Understanding Mosquitoes and Mosquito Control Options

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Adapted from Dr. Mike Merchant

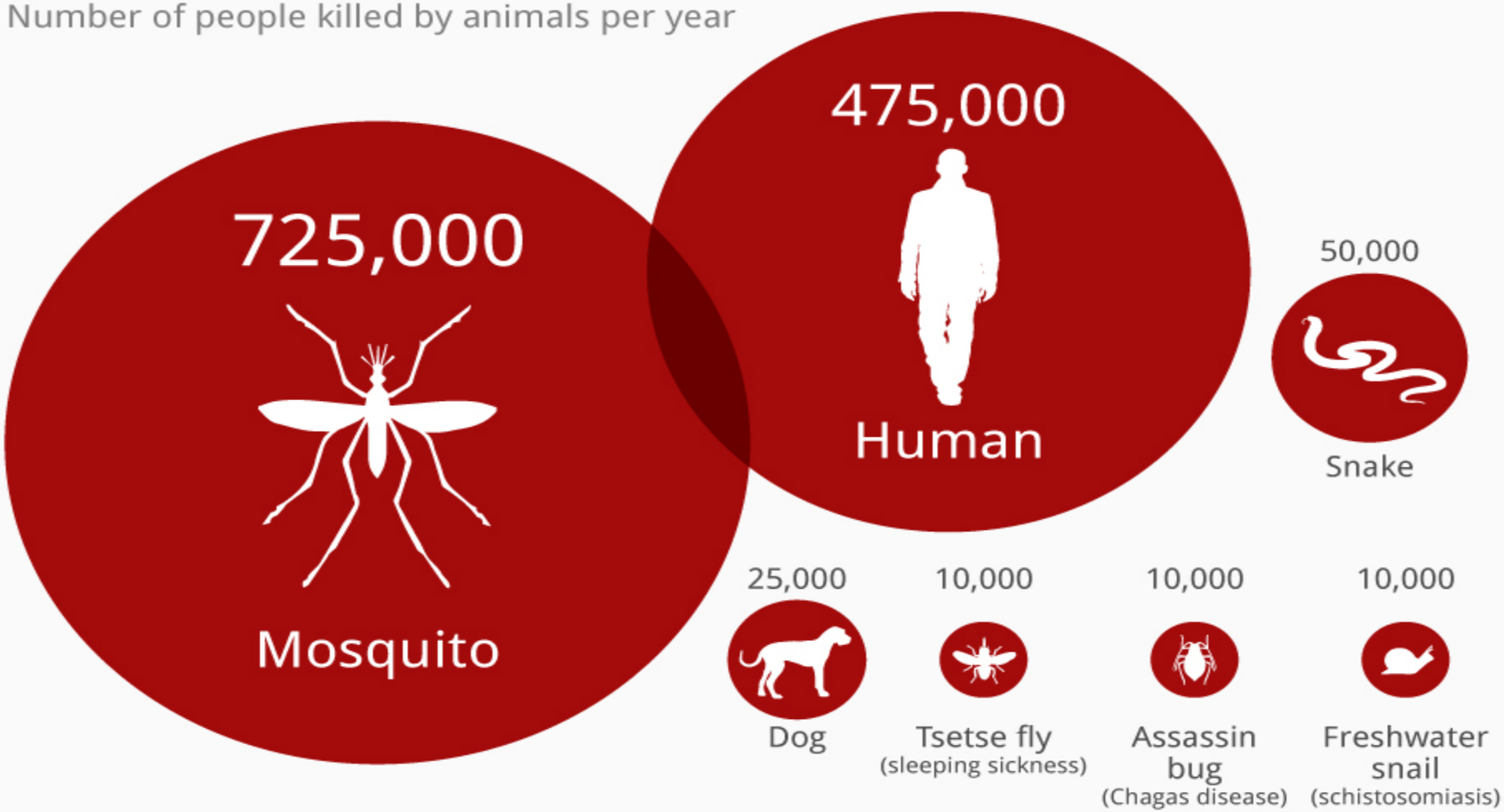
TEXAS A&M AGRILIFE EXTENSION

Mosquitoes:

- 3,550 species of flies are mosquitoes
- Occur on every continent except Antarctica.
- Most important arthropod affecting human and animal health.

The World's Deadliest Animals

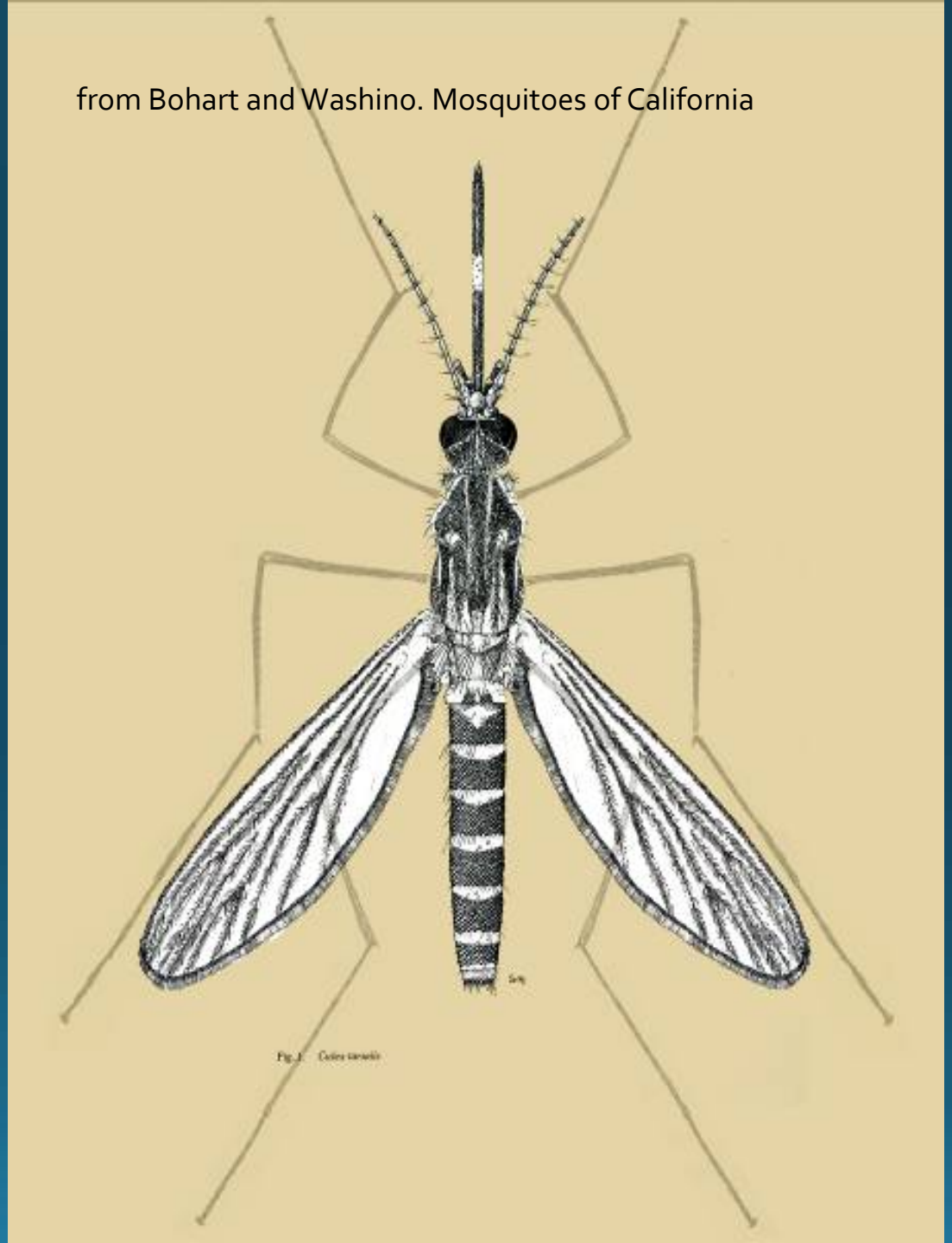
Number of people killed by animals per year



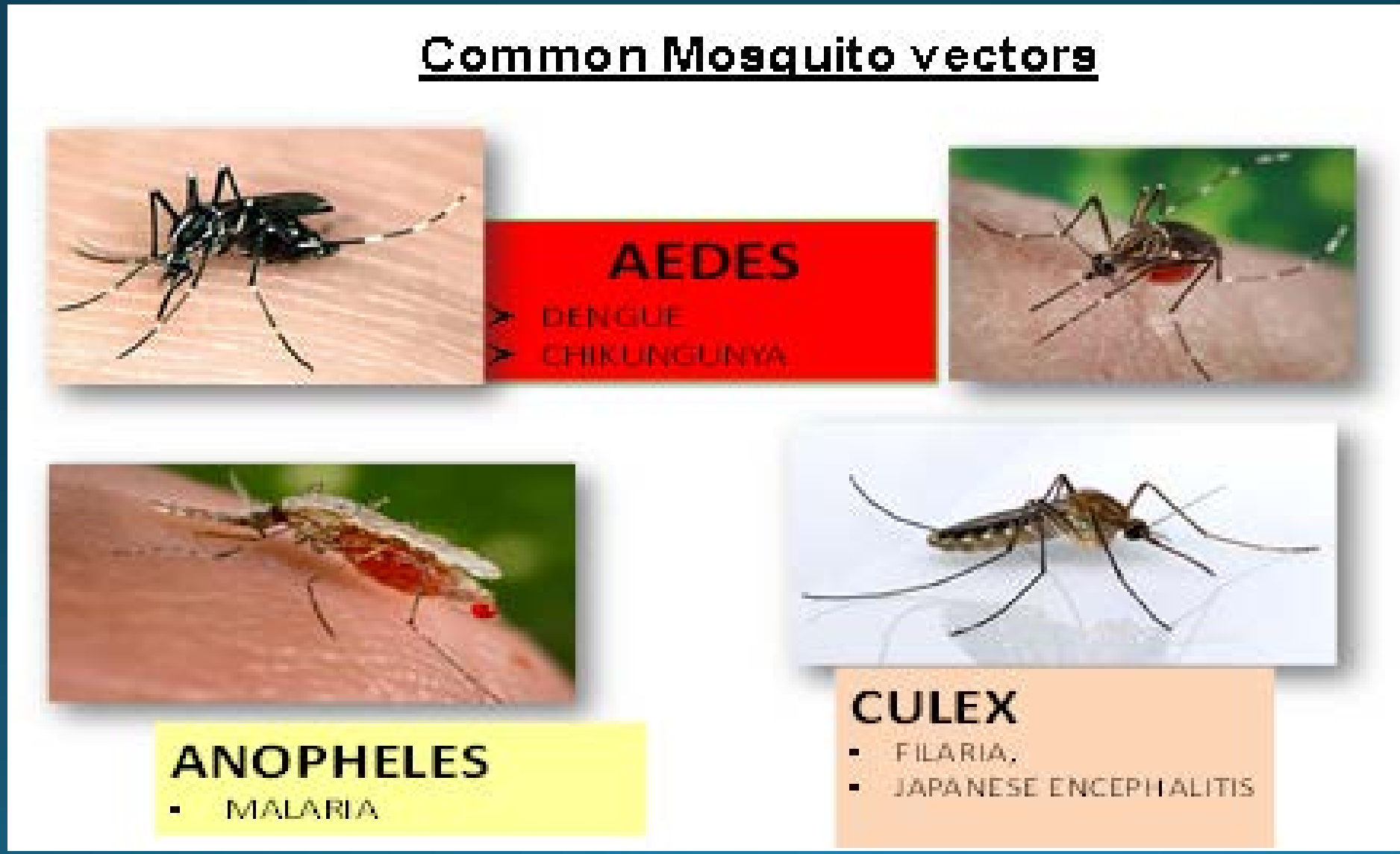
Mosquitoes

- The fly order (Diptera)
  - Family Culicidae
  - long proboscis
  - long legs
  - scales on wing veins
- 176 species in U.S.
- 86 species in Texas

from Bohart and Washino. Mosquitoes of California

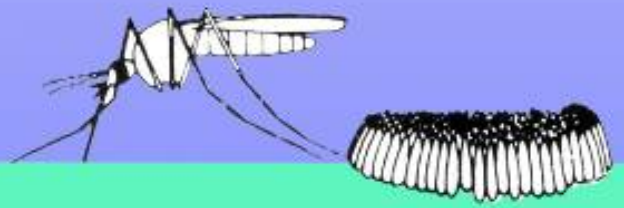


3 Species of Medical Importance



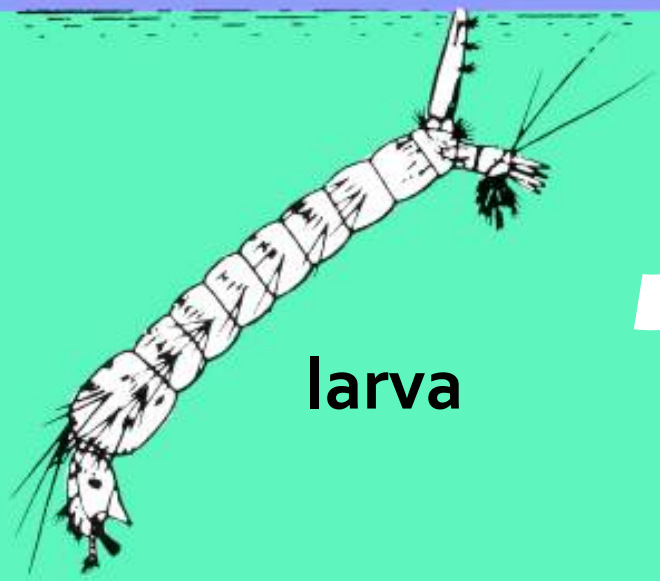
Mosquito
life cycle

adult



eggs

pupa



larva

Culex Eggs

Photos: Institute for Clinical Pathology and Medical Research, University of Sydney, Australia

Aedes eggs

US Armed Forces Pest Management Board

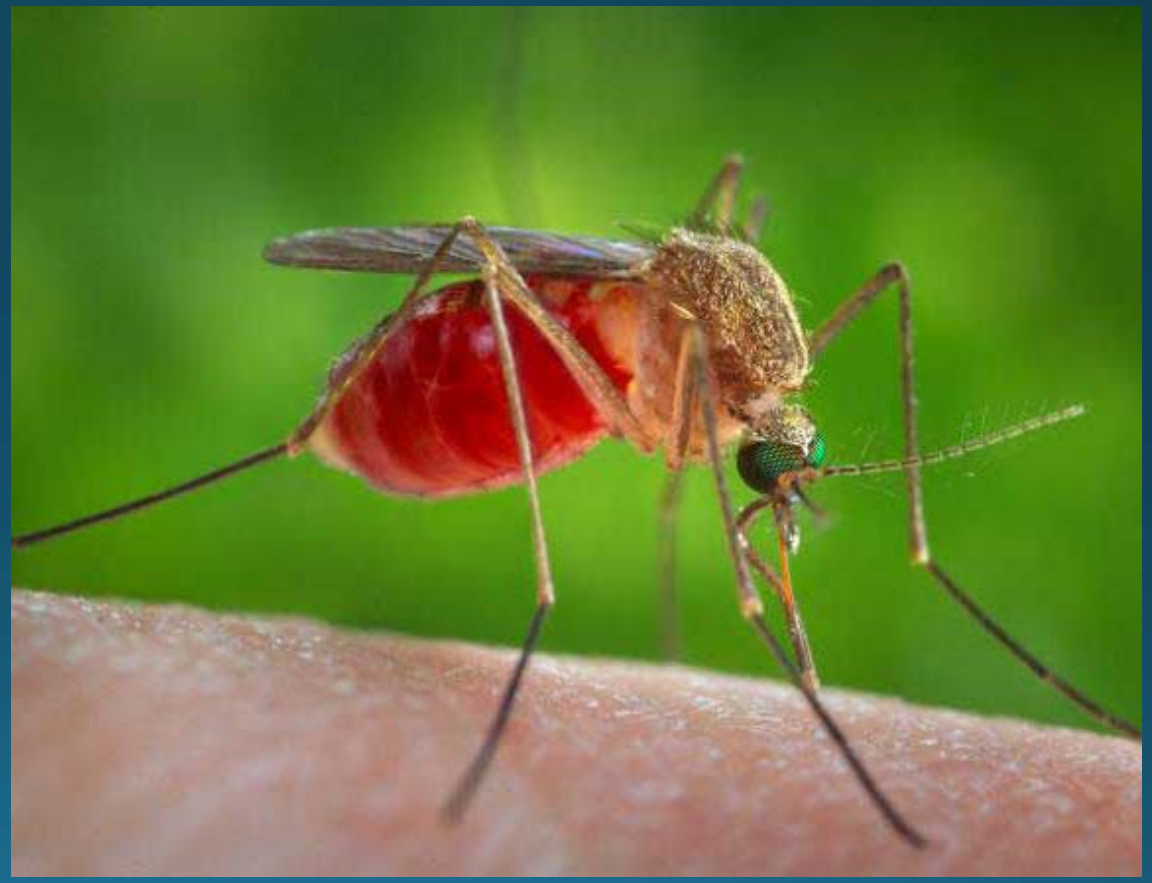
Ovitrap with eggs of *Aedes aegypti*

Mosquito larvae

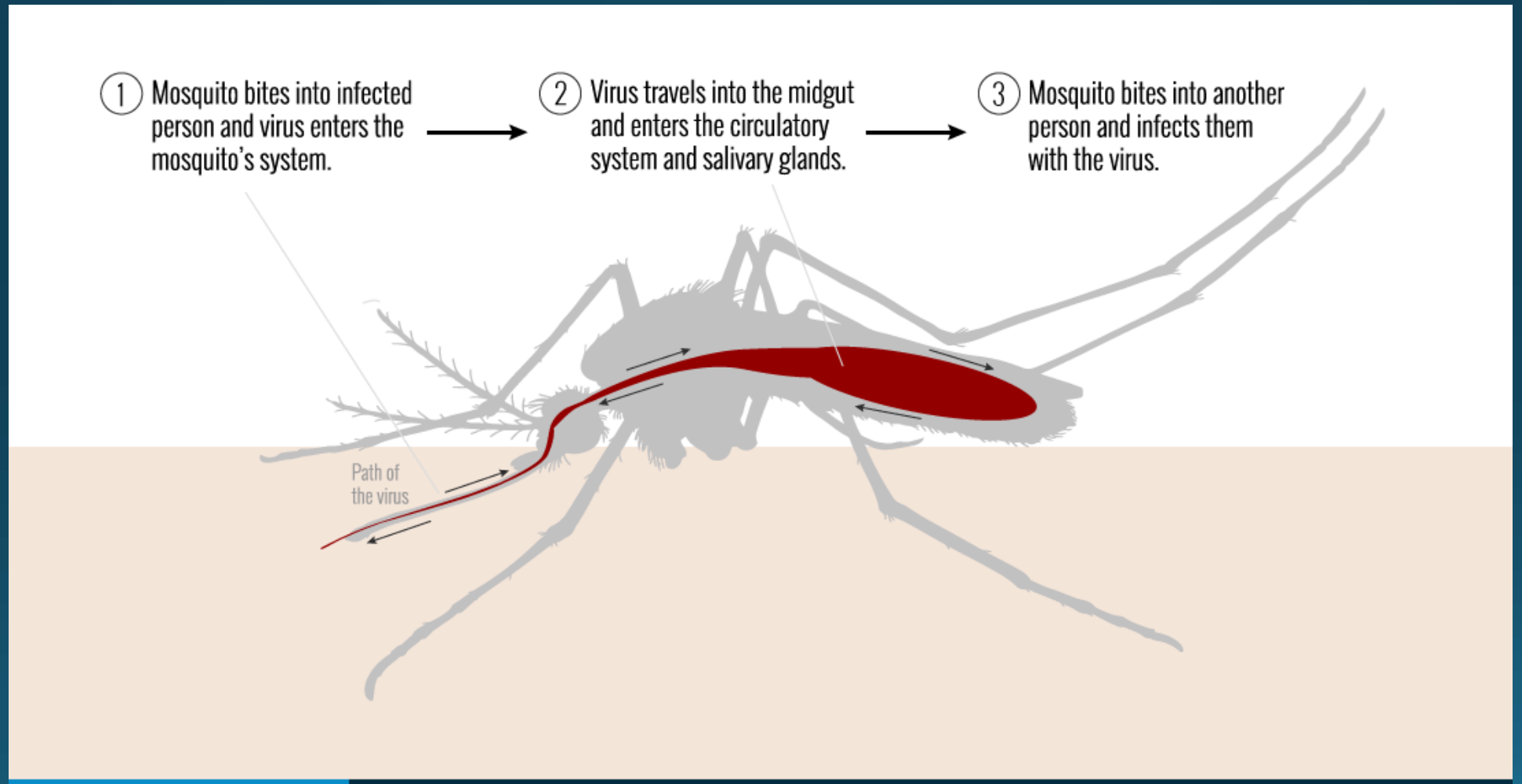
- Aquatic insects
- Adults live 4-30 days

Mosquito Adult

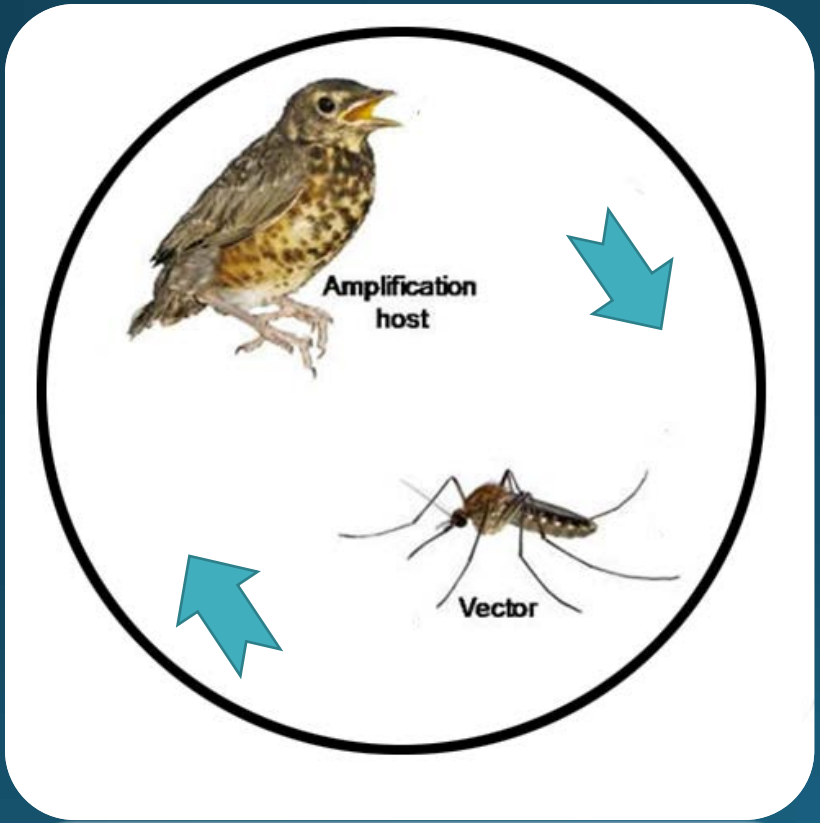
- 4-14+ days from egg to adult
- Strong to weak fliers, depending on species
- Potential disease transmitters



How mosquitoes transmit viruses



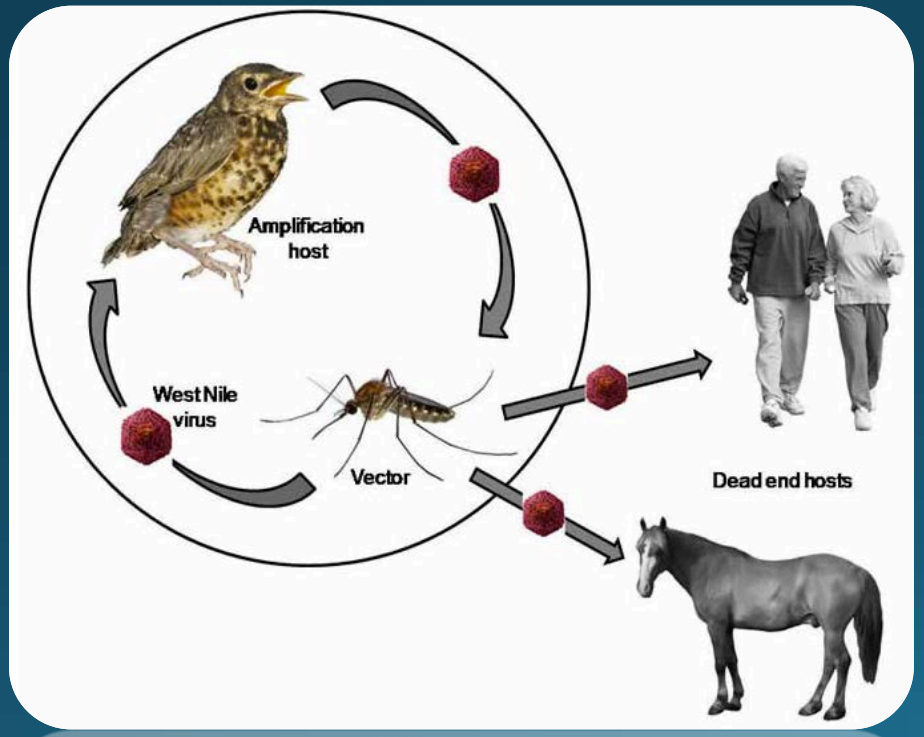
Mosquito feeding



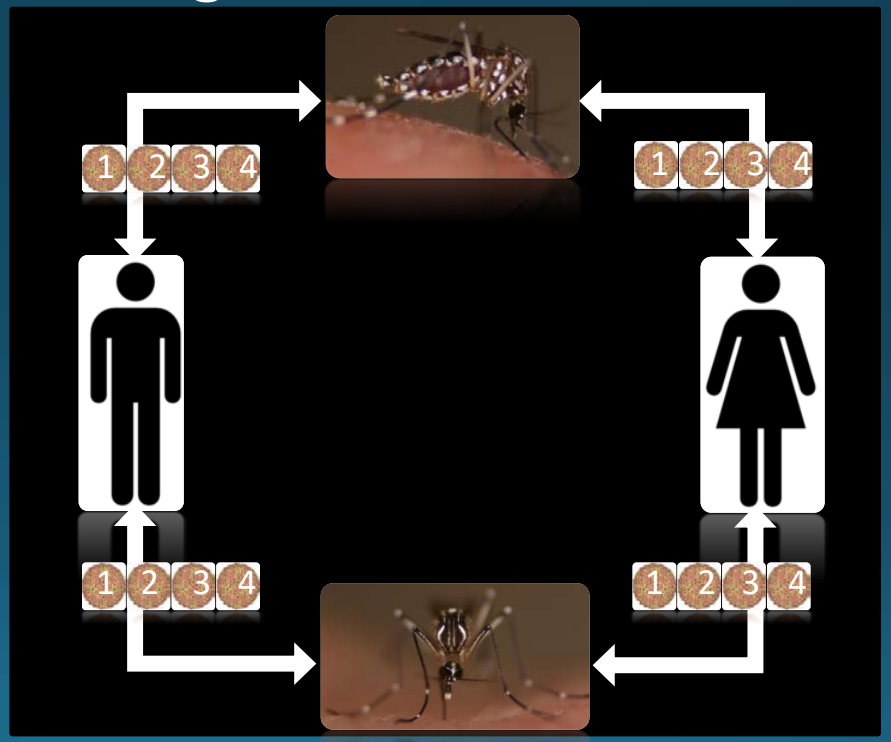
- Plant nectar or honeydew for first 3-5 days after emergence
- Blood of vertebrate hosts need for most species to initiate egg development
  - Birds
  - Mammals
  - Reptiles
  - Amphibians

Mosquito-borne virus transmission cycles

West Nile virus



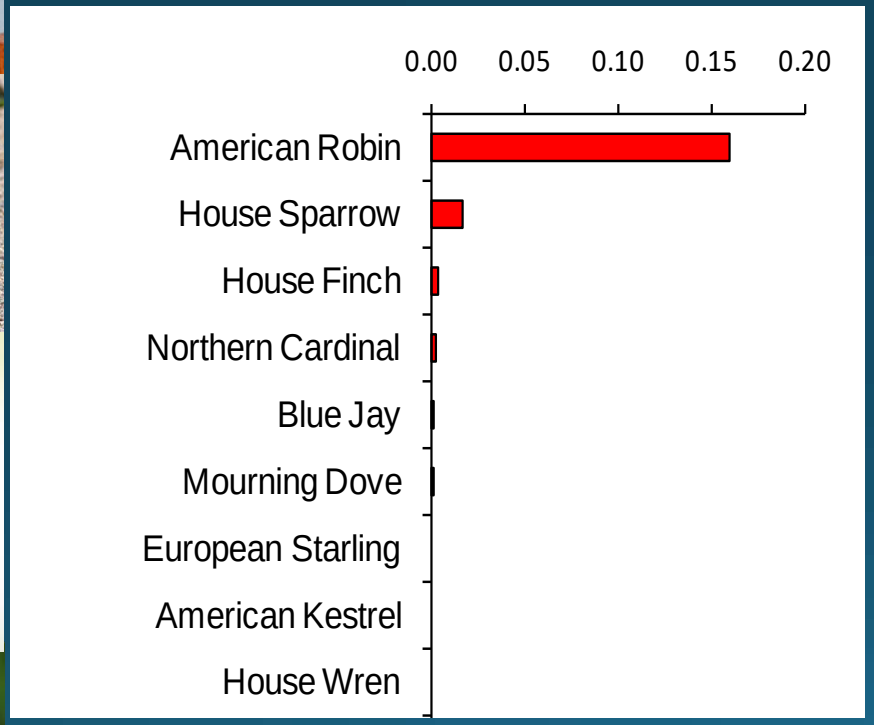
Zika virus
Chikungunya virus
Dengue virus



G. Hamer, Dept. Entomology, Texas A&M University

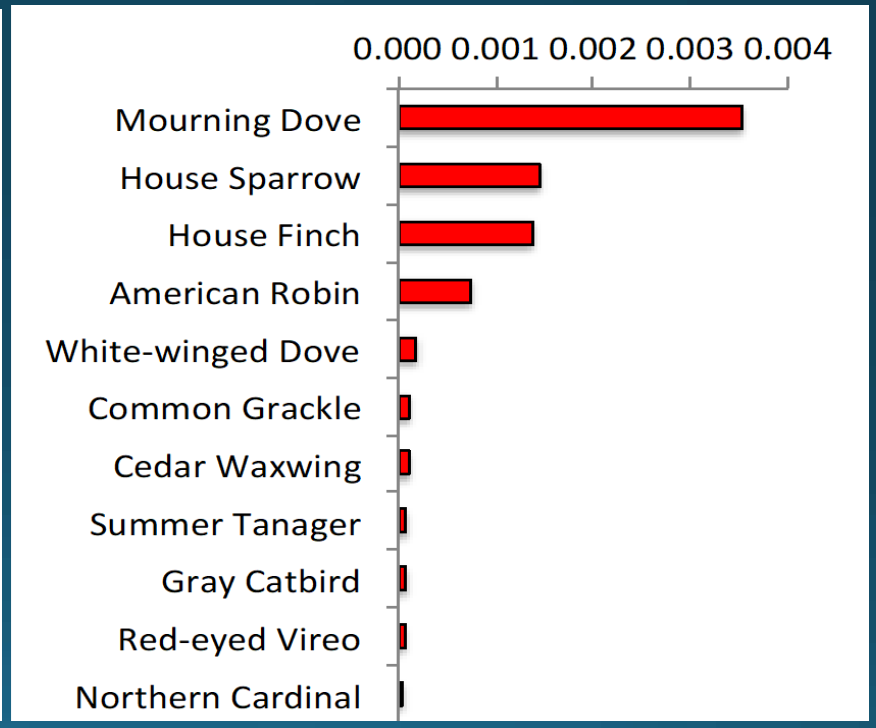
Birds important for WNV transmission

Chicago, Illinois



Hamer et al. PLoS ONE 2011

Harris, Co. Texas



Analysis performed using data from Molaei et al. 2007

Common pest species in Texas

Two Basic Types

- Standing water species
  - *Aedes albopictus/aegypti*
  - *Aedes sollicitans*
  - *Culex quinquefasciatus*
- Floodwater species
  - *Psorophora columbiae*
  - *Aedes vexans*

Floodwater species

Psorophora columbiae
Aedes vexans

- Typically live 4-5 days (up to one month)
- Excellent fliers (5-10 miles or more)
- eggs survive up to 2 years in soil
- painful bites

Floodwater species

- Difficult to control due to flight range
  - drainage of marshes
  - floodwater control
  - community fogging
  - avoidance
- Water need only stand 3-4 days to breed mosquitoes
- Not as frequent vectors of human disease (except *Cx. tarsalis* in western U.S.)

Photo by Sean McCann, BugGuide.net

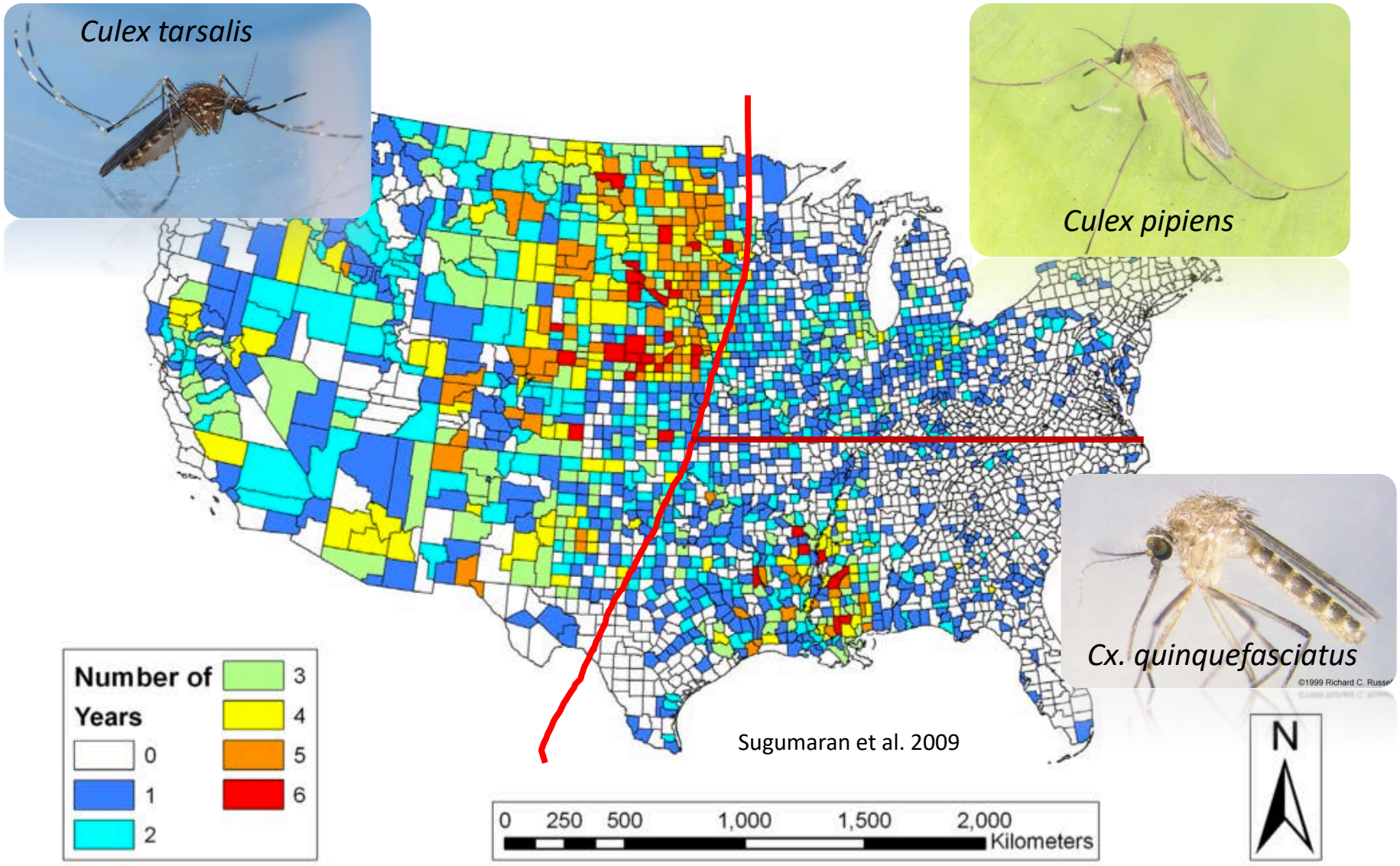
Standing water species

- More a problem in urban settings
  - *Culex quinquefasciatus*
  - *Aedes aegypti*
  - *Aedes albopictus*
- Breed in small containers
  - Water + organic matter
  - Standing water for 7-12+ days
- Includes important disease vectors

Other breeding sites

- Irrigated pastures, rice fields, ground pools
  - *Culex tarsalis*
  - Major vector of WNV in western U.S.
- Salt marshes
  - *Aedes solicitans*
  - Common coastal mosquito
  - Daytime biter
  - 40-50 mile dispersal

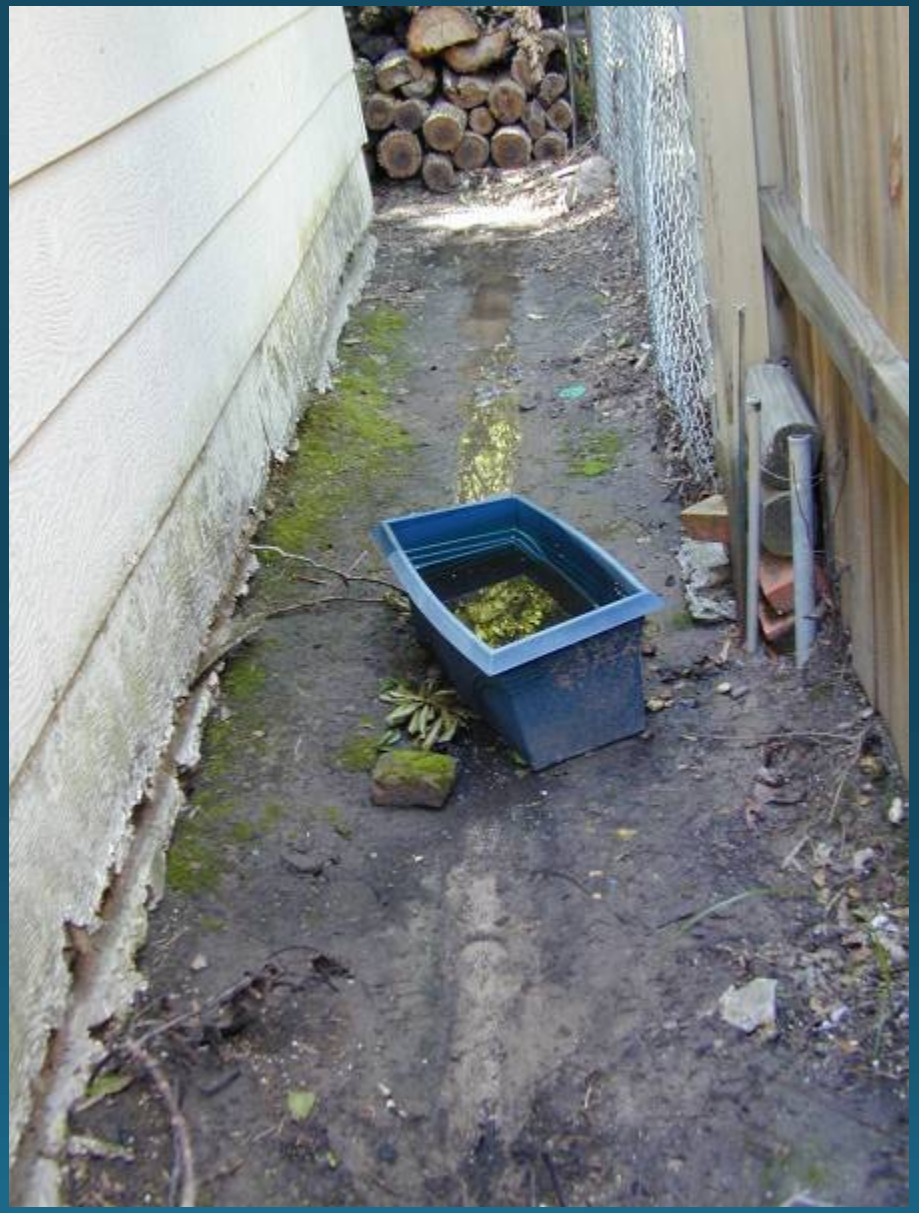
Culex species responsible for WNV transmission to humans



Culex quinquefasciatus – Southern house mosquito

- delicate, dull brown mosquito; lacks bands on tarsi and proboscis
- Prefers polluted water in containers or other standing water
- Principally a nighttime feeder
- mostly feeds on birds, but thought to be principal vector of WNV to humans

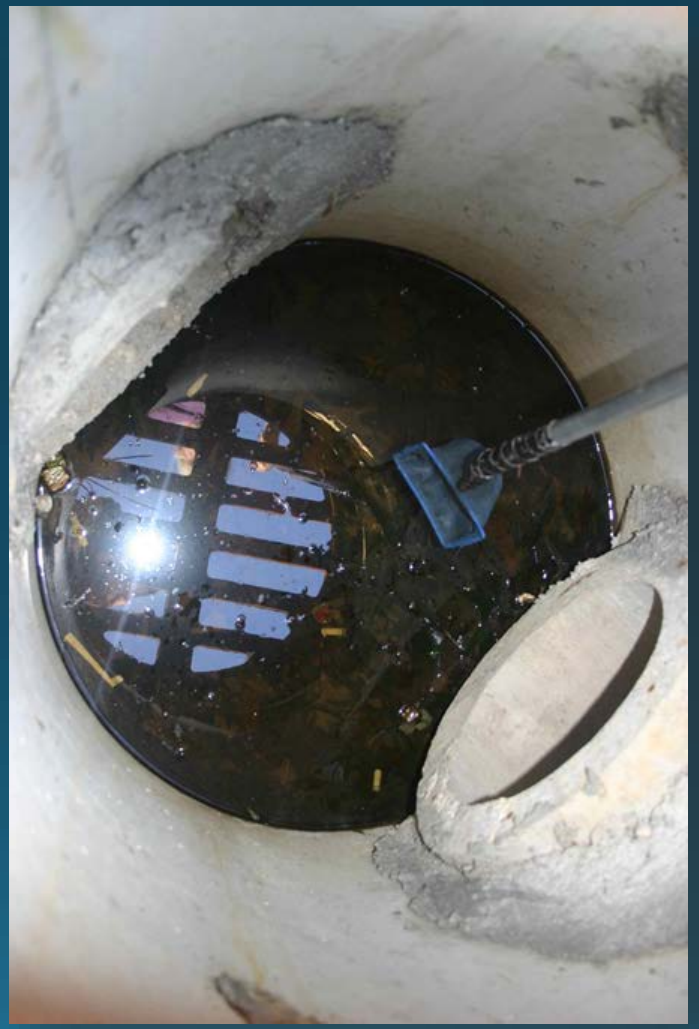
Typical backyard breeding sites

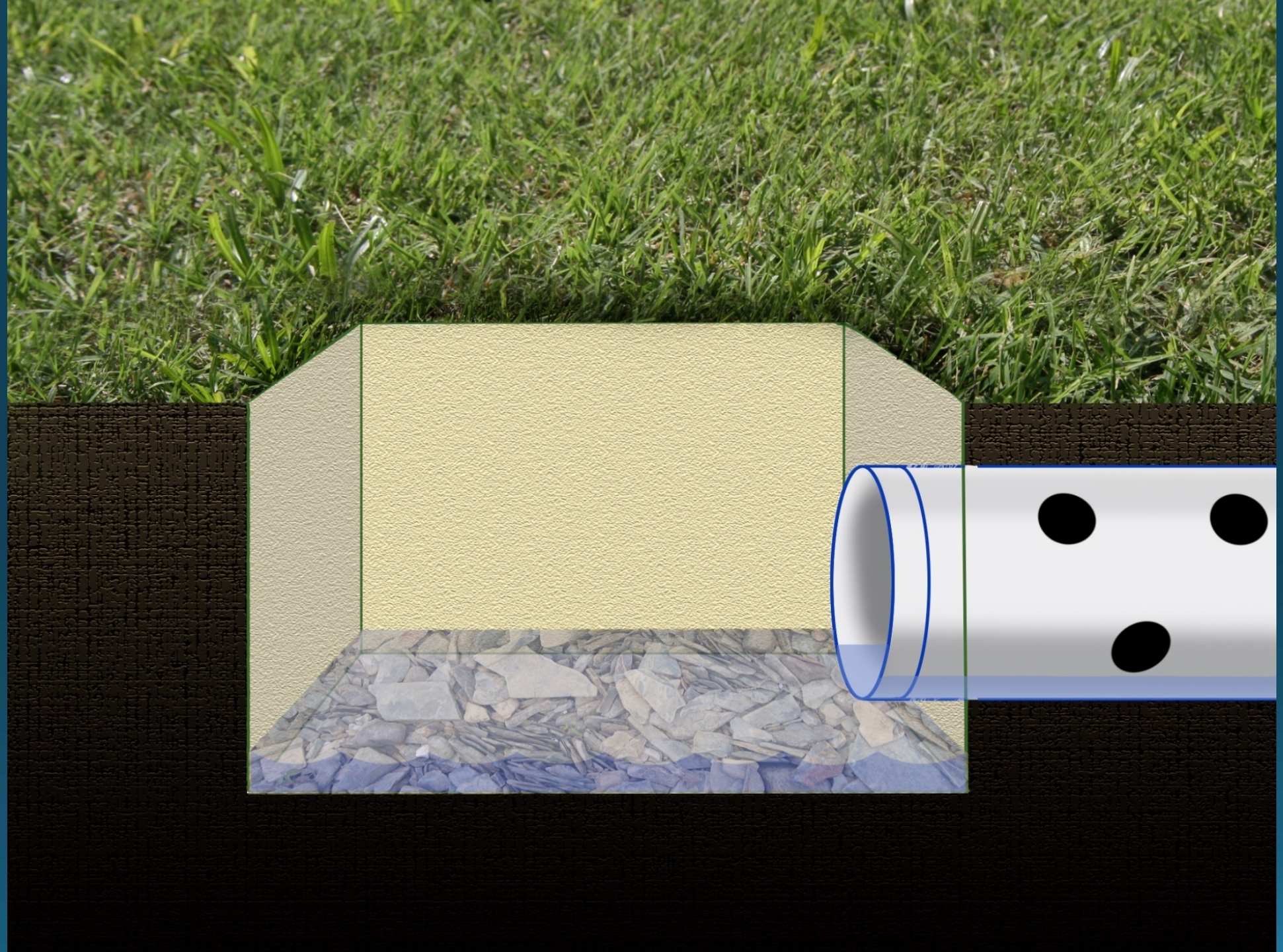


Neglected pools

Culex breeding sites

Stormwater catch basins



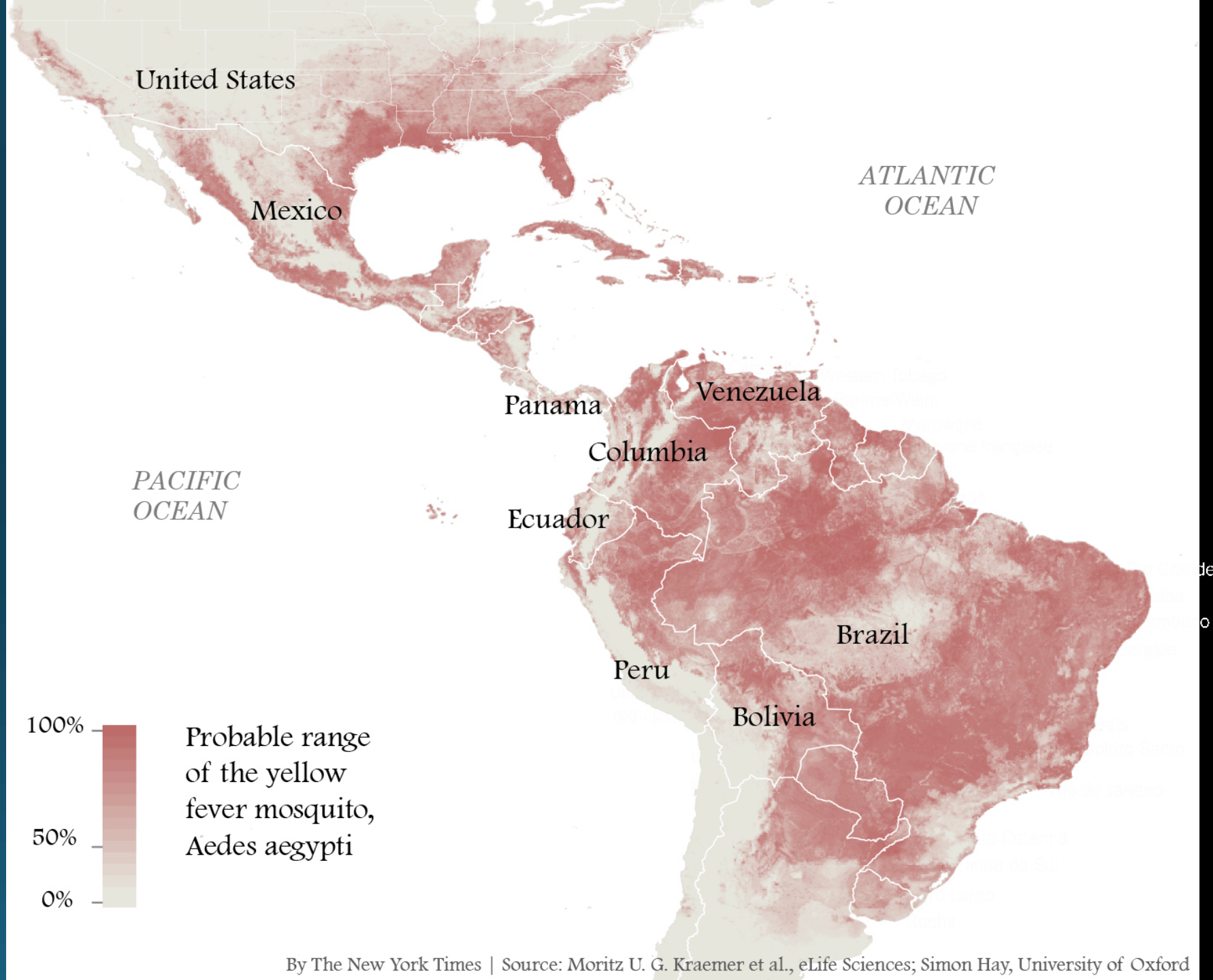


Aedes albopictus
Asian tiger mosquito

Aedes aegypti
Yellow fever mosquito

Two bad skeeters

- Two species thought to be most likely vectors of CHIKV, ZIKV, DENV
- Feed on humans only
- Aggressive daytime biters
- Breed in containers with cleaner water than Culex
- Weak fliers (most travel < 200 meters from breeding sites)
- 25% complaints can be traced to complainer's property (Dallas Co. Health Dept.)

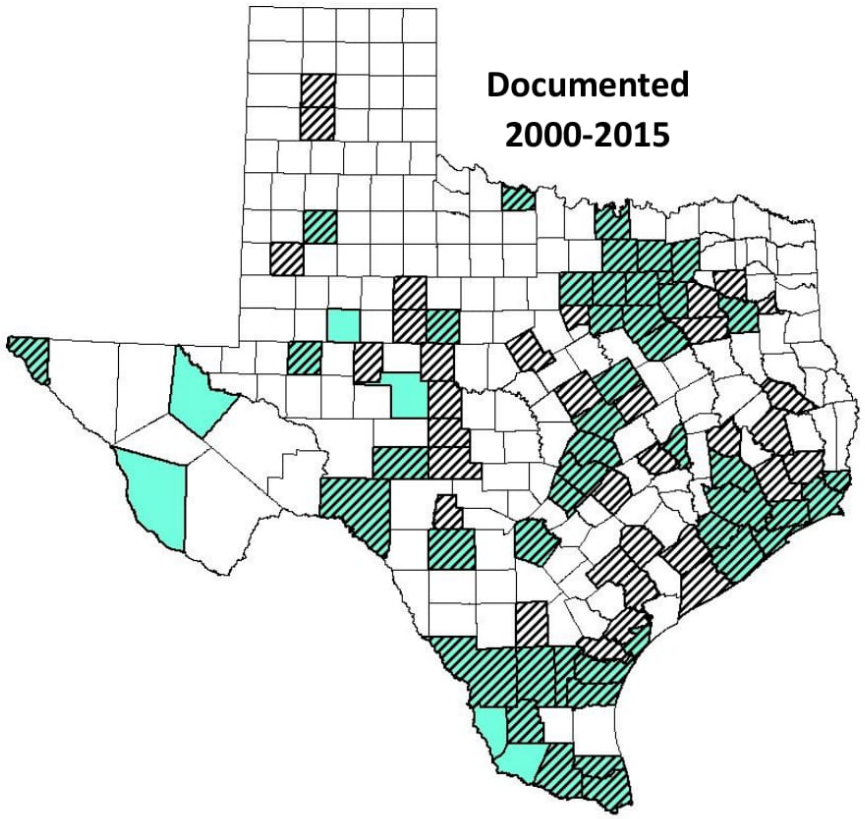


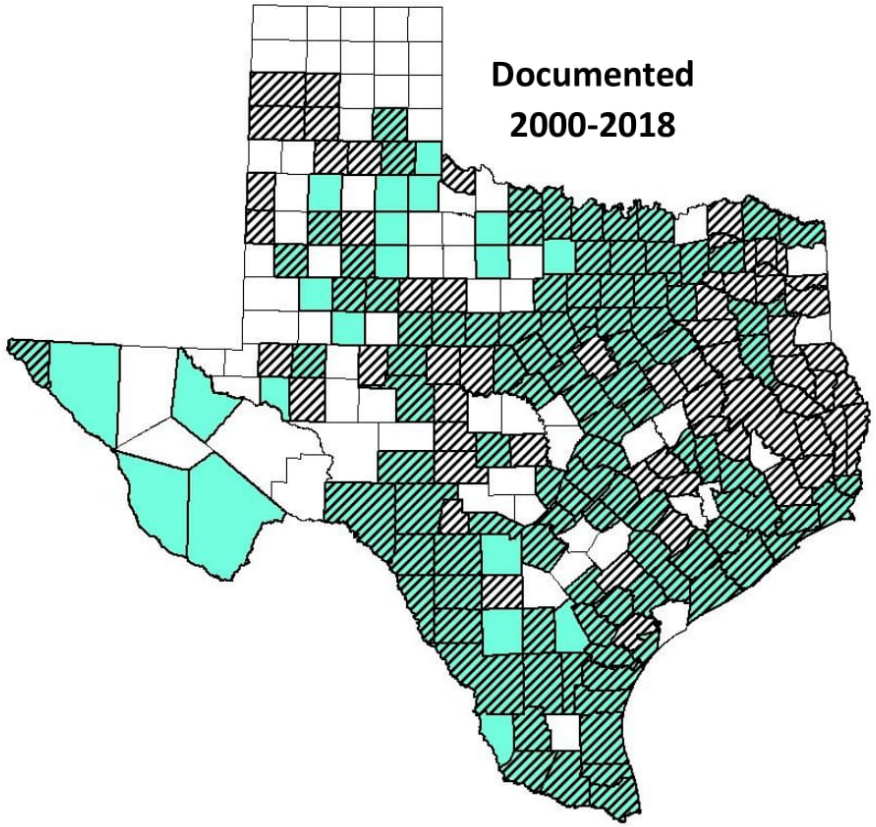
By The New York Times | Source: Moritz U. G. Kraemer et al., eLife Sciences; Simon Hay, University of Oxford

TEXAS
Health and Human Services

Texas Department of State
Health Services

Documented presence of *Stegomyia* species in Texas*

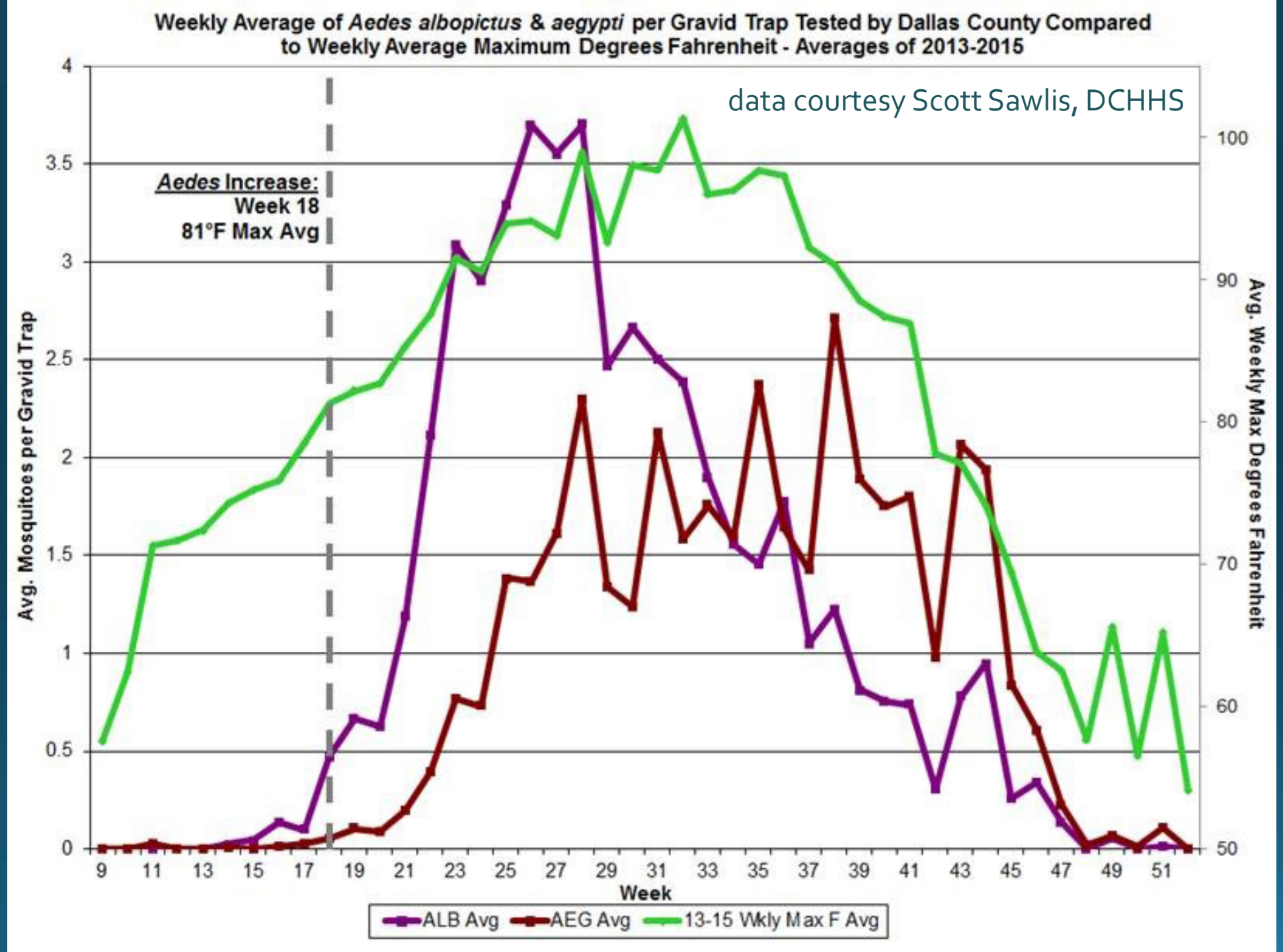




*Based on mosquito collections submitted to the Texas DSHS Arbovirus Laboratory from local jurisdictions, data records obtained from the Centers for Disease Control and Prevention, and documentation provided by Texas entomologists. Counties with newly documented presence of *Aedes aegypti* and/or *Ae. albopictus* during 2016-2018 were added based on collaborative projects between DSHS, Texas AgriLife Extension, and University partners. Updated 2.4.19.

Aedes albopictus

Aedes aegypti


Weekly Average of Aedes albopictus & aegypti per Gravid Trap Tested by Dallas County Compared to Weekly Average Maximum Degrees Fahrenheit - Averages of 2013-2015
data courtesy Scott Sawlis, DCHHS
Aedes Increase:
Week 18
81°F Max Avg
Avg. Mosquitoes per Gravid Trap
Avg. Weekly Max Degrees Fahrenheit
Week
ALB Avg
AEG Avg
13-15 Wkly Max F Avg

Backyard containers

The terrible tire: A municipal nuisance

\+

Leaves
Dust
Organic debris

=

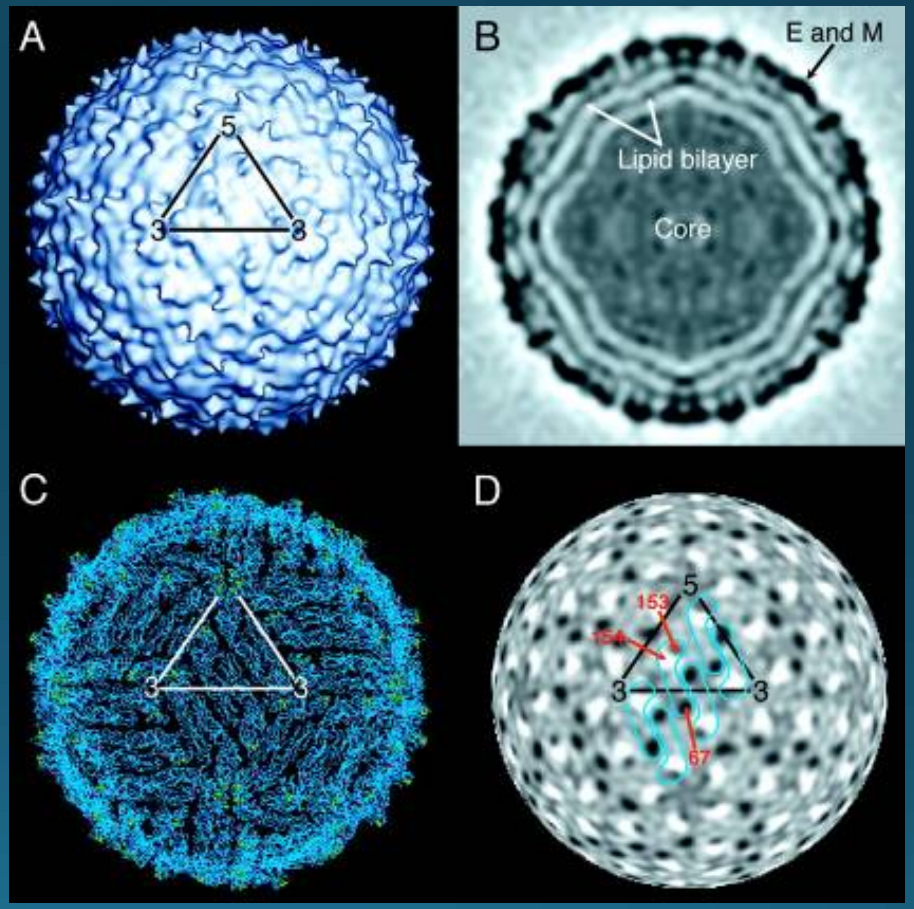
MOSQUITOES

Arboviruses – arthropod borne viruses

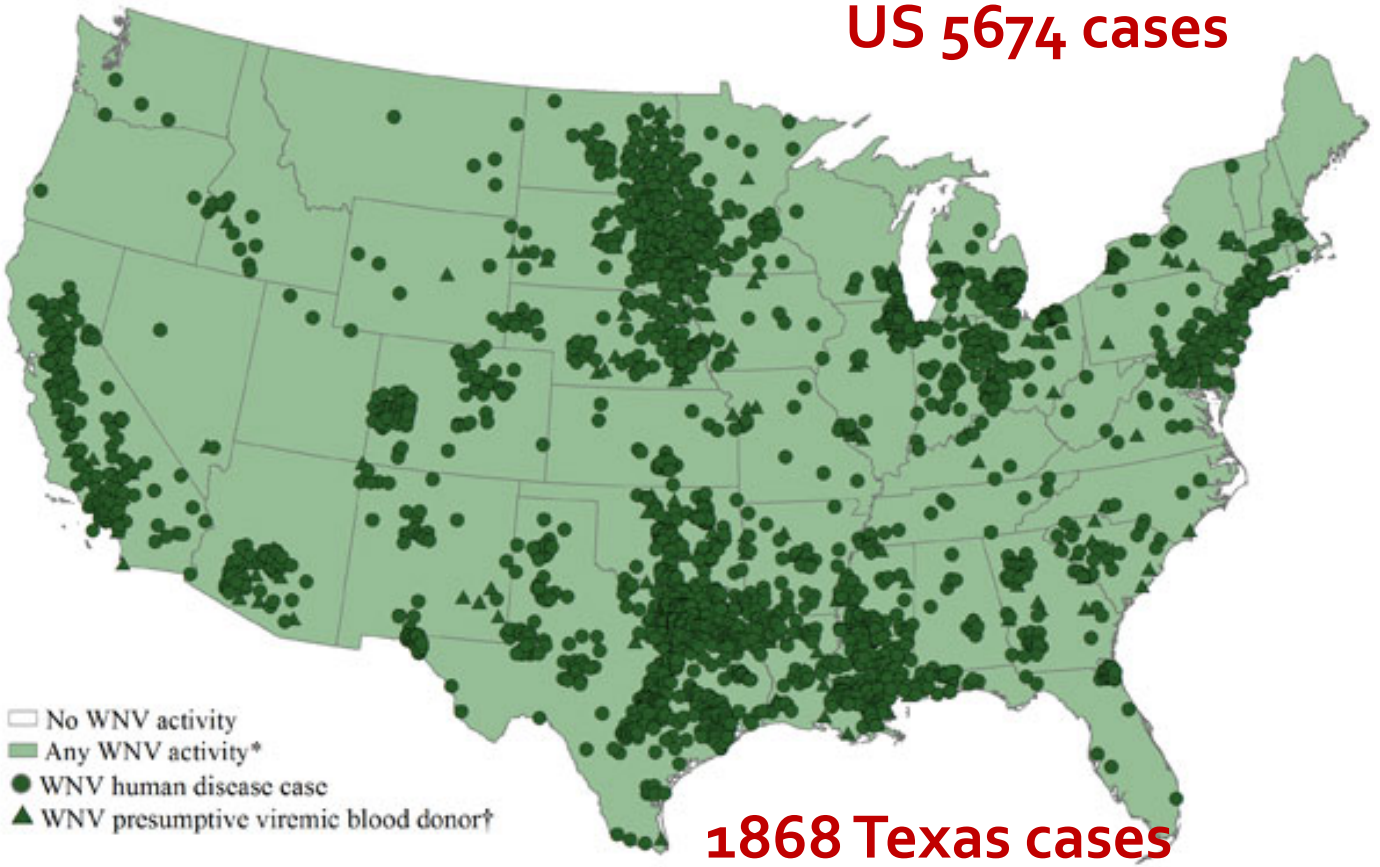
- Bunyaviruses
  - LaCrosse
- Flaviviridae
  - Dengue fever virus
  - St Louis
  - West Nile virus
  - Zika virus
- Togaviridae
  - Eastern equine
  - Western equine
  - Chikungunya virus

West Nile virus

- Most common neuroinvasive arboviral disease in U.S. in recent years
- Discovered in Uganda in 1937
- Found in New York state in 1999
- Estimated 33-88,000 cases in U.S. in 2013, only 1,200 diagnosed and reported



2012 worst year for virus since introduction

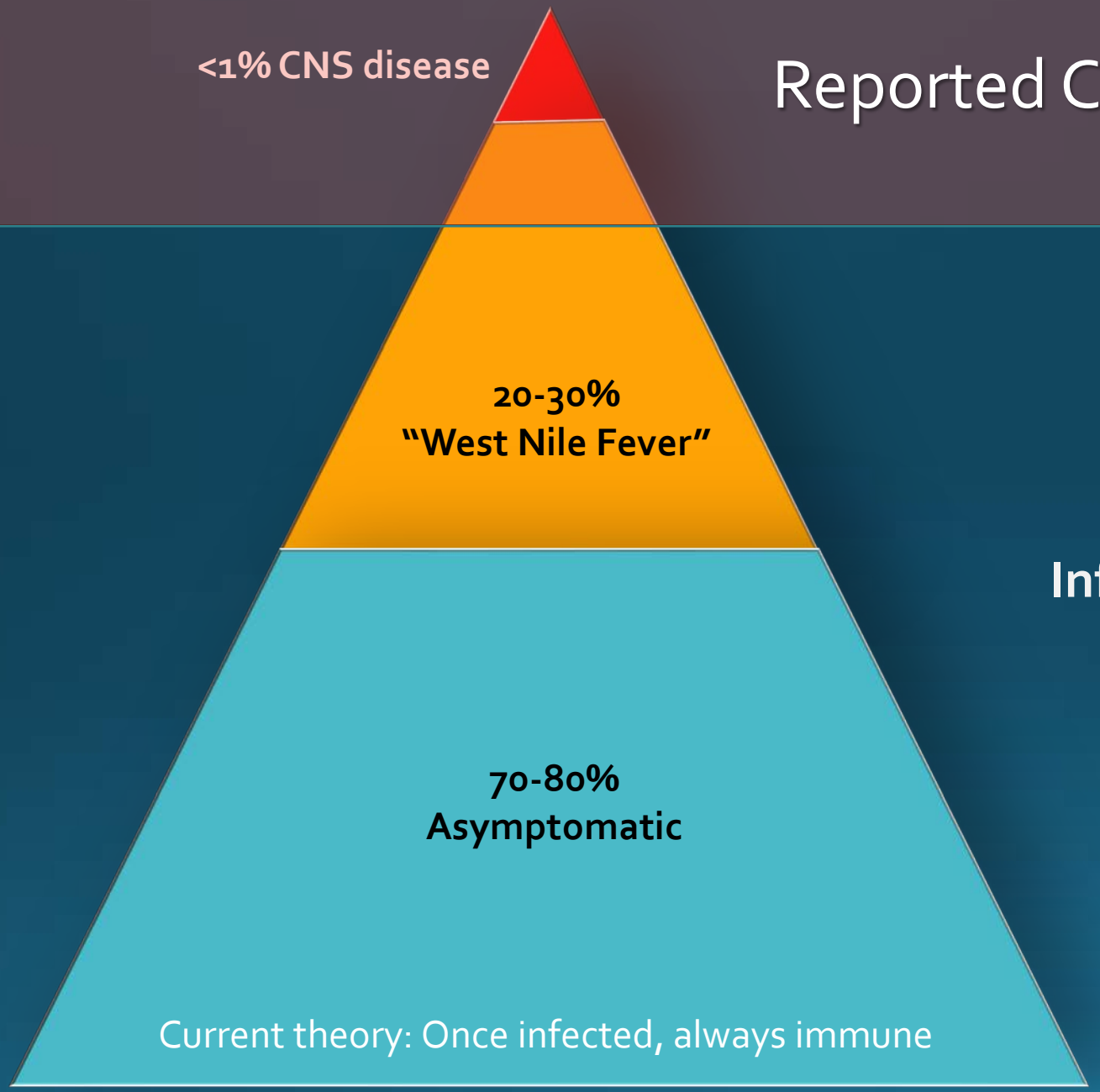


US 5674 cases

1868 Texas cases

286 deaths in 2012

http://www.cdc.gov/media/releases/2013/a0513-west-nile.html



WNV Human Infection "Iceberg"

West Nile Fever

- 20-30% of infected people develop WNF
- Incubation period of 2-15 days
- Most illness: "West Nile fever"
  - Self-limited dengue-like illness
  - Fever, headache
  - Rash, lymphadenopathy
  - Nausea, vomiting
- Rarely pancreatitis, hepatitis, myocarditis
- Average 60 day recovery

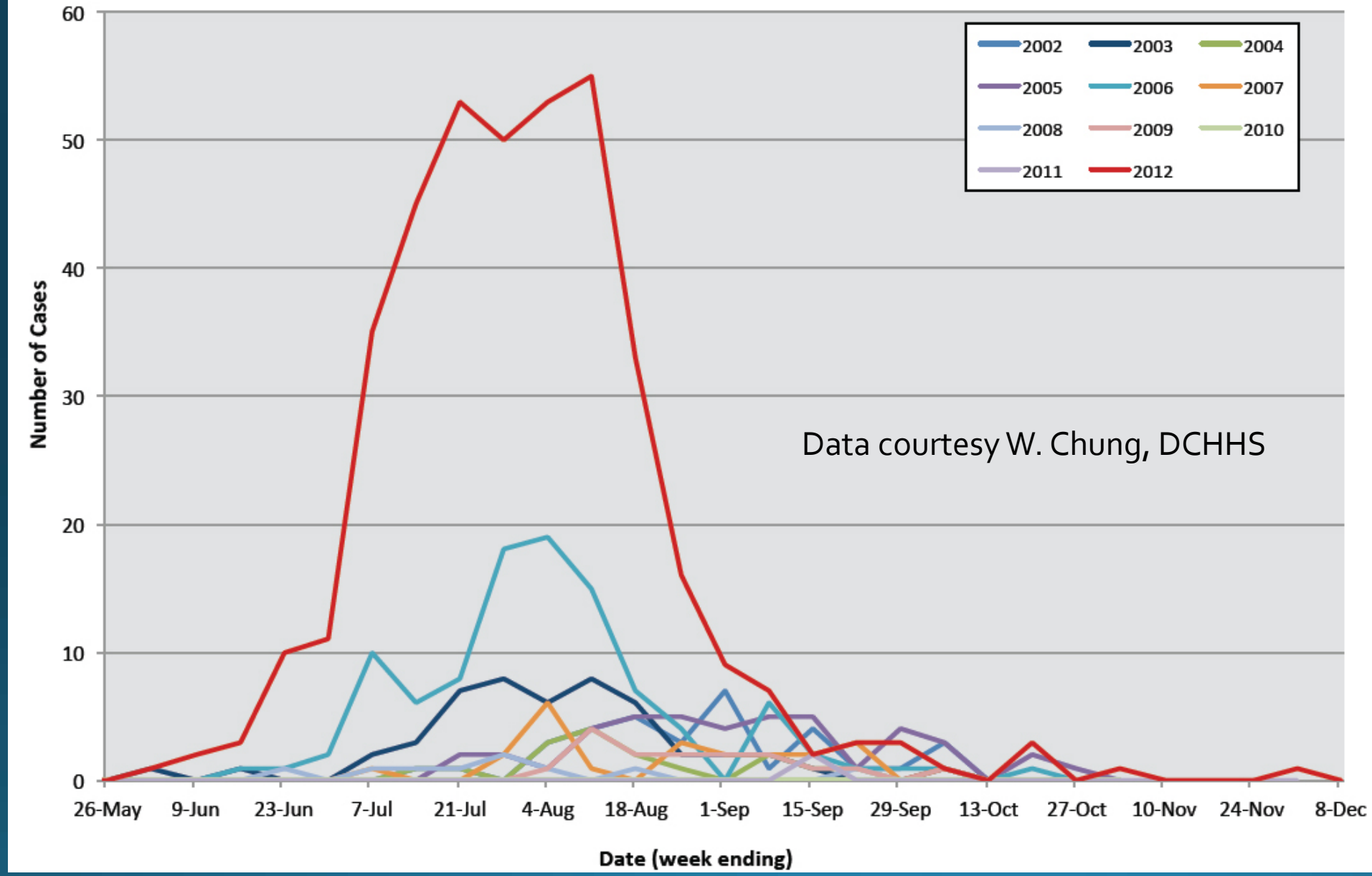
Southern house mosquito
Culex quinquefasciatus

West Nile Neuroinvasive Disease

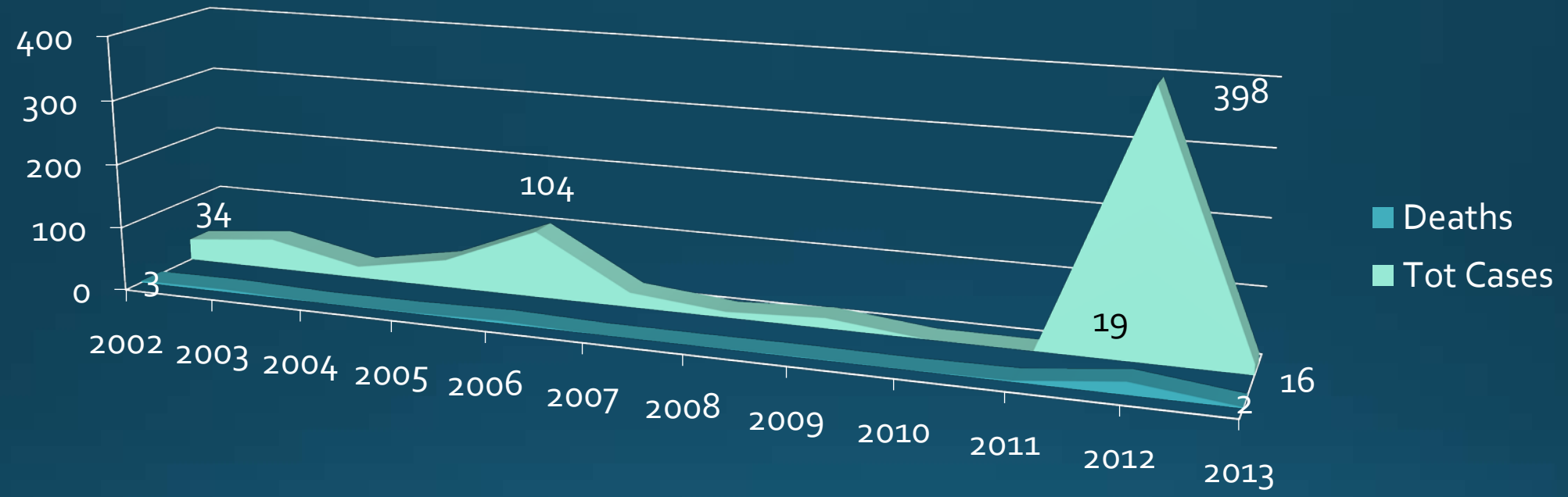
- One in 150 infected people develop WNND (most older than 50)
- Severe neurologic illness categories
  - Disorientation, cognitive impairment
  - Stiff neck
  - Muscle weakness
  - Parkinson-like muscle movement disorders
- 4-18% fatality rate
- Multi-year recovery or permanent disability

Photo: Salvador Vitanza

Number of West Nile Virus Cases by Week of Onset, Dallas County: 2002-2012



Total WNV cases and deaths – Dallas County 2002-2013



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
West Nile Disease	89	27	1868	183	379	275	370	135	146	32	84
West Nile Encephalitis	77	20	844	113	253	196	252	87	108	24	73
West Nile Fever	12	7	1024	70	126	79	118	48	38	8	11

What happened in Texas in 2012?

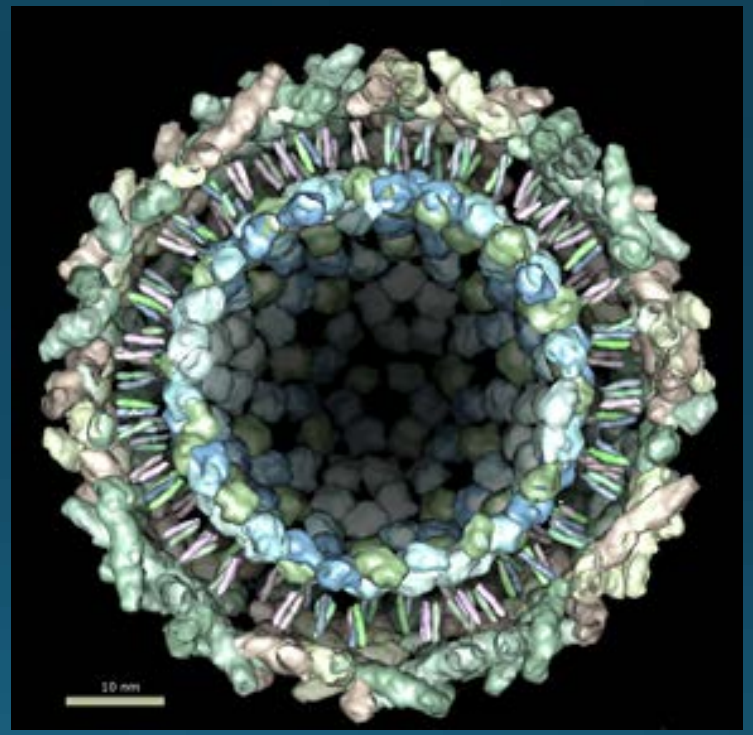
- WNV in Texas since 2002
- Mild winter in 2012 – fewest number of freezes on record
- Wet weather in first four months – wettest in decade
- Dry May, followed by relatively dry weather through mid August

Chikungunya

- "**that which bends up**" a very painful disease
- Symptoms: fever and joint pain, headache, muscle pain, joint swelling, rash (week duration)
- 2013 first local transmission of chikungunya virus in the Americas
- 2014 1.2 million cases of chikungunya virus in Americas. Traveler cases increase among U.S. tourists

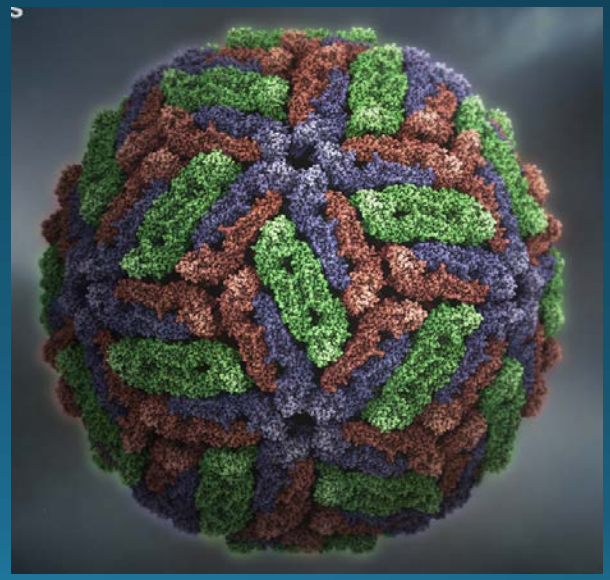
Chikungunya virus (CHIKV)

- Hosts are primates, possibly rodents or birds
- After 1 year, 20% patients will have severe recurring joint pain
- Almost everyone has symptoms (96%+), and person is infectious on days 2-6
- Asian strain of CHIKV thought to be only carried by *Ae. aegypti*
- 12 locally-acquired cases documented from Florida in 2014, none in 2015
- 116 traveler cases confirmed in Texas in 2014, 43 in 2015



Dengue

- Disease of primates only (400 million people infected annually)
- Principally transmitted by *Ae. aegypti* (also *Ae. albopictus*)
- Locally acquired cases in U.S. only in Hawaii, Texas, and Florida
- 4 (poss. 5) serotypes known.
- Getting one serotype does not make one immune to other serotypes.
- A person who is infected subsequently by a second serotype may get especially sick with hemorrhagic fever.
- Most people who are infectious will get sick.



Dengue fever symptoms

- Headache, malaise, sudden onset fever (106°) pain behind eyes, joint pain, bleeding from nose or gums, rash, nausea, vomiting.
- More severe form of disease, skin hemorrhages, nose bleeds, shock, death

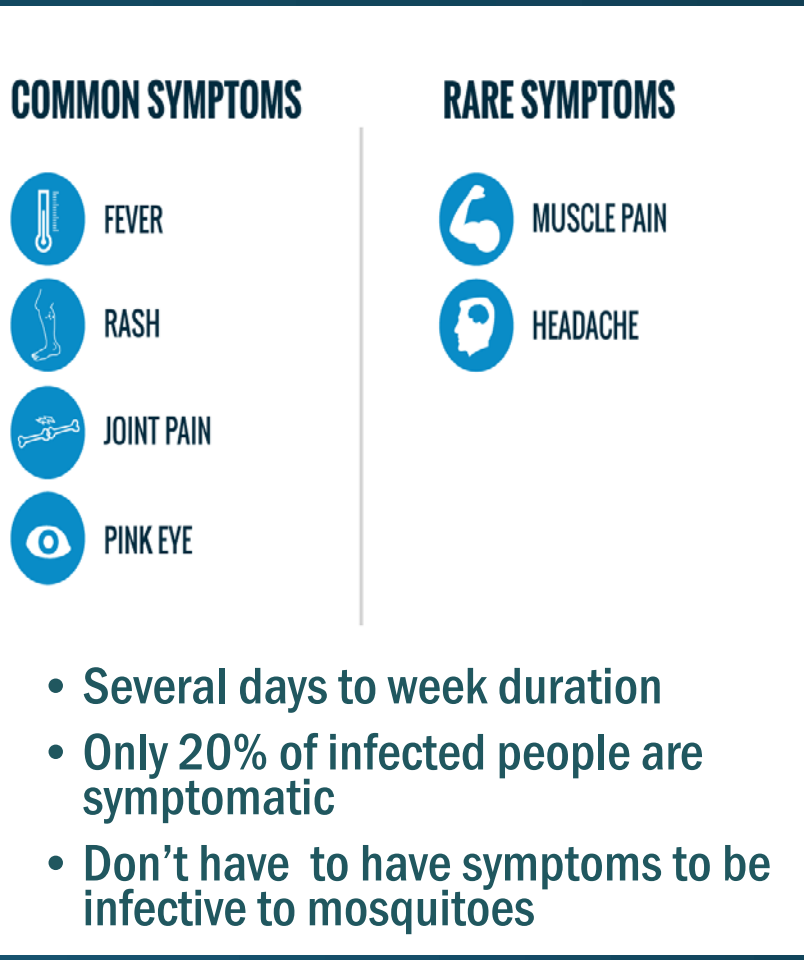
Zika virus

- **No symptoms in most people** – 8 out of 10 infected with Zika virus do not develop any symptoms.

- **Mild symptoms in some people** – Approximately 20% of infections develop symptoms. The most common symptoms of Zika virus infection are fever, rash, headache, joint pain, conjunctivitis (red eyes), and muscle pain.

- **Infection during pregnancy can have severe outcomes** – Zika infection during pregnancy can cause a birth defect of the brain called microcephaly and other severe brain defects.
  - It is also linked to other problems, such as miscarriage, stillbirth, and other birth defects.

- There have also been increased reports of Guillain-Barré syndrome, an uncommon sickness of the nervous system, in areas affected by Zika.



PROTECT YOUR FAMILY AND COMMUNITY:
HOW ZIKA SPREADS

Most people get Zika from a mosquito bite

A mosquito bites a person infected with Zika virus

The mosquito becomes infected

A mosquito will often live in a single house during its lifetime

The infected mosquito bites a family member or neighbor and infects them

More mosquitoes get infected and spread the virus

More members in the community become infected

Other, less common ways, people get Zika:

During pregnancy
A pregnant woman can pass Zika virus to her fetus during pregnancy. Zika causes microcephaly, a severe birth defect that is a sign of incomplete brain development

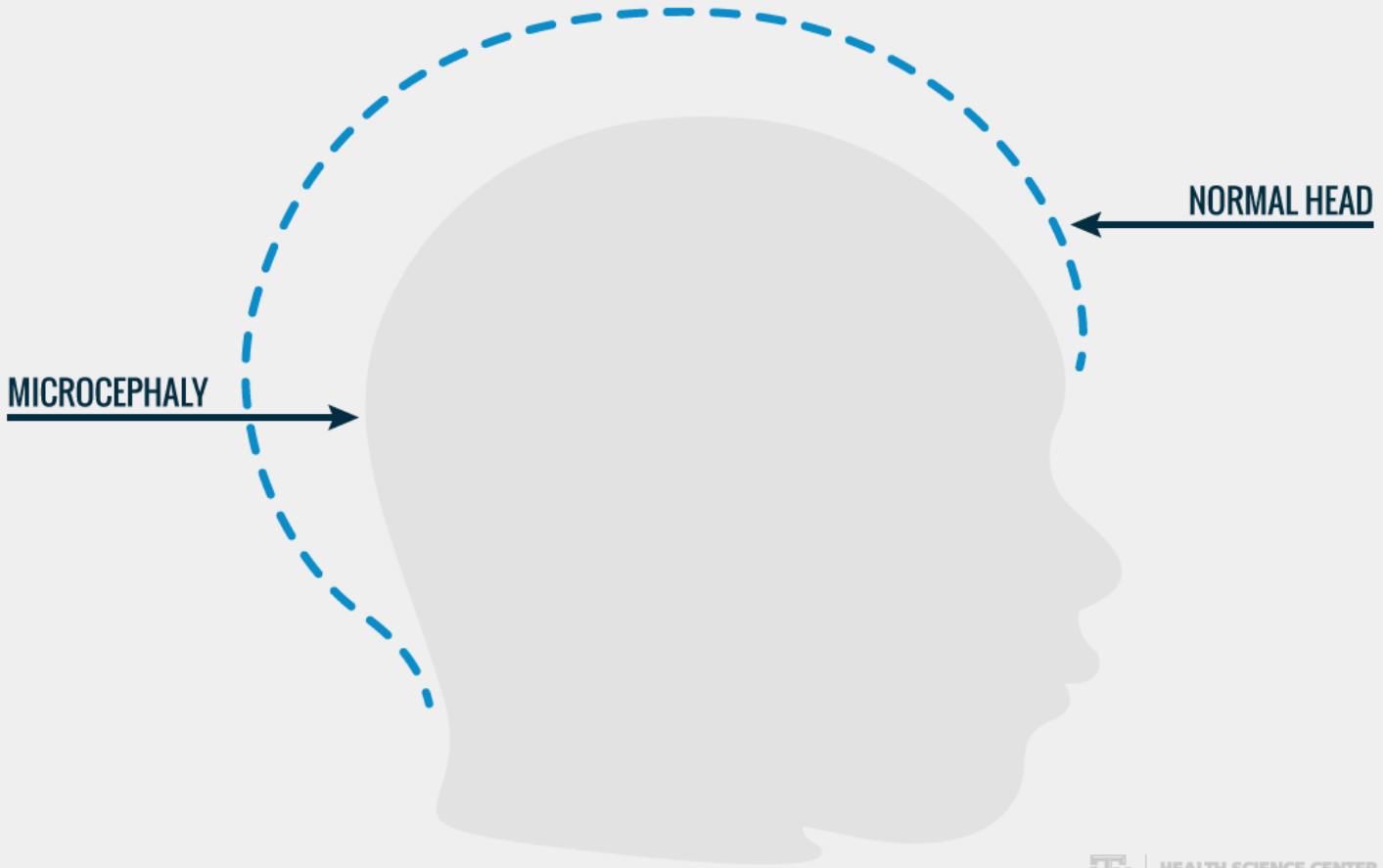
Through sex
Zika virus can be passed through sex from a person who has Zika to his or her sex partners

Through blood transfusion
There is a strong possibility that Zika virus can be spread through blood transfusions

CDC

Birth defects

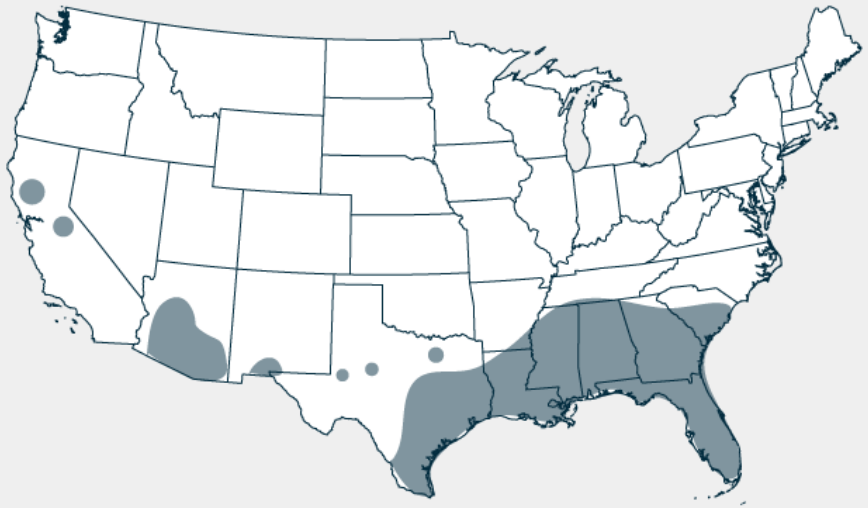
Researchers think Zika might be behind the alarming rise of “microcephaly,” a birth defect where a baby’s head is unusually small because the brain has not developed properly.



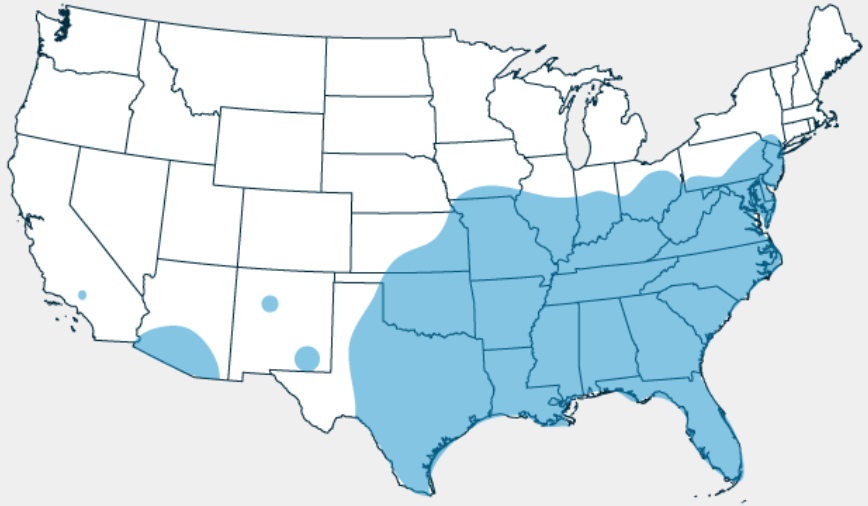
Affected areas

Ae. aegypti primary vector

REGIONS OF THE UNITED STATES MOST LIKELY TO BE AFFECTED



APPROXIMATE DISTRIBUTION OF AEDES AEGYPTI MOSQUITOS



APPROXIMATE DISTRIBUTION OF AEDES ALBOPICTUS MOSQUITOS

SOURCE: CDC

Mosquito Control

Government IMM options (SSLAP)

- Surveillance
- Source reduction
- Larvicides
- Adult mosquito control
  - Truck-mounted ULV
  - Aerial application
- Public Education
  - source reduction
  - personal Protection

Sampling adult *house* mosquitoes

Checking breeding sites

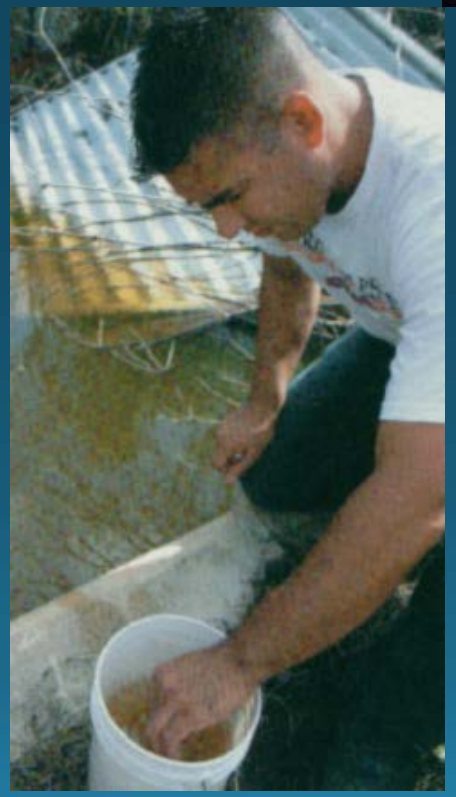
Treatments for standing water

- *Bacillus spp.* (briquettes and granules)
- Methoprene (Altosid, Pre-Strike) granules
- Biodegradable films and oils
- Traditional insecticide

Biological control of mosquitoes

- fish are excellent mosquito predators
- Streams with fish unlikely to produce significant numbers of mosquitoes
- Swimming pools, ditches, temporary ponds may be stocked

Gambusia mosquito fish



stocking swimming pools in New Orleans C. Guillot, Pest Control magazine

Municipal adult mosquito control

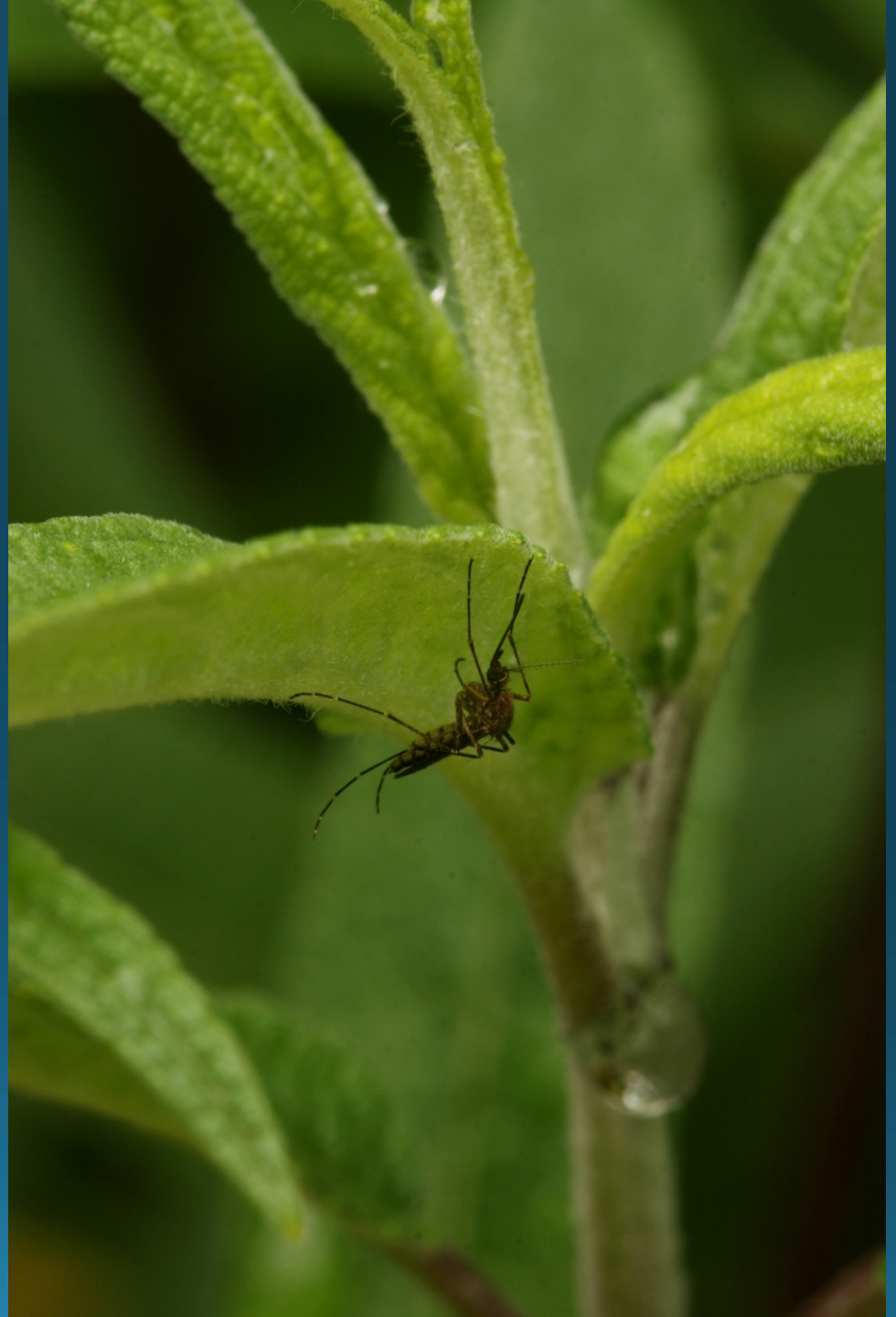
- Needed when source reduction is insufficient to prevent significant mosquito infection rates
- May be only response to Zika outbreaks
- Effectiveness lessened in neighborhoods with vegetation, fence screens
- Used during times of high-disease risk
- Cover same area on three consecutive nights
  for best control

Aerial spraying

- Aerial application superior to ground applications for treating tree canopies, inaccessible areas.
- Especially effective for *Culex*.
- One plane can treat 64,000 Acres/night (100X more than ground-based truck)
- Recommended sprays on 2-3 consecutive nights

On campus options for mosquito control

- Treat mosquito resting sites
  - under eaves of buildings
  - around doorways
  - trees
  - shrubbery
  - foundation plantings
- 3-4 weeks residual control
- PCT magazine Oct. 2006 for University of KY studies



Treat vegetation around home, in yard and around yard perimeter

Residual treatments with pyrethroid insecticides

- Backpack mist blowers
  - larger particle size (50-60 microns)
- 1-3 gallons per home
  - Suspend
  - Talstar
  - Demand CS
- $500-$700/unit
  - Stihl
  - Solo
  - Maruyama
  - Curtis

Photo by Mike Potter, U of KY

Most backyard treatments better against *Aedes*

Culex resting sites

8 – 10 feet

Insecticide layer & Aedes resting sites

In2Care trap

- The In2Care Mosquito Trap effectively attracts and kills Aedes mosquitoes with novel and green ingredients that target both larvae and adults. Trap activity is not limited to the trap itself but extends to the surrounding area.

Mosquito repellents remain the single most effective protection from mosquitoes

- N,N-diethyl m-toluamide (DEET) Gives longest lasting protection (5 hrs using 24% solution)

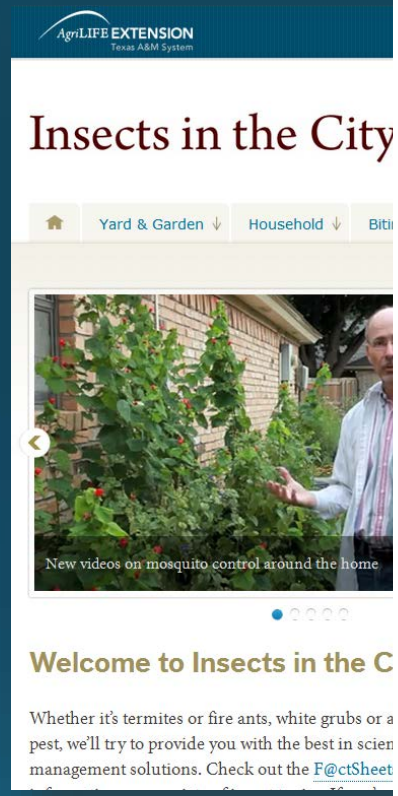
New alternatives to **DEET**

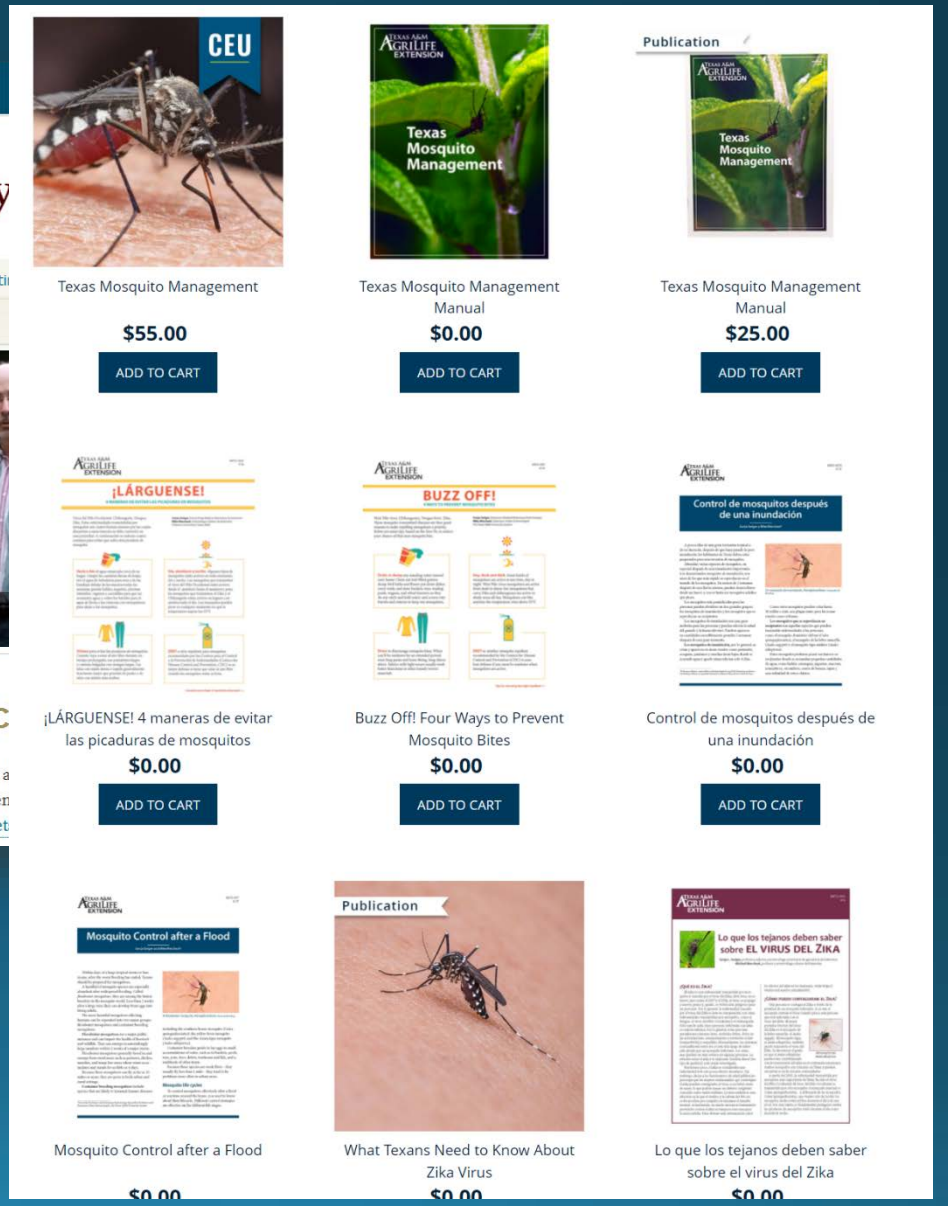
- Picaridin (Cutter brand)
- Lemon Oil of Eucalyptus (Repel brand)
- IR-3535 (Avon)
- 2-undecanone

Extension Online Resources

http://citybugs.tamu.edu

- **Insects in the City** website
  - FAQs about aerial spraying
  - Videos on mosquito control around the home
- AgriLife Learn

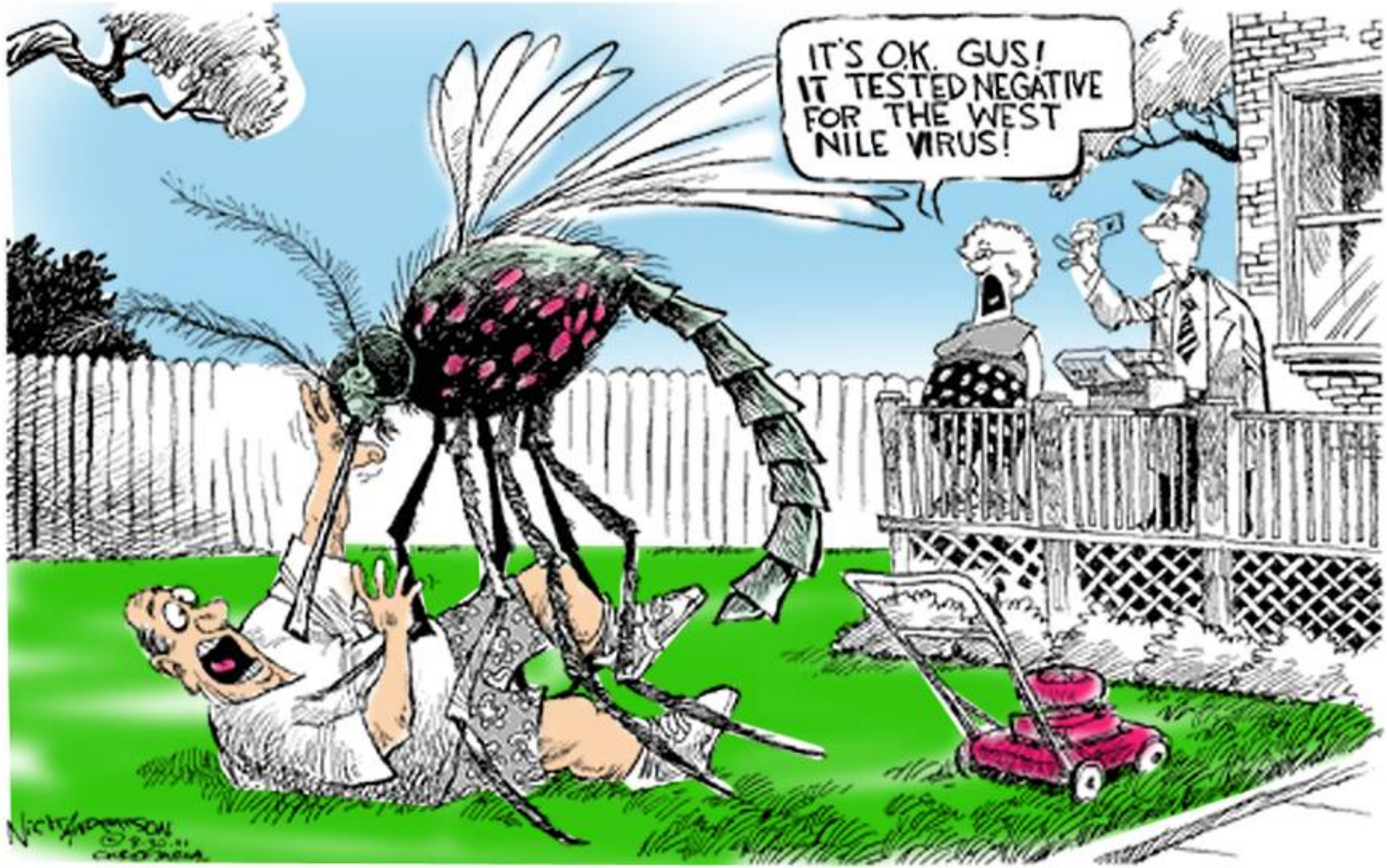




Mosquito Safari website

Take a virtual tour of a backyard in search of mosquito breeding sites

http://mosquitosafari.tamu.edu


IT'S O.K. GUS! IT TESTED NEGATIVE FOR THE WEST NILE VIRUS!