Clinton County West Nile Virus Report 2019

Lake Champlain Research Institute
SUNY Plattsburgh

Clinton County Health Department's West Nile Virus Program
2019 Annual Report

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The Clinton County Mosquito Arbovirus Surveillance Program was conducted by research aides (Alyssa Turner with other student support) employed by the Lake Champlain Research Institute in 2019. Entomological training was provided by the State Health department. Supervisors Tim Simonette, PPHS, Ryan Davies, P.E., Director of Environmental Health, and Dr. Timothy Mihuc, Coordinator of Lake Champlain Research Institute, monitored the efforts of LCRI employees.

Gravid traps, CDC miniature light traps, and resting boxes were used in this year's Mosquito Surveillance Program. Traps were operated and maintained at six locations around the county, based on three criteria:

1. Even distribution according to the square mileage of the county
2. High quality mosquito habitat
3. High human population densities

Mosquito surveillance was discontinued after the 2011 season and resumed again in 2016.
This season's collection yielded 73 mosquito pools that were submitted to Wadsworth Arbovirus Laboratory in Albany, NY. None of the pools (0) tested positive for West Nile Virus.

The mammalian surveillance protocol is passive. The 2009 season concluded with one horse testing positive for West Nile Virus. This is the first mammal to test positive for West Nile Virus in Clinton County (though some birds have tested positive in the past). Clinton County has had only one human positive case in 2002 during the 14 years of surveillance.

Partnerships with local organizations have benefited the Mosquito Surveillance Program. The Clinton County Health Department continued working in collaboration with the Lake Champlain Research Institute (LCRI). These organizations provided such materials as lab space, equipment, and personnel. Work done in conjunction with these partners has been featured in the Press-Republican newspaper, WCAX Channel 3 and WPTZ News Channel 5.

The combination of the above mentioned factors has allowed for a productive mosquito-borne Virus Surveillance and Monitoring Program since its launch in the summer of 1999.

I. Mosquito Surveillance

Methods and Materials

During the 2019 mosquito-borne virus surveillance season, mosquito traps purchased from the J.W. Hawk Company were placed in 6 distinct locations in Clinton County. Both gravid and CDC miniature light traps were used at each of the sites, and resting boxes were used at one site (Champlain) to target potential carriers of Eastern Equine Encephalitis (this was also done in 2009). These traps were operated and maintained at their designated location for the entirety of the season. Traps were stationed according to three specific criteria; 1) Even distribution according to the square mileage of the county, 2) High quality mosquito habitat, 3) High human population densities.

Clinton County Light and Gravid Trap Locations

Point Au Roche (State Park)
- 44 degrees 47' 13N
- 73 degrees 22' 75W

Plattsburgh (SUNY Plattsburgh Field House)
- 44 degrees 40' 97N
- 73 degrees 28' 46W

Plattsburgh Chamber of Commerce
- 44 degrees 43' 19.0N
- 73 degrees 26' 26.8W

Morrisonville (River Road)
- 44 degrees 41' 73N
- 73 degrees 33' 05W

West Chazy (Spring on Recore Rd)
- 44 degrees 49' 8.7N
- 73 degrees 32' 26W

Champlain (Southwick Road)
- 44 degrees 57' 568N
- 73 degrees 30' 354W

Once locations were determined, a weekly route was planned to allow for optimum efficiency in regards to trap set up and collection. Typically traps were set between 10:00 a.m. and 2:00 p.m. and collected between 10:00 a.m. and 2:00 p.m. the following day. The traps were set Monday-Wednesday during a typical week. Trap routes did deviate on occasion depending on time and weather conditions.

Typical Weekly Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Set Route	Collect Route Set Route	Collect route Set Route	Identify Mosquitoes	Identify Mosquitoes		
Identify Mosquitoes	Identify Mosquitoes	Identify Mosquitoes	Ship Mosquitoes			

The 2019 season yielded no West Nile Virus positive pools. The following table shows trap dates, number of collected mosquito pools, and test results.

	# of Trap Dates	Trapping Season	Mosquito Pools	Positive Test Results
2001	52	July 9 - October 4	52	0
2002	62	May 29 - September 29	76	0
2003	42	June 25 - October 1	126	1*
2004	36	June 7 – September 14	175	1**
2005	32	June 15 – September 20	101	0
2006	33	June 3 – October 7	56	0
2007	53	May 31 - September 4	93	0
2008	53	June 2 - September 11	112	1***
2009	53	June 1 - October 9	147	0
2010	50	May 1- September 20	117	0
2011	50	May 15-October 1	96	0
2016	51	June 16-September 17	52	0
2017	31	June 7 - September 21	93	6*
2018	25	June 7 - September 21	68	3*
2019	31	June 12 - September 4	73	0

* tested positive for West Nile Virus

** tested positive for Jamestown Canyon virus

*** tested positive for CVV

The 2001 trapping season was the shortest of all seasons and produced the fewest number of mosquito pools. The number of trap dates and pools varied from 2001-2006. During seasons 2007 - 2011, the number of trap dates increased, in addition to the mosquito pools collected. In recent years, the early cool season in September resulted in the 2016 season yielding 52 pools. In contrast, the 2017 season was prolonged and more humid than 2016, and thus yielded more pools. 2018 was drier than 2017 and yielded 68 total pools. 2019 was cooler than average, resulting in a fewer pools at the beginning and end of the season and yielding 73 total pools.

Prior to the 2008 season, the first and only West Nile Virus positive pool was found in 2003. One pool tested positive for Jamestown Canyon in 2004, and one pool tested positive for CVV (Cache Valley Virus) in 2008. Since 2008, six (6) pools tested positive for West Nile Virus in 2017, and in 2018, three (3) pools tested positive. However, there were no positive pools in 2019.

Half of the traps set and collected were of the gravid variety while the other half used were CDC light traps. Diurnal resting boxes were used at only one site (Champlain). Possible explanations for trap night and pool number fluctuation may include aide experience, trapping season, duration, and weather conditions.

MOSQUITO RESULTS

Throughout the Mosquito Surveillance Program in Clinton County, the number of mosquito species increased with each season until 2005. During 2001, 12 species were found, in which 7 were pooled. The 2002 season collected 17 species, in which 13 were pooled. Similarly in 2003-05 we collected 17-18 species. In 2004, three species were recorded that had not been present the previous year, and two of these were not found the following year. The 2005 season presented one new species. In 2006, yet another new species was identified. The 2007 and 2008 seasons yielded almost as many species as the previous year. In 2009, an all-time high of 147 pools and 23 species were collected. The 2010 season collected only 10 species of mosquitoes totaling 117 pools sent for analysis. 2011 had 21 species totaling 96 pools. During 2016 we collected 52 pools and 13 species. 2017 season yielded a total of 20 species, 7 of which were pooled (93 total pools) while 2018 yielded 19 species, 8 of which were pooled (68 total pools). 2019 yielded 21 species, 11 of which were pooled with 73 total pools. Differences in species richness between years was likely impacted by field season length, climate, and varying ecological conditions.

CLINTON COUNTY MOSQUITO POPULATION DYNAMICS

Clinton County's 2019 mosquito pools were collected from 6 gravid and 6 CDC light traps as well as one set of resting traps in Champlain, NY. Multiple trapping methods are critical to a surveillance program; however, it is the gravid traps that are most likely to provide West Nile Virus positive mosquitoes. The West Nile Virus (WNV) positive mosquito pool in 2003 was collected using a gravid trap, as were all of the positive WNV pools in 2017 and 2018. Gravid traps selectively attract female *Culex spp* mosquitoes, which are the most common vector of WNV.

Results from each trap have varied in the past several years. Few gravid traps were used in Clinton County's 2002 program. It was the addition of this method (adding gravid traps) which allowed for the initial increase in the number of mosquito species caught and pooled. In 2019, gravid mosquitoes were found in significantly fewer densities than those in 2018, which resulted in fewer blooded-gravid pools. As a consequence of the low densities of gravid mosquitoes, most pools for the 2019 season were selected from CDC light traps. CDC light traps often capture higher densities and diverse species of mosquitoes. This component is the most critical in establishing population dynamics, however is statistically unlikely to capture West Nile Virus laden mosquitoes.

In 2009, the highest number of taxa was sampled, most likely due to the addition of new trap sites (e.g. Champlain). 2009 also produced four new species in trap samples as a result of the increased trapping effort and the use of new methods (resting boxes). 2010 species richness declined to 10 species, but returned to 21 species in 2011, most likely due to 2011 wet conditions promoting mosquito populations throughout the county. In 2016 a total of 13 species were found, most likely due to dry conditions throughout the field season. Moist conditions returned in 2017, increasing diversity of trapped mosquitoes to 20 species. 19 species were collected in 2018 trap sampling. Despite cool conditions, diversity remained high in 2019, with 21 species and one county record of *Anopheles earlei* collected.

CLINTON COUNTY MOSQUITO POPULATION DYNAMICS

^ - pooled species
# - new from previous year
* - not found the following year

2001	2002	2003
Oc. canadensis (CAN)	#*^ *Oc. abserratus-punctor* (ABP)	^ *Oc. canadensis* (CAN)
Oc. japonicus (JAP)	#*^ *Oc. aurifer* (AUR)	# *Oc. canator* (CTT)
Oc. stimulans gr. (SEF)	^ *Oc. canadensis* (CAN)	#^ *Oc. communis gr.* (CGR)
^ *Oc. trivittatus* (TVT)	^ *Oc. japonicus* (JAP)	*Oc. japonicus* (JAP)
^ *Oc. triseriatus* (TRI)	#*^ *Oc. sticticus* (STC)	^ *Oc. stimulans group* (SEF)
^ *Ae. vexans* (VEX)	^ *Oc. stimulans gr.* (SEF)	^ *Oc. triseriatus* (TRI)
^ *An. punctipennis* (PUN)	*Oc. triseriatus* (TRI)	^ *Oc. trivittatus* (TVT)
* *An. quadrimaculatus* (QUA)	*Oc. trivittatus* (TVT)	#^ *Ae. cinereus* (CIN)
^ *Cq. perturbans* (PER)	#*^ *Oc. trichurus* (TCH)	^ *Ae. vexans* (VEX)
^ *Cx. pipiens* (PIP)	^ *Ae. vexans* (VEX)	#* *An. bradleyi* (BRD)
^ *Cx. restuans* (RES)	^ *An. punctipennis* (PUN) # ^	^ *An. punctipennis* (PUN) # ^
^ *Cx. pipiens-restuans* (PRE)	*An. walkeri* (WAK)	*An. walkeri* (WAK)
	^ *Cq. perturbans* (PER)	^ *Cq. perturbans* (PER)
	^ *Cx. pipiens* (PIP)	^ *Cx. pipiens* (PIP)
	^ *Cx. restuans* (RES)	^ *Cx. restuans* (RES)
	^ *Cx. pipiens-restuans* (PRE)	^ *Cx. pipiens-restuans* (PRE)
	#* *Cs. Morsitans* (MOR)	#* *Cs. Melanura* (MEL)
		#^ *Ur. Sapphirina* (USA)

2004	2005	2006
#^ *Oc. aurifer* (AUR)	#^ *Oc. abserratus-punctor* (ABP)	*Oc. abserratus-punctor* (ABP)
^ *Oc. canadensis* (CAN)	#^ *Oc. aurifer* (AUR)	*Oc. aurifer* (AUR)
^ *Oc. canator* (CTT)	^ *Oc. canadensis* (CAN)	*Oc. canadensis* (CAN)
Oc. japonicus (JAP)	*Oc. canator* (CTT)	* *Oc. canator* (CTT)
#* *Oc. sticticus* (STC)	^ *Oc. japonicus* (JAP)	^ *Oc. japonicus* (JAP)
^ *Oc. stimulans group* (SEF)	^ *Oc. stimulans group* (SEF)	^ *Oc. stimulans group* (SEF)
^ *Oc. triseriatus* (TRI)	^ *Oc. triseriatus* (TRI)	^ *Oc. triseriatus* (TRI)
^ *Oc. trivittatus* (TVT)	^ *Oc. trivittatus* (TVT)	^ *Oc. trivittatus* (TVT)
^ *Ae. cinereus* (CIN)	^ *Ae. cinereus* (CIN)	*Ae. cinereus* (CIN)
^ *Ae. vexans* (VEX)	^ *Ae. vexans* (VEX)	^ *Ae. vexans* (VEX)
^ *An. punctipennis* (PUN)	*An. punctipennis* (PUN)	^ *An. punctipennis* (PUN)
#^ *An. quadrimaculatus* (QUA)	^ *An. quadrimaculatus* (QUA)	*An. quadrimaculatus* (QUA)
^ *An. walkeri* (WAK)	^ *An. walkeri* (WAK)	^ *An. walkeri* (WAK)
^ *Cq. perturbans* (PER)	^ *Cq. perturbans* (PER)	^ *Cq. perturbans* (PER)
^ *Cx. pipiens* (PIP)	^ *Cx. pipiens* (PIP)	^ *Cx. pipiens* (PIP)
^ *Cx. restuans* (RES)	^ *Cx. restuans* (RES)	^ *Cx. restuans* (RES)
^ *Cx. pipiens-restuans* (PRE)	^ *Cx. pipiens-restuans* (PRE)	^ *Cx. pipiens-restuans* (PRE)
#*^ *Cs. Salinarius* (SVT)	#^ *Ur. Sapphirina* (USA)	#* *Ps. ferox* (PFR)
#^ *Ur. Sapphirina* (USA)		^ *Ur. sapphirina* (USA)

2007	2008	2009
^ _Oc. abserratus-punctor_ (ABP) _Oc. aurifer_ (AUR) _Oc. canadensis_ (CAN) ^ _Oc. japonicus_ (JAP) ^ _Oc. stimulans group_ (SEF) ^ _Oc. triseriatus_ (TRI) ^ _Oc. trivittatus_ (TVT) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) _An. punctipennis_ (PUN) ^ _An. quadrimaculatus_ (QUA) ^ _An. walkeri_ (WAK) ^ _Cq. perturbans_ (PER) ^ _Cx. pipiens_ (PIP) ^ _Cx. restuans_ (RES) ^ _Cx. pipiens-restuans_ (PRE) _Ps. ferox_ (PFR) _Ur. sapphirina_ (USA)	^ _Oc. abserratus-punctor_ (ABP) _Oc. aurifer_ (AUR) _Oc. canadensis_ (CAN) ^ _Oc. japonicus_ (JAP) #^ _Oc. sticticus_ (STC) _Oc. stimulans group_ (SEF) ^ _Oc. triseriatus_ (TRI) ^ _Oc. trivittatus_ (TVT) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) ^ _An. punctipennis_ (PUN) _An. quadrimaculatus_ (QUA) ^ _An. walkeri_ (WAK) ^ _Cq. perturbans_ (PER) _Cx. pipiens_ (PIP) ^ _Cx. restuans_ (RES) ^ _Cx. pipiens-restuans_ (PRE) _Ps. ferox_ (PFR) _Ur. sapphirina_ (USA)	*^ _Oc. abserratus-punctor_ (ABP) _Oc. aurifer_ (AUR) *^ _Oc. canadensis_ (CAN) *#^ _Oc. communis gr._ (CGR) ^ _Oc. japonicus_ (JAP) *#^ _Oc. sticticus_ (STC) _Oc. stimulans group_ (SEF) *^ _Oc. triseriatus_ (TRI) ^ _Oc. trivittatus_ (TVT) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) *^ _An. punctipennis_ (PUN) _An. quadrimaculatus_ (QUA) ^ _An. walkeri_ (WAK) #* _Cs. melanura_ (MEL) #*^ _Cs. morsitans_ (MOR) ^ _Cq. perturbans_ (PER) * _Cx. pipiens_ (PIP) * _Cx. restuans_ (RES) * _Cx. pipiens-restuans_ (PRE) * _Ps. ciliata_ (CIL) * _Ps. ferox_ (PFR) * _Ur. sapphirina_ (USA)

2010* Only pooled taxa	2011	2016
^ _Oc. aurifer_ (AUR) ^ _Oc. japonicus_ (JAP) ^ _Oc. provacans_ (PRO) ^ _Oc. stimulans group_ (SEF) ^ _Oc. trivittatus_ (TVT) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) ^ _An. quadrimaculatus_ (QUA) ^ _An. walkeri_ (WAK) ^ _Cq. perturbans_ (PER)	#^ _Oc. abserratus-punctor_ (ABP) ^ _Oc. aurifer_ (AUR) #^ _Oc. canadensis_ (CAN) #^ _Oc. intrudens_ (INT) ^ _Oc. japonicus_ (JAP) #^ _Oc. sticticus_ (STC) ^ _Oc. provacans_ (PRO) ^ _Oc. stimulans group_ (SEF) #^ _Oc. triseriatus_ (TRI) #^ _Oc. taeniorhynchus_ (TAE) ^ _Oc. trivittatus_ (TVT) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) #^ _An. punctipennis_ (PUN) ^ _An. quadrimaculatus_ (QUA) ^ _An. walkeri_ (WAK) #^ _Cs. melanura_ (MEL) #^ _Cs. morsitans_ (MOR) ^ _Cq. perturbans_ (PER) #^ _Cx. pipiens_ (PIP) # _Ps. ferox_ (PFR) # _Ur. sapphirina_ (USA)	^ _Oc. aurifer_ (AUR) ^ _Oc. canadensis_ (CAN) ^ _Oc. communis gr._ (CGR) _Oc. japonicus_ (JAP) *^ _Oc. provacans_ (PRO) ^ _Oc. stimulans group_ (SEF) ^ _Ae. cinereus_ (CIN) ^ _Ae. vexans_ (VEX) _An. punctipennis_ (PUN) _An. quadrimaculatus_ (QUA) _An. walkeri_ (WAK) ^ _Cs. morsitans_ (MOR) ^ _Cq. perturbans_ (PER)

2017		
#^* *Oc. abserratus-punctor* (ABP)	#^ *Oc. trivittatus* (TVT)	#^ *Cs. melanura* (MEL)
^ *Oc. aurifer* (AUR)	^ *Ae. cinereus* (CIN)	^ *Cs. morsitans* (MOR)
^ *Oc. canadensis* (CAN)	^ *Ae. vexans* (VEX)	^ *Cq. perturbans* (PER)
^ *Oc. communis gr.* (CGR)	*An. punctipennis* (PUN)	#^ *Cx. pipiens-restuans* (PRE)
^ *Oc. japonicus* (JAP)	*An. quadrimaculatus* (QUA)	# *Ps. ferox* (PFR)
^ *Oc. stimulans group* (SEF)	*An. walkeri* (WAK)	# *Ur. sapphirina* (USA)
# *Oc. triseriatus* (TRI)		
2018		
Oc. aurifer (AUR)	* *Oc. trivittatus* (TVT)	^ *Cs. melanura* (MEL)
^ *Oc. canadensis* (CAN)	^ *Ae. cinereus* (CIN)	^ *Cs. morsitans* (MOR)
Oc. communis gr. (CGR)	^ *Ae. vexans* (VEX)	^ *Cq. perturbans* (PER)
Oc. japonicus (JAP)	*An. punctipennis* (PUN)	^ *Cx. pipiens-restuans* (PRE)
^ *Oc. stimulans group* (SEF)	*An. quadrimaculatus* (QUA)	# *Cx. Territans* (TER)
Oc. triseriatus (TRI)	*An. walkeri* (WAK)	* *Ps. ferox* (PFR)
		Ur. sapphirina (USA)
2019		
# *Oc. abserratus-punctor* (ABP)	^ *Oc. triseriatus* (TRI)	*Cs. melanura* (MEL)
^ *Oc. aurifer* (AUR)	^ *Ae. cinereus* (CIN)	*Cs. morsitans* (MOR)
^ *Oc. canadensis* (CAN)	*Ae. vexans* (VEX)	^ *Cq. perturbans* (PER)
^ *Oc. communis gr.* (CGR)	# *An. earlei* (EAR)	^ *Cx. pipiens-restuans* (PRE)
^ *Oc. japonicus* (JAP)	*An. punctipennis* (PUN)	# Cx. *salinarius* (SAL)
#^ *Oc. provacans* (PRO)	^ *An. quadrimaculatus* (QUA)	*Cx. Territans* (TER)
^ *Oc. stimulans group* (SEF)	*An. walkeri* (WAK)	*Ur. sapphirina* (USA)

Clinton County's mosquito surveillance in prior seasons took similar approaches. Both trap types were used with similar regularity. CDC light traps capture higher quantities of mosquitoes and therefore will often produce more pools. However, it is the gravid traps that are most likely to produce positive results due to the physiological life stage in which the mosquitoes are captured.

TARGET SPECIES

Mosquitoes of the genus *Culex* have been found to be the primary vector of West Nile Virus. Statistically this can be shown by New York State mosquito pool lab results. In 2002 statewide, 96% of positive mosquito pools tested were of this genus; 92% of these *Culex* pools originated in gravid traps. This is a function of the positive correlation between reproductive behavior of this genus and the conditions indicative of rearing their offspring. Similar numbers were supplied in 2003 when 193 out of 196 or 98.5% of the positive mosquito pools tested were again *Culex*. In 2017 and 2018 100% of positive WNV pools were *Culex* in Clinton County

Clinton County's *Culex* pool statistics have varied over the course of the mosquito monitoring program. Monitoring for the mosquito host for Zika, *Aedes egypti*, resulted in no collections of this species in 2016-2019, suggesting the likelihood of ZIKA virus in Clinton County is very low.

Clinton County *Culex* Pools

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2016	2017	2018	2019
# of Total Pools	52	76	126	175	101	56	93	112	147	117	96	52	93	68	73
# of *Culex* Pools	11	4	31	9	4	8	9	6	5	0	2	0	28	25	7
% *Culex* Pools	21%	5%	25%	5%	4%	14%	10%	5%	3%	0%	2%	0%	30%	37%	10%
# of *Culex* from Gravid Traps	8	0	20	4	3	8	9	4	3	0	20	0	28	25	6
% *Culex* from Gravid Traps	72%	0%	65%	45%	75%	100%	100%	67%	60%	0	50%	0	100%	100%	86%
# *Culex* (WNV) Positive Pools	0	0	1	0	0	0	0	0	0	0	0	0	6	3	0

These fluctuations may be attributed to methods, weather, and other variables that may still be unknown. Evidence has shown the number of gathered *Culex spp* pools increases with gravid trap usage.

OTHER FINDINGS OF INTEREST

Hydrachnidia are a taxonomically unranked group of freshwater mites in which the larvae parasitize a variety of invertebrate hosts (Di Sabatino et al. 2000). Approximately 5% of all mosquitoes caught in CDC light traps during the 2017-18 seasons were parasitized by Hydrachnidia larvae. *Cq. perturbans* (9.63%), *Oc. stimulans group* (8.28%), and *Oc. trivitattus* (4.79%) were the most parasitized. Hydrachnidia are of interest because adult forms feed on mosquito and other insect larvae, thus impacting the ecology of an organism(s) with profound relevance to human health (Di Sabatino et al. 2000).

Figure 1. Adult female *Cq. perturbans* parasitized by freshwater mite larvae.

COMMUNITY PARTNERSHIPS

The ongoing Mosquito-borne Virus Surveillance Program is a partnership with SUNY Plattsburgh's Lake Champlain Research Institute (LCRI). This partner provided valuable services and supplies which made this year's program a success.

Community Partners

1. Lake Champlain Research Institute (LCRI) at Plattsburgh State University
   LCRI Director Dr. Timothy Mihuc
   (Dissecting Microscopes and -20° freezer; Dry Ice Equipment; Lab Space)

MEDIA COVERAGE

In previous years, the Clinton County Mosquito-borne Virus Surveillance Program was featured in the Press Republican as well as WCAX TV Channel 3 and WPTZ News Channel 5. Local media coverage was average this year mainly focused on positive pools as they were reported.

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