2022 Mosquito Surveillance and Control Report

Acknowledgments

The following departments and agencies participated in mosquito surveillance and control activities.

- Nassau County Department of Public Works (NCDPW) Commissioner Kenneth G. Arnold, Anthony Falco and field staff provide services and equipment for mosquito control, complaint response, monitoring of storm water basins, freshwater wetlands, waterways and salt marsh, and water management maintenance.

Nassau County Department of Health has three divisions involved with the mosquito program headed by the Commissioner of Health, Dr. Irina Gelman. They are the Division of Environmental Health, Division Communicable of Disease Control, and the Division of Public Health Laboratories.

- Nassau County Department of Health (NCDOH), Division of Environmental Health, provides equipment and personnel for mosquito surveillance, mosquito trapping and data compilation.

- Nassau County Department of Health, Division of Communicable Disease Control, works with health care providers to assure suspect West Nile Virus (WNV) cases are reported, and appropriate diagnostic tests are done.

- Nassau County Department of Health, Division of Public Health Laboratories, identifies (speciates) mosquitoes captured in gravid, BG Sentinel and CDC light traps, stores "pools" of mosquito specimens, and packages/mails them to the NYSDOH Wadsworth Laboratory for viral testing.

New York State Department of Health (NYSDOH) tests mosquitoes for arboviruses by screening for arboviral agents using polymerase chain reaction protocols. Pools from Nassau County are tested for Eastern Equine Encephalitis (EEE), West Nile Encephalitis (WNV), as well as other mosquito-borne diseases.

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Background

Mosquito Control began in Nassau County in 1915 in response to mosquito-borne malaria outbreaks. Kerosene or #2 oil was used to coat bodies of water suspected of breeding mosquitoes, suffocating the mosquito larvae, thereby reducing the overall mosquito population. This practice was continued until 1920, at which time the malaria threat was brought under control.

In 1929, the first Mosquito Commission was formed in Nassau County. The Commission was comprised of village mayors and officials, businessmen, and other residents from the community. They introduced the concept of ditching to provide effective drainage of the salt marshes, consequently removing many of the conditions conducive to breeding mosquitoes. Ditches were dug by hand, and, in some cases, dynamite was used to quickly remove soil, vegetation and sand.

In 1948, the Nassau County Mosquito Commission was placed under the direction of the Department of Public Works (NCDPW). Under new consolidated direction, improvements were made to the antiquated mosquito control techniques. Mechanization of ditching procedures, the use of spray trucks, and introduction of new mosquito control products helped to control the mosquito population. By 1970, a surveillance program to assess mosquito populations was initiated by placing mosquito traps at 8 sites across the County, and modern mosquito control began.

Figure 1 - Back in the 1950's and 60's mosquito control relied on spraying oils on standing water.

In 1996, NCDOH and NCDPW were directed to work together to establish a new mosquito control program. Both departments transferred personnel into the program, and equipment was purchased for ditch rehabilitation, surveillance activities, control tactics, etc. With the addition of the Health

Department to the Mosquito Surveillance and Control Program, the Board of Health implemented a new pest control concept called Integrated Pest Management (IPM), which had recently been initiated in County-owned buildings. IPM is a system which seeks to control pests, including mosquitoes, by non-chemical means whenever possible, incorporating all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological, or chemical control methods to reduce pest populations to acceptable levels. Pesticides would only be used if other methods of control failed, and the risk of disease or nuisance outweighed the potential risk of controlling the mosquito. If that occurred, then the least toxic mosquito control product to humans, non-target organisms, and the environment would be used.

In 1999, with the outbreak of WNV, Nassau County expanded its Mosquito Control Program using IPM principles. This resulted in the addition, increase, or expansion of the number and types of mosquito traps deployed, mosquito surveillance activities, mosquito identification, submittal to the New York State Laboratory for virus testing, weekly mosquito update reports, interaction with media, and mosquito complaint response.

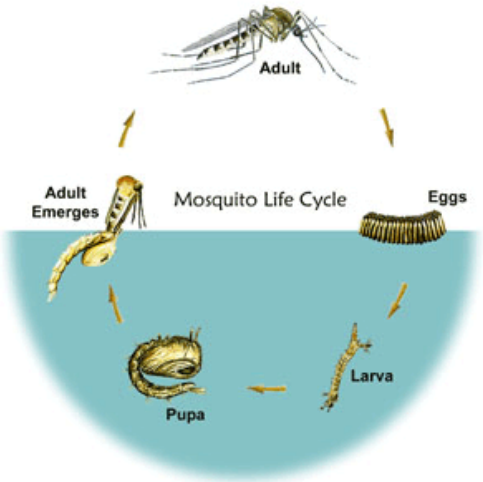
In 2006, responsibilities within the mosquito control program were divided into Mosquito Surveillance under the direction of the Nassau County Department of Health and Mosquito Control conducted by Nassau County Department of Public Works. The NCDOH assumed responsibility for mosquito trapping, surveillance and public information and education. NCDPW assumed all larvicide and pesticide applications, dipping for mosquito larvae and complaint response.

In 2022, Nassau County had its first and only positive pool of Jamestown Canyon virus in Bayville. It is a common mosquito borne illness in the United States. When transmitted to humans, it causes fever, headache, and fatigue. Jamestown Canyon virus can cause more severe disease including encephalitis. This year also provided our first introduction to Flanders virus. This disease is not found in humans and is only transmitted by mosquitoes to birds. It has been shown to be a precursor to West Nile virus.

Mosquito Habitat

Mosquitoes have four distinct life stages: the egg, larvae, pupae and adult. The larvae, also known as "wrigglers" and the pupae, sometimes called "tumblers," are found in water. Although the larvae live and get their food in the water, they must come to the surface for air or obtain air from the underwater portions of aquatic plants.

Figure 2 – Mosquito Life Cycle



Mosquitoes have adapted to most kinds of aquatic habitats except running water and the open water of lakes, seas, and oceans. Different species of mosquitoes prefer certain types of aquatic habitat and can be categorized based on this preference. The five types of habitats are: permanent pools, transient water, floodwater, artificial containers and tree holes. Mosquitoes preferring permanent pools are generally found in fresh bodies of quiet water. Typical habitats are shallow marginal ponds, lakes, and smaller impoundments, the main characteristic being a degree of permanency. Transient water types are generally associated with waters found in street storm drains, roadside ditches, clogged streams and puddles. Floodwater species of mosquitoes prefer areas that are intermittently inundated with water. Tidal marshes on the County's north and south shores provide extensive areas of floodwater habitat. The final category is composed of mosquitoes that favor artificial containers and tree holes. This type of habitat is extremely common in all residential areas of the County. Swimming pools, bird baths, rain gutters, old tires, pails, cans, children's toys, or any object that can collect and hold water may serve as a breeding site.

Table 1- Description of Larval Habitat by Species Trapped in 2022

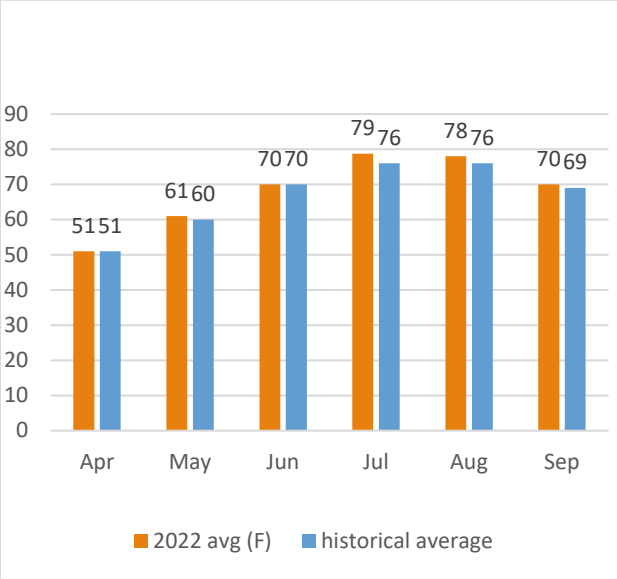
Larval Habitat by Species Trapped – 2022			
Species	Larval Habitat	Total	Percentage
Culex pipiens/ restuans	AC, T, CB	41,514	78.88%
Ochlerotatus sollicitans	SM	6,467	12.28%
Aedes albopictus	AC, CW, FBW	1,421	2.70%
Ochlerotatus cantator	SM	689	1.31%
Coquillettidia perturbans	FM	592	1.12%
Aedes vexans	WP, FW	495	0.94%
Culiseta Melanura	FM, WP, FW	327	0.62%
Psorophora ferox	FW, WP	258	0.49%
Anopheles punctipennis	AC, CW, FBW	177	0.34%
Ochlerotatus japonicus	AC, T, TH, RP	162	0.31%
Anopheles quadrimaculatus	CW	155	0.29%
Ochlerotatus canadensis	FW, SP	98	0.19%
Ochlerotatus triseriatus	AC, T, TH	88	0.17%
Ochlerotatus trivittatus	WP, SP	62	0.12%
Unspecified species*	--	145	0.28%
GRAND TOTAL		52,650	100.00
KEY: Larval Habitats			
AC - Artificial Containers	**SM** – Salt Marsh	**WP** - Woodland Pools	**FW** - Floodwater
CW - Confined Bodies of Water	**CB** –Catch Basins	**SP** - Snowmelt Pools	**FM** - Freshwater Marsh
FBW - Flowing Bodies of Water	**T** - Tires	**TH** - Tree Holes	**RP** - Rock Pools

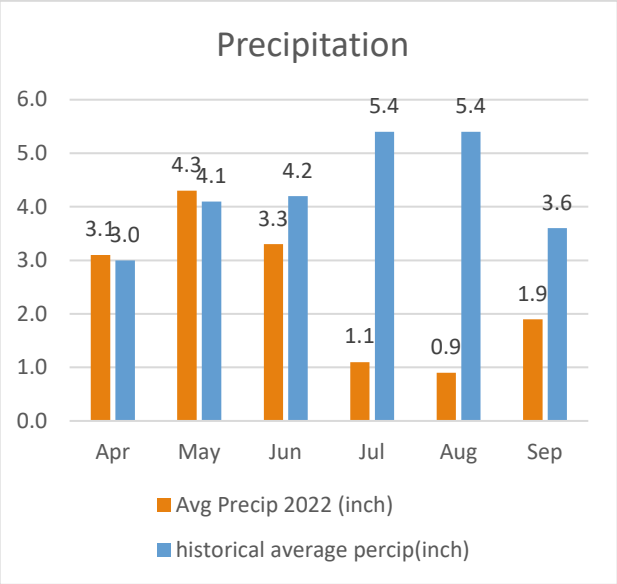
* - unspecified species include female mosquito specimens that were damaged either in collection or transport that no longer can be identified to the species level

Seasonal Duration and Weather

Nassau County's mosquito program operates throughout the year; however, the most active time is from May through October with peak viral activity from July through early September. In the past, mosquito larvae have been found as late as the middle of November. Surveillance activities began on May 16th and continued through September 30th for the 2022 mosquito season.

Air temperatures have a critical effect on mosquito activity. Hot, dry periods during the summer months may lead to increased viral activity in the mosquito population. Extended periods of high temperatures with low precipitation can cause birds to travel distances further than their normal habitat, in search of water. It is suggested that this activity, alongside reproduction, can thereby stress birds which can then cause them to become viremic; mosquitoes searching for a blood meal from a bird, can then become infected with West Nile Virus. (**Johnson, B.J. and M.V.K. Sukhdeo 2013**. Drought- Induced Amplification of Local and Regional West Nile Virus Infection Rates in New Jersey. J.Med Entomol. 50(1): 195-204) Temperatures during the 2022 mosquito season were close to normal historic averages.





Climatological data is depicted in Graph 1a, 2022 Temperature and 1b, 2022 Precipitation.

Precipitation is also a factor affecting mosquito activity. Storms from April through October are a major factor leading to mosquito breeding, as well as higher than normal tides, which affect the egg hatching of the salt marsh mosquito. The accumulation of water, with the presence of organic matter in any container, depression, object, etc., for as little as four days, or in most cases 1-2 weeks, can serve as a breeding site for mosquitoes. Rainfall amounts were below normal monthly averages for June thru September.

Mosquito Surveillance

Surveillance of the larval and adult stages of the mosquito is an integral part for the success of the program. Two methods of monitoring actual and/or potential mosquito populations are "dipping" for larvae, and "trapping" adult mosquitoes with CDC light traps, gravid traps, and BG-Sentinel traps.

Dipping for Mosquito Larvae

The most effective means of controlling mosquito populations is to identify breeding sites so that they can be modified to prevent standing water conditions conducive to mosquito breeding and/or treated to kill the larvae before they become flying, biting adult mosquitoes.

"Dipping" for larvae is the sampling technique used to estimate the number of larvae present in standing water. If the number of larvae is excessive, the habitat may be modified or an appropriate larvicide applied. All treatments are made in compliance with the product labels and permits obtained from New York State Department of Environmental Conservation (NYSDEC). The information gained from these larval dipping surveys determines if control measures are necessary and, if so, what measures to take. NCDOH's Integrated Pest Management Program (IPM) dictates that pest control products are not indiscriminately applied; therefore, dipping plays an important role in minimizing the use of pesticides. When necessary, treatment (larviciding) can be applied by hand to specific breeding locations or by helicopter over larger and less accessible areas.

A "dipper" consists of a long pole with a cup on the end. The inspector dips the cup into the standing water and then views what is captured in the cup. Larvae and debris are scooped from the standing water. The larvae are counted and possibly speciated, to provide the inspector with information to determine proper treatment, and/or type of mosquito that is breeding in the body of water. There are 4 molts or "instars", lasting approximately 4 days each, which provide information as to how soon the flying mosquitoes might emerge.

Figure 3 – "Dipper" containing mosquito larvae (approximately ¼ inch long)

Figure 4 - Mosquito Rearing Chamber; used to allow larvae to mature into adult mosquitoes which can then be identified.

Trapping Mosquitoes

Mosquito trapping is conducted for the following purposes:

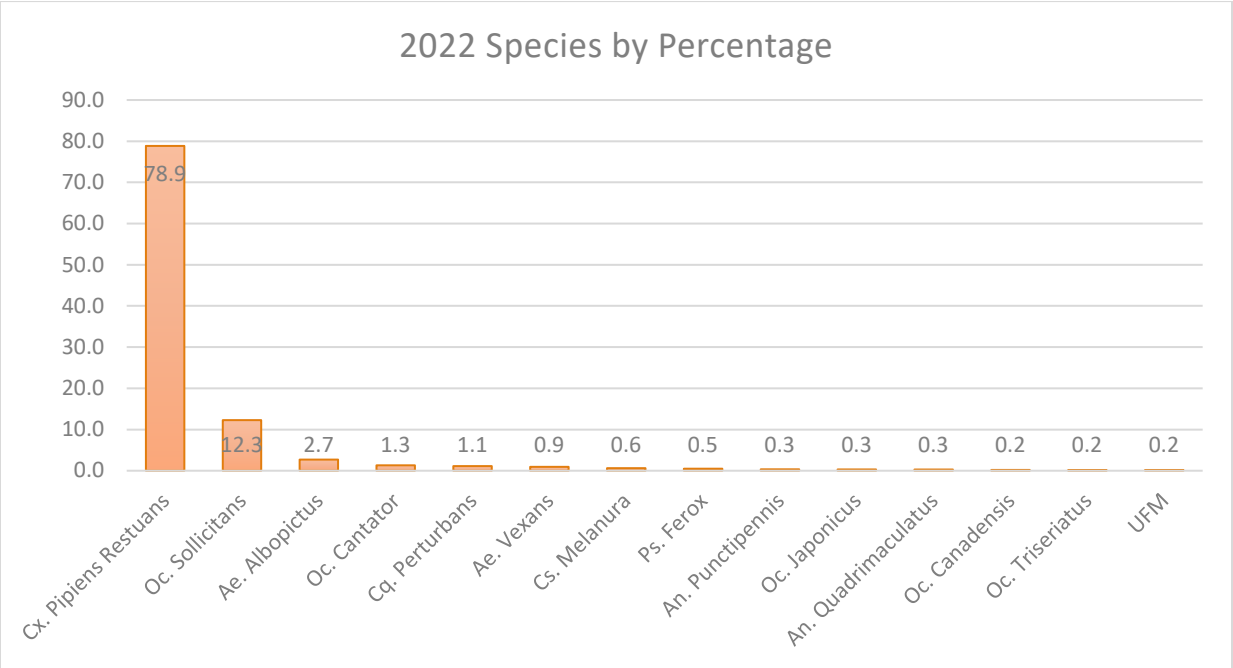
1. Estimate the Countywide adult mosquito population at a given time.
2. Identify specific areas with high mosquito populations.
3. Identify genus and species of mosquitoes.
4. Test for disease, especially West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE).
5. Assess effectiveness of control efforts.

If the number of adult mosquitoes is excessive, an appropriate control measure may be recommended, including a closer look at breeding areas in the vicinity.

There are currently 43 sites situated strategically throughout the County where CDC, BG-Sentinel and gravid traps were utilized, although auxiliary sites may be added to assess special situations. *See Map 1.*

For the 2022 mosquito season, trapping began on May 16th and continued through September 30th. Trapping begins with CDC light traps, exclusively, until a sufficient population is detected at which point gravid traps are added to each site. Gravid traps were first placed in the field on June 6th.

Graph 2



The graph above depicts the percentage, by species, of all mosquitoes collected this season in Nassau County; it begins in May and continues into September. Culex pipiens-restuans (the northern house mosquito), comprised 79% of all the mosquitoes captured.

CDC Light Traps

CDC light traps use a combination of light and carbon dioxide (from the sublimation of dry ice) to attract mosquitoes. CDC light traps were placed at all 43 trap sites throughout the season. In total, 739 CDC traps were run, capturing 11,691 mosquitoes, resulting in an average of 16 mosquitoes per trap night.

Figure 5 - CDC Light Trap with dry ice attractant

Gravid Traps

Gravid traps are another type of trap used to capture mosquitoes (especially *Culex*.) In 2022, gravid traps were also used at all 43 trap sites. A female mosquito is gravid when she is heavy with eggs. Generally, a blood meal is required to provide the nourishment necessary to develop her eggs, which then can be deposited. Gravid mosquitoes are considered to have a higher probability of carrying disease because they are more likely to have taken a blood meal.

The gravid trap consists of a tray containing standing water with the high organic content necessary to nourish mosquito larvae once they emerge from their eggs. A cylinder with a battery driven fan is placed just above the water level in the tray. The fan sucks the mosquitoes into the collection bag above when they fly in to deposit their eggs on the organically rich water. In total, 331 gravid traps were run, trapping 40,561 mosquitoes, resulting in an average of 123 mosquitoes per trap night.

Figure 6 - The gravid trap imitates the stagnant water scenario the mosquito instinctively seeks to lay eggs

BG-Sentinel Traps

BG-Sentinel traps are primarily used for attracting the Aedes albopictus species of mosquito that are known vectors for West Nile Virus and increasingly significant vectors for dengue and chikungunya. The BG- Sentinel trap:

- mimics convection currents created by a human body
- employs attractive visual cues
- releases artificial skin emanations through a large surface area

These traps are utilized when numbers of A. albopictus increase in light traps or gravid traps. Since larger numbers of A. albopictus are drawn to the BG-Sentinel traps it affords NCDOH a greater opportunity to actively survey and test the A. albopictus population for virus. In total, BG-Sentinel traps were utilized 60 times, trapping 398 mosquitoes, resulting in an average of 7 mosquitoes per trap night.

Figure 7 - BG-Sentinel Trap

Positive Mosquito Pools

After trapping, the mosquitoes are delivered to the Nassau County Department of Health (NCDOH) Laboratory for identification and enumeration. The mosquitoes are then sorted into "pools". Pools are groups of mosquitoes sorted by genus and species collected at a trap site. These pools consist of 10-60 mosquitoes which are then shipped to the New York State Department of Health (NYSDOH) Laboratory for viral testing.

This season, 52,650 mosquitoes were captured, identified, and screened for disease. Those mosquitoes were divided into 453 pools of mosquitoes. Of those 453 pools sent to the NYSDOH Laboratory, 88 were reported positive for West Nile Virus.

West Nile virus activity for the 2022 mosquito season began with the first positive from a pool collected on July 1st in Kings Point and ended with the last positive collected on September 30th in East Hills. West Nile virus activity is listed chronologically on the table below.

Table 2 - West Nile Virus Activity by Town, Mosquito Positive Pools, 2022

#	Town	MOSQ POOLS	DATE
1	*Baldwin*	*Culex pre*	*26-Jul*
2	*Baldwin*	*Culex pre*	*23-Aug*
3	*Bayville*	*Culex pre*	*21-Jul*
4	*Bayville*	*Culex pre*	*4-Aug*
5	*Bayville*	*Culex pre*	*18-Aug*
6	*Bethpage*	*Culex pre*	*27-Jul*
7	*Bethpage*	*Culex pre*	*10-Aug*
8	*Bethpage*	*Culex pre*	*21-Sep*
9	*East Garden City*	*Culex pre*	*5-Aug*
10	*East Garden City*	*Culex pre*	*5-Aug*
11	*East Garden City*	*Culex pre*	*19-Aug*
12	*East Hills*	*Culex pre*	*2-Sep*
13	*East Hills*	*Culex pre*	*30-Sep*
14	East Meadow	Culex pre	25-Aug
15	*East Rockaway*	*Culex pre*	*26-Jul*
16	*East Rockaway*	*Culex pre*	*9-Aug*
17	*Elmont*	*Culex pre*	*2-Aug*
18	*Elmont*	*Culex pre*	*19-Jul*
19	*Elmont*	*Culex pre*	*16-Aug*
20	*Elmont*	*Culex pre*	*30-Aug*
21	*Farmingdale*	*Culex pre*	*27-Jul*
22	*Farmingdale*	*Culex pre*	*10-Aug*
23	*Farmingdale*	*Culex pre*	*24-Aug*
24	*Farmingdale*	*Culex pre*	*7-Sep*

25	***Garden City***	***Culex pre***	***8-Jul***
26	***Garden City***	***Culex pre***	***22-Jul***
27	***Garden City***	***Culex pre***	***5-Aug***
28	***Glen Cove***	***Culex pre***	***18-Aug***
29	***Glen Cove***	***Culex pre***	***1-Sep***
30	***Glen Cove***	***Culex pre***	***1-Sep***
31	***Glen Cove***	***Culex pre***	***29-Sep***
32	Greenvale	Culex pre	8-Sep
33	***Hicksville***	***Culex pre***	***27-Jul***
34	***Hicksville***	***Culex pre***	***10-Aug***
35	***Jericho***	***Culex pre***	***11-Aug***
36	***Jericho***	***Culex pre***	***25-Aug***
37	***Kings Point***	***Culex pre***	***1-Jul***
38	***Kings Point***	***Culex pre***	***29-Jul***
39	***Lake Success***	***Culex pre***	***29-Jul***
40	***Lake Success***	***Culex pre***	***25-Aug***
41	Lakeview	Culex pre	16-Aug
42	Long Beach	Culex pre	23-Aug
43	***Massapequa***	***Culex pre***	***3-Aug***
44	***Massapequa***	***Culex pre***	***17-Aug***
45	***Massapequa Park***	***Culex pre***	***3-Aug***
46	***Massapequa Park***	***Culex pre***	***17-Aug***
47	***Massapequa Park***	***Culex pre***	***31-Aug***
48	***Merrick***	***Culex pre***	***3-Aug***
49	***Merrick***	***Culex pre***	***17-Aug***
50	***Mineola***	***Culex pre***	***22-Jul***
51	***Mineola***	***Culex pre***	***5-Aug***
52	***Mineola***	***Culex pre***	***19-Aug***
53	Old Bethpage	Ae cantator	13-Jul
54	Old Bethpage	Culex pre	24-Aug
55	***Old Westbury***	***Culex pre***	***5-Aug***
56	***Old Westbury***	***Culex pre***	***19-Aug***
57	Oyster Bay Cove	Culex pre	15-Sep
58	***Plainview***	***Culex pre***	***28-Jul***
59	***Plainview***	***Culex pre***	***11-Aug***
60	***Plainview***	***Culex pre***	***25-Aug***
61	Point Lookout	Culex pre	23-Aug
62	***Roosevelt***	***Culex pre***	***27-Jul***
63	***Roosevelt***	***Culex pre***	***10-Aug***
64	***Roosevelt***	***Culex pre***	***7-Sep***
65	***Roslyn Estates***	***Culex pre***	***15-Jul***
66	***Roslyn Estates***	***Culex pre***	***29-Jul***

67	***Roslyn Estates***	***Culex pre***	***25-Aug***
68	***Sands Point***	***Culex pre***	***25-Aug***
69	***Sands Point***	***Culex pre***	***9-Sep***
70	***Searingtown***	***Culex pre***	***12-Aug***
71	***Searingtown***	***Culex pre***	***25-Aug***
72	***Valley Stream***	***Culex pre***	***2-Aug***
73	***Valley Stream***	***Culex pre***	***16-Aug***
74	***Wantagh***	***Culex pre***	***3-Aug***
75	***Wantagh***	***Culex pre***	***17-Aug***
76	***Wantagh***	***Culex pre***	***31-Aug***
77	***West Hempstead***	***Culex pre***	***6-Jul***
78	***West Hempstead***	***Culex pre***	***19-Jul***
79	***West Hempstead***	***Culex pre***	***2-Aug***
80	***West Hempstead***	***Culex pre***	***16-Aug***
81	***Westbury***	***Culex pre***	***5-Aug***
82	***Westbury***	***Culex pre***	***5-Aug***
83	***Westbury***	***Culex pre***	***19-Aug***
84	***Woodbury***	***Culex pre***	***11-Aug***
85	***Woodbury***	***Culex pre***	***7-Sep***
86	***Woodmere***	***Culex pre***	***16-Aug***
87	***Woodmere***	***Culex pre***	***30-Aug***
88	***Woodmere***	***Culex pre***	***30-Aug***

Multiple positives, bold italics

Other Surveillance

Salt Marsh Surveys

Salt marsh areas, especially on the south shore of Nassau County, are potential breeding sites for mosquitoes. High tides, storm water, or heavy rains can cause areas not normally covered by daily tidal activity to flood, hatching mosquito eggs within minutes of contact with the water. Therefore, the marsh areas are surveyed periodically and larvicide is applied where necessary.

Upland Surveys

In addition to the salt marsh surveys, upland surveys of streams, drains, ponds and freshwater marshes were made to determine mosquito breeding potential and, especially, to determine suitability of these

sites as breeding areas for *Culiseta melanura* and *Culex pipiens* mosquitoes which are involved in the bird-to-bird/human transmission of EEE and WNV.

Storm Water Recharge Basin Surveys

Storm water recharge basins (SWB's), commonly called sumps, are designed to return surface runoff water to the ground water table. There are approximately 953 sumps in Nassau County: 580 sumps are managed by Nassau County; the rest are managed by New York state or local municipalities. Sometimes, they retain sufficient water to become major sources of mosquitoes. In 2022, 120 storm water basins were pretreated because they are known mosquito breeding locations. Throughout the summer other sumps are visited routinely or on a complaint basis.

Figure 8 - This storm water recharge basin (SWB), also known as a sump, holds water all year long. These basins sometimes become a dumping ground for old tires and debris, which can collect water and serve as ancillary breeding sites for mosquitoes. NCDPW tries to remove these items on a regular basis.

Birds and WNV

Birds have been implicated as the reservoir or source of WNV. When a mosquito bites a bird that is infected with WNV, the mosquito may then spread the virus to another bird, other animal, or human. Apparently, the American Crow is quite sensitive to WNV. Although most birds are only sick for a few days and fully recover with immunity to new infection, crows are more likely to die from the disease. NYS has deemed that the collection and analysis of dead birds is no longer a useful indicator of West Nile Virus activity therefore this activity is not performed in Nassau County.

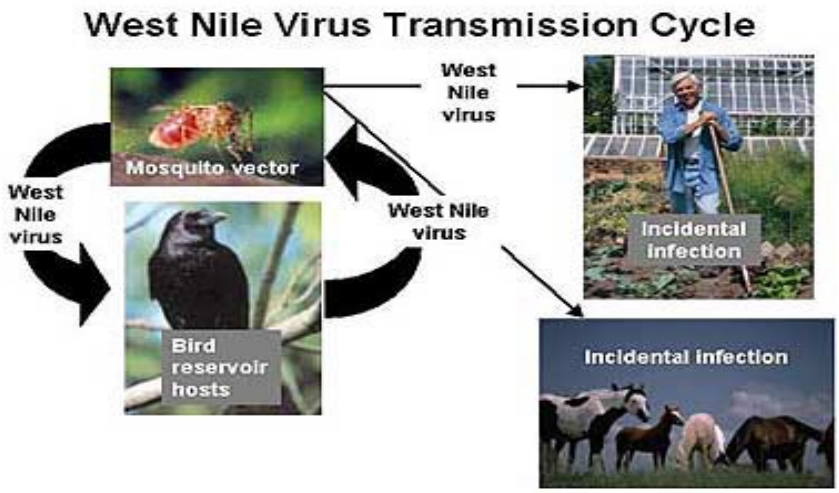


Figure 9 – West Nile Transmission Cycle

Graphic Courtesy - Centers for Disease Control and Prevention.

Complaints/Service Requests and Inquiries

In 2022, 125 complaints/inquiries were received in response to the WNV threat and nuisance mosquito populations. All complaints, whether received by telephone, email, letter, or referral within the county system, were entered in a log and assigned for inspection. Inspection generally involved a visit to the complainant's home, inspection of a specific situation, or more often a neighborhood survey. Surveys included, but were not limited to, streams, ponds, marshes, drainage ditches, standing water, swimming pools, artificial containers, street drains and nearby storm water recharge basins. Property owners were apprised of conditions when present. Otherwise, visit notices and mosquito information pamphlets were left at the residence. If appropriate, treatment was made by hand with a suitable larvicide. If a major breeding area was identified, follow-up inspections were made in one to two weeks. Inspection results and control efforts were then entered in the complaint log after review by the supervisor. Inquiries were defined as those situations which were handled by phone or letter. For example, if a resident called and requested information about mosquito breeding, a Nassau County Inspector would educate the person and possibly send a Mosquito Pamphlet, which provides much useful information.

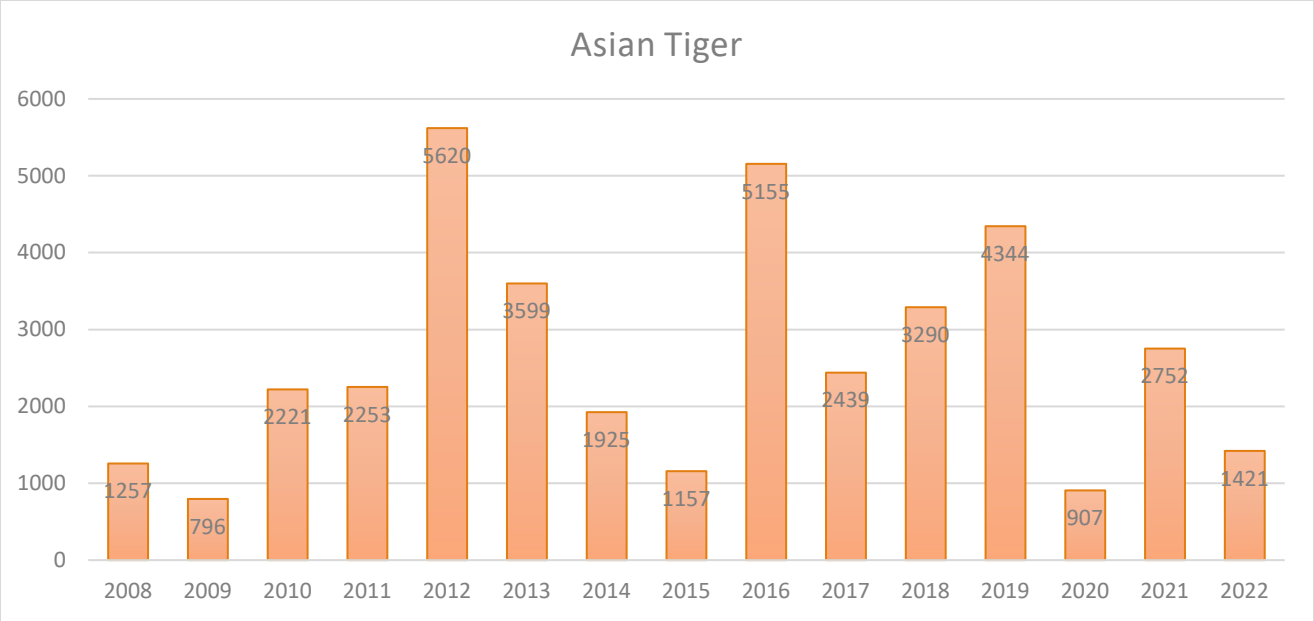
Asian Tiger Mosquito

Mosquito surveillance in 2022 saw a decrease in the population of the Asian Tiger Mosquito (ATM) or Aedes albopictus. The Asian tiger mosquito is an invasive species whose control is posing challenges for vector control staff.

It will seek blood meals (bite) during the day, not solely at dawn and dusk. Its competence as a vector of West Nile virus has not been established. It has demonstrated its competence as a vector of other arboviruses, specifically Dengue and Chikungunya in other regions of the world. The Department is planning an education campaign to inform the public regarding this new pest and the need for continued diligence with respect to eliminating local breeding sites.

The Asian tiger mosquito presents new challenges due to their feeding habits. They are active during the daytime hours, yet they are not active flyers. Traditional methods of adult treatment have demonstrated limited effectiveness on the Asian tiger mosquito.

Table 3



The table above illustrates the ATM population since 2008.

Control Activities

As stated previously, Nassau County is committed to applying the principles of IPM to all its pest control activities. The cornerstone of our control strategy is surveillance; control strategies are based on reliable information and then monitored for the effectiveness of that strategy. In some situations, no treatment is necessary (for example, there may be mosquito-eating fish or insect predators such as dragonfly and damselfly larvae present; or a puddle may dry up before larval development can be completed). In other situations, there are treatment restrictions to be observed to avoid harm to non-target organisms, especially in environmentally sensitive areas such as freshwater wetlands. Several treatment options have restrictions on the label, or on the NYSDEC permits, when fish are present. NYSDEC has issued permits for each aspect of the mosquito control program specifying application detail. All control measures must fully comply with these permits. Furthermore, all pesticides must be used in accordance with the product labels and all applicable pesticide laws. When treatment is necessary, there are several options available.

The most effective strategy for mosquito control is pre-emergent larval control and diligent surveillance. Continued emphasis should be placed on early season larvaciding to limit the need for adult control. As stated in the Centers for Disease Control (CDC) guidance document*, "Before the Swarm: Guidelines for the Emergency Management of Mosquito-Borne Disease Outbreaks":*

Effective surveillance is key to any effective response, as it allows mosquito control programs to rapidly assess the scale of the emergency and determine the type and extent of proper response measures.

By monitoring activity in mosquitoes, vector control programs can anticipate increased virus activity and take appropriate action.

Early-season source reduction (that is, larval habitat elimination) and the application of larvicides, if properly carried out, can greatly reduce the likelihood of an epidemic.

Unfortunately, once emergence of new adult mosquitoes has peaked and large numbers of infected mosquitoes are present, larviciding and source reduction are much more limited in their impact on virus transmission. At this point, adult mosquito control becomes the primary resource for interrupting virus transmission.

A decision matrix was utilized for the 2019 mosquito season to define the parameters by which control measures would be implemented. This matrix was developed utilizing current New York State Health Department and the Centers for Disease Control guidance documents along with ten years of local surveillance data and experience. The Nassau County Mosquito Control Decision Matrix is listed below.

Nassau County - Mosquito Control Decision Matrix		
Early Season (prior to July 15)	Mid Season (July 15 - Sept 15)	Late Season (after September 15)
Single elevated trap site (aedes sp. >50, culex / other sp. > 100)		
Increase larval surveillance Increase larval control Consider aerial larvicide for *O. sollicitans*	Increase larval surveillance Increase larval control Consider ground based adult control Conduct aerial larvicide for *O. sollicitans*	Increase larval surveillance Consider ground based adult control of targeted species if weather pattern favors continued activity
Persistent elevated trap site or multiple elevated trap sites (aedes sp. >50, culex / other sp. > 100)		
above actions plus… Consider ground based adult control Conduct aerial larvicide for *O. sollicitans*	*above actions plus…* Conduct ground based adult control Consider aerial control of adult mosquitoes	*above actions plus…* Conduct ground based adult control of targeted species if weather pattern favors continued activity
West Nile virus detection - single trap site		
Increase larval surveillance Increase larval control	Increase larval surveillance Increase larval control Consider ground based adult control	Increase larval surveillance Consider ground based adult control of targeted species if weather pattern favors continued activity
West Nile virus detection -persistent or multiple trap sites		
above actions plus… Consider ground based adult control	*above actions plus…* Conduct ground based adult control Consider aerial control of adult mosquitoes	*above actions plus…* Conduct ground based adult control of targeted species if weather pattern favors continued activity
Note : detection of EEE, other non-endemic virus' or other extraordinary circumstances may require additional control activity		
Arboviruses transmitted by Aedes albopictus		
Zika, Dengue, Chikungunya or Yellow Fever virus detection Single confirmed locally acquired case or positive mosquito pool		
Perform larval surveillance and control, eliminate larval habitats up to 200 yards around detection site Conduct community education aimed at preventing or minimizing contact between vectors and residents (source reduction, disposing/emptying water holding containers). Conduct ground based adult mosquito control up to 200 yards around detection site. Initate/maintain adult mosquito surveillance at detection site to estimate mosquito abundance and evaluate control efforts.		
Zika, Dengue, Chikungunya or Yellow Fever virus detection Outbreak; clusters of confirmed locally aquired human cases or multiple positive mosquito pools		
Conduct community education and outreach aimed at preventing or minimizing contact between vectors and residents (source reduction, disposing/emptying water holding containers). Divide the outbreak area into operational management areas where adult control measures can be applied within a few days and repeated as needed to reduce mosquito density. Increase adult mosquito surveillance within operational management areas to estimate mosquito abundance and evaluate control efforts.		

Table 4 – Nassau County Decision Control Matrix

Modification of Habitat

In addition to the fresh-water mosquitoes, there are several species of mosquitoes that inhabit the extensive saltwater wetlands on both the north and south shores of Nassau County. To reduce salt marsh mosquito populations, approximately 1000 miles of ditches were dug in the past years of which 700 miles have been reconditioned since 1977, to improve drainage along the shoreline, on the south shore barrier islands, and among the numerous hassocks and islets. This reduces the size and number of puddles and areas of standing water suitable for mosquito egg hatching and larval development. The NCDPW utilizes specialized equipment to maintain and recondition the drainage ditches, and to cut access paths that facilitate inspection, maintenance, and treatment of mosquito breeding areas. Natural forces such as wind, rain, tides, and major storms continually influence and modify the marsh topography, resulting in new and altered mosquito breeding areas; therefore, ditch maintenance is an ongoing and long term project. Well maintained drainage ditches provide a habitat for killifish that feed on mosquito larvae, as well as facilitate tidal water movement and create a suitable environment for waterfowl.

Figure 10- This floodwater ditch, filled with sand and debris, is in need of maintenance to prevent mosquito breeding

Figure 11 - This ditch is well maintained, allowing tidal flows to move in and out, enabling killifish to swim in and eat the mosquito larvae.

Once mosquitoes reach the adult stage, they need a place to hide and rest. Commonly, these areas are high grass, weeds, and undergrowth, close to a pond, depression, ditch, or sump. County workers identify these sites and cut down or otherwise modify them so that the mosquitoes are then exposed to the elements and predators, naturally reducing their numbers.

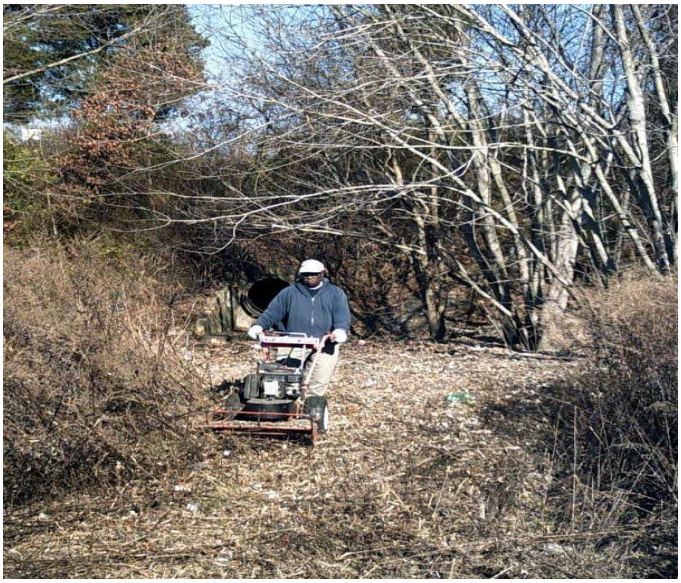


Figure 12 - WNV Program worker cutting back brush used as refuge by adult mosquitoes

Elimination of Standing Water

Mosquito larvae are often found in clogged roof gutters, old tires, boat covers, swimming pools, swimming pool covers and other artificial containers. Swimming pools themselves, when properly

Figure 13 - Swimming pool cover with stagnant water and leaves

maintained or periodically chlorinated, are not a problem. During complaint inspections property owners are advised of conditions conducive to larval development of mosquitoes. The Mosquito Control pamphlet given out during complaint inspections emphasizes the need for eliminating these localized breeding situations.

Hand Treatment with Larvicides

Four larvicides that may be used:

1. BTI (*Bacillus thuringiensis var. israeliensis*) is a naturally occurring soil bacterium that is eaten by the larvae, infecting them, and killing them. It is available in granular form or in a donut shaped briquette. It is very target specific, but will not work against the pupae stage, as pupae do not eat.
2. Vectolex CG (*Bacillus sphaericus*) is also a naturally occurring bacterium that infects mosquito larvae. It persists well in the organic rich environments favored by the *Culex* species of mosquitoes. It also is ineffective against pupae.
3. Altosid XR (Methoprene) is an insect growth regulator that prevents mosquito larvae from changing into adults. It is used in a briquette form for hand treating SWB's and other sites requiring long acting control (150 days).
4. BVA Oil (97% mineral oil) is an oil that produces a film on top of the water surface that prevents the mosquito larvae and pupae from obtaining oxygen (breathing) resulting in their rapid suffocation.

Figure 14 - BTI Briquette

Aerial Spraying of Larvicides

NCDPW has a contract with a private company for aerial larvicide spraying by helicopter. The helicopter is able to spray large non-populated, inaccessible areas with a suitable larvicide, usually a liquid formulation of Altosid. Areas sprayed include the marshy areas of Jones Beach, Lido Beach, and a number of islets and hassocks on the south shore of Nassau County. Decisions as to when and where to treat are based upon the salt marsh surveys, tidal conditions, and boat surveys. The helicopter has been a very effective control measure. The helicopter was used four times in 2022 to control *Ochlerotatus sollicitans* populations. There was an overall reduction in numbers of *Ochlerotatus sollicitans* population compared to prior years and this may be attributed to effective early season larvaciding.

Adulticiding

Adult mosquitoes are sensitive to several contact pesticides. "Scourge" (Resmethrin 18% and Piperonyl butoxide 54%) was the mosquito adulticide utilized in 2014. This product can be sprayed by an Ultra-Low Volume generator mounted on the back of a pickup truck. Driven at a constant 5 mph rate, this method can treat large areas on either side of a roadway. Spraying must be done at times of low wind, usually early morning, or evening, to minimize drift. Adulticiding is only conducted when excessive numbers of adults are present, disease is detected, and other means of control are ineffective. As stated earlier, a decision matrix was utilized to define the conditions necessary to consider adult mosquito control. No truck spraying was conducted in 2022.

Figure 15 - NCDPW Vehicle equipped for spraying activities

Off Season

NCDOH and NCDPW have recognized a need to enhance collaborative efforts to successfully achieve the goals and objectives of the Mosquito Surveillance and Control program. After evaluating past efforts, NCDOH and NCDPW will plan to further revise the Mosquito Surveillance and Control Plan. In addition, NCDOH and NCDPW have developed the following goals for upcoming mosquito seasons.

- NCDOH will continue to participate in teleconferences facilitated by the New York State Department of Health, Arthropod-Borne Disease Program, to define program objectives, goals, and methods to be used to respond to the West Nile virus threat. NCDOH will also participate in additional teleconferences and meetings with representatives of NYS counties, New York City, NYSDOH, NYSDEC, and Wadsworth Laboratory.
- Evaluation of the control matrix to help further aide in the decision to implement control measures.
- NCDOH plans to coordinate with NCDPW to improve the development of spray maps for vector control initiatives and public notification.
- Maintenance of surveillance efforts.
- Additional training for mosquito identification.

Fig. 16 – Laboratory sorting of mosquitoes. In 2022, 52,650 mosquitoes were sorted and identified.

Appendix A

ACROYNMS

1. **ATM**- Asian Tiger Mosquito
2. **CDC**- Centers for Disease Control and Prevention
3. **NCDPW**- Nassau County Department of Public Works
4. **EEE-** Eastern Equine Encephalitis
5. **IPM**- Integrated Pest Management
6. **NCDOH**- Nassau County Department of Health
7. **NYSDEC**- New York State Department of Environmental Conservation
8. **NYSDOH**- New York State Department of Health
9. **PCR**- polymerase chain reaction
10. **SWB**- Storm water recharge basin
11. **WNV**- West Nile Virus

Appendix B

CHARTS AND GRAPHS

Mosquito Surveillance 2022 by total captured and percentage of total

Species	Total	Percent
Cx. Pipiens Restuans	41,514	78.88
Oc. Sollicitans	6,467	12.28
Ae. Albopictus	1,421	2.70
Oc. Cantator	689	1.31
Cq. Perturbans	592	1.12
Ae. Vexans	495	0.94
Cs. Melanura	327	0.62
Ps. Ferox	258	0.49
An. Punctipennis	177	0.34
Oc. Japonicus	162	0.31
An. Quadrimaculatus	155	0.29
Oc. Canadensis	98	0.19
Oc. Triseriatus	88	0.17
Oc. Trivittatus	62	0.12
UFM	145	0.28
FEMALE Total	52,650	100%

The table above shows the species collected throughout the season.

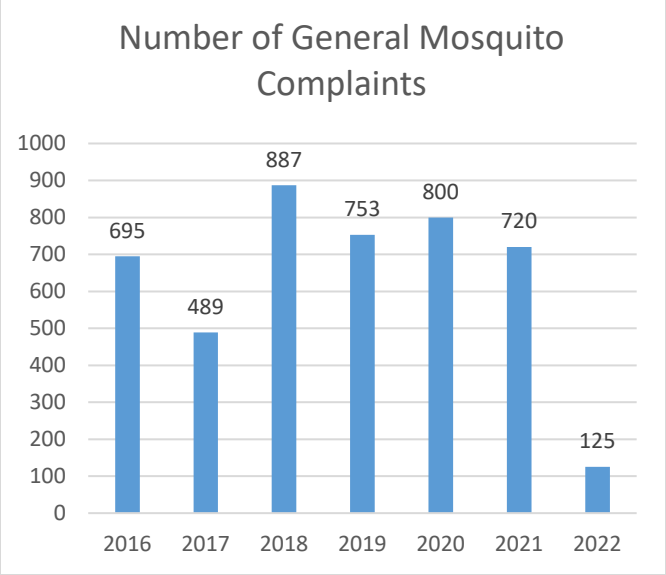
A total of 14 species were identified.

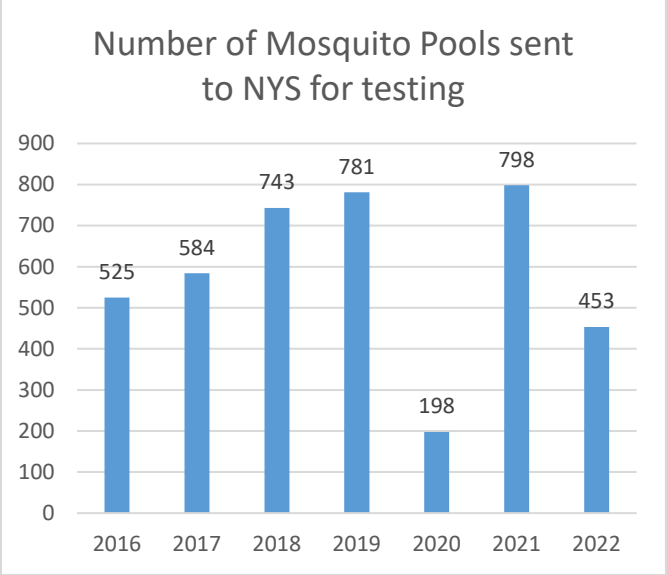
Comparative Mosquito Program Statistics

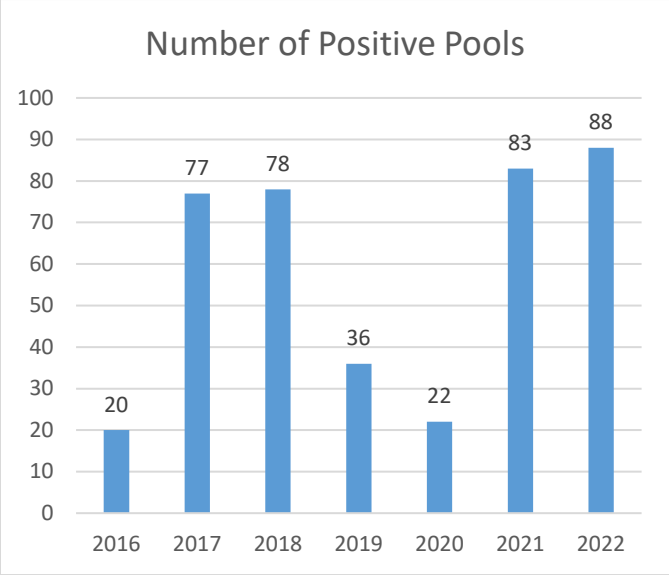
	2019	2020	2021	2022
# of CDC Mosquito Light Traps Set (Trapnights)	741	179	581	739
Total CDC Female Mosquito Catch	41,658	19,658	33,780	11,961
CDC Trapnight Average for Female Mosquitoes	56	110	58	16
# Gravid Traps Set (Trapnights)	344	100	321	331
Total Gravid Trap Female Mosquito Catch	38,731	10,844	50.988	40,561
Gravid Trapnight Average for Female Mosquitoes	113	108	159	123
# of BG Sentinel Traps Set (Trapnights)	84	22	59	60
Total of BG Sentinel Female Mosquito Catch	2,219	289	1,015	398
BG Sentinel Trapnight Average for Female Mosquitoes	26	13	17	7
Total # of All Mosquitoes Trapped (CDC, Gravid & BG Sentinel)	82,608	30,791	85,783	52,650
Number of Mosquito Pools Sent to NYS for Testing *	781	198	798	453
Number of Positive Mosquito Pools Reported	34	22	83	155
Number of PCR Negative Pools (NYSDOH Lab) Reported	745	155	715	298
Number of Human Cases Reported **	2	5	4	21
Number of A. albopictus	4,344	907	2,752	1,421

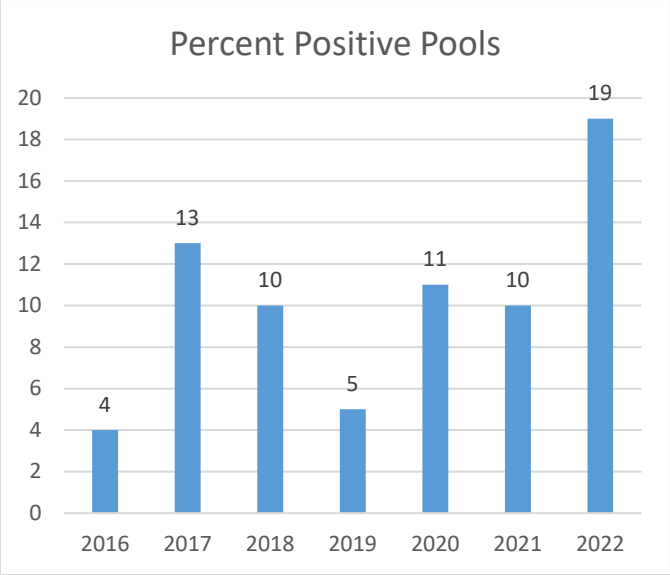
*****New York State Department of Health (NYSDOH) tests mosquitoes for arbovirus by screening for arboviral agents using polymerase chain reaction (PCR) protocols

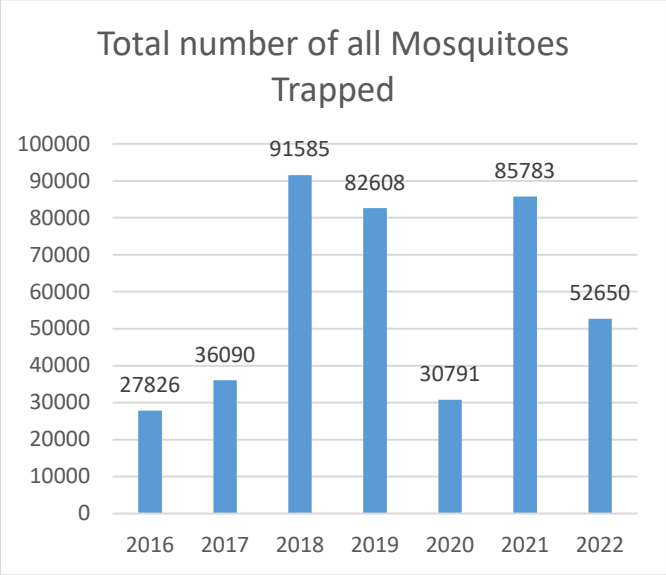
****** Human Cases **-** Clinical Description, most arboviral infections are asymptomatic. Clinical disease ranges from mild febrile illness to severe encephalitis. For surveillance and reporting, based on their clinical presentation, arboviral disease cases are often categorized into two primary groups: neuroinvasive disease and nonneuroinvasive disease.

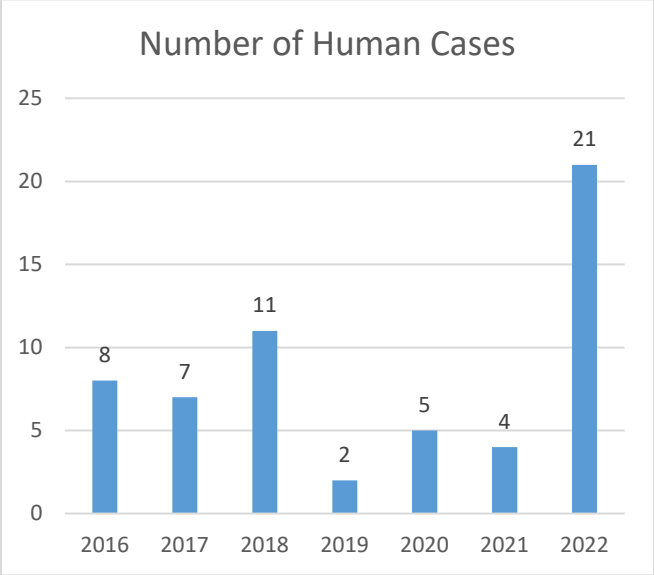

Number of General Mosquito Complaints
1000
900
800
700
600
500
400
300
200
100
0
695
489
887
753
800
720
125
2016
2017
2018
2019
2020
2021
2022


Number of Mosquito Pools sent to NYS for testing
900
800
700
600
500
400
300
200
100
0
525
584
743
781
198
798
453
2016
2017
2018
2019
2020
2021
2022


Number of Positive Pools
100
90
80
70
60
50
40
30
20
10
0
20
77
78
36
22
83
88
2016
2017
2018
2019
2020
2021
2022


Percent Positive Pools
20
18
16
14
12
10
8
6
4
2
0
4
13
10
5
11
10
19
2016
2017
2018
2019
2020
2021
2022


Total number of all Mosquitoes Trapped
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
27826
36090
91585
82608
30791
85783
52650
2016
2017
2018
2019
2020
2021
2022


Number of Human Cases
25
20
15
10
5
0
8
7
11
2
5
4
21
2016
2017
2018
2019
2020
2021
2022

Appendix C

ADDITIONAL INFORMATION

1. Inquiries related to mosquito surveillance can be directed to NCDOH at 516 571-1211.

2. Any concerns regarding mosquito control should be directed to NCDPW at 516 572-1166.

3. **https://www.nassaucountyny.gov/5262/Zoonotic-Diseases**

4. **https://www.health.ny.gov/diseases/west_nile_virus/**

5. **http://www.cdc.gov/ncidod/dvbid/westnile/index**