

# Identifying high risk areas

# for Foot-and-mouth Disease (FMD) outbreaks in South Africa

Sirdar M.M.<sup>1</sup>, Gummow B.<sup>1,3</sup>, Blignaut B.<sup>1,2</sup>, Mampane R.L.<sup>4</sup>, Rikhotso O.<sup>5</sup>, Du Plessis B.<sup>5</sup>, Fosgate G.T.<sup>1</sup>

<sup>1</sup> Epidemiology Section, Department of Production Animal Studies, Faculty of Veterinary Sciences, University of Pretoria, Onderstepoort, 0110, South Africa, e-mail: sirdar44@hotmail.com | <sup>2</sup> Trans-boundary Animal Diseases Programme, Onderstepoort Veterinary Institute, Agricultural Research Council, Onderstepoort, 0110, South Africa | <sup>3</sup> College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, 4811, Queensland, Australia | <sup>4</sup> Limpopo Veterinary Services, Department of Agriculture and Rural Development, Polokwane, Limpopo, South Africa. | <sup>5</sup> Mpumalanga Veterinary Services, Department of Agriculture, Rural Development, Land and Environmental Affairs, Mpumalanga, South Africa.



## WHY?

Foot-and-mouth disease (FMD) is a controlled disease in accordance with the South African Animal Diseases Act (Act 35) of 1984. In South Africa, FMD is endemic in the Kruger National Park (KNP), where it is maintained through persistent infections of African buffalo. During 2005-2015, at least one FMD outbreak has occurred per year in the FMD protection zone with the exception of 2005, 2007, and 2008 (Table 1). Continuing outbreaks in the protection zone threatens the FMD-free status of the remainder of the country.

## WHERE?

Areas serviced by dip-tanks (crushes) in the vaccinated FMD protection zone of Mpumalanga and Limpopo Provinces.

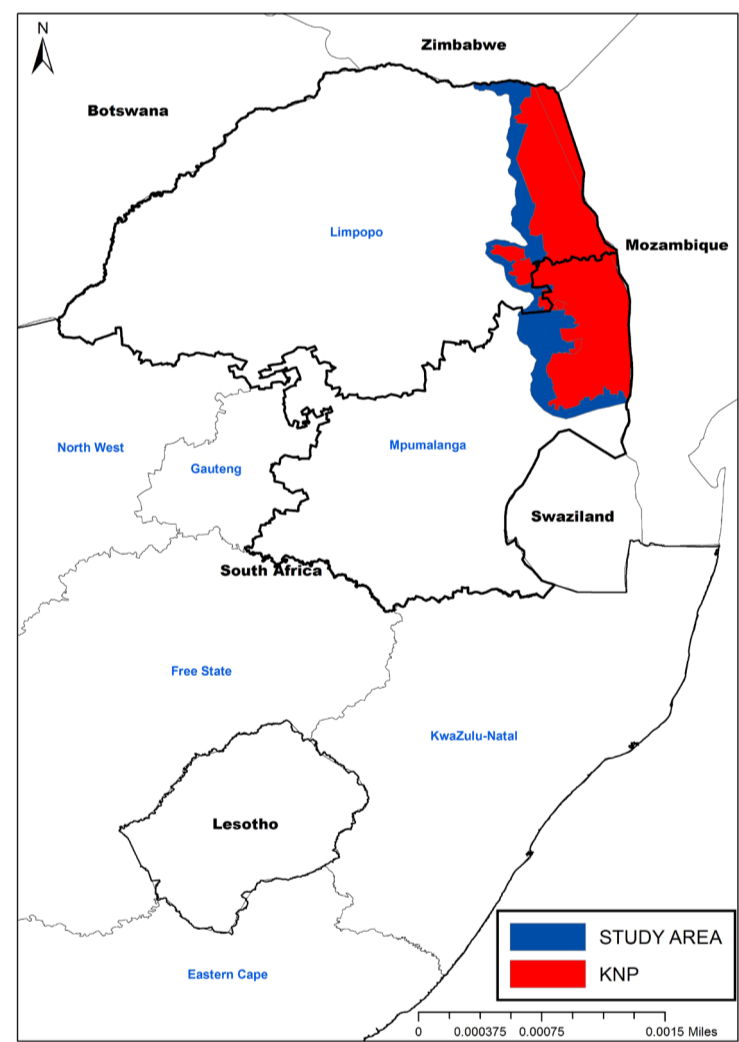


Figure 1: Study Area-FMD Protection Zone with Vaccination (Limpopo and Mpumalanga)

## WHO?

Cattle residing in the FMD protection zone and at risk for infection with FMD virus (FMDV).

## WHEN?

Data for the years 2005-2015 collected from provincial veterinary services databases and the World Animal Health Information Database (WAHIS) Interface.

## HOW?

1. Calculated the proportion of FMD affected cattle at the dip-tank level (dependent variable).
2. Assessed affected proportions and cattle numbers for normality by performing the Anderson-Darling test.
3. Developed isopleth risk maps using ordinary kriging of affected cattle proportions and cattle numbers in ArcGIS 10.2 (ESRI, 2014).
4. Evaluated spatial autocorrelation using Moran's I.

## WHAT?

### Results

- Mpumalanga and Limpopo FMD protection zones with vaccination had 193 functioning dip-tanks with 73% (141/193) being located in Mpumalanga Province (Figure 1).
- The proportion of affected cattle and cattle at the start of each outbreak were not normally distributed and therefore log transformed prior to statistical analysis.
- There was significant spatial clustering of the proportion of cattle affected by FMD in Limpopo and Mpumalanga Provinces (Table 2).

- The risk of FMD outbreaks were descriptively higher for the dip-tanks that were close to the western boundary of the Kruger National Park (KNP) (Figure 2).
- The risk of FMD outbreaks in the Ehlanzeni North-Bushbuckridge area of Mpumalanga Province appeared to increase with increasing cattle and dip-tank density (Figure 3).
- Cattle density and affected cattle proportions also appeared to be descriptively related within Limpopo Province.

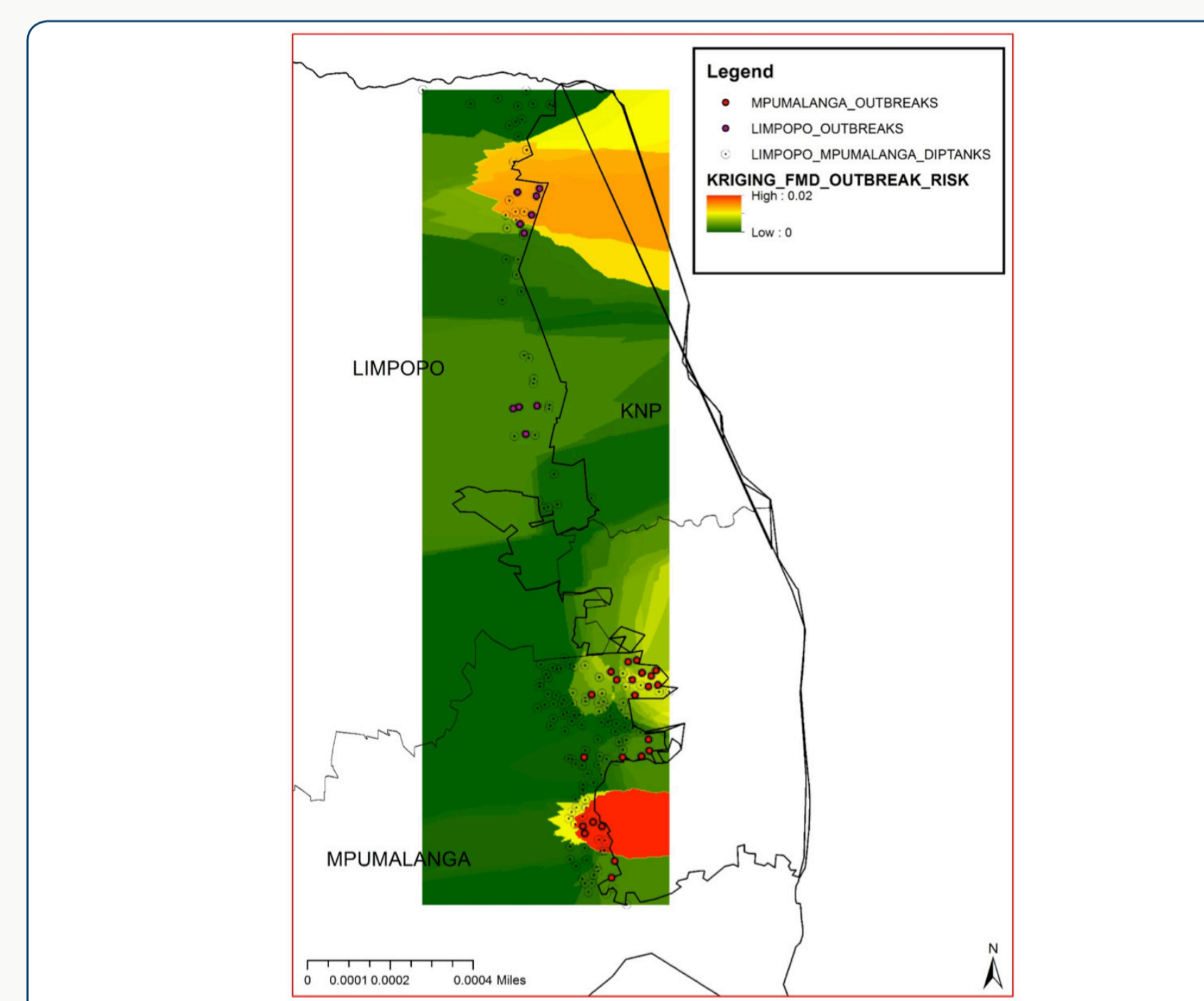


Figure 2: Kriging proportion of cattle affected by FMDV (Limpopo and Mpumalanga)

Table 1: FMDV outbreaks in Mpumalanga and Limpopo FMD protection zones with vaccination (2005-2015)

Year	Province	Start of outbreak	End of outbreak	No. of affected dip-tanks	Serotype
2009	Mpumalanga	06 Sep 2009	14 May 2010	4	SAT 1
2011	Mpumalanga	30 Dec 2011	27 Jul 2012	7	SAT 2
2013	Mpumalanga	06 Aug 2013	10 Feb 2015	12	SAT 2
2006	Limpopo	31 Jul 2006	23 Nov 2006	2	SAT 3
2013	Limpopo	17 Jul 2013	01 Dec 2013	4	SAT 1
2015	Limpopo	08 Dec 2015	31 May 2016	6	SAT 3

Table 2: Moran's I spatial autocorrelation

	Moran's I Index	P-value
Mpumalanga Province	0.061	<0.001
Limpopo Province	0.061	0.005
Mpumalanga & Limpopo Combined	0.125	0.129

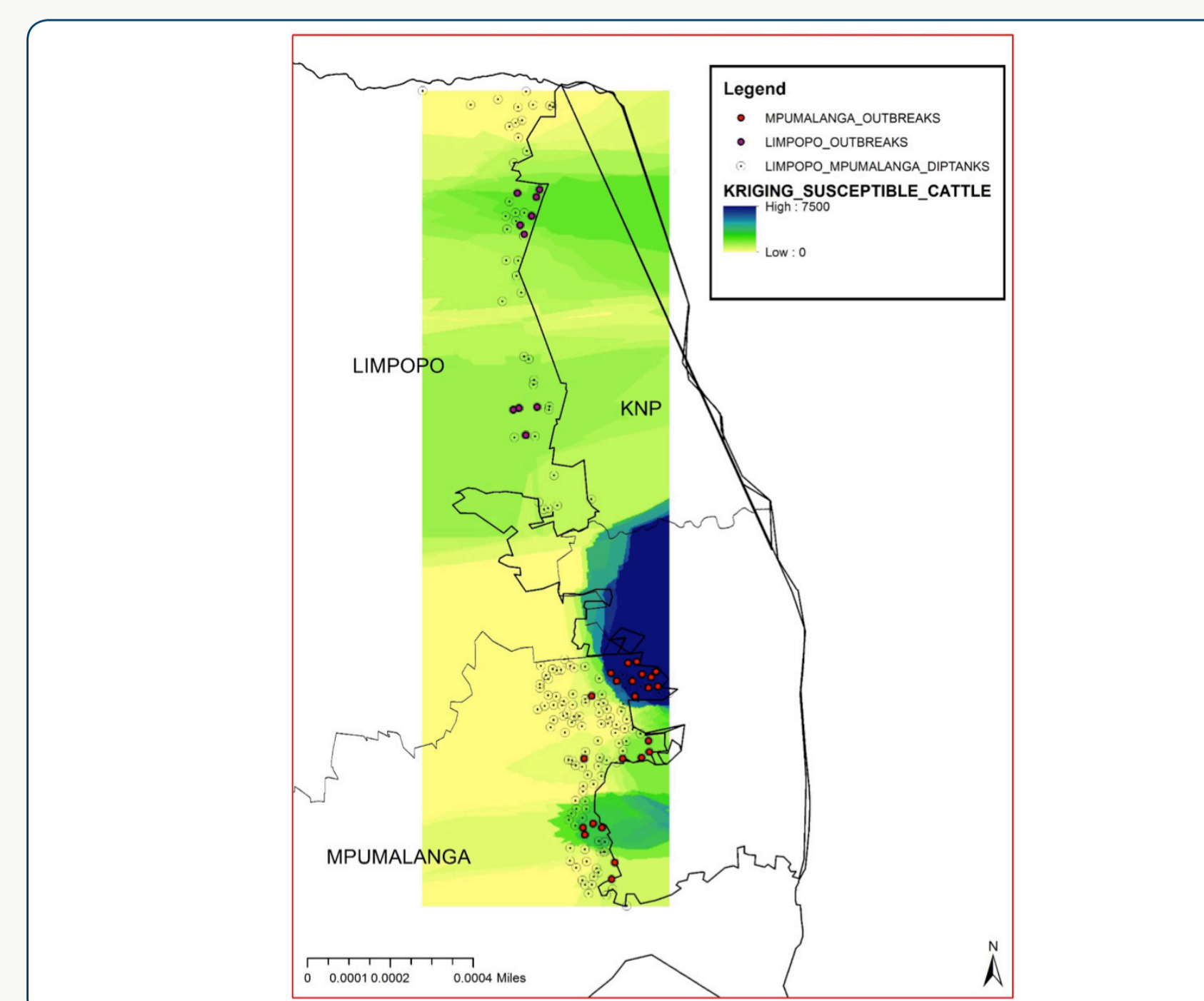


Figure 3: Kriging cattle susceptible for FMD outbreaks (Limpopo and Mpumalanga)

## Discussion

- The combined analysis of FMD outbreaks in both provinces was not significant despite significant clustering when each province was evaluated on its own.
- The cattle distribution might have an important effect on the observed clustering and further analyses are necessary to assess these patterns.
- The two dip-tanks further away from the western boundary of KNP might have been false-positives rather than representing true FMD outbreaks. Few cattle were affected in these dip-tanks (1/870 and 3/1344 respectively) and clinical signs and PCR were used to confirm the FMDV spread rather than virus isolation.

## THEN?

The further analysis of risk factors for FMD outbreaks in the protection zone of the country is on-going. Results could be used to inform policy related to FMD control measures.

## ACKNOWLEDGMENT

- This work is based on research supported in part by the National Research Foundation of South Africa. (Grant Numbers 90578 and 76734)
- Mpumalanga Veterinary Services.
- Limpopo Veterinary Services.
- Centre of Wildlife Studies-Hans Hoheisen Wildlife Research Station.

