

## PHILOSOPHY OF MOSQUITO CONTROL

Portions of this chapter were obtained from the University of Florida and the American Mosquito Control Association Public Health Pest Control web site at <http://vector.ifas.ufl.edu>, the University of Sydney Department of Medical Entomology website at <http://medent.usyd.edu.au/fact/irrigwet.htm>, the Environmental Protection Agency Mosquito Control web site at <http://www.epa.gov/pesticides/health/mosquitoes/control.htm>, and the Association of State and Territorial Health Officials' Public Health Confronts the Mosquito report at [http://www.astho.org/?template=mosquito\\_control.html](http://www.astho.org/?template=mosquito_control.html).

The underlying philosophy of mosquito control is based on the fact that the greatest control impact on mosquito populations will occur when they are *concentrated, immobile* and *accessible*. This emphasis focuses on habitat management and controlling the immature stages before mosquitoes emerge as adults. This policy reduces the need for widespread pesticide application in residential areas.

The use of pesticides for mosquito control is considered a temporary form of control. Since it is unreasonable to expect to completely eliminate the next generation by treating the current generation, the process may have to be repeated time and again. This is true for chemical treatment of both immature and adult populations of mosquitoes. By contrast, source reduction that prevents mosquito development can be a permanent form of control, perhaps requiring limited maintenance from time to time.

**Integrated Mosquito Management** is the use of all appropriate technological and management techniques that brings about an effective degree of mosquito prevention and suppression in a safe, cost-effective, and environmentally sound manner. The major components of integrated mosquito management are:

1. Source reduction
2. Biological control
3. Larviciding
4. Adulticiding
5. Public education

All of these control methods should be based on surveillance data to determine need and timing of application.

### SOURCE REDUCTION

Source reduction consists of elimination of larval habitats or rendering such habitats unsuitable for larval development. Source reduction ranges from the simple overturning of a discarded bucket or disposing of waste tires to complex water level manipulations in marshes. The removal or reduction of mosquito breeding habitat is often the most effective and economical long-term method of mosquito control. These efforts minimize or even eliminate the need for mosquito larviciding in the affected habitat and greatly reduce adulticiding in nearby areas.

## Sanitation

Containers of all types, man-made structures such as unscreened rain barrels, roof gutters and discarded tires are capable of producing prodigious numbers of mosquitoes, including species that can transmit disease. Removal of debris and regular inspection, when conducted on a continuous basis, reduces breeding in such sites. Typically, mosquito control-related sanitation efforts are best accomplished by homeowners and residents who, through their own actions, have created mosquito breeding around their homesites (peridomestic). Mosquito control agencies support educational programs that call attention to the hazards and recommend individual effort on residential area cleanup. (See specific recommendations for homeowners under “Public Education”).



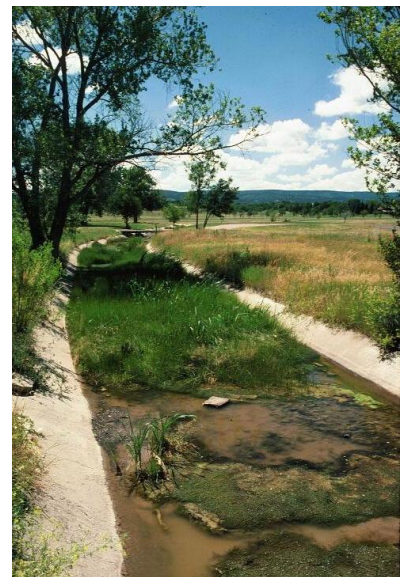
## Water Management

Prevention of breeding can be accomplished by removing surface waters from productive sites, manipulating shoreline water levels, or flooding areas in which mosquitoes oviposit in the soil. Special care must be given to wetlands and sensitive natural areas. Wetlands, streams and even constructed drainage systems can provide habitat for an array of wildlife, including amphibians, mammals, birds and insects. Wetlands also help control flooding, improve water quality, and provide recreational opportunities. Draining healthy wetlands is a controversial and often inappropriate option, whereas controlling breeding sites such as sewer catch basins, puddles, containers, and poorly designed or poorly managed stormwater management areas are practices routinely incorporated in integrated mosquito management programs.

Irrigated agriculture is widespread in New Mexico and irrigation systems can be sources of mosquitoes. Water management is the essence of good irrigation practice, and water management should be the essence of mosquito management in irrigation areas. Overuse of water and inadequate drainage are the principal causes of mosquito production associated with irrigation areas.

Water delivery channels 'above' the land to be irrigated are usually well maintained and free of marginal vegetation in order to enhance water flow. They may be lined with concrete, or if earthen lined any vegetation that establishes is periodically removed. In this state they usually do not provide a suitable habitat to support mosquito larvae.

Water drainage channels 'below' the irrigated land, designed to dispose of unused water, are usually earthen lined and often not well maintained. They can become heavily vegetated, restricting water flow and providing suitable habitat with harborage and nutrient resources for various mosquito species.



The different methods of irrigation itself also vary in their potential for the creation of habitat for various mosquito species.

**Flood irrigation**, where areas of land are inundated by relatively large amounts of water, provides the most obvious potential mosquito habitat. However, providing the water infiltrates, evaporates, or drains off and is delivered elsewhere and does not persist as stagnant pools for more than 5 days, there is usually no concern for mosquito production.

**Sprinkler irrigation** and **channel irrigation**, are of intermediate concern and these usually provide for mosquito habitat only when the water is over-applied, the area is poorly drained, and stagnant pools are able to persist for more than 5 days.

Irrigation of pastures is usually accomplished by flooding or by using fixed or traveling sprinkler systems. Invariably, the result will be very shallow water on level pasture, but there may be deeper pools in depressed areas within the pasture or in the perimeter drainage zones. Ensuring water does not persist on pastures and in row crop channels for more than 5 days will usually prevent mosquito production. Effective slope drainage, and infiltration and evaporation rates associated with the soil must be considered with respect to the water application rates and frequencies. Ensuring free flow of water in the delivery and (particularly) the drainage channels by clearing emergent and floating vegetation will help to prevent buildup of mosquito populations.



On the shores of lakes or lagoons, clear emergent vegetation or prevent it from taking hold by lining the lagoon or steepening the sides of the lagoon.



### **Managing retention ponds/stormwater impoundments**

Stormwater structures that temporarily or permanently retain runoff are receiving increasing attention as potential mosquito breeding areas. Measures that lower mosquito production in stormwater structures are needed to protect public health. If designed properly, stormwater structures should not promote mosquito breeding. Ensuring that these structures are properly designed and maintained is the key to limiting mosquito production.

Historically, stormwater controls were designed to quickly collect, store and transport runoff away from developed areas into nearby streams to prevent flooding. However, it is now recognized that these systems alone are often not the ideal solution because they impact streams by increasing the volume and velocity of water and amount of pollutants.

Today stormwater management promotes a variety of practices and controls that help runoff to infiltrate and minimize contact of runoff with pollutants. For example, infiltration practices using vegetated areas like swales and rain gardens slow the velocity of water and allow for percolation into the ground. When properly designed and maintained, stormwater management practices do not encourage mosquito breeding. Stormwater managers should incorporate design, construction, management and maintenance features into stormwater structures to minimize mosquito production (and therefore decrease or eliminate the need for insecticides) without compromising water quality functions.

Design and management of stormwater best management practices (BMPs) is beyond the scope of this manual. More information is available at the EPA stormwater website at: <http://www.epa.gov/npdes/stormwater>.

### **BIOLOGICAL CONTROL**

Biological control, or biocontrol, is the use of biological organisms to control pests—in this case, mosquitoes. Biocontrol is popular in theory because of its potential to be host-specific with virtually no effect on non-target organisms. Overall, larvivorous fish are the most extensively used biocontrol agent for mosquito control. Predacious fish such as *Gambusia affinis* and other top minnows (Poeciliidae) and killifishes (Cyprinodontidae) that occur naturally in many aquatic habitats, can be collected (or in some cases propagated) and placed in permanent or semi-permanent water bodies for larval control. Other biocontrol agents have been tested for use in mosquito control but to date have not been found feasible. These include the predacious mosquito *Toxorhynchites*, predacious copepods, the parasitic nematode *Romanomermis* and the fungus *Lagenidium giganteum*. Biocontrol certainly holds the possibility of becoming a more important tool and playing a larger role in mosquito control in the future when improved technology and economics may enhance their usefulness. Although bacteria and insect growth regulators may be considered a form of biocontrol, they are discussed in detail in the “Larviciding” section.

Unfortunately, the role of bats and purple martins in mosquito “control” has been exaggerated. Bats may be both opportunistic and selective in their feeding, and several factors determine which specific insects may be consumed in the greatest quantity. In general, research has shown that the little brown bat feeds on softbodied insects such as moths, flies, midges, mosquitoes and

mayflies. The larger big brown bat is opportunistic, and preys mostly upon beetles such as ground beetles, June bugs, cucumber beetles and other beetles and insects. The Mexican free-tailed bat consumes primarily moths and beetles. Bats are biologically beneficial mammals, and are a very important and unique part of our wildlife. But relative to pest populations, whether or not the feeding of bats in our urban and agricultural communities provides any measurable benefit (such as reduction of mosquito biting density or number of West Nile cases) is highly questionable. At best, their beneficial contributions are likely to vary tremendously depending on the complex local environmental conditions and particular ecosystem (<http://www.texasmosquito.org/Bats.html>). Purple martins are not prodigious consumers of mosquitoes as is so often claimed by companies that manufacture martin housing. Purple martins and freshwater mosquitoes rarely ever cross paths. Martins are daytime feeders, and feed high in the sky; mosquitoes, on the other hand, stay low in damp places during daylight hours, and are most active at night (<http://www.purplemartin.org/main/mgt.html>). It makes sense, though, to minimize adverse effects on natural mosquito predators by using alternatives to pesticides or choosing those pesticides with the least impact on non-target organisms.

### ***Gambusia affinis*, the western mosquitofish**

*Gambusia* belong to the Poeciliidae family. Mosquitofish prefer quiet, shallow ponds, lakes, ditches, drains, marshes and sluggish creeks with clear water and aquatic vegetation. They prefer warm water temperatures and can tolerate water temperatures between 40 and 100 degrees Fahrenheit. Their life span is short, probably less than 15 months, but they may live two to three years under favorable conditions. They are ovoviviparous, meaning the females give birth to live young. *Gambusia* reach sexual maturity in 6 to 8 weeks. Each female can produce three to four broods per season, every 3 to 6 weeks. The number of young in each brood is highly variable, and average about 60 to 70. The young are born in spring and summer when they are about 0.4 inches long. Adult length ranges from 0.8 to 2.5 inches (the females are larger than the males). Mosquitofish eat a variety of macro-invertebrates, including mosquito larvae, other small insect larvae, zooplankton, crustaceans and aquatic plants such as algae and diatoms. *Gambusia* are aggressive and may also feed on fish fry including their own young. Feeding is at the water's surface.



*Gambusia* have been used for mosquito control in the US since the early 1900's. Various agencies throughout the world have developed stocking guidelines for mosquito control in swimming pools (abandoned), ornamental pools, ditches, wetlands, mine pits, storm water and waste water disposal lagoons, natural creeks, animal watering troughs and small seasonal or permanent ponds. Recommended stocking rates in the US range from 15-100 fish for backyard ornamental ponds to 2,500 fish/acre for small ponds and ditches. Reports from mosquito control organizations indicate that the greatest problem associated with the inability of *Gambusia* to control mosquito larvae are aquatic vegetation, inadequate fish numbers or a lack of distribution by the fish in a water site.

The introduction of mosquitofish into areas where they have not previously been found may have adverse effects. They are very quick to adapt to changing conditions, reproduce quickly and are voracious and aggressive feeders. Their presence may be detrimental to economically important fish or endangered native fish such as the closely related Pecos gambusia. Therefore new introduction of mosquitofish should be limited to isolated sites with no connection to lakes, rivers, streams or canals where they may have a positive impact upon the existing or potential mosquito populations.

### LARVICIDING

The application of chemicals to kill immature mosquitoes by ground or aerial applications is typically more effective and target-specific than adulticiding, although less permanent than source reduction. Several materials in various formulations are labeled for mosquito larviciding, including some biorational pesticides such as insect growth regulators (IGRs) and bacteria that target mosquitoes and blackflies. Also labeled for mosquito control are conventional organophosphate insecticides, oils, and monomolecular surface films.

The timing of larvicide application is dependent on the nature of the control agent. Conventional insecticides, for example, kill larvae at all stages and thus can be applied when convenient. Bacteria must be consumed by the larvae and are usually applied well before the 4<sup>th</sup> instar to ensure that consumption occurs. Insect growth regulators mimic an essential hormone present in high concentration in early instar larvae but in very low concentration in 4<sup>th</sup> instar larvae. Exposure of 4<sup>th</sup> instar larvae to the IGR upsets the physiological molting process and kills mosquitoes in the subsequent pupal stage. IGRs can be formulated as slow release insecticides so that application in the 2<sup>nd</sup> or 3<sup>rd</sup> instar will result in an adequate exposure during the 4<sup>th</sup> instar. Monomolecular films prevent the insect from remaining at the surface of the water by reducing surface tension. Under these conditions larvae of all stages and pupae deplete their energy reserves trying to stay at the surface and succumb to exhaustion. The oils kill larvae and pupae by suffocation, because the insect is not able to obtain air through the siphon at the oily surface.

Each larvicide has very specific applications and may be more effective against one species or group than another. Each label (the law when using pesticides) is different and special attention must be given to a full understanding of the provisions of the label for each chemical being considered for use in mosquito control programs. The label prescribes application methods and rates, habitat restrictions, personal and environmental exposure limits, etc. Pesticide applicators must be knowledgeable of the label contents and abide by the label.

Important characteristics for larvicides include specificity for mosquitoes, minimal impact on non-target organisms and, in many instances, ability to penetrate dense vegetative canopy. Larvicide formulations (e.g., liquid, granular, solid) must be accurately applied and appropriate to the habitat being treated. Some dry formulations, such as briquets and granules, may also be applied pre-flooding, if the label allows. Larvicide applications, when based on accurate surveillance data, are an important component of an integrated mosquito control operation. Accuracy of application coverage is important, as failure to expose even a relatively small portion of a breeding area can result in the emergence of a large mosquito brood and lead to the need for immediate broad-scale adulticiding.

### **Dipteran-specific bacteria**

Two species of bacteria are labeled for mosquito larval control: *Bacillus thuringiensis* var. *israelensis* (*Bti*) and *Bacillus sphaericus* (*Bs*). Both types of naturally-occurring bacteria produce spores and a crystalline protein known as delta-endotoxin. These crystals are toxic to mosquito larvae when ingested. *Bti* is also used to control larvae of black flies, midges and fungus gnats. All species of *Culex* are susceptible to *Bs*, as well as some species of *Aedes*, *Psorophora* and *Anopheles*. *Bti* breaks down quickly in the environment and thus has no residual effect. *Bs*, however, recycles in dead mosquito larvae and provides extended control. This is useful for multiple-brood species. Neither bacterium is harmful to non-target organisms, including plants, fish and other organisms in the aquatic environment, when used according to the label.

### **Insect growth regulators**

Methoprene is an insect growth regulator which interferes with normal mosquito development. Treated larvae continue normal development to the pupal stage where they die. Methoprene has no effect on mosquitoes which have already reached the pupal or adult stage prior to treatment. Methoprene is target-specific, and will not affect fish, waterfowl, mammals or beneficial predatory insects when used according to the label.

When using methoprene for mosquito control it is important to remember you will still see larvae; dip counts will not tell you if the product is working. To determine the effectiveness of treatment, it is necessary to collect a sample of pupae from treated and untreated areas and to rear them in emergence cages to count the number of live adults that emerge.

### **Surface films and oils**

Monomolecular surface films are alcohol-based products that produce a film on the water surface. This film makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown. Species that do not require surface contact for breathing while in the larval or pupal stage (i.e., *Coquillettidia*) will be affected when the adults emerge. Monomolecular surface films can be applied at either the larval or pupal stage. Sustained winds of 10 mph or greater will push the film and thus result in poor control. Surface films are not visible and an indicator oil must be used to determine presence of the product. Monomolecular surface films do not last long in the environment and do not adversely affect fish, birds or other wildlife when used according to the label.

Petroleum-based oils were widely used in the past but few products remains available, due to environmental hazards of petroleum-based products and adverse non-target effects. Oil kills both

larvae and pupae through suffocation. Oils will also kill emerging adults and may inhibit oviposition.

### **Organophosphate larvicides**

Temephos is currently the only organophosphate registered for larval mosquito control. Aquatic invertebrates (in addition to mosquito larvae) are extremely sensitive to temephos. Temephos is also slightly to moderately toxic to fish, more so in the liquid formulation than granular. Because temephos is applied directly to water, it is not expected to have a direct impact on terrestrial animals or birds. It is best used in highly polluted waters or water with high organic content, where less hazardous alternatives may not be effective. The power backpack blower application to tire piles is a minor but critical use. The temephos product used for this application is uniquely formulated for penetration of large tire piles and residual action (30 days or more). It is more effective and longer lasting than alternatives for this use.

### **ADULTICIDING**

The ground or aerial application of chemicals to kill adult mosquitoes is usually the least efficient mosquito control technique and is considered the last resort. Effective sustainable integrated mosquito management programs strive to prevent large flights or swarms of mosquitoes through all the measures described above, but heavy precipitation, flooding, environmental constraints, inaccessible larval habitats, missed breeding sites, human disease outbreaks, as well as budget shortfalls, absent employees, or equipment failures, may necessitate use of adulticides. Therefore it remains an important part of an integrated mosquito management program.

Effective adult mosquito control with insecticides requires small droplets that drift through areas where mosquitoes are flying. The droplets that impinge on mosquitoes provide the contact activity necessary to kill them. Large droplets that settle on the ground or vegetation without contacting mosquitoes waste material and may cause undesirable effects on non-targeted organisms. To achieve small droplets, special aerial and ground ultra-low-volume (ULV) equipment is used. Ground ULV applicators produce droplets of 8 to 30 microns in diameter. Insecticides are applied in concentrated form at very low volumes, usually less than 3 ounces per acre. Ground or aerially applied thermal application of adulticides (thermal fogger) is also used in some areas but to a much lesser degree.

As with all uses of pesticides, the label is the law. Adulticiding labels specify application rate, vehicle and wind speed and required droplet size. It is important to calibrate the application equipment regularly to ensure it is producing the required droplet size and flow rate. Fogging should take place in early morning and evening when mosquitoes are active and convection currents are minimal, to hold the fog closer to the ground.

Most currently registered adulticides fall into one of two groups of insecticides: synthetic pyrethroids or organophosphates. **Pyrethroids** are synthetic chemical insecticides that act in a similar manner to pyrethrins, which are derived from chrysanthemum flowers. Pyrethroids used in mosquito control are typically mixed with a synergist compound, such as piperonyl butoxide which enhances the effectiveness of the active ingredient. The product is often diluted in water or



oil and applied using ULV equipment at rates less than 1/100<sup>th</sup> of a pound of active ingredient or less than 4 fluid ounces of mixed formulation per acre. The synthetic pyrethroids commonly used in mosquito control programs are permethrin, resmethrin (restricted use) and sumithrin. Pyrethroids are considered to pose slight risks of acute toxicity to humans, but at high doses, pyrethroids can affect the nervous system. Pyrethroids, when applied at mosquito control rates, are low in toxicity to mammals and birds, but are toxic to fish and bees. For this reason the labels have restrictions about application over water or blooming crops when bees may be present.

**Organophosphates** registered for adult mosquito control include chlorpyrifos, malathion and naled. When applied according to the label, these products can be used for adult mosquito control without posing “unreasonable risks” (EPA language) to human health, wildlife or the environment. In high doses organophosphates can overstimulate the nervous system causing nausea, dizziness or confusion. Severe high dose poisoning can cause convulsions, respiratory paralysis and death. Because there are relatively few chemicals registered for adult mosquito control, organophosphates remain an important part of an integrated mosquito management program.

Mosquito resistance to insecticides may occur between insecticides within a class (for example, resistance to both malathion and naled) or could be passed from immature to adult stages subject to the same insecticidal mode of action. Different species of mosquitoes may also vary in susceptibility to different larvicides and adulticides. Sustained integrated mosquito management requires alternative use of different classes of insecticides, in conjunction with resistance monitoring, source reduction, biological control and public education.

## **PUBLIC EDUCATION**

An integrated mosquito management program involves the public by instituting a public information program emphasizing personal responsibility, ways in which people can prevent mosquito breeding, and how they can reduce the risk of being bitten by observing personal protection measures such as repellent use. A public education program should also inform the public about the use and timing of pesticides in their community, and pesticide risks and benefits. Mosquito control programs need the support of an informed public. Informing the public shows a respect for the community and will lead to a stronger, better supported program that is tailored to the community and its values.

Strategies to inform the public can include press education prior to the mosquito season; educational meetings with policy-makers such as city councils and county commissioners; preparation of materials such as fact sheets for the public; website development; plans for a hotline and recorded messages; and regular information to the public about mosquito surveillance and disease incidence. The New Mexico Department of Health can provide West Nile virus brochures upon request, and also maintains a website mapping West Nile virus activity in humans, horses and mosquitoes. That website is:

<http://www.health.state.nm.us/epi/wnv.html>.

### **Prevent mosquito breeding**

The following recommendations, aimed at residents and homeowners, were adapted from the AMCA website: <http://www.mosquito.org/mosquito-information/control.aspx>.

1. Destroy or dispose of tin cans, old tires, buckets, unused plastic swimming pools or other containers that collect and hold water. Do not allow water to accumulate in the saucers of flowerpots, cemetery urns or in pet dishes for more than 2 days.
2. Clean debris from rain gutters and remove any standing water under or around structures, or on flat roofs. Check around faucets and air conditioner units and repair leaks or eliminate puddles that remain for several days.
3. Change the water in birdbaths and wading pools at least once a week and stock ornamental pools with top feeding predacious minnows. Known as mosquito fish, these minnows are about 1 – 1½ inches in length and can be purchased or seined from streams and creeks locally. Ornamental pools may be treated with biorational larvicides [*Bacillus thuringiensis israelensis* (*Bti*) or S-methoprene (IGR) containing products] under certain circumstances. Commercial products containing *Bti* ("Mosquito Dunks" and "Mosquito Bits") can be purchased at many hardware/garden stores for residential use. S-Methoprene insect growth regulator is available commercially as "Pre-Strike". Like Mosquito Dunks, Pre-Strike can be found at many home/garden and pet specialty stores.
4. Fill or drain puddles, ditches and swampy areas, and either remove, drain or fill tree holes and stumps. These areas may be treated with *Bti* or methoprene products also.
5. Eliminate seepage from cisterns, cesspools, and septic tanks.
6. Eliminate standing water around animal watering troughs. Flush livestock water troughs twice a week.
7. Check for trapped water in plastic or canvas tarps used to cover boats, pools, etc. Arrange the tarp to drain the water.
8. Check around construction sites or do-it-yourself improvements to ensure that proper backfilling and grading prevent drainage problems.
9. Irrigate lawns and gardens carefully to prevent water from standing for several days.

### **Traps and Misting Systems**

Focal or homeowner-based mosquito control strategies, such as traps and misting systems, may be perceived as an alternative by the public in affected communities. There has been a rapid proliferation of backyard mosquito control equipment and technologies. However, there is little data on the efficacy of these methods, machines, and materials either for area-wide or focal programs, especially for mosquito-borne disease control. Some of these technologies may result in the misuses of pesticides and have other negative impacts. If the public believes that these alternatives are best for them (for example, because of intensive advertising), they could rationalize not authorizing public support for community-wide mosquito control. Therefore, organized mosquito control

programs could suffer. These methods also do not adequately address the need for surveillance, monitoring, source reduction, or larval control – all basic components of integrated mosquito management. In addition to not providing area-wide protection, focal strategies are usually more expensive than the annual per person cost of organized, community mosquito control.

## **Repellents**

It is important for both vector control personnel and the public to protect themselves from mosquito bites by consistently using an effective insect repellent. For years, DEET (N,N-diethyl-m-toluamide) has been the most common active ingredient in commercial insect repellents. DEET has been shown to be effective and has a long safety record when used according to the label. Recently, two new active ingredients have been registered by the EPA. In recent scientific articles, repellents with Picaridin (KBR 3023) have been shown to provide long-lasting protection similar to DEET. Oil of lemon eucalyptus [p-menthane 3,8-diol (PMD)], a plant based repellent, is also registered with EPA. In two recent scientific publications, when oil of lemon eucalyptus was tested against mosquitoes found in the U.S. it provided protection similar to repellents with low concentrations of DEET.

The EPA makes the following recommendations on any repellent use:

- Apply repellents only to exposed skin and/or clothing (as directed on the product label). Do not use under clothing.
- Never use repellents over cuts, wounds, or irritated skin.
- Do not apply to eyes and mouth, and apply sparingly around ears. When using sprays do not spray directly onto face; spray on hands first and then apply to face.
- Do not allow children to handle the products, and do not apply to children's hands. When using on children, apply the product to your own hands and then put it on the child.
- Do not spray in enclosed areas. Avoid breathing repellent spray, and do not use near food.
- Use just enough repellent to cover exposed skin and/or clothing. Heavy application and saturation is generally unnecessary for effectiveness; if biting insects do not respond to a thin film of repellent, then apply a bit more.
- After returning indoors, wash treated skin with soap and water or bathe. This is particularly important when repellents are used repeatedly in a day or on consecutive days. Also, wash treated clothing before wearing it again. If you suspect that you or your child are reacting to an insect repellent, discontinue use, wash treated skin, and then call your local poison control center (1-800-222-1222 in New Mexico). If you go to a doctor, take the repellent with you.

Choose a repellent that provides protection for the amount of time that you will be outdoors. A product with a higher percentage of active ingredient is a good choice if you will be outdoors for several hours while a product with a lower concentration can be used if time outdoors will be limited. Simply re-apply repellent (following label instructions) if you are outdoors for a longer time than expected and start to be bitten by mosquitoes.

Certain products which contain permethrin are recommended for use on clothing, shoes, bed nets, and camping gear, and are registered with EPA for this use. Permethrin is highly effective

as an insecticide and as a repellent. Permethrin-treated clothing repels and kills ticks, mosquitoes, and other arthropods and retains this effect after repeated laundering. The permethrin insecticide should be reapplied following the label instructions. Some commercial products are available pretreated with permethrin.

## **AMCA POLICY ON MOSQUITO CONTROL**

The American Mosquito Control Association advocates management of mosquito populations when and where necessary by means of integrated programs designed to benefit or to have minimal adverse effects on people, wildlife, and the environment. This integrated pest management policy recognizes that mosquito populations cannot always be eliminated but often must be suppressed to tolerable levels for the well-being of humans, domestic animals, and wildlife, and that selection of scientifically sound suppression methods must be based on consideration of what is ecologically and economically in the long-term best interest of mankind.

### The following principles are advocated:

1. Mosquito control measures should be undertaken only when there is adequate justification based upon surveillance data.
2. Integrated mosquito management programs should be tailored to the needs and requirements of the local situation. The combination of methods for mosquito control should be chosen after careful consideration of the efficacy, ecological effects and costs versus benefits of the various options, including public education, legal action, natural and biological control, elimination of breeding sources, and insecticide applications.
3. Mosquito breeding sources, whether natural or created by human activity, should be altered in such a manner as to cause the least undesirable impact on the environment.
4. Insecticides and application methods should be used in the most efficient and least hazardous manner, in accordance with all applicable laws and regulations and available scientific data. The registered label requirements for insecticide should be followed. When choices are available among effective insecticides, those offering the least hazard to non-target organisms should be used. Insecticides should be chosen and used in a manner that will minimize the development of resistance in the mosquito populations.
5. Personnel involved in mosquito management programs should be properly trained and supervised, and certified in accordance with relevant laws and regulations, and should keep current with improvements in management techniques through continuing education and/or training problems.

Official policy of the AMCA, adopted at the annual meeting held April 17-21, 1978, Chicago, Illinois

This rule was filed as 20 NMAC 8.2.

**TITLE 20 ENVIRONMENTAL PROTECTION**  
**CHAPTER 8 NUISANCE ABATEMENT**  
**PART 2 MOSQUITO ABATEMENT AND CONTROL**

20.8.2.1 ISSUING AGENCY: New Mexico Environmental Improvement Board.  
[11/30/95; 20.8.2.1 NMAC - Rn, 20 NMAC 8.2.100, Recompiled 11/27/01]

20.8.2.2 SCOPE: All persons having ownership of or control over any property upon which water may collect.  
[11/30/95; 20.8.2.2 NMAC - Rn, 20 NMAC 8.2.101, Recompiled 11/27/01]

20.8.2.3 STATUTORY AUTHORITY: Section 74-1-8 NMSA 1978.  
[11/30/95; 20.8.2.3 NMAC - Rn, 20 NMAC 8.2.102, Recompiled 11/27/01]

20.8.2.4 DURATION: Permanent.  
[11/30/95; 20.8.2.4 NMAC - Rn, 20 NMAC 8.2.103, Recompiled 11/27/01]

20.8.2.5 EFFECTIVE DATE: November 30, 1995.  
[11/30/95; 20.8.2.5 NMAC - Rn, 20 NMAC 8.2.104, Recompiled 11/27/01]

20.8.2.6 OBJECTIVE: To prevent or control the occurrence of mosquitoes that are a nuisance or are capable of transmitting disease to man or domestic animals.  
[9/22/72, 11/30/95; 20.8.2.6 NMAC - Rn, 20 NMAC.7.2.105, Recompiled 11/27/01]

20.8.2.7 DEFINITIONS: As used in this part [20.8.2 NMAC]:

A. "abatement" means the control or elimination of mosquitoes by elimination of their breeding sources or by poisoning, spraying, or the use of biological and environmental controls, or any other method approved by the Department;

B. "collection of water" includes any collection of water contained in ditches, borrow pits, pools, crop fields, ponds, streams, excavations, holes, depressions, open cesspools, privy vaults, fountains, cisterns, tanks, shallow wells, troughs, sewage oxidation ponds and lagoons, barrels, urns, cans, boxes, bottles, tubes, buckets, roof gutters, tanks of flush closets, reservoirs, vessels, receptacles of any kind, or other containers or devices which may hold water;

C. "Department" means the New Mexico Environment Department;

D. "mosquito" means any arthropod belonging to the Class Insects, Order Diptera, Family Culicidae, Subfamily Culicinae;

E. "mosquito larvae" means the immature aquatic stages of mosquitoes occurring between the egg and pupal stages;

F. "mosquito pupae" means the aquatic stages between the larval and adult stages of mosquitoes; and

G. "person" means any individual, partnership, firm public or private corporation, trust, estate, company, society, political subdivision or agency, or any other legal entity or their legal representatives, agents or assigns.

[9/22/72, 11/30/95; 20.8.2.7 NMAC – Rn, 20 NMAC.8.2.106, Recompiled 11/27/01]

20.8.2.8 to 20.8.2.106 [RESERVED]

20.8.2.107 PROHIBITED ACTS: No person shall create or maintain any collection of water in or on which mosquitoes breed or are likely to breed unless approved methods of abatement are employed as specified by the Department. The presence of mosquito larvae or mosquito pupae, or both, in collections of water shall constitute conclusive evidence that mosquitoes are breeding there.  
[9/22/72; 11/30/95; 20.8.2.107 NMAC – Rn, 20 NMAC 8.2.107, Recompiled 11/27/01]

20.8.2 NMAC

20.2.8.108 APPROVED METHODS OF ABATEMENT: Approved methods of mosquito abatement may consist of one or more of the following procedures:

- A. eliminate collections of water by filling or draining;
- B. free collections of water of all vegetative growth, floating debris and other obstruction;
- C. clean premises by disposal, removal or destruction of the cans, boxes, broken or empty bottles, vehicles, tires and similar articles likely to hold water;
- D. empty collections of water every four (4) days;
- E. stock collections of water with mosquito-destroying fish;
- F. screen collections of water with corrosion resistant netting of at least 16 meshes to the inch each way, or with other material which will effectually prevent the ingress and egress of mosquitoes;
- G. treat collections of water with chemicals approved by the Department; or
- H. any other method approved by the Department.

[9/22/72, 11/30/95; 20.8.2.108 NMAC – Rn, 20 NMAC 8.2.108, Recompiled 11/27/01]

20.8.2.109 SEVERABILITY: If any provision of application of this Part is held invalid, the remainder, or its application to other situations or persons, shall not be affected.

[11/30/95; 20.8.2.109 NMAC – Rn, 20 NMAC 8.2.109, Recompiled 11/27/01]

20.8.2.110 AMENDMENT AND SUPERSESION OF PRIOR REGULATIONS: This Part shall be construed as amending and superseding the Regulations Governing Mosquito Abatement and Control, EIB 72-1, filed August 23, 1972. All references to the Regulations Governing Mosquito Abatement and Control in any other rule shall be construed as a reference to this Part.

[11/30/95; 20.8.2.110 NMAC – Rn, 20 NMAC 8.2.110, Recompiled 11/27/01]

20.8.2.111 SAVING CLAUSE: Supersession of the Regulations Governing Mosquito Abatement and Control shall not affect any administrative or judicial enforcement action pending on the effective date of this Part. [11/30/95; 20.8.2.111 NMAC – Rn, 20 NMAC 8.2.111, Recompiled 11/27/01]

20.8.2.112 COMPLIANCE WITH OTHER REGULATIONS: Compliance with this Part does not relieve a person from the obligation to comply with other applicable state and federal regulations.

[11/30/95; 20.8.2.112 NMAC – Rn, 20 NMAC 8.2.112, Recompiled 11/27/01]

HISTORY OF 20.8.2 NMAC: The material in this part was derived from that previously filed with the commission of public records – state records center and archives.

EIB 72-1, Regulations Governing Mosquito Abatement And Control, 8/23/1972.

History of Repealed Material: [RESERVED]