Persistence of Infection in Spatial Populations

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Keeling and Gubbins are already offering a group-project on the Critical Community Size for Foot-and-Mouth Disease; this MSc project and any continuation to PhD can either be considered as a continuation of the group project or a separate piece of work.

For a great many infectious disease (of both humans and livestock) the issue of persistence is key. We know for example that often individual farms are not continually infected; instead the infection persists as a continually shifting spatial mosaic of infection jumping between farms. In this way infection persists at the population level, but not at the local scale. A similar argument could be made for human infections in households or communities.

The aim of this work is to investigate this population-level persistence through simulation and theoretical model development. The key question is to understand how persistence at the local scale and the movement of infection couple to generate persistence at the global scale. A range of problems can be studied and a range of methodologies utilised. Some questions that could be addressed include:

1) How do local parameters and local persistence affect the global persistence?
2) What is the impact of the transmission network between local patches?
3) For UK livestock, what is the national pattern of persistence given the known structure of the movement network and the seasonality of both births and movements?
4) What are the evolutionary consequences of these local and global processes? How do we expect infections to respond to the UK livestock movement network and changes in farm sizes?

This work would be easily extendable into a PhD.

Suitable Literature:

- Proc Roy Soc London B. 2009 http://rspb.royalsocietypublishing.org/content/276/1656/469
- J. Theor Biol. 2000 http://www.sciencedirect.com/science/article/pii/S0022519300920666
- Proc Roy Soc London B 2000 http://rspb.royalsocietypublishing.org/content/267/1441/385
- Ecology Letters 2002 http://onlinelibrary.wiley.com/doi/10.1046/j.1461-0248.2002.00378.x/