

CHAPTER 4

AQUARIA

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CHAPTER 4

AQUARIA



Figure 1. The dangling moss *Fontinalis antipyretica* (willow moss) adds interest and hiding places in aquaria. Photo by Li Zhang, with permission.

Aquarium Bryophytes

In aquaria, mosses not only are decorative, but provide oxygen, hiding places, and egg-laying substrates (Benl 1958). Fish such as danios and killies will lay their eggs in the moss (Tinkerfish). Many taxa can be used, provided the water is not too warm and copper content is low, including common taxa: *Bryum pseudotriquetrum* (Figure 2), *Fontinalis antipyretica* (Figure 1), *Leptodictyum riparium* (Figure 3), *Platyhypnidium riparioides* (Figure 6), *Riccia fluitans* (Figure 7), *Ricciocarpos natans* (Figure 8), *Taxiphyllum barbieri* (Figure 9-Figure 10), and *Vesicularia dubyana* (Figure 11) (Benl 1958; Cook *et al.* 1974; Takaki *et al.* 1982; Gradstein *et al.* 2003; Tan 2003; Tan *et al.* 2004).

One should be aware that scientific names provided by aquarium stores are often wrong. I have seen *Leptodictyum riparium* (Figure 3) labelled *Fontinalis* (Figure 1) and *Taxiphyllum barbieri* (Figure 9-Figure 10) is often misnamed as *Vesicularia dubyana* (Figure 11).



Figure 2. *Bryum pseudotriquetrum* grows in marshes and in shallow water at lake and stream edges. It can make an interesting small forest on the bottom of an aquarium. Photo by Michael Lüth, with permission.



Figure 3. *Leptodictyum riparium* (stringy moss) adorning an unusual aquarium. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 4. *Leptodictyum riparium* showing its growth habit in an aquarium. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 5. *Leptodictyum riparium* leaves showing the rib and leaf arrangement. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 6. *Platyhypnidium riparioides* (also known as *Rhynchostegium riparioides* and *Eurhynchium riparioides*) is a stream moss that grows in dense clumps. However, some people have succeeded in keeping it as an aquarium moss. Photo by Michael Lüth, with permission.

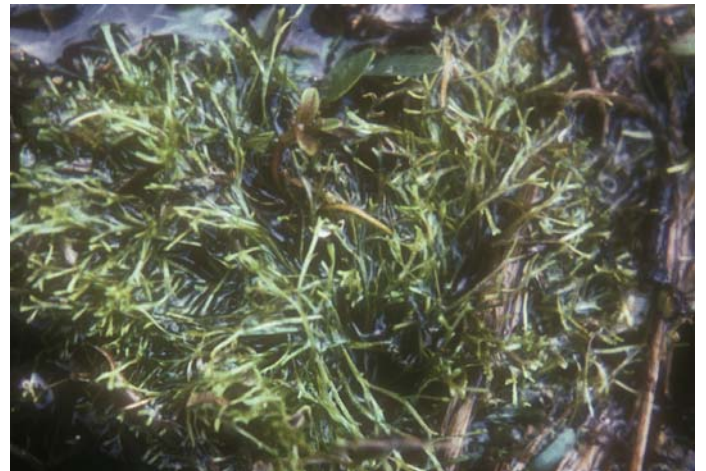


Figure 7. *Riccia fluitans* can be grown floating or in balls at the bottom of the aquarium in medium soft to hard water, pH 6-8, 15-30°C (Aquatic Community). Photo by Janice Glime

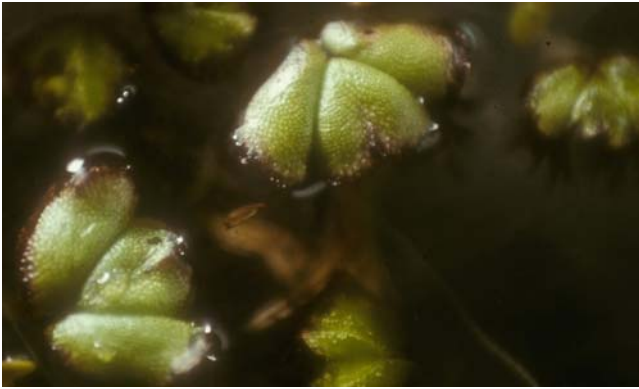


Figure 8. *Riccio carpos natans*, a thallose liverwort sometimes used in aquaria. Photo by Janice Glime.

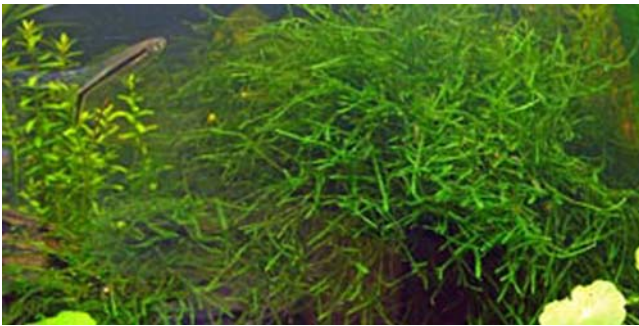


Figure 9. *Taxiphyllum barbieri* (Java moss) provides dimension to the aquarium and permits little fish to hide from larger aggressive fish. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.

Java moss [often incorrectly identified as *Vesicularia dubyana* (Figure 11), Iwatsuki 1970; Tan *et al.* 2004] is a popular tropical moss that is highly tolerant of a wide array of water chemistries and temperatures and may even help to absorb the ammonia derived from the fish. Singh (in Tan 2006a) describes growing conditions as with or without fertilizer, with or without added CO₂, with or without added light, temperatures to 30°C, and tap water. It grows rapidly and will fill the tank in short order, but is easily removed. Compared to the wild mosses I have tried to grow, this is much easier.

Unfortunately, the name Java moss has been applied to a variety of aquatic mosses sold for aquaria (Tan *et al.* 2004; Akiyama 2009). "Java moss" most likely was originally applied to *Vesicularia dubyana* (Figure 11), but the faster-growing *Taxiphyllum barbieri* (Figure 9-Figure 10) was later used in its place (Stephan Mifsud, pers. comm. 14 December 2007). The current Java moss (*Taxiphyllum barbieri*; Figure 9-Figure 10) has flattened, oval-oblong leaves arranged on two sides of the stem and branches, and possesses two short costae (Figure 10). Its narrowly oblong leaf cells differ from the shorter ones of *Vesicularia* spp. (Figure 11).

The true Java moss is the easiest to grow of all aquatic mosses (Tan 2006; Tan & Leong 2007). It thrives not only in cool water, but in low light at tropical temperatures of 28-30°C, temperatures that would soon result in death of the common temperate moss *Fontinalis antipyretica* (willow moss; Figure 1). In my aquarium, I need to remove vast quantities of Java moss approximately every month. It adheres to driftwood, stones, or rests on the bottom. As an aquarium plant, it provides a nice green,

filmy look and provides good hiding places for small fish and fish eggs (Takaki *et al.* 1982). On the other hand, I have had spiny fish get caught in it and die struggling to get free.

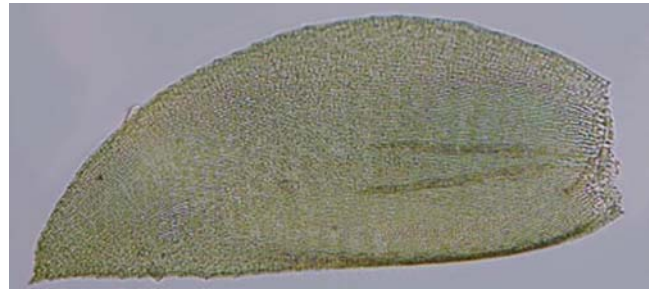


Figure 10. The leaf of *Taxiphyllum barbieri*, the true Java moss, has two short costae and narrowly oblong leaf cells. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 11. The moss often mistakenly called Java moss is *Vesicularia dubyana* (Singapore moss) and has shorter cells. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.

Cliff Townsend sent me a short note (22 Nov 2004) that attests to the aggressive nature of this group of "Java mosses," given the right conditions:

"A slant on British 'Java Moss' is given by C. R. Stevenson & E. W. Jones in *Journal of Bryology* 15: 624-626 (1989). The material of *Vesicularia reticulata*, mentioned by them as having been distributed by me through the B.B.S. exchange in 1962 as *V. dubyana*, was collected from the former orchid pits at Kew (since demolished), where this moss grew in great quantity and fruiting very freely. It still occurs in other greenhouses at Kew, and I was informed by P. J. Edwards of the pteridophyte department in the Kew Herbarium that both this and *Racopilum cuspidigerum* (Schwaegr.) Aongstr. (det. B. O. Zanten from a gathering of mine) are quite valuable for water retention."

"Fairly recently, this *Vesicularia* was sent to me for opinion by the late Theo Arts, who had collected it in the *Victoria amazonica* house at the Nationale Plantentuin van Belgie, Domein non Bouchout, Meise, Belgium in 1987. I have also received material from the same greenhouse collected by H. Stieperaere in 1996. It is of interest that I recorded the species from a bank by a millstream near Mogul Gardens, Wah, Pakistan in 1973 in *Journal of Bryology* 17: 677 (1993). Unfortunately, this and other mosses from the same spot (which included an *Entodon* as yet unidentified) were grubbed up in a hurry and not named until I got home, so there is no means of knowing if the moss was native there (the place is within its area) or was an escape from the gardens, having been introduced to them with phanerogams."

"Gangulee (Mosses of eastern India: 2001) reports *Vesicularia montagnei* as occurring 'on the floors of nurseries in Calcutta and in Howrah National Botanic Garden.' In the description, he cites it as 'forming thin but very extensive mat covering whole nursery floor and brick edging...'. The leaf-shape depicted by Gangulee looks very like that of *V. reticulata*, whereas that given of *reticulata* itself shows the leaves much too narrow. One cannot but wonder if the Calcutta nursery plant is in fact *reticulata*, perhaps even the source from which it has reached other botanic gardens."

"It would no doubt take more time than it is worth to trace the source from which *V. reticulata* entered the aquarium trade, but it seems very likely that it has been propagated from material occurring as a weed in some nursery or botanic garden."

The Christmas moss (*Vesicularia montagnei*, Figure 12-Figure 13) is often used to provide a backdrop to aquaria (Tan & Leong 2007). It is semi-aquatic and grows on shaded, wet banks. In an aquarium, it becomes distinctly pinnate to subpinnate, giving a miniature fernlike appearance. Unlike the hanging habit of *Vesicularia montagnei*, the habit of *Vesicularia reticulata* (erect moss; Figure 14) is upright, giving it a different role when tied to driftwood or other substrate under water (Tan & Leong 2007). The true *Vesicularia dubyana* (Figure 16), now dubbed Singapore moss, looks like a smaller version of Christmas moss.



Figure 12. *Vesicularia montagnei*, the Christmas moss, serving as an aquarium backdrop. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 13. *Vesicularia montagnei* (Christmas moss) is a hanging moss. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 14. *Vesicularia reticulata* (erect moss) works well when tied to driftwood or other substrate. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 15. *Vesicularia dubyana* (Singapore moss), the original Java moss and a species suitable for aquaria. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 16. *Vesicularia dubyana* (Singapore moss). Photo by Sze Wei Tan, with permission <www.aquamoss.net>.

Taxiphyllum cf. alternans (Figure 17) is a beautiful, soft moss that is sought after by hobbyists, but is more expensive (Tan *et al.* 2004). Its true identity remains uncertain because no capsules have been available to permit certain affiliation.



Figure 17. *Taxiphyllum alternans* (Taiwan moss) is a pinnately divided moss often sold for aquaria. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.

Many mosses can be grown successfully in an aquarium. The limits may depend on the water quality, whether it is acid or alkaline, on the temperature, and on your ability to keep algae from taking over. Table 1 includes the more common ones available in North America, Europe, and Asian areas. Nevertheless, aquarium stores in other parts of the world sell some of these, and local aquatic mosses may be added to them.

Several liverworts are suitable, including the rare *Monosolenium tenerum* (Figure 18), originally from Asia (Wikipedia). While this species is hard to find in the wild and should be protected, it seems to do well in aquaria and can be easily grown from a small clump of plants. You may find it sold as *Pellia* because it was originally misidentified as *Pellia endiviifolia* (Figure 19) (Stephan Mifsud, pers. comm. 14 December 2007).



Figure 18. *Monosolenium tenerum* growing on soil in its natural habitat. Photo by Li Zhang, with permission.



Figure 19. *Pellia endiviifolia*, the real species, and not usually a submersed species. Photo by Hermann Schachner, through Creative Commons.

Table 1. Mosses suitable for aquarium culture (Benl 1958; Cook *et al.* 1974; Takaki *et al.* 1982; Gradstein *et al.* 2003; Tan *et al.* 2004; Tan 2006a).

<i>Amblystegium serpens</i>	nano moss	Figure 20
<i>Bryum pseudotriquetrum</i>	marsh bryum	Figure 21
<i>Chiloscyphus polyanthos</i>	square leaved liverwort	Figure 22
<i>Ectropothecium zollingeri</i>	Bogor's moss	Figure 23
<i>Fissidens crassipes</i>		Figure 24
<i>Fissidens fontanus</i>	Phoenix moss	Figure 25
<i>Fissidens grandifrons</i>	Christmas tree moss	Figure 26
<i>Fissidens nobilis</i>	doormat moss	Figure 27
<i>Fissidens rivularis</i>	river pocket moss	Figure 28
<i>Fissidens splachnobryoides</i>	doormat moss	
<i>Fissidens taxifolius</i>	common pocket moss	Figure 29
<i>Fissidens zippelianus</i>	zipper moss	
<i>Fontinalis antipyretica</i>	willow moss	Figure 1
<i>Hyophila involuta</i>	cement moss	Figure 30
<i>Isopterygium sp.</i>	mini Taiwan moss	Figure 31
<i>Leptodictyum riparium</i>	stringy moss	Figure 5
<i>Monosolenium tenerum</i>	giant riccia	Figure 18
<i>Plagiomnium acutum</i>		Figure 32
<i>Platyhypnidium riparioides</i>	beaked water moss	Figure 6
<i>Rhacopilum aristatum</i>		
<i>Riccardia chamedryfolia</i>	mini peltia	Figure 33
<i>Riccia fluitans</i>	floating crystalwort	Figure 7
<i>Ricciocarpos natans</i>	water star	Figure 8
<i>Taxiphyllum alternans</i>	Taiwan moss	Figure 17
<i>Taxiphyllum barbieri</i>	Java moss	Figure 9
<i>Taxiphyllum sp.</i>	flame moss	Figure 34
<i>Taxiphyllum sp.</i>	giant moss	Figure 35
<i>Taxiphyllum sp.</i>	green sock moss	Figure 36
<i>Taxiphyllum sp.</i>	peacock moss	Figure 37
<i>Taxiphyllum sp.</i>	spiky moss	Figure 38
<i>Taxiphyllum sp.</i>	string moss	Figure 39
<i>Vesicularia dubyana</i>	Singapore moss	Figure 15
<i>Vesicularia ferriei</i>	weeping moss	Figure 40
<i>Vesicularia montagnei</i>	Christmas moss	Figure 12
<i>Vesicularia reticulata</i>	erect moss	Figure 14
<i>Vesicularia sp.</i>	creeping moss	Figure 41



Figure 20. *Amblystegium serpens*, a terrestrial moss that can be used in aquaria. Photo by Andrew Spink, with permission.



Figure 23. *Ectoprotecium zollingeri*, a moss previously listed as *Glossadelphus zollingeri*. Photo by Jan-Peter Frahm, with permission.



Figure 21. *Bryum pseudotriquetrum*, a moss of wetlands that can survive under water. Hermann Schachner, through Creative Commons.



Figure 24. *Fissidens crassipes*, a species of on limestone or siliceous rocks, avoiding very acid situations, submerged or on stream banks. Photo by Michael Luth, with permission.



Figure 22. *Chiloscypus polyanthos*, an aquatic liverwort. Photo by Hermann Schachner, through Creative Commons.



Figure 25. *Fissidens fontanus*, a true aquatic *Fissidens*. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 26. *Fissidens grandifrons*, largest species of *Fissidens*, living in limestone and alkaline areas that are either cold water or turbulent water with lots of CO₂. Photo by Michael Lüth, with permission.



Figure 27. *Fissidens nobilis* comes from Asia and nearby islands. Photo by Jan-Peter Frahm, with permission.



Figure 28. *Fissidens rivularis* grows on shaded, moist or submerged, rocks in lowland neutral to acidic streams, rivers, and by lakes. Photo by Jan-Peter Frahm, with permission.



Figure 29. *Fissidens taxifolius*, worldwide species from damp, shaded soil and rocks. Photo by David Holyoak, with permission.



Figure 30. *Hyophila involuta*, a species that has been spread on calcareous walls of locks (Ireland & Shchepanek 1993) and therefore should not be dumped from aquaria because it could become invasive, although it is naturally rare. Photo by Li Zhang, with permission.



Figure 31. *Isopterygium* sp., a genus that has some aquatic species suitable for aquaria. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 32. *Plagiomnium acutum*, a species known to many aquarists by its synonym *Plagiomnium trichomanes*. Photo by Harum Koh through Creative Commons.



Figure 33. *Riccardia chamedryfolia*, a thallose liverwort that is a slow-growing species that is easily overtaken by algae or mosses. Photo by David T. Holyoak, with permission.



Figure 34. *Taxiphyllum* sp., known in the aquarium world as flame moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.

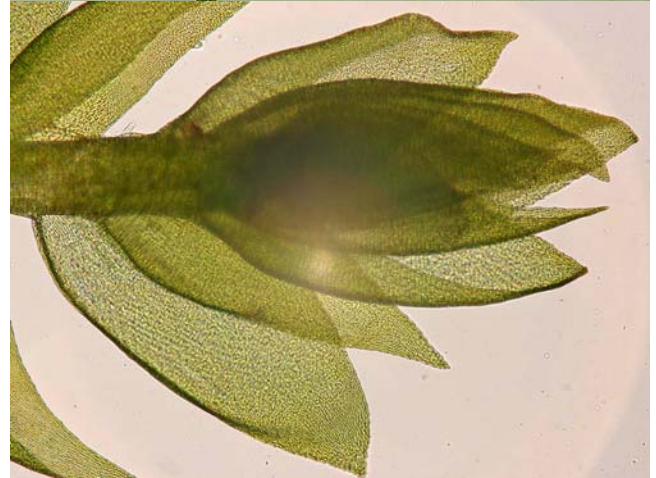


Figure 35. *Taxiphyllum*, giant moss, commonly sold as an aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 36. *Taxiphyllum*, green sock moss, a common aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 37. *Taxiphyllum*, peacock moss, a common aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 38. *Taxiphyllum*, spiky moss, a common aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 39. *Taxiphyllum*, string moss, a common aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 40. *Vesicularia ferriei*, weeping moss, a common aquarium moss in Asia. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.



Figure 41. *Vesicularia*, creeping moss, a common aquarium moss. Photo by Tan Sze Wei <www.aquamoss.net>, with permission.

Mifsud (pers. comm. 7 December 2007) found that *Hyophila involuta* (cemet moss) is sold on ebay, often mislabelled as star moss (*Tortula ruralis*). He has successfully grown *Barbula*, probably *Barbula bolleana*. Others that grow well but lack an attractive form are *Rhynchostegiella curviseta*, *Didymodon tophaceus*, *Pohlia melanodon*, and *Leptodictyum humile*. These species are either too small or become stringy (probably due to low light). In addition to the *Vesicularia* mix up, *Monosolenium tenerum* is often sold as *Pellia* due to its original misidentification as *Pellia endiviifolia*.

This list of mosses may not match the names being used in aquarium shops. We cannot expect these shop owners to keep up with changes in bryological nomenclature. That is not their area of expertise. For example, *Glossadelphus zollingeri* is now under the name *Ectoprothecium zollingeri* (see www.tropicos.org).

Preparing a Moss Wall

One aquarium website describes a method to make a wall of mosses in the aquarium (Tan 2006b). A plastic mesh of 7 -10 mm, preferably black or other neutral color, is used as the foundation (Figure 42). The author suggests cutting the mesh to twice the size of the aquarium, folding

it, and putting the moss in between taco style (like a sandwich; Figure 43). The wall can be affixed with suction cups or rocks at the bottom with clamps at the top (Figure 44). The sandwich can be tied together where needed with fishing line so that fish cannot enter and get stuck. Mosses will grow through the mesh and soon fill in the spaces (Figure 45; Figure 46). Mosses can be grown on the bottom in a similar manner, again making sure fish cannot get under the layers of mesh (Figure 47).

To add interest, you might want to add some wood (without bark) where your mosses can grow. The best is wood that has soaked in a lake, then been sun-baked. More fresh wood must be soaked several days to remove the tannins (Sheng 2007). Moss can be tied to the wood with fishing line. Wait a week or so before introducing fauna to give the mosses a chance to attach. Sheng (2007) suggests setting the light at 9 watts to slow the growth of the moss (and algae).



Figure 42. To make a moss wall for an aquarium, one needs scissors, moss, screening, something to sew the screening together, and something to affix the moss wall to the aquarium wall. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 43. Mosses are woven into or sandwiched into the mat. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 44. The two halves of the mat are folded over and sewn together to prevent fish from entering. Suction cups or other means are used to attach the moss wall to the wall of the aquarium. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 47. A modification of the wall idea can be used to anchor mosses such as this *Fissidens fontanus* (Phoenix moss) to the floor of the aquarium. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 45. As time passes, mosses grow through the mesh to cover the wall of the aquarium. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 46. An established moss wall can extend into the aquarium and provide hiding places for fish and nesting sites for eggs. Photo by Sze Wei Tan <www.aquamoss.net>, with permission.

Maintenance

Most mosses are not as easy to cultivate as Java moss. If you are successful, the mosses often will grow long and fill a tank, collecting lots of organic matter from the fish. One trick to give them a fluffier look is to keep them trimmed (Jelsoft Enterprises Ltd. 2007).

Moss and other aquatic plant growth is usually enhanced by additional CO₂, up to 15-30 ppm (Stephan Mifsud, pers. comm. 14 December 2007). Light needs vary, so pay attention to the field light conditions for any wild mosses you use. *Vesicularia reticulata* (erect moss; Figure 14), for example, requires a brighter light than other species. Most of the aquarium mosses cannot tolerate temperatures greater than 26-28°C and stream mosses usually do better at temperatures closer to 15°C.

The mosses will typically collect detritus from fish feces and algae. Some of the small shrimp discussed below can help to clean these up, but check to be sure they aren't eating the mosses.

Dangers from other Organisms

Tan (2006a) warns against including the Siamese algae eater (*Crossocheilus siamensis*) in a tank with aquatic mosses (Figure 48). They will devour the moss and leave only a stubble of plants. Another moss scavenger, when the algae and other plants are scarce, is the Yamato shrimp (Yamato numa-ebi in Japanese), also known as Amano shrimp, Algae shrimp, or Japanese marsh shrimp (*Caridina multidentata*; Figure 49). When there is ample food, these shrimp will keep the mosses clean from algae without eating the mosses (Stephan Mifsud, pers. comm. 14 December 2007). Crystal red shrimps (*Caridina cantonensis* sp. Crystal Red; Figure 50-Figure 51) and red cherry shrimps (*Neocaridina davidi*; Figure 52) are a nice color contrast in small aquaria with mosses. I would suggest also being careful about including snails, especially with *Fissidens*, as they can likewise consume the mosses, although they seem to avoid *Fontinalis* (Figure 1) (Lohammar 1956).

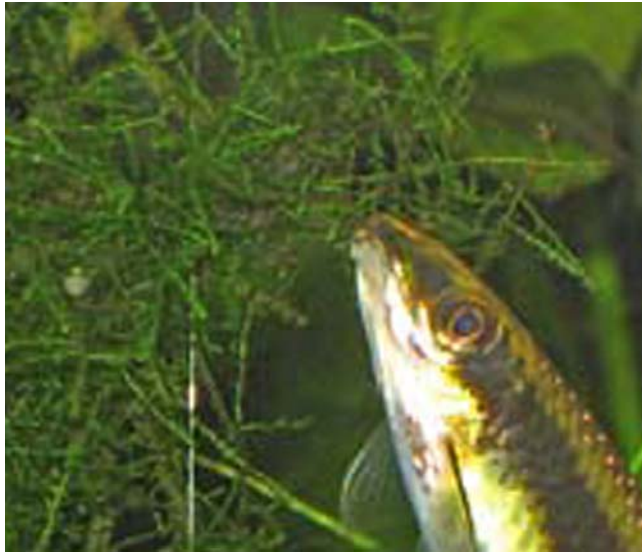


Figure 48. Siamese algae eater (*Crossocheilus siamensis*) eating *Taxiphyllum alternans* (Taiwan moss). Photo by Sze Wei Tan <www.aquamoss.net>, with permission.



Figure 49. The Yamato shrimp (*Caridina multidentata*) will eat mosses when algae and other plants become scarce. Photo by Richard Bartz through Creative Commons.



Figure 50. *Caridina cf cantonensis*, a species that helps to keep aquarium mosses clean. Photo by D. Tng through Public Domain.



Figure 51. *Caridina cf cantonensis* (crystal red shrimp) in an aquarium with mosses and other aquatic plants. Photo by Sean Murray through Creative Commons.



Figure 52. *Neocaridina heteropoda* (red cherry shrimp) in an aquarium – a species that can help keep mosses clean. Photo by Joseph Hoetzl through Creative Commons.

Algae Problems

Maintaining the moss is not difficult once you have established the right water conditions. However, eliminating the algae that can overgrow the moss is another story indeed. My own Java moss soon became so covered with algae that it no longer looked like a moss (Figure 53). Tan (2006a) recommends using a 5% solution of bleach. The alga-covered moss is placed into the solution and stirred in the solution for about two minutes. When the algae begin to turn white, the moss should be removed and placed into a rinse bucket. It should be rinsed several times in fresh water to remove all the bleach. This method is too harsh for some mosses, and in much less than two minutes. It was the moss *Fontinalis antipyretica* (Figure 1) that I found to be white; the algae, fungi, and bacteria seemed to survive quite well! Be sure to bleach the aquarium also to reduce new infections, and replace the water in the aquarium with clean water. The same goes for any rocks collected from outside or from an aquarium with algal growths. Let these sit for a while to let the chlorine escape before introducing fish, or use one of the agents for removing chlorine.

In my own research, I have found that high nutrient levels encourage algae at the expense of the mosses. These soon cover the mosses and rob them of CO₂ and light.

Mosses are usually low nutrient plants and will probably do best in the water they came from. However that water may carry disease organisms for which your fish have no immunity, so it might help to boil the water first for about 20 minutes. **Cyanobacteria**, those smelly blue-green things, can be especially problematic and take over your aquarium. Filter feeders can have problems because the gelatinous matrix around them can clog their feeding mechanisms and in some cases can clog gills.

Sheng (2007) cautions against putting your aquarium where it will receive direct sunlight, as that encourages the growth of algae. However, some mosses will need more light than is available to the typical indoor aquarium and may benefit from the addition of LED or other higher intensity light.



Figure 53. *Taxiphyllum barbieri* (Java moss) is soon densely covered with algae in an aquarium. Photo by Janice Glime.

Some organisms are browsers on the algae and will eat them without harming the moss. The small shrimp have already been mentioned as cleaners. In addition, some snails will keep the mosses clean. The Ramshorn snail, *Planorbis* sp. (Figure 54), will not eat mosses, but it will eat both **Cyanobacteria** (Figure 55) and **diatoms** (Stephan Misud, pers. comm. 14 December 2007). The shrimp are best for the filamentous algae. Mifsud finds that high CO₂ (15-30 ppm) will lower the pH enough to make it unsuitable for most of the invading algae.



Figure 54. *Planorbis corneus/rubrum*, a snail that can be used to keep aquarium mosses clean. Photo by Adilson Borszcz, through Creative Commons.



Figure 55. *Oscillatoria*, a common genus of **Cyanobacteria** that can overtake aquarium mosses. Photo by Janice Glime.

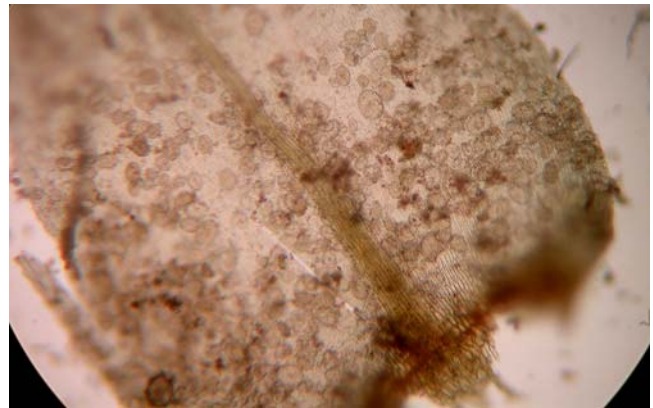


Figure 56. Diatoms (*Cocconeis*) on *Platyhypnidium riparioides*. These are easily introduced into the aquarium from mosses collected from the wild. Photo by Daniel Spitale, with permission

Commercial Fisheries

Little has been published on use of bryophytes for the commercial rearing of fish or use in fish hatcheries. However, persons interested in spawning fish for such purposes might learn something from the aquarium industry. In one of the few studies in the laboratory, Bohlen (1999) describes breeding the spined loach, *Cobitis taenia* (Figure 57). He used thick tufts of moss on top of gauze-covered plastic boxes as spawning sites. Those eggs that were nonadhesive fell through the gauze into the box. The oviposition occurred in the most dense areas of moss and produced numerous young.



Figure 57. *Cobitis taenia*, a fish that benefits from breeding in a bed of aquarium mosses. Photo by Ron Offermans, through Creative Commons.

Summary

Mosses in aquaria help to decorate while providing oxygen and hiding places, especially for laying eggs. They can be used to make walls, attached to logs and rocks, or grown from the sand on the floor of the aquarium. Most aquatic bryophytes prefer cool temperatures, low nutrients, and medium light; more light encourages algal growth. A mesh wall can hold the mosses or they can be allowed to grow free.

Some animals (fish, snails, algae shrimp) may eat the mosses. Others can be used to keep the mosses clean. Algae can be removed with a weak bleach solution.

Use of mosses as spawning grounds for commercial rearing of fish warrants further exploration.

Acknowledgments

Tan Sze Wei kindly allowed me to use any pictures I wished from his Aquamoss website. Stephan Mifsud wrote to me to add many bryophyte species to the list, updated nomenclature, provided advice on cleaner shrimp, and suggested growing conditions. I rarely get suggestions on my chapters, so his comments were greatly appreciated and have strengthened this chapter.

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