United States Department of Agriculture

NRCS Natural Resources Conservation Service

Biology Technical Note

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Wetlands, Mosquitoes, and West Nile Virus

The purpose of this document is to:

- Provide an understanding of the interaction between wetlands, mosquitoes, and West Nile virus (WNV).
- Reduce the fear that wetlands are a primary breeding ground for mosquitoes carrying WNV.
- List ways to reduce mosquito-breeding areas around your home and to prevent mosquito bites.

DISCLAIMER

The West Nile virus is relatively new to North America and many unknowns still exist. Every attempt has been made to see that the material presented in this document was the latest information available at the time of its publication. However, be aware that scientific research and information is constantly changing. Please contact the agencies and resources listed in the REFERENCES Section for the most current information regarding the interaction of West Nile virus, mosquitoes and wetlands.

WEST NILE VIRUS

Concerns over the spread of WNV have brought considerable attention to mosquitoes and their habitats.

To a large degree, West Nile virus is a disease associated with human habitats and not wetland sites.

The by-products of human's activities have been a major contributor to the creation of mosquito breeding habitats. In 2002, for example, the Fort Wayne/Allen County Department of Health surveyed mosquito-breeding sites near human West Nile virus cases. The survey found that 66% of these breeding sites were **tires.**

***Culex* mosquito laying eggs**

The West Nile virus is a mosquito-borne virus that was first isolated in the West Nile District of Uganda in 1937. In the U.S. since 1999, WNV human, bird, veterinary or mosquito activity have been reported from all states except Hawaii and Alaska.

It is important to note that not all mosquitoes carry WNV, not all mosquitoes feed on humans, and breeding habitat varies for each mosquito species.

About 200 mosquito species are found in the United States. The mosquito that has been most closely associated with transmitting West Nile virus in the northeast United States, and in Indiana, is the northern house mosquito (*Culex pipiens*). These mosquitoes "prefer" to bite birds, but if breeding sites are available near people's homes and domestic animal enclosures, *Culex pipiens* will bite people and domestic animals. The Centers for Disease Control and Prevention (CDC) indicates that although other species may contribute to human WNV transmission, control of *Culex* mosquitoes continues to be the most important strategy to reduce risk for WNV transmission to humans.

The larvae of *Culex* mosquitoes prefer to live in nutrient-rich, organic (often polluted) sites, such as leakage from septic tanks, abandoned swimming pools, clogged gutters, and similar enriched-water containers. *Culex* are generally weak fliers and do not move far from home, although they have been known to fly up to two miles. *Culex pipiens* are most active during dawn and dusk.

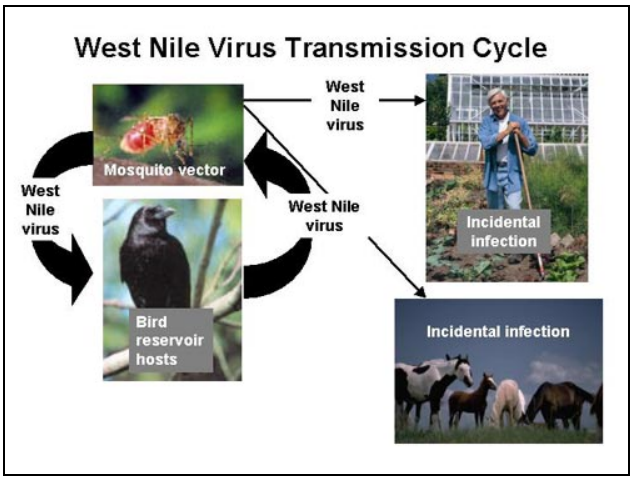
WNV is spread to people by the bite of an infected mosquito. Mosquitoes acquire WNV when feeding on infected birds that have high levels of WNV in their blood. The virus replicates and is then stored in the mosquito's salivary glands before being transmitted to humans or other animals during the mosquito bite.

Humans and domestic mammals are considered "dead-end" hosts, because they do not contribute to the transmission cycle even though they become ill. In a very small number of cases, WNV also has been spread through blood transfusions, organ transplants, breastfeeding and during pregnancy from mother to baby (one case). WNV is not spread through casual contact such as touching or kissing a person with the virus.

Statistically, a person's risk of contracting West Nile is low, and less than 1% of those infected develop serious illness from the virus.

Those at highest risk for serious illness are the elderly and those with lowered immune systems. However, people of all ages can develop serious illness, so it is important for everyone to protect themselves from mosquito bites to minimize the risk of infection. While people may feel that they have no control over the risk of exposure, this is not true. Self-protection is still the best way to reduce your risk of contracting WNV. There are many ways you can prevent mosquito bites and reduce mosquito-breeding areas around your home. See PREVENTION/ACTIONS for additional information.

Horses. Mosquitoes may also spread the WNV to horses. It is important to take preventive actions early, prior to the time of the year when mosquitoes are likely to bite and infect horses. Horses may become infected without showing any clinical signs. See APHIS Animal Disease Alert, *West Nile Virus: Protecting Your Horses,* for further information. The Alert also has information on WNV vaccines available for horses, reducing mosquito-breeding sites, use of insect repellants, and reducing outdoor exposure.



Reporting Dead Birds. While most survive, birds infected with West Nile virus can become ill or die. Dead birds in an area may mean that WNV is circulating between the birds and the mosquitoes in that area. At least 220 bird species that reside in North America have become infected with West Nile virus. However, blue jays, crows, falcons, and hawks are highly sensitive to the virus, and therefore, are the best indicators of West Nile virus activity in a community.

Warning:
Dead wild birds should not be handled with bare hands.

If you find a dead blue jay, crow, falcon, or hawk, please call your local health department and ask them if they would like to pick it up and send it to the State Laboratory. Local agencies have different policies for collecting and testing birds. Many health departments will not start collecting sick or dead birds until the peak of the mosquito-breeding season. Once West Nile virus is detected in a county, further testing of dead birds is usually not necessary.

HEALTHY WETLANDS

Wetlands play an essential role in maintaining a well-functioning environment. Wetlands filter and clean water, reduce flooding, control erosion, and provide sites for recreational activities such as canoeing, fishing, and bird watching. Before European settlement, Indiana's wetlands covered approximately 25% of the state. As settlers moved west, wetlands were drained for timber, farming, and commercial and industrial development thus eliminating approximately 87% of the state's original wetlands.

Wetland-dependent wildlife species have been severely impacted by this significant reduction in the amount and quality of wetland habitat. Wetlands are among the most biologically productive habitats in the world. Wetlands warm quickly in the spring and produce abundant quantities of food for amphibians, reptiles, shorebirds, migrating birds, and waterfowl. Even small sites, much less than an acre, can produce hundreds of frogs, toads, and salamanders. Wetlands also provide critical links to other habitat types and wildlife populations.

Mosquitoes and other aquatic invertebrates are an integrated part of the wetland ecosystem providing a food source for many invertebrates, birds, bats, amphibians, and fish species. They also are crucial in the pollination of some rare species of plants, such as orchids.

Culex pipiens rarely breeds in healthy wetlands, which do not support prolific mosquito breeding because of the presence of predators, including many mosquito-eating predators.

Insects, wildlife, and fish that eat immature mosquitoes (larvae) in the water, or eat flying adults, are often present in wetlands. Frogs, salamanders, and many aquatic insects such as backswimmers, damselflies, water striders, dragonflies, and dragonfly larvae feed on mosquitoes. Wetland wildlife including birds (e.g. swallows and ducklings) and little brown bats also consume numerous mosquitoes.

These natural predators make wetlands less than ideal mosquito breeding sites. The two-acre Edmond Avenue wetland restoration project near Portsmouth, New Hampshire, for example, demonstrated a near 100% reduction in mosquito habitat and the virtual elimination of *Culex* species.

DEGRADED AND ALTERED WETLANDS

Sometimes mosquito control programs recommend that wetlands be drained in order to control mosquitoes. While it is true that mosquitoes require standing water to breed, they also have a very short life cycle (from 4 days to a month), and the eggs can remain dormant for more than a year. Therefore, even after a wetland has been drained, it may still hold enough water after a rain to breed mosquitoes.

***Culex* mosquitoes are rarely found in healthy wetlands**

Damaged or degraded wetlands can provide ideal habitat for some mosquito species that carry West Nile virus. Excess nutrients in contaminated waters can spur microbial growth and cause harmful algal blooms, which feed mosquito larvae. Filling or draining wetlands may also increase mosquito outbreaks, as an altered landscape with stagnant pools of water may no longer contain mosquito predators. Note that most wetlands are considered "Waters of the United States" and are protected by the Clean Water Act. As such, any drainage or filling action may require a federal and/or state permit.

A *drained* area may actually produce *more* mosquitoes than it did when it was a wetland because it can no longer support natural mosquito predators.

Research from South Dakota State University found that there were many more mosquitoes in degraded wetlands than in higher quality wetlands. Storm water runoff and incompatible surrounding land use practices adversely affect natural wetlands. This includes storm water runoff from urban and newly urbanized areas and sediment from both agriculture and construction activities. Therefore, maintaining the natural functions of wetlands (i.e., minimizing disturbance) is a good start to potentially reducing mosquito habitat.

MANAGEMENT CONSIDERATIONS

In situations where wetlands pose an unacceptable risk of exposure to mosquitoes, attempting to reduce the mosquito population in the wetland may be a consideration.

The following recommendations are intended to increase mosquito predators, and to reduce mosquito-breeding areas in wetlands:

- Design meandering channel connections between shallow and deeper waters to allow the flow of predators into and out of habitats where mosquitoes may breed.
- Design or manage wetlands to have at least some permanent or semi-permanent open water. More mosquito predators are found in open water areas. Mosquito larvae also tend to use emergent vegetation as protection from predators. Note, however, that the emergent fringe provides much of the wetland's wildlife value.
- Reduce nutrient-loading and sedimentation problems by installing perimeter fences to keep cattle or other livestock from entering the wetland.
- Reduce the number of isolated, stagnant, shallow (2-3 inches deep) areas. Mosquitoes tend to congregate in these types of pools.
- Construct a buffer between the adjacent land and the wetland to filter nutrients and sediments.
- Construct artificial homes for mosquito predators such as purple martins, swallows and bats, which feed on adult mosquitoes.

Water level management. Some studies seem to indicate that maintaining high water levels in early spring, followed by a drawdown in late spring, will reduce mosquito populations. This process will tend to dehydrate mosquito larvae. After drawdown, the water is allowed to return to pre-drawdown levels. This type of management, however, can adversely affect aquatic vegetation and wetland-associated wildlife.

Larvicides. When surveillance indicates the presence of infected mosquitoes that pose a risk to health, chemical controls may be required if elimination or modification of breeding sites is not possible or is ineffective. EPA-approved larvicides, that target mosquitoes during their aquatic stage, are viewed as the least damaging to non-target wildlife. These and other chemicals used by mosquito control agencies must be applied by qualified applicators and comply with state and federal requirements. An effective larviciding program must be part of an Integrated Pest Management program.

Ornamental ponds. In addition to the applicable recommendations above, consider the following suggestions to help reduce mosquito populations in ornamental ponds**:**

- Add a waterfall, or install an aerating pump, to keep water moving. Wave action or water movement on the pond surface is an important factor in reducing mosquito larvae. Note that natural ponds and most Indiana farm ponds have sufficient surface water movement to provide adequate aeration.
- Keep the surface of the water clear of free-floating vegetation and debris during the peak mosquito season, as some species of mosquitoes will tend to seek out surfaces on which to deposit eggs.
- Consider stocking fathead minnows, topminnows, or goldfish to reduce mosquito production. This type of biological control can be a viable control method where the use of pesticides is not preferred, particularly in artificial water bodies where concerns about the impact on non-target animals are lower.

Mosquito fish. Some county mosquito-control programs distribute mosquito fish (*Gambusia affinis*) as a means of mosquito control. While mosquito fish can be an effective control approach in artificial fishponds, they are not the control choice for wetlands. Of the Indiana wetlands that will support fish, most are already inhabited by insect-eating fish as effective as mosquito fish. Furthermore, studies indicate that mosquito fish will feed on naturally occurring mosquito predators including amphibians, reptiles and other beneficial organisms found in wetlands.

Bug Zappers. Studies indicate that the use of bug zappers around the home to control mosquitoes are ineffective. In fact, the probability of being bitten by mosquitoes increases in the vicinity of these traps. Many of the non-target insects killed by bug zappers are insect predators and parasites. An estimated 71 billion to 350 billion beneficial insects may be killed annually in the United States by these electrocuting devices. In addition, studies indicate that bug zappers pose an immediate threat because of the release of insect-borne bacteria and viruses. They also release insect particles that are potential allergens and/or cause various respiratory conditions such as asthma.

PREVENTION / ACTIONS

While natural wetlands do not support large populations of *Culex pipiens*, water that stands for more than a week near your home is sufficient to breed mosquitoes. Eliminating mosquito habitat in your backyard is the primary method for minimizing mosquito population booms.

Take the following steps to reduce mosquito-breeding opportunities around your home:

- Get rid of unused tires, or keep them under cover, so they do not collect water.

Tires create a nearly perfect breeding environment for mosquitoes because they hold water, absorb heat and offer protection from predators and chemical treatments.

- Eliminate or empty any artificial water-collecting containers such as unused buckets, water troughs, and wheelbarrows, etc., when not in use.
- Clean out house roof gutters.
- Clean bird baths and animal water bowls at least once a week.
- Empty plant pots or drip trays at least once a week.
- Clean and chlorinate outdoor swimming pools, saunas and hot tubs. If not in use, keep empty and covered.
- Check for standing water below air conditioner drain outlets and outdoor faucets.
- Drain and cover boats.
- Check for standing water especially after any rain, watering the lawn or garden, or after washing the car.
- Level the ground around your home so water can run off or be absorbed evenly and not collect in low spots.
- Fill or drain tire ruts.
- Check for soggy areas over septic absorption fields.
- Drain or cover old cisterns.
- Drain culverts and ditches containing stagnant water.

Eliminating sources of stagnant water can reduce potential breeding sites for mosquitoes

Take these actions to reduce your contact with mosquitoes:

- The CDC recommends using a mosquito repellent that contains DEET (N,N-diethyl-m-toluamide) or Picaridin (KBR 3023), following label directions. Of the active ingredients registered with the EPA, the CDC believes that these two have demonstrated a higher degree of efficacy and typically provide longer-lasting protection than others. For details on when and how to apply repellent, see *Insect Repellent Use and Safety* on the CDC West Nile virus Web site.
- Wear clothing that covers the skin such as long sleeve shirts and pants when out after dusk or in shaded areas during the daytime.
- Reduce outside activity during dawn and dusk when mosquitoes are actively feeding.
- Make sure that doors and windows have tight-fitting screens. Repair or replace all screens that have tears or holes.
- Use the proper type of light outside: incandescent lights attract mosquitoes, whereas fluorescent lights neither attract nor repel mosquitoes.
- Be aware that crowds or other “mass gatherings” give off large amounts of carbon dioxide, which can attract more mosquitoes from a greater distance.
- As you plan outdoor activities, remember that West Nile virus infections usually peak in late summer and early autumn, before mosquito numbers are reduced by hard freezes.
- Vitamin B and “ultrasonic” devices are NOT effective in preventing mosquito bites.

Prevention and control of West Nile virus is most effectively accomplished through Integrated Pest Management (IPM) programs. IPM, as the name implies, utilizes a variety of physical, chemical, mechanical, cultural, biological, and educational measures, singly or in appropriate combination, to exploit the mosquito's vulnerabilities and attain the desired level of control. These programs should include surveillance for West Nile virus activity in mosquito vectors, birds, horses, other animals, and humans, and implementation of appropriate mosquito control measures to reduce mosquito populations when necessary.

REFERENCES

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Indiana Wetland Conservation Plan Fact Sheet:
Did You Know?...Healthy Wetlands Devour Mosquitoes

IN State Board of Animal Health (ISBAH)
West Nile virus

IN State Department of Health (ISDH)
West Nile virus

Local Health Departments

Purdue University
West Nile virus

Mosquitoes in and Around the Home

Management of Ponds, Wetlands, & Other Water Reservoirs to Minimize Mosquitoes (WQ-41-W)

U.S. Department of Agriculture (U.S.D.A.) Animal and Plant Health Inspection Service (APHIS)
Animal Disease Alert:
West Nile Virus: Protecting Your Horses

U.S.D.A Cooperative State Research, Education and Extension Service (CSREES)
National Pest Alert:
West Nile virus

U.S. Department of Health & Human Services - Centers for Disease Control and Prevention (CDC)
West Nile virus Basics

U.S. Environmental Protection Agency (EPA)
Pesticide Fact Sheet:
The Insect Repellent DEET

West Nile virus Facts

Wetlands and West Nile Virus.

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