



Combatting Mosquitoes in the Backyard

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My background

- Originally from the Cleveland area
- My education is OSU through and through!
 - 2008 BS in Entomology and Microbiology
 - 2014 PhD in Entomology
- Taught at Kenyon College for 1 year
- Hired at OSU in 2016
- Teaching:
 - Graduate: Insect Physiology and Molecular Biology
 - Undergraduate: Insects in Human Affairs, Biology of Hope and Belief
- Research: molecular and ecological regulation of seasonal responses in the Northern house mosquito
 - [TED-style talk](#)
 - [Minute professor talk](#)

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Talk Outline

- Introduction to mosquito biology
 - Life-cycle and stages
- Why we want to combat mosquitoes
 - Mosquito-borne illnesses in Ohio and around the world
- How to combat mosquitoes
 - Drain
 - Dress
 - Defend

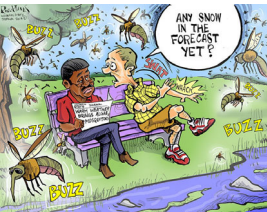




Image from Wisconsin State Journal.

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Mosquito overview


- Belong to Family Culicidae, Order Diptera
- Eggs, larvae and pupae are aquatic
- Adults are terrestrial
- Male and female mosquitoes
 - Are delicate, gnat-like flies
 - Have scales on their wings
 - Use piercing, sucking mouthparts to feed on nectar
- Only female mosquitoes feed on blood and transmit pathogens that cause diseases


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Mosquito-borne pathogens and diseases


- Filarial nematodes/round worms
 - canine heartworm
 - Elephantiasis
- Eukaryotic pathogens
 - malaria
- Viruses
 - dengue virus
 - Chikungunya virus
 - Zika virus
 - West Nile virus
 - St. Louis encephalitis virus
 - LaCrosse encephalitis virus
 - Eastern equine encephalitis virus



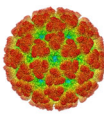
Microfilaria 400x, CC BY Joel Mito



Woman suffering from elephantiasis, Public Domain

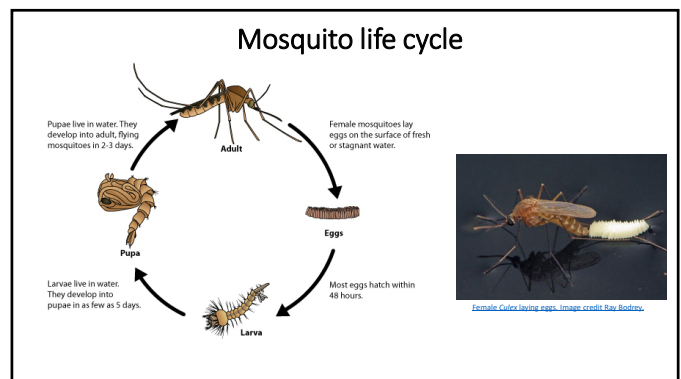


Malaria sporozoites, CC BY NIAID

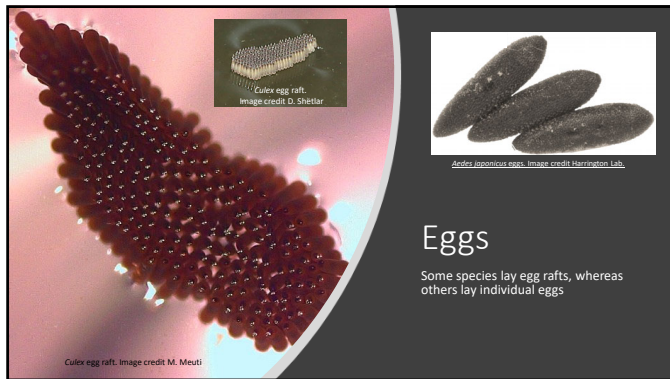


Chikungunya virus, CC BY A2-31

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Larvae (wigglers)

- Mosquito larvae undergo four larval instars (molts) before they become pupae.
- Take 5-10 days to reach the pupal stage (depending on the temperature and species).
- Breathe through a siphon/tube at the end of their body

Culex larvae and 1 pupa. CC BY James Gathany

Culex larva. Image credit M. Meuti

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Pupae

- Take 2-3 days to finish development.
- Flip around (tumble) when disturbed.
- Breathe through two anterior tubes called trumpets

Dorsal view of Culex pupa. Image credit M. Meuti

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Adult mosquitoes

- Both male and female adults feed on nectar from flowers
- Adult mosquitoes can live 4-6 weeks, while males only live a few days
- Females usually produce eggs after obtaining blood meal one or several blood meals
- Each species has preferred hosts (birds, reptiles, amphibians, mammals)

Female mosquito taking nectar. Image credit Manitoba Museum

Female mosquito taking a blood meal. Image credit Wikipedia

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Image from Wisconsin State Journal

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Why combat mosquitoes in your backyard?

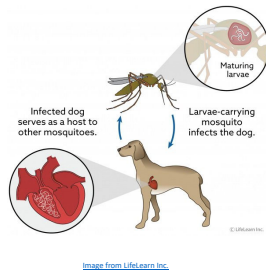
- Generally: their bites itch!
- Public health: they transmit diseases that make people & animals sick

www.swamp.com.au

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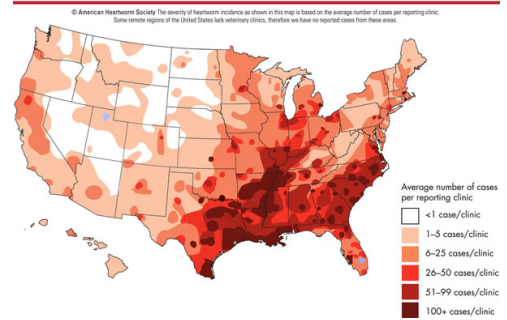
Canine Heartworm

- Mammalian circulatory system nematode parasite – mainly canines
- Naturally infests foxes and coyotes
- Infests domestic dogs and cats
- Mosquito picks up microfilarial worms from infected host
- Microfilaria complete a molt in mosquito and move to mouthparts
- Larval nematode enters into bite wound when mosquito feeds again.



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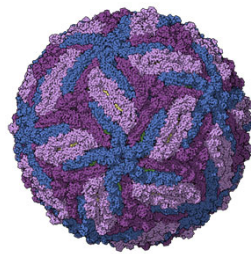
2019 HEARTWORM INCIDENCE



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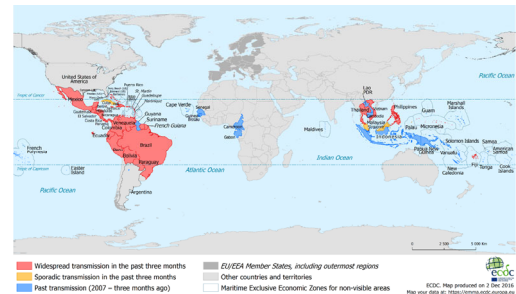
Zika Virus

- Mosquito-borne flavivirus
- First identified from Uganda in 1947
- First found in humans in 1952
- Outbreaks mainly in Africa, Asia, Pacific Rim until 2015
- Outbreak in South America starts in 2015
- Then associated with microcephaly and Guillian-Barre syndrome
- Transmitted sexually in humans

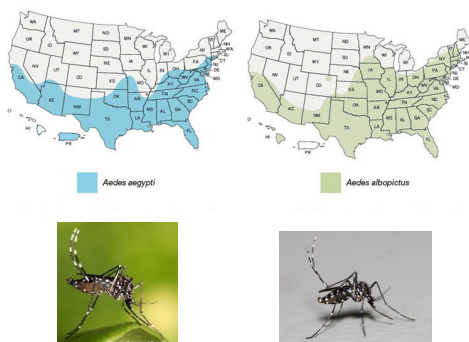


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Zika Distribution



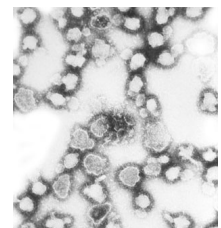
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La Crosse Encephalitis virus

- Mosquito-borne bunyavirus
- Transmitted by the Eastern tree hole mosquito, *Aedes triseriatus* to chipmunks and squirrels
- Humans are a dead-end host
- More common in rural, deciduous areas, but still quite rare (~68 cases/year in US)
- Neuroinvasive form is more serious, and is most common in children under the age of 16
- Less than 1% of people die from disease



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Distribution of neuroinvasive forms of La Crosse Encephalitis virus 2010 - 2019

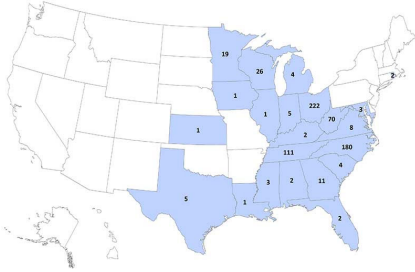
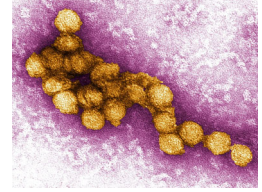


Image from CDC.

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West Nile virus

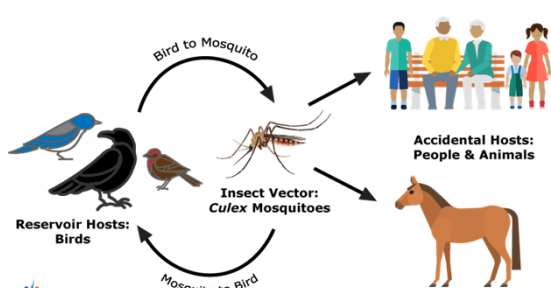
- Mosquito-borne flavivirus
- First identified from Tanzania in 1952; now found worldwide in temperate to tropical zones
- Now most common mosquito-borne disease in US
- Can cause major bird die-offs, particularly in corvids (crows & blue jays)
- When mosquitoes can't find birds, they bite other animals.
- 70-80% of infected humans display no symptoms, other have flu-like symptoms
- 1/150 symptomatic cases are fatal



Micrograph of West Nile virus, CCO

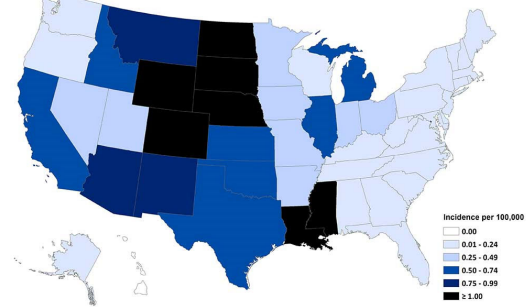
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West Nile Virus Transmission Cycle



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West Nile virus distribution



Average annual incidence of West Nile virus neuroinvasive disease reported to CDC by state, 1999-2019

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 - Dress
 - Defend
 - Alert the experts



Image from Wisconsin State Journal.

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Drain

- Mosquitoes require water for their eggs, larval and pupal phases
- Any pools of standing water that are present for 7-14 days are sufficient for mosquito development
- Many mosquitoes that transmit disease are container breeders and will lay eggs/develop in just about any container



Image from Great Garden Supply.

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An ounce of prevention . . .

- Turn over buckets, lids, and kids toys that might collect water
- Change the water in bird baths frequently
- Treat water features or koi ponds with a mosquito larva killer like Mosquito Dunks (and repeat monthly)
- Clean-out your gutters! Blocked gutters are also a terrific breeding ground for mosquitoes
- Fill-in any low spot in the lawn that collects rain or irrigation water

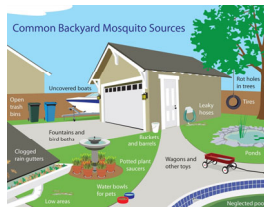


Image from Alameda County Mosquito Abatement District.

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From: Bryan Massery

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Dress

- Whenever possible, wear long sleeves and long pants
- Make sure clothing is not sheer and clothing is free of holes
- Wear hats (with or without nets) to prevent mosquito bites on the head
- Avoid wearing dark clothing as studies have shown dark colors make you more attractive to mosquitoes.



Image from Expert Vagel.com



Bug jacket with hood
\$16.95 on Amazon.com
Fair Use.

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Defend: Repellants

- DEET is the most effective and commonly used repellent
 - Higher percentages (~15-20%) last longer than lower percentages
- Picaridin is a man-made chemical that was synthesized to resemble the natural compound piperine, found in black pepper plants, and an alternative to DEET
- Consumer reports also states that products containing 30% of Oil of Lemon Eucalyptus performed as well as DEET
- Citronella candles can also work if little air movement



Image from REI.
Fair use.

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Defend: Physical Barriers

- Limit bushes/shrubs which provide good resting habitats for adult mosquitoes
- Ensure that all screens on windows and doors are free from holes
- Use fans/air curtains to create air movement around you or building entrances to keep mosquitoes out
 - Mosquitoes do NOT like air movement



ceiling



floor



air curtains

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Defend: DIY Pesticides

- **Adulticides**
 - Area Sprays – on plants and surfaces can kill resting adult mosquitoes (hours to a few days)
 - Fogging (lasts until air is replaced)
 - **Bait Sprays** – new technology that uses sugar sprays laced with garlic oil. Appears to be lethal to adult mosquitoes that feed on the sugar droplets!

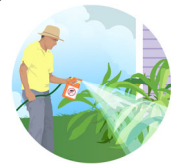


Image from CDC.

- **Larvicides**
 - Insecticides – insect growth regulators
 - Oils – sufficant (clogs respiratory system)
 - *Bt* strains – pellets & briquettes to treat standing water that you cannot drain and will not drink



Image from CDC.

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Mosquito Adulticides

(for small areas)

- **Pyrethroids**
 - Bifenthrin
 - Cyfluthrin
 - Cypermethrin
 - Deltamethrin
 - Esfenvalerate
 - Tau-Cyfluthrin
- **Combos (pyrethroid + IGR)**
 - Proflex
- **Garlic Baits**
 - Final Feed
 - Terminex AllClear



Alert the Experts

- Because mosquitoes are vectors of disease and parasites State & Local Health Departments actively sample and monitor mosquito populations.
- Professionals in mosquito abatement districts remove breeding mosquito sites/standing water
- Mosquito control districts implement control measures when triggers are reached. Triggers include:
 - High numbers of adult mosquitoes
 - Mosquito that tested positive for a disease
 - Human cases of the disease

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What Do Vector Control Agencies Use?

Adulticides



Larvicides



From: Bryan Massery

What does NOT work

- **The following do NOT repel mosquitoes**
 - Ultra sonic devices or smart phone apps
 - Plus these can be irritating to pets
 - Avon Skin So Soft (at least not for more than 10 minutes)
 - Lemon-scented plants
 - Wristbands with sound or pesticide as these generally only protect a small part of your body
 - But clip on fans that have metafluthron can be effective
- **The following do NOT reduce mosquito populations**
 - Bats
 - Bats are generalist predators, and bats mostly eat moths.
 - Black light/UV light traps
 - But traps that incorporate CO₂, light and a fan *might* work



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Thank you so much for your attention!



I'm delighted to answer any of your questions

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