Abiotic and biotic factors' impact on *Aedes albopictus* vectorial capacity

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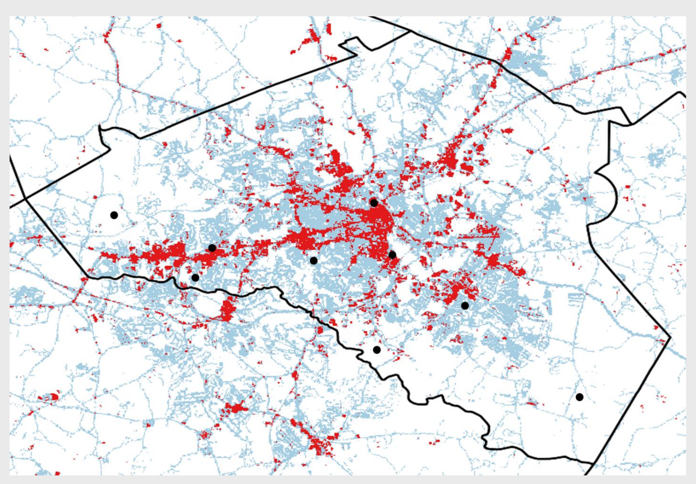
Introduction

Vectorial Capacity is highly influenced by vector density, so understanding vector population dynamics is essential to combatting disease. Small variation in abiotic factors such as temperature and biotic factors such as intraspecific competition can have a large impact on population characteristics including fecundity and growth rate. In this study we test how variation in land use and larval density impact population parameters that are important to predicting vectorial capacity.

$$\text{VC} = \frac{Ma^2be^{-\mu EIP}}{\mu}$$



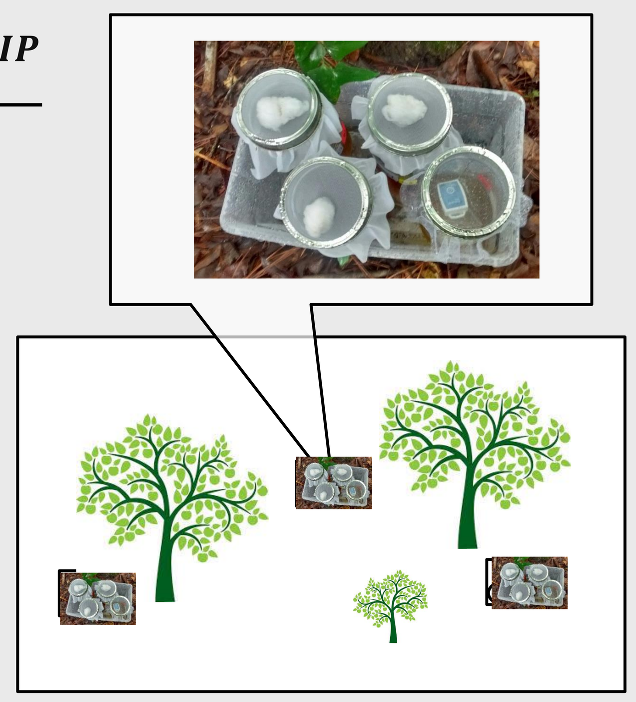


Figure 1. (A) Impervious surface map of Athens-Clarke County, GA. Red indicates high density. (B) Diagram of representative study site; three clusters of four jars in full shade.

Hypothesis

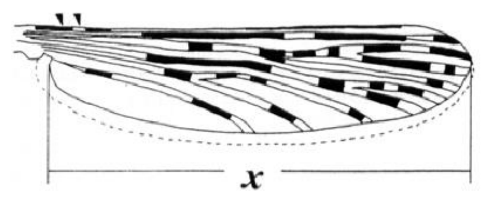
Areas with higher amounts of impervious surface typically have higher mean temperatures and larger amount of temperature fluctuation.

1. Probability egg to adult survival (PEA) is higher in rural sites, and in low density sites.
2. Predicted fecundity (inferred from wing length) is higher in rural sites and high density replicates.
3. Mosquito development rate (MDR) is higher in urban sites and low density replicates.
4. The impacts of larval density are larger than the impacts of site location.

Methods

We established three clusters of pots in full shade at each of the nine field sites.

1. Prepared leaf infusion using live oak leaves, yeast, and albumen.
2. Arranged four jars in each cluster. A data logger was placed in one jar and the other three jars were populated with 30, 60, and 120 mosquito larvae.
3. Checked sites daily, adults aspirated, transported, and frozen in the lab. Processed adults by identifying sex and measuring wing length.



$$\text{VC} = \frac{Ma^2be^{-\mu EIP}}{\mu}$$

$$m = \frac{EFDp_{EA}MDR}{\mu^2},$$

We measured the following: The proportion larvae surviving to adulthood. The time to eclosion. The sex and wing length of the adult mosquitoes.

This information is needed to estimate M, which is an important contributor to vectorial capacity.

Fig 2 M = number of mosquitoes alive upon completion of the parasite incubation period (*EIP*), a = daily bite rate, b = proportion of infectious mosquitoes, and μ = daily mortality rate.

M Is a function of EFD = Eggs/Female/Day, PEA = Probability Egg to Adult Survival, MDR = Mosquito Development Rate, and μ = daily mortality rate.

Estimate EFD Use female wing length to infer fecundity. PEA and MDR is calculated from daily adult emergence (DAE).

Results & Discussion

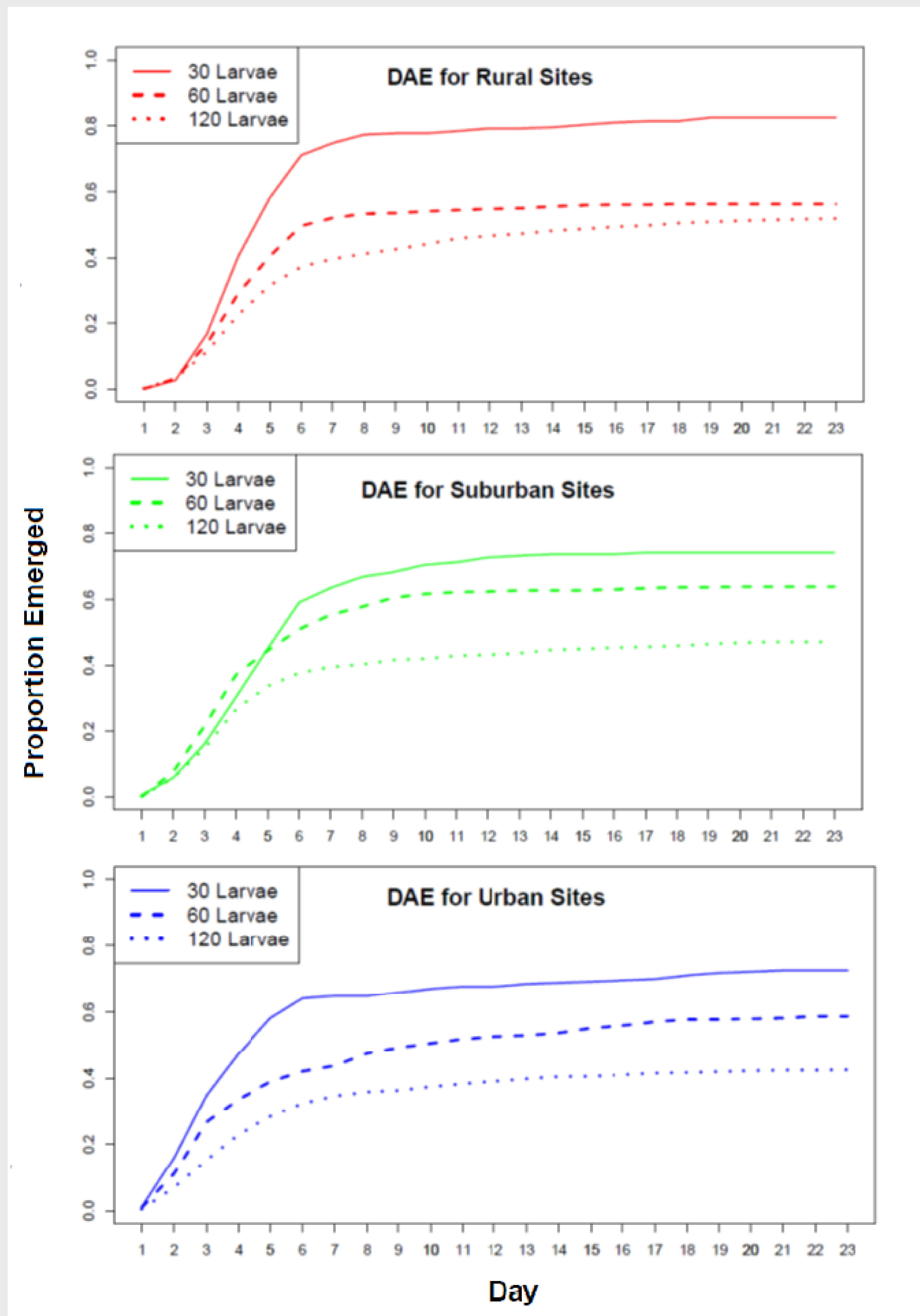


Figure 3 Mean daily adult emergence at rural, urban and suburban sites. From top to bottom, estimated PEA is (0.815, 0.561, 0.497, 0.743, 0.634, 0.456, 0.700, 0.570, 0.415). Day one marks the first day adults emerged from any of the sites or the 9th day of the experiment.

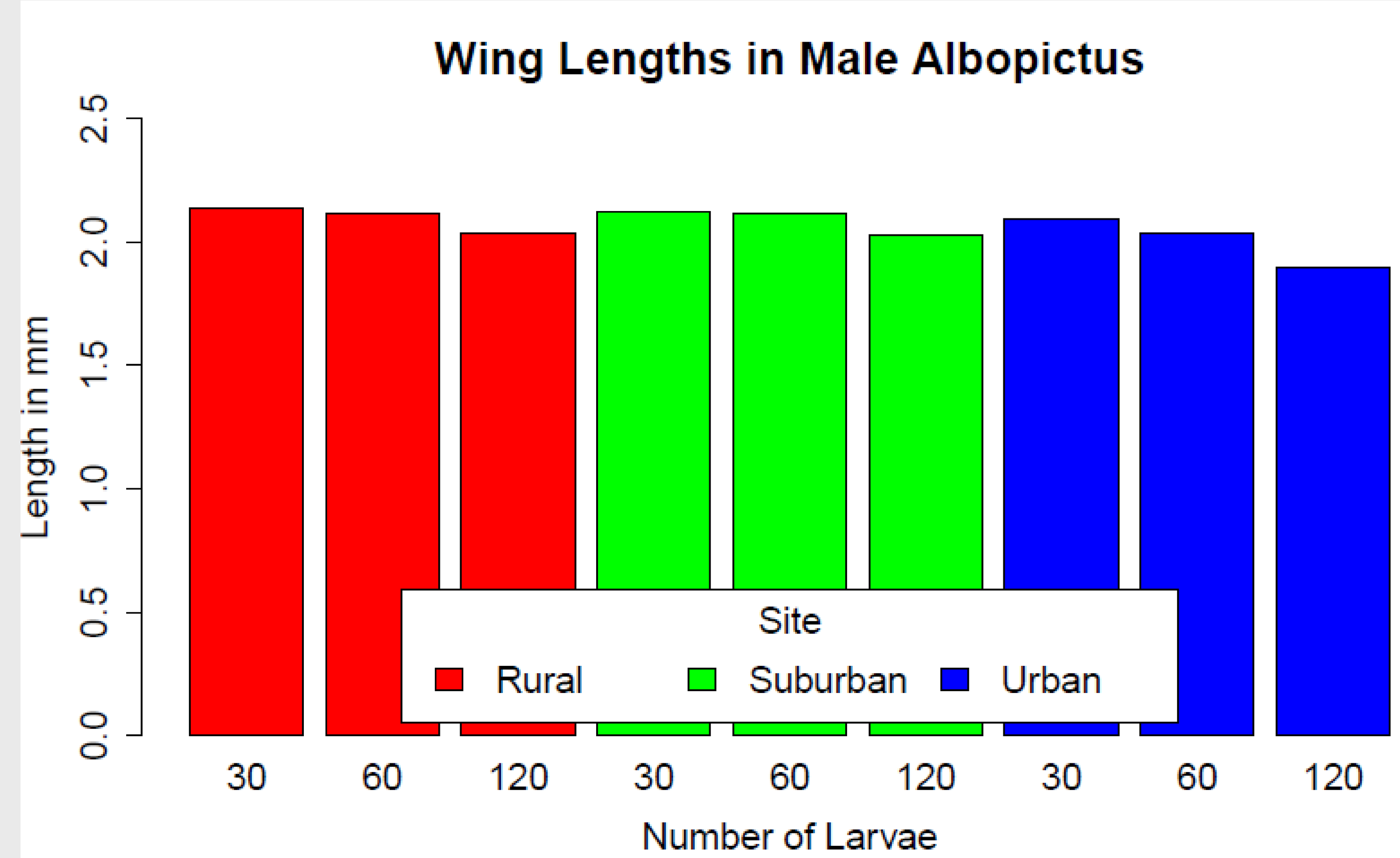


Fig 4 Mean wing lengths for adult males from first three days of emergence, n = 855. From left to right mean = (2.134, 2.113, 2.035, 2.124, 2.112, 2.029, 2.096, 2.034, 1.896 mm) and standard error = (0.014, 0.009, 0.010, 0.009, 0.009, 0.009, 0.009, 0.012, 0.013)

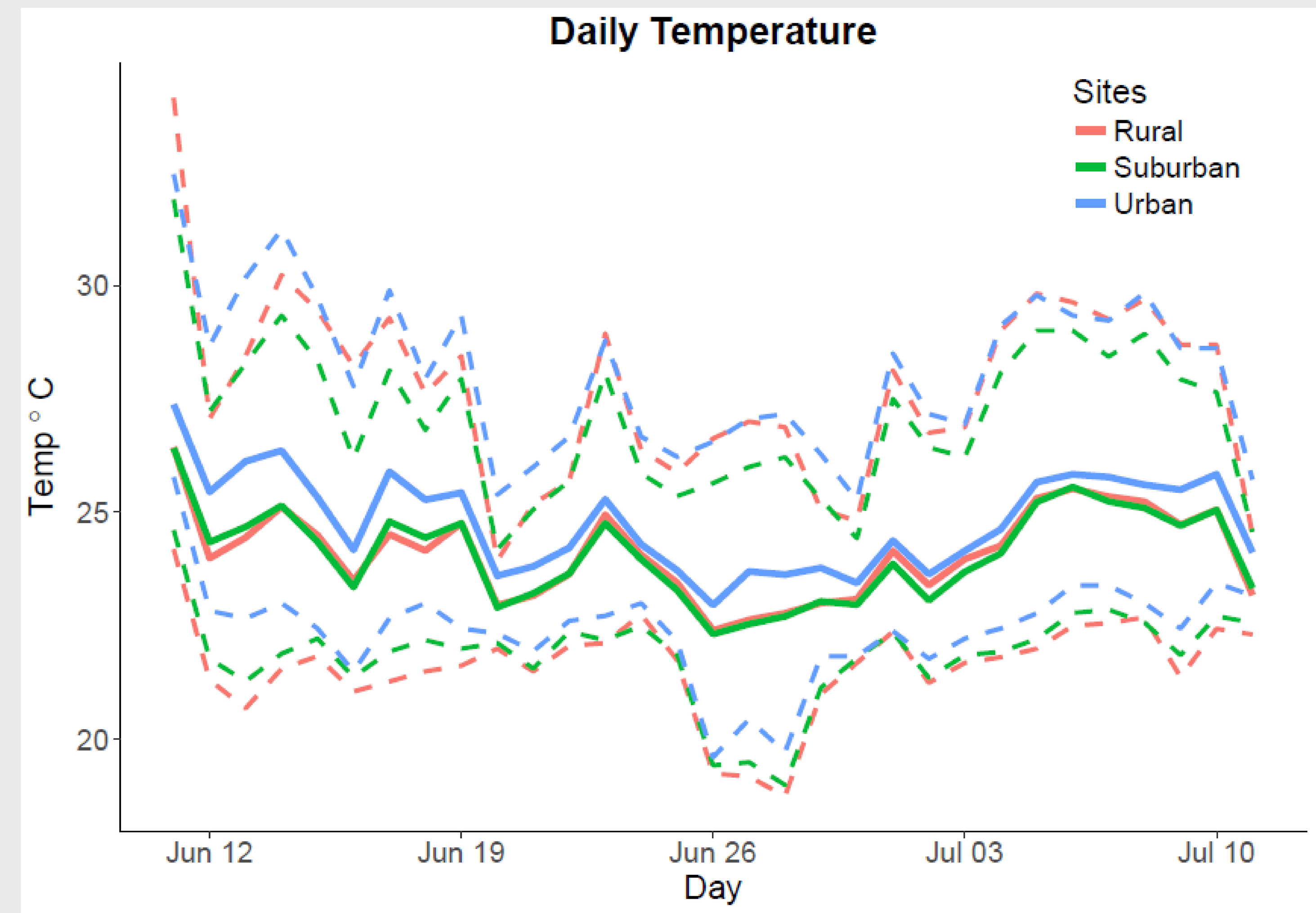


Fig 5 Maximum, minimum and mean temperatures from larval loggers at rural, suburban and urban sites.

1. Urban sites have lower survival, faster development, and smaller body size than rural or suburban sites. The mean temperature is substantially higher at urban sites.
2. High density replicates have lower survival, slower development, and smaller body size. High density replicates appeared less turbid suggesting a shortage of food. Overall, density had a larger impact than land use.

Next steps include fitting a logistic regression to emergence data, estimating vector density and capacity, and analyzing the potential interaction between larval density and land use. Potential future studies include completing replicates at different latitudes and examining the sensitivity of existing vector models to variation in microclimate.

Acknowledgements: Special thanks to Michelle Evans. Additional thanks to the Population Biology of Infectious Disease REU, to the NSF and to the 5670 *Ades albopictus* that involuntarily participated in this study.