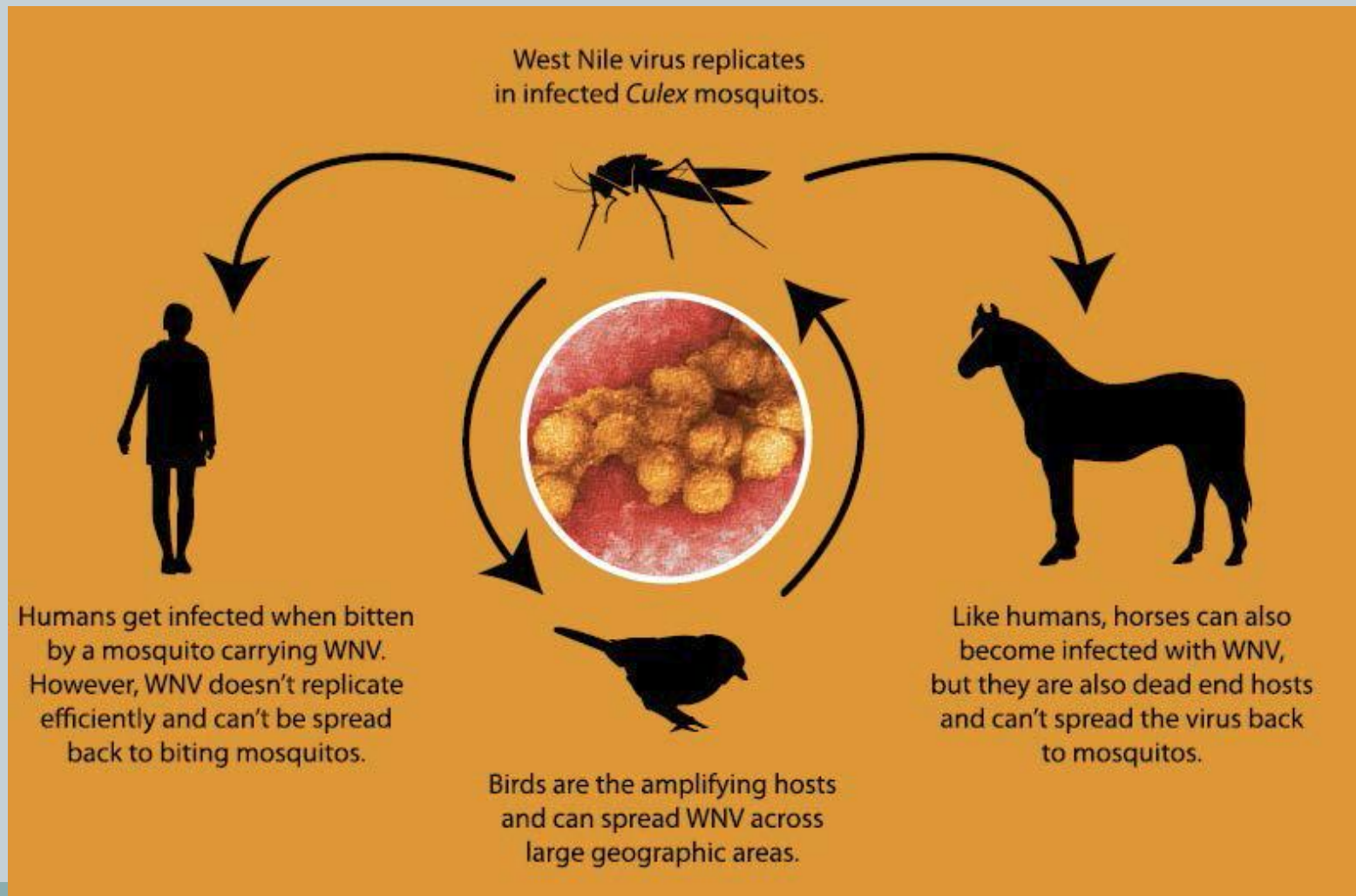


Influence of Forest to Urban Conversions on Incidence of West Nile Virus near Atlanta, GA



B.G. LOCKABY

West Nile Virus

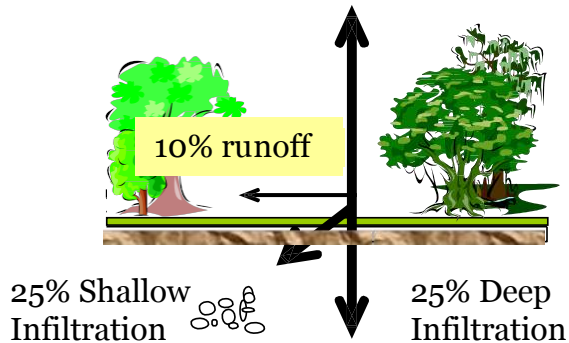


West Nile Virus



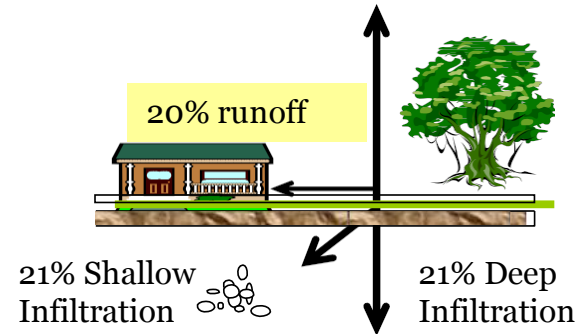
Human cases in U.S. since 1999	42,000
Alabama	245
Georgia	368
Mississippi	1,232
Texas	4,632
Deaths in U.S. since 1999	1,753
286 in 2012 alone	
Mortality rate of reported cases	4-6%

40% Evapo-Transpiration



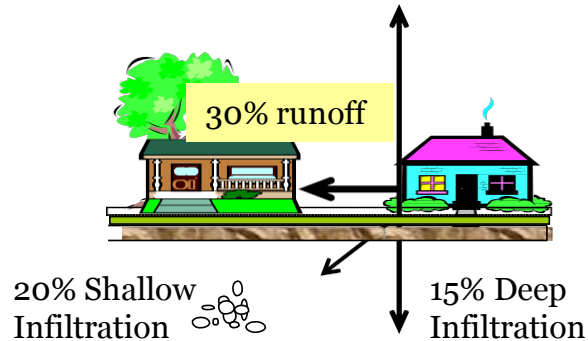
Natural Ground Cover

38% Evapo-Transpiration



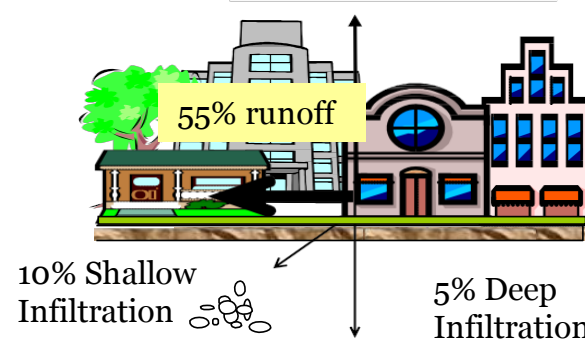
10-20% Impervious Surface

35% Evapo-Transpiration



35-50% Impervious Surface

30% Evapo-Transpiration



75-100% Impervious Surface

Changes when forests are developed?

Hydrographs – reduced stability

2a. Representative hydrograph of a forested watershed.

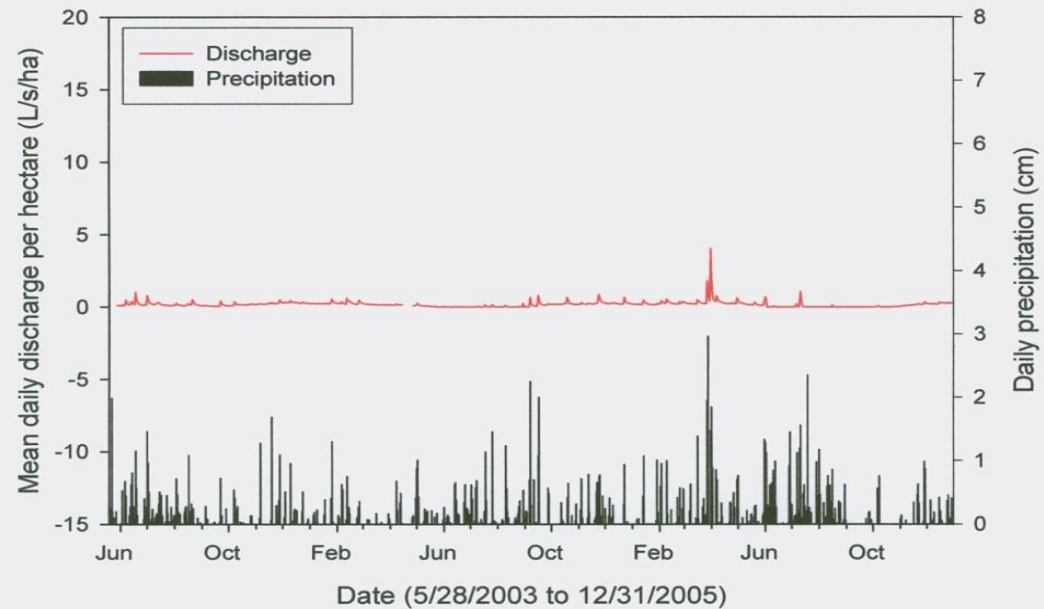


Figure 2 (a)

2b. Representative hydrograph of an urban watershed.

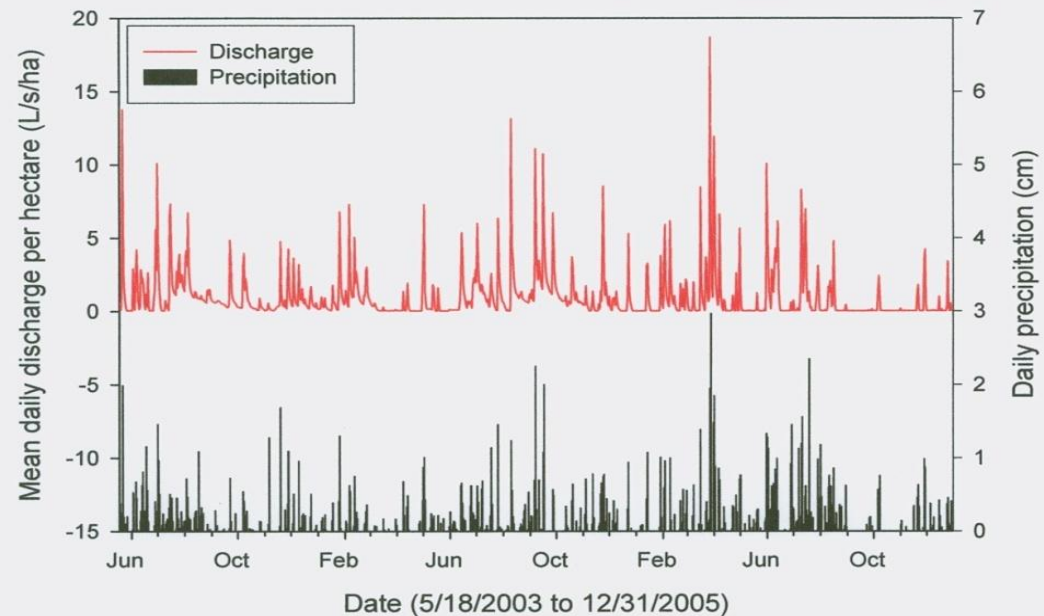


Figure 2 (b)

Loss of hydrologic stability and polluted urban waters

Combined stormwater –sewer overflow



Credit: Alan Cressler

<http://water.usgs.gov/edu/urbansew.html>

West Nile Virus – Related Factors



- **Habitat factors**
 - Forest characteristics
 - Urban hydrology
 - Corvid habitat (reservoir)
 - Socioeconomics

- **The Vector**
 - *Culex* sp. mosquitoes
 - ✦ Mosquito habitat
 - ✦ Nutrients in water



Effects of Forest to Urban Conversion on WNV in Atlanta



- WNV data from GA Dept. of Public Health
- 522 sampling locations across 58 sites
- Vegetation sampling (forest structure, species)
- Socioeconomic – census and field
- Climate (meteorological) modelling
- Land use/Land cover analysis
- Funded by USDA

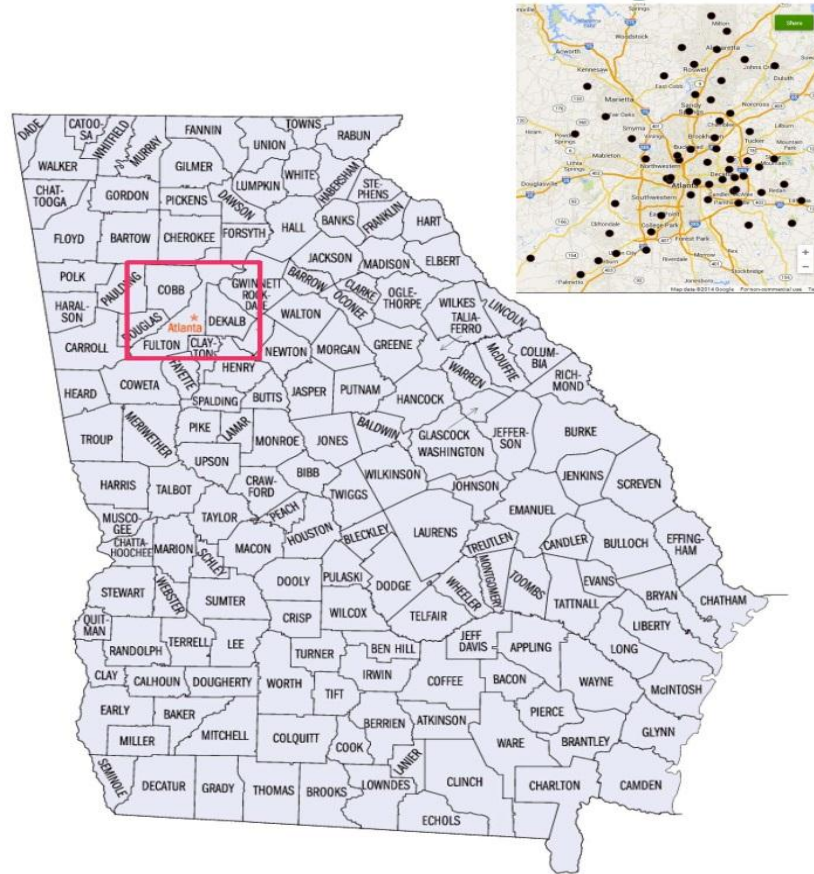
Mosquito breeding sites, corvids, and poverty





Vector Index (VI) = average WNV positive mosquitoes collected per trap night

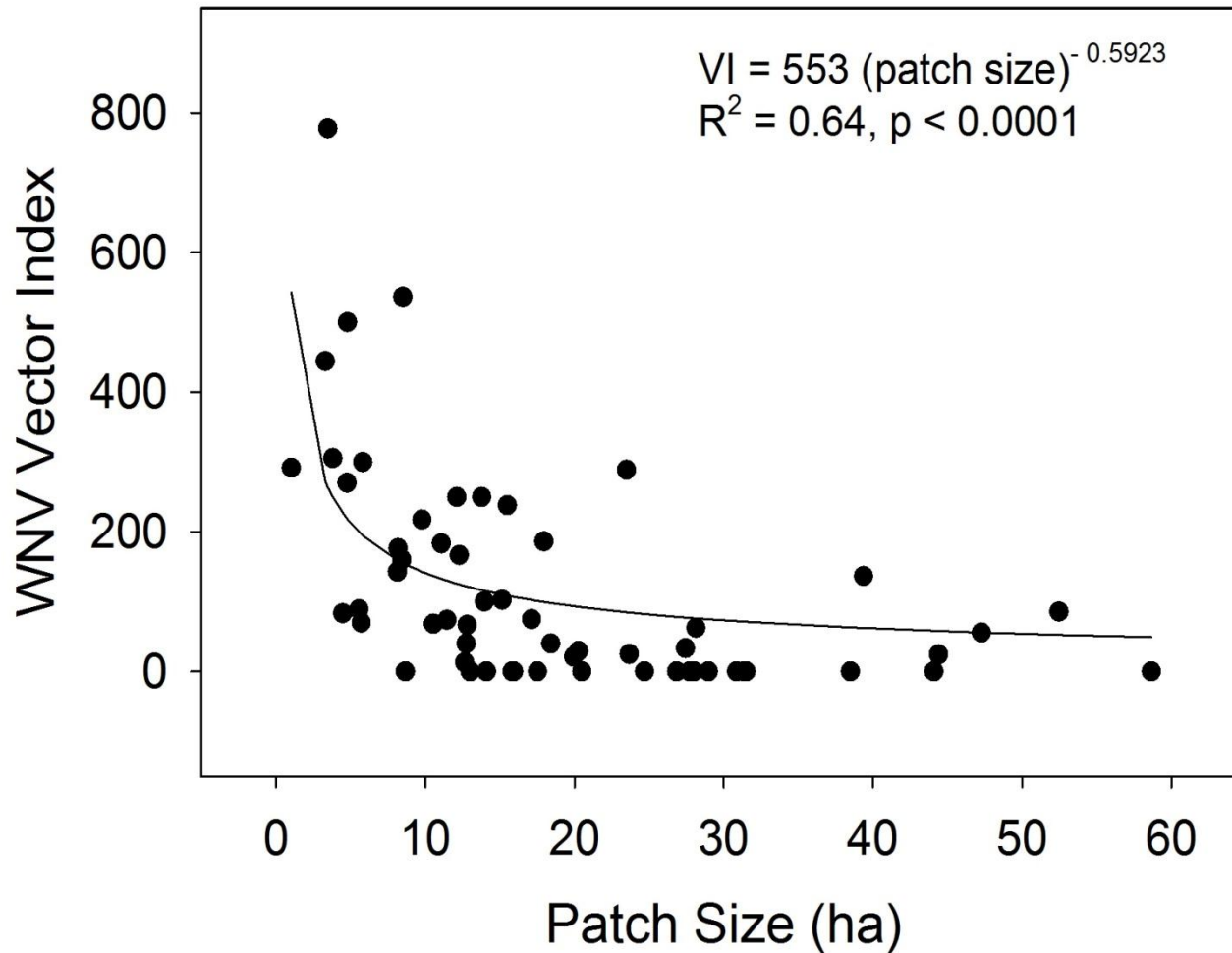
Study sites used in Fulton, DeKalb and Cobb Counties in Georgia



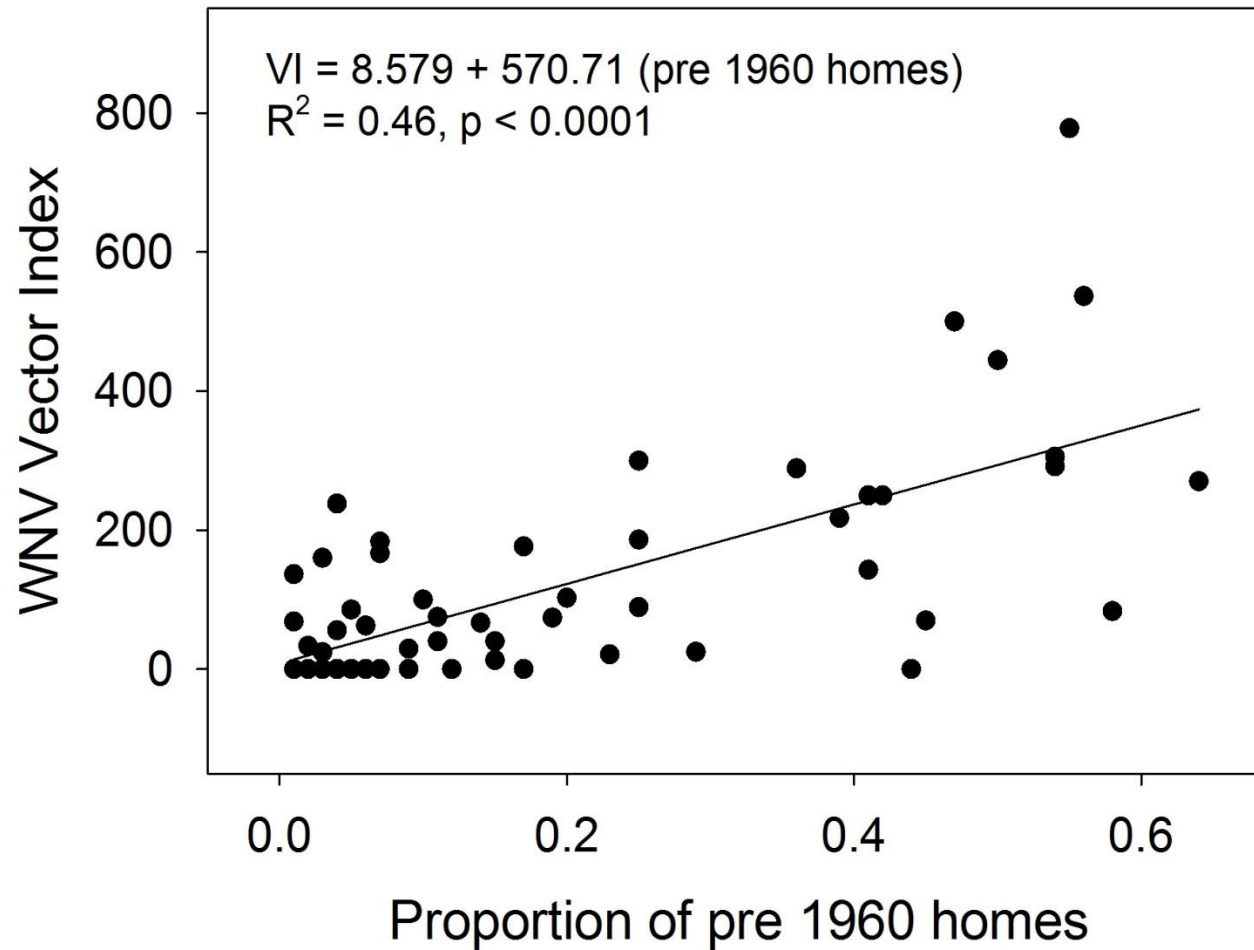
- The red rectangle represents the approximate study area.
- The black dots on the inset represent 58 study sites with 1km buffer.

Scatter plot showing the relationship between Percent Pine in Forest Patches (X-axis) and WNV Vector Index (Y-axis). The regression line is defined by the equation: $VI = 379.1304 - 6.0907 (\text{percent pine})$, with $R^2 = 0.43$ and $p < 0.0001$.

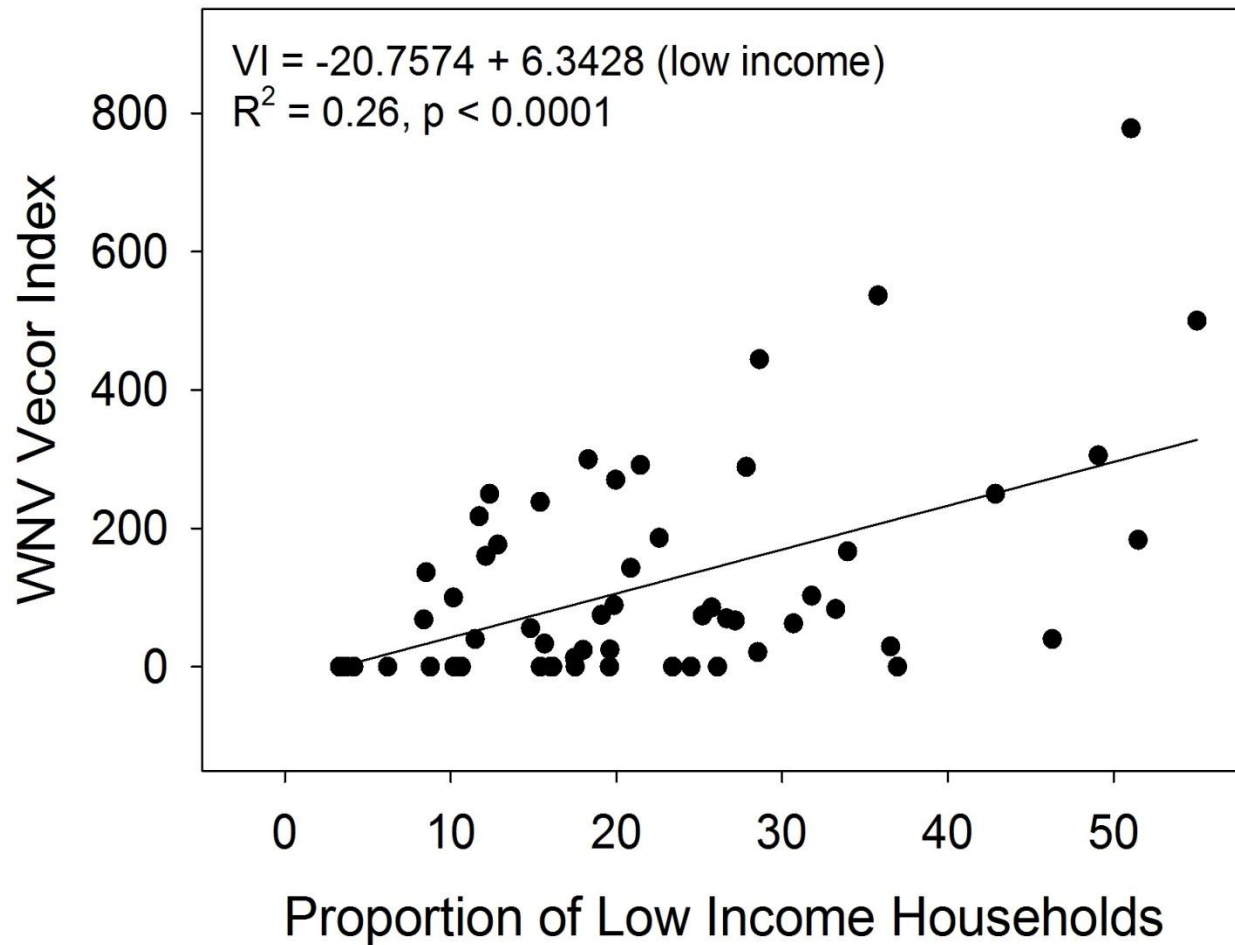
Relationship between average urban forest patch size and West Nile Virus



Relationship between pre 1960 homes and West Nile Virus



Relationship between low income households and West Nile VI



Climate scenario favorable for WNV = warm winter, wet early spring, dry late spring and summer

Conclusions



- Larger forest patches and higher pine composition of patches are associated with lower VI.
- As % impervious surface rises, the vector index follow.
- Older neighborhoods and low income households are associated with higher vector indices.

Conclusions continued



- Lagged 4 week moving averages of soil moisture were effective predictors of VI and, as average soil moisture increases, VI rose accordingly.
- There is a strong need for greater detail in the metrics measured, particularly socioeconomics.
- Results reinforce the critical need for well coordinated, interdisciplinary studies.

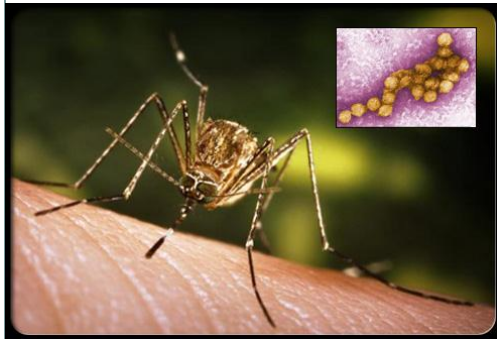
Summary



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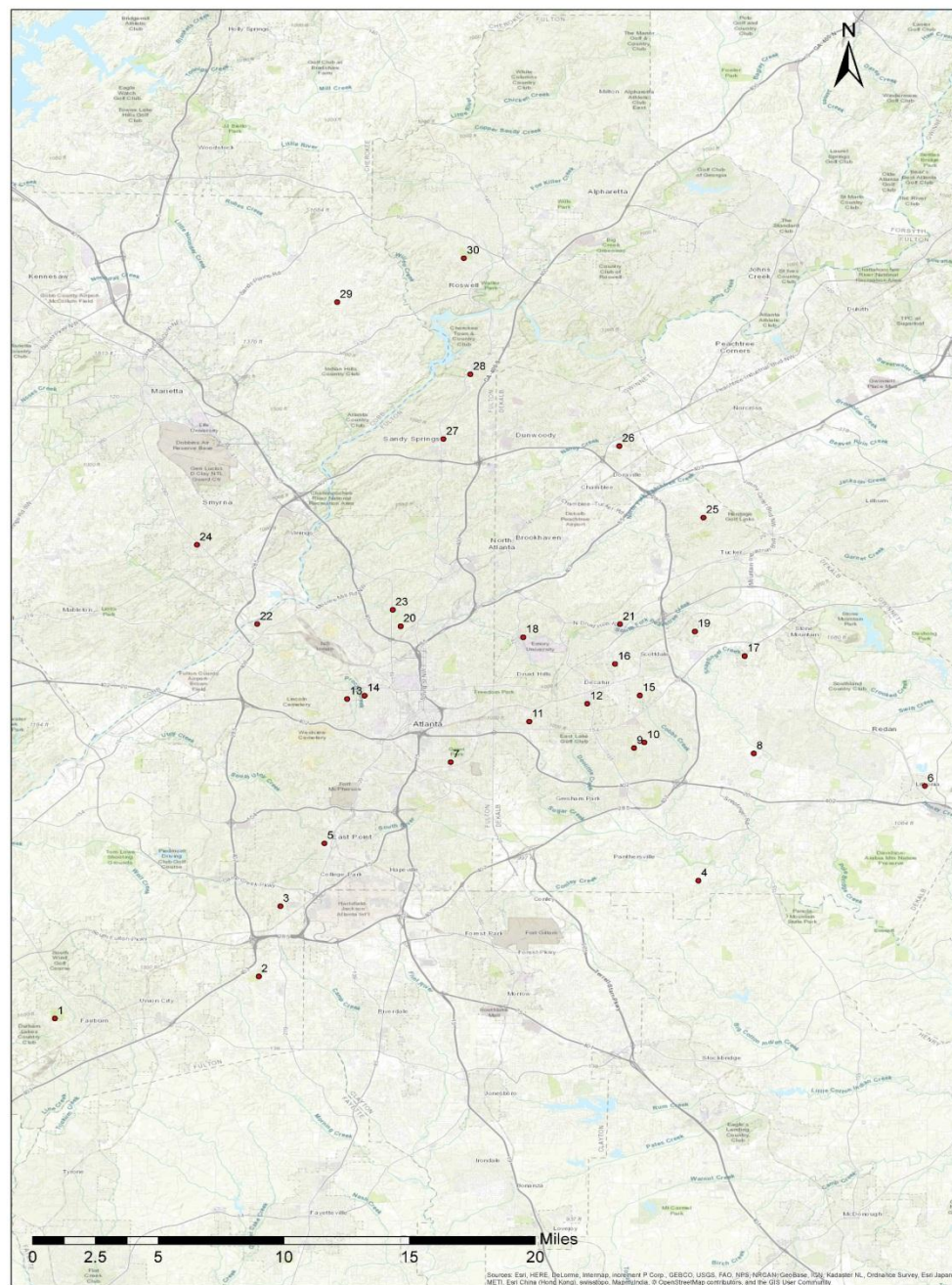
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New Study Overview



- 30 of the original 58 sites
- Chose sites based on gradients of socio-economics and vegetation
- Added new components to get a better understanding of what is going on



Additions

- Bird Surveys
- Mosquito Trapping
- WNV Testing
- Vegetation Survey



Why Birds?



- Birds are the main host for WNV
- Culex mosquitoes are ornithophilic mosquitoes
- Not testing blood of birds



Methods



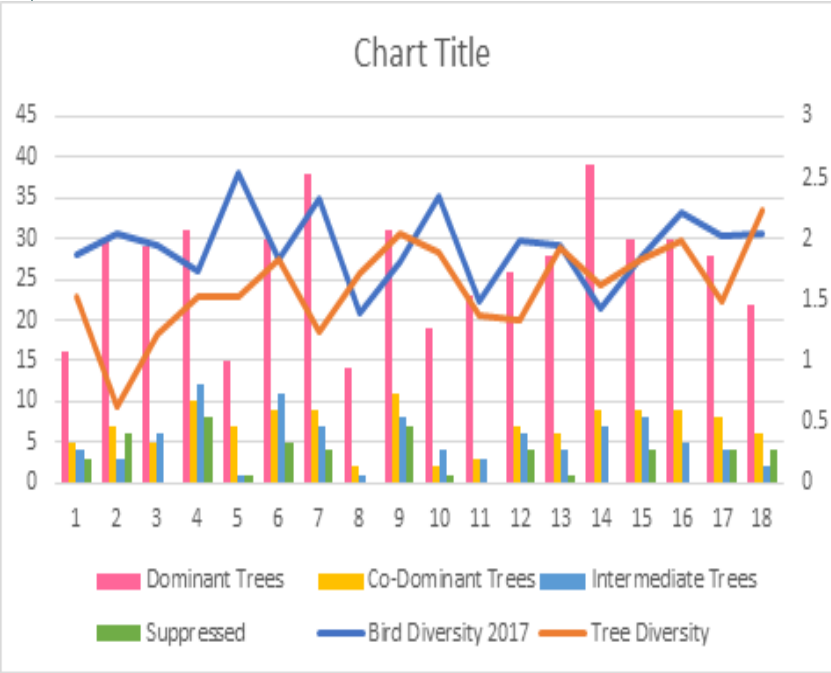
- Bird Surveys – Point Counts
- Vegetation Survey – Tree Health, Crown Class, % Canopy Closure, % Live Crown, Basal Area, % Pine vs % Hardwood, Forest Patch Size
- Topography – % Slope, Soil
- Socioeconomics - Income level and Age of Neighborhoods
- Mosquito trapping – CDC Light Traps and Gravid Traps
- WNV Testing - PCR



Preliminary Results	Correlation	Correlation Coefficient	P-Level
Correlation Analysis	# Adult Mosquito vs Tree Diversity	0.42	0.02
	# Adult Mosquito vs % Canopy Closure	-0.34	0.06
	# Adult Mosquito vs Average Tree Height	-0.32	0.08
	Bird Diversity vs # Cavities	-0.3	0.10
	Number of Bird Species vs % Canopy Closure	-0.34	0.06
	Number of Corvids vs % Live Crown	0.37	0.04
	Number of Corvids vs % Barren	0.46	0.01
	Number of Corvids vs % Forest	-0.30	0.10

Preliminary
Results
Continued...

Correlation	Correlation Coefficient	P-level
# American Robins vs Basal Area	-0.38	0.04
# American Robins vs % Live Crown	0.36	0.04
# American Robins vs % Barren	0.46	0.01
# American Robins vs % Grass	0.38	0.04
Number of American Robins vs % Shrub	0.46	0.01



What Does This Mean?



- It is apparent the both corvids in general and robins are significantly associated with more open areas including grass, shrubby areas, and barren zones.
- Numbers of adult mosquitoes are weakly related to certain forest characteristics. The positive correlations with closed canopies and average tree height may suggest that older forests with high LAI reflect favorable habitat.

Future Analysis



- Multivariate model
- AIC
- Vector Index Analysis

Acknowledgements

- Auburn University – School of Forestry and Wildlife
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 - Atlanta Audubon Society
- Adam Beutel, Vinod Babu, Jean-luc Betoulle



Disease Ecology Lab



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Questions?

