

# Mosquito Control Around Homes and in Communities

## Biting and Stinging Pests

### Background

Mosquitoes are significant public health pests because they transmit disease-causing pathogens to humans as well as wild and domesticated animals. In addition, mosquitoes are considered nuisance pests because their bites interfere with human activities. Most mosquitoes are active during twilight hours and at night; however, mosquito species that are common around the home, (those that breed in ephemeral pools of water) are active during the day. Mosquitoes need water to complete their life cycle—they have evolved to live in nearly every aquatic habitat. It is important to note that pesticides are only a short-term solution to a mosquito issue. Long-term, effective population control requires **integrated pest management**. Integrated pest management is a strategic, science-based approach that combines multiple control strategies in a way that will minimize economic, health, and environmental risks while effectively managing target pests. In this article, we will discuss mosquito biology, behavior, and how to utilize integrated pest management strategies to manage backyard populations of mosquitoes.

### Mosquito Life Cycle

All mosquitoes need water of some sort to complete their life cycle, which is four stages—egg, larva, pupa, and adult ([Figure 1](#)). Water is required for egg hatching and juvenile mosquito development. Some mosquitoes lay their eggs on the surface of the water, either individually or in "rafts." A raft can contain as many as 100-200 eggs. These eggs usually hatch within 24-48 hours depending on water temperature. Other mosquitoes deposit individual eggs on the sides of tree holes, in discarded containers, or in depressions in the ground that hold water. These eggs are hearty, survive over the winter, and can lie dormant for several years and cycles of dry weather. Egg hatching is triggered when they are flooded by rainfall, but several flooding and drying cycles may be required before all of the eggs laid by a particular female mosquito hatch. Regardless of where a mosquito lays their eggs, once they hatch, they release larvae that are commonly called "wrigglers" because you can often see them wriggling up and down from the surface of the water. Most mosquito larvae feed on organic material as well as bacteria, algae and other microorganisms in the water. There are a few mosquito species that are beneficial because their larvae prey on the larvae of other mosquito species and aquatic insects. Mosquito larvae go through four 'instars' (phases) and four molts (shedding of the exoskeleton). This process typically takes 7-10 days from hatching for completion. After the 4<sup>th</sup> instar, larvae transform into the pupa or "tumbler" life stage in preparation for adult life. Mosquito pupa, unlike larvae, do not feed, but they are very active and can be seen moving around or breathing near the water's surface. At the end of the pupal stage (usually 3-4 days) mosquitoes emerge and will typically feed first on plant nectar for energy. Mating between male and female mosquitoes typically occurs 1-2 days after emergence. Female mosquitoes then begin searching for an animal on which to feed, as blood is required for egg development. They are attracted to hosts via a number of cues including carbon dioxide and odors that emanate from skin. Males do not feed on blood or bite; they feed strictly on plant juices. The life span of female mosquitoes is usually 1-2 months, while males survive for approximately 6-7 days.

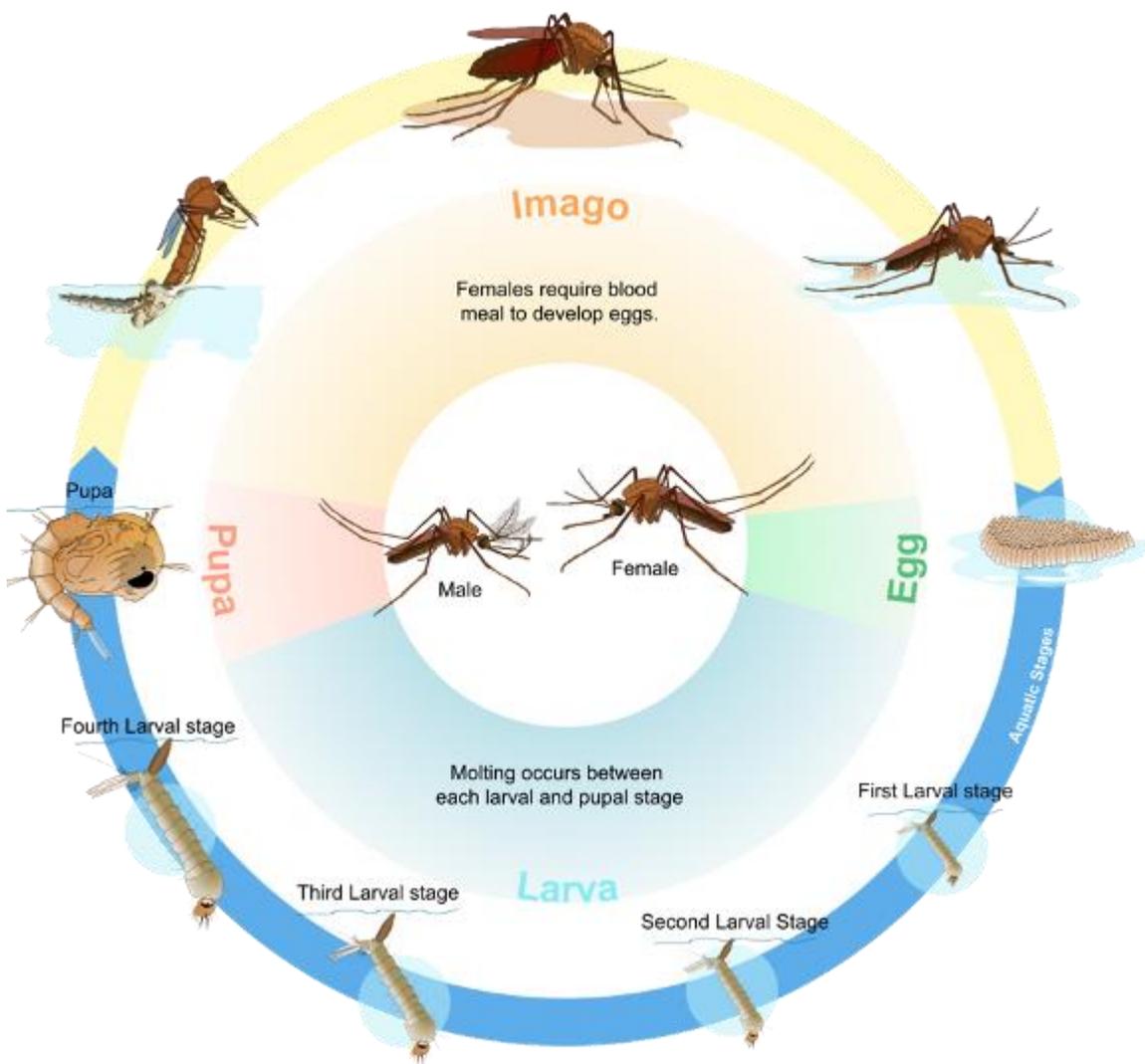


Figure 1. Mosquito life cycle.

Iowa State University, Extension and Outreach

## Mosquito Breeding Sites

Since mosquitoes need water to complete their life cycle, the source of a mosquito problem is often difficult to pin down as larvae can accumulate nearly anywhere that water can collect and become stagnant. Typically, these areas are small and difficult to detect. Contrary to popular belief, farm ponds and lakes are typically not major breeding areas for the mosquitoes that most concern us. Natural predators such as fish, and predatory insects (such as dragonflies), often keep mosquitoes in these environments in check. We can maintain and improve the environment for mosquito predators by keeping ponds free of weeds, algae and floating debris where mosquito larvae can hide. Although large bodies of water like ponds are not often sources of nuisance mosquitoes, severe storms, such as hurricanes, can lead to booms in mosquito populations. For example, tree limbs that break off during storms can create holes in tree trunks where water collects and allows mosquitoes to breed (Figure 2). In residential areas, human activity often creates mosquito breeding sites or promotes increased mosquito activity around natural bodies of water. For instance, clogged drainage ditches along roads can become productive mosquito breeding sites. Logging and construction activities often leave deep tire ruts and holes in the soil where pools of water can form. These depressions are ideal breeding sites for "floodwater" mosquito species. Importantly, man-made containers serve as one of the most common breeding sites for mosquitoes. Discarded tires, bird baths, bottle caps, potted plants, and other artificial materials/containers are ideal breeding sites for one of the most aggressive (and most common) mosquito species, *Aedes albopictus* (the Asian tiger mosquito).

Eliminating or reducing acceptable breeding sites is an important mosquito management tactic and will be discussed in detail below.



*Figure 2. Holes left by fallen tree limbs collect rain water and make an ideal habitat for mosquito breeding.*

*M. Waldvogel, NC State*

## Mosquito Control

Due to their cryptic breeding sites as well as propensity to move away from those breeding sites (e.g., saltmarsh mosquitoes can fly for several miles), mosquito control at the individual level is difficult and population management often requires community-wide approaches. For instance, the Asian tiger mosquito, the most common mosquito species in North Carolina and an aggressive daytime biter, can fly anywhere from 100-300 yards from where they emerged. This means that a mosquito that did not originate on your property can still affect you by invading from surrounding areas in the neighborhood. This is why multiple control measures following an **integrated mosquito management** plan are recommended for optimal mosquito management. These tactics are not “one-and-done.” Prepare to engage in these practices for the entire mosquito season for best results.

## **Source reduction**

A community-wide effort is needed to reduce and, hopefully, eliminate mosquito breeding sites. Around your home and neighborhood, natural tree holes and man-made objects such as bird baths, boats, canoes, discarded tires, and plant pots (previously mentioned) collect rainwater and allow mosquitoes to breed literally right in our own backyard. Stagnant water in abandoned or poorly-maintained swimming pools becomes an ideal breeding site. Even items that you may overlook, such as upturned bottle caps, can support the development of multiple mosquito larvae. You can help reduce mosquito populations by eliminating or properly following the protocols below:

1. **"Tip and Toss."** Empty or (preferably) get rid of containers, old tires, etc. that can hold stagnating water ([Figure 3](#)).
2. If you use barrels/containers to collect rainwater for watering gardens, cover them with screening to keep out debris and mosquitoes. Keep the screens clear of debris as well.
3. Dump excess water from dishes under outdoor flower pots.
4. Flush the water out of bird baths at least twice weekly (the birds will appreciate the fresh water, too).
5. Store boats, canoes and other objects so that they do not collect rainwater. Remove water that collects in depressions in tarpaulins covering boats and other equipment or objects ([Figure 4](#)).
6. Cover or drain unused swimming pools. If you cover them with a tarp, make sure you remove leaves and other debris that collect on the surface.
7. Keep your rain gutters free of leaves and other debris that prevent water from draining and will attract mosquitoes.
8. Correct drainage problems in your yard that allow rainwater to pool in low-lying areas.
9. Fill tree holes with expanding foam (not cement) to keep them from being used as breeding sites by mosquitoes.
10. Remove debris (or report drainage problems) in drainage ditches and culverts along private or public roadways.

## **Personal Protection: Mosquito Repellents**

Wearing long-sleeved, light colored shirts and long pants outdoors will help to reduce mosquito bites, but can be uncomfortable during hot summer months. Instead, insect repellents can provide personal protection from mosquitoes. Many of these products contain **DEET** (N,N-diethyl-m-toluamide), but the United States Environmental Protection Agency (US EPA) has updated its information on [selecting repellent products](#). Select the desired formulation (e.g., lotion, aerosol spray or cream) containing the highest percent of active ingredient and/or longevity period, as stated on the product label, and apply it to exposed skin. Repeated use of repellents over a short period of time is not recommended, especially for children and pregnant women. For additional information on repellent products, see [Insect Repellent Products](#). Ideally, select repellent products that have been approved and registered by the EPA.

Do not forget to protect your pets, too! Mosquitoes can transmit the parasites that cause dog heartworm. Consult your veterinarian for an appropriate preventative product.

## **Chemical Control**

Chemical control of mosquitoes primarily targets the adult life stage. Some counties and municipalities may have ongoing mosquito control programs. Such wide area spraying should be based on surveying areas (rather than simply responding to complaints).

[Outdoor backpack](#) or hand-held foggers (best left to professional use) will kill mosquitoes in the immediate area and keep invaders away for several hours, but once the chemical dissipates, mosquitoes may return to the area. Spraying thickets or shrubs along the perimeter of your yard with a ready-to-spray pesticide formulation helps reduce the population of mosquitoes that rest in these areas. In general, this protection will last several weeks (depending on the chemicals used). However, some species of mosquitoes will move readily back into these areas from surrounding untreated places. Consult the [North Carolina Agricultural Chemicals Manual](#) or your county Cooperative Extension center for more information on selecting appropriate pesticides for use against mosquitoes.

Insecticides are available for controlling larvae, but their application in either large bodies of water or small artificial breeding sites can be difficult and expensive, particularly for an individual homeowner. Control programs targeting mosquito larvae are best left to trained individuals in county or local government agencies. Most of these chemicals are not selective and some may even harm beneficial insects and other non-target organisms. Furthermore, use of these chemicals will provide only temporary reduction in mosquito populations. **Modifying or eliminating breeding sites is the long-term solution to severe mosquito problems.** Instead, homeowners that want to treat small areas, such as garden pools, etc., can use bacterial insecticides that are available at many retail stores, garden centers, and on-line garden suppliers. There are several products formulated as "donuts" ("dunks") or as granules that contain the bacterium *Bacillus thuringiensis israelensis* or "Bti." This bacterium kills mosquitoes and some other types of flies (such as fungus gnats), but does not harm most insects, fish, birds or other wildlife. The "dunk" versions are well-suited for small breeding sites (100 square feet or less) and will control mosquito larvae for about 30 days. Keep in mind that these products are not a substitute for removing water sources or cleaning out water sources such as bird baths and pet water bowls.

### ***Pesticide Safety***

Whether applying pesticides yourself or hiring a professional service, please remember that insecticides can drift, i.e., can be carried by wind onto someone else's property. Regardless of the amount of chemical involved, "drift" is actually illegal no matter how small of the quantity travels goes off-site. Before using chemicals on your property, you should take these precautions:

If you're hiring a professional applicator, ask to see a copy of the product label for the pesticide(s) that they will use. Some products advertised as "natural" or "the ingredient found in chrysanthemum flowers" are actually synthetic pesticides (in a class called "pyrethroids") which can be toxic to many other insects including beneficials (such as ground beetles, lady beetles, lacewings, and honey bees). Many product labels have restrictions on spraying (or allowing drift onto) flowering plants when bees are actively visiting those areas ([Figure 6](#)). These products are also toxic to fish and may have restrictions on spraying too close to lakes, ponds and other bodies of water. It is important to follow the directions for use on products that contain pyrethroids and/or neonicotinoids. If you need to know what class of insecticides an active ingredient in a product falls into, this [Modes of Action chart](#) can help.

Talk to your neighbors about when and where you plan to treat your yard.

Many product labels have restrictions on spraying (or allowing drift onto) flowering plants when bees are actively visiting those areas. Read the labels carefully before using the product. Avoid spraying when bees and other pollinators are actively foraging (visiting flowers). Spray early in the morning or later in the evening.

Before applying any pesticides in your yard (or having them applied for you) be sure that you look at what is on the other side of your fence, property line, or wherever you are spraying. Are there pets or children in the yard? Does your neighbor have any bee hives, a fish pond, or a vegetable garden? Many of the pesticides used to treat yards are not intended to be sprayed on edible plants.

### ***Other Biological and Non-chemical Control Measures***

Exclusion works well to keep mosquitoes outside. Install tight-fitting screens on doors and windows to help keep mosquitoes out of your home.

Although bats and birds, such as [purple martins](#), consume mosquitoes as part of their diet, they do not have a significant impact on mosquito populations. You can install nesting boxes around your property to attract these natural predators to the area. However, bear in mind that the feeding activity of insect-eating bats and birds may not be sufficiently selective to cause noticeable reductions in mosquito populations. Also, many of our major mosquito problems occur when some predators are inactive (or less active). For example, the Asian tiger mosquito is most active during the daytime when bats are normally roosting.



Figure 3. Empty or get rid of containers that can hold stagnating water.

M. Waldvogel, NC State



Figure 4. Mosquito larvae in stagnant water in a fold of a tarpaulin.

M. Waldvogel - NC State



Figure 5. Treating mosquito resting sites.

Pest Management Systems, Greensboro, NC

## Environmental Hazards

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Figure 6. Example of "bee warning" on a pesticide label.

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## What Will NOT Work

Electrocutor traps ("bug zappers") placed out of doors are **not** effective in reducing or eliminating mosquito populations. Studies have shown that less than ¼ of 1% of the insects "zapped" in such devices were actually biting insects. The majority of the insects killed in electrocutor traps are actually beneficial in some form. Electronic mosquito repellents that emit high frequency sound to "repel" mosquitoes have not been shown to be effective either.

Claims that certain plants placed around a porch or deck will keep mosquitoes away are not supported by any scientifically-based test results. Plants or devices that emit repellent chemicals will not be effective under conditions such as high winds. This includes citronella candles, which often do not put out a concentration of oils high enough to repel mosquitoes—especially in windy conditions.

Several types mosquito traps that use radiant heat and / or chemicals such as carbon dioxide or octenol to attract mosquitoes are available. Keep in mind that these traps have certain effective distance in which they attract mosquitoes. Thus, a single trap may attract mosquitoes but not provide "control." As with repellent plants, windy days / nights may push the chemical in directions that may reduce their ability to provide reasonable coverage.

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