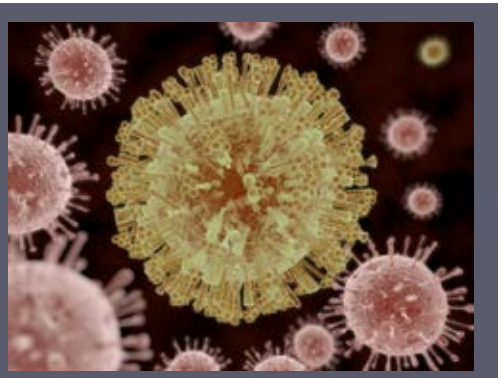
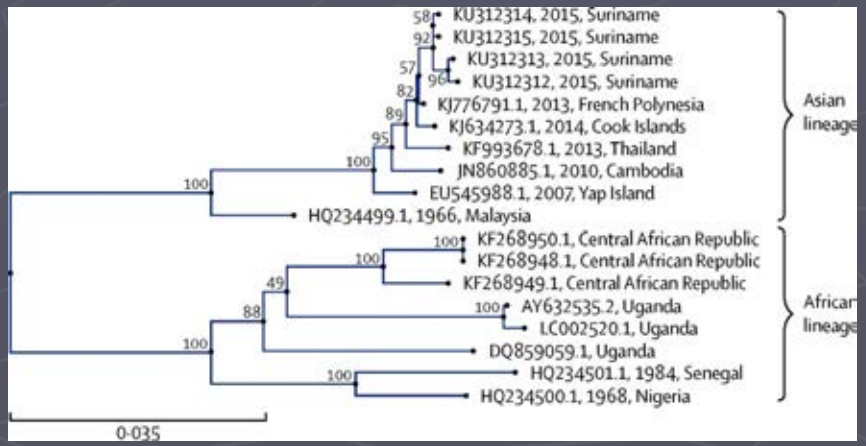
Zika in the U.S.: What Environmental Health and Pest Management Professionals Need to Know

Sarah R. Michaels, MSPH
New Orleans Mosquito & Termite Control Board
New Orleans, Louisiana

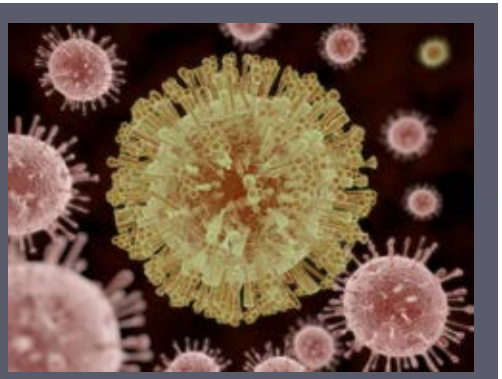
Zika virus



- Zika virus is a mosquito-transmitted RNA virus in the Flavivirus genus (West Nile, dengue & yellow fever viruses)
- Transmitted by the yellow fever mosquito, *Aedes aegypti,* and the Asian tiger mosquito, *Ae. albopictus*
- There are two virus lineages: African & Asian
- The virus spreading in the Americas is related to the Asian strain, which circulated in French Polynesia during 2013-14



Zika virus



- Identified in 1947 in Uganda (captive primate & mosquitoes)
- Human infections rare, since the 1950s, cases occurred in a narrow equatorial belt from Africa to Asia
- 2007: outbreak in Micronesia (Yap)
- 2013-14: eastward across Pacific Ocean to French Polynesia
- 2014-15: South America, Central America, Mexico, Caribbean

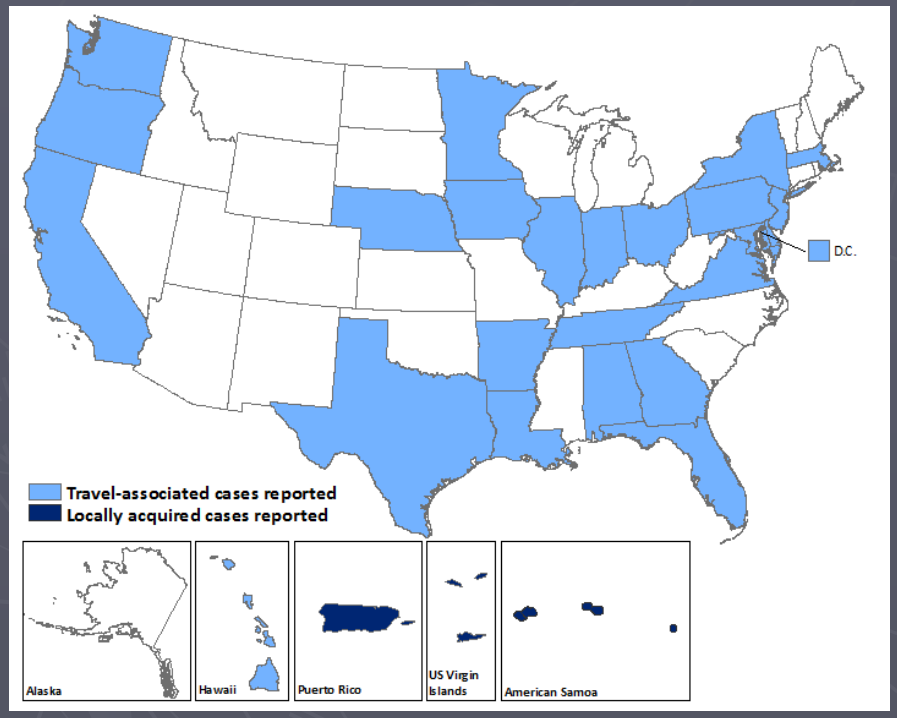
University of Florida

Areas of Current Zika Virus Local Transmission

http://www.cdc.gov/zika/geo/index.html
2/24/16

- In May 2015, the Pan American Health Organization (PAHO) issued an alert regarding the first confirmed Zika virus infections in Brazil.
- Outbreaks are now occurring in 40 countries (31 in Americas)
- Zika virus is expected to continue to spread into areas where the vector mosquitoes are present
- CDC travel alerts (Level 2 – Practice Enhanced Precautions)
- World Health Organization (WHO) declaration: Public Health Emergency of International Concern

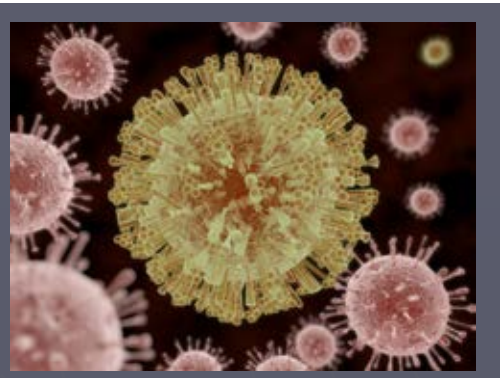
Zika in the United States



http://www.cdc.gov/zika/geo/united-states.html

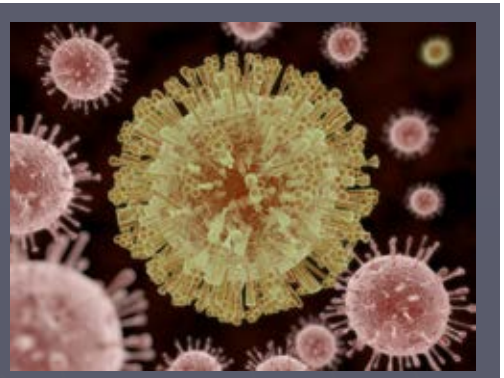
- Zika cases of returning travelers (107 - 2/24/16).
- No locally-transmitted cases reported in the continental U.S.
- Local transmission in Puerto Rico & U.S. Virgin Islands (39)
- The number of Zika cases among travelers will increase
- Increasing number of cases of sexual transmission
- Imported cases could result in limited, local spread of the virus where vector mosquitoes are present

Transmission

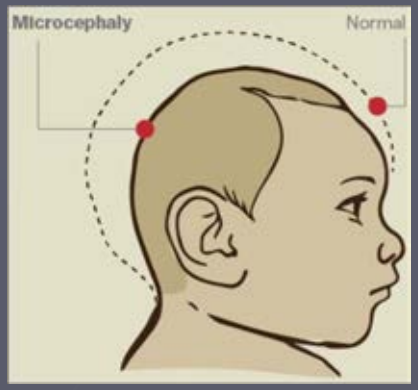


- The primary means of transmission of Zika virus is through the bite of an infected *Aedes aegypti* or *Aedes albopictus* mosquito
- Mother to child – during pregnancy & at the time of birth, breastfeeding
- Sexual contact – by a man to his sex partners, symptomatic, persistent in serum longer than blood
- Blood transfusion – Brazil, donor screening in US
- Virus is present in but not known to spread through saliva or urine

Symptoms



- About 1 in 5 people infected with Zika virus become ill
- Incubation period (the time from exposure to symptoms) is 2-7 days
- Most common symptoms of Zika are fever, rash, joint pain, or conjunctivitis (red eyes), sometimes muscle pain and headache
- Symptoms are similar to dengue and chikungunya
- Illness is usually mild, lasting for several days to a week
- Most are not hospitalized and deaths are rare
- However, occasionally neurologic complications including Guillain–Barré
- Once a person has been infected, he or she is likely to be protected from future infections.



Zika & Pregnant Women

- Brazil (2015) - health authorities observed an increase in babies born with microcephaly in areas newly infected with Zika virus
- Information on virus transmission during pregnancy or childbirth is under extensive study, increasing body of evidence
- World Health Organization (WHO) Emergency Committee declared the pandemic a Public Health Emergency of International Concern

- CDC recommends special precautions for women who are pregnant:
  - Consider postponing travel to any area where Zika virus transmission is ongoing.
  - If you must travel to one of these areas, talk to your doctor first and strictly follow steps to prevent mosquito bites during your trip.
  - If male sexual partner travels to area of Zika transmission, abstain from or practice safe sex (condoms)

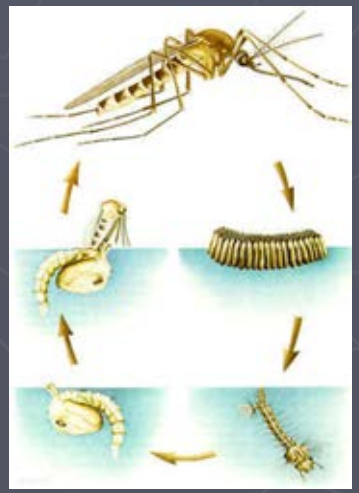
Diagnosis & Treatment

- Virus in blood up to 7 days after onset of symptoms
- Antibodies in blood (IgM after 1 week or 4 fold increase in neutralizing antibodies in acute & convalescent samples)

- Presently treatment is purely symptomatic - supportive care and rest
- Treated with rest, fluids, and acetaminophen, aspirin should be used only when dengue has been ruled out to reduce the risk of bleeding
- Diagnosis of viral infection important to rule out other infections and for epidemiologic investigations
- Currently, there are no licensed vaccines or therapies available

West Nile virus

- Birds as reservoir host, enzootic cycle
  - Humans – dead-end host
  - Endemic – annual transmission in U.S.
  - Warmer temperatures/ mild winter - 2012
- Mosquito vector – Southern House mosquito
  - *Culex quinquefasciatus*
  - *Cx. pipiens, Cx. tarsalis*
- Different habitats, surveillance
  - Similar control measures

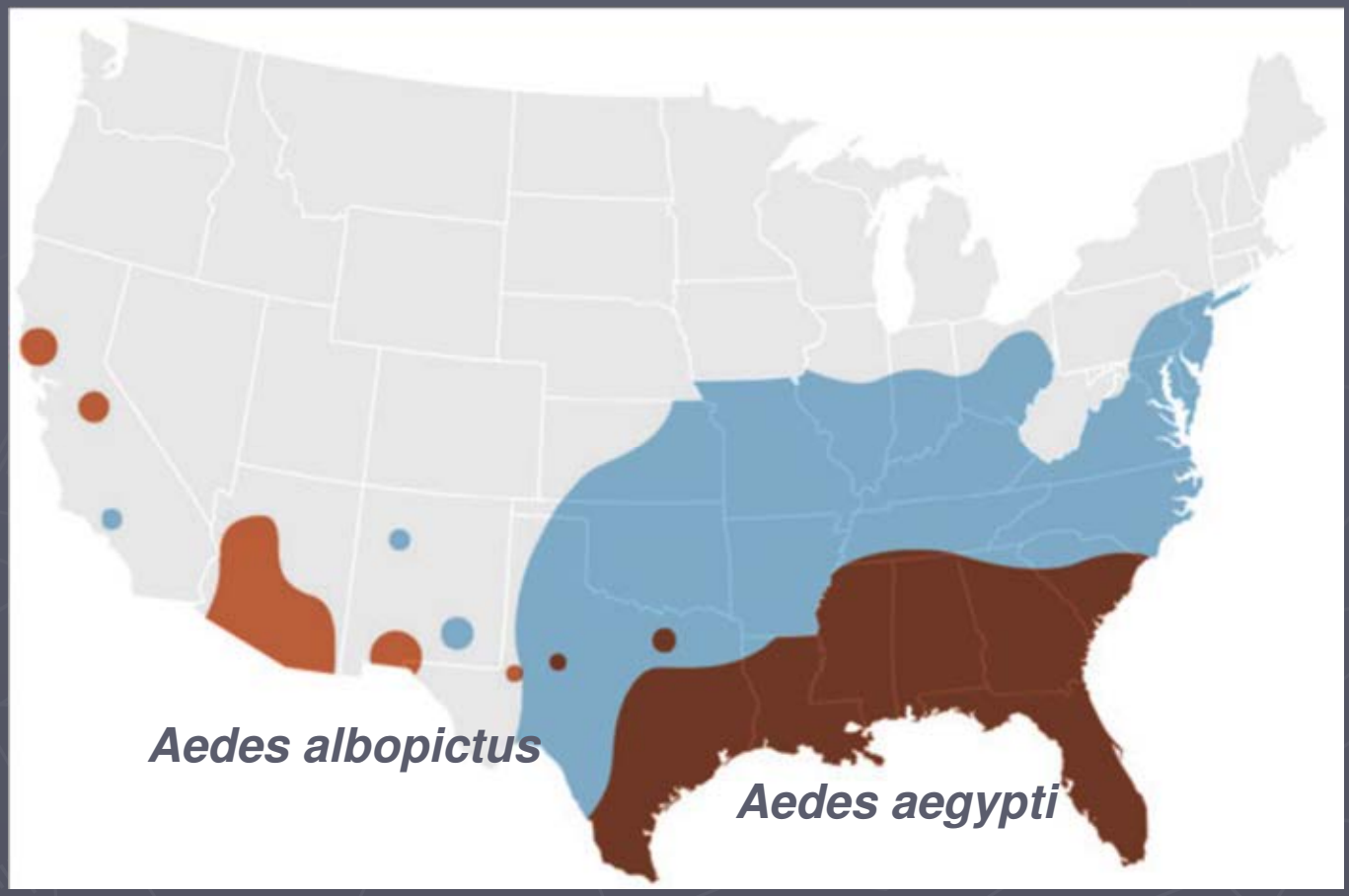


Mosquito Vectors

Aedes aegypti
Yellow Fever mosquito*

Aedes albopictus
Asian Tiger mosquito

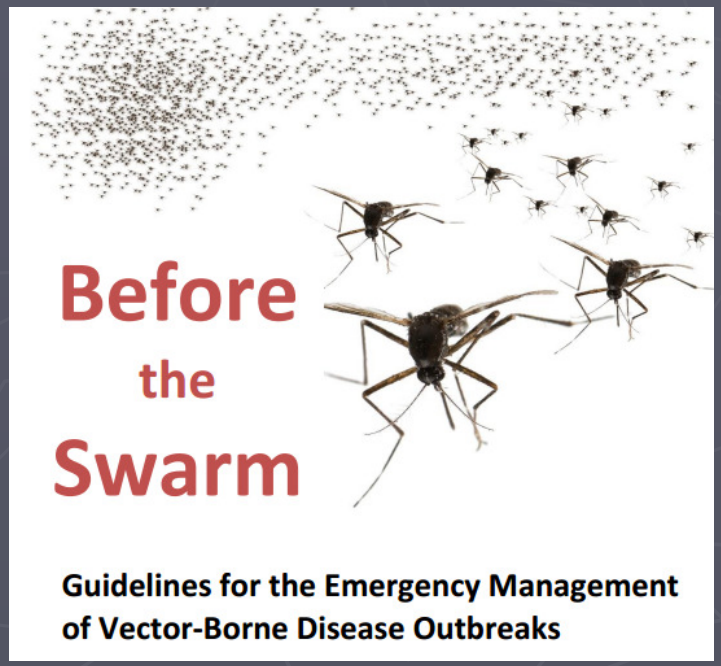
Aedes Distribution – U.S.



National Pest Alert - ncipmc.org/action/alerts/zika.php

Before the Swarm – Association of State and Territorial Health Officials (ASTHO)

- Responding to a Mosquito-Borne Epidemic Emergency
- Plan Ahead
- Involve Others
- Use the Best Science & Data
- Inform the Public



Responding to a Mosquito-Borne Epidemic Emergency

- Collaborate with a variety of organizations that could conduct mosquito control operations, such as public works departments, community groups
  - Regional mosquito control teams - technical expertise
  - Shared service agreements with nearby jurisdictions before an emergency occurs - equipment pools, standard contracts for services
- Make informed, evidence-based decisions regarding pesticide applications in the areas of highest risk for mosquito-borne disease
  - Coordinate with public health laboratories for testing and surveillance
  - Eliminate possible larval habitats
  - Take advantage of GIS tools to track the status of pesticide applications, source reduction efforts and public health message coverage
- Become familiar with federal response partners and protocols for requesting assistance

Surveillance & Control of Aedes in U.S.

- Intended for public health officials and vector control specialists
- Function of mosquito -based surveillance programs are to:
  - Determine presence or absence *Aedes* species in a geographic area
  - Identify types of containers are producing the most mosquitoes for targeting vector control efforts
  - Develop detailed maps to track larval sites if *Ae. aegypti* or *Ae. albopictus* are detected in an area
  - Collect mosquito population data and identify geographic areas of high abundance (high-risk)
  - Monitor the effectiveness of vector control efforts
- Varies based on funding, resources, and trained staff. However, to quickly identify and mitigate a mosquito-borne disease outbreak, establishing and maintaining a local vector surveillance program is critical.

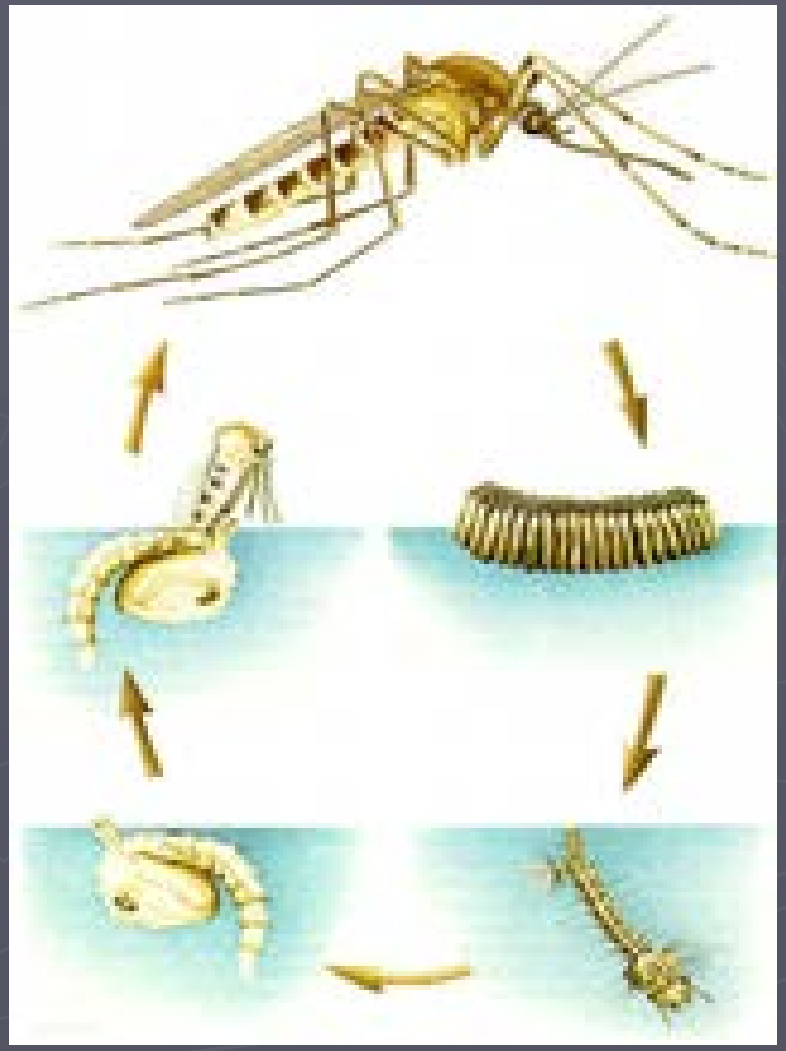
http://www.cdc.gov/chikungunya/resources/vector-control.html

Aedes Area-wide Control

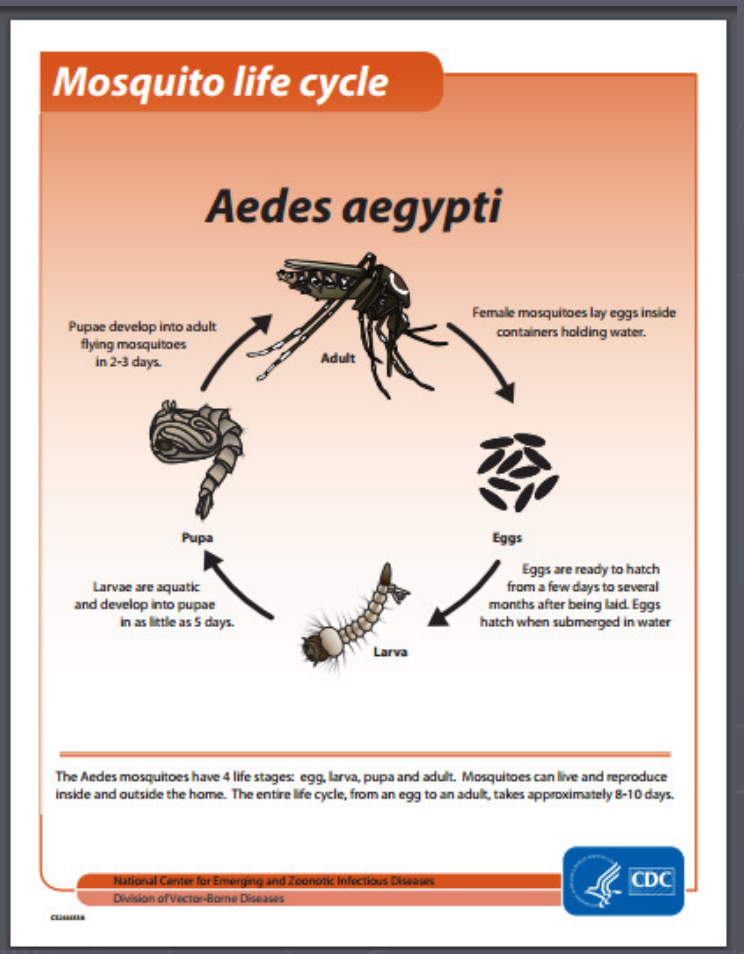
http://asiantigermosquito.rutgers.edu/

General Biology of Mosquitoes

- Order: Diptera, flies
- Have 4 life stages:
  - Egg
  - Larvae
  - Pupae
  - Adult



Aedes Life Cycle – Fact Sheet



Mosquito life cycle

Aedes aegypti

Pupae develop into adult flying mosquitoes in 2-3 days.

Adult

Female mosquitoes lay eggs inside containers holding water.

Pupa

Eggs

Larvae are aquatic and develop into pupae in as little as 5 days.

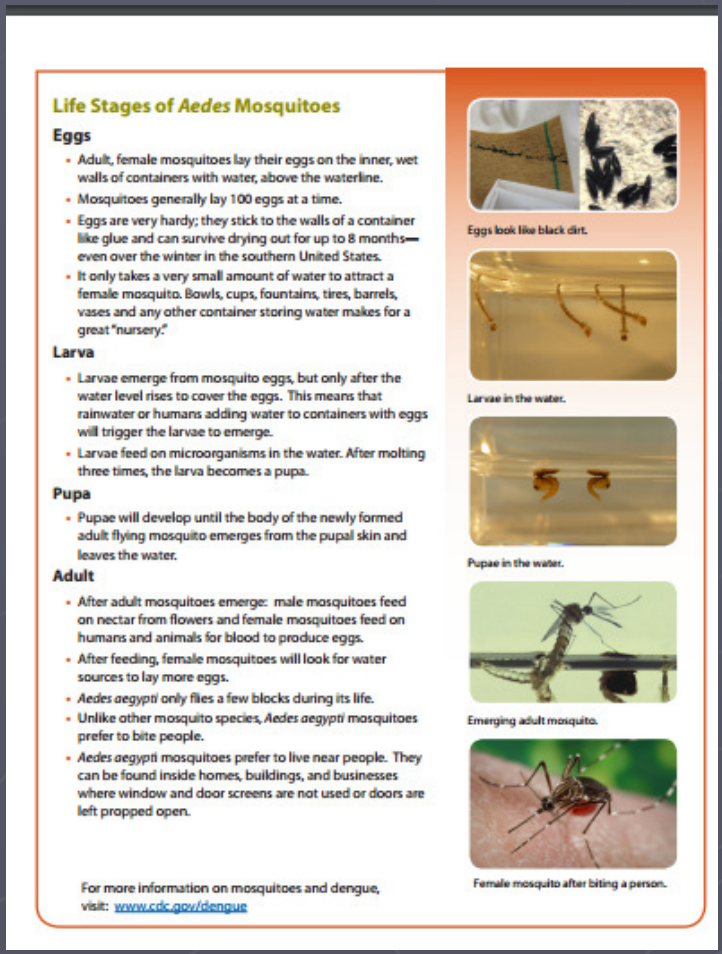
Eggs are ready to hatch from a few days to several months after being laid. Eggs hatch when submerged in water

Larva

The Aedes mosquitoes have 4 life stages: egg, larva, pupa and adult. Mosquitoes can live and reproduce inside and outside the home. The entire life cycle, from an egg to an adult, takes approximately 8-10 days.

National Center for Emerging and Zoonotic Infectious Diseases
Division of Vector-Borne Diseases

CDC



Life Stages of *Aedes* Mosquitoes

Eggs

- Adult, female mosquitoes lay their eggs on the inner, wet walls of containers with water, above the waterline.
- Mosquitoes generally lay 100 eggs at a time.
- Eggs are very hardy; they stick to the walls of a container like glue and can survive drying out for up to 8 months—even over the winter in the southern United States.
- It only takes a very small amount of water to attract a female mosquito. Bowls, cups, fountains, tires, barrels, vases and any other container storing water makes for a great "nursery."

Larva

- Larvae emerge from mosquito eggs, but only after the water level rises to cover the eggs. This means that rainwater or humans adding water to containers with eggs will trigger the larvae to emerge.
- Larvae feed on microorganisms in the water. After molting three times, the larva becomes a pupa.

Pupa

- Pupae will develop until the body of the newly formed adult flying mosquito emerges from the pupal skin and leaves the water.

Adult

- After adult mosquitoes emerge: male mosquitoes feed on nectar from flowers and female mosquitoes feed on humans and animals for blood to produce eggs.
- After feeding, female mosquitoes will look for water sources to lay more eggs.
- *Aedes aegypti* only flies a few blocks during its life.
- Unlike other mosquito species, *Aedes aegypti* mosquitoes prefer to bite people.
- *Aedes aegypti* mosquitoes prefer to live near people. They can be found inside homes, buildings, and businesses where window and door screens are not used or doors are left propped open.

For more information on mosquitoes and dengue, visit: www.cdc.gov/dengue

Eggs look like black dirt.

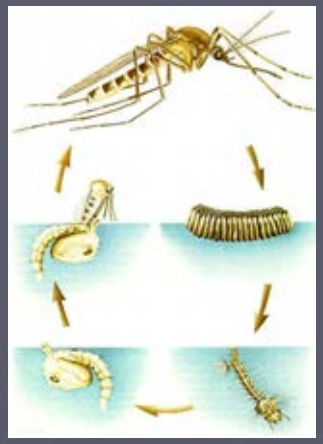
Larvae in the water.

Pupae in the water.

Emerging adult mosquito.

Female mosquito after biting a person.

http://www.cdc.gov/dengue/resources/factSheets/MosquitoLifecycleFINAL.pdf

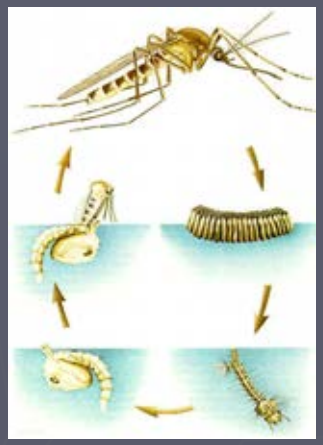


Mosquito Eggs

- Eggs laid inside containers, along the waterline
- As small as bottle-cap
- Can hatch in as little as 24-36 hrs, are desiccation-resistant & can survive 6mo-1yr
- *Aedes albopictus* can overwinter in this stage

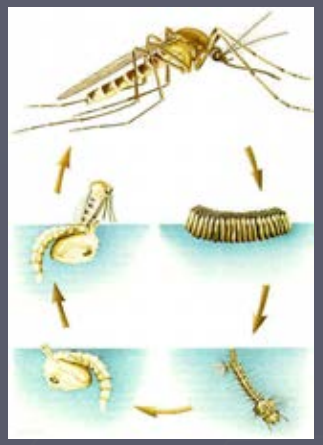
Egg Collections- Ovitrap

- Used to collect container-breeding mosquito eggs
- LBJs – little black jars
  - Plastic cups
- Filled with water
- Seed germination paper
- Counting, rearing, species ID



Larvae

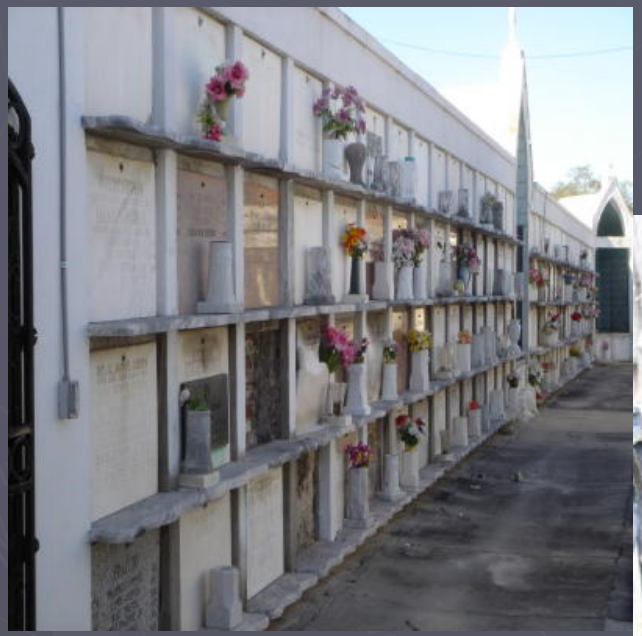
- Four instars: 1st - 4th
- "Wigglers": active, come to surface for air.
- Temperature and resource-dependant (days-weeks)



Pupae

- Metamorphosis Stage: changes from larvae to adult
- "Tumblers" active, come to surface for air.
- 2-6 days

Container Assessments



- Pipettes
  - Turkey baster
- Larval Container
- Whirl-pack bags
- Larval rearing & ID

Integrated Mosquito Management

- Surveillance
- Source Reduction
- Larvicides
- Biological Control Agents
- Adulticides – "when to & when not to spray"
- Public Education
  - Reduce conducive conditions
  - Eliminate containers holding water
  - Repellents

Adult Collection - Aspirations

- Flashlight aspirator
- Prokopack
- Nasci aspirator
- Vacuum aspiration
- Length of time (5 mins)

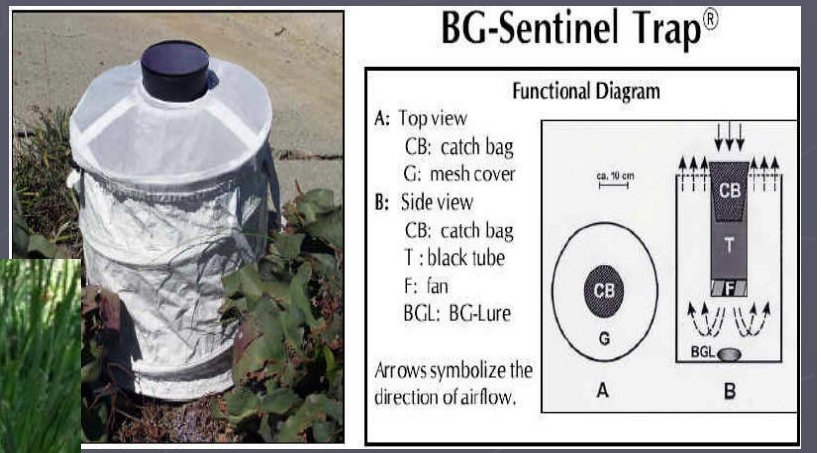
Photo: JW Hock

Adult Collection – CDC Miniature Light Trap

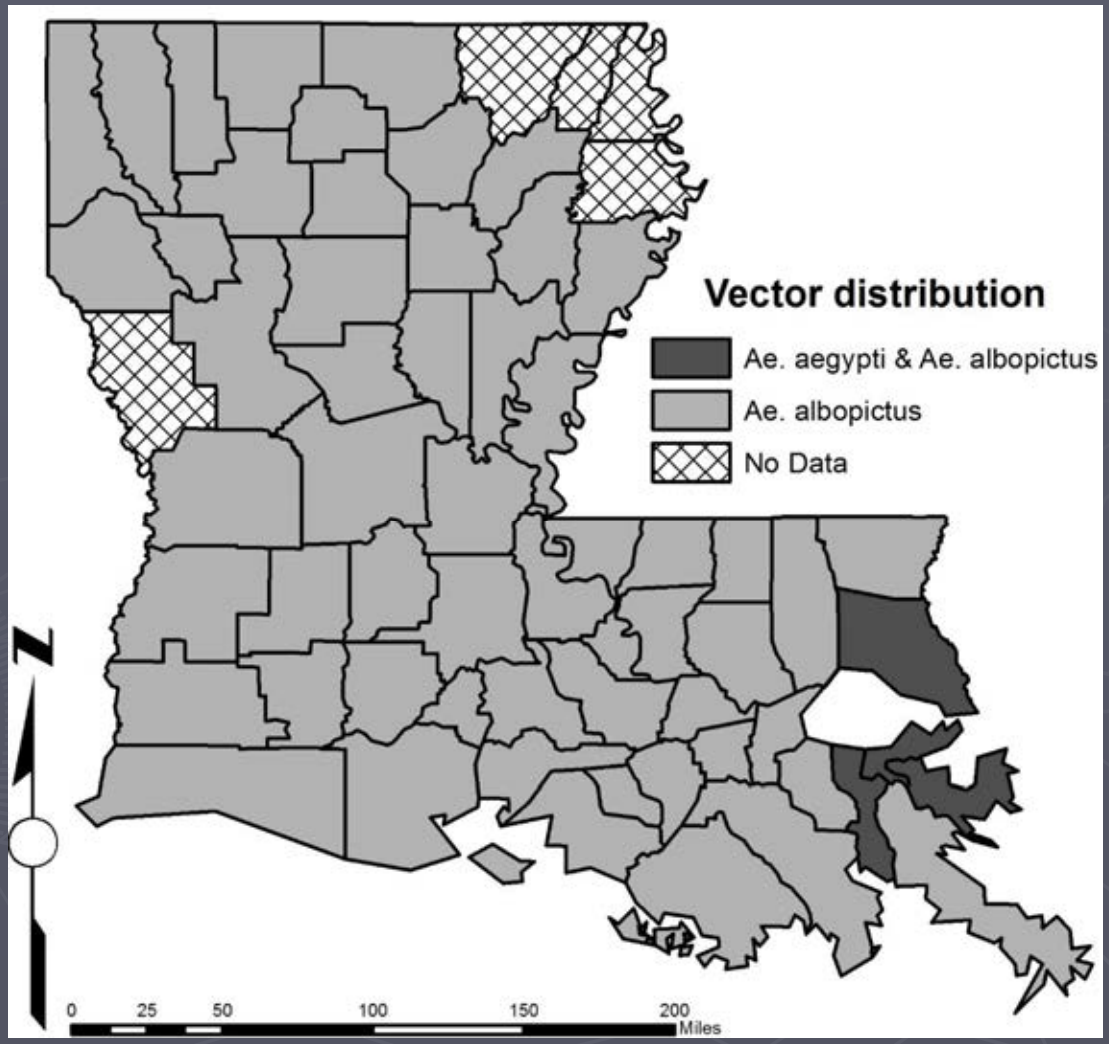
- Portable
- 6v battery
- Light & fan, removable collection container
- Can be used with dry ice (CO_2) as attractant
- Standard survey tool
  - Virus testing

BG Sentinel (BGS) Trap

- Targets collection of *Aedes*
- Contrasting black/ white
- Used in conjunction with lures & CO_2
- Fan, downdraft
- Expensive, maintenance
- BGS2 model

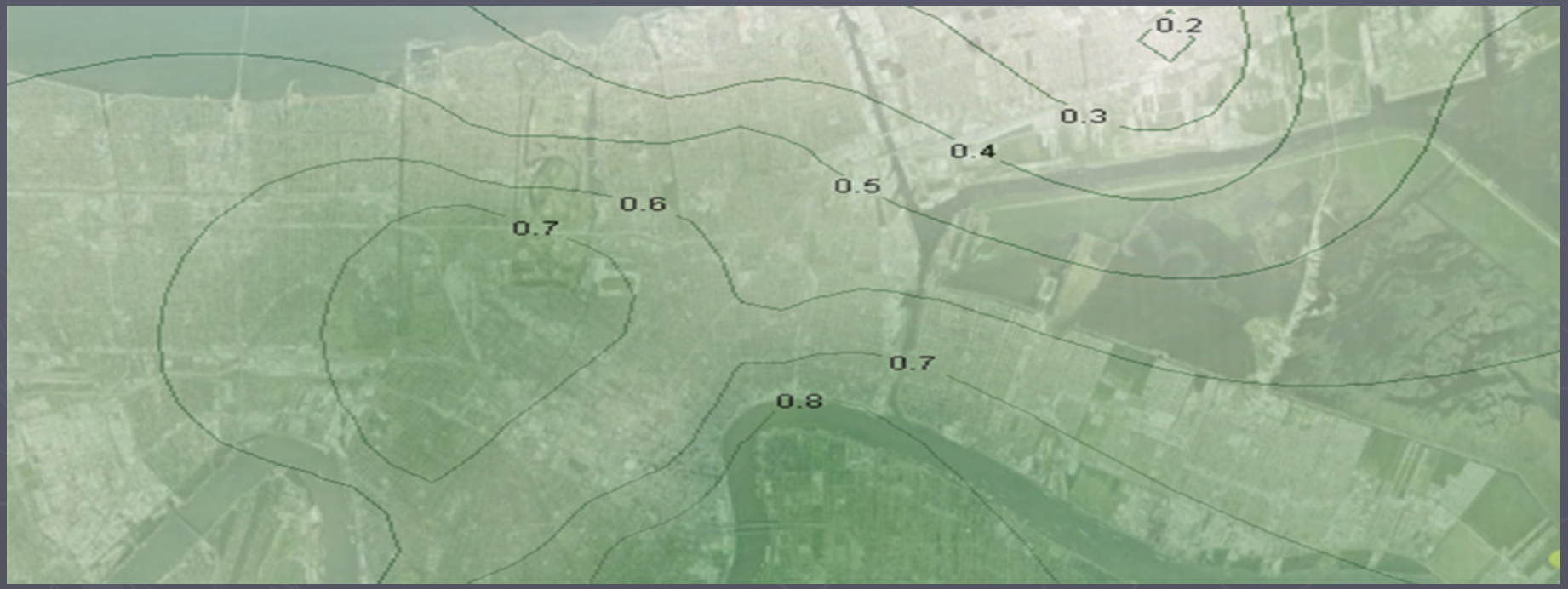


Aedes Distribution in Louisiana



Kevin Caillouet, unpublished

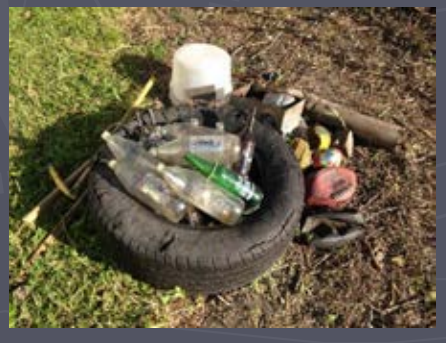
Aedes Population based on 2013 Ovitrap Collections



Ae. aegypti to total *Aedes* ratio

Container Inspections - 2015

- Property inspections in Nov-Dec average of 1.4 water-holding containers/ residence (SD 1.9, range 0-8)
- Containers were likely to be small (45.2%)
  - Buckets (18), coolers (12), planters & plant saucers (12), watering cans (7), dog bowls (6), plastic barrels and tubs (6), bird baths (3), rain barrels (3) and wheelbarrows (3) (n=115)
- 42/115 containers contained larvae (Container Index - 36.5) and 16 pupae (13.9)
- 27 of 85 yards inspected were positive for immature mosquitoes (House Index - 31.8) – above 10 can support transmission
- The most common species was *Aedes aegypti* (85.9%) less common *Culex quinquefasciatus* (11.3%) and *Ae. albopictus* (3.3%) - seasonality



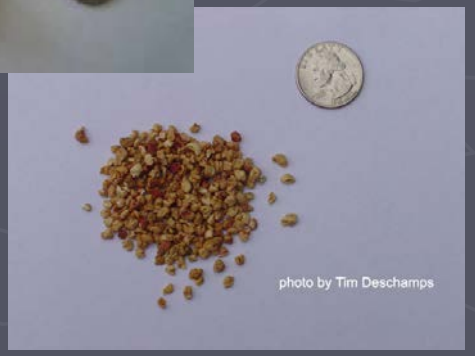

Biological Control Species

- Fish - *Gambusia affinis*
- Turtles - Red eared sliders
- Copepods -*Mesocyclops*
- Cannibal mosquito
  -Toxorhynchites

Ary Farajollahi

Chemical Control - Larvacides

- Bacterial (Bti, *B. sphaericus*)
- IGR (growth hormones - methoprene)
- Oils (CocoBear)



Backyard Treatments

- Backyard treatments
  - Barrier/residual
    - Bifenthrin
    - λ-cyhalothrin
  - Non-residual
- Equipment
  - Backpack sprayers
  - Hand-held foggers

Chemical Control - Adulticides

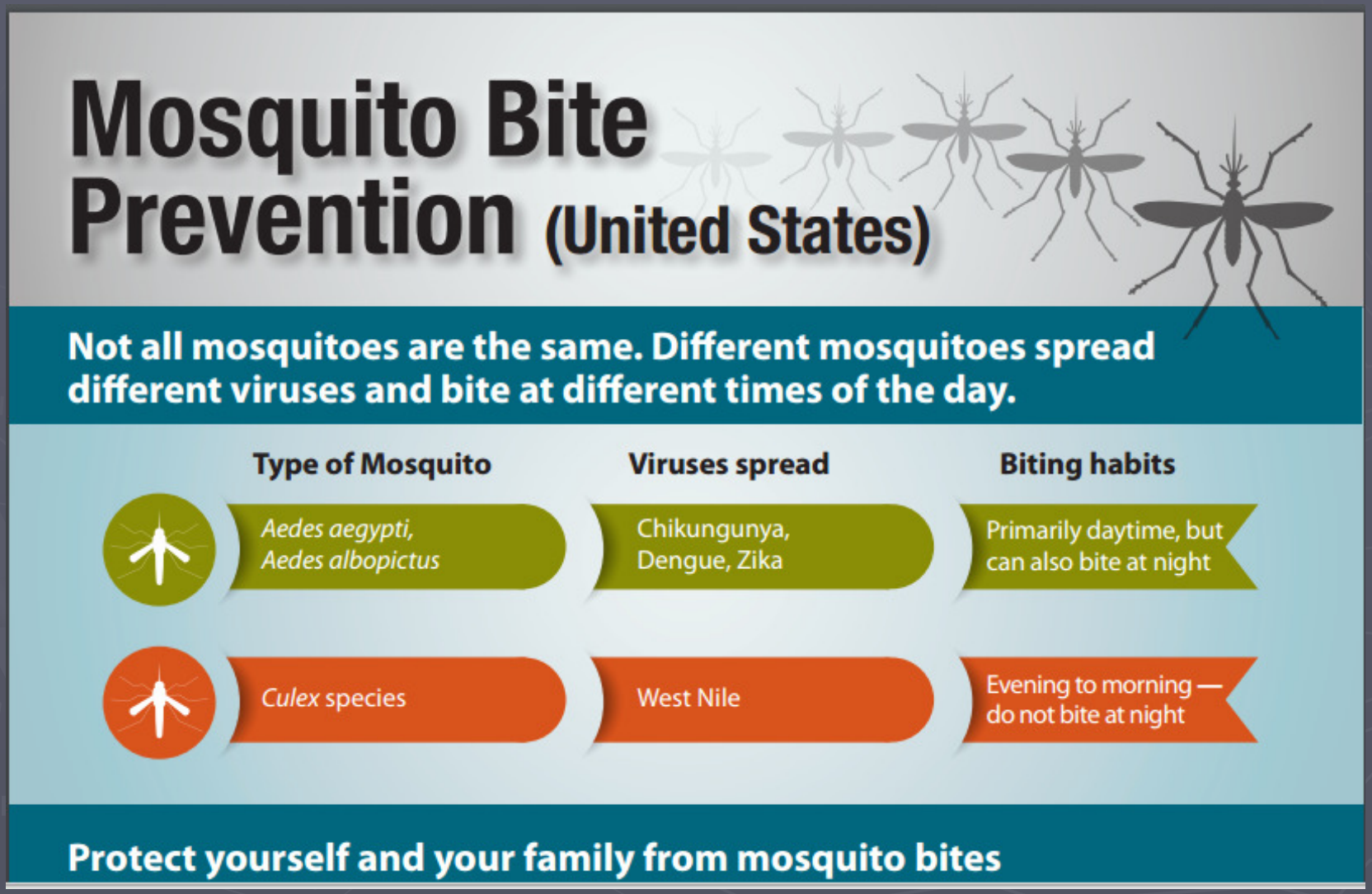
- Area-wide
- Dusk/ dawn
- Zones

- Ground ULV (ultra low volume)

- Aerial

Chemical Resistance

Public Education - Arboviruses

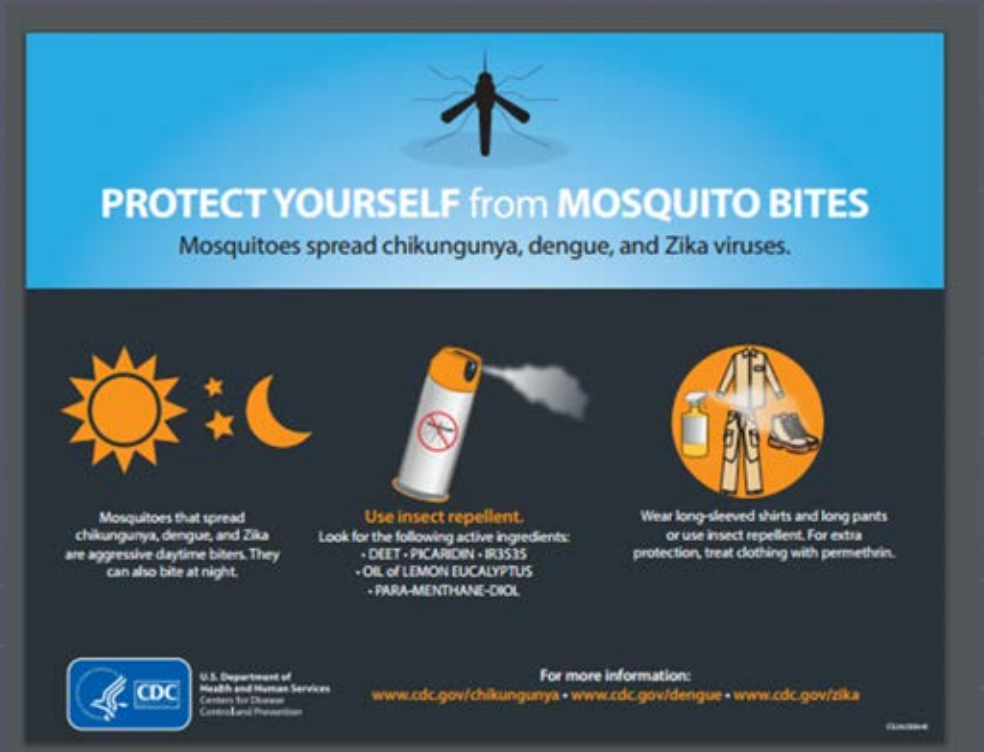


Public Education - Travel

Public Education - Repellants

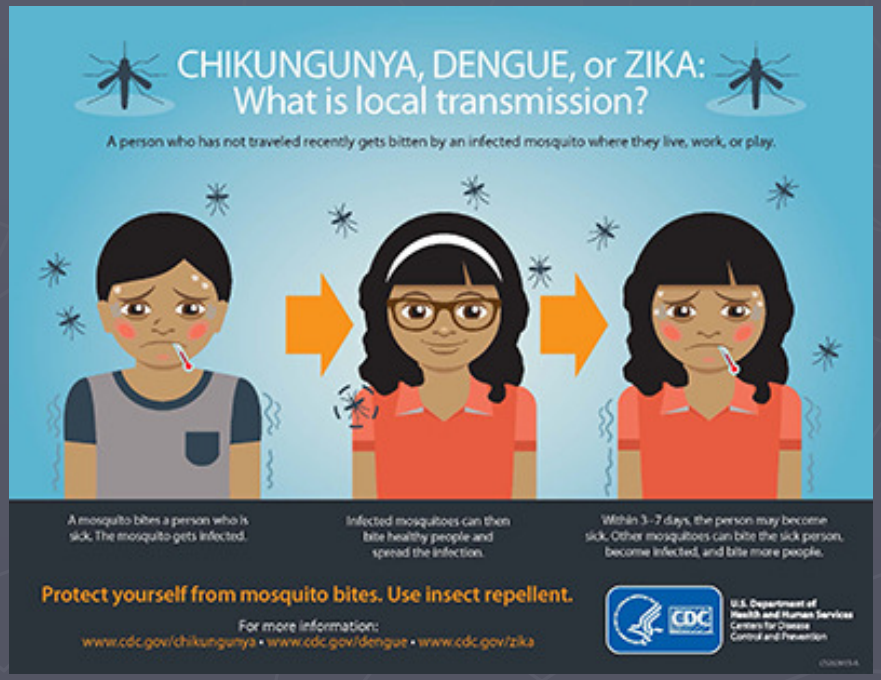
- CDC recommends the use of products containing active ingredients which have been registered with the U.S. EPA
- These provide longer-lasting protection
- DEET (N,N-diethyl-m-toluamide)
- Picaridin (KBR 3023)
- Oil of lemon eucalyptus [p-menthane 3,8-diol (PMD)], a plant based repellent
- Protection similar to low DEET concentrations
- Workers

Public Education & Source Reduction



Outreach - High Transmission Risk Areas

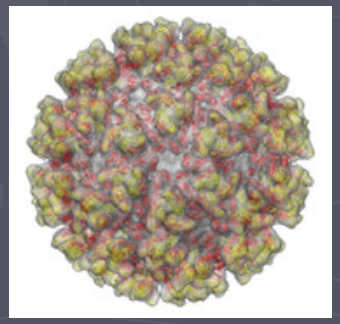
Public Education – CDC Health Materials

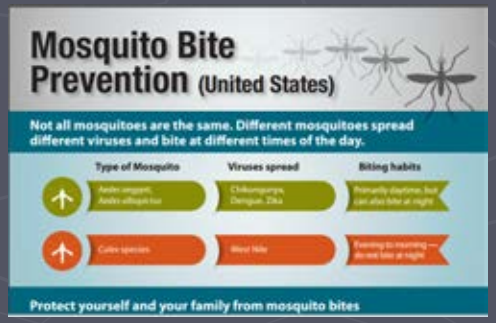


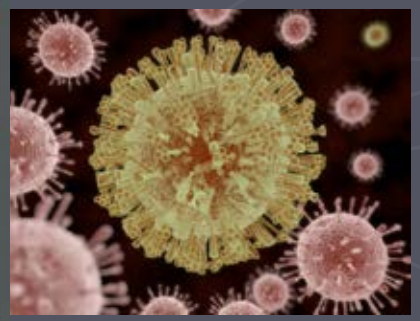
CDC webpage: www.cdc.gov/zika

Zika Virus

- Potential for introduction in U.S. by a returning viremic traveler
- Surveillance program - mosquito adult & immature collections
- Areas with high container and house indices for *Aedes* species, indicate local mosquito-borne transmission can be supported
- Infrastructure/ Response capacity - Equipment (larviciding and adulticiding), Supplies and insecticides, Trained & licensed personnel, Contingency contracts
- Need for public education and outreach – travelers
- Additional Education - Government officials, medical professionals
- Interagency cooperation







Questions?

mosquitocontrol@nola.gov
504-658-2440

- Thank you for joining us for today's webinar.
- Please take a minute to answer a few brief questions:
- https://www.surveymonkey.com/r/GKPGRXS