Math Model on the Effect of Deforestation and Anthropization on the Transmission Rates of Bat-Related Diseases

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Bat-related diseases make up a majority of emerging pathogens. Simultaneously, rising rates of deforestation and anthropization tend to displace bats which may impact the transmission of diseases to other populations, including humans. The first two subsystems were based on the basic logistic population growth model and SEIR model for diseases. The logistic population growth model was redesigned to incorporate deforestation and anthropization rates to deliver an output of varying subpopulation concentrations. The redesigned SEIR model incorporated the behavior responses of bats and delivered a basic reproduction number. The basic reproduction number was derived with a Markov chain/next-generation matrix using the differential equations from sub-system two. The model was simulated with assumed data from previous research papers, then redesigned to align with the performance criteria. The model demonstrated differences in carrying capacity and bat populations due to biodiversity loss. The model produced three different basic reproduction numbers outputs for an ideal environment, environment with deforestation, and environment with deforestation and anthropization. All these outputs were under the value of one, indicating disease transmission and a potential outbreak would end. Conclusion: The math model effectively incorporated behaviors of bats, illustrated changes in subpopulation distribution, and delivered varying basic reproduction numbers based on environmental factors the bats endured. However, the parameters are still based on several assumptions, which strongly encourages more advanced and intricate data collection on the behaviors and population of bats to accurately estimate the basic reproduction numbers.

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