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NEW PRODUCT SPOTLIGHT

Leptoseris gardineri

JAKE'S FAVE FIVE - CORALS

JAKE ADAMS

There are so many different types of corals available these days and so many variants and strains of the same corals that it's sometimes hard to tell which corals are trending. Beginning with the collectors and all the way through the exporters, importers, retailers, and hobbyists, every year the aquarium hobby experiences pulses of new corals and new coral strains. If you know what to look for, it's easy to score super-sweet corals before the rest of the world even has them on their radar. Here are a few that have recently risen in visibility and availability.

Leptoseris corals have been in the aquarium trade since the beginning of the surge in stony coral collection. I can remember having some nondescript colonies of *Leptoseris tubulifera* and another unidentified species as early as 2003. Back then, I thought no one would ever care about any species of *Leptoseris* coral regardless of how neat I thought they were, but I had no idea that so many color forms existed. Fast forward 10 years, and now it is not uncommon to come across reefers who identify themselves as *Leptoseris* collectors. This coral genus is currently available in a wide range of species and colors, and we have just begun to scratch the surface of what's out there.

The most common species of *Leptoseris* you are likely to come across is *L. mycetoseroides*. This species has a somewhat wrinkled appearance which varies from fairly smooth to highly convoluted. The features of the corallites are very regular and form distinctive lines of color and pattern which radiate out from the central corallite. Commonly available in orange, green, and a much rarer pinkish-orange, *L. mycetoseroides* also includes the ever popular Jack-O-Lantern Lepto.

Once you know what to look for, you'll start seeing *Leptoseris* colonies everywhere, especially on the sides of zoanthid, mushroom

anemone, and polyp rocks, traveling as unintended hitchhikers. From these discoveries, you can gather that this species is borderline cryptic in nature, preferring to live under and around corals, often shaded by its neighbors; this should clue you in to the preferred habitat for *Leptoseris*.

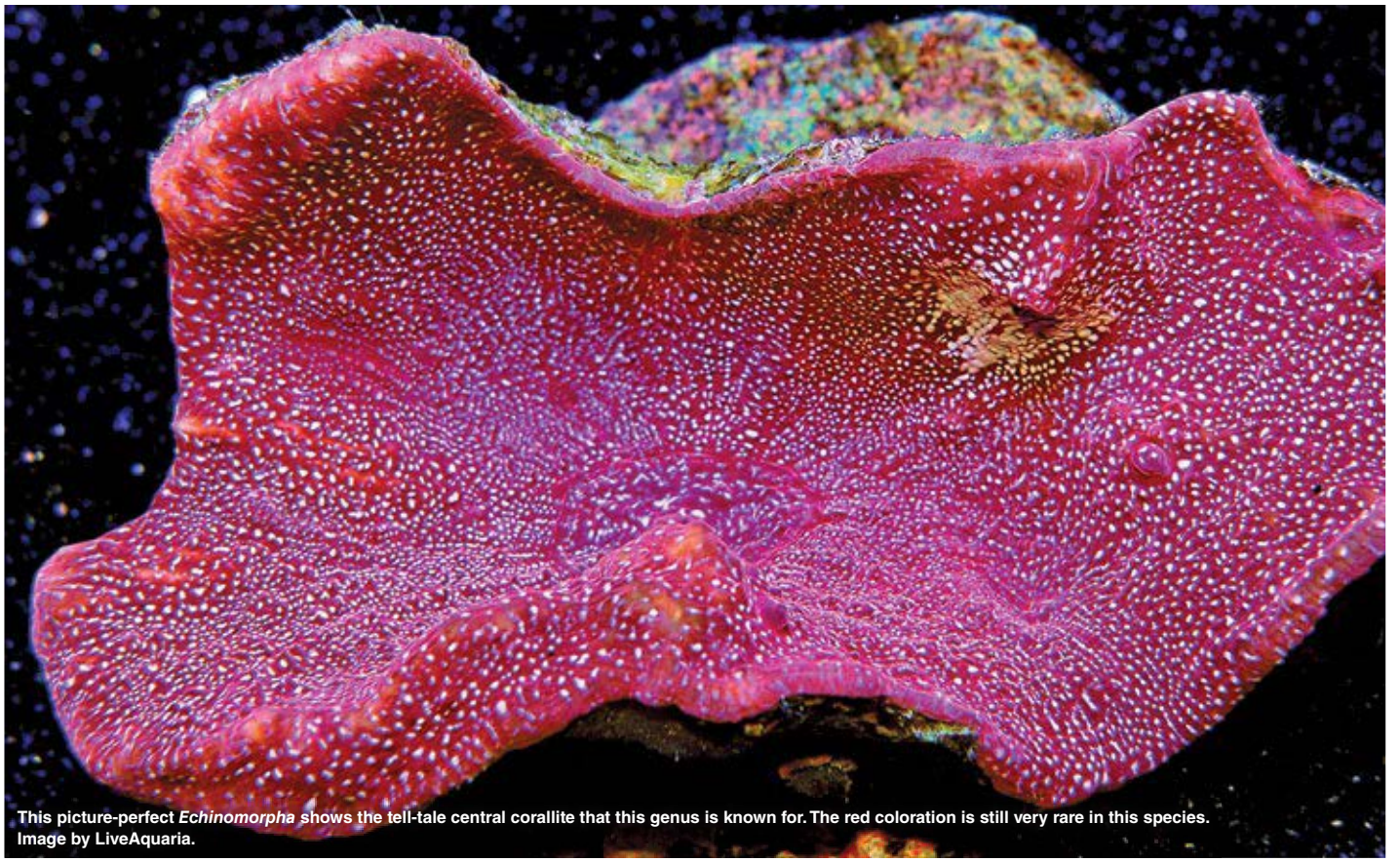

A close-up of my own orange, wrinkled *Leptoseris* showing the exquisite detail that each corallite produces.

In the wild, *Leptoseris* is most often found living in sheltered environments, be they deep and dim or shallow and protected. Just this year, there was even a species discovered living in caves! So if you end up getting a Lepto coral, make sure to keep it in fairly dim light at first and gradually acclimate it to brighter lighting. You can actually give *Leptoseris* a fair amount of light intensity, but it's important that it isn't direct lighting. Avoid placing it under the hot spots of LED light if you're using a light with strong secondary lenses. Water flow should also be somewhat mild for *Leptoseris* corals, enough to keep detritus from settling on them (as their colony shape tends to encourage), but not so much that their delicate tissue is stressed from the flow.

Unless you've been living under a large piece of live rock, you'll have noticed that chalice corals such as *Oxypora* and *Echinophyllia* have all but dominated the rare coral spotlight for many years now. With such a craze for chalices, it's no wonder that the collectors eventually shifted their focus to *Mycedium* and *Pectinia* species, which are similarly wonderful, colorful, and exotic. But there's a fifth genus of chalice coral which is just now coming out of the shadows and being seen with regularity.


This is the typical appearance of an *Echinomorpha* colony, with the crazy, spotted speckling and a large central corallite.

Echinomorpha nishihirai is such a rare coral that no one is really even distinguishing it for what it is. Like all corals, there are some duds in this species, but the pretty ones are radically different from the regular chalice corals we come across. Most notably, the best ones I've seen range from dark gray to red with a pattern of white spotting which can all but cover the coral tissue with a trippy pattern. Or this spotting can be very mild, giving the colony a subtle sparkling appearance. I recently spotted a gorgeous specimen at MACNA 2013 on the Thursday before the doors opened, and it was still there at the end of the show. I couldn't believe no one had picked it up, so I brought it home; it's sitting pretty, glued to a magnet affixed to the back wall of the tank. *Echinomorpha* has



This picture-perfect *Echinomorpha* shows the tell-tale central corallite that this genus is known for. The red coloration is still very rare in this species. Image by LiveAquaria.

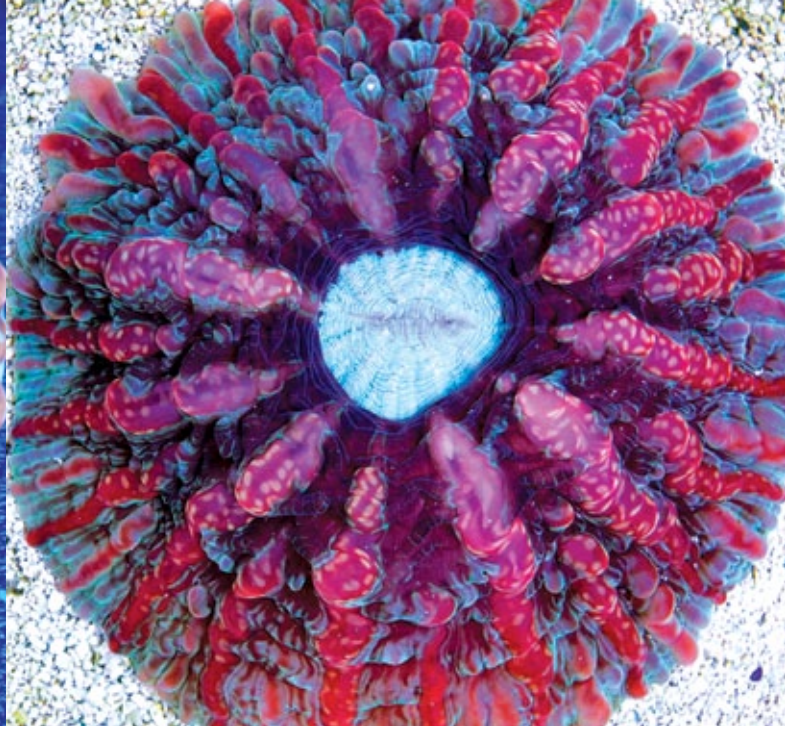
been sporadically harvested for reef aquariums, but in just the last 2 months, it seems like there's been a definite uptick in the number of appearances of this coral.

No matter how you slice it or dice it, *Echinomorpha nishihirai* is very rare and is likely to remain so due to its colony growth form; it often consists of only a single prominent central corallite. Only seldom does *Echinomorpha* develop incipient corallites which could be separated from the large mother corallite to grow and develop into a new colony, but it does happen. Since *Echinomorpha* propagation is practically nonexistent, we have little observational evidence to indicate how suitable it would be for captive culture, but I do have a couple of ideas.

One, it may be possible to separate some tissue from the mouth, with no mouth of its own. Given some time, this tissue may differentiate and grow mouths if provided proper care. Furthermore, many chalice coral strains tend to develop smaller and more numerous mouths in captive culture, so it might be possible to induce *Echinomorpha* to grow into more colonial strains in aquaria. With such unique and colorful versions of *Echinomorpha* popping up these days and the scarcity of this coral in the hobby, this is a species ripe for experimentation.

Another large polyp stony coral which has been rarely available but is now being seen in greater numbers is *Indophyllia macassarensis*. For years now, specimens of *Indophyllia* have sporadically been mixed in with *Cynarina*, which they greatly resemble. Most of these

This close relative of *Cynarina* is in fact an *Indophyllia* showing the less developed vesicles of the polyp's tissue, and this particular one is orange compared to the typically red or pink *Cynarina*.



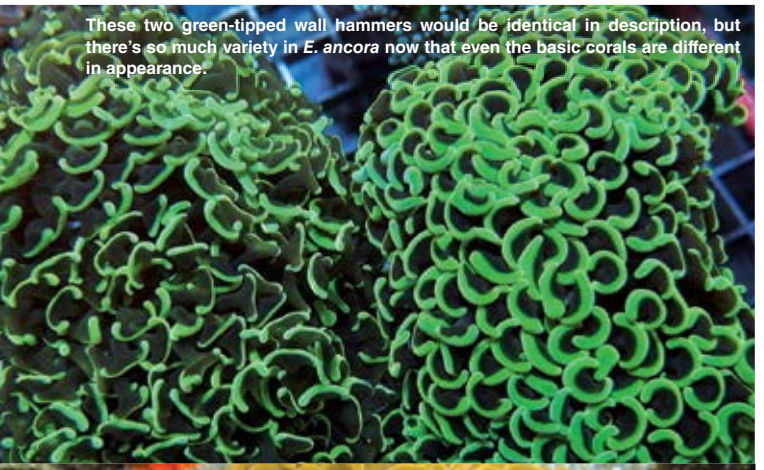
This *Indophyllia* is the bee's knees, the type of specimen to put the species on the reefer's map. Although it is exceptional, others like it have been seen with a similar level of color, pattern, and detail. Image by Cherry Corals.

have been brown, bordering on doo-doo brown. More recently, however, specimens of *Indophyllia* have been spotted with much, much prettier colors and patterns.

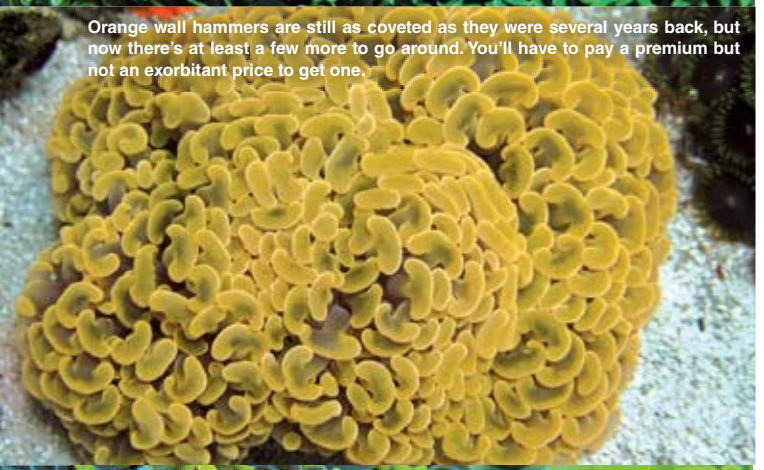
Simply put, *Indophyllia* looks like a modified *Cynarina* with fewer and less pronounced vesicles in the expanded tissue, and it often sports a much thicker, rounder base to the skeleton underlying the

tissue. As gorgeous as *Cynarina* can be, we are finally beginning to see some *Indophyllia* which are just as beautiful. Aside from the brownies already mentioned, *Indophyllia* is now appearing in shades of purple, pink, and orangish-red, but the real kicker is in the subtle details that this species can develop.

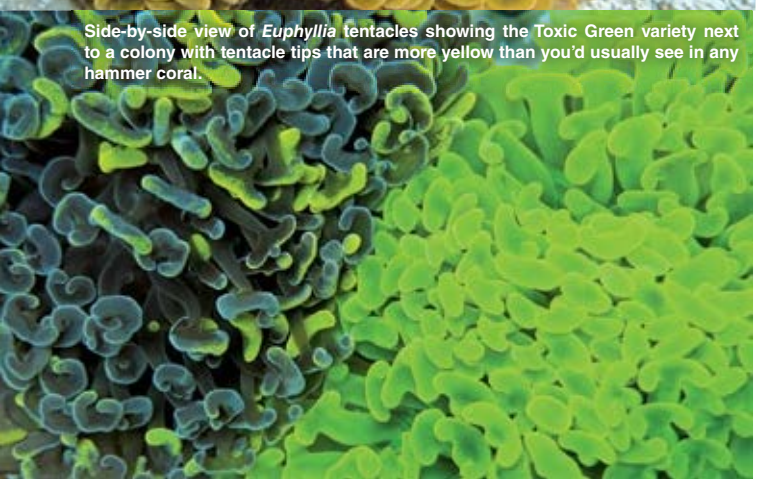
It's hard to describe the exact appearance, but some specimens have a really interesting pattern of blue to green lines on the tissue (I've even seen one with blue jaguar spots). The rim of an *Indophyllia*'s extended mantle of tissue is also further adorned with an abundance of light markings and sometimes gold edging, which can be a real eye-catcher in the right lighting. If you're familiar with the care requirements of *Cynarina*, then *Indophyllia* should more or less follow suit, being able to handle fairly bright lighting but only extending its polyp to full potential in moderate to low flow.



These two green-tipped wall hammers would be identical in description, but there's so much variety in *E. ancora* now that even the basic corals are different in appearance.



Orange wall hammers are still as coveted as they were several years back, but now there's at least a few more to go around. You'll have to pay a premium but not an exorbitant price to get one.



Side-by-side view of *Euphyllia* tentacles showing the Toxic Green variety next to a colony with tentacle tips that are more yellow than you'd usually see in any hammer coral.

Hammer corals have been around the aquarium trade and hobby since the very beginning, but the colonies of wall hammers (*Euphyllia ancora*) coming in these days take this species to a whole new level. The difference between today's Aussie and Indo wall hammers is like the difference between piddly Jakarta acros and the stupendous colonies that are available from Australia. It's easy to see why large, juicy, colorful wall hammers are popular; they're hardy, with tentacles that react beautifully to water flow, and they're just darned showy!

The real question is why 2013 was the year that we saw such variety in *Euphyllia ancora*, so much so that some collectors even started naming certain color morphs. Whether you're looking at a stupendous orange wall hammer or a toxic green hammer which practically glows in the dark, the large and super healthy colonies of this reef aquarium classic are a completely different animal than what was available before. Even the more subdued color forms are quite exceptional, and if you place several seemingly identical colonies with deep brown tentacles and brown tentacle tips close to each other, you'll notice small differences at the micro level which translate to a very different looking colony from a regular viewing distance.

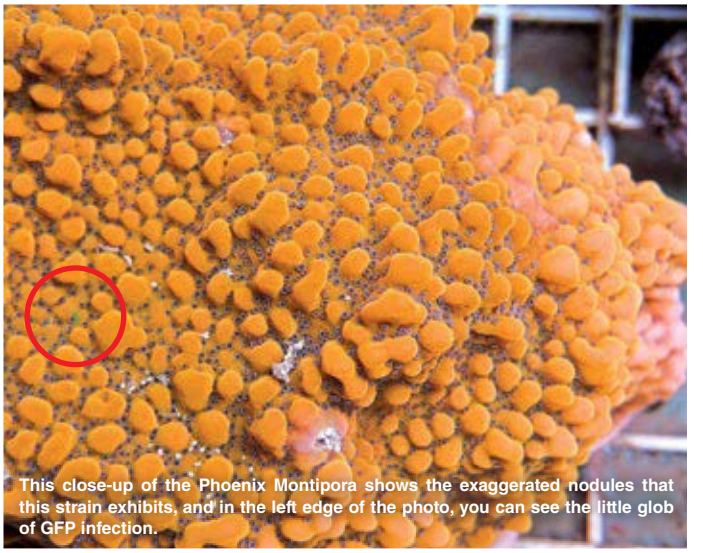
The best part about the super showy new crop of wall hammer corals is that despite displaying so much variety, there are plenty of them to go around. This means they're affordable, and you won't be battling the die-hard collectors in bidding wars to get your hands on a sweet colony. Finally, if you're reading this magazine, you don't need me or anyone else to tell you how to keep a wall hammer in captivity. Follow basic reef aquarium guidelines, and your new-school Indo or Aussie wall hammer will reward you with that iconic appearance that very few other corals can match.

The final coral I want to spotlight is not a new species or a new genus, but a particular variety of another aquarium favorite. It seems like the *Montipora* craze came and went with the Superman and Pokerstar. Then it came again with the availability of the Jedi Mindtrick and other super dope *Montipora* colonies from Australia. *Montipora danae* has always been one of the higher profile species of *Montipora*, and despite my personal mild burnout with this genus, I recently saw a new variety of this species that really grabbed my attention.

I first wrote about the Phoenix Montipora that Route 66 Marine acquired earlier this year, and even then, the pictures didn't do this unique coral strain justice. But then I got to see the Phoenix Monti in person, and I can just about guarantee that all the SPS heads are going to be scrambling for a frag of their own. The Phoenix Montipora is a strain of *Montipora danae* with some very special features, any one of which on their own would make this a desirable SPS.

Unlike other *danae*, the Phoenix Montipora has very large nodules that become irregular in higher lighting and come together to 'mound-up' so that the coral is not altogether flat. The coloration of the Phoenix Monti is orange, but it's a strange shade of metallic orange with a lustrous quality that can vary depending on the

You can easily see in this close-up how much the Phoenix Monti can morph when it decides to throw down a different growth pattern.



This close-up of the Phoenix Montipora shows the exaggerated nodules that this strain exhibits, and in the left edge of the photo, you can see the little glob of GFP infection.

quantity and quality of light. Furthermore, the OG colony of the Phoenix Monti is peppered with little green specks of Green Fluorescent Protein (GFP) infection that could spread a la Steve Garrett's Green Jacket Acro.

At the edges, this strain can develop relatively smooth, flat plates where the tissue is pink, the polyps are blue, and the nodules are mostly absent. It's just crazy the variability of form and coloration present in a single colony of the Phoenix Montipora. Hopefully, some frags will be released soon so that this special strain of *M. danae* will be forever encapsulated and propagated into the living canon of captive-raised corals.

It's easy for reefers to become jaded about the corals available in our hobby, but anyone who's been reefing long enough knows that there are always new corals around the corner. If you keep your eyes peeled, you never know what you'll find. I know for a fact that there are some exciting new coral developments coming down the pipe for 2014. We are firmly in a golden age of aquarium reefing, and sexy new corals like the ones above are just the tip of the iceberg.

A reef tank shortly after being established.

BRILLIANT BACTERIA

SHAYNE BALLOU
Images by Tim Wong

From the tip of your tongue to the soles of even the cleanest feet, bacteria infest every crevice and pore in our bodies. Without our body's symbiotic and normal flora, life would be extremely different. But why is this important to the marine hobbyist? In order to answer this question, it is important to understand some of the basics of bacterial life and the roles these bacteria play in nature and normal biological processes.

Bacteria were the sole inhabitants of the earth for over 2 billion years. This gave them plenty of time to perfect the process of passing on their genetics to subsequent generations and adapting to different environments. Bacteria are classified as prokaryotic organisms and house most of their important genetic material in a nucleolus and plasmid. This is quite primitive in comparison to the more elaborate eukaryotic cells and viruses, which house their DNA in a membrane-surrounded nucleus. Another important concept to understand is how bacteria function metabolically and how they sequester nutrients. Many of these functions are performed through the use of enzymes, which are encoded via the genome of the bacteria. The types of enzymes that bacteria can produce and utilize are important factors used in bacterial classification. Other important factors for classification include the shape of the bacteria (rods, spirals, and pleomorphic shapes) and the type of stain that is used to observe the bacteria under the microscope (gram-positive or gram-negative stains). For the purpose of this article, we will be focusing on bacteria that use the enzymes ammonia oxygenase, nitrite reductase, and nitrogenase reductase. The three main groups of bacteria that we will be discussing are *Nitrobacter*, *Nitrosomonas*, and Cyanobacteria, respectively. All three of these types of bacteria are wildly abundant in the open oceans and have helped shape oceanic ecosystems into what we know today. As a result, it is easy to see why this is such an important topic to understand for both amateur and expert hobbyists alike.

This brings up the next important topic: the process of colonization of marine tanks by bacteria. While this subject could fill an entire article itself, we will only cover the essential ideas. When a marine tank is brand new and bacterial colonies have not yet had a chance to become established, large amounts of free nutrients, such as ammonia, nitrite, and nitrate, can be found in the water. These organic compounds must be broken down in order for the tank to become safe for our cherished fish and coral. There is a large difference in the number and type of viable bacteria in a tank that has just been set up and a tank that has been running for years. This is why slowly stocking an aquarium is critically important. In one of my previous articles titled "Diversify Now," I touched on the idea of tank stability as a product of diversification. Bacteria also play a large role in tank stability as the greater the diversity and

The same reef tank has gained stability and beauty over time.

number of bacteria within the system, the higher the affinity for nutrient export. Most hobbyists are familiar with the idea of tank cycling, but the secret that eludes many is that during this key time of tank development, the various dominant species of bacteria within the tank change as the tank matures.

Each subsequent species provides an essential pathway for nutrient utilization and disposal, and each species is more or less dependent on the nutrients produced by its precursor. These bacteria do not appear at random but exist in live rock, live sand, and water. This is why using pre-cycled live rock and already-established live sand and water are great assets, as they provide bacteria that will quickly spread via binary fission. While small colonies of many species will come with the live rock, live sand, and water, the marine system will become more stable as the colonies grow. This is where the enzymes that I previously mentioned come into play. As you remember, the different species of bacteria are partially classified based on the type of enzymes that they produce, and each enzyme's activity provides for an essential part of the nitrogen cycle within the marine system.

The first type of bacteria to flourish in a new marine tank is usually some species of *Nitrosomonas*. These bacteria contain the enzyme ammonia oxygenase, and due to the initially high levels of ammonia present when the tank is first established, *Nitrosomonas* bacteria will rapidly flourish and spread. *Nitrosomonas* were found to use the enzyme ammonia oxygenase to oxidize ammonia into nitrite. When this process takes place, these bacteria fix gaseous carbon dioxide, which is important in pH regulation. In regards to specific growth rates of *Nitrosomonas* bacteria, it has been shown that "an optimum pH of approximately 7.8 was determined, and the effective maximum specific growth rate was found to be a monotonically increasing function of temperature in the range of 15-25°C (ed. note: approx. 59-77°F)."[1] While a pH of 7.8 is not ideal for the marine aquarium (8.2-8.4 being ideal), a temperature of 77°F is quite acceptable. Now that colonies of *Nitrosomonas* are flourishing within the tank and converting ammonia into nitrite, this will allow another genus of bacteria to flourish: *Nitrobacter*.

Species of *Nitrobacter* will be responsible for the conversion of nitrite into nitrate. *Nitrobacter* are gram-negative, rod-shaped bacteria. They are very important in the nitrogen cycle, especially for a tank housing numerous fish, corals, and invertebrates, as nitrite is much more toxic to fish than nitrate. But it is important to note that either can cause complications with animal health when present in excessive amounts. The main enzyme used in this conversion is nitrite reductase; it was found that this "oxidation

is the sole means for this organism to obtain energy required for growth and cell synthesis."[2] Essentially, what this means is that the growth of *Nitrobacter* species and their resulting conversion of nitrite to nitrate are dependent upon the preceding conversion of ammonia into nitrite by *Nitrosomonas*.

In recent years, it has become apparent that the various roles of bacteria in the marine aquarium are much more complicated than first imagined, and more than a single genus is able to perform each of the important conversions described above. It is now known that various other genera of bacteria use enzymes for the acquisition of the same nutrients. Two other notable bacteria that yield similar results as *Nitrosomonas* and *Nitrobacter* are *Nitrosococcus* and *Nitrococcus* spp. These bacteria have also been utilized to achieve rapid nitrogen cycling effects, which are very beneficial to marine aquarium hobbyists who may not have access to live rock or live sand.

Now that the conversion of nitrite into nitrate has been covered, it is important to understand that it mainly becomes the aquarist's responsibility to remove nitrates from the aquarium, though some can be processed through anaerobic filtration. Some nitrates will be lost via surface water interaction, which will favor the formation of nitrogen gas; but this effect is very minor, and the majority of accumulated nitrates must be controlled through the use of activated media, protein skimmers, water changes, and careful feeding techniques. Should large amounts of organics be allowed to accumulate in the tank, another group of bacteria can gain a foothold: the much-dreaded Cyanobacteria.

While Cyanobacteria are wildly fascinating from a biological perspective, in a reef tank, they can prove to be quite a headache by choking off coral and covering rocks and the sand bed. Typically, Cyanobacteria will only appear when phosphates and nitrogen products accumulate over time. They tend to be more common in older, established tanks, but every high-nutrient tank is at risk. Cyanobacteria produce oxygen gas as a byproduct of photosynthesis and have the ability to fix nitrogen. Photosynthesis is the main metabolic driving force for this organism, which means it is highly light dependent. Wait, a bacterium that uses light? How cool is that?! During photosynthesis, the bacteria actually split water molecules and use the high energy electrons for their metabolic needs.

Cyanobacteria also contain the enzyme nitrogenase reductase. Furthermore, it is important to understand that nitrogen fixation and photosynthesis complement each other in that they both represent different phases of nutrient acquisition. The use of nitrogenase reductase allows the bacteria to directly absorb nitrogen gas. Combine this ability with photosynthesis, and it becomes easy to see why Cyanobacteria have existed for so long and why they can be so difficult to remove completely from a marine aquarium. Cyanobacteria are essentially professionals at nutrient acquisition. Currently, the most effective treatment to rid a tank of Cyanobacteria is to perform active water changes and run activated media in reactors. A combination of SeaChem's Phosguard, Purigen, and activated carbon will be effective if feeding is also strictly controlled. It is important to keep Purigen and Phosguard in separate reactors, as the pellets can rub and create noxious compounds. If these


Cyanobacteria


Cyanobacteria

methods are ineffective, then the antibiotic Erythromycin can be used. Dosages must be precise as anoxic conditions can result from overdosing and can cause fish and coral to die.

In closing, I hope this article will allow you to better understand and appreciate bacteria and give you the needed edge in the management of your marine ecosystem. Shayne Ballou, signing off until next time!

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EXTREME AUTOMATION PART 1:
BASIC AUTOMATION PROJECTS

MATT HARRIS

Some say I went off the deep end when it comes to aquarium automation. I tend to agree with them as it's become a second hobby for me. Taking a repeated task, such as adding salt mix to purified water for a water change, and automating it can be a decent time saver, not to mention a challenging and rewarding project. Couple that with automatic water changes, and now we are starting to save a few hours a week, which can be used to enjoy our livestock.

The idea behind this three-part series is to share what I have automated along with an overview of how I did it. You can then use my work as a template, make modifications, and take it from there. The one thing I try to do in all of my automation projects is to plan for the worst-case scenario. At some point, every mechanical product is going to fail; there is no way around this. Taking that into consideration, I try to build in some redundancy whenever possible. Sometimes people think that once a task is automated, you never have to worry about it anymore. This is not the case. Once a task is automated, both the equipment being automated and the controllers (and probes) need to be monitored and maintained. Failure to maintain the equipment can result in disastrous consequences. With that said, this first article will cover some of the basics of automation to lay the groundwork for more advanced projects. Each of the other articles will detail a few projects, with the second and third articles covering intermediate and then advanced projects, respectively.

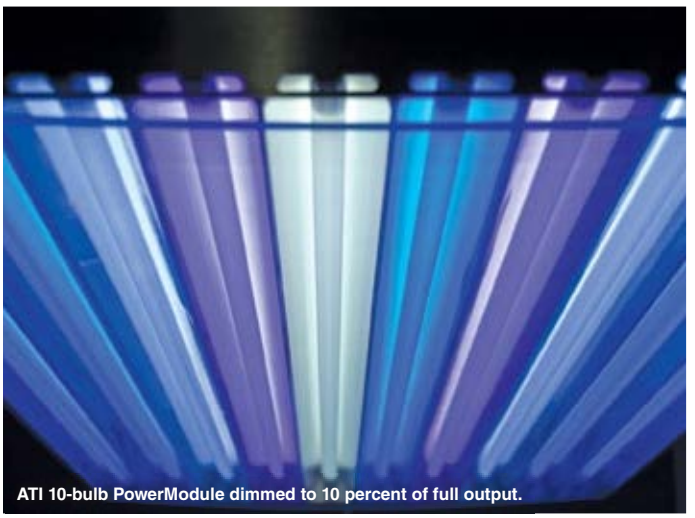
On to a little about my system. This aquarium was set up just over 2 years ago and is 120 gallons in volume. Livestock consists primarily of SPS corals along with some angelfish. The controller I use is a Neptune Apex, so a lot of the examples that I discuss will be based on that controller's functions.

BASIC AUTOMATION

• Lighting Control

Aquarium lighting control is a topic that can be described as basic, intermediate, *and* advanced. The complexity of your lighting automation need only be limited by the equipment available and your creativity. Most of my previous systems used metal halides for lighting. When I set up this aquarium, I wanted to try something different, but I didn't want to switch to LEDs yet. The one feature I wanted was the ability to dim the lights. So, I decided to use a T5 fixture. Being that I travel quite a bit for work, I didn't have the time to build a DIY fixture, so I went with a 10-bulb ATI dimmable PowerModule.

ATI ballasts are only dimmable down to 10 percent of maximum output, so to turn the lights off completely, you have to turn off the



ATI 10-bulb PowerModule dimmed to 10 percent of full output.

10-volt control output on Apex controller.

ATI PowerModule 10-volt control module connected to Apex.

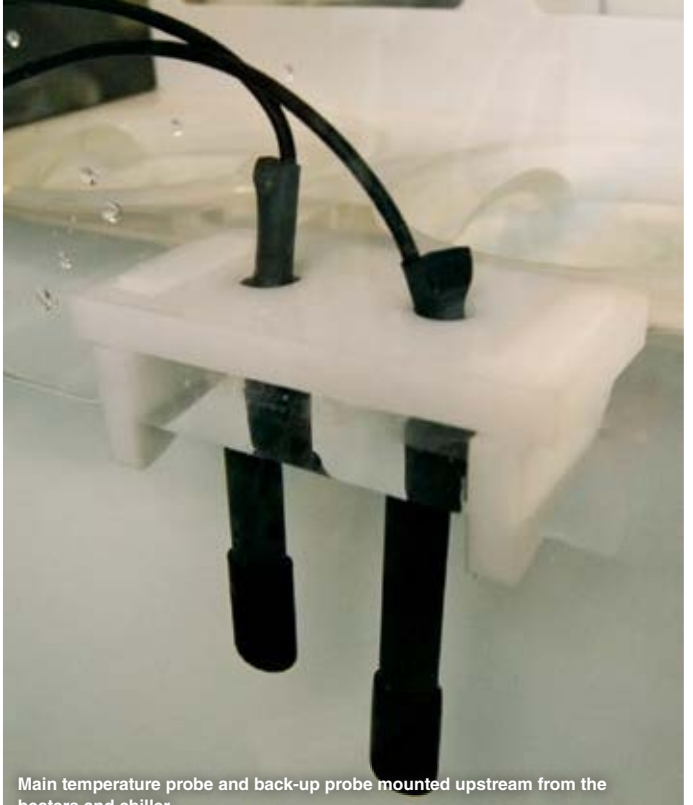
bulbs on, the fans are on as well. The fixture is also set to turn off should the temperature of the water rise above the programmed value.

• Temperature Control

Before we go into this topic, I should bring up alarms. Alarms are very powerful; they can alert you via email, text, or both should a dangerous system condition arise. One thing I suggest is setting up an alarm to send an email and text once a day at a certain time. If I don't receive that email and text on time every day, I know I have an issue. This could be something to do with the WiFi connection to the controller, an issue with the SMTP email server that I use, or an actual emergency with the tank.

power to the fixture. The 10-bulb fixture has two power cords for the lamps. Two bulbs are on the first channel and eight bulbs are on the second channel. Using two of the 10-volt variable speed ports on the APEX, I can have the T5 lights ramp up from 10 percent to 100 percent over the course of 3 hours, stay at 100 percent for 2 hours, and then ramp back down to 10 percent for the last 3 hours, giving me a total photoperiod of 8 hours. The light fixture has a separate plug for the fans. I have this plugged into its own outlet on an EB8 power bar. The programming of the fan outlet is set so that if either of the two light channels of the T5 fixture is on, the fan outlet is also on. This is useful because if I am doing maintenance with only two

Getting back to temperature control, I use three heaters along with a chiller. Using fans to blow across the sump or the display to increase evaporative cooling would be another option. One nice feature of the Apex controller is the season table. Using the season table, the controller can slightly adjust the duration of the light cycle, the intensity of the moon lights, and the temperature of the aquarium to simulate natural seasonal changes. I use the temperature feature of the season table to control my tank temperature. The temperature probe that I use to monitor the temperature of the water is located downstream of the overflow filter socks in the sump and upstream from any heaters and the chiller output. The idea is to monitor the



Main temperature probe and back-up probe mounted upstream from the heaters and chiller.

Chiller

temperature of the aquarium water as soon as it exits from the aquarium. I have two of the heaters plugged in to one of the triac outlets on an EB8 outlet bar. The third heater is plugged into a second triac outlet on the same EB8 outlet bar. The reason I did this is simply for redundancy of the triac outlets. Each of the two heater outlets are programmed the same, so they turn on and off together.

The heaters are programmed to turn on when the water temperature falls .4 of a degree below the value that the season table has set for the day, with the heaters turning off when the correct temperature value is restored. In addition, the heaters are programmed to stay off should the temperature probe start reporting values that are 6 degrees above or below the specified temperature on the season table. The reason I do this is that usually when a temperature probe fails, it starts to report a really high or low value. What I don't want is to have the heaters kick on because the temperature probe failed and is reporting the water temp to be 24 degrees when in fact that is not the case. Instead, I want the heaters to stay off, and I want an alarm email alerting me that there is an issue. Should this happen, I can quickly reference the other temperature probe that sits next to the suspect temperature probe and diagnose the problem. If the first probe has failed, I can quickly replace the failed probe name in the programming with the backup probe name and replace the faulty probe as soon as I'm home. In addition to that, the thermostat on each heater has been set to a degree higher than the highest temperature value that is used in the seasonal temperature table. Let's say the outlet connected to a heater somehow got stuck in the on position; the heater should only heat the water up to the set value on its internal thermostat. The heaters are also programmed to switch off should the water level in the sump drop and activate the low water float switch.

The chiller is plugged into a relay outlet on an EB4 outlet bar. This was done because the amperage draw on the chiller is higher than a triac outlet will support. The programming is similar to that of the heaters except for two things. After the chiller turns off, it is set to stay off for at least 10 minutes before it can come back on. This is done to reduce wear and tear on the compressor. The chiller is also set to turn off should the pump that feeds it turn off.

•In-Tank Circulation Pump Control

For in-tank circulation, I use three EcoTech VorTech pumps: two MP40s on the sides of the aquarium and one MP10 on the back wall. The pumps are wirelessly synced to the Apex with a WXM module. With the pumps connected to the Apex, I can change the intensity and the wave mode of the pumps based on specific conditions. For example, I can slow the flow down at night, or as the lights start to ramp up, I can slowly increase the intensity of the flow. The three pumps are usually on *Lagoon Random* mode and alternating between the *sync* and *anti-sync* settings. There is also a time when all three pumps switch over to *constant* mode at 100 percent power to help dislodge and suspend detritus.

There is an automatic fish feeder on the system that is controlled by the Apex as well. The fish feeder is mounted above a feeding ring that corrals the pellet food after it falls. To help keep the pellets from ending up in the overflow, I also have the VorTech pumps change modes when the autofeeder is on. The pump furthest away from the auto feeder shuts off completely. The pump that is located on the back wall switches to feed mode and slows down considerably. The other pump, located on the side of the aquarium that is closest to the auto feeder, is put into pulse mode. This method draws pellets underwater, which makes it easier for all of the fish to eat without competing at the surface.

•Automatic Freshwater Top-Off

Automatic top-off, or ATO, is the automatic addition of purified freshwater to replace evaporated water. It's not anything new, but controlling this function with a modern aquarium controller versus a standalone controller or system allows for more redundancy in the programming. I have tried quite a few different switch types, from simple float, optic level sensor, and pressure switches, to ultrasonic level switches. Simple float switches have worked the best for me. I've found that they require the least amount of maintenance; typically, all that is required is cleaning them with a brush every 4 months or so. I usually get a few years of reliable operation out of them, with some now being over 5 years old. I currently use three for the ATO system: one float switch is set up as a high water point, another set as a working water level, and the last as a low water point.

My system sees a little less than 2 gallons of evaporation per day. When the water level starts to drop, the working water level float switch will activate, and the Apex controller will turn on a slow-flow water pump that pumps purified freshwater from a 2 gallon reservoir into the sump. The sump refills from the float trigger level to the working water level in approximately 2 minutes, so for redundancy, the pump is programmed to run for a maximum of 3 minutes. After the water level is brought back up in the sump, the Apex turns off the slow-flow water pump, which then stays in the off position for at least 20 minutes. I have this slow-flow water pump programmed this way so that it does not turn on and off and on and off rapidly whenever the water level drops a slight amount or a wave in the sump allows the float on the switch to bounce up and down. I also have a conductivity probe installed to measure salinity in the display. Should the conductivity reading register below the programmed value, the slow-flow water pump will not turn on, and I will receive an alarm email. In addition, this pump will not turn on when the liquid PO4 removal system or denitrator are active. I will go into more detail on those systems in the next two articles, but the point here is that when those systems are active, the sump's water level drops. I don't want the ATO to bring the water level back up at that time because when those systems turn off, the water level in the sump returns to the normal working level automatically.

Then there are the two other switches: the high water point switch and the low water point switch. The low water point switch is used just as its name suggests: to detect a low water condition in the sump. This condition could be caused by a leak somewhere, the ATO not functioning correctly, or a variety of other problems. Should the water in the sump drop and trigger this switch, the controller will send out an alarm email and turn off the return pump, chiller pump, protein skimmer pump, utility pumps that are used by the various reactors, water exchange pumps, and the heaters. In addition, the VorTech pumps are then turned up to their highest speeds to maximize surface agitation. The purpose of this is to keep the water oxygenated in the display since the overflow is not running and the return pump is off. If the water level in the sump should rise and activate the high water point switch, the same programming is used to shut down most of the system and send an alarm email.

Returning to the discussion at the beginning of this section, I had mentioned that my system evaporates a little under 2 gallons of water per day. I use an intermediate 2 gallon reservoir that supplies the ATO to the sump. The idea behind this was that should the ATO pump ever stay on, no more than 2 gallons of purified RO water can be added to the sump. This intermediate 2 gallon reservoir contains two float switches: one set for a low water point and one set for a high water point. The pump that fills this 2 gallon reservoir from the main RO/DI water vat can only come on once per day to top it off, and that pump is limited by time as well. So whichever trigger occurs first, either the end of the programmed time limit or the activation of the float switch, will turn the pump off.

Coming up in the next article, we will discuss automating alkalinity and calcium dosing, automating water changes, protein skimmer automation, and an automated liquid phosphate control system.

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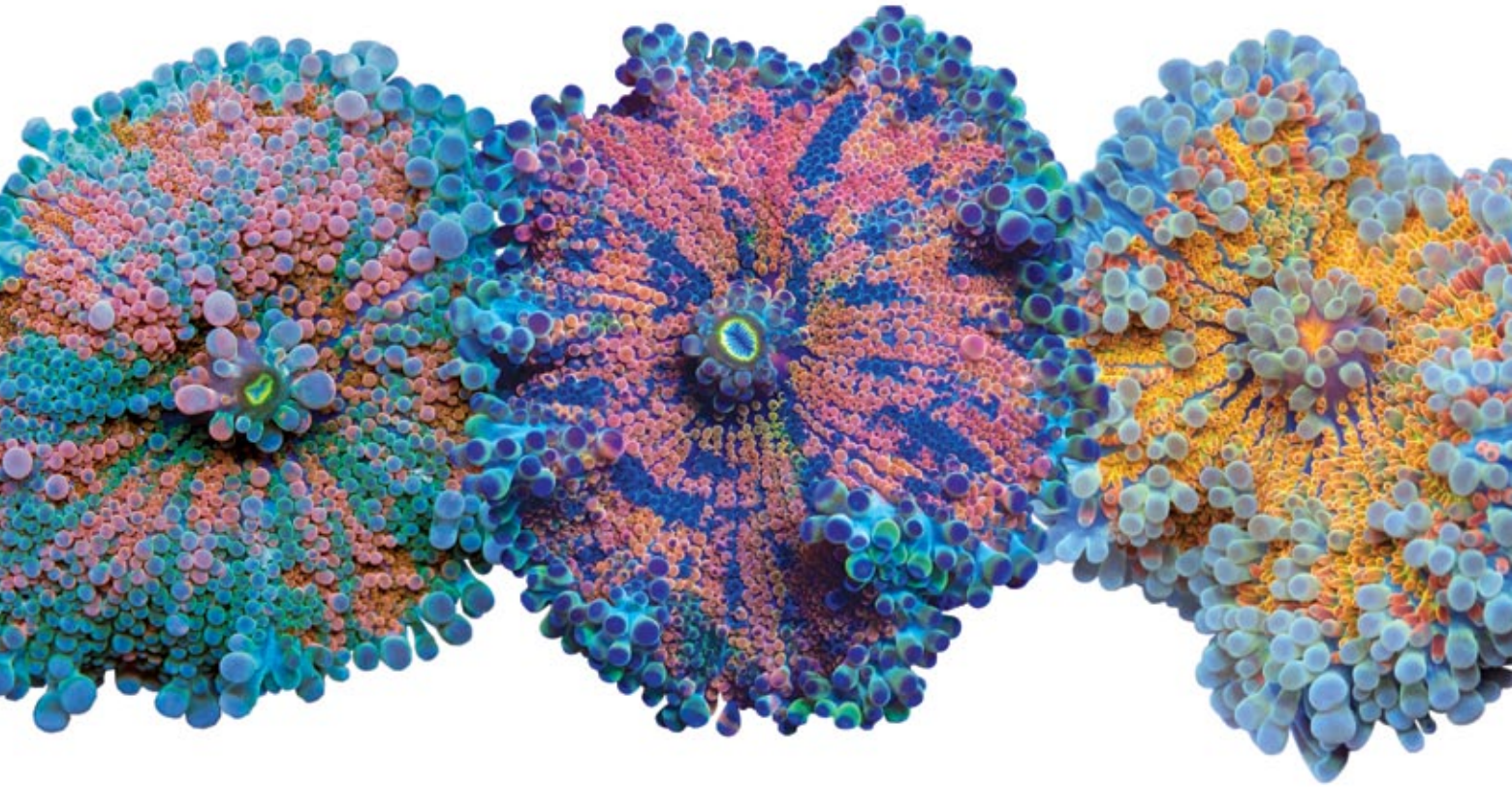


ADDICTED TO PSYCHEDELIC MUSHROOMS

GORDON GREENLEY
Images by Cherry Corals

Mushroom corals are quite possibly the most underrated corals in the aquarium trade. Often regarded as only a beginner coral, many people view mushroom corals as bland and even annoying in a typical reef aquarium. However, new mushroom coral species and morphs have started trickling into the trade, heralding the possibility of a new mushroom craze. Although it is one of the most common types of corals in the aquarium trade, many of the mushroom coral's specific qualities and needs remain poorly understood.

Mushroom corals are found all over the world. Many species are found throughout the Indian and Pacific Oceans, and several are found in the Atlantic and specifically the Caribbean Sea. Species of mushroom corals found in the Caribbean include *Ricordea florida*, *Discosoma carlgreni*, and *Discosoma sanctithomae*. *Ricordea yuma* and numerous species of *Discosoma*, *Rhodactis*, and *Amplexidiscus* are widespread throughout the Indian and Pacific Oceans and are commonly collected from areas around Fiji, Tonga, and more recently, Australia.

Mushroom corals are a soft coral and lack a calcium carbonate skeleton. Closely related to true sea anemones, mushroom corals can even crawl, but only extremely slowly. They are typically referred to as beginner corals, and while many do indeed have specific

care requirements, as a group, they're fairly forgiving of fluctuating water parameters. Mushroom corals can be found in almost every color of the rainbow, and with their striking patterns and diverse morphology, they make a stunning addition to any reef aquarium.

As with other photosynthetic corals, proper lighting is one of the most important considerations in keeping mushroom corals looking their best. Many will survive under almost any lighting, but all have specific lighting preferences which will produce the best color and growth. *Ricordea florida* and the smaller-sized strains of *Ricordea yuma*, for example, are typically found in shallow water in the wild and prefer medium to high light. *Discosoma* species will thrive under almost any lighting conditions, and *Rhodactis* species prefer medium to high light. If too little light is present, most mushroom corals will either spread out and inflate or form a cup shape and reach upwards towards the light. They will also commonly turn brown in color as excess zooxanthellae are produced in an attempt to compensate for insufficient light. Under proper lighting conditions, mushroom corals can develop incredibly bright colors which fluoresce under actinic lighting, producing a psychedelic effect. Therefore, many mushroom coral keepers prefer to include a generous amount of actinic spectrum in their lighting setups.

Nearly all species of mushroom coral prefer low to medium flow in the aquarium. Composed only of fleshy tissue and filled with water and slime, mushroom corals are easily disturbed by strong, direct flow. This can cause them to shrivel and possibly detach from their holdfasts in an attempt to find a more suitable environment. Indirect flow is ideal for this group of corals. It should be just strong enough to gently move the edges of the corals from time to time and to keep any debris from collecting on their surface.

***Rhodactis* sp. mushrooms can exhibit a patchwork of color.**

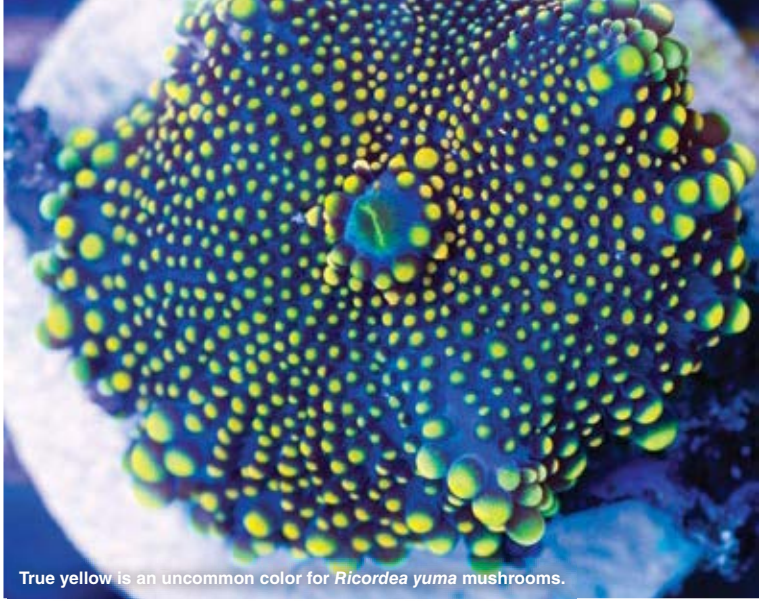
A *Discosoma* mushroom with an almost iridescent quality.

Almost every color of the rainbow can be seen on some *Rhodactis* mushroom morphs.

***Discosoma* mushrooms often have raised spots resembling pimples.**

Some mushroom corals can survive by taking in leftover scraps from other aquarium inhabitants, and some barely eat at all. However, many will do best with the addition of various meaty foods. Recommended foods for mushroom corals include small- to medium-sized frozen foods, such as mysid shrimp, cyclops, brine shrimp, krill, and even sliced silversides. There are also several specially formulated pellet foods available for mushroom corals, but as with all aquarium inhabitants, it is best to vary their diet.

Discosoma carlgreni **is an uncommon species found in the Caribbean, often around southern Florida.**



True yellow is an uncommon color for *Ricordea yuma* mushrooms.

In order to feed mushrooms, flow should be reduced and a turkey baster or similar syringe-type tool can be used to target feed each polyp. After gently placing the food in the center of each polyp, time should be allowed for the polyp to consume the food. Flow can then be returned to normal. Some mushroom corals, such as *Amplexidiscus* spp. (Elephant Ear mushrooms), can grow to approximately 10 inches in diameter and can be predatory on other aquarium inhabitants. Although instances of fish and shrimp being captured and consumed by these behemoth mushroom corals have been reported, such victims are typically already weak or injured, and it is highly unlikely that a healthy fish or shrimp would be preyed upon.

While many mushroom corals can live in a wide range of water parameters, they will only flourish if certain base levels are maintained. The following are my suggested water parameter values which should encourage most mushroom corals to thrive:

-pH value of approximately 8.1
-specific gravity of 1.024 to 1.025
-alkalinity of about 8-9 dKH (degrees of carbonate hardness)
-calcium level of about 350-450 ppm (parts per million)
-ammonia, nitrate, and phosphate should be kept at zero

Calcium and alkalinity are not as important as the other parameters when it comes to mushroom corals due to their lack of a calcium carbonate skeleton. They are, however, specifically sensitive to pH changes and salinity swings. When upset, mushroom corals may shrivel up until they become very small and can extrude their internal digestive tissues, which look like thin, swirly, white filaments. Under extreme circumstances, these corals can detach from their moorings but may possibly reattach and recover if relocated to a better environment.

Adding new mushroom corals to an aquarium is always very exciting. Care should be taken so that the transition to their new world is not traumatic for the corals. The most important things to do with new corals, especially mushroom corals, is to first dip them to get rid of unwanted pests and then to acclimate them to the new aquarium. Dipping mushroom corals is a cheap and easy process and can save reef keepers from major headaches down the road. It is also just a responsible practice to use with any new additions.

Many *R. yuma* mushrooms have a single white radial line.

St. Thomas mushrooms (*Discosoma sanctithomae*) are collected in the Caribbean.

The Jawbreaker mushroom is a must-have for collectors.

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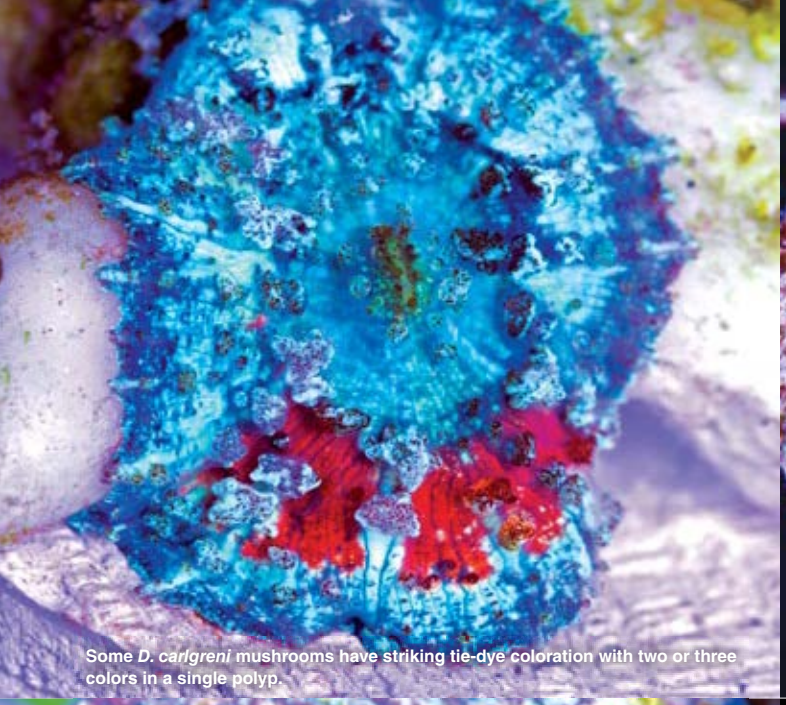
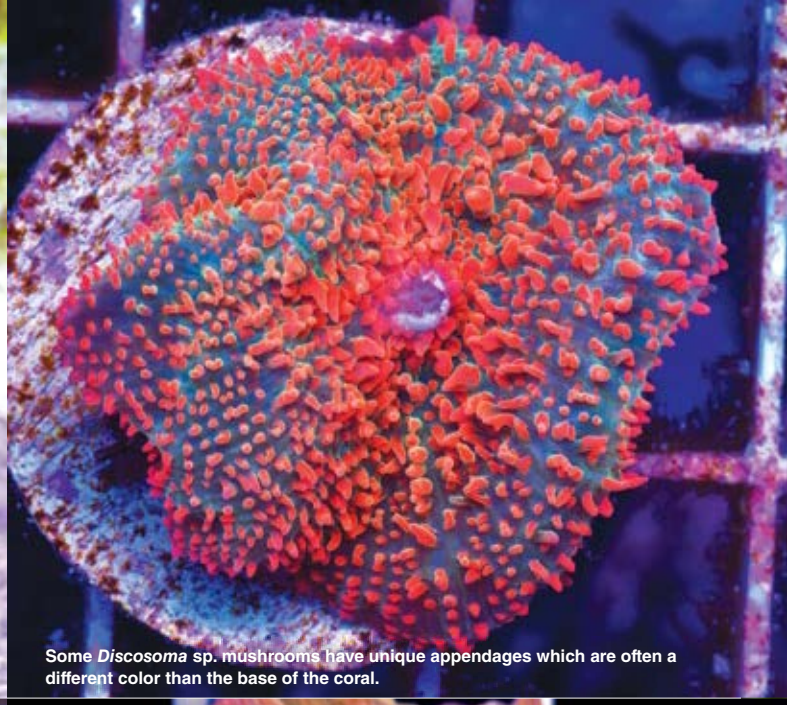
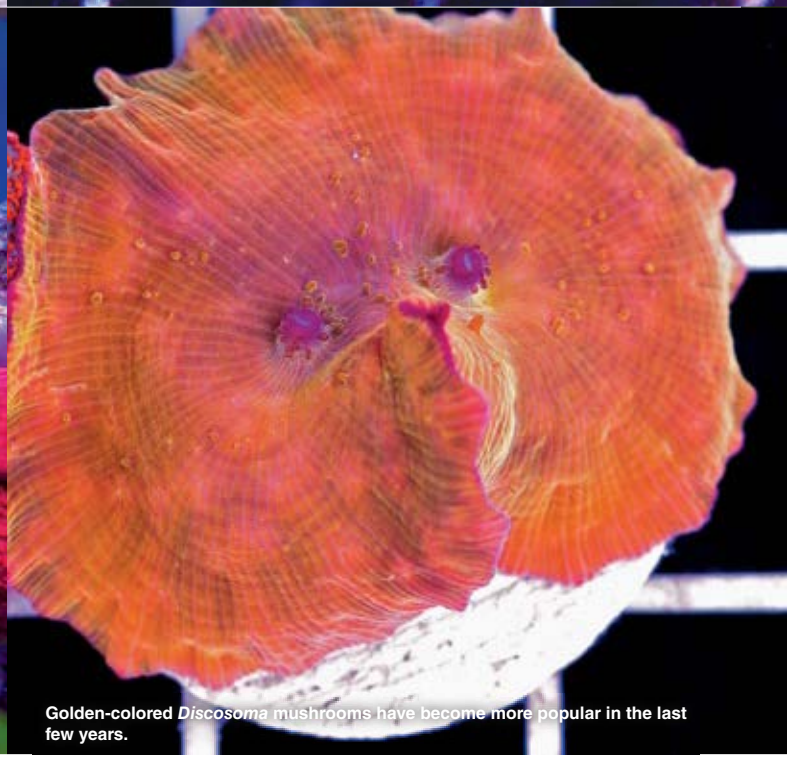


Some *D. carlgreni* mushrooms have striking tie-dye coloration with two or three colors in a single polyp.



Some *Discosoma* sp. mushrooms have unique appendages which are often a different color than the base of the coral.

Different color morphs of the same species and even different species of the same genus of mushroom corals will often coexist peacefully.

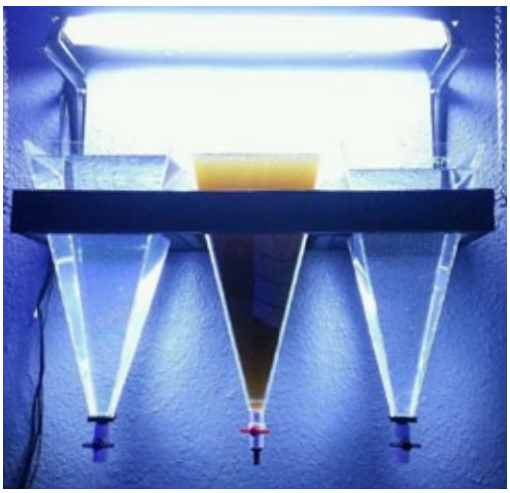


Golden-colored *Discosoma* mushrooms have become more popular in the last few years.

Common pests that are known hitchhikers on mushroom corals include several species of flatworms (some of which feed specifically on mushroom corals), some types of undesirable copepods or isopods, and several species of predatory nudibranchs or sea slugs. There are a number of different coral dip products available which are very effective for removing these pests. Iodine is a favorite among many aquarists and is very comprehensive. It is important to remember that dipping alone cannot destroy the eggs of some pests. If pests and eggs are found on a new coral, it may be wise to isolate the new coral and treat it with multiple dips over a prolonged period before adding it to the aquarium. Also, even if no pests are seen, that does not mean they are not there. The practice of dipping everything is good insurance for your reef.

Acclimation is the process of slowly introducing a coral to the conditions of a new environment. Mushroom corals typically only require temperature acclimation, but drip acclimation can be used if the water parameters of the new aquarium are significantly different than that of the old one, or just for extra safety. It is important to remember that when first introduced to a new aquarium, mushroom corals may appear stressed for a day or two. They should return to normal once they get used to their new environment.

INTRODUCING ALGAGEN'S LIVE FEEDS PROGRAM



A healthy reef depends on plankton, and in this case, fresh is best! AlgaGen has recently launched its Live Feeds Program, which aims to set up culture holding systems in local fish stores across the country. Stores offering the Live Feeds Program will have live phytoplankton, rotifers, brine and/or copepods available to customers to feed their reefs or breed marine livestock with. Now you can provide your reef the nutrition found in nature and elicit the natural feeding responses from all of your tank inhabitants. Ask your local fish store for AlgaGen's Live Feeds Program.

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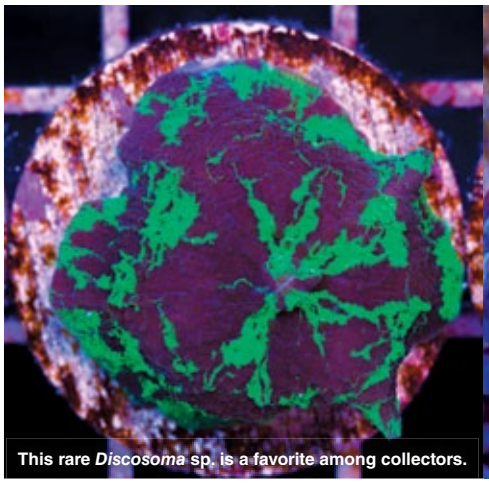


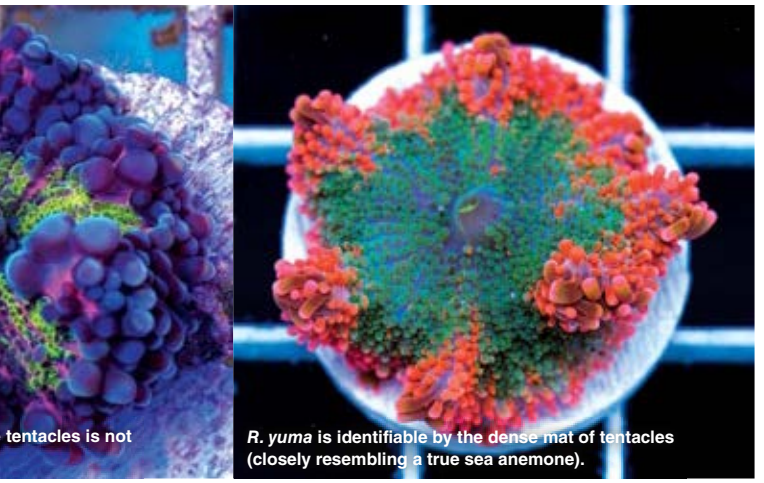
This rare *Discosoma* sp. is a favorite among collectors.

The presence of small and large uncommon on *R. yuma*.

Propagating mushroom corals is very easy and can often be achieved simply by giving the corals optimum conditions for growth. Many species of mushrooms grow extremely fast and reproduce by budding. Manual propagation is also easy, as most mushroom corals can be cut, ripped, and shredded, as long as part of the mouth and foot remain attached to each piece. However, some species, such as *Ricordea yuma*, can be very sensitive to these methods and may not always survive. Cutting can be done with almost any tool, but scalpels are especially efficient. The new piece will then regrow as a clone of the parent polyp. Some reef keepers advocate keeping freshly cut pieces of mushroom coral in an aquarium with an anti-bacterial in order to help reduce the possibility of infection and to allow the new clones to heal faster.

Under the right conditions, some mushroom corals can grow out of control, taking over entire rocks or even entire aquariums. They can slowly outcompete and overgrow other corals if left unchecked. If needed, there are methods for exterminating unwanted mushroom corals as well. An easy way to remove mushroom corals is with chemicals such as calcium hydroxide, or kalkwasser. Powdered kalkwasser can be mixed with aquarium water and then placed on top of or fed to mushroom corals in order to exterminate them. If you use a chemical such as kalkwasser in the aquarium, always be careful to use only a little at a time. Another way to get rid of unwanted mushroom corals is through manual removal. A barbecue brush with plastic bristles can be used to scrub mushroom corals off surfaces. If possible, remove the mushroom rock from the tank before scrubbing. After scrubbing, rinse the work surface with RO/DI or distilled water.

While not many invertebrates are known to pair up with mushroom corals specifically, Anemone Shrimp (*Periclimenes* sp.), Sexy Shrimp (*Thor amboinensis*), Pederson Cleaner Shrimp (*Periclimenes pedersoni*), and anemone crabs (*Neopetrolisthes ohshimai*) will form symbiotic relationships with mushroom corals. The shrimp or crab gets somewhere to hide from predators, and the mushroom will get some of the food scraps that are dropped by the shrimp or crab. Sometimes, anemone fish and mushroom corals may form a relationship where the mushroom plays host to the fish. If an anemone is not present in the aquarium, these fish sometimes decide that mushroom corals are the next best thing. This relationship can, however, irritate the mushroom corals.



tentacles is not

R. yuma is identifiable by the dense mat of tentacles (closely resembling a true sea anemone).

Many new and amazing mushroom coral morphs are currently being imported into the U.S. These new morphs sport a dazzling array of different color patterns and shapes. Recently, a single mushroom coral polyp was sold for approximately $1,500 by a retail vendor. Some popular and in-demand morphs include the Jawbreaker mushroom, which is gold with red and green streaks; the Godspawn mushroom, which is green and gray with large bubble-like appendages that are neon orange; the Lava Lamp mushroom, which is green with numerous bumps and a bright purple rim; and the Australian Candle Light mushroom, which is gray with bright orange or yellow pimple-like appendages.

Mushroom corals have moved far beyond their former status as simply a beginner coral. Under the right conditions of light, flow, and water chemistry, they can become an impressive element in any coral reef aquarium. These beautiful corals are found in all colors, shapes, and sizes, and every hobbyist should be able to find one that suits his or her fancy. But be careful…the mushroom craze can be powerfully addicting!

***Rhodactis* mushrooms can exhibit highlighter yellows and oranges, making them a great way to add color to any reef aquarium.**

Tomini Tang

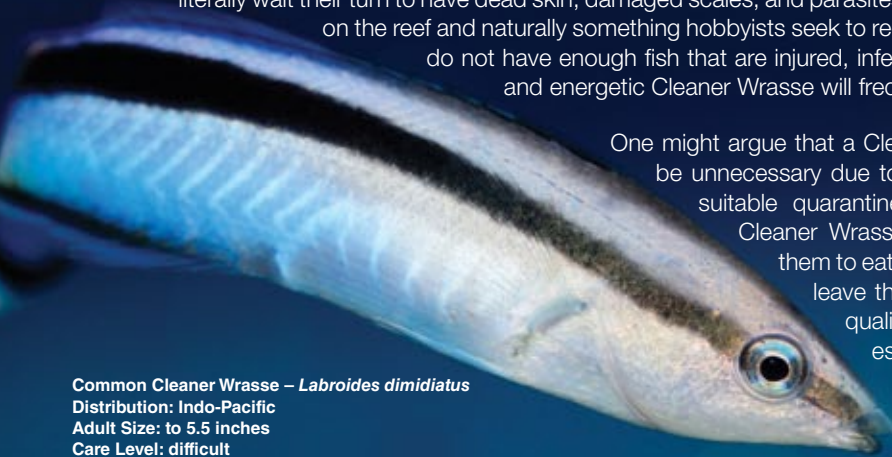
FISH WITH JOBS

RICHARD ASPINALL
Images by www.triggerfishphotography.com

There are many animals that we introduce to our marine tanks that perform useful roles, and there are also some that we introduce accidentally that are anything but useful. We often consider the services carried out by the unsung heroes of the clean-up crew in the aquarium essential. Be they hermit crabs, conchs, assorted snails, or shrimps, they are remarkably useful in processing and removing waste and keeping on top of nuisance algae. But they can't do everything. This is where the hobbyist might consider calling for back-up. Here then is my guide to some fish with jobs.

The Common Cleaner Wrasse is probably the first fish that comes to mind when you think of an aquarium inhabitant with a well-defined job description. However, the Cleaner Wrasse comes with some warnings as it is not always suited to life in the home aquarium. In the wild, Cleaner Wrasses establish cleaning stations on the reef. Oftentimes, these stations are located at a prominent coral bommie where fish will literally wait their turn to have dead skin, damaged scales, and parasites picked off. It is one of the most interesting things to watch on the reef and naturally something hobbyists seek to recreate at home. The problem is that most hobbyists simply do not have enough fish that are injured, infected, or in need of cleaning. This means the hardworking and energetic Cleaner Wrasse will frequently go hungry and eventually fade away.

One might argue that a Cleaner Wrasse in an average-sized home aquarium should be unnecessary due to the hobbyist's careful husbandry of the fish and use of suitable quarantine procedures. But sometimes hobbyists do purchase Cleaner Wrasses and have had occasional success with encouraging them to eat food such as brine and *Mysis* shrimp. Personally, I'd rather leave them in the ocean and rely on quarantine and good water quality with UV sterilization to deal with infectious pathogens, especially since some diseases that reside under a fish's skin cannot be reached by a Cleaner Wrasse – *Cryptocaryon* for example.



Common Cleaner Wrasse – *Labroides dimidiatus*
Distribution: Indo-Pacific
Adult Size: to 5.5 inches
Care Level: difficult

You may, of course, try Neon Gobies, which are also known to perform some cleaning duties along with other species from the *Elacatinus* genus.

***Zebrasoma* Tangs** (e.g. *Z. desjardinii, Z. veliferum, Z. flavescens, Z. rostratum, Z. xanthurum*)
Distribution: Indo Pacific (*Z. xanthurum* – Red Sea only)
Adult Size: 7+ inches
Care Level: easy to moderate

I had at first decided to only discuss the Yellow Tang, as it is easily maintained, hardy, and commonly available. But many other species will perform the same algae grazing services as *Z. flavescens*, given that they all have similar dentition and similarly shaped snouts for reaching into crevices and coral. One example is the Sailfin Tang. Although it is regularly sold as a small, cute juvenile, it will grow to be a sizeable fish and should only be bought by those with the largest of aquaria.

Some *Zebrasoma* species are harder to source and thus more costly than others – one example is the Purple Tang (*Z. xanthurum*), which is endemic to the Red Sea and incidentally one of my favorite fish. I have one called Pete.

Whilst *Zebrasoma* tangs may get a great deal to eat during the later cycling stages of reef tanks, most will not once the tank is fully cycled and algal growth is at a minimum. Therefore hobbyists will need to supply supplemental foodstuffs such as dried *Porphyra* seaweed. This should be offered at least twice a day along with protein-rich frozen, pelletized, and flake foods. Remember that many of these fish graze continuously in the wild.

Bristletooth Tangs (e.g. *Ctenochaetus strigosus, C. tominiensis, C. truncatus, C. hawaiiensis*)
Distribution: Indo Pacific (with localized species)
Adult Size: 4.6 to 8+ inches (depending on species)
Care Level: easy

Bristletooth Tangs have specialized dentition and mouth parts that allow them to scrape detritus, diatoms, and debris from rock (and to some extent substrate). Whilst they may not eliminate established growths of filamentous algae, they can be very useful in keeping rockwork clean and thus preventing new patches from forming. Their grazing action also dislodges detritus and sends it up into the water column for removal by physical filtration.

Bristletooths are some of the least aggressive and territorial of the tangs and in general are some of the smallest, averaging around 7 inches (though the Chevron Tang (*C. hawaiiensis*) may get larger). As with other tangs, Bristletooth Tangs will require supplemental and varied feeding. Standard practice is to offer sheets of *Porphyra*, but they will also welcome frozen foods such as *Mysis* and high quality prepared foods.

Whilst I've never kept a Chevron Tang, the undisputable king of the genus, I have had a Kole Tang that I found to be a charming member of my aquatic community. I have also, over the years, come to admire the subtle merging of brown and yellow on the fins of the Tomini Tang.


Neon Goby


Sailfin Tang

Purple Tang

Copperband Butterfly

Yellow Coris Wrasse

Copperband Butterfly (*Chelmon rostratus*)
Distribution: East Indian and Western Pacific
Adult Size: 7 inches
Care Level: difficult

Many butterflies are challenging to a greater or lesser extent, and the Copperband is no exception. For that reason, I have never even considered buying one, and it's also fairly rare to see them in stores in my native U.K.

The Copperband is normally added to tanks to deal with that most annoying pest: *Aiptasia*. Most individuals will reportedly dispatch them with relish but may also take a liking to other inverts. They are known to be fond of LPS and zoanthids but are likely to leave SPS corals alone.

Should you have *Aiptasia*, you may wish to try other natural predators such as *Berghia* nudibranchs (assuming they won't get eaten), Peppermint Shrimp, or a filefish such as *Acreichthys tomentosus*. These creatures all vary in their reef-safe rating and, in the experience of some hobbyists, their *Aiptasia*-safe rating as well.

Sixline Wrasse (*Pseudocheilinus hexataenia*)
Distribution: Indo Pacific
Adult Size: 3 inches
Care Level: easy

There are a number of wrasses that are enormously useful in the aquarium. I've chosen to focus on the Sixline because it is hardy and common. This fish is also bold and can thus hold its own amongst bigger, more boisterous fish. If your system is more modestly sized or you have fish that may be susceptible to bullying, then you may instead wish to consider the Pinkstreak Wrasse (*Pseudocheilinops ataenia*), which is equally useful but won't become as aggressive. Do be careful though, as many wrasses will jump from open-topped tanks when they are startled or chased.

Whilst many wrasses can be predatory on small shrimps and crabs, they are very useful in controlling the population and spread of nuisance animals such as flatworms. Many hobbyists faced with potentially devastating outbreaks of corallivorous flatworms have found a small wrasse such as the Sixline to be ideal for getting deep into the coral heads and picking the flatworms out. Needless to say, some specimens are better than others and nothing is guaranteed.

Other fish worth considering are the Yellow Coris Wrasse and the Yellow and Purple Wrasse (*Halichoeres chrysus* and *Halichoeres leucoxanthus*). I've kept *H. leucoxanthus* and regarded it as possibly the best fish purchase I ever made; it was hardy, peaceful, and full of character.

Wrasses can reduce populations of useful invertebrates as well. Most hobbyists accept that the presence of polychaete worms such as *Eurythoe* sp. bristleworms are mostly harmless and potentially even useful, but there are some polychaetes (that will prey on soft corals) that should be controlled. Luckily these problem polychaetes are quite uncommon.

So that's it, a quick look at career-minded fish that will contribute to the overall well-being of your tank. As always, be conscientious and only consider buying fish that you know you can keep for the long term. R

Sixline Wrasse

CAMERA SETTINGS EXPLAINED: GOING BEYOND AUTO (part 1)

SABINE PENISSON

My name is Sabine Penisson, and I am a photography advisor and contributor here at Reef Hobbyist Magazine. I'm a 38-year-old French photographer specializing in aquatic photography both in aquaria and in the wild. My work has been featured in aquarium magazines and books, scientific publications, and educational panels in museums. However, I am also very careful to dedicate some time to my artistic side, putting on public exhibitions and promoting my online gallery, Ars Natura, where I sell limited edition prints, calendars, and postcards.

In my childhood, I used to spend 6 months every year in our house in Corsica, an island off the southeastern coast of France, in the Mediterranean Sea. By the age of seven, a family friend had taught me to snorkel, and each summer, we went on daily excursions. Through these adventures, I came to love the local wildlife. The beautiful wrasses, well-camouflaged red scorpionfish, cuttlefish, and octopuses were all flourishing in the *Posidonia* seagrass beds along the coast. At that time, there were very few tourists in this area, and it was almost untouched. The biodiversity was enormous everywhere our eyes could see. This was the beginning of my love for sealife, biology, and all types of underwater activities. It was heaven, even if I didn't know it at the time. These coasts have now been mostly destroyed by the tourism industry, beach restaurants, and intense yachting, but will remain in my heart as a lost Eden.

Although I studied journalism and communications, I am passionate about zoology and most of all, about marine fauna. I began scuba diving at the age of 16 and started to teach myself photography around the same time. Both disciplines share many of the same qualities; they require calmness, self-control, curiosity, and silence. I entered the marine aquarium hobby because I couldn't afford to travel to the natural reefs as often as I would have liked. Additionally, I was very curious to meet my favorite fish and invertebrates for extended observations since one's time is limited when scuba diving. At last, I was able to spend hours watching the goby and his shrimp pal, the clownfish spawn, and the wrasses' nuptial parades. What a fantastic opportunity for my insatiable curiosity!

Through the lens, I try to portray the beauty of all forms of life. I like to highlight original behaviors and capture unusual, tiny creatures as they go about their daily lives. I can spend hours observing or moving around my subject to find the best angles and compositions. But I also love the challenge of capturing the best portrait of a fast fish that will allow you only one shot before disappearing!

The tropical reef is a fascinating ecosystem filled with incomparable visual richness; nowhere else can you find as many colors, shapes, and textures in just a few square inches. These psychedelic mosaics are the ultimate playground for any amateur artist. As a small scale replica of the natural reef, a marine aquarium can be as appealing and as full of photographic subjects as a wild reefscape.

Many of us now own good photography gear, and digital cameras allow everybody to shoot as much as they want without spending a fortune on film. It may therefore seem that a mastery of techniques is of secondary importance. But is it that simple? I would ask you this: do you want to advance from just a decent photographer to a good one and create interesting images instead of just clear ones?

If you ask me how to be a good wildlife photographer, I'll tell you that there are three areas to focus on. The first is an intimate, detailed biological and behavioral knowledge of the subject. This is important because you need to anticipate the behaviors of the species you're

focusing on, and you also need to know about their special physical features that you want to capture. Next is a perfect mastery of the gear you work with, whether this is only photographic and lighting gear or scuba gear for diving in the wild. It's especially important to master neutral buoyancy because struggling to maintain position while composing a good picture can be very trying, and the last thing you want to do is harm the sessile invertebrates around you with a careless fin move. The last aspect of good wildlife photography requires creativity and the artistic brain. You may be born with a very highly developed creative sensibility, but it is also something you can learn and develop further. Especially useful is learning the classical rules of drawing. These rules are all about perspective and optic concepts. They will teach you how the human eye reads an image and therefore how to make a picture bold and eye-catching. Have you ever looked at two images of the same subject, one seemingly dull and flat while the other is visually interesting? You don't really know why; it's only a feeling, but you can tell which image is better. By learning the academic rules of art, you'll know how to set your composition to take a striking picture.

Beauty is not the only measure of a photograph. To strike the eye, you have to intrigue or interest the audience with your subject. The photo has to show a clear purpose, angle, or perspective. You may find it useful to focus on showing a particular behavior, specific feature, or unusual species. As aquarium hobbyists or scuba divers, most of us are very curious about fish and corals. Let's take on the challenge to show the surprising Dracula-like teeth of the Clown Goby, the perfect net structure of the *Acropora* tegument, or the persistent and careful clownfish tending her nest.

Even though a beautiful *and* interesting image is often best, we're not forbidden our aesthetic cravings, and producing art for art's sake is not prohibited! If you go this route, you may be inspired to articulate an idea within a series or express a concept that is your obsession of the moment.

Either as a beginner or more advanced photographer, you may find some tips useful to get the best pictures of your aquarium mates. We'll begin with the basic definitions of some technical terms so everybody can follow the mumbo jumbo we'll put into use later. As we progress in subsequent issues, I will discuss in greater depth the various functions of our cameras and how to manipulate them for the best photographic results.

For the next issue, I encourage all readers who have specific questions about their photographs to send an email to me at sabine@rhmag.com with the following info:

- title the email "my photo issue"
- detail the problem you encountered or the specific topic you want explained
- attach a photo or two that illustrate your problem, along with the EXIF data of each shot (EXIF explained at end of this article)
- detail the changes you made from the initial shot, if any (retouch, crop, color adjustment, etc.)

I will show some of these pictures in future articles as I address specific photographic challenges and remedies. I hope you'll be interested in this new column and in sharing your images!

TECHNICAL TERMS

Diaphragm/Aperture: The diaphragm is a mechanical part of the lens; it is made of thin metal blades, is iris shaped, and opens and closes in a circular movement. The aperture is the hole at the center of the diaphragm that regulates the amount of light illuminating the sensor. The principle is simple; starting with the maximum aperture (the smallest number), each value tightens the diaphragm iris, allowing half the quantity of light through the lens compared to the previous figure. For example, f/2.8 lets in twice as much light as f/4.

Too large of an aperture resulted in a very shallow depth of field that left most of the image out of focus.

DOF/Depth of Field: The DOF is composed of the sharp area surrounding the main subject targeted by the photographer. Thicker or thinner, it is determined by the diaphragm setting and the focal length of the lens or the part of the zoom you choose (e.g. 17mm, 50mm, 105mm, etc.). The more the diaphragm is closed, the greater the depth of field, so more different parts of the photo will be clear (subject, middle distance objects, and background). Conversely, the more the aperture is open, the less the depth of field, and only the chosen subject will be sharp, with the surroundings all blurry.

• Maximum Aperture = small number = allowing more light = shallow depth of field
• Minimum Aperture = big number = less light = great depth of field

Shutter Speed: Shutter speed is another critical parameter. The speed of a shutter can go from very short (1/8000 of a second, for example) to quite long (several seconds of exposure, even minutes for night photography).

The brighter the ambient light, the shorter the shutter speed required for a correctly exposed shot. Conversely, a dark ambiance will require a long exposure and therefore a slow shutter speed. The more your subject moves, the more you'll need to increase the shutter speed to capture it in sharp detail. An incorrect setting will result in motion blur on your image.

EV/Exposure Compensation: EV (exposure value) is the sum of the logarithms of the shutter speed and aperture setting. Put simply, this allows the photographer to experiment with different shutter speeds and aperture settings that yield the same exposure for any given picture.

Focus/Collimator Choice: For beginners, I advise you to stay on autofocus mode while dealing with moving subjects. Manual focus requires fast instincts in addition to a total mastery of your gear.

Metering/Center-Weighted Average System: The aquarium is a subject with high contrast, where dense shadows border areas that are intensely illuminated. With the automatic mode, to get a

Too slow of a shutter speed resulted in a blurry picture.

More attention to exposure compensation was needed here.

Poor metering choices have led to this dark picture.

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better average, you need to set the exposure option on *center-weighted average metering* instead of the *multi-segment metering*, which is the default setting. This center-weighted metering system calculates the correct exposure around the targeted subject and not the average of the entire frame, as with multi-segment metering.

ISO Value: The ISO value determines the sensitivity of the camera's sensor to light. The lower the ambient light, the higher a sensitivity is needed. The downside of high sensitivity is the appearance of 'noise.'

An incorrect ISO setting can lead to overexposed areas in the final picture.

Noise: Noise is equivalent to the 'grain' known in classic film photography. But, while analog grain is gray and sometimes used as an aesthetic effect, digital noise is colored and appears as an ugly intrusion that blurs the image.

Priority Mode: To improve your photos, I would advise you to forget about the automatic mode and turn your attention to the priority modes (before going to full manual mode, once you're an expert).

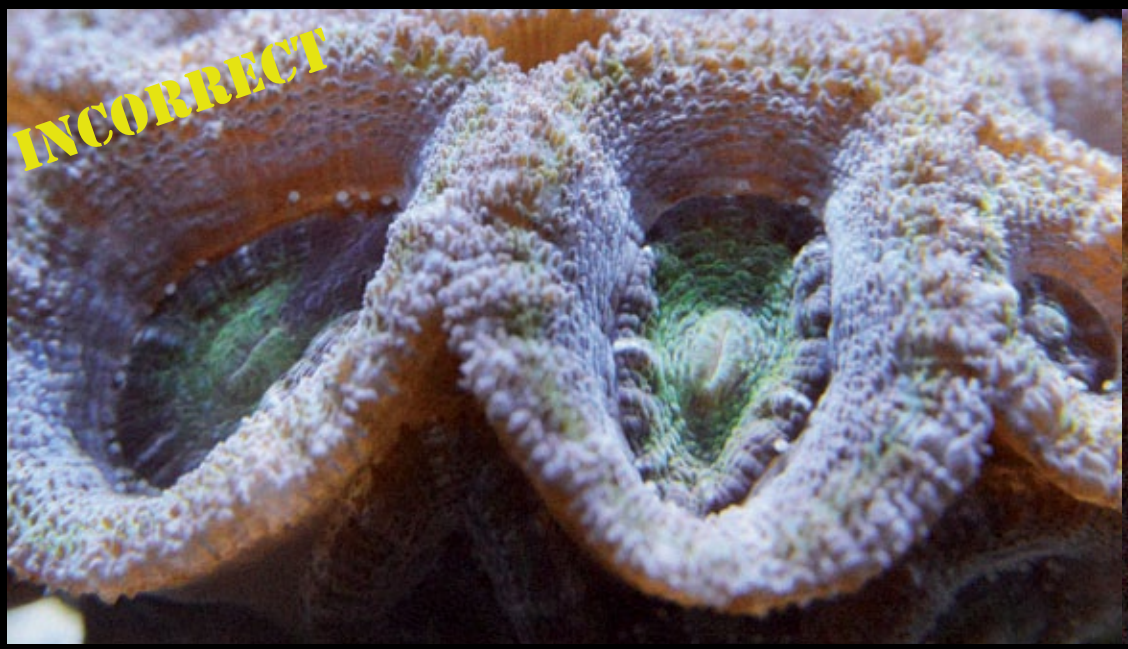
Speed Priority mode (named S or TV depending on the manufacturer) will allow you, as its name suggests, to choose the desired shutter speed, and the processor will automatically calculate the most appropriate diaphragm aperture to obtain the correct exposure of the targeted subject.

Aperture Priority mode (named A or AV) allows you to manually adjust the aperture (depending on whether you want more or less depth of field), and the camera will calculate the correct shutter speed to illuminate the subject.

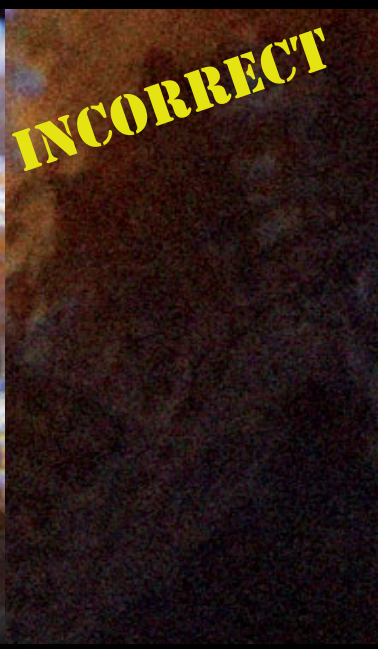
For expert photographers familiar with exposure values, full manual mode allows you to adjust the correct exposure without processor intervention. If you get a poor result in manual mode, the camera is not to blame.

White Balance: By calibrating the white balance (or trusting the automatic calibration), you can adjust the color temperature of the photo to produce an accurate white color in the white tones on the subject. You already know about color temperature as it relates to your tank's light fixtures; the higher the temperature (in Kelvin), the colder (bluer) the perceived color. It is important to properly calibrate the white balance to accurately capture an animal's subtle colors. On most cameras, even sophisticated ones, the automatic white balance does not do well with our aquarium lighting, which doesn't fit into the averages expected by the camera makers. It is even worse with LED lightning. I therefore advise you to experiment with the manual white balance to find the best setting, which will differ for each aquarium.

EXIF Data: The EXIF (Exchangeable Image File Format) is a standard file that stores the metadata in each photo taken by a digital camera. This metadata includes the brand and model of the camera, date, and time when the shot was taken, geographic coordinates (if the camera has internal GPS), and most important for us, all the settings (image size, focal length, aperture setting, shutter



Digital noise



Detail of digital noise

An incorrect white balance can be either too cold or too warm.

speed, ISO value, flash mode, and exposure compensation). You can retrieve all these details by selecting the information command in any graphic edition software or by choosing properties and then details after right-clicking on your image file.

I look forward to covering these topics with you in greater detail in subsequent issues. Please remember to send me your pictures and questions!

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Front view

A FLOURISHING DUTCH SYNTHETIC REEF

GLENN FONG

My name is Glenn Fong, and I live in Rotterdam, the second largest city in the Netherlands. Throughout my life, I had kept all kinds of freshwater aquariums until I was infected with the saltwater bug. My current tank is approximately 250 cm x 80 cm x 70 cm (~98.5" x 32" x 28") and was built in 1994. Until December 2004, it was a freshwater tank with Malawi cichlids. At that time, I drilled a hole in the bottom, installed a sump, and filled it with saltwater. This was the beginning of my saltwater adventure.

From the start, I never did any water changes (same as in my freshwater tank). I started with the usual soft corals, a few LPS, and some easy SPS. I built my own protein skimmer and calcium reactor, and for a while, everything went quite well; then I started putting more SPS into the tank. In 2008, I lost some SPS and LPS corals as a result of my calcium reactor being insufficient, so I built a larger one and reintroduced some new SPS corals. At the end of 2010, I lost the majority of my SPS and LPS corals, and this was due to a few factors: a defective RO device, a calcium reactor with hiccups, and a 500 liter (~132 gallons) non-photosynthetic (NPS) reef tank that I connected to my original reef display. The addition of the NPS tank was a big mistake. On top of the calcium reactor problem, I had a sky-high phosphate level in my reef (0.64 ppm). After struggling with this setup, I decided to give up the hobby. I left the tank alone and began to renovate my house.

In November 2011, after a 30-day vacation to Thailand, I decided to give reefkeeping another try. This time, I was determined to do it the right way. I started reading about reef chemistry and decided to design my own reef salt. I started with a 10 liter (~2.62 gallon) fishbowl; I filled it with my own saltwater blend and placed some small frags inside. I was pleasantly surprised when I saw evidence of coral growth in this little tank. After 2 months, I decided to apply the same salt to my larger reef tank. I replaced 450 liters (~119 gallons) of the old saltwater with my new synthetic saltwater blend (this water had not been replaced since 2004). In the past, I could not lower my phosphate level with GFO (it always fluctuated between 0.16-0.64 ppm). Since my new synthetic water had zero ppm of phosphate, I was able to dilute down the phosphate level. I started stocking the reef with SPS and LPS coral frags again.

During the following half year, I started measuring and controlling every parameter of my saltwater with the minerals I had used to compose the synthetic salt; everything was going well, and my phosphate and nitrate levels were immeasurably low.

As time went on, some corals grew well as others turned pale. Eventually, all of my corals turned pale. They started to bleach from

Rear view

the bottom and lose tissue. After hesitating for a while, I decided that this was not a healthy situation, so I started dosing phosphate (0.08 ppm) and nitrate (2.50 ppm) into my reef. To my surprise, all of my corals regained their colors and started to grow again. I began to play with the phosphate and nitrate levels to see what was optimal and saw how certain corals reacted differently to specific nutrient levels. I decided that controlling phosphate and nitrate together along with all the other known parameters was an important key to success.

Having fine-tuned my water parameters since January 2012, I've learned a lot about corals and their needs. This culminated in the way I keep my reef now, still without water changes. I named it the DSR method, which stands for Dutch Synthetic Reefing. At the moment, I control 12 parameters in DSR using 15 minerals and supplements. To make it easy to use and eliminate calculation errors, I also developed a special calculator using a spreadsheet. With this calculator, it is possible to calculate exactly what you need to dose in order to top-up all your levels of minerals. This is done by testing, feeding those parameters into the calculator, and dosing the calculated weight/volume into the tank.

Currently, the calculator can be used for controlling salinity, dKH, calcium, magnesium, potassium, strontium, boron, iodine, phosphate, nitrate, and iron. I use a carbon source (vinegar/sugar) to lower nitrate and an iron solution to lower phosphate. In addition, I also use an amino acid supplement and monitor and adjust pH.

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I am looking into a few other minerals, but for now, I don't see any benefit to adding them. With the dosing calculator, it is also possible to make your own saltwater. The benefit is that you can mix saltwater that correctly addresses the needs of your tank at any specific time.

Currently, my tank is a mixed reef with soft corals, LPS, and SPS, and it's thriving like never before. I have 182 species of corals and invertebrates living in the display. My latest challenge has been introducing NPS corals into my tank, knowing they will require more extensive feeding. I have already started with an orange *Scleronepthya*, a dark-purple *Menella*, a red *Menella* with yellow polyps, a light-purple *Diodogorgia nodulifera* with pink polyps, a *Tubastraea faulkneri*, a yellow *Comanthus* (crinoid), and an *Acalycigorgia* (Blueberry Seafan).

I feed my reef a daily mix of ~25 grams of frozen *Mysis*, lobster eggs, and copepods. I also feed dry food and D&D LPS food; I add it into a 300 ml jar filled with 250 ml of reef water and shake it until it dissolves into small particles. This is then fed into the tank throughout the day using a turkey baster. I additionally feed my tangs a half sheet of nori daily.

My sump, as it stands, is nothing special and very basic:

- An outdated, modified Schuran skimmer using only four wooden airstones with ozone dosing
- Aqua Medic KR1000 calcium reactor
- Zeolite reactor for bacterioplankton breeding (food for the corals)
- UV lamp
- Red Dragon 6500 L/h pump with a prefilter
- 300-watt heater

For flow, I use three Tunze 6101s and a 12,000 L/h pump in random intervals, controlled by an IKS computer. Because of the random intervals, sometimes one, two, or three Tunze's are on and sometimes none at all.

For lighting, I use 14 T5/54-watt lamps:

-(6) Giesemann AquaBluePlus
-(4) ATI Blue Plus
-(2) Aqualight 10,000K
-(2) Giesemann AquaPink

If you'd like to learn more about the DSR method, I explain it in detail in my threads on several forums under the name GlennF (ReefCentral.com, Zeewaterforum.info, Belgianseater.be, Ultimatereef.net). I will also be discussing it on DSRreefing.nl in the future when the site is completed.

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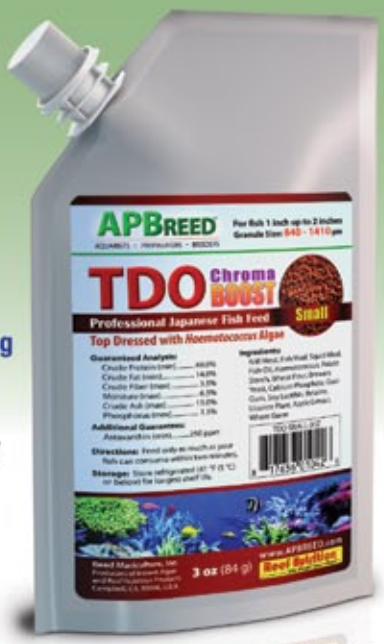

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