



# Next Generation Sequencing Reveals New Southern African Territories Genotypes Bringing Us Closer to Understanding the History of Foot-and-Mouth Disease Virus in Africa

Lidia Lasecka-Dykes, Nick J. Knowles, Caroline F. Wright, Grace Logan, Toby Tuthill, Terry Jackson and Donald P. King

OS'16

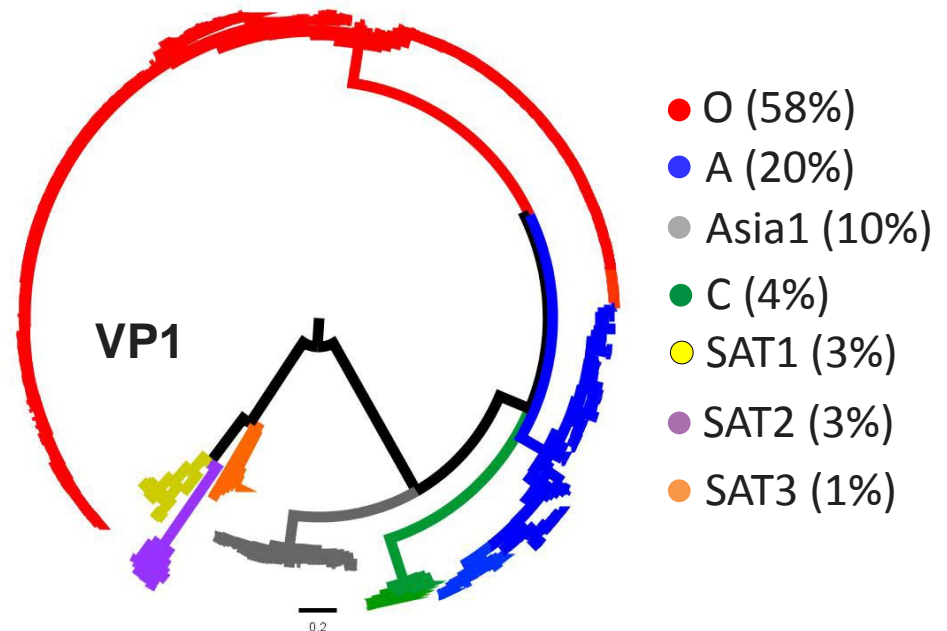
Open Session of the EuFMD - Cascais - Portugal 26-28 October 2016

European Commission for the Control  
of Foot-and-Mouth Disease

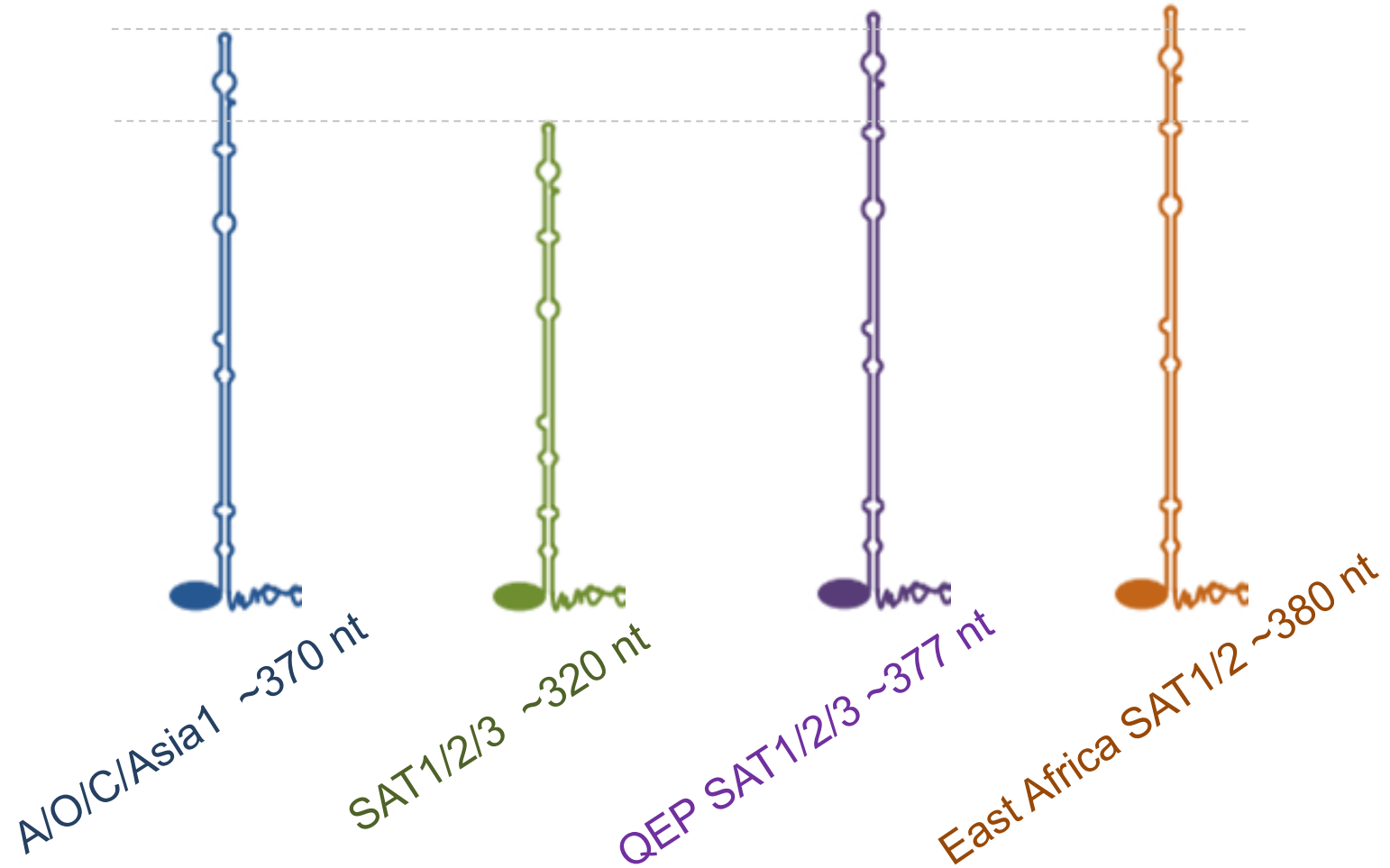
**eofmd**

# Foot-and-mouth disease virus (FMDV)

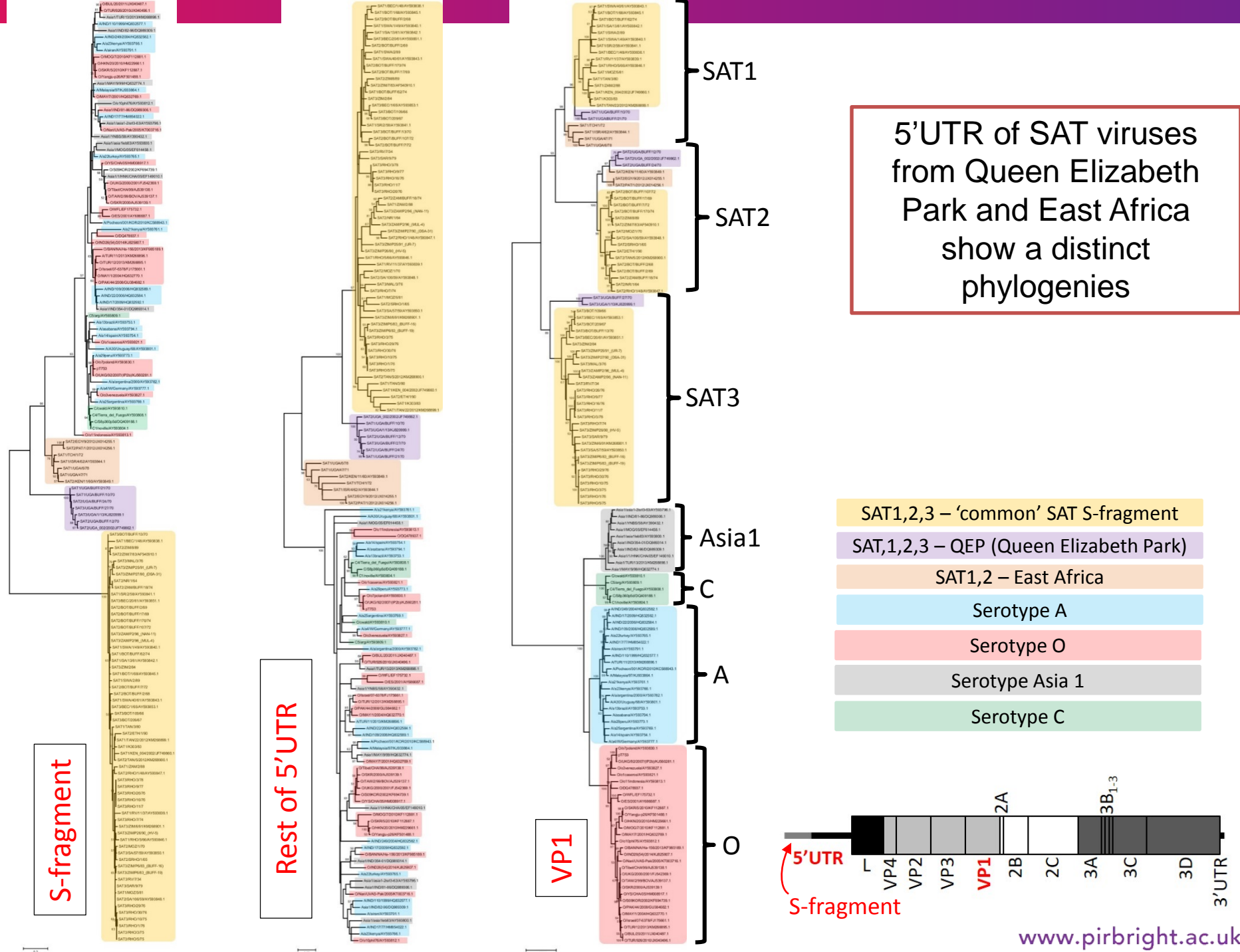
- Genus *Aphthovirus* , family *Picornaviridae*;
- Causes highly contagious disease of cloven-hoofed animals;
- 7 serotypes: O, A, Asia1, C, SAT1-3;
- African buffalo (*Syncerus caffer*) as ancestral reservoir of FMDV;
- Biased sampling of true sequence diversity.



# SAT viruses with 'non-SAT' S-fragment

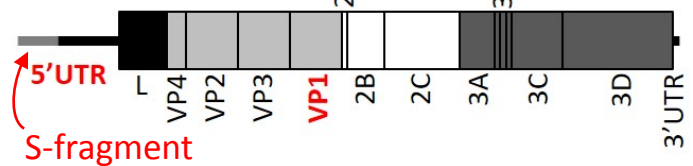


What is the genetic basis of these unusual S-fragments?



5'UTR of SAT viruses from Queen Elizabeth Park and East Africa show a distinct phylogenies

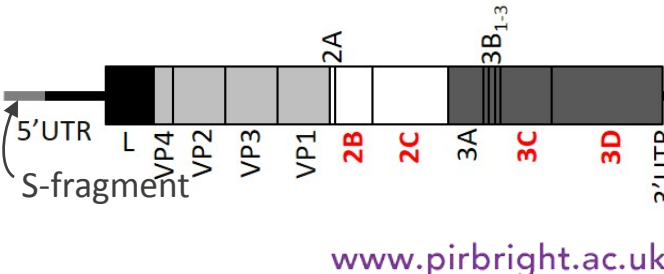
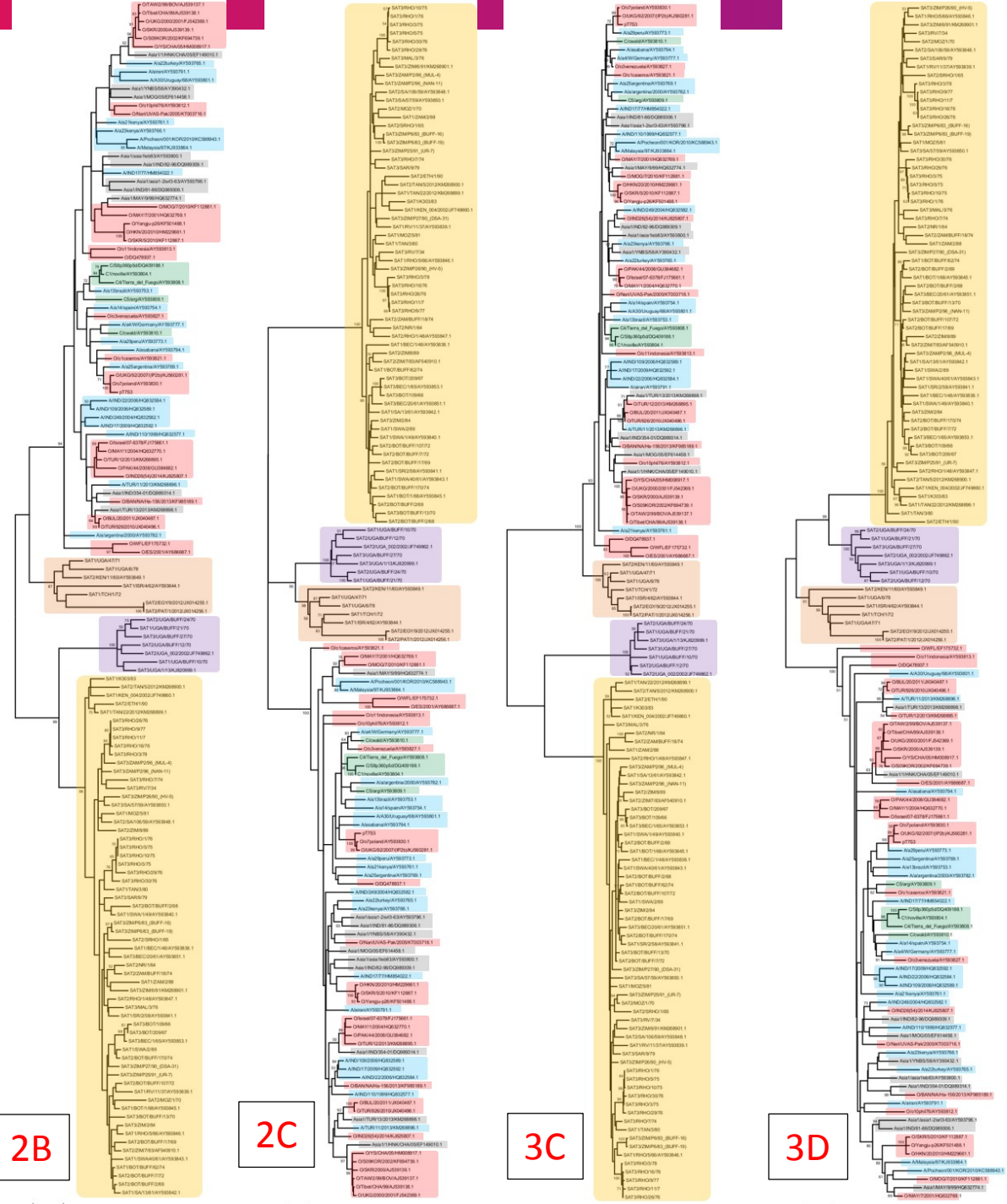
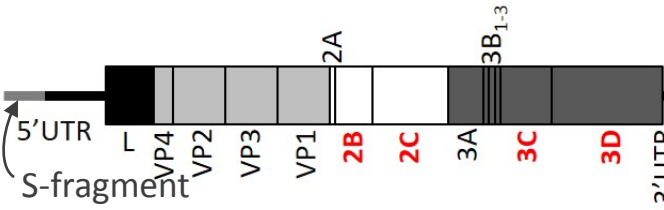
- SAT1,2,3 – 'common' SAT S-fragment
- SAT1,2,3 – QEP (Queen Elizabeth Park)
- SAT1,2 – East Africa
- Serotype A
- Serotype O
- Serotype Asia 1
- Serotype C



Non-structural proteins of SAT viruses from Queen Elizabeth Park and East Africa also show distinct phylogenies

Maximum likelihood trees suggest distinct evolutionary pathway of these viruses

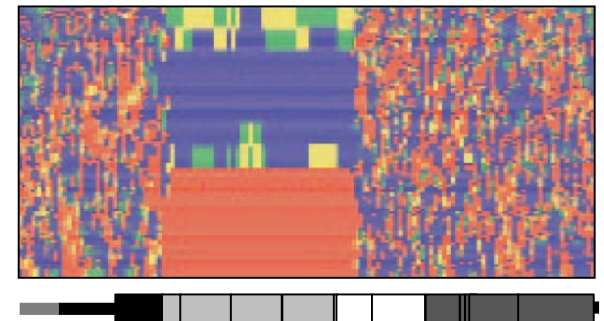
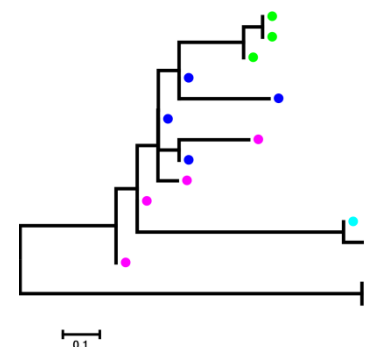
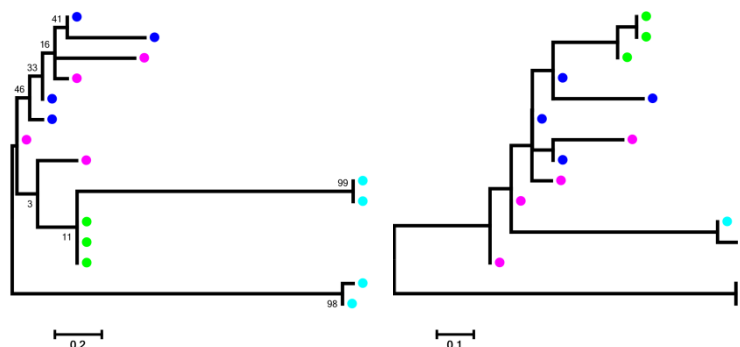
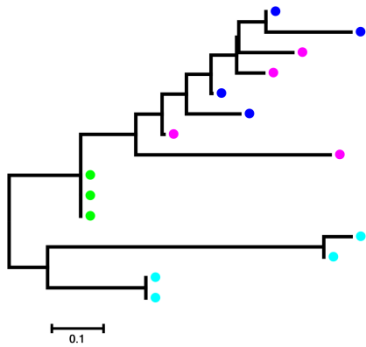
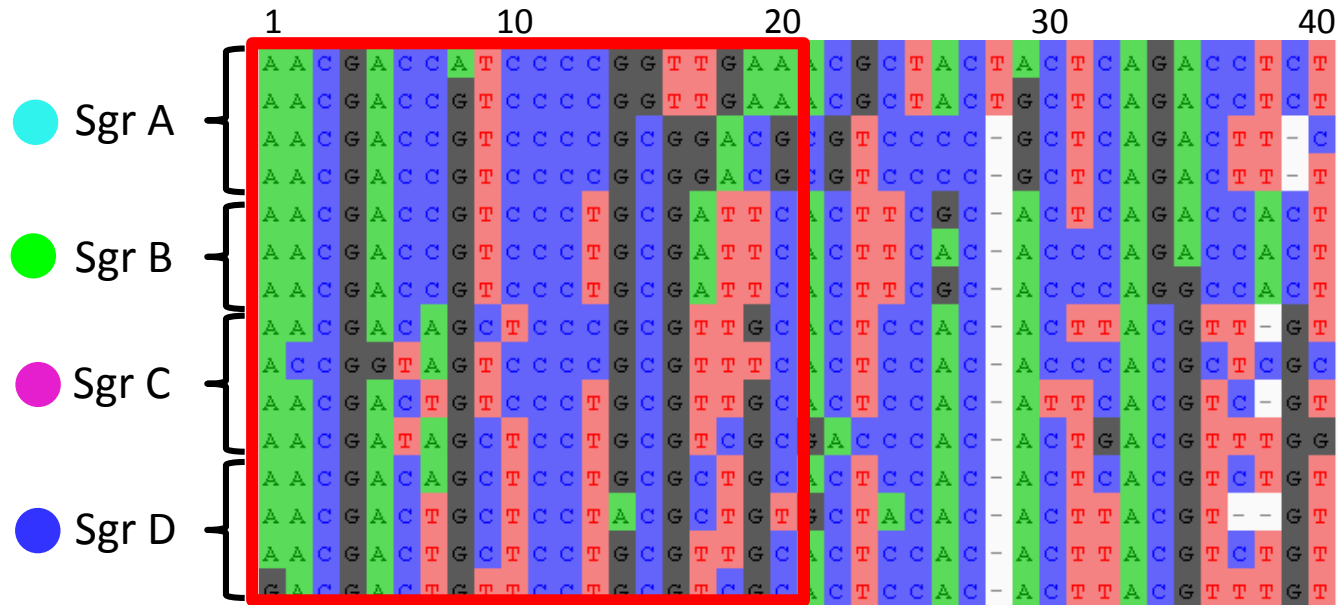
- SAT1,2,3 – ‘common’ SAT S-fragment
- SAT,1,2,3 – QE (Queen Elizabeth Park)
- SAT1,2 – East Africa
- Serotype A
- Serotype O
- Serotype Asia 1
- Serotype C



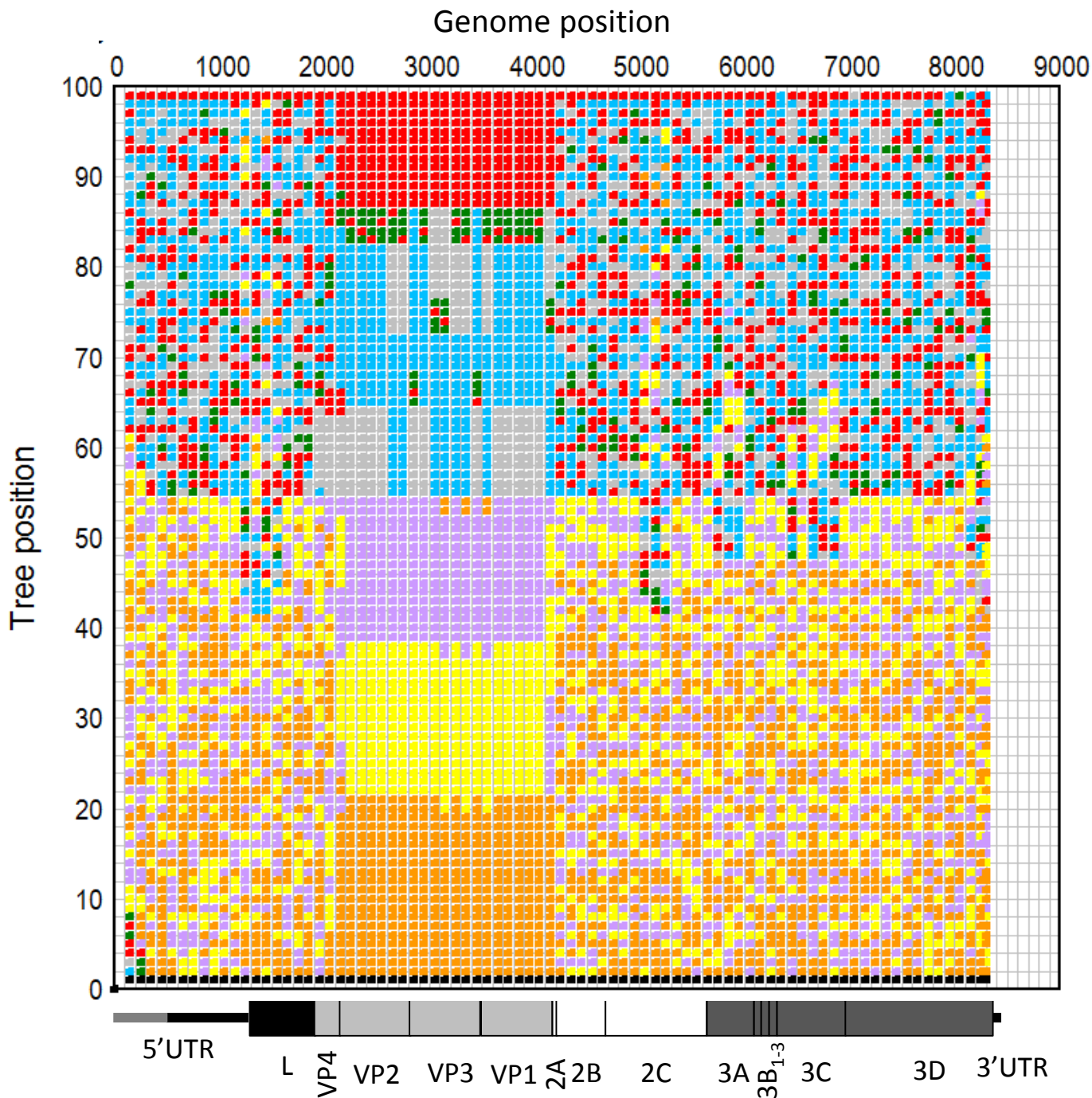


# Method for identifying recombination

[Phylogenetic Signal Scan (SSE) - Toy Example]



Simmonds (2006) *J Virol*; 80 [modified]



Evidence of frequent recombination events in 5'UTR and NS region but not capsid

- O
- C
- A
- Asia1
- SAT2
- SAT1
- SAT3

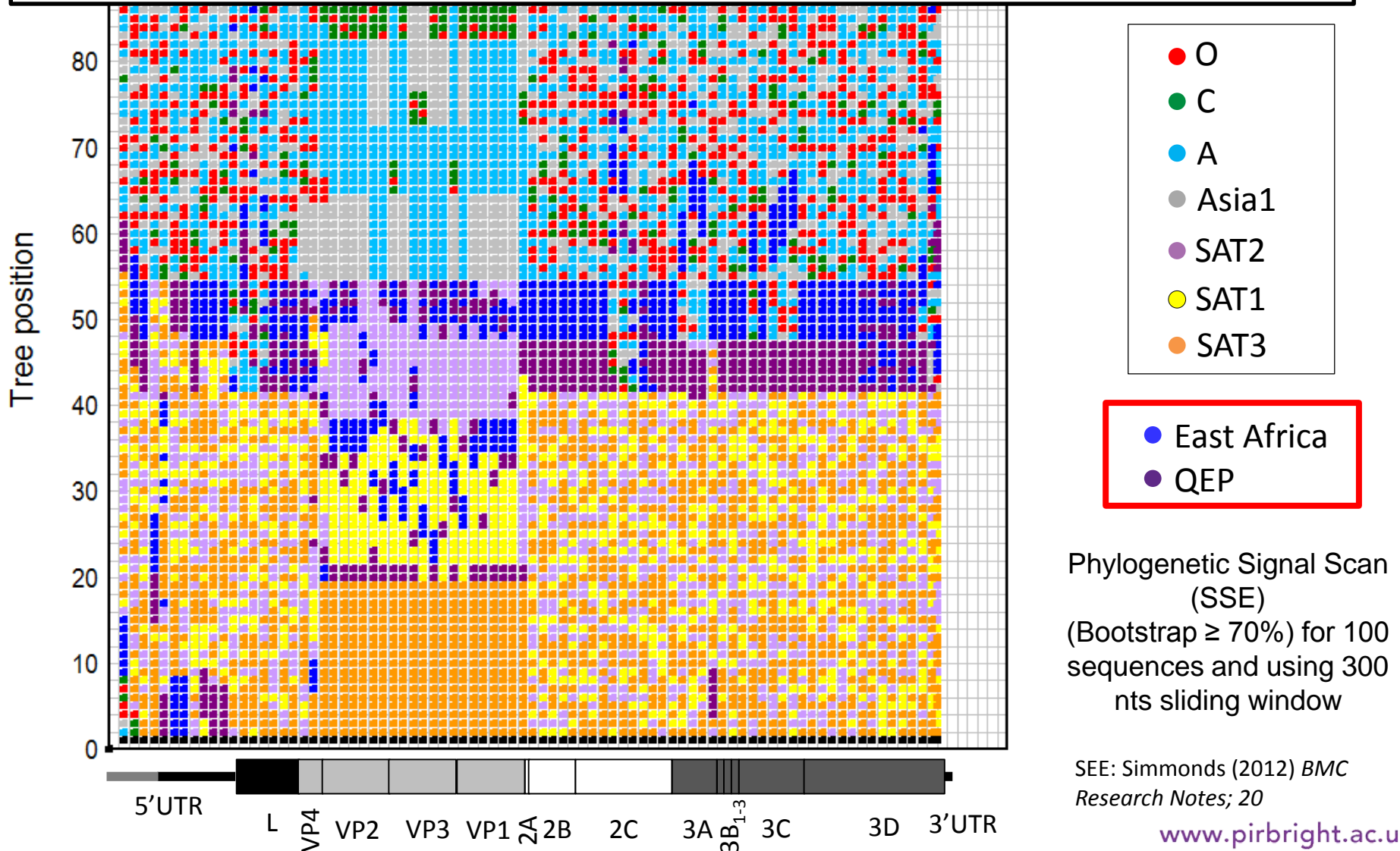
Phylogenetic Signal Scan (SSE)  
(Bootstrap  $\geq 70\%$ ) for 100 sequences and using 300 nts sliding window

SSE: Simmonds (2012) *BMC Research Notes*; 20

Genome position

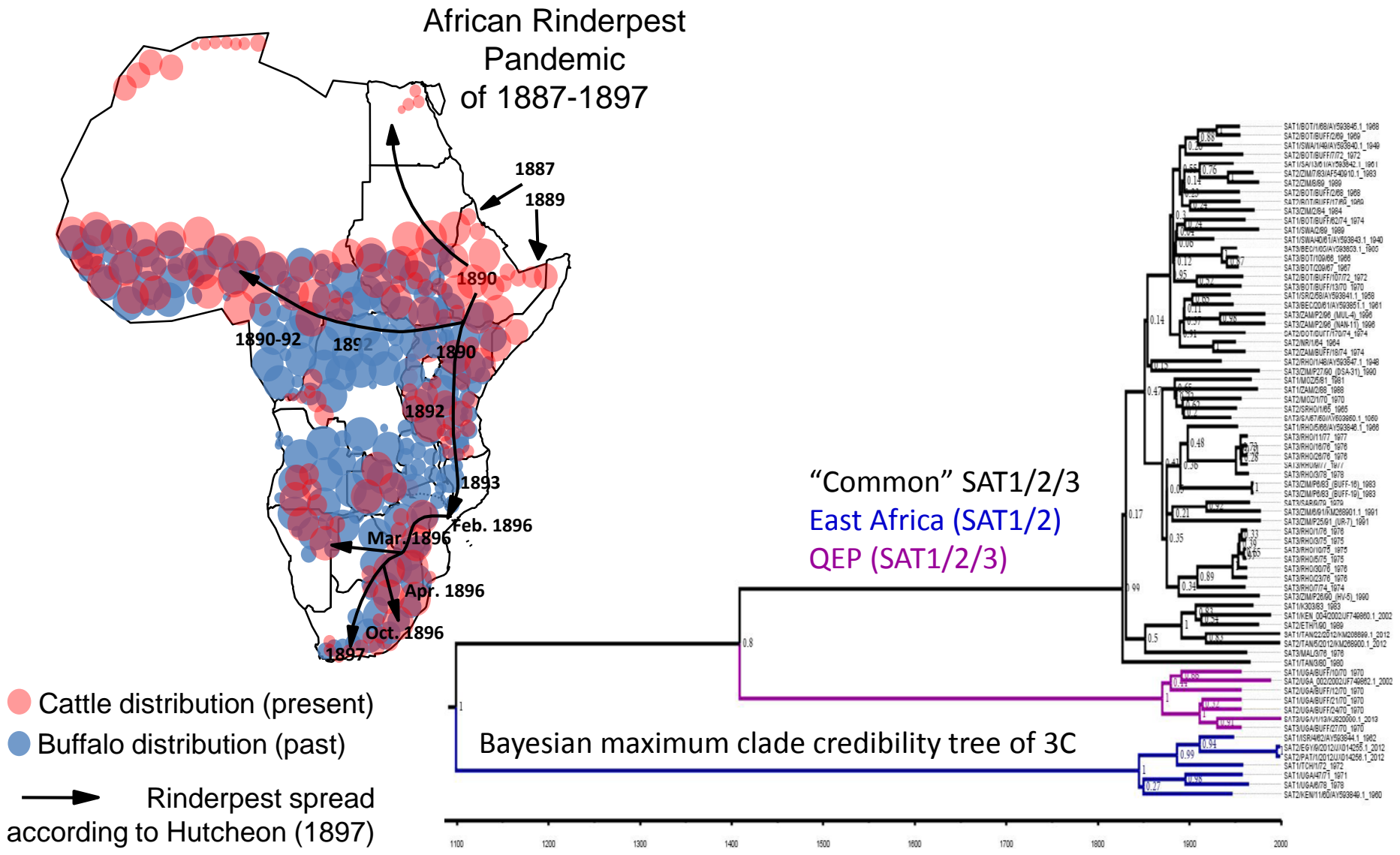
0 1000 2000 3000 4000 5000 6000 7000 8000 9000

Lack of recombination SAT viruses from East Africa and Queen Elizabeth Park suggests that these viruses evolved separately (e.g. parallel evolution?)





# Cattle plague (Rinderpest) epidemic has influenced the genetic variability of SAT viruses currently found in Africa



# Historical Records: QENP

## NUFFIELD UNIT OF TROPICAL ANIMAL ECOLOGY

Telegrams: "NATPARKS"  
LAKE KATWE

P. O. QUEEN ELIZABETH PARK  
LAKE KATWE  
Uganda, East Africa

Your Ref. ....

Our Ref. RES/SP 1.

8th January 1971.

Dear Bob,

### Isolation of FMDV from buffalo.

Thank you for sending me a copy of your letter of 31/12/70 to Mr.Kagoda.

The results of the survey are most interesting. You ask for my comments on the ecological isolation of the Ishasha buffalo population. Although the Maramagambo Forest is an incomplete ecological barrier and there are certainly some groups of buffalo living in the more lightly forested areas I consider that there is evidence that we can consider

information from the Congo. But the Congo side of the river is in the Parc National Albert, formed in 1928, and I think that it is very unlikely that there have been any cattle anywhere near that Park for a similar period - There were some cattle in the area of Q.E.Park north of the Maramagambo but south of the Kazinga Channel (i.e. in the area designated "Ankole Channel area") up to 1924 when most of them died of nagana. On the north side of the Channel (Nyamagasani, Kikorongo, Mweya and Kasenyi) the last cattle, about 200, were moved to Buganda because of the depredations of nagana, in 1928. North west of Nyamagasani, toward the Congo border, north of Lake Edward there were many cattle up to 1924 when between 10,000 and 15,000 were moved away. I append a rough Chronology of the events concerning cattle and human occupation of the area now embraced by Q.E.Park.

### Before 1871.

Kikorongo and Kasenyi areas occupied by the Batoro with many cattle kept on the western shores of Lake George. Nyamagasani and Kayaanja areas occupied by the Wasongora with many cattle which were watered at Kayaanja lagoon, 1871.

..../2.

1871

Wasongora defeated by the Waganda who drove their cattle away, 1889 Stanley visited the area, coming through Kayaanja and Nyamagasani from the west. He said that the Nyamagasani plain was empty of cattle but Katwe had a population of about 2,000 people. On Mweya he reported there were 81 huts and many sheep and goats.

1890 Small pox broke out among the human population and rinderpest among the cattle and game.

1891. Lugard visited from the East and reported the villages were deserted and the buffalo all dead.

1894. Elliott visited Mweya and reported that the eastern shore of L.Edward held little game and the plain behind it was almost completely uninhabited.

1910 - 1912. Sleeping sickness broke out in Katwe Bay, along Kazinga Channel and around L.George. The British authorities evacuated the area which was not resettled until 1920. Concurrent with the outbreak of sleeping sickness, nagana broke out in the cattle which had replaced those killed by rinderpest.

1920. Only 20 or 30 cattle remained at Katwe.

1924. Between 10,000 and 15,000 cattle removed from Nyamagasani/Kayaanja

cattle since 1924 and those living north of the Channel have had no contact with cattle since 1928. I believe that the Ishasha buffalo probably have not been in contact with cattle for at least 80 years and maybe longer. It must however be remembered that before the great

1931. Worthington visited with Cambridge University expedition and reported game in enormous numbers. The area was made a game Reserve in that year.

1932. Rinderpest again broke out in the area and many buffalo died.

1933. Hancock visited the area northwest of Nyamagasani to examine it with a view to resettlement.

1952. Queen Elizabeth National Park gazetted. By this time the game populations had recovered from the 1932 rinderpest outbreak and the buffalo were numerous again. It is probable that those buffalo living south of the Channel and north of the Forest have had no contact with cattle since 1924 and those living north of the Channel have had no contact with cattle since 1928. I believe that the Ishasha buffalo probably have not been in contact with cattle for at least 80 years and maybe longer. It must however be remembered that before the great rinderpest epidemic of 1890 game populations were much more extensive than they are now and were probably continuous from the Sudan to the Cape. Thus disease like rinderpest and FMD could spread over very large

# Acknowledgements

## The Pirbright Institute:

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strategic longer and larger grant

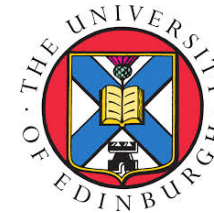


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