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Periodic phenomena and driven mechanisms in transmission of West Nile virus with maturation time

In this talk we will formulate a compartmental model with bird demographics and maturation time of mosquitoes during metamorphosis to study the impact of ambient temperature on the transmission and recurrence of the disease. We show that avian birds serve as a reservoir of viruses, whilst maturation time affects disease transmission in sophisticated ways. It turns out that large maturation delay will lead to the extinction of mosquitoes and the disease; small maturation delay will stabilize the epidemic level of the disease; and intermediate maturation delay will cause sustainable oscillations of mosquito population, recurrence of diseases, and even mixed-mode oscillation of diseases with an alternation between oscillations of distinct large and small amplitudes. With bifurcation theory, we prove that temperature can drive the oscillation of mosquito population, which leads to recurrence of WNV through the incidence interaction between mosquitoes and hosts, while the biting and transmission process itself will not generate sustained oscillations. Our results provide a sound explanation for understanding interactions between vectors and hosts and driven mechanisms of periodic phenomena in the transmission of WNV and other mosquito-borne diseases.