A model-based investigation of the role of density dependence in juvenile mosquito development and survival

Melody Walker Ms
Virginia Polytechnic Institute and State University, melody@vt.edu

Lauren M. Childs
Virginia Polytechnic Institute and State University

Michael A. Robert
University of the Sciences in Philadelphia, m.robert@usciences.edu

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Melody Walker[1] **Michael A. Robert**[2] **Lauren Childs**[1]

[1] *Virginia Tech, 225 Stanger Street Blacksburg, VA, US, 24061*
melody@vt.edu, lchilds@vt.edu

[2] *University of The Sciences, 600 S. 43rd Street, Philadelphia, PA, US, 19104*
m.robert@usciences.edu

Mosquitoes pose a significant global health burden as they are carriers for multiple infectious diseases. In *Aedes* mosquitoes, the progression through aquatic developmental stages is known to be density-dependent. However, these nonlinear interactions are often ignored or oversimplified in simulation models, and density dependence is frequently assumed to impact survival only. Specifically, larval density may change the rate the development time and the survival probability of larvae. In turn, these effects of density on larvae may alter the spread of mosquitoes. We develop a discrete-time model of mosquito larval population dynamics incorporating simple forms for density dependence regulating both survival and development time. We demonstrate the validity of our model on publicly available data of larval density and pupation time over six months [1]. The incorporation of density-dependent larval development time was necessary to fit the experimental data, while density-dependent survival was not. Further, including age-dependent development time, along with density dependence gave the best fit to the timing of pupation. Overall, we found that the incorporation of density dependence, particularly on development time during the larval stages, is important for accurately predicting mosquito pupation. Our results could be used to help improve models of mosquito dynamics and more precisely simulate the location and dynamics of mosquito populations.

Keywords: *Aedes* mosquitoes, density dependence, mathematical model, survival, development time, mosquito development, population dynamics, vector-borne disease, mosquito demography

References

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