Spatial point process models to determine clustering of American Foulbrood in UK Honeybees

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Abstract: American Foulbrood (AFB) caused by *Paenibacillus larvae* is the most damaging bacterial brood disease of the honey bee (*Apis mellifera*) and is usually lethal to the colony if left untreated. AFB has been a persistent problem in the UK for over 70 years, with a fluctuating number of cases discovered annually. Current management measures include destroying infected colonies to reduce pathogen spread. We use complimentary spatial point process models to detect global clustering and characterise local clusters of AFB across England and Wales between 1994 and 2012 with the aim to improve our understanding of the epidemiology of this damaging disease. Our results indicated that AFB exhibits significant spatial aggregation at distances from 10-30 km with aggregations lasting between 1 and 5 year periods. Kernel smoothing indicated areas of elevated relative risk in different years and these were further detailed by spatial scan statistics. We identified disease clusters and successfully estimated their size, location and duration. The majority of clusters did not persist in all years indicating that management measures may lead to localised extinction of the disease. Whilst less common, persistent clusters likely indicate potential endemic or exotic risk points. The application of robust epidemiological approaches to improve the control of AFB are discussed.