Category 10: Mosquito Pest Control

IF YOU WISH TO APPLY PESTICIDES TO PUBLIC PROPERTIES YOU MUST NOW BE A LICENSED GOVERNMENT APPLICATOR.

Mosquito Pest Control Learning Objectives

After studying this section, you should be able to:

✓ Describe the life cycle of mosquitoes and the best time during their life cycle to institute control.
✓ Identify the most common species of mosquitoes in Nevada.
✓ Describe West Nile virus (WNV) and those species of animals it affects.
✓ Detail precautions to take to reduce the possibility of contracting WNV.
✓ Describe methods to reduce the mosquito population around homes and other structures.

Category 10, Mosquito Pest Control

Recent changes in Nevada’s legislation limit certified applicators to the following: residential landscapers, homeowners, commercial establishments with their own pest control staff (hotels, casinos, resorts, restaurants, etc.), home owner association (HOA) employees, private golf courses or clubs with their own pest control staff, Nevada mine staff and Tribes.

As of July 1, 2017, pesticide applications at public buildings, public schools, all Federal (BLM, USFS, etc.), State, County, City or other municipality properties, including County or State owned golf courses and City, County or State Parks, must be made by a Licensed Government Applicator or a licensed pest control company. The new requirements are detailed in the Pesticides and the Law chapter of this manual. Additional information can be found at http://agri.nv.gov/Pest-Control/.

Category 10, Mosquito Pest Control, involves the management of mosquitoes to reduce infestations and control mosquito-transmitted diseases in humans and other animals.
Category 10, Mosquito Pest Control, involves the management of mosquitoes to reduce infestations and control mosquito-transmitted diseases in humans and other animals. Mosquitoes are flies, members of the order Diptera. They are pests to humans and other animals. They act as vectors of several diseases, including malaria, filariasis, yellow fever, dengue fever, West Nile virus, St. Louis encephalitis, Western equine encephalitis, Eastern equine encephalitis and dog heartworm. In addition to being the vector of many diseases, they are annoying and can reduce property values.

Mosquito Life Cycle

Mosquitoes undergo complete metamorphosis. The female lays eggs on or near water. Eggs of mosquitoes may be laid singly on water or in mud, in rafts on the water surface, or attached to aquatic plants. The incubation period varies between species and is detailed later in the individual species discussion. In general, the incubation period lasts 16 to 24 hours. The eggs hatch and the mosquito larvae are aquatic, living in water and breathing by surfacing or via a breathing tube or siphon. The larvae, also called wrigglers, do not depend on the oxygen in the water. Large numbers of larvae can survive in a small amount of water, even stagnant water. The larvae feed on algae and other organic material in the water. Controlling mosquitoes is most effective in the early life stages.

Mosquito larvae go through four instars or molts. After the fourth molt, the larvae pupate. The adult mosquito develops within the pupa case. The pupal stage varies among species and also varies with water temperature, but it is usually between two and four days. The pupae, also called tumblers, are comma-shaped and breathe through a pair of siphon tubes located on the sides of the thorax. The pupae do not feed but do remain active and will avoid predators by tumbling through the water, similar to larvae.

Because they are active feeders and their development is sensitive to water chemistry, larvae are easy to control using biological or chemical methods. Because pupae do not feed, control at this stage is limited to disrupting the surface tension of the water where pupae raise to the surface to breath. This is generally less effective than controlling larval populations.

The adult mosquito emerges and rests on the water surface until its skin hardens and its wings dry. At this point it is able to fly and will disperse. Male and female mosquitoes may feed on the nectar of flowers after emerging from the water surface, depending on the species. Females typically require a blood meal as a protein source before they are able to develop eggs.

The length of the metamorphosis cycle and the overwintering life stage
varies from species to species. *Aedes* species generally overwinter as eggs on the soil surface. *Anopheles, Culex* and *Culiseta* species typically overwinter as adults. During the active season, generation times can vary from five days to several weeks depending on both the species and average daily temperatures.

**Species of Mosquitoes in Nevada**

There are 37 species of mosquitoes in Nevada. The most important species are:

- *Aedes dorsalis*: a major pest mosquito often produced through flood irrigation; feeds anytime but mainly during the day and early evening; females live up to three months; over-winters as eggs.
- *Aedes melanimon*: another major pest mosquito; six to seven day larval period during warm days; also associated with irrigated pastures and fields.
- *Aedes nigromaculis*: daytime biter; will not enter houses; can vector encephalitis; very tolerant to alkaline water; five day larval period.
- *Aedes sierrensis*: western treehole mosquito; carries dog heartworm; occurs up to 6000 feet along the Sierras (both sides); one brood/year. In areas where this is a problem, the release of sterile males can aid in control.
- *Aedes vexans*: day and evening biter; does not enter houses; found in swamps, stream overflows and borrow pits. Occasionally breeds in open pastures.
- *Anopheles freeborni*: main vector of malaria; night biter; enters houses; found in permanent open water.
- *Culex pipiens quinquefasciatus* (the southern house mosquito): southern Nevada species; birds are principle hosts, but does attack humans and readily invades homes; breeds in artificial pools and ponds, catch basins, waste treatment ponds, and roadside ditches.
- *Culex pipiens pipiens* is ecologically very similar to the southern house mosquito but occurs in northern regions.
- *Culex tarsalis*: evening and night biter; enters houses; principal vector of encephalitis; prefers birds; migrates readily; found in pastures and flood waters, rain pools, ornamental pools/ponds, roadside ditches and dairy drains.
- *Culiseta inomata*: primarily feeds on cattle; they are large; survive well in cool weather; found in duck clubs, pastures and ditches.
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Mosquito Control History

Malaria remains the world’s most prolific and devastating mosquito-borne disease, infecting as many as 274 million people annually. During the 1800s, malaria was introduced into much of North America by settlers who spread across the continent. Today, the disease in North America is limited to sporadic, contained introductions that result from people traveling to regions where malaria is indigenous. The first active mosquito control efforts in the United States began early in the 20th century and by 1921, malaria was virtually eliminated. Before the advent of chemical controls, mosquito-contaminated water sources were often drained and eliminated. This is referred to as source reduction. The use of predatory fish as biological controls was also common before the advent of chemical controls.

By 1945, chemical controls became widely available. Among them was DDT, which was used to control a wide variety of insect pests in addition to mosquitoes. Evidence of resistance to DDT and other hydrocarbon-based chemicals became apparent by 1954. From 1954 to 1964, mosquito control relied on organophosphate products, but by 1964, resistance to organophosphates began to develop. In 1979, there were 270 cases of imported malaria in North America and increases in malaria worldwide. This resulted from mosquito resistance to “older” pesticides, first to the chlorinated hydrocarbons, then to the organophosphorus compounds, and finally, cross-resistance developed. Resistance does not occur overnight. This problem has been widespread among types of mosquitoes, including populations of *Aedes nigromaculis*, *Culex tarsalis* and *C. pipiens quinquefasciatus*.

Today, source reduction has again become an invaluable tool for controlling mosquito populations as the costs of chemical controls are increasing along with greater public environmental awareness. Effective mosquito control should use a diverse array of tools, including source reduction, surveillance and responsible, effective chemical controls when necessary.

Mosquito Control

The primary goal of mosquito control is the elimination or treatment of the water source where larvae develop. First, determine the primary species. Next, sources must be determined, mapped and monitored regularly. This should first be attempted through the use of cultural controls (source reduction) or biological controls. Cultural controls may include draining, filling, flushing and lining swamps, ponds and ditches. In general, source reduction should eliminate the water source or alter the habitat by
improving water flow and making the habitat less conducive to mosquito development. Biological controls include *Gambusia affinis* (mosquito fish) and some biological insecticides, such as *Bacillus thuringiensis var. israelensis* (Bti) or *Bacillus sphaericus*.

Mosquito fish have been used very successfully in a wide variety of sources, from large ponds to small urban water features. When relocating mosquito fish, you must use locally adapted stock and notify the Nevada Department of Wildlife before moving the fish.

*Bacillus thuringiensis var. israelensis* (Bti) and *Bacillus sphaericus* are bacterial biological control products. They can provide excellent control if applied from the first to early fourth instar. This timing is very critical.

Once these methods have been exhausted, chemical controls can be used to control both adults and larvae. It is best if control measures for both are undertaken, but the primary goal should always be control of the larvae.

Chemical controls that target adult mosquitoes are called adulticides. Adulticides are usually applied as fogs, sprays, and as sprays from ULV (Ultra-Low Volume) sprayers.

Chemical controls that target mosquito larvae are called larvicides. Larvicides can be applied as liquids, granules or pellets. The granular and pellet formulations are best for areas with thick vegetation cover. The granules readily settle through vegetation, whereas liquids will not.

Pesticide formulations change often. Consult your local dealer for the latest pesticide formulations that will control the particular species of mosquito on the specific site. Given the history of pesticide resistance developing in mosquitoes, alternating chemicals throughout the season is always advisable.

**West Nile Virus Management**

West Nile virus (WNV) infection is a mosquito-borne virus and is closely related to St. Louis encephalitis (SLE) virus. In 1999, the first confirmed cases in the United States were all recorded in New York City. Since then, confirmed cases of WNV in animals and humans have spread across the continental United States.

Mosquitoes that feed on infected birds pass WNV to other birds, animals and people. West Nile virus (WNV) is not spread by person-to-person contact. Healthy people of any age can become ill with the disease. It can be fatal or permanently disabling, although the majority of people who are bitten by a mosquito with WNV never develop symptoms.
Common symptoms of mild infections include fever, headache, body ache, skin rash and swollen lymph glands. Those with a more severe infection may experience high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, paralysis and death. In humans, the virus has an incubation period of three to 10 days.

There is no human vaccine or treatment for the WNV infection. Most people fully recover from the viral infection, but those with severe symptoms may have to be hospitalized to receive supportive care.

There is no vaccine for dogs or cats. However, horse owners should ensure their horses are vaccinated against WNV, Eastern Equine Encephalitis (EEE), and Western Equine Encephalitis (WEE). Consult a veterinarian for more information.

Unexplained bird deaths may indicate the presence of West Nile virus. If dead birds of a susceptible species, such as crows or jays, are found, contact the county health department. The bird must have died within 24 hours. If maggots are present or the body is stiff, the carcass is unacceptable. Decomposed or scavenged carcasses cannot be tested. DO NOT touch the carcass with bare hands. Wear rubber or latex gloves when picking it up and handling it. If gloves are not available, use a plastic bag turned inside out to pick up the bird. Place each bird carcass into a plastic bag and secure it inside a second zip-top plastic bag and zip lock it shut. Double bagging prevents cross-contamination and leakage.

If a carcass is not testable, collect the bird and dispose of it by placing it inside a double bag and putting it in a secure garbage can or dumpster.

While there is no recommendation to limit outdoor activity, there are certain precautions to take in areas where WNV is found.

- Limit outdoor activity when mosquitoes are most active in the evening.
- When outdoors, wear mosquito repellant.
- Repellants containing 20 to 30 percent DEET for adults and no more than 10 percent for children are effective. Do not use repellant containing DEET on children under three. Non-DEET based products have also become widely available and effective.
- Spray repellant on the hands and then apply to the face. Only adults should apply repellant on a child.
- Apply repellant to exposed skin and clothing only. Do not use repellant under clothing or apply on cuts, wounds, sunburned or irritated skin.
- Wash treated clothes before wearing them again.
- Wear long-sleeved shirts and pants when outdoors for long periods of time.
• Avoid perfumes and colognes when outdoors for extended periods of time.
• Repair window screens if needed, and make sure window and door screens remain closed.

To reduce the mosquito population around homes and other structures:
• Change water every few days in bird baths, pet water bowls and water troughs for large animals.
• Mosquito fish or gold fish can be put in large water troughs to eliminate mosquitoes.
• Clean clogged roof gutters on an annual basis. Roof gutters are easily overlooked and can be ideal mosquito breeding sources.
• Aerate ornamental pools or stock them with fish. Water gardens are major mosquito producers if allowed to stagnate.
• Dispose of tin cans, ceramic pots or similar water holding containers on your property.

Endangered Species

If you are conducting pest control activities in eastern Clark County, be aware that there are several endangered species in this county. There may be restrictions on the chemicals that can be used and where they can be sprayed. This information can be obtained from the pesticide label.

Conclusion

For more information go to the following websites:
• American Mosquito Control Association:  http://www.mosquito.org/
• Centers for Disease Control and Prevention (CDC): https://www.cdc.gov
• Nevada Department of Agriculture, Division of Animal Industry:  
  http://agri.nv.gov/Animals/Animal_Home/
• Nevada Department of Health and Human Services,  http://dhhs.nv.gov
• Southern Nevada Health District:  
  http://www.southernnevadahealthdistrict.org/
• Washoe District Health Department:  
  http://www.co.washoe.nv.us/health

Reducing mosquito populations around homes or other structures requires eliminating breeding sites, usually water sources.

If you are conducting pest control activities in eastern Clark County, be aware that there are several endangered species in this county. There may be restrictions on the chemicals that can be used and where they can be sprayed.

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