

# **ESTABLISHMENT & LINEAGE DYNAMICS OF THE SARS-COV-2 EPIDEMIC IN THE UK**

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**LOUIS DU PLESSIS**



Alex Cagan



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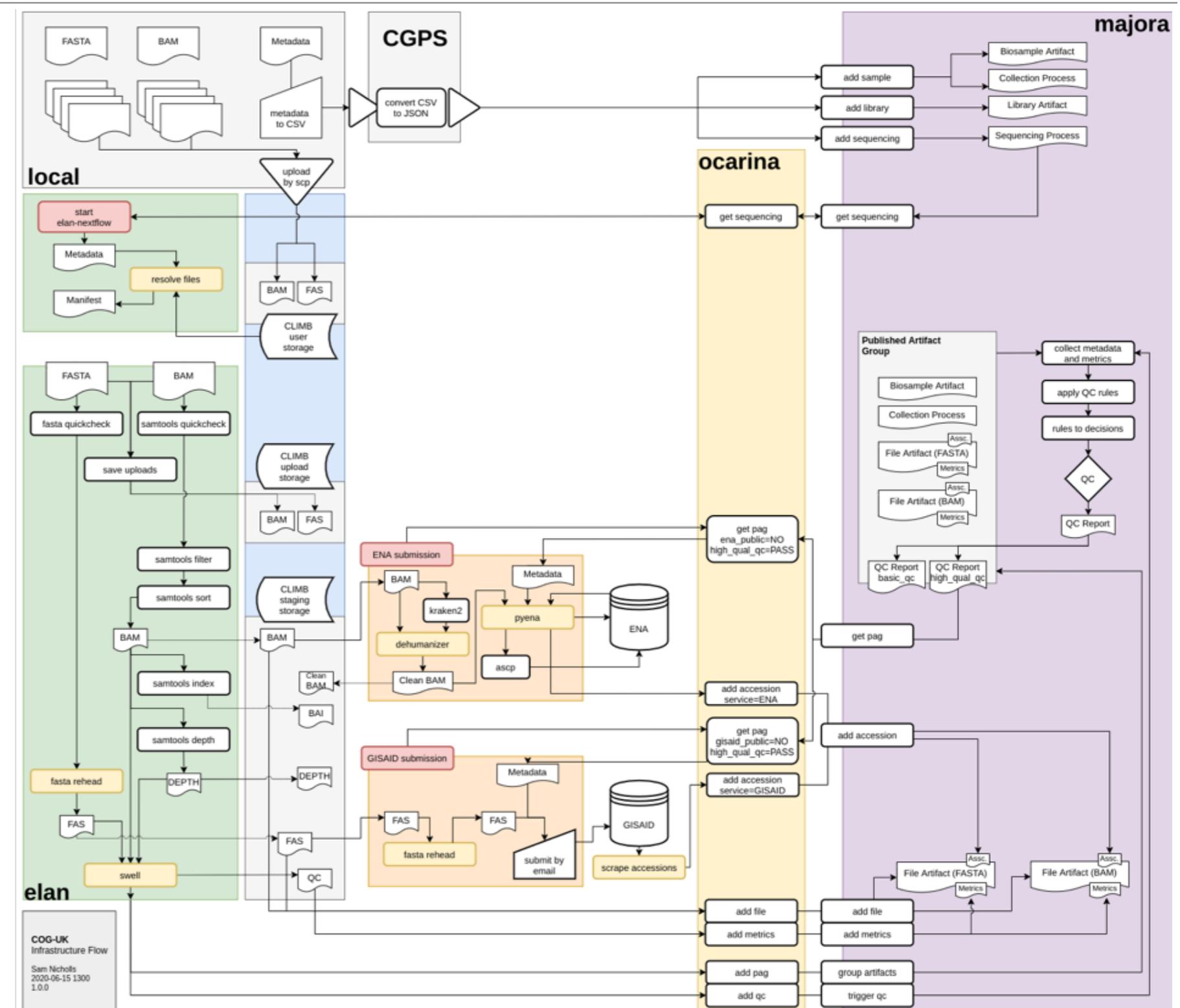
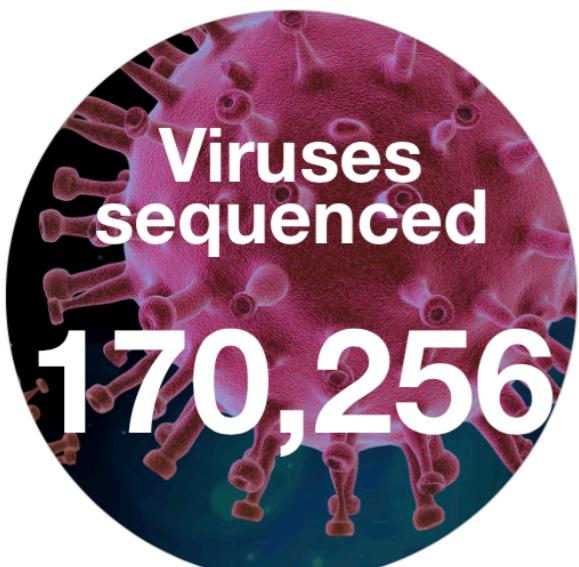
Everything  
I'm presenting  
about

Phylogenetics  
pipelines

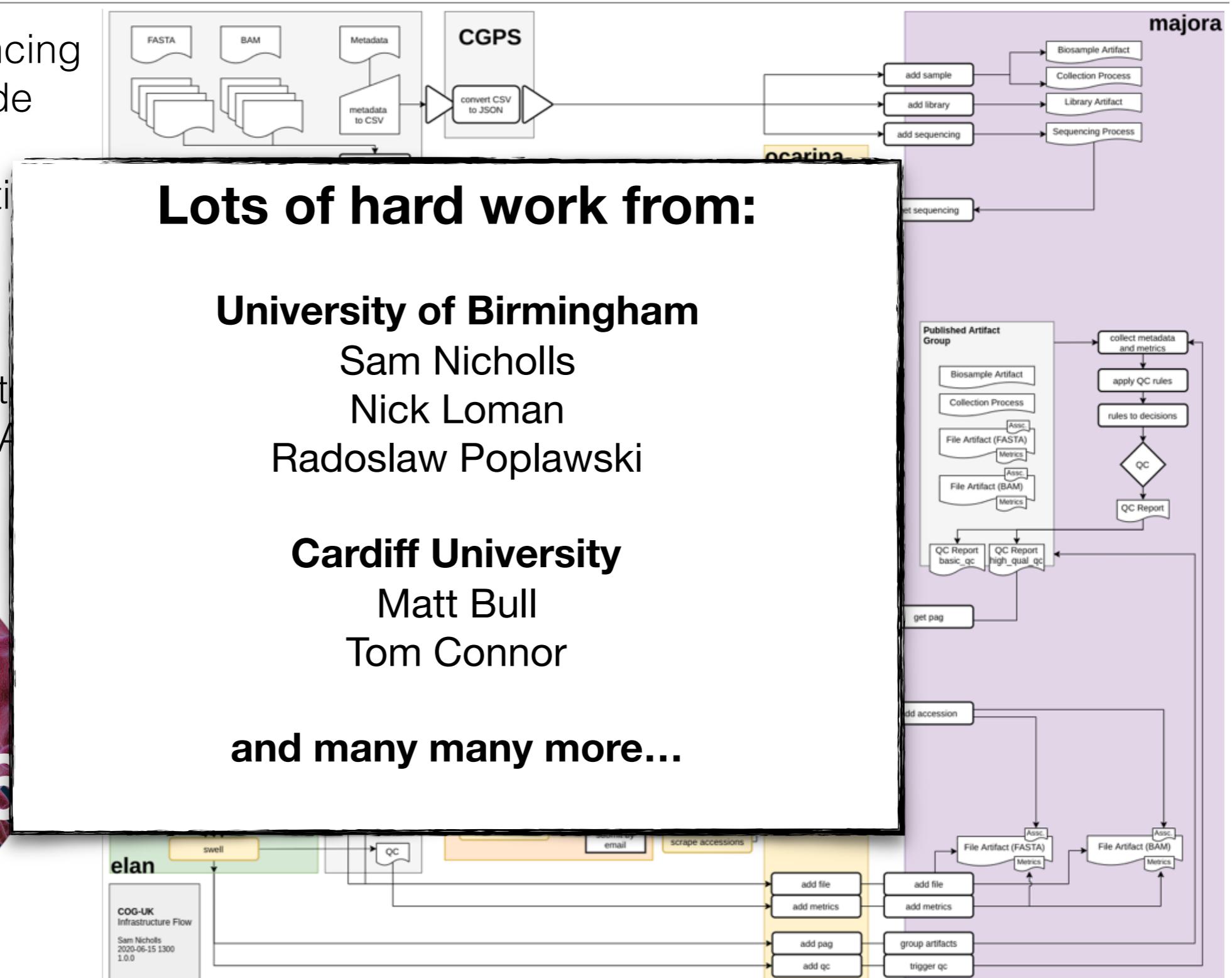
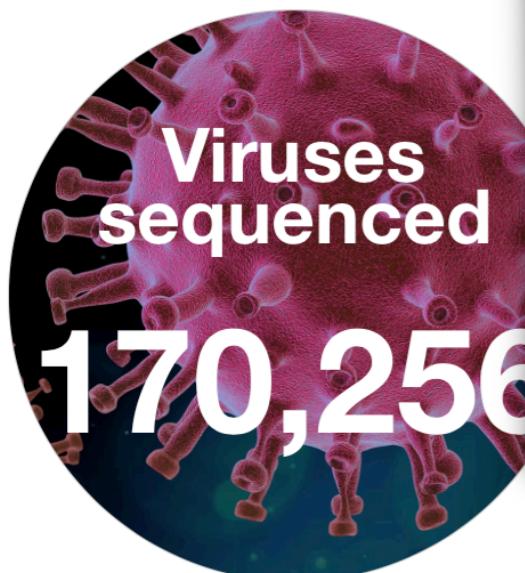
Sequencing  
pipelines

Lighthouse  
Labs

- Multiple sequencing teams nationwide
- Unified informatics for genomes & metadata
- Data uploaded to GISAID and ENA

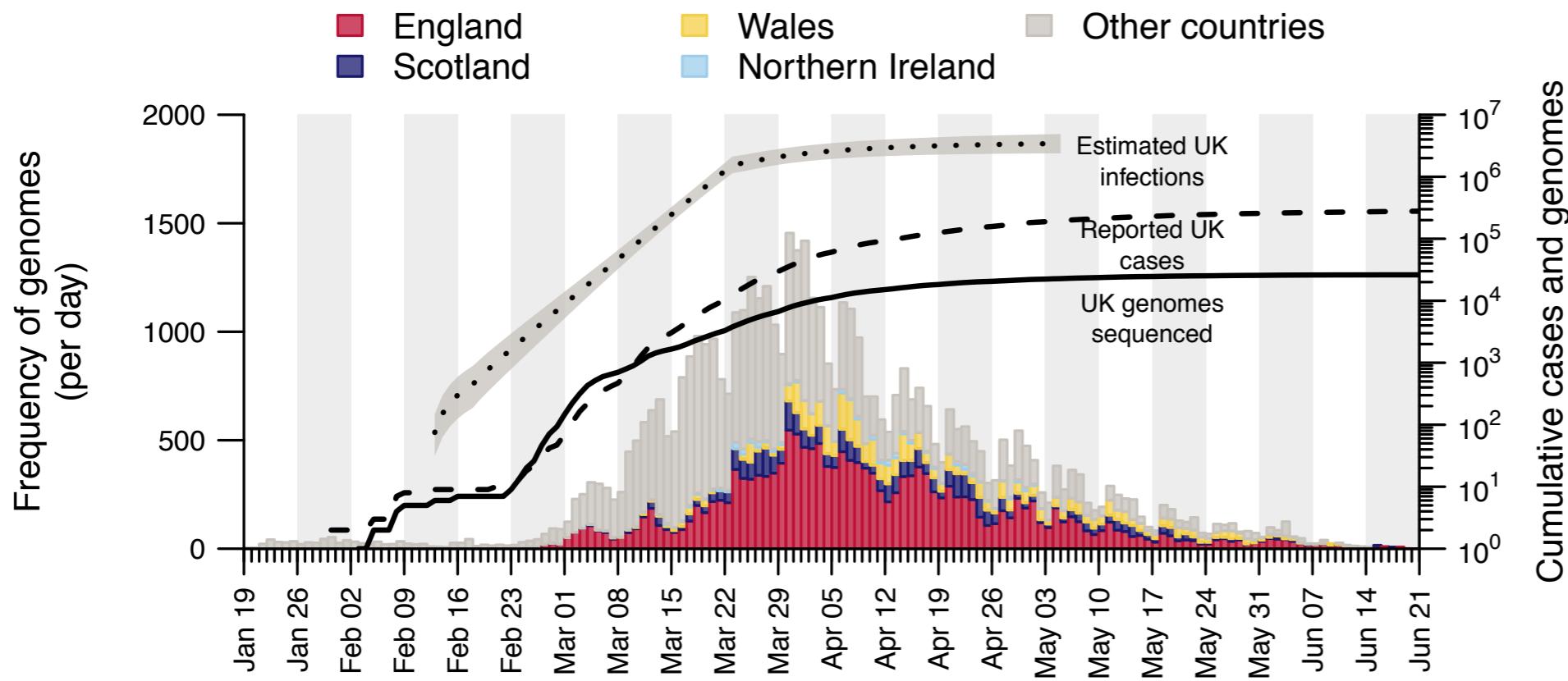


- Multiple sequencing teams nationwide
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- Data uploaded to GISAID and ENA



# Sampling of SARS-CoV-2 genomes

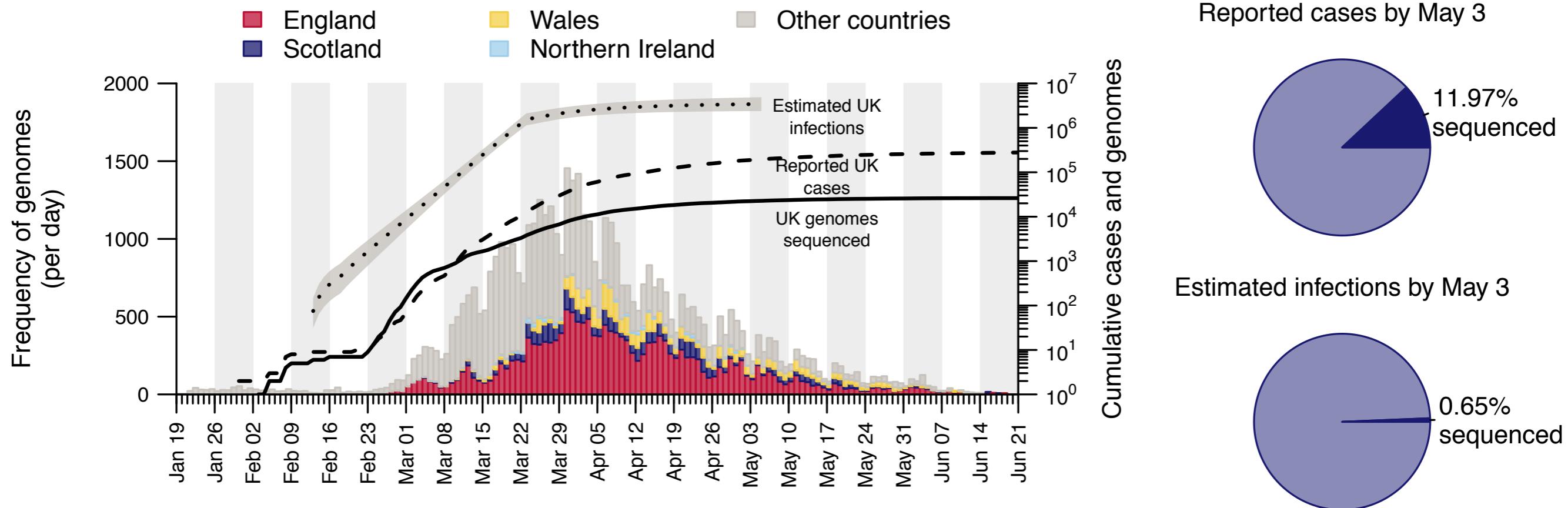
First 6 months of the pandemic



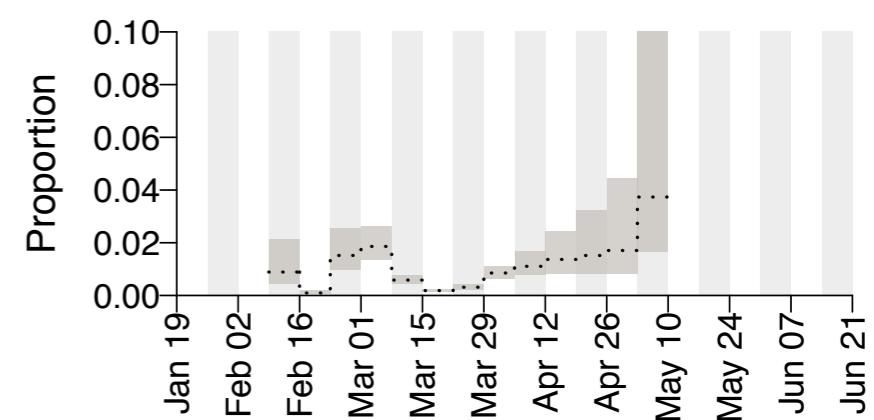
- **50,887** SARS-CoV-2 genomes
- **26,181** from the UK (51.5%)

# Sampling of SARS-CoV-2 genomes

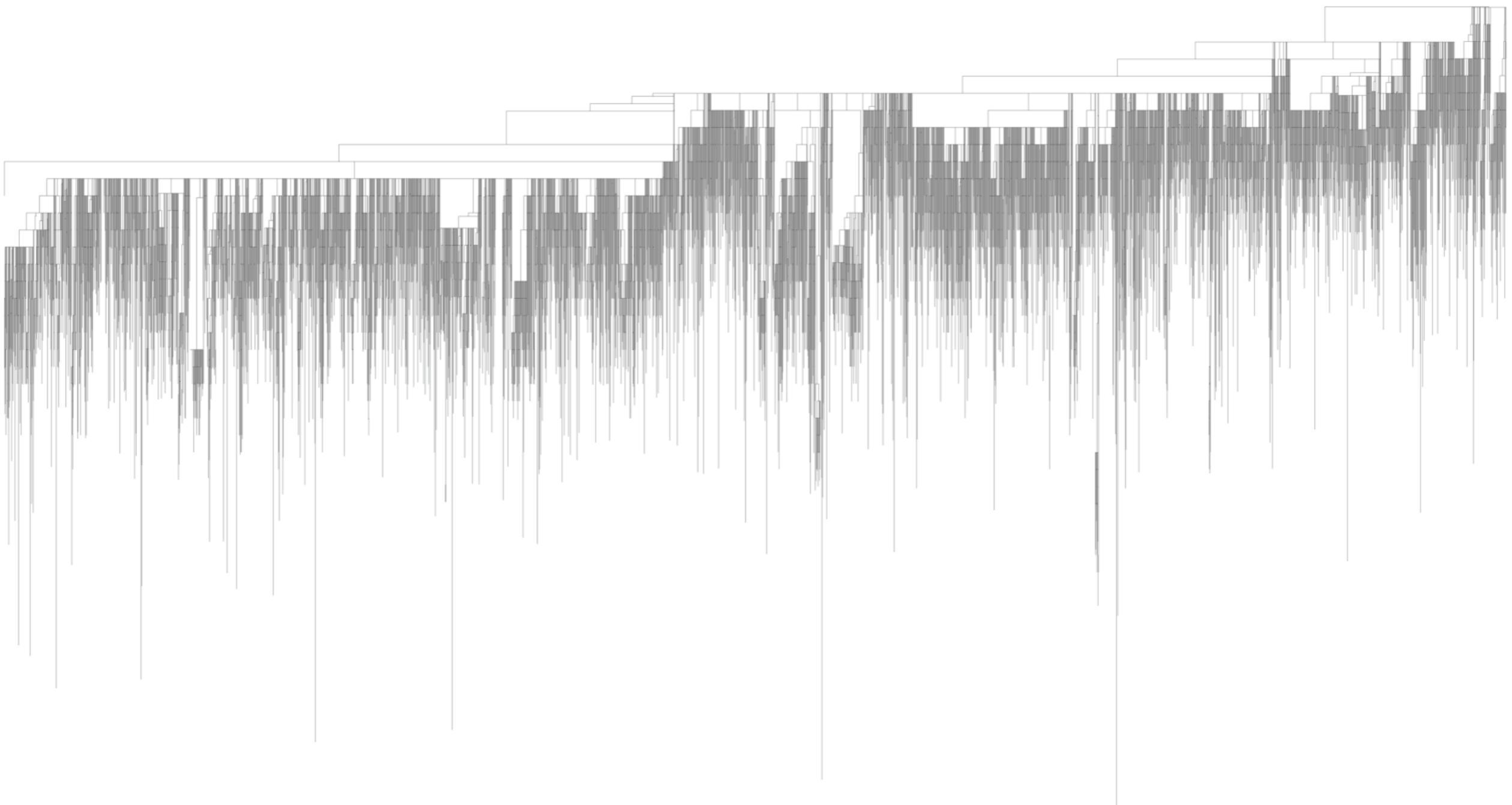
First 6 months of the pandemic



- **50,887** SARS-CoV-2 genomes
- **26,181** from the UK (51.5%)

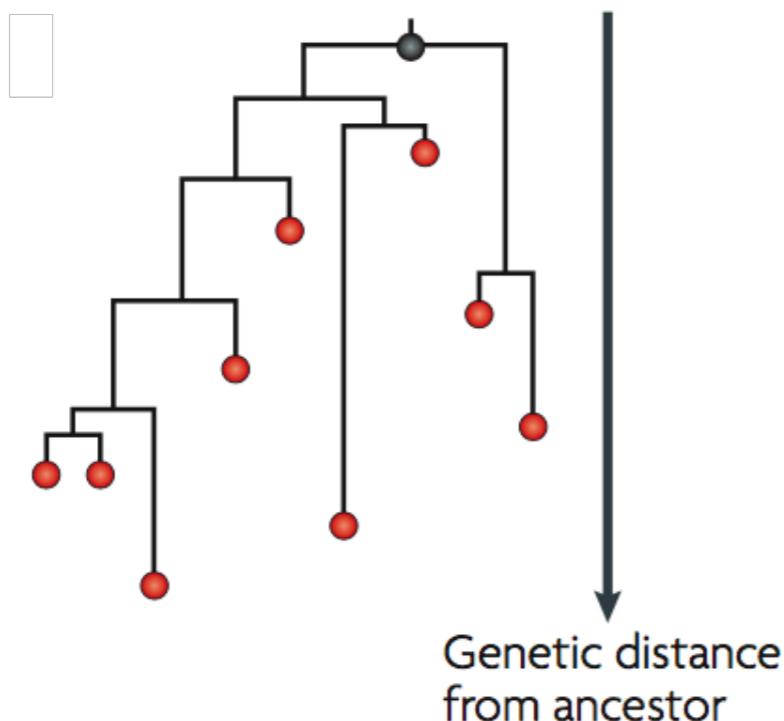


~88,000 SARS-CoV-2 genomes

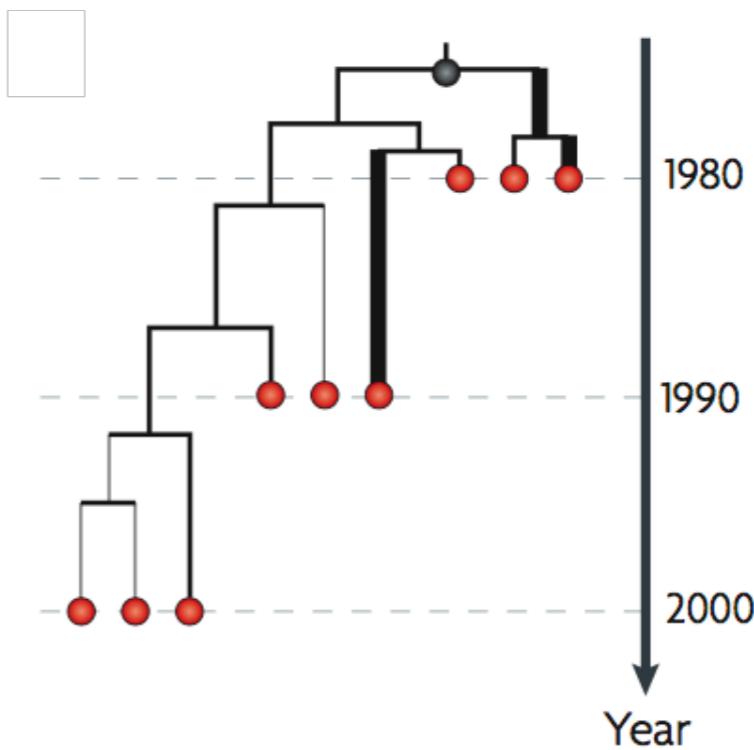


# Getting to a time-calibrated tree

**Genetic distance tree**  
(subst/site)



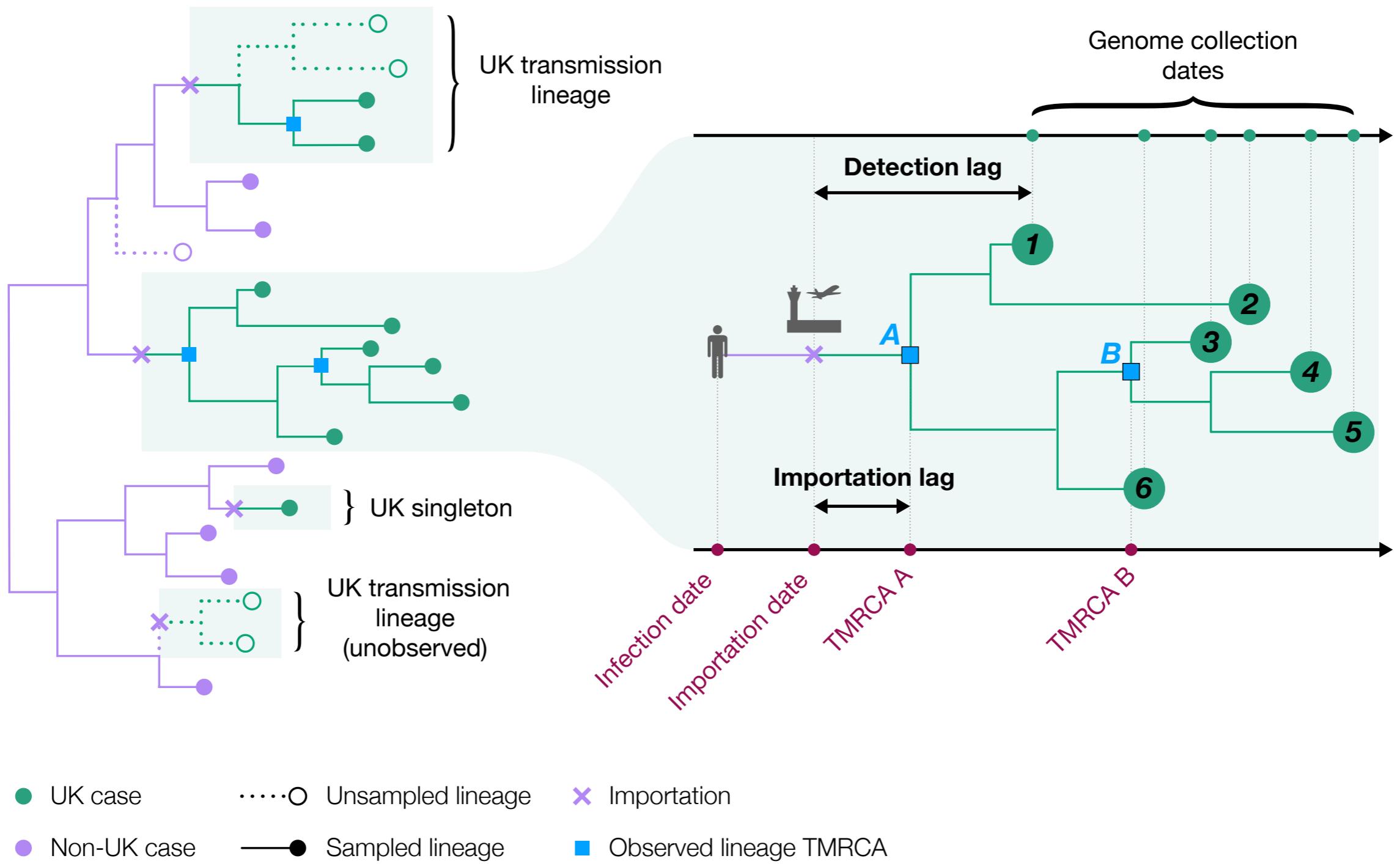
**Time tree**  
(year)



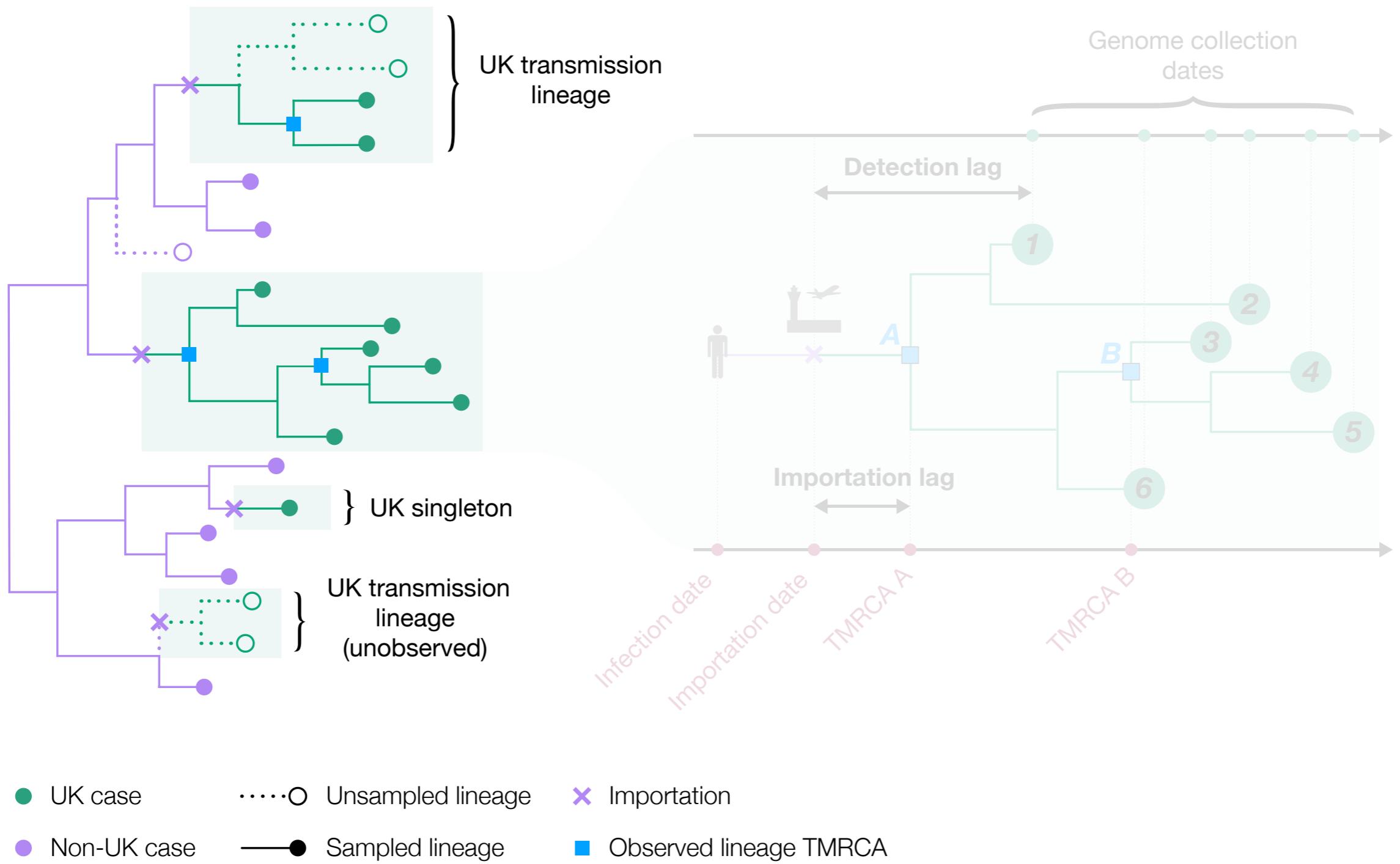
**Clock rate**  
(subst/site/year)  
 $= \mu \times$

[https://beast.community/thorney\\_beast](https://beast.community/thorney_beast)

# Definition: UK transmission lineages

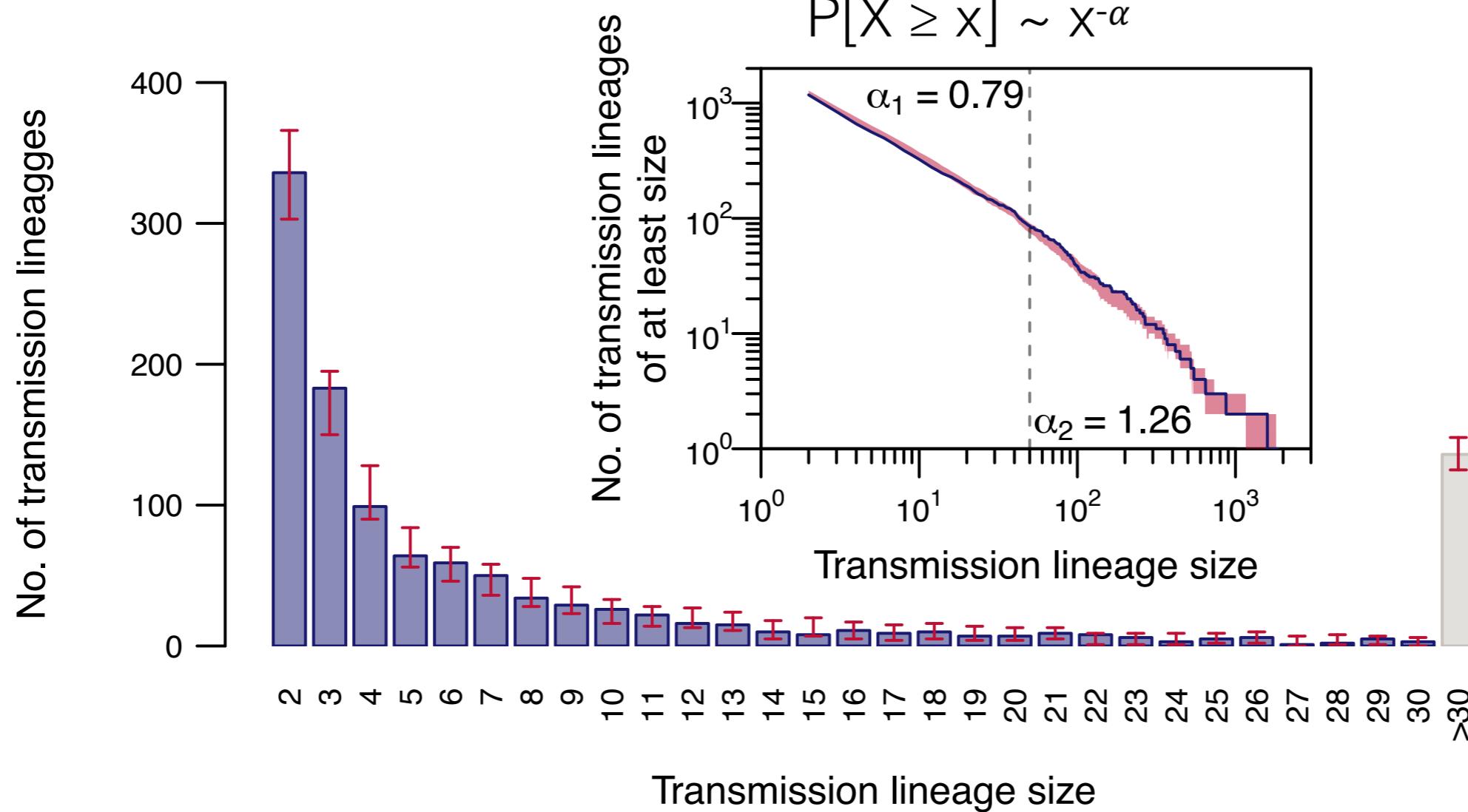


# Definition: UK transmission lineages



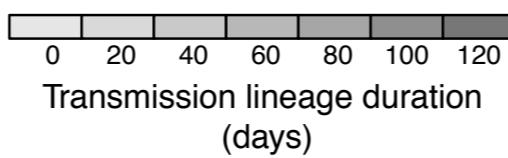
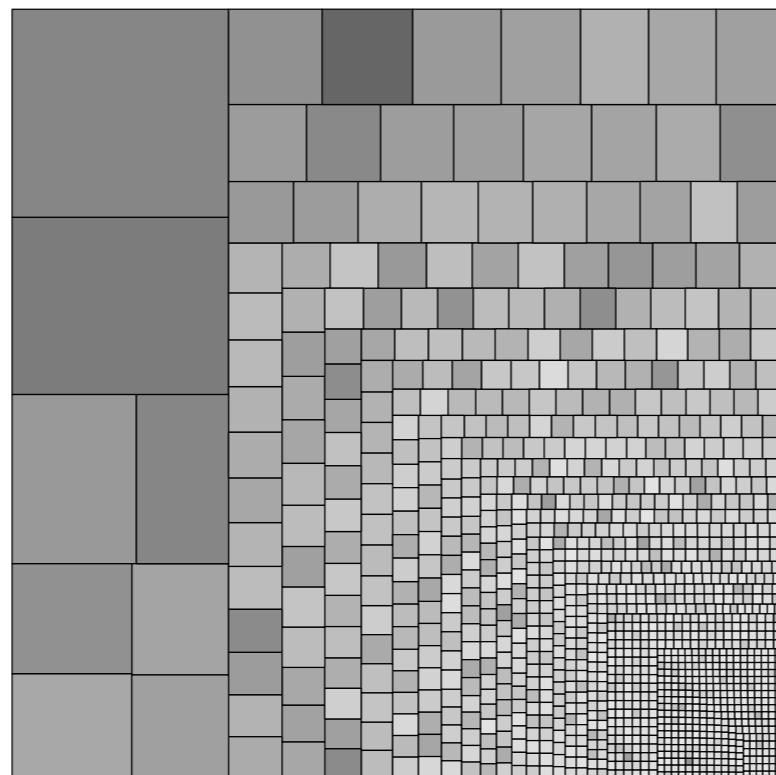
# Sizes of UK transmission lineages

**26,181** UK genomes into **1179** lineages and **1650** singletons



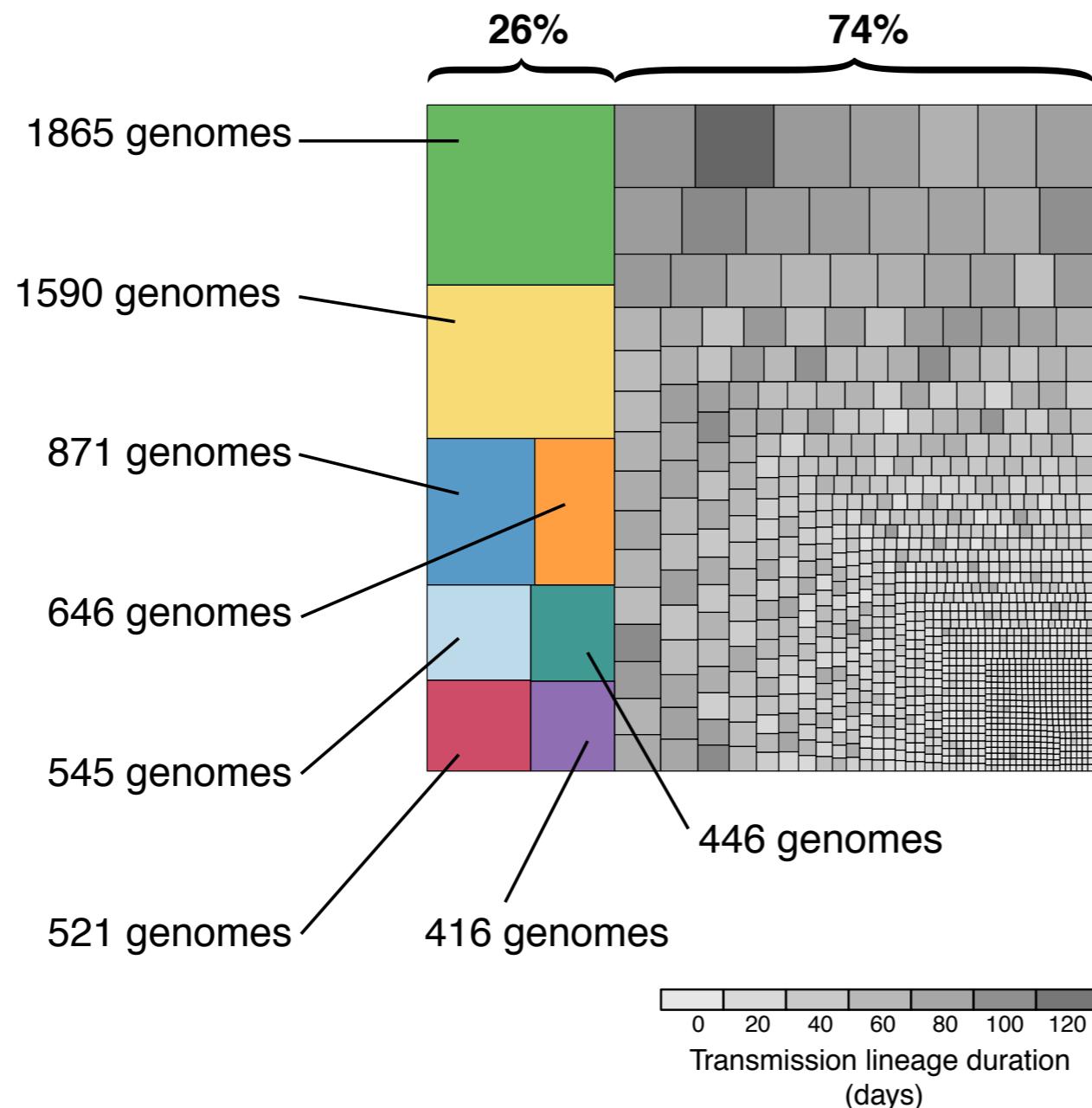
# UK transmission lineage breakdown

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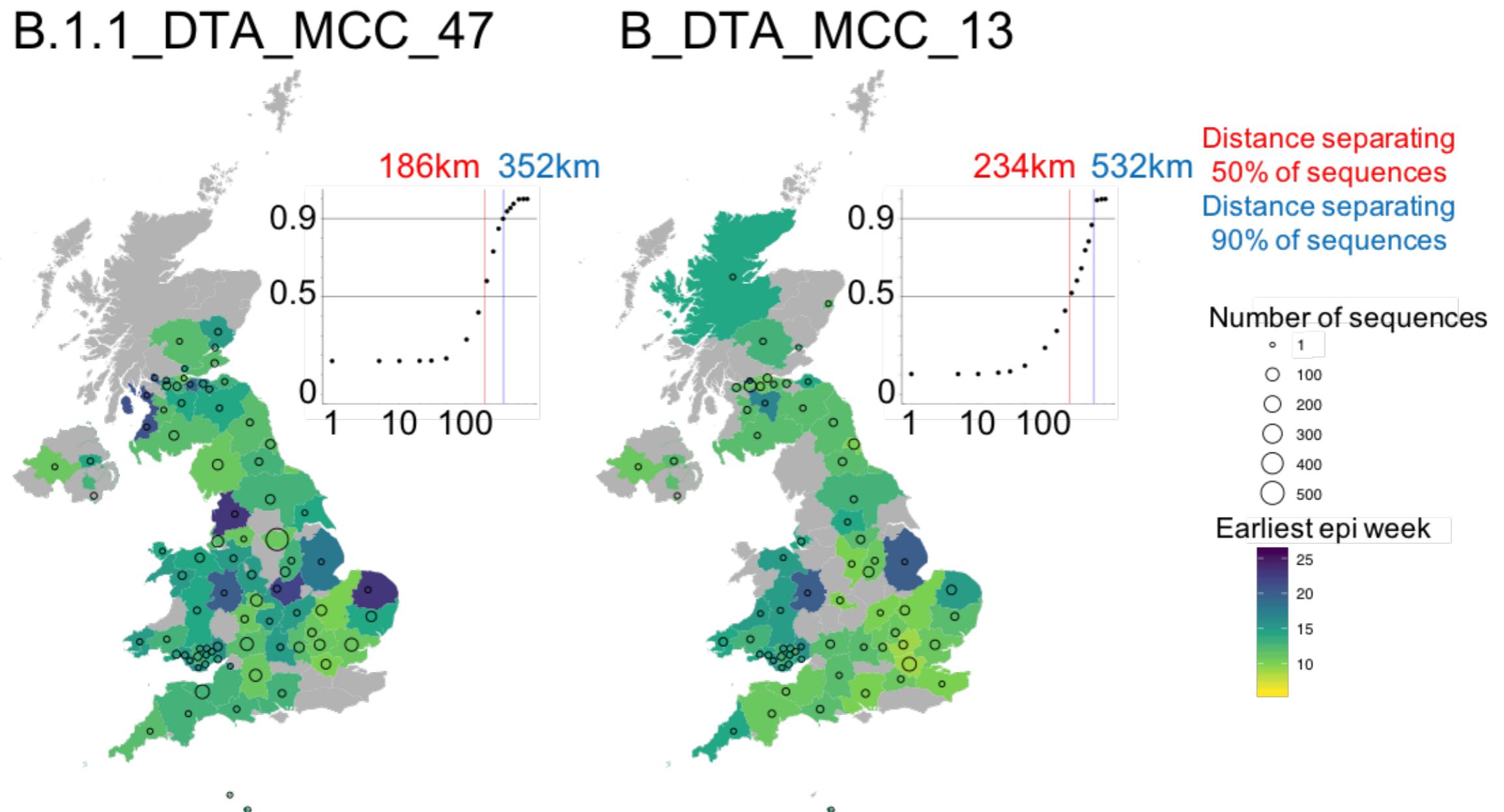


# UK transmission lineage breakdown

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# Some lineages spread far and wide...

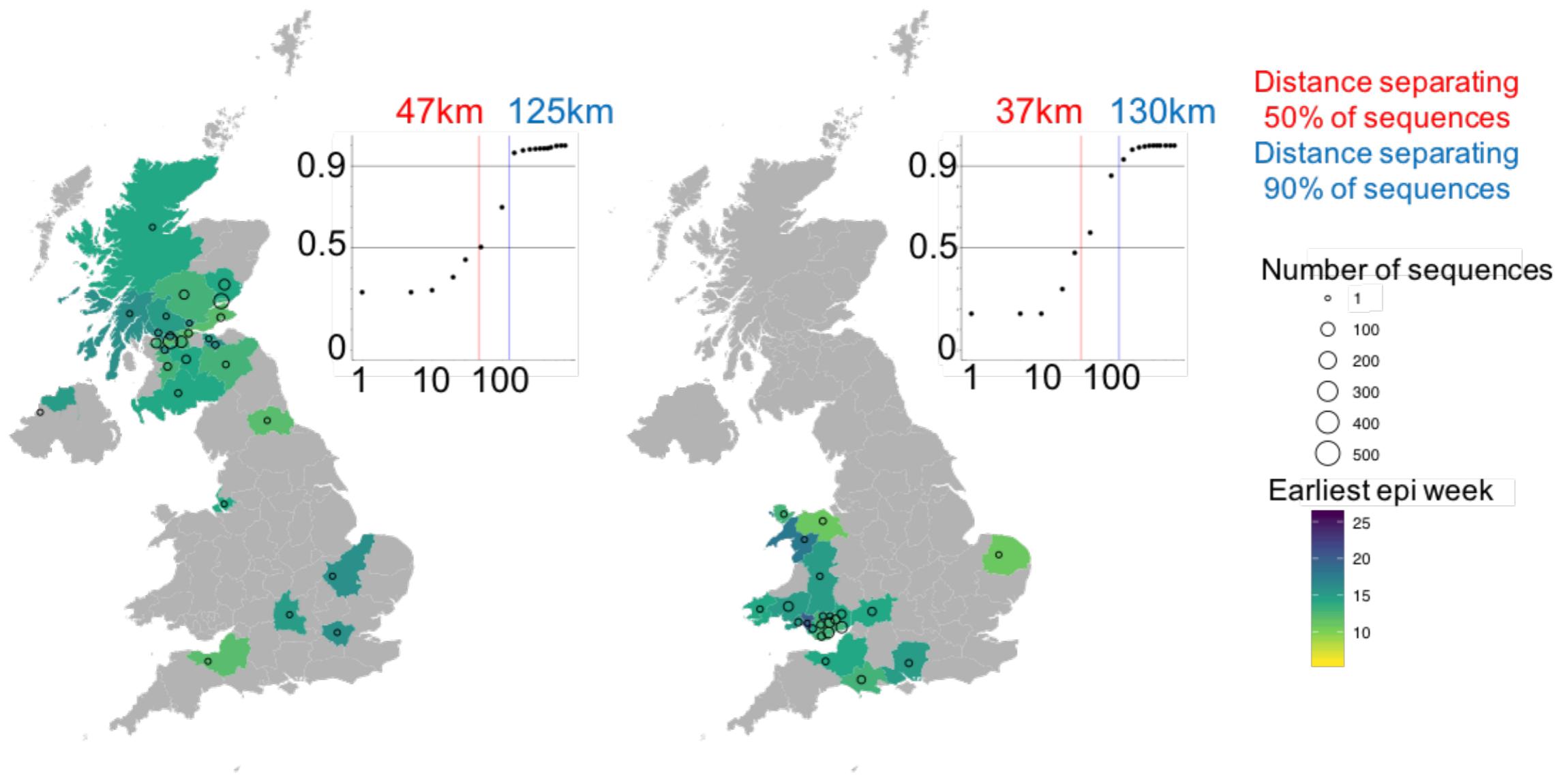


figures: Chris Ruis

others remained local...

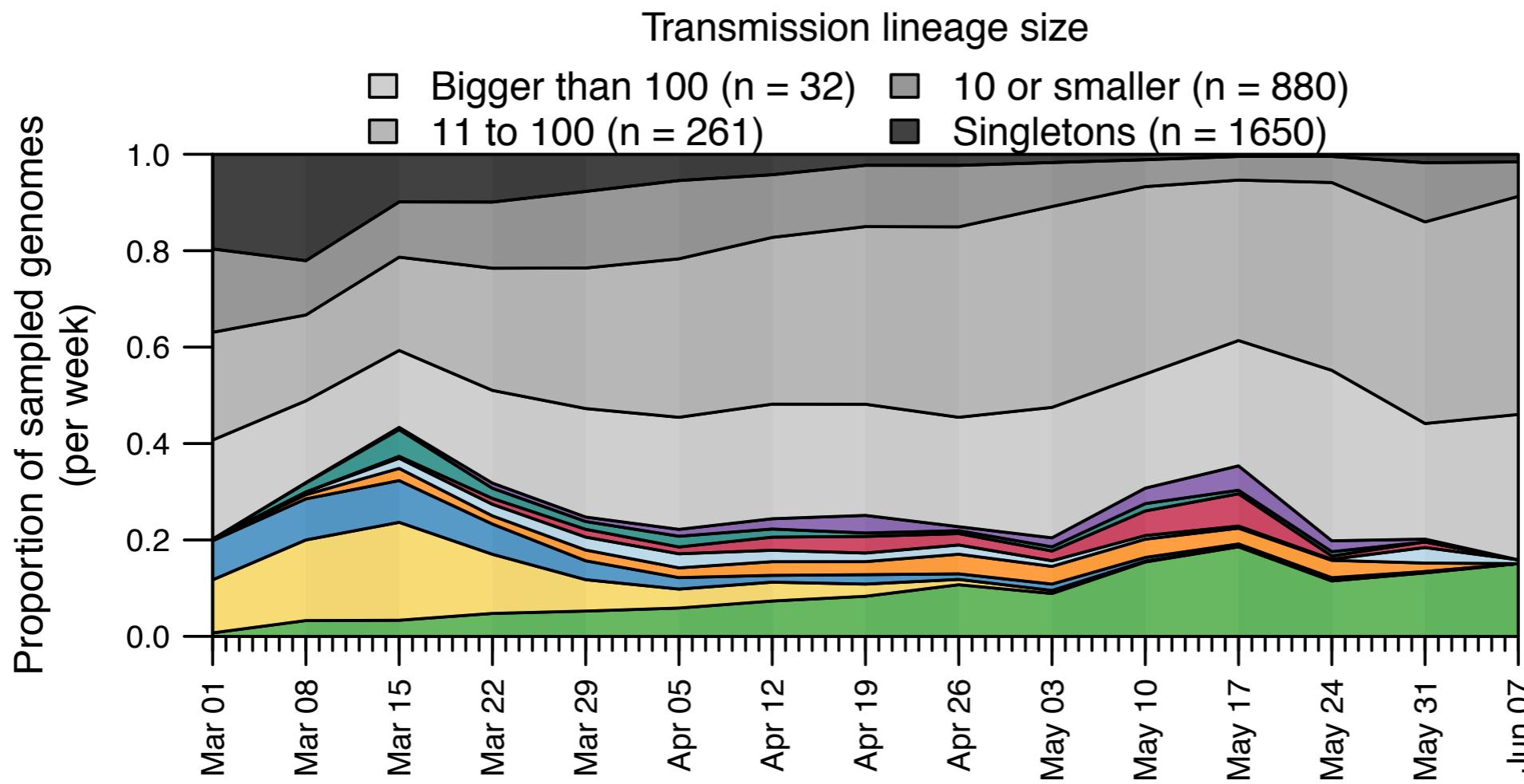
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B.1.pruned\_DTA\_MCC\_234    B\_DTA\_MCC\_172

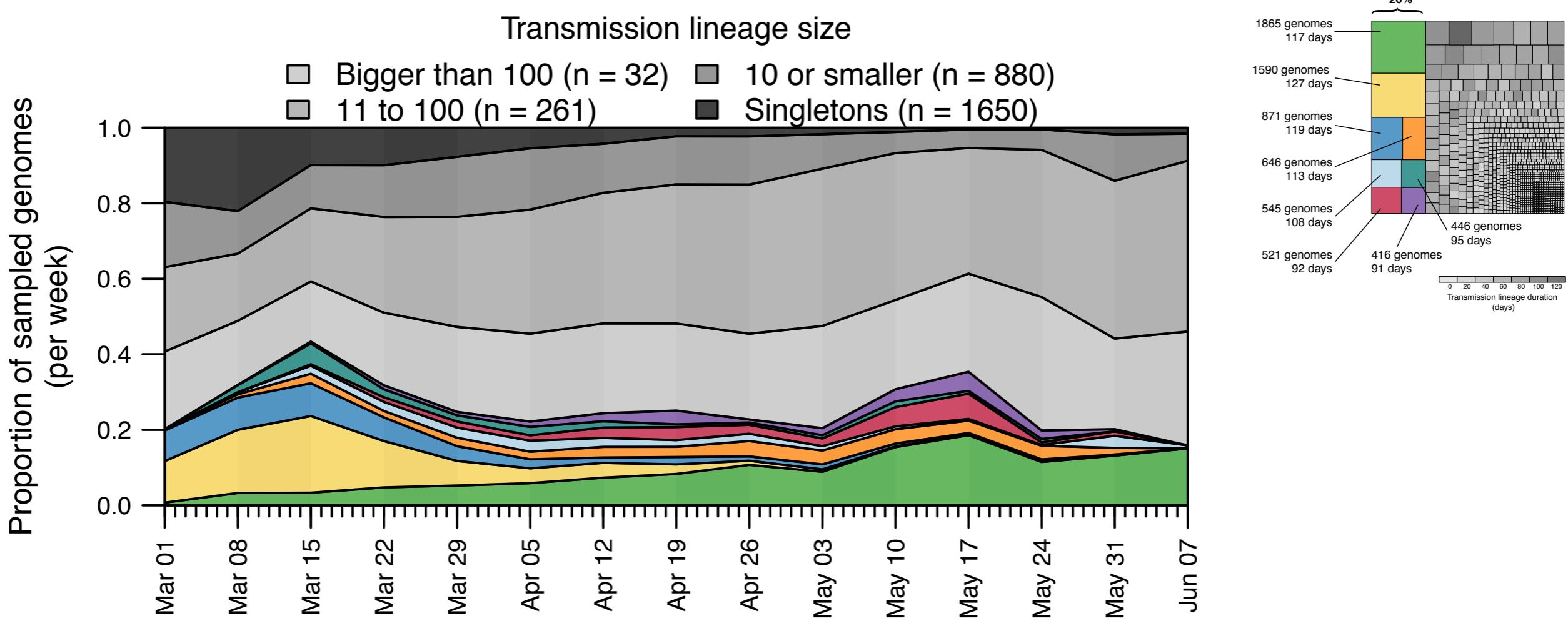


# Sample breakdown by UK transmission lineage

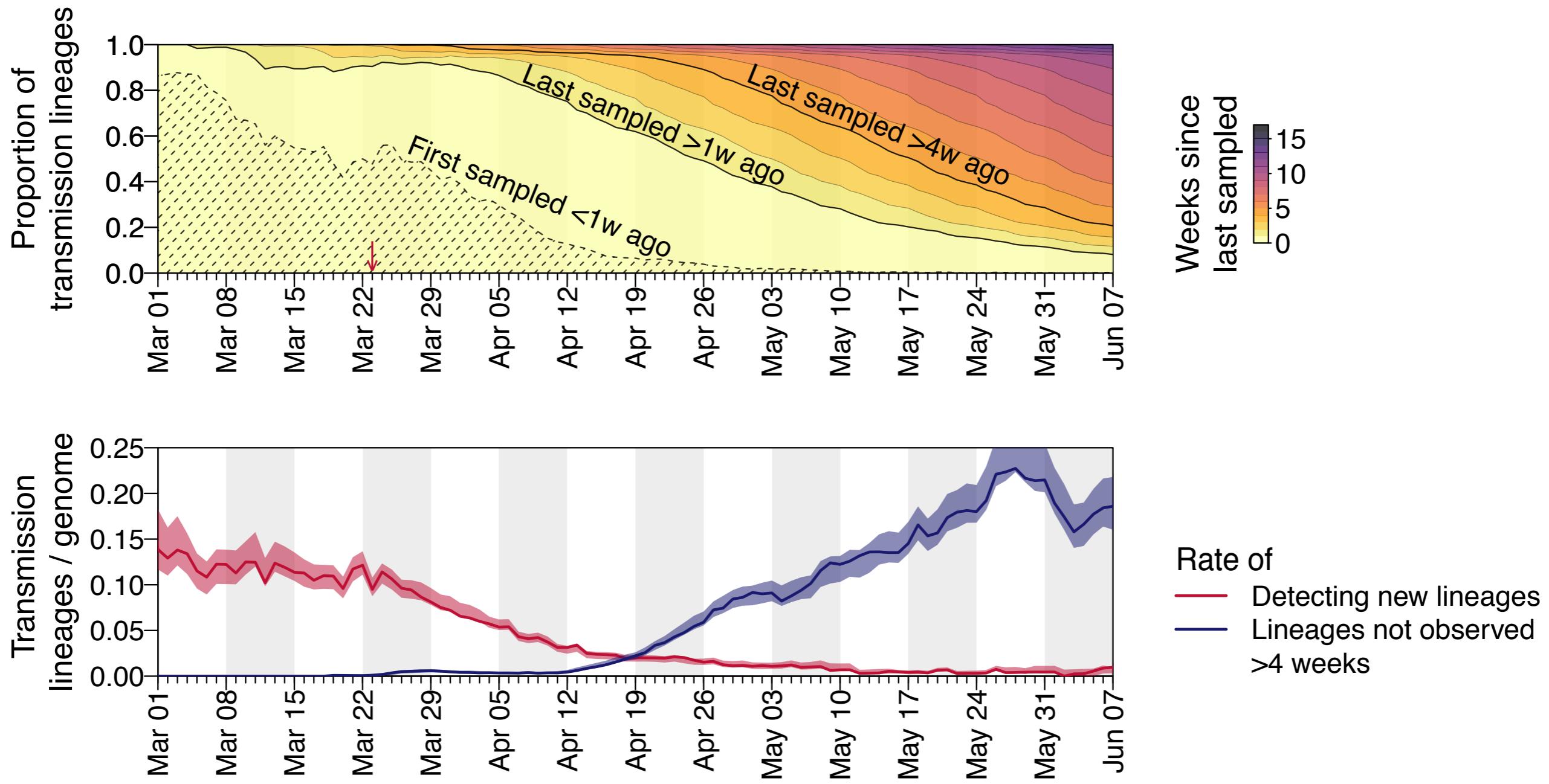
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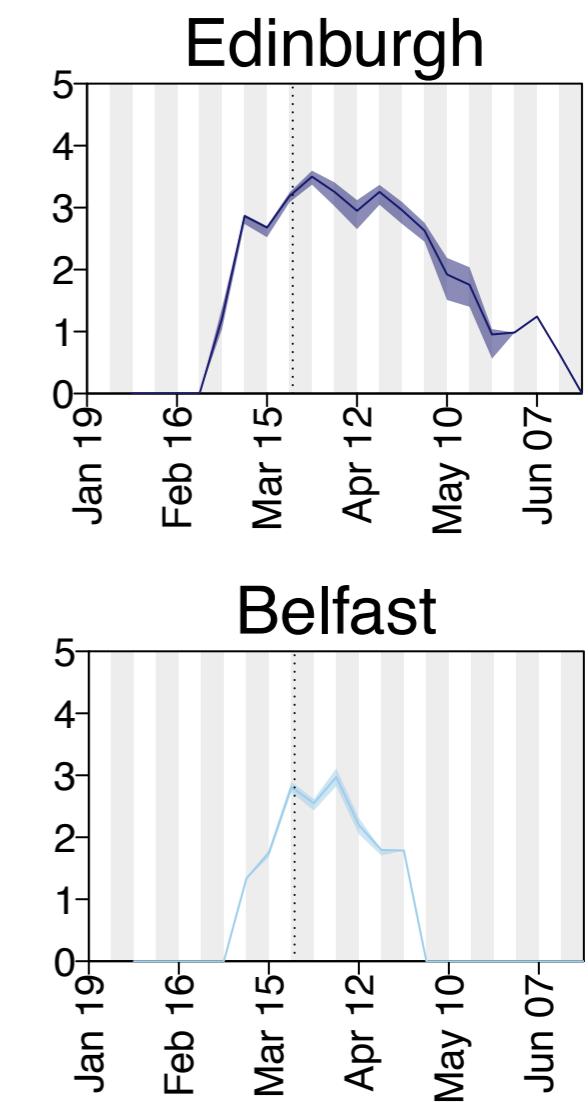
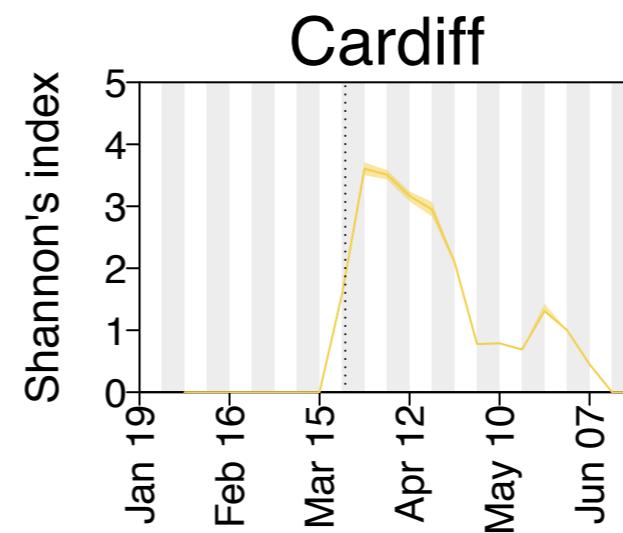
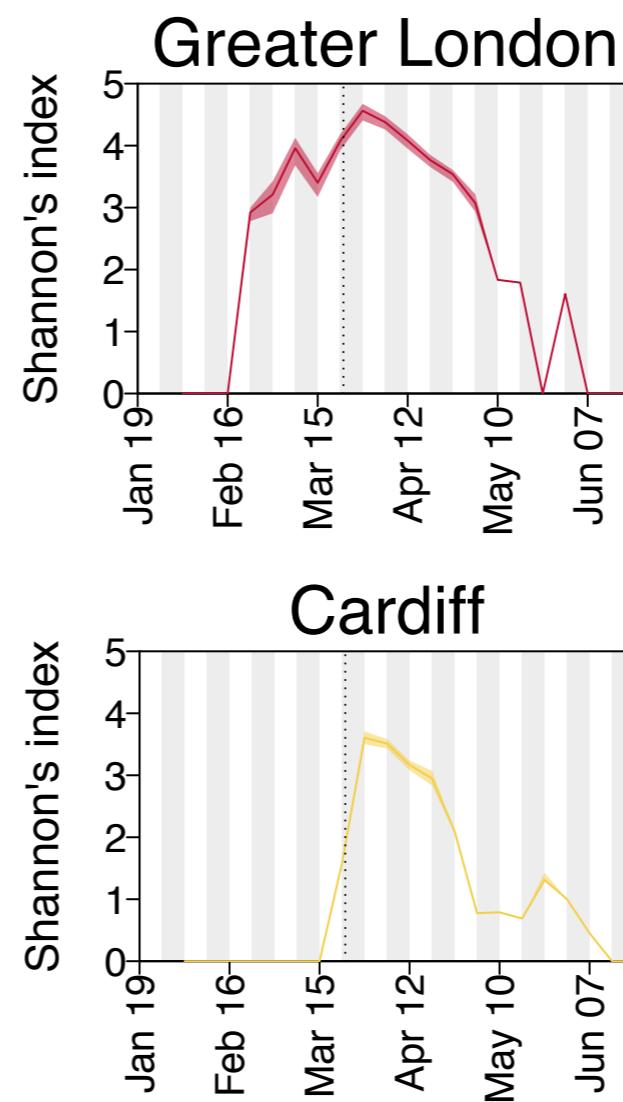
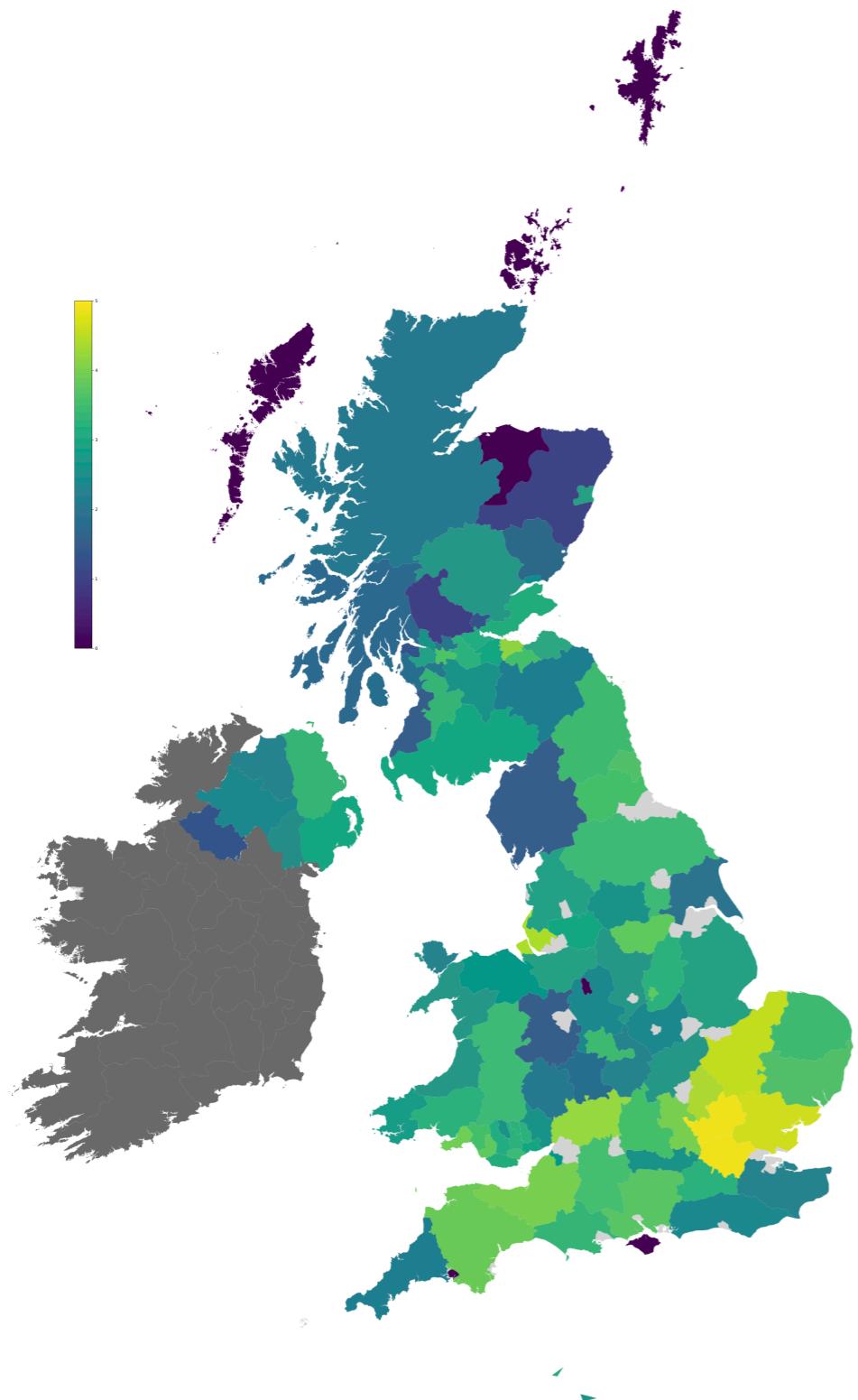
# Sample breakdown by UK transmission lineage



# Detection of UK transmission lineages

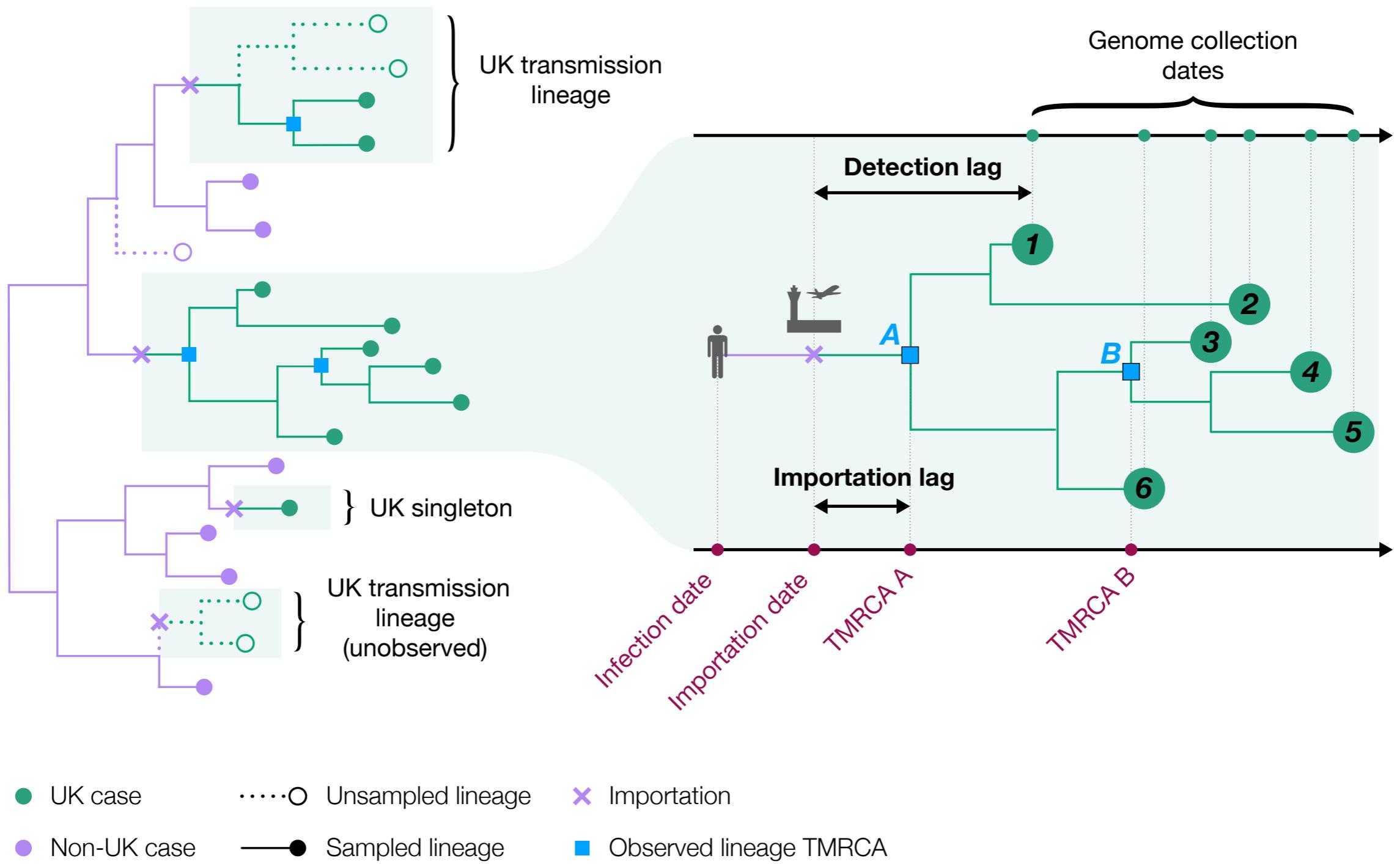


# Shannon's index for lineage diversity

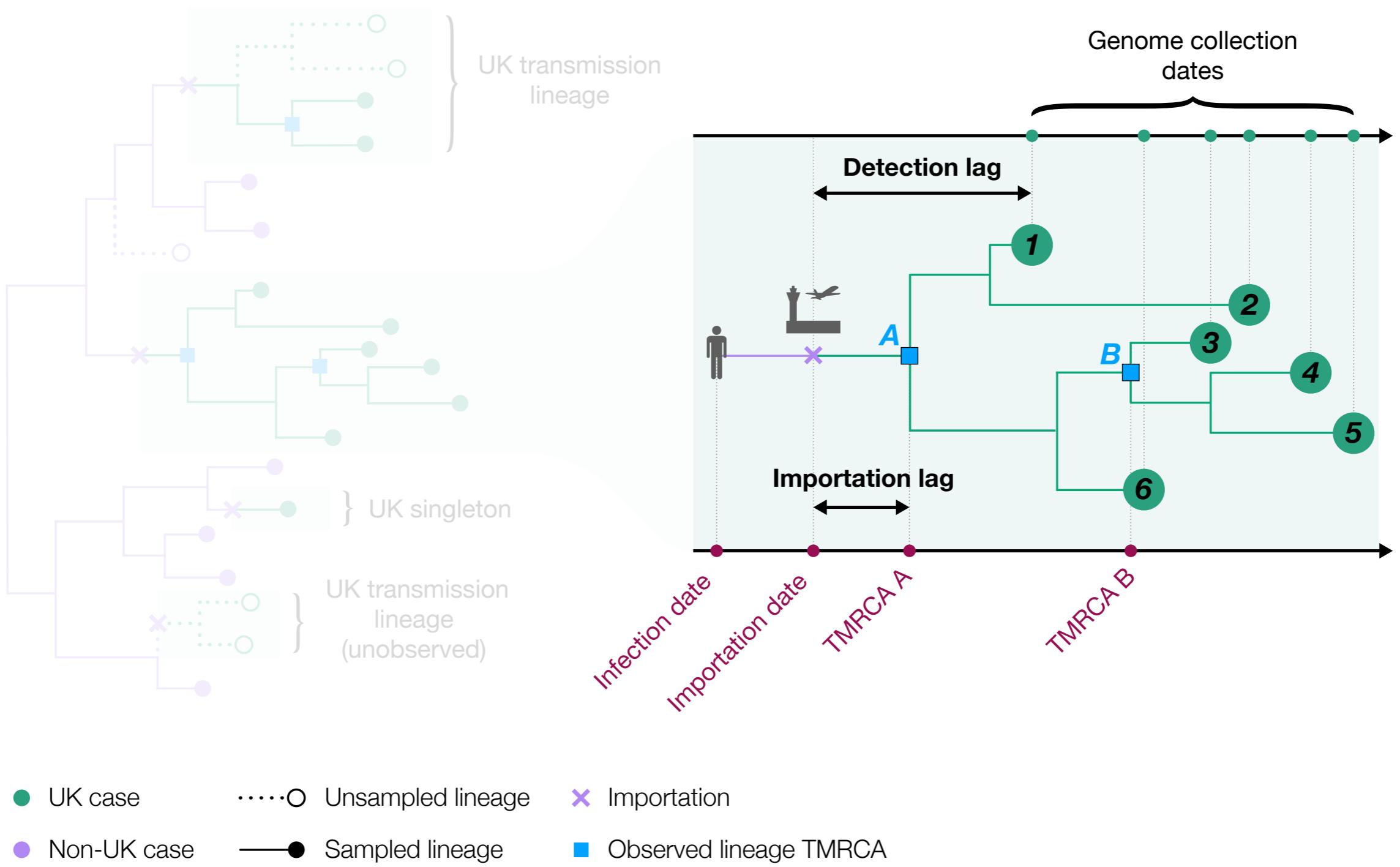


figures: Verity Hill

# Definition: TMRCA and importation lag

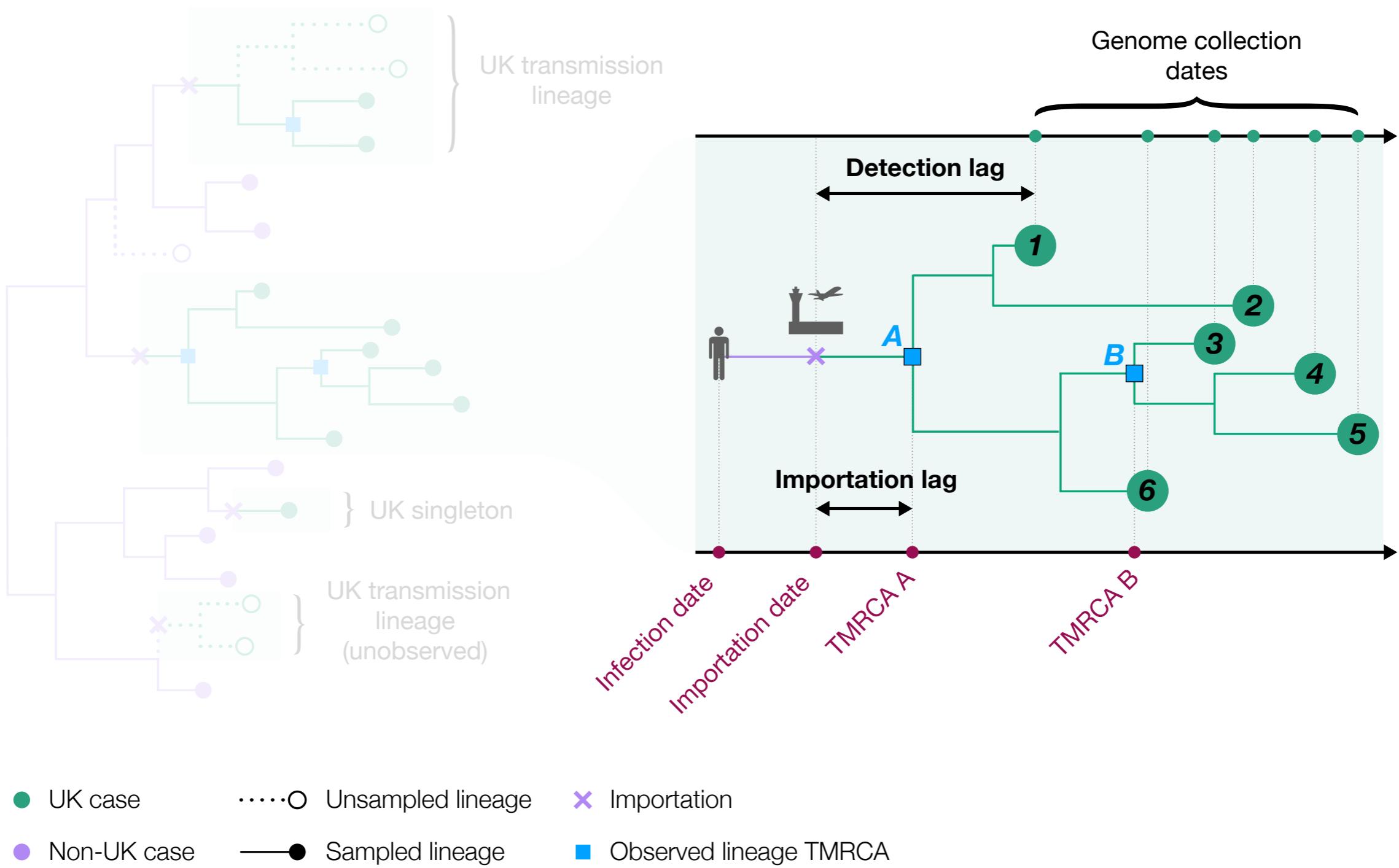


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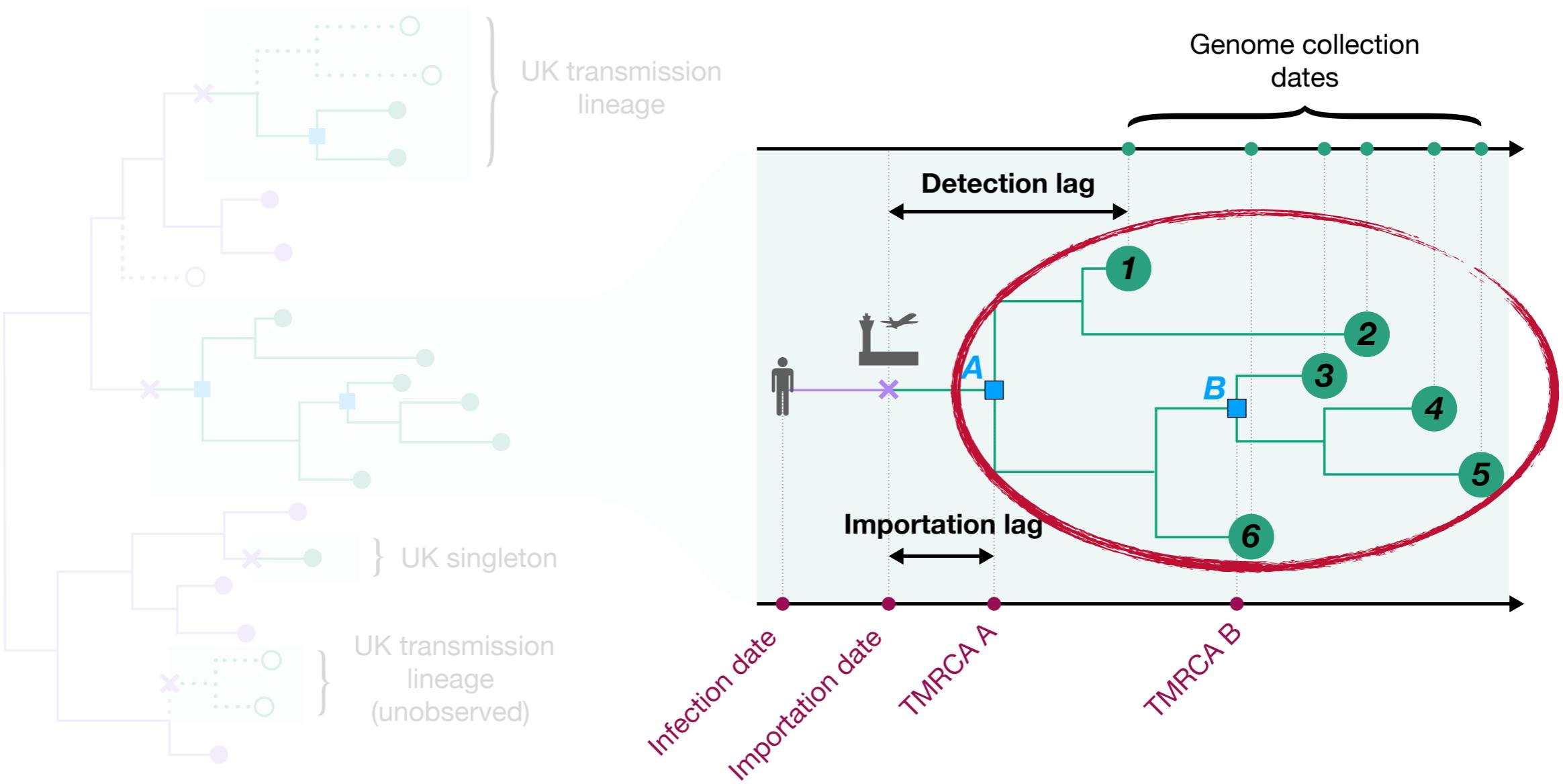


time of the most recent  
common ancestor

# Definition: TMRCA and importation lag

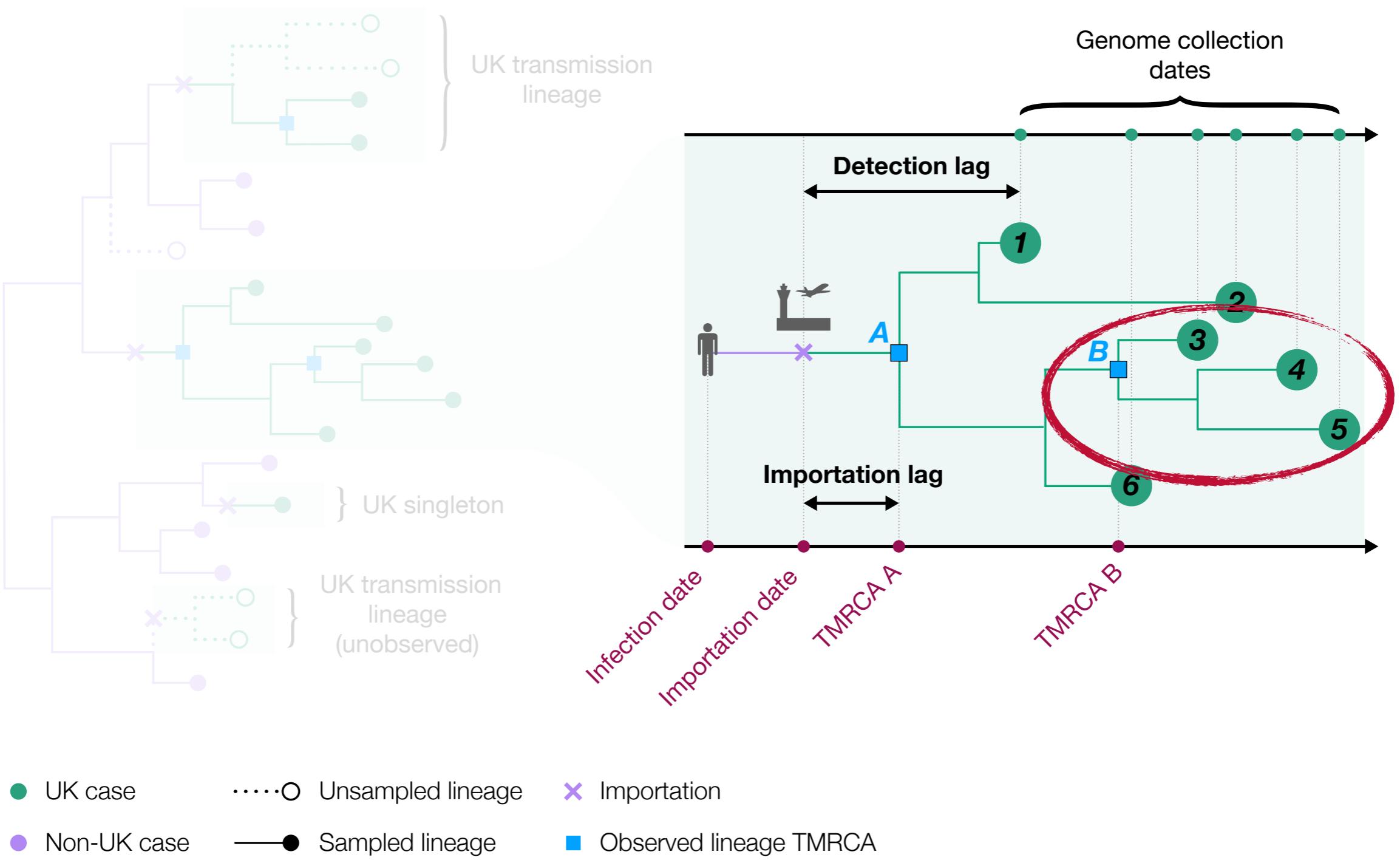


# Definition: TMRCA and importation lag



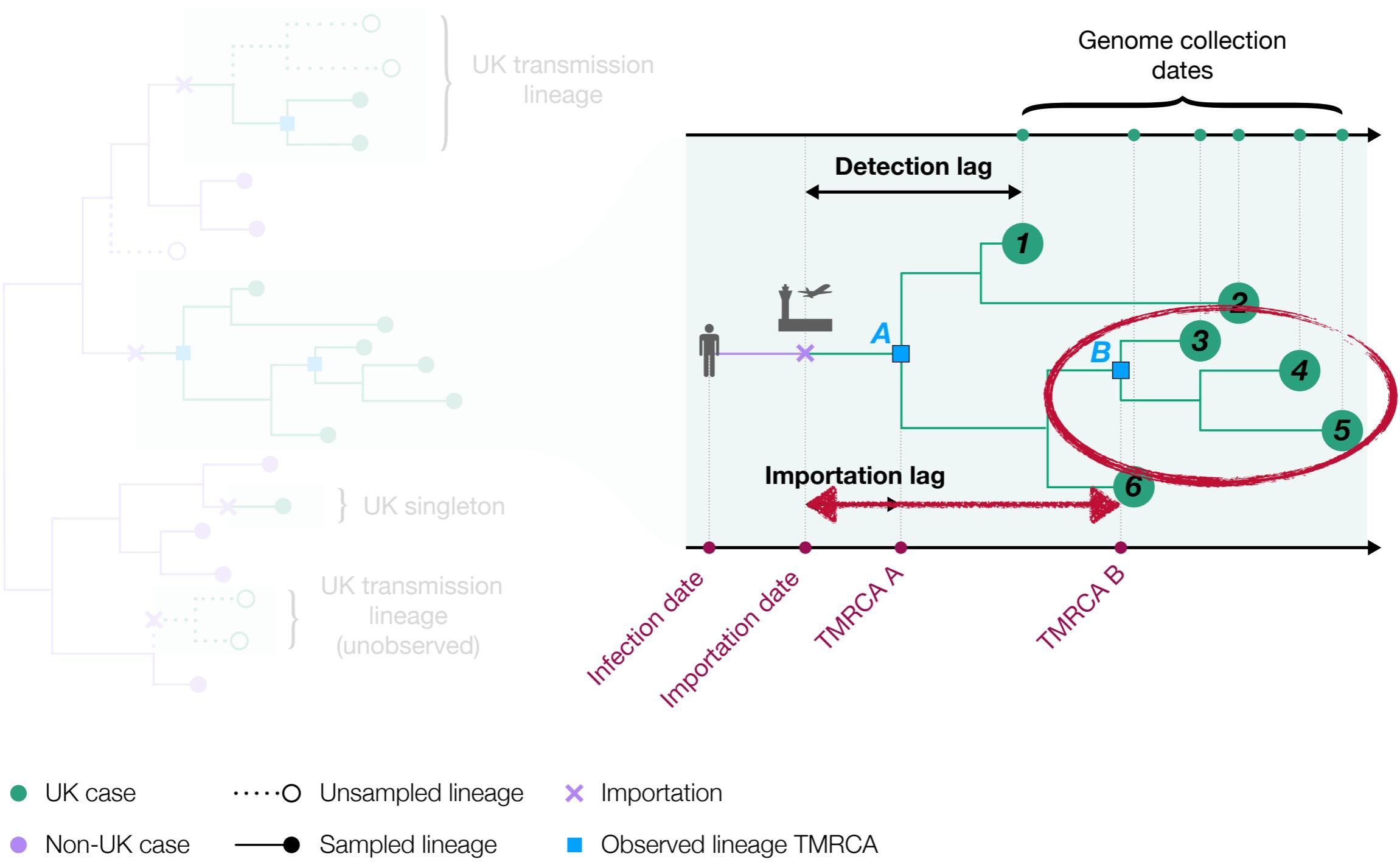
- UK case      .....○ Unsampled lineage      ✕ Importation
- Non-UK case      —● Sampled lineage      ■ Observed lineage TMRCA

# Definition: TMRCA and importation lag

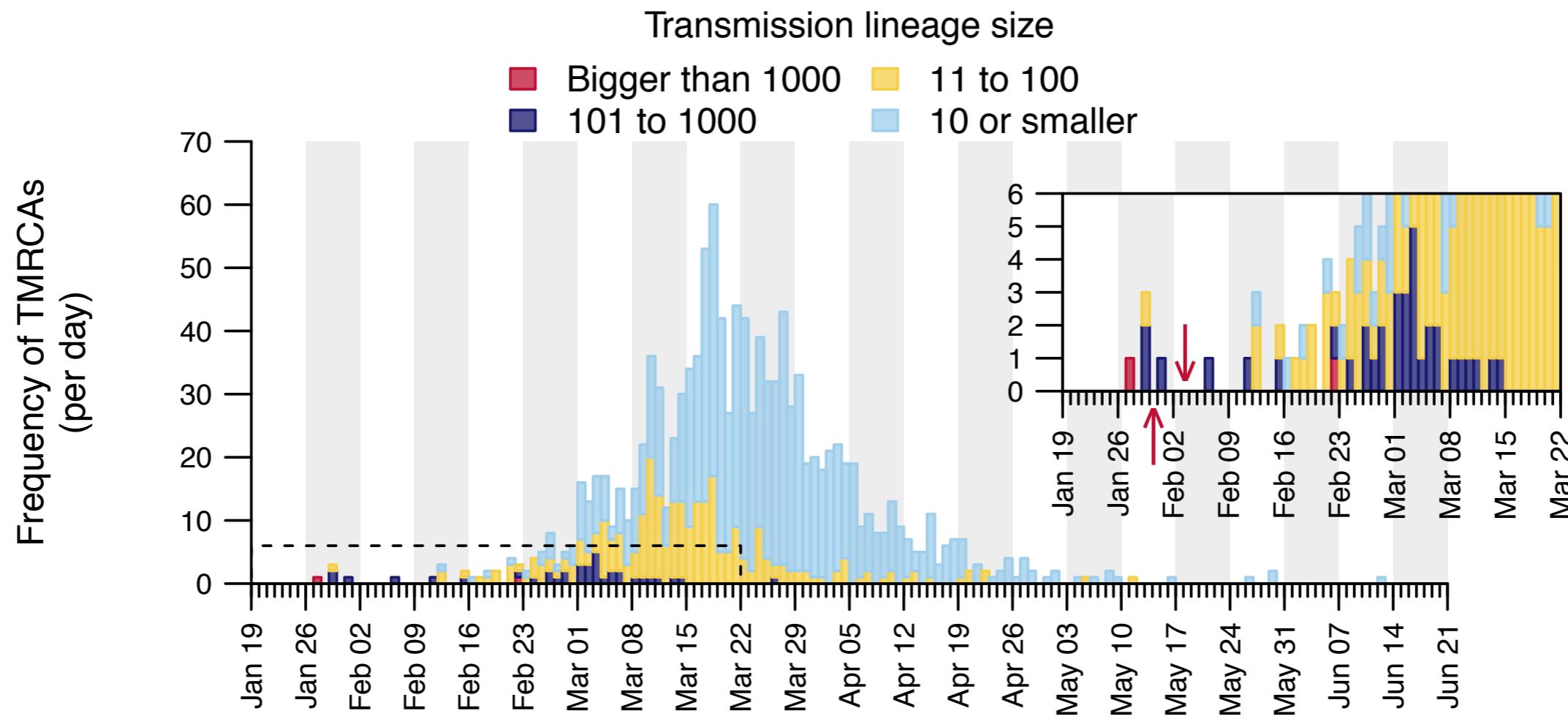


# time of the most recent common ancestor

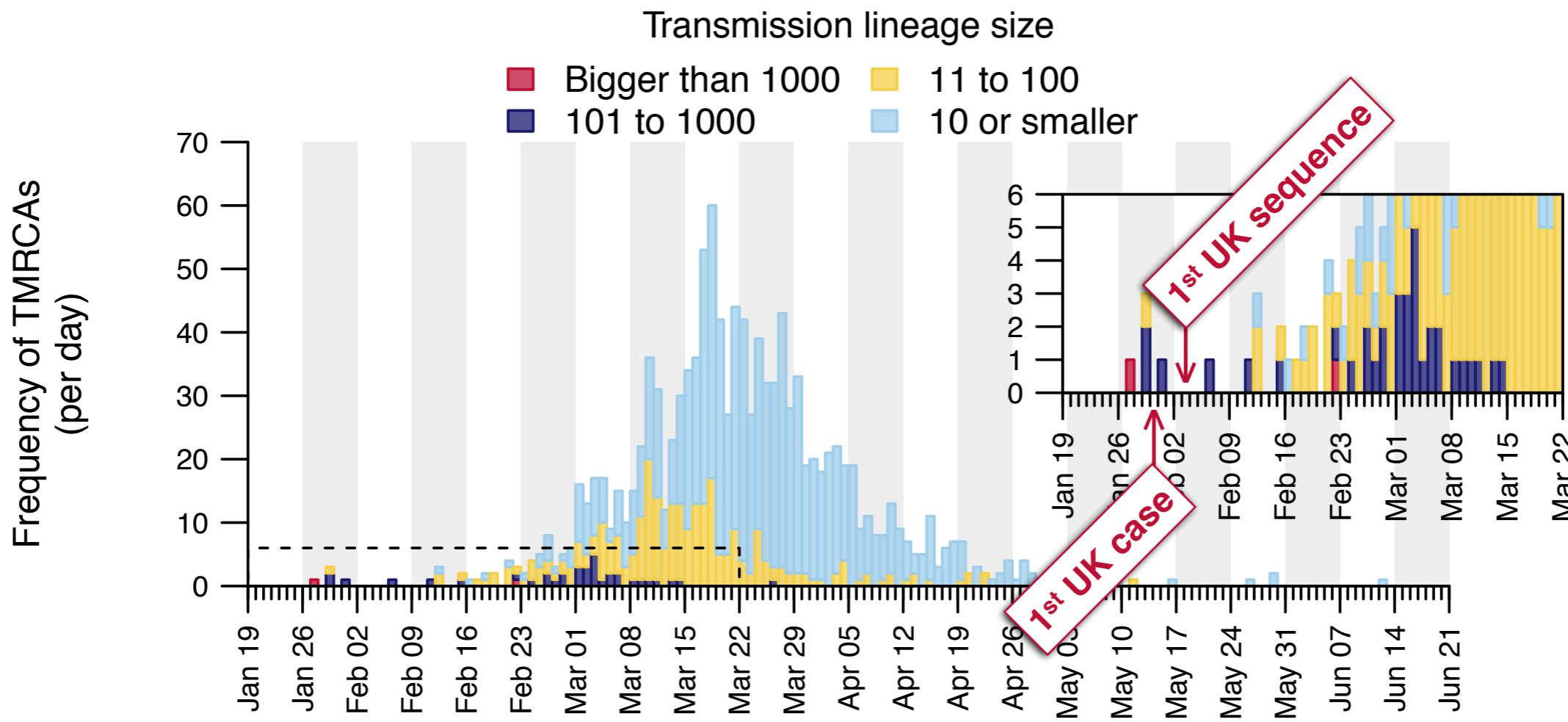
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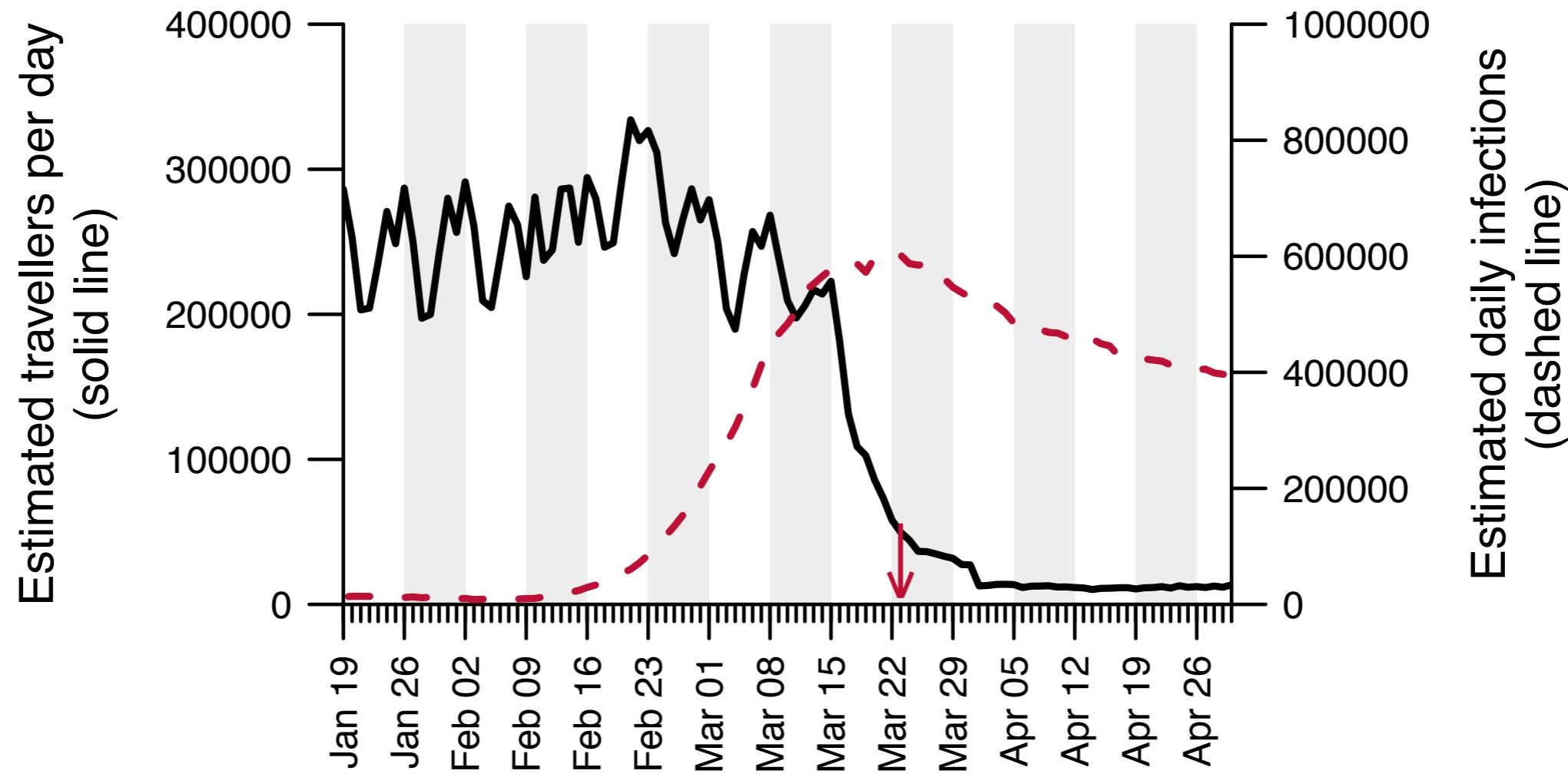
# Estimated TMRCAs of UK transmission lineages



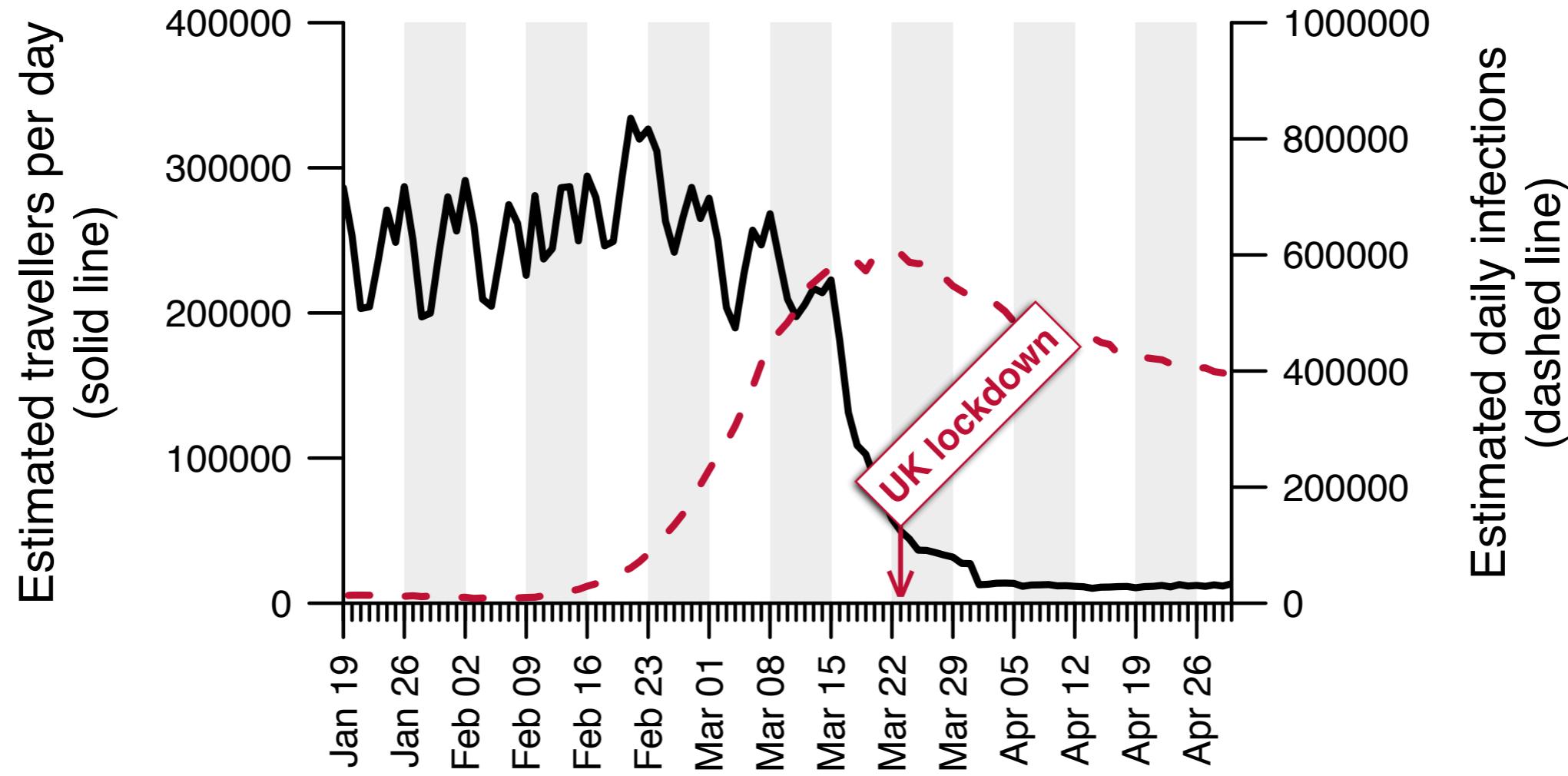
# Estimated TMRCAs of UK transmission lineages



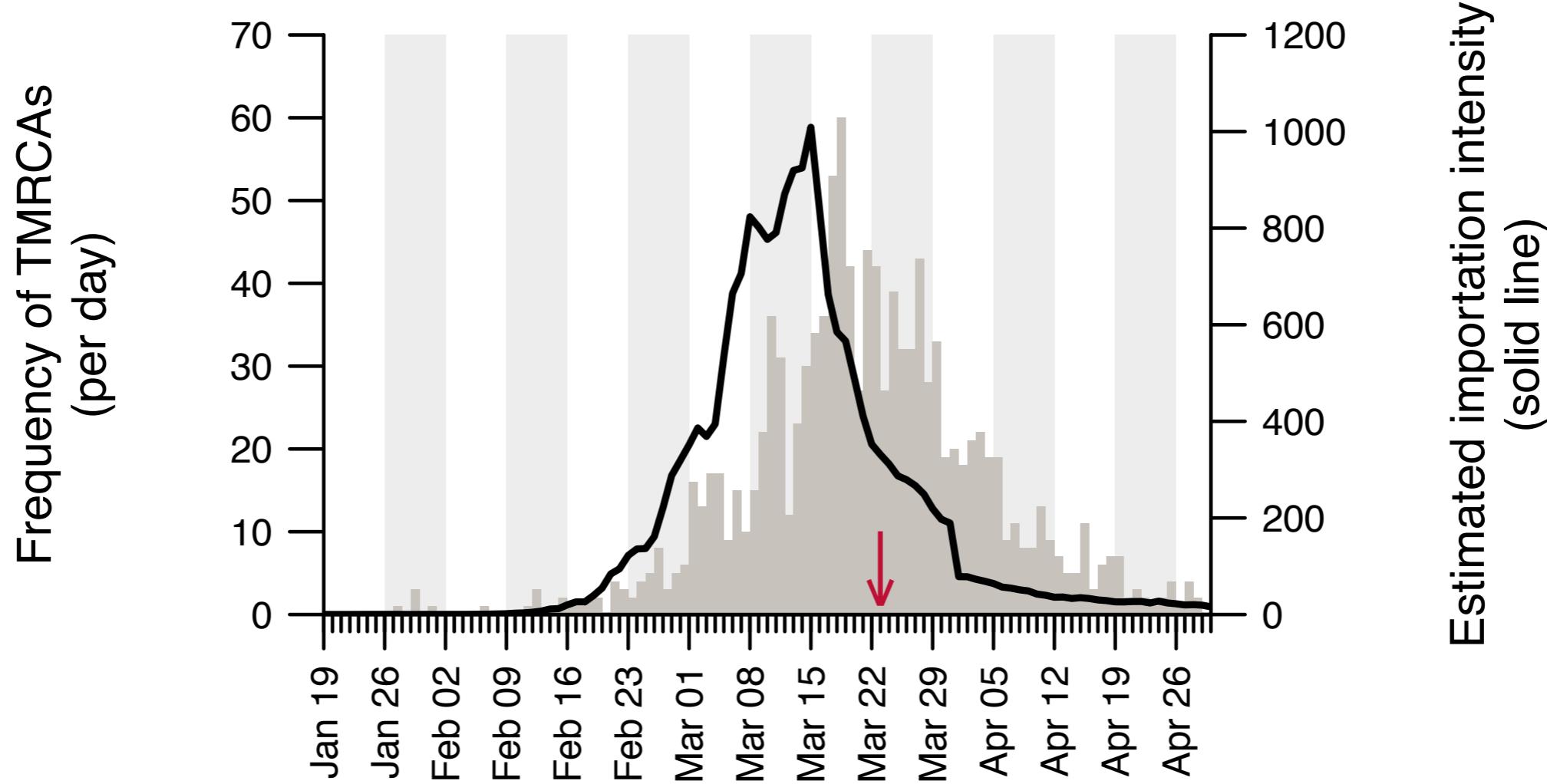
# Trends in inbound travel and COVID-19 cases



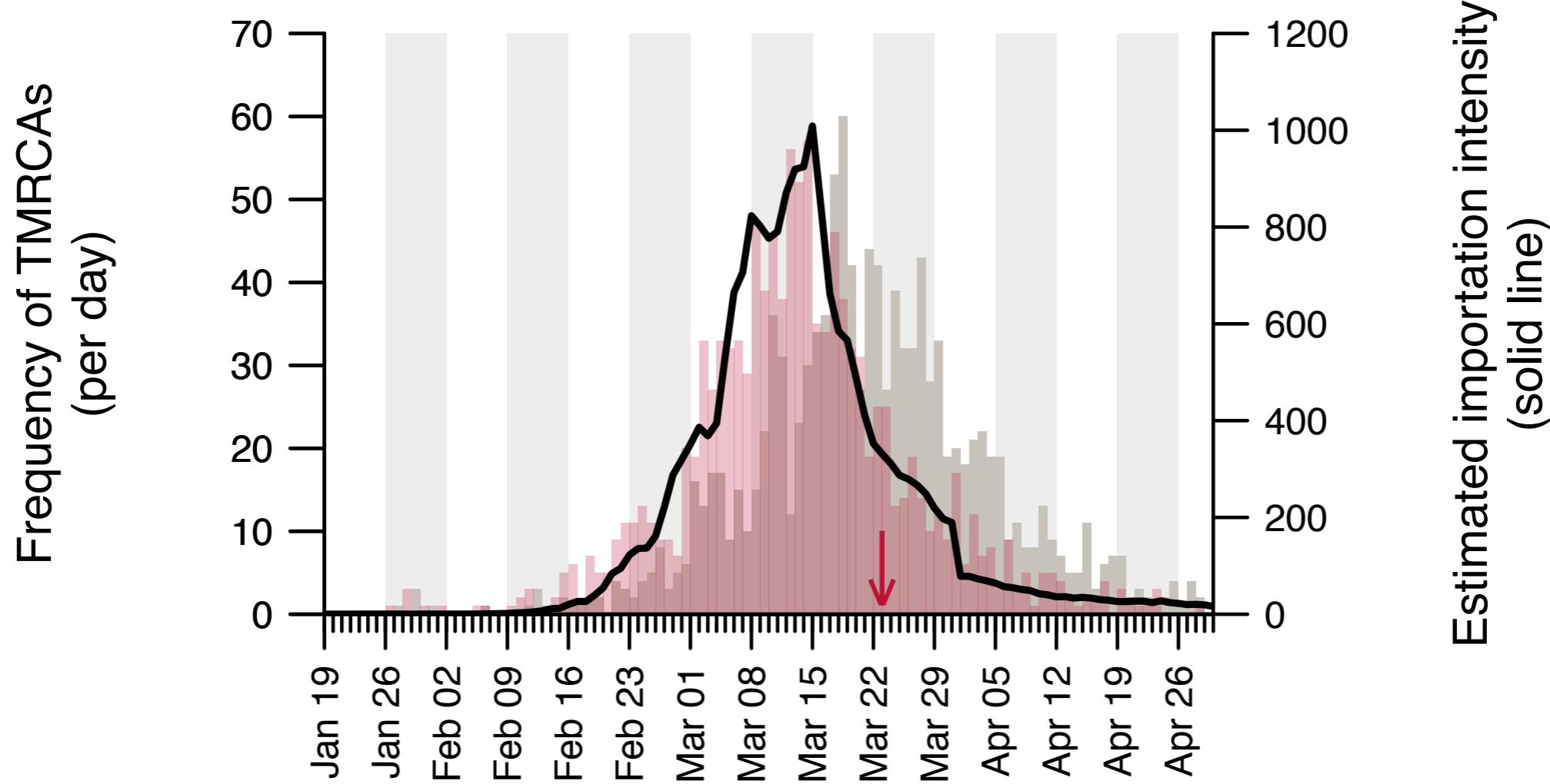
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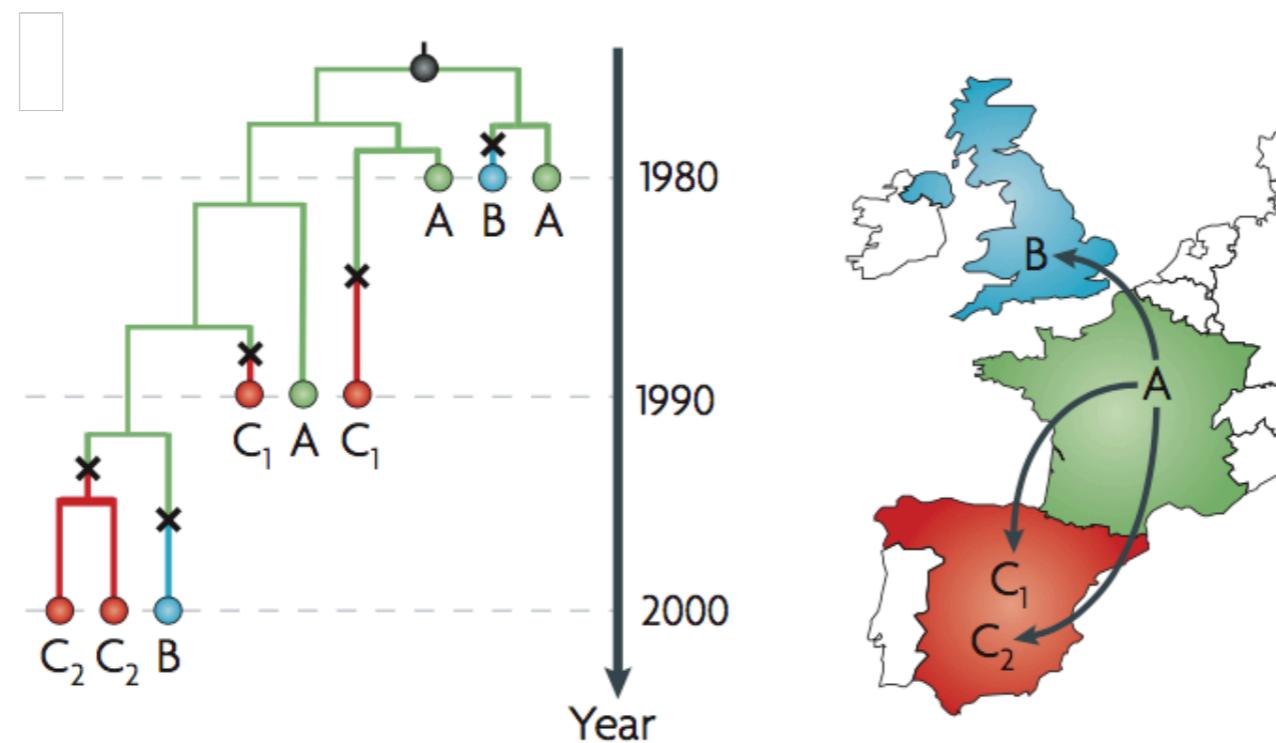
# Estimated Importation Intensity



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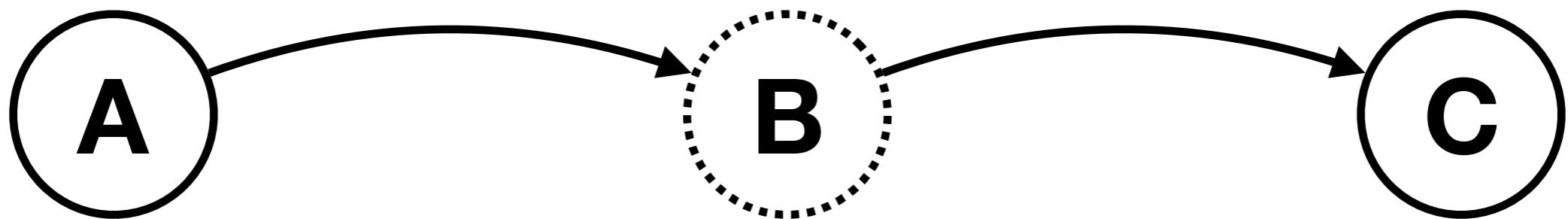


# Phylogeography



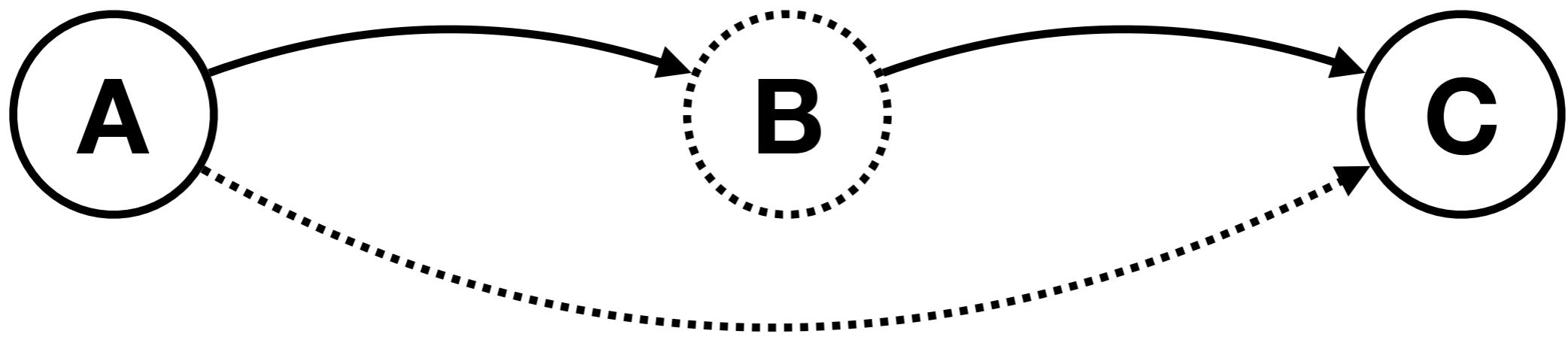
# 3-body problem

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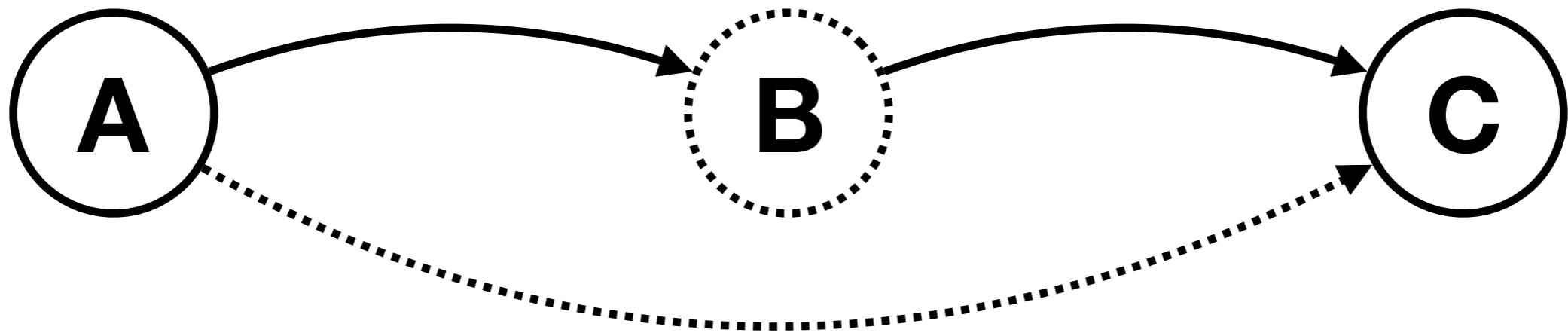
# 3-body problem

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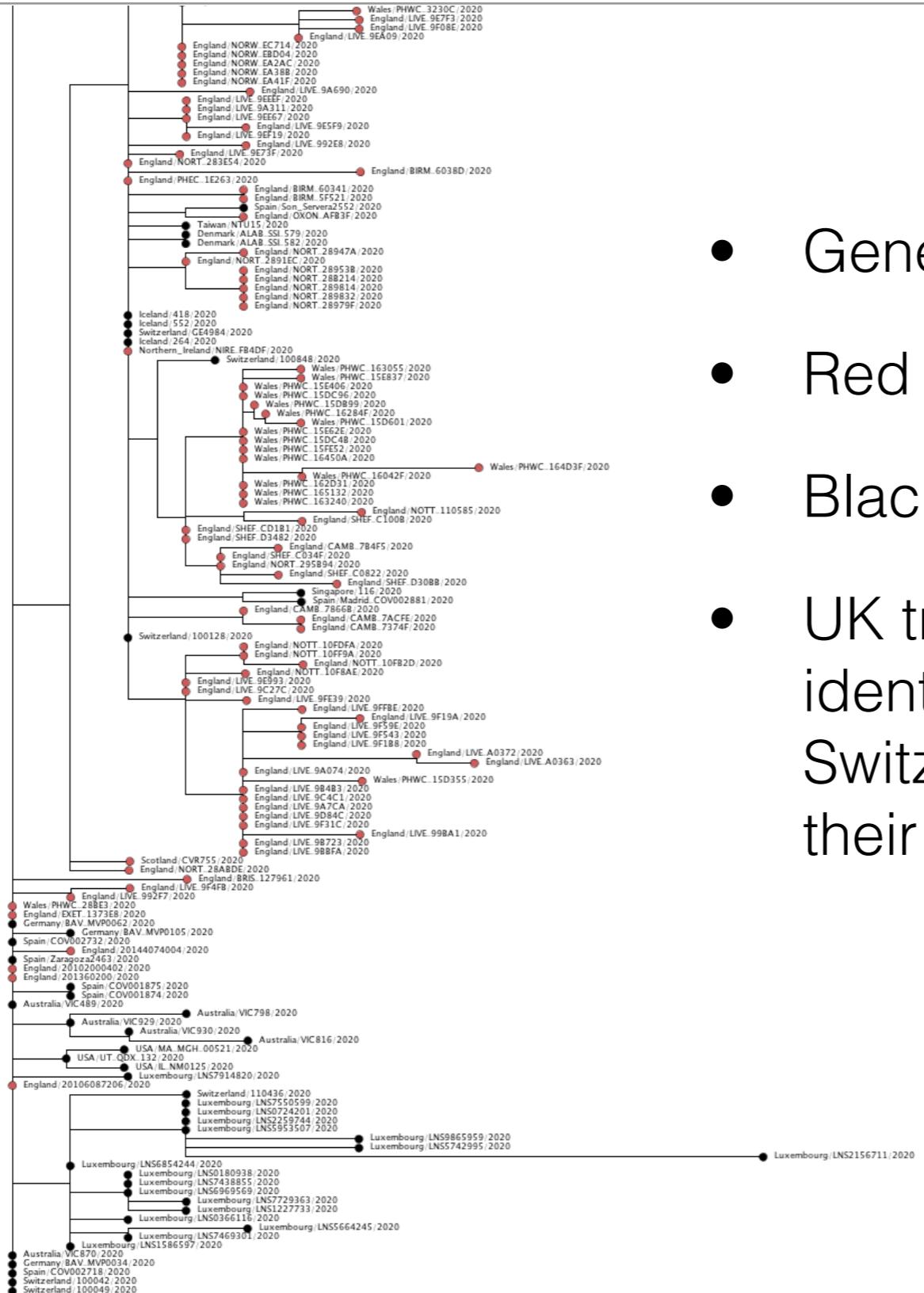
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**Cases, sequences and genomes until 5 May 2020**

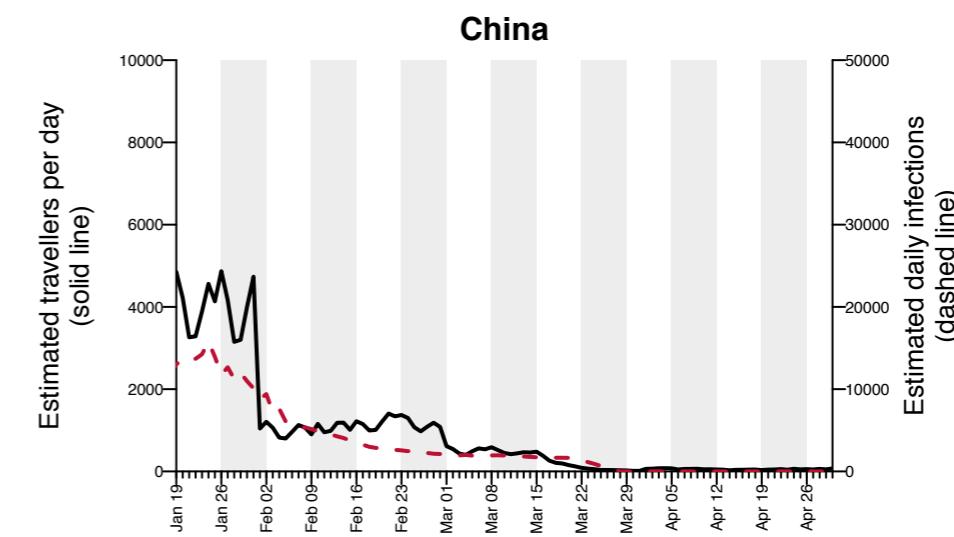
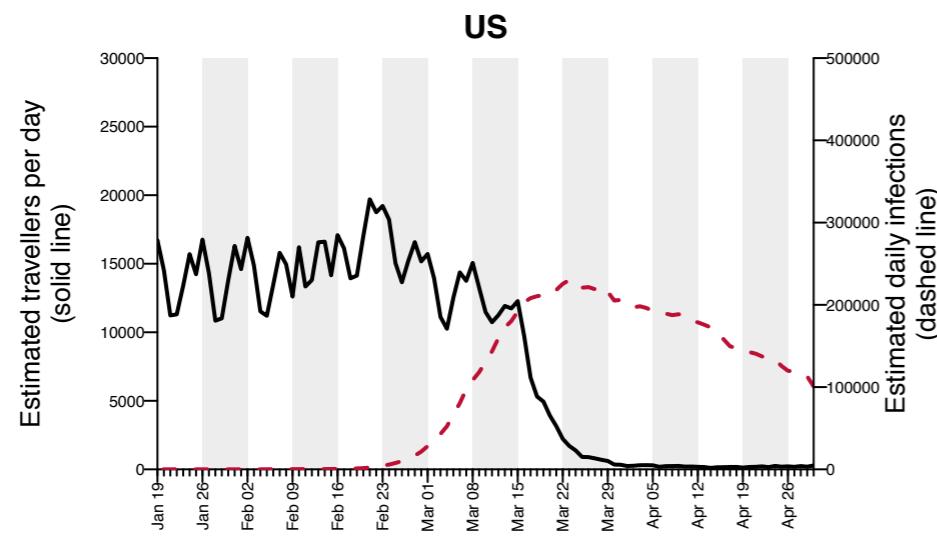
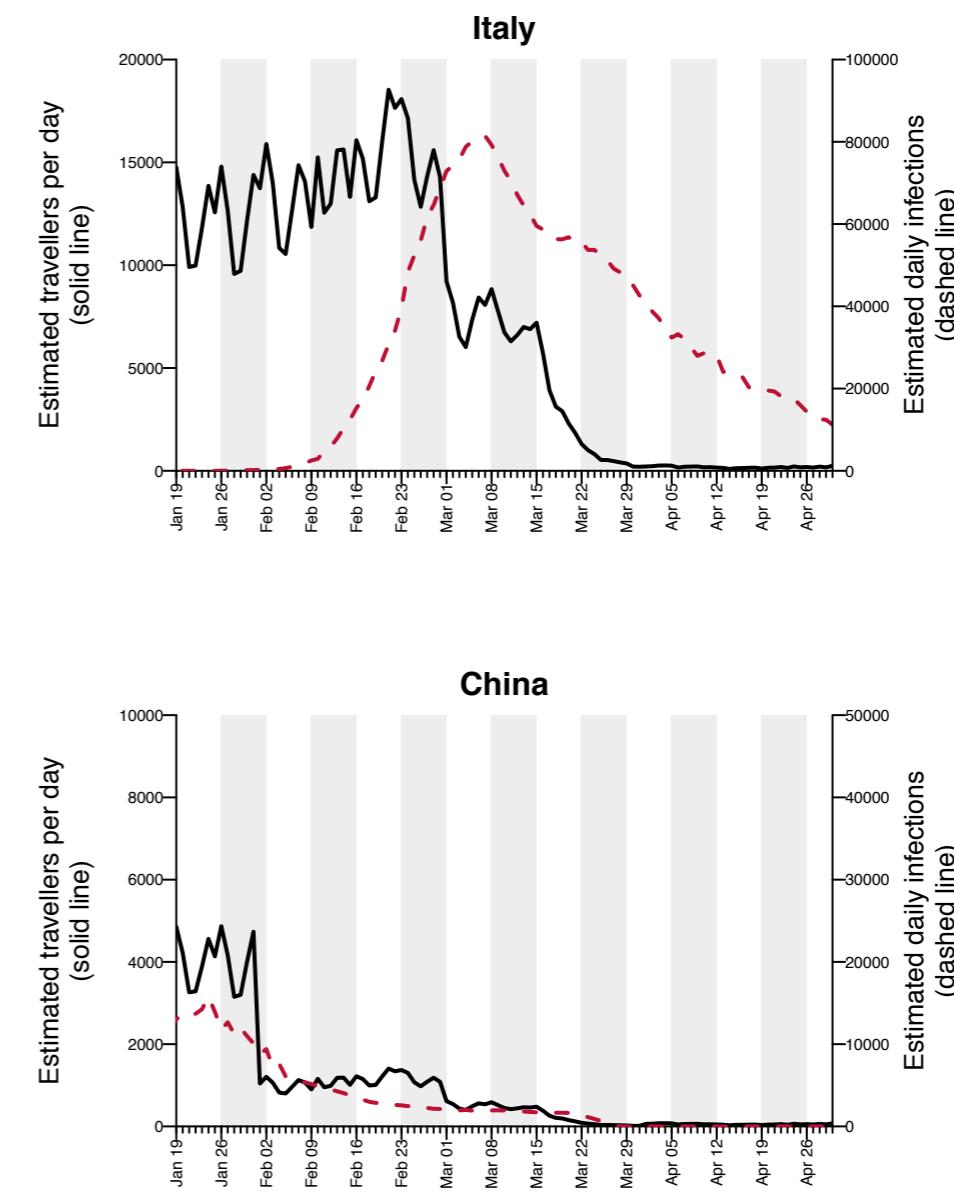
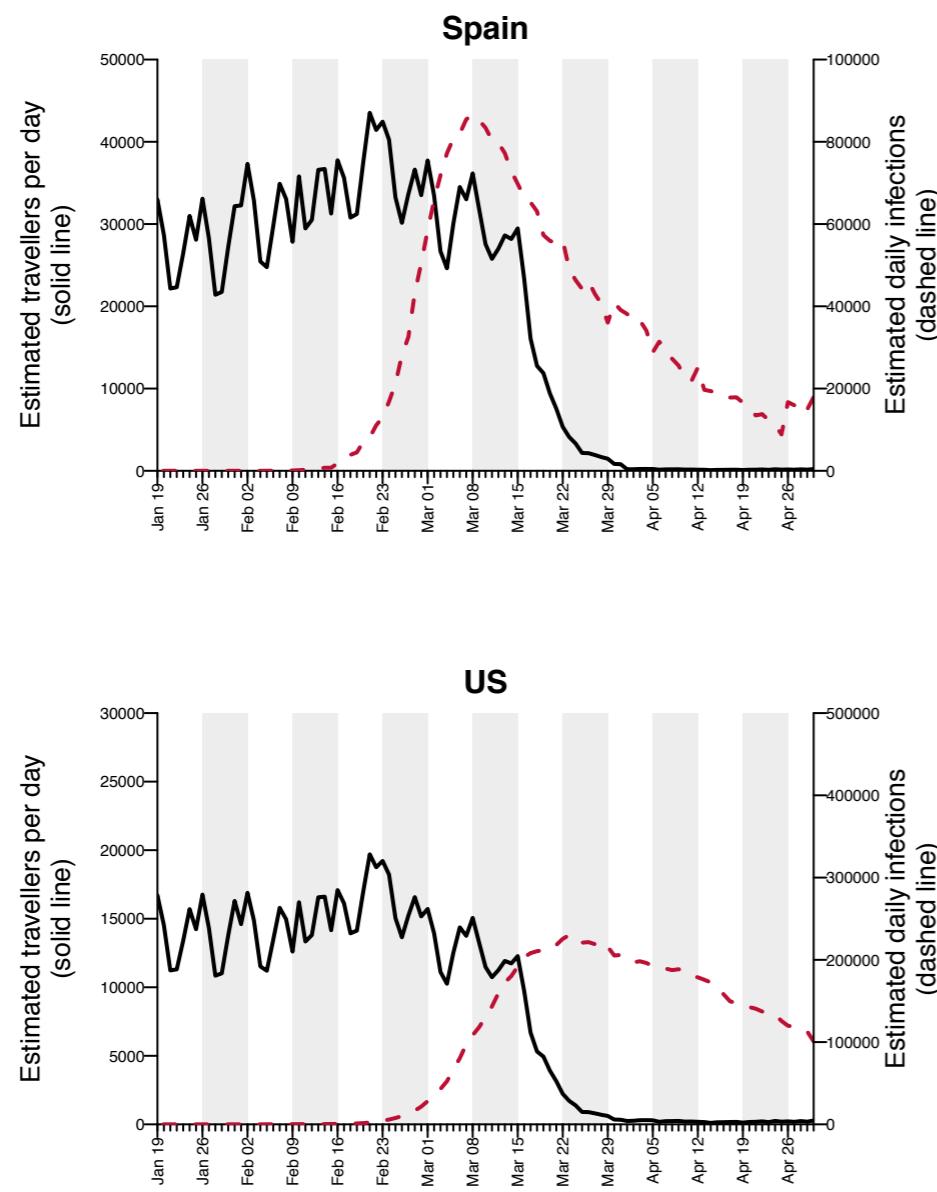
Country	Reported cases	Estimated infections	Genomes sequenced	Estimated sampling
United Kingdom	190,576	3,431,442	22,749	0.66%
Spain	218,010	2,592,585	1,612	0.062%
France	131,857	2,215,432	295	0.013%
Italy	211,938	2,764,563	136	0.0049%

# Genetic diversity problem

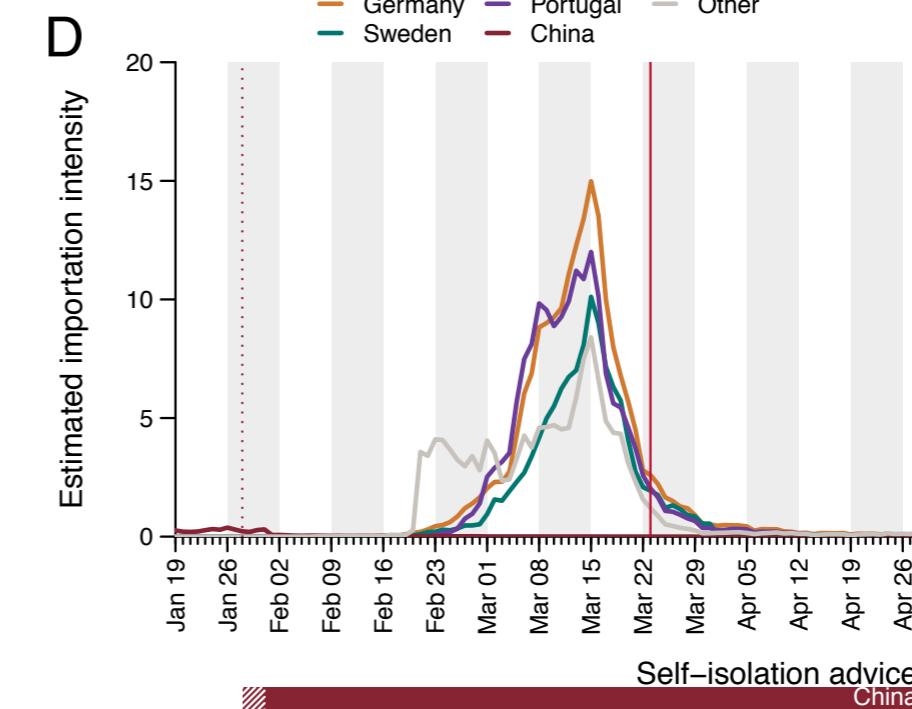
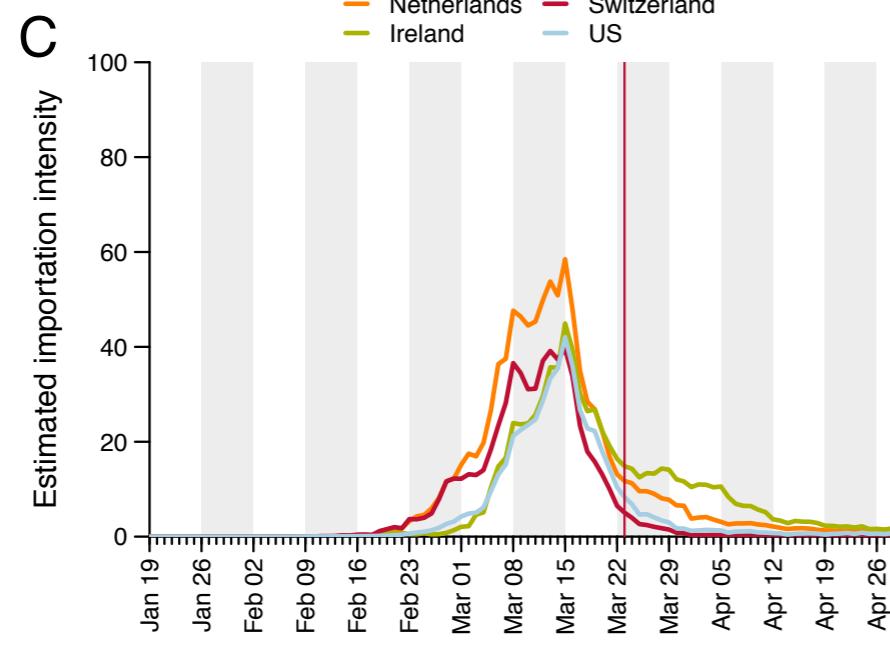
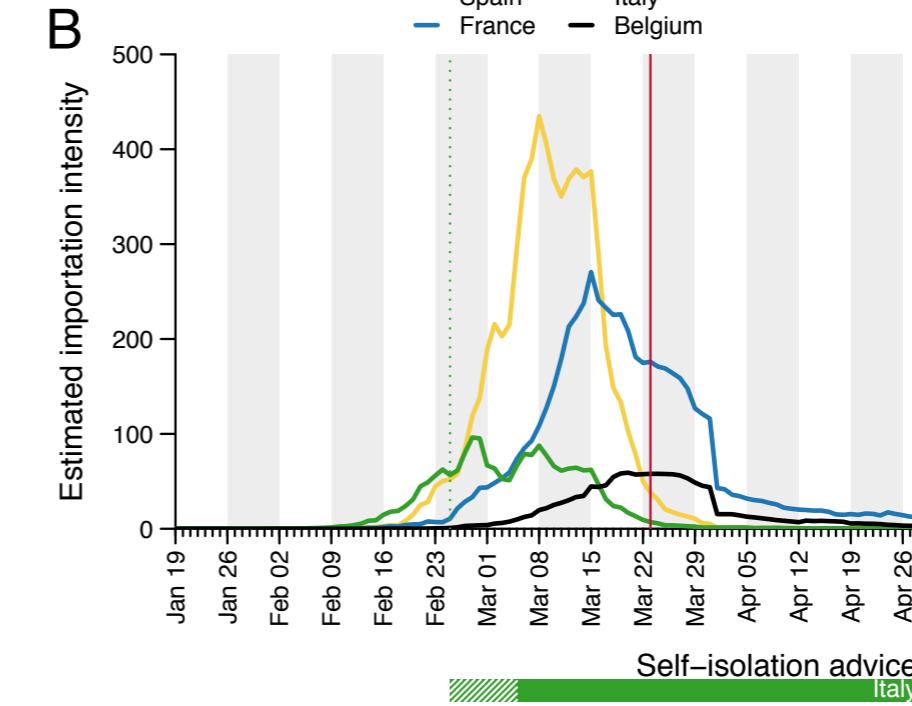
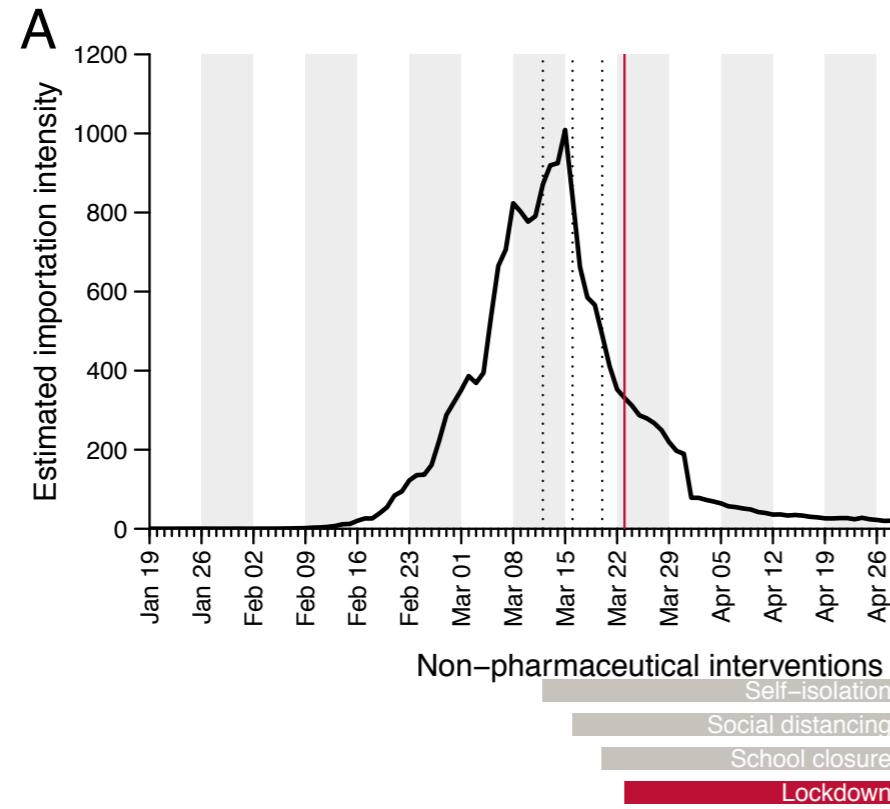


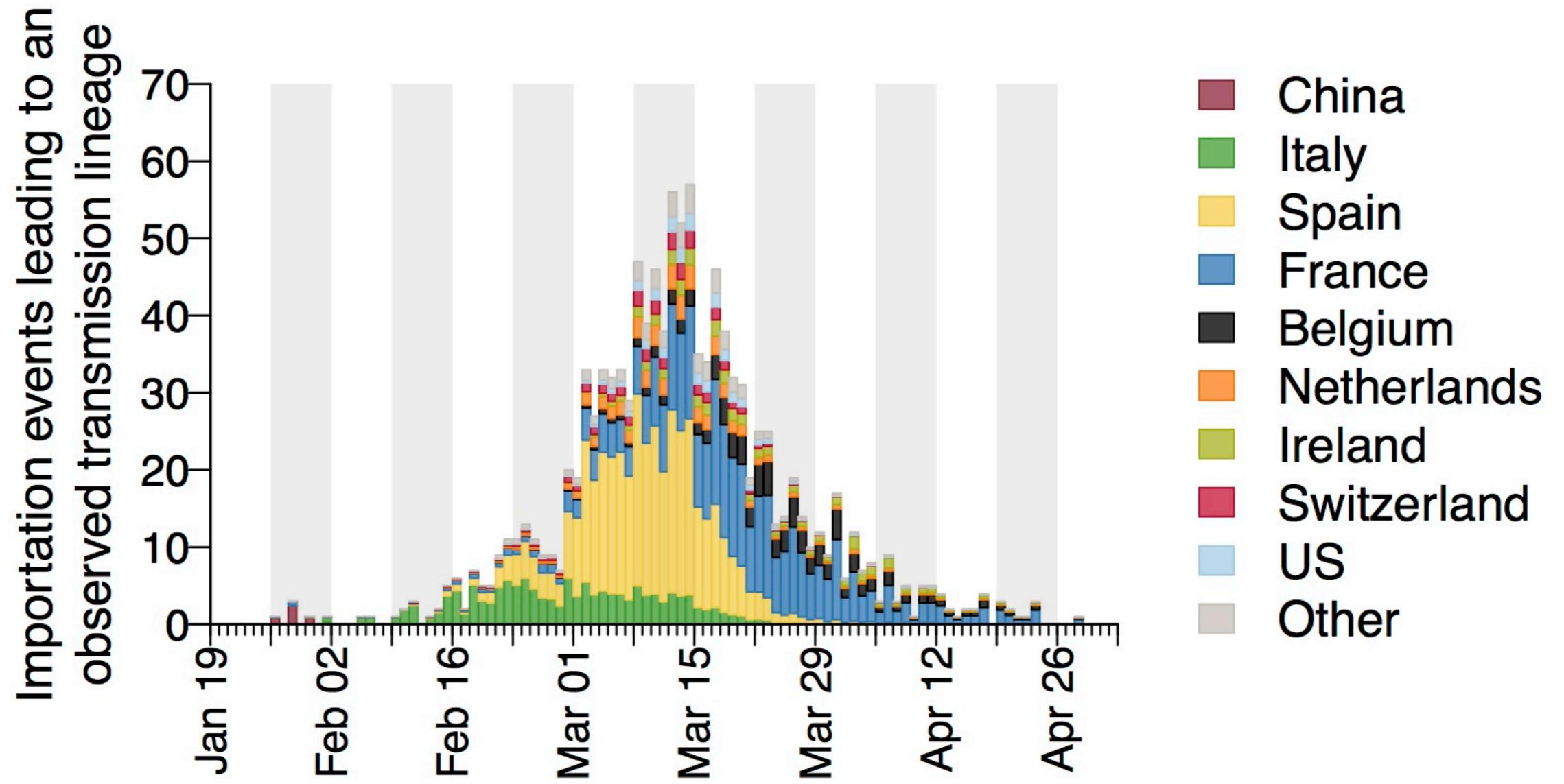
- Genetic distance tree
- Red nodes are in the UK
- Black nodes are outside of the UK
- UK transmission lineages have identical genomes from Iceland, Switzerland, Spain, Germany etc. at their roots

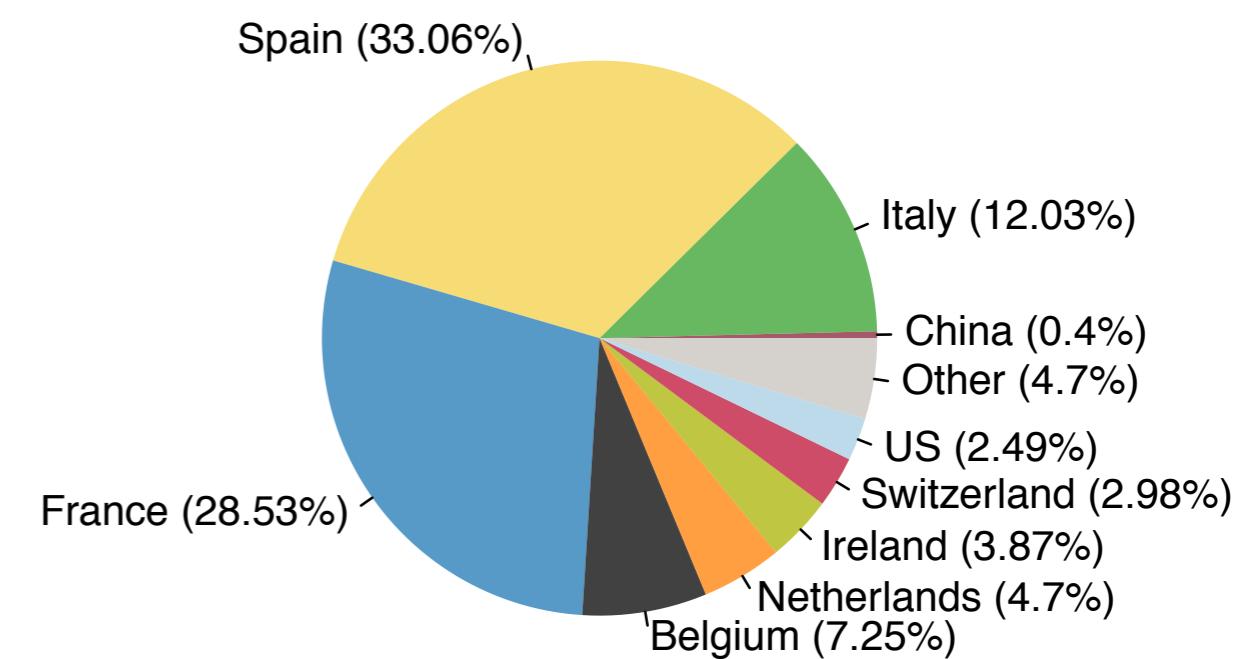
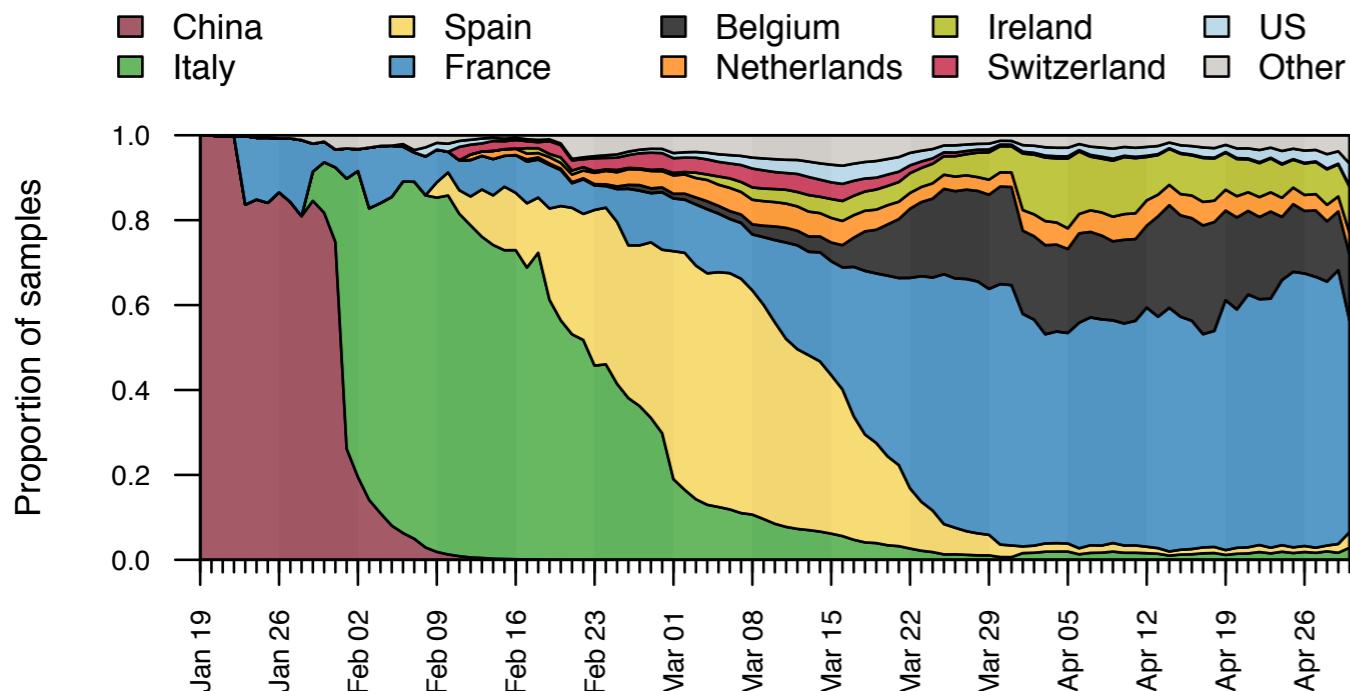
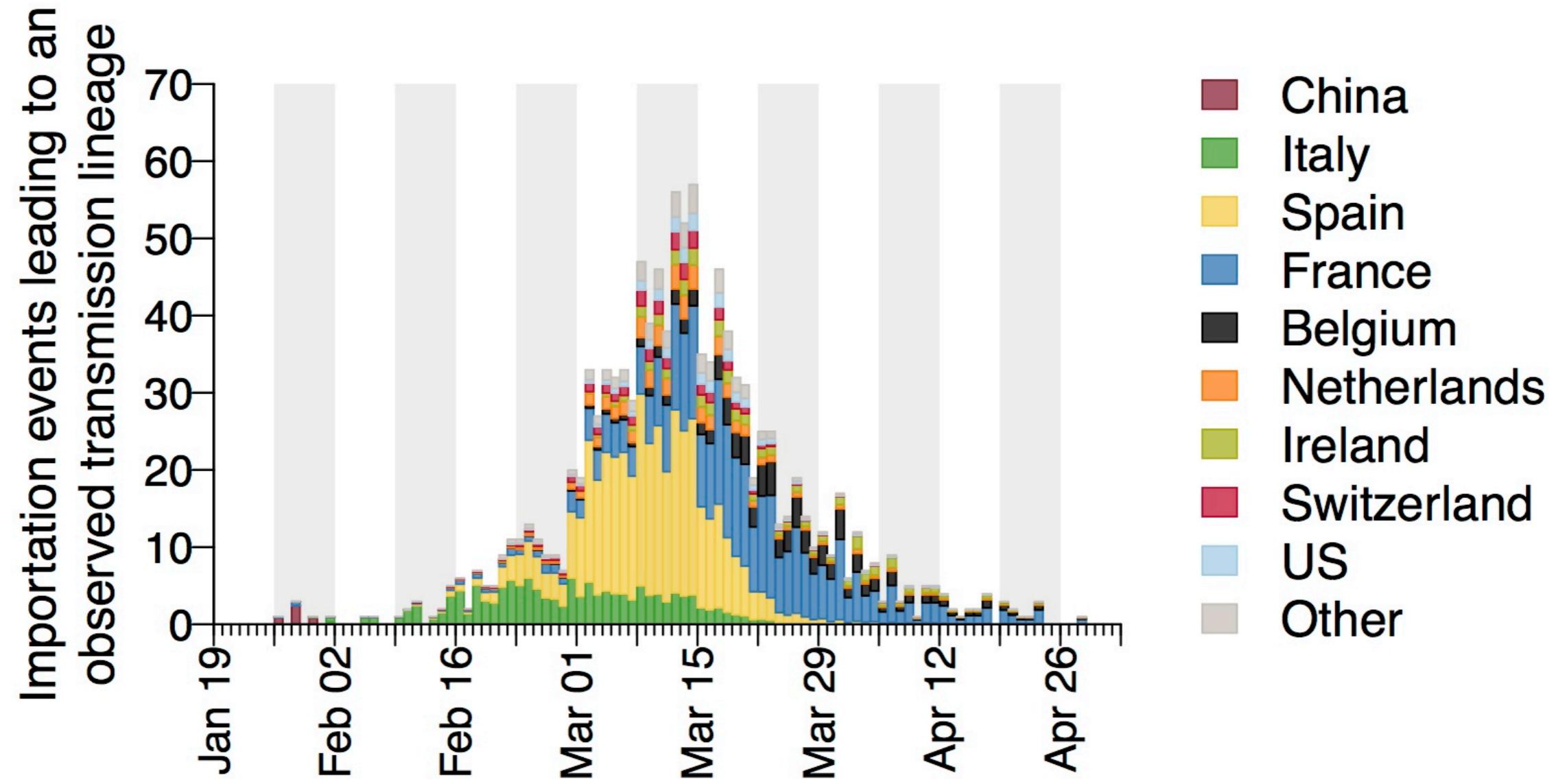
# Country-specific travel and COVID-19 cases



# Country-specific importation intensity







# Acknowledgments

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## **University of Oxford**

Oliver Pybus  
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Moritz Kraemer  
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Rachel Colquhoun  
Ben Jackson  
Áine O'Toole  
Jordan Ashworth  
Andrew Rambaut

## **University of Birmingham**

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Samuel Nicholls

## **University of Cambridge**

Chris Ruis

## **University of Toronto / BlueDot**

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Isaac Bogoch  
Kamran Khan

## **Imperial College**

Kris Parag

## **Public Health Wales**

Tom Connor



<https://www.cogconsortium.uk>



