Stray buffaloes

Group & Spatio-temporal Characteristics

Greater Kruger National Park & surrounds, 1998-2008

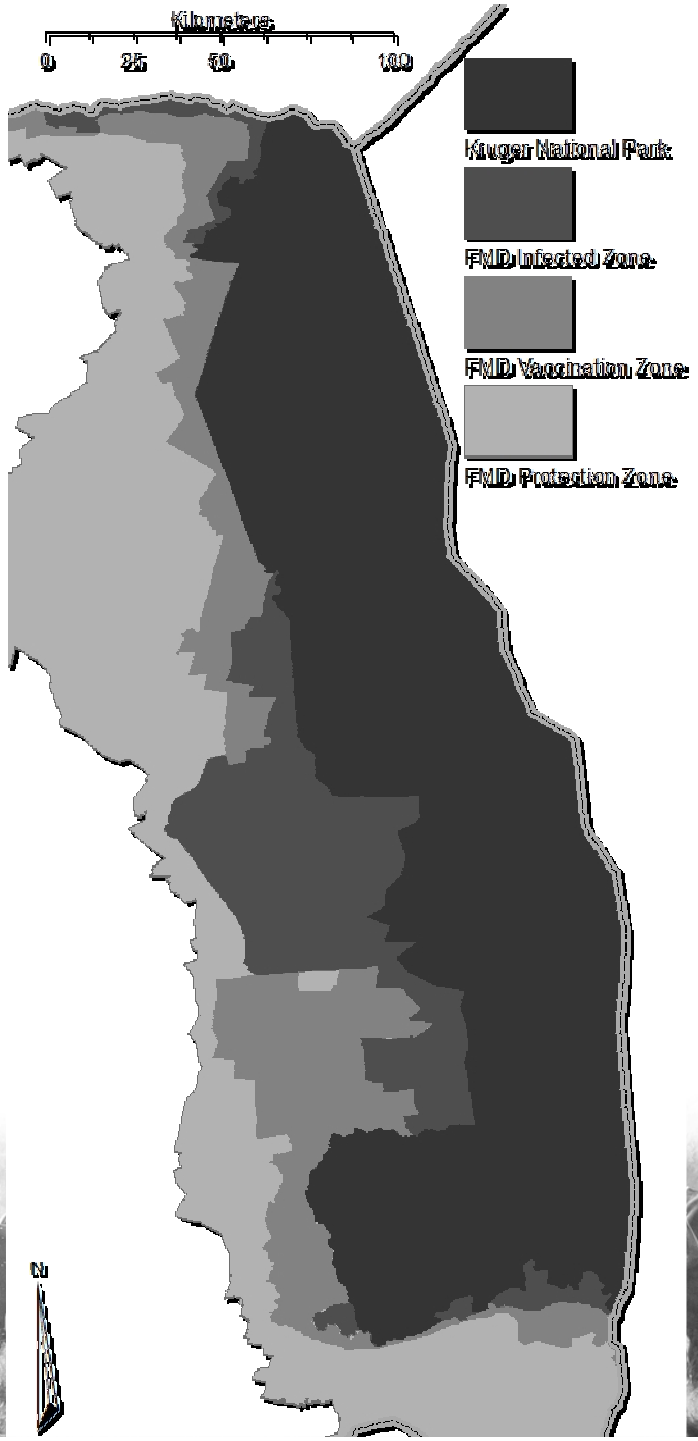
Background

- 40000-45000 African buffaloes (*Syncerus caffer*) in GLTP
- Buffaloes endemic host of FMD in Southern Africa
  - Makes eradication virtually impossible
- Up to 60% of KNP buffaloes harbour one/more SAT type FMD virus
- 85% of buffaloes >1 year exposed to all SAT FMD types
- Infection postulated to happen when calves lose maternal immunity
  - Synchronous calving species – i.e. concurrent susceptibility
  - Calf "epidemics"
- Calves & possibly sub-adults considered highest risk

Background

- Control mainly based on separation of buffaloes & cattle
  - Fencing
    - Type, ownership & maintenance varies along boundary
    - Vulnerable to damage by
      - People
      - Elephants
      - Flooding
    - Buffaloes generally "respect" fences
  - Vaccination
    - Efficacy recently called into question
- Exact mechanism for transmission from buffaloes to cattle remains speculative

Study area

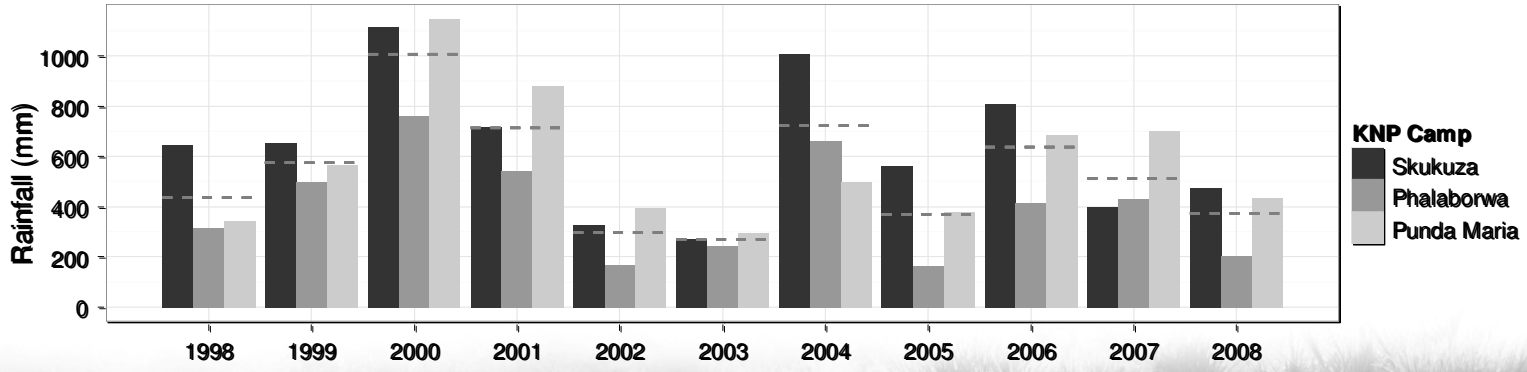

Kilometers
0
25
50
100
Kruger National Park
FMD Infected Zone
FMD Vaccination Zone
FMD Protection Zone
N

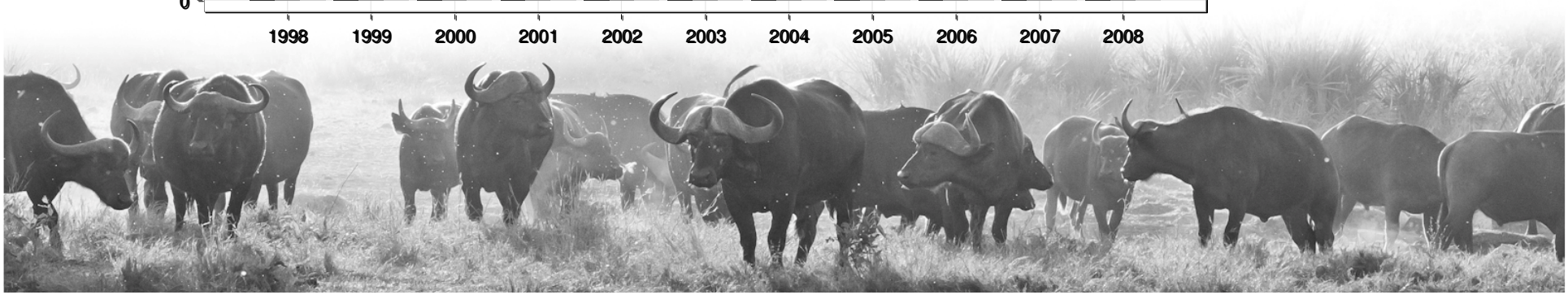
Source data

- 11 years: 1998-2008
- Official reports
  - Provincial & National Veterinary Services
  - Provincial Environmental Departments
- Spatial reports
  - Official reports (some)
  - Workshops with officials involved in control of stray buffaloes
    - Participatory mapping utilising high resolution imagery & fine scale data
- Duplicates removed
- Non-exhaustive

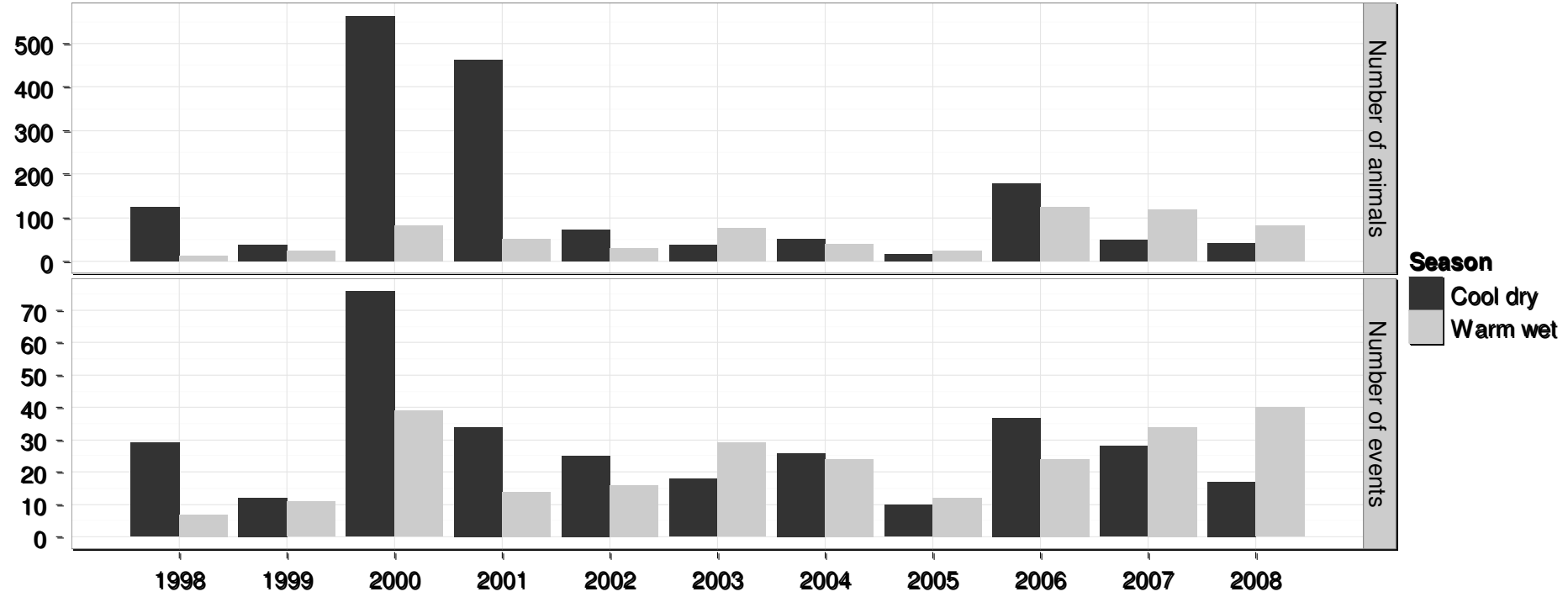
Main results

- Events: 645
  - 315 with adequate spatial info
- Animals: 3124
- 38.5% of events recorded in 2000/2001 "flood years"
- No significant seasonal pattern
  - Both number of events &/ number of animals





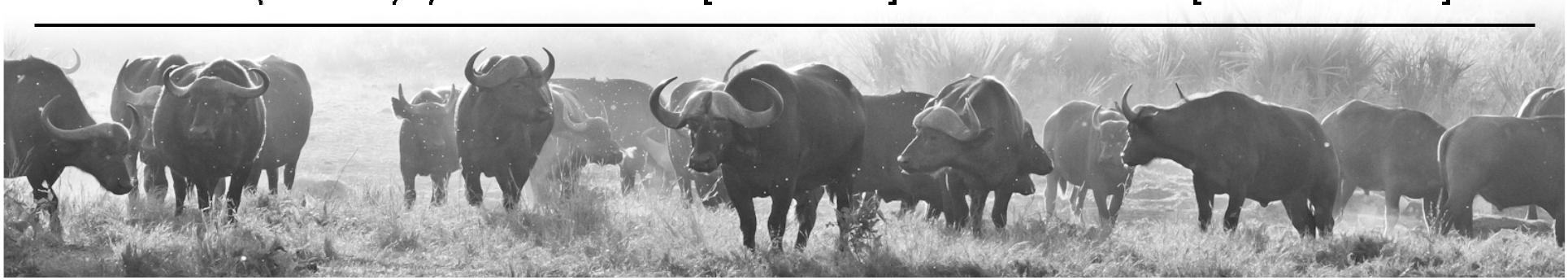
Temporal pattern



Group size

- Median: 1 [IQR: 1 – 2]
- Single animal: 46.5% of events
- >5 animals: 10% of events
- Only 7 events larger >50 animals
  - 3 of which during "flood years"
  - Max: 285
- Groups outside Park significantly smaller than census groups

Group	*Stray*	*KNP census*
Males ("Bachelor")	1 [IQR: 1 – 2]	3 [IQR: 2 – 6]
Mixed ("Family")	2 [IQR: 1 – 3]	130 [IQR: 44 – 292]



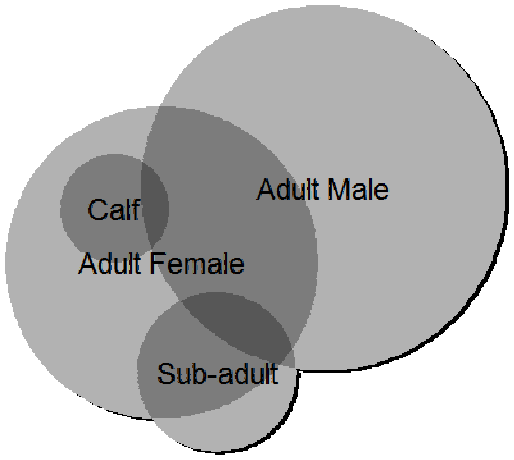
Group composition

- 55.3% of groups adult bulls only ("Bachelor groups")
  - 77.9% if which were single animals
- Young animals "underrepresented"
  - Sub-adults: only 9.5% of events
  - Calves: only 3% of events

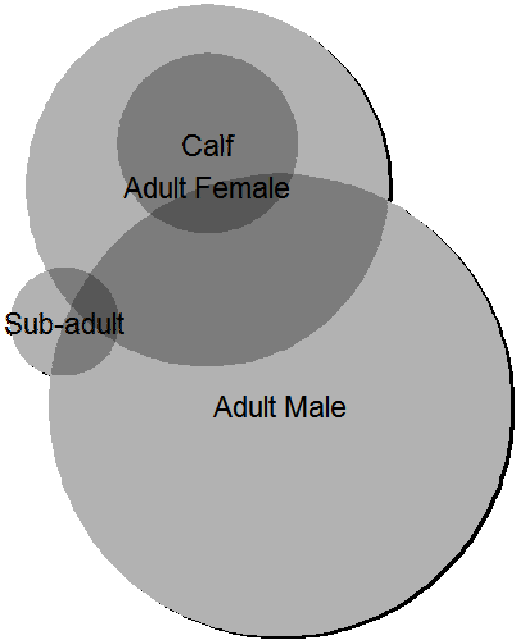
Group	*Stray*	*KNP census*
Sub-adult	7.3%	~32%
Calf	2.3%	~15%

Group composition

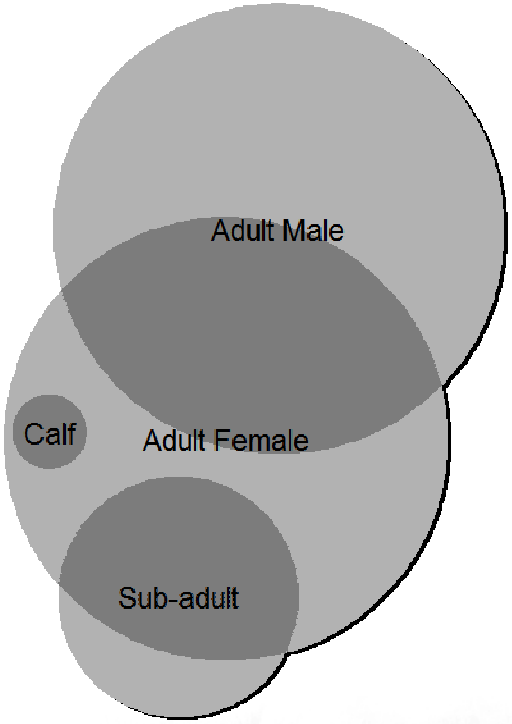
Overall



Cool dry

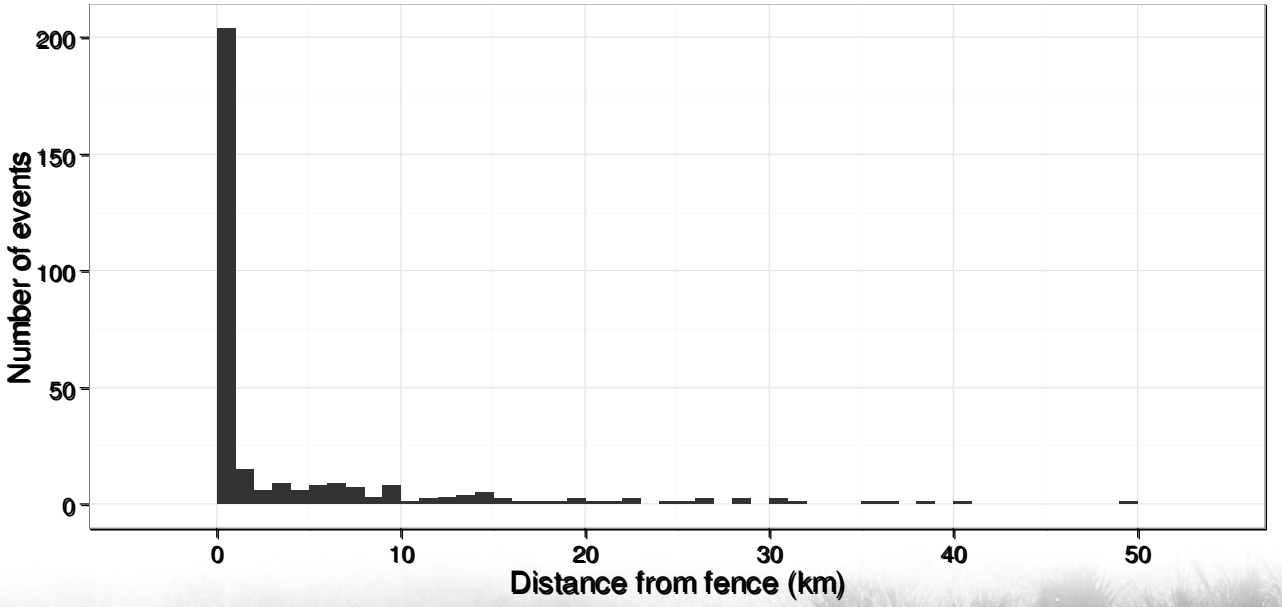


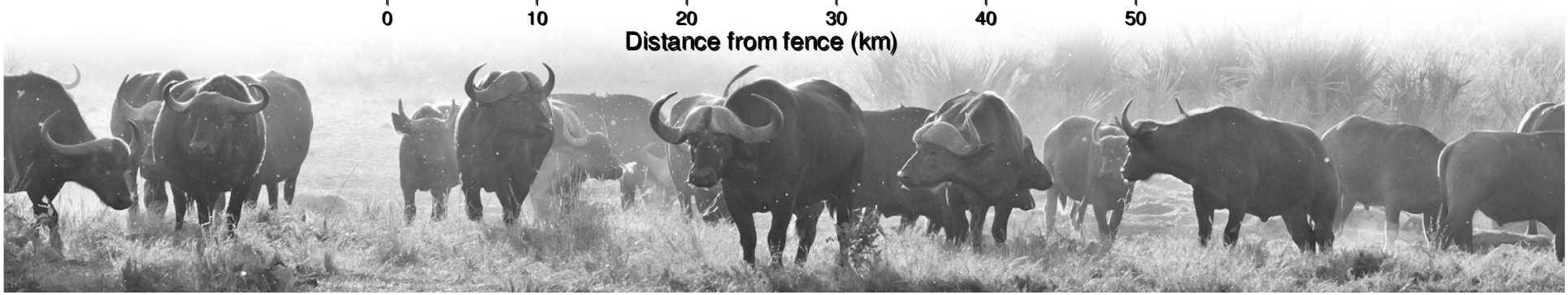
Warm wet



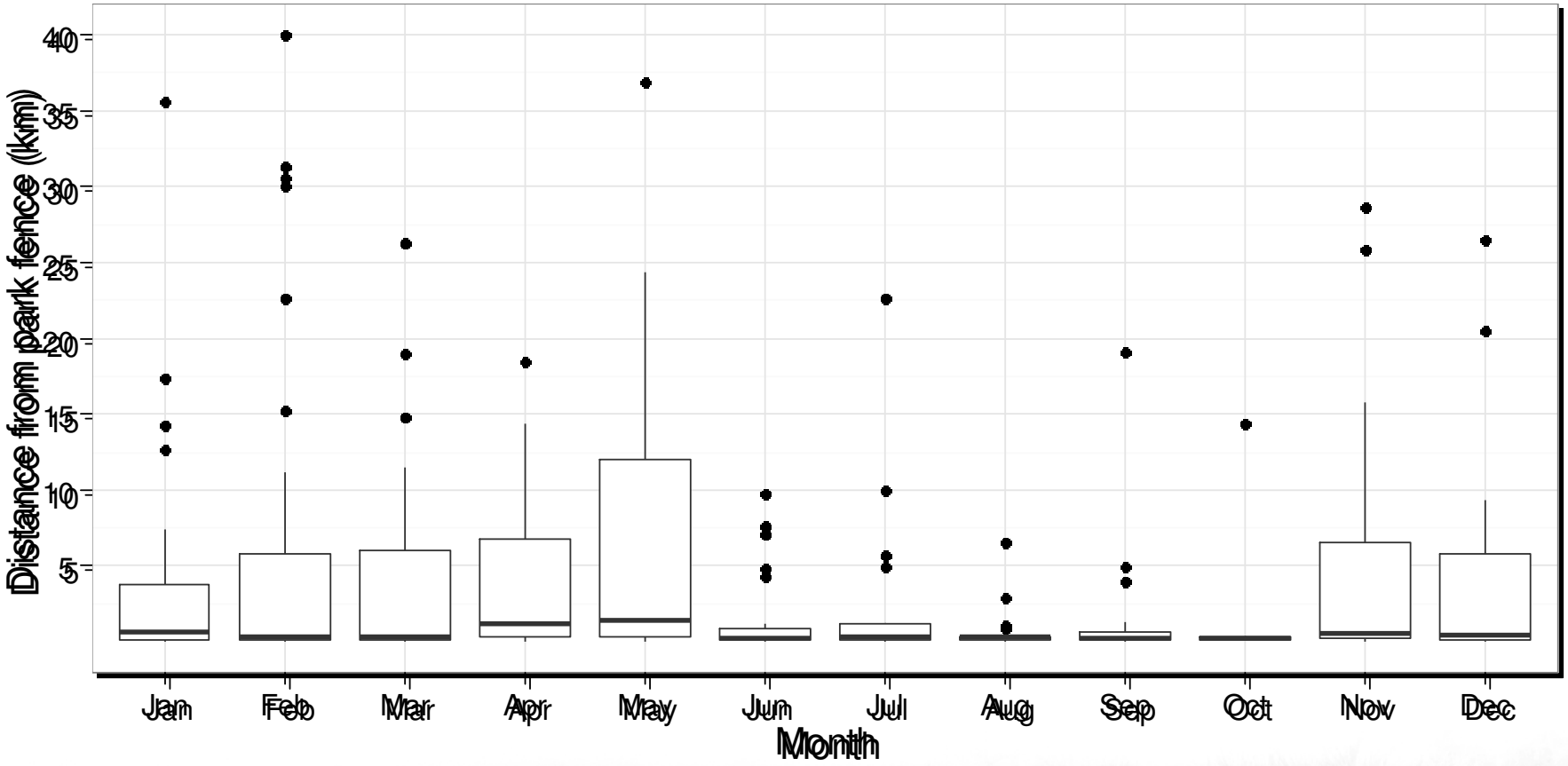
Spatial pattern

- 12.7% if events recorded beyond vaccinated area of protection zone
  - 32% of which during "flood years"
  - 38.2% of which bull groups

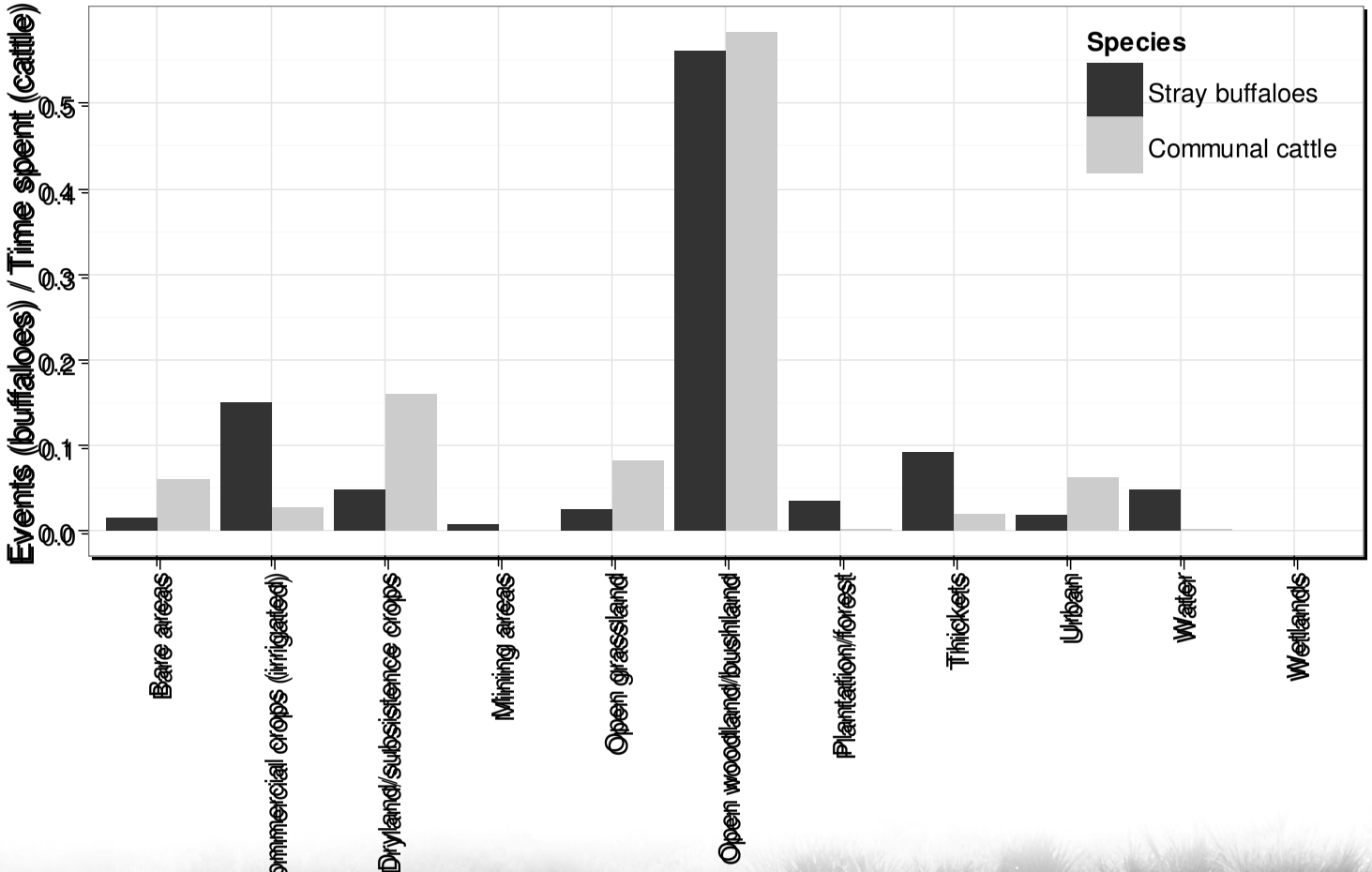




Spatio-temporal pattern



Cattle - Land Cover Overlap



Control/Resolution of events

- Destruction
  - 76.6% of events
  - Group size: 1 [IQR: 1 – 2]
- Chased back to Park
  - 6.2% of events
  - Group size: 10 [4 – 30]
- Translocation
  - 2.2% of events
  - Group size: 3 [1 – 4]
  - Distance from fence: 9.9km [IQR: 5.0 – 19.6km]
- Returned self
  - 5.1% of events
- Some not found
  - 8.8% of events

Discussion

- Impact of extreme events – eg flooding
- Generally small groups
  - mainly adult males
  - Young animals underrepresented
  - Low risk profile?
- Generally found very close to fence
- Period when animals moves shortest distance from fence coincides with period of perceived highest infectivity
- Very few manage to move through vaccination zone
- Resolution aimed at controlling all animals in group
  - Role of "acute stress" in shedding virus?

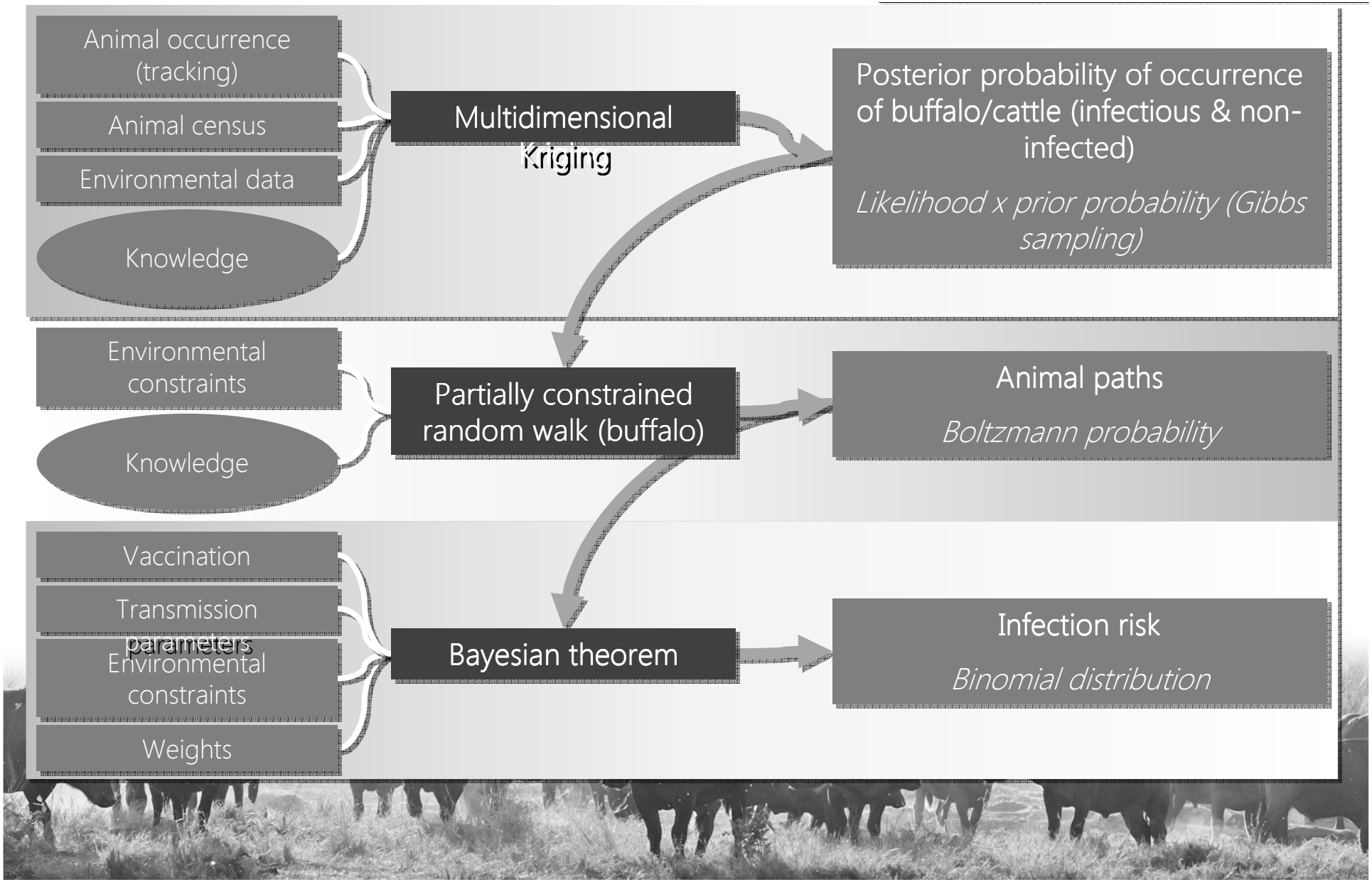
Potential bias?

- Recollection bias
- Reporting bias
  - Proximity to people
    - cattle herding distances vs reported distances from urban areas
    - Incentive for reporting stray animals
- Spatial data
  - Difficult to measure accuracy
  - Experienced officers with good orientation & landscape knowledge
- Non-exhaustive
  - Lost data (eg diaries)
  - Poor reporting

Conclusion

- Considering number of animals managing to escape from the Park & relatively "low" number of outbreaks
- Need for integrated/centralised data collection system on these events
  - preferably in conjunction with fence monitoring systems

Algorithm


Animal occurrence (tracking)
Animal census
Environmental data
Knowledge
Multidimensional Kriging
Posterior probability of occurrence of buffalo/cattle (infectious & non-infected)
Likelihood x prior probability (Gibbs sampling)
Environmental constraints
Knowledge
Partially constrained random walk (buffalo)
Animal paths
Boltzmann probability
Vaccination
Transmission parameters
Environmental constraints
Weights
Bayesian theorem
Infection risk
Binomial distribution

Thank you

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Peace Parks Foundation

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Mpumalanga Veterinary Services

Mpumalanga Tourism & Parks Agency

Limpopo Veterinary Services

Limpopo Department of Economic Development, Environment & Rural Development