CO-FEEDING, CO-INFECTION, CO-TRANSMISSION DYNAMICS OF TICK-BORNE VIRUSES

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Co-infection of a single host by different pathogens is ubiquitous in nature.
In order to model co-infection dynamics, we consider two interacting populations, namely hosts (e.g., small or large vertebrates) and ticks, both susceptible to infection with two distinct strains of the same virus. The infection can be transmitted by infected ticks to susceptible hosts and from infected hosts to susceptible ticks (systemic transmission), and also from infected ticks to susceptible ticks through co-feeding (non-systemic transmission).
We first analyse the dynamics of a single infection, proposing both a deterministic and a stochastic model to understand the role of the different routes of virus transmission. In the deterministic setting, we compute the basic reproduction number by means of the next-generation matrix approach. We make use of a stochastic model and first-step arguments to compute the probability and expected time to virus extinction or establishment.
When considering co-infection by two distinct strains (one resident and one mutant), we make use of differential equations to model the dynamics of susceptible, infected and co-infected species, and we compute the invasion reproduction number of the mutant strain, which is not-neutral. We propose alternative models which are instead neutral