

NO LONGER JUST INTOLERABLE ANNOYANCES, THESE BLOOD-SUCKING PESTS CAN POSE HEALTH RISK TO HUMANS AND HORSES. KEEPING THEM UNDER CONTROL WITH ENVIRONMENTALLY SAFE METHODS IS THE JOB OF THE STATE'S MOSQUITO CONTROL 'SWAT TEAM'

THE BUZZ ON **Mosqu**

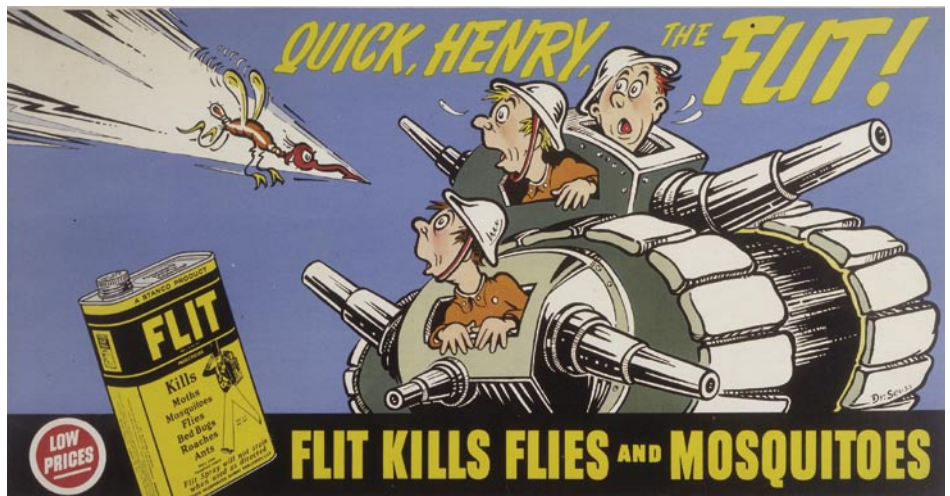
By WILLIAM H. MEREDITH

B z zzzzslap. Sound familiar? The whine of buzzing mosquitoes followed by swats (and maybe even expletives) is a tell-tale sign of summer in Delaware. And just about any place else where they're not constantly monitored and controlled. Wetlands, woodlands, coastal areas – all are potential hatcheries. Not to mention your own neighborhood.

Step outside in summer and before you can say “Quick, Henry, get the Flit!” there’s an annoying buzz in your ear soon followed by a tingle on the back of your neck. Attracted by cues

that include body heat, moisture, sweat, exhaled carbon dioxide or lactic acid, a female mosquito has been suctioning a blood meal out of your hide.

She needs the protein to nourish and develop her eggs before depositing them, but – lucky for you, unlucky for her – your swat got her before she could create another generation of her irritating kind.



This dive-bombing mosquito gained fame in a Depression-era advertising campaign that continued for 17 years and made “Quick, Henry, the FLIT!” into a national catchphrase. Theodore Geisel created the artwork years before he started writing the children’s books that made him famous as Dr. Seuss. QUICK HENRY THE FLIT AD CREDIT: FROM THE DR. SEUSS COLLECTION, MANDEVILLE SPECIAL COLLECTIONS LIBRARY, UNIVERSITY OF CALIFORNIA AT SAN DIEGO.

Drinking its fill may take a mosquito a few minutes. By the time you feel the bite, you already have an itchy welt caused by an allergic reaction to anticoagulants in mosquito saliva. The anticoagulants allow the little buggers

basin, clogged rain gutter, standing water in junked tires or empty flower pots, or an uncovered garbage can. You'll find some kind

several types of encephalitis, including West Nile virus. The latter, which gets its name from the West Nile region of Africa

where this virus was first identified in the 1930s, had never been reported in North America until the summer of 1999 in the New York City area. Since then it has spread rapidly across the country, attacking a wide range of animals – from sparrows to horses to humans. Some birds – especially crows and blue jays –

are easily killed by the virus. Although the *virus* can infect humans, we don't pass it on to the next mosquito that bites us. Birds as reservoir hosts keep the *virus* going because it replicates easily in their cells. The common house mosquito is the primary vector for transmitting West Nile to humans.

West Nile's first appearance in Delaware was in 2001. Virus activity peaked in 2003, with 17 confirmed cases involving some pretty sick patients and two deaths, plus a hundred or so Delawareans who got somewhat sick but did not seek medical attention, and thus could not be diagnosed as virus positive. No human cases were reported in 2004 and only two cases in 2005; hopefully, numbers will stay low this summer as well.

West Nile illness is characterized by fever, headache, fatigue, muscle pain and sometimes rash. Most cases are mild and go undetected. Although the illness can be as short as a few days, in more serious cases, patients can be sick for several weeks. In its most severe form, which primarily affects the elderly, the virus attacks a person's nervous system and can cause an inflammation of the brain known as encephalitis. West Nile has a fatality rate of about five percent in patients who are severely infected.

Eastern equine encephalitis, or EEE, is a West Nile cousin that is more virulent and deadly, but fortunately much rarer in Delaware and elsewhere. EEE is cycled in nature by a species of mosquitoes that bites infected birds but doesn't bite people. However, other species that feed

MOSQUITOES

to keep siphoning your blood without clotting once they drill into a blood vessel. (She doesn't actually bite you; six stylets equipped with serrated edges inside her proboscis rip away at small capillaries just below the surface of your skin, creating a pool of blood.) In one feeding, a female mosquito might more than double her body weight. Depending upon her species, from a few to several days later she'll lay her eggs and go look for another meal.

Delaware hosts 57 mosquito species. At least nineteen of these can dine on human blood. Seventeen can make you sick. (See box for the worst culprits). Worldwide, there are around 2,700 different species. It often takes an expert in wing scale patterns and markings on the legs, proboscis and abdomen to distinguish between them.

Only female mosquitoes seek blood meals. Males live quite inoffensively on plant nectars and fruits high in sugar; their primary role is to mate with females then they die. After mating once, females of many species can bite again and again to produce one batch of eggs after another, each time leaving a tiny souvenir of saliva to itch and cause varying degrees of misery for their victims.

Your biter could have come from a variety of watery environments, some miles away: a salt marsh, roadside ditch, wet meadow, woodland pool, freshwater wetland, storm water pond, sewer catch

of mosquito developing from egg to larvae to pupae and finally emerging as an adult in almost all types of aquatic habitats in Delaware, whether natural or man-made. Not much water is needed: a tablespoon in an old soda can is enough to provide a home for numerous wrigglers.



Over the past 20 years, the Asian tiger mosquito has become a major pest in Delaware's cities, towns and suburbs.

JAMES GATHANY, CENTERS FOR DISEASE CONTROL

WILL YOU GET SICK?

Fortunately, mosquito bites only cause irritation, not like the severe reactions to the venom of yellow jackets, fire ants or Africanized honeybees. However, like fleas and ticks, mosquitoes are vectors – blood-sucking insects that ingest, along with the blood from an infected host, disease-causing organisms such as viruses or other microbes, which they then inject into a new host when taking their next blood-meal. Mosquitoes cannot transmit all diseases – HIV for example – but they are responsible for the spread of a host of others, including malaria, yellow fever, dengue fever, canine heartworm, and



DELAWARE MOSQUITO CONTROL SECTION

In the spring, Mosquito Control employees with backpack sprayers apply preventative larvicides in marshy breeding sites to prevent the mosquitoes from becoming adults.

on both birds and mammals, such as salt-marsh mosquitoes, can pick up the virus and transmit it to horses and humans. EEE kills about a third of those patients who are severely infected and leaves many survivors with nerve damage. Unlike malaria and yellow fever, which use to be problematic mosquito-borne diseases in Delaware, modern mosquito control and modern medicine have not yet been able to eliminate EEE as a human health concern in our state.

For humans, there is no cure for West Nile virus or EEE, only prevention. For horses, excellent vaccines are available to prevent these diseases. Keeping mosquitoes at bay by eliminating larval habitats is as important for horses as humans.

The good news is that there is very low probability that any single mosquito harbors West Nile virus or EEE. The chance of contracting a mosquito-borne disease is still pretty slim, even after receiving numerous bites, but the risk increases, at least a little, for every bite received.

DELAWARE'S MOSQUITO CONTROL CHALLENGES

Years ago, mosquito populations were out of control in many areas of Delaware. Females looking for blood meals besieged

anyone daring to venture outside in summer. Stories told by "old timers" of clouds of saltmarsh mosquitoes in numbers so great that the sky would literally darken aren't just hyperbole.

The state's first line of defense is the Division of Fish and Wildlife's Mosquito Control Section. Twenty full-time and 15 part-time biologists, conservation technicians and other staff, working with an annual operating budget of about \$2 million, are fighting an ongoing battle against a tenacious and adaptable foe. This battle requires constant vigilance and use of a variety of weapons and tactics. Today many inhabited parts of the state are relatively mosquito-free, but only because of the aggressive prevention and control work that goes on behind the scenes to keep it that way.

"Because mosquitoes arise from natural, healthy ecosystems, the idea is not to eliminate every one," says Tom Moran, the regional manager in charge of Mosquito Control's northern district. "Our mission is to prevent the proliferation of those that are a health risk, and to limit those that cause intolerable nuisances. And we must do all this using environmentally safe measures."

Dragonfly nymphs, other aquatic

insects, small fish and salamander larvae eat mosquito larvae. Bats, frogs, spiders, purple martins and other birds eat adult mosquitoes. While these predators help to lower mosquito populations, this usually falls far short of the level of control that's expected and demanded by modern society. In addition, mosquitoes have successfully evolved in the timing of their occurrences and preferred habitats to avoid being preyed upon. This routinely allows their numbers to outstrip any natural controls.

SURVEILLANCE IS KEY

"The key to mosquito control is knowing when and where they're occurring," explains Dave Saveikis, program manager in charge of Mosquito Control in Kent and Sussex counties. "Our emphasis these days is on outsmarting them, and to do



DELAWARE MOSQUITO CONTROL SECTION

When vast expanses of marsh must be treated for mosquitoes, aerial spraying is the only way to go.

that you have to understand their ecology and behavior to know when and where to attack them."

The Mosquito Control Section's extensive and intensive surveillance and monitoring program keeps tabs on both larval and adult mosquito populations and the viruses they might carry. Examining mosquito populations, including species types and abundances, can involve collecting "dipper" samples to check for larvae in wetlands; collecting adults in light traps placed at over 30 permanent stations around the state and numerous temporary locations; or by performing landing rate counts. The latter involves counting how many mosquitoes land on the front of a field technician's body in one minute. The goal is to shoo them away before they actually bite, all done while trying not to double-count any potential biters.

That's a real challenge when infestations start producing numbers of 50 or more per minute!

The Mosquito Control Section relies on and actually encourages mosquito complaints from the public; that helps us focus control resources. However, it's imperative that property owners also do their part to prevent skeeter eruptions by eliminating even small puddles of standing water. Mosquito Control employees are happy to help landowners identify problem sites.

The search for West Nile entails testing wild birds that are reservoir hosts of this virus. People are urged to report sick or dead crows, blue jays, robins, cardinals, hawks and owls that might have contracted West Nile. "Sentinel" chickens are also checked weekly for viral antibodies induced by West Nile or EEE. They are placed four to a cage at 22 stations around the state. In addition, we look for the presence of virus in mosquitoes themselves. Laboratory analyses for mosquito-borne viruses are conducted by the Delaware Public Health Laboratory.

SOURCE REDUCTION WHERE POSSIBLE

When surveillance and monitoring indicate that control action is needed, "source reduction" involving non-chemical controls, is often the method of choice.

One such method is stocking native, larvae-eating fishes, primarily mosquitofish, in appropriate habitats. Unfortunately, there are environmental and logistical factors that limit this type of biological control, so it's not always an effective solution.

The primary source reduction tech-



Blood samples from sentinel chickens at 22 monitoring stations around the state are tested weekly for mosquito-borne viruses.

nique for saltmarsh mosquito control is Open Marsh Water Management, which involves digging shallow ponds and small ditches in areas of irregularly-flooded coastal marsh where most saltmarsh mosquitoes are produced. This provides greater access to larval habitats for small native fish, primarily killifish, to consume mosquito larvae. OMWM also reverses some of the damage done to marshes that had been "parallel-grid-ditched" by the Civilian Conservation Corps in the 1930s, and restores or creates better habitat for waterbirds and other estuarine animals. Because OMWM provides mos-

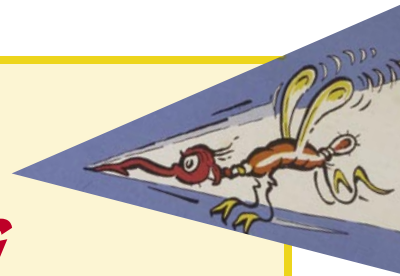
quito control while reducing the need for chemical controls, it has support from a wide range of environmental groups and agencies.

Around homes or businesses, the primary source reduction method is simply preventing or getting rid of any unnecessary standing water. This is a simple matter to address, if only more property owners would do this! We urge everyone to help us "fight the bite."

INSECTICIDE USE WHEN NEEDED

While the Mosquito Control Section prefers non-chemical, source reduction

7 TIPS FOR BEATING BUG BITES



1. Stay inside when mosquitoes are most active, at dawn and dusk and into the evening. . And that goes for city slickers and country folks alike.
2. If you must be outside, applying an insect repellent containing the active ingredient DEET can be effective and safe, as long you follow all application instructions on the label. The EPA has recently recognized picaridin and, for the organically inclined, oil of lemon eucalyptus as active ingredients effective in repelling mosquitoes.
3. Rid your yard of mosquito habitat by draining areas where larvae might occur. If you're producing the pests in your own backyard, chances are they're going after you first!
4. Mosquitoes are attracted to body heat, sweat and skin odor, so somebody who's vigorously moving around or exercising can present a more tempting target.
5. The colognes and colorful clothing that make you more attractive to your own species can make you more attractive to mosquitoes too.
6. Wearing long-sleeved shirts and long pants helps, but this is not the most comfortable clothing for hot summer months.
7. Forget bug zappers. They kill far more non-target insects than mosquitoes themselves, many which are harmless or beneficial species.

methods wherever practicable to use, we must frequently fall back on insecticide treatments. Mosquitoes spend their first several days as aquatic larvae. This is the easiest time to get rid of them since they're more localized and confined. Larvicides are applied to larval habitats in wetland areas to kill the immature mosquitoes, usually by airplane or helicopter.

Roadside ditches are usually treated by truck-mounted sprayers. Other man-made locations are often treated with hand-applied larvicides.

If larviciding doesn't do the trick, the last resort is adulticide spraying to kill adult mosquitoes that unfortunately are often widely dispersed. This typically entails aerial applications over wide-

spread areas that are being plagued by mosquitoes, or by more targeted ground applications using truck-mounted sprayers or "foggers."

Delaware's mosquito control season starts in mid-March with aerial larviciding of spring woodland pools before forest canopy leaf-out occurs. It continues in many other areas throughout the

AN UNLUCKY 13

Not all of Delaware's 57 species of mosquitoes cause problems for people. But here are 13 of the worst culprits. [WNV = West Nile virus; EEE = eastern equine encephalitis.]

Ochlerotatus (Aedes) sollicitans – **common saltmarsh mosquito**

Historically Delaware's number one pest mosquito and still a major problem today; breeds in coastal/tidal wetland "potholes" of the high marsh; erupts after lunar tidal floodings or rains from May until October; bites day/night; long-distance flyer; primary EEE vector, also found WNV-positive in the field.

Ochlerotatus (Aedes) cantator – **brown saltmarsh mosquito**

Similar to the common saltmarsh mosquito, but can appear as early as April; not as abundant in late summer and fall, nor as active during day; an EEE vector, also found WNV-positive in the field.

Ochlerotatus (Aedes) canadensis – **woodland pool mosquito**

Biggest spring problem in temporary woodland pools; long-lived; relatively limited flight range; found WNV-positive in the field.

Aedes vexans – **floodwater mosquito**

Prefers temporary waters of inland freshwater wetlands and wet woodlots; biggest summer woodland-pool pest; long-distance flyer; evening/night biter; EEE vector, found WNV-positive in the field.

Aedes albopictus – **Asian tiger mosquito**

Spread to Western Hemisphere in mid-1980s as a result of international trade in used tires; first found in Delaware in 1987,

now a major urban/suburban problem; does best in residential areas where shade and water-holding containers are common; aggressive daytime biter; limited flight range; found WNV-positive in the field.

Ochlerotatus (Aedes) japonicus – **Japanese or rockpool mosquito**

First found in Delaware in 2000; container-breeder plus occurs in isolated standing waters; not too numerous yet, but could become a serious urban/suburban problem; found WNV-positive in the field.

Culex pipiens – **common house mosquito**

Major problem in domestic environs; primarily takes avian blood meals but readily bites humans; container-breeder around houses; also likes sewer catch-basins and stormwater ponds or wastewater lagoons; limited flight range; night biter; can breed continuously throughout the summer, producing several generations; the primary vector in the east for WNV transmission to humans.

Culex salinarius – **unbanded saltmarsh mosquito**

Breeds in standing waters of coastal wetlands, both salt and fresh; night biter; locally very abundant; seems to prefer mammals for blood meals; found WNV-positive in the field.

Coquilletidia (Mansonia) perturbans – **cattail or irritating mosquito**

Prefers freshwater marshes with thick vegetation; one generation per year in late spring/early summer; long-distance flyers; aggressive evening and nighttime biters; EEE vector, found WNV-positive in the field.

Anopheles quadrimaculatus – **common malaria mosquito**

Breeds in permanent waters of freshwater wetlands; night biter, will enter houses; limited flight range; historic vector for malaria in southeastern U.S. as far north as New York; found WNV-positive in the field.

Psorophora columbiae – **dark ricefield or glades mosquito**

Likes temporary waters of freshwater wetlands or irrigation systems; long-distance flyers; aggressive day/night biter; found WNV-positive in the field.

Psorophora ciliata – **gallinipper**

A large mosquito often noticeably alarming to public; aggressive day/night biter; found WNV-positive in the field.

Culiseta melanura – **cedar swamp or black-tailed mosquito**

Not a problem biter for humans, but a major player for cycling viruses (EEE, WNV) in birds that can ultimately affect humans through the bites of other mosquito species; found in wet woodlands, but due to its deep woodland habitats very impracticable to try to control.



DELAWARE MOSQUITO CONTROL SECTION

Vigilant surveillance is key to good mosquito control. Here a technician checks a Delaware saltmarsh – a perfect breeding ground for mosquitoes – for larval development.

spring, summer and fall as we treat various mosquito production problems in salt marshes, freshwater wetlands, and urban/suburban environments. The season doesn't end until the first killing freeze of the fall.

The Mosquito Control Section only uses insecticides that are registered by the U.S. Environmental Protection Agency for mosquito control purposes. The EPA has scientifically determined that when used in prescribed manner, applications of larvicides or adulticides pose no unreasonable risks to human health, wildlife or the environment. The active ingredients in mosquito control insecticides break down quickly in sunlight and water and do not leave toxic residues. Additionally, modern larvicides have become much more target-specific.

The Mosquito Control Section puts out information about where and when spraying will occur with radio announcements, by fax to many federal, state, county and municipal officials, on a toll-free phone hotline (800-338-8181), on DNREC's website, and via e-mails to people who have subscribed to the Mosquito Control listserver. (To sign up, go to the DNREC homepage, click on "E-mail List Subscription" under services and follow directions.)



DELAWARE MOSQUITO CONTROL SECTION

When larval densities, like that in the dipper, are found in widespread areas, quick control measures are needed to prevent future misery.

The Mosquito Control Section is engaged in applied research projects to improve surveillance-and-monitoring practices and our control responses. We have a long and fruitful history working with University of Delaware researchers to help do this.

"Delaware's Mosquito Control program has developed a realistic and cost-effective approach to mosquito control that makes things bearable and our modern way of life possible," Department of Natural Resources Secretary John Hughes says with pride. "Though the situation is much improved when compared to historical infestations, Delawareans shouldn't expect us to eradicate all mosquitoes -- the economic and environmental costs of trying to do this would not be worth the effort."

While researchers continue to look

for new ways to conquer mosquitoes – from introducing mosquito pathogens to genetic engineering – the biologists and technicians of the Mosquito Control Section will carry on the fight to keep the state's mosquito populations at tolerable levels.

However, we might as well face it: mosquitoes have been around for millions of years and they'll be here long after we're gone, despite all our best efforts to eliminate or reduce them. If the onslaught is intolerable, call your local Mosquito Control field office at 302-836-2555 for New Castle and northwestern Kent County, or at 302-422-1512 for the rest of Kent and all of Sussex County. Otherwise, the best solution is to try to avoid being where the little buggers abound, or covering up and using a repellent containing DEET.

DR. WILLIAM H. MEREDITH IS THE MOSQUITO CONTROL SECTION ADMINISTRATOR. THERE IS MORE INFORMATION ABOUT MOSQUITO CONTROL IN DELAWARE ON-LINE AT [HTTP://WWW.DNREC.STATE.DE.US/FW/MOSQUITO.HTM](http://WWW.DNREC.STATE.DE.US/FW/MOSQUITO.HTM).