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Chesapeake Mosquito Control Commission

Annual Report
2019

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February 27, 2020

TO: Citizens of the City of Chesapeake, VA

FROM: Dreda A. Symonds, Director

SUBJECT: 2019 Chesapeake Mosquito Control Commission (CMCC) Annual Report

For readers who need background information on our organization, mosquito biology and mosquito control practices, we refer you to the publication, "Chesapeake Mosquito Control Commission Information Handbook". The following annual report was compiled for those with a basic understanding of mosquito control principals.

Here are some highlights of the 2019 CMCC annual report:

- The **mosquito season was more "average"** than in the past few years, with minimal mosquito-borne disease activity and more manageable nuisance mosquito numbers than last year.
- Although temperatures stayed well above normal, rainfall was close to normal, limiting floodwater mosquito breeding sites.
- The biology laboratory continued our existing pesticide resistance testing and added a **new testing program** for pesticides used to treat standing water (larvicides). This will help us determine the best products to purchase, and make control efforts most cost effective. The lab also monitored multiple field trials of an experimental technique to treat West Nile Virus mosquitoes.
- Field operations continue to become more efficient as we mechanize more pesticide applications and utilize sustained-release products. Although week-acres of larvicides applied were only 6% lower this season (rainfall was significantly lower), the **hours** required to apply those larvicides were **reduced by 18%.**
- The commission remained fiscally responsible by keeping **expenditures below revenues by $777,397 for FY 2019.**

We continue to pledge our commitment to protecting the public's health and comfort. By making mosquito control decisions based on both scientific data and citizen input, we will make the biggest impact on problem species while minimizing side effects on the environment.

Dreda A. Symonds, Director
Chesapeake Mosquito Control Commission

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**NOTE: The financial overview covers fiscal year 2018-2019, while the rest of this report covers calendar year 2019 to encompass one mosquito season.*

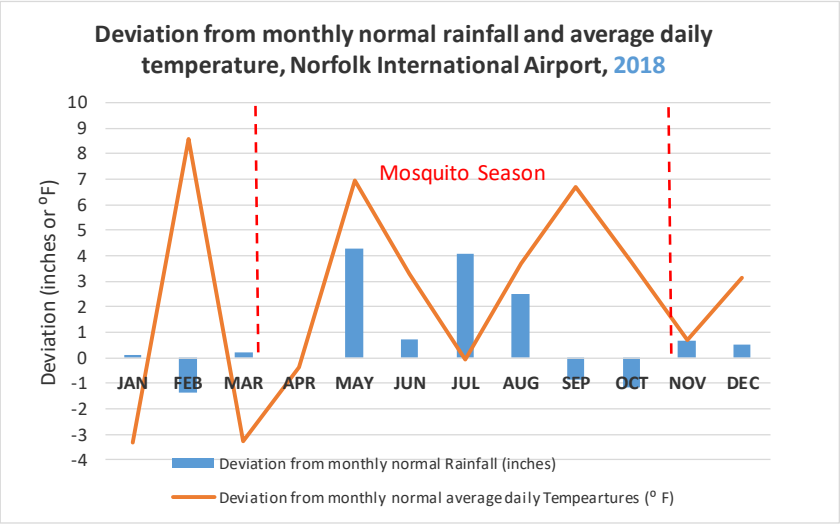
I. ANALYSIS OF THE MOSQUITO SEASON

Weather conditions, mosquito populations & arboviral disease activity

A. General observations

Figure 1 (pg. 1) illustrates the deviation from normal weather conditions recorded at Norfolk International Airport in 2018 and 2019. Unusually high average daily temperatures dominated both mosquito seasons, with those in 2019 being consistently elevated every month. However, rainfall during the mosquito season of 2019 was close to normal, with only one month (August) experiencing more than 1 inch over normal rainfall.

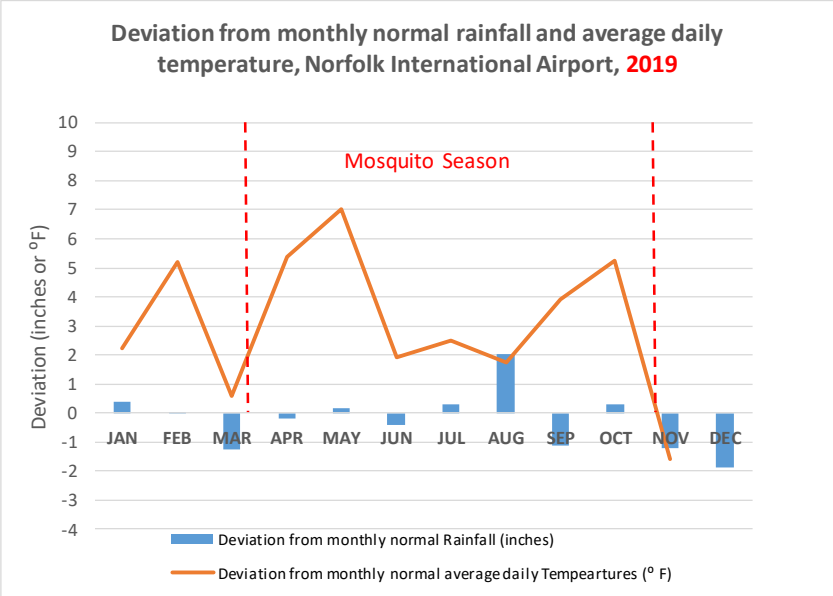
Figure 1. Deviation from normal weather conditions, Norfolk International Airport, 2018 & 2019.



Weather deviations during Mosquito Season

2018 Total Rainfall Deviation = **9.53 inches**

2018 Ave. Daily Temp Monthly Deviation = **3.42 °**



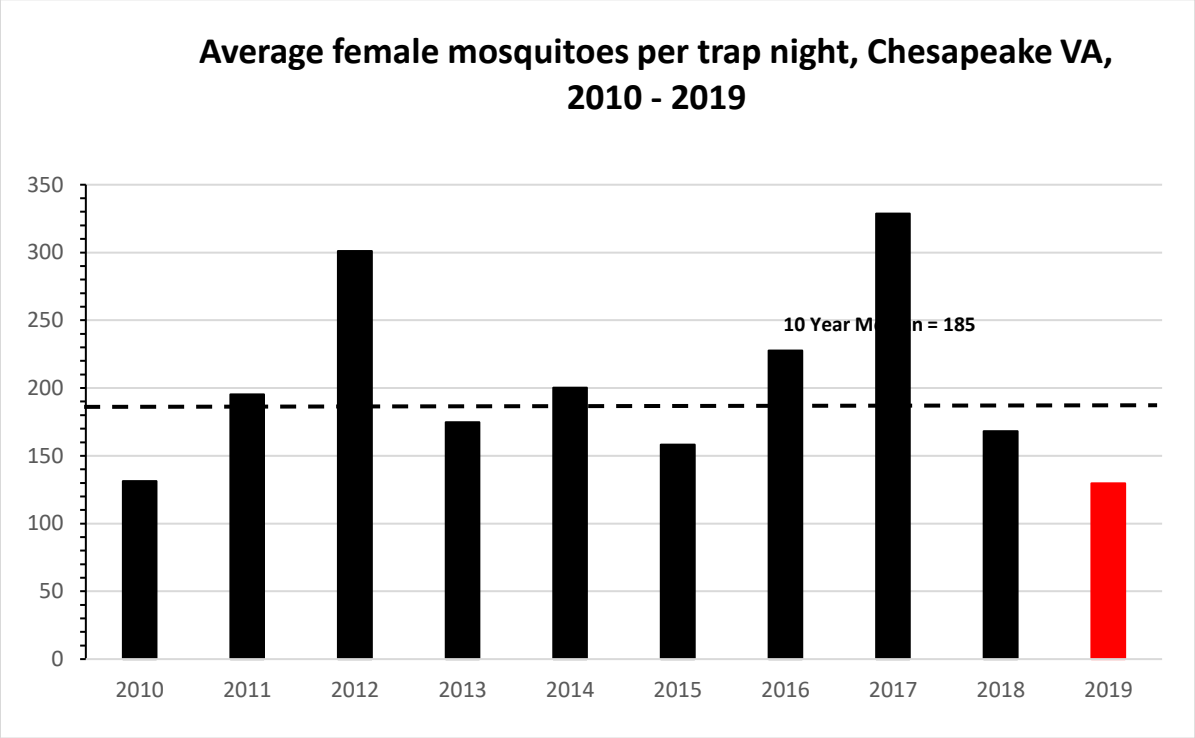
Weather deviations during Mosquito Season

2019 Total Rainfall Deviation = **1.13 inches**

2019 Ave. Daily Temp Monthly Deviation = **3.96 °**

The total number of mosquitoes trapped was ***23% lower*** this season than last. Figure 2 (p. 2) illustrates the fluctuations of the average number of female mosquitoes per trap night over the past 10 years. Although some trap sites and types have changed over the years, many have remained constant, so this is likely an accurate representation of overall mosquito abundance through the years.

Figure 2. Comparison of overall number of mosquitoes trapped, CMCC, 2010 – 2019.



Much of the decrease in 2019 was concentrated in those species that can result in extreme nuisance to our citizens. *Cs. melanura* (the EEE primary vector) underwent a slight decrease in numbers trapped, while *Cx. pipiens* (the WNV mosquito) experienced a more significant drop in numbers (19%) (Figure 3, p. 3).

Figure 3. Comparison of catches of species of interest, CMCC, 2018 vs. 2019.

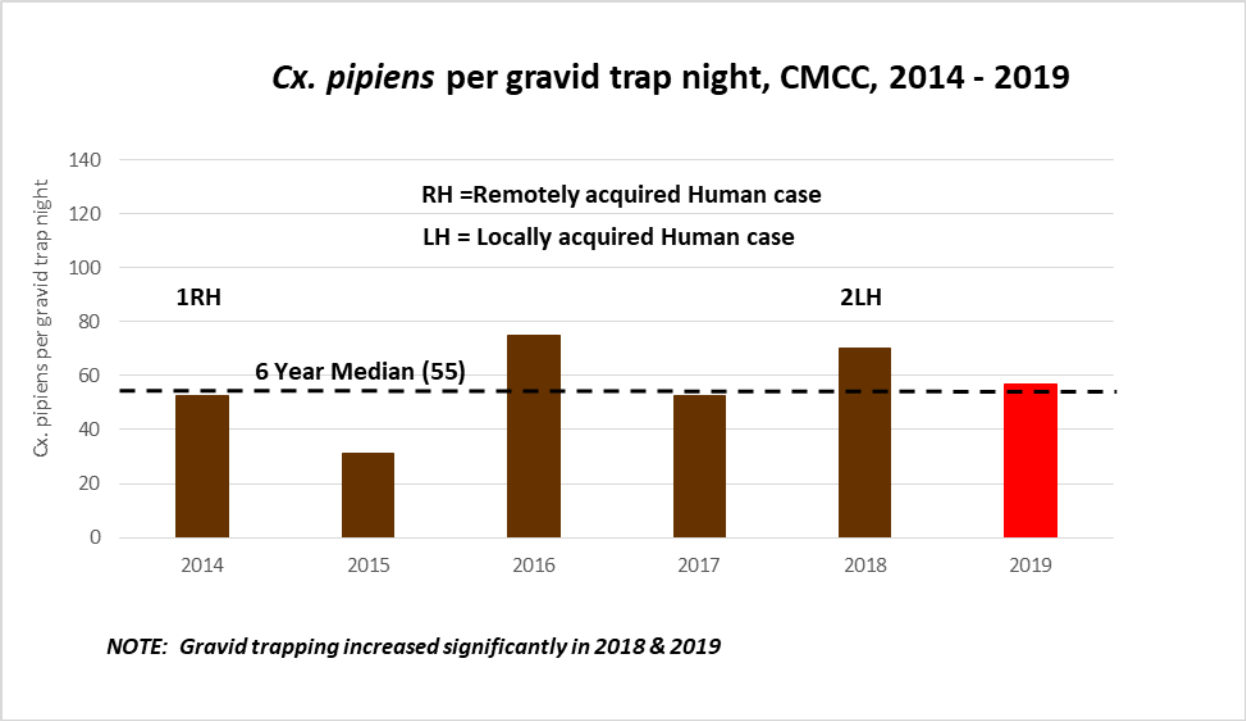
2018 / 2019 Catch Comparisons - Species of Interest	2018 Total Catch	*Per Trap Night*	2019 Total Catch	*Per Trap Night*	*% Increase / Decrease per Trap Night*	Reason for concern when higher (pink highlight)
Ae albopictus	8,107	40	7,738	39	-3%	Nuisance / WNV bridge vector
Ae vexans	2,322	3	1,696	2	-28%	
An crucians/bradleyi	15,557	*20*	10,666	*14*	-32%	
An punctipennis	1,634	*2*	731	*1*	-56%	
An quadrimaculatus	4,914	*6*	2,502	*3*	-50%	Nuisance at night
Cq pertubans	15,112	19	23,364	30	**53%**	Nuisance / EEE bridge vector
Cs melanura	69,105	89	68,717	88	-2%	
Cx erraticus	8,910	*11*	11,848	*15*	32%	EEE bridge vector
Cx pipiens	19,914	*70*	24,653	*57*	-19%	WNV Primary & bridge vector
Cx restuans	206	*1*	413	*1*	31%	
Cx salinarius	20,360	*26*	11,171	*14*	-46%	Nuisance / bridge vector
Cx territans	114	0	170	0	48%	
Oc atlanticus	7,262	9	959	1	-87%	Extreme nuisance
Oc canadensis	3,889	5	4,391	6	12%	EEE bridge vector
Oc infirmatus	1,826	2	1,531	2	-17%	
Oc solicitans	15	*0*	6	*0*	-60%	
Oc taeniorhynchus	16	0	12	0	-26%	
Oc triseriatus	125	*0*	89	*0*	-30%	
Ps ciliata	157	0	30	0	-81%	
Ps columbiae	13,771	18	8,124	10	-42%	Extreme nuisance
Ps ferox	16901	*22*	3771	5	-78%	Extreme nuisance
Ps howardii	101	*0*	56	*0*	-45%	
Total Female Species of Interest	**210,318**	***167***	**182,638**	***129***	***-23%***	

B. Specific observations

1. West Nile virus (WNV) mosquitoes

Cx. pipiens, both the primary and bridge vector of West Nile virus, was of great concern at the outset of this season due to the high WNV activity rate and the locally contracted human cases in 2018. The 2019 number of *Cx. pipiens* per routine trap night (57) was just slightly over the 6 year average of 55 (figure 4, p.4), reflecting a decrease in local populations from the previous season.

Figure 4. *Cx. pipiens* (WNV mosquitoes) per trap night, CMCC, 2014 – 2019.



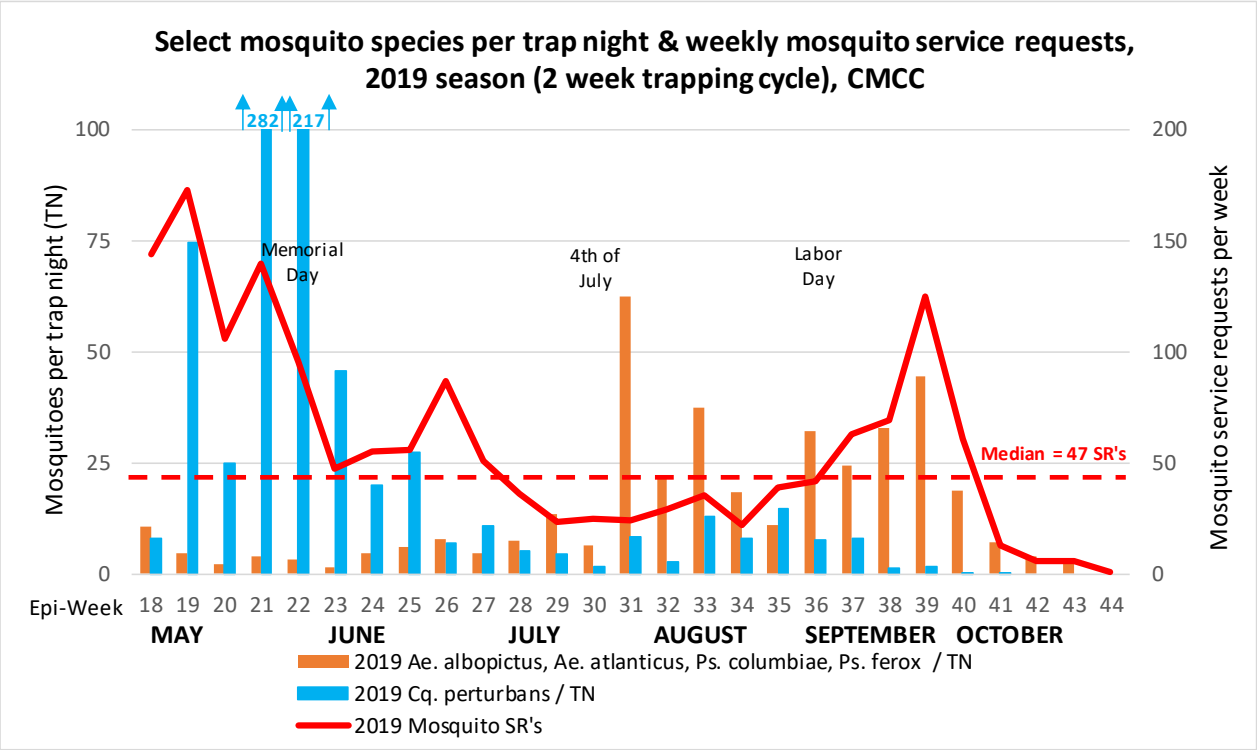
The biology laboratory conducted additional *Cx. pipiens* surveillance in areas of special concern and in areas where a new type of control method for this species was being evaluated. 101 extra gravid traps were deployed in 2019 (data not included in the summary above).

2. Nuisance mosquito species

As figure 3 (p. 3) illustrates, at least seven species of nuisance mosquitoes (green highlight) were less numerous in 2019 than in 2018. Most of these species take advantage of either containers with rainwater, or floodwaters resulting from rainfall, to breed. With the exception of August, rainfall from April through October was near normal or slightly below. These conditions helped keep floodwater species populations below the high levels of 2018.

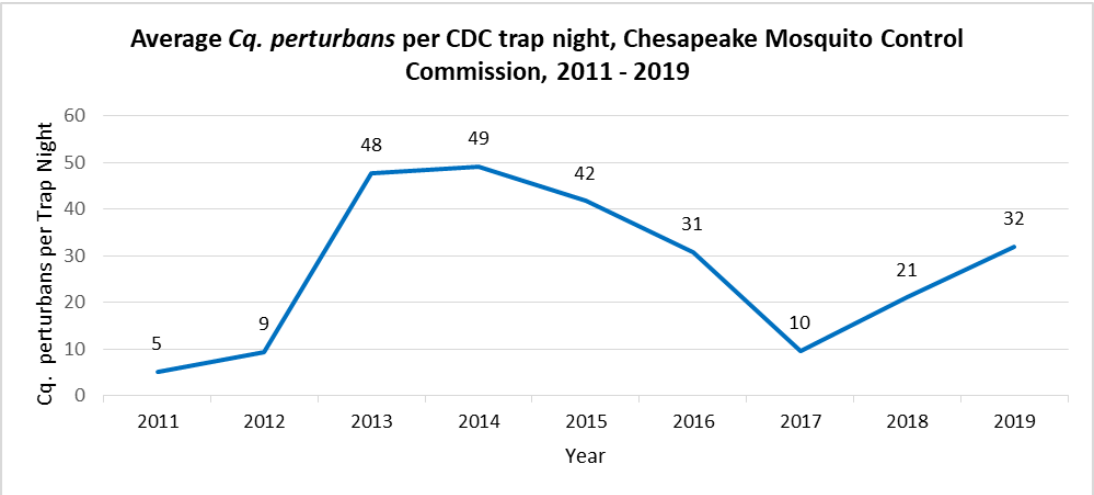
Our response to mosquito problems varies depending on the species. However, service requests usually increase with the rise of certain mosquitoes, and most dramatically from mid to late season in response to nuisance species *Ae. atlanticus*, *Ps. ferox*, *Ps. columbiae* and *Ae. albopictus*. Note the correlation between the catches of these species (gold bars) and mosquito service requests from August through October illustrated in figure 5 (p. 5). Even more dramatic is the effect that high populations of *Cq. perturbans* (blue bars) has on service requests during the first half of the season.

Figure 5. Weekly nuisance mosquito abundance vs. citizen service requests, CMCC, 2019.



Cq. perturbans is a large, aggressive mosquito that breeds in cattail marshes and is most abundant in late May. Populations seem to fluctuate in a long cycle of several years (see figure 6, p. 5). This species is very difficult to control in the immature stages, due to the inaccessability of its breeding sites. However, it is a strong flyer and will travel to nearby neighborhoods where it causes problems for residents. The Commission always responds to these invasions with nighttime spray. However, we are working on plans for future larvicide treatments of cattail marshes to control these mosquitoes before they emerge and become a problem.

Figure 6. Fluctuation in *Cq. perturbans* populations over 9 years, CMCC

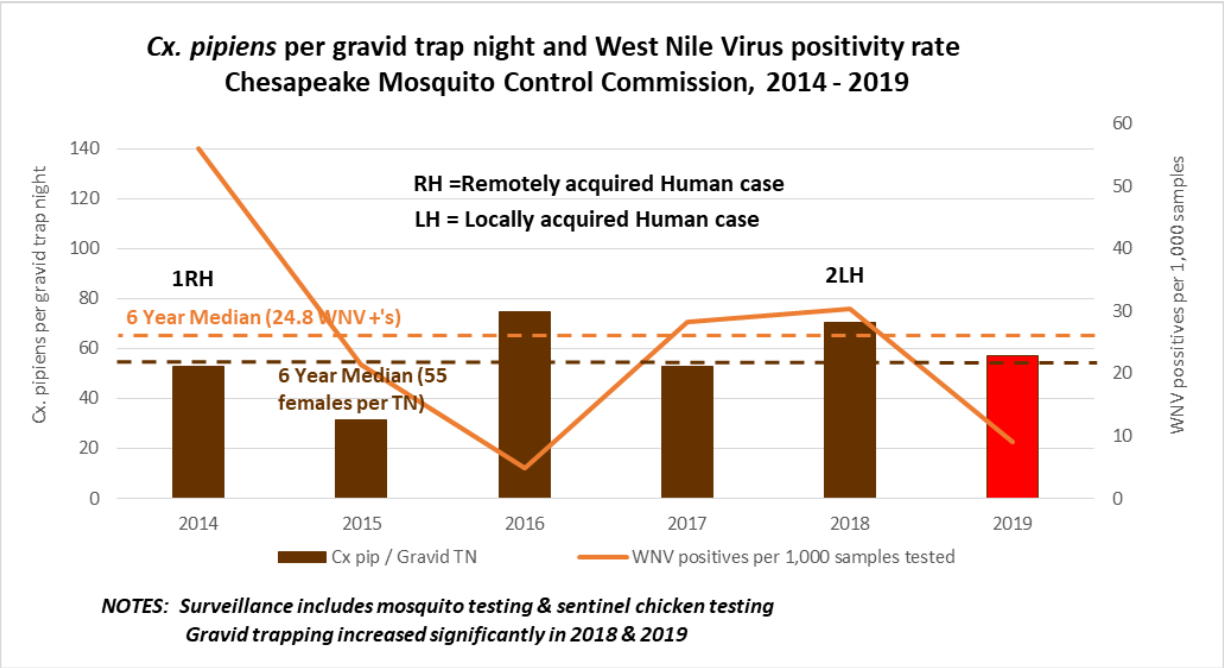


C. Arboviral (mosquito-borne) disease activity

1. West Nile Virus (WNV)

WNV activity decreased significantly in 2019 after reaching a recent peak in Virginia and all along the eastern seaboard during 2018. Figure 7 (p. 6) illustrates catches of the primary vector (*Cx. pipiens*) in Chesapeake from 2014 to 2019, and the WNV positivity rate of samples tested. Although 2019 *Cx. pipiens* populations appeared to be slightly higher than normal, WNV activity as measured by positive mosquito pools and chicken sera seemed to be much lower. The Virginia Department of Health Entomologist postulates that WNV activity in Virginia appears to be on a three-year cycle in more recent years, with 2021 slated to be the next problematic year. This species is difficult to control, and CMCC is currently engaged in a study of a novel approach to target resting, gravid females.

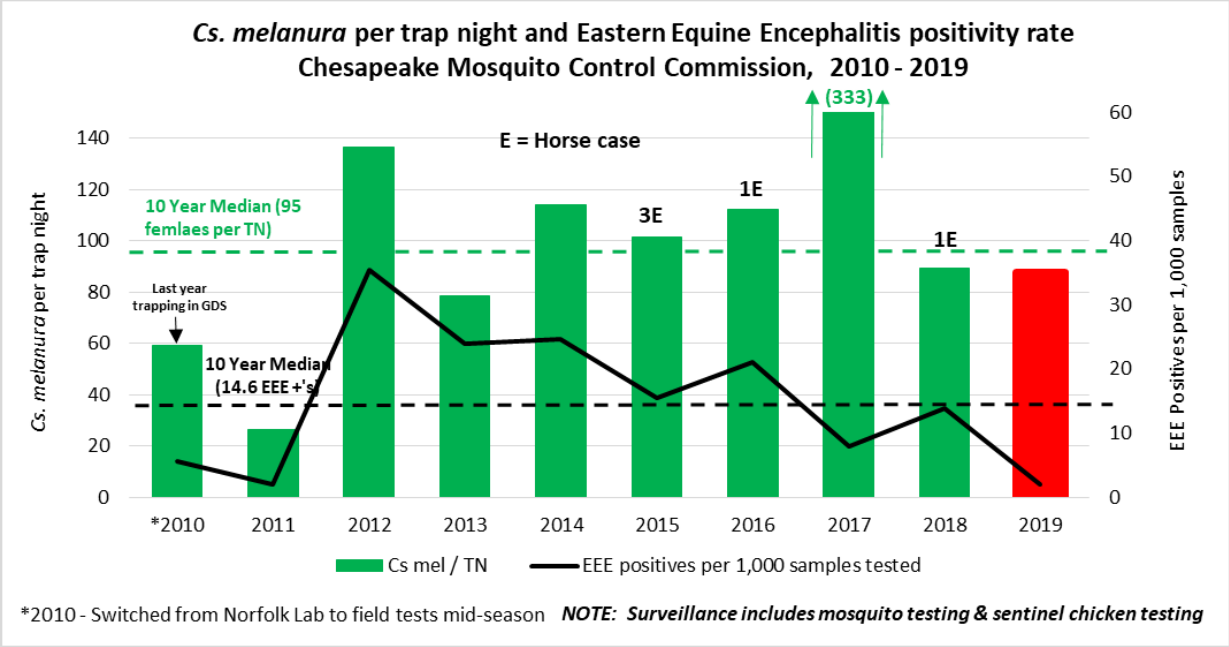
Figure 7. *Cx. pipiens* gravid trap catches and WNV positivity rates, CMCC, 2014 - 2019



2. Eastern equine encephalitis (EEE)

Figure 8 (p. 7) illustrates the relationship between catches of the primary vector (*Cs. melanura*) and the EEE positivity rates of samples tested over the past 10 years. 2019 and 2018 catches of *Cs. melanura* were very similar, but EEE activity measured by our testing was at a 10-year low in 2019. There does not seem to be a direct correlation between abundance of this primary vector and EEE activity in recent years. Therefore, it is important to maintain testing programs for EEE, rather than relying solely on mosquito numbers to determine risk of infection.

Figure 8. *Cs. melanura* trap catches and EEE positivity rates, 2010 - 2019



II. OPERATIONS

Accomplishments, work reports & service requests

A. Biology Laboratory

1. Surveillance

Figure 9 (p. 8) contains details of the Biology Laboratory work report, 2018 vs 2019. The employee compliment for the 2018 mosquito season was one full time Biologist II, one full time Biologist I, two part-time seasonal student interns, and one extended intern. This extended intern position was eliminated in 2019 when the biology technician position was reinstated and filled. Note the 12% increase in number of routine traps set, the 19% increase in pesticide resistance tests and the addition this year of larvicide efficacy tests and Nuvan strip trials for *Cx. pipiens* control. Lower female mosquitoes and mosquito pool numbers are indicative of lower mosquito populations and better control measures rather than decreased laboratory efficiency.

Figure 9. Biology Laboratory work report, 2018 & 2019.

Biology Lab	2018	2019	% Increase / Decrease
Total FTE's (includes seasonal)	**3.77**	**3.48**	**-8%**
Total Routine Traps Set	1,259	1,413	12%
*Total Female Mosquitoes	211,669	189,927	-10%
Total mosquito pools tested	1,146	1,089	-5%
Total Chicken Samples	420	400	-5%
**Total Larval surveys	102	60	-41%
Total pesticide resistance tests	26	31	19%
Special projects			
Larvicide efficacy tests		18	N/A
Special trap settings (e.g., Nuvan strip trials)		102	N/A
Education / Outreach (includes Director)			
School sessions	23	22	
Outreach Activities	7	8	
***Training	9	10	
Total Education / Outreach	39	40	3%

**2019 Total Female Mosquitoes = routine catches + 6,675 from special settings*

***Aerial program in 2018 required monitoring fewer larval sites more frequently*

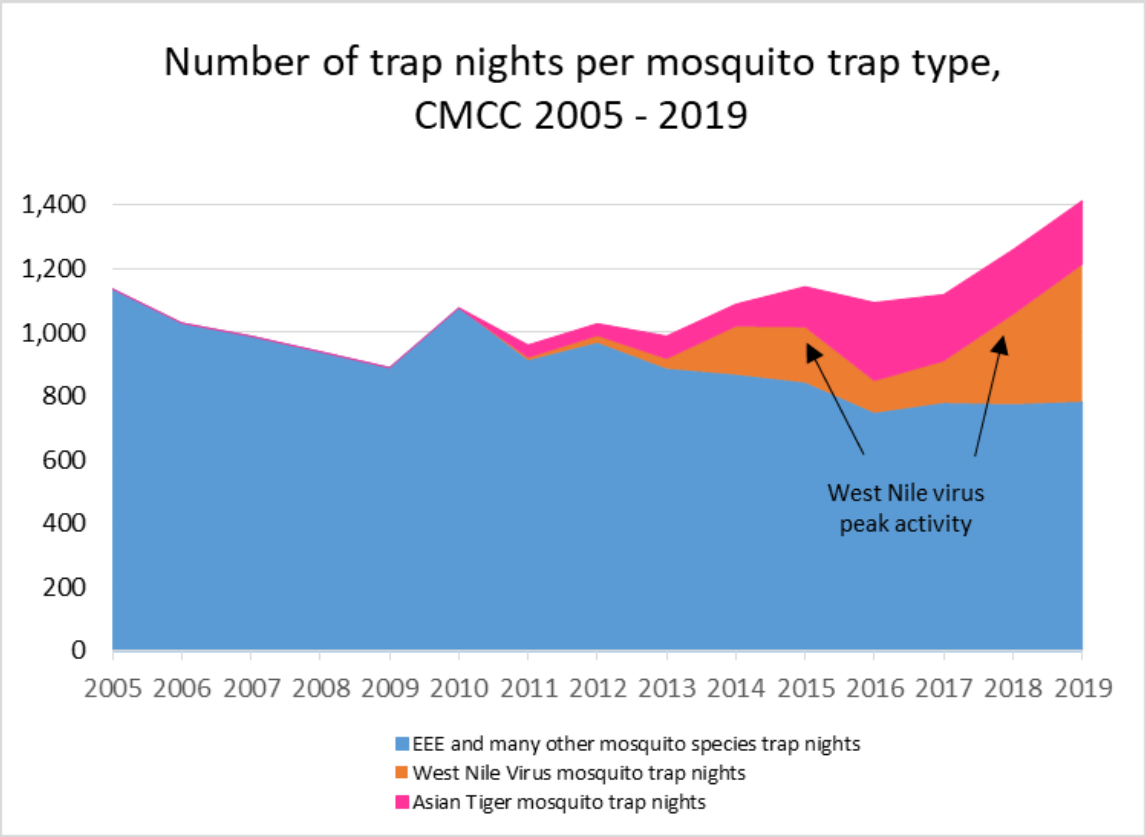
****Training includes presentations at regional conferences, teaching classes for state and regional associations, in-house personnel training and onboarding.*

2. Mosquito monitoring strategy

Although it is important to retain most trapping sites for historic reference, it is also vital to change other aspects of the mosquito monitoring program to adapt to changing conditions and control strategies. The biology laboratory eliminated some sites that produced redundant information in 2018, and changed the trapping cycle from a 3-week to a 2-week cycle. This 2-week period was chosen to more accurately measure the impact of control efforts. The information from this cycle is more useful for field operations and will be continued next year.

The lab has also become more responsive to the types of traps necessary during each mosquito season. Figure 10 (p. 9) illustrates the increase in routine trap nights of particular trap types over the years. Note that the emphasis on surveillance for WNV mosquitoes has increased, as has that for the Asian Tiger, a potential Zika vector and extreme nuisance species.

Figure 10. Change in routine trapping strategy, CMCC, 2005 – 2019.

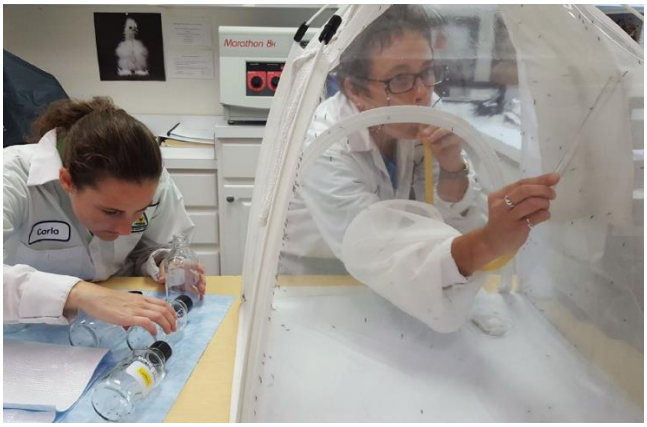


3. Pesticide efficacy testing

a. Adult mosquito tests

Bottle bioassays of local *Culex pipiens* & *Aedes albopictus* populations were continued this season (see figure 11, p. 10) with important results. According to the Centers for Disease Control protocols, some of our local mosquito populations are resistant to some of the active ingredients in our adulticides. However, the adulticides also include other ingredients that can make them more effective, so more practical field tests of caged mosquitoes are planned for 2020.

Figure 11. Egg raft collection and pesticide resistance testing in the CMCC Biology Laboratory



b. Immature mosquito tests

Sustained-release larvicide formulations can save labor hours by reducing the number of times a mosquito breeding site is treated. The longer the pesticide is active, the more savings can be realized, and the greater the number of sites treated. However, these savings are unimportant if the formulation does not stand up to the active period that the label claims. The biology lab performed field evaluations of some larvicides and designed tests for others under semi-controlled conditions. Figure 12 (p. 10) illustrates the experimental pools designed and produced in the small engine mechanic's shop especially for these trials. Thousands of mosquito larvae were required, so the biologists and techs spent many extra hours collecting eggs and rearing larvae to 2nd instar stage (figure 12, p. 10) to stock the experimental pools. Since the formulations are sustained-release, the trials take considerable time, so they will be continued into 2020 and beyond.

Figure 12. A larvicide test pool and larvae for stocking

B. Control Operations

1. Drainage maintenance

Figure 13 (pg. 11) illustrates control work accomplished during calendar years 2018 and 2019 and the percent increase or decrease per category. Note that although most categories under drainage maintenance indicate an increase in accomplishments, the hours required to perform this work decreased by 14%.

Figure. 13. Control operations work report comparison, calendar years 2018 - 2019.

Control Operations Work Report Comparison	2018	2019	% Increase / Decrease
Field Personnel - Total FTE's	**21.52**	**20.52**	**-5%**
Drainage Maintenance			
Bush - Mach (acres)	25	27	8%
Cleaning (miles)	24	24	0%
Refuse Removed (tons)	32	37	16%
Total Drainage Maintenance hours	***6,395***	***5,528***	***-14%***
***Path clearing (miles cleared)**	*Not recorded*	25	
Inclement weather / maintenance	4,845	3,820	-21%
Pesticide Application			
**Ground Larvicidng (week-acres)	12,712	11,953	-6%
Ground Larvicide Application hours	*19,034*	*15,585*	*-18%*
# of Backyard ULV Treatments (Asian tiger problems)	2,214	861	-61%
Ground ULV (acres truck-mounted + UTV+ backyard+ catch basins)	674,221	258,927	-62%
Total Ground Pesticide Application Hrs.	***21,210***	***16,821***	***-21%***
Aerial Larviciding (week-acres)	1,076	0	-100%

Service Requests (dependent on environmental conditions)			
Mosquitoes	2,601	1,694	-35%
Drainage	77	76	-1%
Property Release	64	31	-52%
Special Event Treatment	135	155	15%
Other	115	96	-17%
TOTAL	**2,992**	**2,052**	**-31%**

**Making sites accessible for pesticide application*

***Week-acres = number of Weeks of larval control X Acres treated*

2. **Pesticide application**

a. **Ground larviciding**

Ground larviciding encompasses application of 150-day and 30-day sustained release pesticides, application of various types of granules via hand or through blowers through special projects, and application of liquid larvicides to road-side ditches from our jeeps. Note the 6% decrease from 2018 in week-acres treated. This is directly related to a drier season with fewer breeding sites to treat. The fact that labor hours decreased by 18% this year can be attributed to further mechanization of our ground larviciding program.

Operations Support tuned, updated and calibrated the buffalo turbine (figure 14, p. 12), which was used routinely for the first time in 2019. This machine is useful under certain circumstances when granule application over large areas is desirable. Although it is limited to roadside operation, it has proven very effective this season.

Figure 7. Buffalo turbine.

b. **Ground adulticiding (ULV or nighttime spraying)**

Adulticiding (Ground ULV in figure 6, p. 4) is employed when surveillance indicates that species action thresholds have been met, when arboviral disease is detected, or when mosquito service request numbers are high. None of these conditions were as prevalent in 2019 as they were in 2018, so ground adulticiding decreased accordingly. Species of interest were down 23%, arboviral disease positives were down 72% and mosquito service requests were down 35% from 2018.

C. Goals & Challenges for 2020

1. Arboviral diseases

West Nile virus continues to be the mosquito-borne disease of greatest concern to people in Chesapeake. The primary vector, *Cx. pipiens*, has been difficult to control through traditional techniques in some neighborhoods. We began a novel approach this season by targeting areas where we think the adult females are resting, in underground stormwater catch basins and pipes. Since this species overwinters as adult gravid females in the same type of environments, we continued the treatment through January of 2020 in certain neighborhoods. Early gravid trap catches in 2020 will help us assess the effectiveness of this treatment and help us determine whether to expand its use.

2. Coquillettidia perturbans

If the long-range population fluctuation trends of this species continue, 2020 will be a year of peak numbers and may present a severe nuisance problem early in the season. This species is also a potential bridge vector for EEE, so we will be monitoring it closely and responding quickly to rising numbers with multiple nighttime spray treatments.

To combat this mosquito in the future, we hope to implement a fall aerial larvicide treatment to target cattail marshes where the immatures develop over the winter. The first step in planning this treatment is to identify the boundaries of the marshes and document the areas. We have purchased a surveillance drone for this purpose and will begin the mapping process in spring of 2020.

3. Pesticide resistance studies

The biology laboratory will continue testing sustained-release larvicides to assure that we are using the most effective formulations available. They will also conduct adulticide field tests on caged adult female mosquitoes. These tests will use technical grade pesticides rather than pure active ingredients, and will take into account all the other components of the formulations that may affect their efficacy.

Financial Overview

CITY OF CHESAPEAKE, VIRGINIA
2019 COMPREHENSIVE ANNUAL FINANCIAL REPORT *Schedule T-2*
Statement of Revenues, Expenditures, and Changes in Fund Balance
Chesapeake Mosquito Control Commission
Year Ended June 30, 2019

REVENUES	
Property taxes*	$ 4,628,352
Investment income	67,154
Other	154,637
Total revenues	4,850,143
EXPENDITURES	
Other salaries and wages	1,824,103
Other fringe benefits	794,567
Other repairs and supplies	714,689
Insurance premiums	234,458
Capital outlay	144,003
Other	360,926
Total expenditures	4,072,746
Excess of revenues over expenditures	777,397
Net change in fund balance	**777,397**
Fund balance – beginning	**$ 4,510,339**
Fund balance – ending	**$ 5,287,736**

Reconciliation to Change in Net Assets:

Governmental funds report capital outlay as expenditures. However, when reporting net assets, the cost of those assets is allocated over their estimated useful lives and reported as depreciation expense.

Net change in fund balance	$ 777,397
Pension expense	329,409
OPEB expense	33,508
Depreciation expense	(153,570)
Capital outlay expenditures	144,003
Change in Net Position	$ 1,130,747

**The City finances the operations of the Commission through incremental property taxes of $.01 per $100 of assessed value for real estate properties and $.08 per $100 of assessed value for personal property.*