School of Mathematical and Statistical Sciences
Arizona State University

M E M O R A N D U M

DATE: 10/17/2023

TO: Faculty and Students

FROM: Professor(s) Fabio Milner
Chair/Co-Chairs of Marina Mancuso
Defense for the PhD in Applied Mathematics
Committee Members
Carrie Manore
Eric Kostelich
Steffen Eikenberry
Yang Kuang

DEFENSE ANNOUNCEMENT

Candidate: Marina Mancuso

Defense Date: November 02, 2023

Defense Time: 4:30 PM

Virtual Meeting Link: https://asu.zoom.us/j/88683751926 Or Live: WXLR A206 Wexler Hall (Tempe)

Title: Climate and Infection-Age on West Nile Virus Transmission

Please share this information with colleagues and other students, especially those studying in similar fields. Faculty and students are encouraged to attend. The defending candidate will give a 40-minute talk, after which the committee members will ask questions. There may be time for questions from those in attendance. However, guests are primarily invited to attend as observers and will be excused when the committee begins its deliberations or if the committee wishes to question the candidate privately.

ABSTRACT
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ABSTRACT

Climate change is one of the most pressing issues affecting the world today. One of the impacts of climate change is on the transmission of mosquito-borne diseases (MBDs), such as West Nile Virus (WNV). Climate is known to influence vector and host demography as well as MBD transmission. This dissertation addresses the questions of how vector and host demography impact WNV dynamics, and how expected and likely climate change scenarios will affect demographic and epidemiological processes of WNV transmission. First, a data fusion method is developed that connects non-autonomous logistic model parameters to mosquito time series data. This method captures the inter-annual and intra-seasonal variation of mosquito populations within a geographical location. Next, a three-population WNV model between mosquito vectors, bird hosts, and human hosts with infection-age structure for the vector and bird host populations is introduced. A sensitivity analysis uncovers which parameters have the most influence on WNV outbreaks. Finally, the WNV model is extended to include the non-autonomous population model and temperature-dependent processes. Model parameterization using historical temperature and human WNV case data from the Greater Toronto Area (GTA) is conducted. Parameter fitting results are then used to analyze possible future WNV dynamics under two climate change scenarios. These results suggest that WNV risk for the GTA will substantially increase as temperature increases from climate change, even under the most conservative assumptions. This demonstrates the importance of ensuring that the warming of the planet is limited as much as possible.