Exploring possible regional variation in the effective control of avian influenza in British poultry

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Introduction

• Both density-dependent and frequency-dependent transmission modes are likely to play a role in between-farm spread of AI. However, the predominant mode operating at farm, regional and industry sector levels is not known.

• The aim of our analysis is to explore potential regional differences in the dependency of models on transmission mode, for avian influenza (AI) in Great Britain (GB).

• Implications relate to model predictions of current AI control measure effectiveness, such as 3km Protection Zones (PZ) and 10km Surveillance Zones (SZ), which may depend upon the transmission mode, i.e., density-independency is suggested to result in ineffective control zones (Truscott *et al.,* 2007).

• Although the declaration of control zones is consistent across GB in the event of an outbreak of highly pathogenic AI, irrespective of region and in line with European Commission directive 2005/94/EC, regional differences in model dependency may suggest a more targeted control strategy is warranted.

Methods

An extract of the Great Britain Poultry Register (GBPR) dataset (Defra, 2009) was used to obtain the geographical location and size of every registered poultry farm within GB (n=23,482 farms; with a potential maximum of 6% being duplicate farms following data cleaning). The **objectives** using ArcGIS software were:

(i) To investigate density-dependent transmission: using a count of farms located within each possible PZ and SZ, which act as a proxy for the distance over which density-dependency may operate.

(ii) To investigate frequency-dependent transmission: using the average number of daily catching company (cc) team visits per farm, estimated from Dent *et al.* (2009), with visit frequency increasing with farm size.

(iii) To calculate a comparative ratio: by dividing the density-dependent value by the frequency-dependent value for each farm, to demonstrate variation in model dependency.

Each of the three analyses above were then averaged on a county level to explore regional differences across GB.

Results

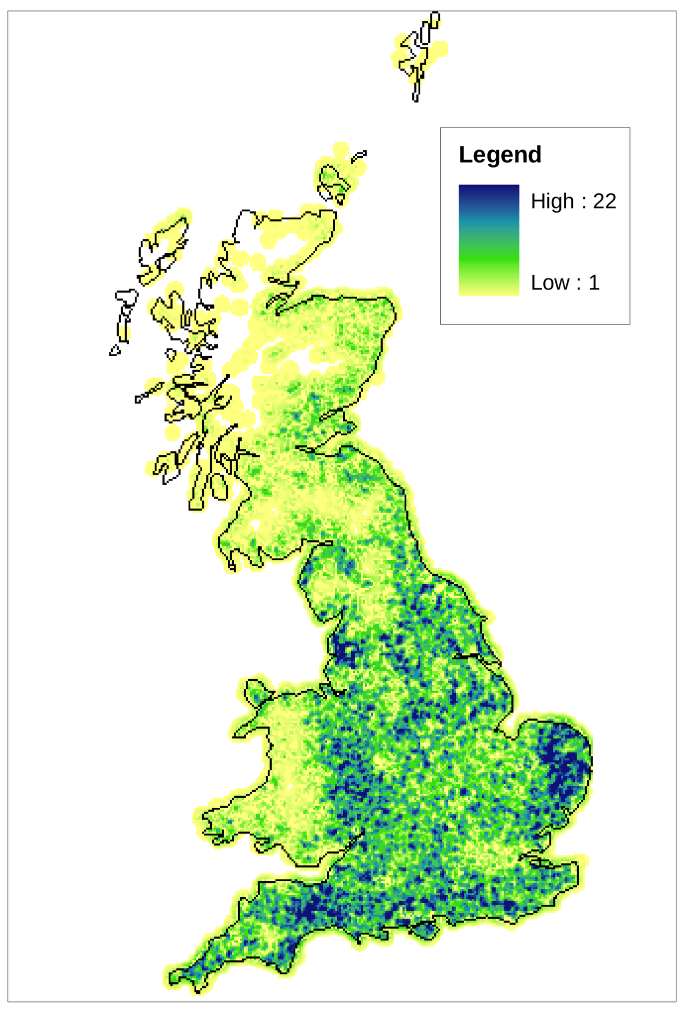

Figure 1. Poultry farm count within **3km** zones for each farm (range: 1 - 22).

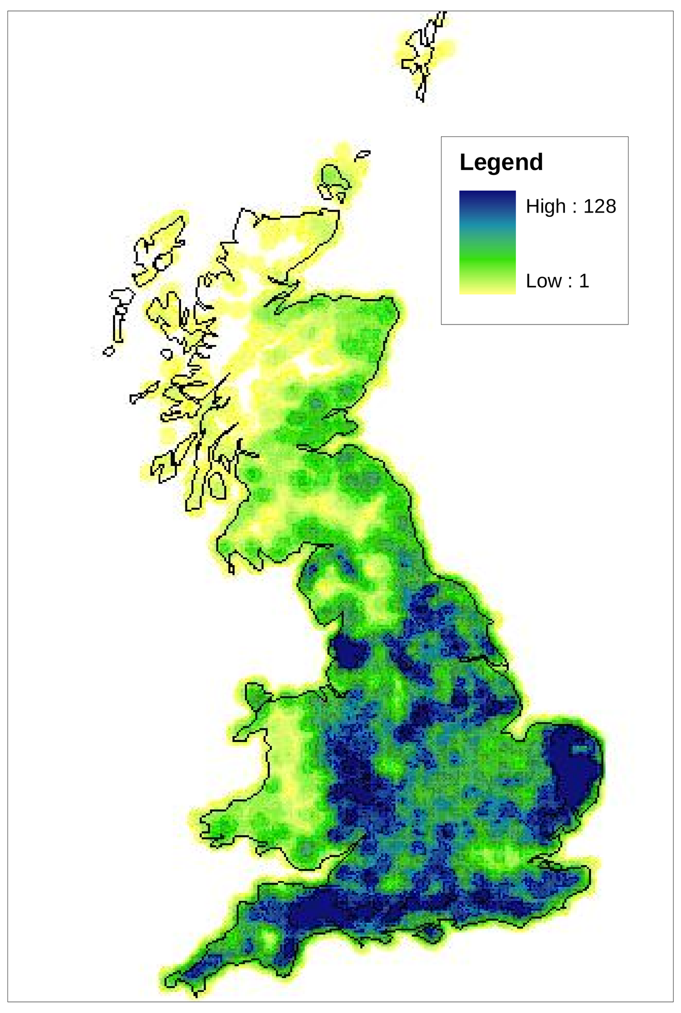

Figure 2. Poultry farm count within **10km** zones for each farm (range: 1 - 128 farms).

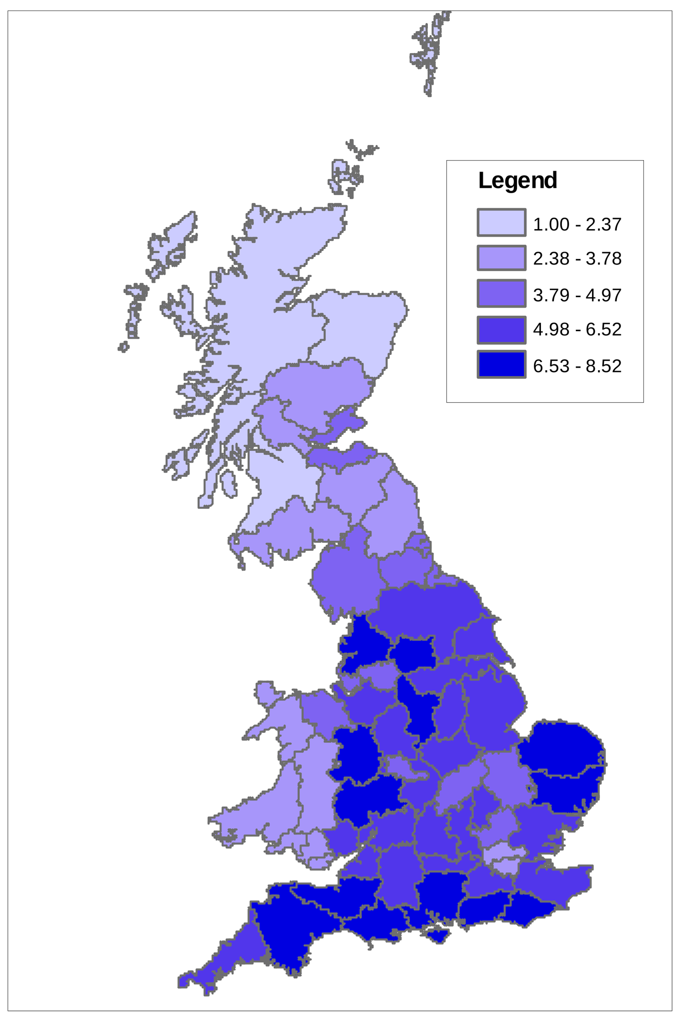

Figure 3. **County** average poultry farm count within **3km** zones (range: 1 - 8.5 farms).

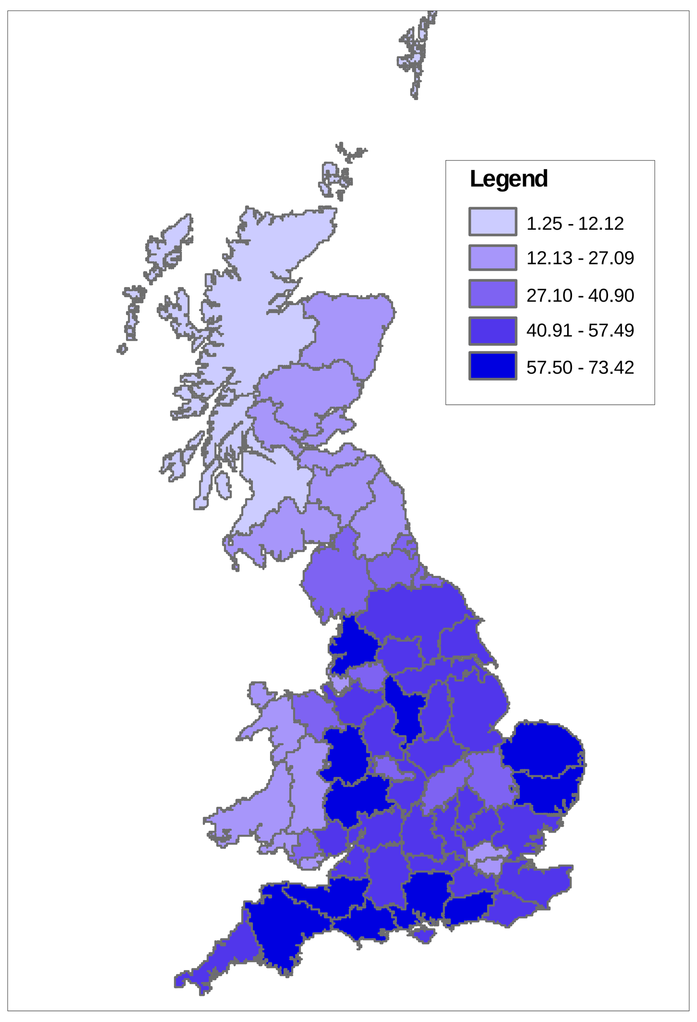

Figure 4. **County** average poultry farm count within **10km** zones (range: 1.3 - 73.4 farms).

(i) Density-dependent transmission

The number of farms captured within the PZ's (Figures 1 and 3) and SZ's (Figures 2 and 4) varied across GB; with more farms per zone in England than Scotland, reflecting the difference in premise density.

(ii) Frequency-dependent transmission

Average (median) number of daily cc visits, approximated from Dent *et al.,* 2009:

- <100k birds = 0.053 per day
- 100k-200k birds = 0.107 per day
- >200k birds = 0.214 per day

The average daily cc visits were found to vary by county (Figure 5), reflecting county variation in average farm size.

(iii) Comparative ratio

Figures 6 and 7 represent normalised county averages of model dependency. **Between-county variation and a marked difference between Scotland and England was observed.**

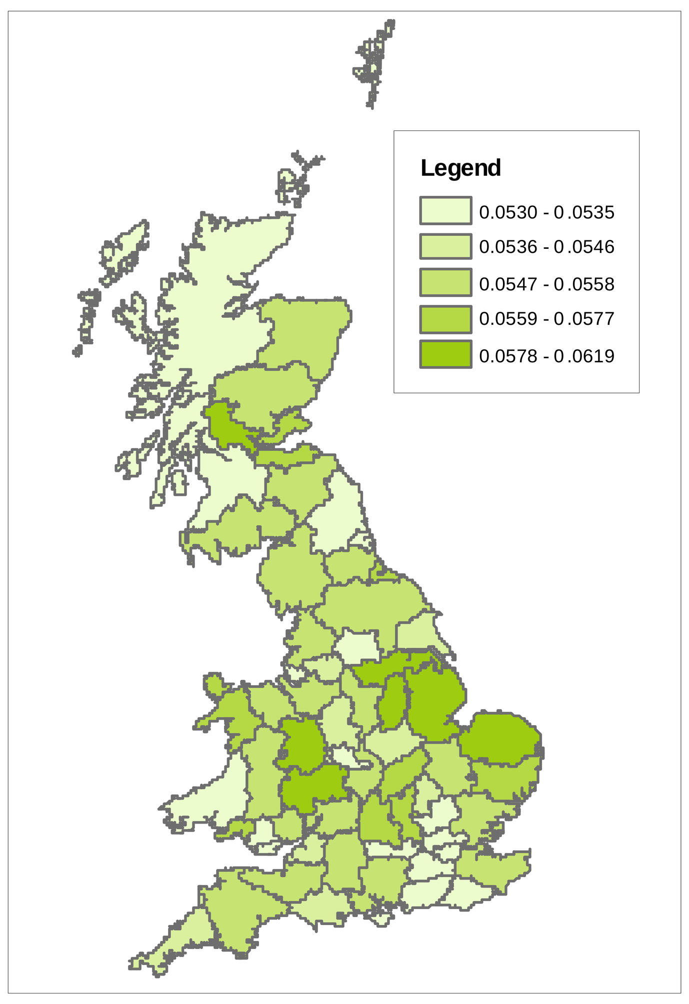

Figure 5. **County** average daily **CC visit** frequencies. (range: 0.053 – 0.062 visits).

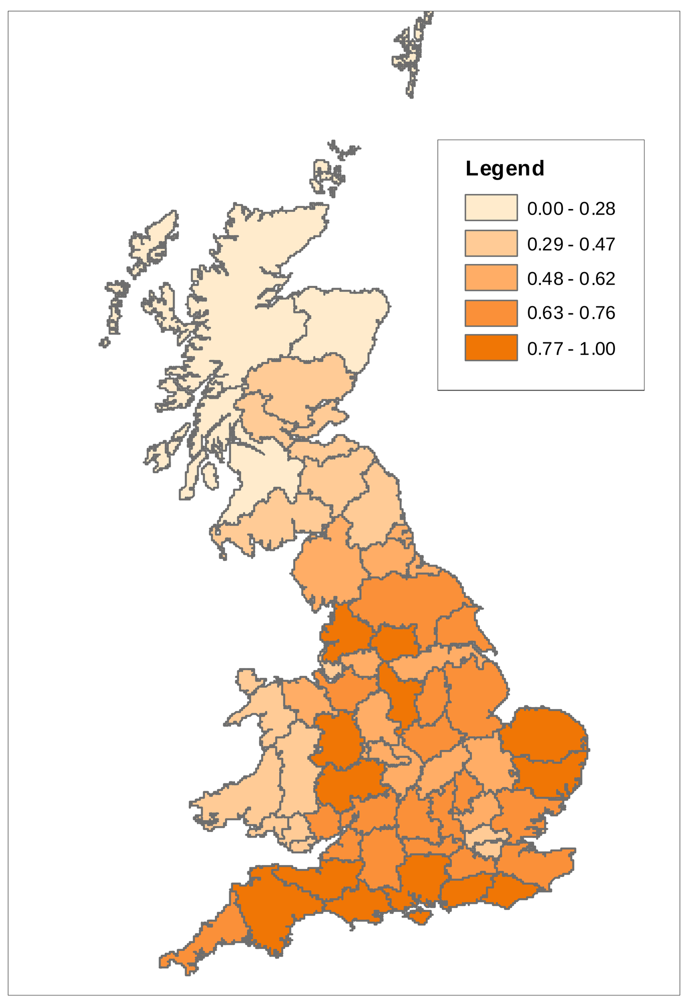

Figure 6. Farm count within **3km** zones divided by CC visits, averaged by **county** (normalised by max county average value).

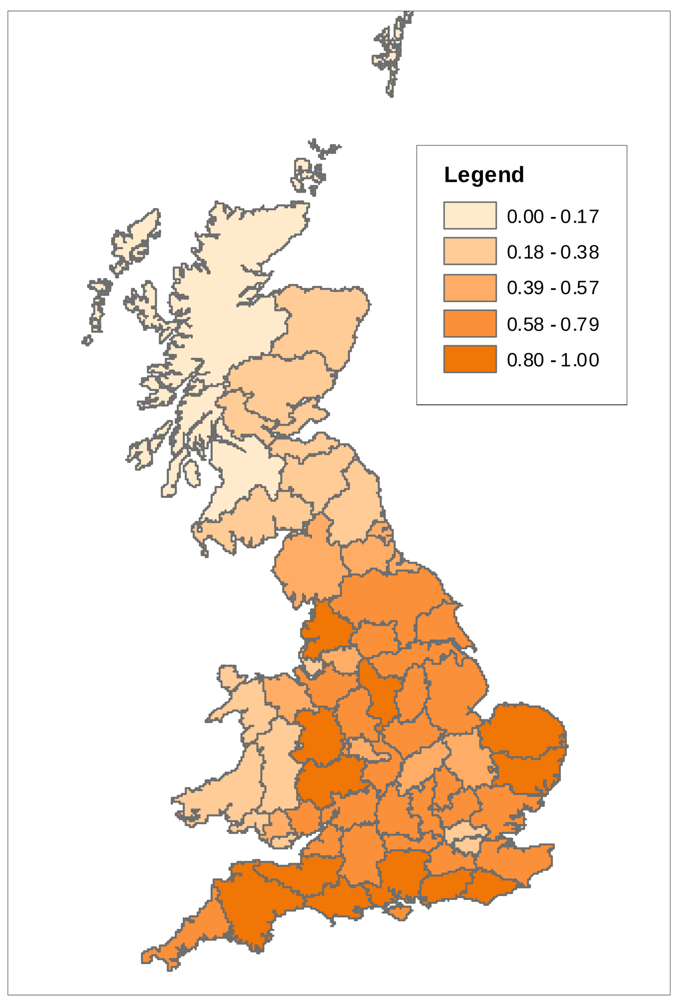

Figure 7. Farm count within **10km** zones divided by CC visits, averaged by **county** (normalised by max county average value).

Conclusion

The substantial regional differences in the comparative ratios suggests that both geographic location and transmission mode may affect our ability to predict the potential effectiveness of control zones. Further work in underway to quantify, on a regional level, the potential effectiveness of these control measures under different transmission assumptions using simulated models.

References

Dent, J. *et al.* 2009. In review.
Truscott, J. *et al.,* 2007. *Proc.R.Soc.B* **274:** 2287-2295.
Council Directive 2005/94/EC www.defra.gov.uk/animal/diseases/notifiable/ai/pdf/ai-directive-oj.pdf
Defra, 2009. Veterinary Surveillance: GBPR. www.defra.gov.uk/animalh/diseases/vetsurveillance/poultry/index.htm

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