URBAN MICROCLIMATE AND DENGUE VECTOR COMPETENCE OF THE INVASIVE ASIAN TIGER MOSQUITO, *AE. ALBOPICTUS*

Michelle V. Evans[1,2], Nicole Solano[3], Justine Shiau[4], Courtney C. Murdock[1,2,4]

[1]Odum School of Ecology, University of Georgia, Athens, GA [2]Center for the Ecology of Infectious Diseases, University of Georgia, Athens, GA [3]Agness Scott College, Atlanta, GA

[4] Department of Infectious Disease, University of Georgia, Athens, GA

INTRODUCTION

Asian Tiger Mosquito

Aedes albopictus

- Invasive in Eastern US
- Vector of chikungunya & Zika
- Anthropophilic

- Landscape-scale studies of vector borne disease are often based on coarse measures of climate, failing to incorporate fine scale heterogeneity
- Urban landscapes have heterogeneous microclimate profiles (e.g. the urban heat island effect)
- Mosquitoes are especially sensitive to this variation in microclimate, particularly temperature[1]
- Warmer temperatures may lead to a shorter larval development and smaller body size[2], decreasing the population growth rate
- Increased temperatures can possibly increase or decrease vector competence, depending on vector immunology[3]
- Fine scale changes in mosquito mosquito life-history traits across the landscape due to microclimate will correspond to spatial changes in disease risk

How does urban microclimate in the larval stage affect adult mosquito vector competence?

METHODS

Rural

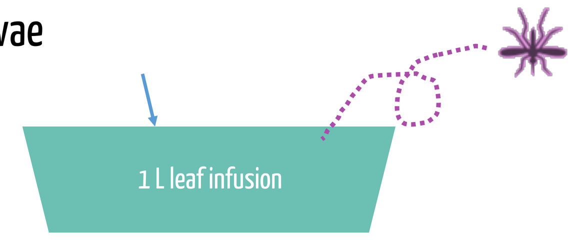
Suburban

Urban

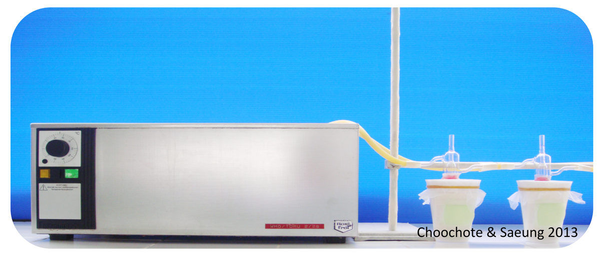
- Rural, suburban, and urban sites were chosen based on their percentage of impervious surface
- Placed four rearing trays in a 30 x 30 m area at each site
- Conducted in the summer of 2016
- Collected fine-scale adult and larval temperature and relative humidity data of each trays' microclimate

At each 30 x 30 m site:

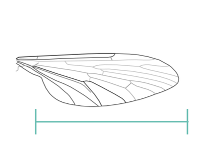
100 1st instar *Ae. albopictus* larvae



Offered dengue infectious blood meal to *Ae. albopictus* aged 4-6 days old

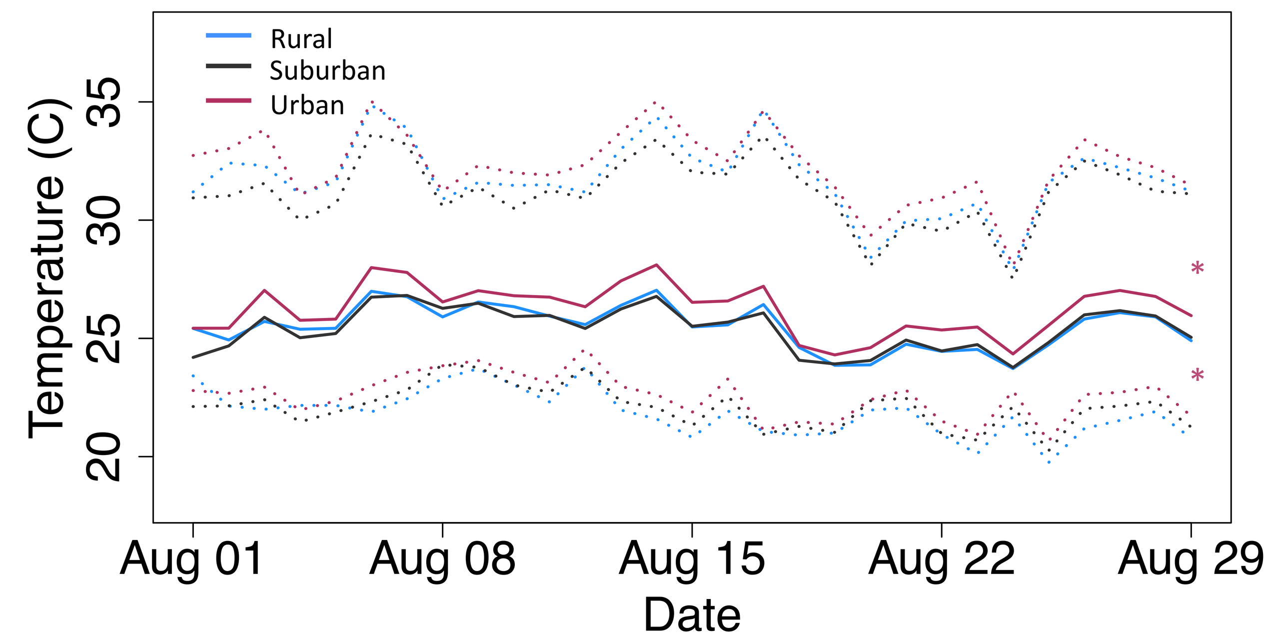


Tested mosquitoes for dengue infection and infectiousness 14 and 21 days post infection (dpi) & measured wing length



RESULTS

MEAN AMBIENT TEMPERATURE BY LAND CLASS

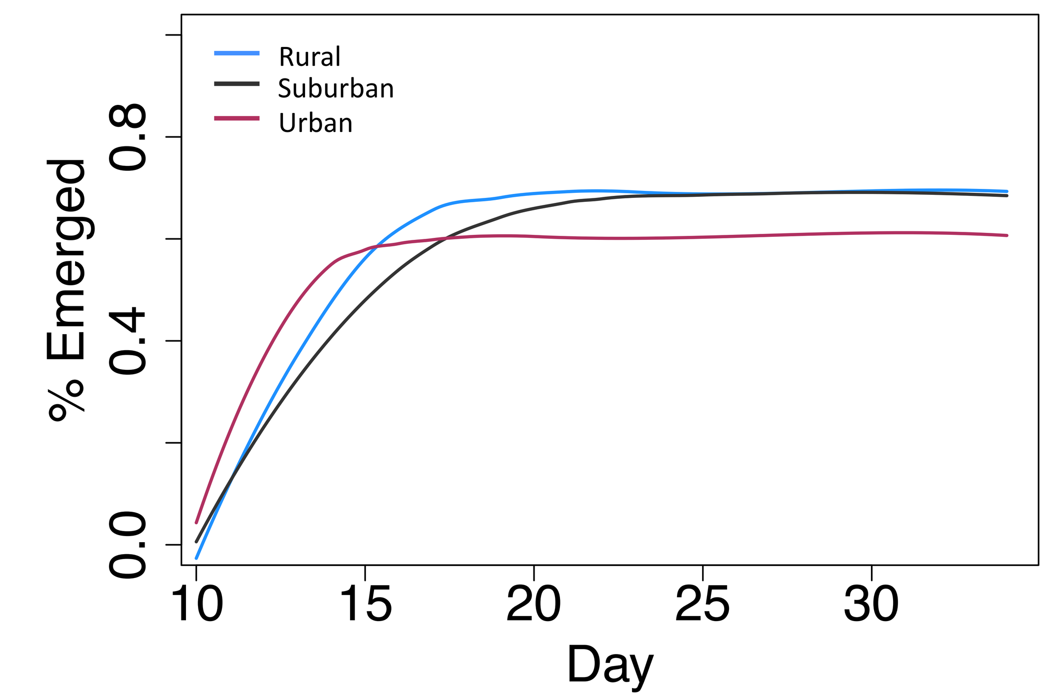


Plot of mosquito adult environmental temperature (i.e. ambient) in Athens, GA in 2016. Bolded line represents the daily mean temperature by land class, and dotted lines are the daily minimum and maximum.

Urban sites were significantly hotter than other land classes

Evidence of an urban heat island effect

FEMALE EMERGENCE CURVES

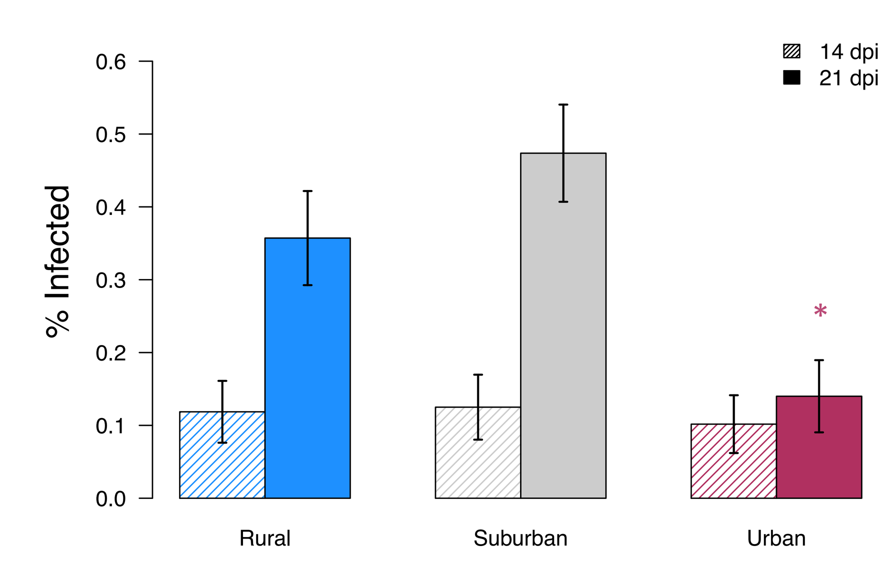


Mosquitoes emerged earlier and at a faster rate in urban land classes

Fewer larvae emerged in urban land classes than in rural or suburban

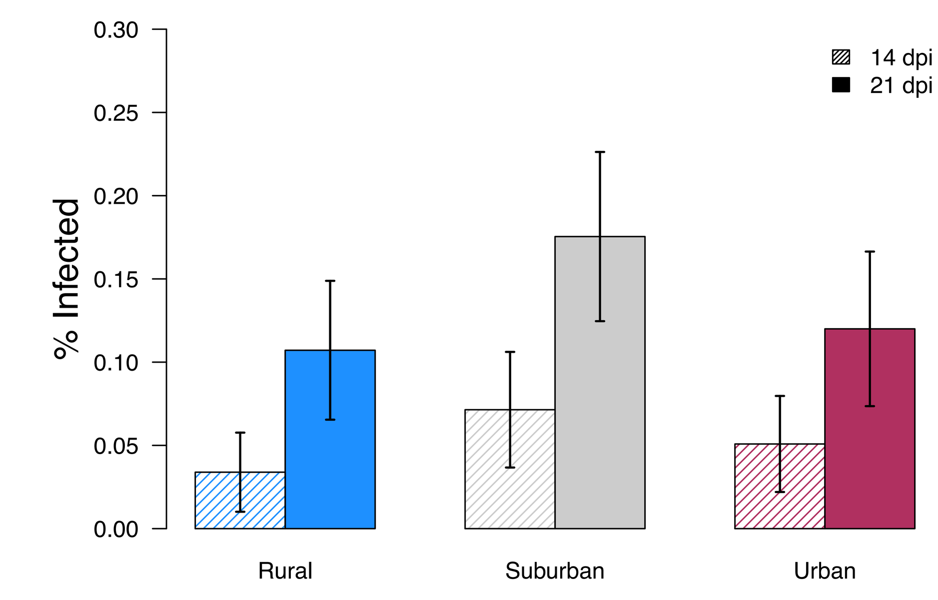
ADULT INFECTION

BODY POSITIVITY



ADULT INFECTIOUSNESS

SALIVA POSITIVTY



Plots of mean values, with error bars representing standard error. The effect of land class on infection and infectiousness was calculated via mixed-effects models with site as a random factor.

Urban sites have the lowest infection rates, but there is no difference across sites in infectiousness

CONCLUSIONS

Predicted disease transmission can be calculated by parameterizing the Ross-McDonald equation for vectorial capacity:

$$VC = \frac{ma^2bp^n}{-\ln(p)}$$

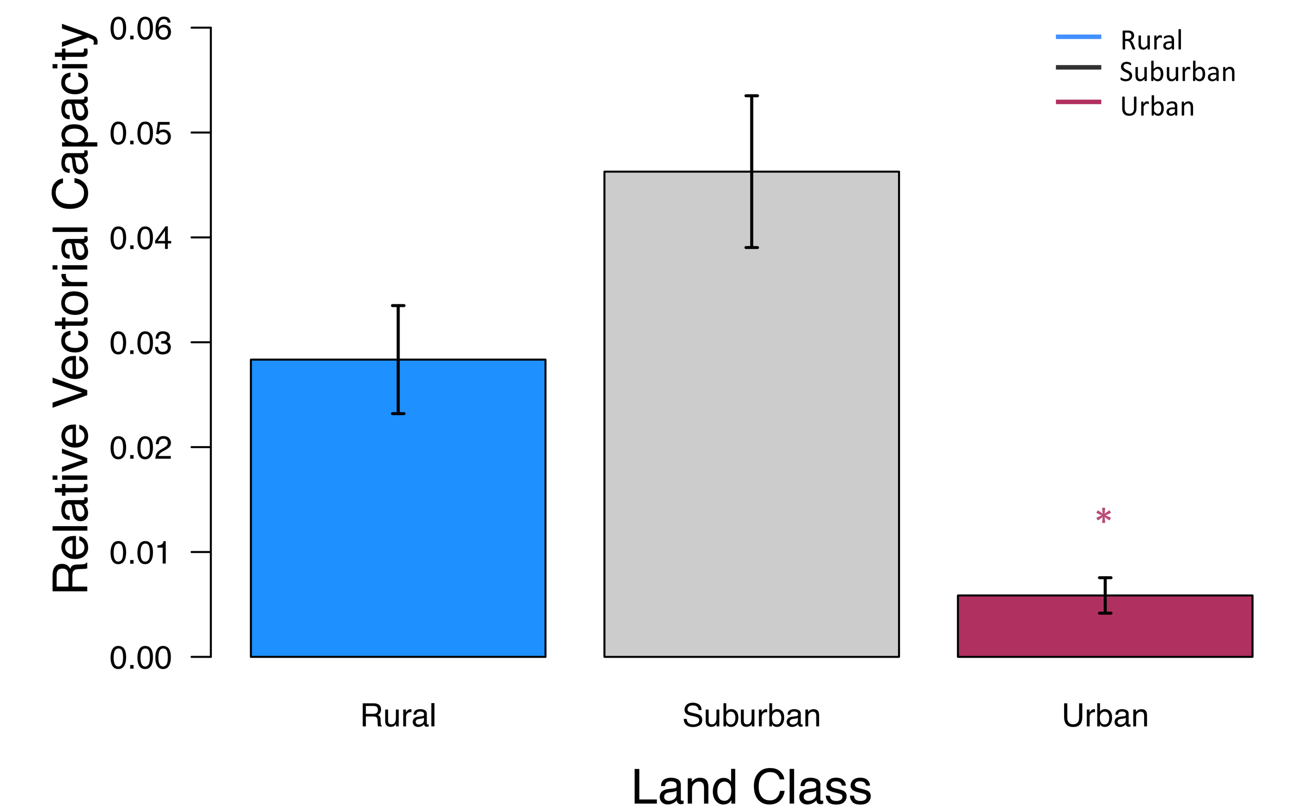
Parameter	Source
m mosquito density [a]	field-derived
a bite rate [b]	Mordecai et al 2016[4]
b vector competence	field-derived
p adult mosquito survival [b]	Mordecai et al 2016[4]
n extrinsic incubation period [c]	Mordecai et al 2016[4]

a: Mosquito densities were calculated from field-derived larval, scaled up to initial numbers of 1000 larvae.
b: Parameter was calculated by tray using rate summation.
c: EIP was calculated based on adult incubator temperature of 28C.

Although there is no difference in vector competence across land class, overall predicted disease transmission varies significantly.

Incorporating the effect of microclimate leads to more accurate predictions of disease transmission.

PREDICTED DISEASE TRANSMISSION



Plot of mean values, with error bars representing standard error. The effect of land class on vectorial capacity was calculated via mixed-effects models with site as a random factor.

MVEVANS@UGA.EDU MV_EVANS MVEVANS89

ICON Integrative Conservation Ph.D. Program · The Graduate School, The University of Georgia · Odum School of Ecology, The University of Georgia

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