

Geographic and temporal variation in risk of African Horse Sickness (AHS) in Britain



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Can we map the risk of an outbreak of AHS in Great Britain?

CONTEXT and AIM

AHS is a vector (*Culicoides* midge) transmitted equine disease with the potential to invade non-endemic regions such as GB. Our aims are:

To infer **the spatial distribution of horses** as the National Equine Database (NED) provides owner, not horse, address.

Based on the distribution above, **to estimate the risk of an outbreak of AHS spreading in GB at different times.**

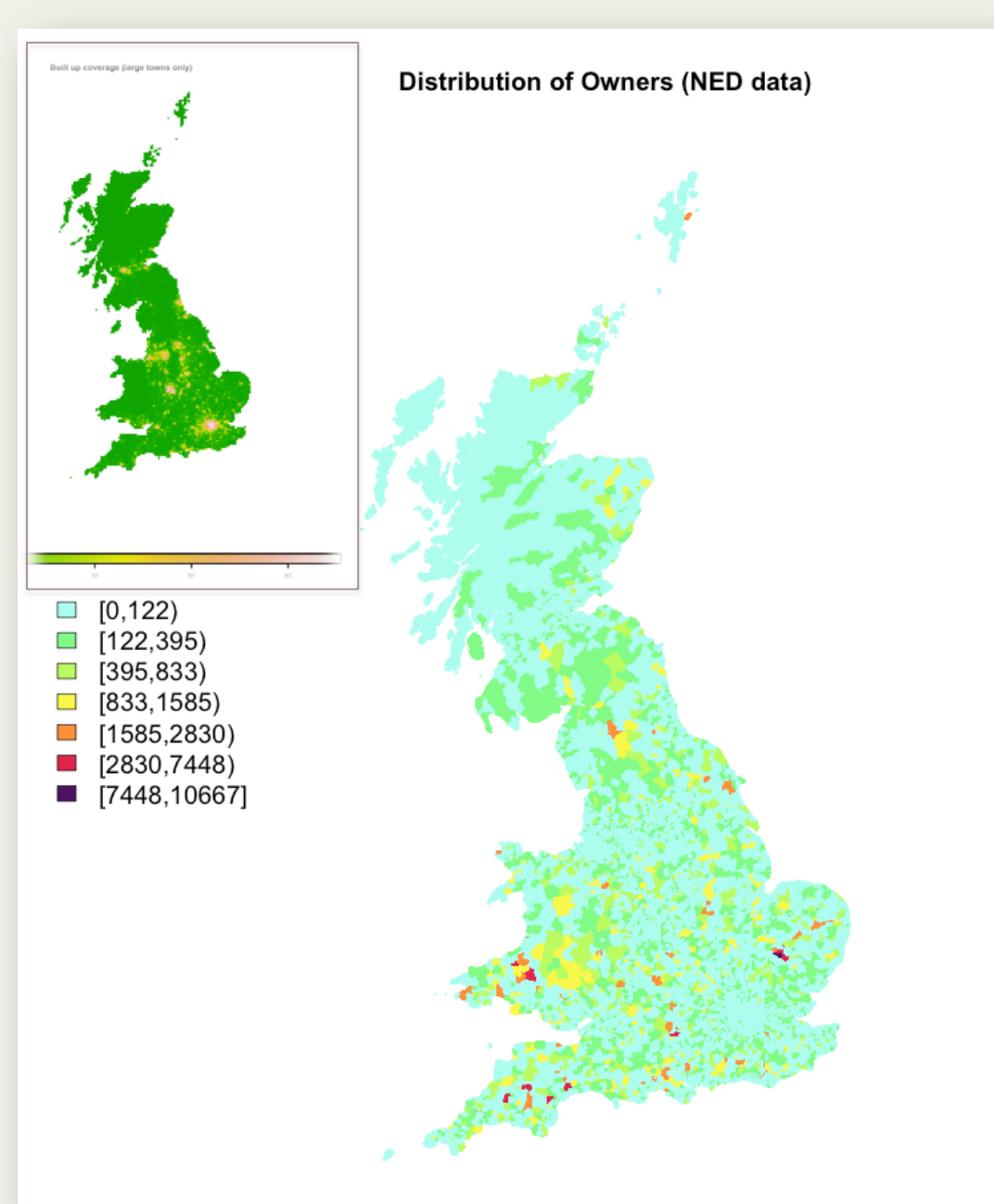
METHOD

Using NED and land use data in a Bayesian framework, we developed an algorithm to infer a realistic distribution for the location of horses.

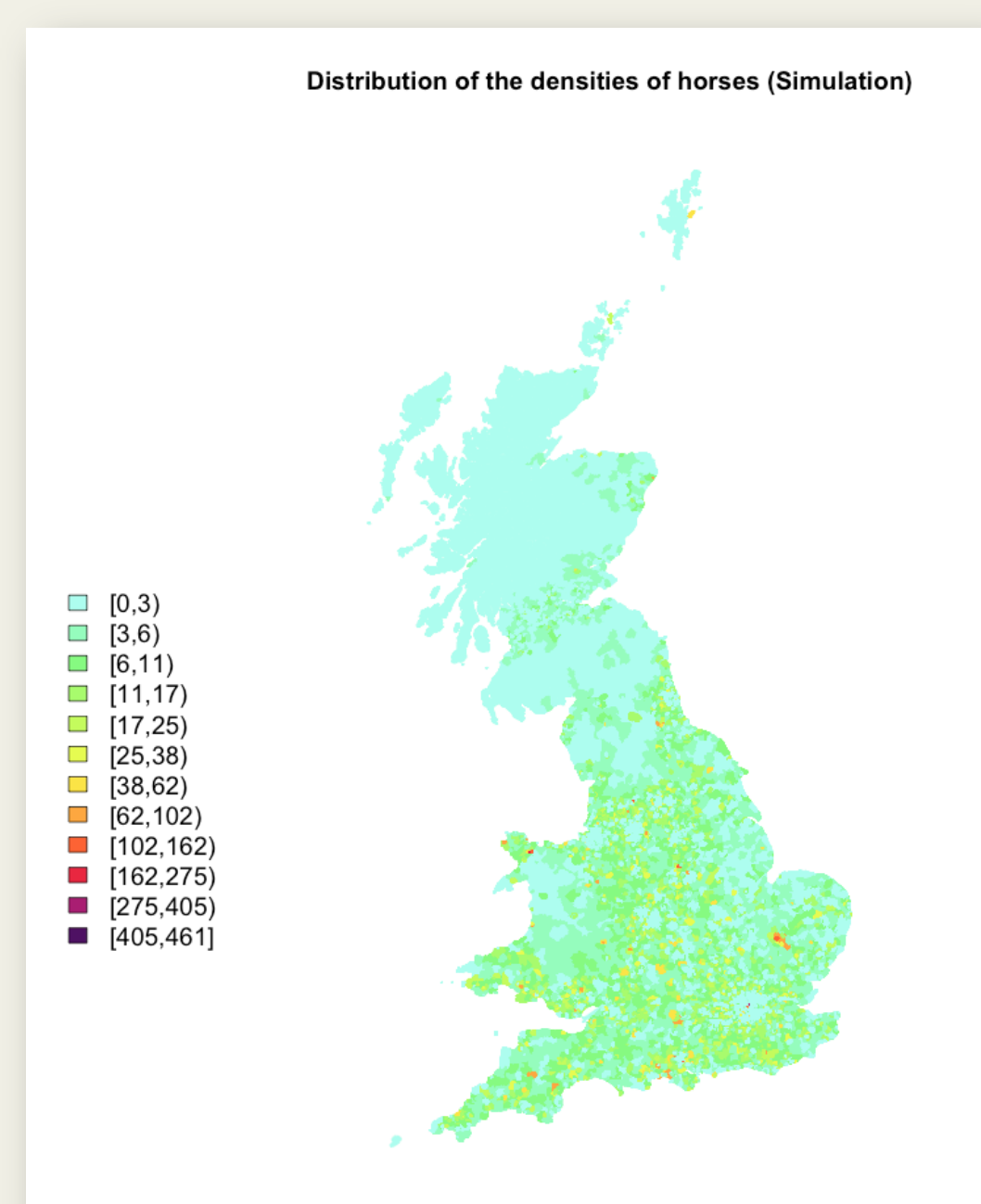
Using the new horse distribution as input, we analytically estimate temporal and spatial variations of the Basic Reproductive Number, R_0 (Next Generation Matrix). We consider a range of scenarios. Here we only present the case when non-susceptible vertebrate hosts (cattle and sheep) is included.

PREDICTIONS

A realistic map of the location of horses

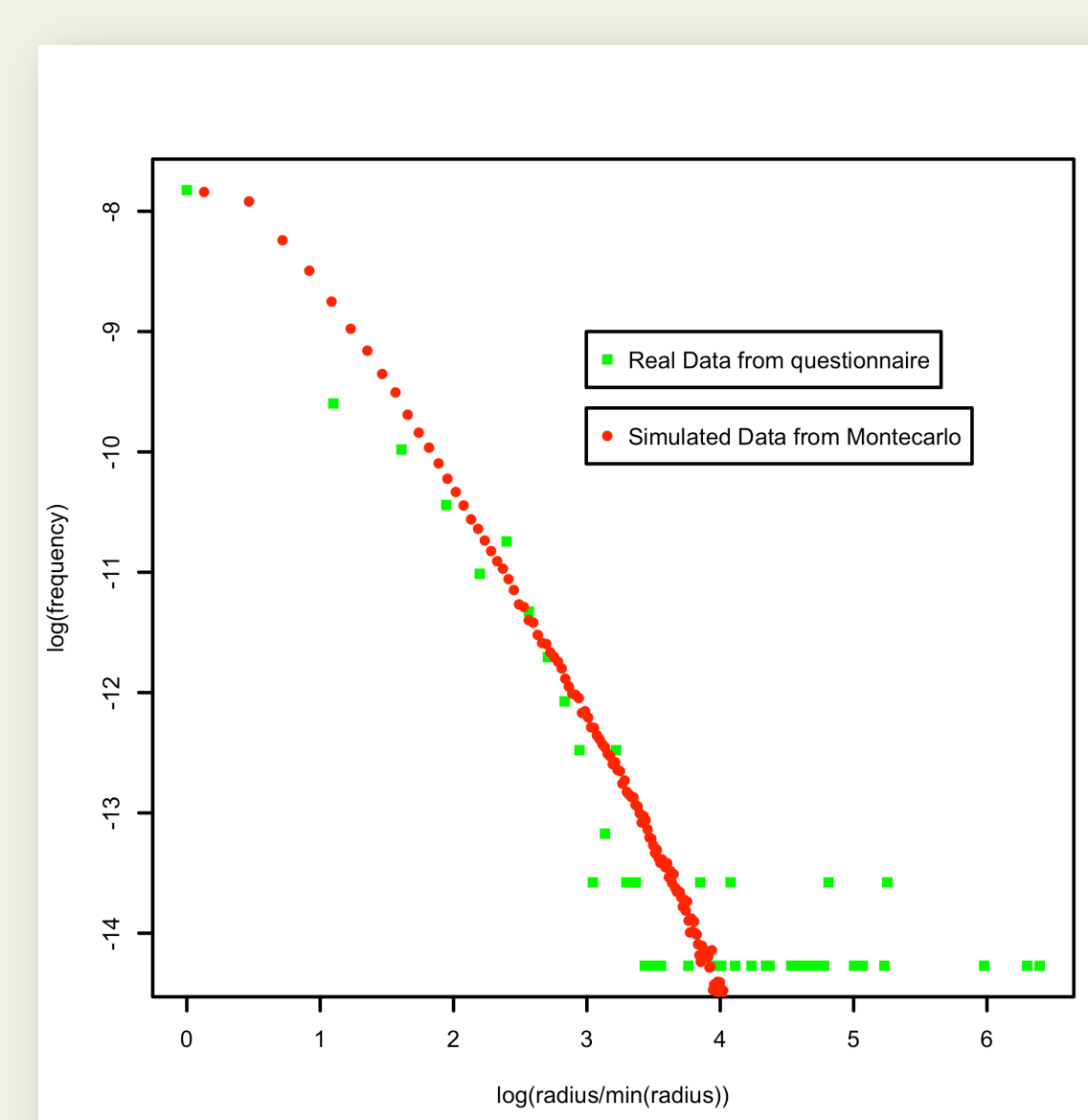


Distribution of horse owners according to NED data and built-up coverage (inset).



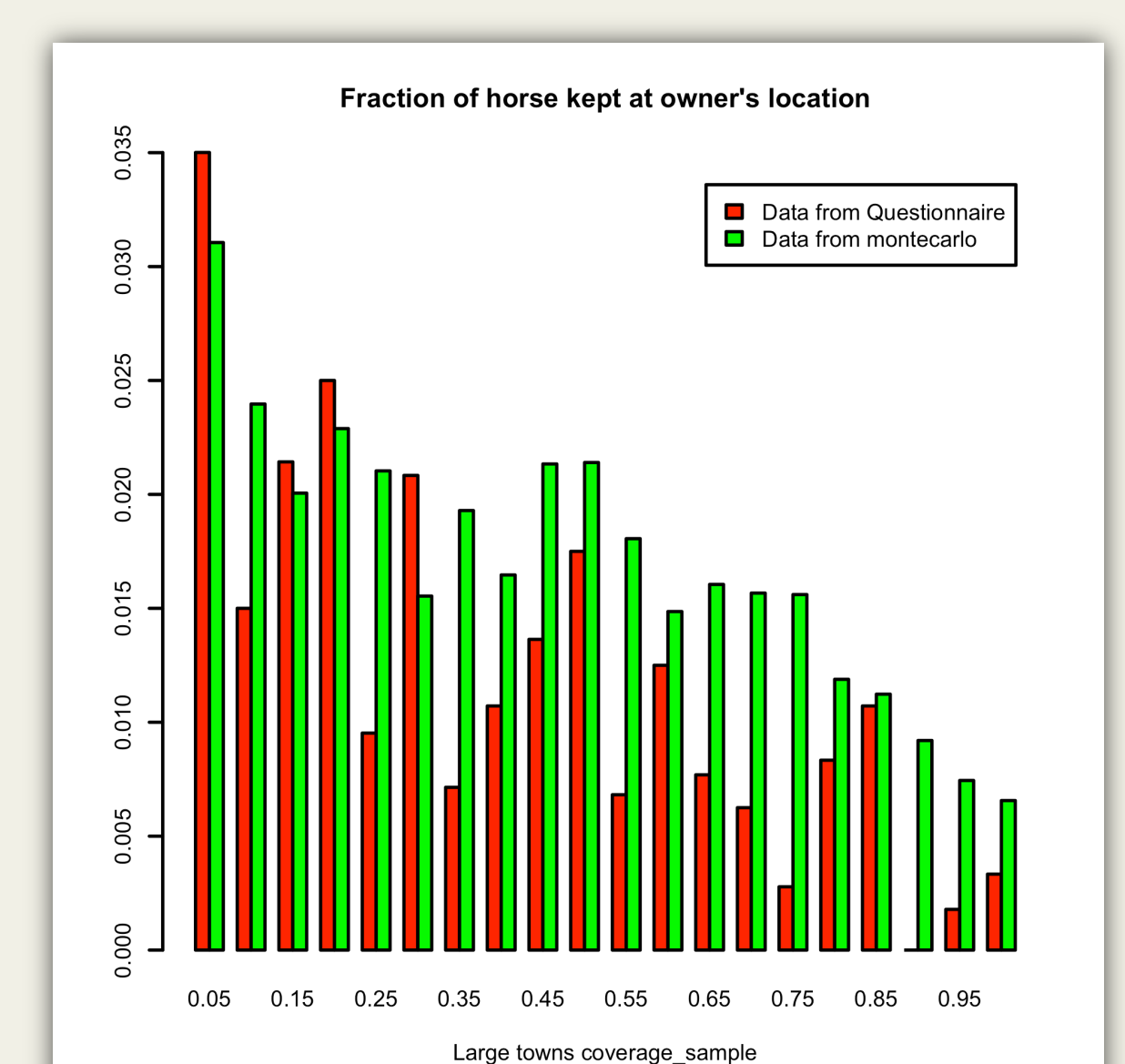
Corrected distribution of the density of horses (per Km²) by including the effect of land usage.

Comparison with a sample of owners



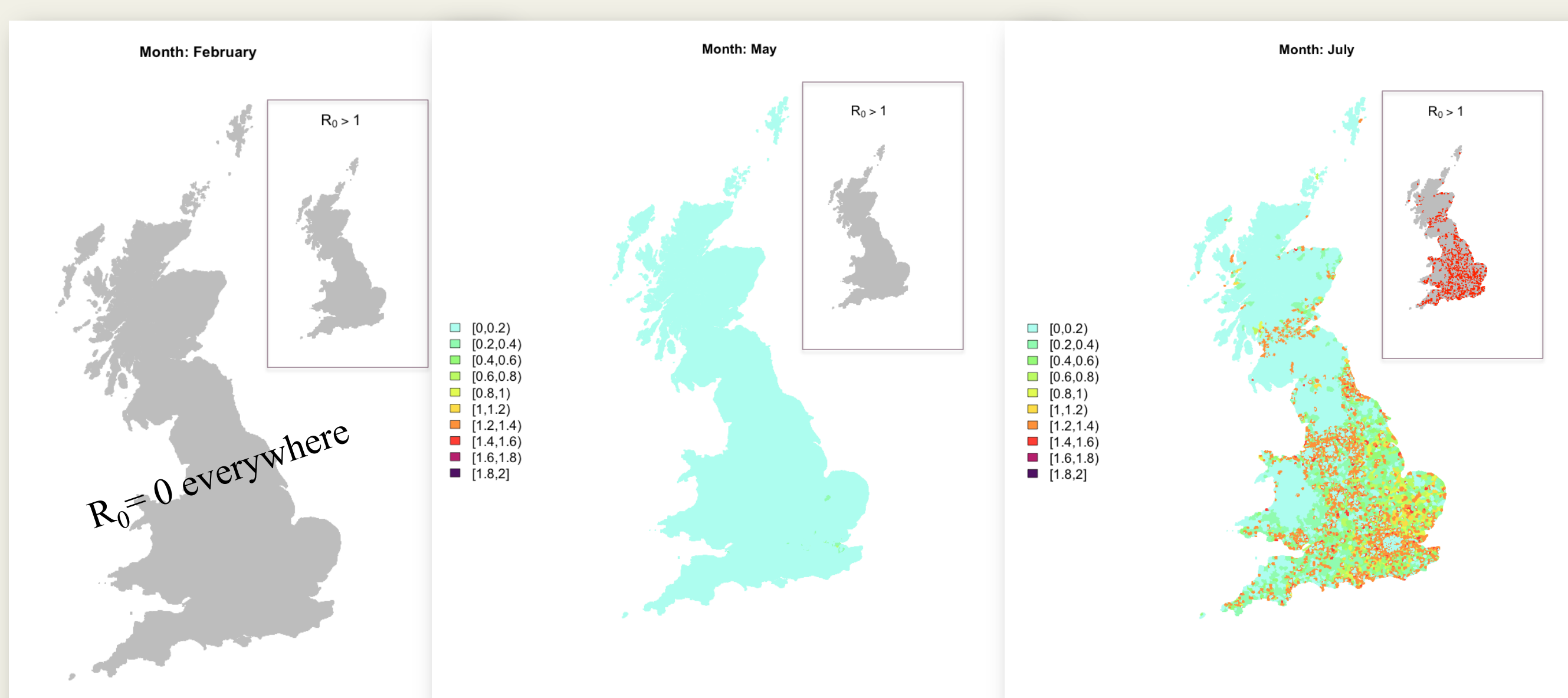
Distribution of horse-owner separations.

Data from 1010 questionnaire (green) were used to estimate parameters for correction algorithm to simulate the location of horses (red).



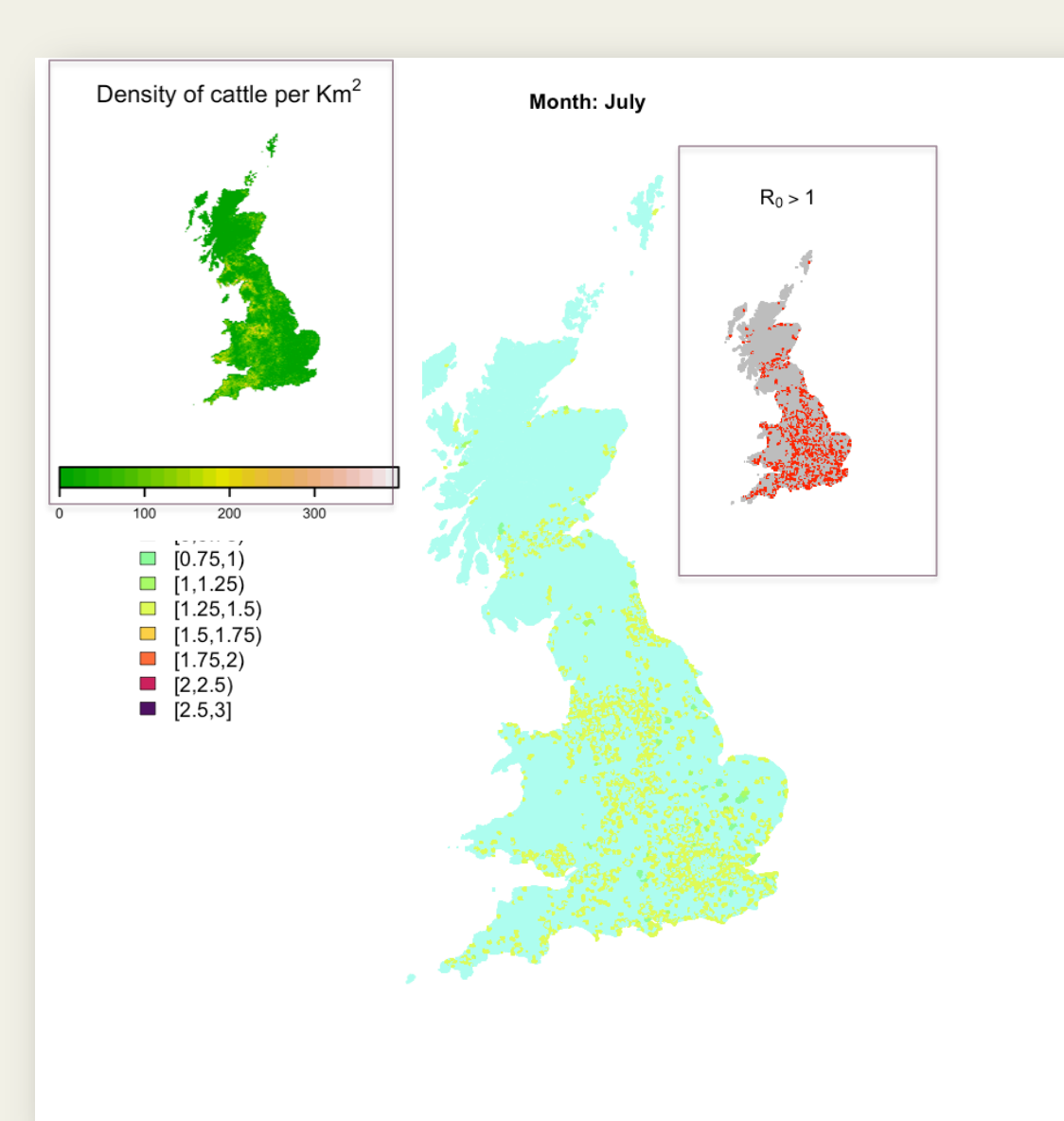
Proportion of horses located at owners' postcodes vs. built-up coverage.

Temporal maps of the risk of an outbreak of AHS (R_0) in Great Britain

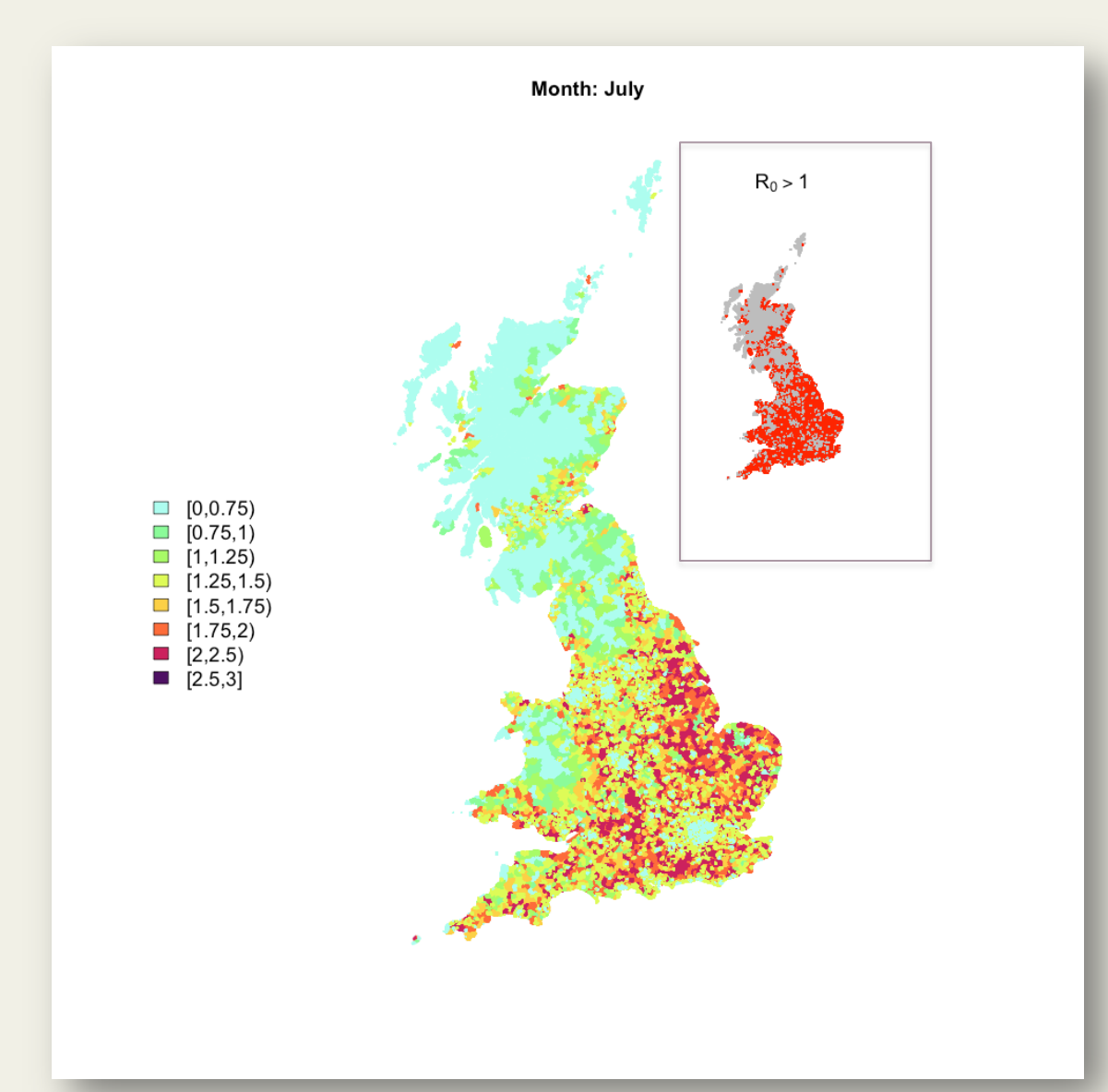


The risk of an epidemic is negligible ($R_0=0$ on average) in cold months (Jan-Apr: Nov-Dec) and reach its peak in July – Aug. The patterns are largely influenced by the distribution of horses, the presence of other non-susceptible host (cattle and sheep) and the abundance of *Culicoides*. Here we assume that *Culicoides* have no preference towards any particular host and their abundance is proportional to the host density. Areas where $R_0 > 1$ are also shown in the inset.

Risk under different hypothesis on the effects of non-susceptible host



The risk of an epidemic when *Culicoides* spp. midges exhibit large feeding preference (8x) towards cattle. The distribution of cattle is also shown (inset).



The risk of an epidemic when *Culicoides* spp. midges exhibit large feeding preference (8x) towards horses rather than cattle and sheep.

CONCLUSIONS

The risk of AHS, its dependence on key parameters (e.g. temperature, vector abundance and host feeding preference) and its temporal and geographic variation have not been adequately assessed in the light of current knowledge. We produced a realistic map of the predicted location of horses in GB, a spatio-temporal assessment of the risk of AHS transmission – and a quantitative framework to investigate different hypotheses on the effect of the presence of non susceptible hosts.

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