

Invasive Mosquito Network

Lesson 1

An introduction to mosquitoes and
mosquito transmitted diseases

Day 1

-Introduction to Mosquitoes

Mosquito

- Small, flying, blood-sucking insects
- Family: *Culicidae*
- Can be a threat and a nuisance
- Found on every continent except Antarctica



Image #9187 from the CDC Public Health Image Library

Types of Mosquitoes

- 41 genera
- >3,000 species
- 176 species in the United States
- Not all species transmit disease causing pathogens
- Some rarely interact with humans

Invasive Mosquitoes

- Mosquitoes that are not native and spread rapidly in new location
- Can be very detrimental to native species and overall ecosystem
- Bring diseases that native species have no immunity

Example: Hawaii's invasive mosquitoes

Aedes

- Throughout the United States
- Spreading quickly
- Container-breeders and accumulated water
- Feeds during the day
- Prefers mammals
- Fly short distances
- Transmits encephalitis, Chikungunya, yellow fever, dengue, and more



Mosquito species	Diseases they transmit	Known Location in the U.S.
<i>Aedes albopictus</i> Asian tiger mosquito	Yellow fever, dengue, and Chikungunya	Southern and eastern United States
<i>Aedes aegypti</i> Yellow fever mosquito	Yellow fever, dengue, and Chikungunya	Throughout the southern United States
<i>Aedes triseriatus</i> Eastern tree hole mosquito	La Crosse encephalitis, yellow fever, Eastern equine encephalitis, Venezuelan encephalitis, Western equine encephalitis, and canine heartworm	Eastern United States
<i>Aedes sierrensis</i> Western tree hole mosquito	Western equine encephalitis, eastern equine encephalitis, Jamestown canyon, West Nile, Cache Valley, and canine heartworm	Northwest United States and western California
<i>Aedes japonicus</i>	West Nile virus	Northeastern United States
<i>Aedes atropalpus</i>	Eastern equine encephalitis	Northeastern United States
<i>Aedes hendersoni</i>	Canine heartworm	Most of the United States except the southwestern portion

Culex

- Found all over the United States
- Container-breeders
- Feeds at dusk and after dark
- Can enter human homes for meals
- Prefers birds
- May travel far
- Transmits filariasis and many forms of encephalitis



Mosquito species	Diseases they transmit	Known Location in the U.S.
<i>Culex pipiens</i>	St. Louis encephalitis, West Nile virus	Northern half of United States
<i>Culex restuans</i>	Eastern equine encephalitis	Eastern half of the United States and parts of Iowa
<i>Culex quinquefasciatus</i>	Eastern equine encephalitis, St. Louis encephalitis, canine heartworm, West Nile	Southern half of United States
<i>Culex tarsalis</i>	St. Louis encephalitis, equine encephalitis, Japanese encephalitis, Venezuelan encephalitis, West Nile	Most of the United States except the north-eastern portion
<i>Culex nigrapalpus</i>	St. Louis encephalitis, West Nile virus, Eastern equine encephalitis, and dog heartworm	South-eastern United States



By Woodbridge Foster

Diet

- Blood
 - Females of anautogenous species
- Sugar (flower nectar)
 - Both females and males of all species

Blood Feeding

- Most mosquito species bite and habits vary depending on species
- Female will inject saliva to prevent coagulation
- Generally blood is needed for egg production and flight. In some species, blood increases egg production
- Blood offers mosquitoes concentrated nutrients and proteins



Sugar Feeding

- Both males and females sugar feed
- Sugar meals are usually in the form of flower nectar
- Male proboscides are specifically developed for sugar feeding
- Most female proboscides are developed to pierce animal skin but can also be used for sugar feeding

Human Reaction to Bites

- The itchy bump is a result of histamines reacting to proteins in mosquito saliva
- Skeeter syndrome is an allergic reaction to mosquito bites
 - Mostly occurs in children
 - Comes with swelling and fever

Breeding

- Females lay eggs on or near water
 - Directly on water
 - Near water (mud, plants, etc)
 - On aquatic plants
- Some species lay 100-200 in a batch
- *Aedes* eggs are laid near water and go into diapause when dried out—they only hatch when soaked in water

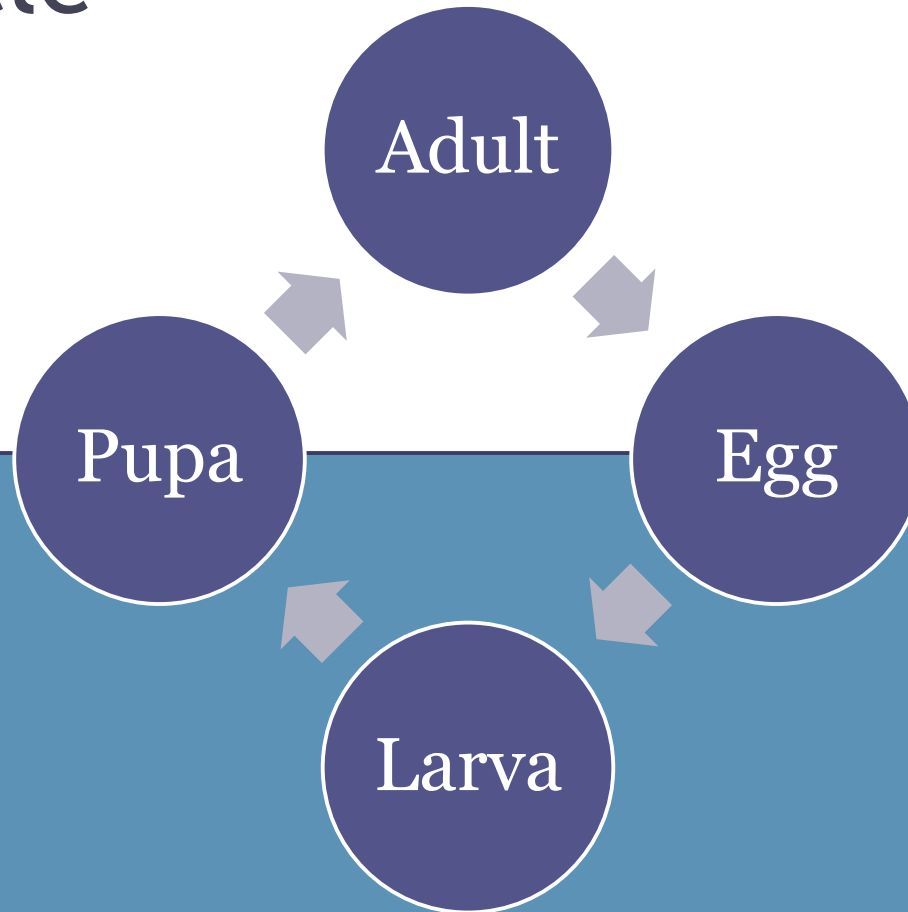
Habitat

- Found in nearly all climates
- Prefer wet areas with vegetation
- Near stagnant water

Why do they prefer these locations?



Life Cycle



Day 2

- Invasive Mosquito Network
- Mosquito-borne diseases

Invasive Mosquito Collection Goals

- Update knowledge of mosquito species distribution
- Estimate human and animal risk based on distributions of mosquito species
- Educate public of mosquito transmitted diseases

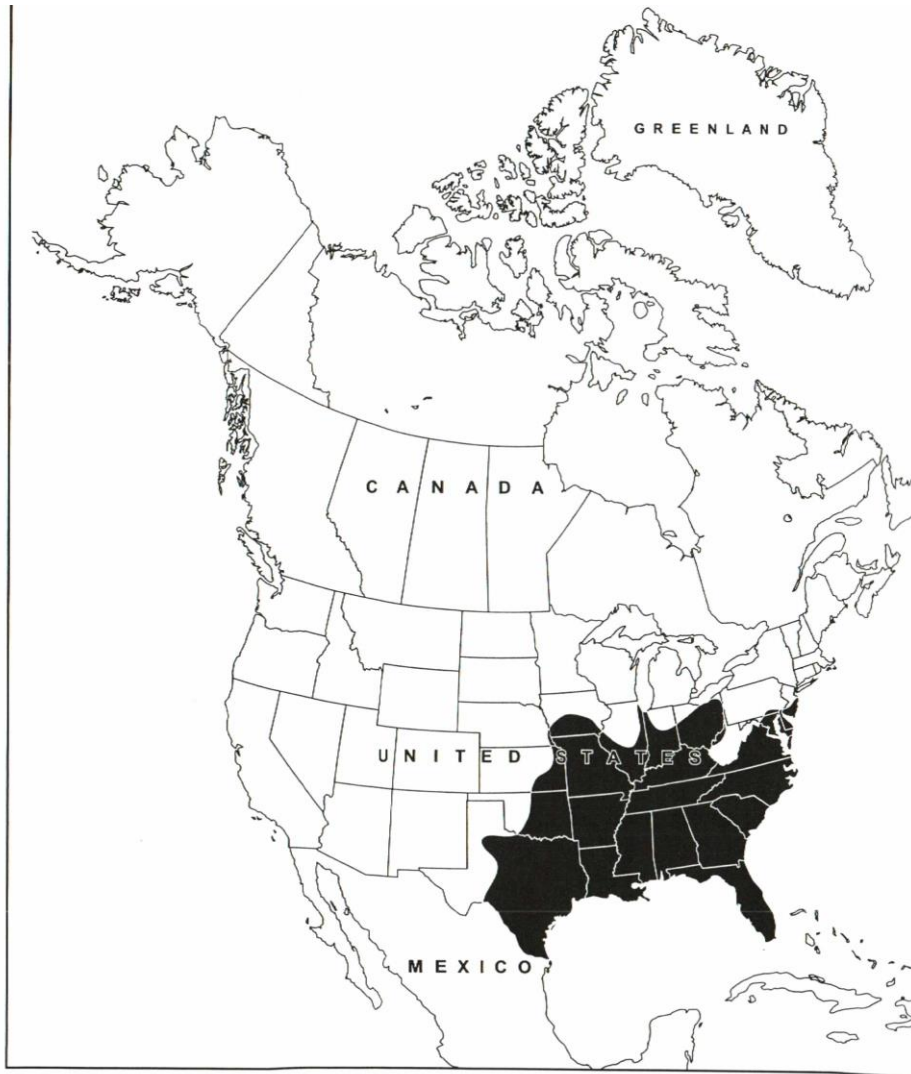


Plate 9 D. Distribution of *Aedes albopictus*—USA: AL, AR, DE, FL, GA, IA, IL, IN, KS, KY, LA, MD, MN, MO, MS, NC, N
OH, OK, PA, SC, TN, TX, VA, WV (499); Tax. 325.

Knowledge of Species Distribution

Ten years after *Aedes albopictus* was accidentally introduced to Texas in 1985, it was found to have spread to 28 states. Since then, it has spread further across The United States but no concise study has taken place to find the species distributions. Such a study would be beneficial to determining possible threats to public health.

Mosquito-Borne Diseases

- Pathogenic bacteria, viruses, and parasites transmitted to animals by mosquitoes
- Mosquitoes not affected by diseases they transmit
- Growing problem for humans



Image #6765 from the CDC Public Health Image Library

Mosquitoes as Vectors of Disease agents

All these factors combine to make mosquitoes a transmitter of pathogens

- Very widespread
- Reproduce quickly
- Habitat coincides with human and livestock locations
- Hard to prevent and eradicate
- Feed on humans

Transmission

- Pathogens are transferred through mosquito saliva
- Many pathogens target mosquito salivary glands to breed and multiply
- The exchange of fluids (saliva) between host and mosquito perpetuates the infection cycle

Dengue Fever

- Vectors are *Aedes aegypti* and *Ae. albopictus*
- Symptoms include fever and rash
- Can develop into potentially fatal dengue hemorrhagic fever
- With treatment, low fatality rate

Chikungunya

- Disease new to North America
- Causes fever and extreme joint pain
- Joint pain can last for years after infection
- Low mortality rate
- Vectors are *Aedes aegypti* and *Ae. albopictus*
- No vaccines or cures

Encephalitis

- Inflammation of the brain
- Can be mild to severe
- Mild symptoms include
 - Mild headache
 - Fever
- Severe symptoms include
 - Seizure
 - Changed mental function
- Affects birds and mammals
- Can be lethal if severe



Figure 1

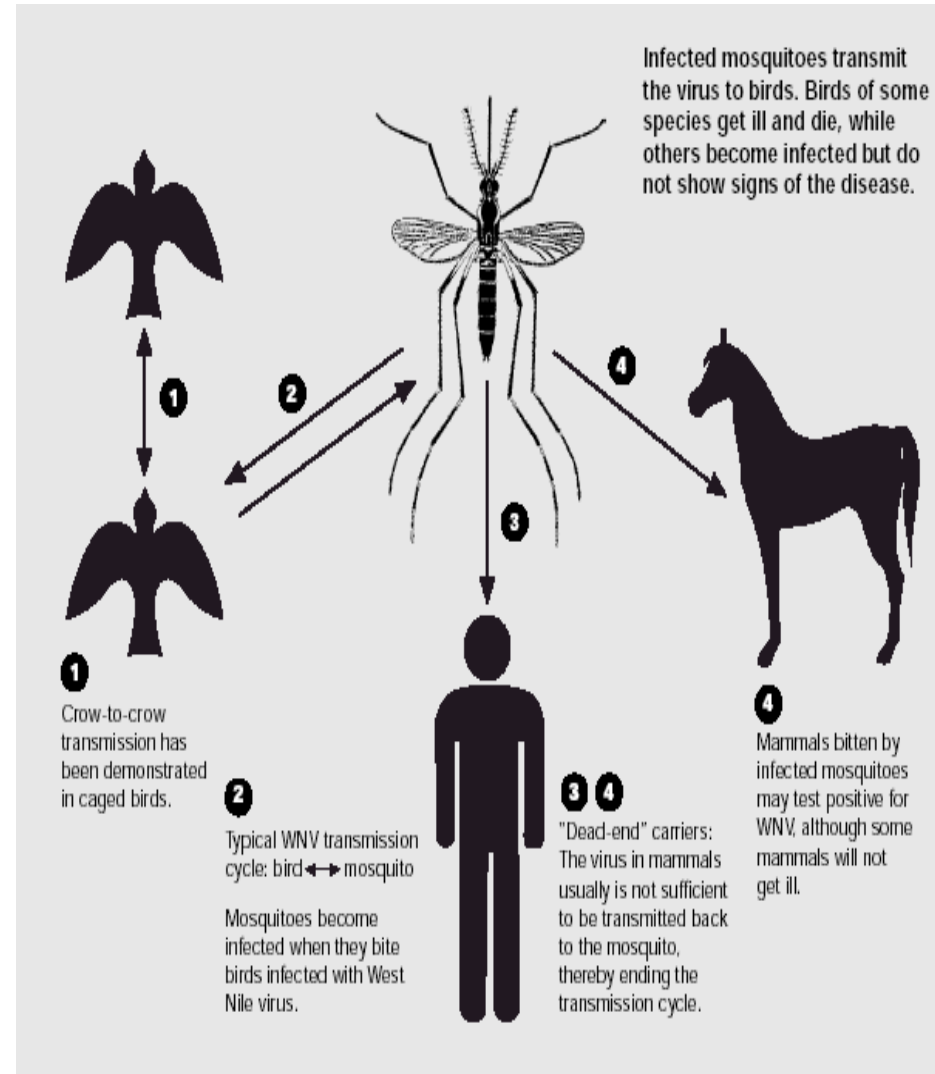


Figure 2

http://img.webmd.com/dtmcms/live/webmd/consumer_assets/site_images/media/medical/hw/h9991203.jpg

West Nile Virus

- Transferred from birds to humans via mosquitoes
- Symptoms can be so mild that people do not know they have it
- Symptoms can be very severe also
- Can develop into West Nile encephalitis



Canine Heartworm

- Parasitic worm called *Dirofilaria immitis*
- Lives in infected dogs' hearts and lungs
- There can be anywhere from 1 to over 200 worms living in a single host
- If left untreated, they will block blood flow and damage organs
- If left untreated, it is fatal
- Can infect cats and ferrets but is less severe

Lymphatic Filariasis

- Caused by parasitic worms living in the lymphatic system
- Causes engorgement of legs (elephantiasis) and other disfiguring swelling
- Leading cause of permanent disability in the world

Egg Collection

In order to get information on invasive mosquitoes' species distribution, students (you) have been asked to collect and send eggs to the USDA. These efforts will help immensely in determining species distributions.

Procedure

- Label cups and egg paper
- Place egg papers in oviposition cups
- Fill cups 2/3 of the way with water
- Tape cups in respective places
- Check once a day and refill or dump water when needed (be careful of eggs)
- See handout for details

Placement

- Cup “A” is to go in a sunny location
- Cup “B” is to go in a shady location
- For class discussion, note the surroundings of the oviposition cups (such as flowering plants, etc.)

Safety

- Avoid going near the oviposition cups during the day because *Aedes* mosquitoes feed at that time.
- Only place the oviposition cups near your home-traveling is not needed for this project.
- Wear long sleeves, long pants, and insect repellent when placing and approaching cups.

Possible Complications

- Temperature and weather
 - Try to collect eggs in warm weather
- Cups blowing away
 - Tape down the cups
- Water evaporating/overflowing
 - Check cups once a day and refill/dump water as needed to maintain proper water level. Holes can be punched in the cup at the 2/3 water line to prevent overflowing.

Identifying Eggs

- Mosquito eggs are extremely tiny
- Resemble dirt
- *Aedes* eggs will be attached to egg paper
- *Culex* eggs will be floating on the water surface

Culex

They are very small

12pt Times New Roman font

Culex egg raft

Aedes

Separate Aedes eggs

Collection

- After 7 days, check the egg paper for eggs
- If eggs are present, remove egg paper containing the eggs and dry the paper—this will cause eggs to go into diapause
- Store eggs and egg paper in a plastic bag

Day 3

- Counting and Shipping
- Conclusion

Counting, Observing, and Shipping

- Count the number of eggs on each egg paper and record
- Note the differences between number and types of eggs found in different locations
- If desired, look at eggs under a microscope and note the appearance
- If desired, raise $\frac{1}{4}$ of the eggs to adulthood with lesson 2
- Send the other $\frac{3}{4}$ th of the slightly damp paper (paper should not crinkle) and eggs to your local branch of the American Mosquito Control Association (AMCA) for species confirmation or to the USDA in Manhattan, Kansas.

Closing Questions

- Why does location affect type and number of eggs?
- In what ways do invasive species impact ecosystems?
- How does knowing species distributions of invasive mosquitoes help public health?