

## Frequently Asked Questions Regarding Mosquitoes and Mosquito Control in North Carolina

### Overview

Several questions and concerns have arisen regarding increases in mosquito population and spraying to control mosquitoes. Here are some frequently asked questions and responses. This document can be used when addressing increased amounts of rain due to storms.

### What mosquitoes are present in NC?

There are approximately 60 species of mosquitoes present in NC, and each has unique ecological and biological characteristics (e.g., different larval habitat, blood feeding behaviors, biting activities, and distributions) that may require a variety of thoughtful prevention and control measures to reduce their populations. Some mosquito species are common and are likely distributed throughout the state, while others may be found only in large abundance near the coast. See the **table 1** for an overview of common NC mosquitoes.

### What is the mosquito that transmits Zika virus?

*Aedes aegypti* (common name yellow fever mosquito) is recognized as the primary, most efficient vector, of Zika virus. It is also the primary vector for Yellow Fever, Dengue and Chikungunya viruses. *Ae. aegypti* is an invasive species of mosquito and was likely introduced into the Western Hemisphere via the slave trade in the 1600s. An excellent review of this is located here: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4109175/> *Ae. aegypti* preferentially feeds on people (in contrast to *Ae. albopictus*, which feeds on a variety of species, including humans), and thus has behavioral characteristics that make it a good disease vector.

Because *Ae. aegypti* is widespread in many parts of central and south America, people from North Carolina frequently travel and become infected with dengue, chikungunya and Zika viruses while abroad. So while cases of these infections are reported in NC, local transmission of them has never been identified.

Fortunately, yellow fever, which is also transmitted locally in portions of South America, has not been identified in any North Carolinians who have travelled. There is a vaccine for yellow fever and international travelers should consult a travel medicine specialist about the need for vaccination prior to travel. For more information see:

<http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/yellow-fever>

### Is NC looking to see if the Yellow Fever mosquito is present in the state?

Yes. The N.C. Division of Public Health (NC DPH) continues to prepare and respond to Zika virus. Although several travel-related cases have occurred, currently there are no reported cases of local transmission in the state. The North Carolina Division of Public Health, in partnership with local health departments, Western Carolina University, East Carolina University and North Carolina State University continue to collect and identify mosquitoes. To date, more than 25,000 container-inhabiting mosquitoes collected from participating counties, municipalities, and partners have been identified to date. From these collections, the universities have identified NO *Aedes aegypti* mosquitoes.

**What is Florida doing to control the spread of Zika virus?**

The current situation in Florida is very different from that in North Carolina. Florida is dealing with multiple cases of travel associated and locally transmitted cases of Zika virus. Florida is utilizing pesticide application (disseminated by both trucks and aircraft) to reduce populations of mosquito vectors of Zika virus. This is being done because Florida has both:

1. Defined areas of local transmission of Zika virus and
2. Established populations of the primary Zika virus vector, *Aedes aegypti*.

For more information on Zika virus in Florida see: <http://www.floridahealth.gov/diseases-and-conditions/zika-virus/>

**I have heard some counties are spraying for mosquitoes. If we don't have the Zika vector, why are they doing that?**

Local health departments may initiate aerial or land based spraying to control "floodwater" or salt marsh mosquitoes following a tropical storm or hurricane. This is done to control what are considered "nuisance" species of mosquitoes that generally do not vector disease, but may significantly impact quality of life and recovery efforts after a large rain event. Determination on mosquito control after a major flooding event depends on many factors, including amount and duration of standing water, number of mosquitoes found in traps during population monitoring, and temperature. Aerial spraying is generally a control method of last resort, used only when a large area has been flooded and mosquito populations are rapidly increasing or a large number of locally transmitted cases of disease (such as Zika) are present and it is necessary to quickly control mosquito populations. See **table 2** which compares and contrasts methods of mosquito surveillance and control depending on the mosquito of interest.

**In NC, who has the authority to spray for mosquitoes?**

In North Carolina, the Local Health Director (LHD) has the statutory authority to investigate and control communicable diseases. For conditions transmitted by mosquitoes, the LHD will work collaboratively with their environmental health program and mosquito control program (assuming a mosquito control program is present in the city/county). If it is determined that mosquito abatement is required, the principles of Integrated Mosquito Management will be utilized in accordance with Center for Disease Control and Prevention (CDC) and American Mosquito Control Association (AMCA) guidelines. Mosquito populations are primarily controlled by the elimination of breeding sites by draining standing water. The application of biological or chemical larvicides or adulticides must be made by a trained applicator licensed by the NC Department of Agriculture & Consumer Services. See link for additional details: <http://www.ncagr.gov/SPCAP/pesticides/index.htm>

**We received rainfall as a result of a storm. Will my county spray for floodplain mosquitoes?**

A county might make the decision to spray due to the need for floodwater or saltmarsh mosquito control. Again, these mosquito species are not generally disease vectors. Localized spraying is not unusual and has been done for past hurricanes or tropical storms that affected North Carolina. This action is based on a demonstrated need for control based on local surveillance. Mosquito control programs may apply land-based adulticides to control these mosquitoes as well as treatments of storm sewers, catch basins, etc. to kill mosquito larvae. This activity is generally carried out by truck mounted ultra-low volume (ULV) spraying, also commonly referred to as fogging. These applications are generally carried out in the very early

morning and late evening hours, often at times when flying mosquitoes are abundant and human activities outdoors are decreasing. Aerial adulticide application is a rare activity and is generally only done IF a public health emergency is declared.

**We received rainfall as a result of a tropical storm or hurricane. Will my county spray for Zika vectors?**

No. In North Carolina, adulticide application would generally only be done if local transmission of Zika, Dengue, or Chikungunya cases has been identified. The NC Zika Action Plan supports focal spraying (150 meter radius from at the residence of cases). The range of the mosquito that carries Zika virus is small and focal spraying would prevent local transmission by mosquitos. Aerial spraying would not be used, but is most commonly used after following a declared state of emergency.

If case residences or areas of local transmission can be rapidly identified, a space spray or barrier applications to individual residences **may** be warranted to further reduce the likelihood of vectors feeding on infectious people. Adulticide applications must be administered by knowledgeable and licensed professionals pursuant to NC Pesticide Law and regulations.

**It is critical to have surveillance programs in place to understand the risk for disease and the effectiveness of mosquito control.**

Similarly, the effectiveness of any control measure should be documented, ideally with pre- and post-intervention entomologic measures. These measures generally consist of the following items to ensure the control measures are meeting the intended goal, cost effective, and sustainable.

1. Post control measure surveillance. Target mosquito populations should be reduced. Non-target populations should be relatively unaffected.
2. Post control insecticide resistance monitoring. Just as bacteria can develop resistance to antibiotics, mosquitoes can develop resistance to insecticides. If resistance develops, the product should no longer be used.

**Where can I find more information about ULV application of adulticide?**

The Environmental Protection Agency has website explaining ULV in more detail:

<https://www.epa.gov/mosquitocontrol/controlling-adult-mosquitoes>. It is important to remember that application of adulticide (while it can be effective at controlling adult mosquitoes) is only one component of a comprehensive mosquito surveillance and abatement program, as outlined by the American Mosquito Control Association: <http://www.mosquito.org/assets/Resources/PRTTools/Resources/bmpsformosquitomanagement.pdf>.

**What can I do to protect myself and my property?**

Personal protection

- Wear insect repellent: It is important to use insect repellent as directed by the product label instructions. It is the BEST way to protect yourself from mosquito bites. Pregnant women and children should use insect repellent as well. Apply repellents to children (don't let them handle the chemical). Do not put repellents on infants younger than 2 months of age. Protect infants from mosquito bites by using netting properly draped over a carrier with a tight fit along the edges. Insect repellent options include:

- DEET: Products containing DEET include Cutter, OFF!, and Skintastic. Concentrations of DEET in these products vary. In general, the concentration of DEET in a product indicates how long the product will be effective. Therefore, products containing lower concentrations may need to be reapplied depending on the length of time the person is outdoors.
- Picaridin (also known as KBR 3023, Bayrepel, and icaridin): Products containing picaridin include Cutter Advanced, Skin So Soft Bug Guard Plus, and Autan (outside the United States).
- Oil of lemon eucalyptus (OLE) or PMD: Repel contains OLE. (Note: Products using OLE should not be used on children under the age of three years). Do not use the essential oil versions of OLE. Stick with EPA-registered repellents products containing OLE.
- IR3535: Products containing IR3535 include Skin So Soft Bug Guard Plus Expedition and SkinSmart.
- Additional information about the safe use of repellents may be found here: <http://epi.publichealth.nc.gov/cd/diseases/deet.html>
- Find the right insect repellent for you (EPA Tool): <https://www.epa.gov/insect-repellents/find-insect-repellent-right-you>
- When weather permits, wear long-sleeved shirts and pants.
- Use air conditioning or make sure that you repair and use window/door screens.
- When traveling, look for country-specific guidance on mosquito protection.

#### Home and landscape management

- **“Tip and Toss”**: Make sure that standing water is tipped out of bird baths, flower containers, wading pools and other containers around your yard at least once every five days. Mosquitoes use containers to breed and larvae will develop in these areas.
- Store, discard, or recycle any items that can accumulate any amounts of standing water.
- Keep pools chlorinated, clean, and properly maintained. Prevent pool covers and liners from holding standing water.
- Clean gutters frequently as debris can clog and reduced water flow thus causing gutters to fill up with standing water.
- Treat standing water in ornamental ponds or water features known to have mosquito larvae with mosquito “dunks” (e.g., briquettes containing the bacteria Bti). Be sure to follow all package directions and pay attention to the number of dunks needed per volume of water as well as directions on when reapplication is needed. When possible, stock ornamental water features with fish that will eat mosquito larvae.

**I saw the story about the large bee kill in South Carolina due to widespread spraying for mosquitoes. I’m concerned that this could also happen in North Carolina. What can I do to protect bees?**

Learn about protecting pollinators: <http://ncagr.gov/spcap/bee/>. Stay in touch with your local mosquito control program so you know when they may be spraying pesticides.

**Many private companies are conducting mosquito spraying in neighborhoods. I’m concerned about the chemicals used to spray for mosquitoes. What chemicals are being used?**

The chemicals that these companies use may vary. In general, most companies are using a synthetic pyrethroid (e.g., bifenthrin). To learn more about bifenthrin, go to: <http://npic.orst.edu/factsheets/bifgen.html>

If a private company is conducting mosquito spraying in your neighborhood, talk with them to understand where they will be spraying and make them aware of any areas to avoid (vegetable gardens, beehives, decorative ponds, etc.) Take precautions to cover grills and water bowls used by pets.

#### **General Information about Zika Virus/Dengue Fever/Chikungunya/Yellow Fever**

- These four viruses are all transmitted primarily by *Ae. aegypti*. *Aedes albopictus* may serve as a less efficient secondary vector.
- Travel associated cases of Zika, Dengue and Chikungunya are routinely identified in NC. Local transmission of these viruses by mosquitoes has never been identified in NC.
- Yellow Fever is a very severe hemorrhagic fever that is less common than Zika, Dengue and Chikungunya. While outbreaks of Yellow Fever are common throughout the world ([http://www.who.int/csr/don/archive/disease/yellow\\_fever/en/](http://www.who.int/csr/don/archive/disease/yellow_fever/en/)), we have not identified imported cases in NC.
- There is no vaccine or medication to prevent or treat Zika virus infections. At this time, the main risk is for people who travel to areas with active transmission.
- It is of concern that Zika virus can be spread from a pregnant woman to her unborn baby. There have been reports of a serious birth defect of the brain called microcephaly and other adverse pregnancy outcomes in babies of mothers who were infected with Zika virus while pregnant.
- The major mode of transmission is through the bite of an infective mosquito. There are limited reports of sexual transmission and blood transfusion. Zika virus can be found in blood, semen, urine and saliva.
- Only about 1 in 5 people infected with Zika virus will become sick. Among those who do get sick, Zika usually causes mild symptoms that may include rash, fever, joint pain and red eyes.

Table 1 (Common mosquitoes of NC)

<b><i>Culex pipiens &amp; Culex quinquefasciatus</i></b>
<p><i>Common Name(s):</i> Northern house mosquito &amp; Southern house mosquito  <i>Pronunciation:</i> Cue-lex pip-e-ens &amp; Cue-lex kwink-uh-fas-e-ah-tus  <i>Biting Activity:</i> Crepuscular and nocturnal  <i>Geographic Distribution:</i> Believed to be statewide  <i>Larval "Breeding" Locations:</i> Storm sewer catch basins, ground pools, ditches, other high organic sites  <i>Associated Disease(s):</i> West Nile Disease  <i>ULV Adulticiding Effective:</i> Yes, when applied by a knowledgeable professional</p>
<b><i>Culiseta melanura</i></b>
<p><i>Common Name(s):</i> Black tailed mosquito  <i>Pronunciation:</i> Cue-la-see-ta mel-uh-nur-uh  <i>Biting Activity:</i> Nocturnal, perhaps crepuscular (twilight)  <i>Geographic Distribution:</i> Most abundant in the coastal plains, but also found in piedmont and foothills  <i>Larval "Breeding" Locations:</i> Cryptic and subterranean habitats in freshwater swamp complexes  <i>Associated Disease(s):</i> Eastern Equine Encephalitis  <i>ULV Adulticiding Effective:</i> Yes, when applied by a knowledgeable professional</p>
<b><i>Aedes albopictus</i></b>
<p><i>Common Name(s):</i> Asian tiger mosquito  <i>Pronunciation:</i> Aye-dees al-bow-pic-tus  <i>Biting Activity:</i> Diurnal and crepuscular  <i>Geographic Distribution:</i> Believed to be statewide  <i>Larval "Breeding" Locations:</i> Man-made and natural containers are ideal habitats  <i>Associated Disease(s):</i> Potentially Chikungunya, Dengue, La Crosse Encephalitis, and Zika  <i>ULV Adulticiding Effective:</i> Not effectively controlled by standard nighttime ULV applications.</p>
<b><i>Aedes triseriatus</i></b>
<p><i>Common Name(s):</i> Eastern treehole mosquito  <i>Pronunciation:</i> Aye-dees try-seer-e-ay-tuss  <i>Biting Activity:</i> Diurnal and crepuscular  <i>Geographic Distribution:</i> Believed to be statewide  <i>Larval "Breeding" Locations:</i> Man-made and natural containers are ideal habitats  <i>Associated Disease(s):</i> La Crosse Encephalitis  <i>ULV Adulticiding Effective:</i> Not effectively controlled by standard nighttime ULV applications.</p>
<b><i>Aedes sollicitans</i></b>
<p><i>Common Name(s):</i> Eastern saltmarsh mosquito  <i>Pronunciation:</i> Aye-dees soul-liss-uh-tans  <i>Biting Activity:</i> Crepuscular (peak activity); will readily bite at other times if host nearby  <i>Geographic Distribution:</i> Coastal  <i>Larval "Breeding" Locations:</i> Coastal saltmarshes  <i>Associated Disease(s):</i> Potential epidemic vector for Eastern Equine Encephalitis, primarily a nuisance mosquito  <i>ULV Adulticiding Effective:</i> Yes, when applied by a knowledgeable professional; aerial spray missions are often required post hurricane</p>
<b><i>Aedes taeniorhynchus</i></b>

*Common Name(s):* Black saltmarsh mosquito  
*Pronunciation:* Aye-dees tee-knee-oh-rink-us  
*Biting Activity:* Crepuscular (peak activity); will readily bite at other times if host nearby  
*Geographic Distribution:* Coastal  
*Larval "Breeding" Locations:* Coastal saltmarshes  
*Associated Disease(s):* Primarily a nuisance mosquito  
*ULV Adulticiding Effective:* Yes, when applied by a knowledgeable professional; aerial spray missions are often required post hurricane

**Table 2** (Compare and contrast control methods)

	<b>Floodwater &amp; Saltmarsh Mosquitoes</b>	<b>Peridomestic Container Breeding Mosquitoes</b>
Species of Interest	Increases in <i>Aedes sollicitans</i> , <i>Aedes taeniorhynchus</i> , <i>Aedes vexans</i> , and others caused by storm water	<i>Aedes albopictus</i> and <i>aegypti</i> *
Disease vector	This type of mosquito is generally regarded as a nuisance mosquito that would not carry Zika, Dengue or Chikungunya.	These types of mosquitoes may carry Zika virus, Dengue fever or Chikungunya
Surveillance method	Routine CDC light trap and larval collection; landing counts	BG-Sentinel trap; Ovitrap, Container index and larval identification
Indication for needed Abatement	Large increase in mosquito counts or landing counts post rain event. Chemical control measures are needed	Locally acquired human cases which would indicate possible infected mosquitoes
Adult mosquito abatement method	Ultra-low volume (ULV) application of insecticide, generally truck based, possible aircraft	Application of insecticide (i.e., adulticide or larvicides) with handheld or backpack sprayers around case residence
Post Abatement Surveillance	Monitor population; insecticide resistance testing	Monitor population; insecticide resistance testing
Authority	Local health department and mosquito control program	Local Health department and mosquito control program

\* These species of mosquitoes are recognized as the primary (*Ae. aegypti*) and secondary, less efficient (*Ae. albopictus*) vectors of Zika, chikungunya and Dengue viruses. *Aedes aegypti* is not present at detectable levels in NC based on a recent survey. *Aedes albopictus* is present in large numbers but is not recognized as the optimal vector for any of the three viruses of concern.