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Assessing the Spatial Distribution of *Ixodes ricinus* in Scotland Using a Bayesian Approach

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Introduction

In Northern and Western Europe *Ixodes ricinus* tick is a vector of several pathogens, including the complex of *Borrelia* bacteria that causes Lyme disease [1], whose reported incidence is increasing in Scotland [2]. Predictive maps with the spatial and seasonal distribution of vectors are important tools in assessing the risk of vector-borne diseases, enabling better targeting of surveillance and control, as well as increasing awareness [3].

The objectives of this study are to identify the climate, habitat, topography and host related predictors of *I. ricinus* abundance and to create a risk map of ticks across mainland Scotland.

Methods

- Questing nymphs were counted by scientists during tick abundance surveys (2006 - 2017).
- An average of 15 survey transects were performed in each site and visit.
- To account for the complex structure of the dataset a Bayesian model [4] was fitted with a zero inflated Poisson distribution and two random effects (site and number of drags per site).
- The model fixed effects were georeferenced environmental variables.
- The model was assessed using Bayesian information criteria and cross validation leave-one-out.
- The model and the risk map were developed using R software.

Results

**Model expression:** Count of nymphs ~ climate + habitat + hosts + month (April slope) + f (site) + f (drag)

**Discussion and conclusions**

- The count of nymphs per drag was chosen as the response variable because nymphs have the highest risk of biting and transmitting the bacteria that causes Lyme disease in humans.
- The selected model shows significant and positive relationships between tick abundance and temperature in July, roe deer presence, coniferous and deciduous forest, and a negative association with frost in September.
- The model choice seemed suitable to capture data complexity (the model fits the data well) and the significant predictors (climate, deer and habitat) are supported by knowledge from the published literature.
- The risk of vector-borne disease is likely to be most robust for the Grampian region, where most data were collected, and less accurate for areas where there were few data from surveys, such as the West coast of Scotland. This is useful in highlighting where data collection efforts are now needed for more accurate models.

**Bibliographic references:**