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In addition, Reef Phytoplankton™ is enhanced to increase the bioavailability of important nutrients such as proteins, lipids, B vitamins, and other organic pigments, thus, corals expend less energy to derive the nutritional benefit.

It is blended to contain the proper ratio of fatty acids, carbohydrates, and proteins. Blending phytoplankton also yields better nutritional value. Studies* show increased consumption of phytoplankton in filter feeders when using mixed cultures versus a single culture of phytoplankton.

^{*} Villa, B. Rico, Le Coz, J. R., Mingant, C., and Robert, R. (2006). Aquaculture. 256, 377-388.

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features

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Ryuoh stones and stem plants can be effectively combined to simulate depthful expanses of forests and mountain ranges in the Nature Aquarium. **Takashi Amano**

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The results of the annual International Aquatic Plants Layout Contest are in, revealing the best of the best Nature Aquariums from around the world.

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Angelfish have long been a staple of the aquarium hobby due to their elegant appearance and graceful movements, and with new varieties consistently becoming available, they make an excellent choice for many home aquarists. **Maddy Hargrove**

70 Nano Fish: The Best Choices for 5-Gallon and Under Tanks

Nano tanks are often popular choices for beginners on up, but it's often hard to know what fish do best in them. An experienced nano keeper offers a selection of appropriate choices for aquariums 5 gallons or less. **Mark Denaro**

76 Fahaka Puffers

Famed for their entertaining personalities, puffers are loved by many. The fahaka puffer is no exception, and when kept in a large tank and given the right environment, it can make for a truly interactive pet.

Bill Rosser

82 A Cool Fish in More Than One Sense: The Blue-Spotted Jawfish Opistognathus rosenblatti

A cool-water fish, the blue-spotted jawfish makes a wonderful aquarium specimen for large tanks with plenty of hiding places. **Bob Fenner**

90 Retailer Spotlight: Tropiquarium in Ocean, New Jersey Located by the famous Jersey Shore, Tropiquarium features the best in

Located by the famous Jersey Shore, Tropiquarium features the best in both marine and freshwater livestock, as well as interesting setups to impress any hobbyist. **Albert Connelly, Jr.**





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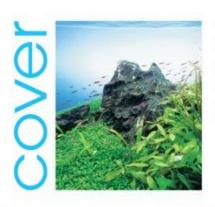
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The Nature Aquarium, with its elegant beauty, has served as a source of inspiration for countless hobbyists. Its creator, master aquascaper Takashi Amano, has perfected the art of making gorgeous layouts and continually offers new methods of design to keep things fresh. In the innovative layout on the cover, Mr. Amano shows a way to combine rocks and stem plants in his signature iwagumi layout in order to create a sense of depth without an awkward feeling (p. 54). Photograph by Takashi Amano

Our cover photo is available for your wallpaper and/or screensaver in the downloads section of thmagazine.com.

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from the publisher



oll is an extra-special year for us here at *TFH*, as we celebrate our 60th birthday with the September 2012 issue! What started as a small magazine launched in September 1952 by the father and uncle of our Executive Editor and CEO, Glen Axelrod, has now become the ultimate aquarium magazine for beginners through advanced hobbyists, freshwater to marine, and everything in between.

As part of our commitment to bring you the best, this year we are launching a new mobile app for Apple and Android devices. With this handheld version of *TFH*, you will be able to easily read the magazine anytime, anywhere, as well as get updates on breaking aquatic news and *TFH* Blog entries. And be sure to continue to be part of the ACTION in all things AQUATIC by visiting our website (tfhmagazine.com), liking us on Facebook, and following us on Twitter!

There are many different reasons why each of us is drawn to the aquarium hobby, and part of what inspires me when it comes to setting up a tank is how it contributes aesthetically to my surroundings. My decorating style has developed along the lines of rustic modernism—I've recently added a stark, clean-lined stone-slab dining table and white L-shaped couch to my living space, while reducing the overall amount of "stuff" in my home to what really matters to me. While I've always enjoyed the sleek and simple sandand rock-scaped 55-gallon rainbowfish tank in my office, with its clean lines and peaceful aura, I'm currently planning on introducing a large display tank at home to watch from my new couch. Certainly, any one of this year's winners of the International Aquatic Plants Layout Contest would be an inspiring addition to any home's decor. These gorgeous layouts would add quite a serene feeling to whatever room they are in (p. 58).

For those who prefer the many colors of the coral reef, professional aquascaper Ben Johnson begins his "Adventures in Aquascaping" project this month with a reefscape. In order to fit it in perfectly with the look of the owner's home, the tank is contained inside a wall and all the equipment is hidden behind it (p. 42).

We are also introducing two exciting new columns in this issue. The former president of the International Betta Congress, Mark Denaro, is sharing his extensive knowledge of bettas and their close relatives with "Into the Labyrinth" (p. 38). Renowned fish farmer Charles Clapsaddle is also coming onboard this month with his new column, "Life with Livebearers," in which he will share his love of the great variety of livebearers there are to keep and enjoy (p. 34).

There are also some important changes happening here at *TFH*. It is with some sadness but a great deal of excitement for the future that I am stepping aside as *TFH* Magazine's Publisher to accept more responsibility as Vice President of Creative Direction for T.F.H. Publications, Inc/Nylabone Products. Christopher T. Reggio will be coming onboard as the new publisher of the magazine; Christopher has served as the Publisher of T.F.H. Publications' book department for over the past six years, and he has an extensive history in the publishing industry.

I would also like to take this opportunity to say goodbye and thank you to our Editor-in-Chief David E. Boruchowitz, who has been with this magazine in various capacities since the late 1990s, as this is his last issue. Our longtime Q&A writer and all-around hobby expert, Jeff Kurtz, will be taking on a greater role at *TFH* as our new Senior Consulting Editor. We are thrilled to have him join the editorial team!

Also, our former Associate Publisher and Managing Editor, Albert Connelly, Jr., has accepted a promotion as T.F.H./Nylabone's Digital Communications Director, bringing his long editorial tenure at the magazine to a close. Shari Horowitz has been promoted to Managing Editor, and Tsing Mui will be taking on a greater role as Associate Editor and Digital Designer. I know they will continue to uphold *TFH*'s tradition of aquatic excellence as we move forward into our 60th birthday and beyond!

We at *TFH* wish all of our loyal readers and fishkeeping friends success, happiness, and health for 2012. Happy New Year! *¡Feliz Año Nuevo!*

Nancy Rivadeneira-Troccoli Publisher Tropical Fish Hobbyist



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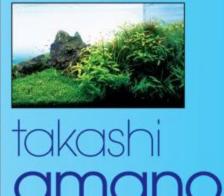
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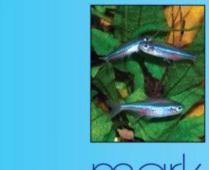
In This Issue: The world-famous master aquascaper and inventor of the Nature Aquarium layout style describes how to create a different type of Nature Aquarium layout. "I devised perspective for *iwagumi* to combine stem plants with an *iwagumi* layout for simulating mountainous scenery without creating an odd feeling."

Other Works: Nature Aquarium World, Aqua Journal

Inspiration for the Nature Aquarium Style: "Although plants may appear untidy in nature, they are growing in an orderly manner. Rocks are arranged naturally by the flow of water, and they create various scenes. These scenes are truly the examples of natural beauty. I have observed and learned many things from nature while creating Nature Aquarium, which recreate such scenery in an aquarium."











In This Issue: With the increasing popularity of nano tanks, many people need to know exactly what fish can go into them. Along with that, people need to know what doesn't belong in a nano. According to Mark, "On the bright side, the list of species that do well in small tanks is actually rather extensive."

Founder of: Anubias Design

Most Exciting Aspect of Your Job: "Trying to track down new species and, even more, to find known species that are very rare in the hobby. I really like to bring in fish that are not generally available and get them into the hands of hobbyists who should be successful with them in the hopes of getting these species established in the hobby."

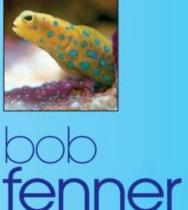
In This Issue: One of the most renowned marine aquarists worldwide chose to cover a commonly misrepresented species—the blue-spotted jawfish. "I have seen a few cycles of cool to colder water organisms sold (or may I say misrepresented) as tropicals, including Catalina gobies, Garibaldi, Metridium and Tealia anemones, moon snails, many types of algae, etc. None of these will live for long in too-warm surroundings, and neither will this coolwater jawfish."

Other Works: The Conscientious Marine Aquarist, WetWebMedia.com

Inspiration for Starting WetWebMedia.com: "I had a burning desire to help inspire and educate folks interested in ornamental aquatics."

Best Place You've Ever Been Diving: "Gosh, there are several—likely the Red Sea though overall, for water clarity, ease of access, topography, biodiversity, and abundance."







rosser



In This Issue: A professional aquarium designer writes about the Fahaka puffer, a beautiful and popular freshwater fish. "The need to dedicate a whole aquarium to one fish is, for many puffer aficionados, more than made up for by the interactive pet the puffer becomes. Puffers are the comics of the fish world, oftentimes serving as the clowns of an aquarium," he wrote.

Founder of: Reptaquatics.com

What's Your Favorite Fish? "That's a hard question to answer. I've worked with hundreds of species and have a love for all fish. However, I'm fascinated by large predatory fish that are still suitable for larger home aquariums. I can tell you my top three are marine bamboo sharks *Chiloscyllium* spp., the freshwater giant puffer *Tetraodon mbu*, and the freshwater saber tusk barracuda *Hydrolycus scomberoides*."

also in this issue:

Maddy Hargrove, Albert Connelly, Jr., Jack Wattley, Ted Judy, Rhonda Wilson, Charles Clapsaddle, Ben Johnson, James Fatherree



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Q&Afreshwater

Koi in Aquarium?
An indoor garden center in my community has small koi (5 or 6 inches) for sale in one of those black, rigid pond liners, and I would like to know whether I could reasonably keep three or so in a 55-gallon tank.

Monica Westerberg via email

If your intention is to keep the koi in the aquarium just for the winter months and then transfer them permanently to an outdoor pond in the spring, then they should be just fine. However, if your plan is to keep the koi as permanent residents in your 55-gallon tank, that will not work. Being bulky, messy fish that can reach upward of 3 to 4 feet in length, koi are very poorly suited for almost any home aquarium. In fact, they're not even well suited for the average garden pond, where goldfish are a much better choice. To keep koi in good health for the long term, they need a pond in the thousands of gallons that includes a deep section (at least 4 feet) where they can refuge in winter and escape the sun's intense heat in summer.

Besides, koi have been selectively bred to develop colors and patterns that are observed to their greatest advantage from above—as when viewing them in a pond—rather than from the side as you would see them in an aquarium.

Peacock Cichlid Hybridization
I am interested in keeping, and potentially breeding, peacock cichlids from Lake Malawi. Originally, I

was planning to keep several different peacock species in the same 100-gallon tank, but a friend advised me against that because he says that they'll hybridize. What difference does it make if they hybridize? It's not as if I'm planning to reintroduce them to the wild!

Jill Steinrod Baltimore, Maryland

As long as any resultant offspring remain in your care, it doesn't really matter at all whether the different peacock cichlids (Aulonocara spp.) in your tank hybridize. However, even though they'll never end up in Lake Malawi, problems can easily come into play if you ever decide to trade any of the hybridized offspring with your dealer or fellow hobbyists—a likely eventuality given the relative ease with which Aulonocara cichlids breed. Aulonocara species can be very difficult to distinguish at a glance—especially the more drably colored females—and they tend to hybridize readily in captivity.

For these reasons, the identification of Aulonocara cichlids (and their labeling at the retail level) has become quite muddled, and hobbyists are hard pressed to find true strains. Introducing additional hybrids to the hobby just sows more confusion.

So, if your goal is to breed peacock cichlids and you want to avoid hybridization, it's best to acquire your specimens from a reputable dealer or breeder who specializes in cichlids and keep only one species per tank. If you decide to mix different species, just make sure none of the offspring wind up in the trade.

got a question?

Send your questions about the freshwater side of the aquarium hobby to "Q&A," T.F.H. Publications, P.O. Box 427, Neptune, NJ 07754, or submit via e-mail to editor@tfh. com. For answers to more time-sensitive questions, opinions on your setup, or just to converse with likeminded members of the aquarium community, please visit the TFH Forum at forums.tfhmagazine.com.

Extended Power Loss

As a hobby aquarist, there are a few things you assume when being a responsible caretaker for your fish. You assume the tank will hold together at the seams, that you will have a water supply to replenish your tank, and that you will have electricity to power your tank's devices.

After surviving the wrath of Hurricane Irene, I lost power in my home. Immediately after the outage occurred, I was concerned for my 30- and 20-gallon cichlid tanks. Early estimates from the utility company depicted a scenario in which power could be restored in, at best, five days.

During that time, not knowing when the power would return, I monitored and maintained my tanks as best I could. Despite doing daily water changes, physically agitating the water to aerate the water column, and meticulously monitoring ammonia and nitrate levels, I lost an eightyear-old blood parrot cichlid and a twoyear-old electric yellow cichlid.

On the sixth day, power was restored, and luckily, the other seven fish in my tanks survived the ordeal. Short of moving the fish to another location, what advice can you give other hobby aquarists in terms of maintaining a tank when there is no electricity to run filters, aeration units, and powerheads?

An-Shih Lee Long Island, New York

First, let me say that I think you did an admirable job under some very trying circumstances. It's certainly regrettable that you lost two specimens, but your valiant effort did save the majority of your fish.

In a perfect world, every aquarium hobbyist would have a backup generator on hand to prevent losses in the event of a prolonged power outage, but given the potential cost of these units, that's not necessarily a realistic option for everyone. Besides, generators have to be operated outdoors to prevent carbon monoxide poisoning, so if your area was among those that experienced significant flooding, it might not have even been practical to run one outside your home.

The most significant threats to aquarium livestock during a power outage are rapid or precipitous temperature changes, depletion of dissolved oxygen, and the buildup of toxic pollutants. With respect to the first point,



■ A pond in the thousands of gallons is ideal for koi, which reach large sizes and require deep areas for refuge during winters and summers.



Peacock cichlid Aulonocara jacobfreibergi; hybridized offspring of peacock cichlids should not be traded, as this would only compound the existing complexity of identifying pure strains.

the emphasis should be placed on "rapid or precipitous." A change of a few degrees in either direction that occurs over the course of many hours or a few days generally won't harm fish. However, a shift occurring over just a few hours or a very significant shift that moves the temperature outside the range that is acceptable for your fish can be deadly.

To help minimize temperature swings, it's a good idea to surround your tank with an insulating blanket of some sort. If the power is out for a long time, the water temperature will still change, but the shift will be more gradual and, hopefully, not overly stressful to the fish. It's also helpful to keep several plastic water

bottles in your freezer at all times. That way, if the power goes out and the temperature is expected to climb, you can float the frozen bottles in your aquariums to slow the shift. Of course, this method is only practicable while the bottles remain frozen. After power has been out for an extended period, they'll begin to thaw along with everything else in your freezer. Still, you might be able to buy your fish a little time with this technique.

As far as dissolved oxygen depletion is concerned, your best hedge against that is to have on hand several battery-powered air pumps (which are very modestly priced) along with airline tubing and airstones, and a



Passive tankmates will pair best with the slow-moving banjo catfish Bunocephalus coracoideus.

good supply of replacement batteries. (There are also air pumps that are designed to run on a 12-volt car or boat battery.) A few bubbling airstones in each tank will help provide aeration and circulation, thereby maintaining an oxygen level that is survivable for the fish and minimizing the impact on your biological filter.

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Daily (or even more frequent) water changes during the outage are your best defense against the buildup of toxic pollutants, e.g., ammonia, in the water. Also, it's best to avoid feeding your fish during a power outage. Any uneaten food and the resultant fish waste will put too great a burden on the already tenuous biofilter. Besides, most fish will be just fine without food for up to a week or even longer.

Banjo Caffish in Platy Tank
My local fish store is selling banjo catfish (I don't know the scientific name), and I'm thinking about getting one to put in my 29-gallon freshwater tank, which contains three different platy varieties. Right now, there's a total of 12 fish in the tank. Will the banjo catfish and platies get along okay?

Sylvia Cook via email

You wouldn't have any problems in terms of aggression between the banjo catfish, likely a Bunocephalus species, and your platies, but I still wouldn't recommend adding one to your tank. There are two reasons for this. One, the various banjo catfishes are very slow-moving bottom feeders and would be outcompeted at every mealtime by the fast-moving, ever-hungry, top-waterfeeding platies. Two, Bunocephalus catfishes enjoy very different water parameters than platies do. Whereas platies thrive in hard, alkaline water and cooler temperatures, the banjo catfishes prefer softer, slightly acidic, warmer water. Generally speaking, the banjo

catfishes are best kept in a species tank that caters to their specific needs or with very passive tankmates that have the same water chemistry and temperature requirements.

Water Change Frequency
Hello from a new subscriber to your magazine based in Perth,
Western Australia. I have to say, from the few issues I've read so far, you blokes do a bloody good job!

My question relates to the contentious issue of the frequency of water changes. I have a tropical freshwater tank, measuring 5 feet by 2 feet by 2 feet, that has been going for about four years with CO₂ supplementation. The tank is moderately planted and houses about 40 fish (tetras, danios, cories, etc).

During the first 12 months or so, I changed about half of the water fortnightly, but since then, mainly due to laziness, water changes have stretched out to half the water every six weeks and sometimes longer. I monitor pH, ammonia, nitrite, and nitrate regularly, and these values have remained at 6.8, 0, 0, and 5 to 10 ppm, respectively, the whole time. I only occasionally lose a fish, and plant growth is robust.

This situation doesn't seem to fit the frequent, significant water change schedule that is generally recommended. Am I walking a knife's edge, or, more generally, is the water change issue dependent on the ecology of the tank in question more than anything else?

Peter Dallas Perth, Western Australia

Thank you so much for your kind remarks, and welcome! It's great to have you with us! I think you nailed it right on the head. The appropriate frequency and volume of water changes does depend to a large extent on the ecology of the aquarium in question, particularly the stocking level/feeding regimen. In your tank, which holds approximately 150 gallons, 40 small fishes, such as tetras, danios, and Corydoras catfishes, won't have nearly as big an effect on water quality as they would in a much smaller tank or that, say, 5 or 6 fullgrown oscars or piranhas, with their messy eating habits and copious waste production, would have in your 150. Generally speaking, the water quality in lightly stocked, judiciously fed aquariums can be maintained with fewer or smaller water changes.

Nonetheless, it's important to consider that there are numerous benefits to frequent water changes that go beyond the mere export/dilution of nitrogenous compounds, such as the replenishment of vital trace elements, the promotion of more stable water chemistry, better water clarity, and better rates of growth and longevity in the fish. Perhaps the best way to look at it is that there are myriad benefits to performing frequent, large water changes but virtually no drawbacks.

Premature

Today, my wife and I bought one male and two female red velvet swordtails from a local pet store. While we were driving home, one of the females gave birth to several babies, but unfortunately all of them died. Do you suppose the birth was premature and brought on by the stress of transfer, or was the female just ready to deliver right when we bought her? Since the babies were stillborn or died right after delivery, we're concerned that the female won't have healthy babies in the future. Is our worrying justified?

Carl Young via email



■ Hi-fin lyretail swordtails; female swordtails may deliver their brood prematurely when stressed, but this has no ill effect on later spawns.

While it is possible that the female swordtail was coincidentally ready to deliver right when you bought her, the more likely scenario is the first one that you describe—the stress of being netted, bagged, and transported induced her to deliver her fry prematurely. Not to worry, though. This is a very common

occurrence with livebearers and no cause for concern that the female (or females) who delivered the young won't give birth to healthy, viable offspring in the future. Given adequate space, appropriate water conditions, and nutritious foods, both females should eventually reward you with more babies than you know what to do with.



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Anubias and other aquatic plants can be quarantined in a separate tank to prevent the introduction of snails, parasites, and other undesirables.

Aquarium Plant Quarantine
I have a question about aquarium plants that I hope isn't too silly. Is it necessary to quarantine new plants just as one would a fish?
Rod Johnson
San Antonio, Texas

That's an excellent question, and there's nothing silly about it at all! A period of quarantine is recommended for plants just as it is for fish or any other form of aquarium livestock. Remember, certain irksome pests that can reproduce to epidemic proportions in aquariums, such

as snails and hydra, commonly arrive as hitchhikers on live plants. Keeping plants in quarantine for at least a few weeks gives the aquarist an opportunity to observe them closely for evidence of such undesirable critters and to eliminate them either through manual removal or chemical disinfection (e.g., dipping the plants in a potassium permanganate solution).

Also keep in mind that aquarium plants can harbor certain parasites that feed upon fish, such as cysts of the freshwater ich parasite. You certainly wouldn't want these cysts hatching and releasing free-swimming parasites into an aquarium containing fish. On the other hand, if they hatch in a quarantine tank where no fish are present, no harm will be done because, absent any host fishes, the free swimmers will simply die in a matter of days, and the ich lifecycle will be broken before the plants are introduced to the main system.

Condensation in Heater
My aquarium heater recently died, and a friend was kind enough to bail me out by giving me



his spare submersible heater. So far, it's been working fine, but today I was looking very closely at it and noticed that some condensation is visible inside the glass tube. I haven't been shocked or anything, but should I be worried about that moisture?

Clayton Brown via email

I would say you're more than justified in worrying about condensation inside your aquarium heater. As the old saying goes, water and electricity don't mix (well, not without serious consequences, anyway), so I would replace that heater posthaste. It may be working fine for now, but how long will that last? At best, the condensation could eventually lead to corrosion that impairs the heater's performance. At worst, the moisture could cause a catastrophic failure, resulting in a shattered heater and the risk of electrocution. Given the relatively modest cost of replacing a faulty heater, that's simply not a risk worth taking.

This experience should also reinforce the importance of plugging all electrical aquarium devices into a ground fault circuit interrupter (GFCI), which prevents electrical shock by instantly cutting off the electricity any time a difference in the flow of current is detected between the hot and ground sides of the circuit.

Fishless

Cycling

I've cycled many an aquarium before using fish, but now I'd like to try the fishless method I've been hearing so much about lately. How much ammonia is needed to get the cycle started, and what do you recommend as an ammonia source? Also, is it necessary to add gravel or filter media from a mature tank or will the beneficial bacteria populate the tank either way?

Barry Adams via email

A good target ammonia level for initiating cycling is somewhere between 3 and 5 parts per million.

The ammonia can be introduced either directly by adding an ammonia salt or an ammonia solution (with no perfumes, colorants, etc. added) to the water or indirectly by putting fish food in the tank and allowing it to decompose. Either method will work just as well as the other. I've found that meaty foods, such as brine shrimp or pieces of table shrimp,

work faster than flakes for achieving the desired ammonia level. It's not absolutely necessary to seed the new tank with substrate or filter media from an established system, but it certainly helps to speed the process along. So, if you can source these materials from another tank or a fellow hobbyist's system, so much the better.



2000 CaAsaltwater

Safe to Add Scarlet Cleaner Shrimp?

Hello, I am 11 years old, and I am currently setting up a 150-gallon saltwater aquarium. I am wondering if I am too inexperienced to maintain three or so scarlet cleaner shrimp. I plan on adding them once the tank is fully established and all the water parameters are stabilized. The selection of fish I plan to add includes ocellaris clownfish, a sailfin tang, several blue-striped neon gobies, and a school of pajama cardinalfish. Please tell me if some red leg reef hermit crabs would bother them in any way. Also, since I live in Trinidad and Tobago, I do not live near any aquarium stores that sell quality saltwater livestock, so I plan to purchase all my livestock online. Do these shrimp suffer during shipping? Thanks!

Matthew Teelucksingh via email

I don't think you'll have any problems keeping a small group of scarlet cleaner shrimps, presumably Lysmata amboinensis or L. debelius, in your 150-gallon. It's especially encouraging to hear that you plan to wait to introduce them until the tank is fully established and the water parameters have stabilized. That tells me you're already thinking like a successful saltwater aquarist! I also think you've selected a nice assortment of fish that should get along well with each other and with the shrimps.

As far as the red leg reef hermit crabs are concerned, I can't say for certain whether they would be compatible with the shrimps because many hermit crab species are sold under that name, including various Dardanus, Paguristes, and Calcinus species to name a few. Some are larger, more aggressive, and less trustworthy

than others. Make sure you know exactly which hermit crab species you're adding, and fully research its characteristics ahead of time.

The cleaner shrimps should ship just fine, but do keep in mind that Lysmata species are very sensitive to sudden changes in water parameters. It's very important to acclimate them to your tank slowly until the water chemistry and temperature are exactly the same.

Protein Skimmer Maintenance Schedule

What type of maintenance schedule would you recommend for a protein skimmer? Can you tell me what needs to be done on a daily, weekly, and monthly basis to keep the skimmer operating at peak efficiency?

Glen Napier Wheeling, West Virginia

Well, the exact timing of protein skimmer maintenance tasks will vary depending on bioload and other system particulars, but here's what works for me: Every day or couple of days, I pour the accumulated skimmate from the collection cup down the sink drain and rinse the cup thoroughly under running tap water. Then, every week or so, I wipe the neck of the skimmer chamber and the collection cup with a clean paper towel to remove any accumulated gunk so it doesn't interfere with foam production. On a monthly basis, I remove the skimmer from the sump, disassemble it, and soak the pump, valves, and tubes in white vinegar to dissolve any calcium buildup that might be clogging up the works. After that, I use a pipe cleaner to eliminate any gunk or debris that remains inside these components. Finally, I rinse everything off in tap water, reassemble the skimmer, and return it to my sump.

got a question?

Send your questions about the saltwater side of the aquarium hobby to "Q&A," T.F.H. Publications, P.O. Box 427, Neptune, NJ 07754, or submit via e-mail to editor@tfh. com. For answers to more time-sensitive questions, opinions on your setup, or just to converse with likeminded members of the aquarium community, please visit the TFH Forum at forums.tfhmagazine.com.

Specific Gravity Dropping

I've kept freshwater aquariums for a long time but just recently started my first saltwater tank. For some reason, my specific gravity keeps dropping. I usually notice the drop after I do a water change, which baffles me because whenever I mix up replacement water, I make sure it is the exact same specific gravity as the water in the aquarium. Any idea what's going on here?

Carty Kestenbaum via email

Since the drop in specific gravity seems to coincide with water changes, I'm wondering whether you're using the replacement water immediately after mixing it rather than aging it for a day or so first. I've found that immediately after mixing up a batch of salt water, I tend to get a false high specific gravity reading because there are a lot of tiny air bubbles in the water, which cling to the hydrometer needle and cause it to rise higher than it should. However, if I aerate and heat the water at least overnight so those excess bubbles can off-gas, the salt has a chance to dissolve completely, and the water chemistry has a chance to stabilize, I tend to get a lower specific gravity reading when I test again the next day. I can then add a bit more salt to bring the specific gravity to the desired level and then use it for a water change.

Another possibility is that whenever you do water changes, you're actually replacing a smaller volume of salt water than you remove. Then, when you top off the system with fresh water to compensate for evaporation, you essentially replace some of the salt water with fresh water, causing your specific gravity to drop. Obviously, there should be an exact 1:1 ratio of salt water removed to salt water replaced. Approximations will throw off your specific gravity in one direction or the other.

Hitchhiking Featherduster Worms

I'm setting up a 90-gallon reef system and enjoying every step of the process (well, mostly anyway). Things are really starting to get exciting now that I've added my live rock. I can't believe all the amazing little creatures that are emerging! My question is about the tiny featherduster worms I'm seeing on the rocks. Are they likely to survive? They're such a neat



Scarlet cleaner shrimp Lysmata debelius; the health of Lysmata species can be maintained under stable water conditions.



■ Pink featherduster worm Sabellastarte indica; featherduster worms have a much better chance of survival in a predator-free aquarium that offers a regular supply of fine, suspended particulate matter.

feature, and I'd hate to lose them!
Thomas Connair
Pasadena, Texas

My experience with the various little featherduster worms that hitchhike on live rock is that they tend to hang on for a while but then eventually disappear—either because they've been eaten by the resident fishes or motile invertebrates, or they starve to

death because food of the appropriate type and particle size isn't available in sufficient quantities in the average reef aquarium. Still, they have been known to survive and even reproduce in predator-free systems with adequate levels of fine, suspended particulate matter. There are also various commercial products containing phytoplankton that you might try as a food source for the worms, though there's no guarantee that they'll be accepted by the particular species in your tank.



Clownfish have the ability to lay hundreds of eggs in a single week.

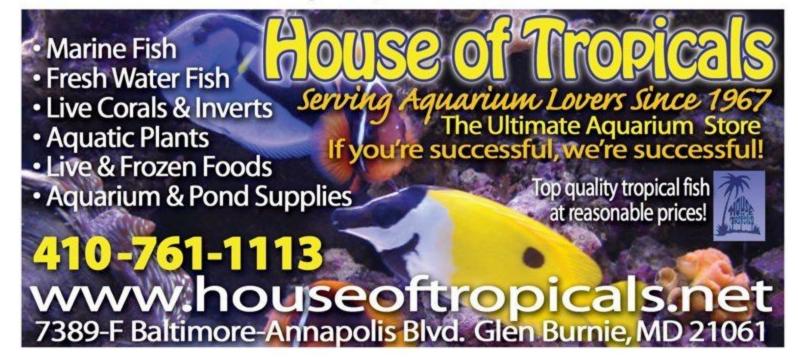
Placement of Live Rock
I have a newbie question for you. When placing live rocks in an aquarium, is it best to put them directly on the glass bottom of the tank and then fill in with sand around them or to put them on top of the sand bed? To me, it would seem to make more sense to put them on top of the sand, but my dealer says otherwise. Which way would you recommend?

Randy Pietrykowski via email

It's generally preferable to put the rocks directly on the bottom of the tank and then fill in around them with substrate material. Or, if you're a butterfingers like I am and you're worried that you'll accidentally drop one of the rocks and crack the bottom pane as you

put together your rock layout, you could put down a thin cushioning layer (a quarter inch or so) of substrate first, followed by the rocks and then the rest of the sand bed. Rockwork placed on top of a deep substrate can be easily undermined by digging or burrowing livestock, which could destabilize it to the point that rocks tumble over and crack the aquarium. If you choose not to include any burrowing/digging species in your system, you can get away with putting the rocks on top of the substrate, but then you'll be limited in terms of the livestock you can add later on.

Clownfish Eggs
Hi TFH! My name is Nicklas, and I'm seven years old. Can you tell me how many eggs a clownfish can lay?
Nicklas Pawlicki



via email

Joyce Wilkerson, a person who wrote a really good book about clownfishes and has raised a lot of them in aquariums, writes that a clownfish pair (a male and female together), depending on which species it is (a lot of people think there is just one type of clownfish, but did you know there are actually 28 different clownfish species?), will lay somewhere between 400 and 1500 eggs every two weeks. That means that every year, a clownfish pair can lay about 10,000 to 40,000 eggs! Now, it's important to remember that these amounts are just averages. We should think of these numbers as being normal or usual amounts, not exact amounts that are true for every clownfish. Some clownfish will lay more eggs or fewer eggs than usual.

Non-Photosynthetic Invertebrates Easier?

I'm a novice reef aquarist, and I'm curious as to whether I would be better off starting with non-photosynthetic invertebrates rather than the photosynthetic kind. Are they generally considered easier to keep?

Robert Algerton Portland, Oregon

On the contrary, I would recommend that you start with photosynthetic, or hermatypic, invertebrates (those that derive much of their nutrition from the symbiotic zooxanthellae in their tissues) rather than the non-photosynthetic, or ahermatypic, kinds (those that lack zooxanthellae and derive their nutrition solely from filter feeding).

Ahermatypic sessile invertebrates, such as Tubastraea, Dendronephthya, and many gorgonians, demand frequent, heavy feedings of zooplankton, which can quickly pollute the water and overwhelm the biofilter in a closed system. What's more, the various ahermatypic invertebrates tend to be very exacting with respect to the type and particle size of food they can eat, and it's not always easy to figure out what type of food is best.

On the other hand, there are quite a few hardy, beginner-friendly hermatypic sessile invertebrates in the trade—especially among the so-called soft corals—that will thrive with minimal to no supplemental feeding as long as the proper lighting, water quality, and water movement are provided. A few good choices for the novice include the leather corals, e.g., various Sinularia and Sarcophyton spp.; pulse corals Xenia spp.; zoanthid polyps, e.g., Zoanthus

sociatus; and green star polyps Pachyclavularia violacea.

Acropora Bleaching I have a 125-gallon reef aquarium housing a nice mix of soft- and large-polyp stony (SPS, LPS) corals. Lighting is provided by three 250-watt metal halides along with T5 actinic tubes. Water parameters are as follows: temperature 78°F, specific gravity 1.025, pH 8.2, alkalinity 3.0 meg/l, ammonia and nitrite 0, and nitrate less than 5 ppm. I do bi-weekly, 20-percent water changes. The tank has been up and running for two years, but there's still a decent amount of space available for additional coral specimens. On several occasions, I've tried to add an Acropora frag to the tank, but each time, the coral has bleached over the course of a few days and then died. My water conditions are all right in line, so I'm not sure why I can't keep these corals alive. Water movement is pretty strong in the tank, so I don't think that's the problem. Could it be that my lighting isn't powerful enough for Acropora?

Grinnell Blankenship Newport News, Virginia



■ To avoid the bleaching of Acropora, provide proper lighting and avoid placing them too close to other soft corals, which may incite allelopathy (chemical warfare).

Your 250-watt halides should provide ample light for Acropora spp. corals. However, depending on the level of illumination the Acropora frags were originally kept under and where you've tried to place them in your tank relative to the metal halides, it is possible that they're getting stressed by sudden exposure to a significantly greater light intensity than

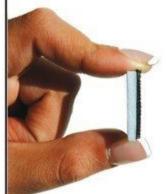
they're accustomed to. That's one possibility you might need to explore. If it turns out they were accustomed to lower light levels, you'll need to acclimate them very gradually to your lighting, either by starting them at the bottom of the tank and moving them incrementally higher on the rockwork or by placing several layers of some type of shading material (e.g., window screening) between the coral specimen and the lamp and then gradually removing the shading material one layer at a time.

Another strong possibility here is that there's a lot of allelopathy (chemical warfare) going on among the established corals in your tank. Many soft corals can be especially volatile in this regard, and sensitive small-polyped stony corals, such as Acropora, don't always fare well when they're housed together with soft corals. Sometimes this arrangement can work, but it's usually best to focus on either soft or stony corals, not both.

Dead Dottyback
The magenta dottyback that
I had in my 90-gallon reef
tank has been missing for
several days, and I'm starting to think it
probably died somewhere in the live rock.

What do they mean if it's Little it's Big ?

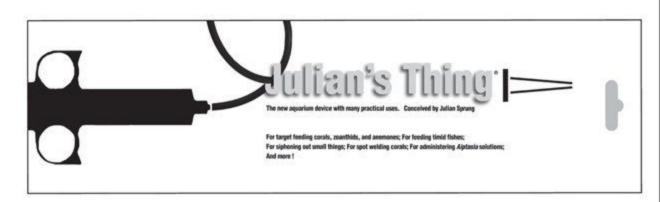
We can't help it. Try as we might to leave small footprints and walk softly we always end up making a big impression. What more can we say than this: If you try a Little, you will be satisfied a lot.





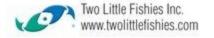


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Patent pending design by Julian Sprung.



My question is, assuming the fish died and doesn't reappear, how big a deal will it be to just leave it in the tank? It's a wellestablished reef system, and trying to find the body will be a major hassle. On the other hand, I would hate for ammonia to kill any of my corals.

Cliff Bonson Littleton, Colorado In a tank that large, assuming you have a decent amount of live rock in there, the biological filter should be able to manage the additional bioload of a decaying dead fish the size of a magenta dottyback. I would be inclined to recommend that you leave the body in place if, as you suggest, locating and removing it would be problematic. Besides,

if you have any scavenging organisms in there (e.g., hermit crabs), they might help by consuming much of the fish before it decomposes. Of course, you'll want to test your water frequently over the next few weeks and be prepared to conduct a major water change if any ammonia or nitrite is detected. Also, be sure to check the floor all around your tank for the body. Dottybacks are notorious for jumping out of aquariums to their death.

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Zebra or Snowflake Moray?

I'm debating between getting a zebra moray eel or a snowflake moray eel for my 55-gallon FOWLR (fish-only-with-live-rock) tank. My dealer has one of each in stock, and both are impressive specimens, but I can't decide which one to go with. Can you give me a push one way or the other?

Vernon Unger via email



The zebra moray Gymnomuraena zebra is a gorgeous eel, but it is quite tough to get it to take non-living foods.

For my money, you can't go wrong with the snowflake moray Echidna nebulosa. Its manageable adult size (only about 30 inches), generally peaceful disposition, compatibility with most fish too big to be swallowed, adaptability to a wide variety of easily attainable foods, and overall good looks make this moray about the ideal aquarium candidate. The zebra moray Gymnomuraena zebra is equally stunning and peaceful, but it does tend to require more coaxing to accept non-living foods. Not to mention, reaching approximately 5 feet in length, G. zebra is completely out of the question for a 55-gallon tank. Since you seem to be happy either way, I would recommend going with E. nebulosa. I doubt you'll regret it! 💖



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Dear Jack,

I've been successfully raising my discus fry using your method, feeding them powdered egg yolk mixed with newly hatched brine shrimp. Using this formula, the fry grow rapidly and I don't have any problems. When the discus fry are about 10 to 14 days old, I gradually begin to include powdered flake food, but I see from your writings that you include *Spirulina* to the formula. I would like to include *Spirulina* to the food for the discus fry, but I can't find it here in Uruguay. Please tell me, is *Spirulina* necessary?

José Tallin Maldonado, Uruguay

Dear José,

For your success, Spirulina does not seem to be necessary. This supplementary green food is good for humans, but for discus fry, it would provide only a little boost to their diet. Discus are, however, omnivorous feeders, and I quickly found the fry accepting the green food formula.

I've only been to Montevideo, Uruguay, but on my map I see that you are only about an hour from this city. You should be able to find it in any of the area's health food shops and some supermarkets. If you find Spirulina, you should also be able to find Chlorella, which is also a microalgae green food in capsule form. Both Spirulina and Chlorella include vitamins, minerals, and enzymes for our use, so you can include them in your daily diet. For all discus, I usually add any green foods to the formula: approximately ½-part green food to ½-part powdered egg yolk mixed with Artemia. Before I forget, let me state that powdered

egg yolk is not necessary. Yolk from any type of egg works just as well, though I would recommend organic if possible.

All green foods added to your discus formula, unless they are organic, are heavily sprayed with pesticides. Before using any of them for your discus (or yourself), rinse them thoroughly. I'm also told that many of our green vegetables are sprayed with a systemic spray. If cost isn't a major concern, you might want to make your green food from some type of Japanese algae. All should be available in health food stores.

Dear Jack,

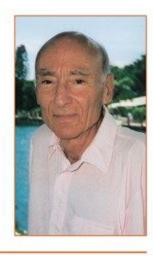
You write and talk about the merits of feeding our discus pellets and flakes, and I've done so, with good results. But I would still like to get back to making my own discus foods using beef heart. Do you still have the data as to how I can make a discus formula for my fish? I successfully raise other fish as well.

Ruth L. Gracey Jacksonville, Florida

Dear Ruth,

Thank you for your inquiry about making discus food for your tropical fish. The discus world, for the most part, has moved away from using beef heart in any form to quality dry food. Beef hearts have generally never been available in supermarkets, but they can be found in some small ethnic food markets. You purchase the beef hearts by the pound, and after trimming and cutting off all the veins, fat, and tissue from the meat, you'll be left with about ¾ to be fed. Always purchase the most inexpensive hearts available, as the best quality hearts

Jack Wattley is worldwide the most recognized name in discus breeding. Breeder, judge, collector, scholar, Jack is the foundation on which modern discus keeping has been built. He has been sharing his experience and knowledge—and the discus he breeds—with aquarists throughout the world for decades, and just one of his many awards was his recent Lifetime Achievement award from the ACA. Long past the age at which most people retire, he still serves as ambassador of discus and goodwill across the planet.



jack wattley

will be from corn-fed cattle. These have much more fat to remove.

After your hearts have been completely trimmed, they can be cut into small pieces and run through a meat grinder. Meat grinders have a perforated metal plate that grounds the meat into pieces, but these are generally too large for feeding most tropicals, including discus. One should run the meat through the grinder a second (or third) time, or obtain a second plate with smaller apertures.

The heart is then frozen or blended in with other foods, such as clams, shrimp, fish roe, and dark green vegetables (I recently used "varech," a Korean algae). These would be good in any discus formula, and relished by most freshwater tropicals. Some time ago, a Southern California distributor of tropical fish foods was interested in introducing my discus food diets to aquarium shops in the area, so we drove from San Diego down the coast, ending in San Isidro, which is directly at the Mexican border. Stopping at the best shops with the food, it was very interesting to see that it was not only quickly accepted by the freshwater fish but also a number of the marine fish, including a newly arrived shipment of yellow tangs.

Before turning north again, and being hungry, we both sampled the very best Mexican chicken tacos in San Isidro. All the tacos were made to order in the tiny openair restaurant. Currently, here in South Florida, tacos are found even in our best trendy locations.

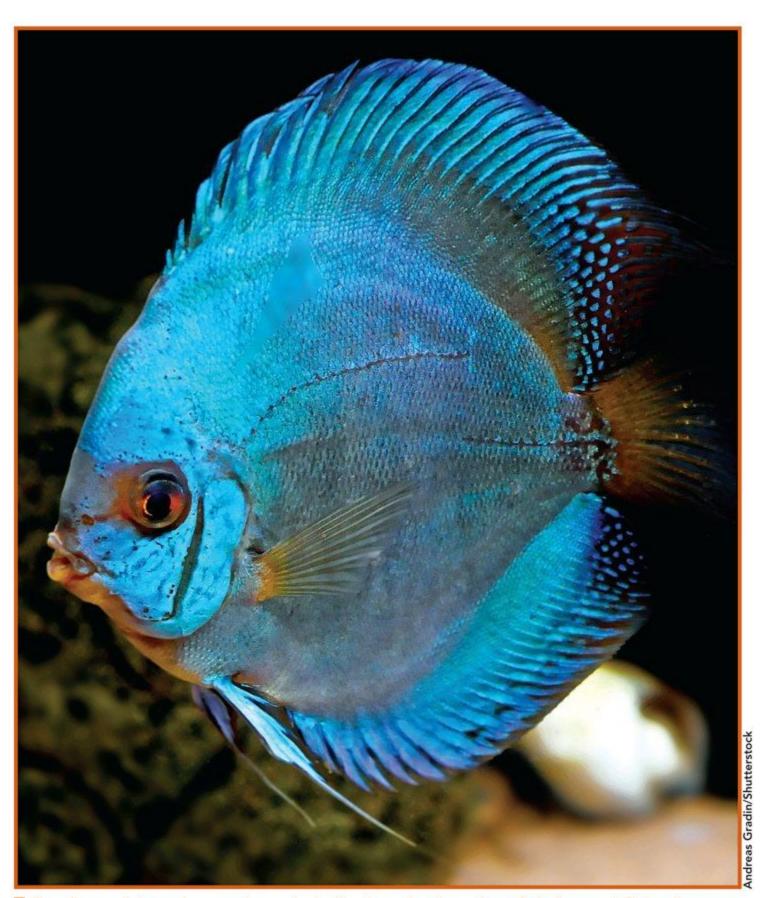
Dear Jack,

For the past week, I've found a number of small white worms on the glass of several of my discus aquariums. I had taken your advice and purchased a microscope, and now I see that the worms are more numerous than when I first saw them. My discus don't seem to notice them, but I would like to remove them. Please tell me what I must do.

B.J. Kent Marietta, Georgia

Dear B.J.,

It's good that you have a microscope. Remember that nearly all inexpensive microscopes are adequate for viewing most aquatic protozoan skin and gill parasites, as well as your "small white worms," which are planaria. Planaria are usually the result of overfeeding our discus a diet of heavy



■ The discus diet can be supplemented with algae foods such as Spirulina and Chlorella.

animal protein food. You said nothing about the diet for your discus.

A bloom of planaria can quickly take place in any tropical fish tank if an excessive amount of food is fed to our discus on a continuous basis. With good aquarium filtration, the planaria can be picked up and carried to the filter, but in time a number of them will find their way to the aquarium glass—where they can be easily seen.

Are they dangerous in the aquarium? Yes, and no. In small numbers, they can quickly be removed by feeding much less food, and by wiping them off the glass when seen. With a large infestation, there is another way in saying adios to the bothersome planaria: the common guppy. Guppies can be considered safe in discus tanks, with the discus virtually ignoring the guppies. Guppies in any aquarium with

an infestation of planaria will look upon them as food, and with enough guppies to do the job, planaria should be gone within approximately 48 hours. But if guppies are used, it's important not to use feeder guppies (those used for live food for other tropicals) and invest in regular guppies. They don't have to be show-quality fish, but you should be certain they don't carry any harmful parasites that some feeder guppies and goldfish have. In a 55-gallon tank, with five or six adult discus, the addition of about 12 guppies should make the tank planaria-free, but not guppy-free.

And what if you hit the tropical fish lottery when purchasing your guppies, and they turn out to be the very best quality guppies seen here in the United States, Asia, or Europe? Beautiful discus and show-quality guppies breeding in the same tank!



cichlidworld

Spawning Cichlids, Part 1: Natural Act, Unnatural Setting

ome cichlid species do not require much prodding to reproduce, while others can be frustratingly stubborn. Most fish breeders will eventually keep a species that proves to be a challenge to breed (it once took me six months to get a pair of convict cichlids to spawn), so I decided to write a few columns to share some of my observations and experiences with breeding cichlids.

Cichlids Want to Spawn

Nature is on the fish breeder's side. Cichlids are instinctually driven to reproduce (as are all living things), and the trick is how to facilitate this natural act in the unnatural setting of an aquarium. There are hundreds of factors that can come into play, but I have become convinced that the first thing a breeder should be paying attention to is usually the last thing considered—the behavior of the species. Color and form draw us to cichlids, but it is their behaviors that engage us. And most behaviors can be divided into two categories: feeding or breeding. Saying that cichlid behavior is "territorial" is oversimplifying a complex concept. Cichlids are territorial because they need that territory to breed (and perhaps to feed).

A Specific Point in Space

Cichlids differ from most other egg-laying fish in that they choose a specific spot to lay their eggs. There are exceptions among other groups of fish, species that do choose a specific spawning site, but *all* cichlids spawn at a particular point in space, and that location is the focal point of the territory. In the case of mouthbrooding cichlid species that do not form pairs, a male will defend the spawning site and attract the females to it. That spot may shift position between spawns, but the

behavior is still the same: The spawning fish are breeding in one spot, and their eggs are then incubated together.

KNOW THE NEED

Some cichlid species are very picky about that point in space. Take the obligate shell-dwelling species from Lake Tanganyika. These lamprologine cichlids are closely associated with empty snail shells that are used as shelter from predators and for raising offspring. Most of them will not spawn without a shell, though sometimes they can be fooled into using little pieces of PVC pipe or ceramic caves. Natural shells are the preferred spawning sites, however, and providing shells will encourage the fish to spawn more frequently and with greater success.

Another example from Lake Tanganyika is Gnathochromis permaxillaris, a deepwater species that is associated with sandy open spaces adjacent to rock structures. Successful spawns of this biparental mouthbrooder in an aquarium were very rare until someone discovered that the preferred point in space is an enclosed cavity—a cave! G. permaxillaris will excavate the sand from under a rock in a pinch, but when provided a roomy cave (with an opening just large enough for the pair to slip into), a pair will spawn much more frequently. This is an example of how just one missing piece of the equation can stop the entire process. Luckily, most cichlids are not as picky as G. permaxillaris.

NOT JUST ANY CAVE WILL DO

Most cichlid keepers underestimate how important the cave can be because most cave-spawning species make do with whatever cave is available. The fish do have preferences, however, and if the right

Ted Judy is an aquarist with over 25 years of fishkeeping and breeding experience. He is a generalist who enjoys all types of fish, from anabantids to tetras, and always finds plenty of space in his fishroom for species from West Africa—especially the dwarf cichlids. Ted has served on the Board of Trustees of the American Cichlid Association, and is an active member of the Milwaukee Aquarium Society. Ted also maintains the websites www.tedsfishroom.com and www.forum.apistogramma.com.



ted judy photographs by the author

cave is provided, they will spawn more frequently and with greater success. Several years ago, I was working with the species *Pelvicachromis taeniatus* and observed cave preference firsthand.

I purchased a group of 30 wild-caught young adult *P. taeniatus* collected from the Moliwe area of northwestern Cameroon, and placed the whole group into a 75-gallon aquarium decorated with piles of driftwood and about 20 different caves. There were cracked flowerpots, half and whole coconut shells, ceramic caves of all shapes and sizes, breeding tubes and cones (more commonly used with spawning catfish), and anything else I had lying around. Whenever a male and female paired up and moved into a cave, I would move them (with their cave) to a spawning tank.

It was pretty obvious that there was a preferred type of cave—one that has a bottom and a top, a roomy interior large enough for the male to maneuver in, and an opening that is small enough for the female to block with her head. No opening is too small unless the male cannot fit through it.

I was also able to do some experimentation with cave choice. Each pair was housed in a 20-gallon high aquarium with a sponge filter, a ½-inch layer of sand, a couple pieces of driftwood for structure, some floating plants (wisteria, hornwort, and *Anubias*), and three cave choices: a ceramic burrito, a whole coconut shell with a small opening, and a ceramic dome with an opening on the side. The location of the cave is probably also important, so to control for that factor, I placed all three caves next to each other in the center of the breeding tank, with their openings all facing the front glass.

During this experiment, I observed 34 spawns over a period of six months. Twenty-four took place in the ceramic burrito, eight occurred in the ceramic dome, and only two spawns occurred in the coconut shell (both by a single pair, and those two spawns were the only attempts that pair made). Of the 24 spawns that took place in burrito caves, all but two produced fry, and the average number of fry per spawn was 27.4. The eight spawns that took place in the dome caves were less successful: only five produced fry, and the average brood was 19.7 fry. One of the two spawns in the coconut shell produced 14 fry, while the other was not successful.

THERE HAS TO BE A REASON

The results of my little test do not mean that P. taeniatus will not spawn successfully



Male (front) and female (back) Pelvicachromis taeniatus; the right type of cave goes a long way toward the successful breeding of cichlids.



Caves with smaller openings are ideal, as they are much more easily defended.

in other types of caves. When given only one choice, most cichlids will learn to make it work. I have been to Moliwe, Cameroon, and can say with full confidence that there are no ceramic burritos in the stream, so the fish in my tanks had to learn to use an unnatural spawning site. They chose one specific type of artificial cave more frequently than others, and there has to be a reason why. I suspect that egg predation is the driving force behind the development of cave spawning. Caves that are easy to defend should be preferred over caves that are not.

To test this hypothesis, I set up another study. Five of the pairs were given a burrito cave with a one-inch diameter hole for an opening. The other five were given a tube cave with one end wide open (3-inch diameter) and the other end pinched closed. So, the difference between them is that the burrito has both ends pinched closed and just a small

access hole. Each pair was permitted two undisturbed spawns, which took a couple months to complete for the entire group, and then a single small egg predator was added to each aquarium.

This predator was Microsynodontis batesii, a very small catfish from West Africa, which poses no threat to the adult cichlids but is most definitely a problem for eggs and fry. They like to live in caves as well, so if the cichlids were going to spawn successfully, they would have to be diligent at keeping the catfish out.

Over the next three months, the number of successful cichlid spawns was greatly reduced. Only six spawns produced fry, and all six occurred in the caves with a small opening. There were no fry produced in the caves with a large opening. I removed the catfish from the tanks with the caves with large openings, and the pairs were then able to successfully raise some fry.



■ The author found that the number of successful cichlid spawns hinged greatly on the level of safety provided by the spawning cave.

My test was not a perfectly controlled experiment, but my goal was not to prove anything beyond a shadow of a doubt. My curiosity was sated: P. taeniatus can more easily defend its offspring in caves with small openings. A cave that is not easily defended is more likely to make them nervous about their situation than would a better cave.

Not All Cichlids Spawn in Caves

Many larger cichlids spawn in an open, relatively unprotected area. I have seen some of the weirdest site choices by some cichlids:

a pair of angelfish that ignored the breeding slate and spawned on the silicone sealant in the corner of the tank; a pair of Bujurquina vittata that deposited their eggs on a suction cup that fell to the floor of the aquarium, and then dragged it to a different place every few hours until the eggs hatched; a pair of discus in an aquarium store that laid eggs on the front glass of the aquarium behind a sticker (on the outside of the aquarium) that said "spawning pair of discus—not for sale"; a pair of jaguar cichlids Parachromis managuensis

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that used all of the sand at one end of the aquarium to cover the spawning rock at the other end, and then laid thousands of eggs on the now-bare bottom of the tank.

Cichlids will do what they want to do, but I do not believe there is anything random about their choices.

Is Security the Only Concern?

Protecting eggs from predators is a lot more difficult for an open-substrate spawning species than for one that uses a cave. Why are there so many species that lay their eggs out in the open? Some cichlids are really big, but even they could find a somewhat protected place to spawn if they wanted to. Many species live in very open spaces without structure, such as the open sand areas of Lake Malawi, but most of those species are mouthbrooders.

Why does Hemichromis elongatus (one of the smaller five-spot jewel cichlids) clear an area around an exposed location and lay its eggs on the top of a rock? This behavior seems to be common with the species that are the baddest hombres in the pool, but even the meanest cichlids have a tough time dealing with a school of large, fast, voracious tetras determined to eat the eggs. If the security of the eggs is the only reason to choose one spawning site over another, then all cichlids would spawn in caves or be mouthbrooders.

There are many factors we do not yet understand about what cichlid eggs need in order to develop and hatch correctly, factors that the cichlids themselves know instinctually. Each species probably has a set of conditions that are optimal for breeding success, but they also have the versatility to adapt to a range of conditions that will suffice. Oxygen levels, pH, temperature, light intensity, current, and a myriad of other parameters go into the instinctual calculation of whether or not a spawning site is good or not. In a natural habitat, there will be a wide range of microhabitats the fish may choose from, and there will be a range in an aquarium as well.

The fish will choose what they deem is best for their eggs (not necessarily what you want them to do). Many spawns in captivity are unsuccessful, and the fault usually lies with the aquarist. There is something the fish wants that has not been provided. If a pair of fish is continually unsuccessful, then the keeper's challenge is to adjust the factors to help the fish accomplish their goal. All healthy cichlids want to spawn. Our job is to help the fish do this natural act in an unnatural setting.

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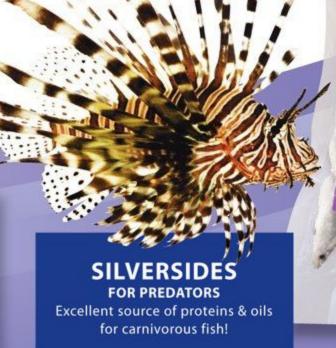
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The Challenges of a Tall Planted Aquarium

all aquariums may not be ideal for many practical reasons, but that does not mean they can't be used effectively. In fact, with a little research and planning in advance, tall aquariums can work out quite nicely.

Lessons in What Not to

My first tall planted aquarium was a 20-gallon extra-high tank. It measures about 20 x 10 x 24 inches, the same as two standard 10-gallon tanks stacked on top of each other. I bought the tank because it was the largest

I made a divider to serve as planters so some plants would be higher up and closer to the light. Though I'd kept easy-to-grow plants in many of my tanks, I wasn't as practiced as I am now and made several errors. I filled the back, higher-up planter spaces with light-colored sand, and put white gravel on top and in the front area.

I would really not advise these choices for the substrate, however. Unless the owner of the aquarium has no opposition to vacuuming the substrate three times a day, white is a really poor color choice. Aquariums are a bit messy, as is nature. White will show everything: feces, uneaten food, plant pieces, and so on. The other problem is that plain sand has no real nutrients in it, and it is so compact that nothing will get in it to decompose and provide nutrients later.

One of the other unforeseen problems I had was the lack of space between the back of the tank and the front. After dividing the tank using a wall cutting across the back, there was a great deal less space in the front. There were only 10 inches of space to start with before the planters were put in. Part of what makes it possible to create a scene in an aquarium is the ability to stack things from back to front to create depth. If there isn't much room between the back and front, the aquarium can look

I still have this tank with the sand and white gravel. It has undergone a couple of incarnations, but I haven't replaced the substrate yet. I think that is going to change soon, though I haven't decided what exactly I'm going to do with it yet.

Second Attempt

The next really tall tank I acquired was a 30-gallon. For this tank, I decided to use a large piece of wood to try to fill the space. When using real wood, remember that dry wood swells once it gets wet. I learned this the hard way about 18 years ago, when I used a piece of wood to make a front-to-back border that went from side to side of a 10-gallon tank. Not long after the tank was filled and the wood started to swell, I heard a crack and the water started pouring. Fortunately, having already had that experience, I didn't repeat it with this aquarium. Though I did find a piece of wood that filled a large portion of the tank, I made sure there was space on all sides for it to expand when it began to soak up water.

In this aquarium I planted jungle val, which is a wide and very long-growing Vallisneria. While it is a cool plant, it is not appropriate in most aquariums because of its incredibly long leaves. The piece of wood was covered with Christmas tree moss to make up the bulk of the vegetation in the tank. Mosses aren't usually too fussy about lighting, though they will grow even more slowly with less light. Between the depth of the tank and shading of the jungle val leaves, many other plants might not do well with the lack of lighting. This aquarium did quite well and still houses a group of Xiphophorus nezahualcoyotl. I did eventually change the piece of wood to a smaller, fake piece. The original just looked too big for the aquarium.

Tall Hex Tanks and Other Decorating Ideas

A hex tank was the next tall aquarium

Do: My First Tall Tank

one that would fit in the space I had available.

rather compressed.

Rhonda Wilson has a lifelong interest in all things aquatic and started keeping aquariums at age six. She has a fishroom with about 80 planted tanks. Rhonda has read TFH since the mid-70s, and she co-authored the T.F.H. book The Simple Guide to Planted Aquariums. Active in local and national aquarium groups for over 16 years, including as the past chairman of the American Livebearer Association, she now maintains a forum on her website at http://naturalaquariums.com.



nda **wilson** photographs by the author

given to me. I like the less commonly shaped aquariums and have several small hex tanks, but this was my first large one. It's constructed out of plexiglass and features a blue background. The background color is kind of bright, but a lot of them were made this way, and it was free. I planted this tank with a large Amazon swordplant with moss on the bottom below it. The biggest difficulty I have with this tank is the small amount of room I have to put lights on at the top versus how tall the tank is. The very small access hole at the top also makes it quite difficult to get things done at times. Additionally, the tank tends to easily spill over if I put my hands-well, with a tall tank like this one, I should say arms-in for maintenance, when the water is filled close to the top.

More tall tanks came to me several years ago when I found out about someone taking down a cichlid fishroom. I purchased several 20-gallon long aquariums from them, which I think is my favorite size for general fishkeeping. After a few weeks, they called me back and made me a great offer for the remaining aquariums, which I took. The aquariums literally filled my van from top to bottom and front to back. Quite a few of these tanks were 15-highs. Because I needed to fill these tanks in rapidly with tall, fastgrowing plants, they were mostly planted with Vallisneria in the back and moss in the front. Some had Vallisneria and Cryptocoryne. I always find it rather interesting to watch the development of the aquarium over time and the way some plants outcompete others and take over more of the tank.

There are many other ideas I've considered for tall aquariums, such as using aquarium silicon to cement rocks together to create a rock wall or, probably even better, crafting rocks for the aquarium so they won't be as heavy to ease the creation of a design. Cork walls and moss walls are also both good ideas for tall aquariums because they can be made to the height of the tank. The idea is to be able to create interest from the bottom to top of the aquarium. Using materials such as tall vases could also be considered for a different look. Another bold plan that could work nicely in a tall tank would be to create a terrarium with a waterfall.

Practical Issues to Consider

Another issue with the depth of the aquarium is the lighting. Not only is the depth and clarity of the water going to affect how much light gets to the bottom of the tank, but



Plant presence is greatly augmented in tall planted tanks.



Xiphophorus hellerii "Rio Otapa"; the height of fish species in a tall tank will have considerable impact on its perceived proportion.

the actual walls of the aquarium reflect some of the light as well. This is also diminished as the angle increases with the height of the tank. The light at the bottom is going to be less than that at the top. Tall plants are going to get a lot more light at the top than at their base, which can make the plants lose leaves at the bottom and look like long, stringy stems with foliage only at the top. Shorter plants grown on the bottom will have to be tolerant of lower light levels, or very strong lighting is going to be needed.

As I mentioned briefly before, the planting and decoration can easily look squished in a taller aquarium. In a more standard-sized, shorter aquarium, there is less of a difference between the top and bottom of the aquarium, so the angle from the height of the decorations and plants in the back to those of the front is much sharper. The line is longer compared to the space below it than in a shorter tank of the same size. With a longer line to fill and the same amount of bottom



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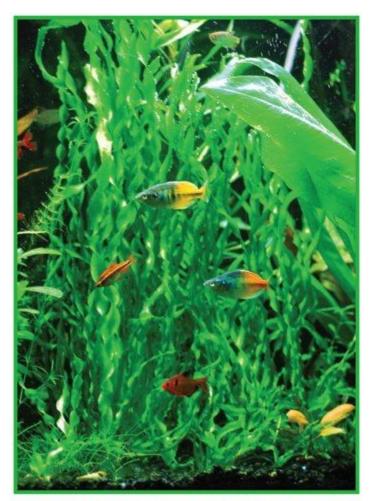


space to fill it with, it becomes more difficult to get the line filled out comfortably visually than in a shorter aquarium. Some more space can be found by planting the tank diagonally, with tall plants in one back corner and shorter ones in the opposite front corner.

Because of this, the height of the plants and decorations has to be considered more carefully so the space can be filled without awkward gaps. Some plants that might be considered for a taller tank are *Vallisneria*; these make good choices for a taller aquarium because of their very long, grass-like leaves. Amazon swordplants can also work well in these tanks if not too much else is used. Mosses and *Cryptocoryne* are good choices for the bottom of the tank.

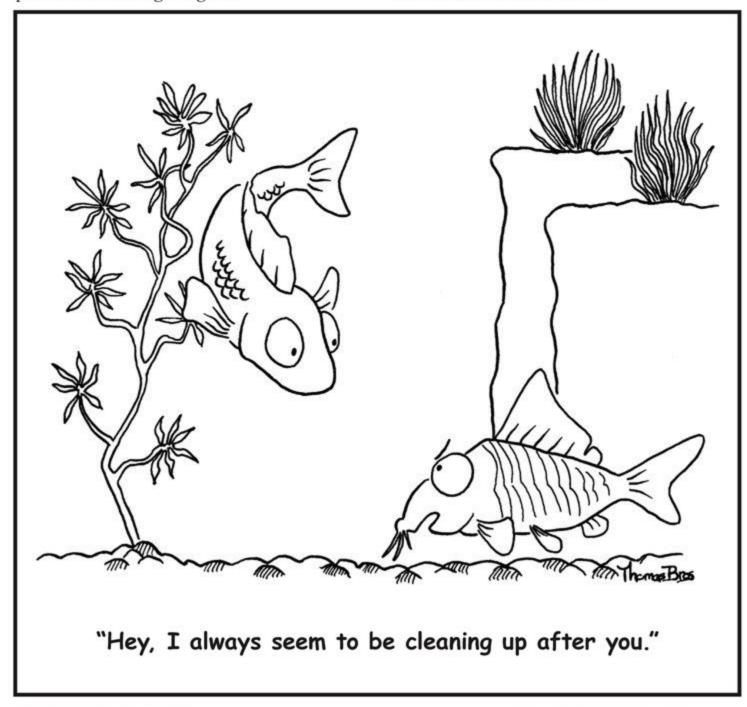
Another element that affects the look of the aquarium is fish. Taller fish can help fill space and provide a more proportionally correct appearance. Angelfish and discus are some of the first that come to mind. Small schooling fish can also look good in these types of tanks, as they dither in between the tall plants.

Another potential challenge with a taller aquarium is performing regular maintenance chores, as tighter dimensions make it more difficult to access certain areas when trimming plants and cleaning the glass.



With the right combination of plant and fish species, a tall planted tank can be a visual spectacle that nicely contrasts from typical aquarium setups.

Tall aquariums can be trickier to design and landscape, but they can also be striking due to their atypical shape. Some might be the perfect fit for a special place. With careful planning, a tall aquarium can be successfully created and maintained.







Group Breeding

've been in the hobby more than five decades, including functioning as chief scientist and general flunky for Goliad Farms, Inc., a tropical fish hatchery in South Texas, originally Santa Fe Tropical Fish in New Mexico. I currently keep and breed 150 species and varieties of livebearers. And over the decades I've raised fish, many more livebearer species and varieties have been in my tanks.

A Bit of History

My first livebearer was the mosquito fish was probably eight years old and had been breeding goldfish for a couple of years in two cattle-watering troughs. Once placed in the water troughs, the mosquito fish dropped fry, and I had an abundance of worthless fish.

What was worse, they competed with the goldfish for food, ate goldfish eggs (and probably fry), and quickly overpopulated the troughs. It was a disaster, one I finally rectified by emptying the tanks and starting over.

the water.

The angels, like wolves stalking fawns, promptly picked them off one by one. Determined that wouldn't happen again, I bought a breeding trap and a T.F.H. booklet on swordtails. Able to recognize impending delivery of fry due to the booklet, I separated a very gravid female swordtail into the breeding trap and was rewarded with a couple dozen living fry. I was hooked.

Making Money

Having an entrepreneurial bent, I decided to raise fish and make tons of money. You know that old joke? Having won the lottery, a fish farmer was asked, "What will you do now?" He shrugged, "Guess I'll just keep on raising fish until the money's all gone."

Anyway, I saw the prices of delta guppies and decided I'd make my fortune with them. I spent the next four years raising guppies and got pretty good at it and even made some money, thanks mostly to my doting grandparents who'd drive me two and a half hours one way to Houston to sell them to retailers.

I learned how difficult it is to maintain a pure-breeding strain of guppies, and I learned some tricks in rearing and breeding I still use today. I didn't, however, make a fortune raising them, and by the time I went away to college in Austin I switched to killifish and Betta splendens. I largely paid my way through college raising those fish.

After college and a BSc in zoology, a friend and I accidently bought a failing tropical fish shop. We turned the business around and expanded to two shops, opened a wholesale business, and started a pond-based fish hatchery on my grandparents' farm. When my partner wanted to move away, we sold the shops and the wholesale business, and I continued to raise fish in ponds.

I finally gave that up after enduring floods, droughts, etc. It was at that time

Gambusia affinis, which I collected on my grandparents' farm. That farm is where my wife and I live and work now. At the time I

After that first unpleasant experience, it was a few years before I tried livebearers again. For my twelfth birthday I got a 10-gallon aquarium setup. I bought, as best I remember, a couple of angels, some swordtails, two Corydoras aeneus, and a small school of tiger barbs. One morning a swordtail dropped fry, which quickly tried to hide along the sides at the top of

Charles Clapsaddle began keeping fish at age 7, winning some goldfish at a carnival. Successfully spawning them, he was hooked on fish. Mastering goldfish, his attention turned to live bearers, locally collected mosquito fish Gambusia affinis, and sailfin mollies Poecilia latipinna. By junior high he graduated to fancy guppies. His fascination with livebearers continues. Although his commercial hatchery breeds many other fishes, the development of new livebearer strains and the improvement of existing strains occupy his best efforts. Charles speaks to aquarium clubs across the country on various hobby topics. He has a BSc in Zoology from The University of Texas at Austin.



I started testing systems that led to the current business, Goliad Farms, Inc. That brings us to today.

Group Breeding

This column will contain a mixture of topics: how-to articles, breeding and rearing techniques, fish descriptions, natural history of fish, etc. This time I'm going to describe how to group-breed livebearers. Next column I'm going to describe a beautiful wild swordtail collected by Rusty Wessel from the Río Otapa. And so on.

Also, I'm hoping my readers suggest topics. While I'm notoriously slow about responding to emails, I do finally respond (email me at goliadfish@goliadfarms.com). With luck, I'll get some good topics from emails. I might even pick an email to answer in my column, and your name will be in print.

Probably the most frequent question I get when I'm speaking at fish clubs around the country is, "How do you raise so many fish?" That refers to the 500 to 600 fish per month from 30 to 40 breeders in a 55-gallon vat. We actually get that many, especially with our mollies, both natural species and commercial strains.

How do we do it? First of all, water quality is critical. I'm going to assume you know how to keep ammonia at zero while adequately feeding your fish (I always feed generously to get optimum growth). If you don't, you might want to read my article on plant filtration ("Plant Filtration—No Water Changes!" TFH April 2010) for some pointers. But there are many ways to achieve good water quality, virtually all of them being "make lots of big water changes!" Clean water cannot be stressed enough.

Our livebearers are raised in 55-gallon vats. For a typical livebearer, let's say *Limia* vittata, we place about six males and 30 females in a vat. Why six males? There are two reasons.

Livebearer males tend to be combative, so we use either one male or six. Fewer than six, and somebody gets picked on all the time. With six, everybody gets chased some, but no one fish gets picked on all the time. We find there is better male survivability with six rather than fewer males. We occasionally use a single male if he is much superior to all the other males, but if a single male is used and he dies, we can lose a breeding cycle.

Our vats are opaque, and we can't see the fish very well. If the single male dies, we



Male Limia vittata; a group of six male livebearers is used for group breeding to minimize aggression and increase survivability.



Female L. vittata; a female heading off alone to cover likely means she is ready to deliver.

lose production. Although commonly kept livebearer females retain sperm and can have serial deliveries from earlier matings, my experience is that successive batches of fry are smaller.

Using Cages

In each vat we place a cage made of aquaculture netting. The cage provides a refuge for fry. While not all livebearers are voracious fry eaters, almost all will eat them if given a chance. Without a refuge, your fish are just producing their own live food. After much trial and error, I discovered the best material for building cages is plastic netting.

The simplest design for the cage is a cylinder with a bottom. All you will need is scissors, netting (for most livebearers 1/4-inch mesh netting is perfect), and 4-inch cable ties. Let's say you wish to make a cage

for a standard 20-gallon aquarium; first you'll need to properly size the cage.

The aquarium's inside width is 12 inches. I like to allow some space between the cage and the back and front of the glass to allow the adults, who will be outside the cage, to swim around it. Let's go with a diameter of 10 inches; that will allow even large adults to negotiate around the cage.

Since the aquarium has a height of 16 inches, we'll make our cage a little taller than that. But how long a piece of netting should be cut? The circumference of a circle with a diameter of 10 inches is calculated by multiplying the diameter by π (roughly 3.14), yielding a circumference of about 31 inches. We'll add 3 inches to provide a surface to fasten the two ends together to form a cylinder.

First we cut the netting. I like to cut in the notch so that all edges are even and



Cages constructed out of mesh netting can serve as refuge for fry and gravid females.

there are no burrs to snag fingers and nets. A piece of netting 18 by 341/2 inches will form the cylinder, and cable ties connect the ends to secure the shape. Then I attach a bottom to the cage.

The netting is slightly less dense than water and will float. A bottom allows a weight to be dropped into the cage to prevent floating. I cut a square piece of netting slightly greater than the diameter and attach it to the cage using more cable ties. It's not necessary to trim the bottom into a circle, but I usually do.

I like to place two cages in the aquarium, one at each end. This has the benefit of providing more refuge for the fry, but also for the gravid females. I've noticed when a female is ready to deliver she likes to go off alone near cover. Having two cages gives her more places to hide.

The final touch is to place a few sprigs of hornwort Ceratophyllum demersum or guppy grass Najas guadalupensis in the cages. This will make them attractive to fry.

Limia vittata are guppy-sized fish, and a 20-gallon aquarium is adequate for a breeding colony of six males and 20 females. Now, feed your fish, sit back, and watch the fry thrive. You'll note as the fry grow they'll venture out to mingle safely with the adults. You may even see tiny fry swimming with the adults.

Often once the adults are used to seeing fry they often cease considering them food. At some point you'll want to remove either the youngsters or adults and start the process over. We maintain our fish at high temperatures and feed lots of high-quality

food, so we usually start over about every six weeks. By that time, the oldest fry are nearing sexual maturity. Since I like to maintain tight control over who gets to breed, separating the juveniles from the adults before they are ready to breed is necessary.

When I select replacement breeders, I ruthlessly cull and select only the very best fish as broodstock. Since there are many fish to choose from, the breeding colony can be improved easily. In any batch of fish there are usually 5 percent culls and 5 percent superior fish.

From among the superior fish you select the next generation of breeders. In commercial strains under development, the percentage of culls is much higher, and the percentage of superior fish is much lower.

That is the reason you should strive to raise as many fish as possible; it's a game of odds. If only one out of a hundred fish deserves to be a breeder (in other words, has the characteristics you want), then raising just 50 fish won't do you much good. Raising 1000 would give you reasonable odds of getting a few desirable breeders.

Good fishkeeping!



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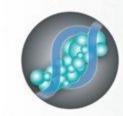


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Three-Spots

blue gourami Trichopodus (Trichogaster) trichopterus was first imported into Europe as an aquarium fish in 1896 and rapidly became a mainstay in the aquarium hobby. It is regularly sold by every pet shop stocking freshwater fish. Its popularity has only increased over the years, as the number of color variants has expanded. The wild color form is very attractive in and of itself, but the other colors have surpassed it in popularity. The wild form is used as a food fish in its native Southeast Asia and can occasionally be found packed in jars in Asian food markets in the United States. Fortunately for the species, in this country many more are sold for aquariums than for the table.

Appearance

A particularly interesting feature of *T. trichopterus* and many other gouramis is the ventral fin structure. The first ray is greatly extended while the remaining rays are essentially vestigial. The first ray contains taste buds and numerous free nerve endings, so it can be presumed that the fish use these fins to both taste and feel objects in their environment. Observation of the fish would certainly indicate that this is the case. Watching your fish utilize these fins is one of the most appealing aspects of their behavior.

I suspect such fins developed in response to living in muddy or turbid environments with limited visibility. There is some indication in the scientific literature that *T. trichopterus* prefers to use the left ventral fin to check out inanimate objects. Interestingly, there is also evidence that this species typically turns in a way that will allow it to keep its right eye focused on potential predators. *T. trichopterus* is thus an interesting subject for the study of handedness—the dominance of one side of the body over the other for

certain tasks—with bearing on primates and other animals.

Color Forms

Wild fish are now regularly exported from Vietnam, and the wild type is definitely my favorite color variety. They are pale blue with a bit of variation or mottling in the blue and feature a black spot on the caudal peduncle, a black spot on the midbody, and a black iris, all arranged in a horizontal row and leading to the old common name of three-spot gourami. They display a wonderful shade of orange in the anal fin. The captive-bred color forms generally display a much more pronounced mottling than the wild form.

The opaline gourami is the most popular of these morphs and features a darker blue ground color with light blue mottling. The gold gourami was the next color to be developed. It features a ground color that can vary from pale through dark yellow to a shade that borders on orange with a dark mottling overlaying the ground color. All in all, this can be a very eye-catching pattern and makes it a close second to the opaline gourami in popularity.

The platinum color variant is a pearly white with off-white mottling. This color form really stands out in a heavily planted tank. The body takes on a luster when viewed against a background of dark green plants. The most recent color morph to be developed is the lavender gourami, which is a light purple with darker mottling.

Aquarium Care

T. trichopterus is adaptable to most water conditions within the typical range of pH, hardness, and temperature—in fact, it can handle temperatures from the upper 60s to the upper 80s. It has a reputation as a somewhat aggressive species, but this is really not deserved. The reality is that this is a

Mark Denaro has been keeping freshwater aquariums since 1970 and marine aquariums since 1976. He currently operates Anubias Design (www.anubiasdesign.com), an aquarium and terrarium design, maintenance installation, and serving southeastern company Pennsylvania, and importer/online retailer of new, rare, and interesting freshwater fishes, invertebrates, and plants. A former president of the International Betta Congress, Mark's primary interests are anabantoids, cichlids, and planted aquariums.



mark denaro

photographs by the author

misunderstood species despite its popularity. Due to its extreme hardiness, this fish is often suggested as appropriate for beginning hobbyists. The trouble begins when they are added to the typical starter tank, which is usually around 10 gallons.

T. trichopterus typically grows to a length of at least 4 inches, but it can reach 6 inches, making such a small tank unsuitable, and as the fish grow, problems arise. Males are definitely aggressive toward each other, and two mature males cannot cohabitate successfully in a small tank. The males also have, shall we say, a high sex drive, and will harass any female that is not in the mood to be cooperative. In small tanks, the females cannot escape the male's amorous intentions and will be in a constant state of stress due to his unwanted attentions.

Add a pair to a community tank of at least 30 gallons, however, and they'll get along quite nicely, particularly if the tank is well decorated and the female can hide when she wants to avoid the male's notice. Add three males and six females to a 125-gallon community tank, and they'll chase each other here and there but will basically get along fairly well. Still, though, the best way to maintain any color variant of this species is with one male and at least two females in a tank of at least 30 gallons. Fortunately for the hobbyist, this species is easy to sex even at a small size. Males have larger dorsal and anal fins, both of which are pointed. Females have rounded dorsal fins.

Breeding

T. trichopterus is a typical bubblenest-building anabantoid. The male constructs a nest of mucus-covered bubbles at the surface, usually attached to a floating plant or an artificial spawning aid. He then entices the female to spawn below the nest. The pair embraces many times, with the male wrapping his body around the female and the female releasing a small number of eggs each time. The eggs are fertilized by the male and then drop toward the bottom of the tank. The male retrieves them in the water column or picks them up off the bottom and blows them into the bubblenest. Some females will help with this process, but others show no interest.

When the pair finishes spawning, the male will drive the female away and will care for the eggs and the fry until they are free-swimming. The length of time varies with temperature, but in general brood care extends for approximately four days at temperatures of 78° to 80°F. They will spawn in a community



■ The lavender gourami, the most recent *Trichopodus trichopterus* morph, features subtle shades of purple.



■ The opaline gourami is popular for its blue coloration.

tank, but it is better to breed them in their own spawning tank. A 15-gallon or 20-gallon long tank will work quite well for this purpose.

The pair should be conditioned with live and frozen foods if possible. The female will become quite plump as she fills with eggs. Large females can produce in excess of 1000 eggs in a single spawning. When she is rather rotund and ready to spawn, prepare the tank by adding about 6 to 8 inches of water along with some plants such as Java moss and Java ferns. Add a foam cup that has been split in half lengthwise so that the male can build his nest inside the cup. Water parameters should be the same as the water in which the adults are maintained, and the temperature should be 78° to 80°.

Add the male to the tank, and the next day add the female. If they have been properly conditioned, spawning should take place within 48 hours. After the pair has spawned, remove the female so that the male does not damage her in his zealous protection of the eggs. When the fry are free-swimming, remove the male. At this time you can add a seasoned sponge filter with a very slow airflow.

The fry should be fed infusorians at first. They should be able to take newly hatched brine shrimp within a few days, and growth from that point is fairly rapid. If the pair doesn't spawn within 48 hours, separate them and feed them heavily for a few days, increase the temperature in the spawning tank to 82°, and then reintroduce them to the spawning tank. The ease with which this species can be bred makes it an excellent choice as a first anabantoid as one gets started with breeding fish.

Expand Your Limits

Don't feel limited to an aquarium when it comes to keeping this species. *T. trichopterus* is one of my favorite tropical fish for outdoor ponds. The length of time that they can be

kept outside will vary with your climate, so be careful not to add them to the pond until the water temperature is consistently in the 70s and remove them in the fall before the temperature drops much below that. There are several reasons why I like to add them to water gardens.

First, they are colorful, and in particular the gold and platinum varieties really show their colors well in this environment. Second, they tend to hang out near the surface so they are almost always visible. Third, they are ravenous consumers of mosquito larvae. Fourth, they are highly prolific, and even a single pair will produce thousands of young throughout the summer.

Now, you may be wondering what I'd possibly want with thousands of young gouramis at the end of the summer, but that is the wrong question. The right question is: What am I going to do with the other species that I put in the pond to breed for the summer? You see, we're playing a numbers game here. Highly predatory dragonfly larvae are a fact of life for any pondkeeper, and their favorite food just happens to be small fish, not a good thing if you're trying to breed and grow out fish in your pond.



Darker, planted backdrops are a good way to bring out the luster of platinum gouramis.

Let's say that I decide to breed a pair of red-breasted acaras *Laetacara dorsigera* in my pond this year. This pair may produce 500 fry over the summer. If I also add a pair of *T. trichopterus* that produces 5000 fry, and my unwanted but unavoidable dragonfly larvae population eats 4000 juvenile fish, I would hope to be able to pull out 150 or so *L. dorsigera* along

with more *T. trichopterus* than I will know what to do with. Hopefully, the gouramis that are an inch in length or more can be traded in to an area wholesaler or large regional store, or maybe a bunch can be used as part of a grow-out contest at a local aquarium society. This is really an excellent species for grow-out contests due to their potential size and mild temperament—too often really aggressive large cichlids are used, and they are more difficult for many hobbyists to house.

The key, though, is that I am able to get more of the *L. dorsigera* at the end of the summer than I would have been able to grow out without the addition of the gouramis.

Whether you're a beginner or an advanced hobbyist, the many color varieties of *T. trichopterus* have something to offer. Consider adding them to your next community aquarium or water garden, or making them your next breeding project.

Acknowledgements

I'd like to thank Nautilus Marine Wholesale of Plant City, Florida for providing the fish used for the accompanying photographs.





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adventures in aquascaping

A 90-Gallon In-Wall Reef Aquarium, Part 1

ow would you design an in-wall reef aquarium so that a chiller would not be needed? It requires a bit of improvisation, but I accomplished this for a new client.

In July 2011, I received a phone call from a lady who needed me to move the contents of her 90-gallon, in-wall reef aquarium to a free-standing, 120-gallon aquarium in her new home. The gentleman who bought her old house requested an estimate for bringing the 90-gallon back into commission as a reef aquarium. The tank wasn't big, so I wanted to make sure that I made up for this by equipping it with great filtration and very bright lighting, all without causing too much heat to build up inside the cabinetry.

In many cases, a chiller would be used to make certain the water temperature does not exceed 80° to 82°F, but not only was there zero space to add a chiller, it is also a huge mistake to put a chiller in a tight, enclosed, poorly ventilated space. A chiller dumps the heat that it removes to cool the water down, just like a window air conditioner, so it will seriously heat up the air in the cabinet. Also, the cooler the air it's allowed to draw in, the more efficiently it will cool the water.

Ben Johnson has been a professional aquarist since 1995 and is the owner of Captive Aquatic Ecosystems (www.caecosystems.com), a custom aquarium sales and maintenance company in the Houston, Texas area. From 2002 to 2004, Ben worked as a zookeeper at the Houston Zoo and Kipp Aquarium where he was the sole keeper in charge of the 4000-gallon Reef Zones exhibit.

ben johnson photographs by the author

Lighting

Right away I knew I was going to use LED lighting on this system. LEDs have come a long way since even a couple of years ago, and using T5 fluorescents or metal halides wouldn't have worked because too much heat would have been created inside the cabinetry. LEDs do produce some heat, but much less than either of the aforementioned light sources. When left on for an hour, a 150-watt metal halide bulb would burn your skin if touched, T5 fluorescents would be uncomfortably hot, and LEDs would only be warm to the touch.

There was already a bathroom exhaust fan installed in the ceiling inside of the cabinetry, which is great for removing lingering heat and humidity. Remember that the cooler you keep the area around an LED fixture, the longer you can expect to have them around functioning properly. When I called in to order the LED fixtures I was going to use, the manufacturer alerted me that a second-generation version was coming out that was brighter and would actually cost a little less. Unfortunately, it wouldn't be ready to ship for two months. I informed the new client about this and got him to see the virtue of being patient for this lighting system. Since I usually want the system to run for a month or so anyway before adding corals and other livestock, we could afford to wait for the lights.

Filtration

The former homeowner took all the filtration in the move, but that was fine because we had decided to upgrade anyway. For a year prior to setting up this reef system, I had been slowly adding solid carbon dosing to my clients' saltwater

fish-only and reef systems to great effect. Solid carbon dosing is a method by which biodegradable plastic-like pellets are fluidized in a media reactor. The material the pellets are made from acts as both food source and colonizing surface for beneficial bacteria that consume nitrate and phosphate on a 1:1 basis.

It is important to place the effluent from the media reactor that you are using to fluidize the bio-pellets close to the intake of a protein skimmer. The bacteria are sloughed off of the surfaces of the pellets as they collide and are easily picked up by the skimmer, thus removing them, along with the nitrate and phosphate they utilized from the system.

People trying solid carbon dosing for the first time in an established saltwater aquarium quickly notice that their protein skimmer pulls out more and darker skimmate once the bacteria have established themselves. This may take around a month depending on whether you use a bacterial booster or not. To feed the bio-pellet reactor, I plumbed a fitting to branch off of the main pump and used a small ball valve to regulate the flow.

Choosing an external main pump in this situation was easy, since it is very well known that submersible pumps transfer much more heat to the aquarium water than do those that are mounted outside of the sump (a sump is a glass or acrylic tank that sits underneath the aquarium and houses all the filtration). I sized the main pump, choosing one that was pressure rated rather than volume rated.

Most external water pumps have two versions: volume-rated pumps and pressure-rated pumps. The pressure-rated pumps are designed to handle more back pressure without losing as much pumping volume as a volume-rated pump will. I always use pressure-rated pumps if I know that I am going to branch off of the main line to power a media reactor, push through a chiller, or run through an ultraviolet sterilizer. I also intentionally chose a pump that would move a couple hundred more gallons per hour (gph) than was required for the aquarium turnover rate, because I would be diverting that amount to power the media reactor.

Sump and Skimmer

The protein skimmer I used was a venturi-driven model with a needle wheel impeller. I used a space-saver model in



An exhaust fan inside the existing cabinetry will help reduce heat and humidity in the new setup.



To minimize heat transfer to the aquarium water, an external pump was chosen over a submersible type.

which the water pump that powers the skimmer is located underneath it. This way, it takes up very little space in the small, acrylic sump.

The built-in, submersible pump that powers this skimmer uses very little electricity, especially when compared to older skimmer types that utilize a large, high-pressure pump that would only create more heat for the system to deal with. The acrylic sump was custom made to fit exactly the space I needed under the aquarium. I had it built to exact specs by a local fish store.

I employed a 100-micron filter bag where the drain pipe coming from the aquarium brings water into the sump. This is a great way to polish the aquarium water and remove small particles floating around in the water column. Once a week or as needed, this bag is taken outside, hosed out with a pressure nozzle on a garden hose, wrung out to remove excess tap water, and put back into place.

Evaporative Loss Top-Off

I equipped the aquarium with an automatic evaporation top-off system in order to maintain a constant water level in the sump. As water evaporates from the system, an equal amount of fresh water is put back into the system. A sensor located in the sump tells a small, submersible pump located in the top-off reservoir when to turn on or shut off depending where the water level is in relation to this sensor.

Maintaining a constant water level in the sump is important both for the protein skimmer to work efficiently and to ensure that the main pump does not run dry. I keep the reservoir filled with purified water (RO/DI) because when water evaporates, it leaves behind nearly all of the substances dissolved in it. These substances are known as TDS (total dissolved solids) and include minerals such as calcium and magnesium carbonate and sodium chloride.

When a saltwater aquarium loses volume due to evaporation, it is fresh water that you must add back into the system, not salt water. This highly purified water has next to no mineral content or pH buffering ability, so I have the top-off go through a kalkwasser (calcium hydroxide) stirrer before entering the system.

If aquarium evaporation is too high, it can be dangerous to run kalkwasser in line with your top-off. You don't want to dose too much at one time, as it is a very caustic basic substance (pH of 12 after initial mixing with water). To prevent overdosing, I only keep about a tablespoon of calcium hydroxide in the stirrer at any given time. Between this and bi-weekly water changes (10 gallons at a time), all the necessary elements required by soft corals and large-polyped stony (LPS) corals are taken care of.

This system was designed to evaporate at a great rate because one of the best ways to cool water temperature down is through the use of fans blowing across the water surface, which causes massive evaporation. Besides the previously mentioned exhaust fan in the ceiling above the lights, I also ventilated the bottom cabinetry to help remove hot, humid air. I cut out a square in the drywall, installed a ventilation grate, and mounted a quiet, 4-inch fan that blows out of this grate.

Temperature

Though no chiller was used to cool the water, a heater was necessary to keep the water temperature from dropping too low at night in the cooler months. Here in southeast Texas winters are not usually very cold, but we do experience temperature swings during the fall and winter that can catch an aquarium

off guard and cause its inhabitants' immune systems to lower, making them more susceptible to parasites and diseases.

Therefore, I use a heater as a safety net to ensure that the temperature does not get too low. I use an external heater controller instead of relying on the controls inside the heater. A heater is



After some creative engineering, the author successfully created a tank that functions effectively even without a chiller.

no place to skimp. When your aquarium contains several thousand dollars of sensitive corals and fish, you don't want to leave things to chance.

Overview of Installation

By using energy-efficient LED lighting with a strong-yet-quiet bathroom exhaust fan mounted in the ceiling, external water pumps instead of submersible, and ventilating the cabinet below where the filtration is located, I was able to avoid installing a chiller on this system. The ambient temperature in the house stays around 76°, and the water temperature of the 90-gallon, in-wall reef averages 80° to 82°.

In the next issue, I will discuss how I positioned the live rock structure and detail all the initial life placed inside the aquarium.













the salt mix

Angels of the Caribbean

here are a great many angelfishes available to hobbyists, and they are collected in many locations around the world. However, there are only five large angels that live in the Caribbean, Gulf of Mexico, and tropical Atlantic. These are the French angelfish, gray angelfish, queen angelfish, blue angelfish, and rock beauty angelfish. The first two in the list are the only two of thirteen species in the genus Pomacanthus that are found in these waters, while the latter three are the only three of eight species in the genus Holacanthus found there. They're certainly the minorities within their genera when it comes to where they live. Regardless, all but one of these are great fish if you're into tankbusting marines.

The French Angelfish

The French angelfish *Pomacanthus paru* can be found in the western Atlantic from Florida down to Brazil and in the Gulf of Mexico and the Caribbean. It also lives around Ascension Island and St. Paul's Rocks on the other side of the Atlantic. These fish are typically found in shallow waters on reefs, but they can also be found at depths of over 300 feet.

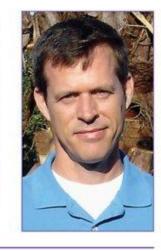
French angels can reach a maximum length of just over 16 inches, but a full size of closer to 11 inches is common. Of course, this fish also has a rather tall body. It really needs to be kept in a large tank, with something in the range of 300 gallons (or even bigger) being best for larger individuals.

While cleaner wrasses and gobies are well known for their ability to clean other fishes of parasites and dead skin, juvenile French angels will also do the same thing. When small, they'll choose a location as a cleaning station and scour other fishes that show up for a cleaning. However, this is done only when they're young, as they tend to shift away from cleaning and toward their adult diet when they reach a length of just 3 or 4 inches.

Aside from feeding themselves by cleaning when small, French angels typically feed primarily on sponges and algae, and will also eat tunicates, bryozoans, zoanthids, and gorgonians. This obviously means they're not good choices for many reef aquariums, and it also means that they won't be too happy if regular flake food is the only thing they get.

Instead, you'll need to feed a French angel plenty of green stuff, like Caulerpa or Ulva if available, although unflavored dried sushi wrap (nori) and algae-based pellet and flake foods work great, too. It will also need some sponge-based food, usually in the form of frozen cubes that are made specifically for sponge eaters in order to keep them as healthy as possible. I suppose it could be possible to keep a French angel in an aquarium loaded with sponge-covered live rock, but I bet the sponge won't last too long unless there's a ton of rock and the fish is rather small. Still, they'll also typically eat meaty foods like mysis shrimp, krill, chopped clam or squid, etc., and I recommend giving them some of each (algae, sponge, meat) on a regular basis.

James Fatherree, MSc has had more than a quarter century's experience with aquariums of all kinds and has been deeply involved in the reef hobby for more than a decade. His background includes diving, collecting, and photography, and he has worked in the trade on both retail and wholesale levels. With all this experience, he has seen his share of aquarium disasters, both natural and manmade, making invaluable his insights on how to save your tank during a crisis.



photographs by the author



A friendly and curious fish, the French angelfish Pomacanthus paru can be a real pet.

The appeal of French angels isn't just their impressive looks; they also tend to be both friendly and curious by nature, usually having a pleasant personality. However, that's only the case when a tank is stocked with only one of them, and no other big angels. They're often found living in pairs in the wild, but trying to get two to get along peacefully in an aquarium is very, very unlikely to work. Unfortunately, I've never seen a mated pair of these being sold together either, so you can only have one. As I indicated, they typically won't get along with any other angel species, although I'm aware that a few hobbyists and some public aquariums have gotten away with it in huge tanks.

Aside from that, I can tell you that French angels are generally very hardy, disease-resistant fish when fed well. However, it's best to buy one in the 3-to 5-inch range, as smaller specimens seem to have a harder time adapting to aquarium life. The same goes for larger ones, as they apparently become set in their ways in adulthood and also have a difficult time adapting to tank life.

The Gray Angelfish

The gray angelfish *Pomacanthus arcuatus* can also be found in the western Atlantic from New England down to Brazil and in the Gulf of Mexico and the Caribbean. It is also most commonly seen in shallow waters on reefs like the French angel, but stays within about 100 feet of the surface. Also note that these two species look almost identical when small, but as they grow larger, the French angel develops bright gold edges on most of its black scales and becomes quite distinctive.

Despite their similar appearances, gray angels are considerably larger, with a maximum length of almost 24 inches and 18-inch specimens being common. These tend to be even bigger than French angels by several inches and need an appropriately large aquarium. Bigger than 300 gallons is better for one of these monsters.

As is the case with French angels, juvenile gray angels are also cleaners, but the adults have a somewhat more varied diet. Gray angels do feed primarily on sponges and algae, and will also eat tunicates, bryozoans, zoanthids, and gorgonians, but they'll eat sea

grasses and hydroids as well. So, again, they're not good choices for many reef aquariums, and will need a varied diet as covered above.

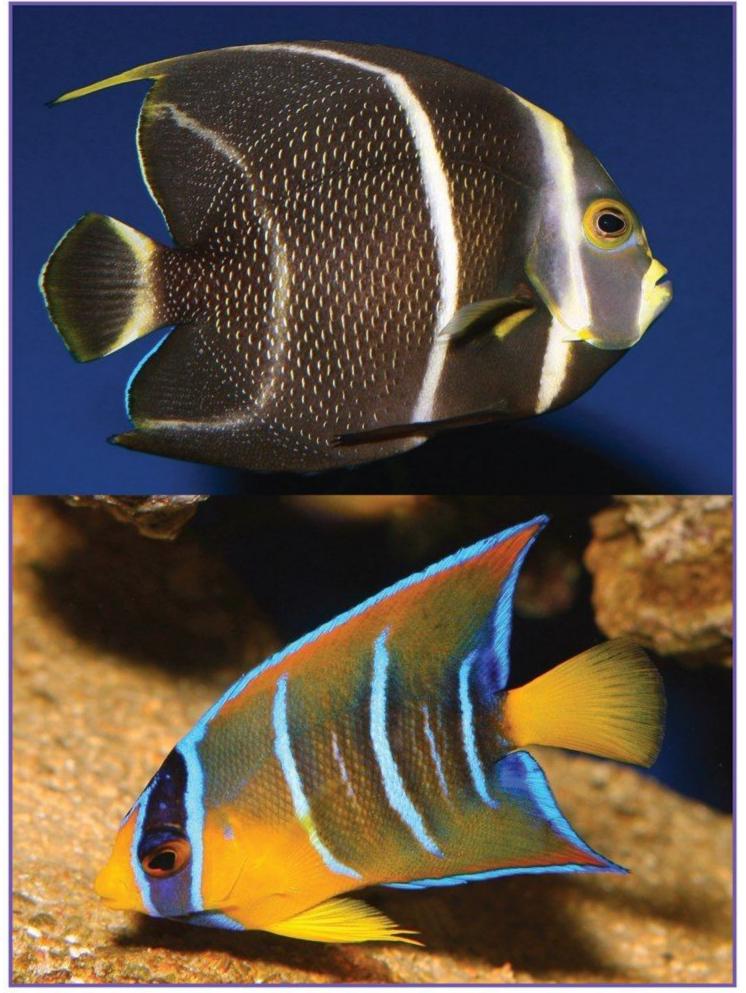
Gray angels also tend to be both friendly and curious by nature, but again, a tank should be stocked with only one of them, and no other big angels. Apparently they don't even pair up as frequently as French angels do, as they are reported to be solitary, and I don't recall ever seeing two together while diving. So I doubt you'll ever find a mated pair of these either. It's better to stick with the purchase of a 3- to 5-inch specimen, and you should wind up with a very hardy, disease-resistant fish when it is fed well.

The Queen Angelfish

Like the previous two angels, the queen angelfish *Holacanthus ciliaris* can be found in the western Atlantic from Florida down to Brazil and in the Gulf of Mexico and the Caribbean. It also lives around St. Paul's Rocks in the eastern Central Atlantic. It is also typically found in shallow waters on reefs, but can be found at depths of over 200 feet at times.



Like most large angels, the queen angelfish Holacanthus ciliaris must be the only one of its kind in the aquarium.



■ Juvenile French angelfish (top) and queen angel (bottom); juvenile angels can look quite different from the adults.

Queen angels can reach a maximum length of almost 18 inches, but a full size of closer to 12 inches is common. Again, these should be kept in something like a 300-gallon tank or bigger for a full-size individual.

Juvenile queen angels are also cleaners and algae eaters, but adults depend almost entirely on sponges in the wild. They'll eat small quantities of algae, tunicates, bryozoans, and hydroids as well. And, I know for a fact that these will also nibble on soft corals, stony corals, and even giant clams, and so should not be tried in any reef aquarium. They will, of course, need a varied diet as covered above, with a heavy emphasis on sponge matter.

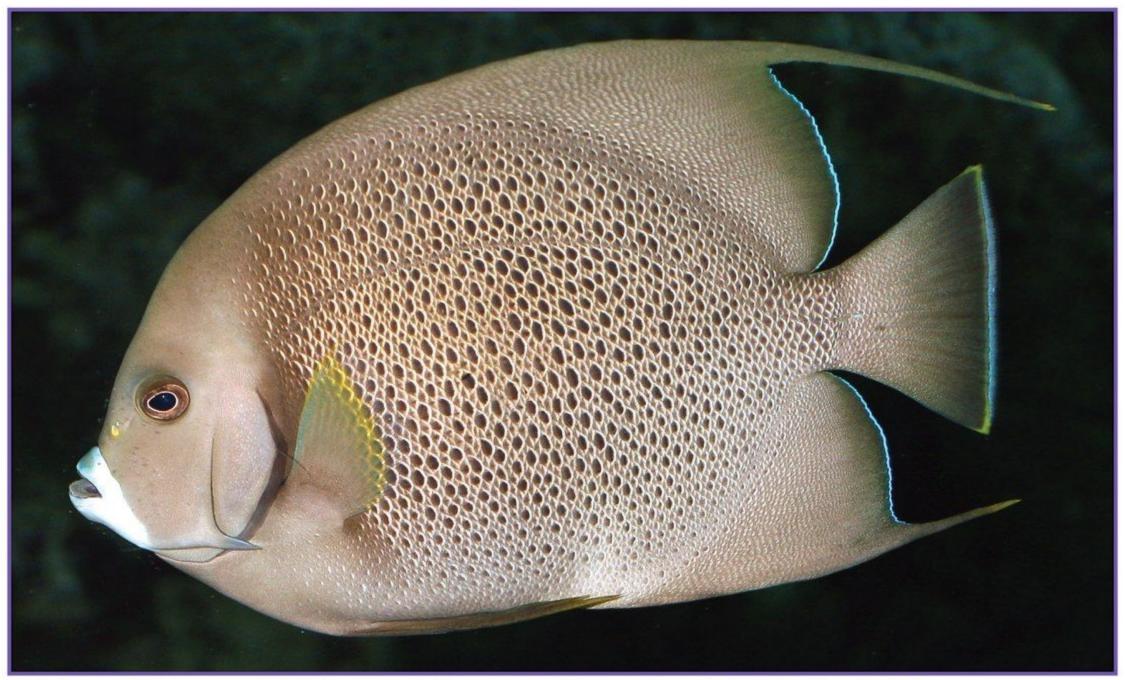
These are also found alone or in pairs in the wild, but as is the case with the others, they should be housed one per tank, with no other large angels. Again, I've never seen a mated pair of these being sold together either, so one individual is all you get. Regardless, these are also relatively hardy when well fed, if purchased at the right size, which is the same 3 to 5 inches recommended for the others.

The Blue Angelfish

The blue angelfish Holacanthus bermudensis is found only in the Caribbean, the western Atlantic from Bermuda down to Yucatán, Mexico, and the lower parts of the Gulf of Mexico. Its range is significantly smaller than the queen angel's. It is also found at greater depths, up to 300 feet at times.

However, other than that, queen and blue angels are very much alike. Both can reach almost 18 inches in length, but are most commonly around 12 inches. Both feed on the same things, and will need the same sponge-heavy diet. Both should be kept singly and without other big angels in non-reef aquariums, and both are hardy fishes when well cared for and bought at the right size. And they even look very similar, especially when young.

In fact, they're so closely related that they're well known for hybridizing. The hybrids are sometimes called Townsend angels in the hobby and are even often given the name *Holacanthus townsendii*, but this name is not legitimate, as the fish is a naturally occurring hybrid between the queen and blue.



■ With the capability to grow up to 24 inches in length, the gray angelfish P. arcuatus needs at least a 300-gallon tank.

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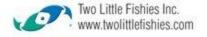
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Regardless, it's still pretty easy to tell the two species apart, as the adolescent to adult queen angel tends to be more colorful and always has a black spot ringed in blue around its head (since it looks like a little black-and-blue crown, I assume that's where the queen angel got its name), while the blue angel doesn't. When it's small, the vertical stripes on

a queen angel's body also tend to curve slightly backward, which is about the only way to distinguish juveniles of the two species.

The Rock Beauty Angelfish

The rock beauty angelfish Holacanthus tricolor can be found in the western Atlantic

from Georgia down to Brazil and in the Gulf of Mexico and the Caribbean. Like the others, this fish is typically found in shallow waters on reefs, and also around rocky areas, but it has also been found at depths of over 300 feet.

Rock beauty angels can reach a maximum length of almost 14 inches, but you'll usually see them closer to 8 inches. They can be kept in a smaller tank than the others, with "smaller" being a relative term—something like a 150-gallon or larger for a big one.



Rock beauty angelfish H. tricolor are exceptionally difficult to keep and are inappropriate for most aquarists.

Rock beauty angels also feed primarily on sponges and algae, and will also eat tunicates and zoanthids in the wild, but they'll oftentimes nip at corals and clams in an aquarium, too. Again, they're not a good choice for the reef aquarium, and will need a varied diet heavy in sponge matter and algae. Unfortunately, no matter what food you try, rock beauties will often refuse to take it. In fact, they're some of the most difficult fishes to keep, and the vast majority end up starving to death over a period of weeks to months.

For whatever reason, more often than not they simply refuse to eat what you can offer, and after trying my best with a few of them in the past, I gave up. Yes, there are scattered rumors of success, but these are the exceptions to the experiences of many other hobbyists.

In addition, unlike the other angels discussed, rock beauties are also relatively shy and are prone to hiding much of the time. This can be made even worse if any more aggressive species of fishes are kept with them. Still, if you insist on trying one, make sure to use plenty of rocks to provide it with hiding places and give it plenty of sponge and algae in its diet, along with some meaty foods as covered above.



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fish of the month

Black Molly

(Cyprinodontiformes, Poeciliidae)

Common Names: Black molly, short-fin molly, sphenops molly

Type Locality: N/A

Range: Not a natural species; ancestral species range from the southern United States through Mexico and Central America



Taxonomic Troubles: Domesticated strains of mollies are of hybrid descent from a variety of natural species. Mollies are typically divided into long-finned species such as *Poecilia latipinna* and *P. velifera*, and short-finned species such as *P. mexicana*, *P. sphenops*, or *P. formosa*.

Size: 6 to 15 cm (3½ to 6 inches).

Preferred Water Chemistry: Hard, basic fresh water to brackish or marine. Mollies are euryhaline, meaning they do well in fresh, brackish, or marine systems, but they do not thrive in soft water.

Difficulty: A very hardy fish with one weakness: It requires mineral-rich, high-quality water. Mollies cannot tolerate any ammonia or nitrite.

Tank Setup: This fish needs room. A 20-gallon is the absolute smallest acceptable aquarium, and larger is much better. Filtration should be robust, and water changes must be frequent. Mollies are quite peaceful and will not bother tankmates too large to swallow. Avoid aggressive tankmates that might harass the mollies.

Feeding: Primarily herbivorous. Will take any and all fish foods, but the diet should be largely based on algae and other plant material.

Description: The black molly is completely black—body, fins, eyes. This is a flat, velvety black, without iridescence. Its unusual appearance has kept it a hobby favorite since the beginning. Black specimens exist in all types of mollies, from the smallest shortfins to the largest sailfins.

Breeding: Kept in high-quality water and given plenty of room, females will drop a brood of fry about once a month. Adults are not overly cannibalistic, and given some cover of floating plants, most of the fry should survive.

Notes: Mollies of all colors are often recommended for beginners, but they are also often considered delicate. That isn't a coincidence. Because these fish require excellent, stable water conditions and plenty of room, they are actually bad choices for new hobbyists. Kept in an overcrowded, underfiltered 10-gallon tank, mollies will quickly fall ill. On the other hand, when kept in large tanks with quality water, especially with some salt, they do extremely well. Although they can and do thrive in pure fresh water, many aquarists believe that the largest, healthiest mollies are produced in brackish or marine setups.



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Expressing a Sense of Depth Using Ryuoh Stones and Stem Plants Takashi Amano photographs by the author • translated by Tomoko Schum



n the Nature Aquarium, techniques that are often used in painting are adopted to express a sense of depth in a tank in order to replicate natural scenery. One of the techniques involves the use of a composition. In particular, a basic Nature Aquarium composition that is used is U-shaped since it is easy to express a sense of depth with it. In the case of a standard U-shaped composition, the left and right bushes of aquatic plants express a relatively up-close view of a forest, while the expression of a distant view that spreads beyond the open space in the center is left up to the viewer's imagination.

In actual scenery, a distant mountain often appears hazy due to airborne dust or water vapor, and cannot be seen clearly. This tendency becomes stronger as the distance becomes greater. A similar tendency exists underwater as well. Even in very clear spring water, a distant object appears vague while a nearby object looks very clear. Although the depth is limited in an aquarium, creating an open space in it leaves room for imagining a distant view that continues farther.

Creating a Natural-Looking Iwagumi

On the other hand, a traditional iwagumi layout often expressed a relatively wide expanse, such as a high plateau or a mountain range, and it did not express a strong sense of depth in the past. It created an image of scenery in which a distant mountain range is clearly seen in clear air, as if it was captured from the top of a mountain. Additionally, in a painting, a nearby object is painted large and a far-away object is painted small to express a sense of depth. This technique is also adopted as a layout technique in the Nature Aquarium. Although there are some exceptions, aquatic



plants with relatively large leaves are planted toward the front of a layout and those with fine leaves are planted in the back as a general rule.

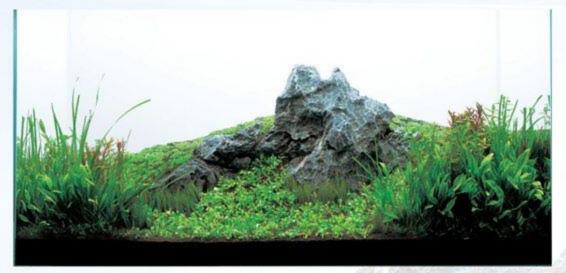
These techniques are developed primarily in layouts with driftwood. In an *iwagumi* layout that expressed a wide, open landscape, it was customary to primarily use short aquatic plants. Among the International Aquatic Plants Layout Contest entries for the past few years, some *iwagumi* layouts that combine stem plants with rocks started to appear as a variation of an *iwagumi* layout. These layouts often express a distant view of a mountain range. However, some layouts had stem plants behind the mountain range, as if there is forest behind the mountains. While one can express any idea freely in a layout submitted to the contest, this type of layout feels odd, since it creates a glaring contradiction in the expression of the sense of depth.

Arranging Plants and Ryuoh Stones

I devised perspective for *iwagumi*, which is introduced in this article, to combine stem plants with an *iwagumi* layout for simulating mountainous scenery without creating an odd feeling. With this technique, a close-up view is expressed by using primarily stem plants and creating bushes of aquatic plants with relatively large leaves, and the distance view is expressed by arranging rocks in the image of a mountain range farther back in the layout. I have already introduced several layouts using this technique. The layout introduced in this article expresses a distant mountain with *ryuoh* stones and a nearby forest with stem plants. It is an image of a far-away mountain, seen between trees in the forest in autumn colors.



■ This is the same layout before planting the aquatic plants. Ryuoh stones are arranged toward the back of the layout and the soil was mounded somewhat high. Giving height to the rock arrangement by mounding the substrate is another key point to this type of layout.



■ The layout planted with aquatic plants. Aquatic plants were selected and planted, keeping the image of grown plants in mind. It is important to provide some space between the plants and the glass surface.



Aquatic plants are shaped into bushes through repeated trimming according to the image in mind. The undergrowth was also trimmed at the same time to keep their growth in sync with stem plants.

DATA

Aquarium: Cube Garden W120 x D45 x H60 cm

Lighting: Solar I (NAG-150W-Green) x 2 units, turned on for 10

hours per day

Filter: Super Jet Filter ES-1200 (Bio Rio M, NA Carbon) Substrate: Aqua Soil Amazonia, Power Sand Special L, Bacter

100, Clear Super, Penac W/for Aquarium, Penac P, Tourmaline BC CO₂: Pollen Glass Beetle Series 40 mm, 4 bubbles per second via CO₂ Beetle Counter (using Tower) **Aeration:** For 14 hours after the light is turned off using Lily

Pipe P-4 Water Change: 1/3 once a week

Water Change: 1/3 office a week
Water Quality: Temperature 25°C (77°F), pH 6.8, TH 20 mg/l
Aquatic Plants: Hygrophila polysperma, Rotala rotundifolia, Blyxa
aubertii, Cyperus helferi, Echinodorus grisebachii, E. tenellus, Glossostigma elatinoides, Hemianthus callitrichoides "Cuba," Eleocharis acicularis

Fish/Invertebrates: Paracheirodon axelrodi, Otocinclus sp., Caridina japonica

[Note: The hardware itemized above represents the author's specific choices; equivalent results may be obtained with other equipment and accessories—Eds.1



■ The composition is a variation of a U-shaped composition. A rock arrangement is placed in the center instead of creating an open space. This technique enhances a sense of depth with the contrast of a close view and a distance view.

Stem plants are planted toward the front of the aquarium in this layout. Hygrophila polysperma, which has relatively large leaves compared to other stem plants, was planted in the front center of the layout. Stem plants in the genus Rotala with relatively small leaves are planted behind it and toward the outside. Additionally, Echinodorus grisebachii was planted at the base of the stem plants, somewhat away from the glass surface, since it feels cramped to have the leaves of stem plants touching the glass surface. E. grisebachii has moderately sized leaves, and it can hide the lower part of stem plants that can appear unsightly.

There is another technique used to create a sense of depth in the field of underbrush besides the stem plants that forms the forest. Cuba pearl grass was planted in the planting space created behind the rockwork. In addition, Glossostigma is planted in the front of the rockwork. Both are typical underbrush plants that spread over the substrate. The important point, however, is that the sizes of their leaves are different. The sense of depth is enhanced further by planting Glossostigma with larger leaves toward the front and Cuba pearl grass with tiny leaves in the back. The sense of depth can be expressed more naturally by using such a technique in a plant arrangement.

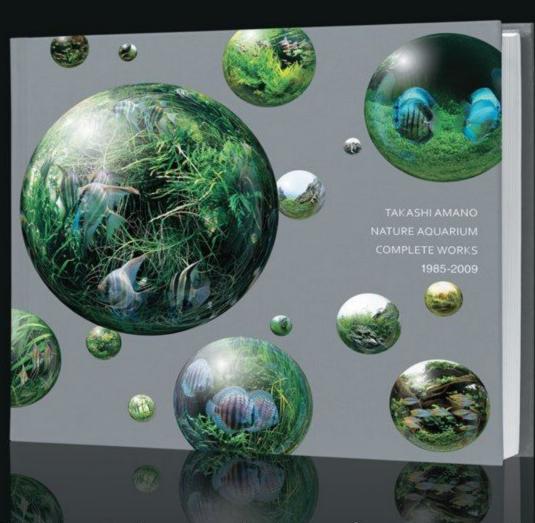
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Nature Aquarium: Complete Works 1985–2009

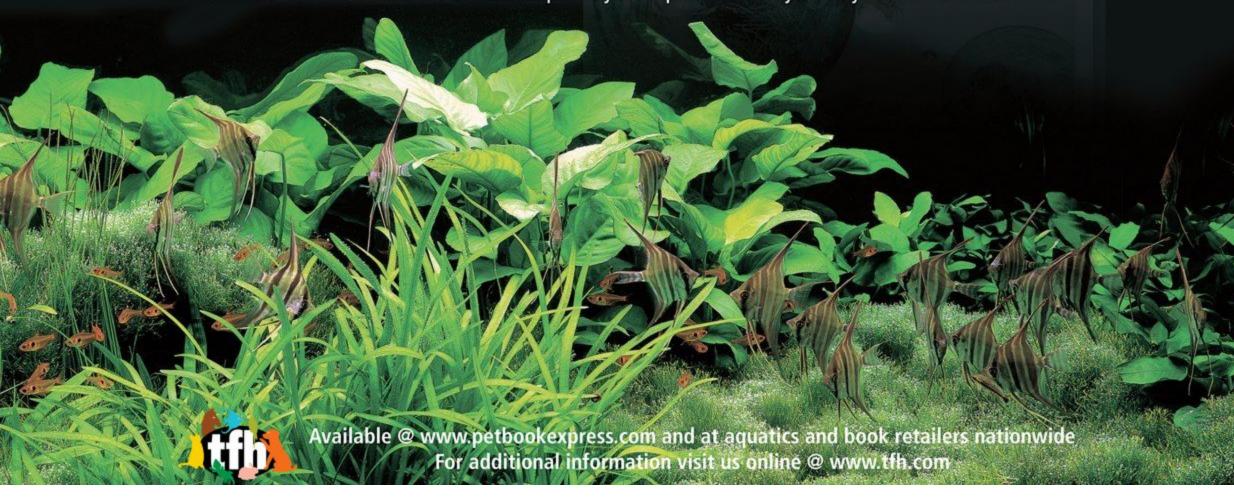
Takashi Amano

ISBN: 9780-7938-0649-2

264 pages; hard cover with jacket; \$59.95



Nature Aquarium: Complete Works 1985–2009 showcases the spectacular designs of aquarium innovator Takashi Amano. Inside are more than 200 photos of his lush aquascapes—perfect inspiration for you to try your hand at creating your own. Each photo is accompanied by a full list of the equipment, plants, animals, and water chemistry used to create it. Along with the fantastic images of nature aquariums, Mr. Amano includes entertaining and insightful essays on his design philosophy that will stimulate any aquarist's creativity. This beautiful volume is sure to find a welcome spot in your aquarium library or on your coffee table.



2611 INTERNATIONAL



Grand Prize
World Ranking #1
Long Tran Hoang
VIETNAM
Title: Delicate World

Dimensions: W150 x D81 x H48 cm (W60 x D30 x H20 inches) **Aquatic Plants:** Glossostigma elatinoides, Hydrocotyle sibthorpioides, Marsilea hirsuta, M. quadrifolia, Bolbitis heudelotii, Sagittaria subulata

Fish & Invertebrates: Hyphessobrycon amandae, Neocaridina heteropoda

Evaluation: This year, a very strong layout from Vietnam received the Grand Prize. The composition of rocks arranged in a fine balance gives a strong impact, like a superb view found in the ocean floor. Not only does he create a unique layout style, Mr. Long Tran Hoang also utilizes the distinctive aquarium size ratio to create short-and long-distance views, skillfully expressing perspective and power in the layout. Small ferns and mosses attached on the stones are all natural, and they emphasize the unique stone layout. By arranging various plants around the stones, he succeeds in making a delicate world.







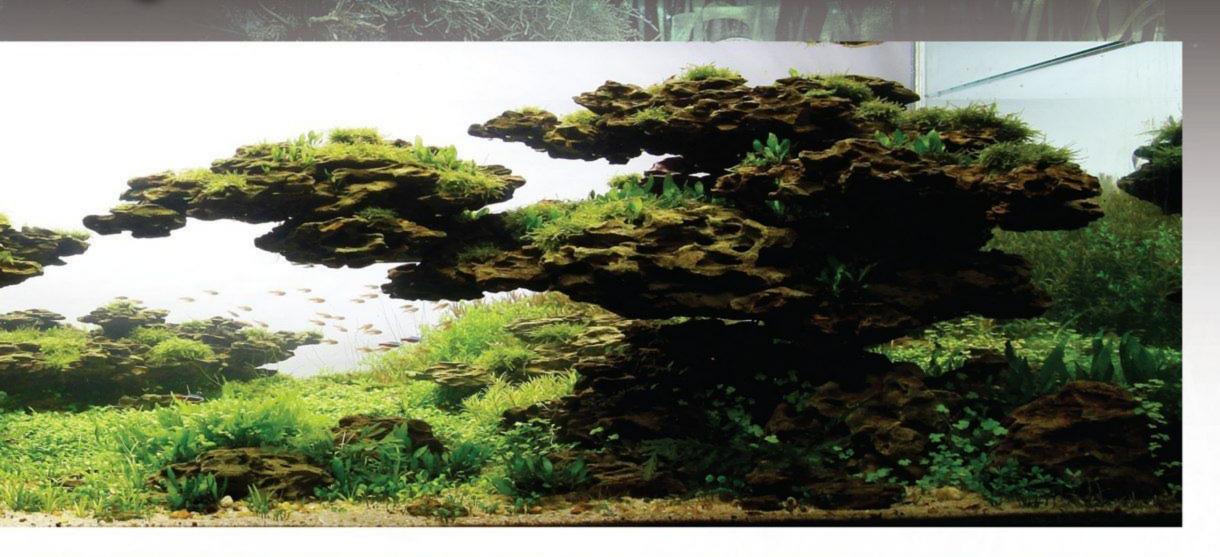
Dimensions: W150 x D60 x H50 cm (W60 x D25 x H20 inches)

Aquatic Plants: Cryptocoryne yujii, C. wendtii, Rotala pusilla, Microsorum pteropus, Pellia endiviifolia, Hypnum plumaeforme, Blyxa alternifolia, Anubias barteri var. "nana," Eleocharis minima, Bolbitis heudelotii, Hygrophila sp., Glossostigma elatinoides, Ranunculus papulentus, Ranalisma humile

Fish: Paracheirodon simulans, Nematobrycon palmeri

Evaluation: The Gold Prize winner is from Taiwan, and it gives an impression similar to that of the 2010 Grand Prize winning layout. But what makes this layout attractive is the creator's fussing over details. The fern and moss "gloves" on each and every tree are used to express epiphytes, and cosmetic sand and pebbles suggest a stream running through the forest floor. The detailed arrangement of various plants was highly evaluated.

AQUATIC PLANTS LAYOUT CONTEST







Silver Prize World Ranking #3 **Dmitriy Parshin RUSSIA** Title: Brotherhood

Dimensions: W120 x D45 x H45 cm (W50 x D20 x H20 inches)

Aquatic Plants: Eriocaulon sp., Riccardia chamedryfolia, Fissidens sp. "fontanus," Hanegoke moss "Cameroon," Anubias barteri var. nana "petite," Hemianthus micranthemoides, Crassula sp., Microsorum pteropus

Fish & Invertebrates: Paracheirodon axelrodi, Siamese algae eater, Caridina

japonica, Neocaridina sp.

Evaluation: The first Silver Prize winner is from Russia, and the layout is an image of a Russian forest. In this year's contest, we received many layouts with an image of a forest, likely due to the influence of last year's Grand Prize winning layout, but this layout shows the highest level of completion. Here the creator expresses a deep natural feeling by rugged bark textures and greens of plants. He also skillfully arranges various sizes of trees, sometimes in inclined positions, and succeeds in emphasizing a perspective in the central open space. The position of the fish at the moment of shooting the picture was also good.





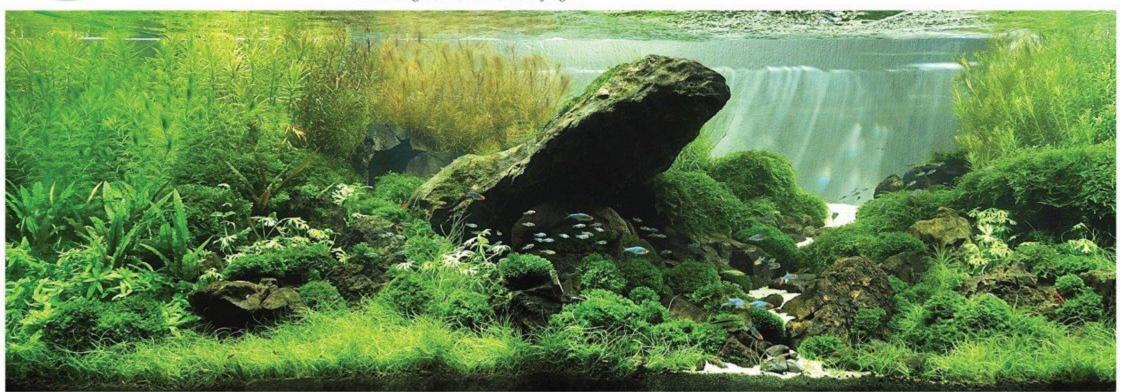
Silver Prize World Ranking #4 Cliff Hui HONG KONG Title: Alongside

Dimensions: W120 x D45 x H50 cm (W50 x D20 x H20 inches)

Aquatic Plants: Rotala rotundifolia, Hemianthus micranthemoides, Glossostigma elatinoides, Microsorum sp., baby tear moss, Vesicularia sp., Fissidens fontanus, Fontinalis antipyretica, Riccardia chamedryfolia

Fish & Invertebrates: Paracheirodon simulans, Nannostomus beckfordi, Rasbora borapetensis, Otocinclus sp., Caridina japonica

Evaluation: The second Silver Prize winner is from Hong Kong, and his layout gives a good impression of a natural feeling and perspective. He combines both stones and driftwood, and expresses a natural feeling by attaching several species of moss on those layout materials. He emphasizes perspectives by spreading cosmetic sand from the central open space toward the back. The use of driftwood looking like a rustic bridge over the valley draws the viewer's attention. These techniques are nothing new, but the level of expression is very high, and it received high evaluation from the judges.





Bronze Prize World Ranking #5 Fa Loy Lee MALAYSIA Title: Broga

Dimensions: W150 x D60 x H45 cm (W60 x D25 x H20 inches)

Aquatic Plants: Riccardia chamedryfolia, Vesicularia sp., Staurogyne repens, Ranunculus papulentus, Myriophyllum mattogrossense, Rotala rotundifolia "green and red," Rotala wallichii "long leaf," Ludwigia inclinata var. "verticillata Cuba," L. arcuata, R. sp. "nanjenshan," Cryptocoryne wendtii, Limnophila sp. "Vietnam," Fissidens sp., Eleocharis vivipara, E. acicularis, Eleocharis sp.

Fish & Invertebrates: Corydoras pygmaeus, Sawbwa resplendens, cherry shrimp

Evaluation: The first Bronze Prize winning layout is an iwagumi layout from Malaysia. Using a panoramic aquarium tank and a large main stone, the creator makes a layout with a sedate impression. A dark shadow under the overhanging main stone gives a heavy impression, but white cosmetic sand in the center and bright stemmed plants on both sides counter this dark impression. The ratio of open space and densely planted area is just right, and the use of mosses is very good.





Bronze Prize World Ranking #6 Koji Kogure JAPAN Title:

Unspoilt Scenery
Dimensions: W90 x D45 x H45 cm (W35 x D20 x H20 inches)

Aquatic Plants: Rotala rotundifolia, Hemianthus micranthemoides, H. callitrichoides, Hydrocotyle sp., Glossostigma elatinoides, Riccardia chamedryfolia,

Fish & Invertebrates: Paracheirodon axelrodi, Endler's livebearer, Crossocheilus oblongus, Caridina japonica, Indoplanorbis exustus

Evaluation: The second Bronze Prize winning layout is a mountainous layout from Japan. This type of layout is usually produced by heaping up ryuoh stone high for expressing a steep rock mountain, but in this layout the creator expresses a waterfall and mountain stream with a white band of ryuoh stone and white cosmetic sand, and succeeds in making a large-scale layout. The nicely grown plants are used





Bronze Prize World Ranking #7 Chow Wai Sun HONG KONG

Title: VERVE!

Dimensions: W200 x D66 x H66 cm (W80 x D25 x H25 inches) Aquatic Plants: Anubias barteri var. "nana," Bolbitis sp., Bolbitis heudelotii, Cladophora aegagrophila, Echinodorus tenellus, Hygrophila pinnatifida, Marsilea hirsuta, Microsorum pteropus "narrow," Nymphaea lotus "Zenkeri," Taxiphyllum barbieri, Vesicularia ferriei, V. dubyana

barbieri, Vesicularia ferriei, V. dubyana

Fish & Invertebrates: Paracheirodon axelrodi, Otocinclus sp.,
Neocaridina sp.

Evaluation: The third Bronze Prize winner is a unique layout from Hong Kong. The creator of this layout is famous for arranging driftwood uniquely, and every year he sends a

for arranging driftwood uniquely, and every year he sends a dramatic layout. This year the layout with a bold composition produced by driftwood in a large-size aquarium is very powerful. But some arrangements of driftwood and stones got negative remarks due to the existence of driftwood with a different impression in the left side of aquarium tank, and the lack of unity in arrangement of driftwood and stones. The aquatic plants still look young, and it does not have a resonance of nature.



World Ranking #8 Yuji Yoshinaga • JAPAN Title: Great Nature on the Desk

Dimensions: W45 x D24 x H16 cm (W20 x D10 x H6 inches) **Evaluation:** This is a mountainous layout in a wide, flat aquarium. Utilizing asperity and a white band of *ryuoh* stone, the creator succeeds in making a large-scale layout in a small tank. The plant arrangement is also delicate. But one drawback is the use of stones with different colors/textures on the left side.







World Ranking #9 Wai Hung Tony Wong • HONG KONG Title: Pillar Cliff Glory

Dimensions: W120 x D45 x H45 cm (W50 x D20 x H20 inches) **Evaluation:** This is a concave composition layout produced in a panoramic-sized aquarium. Cosmetic sand in the center emphasizes the perspective, and the color and texture of the stones matches well with brightly colored aquatic plants. It is regrettable the composition is symmetrical, and some red-stemmed plant shoots stick out.



Dimensions: W90 x D45 x H45 cm (W35 x D20 x H20 inches) **Evaluation:** Well maintained thickets of plants draw gentle curves, and many layers of such curves make a unique layout style. A part of the *ryuoh* stone is exposed, but the surface of the stones should be hidden in such a fantastic layout. The open space in the upper corners would have looked better if filled with stemmed plants.







World Ranking #11 Hidekazu Tsukiji • JAPAN Title: Gentle Breeze

Dimensions: W120 x D45 x H45 cm (W50 x D20 x H20 inches) **Evaluation:** A large-sized stone sticking out from the water surface draws the eye. The stone's impact is very strong, but when observing details, some people may find the arrangement rough. The use of mosses and spreading of cosmetic sand, even in the indented part, look natural. There are some species of slender plants in the background, but the whole layout would be better without these plants.



Dimensions: W150 x D50 x H55 cm (W60 x D20 x H25 inches) **Evaluation:** The use of stones expressing the perspective and spatial impression of gentle slopes of green is very impressive. But the aquarium silicone seal of the back corners stands out clearly, and this undermines the beauty of the layout. It is advisable to use an aquarium with less obstructive silicone or









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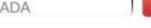
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AMAZING

for one have always believed that angelfish truly deserve the common name that they were given. They have an angelic quality due to their soft flowing lines and graceful movements. Nothing can compare to the sight of angelfish in a tank with lighting casting a shimmering glow on their beautiful bodies. These fish are gorgeous and relaxing to watch, and are a very popular part of our hobby.

Angelfish belong to the genus Pterophyllum in the Cichlidae family. It is likely that aquarium strains are hybrids of different wild species, but they are most often considered to be P. scalare. This species is found throughout a very large range in South America and most of the Amazon River Basin.

Although most cichlids are aggressive, angelfish are an exception to the rule. These funloving and peaceful fish really shine when placed in a proper home aquarium. Their sheer size is enough to catch the eye of children who seem captivated by their every movement. Even people who are unfamiliar with the aquarium hobby can identify an angelfish by its majestic and unique shape because they have become a popular icon for tropical fish.



Physical Attributes

Angelfish are unusually shaped for cichlids because they are laterally compressed, with round bodies and elongated triangular dorsal and anal fins. This unique diamond-shaped body allows them to hide and move easily among roots and plants. Their natural coloration includes dark vertical stripes, thought to provide camouflage like a zebra's stripes. Angelfish are ambush predators that prey on small fish and invertebrates that they stalk in the plants.

Aquarium Care

Angelfish are easy to care for and can live up to 10 years in captivity if they are provided with proper aquarium conditions. Because of their shape, angels prefer tall aquariums with a capacity of at least 20 gallons. However, if you want to keep several in a beautiful setup, I would highly recommend an aquarium that is 55 gallons or larger. Another advantage of purchasing a larger tank for your angelfish is that the increased space will offer a better feeling of security, and breeding parents will not be as quick to eat their eggs or hatched young.

They should be kept in a warm aquarium, with a temperature that remains around 78° to 80°F. Although they come originally from slightly acidic, fairly soft water, angels are quite adaptable to waters of various pH and hardness. Any tank decor should consist of smooth rocks and wood, as the fish can be injured by sharp objects.

Broadleaf aquatic plants such as Amazon swordplants *Echinodorus* spp. are great for an angelfish tank because they will allow them a nice natural surface on which to lay their eggs. Java moss, water sprite *Ceratopteris* spp., and Java fern are also good choices for an angelfish aquarium.

Angels will flourish if they are fed a mixture of flake, live, and frozen foods such as brine shrimp, mosquito larvae, and bloodworms. It should be noted that angelfish are gluttons and will gorge themselves on food, so stick with a strict feeding schedule unless you want your aquatic pets to resemble floating basketballs with fins sticking out. Overfeeding also leads to health problems and water fouling.

When choosing tankmates for your angelfish, make sure that you pick non-aggressive species that will not nip at their large, flowing fins. Angelfish are generally peaceful, but can be very aggressive eaters and become territorial while breeding. A common choice is to stock a tank with just angelfish, either one variety or several, and perhaps some cory catfish to provide activity on the bottom.

Keeping Angels Healthy

Angelfish are hardy, and it is much better to concentrate on disease prevention than on diagnosing and treating illnesses. You can lower the chance of disease by doing frequent water changes and keeping the aquarium environment in top condition. And always quarantine new specimens before adding them to your established tanks.

These fish are especially sensitive to poor water quality. They also really, really respond to large, frequent water changes. Many commercial breeders make 50-percent daily changes on their tanks and attribute spawning success and rapid growth of fry to this simple maintenance procedure.

Ich, also known as white spot disease because of the appearance of the parasites *Ichthyophthirius multifiliis* on infected fish, is the most common aquarium fish illness. It is usually easily treated with commercially available preparations, so it is a good idea to keep ich medication on hand, though hopefully you won't need it.



Marble angelfish are named for the irregular patterning of their markings.

Breeding

Angelfish form monogamous pairs. Eggs are generally laid on a vertical surface: a piece of wood, a flat leaf, or even the aquarium glass. Breeders often provide an artificial spawning site such as a piece of slate, a ceramic cone, or a vertical piece of plastic pipe.

As is the case with most cichlids, brood care is highly developed. The parents tend the eggs, and when they hatch, the parents hang their fry on vertical surfaces until they become free-swimming. Although experienced angelfish breeders can usually discriminate male from female visually, it isn't foolproof. Only during spawning will you be able to tell the male from the female because the female has a thick, blunt breeding tube, and the male has a thin, more pointed breeding tube.

Obtaining a Pair

The best way to get compatible pairs is to start with six or more fish and raise them until they pair off. Often you will find that a pair has spawned and is keeping all the other fish in the tank at the far end from the spawning site. If you are attentive, you will be able to spot pairs before they spawn, with the two fish staying close together, sometimes chasing off other fish, and often hanging out in the same area of the aquarium.

Your angelfish will generally reach sexual maturity between the ages of 6 and 12 months, and can spawn every seven to ten days if the eggs are removed. When a pair is ready to spawn, they will choose a site and meticulously clean the surface. The female will then deposit a line of eggs. The male follows and fertilizes them. This process is repeated until the spawn—often several hundred eggs—is complete. Although some strains of angelfish have very poor parenting skills, in an ideal world, both parents will take turns maintaining a high rate of water circulation around the



Gold angels are a good choice for hobbyists seeking a richly colored fish without black markings.

eggs by fanning them with their pectoral fins and mouthing them gently to remove dirt or infertile eggs, which will turn white. After a few days, the eggs hatch, and the fry remain attached to the spawning substrate or to whatever surface their parents move them to. During this period, the fry do not eat and survive by consuming the remains of their yolk sacs. After about a week they become free-swimming, at which point they can take newly hatched brine shrimp and other similar-sized foods.

The best system for filtering a fry tank is to use a sponge filter, which will provide gentle water circulation. A sponge filter also will not suck in the fry the way more powerful filters can. Water quality is even more critical in a breeding tank, since even small amounts of dissolved wastes can be fatal to young fry.

Fry Diet

Millions of angelfish fry have been successfully raised on a diet of newly hatched brine shrimp. They should be fed three to four times per day until they are large enough to consume flake food and dried bloodworms. Once their bodies reach the size of a quarter, they can be fed the regular adult food.

Varieties

Many mutations have occurred in domestic angelfish stocks and have been established into fixed strains. Some varieties of angelfish will breed true, meaning that if you pair two fish of the same variety, all the offspring will be of that type. Other varieties will produce a variety of types. And, if a fish with a dominant trait mates with a fish with the recessive variant of that trait, the offspring may all display the dominant trait.

The genetics of angelfish are fascinating and complex, but outside the scope of this introduction. We'll look at some of the more common varieties, but realize that there is much more to the breeding of various angelfish varieties.

SILVER

The silver angelfish sports the coloration of the wild angelfish. It has a silver body with red eyes. Three vertical black stripes adorn the side. These stripes fade or darken depending on the mood of the fish.

VEIL AND SUPER VEIL

The veiltail gene causes all of the finnage to be longer and more flowing. A fish with one veiltail gene is called a veiltail, and one with two has even more elaborate fins and is called a super veil. A veiltail bred to a standard fin will produce half of each type, while a super veil bred to a standard will produce all veiltail offspring.

BLACK AND BLACK LACE

The first color mutation in captivity was the dark gene. A fish with one dark gene is called a black lace. The entire body is darkened, and there is a very attractive lace pattern in the fins. A fish with two dark genes is called a black, double black, or double dark angel and is nearly completely black, though faint barring can be seen in some strains or in the right light.

ZEBRA

The zebra angelfish is similar to the silver, but it has four to six vertical stripes. If a zebra has one dark gene, it is called a zebra lace and is a darkened version of the zebra, also with beautiful lacing on the fins. (A double dark zebra looks like a regular double dark.)

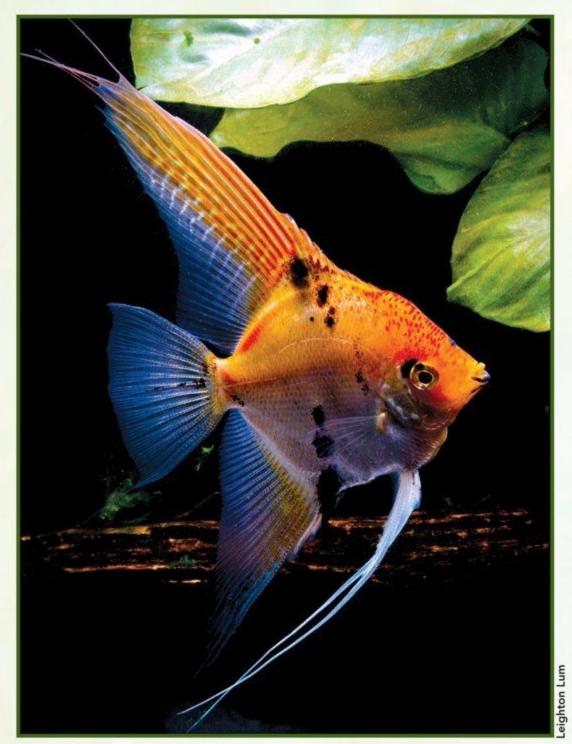
GOLD

Gold angelfish have no black markings, and the base color is a yellow gold. They often have considerable yellow or orange markings on the face, head, and back.



Albino pearlscale; pearlscales of lighter colors are generally more popular, as this brings out their unique tinfoil appearance.





■ Marble kois are easily identified by their red-orange pigment.



■ Marble veiltail; veiltails are characterized by long, flowing finnage.

MARBLE

In marble angelfish the silver and black markings are marbleized rather than in stripes. The fish can be lightly or heavily marbled.

GOLD MARBLE

A different gene causes the gold marble coloration, which is more gold than silver and has only a small amount black marbling compared to a regular marble angelfish.

Platinum Angels

The newest mutation in angelfish is the gene known officially as Philippine blue. Identified and established by Ken Kennedy in the Philippines, this trait can combine with other varieties in beautiful ways. A gold angel with two Philippine blue genes is called a platinum and is a spectacular, blue-white fish with amazing iridescence. A black angel with two blue genes is called a pinoy angel, and a gold blushing angel with two blue genes is called a Paraiba.



These new types have caused quite a stir in the hobby, as they display

traits heretofore not seen in angelfish and are truly gorgeous. A particularly popular strain is the pearlscale platinum, whose iridescent body looks positively metallic.

BLUSHING

The blushing trait removes the dark bars and causes the gill covers to be translucent in young fish. The bright red gills showing through explain the "blushing" name. As the fish mature, their gill covers become opaque, however. A silver blushing is all-over silver with the red "cheeks," and these often show considerable blue iridescence and are sometimes called blue angels or German blues. A gold blushing is all-over gold with the blushes.

KOI AND SUNSET

A gold marble blushing is called a koi angelfish. Originally they had red-orange on their heads, but strains have been developed in which the red-orange pigment is displayed on the entire body and into the fins. A gold blushing fish with a prominent orange crown is called a sunset angel.

HALF-BLACK

In the half-black angel, the back half of the fish is solid black. The front half is like that of a silver. This trait can be affected by environmental conditions, so fish that are genetically half-blacks can appear as silvers if their rearing conditions were less than ideal.

PEARLSCALE

Pearlscale is a scale mutation and can occur on any color angelfish. It produces a finely crinkled tinfoil appearance to the scales and is much more visible on light fish than on darker ones. Most people prefer, say, an albino pearlscale to a black pearlscale.

ALBINO

Albino angelfish lack dark pigments, but may retain yellow or red pigments. In the right light you will see a white-on-white effect that shows the bars. The eye pupils are pink/red as in all other types of albino animals. Albinos do not produce any dark pigments and therefore show a white to yellow body.

Plenty to Choose From!

There are many different types of angelfish to choose from in addition to the varieties covered. No matter what your taste is in coloration or pattern, you will find an angelfish to suit you. Angelfish have fascinated hobbyists over the years, and will continue to do so as they majestically cruise through the waters of our home aquariums.



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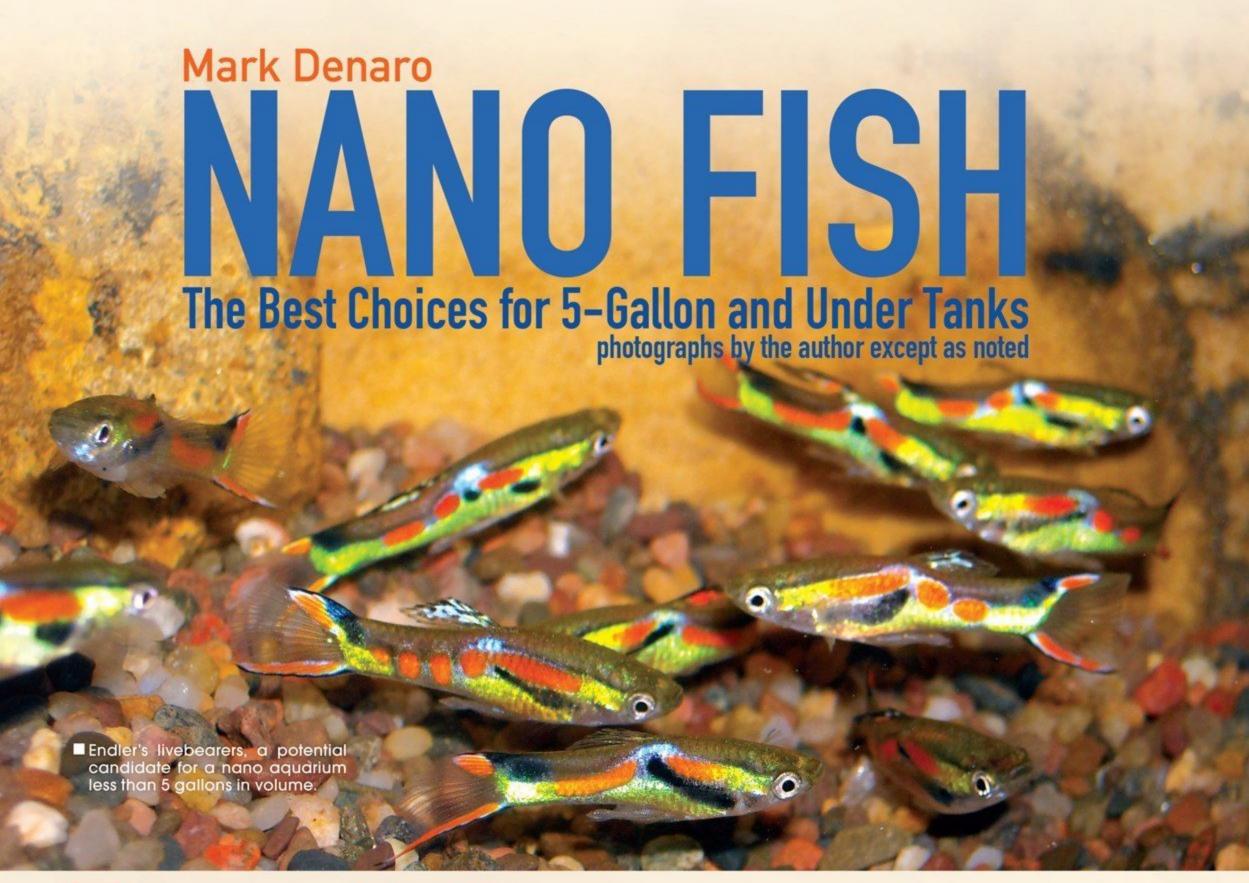
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he increasing popularity of nano tanks is a wonderful trend in the hobby. Unfortunately, there is not a lot of information available to the hobbyist regarding appropriate species for inclusion in these tanks, so it is very easy for the hobbyist, and especially the beginning hobbyist, to purchase fish that are unsuitable. On the bright side, the list of species that do well in small tanks is actually rather extensive, though many of these are specialty fish not likely to be found in your local pet store.

We'll look at species that you should be able to find in stock at your local aquarium store, along with some that your local shop may be able to special order or that you will be able to find at a regional aquarium specialty store. Just a few may only be available through private breeders.

First, we need to define nano tanks. The key factor is size. There are many definitions out there, but when I think of "nano" I think of tanks that are 5 gallons or less.

Killies

Killifish hobbyists can be regarded as the original nano tank keepers. Many killie hobbyists keep their breeding pairs in 2½-gallon setups. The problem with this approach is that these are set up more as utilitarian containers than decorative aquariums. But since most small- to medium-size killifish can be successfully bred in 2½ gallons, they can also be maintained in decorated nano tanks.

More killifish are available in the trade now than in the past. It's not unusual to see anywhere from 8 to 15 killifish species on a wholesaler's availability list these days, which is a big improvement over the time not long ago when they were only available through members of the American Killifish Association and other specialty organizations.

Some of the regularly available species that are suitable for our purposes are the various forms of Fundulopanchax gardneri, Aphyosemion australe, A. striatum, the various Cynolebias and Nothobranchius species, and Pseudepiplatys annulatus.

Of these, the clown killifish *P. annulatus* is the best, as they seldom exceed an inch in length. They are commercially bred in Indonesia and are regularly available to importers, so your local shop should be able to get them for you. Many other small- to medium-size species are good choices, too, and your decision may only be limited by the number of species to which you have access. It is important to remember that killifish require tight-fitting tops; without these, they will definitely end up on the floor.

For general maintenance, most killifish are fairly adaptable when it comes to water conditions, though most prefer soft water, and their colors will be more vibrant if the water is more to their liking.

The exception to this is *Nothobranchius*, which prefer harder water and will benefit from the addition of a teaspoon of aquarium

salt per 5 gallons or so. This also helps because *Nothobranchius* is somewhat susceptible to velvet. Thus they are probably not the best choice for beginners, but this genus includes some of the world's most beautiful fish that are excellent choices for the aquarist with some experience.

Guppies and Beyond

If killifish hobbyists are not the original nano tank keepers, that honor would fall to guppy enthusiasts. Many serious guppy breeders make extensive use of 2½- to 5½-gallon tanks in breeding and rearing their fish. Guppies have several advantages for use in nano tanks.

They're readily available in every color of the rainbow from every aquarium shop, and they are hardy, active, and suitable for hobbyists of all experience levels. The most important factor in keeping them successfully in nano tanks is the sex ratio. Unless you keep only males, it is best to keep one male with two to three females.

This will spread the male's amorous intentions among several females, enabling those not currently being wooed to rest a bit. In smaller tanks, it may be difficult for a single female to get a respite from the male's attention, and she may live in a constant state of stress.

Something that I have found particularly interesting the last few years is the availability of wild guppies from all over the world. This species was introduced throughout the tropics in an attempt to control the world's mosquito population in the first half of the 20th century, so they're established across the planet. The most frequently available wild guppies are imported from Colombia, Trinidad, eastern Brazil, and Indonesia.

The fish coming out of Colombia and Trinidad are treated as feeders and packed very heavily. Consequently, they are usually not in good condition upon arrival. If you can get them, the best choices are those from Indonesia or Belém.

The exporters in these locations pack and ship wild guppies the same as they do any other fish they're exporting, in reasonable quantities based on the size of the bag and the length of time that the fish will be packed. As a result, the fish arrive in excellent condition. They are more expensive due to the extra shipping cost per fish, and you should expect to pay about the same price for these as you would for fancy guppies.



■ Gold tetras *Hemigrammus rodwayi* are readily available and make good choices for the nano tank.



Yellow neon microrasboras Microdevario kubotai display a metallic sheen that can appear yellow or green, depending on the lighting.

Some populations of wild guppies show fairly consistent patterns on the males, though each fish is slightly different, while other populations display a great deal of diversity in color pattern. They make quite interesting subjects for breeding and can also be used to inject increased vigor into lines of fancy guppies that you may be working with.

No discussion of guppies can be complete without mentioning Endler's livebearers, which are also excellent choices for the nano tank. Due to its smaller size, the Endler's livebearer is actually a better choice for the nano tank than the regular guppy.

Wild-type Endler's livebearers tend to be very consistent in color pattern, and that pattern is particularly vibrant and striking. They are being selectively bred for color and finnage now in the same way that guppies have been, so a number of variants are available. Some of this selective breeding involves crossing them with regular guppies, so some get larger than the original wild fish.

The genus *Micropoecilia* includes species that are also highly suitable for nano tanks, but they are more difficult to obtain. *M. picta*, *M. parae*, and *M. branneri* are occasionally available through the trade but will take some effort on the part of your local shop to find. A better option for obtaining these species would be to find them through private breeders. The American Livebearer Association or your local aquarium society are good places to start.

Tetras

When one thinks of small fish, the first to come to mind for most hobbyists is the neon tetra *Paracheirodon innesi*. This diminutive little jewel is just one of many tetras that make great additions to nano tanks. The neon has the additional advantages of being one of the most easily obtained freshwater fish as well as one of the most colorful.

Like other tetras, this is a schooling species that should be kept in a group. I would consider three as an absolute minimum number, though a school of five to ten is certainly preferable.

The green neon *P. simulans* is another fish you should consider very strongly. It grows to a slightly larger size than the neon and has a somewhat different color pattern. While the neon sports a seemingly luminous blue stripe, that of the green neon can appear to be either green or blue depending on the lighting and backdrop.

It may require a bit more patience until you can locate this species through your local shop, but they are available regularly from exporters in Brazil, and your shop should be able to get them for you within a few weeks.



Lyretail killifish Aphyosemion australe and other killies are great for nano setups.

Another readily available tetra that makes an excellent choice is the gold tetra *Hemigrammus rodwayi*. A school of three to six gold tetras combined with a school of three to six neons or green neons makes a beautiful display in a nano tank, as their colors complement each other, and they occupy different levels in the water column, with the gold tetras hanging out above the neons.

Aesthetically it is more pleasing to the eye to keep odd numbers of fish in the school and to have a different number of each species, like three gold tetras and five neons or something along those lines.

While almost any tetra with maximum growth potential of 1½ inches or so can be kept in nano tanks, a few others worthy of mention are the dwarf pencilfish Nannostomus marginatus; the glowlight tetra Hemigrammus erythrozonus, which is available in both its wild color form and albino; the ember tetra Hyphessobrycon amandae; the panda tetra Aphyocharax paraguayensis; and, in particular, the ruby tetra Axelrodia riesei.

The ruby tetra is probably the perfect tetra for the nano tank. It reaches a maximum size of less than ¾ inches and, when happily settled into a planted tank, sports a color pattern that must be seen to be appreciated. This stunning little fish may require some time and effort to find, but that effort will be well rewarded. There are several other species in the genus, but *A. riesei* is far and away the most frequently imported.

Cyprinids

The smallest vertebrates on earth are members of the family Cyprinidae. Though occasionally imported, you are not likely to find the tiny species of the genus *Danionella* in your local shop. Their slightly larger cousins, the *Boraras* species, are available regularly through specialist shops. The members of this genus probably constitute the best choices for the nano tank.

They're small, colorful, and hardy. They prefer soft water but are adaptable and will adjust to life in hard water. They are easy to feed on a variety of dry and frozen foods and are completely inoffensive.

The dwarf rasbora *B. maculatus* has been imported on a somewhat regular basis for many years and is the most readily available. Despite its common name, it is the largest species in the genus, reaching up to an inch in length.

The least rasbora *B. urophthalmoides* and the micro rasbora *B. micros* grow to just under an inch in length. *B. brigittae*, commonly known as the mosquito or chili rasbora, and *B. merah*, the phoenix rasbora, will not exceed ¾ inches in length.

While *B. merah* gives it a good run for the money, *B. brigittae* is the most beautiful species in the genus and would have to make most people's short lists of the world's most beautiful freshwater fish. The sight of a school of happy, settled *B. brigittae* in a planted tank is one you will not soon forget.

They rank right up there with cardinal tetras for color, featuring an orange stripe that glows as brightly as the blue stripe of the cardinal. Their diminutive size combined with their brilliant colors makes them the ultimate nano tank fish.

Another cyprinid worthy of consideration is the galaxy danio *Danio margaritatus*, which

grows slightly larger than the boraras and compares quite favorably with *B. brigittae* in terms of color.

The next step up the cyprinid size scale are fish in the genus *Microdevario*. *M. kubotai* is available in the trade fairly regularly and is another great choice for the nano tank. This species has an interesting metallic color that can appear to be either yellow or green depending on lighting and the background against which you are viewing the fish.

Gouramis and Kin

GOURAMIS

The family Anabantidae includes some prime candidates for the nano tank. The sparkling gourami *Trichopsis pumila* is readily available in the trade and makes a great addition to any nano setup. It is a different shape than most of the other species we've discussed so far and makes a good visual contrast.

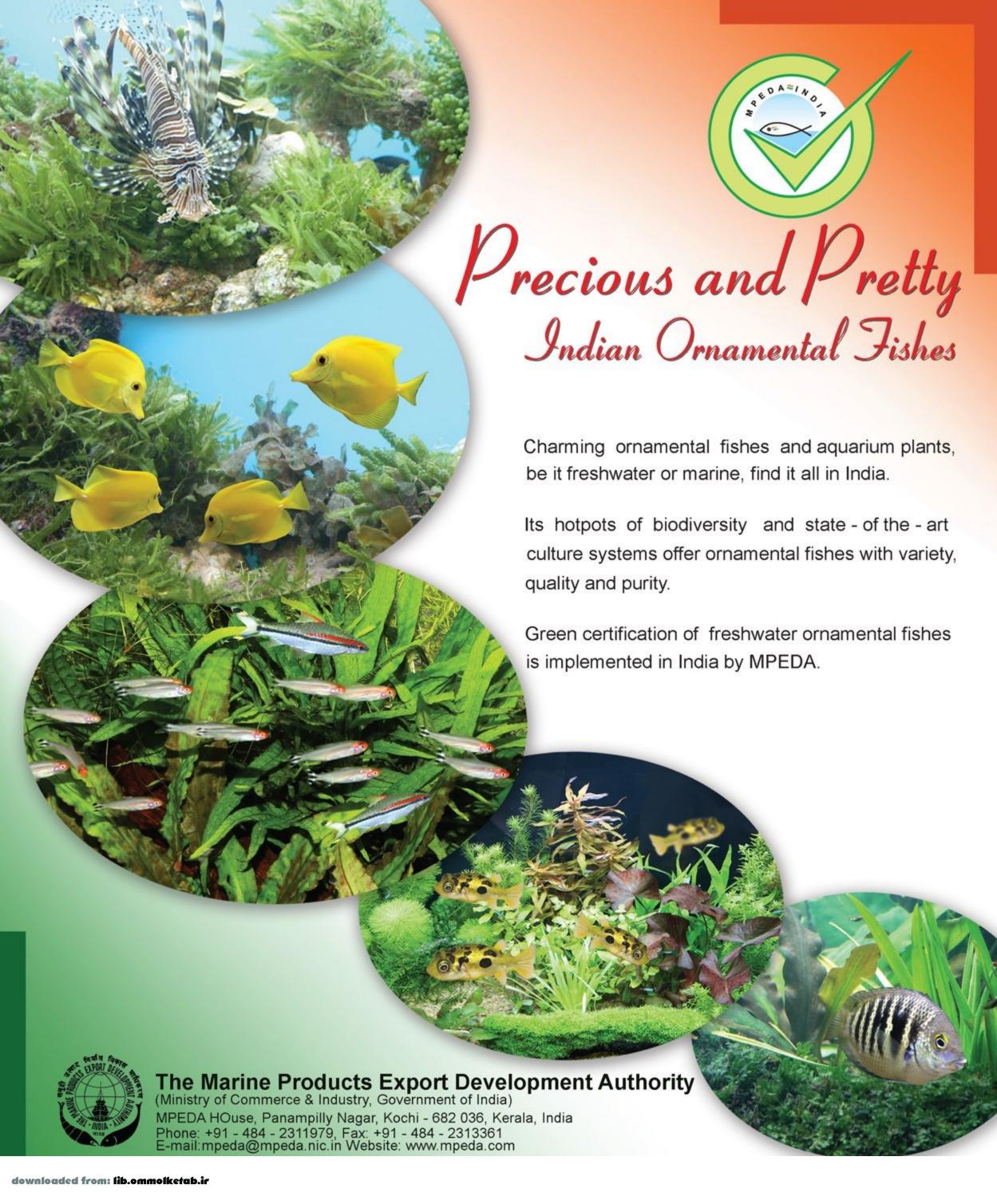
A pair of these with a school of one of the cyprinids will make a beautiful display, and when combined with Asian plants can be part of a miniature biotope tank.

For experienced hobbyists, licorice gouramis are very good choices. The most frequently available species, *Parosphromenus deissneri*, *P. sumatranus*, *P. anjunganensis*, *P. nagyi*, and the undescribed *P.* sp. "blue line" are all quite suitable. The other species that is occasionally found in the trade, *P. ornaticauda*, is less suitable because it requires extremely soft and acidic water to do well.

One advantage of choosing the licorice gouramis is their preference for water in the low 70s, meaning that room temperature water should suffice for them. This group is rather shy and retiring, and the addition of a small school of boraras or similar species will serve as dithers for them and greatly increase the amount of time they spend out in the open. Diet is very important with this genus, and the occasional addition of some small live food will be greatly appreciated.

They can be successfully maintained on a dry food diet, but be sure to get the highest quality food that you can find. They will take both small pellets and flakes. Frozen foods such as mosquito larvae, bloodworms, and brine shrimp should also be fed.

The licorice gouramis will do well as pairs or in small groups. In general, they can be sexed by looking at the unpaired fins. The males will typically have a pattern in these fins while the female's fins are generally clear.





■ Betta coccina will do well in a nano environment.

The Burmese mini chocolate gourami *Parasphaerichthys ocellatus* also works quite well in the nano tank. This species seldom exceeds 1½ inches in length and will do well in any water conditions. It is more active and outgoing than the licorice gouramis and will fare better than they do on a diet consisting solely of prepared foods.

BETTAS

A single male Siamese fighting fish *Betta* splendens is always a good choice for a small tank. These are available in a variety of colors and finnage types, ranging from the veiltails commonly found in most shops through the half moons, crowntails, and double tails that are the show standards in the International Betta Congress (IBC).

Care should be taken when combining bettas with other species, particularly in smaller tanks. Many of the other fish we've discussed are small enough to be eaten by the betta and are not appropriate tankmates. Fish like dwarf pencils or glowlight tetras would be good choices. Fancy guppies, however, are particularly poor tankmates, as the males' large caudal fins seem to trigger the same fighting response that the sight of another male betta would trigger, and some real aggression may follow.

Some of the smaller *Betta* species, particularly the members of the coccina species complex, are excellent choices. This diminutive group constitutes the so-called red fighters and includes species such as *coccina*, *brownorum*, *rutilans*, *persephone*, and several others. These four are the species most likely to be encountered in the trade, and *B. coccina* in particular is a species your local or regional shop should be able to obtain for you.



A relative of cory cats, Aspidoras pauciradiatus are recommended for their small size.

They can also be obtained through private breeders, especially those involved in the IBC Species Maintenance Program. In general, these species will not exceed 2 inches in length. They are somewhat shy and will spend some time hiding in the plants or under driftwood. In nature, many of them spend their time in leaf litter.

Unlike *B. splendens*, these species are peaceful, and the males and females can be kept together without any problems. Multiple males can also be kept together quite successfully. They make excellent tankmates for a school of small cyprinids or tetras. Their ability to jump is second only to the killifish, so their tank should be well covered.

BADIS

The smaller members of the family Badidae are good choices for the experienced hobbyist but not really suitable for beginners. The genus *Dario* in particular is well suited for nano tanks, as its members are essentially ½-inch fish. *Dario dario*, the scarlet badis, is commonly available through specialty shops and is the most colorful member of this group.

As with other members of the genus, this species needs tiny live foods to thrive. That is

the primary reason I only recommend them for experienced aquarists. They are active little guys and will be in and out of the plants and constantly on the lookout for a tasty morsel. If well cared for, they will breed in a nano setup.

If there is a sufficient population of infusorians in and among the plants, some of the fry will grow up in the tank. If you have been keeping tanks for a while and are willing to make the commitment to raising live food, this is definitely a species you should consider.

Catfish

No discussion of aquarium fish is complete without mentioning the catfish. There are several cats that are appropriate for use in the nano tank. While many consider these to be their cleanup crew, it is important to remember that they have specific requirements that must be met.

The various Otocinclus species are effective algae eaters and can be added to any nano tank. While they will eat any green algae that grows in the tank, they should also be fed pellets or wafers intended for herbivorous catfish to supplement their diet and be sure that they are getting enough to eat.

Some of the smaller *Aspidoras* and *Corydoras* species will also do well in the nano tank. In particular, I recommend *A. pauciradiatus* and *C. habrosus*. These two species will spend most of their time on the bottom of the tank in the manner one would expect of the larger species of *Corydoras*. It is important to leave some open space on the bottom of the tank to give these species an area in which to hang out. If the substrate is completely planted, they will not be comfortable in the tank.

They will eat any food that hits the bottom of the tank, but again, the aquarist must be sure that they are getting enough to eat by feeding some food specifically designed for catfish rather than just expecting them to survive on any excess food that other fish in the tank don't eat.

C. pygmaeus and C. hastatus are also very good choices for the nano tank. These species will spend most of their time schooling in midwater, and while they will search the bottom for food, they are not as efficient at keeping the bottom clean as the former species.

While this is not an exhaustive list of the possible inhabitants for your nano tank, it should aid you in selecting specimens for your nano aquarium and help you create a beautiful habitat with fish that will not just survive but thrive.

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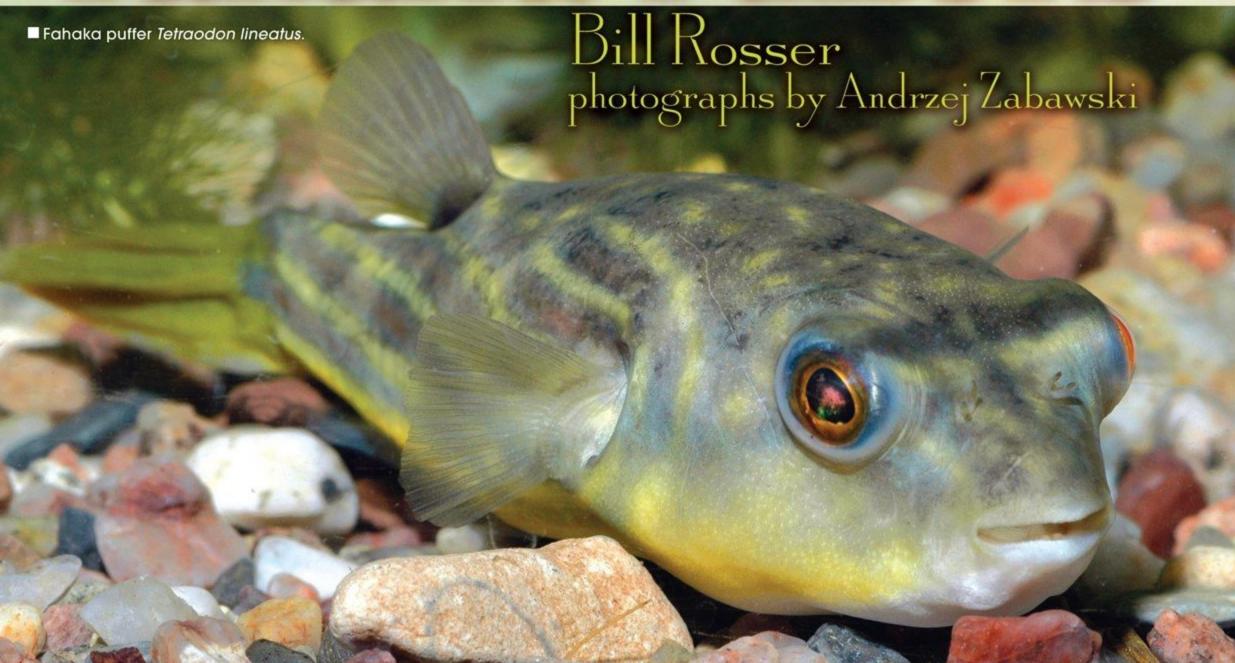
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Fahaka Puffers



ufferfish of the genus Tetraodon are among the most unique freshwater and marine fish available to hobbyists. One of the most alluring traits of puffers is the trait that earned them their name: They are capable of inflating themselves with water or air when stressed, frightened, or excited. Inflating with air can kill a puffer, so it is important never to take them out of the water. They should be transferred to a container underwater when it is necessary to move them. Some inflate proportionally, and others really balloon up. Seeing an animal increase its size two to three times is amazing and sure to bring a smile to anyone's face in amazement. All species of Tetraodon have large orbital eyes that move independently from one another, providing the puffer with the ability to completely assess its environment

for food and predators alike. Puffers share this ability with chameleons, and both types of animals really catch our eye because of it.

These fish also have a unique tooth structure that gives them the appearance of buckteeth, lips, or a snout depending on the species. The distinctive tooth structure allows them to snack on their favorite foods, cracking and tearing through shell and exoskeleton with ease. These unique species traits combined with their enduring personalities capture the attention of many tropical fish hobbyists, novice and experienced alike. They are the comics of the fish world, oftentimes serving as the clowns of the aquarium.

A Great Puffer

One of the more common species offered for sale is *Tetraodon lineatus*. This puffer makes its way into pet stores and home aquariums with some frequency, and for good reason. *T. lineatus* are oddly attractive fish with huge personalities.

T. lineatus has several common names, including African yellow-tail puffer, Nile puffer, banded puffer, globe puffer, and fahaka. As one of their common names suggests, this species has a bright yellow tail. As their scientific name suggests, they also display distinct lines that run horizontally, which leads to another common name, the globe puffer, as these lines look like the latitude lines on a globe.

Fahaka puffers are a diurnal species of tropical freshwater pufferfish from the Nile River and other river basins of Africa. These fish are not brackish in any way. In fact, keeping these fish in a brackish aquarium is a common mistake and 9 times out of 10 leads to the fishes' early demise.

FEEDING

They are typically found in large rivers, open water, weed beds, and vegetated fringes. They spend their days cruising along in search of tasty morsels. Like other tetraodontids, fahaka pufferfish are molluscivores, feeding mainly on shelled benthic organisms that include mussels, clams, oysters, and snails. They also eat worms, shrimp, and fish; basically they will feed on anything that they can catch and overpower. For all intents and purposes, they can be thought of as opportunistic predators.

A puffer's four front teeth resemble the structure of the beak of a bird. In babies the teeth are very close to one another, but distinctly separate from one another. As the fish matures, the teeth of the top jaw and the teeth of the bottom jaw fuse horizontally, essentially creating one top tooth and one bottom tooth. Both sets of teeth come to a dull point. By having their teeth fused together and coming to a point, they are able to exert more pressure per square inch, which allows them to break, puncture, and tear the exoskeletons, shells, and flesh of the animals they prey upon. Specimens kept in captivity require a varied diet consisting heavily of shelled foods to help ensure good health and to prevent tooth overgrowth.

Unlike so many aquarium fishes, the vast majority of puffers in captivity will not consume prepared fish foods such as pellets and flakes. In fact, it is not unheard of for some to starve themselves to death instead of eating these foods. Fahakas will enjoy bloodworms, mysid shrimp, blackworms, krill, prawn, fish, crawfish, mollusks, crabs, and snails. The last four food items are perhaps the most important, and it should be stressed that these delicacies be offered as often as possible. Not only are they a natural food source and full of nutrition, their hard exoskeletons and shells are very effective at keeping the dentition of pufferfish worn. If the teeth are not worn down, they will continue to grow, eventually leading to the top and bottom teeth overlapping. This prevents puffers from getting food in their mouth. In cases this extreme, the teeth need to be cut or ground down. If you need to do this, enlist the help of an experienced aquarist or a piscine veterinarian. With a proper diet, this very stressful and potentially fatal procedure can be avoided.

If no crunchy morsels are readily available, cuttlebones are an excellent



Fahaka puffers are well regarded for their amusing behaviors and cheerful demeanors.



A puffer's unique teeth are powerful and allow the fish to crunch through shells and exoskeletons with ease.

alternative and will provide pufferfish with something to chew on to keep their teeth worn down. Cuttlebones are harvested from cuttlefish, but they are vestigial shells, not bones. Be sure to get one that has no additives. Many are supplemented with vitamins, flavors, or colors intended for birds and may foul the water. Cuttlebones can be secured to a rock with a zip tie or to the side of the aquarium with a suction cup and fastener.

Feed juveniles once or maybe twice a day, and their adult counterparts about four to five times a week.

DEFENSE

Not only are pufferfish armed with a formidable set of teeth, they also have that amazing ability to inflate themselves to intimidate predators by rapidly swallowing water. The elastic skin on the ventral portion of a puffer's body is capable of stretching and ballooning two to even four times the fish's normal size. Once the threat has passed, the pufferfish releases the excess water, returning to its normal size. Beware, though—as neat as this may be to witness, it can be very taxing on the fish, so try to avoid making a pufferfish live



■ A 75-gallon or larger aquarium is recommended for *T. lineatus*, which can reach 10 inches in length.

up to its name, and never let them puff up with air.

SIZE

Fahaka puffers are a medium-large fish. In the wild they typically attain 6 to 8 inches; however, in captivity with a proper diet and care, it would not be unlikely for specimens to approach the 10-inch mark. It should go without saying that this species needs a spacious aquarium if it is to thrive and live a long, healthy life.

Most puffers offered in pet stores are small to medium sized, ranging from 2 to 3 inches. For puffers this size, smaller aquariums can be suitable, but the fish will quickly need an aquarium of no less than 75 gallons. This is an absolute and immediate minimum. With a proper diet, this species can easily double its size in its first year of life, so it's better to start off with an appropriately sized tank.

After the initial acclimation process, fahaka puffers make a hardy aquarium inhabitant. With proper care, *T. lineatus* can live in excess of 10 years. They aren't just long-lived—they become real pets! Many older, well acclimated puffers have been known to beg for food by spitting water and pieces of gravel out of the aquarium in anticipation of food or to get their keeper's attention. Another common begging behavior is "kissing" the glass. They push their mouth against the aquarium, pushing their lips back and exposing their teeth while opening and closing their mouth.

FILTRATION

For large carnivorous fish, using a sump design with wet/dry filtration is often the most logical and beneficial choice. Use a pump capable of moving water through the filter media at rapid rates, ensuring that the tank's water is turned over several times an hour. By incorporating wet/dry or trickle filtration into your sump, you will be increasing the efficiency of breaking down ammonia and nitrite. It will also increase the total amount of dissolved oxygen in the water, which is vital to keeping large fish alive.

Another alternative is to use a large canister filter. These filters have great flexibility, and you can fill their baskets with a wide variety of media to provide exactly the type of filtration you need. The larger ones have flow rates sufficient for a large puffer setup.

Chemical filtration is also a very important aspect in the long-term keeping



■ Being quite aggressive, fahaka puffers will do best in solitary setups.

Aquarium Setup

Since puffers are carnivorous fish with messy table manners, they naturally will produce a large amount of nitrogenous waste. The aquarium's filtration should be designed with this in mind. For the size tank that these fish require, standard filters may not be powerful enough to properly filter the water, depending on the bioload and the feeding and maintenance schedule.

of these moderately large fish. This is easily accomplished by placing a bag of aquarium carbon in an area of high water flow within the sump. Carbon will aid in removing impurities from the water as well as giving the water a polished look by removing discoloration.

As an added bonus to carbon's efficiency in removing pollutants, it can also keep the water clear of staining. If you use



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■ Take care never to lift puffers out of water, as they may inflate themselves with air, which can lead to death.

driftwood in your tank, you will notice some yellowing of the water. This is due to tannins being released from the wood. It is harmless to the fish, but may not be very visually appealing. Carbon will aid in removing this discoloration.

Two other types of filtration that you may choose to utilize in your filtration system are worth mentioning. Fluidized sand beds are no more than an enclosed vessel filled with fine sand in which water is pumped through the bottom and flows up though the sand and back out, but they provide powerful biofiltration and are a useful alternative to wet-dry systems. As the water flows through the sand, it keeps the sand suspended—fluidized—thereby allowing beneficial bacteria to colonize each and every grain of sand, greatly increasing the surface area for nitrification to occur.

UV sterilizers are used in conjunction with a main filter. These devices pump water past a light that emits strong UV radiation that will kill a number of organisms ranging from various parasites and bacteria to types of algae.

WATER PARAMETERS

Whatever equipment you use, the puffer aquarium should be well filtered and circulated, and the water parameters must be monitored on a regular basis. Water quality should be maintained in optimal conditions to keep puffers long term. Ideally the pH should be kept between 7.0

and 7.6. Alkalinity should be between 4.0 to 5.0 meq/L (or 11 to 13 dKH). Ammonia and nitrite should be zero, as these can be very toxic even in low concentrations. Nitrate should remain as close to zero as possible, but is acceptable up to 10 ppm. The aquarium temperature should be 77° to 80°F. It is important that this temperature does not fluctuate rapidly (i.e., several degrees in an hour, such as when the lights come on and go off), as this will cause the fish undue stress.

TANKMATES

The fahaka puffer is aggressive. Cantankerous actually better describes them. Most puffers need to be kept alone. If you want to gamble, you can keep them with other fish of similar size and disposition. Puffers suffer from a Jekyll and Hyde anger complex. They may appear to be the sweetest, friendliest, most comical fish one has ever laid their eyes on, but make no mistake about their bloodlust and homicidal tendencies. Puffers are highly unpredictable in their behavior, and they are typically the apex predator in an aquarium. Normally, it's not a matter of if, but a matter of when—usually tankmates become an expensive lunch or chew toy for the puffer. You will definitely be taking a huge risk by placing other fish in with a fahaka.

If you really want tankmates, perhaps the best choice would be African cichlids of the rift lakes. They're fast, pugnacious, and able to hold their own against a fish as formidable as the puffer. One may also look into maintaining a school of dither fish such as zebra danios to distract the puffer from other more desirable fish. Whatever species one chooses as dither fish, the objective is the same: a group of fish that are fast and disorienting and difficult to catch that will distract an aggressive fish's attention away from its other tankmates. In this case, the goal would be to have danios distract the puffer fish from African cichlids. As previously stated, keep a close eye on the situation and remember that puffers are very unpredictable fish. One may also wish to maintain several puffers in one aquarium. This normally ends in death or maining. Tetraodon are solitary fish by nature and in captivity would require a sizeable aquarium with ample visual barriers to allow these fish to thrive in the same tank. Just because pet shops do it does not mean that they are not losing fish to aggression!

A Good Pick for the Puffer Fan

The need to dedicate a whole aquarium to one fish is, for many puffer aficionados, more than made up for by the interactive pet that a puffer becomes. If you have been bitten by the puffer bug and have an appropriately sized aquarium, strongly consider a fahaka puffer. You won't be disappointed by its many entertaining antics.

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Filtration 103

Filtration Problems due to Van der Waal Forces

The effectiveness of all chemical filtration media is determined by a Law of Physics called Van der Waal Forces. These weak atomic bonding forces are the mechanism that allow all chemical filtration media to remove dissolved contaminants / pollutants (called solutes) from a solution (water) through adsorption into the media pores.

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- 2. Remove as many contaminants / pollutants early, through pre-filtering.
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- 4. Resist the notion that effective filtration can be performed by small volumes of IE resins.
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THE BLUE-SPO Opistognathus rosenblatti **Bob Fenner** ■ Blue-spotted jawfish *Opistognathus rosenblatti*.

ue to the relative age of the marine aquarium hobby and my long involvement in it, there are several species of saltwater organisms that I've been familiar with from the beginning of their use as ornamentals. One of these is the spectacular blue-spotted jawfish Opistognathus rosenblatti, also called the blue-jaw or Rosenblatt's jawfish. As a matter of fact, I had the experience of diving and seeing this fish in the early 1970s, years before its original scientific description by Gerald Allen and D. Ross Robertson in 1991.

Due to its rather limited range, its on-and-off-again collection for the trade, and transport limitations out of Mexico, Rosenblatt's jawfish has had a spotty, punctuated presence in the hobby. At times a few will come in, even go on display in public aquariums with Eastern Pacific displays, but the blue-jaw has two major strikes against it, all to do with its requirements: This fish needs a good deal of dedicated space, and really a chilled setting, to do well.

Named in honor of Richard Rosenblatt of the Scripps Institute of Oceanography, an early (1960s) collector of the species in Mexico, the blue-spotted jawfish of Mexico's Sea of Cortez (Gulf of California in older, less politically correct texts) is a real striker, with brilliant blue dots over its overall dark brownish body. The males become bright white in the front half of their bodies during spawning and courtship. The fish grows 4 to 6 inches total length.

Distribution and Habitat

This fish is found in sandy (not really adjacent to rock) bays and open ocean areas from about the middle of Baja Mexico's Sea of Cortez, down to the tip (Los Arcos), which is where I first encountered it (Cabo

San Lucas, at the Playa del Amor), in 30- to 90-foot depths. The species is unmistakable in terms of coloration, markings, and behavior. Juveniles are uniformly colored yellow with blue spots, females with darkbrown bodies and larger blue spots, and courting males being stark white in their anterior halves and blackish posteriorly during displays.

Behavior

This is a very social species, with several individuals living almost evenly spaced about 3 feet apart from each other in offshore sandy areas in open ocean and bays, living almost entirely within their dug-out burrows. Unlike the commonly available member of the family, the pearly jawfish of the Atlantic (O. aurifrons), which spends a good deal of time out and above their burrows yearlong in the wild, O. rosenblatti males only display during warm summer months, when competitions for females include a change in color and



Blue-spotted jawfish require expansive living space and a chilled environment.



O. rosenblatti need to burrow and hide, so a deep, sandy substrate is essential.

openings.

Compatibility

Due to their secretive ways, this fish is best kept without other fishes, and with very little else in the way of livestock. They live in very open sandy or rubble areas, with other fish swimming nearby only occasionally. You can keep them in groups if you have a very large setup. If you want

hovering a few feet above their burrow to see yours any percentage of the time, maintain it/them in a dedicated setup. If you do opt for tankmates, make sure they are easygoing, slow moving, and not too competitive at feeding time.

Selection

This whole family ships exceptionally well, and the blue-spot is almost always exemplary on arrival. Other than waiting for a day or so to see if the fish will die

mysteriously, I would not leave this species at a dealer for any more time, nor would I quarantine this or any other opistognathid. Jawfishes require plenty of hiding places and deep, sandy substrates to burrow in, two features that are not present in most (if any) quarantine tanks. Therefore, there's far more to be lost than gained in such delays because of stress and the very real possibility of the fish damaging themselves versus the small likelihood of advancing biological disease.

System

Aquarists almost never provide this species with a system of the proper size and shape.

Though this fish is small, it really requires a large area of open expanse in a wide tank to feel comfortable. How much dimensionally? A good 3 feet between specimens and at least 2 feet front to back in the aquarium. There should be at least 8 inches of mixed fine sand and rubble substrate for them to create their burrows.

Now you say, "But I've seen other folks who have kept this jawfish in smaller settings, crowded even with other fishes!" Maybe they were lucky, but very likely their blue-spot did not live very long or well.

As if the call for grand-size systems with few if any roommates and great bunches of sand weren't enough, these fish are not really tropical animals. That's right—they





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■ The secretive nature of *O. rosenblatti* can be partially offset by providing a dedicated, exclusive environment.

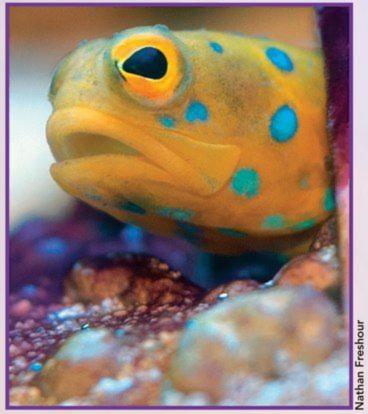
coast, where the jawfish is found, is cooled by the California Current, a stream of cold water from Alaska. This makes it surprisingly cooler than you might think.

The practical implication is that water off the Californias is appreciably cooler than the same latitudes in the West Pacific, with the habitat of this jawfish being mostly in the upper 50s to upper 60s, and rarely lower 70s. Being an old-timer in this

live in cooler water. The Eastern Pacific interest, including the hobby, trade, and sciences, I have seen a few cycles of cool to colder water organisms sold (or may I say misrepresented) as tropicals, including Catalina gobies, Garibaldi, Metridium and Tealia anemones, moon snails, many types of algae, etc. None of these will live for long in too-warm surroundings, and neither will this coolwater jawfish. No matter where you live, it is very likely you will need to buy and run a chiller to keep this fish.

There are jawfish species that have a broader diet, consuming worms, crustaceans, and other invertebrates, but the blue-spot is almost exclusively a zooplanktivore, looking for and snapping plankton—tiny animals in the water column as they float or drift by over their immediate territory. Ideally, you might have a good-sized refugium attached to your main display tank with a reverse daylight photoperiod arrangement





■ Blue-spotted jawfish require cool water in the upper 50s to upper 60s.



■ While the blue-spot is one of the more challenging jawfish species to keep, the successful keeper will be well rewarded by its dazzling appearance.

for lighting it during the off times for the main tank. Since much of the life in vibrant, established refugiums is nocturnal, some of this will be swept up and delivered to the main system while the tank is in daylight, when your jawfish will feed on it. Alternatively, providing small whole or cutup meaty foods into a pump discharge a few times a day will also work.

Health

Even though these fish have small scales, they are not as great a risk of parasitic infestations and infectious diseases as other fish families with small scales are. Jawfishes are remarkable in that they are the last or near last to become ill, and they typically don't suffer when treated with the various—sometimes harsh—medications that are available for fish. Nonetheless, I

Surprises Are Bad

hen it comes to adding a fish to your collection, surprises are almost always bad. Aquarium experts often advise us to do our homework before acquiring any livestock, but we sometimes take shortcuts, like acting on the basis of personal experience with closely related species. The problem is that this

often works well. Why is that a problem? Because it reinforces that risky behavior!

Related fishes are often similar in their needs and can be kept in the same types of setups. Sometimes, however, even closely related species can have very different requirements, and that's where our shortcut fails us. The blue-spotted jawfish Opistognathus rosenblatti can be one of those bad surprises. Similar in size and appearance to other jawfish in the hobby, like the pearly jawfish O. aurifrons, it differs in other, significant ways.

While pearly jawfish can be kept in groups in typical marine systems and will delight their owners with color and dynamic behavior, blue-spots need much larger tanks that include an integral chiller to maintain low water temperature, and they will spend much of their time submerged in Yellow-headed jawfish O. aurifrons.

their burrows in the sand.



Another example can be found with the chromides of the cichlid genus Etroplus. The more common yellow chromide E. maculatus grows to 3 inches and can do well in slightly brackish or sometimes even fresh water, while the green chromide E. suratensis can reach 16 inches and must have brackish water. A hobbyist familiar with yellow chromides would make a grave mistake in assuming their green cousins needed the same basic care. But that's not all. A third species, E. canarensis, which is rare in the hobby, is strictly a freshwater fish that grows to 4½ inches.

So, do your homework—without taking shortcuts—and you will be much happier, as will your fish!

urge you to take care in treating these and all other fishes with formalin, dyes like malachite green, and metal salt solutions (e.g., copper-based medications), and instead opt for quinine compounds (e.g., chloroquine phosphate) if you find yourself having to treat for protozoan complaints.

Reproduction

The late Alex Kerstitch reported the bluespotted jawfish to be a mouthbrooder like its common congener, the yellow-head of the Atlantic. Males display behaviorally and color-wise in the summer months, dashing 3 to 4 feet above their burrows, trying to attract a female. If he's successful, the female joins the male in his tube for a few minutes, emerging to return to her own. I could not find further details on length of incubation, time spent as planktonic larvae, foods taken, etc. Very small, post-settlement young have been observed in the wild.

Definitely a Cool Fish

I suspect all who read this brief report

will grasp the salient needs of keeping this species in captivity: the first of which is space! Even just one specimen needs several tens of gallons of volume to feel comfortable. Second, this is a very social species that only exhibits well in the presence of conspecifics, necessitating an even larger aquarium to provide a good few feet of space between each specimen. Furthermore, such space needs to be two-dimensional, i.e., wide as well as long, to allow the jawfish reasonable security that it can get away from whatever approaches the viewing panel of the system. Lastly, this is not a tropical fish, but a subtropical-to-temperate species that will require a chiller to keep its water at a sufficiently low temperature.

The reality is that *O. rosenblatti* is far from being a good choice for most hobbyists as an aquarium species. Aquarists are better redirected to keeping more suitable members of the family Opistognathidae, like the standard pearly or golden-headed jawfish O. aurifrons of the tropical West Atlantic.



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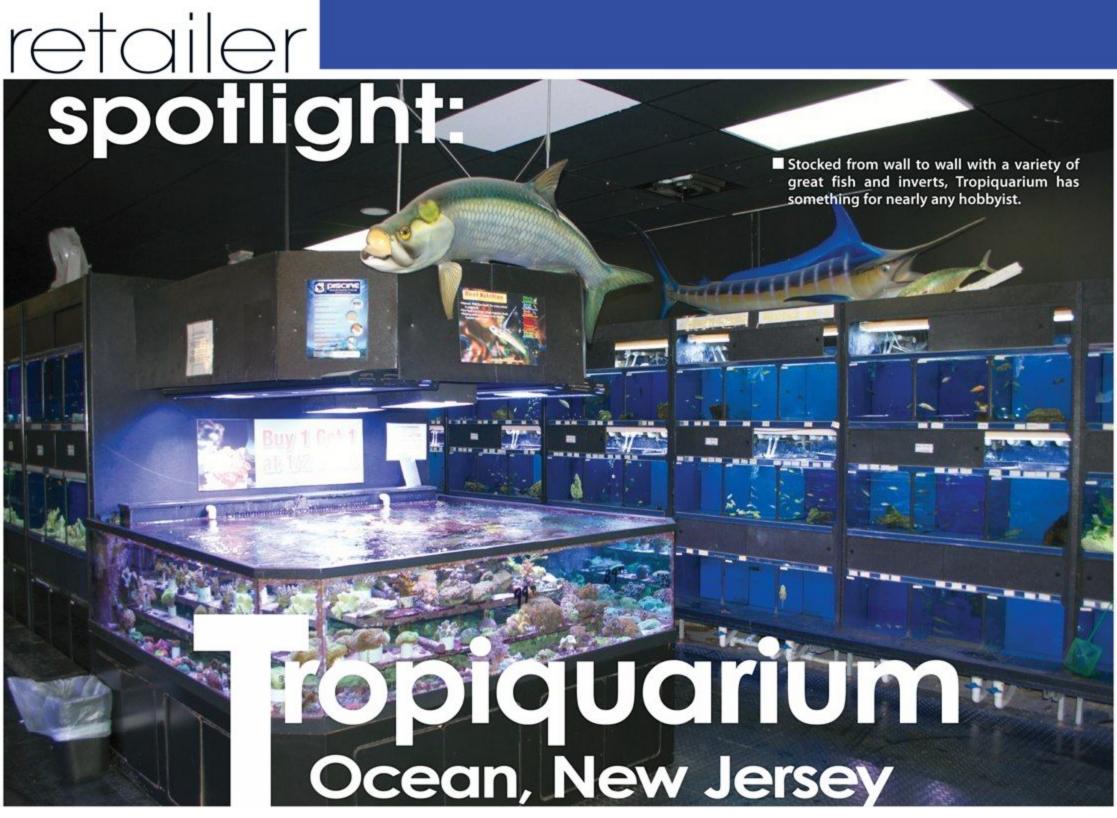
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Albert Connelly, Jr. photographs by the author except as noted

hen Gary Hersch, at the young and restless age of 12, was bedridden with rheumatic fever for the better part of a year, his parents set up a 20-gallon fish tank in the budding naturelover's bedroom to provide him some needed company and entertainment. But here a strange thing happened; beyond helping to merely pass the time, the prolific life in that tank-the fascinating fish, plants, and invertebrates going about their bustling and beautiful business within those four glass walls—inspired a lifelong aquarium hobbyist and planted the seed that would become one of the Northeast's premier aquatics stores: Tropiquarium in scenic Ocean, New Jersey.

As a gift for his 16th birthday, Gary's mother opened Tropiquarium with her son as an equal partner in Oakhurst, New Jersey. After the Oakhurst store was lost to a fire two years after its grand opening, Gary's family begged him to return to his childhood home of Brooklyn, but he would not relent; he and his mother rebuilt their store in Oakhurst, and when the lease on that property was up more than two decades later, Tropiquarium moved 2 miles down the road to where it stands today in Ocean. Fifty years later, that little tropical fish shop has become a true hobbyist's destination, with an always-impressive selection of freshwater and marine fish,

plants, corals, tanks, equipment, and just about everything else to outfit the most selective of aquarium keepers, from beginner to expert. A plaque and photograph in the store's entryway pays a lasting tribute to Gary's late mother, in whose memory Gary carries on his family business.

The present-day Tropiquarium was designed by Lammert de Haan of Dutch Aquarium Systems, modeled according to Gary's inspiration for an aquatics shop "with a European public aquarium feel," as emulated by other fine American institutions like the Shedd Aquarium in Chicago. Gary's infectious love of the natural world, and his passion for sharing his love of the aquarium hobby with his staff and customers, is a cornerstone of his philosophy in the way he manages his store, stocks his shelves, fills his tanks, and otherwise keeps the day-to-day operations of Tropiquarium up to the high standards of the premier tropical fish shop he and his mother envisioned when they began the business a half century ago.

But as Gary stresses when discussing the success of Tropiquarium, it's the store's knowledgeable and enthusiastic staff who make the business what it is today. Gary says every member of his staff is eminently more concerned with helping their customers be successful aquarium keepers than simply making another sale.

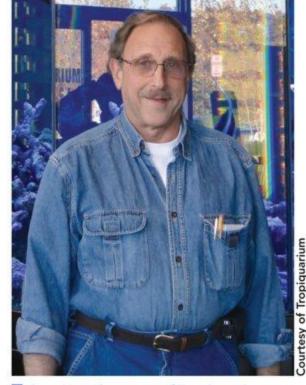


A gorgeous reef tank greets visitors at Tropiquarium's entrance.

And the optics bear out Gary's vision; from the majestic koi and marine angelfish in the entryway down to the lowly freshwater shrimp and budding coral frags on display throughout the aisles, the overall impression is a beautiful, vibrant quality that colors every part of the store.

First Impressions

When you walk into Tropiquarium's entryway, the first thing you will notice is a pair of 1650-gallon saltwater tanks flanking the archway that leads to the store's fishroom. The aquarium on the right is a majestic reef setup rivaling those found in the finest public aquariums, with thriving Acropora corals, Tridacna clams, mushrooms, anemones, urchins, and so much more reef life that the eye does not know where to focus next. As a testament to the health of its teeming life,



■ Gary Hersch, owner of Tropiquarium.

this tank is home to a Banggai cardinal pair that was pointed out to me on a recent visit as they were holding fry, as I could see by the mouthbrooding male's bulging cheeks.

Across from this display, on the left side of the archway is a spectacular "fish-only" marine tank, which is home to several large and gorgeous specimens including a queen angelfish, a longfin bannerfish, and a unicorn tang, holding court around a live-rock island with an encrusting patina of coralline algae and several sturdy, overgrown stands of plate coral. Directly behind you as you face this living-ocean archway is a koi pond with a glass-front viewing panel, housing a collection of several huge, 32-year-old koi that once belonged to Gary's mother.

Children who visit the store are invariably drawn to this unusual eye-level koi pond, where they can watch these gracefully lumbering beauties swim about their generously allocated corner of the shop, and there's even a gumball-type koi pellet dispenser for kids (and inquiring journalists, of course) to feed the gentle giants. And to round out the entryway's aquatic displays, to the right of the archway is a 1100-gallon African cichlid tank featuring some impressive specimens from Africa's Lakes Malawi and Tanganyika, including a large frontosa, its regal bearing matched only by its large nuchal hump, which it wears like a crown as it regards the store's visitors with a kingly demeanor.

The Fishroom

Tropiquarium's fishroom houses approximately 600 aquariums, which run from ceiling to floor in tidy aisles: one row for tetras and community fish, one for livebearers, one for South American fish, one for African cichlids, one for fancy goldfish, two for marine fish, and two 8-foot square coral tanks. This system simplifies customers' livestock searches, making everything easy to locate, no matter what type of aquarium one is looking to stock. The shop's filtration room is an impressive sight for those of us



Discus are among some of the store's many freshwater offerings.

fortunate to have seen the behind-the-scenes operation. Each row of livestock tanks is plumbed to its own separate, central system, with each tank able to be shut off and isolated from the system if needed. The filtration includes protein skimmers, fluidized sand filters, ammonia towers, micron bags, ammonia bacteria wheels, UV sterilizers, ozone, and automatic water changers. Tropiquarium makes its own DI and RO water, both for store use and for sale to their customers.

The staff at Tropiquarium do their own coral fragging, a delicate operation they perform in the back of the store near the massive, towering filtration equipment. When they are ready, these numerous, colorful, and healthy-looking frags are offered for sale in the fishroom's two large, shallow coral tanks, which are the first displays one sees when entering the fishroom through the living-ocean archway. For its marine and reef aquarium customers, aside from the healthy reef fish and corals on offer, the store sells only cured, cycled live rock, to help ensure "plug-and-play" success for these more challenging setups.

retailer spotlight



■ Tropiquarium's variety of marine livestock includes beautiful Banggai cardinalfish *Pterapogon kauderni*.

Plantariums

But what Gary was most excited about when I met up with him recently at Tropiquarium was his innovative new "plantarium" tanks, which were developed by Lammert de Haan at Dutch Aquarium Systems, in close consultation with Gary and his crew. The plantarium is a combination aquarium and terrarium containing a unique plant-fertilizing tray, filled with a biomedia made to replicate the natural mulch of a tropical lake or Amazonian river, which is placed under the gravel bed. Gary describes it as an internal freshwater refugium of sorts: You cover the tray with gravel, turn on the filter (basically a powerhead that draws water down through the gravel and biomedia tray, and then up to a waterfall return down a faux-rock back wall), and turn on the bright compactfluorescent light on top. The plants thrive, and their prolific growth eats up much of the nitrates and the ammonia that can bedevil aquarium keepers, especially in the beginning stages of the hobby.

But when Gary showed me the stocked-to-the-brim livebearerand-shrimp-filled plantarium he has set up in the dry-goods section of the shop near the cash registers, the most striking aspect to my eye was how gorgeous the plant growth was, emerging not only out of the water and up the back wall, but in the case of some unusually ambitious pennywort, straight out of the tank, across a small gap on the shelf, and back down again into an empty glass tank standing next to it for sale. Gary chuckled as he pulled the errant plant out of its neighbor and bagged some clippings for me (which now reside in my koi angel tank at home, where my fish nip at its tender leaves to let me know it's past feeding time).

As Gary marvels, "This stuff really grows, and you don't have an algae problem, because algae can't compete with the plants." And he credits the lush, overgrown plants with providing an exceptionally healthy environment for the fish, even in an overstocked tank like his livebearer-filled plantarium. "No tail rot, no fungus, no nothing." He says, "Their fins are straight up, and they come at the glass attacking you for food every time you're there."

A Simple Philosophy

Gary notes that, for independent tropical fish stores (as with so many things), things have changed very rapidly in the past few years. Competing with the internet and superstores, in the midst of a lingering recession, has been very difficult for many small businesses, and to say that aquatic shops have not been spared the pain would be an understatement. But "Tropiquarium is thriving," as Gary puts it, "by simply selling the best, on sale. No shortcuts, no gimmicks. We love our business and expect to be here another 50 years." He gestures to a shelf filled with numerous pieces of driftwood, in all sizes and shapes: "Take a look at the driftwood in this store, the handpicked driftwood that I have. Take a look at these plants that nobody else has; look at the plantariums, look at the marine fish, look at the corals—look at this stuff!"



One of the store's more novel setups is a lush plantarium featuring platies and cardinal tetras.

Gary's philosophy is to always try to get better, and strive to be the very best. He is proud of the caring, knowledgeable staff he has cultivated at Tropiquarium, including among others Dry Goods Manager Michelle DiStefano, Livestock Manager Brent Nash, and Assistant Manager (and accomplished marine biologist) Austin Sweerus. Gary says "it's their store," and it is his oft-stated desire that Tropiquarium will continue operating by its staff long after he's gone. But for now, he says, "I don't ever want to retire. I don't want to ever stop working. I want to

do the marketing, I want to play, I want to see the new fish, I want to see the new fish, I want to see what's going on—I want to see the golden zebra loach that I haven't seen in years! I want to see this stuff. I'm fortunate because I'm living and working my hobby; I'm a nature lover, and it's an adventure."

Tropiquarium

Ocean Plaza Shopping Center 1100 Rt. 35 & Sunset Ave. Ocean, NJ 07712 Phone: (732) 922-2300 Website: http://tropiquarium.net

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oyd Enterprises, manufacturer of the acclaimed Chemipure line of filtration media, began as the brainchild of a pet store employee in the 1940s who wanted to invent a product that would ultimately help increase the survival rate of his livestock. Over the 50 years that Chemipure has been on the market, its creators pride themselves on manufacturing it entirely in the United States.

Experimenting at Work

Dick Boyd enjoyed the aquarium hobby from a very young age and turned his passion into a career by working at various pet stores. While working at a pet store in Los Angeles, California, Dick decided to experiment with filtration media to create a product that would keep harmful pollutants out of the aquariums with the goal of keeping his fish alive longer. Dick Boyd was the first to experiment with mixed bed media combining various resins and carbon to create what was considered to be a groundbreaking product, Chemipure. Once he created the product, he began selling it through the pet stores he worked for. Dick eventually moved to South Florida, and after getting married, his wife, Linda Boyd, assisted him by making the product at home while he worked during the day at local pet stores. As Chemipure's popularity grew, Linda enlisted the help of neighborhood friends to produce the product and ultimately told Dick he needed to quit working in pet stores to help make the product with her.

Years later, in 1983, Boyd Enterprises was created, and Chemipure was sold commercially on a larger scale. According to Matt Boyd, Dick's son and Boyd Enterprises' customer service and shipping manager, "It was pretty much an American success story built up from nothing to where we are today."

Two Families Coming Together

Meanwhile, Dick helped start the Florida Marine Aquarium Society in 1955 along with his friends and avid divers, Joe Turner and Robert Straughan. Joe's son, Jeff Turner, currently the national sales manager of Boyd Enterprises, was slightly older than Matt and worked with his father in the family business, professionally installing and maintaining aquariums. In 1988, Jeff moved his family business next door to Boyd Enterprises, where Dick would regularly



The Boyd Enterprises booth display tank at the Marine Aquarium Conference of North America 2011, set up by Jeff Turner featuring corals from the Coral Restoration Foundation and filtered by Chemipure.



Jeff and Joleen Turner, owners of Boyd Enterprises and Reef Aquaria Design, Inc.

purchase livestock for his 3000-gallon marine aquarium.

Unfortunately, Dick passed away several years later, but Jeff continued to stay close with the Boyd family. As their two businesses grew closer, Jeff proposed the then-novel idea of putting in a live marine aquarium display at an industry trade show. It was such an overwhelming success that together they won "Best Booth" at a trade show in 1996. To date, Jeff has set up over 500 beautiful trade show aquariums. "A successful aquarium really excites people about getting involved in the hobby," Jeff said.

Boyd Enterprises and Jeff's aquarium installation and maintenance company, Reef Aquaria Design, Inc., continued to work together at shows, with Jeff's tank being filtered with Chemipure to create a crystal-clear aquarium every time! Then, after Linda Boyd passed away, Jeff felt he should offer to help her three sons if they needed it. As a result, Jeff purchased Boyd Enterprises and retained the services of two of the sons, Eben Boyd, as production manager, and Matthew Boyd.

"For the betterment of the company, the customers and our father's legacy, we decided



The Boyd crew out on a boating expedition.

to join forces with an old ally—Jeff and his wife, Joleen Turner," Matt explained.

Moving Forward

Jeff and Matt both believe that their main priority is to educate aquarists. Matt said, "It hearkens back to my father's and also Jeff's father's philosophy that we have a responsibility to share what we've learned and what we know in order to better care for the organisms we keep in captivity."

To that end, before joining Boyd, Jeff created the first financially successful clownfish farm at Oceans, Reefs & Aquariums, the leading producer of aquacultured ornamental marines, and was selected to design and fabricate the Indo-Pacific coral reef aquarium for the Smithsonian Institution National Museum of Natural History. Boyd Enterprises currently sponsors the Coral Restoration Foundation and ongoing research in the marine sciences. They are looking to set up additional freshwater and marine scholarships as well.

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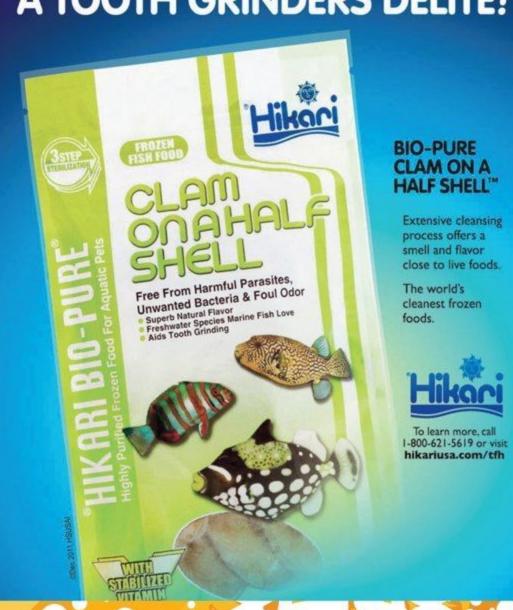




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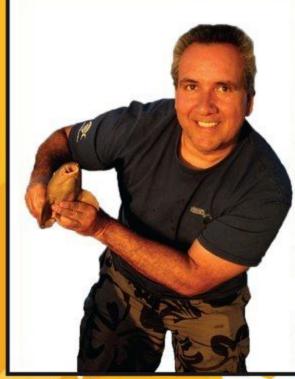
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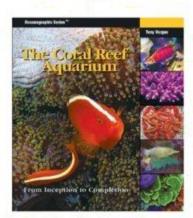




Have you seen this guy?

Tony Vargas has finally finished his book. Whoop-de-doo. You'd think it was some kind of major big deal to write a book about beautiful reef aquariums from around the world. Sheesh, that's been done already, what's the big deal, right? Okay, so this one's got all the dirt about how to plan and build the tank of your dreams, and features the inside scoop on how and why all these fish geeks did that. Allright, so it's friggin' awesome. Geeze, all the promotion, on Facebook, the blogs, the club meetings, all you hear lately is Tony this Tony that, when's the book coming out Tony?





Here it is!

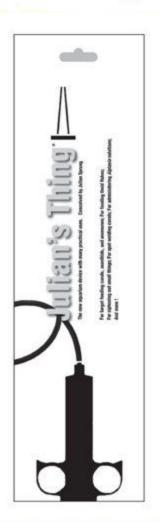






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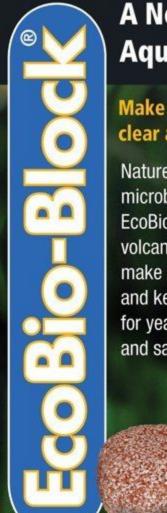
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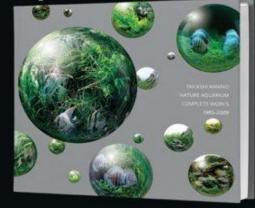
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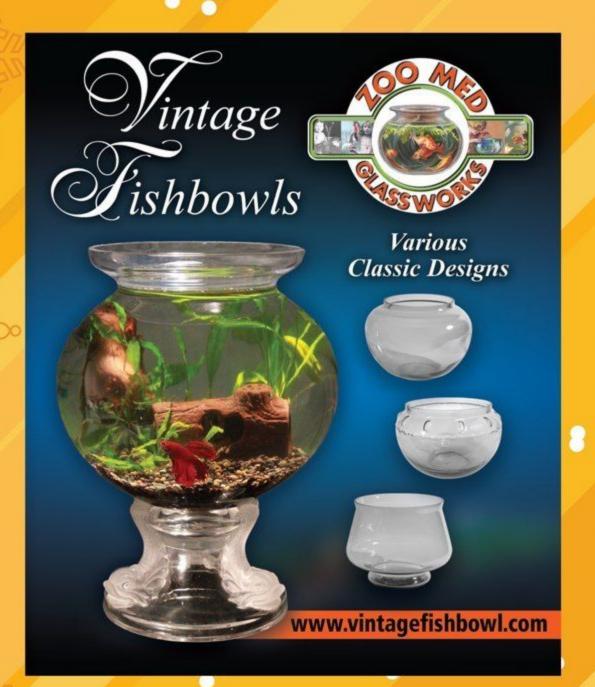
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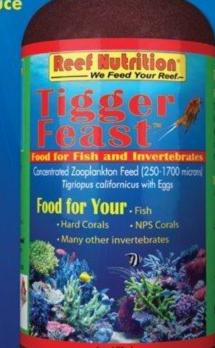


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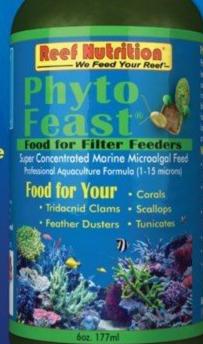


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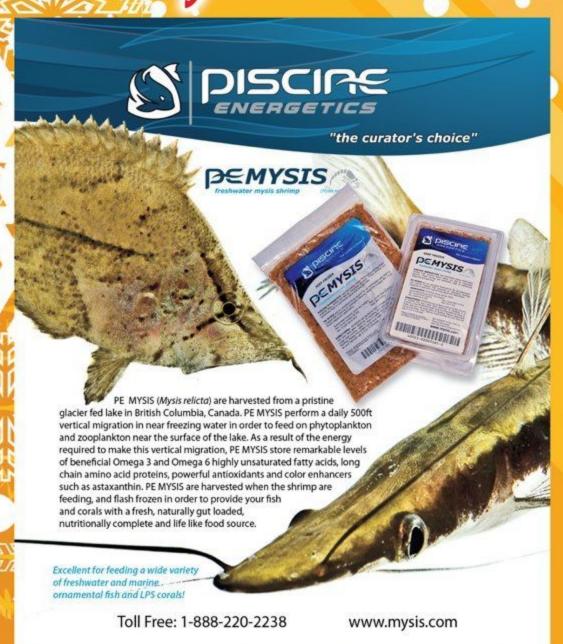
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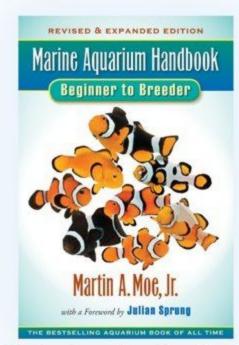






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in **next** month's **issue...**

bucktooth tetra

Many think of piranhas or sharks when it comes to aggressive fish, but the bucktooth tetra puts them both to shame. A large school of *Exodon paradoxus* kept in a large tank can make for an active and exciting setup.





powder blue tang

The lively and gorgeous powder blue tang is a favorite among marine aquarium keepers. When a little forethought is put into setting up its environment, it can make a great addition to a home aquarium.

collecting locally

Sometimes, the most dazzling discoveries can be had in your own backyard. Two adventurers share a variety of excellent aquarium specimens native to the United States.



Read About All This and Much, Much More in the February 2012 Issue of TFH!

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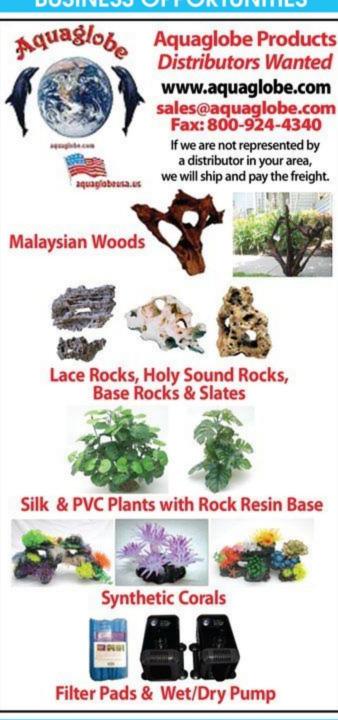
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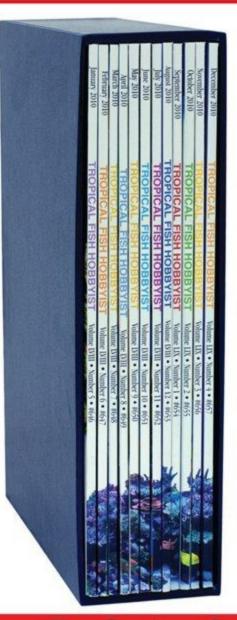
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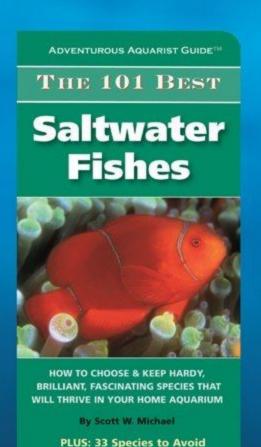


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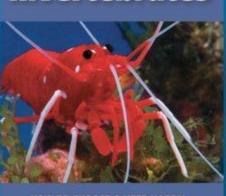


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he silver arowana Osteoglossum bicirrhosum, also known as the dragonfish, is a popular species with an iconic look. But despite its appeal, the silver arowana is not appropriate for the vast majority of aquarium keepers. The first issue is size; O. bicirrhosum can grow to over 3 feet in length. Furthermore, the silver arowana is a predatory fish that catches prey in its native Amazon River habitat by swimming along the

water's surface, often leaping out of it to catch insects and other small animals that get too close. For these reasons, the silver arowana requires a very large tank—an absolute minimum of 200 gallons—with a tight-fitting, weighted-down cover. The fish should have enough room to swim several lengths before turning around, and the width of its living quarters should allow for easy maneuvering.

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