MATHEMATICAL MODELS FOR THE COMMUNITY ECOLOGY OF TICK-BORNE MICROBES

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Many species and strains of tick-borne microbes co-circulate and co-infection is common in natural hosts. I will discuss two examples of this community ecology.

i) Borrelia burgdorferi and Babesia microti. These tick-borne parasites co-circulate in some North American mouse populations. The epidemiological dynamics are entwined through within-host interactions that modify susceptibility and transmissibility. We introduce a mathematical model that places these epidemiological dynamics in an ecological context with complex seasonality driven by tick life-history. We analyse this model to explore how the various interactions shape prevalence and other epidemiological characteristics at different points in the seasonal cycle.

ii) Borrelia burgdorferi strains. In many regions a diverse community of Borrelia burgdorferi strains co-circulate in rodent and bird host populations. Mechanisms governing the composition of these communities are believed to include multiple niche polymorphism, where strains are specialised to particular host species, and negative frequency dependence, where infection with one strain elicits an immune that provides protection against re-infection with similar strains. We use a mathematical model to examine how Borrelia strain communities may be structured by the combined effects of host specialization and immune cross-protection, given that transmission occurs via a generalist vector.