

Setting the Thresholds of Potential Concern for Bovine Tuberculosis

Rationale

Mycobacterium bovis is considered to be an alien organism within African ecosystems. In the Kruger National Park the disease probably originated from infected domestic cattle and is believed to have entered the Park from across the southern river boundary in the early 1960s. It has since been detected in ten wildlife species, including buffalo, lion, leopard, cheetah, hyena, kudu, baboon, warthog, honey badger and genet. Buffalo are considered to be the primary maintenance host, and kudu and warthog appear to have maintenance host potential. Large predators, especially lions, seem to be highly vulnerable to infection with BTB, because being at the top of the “food chain” they are at a high risk of exposure from infected prey animals or carcasses. BTB is a declared controlled disease in South Africa and there is a risk of transmission of the mycobacteria from infected buffalo to domestic livestock and humans within neighbouring communities.

Relation to KNP objectives

As an alien organism, and a potential source of risk to animal population dynamics and heterogeneity within KNP, BTB is strongly linked to the alien impact objectives of the KNP ecosystem objectives.

Objectives
ECOSYSTEM OBJECTIVES
Alien impact
<ul style="list-style-type: none">◆ Prevention Objective: prevent entry into KNP& risk assessment of disease◆ Control: implementation & best management practices◆ Research Objective: Ecology of the disease
<u>BUFFALO</u>
ECOSYSTEM OBJECTIVES
Terrestrial Ecosystem
Ecological process
<ul style="list-style-type: none">◆ Abiotic: Fire – vegetation homogenization◆ Biotic: Community and species◆ Community: Competition and community dynamics – plant animal interactions & management implications, succession◆ Herbivory – herbivore impacts, trees and fire

- ◆ Species: Reproduction, survival & mortality – factors affecting the above
- ◆ Migration, nomadism, dispersal & colonization – spread of BTB to other herds / species / rare / interface

Composition, structure and pattern

- ◆ Genetic documentations: protecting KNP gene pools – buffalo breeding, biobanking
- ◆ Autecology: determine population dynamics and threats

Alien Impact

- ◆ Strategy and support: long term, contingency, funding, building support, advisory groups, government link, awareness and policy development
- ◆ Prevention: detection & risk assessment
- ◆ Control: Evaluation, management practices, interface
- ◆ Research: Evaluate impacts, ecology patterns and processes, efficacy of control
- ◆ Awareness: Activities – education, training and fund raising

LIONS

ECOSYSTEM OBJECTIVES

Terrestrial Ecosystem

Ecological Processes

- ◆ Biotic: Community and species
- ◆ Community: Competition and community dynamics – plant-animal interactions & management implications. Predation – role of predators, prey selection & large mammal predator-prey relationship
- ◆ Species: Reproduction, survival & mortality – factors affecting the above. Migration, nomadism, dispersal & colonization – current source-sink theory

Composition, structure and pattern

- ◆ Genetic documentation: genetic variation between southern and northern lions
- ◆ Autecology: determine population dynamics and threats

Alien Impact

- ◆ Strategy and support: long term, contingency, funding, building support, advisory groups, government link, awareness and policy development
- ◆ Prevention: detection & risk assessment

- ◆ Control: Evaluation, management practices, interface
- ◆ Research: Evaluate impacts, ecology patterns and processes, efficacy of control
- ◆ Awareness: Activities – education, training and fund raising

ALTERNATIVE SPECIES

Reaching the threshold levels in any of these three TPCs will result in the development of specific TPCs for the species involved. These will then be linked to specific KNP Management Objectives

ECOSYSTEM OBJECTIVES

Rare biota objectives

Autecology studies
Establish and monitor TPCs

ECOSYSTEM OBJECTIVES

Alien Impact

- ◆ Strategy and support: long term, contingency, funding, building support, advisory groups, government link, awareness and policy development
- ◆ Prevention: detection & risk assessment
- ◆ Control: Evaluation, management practices, interface
- ◆ Research: Efficacy of control
- ◆ Awareness: Activities – education, training and fund raising

BALANCING

VSTEEP

- ◆ Veterinary-human health-wildlife dilemma (veterinary socio-politics)

TPC

Class A: Intrinsic demographics of an invasive alien species (Tracking TPC)

Level:

- i) Arrival of BTB within the boundaries of KNP
- ii) Increase in spatial distribution of BTB into the adjacent Transfrontier Conservation Areas
- iii) Increased or sustained zonal prevalence of BTB in buffalo to above 40% in any zone

Class B: Biodiversity TPCs

Significant measured or predicted (through modeling) negative effects on population growth and structure, and long-term viability of a species that can be attributed to BTB

Buffalo

i) A decline in zonal population growth rate to below 5% (normal growth rate 8% to 12%) in three consecutive years during a wet cycle, in a total buffalo population of less than 30 000

wet cycle – a mean annual rainfall for three consecutive years, including the year under consideration, above the long-term annual mean

Lion

I) TPC

A progressive decline in the zonal population of adult and sub-adult (> 2yrs old) lions of 15% over three successive surveys or a single decline of 30% between two successive surveys.

An interval of three years between monitoring surveys is proposed. This is based on a generation interval for lions in KNP of approximately two years. It is believed that this is an adequate time period to allow for significant and measurable changes in a population to occur.

Prey biomass is considered to be one of the main determinants of lion population densities and this TPC assumes that it remains relatively stable in the KNP. Although, biomass may fluctuate in the short-term, e.g. as a result of droughts or seasonal changes, it is believed to be comparatively constant in the longer-term. Lions are also known to change their prey selection according to prey availability which will assist them in compensating for short-term changes in the numbers of various prey species.

The monitoring of this TPC depends on the development and validation of a suitable non-invasive survey technique that is able to determine the density, and sex and age structures of a lion population. A research project by Paul Funston (“Assessment of lion population demography and abundance in the Kruger National Park: is bovine tuberculosis having an effect”) is currently testing such a technique. The initial results of this project are encouraging, and the final report on both the feasibility and confidence intervals of the method are eagerly anticipated.

This TPC will have to be changed should a non-invasive technique not be available and the use of the more traditional method of doing a lion census as developed by Smuts considered. In this case, the use of genetic biodiversity and blood biochemistry parameters should be considered as possible threshold variables to be included in the TPC.

This TPC excludes lions less than two years old as the numbers of animals in this age group are considered to be the most volatile and are likely to cause short-term variations in population densities which may have a disproportionate influence on the results of a census. Not including these juvenile animals also excludes very young cubs that will not come to calling stations.

II) TPC

The number of emaciated ($\leq 2/5$ condition score) lions throughout KNP that are confirmed positive for BTB in any single year, increases by 100% above the mean for the previous 5 years.

This TPC is intended to allow a more direct and specific monitoring of the influence of BTB on the KNP lion population. If the threshold is reached it will indicate a direct link between BTB and an increase in lion mortalities to an unacceptable level. Other factors that may be contributing to the increase in deaths due to the disease would have to be considered. It is also not a measure of the influence of BTB at a population level, but should give an indication of when the population is under threat from BTB. Should the threshold of the first TPC (I) be exceeded then the cause, of which BTB is one possibility, would have to be investigated.

It has been agreed that every case in which an emaciated lion is reported in KNP must be investigated. This will be done by the veterinarians of SANParks and the Department of Agriculture as a combined effort. Dewald Keet will provide pictures of animals representing the different condition scores to assist rangers, veterinary staff and other SANPark staff in recognizing emaciated lions. A full necropsy will be performed on each animal according to a SOP to confirm that it is infected with BTB and to gain as much information as possible from each case.

Alternative Species

- i) Identification of a BTB maintenance cycle in another species
- ii) BTB in any other species (other than buffalo and lion) where it has been shown that it impacts negatively on its population growth
- iii) BTB in any species that is on KNP threatened list

Class C: Socio-political TPCs

Any detection of infection in neighbouring communities and livestock.

- i) Detection of KNP buffalo strain BTB in livestock adjacent to KNP
- ii) Detection of KNP buffalo strain BTB in a human

Once the level 1 TPC have been exceeded then level 2 and 3 will be established

Wildlife tuberculosis publications from the Kruger National Park

1. KEET, D.F., N.P.J. KRIEK, H. HUCHZERMEYER and R.G. BENGIS. 1994. Advanced tuberculosis in an African buffalo (*Syncerus caffer* Sparrman). *Journal of the South African Veterinary Association* 65(2): 79-83.
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3. KEET, D.F., KRIEK, N.P.J., PENRITH, M-L. MICHEL, A. & HUCHZERMEYER, H. 1996. Tuberculosis in buffaloes (*Syncerus caffer*) in the Kruger National Park : spread of the disease to other species. *Onderstepoort J. Vet. Res.*, 63, pp 239 - 244
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9. KEET, D.F., KRIEK, N.P.J., BENGIS, R.G., GROBLER, D.G. & MICHEL, A. 2000. The rise and fall of tuberculosis in a free-ranging chacma baboon troop in the Kruger National Park. *Onderstepoort Journal of Veterinary Research*, 67: 115 – 122.

10. RODWELL, T.C., KRIEK, N.P., BENGIS, R.G., WHYTE, I.J., VILJOEN, P.C., DE VOS, V. & BOYCE, W.M. 2000 Prevalence of bovine tuberculosis in African buffalo in the Kruger National Park. *Journal of Wildlife Diseases*, : 37(2), 258 – 264.
11. RODWELL, T.C., WHYTE, I.J., & BOYCE, W.M. 2001. Evaluation of population effects of bovine tuberculosis in free-ranging African buffalo (*Syncerus caffer*). *Journal of Mammology* : 82
12. DE VOS, V., BENGIS, R.G., KRIEK, N.P.J., MICHEL, A., KEET, D.F., RAATH, J.P. & HUCHZERMEYER H.F.A.K. 2001. The Epidemiology of tuberculosis in free-ranging African buffalo (*Syncerus caffer*) in the Kruger National Park, South Africa. *Onderstepoort Journal of Veterinary Research*, 68 : 119 – 130.
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