OHIO MOSQUITO & VECTOR CONTROL ASSOCIATION

SPRING TRAINING 2024: MOSQUITO SURVEILLANCE 101

TEAMS WEBINAR HOUSEKEEPING

All attendees that are not presenting are automatically muted and cameras turned off.

Please use the chat feature if you have a question or comment. If you are unable to use the chat feature or would prefer to ask your question live, please use the raise hand feature so we can unmute you.

Your attendance is automatically tracked.

OHIO MOSQUITO & VECTOR CONTROL ASSOCIATION

OMVCA

Professional organization with members from local health departments, mosquito control districts, academia, state agencies, and industry

Our mission is to provide leadership, information and education leading to the enhancement of health and quality of life through the suppression of mosquito and other vector transmitted diseases and the reduction of annoyance levels caused by mosquitoes and other vectors and pests of public health importance.

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National Mosquito Control Awareness Week

June 16-22, 2024

AMCA®
THE AMERICAN MOSQUITO CONTROL ASSOCIATION

#AMCA
#MosquitoWeek
#MosquitoControlAwarenessWeek

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Visit https://www.mosquito.org/mosquito-awareness-week/ for social media graphics

OMVCA ANNUAL FALL MEETING

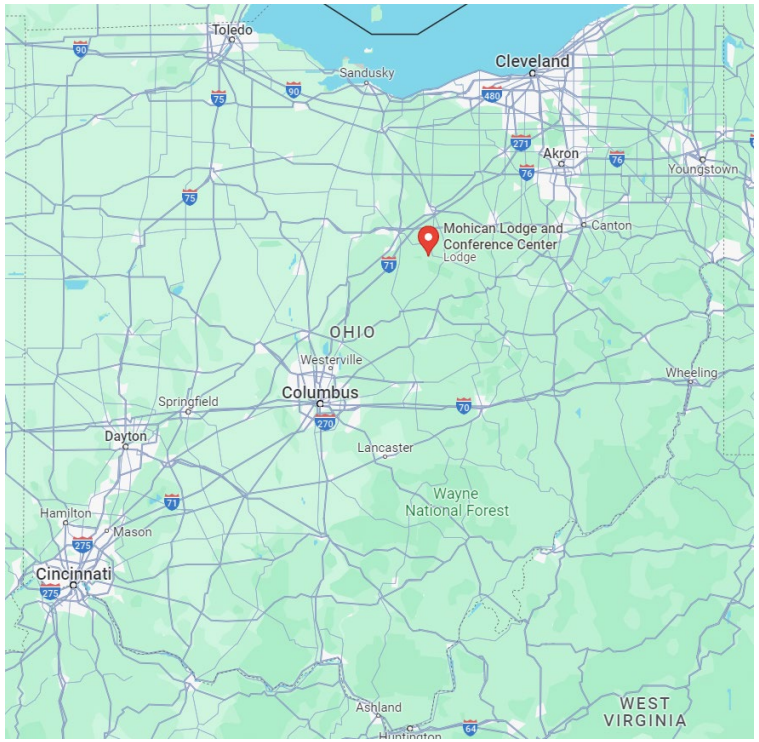
Monday & Tuesday (1/2 day)

October 21-22, 2024

1974 50 years 2024

MOHICAN

LODGE & CONFERENCE CENTER



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INTERESTED IN JOINING OMVCA'S BOARD?

We will be choosing a new President-elect at our fall meeting, plus there are many more opportunities to get involved!

President
Sarah Fink, REHS
Ohio EPA

President-elect
Zach Holbert-Watson, REHS
Franklin County Public Health

Vice President
Matt Bolenbaugh, REHS
Columbus Public Health

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Past President
Ryan Younge, RS, REHS, MEP
Columbus Public Health

Member at Large
Annie Bartosh, REHS
Cuyahoga County Health Dept.

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SPECIAL THANKS

Thank you to Ohio EPA Division of Materials & Waste Management for hosting this webinar through their Teams account and supporting vector management programs through the Mosquito Control Grant.

Ohio™ Environmental Protection Agency

OHIO EPA MOSQUITO CONTROL GRANT REMINDERS

- Ohio EPA Mosquito Control Grant
- 2023 Mosquito Control Grant Spending Deadline
- 2024 Mosquito Control Grant Payments

TRAINING AGENDA

- Why surveillance matters
- Trapping logistics
- Gravid traps
- CDC light traps
- BG Sentinel traps
- Other traps
- Batteries & power sources
- Specimen handling and submission to ODH
- Databases & recording trap data

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WHY SURVEILLANCE MATTERS

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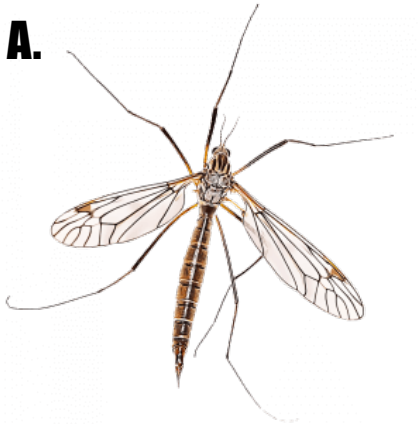
WHICH ONE IS A MOSQUITO?

A.



B.

C.

G.

D.

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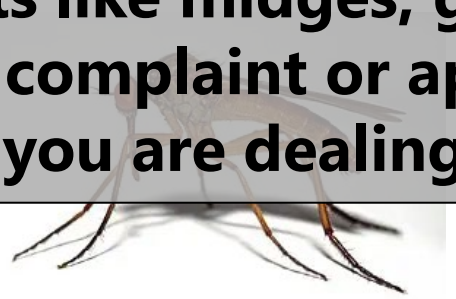
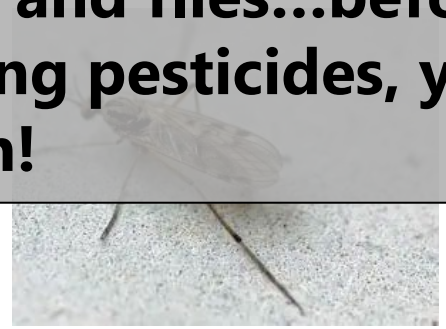
WHICH ONE IS A MOSQUITO?

A.

D.





This is a trick question, as none of these are mosquitoes!

All of these images come from the American Mosquito Control Association's webpage "Mistaken IDs" at https://www.mosquito.org/mistaken-ids/

The average person struggles to identify mosquitoes from other insects like midges, gnats and flies…before taking action on a complaint or applying pesticides, you should know what you are dealing with!

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BASIC MOSQUITO BIOLOGY

- Mosquitoes are flies
  - Order: Diptera
  - Family: Culicidae
- All mosquitoes have 2 wings with scales and a proboscis (long needle like mouthpart used to pierce and suck blood)

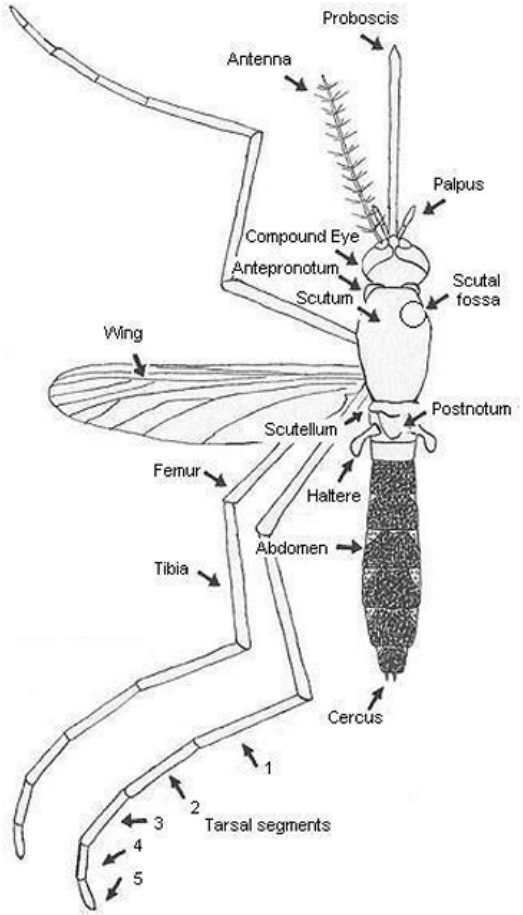

Figure 1.4 Generalized mosquito anatomy, dorsal view

Drawings from “Mosquitoes of the Ohio River Basin”

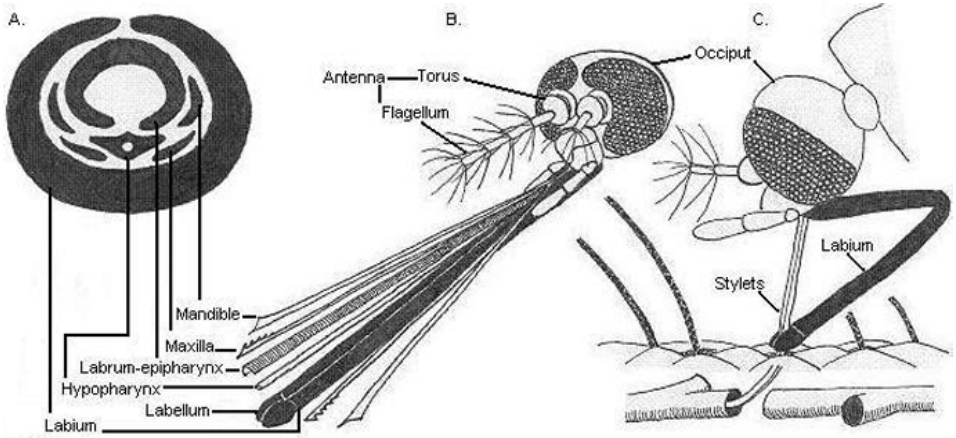

Figure 1.1 Female mosquito head showing anatomy of the proboscis. A: cross section of proboscis. B: Dissection of proboscis, showing stylets. C: Mosquito in the act of biting, with cross section of host skin and blood vessel.

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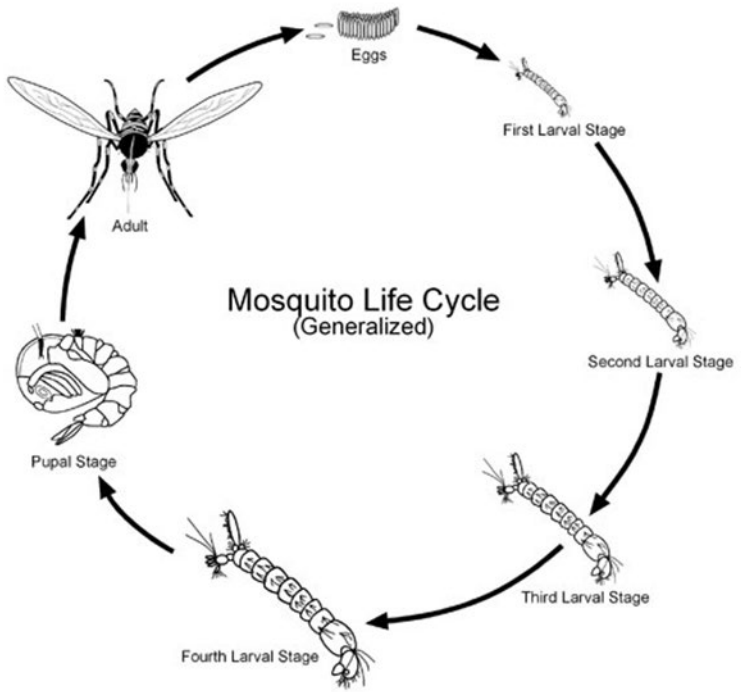
MOSQUITO LIFECYCLE

- Ohio has between 40-60 species of mosquitoes (most don't vector disease)
- Lifecycle is roughly the same for all species, but there is variation in preferred habitat, oviposition (egg laying) sites and overwintering life stage
- Larval stage is called instar
- Only females take bloodmeals (protein for egg development)



Male *Aedes vexans*

VS

Female *Aedes vexans*

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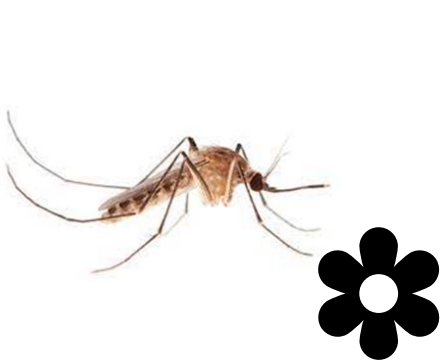
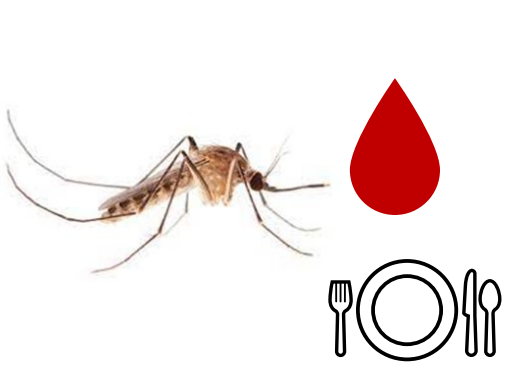
ADULT FEMALE MOSQUITO BEHAVIOR



All mosquitoes feed on nectar or other sources of sugary water. A nulliparous female has not laid eggs yet (typically young).



After mating, the female will need a bloodmeal to have enough protein to develop eggs*. At this point she is **host-seeking.** She finds her hosts by sensing CO_2 and other means.

A female ready to lay her eggs is **gravid.** She will be looking for a source of water to lay her eggs on or nearby. Preferred oviposition sites vary by species.

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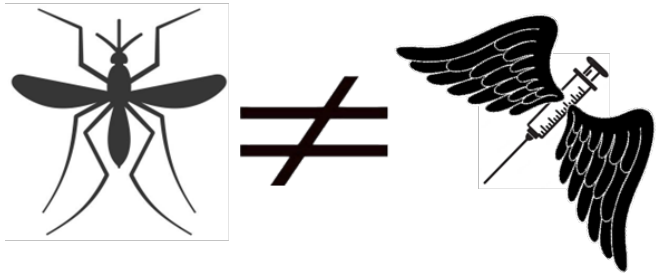
**Some species get protein in larval stage by eating smaller species of mosquito larva*

VECTOR VS NUISANCE

- In order to vector a disease, a mosquito must bite an infected host. This virus or parasite then must replicate within the mosquito, spread to its salivary glands and the mosquito must then bite another susceptible host (or the pathogen must spread to genitalia to spread to mate or offspring).
- Even if a mosquito is a competent vector for a pathogen, there are a lot of other factors that may impact disease transmission.
- It can be hard to target only vector species, plus there are public health and other benefits to targeting nuisance species as well.



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COMMON GENERA OF MOSQUITOES

Anopheles spp.

Vector for malaria
Lays single eggs on surface of fresh water
Overwinters as adult

Culex spp.

***Culex pipiens* (aka Northern House Mosquito)**
Vector for West Nile Virus
Lays eggs on surface of organic rich water in rafts of ~200 eggs
Overwinters as adult

Culiseta melanura
Vector for Eastern Equine Encephalitis
Preferred habitat hardwood swamps

Coquillettidia perturbans (aka cattail mosquito)
Bridge vector for Eastern Equine Encephalitis

***Psorophora ciliata* (aka gallinipper)**
Massive floodwater species
Overwinters as eggs
Large hatch-offs of *Psorophora* sometimes seen after hurricanes

All of these species and genera can be found in Ohio

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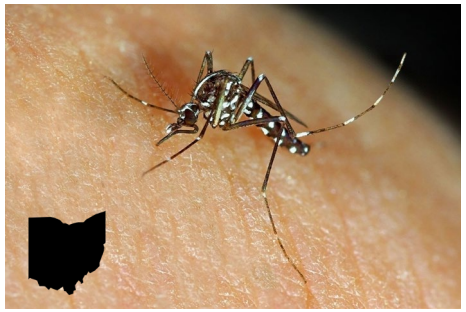
AEDES GENUS

***Aedes aegypti* (aka Yellow Fever Mosquito)**
Vector for Dengue, Zika, Yellow Fever, Chikungunya



***Aedes albopictus* (aka Asian Tiger Mosquito)**
Can vector similar diseases to *aegypti*

Daytime biters, preferred oviposition site containers
Lays eggs above waterline
Overwinters as eggs (can survive drying out for 8 months)

***Aedes triseriatus* (aka Eastern Treehole Mosquito)**
Vector for LaCrosse Encephalitis
Prefers laying eggs in treeholes

Aedes vexans
Vector for canine heartworm
Classic floodwater mosquito
Lays eggs singly in moist soil where they can remain dormant for years

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QUESTIONS THAT SURVEILLANCE CAN ANSWER

Are these mosquitoes?

Are these species that can spread disease?

Are they infected?

Where are they coming from?

How do I prevent them?

Where to look for larva?

Are numbers of mosquitoes increasing?

Which species are in my area? Any new ones?

Are my control efforts effective?

What do my residents need to know?

Are there patterns or trends from year to year?

What does my mosquito population normally look like?

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INTEGRATED MOSQUITO MANAGEMENT

Toledo Area Sanitary District's IMM approach

Based on Integrated Pest Management (IPM), which is a comprehensive approach to pest management that focuses on prevention, education, and controlling pests at their most vulnerable stage while minimizing hazards to the environment. IPM emphasizes data-based decision making with set action thresholds.

An essential step in IPM is to always identify your pest!

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TRAPPING LOGISTICS

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TRAPPING LOGISTICS

- When?
  - Time of year and frequency
  - How long do I leave it out?
- Where?
  - Public vs private property
  - Distribution

There is no single right answer to most of these questions as different programs have different needs! There are a few things to take into consideration though.

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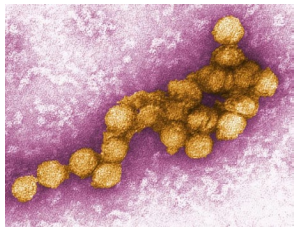
WHEN TO START AND STOP TRAPPING?

It depends! Weather, virus levels, resources, staff availability…



MMWR 15

MMWR 44

April-May
Spring floodwater can species emerge

May-June
Culex begin reproducing

June-July
May start to see some West Nile positive *Culex*

July
BG traps typically start catching *Aedes albopictus*

August-September
West Nile virus levels amplify

October
Mosquitoes still active until first hard frost, but control gets challenging

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**roughly based on Central OH mosquito populations past 5 years, adjust for latitude*

HOW LONG DO I SET TRAPS FOR?

For most battery powered traps, it might be best to leave them out for only one night

- Battery might die, resulting in loss of catch
- Mosquitoes might die and dry out; harder to identify and possibly even test
- Attractant (stinky water, dry ice, etc might dry/run out)
- Longer traps sit out, might be more prone to vandalism

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HOW FREQUENTLY DO I SET TRAPS

Again it depends!

- Typically, you don't need to set more than one night per week for one location. ODH won't test pools from multiple nights within same week from same location.
- Some programs will rotate which portion of their district gets traps set each week (ie western half gets set week 1, eastern half week 2)
- Regular surveillance on a set schedule can give you better baseline data. Some programs only set traps as they get complaints

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PRIVATE VS PUBLIC PROPERTY

Private property (single family home)

- Pros
  - Less likely to be tampered with
  - More accurate risk of typical daily exposure to mosquitoes
- Cons
  - May not be able to place traps in same spot from year to year
  - Can be difficult to obtain permission

Public property (park/cemetery)

- Pros
  - Locations stay consistent from year to year
  - Traps more visible
- Cons
  - More likely to be tampered with
  - Might not be best representation of typical exposure risks

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DISTRIBUTION

- Some programs will space traps evenly throughout their district, or place one per township/municipality.
- Others place more traps in areas of higher population density or target areas where people may be gathered outdoors frequently like a park.
- Transparency and consistency are key! If you keep moving trap locations each week or from year to year, it will be difficult to establish baseline data.

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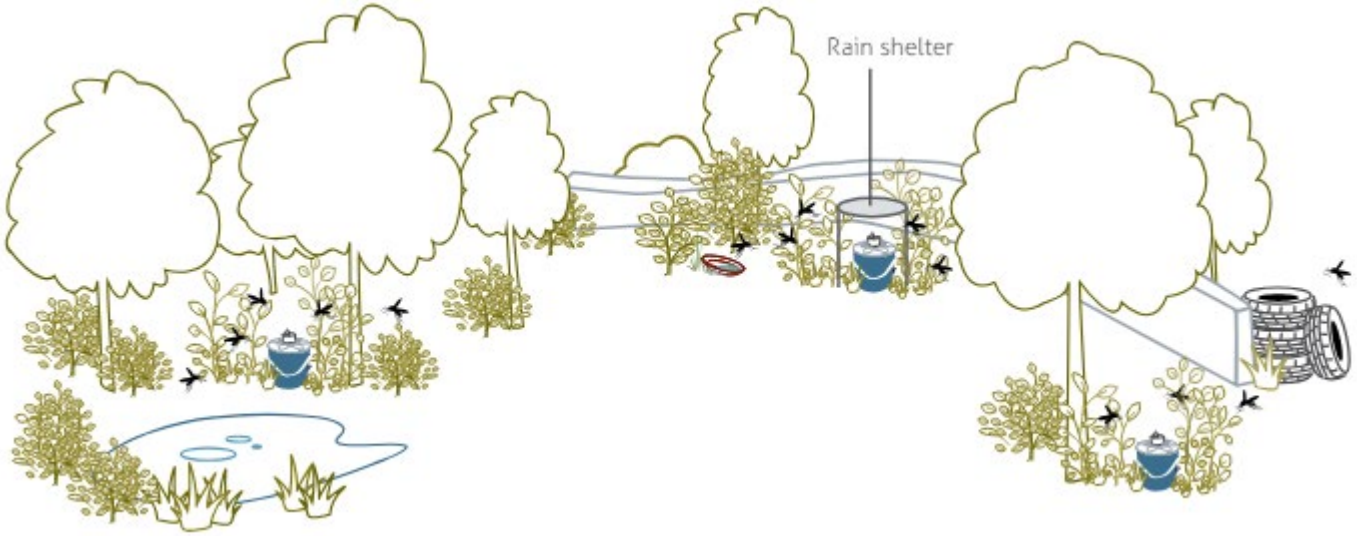
WHERE TO SET TRAPS

Set traps close to areas where you expect mosquitoes.

- Harborage sites- areas that mosquitoes like to rest
- Potential breeding sites

Can I set more than one trap/type of trap at a location? Will they compete with each other?



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GRAVID TRAPS

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GRAVID TRAPS

- These are the most common type of trap used for mosquito surveillance in Ohio.
  - Organic-rich “brew” mimics a pool of stagnant water.
  - Targets female Culex spp. mosquitoes looking for a place to deposit eggs.
  - Traps should be placed in an open area near taller vegetation and should run overnight.

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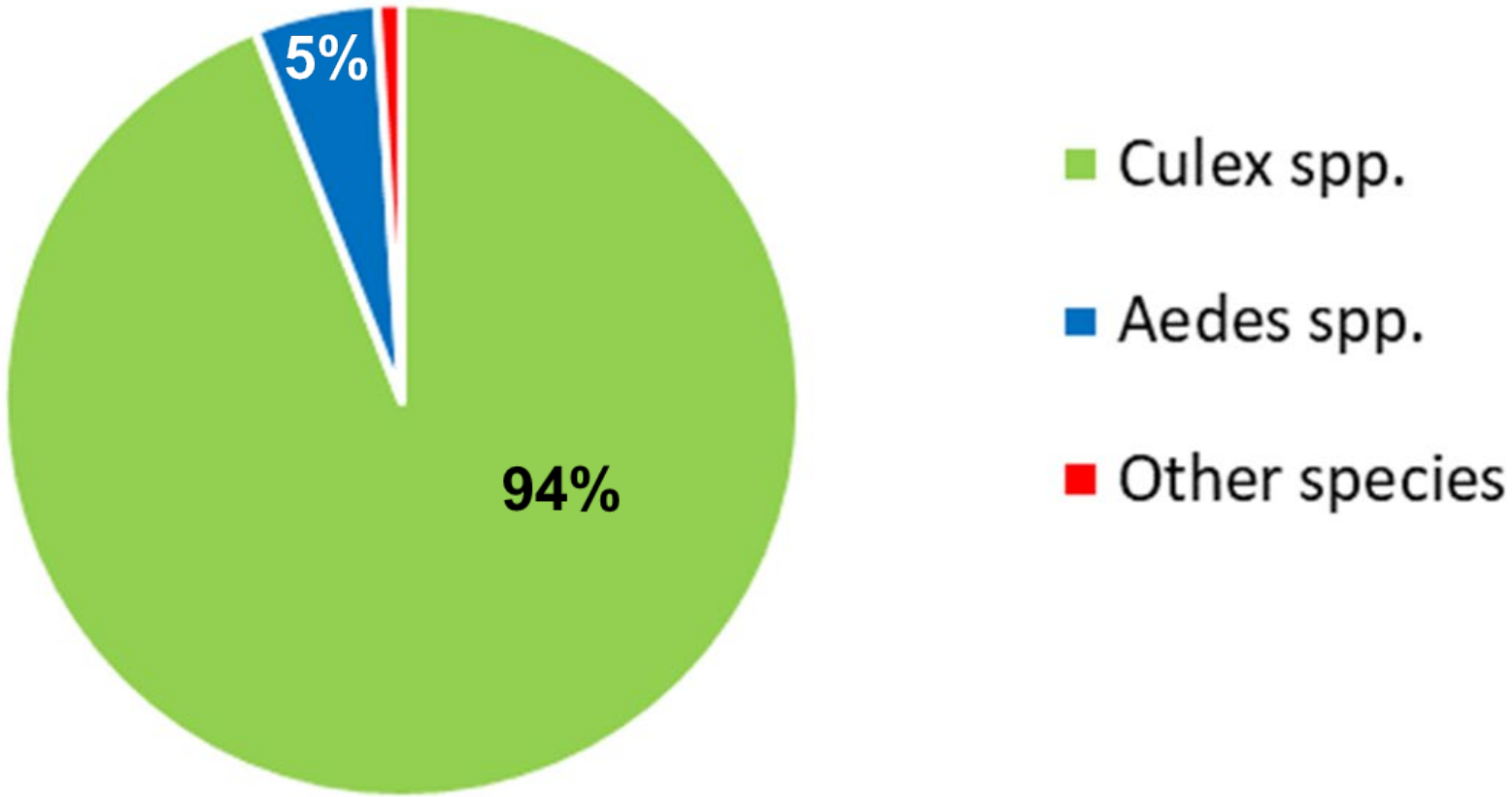
Mosquitoes Collected in Gravid Traps in Ohio, 2017-2023



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BG SENTINEL TRAPS

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BG SENTINEL TRAPS

- Designed to catch invasive *Aedes* mosquitoes like *Aedes albopictus* and *Aedes aegypti*
  - Potential vectors of dengue, chikungunya, Zika, and yellow fever
  - These mosquitoes are thought to have arrived in the US as part of the used tire trade
  - Both have spread rapidly in the past few decades. We do not have *Aedes aegypti* in Ohio (yet), but *Aedes albopictus* is well-established

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BG SENTINEL TRAPS

- Shaped like a bucket as these mosquitoes' preferred breeding sites are artificial containers
- Includes a chemical lure like Octenol and/or Carbon Dioxide
  - Octenol is found in human breath and sweat
  - Also a flavor component of maitake mushrooms!

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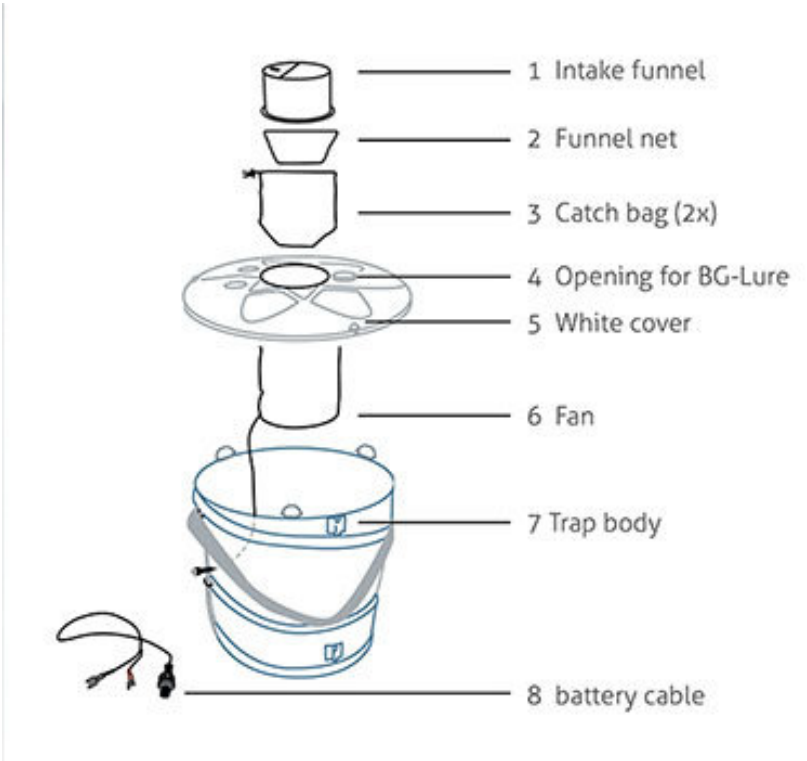
BG SENTINEL TRAPS

- Mosquitoes are attracted by the Octenol/CO_2 and drawn in by a small fan located under the net
  - Since the mosquitoes do not pass through the fan, they usually stay intact, making them easier to identify



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BG SENTINEL TRAPS

PROS

- Great monitoring for invasive *Aedes*
- Mosquito samples are typically intact and undamaged
- Captures host-seeking mosquitoes

CONS

- Expensive to purchase and maintain
- Lures need periodic replacement

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CDC MINIATURE LIGHT TRAPS

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CDC MINIATURE LIGHT TRAPS

- Designed to catch any and all host-seeking mosquitoes in an area
    - Great for finding nuisance mosquitoes
    - Gives a general idea of the diversity of mosquito species and their abundance in an area

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CDC MINIATURE LIGHT TRAPS

- Like the name says, uses a small light as an attractant
  - Not all mosquito species are attracted to light, but light exposure can stimulate host-seeking behavior in some mosquitoes found in Ohio

- Most commonly includes CO_2 as an additional attractant

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CDC MINIATURE LIGHT TRAPS

- Mosquitoes are drawn in by the light and/or the CO_2, then sucked into the collection cup by a small fan

- If a good location is found and the weather cooperates, these traps can catch hundreds or thousands of mosquitoes representing over a dozen species in a single night!

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CDC MINIATURE LIGHT TRAPS

PROS

- Great for estimating species diversity and abundance
- Can catch a *ton* of mosquitoes
- Captures host-seeking mosquitoes

CONS

- Require a CO_2 source, which may be hard to obtain or pricey
- Lots of parts – transporting many of them can be cumbersome and replacing the mechanical bits can get expensive and time-consuming
- Bycatch

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OTHER TRAPS

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OVITRAPS

- Oviposition + Trap = Ovitrap
- A small, dark-colored cup partly filled with water and a surface, like filter paper, onto which mosquitoes can lay their eggs
  - Mimics the preferred oviposition site of *Aedes albopictus*, *Aedes aegypti*, and *Aedes triseriatus*
- Can be used to collect eggs to rear into adults for insecticide resistance testing or establishing a colony
- Can include a net to trap any eggs that complete their life cycle

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OVITRAPS

PROS

- Cheap
- Easy to use
- Supports programmatic activities like insecticide resistance testing in addition to surveillance

CONS

- Requires larval ID (or a lot of patience)
- Requires regular inspection or could become a breeding source
- Easily disturbed or tampered with

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AUTOCIDAL OVITRAPS

- Ovitraps with pesticide added
- Can be larvicidal, adulticidal, or both
  - Larvicidal might include Bti or spinosad in the water
  - Adulticidal might have a pesticide or adhesive applied to the interior surface
- Can reduce the mosquito population, but only when *densely* applied

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AUTOCIDAL OVITRAPS

PROS

- Easy to use
- May provide slight population reduction if enough are used, though that could get pricey

CONS

- Mosquitoes on sticky cards are easily damaged and can be hard to ID
- Easily disturbed or tampered with
- Depending on type, may become a breeding source

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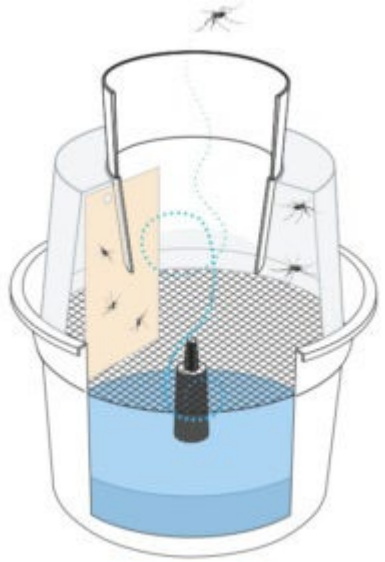
GRAVID AEDES TRAPS (GAT)

- A dark-colored container partly filled with water
- A funnel-shaped entrance to prevent escape
- A net preventing mosquitoes from getting to the water and allowing collection
- Some models include a sticky card



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GRAVID AEDES TRAP (GAT)

PROS

- Easy to use
- Low-maintenance
- Can be used in response to complaints

CONS

- Mosquitoes on sticky cards are easily damaged and can be hard to ID
- Easily disturbed or tampered with
- May become a breeding source

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BG COUNTER

- Uses CO_2 and a fan to collect mosquitoes like many other traps
- Stainless steel frame and roof for durability and weatherproofing
- Can draw power from an outlet, a battery, or be modified to work with a solar panel
- Counts mosquitoes and differentiates them from bycatch and debris *as they are collected*

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BG COUNTER

PROS

- Designed to be durable and low-maintenance
- Does some of the surveillance work for you
- Also capable of recording time and environmental data

CONS

- Expensive to purchase and to deploy
- Count accuracy is about 90% and it cannot provide species ID, so some human effort is still required
- Requires specialized knowledge to make the most of all included features

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BATTERIES & POWER SOURCES

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POWER OPTIONS

Your battery/power options will vary based on the trap. Most traps can be converted to use different types of batteries. *Not all traps require batteries*

Biogents includes an interchangeable power cord that can be plugged in to a wall outlet or attached to sealed lead acid batteries (12V). You can even buy solar panel attachment to charge them.

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BATTERY OPTIONS

Gravid/CDC light traps: single use D-cells or rechargeable 6v sealed lead acid batteries (also called marine batteries)

Less than 12 Amp Hours may die overnight if using with a CDC light trap

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CHARGERS

If using sealed lead acid batteries, select a charger based on your needs. Some chargers can be used for both 6v and 12 v batteries. Some charge in series, meaning that all will charge as slow as your weakest battery.

A multimeter is a good investment if you have multiple batteries

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SPECIMEN HANDLING & SUBMISSION TO ODH

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DATABASES & RECORDING TRAP DATA

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WHY RECORD DATA?

Even though ODH will maintain a database of all samples submitted via field collection records, it is not a bad idea to record and maintain your own data somewhere

- Field collection record does not have a spot for a no-catch
- Setting a trap that doesn't catch anything is still an important data point to capture!
- You can put it in a format that you prefer and add other fields

Your mosquito database can be extremely helpful during accreditation—excellent example of primary data collection

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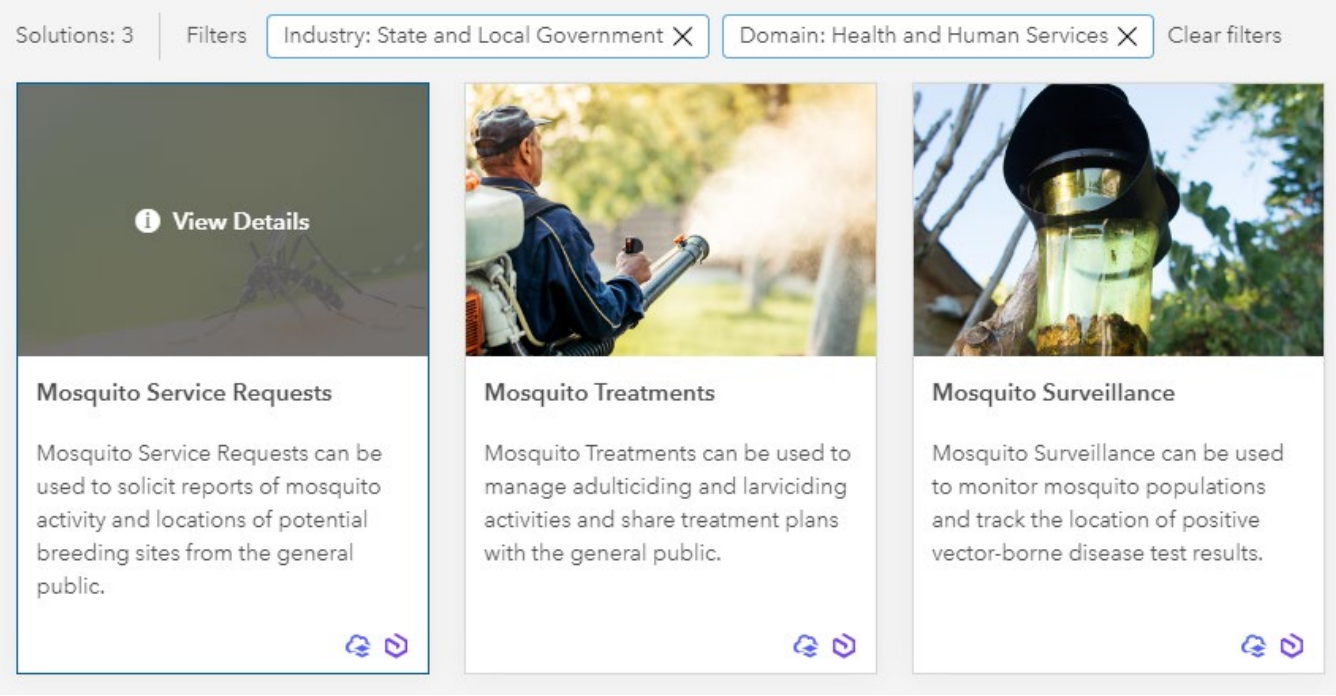
OPTIONS

- Paper copies (do you want to touch a laptop while sorting bugs?)
- Excel
- ArcGIS Solutions



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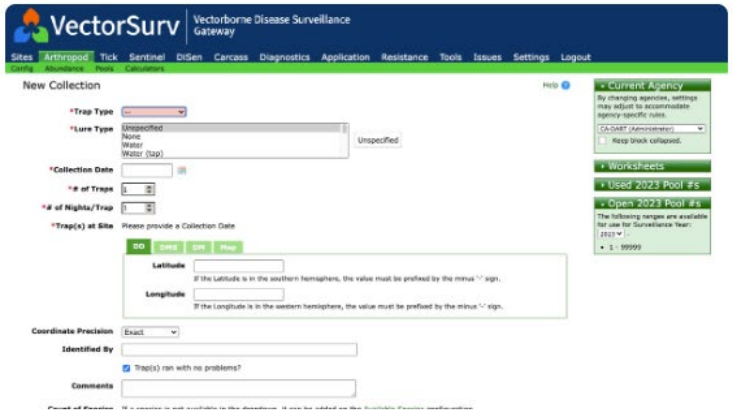
OPTIONS

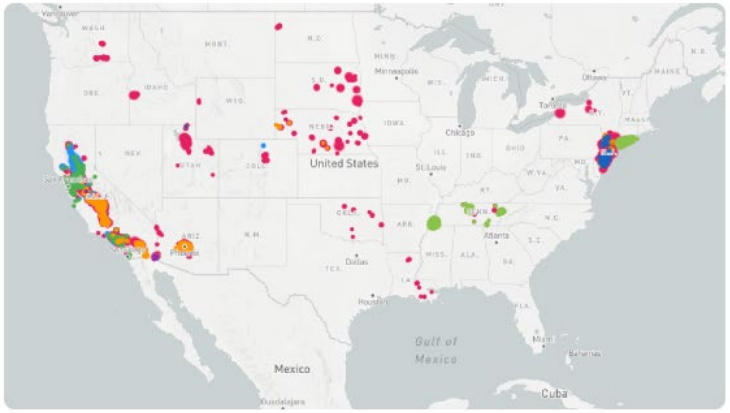
- Pre-built software (FieldSeeker from Frontier Precision, contact your mosquito control suppliers)
- VectorSurv (free!)

VectorSurv Gateway



Vector control and public health agencies use the Gateway to manage and analyze surveillance and control data. Each agency maintains all privileges to manage its own data and user accounts.

VectorSurv Maps



Shows past and present results of surveillance for arboviruses and invasive mosquitoes. Users with a Gateway login can also visualize abundance, insecticide resistance, and West Nile Virus risk.

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QUESTIONS?

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OTHER TRAINING RESOURCES

- American Mosquito Control Association Training Center
  - https://www.mosquito.org/bmp/
- VectorED Network
  - https://www.vectorednetwork.org/
- ODH website
- DMWM MCG website
- OMVCA's website and youtube channel
- NACCHO
- Mosquito product suppliers
  - https://www.johnwhock.com/
  - https://www.clarke.com/mosquito-equipment/biogents-surveillance-equipment/

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THANK YOU!

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