

# Emerging Environmental Health Issues Affecting Wildlife

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## Introduction

Most emerging environmental health issues are related to certain human activities in the environment. These anthropogenic manipulations include :

- Impoundment of water drainage systems, reduced flow and flushing of water systems, siltation and bio-accumulations.
- Non-sustainable abuse of natural resources (including marine resources) -as well as ecosystem services such as clean air, water, soil production, oxygen production, carbon sequestration, wetlands and the circulation of nitrogen)
- Intensification of agricultural production systems and practices, fertilizers and soil erosion.
- Pollution from industry, untreated sewerage, mining activities, coal-fired power stations, vehicle emissions, agricultural pesticides.
- Commercial forestry activities including sawmills and paper mills
- Introduction of invasive alien species including micro-organisms, plants, invertebrates and vertebrates..

All of these activities affect our environment, animal health and human health, and the following are recent examples of emerging wildlife health issues linked to one or more of these practices.

## Cyanobacterial bio-intoxications

Blue-green algal blooms are generally linked to pollution and eutrophication of water bodies by urban raw sewerage, agricultural fertilizers (especially nitrates and phosphates), compounded by decreased river flow and stagnation. Overpopulation of small stagnant water bodies by large amphibious animals can also result in eutrophication and algal blooms.

## Example

In the late summer and autumn of 2005, and then again in the autumns of 2007 and 2008, several outbreaks of blue-green algal poisoning occurred in the southern and central districts of the Kruger National Park. The algal blooms occurred in man-made still-water impoundments that supported high hippopotamus densities. The curtailment of hippo population management in 1995 had resulted in overpopulation of this species in perennial river systems and resulted in dispersal of large numbers of hippos to localised small impoundments on seasonal drainage systems. These years were also characterized by failure of late summer rains to materialize, and relatively warm to mild temperatures. The mammalian species most affected during these bio-toxicity events included white rhinoceroses, blue wildebeest and Burchell's zebra. Typical macro and micro hepatic lesions were noted on necropsy, and confirmed on histopathology. Water/bloom toxicity was confirmed using

intra-peritoneal mouse toxicity tests, barbell liver cell culture bio-assays, and a new microcystin ELISA.

Control measures included strategic veld burning, breaching dam walls and draining of the affected dam, and pumping the water out of an affected dam.

Risk factors identified for these algal blooms to occur include :

- Man-made, still water impoundments that rarely flush during the rainy season.
- Mature dams that are 30+ years old.
- Failure of late summer rains with shrinking water levels.
- Water temperatures between 18 and 22° C
- High hippo densities resulting in a build up of nutrient rich sediments.
- Hippo activity that stir up the sediments, releasing nitrogen and phosphates which results in eutrophication of the water.

Pollution and reduced flow in the Olifants River system – the effect on resident fish and crocodiles

The Olifants river originates in Gauteng and initially passes through urban and industrial areas with raw or inadequately treated sewerage and industrial pollution. Thereafter it flows through an area with extensive coal mining activities and coal-driven power stations, with high sulphur loading and acidification. It then flows through agricultural and commercial forestry areas and then finally through a copper and phosphate mining area before entering the Kruger National Park. This river has 58 large dams and 228 small dams along its tributaries and length, but generally flushed well during the rainy season. In the 1990's a large irrigation dam was built at Massingiri in Mozambique, at the point where the river leaves the KNP eastern boundary. The height of the wall of this dam was increased further in the early 2000's, resulting in reduced flow, damming back into the Olifants gorge and siltation. This also resulted in bio-accumulation of all the upstream pollutants in the region of the Olifants river gorge in the KNP.

During May, 2008 three crocodile carcasses were reported downstream of the Olifants trails camp, and necropsy examination on one decomposed animal revealed that the fat stores in the tail was yellow-orange in colour and hardened. This sounded frighteningly similar to the condition observed in dead crocodiles in Loskop Dam, during a major sewerage and acid mine water spillage in September 2007.

A decision was made to fly the whole Olifants River within the KNP boundaries in order to attempt to determine the extent of these crocodile mortalities. During this initial flight, more than 30 crocodile carcasses were located, mostly concentrated in the area of the confluence of the Olifants and Letaba river and eastwards into the Olifants river gorge. In addition several lethargic live crocodiles were seen that were slow to react to any stimuli. Most of these crocodiles were in the 3-4 meter size class, and specimens were collected from two more fresh carcasses, and a complete necropsy was performed on a 2 meter crocodile that was brought back to Skukuza.

All of the carcasses were in excellent body condition, and all of them had the same dominant lesion characterised by hardened, saponified and ochre-coloured fat.

A macroscopic diagnosis of Pansteatitis was made, which was confirmed histologically. This condition is generally associated with a deficiency or depletion of anti-oxidants in the animals' body, generally as a result of eating rancid fish, or due to pollution of the food chain with heavy metals (divalent cations) or organic pro-oxidants such as certain pesticides, industrial waste or dioxans. The drop in water temperatures in the Olifants river as winter approaches, was thought to be an exacerbating factor.

Specimens of the water, silt, and dead crocodiles were collected and sent to DWAF, CSIR, OVI and the Faculty for analysis, in a bid to determine the aetiology of these mortalities.. In addition, certain baseline values were obtained from similar samples collected from unaffected rivers traversing the Kruger Park, to establish normal levels of anti-oxidants and pro-oxidants in the crocodiles and fish, as well as existing levels of heavy metals and pro-oxidants in silt and water. Bottom living fish such as barbel and mudfish were also sampled from affected and non-affected rivers, and those captured in the Olifants / Letaba drainage also showed pale hyperplastic gills, swollen yellow livers (fatty infiltration +, ceroid pigment) and abdominal fat accumulation and necrosis.

To date, more than X crocodile carcasses have been detected, and the crocodile populations in the eastern Olifants and Letaba rivers have been severely affected.

#### Rift Valley Fever

In October / November of 2009, an outbreak of Rift Valley Fever was detected on farms bordering on the Orange river in the Northern Cape Province. The RVF virus is mosquito –borne and is also transmitted transovarially to offspring in Aedine mosquitoes. The eggs lie dormant and require a drying out period followed by rewetting before they hatch. The time course for this drying and re-wetting cycle in natural systems may be weeks, months, years or even decades. In this area of the Northern Cape, flood irrigation agricultural practices provided ideal breeding and hatching conditions for the endemic vectors of RVF, followed by biological transmission of the virus to the ruminant hosts.. Each infected and viraemic ruminant then becomes a source of virus to epidemic vectors such as other mosquito genera (Culex, Mansonia etc), biting flies and midges which transmit the virus mechanically, facilitating spread of the outbreak. The disease spread into the panveld areas of the Free State, Eastern Cape and Western Cape during the late summer and autumn of 2010, and eventually 329 outbreaks affecting more than 10,000 animals (mainly sheep and cattle) with 6,300 deaths were recorded. RVF –associated abortions and deaths were also recorded on wildlife ranches in buffalo, sable, eland, nyala, waterbuck, springbok and bontebok. Abortions and deaths were also recorded in Llamas, Alpacas and fallow deer on game farms.

#### Floppy trunk syndrome in elephants

A sporadic syndrome reported from Zimbabwe (Lake Kariba) and the Kruger National Park. It is characterised by progressive ascending paralysis of the trunk, and affects predominantly bull elephants. Apart from emaciation and cachexia, no significant macroscopic lesions are seen on necropsy. Dissection and histopathological examination of the facial nerves could not demonstrate any inflammatory or infectious process. The most striking microscopic feature was one of Wallerian degeneration of the axons. Other peripheral motor nerves examined as controls, were normal. The most popular current aetiological hypothesis is that this syndrome results from a poisoning, caused by the ingestion of certain pioneer plants on disturbed ground and exposed flood plains, which are

frequented by bull elephants. Potential candidate plants include the leguminous bushes of the genera Indigofera, Tephrosia or Heliotropium.

#### Recently Emerging Zoonoses

Associated with Fructivorous bats : These include Ebola virus, SARS, Nipah, Hendra and Menagle virus infections.

Associated with insectivorous bats : These include Marburg virus, Lagos bat virus, Duvenage virus, European bat lyssa virus 1 & 2, and Australian bat lyssa virus.

Associated with rodents : Hanta virus infection, Mokola virus, Monkeypox, Tularaemia and bubonic plague

Associated with birds : Avian influenza and West Nile virus infection.

Associated with primates : HIV 1 & 2, Marburg and Ebola virus.

# Disease surveillance and monitoring in Free-ranging African wildlife

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## INTRODUCTION

It is generally recognized that countries that conduct disease surveillance in their wildlife populations are more likely to detect the presence of infectious animal diseases, be they pre-existing or newly established, within their borders (Morner et al, 2002). Many indigenous and endemic pathogens frequently cycle “silently” in their traditional hosts, with little expression of disease. Newly emerging or novel diseases entering an ecosystem are generally present at low incidence or prevalence (Williams et al, 2002). These two categories of infections are difficult to detect unless dedicated and targeted surveys are introduced.

Other indigenous pathogens, in order to fulfill their survival, propagation and transmission strategies (e.g. anthrax and rabies), may cause severe disease in wildlife. These diseases generally affect a broad range of species, and are inherently fatal. Clinical outbreaks are frequently driven by climatic factors and host population densities. These outbreaks are frequently highly visible and dramatic, but usually of short duration, and present as localized focal or multi-focal clusters, and have a zonal propagating pattern.

Alien diseases on the other hand may have devastating effects on indigenous wildlife, and are a major cause for concern because they frequently cycle independent of conventional ecological drivers, and may have wide spatial spread and extended temporal patterns (Bengis, et al, 2003.). Examples are rinderpest, canine distemper and bovine tuberculosis (BTB).

Examples of these last two categories of diseases are relatively easy to detect (except BTB) because of their high clinical profiles.

This paper will address some disease surveillance and monitoring techniques and strategies that have been found to be practical and functional for use in free-ranging wildlife in African National Parks and game reserves.

Surveillance, surveys and monitoring.

In general, disease surveillance in free-ranging wildlife is employed to detect the presence of pathogens, as well as emergence or cyclical recurrence of disease outbreaks in wildlife populations.

Disease surveys, however, are generally implemented to evaluate and document the presence, prevalence and spatial distribution of infectious agents or vectors. Many disease surveys are dedicated to specific diseases or vectors known to occur in a specific area. Serological and vector surveys are the two most common techniques utilized. Disease surveys produce information on the current status of the infection at a specific point in time (snapshot). The sampling technique used during these surveys may be random, selective or targeted.

Disease monitoring, on the other hand, frequently involves repeat surveys, and is usually implemented to obtain spatial and temporal information during known disease outbreaks or inter-epidemic periods, in order to document disease trends and to determine species, age and gender predilection, rate of propagation, spatial spread and other disease determinants (Thrusfield, 1985).

### SURVEILLANCE TECHNIQUES AND STRATEGIES

The responsibility for disease surveillance in domestic animals generally rests with the veterinary regulatory authority of a given country, and the surveillance techniques used may include passive reporting, farm inspections, problem investigations, abattoir surveys, serological surveys and dedicated surveys for specific disease eradication schemes (Thrusfield, 1985). The assistance of private veterinarians, diagnostic laboratories, animal scientists, farmers and breeders association are frequently included.

Wildlife disease surveillance is generally less well structured and usually passive because free-ranging wildlife are not visited and visualized on a regular basis, frequently do not have owners, and are not easily manipulated for “hands on” examination or specimen collection (Bengis et al, 2002).

For this reason, surveillance techniques for wildlife should be structured to maximize the information gained from the limited availability of captured animals and carcasses that are presented.

Examples of various techniques that can be applied are as follows :-

- Active investigation of any reports of abnormal clinical signs, mortalities or sustained increase in scavenger activity in a given geographical area.
- Perform detailed diagnostic necropsies on all carcasses that become available on an ad hoc basis. Innovative initiatives, such as collection of road kills or examining hunter kills, can substantially increase the number of carcasses examined.
- Perform veterinary and veterinary public health inspections at all lethal wildlife population management (culling) operations, as well as at livestock slaughter premises at the interface zone adjoining conservation areas. Wildlife culls are frequently an excellent opportunity to develop and document inventory lists of pathological processes, micro-pathogens and parasites cycling in a specific population.
- Active veterinary participation in protected area management, with emphasis on training of technicians, rangers and field biologists regarding surveillance techniques, clinical signs of diseases, sampling techniques, data collection, and reporting.
- Veterinary clinical examination and tissue sampling of all animals captured for any reason at all, including translocation, clinical assistance, fitting radio transmitters, or removal of problem animals.
- Veterinary supervision at all wild animal holding facilities and game sales.

- Active or targeted surveillance is also an excellent, though expensive surveillance technique. The value of serum and tissue banks for retrospective studies and analysis cannot be over-emphasized.

In all the above-mentioned “hands on” situations, sample collection, including body fluids, tissues, excretions and parasites should be maximized.

Additional indirect techniques for disease surveillance may include :-

- Vector trapping for distribution studies (e.g. Tsetse flies, mosquitoes, Culicoides, ixodid and argasid ticks, etc.) or pathogen isolation and xenodiagnosis.
- Rodent trapping for serological surveys (arbo and cardio-viruses) or disease agent isolations. The identification and confirmation of the aetiological cause of morbidity or mortality in wildlife disease outbreaks is paramount. Once the aetiological agent has been positively identified, then monitoring actions should follow to ascertain trends, and evaluate the importance or impact of the disease at the population level. The potential impact of the specific disease on regional domestic livestock, its zoonotic potential and trade sensitivity are also extremely important considerations. Only after considering all these aspects should multi-disciplinary decisions be made with regards to appropriate disease management, if and where necessary.

#### SURVEILLANCE AND MONITORING IN KRUGER AND OTHER NATIONAL PARKS : DISEASE PATTERNS

##### Anthrax

Although anthrax was first diagnosed in the Kruger National Park in 1959, there is irrefutable evidence that *Bacillus anthracis* has been present in this ecosystem for many centuries (De Vos, 1998). It is thus considered to be an indigenous disease, and certain endemic foci are the source of infection that initiate the recurrent epidemics that occur intermittently, approximately every 10 years. In Etosha National Park, anthrax follows a more endemic pattern, with cases occurring annually (Lindeque & Turnbull (1994).

Epidemics have a typical zonal propagating pattern, and usually occur during the driest period of the year. They are short lived and are dramatically terminated or interrupted by the onset of the rainy season. Anthrax generally moves through an area in a wave-like front, with a high incidence of cases at the frontal surface, and only sporadic cases occurring behind the front. In Kruger, anthrax is a multi-species disease, but kudu and buffalo form the bulk (80%) of the victims (De Vos & Bryden, 1996).

Passive surveillance for anthrax is mainly executed by trained field staff, including rangers, game guards, biologists and veterinary technicians. The signalment of an outbreak is frequently characterized by a sustained increase in vulture activity in a given area, and finding carcasses of different species in reasonable body condition, with no signs of predation. Field personnel are issued with blood smear collection kits, wrapped in a small data sheet. Blood smears are taken from all suspect carcasses, the data sheets are completed and the samples are then sent through to the State Veterinary Investigation Center at Skukuza for staining and microscopic examination, and /or culture if necessary. Once an outbreak has been detected, then activities shift up a gear into active surveillance /monitoring mode, involving moderate-scale deployment of staff, vehicles, a mobile laboratory and a helicopter. A central command center is established at the nearest rest camp, and data collected is captured, stored and mapped on a daily basis to identify spatio / temporal trends (De Vos & Bryden, 1995). Circling and descending vultures are one of the most important indicators

for pin-pointing carcasses. In the past, the position of carcasses spotted from the helicopter were marked with toilet paper streamers in the top of the nearest tree, and frequently a paper trail (in the tops of trees) was created to the nearest access road, so that ground vehicles could locate and deal with the carcass. Currently, the use of GPS systems co-ordinates are employed to “go to” carcasses spotted from the air. The use of GPS technology facilitates data management and mapping via a GIS system. Containment and control exercises include incineration, covering or burying of carcasses, disinfection of man-made drinking troughs, strategic veld burning, and vaccination of endangered species and important disease amplifiers, as well as livestock at risk at the interface..

### Foot and mouth disease

The endemic cycle of foot and mouth disease (FMD) is maintained in buffalo herds with virus cycling between adult carriers and the annual calf cohort component (Thomson, et al, 1992). Buffalo are seasonal breeders, with most calves being born between December and March. Buffalo calves receive colostral antibodies against FMD from their dams, and this passive immunity wanes at between 5 and 9 months of age. Thus most juvenile buffalo become susceptible to infection during the dry season of mid-winter and early spring, when many species are congregating at the remaining permanent water points. During primary infection, buffalo calves shed large amounts of virus, and the infection (usually sub-clinical) rapidly spreads to the other buffalo calves in the herd, and may spill over into other sympatric cloven-hoofed species, resulting in an epidemic cycle. These epidemic cycles are the periods of greatest risk for the spread of infection over the KNP boundaries into the livestock of adjoining communities.

In the KNP, impala are the most numerous of the wild cloven-hoofed ungulates, they are highly susceptible to FMD infection and develop clinical disease when infected. To detect FMD epidemic outbreaks, impala are targeted as a disease indicator species, and passive surveillance of impala herds by veterinary field staff is an ongoing activity (Bengis, et al,1994). Clinical signs of FMD in impala include pilo-erection (febrile response), “walking on eggs”, weight shifting from one limb to another, overt lameness, lagging behind the herd and lying down. Animals with clinical signs are sampled non-lethally or lethally, to obtain blood and tissue samples for virus isolation and serology. It is important to “fingerprint” the virus causing each outbreak, in order to evaluate the coverage by vaccine strains used in cattle in the adjoining buffer zone. During epidemic outbreaks, clinical disease may occasionally also be diagnosed in kudu, and less frequently in giraffe, bushbuck, nyala and warthog. In more recent years, an active sero-surveillance technique for FMD in impala has been employed, whereby 30 – 40 randomly selected animals are chemically immobilized, examined and blood sampled per month. This sampling is applied to three geographically distinct populations of impala in the Kruger National Park, on a three monthly rotation cycle.

### Bovine tuberculosis

Bovine tuberculosis (BTB) is an alien disease that probably entered the African continent with cattle brought from Europe by colonial settlers (Henning, 1956). It is a disease with a wide host spectrum, and has opportunistically entered several free- ranging populations of buffalo (Guildbride, et al, 1963, Woodford, 1982; Bengis et al, 1996, De Vos et al, 2001), kudu (Thorburn & Thomas, 1940, Keet et al, 2001) and lechwe (Gallagher et al, 1972). These species all appear to be efficient maintenance hosts, with aerosol transmission predominating. ‘Spill-over’ of infection also occurs into predators and scavengers that ingest infected material, with infection frequently involving the mesenteric lymph nodes, with secondary haematogenous spread to distal sites, including bone, lungs, spleen



kidney and serosal surfaces (Keet et al, 1996; Keet et al, 2000). Aerosol and percutaneous infection are also important transmission modes in lions.

BTB is a slow progressive disease with a long sub-clinical phase, lasting months to years. In buffalo, lechwe, baboons and wathogs, only animals with disseminated or advanced disease show any clinical signs, which may include coughing, emaciation, staring hair-coats, non-healing skin lesions, depression and lameness. Therefore passive surveillance generally only detects the tip of the iceberg.

Kudu, however, frequently developing overt swellings of one or more of the head nodes, at a relatively early stage. The parotid lymph nodes, in particular, tend to enlarge massively due to abscess formation, and fistulous tracts draining muco-purulent material are commonly seen below the ears. These are easily visible from a distance.

Lions frequently present with swellings of bones and joints (elbow hygromata), non-healing bite wounds with granulomatous infection of the subcutaneous and underlying muscular tissue, emaciation and eye lesions.

In most species however, active surveillance, employing lethal sampling with detailed necropsies, OR non-lethal sampling with ante mortem testing using the intradermal tuberculin or blood-based tests (if validated for the species) are necessary for BTB detection and monitoring. There are unfortunately no sensitive or specific diagnostic tests currently available for pachyderms.

### Rabies

On the African continent, rabies has been diagnosed in 33 carnivorous species and 23 herbivorous species, with a regional variation of dominant role-players (Swanepoel, 1994). In spite of this, by far the largest number of rabies cases reported in the developing world, occur in domestic dogs, with “spill over” into domestic livestock, humans, and wildlife. Passive surveillance for rabies involves the sampling of individuals of any species that display inappropriate or abnormal behaviour. The abnormal behaviour may include extreme aggression, dumbness, tameness, paralysis, hypersexuality and excessive vocalization. Salivation and an inability to drink or swallow may be seen. Such animals should be shot in the chest and not brain shot, because the brain is needed for confirmation diagnostics.

### Trypanosomiasis

Trypanosomiasis surveillance can entail looking for, and identifying the infectious agents in blood samples using appropriate laboratory techniques, or more commonly by instituting vector surveillance using a variety of odour –baited traps, insecticide impregnated targets or vehicle mounted mobile targets. These techniques are commonly employed in many sub-Saharan countries and are also currently used in the Kruger Park tsetse surveillance program. These techniques are most sensitive when tsetse populations are reasonably well established. When tsetse populations are extremely low, the use of sentinel cattle herds has higher sensitivity for detection of nagana and its vectors.

### Sero-surveys

In the Kruger Park serum from a variety of species is opportunistically collected and banked during all “hands on” situations. These serum samples may be utilized immediately or banked for retrospective studies. In the Kruger Park, sero-surveys are generally employed to monitor the spatial and temporal activity of certain established diseases such as Brucellosis, Leptospirosis, Rift Valley fever, FIV and encephalomyocarditis.

## Conclusion

This paper attempts to illustrate the multi-faceted approaches that are required to establish a meaningful disease surveillance system for free-ranging wildlife populations. It is stressed that information gained at all “hands on” activities involving wildlife should be maximized, diagnostic necropsies should be detailed and intensive, and data collection, storing and management must be efficient. The value of serum and tissue banks for retrospective studies and analysis is also emphasized.

Different patterns of disease require their own specific surveillance techniques, and because many wildlife disease events are climate or population density driven, improved surveillance and monitoring will result in better understanding of spatio / temporal patterns and drivers, which should be useful for predicting these events.

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# Corridor disease (Theileria parva buffalo-associated infection in cattle): Investigations on the carrier-state in naturally infected cattle and buffalo in South Africa

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In spite of strict regulations to control Corridor disease (*Theileria parva* infection in cattle) by the veterinary authorities, outbreaks in cattle have increased in areas where the disease is endemic in buffalo populations. We closely monitored the occurrence of outbreaks from 2004-2013 covering over 20 localities, mostly in and around Kwa-Zulu Natal. The observations included the number of cattle involved in the outbreaks, clinical signs, parasitological and post-mortem examinations, as well as serological and molecular tests specific for *T. parva*. We also investigated the risk that infected cattle may recover and become carriers of the infection, which poses a threat of re-emergence of cattle to cattle transmission, similar to East Coast fever and Zimbabwean theileriosis. Thirty eight Corridor disease outbreaks were recorded during the study period. Of the 946 cattle tested for Corridor disease during the outbreak period, 278 (29%) were found positive by the real time PCR and IFA tests. A total of 117 (12.4%) cattle remained positive by the IFA test only after the outbreaks. Six cattle which had experienced severe *T. parva* infections in the field, confirmed positive by real-time PCR test and all had recovered, became negative on the test 35-75 days after initial infection. They were brought to OVI quarantine stables for further investigations on their possible *T. parva* carrier-state. Adult *Rhipicephalus appendiculatus* fed as

nymphs on these cattle were used to infect six susceptible bovines. All the six attempts failed to transmit *T. parva* infections and only *T. taurotragi* was transmitted by three tick batches. All of the cattle were splenectomized to confirm sterile immunity in these cattle. *Theileria parva* parasites have not been detected by real-time PCR for over 100 days post splenectomy. However, 8 of the field recovered cattle were found solidly immune to lethal challenge using *T. parva* sporozoite stabilate. Ticks fed on these cattle did not transmit Corridor disease to susceptible bovines and testing of the tick's salivary glands by PCR did not demonstrate any positives to *T. parva*. Therefore, the long-term carrier state to *T. parva* in naturally infected and recovered cattle could not be confirmed. On the other hand, *T. parva* carrier buffalo kept under strict tick-free conditions at OVI can be a continuous carrier, infective to ticks and transmitting fatal Corridor to cattle for eight years. Though the study could not demonstrate cattle-to-cattle transmission by ticks it is suggested that Corridor disease should be considered a potential "emerging disease" and more stringent control methods should be implemented.

Key words: *Theileria parva*, cattle, buffalo, carrier-state

# Diversity of Theileria species infecting buffaloes and their diagnosis

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Corridor disease is a controlled disease of cattle in South Africa caused by *Theileria parva*. African buffalo (*Syncerus caffer*) is the natural carrier-host and testing for Corridor disease status is by the Department of Agriculture, Forestry and Fisheries (DAFF) for buffalo movement in South Africa. As a consequence, “disease-free” buffalo has become a lucrative commodity of the wildlife industry. The ARC-OVI is mandated by DAFF to test buffalo for Corridor disease and serves both Government and industry by providing a SANAS accredited and DAFF approved diagnostic service. The ARC-OVI is committed to the continued improvement and assessment of current and new technologies in order to provide test results that will assist in the mitigation of Corridor disease risk. The current molecular test for Corridor disease is based on real-time PCR hybridization technology that targets the hyper-variable region of the 18S rRNA gene. Our research aims to understand the measurements of uncertainty for this test that is directly related to issues regarding specificity and sensitivity. Regarding specificity, it has been shown that the only parasites amplified to date by the current test include *T. parva* T.sp (buffalo) and *T. sp. (bougasvlei)*, even though 17 *Theileria* genotypes exist in buffalo. The test also detected all *T. parva* genotypic variants found to date that consist of single nucleotide polymorphisms in the probe region. *T. sp. (buffalo)* and *T. sp. (bougasvlei)* were shown to be independent species in their own right and not considered to be *T. parva* variants. True positive status was verified using independent protein genes specific for *T. parva*. With regard to sensitivity, the analytical sensitivity of the current test falls within the theoretical limits of PCR detecting ~1-10 copies. The diagnostic sensitivity indicated that the test detects as low as 0.00002% parasitaemia in a carrier buffalo, while observed field parasitaemia ranges within a herd were above this detection limit. However, parasitaemia in individual animals may fluctuate below this level and the test is therefore considered to be herd based. Mixed-infections with *T. sp. (buffalo)*-like parasites could lead to false negatives and this led to the development of the Hybrid II assay that is not affected by mixed-infections. DAFF recently mandated that all samples that show *T. sp. (buffalo)*-like profiles should be retested using the Hybrid II assay. Research continues to aim at understanding any weaknesses and improvement on the current available tests. This includes considerations regarding the *Theileria* carrier-state in buffalo, tick load in endemic and non-endemic areas, fluctuation of parasitaemia in carrier-animals, factors determining the carrier-state and how carrier-state is defined.

# The Relationship between Soil Health, Natural Pasture Grass Yield and Sustainable Herbivore Farming – An Introduction

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## Introduction

Man owes his physical existence to the process of photosynthesis – the process where plant chlorophyll captures sunlight energy and transforms it into energy-rich carbon compounds (Syltie 2002). For photosynthesis to function efficiently, it is necessary that we understand that the plant cannot be separated from the soil. Management decisions should always be made with one ultimate outcome: to ensure improved soil health. The interface between the plant and the soil is at the level of the roots – and more specifically at the rhizosphere. In the past the powerful role of soil organisms in the uptake of nutrients by plant roots was not fully recognised. Yet, the fact remains that nutrients are brought into available form largely through microbial transformation within the rhizosphere. The ecosystem in the rhizosphere and the chemical processes that occur there are important to understand should one wish to manage pasture for sustainable and profitable beef yields per hectare. Overall it is the plant that engineers a brilliant communal system in the “garden” at the rhizosphere to ensure its growth and existence.

## The Rhizosphere

This refers to the narrow region of soil that is directly influenced by root secretions and associated with the soil micro-organisms. The number of micro-organisms in the upper 30 cm of average soil widely ranges in mass (kg) per area (hectare) (Syltie, 2002) – depending on the soil type, climate and organic matter content:

Bacteria: 500 -1,200

Actinomycetes: 900 -1,700

Fungi: 1,600 - 2,250

Algae: 200 - 250

Protozoa: 225 - 450

Nematodes: 28- 60

Earthworms: 16-1,200

Without a healthy rhizosphere the water, mineral, carbon and gas cycles cannot function efficiently and life on earth would not be possible. Theoretically the rhizosphere takes up little more than 1 mm from the root surface, yet microbes find benefit up to 5mm away. It differs from the bulk soil mass in that it is very energy rich and supports a microbial population that can be as high as a billion cells per cubic centimetre (Foster et. al. 1983). Chemical and microbial activity in the rhizosphere is determined by microbial activity in the root. The plant maintains the rhizosphere as a carefully cultivated, well nourished garden – a prime example of mutualism. More than 25% and as much as 40% of the plant's chemical energy manufactured in the leaves through photosynthesis is excreted via the phloem through the roots into the rhizosphere as exudes and dead cells (Smith, 1977). This is used to build root cells which excrete a high energy mucigel into the rhizosphere. Whilst at any time, depending on vegetation, the rhizosphere makes up only about 1% of the total soil mass, we must realise that during the lifetime of the grass plant, the continual growth of new roots leads to much more soil being penetrated by roots. A root tip produces as many as 18,000 new cells per day (Foster et. al. 1983). Despite root cells being oxygen-loving cells, it can penetrate through an oxygen-deprived soil for about 2 centimetres, but thereafter it stops growing.

The plant employs several strategies in the rhizosphere to improve soil structure – enabling it to grow its roots into the soil as deep as possible:

1. Mycorrhizal fungi: Mycorrhiza means “fungal root”. They proliferate from the inside of the root cortex cells, without disturbing them, out into the surrounding soil and are responsible for nutrient transport from beyond the reach of root hairs up into the xylem towards the leaves. Their lifespan is about 2 weeks where after they are digested by the plant. Exudates like glomalin (see later), released into the root zone, regulate the size of the fungal colony. Not only are the mycorrhizal fungi beneficial to the plant they are directly associated with, but they also extend their hyphae to attach to the roots of other plants. Because elements like iron, copper, zinc, manganese, magnesium, calcium and phosphorous are all immobile in the soil and firmly attached to colloidal exchange complexes, they need direct contact with roots for their uptake or else an extension system – the latter which is achieved by hyphae of mycorrhizal fungi. Soils traversed by a network of mycorrhizal fungi can tolerate dry conditions better because water can now be extracted from a larger soil volume.
2. Polysaccharides are produced by micro-organisms in the rhizosphere. These are sticky substances that, together with glomalin, hold the soil particles together into micro-aggregates. Within these aggregates the oxygen concentration is very low – resulting in storage of nutrients because of little oxidation that takes place here.
3. Roots and root hairs: The “channels” of conduits that these leave after they have died back encourages water and air movement and together with the action of earthworms, arthropods and mites pores are formed for new roots to easily grow into.

Glomalin

Glomalin was discovered in 1996 by Sarah Wright. It is a glycoprotein produced abundantly by hyphae and spores of arbuscular mycorrhizal fungi in the soil – especially in and close to the



rhizosphere – hence the name “glomalin”. Containing 30-40% carbon, it is understandable that most soil carbon is contained in glomalin. It binds to silt, clay and sand particles – forming clumps of soil particles also known as aggregates, adding structure to the soil – minimising carbon loss from soil into the atmosphere. It weighs 2-24x more than humic acid – which was previously thought to be the main contributor to soil carbon. Humic acid, however, contributes only about 8% of the soil carbon

#### The Oxygen-Ethylene Cycle (OEC)

Grass health requires an abundance of oxygen in the rhizosphere. Root cells need oxygen for division. Poor soil aeration due to compaction will lead to fewer spaces between the soil particles and reduce root growth ability by as much as 8% (Trowse, 1988).

The OEC occurs on the root surface and in the rhizosphere in microbial “pockets” called the anaerobic microsities. The OEC only functions efficiently in undisturbed soil where there is a continuous organic matter breakdown. In tilled soil there is an absence of ethylene. This emphasises the necessity of mulching through cattle hooves and urine and faecal deposition by large herds under high grazing pressure with relatively long recovery periods to ensure adequate humus concentration on and in the upper layers of the soil surface. The OEC can be summarised into four steps (Syltie, 2002):

1. There is an abundance of oxygen in the rhizosphere. Root exudates (mucigel) in the rhizosphere - originating from photosynthesis in the leaves and transported to the roots - supports rapid aerobic bacterial, fungal, algal and actinomycetes growth. In addition the mycorrhizal fungi produce glomalin which is a source of carbon. Acetic acid, which aids in dissolving nutrients for uptake by roots, is produced by aerobes in the presence of oxygen.
2. Oxygen is rapidly depleted in the microsities and this allows the production of ethylene ( $\text{CH}_2=\text{CH}_2$ ) from humus by anaerobic bacteria where abundant  $\text{Fe}^{3+}$  in the form of  $\text{Fe}_2\text{O}_3$  is reduced to  $\text{Fe}^{2+}$ .  $\text{H}_2\text{PO}_4^{-1}$ , boron (B), molybdenum (Mo) and sulphates are tightly bound to the  $\text{Fe}^{3+}$ , but the anaerobic environment created by ethylene allows these anions to be released into the soil in soluble form – ready for plant uptake. Cations like Zn, Cu,  $\text{Ca}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$  and others are important to both plant growth as well as herbivore health and are taken up by the hair roots from the rhizosphere. To ensure the formation of sufficient ethylene we require adequate mature organic residues (humus), minimum tillage, ammonium fertilizer rather than nitrates, intense rhizospheral activity to create anaerobic microsities where iron can be reduced to  $\text{Fe}^{2+}$ .
3. After ethylene has diffused into the surrounding soil pores and having had an “anaesthetic” or de-activating effect on microbes to slow down their metabolic processes, the lower oxygen demand leads to oxygen to accumulate or re-enter the microsities. More rapid aerobic microbial metabolism again ensues.
4. Photosynthesis and metabolism are stimulated with  $\text{CO}_2$  and light energy being transformed into carbon compounds. This stimulates the production of glomalin. Metabolites and products of decomposition are available in the rhizosphere for absorption into the root following acetic acid production by the microbes.

When the OEC operates smoothly, it aids the plant’s defence mechanisms to fend off plant pathogens through the following important prerequisites for plant health (Anon, 1999, Acres USA 29(9):40:

- Absorption of minerals (Ca, P Mg, K, B, Cu, Zn)
- Cyanobacteria and Mycorrhiza produce growth regulators
- Some bacteria and actinomycetes produce antibiotics
- Nitrogen compounds are produced by non-symbiotic N-fixing bacteria like Azotobacter or symbiotic N-fixing bacteria like Rhizobium

The mutualism that occurs in the rhizosphere through the OEC to release cationic and anionic nutrients to the plant via the roots is a perfectly orchestrated symphony to ultimately provide food to animals and man. It is the basis of sustainability of any farming system where soil-grass-animal interaction takes place.

#### Non-legume Symbiotic Nitrogen (N) Fixation

As many as 20x more N-fixing micro-organisms reside in the rhizosphere compared to the rest of the soil body. Here they utilize fixed carbon energy to grow and fix atmospheric nitrogen. The effectiveness of fixing atmospheric N depend on factors like soil temperature, oxygen and moisture concentration, root exudate levels (depending on the health of the rhizosphere microbial population). The application of nitrate greatly inhibits or even stops N fixation.

#### Clay Minerals and Organic Matter: Two Keys to Soil Fertility

Along with the presence of organic matter, clay minerals determine the reactivity of soils. Because soil chemistry involves mostly surface chemistry, one must take cognizance of the fact that clay has a surface area that is about 8 million times greater than that of coarse sand. About 500g clay has a total surface area of about 50 football fields. No wonder that clay content of soils is so important. Clay lattices have a negative charge on their surface which enables the soil to hold cations like Ca, Mg, K, Na and H – in that order of binding strength. This is referred to as the cation exchange capacity. Organic matter also contributes to this ability – more so than clay on a mass per mass basis. For most soils over half of the cation exchange capacity is derived from organic matter.

Soil organic matter contributes to soil health in the following ways:

- Reduces impact of rain drops and prevents erosion
- Decomposing organic matter produces polysaccharides and “glues” like glomalin that provide soil structure
- “Internal” organic matter like live roots decay following defoliation (grazing) provide channels for further root growth and movement of air and water
- Fresh organic matter is a source of food for earthworms and other soil creatures
- Mulches on the surface prevent soil temperatures to rise excessively and helps ensure soil microbial health
- Evaporation losses are reduced
- Decomposition provides nutrients – especially N, and cations are held (not lost through leaching) by its high cation exchange rate
- In more acid soils, soil P is made more available by organic matter
- Organic matter acts as a buffer against sudden chemical changes and prevents certain plant diseases
- Organic matter acts as a sponge and increases available water for growth

## The importance of soil temperature

As the soil temperature drops, the ability of the microbes to make nutrients available decreases. A surface mulch greatly reduces temperature fluctuations in the soil and about 2 hours after noon, the difference between mulched and exposed soil may be as much as 10°C. When soil temperature drops below 10°C, some nutrients like phosphorus become very difficult to extract.

## Soil compaction and water availability to plants

Soil compaction is enhanced by under-grazing (relatively too few cattle on too large pasture area), fires, tractor tyres, exposure to direct sunlight. The structural units in soil collapse and leave fewer pores – restricting oxygen and air movement as well as the functioning of organisms within the oxygen-ethylene cycle. The result is that nutrient release mechanisms are suppressed.

- The biggest organisms are most susceptible to compaction and are affected first. When this happens the microbial system in soils change from a fungal to a predominantly bacterial one.
- With more compaction, the larger fungal-feeding predators (nematodes and mites) die. This prevents nutrient release from the fungal biomass
- The only micro-organisms that survive when compaction becomes severe are some bacteria, fungi and nematodes. What little oxygen left is used up quickly and the system becomes more anaerobic. Under these circumstances toxic by products of bacteria are formed that further damages the root hairs. Roots become more susceptible to diseases.

The water field capacity of soil refers to the amount of water between the soil particles where no more outflow due to gravity occurs. Here the micropores are all filled with water. When plants have absorbed water to the point where only the water clinging to the particles, which the roots and mycorrhizae cannot remove, remains, it is referred to as the wilting point. If the soil is allowed to dry out even more beyond the wilting point, then the hygroscopic coefficient is reached. Unavailable hygroscopic water represents a significant amount of water that the plant cannot use because it clings to the soil particles with great force. A pressure of 15 atmospheres (=1,519.8 kPa) or more is required to remove water on soil particles that has not been extracted by plant roots, whereas water at the hygroscopic coefficient point can only be removed by a force of 31 atmospheres (3,141 kPa). Water directly adhering to soil particles need 10,000 atmospheres to remove it. Water adhering to the surface of the soil particles between Field Capacity and the Hygroscopic Coefficient is called Capillary water and is mostly available to plants. It can move freely in the spaces between the soil particles: more rapidly where the micropores are large in well-structured soil and much slower where the soil is compacted – the latter situation making plants more susceptible to drought. Horizontal capillary flow of water is more pronounced in clay-loam soils compared to sandy loam soils where the water flow is more subject to gravity and leaching occurs more readily.

## Conclusion

In an extensive rangeland grazing system it can be stated that the most important day-to-day decision to make is: When to move the herd to a new grazing area; and for how long they will stay there before moved further in order that they do not return too soon to the original grazing area. The objective is to maximise annual grass yield per hectare and to graze at least 80% of what was grown for its transformation into beef – either through reproduction or growth.

Although the topic of grass production in cattle rangeland farming systems may seem too idealistic and even boring to some, those that take heed and set out to implement the principles of soil care through cattle grazing management will be greatly rewarded. Sustainability means generating lasting wealth. It starts with understanding soil.

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# Compounding of drugs for veterinary use

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## Introduction

The practice of the veterinary profession is highly dependant on the use of commercial veterinary remedies. While a large number of these drugs are currently available as either stock remedies or veterinary medicines, the drugs available do not cover the entire spectrum of therapeutic agents required in the management of animal disease. Whilst a number of different factors may be responsible for the absence of required medication, the most common has to do with the size of the veterinary market i.e. the local market is not large enough to support the sale of these remedies.

As a result of the non-availability of veterinary remedies, veterinarians have been afforded the privilege to use drugs extralabel, which essentially allows one to use non-registered drugs for animal use in South Africa. While in the main, this implies the use of human medication in animals, this also encompasses the process of drug compounding. In addition to non-availability mentioned above, other factors that favour compounding usually include an inability to obtain correct dosage forms e.g. only tablets available when oral solutions may be required, or when current dosage concentrations are too high to safely allow for use in small animals.

## What is Drug Compounding?

Compounding is a veterinary privilege afforded by the Medicines and Related Substances Control Act (Act 101 of 1965). Whilst the Act does not strictly define compounding, this process may be defined as the manipulation of an available medicines or pure chemical substances to obtain a new dosage form. In the case of registered medicines this would also include any product manipulation that results in alternate instructions other than that already provided on the approved drug packaging. As such veterinary compounding may be simply defined as the self preparation of a medicine for animal use such as the formulation of a new veterinary medicine from self-sourced raw material and/or the reformulation of an available remedy viz. drug dilution, crushing of tablets into food, mixing of drugs for wildlife capture, etc. In addition, as vets we not only have the privilege of being able to compound drugs in house, we may also instruct a pharmacist to compound on prescription.

## The legalities of registered medicines

As in almost every country in the world, drug availability is highly regulated. This is important as the registration process ensures that commercial products are of adequate quality, safety and efficacy:

- Quality: Most drugs are mixture of chemicals with the exception of the newer high molecular weight protein drugs like erythropoietin. None the less, despite the source of the product, medicines are produced by manufacturing companies under laboratory or factory conditions. As a result of the production process, it is possible that foreign contaminants

such as endotoxins or other foreign chemicals could inadvertently enter into the final raw or finished product thereby resulting in an inferior and possibly hazardous medicine e.g. the recent contamination of pet food with cyanuric acid/melamine highlighted the dangers of this process. Therefore to ensure the quality of manufactured product, every aspect of drug production is strictly controlled by the quality process known as Good Manufacturing Practice (GMP).

- **Efficacy:** Drug formulations are complex mixtures of active and inactive ingredients. As a result of these differences, formulations with the same active ingredient may not necessarily produce the same effect as their inactive ingredients may well differ e.g. medical oral clavulanic formulations are not considered equivalent to the veterinary formulations. As a result of this well understood pharmaceutical factor, every formulation has to be extensively tested prior to registration. While for new chemical entities (NCE) this would entail exhaustive studies in a few hundred animals, the pharmaceutical alternative/similar products (generic products) may be registered based on strict bioequivalence guidelines. As a result registered products are usually effective in 80% of the recommended target population (Natural population variation), at the recommended dose barring external factors such as microbial resistance.
- **Safety:** Since different formulations are manufactured by different companies, they will always to some extent differ. With these differences lying mainly in the specific combination of active and inactive ingredients, every formulation has to be initially tested for its potential to be toxic, irritant or harmful in the target population (Target animal tolerance studies). These tests are in addition to full preclinical safety testing of the active ingredient as pure chemicals in laboratory animals, as well as meeting manufacturing criteria controlled by GMP. For these studies, the target species is exposed to the product at various doses above that recommended to elucidate all known side effects, which may then be recorded on the package insert. At present this is the only means of evaluating the side effects that a drug formulation could potentially have. In addition the pharmaceutical industry and veterinarians are legally obliged to report any adverse reaction that results from the use of a veterinary medicine or stock remedy in the aim of improving product safety.

While the necessity of drug regulatory control has often been questioned, incidents in other countries where no control exists have highlighted the dangers of open markets, such as the unscrupulous marketing of fake products to the veterinary communities. In other instances, random sampling has shown deficiencies in not only the quantity but the quality of the active ingredients. More importantly since these fake/counterfeit products are freely marketed at lower prices, they essentially kill the market for ethical good quality products as well as the commercial veterinary industry. Therefore drug regulatory control is essential to protect the availability of drugs to the veterinary market as well as the veterinary market itself.

Why should we compound?

- As mentioned above the privilege of compounding allows veterinarians the ability to treat animals with available human medical drugs.
- In addition the process makes it possible to manage wildlife as dart cocktails need to be made up specifically for the species being managed.
- In small animal practice it can allow for the easier dosing of tiny animals with diluted concentrated solutions that would otherwise not be possible.
- Most importantly it allows for the use of certain medication in animals that are not currently available for use in South Africa.

## What Should I be wary of Compounding?

- Formulation Differences: As mentioned above drugs are formulated in very specific manner by the drug companies. While in many cases these formulations are designed to control the release of the active ingredient, they are also important in protecting the active ingredient. Therefore if the compounded product lacks a specific inactive ingredient, the clinical effect of the active ingredient is automatically reduced e.g. erythromycin is sold commercially as an enteric coated tablet to protect the molecule from the low gastric pH. By crushing these tablets, the outer coating is damaged, which subsequently leads to a high presystemic elimination.

Another important concept in pharmacology is the bioavailability of the active ingredient i.e. failure in absorption will automatically result in the failure of the product. In pharmaceuticals and pharmacokinetics (study of biopharmaceutics) the interrelation of the formulation and absorption is widely accepted. As such any modification to the formulation could therefore result in decrease bioavailability and inefficacy e.g. the use of fentanyl patches in dogs are not always effective as its release characteristics is specific for human skin.

- The pH of the formulation. In pharmaceutical manufacture the specific salt of the active ingredient is selected for its stability in formulation. By using a different salt during compounding, one can alter factors such as formulation pH, ionization, stability and absorption. Even preservatives added to a formulation need to be tested for their influence on the pH e.g. the preservative may chemically neutralize the active ingredient. Another important consideration is the use of product for intramuscular administration. Any changes in the pH can cause severe pain, irritation and or muscle damage on administration.
- Chemical Contamination: Since the source of the active ingredient in the formulation is not under strict GMP control, the potential for contaminants to enter into the formulation is always present (It has been speculated that some foreign chemical manufacturing companies intentionally profiteer through the sale of poor quality chemical products). While some of these contaminants can be minor toxins, others are very potent and result in mortality. Unfortunately the degree of contamination of the product cannot be tested, as the current tests can only look for certain chemical i.e. you can't test for everything.
- Microbial contamination. A major concern with any formulation is their potential contaminations with a micro-organism e.g. fungal organism grow remarkably well in drug vials. In addition to the microbial contamination directly, metabolic products like endotoxins are also a major concern. The production standard for the preparation of sterile parenteral drug products which pharmaceutical companies follow is clearly stated in the pharmacopoeias. Therefore if parenteral formulations are to be compounded, veterinary dispensaries or pharmacies must meet these strict requirements. This is important to prevent septic or endotoxic complications in treated patients.

## The Vet's legal responsibilities with regards to compounding

Since compounded products usually do not comply with the strict testing requirements, enforced for registration by South African law, the use of compounded products is controlled in the following manner:

- The Medicines and Related Substances Control Act (Act 101/1965): A veterinarian may compound or request a pharmacist to compound (via a valid prescription) any product contained within its schedule, on condition that this is per patient (Patient as defined in the Veterinary Act). More importantly compounded products must have a specified shelf-life of

only 30 days i.e. these products expire within 30 days of compounding irrespective of the batch size produced. The Act does not allow or make provisions for veterinarians to stock compounded product on shelf per chance it be required i.e. compounding may only be undertaken after consultation. The stocking of compounded product is the responsibility of only the pharmacist. Most important, all compounded medicines are subject to the rules and regulations that govern the schedule (or highest schedule) in which the chosen active ingredient(s) belongs e.g. compounded butorphenol automatically falls under the control of Schedule 6.

- The Veterinary and Paraveterinary Professions Act (Act 19 of 1982): According to this Act, veterinarians may not run an open pharmacy. As such the selling or stocking of these compounded remedy in bulk is illegal. The Act also indicates that scripting is a component of the consultation process, and therefore the owner may not be charged additionally for this service if a consult fee has already been levied. In addition the Act also regulates the extralabel use of medicines. From a recent ruling of the Council, veterinarians may only use an animal product extralabel if the informed owner consent is received and at that on condition that an alternate veterinary product is not already registered for use in the country. Lastly the Act states that the vet must protect public health. Therefore the use of compounded products in animals may not be undertaken without taking cognisance of the consumer safety and food drug residues.
- The Foodstuffs, Cosmetics and Disinfectants Act. (Act 54 of 1972): This act protects the consumer from potential residues of veterinary remedies in the human food chain. This act states that no person may use any remedy in a food producing animal if an adequate withdrawal period has not been set. This therefore implies that the veterinarian must set a new withdrawal period whenever a product is used extra-label or being compounded.

Practical tips when compounding.

#### Companion Animals

With the current constraints in companion animal practice, compounding will always be a part of the veterinary profession. Therefore when using drugs in this group of animals, ensure that the owner is informed on the extralabel nature of the product, preferably in writing (notes must always be kept in the patient record). Be aware that you are legally responsibility for any negative outcome from the use of the said remedy, even if the remedy is prepared by a pharmacist. Avoid using compounded parenteral formulations as they have a greater chance of causing harm.

#### Production Animals

The use of compounded remedies in production animals is not supported due to food safety issues. Therefore whenever any compounded product is used, an adequately scientifically determined withdrawal must be set by a person experienced in pharmacokinetic extrapolations and interspecies scaling. Alternatively, the veterinarian should enforce a withdrawal period of at least three to six months depending on the nature of the compound in use. This applies equally to the wildlife industry, where the potential exists for trophy kills to end up in the food chain, soon after immobilisation.

#### Suggestions for the use of compounded medicines

- Compounding should not be used as a cheap alternate source of medication.



- Compounding should be used when no alternate/suitable remedy is available.
- Ensure that owners are fully informed when compounded products are being used.
- Compounding should preferably be avoided in production animals. When used, it should be reserved as a last resort and on condition that public safety is ensured i.e. set an adequate withdrawal period.
- Compounded drugs have a legal shelf life of only 30 days.
- Compounding is patient specific and therefore compounding product should not be kept of shelf for routine dispensing.

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# Review of the rules

Explanation of colour coding:

1. Red=Obsolete
2. Blue=To be inserted
3. Green=To be moved to another rule
4. Black=No amendments required.

## Amendment to the rules relating to the practising of veterinary professions

Why do we have to change the rules? Change is as inevitable as life itself! I want to use two illustrations:

The first one was brought to my attention by Dr Anne de Vos.

At Cambridge University during an examination one day a bright young student popped up and asked the proctor to bring him Cakes and Ale. The following dialog ensued:

Proctor: I beg your pardon?

Student: Sir, I request that you bring me Cakes and Ale!

Proctor: Sorry, no!

Student: Sir, I really must insist. I request and require that you bring me Cakes and Ale!

At this point, the student produced a copy of the four hundred year old Laws of Cambridge, written in Latin and still nominally in effect, and pointed to the section which read (roughly translated): "Gentlemen sitting examinations may request and require Cakes and Ale." Pepsi and hamburgers were judged the modern equivalent, and the student sat there, writing his examination and happily slurping away.

Three weeks later, the student was fined five pounds for not wearing a sword to the examination!

The second a colleague of mine "discovered"!

"Then", going back in time! Though not as far back as speaking Latin! As you can see from the slide, "back then" times were slow, simple and enjoyable. But times are changing! Fast! Council decided, as far back as 2008, that the rules relating to veterinary practice had to be reviewed and modernised to keep abreast with new technological advances and life in the fast lane." Now", As you can see, these days the poor bull loses out on simple pleasures and the cow? Not even a glimmer of pleasure in human kind's race to produce more so much quicker!

So, here we are at a time when all of you will have the opportunity to give input and to influence the way veterinary medicine will be practiced for the next 10 to 20 years. What a tremendous opportunity! Please use it.

Council embarked on the amendments to the Act [Act No 16 of 2012] in January 2005. It was also resolved that the review of regulations and rules will follow the amendments to the Act. The process to amend the Act was a protracted process having to solicit input from the professions first,

submit to the Department of Agriculture, Forestry and Fisheries and then to follow the Parliamentary legislative programme.

The best opportunity to review the regulations and the rules presented only after the amendment Act was assented to (though not enacted yet) and the new Council was appointed on 31 July 2013. Events may have overtaken us in the form of the Competition Commission. However the intention as per the strategic planning over the past seven years [transition of three Councils] was to revise all legislation. Council created a standing Review Committee during its July 2013 meeting for this exact purpose and its first meeting took place during September 2013. The legislation governing the veterinary professions will in future be reviewed by a standing Review Committee on an ongoing basis. Obviously no changes can be made without the input of the professions and other stakeholders.

The veterinary professions have, as many of you may already know from the SAVC Newsletters and material placed on its website, been placed in the invidious position of being forced to amend some of its rules and code of conduct and practice for veterinarians (COCP) relating to the veterinary professions. The affected rules are those relating to advertising, touting and undercharging.

In terms of section 3 of the Veterinary and Para-Veterinary Professions Act, 1982, Act 19 of 1982, (the "Act"), the objects of the Council are as follows:

- 1) To regulate the practising of the veterinary professions and para-veterinary professions and the registration of persons practising such professions.
- 2) To determine the standards of professional conduct of persons practising the veterinary and para-veterinary professions.
- 3) To maintain and enhance the prestige, status and dignity of the veterinary and para-veterinary professions and the integrity of the persons practising such professions.

In order to achieve its objects, the Council is empowered to, in conjunction with the Minister of Agriculture, Forestry & Fisheries, to promulgate regulations and rules in terms of sections 43 and 30 of the Act. These regulations and rules are referred to as subordinate legislation. The rules are the lowest level or tier of subordinate legislation. To explain, you get an Act (in our case a national Act, which is the governing legislation. These acts are all subject to the Constitution. A law allows for regulations and/or rules to be promulgated in terms of such Act, only to the extent allowed by such Act. You may have heard the term that a regulation is "ultra vires". It simply means that the regulation was not compliant with the enabling act. The Competition Act has concurrent (parallel) jurisdiction with the Veterinary and Para-Veterinary Professions Act. It simply means that both Acts apply to the profession.

Whilst all persons practising the veterinary or para-veterinary professions are subject to the provisions of the legislation and subordinate legislation mentioned above, they are also subject to other national legislation as well. For instance, when driving to perform your duties as a veterinarian, you still have to keep within the speed limit! If you have your own practice, you have to comply with zoning requirements, health and safety laws, labour laws, etc.

In 1998 a piece of legislation was passed in Parliament and signed into law which would have a huge effect on the veterinary profession in 2014. That piece of legislation was the Competition Act, 1998,

Act no 89 of 1998. Its main aim is to enhance competition in South Africa and to ensure a level playing field for everybody in the same business. An amendment to the Competition Act in 2002 made it very clear that the Competition Act has concurrent (parallel) jurisdiction in respect of regulatory bodies, such as the SAVC, by name.

Several countries have similar laws, such as the United Kingdom, Ireland, the Netherlands, Australia, America and New Zealand for instance.

Now, after that little bit of background, we return to the topic at hand. The Council duly promulgated the rules relating to the practising of the veterinary professions. These rules included amongst others, rules relating to canvassing and touting, covering, supersession, advertising, promotion of products and services and articles and editorials. The Council also, at the request of the profession via SAVA and in order to fulfil its obligations in terms of rules 14(3), 14(4) and 14(5) annually published a guideline of tariffs, after obtaining the blessing of the Competition Commission. The guideline of tariffs contained a minimum and maximum range of prices. The minimum tariff was calculated to ensure that a veterinary professional can render a profession service at the standard required by the SAVC, the profession itself, the public and the animals. The maximum tariffs were utilised to adjudicate complaints of overcharging from the public. Provision was made for veterinary professionals to charge less than the recommended minimum under certain circumstances, as charging less than the minimum recommended fee may amount to touting, which is regarded as unprofessional conduct.

To complicate the already complex situation of modernising our rules, an aggrieved young professional during 2012, accused of touting by his colleagues, referred a complaint to the Competition Commission. The complaint was that the Council engaged in price fixing, which is a contravention of the Competition Act, by publishing the guideline of tariffs and by enforcing the minimum tariffs by entertaining complaints of touting against a veterinary professional if he/she charges less than the minimum recommended tariff, unless he/she could justify it. Instead of justifying his actions, the vet referred a complaint to the Competition Commission. The matter was duly defended by the Council at a huge cost, as competition lawyers are few and far between and therefore commanding specialist fees. Council resolved to defend itself against the complaint based on legal advice obtained from a very well known legal firm, as Council was extremely concerned about the impact an adverse finding would have on the profession, particularly on rural veterinarians who are by and large responsible for the safety of the food that we eat.

What Council feared, came to pass during November 2013. The Competition Commission disregarded its previous advices and decided to refer the dispute to the Competition Tribunal for adjudication as it considered the Council to be a cartel engaged in price fixing. It simultaneously extended an offer to Council to enter into a settlement agreement. Such an agreement entails that the Council and the profession must immediately mend their erroneous ways. The penalty for price fixing and/or collusion is quite steep. An administrative fine of up to 10% of the gross annual income of each person/entity engaged in price fixing or collusion can be levied by the Competition Tribunal. You may remember the spectacular fines levied on the bread and construction industries!

Council, taking into consideration the recent judgments by the Competition Tribunal, decided to accept the offer to settle, as adverse as the impact on the profession may be. The Competition

Commission firmly believes that measures other than price can be introduced to ensure compliance with minimum standards of service.

That brings us to the reasons for today's gathering. In order to modernise (keeping up with the times, so to speak) fulfilling Council's strategic plan and to simultaneously comply with the Competition Act, several of our rules will have to be amended or withdrawn. The medical and legal professions, which had rules very similar to ours, already went through this long and difficult procedure with the concomitant commotion and upheaval in the professions.

We can assume that the upcoming amendments will be earth moving and very difficult to stomach, as they will usher in a way of doing things that will be very new and very scary and strange to people used to doing certain things in a certain way. For example, sometime during last year, whilst I was still a practising attorney, a much, much younger colleague told me on occasion: "What didn't you understand when I said I would call you? I do not want to speak to you!" That was after I telephonically requested feedback in a matter and did not hear from the young man for a period of 3 days. It was quite a shock to my system. At the time when I qualified, we were inculcated with the ethical value that you will (no excuses) respect more senior practitioners. How times changed! The point I am making is that we are living in a different world that we grew accustomed to and comfortable in and that the veterinary profession is not the only profession which has to adapt or die, so to speak. We will have to think innovatively and pro-actively to overcome this very real challenge to the veterinary profession. For that very reason, the constructive input of each and every veterinary professional is required. The Council made each and every conceivable argument over a period of approximately two years to sway the Competition Commission, to no avail. We are not here today to regurgitate all the arguments against the impending changes, those are water beneath the bridge and we cannot change the situation. We are here to address the changes in an innovative and responsible manner in order to best preserve the exemplary image of the profession and the interest of the animals concerned, who cannot speak for themselves.

The rules most obviously in contravention of the Competition Act are the rules relating to canvassing and touting, covering, supersession, advertising, promotion of products and services and articles and editorials. I will point out which rules pertain to modernisation or to the Competition Commission as we go along!

Let us deal with each rule on its own! The amendments to the rules will obviously be followed with relevant amendments to the concomitant clauses of the CoCP. Please bear in mind that this discussion is by no means an answer to all the questions posed! It is intended to alert the profession of impending changes and to get crucial input from the profession.

At the outset, you must bear in mind that a great number of the profession, as well as the Competition Commission believe that;

1. competition is good and should not be stifled, particularly competition in regards to prices, as it will benefit the consumer;
2. advertisements positively contribute to competition and allows the public to make informed choices about the where, when and how they wish to utilise a service, and importantly, at which rate; and

3. the offering of discounts per se does not mean that the standard of service will necessarily be compromised, the argument being that a professional will know that he/ she still has to render a professional service, notwithstanding the price or discount offered.

We have also, through queries raised by members of the profession, been alerted to the fact that some practises and rules may be outdated. It is a commonly known fact that the law lags behind and cannot keep up with modernisation. It is particularly true in the fast changing and developing world in which we live.

#### Rule 2: Services pertaining specially to veterinary professions. (Modernisation)

2.” For the purposes of the Act -

- (a) the diagnosis, treatment, prevention of, or advice on a disease, physiological or pathological condition in an animal;
- (b) chemical restraint of an animal, which includes general, standing, and/or regional anaesthesia, as well as chemical immobilisation of an animal;
- (c) a surgical or dental operation or procedure on an animal; and
- (d) the prescribing or administration of medicine to an animal;

shall be deemed to be services which pertain specially to a veterinary profession”

With the advent of new technology, medical and/or veterinary devices and lay people having access to these without any legal implications for them whilst intruding on services that should pertain to veterinarians only, it may be time to broaden the scope of the services pertaining to the veterinary professions. Your inputs would be welcomed!

#### Rule 4: General principles

4.(1) “ A veterinary professional shall base his/her personal and professional conduct thereon that -

- (a) he/she is a member of a learned and honourable profession and is required to act at all times in such a manner as will maintain and promote the prestige, honour, dignity and interests of the profession and of the persons by whom it is practised;
- (b) he/she is morally obliged to serve the public to the best of his/her ability and in the light of the latest scientific knowledge;
- (c) he/she will not seek any personal advantage at the expense of any colleague in the profession;
- (d) he/she will not permit himself/herself to be exploited in a manner which may be detrimental to an animal, his/her client, the public or the profession; and
- (e) he/she shall, as far as it is within his/her professional ability -
  - (i) not refuse treatment to an animal; and
  - (ii) not abandon the treatment of an animal under his/her professional care unless he/she is satisfied that he/she has done his/her utmost to safeguard the welfare of the animal concerned.

(2) A veterinary professional shall keep himself/herself informed of the laws which affect him/her in the practising of his/her profession and shall, as far as it lies in his/her power, assist in the application of those laws.

(3) All persons practising veterinary professions are working for the same good cause, irrespective whether they are in private practice or in the service of an employer, and they shall therefore co-operate with each other and the authorities concerned to promote that cause.

(4) A person who practises a veterinary profession shall refrain from expressing any criticism in public through which the reputation, status or practise of a colleague in the profession is or could be undermined or injured, or through which a reflection is or could be cast on the probity, skill, methods or conduct of such colleague.

(5) The place at or from which a person practises a veterinary profession shall comply with the applicable minimum standards for a consulting room, or an animal hospital, as the case may be, which are specified in these Rules, and be registered with Council”.

In order to get the ball rolling, the Review Committee decided to define the concept of professional and unprofessional conduct in order to move away from price in order to maintain certain expected standards of service and to shift the emphasis towards professionalism. These are still in draft format, pending input from the profession. Here they are, warts and all!

#### Professional conduct

A veterinary professional shall comply with the following fundamental principles:

- (a) Integrity – to be straightforward and honest in all professional relationships. The principle of integrity imposes an obligation on all veterinary professionals to be straight forward and honest in all professional relationships. Integrity implies fair dealing and truthfulness.
- (b) Objectivity – to not allow bias, conflict of interest or undue influence of others to override professional judgments.
- (c) Professional Competence and Due Care – to maintain professional knowledge and skill at the level required to ensure that a client receives competent professional services based on current developments in practice, legislation and techniques and act diligently and in accordance with applicable technical and professional standards.

The principle of professional competence and care imposes the following obligations on veterinary professionals:

- To maintain professional knowledge and skill at the level required to ensure that clients receive competent professional service.
- To act diligently in accordance with applicable technical and professional standards when providing professional services. Competent professional service requires the exercise of sound judgment in applying professional knowledge and skill in the performance of such service.
- The maintenance of professional competence requires a continuing awareness and an understanding of relevant technical, professional and business developments.
- Continuing professional development enables a veterinary professional to develop and maintain the capabilities to perform competently within the professional environment.

- (d) Confidentiality – to respect the confidentiality of information acquired as a result of professional and relationships and, therefore, not disclose any such information to third parties without proper and specific authority, unless there is a legal or professional right or duty to disclose, nor use the information for the personal advantage of the veterinary professional or third parties.
- e) Professional Behaviour – to comply with relevant laws, regulations, rules and Code of Conduct and Practise and to avoid any action that discredits the veterinary profession.

The principle of professional behaviour imposes an obligation on all veterinary professionals to comply with relevant laws and regulations and avoid any action that the veterinary professional knows or should know may discredit the profession. This includes actions that a reasonable and informed third party, weighing all the specific facts and circumstances available to the veterinary professional at that time, would be likely to conclude adversely affects the good reputation of the profession.

#### Unprofessional conduct

Unprofessional conduct on the part of a veterinary professional shall include, inter alia, the following acts and omissions:

- a. without reasonable cause or excuse, failing to perform professional work, or work of a kind commonly performed by a registered veterinary professional, with such a degree of skill, competence, care or attention, or of such a quality or standard, as in the opinion of the Council may reasonable be expected;
- b. in any way directly or indirectly assisting, allowing or enabling an unqualified person to charge, recover or receive any fee or derive any remuneration for or in respect of or in connection the performance of any professional work which only a veterinary professional is qualified by law to perform, or in any way conniving at any arrangement, agreement or understanding whatsoever whereby any such fee or remuneration is or shall be charged, recovered or received by any such unqualified person, with the intention to derive financial benefit from any such conduct;
- c. non-payment after demand of any subscription or any fee, levy or other charge payable to the Council and non-submission of any relevant records requested by Council;
- d. any contravention of the provisions of the Act or of these rules or of the then current Code of Conduct and Practise;
- e. neglecting to give proper and reasonable attention to his/her clients and/or patients;
- f. failing adequately to supervise his/her staff,
- g. overreaching or over servicing a client or providing services/treatment which are not strictly required to treat the condition of the patient or charging of a fee which in the view of the Council is unreasonably high, having regard to the circumstances of the matter,
- h. failure to comply with an order, requirement or request of the Council and/ or the Registrar;



- i. referring work, the performance of which is reserved by law to a veterinarian, specialist veterinarian or para-veterinary professional to a non-registered person and/or authorised person.

You will notice that the current rule 4 overlaps to a certain extent with the draft definition of professional conduct.

With the exception of subrule 4(5), which provides that the place at or from which a person practises a veterinary profession shall comply with the applicable minimum standards for a consulting room, or an animal hospital, as the case may be, which are specified in these rules, the current rule 4 could be replaced by a definition in similar vein to the draft definitions. In view of the fact that limited service practises may very well be allowed in terms of the requirements of the Competition Act, as opposed to the current comprehensive services, with its concomitant costs, that each registered veterinarian must be able to provide, it is probably necessary to rethink the issue of minimum standards for each kind of conceivable practise. From this perspective the active input from each practising veterinarian is a necessity.

Subrule 4(d) will be dealt with under Rule 6, as they overlap to a certain extent.

The Competition Commission confirmed that the Council may set the minimum standards for the profession. We have been warned not to conflate price with quality or a particular standard of practise. That said, we can raise the minimum standards if need be, but great care has to be taken not to set the minimum standards so high that it will preclude new entrants from entering the market. The most important fact is that all veterinarians are members of a profession.

In Medieval times only three professions were recognized: theology, medicine, and law. But when formal veterinary education was introduced in 1761 in Lyon, France, a veterinary profession was founded, and it was made clear it was not to be a trade nor an occupation.

An internationally accepted definition of a profession reads as follows (Gruess, 2003 - abbreviated):

“An occupation whose core element is work based upon the mastery of a complex body of knowledge and skills - which is used in the service of others.

Its members are governed by codes of ethics and profess a commitment to competence, integrity and morality, altruism, and the promotion of the public good within their domain.

These commitments form the basis of a social contract between a profession and society, which in return grants the profession a monopoly over the use of its knowledge base, the right to considerable autonomy in practice and the privilege of self-regulation.

Professions and their members are accountable to those served and to society”.

Rights and privileges are therefore not inherent, but are granted by society in return for certain behaviours and skills, and the social contract implies that we are accountable to both our patients and to society for our actions and our services. Also for what happens later – to animals, man, products and economy.

Professionalism is described as being the skill, good judgment, and polite behaviour that is expected from a person who is trained to do a job well, with the opposite being “unprofessional behaviour”.

Thus “Professionalism is more than just doing your job”.

As custodians of animal welfare, veterinary professionalism is defined as being able to balance the requirements and expectations of their clients, the animals under their care, society and the veterinary practice that provides their employment.

They must beware these two of the “Seven Deadly Social Sins” formulated by Mahatma Gandhi in 1925, being, Business without morality (ethics), and Science without compassion.

The Veterinary Profession as a whole must take “ownership” and be a dedicated and committed partner of the SAVC in order to protect and guard the right of self-regulation of the profession and to be at all times part of the “solution” in achieving excellence in and quality of veterinary services now and in the future

#### Rule 6: Acceptance and payment of commission (Modernisation)

- 6.(1) Subject to rule 6 (2) a veterinary professional shall not -
- (a) pay or offer any commission to any person as a consideration for clients that are referred to the veterinary professional, by such person;
  - (b) accept any commission from any person as a consideration for referrals of any clients by such veterinary professional to such person;
  - (c) share with any person, fees charged for a service unless -
    - (i) such sharing is commensurate with the extent of such other person's participation in the rendering of the service concerned; or
    - (ii) he/she is a veterinary professional associated with the veterinary professional as a partner, shareholder, employee or locum tenens; and
  - (d) charge or accept any fee for the examination of an animal from both the buyer and the seller of that animal or both the insurer and the owner of that animal.
- (2) The provisions of rule 6 (1) shall not be so construed as to prohibit a veterinary professional
- (a) from paying to a debt collection agency any commission in respect of debts which are collected by such agency on his/her behalf; or
  - (b) from accepting any royalty or similar compensation in respect of an article or product to which he/she holds the patent rights.”

Subrule 4(1)(d) provides that a veterinarian shall not permit/ him/herself to be exploited in a manner which may be detrimental to an animal, his/her client, the public or the profession. Rule 6 deals with the prohibition of payment of commission to veterinary professionals under certain prescribed situations. These rules may need to be broadened to deal with the situation down on the ground, in that veterinary professionals are increasingly being employed by co-operatives, manufacturers of veterinary medicines and foodstuffs. From the complaints that we receive, I can only surmise that some of these veterinarians find themselves in a quagmire of ethical dilemmas.

#### Rule 7: Canvassing and touting (Competition Commission)

c) Rule 7: Canvassing and touting

- 7.(1) Nothing in these rules shall be construed as authorising a veterinary professional to canvass or tout, directly or indirectly, for work commonly performed by a veterinary professional.
- (2) For purposes of rule 7(1) a veterinary professional will be deemed to be canvassing or touting for work, but not limited thereto, if he/she -
- (a) approaches a person who is not a client with a view to persuade such a person to make use of his/her professional services;
  - (b) solicits custom or work directly from any person;
  - (c) with a view to attract clients, grants or undertakes to grant any person, firm, association or other body, a discount on the fee usually charged for a service;
  - (d) makes unsolicited visits or telephone calls or sends unsolicited letters or printed material to any person, with a view to establishing a professional relationship with such a person; or
  - (e) enters into an arrangement with any person, whether employee or not, for the introduction of a client to his/her practice; but this will not apply to any arrangement between a veterinary professional and another veterinary professional for the referral of work in the normal course of either's practice.
- (3) the provisions of rule 7(1) and 7(2) shall however not be construed so as to prohibit a veterinary professional -
- (a) from directing letters or printed material to a person to whom he/she has rendered professional services during the preceding three years, or to colleagues in the profession; Provided that such letters or printed material shall be contained in an envelope on which the names and addresses of persons to whom it is directed appears; and
  - (b) from delivering a lecture or speech or publishing any report, interview or article or permitting the publication thereof in a bona fide attempt to save animals in a specific area during an emergency situation."

The entire rule, with the exception of subrule 7(2)(e) (indicated in green), is obsolete, unless a definition of "touting" can be given which will be acceptable to the Competition Commission. Subrule 7(2)(e) (indicated in green) can be moved to Rule 6.

Veterinary professionals are not allowed to tout or canvass, directly or indirectly, for work commonly performed by veterinary professionals. This rule will change significantly, as would rules 15, 16 and 17, which relate to advertising. We will have to look very carefully at the definition of the words "touting" and "canvassing" in conjunction with the Competition Commission. In principle we should accept that henceforth veterinarians will be able to advertise their services and perhaps even their prices, which in turn will allow the public the freedom to make an informed choice about which veterinarian he/she wants to treat their animals. We will have to take great care to ensure that minimum standards of service are not being compromised, as it is very clear from the complaints received by us, that the public wishes to receive sterling service, irrespective of the price charged.

Clients will have difficulty in understanding that a spay from a bakkie which costs R 50-00, will of necessity entail much graver and more side effects than a spay conducted from an adequately stocked and equipped theatre, with resuscitation equipment at hand. The Competition Commission is surely of the opinion that the same standard of care can be given in such an example.

You will have to bear in mind that though a client may pay for a Golf, he/she will still require services equal to that of a Rolls Royce, which is where the Council come in!

Rule 8: Covering (Modernisation/Competition Commission)

- 8.(1)" A veterinary professional shall not -
- (a) enter into a partnership in his/her practice with another person;
  - (b) offer a professional appointment in his/her practice to another person;
  - (c) employ another person in a professional capacity at his/her practice; or
  - (d) share his/her waiting and consulting rooms with another person;
- unless such other person is also registered or deemed to be registered in terms of the Act to practise a veterinary or a para-veterinary profession, as the case may be.
- (2) Subject to rule 8 (3) a veterinary professional shall not
- (a) place his/her professional knowledge at the disposal of a member of the public or a lay organisation; or
  - (b) be involved in co-operation or collaboration with a member of the public or a lay organisation;
- if unlawful or irregular practices are or may be encouraged thereby or it may adversely affect a veterinary professional.
- (3) The provisions of rule 8 (2) shall not be so construed as to prohibit a veterinary professional from rendering assistance under the circumstances concerned to a member of the public or a lay organisation in an emergency in order to save a life or to prevent suffering: Provided that the person concerned shall as soon as possible thereafter notify the Council in writing of the relevant circumstances."

This rule may come under the scrutiny of the Competition Commission, as it may be viewed as anti-competitive, as the Competition Commission's mandate is to open up markets. That said, however, the legal and medical fraternity thus far have the same rule and it seems to have survived up to now.

Rule 10: Use of veterinary medicine (Competition Commission)

- 10(1) "Whenever a veterinary professional, administers medicine to an animal or prescribes the administering thereof, he/she shall satisfy himself that the administering thereof is justified with due allowance for the benefits and risks which that medicine may hold for -
- (a) the animal to which it is administered;
  - (b) the person by whom it is administered; and
  - (c) the consumer of the products of that animal if residues of the medicine concerned should be present in those products.
- (1A) To tranquillise, sedate, chemically immobilize or anaesthetize wildlife, any schedule 5 or 6 substance must be administered by a veterinary

professional personally.

(1 B) Notwithstanding the provisions of sub rule (1 A) a veterinary professional may prescribe, sell, donate or make available the following substances or medicines for a single purchase:

- (i) perphenazine enanthate,
- (ii) haloperidol,
- (iii) zuclopenthixol acetate,
- (iv) diazepam; and
- (v) azaperone

(2) A veterinary professional shall inform the owner of an animal to which medicine is administered, fully with regard to -

- (a) the application and effect of and precautionary measures in connection with that medicine; and
- (b) the period, if any, during which the products of that animal are to be withheld from human consumption.”

The amendment of rule 10 on 8 June 2012 in Government Gazette number 35414 which added a requirement that a veterinary professional must personally administer any schedule 5 or 6 substance to tranquilise, sedate, chemically immobilise or anaesthetise wildlife attracted a lot of controversy, mainly from the game owners, as they wish to dart their animals themselves. This is currently the substance of High Court Action brought against the Council. I may perhaps just mention that this issue was referred to the Competition Commission in 2010 as being anti-competitive and restrictive, but the complaint was dismissed.

#### Rule 11: Supersession (Modernisation)

11. “A veterinary professional shall not examine or treat any animal currently being treated by a colleague in the profession, or advise the owner of such animal on the diagnosis or treatment of that animal unless -

- (a) he/she is in terms of rule 9 requested to furnish a second opinion on the condition of the animal concerned;
- (b) he/she is unaware of the fact that a colleague is treating the animal concerned;
- (c) the colleague concerned agrees that the veterinary professional may take over the treatment of the animal concerned; or
- (d) the client/owner of the animal concerned has requested the veterinary professional to take over the treatment of the animal concerned, in which case, such veterinary professional shall notify the colleague concerned thereof as soon as possible; or
- (e) he/she applies emergency treatment on the animal concerned, in which case -
  - (i) the veterinary professional shall ascertain beforehand that the colleague concerned is not available to apply such emergency treatment; and
  - (ii) the veterinary professional shall notify the colleague concerned of the nature and extent of the emergency treatment applied.”

We need to ascertain whether this rule in its current format is still relevant. Your input would be valued!

Rule 14: Approximate fees (Modernisation in view of the fact that the Guideline of Fees will not be published in future.

- 14.(1) "A veterinary professional shall inform the person in charge of an animal in respect of which a service is to be rendered beforehand of the approximate fee which he/she intends to charge for such service -
  - (a) when so requested by the person in charge of the animal;
  - (b) when such fee exceeds the fee usually charged for such service; and
  - (c) when a service is required in addition to the original service anticipated.
- (2) Any veterinary professional claiming payment from a person in respect of any service rendered by him/her shall furnish such person with a detailed account within 30 days after being so requested by such person.
- (3) A person who has been so furnished with such detailed account may, in writing, apply to the Council to determine the amount which, in the opinion of the Council, should have been charged in respect of the service to which the account relates.
- (4) The Council shall, as soon as possible after receipt of such application, afford the person who furnished the account concerned the opportunity to submit to the Council in writing his/her case in support of the amount charged.
- (5) The Council shall, after consideration of the case, determine the amount that in its opinion should have been charged for the service to which the account related and notify the applicant and the person who furnished the account thereof in writing.
- (6) The Council's decision is final."

As you all know by this time, the Guideline of Fees will not be published again. This leaves the profession with a void, not necessarily at the lower end of the scale, where market forces will probably force out those who deliver substandard services at a lower fee in order to attract, but at the higher end and where we receive complaints of overcharging. We need to come up with an innovative mechanism to adjudicate complaints of overcharging. We can possibly look into a question of over servicing than overcharging.

I want to add a very stern word of warning to the profession as a precautionary measure and in your own interest. Please do not get together and decide in groups what fees to charge for a number of practices or within a particular geographical area. This conduct will constitute collusion and direct price fixing. Each and every practice engaged in such an arrangement/agreement may be fined up to 10% of its gross annual income (no deductions taken into consideration). Please refrain from doing so!

Rules 15: Advertising (Competition Commission)

- 15.(1) A veterinary professional may advertise his/her services, products and facilities or permit another person to do so without limitation on the size, format, artistic or literary style: Provided that the advertisement complies with the provisions of these rules and shall in no way compromise or impair any of the following, namely -

- (a) the client's freedom to consult a veterinary professional of his/her choice; and
  - (b) the good reputation of the veterinary profession.
- (2) All advertising by a veterinary professional shall be in good taste with regard to content, prominence and medium and may not be offensive to any cultural, religious or linguistic community or be contrary to the spirit of the code of conduct of the veterinary profession.
- (3) Subject to the provisions of rule 15(7) and 15 (8) the content of an advertisement shall not be limited to -
  - (a) a description of -
    - (i) the nature of the services rendered; and
    - (ii) the products, merchandise and foodstuffs stocked and sold;
  - (b) the address at which such services are rendered and the products, merchandise and foodstuffs sold;
  - (c) the times the services are provided;
  - (d) the name of the veterinary professional concerned; and
  - (e) a logo.
- (4) An advertisement describing a specific veterinary animal care service direct to the public shall contain the telephone number of the veterinary professional concerned as well as information regarding emergency and out-of-hours service.
- (5) A veterinary group, however, may advertise without any limitation on the content of an advertisement subject to the requirements of rule 15(7): Provided that the advertisement concerned has the approval of the majority of its members.
- (6) The responsibility for ensuring that a group advertisement complies with the standards required by these rules shall be borne by the Chairperson or President, and executive committee of the group and in all other cases by the veterinary professional submitting the advertisement.
- (7) Advertisements shall not -
  - (a) be misleading in any respect;
  - (b) compare the quality of services, products, merchandise and/or foodstuffs provided, the standards of facilities and/or the knowledge or expertise of a veterinary professional with that of another veterinary professional or the veterinary profession generally, nor may it claim to be superior in any respect;
  - (c) criticise the quality of services, products, merchandise and/or foodstuffs provided by another veterinary professional; and
  - (d) have fees and incentives that relate to any services that pertain specially to the veterinary profession as the subject of any advertisement. Prices of products, merchandise and foodstuffs sold and services that do not pertain specially to the veterinary profession rendered at the facility may, however, be advertised. Incentives including the word "discount" may be used when advertising such products, merchandise and foodstuffs and non-veterinary services provided that the advertisement clearly states that incentives and discounts do not apply to any services that pertain specially to the veterinary profession.
- (8) No veterinary professional other than a specialist registered as such with the Council may claim that he/she is a specialist or an expert in a particular field in any advertisement.

- (9) A veterinary professional may advertise that he/she has a particular interest in a certain species, organ or discipline: Provided that the advertisement indicates that the veterinary professional is a general practitioner with such a particular interest.
- (10) A veterinary professional shall not collude with any person to ensure that his/her advertisement appears adjacent to an article and/or advertorial published by such person if the said article and/or advertorial would be in contravention of these rules if published by a veterinary professional.
- (11) If a veterinary professional is identified in any way in an article, then an advertisement by such veterinary professional may not appear on the same page as the article.
- (12) A veterinary professional shall not utilise a pop-up or pop-under advertisement in connection with computer accessed communications other than on the veterinary professional's own web site or other internet presence.
- (13) A veterinary professional may refer to the Guideline of Tariffs published on the Council's website [www.savc.co.za](http://www.savc.co.za) and may create a link to the relevant webpage in computer accessed communications.

The subclauses indicated in red are obsolete. In subclause 3 the word “not” should be added (indicated in blue).

If the principle of single service practises is accepted, subrule 4 should indicate that the veterinarian must inform his/her client of the after-hours arrangements and that he/she may not be equipped to deal with emergencies as a result of post operative complications. This must be brought pertinently to the client’s attention by billboards, inclusion on all stationary, the invoice and clinical records.

A veterinarian will be able to pronounce on the standards of care he/she will provide, as well as the facilities and equipment available at his/her practice.

In principle this rule is very broad and allows veterinary professionals to advertise. The problem occurs with Rule 7(d) which provides that an advertisement may not contain any fees or incentives related to veterinarian services. This requirement is obsolete in modern times and anti-competitive. It may very well be that the publication of discounts are damaging to the image and stature of the profession. Not publishing prices do however restrict a consumer in making informed choices, which is the guiding criterium in this issue.

Rule 16: Promotion of products and services (Competition Commission)

- 16.(1) “Subject to rule 16 (2) the name of a veterinary professional shall not in any manner whatsoever, whether direct or indirect, be used –
- (a) as part of the name of any business or organisation;
  - (b) in appeals to the public for contributions in aid of animal welfare;
  - (c) in an advertisement to promote an article or a product which is or may be used in connection with the practising of a veterinary profession or a para-veterinary profession or the feeding, treatment or care of animals;
  - (d) in an advertisement in connection with any place at which animals are sold or boarded, or is owned, controlled or managed by himself or another person; or
  - (e) in an advertisement in connection with any business or trade in which he/she has an interest or is employed in a capacity other than as a veterinary professional, if it is



used thus in conjunction with his/her professional title or qualifications or his/her professional address or telephone number.

- (2) The provisions of rule 16 (1) shall not be so construed as to prohibit -
- (a) a veterinary professional from promoting a particular product or service in a bona fide attempt to save animals in a specific area during an emergency situation;
  - (b) a veterinary professional who signs a letter regarding a veterinary matter on behalf of his/her employer, from indicating his/her professional title and qualifications with his/her signature; or
  - (c) a veterinary professional from stating his/her name and professional title and qualifications in a document which is required in terms of the Companies Act (Act No.19 of 1973), in respect of a company of which he/she is a director; or
  - (d) the use of separate advertising boards that indicate products stocked or used by the veterinary professional at his/her registered veterinary facility. Provided that such boards shall not contain the name of the veterinary professional or name of the registered veterinary facility or any other words that are misleading, confusing or conveying a false perception to the public or that may be construed as endorsement of such a product."

Careful consideration should be given as to whether any part of this rule should survive, as it is mostly obsolete (by being anti-competitive at face value)

#### Rule 17: Articles and editorials (Modernisation and Competition Commission)

17. "A veterinary professional is allowed to state his/her name, qualifications and his/her capacity in articles or editorials published in the printed media. However, the address, telephone numbers and/or name of the veterinary facility from which the veterinary professional practises may not appear in such an article or editorial".

The requirement that a veterinary professional may not display or mention his/ her practise address, telephone numbers and the name of the facility from which he/she practises in an article or editorial in the printed media is truly outdated.

#### Rules 34 to 38: Discipline and inquiries

To guarantee that the ethical standards of the profession are met, the SAVC has always laid down Rules for professional conduct, and the applied disciplinary measures where needed. I am not going to bore you with all these rules. I would however like to bring a few matters to your attention.

In the past focus may have been seen to be placed on the guiding Rules - the actual advertisement or proof of touting etc.

In future SAVC will focus more on enhancing standards of professionalism: If the map is removed, that will be the compass to refer to, when SAVC has to adjudicate between colleagues

The questions to answer to will be how did the actions in question improve the profession/the availability of veterinary service/ the delivery of primary animal health care/ the vision and mission of Council/ the oath?

As well as - Was harm done to the profession / colleagues/ the public /the patient/ the economy?

If in the name of free trade and competition, the livelihood of the practitioner in the town next door is destroyed, and there is now no veterinary clinic anymore, is that ethical? This is a question that the profession has to decide for itself!

An issue which regularly crops up in the process of enquiry is the submission of records to the Council in terms Rule 26(5) when the Council requests these as a matter of course. Apart from the fact that you are obliged to keep records in terms of rule 26, these records serve to protect you from frivolous complaints by disgruntled clients. If your records are complete and submitted when requested after a complaint has been received, these will serve to exonerate you during the screening process of complaints. This happens in almost 80% of complaints. The benefit for you is obviously that you will not be subjected to a disciplinary inquiry with its concomitant stress and costs. I therefore request you to help us help you!

#### MINIMUM STANDARDS FOR VETERINARY FACILITIES.

In view of what we just discussed, minimum standards for veterinary facilities may very well be increased in order to ensure that veterinary services remain of a high standard. The Inspections Committee is currently looking into this issue.

#### REQUEST:

Please provide your input on any amendments to the rules that you think should be amended to me at [legaldirector@savc.org.za](mailto:legaldirector@savc.org.za). Unless we receive input from all of you, the attempt to modernise and revamp our rules will be an exercise in futility!

THE END!

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Prepared by Dinamarie Stoltz, acknowledging with thanks the input of Dr Anne de Vos.

20 February 2014.

# Aardvark studies: New insights on the anaesthesia and ecophysiology of Africa's enigmatic anteater

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## Introduction

Biological investigations of free living aardvark (*Orycteropus afer*) are hampered by the animal's nocturnal and elusive lifestyle. Improving methods of capture and long-duration anesthesia is a necessary step to implement management actions and to investigate the behavior, the ecology and the physiology of aardvark in their natural habitat (Van Aarde et al., 1992; Taylor & Skinner, 2004). This work is part of a study requiring the capture of aardvark and implantation of data loggers into their abdominal cavity.

Aardvark capture techniques include hand capture, setting funnel traps at burrow entrances and netting, followed by intramuscular injection of immobilizing agents (van Aarde et al., 1992; Nel et al., 2000). It is possible that these methods of capture elicit a severe stress response as mortalities have been reported for aardvark (Taylor and Skinner, 2003). Projectile darts provide a means of remotely injecting immobilizing drugs, thus reducing the stress response to capture (Boesch et al., 2011).

However, remote injection techniques have not been used in wild armadillos, despite their effective use for animals in captivity (Langan, 2008).

The drug cocktail for armadillo immobilization generally includes ketamine combined with medetomidine, dexmedetomidine, diazepam, xylazine or droperidol and fentanyl (Stetter, 2003; Langan, 2008). Ketamine has also been used with medetomidine, midazolam or xylazine in trapped and restrained wild armadillo with various levels of success (van Aarde et al., 1992; Nel et al., 2000); the combination of ketamine and medetomidine being the most effective. If long-term surgical procedures are planned, anesthesia may be prolonged with volatile anesthetic agents (Stetter, 2003; Langan, 2008). Simple clinical parameters such as heart rate and respiratory rate have been reported, however, as far as we know, no other clinical parameters have been described for immobilized armadillo. The aim of the presentation is to discuss the effectiveness of projectile darts for immobilizing free-ranging armadillo using a combination of ketamine, medetomidine and midazolam. Some of the clinical parameters that were measured following capture and during prolonged isoflurane anesthesia will be highlighted to show the safety of this drug protocol. In addition, clinical considerations related to armadillo handling and interesting preliminary findings on the ecophysiology of armadillo will also be discussed.

#### Summary of anaesthesia results and discussion

Seven armadillos weighing 33-45 kg were immobilized to perform surgical implantation of temperature loggers using  $3.8 \text{ mg}\cdot\text{kg}^{-1}$  ketamine,  $0.1 \text{ mg}\cdot\text{kg}^{-1}$  medetomidine and  $0.25 \text{ mg}\cdot\text{kg}^{-1}$  midazolam. Immobilized armadillos were transported to a surgical theater and received 0.5-1% isoflurane in oxygen after tracheal intubation. After surgery, medetomidine was antagonized with  $0.5 \text{ mg}\cdot\text{kg}^{-1}$  atipamezole and armadillos were released at their site of capture. We recorded induction and recovery times, clinical and physiological parameters and conducted blood gas analyses before and during isoflurane administration. Armadillo showed initial effects within 3 minutes and reached lateral recumbency within 7 minutes after drug administration. Heart rate ( $50\text{-}67 \text{ pulse}\cdot\text{min}^{-1}$ ),

respiratory rate (10-15 breaths.min<sup>-1</sup>), oxygen hemoglobin saturation (90-97%) and rectal temperature (34.0-37.5°C) were within acceptable physiological ranges. Mean arterial blood pressure was initially high (146 ± 12 mmHg) but the hypertension resolved over time. Rectal temperature dropped significantly during anesthesia. Four animals had to be treated to relieve apnea. Blood gas analyses revealed mild to moderate hypercapnia but no hypoxaemia. The ketamine-medetomidine-midazolam combination provided effective immobilization. Combined with a low concentration of isoflurane, it can be used for prolonged surgical procedures in wild aardvark. However, caution is needed and monitoring of clinical parameters is required.

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# Managing hoofstock in captivity – Examples from the National Zoological Gardens of South Africa (NZG)

A C Bruns<sup>1</sup>

As with livestock keeping, intensification of wildlife farming necessitates intensification of management. The more the ecosystem is changed from its natural state, the greater the management interventions will have to be to counteract negative effects of human interference. This fact becomes more apparent in a zoological collection, where space is extremely limited, the environment is artificial and nutrition comprised of a complete replacement diet.

Problems frequently encountered can be ascribed to three major causes: enclosure size and design, nutrition and demographics.

Confining animals in small areas will eventually lead to increased parasite burdens. This process seems to accelerate with decreasing enclosure size. In the case of endoparasites, regular removal of faecal matter to interrupt the life cycle becomes necessary. Enclosure design will influence the feasibility of this practise. The denser the ground cover, the more difficult removal of faeces will be. Furthermore dense grass cover provides an ideal environment for the survival of worm larvae. Addition of poor drainage aggravates this problem. Limited availability of hands-off deworming remedies favours the potential for the development of drug resistant parasites.

Enclosure design will also influence hoof wear and lack of abrasive surfaces will promote hoof overgrowth and if unattended eventually hoof malformation. The latter will lead to chronic pain leading to decreased locomotion with ensuing decreased food intake and finally increased susceptibility to parasites and disease.

Effects of inappropriate nutrition are less obvious and in the long term will have detrimental effects. Incorrect micronutrient supplementation in a complete replacement diet might lead to Vitamin E

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and Selenium deficiency, leading to increased incidences of white muscle disease, capture myopathy and neonate mortality.

Incorrect structural elements in the diet might promote abnormal dental wear leading to either increased incidences of oral abscess or decreased efficiency of mastication and subsequent inadequate energy uptake.

Especially in browsers, the structural elements of the diet seem to play an important role to retain a healthy digestive system. Lack of appropriate browse will eventually have detrimental effects on the rumen anatomy and physiology, leading to atrophy of ruminal papillae with subsequent ruminal malfunction, malabsorption, cachexia and death.

Demographics of the captive population encompass the management of herd composition, species composition as well as genetic composition. Inappropriate herd structure, e.g. young bulls remaining in the herd at a time when they should get expelled by the breeding bull, will lead to chronic stress, limited access to the food source and increased susceptibility to parasites and disease. Furthermore physical trauma might ensue due to aggression. Interspecies aggression with mixed exhibits might also lead to physical trauma.

A sound genetic profile will promote the overall health of the population, while inbreeding will contribute to poor hoof conformation, susceptibility to parasites and dental abnormalities.

In conclusion a genetically founded breeding plan should be followed, faecal samples monitored for parasites, enclosures designed to avoid build-up of endoparasites and to promote hoof health and a macro- and micronutrient balanced diet with appropriate structural elements offered. These principles should also apply to less intensive management systems than a zoological collection, where the same problems occur but build up over a longer time period.

#### Important aspects of claw function and anatomy when considering wild ungulate claw problems

T.Shakespeare

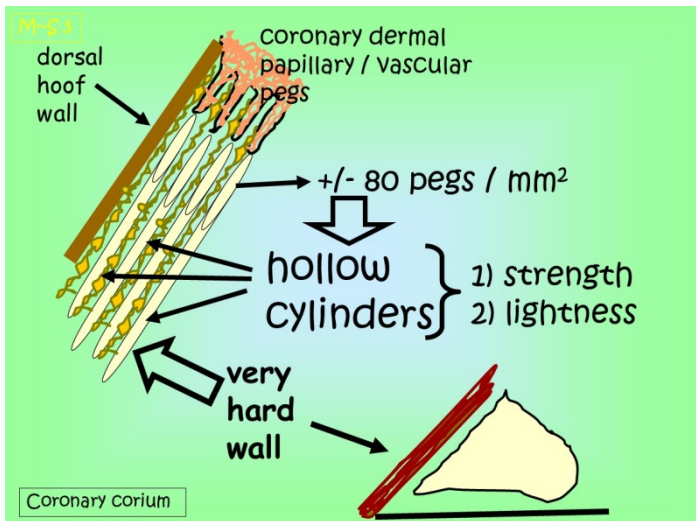
Sound, healthy claws are essential for wild ungulates to seek optimal grazing and to flee predators.

Problems of these claw(s) can be better managed if the function, anatomy and nutritional requirements are known.

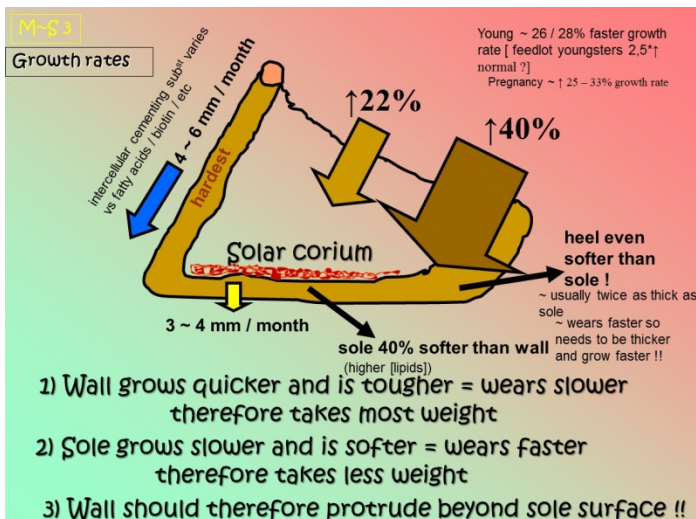
The following lecture will describe the 4 coriums and their respective participation and differences in the claw function.

These are;

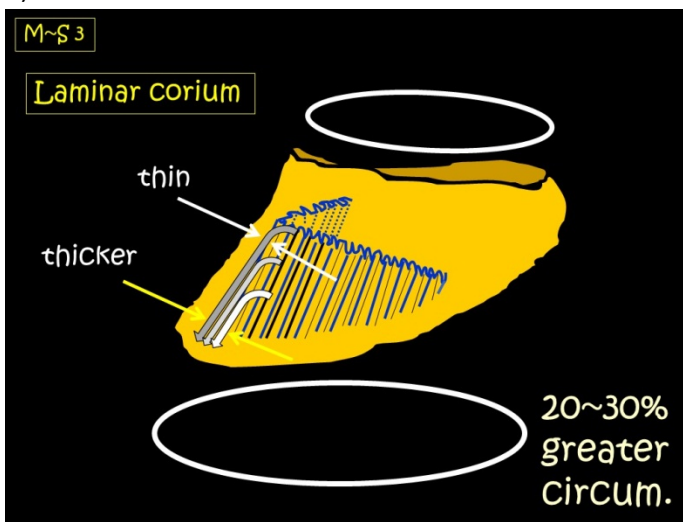
1) Coronary corium



2) Solar corium

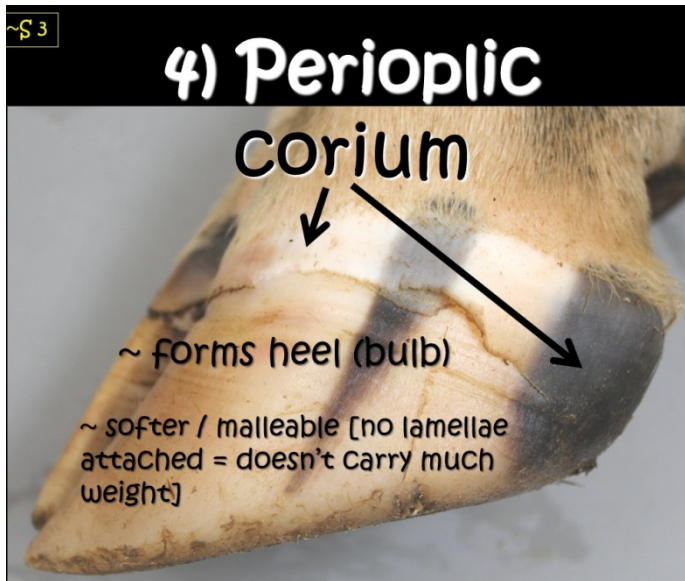


3) Laminar corium





### 3) Periopic corium



Whenever the claw is approached with a sharp object it is best for the patient if the different functions of these various coriums is appreciated and attempts to closely mimic normal weight distribution within the claws can then be achieved. A number of practical examples are discussed to try and illustrate the above and to encourage doing a normal routine trim before hacking away at any pathology.

Curative trimming if required, usually follows a routine trim as is the case with penetrating lesions, ulcers and “white line disease”. Deep seated infections can affect the bone and drastic surgical intervention maybe required including claw amputation. Most practitioners are familiar with this procedure however the remaining claw is functionally less viable and aesthetically less desirable. Arthrodesis of the D.I.P. joint, as a viable alternative to amputation, will be briefly illustrated. If this procedure is successful it is more rewarding to the animal and owner alike.

#### Practical Parasitology for the Wildlife Veterinarian

Dave Midgley:

I cannot think when last I enjoyed putting a talk/lecture together as much as this one, not to mention how much fulfilment I have had doing this.

My idea is to show you some hidden opportunities I believe we should look into further – parasitology being just one...

- Turn a “call” into a “Flock/Herd visit”...
- Look at the animals
- Weigh – electronic scales. Whenever possible. Compare with other data...
- Do clinical examinations + post mortems – take samples (Histopath + Liver samples for trace elements). Sick animals not always good references!

- Run through the facilities – layout, feeding and watering systems – take samples! Bemlab a division of Pathcare - [www.bemlab.co.za](http://www.bemlab.co.za) Microbes – 500 ml not fill to top - shake. Chemical analysis – 1 l filled to top
- Medicine Cupboard – check expiry dates, treatment protocols, see what is in there that he does not buy from you...
- Blood + serum samples
- Lambs/Calves – passive immunity transfer (TSP = R39-00) or Gamma globulins,  $\delta$ -GT... 0-3 days (7?)
- Adults
- EDTA for Fasciola (PCR/PKR)
- Trace Elements – Blood samples or Liver biopsies. Monitor supplementation – Se, Co, Zn, Mn, Cu, ...
- SEROLOGY – “Profiles” = Disease Surveillance
- Faecal samples – Flotation + Fasciola ( PKR/PCR – EDTA blood or faeces)
- External parasites – Ticks, Lice, Flies, Blowflies
- Record Keeping – lambing book – look for trends...
- Staff training –
- Record keeping – what and why.
- Stomach tube passing,...
- Milk samples?

CHEMICAL COMPOSITION OF MILK IN DIFFERENT ANIMALS					
ANIMAL	WATER	PROTEIN	FAT	LACTOSE	ASH
Cow	86.2	3.8	4.4	4.9	0.7
Donkey	90.3	1.7	1.4	6.2	0.4
Horse	90.1	2.6	1.0	6.9	0.35
Camel	85.49	4.6	4.3	4.6	1.01
Sheep	82.0	5.6	6.4	4.7	0.91
Goat	87.1	3.7	4.1	4.2	0.8
Pig	82.8	7.1	5.1	3.7	1.1
Dog	44.9	10.6	34.9	0.9	0.53
Cat	81.6	10.1	6.3	4.4	0.75
Hare	71.3	12.3	13.1	1.9	2.3

Monkey	88.4	2.2	2.7	6.4	0.18
Reindeer	65.9	10.4	19.7	2.6	1.4
Eland	?	8.19	11.1	?	?
Jackal	81.6	6.6	5.9	4.9	0.93
Rat	72.5	9.2	12.6	3.3	1.4
Zebra	86.2	3.0	4.8	5.3	0.7
AND IF INTERESTED					
Man	88.0	1.2	3.8	7.0	0.21
Orang-Otang	88.5	1.4	3.5	6.0	0.24
Dove - Crop Milk	71.5	16.6	9.7	0	1.3
Elephant	70.7	3.6	17.6	4.6	0.63
Dolphin	44.9	10.6	34.9	0.9	0.53

My field PARASITOLOGY lab:



External Parasites:



Parasites of Impala – Kruger Park – Horak, Boomker et al, 1983.

## Efficacy of Ivermectin

- Highly effective against 7 nematode species
- Effective against 3 others
- Of the 4 tick species recovered, only *Boophilus decoloratus* appeared to have been affected
- Lice infestations – highly effective against 3 *Linognathus*, but ineffective against the 2 *Damalinea* spp present

## S.O.S. – Stress, Overpopulation and Stagnation.

can be evaluated. Without this base-line knowledge, how would a total count of over 124 million internal parasites in a single host be judged, without knowing that this burden of *Probostmayria vivipara* was recovered from a fat zebra, *Equus burchelli antiquorum*, that was obviously unaffected by the vast numbers? Indeed, now we also know that this was no exception; ‘impossible’ figures of many millions of *P. vivipara* still fall within the acceptable range for zebras of that particular sex and age, under environmental conditions such as those reigning at the time the particular necropsy was performed (Krecek et al., 1987).

1-2 year old Impala had highest parasite burdens. Nature selects between 1+2 years of age...

Rams - mating season.

Ewes - lambing time/season

At no stage of a study in which two to four impalas were culled each month for a period of a year, did it appear as if the worm burdens harboured by the impalas affected them adversely (Horak, 1978). Subsequently, monthly necropsies over two consecutive years on impalas indicated that lambs up to 9 months have fewer parasites than 1 to 2-year-old impalas and that selection for the fittest animals seems to occur during the second year of life (Boomker, Horak and de Vos, unpublished observations, 1996).

While impala males have the highest parasite burdens during the mating season, possibly as a result of the stress of fighting, the burdens of the ewes peak during the lambing season.

## Parasite BASICS:

Some controversial “issues”...

- Use broad spectrum remedies
- Use combinations to combat or fight off resistance
- Persistency leads to a better effect and therefore less resistant parasites remaining behind to reproduce. In this way resistance is “retarded”...
- IPM (Wormboss, Agnotes, SCOPS...)

## Case Studies from Wildvet:

Alcelaphinae = “Head Nodders”

... herewith a little 'lecture' in Entomology. 'Blesbokke' carry the larvae of both *Oestrus* spp. (nasal worm) and *Gedoelestia* spp. (uitpeuloog). *Oestrus* flies fly very fast and deposit live larvae around or in the nostrils, from where they go to the paranasal sinuses. When the larvae are mature, they crawl to the nostrils, are sneezed out and pupate in the soil. The larvae of the *Gedoelestia* spp. are also deposited in the eyes.

They crawl over the eye-ball, get into the blood vessels and spend quite a bit of time in the heart and the vessels of the dura mater. They often go through the cribiform plate to get into the paranasal sinuses, where they mature. Others mature in the throat and move to the sinuses via the internal nares. When fully mature, they are sneezed out, pupate in the ground and after some time the fly appears. In the normal host, which include blesbok, bontebok, black and blue wildebeest (i.e. the head-nodders or Alcelaphinae), the larvae cause little damage but you know the story about uitpeuloog in sheep and cattle and the extensive nasal discharge seen with *Oestrus*.

Treatment is quite difficult and in the old days we used rafoxanide per os, but I'm not entirely sure that one does antelope a favour by treating them. There is a firm, Safari feeds, somewhere in Gauteng, which sells medicated pellets, containing ivermectin and other anthelmintics. One of the automatic tick-control machines, like Tick-off or the Duncan applicator can be primed with an ectendocide, which should have the desired results. In the Free State, the winters get too cold for the pupae to survive, and the larvae remain in the blesbokke, much the same as *Haemonchus*. The best time to treat would then be June and July, since the pupae are dead and the larvae concentrated in the game. (Prof Joop Boomker)

Lungworm + lice in Springbok ( *Dictyocaulus viviparus*, *Dictyocaulus filaria*, *Muellerius capillaris*)

I need some advice on these springbok.

I did several PM's and all the 'diseased' animals were emaciated, pale and had severe lungworm and sucking lice burdens.

The damage caused by the lungworms is severe, and I believe this is the final cause of death.

The chronic blood loss via the lice adds to the general weakness of the animals.

Most of the sick animals were older rams although younger ones also died, so do females.

As far as I know (in cattle) lungworm is only a problem in young animals and from there on a good immunity develops

My questions are:

- 1) why would there be such a high load of lungworm

Gary Bauer:

Whilst on this topic, has anyone seen an increasing number of intensive herds (sable) with growing numbers of coccidial oocysts on faecal examination (samples taken because of diarrhoea).

Advice given:

- spray herbicide in the camp to prevent any grass growth from occurring
- feed only from troughs where animals can't climb in to them (esp young animals)
- move the feeding area around to prevent buildup of oocysts in one area
- build a concrete slab around watertroughs as this is easy to clean, it also helps with overgrown hooves
- best to increase camp size and apply rotation

Tapeworms:

The presence of cysticerci of *Taenia solium* or *Taenia saginata* in gemsbok would be very rare indeed, but there are a number of carnivore *Taenia* spp. that produce cysticerci and coenuri in a variety of antelopes. The most common ones are *Taenia hydatigena* (jackal to impala and springbok), *Taenia crocutae* and *Taenia hyaenae* (from jackal and hyaena to virtually all antelope), *Taenia multiceps* (mainly jackals, coenurus in gemsbok and sable) and *Taenia regis* (lion and hyaena to impala and buffalo). It is possible to tentatively identify the cysticerci by counting the number of hooks in each of the two rows, measuring these hooks and comparing with the great study that Prof. Anna Verster did in 1969. *Taenia solium* does not have hooks, which makes identification easy

Jan van Wyk: Oor die lintwurms sal Joop kan uitbrei, maar ek herhaal graag dat ek geen rede wat ookal sien om as roetine selfs by kleinvee en kalwers vir die "derm" lintwurms (*Moniezia*, *Avitellina*, *Thysaniezia*) te behandel nie, en wel omdat daar weinig indien enige bewys van 'n effek van die besmetting op produksie van die betrokke diere is. *Stilesia* spp. (veral *S. globipunctata* wat gesondheid betref, en in verspreiding tot die Suid-Kaap beperk) kan egter 'n uitsondering wees.

Lintwurms is tot groot mate daartoe in staat om weerstand teen die middels te ontwikkel, soos in die geval van die bensimidazole en ook niklosamied, waar weerstand soos 'n veldbrand in die land versprei, en weerstand reeds 20 jaar gelede ernstige afmetings begin aanneem het. Dus beveel ek aan dat daar selfs in die geval van uitermatige lintwurmdaging nie soos gebruiklik voorkomend ontworm word nie, maar eers nadat daar heelwat lintwurmsegmente in die mis is, in welke geval daar dan voldoende besmetting in refugia is om seleksie vir weerstandige wurms teen te werk.

Sheep, Cattle, Impala and Blesbok in the "Northern Transvaal":

- *Haemonchus* spp. and *Trichostrongylus* spp. in all 4 hosts
- *Ostertagia* spp in sheep
- *Longistrongylus* spp in Impala
- *Cooperia* spp in Impala
- *Cooperoides* spp in Impala
- *Impalaia* spp in Impala and Blesbok
- *Oesophagostomum* spp in sheep, cattle and Implala

*Trichostrongylus* and *Nematodirus* in wide variety of wild species. Rest more host specific...

Except for a few helminth species, such as *T. thomasi*, *Trichostrongylus deflexus*, *Trichostrongylus falculatus* and *Nematodirus spathiger* which occur in a wide variety of wild animals, the nematodes of wildlife are generally host specific, or infect animals within a particular genus or within a grouping of generically related animals (I.G. Horak, unpublished observations, 1996).

Goats:

- Eight species and two genera in young goats
- Six species and 3 genera in older goats
- *Strongyloides papillosus* was the most numerous and most prevalent!
- *Haemonchus contortus* more in older goats

Significance? - *Strongyloides papillosus* has a different life cycle...

- Life cycle *Strongyloides*
  - April to Sept
- *Haemonchus* more during summer months
- Gobabis Boksiekte
- Parthenogesis
- Trans-cutaneous and trans-mammary, migrate through lungs
- 21 days in lambs and kids, 14 days in calves

*Cooperia hungi*, *Cooperia pectinata*, *Skrjabinema* spp., *Trichostrongylus* spp, *T. colubriformis* *T. deflexus*, *T. falculatus*, *Trich* spp females, *Trichurus* spp

Andreas Gaugler - Marienthal, Namibia (2009/2010) - found *Skrabinodera kuelzii* in Springbok originating from Kois. Other species found in other parts of the world

*S. saiga*

*S. tanganyika*

Normally found in Saiga antelope (*Saiga tatarica*) in Kazakhstan and Mongolia...

Stuart McKernan:

Examined a roan bull about 2 weeks ago with a profuse watery diarrhoea (and straining) of a few days duration. Intensive breeding camp (near Rooibokkraal); rest of breeding herd fine (although treated a calf a week later). Dehydrated but not anaemic (Ht 57); gave symptomatic treatment.

Prof Joop's answer:

Strongyles 2400 epg (negative coccidia/cestodes/trematodes). *Haemonchus* did not sit well with me due to the acute diarrhoea presentation and absence of anaemia so requested larval culture-returned 98% *Haemonchus* and 2% *Oesophagostomum*

I am familiar with the case and *Haemonchus* was the predominant helminth.

*Oesophagostomum* is uncommon in antelope, which explains the low prevalence. Ivan Horak and I did a lot of work on antelopes in various parts of the country and *Oesophagostomum* only featured where the antelope grazed together with sheep.

Indigenous, or naturally occurring parasitic or infectious life forms have had a common evolutionary history with their hosts in a specific habitat and this has led to a reduction, or a cessation in detrimental effects such as the virtual absence of nodules cause by *Oesophagostomum columbianum* in impala, *Aepyceros melampus* as opposed to domestic sheep (Horak, 1981). The co-evolutionary trajectory followed by any

Joop's comment on an e-mail of mine on *Haemonchus*:

It is *Haemonchus horaki*, that occurs in both grey rhebuck and bontebok, although more often so in rhebuck (vaalribbok). I probably said this before, but a major concern is that the perception is that every *Haemonchus* should and must be *H. contortus*, according to the owner of even a veterinarian, which is not true.

There are five or six other species of *Haemonchus* that occur in free-living ruminants. We know little about the wildlife *Haemonchus* and it is entirely possible that they have the same capability to become resistant as *H. contortus* has.

We do know that all *Haemonchus* spp. live sympatrically, and it therefore possible to find *H. krugeri* from impala to be present in the same area as *H. vegliai* from kudu. On game farms both may be present together with *H. contortus*, and it is not easy to determine in living animals.

You guys out there should be careful, because I am not entirely optimistic about the control of *Haemonchus*, resistant or otherwise, in free-living antelope.

*Onderstepoort J. vet. Res.*, 45, 221–228 (1978)

**PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. X.  
HELMINTHS IN IMPALA\***

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## ABSTRACT

HORAK, I. G., 1978. Parasites of domestic and wild animals in South Africa. X. Helminths in impala. *Onderstepoort Journal of Veterinary Research*, 45, 221–228 (1978).

Two to four impala in the Nylsvley Nature Reserve were culled each month from February 1975–February 1976.

Two trematode species, 1 cestode species and 13 species of nematodes were recovered from these antelope. Of these, *Fasciola gigantica*, *Gongylonema pulchrum*, *Haemonchus placei* and *Trichostrongylus falculatus* are new records for impala.

In general, *H. placei*, *Longistronchylus sabie* and *Impalaia tuberculata* exhibited a similar pattern of seasonal occurrence. Adult worms were present during November–February, while marked inhibition in the development of large numbers of 4th stage larvae occurred from April–September or October. *Cooperia hungi*, *Cooperioides hamiltoni* and *Cooperioides hepaticae* followed a similar pattern, but inhibition in the 4th larval stage was not as marked and lasted from June–September.

No seasonal pattern of prevalence could be determined for *Trichostrongylus* spp.

The worm burdens of young impala increased with the age of the animals and reached a peak when the impala were 1 year old.

### Back to BASICS:

BVA - Responsible use of ANTHELMINTICS in grazing animals

Resistance to anthelmintics in grazing animals is serious and increasing

If not checked resistance could have a catastrophic impact on animal welfare and on economic production

Anthelmintics are a necessary option but their use must be judicious

Every application increases the risk

DO - ☺

- Encourage – Development of farm health planning including worming strategies
- Ensure – full grazing management programs and the use of FEC and other monitoring systems
- Target – the drug used to the parasite to be treated
- Emphasize – the importance of NOT under dosing
- Advise – not to dose and move
- Explain and Emphasize – the importance of quarantine treatment
- Investigate – cases of resistance
- Report – suspected cases of lack of efficiency

DO NOT - X

- Treat unnecessarily
- Blanket treat

- Dose and move

## THINK TWICE BEFORE PRESCRIBING ANTHELMINTICS

Definitions we should know and discuss:

Strategic and Tactical dosing

Management dosing

Quarantine dosing

PPRR

FECRT and Dose- or Drench Testing

IPM = Integrated Parasite management

Sustainability...

Refugia

Hypobiosis

Histrotrophic phase of Nodular worm

Self cure

Resistance

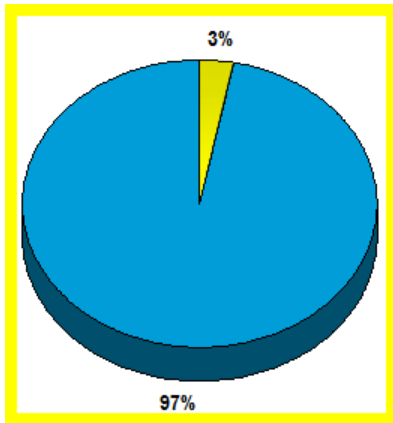
Resilience

What Is Refugia and How Does It Work?

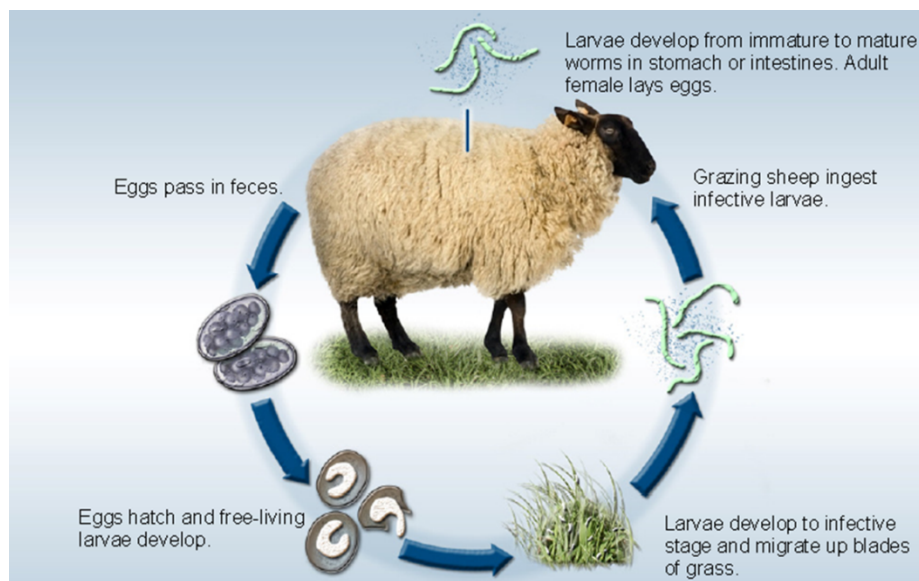
Refugia is that portion of the total worm population (eggs and larvae) that escapes exposure to a drench. Presence of worms in refugia assures that some susceptible worms are left to reproduce. The theory behind intentionally leaving worms in refugia is to create a safe haven for susceptible worms in the population base. Ideally, the reservoir of susceptible larvae should significantly outnumber resistant larvae on pasture. That way when the larvae are ingested and the adults breed in the host animal, the number of resistant worms will be reduced

REFUGIA in Practice:

- Do not treat the whole flock and put them into a clean camp
- Leave 10% of the group to “sow” susceptible worms (?)
- Keep 2 different flocks together, and dose them at different times (Multiple lambing systems, or scan and split into those lambing early and those lambing later on foetal size)
- Dose and leave in the camp they were in to first gather susceptible worms ( be careful with persistent drugs)
- FAMACHA© + condition scoring



Normal Life Cycle of Roundworms:



Important Aspects of the Life Cycle

- Periparturient relaxation in immunity (PPRI) or Periparturient resistance relaxation (PPRR)

- Hypobiosis (arrested development)

Important variations on the basic life cycle:

- Nematodirus spp. – Long-necked bankrupt worm
  - Development to L3 takes place within the egg
  - L3 release on climatic stimulus. Period of chill followed by mean day/night temperature of >10°C
  - Prepatent period can be as short as 14 days
- Strongyloides papillosus – White bankrupt worm/”Gobabis Goat Disease”
  - Parthenogenic
  - L3 has no protective sheath
  - Ingestion or skin penetration
  - Transmission also via milk from ewe to lamb
  - Prepatent period about 9 days
- Bunostomum trigonocephalum – Grassveld hookworm
  - Ingestion or through the skin
  - From skin to small intestine via the LUNGS
  - Prepatent period about 56 days
- Trichuris ovis – Whip worm
  - Ingestion of L1 IN THE EGG
  - Plugs at the ends are digested and L1 is released
  - All four moults occur within the sheep
  - Prepatent period is 1 to 3 months

Should parasite control in wildlife be necessary?

IG HORAK - Faculty of Veterinary Science and Onderstepoort Veterinary Institute, Onderstepoort

The role of parasites

- Large parasite loads often accumulate in young animals until they are 12 to 18 months old
- Weaker individuals and those that do not develop an effective immune response, are caught by predators before they can contribute towards the gene pool
- Diseased, injured, or old animals become heavily infected resulting in rapid removal by predators
- Between the parasites and the predators the population is screened for fitness
- To protect the environment against intruders
  - 1) Gemsbok in the southern Free State (paralysis)
  - 2) Gemsbok in Limpopo Province (Theileriosis)
  - 3) Blue wildebeest in Valley Bushveld (mange)

## Healthy wildlife

Normal healthy wild animals can harbour either several 1 000 parasites, or large numbers of parasite species, or both without apparent ill-effects.

Eland and buffaloes: 50 000 ticks

Zebras: 1 000 000+ worms

Blue wildebeest: 18 worm species, the larvae of 5 nasal botflies, 3 louse species, 7 tick species, 1 mite species and tongue worm nymphs

Ticks collected from pairs of male and female kudu and nyalas

Tick species	Average No. of adult ticks collected			
	Kudu (No. examined)		Nyalas (No. examined)	
	Male (15)	Female (15)	Male (24)	Female (24)
<i>A. hebraeum</i>	33	3	3	2
<i>R. (B.) decoloratus</i>	806	492	105	29
<i>R. appendiculatus</i>	39	18	345	7
<i>R. maculatus</i>	-	-	10	1
<i>R. muelhensi</i>	-	-	646	292

Ticks collected from impala rams at Crocodile Bridge:

Month examined	Total number of ticks collected
January	1 403
February	2 106
March	1 479
April	7 113
May	22 404
June	9 768
July	3 460

There are approximately 85 tick species in South Africa and the immature stages of 18 are obligate parasites of rodents, elephant shrews, hares, and birds

Average numbers of ticks on animals in the Kruger National Park

Host	Number examined	Average No. of ticks
Burchell's zebras	33	3 432
Kudus	95	4 543
Impalas	135	4 205
Blue wildebeest	47	812
Wildebeest, broken leg	1	2 732

Stress – Broken leg  
 Internal parasites appear + Ticks increase a.w.a. population composition = more adults???

For example, a 6-month-old blue wildebeest, which had broken a leg ca. 4 weeks previously, harboured 575 adult *Strongyloides* spp. and 175 adult *T. falculatus* when shot. In contrast, a healthy calf of similar age and shot at the same time, harboured neither of these helminth species. Furthermore, while the stressed calf housed 2071 *Boophilus decoloratus*, of which more than 24% were adults, the healthy calf and 2 others (which were 12 months older when shot) were infested with only 390–805 of this tick species, only 4–12% of which were adults (Horak et al., 1983).

Average numbers of ticks on animals in the Mountain Zebra National Park

Host	Number examined	Average No. of ticks
Mountain zebras	14	8 348
Eland	11	3 616
Black wildebeest	9	156
Old wildebeest	1	13 019

What have we done wrong?

- Overstocked
- Fenced
- Introduced foreign species
- Removed predators
- Failed to remove weak, sick, or old animals

#### PARASITE CONTROL IN WILDLIFE

- (i) Biological
  - (a) Grooming and grooming adaptations
  - (b) Mud-wallows and rubbing posts

- (c) Oxpeckers, obligatory predators
- (d) Starlings and turtles opportunistic
- (e) Immunity and resistant host species
- (f) Aloes do not work

(ii) Managemental

- (a) Host species mixes, avoid too many large hosts in too small an area
- (b) Stocking rates
- (c) Remove sick, stressed and old animals
- (d) Fire does not work

(iii) Chemical

- (a) Medicated feedblocks or food items
- (b) Duncan applicator, Appligator
- (c) Self-application, pressure or light sensitive
- (d) Flood with cattle, which are then dipped
- (e) Pheromone/acaricide impregnated tags

Know your status

Health process:

Soil health

Plant health

Animal health

Environmental health

Financial health

General Principles to Remember About Worm Control

Most animals have worms of some kind in their digestive system. This is pretty normal and actually is essential to their long-term health if they are to develop and maintain immunity to worms.

Problems occur only when worm populations grow to such an extent that production losses occur or animals become susceptible to other disease conditions.

Drenching with anthelmintics is only one component of an effective worm control program, the others being grazing management, nutrition and breeding worm-resistant sheep.

This suggests that drenching alone will not resolve a worm problem. In reality, frequent drenching may reduce sheep's natural immunity, is known to be one of the major causes of drench resistance and is in most cases, a waste of money, time and effort.

New Guidelines for Managing Parasites and Drug Resistance which I recommend to farmers:

<b>Worm Control Guidelines</b>
<ol style="list-style-type: none"><li>1. Work with a veterinarian to devise a worm control strategy.</li><li>2. Use effective quarantine procedures to prevent importation of resistant worms.</li><li>3. Test for anthelmintic resistance.</li><li>4. Administer anthelmintics effectively.</li><li>5. Use anthelmintics only when necessary.</li><li>6. Avoid 'High Risk' Strategies.</li><li>7. Select the appropriate anthelmintic for the problem.</li><li>8. Preserve susceptible worms on the property.</li><li>9. Reduce dependence on anthelmintics.</li><li>10. Use drugs in combination.</li></ol>

Reduce dependence on anthelmintics.

All of the following non-chemical procedures contribute to parasite control:

- Provide quality nutrition. Energy and protein supplements are useful in stimulating immunity to parasites.
- Manage pastures to control parasites. Where sheep, cattle and horses are raised on the same property, rotate pastures. Also, faeces removal eliminates most sources of re-infection including resistant worms.
- Use rams that are bred for resistance to worms. If producers want to improve the genetic resistance of their flocks they must either breed rams themselves or buy rams that have been selected for resistance to worms. Modern tools like WormSTAR® can be used to identify these rams with superior genetic resistance to parasites and that shed fewer eggs in the pasture.

Nature's own "dewormers"?





Cotyledon + Kalanchoe = Krimpsiekte

Die Kalahari en sy plante (Van der Walt + Le Riche) – “Keijgarries: groot bloedsiekte (miltvuur). Die beeste van die Koranna het hier aan die siekte gevrek. Nadat hulle van die beesvleis geëet het, is baie mense dood”.

Karoo – Veldblomgids van Suid-Afrika 6. P72 – Plakkie, kouterie, Pig’s ear. Behandeling van liddorings en vratte. “Die Koi het die blare geëet nadat hulle vleis van diere, wat van miltsiekte gesterf het, geëet het.”

Peoples Plants – Ben-Erik van Wyk + Nigel Gericke: Warmed leaf juice used for tooth ache and earache (Rood 1994).

Medicinal Plants – same authors as above + Bosch van Oudshoorn: “A single leaf is eaten as a vermifuge”. Also used to treat boils and inflammation. Juice has been used to treat epilepsy...

Worms, including pinworm, roundworm and tapeworm:

Aster bakeranus, Cotyledon orbiculata, Embilia ruminata, Punicia granatum, Rumix lanceolatus and Sansevieria hyacinthoides...

?????

I sincerely hope that this presentation will give you as much pleasure as it gave me, just putting it together...

# Ethical Considerations in Wildlife Research

The National Council of SPCAs (NSPCA) is the largest animal welfare organization in South Africa. One of its units, the Animal Ethics Unit (AEU), is the only of its kind in South Africa, focusing on the improvement of welfare of the animals used in research and education by identifying areas of improvement in the laws and standards that govern animal research.

Objectives are achieved by carrying out inspections at research facilities, serving on Animal Ethics Committees (AECs) (currently serving on 37 AECs), reviewing research protocols (100 to 150 per month) and working towards improving South African legislation, which protects animals used in research and enforcing this legislation.

Animals in South Africa are used for the advancement of knowledge and science, hypothesis testing, production of medicines, to provide tissues, organs and serum, to impart or demonstrate existing knowledge, to teach or learn surgical techniques, to improve conservation of species or amongst other to fulfil statutory requirements for the testing or collecting of data on a substance or product.

Currently we are the only organization in South Africa that collates statistics on the use of animals for research. Since we are mostly involved with Universities, the statistics of the use of wildlife is not accurately recorded since not all wildlife studies go through an ethical review process at University level.

Through our experience, wildlife studies appear to be conducted at rehabilitations centres, private game farms and other similar set ups. There is no information available to confirm that this research is done in an ethical manner or whether the research has been approved by a properly constituted ethics committee.

The National Health Act prescribes that all animal research that could impact on human health, requires ethical approval from a research committee in South Africa. The newly established National Health Research Ethics Committee (NHREC) requires anyone who conducts research on animals that could impact on human health to be registered with them. They will be auditing research facilities from 2014. Currently the Department of Health is not taking responsibility for the use of animals where the end beneficiary is animals. This means that there is a lack of legislation in that specific area of research.

The Animal Protections Act 71 of 1962 protects all animals for whichever purpose they might be used, the South African National Standards (SANS) 10386:2008, for the care and use of animals for scientific purposes, is the Standard that is currently being implemented by most Universities country wide as part of their Terms of Reference for conducting ethical research. The SANS covers all aspects of the care and use of animals in medicine, biology, agriculture, industry, veterinary, wildlife and other animal sciences, including animal use in research, teaching, field trials, product testing, diagnosis, the production of biological substances and environmental studies, needs to be approved by a properly constituted animal ethics committee (AEC).

The membership of AECs should comply with the requirements of the SANS 10386 and should comprise at least four categories of members – i.e. veterinarians, persons with substantial recent experience in the use of animals in scientific study or teaching, representatives from independent animal welfare organisations, and independent persons who have not conducted scientific studies or teaching that involved the use of animals.

Animal ethics Committees in South Africa are decentralised, i.e. each institution's AEC operates according to its own policies. Recently, Zoo's and other non-University institutions are realizing the need to establish their own AECs in accordance with their own Codes and Standards i.e. the World Association of Zoos and aquariums code of ethics and animal welfare and the Professional Code of ethics of the African Association of Zoos and Aquaria.

The SANS 10386 refers to wildlife research and includes free-living animals or those captured from free-living populations, including both indigenous and non-indigenous species, and feral species. All studies and teaching activities that involve wildlife, which are performed in order to acquire, develop or demonstrate knowledge or techniques in any scientific discipline, require animal ethics approval.

Special considerations need to be taken into account when doing wildlife research. These include the need for Provincial Conservation and other relevant permits, capture, holding, transport, handling, intervention and release are some of the vital aspects to consider.

Although South Africa is following international best practice and generally conforms to National Standards, there is still a big gap to fill with regards to education of compliance related to animal research. The NSPCA Animal Ethics Unit strives to fulfil this role.

Erika Verduel

National Council of SPCA's

Animal Ethics Unit

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# **A Systematic Health Assessment of the Indian Ocean Bottlenose Dolphin and the Indo-Pacific Humpback Dolphin By-caught in Shark Nets off the KwaZulu-Natal Coast, South Africa**

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Factors associated with degradation of the marine environment, such as pollution ( ), habitat degradation, and depletion of prey, as well as stress resulting from other anthropogenic impacts may cause cetaceans to become more susceptible to disease (Harvell, et al., 1999; Lafferty, et al., 2004; Geraci and Lounsbury, 2009). In addition, dolphins have long life spans, feed at a high trophic level, and have extensive fat stores that can accumulate pollutants. They are therefore ideal species to use as sentinels for the marine environment (Reddy, et al., 2001; Wells, et al., 2004). Monitoring for disease in sentinel species can provide valuable information to monitor temporal trends of environmental change (Bossart, 2006). An increase in the prevalence of diseases has been observed worldwide in studies of cetacean populations (Epstein, et al., 1998; Harvell, et al., 1999). However, due to the lack of baseline data on the health status of coastal dolphins off South Africa, inadequately trained personnel and a general lack of facilities, diseases present in the dolphin populations have remained unidentified, and temporal trends have remained undetermined. We provide here a baseline assessment of the present health status of incidentally caught Bottlenose dolphins (*Tursiops aduncus* ) and Humpback dolphins (*S. chinensis* ) from the KwaZulu-Natal coast, which may be used to monitor future temporal trends.

A further complicating factor to disease investigation is that many different people or research groups may be responsible for collecting data from carcasses. A major difficulty in using such data is that the results are seldom directly comparable (Norris, 1961). For this reason, a standardized necropsy protocol was developed and tested for the South African context. This protocol yielded diagnostic samples, even for dolphins frozen for up to 12 months before necropsy. Furthermore, the application of this protocol in incidentally caught animals highlighted the importance of a comprehensive necropsy and sample collection, as many lesions were only found on histopathology, with no gross abnormalities seen. It is expected that requirements may change over time as new evidence emerges, such as the detection of antibody titres to specific agents. Any protocol should therefore be adapted to such changing circumstances (Raverty and Gaydos, 2004).

We report the diagnosis of the first confirmed cases of lobomycosis and sarcocystosis in dolphins from the South African coast. Lobomycosis may be associated with significant concurrent impairment of the adaptive immune response (both humoral and cell mediated components) in dolphins and humans, with a decrease in circulating lymphocyte counts. The immune status of these dolphins was not determined, but both environmental contaminants (such as mercury and polychlorinated biphenyls) and chronic stress as a result of anthropogenic factors, have been suggested (Reif, et al., 2006; Reif, et al., 2009). Specific testing of the adaptive immune response was not possible in our study, but should be attempted in future studies.

We present evidence indicating that the dolphins incidentally caught in the shark nets may have been stressed, with about half the population showing diffuse or nodular adrenocortical hyperplasia. Environmental stressors related to anthropogenic factors could be related to the heavy ship traffic along the KwaZulu-Natal coast, overfishing or chemical pollutants. Continued monitoring of lesions that may be related to stress is essential to determine temporal changes, and a larger sample size may allow more detailed spatial evaluations. The determination and monitoring of blood or faecal cortisol levels, adrenal dimensions and weights and objective adrenal corticomedullary ratios by a point-counting technique (Clark, et al., 2006) may aid in confirming the status of stress in the population. These results, combined with the toxicological studies, would aid in elucidating possible stress factors.

The southern Indian Ocean has traditionally been thought to contain relatively low contaminant levels, although recent studies have shown very high concentrations of chemical pollutants in dolphins off the coast of Brazil (Lailson-Brito, et al., 2012). Current contaminant levels are unknown for cetaceans off the coast of South Africa, although *T. aduncus* and *S. chinensis* have historically been shown to contain high contaminant levels (Cockcroft, et al., 1991; Cockcroft, 1999). Furthermore, recent studies off Durban indicated high concentrations of pathogenic organisms related to sewage entering the marine environment (Mardon and Stretch, 2004). Examining the coastal dolphin populations for lobomycosis can be a valuable monitoring tool, as an increase in the prevalence of lobomycosis could be an indication of environmental degradation or an indication of stress (Van Bresse et al., 2009a). Monitoring should strive to determine a definitive diagnosis of all skin lesions by histology, as macroscopic lesions, even if documented by photographs, cannot be used to make definitive diagnoses.

All 40 animals evaluated had lesions that were related to parasites, and multifocal peritonitis that was observed to be on the increase in 2009 may also have been of parasitic origin. This observed increase may be attributed to better systematic evaluation, although neither the dissecting protocol nor the personnel performing the dissections changed during this time. Alternatively, the increase may be due to changing prey composition and parasite exposure of the populations. The majority of parasites have little effect on the host, causing mainly minor parasite associated inflammation and not severe disease, but growing evidence suggests that compromise of the host's immune system leads to an increase in the severity and prevalence of parasite associated diseases so that parasite burdens may then be used as indicators of the overall health status of the individual (Siebert, et al., 1999; Raga, et al., 2009). This assumption should, however, be used with caution, as some environmental factors, in particular pollution, may also negatively affect the parasite populations (Torchin, et al., 2002). Health assessments should therefore monitor multiple variables in the population and not focus on a single indicator. Further research into parasite identification and quantification as well as into the cause of death in stranded as well as incidentally caught dolphins is essential to develop valuable information regarding parasite burdens, and the effect of these on the host animal.

Bronchiolar mucosal calcification has been described associated with lungworm infections (Woodard, et al., 1969), although mineralisation was not a common feature of verminous pneumonia in dolphins in other studies (Siebert, et al., 2001; Jauniaux, et al., 2002; Fauquier, et al., 2010). Although identification of the material causing the pneumoconiosis was not possible, inhalation is the likely source of the foreign material, which could indicate air pollution. Although it did not appear to affect the health of the affected individual animals, it does suggest that these animals had been exposed to environmental air pollution, the origin and extent of which is currently unknown.

Immunohistochemical stains for brucellosis, toxoplasmosis, and cetacean morbillivirus were negative in suspected lesions, which may indicate the absence of these diseases. Alternatively, the testing may not have been sensitive enough to detect these agents or the prevalence was too low to detect with the tests used and the small sample size. Routine testing for specific antibodies against *Brucella* spp., *Toxoplasma gondii* and cetacean morbillivirus would be necessary to confirm the naivety of the population (Van Bresseem, et al., 2001). Brucellosis and toxoplasmosis are zoonotic diseases, posing a risk to animals and humans alike (Waltzek, et al., 2012). Brucellosis is a naturally occurring infection in marine mammals and endemic in some populations, with pathology often absent (Ross, et al., 1996; Van Bresseem, et al., 2009a). Toxoplasmosis is generally asymptomatic in dolphins. Most dolphins that die of toxoplasmosis show below average body condition, have concurrent disease, or are for some reason immunosuppressed, potentially as a result of stress or morbillivirus infection (Migaki, et al., 1990; Bowater, et al., 2003; Dubey, et al., 2003; Forman, et al., 2007). Therefore, the prevalence of clinical toxoplasmosis may be useful in monitoring population health trends. Cetacean morbillivirus can have a devastating effect on naïve populations (Van Bresseem et al., 2009a), and can be of particular concern for endangered species.

Although aspects of nutritional condition have previously been explored in dolphin species off the South African coast (Young, 1998), concurrent health investigation was not undertaken. Therefore, the degree to which animals may be affected by disease, and the effect that this may have on the

nutritional condition, has not been determined. Further determination of blubber thickness measurements in incidentally caught animals as well as in stranded animals, with concurrent pathological investigations, will elucidate associations between disease and nutritional condition, and will greatly aid in interpretation of blubber thickness measurements and the assessment of nutritional condition.

In conclusion, this project yielded valuable information on the current health status of the incidentally caught dolphins off the KwaZulu-Natal coast. Furthermore, these dolphins provide a unique opportunity to evaluate individuals thought to be representative of the general population, whereas stranded dolphins may present a biased view of population health. This will be useful in monitoring the temporal and spatial changes in the health status of the population and may indicate changes in the health of the environment. These findings highlight the importance of a standardized necropsy and sampling protocol for disease investigation in marine mammals

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# Evaluation of butorphanol combined with oxygen insufflation to improve cardiorespiratory function in chemically immobilized white rhinoceros (*Ceratotherium simum*)

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White rhinoceros (*Ceratotherium simum*) immobilized with the opioid receptor agonist etorphine experience severe respiratory depression resulting in adverse physiological changes. We have showed previously that butorphanol combined with oxygen insufflation offered the best cardiorespiratory support for immobilized boma-confined white rhinoceros. The goal of the present study was to verify these results in field-immobilized rhinoceros. We immobilized 14 free-ranging white rhinoceros with a combination of etorphine, azaperone and hyaluronidase. Six minutes after the rhinoceros became laterally recumbent, we administered butorphanol (IV) and oxygen (intratracheal). Arterial blood gas analyses and non-invasive cardiopulmonary measurements were taken at 5-minute intervals throughout the 25-minute immobilization period. All immobilized rhinoceros were initially hypoxic ( $P_aO_2 = 36 \pm 6$  mmHg [mean  $\pm$  SD]), hypercapnic ( $P_aCO_2 = 63 \pm 8$  mmHg), acidaemic ( $pH_a = 7.10 \pm 0.14$ ), tachycardic (HR =  $136 \pm 34$  beats/min) and hypertensive (mean arterial pressure =  $158 \pm 18$  mmHg). Butorphanol combined with oxygen resulted in a rapid and significant improvement in  $P_aO_2$ ,  $P_aCO_2$ , pH, mean arterial blood pressure and heart rate ( $p < 0.01$ ). However, most rhinoceros did not achieve normoxia by the end of the immobilization period ( $P_aO_2 = 80.9 \pm 31.2$  mmHg), which differed from the effects of butorphanol+oxygen in boma-housed rhinoceros ( $P_aO_2 = 154 \pm 53$  mmHg) ( $p < 0.001$ ). Our results indicate that butorphanol combined with oxygen insufflation is a simple technique to significantly improve, but not fully correct, cardiopulmonary imbalances in field-immobilized white rhinoceros.

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# Rapid detection of cryptococcal infections

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## Abstract

Cryptococcus causes disease in man and many animals as well as cheetahs. It is found worldwide, with most documented infections in man in Africa and Asia. Animals become infected by inhaling dust containing the yeast, resulting in respiratory, neurological and septicaemic infections. *Cryptococcus neoformans* is now recognized as 3 entities; *C. neoformans* var. *neoformans*, (serotype D) *C. neoformans* var. *grubii* (serotype A) and *Cryptococcus gattii* (serotypes B and C). Of the three documented South African cheetah isolates, two were identified as *C. gattii*. Although numbers are small, this is an important finding, as it appears as if *C. gattii* infections are more severe, and more refractory to treatment. Diagnosis relies on smears, culture, serological tests and a rapid cryptococcal lateral flow assay to detect antigen. Therapy is based on surgery, if the lesions are large and amenable to surgery, as well as antifungals.

*Cryptococcus* is the most common systemic mycosis of cats<sup>3</sup>, but is also a problem in man and many animals as well as cheetahs<sup>2</sup>. Infections are not zoonotic, but environmental.

*Cryptococcus* is a yeast which forms a large capsule in tissues. It is found worldwide, with most documented infections in man in Africa and Asia<sup>2</sup>. *Cryptococcus* requires a rich nitrogenous environment, high in creatinine, and environmental sources are pigeon and other bird droppings, rich organic soil, house dust and plant debris, particularly from eucalypts, but other trees such as mopane and figs can also harbor the yeast<sup>4</sup>. It can survive for two years in faeces. Environmental stages survive in a dessicated form, in which case the capsule becomes small. This decreases the total size of the organism, allowing for better airborne dispersal<sup>4</sup>.

Animals become infected by inhaling dust containing the yeast. Lesions may be formed in the nose and sinuses. This seems to depend on the anatomy of the nose, as cats, dogs, koalas and psittacine birds show the highest incidence of nasal infections<sup>3</sup>. The yeast is also inhaled into the lungs, and from there can become septicaemic. *Cryptococcus* is relatively neurotropic, and central nervous system infections may result from septicaemic spread, or from nasal infections via the cribiform plate<sup>3</sup>.

Cryptococcal infections in man are associated with HIV/AIDS<sup>2</sup>, but cat infections are not associated with FIV. There is controversy about its association with FeLV, with only some authors describing a link<sup>3</sup>. Cheetah infections have not been linked to FeLV or FIV<sup>1,4</sup>.

*Cryptococcus neoformans* is now recognized as 3 entities; *C. neoformans* var. *neoformans*, (serotype D) *C. neoformans* var. *grubii* (serotype A) and *Cryptococcus gattii* (serotypes B and C). The old serotyping system is no longer commonly used, as molecular methods give better discrimination

between types. There are now 5 major *C. neoformans* types, designated VNI – IV, and VNB; and 4 *C. gattii* types, VGI-IV. *C. neoformans* is found world-wide, and *C. gattii* mostly in tropical and subtropical areas, and is common in Australia<sup>2</sup>.

Only a small percentage of isolates have been fully typed. In one large review, 68, 811 isolates, mostly from humans, were studied, and 505 were typed. Of these, 475 were *C. neoformans*, mostly VNI, and only 30 were *C. gattii*<sup>2</sup>. Of the three documented South African cheetah isolates, two were identified as *C. gattii*<sup>1,4</sup>. Although numbers are small, this is an important finding, as it appears as if *C. gattii* infections are more severe, and more refractory to treatment<sup>4</sup>.

Diagnosis may be made on direct smears from lesions or fluids such as cerebrospinal fluid<sup>3</sup>. CSF smears are only 60% sensitive. Culture from lesions, deep nasal swabs, and fluids such as CSF, pleural or broncho-alveolar washes are more sensitive than smears, and an antibiogram can also be generated. Culture is slow, and a result may take 1-2 weeks to complete. There are a number of available serological tests which are 90 – 100% sensitive, and 97 – 100% specific<sup>3</sup>.

The CrAg lateral flow assay dipstick is an immunochromatographic assay<sup>a</sup>, based on monoclonal antibodies. It is 100% sensitive and specific for human serum and CSF samples, and only slightly less sensitive (98.9%) but still 100% specific for human plasma. The CrAg lateral flow assay detects all pathogens in the *C. neoformans* complex, and includes serotypes A, B, C and D.

IDEXX has been using the CrAg test since January 2012, mostly on cheetah samples. It is not possible to validate the test properly for animal samples, due to far lower sample numbers, but the CrAg test has correlated well with diagnosis, culture and treatment response in cheetahs and dogs. Less than ½ ml of serum, CSF or plasma is needed, and it should reach the laboratory within 72 hours, being kept cold during transport. Samples can be frozen if they need to be stored for longer than 3 days, but should not be repeatedly frozen and defrosted before testing. The test can be completed within hours of receipt. Samples can be diluted to provide a semi-quantitative result. Response to treatment can also be monitored using the test.

Therapy is based on surgery, if the lesions are large and amenable to surgery, as well as antifungals. A combination of Amphotericin B and flucytosine has been found to be best, as they are synergistic. Other antifungal drugs such as fluconazole, itraconazole and ketoconazole have been used, with ketoconazole giving the poorest results<sup>3</sup>. Treatment varies from 6 – 18 months, depending on the drug(s) and regime followed. Long term follow-up is necessary, and serial antigen titre determinations are useful in this regard. Clinical improvement is far more rapid than actual cure, and the antigen titre may take up to 2 years before it is entirely negative<sup>3</sup>.

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# Pregnancy diagnosis of wildlife by ultrasound

Dr David Gerber

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# The role of assisted reproductive technologies in research and conservation

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## Abstract

The International union for conservation of species (IUCN) has ideally one aim: to have established populations of vulnerable or threatened species maintained within conservation areas that are self-sustaining and genetically healthy reservoirs available should the need arise to intervene or supplement free-roaming populations. However, the reality is that we are still replacing captive populations with free-roaming individuals. Maintaining healthy wildlife populations is only possible with an adequate genetic pool. The rationale to conduct reproduction biology research is to gain knowledge and understanding of basic reproductive function and activity. This in turn that can lead to the development of appropriate reproductive technologies that could play a vital tool in strengthening current in situ and ex situ conservation and genetic diversity efforts. A basic knowledge and understanding can help to troubleshoot present reproductive challenges faced by conservationists. Declining population numbers and habitat fragmentation are threatening this diversity in many instances. Large cats, such as lion, leopard and cheetah face these problems in their range countries. For wild and domestic felids, electroejaculation (EE) is the most common semen collection method. However, the equipment is expensive, there is a risk of urine contamination and animals usually show strong muscular contraction despite general anaesthesia. We accordingly tested the feasibility of a different approach using urethral catheterization (UC). After general anaesthesia with the  $\alpha$ 2-agonist medetomidin (which also stimulates semen release into the urethra) and ketamin, a transrectal ultrasound was performed to locate the prostate. A commercial dog urinary catheter (2.6 or 3.3 mm in diameter) was advanced approximately 30 cm into the urethra to allow semen collection into the lumen of the catheter by capillary forces. After

retraction, sperm volumes between of  $422.86 \pm 296.07 \mu\text{l}$  yielded motility of  $88.83 \pm 13.27 \%$  (mean  $\pm$  SD) with a mean sperm concentration of  $1.94 \times 10^9/\text{ml}$ . Here we describe a simple, field friendly and effective method to attain highly concentrated semen samples with excellent motility in lions and potentially other wild felid species as an alternative to electroejaculation. Artificial Insemination success was achieved in an Asiatic Golden cat (*Catopuma temmincki*) with the birth of two Asiatic Golden cubs. Due to routine fecal hormone analysis estrus was accurately identified together with behaviour observations. Semen was collected from tomcat using urethral catheterisation (UC) and deposited in the the uterus of the queen by means of transcervical AI that resulted in the birth off live offspring.

Keywords: urethral catheter, electroejaculation, wild cats, semen sampling, transcervical A.I,