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Threshold Dynamics of a Temperature-Dependent Stage-Structured Mosquito Population Model with Nested Delays

Mosquito-borne diseases remain a significant threat to public health and economics. Since mosquitoes are quite sensitive to temperature, global warming may not only worsen the disease transmission case in current endemic areas but also facilitate mosquito population together with pathogens to establish in new regions. Therefore, understanding mosquito population dynamics under the impact of temperature is considerably important for making disease control policies. In this talk, I will introduce our recent work on the dynamics of a stage structured mosquito population model in the environment of a temperature-controlled experiment. The model turns out to be a system of periodic delay differential equations with periodic delays. We show that the basic reproduction number is a threshold parameter which determines whether the mosquito population goes to extinction or remains persistent. We then estimate the parameter values for Aedes aegypti, the mosquito that transmits dengue virus. We verify the analytic result by numerical simulations with the temperature data of Colombo, Sri Lanka where a dengue outbreak occurred in 2017. This talk is based on a joint work with Prof. Xingfu Zou.