Annual Arbovirus Report
Rhode Island, 2021

The Rhode Island Department of Environmental Management (DEM) traps mosquitoes at various locations throughout Rhode Island from early June to late September or October annually. Mosquito traps are placed strategically throughout the state based on the knowledge of environmental conditions conducive to West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) amplification in the mosquito population. Once traps are collected, the mosquitoes captured in each trap are sorted by species into "pools." The Rhode Island State Health Laboratory tests each pool for the presence of WNV and EEE through PCR testing.

Human arboviral cases are investigated by the Center of Acute Infectious Disease Epidemiology within the Rhode Island Department of Health to try to identify potential locations of exposure and ensure that the national arboviral case definition is met. Suspected human cases are reported by providers. Additionally, positive human arboviral test results are received from commercial laboratories by fax or electronic laboratory reports. In either case, confirmatory testing is performed by the Centers for Disease Control in Ft. Collins, Colorado.

2021 Highlights:

- Mosquito traps were set weekly from June 2-October 12, 2021.
- In 2021, 2,613 mosquito pools (28,429 individual mosquitos) were trapped. Of those, 2,598 mosquito pools (28,314 individual mosquitoes) were prioritized for testing for the presence of WNV and EEE, of which six pools tested positive for WNV. No pools tested positive for EEE. In 2020, there was one pool which tested positive for EEE, while no pools tested positive for WNV.
- The WNV positive mosquito pools were collected in East Providence (2 pools), Cranston, Warren, Johnston, and Glocester.
- In 2021, there were two human cases of WNV, one human case of Jamestown Canyon Virus and one human case of Powassan virus reported. There were no human cases of EEE reported in 2021.
- There were no veterinary cases of arboviral disease in 2021.

2021 Rhode Island Arbovirus Surveillance

Total Number of Mosquito Pools Tested	2,598
WNV-Positive Mosquito Pools	6
EEE-Positive Mosquito Pools	0
Human WNV Cases	2
Human Jamestown Canyon Virus Cases	1
Human Powassan Virus Cases	1
Human EEE Cases	0

Over the summer months, DEM issues a weekly mosquito advisory announcing the most recent mosquito pool test results along with information on how Rhode Islanders can prevent mosquito bites. Please refer to the RIDEM website for past and future mosquito advisories, as well as for additional information on mosquito control and prevention.

- Please refer to the RIDOH EEE website for more information on EEE
- Please refer to the RIDOH WNV website for more information on WNV.
- Additional information can be found on the CDC's WNV website and the CDC's EEE website.

Figure 1. Average Mosquito Density per Trap by Week, Rhode Island, 2021

- The figure below demonstrates the weekly Rhode Island mosquito trap density (average number of mosquitos per trap) from June to October 2021.
- Historically, Rhode Island's overall mosquito trap densities peak in late July and early August and decline throughout the remainder of the summer and fall. This is illustrated by both the 2020 and the 5-Year Average (2016-2020) mosquito trap densities. Rhode Island's 2021 arboviral season differed from past years as two mosquito trap density peaks occurred. The first peak that occurred was the traditional peak seen annually. This was followed by a second peak that occurred throughout September and early October and was driven by a steep increase in the population of *Aedes vexans*. There is more information about *A. vexans* on page 6.
- Historically, positive mosquito pools are identified in late summer and early fall in Rhode Island as mosquito-bourne diseases have had the opportunity over the summer to magnify in the mosquito population. Rhode Island's 2021 arboviral season differed from past years as 4 of the 6 WNV positive mosquito pools detected in 2021 were trapped between July 29th and August 5th.

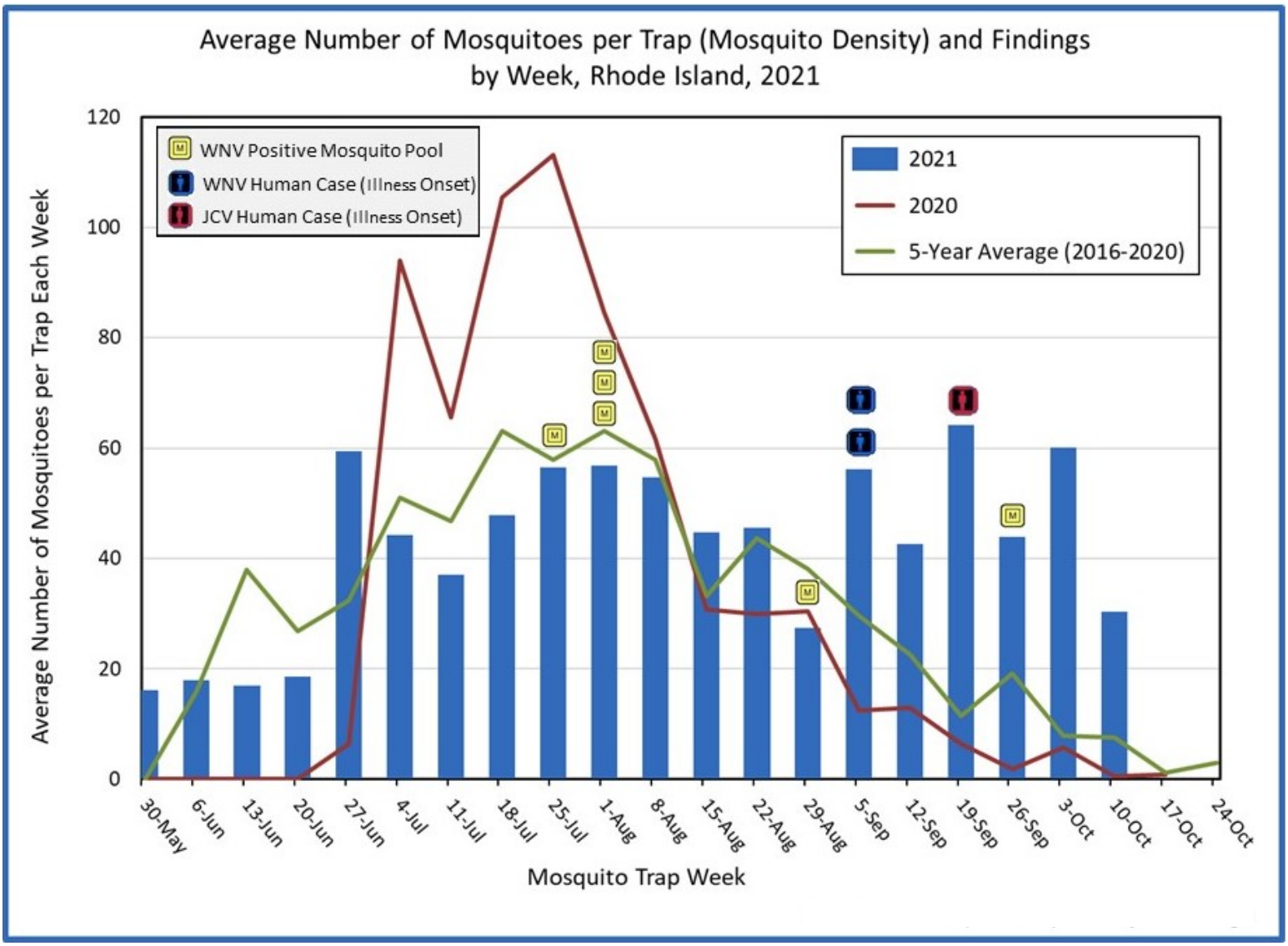

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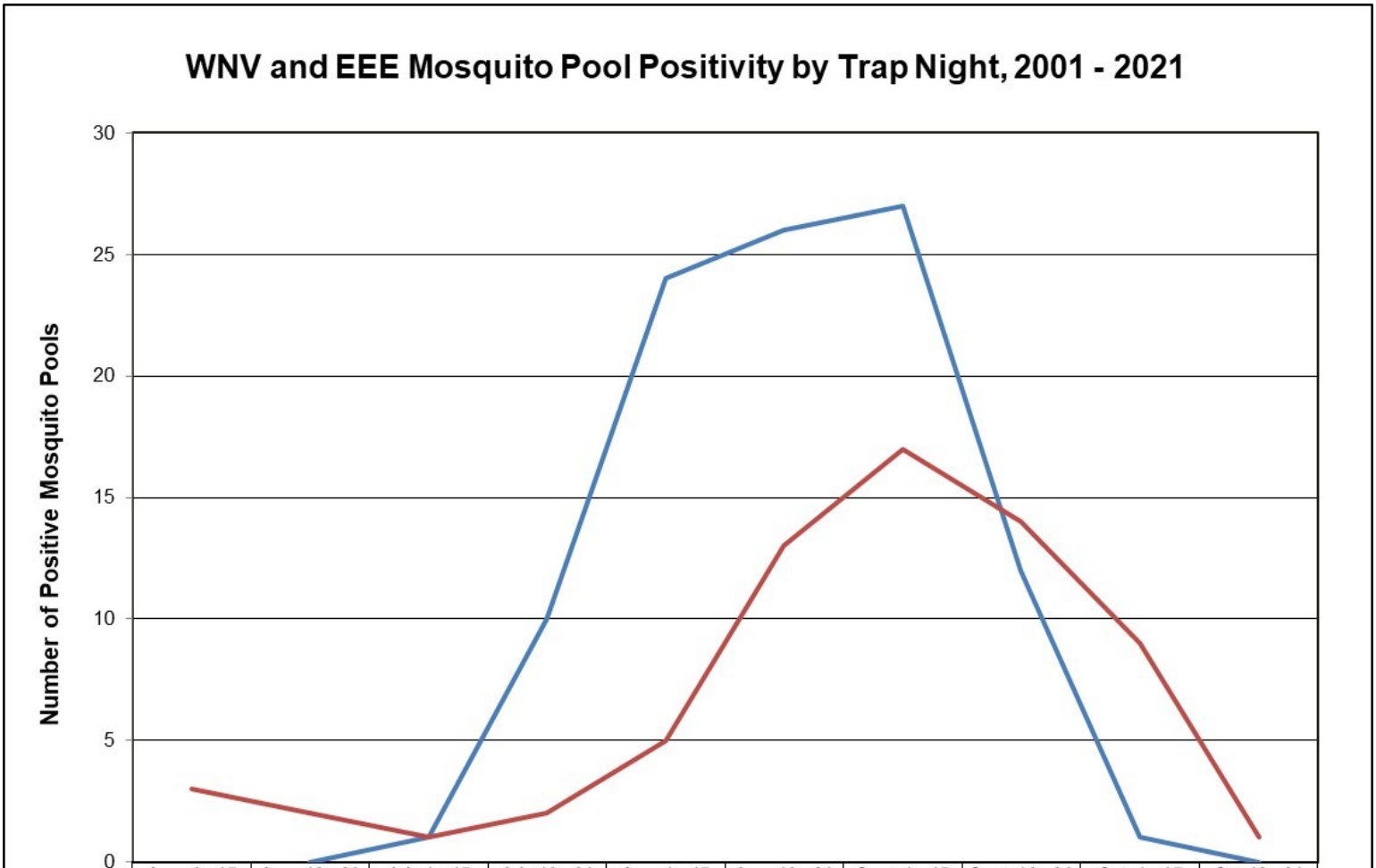
Table 1. Mosquito Surveillance: Pools by Species, Rhode Island, 2021

Between June 6th, 2021 and October 21st, 2021, the Rhode Island Department of Environmental Management trapped 2,613 mosquito pools, of which 2,598 were tested for the presence of WNV and EEE. The table below describes the mosquito species trapped monthly during the 2021 arboviral season. There were three significant species of mosquito which tested positive for West Nile Virus; *Coquilletidia perturbans*, *Culex spp.*, and *Culiseta melanura*. All three species were observed throughout the summer months, giving the virus a chance to amplify and spread throughout the mosquito population.

Species	June	July	August	September	October	Total
Aedes abserratus	5		1			6
Aedes albopictus	1	5	13	7		26
Aedes aurifer	21					21
Aedes canadensis	62	67	90	73	36	328
Aedes cantator	13	3	2	1		19
Aedes intrudens	3					3
Aedes japonicus	5	20	13	20	2	60
Aedes provocans	3	1	1			5
Aedes sollicitans	1	2	1	3		7
Aedes stimulans	5					5
Aedes taeniorhynchus	5	19	27	14		65
Aedes triseriatus	21	56	47	74	5	203
Aedes trivittatus			3	9	7	19
Aedes vexans	23	78	99	133	16	349
Aedes spp.	7	1	1			9
Anopheles crucians	1			7	2	10
Anopheles punctipennis	33	52	64	49	3	201
Anopheles quadrimaculatus	12	31	28	24	11	106
Anopheles walkeri	9	15	29	17	2	72
Coquilletidia perturbans	47	122	103 **2 WNV (+)**	8		280 278 of 280 Pools Tested: **0.7% Positivity**
Culex spp.	45	119 **1 WNV (+)**	155 **2 WNV (+)**	132	13	464 461 of 464 Pools Tested: **0.6% Positivity**
Culiseta melanura	24	28	30	52 **1 WNV (+)**	23	157 156 of 157 Pools Tested: **0.6% Positivity**
Orthopodomyia signifera			1	1		2
Psorophora ciliata				4		4
Psorophora columbiae				1		1
Psorophora ferox		16	42	48	18	124
Uranotaenia sapphirina	2	12	31	21		66
Unknown spp.	1					1
Total	**349**	**647**	**781**	**698**	**138**	**2,613 / 2,598 Tested**

Figure 2. Mosquito Pools Identified by Trap Night

- During the latter part of summer, mosquito populations decrease, but older mosquitos are more likely to carry arboviruses, thus increasing the risk of human infection. This is illustrated in the Figure below. This figure describes the biweekly frequency of WNV and EEE positive mosquito pools for 2001 – 2021.
- As can be seen from the figure, the frequency of positive pools increases through the mid-summer months until it peaks in late early September.



	June 1 - 15	June 16 - 30	July 1 - 15	July 16 - 31	Aug. 1 - 15	Aug. 16 - 31	Sept. 1 - 15	Sept. 16 - 30	Oct. 1 - 15	Oct 16 - 31
WNV	0	0	1	10	24	26	27	12	1	0
EEE	3	2	1	2	5	13	17	14	9	1

Figure 3: Mosquito Trap Density of All Species by MMWR Week:

- The graph below compares five consecutive years (2017-2021) of mosquito trap densities for mosquitoes trapped throughout Rhode Island's arboviral season, in addition to an overall five-year average. Many environmental factors such as temperature, rainfall, availability of breeding grounds, and human travel have the ability to affect mosquito densities throughout the season.
- In 2021, mosquito densities were much higher in September and October when compared to historical data and as mentioned previously, this was due to a steep increase in the population of *Aedes vexans* during that time frame.
- Over the past few years there have been other examples of Rhode Island's overall mosquito densities becoming elevated when compared to historical averages. The increase in late June through late July in 2020 was due to an increase in *Coquillettidia perturbans*, while the increase in mid-August through early October in 2019 was due to an increase in *Culiseta melanura*.

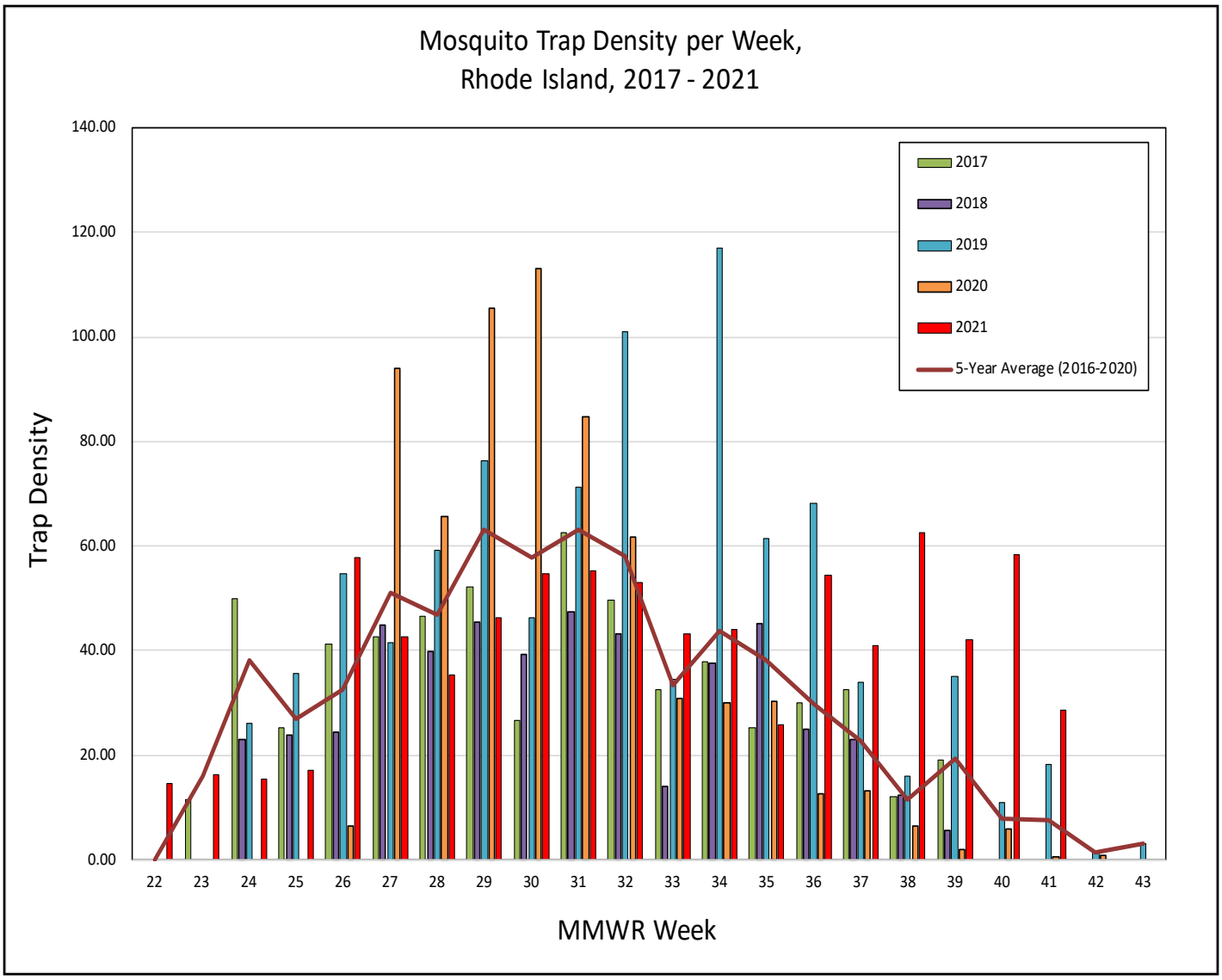


Figure 4: Mosquito Spotlight: *Aedes vexans*

- *Aedes vexans* (i.e. Inland Floodwater Mosquito) is a potential vector for both WNV and EEE, and is typically identified in traps earlier in the season. Females place their eggs in areas that have a high likelihood of remaining moist and also inundated with water at a future point in time. The eggs of this species can lay dormant in dry conditions for several years, which can lead to higher populations in subsequent wet seasons alongside excessive flooding.
- This species rarely tests positive for either virus in Rhode Island, the last positive pool occurring in August of 2005 for WNV.
- Throughout the 2021 season, the density for A. vexans was significantly higher than historical averages for Rhode Island and was most likely due to significant rainfall in Rhode Island during the summer months. For instance, the Providence weather station saw elevated rainfall in July (7.12 inches), August (4.83 inches) and September (5.18 inches), 2021.

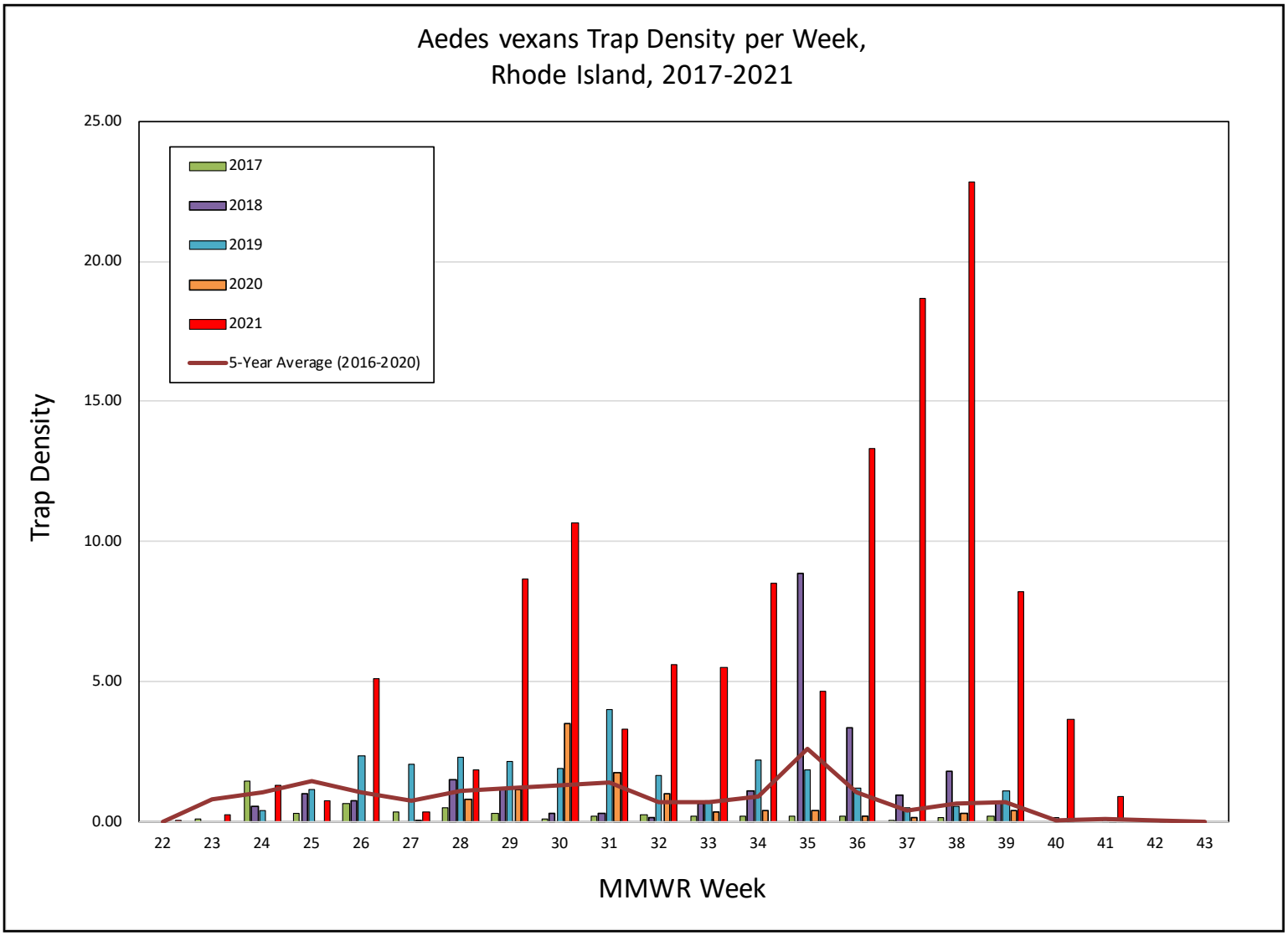
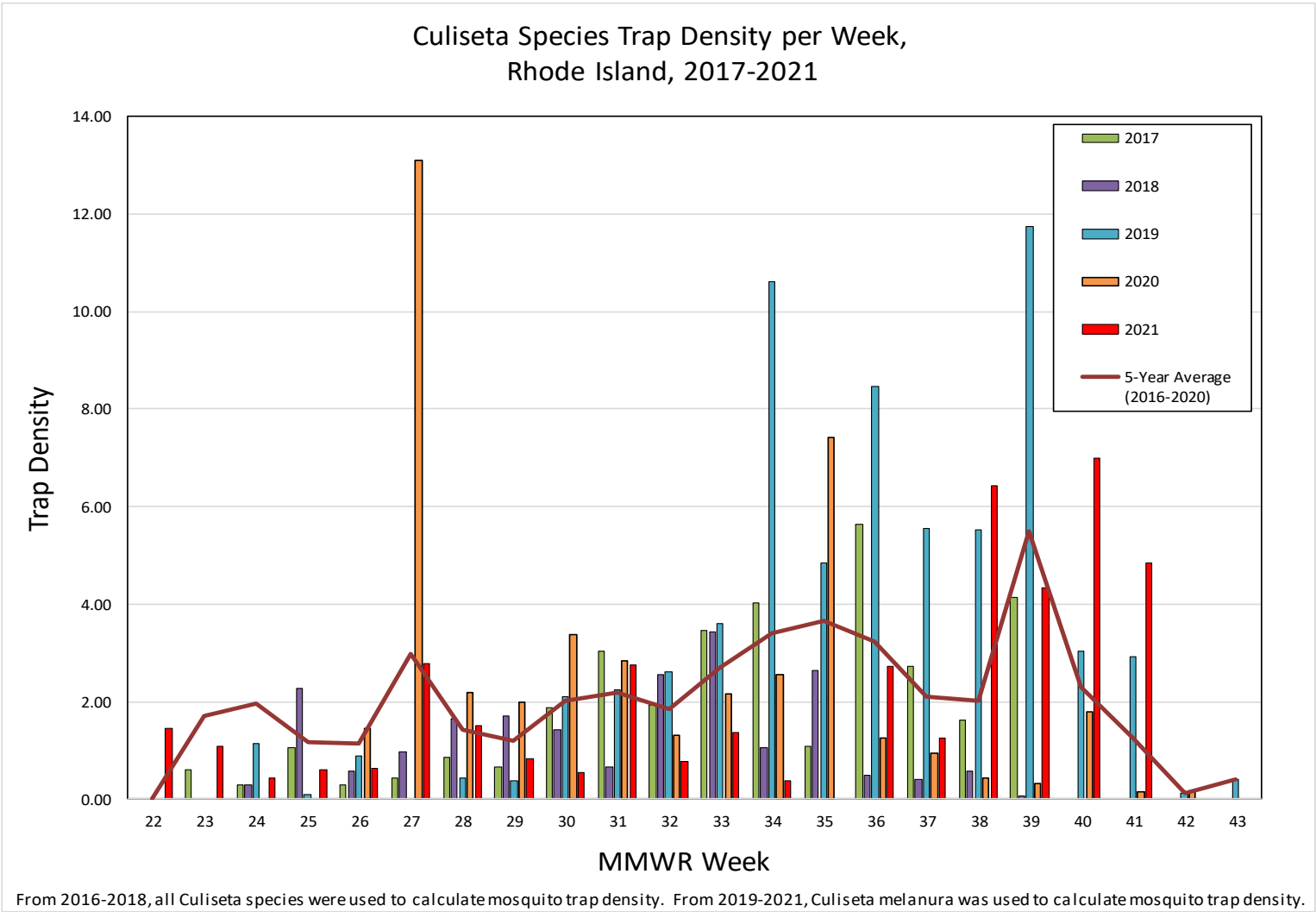


Figure 5. Mosquito Spotlight: *Culiseta melanura*

- *Culiseta melanura* (i.e. Blacktailed Mosquito) is proven to be the mosquito species most important for maintaining EEE in bird populations. This species prefers birds as its main food source and rarely bites humans. Birds act as a reservoir for EEE in the environment. After being bitten by a EEE infected mosquito, birds will become viremic and can transmit the virus to other mosquitoes. Some mosquito species, such as *Coquillettidia perturbans, Aedes* species and *Culex* species, act as bridge vectors as they readily bite both birds and mammals. These mosquitoes can become infected with EEE after biting a mosquito and subsequently transmit it to humans.
- In 2021, *C. melanura* had elevated mosquito densities in September when compared to historical averages. This could potentially lead to an increase in their population in the beginning of Rhode Island's 2022 arboviral season due to overwintering larvae reaching adulthood in the spring.
- In 2019, *C. melanura* had elevated mosquito densities in mid-August through early October. This was the same year that saw Rhode Island and many of the Northeast states have significantly increased EEE findings. For a detailed review of Rhode Island's 2019 EEE outbreak, please refer to Eastern Equine Encephalitis Surveillance and

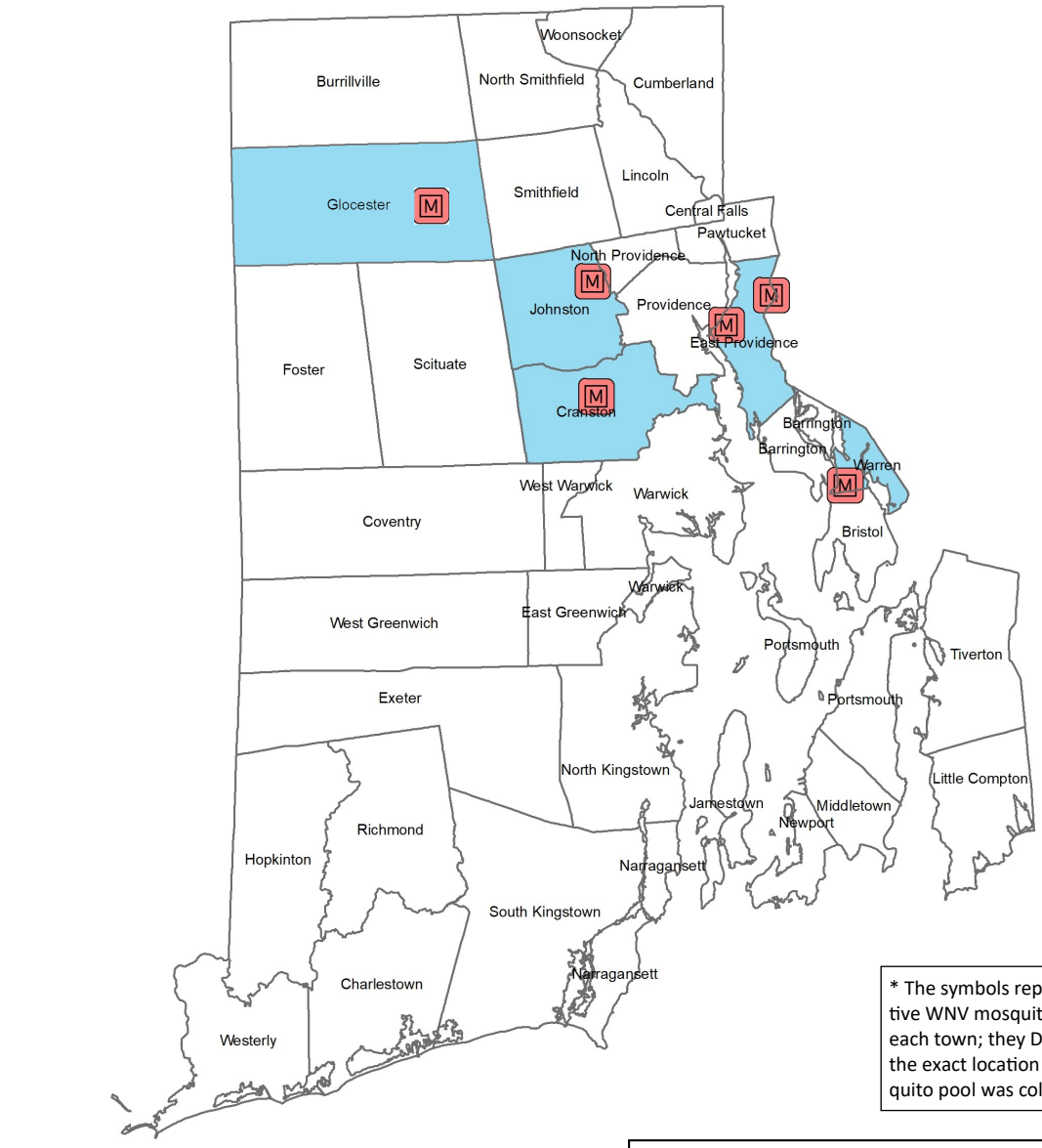


From 2016-2018, all Culiseta species were used to calculate mosquito trap density. From 2019-2021, Culiseta melanura was used to calculate mosquito trap density.

Table 2: Mosquito Surveillance: Mosquito Pools Collected by Town, Rhode Island, 2021

Town	Total Pools	Percentage of all Pools Collected	Positive Pools	Percent Positivity by Town
Barrington	44	1.7	0	0
Bristol	50	1.9	0	0
Burrillville	61	2.3	0	0
Central Falls	72	2.8	0	0
Charlestown	60	2.3	0	0
Coventry	105	4.0	0	0
Cranston	116	4.4	1 WNV	0.9
East Providence	63	2.4	2 WNV	3.2
Exeter	6	0.2	0	0
Foster	87	3.3	0	0
Glocester	96	3.7	1 WNV	1.0
Hopkinton	64	2.4	0	0
Johnston	78	3.0	1 WNV	1.3 **(77 of 78 Pools Tested)**
Lincoln	44	1.7	0	0
Middletown	10	0.4	0	0
Narragansett	8	0.3	0	0
New Shoreham	156	6.0	0	0
Newport	13	0.5	0	0
North Kingstown	188	7.2	0	0
Pawtucket	54	2.1	0	0
Portsmouth	93	3.6	0	0
Providence	39	1.5	0	0
Richmond	60	2.3	0	0
Scituate	64	2.4	0	0
South Kingstown	253	9.7	0	0
Tiverton	144	5.5	0	0
Warren	58	2.2	1 WNV	1.7
Wawick	38	1.5	0	0
West Greenwich	36	1.4	0	0
West Warwick	64	2.4	0	0
Westerly	389	14.9	0	0
Total	**2,613**	**100.0**	**6 WNV**	**0.2 (2,598 of 2,613 Pools Tested)**

Rhode Island West Nile Virus Activity
Rhode Island, 2021



* The symbols represent the positive WNV mosquito pool within each town; they DO NOT represent the exact location where the mosquito pool was collected.

WNV Activity

- WNV Positive Mosquito
- Confirmed WNV Activity

Center for Acute Infectious Disease Epidemiology, Rhode Island Department of Health

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Table 3: Mosquito Surveillance: Summary Data, Rhode Island, 2001-2021

Year	Number of pools tested	Number of positive counties	Total number of positive Pools	Number of WNV positive pools	Earliest positive trap date for WNV	Number of EEE positive pools	Earliest positive trap date for EEE
2001	1856	3	26	14	7/16/2001	6	8/27/2001
2002	1417	2	4	4	8/28/2002	0	NA
2003	2383	4	27	7	8/21/2003	17	9/10/2003
2004	3062	2	7	0	NA	7	7/19/2004
2005	1466	2	2	1	9/19/2005	0	NA
2006	1382	4	19	10	8/8/2006	3	9/17/2006
2007	1048	2	5	5	8/20/2007	0	NA
2008	1207	2	10	10	8/19/2009	0	NA
2009	1138	2	14	3	9/8/2009	4	8/24/2009
2010	1621	3	8	2	8/30/2010	2	8/23/2010
2011	1690	3	3	2	8/22/2011	0	NA
2012	2234	4	16	5	7/9/2012	6	8/6/2012
2013	2311	4	17	8	7/29/2013	4	8/26/2013
2014	1727	2	4	2	8/4/2014	0	NA
2015	2117	3	5	4	8/12/2015	0	NA
2016	1969	3	4	1	7/25/2016	2	8/1/2016
2017	1533	3	5	3	8/7/2017	2	6/26/2017
2018	1967	5	14	10	7/30/2018	4	6/11/2018
2019	2501	4	13	4	8/26/2019	9	8/5/2019
2020	1681	1	1	0	NA	1	8/11/2020
2021	2598	2	6	6	7/29/2021	0	NA

Table 4: Human Arboviral Cases, Rhode Island, 2017-2021

Date	2017	2018	2019	2020	2021	5-Year Total
Eastern Equine Encephalitis Virus (Neuroinvasive)	0	0	3	0	0	3
Jamestown Canyon Virus (Neuroinvasive)	0	0	0	0	1	1
Powassan Virus (Neuroinvasive)	2	0	1	0	1	4
West Nile Virus	2	1	0	0	2	5
Neuroinvasive	1	0	0	0	1	2
Non-neuroinvasive	1	1	0	0	1	3
Travel Associated Arboviral Cases						
Chikungunya	0	0	1	0	0	1
Dengue	1	1	8	1	1	12
La Crosse Virus (Neuroinvasive)	0	1	1	0	0	2
Zika Virus	23	0	0	0	0	23
Zika Virus Disease, Non-congenital	3	0	0	0	0	3
Zika Virus Infection, Non-congenital	20	0	0	0	0	20
Zika Virus Infection, Congenital	0	0	0	0	0	0

Preventing Mosquito Bites

Mosquitoes are carriers (vectors) for many diseases, including West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE). The species of mosquitoes that carry WNV and EEE are found in Rhode Island and bite until the first heavy frost (usually the end of October). Everyone who participates in outdoor activities should take actions to protect themselves from mosquito bites.

WEST NILE VIRUS

Severe West Nile Virus symptoms can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness, and paralysis. Milder symptoms can include fever, headache, body aches, nausea, vomiting, swollen lymph glands, or rash on the chest, stomach, and back.

EASTERN EQUINE ENCEPHALITIS

EEE symptoms include an abrupt onset of chills, fever, generally unhealthy feeling, joint pain, and muscle pain. Signs and symptoms in patients with encephalitis (brain inflammation) are fever, headache, irritability, restlessness, drowsiness, loss of appetite, vomiting, diarrhea, bluish discoloration, convulsions, and coma.

WHAT YOU SHOULD DO

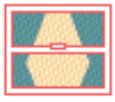
PROTECT YOURSELF

NETTING

Put insect netting over strollers and playpens.

CLOTHING

When spending time outside during warm weather, wear long-sleeved shirts/pants whenever possible, especially if outside during dawn or dusk.



SCREENS

Put screens on windows and doors.
Fix screens that have holes.

BUG SPRAY

Use EPA-approved bug spray with one of the following active ingredients: DEET (20-30% strength), picaridin, IR3535, and oil of lemon eucalyptus or paramenthane-diol.
Do not use DEET on infants.

GET RID OF MOSQUITO BREEDING GROUNDS

CLEAN GUTTERS

Remove anything around your house and yard that collects water. Clean gutters and downspouts to ensure proper drainage.

DUMP STANDING WATER

Remove any water from unused swimming pools, wading pools, boats, planters, trash and recycling bins, tires, and anything else that collects water, and cover them.

PRACTICE SMART SCHEDULING

Avoid scheduling outdoor activities between dusk and dawn.

TIP: Try to end outdoor activities ½ hour before sunset.

For more information, visit the Rhode Island Department of Health's website
www.health.ri.gov/mosquito
or the Centers for Disease Control and Prevention Website: www.cdc.gov/eee

FIGHT THE BITE

Division of Preparedness, Response, Infectious Disease and EMS
Center for Acute Infectious Disease Epidemiology