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On a Network Model of Two Competitors with Applications to the Invasion and Competition of Aedes Albopictus and Aedes Aegypti Mo

The two prominent mosquito species, Aedes aegypti and Ae. albopictus, are the primary vectors that transmit several arboviral diseases, including chikungunya, dengue fever, yellow fever, and Zika. The world is presently experiencing a series of major outbreaks of these vector-borne diseases, so it is very important and necessary to understand the current distributions and movements of these mosquito vectors for successful surveillance and control programs. Based on the invasion of the Ae. albopictus mosquitoes and the competition between Ae. Albopictus and Ae. aegypti mosquitoes in the US, we study a two-species competition model in a network, that is with discrete Laplacian diffusion. In the case of strong-weak competition where the invasive competitor is stronger than the local one, it is shown that the invasive species (Ae. albopictus) wins over the local species (Ae. aegypti) and the solutions converge uniformly to the semi-positive equilibrium such that the invasive species survives while the local species becomes extinct, and vice versa. In the case of weak-weak competition, the solutions converge uniformly to the positive equilibrium so that both invasive and local species coexist. By using numerical simulations, we apply the two-species competition model in a network to explain the invasion and competition of Ae. Albopictus and Ae. Aegypti in the US. We also show that discrete Laplacian diffusion induces different spreading speeds in different invasive directions.