# CHAPTER 4
# AQUARIA

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

## 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 4), *Riccia fluitans* (Figure 5), *Ricciocarpos natans* (Figure 6), *Taxiphyllum barbieri* (Figure 7; Figure 8), and *Vesicularia dubyana* (Figure 9) (Benl 1958; Cook *et al.* 1974; Takaki *et al.* 1982; Gradstein *et al*. 2003; Tan *et al.* 2004).

One should be aware that scientific names provided by aquarium stores are often wrong. I have seen *Leptodictyum riparium* labelled *Fontinalis* and *Taxiphyllum barbieri* is often misnamed as *Vesicularia dubyana*.

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.


Figure 3. *Leptodictyum riparium* (stringy moss) adorning an unusual aquarium. Photo by Sze Wei Tan.

Figure 4. *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.

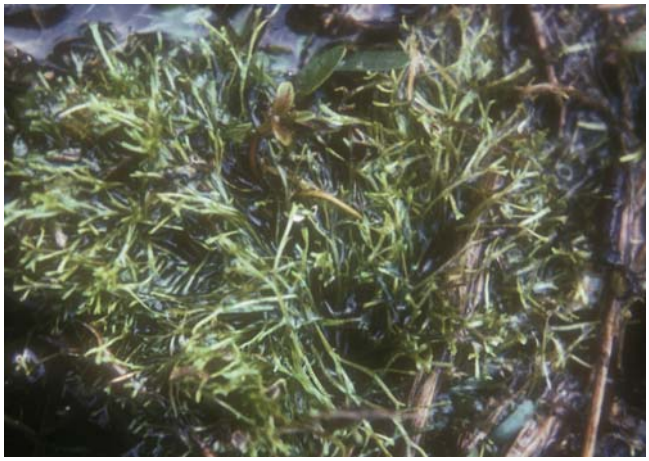

Figure 5. *Riccia fluitans* can be grown floating or in balls at the bottom of the aquarium in medium soft to hard water, *p*H 6-8, 15-30ºC (Aquatic Community). Photo by Janice Glime

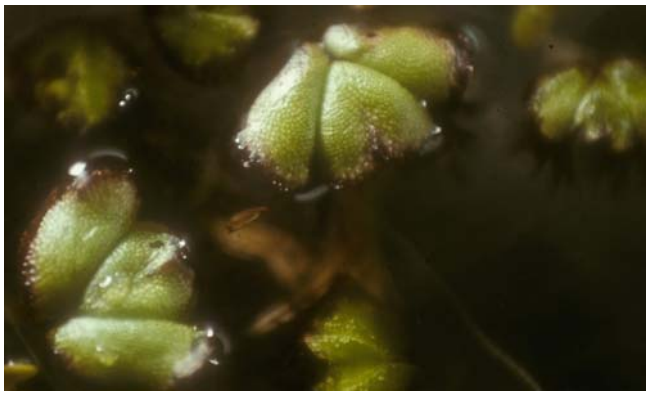

Figure 6. *Ricciocarpos natans*, a thallose liverwort sometimes used in aquaria. Photo by Janice Glime.

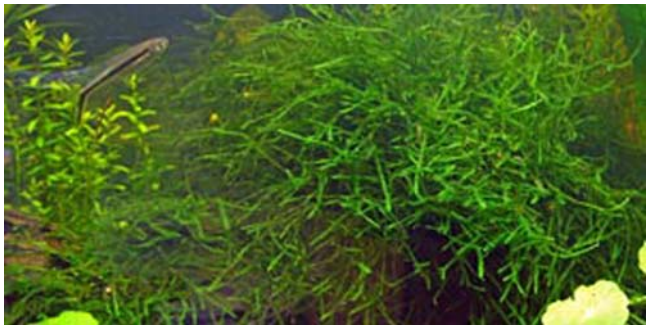

Figure 7. *Taxiphyllum barbieri* (Java moss) provides dimension to the aquarium and permits little fish to hide from larger aggressive fish. Photo by Sze Wei Tan.

Java moss (often incorrectly identified as *Vesicularia dubyana*, 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 $CO_2$, with or without added light, temperatures to 30ºC, and tap water. It grows rapidly and will fill the tank in short order, but is easily removed.

Unfortunately, the name Java moss has been applied to a variety of aquatic mosses sold for aquaria (Tan *et al.* 2004). The true Java moss (*Taxiphyllum barbieri*; Figure 7) has flattened, oval-oblong leaves arranged on two sides of the stem and branches, and possesses two short costae

(Figure 8). Its narrowly oblong leaf cells differ from the shorter ones of *Vesicularia* spp. (Figure 9)


Figure 8. The leaf of *Taxiphyllum barbieri*, the true Java moss, has two short costae and narrowly oblong leaf cells. Photo by Sze Wei Tan.


Figure 9. The moss often mistakenly called Java moss is *Vesicularia dubyana* (Singapore moss) and has shorter cells. Photo by Sze Wei Tan.

The true Java moss is the easiest to grow of all the aquatic mosses (Tan & Leong; Tan 2006). It thrives not only in cool water, but in low light at tropical temperatures of 28-30ºC, temperatures that would soon result in the death of the common temperate moss *Fontinalis antipyretica* (willow moss). In my aquarium, I need to remove vast quantities of Java moss approximately every month. It will adhere to driftwood, stones, or rest 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 in the struggle to get free.

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*) is often used to provide a backdrop to aquaria (Tan & Leong). 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* (Figure 10), the habit of *Vesicularia reticulata* (erect moss; Figure 11) is upright, giving it a different role when tied to driftwood or other substrate under water (Tan & Leong). The true *Vesicularia dubyana* (Figure 12), now dubbed Singapore moss, looks like a smaller version of Christmas moss.


Figure 10. *Vesicularia montagnei* (Christmas moss) is a hanging moss. Photo by Sze Wei Tan.


Figure 11. *Vesicularia reticulata* (erect moss) works well when tied to driftwood or other substrate. Photo by Sze Wei Tan.


Figure 12. *Vesicularia dubyana* (Singapore moss). Photo by Sze Wei Tan.

*Taxiphyllum cf. alternans* (Figure 13) 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 13. *Taxiphyllum alternans* (Taiwan moss) is a pinnately divided moss often sold for aquaria. Photo by Sze Wei Tan.

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 14), 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.

Figure 14. *Monosolenium tenerum* growing on soil in its natural habitat. Photo by Li Zhang.

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).

| | |
|---|---|
| *Amblystegium serpens* | nano moss |
| *Bryum pseudotriquetrum* | marsh bryum |
| *Chiloscyphus polyanthos* | square leaved liverwort |
| *Fissidens fontanus* | Phoenix moss |
| *Fontinalis antipyretica* | willow moss |
| *Glossadelphus zollingeri* | Bogor's moss |
| *Isopterygium* sp. | mini Taiwan moss |
| *Leptodictyum riparium* | stringy moss |
| *Monosolenium tenerum* | giant riccia |
| *Platyhypnidium riparioides* | beaked water moss |
| *Rhacopilum aristatum* | |
| *Riccia fluitans* | floating crystalwort |
| *Ricciocarpos natans* | water star |
| *Taxiphyllum alternans* | Taiwan moss |
| *Taxiphyllum barbieri* | Java moss |
| *Taxiphyllum* sp. | flame moss |
| *Taxiphyllum* sp. | giant moss |
| *Taxiphyllum* sp. | green sock moss |
| *Taxiphyllum* sp. | peacock moss |
| *Taxiphyllum* sp. | spiky moss |
| *Taxiphyllum* sp. | string moss |
| *Vesicularia dubyana* | Singapore moss |
| *Vesicularia ferriei* | weeping moss |
| *Vesicularia montagnei* | Christmas moss |
| *Vesicularia reticulata* | erect moss |
| *Vesicularia* sp. | creeping moss |

## 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 15). 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 16). The wall can be affixed with suction cups or rocks at the bottom with clamps at the top (Figure 17). 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 18; Figure 19). Mosses can be grown on the bottom in a similar manner, again making sure fish cannot get under the layers of mesh (Figure 20).

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). 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 suggests setting the light at 9 watts to slow the growth of the moss (and algae).


Figure 15. 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.


Figure 16. Mosses are woven into or sandwiched into the mat. Photo by Sze Wei Tan.


Figure 17. 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.


Figure 18. As time passes, mosses grow through the mesh to cover the wall of the aquarium. Photo by Sze Wei Tan.


Figure 19. 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.

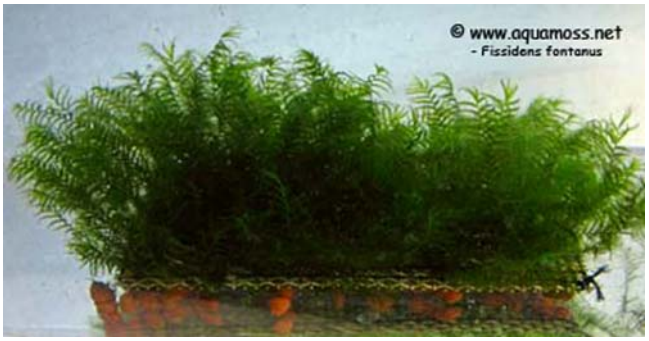


Figure 20. A modification of the wall idea can be used to anchor mosses such as this *Fissidens fontanus* (Phoenix moss) to the floor of the aquarium. Photo by Sze Wei Tan.

## Maintenance

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).

### Dangers from other Organisms

Tan (2006a) warns against including the Siamese algae eater (*Crossocheilus siamensis*) in a tank with aquatic mosses (Figure 21). 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 japonica*; Figure 22). 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* (Lohammar 1956).


Figure 21. Siamese algae eater (*Crossocheilus siamensis*) eating *Taxiphyllum alternans* (Taiwan moss). Photo by Sze Wei Tan.


Figure 22. The Yamato shrimp (*Caridina japonica*) will eat mosses when algae and other plants become scarce. Photo by Sze Wei Tan.

### 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 23). 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* 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. Let these sit for a while to let the chlorine escape before introducing fish, or use one of the agents for removing chlorine.

Sheng (Aquarium Life website) cautions against putting your aquarium where it will receive direct sunlight, as that encourages the growth of algae.

Figure 23. *Taxiphyllum barbieri* (Java moss) is soon densely covered with algae in an aquarium. Photo by Janice Glime.

## 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.* 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.


## 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.

Some animals (fish, snails, algae shrimp) may eat the mosses. A mesh wall can hold the mosses or they can be allowed to grow free. Algae can be removed with a weak bleach solution.

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


## Acknowledgments

Sze Wei Tan kindly allowed me to use any pictures I wished from his Aquamoss website.

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