Cases for the Student Sessions

Friday 27th of April

Kenneth Cameron - Ebola hemorrhagic fever in great apes and humans

The Republic of Congo is home to the greatest remaining population of western lowland gorilla (*Gorilla gorilla gorilla*). The ebola virus*, which causes ebola hemorrhagic fever (EHV), is endemic to Equatorial Africa. The virus, highly pathogenic to humans, has in more recent years been shown to be at least as pathogenic to great apes (chimpanzees and gorillas), with as high as 97% mortality. Several outbreaks in past years have erupted in and around Odzala-Kokoua National Park (OKNP) in northern Republic of Congo, as well as in neighboring Gabon.
It's late 2003 in a small village in the Cuvette region. A local villager, having returned from hunting with two companions to supply their families with meat, falls ill with fever, bloody diarrhea and vomiting, and dies within days. One of his companions is also seriously ill and admits to having consumed meat of a gorilla they found dead in the forest. The whereabouts of the third companion are unknown. Within a week, the second hunter has died and several members of both families who had either cared for the ill men or prepared the bodies for burial are showing similar clinical signs.
It's now early 2007 and a survey team, having completing ecological surveys in the Ngombe logging concession[2], is preparing to exit the forest. As they leave, they find the fresh carcass of an adult female gorilla. Aware of the threat of ebola virus, they keep their distance and notify the WCS Field Veterinary Program. Within a day and a half a FVP rapid response team is on-site, sampling the carcass and national public health officials are notified. Two days later, the samples, having been transported to the capitol Brazzaville, are awaiting export authorization from the government. Two weeks following the discovery of the carcass, the samples arrive at the diagnostic laboratory in neighboring Gabon.

- What, if anything, can be done to protect the remaining populations of western lowland gorilla from ebola virus?
- If ebola virus is naturally-occurring in great ape populations, should we be intervening?
- What can be done to protect human populations from zoonotic transmission?
- How can present systems for surveillance and rapid diagnosis of ebola epizootics be improved?

* Ebola virus (EBOV), along with Marburg virus, is a member of the Family filoviridae. There are several strains of EBOV, including Zaïre, Ivory Coast, Sudan and Reston. There have been 9 human epidemics in eastern Gabon & northwestern Congo since 1994. To date, reservoir, vector and species susceptibility are poorly understood.
2The Ngombe logging concession is part of the greater Ngombe-Ntokou-Pikounda region, a vast region immediately east of OKNP. Initial recent survey data suggests several areas of high great ape density.

Some useful references:

Peterson et al. Ecological and Geographical Distribution of Filovirus Disease. *Emerging Infectious Disease*, Vol. 10, No. 1. 2004

Pourrut et al. The Natural History of Ebola Virus in Africa. *Microbes and Infection* 7 (2005) 1005 – 1014.

Lahm et al. Morbidity and mortality of wild animals in relation to outbreaks of Ebola hemorrhagic fever in Gabon, 1994-2003. *Royal Society of Tropical Medicine and Hygiene*. 2006.

Caillaud et al. Gorilla susceptibility to Ebola virus: The cost of sociality. *Current Biology*. 2006.

Leroy et al. Fruit bats as reservoirs of Ebola virus. *Nature*, Vol. 438. 2005.

Bermejo et al. Status and conservation of primates in Odzala National Park, Republic of the Congo. *Oryx*, Vol. 10, No. 1. 2004.

Bermejo et al. Ebola Outbreak Kills 5000 Gorillas. *Science*. 2006

Albert Osterhaus – Respiratory infection of unknown aetiology: a pandemic threat?

A newly emerging respiratory infection in humans that originated in Bangladesh and is spreading rapidly in the area. Now also in New York, Toronto and Paris cases have been identified.

WHO has issued a global alert and brought together a team to investigate reports. More than 200 people have died locally and in the other areas, more than 70. Overall case fatality rate estimated at about 30%.

Question: How to deal with the problem nationally and internationally?

References:
T.Kuiken, F.A. Leighton, R.A. M. Fouchier, J.W. LeDuc, J. S. M. Peiris,
A. Schudel, K. Stöhr, A.D. M. E. Osterhaus, Pathogen Surveillance in Animals, Science, 2005 vol 309

Thijs Kuiken, Ron Fouchiery, Guus Rimmelzwaanz and Albert Osterhaus, Emerging viral infections in a rapidly changing world, Current Opinion in Biotechnology, 2003, 14:641–646

Also recommended:

Osterhaus, A. Catastrophes after crossing species barriers, Phil. Trans. R. Soc. Lond. B (2001) 356, 791-793

A. D. M. E. Osterhaus, R. A. M. Fouchier and T. Kuiken, The aetiology of SARS: Koch's postulates fulfilled, Phil. Trans. R. Soc. Lond. B (2004) 359, 1081–1082

Marc Artois – Classical Swine Fever outbreak

Imagine...
You are in a nice country where the life standard is relatively low and where "bush meat" and traditional farm products have a significant impact of the quality of life of citizens...
Then, as a game officer, you have to keep wild animal population as safe as you can,

it is what you do by practicing a sustainable use of game and game meat. Yourself, just like most of the people in this country, are breeding domestic pigs in open air (the taste of this meat is just a God blessing! As you are aware, everything is good and useful in a pig carcass).
Your problem is the following:
You are aware by OIE notification that neighbour countries are affected by a large outbreak of classical swine fever (CSF*) in wild boars (*Sus scrofa*). Your game territory is neighbouring a transboundary national park (wildlife have no border).As you can fear (since the problem comes from me, Marc Artois) your neighbours are just those affected by CSF. You are expected to give advice to the District Veterinary Officer on the way to anticipate a possible outbreak of CSF. What are you going to suggest ?
Key words for answer are Investigation and Management! Be realistic, consider that the situation is relatively urgent (no time gap to develop long term strategy, it is too late for prevention, you have to consider "alert and protection" solely).

*Hog cholera

References:
M. Artois , K.R. Depner , V. Guberti, J. Hars, S. Rossi, D. Rutili Classical swine fever (hog cholera) in wild boar in Europe, *Rev. sci. tech. Off. int. Epiz*., 2002, 21 (2), 287-303

S. Rossi, E.Frommont, D. Pontier, C. Crucière, J. Hars, J. Barrat, X. Pacholek, M. Artois Incidence and persisitence of Classical Swine Fever in free-ranging wild boar (*Sus scrofa*), *Epidemiol. Infect*., 2005, 133, 559-569

Alonso Aguirre - Brucellosis in Yellowstone National Park

Students need to read the 3 articles on Brucellosis in Yellowstone National Park. They will be given a situation on site and teams will be made for a roundtable discussion.

References:
Alonso Aguirre, Edward E. Starkey, Wildlife Disease in U.S. National Parks: Historical and Coevolutionary Perspectives, *Conservation Biology*, Pages 654-661, Volume 8, No. 3, September 1994

Ryan P. Etter and Mark L. Drew, BRUCELLOSIS IN ELK OF EASTERN IDAHO, Journal of Wildlife Diseases, 42(2), 2006, pp. 271–278

Letter to the editor, Brucellosis in Free-ranging Bison *(Bison bison)* in Yellowstone, Grand Teton, and Wood Buffalo National Parks: A Review, *Journal of Wildlife Diseases,* 31(4), 1995, pp. 579-598

Sarah Randolph - Upsurge in the incidence of a tick-borne pathogen

The figure shows the changing incidence in tick-borne encephalitis in each county of the three Baltic countries between 1970 and 2005. This is a serious disease of humans (1% case fatality rate, up to 50% long-term morbidity rate), but the principles apply equally well to any vector-borne wildlife disease.
Because the x-axis is impossible to read at this scale, the following table shows the time of the start of the upsurge (defined as the year in which TBE incidence first showed a 2-

fold increase above the previous 10-year mean and also exceeded any previous level in any one year during those 10 years).

No. counties with TBE upsurg starting in each year

	Estonia	Latvia	Lithuania
1990		1	
1991	2	2	1
1992	2	3	2
1993	1	12	13
1994	4	3	10
1995	1	1	5
1996	2	1	2
1997	1		4
1998	1		1
no consistent change	1	3	6

* Make a list of the most notable features that you observe in these epidemiological data.
* Several obvious explanations are repeatedly offered, e.g. the upsurge is an artefact due to changes in public health activities; climate change.
* Consider all aspects of the data shown in the figure and draw up a list of data that ideally you would need to test various possible causes of this upsurge in incidence.
* Even without those data, can you draw conclusions from the observed epidemiological patterns about the likelihood of the more obvious explanations?

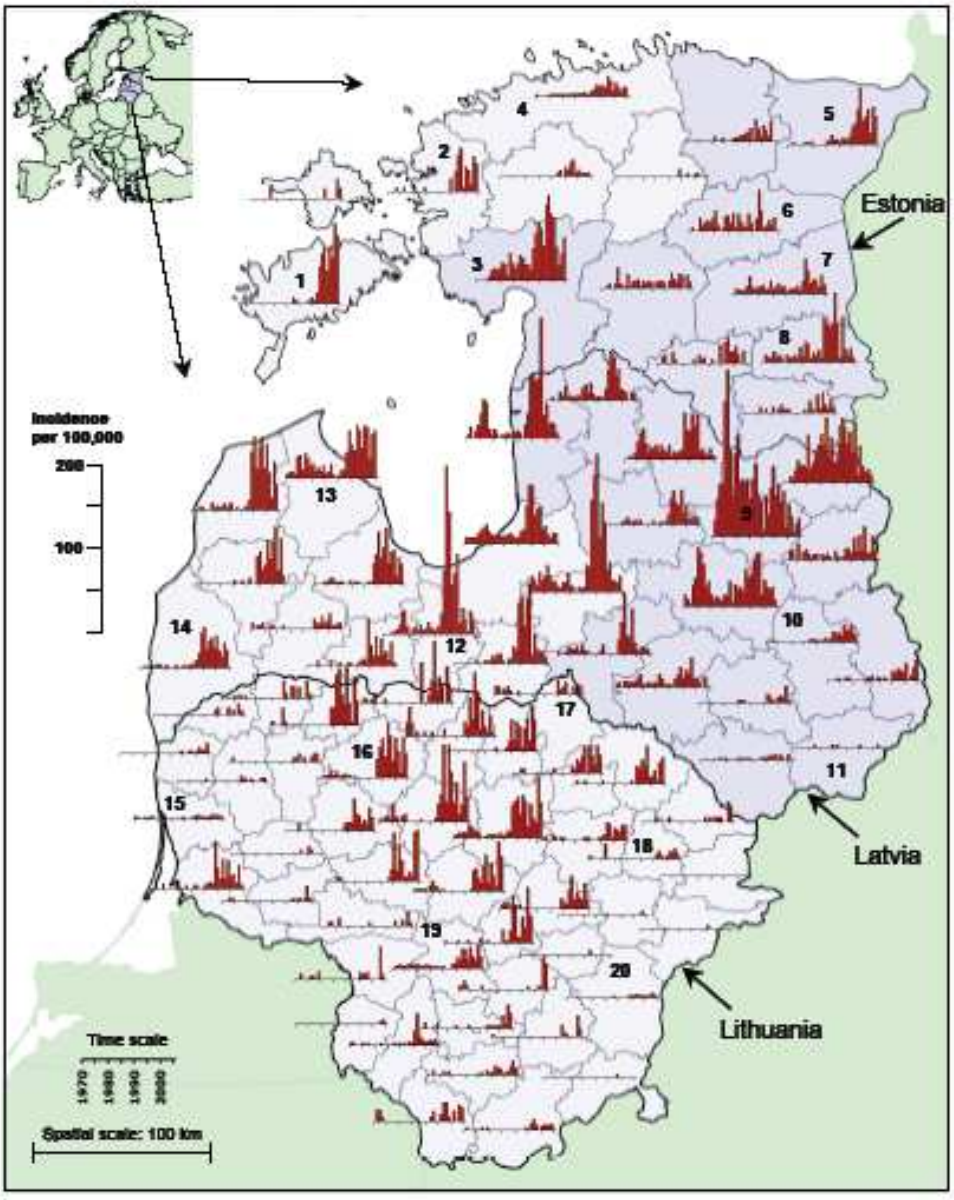
References:

Sarah E. Randolph and David J. Rogers, Fragile transmission cycles of tick-borne encephalitis virus may be disrupted by predicted climate change, *Proc. R. Soc. Lond.* B (2000) 267, 1741^1744

Bethan V. Purse, Philip S.Mellor, David J. Rogers, Alan R. Samuel, Peter P. C.Mertens and Matthew Baylis, Climate change and the recent emergence of bluetongue in Europe, *Nature reviews*, volume 3, feb 2005

Figure:

Annual TBE incidence per 100,000 population (*y*-axis) in each county of Estonia, Latvia and Lithuania, 1970-2004 (*x*-axis). *I. ricinus* is present throughout and *I. persulcatus* occurs in the darker shaded areas of Estonia and Latvia. Numbers refer to 20 counties where meteorological data are available.



Saturday 28th of April

Sarah Cleaveland - Management of African wild dogs in East Africa

Following successive outbreaks of rabies in the 1980s and early 1990s, the African wild dog (*Lycaon pictus*) population became locally extinct in the Serengeti National Park, Tanzania and Maasai Mara National Reserve, Kenya. After an absence of more than 10 years, new packs have reappeared in the area, but domestic dog diseases continue to pose a threat to the re-establishment of the population.

Do you think disease control is an important component of the conservation management of this population?

If so, identify the possible disease control options and outline the advantages and disadvantages of each, addressing issues relating to epidemiology, demography, economics, public health, logistics, politics and animal welfare.

References:

Haydon D., Randall, D., Matthews, L., Knobel, D., Tallents, L., Gravenor, M., Williams S., Pollinger, J., Cleaveland, S., Woolhouse, M., Sillero-Zubiri, C., Marino, J., Macdonald, D., Laurenson, K. Low-coverage vaccination strategies for the conservation of endangered species. *Nature*, 443: 692-695.

Vial, F., Cleaveland, S., Rasmussen, G., and Haydon, D.T. (2006) Development of vaccination protocols for the management of rabies in African wild dogs. *Biological Conservation.* 131: 180-192.

Also recommended:

Laurenson, M.K., C. Sillero-Zubiri, H. Thompson, F. Shiferaw, S. Thirgood, and J.R. Malcolm. 1998. Disease threats to endangered species; Ethiopian wolves, domestic dogs and canine pathogens. *Animal Conservation* 1: 273-280.

Woodroffe, R. 2001. Assessing the risks of intervention: immobilization, radio- collaring and vaccination of African wild dogs. *Oryx* 35(3):234-44.

Woodroffe, R., S.Cleaveland , O. Courtenay , K. Laurenson , and M. Artois . 2004. Infectious diseases in the management and conservation of wild canids. In: Macdonald DM, Sillero-Subiri C, editors. *The Biology and Conservation of Wild Canids*. Oxford: Oxford University Press; p 123-142.

Christian Gortazar – Release of captive-bred bobo-cats into the wild

This is the year 2015. The “bobo” cat (Lynx stupidus) *(“Bobo” means dumb in Spanish. This name was given to the species after an Environment Minister who, speaking in the Parliament, considered that it was getting extinct because it was too dumb to adapt to a changing environment)* is still considered the world´s most endangered cat species. Two viral diseases of its main prey, the European wild rabbit (*Oryctolagus cuniculus*), have severely reduced this food resource (myxomatosis in the 1960s and rabbit haemorrhagic disease in the 1990s), boosting the decline of this already endangered predator.

Its last wild individual died of tuberculosis in 2010, and the only remaining populations survive in captivity. An earlier attempt to release translocated bobo-cats failed: all died either accidentally while searching for rabbits out of the release area or due to unknown mortality causes.

Meanwhile, the captive breeding programme was successful, and 12 captive-bred juvenile bobo-cats are scheduled to be re-introduced into historical bobo-cat habitats. But prior to this re-introduction, scientific advice is requested regarding the disease aspects of the project:

- Which controls or preventive measures prior to release? What applied science is needed?
- How to study mortality in wildlife populations?
- What can be done regarding the health and abundance of the main prey (rabbits)?
- What measures to take regarding diseases carried by ungulates, specifically TB and Aujeszky´s disease?

The discussion will focus mainly on the "ungulates – diseases – predators" triangle, making use of the model to underline how changes in land use and in diseases interact creating a complicated challenge for wildlife managers, including veterinary epidemiologists. This situation is not unique and can easily be extrapolated to other disease-related conservation conflicts.

References:

Gortázar, C., Acevedo, P., Ruiz-Fons, F. & J. Vicente (2006). Disease Risks and Overabundance of Game Species. European Journal of Wildlife Research 52: 81-87.

Vicente J, U Höfle, J M. Garrido, I.G. Fernández-De-Mera, R Juste, M Barral, C Gortazar (2006). Wild boar and red deer display high prevalences of tuberculosis-like lesions in Spain. Veterinary Research 37(1): 107-119.

Also recommended:

Ruiz-Fons F.; Vidal D.; Höfle U.; Vicente J. & Gortázar C (2007). Aujeszky´s disease virus infection patterns in European wild boar. Veterinary Microbiology 120: 241–250.

Vicente J, U Höfle, J M. Garrido, I.G. Fernández-De-Mera, P. Acevedo, R Juste, M Barral, C Gortazar (2007). Risk factors associated with the prevalence of tuberculosis-like lesions in fenced wild boar and red deer in south central Spain. Veterinary Research 38: 000-000.

Williams D, P Acevedo, C Gortázar, MA Escudero, JL Labarta, J Marco and R Villafuerte (2007). Hunting for answers: rabbit (Oryctolagus cuniculus) population trends in northeastern Spain following rabbit hemorrhagic disease and their relation to hunting pressure. European Journal of Wildlife Research 53: 19–28.

Spyros Kotomatas – Mass die-off of an endangered species- handling an international crisis: scientific conflicts of conflicts of scientists: Mauritania (1997): Die-off in Mediterranean Monk Seals

A very high mortality rate among Mediterranean monk seals was observed on the north coast of the Cap Blanc peninsula, with 47% - 70% of the total population having been affected. In fact from mid-May to mid-July an estimated total of 200 individuals from an estimated total initial population of 310 individuals were affected, 117 corpses were found washed ashore. The mortality almost only affected adults of both sexes, with only 3 juveniles having being found among the corpses.

In response to this crisis activities included: monitoring beaching, carrying out necropsies to investigate cause of death, taking samples for virological and

toxicological analysis, and rehabilitating live animals. Laboratory analysis showed that certain seals were exposed to a morbilli virus capable of causing a significant mortality rate. In two other individuals examined, high levels of biotoxins were detected, produced by toxic algae in their feeding areas and contributed to their death. The overall cause of mortality has not been determined though with any certainty (Harwood et al, 1997).

In such an uncertain situation and in view that no conclusive results have been found to explain this phenomenon, if you were in charge of the situation, how would you:

- Prepare a protocol to determine the cause of the mass die off
- What recommendations would you make to respond to the situation?
- Consider what policy conflicts came into play in the "real world" and how do you think they can be avoided in the future.

References:

Harwood, John, David Lavigne, and Peter Reijnders. 1998. Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara. Amsterdam, 11-14 December 1997. IBN Scientific Contributions 11. International Fund for Animal Welfare (IFAW); Institute for Forestry and Nature Research (IBN-DLO), Wageningen, the Netherlands. pp. 32

Albert Osterhaus, Jan Groen, Hubert Niesters, Marco van de Bildt, Byron Martina, Lies Vedder, Joseph Vos, Hans van Egmond, Ba Abou Sidi and Mohamed Ely Ould Barham Morbillivirus in monk seal mass mortality. Nature 388, 838-839 (28 August 1997)

Hernandez M, Robinson I, Aguilar A, Gonzalez LM, Lopez-Jurado LF, Reyero MI,Cacho E, Franco J, Lopez-Rodas V, Costas E. Did algal toxins cause monk seal mortality? Nature. 1998 May 7;393(6680):17-8.

Derek Smith – Avian Influenza vaccines

Avian influenza is evolving at a rate fast enough that every couple of years a vaccine designed to match the currently circulating strains needs to be updated to remain effective--both in birds and humans. The rate of H5 evolution from 1997 has been about the same as that seen in human H3 over the same period. It is not clear why H5 is evolving at the rate it is as avian influenza strains have not previously been know to evolve antigenically or genetically at any substantial rate. For humans a single strain is used in the vaccine, for birds more than one strain can be used. The choice will have huge economic impact on the poultry industry, and huge impact on human health if a highly pathogenic H5 strain causes an influenza pandemic in humans. It takes 6 months before the choice can be used, to allow for manufacture, distribution, vaccination, and an immune response.

What strategy would you use for choosing vaccine strains, and how would you test your choice?

References:

Derek J. Smith, Alan S. Lapedes, Jan C. de Jong, Theo M. Bestebroer, Guus F. Rimmelzwaan, Albert D. M. E. Osterhaus, Ron A. M. Fouchier, Mapping the Antigenic and Genetic Evolution of Influenza Virus, *Science*, Vol 305, 16 July 2004

Derek J. Smith, Stephanie Forrest, David H. Ackley, and Alan S. Perelson, Variable efficacy of repeated annual influenza vaccination, *PNAS*, 1999, vol. 96, no. 24, 14001–14006

Andrew Dobson – A new pathogen infecting deer and wild artiodactyl species

The local cattle farmers are worried about a new pathogen that is infecting deer and other wild artiodactyl species in a region where cattle ranching is considered an important 'traditional' way of life. The disease the cattle ranchers are most worried about is caused by a chronic bacterial pathogen that causes abortion in cattle and deer. However, infected deer show no other symptoms of the disease. If the pathogen is detected in a cattle herd, the entire herd has to be destroyed and the area risks losing its 'disease-free' status. This would place state-wide restrictions on the export of meat and dairy products from the region.

A serology test is available for the pathogen, but it has very low specificity (50%) and sensitivity (40%); infected animals can be detected at autopsy. Luckily, the biotechnology faculty at a local university have developed a vaccine for the pathogen, but the vaccine has a high failure rate (50%) and only lasts for two years in tests on wild deer. The vaccine can not be used in domestic cattle as animals that test positive from vaccine use can not be exported from the region.

A local politician, E.Gregious Smallplant, has suggested widespread culling of the wild deer population. The local 'Green' party, led by I. Hasbeen Gored, are more sympathetic to the fate of the region's 200,000 deer, particularly as the local economy is increasingly dependent upon ecotourism. The situation is further complicated as deer-hunting is the principle form of recreation for the local cattle ranchers when not leaning against fences, chewing grass, and staring wistfully at their cattle.

Just in time for the local election, the politicians arrive at a compromise and decide to commission a 'blue-ribbon' scientific panel to investigate the problem. You have been invited to serve on this pane and find a solution that will bring peace and harmony to ranchers, hunters and ecotourists within two years. Fortunately, the election is decided when Congressman Smallplant is found in compromising circumstance at a local massage parlor with his colleague Ronald Dumfailed; but this gives you twelve additional months to solve the wildlife disease problem while the politicians trawl the local lunch parlors, churches and bars for a new 'WiseUse' Party candidate.

References:

Andy Dobson*, Isabella Cattadori, Robert Holt, Richard S. Ostfeld, Felicia Keesing, Kristle Krichbaum, Jason Rohr, Sarah E., Perkins, Peter J. Hudson , Sacred Cows and Sympathetic Squirrels:
The Importance of Biological Diversity to Human Health, PLoS Medicine, June 2006, Volume 3, Issue 6, e231

Kevin D. Lafferty, Andrew P. Dobson, and Armand M. Kuris, Parasites dominate food web links, PNAS Early Edition Ecology, Communicated by G. David Tilman, University of Minnesota, St. Paul, MN, June 7, 2006 (received for review March 17, 2006),

Jacques Godfroid – TB in the Kruger Park

Scenario 1 (real life):

You now know that bovine tuberculosis is found in buffalo herds in almost all parts of the Kruger National Park (KNP), with high prevalence rates in the Southern part of the park (more than 30% individual prevalence rate). The management of the Park wants to "do something". Draw a strategic plan to tackle the issue (define the goal of your plan, the strategy you want to follow; testing? culling? vaccination? ... , the time table, possible actions in other wildlife species)

Scenario 2 (fictive):

Up to now, tuberculosis has not been diagnosed in pachyderma in KNP. However, yesterday, for the first time ever, positive skin tests reactions have been documented in white rhinos and elephants. Help the management to define the different actions to be taken in order to deal with this new situation.

References:

Brandt L, Feino Cunha J, Weinreich Olsen A, Chilima B, Hirsch P, Appelberg R, Andersen P.Failure of the Mycobacterium bovis BCG vaccine: some species of environmental mycobacteria block multiplication of BCG and induction of protective immunity to tuberculosis. Infect Immun. 2002 Feb;70(2):672-8.

Michel AL, Bengis RG, Keet DF, Hofmeyr M, Klerk LM, Cross PC, Jolles AE, Cooper D, Whyte IJ, Buss P, Godfroid J. Wildlife tuberculosis in South African conservation areas: implications and challenges. Vet Microbiol. 2006 Feb 25;112(2-4):91-100. Epub 2005 Dec 15.