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Spatiotemporal Patterns of Vector-borne Disease Spread

There are many factors contributing to the complicated and interesting spatiotemporal spread patterns of vector-borne diseases. Here, we focus on two major factors: the demographic and disease ages and the spatial movement of the disease hosts. We derive from a structured population model a system of delay differential equations describing the interaction of five sub-populations for a vector-born disease with particular reference to West Nile virus, and we also incorporate the spatial movements by considering the analogue reaction-diffusion systems with non-local delayed terms. Specific conditions for the disease eradication and sharp conditions for the local stability of the disease-free equilibrium are obtained using comparison techniques coupled with the spectral theory of monotone linear semiflows. A formal calculation of the minimal wave speed for the traveling waves is given.