Small Planted Tanks for Pet Shrimp

by Diana Walstad
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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. They may have to adapt to the submerged condition and grow new leaves. Chances are some plant species will not survive. Algae may become a problem. Fish add another layer of complication. Sometimes newly purchased fish become diseased, and hobbyists add chemicals that injure the ecosystem.

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

It was only last year that I started keeping shrimp as pets. 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, no fish diseases. Water changes are easy, because you're only working with one or two gallons. It's a great way to start out with planted tanks. The beginner discovers the plant species that can adapt best to his/her unique conditions and learns how to work with soil.

Fig 1. RCS (Red Cherry Shrimp) or *Neocaridina heteropoda*. This brightly-colored female is enjoying some freshly chopped shrimp meat. Only the adult females, which reach about ¾" in length, are colored. Adult males (about ½" in length) and all juveniles are cream-colored. RCS are less demanding than some of the other shrimp. RCS will eat almost anything (including debris), and you don't have to feed them every day. Generally, I feed mine crushed fishfood pellets once a day.

Learning how to grow plants in an aquarium is worth the effort. Plants purify the water and substrate, thereby reducing tank maintenance (water changes, gravel vacuuming, etc). Plants make it easy to keep shrimp (and fish) healthy.[1]

[1]My book *Ecology of the Planted Aquarium* explains how plants make fishkeeping easier. 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 tremendous preference of aquatic plants for ammonia over nitrates as their nitrogen source. This ammonia preference means plants can protect fish and shrimp from ammonia as well as filters.

Bowl Setup Procedure

I set up two 1-gal bowls using a procedure similar to the one I use for my fish tanks.[2]

Materials and Key Factors:

- Round glass bowls of 1-gal size
- Red Cherry Shrimp- I purchased shrimp from an on-line vendor and an aquarium store.
- Soil- I used Miracle Gro's Organic Choice 'Potting Mix' (Fig 2)
- Sand- pool-filter sand
- Plants- I chose small plants that for me are reliable growers (Fig 3)
- Water- I used either old aquarium water or fresh tapwater treated with an aquarium water conditioner that neutralizes heavy metals (e.g., Tetra's AquaSafe).[3]
- Light- window light and a 10.5" Clamp Light with a screw-in CFL (compact fluorescent light). I use a 14 watt GE "Bright White" CFL, reportedly equivalent to a 60 watt light bulb.[4]
- Daylength for plants should be at least 12 hr [5]. I use a 14 hr daylength but with a 4 hr afternoon Siesta. Thus, overhead lights are on for 5 hr in the morning and 5 hrs between 4 PM and 9 PM.[5]
- Temperature- I set up the bowls in early summer when temperatures were ideal (72-82°F range).

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, no chemical fertilizers (e.g., ammonium sulfate), and has a desirably low NPK ratio of 0.010, 0.05, 0.05. The soil does not generate much turbidity, nor contain nuisance perlite pieces that float to the surface.

Procedure:

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.

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[2] See Chapter XI 'Practical Aquarium Setup and Maintenance'.

[3] Invertebrates are exquisitely sensitive to any heavy metals in tapwater, more so than fish or plants. Metal toxicity is the bane of keeping invertebrates. My tapwater contains enough zinc to kill shrimp. Other hobbyists have reported problems with copper. See pp 9-19 for a complete discussion of metal toxicity.

[4] I use a variety of light sources. Aquatic plants are surprisingly adaptive to different light spectra (pp 178-181).

[5] The Siesta Regimen saves electricity while giving plants the long daylength they need. It also better balances the CO_2 and lighting needs of plants [6].

I covered the soil and plant roots with sand. Aquarium gravel would work,[6] but it is much easier for shrimp to turn over sand grains than gravel when looking for food. I used about a cup of sand-- just enough sand to hold down soil particles.[7]

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- 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 to the bowls.

Bowl Results: Bowls have been without problems (Fig 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 right-hand bowl has a little mat alga that I pull off the substrate with tweezers.

[6] Ordinarily, I prefer gravel over sand as a soil cover. A gravel layer encourages solid waste decomposition, because it is more permeable. Solid waste falls between the cracks and is decomposed by billions of soil bacteria into nutrients that plants can use. In contrast, a sand layer, especially if it is thick, creates a barrier to decomposition. The result is that solid waste accumulates on the sand surface.

[7] You don't want to inhibit water exchange between the soil and overlying water. For, if the soil becomes too anaerobic, it will generate toxins that can damage plant roots (pp 132-134).

Two Tanks with DSM Setup

Recently, 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), do you submerge them.

The DSM has several major advantages over the usual "wet start" method. Emergent-grown plants often grow 4-10 faster than plants grown submersed.[8] Plants quickly develop an extensive root system. Because it's a dry start, plants 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 before it is submerged; it will be more stable.[9]

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.

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.

Because of the emergent startup, I deviated from my usual setup procedure. I included a layer of mineral soil (i.e., yard dirt). For a submerged startup, this would release iron into the water and greatly stimulate algae.[10] 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.[11]

Emergent plants actually grow better in a mineral soil than an organic soil [1]. However, I needed soil organic matter to provide CO_2 to the plants, both before and after submergence.[12] Therefore, I used some of each.

I added fertilizers to the soil layer, which I would never do in my usual setups.[13]

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[8]Submerged aquatic plants are innately handicapped, while their emergent form is not. For a complete discussion, see Ch IX, 'The Aerial Advantage'.

[9] Freshly submerged soils are temporarily unstable in terms of pH and Redox. Moreover, the soil releases large quantities of nutrients that can stimulate algae. See 'Chaos in Freshly Submerged Soils' pp 130-135.

[10]Iron deficiency helps control algae in my planted tanks. See pp 167-170 in Chapter X 'Algae Control'.

[11] Floating plants often don't survive long-term in my tanks set up with pure Potting Mix. Mineral soils contain much more iron (p 83), releasing enough iron into the water to better sustain floating plants.

[12] For more about soil and sediment release of CO_2, see pp 60, 83-84.

[13] Once a terrestrial soil is submerged, inorganic chemical fertilizers will not only stimulate algae but cause major toxicity problems for plants and fish. See pp 138-139.

Materials and Key Factors:

- Two 2-gal tanks
- Glass lids to keep in warmth and moisture
- Mineral Soil (yard dirt); mine is a Southeastern Piedmont clay
- Organic Soil (Miracle Gro's Organic Choice 'Potting Mix')
- Plant Tabs containing fertilizers KNO_3, $NH_4H_2PO_4$, etc in a clay filler
- Sand- pool filter sand
- Water- aged aquarium water or tapwater treated with Tetra AquaSafe™ to neutralize heavy metals
- Light- 10.5" Clamp Light with a 14 watt screw-in CFL (GE's "Bright White"). The clamp light rests directly on the glass lids of both tanks.
- Daylength- During the emergent phase, I kept lights on continuously for 14 hr per day.[14] After submergence, I put tanks on the "Siesta Regimen" that I use for the bowls.
- Heaters- 7.5 watt Hydor Mini-heaters (after submergence)
- Air bubblers (after submergence)
- "Carpet Plants": *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, but they were actually grown by Florida Aquatic Plant Nurseries. Plants, which arrived in excellent condition, were in their emergent form. Later (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 hardly grew at all (it might as well be plastic). 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.

[14] 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 (p 146).

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 replenishment 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.

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.

Fig 7. DSM Tanks after Submergence. Here are the two 2-gal tanks 3 weeks after submergence. Carpet plants are growing very well submerged. They have made such a thick mat, I can pour water into the tank without disturbing the soil layer. 'Tank A' on the right has RCS, while 'Tank B' contains a pair of native Grass Shrimp.

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.

Tank Results:

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

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. As long as the Frogbit does well, I believe the tanks will be safe from algae.[15]

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

[15] Emergent plants and floating plants have a couple major advantages over algae (p 165).

Discussion

Temperature

The shrimp bowls are 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. Daytime temperature rarely gets above 70°F. Apparently, RCS can tolerate temperatures ranging from 35 to 86°F. However, they don't breed at temperatures below 68°F. Some hobbyists heat their 1-gal shrimp bowls with hourly heat pulses from a mini-heater (a light timer switches the heater on and off every hour, such that the water doesn't overheat).

The optimum temperature range for most aquarium plants is 72- 82°F. However, the lower winter temperatures don't seem to have affected plant growth in the bowls. Recently (Jan 2009), I measured CO_2 levels throughout the day in the bowls. Surprisingly, I found rapid daytime CO_2 depletion comparable to what I measured in September when water temperatures were optimal. This CO_2 depletion means that some plants-- despite the cooler temperatures-- are actively photosynthesizing.

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. You always want startup conditions to be optimal.

As for the 2-gal tanks…. They are coddled. I heat them with a mini-heater and use *very* gentle air bubbling to help circulate the heater's warmth.[16] The temperature doesn't go below 70°F in these two tanks. The RCS (Fig 9) are the only ones to have had babies since the onset of winter. I routinely see RCS babies attached to the mini-heater. Although the Grass Shrimp in Tank B have not yet reproduced, the female is now carrying eggs.

Fig 8. Frogbit to the Rescue. I removed the tank lids to get this photo showing the Frogbit plant 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. Photo taken at 6 weeks post-submergence.

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.

[16] Vigorous air bubbling will degas CO_2 from the water and block plant growth. CO_2 is the one nutrient plants need most *and* the one that can be most easily lost (p 88).

Plant Considerations

Advanced hobbyists usually have a ready supply of plants from their established tanks. These surplus plants have already performed well under the lighting, substrate, and water conditions unique to the hobbyist's situation. In addition, the plants are already adapted to the submerged condition.

In contrast, beginners usually start with unfamiliar and newly purchased plants. Most vendors sell plants in their emergent form (it's so much easier for nurseries to grow plants emergent). Some plant species adjust to submergence better than others, but they still have to adjust—and that requires energy. 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,[17] making it difficult for plants to photosynthesize and produce enough energy to survive.

Fig 9. RCS in DSM Tank. Two young females are browsing for food. One thing I like about carpet planting is that you can see the shrimp more easily than in the bowls.

I set up the DSM tanks to see how well the new method worked with some challenging plants, that is, "carpet plants". I consider them difficult plants for a low-tech setup where there's no artificial CO_2 injection.[18] Indeed, I put a few extra specimens of the purchased carpet plants into an ordinary submerged setup. The tank was a total disaster. No matter what I did, the plants never took root, much less multiplied. Eventually, the plants were smothered by algae. I tore down the tank.

Carpet plants *H. callitrichoides* and *E. acicularis* 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 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 "bubble" air into the tanks during the emergent phase.

I do not enthusiastically recommend carpet plants. They are not that competitive with algae or other plants. I started my carpet plants under ideal (i.e., emergent) conditions and now

[17] Algae can grow at lower CO_2 levels [4] and use bicarbonates (as an alternate carbon source) more effectively than plants (p 163).

[18] 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 tanks like mine, plants compete for a limited CO_2 supply, so not every plant species is going to do well.

provide them with a carefully controlled environment. In the 2-gal tanks, they don't have to compete for CO_2 with more robust plants (e.g., *Sagittaria subulata*). Almost surely, carpet plants must be 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 (and shrimp) without competing with the carpet plants for CO_2.[19]

My DSM tanks require more maintenance than the bowls. They are move vulnerable to algae. 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. However, I noticed that the algae retreated considerably once the Frogbit started growing well. I continue with biweekly water changes and thinning out excess Frogbit.

For the more advanced hobbyist who wants to experiment, the DSM is an interesting option. If it works for carpet plants, it should also work with many other plant species. 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 don't have an emergent form; these include species of *Aponogenton*, *Najas*, *Crinum*, *Ceratophyllum* and the Hydrocharitaceae family (e.g., *Blyxa*, *Elodea*, *Lagarosiphon*, *Vallisneria*, etc) [3].

I used 2-gal tanks, because that is what I had on hand. However, a 5-gal tank would be much less expensive and ideally suited (in size) for a 10.5" Clamp Light.

In this article, I describe two ways to keep planted tanks for pet shrimp. The bowls are easy and simple—a nice way for beginners to start. The DSM (Dry Start Method) is more challenging and less-tested, but it has potential.

As for the shrimp…as long as I feed them, they don't seem to care.

Diana Walstad's *Ecology of the Planted Aquarium* contains practical and theoretical information about keeping natural planted tanks. It is available from many Internet vendors. Book's website is: [http://www.atlasbooks.com/marktplc/00388.htm]

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[19] Floating plants get their CO_2 from the air, not the water (p 144).