Russell Barbour

Spatial Modeling of Mosquito Densities Using the New MODIS Enhanced Vegetation Index (EVI) and Near Ground Humidity Indexes: adult female *Culex tarsalis* and *Aedes vexans* clustering in Colorado and Louisiana

The purpose of this lecture will be to introduce basic concepts of spatial statistics and the application of **Moderate Resolution Imaging Spectroradiometer** (MODIS)vegetation and atmospheric humidity products to problems in vector borne disease at various scales. High human incidence in St. Tammany Parish La. in 2002 and in the Ft. Collins, CO. area in 2003 has engendered greater efforts at vector surveillance and control. Newly available micro climate data from the MODIS platform permits the spatial modeling of mosquito densities from light trap counts by applying spatial statistics. We will use two examples; a strongly autocorrelated species *Aedes vexans* in Louisiana and a more weakly autocorrelated species, *Culex tarsalis*, in Colorado. The New MODIS Enhanced Vegetation Index (EVI) , replaces the less robust NDVI . EVI corrects many of the weaknesses of NDVI:

- more sensitive to periods of light vegetation , spring and fall
- distinguishing between damp soil and vegetation
- identifies discontinuity in landscapes better than NDVI

At the Colorado site clusters of *Culex tarsalis* are associated with specific EVI values during the early part of the season. May- July.

In addition the MODIS Infrared and Near Infrared water column products which are available daily at one kilometer resolution give excellent estimates of near ground moisture, enhancing the microclimate variable estimates for those mosquito species that are sensitive to atmospheric moisture. In the Louisiana example *Aedes vexans* clusters can be directly related MODIS atmospheric humidity values.

Spatial statistics will be applied to demonstrate how these diverse data sources can be combined to create robust forward looking estimates of host seeking female mosquitoes. Quantifying mosquito aggregation through calculation of Moran's *I* , and variography will be reviewed.

Russell Barbour Ph.D.
Research Associate in Applied Mathematics
Vector Ecology Laboratory
Yale School of Medicine

BACKGROUND AND RESEARCH INTERESTS

Russell Barbour has worked in a number of fields where climate and micro-climate impact human well being. As an agronomist he worked on USAID funded projects throughout Africa. In 1985 he was appointed by President Reagan to the Presidential Agricultural Task Force to Zaire, a White House Commission. Since 1987 he has been affiliated with the Beza Mahafaly Integrated Conservation and Development Project in Southwestern Madagascar, a semi-arid area of marginal agriculture. As part of that project he helped design a Child Survival Plan that integrated children's health needs into the effort to conserve wildlife at this Special Reserve. The project which addresses seasonal childhood morbidity and mortality continues and has since been expanded with USAID funding to a much larger area in that part of Madagascar. Quantifiable improvements in child health indicators have resulted. His current research applies spatial statistics and Artificial Neural Networks (ANN) to problems in vector borne disease here in the United States. As Research Associate in Applied Mathematics at the Vector Ecology Laboratory at the Yale School of Medicine, Dr. Barbour applies these evolving methods to integrate climate and microclimate data into assessments of human risk of Lyme disease and West Nile Virus. As a member of the Board of Trustees of the non-profit organization Medical Care Development, Dr. Barbour continues to be involved in international health projects in South Africa, Equatorial Guinea and Madagascar. He also continues his interest in wildlife conservation and has served as a member of the International Advisory Board of the Cape Peninsula National Park in South Africa.

Recent Abstracts and Presentations in Spatial Modeling, Spatial Statistics and Remotely Sensed Climate Indicators:

Barbour, R. 2004 Microbes, People And Lemurs: a multi-disciplinary analysis of land use and conservation in Southwestern Madagascar. The 2004 Schumann Environmental Lecture Wesleyan University, Middletown CT.

Barbour , R. and Durland Fish 2004, REMOTELY SENSED INDICATORS OF *Aedes vexans* CLUSTERING AT A FOCI OF WEST NILE VIRUS IN NEW YORK: Development of an Atmospheric Model for Mosquito Density Presented to the Annual Meeting of the American Mosquito Control Association, Savanna, March 2004.

Barbour, R. and Durland Fish 2004, Spatial Analysis Of Light Trap Data: measuring estimate quality., Presented to the Eastern Branch of the Entomology Society of America, March 7-9 New Haven CT.

Russell Barbour ,John Brownstein, Brian Russell, and Durland Fish, 2003,

"Spatial Statistics and Multiple Stepwise Regression in Estimating Clustering Of Mosquito Vectors Of West Nile Virus in New York City" Presented to the Annual Meeting of the American Mosquito Control Association, Minneapolis, March 2003.

Russell Barbour, John Brownstein, Brian Russell, Robert Cook, and Durland Fish, 2002, "*A Multi-Disciplinary Analysis of Species Clustering of Mosquito Vectors of West Nile Virus at the Bronx Zoo, New York*" Presentation to the Entomology Society of America Annual Meeting, Ft. Lauderdale, Nov 2002.

Barbour, R., Jean Tsao, Jonas Bunikis, Alan Barbour and Durland Fish, 2002, " Seroprevalence to *Borrelia Burgdorferi* In *Peromyscus leucopus* in an Intensely Enzoonotic Area of Southern Connecticut: Tick Clustering and Reservoir Host Seroprevalence "Presentation to the IX International Conference On Lyme Borreliosis And Other Tick-Borne Diseases. August 18-22, 2002, New York, New York.

Russell Barbour, Brian Russell, Robert Burgan, John Brownstein, and Durland Fish, 2002 " *A Dynamic Model of Human Lyme Disease Risk In Space And Time: Validation of a Geostatistical Model in Wisconsin*" Presentation to the 4th International Conference on Ticks and Tick-borne Pathogens, 21-26 July 2002, Banff, Alberta, Canada

Barbour, Russell, Jean Tsao, Jonas Bunikis, Alan Barbour and Durland Fish,2002, SEROPREVALENCE TO *Borrelia burgdorferi* IN *Peromyscus leucopus* IN AN INTENSELY ENZOONOTIC AREA OF SOUTHERN CONNECTICUT: TICK CLUSTERING AND RESERVOIR HOST SEROPREVALENCE, International Conference On Lyme Borreliosis And Other Tick-Borne Diseases. August 18-22, 2002, New York, New York.

Barbour, R., Brian Russell, and Robert Burgan.1999, A Landscape Epidemiology Algorithm for National Estimates of Human Lyme Disease Risk: geostatistical co-kriging of remotely sensed habitat suitability with archival canine serology, Proceedings North American Council on Geostatistics, Annual Meeting October 1999, Austin, Texas.

Barbour, R. and Curtis Patton, 1999, *Madagascar Prospective Study: Distribution of Malaria /Non Malaria Febrile Agents in the Betioky Sud Health District* Report to Medical Care Development International, and the United States Agency for International Development, Washington D.C. December 2, 1999

Russell Barbour, Brian Russell, Robert E. Burgan and Durland Fish, 2000, *A Geostatistical Algorithm for Estimating Human Risk of Lyme Disease on a National Scale.* Proceedings of the North American Entomological Societies Meeting, Montreal, December 2000.

Russell Barbour and Durland Fish, 2001,*Geostatistical Estimates of Mosquito Density Within a Focus of West Nile Virus*, Presentation to the International Conference on the West Nile Virus held April 5-7 2001, New York Academy of Sciences, New York, N.Y.

Russell Barbour, John Brownstein, Maud Sandbo, Travis Dynes, Brian Russell, and Durland Fish, 2001*, Integration of Spatial Statistics, Artificial Neural Networks, and GIS for Surveillance of Mosquito Vectors of West Nile Virus at the Bronx Zoo, New York*, Presentation to the ESRI Conference on GIS and Health, Washington, D.C. November 2001

Barbour R, 2001*, Application of Spatial Statistics to Vector-Borne Disease Risk Assessment: Identifying Non-Random Observations in Spatially Explicit Data*. Seminar at the University Of Connecticut, Department of Pathobiology, Storrs Ct. October 18, 2001.