The Danger of Arbovirus Risk from Mosquitos Developing in Standing or Stored Water

THE UNIVERSITY OF ARIZONA
Agriculture, Life & Veterinary Sciences & Cooperative Extension

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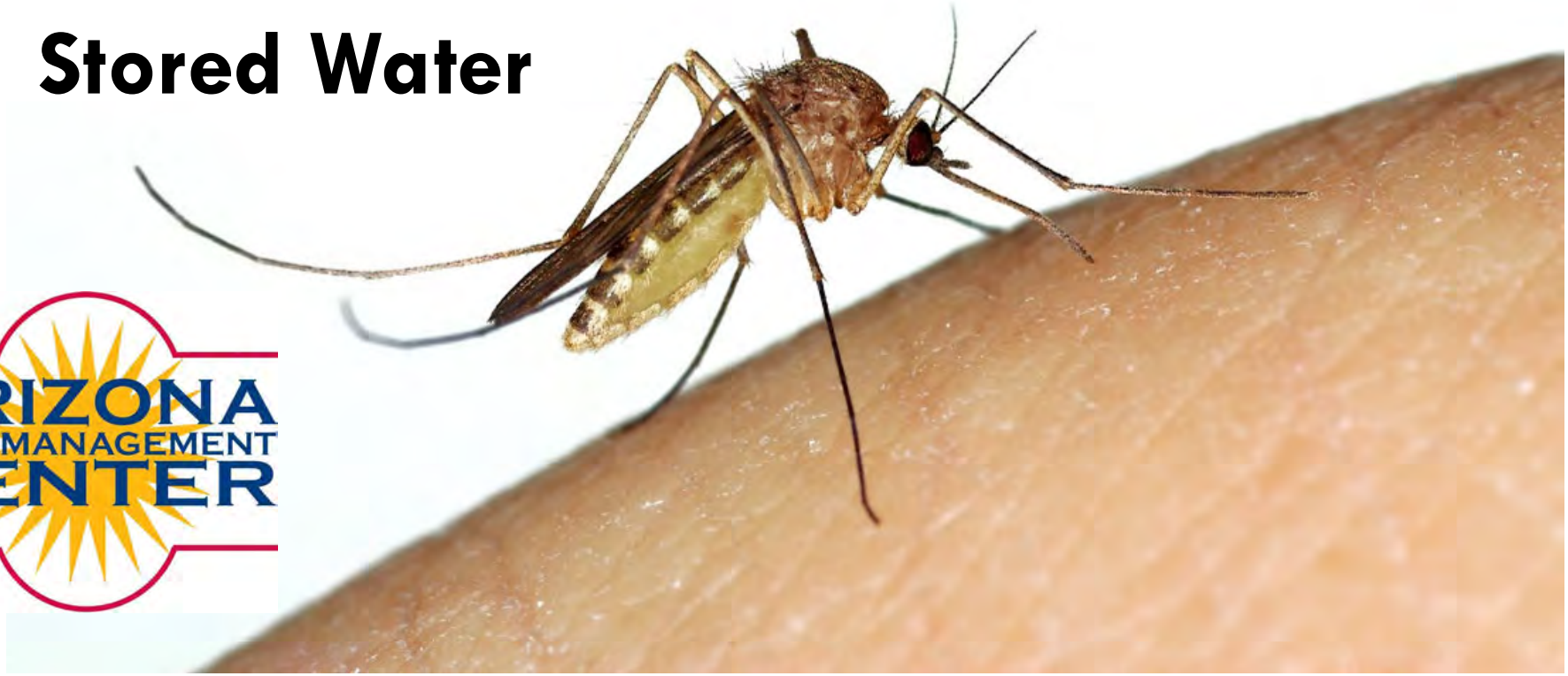


ARIZONA PEST MANAGEMENT CENTER

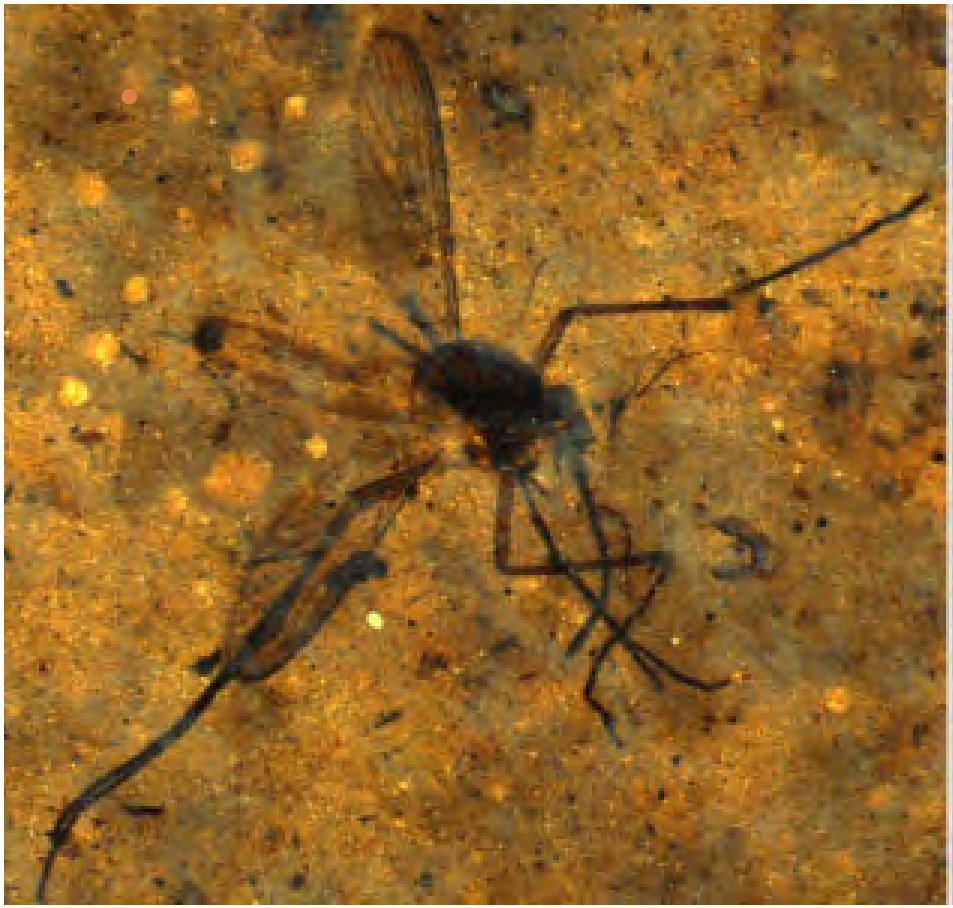
Outline

- Recognizing mosquitoes
- Common Arizona species and related risks
- Mosquito life cycle
- The opportunities we provide and reducing risks
- Climate change influences

A story about water

Mosquitoes

- Cretaceous 140-65 million years ago



Mosquitoes

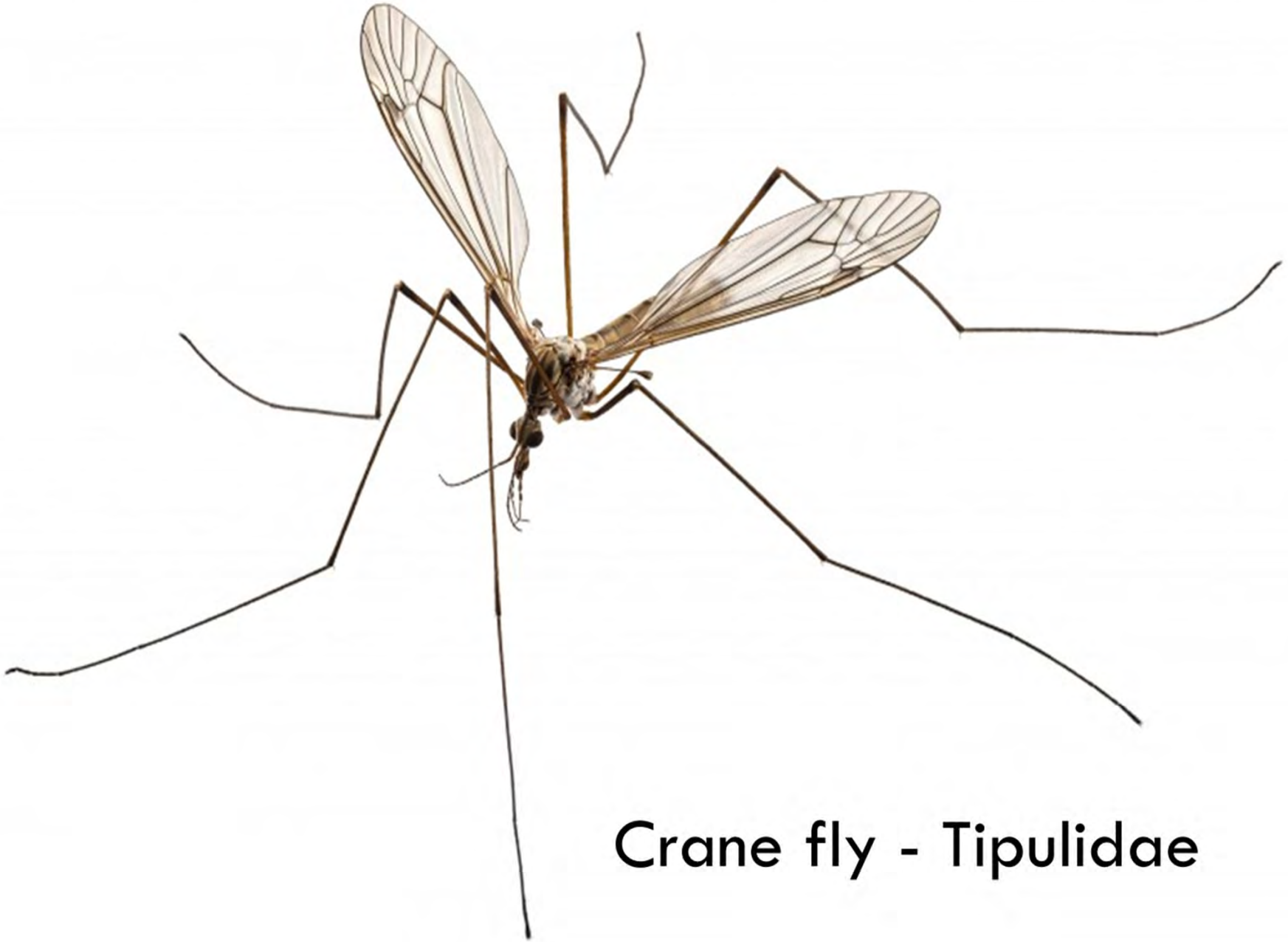
- Slender body, long-legs, long proboscis
- Larvae/pupae are aquatic
- Order Diptera (true flies – 2 wings)
- Family Culicidae (scales)

Mosquitoes

- >3,500 species, 176 U.S., >40 AZ
- Subfamilies
  - **Culicinae** (***Culex***, ***Aedes***, *Psorophora*, *Culiseta* + others)
  - **Anophelinae** (***Anopheles***)
  - **Toxorhynchitinae**

Elephant mosquito - *Toxorhynchites rutilus*

Toxorhynchites

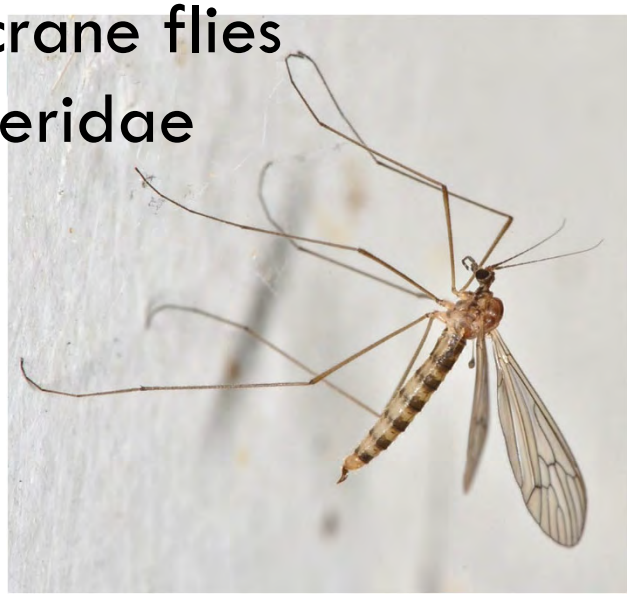


Crane fly - Tipulidae

Not mosquitoes but often confused

Dixid midges- Dixidae

Winter crane flies
- Trichoceridae



Drain flies - Psychodidae

Wood gnats
- Anisopodidae

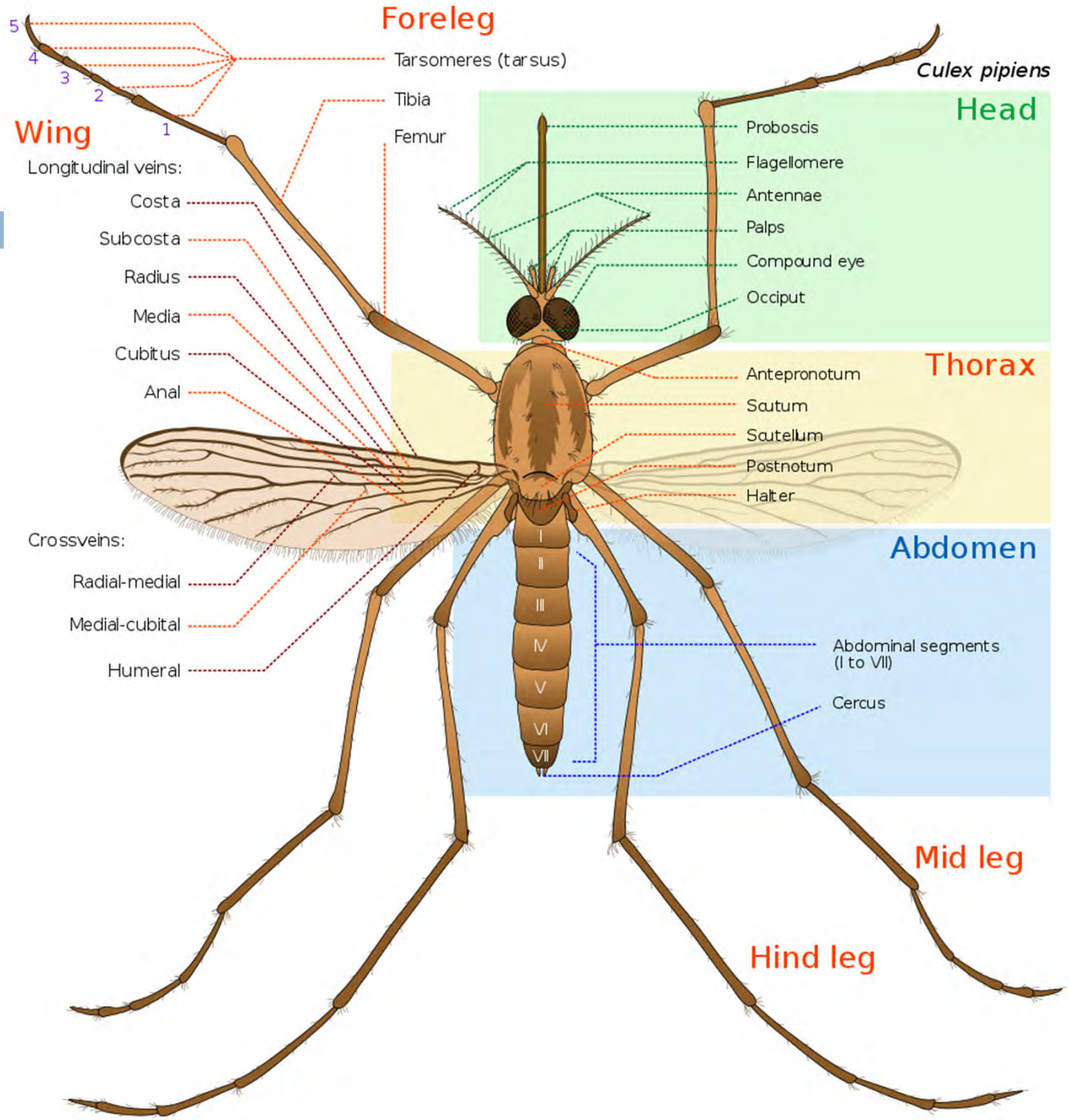
Dark-winged fungus gnats
- Sciaridae

Hump-backed flies
- Phoridae

<u>Not</u> a mosquito but often confused

Mayflies - **Order** Ephemeroptera

Mosquito

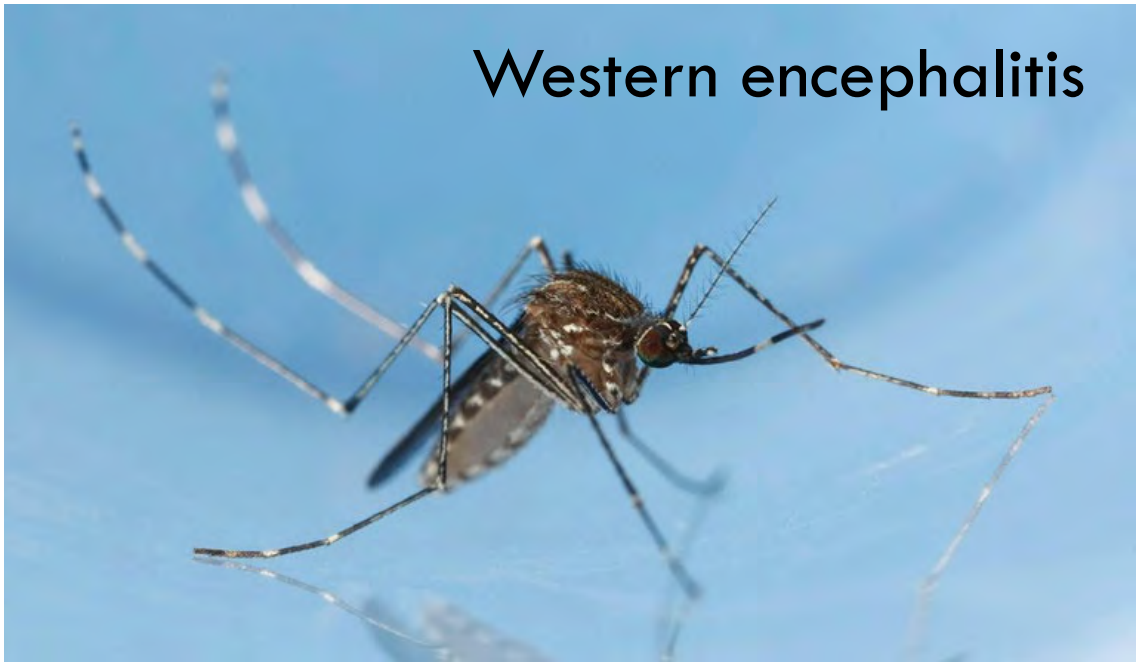

Foreleg
Tarsomeres (tarsus)
Tibia
Femur
5
4
3
2
1
Wing
Longitudinal veins:
Costa
Subcosta
Radius
Media
Cubitus
Anal
Crossveins:
Radial-medial
Medial-cubital
Humeral
Culex pipiens
Head
Proboscis
Flagellomere
Antennae
Palps
Compound eye
Occiput
Thorax
Antepronotum
Scutum
Scutellum
Postnotum
Halter
Abdomen
I
II
III
IV
V
VI
VII
Abdominal segments (I to VII)
Cercus
Mid leg
Hind leg

Not all blood-feeding insects vector disease-causing pathogens

Some mosquito species vector disease-causing pathogens

Mosquitoes of concern in AZ
Culex tarsalis & *Culex quinquefasciatus*

- Primarily feed on **birds**
  - **West Nile** virus (birds, humans, horses)
  - **St. Louis encephalitis** virus (humans)



Culex quinquefasciatus

- **Fly <5 miles**
- Larvae develop in **high organic content** water
- **Night biter**

Southern house mosquito

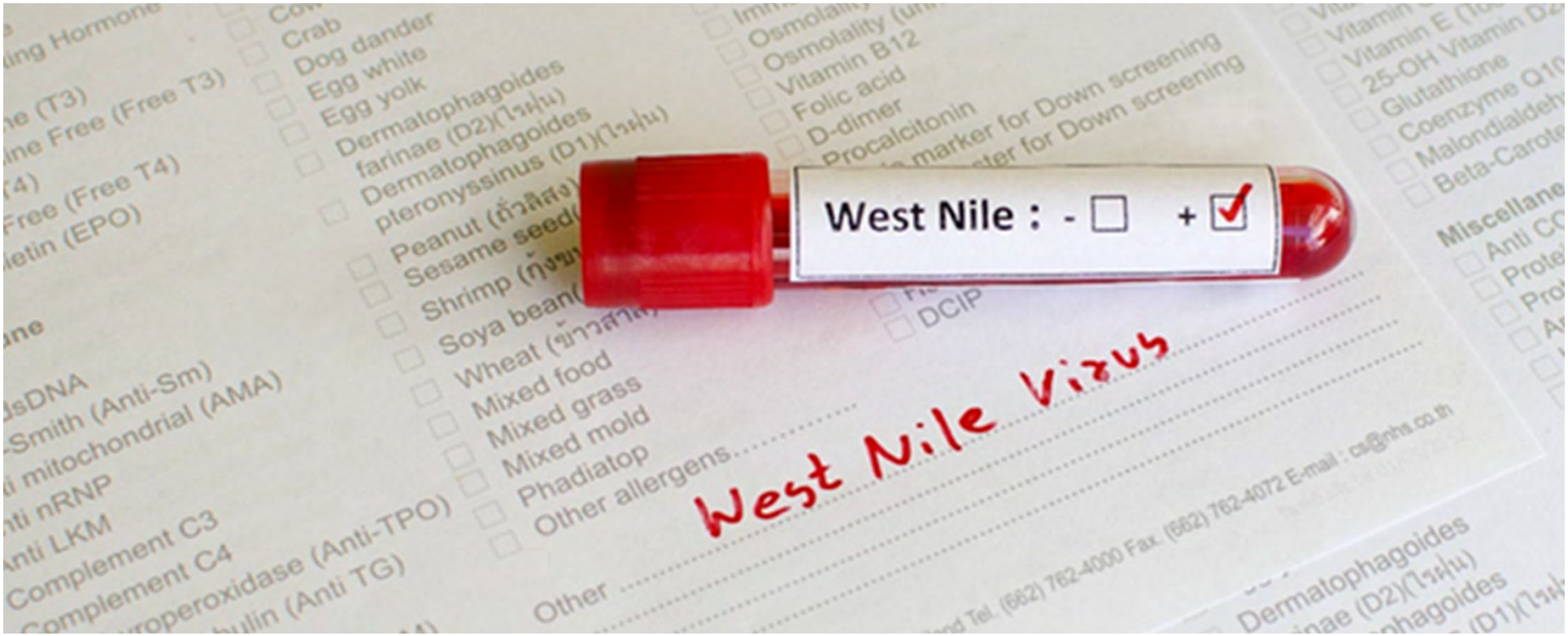
Culex tarsalis

- **Fly >10 miles**
- Larval development in **high organic content** water
- **Night biter**

Western encephalitis mosquito

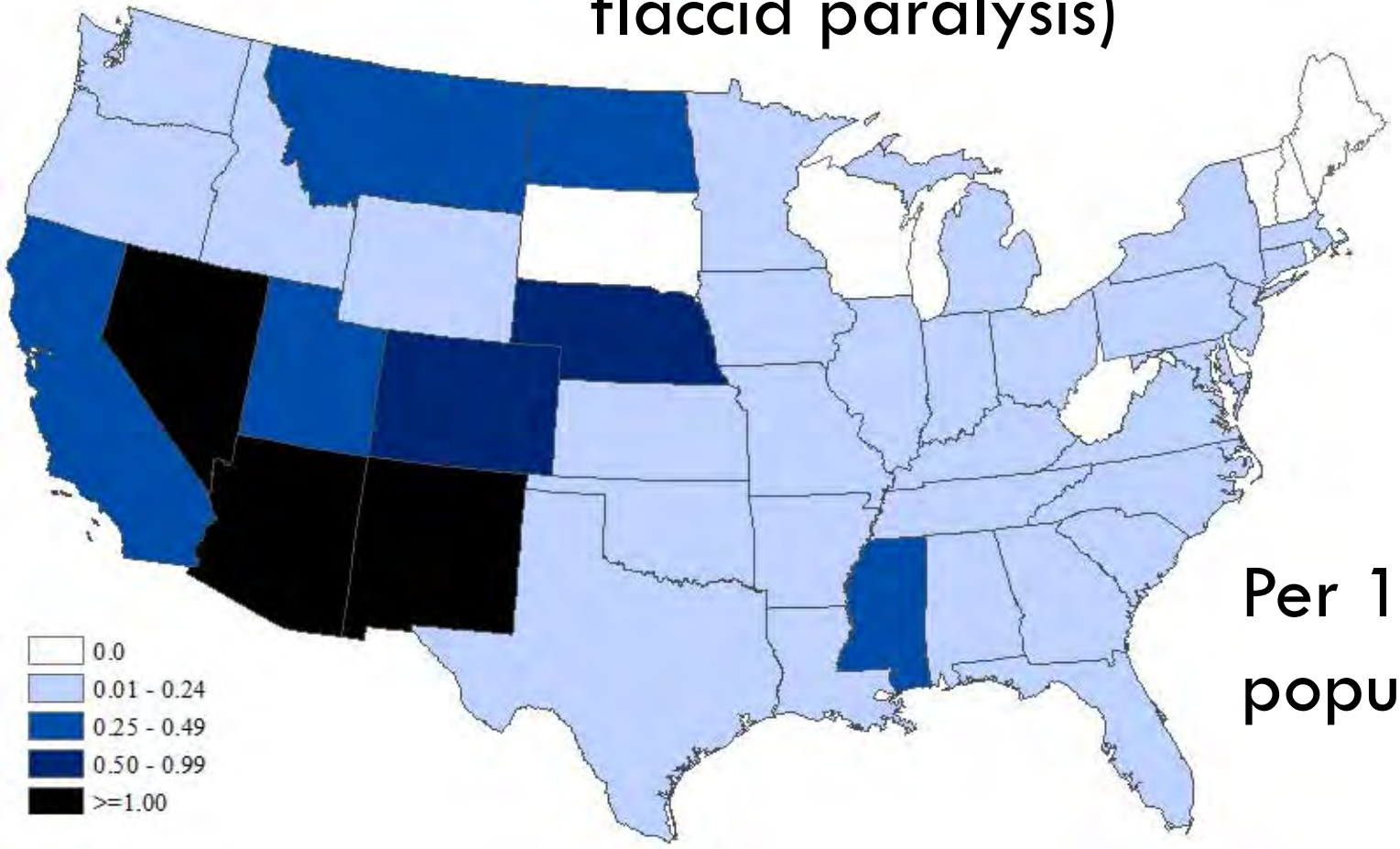
Domestic virus vectoring in the continental U.S.

- **West Nile virus** - leading vectored arbovirus
- 917 WNV cases - 2019 & 557 cases - 2020



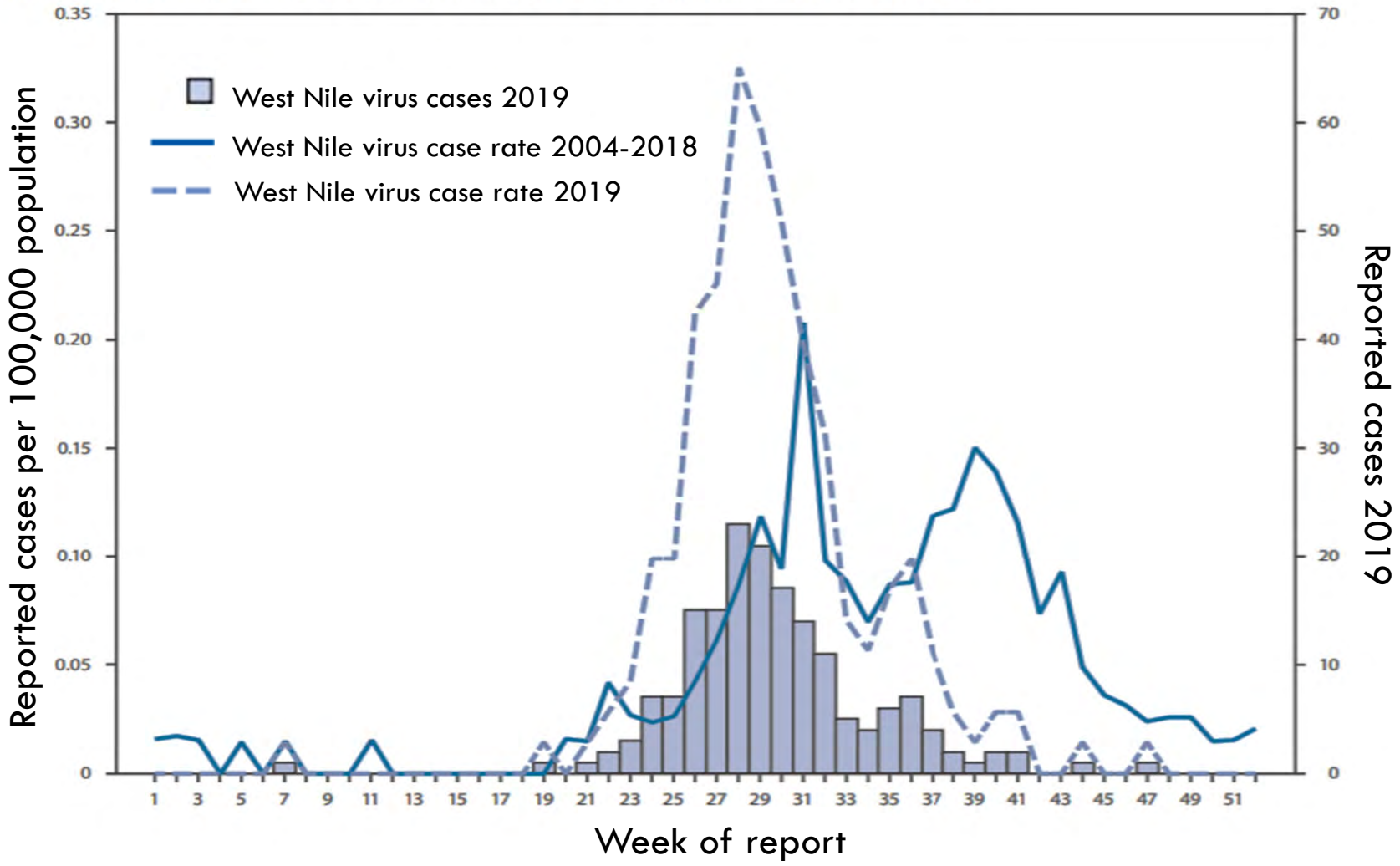
AZ 2019 - 174 West Nile clinical cases & 18 deaths

AZ has high incidence of human West Nile **neuroinvasive disease** (e.g., meningitis, encephalitis, acute flaccid paralysis)



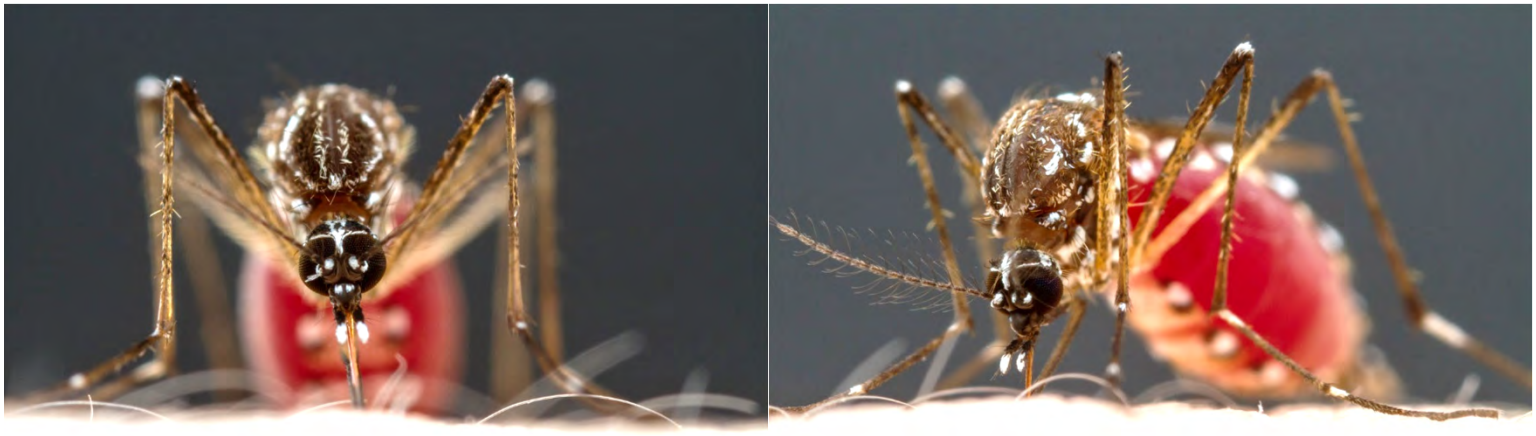
Per 100,000 population

West Nile virus disease cases and incidence per 100,000 population AZ 2004-2019



Aedes aegypti

- **Yellow fever mosquito**
  - Zika, dengue, chikungunya, yellow fever viruses (**humans**, primates)
  - Common in tropical, subtropical, and in <u>some</u> temperate regions – **sensitive to freezing**



Aedes aegypti - Yellow fever mosquito

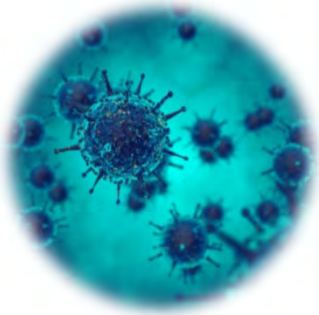
- **Peridomestic - you breed 'em, you feed 'em**
- Stays close to home
- **Cryptic** larval habitats
- **Day biter**

Aedes albopictus

- **Asian tiger mosquito**
  - Zika, dengue, chikungunya, yellow fever viruses (humans, primates)
  - Not established in AZ….. So far.

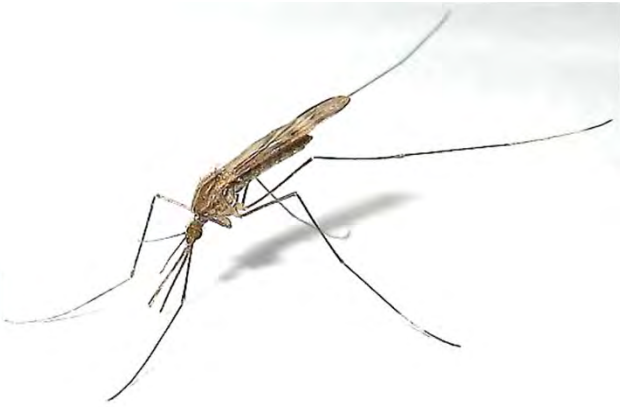
Disease

Pathogen, vector, host in one **location** at the same **time,** with supportive **environmental conditions**

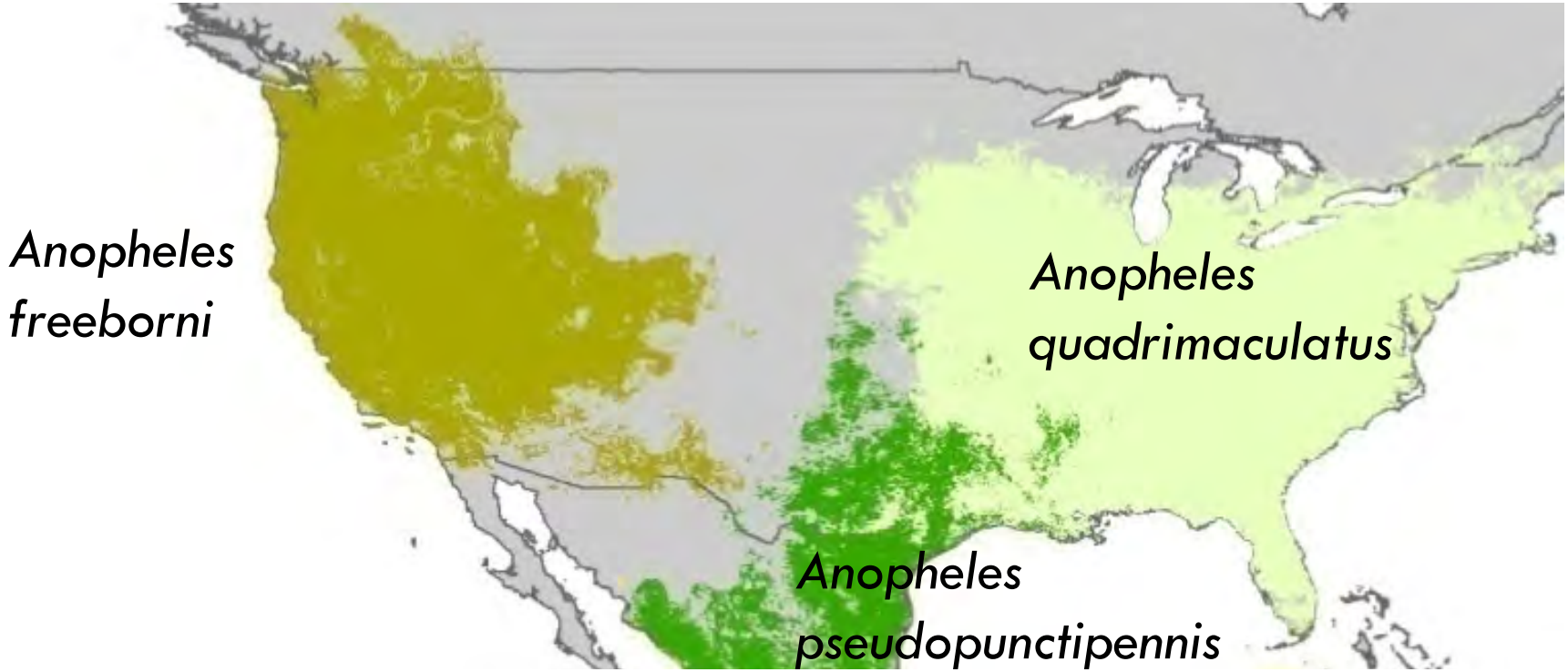


Pathogens that <u>could</u> be vectored to humans by *Aedes aegypti*

Anopheles freeborni



- **Western malaria mosquito**
  - *Plasmodium* parasites (reptiles, birds, mammals)



Not considered to be important vectors

- Bite humans, livestock, pets
- Can have **very** large populations in spring and fall
- **Day biters**

Psorophora columbiae

Aedes vexans

Generalized mosquito lifecycle & control

Adults emerge & feed on nectar

Female mosquitoes lay eggs on or near water

Adult females take blood meals

Culex quinquefasciatus eggs

Aedes aegypti eggs

Eggs hatch in water in hours - weeks

Larvae breath at the surface

Larvae develop in water – feed on microbes

Pupa

Pupae develop in water, breathing at the surface

Adult emergence

Aedes aegypti

Adult emergence

Males

- **Emerges first**
- **Feeds on nectar**
- Mates within 2-7 days multiple times
- Short lived

Females

- **Feed on nectar**
- Mate usually once
- Needs a **blood meal** to develop eggs
- 1-5 blood meals
- Lives 7 - 28 days

Mosquito mating

Many species mate in flight

- **Lekking** - males emerge first and gather over swarm markers specific times

Mosquito mating

- Males cue in on the humming frequency of female wings
- Both sexes alter wing speed to cause the convergence of harmonic frequencies (*Culex, Aedes, Anopheles*)

Culex quinquefasciatus – egg rafts >50 eggs

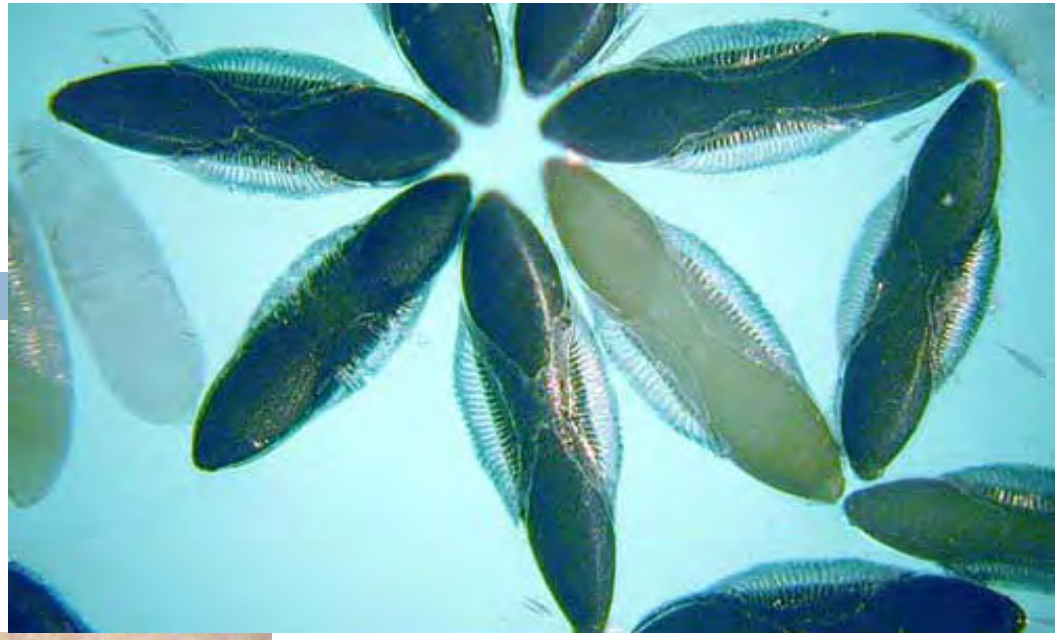
Culex eggs

- In rafts on the surface of water

Culex

Eggs laid

- Singly on surface or edge of water



Anopheles

Aedes aegypti

Aedes aegypti eggs

- Some eggs hatch **immediately**
- Some hatch is **delayed**

Larvae

- Filter-feeders
- Come to the surface to breath

Culex quinquefasciatus

Anopheles

Aedes aegypti

Larvae

Larvae

Pupae

Aedes

Culex

- Non-feeding stage
- Come to the surface to breath

Anopheles

Overwintering

- Egg stage e.g., *Aedes* and *Psorophora*
- Larvae e.g., *Anopheles*
- Adults e.g., *Culex* and *Anopheles*
- Mated females rest in protected locations

Reducing risk – all about water

Reducing opportunities - plants

1. Repair leaks in hoses, drip lines, and sprinkler heads
2. Use native and low-water-use plants
3. Group plants into hydrozones
4. Remove unnecessary turf
5. Integrate rain sensors
6. Mulch
7. Remove weeds and minimize fertilizer
8. Aerate compacted soil and add organic matter
9. Irrigate in the morning, deeply, infrequently, and avoid run-off

Reducing opportunities – water

Reducing opportunities – water harvesting

Reducing opportunities – water harvesting

Keep gutters clear of debris

Reducing opportunities – human structures

Culex quinquefasciatus

Egg rafts

Human structures

Roadside ditches

Wastewater treatment

Semi-permanent waters (with **high organic matter** content)

Dipping for immature mosquitoes

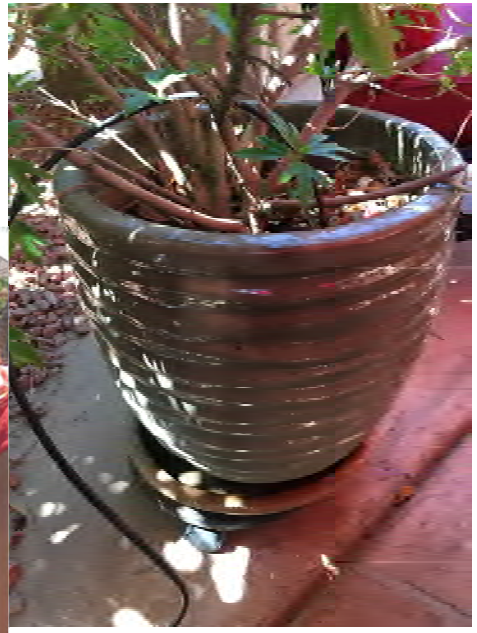
Neighborhood retention areas

Aedes aegypti larvae doing what they are not supposed to do

Aedes aegypti

- Tree holes, rock pools, leaf axils
- Man-made containers and materials that hold water

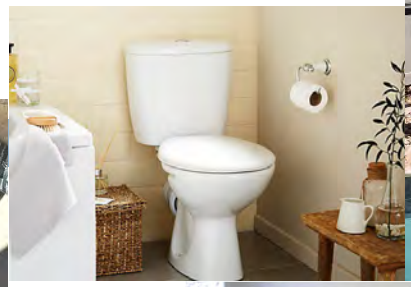
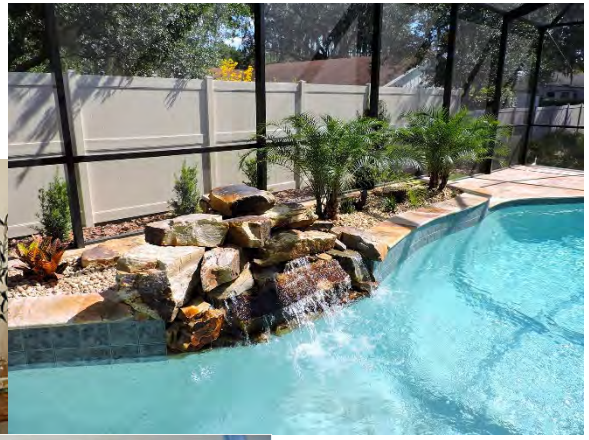
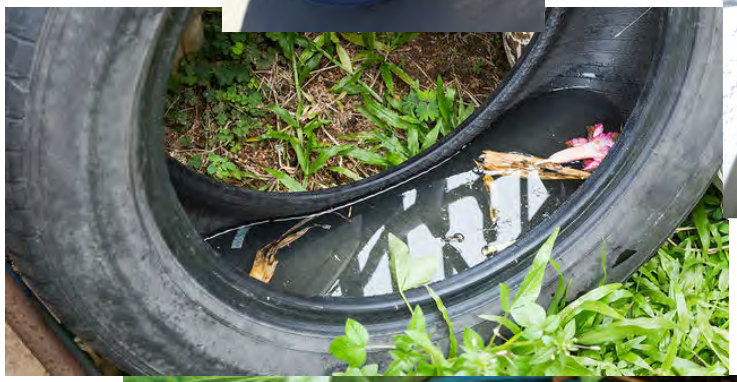
You breed ‘em – you feed ‘em



You breed ‘em – you feed ‘em

Ae. aegypti skip oviposition






Controlling larvae

Gambusia

- Predators
- Microbial
  - *Bacillus thuringiensis israelensis*
  - *Bacillus sphaericus*
  - *B. thuringiensis israelensis* & *B. sphaericus*

Copepod

Controlling larvae

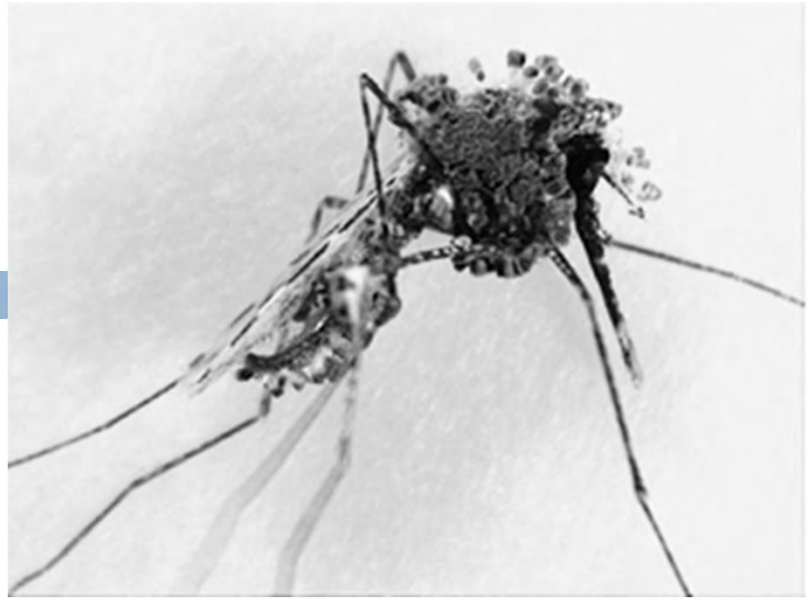
- Monomolecular films & oils
- Insect growth regulators
- Spinosad
- Organophosphate insecticides
  - Temephos

Controlling pupae

- Monomolecular films & oils
- Predators

Purple martin

Controlling adults



- Traps
- Microbial
  - *Beauveria bassiana* and *Metarhizium anisopliae*

Controlling adults

- Sugar baits
- Call county, city, or HOA
  - Pyrethroids
  - Organophosphate
  - Dual action

Controlling adults

- Predators

Female blood-feeding

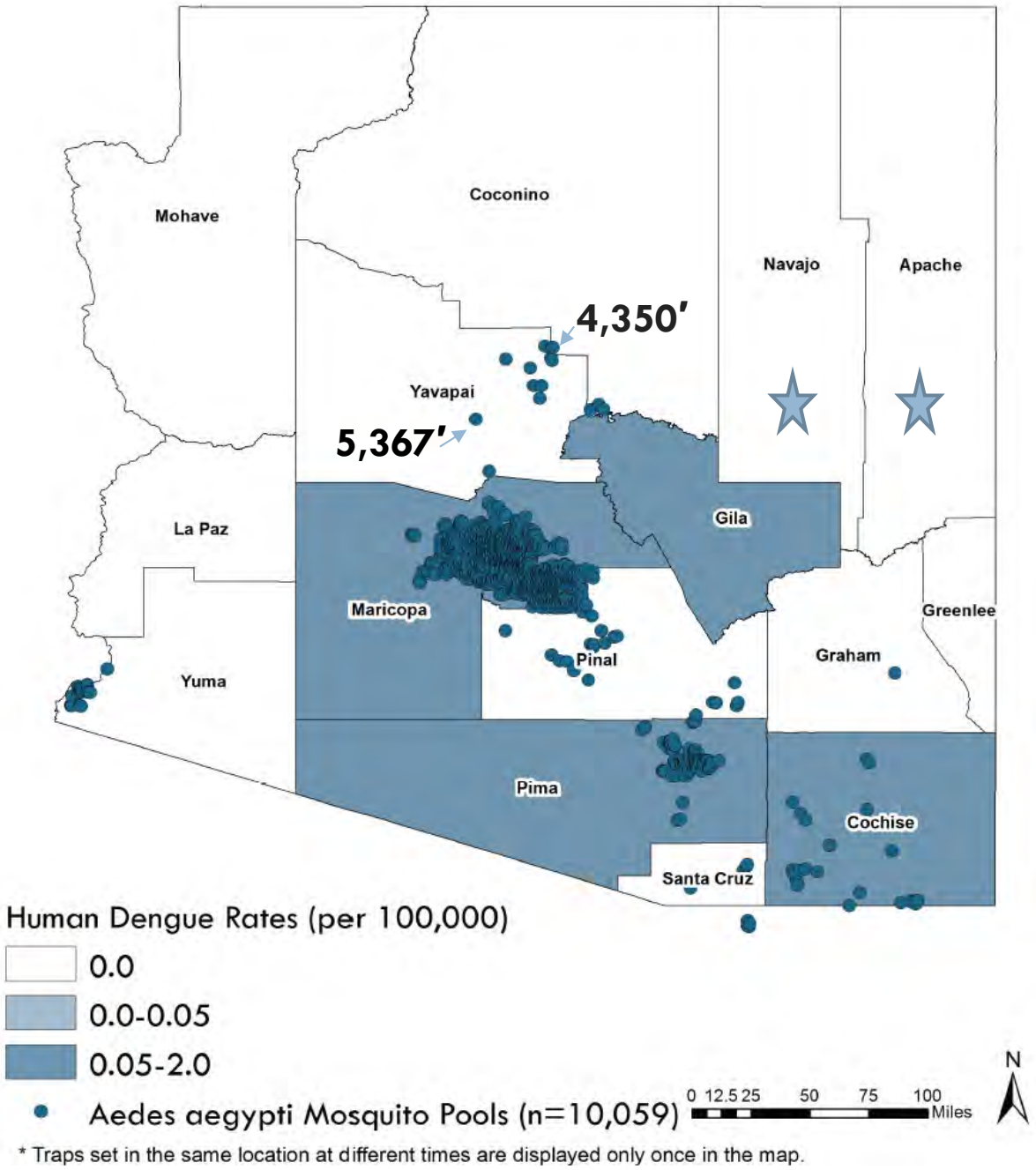
- Clothing
- Clothing applied repellant (permethrin)
- Clip-on and special repellants (pyrethroids)
- Personal insect repellants
  - DEET
  - Picaridin
  - IR3535
  - Oil of lemon eucalyptus (OLE)
  - Para-menthane-diol (PMD)
  - 2-undecanone (specific botanical oils)
  - Nootkatone

Hottest years on record and fastest warming cities

1) Las Vegas, NV has risen 5.76°
2) El Paso, TX has risen 4.74°
3) Tucson, AZ has risen 4.48°
4) Phoenix, AZ has risen 4.35°

Phoenix set 33 record high temperatures in 2020

- 130 days over 100°F
- 53 days with temperatures of 110°F or more
- 14 days with maximum temperatures over 115°F
- July was the hottest month ever recorded in Phoenix



No *Aedes aegypti* over 5,500 feet elevation?

Thank you

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