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Chesapeake Mosquito Control Commission

Annual Report
2016

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CHESAPEAKE MOSQUITO CONTROL COMMISSION OVERVIEW OF 2016

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Chesapeake
VIRGINIA
MOSQUITO CONTROL COMMISSION
HEALTH • SAFETY • COMFORT

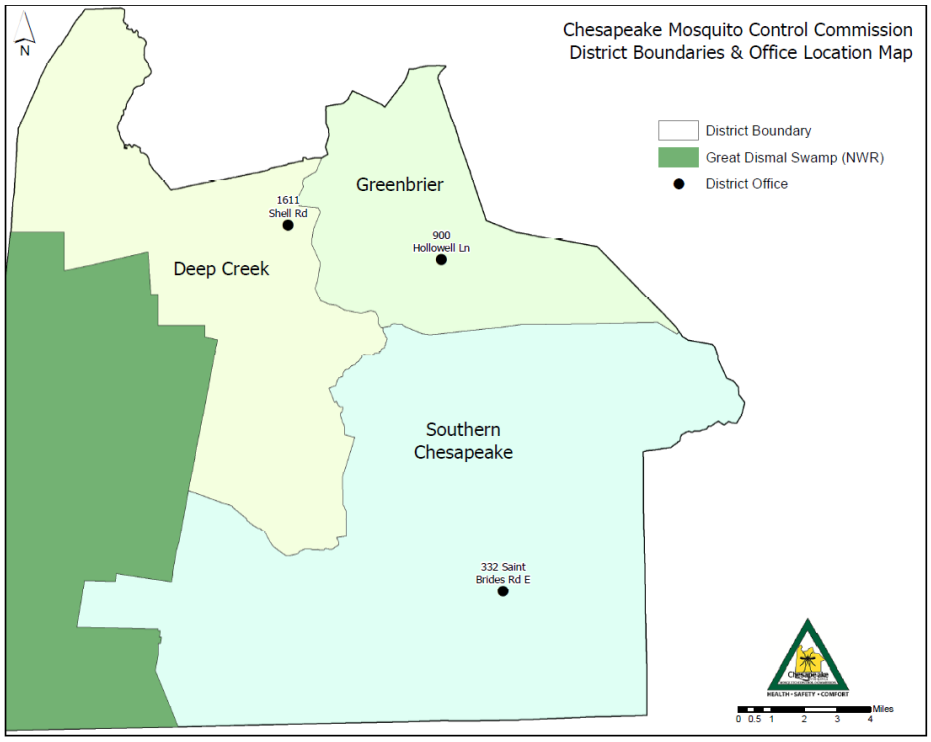
GENERAL INFORMATION ON MOSQUITOES & MOSQUITO CONTROL IN THE CITY OF CHESAPEAKE

Mission and Organization

The mission of the Chesapeake Mosquito Control Commission is to protect the health and welfare of the citizens and visitors of Chesapeake by controlling mosquito populations and mosquito-borne diseases. Our philosophy is to use integrated pest management (IPM) practices, with an ecologically sensitive approach. By employing several different control techniques and the safest, most effective pesticides for target species, we strive to achieve our goals with minimal disruption to people or the environment.

The Chesapeake Mosquito Control Board of Commissioners consists of six volunteer members appointed by the Chesapeake City Council, and a designee of the Virginia State Health Commissioner who serves as Commission Chair. The commissioners' role is oversight of the operating budget and the overall mosquito control program. Details of the operation and day-to-day financial decisions are the responsibility of the Director.

The Commission consists of three working districts: Deep Creek, Greenbrier and Southern Chesapeake. Administration headquarters and the biology laboratory are located at the Deep Creek office.



History of Mosquito Control in Chesapeake

Following is the sequence of events leading to the creation of five independent mosquito control districts in what is now the City of Chesapeake, Virginia, and their eventual consolidation into one operation. Each of the five commissions originally operated independently and were individually funded by special taxes levied specifically for mosquito control.

May, 1948 - The Norfolk County Board of Supervisors created ***Deep Creek*** Mosquito Control Commission, which served that district only.

November, 1949 – The City of ***South Norfolk*** Council voted in favor of creating their own mosquito control district.

July, 1954 - Norfolk County Board of Supervisors recognized the need for mosquito control in ***Western Branch*** and that district was formed.

November, 1956 - A desire for mosquito control in ***Washington Borough*** resulted in a vote for a commission covering that district of Norfolk County.

January, 1963 - Norfolk County and the City of South Norfolk merged to become the ***City of Chesapeake.***

October, 1965 - Chesapeake City Council passed an ordinance forming the ***Great Bridge*** Mosquito Control Commission.

September, 2002 – The boundaries of the Great Bridge district were expanded to include the entire southern region of the city not previously included in mosquito control activities. This increased the service delivery area significantly.

January, 2003 – The five independent mosquito control commissions consolidated to become the ***Chesapeake Mosquito Control Commission***.

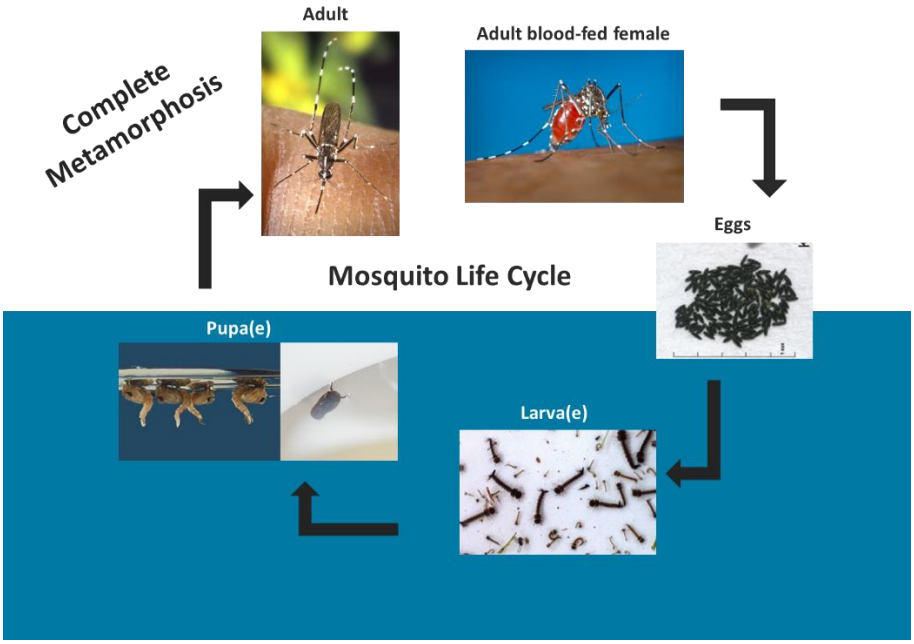
Mosquito Biology

Mosquitoes are a huge group of insects that differ significantly from species to species. One of the biggest misconceptions about mosquitoes is that they are all the same, all "bad", and can be controlled using a few basic techniques. Nothing could be further from the truth: there are 2,700 species of mosquitoes worldwide (59 of these reside in Virginia). Each species is unique in its appearance, behavior and habitat. Considering mosquitoes as a group is akin to considering water birds – one species is as different from another as a goose is from a penguin.

As different as they are, all mosquitoes have one thing in common - their life cycle (Figure 1) and its dependence on stagnant water. Mosquitoes undergo complete metamorphosis, i.e., they pass through four successive stages of development: egg, larva, pupa and adult. Depending on the species and environmental conditions, the life cycle can take from 3 days to 2 years, but averages ten to fourteen days during the season. The fact that the first three stages of a mosquitos' lifecycle occurs in stagnant water focuses many control efforts at this source.

Upon emergence, almost all adult female mosquitoes will seek a blood meal. Only female mosquitoes bite, because they require proteins from blood for the development of eggs. Male mosquitoes feed on plant juices or flower nectar and do not take blood meals. The adult females of some species lay their eggs in masses or "rafts" on the surface of the water. Other species lay eggs in depressions that will later be flooded, or in containers that will catch and hold rainwater. After two days these eggs are ready to hatch but if not flooded, can withstand drying for months. Heavy rains and flooding can produce huge mosquito populations in short periods.

Figure 1. The mosquito life cycle.



The Impact of Mosquitoes on Health and Welfare

"Of all disease-transmitting insects, the mosquito is the greatest menace…" (World Health Organization). Certain species of mosquitoes can pick up and transmit some very devastating diseases that have significant impacts on human and animal health and the economic well-being of our region. Not only do these diseases sometimes result in death, the long-term suffering and medical costs imposed upon survivors are significant.

Several local mosquito species transmit West Nile virus (WNV) and eastern equine encephalitis (EEE), neurological diseases that are endemic in southeast Virginia. Newly discovered mosquito-borne diseases such as Chikungunya and Zika virus have very recently emerged in the western hemisphere. These are readily spread by one of our most common and bothersome suburban species, the Asian tiger mosquito. Although malaria is no longer endemic in our area, mosquito species that can transmit the disease are common in Chesapeake. Figure 2 lists some common mosquito species in Chesapeake and the diseases they can transmit to humans and domestic animals.

Figure 2. Some common mosquito species in southeast Virginia and the diseases they can transmit (from "Mosquitoes of the Southeastern United States", Nathan D. Burkett-Cadena)

Scientific Name	Common Name	Diseases potentially transmitted
**Aedes albopictus*	Asian Tiger mosquito	CHIK. ZIKA
**Aedes canadensis*	Spring woodland pool mosquito	EEE, LAC, JCV
Aedes sollicitans	Golden salt marsh mosquito	EEE, DHW
Aedes triseriatus	Eastern tree hole mosquito	LAC
**Aedes vexans*	Common floodwater mosquito	EEE, WNV, DHW
Anopheles mosquitoes (4 species)	Freshwater marsh mosquito	MAL
**Coquillittidia perturbans*	Cattail mosquito	EEE
**Culex pipiens*	Northern house mosquito	WNV, EEE, SLE, DHW
**Culex restuans*	Spotted brown house mosquito	WNV, EEE
Culex salinarius	Salt-marsh Culex	WNV, EEE, SLE
Culiseta melanura	Dusky encephalitis mosquito	EEE, WNV

CHK – Chikungunya
DHW – Dog Heartworms
EEE - Eastern equine encephalitis
JCV – Jamestown Canyon virus
LAC – La Crosse encephalitis
MAL – Malaria
SLE – Saint Louis encephalitis
WNV – West Nile virus
ZIKA – Zika virus

* Important nuisance species in Chesapeake

Note that many of the mosquitoes listed above are characterized as “nuisance” species. There are many more species in Chesapeake that cause considerable pain and irritation to humans and domestic animals, especially when they emerge in large numbers. The discomfort and annoyance inflicted by these mosquitoes can cause major economic impact, especially in recreational areas and places where mosquito problems can result in depreciation of real estate values. Finally, huge mosquito broods can make storm clean-up and recovery efforts very difficult or impossible.

Modern Mosquito Control in Chesapeake

The basic philosophy of Chesapeake Mosquito Control Commission is an integrated pest management (IPM) approach. IPM requires the use of several different techniques and types of pesticides to control problem mosquito populations. Using IPM with various methods and materials accomplishes many goals:

1. It acknowledges that mosquito species differ dramatically in habitat, host preference (animals they will bite) and behavior, and require different monitoring and control techniques.

2. It emphasizes source reduction (eliminating mosquito egg-laying sites) which is a longer-term control strategy and does not involve pesticides. Source reduction involves many methods, from public education about artificial containers to drainage maintenance.

3. It increases the types of both natural and synthetic pesticides used to reduce the possibility of pesticide resistance. Different pesticides work in diverse ways in the mosquitoes’ bodies. They are less likely to become resistant to any one class of pesticide if there are multiple effects on their biological systems.

4. It places priority on controlling immature stages (larvae & pupae) to reduce mosquito numbers before they become adults.

5. It is the safest system for humans and the environment and has the biggest impact on the target species.

6. It saves money by making pesticide applications dependent on surveillance data, rather than on a set schedule.

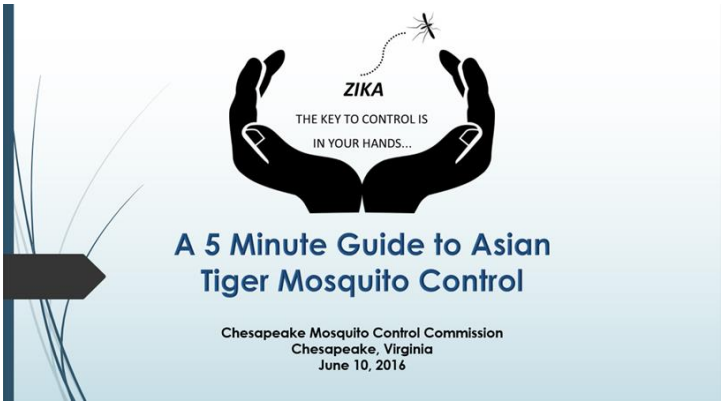
Integrated Pest Management Techniques

A. Public Education

The mosquito species responsible for the most service requests in the City of Chesapeake is the Asian tiger mosquito. This species lives in close association with humans, lays eggs in small containers that catch and hold rainwater, and is active during the day when people are most likely to be exposed. In addition, the Asian tiger mosquito is the local mosquito species capable of transmitting Zika virus. Educating the public on the role their own property plays in the development of these mosquitoes empowers them to eliminate breeding sites before adult infestation becomes a problem. It also alerts them to favorable harborage for adult mosquitoes (tall grass, overgrown shrubbery, ivy, etc.). It advises the best and safest methods of using insect repellants and (if desired) pesticide application. Finally, it alerts the public in the event of heightened mosquito-borne disease activity. Public education efforts include the following:

1. Seasonal personalized inspections in response to service requests
2. Special presentations or assemblies for public schools
3. Outreach programs for civic and special interest groups
4. Participation at public events, such as fairs and career days
5. Maintenance of a web site link and a telephone hotline
6. Press releases (in conjunction with the Chesapeake Health Department)
7. Appearances in various local media

Figure 3. Live and online forms of public education.



B. Source Reduction

In addition to the elimination of container breeding sites mentioned above, the commission performs drainage maintenance of mosquito control ditches in the late fall, winter and early spring seasons (figure 4). In most instances, this will improve drainage and eliminate stagnant water breeding sites. Sometimes crews will clear ditches or paths although the grade may not be great enough for proper drainage. This provides clear access to areas that may later be treated for immature mosquitoes, a process called larviciding.

Figure 4. Drainage maintenance.

C. Larviciding

The optimal time to control mosquitoes is when they are in the aquatic immature stages. They are more concentrated in a smaller area, making them easier to find and treat. They also have not yet emerged as biting females or become a source of nuisance and disease transmission. If treated with certain pesticides, they also survive long enough in the aquatic habitat to provide food for some predaceous animals.

Larvicides are available in several different formulations, and may be applied by ground crews or aerial systems (figure 5). All pesticide applicators have extensive training and certification through the state of Virginia as either registered technicians or certified pesticide applicators in the Public Health category.

One of the larvicides employed by the commission is a bacterial spore that only targets mosquito and black fly larvae and is very selective in its action. Another mimics the insects natural growth hormones and does not complete its action until the larva reaches a certain stage of development. Yet another type of pesticide is more useful for late stage larvae and

pupae that are not susceptible to the other larvicides. The modes of action of all three pesticides are very different, a fact which makes development of resistance to all of them very unlikely.

Figure 5. Some larviciding techniques.

D. Adulticiding

If the pesticide applicators cannot detect or reach larvae for treatment before they emerge, it is sometimes necessary to spray for adult mosquitoes. This process is called adulticiding or ULV (Ultra Low Volume) treatment. ULV treatments are usually accomplished by ground application (figure 6), but can be applied aerially when emergencies exist. Although there are not as many basic types of adulticides available, the commission uses at least two different types to avoid development of resistance. Adulticides (and larvicides) are extensively tested for toxicity levels, carcinogenic properties, environmental impacts and safety to non-target organisms. All mosquito control pesticides must be registered through the Environmental Protection Agency and, when used according to label instructions, have a very high level of safety.

Figure 6. Ground Adulticiding.

E. Surveillance

Surveillance of mosquito populations and mosquito-borne disease activity drives all pesticide application decisions. Monitoring mosquito populations can be as simple as identifying biting Asian tiger mosquitoes during a service request or dipping stagnant water in search of mosquito larvae. However, the commission also has a sophisticated monitoring program designed to provide data on the populations of many different mosquito species and the activity of EEE, WNV and Zika virus. The biology laboratory carries out this program, employing several different types of mosquito traps (figure 7). These devices have various designs and use different attractants to trap the many different mosquito species in Chesapeake. Depending on the species, technical personnel may test some of the mosquitoes for the presence of EEE and WNV using a dipstick type test (Figure 8).

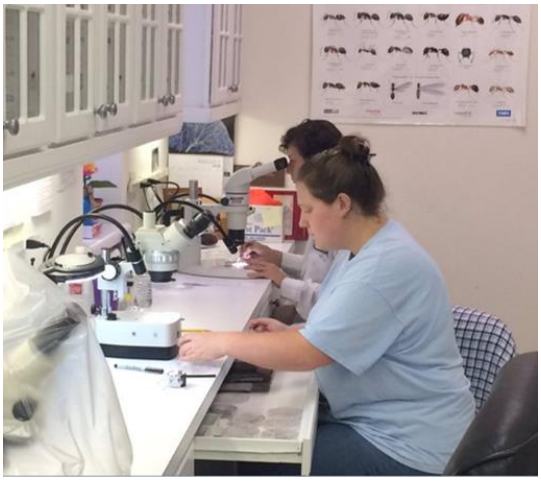
Figure 7. Mosquito traps.

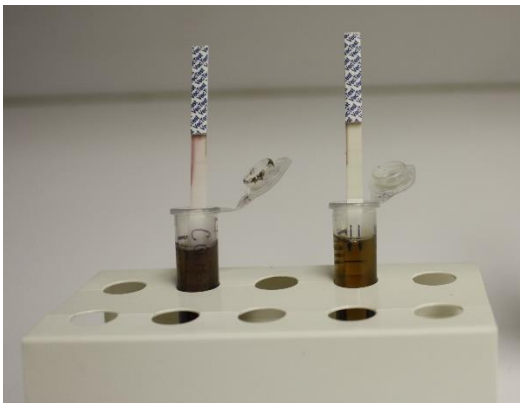
CO2 baited **CDC** miniature light trap

CO2 and special lure baited **BG** sentinel trap

Gravid trap baited with water imitating an egg-laying site

Figure 8. Identifying and sorting mosquitoes for disease testing.





The other main technique for monitoring disease activity is the sentinel chicken program. Small groups of chickens are placed strategically throughout the city where they may be exposed to biting mosquitoes. Both EEE and WNV depend on circulation through the wild bird population, and as the diseases amplify, the chickens are often infected. This does not harm the chickens in any way – they quickly produce antibodies to the viruses and there is no ill effect. By taking a very small sample of the chickens' blood (figure 9) and submitting it to the state laboratory, technicians can detect the antibodies very quickly, the public can be notified of heightened disease activity, and control measures can be implemented.

Figure 9. Collecting a small blood sample for detection of mosquito-borne disease antibodies.

More than any other factor, mosquito populations and disease activity are dependent on weather conditions. The biology laboratory records daily weather data, including temperatures,

rainfall and wind speed / direction, from different sources including weather stations at Deep Creek and Southern Chesapeake (figure 10). This information is used to predict problems with certain species and direct control efforts. It is also essential in planning aerial larvicide and ground adulticide treatments.

Figure 10. Weather station equipment.

F. Data Management & Geographic Information System (GIS)

All information, from requests for service to mosquito trap numbers and work accomplishments, is stored in various databases and can be retrieved at any time for analysis. Mosquito populations, and in turn the mosquito control work performed, are very dependent on geographic features, especially low-lying areas with accumulated water. The GIS expert maintains all pertinent information on these features, as well as human population densities, pesticide-sensitive sites, property boundaries, vegetative types, location of mosquito control ditches, and surveillance sites. Data on trap catches, work accomplished, location of disease positives, and other information is mapped daily to assist in data analysis and work planning (example, figures 11 & 12).

Figure 11. Map of pesticide application.

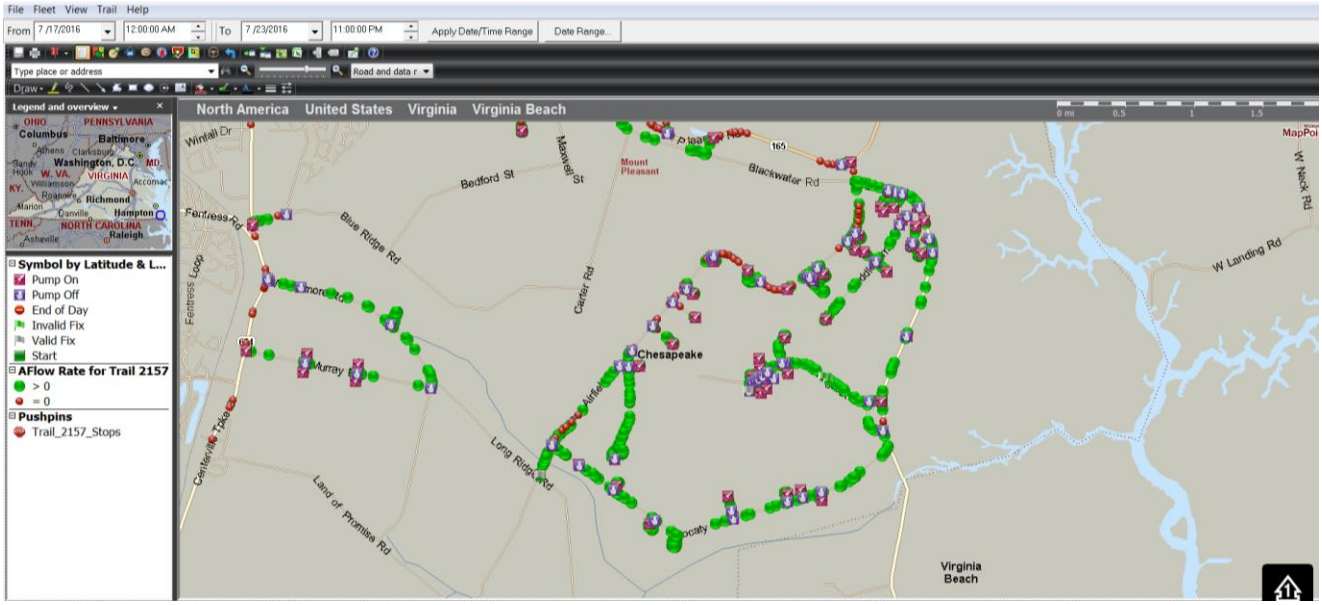
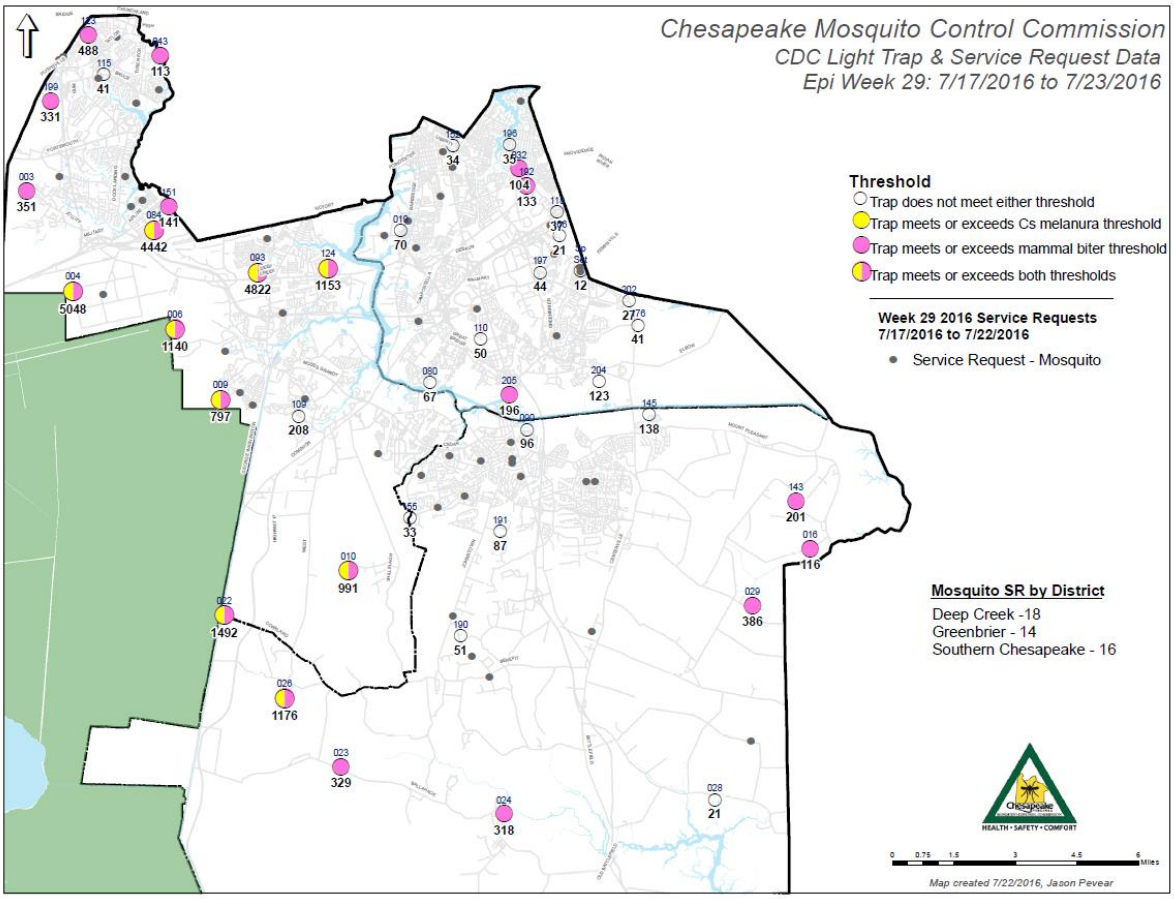


Figure 12. Representative map of mosquito trap counts and citizen service requests.



CHESAPEAKE MOSQUITO CONTRTOL COMMISSION

Overview of 2016

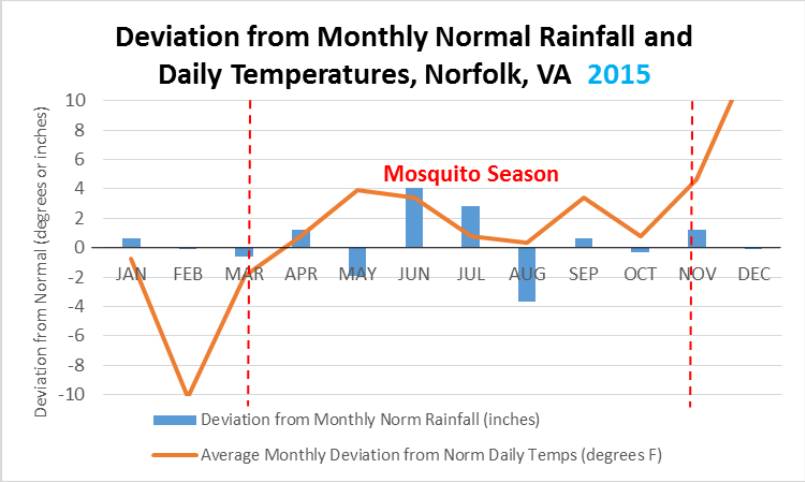
I. ANALYSIS OF THE MOSQUITO SEASON

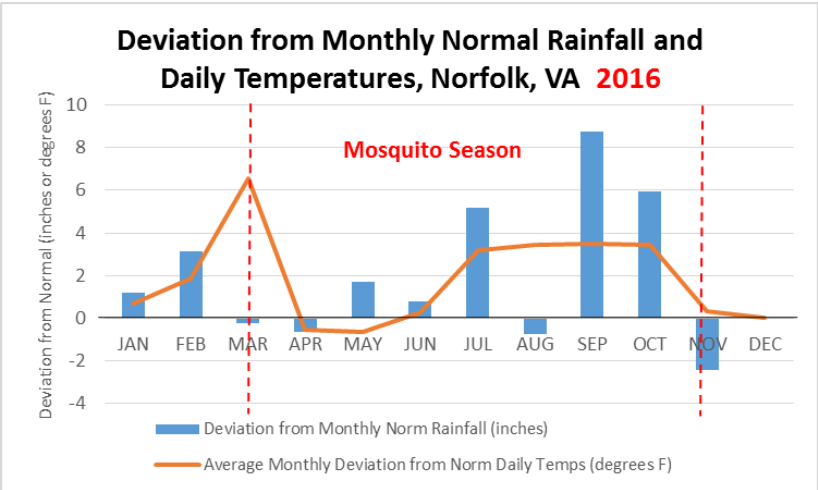
Weather Conditions & Mosquito Populations

A. General observations

Figure 1 illustrates the deviation from normal weather conditions recorded at Norfolk International Airport in 2015 and 2016. Note that the period generally considered the mosquito season (March – October) had close to normal rainfall in 2015 (average monthly deviation = 0.28 inches) but much ***more precipitation in 2016*** (average monthly deviation = 2.07 inches), especially during the mosquito season. Normal average daily temperatures were slightly higher than normal in 2015 (deviation = 1.43 degrees F), but even greater in 2016 (2.01 degrees F). Both these factors contributed to a more severe mosquito season in 2016 than the "normal" season we had in 2015.

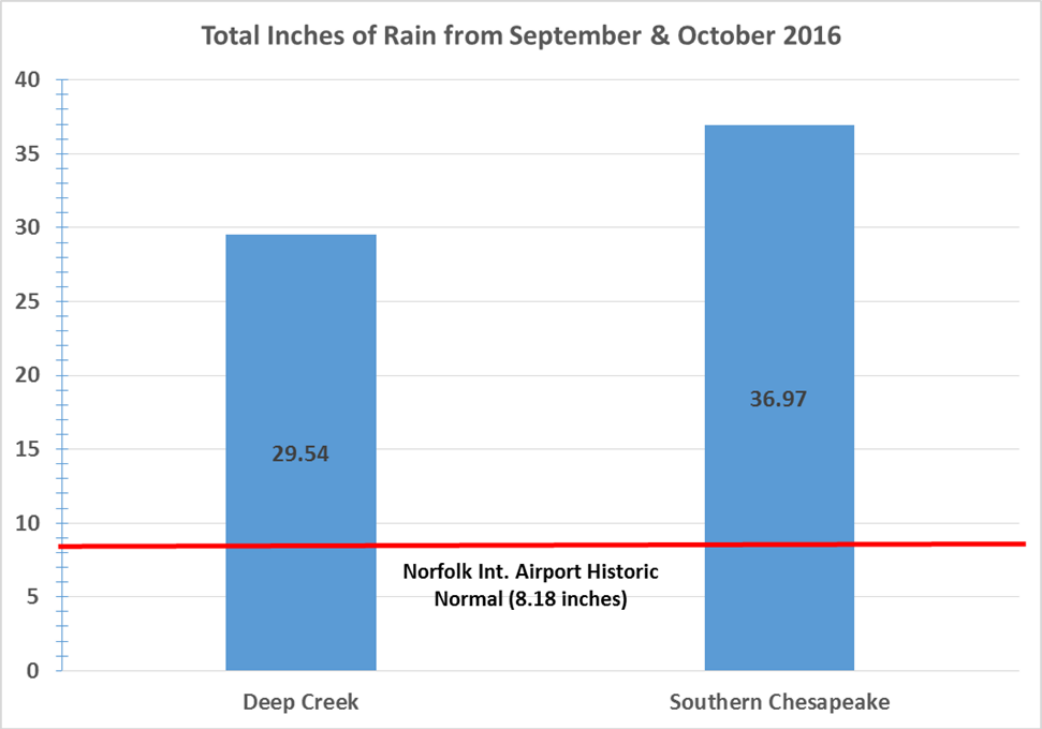
Figure 1. Deviation from normal weather conditions, Norfolk International Airport, 2015 & 2016.





A very large portion of the rainfall during the mosquito season occurred within a 3-week period, causing widespread flooding. A historic rain event in September, followed 2 ½ weeks later by Hurricane Mathew, created the perfect conditions for several mosquito species that emerged and became huge problems for our citizens. Figure 2 illustrates the precipitation recorded at the Deep Creek and Southern Chesapeake district offices during September and October vs. the normal historic rainfall.

Figure 2. September and October 2016 rainfall totals for Deep Creek and Southern Chesapeake districts.



The impact of this flooding on mosquito populations is illustrated in figure 3, which shows the average number of female mosquitoes caught per trap night from 2007 to 2016. Note that the 10-year median in Chesapeake is 185 females per trap night. The overall number of females per trap night for 2016 was 228, placing it ***second highest in the ranking of mosquito populations*** over the past 10 years (figure 4).

Figure 3. Overall mosquito population fluctuations, 2007 – 2016.

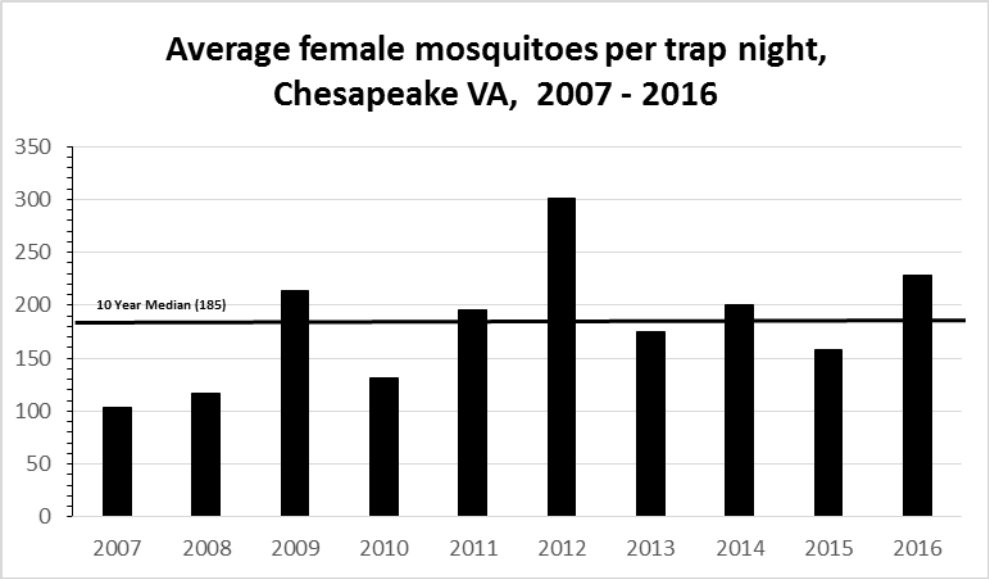


Figure 4. Ranking of the last 10 mosquito seasons, from most to least severe.

Year	Average female mosquitoes / trap night	10 year Median female mosquitoes / trap night
2012	301	
2016	228	
2009	213	
2014	200	**185**
2011	195	
2013	175	
2015	158	
**2010*	131	
2008	116	
2007	103	

* Last year trapping in Great Dismal Swamp

B. Species specific observations

Figure 5 contains a detailed comparison of some of the species trapped and identified by our biology lab staff during 2015 and 2016. The pink bars indicate a significant increase in 2016 and the green indicate significant decreases or less concern. The overall predominance of pink reflects a ***more severe season in 2016 than 2015***. One of the exceptions to this rule was the decrease in *Coquillittidia perturbans,* which may have been due to different strategies

employed during the spring aerial larvicide mission. By using more granular larvicide in more marshy areas, we were able to treat this species more effectively and overall catches decreased by 29%. Catches from traps deployed close to the areas treated with granules actually experienced even greater decreases in *Cq. perturbans* (41%).

Although their numbers per trap night increased by 3%, *Cs. melanura* (primary vector of EEE) were not an outstanding concern in 2016. They did not comprise the massive portion of CDC trap catches we normally see and their minor increase in numbers did not compare to the overall 44% increase in total female mosquitoes trapped.

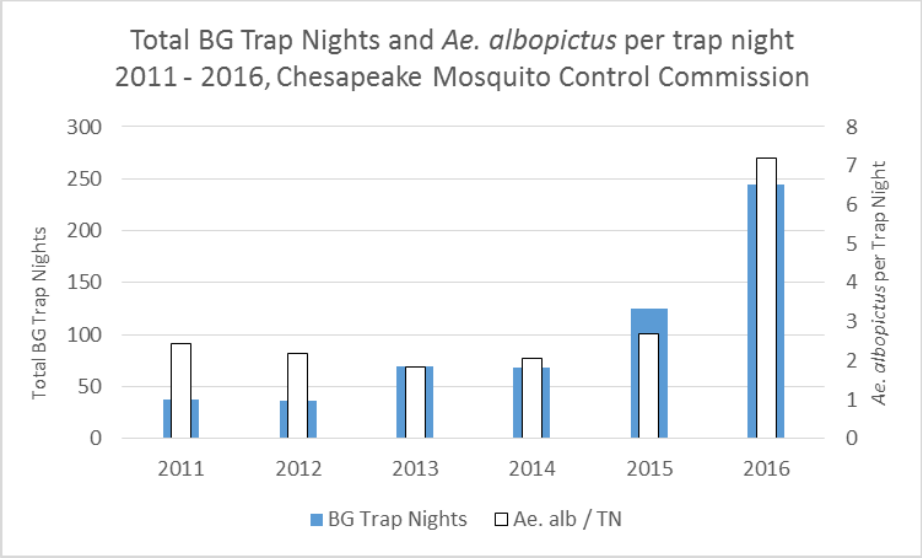
Figure 5. Comparison of most mosquito species (females) trapped in 2015 and 2016 .

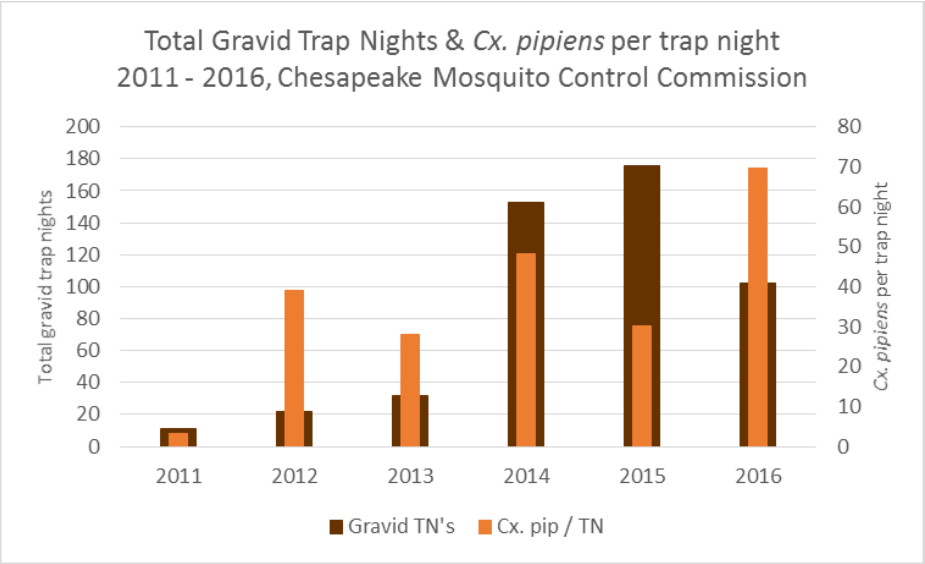
	2015 Total	*Per TN*	2016 Total	*Per TN*	*% Increase / Decrease per Trap Night*
Trap Nights (TN)	**1143**		**1,096**		
Ae albopictus	3,077	*3*	7,900	*7*	168%
Ae vexans	5,466	*5*	4,429	*4*	-15%
An crucians/bradleyi	12,698	*11*	22,924	*21*	88%
An punctipennis	910	*1*	2,162	*2*	148%
An quadrimaculatus	3,045	*3*	1,573	*1*	-46%
Cq pertubans	**31,454**	***28***	**21,361**	***19***	**-29%**
Cs melanura	**85,359**	***75***	**83,998**	***77***	**3%**
Cx erraticus	4,699	*4*	2,326	*2*	-48%
Cx pipiens	5,494	*5*	7,630	*7*	45%
Cx restuans	264	*0*	624	*1*	146%
Cx salinarius	7,741	*7*	35,059	*32*	372%
Cx territans	60	*0*	100	*0*	74%
Oc atlanticus	**2,020**	***2***	**8,000**	***7***	**313%**
Oc canadensis	**7,966**	***7***	**20,312**	***19***	**166%**
Oc cantator	50	*0*	0	*0*	-100%
Oc infirmatus	1,867	*2*	4,547	*4*	154%
Oc solicitans	46	*0*	110	*0*	149%
Oc taeniorhynchus	124	*0*	13	*0*	-89%
Oc triseriatus	133	*0*	253	*0*	98%
Or signifera	19	*0*	31	*0*	70%
Ps ciliata	114	*0*	153	*0*	40%
Ps columbiae	5,361	*5*	7,283	*7*	42%
Ps ferox	**2,447**	***2***	**18,285**	***17***	**679%**
Ps howardii	104	*0*	214	*0*	115%
Ur sapphirina	412	*0*	169	*0*	-57%
Total Males	2,293	*2*	4941	*5*	125%
Total Females	180,930	***158***	249,456	***228***	***44%***
	2015		***2016***		
BG Trap Nights	126		244		94%
Ae albopictus	3,077	*24*	7,900	*32*	***33%***
Gravid Trap Nights	176		102		-42%
Cx pipiens	5,319	*30*	7,090	*70*	***130%***

The red arrows in figure 5 indicate species that were responsible for most citizen requests following the storms. *Ps. ferox* reached the highest numbers in the past 14 years of trapping and was a major nuisance for anyone working outside post-storm. *Oc. atlanticus*, another floodwater species, reached its highest populations since trapping in the Great Dismal Swamp was discontinued in 2010. *Oc. canadensis* is typically a spring emergence mosquito, but the vast majority of the total catch in 2016 emerged after the storms as a result of widespread woodland flooding. Neighborhoods adjacent to the Great Dismal Swamp were impacted the most by this species, which also reached it's largest population since swamp trapping was discontinued 6 years ago.

The first graph in figure 6 illustrates the increase in Asian Tiger mosquito populations during 2016. In response to the threat of Zika virus, we deployed many more BG traps to monitor Asian tiger activity and infectivity. This increase is indicated by the blue bars. The increase in numbers of this species cannot be wholly explained by more specialty traps – the number per trap night (white bars) increased disproportionally from 2015 to 2016, indicating that populations were truly greater. Higher than normal precipitation and temperatures through most of the season were contributing factors.

Figure 6. Specialty traps and the corresponding target species per trap night, 2011 – 2016.





Similarly, *Cx. pipiens* populations appeared to be greater during the 2016 season, as measured through gravid trap catches.

Mosquito-borne Disease Activity

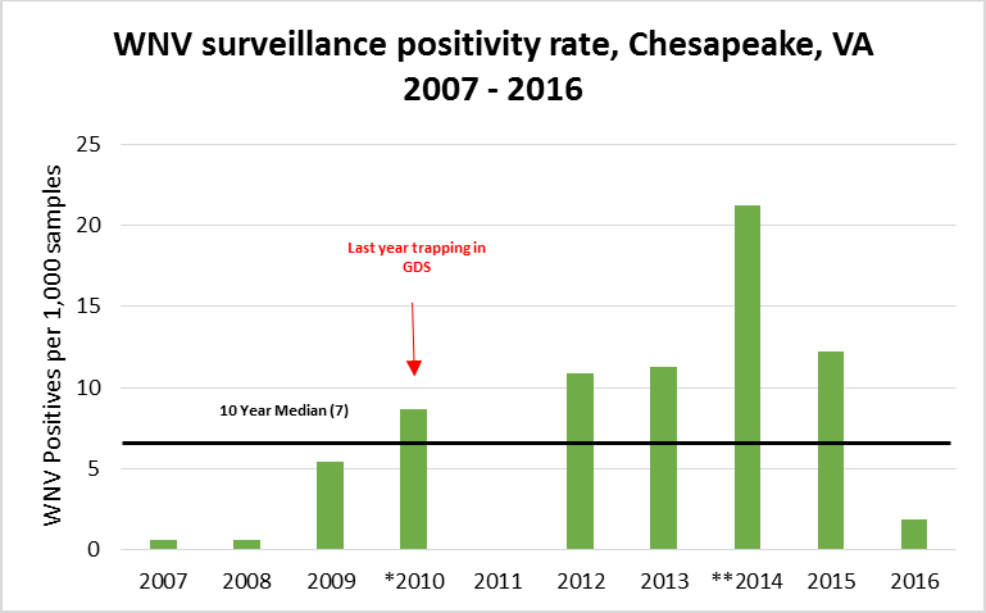
A. West Nile Virus (WNV)

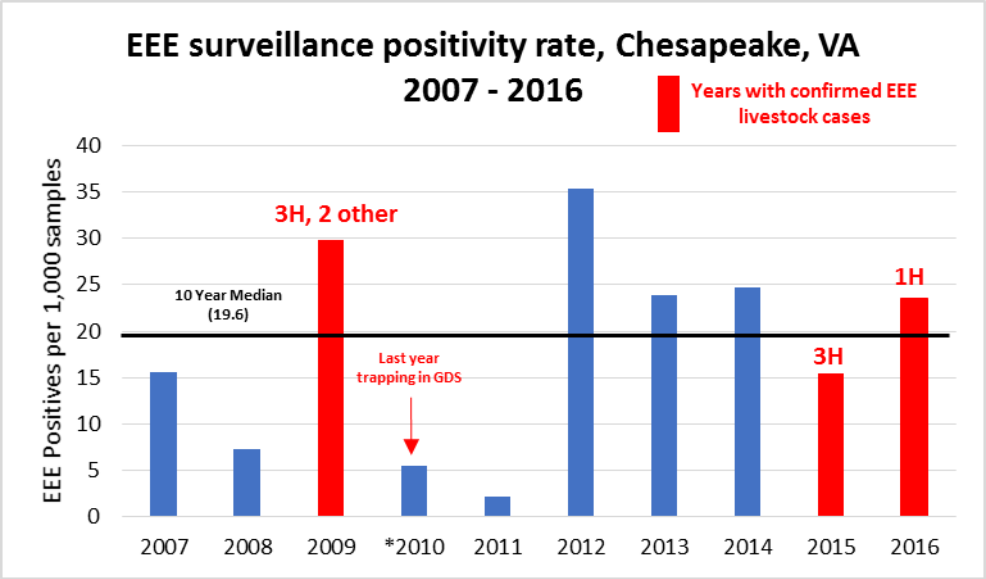
Although *Cx. pipiens* is the primary vector for West Nile virus and their numbers were higher, ***activity of WNV was lower than normal in 2016*** and appeared to be much lower than the 10 year median (figure 7). The greatest number of *Cx. pipiens* were trapped and tested early in the season before WNV had amplified and become detectable. Gravid trapping did decrease in frequency during 2016 due to problems with other flood species (see the total trap nights in figure 6). However, flooding rains flushed breeding and adult resting sites later in the season when arboviral activity is usually increasing, so the absence of positive events probably acurately reflects lower WNV activity.

B. Eastern equine encephalitis (EEE)

Conversely, ***EEE activity seemed to be a little higher*** than the 10 year median during 2016 (figure 7). There was one equine case of EEE in the City during 2016, but the horses' vaccination history was incomplete (equine cases almost always involve non-vaccinated or inadequately vaccinated animals). *Coquillittidia perturbans,* one of the bridge vectors of EEE, was less abundant in 2016, having dropped 29% in CDC trap catches (see figure 5, p. 4). Having noted a surge in their population from 2013 to 2015 (figure 8), we targeted this species for the 2016 aerial larvicide mission. This action may have reduced their population enough to prevent EEE from "spilling over" to mammalian hosts.

Figure 7. 10 Year positivity rates of all samples from surveillance of WNV and EEE, 2006 – 2015.

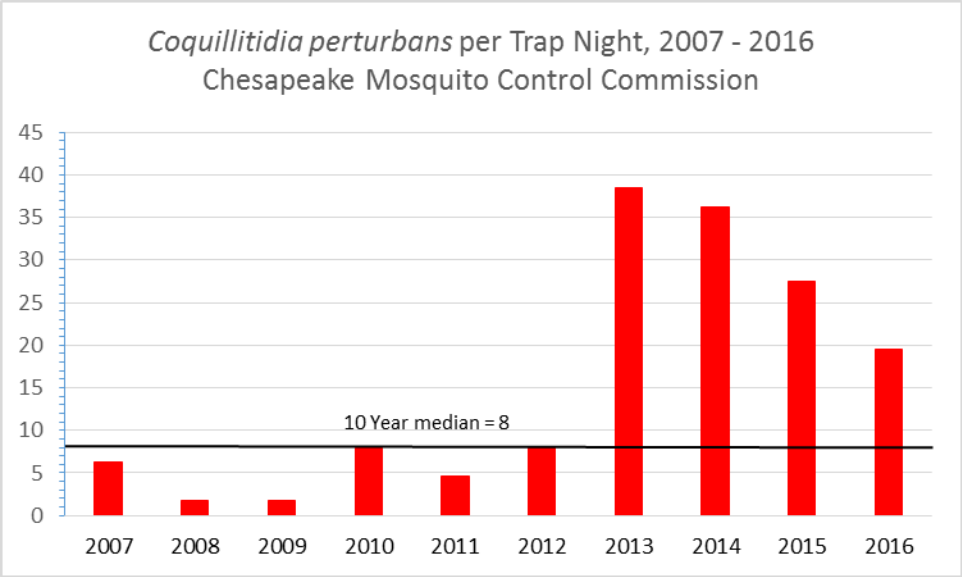




*Notes: * Switched from Norfolk Health Dept. Lab testing to less sensitive field mosquito pool tests mid-season*

*** Increased Cx. pipiens (WNV primary vector) trapping, 2014 - 2015*

Figure 8. EEE bridge vector (*Cq. perturbans*) annual population fluctuations, 2007 – 2016.



C. *Zika Virus*

Imported human cases of Zika virus became a concern in the continental United States for the first time during the 2016 mosquito season. Severe birth defects associated with infection of pregnant women have made this disease a public health threat and prompted the formation of the Governor's Zika Virus Task Force in Virginia. This multi-departmental group devised an action plan to deal with imported human cases and control of the primary vector in our state – the Asian tiger mosquito. The directors of Chesapeake Mosquito Control Commission and Prince William County Mosquito and Forest Pest Management represented mosquito control districts on the task force.

The task force created a response annex to define the responsibilities of various agencies and outline a plan of action in the event that Zika virus is introduced into the state. In addition, the federal government provided funding for pesticide resistance testing and arboviral disease testing programs. The biology lab took advantage of this funding and concentrated ***more on Asian tiger mosquito surveillance*** (see the increase in BG trap nights illustrated in figure 6). In conjunction with other public mosquito control agencies, we submitted 99 pools of Asian tiger mosquitoes to the state laboratory for Zika testing. We also set ovitraps at different locations (see figure 9), collected 1,231 Asian tiger mosquito eggs, and submitted them to Virginia Tech as part of a pesticide resistance study.

We helped define and adopted the official procedure for surveillance and control of Asian tigers when confirmed cases of Zika are identified in our community. This procedure places great emphasis on public education, backyard inspections and yard spraying.

Figure 9. Collecting Asian tiger mosquito eggs from an ovitrap.

II. OPERATIONS

Work & Service Request Report

A. Field Work

Figure 1 illustrates work accomplished during calendar years 2015 and 2016 and the percent increase or decrease per category. Note the ***increase in drainage maintenance production in 2016***. Part of this increase may be due to employment of temporary services agency workers who do not earn leave time. Many of our permanent employees have extended annual leave on record that they must use or lose and many choose to take this time off during the drainage maintenance season.

Work accomplished in pesticide application is almost entirely dependent on weather conditions and the resulting mosquito populations. Most of the mosquito season included low to normal activity for most species and ***pesticide applications were correspondingly lower*** than in 2015. It was only after the September rain event and Hurricane Mathew that there was a significant increase in acres treated.

Figure. 1. Work report, calendar years 2015 – 2016.

Work Report Comparison	2015	2016	% Increase / Decrease
Field Personnel - Total FTE's	**26.20**	**24.35**	**-7%**
Drainage			
Bush - Mach (acres)	26.00	42.02	**62%**
Bush - Hog (acres)	8.75	0.00	
Cleaning (miles)	31.36	39.26	**25%**
Grading (cu. Ft)	9,947	0.00	
Refuse Removed (tons)	29.55	53.86	**82%**
Total Drainage Maintenance Hrs.	**8,832**	**10,554**	**19%**
Pesticide Application			
Ground Larvicidng (acres)	3,779.00	2,435	**-36%**
Blocking (acres)		179	
Aerial Larviciding (acres)	9,879.00	3,985	-60%
Ground ULV (acres)	422,483.00	337,100.11	**-20%**
Total Pesticide Application Hrs.	**25,530.25**	**23,316.74**	**-9%**
Service Requests (dependent on environmental conditions)			
Mosquitoes	1,944	3,328	71%
Drainage	75	153	104%
Property Release	23	40	74%
Special Event	449	450	0%
Standing Water	91	149	64%
Other	35	61	74%
TOTAL	**2,617**	**4,181**	**60%**
Biology Lab - Total FTE's	**3.20**	**3.20**	**0%**
Biology			
Total Mosquito Traps Set	1,143	1,096	-4%
Total Female Mosquitoes	180,942	249,473	38%
Total Chicken Samples	246	287	17%
Education / Outreach (includes Director)			
Schools	24	22	
Outreach Activities/ Training	7	29	
Total Education / Outreach	**31**	**51**	**65%**

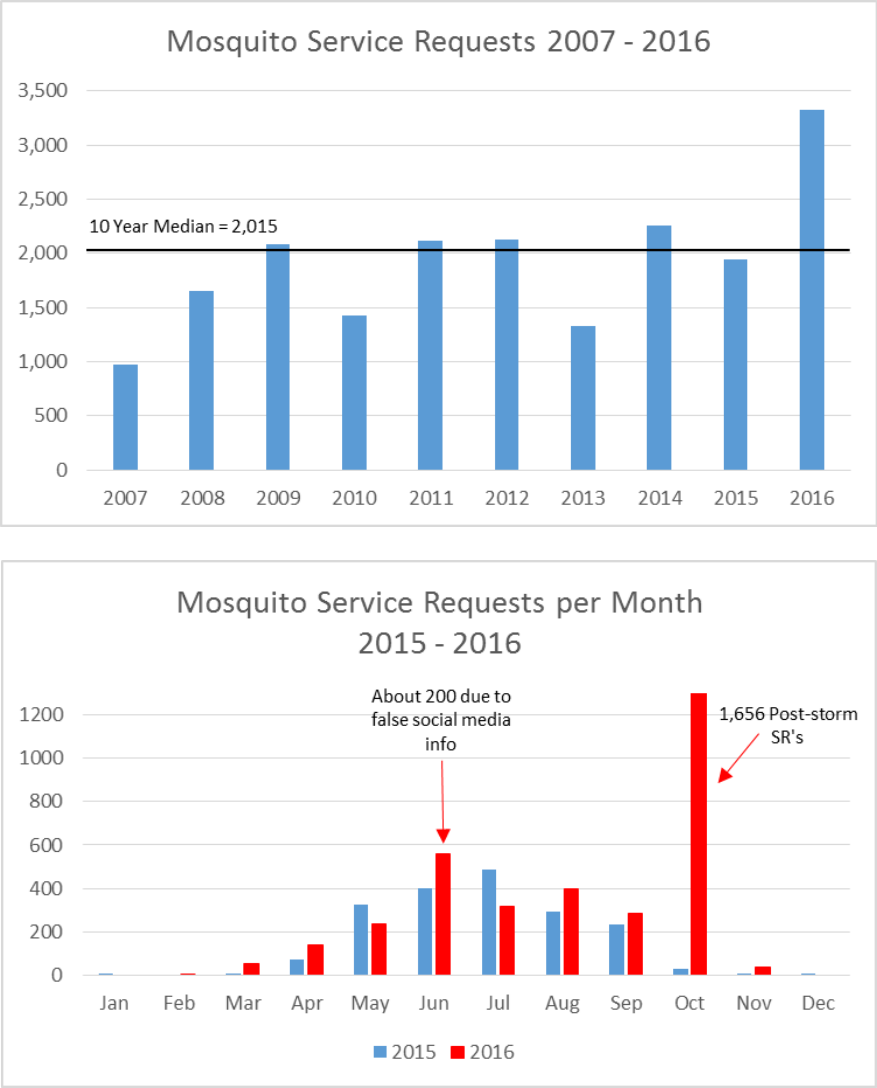
B. Service Requests

Service request numbers are also intimately tied to weather and subsequent mosquito populations. Mosquito service requests were submitted at the ***highest level in 10 years*** in 2016 (figure 2). Three very unusual events contributed to these high numbers. The second chart in figure 2 illustrates the monthly total mosquito service requests during 2015 vs. 2016. Numbers

of service requests were close to the median in 2015 and were submitted in a fairly "normal" pattern throughout the season, with a peak around June & July and declining numbers thereafter. The first event that created an unusual trend in 2016 occurred in June. A false ***social media statement*** that claimed the commission provided free services equivalent to those of private pest control companies was posted the end of May and resulted in a great number of calls early in June. Multiple posts on our social media sites and a presence in the news media quickly dispelled the claim and service request numbers returned to normal within 1 ½ weeks of the spike.

Another factor in the higher number of service requests was the enduring presence of ***Zika virus*** in all forms of media throughout the summer. Fear of this new health threat and the knowledge that the virus may be spread by "backyard" mosquitoes prompted many more citizens to request service, specifically in the form of backyard sprays.

Figure 2. Mosquito service requests.



Finally, huge broods of very vicious mosquito species emerged after the ***September rain event and Hurricane Mathew*** (figure 3). Large broods of these mosquitoes are abnormal in October, and resulted from highly unusual weather conditions. Citizen response to these mosquitoes was almost immediate and service request numbers rose very quickly. This sequence of events rarely occurs so late in the season (October).

Figure 3. Select mosquito species trapped post-storm and the service requests resulting from their abundance.

Select Vicious Biting Floodwater Species	Numbers Trapped Post-Storm		
Oc atlanticus/tormentor	5,770		
Oc canadensis	8,840		
Oc infirmatus	3,909		
Ps ciliata	64		
Ps columbiae	2,459		
Ps ferox	15,992		
Ps howardii	69		
Total Post-storm Select Species	**37,103**	**Total Post-storm Mosquito Service Requests**	**1,656**
Percent of Yearly Total of Select Species	***63%***	**Percent of Yearly Total Mosquito Service Requests**	***46%***

C. Biology Laboratory

The biology lab logged 4% fewer trap nights in 2016 than 2015 for several reasons, the most significant involving 2 interns who left early in the season. We dealt with this issue by reassigning a senior applicator to the lab temporarily for the mosquito season. Another challenge was the dramatic ***38% increase in total number of mosquitoes trapped*** and the hours required to process them. Additional processing of Asian tiger mosquitoes for Zika virus testing and initiation of an ovitrap program also taxed available resources.

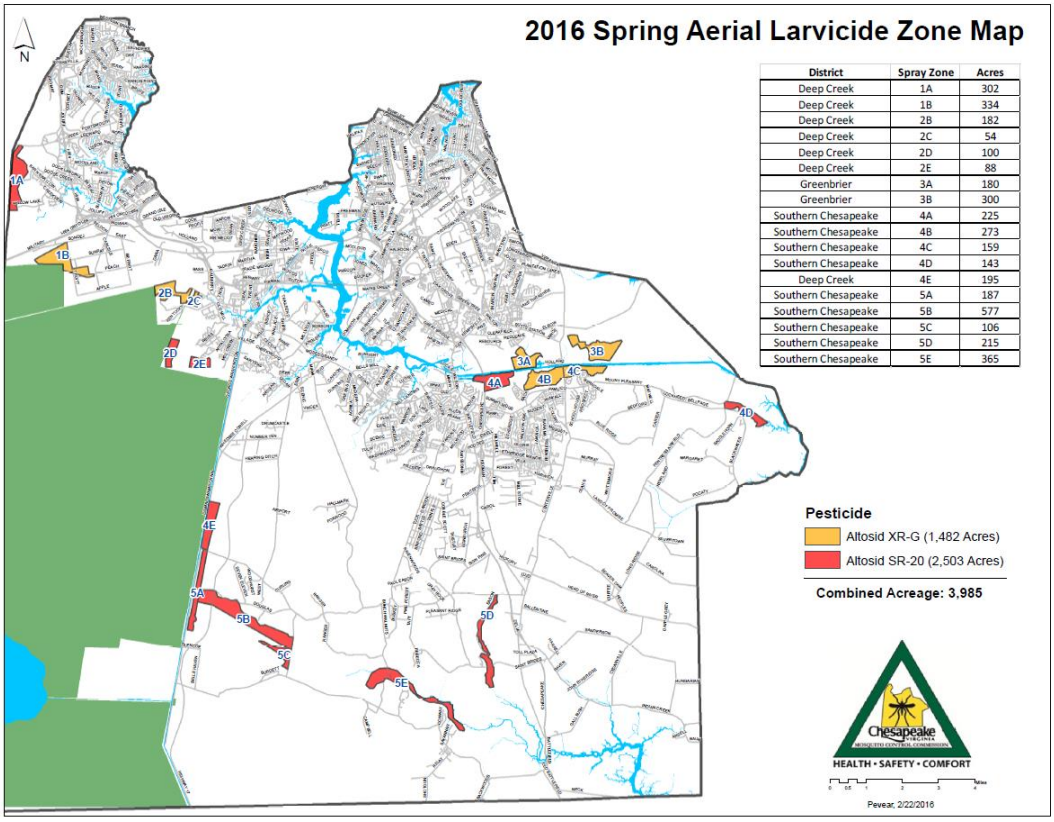
One very big increase in accomplishments from the biology lab involves outreach programs. The biologist and the director together were involved in ***65% more outreach efforts*** in 2016 (figure 1, p. 11) due to the Zika virus concerns of our citizens. We expect a greater number of outreach opportunities in the future for this reason, but the percentage increase should lower as public understanding improves.

Aerial Larvicide Application

Kritter Crop-dusting performed the aerial larvicide application from March 29-30, 2016. A map of the treatment zones is pictured in figure 4. The pink areas indicate treatment with a liquid mixture of B.t.i. (a bacterial spore) and Altosid (an insect growth regulator) and comprise about 63% of the total acreage. Zones colored gold were treated with longer-lasting granular Altosid formulations. These applications were made in marshy areas where *Cq. perturbans* develop. Greater success with granules for this particular bridge vector during the 2015 mission led to a shift in emphasis from past missions. Since granular treatments are more expensive, treatment zones were reduced considerably.

As noted on p. 4, *Cq. perturbans* collections decreased 41% in traps near the granular treatment zones and 29% in all traps combined, indicating that the ***granules were effective*** in controlling this species. However, the alarming emergence of spring woodland pool mosquitoes (*Oc. canadensis*) after Hurricane Mathew increases the risk of an overwhelming emergence in spring of 2017. Therefore, the 2017 aerial mission will target this species and the treatment zones and amounts of pesticides used will be similar to those of 2015. The 2017 plan includes earlier treatment to target this springtime species.

Figure 4. Aerial larvicide treatment zones, 2016



District	Spray Zone	Acres
Deep Creek	1A	302
Deep Creek	1B	334
Deep Creek	2B	182
Deep Creek	2C	54
Deep Creek	2D	100
Deep Creek	2E	88
Greenbrier	3A	180
Greenbrier	3B	300
Southern Chesapeake	4A	225
Southern Chesapeake	4B	273
Southern Chesapeake	4C	159
Southern Chesapeake	4D	143
Deep Creek	4E	195
Southern Chesapeake	5A	187
Southern Chesapeake	5B	577
Southern Chesapeake	5C	106
Southern Chesapeake	5D	215
Southern Chesapeake	5E	365

Goals & Challenges for 2016

A. Zika virus

Zika virus will continue to be an important challenge for mosquito control in 2017. There were 104 travel-associated cases of the virus in the state of Virginia in 2016 and that number is likely to increase. Although local transmission of the disease has not been documented here, it has occurred in Florida and Texas. We must remain diligent and participate in any surveillance and testing programs offered through the state. We will continue to work closely with the Chesapeake Department of Health to educate the public and respond quickly, with enhanced mosquito control efforts, to areas near any documented human cases.

B. Incorporation of Newer, "Greener" Pesticides & Equipment

We have been evaluating rechargeable battery operated backpack ULV sprayers for Asian tiger control since the summer of 2016. We will replace more of our old equipment with these cleaner machines as the budget allows. In addition, we will be evaluating and subsequently converting most of our nighttime ULV equipment to water-based pesticides. This presents an opportunity for even less dependence on fossil fuels.

C. Records Management

A major cooperative effort between our GIS Analyst and supervisors has resulted in a new, more accurate and easier to use work database. Efforts are currently underway to replace the antiquated pesticide inventory spreadsheet with a database. This database will document movement and use of pesticides in detail and more accurately.

III. FINANCIAL OVERVIEW

CITY OF CHESAPEAKE, VIRGINIA
2016 COMPREHENSIVE ANNUAL FINANCIAL REPORT *Schedule T-2*
Statement of Revenues, Expenditures, and Changes in Fund Balance
Chesapeake Mosquito Control Commission
Year Ended June 30, 2016

REVENUES	
Property taxes*	$ 4,128,630
Investment income	8,051
Other	32,787
Total revenues	4,169,468
EXPENDITURES	
Other salaries and wages	1,778,100
Other fringe benefits	808,803
Other repairs and supplies	756,055
Insurance premiums	248,564
Capital outlay	86,464
Payment to the Primary Government**	1,250,000
Other	378,944
Total expenditures	5,306,930
Excess (deficiency) of revenues over (under) expenditures	(1,137,462)
Fund balance – beginning	**$ 4,721,471**
Fund balance – ending	**$ 3,584,009**

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	$(1,137,462)
Pension expense	189,483
Depreciation expense	(150,776)
Loss on disposal	(7,420)
Capital outlay expenditures	86,464
Change in Net Position	(1,019,711)

**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.*

***CIB Project Starting in 2017-Construction of New Facilities on Shell Road*