

POND-BUILDING GUIDE



CHARACTERISTICS OF AMPHIBIAN FRIENDLY PONDS

Amphibians live and breed in a wide variety of habitats, so there is not a single pond or wetland design that will satisfy the needs of all amphibian species or amphibians in all localities. A major objective of Operation Frog Pond is to encourage research and experimentation to develop designs and management practices to accommodate a diverse range of amphibian species with different habitat requirements. Guidelines for creating amphibian friendly habitats will be published as new information becomes available. We offer the following guidelines for creating your own amphibian haven:

SHALLOW SLOPING SIDES

While traditional water gardens are built with rather steeply sloped sides and deep shelves designed to hold marginal plants, many amphibians prefer to breed in temporary pools and relatively shallow water. Many amphibian spawning sites are in water only a few centimeters deep. Creating ponds with gently sloping sides and shallow water areas provides a variety of water depths for amphibians to seek their preferred water depth for courting and spawning.

FISH

Most traditional water gardens are stocked with brightly colored goldfish or koi and often these fish are one of the main purposes for maintaining water gardens. However, these and other large, predatory fish can be detrimental to amphibians by feeding on amphibian eggs, larvae, and even adults. Although ponds stocked with goldfish, koi, or other fish may be used by adult amphibians, it's possible that little or no successful amphibian reproduction takes place in such ponds. The widespread introduction of both native and non-native fish into historically fishless habitats is believed to be a major cause of amphibian declines in some areas. We suggest avoiding stocking amphibian ponds with fish since even small fish may prey on amphibian eggs or larvae. If mosquitoes become a problem, try experimenting with small, locally native fishes such as minnows, dace and darters which are quite beautiful in their own right and may enhance the value of the pond for wildlife conservation. Such fish are usually easily obtained with dip nets or seines with the proper permits. Always check with your local wildlife agency before capturing any wild fish. If there is potential for your frog pond to overflow into native streams (including storm sewers) during periods of heavy rain or snowmelt, then you should only stock your pond with fishes obtained from your local watershed to prevent inadvertently introducing non-native fishes into natural waterways. For more suggestions about mosquito control, see the "Mosquito Control" section below.

actually be quite aggressive/invasive in smaller ponds, creating a monoculture of vegetation that is not conducive to the egg laying of most amphibian species.

SURROUNDING VEGETATION

A mix of vegetation types around the pond will likely provide habitat for the widest variety of amphibians. Some amphibians like to bask on rocks or mud banks or beneath shallow water in full sun while others prefer to remain concealed in thick vegetation or in the shade to stay cool. Providing basking rocks, shallow mud banks, and a mix of spiky and broadleaved vegetation should provide a variety of micro-habitats to suit species preferences. Of course small ponds may not allow the creation of all possible habitats around the edge. Very small ponds most likely will appeal to amphibians that live and breed in temporary pools. Surrounding the pond with uncut grasses and sedges is a good way to simulate these habitats.

WATER MOVEMENT

Many amphibians prefer to live and breed in small, quiet pools or still side channels of streams and may be unable to successfully reproduce in water gardens with a current. Other amphibians only live and breed in moving water so the correct design depends on the species of amphibians you hope to attract. Placing recirculating pumps at the base of waterfalls minimizes the current created in the main pool. In contrast placing waterfalls and pumps at opposite ends of the pond creates a current that may benefit some species. In general, the species most likely to use artificial wetlands are probably those that prefer still or slowly moving water.



MUD/SILT BOTTOM

Traditional water gardens are typically constructed using a rubber liner such as EPDM or Polyethylene. These materials can work well for amphibian ponds too but more and more ponds are being constructed by lining the depression with bentonite clay instead. Bentonite is a natural mineral that swells when wet and makes a nearly water tight barrier. The potential advantage of bentonite lined ponds may be that they provide a more natural substrate for amphibians to burrow into, particularly over winter. However, even rubber lined ponds can accumulate a layer of sediment at the bottom to serve the same function but the potential advantages of different liner materials is an area worth exploring.

PREDATORS/PETS

Cats and dogs can pose a serious threat to amphibians living around artificial wetlands. These predators are particularly efficient at killing wildlife because they are always well fed and in peak condition plus they are typically confined to a rather small space where they can kill a large proportion of the resident amphibian population. It is best to keep cats and dogs excluded from artificial wetlands. Natural predators such as snakes, raccoons, and herons are a different story. Truly healthy amphibians habitats should allow amphibians to reproduce at a rate to maintain their populations while still feeding their natural predators. Creating wetland habitat that produce a surplus of amphibians that support their natural predators is a benchmark of success and should be the goal of every Operation Frog Pond participant.

PESTICIDES

Pesticides and amphibians don't mix, period. A wide variety of commonly used weed and insect poisons have been shown to have detrimental effects on amphibians. Chemical pesticides simply should not be used in the vicinity of amphibian ponds. Fortunately, natural plantings that are likely to produce the best amphibian habitat are also very resistant to weeds and insects once fully established. Until such areas are established, weed and insect control should be confined to mechanical and safe biological control methods.

MOSQUITO CONTROL

Operation Frog Pond continues to research the most effective methods for controlling mosquitoes around frog ponds without negatively impacting amphibians. Mosquitoes occur almost anywhere where there is standing water. There are a number of tools available to control mosquitoes and each has

genus *Culex* which prefer to breed in stagnant pools of polluted water. They breed commonly in small pools of water such as in old tires, flower pot trays, dirty bird baths, or in tin cans or other debris laying around that collects water. A well-designed amphibian pond will contain plants to provide cover for amphibians, as well as filter and clean the water to prevent it from becoming polluted.



Also, *Culex* mosquitoes do not like moving water so adding an aerator or circulating pump to an amphibian pool will reduce a ponds attractiveness to these disease-carrying insects. However, moving water may also discourage some species of amphibian from using the pond but this can be solved by providing some still, backwater areas, of calm water. Many amphibians breed in ephemeral pools that typically evaporate during dry periods. Such pools are a very easy and inexpensive way to provide amphibian breeding habitat. As these pools shrink, they may provide excellent breeding habitat for mosquitoes so owners may need to provide some form of mosquito control during the brief period when ephemeral pools are drying out and become stagnant.

NATURAL ENEMIES

A vast number of other animals feed on mosquitoes at both the adult and larval stages. Providing natural enemies is perhaps the most effective, and environmentally safe, way of controlling mosquitoes around a pond. In addition, these predators increase the biodiversity around a pond to make the amphibian pond a more interesting place.

AMPHIBIANS

The most obvious natural enemy of mosquitoes around an amphibian pond are the amphibians themselves. Frogs, toads and salamanders will consume both mosquito adults and larvae. Adult frogs and toads will consume adult mosquitoes around the pond while tadpoles and aquatic salamanders will feed on larvae. In fact, the extra protein provided by mosquito larvae can speed development, allowing tadpoles to win the race to metamorphose into adults before ephemeral pools dry up.

DRAGONFLIES

These flying insects are the sworn enemy of mosquitoes. Like amphibians, dragonflies and damselflies consume both adult and larvae mosquitoes. Adult dragonflies catch mosquitoes on the wing and their aquatic nymphs consume hundreds of larvae. Bear in mind, however, that most amphibian tadpoles begin life as small as a mosquito larvae and many tadpoles wind up as meals for dragonfly nymphs. Some amphibians avoid this by breeding in ephemeral pools so their larvae metamorphose before significant numbers of dragonfly nymphs appear. Regardless, dragonflies are a natural part of amphibian ponds and should be welcomed (they are often the first to appear when a suitable wetland habitat is constructed).

BIRDS AND BATS

Birds and bats can consume enormous numbers of flying insects including mosquitoes. Among birds, the purple martin is most famous as mosquito control. But studies have shown that bats are much more effective because martins go to roost just as mosquitoes are becoming active in the evening, while bats do most of their feeding while mosquitoes are out. Placing bird houses and nesting shelves to encourage purple martins, and other swallows such as tree swallows and barn swallows to nest in the area can help with mosquito control. But erecting a successful bat house may be the ultimate natural mosquito control. For more information about attracting bats to a bat house, visit [Bat Conservation International](#).

FISH

Few mosquito larvae survive in the presence of a healthy fish population. Unfortunately, the same can often be said for amphibian larvae. Many amphibians have adapted breeding strategies to avoid predation by fish and the widespread introduction of sport fish into naturally fish free waters has impacted amphibian breeding habitat in many areas. So using fish to control mosquitoes in amphibian ponds needs to be carefully planned. Large fish, including anything that could be caught with a fishing rod, or goldfish and koi are out because they can prey on large numbers of amphibian larvae, and even adults. But smaller fish provide effective mosquito control and are likely to harm amphibians far less. The preferred choice for fish is small species of local natives such as dace, darters, and topminnows. Many native fish are strikingly beautiful in their own right. These fish can be easily obtained with a dip net or seine but always check with your local wildlife agency before catching or transporting fish and make sure you have necessary permits and obey the law.

Mosquito fish (*Gambusia affinis* and *Gambusia hoolbrooki*) have been widely used as “biological” mosquito control in many countries. However, *Gambusia* released outside their native range have had serious negative impacts on native fish and amphibians. *Gambusia* should only be used in amphibian ponds inside the native range of the fish, or where a pond is land locked with no possibility of overflowing into natural waters during heavy rain or snow melt. Information about the negative effects of mosquitofish, including range maps, for *Gambusia affinis* and *Gambusia hoolbrooki* can be found on the USGS non-indigenous aquatic species web site.

Never introduce non-native animals to natural waterways: the intentional, or accidental introduction of exotic species can have serious negative consequences for wildlife. Ponds located in natural drainage areas may overflow into sewers and creeks in rainy weather or during heavy snowmelt. Even a few millimeters of water flowing over the ground is enough to carry small fish, eggs, or any diseases they may harbor into natural waterways. The safest policy is to only stock amphibian ponds with species that are found naturally in the local watershed. Even moving native specimens from one watershed to another could transmit disease and introduce genes that disrupt natural evolutionary processes.

Even if only small fish are added to an amphibian pond, you should make sure there is an abundance of emergent and submerged vegetation in the pond

use of mosquito dunks cause these problems. Therefore, mosquito dunks may be helpful to control mosquitoes during the first few months after constructing a pond while other natural enemies of mosquitoes are getting established. We recommend mosquito dunks not be used beyond the first growing season after establishing a pond.



OTHER MOSQUITO CONTROL APPROACHES

PESTICIDES

The simple answer here is: **don't do it!** The widespread use of pesticides has been implicated in amphibian declines and there is a growing body of evidence condemning the impact of chemical pesticides on amphibians. There is evidence that even products long considered safe for amphibians are not as innocent as once believed. The best policy is to simply not use chemical insecticides near amphibian ponds. At the very least, such chemicals will kill insects that amphibians depend on for food. And just because a product is labeled "organic" does not mean it is safe to use around amphibians. Remember that some of the most toxic chemicals known are natural and organic. Many organic chemical retailers are not above misleading people to believe their products are perfectly safe simply because they are "natural" or "organic". Manufacturers of truly safe products can back up their claims with studies and evidence. Always research new products thoroughly rather than simply accepting the claims on the label.

MOSQUITO TRAPS

There are a number of mechanical traps on the market which can effectively reduce the number of mosquitoes in an area. These traps use carbon dioxide to attract mosquitoes to a vacuum or sticky trap. Although highly effective, these traps do have the disadvantage of requiring a bottle of carbon dioxide (a greenhouse gas) to be refilled about once a month. Therefore, we would recommend these traps only in places with fairly extreme mosquito problems where natural enemies have been unable to provide acceptable control.

"BUG ZAPPERS"

Another commonly used, but worthless, "mosquito trap" is the infamous "bug zapper" which uses light to attract insects to an electrified grid where they are electrocuted. Despite the macabre entertainment provided by these zappers, they are detrimental to the environment because they kill mostly pollinating, and other beneficial insects. The traps use ultraviolet light to attract insects which is the type of light reflected by many flowers to attract pollinators. Biting insects are typically attracted to heat and exhaled carbon dioxide produced by warm blooded victims. Several studies have confirmed that bug zappers do little to rid our yards of biting pests but are very effective at killing insects that are beneficial.

ON INTRODUCING AMPHIBIANS

Never introduce amphibians to a frog pond without the permission of state and local authorities. The goal of Operation Frog Pond is to enhance habitat for wild, native amphibians. Relocating amphibians to new locations can severely alter the local genetics of wild populations and spread disease. Introducing exotic species such as bullfrogs and African clawed frogs cause serious loss of native amphibians. Non-native species and animals purchased at pet shops or bait stores should *never* be released into the wild.



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