History of Mosquito Control in Georgia

Table of Contents

INTRODUCTION

Georgia, as a home rule state, has no State mosquito control program. In Georgia, home rule refers to the power granted to local governments (counties and municipalities) to govern their own affairs, particularly through the adoption of ordinances and regulations, within certain limitations. This power is derived from the Georgia Constitution and the Municipal Home Rule Act. Therefore, local governments and mosquito control districts in Georgia are responsible for mosquito control efforts within their jurisdictions, so the approach to mosquito control varies widely from county to county as shown in the Mosquito Control Programs in Georgia, 2017 (http://www.gamosquito.org/resources/GA_Mosquito_Control_Programs2017_update.pdf and http://www.gamosquito.org/resources/GA_Mosquito_Control_Map.pdf). The Department of Public Health (GDPH) entomologists collaborate with mosquito control programs and other agencies to collect data on mosquito populations and arboviral disease, to be used in education, training, and to provide risk of arboviral disease transmission in Georgia.

EARLY MOSQUITO ISSUES

Mosquitoes have been documented as pests in Georgia since the earliest English settlers arrived on the coast in the early 1700s. Biology and intuition tell us that the insects were surely a problem before that.

From a disease standpoint, Savannah and Brunswick were the primary hubs of introduction due to shipping, particularly from Caribbean areas. Quarantine Stations were established all along the coast of GA, FL, and SC and arsenic was used to sterilize the ships before releasing them to a main port.

McIntosh County

Fort King George was the first fort built by the English on the land that would become the Georgia colony, making it a crucial point in the early history of the region. From 1721 until 1736, Fort King George was the southern outpost of the British Empire in North America. Journal notations from the construction period for Fort King George describe "Musketos in their Vigour" (https://www.jstor.org/stable/27569705). A nearby river and marshland provided the larval habitats for the mosquitoes. The mosquito population was so significant that it contributed to the difficulty of life at Fort King George, even affecting troop health and mortality. A significant number of deaths came not from battle, but from poor sanitation and camp diseases like malaria.

Malaria

The porous soils, temperate climates, tidal influences and saline atmosphere of the sea islands and adjoining salt marshes of South Carolina and Georgia proved to be ideal for the cultivation of rice and black seed, long-staple (Sea Island) cotton in the period between the American Revolution and the turn of the twentieth century (https://www.sapelonerr.org/wp-content/uploads/2012/09/Ecology-as-History-in-the-SINERR-7-2-09.pdf).

The cultivation of rice was typically centered in the fertile bottomlands of freshwater river systems, which benefited from an infusion of nutrient-rich soils from the uplands of the Georgia piedmont. Rice cultivation in these areas made effective use of tide flow irrigation amid freshwater marsh systems for the alternating cycles of flooding and draining the fields. On the larger tidewater plantations of the eighteenth and nineteenth centuries, a skill originally perfected by West African farmers was adopted in South Carolina and later in Georgia, by which tidal flows and salt water-fresh water interaction filtered through freshwater marshes were utilized to achieve high productivity levels on the floodplains of the principal rivers of the section (Buddy Sullivan 2008).

Fields were laid out as a series of squares of eighteen to twenty-five acres each, penetrated by a grid of drainage ditches to facilitate the flow of water. Embankments separated the squares and provided foot access for workers tending the fields. The largest levees were those along the riverbanks of the tidal flow plantations. Tide gates built at intervals in the river levee facilitated the introduction or removal of water from the fields. Proper irrigation required regular ditching by the workforce to prevent the buildup of silt resulting from the flooding and drainage of the rice squares. The grid-like layout of a rice plantation thus represented a complex system of hydraulics, all predicated on the proper balance of a multiplicity of environmental factors, including landscape, soils, marshes, water, tides and, not least, an assortment of weather conditions (Buddy Sullivan 2008).

Another environmental consideration with direct parallels to tidewater agriculture in general, and the rice industry in particular, is that of the prevalence of malaria and its connection to tidal marshes and the breeding *Anopheles* spp. The flooding of rice fields and the impoundment of water on the fields through the use of wooden rice trunks were factors that led to a greater occurrence of local mosquito infestation with and an associated rise in malaria. Plantation records and contemporary newspaper accounts are rife with instances of malaria breakouts in Darien and the surrounding plantations of the Altamaha section (Buddy Sullivan 2008).

As an interesting side note, In the spring of 1903, James Troup Dent of Hofwyl plantation screened the porches and windows of his home on the mosquito-infested banks of the Altamaha and remained there with his family throughout the malaria season. Dent suspected that the heavy prevalence of mosquitoes in the Altamaha caused the transmission of malaria and that by reducing their exposure to the insects he and his family would be protected from the summer diseases. The Dents suffered no ill effects and families throughout the section adopted his screening methods in future years (Ophelia Troup Dent, unpublished Memoirs).

As one traverses the coastal highway through the brackish tidal marshes, a few lingering vestiges of this legacy remain. Abandoned rice fields and irrigation ditches are now havens for migratory waterfowl and the intricate systems of canals and rice dikes remain as visible symbols of a way of life that has forever disappeared. The tide gates are rotting away in the levees, no longer able to keep the flooding and ebbing tides out of the square fields where rice once thrived (https://www.ugapress.org/9780820343105/the-darien-journal-of-john-girardeau-legare-ricegrower/). Unfortunately, these remnants also have allowed large numbers of

saltmarsh mosquitoes to take advantage of areas blocked to fish predation to plague the coastal areas today.

Quarantine Stations

The Southern Atlantic station, located on Blackbird Island, was established by the US Navy in 1880. It closed in 1910.

Quarantine stations have a long history, dating back to the 14th century, with the primary purpose of protecting communities from imported diseases. Initially, they focused on isolating ships and travelers, particularly from plague outbreaks. Over time, the practice evolved, becoming more formalized and eventually involving federal oversight in many countries.

In the US, quarantine stations date back to the colonies, where they were used to manage diseases like smallpox and yellow fever.

Continued outbreaks of yellow fever led to the National Quarantine Act of 1878, which shifted quarantine powers from state to federal control. The Public Health Service Act of 1944 clearly established the federal government's quarantine authority for the first time. The act gave the US Public Health Service responsibility for preventing the introduction, transmission, and spread of communicable diseases from foreign countries into the United States. The CDC assumed responsibility for the quarantine system in 1967 and now manages the 20 quarantine stations located at major US ports of entry. This network of quarantine stations serves as a premier line of defense against the importation of infectious disease threats across the nation's borders through travelers arriving by air, land, and sea.

Chatham County

Malaria

Historically, Savannah, GA was a major center for rice production, primarily along the Savannah, Ogeechee, and Altamaha Rivers. Wet rice cultivation, as practiced in Savannah's swampy Lowcountry, created an environment conducive to mosquito development. This led to high mortality rates due to mosquito-borne diseases like malaria and yellow fever, making it difficult to attract white laborers to the rice industry. This is also why enslaved Africans and African Americans, who often possessed knowledge of rice cultivation techniques from West Africa, were heavily relied upon for labor in these fields.

This practice began around 1750 and continued until the early 20th century. The New Georgia Encyclopedia notes that rice was the most important commercial agricultural commodity in the region during this time. While it was focused on the freshwater marshes, it still played a significant role in the entire marsh ecosystem and is an important aspect of marsh history in the Southeast.

As planters experimented with a number of approaches, they quickly realized that taking advantage of the large and predictable tides would result in the most efficient method of rice cultivation. Thousands of acres of marshland and tidal rivers were altered by networks of dikes and canals to create rice fields. Structures, called trunks, were strategically placed along the

dikes and used to control the water level in the fields. The tidal influence in old rice plantation fields was usually cut off by dikes and flow control structures. During the early and mid-1800s, this system of impoundments allowed the rice industry to become the dominant form of agriculture along the South Carolina and Georgia coast. It also allowed the emergence of huge numbers of *Anopheles quadrimaculatus*, the southeast's malaria vector.

In 1817 the City of Savannah, which supported a large rice growing culture, approved an ordinance authorizing the city to buy the right of culture from wet to dry from the surrounding landowners.

From 1817 to 1829 the city had expended $72,537 so that only dry rice field culture would be practiced on the adjacent lands. City records show the health of its citizens was much improved.

This successful reduction in mosquito breeding sites was likely the first time that local tax monies were expended to control mosquitoes in the New World.

With the end of the Civil War and the loss of slave labor, rice production dropped considerably. After 1870, rice production continued at lower rates until the early 1900s when the Southeast suffered from a particularly intense series of hurricanes which damaged many of the dikes and trunks, returning natural tidal flow and ruining the rice fields. This marked the end of the rice industry in the Southeast. However, the change from wet rice culture to dry rice culture, and the loss of free labor with knowledge to produce rice, led to the dike and trunk mechanisms breaking down. The remnants of the flow control structures kept fish out of the areas, leading to a massive emergence of saltwater mosquito species in the tidal area and a continuation of the *Anopheles* problems in the freshwater areas, especially where deforestation had occurred.

Malaria continued to be a threat in Georgia even after rice production had been discontinued. As carriers of malaria, a blood-borne disease that causes fever, lethargy, vomiting, and headaches (and may lead to a range of serious complications), mosquitoes have impacted Georgia since colonial times. According to the New Georgia Encyclopedia, the threat of malaria affected Georgia's settlement patterns. In 1806 the state capital had to be moved from Louisville to Milledgeville in part because of so many malarial outbreaks in Louisville. In the 19th century, malaria killed thousands during the Civil War, and during the twentieth century, the disease threatened America's military readiness. While malaria was effectively eliminated in the United States during the 1950s (cases still occur but are mostly limited to travelers returning to the country), it still poses a global threat.

In the late 19th and early 20th centuries, Savannah, like much of the American South, faced a serious health crisis due to malaria. Mosquito control efforts, including the use of DDT, drainage improvements, and educational campaigns, played a vital role in eventually eradicating the disease in the US.

From Public Health Reports, v36 (14), April 8, 2021, pp 705-706. Mosquito control was conducted in Savannah, GA during the summer of 1920 at the request of the city health officer of Savannah to the US Public Health Service to control malaria. "Approximately $50,000 was expended in and around the city of Savannah during 1920 in malaria-control operations, of which $30,000 was contributed by the city, $7,000 by the Seaboard Air Line Railroad, and

$3,000 by the Central of Georgia Railroad. Convict labor employed by Chatham County was estimated at $10,000. The abandoned rice fields on the east and west sides of the city and on Hutchinson's Island demanded anti-mosquito measures of an unusual character, similar to those employed by the Public Health Service in 1918 at and around Wilmington, NC. Until recently these lowlands were maintained in a state of "dry culture,'' but within the last few years the dikes, tide gates, and ditches have been neglected, and the fields, lying at an elevation of from 2 to 4 -feet below mean high tide, were periodically flooded by the tides. Consequently, they were prolific breeding places of *Anopheles quadrimaculatus* and *An. crucians*. The control work included the repair of existing tide gates, the construction of additional gates, and some repairing of dikes, with a view to shutting out the tides. It also included the cleaning of old drainage ditches and the construction of new ditches for the drainage of ponded areas." "In addition to this marsh work, many highland ponds were filled or drained, surface ditches were drained, catch basins and fire barrels were oiled or treated with larvicides, fish control was employed wherever possible, and regular inspections of potential mosquito breeding places were made at necessary intervals. Altogether an area of 25 square miles was under control, and a population of 100,000 persons was protected." A malaria survey was conducted in Savannah in Dec 1919 by public health nurses to determine the malaria prevalence within the city. Four hundred and forty-seven families were visited and 1,587 persons interviewed. Of these, 384, or 24%, gave a history of having had malaria within the previous four months, and 55, or 3.5%, had active malaria at the time of the survey. A similar survey was completed in Jan 1921. Three thousand one hundred and one families were visited and 10,313 persons questioned. This survey showed 456, or 4.4%, with a history of malaria during the previous four months, and 52, or 0.5%, active cases at the time the survey was made. Prior to the anti-malaria operations, the number of malaria cases were determined for the latter part of 1919. After the operations in 1920, there was approximately five and one-half times less malaria in Savannah during the same time period. It was recommended that the city of Savannah set aside $30,000 for the extension and maintenance of anti-malaria work during 1921, and assurance has been given that the city officials will continue this work with an adequate appropriation, with the US Public Health Service providing advisory supervision to the work. https://www.jstor.org/stable/4575944

Yellow Fever

Savannah faced recurring outbreaks of yellow fever, with significant ones in 1733, 1820, 1854 (1040 deaths), and 1876. The 1820 epidemic resulted in the deaths of approximately 700 people, including local physicians who were caring for the sick. Many victims were buried in unmarked graves in Colonial Park Cemetery. The 1876 epidemic was particularly severe, with the city losing an estimated 6% of its population (1066 deaths). Major Ely McClellan, a surgeon in the US Army, analyzed data from the 1876 epidemics in Savannah, Brunswick, Darien, Augusta, Macon, and Atlanta to determine if yellow fever was caused by a miasma or an infection and how it was spreading. He concluded that (1) yellow fever was most severe in port island cities with outbreaks that were usually located on major roads or rail lines, (2) refugees carried the disease inland, and (3) yellow fever was carried on ships with the largest outbreaks associated with ships from Cuba. Because of these observations, a quarantine station was established on Blackbeard Island, to try and limit the spread of the disease.

Yellow fever is a viral disease spread by infected mosquitoes, primarily *Aedes aegypti*. It is not transmitted directly from person to person. A specific experiment in Savannah involving the release of uninfected mosquitoes to study their behavior also highlights the city's role in early mosquito control research. Operation Big Buzz was a US military entomological warfare field test conducted in 1955 in Savannah, Georgia's predominantly Black Carver Village neighborhood, mosquitoes that many believe were infected with disease. The tests involved dispersing over 300,000 mosquitoes from aircraft and through ground dispersal methods.

"Swarms of mosquitoes, the type notorious for transmitting yellow fever, were released in Georgia and Florida in the 1950s by the Army to see if the insects could be used as biological warfare weapons, documents show," the Oct. 29, 1980, article states. "However, none of the mosquitoes, specially bred by the Army Chemical Corps, was infected when released in Savannah, GA, in 1956 and at Avon Park, FL, in 1956 and 1958, according to declassified documents made available Tuesday."

The declassified military document is available online at http://bit.ly/operationbigbuzz. On each page, a header of "Secret" is crossed out and instead stamped "Unclassified."

"The Chemical Corps tested the practicality of employing *Aedes aegypti* mosquitoes to carry a (biological warfare) agent in several ways. Operation Drop Kick occurred in April - November 1956 when the Corps ran trials in Savannah, Georgia, by releasing uninfected female mosquitoes in a residential area, and then, with co-operation of people in the neighborhood, estimating how many mosquitoes entered houses and bit people," reads the document dated January 1960 and titled "Summary of Major Events and Problems, United States Army Chemical Corps."

Additional Research Studies

- In 1954, 2 million radioactive *Aedes taeniorhynchus* were released, with maximum recovery of the marked mosquitoes 20 miles away.
- Operation May Day involved a series of entomological warfare tests from April to November 1956. The tests were designed to reveal information about the dispersal of yellow fever mosquitoes in an urban area. The mosquitoes were released from ground level in Savannah, Georgia, and then recovered using traps baited with dry ice. The operation was detailed in a partially declassified U.S. Army report in 1981.

Quarantine Stations

Quarantine stations were health and safety checkpoints for all trade, not just mosquito-borne illness. The Tybee Island quarantine station was established on August 8, 1750. The Fort Greene station was located on Cockspur Island before Fort Pulaski was built and destroyed by a hurricane in 1804. The Cockspur Island station was established in 1891 by the City of Savannah; it was closed in 1937. There was also the Oyster Island station, the Fort Jackson station (either in GA or SC), Sapelo station, and the Lazaretto Creek station where ships permanently anchored when quarantined.

Health Department

The Chatham County Health Department, originally known as the Savannah Health Center, has a history rooted in the late 19th century and early 20th century, with significant developments in the mid-20th century. Initially, the Board of Health handled public health duties, which were later assumed by the Board of Sanitary Commissioners. In 1943, the *Aedes aegypti* control unit was formed. The Savannah Health Center was established in 1920, and through a collaborative effort with the County Commission, it eventually merged with the Health Department to form the Chatham-Savannah Health Center in 1944.

Mosquito Control

The Chatham County Mosquito Control program was voted into existence in 1956. Prior to 1956, mosquito control efforts in Chatham County were limited. A Savannah Morning News article reported that some residents even resorted to using kerosene-soaked rags to ward off mosquitoes. In 1957, Chatham County officially organized its mosquito control efforts, adopting the Integrated Mosquito Management (IMM) approach. This method emphasizes a combination of strategies rather than relying solely on one method like pesticides.

Glynn County

Yellow Fever

In Brunswick, GA, reports sent to the Public Health Service from the local quarantine station indicated local mosquito control measures had been successful in reducing mosquito numbers. Active measures had been taken to reduce mosquito development during the winter and spring months. "Up to the end of July no *Stegomyia* (*Aedes aegypti*) were observed. If *Stegomyia* were breeding, they were passive. During July there was practically an absence of mosquitoes in Brunswick and the neighboring vicinities. This situation was unquestionably due to the active measures taken by the civic and county authorities to suppress mosquito breeding. The only mosquitoes observed during the month of July were the *Culex* and *Anopheles,* which appeared during the week of July 28. This invasion was mild, and measures were immediately taken to suppress further invasion and to keep the city free from malaria." This work was done under the direction of the sanitary department of Brunswick and the local Board of Health. "Sanitary inspectors are employed to see that all property owners and tenants keep their property free from standing water exposed in such way as to provide a breeding place for mosquitoes. Penalties are also provided for persons who are negligent in observing the sanitary ordinances." In 1923, "(a)t the end of July the status of the public health in Brunswick and, in fact, throughout Glynn County, was remarkably good. There were but few cases of malaria, still fewer cases of typhoid, no dengue, and no diseases of a quarantinable kind." https://www.jstor.org/stable/4576849

Baker County

The Emory University Field Station for Malaria Research was established in 1939 near Newton, GA. Today, the site where the Emory University Field Station once stood at Ichauway is now

the location of the Joseph W. Jones Ecological Research Center, continuing a tradition of focusing on environment and ecology. Digital Collections - National Library of Medicine and https://southernspaces.org/2014/managing-malaria-emory-university-field-station-and-melvin-h-goodwin-papers/ .

Lee County

The Rockefeller Foundation Malaria Lab was established in Leesburg, GA. It was open from 1923-1925 to study malaria in the Southern US and provided training for experts and health officers in malaria control techniques. Samuel Taylor Darling, a prominent malariologist, was sent by the Rockefeller Foundation to establish and direct the station.

Leesburg became a significant location for malaria research and education during this period, with many visiting to learn from Darling. The Leesburg station was one of several field stations established by the Rockefeller Foundation across the globe to combat malaria in the 1920s and 1930s. This was part of a larger campaign to address malaria, which included experimenting with control methods like quinine, screening, and mosquito breeding ground control.

Richmond County

The year 1850 was remarkable for the widespread prevalence of dengue in epidemic form, in various localities, pertaining principally to the south and southwest. Its occurrence in Augusta was preceded, as it was in other places, the same year by a protracted period of unusual heat and drought. Cases were recognized as early as the twenty-second of August, but not until about the 10th of September did the epidemic become fully manifested in its unique and indubitable individuality. From this period until late in the autumn, the disease prevailed throughout the city with the most distressing severity. The number of cases in Augusta alone was estimated between eight and nine thousand, the majority of which did not receive the attention of a physician. Of this vast number, not a death was reported from the epidemic uncomplicated.

Atlanta

The South, like the rest of the country, was forever altered by the dramatic events of the Civil War (1861-65). Few states, however, were more central to the outcome of the conflict than Georgia, which provided an estimated 120,000 soldiers for the Confederacy. In addition, several hundred white and 3,500 Black Georgians enlisted for the Union cause.

Malaria significantly impacted both civilian and military populations during the Civil War. At Vicksburg, the disease-ravaged Union navy and army failed in its first attempt to capture the strategically important Southern city on the Mississippi River. One soldier observed that the gallinippers—slang for mosquitoes—were so thick about the camp that they “filled the air like rain drops.” Mosquito nets, called bars, were not yet widely available, and soldiers exploded gunpowder cartridges in their tents to keep the pests away, unaware that they were the source of much of the illness gripping the encampments. (It would be another 20 years before doctors began to suspect mosquitoes were to blame for malaria and yellow fever.) Almost three-quarters of the besieging Union troops were dead or too sick to work. Vicksburg’s defenders

were no better off, described by a Union army commander as “haggard & care worn.” One of the defending officers wrote, “The command suffers greatly from intermittent fever, and is generally debilitated from the long exposure and inaction of the trenches.” https://www.sciencehistory.org/stories/magazine/the-popular-dose-with-doctors-quinine-and-the-american-civil-war/

The Atlanta Campaign in 1864 was a crucial military operation, with Sherman aiming to capture Atlanta and cut Confederate supply lines. Specific figures for malaria cases during the Atlanta Campaign are difficult to determine from available search results. However, malaria was a widespread illness that affected troop strength and operational effectiveness throughout the war:

Union Army: Over 1.3 million cases and 10,000 deaths from malaria were reported in the Union Army. About one-quarter of all reported illnesses were malarial.

Confederate Army: Confederate soldiers also suffered from malaria, though deaths from the disease were comparatively lower. During 1861 and 1862, one-seventh of all sickness reported by Rebel armies east of the Mississippi River was malaria (https://ucanr.edu/blog/bug-squad/article/mosquitoes-malaria-and-civil-war).

During the Atlanta Campaign, malaria caused high morbidity but relatively low mortality. Mortality was higher for Confederate troops as quinine was unavailable due to the blockade. Confederate Surgeon General Samuel P. Moore, the man in charge of creating an entire medical infrastructure for the South, needed large quantities of quinine to relieve Southern soldiers of fevers (https://www.sciencehistory.org/stories/magazine/the-popular-dose-with-doctors-quinine-and-the-american-civil-war/). Local alternatives, such as dogwood, Georgia bark (*Pinckneya pubens*), and willow were used; however, they were not as effective.

MALARIA AND THE CDC

Today, the Centers for Disease Control and Prevention (CDC) is one of the major operating components of the Department of Health and Human Services and is recognized as the nation’s premiere health promotion, prevention, and preparedness agency. It had its start in Atlanta, GA as part of the malaria control initiative in the Southeast.

In 1942, the US government established a research center in Atlanta as part of the US Public Health Service. Called the Malaria Control in War Areas program, or MCWA, its location was no accident, given Georgia’s strategic role in infantry training as well as the growing prominence of the Ichauway field station in the Public Health Service.

The Office of Malaria Control in War Areas (MCWA), the WWII organization that was to become the forerunner of the present Centers for Disease Control and Prevention, was established by the Public Health Service. As the country mobilized for World War II, the United States grew concerned about preventing the spread of malaria in its military training camps, many of which were in the country’s southern states, where malaria was rampant. This organization was given the task of malaria control and prevention in areas around military bases and industrial areas

concerned with production related to the war (https://www.history.com/articles/malaria-cdc-world-war-ii).

The United States Public Health Service (USPHS) is a collection of agencies of the Department of Health and Human Services that manages public health. The US Public Health Service and the CDC are closely related, with the CDC being one of the key agencies within the USPHS. The Public Health Service Commissioned Corps (PHSCC) is the federal uniformed service of the USPHS and is one of the eight uniformed services of the United States focused on public health, while the CDC is the nation's leading public health agency, working to protect the population from health threats.

The United States Public Health Service had its origins in the system of marine hospitals that originated in 1798. In 1871, these were consolidated into the Marine Hospital Service, and shortly afterwards the position of Surgeon General and the PHSCC were established. As the system's scope grew to include quarantine authority and research, it was renamed the Public Health Service in 1912.

Oatland Island Wildlife Center was home to USPHS Malaria Control in War Areas (MCWA) division starting in late 1944. When the USPHS restructured and became the CDC, the Oatland Island facility became the Technical Development Laboratories. Dichlorvos (DDVP) was developed here in 1955. The site was closed in 1973 and moved to Atlanta.

On July 1, 1946, the Communicable Disease Center (CDC) opened its doors and occupied one floor of a small building in Atlanta. Its primary mission was simple yet highly challenging: prevent malaria from spreading across the nation. Armed with a budget of only $10 million and fewer than 400 employees, the agency's early challenges included obtaining enough trucks, sprayers, and shovels necessary to wage war on mosquitoes.

As the organization took root deep in the South, once known as the heart of the malaria zone, CDC Founder Dr. Joseph Mountin continued to advocate for public health issues and to push for CDC to extend its responsibilities to other communicable diseases. He was a visionary public health leader with high hopes for this small and, at that time, relatively insignificant branch of the Public Health Service. In 1947, CDC made a token payment of $10 to Emory University for 15 acres of land on Clifton Road in Atlanta that now serves as CDC headquarters. The new institution expanded its focus to include all communicable diseases and to provide practical help to state health departments when requested.

Although medical epidemiologists were scarce in those early years, disease surveillance became the cornerstone of CDC's mission of service to the states and over time changed the practice of public health. There have been many significant accomplishments since CDC's humble beginnings. The following highlights some of CDC's important achievements for improving public health worldwide (https://www.cdc.gov/museum/history/our-story.html).

MOSQUITO CONTROL PROGRAMS IN GEORGIA

(http://www.gamosquito.org/resources/GA_Mosquito_Control_Programs2017_update.pdf)

During the 1930s and 40s in the southeastern United States, state boards of health employed entomologists to combat malaria, a significant public health problem at the time. Malaria cases saw a rise during the Great Depression before decreasing in the early 1940s. Mosquito control districts, where present, could be directly under the supervision of the state public health department or there could be a cooperative agreement (Eads et al, 1951). Historically, Environmental Health (EH) programs within Public Health had been tasked with dealing with mosquito complaints. Many of these programs were lost as other, mandated, programs took precedence. Before the arrival of WNV, only 2 County EH programs still did mosquito control at some level.

Mosquito control programs come in many shapes and sizes in Georgia, and it is difficult to find any information about their development and history in most cases. Most organized mosquito control in Georgia is conducted through the city or county department of Public Works. In recent years, commercial pest control operators have added residential mosquito control as an available service. As part of this process, the Department of Agriculture is the lead pesticide agency in the state and is responsible for certifying the commercial pest control operators. A weakness of this system is that governmental mosquito control personnel are not required to be certified or licensed.

Public Health/Environmental Health

Richmond County

Mosquito Control in Richmond County started in the early 1970s. The services were initially without a dedicated budget and relied on funding from the Health Department. However, this changed in the mid-1980s, when public outcry and numerous citizen complaints forced the County Commission to establish a dedicated funding mechanism. This funding structure remained largely unchanged until the mid-1990s. A period of increasing funding began in 2005, continuing annually until FY 2011-2012, when funding levels decreased. Currently, mosquito control services receive funding from County Environmental Services. The program continues to this day, although funding usually varies from year to year.

Muscogee County

In 1955, the State Public Health Division of Insect and Rodent Control conducted an intensified study of the winter breeding activities of *Culex quinquefasciatus* in Columbus, Georgia, with the assistance of the Muscogee County Health Department (Public Health Report, 1955).

The Vector Control Program in Columbus, GA began in 1965 when the county received federal funding through a grant from the CDC. Mosquito-borne diseases were still a public health concern in 1965. In 1965, there were 8 reported cases of EEE, a mosquito-borne disease, in the United States, including 2 cases in Georgia. The presence of the yellow fever mosquito, *Aedes aegypti*, was noted in Georgia, including Columbus, around this time. Additionally, the CDC, established in Atlanta in 1946, demonstrated the effectiveness of combined federal, state, and local efforts in mosquito control. This likely influenced the availability of federal funds for such programs.

Currently, vector control in Columbus, GA is housed withing Environmental Health within the Muscogee County Health Department. The vector control staff investigates rat, roach, mosquito, and other pest complaints. During the warmer months, ditches and potholes are larvicided to assist with mosquito control. In cooler months, the sanitary sewers and city Right-of-Ways are baited for Rat Control. The Vector Control staff also assists with solid waste reduction and the elimination of pest breeding sites.

Metro Atlanta

The health department EH? programs in the metro Atlanta area began seasonal vector surveillance and control when WNV was introduced into Georgia in 2001. Some of these programs are operated using seasonal interns. Other programs contract for vector surveillance and control. Most of these programs did not persist once funding for WNV was reduced. Currently, DeKalb and Cobb counties hire seasonal workers to do surveillance and larviciding. Fulton County hires mosquito control contractors to do surveillance, larviciding, and targeted adulticiding.

Other Programs

When funding and interested personnel are available, several EH programs assist with mosquito surveillance, helping to provide data for summaries created by the State entomologists. One of the programs was also able to test the mosquitoes they collected for viruses. These collaborations help provide data not otherwise attainable by the State vector surveillance program.

Independent Programs

Chatham County

Since 1957, Chatham County Mosquito Control (CCMC) has worked to reduce mosquito populations across the entirety of Chatham County. CCMC has a staff of twenty-nine and is an independent county department, reporting directly to the County Manager. CCMC uses an Integrated Mosquito Control approach to control mosquitoes and is considered a regional and national leader in the mosquito control profession.

Liberty County

Liberty County is an independent mosquito control program within the county government that uses Integrated Mosquito Management (IMM) techniques to help reduce both nuisance and vector mosquito species.

Public Works

Counties in the state of Georgia appropriate considerable funds for public works projects.

Each of these public works' programs fulfills a community need by promoting health, protecting life and property, aiding economic development, and protecting the environment. This list is not considered to be all-inclusive but instead represents a significant number of

responsibilities typically observed in the public works setting in counties throughout the state of Georgia, including the following:

- Project oversight and delivery
- Road construction and maintenance
- Transportation and traffic engineering
- Road lighting
- Transit
- Airports
- Transportation and environmental regulation
- Water
- Environmental protection
- Sanitary sewer
- Sanitation/solid waste
- Cable TV
- Building codes
- Vehicle/equipment purchase and maintenance (https://www.accg.org/docs/handbook/Public%20Works%20and%20Public%20Utilities.pdf)

These responsibilities are under the oversight of the county officials, who also determine if mosquito control becomes a public works responsibility.

If it exists, mosquito control is just a program under the Department of Public Works. The Department of Agriculture does not require municipal applicators to be licensed. This means that training and ability vary widely amongst Public Works mosquito control programs, ranging from scheduled spray events to an actual integrated mosquito control program.

GEORGIA DEPARTMENT OF PUBLIC HEALTH

Georgia's public health history began when the first contingent of 114 brave souls signed an agreement with the Trustees of the Colony of Georgia to come to the new country at their expense. The success of the undertaking necessarily depended upon the health condition and survival of the pioneer colonists.

For an understanding of health conditions in Colonial Georgia that first year, a review of the situation in neighboring colonies, gives pertinent data. Malaria had made its appearance in the records of the Jamestown Settlement as early as 1607. Smallpox was recorded in the South Carolina Gazette of January 1733, as existing in Charleston and the Georgia colonists first landed there. Yellow fever was also present in Charleston at the same time. The colonists had come from a mosquito-free environment to a section that had all the elements conducive to the spread of malaria, typhoid fever, diarrhea, dysentery, and yellow fever.

The first evidence of malaria in Colonial Georgia was in the unhealthfulness of the Old Ebenezer settlement, which had to be abandoned as a consequence. There was malaria in the swamp lands, and the upland settlements did not entirely escape.

Malaria first made its appearance in the interior of the State around Milledgeville in 1807. The Indians had just vacated the territory and the white men cut down the forests and opened up the soil. Dr. TomIinson Fort who went there to practice medicine, says: "Bilious fever appeared as suddenly as the face of nature was changed by the hand of man. For 18 years it was a formidable epidemic. No tables of mortality were kept but I cannot be mistaken in placing the deaths from bilious fever alone as five per cent of the whole population in each year from 1808 to 1813. This mortality happening in a few months each year gave the disease the terror of pestilence."

The importation of slaves was granted the Georgia colonists in 1749. The first slaves were in Jamestown, Virginia, in 1519. The results of bringing the Negro to the colony were far-reaching. The act permitting slavery provided the regulation: "Owing to the number of infected ships bringing the Negroes or Blacks with contagious Distempers (particularly the Yellow Fever), be it further enacted that a Lazaretto be forthwith built within such Province under direction and inspection of the President and Magistrates thereof on the west side of Tybee Island in the said River Savannah for the use and convenience of the said colony where the whole crews of such infected ships and the Negroes brought therein may be conveniently lodged and assisted with medicines and accommodated with refreshments for their more speedy recovery (Abercrombie, 1952).

The General Assembly created the State Board of Health in 1875 but only funded it for two years. After that, it ceased to operate until 1903, when the legislature recreated the State Board of Health. During the 1931 executive reorganization, the legislature abolished the board and reassigned its powers to the new Department of Public Health (GDPH). Two years later, the General Assembly recreated the board as the department's new governing body.

The department's duties were expanded through various federal grant programs and state laws. The department continued until the 1972 executive reorganization, when it was abolished and its duties given to the new Department of Human Resources. The department created a Division of Public Health, which handled public health matters.

This lasted until 2011, when the General Assembly recreated an independent Department of Public Health, transferring most public health powers to the new agency. The Georgia Department of Public Health (DPH) is the state's lead agency for preventing disease, promoting health, and preparing for emergencies. It has a long history, evolving from early colonial efforts to the modern agency it is today. In 2011, DPH was re-established as a separate state agency after being consolidated with other departments for over 30 years. At the state level, DPH functions through numerous divisions, sections, programs, and offices. Locally, DPH funds and collaborates with Georgia's 159 county health departments and 18 public health districts.

Steps were taken early in 1954 to perform necessary public health duties in insect and rodent control through a cooperative plan with other divisions in the department. This Division of Insect and Rodent Control was developed under the Environmental Health Services, with insect and rodent control activities performed by the Divisions of Epidemiology and Public Health Engineering. The Division of Epidemiology having biologic and entomologic personnel implemented the insect and rodent control activities. The Division of Public Health Engineering

was responsible for mosquito control activities on water impoundments (Public Health Report, 1954).

Orlin K. Fletcher, Jr. (1908-1975) from Augusta, Georgia was a medical entomologist with a biology degree from the University of Georgia. He served in a variety of public health roles in the state of Georgia and was president of the Georgia Entomological Society. He has at least two publications of public health importance:

- Studies on Fly Breeding in Sanitary Pit Privies in South Georgia, Orlin K. Fletcher Jr., James Major, and Robert Cable, Volume/Issue: Volume 5: Issue 3, DOI: https://doi.org/10.4269/ajtmh.1956.5.562, Publication Date: 01 May 1956
- Mass Destruction of Adult Anophelines by DDT as a Suggested Malaria Control Measure: A Preliminary Report, Orlin K. Fletcher, Jr. and James B. Krause, II, Volume/Issue: Volume s1-28: Issue 2, DOI: https://doi.org/10.4269/ajtmh.1948.s1-28.323, Publication Date: 01 Mar 1948

After Orin Fletcher, Jr left the Department of Public Health (date unknown), nothing is written about an entomological presence at the State Health Department until the start of the WNV epidemic in the US in 1999. At that time, health departments all over the country began to hire medical entomologists to help deal with this issue. In 2002, the GDPH hired Rosmarie Kelly, PhD MPH, a medical entomologist who studied under Dr John Edman at UMASS, to provide mosquito surveillance in order to better understand WNV in Georgia. In 2017, when additional new and emerging arboviruses (Chikungunya and Zika viruses) became a potential issue for the US, a second medical entomologist, "Tiffany" Thuy-Vi Thi Nguyen, PhD MPH who studied under Dr Brian Forschler at UGA, was hired to assist with the response. Currently, the GDPH has 2 medical entomologists who organize and conduct a wide range of mosquito and tick related programs and services in Georgia. Funding for the vector surveillance program is provided through the Federal Epidemiology and Laboratory Capacity Grant. This funding is distributed on the behalf of the CDC. Some funding also comes from the Preventive Health and Health Services (PHHS) Block Grant, which is used by health departments to support critical programs and services when other resources are unavailable or inadequate.

Both entomologists also serve on the Georgia Mosquito Control Association Board and on the Mid-Atlantic Mosquito Control Association's (MAMCA) Board and are respected leaders in the profession.

GEORGIA MOSQUITO CONTROL ASSOCIATION

In 1975, in Hilton Head Island, SC at the William Hilton Inn, the Virginia, North Carolina, and South Carolina Mosquito Control Associations held a joint meeting to explore the possibility of creating a regional association. Some of the Georgia mosquito control people were also invited to attend and they created the Georgia Mosquito Control Association in a hallway at the meeting facility. All four associations concurred, and the Mid-Atlantic Mosquito Control Association came into being. Rowland "Rollie" Dorer from Virginia was elected the first President and L.A. Williams of South Carolina was elected Vice President. The Georgia

delegation invited the MAMCA to hold their 1976 meeting in Savannah, Georgia. (http://www.MAMCA.org)

The Georgia Mosquito Control Association is a non-profit, professional organization whose membership consists of local and state government officials, commercial applicators, industry, and research/academic members from the state. The Association was founded on the belief that mosquito and other public health pest control problems have a significant impact on the citizens of Georgia. There was a need for interested persons within the state to form an association for these purposes:

- To exchange ideas and procedures to enable mosquito workers to better perform their duties.
- To protect the health and welfare of the people and their environment.
- To keep abreast of the latest and best methods for control of mosquitoes and other pests so the citizens will be served.
- To encourage proper mosquito control, wherever feasible, and to help maintain a positive public interest in areas where mosquito and other public health pest control is operative.
- To keep the general public better informed of the benefits of mosquito and other public health pest control.

The Association hosts an annual educational and trade conference for its members. These conferences help promote inter-governmental cooperation and serve as a forum for the advancement of responsible mosquito and vector control (http://www.GAmosquito.org). A spring workshop was held for the first time in 2025 and was actively supported by the profession. This workshop expanded the impact of the GMCA and will continue in some manner moving forward.

FUTURE DIRECTIONS

As it was in the very beginning, funding continues to be a challenge for the public health profession and mosquito control in Georgia and elsewhere. In 2011, the funding mechanism (Epidemiology and Laboratory Capacity Grant) for vector-borne disease surveillance in Georgia was drastically cut. At that time, the GDPH VBD program lost support for most mosquito and arboviral surveillance and testing. Despite this setback, the program has 10 years of historic data (mosquito data in 98 of 159 Georgia counties, equine cases from 109 counties, WNV dead bird data from 151 counties and human case data from 66 counties) to rely on for decision-making and outreach. The program also has built a strong network of collaborators who continued to share data. While the future of vector-borne disease surveillance is far from ensured, we do have enough existing and historic data to help make informed decisions to help reduce the risk of arboviral disease transmission.

Although DPH is again facing a funding crisis, the program has more resources now, and more collaborations. The vector-borne disease (VBD) surveillance program's scope has been increased by adding tick surveillance to the mosquito surveillance. Yearly arboviral, mosquito surveillance, and tick surveillance data reports (https://dph.georgia.gov/environmental-

health/insects-and-diseases) are shared with public health, collaborators, mosquito control, federal programs like the CDC and APHIS, other State agencies (GaDNR, GDA, and others), and vector surveillance agencies in adjacent counties. These reports provide a wealth of information to associated programs like the Cooperative Extension Service local community governments and are widely shared and depended upon. So, while challenged, the VBD surveillance program continues to participate in the training of future public health entomologists and environmental health specialists. The future is far from ensured, but the VBD surveillance program has created a network of shared data that will hopefully continue to persist.

REFERENCES

- Sapelo Quarantine Station - Address by J.G. Thomas, M.D., Savannah, Georgia, in defense of the National Board of Health, against attacks in Congress, and on the importance of Sapelo quarantine station as a place of refuge for dangerous and infected vessels for the South-Atlantic states : read before the Savannah Citizens' Sanitary Association in September, 1882, and before the Georgia Historical Society in December, 1882 : Thomas, J.G : Free Download, Borrow, and Streaming : Internet Archive (https://archive.org/details/b22303984/mode/2up)
- Malaria control in war areas: field bulletin - Digital Collections - National Library of Medicine (http://resource.nlm.nih.gov/22030170R)
- Justin M. Andrews, Sc. D., and Jean S. Grant, MILITARY MOBILIZATION IN POTENTIALLY MALARIOUS AREAS OF THE UNITED STATES. History | AMEDD Center of History & Heritage (https://dlg.usg.edu/record/dlg_ggpd_s-ga-bh700-b-pm1-b1953-bp8)
- Sullivan, Buddy. 2008. Ecology as History in the Sapelo Island National Estuarine Research Reserve, Occasional Papers of the Sapelo Island NERR, 1:1-28. (https://www.sapelonerr.org/wp-content/uploads/2012/09/Ecology-as-History-in-the-SINERR-7-2-09.pdf)
- Sullivan, Buddy (editor). 1997. The Darien Journal of John Girardeau Legare, Ricegrower. Published by University of Georgia Press. 172 pp. (https://www.ugapress.org/9780820343105/the-darien-journal-of-john-girardeau-legare-ricegrower/)
- Ophelia Troup Dent, Memoirs, unpublished manuscript, copy on file at Hofwyl-Broadfield Plantation State Historic Site, Brunswick, GA (from Sullivan, Buddy 2008).
- Georgia Mosquito Control Association. http://www.GAmosquito.org
- Fort King George: Journal of Col. John Barnwell (Tuscarora) in the Construction of the Fort on the Altamaha in 1721. Joseph W. Barnwell, *The South Carolina Historical and Genealogical Magazine*, Vol. 27, No. 4 (Oct 1926), pp. 189-203 (https://www.jstor.org/stable/27569705)
- Coclanis, Peter. "Rice." New Georgia Encyclopedia, last modified Sep 29, 2020. (https://www.georgiaencyclopedia.org/articles/business-economy/rice/)
- Malaria Control at Savannah, GA. Source: Public Health Reports (1896-1970), Vol. 36, No. 14 (Apr. 8, 1921), pp. 705-706, Published by: Sage Publications, Inc.

  (https://www.jstor.org/stable/4575944)
- Summary of Major Events and Problems, Fiscal Year 1959. United States Army Chemical Corps. Jan 1960. 181 pp. (https://www.osti.gov/opennet/servlets/purl/16006843-5BAfk6/16006843.pdf)

- Mosquito Control in Brunswick, GA. Public Health Reports (1896-1970), Vol. 38, No. 34 (Aug. 24, 1923), pp. 1965-1966. (https://www.jstor.org/stable/4576849)
- Managing Malaria: The Emory University Field Station and The Melvin H. Goodwin Papers. Sean T. Suarez. EMORY UNIVERSITY BLOG POST, PUBLISHED APRIL 8, 2014. (HTTPS://SOUTHERNSPACES.ORG/2014/MANAGING-MALARIA-EMORY-UNIVERSITY-FIELD-STATION-AND-MELVIN-H-GOODWIN-PAPERS/)
- Robert D. Hicks. 2013. The Popular Dose with Doctors: Quinine and the American Civil War. (https://www.sciencehistory.org/stories/magazine/the-popular-dose-with-doctors-quinine-and-the-american-civil-war/)
- University of California, Agriculture and Natural Resources, Bug Squad. 2024. Mosquitoes, Malaria, and the Civil War. (https://ucanr.edu/blog/bug-squad/article/mosquitoes-malaria-and-civil-war)
- CDC History. Last Reviewed: April 19, 2023. https://www.cdc.gov/museum/history/our-story.html
- Andrews, Justin M. Development of the Communicable Disease Center. CDC Bulletin. 1946. 35 pp.
- Abercrombie, TF. History of Public Health in Georgia, 1733-1950. 1950/1959. Digital Library of Georgia. 228 pp. (https://dlg.usg.edu/record/dlg_ggpd_s-ga-bh700-b-pm1-b1953-bp8)
- Little, Becky. How a Malaria Scare at the Start of World War II Gave Rise to the CDC. History. Published: August 31, 2022, Last Updated: May 27, 2025 (https://www.history.com/articles/malaria-cdc-world-war-ii)
- Eads, Richard B and JV Irons. Current Status of Public Health Entomology at the State Level. American Journal of Public Health, 41: 1082-1086.
- Abercrombie, TF. 1952. History of Public Health in Georgia, 1733-1950. Georgia Department of Public Health. 227 pp.
- Annual Report. Georgia Department of Public Health to the Georgia State Board of Health. 1954.
- Annual Report. Georgia Department of Public Health to the Georgia State Board of Health. 1955.