



Virginia Commonwealth University  
VCU Scholars Compass

---

Biology and Medicine Through Mathematics  
Conference

---

## Density-dependent development impacts the success of Wolbachia-based mosquito control programs

Alyssa Petroski

*University of the Sciences in Philadelphia*, [apetroski@mail.usciences.edu](mailto:apetroski@mail.usciences.edu)

Lauren M. Childs

*Virginia Polytechnic Institute and State University*, [lchilds@vt.edu](mailto:lchilds@vt.edu)

Michael Andrew Robert

*University of the Sciences of Philadelphia*, [m.robert@usciences.edu](mailto:m.robert@usciences.edu)

Follow this and additional works at: <https://scholarscompass.vcu.edu/bamm>



Part of the [Medicine and Health Sciences Commons](#), [Other Applied Mathematics Commons](#), [Other Ecology and Evolutionary Biology Commons](#), and the [Population Biology Commons](#)

---

<https://scholarscompass.vcu.edu/bamm/2020/talk/37>

This Event is brought to you for free and open access by the Dept. of Mathematics and Applied Mathematics at VCU Scholars Compass. It has been accepted for inclusion in Biology and Medicine Through Mathematics Conference by an authorized administrator of VCU Scholars Compass. For more information, please contact [libcompass@vcu.edu](mailto:libcompass@vcu.edu).

## Density-dependent development impacts the success of *Wolbachia*-based mosquito control programs

Alyssa D. Petroski<sup>1</sup>, Lauren M. Childs<sup>2</sup>, **Michael A. Robert**<sup>1\*\*</sup>

1. Department of Mathematics, Physics, and Statistics, University of the Sciences of Philadelphia, Philadelphia, PA
2. Department of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, VA

\*\* Presenter

The mosquito species *Aedes aegypti* is responsible for transmitting arboviruses such as Zika virus and dengue. Since traditional control measures have not been successful in eliminating *Ae. aegypti* populations and the viruses they transmit, much attention has been focused on novel control measures. One such measure proposes the release of mosquitoes infected with the bacterium *Wolbachia*, which is known to block transmission of some viruses in mosquitoes. Control measures that involve the release of additional mosquitoes into a population interact directly and indirectly with natural life processes, in particular those processes that are density-dependent. In *Ae. aegypti*, both survival and development of juveniles is regulated by density dependence, and most work focuses on the impacts of density-dependent survival; however, evidence is building that the influence of density-dependent development may be equally important. In this work, we developed an ordinary differential equations model to investigate the influence of density-dependent population regulation on control strategies involving the release of *Wolbachia*-infected mosquitoes. We explore the differential effects of density on both population reduction and population regulation strategies aimed at reducing transmission of viruses by *Ae. aegypti* populations. We found that, while some releases of *Wolbachia* into wild type populations lead to reduction in vectors capable of transmitting viruses (competent vectors), there are a number of scenarios in which releases result in an increase of the competent vector population, either temporarily or in the long-term, particularly when considering the impact of density-dependent development. We discuss our findings in the context of *Ae. aegypti* mosquito control efforts to reduce arbovirus transmission.