



Ongoing Efforts in Mosquito- Based Research at Valdosta State University

Amber N. Holley, Christopher A. Slaton, Erin E.
Grabarczyk, Mark S. Blackmore, and Eric W. Chambers

The influence of climate and land use land coverage (LULC) on West Nile virus transmission in Lowndes County, GA (2012-2023)

Amber N. Holley, Erin E. Grabarczyk, Mark S. Blackmore, and Eric W. Chambers

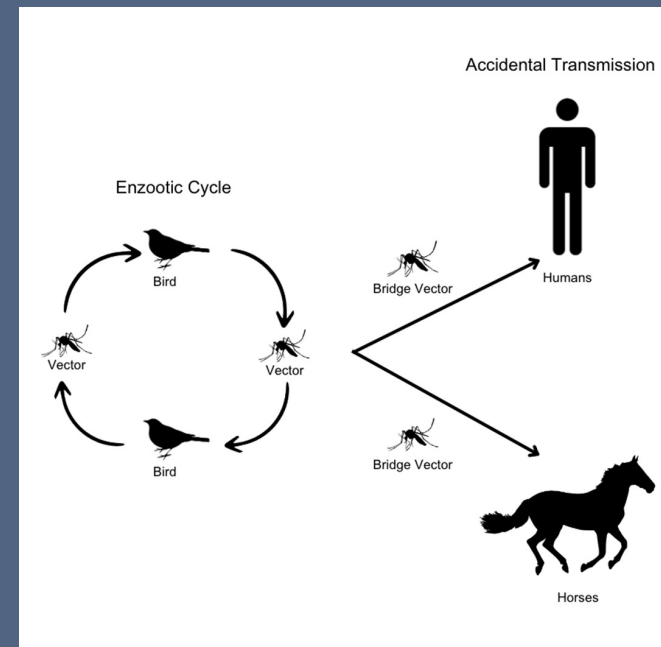
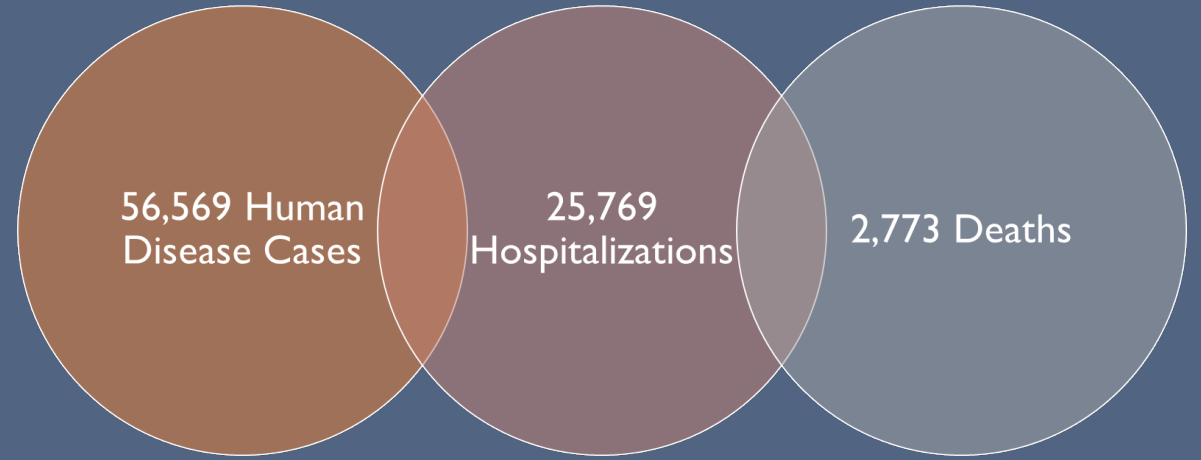
Valdosta State University Mosquito Surveillance Program

- Partnership established in 2001
 - City of Valdosta
 - Lowndes county
 - Valdosta State University
- Dr. Mark Blackmore directed project from 2001 until retirement in 2023
- Project provides data on vector and virus activity-local, state, and national agencies



West Nile Virus

- Mosquito-borne flavivirus
- Enzootic transmission cycle between avian hosts and mosquitoes
- Can infect other vertebrate hosts
- Most human infections result in no symptoms
 - febrile illness, encephalitis, or meningitis can occur



Primary Vectors in United States



Cx. pipiens



Cx. tarsalis



Cx. quinquefasciatus



Impact of Urbanization on WNV Mosquito Infections

- Concentration of human populations into discrete areas-US EPA
- One measure = % impervious area (roads, parking lots, roofs, etc.)
- Creates artificial breeding sites (storm drains, rain gutters, etc.)
- Contributes to the spread of *Culex* mosquitoes into once uninhabitable areas



Land Use and Land Cover (LULC) influences vector distribution

- Measure and classification of human activities and natural elements on the landscape (impervious surface, wetland, forest, etc.)
- Influence on WNV transmission varies geographically
- Bowden et al. 2011 - positive association in the Northeastern United States between urban land covers and WNV incidence and a positive association in the Western United States between agricultural land covers and WNV incidence



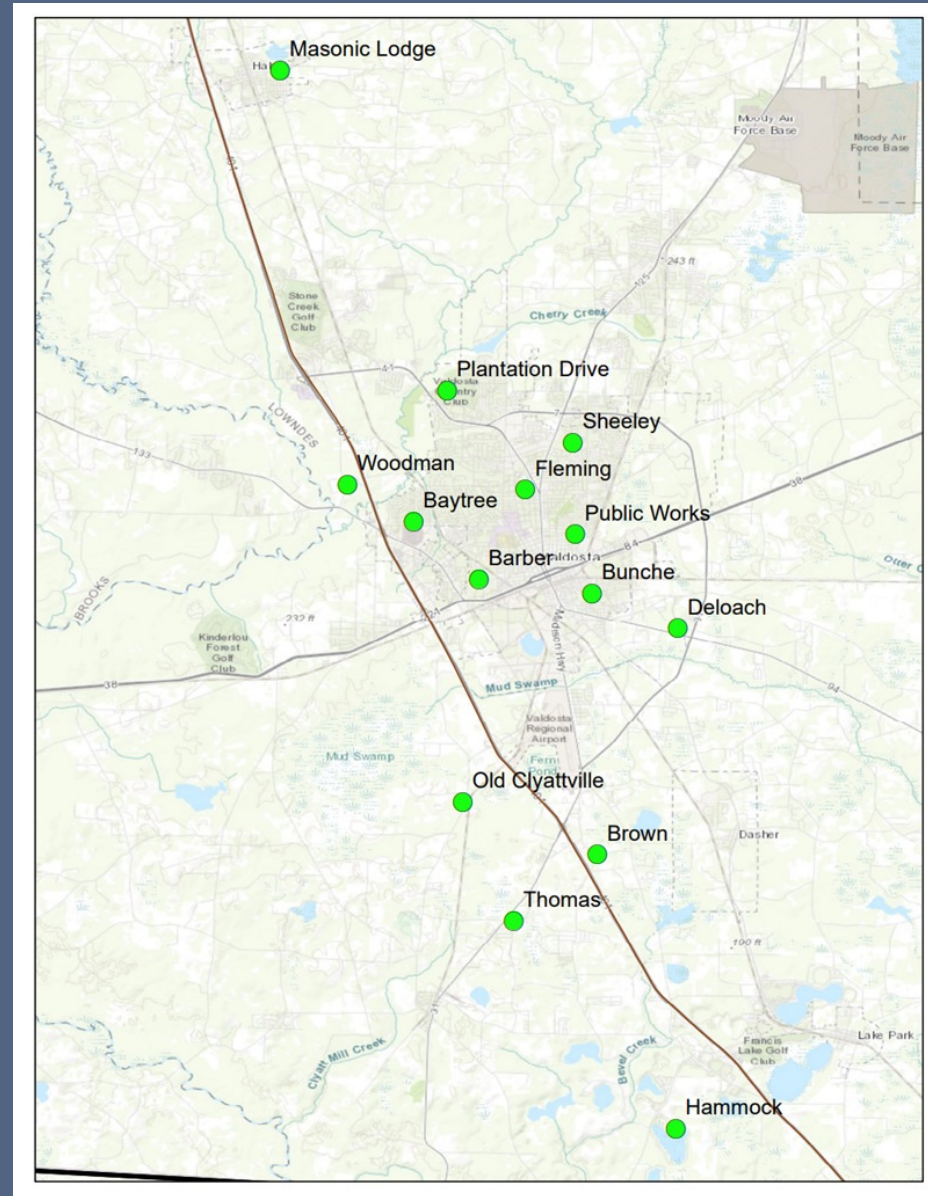
Study Aims



- I. Determine whether trap index influences WNV transmission
- II. Determine whether temperature influences WNV transmission
- III. Determine whether land use and land changes influence WNV transmission or mosquito distribution.



Trap Site Locations-Lowndes County, GA



Specimen collection

CDC Miniature Light Trap



CDC Gravid Trap



Weekly Trap Index

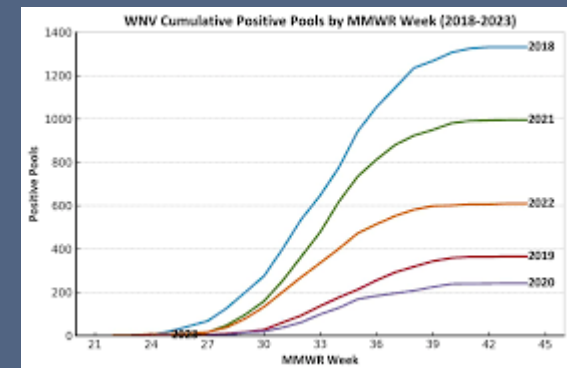
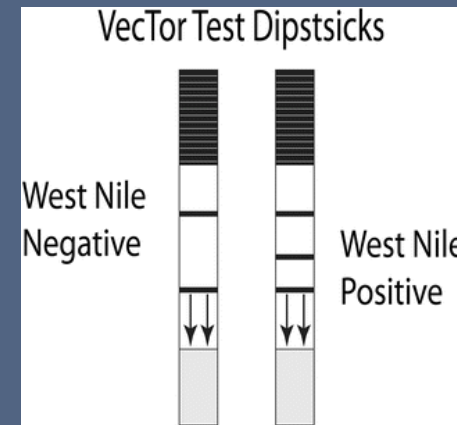
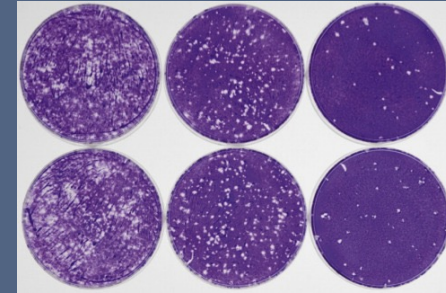
- Average number of female mosquitoes collected per trap night
- Standard representation for mosquito surveillance
- Accounts for changes in the number of traps set or number of nights trapped each week

$$TI = \frac{\text{Total \# of female mosquitoes collected}}{(\text{\# of traps set} \times \text{\# nights running})}$$



Viral Testing

- Mosquito pools were tested for cytopathic effect using a plaque assay
- VectorTest WNV antigen assay performed if cytopathic effect was positive
- Viral isolates were then extracted, and RT-PCR was used to confirm WNV presence



Temperature

- increase in weekly maximum temperature and weekly cumulative temperature can lead to an increase in WNV incidence (Soverow et al. 2009)
- mosquito development and the gonotrophic cycle in *Anopheles* mosquitoes was shown to be temperature dependent (Kweka et al. 2016)



Climate and LULC Data

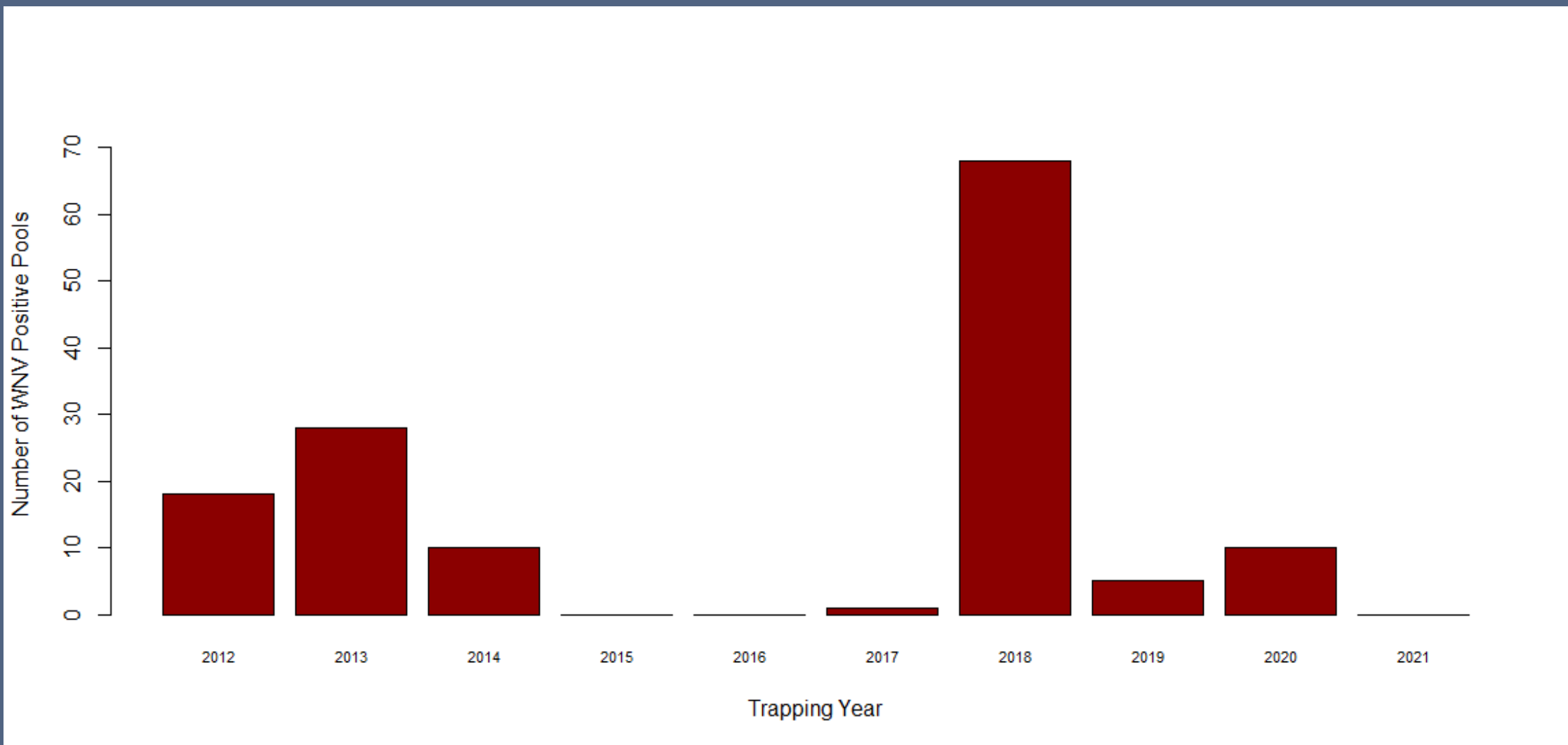
- Weekly average temperature obtained from Weather Underground
- LULC imagery downloaded from the USDA National Agricultural Statistics Service Cropland Data Layer
- ArcGIS was used to classify habitats of interest and extract percent habitat from 1 km buffers from each site



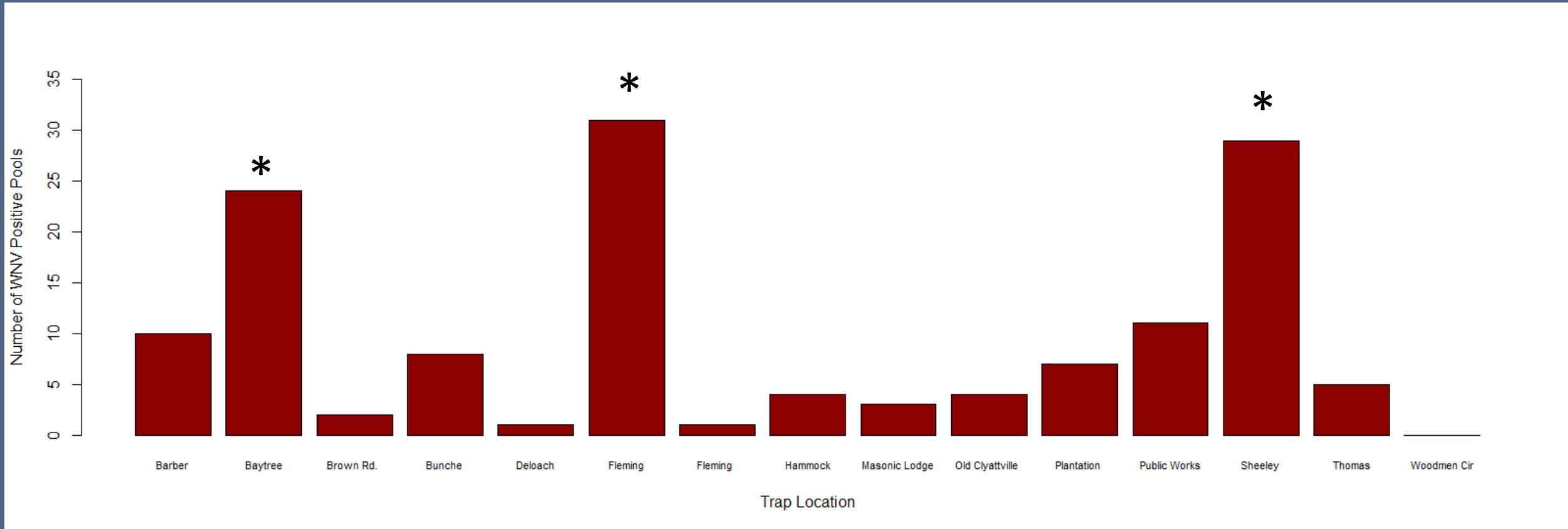
Trap indices of species with WNV positive pools (2012-2021)

Species	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
<i>Cx. nigripalpus</i>	7	9.6	10	5.3	8.4	28.6	23.9	9.7	17.8	26.4
<i>Cx. quinquefasciatus</i>	22.4	11.7	12.2	11	14.9	11.4	13.5	6.8	10.6	7.1
<i>Cx. restuans</i>	0.7	2.9	3.1	1.2	1.7	0.3	2.8	1.4	3.2	0.8

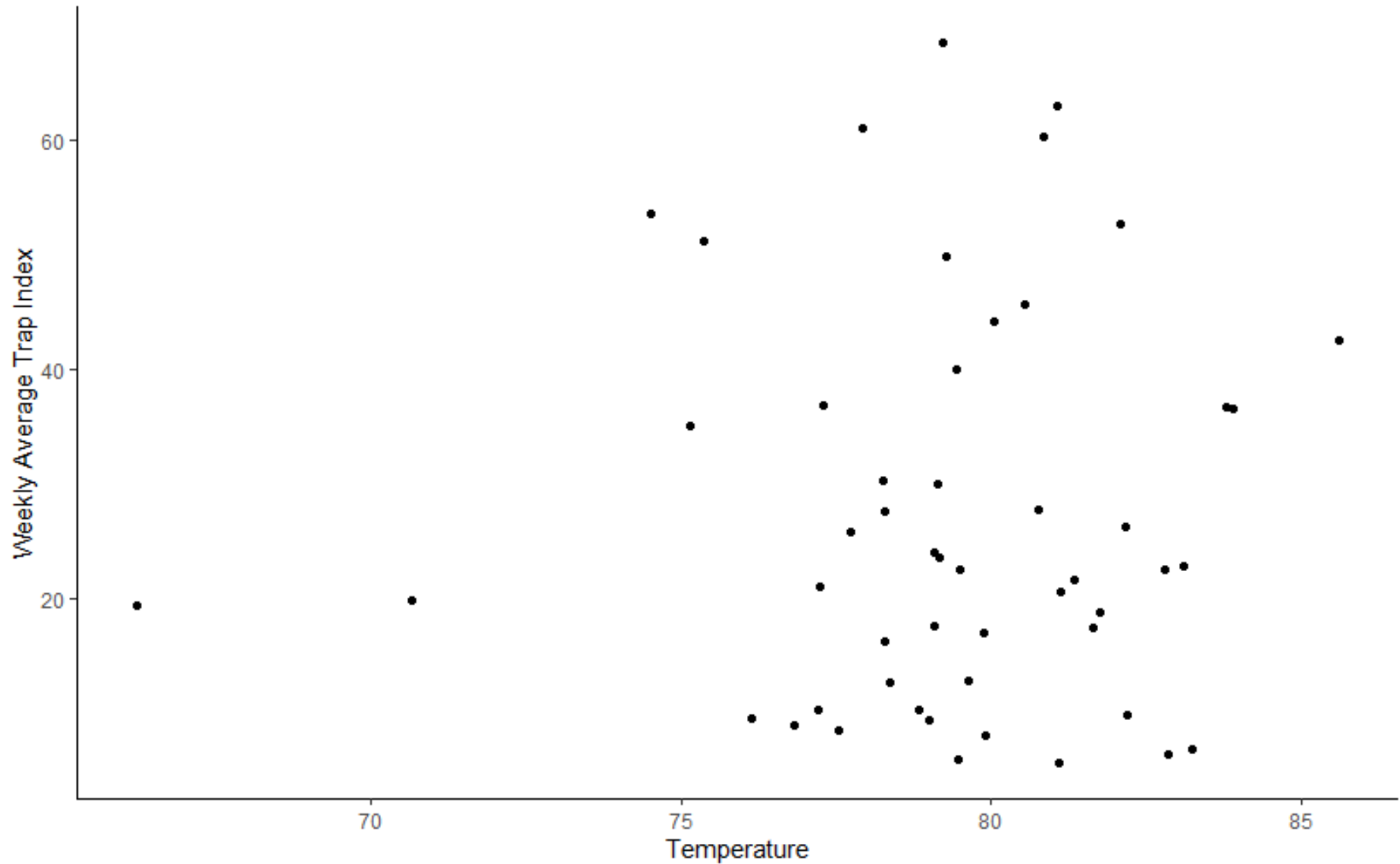
WNV Positive Pools by Year (2012-2021)



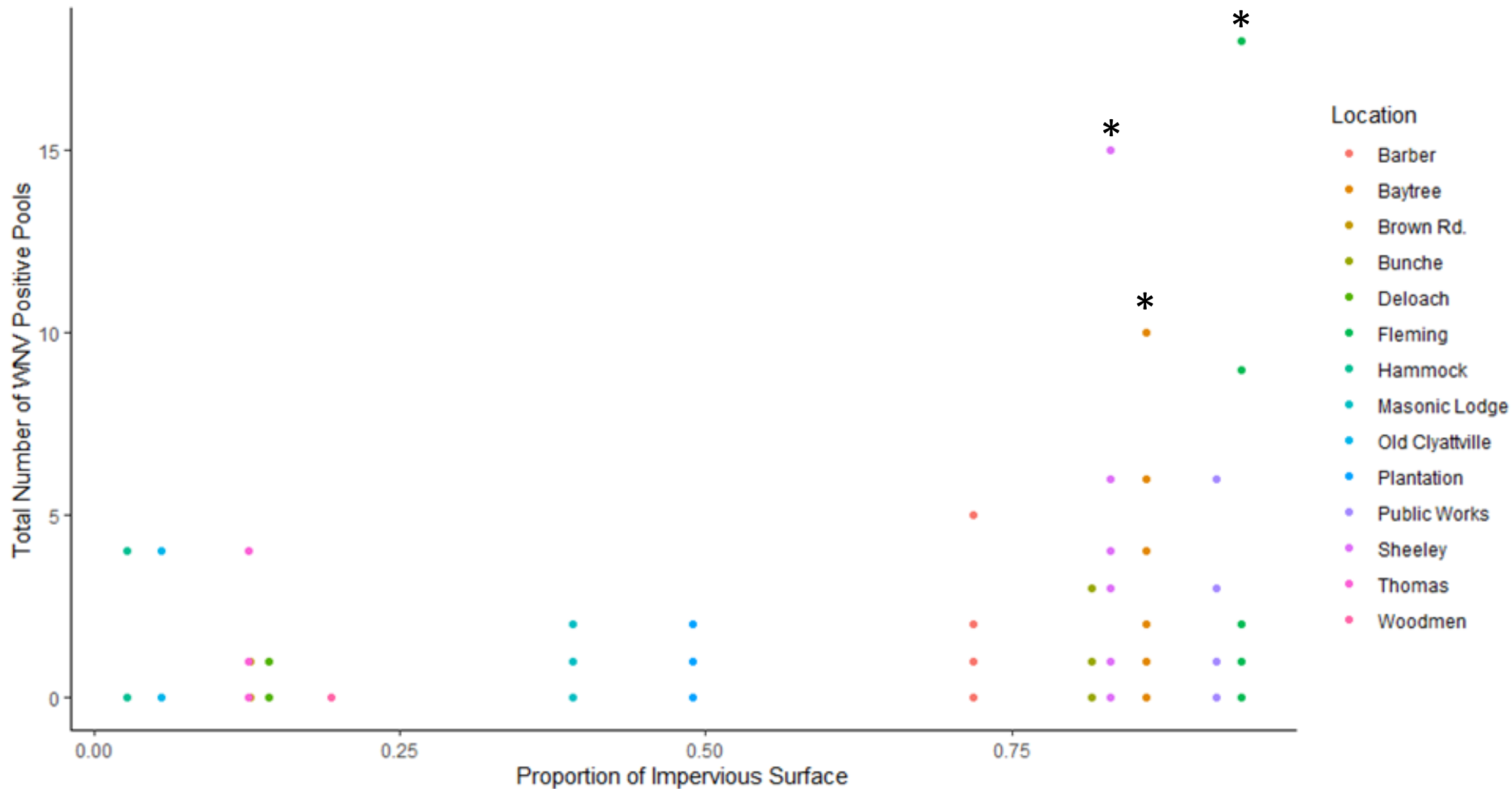
WNV Positive Pools by Trap Location



Influence of Temperature on Trap Index



Influence of Urbanization on the Number of WNV Positive Pools



Discussion

- Most positive pools were collected in weeks where the average temperature was above 24 °C
- The 3 sites with the highest number of WNV positive pools are 3 of the 4 sites with the highest urbanization levels
- Follow up work will include rigorous statistical testing and could include avian surveys and human sero-surveys

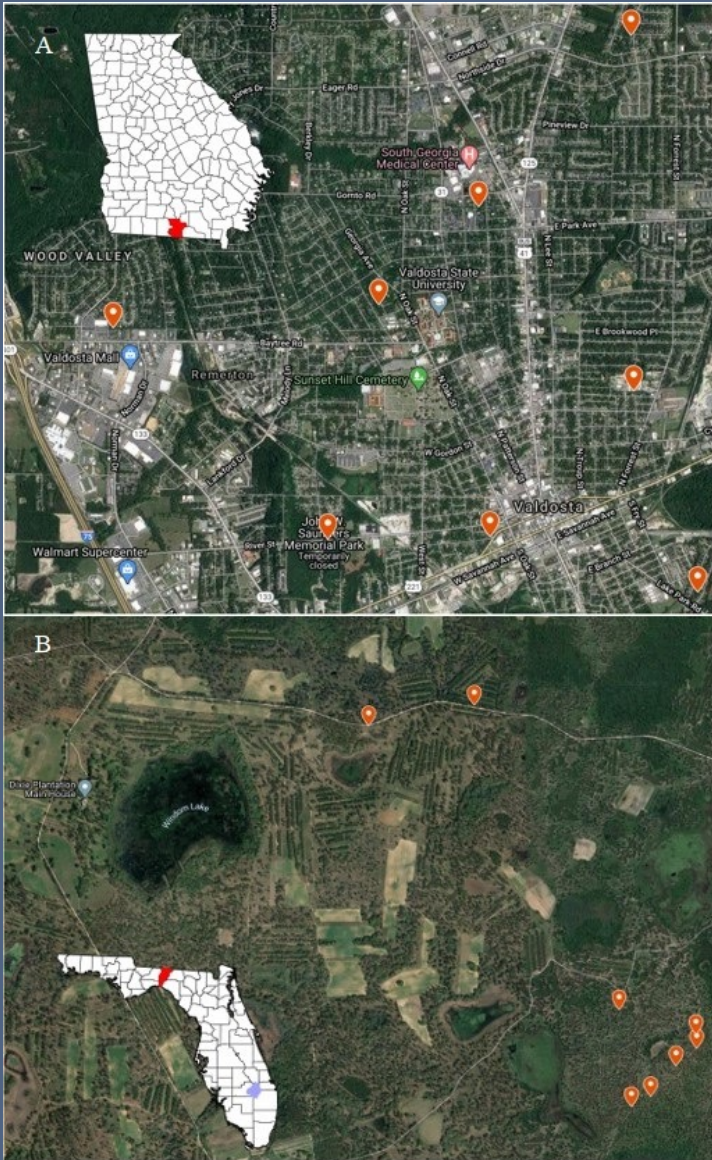


Update:

Molecular detection of *Dirofilaria immitis*
(Rhabditida: Onchocercidae) in mosquitoes (Diptera:
Culicidae) from urban and rural habitats in South
Georgia and North Florida

Christopher A. Slaton, Eric W. Chambers,
and Mark S. Blackmore

Pipeline for *Dirofiliaria immitis* screening of mosquitoes



Sorting and identifying of mosquitoes



DNA extraction and PCR amplification of *D. immitis* 16S rDNA

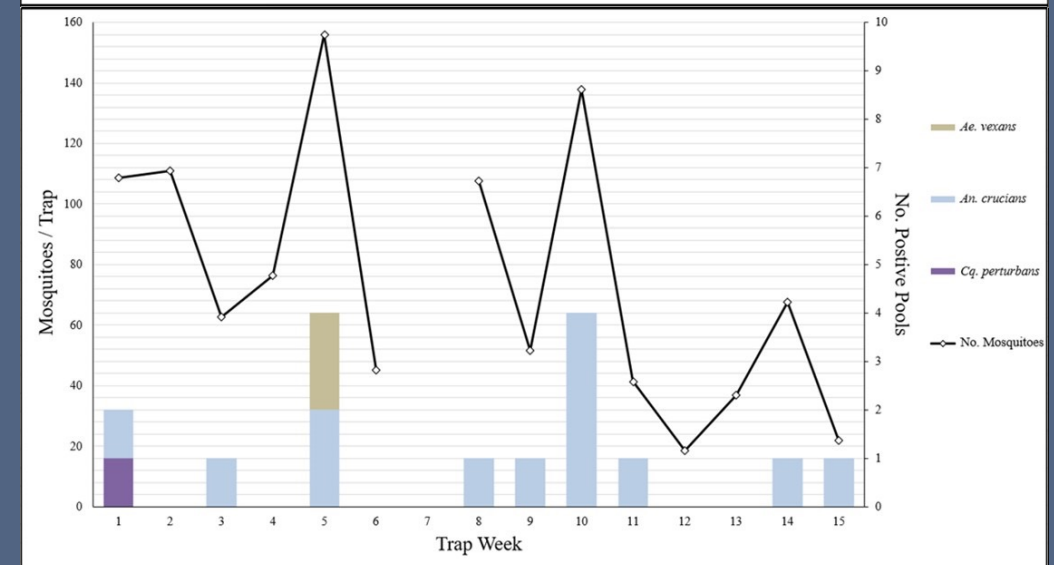
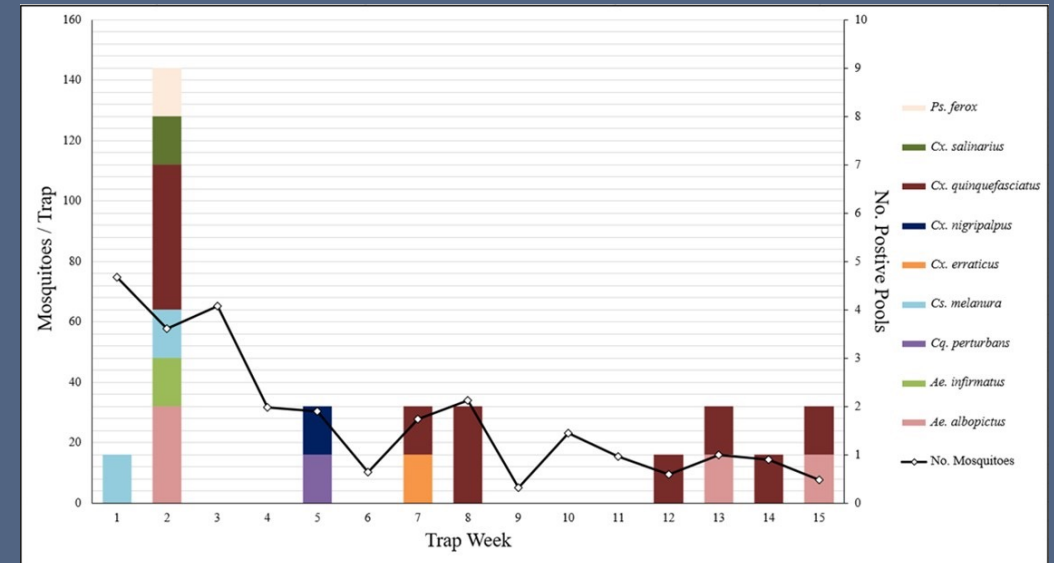
Calculation of MLE using PoolScreen software program



Results

Urban sites = 4,972 mosquitoes
Rural sites = 10,567 mosquitoes
Total = 15,539 mosquitoes

- 10 genera
- 29 species
- Bray Curtis Dis. Index = 0.816
- High species diversity between the two locales



Results

Urban species testing positive for *D. immitis*

Species	No. mosquitoes	MLE (95% CI)
<i>Ae. albopictus</i>	370	10.7 (2.7-27.3)
<i>Ae. infirmatus</i>	104	10.4 (0.32-59.6)
<i>Cq. perturbans</i> **	31	32.3 (1.0-155)
<i>C. melanura</i> **	90	22.6 (2.7-77.2)
<i>Cx. erraticus</i>	87	11.6 (0.36-58.1)
<i>Cx. nigripalpus</i>	230	4.5 (0.14-22.9)
<i>Cx. quinquefasciatus</i>	1807	5.7 (2.6-10.8)
<i>Cx. salinarius</i>	16	62.5 (2-282)
<i>Ps. ferox</i>	187	5.7 (0.2-29.1)
Total	3116	7.3 (4.3-11.3)

Rural species testing positive for *D. immitis*

Species	No. mosquitoes	MLE (95% CI)
<i>Ae. vexans</i>	558	3.8 (0.04-13.4)
<i>An. crucians</i>	2337	5.9 (3.0-10.4)
<i>Cq. perturbans</i>	319	3.1 (0.1-16.1)
Total	6258	2.6 (1.4-4.4)

MLE higher in urban sites (Fisher's exact test, $P < 0.001$, OR = 1.485, 95% CI = 1.338-1.651)

Higher proportion of vector species at urban sites (Fisher's exact test, $P < 0.001$, OR = 2.901, 95% CI = 1.465-5.884)

C. melanura and *Cq. perturbans* both tested positive- perhaps only the 2nd time this has been observed



Acknowledgements

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Funders

Lowndes County University

City of Valdosta



VSU M.S. Degree

