ROSLIN

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Environmental and anthropological factors affect the spread of foot-and-mouth disease in Africa: a novel modelling approach

Introduction

- Significant economic losses in African countries due to foot-and-mouth disease virus (FMDV)
- In Africa there is very little knowledge about the strains present, movements and spreading patterns of FMDV
- Landscape and anthropogenic might influence the spread of FMDV

Aims

- Investigate the movement patterns of FMDV lineages between countries using sequence data and phylodynamic methods
- Determine the effect of environmental and anthropological factors on the disease spread

Phylodynamic and Phylogeographic methods

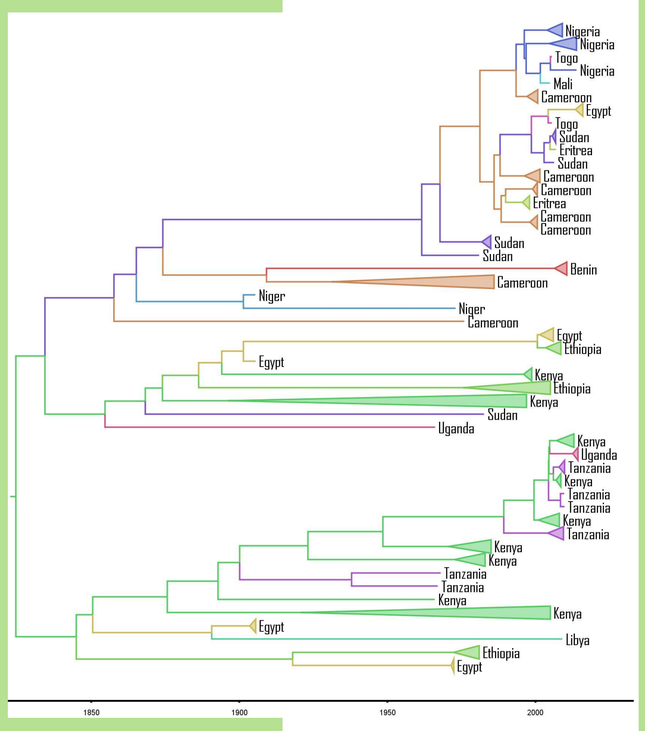
- Infer a posterior set of time-resolved trees (BEAST)
- Include discrete traits
- Use of a generalized linear model (GLM) to incorporate environmental and anthropological heterogeneity using the circuit theory

Data

- 183 sequences of FMDV strain A
- 357 sequences of FMDV strain O
- Rasters of human density, cattle density, elevation, landcover, average precipitations and average temperature

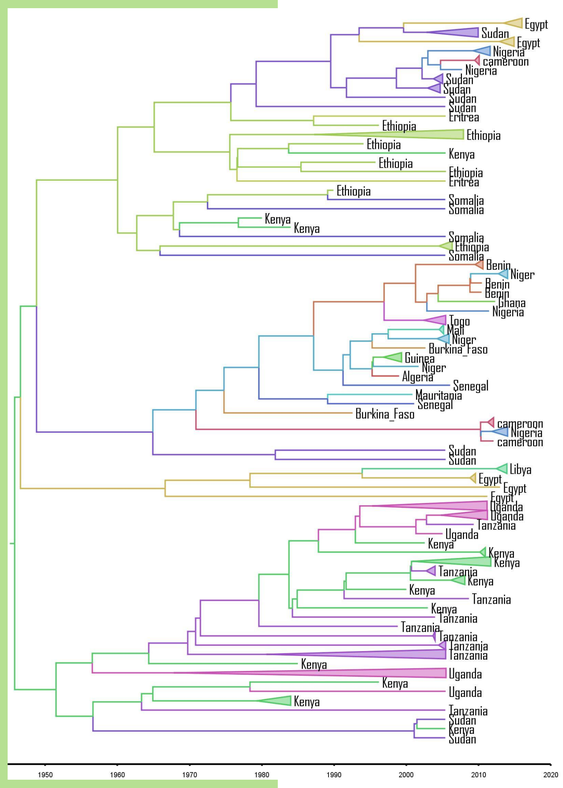
Transmission history

FMDA



- Most recent common ancestor around 1825 in Kenya
- Three main clades, two in eastern Africa and one in western Africa

FMDO

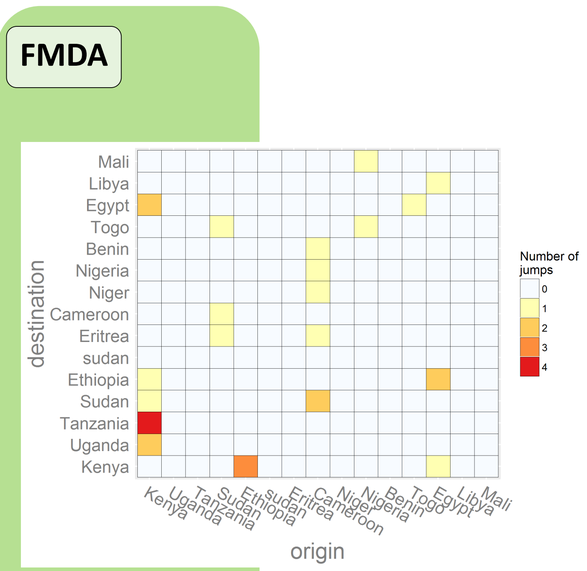


- Most recent common ancestor around 1940 in Kenya
- Few links between the western and eastern side of Africa

Number of transmission events

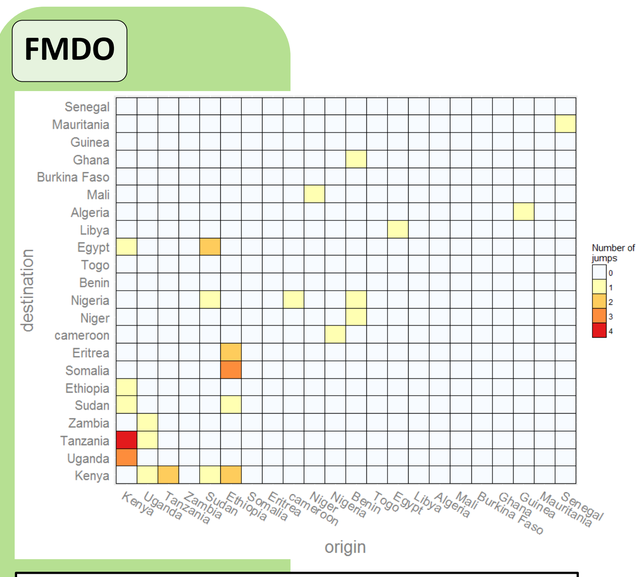
- Count of the number of the migration events (jumps) between two countries along the virus phylogeny
- Quantitatively measure of gene flow between country

FMDA



- Many short and long distance unidirectional transmission events from Kenya and Cameroon

FMDO

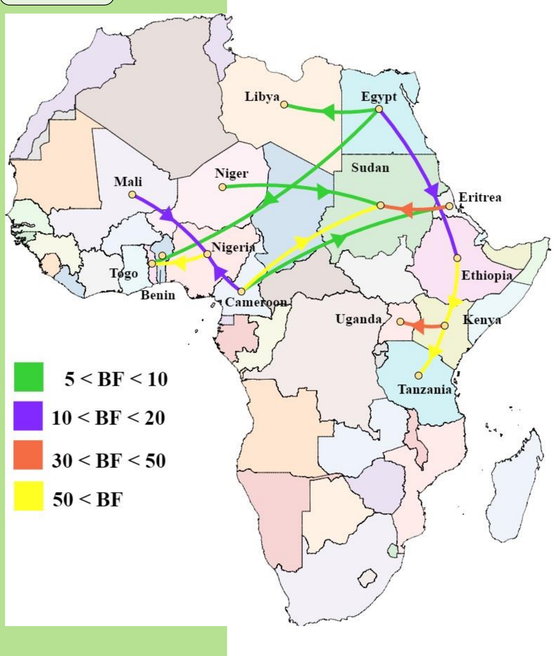


- Many transmission events on the eastern part of Africa
- Smaller number of transmission events on the western part of Africa

Signifiant transmission routes

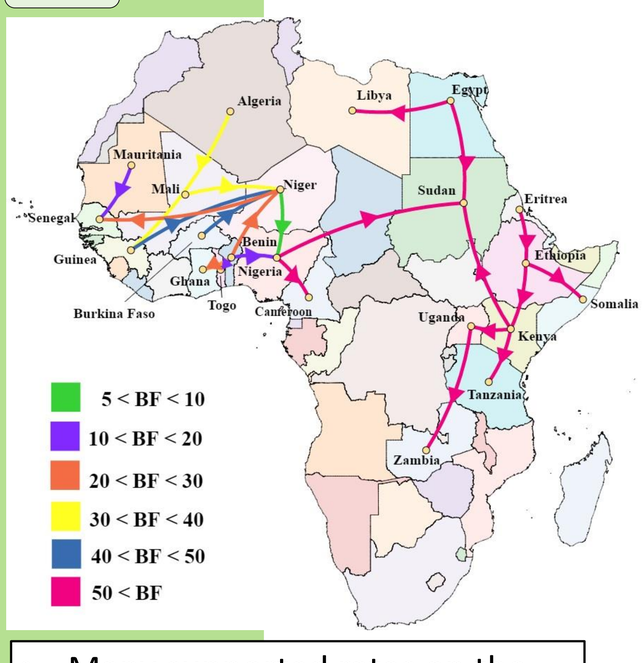
- Best supported rates of discrete transitions between countries

FMDA



- Supported rates of transition between the two sides of Africa

FMDO



- Many supported rates on the eastern part of Africa
- One single supported rate of transition between the two sides of Africa

Environmental and anthropological factors effect

- Parameterisation of each rate transition as a function of predictors

FMDA

- Strong effect of the human density, forest density and temperature on the western part of Africa
- Important effect of the bare areas on the eastern part

FMDO

- Strong effect of the human density on the western part of Africa
- Important effect of the forest areas on the eastern part of Africa

BBSRC bioscience for the future
EBRC Easter Bush Research Consortium
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