Understanding Mosquitoes and Mosquito Control Options

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Mosquitoes:
• 3,500 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

Mosquito
725,000

Human
475,000

Malaria mosquito

Anopheles
Malaria mosquito

• 315 million cases in 2010 (5,460,075 deaths)
• 565,000 deaths annually (90% a virus)

Anopheles
former major public health risk in U.S.

• Vector of malaria
• Breeds in marshes, ponds, edges of shallow streams
• No longer major health threat
  • Combined efforts of DDT and swamp draining in malarious areas
  • 4.6 million homes treated by government between 1947-49
  • Eliminated in U.S. between 1947-51 (135,000 cases in 1947)

Mosquitoes:
• The fly order (Diptera)
  • Family Culicidae
  • long proboscis
  • long legs
  • scales on wing veins
• 172 species in U.S.
• 85 species in Texas
• 37 species in Dallas Co. (DCHHS)
Mosquito larvae

- Aquatic insects
- Adults live 4-30 days
- 4-24+ days from egg to adult
- Strong to weak fliers, depending on species
- Potential disease transmitters

Mosquito life cycle

- Eggs
- Larva
- Pupa
- Adult

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

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

US Armed Forces Pest Management Board

Ovitrap with eggs of Aedes aegypti

How mosquitoes transmit viruses

1. Mosquito bites into infected person and takes the virus into system.
2. Virus travels to the midgut and enters the circulation system and salivary glands.
3. Mosquito bites into another person and injects the virus with the bite.
Mosquito-borne virus transmission cycles

- West Nile virus
- Zika virus
- Chikungunya virus
- Dengue virus

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

**Standing water species**

- More of a problem in urban settings
- Culex quinquefasciatus
- Aedes sollicitans
- Aedes albopictus
- Breed in small containers
- Water + organic matter
- Standing water for 2-32 days
- Includes important disease vectors

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.)
Other breeding sites:

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

*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

*Culex species responsible for WNV transmission to humans*
Weak fliers (most travel < 200 meters from breeding sites)

25% complaints can be traced to complainer's property (Dallas Co. Health Dept.)

Two bad girls

• 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

Map showing probable range of the yellow fever mosquito, Aedes aegypti.
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 33,880,000 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
West Nile Neuroinvasive Disease

- One in 150 infected people develop WNV (most older than 50)
- Severe neurologic illness categories
  - Disorientation, cognitive impairment
  - Stiff neck
  - Muscle weakness
  - Parkinson-like muscle movement disorders
- <1% fatality rate
- Multi-year recovery or permanent disability

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, myocardiits
- Average 60 day recovery

Total WNV cases and deaths — Dallas County 2002-2013

Data courtesy W. Chung, DCHHS

What happened in north 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 (99%), and person is infectious on days 2-6
- Asian strain of CHIKV thought to be only carried by Aedes aegypti
- 12 locally-acquired cases documented from Florida in 2014, none in 2015
- 316 traveler cases confirmed in Texas in 2014, 43 in 2015

**Dengue**

- Disease of primates only (400 million people infected annually)
- Principally transmitted by Aedes aegypti (also Aedes 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°F) 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**

- Several days to week duration
- Only 20% of infected people are symptomatic
- Don’t have to have symptoms to be infective to mosquitoes

**Risk factors**

- Pregnant Women
- Anyone
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

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
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

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
- Manuyama
- Curtis

Most backyard treatments better against Aedes
- Culex resting sites
- 8-10 feet
- Insecticide layer & Aedes resting sites

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)

http://preventingzika.org
Extension Online Resources

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

http://citybugs.tamu.edu

Mosquito Safari website
Take a virtual tour of a backyard in search of mosquito breeding sites

http://mosquitosafari.tamu.edu