

# Investigating the combined effects of distributed delays, logistic growth and density-dependent biting rate on the dynamics of a vector borne-disease.

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*Keywords: Vector-borne disease; Bifurcation; Delay differential equations; Distributed delay.*

We present and analyze a vector-borne disease model with two gamma distributed delays representing the incubation periods of the disease in the vector and hosts. The model assumes a logistic growth for both the host and vector populations and includes a density-dependent biting rate.

We start by highlighting the role of density dependency in the vectors population by fitting the vector model to data on tsetse flies. Our fitting routine uses Bayesian based Markov Chain Monte Carlo methods and statistics comparison tests.

Then we proceed with our mathematical analysis by investigating the impact of both (distributed) delays on the models equilibria and their stability properties. This leads to the derivation of an explicit conditions for the occurrence of backward bifurcation, showing in the process the role of nonlinearity in the biting rate in shaping the models bifurcation behavior.

Finally, a sensitivity analysis is performed by means of the forward sensitivity index of the basic reproductive number to compare the effect of the mean and shape parameters of the delay on the initial disease transmission.