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Modelling the risk of Bluetongue virus 4 to Scotland

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Purpose:

In recent years there have been annual incursions of bluetongue virus (BTV) into Western Europe. Of particular concern during 2014 was an incursion of BTV serotype 4 into the Balkans area that resulted in high morbidity and mortality in sheep. Should BTV-4 overwinter then it could spread during 2015 and potentially reach Scotland. Previous studies have demonstrated that Scotland is at risk of vector borne diseases but is highly sensitive to the timing of introduction and the temperature. This is supplemented by recent studies that demonstrated that the midge vectors of BTV are more likely to feed on cattle compared to sheep. In this study we model the impact of BTV introduction to Scotland given different timings of introduction, different temperatures and optimise vaccination strategies given spread extent and feeding preferences.

Methods:

In this paper we develop a spatially explicit stochastic simulation model for the spread of BTV-4 within and between farms in Scotland. Due to uncertainty in the transmission parameters of BTV-4 and to allow for temperatures varying from the mean, we ran a number of scenarios to vary these parameters. This incorporated midge feeding preferences, varied the timing of BTV introduction and the location sites of introduction. We then explore the impact of vaccination of different groups of animals in different locations.

Results:

Under most scenarios, relatively few sheep become infected (fewer than 100). Under a worst case scenario in which the virus is well adapted to spread at low temperatures and the temperatures are 10C warmer than average then a median 220,000 sheep become infected if BTV is introduced to the south west in mid-May. By vaccinating 487,000 cattle in the south of Scotland, this number of infected sheep is reduced by 150,000; 1,880,000 sheep must be vaccinated to achieve the same reduction.

Conclusions & Relevance:

By considering vector feeding preferences alongside control strategies, large savings can be measures to effectively control BTV and the measures can be implemented more efficiently. This is particularly the case in Scotland where the relative marginality means that spread will be spatially and temporally contained.