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GMCA Newsletter

Did You See the Eclipse?

Why do Insects Behave Strangely During a Total Solar Eclipse?

A solar eclipse darkened the skies in parts of the United States on April 8. Here in Georgia, we only had ~80% occlusion, but many place saw a total eclipse. People in the path of the totality probably noticed that birds got quiet and stopped flying when the skies darkened. However, totality during solar eclipses also affects the behavior of insects and prompts them to go into their nighttime routine.

During a total solar eclipse, it gets dark really fast, and it gets cooler quickly. When totality is reached, all the birds stop singing. Honeybees stop foraging. They stop leaving their hives and start behavior that's consistent with shutting down for the night. Insect sounds stop. Fireflies start to flash.

These are all still obvious changes for anyone who is looking for them, but what about mosquitoes? A couple of studies have been published on

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Inside This Issue

Larval Mosquito Control for Homeowners

By Elmer W. Gray, Public Health Extension Specialist

Mosquitoes are common nuisance and public health pests of both man and other animals around the world. The most efficient and cost-effective manner to suppress mosquito populations is to use an Integrated Pest Management Approach. This approach involves understanding how and where mosquitoes develop so that the habitats where larval mosquitoes occur can be eliminated or managed. If pest populations persist, it becomes necessary to identify which species is causing the problem and where the pest population is developing. Larval habitats that cannot be eliminated through source reduction techniques can be treated with an Environmental Protection Agency (EPA) approved larvicide. If the habitats are expansive, distant, or unable to be identified, adulticide applications may be required.

All mosquitoes require standing water for their larval and pupal development. Mosquito eggs are deposited on soil that will become flooded, above the water line in natural or artificial containers, or on the surface of standing water. Upon hatching, the larva develops through four stages, or instars. Under the ideal conditions of warm temperatures and abundant food (small plants, animals, and particles of organic matter), the larval stage may only require five to six days, but it usually takes longer. After completing the larval stage, pupation occurs. The pupa is a nonfeeding

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mosquito behavior during a total solar eclipse, and not surprisingly, mosquitoes showed an increase in activity during these times.

A paper in Science Advances published in 2020 (https://www.science.org/doi/full/10.1126/sciadv.aay5487), looked at, amongst other things, the behavior of malaria vectors in Tanzania during a Pan-African eclipse. At the study site, the annular solar eclipse on 1 September 2016 started at 10:08 AM and ended at 1:52 PM, with a maximum obscuration at 11:58, blocking 96% of the sunlight. The eclipse caused significant increases in activity levels for both male and female mosquitoes. Male activity increased 87 times and female activity increased 7.4 times, in both cases clearly exceeding the statistical spread for ordinary days by several times. In this study, it was not possible to determine if host-seeking behavior of females increased during the eclipse, so it is unknown whether the eclipses could raise the risk of malaria infection at unexpected hours of the day.

A study done in the Gulf Coast of Texas and published in 1994, looked at the effect of a *lunar* eclipse on mosquito flight activity (https://pubmed.ncbi.nlm.nih.gov/8965069/). Adult mosquito flight activity was monitored at a coastal marshland site in Chambers County in Texas before, during, and after a total eclipse of the moon on August 16, 1989. A vehicle-mounted mobile interceptor trap and a stationary, dry ice-baited CDC miniature light trap were used in this monitoring effort. *Aedes sollicitans*, *Anopheles crucians, Culex salinarius, and Psorophora columbiae* were the mosquito species most abundantly represented in collections made by both traps during the 12-hour study period. The numbers of each of these species collected by the vehicle-mounted trap decreased during the lunar eclipse and increased when the full moon was exposed. Collections of these same species by the light trap increased during the lunar eclipse and decreased when the full moon was exposed.

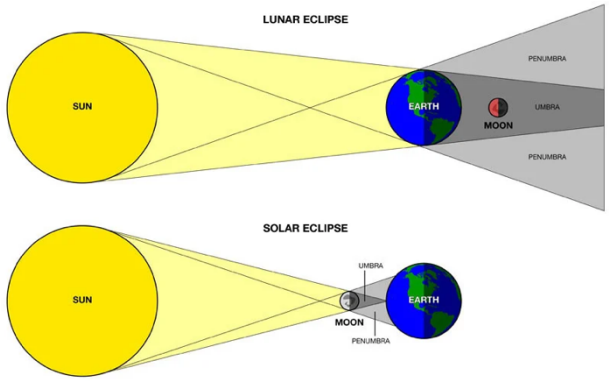
Of the various environmental parameters measured during the night of the study, only the lunar eclipse and associated light intensity changes were found to have a significant effect ($P < 0.05$) upon the flight activity of the 4 mosquito species collected by both trapping methods.

The results from vehicle trap collections are probably more indicative of actual mosquito activity and the effect of a lunar eclipse on flight activity than are results from the light trap. As noted by Bidlingmayer (1966), vehicle-mounted traps provide a more unbiased, non-attractant form of sampling adult mosquito populations than do light traps. The effectiveness of the light emitted by the CDC light trap was enhanced during the dark phase of the lunar eclipse, at which time increased numbers of mosquitoes were collected. Similar activity has been reported for trap catches during the new moon (Bidlingmayer 1964).

References

Bidlingmayer, WL. 1964. The effect of moonlight on the flight activity of mosquitoes. Ecology 45:87-94.

Bidlingmayer, WL. 1966. Use of truck trap for evaluating adult mosquito populations. Mosq. News 26:139-143.

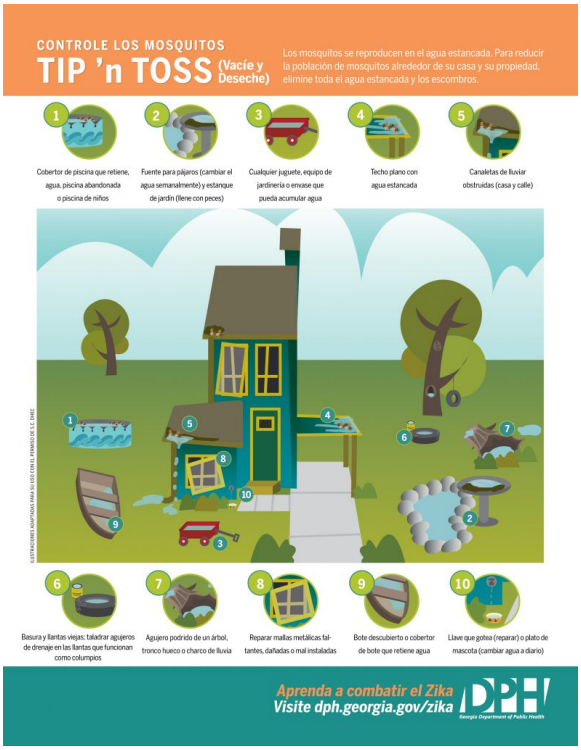


Larval Control - continued from page 1

stage and is a period of transition. It often requires two to three days before the adult mosquito emerges onto the water's surface. The male and female mosquitoes both feed on nectar and other plant fluids to provide energy for flight, but only the female mosquito seeks a blood meal to acquire the nutrients needed to stimulate egg production.

The most efficient way to break this lifecycle is to target the larval stages when they are confined to their standing water habitats. If the larval habitat cannot be eliminated through source reduction techniques (tip and toss, improved drainage, community cleanup…), there are a wide variety of safe and effective larvicides available. The optimum formulation and active ingredient are typically chosen based on the type of larval habitat being targeted and the resources available. Larvicides approved by the EPA include the active ingredients: *Bacillus thuringiensis* subsp. *israelensis* (Bti), *Bacillus sphaericus*, Spinosad, methoprene, pyriproxyfen, and mineral oil. There are combination products available for special situations. These active ingredients are typically available as either liquid, granular, or pelletized formulations. Briquettes, dunks, or water dispersible pouches are available for catch basins and other confined areas (i.e., rain barrels, cisterns, or pools). The mosquito fish, *Gambusia affinis* is also an effective biological control option for some locations.

When a larval habitat has been located, the most effective and practical manner of larvicide application should be identified. Areas of open water with limited vegetation can be effectively treated with a variety of formulations. Often a liquid formulation applied with a backpack or pump-up sprayer can be used in a cost-efficient manner. Larger areas may require a motorized pumping system. For areas of standing water with extensive vegetation, a granular or pelletized formulation will often be best suited. These formulations will penetrate through the vegetation to the aquatic habitats below and can be applied with a variety of cyclone spreaders or backpack blowers. These products are applied in a weight or volume of product/unit of area (i.e., lbs/acre or fluid oz/acre). Applying any of the formulations at the proper rate is critical to the effectiveness of the application. No matter what product or formulation is chosen, it is essential to carefully read and follow the pesticide label as **The Label Is The Law**! A complete list of approved larvicides can be found in UGA Extension Special Bulletins 28 and 48, the *Georgia Pest Management Handbook*. For additional information please contact Elmer W. Gray at ewgray@uga.edu.



C1266.pdf Mosquito Control Around the Home 1.pdf

This article was reprinted from last year due to the timeliness of its message for homeowners.

Weather and Mosquitoes

In any year, at the start of mosquito season, we get asked the question, so what will the mosquito season be like this year? I always want to say, well let me just get out my crystal ball and check on that; but being a State employee, I think twice about it and try to give a more considered answer. Since the answer is usually for the media, it needs to be in short sound bites or all kinds of oddities might get published (they might anyway, but why make it easy).

All that aside, how does winter weather affect the mosquito populations, and what can we expect in 2024? We just lived through the hottest year (2023) since recordkeeping began more than a century ago. Currently, our climate is changing, growing warmer due to the emissions from burning fossil fuels, and our weather is changing with it. It's possible that this year may turn out to be hotter still.

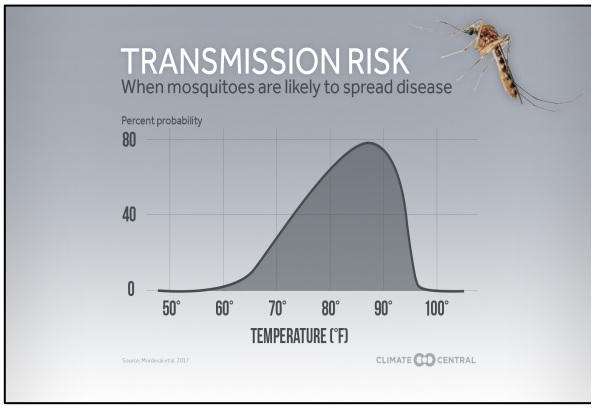
So far in 2024, February has been the hottest February on record since 1940, and periods of unseasonable cold aside, we are looking at another potentially record-setting hot year. This sort of extreme temperature increase comes with an increase in storms, floods, and drought.

Some of the extreme weather we experienced in the latter half of last year and will continue to experience in the first half of this year is a result of El Niño. El Niño is a cyclical climate event where unusually warm ocean waters have an effect of warmer temperatures and increased rainfall across the southern part of the US. Forecasts include warmer temperatures in the northern US, and a colder, wetter winter for the southern states.

So, what about that mosquito season? The biggest driving force for mosquito activity is humidity. Water is also a critical factor for mosquitoes. For many of our nuisance and vector species, this means standing water in containers and low-lying areas. Wind also has an mph, won't really affect a mosquito. But a wind above this may be too strong for mosquitoes to fight to bite you. And, of course, temperature plays its role in mosquito behavior. When temperatures are below 55° F, mosquito activity tends to crash. As temperatures begin to rise, as they are currently doing (or have done), mosquitoes become more active. At 80° F, mosquito activity increases, but the general range in which they thrive is anywhere from 80°to 90°F. The higher the temperature from this range, the less mosquitoes will bite. This is why during a hot, dry, lower humidity summer we may not have many mosquitoes biting at all.

Virus replication inside the mosquito, and transmission to a host, are additional considerations that affect disease risk when determining the effect of weather on mosquitoes. It is important to note that temperature is one of the most significant abiotic factors affecting, in many ways, insect vectors and the pathogens they transmit. Increasing temperature could influence the incidence and severity of the risk of arbovirus outbreaks by altering arbovirus evolution, selection, and transmission.

So, what will the mosquito season be like this year? Wait a minute while I find my crystal ball…



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Recapping the 2023 mosquito season in Chatham County, Georgia

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Now with the 2023 mosquito season in our rearview mirror, we can look back and review what took place in Chatham County over the course of the year. Mosquito trapping was conducted pretty much throughout the year apart from five weeks during January and December when temperatures were deemed too cool for mosquito activity. Trapping first began on 1/17/23 and ended on 12/27/23. Although trapping was primarily accomplished with CDC light traps (47.02%) or gravid traps (46.50%), exit traps (6.34%) affixed to our sentinel chicken cages, and BG Sentinel traps (0.14%) were also used to a much lesser degree in 2023 (Table 1).

Table 1. Type of traps used, and total mosquitoes caught in 2023

Trap Type	Trap Nights	Total ♀♀'s	Total ♂♂'s
BGS	4	239	117
CDC	1364	104064	71
Exit	184	535	0
Gravid	1349	166070	11870

A total of 270,908 female mosquitoes were caught in 2023 on 2901 trap nights at 127 sites across the county. This total was comprised of 37 species from 11 genera. The four species most often encountered were *Culex quinquefasciatus* (53.87%), *Culex salinarius* (9.11%), *Ochlerotatus taeniorhynchus* (6.74%), and *Culex nigripalpus* (4.91%). Of interest was *Aedes aegypti* was found for the second consecutive year, and only the third time since 2020. Between 2010 and 2020 this species was only seen once (Table 2).

Table 2. Mosquito species collected in 2023

Species	Total	Percentage
Ae aegypti	1	0.00%
Ae albopictus	2508	0.93%
Ae vexans	8694	3.21%
An atropos	223	0.08%
An crucians	4383	1.62%
An punctipennis	30	0.01%
An quadrimaculatus	94	0.03%
Cx coronator	5998	2.21%
Cx erraticus	9341	3.45%
Cx nigripalpus	13289	4.91%
Cx quinquefasciatus	145940	53.87%
Cx restuans	7222	2.67%
Cx salinarius	24670	9.11%
Cx territans	32	0.01%
Culex spp	4153	1.53%
Cs inornata	2	0.00%
Cs melanura	530	0.20%
Ma titillans	235	0.09%
Oc atlanticus	10210	3.77%
Oc canadensis	2065	0.76%
Oc dupreei	1289	0.48%
Oc fulvus pallens	4	0.00%
Oc infirmatus	5311	1.96%
Oc mitchellae	36	0.01%
Oc sollicitans	2811	1.04%
Oc sticticus	318	0.12%
Oc taeniorhynchus	18253	6.74%
Oc triseriatus	83	0.03%

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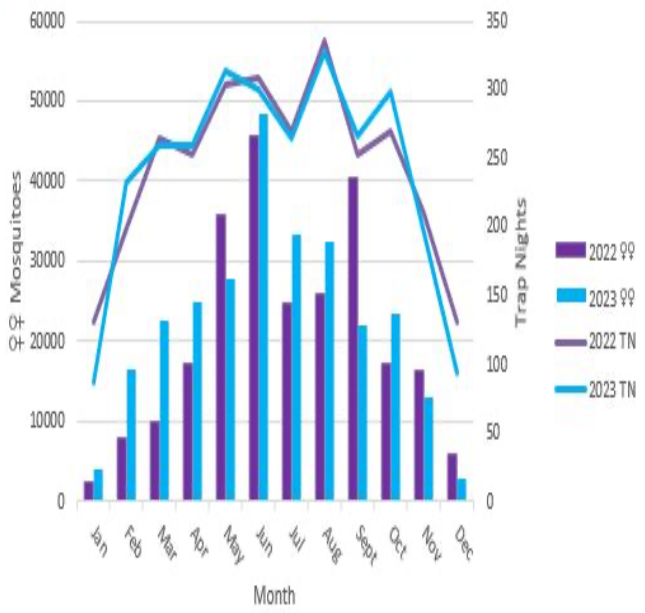
Table 2. Mosquito species collected in 2023		
Species	**Total**	**Percentage**
Cq perturbans	1611	0.59%
Or signifera	30	0.01%
Ps ciliata	30	0.01%
Ps columbiae	268	0.10%
Ps ferox	1170	0.43%
Ps horrida	2	0.00%
Ps howardii	6	0.00%
Tx rutilus	1	0.00%
Ur lowii	4	0.00%
Ur sapphirina	61	0.02%

By comparison, in 2022, a total of 249,358 female mosquitoes were collected over the course of 2924 trap nights at 117 sites. The average number of mosquitoes collected per trap night in 2022 was 85.28, compared to 93.38 in 2023. As in 2023, 37 species of mosquitoes were identified; however, *Ochlerotatus mitchellae*, *Toxorhynchites rutilus*, and *Psorophora horrida* were not seen in 2022, while *Ochlerotatus japonicus*, *Culex pilosus*, and *Psorophora mathesoni* were not observed in 2023. In 2023, monthly totals were higher in eight months (January, February, March, April, June, July, August, and October), and lower in four months (May, September, November, and December) than in 2022 (Figure 1).

We submitted 3898 pools for testing to the Southeastern Cooperative Wildlife Disease Study (SCWDS) at the University of Georgia, and an additional 851 pools were tested in-house. Of the 3898 pools sent to Athens, 60 pools were positive for West Nile virus, one pool for eastern equine encephalitis virus, 49 pools for Flanders virus, and three pools for Highlands J virus. Thirteen species of mosquitoes were pooled and sent for testing, although most of the samples consisted of *Culex quinquefasciatus* (81.25%). *Culex nigripalpus* (6.55%), *Culiseta melanura* (3.78%), and *Culex erraticus* (3.06%) contributed fewer pools for testing. Unidentified *Culex* spp,

Figure 1. Comparison of trap nights and mosquitoes collected in Chatham County, 2022-2023.



made up of groups of *Culex* individuals (3.88%) too damaged to accurately identify to species, were also included among our samples.

In 2023, West Nile virus was found in mosquito samples from 19 locations in the county (Figure 2). More than one third (36.67%) of all positive pools were found at four locations within the south side region of Savannah. This marked the second consecutive year that the south side of Savannah has seen the most West Nile activity in the county, although the West Savannah/Garden City region (26.67%), and the Pooler/ Bloomingdale area (15%) also had substantial activity in 2023. One of our sentinel chickens also tested positive for West Nile virus.

The virus that causes eastern equine encephalitis (EEE) was detected in a single pool containing *Culex quinquefasciatus*. The mosquitoes from this pool were collected on August 1 in an area not usually associated with EEE. Two of our sentinel chickens tested positive for antibodies to EEE from the same location on two different

Figure 2. Locations of positive mosquito pools (green) and a sentinel chicken with antibodies (yellow) for West Nile virus in Chatham County, 2023.

(blue) in Chatham County, 2023.

dates (June 13 and July 25). Results from two other birds deployed on June 20 also revealed an undetermined member of the Alphavirus group that was not EEE. In addition, three pools (two from the same location) were positive for Highlands J virus. These pools contained *Culiseta melanura* and were collected in the western portion of the county (see Figure 3).

Flanders virus was found in 49 samples from 22 locations in Chatham County during 2023. All but four of these samples contained *Culex quinquefasciatus* (three contained *Culex* species and one contained *Culiseta melanura*). The distribution of mosquitoes carrying Flanders virus was scattered throughout the county in suburban to somewhat rural areas (see Figure 4). Flanders virus is a member of the Rhabdoviridae family and does not appear to cause disease.

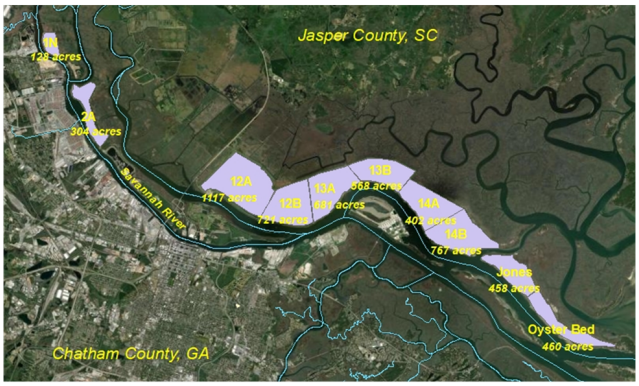
Outside of surveillance work, our source reduction staff ditched a total of 29,425 feet and cleaned out another 31,700 feet of ditches. This work was confined to the Dredge Material Containment Area (DMCA) situated along the

Figure 3. Locations of positive mosquito pools for Highlands J (green) and eastern equine encephalitis viruses (red) and sentinel chickens detected with EEE antibodies (yellow) or an unidentified Alphavirus (blue) in Chatham County, 2023.

Figure 4. Locations of positive mosquito pools for Flanders virus and its variants in Chatham County, 2023.

Savannah River and consist of thousands of acres of compartments where sediment is stored from dredging operations necessary to provide an open channel for the vast shipping industry vital to the port of Savannah and Georgia's economy (Figure 5). During 2023, ditching operations were conducted in cells 13A, 14A, and 14B of the entirety of the DMCA.

Figure 5. Compartment designations and sizes of cells within the DMCA along the Savannah River corridor.



Technicians conducted 481 service requests that were generated through the county's citizen notification system (QAlert). Technicians also conducted 7257 ground inspections on known larval habitats throughout the year and treated 111 acres by hand. An additional 313 sites encompassing 8704 acres were treated by our aircraft for larval mosquitoes. A total of 593,243 acres were treated aerially for adult mosquitoes and another 12,490 acres were treated with ground ULV equipment. Staff also treated 9,535 catch basins in late April/early May as part of our normal West Nile virus prevention program.

https://mosquitocontrol.chathamcountyga.gov