URBAN FORESTRY SOUTH

Leaves of Change

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In this Issue

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Research

How Do Changing Landscapes Affect Human Risk to West Nile Virus?

URBANIZATION is transforming the South. And as forests and farms are converted to urban land uses, there are environmental consequences—reduced water quality, invasive species, and loss of habitat for native wildlife and plant species. The changes also have implications for disease vectors, suvh as birds and insects that can carry West Nile Virus (WNV), Lyme disease, and more recently, the Zika virus.

One group of researchers has been looking at the connection between a wide ranging but integrated group of factors in the transmission of WNV—the loss of forest cover, increases in impervious surface, reduced water quality, socioeconomics, and other factors—that may play a role in supporting the bird and mosquito populations that are key in the spread of WNV.

Graeme Lockaby, a research professor with the School of Forestry and Wildlife Sciences at Auburn University, has been studying the impacts of forest conversion on water quality for decades. In recent years, he has been working with an interdisciplinary team of researchers, including **Wayne Zipperer**, SRS-4952 research forester; Wayde Morse, a social scientist, and Latif Kalin, a hydrologic modeler, both with the School of Forestry and Wildlife Sciences at Auburn; and Navideh Noori, a hydrologic modeler at the University of Georgia. The team has been looking at how urbanization affects streams, creeks, and rivers in a range of settings from rural forested areas to the inner city.

Photo courtesy of: UF/IFAS

The *Culex spp.* mosquito species is the main carrier of West Nile Virus.

Lockaby said that while trudging through polluted streams and creeks flowing through neighborhoods in Atlanta the team began wondering about the connections between the poor water quality they were seeing (specifically high levels of fecal coliform) and the health of people living nearby.

The team approached the Center for Disease Control and Prevention (CDC) in Atlanta about linking their data on forest cover, water quality, and socio-economics with health indicators. While researchers with the CDC said it was difficult to pin the cause of many diseases directly to water quality, they said there might be a way to connect the presence of West Nile Virus (WNV) with the health of nearby waterways. Past studies have shown a link between poor water quality and increased mosquito populations, specifically the *Culex* spp. mosquito species, which carries WNV.

The researchers recruited Krisztian Magori, a disease ecologist at Eastern Washington University, to join the effort and they set about finding ways to make the connection.

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The idea for a research project quickly took shape looking at the spread of WNV in connection with water quality, climate (mild winters followed by warm springs), socioeconomic conditions, and the presence of habitat for mosquitos and bird species, such as crows and jays that are key in WNV transmission.

They started with the hypothesis that upswings in occurrences of WNV would be related to landscape characteristics of urbanization—decreasing forest cover, increasing impervious surface (roads, parking lots, roofs, etc.), and decreasing water quality. They also figured that WNV would be more prevalent in low-income neighborhoods because of the presence of more suitable mosquito habitat (older sewer systems, poor storm drainage, and vacant lots with water-holding containers for breeding).

Key to the study was the WNV transmission cycle. WNV cycles between birds and mosquitoes. Some birds develop high levels of the virus in their bloodstream, and mosquitoes become infected by biting the infected birds. After about a week, the mosquito can pass the virus to other birds when they bite. Humans become infected when bitten by a mosquito carrying WNV. However, although WNV does not replicate very well in human hosts, it can be spread back to other biting mosquitos.

So, the spread and transmission of WNV is directly linked to the size and make-up nearby populations of birds and mosquitoes, which, of course, depend on available habitat.

"We really wanted to look in-depth at mosquito natural history. What are the mosquito's habitat requirements and what do we have on the landscape?" said Zipperer.

The team decided to focus on the city of Atlanta. The Georgia Department of Health has been monitoring the presence of WNV in mosquito traps placed around the city for over a decade, and those data became a way of organizing the project. They selected 58 trap sites around the city and established study sites within a one kilometer radius around these locations. The distance was based on the maximum flight distance of the *Culex quunquefasciaus* mosquito, the main transmitter of WNV.

Land use/land cover was classified into four categories—water, forest, impervious surface, and open/other—within a one kilometer radius of each site using high-resolution aerial imagery. Forest cover was later classified into forest type based on the two to three major species that dominated forest stands.

Census data were used to calculate socioeconomic variables in terms of income, housing age, housing density, and presence of vacant homes for the study areas. Surveys were also completed in transects in the study sites, looking for items that would hold water and provide mosquito breeding locations. The surveyors looked for potential breeding containers, such as tires, planters, buckets, birdbaths, fountains, etc.

The main findings of the study were that:

- Larger forest patches and forest patches with more pine trees were correlated with reduced risk of WNV.
- As the percentage of impervious surface increased, WNV risk also increased.
- Correlations were found between high WNV risk rates and older and lower income neighborhoods.
- Taking soil moisture averages over a four week period showed that as average soil moisture increased, WNV risk rates increased.

Lockaby said the relationship between forest patches and WNV transmission can possibly be explained by looking at the forests from a bird habitat perspective. The types and numbers of birds that are present changes as fragmentation reduces the average size of forest patches. For example, crows, blue jays, and other species that prefer more urbanized landscapes are more abundant in areas with smaller forest patch sizes. Larger forests that support a higher diversity of bird species have a reduced possibility that an infected mosquito will bite a bird that is capable of carrying WNV because of the dilution effect. Greater diversity of birds means that there is less likelihood that a mosquito will bite an infected bird.

The link to older neighborhoods could be connected with old sewer systems, which would attract mosquitoes. Older neighborhoods may also have more mature trees, which are important for bird habitat and may contain cavities where mosquitos can breed. Older homes and neighborhoods were often associated with a higher number of water collecting sources—tires, containers, overgrown lots—that provide likely breeding sites for mosquitos and consequently increase the risk for WNV transmission.

Likewise, vacant lots could lead to more mosquito habitat and consequently more WNV transmission because of the presence of trash, tires, and containers. Similarly, increased impervious surfaces are associated with poor water quality, which promotes breeding habitat for mosquitos.

The team plans on continuing the research and looking more in depth at socioeconomic factors and forest characteristics. Lockaby, a long-time proponent of interdisciplinary research, says that these types of complex questions, which cross so many different fields, can only be addressed by bringing in multiple perspectives and expertise.

"This study is a classic example of research that couldn't have been done any other way," said Lockaby. "When you start looking at disease, these are not simple questions, it accentuates the need for interdisciplinary research."

– Written by Josh McDaniel

In Our Next Issue

We will focus on the Kids in the Woods program in Gainesville, FL.

Kids in the Woods begins fourth year at Westwood Middle School

Photo taken by: Molly Disabb

Annie Hermansen-Báez and Westwood sixth grader Zach Mallet observe birds on the edge of the school campus.

THE KIDS in the Woods program at Westwood Middle School in Gainesville, FL, began initially in 2013 through a Forest Service *More Kids in the Woods* grant developed by SRS-4952's **Annie Hermansen-Báez** and several partners, but is now an integral part of Westwood's 6th grade science program. Over 1,500 students have participated in the program since 2013.

In October 2016, students participated in the Kids in the Woods bird observation study, which was led by the City of Gainesville Parks, Recreation and Cultural Affairs. This study teaches students about the scientific method while enjoying the outdoors and getting to know local bird species. In November and December 2016, students took part in the creek erosion study led by SRS-4952 researcher **Wayne Zipperer.** The creek study gives students an opportunity to learn firsthand about creek erosion and deposition. In March 2017, the University of Florida's **Michael Andreu** will teach students about tree identification and benefits. While this program focuses on 6th graders, a related bird study will also be conducted with 4th and 5th graders at two nearby elementary schools this school year. For more information about the Kids in the Woods program contact Annie Hermansen-Báez, **kidsinwoods-interfacesouth.org, ahermansen@fs.fed.us.**

Urban Forest Strike Team Trainings in Georgia and Virginia

The Georgia Forestry Commission hosted an urban forest strike team (UFST) training exercise for team leaders and task specialists September 26-29, 2016. Four new team leaders from Georgia, Arkansas, and Massachusetts learned about how to prepare a strike team for deployment, the daily deployment routine, demobilization after an event, and reporting results to the impacted municipality. Additionally, 23 new UFST task specialists from GA, NC, AL, and OK were trained. The task specialists were shown the type of damage to expect and look for after a natural disaster, how to record spatial storm damage data using ArcGIS on-line from common smart-devices, how to use the new ANSI A300 Tree Risk Assessment Best Management Practices, and more. All trainees participated in a mock deployment scenario on the final day of the training. These strike team training exercises help each state build capacity to better respond to natural disasters within their own state and to assist other states that may be overwhelmed with disaster response. For more information contact **Eric Kuehler**, **ekuehler@fs.fed.us**.

During the week of October 24, the Virginia Department of Forestry (VDOF), the University of Virginia, the Texas A&M Forest Service, and Urban Forestry South organized and hosted training workshops for GIS specialists, team leaders, and task specialists in Charlottesville.

The first day included a half-day refresher course for previously trained team leaders and the GIS specialists, including an update on the Emergency Management Assistance Compact (EMAC) and record-keeping, a standard Incident Action Plan (IAP), and tree risk assessment for UFST. The rest of the training focused on training task specialists about the UFST initiative, storm (wind and ice) characteristics and tree damage, safety, tree risk assessment for UFST, and smart device data collection using AGOL. The final day included a disaster exercise on the University of Virginia Campus. For more information contact **Dudley Hartel**, **dhartel@fs.fed.us**.

Photo courtesy of: US Forest Service

UFST task specialists use ANSI A300 Tree Risk Assessment Best Management Practices to assess a tree for risk.

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Upcoming Events

Date	Description	Location	Contact
February 19-24, 2017	**Municipal Forestry Institute**	Lake Arrowhead, CA	www.urban-forestry.com/assets/documents/mfi-2017.pdf
March 21-22, 2017	**Green Schools Conference & Expo**	Atlanta, GA	www.greenschoolsconference.org/
April 18-21, 2017	**Children and Nature Network International Conference & Summit**	Vancouver, British Columbia, Canada	www.childrenandnature.org/cnc2017/

This issue and past issues can be found online at:
www.interfacesouth.org/products/leaves

Note: Urban Forestry South is a science delivery center associated with the USFS Southern Research Station work unit, *SRS-4952: Integrating Human and Natural Systems* (**www.srs.fs.usda.gov/humanandnaturalsystems/**), and the USFS Southern Region.

Note: If you would like a copy emailed to you, please send your request to ahermansen@fs.fed.us.