DIDEEBYCHA

GMCA Newsletter

Is it over yet? Mosquitoes in Winter

What we know about diapause comes from the accumulated efforts of scientists who have been studying it since at least 1937 when they first gave the phenomenon its name. Diapause is a period of suspended or arrested development during an insect's life cycle. A dominant feature in the life history of many mosquito species, it offers a mechanism for bridging unfavorable seasons in both temperate and tropical environments and serves to synchronize development within populations, thus directly affecting disease transmission cycles. Some mosquitoes diapause as eggs, some as larvae, and some as adults. One of the interesting things about diapause are changes in behavior leading up to shutting down for the winter. These include endophily (coming inside buildings), changes in food preferences (for nectar instead of blood), and changes in oviposition behavior.

Many species survive as eggs in the soil in a dormant state in which the eggs do not hatch in response to flooding. Instead, they wait for the days to grow long. Some species spend winter as larvae living in water beneath trees and soil in cypress swamps. Here they

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GMCA 2026 Annual Meeting

The Georgia Mosquito Control Association (GMCA) holds an educational conference in the fall of each year as a benefit to its membership and any other interested individuals. The conference is an opportunity for members to interact with colleagues, obtain the latest information concerning all aspects of mosquito control and to earn Continuing Education credits required to maintain the State of Georgia Pesticide Applicator's License. We can also request CEUs for adjoining states if you let us know in a timely manner.

The 2026 GMCA annual meeting was held at Villas by the Sea on Jekyll Island from Oct 21-23. The agenda was well balanced with talks ranging from research-based to safety practices to practical knowledge (https://www.gamosquito.org/resources/2026_GMCA_Program.pdf) There was also a small poster presentation section.

Participants came from Georgia, South Carolina, and Florida, and CEUs were provided for all three States. Vendors from Central Life Sciences, Valent Biosciences, Azelis, Frontier Precision, Amguard, Target, and Clarke attended, as did a number of commercial applicators, contractors, municipal mosquito control, students, health department personnel, and university professionals.

Meeting presentations will be posted on the GMCA website, as will meeting notes.

Business Meeting

Next annual meeting: Griffin UGA Campus, Oct 20-22. 2027

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avoid freezing temperatures while the cold water slows their development and metabolism. Other species can survive the winter in protected places as adult females. The males almost never survive. The adult females that do overwinter are inseminated and live most of the winter in diapause. In northern states, these mosquitoes are in physiological diapause and develop a fat body to sustain them throughout the cold months. While they may move about during warm spells, they almost never bite. In southern states, diapausing adult mosquitoes are in behavioral diapause and can blood feed during warm spells.

What triggers diapause? When days get shorter and the quality and quantity of food declines, these changes signal that the environment will soon be inhospitable, and they prompt animals of all types to begin preparing for winter. Some animals migrate to warmer climes, but others shelter in place. For many of those that stay put, seasonal changes mean it is time to enter a state of suspended animation. For mammals, like ground squirrels, skunks and bats this means preparing for hibernation. And for many, but not all, insects these same cues indicate it is time to enter diapause.

Insect diapause is a lot like hibernation, but there are some differences. The main difference is that mammals remain active until winter is well established and temperatures are frigid, but, depending on the location, insects that enter diapause become dormant in the autumn well before it gets too cold for them to function. Another difference is that mammals can sometimes rouse themselves for short periods of activity during the winter, but once an insect enters diapause in the northern states, it will typically remain dormant until spring even though the weather might be suitable for normal growth and development. This is not always true in the more southerly areas of the US.

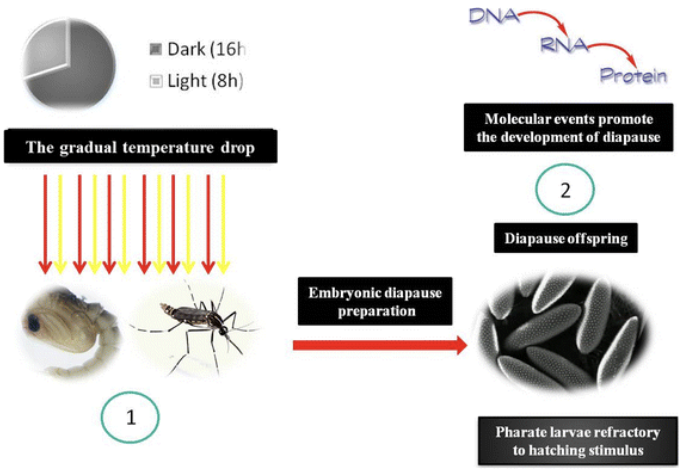
The study of invasive species such as the Asian tiger mosquito has shown that the timing of the diapause can evolve rapidly. During their expansion along different climatic gradients, mosquito populations have been adapting to the signals that trigger the diapause, advancing or delaying it. Not all populations respond the same amount of daily light hours. The answer depends on the latitude at which they are located. This suggests that they will also be able to respond to climate change. Understanding how mosquitoes respond to environmental changes is essential to predict the emergence of nuisance species, as well as the spread of the diseases that vector species transmit.

References

Mosquito Diapause
David L. Denlinger and Peter A. Armbruster
Annual Review of Entomology 2014 59:1, 73-93
https://mosquitoreviews.com/learn/mosquitoes-cold/



Female mosquitoes can gain up to 10 times their warm-weather weight as the cold rolls in. The males are not so lucky and do not survive the winter. (Mijung Kim/OSU)



GMCA Meeting - continued from page 1

GMCA Board 2026-2027

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GA Public Health Rep: Rosmarie Kelly

Planning & Negotiations Rep: Tiffany Nguyen

Past President: Natasha Agramonte

The GMCA Board also awarded a T Oscar Fultz Fellowship to Dr Tiffany Nguyen. For a person to be eligible for this award an in-depth letter must be submitted no later than the July meeting of the Board of Directors. The president will name three members of the current Board of Directors or past presidents to serve on the election committee.

This award does not have to be given every year and must be held in its highest distinction, not to be given lightly.

THE T. OSCAR FULTZ FELLOWSHIP AWARD is the highest award given by the GMCA next to that of the immediate past president of the association. The criteria for this award are exceptional life-time contributions to the association and to the control and study of mosquitoes. This award is not given every year.

"Oscar Fultz was a founding member and 1976 President of the Georgia Mosquito Control Association. He left an indelible mark on the mosquito control industry.

Exceptional life-time contributions are not easy to manage, but our 2026 award winner has done just that. This person has a background in Biology and Public Health. They designed and implemented a residential mosquito control efficacy study, which provides useful information about best management practices for commercial applicators. They designed a protocol for effectively raising mosquitoes from egg to adult for use in pesticide resistance testing. The CDC deemed this protocol so useful that she was asked to train others. She has been instrumental in expanding the GDPH vector surveillance program to include pesticide resistance testing and has created collaborations with the GDA and APHIS. As a GMCA Board member, she has not only been president of the association in 2023, but the Board also created a new position to accommodate her skills as a negotiator that have made it possible for the association to have meetings in places other than UGA. I am of course talking about Dr Nguyen, the Planning & Negotiations Board member and the Public Health Deputy State Entomologist at the GDPH."



Culex and ULV

The exposure of *Culex* mosquitoes to ultra-low volume (ULV) adulticide applications significantly impacts and is impacted by their gonotrophic cycle (the time required for a female mosquito to take a blood meal, digest it, develop eggs, and oviposit).

Instead of fundamentally altering the physiological stages of a single egg-laying cycle, ULV spraying causes distinct structural changes in the population's age and gonotrophic distribution, while the cycle itself dictates how well the population survives the chemical treatment.

1. Shift in Population Age Structure (Parity)

When a ULV application successfully targets a *Culex* population, it eliminates many of the active, older females that have already completed one or more gonotrophic cycles (parous females).

- **The "Nulliparous Shift":** Studies monitoring *Culex pipiens* and *Culex quinquefasciatus* following ULV treatments consistently show a significant spike in the proportion of **nulliparous females** (younger females that have never laid eggs).
- **Vector Disruption:** Because *Culex* mosquitoes must take multiple blood meals across successive gonotrophic cycles to pick up and subsequently transmit pathogens like West Nile virus (WNV), resetting the population to a younger, nulliparous state effectively disrupts disease transmission even if overall mosquito abundance quickly rebounds.

2. Differential Susceptibility by Gonotrophic Stage

A female mosquito's physiological status during her gonotrophic cycle dictates her susceptibility to ULV droplets:

- **Host-Seeking Phase (High Mortality):** Mosquitoes in the unfed, host-seeking stage are highly active and flying. Because ULV droplets rely on contact with flying insects, host-seeking *Culex* suffer high mortality rates (often reduced by 65% or more) immediately post-treatment.
- **Gravid Phase (Low Mortality/Tolerance):** Fully fed or gravid females (carrying mature eggs) are heavy, less active, and typically rest in sheltered microhabitats. ULV applications often reduce gravid populations by less than 30%. Furthermore, blood meal digestion and egg development trigger physiological changes that can temporarily enhance metabolic detoxification, giving gravid mosquitoes a form of transient tolerance or "resistance" to pyrethroids.

3. Delayed Effects and Oscillations

Because ULV treatments fail to kill the aquatic immature stages (larvae/pupae) or the sheltered gravid females, the gonotrophic cycle creates a predictable timeline for population recovery:

- **The 3-to-4 Day Lag:** A *Culex* gonotrophic cycle takes about 3 to 4 days. Consequently, if a ULV spray wipes out host-seeking adults on Day 0, a noticeable reduction in the *gravid* trap population will finally manifest **3 to 4 days later**, as there were fewer host-seeking mosquitoes alive to transition into the gravid phase.
- **Population Rebound:** Within 3 days of a ULV treatment, newly emerged adults from local larval habitats enter the host-seeking population, often causing a sharp post-treatment abundance spike.

Summary of Interactions

Gonotrophic Feature	Impact of / Interaction with ULV Spraying
Nulliparous Ratio	**Increases significantly** as older, multi-cycle females are eliminated.
Host-Seeking Stage	**Highly vulnerable** due to flight activity; experiences the highest immediate mortality.
Gravid Stage	**Highly resilient** due to resting behavior and metabolic changes during egg maturation.
Trap Catch Dynamics	Creates a **3–4 day delayed drop** in gravid trap counts following a nighttime spray.

https://pubmed.ncbi.nlm.nih.gov/37473814/



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