Guide

To Watergardening

In Southern Arizona

REVISED EDITION 2013

Website: http://tucsonwatergardeners.org/

"An addiction to water gardening is not all bad when you consider all the other choices in life! "

Author Unknown

The Tucson Watergardeners
Second Edition - March 2013

Compiled by JoAn Stolley

Tucson, Arizona USA

About The Club

Established in July 1999, The Tucson Watergardeners Club is a non-profit corporation organized under the laws of the State of Arizona. The club has as its purpose:

- To promote an appreciation and understanding of water gardening, including but not limited to ponds, bogs, fountains, wildlife, and aquatic plants;

- To promote responsible ideals of water gardening among our members;

- To help develop an interest in the creation and care of water gardens and the benefits of gardening in general; and,

- To develop and promote friendships and camaraderie among our members, members of other garden clubs, and the community as a whole.

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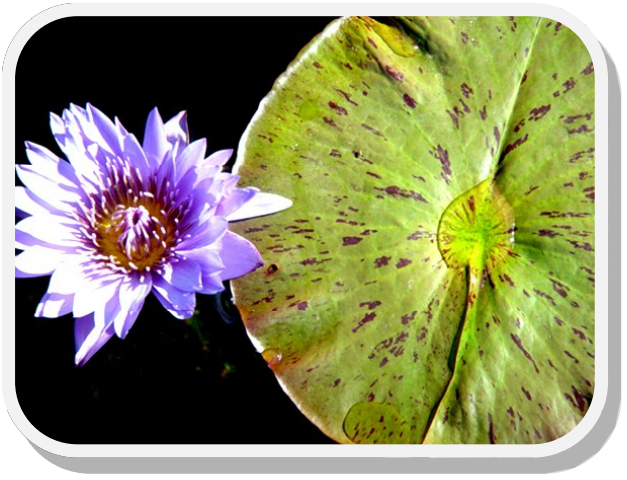
Acknowledgements



This Guide is a compilation of research and the collective wisdom of members' water gardening experiences over the past decade. It is *not* meant to be the definitive book on Southern Arizona water gardening. Rather, what this Guide is meant to do is gather together under one cover, topics, advice, and discussion that have proven to be most useful to the broader community of Tucson Valley water gardeners –from novices to professional landscapers.

Thank you to the members who offered great advice for the revision of this Guide.

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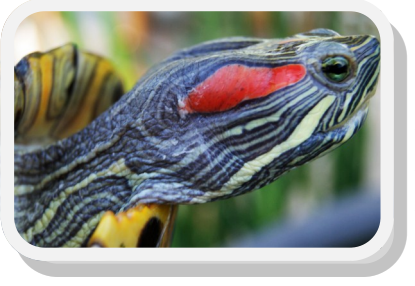
What Have You Got? What Do You Want?

Water Garden. A water garden is usually defined as a self-contained body of water —usually man-made, with many aquatic plants, and, perhaps a biological filter to keep water clear. Waterfalls and streams are also a common feature of water gardens. A water garden can be installed in the ground, such as pre-formed rigid liners, concrete, block or brick, or, above the ground, such as containers without holes, tubs, fountains, buckets, or barrels. A water garden may contain fish, as well. *This Guide is great for you!*

Bog Garden. A bog garden is an area or pocket of saturated soil that is never allowed to dry out and contains moisture-loving plants that grow in conditions of "wet feet and dry ankles", but no standing water. Bog gardens can be contained in an extension of a pond liner that allows water to permeate the soil, but prevents the soil from falling into the pond. Or, a bog garden can be created independently with a non-permeable membrane that slows down the movement of water through the soil. *This Guide is great for you!*

Fish, Duck, or Turtle Pond. As the name implies, a fish (such as Koi or fancy goldfish), duck, or aquatic turtle (such as Red-Eared Slider or Painted turtles) pond primarily features the inhabitants —rather than the aquatic plants; and, *minimizes* plant material—or positions plants in unreachable locations, thus, usually requiring a higher degree of mechanical



filtration to keep water clear. In fact, the inhabitants can be very destructive to aquatic plant collections —as the plants become a food source. *Other guides would be better resources for you!*

A Few More Definitions That Involve Aquatics & Plants

Installation of what is usually considered as an "ornamental" pond or water garden has many of the same elements that are used in Hydroponics and Aquaponics. However, having a pond with fish and plants does *not* necessarily meet the criteria for developing these *highly controlled* systems:

Hydroponics—a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or coconut husk.

Aquaponics –a sustainable food production system that combines the raising of aquatic animals (e.g., fish such a Tilapia and Yellow Perch, prawns, etc.) with hydroponics (cultivating plants in water). It is a symbiotic environment in that the fish by-products are filtered out by the plants as vital nutrients, after which the cleansed water is recirculated back to the animals.

Other guides would be better resources for you!

Introduction

Tucson's location in the largely arid Sonoran Desert of the southwest seems one of the more unlikely places for water gardening. However, that's just not the case! Because of this arid environment, plants that have their "feet" in the water consistently during the desert's hottest summer season, *thrive* —where terrestrial plants, including the abundance of cacti found in this region, generally need lots more attention and various watering schedules in order to just survive. The Sonoran Desert is a place of biological diversity, and man-made water features also attract an abundance of nature's creatures —a terrific side benefit of desert ponding!

Tucsonans absolutely love water for the contrast and respite it brings to their desert life style. That water can come in the form of small container patio water gardens, fountains, larger ponds and waterfalls, bog gardens, swimming pools, and even an occasional swimming pool turned into a water garden. It is hoped that this Guide will offer beneficial advice to a wide variety of gardeners. Remember that the desert has a distinct set of seasons; and, desert ponds, in particular, go through seasonal cycles.

Because water is such a precious desert resource, water conservation is also very much on the minds of desert gardeners, and that is another reason that water gardening has become popular. After the initial filling, a pond environment for water-loving plants uses less maintenance water. This is because that, by re-circulating the water over and over, a pond or fountain requires new water only to counteract evaporation. Total water use is less than the same area of plants being watered in a conventional bed —another great reason for water gardening. *Welcome to the world of desert water gardening!*

Planning For A Water Or Bog Garden

Important Considerations

Location is everything! Where will you enjoy it the most? Lay your concept out and spend some quality time with a chair beside "the spot" imagining the finished water garden *before* you go final on your decision. What are your optimum "viewing" locations?

Water features such as fountains, wall mounted fountains/basins, and water garden pots usually stand alone. However, planning a pond "ecosystem" requires a bit more thought, as there are many combinations: pond alone; pond with waterfall (s); pond with stream and waterfalls; bogs areas surrounding a pond; pondless waterfall—with or without a stream. There are endless possibilities to meet any budget! Look through garden magazines for ideas —or, better yet, go on locally sponsored water garden tours or to public gardens.

Caliche is a fact of life on much of our desert property. If you are planning to sink a new water or bog garden into the ground, dig **test holes**! Findings may or may not change your locations plans.

Keep away from **trees** and **roots** and locate in **full sun** 6-8 hours a day (for the best plant bloom). Too much sun encourages algae growth. If your decision is to locate under trees, such as the desert Mesquite, there will be a lot of tree debris and an automatic pond skimmer is highly recommended for including in your pond design.

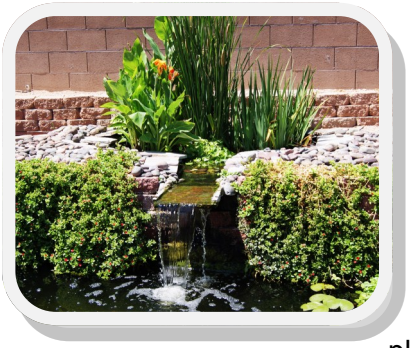
Drainage, back washing, filter cleaning, plant removal, and pond mucking have to periodically be done. These activities can influ-

ence your **location decision**. For example, you don't want pond drainage and residual muck running across your new flagstone patio or flying at your patio furniture!

For **water garden depth**, a *minimum* of 18"-24" is better for plants, such as water lilies, as well as for fish. *For ponds over 3' deep,* ***local building and fencing codes*** *may apply. It is important that the code requirements be checked out during your pond planning phase.* Many times, water features follow pool building codes, based on the 2006 International Residential Code for One– and Two-Family Dwellings, Appendix G, published by the International Code Council (ICC). Building codes would not generally apply to water features such as moist soil bog gardens.

Plan the water or bog garden for proximity to your **utilities** or extend utilities to your pond area –even if you aren't *currently* planning to install pumps. You may change your mind later! Partial water changes and adding water for evaporation loss are essential—so, *as a minimum*, make sure your garden hose bibb, or outside spigot, is in proximity to the planned pond area. For desert water gardening, consider piping water to your water garden and installing a "float" system to automatically maintain water levels to make up for evaporation loss. Electricity in the form of GFCI (ground fault circuit interrupter) outlets is an equally important utility to support pumps, accent lighting, and other electrical considerations. GFCI is always used around potentially "wet" areas.

Rule of Thumb: *Always provide more electrical circuits and/or outlets than you think you will possibly need. Ask any water gardener! Consult with a professional electrician.*



Plant shelves are very important in a water garden, particularly for "marginal" water-loving plants. Make adequate plant shelving a high priority as part of your planning. Plant shelves can be improvised for container water gardens. Another terrific place for aquatic plants is to design a water fall with "pockets" along the sides –or even an intermediate, shallow reservoir, to house aquatic plants. This also helps with water filtration. More about plant shelves in this Guide's aquatic plant discussion section.

Rule of Thumb: *Ponds with gently sloped sides or shallow "plant shelves" are open invitations and handy entries into the pond for predators. Straight sided ponds are much less so and you can easily prop shallow water plants on upturned black nursery pots or concrete blocks if need be.*

Floating islands planters are a bit more exotic. These islands are buoyant mats generally made from recycled polyester fiber with removable plugs for easy planting. Plant roots go down to the water, creating shade, shelter, and spawning opportunities, as well as habitats for other aquatic creatures such as frogs and turtles. There are also planters with polyethylene foam collars or barley straw collars to keep them afloat. Floating islands and planters can be real focal points for the water garden —but, a bit on the pricey side!

Rule of Thumb: *Most water gardeners quickly find their "first" water garden is not "big enough" for all the plants, fish, etc. they fall in love with. Plan the biggest water or bog garden you can afford or for which you have space. You will grow into it, as well as having the fun of experimenting with new aquatic and bog plants!*

SIMPLE IS OK!

Water gardening should be an easy and enjoyable hobby with minimal maintenance, once established. Sometimes water gardeners defeat this by buying every "bell and whistle" they see advertised or are told by vendors they "must have." The more you add, the more work you will have maintaining everything. Use the KISS principal!

Lighting can add real drama to your water garden, but is often overlooked in pond planning stages. There is an infinite variety of lighting to choose from, ranging from submersible halogen lighting in many colors to solar floating lights. Timers for your lighting system are important. Motion detectors that activate lights may also help to discourage nocturnal pond predators. There are various types of transformers for connecting your lighting system—from photo cell that automatically senses light and dark to digital transformer technology. Of course, lighting installations surrounding a water garden can also bring the opportunity to highlight the shapes and forms of your collection of aquatic plants. Just imagine the drama of spot lighting a night blooming waterlily!

A newly created water garden can often look rather “abrupt” in your garden. To soften its edges and make your water garden appear more settled in, especially if it is rock-edged, try adding “terrestrial” plants such as creepers, tufters, small grasses and grass-like plants to give a flowing feeling. Bulbs can also provide that important burst of color.

Water Garden Structural Components

There are several successful alternatives for containment of water to create a water garden. The "right" selection and design is really a matter of taste, location, and how much your budget will allow. *Whatever your design, avoid creating "dead spaces" where water does not easily flow and will stagnate.* Here are some of the selections:

A fiber glass or plastic pre-formed pond. Pre-formed ponds can range in size from about 30 gallons to over 200 gallons. Larger models come with plant shelves. While these plant shelves may be useful, they are often too shallow for pots and great "stepping stones" for predators. Plan accordingly! Site preparation, preferably with a sandy bottom on which the pond rests, is critical. Be sure that a pre-formed pond is level on all sides when installed. The disadvantage of pre-formed liners is that they are not flexible –the shape they come in is the shape you have to stick to. The smaller and shallower pre-formed ponds make excellent bog garden containers, particularly when sunk into the ground and surrounded with stone.

Lining the pond excavation site with concrete. Concrete requires expertise to make a stable pond lining and ensure that it is water-tight. Initial "cure" time is also required before aquatic life can be added. Concrete requires much diligence in yearly maintenance. An alternative is to use an underliner and a flexible liner on top of the concrete. Concrete, as a choice for a water garden,

would also include conversion of a swimming pool or hot tub to a pond. There are many technical issues for swimming pool and hot tub conversions, ranging from treatment of concrete that has constantly absorbed chemicals to strategies for "retro-fitting" pool or spa pumps and pipes to accommodate a water garden. It is advisable to consult a pond professional before undertaking such a large conversion.

Utilizing a flexible pond liner for a pond excavation site or for an above-ground frame that has been pre-built. Pond liners are a popular choice among water gardeners for ease of installation, durability, as well as to achieve flexibility of water garden design. Pond liners come in a variety of material grades. Quality and reliability of the manufacturer should be high on the consideration list, with price relegated to a secondary consideration. The higher quality vinyl liners can have warranties for twenty or more years! Pond liners made from EPDM (Ethylene Propylene Diene Monomer) or Butyl synthetic rubbers are significantly more flexible and durable than liners made from other plastics such as polyvinyl chloride (PVC) or Polypropylene (PP). *Not all vinyl liners are safe for pond use.* For example, durable liner products used in roofing contain algaecides and fire retardant chemicals; swimming pool liners contain herbicides and biocides that can kill aquatic life. PPL-24 containment membrane is stronger, cheaper, and lighter weight than the EDPM, and is also being used by Arizona water gardeners to create pond liners. However, its stiffness is a bit harder to work with around pond curves.

To use a pond liner, the first steps are to excavate, shape, and level the hole where the pond, plant shelves, and/or bog areas are to be installed. This is not a trivial exercise! *A bed of sand*

(2" is recommended) and salvaged carpeting makes an excellent foundation for the liner —as trips into the pond will be necessary, both for plant care and maintenance, as well as mucking. The soft foundation allows give-and-take and may prevent lining punctures when walked on. A thick layer of old newspaper or cardboard for cushioning the liner is *not* advisable in our desert climate, as it deteriorates rather quickly.

Rule of Thumb: *The larger the pond area you wish to cover, the thicker the vinyl liner should be. (Small ponds (up to 100 gallons), 30 mil rubber; larger (over 100 gallons) 40-45 mil rubber; very large projects, such as reservoirs, 60 mil rubber)*

Formula for determining size of pond liner:

Length of liner required = Max. length of pond + (2 x max. depth of pond) + minimum 2 feet (min. 60 cm) overlap

Width of liner required = Max. width of pond + (2 x max. depth of pond) + minimum 2 feet (min. 60 cm) overlap

See the following page for helpful steps in installation your pond liner.

Installing Your Liner

Before installation, allow the liner to warm in the sun for at least an hour to soften before placement. Some lining materials are easier to work when wet. Depending upon the size of your pond, spreading the liner may take more than one person. Do not drag or pull the liner across the yard where it could catch on something and tear:

- Flap the liner over the pool like a sheet (up and down) to force air under and cause it to "float" into place. Smooth the liner out as much as possible; do not pull or stretch.
- Leave small wrinkles in the bottom of the pond. This allows the liner to spread once the soil settles.
- Tuck and fold the liner neatly to fit the contours of the pond. Be sure and leave a lip no less than 6-inches over the outside of the pond; 12 inches is preferred. Use bricks or stones to temporarily hold the liner in place.
- Fill the pool with several inches of water. Re-adjust the liner as needed; pleat and fold excess material neatly. Move the bricks if required.
- Continue filling the pond to halfway; adjust the liner and bricks again.
- Once final adjustments are made, fill the pond to just below the edging shelf. Note: there is no way to get rid of all wrinkles and folds. Tuck and fold excess lining material as neatly and compactly as possible.
- Trim excess liner using heavy scissors or a utility knife, but leave plenty to overlap and protect the edging shelf.
- Cover the exposed lip of liner with soil or concrete, if edges around the pond must support heavy traffic or heavy edging material. You can now install the edging, overhanging the pond by 2 to 3-inches; use flagstone, brick, cut stone, or other decorative or natural stone. Trim the liner one final time; use soil in behind the stone to conceal visible liner.

Rocks As A Liner Cover. Rocks are sometimes used as a liner cover, with the theory that rocks can form planters and provide more surface area for beneficial bacterial activity. If there is not good water flow through this rock layer, stagnation can occur —trapping excess muck; and, the rocks can become a bed for anaerobic (bad) bacteria. If rocks are used, mortared rock, or "Permadirt", which is a colored, exposed aggregate fiber-reinforced covering over the liner makes for a healthier pond and cleanup far easier.

Leak Detection In Established Ponds

While on the subject of vinyl liners, leak detection should also be addressed. As the pond ages and endures many seasonal and temperature changes, leaks are quite possible. Leaks can also be man-made or tears can be the result of an animal. If you start your pond season with a sudden or an unusual drop in water levels, a leak may be present. Gradual water loss may be the result of evaporation at the highest peak of our hot summer season. However, springtime water level drops may be a different story!

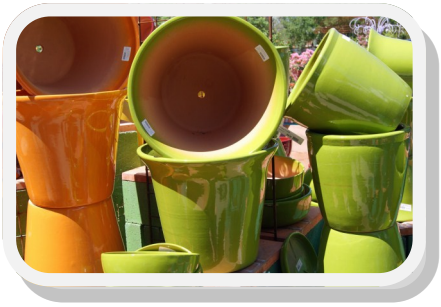
Leak detection is really a process of isolating segments of the total pond system, and using the process of elimination to pinpoint the source of a leak. This bit of detective work is every pond owner's worst nightmare. However, if not promptly attended to, water usage bills can rapidly escalate. Many leaks are due to low edges surrounding the pond, waterfall or stream. Perhaps the pond has settled after winter weather or heavy rainfalls. Wet gravel or wet mulch around a pond edge is a very good clue. Backfilling to raise the edge or compacting soil under the liner may easily solve this overflow –and leakage problem.

Check for obstructions in waterfalls and streams. Someone, such as a child, or even a large animal, such as a raccoon, may inadvertently have dislocated rocks so that water is now spilling over the liner. Excess plant growth and root systems --or even algae, may also be diverting the water, and need to be cleared out so that the water can freely pass. Spring is an optimum time to prune or remove obstructing plants. Whether or not you are on a leak detection mission, water plants surrounding a waterfall and bio-filter should be checked for overgrowth as part of your periodic maintenance chores. If the stream has a concrete liner, cracks in that liner may also be the source of the pond leak. Be sure that your pump is properly flowing and that all filter pads are cleaned. The next step is to turn your pump off for about 12 hours and check the pond water level. Allow gravity to step in and the water level to drop. Be patient as this can take a few hours to a few days! If the water level does not drop, then the waterfall or stream needs to be rechecked. If, in this process, water is *not* flowing through your biofilter for more than an hour, all beneficial bacteria will die off, and have to be replenished.

If you have a skimmer, one of the first suspects is that the seal for the skimmer faceplate has failed or that somehow water is seeping behind the faceplate and the vinyl liner. If the leak drops below the skimmer faceplate, where the water level stops

dropping, you have found the lowest part of the leak. If the pond perimeter is easily accessible, a visual check of that perimeter for wet soil areas may be helpful. If the perimeter is not accessible, then, at this point you may have to clear things out by placing fish and plants in temporary storage tanks to better see the shelves, side walls of the pond liner or the bottom drain. Fish need continuous aeration and the holding tank should be out of the sun. Look for cracks, tears, and areas that stay wet, and carefully check around any pipes, skimmers or bottom drains. Liners generally have an algae build up, so that makes leak or hole detection more challenging. This is a tedious process that could involve moving rocks and gravel, as well as searching for the leak with both your eyes and hands. Be sure to check the general health of the pond liner to make the patch or replace liner decision. Liner patch kits are available through a variety of commercial sources. It is also important to check for seals around bio-filters to ensure that these seals are still tight. In the desert, rodent damage to pipes is also a possibility for water leakage.

Remember to be patient and make leak detection a step-by-step process of elimination. Of course, calling a pond professional is always an option for solving a serious leakage problem.



Selecting and water proofing a **smaller container**, such as a ceramic pot, whiskey barrel, or similar vessel is also a successful approach to water gardening — particularly for small outdoor patio spaces. A no-holes container is preferred, but any ceramic/pottery container can be waterproofed. To seal any drainage hole, tape over the hole on the outside and put plumber's epoxy in the hole from the inside. The epoxy should be mounded a bit. A hole can also be sealed with aquarium sealer. Once the hole is dry, if the pot is unglazed on the inside, then seal the inside of the pot with a polyurethane spray, using 3-5 coats, or use several coats of black exterior latex paint. Let the spray or paint thoroughly dry between coats. Now you are ready to put water and aquatic plants in your pots! If a whiskey barrel is the desired water garden container, a barrel liner can be purchased for a real whiskey/wine barrel; the barrel can be lined with heavy mil pond liner; or, the barrel can be conditioned to hold water by wrapping it tightly in black plastic and constantly refilling it until it swells and holds water to the top.

Pumps

Pumps are recommended if the pond is over 100 gallons or has a heavy fish load.

Water movement and aeration are vitally important to water gardens with fish, or those over 100 gallons. This is accomplished through a pumping system. The pumping system that circulates water through a pond is a 24/7 operation. If you have a biofilter and the supporting pump fails for several hours, the "beneficial" bacteria in that biofilter will die, throwing the whole pond chemis-

try off balance. This situation may significantly reduce oxygen supplies to pond life, including fish. Many pond designers advise a second pump to support the waterfall or other fountains or water features.

The **number of gallons** in a pond, as well as the **height and length the water must be pumped**, are the primary considerations in determining pump size and type. Pond pumps will be rated with numbers such as 1200 gph (gallons per hour), 3000 gph, 4000 gph on the box they are packaged in, as well as showing diminishing strength at different "heights" of water flow.

Rule of Thumb: *The pump should be large enough to circulate the pond water at least once an hour.*

Rule of Thumb*: Never purchase a pump that is only "just" powerful enough.*

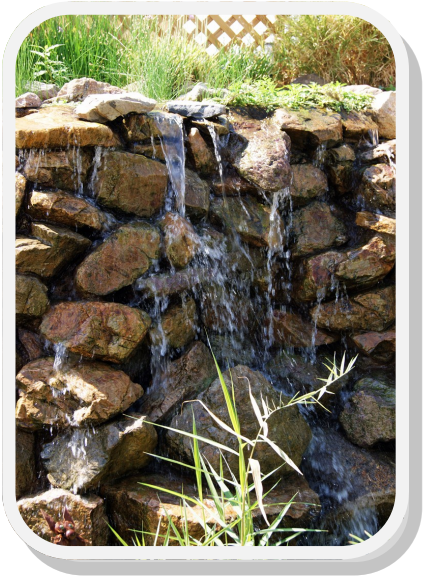
Formulas for calculating the number of gallons in your pond:

Square & Rectangular Ponds

Length x Width x Average Depth = Cubic Feet x 7.48 = Gallons

Round Ponds

Top Diameter x Bottom Diameter x Height x .758 = Cubic Feet x 7.48 = Gallons



Waterfall Pump Calculation

For each foot of waterfall spillway width, allow 1500 gallons of water flow. For example, a 2-foot wide waterfall usually requires a 3000 gph pump. Higher waterfalls and longer runs (plumbing and tubing) mean that your pump will push less water.

It is strongly recommended to have a spare pump on hand in case of pump failure.

In addition to sizing the pump, the right size tubing to circulate the water, as well as valves and fittings to control the flow of water are important considerations. Most pumps produce volume, rather than pressure, so smaller diameter hose or in-line restrictions and length of hose run will seriously reduce water flow and should be avoided. Some of the more familiar brand names in aquatic pumps include Pondmaster, Beckett, Laguna, Little Giant, Savio, Oase, Aquascape, Tetra –to name but a few. However, look for those pumps stating that they are *water cooled* in order to avoid a possible oil leak in your pond. For large, elaborate ponds you might want to consult a pond professional before designing, making a pump system purchase, or installing that system.

There are also small “feature” pumps with fountain heads that do a good job on small water features, such as containers, very small ponds, and smaller fountains. Some brands include: Little Giant, Oase Manufacturing, Pondmaster, CalPump, and TetraPond. Have at least as much distance to the edge of the pond as the nozzle spray height you desire, in order to minimize water loss. However, these feature pumps are not adequate for most water gardens, in terms of circulating water or handling solid waste.

Filtration and Water Quality

Filters are not *absolutely* necessary to have a clean pond with clear, quality water. However, effective filters greatly assist in removing both solid and dissolved matter from pond water, especially in ponds with a heavy fish load or over 100 gallons. There are four filter types:

- Biological Filtration. Media within the filter provides large amounts of surface area where colonies of *beneficial* bacteria can reside. There are many choices for filter media which provide lots of surface areas and spaces through which water can easily flow. Some of the more common media include pea gravel, plastic strapping tape, shaved polyvinyl chloride (PVC), plastic hair curlers, bioballs, and lava rock. Matala® filter media is one of the newer products on the market. Some ponders are getting away from lava rock altogether because of its weight, when lifting to maintain; and, eventual wearing down of the porous rock surfaces. The "good" bacteria, such as Nitrosomonas and Nitrobacteria that live in filter media, breaks down toxins related to the nitrogen cycle caused by fish waste and other organic matter. There are a number of web sites that show you how (and not charge you) to make your own effective biofilter. If you need to clean out your biofilter, remember to wash the filter media in pond water (and, at that, *just rinse*), and never 100% squeaky clean, leaving some of the bacteria (good guys) to re-establish colonies! Commercial products are also available for "jump starting" a new pond biofilter or reintroducing beneficial bacteria into a biofilter when a pump has failed or been turned off for more than one hour.

- Mechanical Filtration. Traps particles, waste, and debris, such as leaves and dead plant material, in a skimmer net and/or filter material for later removal from pond. This type of filtration requires frequent cleaning.
- Chemical Filtration. Removes undesirable chemical substances like pesticides and heavy metals through activated carbon or absorptive resins.
- Ultraviolet Clarifiers (UVCs). Radiation kills algae cells and bacteria in the water –*as well as all beneficial microscopic organisms and defeats the purpose of the biofilter*! The dead organisms are then removed by mechanical filtration. UVCs come in submersible models.

Sizing filters is based on the volume of gallons in a pond, with the general rule being that a biofilter should be at least 30% of the pond volume and can easily be incorporated into your pond design by making the biofilter the upper tier of a multi tiered pond –for instance. For Southern Arizona, increasing the sizing requirement by 10%-35% above this general rule is also recommended to compensate for the desert's intense summer heat and sunlight.

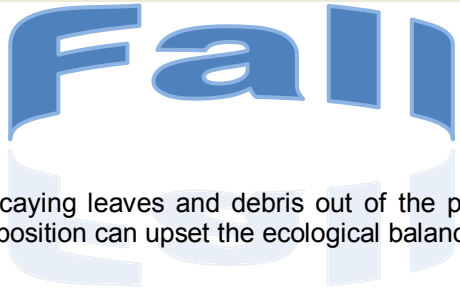
Maintaining high **water quality** is the *key* to a successful pond ecosystem. However, clear pond water doesn't always indicate healthy water, particularly in terms of fish survival. You may wish to do routine water testing which can alert you to your pond's balance of acidity or alkalinity. When you test your pond water, you will be looking at levels of pH, nitrites, nitrates, ammonia, and protein.

Remember that aquatic plants, particularly marginals and floaters, are extremely important to water filtration and water quality.

Seasonal Pond Maintenance Checklist

- Visually check to see if your pond is holding its water level.
- Look for any cracks in pump housing. If the filter media looks warn and dirty, replace it with new media.
- Test your water quality.
- Use a beneficial bacteria to jump start the biological cycle.
- Clean up dead plants and fallen leaves around the pond.
- Move plants that have been hibernating in the deeper parts of the pond closer to the pond surface for spring sun.
- Begin feeding fish with a low protein diet when the water temperature is consistently above 50°.
- Assess your mix of aquatic plants to achieve a balance of oxygenators, floaters, and marginals to help control algae.
- Begin fertilizing aquatic plants when the pond temperatures reach 55° -60°.
- Don't drain your pond completely to cure algae problems!

Seasonal Pond Maintenance Checklist



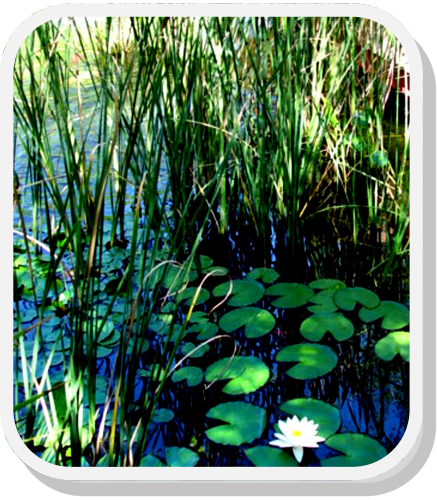
- Get decaying leaves and debris out of the pond, as their decomposition can upset the ecological balance.
- Keep skimmer baskets and filters clean. Remove excess bottom sludge if over 1".
- This is a good time for adding cold water beneficial bacteria.
- Brown and dying aquatic plant foliage should be removed as plants are going dormant.
- Stop fertilizing plants when the water temperature drops below 70°.
- Prune yellow waterlily pads within several inches of the crown, and drop tropical lilies into the deepest part of the pond.
- For your sensitive tropical plants, transfer them to a warmer place or even indoors.
- When water temperature drops below 60°, switch fish to lower protein food; below 50°, stop feeding.
- Do a 10% water change to last through the winter.

A healthy pH level is generally between 6.5 and 7.5, with 7.0 (neutral) being ideal. Water under pH 6.5 is acidic; water above pH 7.5 is alkaline. Having said that, fish and most pond plants can tolerate quite high pH levels –even above 7.5. If you feel you need to test pH levels, it is best to do it in the morning before plants become active and the pH levels go up. Any reputable pond store will have a selection of pH increasers and pH decreasers. Also, when tap water is added to a pond, commercial water conditioners with ammonia chloramines/chlorine removers should be used. These removers should be put in the water first, via bucket, the biofilter, or waterfall.

Rule of Thumb: *During the growing season, a 10% monthly water change is highly advisable. This means that 10% of the existing pond water will be drained (great for watering terrestrial plants) and 10% new, fresh water will be added to the pond. This process rids the water of mineral/biological/bacterial overloads. Note that natural evaporation does not equate to "water changes", as minerals, salts, etc. do not evaporate, but just become more concentrated in the water.*

Pond Mucking

When a pond is built, it immediately begins to age. For every pond owner, that means maintenance. It's just a fact of pond ownership! An important part of maintenance is keeping as much debris as possible from settling into the bottom of your pond. Organic plant and animal debris will decompose, forming deadly ammonia and nitrates that are toxic to aquatic animal life. A lot of debris is created as aquatic plants go through their growth and bloom cycles in the summer. Tree leaf debris in a pond is particularly challenging.

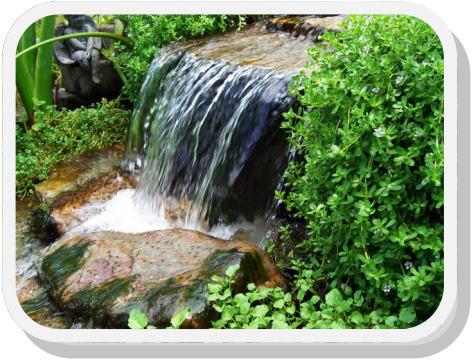


If an inch or more of muck has accumulated, one of the handiest tools to accomplish getting loose debris out of the pond is the pond vacuum. If you have ever used a shop vac or a wet/dry vacuum on your carpets, the pond vacuum operation is very similar. A motor creates suction in the vacuum which draws water from the bottom or sides of the pond, this is then passed through a chamber, with the water released back into the pond, but the debris held in a muslin type bag. The better pond vacuums have an automatic shut off switch, that will turn off the vacuum when the tank is full, and then drain itself before restarting.

Depending on features, pond vacuums can range in price from around $50 to $500, or higher. Features can include such things as two canisters, a variety of nozzles, a telescopic handle, and being fully submersible. The cheapest units attach to a garden hose, but are not powerful enough to cope with large or deep ponds. Most of the quality vacuums come with at least a two year warranty. And what to do with the collected pond muck? It makes an excellent garden mulch and yet becomes another good reason for investing in a pond vacuum!

As a word of caution, when you vacuum out your pond you inadvertently will catch larvae, snails, and other small pond critters. Vacuuming will destroy a lot of the beneficial small and invertebrate critters that inhabit a pond. Be sure that you really have a "mucking" problem before the decision is made to vacuum.

Aquatic Plants: A Palette of Choices



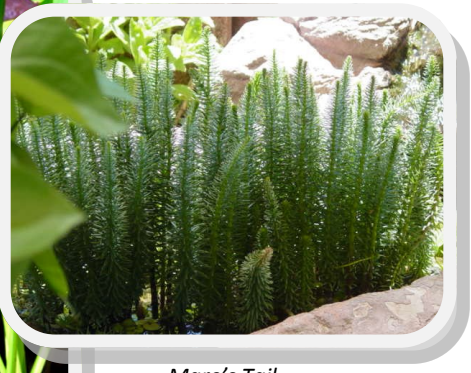
A well-designed water garden blends deep water plants, submerged oxygenators, marginals and surface floaters together in a unified palette to accomplish goals of **visual delight**, natural water **chemistry balance** and **algae control**, as well as any desired fish and wildlife **habitats**.

This portion of the Guide is arranged as follows:

- Waterlilies and Lotus – Deep water grandeur!
- Marginal Aquatic Plants – A wide and varied world!
- Floating Plants
- Oxygenators
- Basic Water Plant Propagation
- Bog Gardens
- Algae & Pest Control

Rule of Thumb: *The best way to keep water clear and to guard against algae growth is to have 60%-75% of the water surface shaded. This shading could come from aquatic plant materials covering the water's surface, adjacent terrestrial plant life, shrubs, trees, etc. shading the water garden –or a combination of both.*

Pickerel Rush



Mare's Tail

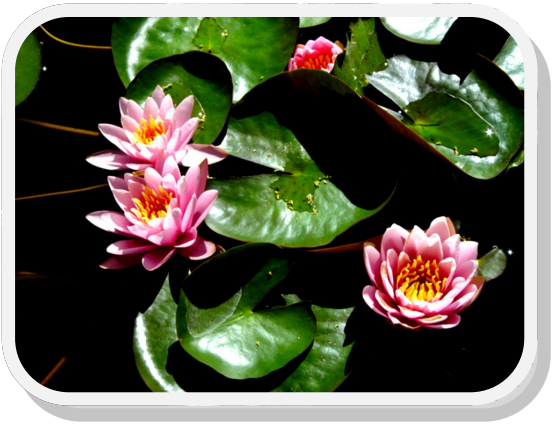
Rule of Thumb: *For visual balance of your plantscape, use the formula of one-to-three --one third of the space contrasted with the other two-thirds. For example, areas of vertical aquatic plants (such as Taros and Pickerel Rush) should be contrasted with horizontal aquatic plants (such as Waterlilies, "floaters", or free-floating water plants). Group plants in odd numbers.*

Waterlilies & Lotus: Deep Water Grandeur

Considered the "royalty" of most water gardens because of their spectacular blooms and waxy, surface-floating leaves, there are **two types of waterlilies** (family Nymphaea) to choose from. Both types of waterlilies do well in Southern Arizona, but the tropicals need more safeguarding during our desert winters, which can reach below freezing temperatures. With much care, **Lotus** can also be grown in our desert environment. —-but tend to only last a couple of seasons under the best of circumstances.

Hardy Waterlilies

This major class of water plants is grown in wide, shallow pots in water 2'-5' deep. Its rhizomes travel across a pot quickly, so planting needs to be at the extreme side of a pot, allowing room for the rhizome to "travel." Dormant in the winter, these lilies bloom from late spring to late fall. Flowers last for 3-4 days and come in every color, except blues and purples. Both the flowers and leaves float on the surface, and like to be in still water (away from waterfalls, bubblers/spitters). As their name implies, hardy waterlilies are tougher than their tropical counterparts. To give additional protection in winter, drop lily pots to the lowest part of a pond, and, in spring, raise on blocks to encourage new leaf growth, before gradually lowering to proper depth.



Tropical Waterlilies

The color range of tropical waterlily blooms includes a wider spectrum than its hardy water lily counterpart, and does include vibrant blues, purples, as well as exotic night bloomers. The tropical lily flowers are generally held on long stems above the water, and the leaves are often more decorative than the hardies, with coloration, ruffled, or zigzagged edges. Tropicals grow from a tuber and should be placed in the center of a pot; some tropical are viviparious (shootlets that form from the "mother" leaf). Tropicals also like calm water. These are tender plants that are sometimes difficult to over winter, so dropping to the deepest parts of a protected pond, relocating away from the pond to a warmer area, or investing in Thermo planters are advisable steps for wintering tropical waterlilies.

Lotus

An aquatic plant with its large, peony-like blossoms and circular leaves (family Nelumbonaceae), the lotus can be grown in Southern Arizona with a lot of tender loving care! It's for the experienced water gardener. You don't even need a pond, as lotus can be grown in a large container – at least 24" deep, without holes so that there is enough depth for 14" of growing medium and 6" of water above that medium. Lotus generally do not last more than a couple of seasons in our dry desert environment.

Hardy Waterlilies—A Representative List

Apricot to Pink Shades
Berit Strawn
Colorado
Georgia Peach
Joanne Pring (pygmy)
Masaniello
Perry's Fire Opal
Pink Beauty, aka Fabiola Luciana
Pink Opal
Pink Sparkle
Solfatare

Colorado

White
Hal Miller
Hermine
Walter Pagel

Yellow
Chromatella
Helvola (pygmy)
Sulphurea

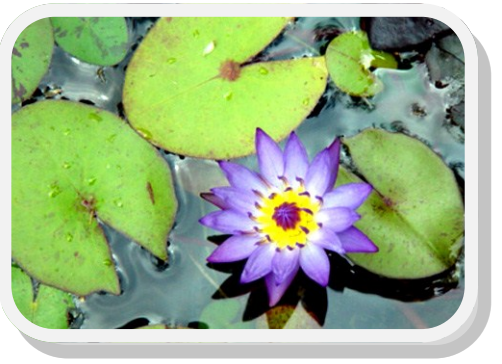
Red-Rose Shades
Attraction
Ellisiana
*Escarboucle, aka Aflame
*Froebeli
*Fulgens
*James Brydon
Little Champion
Lucinda
*Perry's Baby Red (pygmy)
*Perry's Black Opal
Perry's Dwarf Red
*Perry's Red Wonder
*Rembrandt
*Splendida
William Falconer

Sunset/Changeable
Comanche
Chrysantha, aka Graziella
Indiana
Paul Hariot

Note: Some red waterlily blossoms will burn or sulk in the desert's intense summer sun and heat. Those with an asterisk do well.

Tropical Waterlilies—A Representative List

Blue-Violet
August Koch
Bagdad
Bluebird
Charles Thomas
Colorata
Daubeniana, aka Dauben
Director George T. Moore
King of Siam
Lindsey Woods
Margaret Mary
Mrs. Martin E. Randig
Panama Pacific
Paul Stetson
Royal Purple (pygmy)
Tina



Panama Pacific

Pink to Peach
Albert Greenberg
Edward D. Uber
Patricia (pygmy)
Peach Glow
Queen of Siam
Texas Shell Pink (night bloomer)

Red

Red Flare (night bloomer)

White

Isabella Pring

Wood's White Knight (night bloomer)

Yellow

St. Louis Gold

Note: The International Waterlily Collection

http://www.internationalwaterlilycollection.com/index.html

is an excellent resource to identify and browse waterlily photos.

Marginal Aquatic Plants

Spider Lily

Louisiana Iris

Water Clover

Marginals are a wide and varied world. This category of aquatic plants are also referred to as "bog plants," and can be defined as aquatic plants that grow in shallow water or saturated soil commonly found along a pond's edge, wetlands, or streams. They usually thrive best in 1"-8" of water. Marginals add height, texture, and wildlife habitats to the water garden, in addition to interesting foliage and a variety of exotic-looking blossoms. *Many of the aquatic marginals are also excellent water filtration plants!*

Just as with the waterlilies, marginals can be divided into **Hardy Marginals** and **Tropical Marginals**. As their name implies, the hardy marginals can endure more cold and come back in the spring. These are the perennials of the marginal plant world. **Tropical marginal** plants are those that originally grew in sub-tropical or tropical regions and are not perennial in cooler climates or where cold and frost are common. However, for the desert

water gardener, *most* of the tropical marginals do return in the spring —depending on the severity of the desert winter! As an extra precaution, tropical marginal pots can be removed from their pond environment and stored in a warmer location.

Rule of Thumb: *Planting depth of marginals is always figured from the crown of the plant to the surface of the water. The crown is the portion of the plant where the roots and stem divide.*

Elephant Ear

A recommended reference book for aquatic plants is the Encyclopedia of Water Garden Plants by Greg Speichert & Sue Speichert, ©2004.

Hardy Marginals

*Aquatic Mint
*Arrowheads
Chameleon Plant
*Cardinal Flower
Cattails (Dwarf and Giant)
Corkscrew Rush
Flag Iris
Horsetail Rush
Lizard's Tail
Louisiana Iris
Marsh Marigold
*Mexican Petunia (Ruellia)
Obedient Plant
* & **Pickerel Rush
**Soft-Stemmed Bulrush
Sweetflag Water Grass
Water Celery
Water Nasturtium (Watercress)
**Water Parsley (Variegated)
Water Pennywort
Water-Plantain
Water Shamrock
Yellow Floating Heart
Yerba Mansa
Zebra Rush

Tropical Marginals

Bog Lily
Four Leaf Water Clover
Papyrus (Giant, Dwarf, Miniature)
Sensitive Plant
Spider Lily
**Taro (Elephant Ear)
Umbrella Grass
Variegated Shell Ginger
Water Canna (including Longwood hybrids)
Water Hawthorn
*Water Hibiscus
Water Poppy
*Water Snowball
White Butterfly Ginger Lily
Zephyr (Rain) Lily

SPECIAL PROPERTIES

Plants with a single asterisk are terrific for attracting butterflies.

Plants with a double asterisk are excellent water filtering plants.

Floating Plants

Floating plants grow, just as their name suggests, with their root systems freely hanging down in the water. They grow on the water's surface. Floating plants are also a good way to quickly shade water surface for algae control as they multiply rapidly. *These "floaters" are excellent at absorbing nutrients in the water and helping to prevent algae build -up.* They also provide habitats for aquatic life. Most of the floating plants are not frost or cold tolerant, and will die off at the end of the growing season. Some of the more familiar floating plants include: **Azolla**, **Duckweed**, **Frog Bit**, **Water Lettuce**, and **Mosaic Plant**.

If your free floating water plants, particularly Water Lettuce, are turning yellow, it may be that your pond is too clean and they are not getting enough nutrients to survive. Another possibility is that the pond's pH level is too high. A possible solution is to put the plants in a bucket of water with a weak solution of dissolved fertilizer for a day or so. When they perk up, wash the roots well before returning them to the pond. Floating plants do not like the salt you may have added to your pond to benefit your fish! They will not survive in a pond that has been treated with salt to benefit the fish.

Word Of Caution

Floating plants can be extremely prolific, and states label particular aquatic plants as "*invasive*" or "noxious." For example, Arizona has labeled the Water Hyacinth (Eichornia crassipes) —an excellent filtration plant, as "invasive." This means that the identified plant is prohibited from entering the state, cannot be transported, and, if found, can be confiscated, quarantined, or destroyed by a representative of the Arizona Department of Agriculture. Monetary fines may also be involved. When in doubt, always check your state's invasive plant list, or, one of the national invasive aquatic plant lists.

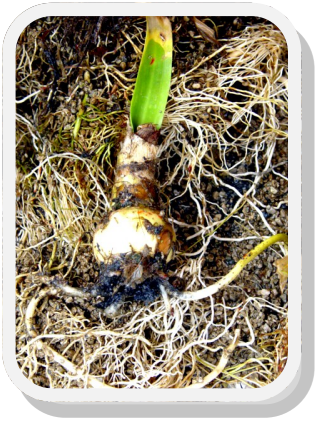
Rule of Thumb: *If you use a chemical to treat algae, you are most likely harming your plants as well. Since algae are a plant and certain chemicals that kill algae are broad-spectrum herbicides –you will likely kill ALL of your plants.*

Oxygenators

Often overlooked, oxygenators are typically completely submerged and not readily visible to the eye at first glance. However, oxygenators have a very important role to play in a well balanced water garden. They absorb the same nutrients that are needed by algae, and thereby can help reduce pond algae. Oxygenators also provide protection and coverage for small aquatic pond life. Some of the more common oxygenators found in Southern Arizona water gardens include **Parrot's Feather** and **American Waterweed** (Anacharis—Elodea canadensis). Do not confuse Anacharis with its extremely invasive counterpart—Hydrilla vertricillata, which is on many noxious and prohibited plant lists across the United States, including Arizona.

Oxygenators can simply be tied together and weighted down in the bottom of a pond, or even grown in a mesh bag.

Basic Water Plant Propagation



Spider Lily Bulb & Roots

While roots aren't the most attractive part of an aquatic plant, they are essential to plant propagation! Roots act as a plant's support, also drawing minerals from the water and surrounding soil, and, sometimes, storing food. Corms, rhizomes, and tubers are also part of a root system, and either bear buds from which new plant shoots arise, or, serve as food storing underground stems.

Just as with their terrestrial counterparts, spring is the time to think about dividing, trimming, repotting, and propagating aquatic plants. Water plants can get quite root bound, if left too many years untouched in your pond. It's good to check your pond plants out every couple of years to see what needs attention. *Not every plant needs attention and repotting every year.* In many cases, aquatic plants can jump their pot —if ignored over a long period of time, and, begin to burrow into pond vinyl and concrete liners —even through pond liners to create holes and leaks, in the worst case scenario.

Dragging overgrown pots out of the pond is the first challenge. There is no "right" way; steps leading down into a pond can help with this task. Because you are working with aquatic plants, buckets with water should be available. *Keeping the roots moist through the planting process is essential.* Try to work away from direct sunlight. A plastic canvas or old shower curtain is a good backdrop to confining the messy dividing and repotting processes. A wheelbarrow can also serve that purpose.

Tackling aquatic plant roots can be very challenging. Tools are needed that will do the job efficiently. While scissors, pruning shears and spades are helpful, sometimes the power of electric tools, such as a Sawzall, are the only way to penetrate large clumps of root bound plants, like those in the sedge and cattail families.

By all means, also have a garden hose available, as carefully washing away soil from the roots makes it easier to see where the cutting or dividing should be directed. Your aquatic soil mixture and fertilizer, as well as the prepared planting containers, should already be prepared and ready to receive the cuttings or transplants.

There are several options for water plant containers. Planters specifically made for water gardening can be rigid, black plastic, wire mesh, or fabric pond pots. Regular black nursery pots can also be recycled for aquatic plant. The larger black nursery pots may need to be cut down somewhat. Fiberglass screen material, or leftover scraps of vinyl pond liner, can be used to line a mesh pot, or to cover the holes in a regular nursery pot. This prevents the medium from spilling out into the water. Instead of screen material, coffee filters can also be used, or even several layers of newspaper. These products will eventually disintegrate, but, by then, roots will keep the planting medium in the pot. For marginals that easily spread and prefer to be shallowly planted (such as Iris), a black plastic concrete mixing trough, or, discount store dish pans work fine (for waterlilies as well). For aquatic plants that spread quickly, it is not advisable to plant directly in rocks or soil at the bottom of your pond. That's asking for eventual trouble — and even holes in your pond liner. It's best to "confine" aquatic plants —waterlilies and marginals, in some type of container that can be lifted out of the water.

Aquatic Soils and Fertilizers

For as many watergardeners as exist in the Tucson area, so do the theories of what makes a good aquatic soil. What is generally agreed on is that the "soil" should be *very lean in nutrients* in terms of potting medium for water plants –in other words, not rich in organic matter. Do not use amended soil or potting soils, as particles from this type soil will float. The leaching of a rich soil mixture into pond water creates excess nutrients that can lead to water quality and algae problems.

Desert "sandy" soil mixtures or heavy garden soil can be used. Soils specifically blended for aquatic plants can also be purchased commercially. Another favorite medium for southern Arizona water gardeners is inexpensive unimproved, unscented kitty litter. Read the *ENTIRE* ingredient label to be sure it only contains clay. It is easy to store kitty litter in a 5-gallon bucket with a lid to keep it dry. Besides the convenience of having a readily available source of planting media on hand, kitty litter is very easy to work with. It moistens quickly and evenly, whereas dirt does not. It also retains its granular shape, making it much easier to unpot plants –and can be rinsed and reused. The downside of kitty litter as an aquatic plant medium, is that it is nutrient poor —and plant fertilizer becomes a must. Many professional waterlily growers do not recommend kitty litter for planting; it is, however, successfully used for planting aquatic marginals.

Begin to fill the lined pot with your planting medium, being careful not to collapse the screen or other lining material. Moisten the medium, add a bit more, and repeat until about 2" from the top of the container. The planting medium should be thoroughly moistened before moving on to the next steps.

Once the container is filled to within 2" of the top and completely moistened, now is the time to add fertilizer and set the water plant. Successfully blooming waterlilies generally take an aquatic fertilizer to ensure heavy bloom cycles. Many water gardeners prefer to use at least two aquatic fertilizer tabs in each waterlily pot, refreshing tabs about every three weeks during the growing and blooming cycle. Six-month aquatic fertilizer stakes or slow release granules are an alternative in assuring adequate fertilization throughout the summer blooming season and require less attention after initially placed in the planting medium. For already potted plants that need a seasonal fertilizer boost, the fertilizer tabs or spikes can be poked into the soil along side the plant with a tool, such as a screwdriver.

Aquatic fertilizer tabs or spikes are also used for marginal planting. Another alternative is a time-release granular fertilizer, such as Osmocote™; blend it *thoroughly* into the planting medium so that it is not exposed to the water at the surface of the pot (to prevent feeding algae). The advantage of time-release fertilizer is that it will last during a whole growing season.

In selecting fertilizer, pay careful attention to the series of three numbers, such as 8-24-8, 10-26-1. This series of numbers signifies the macro-nutrients required for plants. The numbers will always be in the same order, and stand for: N (left number) Nitrogen; P (middle number) Phosphate; and K (right number) Potash. *Aquatic plant fertilizers usually have a much higher middle number to support the heavy seasonal blooms.* Yellow leaves, infrequent blooms or slow growth in aquatic plants usually indicates inadequate fertilization.

Once the fertilizer and plant has been situated, firm down the medium, adding more if needed. Then add about 2" of washed pea gravel or decorative rock on top of the soil, pushing the rock

down slightly into the soil. Some gardeners like to use 1" rock if their fish tend to remove smaller pea gravel and spread it around the bottom of their pond. Moisten thoroughly again. The water draining out of the pot will be "chalky" from the planting medium, but when placed in your pond will quickly settle.

When placing a potted plant into a pond, tip the container slightly so that the pond water gently begins to fill the pot. If you submerge the pot "on the level" of the water surface, the pond water will "whoosh" over the top of the pot and disturb the soil much more.

Newly planted water plants with few leaves and short stems can be placed on top of bricks or another inverted pot to raise it closer to the water surface and sun. Once the leaves have grown and the stems elongated a bit, lower the pot either in graduated steps over several days, or all the way to the appropriate level.

Ideas for plant stands to hold aquatic plants at their right water level include excess concrete blocks, bricks, PVC pipe formed into a pot stand (terrific for waterlily pots in ponds deeper than 3'), and even "plant tables" made out of plywood covered with heavy black plastic or leftover liner material adhered with silicone aquarium sealer, then propped up on blocks or upturned sturdy black nursery pots. "Rough" textures, such as concrete blocks, can also be wrapped in excess pond-quality vinyl liner to assure that the stand does not puncture through the pond liner when it is set in place. Concrete blocks can also be painted with black exterior latex paint to camouflage them.

Thinning and Dividing Aquatic Plants

Don't let plants dry out during the dividing process!

Spring is the optimum time for this task!

Separating Runners and Plantlets. In the spring, after the last frost (mid March), remove vigorous plantlets from the parent plant by either snapping them off from the perimeter of the parent or by cutting the connecting stem of the plantlet. Pot up the plantlet, or, immediately put the plantlet into water, as roots will form later.

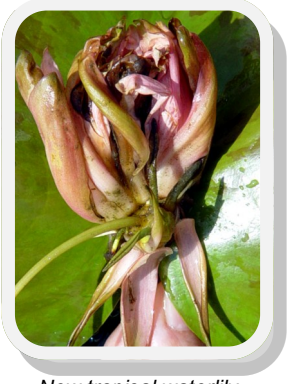
Rhizomatous Plants (such as Water Iris, other than Hardy waterlilies). Lift plant and rinse soil off roots. Cut rhizomes with a sharp knife, leaving some root on each. Trim top growth back to 3"-4" and trim roots so they can be put in containers with enough room to "run." Replant in fresh planting medium and top with rocks. Put in pond to a level so the top growth is just above the water

Fibrous Rooted Plants (such as sedges and grasses). Pull out of pot. A pot may have to be broken or cut to remove densely rooted, overgrown plants. Separate by hand or use an electrical tool to cut the root mat. A power Sawzall type tool or a Japanese pruning saw can be very helpful to cut through really thick root mats, which you can hack away with

abandon. *Note: You really don't have to be "gentle" when dividing most water plants – hack off roots, rip them apart, stomp on them to get them out of pots. They are VERY vigorous plants!* Replant each divided section into a pot and place back in water.

Bulb or Corm Plants (such as bog lilies). Pull out of pot. Carefully pull bulbs or corms apart by hand, and then replant individually.

Submerged and Free-Floating Plants (such as Parrot's Feather or Water Lettuce). Pull surplus stems from water by hand or rake. Free floating plants often put off attached baby plants which can simply be snapped off and moved elsewhere. Excess cuttings or plants can always be directed to the compost pile!



New tropical waterlily viviparous plantlet emerging from spent bloom.

Waterlilies. Mature waterlilies actually prefer to be somewhat crowded in their container. However, if your water lily has grown to the side of the container or has actually grown over the side of the container with roots dangling, then, it's time to move up the size of your container *or* divide the tuber.

Carefully remove the waterlily from its pot. The less you disturb the root mass, the more quickly your lily will reestablish itself in the new container. Trim way all damaged

and dead leaves. Use a knife to cut away any soft or rotted portions of the tuber. Sections of the tuber with no active growth can also be trimmed off. Place the waterlily in its new, larger container. Use wide, shallow water plant containers with no holes, or round or square tubs you can find in the hardware store/dollar store. If the new pot is deeper, add potting soil under the lily to raise it to its original planting level. Continue filling in around the lily, taking care not to bury the growing tip. Don't forget to fertilizer these heavy bloomers.

Propagation of the "Eyes." Carefully remove the lily from its pot. Wash away the potting soil from the tuber so that you can see it clearly. Some waterlilies produce small, protruding bulbs or "eyes" with active growing tips along the body of the tuber. If your lily has developed eyes, these can be pulled or cut off and placed in small, no-hole pots or trays to grow and develop. They need adequate light and warmth, so a warm area is the best place to grow the eyes until they are large enough to transplant as tubers. Otherwise, leave these eyes attached to the tuber to mature naturally and divide the main tuber.

Division of the Tuber. Large waterlily tubers with multiple growing tips can be divided into sections. Each section must have both a strong growing tip and slender, dark feeding roots. Some species can stain your hands, so you may wish to wear gloves when handling the waterlily roots. Using a sharp knife, cut the tuber into sections. Remove the long white anchor roots from the new divisions, making a clean cut close to the tuber. Leave the smaller feeding roots intact. Trim away all large open leaves in the same manner. If left on, these leaves will make the newly planted tuber too buoyant. Leave attached the young

foliage which has not yet unfurled. Follow this procedure on each new section. Now you are ready to pot the divided tubers.

For hardy waterlilies the non-growing end of the rhizome should be placed against the *side* of the pot, as these rhizomes grow horizontally across the pot.

For tropical waterlily tubers, the tuber should be placed upright and in the *center* of the pot, keeping the planting medium and gravel away from the crown. It is helpful to tilt the tuber at a 45° angle, so that the growing tip is above the anticipated soil level and centered.

For viviparous (shootlets that form from the leaves) waterlilies, leave the plantlet attached to the "mother" leaf until roots and small leaves begin to appear. Then the plantlet can be transferred to a planting medium to continue its development.

Be careful not to bury the tender growing tips in the planting medium!

Newly planted water lilies can be elevated with blocks —just under the pond surface water — 6" - 10" of water over the crown, until weather warms and leaves are elongated. Then, as the foliage develops, the waterlily can be lowered to at least 18" below the water surface. Flowering will depend on the amount of sunlight and warmth received. In successive seasons, blooms will become larger and more plentiful.

Rule of Thumb: *Aquatic plants do <u>not</u> have to be repotted every year. Do a visual check for crowding, root mats, and rhizomes curling over the top of a pot, as examples.*

Bog Gardens

In our environment, bog gardens have the advantage of being able to grow interesting aquatic *marginal* plants such as the Louisiana Iris, with very low maintenance and water requirements. There are no pumps; fish to bother the plants; or, algae build-up to worry about!

Bog gardens can be situated in either full sun or filtered light environments, and can either be a direct extension of a water garden or done independently. *The important thing is that the soil never be allowed to dry out, once the bog garden is established.*

Bog gardens should be planned 18”-24” in depth to accommodate root systems of mature plants. Bog gardens linked to a pond should be no more than 10-15% of the total surface area of the pond. Pond liner can either be extended from the pond, up above ground level and back under again, to line a bowl-shaped bog garden; or, a hole dug by the pond’s edge done with a separate liner can also be used. An independent bog garden is also done with vinyl liner, but it does not have to be “pond-quality” liner, as there is no aquatic life to safeguard. Several types of irrigation are possible, including a rigid, perforated pipe to allow water seepage. Drip irrigation poly-tubing on the bog’s surface is another alternative, as well as use of a soaker hose.

Cover the bottom of the lined excavation with a 4” layer or gravel, and, unlike potting water plants, use a heavy, clay soil or amended soil with some organic matter. Some recipes for bog soil combine peat moss, compost or a small amount of cow manure, and heavy black dirt. Others say compost and heavy soil. Tamp the soil as you go. It doesn’t hurt to mix a time release fertilizer into the bog soil. Now you are ready to plant those marginals. Plant plants in dry soil. Then, gently, but thoroughly, water the plants with a sprinkler or hose.

Algae and Pest Control

Algae are a fact of life for pond owners, particularly in the spring as a pond is coming to life. Because algae are plants, they love sunlight and nutrients –similar to your other aquatic plants. *The Rule of Thumb that 60%-70% of a pond's surface be covered or shaded by plant material is critical in the control of "bad" algae.*

Rule of Thumb: *Do not drain and refill your pond to eliminate an algae problem. If you do, you will just be starting all over with fresh nutrients to feed the algae, as well as stressing your fish, the other plants --not to mention your water bill and yourself.*

There are different types of algae:

Side Slime Algae. This covers the sides of your pond, pots, and rocks. This algae is a "good guy" as it provides 60% of the oxygen your pond needs. Do not scrape it all off! Besides, fish love to nibble on this and tend to keep it "mowed" short, and snails lay eggs in it, as do other pond creatures.

Pea Soup Algae. This is where your water appears green, and you can't see very far, if at all, down into your pond. There are flocculants (chemical products) to treat this situation, which essentially make the algae particles clump together and fall to the bottom of the pond. A shade cloth suspended over your pond will slow algae growth, but, is self-defeating, in that it will also slow growth of your other aquatic plants. Pond dye turns water deep blue or black, thereby depriving the algae (and all other plants) of needed sunlight to grow. Make sure that any chemicals you put in your pond specifically state that they "will not

harm fish, plants, or biofilters." *Do not use copper sulfate; it's toxic to fish and insects.* AlgaeFix®, or a similar product, is used frequently by ponders to reduce algae blooms —and is successfully used with both fish and plants.

Biofilters are also extremely helpful in controlling "pea soup" algae growth. A biofilter is a container filled with some type of medium like pea gravel, lava rock, and old plastic hair curlers – anything with a lot of surface area. Pond water is pumped through these medium, micro biotic bacteria colonies form in the medium and feed on and detoxify the "gunk" in the water, returning clean, clear, healthy water to your pond.

String or "Hair" Algae. This filamentous algae is very common in Southern Arizona, particularly in springtime and around waterfalls. It's a good idea to "twirl" string algae out of the pond as much as you can by using a bottle, vegetable or toilet brush, or rake. Many water gardeners swear by barley straw as a means of controlling string algae. Sweepings of barley straw can be obtained from a feed store and stuffed into a leg of an old nylon stocking; tied to close; then dropped with a rock for weighting into your pond. It is thought that barley straw lowers the pH of the water, which string algae does not like. The chemical reaction of barley straw usually takes six to eight weeks to begin controlling new string algae growth. Existing string algae still must be removed manually.

If algae have enveloped your waterfalls, 3% Hydrogen Peroxide can be used to help clean up the algae problem. Shut the waterfalls/water feature off and let it dry a few minutes. Fill a spray bottle with the 3% Hydrogen Peroxide and let is sit for a few more minutes. Then, scrub with a brush and you will find that the algae come off fairly easily. If desired, spray and scrub a second time. This small amount of peroxide should not hurt fish or plants –just don't spray it directly on them! There are also commercial algae removal products, some, specifically designed

for your waterfall.

Slime Algae. Although more frequently associated with aquariums, shallow ponds with high levels of dissolved wastes and nutrients in the water can develop "blue-green" algae that forms in sheets. Physical removal and frequent partial water changes are helpful in controlling this algae. Slime algae is deadly on aquatic plants —particularly the "floaters" —coating the plant's root system.

Rule of Thumb: *A pond filled for the first time in spring will often have a much larger algae bloom problem its first year than one filled for the first time in fall or winter. The colder weather and less intense sunlight allow the water to balance faster than in hot, sunny weather.*

In the Tucson area, the natural algae cycle cannot be cured completely through the creatures that are placed in a pond. There are a couple of tropical creatures that do eat algae, but cannot live when the water drops below about 65°. These include the Plecostomus "sucker fish" and Apple snails. If there is a way to relocate these creatures out of a desert winter pond , then there might be some rate of success at algae control during the warmer months.

Mosquito Control

As responsible water gardeners, we must all do our part to prevent attractive mosquito breeding grounds in the form of standing water, whether that water is in the form of a pond, pot saucers, watering cans, fountains, buckets, rain barrels, slow moving streams, birdbaths, swamp coolers, old tires –or anything else that will hold standing, stagnant water.

Here are some suggestions for mosquito control:

- Use Mosquito Dunks™ or Mosquito Bits in any water container. These larvicide "donuts" can be broken into bits or chunks for smaller applications, such as in a pot saucer. The bacteria that this product releases are not harmful to pond plants and other aquatic life, pets, or people. The Dunks should be replaced every 30 days.
- Stock ponds with fish that will eat mosquito larvae, and, aerate water so that it is moving and will not stagnate.
- Check for clogged gutters
- Check for leaky outdoor faucets.
- Use fluorescent lights vs. incandescent lights (which attract mosquitoes) both inside and out.
- Check that window and door screens are "bug tight".

As a water gardener, a lot of time is spent outdoors; and, in the back of our minds is the fact that West Nile Virus is present in Southern Arizona. It is advisable to wear protective clothing (long sleeves and pants), use insect repellant, avoid going out at dawn or dusk when mosquitoes are most active, and use citronella for working in small, defined areas.

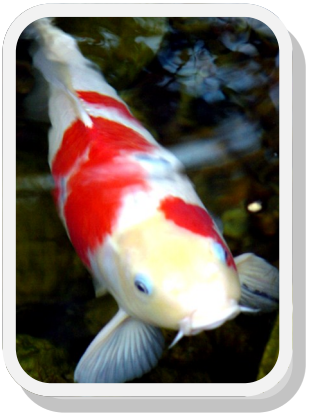
Aphids

Just as with indoor plants, aquatic plants can also experience aphid infestations. These insects, which come in green, pink, white, grey, or black color, are attracted to waterlily leaves, as well as marginals —particularly marginals with broad leaves, such as the taro plant. Because they can fly, aphids can quickly infest pond plants. Not only will there be a sticky "honeydew"

substance on the leaves and/or stems, but there will also be what appears as dots of pepper in these same areas. Severe infestations will eventually kill a plant.

When aphids are identified, there are several suggested methods of combating the infestation: forceful sprays of water from a garden hose; soap suds applied to the infected areas —be careful what kind of soap is used, as the soap residue can end up in your pond water; plant leaf removal; or, laying newspaper on top of the waterlily pads overnight. Whatever method is chosen, repetition is a *must* —until the aphid population is reduced or eliminated.

Fish and Other Pond-Loving Creatures



Koi

Because water is such a precious natural resource in our desert environment, ponds are both an opportunity to provide "homes" to a number of water-loving creatures, as well as being attractive as watering holes for passers-by.

Many watergardeners choose to add fish to their ponds. Here are some of the choices.

Dragonflies

Goldfish. The goldfish is one of the most commonly kept water garden fish. Selective breeding has produced a wide variety of color variations, as well as body shapes, fin and eye configurations. Avoid goldfish with short, fat bodies, as they are unable to compete well for food and swim from predators quickly enough. The hardy, vibrantly multicolored Shubunkins do well in desert water gardens. Goldfish can easily live off nutrients, insects, and algae in the pond –and generally leave aquatic plants alone.

Raccoons

Gambusia. These small fish, also known as topminnows or mosquito fish, are excellent for desert water gardens, as they feed on larval and pupal stages of mosquitoes. However, Gambusia is a *non-native* species, and cannot live in harmony with some of Arizona's native fish species. *Do not attempt to co-mingle species for mosquito control.*

Arizona Native Fish. According to recent studies, the Gila Topminnow appears to be as effective, if not more so, than the Gambusia as a mosquito control agent. However, because of the Gila Topminnow's habitat degradation and destruction, this tiny desert fish is on the Federal list of endangered species under the Endangered Species Act in 1967. At this point in time, a Safe Harbor Agreement (SHA) is required to hold the Gila Topminnow in a pond —and larger conservation habitats are what is being approved. The Longfin Dace is a hardy, silvery minnow native fish that is also used for mosquito control, but does require a Wildlife Holding License to place in a pond. *Consult the Arizona Game and Fish Department for specifics regarding acquiring and maintaining a native fish population.*

Rule of Thumb: *1" of fish for each 1 square foot of water surface. (Tough to adhere to!)*

Koi. Considered the "superstar" of ponds, koi are large carp with a long and distinguished history of being bred for its many varieties and fantastic color combinations. Adhering to the fish "Rule of Thumb" becomes important, as koi can live long lives and grow extremely large –as in 2 or more feet and 10 or more pounds! They need heavy filtration, as well as crystal clear and balanced water. Koi will also uproot aquatic plants. If maintaining koi is the primary interest, then a fish pond with heavier mechanical filtration may be in order –rather than a water garden.

Fish Feeding Guidelines. Fish don't necessarily have to be fed; but, it is fun to see them rush up to you when you feed them –and even train them to eat from your hand. However, if you train them to do this, remember that they don't really know YOU from Mr. Great Blue Heron, and will rush up to HIM as well and become HIS lunch.

Once pond water temperatures fall below 50° in late fall, stop feeding your fish, as their metabolism slows down considerably and continued feeding could result in digestive blocks. In the spring when pond water reaches above 50°, begin to slowly reintroduce small amounts of food that are vegetable or wheat based. Cheerios™ work well to bridge the transition into a more high protein diet, as pond water warms up.

Do not overfeed your fish population; overfeeding creates tremendous water quality issues —as well as affecting the health of your fish.

Aquarium salt can be added to a pond to benefit the slime coat of fish and for their protection from bacterial infections. However, be aware that floating plants do *not* do well in salted ponds.

In the desert, fish, surprisingly, have many predators, including raccoons, hawks, and Blue Heron. To protect fish, provide them with good hiding places, such as a sewer tile on its side; a flagstone shelf to hide under; large diameter black PVC piping, or even 15-gallon black nursery pots laid end-to-end with their bottoms cut out and the pots weighted down. Dense marginal plantings along the pond's edge also deter predators.

Tips For Adding Fish To Your Pond:

- Don't add too many at once.
- Let the temperature of the water in the holding bag equilibrate with the pond water temperature by allowing the bag (tied up) to float in the pond for while.
- Stop feeding the existing fish for a few days before you expect to introduce the new fish, and do not feed the fish at all for a few days after the new addition. Then, when restarting to feed, do this often, and use tiny quantities for each offering.
- If you're going to add expensive koi, then these new fish should be quarantined for about 2 weeks before introducing them into the pond with other fish.

Here are other pond-loving creatures:

Frogs. Arizona has seven species of native leopard frogs, and, with careful planning to create the right environment, frogs can be a part of your ponding experience. Be aware that Bull Frogs are a serious problem in Arizona, attacking and eating the native species. It is advisable not to harbor the Bull Frog.

Creating a frog-friendly environment begins with access to clean water and an area that they can roam outside the pond. A fenced or walled area that will keep the frogs in a contained area close to your pond or water feature is almost a must, as frogs tend to roam —especially during the summer monsoon season. Building a "riparian" area, with filtered light from trees and shrubs, is ideal —along with multiple containers outside the pond with water, where the frogs can easily hide. Be aware that one oleander in the yard can be the death of your frog population.

Being a good steward for frogs requires a fair amount of work and expense, including purchasing crickets, superworms, and earthworms for a growing frog population. It is advisable to consult with a ponder who has successfully built a frog-friendly environment.

Be vigilant around your summer ponds for presence of the carnivorous, semi-aquatic Sonoran Desert Toad. This toad secretes a poison through its warts and glands and can make a dog or cat seriously ill. It can also create a sizeable tadpole population in your pond area —something you don't want!

Aquatic Turtles. Aquatic turtles, such as the Red-eared Slider or Painted Turtles, can make an interesting addition to a pond, but must be added with some forethought. Part of these turtles' diets include fish and plants —including waterlilies! These turtles are very prolific, so make sure there is adequate pond and basking space for a growing collection. Sadly, and much too often, turtles outgrow their space, and are indiscriminately released in public ponds, causing overcrowding; or, along roadsides. Most don't survive release in our desert environment.

Water Insects & Other Critters. Desert ponds also draw a whole spectrum of insect life. This is a good thing! Many live their whole life cycle in or near the water; others need water to complete a critical phase of their development. Delightful to watch are critters such as Water Fleas (quickly moving specs on the water surface); Water Skaters (also known as Daddy long-legs); and, Whirligig Beetles (with their divided eyes that see both above and below water) —to name a few.

Some aquatic invertebrates live in the bottom parts of our ponds. Their presence is a very good indicator of the health of a pond. Aquatic plant decomposition by bacteria and fungi provides food for many of the aquatic invertebrates. These invertebrates, in turn, are used as food by fish and other wildlife species. To drain a pond —or to frequently muck it out, destroys so many important aspects of a pond's healthy ecosystem.

Recommended reference books :

A Guide to Common Freshwater Invertebrates of North America by J. Reese Voshell, Jr. - published by McDonald and Woodward

Field Guide to Freshwater Invertebrates of North America by James Thorp and D. Christopher Rogers—published by Academic Press

Dragonflies & Damselflies. One of the great pleasures of water gardening is to create habitats that attract these fascinating insects. A side benefit is that they consume a large amount of mosquitoes. Dragonflies are larger and more heavy-bodied. Damselflies are smaller and thinner, with wings folded vertically. Water is important for laying their eggs; and, larvae "nymphs" can spend from months to years crawling around the bottom of a pond! In the larvae stage, these nymphs feed on aquatic insects, worms, tadpoles, and even tiny fish. Marginal plants, such as reeds and grasses, perform a critical function, as the aquatic nymphs crawl up the stalks to emerge into the air and into adulthood.

Recommended reference book :

Dragonflies & Damselflies of the Southwest by Robert A. Behrstock—published by Rio Nuevo Publishers

A pond environment in the desert attracts many other water-loving creatures, and, careful selection of aquatic plants – particularly marginals, will ensure a variety of visitors to your water garden. For example, butterflies are most attracted to marginal aquatic plants, such as the Water Snowball, Cardinal Flower, and Pickerel Rush.

Of course, streambeds and waterfalls also attract a wide variety of desert-dwelling birds, bees, reptiles, and mammals. Anything and everything can show up at your pond, particularly if the pond is in open space —coyotes, raccoons, javelina, bobcats —*and more*!

A gardener's best tool is the knowledge

from previous seasons.

And it can be recorded in a $2 notebook.

- Andy Tomolonis

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