

# Introduction to risk assessment

**Inception workshop of the project “Strengthening the regional preparedness, prevention  
and response against lumpy skin disease in Belarus, Moldova and Ukraine” (TCP/RER/3605)**

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## Background

The mechanisms by which lumpy skin disease virus (LSDV) is transmitted between animals is not completely clear. The main transmission mechanism have been suggested to be a variety of blood-feeding vectors that would mechanically transmit the virus (EFSA, 2015).



Due to the fact that vectors play a key role in LSDV transmission, the spread and geographical distribution of the disease is likely to be heavily influenced by climatic conditions, and the presence of surface water. However, there have been few attempts to model the spatial distribution of LSD

# Objective

To analyse the association between the **reported LSD outbreaks** with:

- climatic variables
- land cover
- cattle density

In order to provide information for the design of surveillance and awareness systems, and preventive measures, e.g. vaccination programs.

# Data

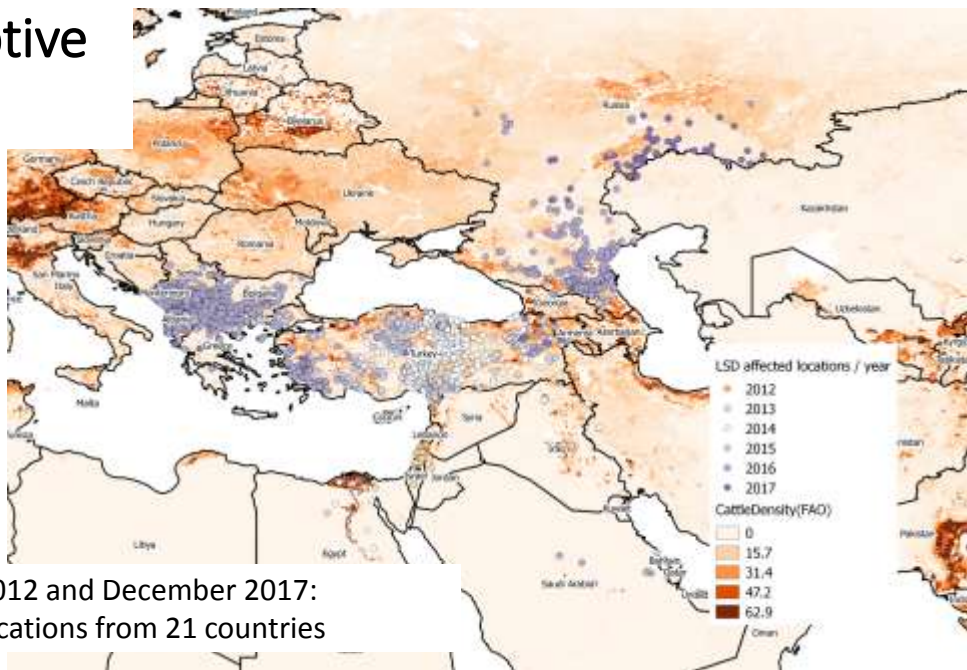
EMPRES-i and ADNS animal health databases: LSD affected locations: date, geographical coordinates and at risk, affected and dead animals  
Between July 2012 and December 2017

Zone: the Balkans, Turkey, the Russian Federation, Caucasus and Middle East regions

More detailed information (number of affected locations) was obtained directly from Albania, Kosovo, the Former Yugoslav Republic of Macedonia, Montenegro and the Russian Federation.

Coordinates of the affected villages were extracted from Google Map Developers web page (<http://www.mapdevelopers.com/index.php>).

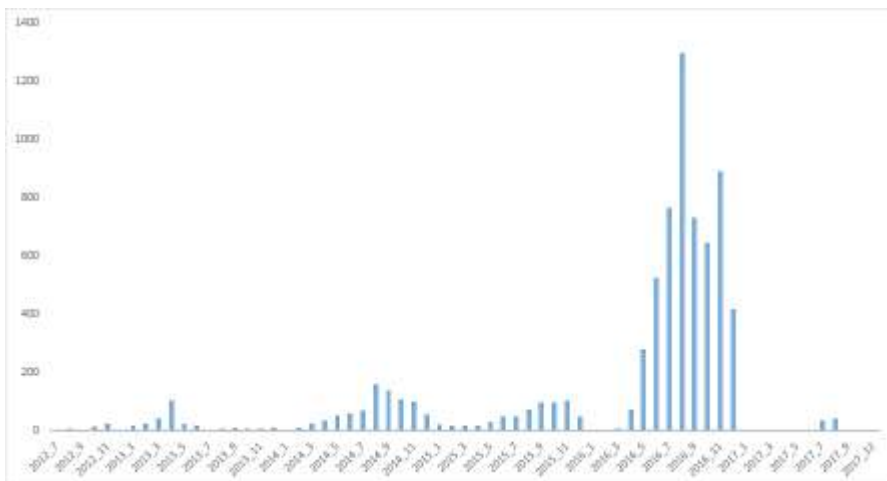
## Descriptive results



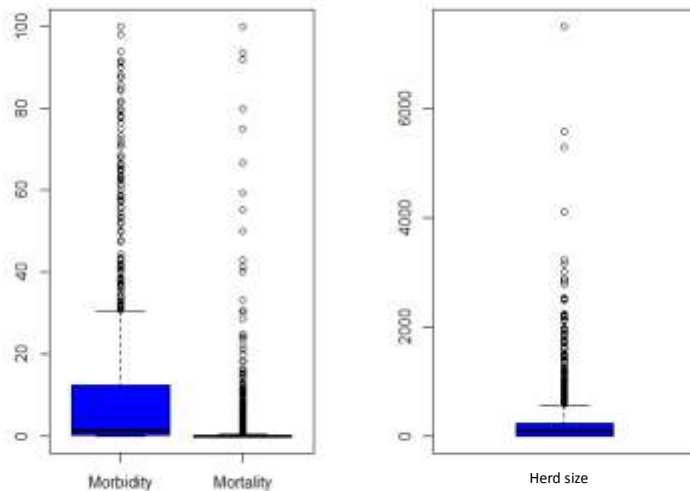
Between July 2012 and December 2017:  
7,529 locations from 21 countries

## Descriptive results

Between July 2012 and December 2017:  
Most of them between May – November 2016



## Descriptive results



Morbidity and mortality in each location:

- Range from 0 to 100%
- Median values: morbidity 1.4% mortality 0% (in most of the locations no mortality was observed).

Herd size: Range from 1 to 7,500 with a median of 90

In some locations the number of animals was very low.

## Spatial Analysis

- Density of cattle: obtained from FAO (Robinson et al. 2014) at a 5km<sup>2</sup> resolution.
- Climate raster data: we obtained the 19 bioclimate variables available at the worldclim resolution
  - Annual mean temperature
  - Temperature ranges
  - Precipitation ranges
  - Average values for the years 1970 to 2000 (Fick et al. 2017).
- Land cover

# Spatial Analysis

Shrublands and savannas

- Land cover: we used the 0.5 km MODIS-based Global Land Cover. It classifies land cover in 16 different categories

We grouped the 16 categories into seven:

Water, urban categories  
(where no susceptible host  
species are expected)



Barren or sparsely vegetated areas.



Shrublands and savannas



Permanent wetlands



Cropland and natural  
vegetation mosaic



Grasslands



Forest (all categories)



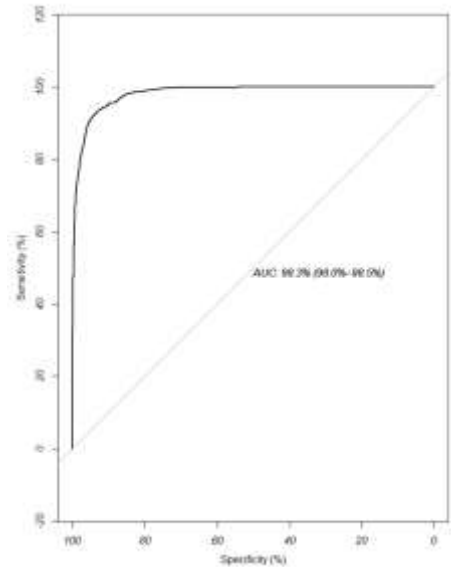
# Spatial Analysis

For modelling purposes, we divided the area of study into a regular grid of 20km by 20km cells. The LSD status of a grid cell was considered as positive if it had at least one positive location and negative otherwise.



# Spatial Analysis

The area under the ROC curve generated using predictions from the model with spatial random effects was 0.98 indicative of a model with very good ability to discriminate between LSD positive and negative grid cells



# Spatial Analysis

Big differences in the odds of being LSD positive due to the **type of land cover**: areas with **sparse vegetation had a much lower** risk of infection as compared to the other land cover categories.

The odds of a grid cell being LSD positive was increased also by the **density of cattle**.

Two climatic variables were also important:

- the annual **precipitation**
- the **temperature** seasonality.

# Spatial Analysis

Adjusted odds ratio and their 95% confidence interval (CI) for each of the risk factors from the hierarchical Bayesian model

	Coefficient	2.50%	97.50%
Cattle density	1.0004	1.0003	1.0005
Land cover: croplands †	4.5294	2.0021	10.4594
Land cover: forest †	3.7311	1.5086	9.3652
Land cover: grassland †	3.6656	1.5677	8.7294
Land cover: permanent waterland †	19.1404	2.6746	124.6238
Land cover: shrubland †	2.9660	1.2596	7.0993
Precipitation Seasonality ‡	0.9981	0.9833	1.0130
Annual Precipitation	1.0024	1.0011	1.0037
Temperature Seasonality §	1.0063	1.0031	1.0095
Mean Diurnal Range ¶	1.1601	0.9974	1.3522

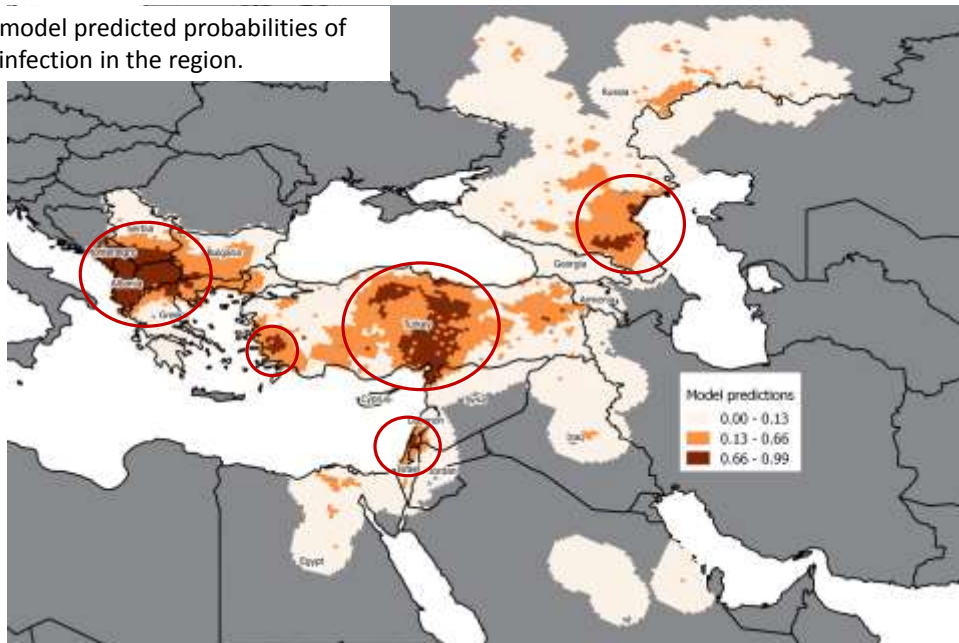
† The reference category for land cover was sparse vegetation.

‡ Precipitation Seasonality: Coefficient of Variation.

§ Temperature Seasonality: standard deviation \*100.

¶ Mean Diurnal Range: Mean of monthly (maximum temperature - minimum temperature)

The model predicted probabilities of LSD infection in the region.



## Conclusion

The risk of LSD infection was linked to:

Cattle density

Type of land cover

Climate variables (temperature and precipitation).

These information could be useful for veterinary services for the development of risk based surveillance, vaccination and general awareness programs by targeting cattle in high risk areas.

Next step: predict risk of infection in Eastern Europe (and central Asia?) by using this model.

## Acknowledgements

Outbreak data providers:

- Sector of Epidemiology and Identification Registration at the Ministry of Agriculture and Rural Development (Albania),
- Food and Veterinary Agency (Kosovo)
- Food and Veterinary Agency (the Former Yugoslav Republic of Macedonia)
- Food Safety, Veterinary and Phytosanitary Affairs Agency (Montenegro), Federal Research Center for Virology and Microbiology (VNIIVVIM; Russian Federation).

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