The EcoSystem Aquarium Revisited

Checking In After Two Years

by Mike Paletta (Aquarium Fish Magazine, February 2000)

I have written more than 50 articles over the past 12 years, and none has produced as great a response as those on the EcoSystem method of filtration developed by Leng Sy. I have received literally hundreds of telephone calls and e-mails to discuss my experiences with this system, which has resulted in two schools of thought as to the attributes of the system. One group feels that, while it could work, they'd still like to see more evidence to that effect, and the other believes that it can't possibly work because it differs so markedly from other systems that use external biofilters.

Because of the interest this system has generated and the fact that there are still so many unanswered questions, I would like to share my experiences with the EcoSystem method over the last two years. Please note that I am not a representative of EcoSystem or its owner. I'm al- ways a bit concerned that the hobby is getting "boring," in that there is very little "new" information being presented - this system may help to keep more hobbyists involved because it provides an interesting alternative to many of the other systems currently in use.

Before I get started, let me briefly explain the EcoSystem method to those of you who are not familiar with it. It's basically the same as other systems - water is drawn off the top of the tank via an overflow box and then flows into the sump. In the sump the water first passes into a tall narrow chamber that contains bioballs, which are submerged, not dry. These bioballs break up any large pieces of detritus and dissipate any large air bubbles that are caused by the water splashing down. The water then flows out through two outlet slots near the bottom of a partition and into the main filtration chamber.

Here is where things start to get different. This central chamber is where virtually all of the filtration occurs. It contains two separate components that work together. In the bottom of the chamber, running from front to back, are several 2-inch high partitions. Within these partitions is the EcoSystem "miracle mud" substrate. This "mud" is the crucial component of the EcoSystem method.

Miracle mud is a non-calcareous medium that looks like a thick brown sludge. It feels like an extremely fine silt mixed with gravel and appears to be slightly buoyant, because at first it does not pack down firmly. It is this buoyancy that seems to keep the oxygen level low (anoxic) rather than completely lacking.

The mud is shipped dry, so it is initially free of micro-organisms. Over time, however, it becomes populated with a variety of microfauna and flora from the live rock in the tank. This also helps to keep it from becoming anaerobic.

Sitting above the mud in this chamber is a large bed of Caulerpa. Initially it was thought that only one species of Caulerpa would work. However, several hobbyists who I have been in contact with have now tried many different species and all have produced positive results. This algal bed performs several functions. It removes waste material from the tank, it helps to maintain a constant pH, and, by rooting in the mud, it also helps to keep the mud anoxic.

One of the major differences between this system and other systems that use algae for filtration is that with the EcoSystem method, the lights over the filter remain on 24 hours per day. That is, the lights above the sump never go off - which has produced some interesting results.

First, the wild pH fluctuations seen in other systems that use algal filtration do not occur in this system. The pH bottoms out at 8.2 one hour prior to the lights being turned on in

the main tank, and it rises to a maximum of 8.4 one hour prior to the light in the main tank going off at night. Additionally, after two years of growth in my system and several years of growth in Leng Sy's system, the Caulerpa in the filters have never crashed or gone into sexual reproduction, so none of this algae has found its way into the main display tanks, which is a common problem in some other algae filtration systems.

Even more interesting is seeing how crystal clear the water is. I should note, however, that in the last six months I have noticed a slightly yellow cast to the water that I did not notice during the previous 18 months, although the yellowing doesn't seem to be as great as I have seen in other systems. Again, it may be a result of the 24-hour light cycle.

Finally, for reasons still unclear to me, the Caulerpa has never out-grown the filter and needed to be harvested or removed. So, even after two years there is little maintenance involved in running this system.

Once the water passes through the Caulerpa it flows over a partition, through the slots near the bottom of a second partition and into a chamber that contains bioballs, from which it is then pumped into the main tank. These last bioballs prevent any of the Caulerpa from being drawn into the pump and fed into the main tank. The amount of water flowing through the filter is approximately three times the tank's volume per hour.

As you can see, the biggest difference between this system and most of the others that are currently being used is that there is no need for a protein skimmer. In my experience, this had both positive and negative consequences. I have now set up 10 tanks using this system and feel my experiences are fairly consistent. The drawbacks to using this system are generally noticed shortly after the tank is set up and before it has hit that "equilibrium" or stable state. The first shortcoming is that unless well-cured live rock is used, this system has a great deal of difficulty handling the large quantities of organics and other waste materials that are dumped from fresh live rock. This inability to handle a large amount of waste manifests itself in several ways.

Cyanobacteria, in the form of red slime algae, carpets the mud and the Caulerpa, resulting in diminished growth of the Caulerpa, which allows other types of unwanted algae to grow in the main tank. In order to prevent this, I have found it necessary to cure the rock outside the main tank for four to six weeks. This has generally been sufficient to reduce the initial waste load.

If, however, red slime still presents a problem, as it may during the early stages of the setup, then this algae should be siphoned off with either a turkey baster or a small diameter siphon hose. For this reason I strongly suggest that the EcoSystem sump not simply rest on the floor under the tank, but instead be raised slightly to make siphoning easier.

The other problem I have en- countered with this system is that Cryptocaryon (marine ich) is unusually difficult to eliminate, particularly until the animals that live in the mud have become fully established. This may be a function of not using a skimmer, but a more likely explanation is that the mud itself may act as a haven for this parasite.

I should point out that the ich outbreaks I experienced were not any more virulent or lethal than in my tanks that did not use this system, but seemed to linger for a longer period of time. Additionally, the ich parasite is difficult to eradicate in any reef tank without harming the invertebrates.

Once the mud was fully populated with animals the problem was greatly reduced. This could be a function of the animals in the mud, as I mentioned earlier, or it could be the result of the tank being fully established - no new specimens being added to stress the

tank's in- habitants.

Regardless of the reasons, care should be taken when introducing new fish into this system. As always, I heartily recommend using a quarantine tank to acclimate all new fish before introducing them into the display tank.

The only other drawback to this system is that there need to be better instructions for setup included with it. This is particularly troublesome when it comes to how much mud to use, how big a sump you need and what the recommended flow rate through the sump should be.

Particularly troublesome is the lack of guidelines as to water flow, which can lead to problems. If the flow is too slow, cyanobacteria may start to grow in the sump. To remedy this it may be necessary to add a powerhead to the sump. When the flow rate is too great it may result in tiny air bubbles passing through the sump from the first chamber and consequently being sucked in by the return pump and blown into the main tank. These bubbles can irritate the corals. Additionally, the mud itself may be pushed into uneven piles, which can cause the Caulerpa not to grow.

This lack of Caulerpa growth puzzled me for a long time until Dave Wodecki of Coral Connection came up with a possible reason. The high flow rate and subsequent high turbulence that resulted as the water flowed from the overflow was driving off C02, resulting in an insufficient amount of C02 to nourish the Caulerpa.

Dave devised a rather elegant solution: simply cover the sump with plastic wrap to help keep the C02 in the system. This simple solution resulted in a rather dramatic turnaround. The Caulerpa began to show signs of growth within three days after the plastic wrap was applied. After two weeks it had filled up the tank! So, like the other problems I have using this system, it was rather simple to remedy.

You are probably asking yourself why I am so positive about the EcoSystem method, given that I have spent so much time dwelling on its drawbacks. The greatest advantage is that I was able to keep more fish and corals with less effort than in any other system I have used. In my 90-gallon tank, before I replaced it with a 180-gallon tank, I was keeping 49 fish and it was packed full of corals, with very little maintenance needed. In fact, over the past two years I even reduced the amount of maintenance I was doing just to see what the impact would be.

Initially I was doing a weekly 6-gallon water change on the 90 gallon tank. During the past nine months I have reduced it to a 6-gallon change every other week. As long as I focused on removing detritus that had accumulated, there was virtually no negative impact on the tank. The only other maintenance that was performed - besides changing light bulbs every five months and cleaning the glass - was the addition of calcium and buffer twice a week.

I have not added trace elements to the tanks in two years using this system. In fact, because of the composition of the mud there is an almost constant slow release of many trace elements rather than a slow removal of these elements via the protein skimmer. Also, there seems to be no "bolus effect" that typically occurs when we dump in our weekly dose of trace elements.

Because it is logical that over time trace elements in the mud would eventually become exhausted, Leng Sy and I have begun experimenting with the rate at which the mud needs to be exchanged. At present, our best estimate is that 25 percent of the mud should be exchanged after approximately 18 months, with an additional 25 percent being exchanged every year after that. I say best estimate because our tanks were set up to test the extremes to which these tanks could be pushed. We have kept far more fish and

invertebrates than most hobbyists would.

The only indication that the nutrients in the mud were becoming depleted was that the growth of Xenia and Anthelia slowed down. I should point out that even when the mud was exhausted, the Xenia never crashed and has been stable and growing for over five years and needs to be harvested regularly. Once the mud was replaced, the Xenia began to double in size each month as it had done previously.

Another advantage of this system is that the mud and Caulerpa seem to act as a natural refugium for plankton production. As a result, small quantities of plankton are almost constantly flowing from the sump back into the display tank. This probably accounts for the continuous polyp extension I have seen in virtually all of the corals in this system.

As most of us know, polyp extension is a good indicator of a healthy coral, and corals in tanks using this system seem to display this attribute to a much greater degree than corals in almost any other of my tanks. This polyp ex- tension is impressive because not only do the corals open more fully during the day, but they also have their polyps extended at night. Even Xenia colonies will continue to pulsate at night as they would on the reef.

This system also seems to allow the successful maintenance of fish and invertebrates that had been thought to be difficult to keep in most other systems. These include the golden angelfish (Centropyge aurantius), the powder blue tang (Acantharus leucosternon), the Mandarinfish (Synchiropus splendidus) and even the delicate fairy and flasher wrasses. It has not just been possible to keep these fish - several species have even spawned, including percula clown- fish (Amphiprion percula), orchid dottybacks (Pseudochromis fridmani), Mandarinfish and Lubbock's fairy wrasse (Cirrhilabrus lubbocki).

The invertebrates typically requiring specialized care or supplemental feeding that have done well include orange carnation corals (Scleronephthya sp.), chili corals (Nephthygorgia sp.) and gorgonians. Sponges have also done exceedingly well. They are now at least 10 times larger than they were when they were placed in the tank as cuttings.

Over the past two years many questions have arisen regarding this system. I still do not have all of the answers, but I am much closer. The number one question still remains, "What's in the mud?" Well, I still don't know. Several individuals have run tests on it and found that it contains just about every compound commonly found in reef tanks. I do not think this is particularly significant. What I do think is important is that Leng Sy has developed the mud so that somehow these elements, particularly the trace elements, seem to be released slowly. This may be a function of the bacteria or other organisms that eventually colonize the mud. This effect seems to be beneficial because the corals are constantly exposed to small amounts of these elements as they would be in nature.

Another question is whether the species of Caulerpa chosen has any significance. I have used two different species - Caulerpa taxifolia and C racemosa - and have not seen much of a difference in the performance of the tank. James Lawrence of Microcosm has used a bed of mixed Caulerpa species and he too has not seen any negative effects. Two other tanks I have set up use other species of Caulerpa and have exhibited results similar to mine. I realize this is a limited sampling, but it is my opinion that the choice of Caulerpa for the bed is insignificant.

A more important question is whether the mud should be seeded or not. For those of you who are not aware, the mud is shipped dry and therefore contains no significant living material. Once it is placed in a tank that contains live rock, many of the organisms within the rock colonize the mud over time. The quality of the live rock and the number of organisms within it will determine how quickly the mud is colonized.

In my experience I believe it took approximately nine months for the mud to be fully

colonized. At this point there were a significant number of worms burrowing in the mud, along with a large population of tiny mysid shrimp and amphipods. At about the same time the corals really started to take off and spawning activity commenced in the fish.

It is therefore my belief that inoculating the mud with these organisms will help the system reach this point earlier. However, my opinion differs from Leng Sy's. He feels inoculating the mud is not necessary. For those of you wishing to inoculate your tank, you can either get some mud from someone with an existing EcoSystem tank or you can contact Morgan Lidster of Inland Aquatics to purchase some of these mud-based organisms.

The last big question has to do with how this system compares to a traditional (i.e., Berlin) system. To see the difference, Tom Frakes of Aquarium Systems set up two identical aquariums. The tanks were identical in terms of live rock, lighting, salt, calcium supplementation and inhabitants. Also, the same maintenance tasks were performed on each tank. The only difference between the two was that one tank used a protein skimmer for filtration and the other used the EcoSystem method.

Looking at these tanks approximately six months after setup there were noticeable differences. The EcoSystem tank had less microalgae on the glass and there was significantly more coralline algae and greater polyp extension. The growth rates of the corals were approximately the same, as was the overall health of the tanks.

The most interesting finding was that despite there being virtually no microalgae in the display tank using the EcoSystem filter, the filter itself had a significant amount of algae. For some reason the filter not only reduces microalgae in the tank, but it acts as a sort of "magnet" for keeping it within the bounds of the sump. This phenomenon has yet to be explained. Comparing these tanks over time will prove quite interesting.

I hope the pictures included with this article will help to show how successful this system has been. Most of the corals I initially placed in my tank were not prime specimens. They were usually cuttings or half dead pieces I got from shops. This was intentional, as I was skeptical when I first started and I did not want to waste my money if the system really did not work and the corals died. As the pictures show, these corals did not simply survive, they thrived.

I should also point out that not only have I never seen any lateral line disease in any fish in this system, but the colors of the fish have remained as vivid as the day they arrived. This last attribute has really impressed me. Not only do the fish not fade in this system, but when I have moved faded fish from other tanks into this system their color has often returned. It is not my intention that everyone should immediately throw out their skimmers and switch to the EcoSystem method. Rather, what I hope to do is point out that if you are not satisfied with your current system, whether reef or fish only, or if you are just starting a new tank, the EcoSystem method (www.EcoSystemaguarium.com) is a viable alternative that may offer several advantages over traditional systems.