

## COMPLETE GENOME ANALYSES OF FOOT- AND-MOUTH DISEASE VIRUSES BELONGING TO SEROTYPES O, A AND SAT 2 IN EAST, WEST AND NORTH AFRICA

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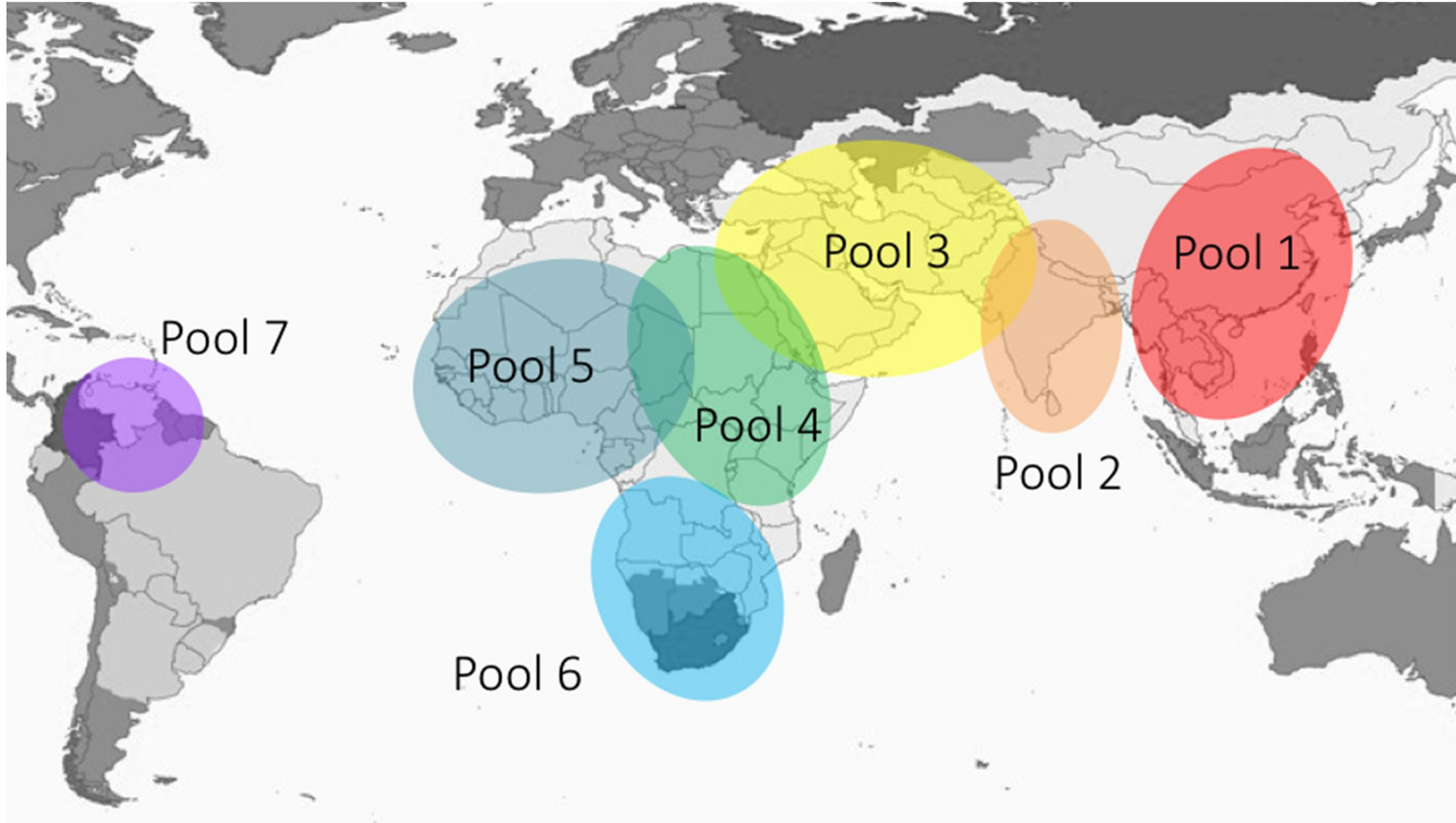
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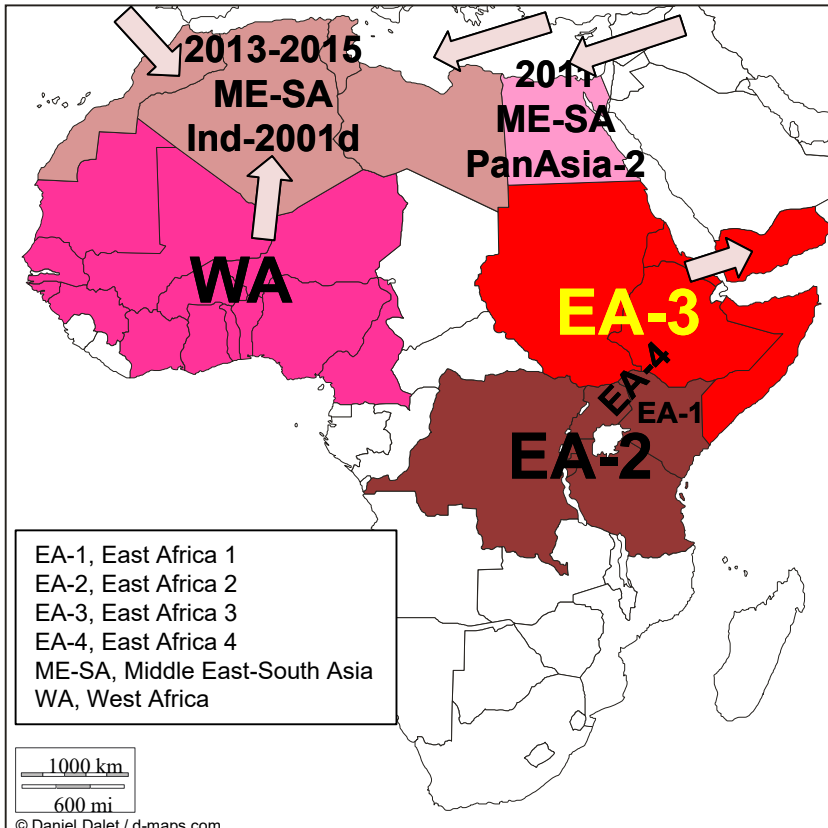


# FMD Virus Pools

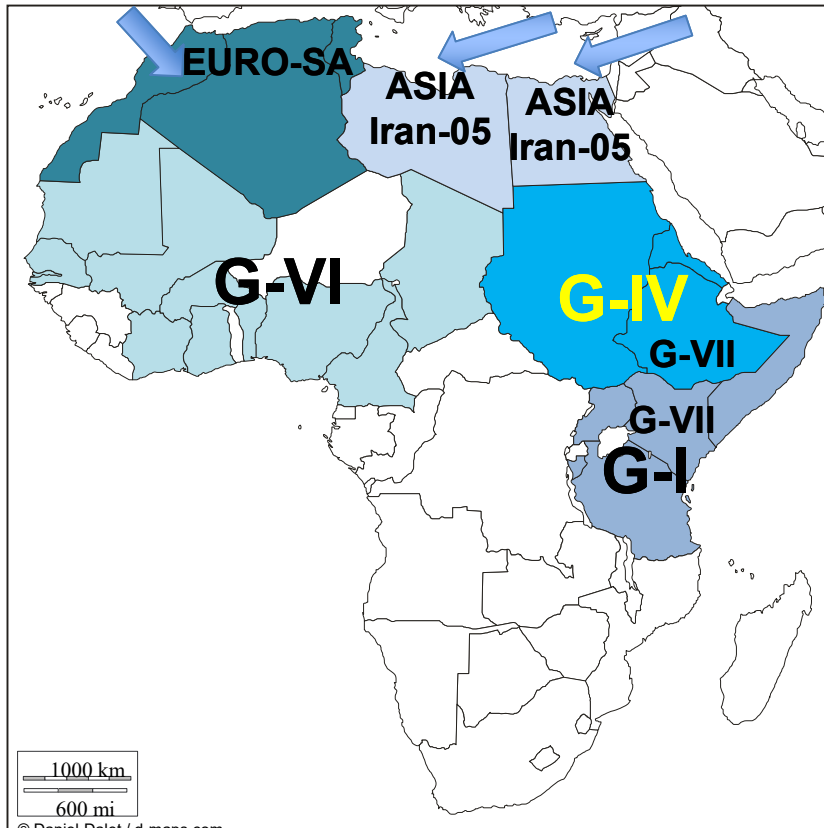


# FMDV Historical Distribution in Pools 4 & 5

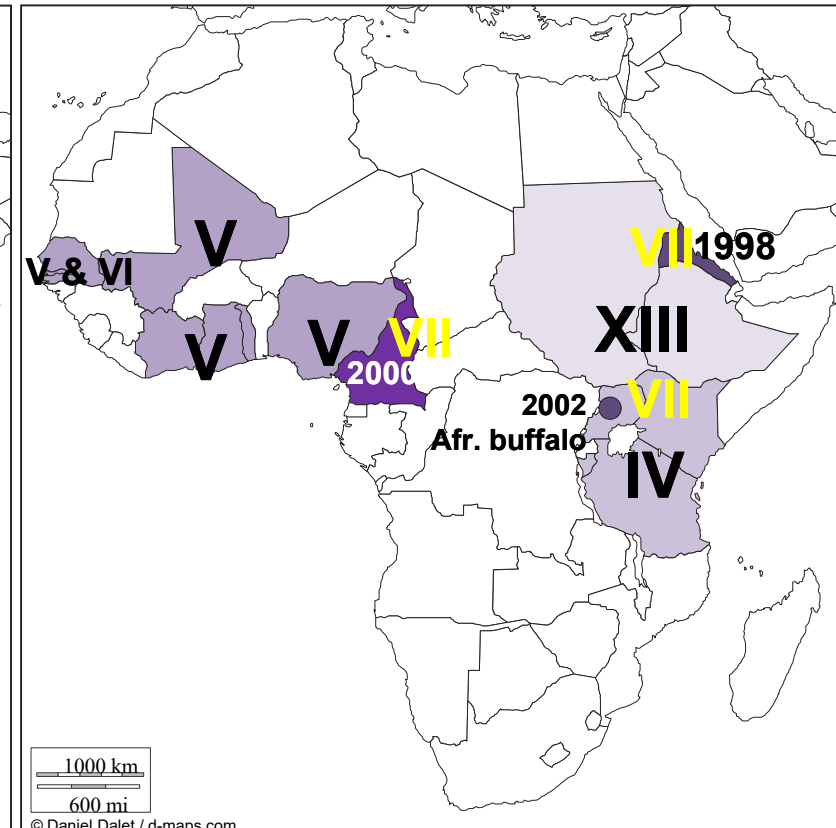
**Type O**



**Type A**



**Type SAT 2**



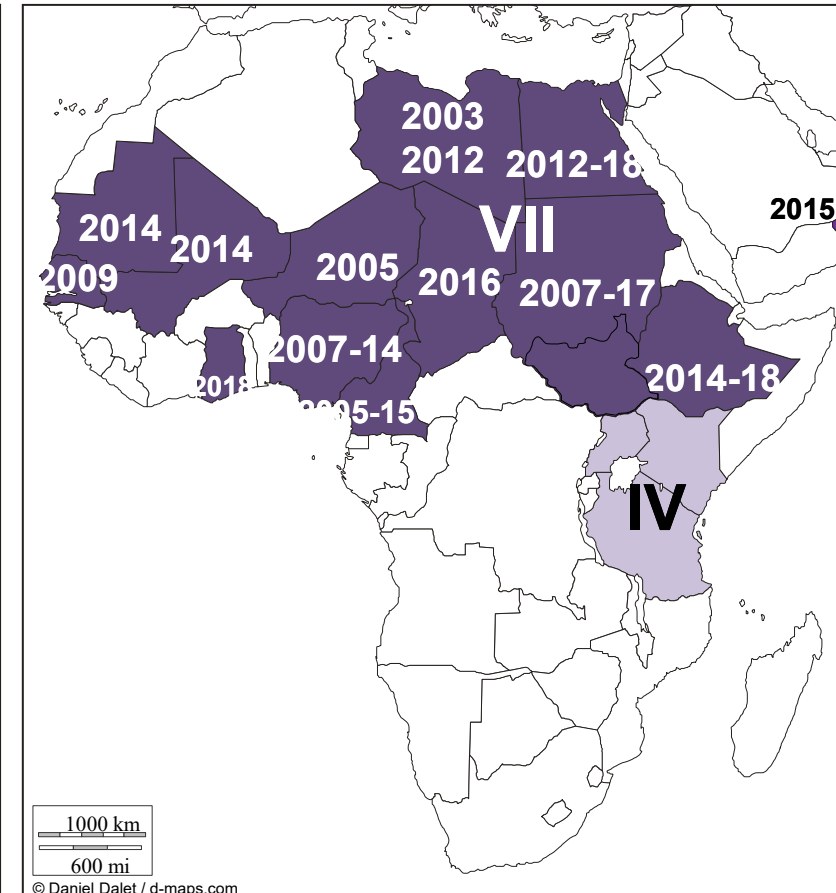
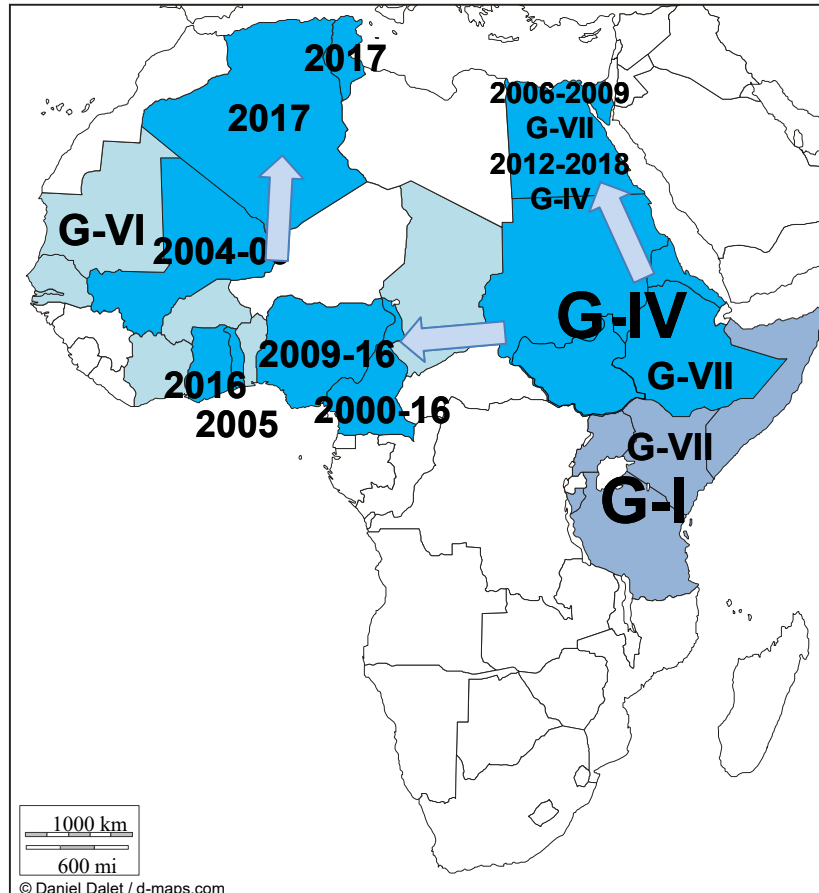
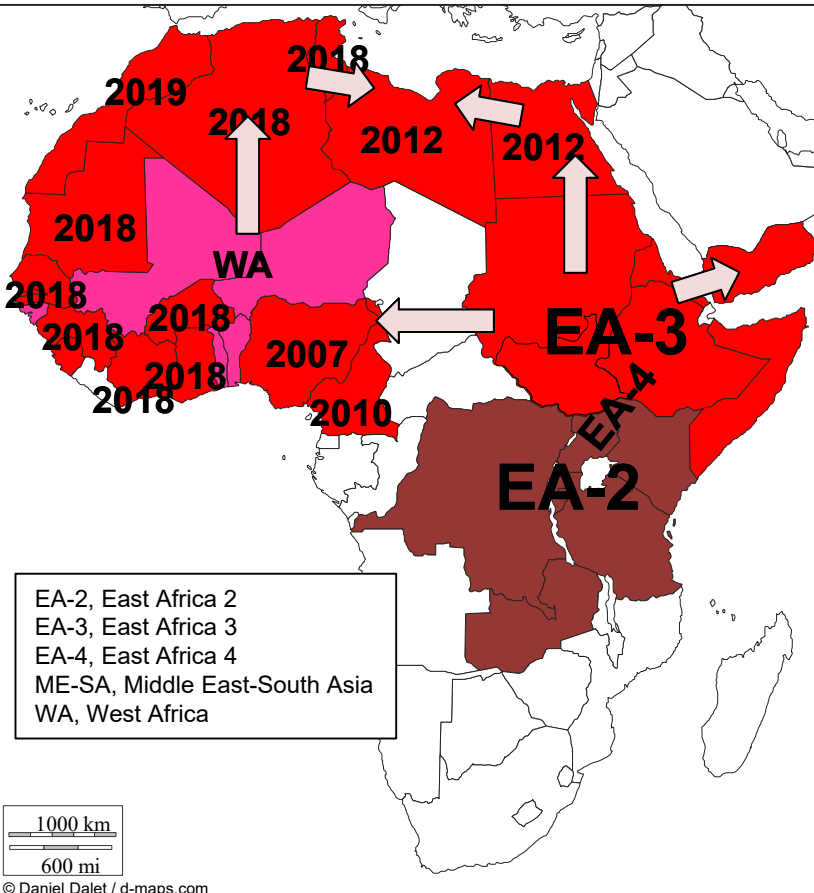
In general, Pool 4 can be divided into two distinct areas, North (Sudan, Ethiopia, Eritrea) and South (Kenya, Uganda, Tanzania, Rwanda, Burundi, DR Congo).

# FMDV 2003-2019

## Type O

## Type A

## Type SAT 2



# Nucleotide Sequences

VP1: Sanger sequencing (ABI)

CG: Next Generation Sequencing (Illumina MiSeq)

Serotype	Topotype	Lineage	VP1*	Complete genomes*
O	EA-3	-	~500 <sup>†</sup>	56 (49 new)
A	AFRICA	G-IV	~160	35 (27 new)
SAT 2	VII	various	~190	36 (29 new)
Total(s)			~850	127 (105 new)

\* Including published sequences and sequences from ANSES

<sup>†</sup> see poster EPI 2 (Session 2) - Souheyla Benfrid *et al.*: Molecular epidemiology of foot-and-mouth disease virus O/EA-3: a recent transboundary emergence in North Africa (2017-2019).

## New genome sequences

Country	Year(s)	O	A	SAT 2
Algeria	2018	4		
Burkina Faso	2018	3		
Cameroon	2000-2013		5	2
Côte d'Ivoire	2018	3		
Egypt	2012-2017	4	3	7
Eritrea	1997-2006		2	1
Ethiopia	2013-2019	5	2	3
Gambia	2018	1		
Guinea	2018	3		
Israel	2017	1		
Libya	2003-2012			2
Mali	2004		1	
Mauritania	2014-2018	1		1
Morocco	2019	4		
Niger	2005			1
Nigeria	1982-2016	4	6	5
Oman	2015			1
Palestine	2017	1		
Sierra Leone	2018	1		
Senegal	2009-2018	1		1
South Sudan	2017	1		
Sudan	1977-2017	10	7	5
Togo	2005		1	
Tunisia	2019	2		
<b>Totals</b>		<b>49</b>	<b>27</b>	<b>29</b>

# Other related presentations at this meeting

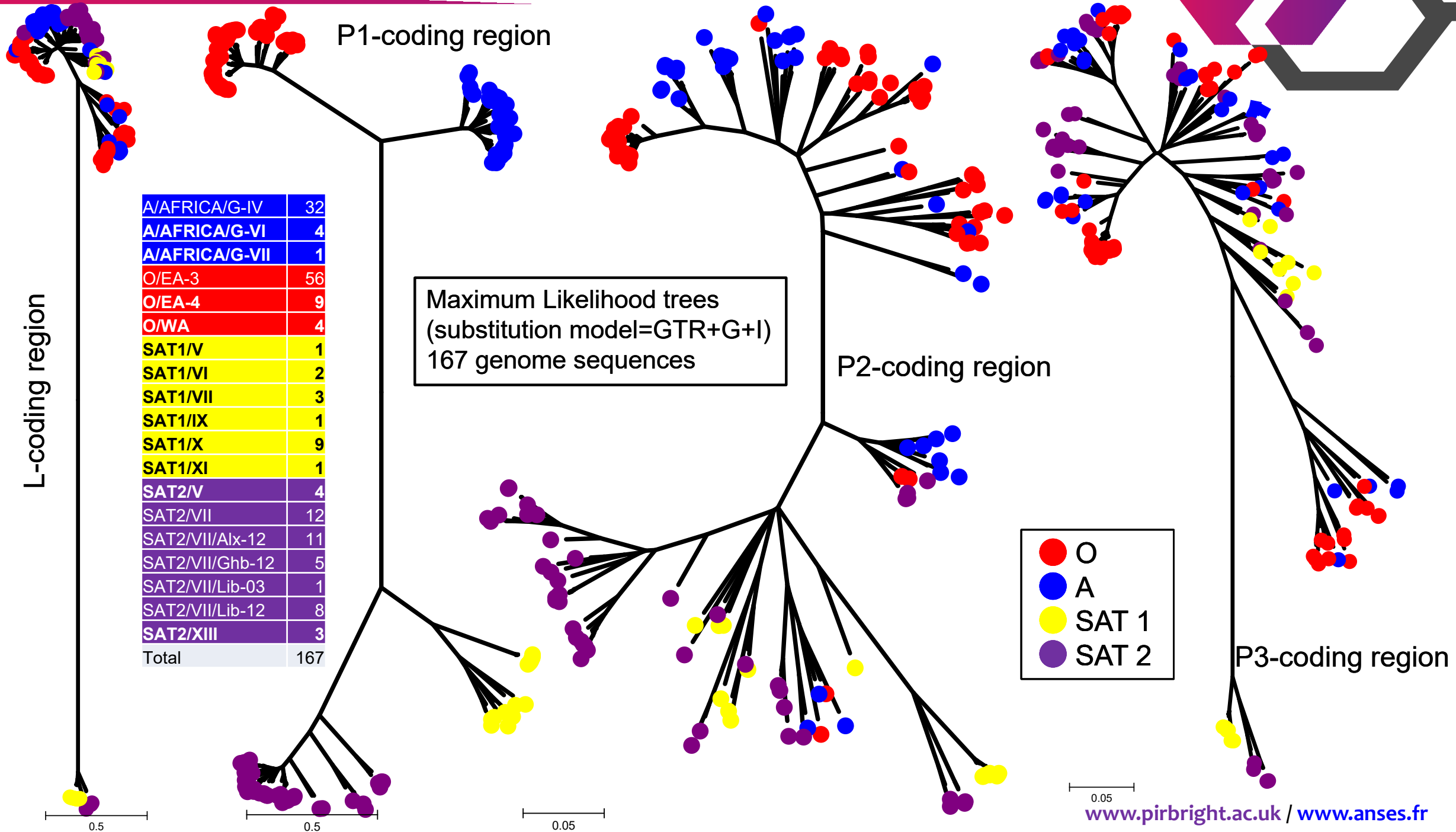
Poster EPI 10 (Session 5) – **Hussaini Ularamu *et al.***: Recent incursion of foot-and-mouth disease (FMD) serotype O East Africa topotype 3 (O/EA-3) in North Central Nigeria.

Poster EPI 19 (Session 7) – **Mohamed Soltan *et al.***: Genetic characterization of foot-and-mouth disease virus (FMD) serotypes in Egypt (2016-2017) and identification of a new lineage of serotype O topotype EA-3.

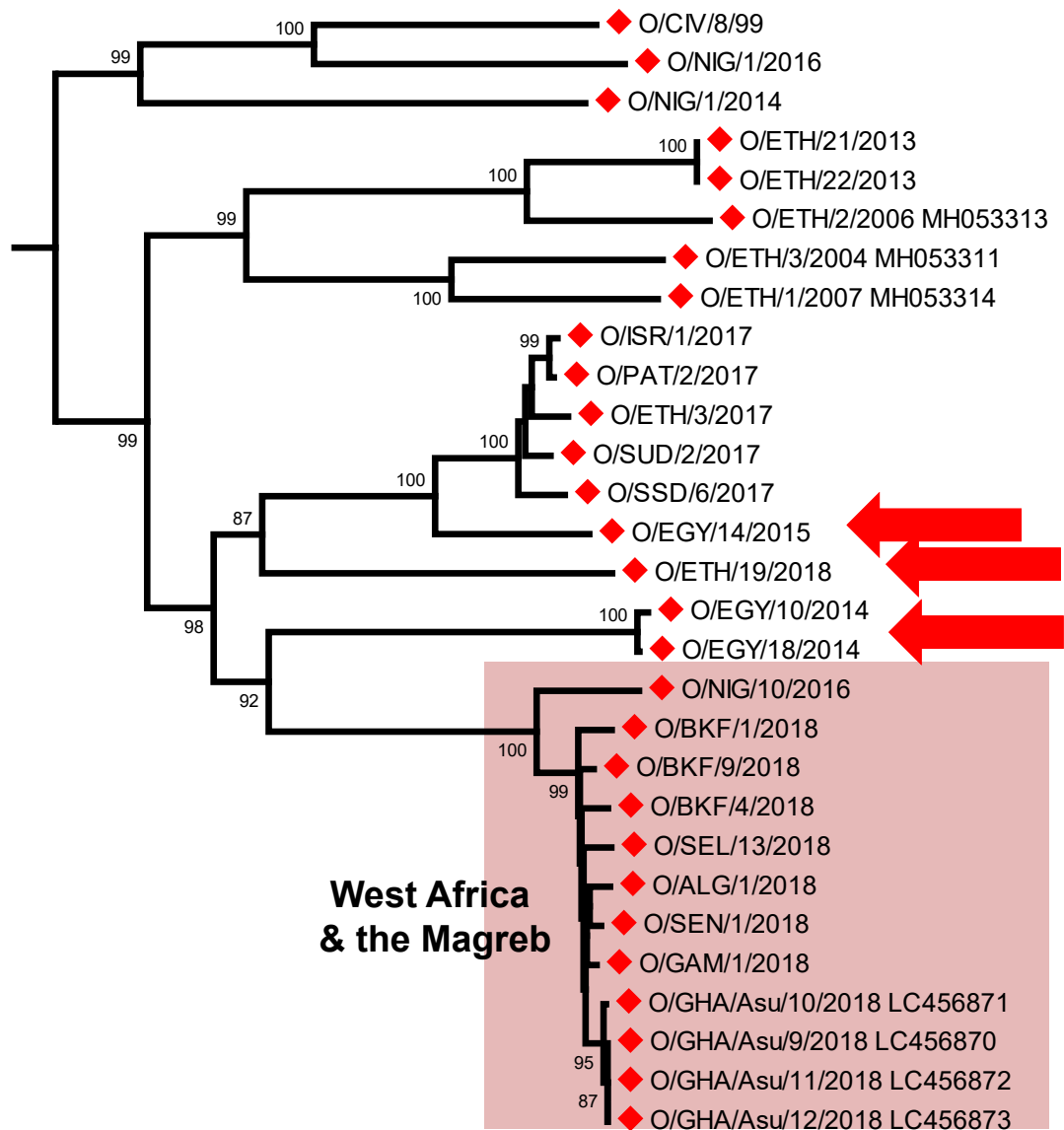
Poster EPI 20 (Session 7) – **Mohamed Soltan *et al.***: Emergence of foot-and-mouth disease virus, Lib-2 lineage of topotype VII, serotype SAT2 in Egypt 2018.

Poster EPI 21 (Session 7) – **David Lefebvre *et al.***: Continued circulation of foot-and-mouth disease virus in Nigeria.

Poster EPI 24 (Session 7) – **David Ehizibolo *et al.***: Reemergence of the novel topotype of foot-and-mouth disease virus serotype SAT 1 in Nigeria and Cameroon.

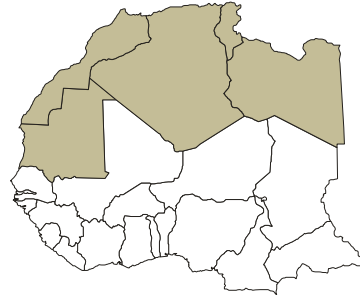


# FMDV O & A P1



WA

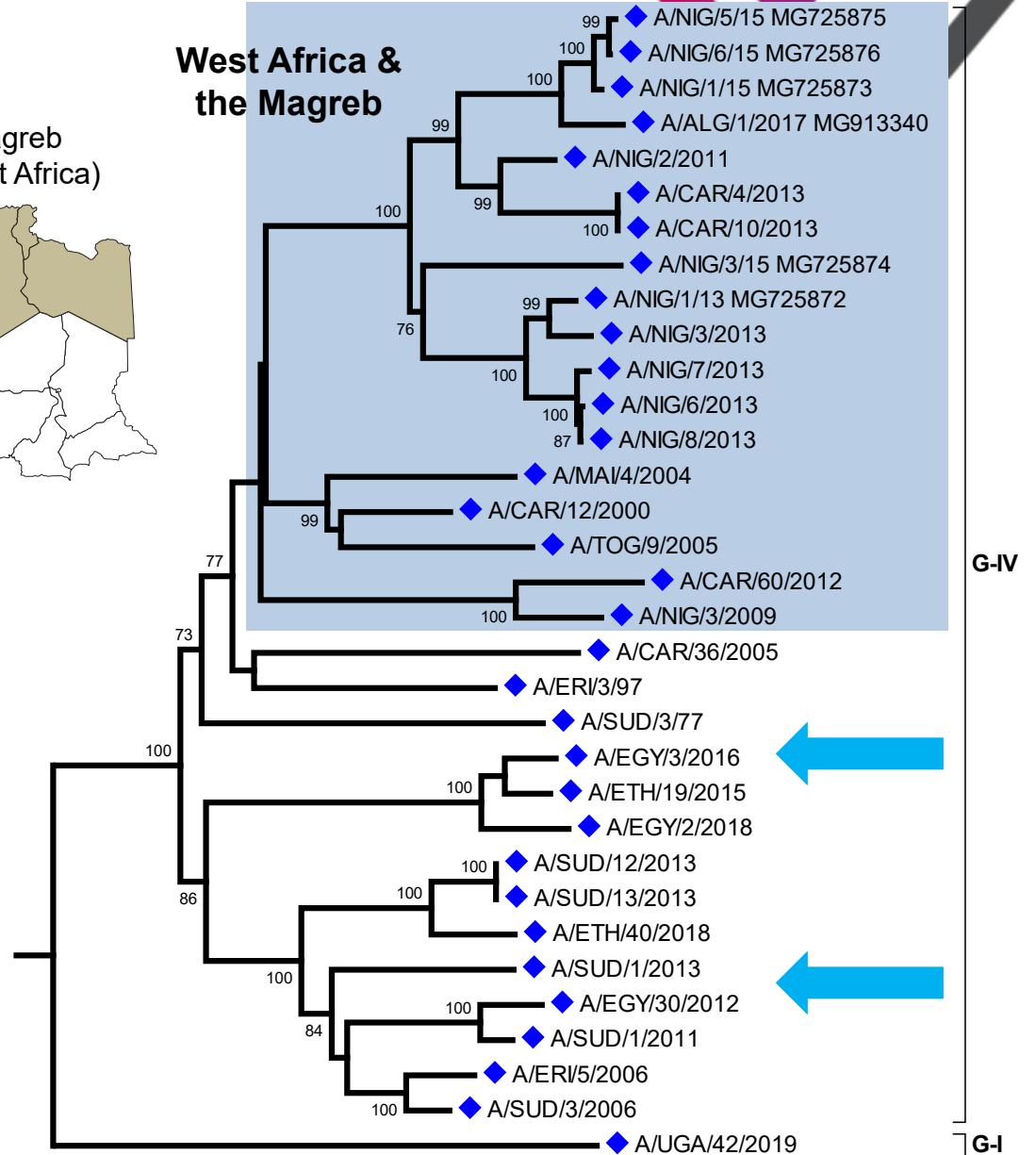
The Magreb  
(Northwest Africa)



EA-3

Plus:  
Cote d'Ivoire  
Guinea  
Mauritania  
Morocco  
Tunisia  
(ANSES)

West Africa & the Magreb



G-IV

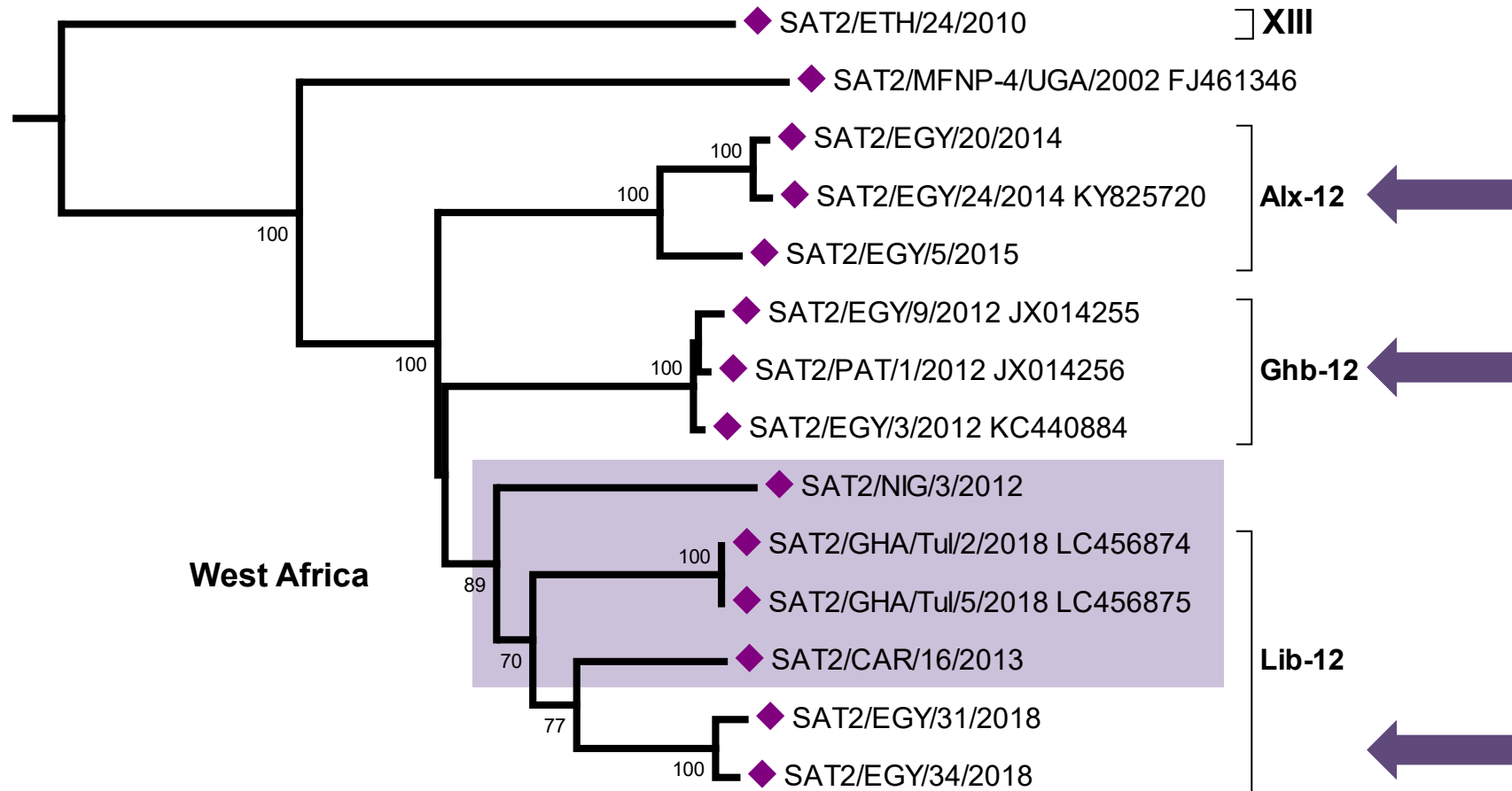
G-I

0.020

0.020

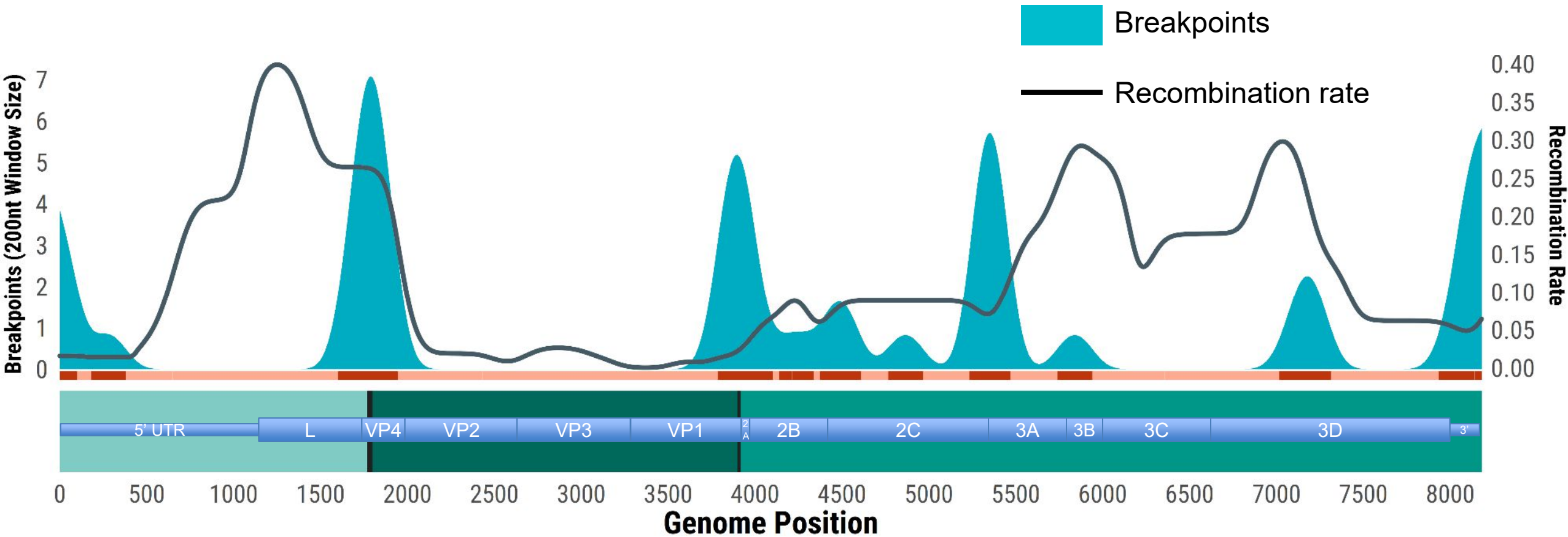


# FMDV SAT 2 P1



0.020

# Recombination analyses



Based on 127 genome sequences of:

O/EA-3

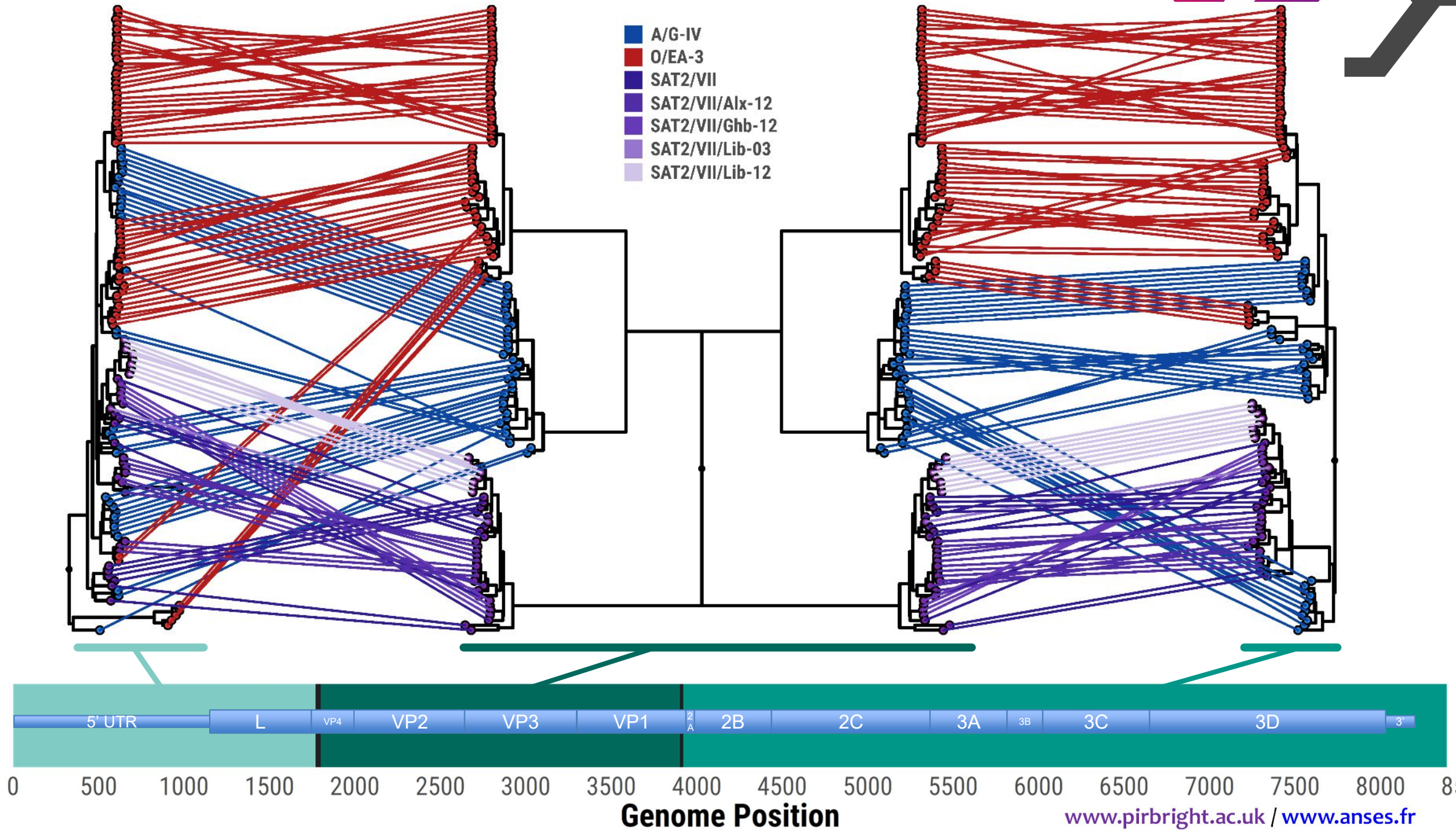
A/AFRICA/G-IV

SAT2/VII

genome-wide map of site-by site variations in recombination rates

$\rho=0.13$  [0.11 – 0.16] rho is the average recombination rate [confidence intervals] per site

$\rho/\theta= 2.26$  this is the ratio of recombination rate/mutation rate per site



# Conclusions

- Intertypic recombination appears to be common. Intratypic recombination was not tested but it would be assumed to be at least as common.
- The three main (northern) East African lineages of O and A appear to have spread independently into Egypt and West Africa (and from there into the Magreb). The directional spread of SAT 2 is less clear since the earliest reports are in Eritrea (1998) and Cameroon (2000).
- Changes in trade (and politics – ‘the Arab Spring’ – 2010 on) may have led to the increased spread of disease.
- New roads crossing the Sahara desert may have increased movements of animals and their products.
- This and other studies have shown that FMD Pool 4 (East Africa) viruses can be subdivided into two sub-pools, North and South.



# Questions

- What role does recombination play in the epidemiology, evolution and pathogenicity of FMDV?
- What will happen to the FMDV lineages that were previously present in West Africa?
  - Disappear
  - Co-exist
  - Re-emerge in subsequent years
- Are FMDV Pools 4 (northern part) and 5 merging into a single pool?

# Acknowledgements

We would like to thank the following people (and their teams) for kindly providing the samples used in this study:

## West Africa

Dr Habibata Ouermi & Dr Joseph Savadogo (Burkina Faso)

Dr Ndamkou Ndamkou Christian & Dr Mark Bronsvort (Cameroon)

Dr M'Bétiégué Coulibaly (Côte d'Ivoire)

Dr Momar Talla Seck (Gambia/Senegal)

Dr Mamadou Lamarana Souare (Guinea)

Dr Mohamed Yahya Bah (Mauritania)

Dr Hussaini Ularamu (Nigeria)

Dr Tesfai Tseggai (Sierra Leone)

Work at Pirbright was funded by Defra UK (SE2943 & SE2944) & EuFMD



Department  
for Environment  
Food & Rural Affairs

## East Africa

Dr Daniel Gizaw & Dr Yeneneh Tesfaye Alemu (Ethiopia)

Dr Abraham Sangula (South Sudan)

Dr Yazeed A. Raouf (Sudan)

## Middle East

Dr Boris Gelman (Israel/Palestine)

## North Africa

Dr Hafsa Madani & Dr Hadj Amar (Algeria)

Dr Mohamed Attia & Dr Iman Farag (Egypt)

Dr Ibrahim Mohamed Eldaghayes & Dr Milad A Farhat (Libya)

Dr El Abrak Abderrahman (Morocco)

Dr Malek Zrelli (Tunisia)

Dr Emiliana Brocchi (IZSLER, Italy)

Work at ANSES was funded by EuFMD & Boehringer Ingelheim



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Ingelheim

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