WHAT’S all the Buzz about?
Vector-borne Diseases and Climate Change

Linh Pham, Ph.D., NIEHS
Common Vectors That Transmit Disease

Mosquito

Tick

Mouse

Deer
Examples of Vector-Borne Diseases

- West Nile Virus
- Malaria
- Dengue
- Lyme Disease
- Hanta Virus
- Yellow Fever
- Rocky Mountain Spotted Fever
- Bubonic Plague

Characteristic bull rash caused by Lyme disease
West Nile Virus Transmission Cycle

- Mosquito Vector
- Bird Reservoir Host
- Incidental Exposure

West Nile Virus

West Nile Virus

Incidental Exposure

Incidental Exposure
Modeling Vector-Borne Diseases

\[
\text{Total # Infected People} = \frac{\text{# Uninfected People}}{\text{Total # People}} \times \text{# Infected Mosquitoes} + \text{# Previously Infected People}
\]

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\text{Total # Infected Mosquitoes} = \frac{\text{# Infected People}}{\text{Total # People}} \times \text{# Uninfected Mosquitoes} + \text{# Previously Infected Mosquitoes}
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## Modeling Vector-Borne Diseases

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<th>Round of Bites</th>
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Example data: 20 people, 0 infected
7 mosquitoes, 2 infected
Modeling Mosquito Transmission of Disease

- Cups with water represent people
- Syringes represent mosquitoes

1. Mosquitoes will “bite” people by squirting out the liquid
2. Mosquitoes get a bloodmeal by sucking up from the host’s cup
3. Afterwards we will use an indicator to find out how many hosts were infected
How well do our numbers match the model?

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Why are our observed results different from the expected results?
How Weather Affects Vector-Borne Diseases

- Temperature
- Humidity
- Surface water
- Tropical and subtropical regions
- Predator patterns
Map image depicting the world’s rise in temperature
Average Air Temperature Anomaly
December 2009
How Weather Affects Vector-Borne Diseases

- Tropical and subtropical regions
- Temperature
- Humidity
- Surface water
- Predator patterns

Climate Change
- Larger geographic area where disease is common
- Intensity and duration of outbreaks
- Altered seasonal distributions
How Climate Change Affects Vector-Borne Diseases

- Mosquitoes develop more rapidly
- Mosquitoes bite more frequently
- Viral load in mosquitoes is higher
- Because more people are infected, more mosquitoes become carriers that transmit disease
How Will Climate Change Affect the Model?

![Graph showing the effect of number of mosquito bites on the number of people infected.]

- **Total People**
- **0 Infected, 2/7 Mosquitoes**
- **Effect of Climate Change**
Modeling Effects of Climate Change on Vector-Borne Diseases

- 2/20 people are infected
- 4/7 mosquitoes are infected
- 4 rounds of bites

What do you anticipate will happen?
Modeling Climate Change Effects

![Graph showing the impact of mosquito bites on the number of infected people. The graph has two lines: one for Total People and another for different infection scenarios involving 0/7 and 2/7 infected mosquitoes. The x-axis represents the number of mosquito bites, and the y-axis represents the number of people.]
2/20 people infected, 4/7 mosquitoes infected

Number of People

Number of Mosquito Bites

Total People
0 Infected, 2/7 Mosquitoes
2 Infected, 4/7 Mosquitoes
What Assumptions Does This Model Make?

• Mosquito bites always transmit disease, both to the vector and to the host

• Mosquitoes are equally capable of transmitting disease

• People do not die or are not cured of disease

• There are more people than mosquitoes

• Assumes all people attract mosquitoes similarly
Acknowledgements

• Lesson plan was adapted from Attack of the Killer Mosquitoes TAMU peer lesson plan submitted by Nick Anthis, 2004

• US Government Stock Images
  – Public Health Image Library
  – NASA (www.nasa.gov)
  – www.whitehouse.gov