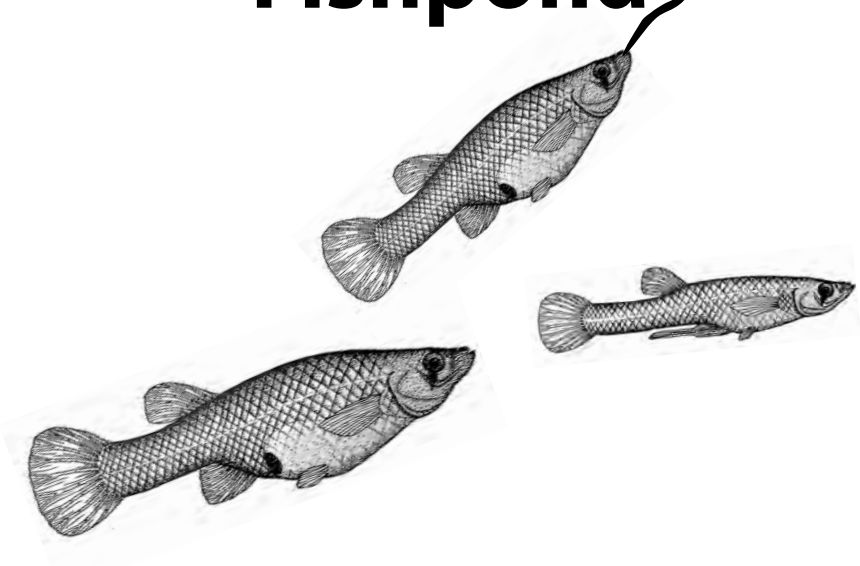


Mosquito Prevention for Fishponds



Alameda County Mosquito Abatement District

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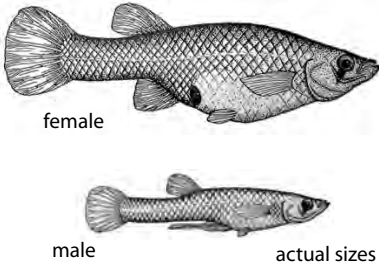
Enjoying your fishpond

A backyard fishpond can be an enjoyable addition to your landscaping and provide a nice point of interest. Bear in mind though, that fish ponds can become major localized producers of mosquitoes. Mosquito problems from a backyard fishpond can be prevented or controlled by proper construction and maintenance. The Alameda County Mosquito Abatement District will be happy to provide advice and information to you before you build your pond or for your existing pond. If you have a fishpond in your yard or are considering building one, there are a number of ways you can prevent or reduce mosquito production.

Controlling mosquitoes with fish

Keeping a healthy population of fish in your pond is the first line of defense against mosquitoes. Goldfish and koi will feed on mosquito larvae but are not as effective as mosquitofish or other top feeding minnows. Overfeeding your fish will also reduce their effectiveness for mosquito control.

The mosquitofish



Gambusia affinis, called "mosquitofish" are indispensable to our mosquito control program in Alameda County. The fish eat mosquito larvae. Mosquitofish are provided, without charge, to the public for ponds, unused swimming pools and animal watering troughs. They require minimal feeding or care other than to protect them from garden sprays,

chlorine, chloramines or other chemicals, and predators such as raccoons, cats, opossums, herons or egrets. Mosquitofish generally live peacefully with other pond fish.

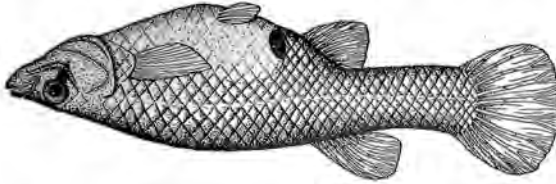
These fish do not lay eggs but give birth to well-developed and very active young. Therefore, they require no special environment for depositing and hatching eggs. Mosquitofish breed throughout the summer producing a new brood at monthly intervals. The newborn are approximately one-half inch in length and are immediately ready to begin the work of eating mosquito larvae. *Gambusia* grow rapidly, reaching a maximum size of about three inches. The fish become sexually mature when 4-5 months old; the earliest broods of the season are born in April to May. Mosquitofish can live two to three years.

How to obtain mosquitofish

To obtain free fish call the District office. Mosquitofish are normally available from March through October. The fish are usually delivered to your pond, but if you have a dog or keep the gates locked, leave a bucket of water (be sure to treat for chloramines) on the porch and indicate the size of the pond when you call. The District is always glad to provide mosquitofish to County residents, even on repeat calls, to encourage the biological control of mosquitoes in ponds and other permanent water sources.

The danger of chloramines to fish

All tap water in Alameda County is now being treated with chloramines (not chlorine) which are **toxic to fish**, shellfish, reptiles and amphibians. Chloramines are chemicals which contain chlorine and ammonia, and are being added to tap water to disinfect it. If you use well water to fill your ponds or troughs, chloramines are not an issue.



What can you do to protect your fish?

Water used for fish must be treated in a manner appropriate to remove both the chlorine and ammonia components of the chloramines. In order to do this you must use conditioning chemicals designed to remove chloramines (such as Amquel[®], Start Right[®], Aqua Safe[®] or ChlorOut[®]) available at pet stores, fish supply stores, and some variety stores.

Treatments which are NOT effective:

- ♦ letting the untreated water stand outside for a day or two
- ♦ boiling the water first
- ♦ using chemicals that remove only chlorine

To be completely safe, always pretreat your water before adding it to your pond or trough no matter how little you add. Treatment and test kits are available at most pet and fish supply stores. Chloramine residuals in treated water should be below 0.1 mg per liter.

For additional information regarding your water, contact:

East Bay Municipal Utilities District (866) 403-2683

Alameda County Water District (510) 668-4200

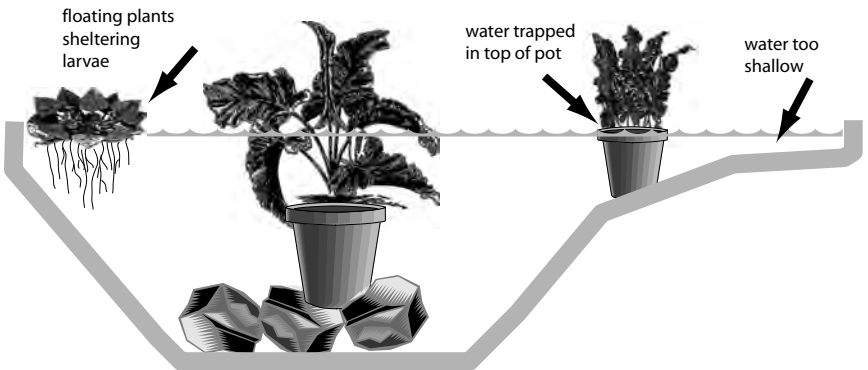
Zone 7 Water Agency (925) 454-5000

City of Hayward (510) 583-4723

Checking your pond for mosquitoes

Mosquitoes and their predators have co-existed for millions of years. Mosquitoes will seek out places in a pond where survival of their next generation is most likely. Egg-laying female mosquitoes will seek areas protected from predators in any pond to lay eggs. Be especially aware of the following : water trapped in the top of planter pots; very shallow margins; water in gravel or between rocks; algae mats; thick emergent aquatic plants and areas sheltered by overhanging plants. By managing these areas to minimize opportunities for egg-laying, you can help prevent any mosquitoes from hatching in your pond.

Potential mosquito producing areas in a typical pond



You can check suspect areas in your pond for the presence of mosquito larvae by looking closely at areas where larvae may find shelter from fish. You can also use a white cup or bowl to dip water from these areas (mosquito control professionals use an old-fashioned dipper attached to a long handle). The white bottom will make it easier to see any larvae, which can be very small and range up to 3/8 inch long. Generally they swim in a snake-like sideways motion ("wrigglers"). Pupae are rounder and tumble as they move ("tumblers"). See page 7 for details on the mosquito life cycle.

Mosquito prevention

Once the pond is built there are some things that can be done to insure that you do not create habitat for mosquitoes to thrive. Most mosquito problems can be prevented by taking the following steps.

Stock your pond with goldfish, koi and/or mosquitofish

A pond with a healthy and hungry fish population will eat most mosquito eggs, larvae and pupae. At no cost to the owner, the District provides fish (*Gambusia affinis*) for ponds. You can pick them up at our office or call us and we will deliver them to you pond. Smaller goldfish or koi, if hungry enough, will generally eat mosquito larvae and pupae. Mosquitofish, koi and goldfish are usually compatible in the same pond. If you have fish and notice mosquito larvae in your pond, stop feeding your fish for a few days and see if the larvae disappear. If they don't, call the District for advice. Note: if your pond is connected to a natural waterway such as a creek or lake, contact the District for advice before introducing any fish. Do not overfeed the fish because hungry fish make better mosquito predators.

Keep landscape plants trimmed away from pond edge

Groundcover plants or other landscaping plants that touch the surface of the water can provide a base for algae growth and shelter for mosquito larvae. Keep surrounding plants trimmed so this won't be a problem.

Remove excess organic material from pond

Organic matter such as leaves, fruit, and dropped flowers should be periodically removed from the pond. Large ponds can absorb a lot of material, but excessive, rapid deposition of organic matter can quickly cause a pond to go "bad". Too much organic matter can require more oxygen than the pond has available for decomposition. Anaerobic bacteria grow in this kind of water (which turns pink to purple and is odiferous) and there can be a rapid die off of fish.

Thin or remove excess aquatic plants

Aquatic plants that are in contact with the surface of the water may provide shelter for mosquito larvae. Thin out or remove plants so that fish can swim around and through vegetation.

Trim or prune landscaping plants

All ponds need some sunlight. Prune landscaping shrubs or trees to thin the shade cover and provide some light to reach the pond. Depending upon your choice of aquatic plants, you may need more or less direct sun to reach the pond. Check with your nursery for specific plant requirements.

Avoid runoff from mud, fertilizers, pesticides and herbicides

If your yard is to be treated for pest control, protect your pond by covering it or not treating that part of the yard. Fertilizers can cause algae to grow rapidly in your pond. And be aware that many pesticides and herbicides used for yard pests can be very toxic to fish.

Mosquitoes found in ponds

There are over 50 species of mosquitoes found in California, and 20 in Alameda County alone. Only a few are found in backyard sources. Below is a listing of the species that might be found in your fishpond.

Culiseta incidens

(the fishpond mosquito)

This is the most common mosquito found in fish ponds. The larvae can be found year-round. The adults are moderately aggressive and attack at dusk or in heavy shade during the day. This species can become quite a nuisance.



Culiseta inornata

(the winter marsh mosquito)

This mosquito is generally found during the winter months and takes advantage of any clean water source available. The adult is moderately aggressive and is a large mosquito.

Culex tarsalis

(the western encephalitis mosquito)

This species utilizes fishponds with clean water primarily in the spring and summer. They are not very aggressive human biters, but are known transmitters of encephalitis and West Nile Virus.



Culex stigmatosoma

(the foul water mosquito)

This mosquito is occasionally found in badly neglected ponds. It feeds primarily on birds.

Culex pipiens

(the house mosquito)

This species is occasionally found in badly neglected ponds. They will enter homes and aggressively attack indoors at night. This mosquito is a known vector of West Nile virus.



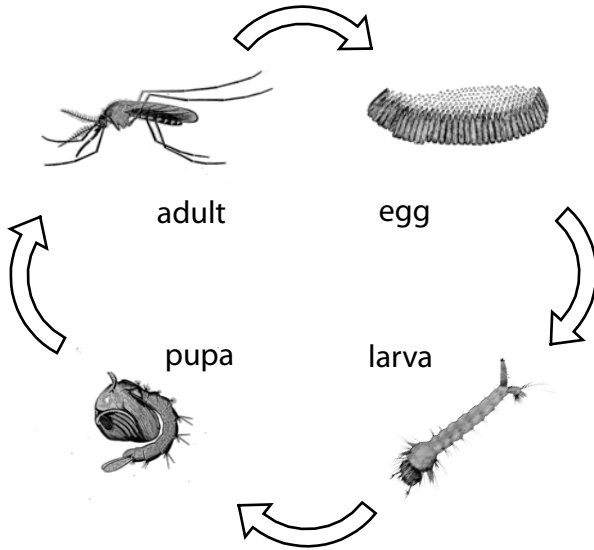
Aedes sierrensis

(the western treehole mosquito)

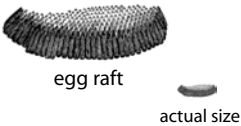
This mosquito is found in badly neglected fishponds that are annually filled by rainwater and generally have become partially filled with leaves. This species transmits dog heart worm and is an aggressive human biter.

**With proper construction and care,
a fish pond can be kept mosquito free!**

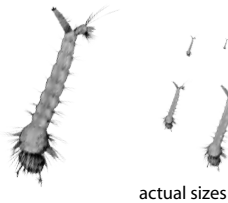
Mosquito Life Cycle



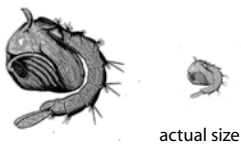
Mosquitoes **must** have standing water to develop



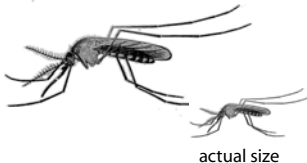
Eggs: Females deposit eggs singly or in rafts (of up to 200 eggs) on the water surface or in places where water will ultimately cover them, depending on the species. The eggs will then hatch into larvae.



Larvae: Because of their distinct movement through the water, larvae are commonly called "wrigglers". They are very active, feeding on microorganisms and detritus and may be readily seen at the water surface. There are four larval stages followed by the pupal stage.



Pupae: These are also active, but nonfeeding, and can be seen resting at the water surface. Because of their method of swimming, they are often called "tumblers". During this stage, the transformation to the adult occurs. Upon completion of this change, the pupal case splits open to allow emergence of the adult.



Adults: Only adult mosquitoes live out of water. After biting to obtain a blood meal and mating, the females return to a water source to deposit eggs. Adult males do not take blood and feed only on plant juices and nectar.

Natural pond residents

A backyard pond provides an attraction for many other aquatic animals. Most of these will arrive in your pond on their own. Many of these aquatic animals are predators on mosquitoes and occasionally on your fish. Below are a few animals you can expect to see. As a pond owner you may want to buy an inexpensive book on pond life to help you identify some of the interesting visitors you may encounter.



adult

Dragonfly



larvae



adult

Damselfly



larvae



adult

Midge



larvae



adult

Mayfly



larvae



adult

Diving beetle



larva



Water strider



Water boatman



Backswimmer



Tadpole (frog or toad)



Giant water bug

Algae, duckweed, leaves, rocks

There are three kinds of algae that grow in ponds: "carpet" algae, string or filamentous algae and plankton algae



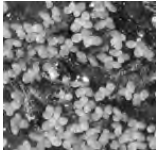
Carpet algae can grow on all the underwater surfaces in the pond, resembles a green carpet (1/2" thick) and is beneficial to the fish and water quality. They produce oxygen and are food for the fish when mosquito larvae are not present.



String algae grow as long, slimy green strands, will adhere to the bottom and sides of the container and also float in the water. This algae can grow at an uncontrolled rate and become a problem. An overabundance of this algae should be avoided.



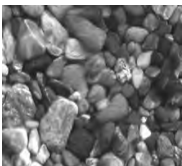
Plankton algae are microscopic, floating plants that turn the water green. In excessive amounts they create the green "pea soup" phenomenon which is also detrimental to the fish.



Duckweed -This is a tiny floating plant that grows rapidly and can quickly cover the entire surface of the pond, especially when the water is polluted with rotting leaves or other organic debris. Fish usually do not survive these conditions. If the pond has a heavy cover of duckweed, it should be cleaned, and the recurring duckweed kept to a minimum.



Leaves - Many leaves like pine, oak, eucalyptus and pittosporum contain chemicals that are harmful to fish. Accumulations of these leaves can make the fish too sick to eat the mosquito larvae and can reduce the oxygen level in your pond.



Rocks - Be aware that some attractive rocks may contain metallic components or certain chemicals harmful to fish. Care should be taken before placing rocks of unknown composition in the pond.

Fishpond construction

See your local nursery for advice on materials and design ideas. Ask other pond owners for advice or surf the Internet (visit our website: www.mosquitoes.org). Check with your city or county for any special considerations before starting construction, such as depth restrictions or fencing requirements. Below are some general principles for constructing a mosquito-free pond.

Construct the pond using a plastic or vinyl liner

These are sold pre-molded for a pond or in large sheets for you to use in your own design layout. Reinforced concrete (with steel rods or wire) may be used, but ground movement from earthquakes and soil expansion/contraction may cause cracking and leaks. Put a waterproof membrane under the concrete to minimize leaks.

Choose a sunny, sheltered location

The pond location ideally should receive at least a half-day of sun and be sheltered from prevailing winds. This will provide sufficient sunlight for aquatic plant growth and reduce evaporation and damage to plants from winds.

Avoid locating under trees or large shrubs

Fallen leaves from trees and shrubs can drastically increase the amount of maintenance needed. Large amounts of leaves can cause a drop in oxygen available in the water and create anaerobic conditions (indicated by pink or purple colored water and foul odors). Some leaves may be directly toxic to fish so especially avoid pines, redwood, eucalyptus, fruit trees (fruit rots quickly in a pond), acacia, oak, walnut and pittosporum. Remember that the tiny tree seedling you just purchased may grow to a hundred feet tall over the years!

Construct pond as large as possible

The pond should be large enough to support fish and resist rapid temperature changes. Most of the oxygen for your fish will come through the surface of the water, so the greater the surface area exposed, the greater the oxygen available (fountains, waterfalls or aerators increase the surface area). Larger volume ponds require less routine maintenance, resist rapid temperature changes and can absorb larger amounts of organic matter (e.g., leaves), all allowing for happier, healthier fish.

Construct pond as deep as possible

A pond should be at least 18 inches deep to provide protection for the fish from temperature changes and predators. The deeper the pond, the more resistant it will be to temperature variations. A shallow pond will heat up fast on sunny summer days and can be too warm for healthy fish. A shallow pond will also expose fish to predation by raccoons, opossums, cats and occasionally herons or egrets. Fish are an easy meal in shallow water. Check with local government agencies for any restrictions on water depth and fencing requirements to protect small children.

Avoid constructing very shallow areas in the pond

A well-designed pond may have some shallow margins, but generally you should avoid having more than 10 to 20 percent of the total surface area in shallows (six inches deep or less). Shallow areas provide warm sheltered areas for mosquitoes to lay eggs and for larvae to grow. However, shallow margins are useful because small fish or fry utilize these areas to keep warm and avoid larger fish. These margins also provide areas for some aquatic plants. Surface-feeding fish such as the mosquitofish for will feed in areas as shallow in one inch deep. If you have potted plants in your pond be aware that shallow water in the tops of pots can provide an area for mosquito larvae to escape from fish.

Construct the sides of the pond to be as steep as possible

The steeper the sides, the less sheltered area is available for mosquito larvae to live. Mosquitofish and aquatic insects such as backswimmers (see page 8) are more effective predators when the sides are vertical or steep.

Provide for drainage

For cleaning purposes provide drainage for complete removal of the pond water. At some time in the future you may need to drain your pond for cleaning and if you plan for this, you can minimize the work that will need to be done. You can build in a drain at the lowest section of the pond, or create a deep area and use a sump pump to remove the water.

Avoid metal to water contact

Many metals, especially copper, can react with chemicals found in the water and produce compounds toxic to fish or aquatic plants. It is preferable to use plastic or vinyl for any piping in the pond.

Provide protection from predators

Protection for fish from predators such as raccoons, cats, opossums, egrets or herons can be built into the design of your pond. Overhanging rock edges can provide cover from sun as well as hiding places from predators. Anchoring ceramic drain pipes, large rocks or concrete blocks to the bottom of the deepest part of the pond can provide protection, as will large planters for lilies or other aquatic plants. Generally items weighing over 10 pounds cannot be moved by a small animal.



Considerations for artificial streams or waterfalls

Many pond owners like to have artificial streams and/or waterfalls leading into their ponds. These require additional considerations for a mosquito-free pond. Water should not stand in small pools when the stream/waterfall is not running (calm pools can be major mosquito producers). Small tube drains can be built into the lowest point of these pools to drain remaining water or rainwater between uses. The water course can also be designed not to hold water when the pump is off. And remember that leaves, soil, organic material, dirt and other contaminants can be picked up along the course and delivered into your pond.

Fishpond removal

If you have a fishpond you no longer use or want, it can be permanently removed to prevent mosquito problems. Unwanted, neglected fishponds are a problem for you and your neighbors. If you are going to remove your pond, or fill it with soil, the goal is to have no standing water.



Completely remove the pond

To completely remove a fishpond, break up and remove the bottom and edge material. Fill the hole with soil.

Provide for complete drainage

A pond may be prevented from causing a problem by breaking large holes in the bottom or removing the bottom. Drainage is successful if water does not stand for more than a few days. Check after rain to be sure drainage is sufficient to remove all the rainwater.

Fill the pond with soil

Provide drainage as above then fill the pond with good soil and landscape it. If you desire to grow plants that prefer continuously wet soils (you could create a "bog garden"), leave pond intact and fill with soil. Allow for shrinkage of the soil and fill above the edges of the pond so that water will not stand on surface. Consult a horticulturist at your local nursery for advice on choosing plants that prefer these wet, sour soil conditions.

District services for pond owners

The Alameda County Mosquito Abatement District provides a number of services to fishpond owners:

- ✦ Preconstruction, mosquito prevention and pond removal advice.
- ✦ Free mosquitofish. You may pick them up at our office or call the District to have them delivered to your pond.
- ✦ Emergency treatment of mosquito larvae in your pond. We use materials for treatment that are very specific for control of mosquitoes and that are safe for animals and aquatic plants.

Alternatives to fish

There are two different types of products available commercially that the homeowner can purchase to control mosquitoes in their pond or water garden. One is a bacterial-based larvicide and the other is an insect growth regulator (IGR) based on the mosquito's own juvenile hormone. Both of these materials are considered "biorational" pesticides as they affect very few other living organisms. Well-stocked hardware, nursery, garden or home improvement stores should have at least one of these products on their shelves. You might want to call for their availability.

Bacteria-based (*Bacillus thuringiensis israelensis*)

Often known as "donuts," mosquito dunks are very effective at killing mosquito larvae within 24 hours (Summit Chemical Mosquito Dunks). They last for approximately 30 days and must be reapplied on a regular, monthly basis. There is also a granular version (Summit Chemical Mosquito Bits)- containing the same active ingredient - but it is not as long-lasting.

Insect Growth Regulator (S-methoprene, Altosid®)

Two different formulations are available to the public, called Pre-Strike, both produced by Wellmark. This material must be applied during the larval stage and kills during the pupal stage, thus preventing adult emergence. A fine, granule version of Pre-Strike, that lasts up to 21 days, can be sprinkled into the water of your pond, fountain, etc. A larger "briquette" version, called the Mosquito Torpedo, is also available which will control the larvae for up to 60 days.

If fish won't survive in your specific circumstance, and treating with pesticides is an issue for you, one solution is to keep the water surface well agitated (24 hours a day!) by means of a pump / fountain, etc. This will prevent the adult female from landing on the water surface and laying her eggs. The ultimate solution is either keeping the pond / water feature completely dry, or removing it. During our wet winters, keeping rainwater out of your pond can be quite challenging. Please remember that in Alameda County mosquitoes can breed all year long, even in the dark of winter. Advice on removing ponds can be found on page 12.





Mosquitofish Stocking Policy

In an effort to minimize unwanted environmental impacts, mosquito abatement personnel refrain from putting mosquitofish in sources known, or suspected to be, habitats for endangered or threatened species. Care must be taken when introducing mosquitofish into sources where they can migrate to habitats used by endangered or threatened species (by flood as an example). Mosquitofish can still be used in ornamental fishponds and abandoned swimming pools in urban and suburban areas without worrying about endangered species conflicts.




It is against California Department of Fish and Game regulations for private citizens to plant mosquitofish into waters of the state without a permit. (California Code of Regulations, Title 14, Sections 1.63 and 238.5; and California Fish and Game Code, Section 6400).

Mosquitofish provided by the Alameda County Mosquito Abatement District are intended for mosquito control only, and should not be introduced into potential mosquito breeding sources by anyone other than certified mosquito control technicians or Fish and Game personnel.

Mosquitofish should not be a problem for endangered species in the following situations:

-  Residential ponds or swimming pools
-  Watering troughs
-  Flood control canals
-  Gravel pits

Mosquitofish stockings that require care to avoid conflicts with endangered species could be:

-  Vernal pools -- temporary rain-filled low areas
-  Seasonal stock ponds -- in rural areas
-  Slow-moving seasonal creeks -- especially those that connect to other potential habitats

Fishpond Checklist

You have a well-constructed and located pond, and with normal maintenance, it should stay mosquito-free

Below are conditions found in your pond which may require attention to prevent mosquito problems.

Too much shallow area

Plant growth too thick

Too much organic material

Not enough sunlight

Plants hanging into water

Leaves in pond are toxic to fish

Runoff contamination possible

Fish need protection from predators

Waterfall pools hold water

Other (see below)

Checked by:

Date:



ENVIRONMENTAL BENEFITS STATEMENT

This project is printed on New Leaf Everest Natural, made with 100% post-consumer waste, and processed chlorine free. **By using this environmentally friendly paper, the following resources were saved:**

trees	water	energy	solid waste	gases
9 fully grown	3,753 gallons	6 million BTUs	415 pounds	820 pounds

Calculated based on research done by Environmental Defense and other members of the Paper Task Force.