UNDERSTANDING AND CONTROLLING MOSQUITO-BORNE DISEASES

Medical Entomology Laboratory

Malaria and dengue fever, transmitted by mosquitoes, have a significant impact on human lives globally. In 1999, a new mosquito-borne virus, West Nile, was first discovered in the New York City area.

Diseases such as malaria and dengue fever have a significant impact on human lives globally. Mosquitoes, also called "vectors," transmit these diseases. The prevalence of dengue fever has increased in the past 50 years, and today more than 2.5 billion people are at risk in more than 100 countries. Malaria kills approximately 3,000 young African children every day and causes up to three million deaths annually.

In 1999, a new mosquito-borne virus, West Nile, was first discovered in the New York City area. Since 1999, the West Nile virus has spread throughout the North American continent and has sickened more than 14,000 people in the United States and caused 563 deaths.

In an effort to understand virus transmission dynamics, mosquito vector ecology and behavior, and human risk, research in Cornell's Medical Entomology Laboratory of Laura C. Harrington, Entomology—which integrates undergraduates into the research—concentrates on two of these disease systems: West Nile and dengue. The research aims to identify targets for intervention in the mosquito, to reduce virus transmission, and ultimately to reduce human suffering and mortality from vectorborne diseases.

Host Feeding Preferences and Insecticide Resistance Status of West Nile Virus Mosquito Vectors in New York State is a current project funded by the Centers for Disease Control. It seeks to identify the mosquito species involved in transmission of the West Nile virus to humans and horses. The project investigates mosquito species-specific feeding patterns. Species that feed readily on humans and horses, as well as wild birds—which are important reservoirs of the West Nile virus—are a major concern. These reservoirs help to maintain the virus in the environment.

Harrington's medical entomology lab tracks and addresses vectorborne threats to human health. Her research team aims to understand virus transmission and human risk and to identify targets for intervention in the mosquito, concentrating on two disease systems: West Nile and dengue.

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Laura Harrington (r.), Entomology, collects Aedes aegypti larvae in Thailand.

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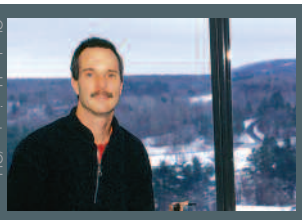
The *Aedes aegypti*, a vector of dengue and yellow fever viruses

The centers for Disease Control funds a project to identify the mosquito species that transmits the West Nile virus to humans and horses specifically in New York State.

Over the past three years, undergraduate researchers have made important contributions to the West Nile virus research. Sharon Weibman '01 completed an entomology honors project, Resting Ecology of Putative West Nile Virus Vectors in Dutchess County, for which she worked in her own community to raise awareness of West Nile virus and mosquitoes. Danielle Inwald '02 conducted mosquito collections in each of the five boroughs of New York City and compared vector populations in different public areas throughout the city. Krystle Brown '03 completed an independent research project, The Effect of Avian Defensive Behavior on Mosquito Feeding Success.

The National Oceanic and Atmospheric Administration (NOAA) and the Office of Global Programs fund a new project to develop predictive models for early warning of West Nile virus activity and human risk.

Charles Harrington/CU



Arthur DeGaetano, Earth and Atmospheric Sciences, is a member of the multidisciplinary team for this project.

Charles Harrington/CU

Laura Harrington, Entomology

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Renee Anderson, Extension Associate, Entomology

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Benjamin Briggs '05 spent the summer working on the dengue project in Mae Sot, Thailand through Cornell's "Create Your Own Internship" program.

A new project, Climate Effects: West Nile Virus Vector Development and Transmission Risk, funded by the National Oceanic and Atmospheric Administration (NOAA) and the Office of Global Programs, began in September 2004. The research involves a multidisciplinary team of scientists at Cornell including a climatologist, Arthur T. DeGaetano, Earth and Atmospheric Sciences; a risk analysis expert, Lois C. Levitan, Communication extension associate; medical entomologists, Harrington and Renee R. Anderson, Entomology extension associate, along with Cornell graduate and undergraduate students and state and county public health professionals. The project aims to develop predictive models for early warning of West Nile virus activity and human risk.

In a dengue vector mosquito study, the lab detected mosquito preferences for individuals and identified risk groups for dengue fever.

In a study on the dengue vector mosquito, the Medical Entomology Laboratory used DNA from human blood in mosquitoes to determine the individual human hosts that a mosquito has fed upon. The study detected mosquito preferences for individuals and identified risk groups for dengue infection. Another aspect of the project is the development of new methods for determining the age of mosquitoes. This is an important issue because only older mosquitoes are able to transmit viruses and other pathogens, due to the

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Laura Harrington identifies mosquitoes in Thailand.

Undergraduate researchers have made important contributions to the research over the past three years.

Sharon Weibman '01 worked in her community, Dutchess County, to raise awareness of West Nile virus and mosquitoes.

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Krystle Brown '03 studied the effects of avian defensive behavior on the success of mosquito feeding.

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Chrystal Wa '03 determined the limits of detection of human DNA in mosquito blood meals.

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Chantal Spencer '03 studied the nutrition of the dengue mosquito.

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The program is closer to answering the critical questions needed to make a difference in human health.

length of pathogen incubation and replication in the mosquito. Cuticular hydrocarbon compounds, extracted from the surface of mosquito legs, have been used to develop aging models that can be applied to wild-caught mosquitoes. The age of the mosquito can then be linked with the feeding history.

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Ariel Zimmerman '07, undergraduate researcher

Chrystal Wa '03, an undergraduate researcher, determined the limits of detection of human DNA in mosquito blood meals from multiple hosts. This was her biology honors thesis on Investigations of DNA Fingerprinting Techniques for Mosquito Feeding Behavior Studies. Chantal Spencer '04 studied nutrition of the dengue mosquito in her independent research project, Plant Sugar Feeding Patterns of the Dengue Vector, *Aedes Aegypti*, During High and Low Transmission Seasons in the Mae Sot Region of Thailand.

The dengue mosquito project also has afforded overseas research opportunities for Cornell students. Veterinary medicine student, Stephanie Janeczko, assisted Harrington with research in Mae Sot, Thailand. Undergraduate researcher Benjamin J. Briggs '05 spent the summer working on the dengue project as well as working with Harrington's colleagues on malaria and scrub typhus research through Cornell's "Create Your Own Internship" program.

Emerging vector-borne disease threats to human health are important issues that medical entomology tracks and addresses. Through the work of many talented graduate and undergraduate students the program is closer to answering the critical questions needed to make a difference. Harrington's primary goal is to improve human health and well-being through an understanding of mosquito vectors and pathogen transmission dynamics.

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