MODELING VACCINATION STRATEGIES TO CONTROL WHITE-NOSE SYNDROME IN LITTLE BROWN BAT COLONIES

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ABSTRACT. Since 2006, the North American bat population has been in rapid decline due to white-nose syndrome (WNS), which is caused by an invasive fungus (*Pseudogymnoascus destructans*). The little brown bat (*Myotis lucifugus*) is the species most affected by this emerging disease. We consider how best to prevent local extinctions of this species using mathematical models. Development began in 2017 of a new vaccine for WNS and thus, we analyze the effects of implementing vaccination as a control measure. We create a Susceptible-Exposed-Infectious-Vaccinated hybrid ordinary differential equation and difference equation model informed by the phenology of little brown bats. We compare the effectiveness of annual, biennial, and one-time vaccination programs for multiple durations of immunity length. We also determine the optimal time to vaccinate, if vaccinating only once, as a function of average duration of immunity. Next, we perform a sensitivity analysis to determine the robustness of our results. Finally, we consider other possible control measures together with vaccination to determine the optimal control strategy. We find that if the vaccine offers lifelong immunity, then it will be the most effective control measure considered thus far.

Keywords: little brown bat, white-nose syndrome, mathematical model, vaccine, disease model, invasive species