MOSQUITO SURVEILLANCE 2022

GEORGIA DEPARTMENT OF PUBLIC HEALTH, ENVIRONMENTAL HEALTH

Mosquito Surveillance 2022

Limited mosquito surveillance programs occur in many Georgia counties (http://www.gamosquito.org/resources/GA_Mosquito_Control_Programs2017.pdf), but most counties with mosquito control programs conduct control activities without appropriate mosquito surveillance. Data obtained from mosquito surveillance activities are important to guide vector control operations by identifying vector species, providing an estimate of vector species abundance, and by indicating geographic areas where humans and animals are at greatest risk of exposure to WNV or other arboviruses.

Current GIS technologies and laboratory diagnostic capacities are strongly improving vector monitoring and vector-borne disease surveillance programs. When entomological and veterinary surveillance activities are organized and implemented with the support of a strong baseline of bio-environmental data, they are useful in the early detection of mosquito and virus activity. Collection of these data also support the risk assessment of vector borne diseases such as West Nile Virus (WNV) through vector density estimation at local scale, surveillance of arbovirus activity in large areas, and the support of epidemiological understanding of vector borne diseases. The efficiency of the surveillance program may be optimized, and the related costs reduced, by the progressive introduction of GIS satellite supported technologies, by understanding the role played by environmental determinants, and by the introduction of more efficient methods of sampling.

MOSQUITO SURVEILLANCE 2022

Although our surveillance team was seriously diminished by funding cuts, our goals for the 2022 mosquito surveillance season included doing some level of mosquito surveillance in as many counties in Georgia as possible, assisting mosquito control programs with surveillance where possible, and providing local outreach for mosquito complaints. We also planned to continue to do pesticide resistance testing in a few areas of Georgia. The accomplishment of these goals allows the Georgia Department of Public Health to be better prepared for dealing with endemic mosquito-borne disease issues and for dealing with the next mosquito-borne disease to emerge. We can accomplish what we do thanks to the assistance of our colleagues and collaborators.

GLYNN COUNTY – SALTMARSH LARVAL BROOD OF 1999

Integrated Mosquito Management

The best way to control the mosquitoes, to reduce the nuisance factor and protect public health, is by utilizing a wide variety of control methods known as Integrated Mosquito Management (IMM). The first part of IMM is trapping and surveillance, which help to quantify the numbers, species, and location of mosquitoes.

What does mosquito control do to protect the public health? In Georgia, there are approximately 60 different mosquito species. Each species of mosquito has a different flight range, host preference, larval habitat, and potential for carrying and transmitting infectious disease. Any mosquito that bites or annoys people can be considered a health problem, but in Georgia the definition includes mosquitoes that carry infectious diseases like WNV, LaCrosse Encephalitis (LAC), and Eastern Equine Encephalitis (EEE), as well as those can transmit new and emerging viruses like CHIK and ZIKV.

What are the techniques of an Integrated Mosquito Management (IMM) program that serve to eliminate the mosquito? If your county has mosquito control, it is usually located in the Public Works Department, but may be in Public Health/Environmental Health, or could be a stand-alone agency. The first response to a mosquito complaint is to send an inspector to find the source of the mosquitoes. Source reduction, also known as physical control, is an important part of IMM. This involves finding and eliminating potential mosquito breeding areas and is typically the most effective and economical of the various techniques used to control mosquitoes.

Mosquitoes need water for their eggs to hatch and for the larvae to survive until adulthood. In areas around a home these sources may anything that can retain water, including birdbaths, unscreened swimming pools, and old tires. This also includes hollow stemmed plants like bromeliads. The inspector should educate the homeowner about keeping these items clean and dry, or rinsing them periodically with fresh water.

If the source is a new pond or other permanent-water area that cannot or should not be drained, the inspector may elect to stock it with small, non-descript mosquito-eating fish called *Gambusia*. Using the mosquito's natural predator to reduce populations is a method of biological control.

Another technique is called larviciding. Larviciding, as the name implies, kills mosquito larvae and pupae using a variety of products, both chemical and biological. This prevents the metamorphosis of the larvae into the flying, biting pests that we know and hate. Larvicide treatments can be applied by ground or air to standing water depending on the size of the area. Different types of larvicides include chemical pesticides that are absorbed or ingested by the larvae, surface control agents that suffocate the pupae, insect growth regulators, and microbial larvicides. Larvicides commonly used in Georgia include microbial larvicides and

insect growth regulators (IGRs). The microbial larvicide consists of two species of the Bacillus bacterium (Bti and *B sphaericus*), that are toxic when ingested by mosquito and black fly larvae. Methoprene, an IGR, prevents mosquito larvae from molting to the adult stage.

Once adult mosquitoes are on the wing, the only way to control them is to use an adulticide. Using truck-mounted sprayers or aircraft, a condensed plume of ultralow volume (ULV) insecticide is released into the air, which spreads out with the prevailing wind. When the pesticide droplets contact flying mosquitoes, it kills them.

Mosquito control may also use a barrier spray to provide the homeowner some temporary relief. This is also one method of controlling day biting mosquitoes. A barrier spray is a coating of pesticide droplets sprayed onto foliage surrounding an area that has been inundated by mosquitoes. This will kill mosquitoes landing in the foliage, and it repels them. It adheres to the underside of the foliage, depriving them of their resting places.

Another technique, thermal fogging, can be used to control day biting mosquitoes or to control mosquitoes in areas where vegetation is so dense that ULV does not penetrate.

The amount of chemical used is designed to be target specific, in that it kills mosquitoes without harming anything else. Since most mosquitoes do not fly during the daytime, adulticiding is done at dusk and beyond, and the hours just before dawn, when mosquito activity is at its peak. Additionally, pesticide sprayed by ULV machines during the heat of the day rises and never interacts with the mosquitoes, and so is wasted.

It is impossible to completely eradicate the mosquito, so the focus should be on controlling mosquito populations to reduce the nuisance factor and protect public health by using all aspects of Integrated Mosquito Management. It is important to remind homeowners that they can also play a role in mosquito control, especially where organized mosquito control is not present. Surveillance can be used to determine if the mosquito is *Aedes albopictus*, the Asian tiger mosquito, or some other species. By standing out in the yard during the day and waiting to see if a small black and silver mosquito comes to bite your legs, it is possible to determine if this species is present. This is the most common nuisance species in Georgia and, unless there have been heavy rains recently or the area is along the coast, the mosquito most likely to come and bite during the day.

Why is this important? This species is a container breeder and does not fly very far from where it lays its eggs. Source reduction is the best means of control. Picking up anything that holds water, emptying it, and disposing of it correctly; refilling bird baths and animal water bowls at least once a week; raking big leaves; and cleaning gutters, will help reduce the populations of this species and other container breeding species. Additionally, pools need to be maintained properly as “green” pools breed large numbers of mosquitoes, including the WNV vector. Homeowners can also buy larvicide, both Bti (mosquito dunks) and methoprene

(mosquito torpedoes). This can be applied to standing water to control mosquitoes by killing larvae. As with any pesticide, it is important to follow the label instructions explicitly.

Finally, it is important to wear repellent outside when mosquitoes are biting. Information about the various types of recommended repellents can be found at https://dph.georgia.gov/environmental-health/insects-and-diseases.

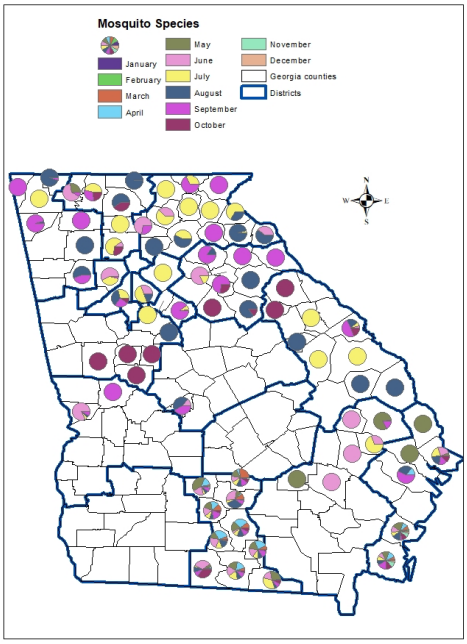
MOSQUITO SURVEILLANCE 2022

Overview

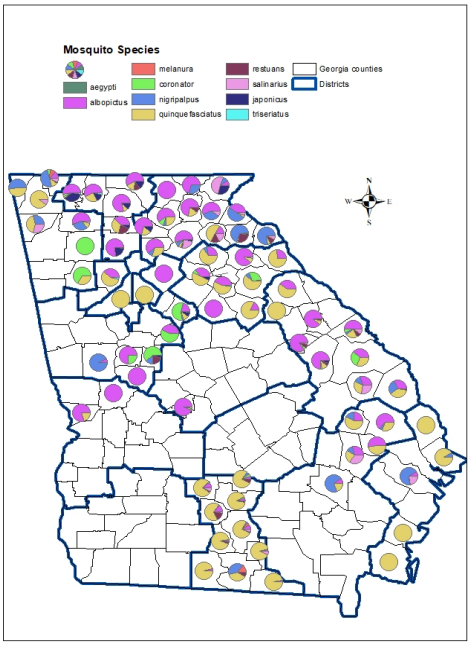
The Vector Surveillance Coordinator (VSC) program ended in August 2020. In addition to mosquito surveillance, the VSCs were involved in collecting mosquito eggs for statewide pesticide resistance testing and distributing collection vials to area veterinarians as part of our collaborative effort with GDA to survey ticks attached to animals. They also provided outreach and training in their regions. The loss of this program left surveillance to the 2 entomologists at the State level and the District-level programs in 1-1, 1-2, 2-0, 3-1, 3-2 (Bug Busters), 3-5, 6-0, and 8-1. We also collaborated with Chatham County Mosquito Control, Liberty County-Hinesville Mosquito Control, Mosquito Control Services (Glynn and Camden counties), and Valdosta State University (Lowndes County). And we were fortunate to have a few interns and volunteers who assisted with mosquito surveillance in various areas throughout the State.

The maps used in this document were all created in March 2023. They depict the month(s) in which surveillance was done in each county and the presence or absence of the important vector species *Aedes aegypti*, *Ae albopictus*, *Culiseta melanura*, *Culex coronator*, *Cx nigripalpus*, *Cx quinquefasciatus*, *Cx restuans*, *Cx salinarius*, and *Ochlerotatus triseriatus*. All species trapped are listed in a table for each District by county.

Mosquito Count by Month, 2022



Vector Species by County, 2022



MOSQUITO SURVEILLANCE 2022

Surveillance

Adult mosquito monitoring is a necessary component of surveillance activities and is directed toward identifying where adults are most numerous. This information drives response to service requests and helps determine whether interventions (source reduction, larviciding, and/or adulticiding) are effective.

There are a variety of different mosquito traps, but generally two different types of traps are used. One type, a gravid trap, selectively attracts container- breeding mosquitoes that have had a blood meal and are looking for a place to lay eggs. The other type, a light trap, attracts mosquitoes looking for a blood meal. Recently, a third type of trap, the BG-Sentinel trap, has been used in areas where exotic arbovirus cases have been detected. This trap is very specific for the Zika (ZIKV), Chikungunya (CHIK), and Dengue (DEN) vectors, *Ae aegypti* and *Ae albopictus*. With all three traps, as the mosquito gets close, it gets suctioned into the trap by a small fan. Mosquitoes caught in these traps are counted and identified. They may also be pooled according to date, species, and location and sent to a lab for testing.

Surveillance and mosquito identification were done by the two GDPH entomologists, by District or County Environmental Health Specialists (EHS), by local mosquito control, and by a variety of other collaborators.

GRAVID TRAP

This trap selectively attracts container-breeding mosquitoes that lay eggs in stagnant, organically rich water. These mosquitoes will have had at least one blood meal, so may possibly have picked up an infected blood meal if there are arbovirus-positive enzootic hosts in the area.

LIGHT TRAP

Light traps attract mosquitoes looking for a blood meal. The attractants used are light and CO_2, in the form of dry ice or as compressed gas in canisters. These traps are useful for providing information about the mosquito species found in the area under surveillance. Because they attract mosquitoes looking for a blood meal that may have just emerged and never had a blood meal previously, the likelihood of finding virus in these mosquitoes is much reduced.

BG SENTINEL TRAP

What makes the BG-S trap different? It:

- Mimics convection currents created by a human body
- Employs attractive visual cues
- Releases artificial skin emanations through a large surface area
- Can be used without CO2 to specifically capture selected mosquito species

Used in combination with the BG-Lure, a dispenser which releases a combination of non-toxic substances that are also found on human skin (ammonia, lactic acid, and caproic acid), the BG-Sentinel trap is especially attractive for the yellow fever (or ZIKV) mosquito, *Aedes aegypti*, the Asian tiger mosquito, *Aedes albopictus*, the southern house mosquito, *Culex quinquefasciatus*, and selected other species.

With the addition of carbon dioxide, the BG-Sentinel trap is an excellent surveillance tool for mosquitoes in general.

MOSQUITO BREEDING HABITAT TYPES

There are two general categories within which mosquito breeding habitats exist: natural mosquito breeding habitats and man-made mosquito breeding habitats. Female mosquitoes lay their eggs either on water or on soils that are periodically flooded. These breeding areas can be found in habitats that exist naturally, such as within a pond or flood plain; or in habitats that have been created by humans, such as bird baths, water-filled tires, or catch basins. Mosquitoes can breed in a wide variety of locations, and the discussion below provides a description of the general types of habitats where mosquitoes are known to breed.

NATURAL MOSQUITO BREEDING HABITATS

Temporary Woodland Pools:

Shallow, temporary pools are common in woodland areas during the spring and wet summers in low lying areas or in small depressions where a variety of mosquito species will breed, most commonly *Ochlerotatus canadensis* and *Aedes vexans*. These mosquitoes lay their eggs along the edges of the pool and when rainwater or melting snow fills these pools the larvae hatch.

Freshwater Ponds:

The larvae of Anopheles are found primarily in small ponds among the emergent vegetation. Ponds clogged with vegetation can breed large numbers of mosquitoes because of the vast amounts of organic matter available to mosquito larvae for feeding, and because fish and other aquatic predators cannot readily feed on the larval mosquitoes.

Streams and Floodplains:

Streams with running water rarely produce mosquitoes. However, mosquitoes need to be near water in order to lay their eggs. *Aedes* and *Culex* species are two types of species that can sometimes be found in isolated pockets adjacent to streams or within floodplain areas that undergo only periodic flooding.

Tree Holes and Other Natural Containers:

Tree holes and other natural containers, such as pitcher plants or water trapped in or on plant leaves, can also serve as breeding habitats for mosquitoes, such as *Ochlerotatus triseriatus*. Frequent rainfalls maintain standing water within these types of microhabitats and can breed mosquitoes throughout the summer.

Freshwater Marshes and Swamps:

Mosquitoes, such as *Coquillettidia perturbans*, breed in freshwater marshes and swamps consisting of emergent vegetation. These types of habitats can occur in both woodland and open field habitats. Larvae attach themselves to the stems and roots of the vegetation to obtain oxygen, and do not need to swim up and down in the water column to feed or breath. Due to this adaptation, these larvae can avoid exposure to predatory fish.

MAN-MADE MOSQUITO BREEDING HABITATS

Stormwater/Wastewater Detention:

A catch basin typically includes a curb inlet where storm water enters the basin to capture sediment, debris, and associated pollutants. These catch basins provide breeding habitat for urban mosquito species, such as *Culex quinquefasciatus*. Moisture and organic debris captured within the catch basin aid in the development of and provide nutrients for growing larvae. Similarly, detention/retention basins that perform similar functions for other types of wastewaters, such as waste treatment settlement ponds, provide a similar type of breeding habitat to that of the storm water catch basin.

Roadside Ditches:

Roadside ditches are the suitable habitat for many species of Culex mosquitoes. The larvae of *Culex quinquefasciatus* and *Culex restuans*, for example, can survive in waters with high organic content. Culex mosquitoes will lay their eggs directly on the water's surface; therefore, ditches that hold water for extended periods of time can breed large numbers of mosquitoes.

Artificial Containers:

Artificial containers left out to collect rainwater such as tires, bottles, buckets, and birdbaths can provide an excellent mosquito-breeding habitat free from any predators. Saucers placed under flowerpots to hold water also provide a habitat for mosquito larva while being detrimental to the plant by causing root rot. Many tree-hole mosquitoes have learned to adapt to using these man-made mosquito nurseries. *Aedes albopictus*, our most common pest species, also breeds readily in these artificial containers. The abundance of organic debris, which can also collect in these containers, allows for the proliferation of mosquito breeding during a season.

Control – A Message for the Public

The mosquitoes of most importance to public health in Georgia are *Culex quinquefasciatus*, the Southern house mosquito, and *Aedes albopictus*, the Asian tiger mosquito. Both these species lay eggs in such artificial containers as birdbaths, gutters, tires, flowerpots, and any other container that holds water for at least a week. The Southern house mosquito prefers organically polluted water for laying its eggs, and bites at dusk. It feeds primarily on birds, but will bite mammals, and is our primary vector for WNV. The Asian tiger mosquito prefers cleaner water for laying its eggs, and bites during the day. It feeds primarily on mammals. *Aedes albopictus* is a potential vector for WNV in Georgia and can be a vector for DEN, ZIKV, and CHIK.

The best way to control these species is to dump out or treat standing water, treat catch basins with larvicide, and to cut back heavy vegetation where the mosquito will rest when not out biting. These mosquitoes will shelter in abandoned houses. Thermal fogging or barrier spray around these houses can help to reduce resting and overwintering mosquitoes. Two larvicides are available to the public for treating standing water, Mosquito Torpedoes (Methoprene) and Mosquito Dunks (Bti). Both are available online, from Home Goods or Hardware Stores, and occasionally from large chain Pet Stores. Hand-held foggers can also be used to reduce biting populations of mosquitoes, but this solution is temporary and needs to be followed up with good source reduction (removing breeding sites) and larviciding.

MOSQUITO SURVEILLANCE 2022

Mosquitoes and Trap Types, 2022

Species	BGS	CDC	Exit	Gravid	Other	TOTAL
Ae. aegypti		9		3		12
Ae. albopictus	1532	2744		842	9	5127
Ae. albopictus (male)		20		31		51
Ae. cinereus		19				19
Ae. dupreei				3		3
Ae. vexans		683		103		786
Ae. vexans (male)		2				2
Aedes/Ochlerotatus spp.	6	129		18		153
An. barberi		5				5
An. crucians		304		39	4	347
An. punctipennis		663		22		685
An. punctipennis (male)		11				11
An. quadrimaculatus		43		80		123
An. quadrimaculatus (male)		2				2
Anopheles spp.		7		2		9
Cq. perturbans		3069	2	79	3	3153
Cs. inornata		1		7		8
Cs. melanura		1358	2	197		1557
Culex spp.		487		2710	1	3198
Culex spp. (male)		24		13		37
Culiseta spp.		8				8
Cx. coronator		414		67		481
Cx. erraticus		1453		164	6	1623
Cx. nigripalpus	1	4252	54	3157	1	7465
Cx. peccator		5				5
Cx. pilosus		8				8

MOSQUITO SURVEILLANCE 2022

Species	**BGS**	**CDC**	**Exit**	**Gravid**	**Other**	**TOTAL**
Cx. quinquefasciatus	241	1901		81502		83644
Cx. quinquefasciatus (male)		2				2
Cx. restuans		311		1359		1670
Cx. restuans (male)		1				1
Cx. salinarius	6	356		258		620
Cx. territans		21		45		66
Ma. titillans		138		10		148
Mansonia spp.		24				24
Oc. atlanticus	8	454				462
Oc. atropalpus		6				6
Oc. canadensis		49				49
Oc. dupreei		16				16
Oc. fulvus pallens		17				17
Oc. infirmatus		190				190
Oc. japonicus	3	235		33		271
Oc. mitchellae		10				10
Oc. sollicitans		6		3		9
Oc. sticticus		41				41
Oc. taeniorhynchus		858				858
Oc. thibaulti		2				2
Oc. triseriatus	1	38		11		50
Oc. trivittatus		5				5
Or. alba		3				3
Or. signifera	1	2		1		4
Ps. ciliata		309		3	12	324
Ps. columbiae		258		22		280
Ps. cyanescens		242		28		270

MOSQUITO SURVEILLANCE 2022

Species	**BGS**	**CDC**	**Exit**	**Gravid**	**Other**	**TOTAL**
Ps. ferox	55	116		11	27	209
Ps. horrida		3				3
Ps. howardii		30		1		31
Ps. mathesoni		1				1
Psorophora spp.	1			13		14
Tx. rutilus	3					3
unknown		32		96		128
Ur. lowii				5		5
Ur. sapphirina		31		4		35

RESTING MOSQUITO

NOTE: Is it *Aedes*, or is it *Ochlerotatus*?

Ochlerotatus had been originally established as a genus in 1891. It became an aedine subgenus in the 1930s. In 2000, John Reinert and his colleagues elevated the subgenus *Ochlerotatus* back to a genus based upon microscopic differences in the male genitalia between it and other subgenera of *Aedes*. However, in 2005 the *Journal of Medical Entomology* and the Entomological Society of America decided to put *Ochlerotatus* back to subgenera level (https://academic.oup.com/jme/article/42/4/511/910895?login=true). After a contentious worldwide debate regarding the effect the taxonomic changes would have on names established over decades of work in scientific, government, and lay communities, many scientists (including those at the CDC), and others affected by the change, espoused the continued use of the previously established names. So, for the time being, everything is *Aedes* again.

HOWEVER, since the GDPH mosquito surveillance database was established after *Ochlerotatus* was elevated to genus status, we appreciate you continuing to use *Ochlerotatus* to make data access easier.

Aedes

- *Ae. aegypti*
- *Ae. albopictus*
- *Ae. cinerius*
- *Ae. vexans*

Ochlerotatus

- *Oc. atlanticus/tormentor*
- *Oc. atropalpus*
- *Oc. canadensis*
- *Oc. dupreei*
- *Oc. fulvus pallens*
- *Oc. hendersoni*
- *Oc. infirmatus*
- *Oc. japonicus*
- *Oc. mathesoni*
- *Oc. mitchellae*
- *Oc. sollicitans*
- *Oc. sticticus*
- *Oc. taeniorhynchus*
- *Oc. thibaulti*
- *Oc. triseriatus*
- *Oc. trivittatus*

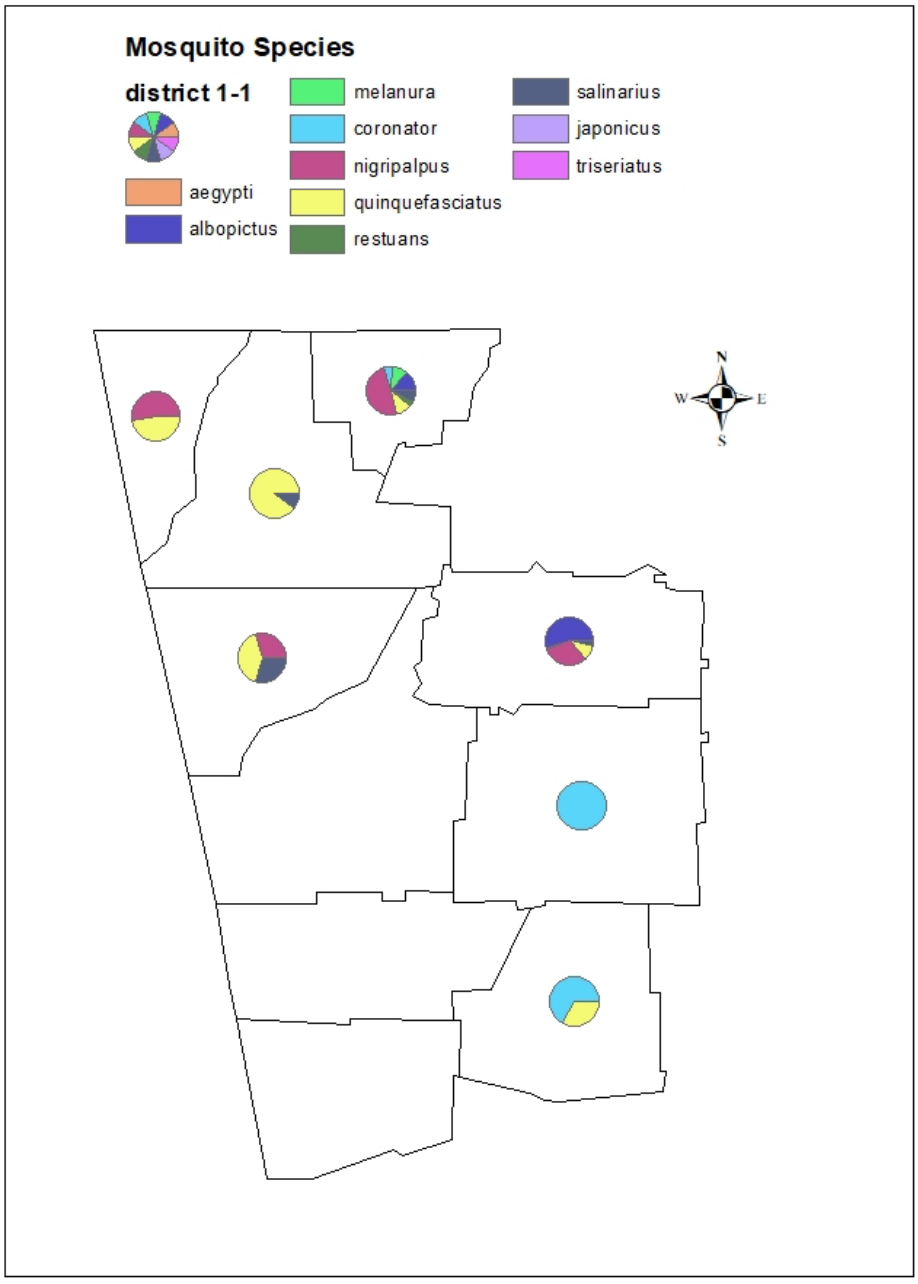
Data by District

District 1-1

Surveillance in District 1-1 was done by local EHS. Surveillance was done from July through September over 66 trap nights.

District 1-1		trap types	
County	**Species**	**CDC**	**Gravid**
Bartow	*Cx. coronator*	14	
Catoosa	*Ae. albopictus*	5	
	Cs. melanura	4	
	Cx. coronator	2	
	Cx. nigripalpus	18	
	Cx. quinquefasciatus	4	
	Cx. restuans	1	
	Cx. salinarius	3	
Chattooga	*Cx. nigripalpus*	5	
	Cx. quinquefasciatus	7	
	Cx. salinarius	5	
Dade	*Cx. nigripalpus*	9	
	Cx. quinquefasciatus	8	
Gordon	*Ae. albopictus*	32	
	Cx. coronator	1	
	Cx. nigripalpus	18	
	Cx. quinquefasciatus	6	
	Cx. salinarius	2	
Paulding	*Cx. coronator*	8	
	Cx. quinquefasciatus	4	
Walker	*Cx. quinquefasciatus*	4	13
	Cx. salinarius	2	

Vector Species, 2022



MOSQUITO SURVEILLANCE 2022

District 1-2

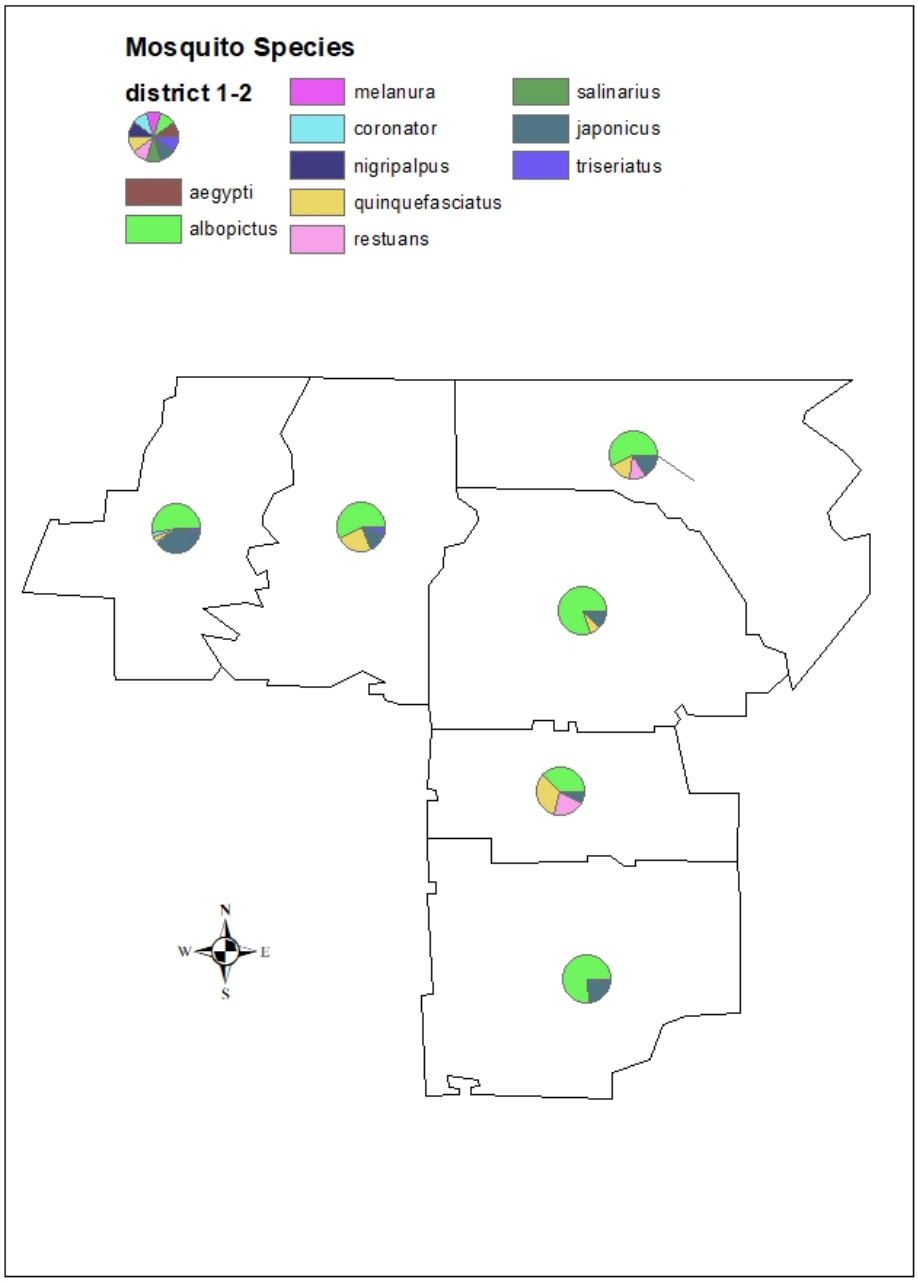
Surveillance in District 1-2 was done by the District EH Director. Surveillance was done from May-October over 307 trap nights.

District 1-2		trap types
County	**Species**	**CDC**
Cherokee	*Ae. albopictus*	180
	Cx. coronator	2
	Cx. nigripalpus	2
	Cx. quinquefasciatus	1
	Oc. japonicus	51
	Oc. triseriatus	4
Fannin	*Ae. albopictus*	205
	Cx. coronator	2
	Cx. quinquefasciatus	56
	Cx. restuans	40
	Cx. salinarius	1
	Oc. japonicus	56
	Oc. triseriatus	1
Gilmer	*Ae. albopictus*	139
	Cx. quinquefasciatus	13
	Oc. japonicus	22
Murray	*Ae. albopictus*	80
	Cx. quinquefasciatus	33
	Oc. japonicus	20
	Oc. triseriatus	6

District 1-2		trap types
County	**Species**	**CDC**
Whitfield	*Ae. albopictus*	92
	Cx. coronator	6
	Cx. quinquefasciatus	6
	Cx. restuans	2
	Cx. salinarius	1
	Oc. japonicus	64
	Oc. triseriatus	5
Pickens	*Ae. albopictus*	75
	Cx. quinquefasciatus	65
	Cx. restuans	42
	Oc. japonicus	16
	Oc. triseriatus	2

BACKPACK SPRAYER

Vector Species, 2022



District 2-0

Surveillance in District 2-0 was done by local EHS. Surveillance was done from June-September over 120 trap nights.

District 2-0		trap types	
County	**Species**	**CDC**	**Gravid**
Banks	*Ae. albopictus*		2
	Cx. quinquefasciatus	4	2
	Cx. restuans	2	
	Cx. salinarius		2
Dawson	*Ae. albopictus*	16	14
	Cx. quinquefasciatus	5	3
	Oc. japonicus		5
Forsyth	*Ae. albopictus*	5	9
	Cx. nigripalpus	1	1
	Cx. quinquefasciatus		7
Franklin	*Ae. albopictus*		2
	Cx. nigripalpus		71
	Cx. quinquefasciatus		2
	Cx. restuans		26
	Oc. japonicus	1	2
Habersham	*Ae. albopictus*	5	1
	Cx. nigripalpus	4	
	Cx. salinarius		1

District 2-0		trap types	
County	**Species**	**County**	**Species**
Hall	*Ae. albopictus*	21	7
	Cx. coronator		1
	Cx. nigripalpus		4
	Cx. quinquefasciatus		3
	Cx. restuans		1
	Cx. salinarius	2	10
	Oc. japonicus		2
Hart	*Cx. nigripalpus*	63	
	Cx. quinquefasciatus	2	2
	Cx. restuans	8	
	Cx. salinarius		6

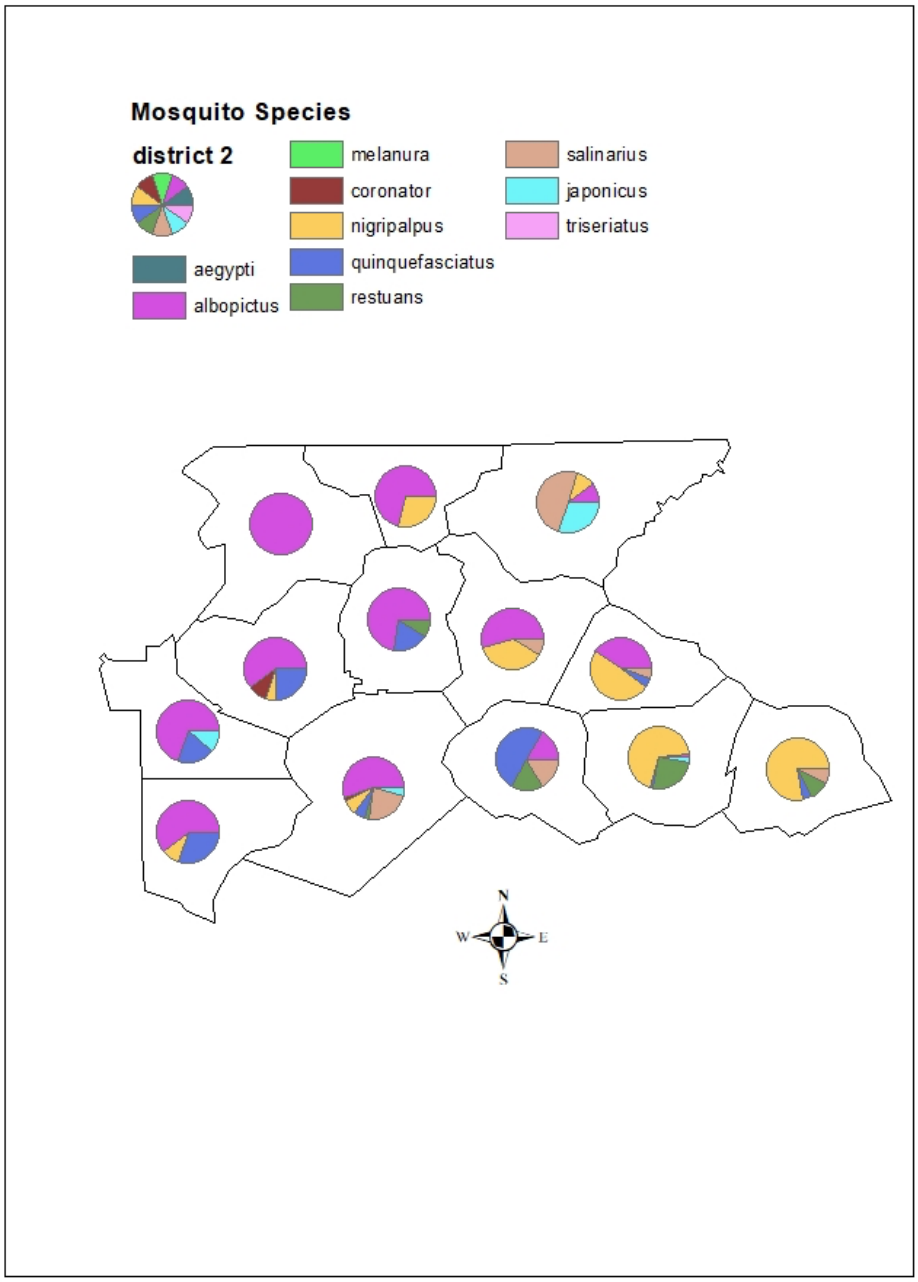
AEDES ALBOPICTUS

MOSQUITO SURVEILLANCE 2022

District 2-0		trap types	
County	**Species**	**CDC**	**Gravid**
Lumpkin	*Ae. albopictus*	4	8
	Cx. coronator	2	
	Cx. nigripalpus	1	
	Cx. quinquefasciatus	5	
Rabun	*Ae. albopictus*		1
	Cx. nigripalpus		1
	Cx. salinarius		5
	Oc. japonicus		3
Stephens	*Ae. albopictus*	2	21
	Cx. nigripalpus	23	5
	Cx. quinquefasciatus		3
	Cx. salinarius		3
Towns	*Ae. albopictus*	2	3
	Cx. nigripalpus	1	1
Union	*Ae. albopictus*		7
White	*Ae. albopictus*	1	15
	Cx. quinquefasciatus		4

AEDES AEGYPTI

Vector Species, 2022



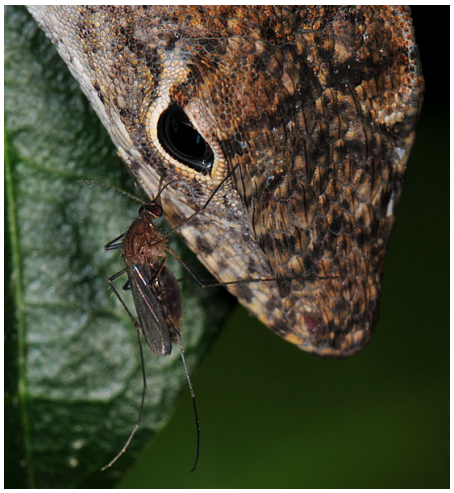
MOSQUITO SURVEILLANCE 2022

District 3-1

District 3-1		trap types	
County	**Species**	**CDC**	**Gravid**
Cobb	*Ae. albopictus*	22	5
	Cx. quinquefasciatus	2	37
	Oc. triseriatus	3	

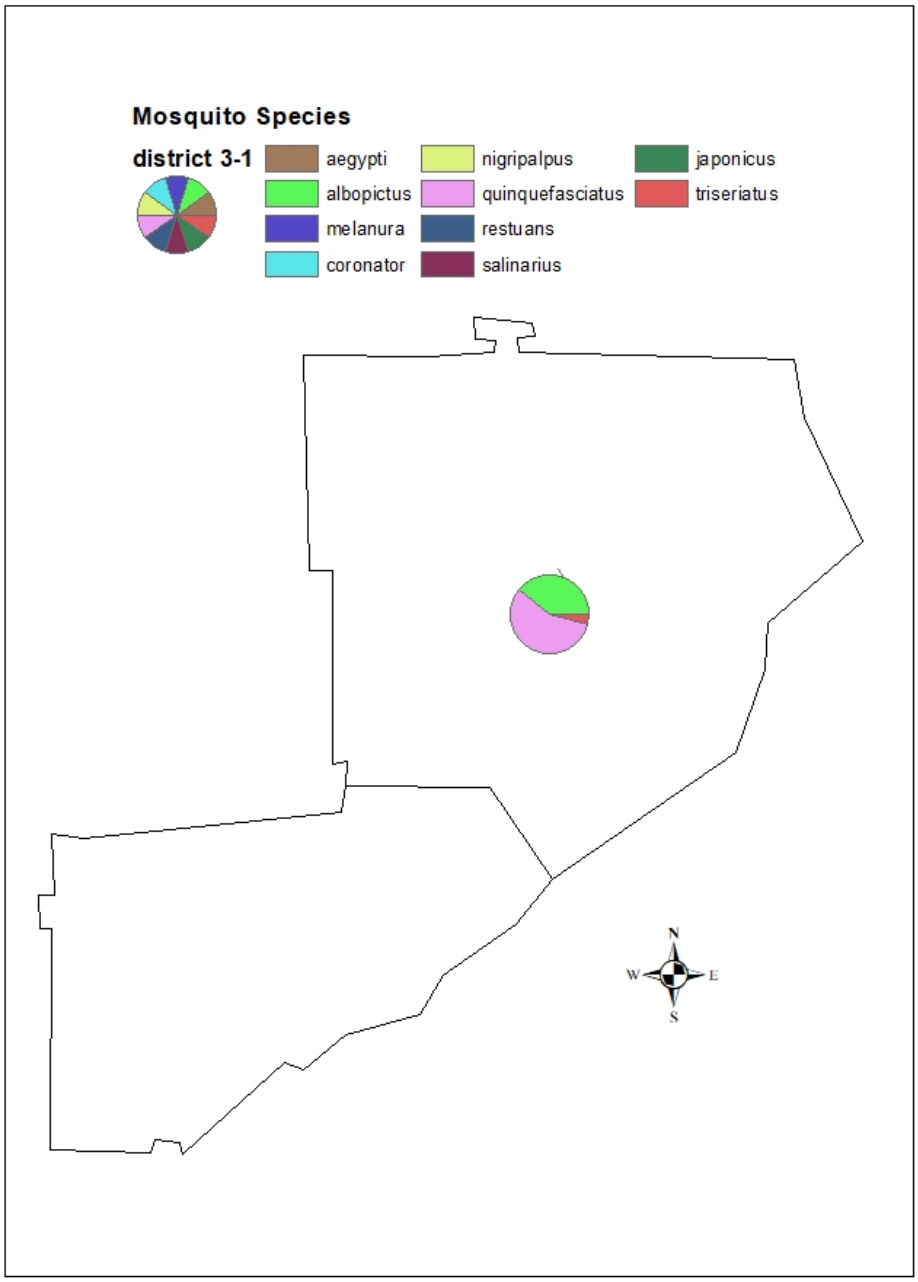
Surveillance in District 3-1 was done by the EHS mosquito technician and the DPH entomologists. Surveillance was done from June-September over 19 trap nights.

CULEX ERRATICUS



Mosquito Feeding on a Lizard

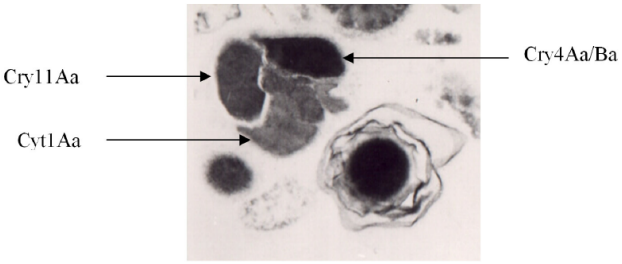
Vector Species, 2022



District 3-2

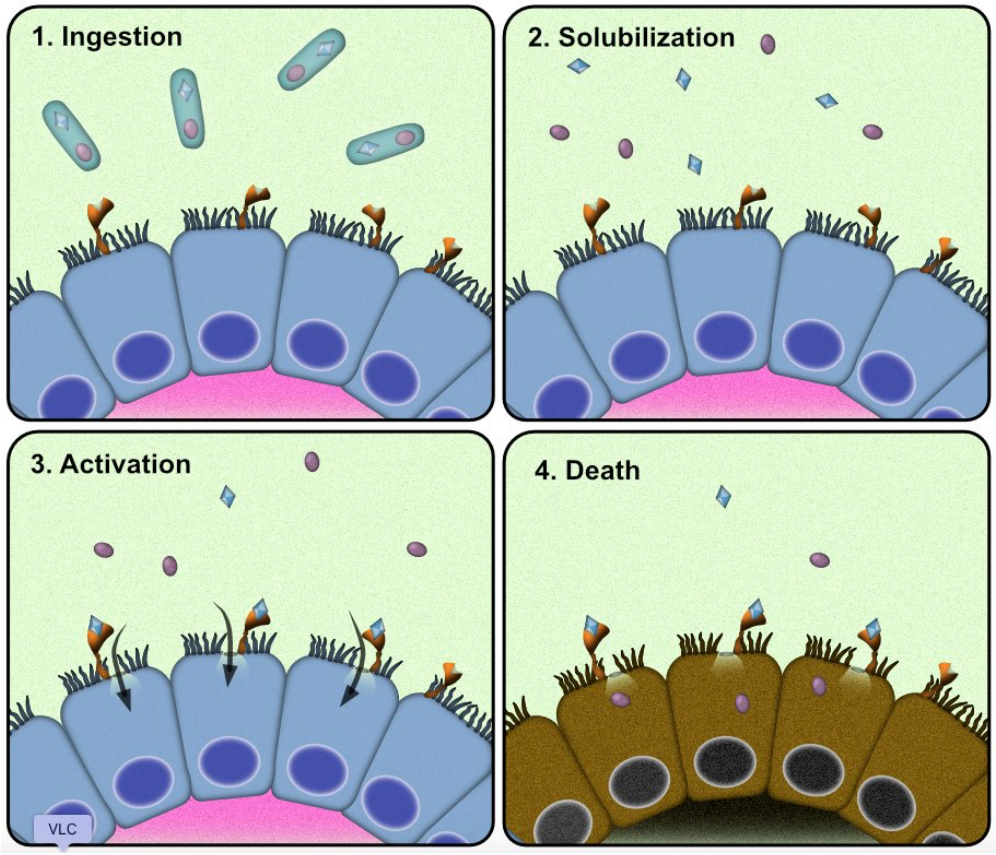
Surveillance in District 3-2 was done by Bug Busters, a pesticide company that contracted with the District to do mosquito surveillance and control. Surveillance was done from July-October over 239 trap nights. Mosquitoes tested for virus were shared.

District 3-2		trap types	
County	**Species**	**CDC**	**Gravid**
Fulton	*Cx. quinquefasciatus*	475	5813

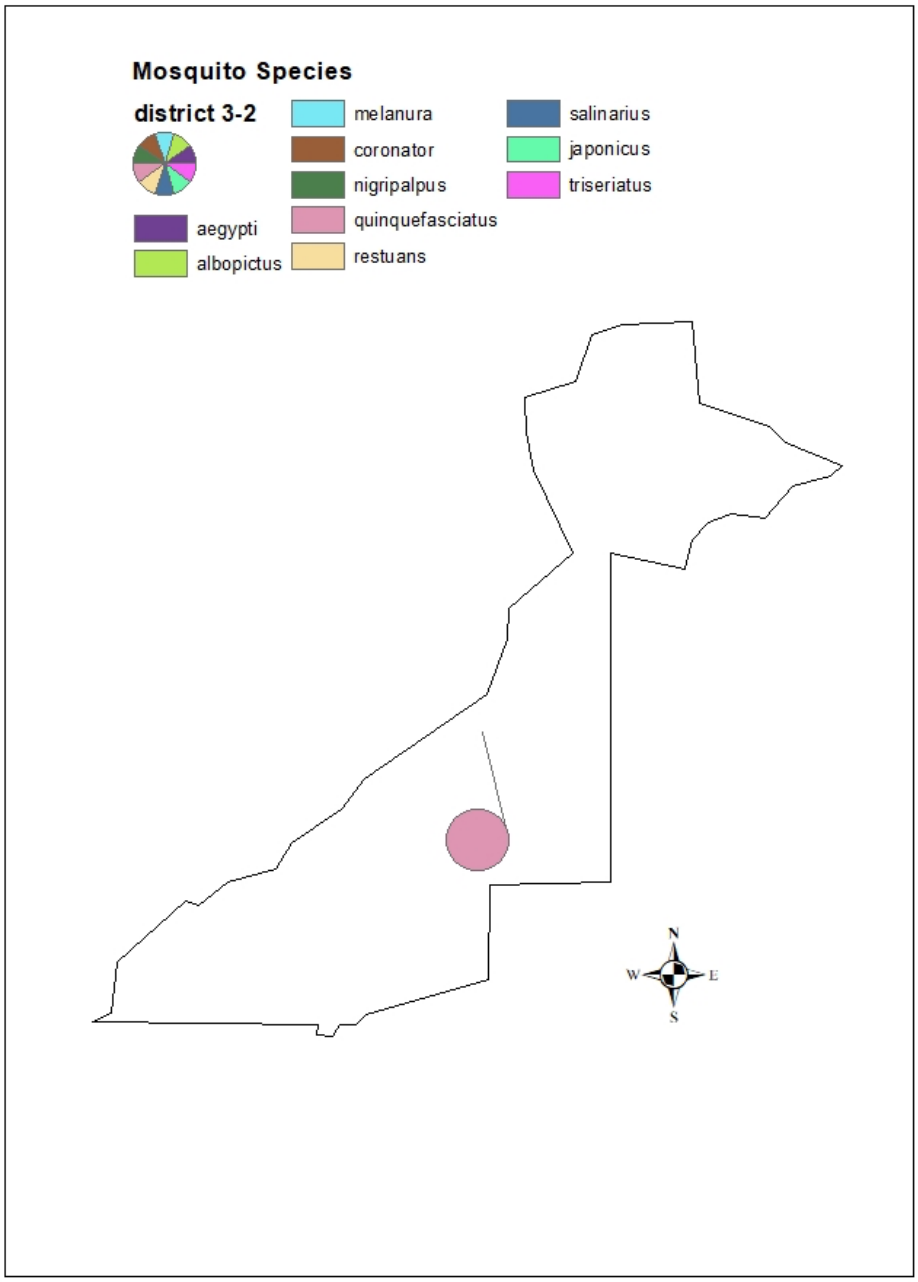


BTI CRYSTAL AND SPORE

BTI MODE OF ACTION



Vector Species, 2022



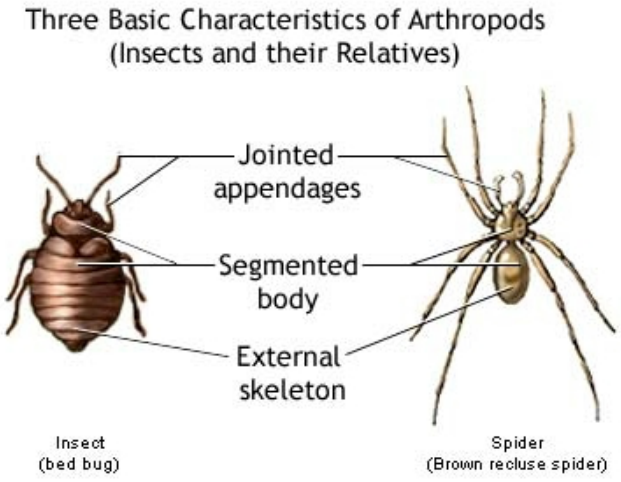
District 3-3

No surveillance was done in District 3-3 in 2022.

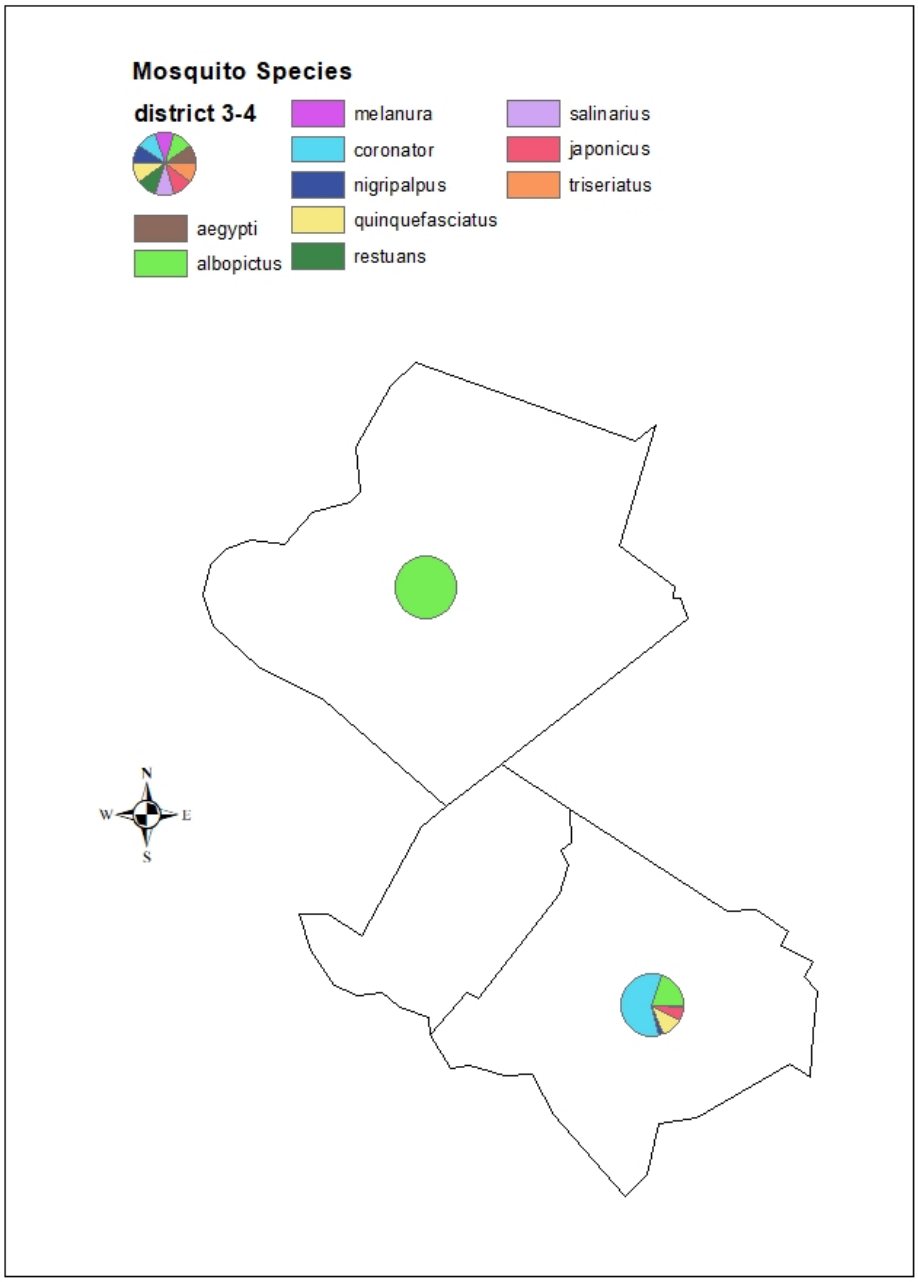
District 3-4

Surveillance in District 3-4 was done by the DPH entomologists. Surveillance was done in June, July, and September over 47 trap nights.

District 3-4		trap types	
County	**Species**	**CDC**	**Gravid**
Gwinnett	*Ae. albopictus*		1
Newton	*Ae. albopictus*	22	15
	Cx. coronator	110	
	Cx. nigripalpus	4	
	Cx. quinquefasciatus	12	8
	Cx. restuans	1	
	Oc. japonicus		14
	Oc. triseriatus	2	



Vector Species, 2022



MOSQUITO SURVEILLANCE 2022

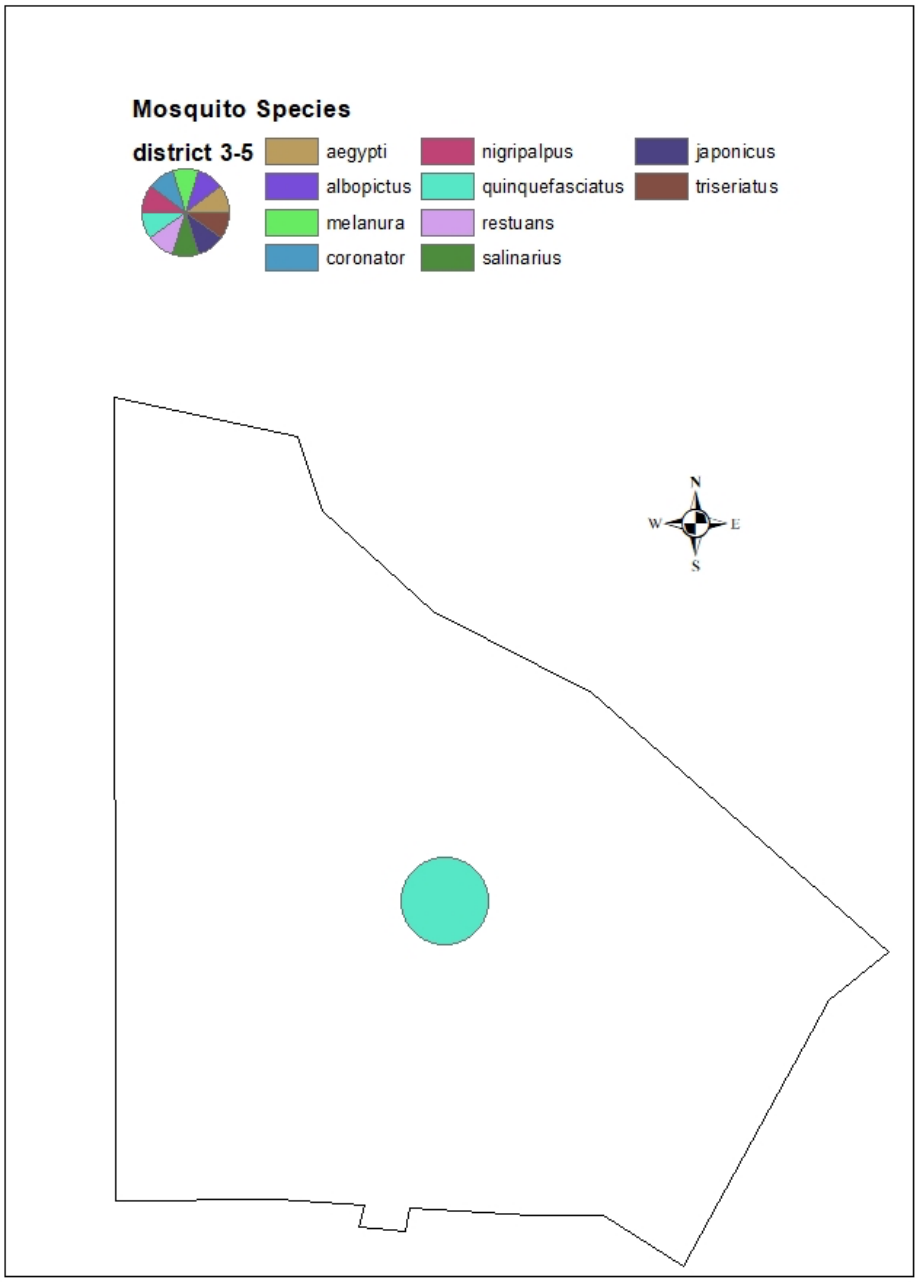
District 3-5

District 3-5		trap type
County	**Species**	**Gravid**
DeKalb	*Ae. albopictus*	38
	Cx. quinquefasciatus	6412

Surveillance in District 3-5 was done by interns in the County Environmental Health program. Surveillance was done from June - September over 295 trap nights. County-level tested mosquito data were shared with the DPH.

SALT MARSH HABITAT

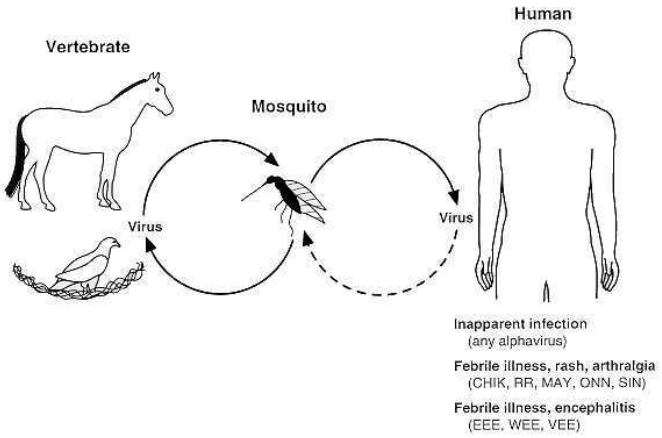
Vector Species, 2022



District 4-0

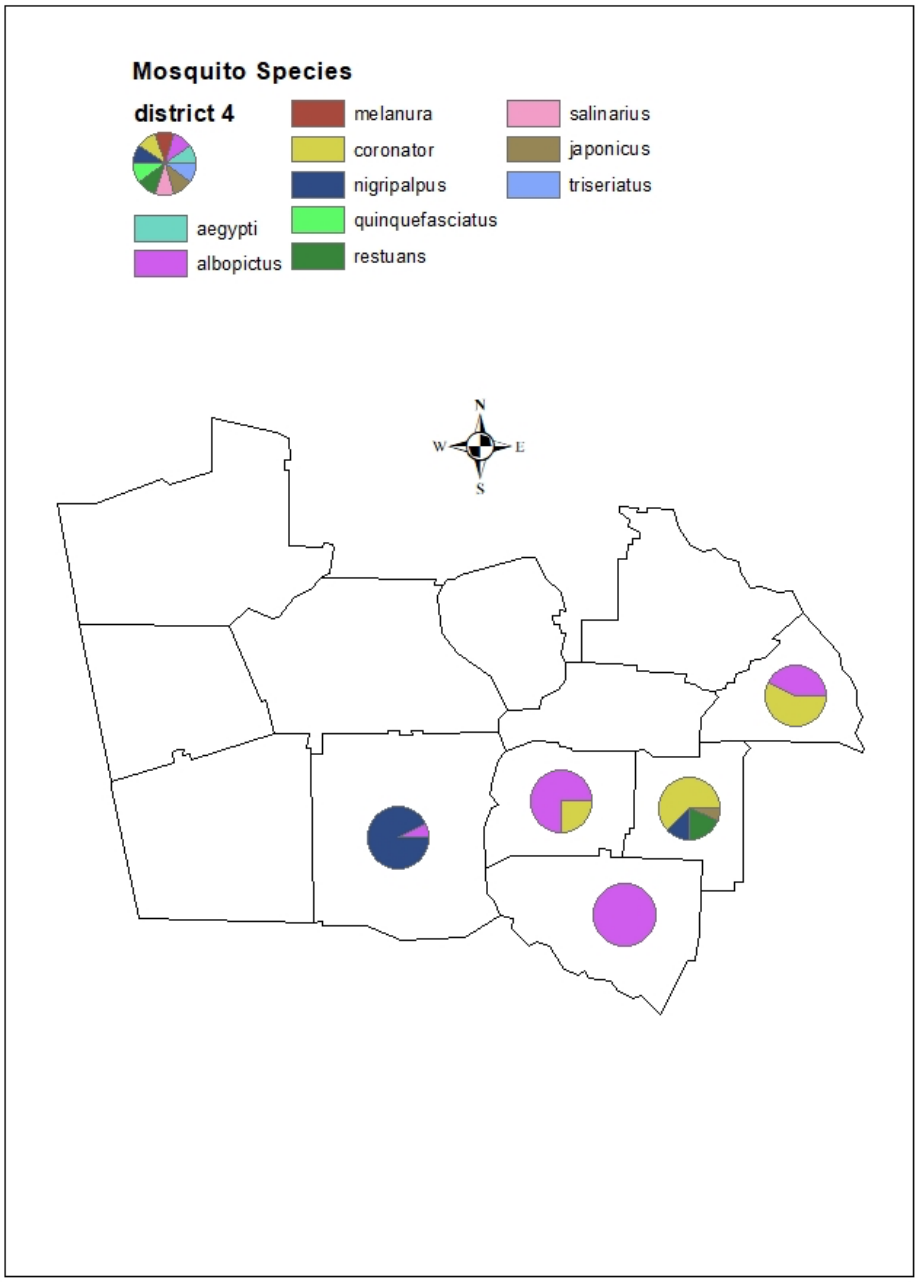
Surveillance in District 4-0 was done by the DPH entomologists. Surveillance was done in August and October over 5 trap nights.

District 4-0		trap types	
County	**Species**	**CDC**	**Gravid**
Butts	*Ae. albopictus*		3
	Cx. coronator	4	
Lamar	*Cx. coronator*	10	
	Cx. nigripalpus	2	
	Cx. restuans	3	
	Oc. japonicus		1
Meriwether	*Ae. albopictus*		1
	Cx. nigripalpus	13	
Pike	*Ae. albopictus*	3	3
	Cx. coronator	2	
Upson	*Ae. albopictus*		5



Arboviral Disease Transmission Cycle

Vector Species, 2022



MOSQUITO SURVEILLANCE 2022

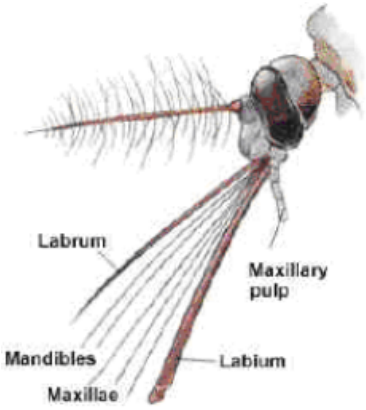
District 5-1

No surveillance was done in District 5-1 in 2022.

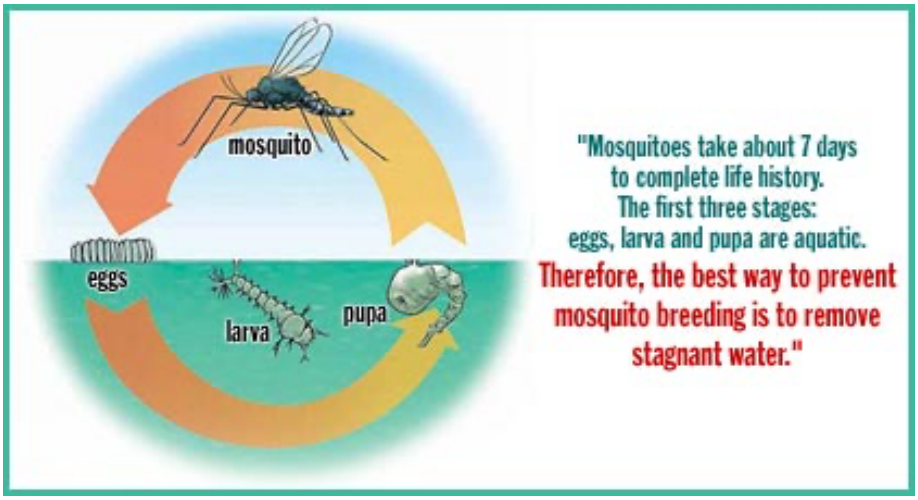
District 5-2

Surveillance in District 5-2 was done by the DPH entomologists in June, August, and September over 5 trap nights.

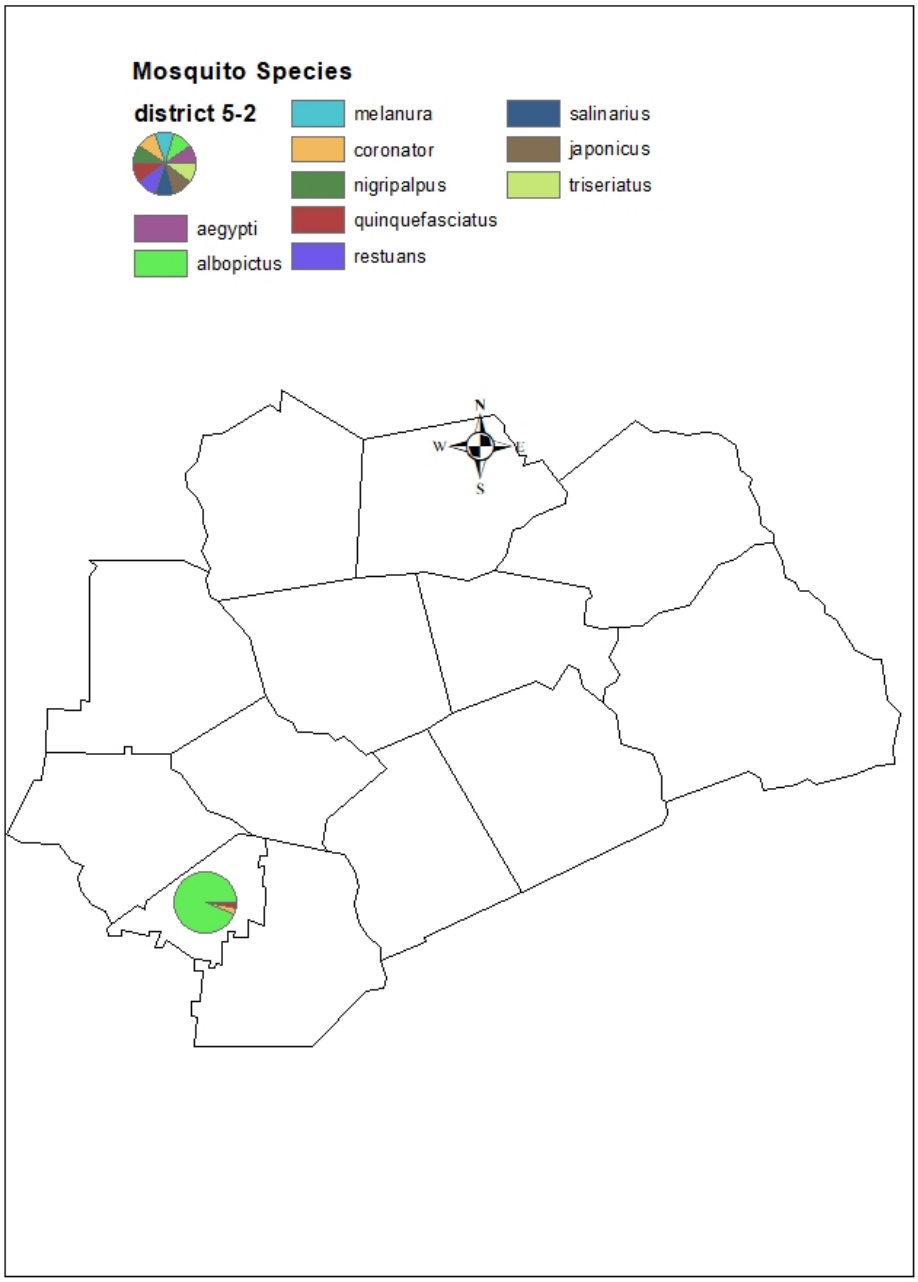
District 5-2		trap types	
County	**Species**	**CDC**	**Gravid**
Peach	*Ae. albopictus*	306	22
	Cx. coronator	10	
	Cx. quinquefasciatus	5	5
	Oc. triseriatus		1



Mosquito



Vector Species, 2022

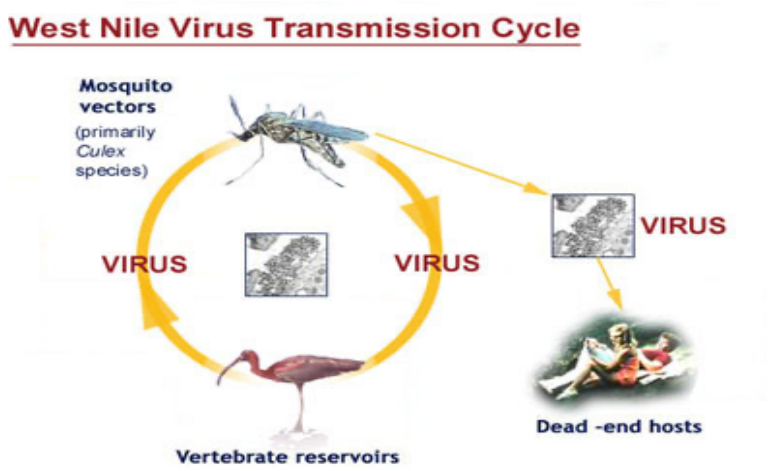


District 6-0

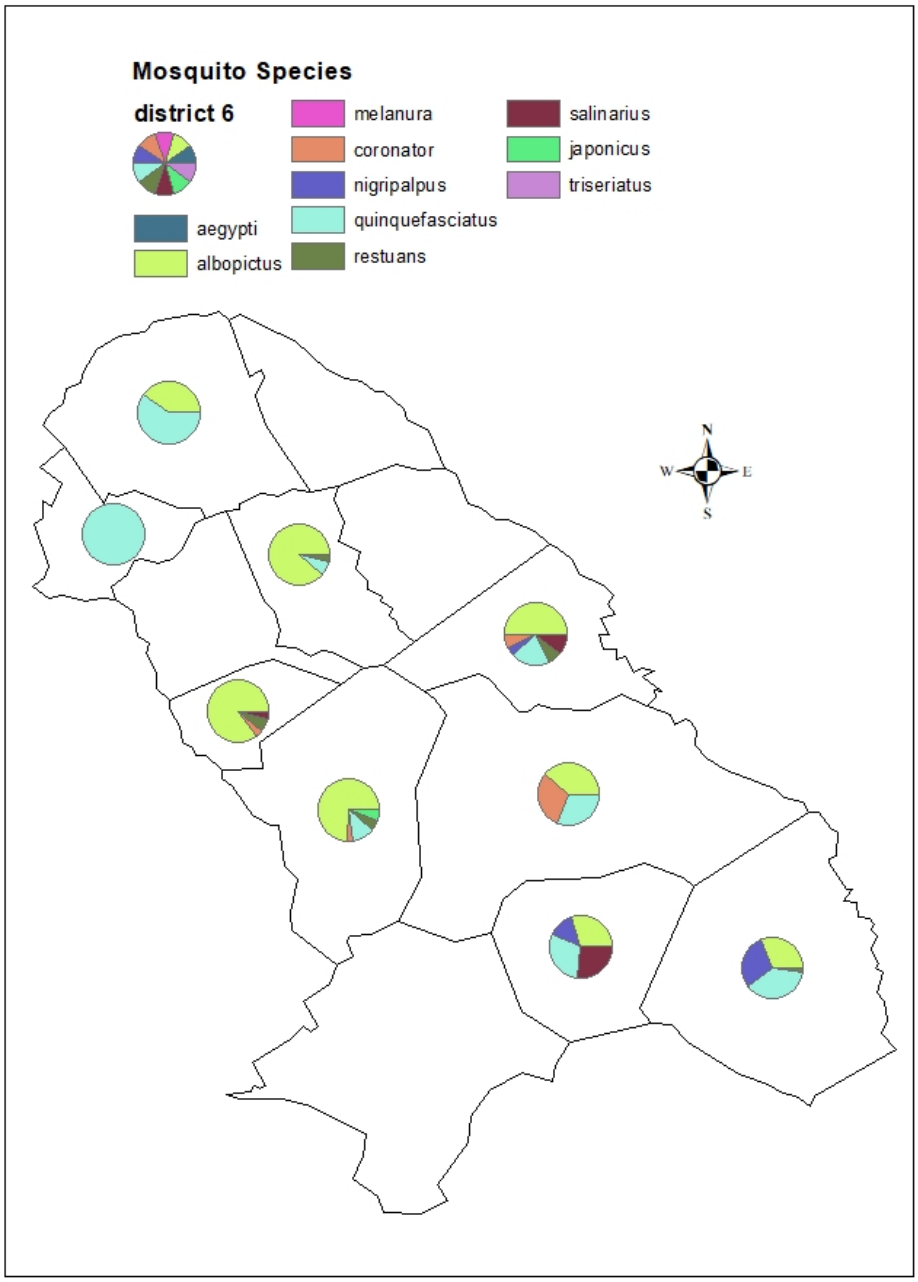
Surveillance in District 6-0 was done by the Richmond County Mosquito Control program. Surveillance was done from June-October over 109 trap nights.

District 6-0		trap types		
County	**Species**	**BGS**	**CDC**	**Gravid**
Burke	*Ae. albopictus*		5	
	Cx. coronator		4	
	Cx. quinquefasciatus		4	
Glascock	*Ae. albopictus*		23	
	Cx. coronator		1	
	Cx. restuans		2	
	Cx. salinarius		1	
Jefferson	*Ae. albopictus*		21	5
	Cx. coronator		1	
	Cx. quinquefasciatus			4
	Cx. restuans		2	
	Oc. japonicus		2	
Jenkins	*Ae. albopictus*		47	
	Cx. nigripalpus		22	
	Cx. quinquefasciatus		47	
	Cx. salinarius	6	37	
McDuffie	*Ae. albopictus*		22	1
	Cx. quinquefasciatus			2
	Cx. restuans			1

District 6-0		trap types		
County	**Species**	**County**	**Species**	**County**
Richmond	*Ae. albopictus*		1087	91
	Cx. coronator		146	4
	Cx. nigripalpus		104	6
	Cx. quinquefasciatus		433	44
	Cx. restuans		155	20
	Cx. salinarius		238	4
	Oc. japonicus		3	4
	Oc. triseriatus			2
Screven	*Ae. albopictus*		46	16
	Cx. nigripalpus		47	11
	Cx. quinquefasciatus		61	14
	Cx. restuans		4	
Taliaferro	*Cx. quinquefasciatus*		24	2
Wilkes	*Ae. albopictus*		8	
	Cx. quinquefasciatus		5	7



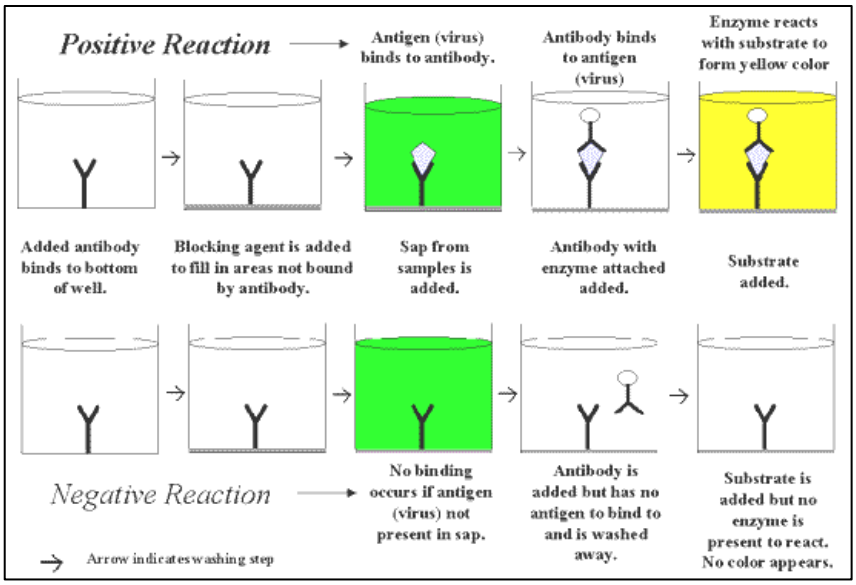
Vector Species, 2022



District 7-0

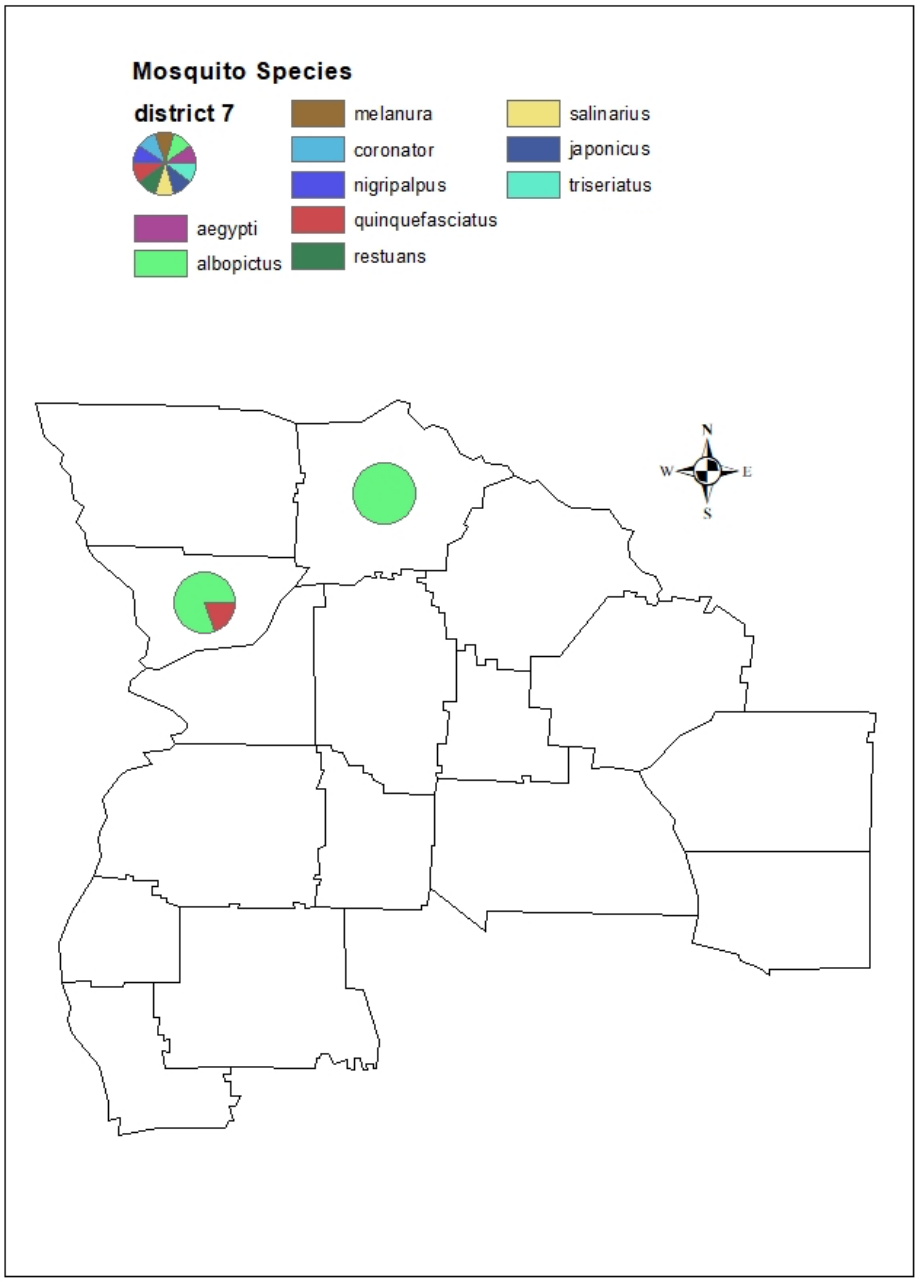
Surveillance in District 7-0 was done by the State entomologists and by a Practicum student, assisted by the Columbus Mosquito Control group in the Environmental Health Section of the Muscogee Public Health Department. Surveillance was done from May-September over 47 trap nights.

District 7-0		trap types		
County	**Species**	**BGS**	**CDC**	**Gravid**
Muscogee	*Ae. aegypti*		9	3
	Ae. albopictus	1532	152	10
	Cx. coronator		14	
	Cx. nigripalpus	1		
	Cx. quinquefasciatus	241	159	5
	Oc. japonicus	3		1
	Oc. triseriatus	1		
Talbot	*Ae. albopictus*		9	



ELISA

Vector Species, 2022



District 8-1

Surveillance in District 8-1 was done by the local EHS and students from VSU. Surveillance was done from March-November over 498 trap nights.

District 8-1		trap types	
County	**Species**	**CDC**	**Gravid**
Ben Hill	*Ae. albopictus*		15
	Cx. coronator		12
	Cx. nigripalpus		12
	Cx. quinquefasciatus		203
	Cx. restuans		20
	Cx. salinarius		1
	Oc. triseriatus		1
Berrien	*Ae. albopictus*	3	14
	Cs. melanura		9
	Cx. nigripalpus		5
	Cx. quinquefasciatus	3	143
	Cx. restuans		3
	Cx. salinarius		8
Brooks	*Ae. albopictus*		56
	Cs. melanura		1
	Cx. coronator		2
	Cx. nigripalpus		5
	Cx. quinquefasciatus	1	1373
	Cx. restuans		11
	Cx. salinarius		5

District 8-1		trap types	
County	**Species**	**CDC**	**Gravid**
Cook	*Ae. albopictus*		25
	Cx. nigripalpus		8
	Cx. quinquefasciatus	4	960
	Cx. restuans		30
	Cx. salinarius		19
Echols	*Ae. albopictus*	1	59
	Cx. coronator	3	
	Cx. nigripalpus	1	1
	Cx. quinquefasciatus	2	1799
	Cx. salinarius		5
Irwin	*Ae. albopictus*		31
	Cx. coronator		19
	Cx. nigripalpus		6
	Cx. quinquefasciatus		598
	Cx. restuans		25
Lanier	*Ae. albopictus*		32
	Cs. melanura		8
	Cx. nigripalpus		13
	Cx. quinquefasciatus		799
	Cx. restuans		4
	Cx. salinarius		59

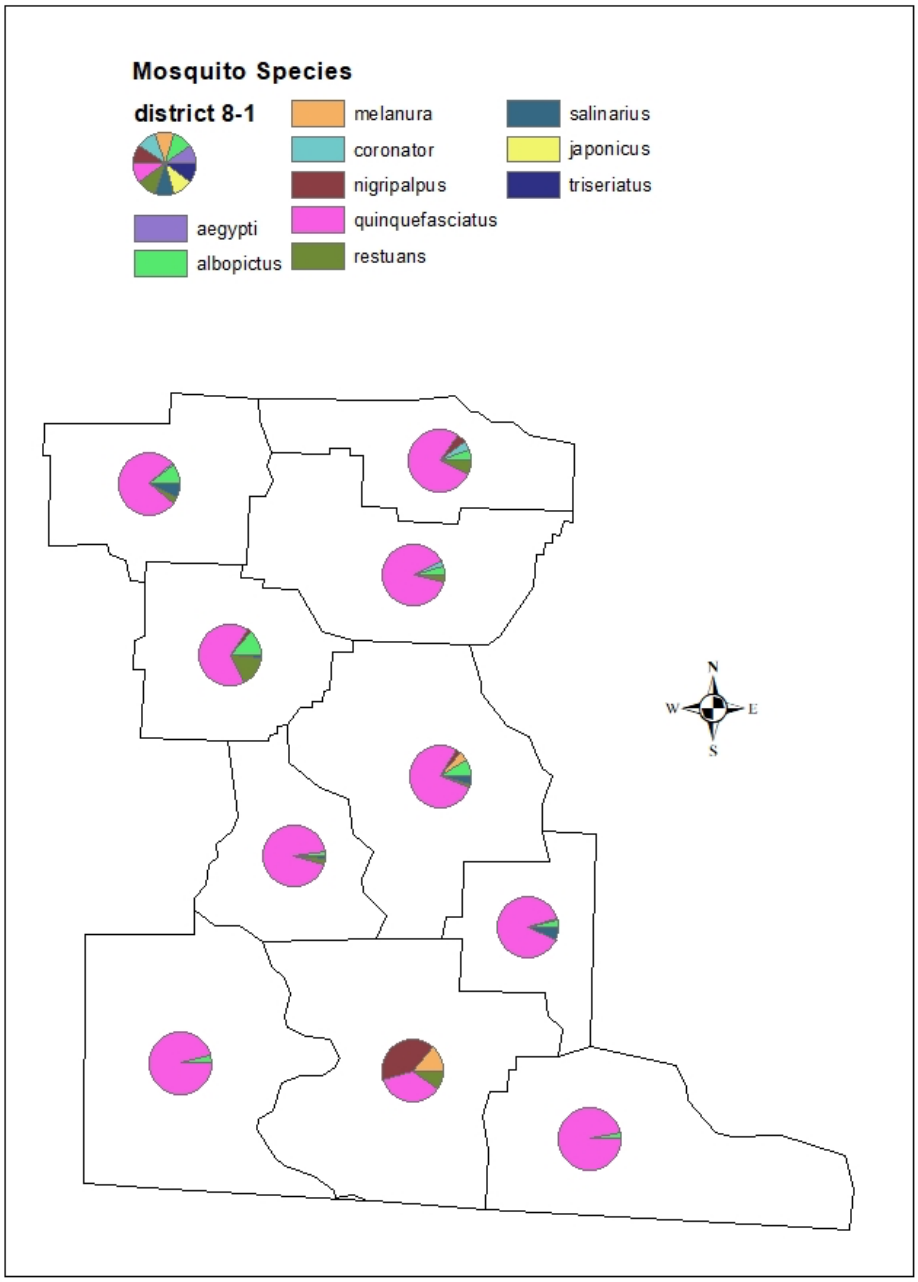
MOSQUITO SURVEILLANCE 2022

District 8-1		trap types	
County	**Species**	**CDC**	**Gravid**
Turner	*Ae. albopictus*		159
	Cs. melanura		2
	Cx. coronator		24
	Cx. nigripalpus		11
	Cx. quinquefasciatus		1161
	Cx. restuans		57
	Cx. salinarius		108
	Oc. triseriatus		2

County	***Species***	**CDC**	**Gravid**
Lowndes	*Cs. melanura*	1309	173
	Cx. coronator	56	
	Cx. nigripalpus	3563	774
	Cx. quinquefasciatus	270	3549
	Cx. restuans	45	987
	Oc. triseriatus		3
Tift	*Ae. albopictus*		97
	Cx. coronator		5
	Cx. nigripalpus		15
	Cx. quinquefasciatus		487
	Cx. restuans		119
	Cx. salinarius		11

MOSQUITO LARVA

Vector Species, 2022



District 8-2

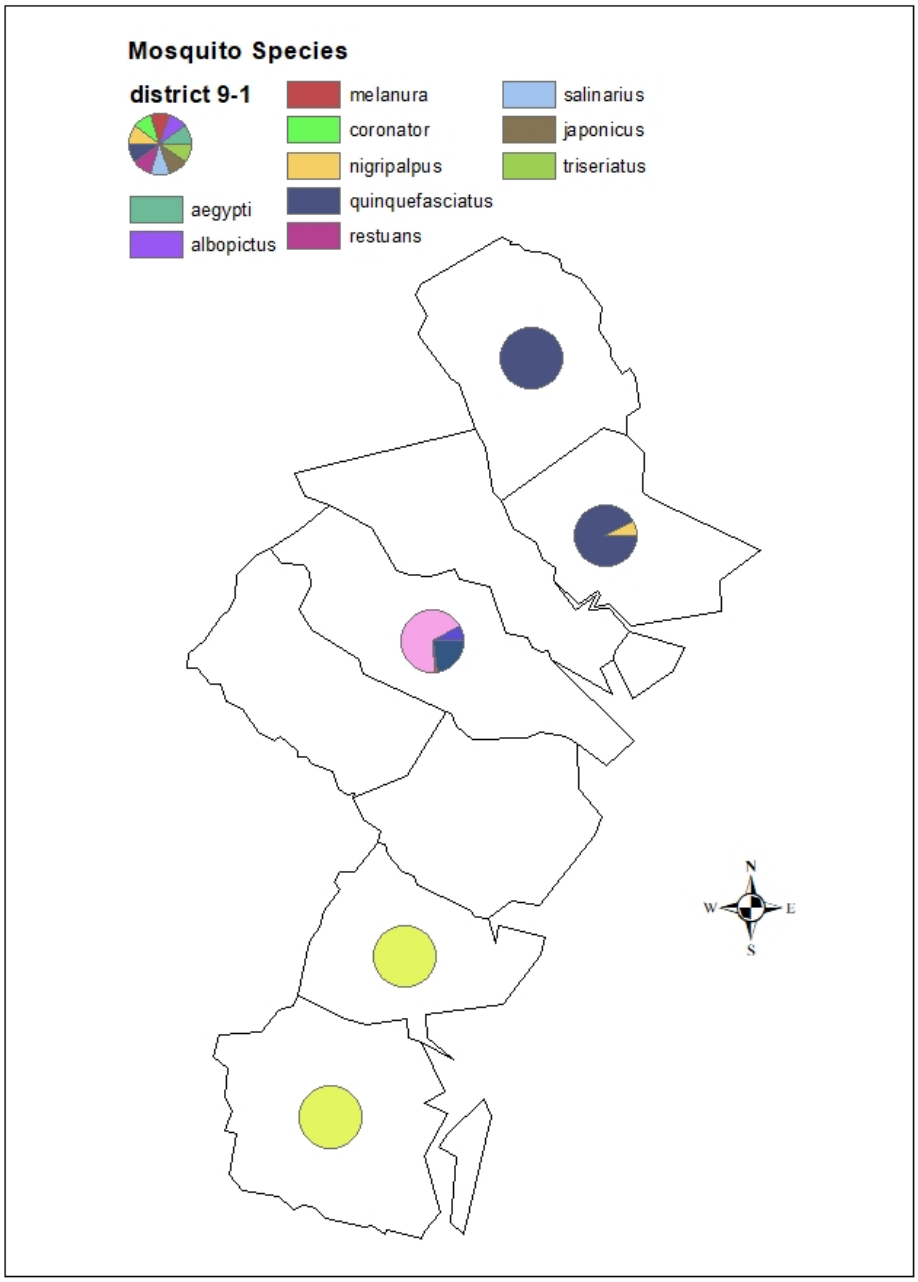
No surveillance was done in District 8-2 in 2022.

District 9-1

Surveillance in District 9-1 was done by Hinesville Public Works (Liberty County), Mosquito Control Services (Glynn & Camden counties), and Chatham County Mosquito Control programs. Surveillance was done from January - December over 1694 trap nights.

District 9-1		trap types		
County	**Species**	**CDC**	**Exit**	**Gravid**
Camden	*Ae. albopictus*	4		
	Cx. nigripalpus	56		
	Cx. quinquefasciatus	3		8575
	Cx. salinarius	3		
Chatham	*Cs. melanura*	45	2	4
	Cx. nigripalpus	103	54	2176
	Cx. quinquefasciatus	46		29295
	Cx. restuans			55
	Oc. triseriatus	13		2
Effingham	*Cx. quinquefasciatus*			2
Glynn	*Ae. albopictus*	5		
	Cx. nigripalpus	61		1
	Cx. quinquefasciatus	12		20091
	Cx. salinarius	19		
Liberty	*Ae. albopictus*	15		
	Cx. coronator	1		
	Cx. nigripalpus	125		
	Cx. quinquefasciatus	1		
	Cx. restuans	2		
	Cx. salinarius	42		

Vector Species, 2022

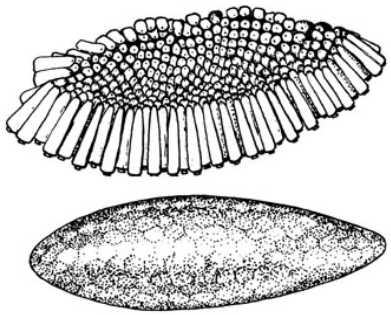


District 9-2

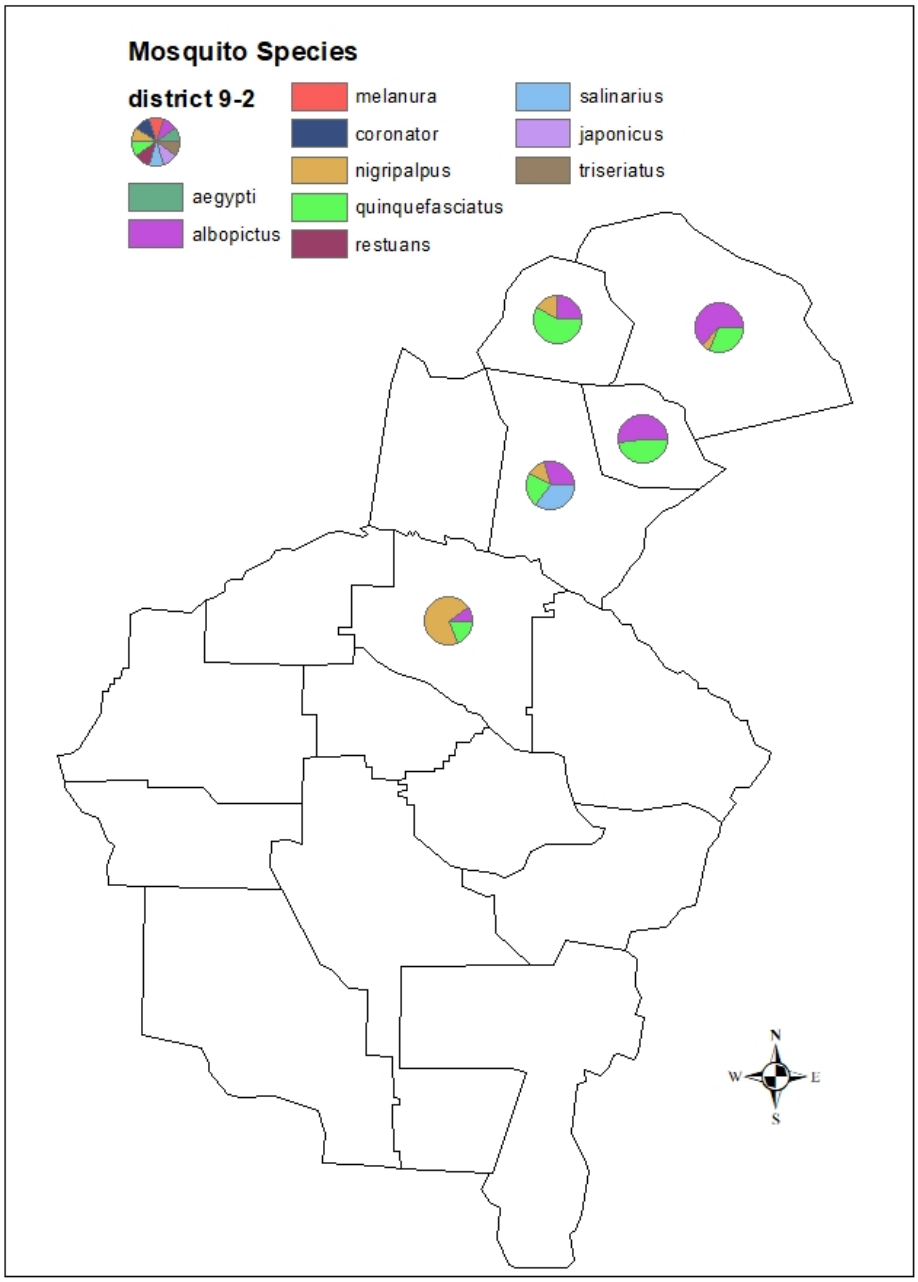
Surveillance in District 9-2 was done by a volunteer from the Health District. Surveillance was done from April-July and in September over 18 trap nights.

District 9-2		trap types		
County	**Species**	**CDC**	**Gravid**	**Other**
Appling	*Ae. albopictus*		3	
	Cx. nigripalpus		23	
	Cx. quinquefasciatus		6	
Bulloch	*Ae. albopictus*		1	9
	Cx. nigripalpus			1
	Cx. quinquefasciatus	5		
Candler	*Ae. albopictus*		3	
	Cx. nigripalpus		2	
	Cx. quinquefasciatus		7	
Evans	*Ae. albopictus*		12	
	Cx. quinquefasciatus		11	
Tattnall	*Ae. albopictus*		9	
	Cx. nigripalpus		4	
	Cx. quinquefasciatus		7	
	Cx. salinarius		11	

MOSQUITO EGG TYPES



Vector Species, 2022

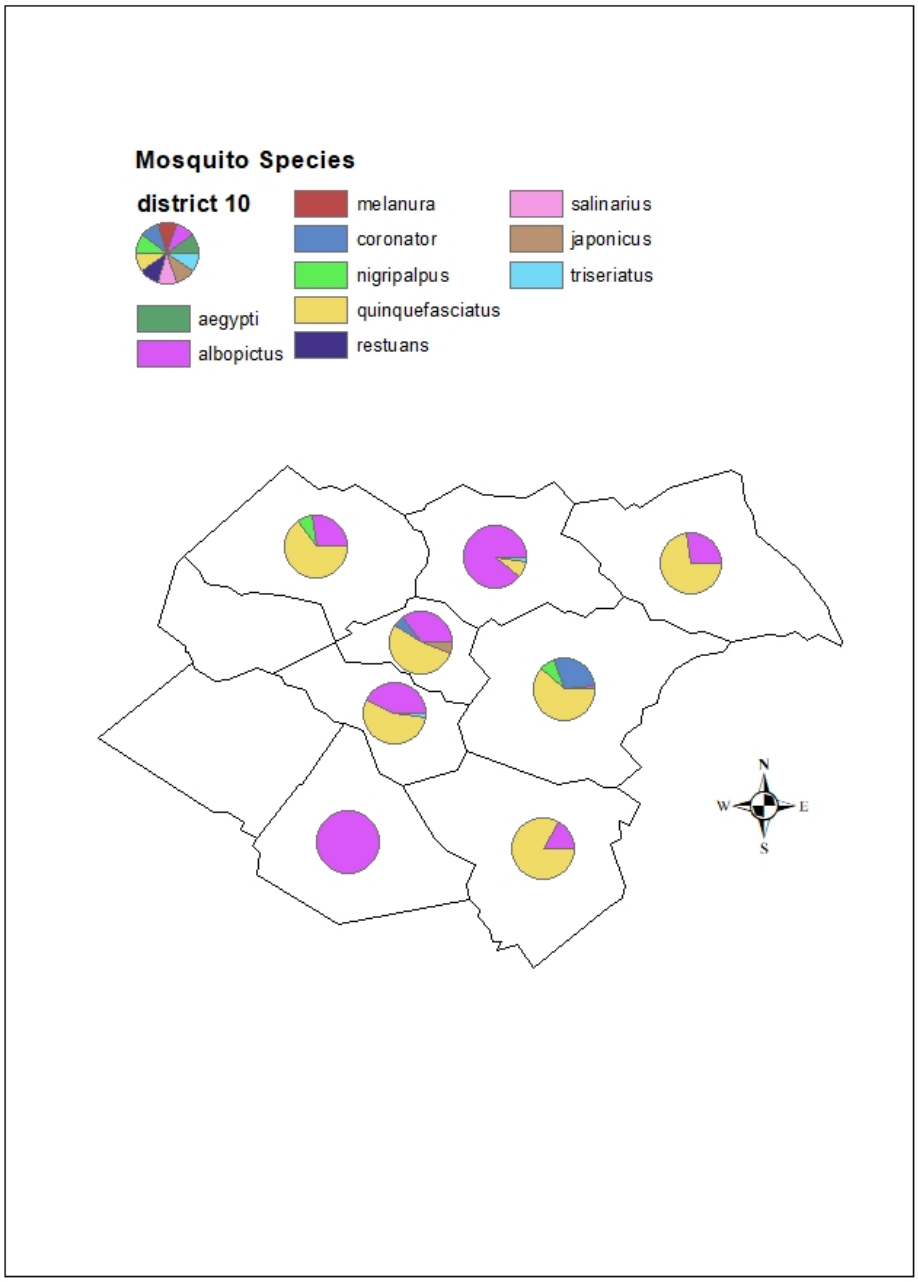


District 10-0

Surveillance in District 10-0 was done by a NEHA intern and by several volunteer entomologists from UGA. Surveillance was done from June-October over 20 trap nights.

District 10-0		trap types	
County	**Species**	**CDC**	**Gravid**
Clarke	*Ae. albopictus*	3	3
	Cx. coronator	1	
	Cx. quinquefasciatus	1	8
	Oc. japonicus		1
Elbert	*Ae. albopictus*	15	3
	Cx. quinquefasciatus	46	2
Greene	*Ae. albopictus*		1
	Cx. quinquefasciatus	2	3
Jackson	*Ae. albopictus*	6	4
	Cx. nigripalpus	3	
	Cx. quinquefasciatus	17	7
Madison	*Ae. albopictus*	33	8
	Cx. quinquefasciatus		4
	Oc. triseriatus	1	
Morgan	*Ae. albopictus*	1	
Oconee	*Ae. albopictus*	20	1
	Cx. quinquefasciatus	14	13
	Oc. triseriatus	1	
Oglethorpe	*Ae. albopictus*	1	
	Cx. coronator	14	
	Cx. nigripalpus	3	1
	Cx. quinquefasciatus	24	7

Vector Species, 2022



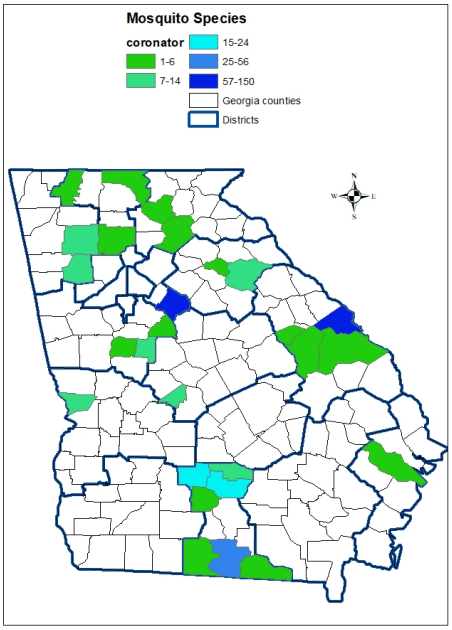
Invasive Mosquito Species

One of the benefits of mosquito surveillance is determining where mosquito species are found. This is especially important for vector species and for invasive species which may become involved in arboviral disease cycles.

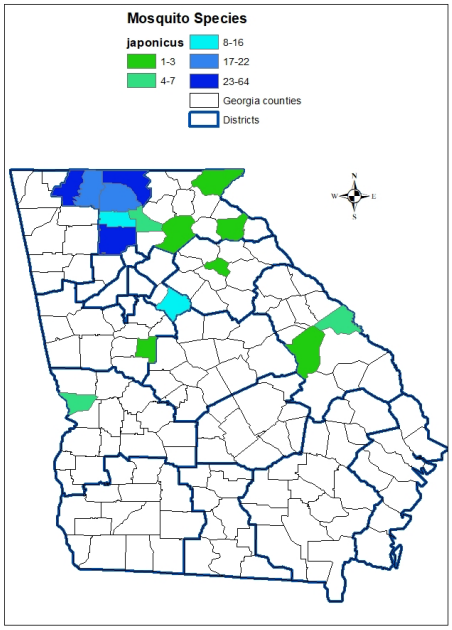
Culex coronator was first detected in Georgia in 2006. It was found initially in counties below the Fall line. Mosquito surveillance done in 2017 - 2020 has shown that this species can now be found in most regions of Georgia. It is important to monitor *Cx coronator* as it has the potential to be involved in the WNV cycle.

Ochlerotatus japonicus was first detected in Georgia in 2002. This species lays its eggs in rock pools, so was initially found only above the Fall line. Mosquito surveillance done in 2017 - 2020 has shown that this species can now be found in most regions of Georgia. It is important to monitor *Oc japonicus* as it has the potential to be involved in the WNV cycle.

Culex coronator, 2022



Ochlerotatus japonicus, 2022



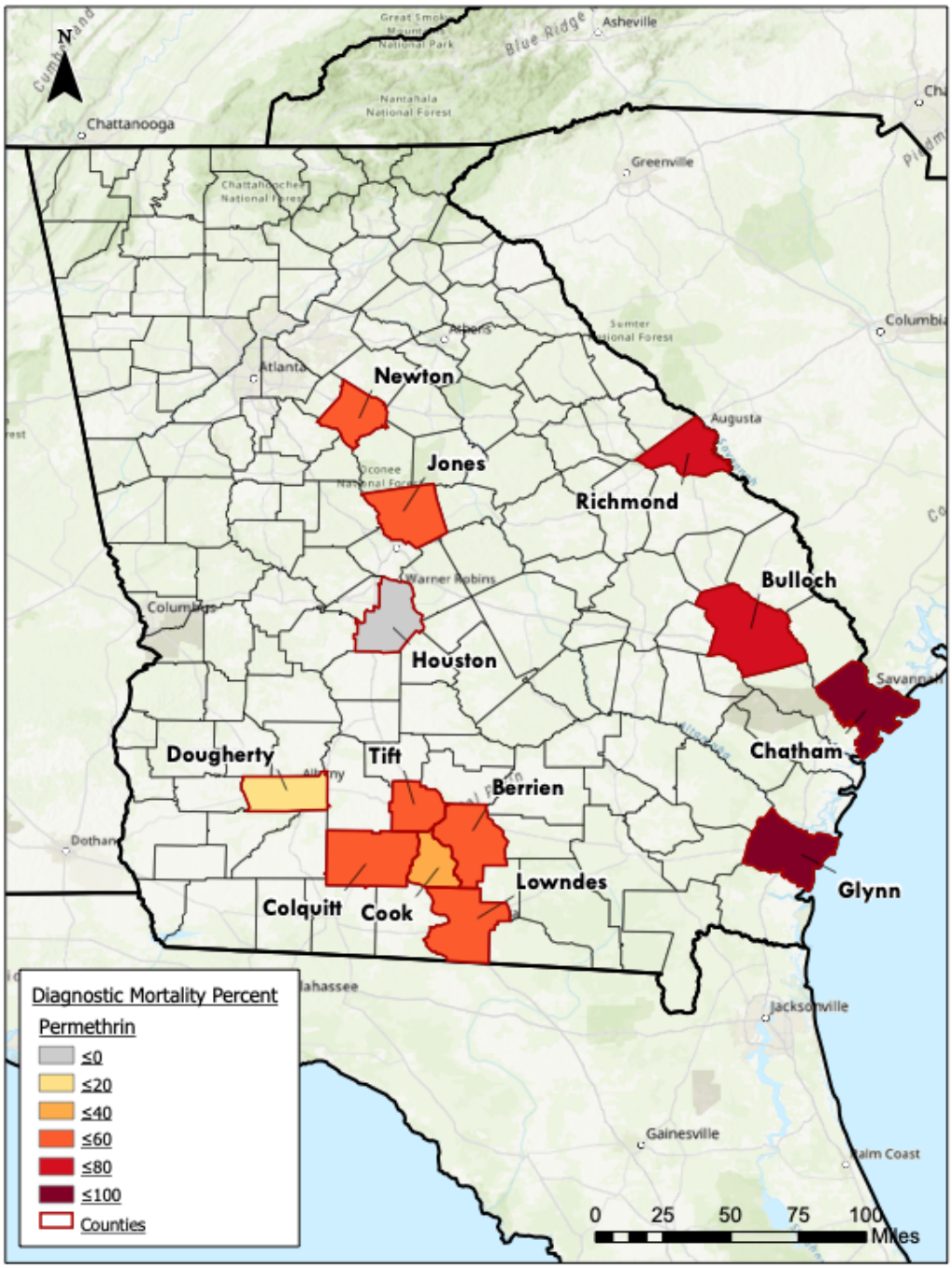
Pesticide Resistance Testing

With the continuation of positive human cases of arboviral diseases such as La Crosse Encephalitis, St. Louis Encephalitis, Eastern Equine Encephalitis, and West Nile Virus in Georgia in 2020, mosquito control methods are critical. Pesticide resistance has been found to be a component for ineffective mosquito control. There is a lack of insecticide resistance studies conducted statewide in Georgia and minimal knowledge of which pesticides mosquitoes are resistant to.

The state entomologists and regional entomologist are tasked to conduct insecticide resistance testing in all high-risk urban regions of Georgia. Mosquito egg collections were initially performed by Vector Surveillance coordinators. Environmental Health Specialists are now assisting with egg collections. Mosquito egg collection training can be provided to all who assist with this endeavor.

Resistance testing is performed using the CDC Bottle Bioassay procedure and the chemicals that were provided in the CDC Bottle Bioassay kits. Preliminary data from several central and southern counties showed *Ae albopictus* to be exhibiting varied levels of resistance to permethrin and deltamethrin but were susceptible at varied levels to bifenthrin and deltamethrin used along with the synergist, PBO. *Culex quinquefasciatus* showed varied levels of resistance to permethrin, lambda cyhalothrin, and deltamethrin; they were susceptible to malathion.

With the implementation of the first statewide pesticide resistance testing program, a clearer picture of the type of mosquitoes and their resistance to specific pesticides commonly used in Georgia will be determined. This information enables DPH to advise and train current mosquito control operators in using the most effective and cost-efficient pesticide for their target-mosquito. The statewide pesticide resistance testing program is a major component in reducing the exposure of mosquito-borne disease risk to the public.



MAP OF MOSQUITO RESISTANCE TO PERMETHRIN, GEORGIA

Resources

- https://cdn.ymaws.com/www.mosquito.org/resource/resmgr/docs/publications/hr_november_2021_amca_bmp_ma.pdf
- http://www.gamosquito.org/publications.htm
- http://cdcsercoevbd-flgateway.org/
- https://www.cdc.gov/parasites/education_training/lab/bottlebioassay.html
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CARTOON BY RAY KING

MOSQUITO SURVEILLANCE 2022

Conclusions

In 2022, due loss of funding, mosquito surveillance was only done in 79 of Georgia's 159 counties. Surveillance was done in areas of highest risk of vector-borne diseases, but in many counties, surveillance was non-existent or limited.

Year	# counties doing surveillance	% of counties
2001	2	1.3%
2002	11	6.9%
2003	26	16.4%
2004	56	35.2%
2005	55	34.6%
2006	28	17.6%
2007	28	17.6%
2008	28	17.6%
2009	26	16.4%
2010	22	13.8%
2011	19	11.9%
2012	12	7.5%
2013	13	8.2%
2014	15	9.4%
2015	13	8.2%
2016	60	37.7%
2017	159	100.0%
2018	159	100.0%
2019	159	100.0%
2020	142	89.3%
2021	103	64.8%
2022	79	49.7%

MOSQUITO SURVEILLANCE 2022

This level of surveillance was only possible through the combined effort of State, District, and County Environmental Health, as well as assistance from several other agencies.

Our goals for the 2023 mosquito surveillance season include:

- Doing some level of mosquito surveillance in every county in Georgia
- Doing targeted surveillance in areas where *Ae aegypti* were found in the 1950s
- Providing continued training to Environmental Health Specialists
- Support local outreach for mosquito complaints and arboviral disease cases
- Continued testing for adulticide resistance, esp in high-risk areas of Georgia
- Beginning testing for larvicide resistance in localized areas
- Spatial analysis of pesticide resistance in Georgia

The accomplishment of these goals will allow the Georgia Department of Public Health to be better prepared for the next mosquito-borne disease to emerge. However, these goals are not attainable without sustainable funding.

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District Map