Emergence of bovine tuberculosis in wildlife in southern Africa: A threat for livestock?

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1st International One Health Congress – 14-16th of February 2011, Melbourne, Australia

TFCAs in Southern Africa

- TFCAs: TransFrontier Conservation Areas
  - TransFrontier parks: Great Limpopo TFCAs
  - Conservation areas (private)
  - Communal land
- Objectives:
  - Conservation
  - Development
  - Ecosystem Health

One Health and TFCAs

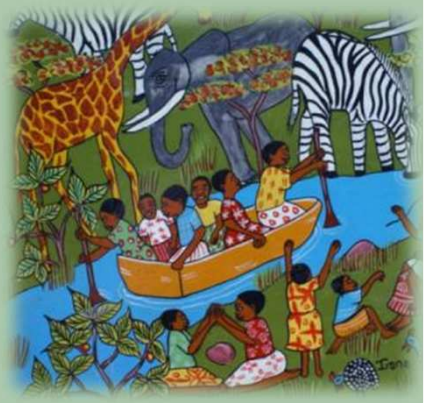
- TFCAs expected to increase movements of wildlife
  → Increased movements of their pathogens

- Sanitary risk:

  – Emerging diseases at the wildlife/domestic interface

- If sanitary risk not adressed, TFCAs could have a negative impact:

  – on international trade (e.g., FMD)
  – on local livelihoods (e.g., tick-borne diseases)
  – on human health (e.g., zoonosis such as brucellosis)



Bovine Tuberculosis (bTB)

- **Threat for animal production & human health**
- **Re-emerging disease**
- **Reservoir in Africa = African buffalo**

Sinclair 1974, Bengis et al. 2002, Michel et al. 2006

bTB in the GLTFCA

- 1950-60's: introduction in KNP
- Retrospective study
- Spread from cattle to wildlife (buffalo)

de Vos et al. 2001

www.sanparks.org

bTB in the GLTFCA

- 1990: First detection in African buffalo in KNP

Bengis et al. 1996

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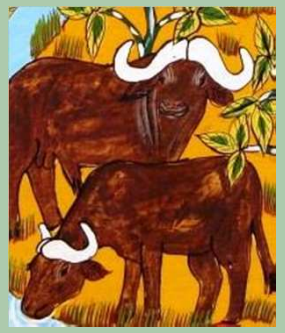
bTB in the GLTFCA

- 2000-2003: Spread in the KNP through the buffalo population

Rodwell et al. 2001



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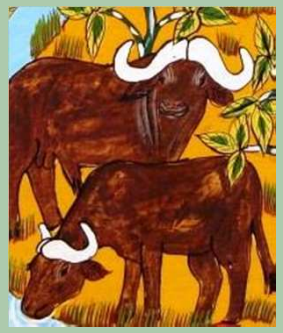
bTB in the GLTFCA

- 2005:
  - -First detection in the great north of KNP *(Keet, pers.com.)*
  - - Spread in Lion in the Southern part of KNP



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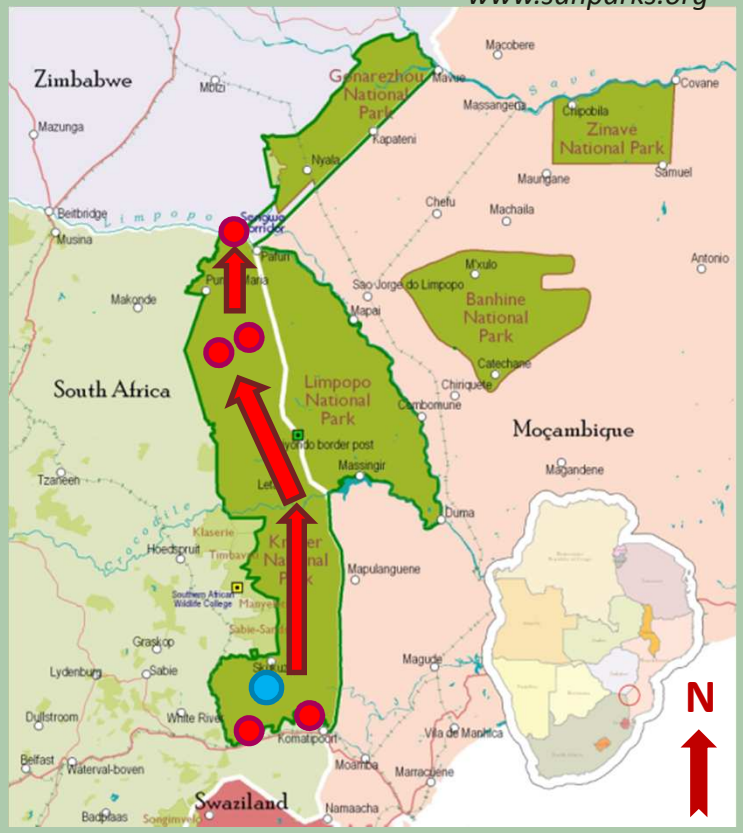

bTB in the GLTFCA

- Up to 2008:
  - Gradient of bTB prevalence in the buffalo population
  - >12 wild species detected with bTB
  - Absence in LNP *(Hofmeyr, pers. com.)*
  - No info in Zimbabwe

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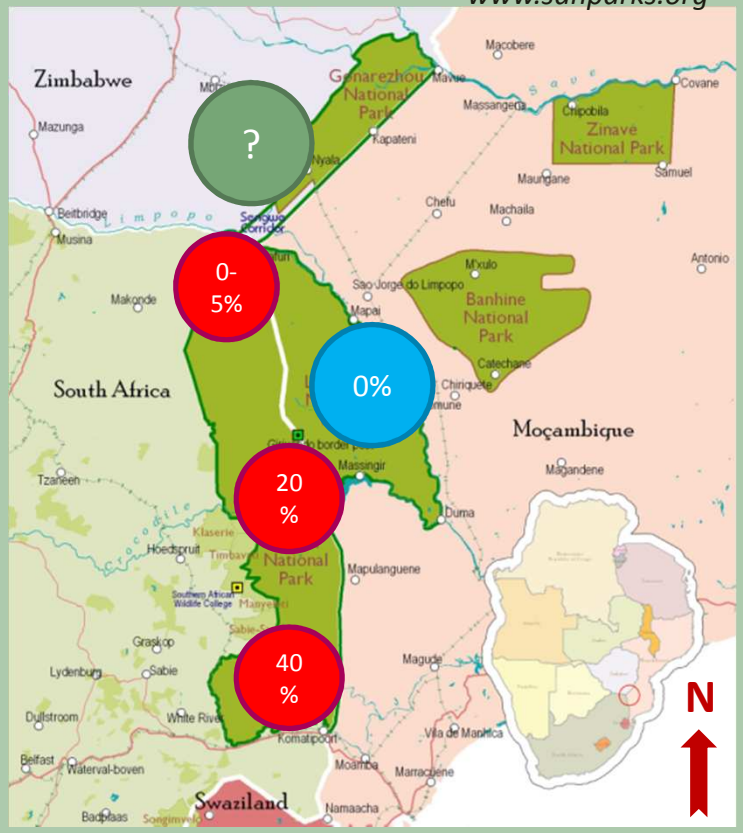
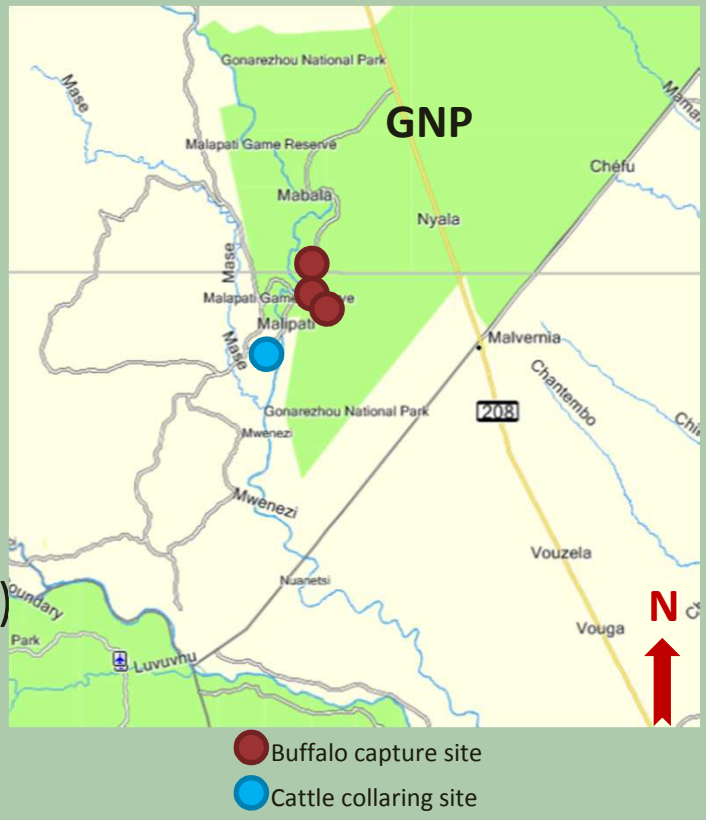


Protocol

- Objective: bTB status + contact at the wildlife/livestock interface
- Surveillance in the South-East Lowveld of Zimbabwe: bTB in wildlife & cattle
- Contact at the wildlife/livestock interface
  - 1 position every hour for 1 year
  - 12 GPS cattle collars (1 adult female in 12 herds)
  - 12 GPS buffalo collars (3 buf in 4 groups)



bTB Survey results in wildlife (1)

- October 2008: Initial boma capture
  - 38 buffalos in 4 groups
    - **4/38** positives by IFG, **(10.5%)**
  - 22 Greater kudus
    - **0/22** positives by IFG **(0.0%)**
- February 2009: Buffalo re-capture
  - **2 positive** buffalos culture/hispatho
  - Both culture positive for bTB
  - Same strain as KNP strain (VNTR technique)

Confirmation of bTB in buffalo

de Garine-Wichatitsky et al. 2010. Emerg Inf Dis

bTB Survey results in wildlife (2)

- Recapture of collared buffalo
- bTB is spreading in the GNP Buffalo population

Buffalo recapture	October 2008	February 2009	November 2009
1	**Pos**	Culled	Neg
2	Neg	X	Neg
3	Neg	X	Neg
4	Neg	X	Neg
5	Neg	X	Neg
6	Neg	X	Neg
7	Neg	X	Neg
8	Neg	X	X
9	Neg	X	Neg
10	Neg	X	Neg
11	**Neg**	X	**Pos**
12	Neg	X	X
13	-	Collared	Neg
Incidence	-	-	**1/10**

bTB Survey results in cattle (1)

- Longitudinal survey in Malipati (collared herd):
  - 2008-2009:
    - **4/193** CITT positive (**2.1%**)
    - Confirmation: 2 IFG negative + 1 culture+histo negative
  - December 2010
    - **0/51** CITT positive (**0.0%**)

No confirmation of bTB in cattle

- In adjacent villages (2008-2009)
  - Pesvi (Limpopo river): **3/176** CITT positive (**1.8%**), 1 IFG negative
  - Chikombedzi (20kms from GNP): **1/60** CITT positive (**1.7%**)
  - Chizvirizvi (North boundary of GNP): **0/60** CITT positive (**0.0%**)

Conclusions of surveillance protocol

- bTB has spread from KNP to GNP:
  - Probably through buffalo mouvements
  - Other wildlife species: possible
  - Buffalo-cattle-buffalo: no information to support this scenario
- What is the risk of bTB spread to cattle?
- No quantification of contacts between potential hosts
- We use **contacts at the widlife/livestock** interface to estimate the risk of bTB transmission

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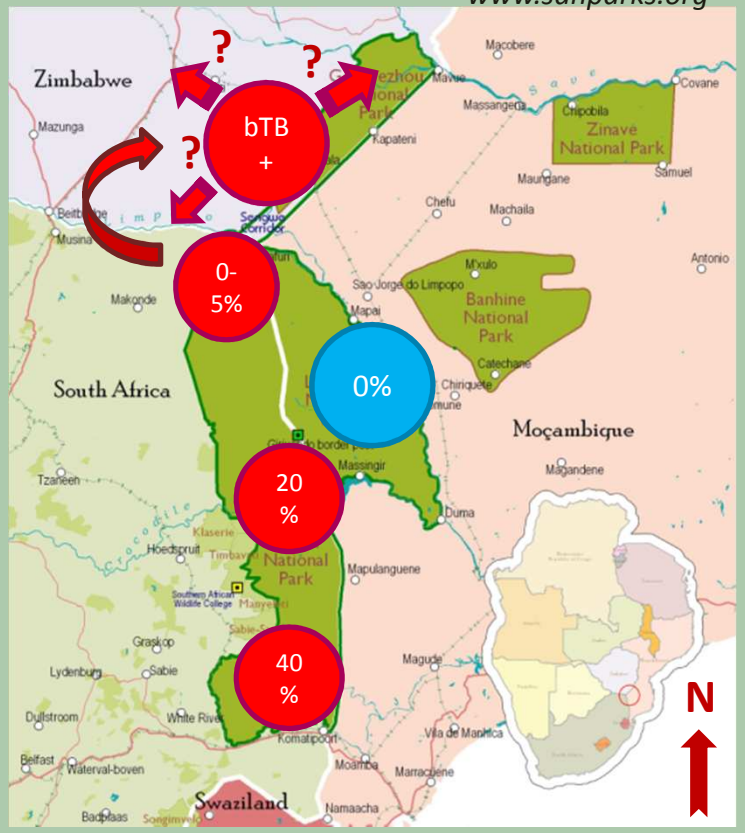


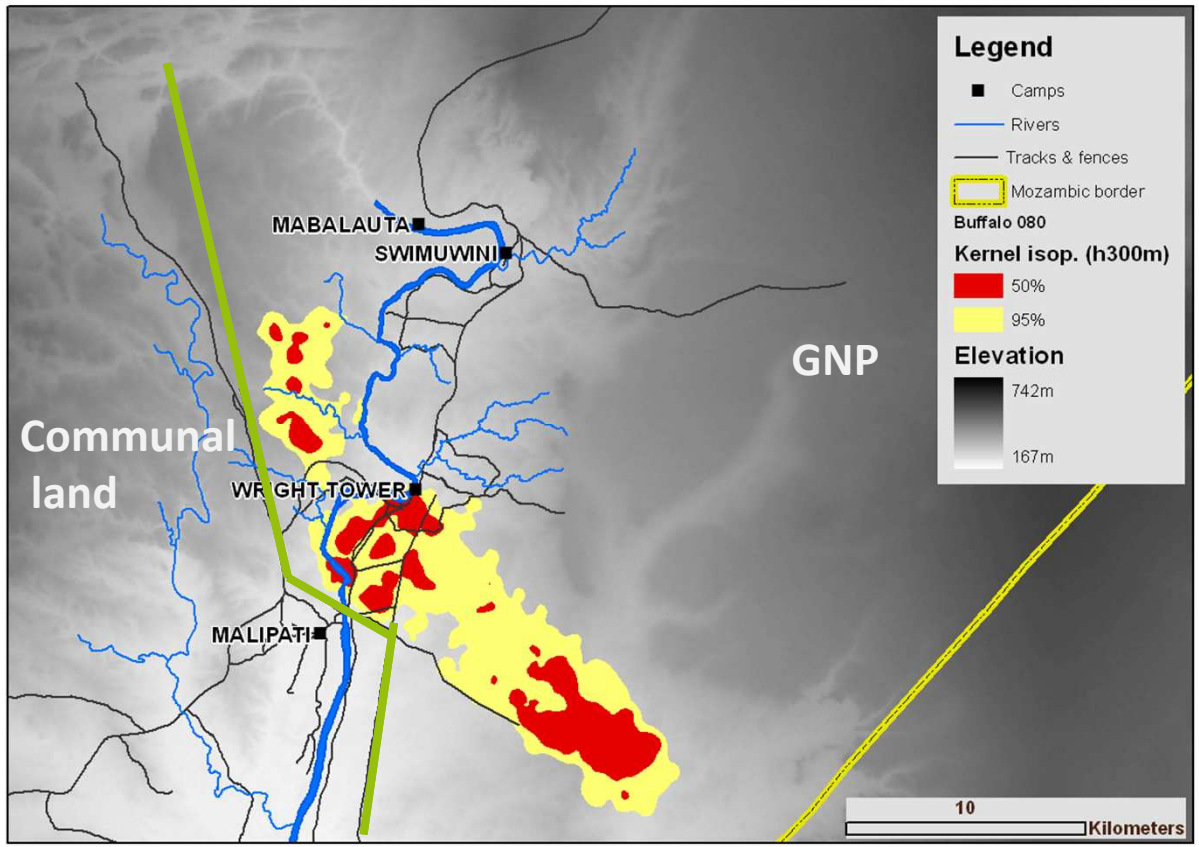
Telemetry protocol results: buffalo

- 12 buffalos

in 4 groups = 2 herds

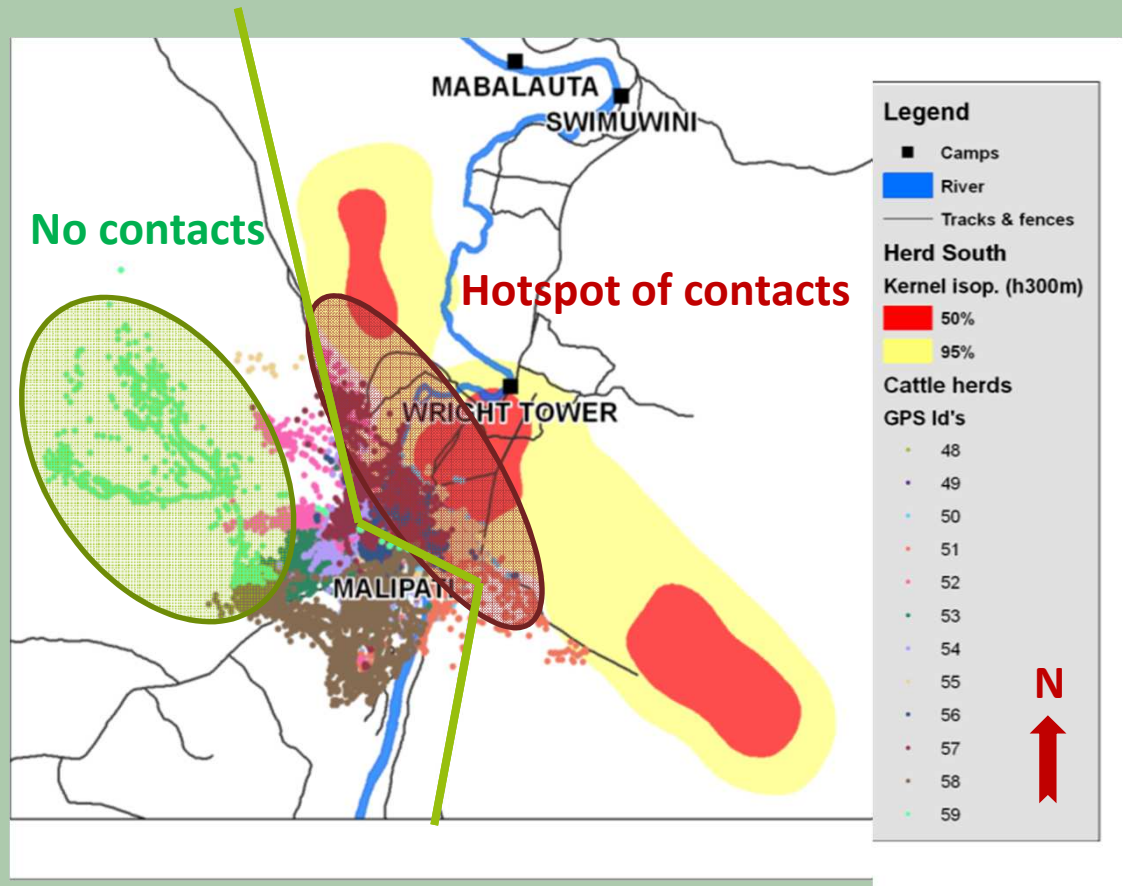
  - Northern herd
  - Southern herd

Kernel density map



Wildlife/livestock Contacts

- Home range overlap:
  - No overlap with the Northern herd (not shown)
  - Overlap between some cattle herds and Southern buffalo herd
  - But not all cattle herd are overlapping with buffalo herd
- What is the spatio-temporal dynamic of these contacts?



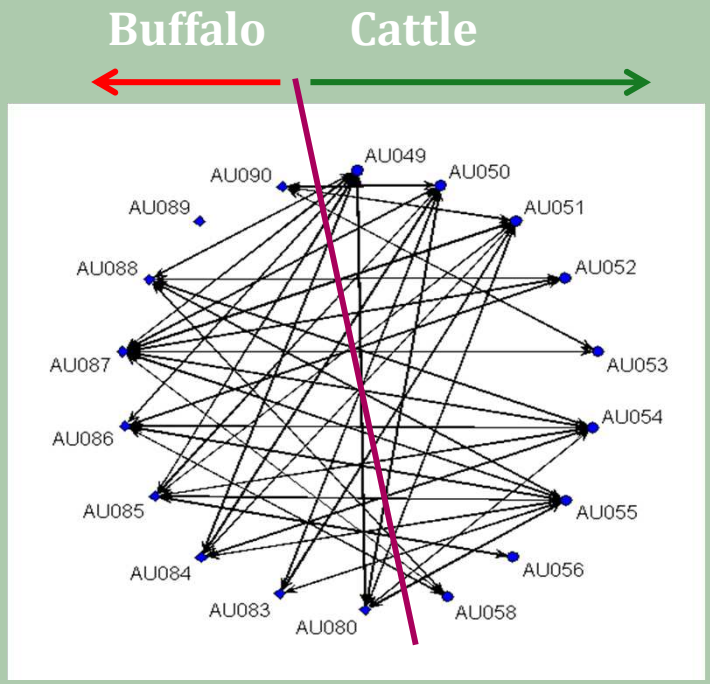
Southern buf herd kernel map + 12 cattle herd locations

Network analysis applied to animal contacts

- What are the number of contacts at a given distance for a given period?

- Nodes = Individuals
- Edges = Contacts

- There are individuals more at risk or provocating more risks than others (superspreader)

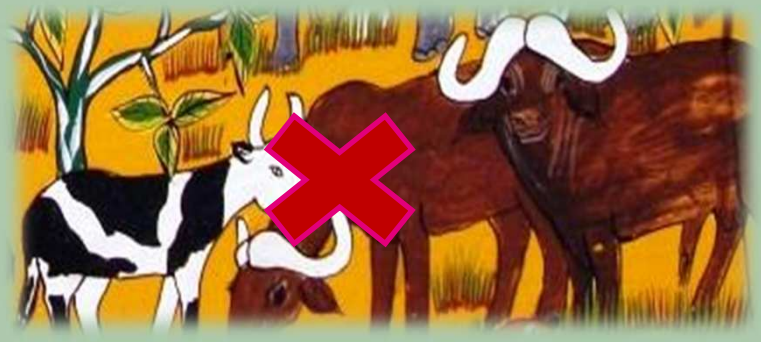


e.g., contact at 300m distance in less than 24h

R Scripts developped by V. Grosbois & R. Duboz

Potential for direct transmission of bTB from buffalo to cattle

- Aerosol transmission
- Time window = 0 (direct contact)
- Distance = 300m (GPS precision + size of herds+ 1 animal per herd)
- There is no direct interaction between cattle and buffalo



Potential for indirect transmission of bTB from buffalo to cattle

- Environmental transmission
- Time window = 30 days

  (Tanner & Michel, 1999)
- Distance = 300m (direct contact)

Buffalo ID	Herd	Nb of contacts
AU080	Southern	291
AU083	Southern	41
AU084	Southern	271
AU085	Southern	264
AU086	Northern	11
AU087	Northern	35
AU088	Northern	11
AU089	Northern	0
AU090	Northern	3

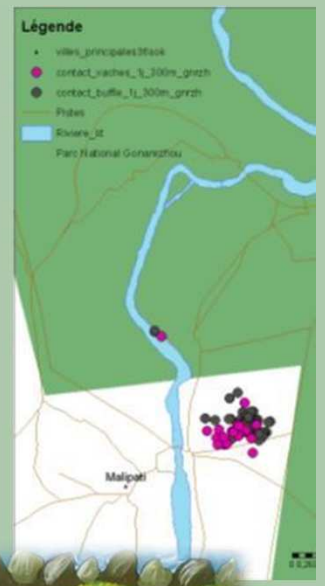
928 indirect contacts

Cattle ID	Nb of contacts
AU049	23
AU050	138
AU051	641
AU052	11
AU053	3
AU054	24
AU055	77
AU056	1
AU058	10

- There are indirect contacts between cattle and buffalo that could lead to bTB transmission

Potential for indirect transmission of bTB

- Spatio-temporal dynamics of contacts
  - Seasonality
  - Resource dependency(water and/or grazing)

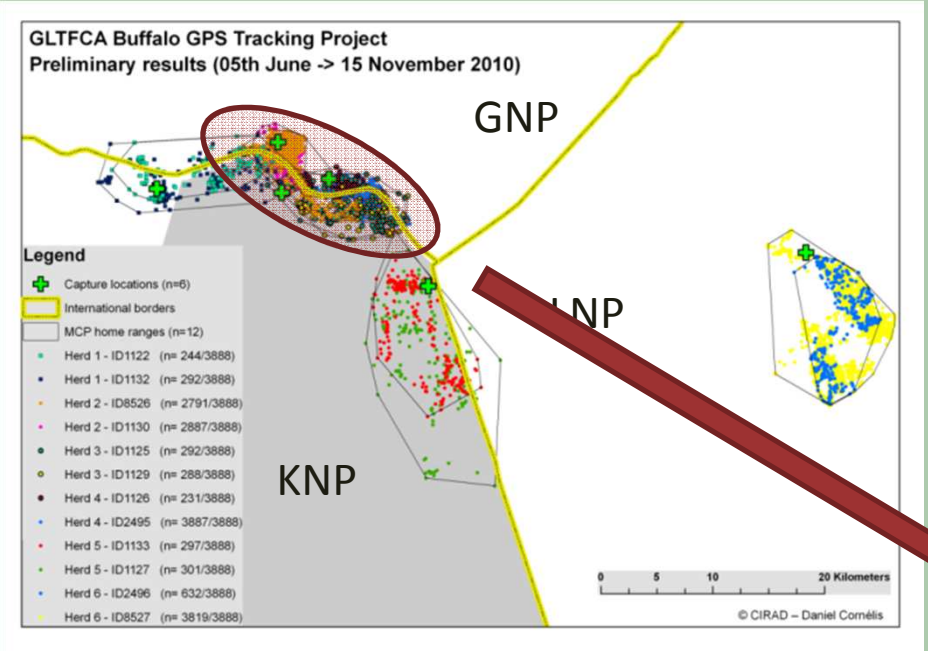


Conclusion

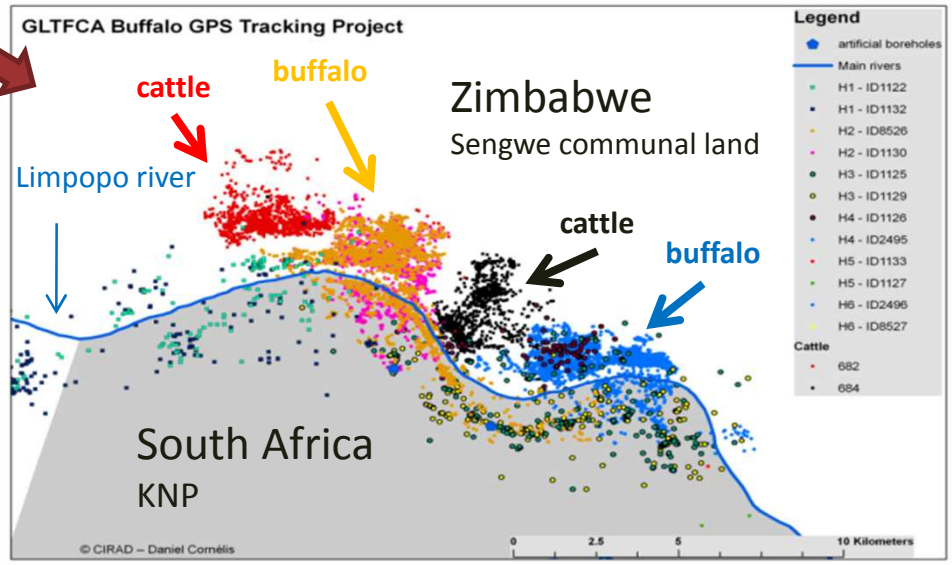
- bTB has spread from KNP buffalo to GNP buffalo
- bTB has not been confirmed in cattle
- We observed home range overlap between cattle and buffalo
- BUT no direct contact between buffalo and cattle has been observed
- Indirect contact were observed and varied:
  - Seasonally
  - Spatially
  - Individually
- **There is a risk for bTB spillover from buffalo to cattle through indirect contact**

Conclusion

- Rate of contact at the wildlife/livestock interface is an important parameter for disease modelling
- Can be extended to modes of transmission of other pathogens (on-going work on FMD, RVF, brucellosis, tick-borne diseases)
- Human/wildlife/livestock contacts should also be quantified for a complete « One Health » approach



- Zimbabwean vet services
- SANParks
- Mozambican vet services
- Zimbabwean Wildlife Authority
- Mozambican Parks



Transboundary Buffalo Movement project in the GLTFCA

- Pilot study June 2010
- Phase II scheduled for August 2011
- **Funding welcome!**

Acknowledgements

Onderstepoort Veterinary Laboratory, Pretoria

Research platform – PCP Zimbabwe

South African National PArks

Mammal Research Institute, Uni. Of Pretoria

- Zimbabwean Veterinary Services
- Park and Wildlife Management Authority

Funding:
- EU
- French cooperation

Merci de votre attention

Thanks to Irene for the paintings