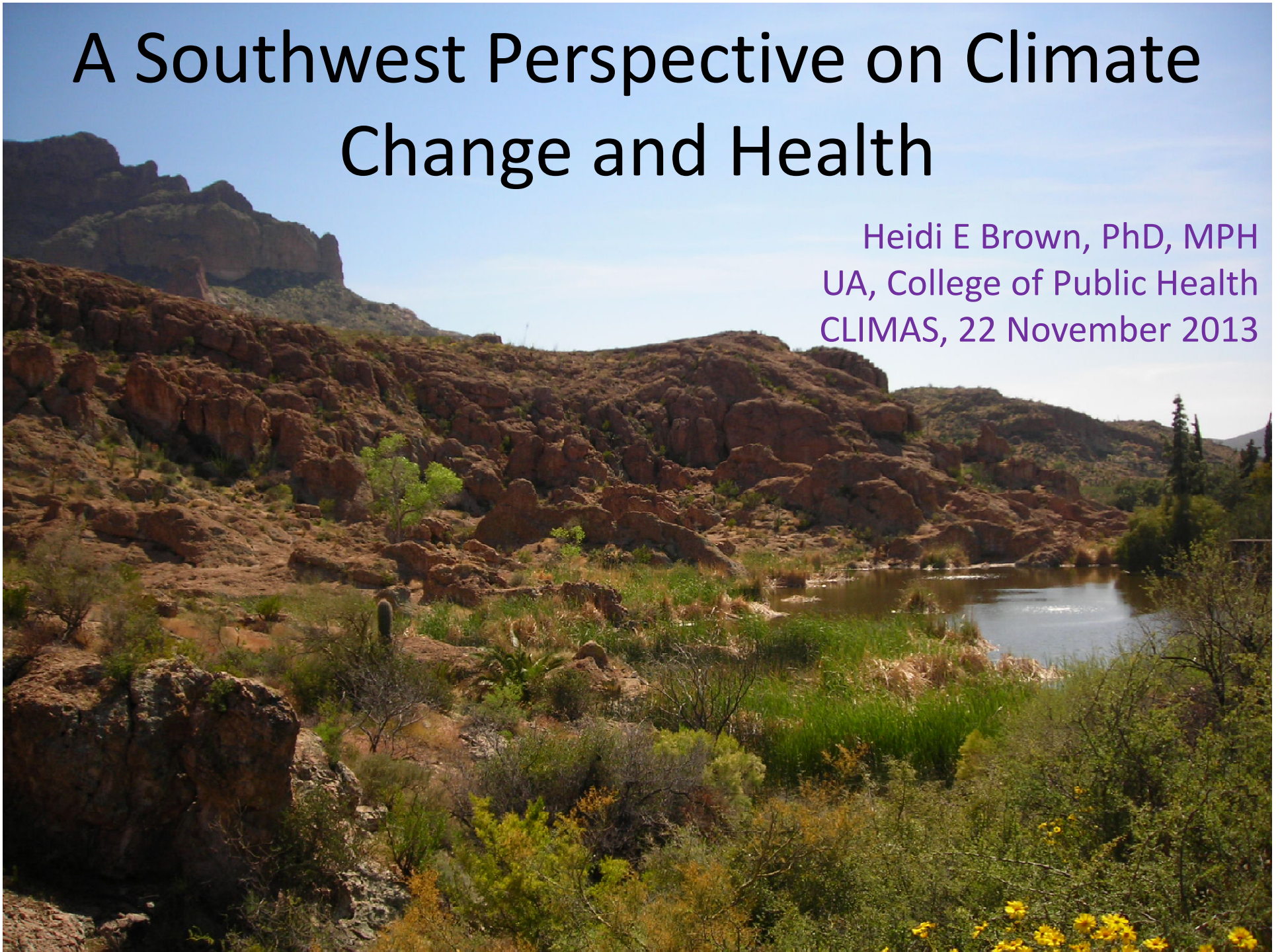


A Southwest Perspective on Climate Change and Health

Heidi E Brown, PhD, MPH
UA, College of Public Health
CLIMAS, 22 November 2013



NATIONAL CLIMATE ASSESSMENT REGIONAL TECHNICAL INPUT REPORT SERIES

ASSESSMENT OF CLIMATE CHANGE IN THE SOUTHWEST UNITED STATES

A Report Prepared for the National Climate Assessment

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Issues for the SW

- Mini Review
 - Who is at risk
- What are the issues we foresee
 1. Heat related illness
 2. Wildfires and the health implications
 3. Changes in disease patterns
 - WNV case study
- Where do we go from here



Climate-related exposures

- **Direct** cause of illness or death
 - such as death from hyperthermia
- **Contributing** cause by
 - exacerbating existing medical condition
 - such as heat and heart disease
 - or exert indirect effects
 - inducing changes in the ranges of organisms that transmit disease

Climate Change in the Southwest

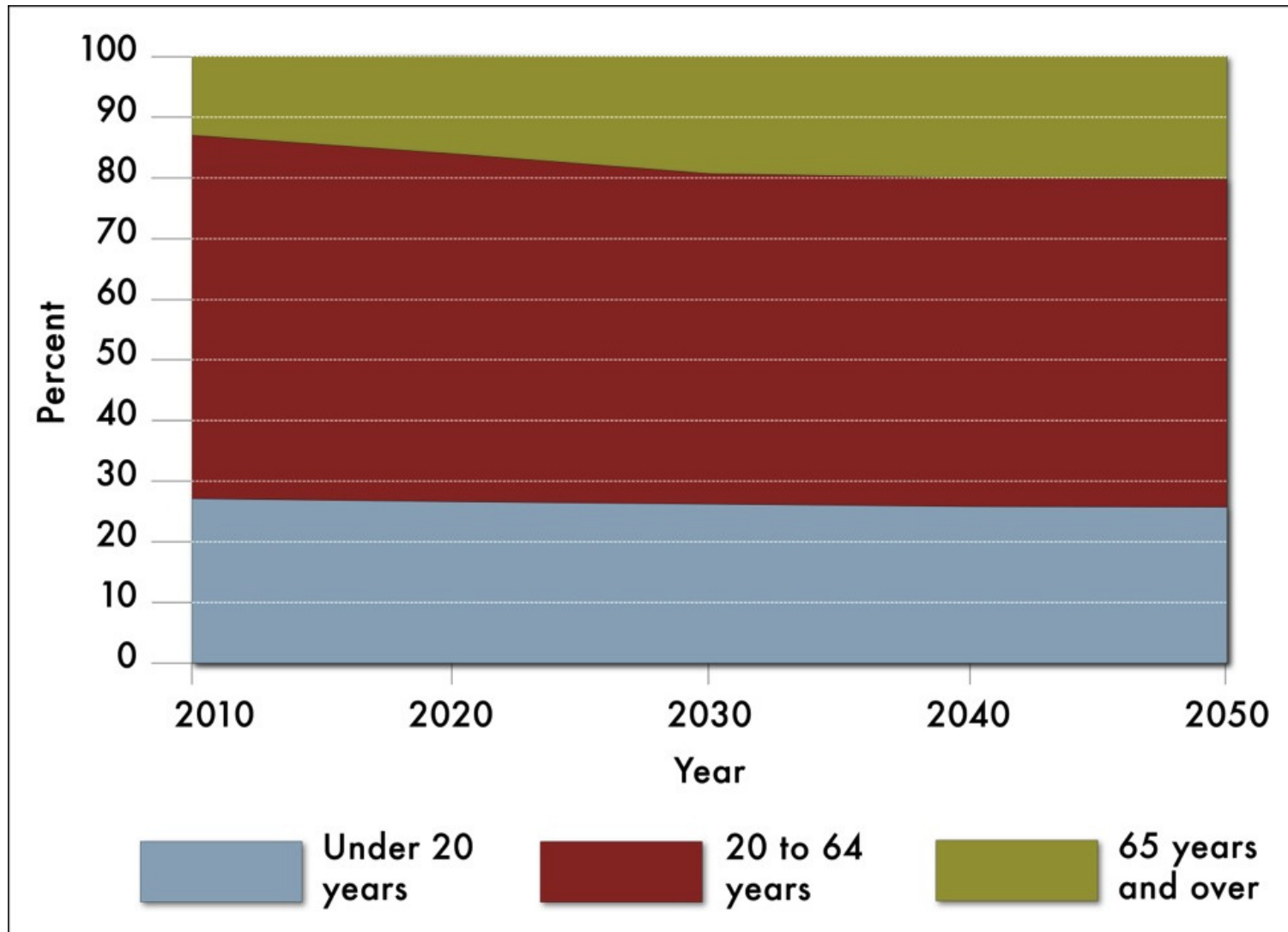
- Increased average annual temperature
 - Shifts in vector ranges (WNV, plague, dengue??)
- Increased in frost-free season
 - Changes in tree season (asthma & allergy)
 - Extension of transmission period (WNV)
- More heat waves and urban warming
 - Heat related illness
- Decrease in winter cold snaps
 - Vector survival (WNV, dengue??)



Climate Change in the Southwest

- Increase in extreme precip events
 - Flooding (GI illness, property loss)
- Decrease in snowpack
 - Changes in vector abundance (WNV)
- Increase in drought severity
 - Wildfire risk (injury, respiratory illness, property loss)

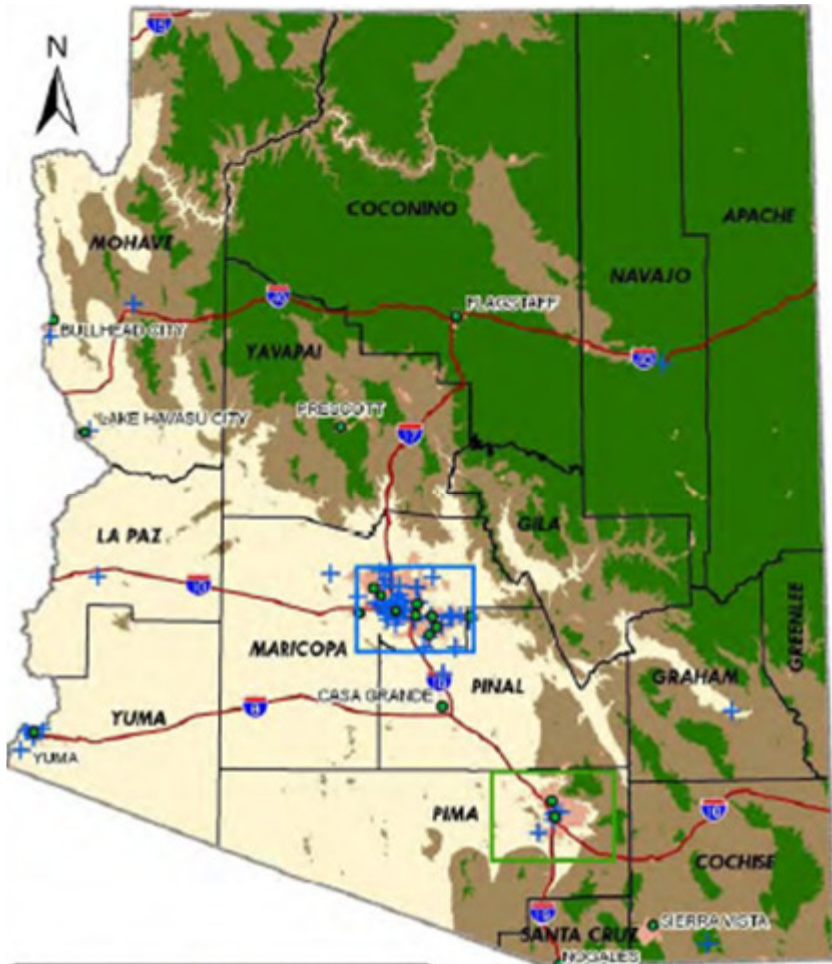
Disadvantaged populations expected to bear greater burden resulting from reduced access to medical care & limited resources for adaptation strategies



Deaths From Exposure to Excessive Natural Heat

Arizona Residents

Migrants



Elevation	+ Location of Death*
□ < 3,000 feet	● Urban Areas
■ 3,001 - 5,000	— Freeways
■ > 5,000	● Cities > 20,000 Pop.

*Due to incomplete data not all deaths were placed at their exact location.



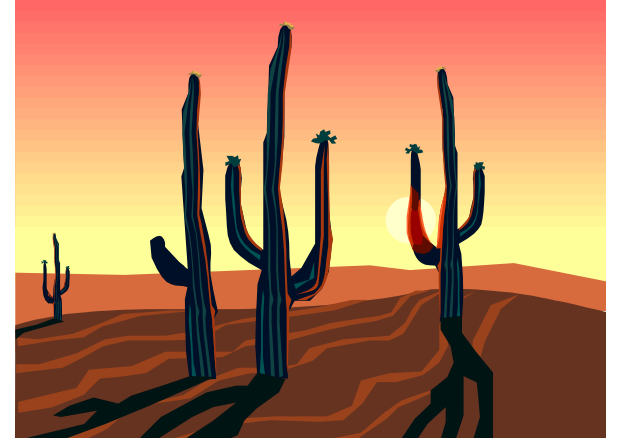
Map Date
March 2010

Median age AZ = 57 yrs
Mgmt. = 30 yrs

<http://www.azdhs.gov/plan/report/heat/heat09.pdf>

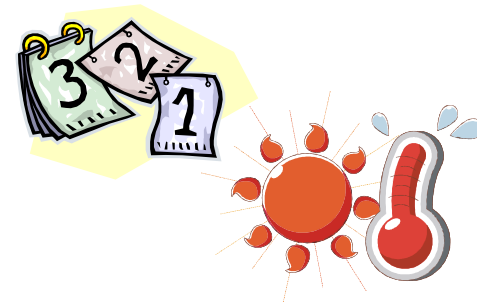
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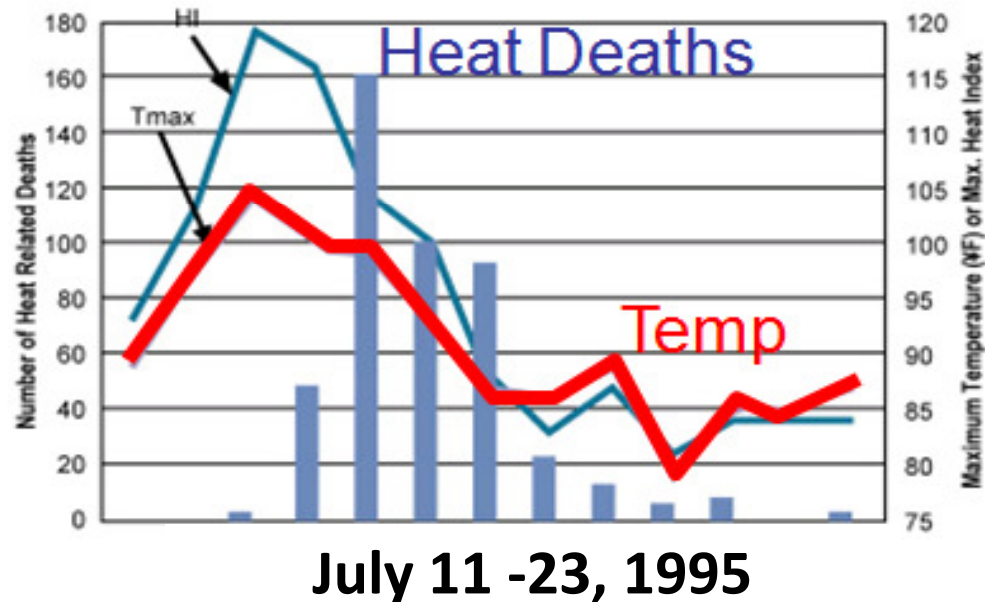
1. Climate change will exacerbate heat-related morbidity and mortality

- Leading weather-related cause of death in US
- Exacerbate preexisting chronic disease
 - Particularly circulatory illness
- Heat stress greater when elevated temps
 - **continue for several days**
 - **hot and humid**
- Future heat waves
 - more humid
 - high overnight temps



Heat-related Mortality, Example

Heat Related Deaths – Chicago



- Mortality will **vary**
 - by **community** and
 - intensity, duration, and timing of the heat event
- Intensification of heat stress by **urban heat islands** will likely **increase heat-related illness and death** in the Southwest
- Higher temp associated with reductions in life expectancy
 - exacerbated by a projected demographic shift toward an older population
 - not only among extremely frail individuals

Heat-related Mortality, Progress

- U.S. heat-related deaths declined between 1964 and 1998, likely due to
 - more air conditioning,
 - improved medical care,
 - better public awareness programs,
 - other infrastructural and biophysical adaptations.



2. Climate change will increase particulate matter levels from wildfires with subsequent effects on respiratory health



2010 Wildfire in Great Sand Dunes National Park, Colorado.

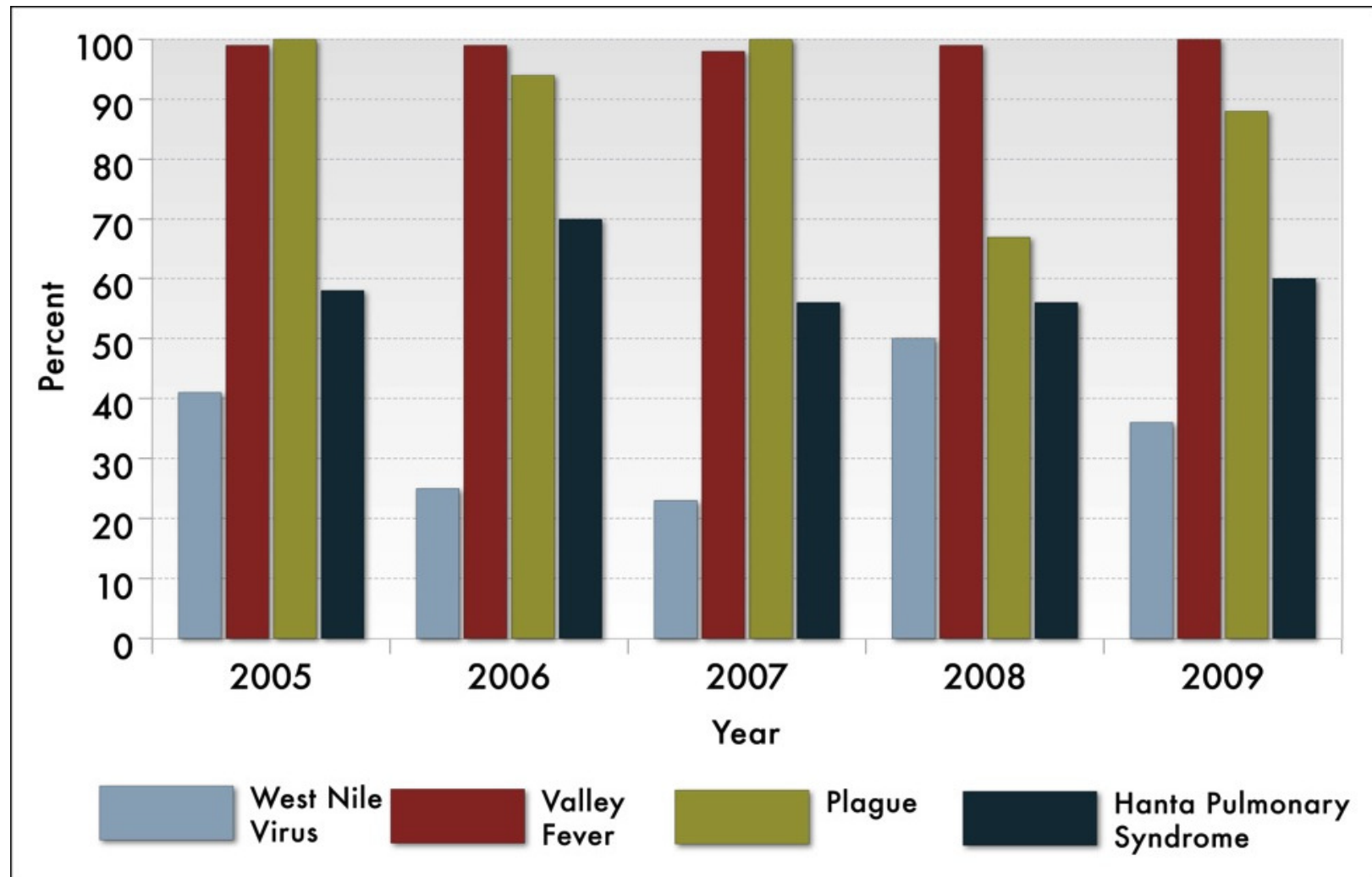
© University Corporation for Atmospheric Research.

- PM2.5 levels >> national standards
- Smoke exposure associated w/
 - Respiratory and eye symptoms
 - Increased ER visits
 - Increased asthma hospital admissions
- Fire
 - Injury & Burn
 - Loss of Property
 - Increased mudslide risk

Wildfires

- Greatest increased risk for hospital admissions
 - Acute bronchitis and pneumonia
 - Particularly among the elderly
- Health effects depend on
 - Size, intensity, and duration of the fire
 - Proximity of the fire to a population
 - Which way the wind blows
 - Smoke plume moves across a populated area

3. Climate change will influence disease prevalence, but the direction of the effects will be location- and disease-specific



Changes in Disease Patterns



Ankle biters in San Antonio, TX

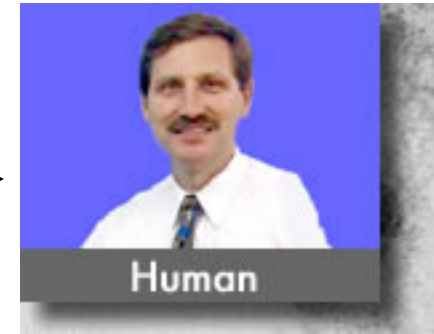
- New diseases
- Magnitude
 - Increase or decrease
- Patterns
 - Space and time

WNV Transmission Cycle

Mosquito Vectors



Reservoir Hosts



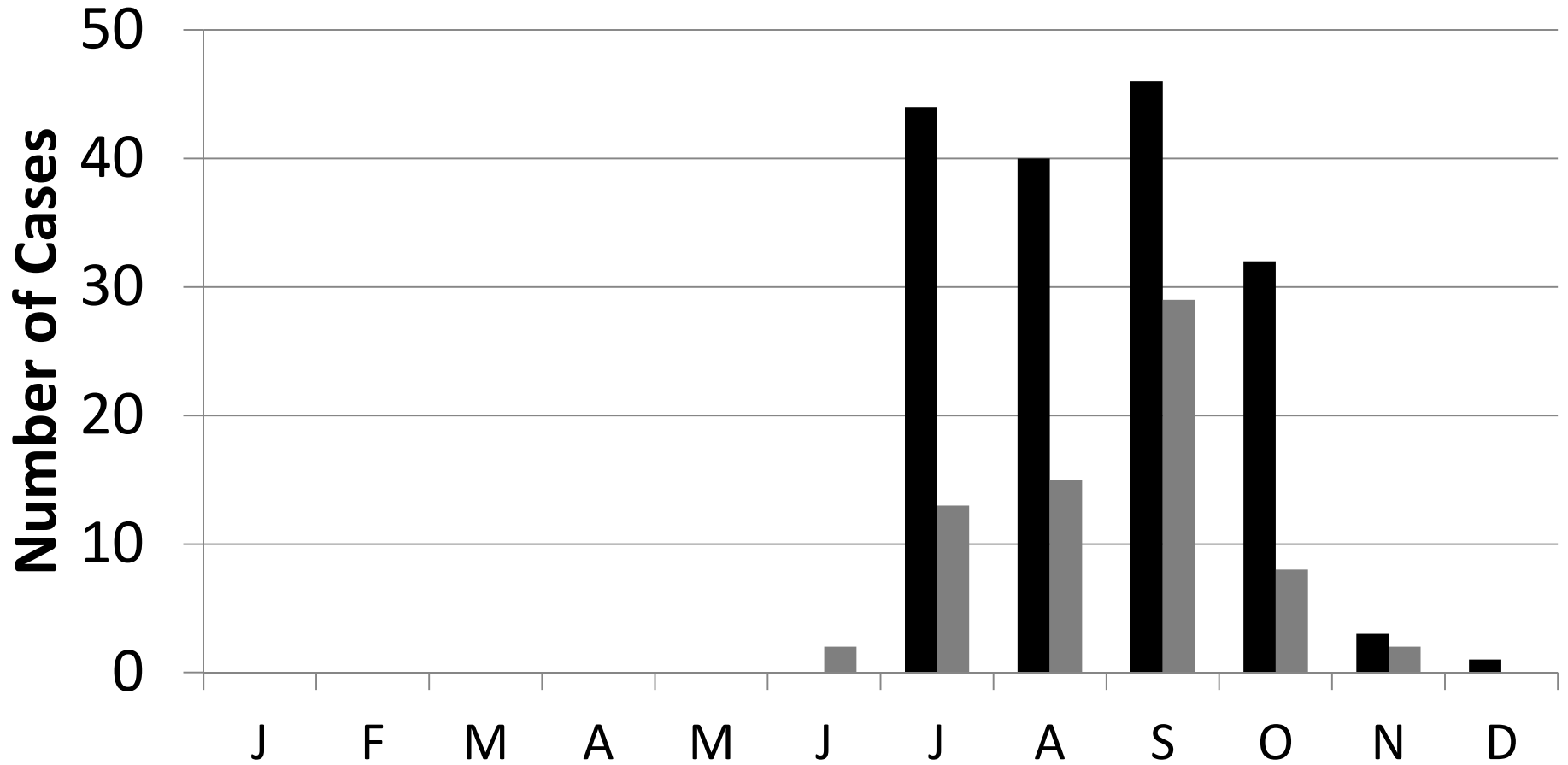
Incidental Infection



2012: 5,674 Cases Reported to CDC
133 Cases in AZ
2013: 2,215 Cases Nationally (93 deaths)
54 Cases in AZ (4 deaths)

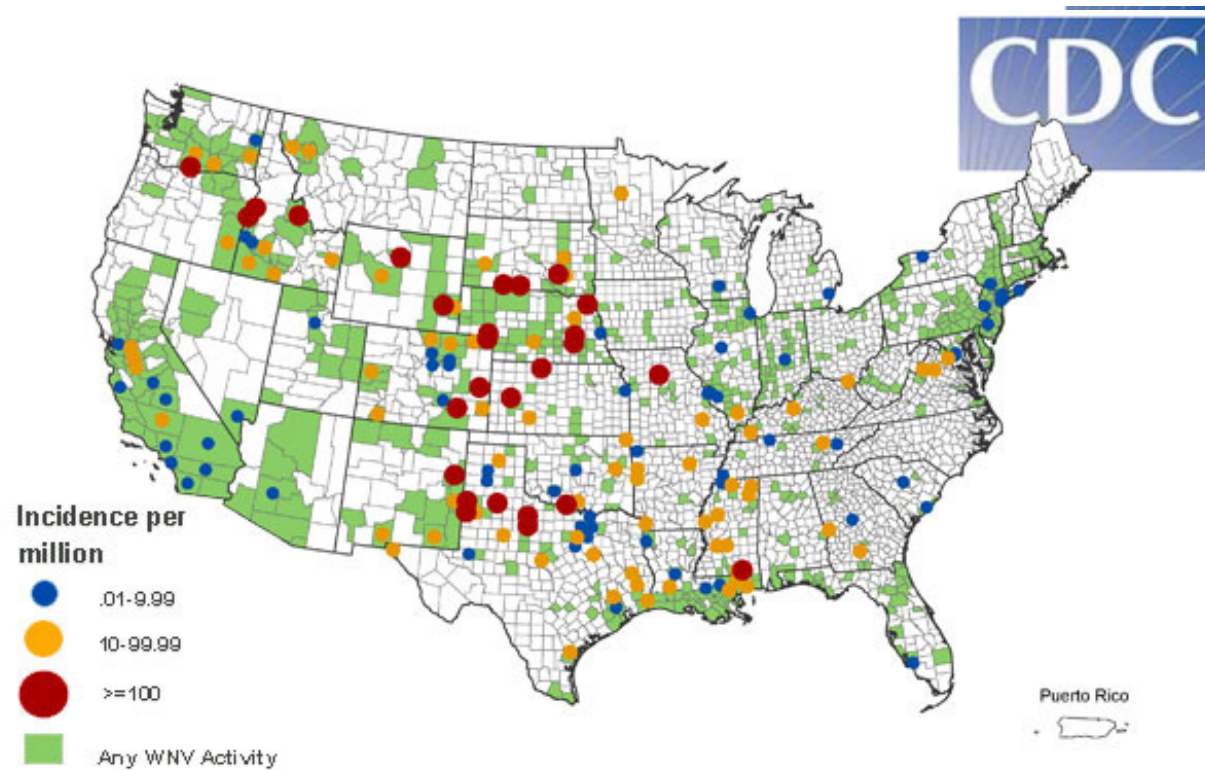
WNV Cases in Arizona, By Month

■ 2010
■ 2011

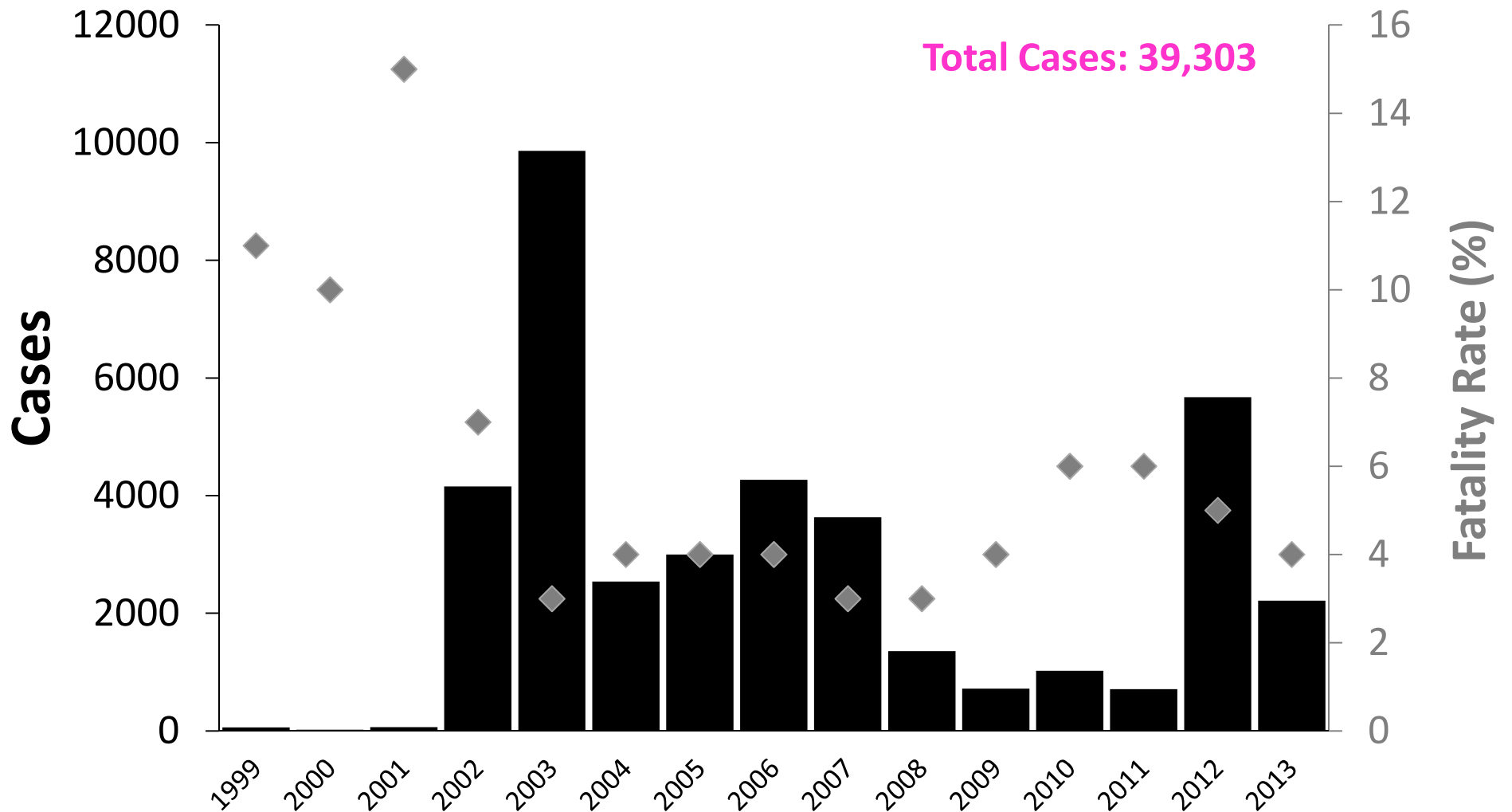


WNV Incidence

1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

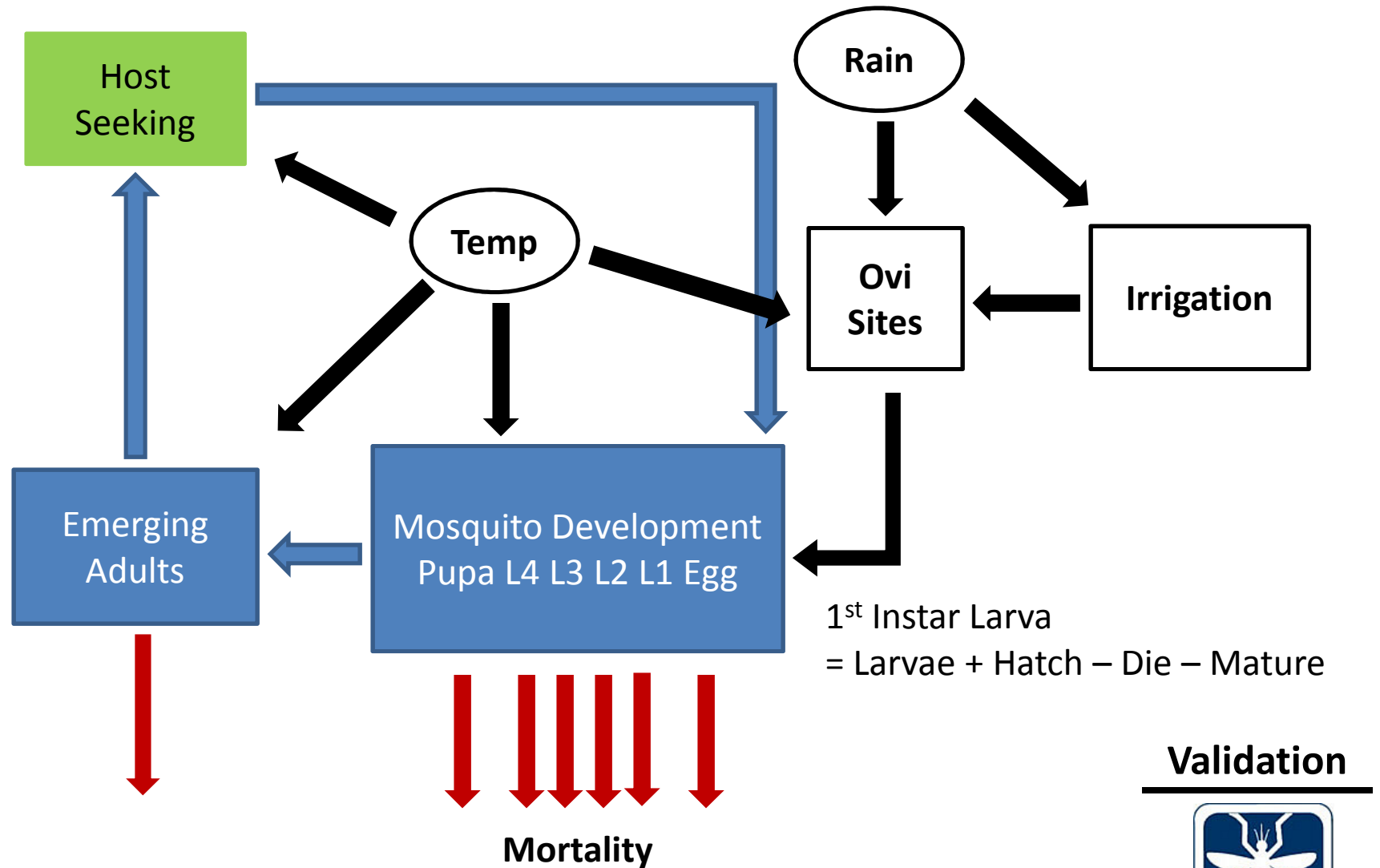


West Nile virus disease cases and deaths reported to CDC by year, 1999-2013*

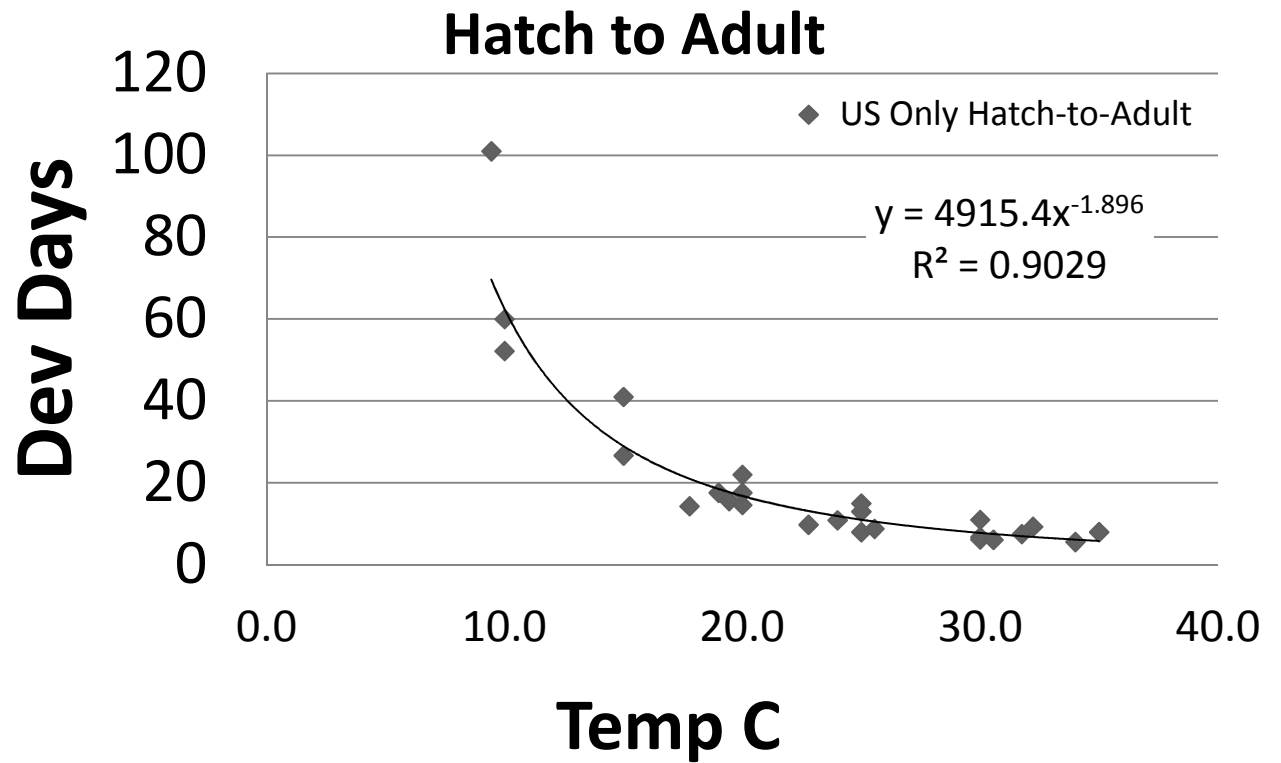


*2013 counts preliminary

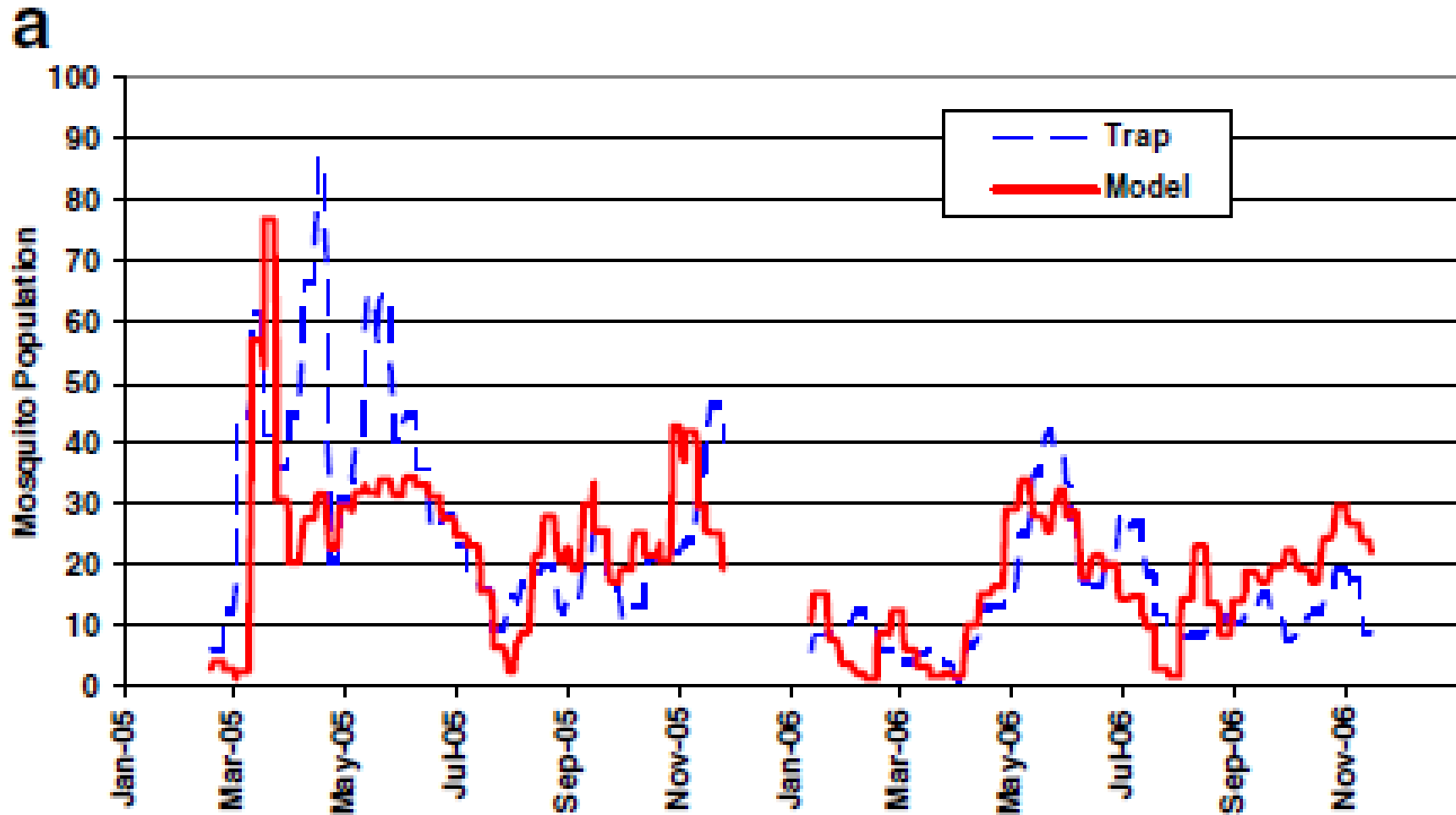
Mosquito Abundance Model



Temp Dependent Growth



Model Fit



Changes in Disease Patterns

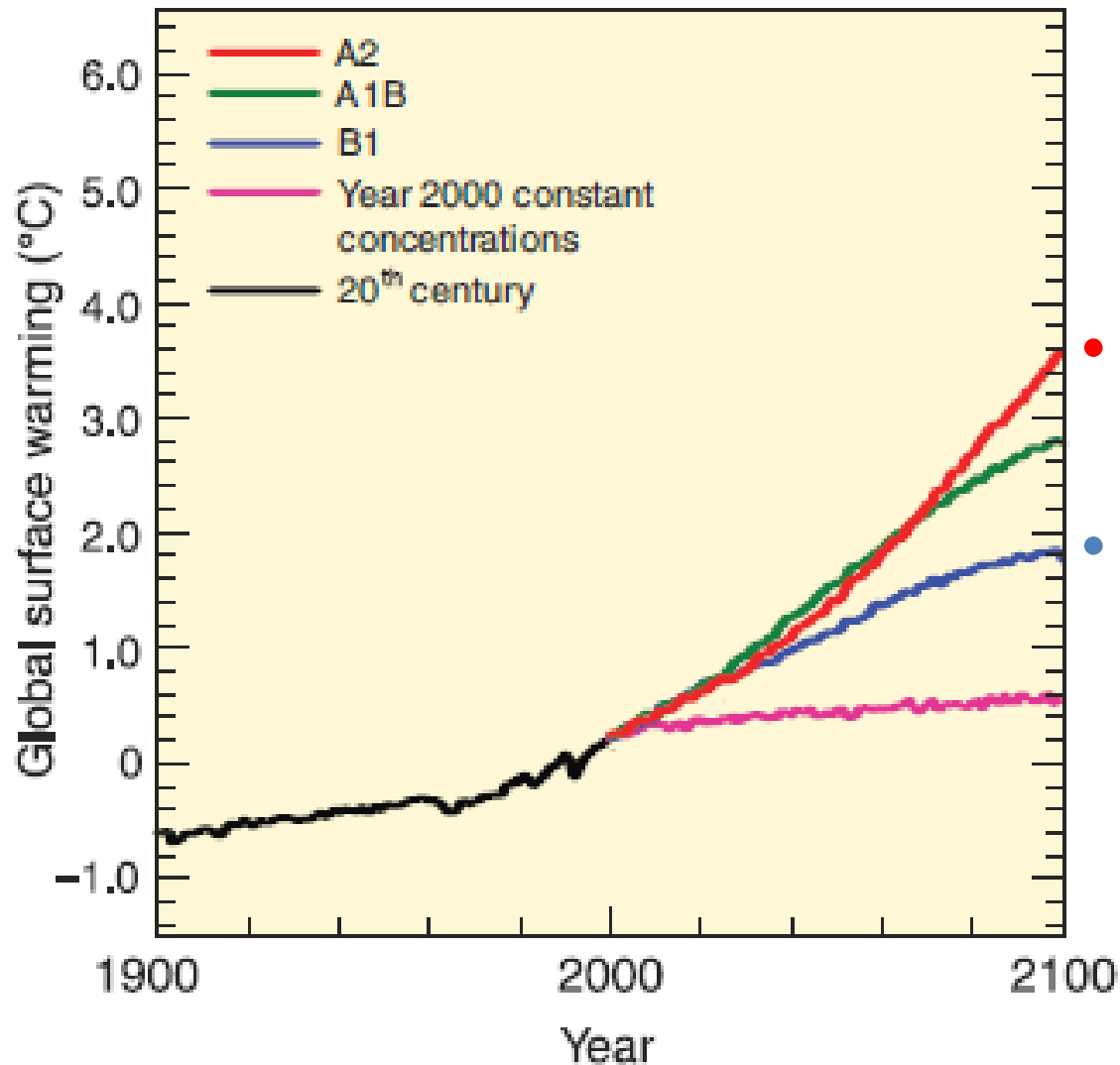
- What we learned
 - Spatial models (not shown)
 - Abundance
- What we don't know
 - Future projections of disease
 - Predicting establishment



Mosq Response to Climate Change

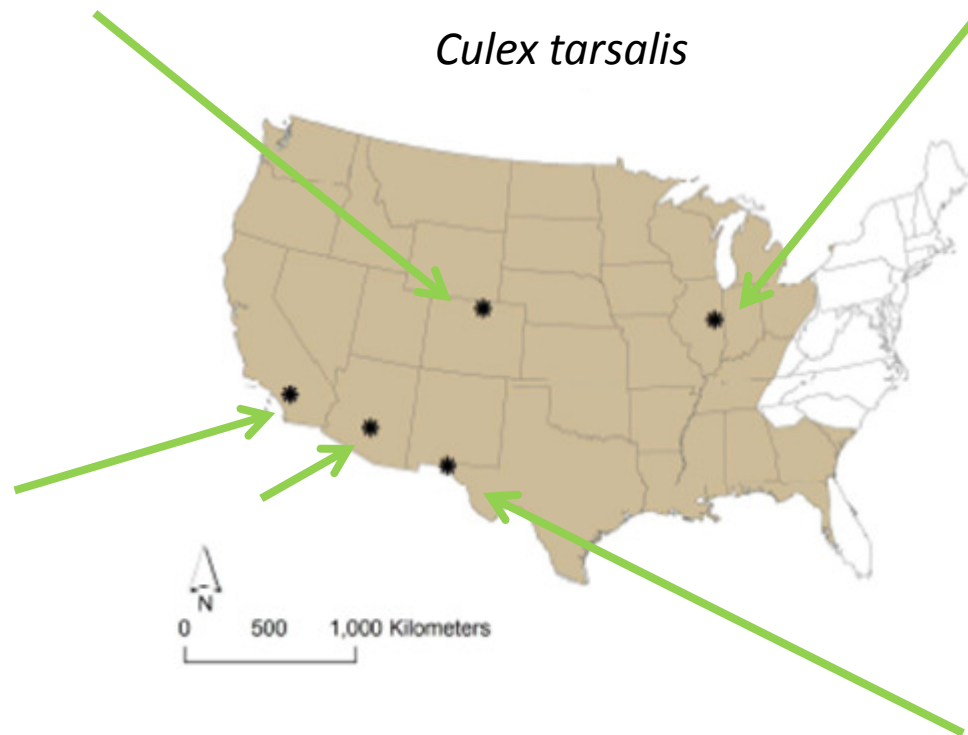
- IPCC 4th AR GCM to generate rain & temp
 - Baseline (1970-2000)
 - Mid-Century (2045-2065)
 - End of century (2080-2099)
- NCAR – Community Climate System Model v3
 - Higher spatial resolution of predictions
- Long Ashton Research Station weather generator
 - Generate time series of daily data for model

Emission Scenarios



- Limited Mitigation
 - 3.4°C rise (End of Cent)
- Moderate Mitigation
 - 1.8°C rise (End of Cent)

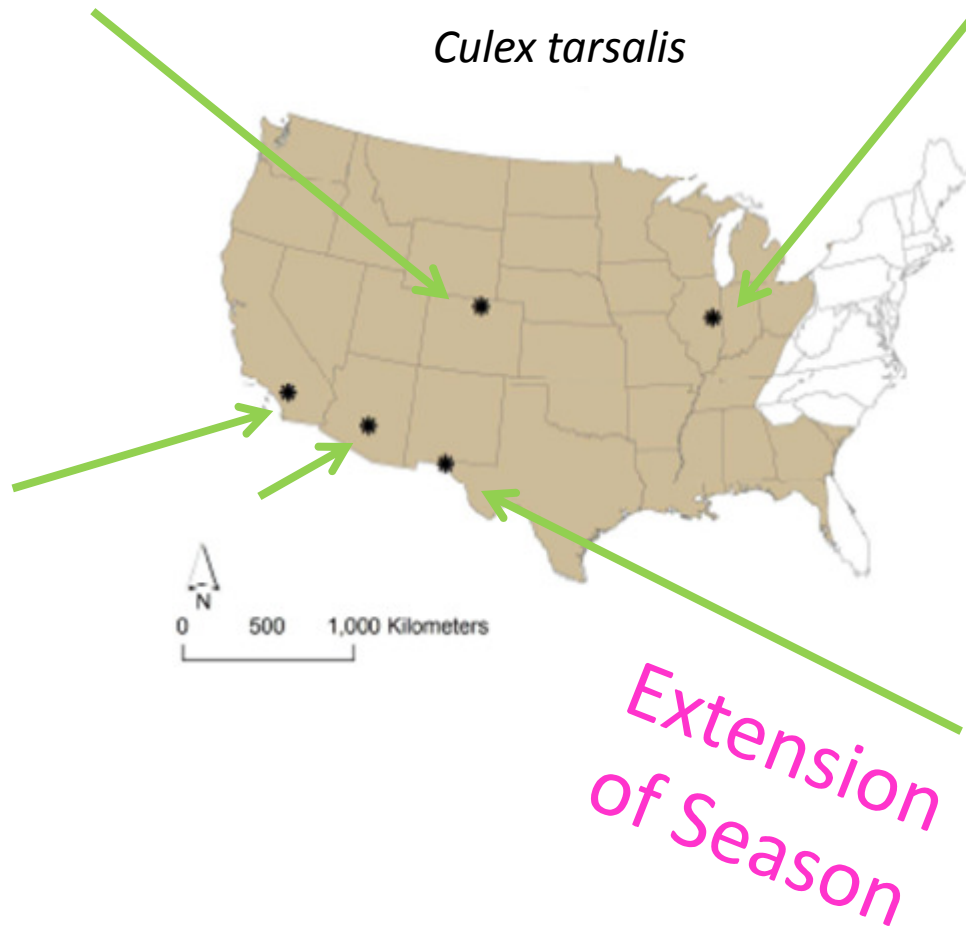
Population Estimates Mid Century



Scenario

Base Limited Mod

Population Estimates End of Century



Scenario

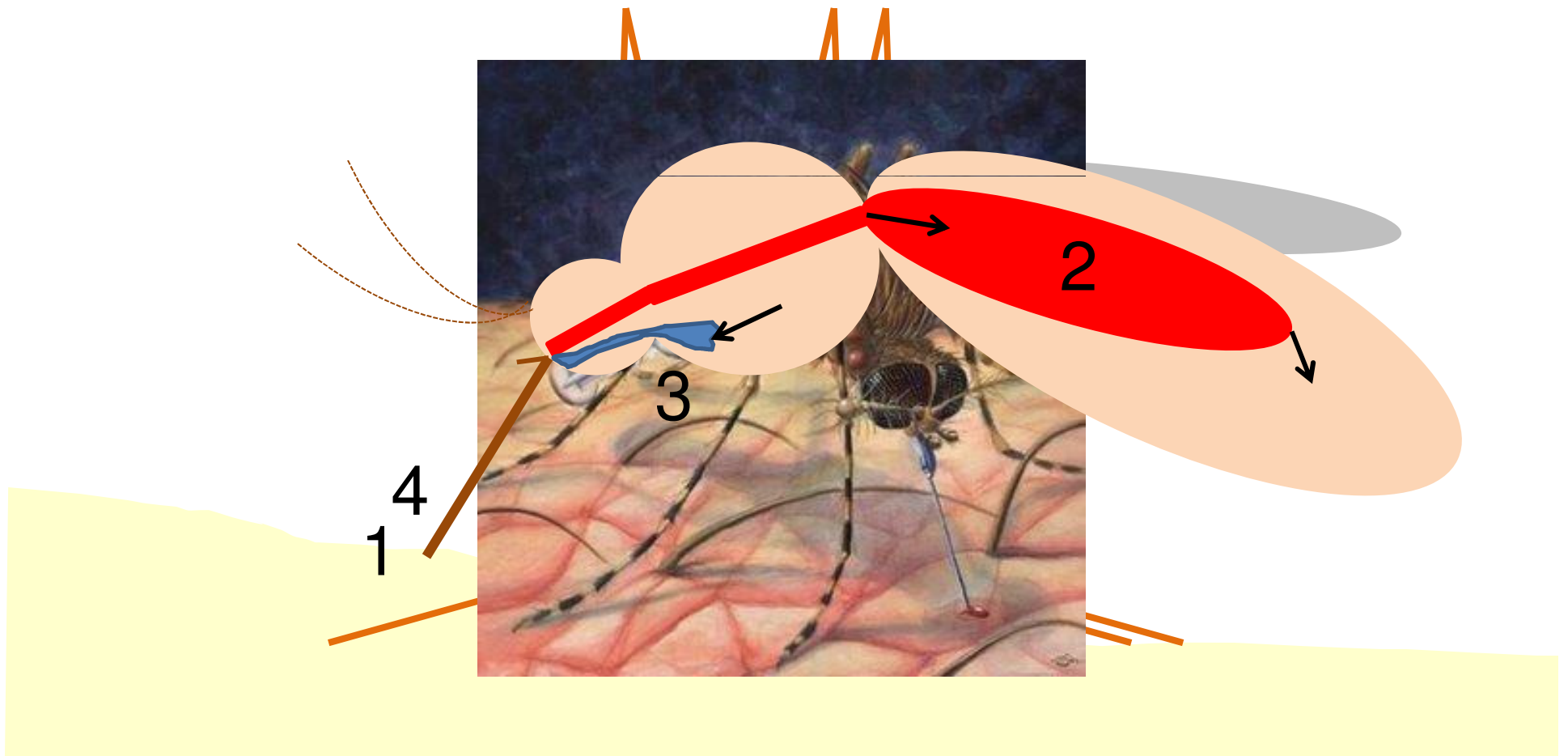
Base Limited Mod

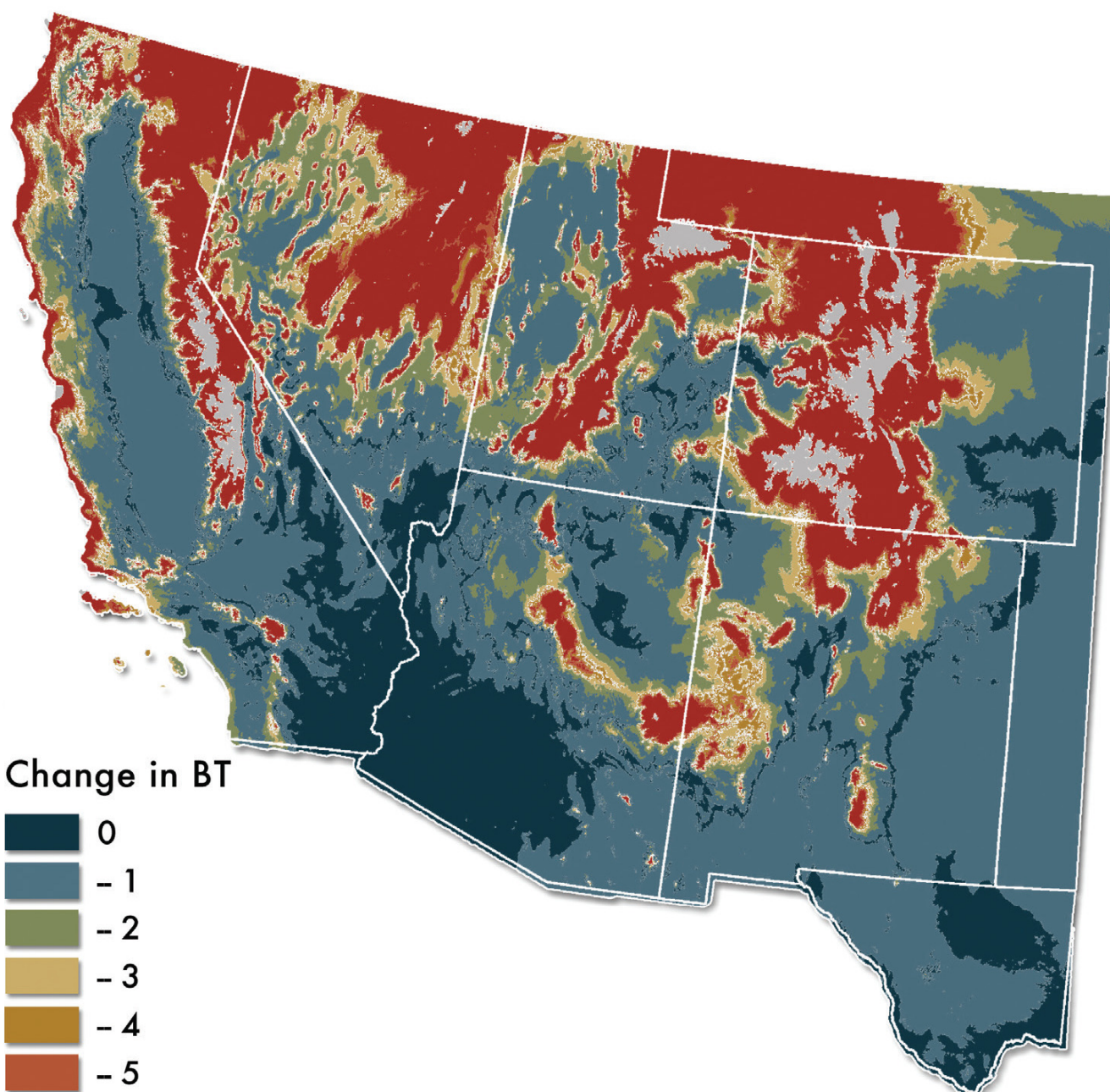
Conclusions

- Simplify reality
 - Identify & explore patterns
 - Insights into the system
- Simulate abundance over time
 - Based on weather (temp & precip)
- Forecast abundance
- ... what about disease???

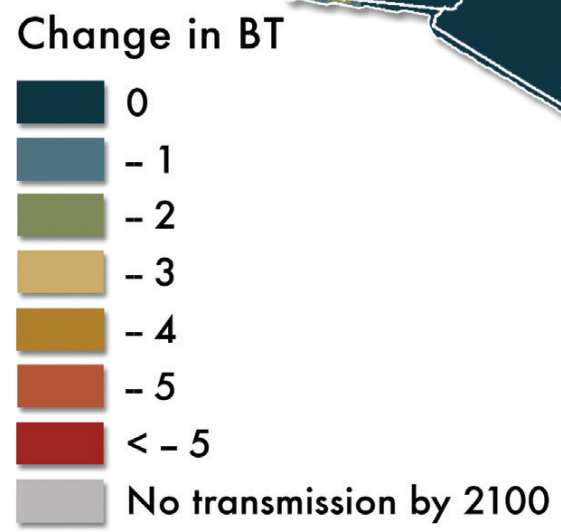
Getting from Mosquito to Disease

Time to complete 1-4:
Extrinsic Incubation Period





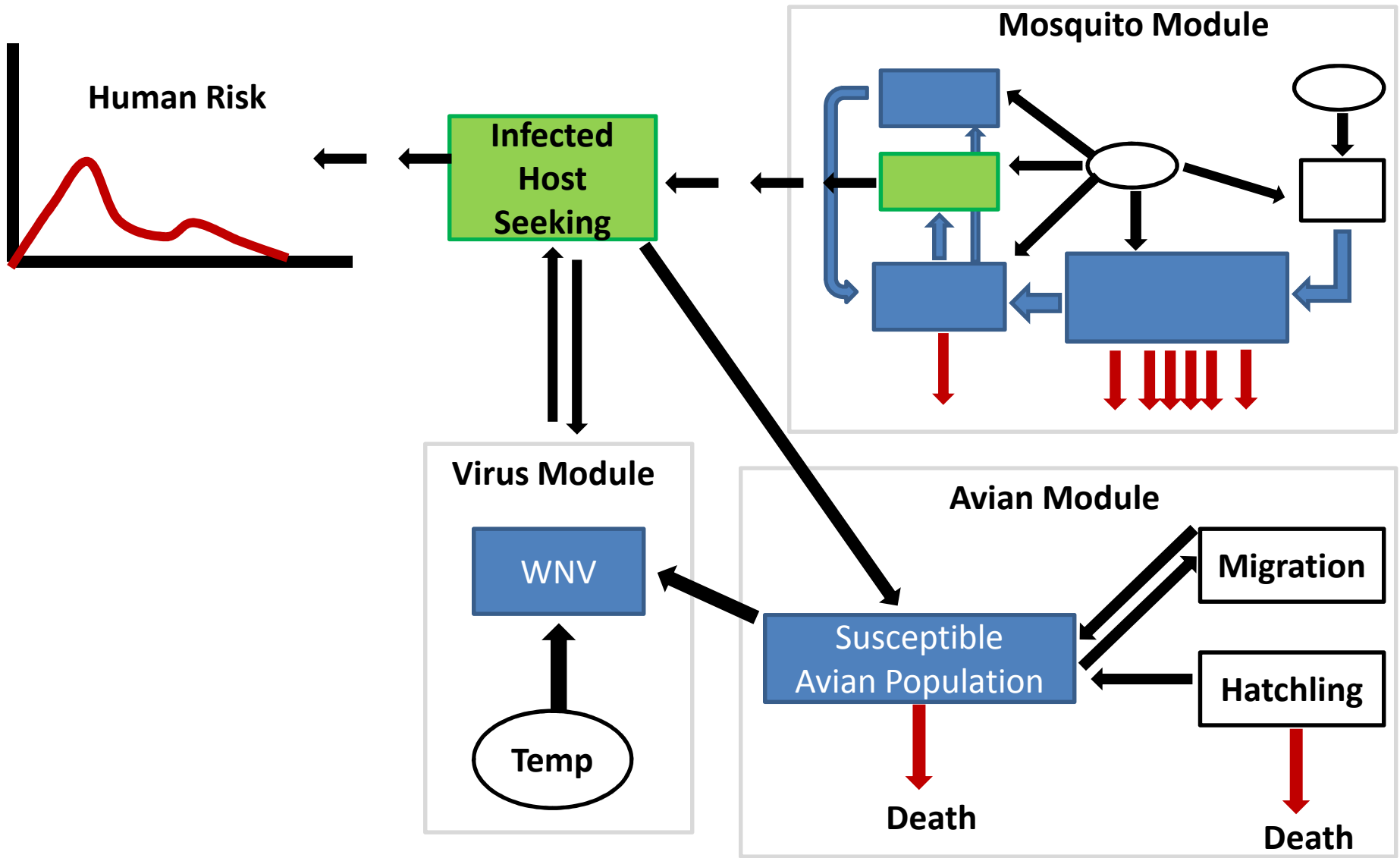
Change in Number of Bites to WNV Transmission

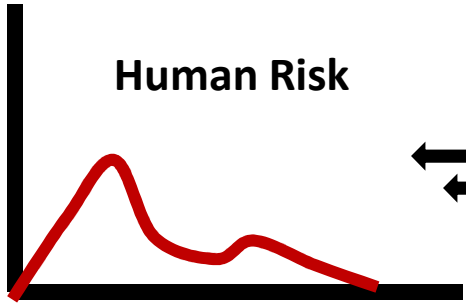


Overview

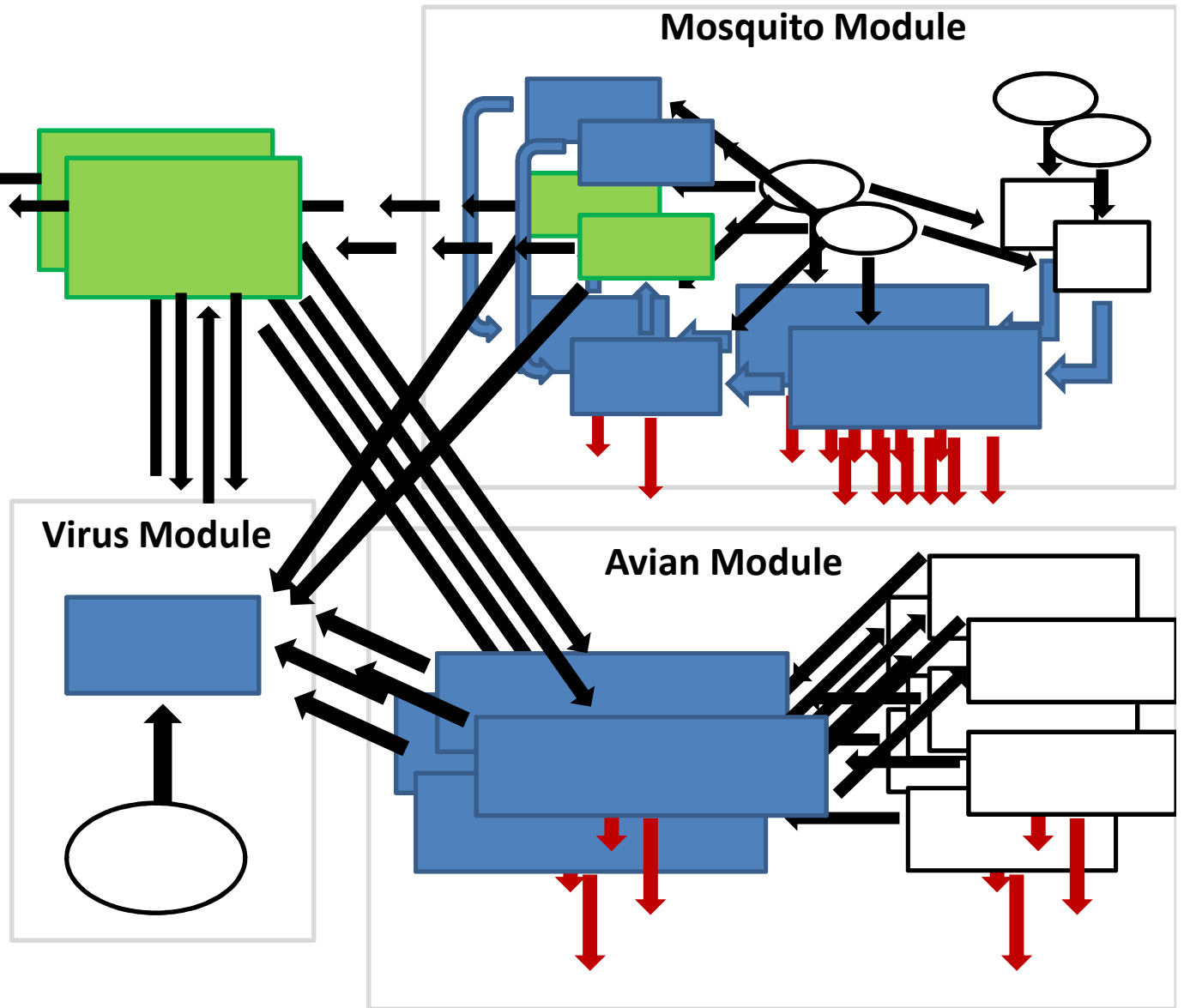
- What we learned
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Multiple avian hosts
2 mosquito species
1 WN virus strain

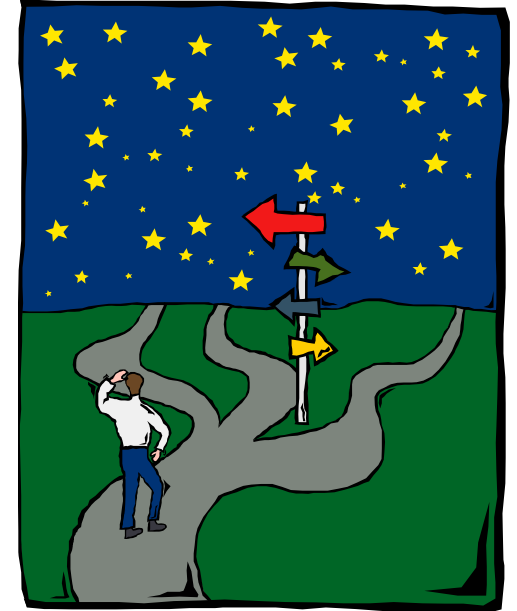


Lessons Learned from WNV

- Will it establish?
 - US susceptible to new (or old) infectious diseases
 - We aren't very good at predicting establishment
- Will it spread?
 - Know which species are involved
 - In space and time (resource targeting)
- How bad will it get?
 - Quantitative predictions (of future risk)
- We need:
 - Better parameter estimates (variable temperatures)
 - Surveillance data to validate models
 - Establishment and elimination

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Mitigation and adaptation plans tailored to the specific vulnerabilities of cities and states will lessen the impacts of climate change.



<http://en.wikipedia.org/wiki/Image:Noga36.jpg>

Public Health Planning

- Immediate improvements to health would result from strengthening public health infrastructure to respond to climate-induced threats
- Assess climate & human health at
 - city, state, and regional levels,
 - develop mitigation & adaptation plans for each level

Establishment and Future Risk



Emerging Infectious Disease Risk and Air Travel



Passengers per day

Thousands

Hundreds

Tens

Not so high...
for now...

Kilpatrick & Randolph, 2012

Thank you

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