



LIVING WITH WILDLIFE: MOSQUITOES, WEST NILE VIRUS, AND MOSQUITO CONTROL

Summertime in New England—beaches, barbecues, mountains, and mosquitoes. Mass Audubon receives many inquiries about mosquitoes and mosquito control practices. Are control practices safe and/or effective? Do they harm the environment? What can be done to minimize risks to human health associated with mosquitoes? This information sheet provides background information on mosquitoes, associated health risks, mosquito control methods, and environmental impacts of mosquito control activities. It also summarizes Mass Audubon's position on mosquito control practices.

Q. What is Mass Audubon's position on mosquito control?

A. Mass Audubon supports a scientifically based approach to mosquito control focused on protecting human health and minimizing environmental impacts. Mass Audubon supports the Department of Public Health's (DPH) plan for management of mosquito-borne diseases, which emphasizes monitoring of mosquitoes and mosquito-borne disease, public education, personal protection from mosquito bites, and elimination of artificial mosquito breeding sites around developed areas. The DPH plan calls for limited use of pesticides, based on the levels of mosquito and disease activity in a specific location. Mass Audubon generally opposes most nuisance control practices, including spraying of pesticides to kill adult mosquitoes when there is a relatively low risk of mosquito-borne disease, because of the harmful environmental effects, human health risks of pesticide exposures, and unproven effectiveness of these activities. Mass Audubon supports administrative and legislative reforms to improve the outdated and inefficient mosquito control laws in Massachusetts.

Q. Why is Mass Audubon concerned about mosquito control practices?

A. Some mosquito control activities, including pesticide applications and wetland ditching or draining, can harm or kill beneficial creatures (e.g., bees, butterflies, dragonflies, frogs, and fish); degrade important natural wetland habitats; alter water levels affecting water flows and supplies; and degrade water quality. In addition to these negative environmental effects, there is insufficient monitoring and reporting to determine whether mosquito control activities as they are routinely conducted in Massachusetts are effective. From a human health perspective, the risks of mosquito-borne disease must be balanced against the risks of human health effects of pesticides. Because mosquitoes breed so rapidly and in so many locations, most mosquito control practices have only local and temporary effects on numbers of biting mosquitoes.

Q. Do mosquitoes threaten human health in Massachusetts?

A. Two known serious human diseases in Massachusetts can be transmitted to humans by mosquitoes: Eastern Equine Encephalitis (EEE) and West Nile Virus.

West Nile Virus (WNV) can cause a form of encephalitis (swelling of the brain). Symptoms can include headache, high fever, neck stiffness, and in extreme cases stupor, coma, paralysis or death. Most cases in humans are mild, causing only a flu-like illness that lasts a few days, or even no symptoms at all. However, WNV can be serious or even fatal in some cases. WNV is new to the US, first appearing in the summer of 1999 in the metropolitan New York area. In 2000 it was detected in Massachusetts and it has since spread rapidly across the continental U.S. and into Canada, Mexico, and the Caribbean. In 2002, there were 25 cases and 3 fatalities in Massachusetts. In 2003 there were 17 locally acquired human cases

of WNV diagnosed in Massachusetts and one of these was fatal. In 2004 there were no confirmed human cases and the number of documented bird cases had dropped significantly compared to the previous several years. In 2005, there were 6 human cases including one fatality, and in 2006 there were 3 human cases in Massachusetts.

EEE is another viral disease affecting the central nervous system and causing encephalitis. It is very serious, but extremely rare. Eighty-four cases of EEE have been confirmed in humans in Massachusetts since 1938. EEE is fatal in one-third to one-half of the cases, and most victims who survive suffer lifelong disabilities. EEE outbreaks tend to occur in ten to fifteen year cycles, with several years of activity followed by periods of lower risk. The latest cycle of human cases began in 2004, with four cases of EEE in humans in southeastern Massachusetts in 2004 and 2005 and five cases in 2006. These cases resulted in two fatalities each year from 2004 through 2006.

EEE in Massachusetts rarely occurs outside the southeastern portion of the state, which contains extensive freshwater swamps (wooded wetlands) that harbor the mosquitoes that may transmit the disease. The risk of contracting EEE in other parts of the state is extremely low.

The Department of Public Health monitors mosquitoes, birds, other animals, and humans for WNV and EEE. People should take precautions to prevent mosquito bites. Young children, the elderly, and people with depressed immune systems are at greatest risk.

If you find a dead bird with no obvious cause of death, i.e. collision with a car or window, contact your local health agent or DPH's WNV Toll Free Hotline at 866-MASS-WNV or (866) 627-7968.

Q. Do mosquitoes threaten the health of wild and domestic animals?

A. WNV has been documented in over 250 species of birds (including various exotic, captive species as well as wild birds) and 18 species of mammals in North America since 1999. There is a very high mortality rate in many native species of birds, but it is still unclear whether the disease will have long-term population effects on native birds.

Horses can contract EEE and WNV, and a vaccine is used for EEE. There have been a few cases of WNV documented in cats. Dogs may contract the disease but do not generally become ill. Contact your veterinarian for more information on the potential susceptibility of particular domestic animal species.

Dogs (and occasionally cats) can contract heartworm from mosquito bites. Dog owners should have their animals tested annually and treated with preventative medication to avoid the serious health effects of heartworm.

Q. How do I know if I am at risk of infection?

A. The Massachusetts Department of Public Health monitors mosquito populations and tests for the presence of the WNV and EEE. The Department warns local boards of health, hospitals, and the public when it detects viruses in mosquitoes. The Department provides daily updates of data and locations of infected birds, horses, mosquitoes, and people on its WNV website at: www.state.ma.us/dph/wnv/wnv1.htm.

Q. Do all mosquitoes bite people? Do all mosquitoes carry EEE or WNV?

A. Absolutely not to both questions. Of the more than 50 species of mosquitoes in Massachusetts, most do not usually bite humans or transmit disease to people. EEE is very rare because the great majority of mosquitoes do not carry the virus, and of those that sometimes do carry EEE, most are a species (*Culiseta melanura*) that bites birds almost exclusively. Exactly which species transmits EEE to humans by biting

an infected bird and then a person is unknown, but the Department of Public Health monitors populations of the three species of mosquitoes that are suspected EEE transmitters.

WNV is somewhat more easily transmitted to people, but it causes serious illness in a much smaller percentage of the total cases. A mosquito called Culex pipiens that commonly breeds in small areas of stagnant water such as catch basins, gutters, discarded tires, etc. is believed to be a primary transmitter of WNV but other mosquito species may also transmit this disease. Since it is new to this continent the transmission routes and trends of WNV are not yet well understood.

Q. What is the recent history of EEE in Massachusetts? When was the last outbreak and what happened?

A. EEE outbreaks tend to occur in ten to fifteen year cycles. A significant outbreak with multiple human cases of EEE occurred in the early 1990s. Single, isolated human cases of EEE were confirmed in Massachusetts in 1992, 1995, 1997, 2000, and 2001. There were no recorded cases in 1998, 1999, 2002, or 2003. In 2004 and 2005, there were four cases each year of EEE in humans in southeastern Massachusetts, and five cases in 2006. There have been two fatalities in each of these past three years. In 1990, 800,000 acres in southeastern Massachusetts were sprayed with malathion from airplanes in response to high numbers of virus-carrying mosquitoes. There were reports of fish kills and human health effects associated with that spraying operation. We published a report, "Learning from Experience" on the subject.

Subsequently, and consistent with our recommendations, the Department of Public Health worked with other agencies, experts, and environmental groups to prepare a phased response plan that established protocols for different levels of response depending on risk indicators.

In 2006, as number of infected mosquitoes, and therefore risk to human health, spiked to record high levels, the Governor declared a public health emergency resulting in two aerial applications of Anvil 10 + 10 (Sumithrin) in southeastern Massachusetts. The first spray, August 8th, covered 159,000 acres, and due to continued high risk to people, there was a second spray August 22-24, which covered 425,000 acres. In 2006, five people contracted EEE, with two mortalities.

Q. What methods are used to control mosquitoes? What are the effects of these activities?

A. Mosquito control methods include:

Source reduction involves removing areas of stagnant water where mosquitoes breed. For example, buckets, tires, and other artificial containers can be removed. Stormwater detention basins should be designed to drain within a few days after each storm or to hold permanent ponds of water that can support mosquito predators like fish. Catch basins should be cleaned regularly. Roadways and stormwater outfalls should be cleaned and maintained to minimize deposition of sediment into streams. Other source reduction methods involve more complicated manipulations of water levels in wetlands, often with significant ecological impacts. Open Water Marsh Management, used in ditched salt marshes to improve access by fish to mosquito breeding areas, can be effective and environmentally sound when carefully managed. There is no equivalent method for freshwater marshes and swamps, and few data are available on the effectiveness and impacts of inland water management practices.

Mass Audubon generally opposes construction, maintenance, and enlargement of drainage ditches in freshwater wetlands for nuisance mosquito control purposes. These activities can have harmful environmental effects including draining of wetlands, destruction of amphibians and reptiles by heavy equipment, erosion and sedimentation, and other, permanent or long-term alterations of productive wildlife habitat. The State Reclamation and Mosquito Control Board was tasked with development of Best Management Practices (BMPs) for freshwater mosquito management in the final Certificate on the Generic Environmental Impact Report in 1998. Mass Audubon supports the development of scientifically

based BMPs and associated monitoring programs to document the effects of mosquito control practices. The primary focus should be on reducing public health risks and promoting a healthy environment. Proper design and maintenance of stormwater systems is also important.

Adulticiding involves spraying chemical pesticides, such as malathion, resmethrin, or sumithrin (Anvil) to kill flying adult mosquitoes. This method has only short-term local effectiveness, as new mosquitoes soon fly into the area or emerge from breeding pools. Spraying of broad-spectrum pesticides also exposes people, pets, and wildlife to the chemicals. Butterflies, bees, aquatic invertebrates and fish are particularly sensitive to some of the commonly used adulticides. Routine spraying for nuisance mosquito control also may lead to pesticide-resistant mosquitoes, which would be more difficult to control in the event of a public health emergency. Pesticide spraying may present some level of human health risk as well, particularly for certain sensitive individuals such as asthmatics. For information on the health effects of pesticides, contact the Department of Public Health's Bureau of Environmental Health Assessment at (617) 624-5757. Mass Audubon opposes adulticiding for nuisance control of mosquitoes.

Larviciding involves application of chemical or bacterial materials to mosquito breeding areas to kill mosquito larvae. *Bacillus thuringiensis israelensis* (Bti) is a toxin producing bacterium that, unlike broad-spectrum chemical pesticides, narrowly targets mosquitoes, midges, and other closely related flies. However, Bti may disrupt the food web in vernal pools where amphibians breed.

Another commonly used larvicide is methoprene. It is a growth regulator, which acts by interfering with the normal metamorphosis process thereby preventing mosquito (and various other insect) larvae from reaching the adult stage. Methoprene briquettes are often used in catch basins, because they provide a much longer duration of control than Bti.

Q. How effective are mosquito control practices?

A. The effectiveness of mosquito control in a rural or suburban landscape with large amounts of wetlands is questionable. There is little documentation of the effectiveness of mosquito control activities in Massachusetts, and most of the available information is on short-term effects within a few days after pesticide applications.

Pesticide applications and wetland ditching or draining can harm or kill beneficial species (including pollinators and mosquito predators), alter water chemistry; lower water levels, and degrade wetland habitats. The high reproductive rate and short life-cycle of mosquitoes may allow populations to evolve which are resistant to the pesticides, while local populations of mosquito predators (such as frogs, fish, and predatory insects) are less resilient.

The mosquitoes of greatest concern for WNV transmission breed primarily in small isolated areas, such as buckets, old tires, and tree hollows. Therefore, local efforts to manage WNV should focus on prevention and removal of human-created breeding habitats, and on public education and personal protection from mosquito bites.

Q. How can I protect myself and my family from mosquito bites?

A. In and around the home, mosquitoes can be excluded by the use of screens. Containers of standing water (e.g., buckets, old tires, clogged gutters, dirty birdbaths) should be removed or cleaned frequently. Some mosquitoes can grow from egg to larvae to adult in less than a week under favorable conditions. Away from home, avoid marshy areas (particularly at dawn and dusk when mosquitoes are most active); wear protective clothing (long sleeved shirts and pants); and use insect repellent on exposed skin. For those concerned about the possible effects of DEET, the most commonly used insect repellent, one can apply the repellent to clothing rather than directly to the skin. Never use DEET repellents on infants.

Some people place bat and/or bird houses on their properties to attract these insect-eating creatures, or purchase dragonfly larvae because adult dragonflies eat mosquitoes. There is no proof that these practices have significant effects on local mosquito populations. Insect-eating birds may benefit from nesting boxes and the property owner may enjoy their presence. There is no harm in placing nesting boxes even though the mosquito control benefits are unproven.

Q. How can I get my property excluded from a local spraying program?

A. Property owners may have their land excluded from routine nuisance control spraying by filing a letter with the town clerk before March 1. In some mosquito districts late exclusion filings will be accepted but they are not required to do so. The exclusion applies only for that year. If a public health emergency is declared in your area, you will probably not be able to get your property excluded (although exceptions might be made for sensitive areas like surface water supplies, beekeeping operations, fish farms, and organic farms).

Q. How does Mass Audubon deal with mosquitoes on its wildlife sanctuaries?

A. Mass Audubon manages its sanctuaries as natural ecosystems of which mosquitoes are a part. We do not use or allow the application of pesticides (adulticides or larvicides) to Mass Audubon properties for control of nuisance mosquitoes. An exception to this policy may be made in the case of a declared public health emergency. Mass Audubon does not interfere with the natural water regime of wetlands on our properties to control mosquitoes, because of the significant adverse effects on wildlife and the natural system as a whole. An exception to this policy may be made for Open Marsh Water Management or other ecologically based management practices where modification of existing mosquito control ditches or degraded wetlands may have ecological benefits as well as reduce mosquito populations. Bird-nesting boxes are also placed on some of our properties to attract and provide breeding sites for insect-eating birds such as tree swallows and bluebirds.

Summary of Mass. Audubon position regarding mosquito control in Massachusetts:

Mass Audubon supports a scientifically based mosquito-borne disease management program to protect public health while minimizing environmental and public health risks associated with some forms of mosquito control. The existing programs for mosquito control in Massachusetts are antiquated and fragmented, and reform is needed.

Mass Audubon supports the consistent application of the Massachusetts Department of Public Health's (DPH) *Massachusetts Arbovirus Surveillance And Response Plan*. This plan is responsible and well thought out, emphasizing public education to prevent mosquito bites and remove artificial sources of standing water around homes and neighborhoods. DPH also supports judicious, targeted use of larvicides such as in catch basins. The DPH only recommend spraying of chemical pesticides to kill adult mosquitoes in high-risk situations where monitoring indicates that the disease risk is high and targeted intervention is warranted.

Unfortunately, communities do not always have access to mosquito control programs that are fully consistent with the DPH plan. There are nine different districts in Massachusetts, operating in nine different ways. There is no single set of Best Management Practices that they all must follow. They are exempt from the Wetlands Protection Act. Some of the districts engage in nuisance control pesticide spraying and other activities not recommended by DPH. Fundamental reform of legislation governing mosquito control in Massachusetts is needed to update the programs and make them consistent with the best available public health based operating standards.

Once a community joins a mosquito control district, it delegates mosquito control activities to the district. The level of local control and tailoring of programs to meet local needs and desires varies from district to district. Some mosquito control districts will voluntarily tailor their services to meet

community requests. If your community is a member of a mosquito district, we recommend that you request that the district voluntarily limit itself to the actions called for in the DPH plan, and that no wetland ditching or draining or nuisance control pesticide applications be conducted. We do not recommend community participation in mosquito districts that refuse to focus and limit their work in accordance with the DPH plan. If there is a public health emergency in your area and immediate action is needed, public health officials can arrange other options for mosquito control treatments.

Spraying of pesticides to control adult mosquitoes is the least effective and most environmentally damaging method of mosquito control. Spraying should be conducted only where the risk of human cases of WNV or EEE is high due to actual presence of WNV- or EEE-carrying mosquitoes in close proximity to concentrations of human habitation. The Department of Public Health should be the primary authority establishing the protocols for spraying based on best available science and risk assessments.

Mass Audubon supports legislative reform of mosquito control practices by establishing integrated pest management standards for nuisance mosquito control; requiring compliance with environmental and public health statutes; and improving public education about the use of personal protective strategies. Although some district managers are incorporating some of these approaches into their operations, the overriding legal issues remain a serious concern.

WNV and EEE Response/Avoidance Actions should be taken IN THE FOLLOWING PRIORITY ORDER:

1. Public education encouraging personal protection measures (long sleeves and pants, hats, repellent). Do not apply repellent directly to skin of infants, young children, or sensitive individuals. Apply to clothing instead.
2. Source reduction: Emptying birdbaths, buckets, tires, gutters, and other stagnant water breeding areas. Larviciding of catch basins, stormwater detention ponds, and other human-constructed breeding sites. Larviciding of natural wetlands should be targeted to areas where there is a high risk of disease, such as wetlands that are in close proximity to both concentrations of disease-positive birds and human habitation. Larviciding activities should be avoided or carefully limited in sensitive wetland habitats such as vernal pools or rare species habitats.
3. Ground spraying: Mass Audubon does not oppose the targeted use of ground spraying from fogging trucks in locations where public health officials have documented an imminent threat to public health based on actual evidence of high levels of WNV or EEE and disease-transmitting mosquitoes in close proximity to concentrations of human habitation. Conditions should include:
 - o applications are targeted to documented high risk areas (pursuant to the Department of Public Health's protocols) and are conducted in careful compliance with EPA label requirements (including avoidance of impacts to rare species, fisheries, and other sensitive resources)
 - o there is ample public notification both before and after spraying, to minimize public exposure to pesticides
 - o officials conducting spraying should emphasize that people still need to take measures to protect themselves from mosquito bites because spraying will not eliminate all mosquitoes, and adults quickly hatch and repopulate the area.
4. Aerial spraying: Interventions through aerial spraying of adulticides should be undertaken only when very high-risk conditions exist and the DPH protocols are triggered. Such decisions must be made very carefully by DPH, balancing the human health and environmental risks of the pesticides with an imminent public health threat due to disease outbreaks. In many instances, the environmental risks outweigh the public health benefits of this method. In 1990, when an aerial application of malathion was used to manage Eastern Equine Encephalitis, 800,000 acres in southeastern MA were sprayed and massive fish kills occurred. Enormous numbers of nontarget species, including harmless insects and mosquito predators like dragonflies were killed. We published a report, "Learning from Experience" on the subject.

Aerial spraying would have minimal benefits for prevention of human cases of West Nile Virus. The mosquitoes of greatest concern for West Nile Virus transmission breed in small isolated areas like catch basins, discarded tires, etc. At best, spraying kills much of the current population of adult mosquitoes, yet many more hatch within several days. Meanwhile, the environment and people are exposed to broad-spectrum pesticides over a large area. West Nile Virus can be managed through source reduction and larvaciding.

To protect the public health, Mass Audubon does not oppose the aerial spraying proposed by the state when consistent with a declared public health emergency pursuant to the DPH's *Massachusetts Arbovirus Surveillance And Response Plan* during periods of extraordinarily high EEE risk. However, we would prefer more emphasis and funding for other approaches including early season larvaciding, public education about preventative measures, and more precise targeting of spraying rather than broadcast spraying over hundreds of thousands of acres. There is a need for greater accountability and transparency in the state's analysis of the efficacy, cost-effectiveness, and the public health and environmental risks associated with such spraying. We are also concerned regarding the adequacy of follow-up monitoring plans to document the effects of the spraying.

For more information on West Nile Virus or Eastern Equine Encephalitis prevention measures, contact the Department of Public Health at WNV Toll Free Hotline at 866-MASS-WNV (866) 627-7968, or visit their website at: www.mass.gov/dph/wnv/wnv1.htm.

The National Wildlife Health Center lists the species of birds and other wildlife that have been confirmed with WNV: http://www.nwhc.usgs.gov/disease_information/west_nile_virus/index.jsp

For more information on Mass Audubon's position, contact Heidi Ricci, Senior Policy Analyst, at 781-259-2172, or hricci@massaudubon.org.

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