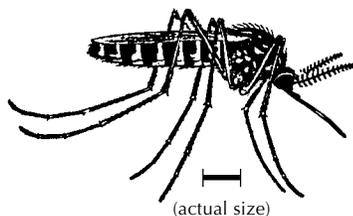


MOSQUITOES

Integrated Pest Management Around the Home



A mosquito

There are more than 50 species of mosquitoes in California. They occur in a variety of habitats in the state, ranging from deserts at or below sea level to high mountain meadows at elevations of 10,000 feet or more. Many species of California mosquitoes are relatively uncommon and seldom pose a threat to the health or well-being of California citizens. However, there are several species that readily attack people, and some species are capable of transmitting microbial organisms that cause human diseases such as malaria and encephalitis. The mosquitoes of major concern in California belong to the genera *Culex*, *Aedes*, and *Anopheles*.

IDENTIFICATION

Mosquito adults are small, flying, midgelike insects. Female mosquitoes can be differentiated from similar insects by the presence of a long slender proboscis that is adapted for piercing skin and sucking blood, and long slender wings that are covered with small scales. Male mosquitoes have scale-covered wings, but their probosces, or beaks, are shorter and thicker than the females', and are adapted for sucking plant juices and other sources of sugar rather than blood. In the immature stages, called larvae or wigglers, mosquitoes are usually black or dark brown and occur in nonmoving or nearly still

water. Most mosquito larvae have a distinctive siphon or air tube at the rear of their bodies. The next stage is the pupal stage; pupae, called tumblers, are also aquatic and are small, roundish forms, usually black in color.

LIFE CYCLE

The life cycles of mosquitoes vary widely from species to species. Some female mosquitoes lay single eggs on water surfaces; others lay single eggs on moist soil where later flooding is likely. Still other species lay batches of eggs, called rafts, 100 or more at a time on water surfaces. Eggs deposited on water surfaces usually hatch within a day or so, but eggs laid on soil surfaces do not hatch until flooding occurs, which may be months or even years later. Larvae, which are nearly invisible to the naked eye, hatch from eggs. Larvae molt three times to become 4th-stage larvae. Several days later, this larval form molts again to become a pupa. Adult mosquitoes emerge from pupae 1 to 2 days after that, with male mosquitoes always emerging first. In summer the

entire life cycle, from egg to adult, may be completed in a week or less.

PUBLIC HEALTH AND VETERINARY IMPORTANCE

Female mosquitoes of nearly all species require blood from vertebrate animals to develop eggs, and many species bite people, pets, and livestock for this purpose. The most important consequence of this is the transmission of microorganisms that cause diseases such as western equine encephalomyelitis and St. Louis encephalitis. Both of these diseases can cause serious, sometimes fatal neurological ailments in people. (Western equine encephalomyelitis virus also causes disease in horses.) Western equine encephalomyelitis infections tend to be more serious in infants while St. Louis encephalitis can be a problem for older people. Some mosquitoes are capable of transmitting malaria to humans. If these mosquitoes suck the blood of a person that has malarial parasites, they may pass on the infection to the next person(s) they bite; however, malaria is currently rare in California.

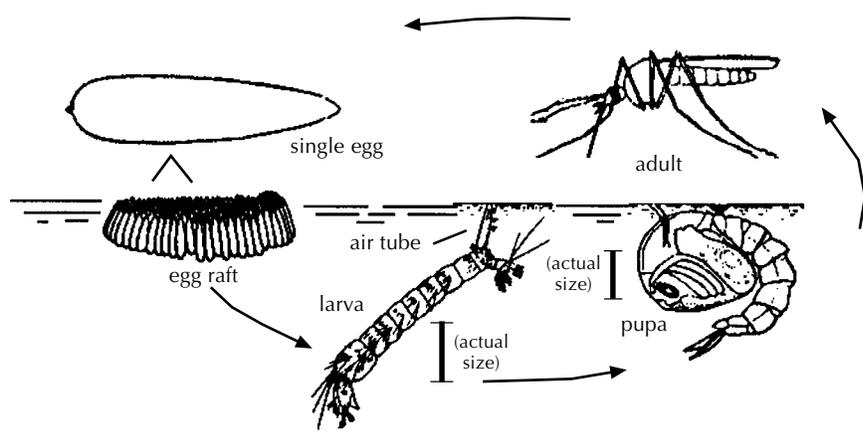


Figure 1. Life cycle of the mosquito

PEST NOTES

Publication 7451

University of California
Division of Agriculture and Natural Resources

February 1998

Mosquitoes vector dog heartworm in California. Oak trees, common in foothill areas of California, provide tree holes that fill with water and harbor the larval stages of the principal vector of this disease. Even when no infectious diseases are transmitted by mosquitoes, they can be a health problem to people and livestock. Mosquito bites can result in secondary infections, allergic reactions, pain, irritation, redness, and itching.

MANAGEMENT

Mosquitoes are best managed on an areawide basis by public agencies that are either components of local health departments or are independent districts organized specifically for mosquito control. In California, there are more than 50 mosquito and vector control districts. Some are small and have responsibility for mosquito abatement in a few hundred square miles, while the activities of others may encompass one entire county or more. Mosquito control is accomplished by searching out mosquito larvae in standing water and treating the water with a material that kills the larvae. Many materials currently in use are biological in origin and are highly specific for mosquitoes, with little or no effect on other organisms.

On occasion, mosquito abatement agencies may also apply chemical pesticides to kill adult mosquitoes, but ordinarily only when adult populations become so large that they cause extreme annoyance to many people or when the threat of disease transmission to people is high. Control of irrigation water in agricultural areas to avoid excess runoff is an important mosquito control method, but in recent years elimination of small bodies of water that can serve as wildlife habitat has ceased to be a mosquito control option because of habitat preservation concerns.

Around the Home

In many areas of California, efforts of public mosquito and vector control agencies keep mosquito numbers down to tolerable levels all or most of the time. However, some people in California live in areas of the state

where there is no organized mosquito control. These are usually low-density areas in foothill, mountain, or desert regions. People living in these areas, or in other areas where mosquito populations become bothersome, can protect themselves from mosquitoes by using a variety of strategies that include maintaining fine mesh screens on windows and doors in good repair; checking for standing water; draining standing water or treating it with the microbial insecticide *Bacillus thuringiensis* subsp. *israelensis* or mosquito-eating fish; and wearing repellents and protective clothing outdoors during the mosquito season.

The most effective control methods are those targeted against the larval stage. Any area (excluding wildlife habitats such as wetlands or vernal pools) or object that can hold water for more than a few days should be filled with soil or cement, drained, discarded, treated with *Bacillus thuringiensis* subsp. *israelensis*, or stocked with mosquito fish. Even small containers like cinder blocks,

flower pot saucers, or crotches of trees can provide a habitat for mosquito development if they remain filled with water for more than a few days. Always combine the use of any product with good sanitation practices that reduce breeding sites. Keep in mind, however, that mosquitoes can migrate several miles from where they develop. Even successful control of mosquito larvae on your premises may not result in reducing mosquito numbers or biting activity. See Table 1 for ways to reduce mosquito populations in a given situation.

Mosquito Fish. The mosquito fish, *Gambusia affinis*, has been used worldwide for mosquito control. These fish are most effectively used in man-made bodies of water that do not connect with natural waters. They can be obtained from most vector control districts.

***Bacillus thuringiensis* subsp. *israelensis*.** The bacterium *Bacillus thuringiensis* subsp. *israelensis* infects and kills mosquito larvae. It must be

Table 1. Checklist of Possible Mosquito Sources Around the Home

Mosquito Sources	What to Do to Reduce Mosquitoes
Ponds	Stock pond with fish, or use <i>Bacillus thuringiensis</i> subsp. <i>israelensis</i> . Remove excess vegetation.
Swimming pools	Keep water off cover. Maintain water quality at all times.
Tree holes	Fill hole with sand or mortar.
Plastic pools	Drain water when not in use, or cover so mosquitoes cannot lay eggs.
Containers	Empty water. Store in an inverted position. Dispose. Cover so mosquitoes cannot lay eggs.
Bird baths	Change water at least once a week.
Standing water	Eliminate by draining. Fill in low areas.
Watering troughs	Stock with fish, or change water weekly.
Cooler drains	Prevent water from standing.
Street gutter or catch basins	Keep litter and garden debris out of gutter. Do not overwater yard.
Cesspool or septic tanks	Seal and cover opening so mosquitoes can't lay eggs.
Roof gutters	Clean once a year to remove debris.
Irrigated lawns or fields	Avoid overirrigation. Drain standing water.

Adapted from the Sacramento/Yolo Mosquito & Vector Control District.

consumed by the larvae and acts as a stomach poison, damaging mid-gut cells of mosquito larvae. It is highly selective, killing only mosquitoes and larvae of a few other related flies. This pesticide is marketed in a variety of formulations for the home owner, the most common being the Mosquito Dunk, a donut-shaped float that lasts for about 30 days in water.

Outdoor Sprays. The use of insecticide sprays or outdoor foggers for control of adult mosquitoes is one option available. This option has its limitations in that while it may provide a temporary reduction of the adult population, which can be useful if the application is made shortly before a backyard picnic or family gathering, it has no lasting effect. Equipment for the application of outdoor sprays is expensive and complex.

Personal Protection

Probably the most effective method of personal protection from mosquito bites is to avoid places where mosquito densities are high and to avoid being out-of-doors at times of the day when mosquito activity is at its highest. In mountainous areas, most species of mosquitoes bite during the morning and afternoon hours and often not at all during periods of darkness. In some low elevation

areas, such as the Central Valley, some mosquitoes tend to bite at night, while others bite during the day. The dominant mosquito species in an area depends on the location in the state; it is good to learn the activity patterns of the mosquitoes in your area.

Repellents. If you find yourself in a situation where you must be exposed to biting mosquitoes, there are several things you can do. First, minimize the exposed skin surface by wearing a hat or head net, long trousers, and a long-sleeved shirt. Some mosquitoes will bite through lightweight clothing, but the number of bites received is definitely reduced if most areas of the body are covered. When mosquito densities become very high, you may want to apply a mosquito repellent. Most effective repellents contain DEET (N,N-diethyl-meta-toluamide). Commercial repellents contain varying concentrations of DEET, usually between 10 and 50%. DEET is an irritant to some people and it may damage synthetic materials such as clothing or plastics. Special formulations for children contain low concentrations of DEET in an oil-based medium that slowly releases the compound and limits its absorption through the skin; these formulations also work well for adults. The insecticide permethrin functions as a repellent when it is applied to clothing; it should not be used directly on the skin. Repellents have their drawbacks: they are effective only for about 4 hours or less depending on wind, high temperature, high humidity, and sweating. When applying DEET, thoroughly apply the material to all exposed skin, including behind the ears.

If you wish to avoid DEET, there are few, if any, effective alternatives. Plant oils such as those from birch, bluestem grass, geranium, pine, rosemary, spearmint, yarrow, lantana, and neem have been shown to be somewhat repellent to mosquitoes, but most are not available in commercial mosquito repellents.

Some body lotions such as Avon Skin-So-Soft offer a degree of protection from mosquito bites at least in part by forming an oily film on the skin's surface that prevents the insect's mouthparts from penetrating. Materials that form protective layers on the skin must be reapplied frequently.

Other Repellents. There is a vast array of other products marketed to repel mosquitoes, most of which are ineffective. These include wrist bands that contain an aromatic repellent, ultrasonic emitters, electric grids, electronic repellents, aromatic plants (the most common one is the so-called mosquito plant, *Pelargonium x citrosum*), incense coils, vitamins (B₁), and mixtures of brewer's yeast and garlic. Researchers have shown that all these methods are of little or no value in repelling mosquitoes. Oil of citronella, which is extracted from *Andropogon nardus*, has long been claimed to repel mosquitoes. Burning citronella candles or mosquito coils works best if there is relatively little air movement, but these products are only for use outdoors, which makes them mostly worthless. Electric bug zappers that are used to kill pest insects are probably counterproductive because many of the insects caught by these traps are those that prey on mosquitoes.

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

WRITTEN BY Bruce Eldridge. EDITOR: B. Ohlendorf. TECHNICAL EDITOR: M. L. Flint. DESIGN AND PRODUCTION: M. Brush. PRODUCED BY IPM Education and Publications, UC Statewide IPM Project, University of California, Davis, CA 95616-8620.

This Pest Note is available on the World Wide Web (<http://www.ipm.ucdavis.edu>)



To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse the containers. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

The University of California, in accordance with applicable Federal and State law and University policy, does not discriminate on the basis of race, color, national origin, religion, sex, disability, age, medical condition (cancer-related), ancestry, marital status, citizenship, sexual orientation, or status as a Vietnam-era veteran or special disabled veteran. The University also prohibits sexual harassment. Inquiries regarding the University's nondiscrimination policies may be directed to the Affirmative Action Director, University of California, Agriculture and Natural Resources, 300 Lakeside Drive, 6th Floor, Oakland, California 94612-3560. (510) 987-0096.