The Spread of the West Nile Virus - A Visual Analysis

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On the Trail of the West Nile Virus

DURING THE HOT SUMMER OF 2002, a deadly disease enveloped Chicago and its suburbs. It was a mysterious virus that had surfaced in Africa and spread to the Americas. The disease, known as West Nile virus, was first identified in the United States in 1999.

You CAN Fight the Bite!

ARIZONA SURVEILLANCE AND FACTS ABOUT West Nile Virus

Officials brace for new season of West Nile infections

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WEST NILE VIRUS

DEPARTMENT OF HEALTH AND HUMAN SERVICES

120
Pests Get Under Their Skin

Wednesday July 24th 1805.

Our trio of pests still invade and obstruct us on all occasions, these are the Musquetoes eye knats and prickley pears, equal to any three curses that ever poor Egypt laboured under

—Meriweather Lewis

As the Corps moved toward the mountains, they left the portage behind but could not outdistance the mosquitoes. Possibly the most often repeated phrase in both Lewis’ and Clark’s journals is “Musquetors verry troublesom.”

Clark claims the men could not have slept without the “musquetoe biers,” or netting, Lewis had brought from Philadelphia. Caught one night away from camp without this protection, Lewis got no sleep at all and swore he would never forget it again.
West Nile Virus ???

Virus

- Initial event - Culex mosquito transmits virus within avian populations
- Bridging Aedes albopictus transmits virus from birds to animals and humans
Overview

- US Analysis
- GIS Visualization: Choropleth Maps
- Statistical Visualization: Micromaps
- DC Analysis
- Web-based Access to WNV Data
- Conclusion
In 2002
- 4,156 total human cases (284 deaths) in US
- Ecological damage
  - 140 species of birds, reptiles and mammals infected and killed - 100 US zoos reporting cases

In 2003:
- 9,862 total human cases (264 deaths) in US
- >> 14,000 horses killed since 1999
- 2004: 2151 cases (68 deaths) by 10/19/04
GIS Visualization: Choropleth Maps
West Nile Virus Maps in the News

West Nile Virus in the United States, 2003

Roll over yellow states for statistics on human cases and deaths.

Click here to see the spread of West Nile Virus in the United States since 1999.

Background
Historical Data
FAQs
Links

New!
Navigate to Adjacent States by clicking on these states.

Legend
- Positive Test Results
- No Data
- Positive Test Results Summarized at State Level Only

Cumulative 2004 Data as of 3 am, Oct 19, 2004
These data are provisional and may be revised or adjusted in the future.
Statistical Visualization: Micromaps
Micromaps

- Link of row-labeled univariate (or multivariate) statistical summaries to corresponding geographical region
- Focus on statistical display and not on maps
Usage of Micromaps

- First presented at 1996 American Statistical Association’s annual meeting (Olsen, Carr, Courbois, Pierson)
- EPA: Cumulative Exposure Project (1998 - intended)
From 2002 CDC Web Page to Micromaps
DC Analysis
DC Analysis
West Nile – DC Geographic Time Series

Washington, DC by Ward

Cooperative Weather Stations
- 182325
- 186350
- 186800
- 448906

Woodland, Water Bodies, Ward ID’s & Boundaries

Weekly Mosquito West Nile Positive Rates by Ward in DC for 2002

06/01-06/08, 2002
06/08-06/15, 2002
06/15-06/22, 2002
06/22-06/29, 2002
07/06-07/13, 2002
07/13-07/20, 2002
07/20-07/27, 2002
07/27-08/03, 2002
08/03-08/10, 2002
08/10-08/17, 2002
08/17-08/24, 2002
08/24-09/01, 2002
09/01-09/08, 2002
09/08-09/15, 2002
09/15-09/22, 2002
Enviro-Climatic Coupling

- Prior precipitation regime conducive to hydration and hatching of mosquito eggs
- Transmission competency (26°C to 30°C) - indicative of higher efficiency of mosquito to transmit the virus
- Positive mosquito and human cases seen previously to occur within this time frame
Web-based Access to WNV Data
WEST NILE VIRUS MICROMAPS - Microsoft Internet Explorer

Left Column Data
- Area: US - state level
- Data Group: West Nile Virus
- Host Group: Human Cases
- Statistic: Infection Rate
- Year: 2003
- Sex: Both Sexes

Right Column Data (optional)
- Data Group: West Nile Virus
- Host Group: Human Cases
- Statistic: Infection Count
- Year: 2003
- Sex: Both Sexes

Human Cases West Nile Virus
- Latest Annual Infection Rate Year 2003
- Total Infections Per Year Year 2003

Micromaps
- Colorado: 2003 Total Cases Per Year = 2,947

Draw | Clear
Overview
Options

United States
WNV in 2004
West Nile Virus 2004 (as of 10/19/04)
Lab-Positive Human Cases

Maps

States
- Arizona
- South Dakota
- Colorado
- New Mexico
- North Dakota
- Nevada
- California
- Wyoming
- Kansas
- Louisiana
- Nebraska
- Missouri
- Arkansas
- Minnesota
- Iowa
- Missouri
- Montana
- Illinois
- Texas
- Oklahoma
- Utah
- Alabama
- Maryland
- Florida
- Georgia
- Wisconsin
- D.C.
- Tennessee
- Idaho
- Kentucky
- Indiana
- Michigan
- Pennsylvania
- Ohio
- Virginia
- North Carolina
- Connecticut
- Oregon
- New York
- South Carolina
- New Jersey
- Alaska
- Delaware
- Hawaii
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont
- Washington
- West Virginia

Rate

Cases

\( \log_{10}(\text{Cases per 100,000}) \)
\( \log_{10}(\text{Total # Cases}) \)
Concluding Remarks

- WNV, as an example of a vector-borne pathogen, is a spatially and temporally complex phenomenon, but can be
  - Described well &
  - Summarized, using visualization techniques
Ongoing Work

- Linking of West Nile Micromap Server with USU Climate Data Base
- Assessment of spatially adjusted WNV-positive human, avian, and mosquito locations in DC
- Spatial statistical analysis tools can be used to provide an analytical representation of the WNV DC data
Acknowledgements

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- S-Plus micromaps adapted from S-Plus sample code from Dan Carr
- Color suggestions obtained from Cindy Brewer’s Web site (http://colorbrewer.com)
Questions ???