger physical and social environments. In Africa, the few Universities and other institutions are out of reach due to economic constraints.

Makerere University, Faculty of Veterinary Medicine employs a new approach to implement the training of the aspiring wildlife veterinarians and other professionals in the animal sector through a more holistic approach, which embodies an integrative and interdisciplinary process. We train veterinarians and other resource managers to be critical thinkers who take ecological and socio-economic factors into consideration when studying systems, defining problems, or attempting interventions, and who interact constructively with all stakeholders in the conservation process such as scientists in other disciplines, representative of local communities, government policy makers, game wardens and others. We believe that field-based, cross-cultural, experiential learning activities are a critical element in providing this sort of interactive and interdisciplinary education. Acting on that belief, we have developed courses for veterinary students and others to achieve that goal.

These courses act as models to educate future veterinarians and other professionals in wildlife conservation medicine, particularly in developing countries, where human needs frequently come into direct conflict with efforts to conserve wildlife. While the courses provide strong basis in specific veterinary aspects of wildlife work such as immobilisation and wildlife disease, they also provide means of understanding and interpreting the larger context of wildlife conservation initiatives and the non-veterinary forces that may influence their successes or failures.

THE CHALLENGES IN WILDLIFE HEALTH MANAGEMENT IN UGANDA

The population pressures and the demands of man on the wildlife resources have culminated into dramatic decline in wildlife populations and in some cases the extinction of certain species in Uganda during the past few decades. The challenges to conservationists are great. A number of compounding factors have contributed to the present scenario in Uganda. There is no single solution to remedy these problems but rather, multiple-pronged approach have to be devised. The professionals (vets and others) are faced with the following challenges;

Intervention and emergency services
- Sneering
- Quarantining
- Clinical services for exotic pets, zoos, fish health management.

Re -introduction & Re-population
- Breeding techniques like embryo transfers and breeding are needed to multiply the species (Labeo victorianus Ningu fish)

Consumptive utilisation
- Intensification of Management
- Crocodiles, ostriches, guinea fowls etc.

Game farming & ranching not yet as advanced as in S. Africa or Kenya. However, there is a big potential exists: Communal lands in Kamengo county. Maruzi county Apac, Lake Mburo & Queen Elizabeth National Parks, Buwama, Mpigi. Ostrich farms such as those in Karamoja by Zwilling Safari & Oxfam & Nyabushozi

Fish farming is being encouraged in Uganda in order to ameliorate the problems with open water fisheries. The role of the veterinarian in Meat Inspection (vernison) is a vital one. There is an increasing demand on wild meats and therefore Public health implications must be assessed by qualified professional vets who are knowledgeable in the wildlife diseases.

Research (Systems research- most appropriate and challenging)
- Collaborative research
- Public health workers
- Strategic control measures e.g. tick control as an example of conflict resolution (Ocaido, *1995)*

Community conservation
Collaboration with other disciplines e.g. Social workers, anthropologists: A new approach in community conservation.

Extension services to local communities to educate and train them in the improved methods of

animal production, aquaculture and poultry production can provide alternative sources of employment, economic gains and improved standards of living. Hence, alleviating the pressures on the meagre wildlife resources and improving community attitudes towards conservation areas and personnel.

TRAINING

Undergraduate BVM Wildlife and Aquaculture management Course

Makerere University, Faculty of Veterinary Medicine steered by Professor F.B.I. Kayanja plus the Uganda Wildlife Authority have tried to meet these challenges on national & international basis through the development of undergraduate program. The first course was run in 1990. This pioneer training was conducted by wildlife experts from S. Africa and Kenya (courtesy of GTZ-Veterinary project). The subsequent years saw staff recruitment to offer fully fledged residential courses and field training components. The undergraduate course in wildlife and fisheries addresses issues of disease control, management, and production and is offered during the fourth year (clinical year). This programme forms a foundation to the Veterinarian to be. It exposes students to the diversity of natural resources in Uganda and east Africa at large, together with the various conservation challenges. Through this programme we intend to initiate our students into the fields of Wildlife and arouse their desires into this discipline.

The basis of offering it at the clinical year is to allow the students to be able to link wildlife health problems to other disciplines and be able to apply what he/she has leant in medicine, pathology, surgery etc.

Post graduate diploma in wildlife health and management (WHM).

By 1996 the needs for higher cadre of training and specialisation was realised. GTZ-vet project was instrumental in encouraging and facilitating the development of postgraduate programme. The principle objectives being to provide skills and professional training in animal production systems for health management and production. And manpower to diagnose problems and implement programs in wildlife health, management and production The taught course addresses issues ranging from information technology, policies and legislation, wildlife production systems-health-financial management, planning and ecosystem restoration.

With the initiation of WHM program, came a department of Wildlife and Animal resources (WARM) to house and co-ordinate the teaching and research of wildlife, aquaculture and animal management of both undergraduates and postgraduates.

The department of WARM, although at infant stages has been involved in research, extension services in the country WARM hopes to create a viable centre to Co-ordinate wildlife health at regional and international levels.

The postgraduate diploma in WHM is designed to address issues of animal resource conservation utilisation and wildlife health management. This programme targets graduates in veterinary medicine and natural resources management (zoologists, foresters, fisheries officers' etc). It has widened the scope and range of the diverse wildlife and non-conventional species management (e.g. giant rats, rabbits, crocodiles, ostriches, and fish) for sustainable development not only in Uganda but the entire East Africa region. This program has taken an international dimension. The pioneer students include vets, foresters and zoologists from Brazil and Africa. And we hope more sub-Saharan African vets will join this programme which is quite diverse and enriching. We continue to receive applications and inquiries from across the world.

Masters

Through recommendations from the pioneer group of the above mentioned programme, a postgraduate masters degree in wildlife health and management has been drafted. This programme, after an approval from the University will provide avenues for upgrading the students who offered WHM at diploma level and the undergraduates. WARM department already has one master's student by research and thesis.

Ph.D.

The need to qualifier both staff and others at Ph.D. level in the wildlife field is vital. However, the major drawback is manpower or professional capacity to handle. Through collaborative programmes, WARM is getting three of it's staff members trained to attain doctoral degrees already. Training in Economic modeling, breeding and domestication is already carrying. We hope to strengthen capacity after more staff qualifications and hopefully these will train others in the future.

CONSERVATION MEDICINE SUMMER COURSE

The course introduces and explores cultural, socio-economic, political and biological frames of reference for problem solving, and offers the challenge of getting to know and work with colleagues from other countries. It promotes co-operative teamwork between professionals of developed and developing countries and between veterinary and non-veterinary scientists in interdisciplinary research projects that form an integral part of conservation efforts.

The program brings Ugandan and American veterinary students together to live and work with each other during summer intervals in their formal veterinary training. The course is divided into two parts, classroom work and field work. The class work provides a basic knowledge of pertinent veterinary techniques, conservation theories, socio-economic issues, and research methodologies. In addition, the students are trained in cultural sensitivity and coping methods for working in an unfamiliar environment. The fieldwork builds on the class work in a hands-on type of learning. The students get to interact closely with people from different backgrounds. For the American students, there is an additional lesson of learning to work in a developing country and to appreciate the various constraints and challenges that are involved in such work. We intend this to become open programme for other international students too!

QUALITY ASSURANCE IN TRAINING

Academic members are drawn from the veterinary Faculty and other disciplines in Makerere University. External professors with long standing experience in Wildlife health management and animal production from the University Kent, UK, Humbolt University - Germany; Dutch Zoo, Netherlands, Tufts University, USA have been involved.

Local staff have had trained by experts from S. Africa and Kenya through the GTZ support.

COLLABORATION

WARM Collaborates with local institutions like the Uganda Wildlife Authority, National Agricultural Research Organisation, other line ministries and stakeholders. Our international collaborators include Morris Animal Foundation (USA), Kurtis Conservation Foundation (USA), Dutch - Zoo –

Netherlands Centre for Conservation Medicine.

OTHER UNIVERSITIES

WARM has strong ties with Tufts University, USA in training Vet students in summer course: "Conservation Medicine", has run for the past two years. This programme has so far attracted students from across North America. Our vision is to form a training consortium for Veterinary students and animal resource managers at an international level. To train students who are able to respond to the challenges posed by wildlife Health.

DISCUSSION

Initially the reception by students and traditional veterinarians was very poor. The basis of their arguments is that very little opportunities existed, conservation is a matter for zoologists, foresters etc. These attitudes are now changing. The general Ugandan public, Uganda Veterinary Association & veterinary board, National Agricultural Research etc. have upheld the Faculty for the wide step taken in this new discipline. Assessments of the two programmes, indicate that there is general appraisals by the students. However improvements need to be made taking into consideration the recommendations made by the pioneer students and resource persons. The consequence of one such recommendation has lead into the upgrading of the diploma into a Masters programme.

Foreign students are extremely keen to join this postgraduate programme. The question is how to balance between indigenous intake visa vis foreign intake. Problems should exist in delivering the practical component.

WARM lacks funds to establish a laboratory of international standards. More collaborative efforts required in this aspect. And funds are being sought to establish one lab to manage and monitor infectious wildlife diseases.

WARM staff: Majority are still young with little experiences, others are yet in training. Collaborative training is the only solutions. But this scenario will change after most have completed their doctoral training.

Equipment: Through GTZ and MAF support, substantial number of equipment were obtained and a small camping facility established. We still require more field, and lab equipment.

CONCLUSION

The demand for professional Veterinary input in Wildlife health and Animal production is increasing. This is reflected by the amount of constancy calls received in WARM. This area could be one of the ways for professionals to diversify their skills and widen their employment opportunities.

Based on faculty assessments and student feedback, the course appears to be achieving its goals. American students have come away with an enhanced understanding of the challenges to successful wildlife conservation in developing countries and a more realistic appreciation of the professional

challenges which face veterinarians who wish to make a meaningful and lasting contribution, to wildlife conservation in the developing world. Ugandan students in turn, have become sensitised to the strong conservation ethic that has emerged in developed countries and have developed a

greater appreciation of the unfulfilled potential role that they can play in conserving wildlife in their own country.

Professional links between Americans and Ugandans have been established and will strengthen the professional activities of all parties through future research projects and exchanges and make wildlife conservation in developing countries a truly international effort based on partnerships and shared commitment.

Though the course does not fully address all the challenges of training effective veterinarians, it takes an important step forward. The cross cultural, field based, experiential learning approach nurtures an integrative and interdisciplinary perspective and fosters critical thinking among veterinary students aspiring to make a lasting and meaningful contribution to conservation medicine.

VETERINARY UNIT - UGANDA WILDLIFE AUTHORITY

Dr. G. Kalema, Uganda Wildlife Authority

1996

Uganda National Parks (UNP) had not had a veterinary unit since the 1960s when wildlife was abundant. The animal populations decreased drastically with poaching and civil wars in the 1970s and 1980s and some species became extinct notably the northern white and black rhinoceroses. With increased stability and security in Uganda there was now a great need to re-establish animal numbers and recreate healthy ecosystems and the endangered mountain gorillas which are the main source of income from tourism also need veterinary care to ensure their welfare and survival so a veterinary unit in was justified. This veterinary unit was to provide a professional service to UWA wardens and other staff and should meet the needs of protected areas. The veterinary unit started in January 1996 with the appointment of a veterinary officer Dr. Gladys Kalema who qualified from the Royal Veterinary College, University of London in 1995. The European Union (EU) with the help of Dr. Jim Else, institutional development adviser to the Ministry of Tourism, Wildlife and Antiquities (MTWA), was going to give a grant to the veterinary unit to get it started until an expected World Bank loan in 1997, but decided that veterinary services were not an emergency. This means that the vehicle, veterinary equipment and drugs the EU was going to donate were not available. The EU was also supposed to give money for 3 months training at the Kenya Wildlife Service veterinary unit which is very well established with 6 veterinarians and an Overseas Development Agency (ODA), now DFID, senior veterinary adviser, Dr. Richard Kock.

The objectives of the veterinary unit were made by assessing the veterinary needs of Uganda National Parks, and given more direction after a consultancy to assess veterinary needs of by Dr. Richard Kock of Kenya Wildlife Service in September 1996. In August 1996 UNP became UWA after merging with the game department (GD). The objectives are as follows:-

- Meet the welfare needs of animals in the protected areas (PAs) which involves disease surveillance, endangered species support and research support.
- Reinforce wild animal populations by translocations and re-introductions to re-stock protected areas and establish healthy ecosystems.
- Problem animal control to improve relations between local communities and PAs as part of community conservation efforts.

Other objectives included:-

- Assist the veterinarian at Uganda Wildlife Education Centre in captive animal management.
- Manage a quarantine facility for confiscated animals; and those for export and import.

- Provide technical expertise to the private sector with sustainable utilisation of wild animals.
- Work with community conservation wardens to control disease of domestic animals infringing on the PA boundaries by education of the local farmers in these areas and veterinary management of their domestic animals.

For the veterinary unit to achieve these goals the following was needed: -

- Training of veterinary and field staff to form a team that can capture and translocate animals
- Training of field staff to monitor animal health by recording collecting samples and reporting disease in wild animals.
- Acquiring a vehicle, equipment and drugs.

Activities

Inspite of not having a vehicle equipment and drugs on hand the veterinary officer managed to do some veterinary work in the national parks which included responding to emergencies where she got help from other veterinarians who wanted to assist her. Some of the emergencies included problem animal control cases e.g. a mountain gorilla that caused bodily harm to farmers a translocation of crop raiding elephants from Mubende district to Queen Elizabeth National Park, disease investigations and endangered species support where Bwindi mountain gorillas with a new fatal disease outbreak, Scabies where one infant died and the rest of the group was successfully treated and a limping elephant in Kidepo was successfully treated. Darting equipment and drugs were borrowed and donated. The veterinary unit would start to function in full capacity when a vehicle was obtained. Fortunately the veterinary unit received a donation from Dian Fossey Gorilla Fund (DFGF) based in the UK after the veterinary officer went to dart a mountain gorilla in Bwindi Impenetrable National Park and had to borrow the equipment from one of their veterinarians, so the DFGF donated a set of darting equipment to the Uganda National Parks veterinary unit.

The veterinary officer also managed to go to Kenya Wildlife Service veterinary unit and received training in elephants and Hirola (hunter's hartebeest) translocations, boma management of rhinos in Tsavo national park and captive animal management at the Nairobi orphanage. This training was timely especially for the elephant translocation as one month later the vet officer was the only veterinarian when elephants were translocated in Uganda. This training was funded by European Union.

Translocation of elephants from Mubende to Queen Elizabeth National Park

The vet unit translocated 2 elephants from a built up rural area in Mubende (160 kms from the capital city Kampala) which were raiding people's crops and took them to Queen Elizabeth National Park which did not suffer as much from poaching in the 1970s and has a growing population of elephants. The 2 adult female elephants have settled well into their new environment and are being monitored by radiotracking. There was no knowledge of elephant translocations in Uganda so I had to go for training at the Kenya Wildlife Service vet unit where we moved 10 elephants from Mwea reserve to Tsavo national park. We also employed the services of Clem Coetsee an animal capture expert from Zimbabwe, who developed the technique for moving adult elephants in Africa. The exercise was sponsored by Save The Elephants of Africa, a German NGO. This was the first translocation of elephants in Uganda and wild animal translocation in the last 30 years and as it was successful has opened the door for future translocations. It was the second translocation since white rhinos were moved from Obonji in Ajai Game reserve in West Nile district to Murchison Falls

National Park in the 1960s. This time we got a lot of community participation from Mubende which was great.

Investigation of skin disease in giraffes of Murchison Falls National Park.

The giraffes in Murchison Falls national park are affected by a skin disease, which is not affecting their health although skin lesions can easily be seen and are unsightly. One of the giraffes was darted and skin biopsies taken which revealed Filariosis. Further studies are going to be done to see how best to manage this disease and also to find out it is affecting any other animals in the park

like buffaloes. This is the first documented evidence of filariosis in wild giraffes. Lack of funds is slowing the process of further investigation of the filariosis.

Investigation of Scabies skin disease in mountain gorillas of Bwindi Impenetrable National Park.

A more fatal skin disease was affecting the mountain gorillas of Bwindi Impenetrable national park. One of the habituated gorilla groups had a Scabies outbreak resulting in the death of one infant. This is the first record of Scabies in mountain gorillas and caught us by surprise. The rest of the group was treated with Ivermectin anti-parasitic and are improving. I am now trying to establish the source of the Scabies which we strongly suspect to be human although the gorillas are never touched by people who include visiting tourists and field staff. However the gorillas sometimes go out of the park and raid banana plantations of the villagers, who get Scabies from time to time. I worked closely with visiting consultant Dr. Richard Kock from Kenya Wildlife Service and Dr. Liz Macfie from the International Gorilla Conservation Programme which is providing veterinary back-up for mountain gorillas. Samples from the gorillas were mishandled by a lab technician so unfortunately up to now we do not know the source. However as humans are the strongest suspect we are carrying out epidemiological controls accordingly to prevent this happening again. More rigorous monitoring is needed to plans were made to do more intensive training of rangers.

Treatment of an injured limping elephant in Kidepo Valley national park.

I successfully treated an elephant in Kidepo Valley National Park that had bullet wounds. The elephant was most likely shot when raiding someone's plantation near the park boundary. We had to fly up to Kidepo. This particular case was special because the warden-in-charge was very organised and got rangers to follow the case until the vets arrived and we were able to deal with the sick elephant immediately. Finding out what caused the elephant to limp also assists the park to plan their anti-poaching patrols more strategically.

1997

The Uganda Wildlife Authority (UWA) veterinary unit established in January 1996 started off in Uganda National Parks. When national parks merged with game department then the unit continued into UWA. The first year went well and there was a lot of positive support in re-establishing a veterinary unit in national parks since the 1960s. Many short medium and long term plans were made.

1997 started off well but within a few months started to have financial difficulties and a lot of plans had to be postponed until the situation improved. However some preparations that were made in 1996 for activities in 1997 went ahead. So the vet unit with the assistance of other vets from Kenya managed to carry out a giraffe translocation from Kenya to Kidepo Valley national park in Uganda. The veterinary unit also with assistance from South African and American vets carried out a survey of Tuberculosis and other diseases in buffaloes of Queen Elizabeth National Park. The regular gorilla cases were attended to especially as UWA started to solely depend on revenue from gorilla tourism after the donors put a hold on immediate funding. Mountain Gorilla Veterinary Project vets from Rwanda assisted sometimes. Frankfurt Zoological Society, USAID, European Union and Giraffe Centre (Kenya) provided funding for the giraffe translocation. Food and Agricultural Organisation (FAO) and Care for the Wild provided funding for the buffalo research.

These activities gave opportunity for training the UWA vet and support staff which included rangers. The UWA vet officer also attended a course in chemical capture of wild animals - Dangerous drugs course in Zimbabwe run by Zimbabwe Veterinary Association Wildlife Group and passed the

exam and got a certificate.

Other cases came in, but many of them could not be dealt with sufficiently because of lack of funds personnel technical expertise equipment and a vehicle.

After fund-raising the unit received donations from NGOs in UK which included a Suzuki vehicle, camera and veterinary supplies from Care For The Wild, a laptop computer and printer from Dian Fossey Gorilla Fund and some money for narcotic drugs from Born Free Foundation.

The unit also received extensive positive publicity from films of the unit that were shown in UK and USA on BBC and National Geographic which also brought good international publicity for UWA. Later on MNet and Uganda Television also featured work of the veterinary unit

Translocation of giraffes from Kenya to Uganda.
3 giraffes were translocated from Lake Nakuru national park in Kenya to Kidepo Valley national park in Uganda. Kidepo had only 1 female and 5 male giraffes so the park urgently needed females to establish a viable breeding population especially if anything happened to the remaining female who also unfortunately kept giving birth to males. UWA was assisted by Frankfurt Zoological Society, USAID, European Union, and Giraffe Centre in Kenya, who paid for most of the exercise. The translocation was successful and I worked closely with Kenya Wildlife Service vet unit. We captured 2 females and 1 male of 9 months to I year old which were small enough to be flown in a military Hercules aircraft to Uganda and kept them in a boma for 1 month at the capture site and 3 weeks at the release site. Kidepo Valley National Park now has 3 females bringing the breeding population up by 200%. The translocated giraffes are being closely monitored by rangers and are settling in well and the older resident giraffes in Kidepo have accepted the Nakuru ones and are looking after them as the greatest threat to their survival now is predation by lions in the park! Unfortunately one of the giraffes got eaten by a lion 6 weeks after releasing them. He was also the most trusting giraffe and had probably lost most of his survival instinct during the 2 month period of captivity. The young zebras of Kidepo are also experiencing the same pressure from predation and there are hardly any young zebras in the park. We are thinking of reintroducing prey like Uganda kobs that the lions can eat so that the attention is removed away from the giraffes and zebras to enable them to recover their numbers. As the vet I had to look for some of the funds co-ordinate ad organise the translocation including the paper work between the Kenya and Uganda governments and then deal with the welfare aspects of the translocation to make sure that the giraffes got optimum care and got to Uganda in a healthy state.

Survey of TB and other diseases in the buffaloes of Queen Elizabeth National Park
In May and June 1997 a survey was completed on Tuberculosis and other diseases in the buffaloes of Queen Elizabeth National Park. Kruger National Park in South Africa is having a problem with a lot of buffaloes dying of TB and wanted to see what the situation in Uganda was as a survey was done in the late 1960s by Dr. Michael Woodford who established the prevalence of TB in the Queen

Elizabeth National Park buffaloes. Working together with Dr. Roy Bengis State Veterinarian of Kruger National Park and Dr. Michael Woodford from IUCN Veterinary Specialist Group we immobilised 42 buffaloes and got blood samples for TB testing Rinderpest, Brucellosis Theileriosis and throat probang samples for Foot and Mouth Disease. Hopefully the results from this survey will help Kruger national park in managing the disease in their buffaloes; and will also assist the wardens of Queen Elizabeth national park to manage the buffaloes and other animals in the park which includes the domestic cattle that infringe on the park boundary and are an important source of infection for the buffaloes and vice versa. Results form the survey will be used to educate farmers on the dangers of

grazing their cattle within the park boundary next to buffaloes which will also help to protect the wildlife. In this survey we worked together with 3 rangers who also got very sound training from Drs. Bengis and Woodford. TB was found in 21.4 % of a random sample of buffalo which was up from 10% of the random sample in the 1960s. However all the buffalo sampled were healthy apart from one found dead implying that the TB in Uganda was not as acute as that one in S. Africa. It was difficult to detect the effect of TB on the buffalo population as some of them had been poached in the 1970s and 1980s.

In 1998

The veterinary unit continued to be very busy and major achievements included the first health and ecological monitoring training workshop for field staff of Bwindi Impenetrable and Mgahinga National Parks in January with certificates for those who passed. There was an investigation of a respiratory disease in chimpanzees in Kibale National Park in February. There was training of rangers in Kibale Queen Elizabeth, Murchison and Lake Mburo National Parks in taking of samples from dead animals to follow on from Ishasha sector and Semliki Valley Wildlife Reserve in 1997. The training is now going to extend and include health assessments of animals in the field while on patrol in conjunction with the monitoring unit of UWA. The veterinary unit successfully translocated a formally captive problem baboon from a classroom in Lugazi to a forest. The veterinary unit successfully treated a mountain gorilla in Bwindi with a new fatal disease a rectal prolapse with surgery. The veterinary unit with the assistance from Mountain Gorilla Veterinary in Rwanda successfully removed a snare from an infant mountain gorilla in Mgahinga National Park. These two gorilla interventions were a valuable opportunity for training of the rangers and trackers in gorilla interventions who performed well after the training workshops earlier in the year. The veterinary unit investigated cause of death in a juvenile mountain gorilla in BINP that died of pneumonia and in a lion cub in QENP that died of starvation due to poor mothering. The veterinary unit assisted Uganda Wildlife Education Centre veterinarian Dr. Josephine Afema to translocate chimpanzees from Isinga island in Lake Edward to UWEC to Ngamba island in Lake Victoria. The veterinary unit organised and co-ordinated a series of workshops to draw up veterinary polices and standard operating procedures for Uganda Wildlife Authority and for Uganda's wildlife for more effective active wildlife management. This is the first time veterinary policies for wildlife in Uganda have been set up an exciting and necessary challenge.

The unit wants to increase the number of personnel as the workload for one veterinary officer is too much and cases in the field are not being attended to sufficiently and office work is also not being attended to efficiently. There are also plans of the unit to assist with more translocations of animals in the next three years and a great emphasis on capacity building. Field staff like rangers will have to be better trained in the necessary aspects of wildlife veterinary work to cope with the growing demands. The unit is still lacking basic equipment sufficient drugs and a reliable vehicle. The unit also wants to start disease surveillance of indicator species together with other related activities to monitor health and disease of wild animals. Training of all veterinarians and support staff in the unit will be emphasised over the next three years.

During the past two and a half years links with other institutions been built up. The unit has worked closely with Mountain Gorilla Veterinary Project in Rwanda, Kenya Wildlife Service veterinary Unit Uganda Wildlife Education Centre, Makerere University Faculty of Veterinary Medicine, Kruger National Park state veterinarian, Zimbabwe's animal capture expert Clem Coetsee. The unit has also established links with Serengeti Wildlife Veterinary Project, Tufts University - School of Veterinary Medicine, Government Veterinary Services, Ministry of Health - public health department, University of California, Davis among others. The unit has also established links with the national and

international NGOs in the donor community which include Dian Fossey Gorilla Fund - UK, International Gorilla Conservation Programme, Care For the Wild - UK and Born Free Foundation, AHEAD Programme in USA. These links, especially the technical ones, now need to be formalised for more effective co-ordination of wildlife veterinary activities in Uganda.

Investigation of coughing chimpanzees in Kibale National Park

In February 1998 I dealt with coughing chimpanzees in Kibale National Park, where one unfortunately died of a secondary bacterial pneumonia due to E. coli. The rest of the chimpanzees are improving. Unfortunately the chimpanzee post-mortem was done by a non- veterinarian so we lost a lot of valuable information so I had to stress to them that a medically trained person should do the post-mortem especially as chimps are so threatened. The chimpanzees of Kibale and Budongo also suffer greatly from snare injuries and efforts have been made by the vet unit to remove them, but there are many limitations especially as the chimpanzee can go up a tree after being darted and fall down and die, so the technique is still being developed.

Mountain gorilla health and ecological training workshop for rangers.

In January 1998 I carried out an intensive 2 weeks workshop for training rangers in the 2 mountain gorilla parks Bwindi Impenetrable National Park and Mgahinga National Park. to monitor and report ill health in the gorillas. It was very successful and I felt that the rangers learnt a lot and will be very useful to me in the field. They were given certificates for passing the exams to an acceptable standard. It was stressed to the rangers when it was important to call out the vet; snare injuries and life threatening diseases were all indications for calling out the vet. Although the policy is that vets do not over intervene and disrupt the group natural behaviour so if 2 gorillas fight, we do not intervene as it is natural behaviour and it may be time for group succession. Treating the wounded gorilla which then gets better may prevent a natural group succession. There is still a lot of debate regarding this policy on mountain gorilla interventions, as animal welfare, visitor distress, economics and politics arc always brought into consideration and not just conservation.

Translocation of baboon from Lugazi to forest.

In March 1998, I rescued a baboon from a classroom in Lugazi High School. He was stoned by villagers when someone brought him on a train from Busitema and abandoned him. This was an orphaned baboon and the owners probably got tired of him when he grew too big to an adult male baboon, and the owners decided to drop him off in Lugazi. So he had a wire around his waist. A wildlife clubs teacher called John Marie, came and rescued him from the villagers when he was unconscious and then nursed him to health. He then became aggressive, so the teacher came to UWA. I went with the law enforcement co-ordinator, Karl Karugaba to Lugazi. We found that the baboon was now in the headmasters office and they were getting desperate so I darted the baboon and we carried him to the car while all the school kids were watching, which also served an educational purpose especially as they had just started a wildlife club in their school. We then took him to a forest and released him. At least he can have a second chance at life.

Mountain gorilla rectal prolapse surgery.

The two week workshop paid off because almost 6 months later in June 1998. One of the gorillas developed a rectal prolapse which did not go back unlike previous cases where it had. These have been the first record of rectal prolapses in mountain gorillas. Therefore after careful assessment I made a decision to intervene and treat the sick individual as the prolapse was not going to resolve naturally because it had started rotting and had maggots. Although the condition was most likely not human caused it was life threatening. Rectal prolapses may be due to a genetic predisposition and we may have interfered with nature and selected for gorillas with weak rectums which are more likely to get prolapses but this has not been proven yet. The biggest challenge was having to do this intervention without any veterinary assistance which was very stressful as I had to monitor

anesthesia at the same time as doing surgery. The juvenile gorilla is improving which is great news especially as she is female and therefore part of the main breeding stock. The biggest challenge in this case was making a decision to intervene as the policy emphases interventions mainly for

human related diseases or injuries like snares.

1999

UWA had a change in management yet again and the vet programmes were slowed down. However in May 1999 the new executive director from South Africa Dr. Robbie Robinson came in to UWA and it is hoped that things will improve.

In January 1999 the veterinary unit with assistance from Dr. Siefert in Makerere University Veterinary faculty removed a snare from an elephant in Ishasha sector of Queen Elizabeth. This is an area that is not adequately patrolled because there is only one vehicle which had broken down.

The veterinary unit held a workshop in February 1999 on Veterinary Standard Operating Procedures with wardens sponsored by USAID Grant Management Unit this will contribute to the operational manual.

In March 1999 a great tragedy occurred where 1 warden and 8 tourists were killed by rebel Hutu Interahamwe in Bwindi Impenetrable National Park. This brought a halt in operations in UWA as gorilla tourism cams 70% of revenue for UWA and the government subvention is getting less and is not adequate. Fortunately the gorilla were not affected as the fighting was not in the area where the gorillas range but activities to protect them reduced because of lack of funds. Security in the form of army men camped in the park was set up immediately. It has received some donations to get operations going again and the tourism started to pick up as soon as the park opened a month later. It is hoped that the numbers will steadily grow as confidence returns.

Rinderpest

The project of disease control will be carried out in collaboration with African Wildlife Veterinary Project part of OAU/IBAR/PARC programme with Dr. Richard Kock as technical adviser. In May 1999 the veterinary unit started Rinderpest disease control in wildlife which has never been done before as part of a programme of African Wildlife Veterinary Project to carry out Rinderpest disease control in wildlife with the global aim of eradicating Rinderpest in Africa. This is an important disease of wildlife and buffaloes are most susceptible usually contracting it from unvaccinated cattle. It causes death in buffaloes. The minister of State for Tourism was the guest of honour and launched the programme which helped as it can lead to more political support for this and other veterinary programmes in UWA. Working with Dr. Richard Kock, John Nyongesa, KWS veterinary technician and Dr. Nantima in Kidepo. We successfully got samples from 11 buffaloes. In Lake Mburo we worked with Drs. Joseph Okori and Christina Whitman form the Makerere veterinary faculty. We successfully got samples from 6 buffalo, 3 Topi, 3 warthog and 1 impala. In Lake Mburo we ended up sampling other ungulates because the buffaloes were very difficult to find. There was also capacity building of veterinarians and rangers.

The next programme is in November and will be in Murchison Falls National Park, Semliki Valley Wildlife Reserve, Ajai Wildlife Reserve, Karamoja Wildlife Reserve and Luweero, and kudu in Karamoja Wildlife Reserve.

PLANNED ACTIVITIES

Mountain Gorilla Health Care.
Time frame - all through the year
- Emergency cases
- Regular health checks at least once a year to all the habituated gorilla groups.

- Routine monitoring of gorilla faecal samples for indicators of disease. This programme is starting soon in collaboration with Mountain Gorilla Veterinary Project who are assisting with laboratory sample analysis.

Tuberculosis survey
The veterinary unit plans to carry out a Tuberculosis survey in Kidepo Valley National Park, where a buffalo was recently found with TB. This is part of management related research to determine the prevalence of TB in KVNP a chronic fatal disease. A similar study was done in Queen Elizabeth National Park in the 1960s and in 1997 and TB was found in 10% and 21% of the random sample respectively and is thought to have come from cattle.

Translocations
Elephant translocation exercise from Luweero to Murchison Falls National Park.

Healthcare of critical species
These include elephants giraffes, lions and other threatened species. In January 1999, the veterinary officer with assistance from a Makerere lecturer/ veterinarian successfully removed a snare from an elephant in Ishasha sector of Queen Elizabeth National Park.

Disease investigations in a disease outbreak in both critical and non-critical species
These include impalas, Uganda kobs and zebras. A few zebra deaths have occurred over the past few months in Lake Mburo National park and Anthrax was diagnosed in one of them. It is an endemic disease of the ecosystem got from the environment so there is not much that can be done apart from burning or burying infected carcasses, but need to be monitored. It is common in zebras.

Problem animal management
Assisting in problem animal cases that come up.

Consumptive utilisation.
The veterinary officer paid a visit to the only crocodile farm at Buwama, Masaka road and did a health check and checked the premises for husbandry standards. The veterinary officer intends to go back in May with reptile expert. Prof. John Cooper and carry out tests on the crocodiles and water quality to improve die health standards on the farm.

Training programmes
Held a veterinary standard operating procedures workshop with wardens – February 1999.
Training workshop in Nairobi, Kenya in Rinderpest disease surveillance - June 1999.
Training of the UWA veterinary officer in S. Africa under Dr. Cobus Raath in translocations, disease surveillance and sustainable utilisation of wildlife - August 1999 funding permitting.
Training of rangers in some protected areas to take samples from dead animals and monitor health in animals funding permitting. This is a continuation of work that started in 1997 in some PAs.
The veterinary officer participated in a Rabies conference in Entebbe in March 1999 and gave a talk on rabies in wildlife.
The veterinary officer intends to attend an annual scientific zoo veterinary meeting in USA in

October and give a talk on a rectal prolapse surgery in a mountain gorilla in Bwindi, funding permitting.

The veterinary officer participated in a workshop to discuss the translocation, reintroduction and introduction policy of UWA in January 1999.

FUTURE ACTIVITIES

Future activities depend on available funding. It is the goal of UWA to set up an efficient and effective veterinary unit which will involve employing more people in the unit and one veterinary officer with no support staff is neither adequate nor sustainable. USAID have expressed a strong interest in funding the proposed three year programme of the veterinary unit subject to UWA's commitment to take on these people after the programme. The UWA board of trustees have approved the proposal recruitment of more people and the veterinary policy. It is hoped that the policy and proposal will be implemented and the VU is in the process of working out the details necessary to get this done. Below is a summary of the objectives of the veterinary unit in the next three years and all activities will fit in with these objectives. These will include health care, translocations (hartebeest, giraffes, roan antelope, Uganda kob, rhino etc.), problem animal control, training programmes publishing and presenting of results.

As there is very little capacity in UWA to carry out capture and translocations for disease investigation, ecosystem health interventions, problem animal control and consumptive utilisation, three policy workshops for veterinary, problem animal, translocation and reintroductions which the veterinary officer participated in, have highlighted the urgent need for capacity building through the establishment of a capture team of mainly rangers. The capture team will work closely with the veterinary team to carry out these functions. A similar system is working well in Kenya Wildlife Service. Funding is needed for this team to be established. Meanwhile, we are trying to make sure that any translocation activities are being carried out by the same people so that they build on their experiences and eventually form a professional capture team.

The following is a summary of the proposed activities for the next three years. which were discussed and concluded in a veterinary policy workshop attended by 17 people most of whom were UWA senior management.

PROJECT DESIGN AND IMPLEMENTATION OF VETERINARY POLICY

Project Results and Implementation.

For the next three years (1999-2001)' the UWA veterinary unit has set the following objectives:

Overall Goal

To enhance the conservation of wild animal species as elements of biodiversity

Programme Purpose

Establishing effective and efficient UWA Veterinary services.

Results

- Wildlife veterinary policies and procedures established and implemented.
- Systems for monitoring health and disease of wild animal populations established.
- Health care of critical wild animal species improved
- Veterinary input to problem animal control provided.
- Veterinary input to commercial use of wild animals provided.

- Required interventions to maintain or improve ecosystem health undertaken.
- Veterinary input to research involving wild animals provided.

The overall goal is the conservation objective to which UWA Veterinary Unit's three year programme is intended to make a significant contribution: it provides the ultimate justification for the investment of time effort and resources involved in implementing the programme. Thus UWA

veterinary unit confirms that its primary concern is sustainable management of Uganda's wildlife.

The programme purpose is the immediate objective or specific intended impact of the programme itself. UWA veterinary unit over the next three years is concentrating on building its capacity on a sustainable basis by establishing effective and efficient veterinary services.

The results or outputs are the particular objectives that UWA veterinary unit must guarantee to achieve through the three year programme if the programme purpose is to be achieved. At the end of the project the aim is that enough capacity would have been built within UWA to carry out the necessary tasks that will meet the needs of UWA.

The project is based on the assumption that funding will be provided; UWA will develop properly and security Uganda will continue. The political risk is insecurity in the country which can lead to the closure of some protected areas so that veterinary problems like disease outbreaks cannot be controlled. The financial and economic risks are if sufficient funds are not made available. Another limitation is if UWA does not take on the extra staff after the project to keep the veterinary services effective and efficient. The social risk is a breakdown in internal UWA and external relations with stakeholders. The flexibility existing for dealing with these unforeseen situations or uncontrollable factors is a veterinary policy and working agreements with stakeholders: ensuring adequate funding and commitment by UWA to take on extra staff in the veterinary unit: protected areas that are not in insecure places in Uganda will continue to have veterinary services provided alternative means of transport can also be used for example air travel instead of road travel to inaccessible areas due to insecurity or bad road conditions for example the road to Kidepo.

FINAL DAY OF WORKSHOP

The final day was dedicated to discussions on PACE and the wildlife component. Feedback from both Anglophone and Francophone countries were constructive and the comments made will influence the global planning for this aspect of PACE as well as the Workplan budget.

The areas covered were basically:

Diseases of interest : with a focus on their regional importance and ecosystem bias.

Institutional involvement and integration of the network in both wildlife and veterinary institutions.

Method of implementation - focus on individuals through appropriate institutions with appropriate support from the Coordination unit Building of a network and a Wildlife Epidemiological team was the aim. Finance and key needs of each country - equipment etc.

There will be 2 routes - from the coordination unit for certain aspects e.g. training and from National budgets for equipment, some running costs etc.

Each country unit will need to prepare a proposal for those elements from National fluids by July

A global plan is in preparation and the countries will be consulted

CLOSING STATEMENT

Dr Rene Bessin, OAU/IBAR

The workshop funded by the EC and hosted by the KWS Vet Unit had the following aims:

1. To bring together the personnel including veterinary and wildlife professionals, selected in the East, Central and West African regions to support the project
2. Provide background information on the function of OAU/IBAR, including the history of PARC and summary of its achievements and proposals for the successor - Pan African Programme for the Control of Epizootic disease (PACE).
3. Explain the rationale for the wildlife epidemiology unit under OAU/IBAR and role of collaborating personnel
4. Establish the first wildlife specialist epidemiological network in Africa involving 9 countries.
5. Sensitise the personnel to wildlife issues, conservation and the importance of welfare of animals during intervention. Explain the management structures for wildlife resources in the region and how these integrate with other authorities.
6. Provide technical information and training in some of the important wildlife and veterinary techniques that need to be employed in the programme's laboratory and field activities - Nairobi and Meru).
7. Provide an opportunity for the exchange of ideas on the programme and on the investigation of the role of wildlife in epizootic diseases of economic importance to African countries.

Participants; including lecturers, attended from Kenya, Tanzania, Uganda, Ethiopia, CAR, CHAD, Burkina Faso, Senegal, Cote d'Ivoire, Spain, France and South Africa.

The workshop has been organised and conducted well with minor technical problems (audiovisual). The participants and lecturers have worked hard to ensure maximum benefit and this has certainly justified the expenditure. I believe the participants understand the role expected of them and the importance of this work in the control and eradication of important diseases in Africa to the benefit of livestock, wildlife and people. Each participant should appreciate they are now pioneers/ambassadors in each of their countries in this new field of work.

I would like to formally close the workshop and welcome all back to Kenya in the future, good luck in Meru National Park, one of Kenya's many jewels and a safe journey home.

ACKNOWLEDGEMENTS

Thanks are due to the President of Kenya, the Hon. Daniel T. Arap Moi and the GOK, the EC, the KWS, the OAU/IBAR and the participants and lecturers for giving their time and energies. Particular thanks to John Wambua for allowing the total disruption of his unit and workplace, Gerald Muchemi for facilitation and organisation of the workshop, Grace Bore of OAU and Mildred Oyamo for secretarial and administrative support, John Kanyingi for availing his capture unit staff for the field operations and Sammy Mwirigi for desktop publishing. Finally thanks to the interpreters especially Philippe Chardonnet and Feran Jori who did a fantastic job.

The food has been adequate (even good at times!) and there has been at least a little time for entertainment (Carnivore evening etc.) and relaxation (in some of the lectures!!).

LIST OF PARTICIPANTS

Burkina Faso
Dr. Roumba Pascal
Dr. Bousinni Hiver

CAR
Ndobale Jean Capitaine
Dr. Etienne Abdallah-Nguertoum

Cote d'Ivoire
Dr. Ouattara Mamadou

Ethiopia
Lakew Berhanu
Fekadu Shiferaw

Kenya
Dr. Richard Kock
Dr. Gerald Muchemi
Dr. John Wambua
John Nyongesa
Dr. Thomas Manyibe
Dr. William Ogara
John Kanyingi
Dennis Mudhaka
Dr. Githaiga Kamau
Dr. Elizabeth Wambwa
Dr. Jacob Mwanzia
Dr. Bernard Mugenyo

Senegal
Dr. L. O Mbargou

Tanzania
Dr. Titus Mlengeya
Dr. Samson Mkumbo

Tchad
Dr. Mbaikari Mekonlaou
Dr. Assandi Oussiguere

Uganda
Dr. Joseph Okori
Dr. Christine Dranzoa
Dr. Gladys Kalema

CIRAD
Dr. Phillippe Chardonnet
Dr. Ferran Jori

TRAINING COURSE ON WILDLIFE RINDERPEST SURVEILLANCE 6 - 12 JUNE 1999 AT KWS CONFERENCE HALL & FIELD TRIP 13-15 JUNE 1999 - MERU NATIONAL PARK

Time	Sunday 6th June	Monday 7th June	Tuesday 8th June
8.30 - 9.00am		Registration	
9.00 - 9.30am			AWVP -Wildlife and Rinderpest Dr. Kock - OAU/PARC
9.30 - 10.00		Opening ceremony	
10.00 -10.30			Discussions
10.30 -11.00		Tea	Tea
11.00 -11.30		Overview and history of PARC Dr. Solomon - OAU/PARC-PA CE	Epidemiological surveillance methods with wildlife species Dr. Kamau - KWS
11.30 -12.00noon		PARC/IBAR and Eastern Africa Dr. Musiime - OAU/IBAR-PACE	
12.00 -12.30pm		PARC/IBAR and West Africa Dr. Bessin - OAU/IBAR-PACE	Epidemiological surveillance methods with Livestock - Dr. Geiger OAU/PARC
12.30 - 1.00		Discussions	Discussions
1.00 - 2.00		Lunch	Lunch
2.00 - 2.30	Arrivals and pick-ups from airport	PARC Epidemiology -Overview of Rinderpest Dr. Rossiter - OAU/PARC-PACE	Field and laboratory procedures for wildlife disease diagnosis D. Mudakha, J. Nyongesa, KWS
2.30 - 3.00			
3.00 - 3.30		Nairobi National Park	
3.30 - 4.00			
4.00 - 4.30			
4.30 - 5.00			
Evening programme		Refreshments	

Training in Wildlife Health in Uganda
Dr. Dranzoa, Makerere University

Time	Saturday 12th June	Sunday 13th - Tuesday 1
9.00 - 9.30am	Review of potential for investigation of wildlife health issues in Western Africa Dr. Chardonnet	Field Operation - MERU National Park
9.30 - 10.00		
10.00 -10.30	Review of potential for investigation of wildlife health issues in Eastern Africa Dr. Kock	
10.30 -11.00	Tea	
11.00 - 11.30	Closing ceremony	
11.30 - 12.00noon		
12.00 - 12.30pm		
1.00 - 2.00	Lunch	
2.00 - 2.30	Free afternoon	

Some major disease problems of domestic antiodactyls of Ethiopia (which are risks to respective wild animals)

Viral Disease

- Rinderpest
- Rabies
- Foot and mouth disease
- Pox
- Lumpy skin disease
- Malignant catarhal fever
- Infectious bovine rhinotrachitis
- Contagious echthyma

Bacterial Disease

- Anthrax
- Blackleg
- Malignant oedema
- Tetanus
- Pestemallosis
- Salmonellosis
- Tuberculosis
- Heart water
- CBPP
- CCPP
- Necrobacillosis

Protozoal

- Babesiosis
- Theleriosis
- Trypanosomiasis

HISTORY OF RINDERPEST: A REVIEW

The **Contagious** nature of the disease was recognised 2,000 years ago. Roman authors, for e.g. advised control by isolation, slaughter and burial (Scott G.B.1 976).

Rinderpest caused panzootic in Africa during the period 1989-1998, spreading first the North East to the cape of west coast. The first epizootic to be observed by Europeans was that which began in Somalia or Ethiopia in 1889 (Mack, 1970, cited by Walter Plowright) probably following the importation or Zebu cattle from India for the Italian armies. It spread along trade routes to reach Uganda and northern Kenya and the then Tanganyika by 1889-1890 and by 1896 to Zambezi River. By 1887 it already reached the southern tip of Africa, the cape. Apart from enormous losses in domestic cattle estimated at 5.3 million in southern Africa alone, the mortality in ruminants was devastating. 90% of Kenya buffalo, and bongo were almost exterminated by rinderpest in 1890. The catastrophic effect of rinderpest mortality in cattle and game on the well-being of pastoral people is a factor not to be forgotten especially when it was combined with small pox, jigger flees and