Herp Water Quality

Water is an important part of your herp's life.

By Kevin Zippel

Do you covet Suriname toads but don't know enough about water quality to keep them properly? Have you added ornamental fish to your turtle tank only to find them belly-up? Maybe you're just tired of the foul odor and daily water changes required for your turtle tank. If you're looking for a better way, then you need a crash course in the maintenance of water quality.

Reptiles have thick, impermeable skin and can tolerate poor water conditions better than fish and amphibians. Consequently, most reptile keepers wait until the water is visibly fouled before changing it. Amphibians, on the other hand, have thin, permeable skin, similar to the gills of fish, through which they absorb water and oxygen. Their thin skin also readily absorbs toxins, so water purity is very important. Reptiles also fare better when kept in immaculate water.

This article is intended to provide enough basic knowledge about water quality and filtration equipment to set up and maintain functional and attractive aquatic vivaria.

Water Source
Water quality begins with the water you put into your tank. There are many possible sources for tank water.

Tap Water
Depending on where you live, tap water might be an appropriate source. You will need to buy kits to test levels of pH and hardness, to ensure your tap water is within acceptable limits.

The number of hydrogen ions (free protons) in your water is measured by the pH on a scale from 0 to 14. The lower the pH, the more acidic the water, the higher the pH, the more basic. A pH of 7 is considered neutral, and most amphibians prosper at pH 6.5 to 7.0. The pH can be lowered by adding peat or sphagnum moss to your filter or tank (preferably in a filter bag), and raised by adding small amounts of baking soda (sodium bicarbonate). Commercial pH buffers can be high in phosphates and cause algae blooms. Always change the pH in small increments in a tank with living animals.

Hardness is a measure of the amount of minerals dissolved in the water, primarily calcium and magnesium. Many amphibians prefer soft water; however, it is always best to consider the natural habitat of the species in question. Water can be hardened by adding calcium and magnesium salts: About one gram of mixed calcium chloride and magnesium sulfate (mixed 6:7 by weight) will raise 10 gallons of water by 1 degree general hardness (1 dGH) and provide an ideal calcium to magnesium ratio (3:1). Water can be softened by diluting with distilled, reverse osmosis or deionized water. Unlike pH, changes in hardness occur linearly, so cutting 6 dGH water by 50 percent gives 3 dGH. Changing water hardness can also affect pH, and vice versa. Make changes slowly and test often. Beware when using household water softeners; they replace hard water minerals with salt, which can dehydrate your captives.

Be sure to add a chemical conditioner to your tap water to remove chlorine and chloramine, which are added to municipal water supplies to kill potential pathogens. Although added in small enough quantities that they are not harmful to mammals and reptiles, they can be toxic to fish and amphibians. Chlorine will dissipate from aerated water within 24 hours, but chloramines will not. They break down gradually to produce chlorine and ammonia, both of which can kill your animals. There are chemical conditioners on the market for treating tap water, or you can run your water through a carbon filter to remove these toxins.

Well Water
Well water can be an acceptable source, but again, be sure to test pH, hardness, and if you are near the coast, salinity. When I lived in Florida, my well water came out of the tap at 10 percent seawater. In some areas, especially where water is pumped up from limestone bedrock, tap and well water can be too hard and the pH too high.

For the sake of your animals and yourself, check to see that all the copper and lead plumbing in your building has been replaced with inert PVC to prevent these deadly metals from leaching into your water.

Rainwater
An alternate water source that I have had great success with is rainwater. Rainwater is naturally soft, but you will want to

test the pH, especially if you are near a city where pollution and acidification are problems. Also, be sure to consider how you collect the rain. It is not a good idea to collect rain from a galvanized metal roof or one that has been treated chemically. I have successfully used a large tarp tied to four posts and angled at one end to drain into a plastic 50-gallon drum.

Water that collects in natural basins, such as ponds, streams and lakes, can be a good source of acceptable water. Check where the water is coming from. Is it draining from a large parking lot covered with oil spills, or from a commercial farmer's field where it might have picked up fertilizers, herbicides or insecticides? Another thing to consider is that this water might be contaminated with diseases or parasites from wild animals. Alternatively, the "stuff" living in the water could make it better. I have raised batches of Suriname toadlets and various tadpoles on muck water from a small pool between a swamp and a private horse pasture. This water was teeming with invertebrate life and offered more diversity and nutrition than I could have ever cultured indoors.

Bottled Water
If your tap water is not acceptable and you aren't confident in an outdoor supply, bottled water might be the way to go. Again, you'll want to test the pH and hardness. Bottled spring water pumped up through bedrock can be unacceptably hard and basic. Furthermore, purity-testing requirements for bottled water are not as strict as are those for tap water. A recent survey by the Natural Resources Defense Council (NRDC) showed that one in three samples of bottled water contained contaminants, including synthetic and organic chemicals, bacteria, even arsenic.

In some cases, bottled "spring" water was shown to simply be bottled tap water. Check out the NRDC Web site (http://www.nrdc.org/) to see the results for your bottled water source.

Reverse Osmosis
The safest and most consistent way to ensure a constant supply of perfect water is to make your own. Reverse osmosis (RO) filters use high pressure to force water through a semipermeable membrane, leaving everything that was dissolved in the water behind. RO filters are now commonly available as affordable models that fit under your kitchen sink and produce modest amounts of purified water in a day.

RO water is absolutely pure, too pure in fact to be used as is. You must reconstitute the water by adding back a few beneficial trace elements, otherwise this ultrapure water will literally suck the ions right out of your animal! Commercial additives containing the trace elements are available, but I prefer to make my own. Test your reconstituted water for carbonate hardness and add baking soda to raise the carbonate hardness and stabilize pH. One teaspoon of baking soda will give 4 degrees carbonate hardness to 13 gallons, but will also raise the pH significantly. Allow the pH sometime to equilibrate, and adjust the dose to give the pH and pH stability you desire.

Use the reconstituted water to fill your tank and for water changes, but use only pure RO water to top off the tank when water evaporates. Evaporating water leaves its dissolved contents behind, concentrating the water in the tank. Adding pure water will bring it back to its original concentration, but adding reconstituted water will make it more concentrated with solutes (harder) with every top-off. RO filter membranes do eventually go bad, so test your water periodically or purchase a model with a built-in purity meter. Using a water softener and a carbon filter inline before your RO unit will extend the life of your filter's membrane.

Filtration
Now that you have a tank full of conditioned water, you must maintain the initial quality of that water. This is done with filtration, testing and regular water changes. There are three categories of water filtration you should be familiar with: mechanical, chemical and biological.

Mechanical Filtration
Mechanical filtration is the easiest to visualize. Mechanical filters pass water through a medium that traps suspended particulate matter, such as uneaten food, feces, shed skin, plant material and other detritus. Filter floss is a common mechanical medium, but sponges and other foams or pads are also sometimes used. Mechanical filters can sit in the tank, hang on the side or sit beside the tank. In-tank filters come in a variety of sizes, but they are generally small and require some minimum water depth. Most hang-on filters require that the water level be at or near the rim of the tank, making them impractical for most herp setups. Canister filters come in a variety of sizes with high flow rates and small-pore mechanical filter inserts that quickly polish large volumes of water. These filters are most appropriate for the average vivarium and can be outfitted to work with any water depth. Larger filters designed for pools employ sand or diatomaceous earth as a medium and are appropriate for large tanks with several hundred gallons or more. These media form dense beds that trap very fine particulate matter and leave the water passing through them crystal clear. Because they are so efficient at removing particles, they must be backwashed frequently to prevent them from becoming clogged.

Note that all mechanical filters only trap waste particles; they do not remove them from the water. Unless you change or clean your filter medium regularly (I recommend weekly), the filtered material will decompose in your filter and release toxins back into the circulating water.

Chemical Filtration
Many common toxins can be removed using chemical filtration. Chemical filters use media that chemically bind certain toxins and remove them from the circulating water.

One popular chemical medium is activated carbon, which removes a wide variety of organic toxins, chlorine, chloramine, pesticides, colors, odors and heavy metals. However, chemical media can become saturated with toxins, and if they are not changed regularly they will begin releasing those toxins back into the water. Unlike mechanical filters, you can't see when a chemical filter needs changing. I prefer to err on the side of caution and change mine every two to four weeks.

One of the most problematic toxins, ammonia, results from decomposition of uneaten food, feces and other detritus. Ammonia is colorless and odorless (at the concentrations we're considering) and unless you are specifically testing for it (which I highly recommend you do), it is impossible to detect. Many fish and aquatic amphibians excrete ammonia as their end product of protein digestion. Ammonia can be chemically filtered with media like Zeolite or Ammo-Chips, but these substances must be replaced regularly as there is no way to tell when they are saturated. Ammonia can also be kept in check with regular water changes. These might be required on a daily basis for tanks with heavy bioloads.

Biological Filtration
A more effective way to eliminate ammonia is to use biofiltration. Biofilters promote the growth of nitrifying bacteria, organisms that break down toxic ammonia into less toxic nitrite, and nitrite into less toxic nitrate. These bacteria are present everywhere; you need only provide a suitable environment for them to grow and allow them ample time (usually three to six weeks) to colonize your filter. You'll want to keep the bioload (number of animals) low at first and test for ammonia often while your biofilter is becoming established. Nitrite tends to cycle with ammonia, and testing only for the more toxic ammonia is generally sufficient. Nitrate, the end product of nitrification, can be broken down to nitrogen by certain existing anaerobic bacteria or it can be utilized by living plants. It can also be controlled through regular water changes.

Biofilters can use a number of different media to provide a large surface area for colonizing the beneficial bacteria.

Undergravel filters use a rising column of air bubbles to draw water down through the gravel bed, which has a large surface area. Unfortunately, the gravel bed also acts as a mechanical filter, trapping detritus that will decompose in the gravel and block continued water flow. The gravel must periodically be "vacuumed." Alternatively, one could pump water down the corner tubes and up through the gravel (reverse flow) to prevent such blockage. However, unless the gravel is the same depth throughout the tank, water will flow preferentially through the shallowest gravel--the path of least resistance--and only a small portion of the bed will be utilized as a biofilter. The sections of the bed with deep gravel receive very little flow and the water there becomes devoid of oxygen. Such "anoxic" water promotes the growth of anaerobic bacteria, which excrete toxins such as hydrogen sulfide (swamp gas). Sponge filters can also act as biofilters. A sponge has countless nooks and crannies and provides a large surface area for bacterial growth. Sponge filters are appropriate for smaller tanks with only a few animals. However, like the gravel bed, the sponge acts as a mechanical filter and can become clogged with detritus. It too must be cleaned periodically to remain effective. The trick is to rinse the sponge free of detritus without wiping out your bacterial colony. Usually, a couple of wringings under a warm stream of water will suffice. Remember to always keep the water level above the plastic air tube on your sponge filter or no water will flow through it.

For larger applications, you might want to use a trickle-type filter. These units consist of a housing container (from a 1-gallon canister to a 50-gallon drum, depending on your needs) filled with a biological medium. Water from the tank is pumped to a spray bar or dispersing plate at the top of the housing container, where it then percolates down through the medium and back into the tank. Huge bacterial colonies then develop on the moistened medium. There are many types of biological media--bio-beads, balls, stars, barrels, pads, etc.--but all simply provide a large surface area for bacterial growth.

The most effective filters specialize in one type of filtration or have a series of different components. For example, many canister filters allow you to add different media in separate compartments. Water will first pass over filter floss to remove visible particulate matter, then over activated carbon to remove chemical impurities. Finally, the clean water passes through the biological medium where ammonia is consumed.

One drawback of canister filters is the difficulty of accessing one medium without disturbing the others. I prefer to keep my chemical medium separate, usually in a small bubble-up corner filter. This way I can easily change it once or twice a month. I keep a little filter floss on top of the medium to act as a mechanical pre-filter to keep the medium from becoming plugged with debris. I use large canister filters for mechanical filtration, and sometimes to hold biological media as well. If the canister has a central compartment, I often put biological media here. Equally, one could put a chemical medium here. Around the central compartment, I pack filter floss as my mechanical medium. In this way, the filter floss can be changed as needed without disturbing the biological medium.

In some tanks, I add leaf litter or Java moss for aesthetic purposes and to provide a place for shy animals to hide. For these tanks, mechanical filtration is not so important; I actually want suspended particles in the water! To provide biofiltration alone, I use fluidized-bed filters. These compact filters utilize the same basic technology as an undergravel filter with several major improvements. A fluidized-bed filter is usually a clear plastic tube about 2 inches in diameter and 1 to 2 feet long that hangs on the outside of the tank. Inside this tube is a second tube with a 1Ú2-inch diameter. A small powerhead (with a sponge prefilter) pumps water from the tank to the top of the inner tube. Water passes down the inner tube and into the base of the outer tube, where it then rises up through a bed of sand, out a port at the top of the filter and back into the tank. The flow of water is just great enough to keep the sand suspended in the water column without blowing it out of the filter. This sand provides a huge surface area for bacterial growth, and because it is constantly suspended in the water (fluidized), there are no dead spots like with an undergravel filter. These filters are rapidly gaining in popularity and replacing the more conventional wet/dry trickle filters.

Try to think of your biofilter as a living entity, which it in fact is. You must provide the bacteria with a constant flow of warm, oxygenated water that contains low levels of ammonia and nitrite. It is a good idea to have an airstone or two in every tank to keep dissolved oxygen levels high; this is good for your animals, too! Also, be aware of the amount of time your biofilter is shut down during servicing. The longer it is down, the more bacteria die and the less effective your filter will be until it recovers. Do not clean your biofilter excessively, and do not use chemicals on it. I always keep a few extra biofilters going on tanks with heavy bioloads, so when I set up a new tank, I already have a living biofilter ready to transfer without having to wait three to six weeks before I can add many animals. This is vital for that impulse buy or the unexpected batch of tadpoles.

Another often-overlooked form of filtration comes with the addition of living plants. Plants help remove organic as well as inorganic waste from the water and are a great source of oxygen. Furthermore, plants greatly enhance the attractiveness of an aquarium and provide an oviposition site for many amphibians and fish. If the inhabitants of your tank are large or active and tear up rooted plants, try culturing the plants in a separate tank adjacent to your animal tank. Use the filters to pump water from one tank to the other.

High-Tech Toys

There are two other devices you might want to consider: UV sterilizers and ozone generators. UV sterilizers expose small amounts of tank water to intense ultraviolet light, thereby killing viruses, bacteria, fungi and algae. The light is entirely contained within the sterilizer, which sits outside the tank, and poses no threat to your captives. The key is that the water and micro-organisms must be exposed to the UV light for a significant amount of time. This is controlled by the water flow rate through the sterilizer. Each unit comes with its own recommended maximum flow rate; exceed this and your unit will be useless. UV sterilizers are usually put inline somewhere after the mechanical filter, as suspended particulates can block the light from hitting the target organisms. A split valve will allow you to direct a small portion of your filter's efflux into the sterilizer tube, and the majority of flow back into the tank.

Like all UV lights, these bulbs are relatively short-lived so you need to replace them periodically. Using your sterilizer for only a couple hours per day is effective and extends bulb life. The amount of time you need to run the sterilizer will depend on your tank size, sterilizer power and flow rate through the sterilizer. Your vendor should be able to help you with these calculations as they relate to your individual system.

Ozone is a chemical compound containing three oxygen ions. It chemically reacts with and destroys all organic molecules, pesticides, colors and micro-organisms in your tank. It provides complete water sterilization, but it can be a dangerous gas if not handled and vented correctly. Ozone generators force ozone into the water inline with the filtration system, and because ozone is a relatively unstable compound, it quickly reverts to molecular oxygen and will not harm your animals.

References

Mattison, C. 1992. The Care of Reptiles and Amphibians in Captivity (3rd ed.). Blandford: London.

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