From *http://dianawalstad.com*

Small Planted Tanks for Pet Shrimp

by Diana Walstad
(updated in October 2017)

Setting up a planted fish tank is littered with pitfalls. Newly purchased plants have to adapt to a new substrate, lighting source, and water conditions. Many will have to adapt to the submerged condition. Chances are some plant species will not survive. Algae may become a problem. Fish add another layer of complication. Too often newly purchased fish become diseased and the hobbyists may add injurious chemicals to the water.

Small bowls for shrimp are much less prone to problems and frustration. In this article, I describe two methods for setting up small planted tanks for pet shrimp. The Bowl Setup is quick and easy. The Dry Start Method (DSM) is more complicated, but it has some major advantages over the usual (submerged) startup.

It was only when I started keeping shrimp as pets that I saw the advantage of scaling down to bowls and tiny tanks. I wish I had done so earlier. The shrimp—Red Cherry Shrimp (or RCS)—are cute, inexpensive and low maintenance (**Fig 1**). They are perfect for small planted tanks and bowls—no heater, no filter, no special foods, and no fish diseases. Water changes are easy, because you're only working with one or two gallons.

Fig 1. Red Cherry Shrimp (*Neocaridina heteropoda*)
This adult female, which is about ¾" in length, is brightly colored. Adult males (about ½" in length) and all juveniles are cream-colored. RCS are less demanding than some of the other aquarium shrimp.

Small shrimp tanks are a great way to start out with aquarium plants. Beginners learn how to work with soil. They discover which plant species adapt best to their aquarium conditions before setting up a large tank.

Learning how to grow aquarium plants is worth the effort. Plants purify the water and substrate, thereby reducing tank maintenance (water changes, gravel vacuuming, etc).[1]

Bowl Setup Procedure

<u>Materials:</u>

- Round glass bowls of 1-gal size
- Soil- I used Miracle Gro's Organic Choice 'Potting Mix' (**Fig 2**)
- Sand- pool-filter sand or "play sand" from hardware stores
- Plants- I chose small plants that for me are reliable growers (**Fig 3**)

[1] My book *Ecology of the Planted Aquarium* explains how plants make aquarium keeping easier. For example, Chapter II ('Plants as Water Purifiers') discusses plant uptake of heavy metals, ammonia, and nitrite. Chapter IV ('Bacteria') discusses toxin processing by soil bacteria. Chapter VII ('Plant Nutrition and Ecology') documents the considerable uptake of toxic ammonia by aquatic plants.

- Water- I treated it with an aquarium water conditioner that neutralizes heavy metals. (Shrimp are quite sensitive to heavy metals, more so than fish. The 0.8 ppm zinc in my well water will kill shrimp.)
- Light- window light and a 10.5" Clamp Light with a screw-in 14 watt CFL (compact fluorescent light)
- Day length was 14 hr (hours) with a 3-4 hr afternoon Siesta of lower light beginning at noon.[2]
- Temperature- I set up the bowls in early summer when temperatures were ideal (72- 82°F range). (Temperatures below 65°F may hinder the growth of the more tropical plant species.)

Fig 2. Potting Mix

While any *unfertilized* potting soil will work, I have gotten good results using Miracle Gro's Organic Choice 'Potting Mix'. It contains well-composted organic matter and has a desirably low NPK ratio of 0.10, 0.05, 0.05. It has no chemical fertilizers (e.g., ammonium sulfate, ammonium nitrate, etc.) that will generate toxins like nitrite and hydrogen sulfide once submerged. It does not generate much turbidity, nor contain nuisance perlite pieces that float to the surface.

<u>Procedure:</u>

I first removed sticks and larger wood pieces from the bagged potting mix (**Fig 2**). Then I placed 2 cups of it into the bottom of the bowl such that the depth was no more than 1 inch. I then added about 1 cup water—enough to moisten the soil but not make it soupy—and put in the rooted plants.

I covered the soil and plant roots with sand. Gravel would also work, but sand is more suitable for a smaller setup; it is easier for shrimp to turn over sand grains than gravel, which to them would be like boulders, looking for food.

I used about a cup of sand, just enough sand to hold down the soil particles.[3] The delicate roots of smaller plants will be able to penetrate a thin layer of sand more easily than a thick layer of gravel. A thin covering will be less likely to inhibit oxygen exchange between the soil and the overlying water; if the soil becomes too anaerobic, it can damage or kill plant roots.

I added water carefully so as not to disturb the soil. I always use my hand (or some other object) to block the main force of the incoming water. Then I made minor adjustments such as pulling out leaves buried by the sand, adding more stem plants, and spooning more sand onto areas where the soil was escaping. The first water I added was a little cloudy and had some floating soil particles, so I just kept changing the water until it was clear. To complete the setup, I added a few snails and shrimp.

---

[2] Plants need a day length of at least 12 hr to mimic summer growing conditions. Shorter day lengths (i.e., 8-10 hr) may signal the onset of winter and thereby trigger slower plant growth [1]. A siesta regenerates CO_2 levels so that plants have some CO_2 for afternoon photosynthesis. It balances light and CO_2 for better plant growth.

[3] If the potting soil has dried out in the bag, it can be soaked in water overnight beforehand so that it doesn't float during the bowl setup.

Bowls have been without problems (**Figs 3 and 4**).

Fig 3. Newly Setup Shrimp Bowl
I used plants (surplus from other tanks) that I knew would do well. These are rosette and grass-like plants (*Sagittaria subulata, S. graminae, Echinodorus tenellus*, and *E. radicans* (dwarf). For stem plants, I included *Bacopa monnieri* and *Rotala rotundifolia*. I later threw in some *Ludwigia arcuata*, Java moss (*Vesicularia dubyana*) and *Riccia fluitans*.

Fig 4. Established Shrimp Bowls
Photo shows the two bowls at 7 months (Jan 2010). Plant growth was rapid from the beginning so that the bowls positively sailed through the startup period. *Bacopa monnieri* is blooming and growing emergent outside one bowl. I've had to do very little maintenance except minor plant pruning and water top-offs. The bowl on the right has a little mat alga that I pull off the substrate with tweezers.

DSM Setup Procedure

In 2009, I set up a couple tanks for shrimp with tiny, ground-covering "carpet plants" using the DSM (Dry Start Method) [2]. Startup involves growing plants emergent under terrarium-like conditions (**Fig 5**). Only after plants become established and multiply sufficiently (usually takes at least 6 weeks), did I submerge them.

The DSM has several major advantages over the usual setup method. Emergent-grown plants often grow 4-10 faster than plants grown submersed. Plants quickly develop an extensive root system. Because plants are not submerged, they don't have to compete with algae. Emergent-grown plants don't have to adapt to the submerged condition and grow all new leaves. Meanwhile, the soil will have gone through several weeks of decomposition (or "mineralization") before it is submerged; it will be more stable and less likely to release large quantities of algae-stimulating nutrients into the water.

For the DSM tanks, I worked with some of the obstacles that handicap beginners. That is, I started with purchased plants that were in their emergent form. In addition, I used either unfamiliar plant species or those that had not done well for me in the past in my larger fish tanks.

Because of the emergent startup, I was less cautious about the soil layer. For example, I mixed soil types, by combining a mineral soil (i.e., yard dirt) with an organic soil (i.e., potting soil). Under these conditions, the yard dirt would release its copious iron into the water and greatly stimulate algae. However, algae is not an issue for a DSM startup. Once I submerged the tank, I planned to include floating plants, which would need iron in the water, and ordinary mineral soils are full of it.

Fig 5. DSM (Dry Start Method) Tanks at Startup

I took this overhead photo of the two 2-gal tanks soon after setup. Plants are identified in the photo with red lettering and the following abbreviations: AN = *Anubias nana* (petite), HC = *Hemianthus callitrichoides*; EA = *Eleocharis acicularis*; and GE = *Glossostigma elatinoides*. Tank A is at the top.

Emergent plants actually grow better in a mineral soil than an organic soil [3]. However, I needed soil organic matter to provide CO_2 to the plants after submergence. (The decomposition of soil organic matter releases copious CO_2 into the water.) I also added fertilizers to the soil layer, which I would never do in my usual setups.[4]

Materials and Key Factors:

- Two-gal tanks
- Glass lids to keep in warmth and moisture
- Mineral soil (garden soil); I used the southeastern Piedmont clay topsoil from my property.
- Organic potting soil (i.e., Miracle Gro's Organic Choice 'Potting Mix' shown in Fig 2)
- Plant tabs containing *small* amounts of KNO_3, $NH_4H_2PO_4$, etc in a clay filler
- Sand- pool filter sand or "play sand" from a hardware store
- Water- tapwater treated with an aquarium water conditioner to neutralize heavy metals

[4] Once a terrestrial soil is submerged, inorganic chemical fertilizers not only stimulate algae but can cause major toxicity problems for plants and fish [4].

- Light- 10.5” Clamp Light with a 14 watt screw-in CFL. The clamp light rests directly on the glass lids of both tanks.
- Day length- During the emergent phase, I kept lights on continuously for 14 hr per day.[5] After submergence, I put tanks on the “Siesta Regimen” that I used for the bowls.
- Heaters (after submergence)- 7.5 watt Hydor Mini-heaters
- Air bubblers (after submergence) that released a single air bubble at a time to provide *gentle* water circulation without driving off precious CO_2
- Plants- Most were “carpet plants” such as *Anubias nana* (petite); *Hemianthus callitrichoides*; Dwarf Hairgrass *(Eleocharis acicularis*); *Glossostigma elatinoides*; and Four Leaf Clover (*Marsilea quadrifolia*). I ordered these tiny, ground-covering species on-line from AquariumPlants.com. (Plants, which arrived in excellent condition, were originally grown by Florida Aquatic Plant Nurseries.) Plants were in their emergent form. After submergence, I added some of my own surplus plants [floating Frogbit (*Limnobium laevigatum*); *Hemianthus micranthemoides*; and *Riccia fluitans*].

Fig 6. DSM Tanks at 10 Weeks
HC and EA have spread considerably since the initial planting. However, within a few days of planting, the GE turned brown and died. The leaves of *Marsilea quadrifolia* turned brown (as shown here in the bottom tank). The AN grew very slowly. Photo was taken just before I submerged plants. ‘Tank A’ is at the top; ‘Tank B’ at the bottom. See Fig 5 for plant abbreviations.

Procedure:

Because I would be planting small delicate plants, I used a shallow, fine-textured substrate. I first removed sticks and larger wood pieces from the bagged potting mix. To Tank A, I added 4 cups garden soil and then 1.5 cups potting mix. To Tank B, I added 2 cups garden soil and 3.5 cups potting mix. I did not mix the soils and made sure the potting mix went on top where it would get more oxygen. I crushed and sprinkled two plant tab fertilizers over the soil in each tank.

I then added 1 to 2 cups of aged aquarium water—enough to thoroughly moisten the soil but not make it soupy. I drained off any excess. I spooned in some washed sand and planted the plants.

For the next 10 weeks, I kept the glass lids snug and made sure that the soil stayed moist. Every week or so, I added a little water. Most mornings, the tanks had condensed water on the glass showing that the tanks were sufficiently humidified. Towards the end when plants were growing rapidly but turning yellow, I added a couple crushed plant fertilizer tabs to the replenishment water.

[5] For emergent plants, the more light, the better. They can use increasing light intensity up to full sunlight for photosynthesis. In contrast, submerged plants can use only about one-tenth of full sunlight [5].

At 10 weeks, I finally added water and submerged the plants. I changed 100% of the water twice within the next two days to wash out leftover fertilizers.

A week later, I added Red Cherry Shrimp to Tank A and Grass Shrimp to Tank B. I probably could have added them sooner, but I wasn't sure what would happen.

Fig 7. DSM Tanks after Submergence

Three weeks after submergence, carpet plants are growing very well. They have made such a thick mat, I can pour water into the tank without disturbing the soil layer. Tank on the right has RCS, while the tank on the left contains native Grass Shrimp.

Tank Results:

During the 10 weeks prior to submergence, the *H. callitrichoides* and *E. acicularis* multiplied well and formed an extensive root system. Submergence did not seem to hurt them, and they did not shed their leaves. Indeed, they seemed to thrive after submergence (**Figs 7 and 8**). *M. quadrifolia* actually seemed to grow better with less leaf-browning after I submerged it.

Tanks dominated by small delicate plants, are extremely vulnerable to algae. Within ten days of submergence, I noticed some alga growth on the glass sides. I took quick action: (1) cleaned the glass; (2) changed water; (3) raised the Clamp Light a few inches; (4) added snails; and (5) added floating Frogbit and *Riccia fluitans*. After the Frogbit started growing well (**Fig 8**) and the algae retreated, I lowered the Clamp Light back down to where it had been before—resting on the glass lids. Once the Frogbit began to grow, the algae retreated.[6]

Fig 8. Frogbit to the Rescue!

I removed the tank lids to get this photo (at 6 weeks post-submergence) showing the Frogbit floating on the water surface (you can also see floating mats of *Riccia*). Algae threatened to take over the tanks within days of submergence. I consider Frogbit vital for controlling algae in these two tanks.

Tank A with 27% Potting Mix has less organic matter in the substrate than Tank B with 64% Potting Mix. The difference didn't seem to matter.

Discussion

The shrimp bowls were unheated. I was concerned that the plants and my RCS might do poorly during the winter. Night-time room temperatures are between 60 and 65°F, and

[6] Emergent plants and floating plants have major advantages over algae [6] that the hobbyist can exploit.

daytime temperature rarely gets above 70°F. Apparently, RCS can tolerate temperatures ranging from 35 to 86°F. However, they purportedly don't breed at temperatures below 68°F.

I set up the bowls in May when water temperatures were optimal for plant growth. I am not sure that I would set up unheated bowls during the winter. The optimum temperature range for most aquarium plants is 72- 82°F, but the lower winter temperatures did not seem to affect plant growth in the bowls. When in January, I measured CO_2 levels throughout the day in the bowls, I found rapid daytime CO_2 depletion comparable to what I measured in September. This CO_2 depletion means that some plants—despite the cooler temperatures—were actively photosynthesizing.

As for the 2-gal tanks…. They were coddled. I heated them with a mini-heater and used *very* gentle air bubbling to help circulate the heater's warmth, but not drive off CO_2. The temperature did not go below 70°F in these two tanks. The RCS in the heated tank were the only ones to have babies with the onset of winter. I routinely saw RCS babies attached to the mini-heater.

For a couple weeks after submergence, I ran Tank B without a heater. The carpet plants looked fine. However, I noticed that the Frogbit was yellow and not multiplying, whereas in Tank A with a heater, it was thriving. Since these tanks depend on Frogbit to control algae, I quickly added a heater and air-bubbler, identical to what I have in Tank A. Frogbit turned green and started multiplying. [This Frogbit was a tropical species (*Limnobium laevigatum*), not the native Frogbit (*Limnobium spongia*) common to the Southeastern U.S.A. and which grows very well at lower temperatures.]

Beginners often start with unfamiliar and newly purchased plants. Most vendors sell plants in their emergent form. Some plant species adjust to submergence better than others, but they still have to adjust. If plants are not growing well by the first couple of weeks and algae becomes entrenched, the tank may not succeed. That's because a large alga mass will quickly remove all CO_2 from the water,[7] making it very difficult for the plants.

I set up the DSM tanks to see how well the method worked with some challenging plants, that is, "carpet plants." I consider them difficult for a low-tech setup where there's no artificial CO_2 injection.[8] These plants have not done well for me in large fish tanks where they had to compete with *Cryptocoryne* and *Echinodorus* species. However, in small tanks by themselves and under conditions that minimize CO_2 loss, they did surprisingly well.

Carpet plants *H. callitrichoides* and *E. aciculari*s started via the DSM did fine. Moreover, the emergent startup period required almost no maintenance (or worry). For 10 weeks all I did was occasionally add a little water to moisten the soil and keep the air humidified.

G. elatinoides and *M. quadrifolia* had problems during the DSM startup (**Fig 6**). I suspect that ethylene gas, a plant hormone produced in large amounts by wounded and/or stressed plants, caused those problems. Ethylene can induce leaf-browning, plant death, and induce even more ethylene production. The two affected plant species may have been more sensitive to ethylene, or they were more damaged during planting than the other plant species. Air circulation helps dilute the released gas. Should I try DSM again, I will handle the plants more gently, remove dying leaves immediately, and air out the tanks more during the emergent phase.

I do not recommend carpet plants for beginning hobbyists. The plants are not that competitive. I started my carpet plants under ideal (i.e., emergent) conditions and then provided them with a

---

[7] Algae can grow at lower CO_2 levels [7] and use bicarbonates more effectively than plants [8].

[8] High-tech tanks have CO_2 injection. There's enough CO_2 for all plants, including those that are less-competitive in obtaining CO_2. In my tanks, plants compete for a limited supply, so not every plant species is going to do well.

carefully controlled tank (e.g., aquascaped). For example, the larger, more robust "baby tears" *Hemianthus micranthemoides* in one tank eventually crowded out the delicate carpet plant *H. callitrichoides*. Carpet plants will have a better chance if they are accompanied by floating plants. Carpet plants—on their own—cannot remove nutrients sufficiently from the water to prevent algae (or purify the water for the shrimp). Floating plants protect carpet plants without competing with them for CO_2. (Floating plants get their CO_2 from the air, not the water [9].)

My DSM tanks required more maintenance than the bowls. I had to change water at least once every week during the first 6 weeks following submergence. Occasionally, I had to remove small algae mats (using a toothbrush) that threatened to spread over the plant carpet. After the Frogbit and *Riccia* started growing, the tanks stabilized and did quite well with minimal maintenance.

For the more advanced hobbyist who wants to experiment, the DSM is an interesting option for large and small tanks. If it works for finicky carpet plants, it should work well for other aquarium plants. Emergent growth is common for aquatic plants during the dry season in their native habitats. The vast majority of aquarium plants (species of *Anubias*, *Echinodorus*, *Sagittaria*, *Cryptocoryne*, *Bacopa, Ludwigia*, *Rotala*, *Myriophyllum*, *Microsorum*, etc) can be grown emergent, and therefore, lend themselves to a DSM startup. Only a few aquatic plants do not have an emergent form; these include species of *Aponogenton*, *Najas*, *Crinum*, *Ceratophyllum*, *Blyxa*, *Elodea*, *Lagarosiphon*, and *Vallisneria*.

I used 2-gal tanks, because that is what I had on hand. However, a 5-gal tank would be much less expensive and is ideally suited for an overhead Clamp Light.

In this article, I describe two ways to keep planted tanks for pet shrimp. The bowls are easy and simple—a nice, inexpensive way for beginners to start. The DSM (Dry Start Method) is more challenging, but it is an interesting and worthy alternative to ordinary setups.

Diana Walstad's *Ecology of the Planted Aquarium* contains more information about keeping natural planted tanks. For a preview and more articles, visit <http://dianawalstad.com>.

REFERENCES

1. Kasselmann, Christel. 2003. *Aquarium Plants.* (Krieger Publishing; Malabar, FL), p. 51.
2. Barr, Tom. 2009. Dry-Start Method. *Freshwater and Marine Aquarium* (Dec issue), pp. 54-61.
3. Barko JW and Smart RM. 1983. Effects of organic matter additions to sediment on the growth of aquatic plants. *Journal of Ecolog*y 71: 161-175.
4. Walstad, Diana. 2013. *Ecology of the Planted Aquarium* (3rd Edition). Echinodorus Publishing (Chapel Hill, NC), pp. 138-39.
5. Walstad (2013), p. 146.
6. Walstad (2013), p. 165.
7. Sand-Jensen K and Borum J. 1991. Interactions among phytoplankton, epiphyton, and macrophytes in temperate freshwaters and estuaries. *Aquatic Botany* 41: 137-175.
8. Simpson PS and Eaton JW. 1986. Comparative studies of the photosynthesis of the submerged macrophyte *Elodea canadensis* and filamentous algae *Cladophora glomerata* and *Spirogyra* sp. *Aquatic Botany* 24: 1-12.
9. Walstad (2013), p. 144.