Mosquitoes can breed in……..

A. natural water catchments, and man-made containers, but not in irrigated lawns
B. in man-made containers holding more than 1 pint of water
C. natural water catchments, man-made containers, and irrigated lawn areas, but not maintained swimming-pools

Mosquitoes in Arizona currently vector the pathogens that cause the following endemic diseases:

A. West Nile, Saint Louis Encephalitis, Dengue, and Chikungunya
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C. Malaria, Chikungunya, and Dengue
**Mosquitoes**

Mosquitoes need water

Four life stages
- egg, larva, pupa, and adult

Larval and pupal stages are aquatic

Two-winged Diptera (flies)

Family Culicidae: most species females have a long proboscis for sucking blood

**Eggs**

- Singly on surface or edge of water
- Eggs in rafts on surface of water
- Some sp. hatch 24-36 h
- Some hatch after 1-3 y
- Overwintering stage for some species

**Larvae**

- 1st, 2nd, 3rd, 4th instars
- "Wigglers"—very active, most come to surface for air
- 4-12 d, some species weeks
Mosquito Madness

- Stage that changes from larva to adult
- “Tumblers” very active, come to surface for air
- 3-6 d
- Non-feeding stage

Pupae

Adult mosquitoes emerge from aquatic stages

Adult (Male)

- Emerges first
- Feeds on nectar sources for energy
- Mates within 2-7 d and dies
**Adult (Females)**

- Emerge and feed on nectar
- Mates usually once
- Needs blood meal to develop eggs
- 1-5 blood meals over life of 7 - 28 d

**Winter Survival Is Important:**

Most overwinter in the egg stage (*Aedes*, *Ochlerotatus*, and *Psorophora*)

Some as larvae (*Anopheles* and *Ochlerotatus*)

Some as adults (*Culex* and *Anopheles*)

Mated females rest in protected, cool locations, such as cellars, sewers, crawl spaces, and well pits

Warm spring days allow females to seek a blood meal

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**Mosquitoes are classified based on larval habitat**

- Floodwater mosquitoes - Eggs laid in damp areas
- Permanent water
- Containers
Flood Water Mosquitoes

- *Aedes* and *Psorophora*
- Some genera are important pest species
- *Bite humans, livestock, pets*
- Can have very large populations in spring and early summer

Floodwater (cont.)

- Can survive in egg stage for several years until flooded
- Can have different hatches within several days if increased water levels hatch new eggs

- Adult populations peak in late April, May, and June, some species hatch with late summer fall rains
- Adults die quickly during hot weather
- Flood water usually dries up too fast to support larvae in hot weather
- Females most active around sunset or in shady areas when disturbed
- Some are active during the day

*Aedes vexans & Psorophora*

Green space (parks, soccer fields, lawns, etc.)
Permanent Water Mosquitoes

- *Anopheles*, some *Culex* spp.
- Quiet bodies of freshwater with sunlight, surface vegetation and little wave action
- Shallow edges of ponds, some lakes backwaters of rivers slow moving streams
- Never in lakes with wave action

Permanent Water Group (cont.)

- *Anopheles* vectors malaria
- 1,500–2,000 cases of malaria
- Most travel related

Mismanaged ponds:

- Excessive vegetation
- Stagnant water
- Lack of predators

U.S. Mosquitoes of Great Concern

- *Culex tarsalis*, *C. quinquefasciatus* (southern house mosquito)

Note: all are permanent water mosquitoes, populations peak in summer through fall at same time virus activity peaks

- Feed on birds and mammals
- Vector WNV, WEE and SLE

*Culex quinquefasciatus*

*Culex tarsalis*
**Permanent Water Group (cont.)**

- Populations low in spring
- Build through the summer
- Peak July-October (varies by location)
- Many prefer birds as hosts, feed on mammals
- Vectors of viruses
- Bite more readily at night

**Container Mosquitoes (you breed ‘em, you feed ‘em)**

- 99% = *Culex* or *Aedes*
- Larvae live in tree holes, rock pools even leaf axils
- Many species associated with man made containers or materials that hold water
  - Tires, cans, buckets, birdbaths, gutters, pet water dishes, plant container bottoms that catch water, even cans, paper cups etc.
Asian Tiger Mosquito (not in AZ)

- *Aedes albopictus*  
  *vector dengue, ChikV*
- Larvae in containers of any size
- Adults active during the day

Yellow Fever Mosquito

*Aedes aegypti*

- Container breeder
- Prefer more sunlight
- Dengue and ChikV

Aedes albopictus

Eggs in Container

- Container breeder
- Eggs laid on surface of water, on sides of container, and on stick
- Immediate egg hatch of some eggs, delayed hatch for others
Locations of mosquito surveillance and *Aedes aegypti* presence in Arizona - 2015

**Integrated Pest Management**
- Surveillance
- Source Reduction
- Larvicides
- Adulticides – “when not to spray”
- Biological Control Agents
- Public Education
  - Reduce conducive conditions
  - Eliminate containers holding water
  - Repellents

**Landing Rates**
- Measure adult mosquito activity in a specific area
- Count the number landing per minute - TMTC
- Same inspector at each location

**CDC Miniature Light Trap**
- For portable collection of mosquitoes and sand flies
- Standard survey tool
- Operates on 6 volts
Attractants

- CO₂ standard attractant (dry ice)
- Increases trap collections
- 200ml/min is average release rate
- CO₂ plus Octenol increases trap catch for some species

CDC Gravid Trap

- Catch gravid *Culex* females
- Females are attracted to the hay/fish oil infusion as an oviposition site
- Used for virus detection
- Operates on 6 volts

Mosquito Magnet

Need to have an overall understanding of the types of mosquitoes in order to properly address pest concerns
Resources

• Local Mosquito Abatement Districts
  http://www.maricopa.gov/wnv/
  • Surveillance data
  • Identification
  • Coordination of management areas
• Local universities
INTEGRATED MOSQUITO MANAGEMENT

- Source Reduction
- Eliminate mosquito breeding sites

INTEGRATED PEST MANAGEMENT

- Surveillance
- Source Reduction
- Larvicides

Types of Larvicides

- Oils
  - Suffocation – mechanical barrier
  - Suffocation – oil entering the siphon blocking air
  - Poisoning due to toxic properties of the volatiles

- Bacterial (*Bti*, *B. sphaericus*)

- Chemicals (organophosphate-temephos, *Abate®*)

- IGR (growth hormones - methoprene)

- Fish, copepods, turtles
**Mosquito “Dunks”**

“Doughnuts” of bacterial larvicide for small bodies of water; e.g. pools, culverts etc.

**INTEGRATED PEST MANAGEMENT**

- Surveillance
- Source Reduction
- Larvicides
- Adulticides

**ULV Fogger**

Expensive and relatively ineffective <60%

**ULV hand fogger and portable mist blowers**

- Organophosphates
- Pyrethroids/pyrethrum

- ULV
- Portable mist blowers
- Large droplet size

- Droplet size 10-46 microns
Misting systems
• Pyrethrum/Pyrethroids
• Restrictions around water - Fish kill
• Often on a timer
• Spray on demand
• Homeowners not typically educated sufficiently
• Not IPM
• Tolerance/resistance

Barrier treatments

• Equipment
  • B&G
  • Backpack Mister
  • Misting systems

• Where & how to spray
  • Porches
  • Areas that are protected by rain
  • Underside of leaves
  • Spray to runoff

• Residual period
  • Depends on weather can get several months

INTEGRATED PEST MANAGEMENT
• Surveillance
• Source Reduction
• Larvicides
• Adulticides
• Biological Control Agents

30-50 Gambusia affinis/pool
Live bearers– 75 young/female

New brood/6-8 weeks
omnivorous
Mosquito Management
- Stop them at their source – larvicide
- Kill vectoring adults – adulticide
- Erect barriers against the ones you miss
- Advocate personal protection as the final layer of protection – repellents

Gambusia

IPM
- Public Education
  - Reduce conducive conditions
  - Eliminate containers holding water
  - Repellents

Educational Materials
Chikungunya

- **2014**: 2,792 imported cases of CHIK in U.S.
- **11 locally transmitted cases in Florida**
- The CDC and PAHO have developed a preparedness and response plan available at: [http://www.cdc.gov/chikungunya](http://www.cdc.gov/chikungunya)
  [http://www.cdc.gov/chikungunya/geo/united-states.html](http://www.cdc.gov/chikungunya/geo/united-states.html)
**Chikungunya Signs & Clinical Symptoms**

Incubation period 2-6 d, symptoms appearing 4–7 d post-infection

Symptoms include:
- Rash
- Pain in the Lower Back
- Joint Pain (with or without swelling)
- Headaches
- Chills
- Nausea
- Vomiting
- Fevers
- Rash
- Chills

**Acute phase**
- Few days - couple of weeks
- Chills, fever up to 104 °F (2 days), vomiting, nausea, head ache, arthralgia (joint pain), rash, insomnia, can last 5 to 7 days
- Severe joint and muscular pain prostrates victims

**Chronic phase**
- Joint pains for up to 2 years
- 60 to 90% of infected adults are symptomatic, most become disabled for weeks to months
- Recurrent joint pain is experienced by 30–40% of those infected
- Death is rare but serious complications include myocarditis, meningoencephalitis

**Presents in two phases:**

**West Nile**
- Virus: *Flavivirus*
- 1º vectors: *Culex*
- Human hosts: Incidental
- % symptomatic: <20%
- % chronic: <1%
- % fatality: <1%

**Chikungunya**
- Virus: *Alphavirus*
- 1º host: *Aedes*
- % symptomatic: 72-97%
- % chronic: 30–40%
- % fatality: 0.03%
Emerging diseases - Arizona

**Dengue**
- **Before 2014:** 4 imported cases of Dengue in AZ
- In 2014: 90 imported (maybe) cases of Dengue in AZ, Yuma, Maricopa and Pima counties

**Saint Louis Encephalitis**
- 4 cases in AZ 2004-2013
- 13 cases confirmed in AZ in 2015

**Saint Louis Encephalitis**

**AZ Oct 27 2015**

**Dengue**
- **Probably cases Sep 12th**
- 125.199 MEX (2,107 Sonora)

**Chikungunya**
- 15 travel

**SLE**
- 17 locally acquired
- 1 death

**WNV**
- 80 locally acquired, 6 deaths

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**CDC**
http://www.cdc.gov/features/stopmosquitoes/

**USGS**
http://diseasemaps.usgs.gov/dep_ga_human.html

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QUESTIONS?

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