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SECOND QUARTER 2014 | VOLUME 8

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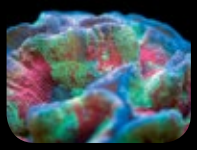

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REEF LIFE OF COZUMEL

Tim Wong is a biologist at the Steinhart Aquarium, California Academy of Sciences in San Francisco. In this photo journal, Tim recalls his recent dive trip to Cozumel and shares the beautiful underwater images of several dive sites he visited.

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Fracking is bad. *Fragging* is good.

The acronym, "**R.E.E.F.**", stands for Responsible, Ecologically-Ethical Fragging. As stewards of natural marine habitats through ethical reef aquarium husbandry practices and responsible selection of aquarium inhabitants as their care requirements are met, and hopefully exceeded, by the capabilities of the aquarium that they are being placed into, the fate of many species' long-term survival on our planet may literally be in the hands of those who understand their needs best: recreational and professional aquarists. Brightwell Aquatics encourages all those maintaining closed-system marine aquaria to do their part by: propagating corals; breeding marine ornamental fishes; and by supporting individuals and businesses who are involved in those pursuits, whenever possible. Maintain pathogen-free reef systems by excercising sound judgement when purchasing or bartering for corals.

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CAN WE CREATE THE HOBBY WE WANT?

RET TALBOT AND RICHARD ROSS

The ocean is Earth's final frontier—should these boats be collecting for aquariums, catching food fish, or doing both sustainably? Image by Richard Ross.

Given the current state of the trade and hobby, it might be argued that a new and evolving mindset away from animals as ornaments and toward a more holistic approach to aquarium keeping is the necessary foundation for a healthy future.

The oceans are Earth's final frontier. Much as our relationships with other frontiers have evolved as wildernesses beyond known borders were explored, our relationship with the sea is necessarily changing as its deepest bathometric details are mapped. This change, while certainly about the physical—removing blank spots from the map—is also very much about the psychological. As the "wildness" is diminished, our attitude towards wild things often turns from one of fear and awe to a desire to conserve and appreciate. When Roman explorers returned to Rome with wild animals from far-flung corners of the newly "found" world, those animals represented the general population's relationship to wildness. While some of those animals were eventually domesticated or became exotic pets and ornamental accoutrements to the lives of the privileged, most were resigned to shortened lives as chained curiosities or participants in the condemnation to beasts (*damnatio ad bestias*—staged hunts held before massive crowds at the Circus Maximus and the Colosseum).

Throughout ancient history, people condemned to death were "thrown to the wolves" or lowered "into the lion's den." Pitting animal against animal or animal against man remains a source of entertainment and even income in many parts of the world. Unfortunately, this illustrates an adversarial view towards our relationship with nature. For much of modern history, animals have been commonly captured from the wild for display in zoos and public aquariums. Most recently, and not without controversy, the documentary *Blackfish* has challenged society's perception of our relationship with captive wild animals. Many marine aquarists are quick to support a film like *Blackfish* or the efforts of the Sea Shepherd Society because of their love for marine life. But are they fully connecting the dots to their own passion for keeping fish in aquaria that once swam free on wild reefs? Discussing the ethics of keeping marine aquarium fishes and other animals is a dialog that has been slow to gain traction amongst aquarists, but having that discussion may be an essential part of both the hobby and trade's future.

THE SEAFOOD ANALOG

The marine aquarium fish trade is one of the last segments of the pet trade to rely almost entirely on wild animals. In some important ways, especially insofar as wildness is concerned, the marine fish trade and the seafood trade share some striking similarities. First and foremost, once a fish is removed from an ecosystem for either purpose, it is gone from the wild forever. Like the seafood industry, the marine aquarium fish trade is largely an extractive industry relying on harvesting a natural resource. While generally considered renewable, both food and aquarium fisheries can be overfished to the point where both species and systems collapse, although the scope and scale of the seafood industry is far greater than the aquarium trade.

Another, perhaps subtler, similarity between seafood and aquarium fishes is what these animals—either on a plate or in an aquarium—represent to us. Seafood is one of the last large-scale wild animal food sources, and our relationship with seafood is very much tied up

with a perceived right to harvest and a growing desire to conserve. These two often-opposing forces trigger something in the deepest recesses of our psyche—something the contemporary notion of sustainability was created to resolve. The idea of sustainable harvest provides both a means and a rationale to continue to fish wild stocks. Not everyone agrees, however, and with ocean ecosystems generally believed to be in crisis, an increasing number of people now argue that both wild fish consumption and keeping wild fishes in aquaria should be severely curtailed, if not explicitly forbidden.

THE RESPONSIBILITY OF PURSUING LUXURY

One aspect of the aquarium trade often cited as differentiating it from seafood is the idea that aquarium keeping is a luxury hobby. As such, critics of the aquarium hobby contend, the aquarium trade's impact on wild fishes and ecosystems should be subject to greater scrutiny than the seafood industry's impact. It is not uncommon, for example, to find stringent opponents to the aquarium hobby who regularly consume seafood. For many people living in developed nations—including many readers of this magazine—seafood consumption is often undertaken, however, as a kind of luxury pursuit. Certainly a great deal of readily available, inexpensive wild seafood is consumed regularly by the public because of its health benefits and ease of preparation. Perhaps nowhere is this better epitomized than in the ubiquitous can of tuna. But is ordering a nice piece of fish at a restaurant, as millions of Americans regularly do, really that different from buying an aquarium fish?

A Blue Tang (*Paracanthurus hepatus*) is one of the United States' most imported species of marine aquarium fishes. A small one retails for anywhere between $20 and $30, which is commensurate with a swordfish entrée at an upscale restaurant. Because the Blue Tang has yet to be bred successfully in captivity, every Blue Tang purchased at an aquarium store is harvested from the wild, in the same way every piece of swordfish is. Making the choice to purchase a Blue Tang for an aquarium or a swordfish steak for dinner is indeed often a luxury choice only considered by those who have the disposable income to do so, but that does not necessarily translate to a guilty pleasure. The aquarist, like the person consuming seafood, may, in fact, occupy a privileged position in society, and increasingly, some people choose to use this position to effect positive change.

Are fish friends or food? This rabbitfish is not only delicious, but it is often collected for home aquariums. Image by Bart Shepherd.

Do you know where your fish are collected? What difference does it make? Should it make a difference? Image by Richard Ross.

Humans have an amazing relationship with the sea. In some places, like the Ebeye in the Marshall Islands, it is still treated as an infinite landfill—and playground. Image by Richard Ross.

Consumers increasingly now have access to information regarding where the products they consume are sourced. When it comes to wild food and aquarium fisheries, this information can allow a consumer to make a choice not only affecting the species itself but also the ecosystem from which it is harvested and the fisher and fisher communities involved. In the seafood world, this information often comes in the form of a seafood guide or app, and while far from perfect, these tools and their creation indicate an important shift in consumers' relationship to wild fishes. Unlike the Roman citizen who may have consciously or subconsciously seen a wild animal imported to Rome from the frontier as representing an omnipresent wildness from which civilization had been carved, progressive restaurant-goers today may view a wild fish on their plates as a connection to a wildness that has all but been eclipsed by civilization. Rather than the Roman reaction motivated by a wildness to be feared, conquered, and domesticated, today's enlightened consumer may be motivated more by a desire to appreciate, conserve, and nurture that same wildness.

Making a concerted effort to support sustainability is often a luxury as well. The millions of people who depend on subsistence fishing throughout the Coral Triangle, where most aquarium fishes and many fishes destined for seafood markets originate, frequently do not have that luxury. Their relationship to wildness is much different, as they are surrounded by it in a way that many people living in the developed world are not. It is not surprising then that they might view an American aquarist's relationship to a Blue Tang in an aquarium as strange, perhaps even amusing. Subsistence fishing is so often about opportunity, and a dinner plate of small reef fishes—many of the same species prized by aquarists—is not an uncommon sight in remote fishing villages.

AN EVOLVING PET TRADE

The pet trade in general has evolved from a trade largely about possessing something exotic from the wild to be displayed as a curiosity, to keeping domesticated (and more often than not, captive bred) animals as companions. The relationship between pet owner and pet has evolved to a point where doggy daycare, organic cat food, and alternative veterinary medicine are common. Today, the pet industry is a multibillion dollar industry, with much of that money generated from dog beds, kitty-cat condominiums, and other products pet owners lavish upon their pets.

When it comes to exotic pets—those animals not indigenous to the places where they are kept—many are headed the way of other more common, long-domesticated pets, especially insofar as captive breeding is concerned. Pet birds, for example, are now primarily bred in captivity, and an increasing number of reptiles are as well. Marine aquarium fishes, on the other hand, remain a vestige of a trade that has morphed into something less about our relationship to the wild and more about the acceptable modern family structure complete with four-legged children. As such, marine aquarists, because they remain so connected to wild animals and the ecosystems from which they originate, have an interesting opportunity.

The marine aquarium trade has always depended primarily on wild animals. This fact is becoming more widely known, discussed, and debated, with an increasing number of people pushing, both through activism and legislation, to end the wild harvest of marine fishes for aquarium use. The arguments against wild aquarium fisheries are generally two-fold. On the one hand, there is the environmental argument, which posits that tropical coral reefs are in crisis and concludes that extracting animals from these beleaguered ecosystems must therefore end. The other argument against wild aquarium fisheries is an argument about animal welfare. This argument is often based on the belief that removing an animal from the wild and placing it in a glass box for display is cruel and outdated.

The environmental argument against wild aquarium fisheries is being increasingly challenged in the scientific literature. Recent peer-reviewed papers show how sustainable aquarium fisheries can provide real economic incentive to conserve in places where conservation is difficult to accomplish through other means. Unfortunately, sustainable aquarium fisheries remain the exception rather than the norm, and the majority of aquarium fishes still originate from source countries of much concern from a sustainability standpoint. To truly address environmental concerns and mitigate anti-trade activism and legislation, the marine aquarium trade must pursue comprehensive reform.

The environmental argument against aquarium fisheries typically captures the headlines, but when one drills a little deeper into much of the anti-aquarium movement, a concern for animal welfare often emerges as the motivating factor. Even in regions where some of the best-managed aquarium fisheries are located, anti-aquarium activists still want to shut the trade down. For example, in West Hawaii's aquarium fishery, a fishery where both the data and the data-based management exist to insure sustainability, anti-aquarium trade activists want to ban collection. Their arguments

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Keeping aquarium fish is often considered to be very different from eating fish, but is it really? How many fish in this Borneo market can you recognize from home aquariums? Image by Richard Ross.

Our relationship with the ocean's animals is constantly changing. Once, this lagoon ran red with the blood of hunted whales, but now is a shining example of well-managed, sustainable fisheries and an eco-tourism success where whales often choose to physically engage with humans. Image by Richard Ross.

frequently focus on post-harvest mortality and emotional appeals regarding the inhumanity of hunting gregarious fishes with which divers develop relationships. While these arguments have little to do with a fishery's environmental sustainability, they have everything to do with the trade's ethical sustainability.

ETHICS AND THE COMPASSIONATE HOBBYIST

As fewer and fewer pets originate from the wild, marine aquarists have an opportunity to leverage their trade's dependence on wild animals to benefit those animals, the ecosystems from which they originate, and the people closely associated with those ecosystems. As the scientific literature makes clear, wild aquarium fisheries can be forces for good, and the aquarium hobbyist can play a role in insuring fishery sustainability through their purchasing decisions. While this remains challenging, the aquarist committed to insuring his or her actions are not furthering the demise of species and ecosystems, as well as the exploitation of fishers, can shop from places where point-of-origin information is commonly available for each fish. For example, an aquarist can purchase a Blue Tang specifically from the Solomon Islands or Fiji rather than Indonesia, knowing the fish harvested in the smaller developing island nation is more than likely a sustainably collected animal and that the fisher and his community benefit from the fishery. The same cannot be said with anywhere near that degree of confidence about a fish coming out of Indonesia or the Philippines.

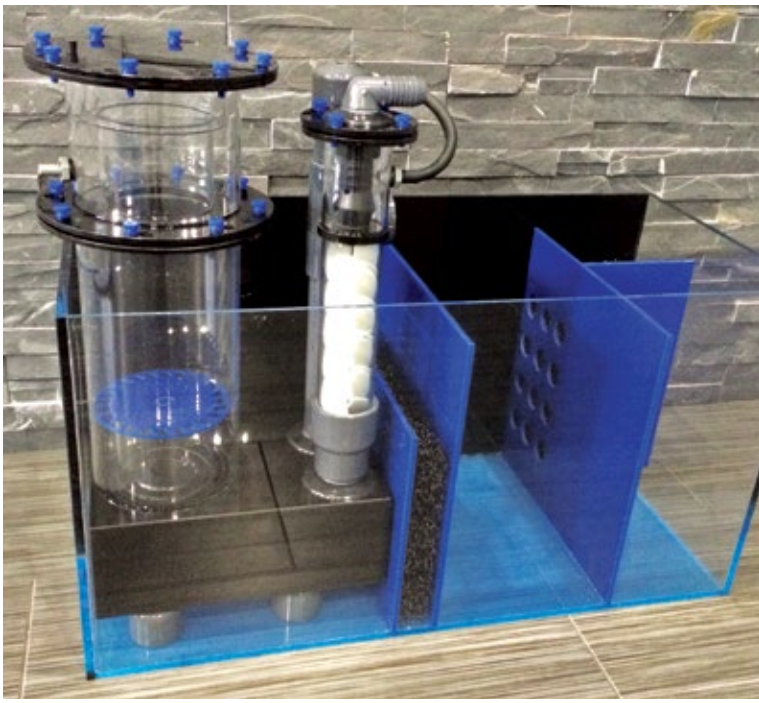
Beyond his or her purchasing decisions, today's informed and compassionate aquarium hobbyist can also rethink the daily relationship between fish and aquarist. The choices made every day in the keeping of aquarium animals can go far beyond the individual aquarium. The discussions generated are ones that can go to the very core of a better understanding of our place in the world. Things as simple as how we care for a sick fish, whether we choose to quarantine, and what risks we are willing to take with our aquatic charges can define us and our relationship to the hobby, the trade, and the environment. Aquarists shouldn't ignore the big questions aquarium-keeping generates regardless of whether those questions arise in a hobby magazine, online in a reef forum, or even in the attacks of anti-aquarium activists.

How do aquarists want to be perceived? Is today's aquarist like the Roman citizen gawking at a chained lion led off a ship recently returned from the frontier, or is he or she more attuned to the fact that the animals in question represent a wildness that needs more attention in the face of globalized civilization and its attendant anthropogenic stressors? Are the fishes aquarists keep akin to cut flowers and kinetic art, or are they a daily connection to embattled ecosystems and citizens of developing island nations living half a world away? Do aquarists view the animals in their aquaria as curiosities, or do they see them as ambassadors of a wildness that needs to be better understood, appreciated, and preserved? Is keeping a rare species more about ego and bolstering one's own status, or is it also about realizing and valuing the remarkable diversity of life? While the psychological well-being of aquarium fishes has little impact on the sustainability of the fisheries themselves, does the compassionate aquarist's approach to the husbandry of every animal in his or her care add real, discernable value to the hobby and aquarium industry?

Given the current state of the trade and hobby, it might be argued an evolving mindset away from animals as ornaments and toward a more holistic approach to aquarium keeping is the necessary foundation for a healthy future. The oceans are Earth's final frontier, and how we interact with that frontier says something about us. Our relationship with what little wildness remains requires an attitude of good stewardship on our part, and marine aquarists are uniquely positioned to be leaders in this regard. While discussions about environmental sustainability often dominate, we are well served to also discuss and debate the ethics that govern both our individual and collective actions. Without this debate, we risk losing something elemental. We risk a return to the condemnation to beasts.

DEMYSTIFYING PROTEIN SKIMMERS

STEVE BASHI



Protein skimmers are certainly one of the hottest topics in the marine and reef aquarium industry, as they should be, considering that a skimmer just might be your most important piece of filtration equipment. Skimmers not only remove dissolved organic waste from your aquarium, they greatly reduce nitrate, saturate the water with oxygen, help stabilize pH, elevate redox levels, and more. The list of benefits that a skimmer provides goes on and on. It's a constant water purification system that no marine aquarium should be without.

To start off, let's go through and quickly pinpoint design-wise what makes a good protein skimmer. Besides the obvious (quality materials and workmanship), ease of maintenance, proper air to water ratios, and as large a reaction chamber as possible are all desirable. To me, one of the greatest advancements in modern protein skimmer design is the diffuser plate, sometimes called the bubble plate. No good skimmer should be without one! At first glance, it really doesn't look like much, but in reality, it's a game changer. This plate rests above the chamber where the initial air and water mixture gets blasted into the skimmer. Its purpose is to contain that initially uneven and chaotic mix and evenly disperse the air and water mixture upwards into the main reaction chamber, greatly reducing turbulence and creating a much calmer rise to the top of the reaction chamber. This makes for a very stable and smooth foam head entering the collection cup, but it also performs one more extremely important function most hobbyists overlook. The diffuser plate gives the air and water mixture a specific, constrained flow path. Because of this, the air and water mixture is in direct contact for the maximum amount time—in the hobby, this is known as dwell time. Dwell time is simply the actual amount of time the bubbles within the skimmer are in direct contact with the dirty water. Anything that increases the dwell time within the skimmer will increase its efficiency and the amount of nutrients it removes, which is the main purpose of a protein skimmer.

There are a wide variety of bubble plate designs. The manufacturer will match the face plate to the size of the skimmer and the volume of air/water mixture to be processed through the bubble plate.

Currently, two of the most popular types of protein skimmers are needle wheel and power (Beckett). The advancements made to both types in the last five years have put them near equal in my opinion.

First, let's start with the needle wheel, the most popular type of skimmer. The needle wheel changed protein skimming as soon as it was introduced. Its design uses a Venturi-type valve called a "volute" on the intake of a water pump. As the water is drawn through the volute, it creates a Venturi Effect, drawing air into the pump. These water pumps are retrofitted with specialized "needle type" impellers specifically made for chopping air up into extremely fine bubbles that are then pumped directly into the skimmer, creating a near perfect environment for waste removal. The needle wheel skimmer has been by far the most popular design in the last six to seven years of the hobby for aquariums under 200 gallons. Due to their huge success in small to mid-size aquaria, needle wheel skimmers are now offered in almost every size and rightfully so. These skimmers are extremely energy-efficient, have small footprints, and come in all sorts of styles and shapes. Also, they are very easy to install for the entry-level hobbyist. The quality and performance of needle wheel skimmers have greatly increased in the last three years, both due to trial and error but even more as a result of hobbyist feedback and modifications.

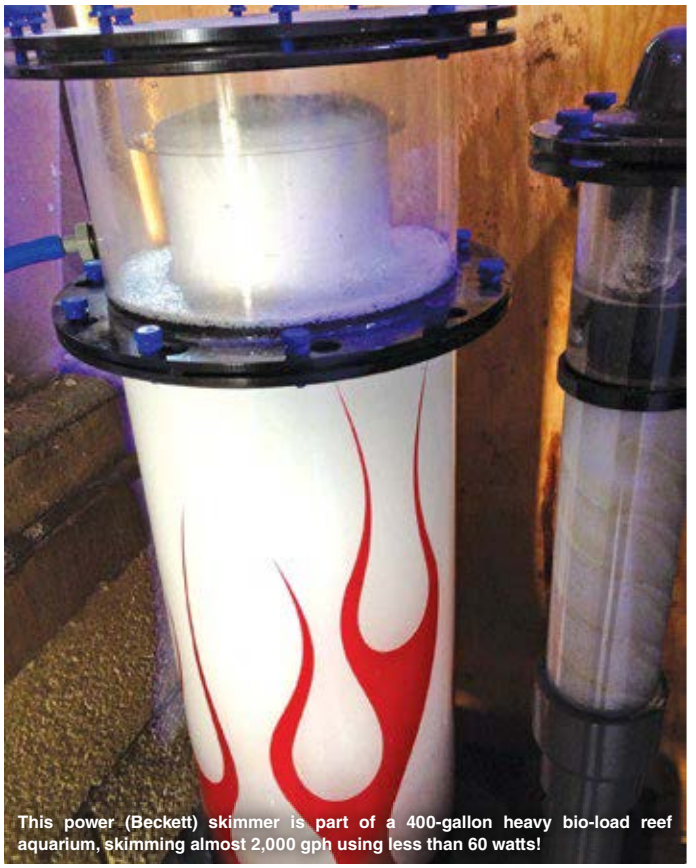
These are modified "needle" or "pin wheel" impellers specifically designed to chop air into tiny bubbles.

The power skimmer (Beckett), on the other hand, is a little more geared towards the intermediate to advanced hobbyist. The Beckett itself is basically another type of Venturi valve with ports built in to draw air. The Beckett valve does, however, require a certain amount of water pressure power in order to draw air through its ports; that's why they are called power skimmers. Pumping more water through the valve will result in drawing more air into the skimmer. There is a little more adjustability that comes along with using a power skimmer compared to a needle wheel. The end-user can dial in his or her preferred air and water mixture according to the aquarium's needs. At one time, these skimmers were designed mostly for larger aquaria and commercial use. Now, power skimmers are widely available for smaller systems due to the development of energy-efficient water pumps that were not available even just a few years ago. The power skimmer is still extremely popular for those aquarists with very heavy bio-loads who demand not only immediate and efficient skimming but also need the ability to skim their total aquarium volume four or more times per hour to keep up with the high levels of waste being produced.

Correctly sizing a skimmer for your system depends on several factors: total water volume including filtration system, number of animals and feeding volume (bio-load), maintenance regimen, use of other natural and chemical media such as activated carbon or bio pellets, use of a refugium (live algae filter), and even the style of aquarium being kept (such as mixed reef or fish only). These are all important factors when choosing what size and even type of skimmer is needed. The advice that I give any beginner or advanced hobbyist is the same advice I have followed for over 20 years—GO BIG! Unfortunately, some manufacturers have been known to overrate their skimmers. If you have a total water volume of 150 gallons, I recommend purchasing a skimmer rated for at least 300 gallons if not more. If you are worried about overskimming, don't be, because it's not going to happen. Trust me, I've tried.

Many hobbyists underestimate the importance of skimmer placement. Skimmers love raw, dirty water. Always place your skimmer so that it is the first piece of filtration equipment that your tank water passes through. In the case of in-sump positioning, place your skimmer first in line where the tank drains into the sump. This water is at its highest nutrient content and lowest oxygen level. A biological filter requires low nutrient levels and very highly oxygenated water to work at peak efficiency. This is exactly the type of water that exits a protein skimmer. Skim first, biological second, live refugium (if used) third, then other chemical media last to remove any residual nutrients.

Whether you have a 20-gallon nano or a 1,000-gallon shark tank, there is a needle wheel skimmer designed to handle the job.



This power (Beckett) skimmer is part of a 400-gallon heavy bio-load reef aquarium, skimming almost 2,000 gph using less than 60 watts!

There are several key components critical to a long-term successful and healthy marine aquarium. Aside from regular water changes, protein skimming is at the top of my list, and I consider it the heart of any complete life-support system. Do your research, ask lots of questions, go on forums, read modern literature, and talk to as many experienced hobbyists as possible before choosing your skimmer. Your fish and coral will thank you for it!

This needle wheel skimmer shows the pump and volute outside the skimmer's main body for quick and easy maintenance. Many space-saving designs have the pump directly underneath the bubble plate.

JAKE'S FAVE FIVE – REEF FISH

Image by Olga Khorochunova.

JAKE ADAMS

Most people know me as a total coral nut, which I am. But I also have a peculiar affinity for certain types of fish that has been shaped by over a decade and a half of piscine appreciation. I often get asked what my favorite fish are, and while I have a default everyday answer, interests come and go with the availability of what can be considered unique fish. Two species of marine fish that will always hold a special place in my heart are some of the commonest fish in aquarium stores: the Catalina Goby, *Lythrypnus dalli*, and the Royal Gramma, *Gramma loreto*. These two perennial aquarium classics aside, there are a handful of neat fish that are currently gracing my home tanks, which might appeal to the broader marine aquarium community, especially when they learn what makes my fave five reef fish special and worthy of consideration.

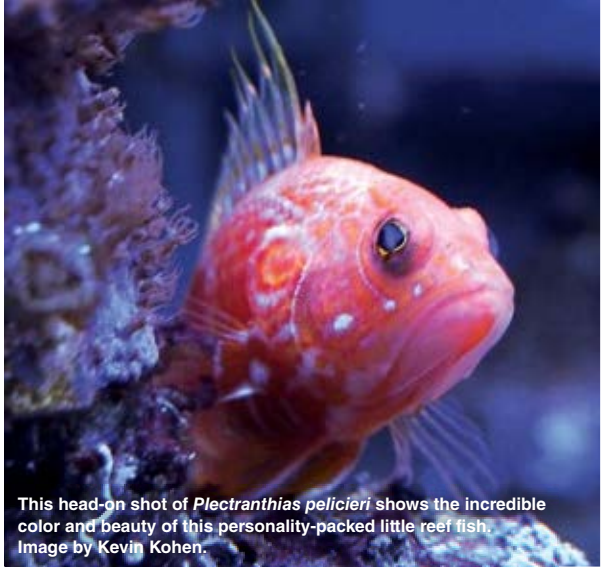
My current top five favorite reef fish range through the rare, the unusual, and some that are only slightly removed from fish that are widespread aquarium staples. Interestingly, each of these species of tropical marine fish first grabbed my attention by plucking at this aquarist's heartstrings and landing a place on my fish wish list through random encounters either in books, in tanks, or while snorkeling in the Indian Ocean. Without further ado, here are five of my favorite new marine and reef aquarium fish that have recently become available in the marine aquarium hobby.

Plectranthias pelicieri is an incredible species of smaller reef fish, which can be considered nano throughout most of its life, although some specimens can grow up to be as punky as unruly little hawkfish. The first time I heard about Pelicier's *Plectranthias* was probably back in 2004 or 2005, when the Geometric Pygmy Hawk, *Plectranthias inermis*, first entered the trade. I was immediately enamored with this group of basslets, which are related to the ubiquitous anthias, yet lack a swim bladder and prefer to perch like a hawkfish. The unique behavior of *Plectranthias* bears an uncanny resemblance to the familiar, yet unrelated, hawkfish of the family Cirrhitidae. But *Plectranthias* are more numerous in species and occur much deeper than hawkfishes, and new species are being discovered every year.

Coming back to the species in focus, although I might have seen a picture of this fish before seeing one in person, like the Yasha Goby, nothing could prepare me for the jaw-dropping appearance of *P. pelicieri* in real life. The fish buyers at the venerable Greenwich Aquarium in Greenwich, Connecticut, are always on the lookout for rare, new, and unusual reef fish, and they often take a chance by buying assorted reef fish from various locations around the world. One of those times, a *Plectranthias pelicieri* came through a shipment from Cebu (Philippines), and its documentation through countless pictures and video helped to fuel the demand for the limited supply of this fish that we now enjoy today.

Besides this one little guy that Greenwich Aquaria imported from Cebu, *P. pelicieri* was previously only known from Japan and Mauritius, the latter being the collecting location for the specimens used in the species' original description. For years, the few specimens that were collected were almost always snapped up by Japanese aquarists for big, big money. Luckily, the species has recently become more available with some regularity from Quality Marine's collecting station in New Caledonia.

The reason this diminutive little fish really caught the world's attention is that it packs an incredible amount of color and patterning into a small package with a very interesting body shape. Brilliant reds and whites are broken up with yellow markings on its face, flanks, and fins. The dorsal fin is slightly transparent with gorgeous yellow spots at the base and with some elongated filaments towards the front. Growing only up to 3 inches long, most specimens that



This head-on shot of *Plectranthias pelicieri* shows the incredible color and beauty of this personality-packed little reef fish. Image by Kevin Kohen.

Plectranthias pelicieri is endowed with a beautiful range of color, markings, and elaborate finnage that are highlighted by bold contrasts of red and white. Image by Jake Adams.

we come across are in the 2-inch (5 cm) range, firmly within cute nano reef fish territory. Furthermore, Pelicier's *Plectranthias* readily takes to aquarium foods, isn't too shy, and can be quite personable if not housed with too many other domineering fish species. While *P. pelicieri* is still a pricey fish species at the retail level, its incredible appearance and ease of maintenance make it a perfect aquarium inhabitant. With some effort, perhaps captive breeding could help this fish become more widespread.

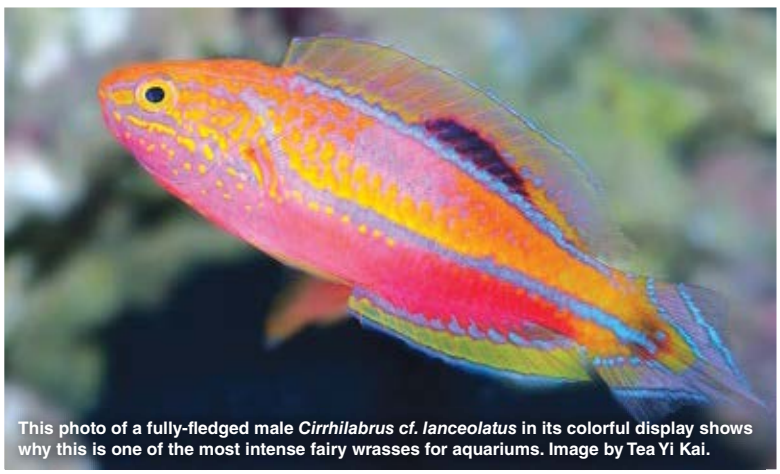
When it comes to the broad groups of marine aquarium fish, the wrasses are not my super favorites. While there are plenty of "wrasse guys" out there, I'm more of an angelfish, butterflyfish, and basslet fan. However, there is a small subset of fairy wrasses of the *Cirrhilabrus* genus that really do it for me. With emphasis on small and cute, the smaller species like *Cirrhilabrus johnsoni* and *Cirrhilabrus lunatus* are more my cup of tea, but my all-time favorite is *Cirrhilabrus cf. lanceolatus*, the Dwarf Pintail Wrasse. At the beginning of my career covering and writing about rare reef aquarium fish, *C. cf. lanceolatus* made a big splash when a small handful of specimens became available in North America in early 2009.

Not to be confused with the much larger Pintail Wrasse, *Cirrhilabrus lanceolatus*, the Dwarf Pintail Wrasse is rather different, save for the lanceolate tail, and it is an undescribed species that went pretty much unseen until very recently. Armed with a perfect picture of an adult male shot by Tony Vargas, RVS Fishworld was tasked with the mission of finding more specimens of the Dwarf Pintail Wrasse. In late 2013, RVS Fishworld succeeded in finding a concentration of this species in the northern Philippines, which resulted in a small, steady supply of this fish for the global aquarium hobby.

Whereas the singular specimens of Dwarf Pintail Wrasses that were available over five years ago commanded top dollar, the recent moderate influx of these wrasses has changed that. Not only is it possible for the average aquarist to afford one, it's even possible to acquire a trio of one male and a couple of females for less than what a single fish cost back in the day. The reason to invest in more than a single fish is to encourage the splendid nuptial display that male Dwarf Pintail Wrasses will perform in the presence of some girlies to impress. And what a show this fish can put on!

Besides the diminutive size of the Dwarf Pintail Fairy Wrasse, what makes this species really stand out is its exceptional color and patterning. The Dwarf Pintail Wrasse has a body coloration that is basically orange in youth, becoming increasingly patterned and colorful with age. The unpaired fins of a male Dwarf Pintail become adorned with blue edging and a light yellow border, somewhat similar to a flasher wrasse of the *Paracheilinus* genus, except for the tail fin, which becomes increasingly elongated to the point of developing a small streaming filament. The body becomes divided by a large, blue girdle-stripe that starts behind the head and gill plate. It continues all the way down the flank and is matched by an equally brilliant blue stripe at the base of the dorsal fin. If that wasn't enough to make the Dwarf Pintail a standout fish, it furthermore develops a red ventral area, a black dorsal patch, and a purple face with intricate yellow spots and reticulations that altogether make this species truly breathtaking.

The Zebra Tang, *Acanthurus polyzona*, is one of those reef fish that I really appreciate for being so similar to the Convict Tang, but with enough distinction to warrant individual species status. For me, the Zebra Tang has long been one of the ultimate "book fish," a species of fish that you only



This photo of a fully-fledged male *Cirrhilabrus cf. lanceolatus* in its colorful display shows why this is one of the most intense fairy wrasses for aquariums. Image by Tea Yi Kai.

The Zebra Tang usually sports nine broad stripes across its body compared to the Convict Tang's five thin stripes. Image by Jake Adams.

Acanthurus polyzona develops a beautiful white ventral area that is peppered with attractive round spots. Image by Jake Adams.

see in a few photos and the original documentation of the species. Hailing from far flung regions of the Indian Ocean's Mascarene Islands, including Madagascar and Mauritius, I never held out any hope that this species would ever see the light of aquarium life.

However, in recent years, the Gurroby family in Grand Baie Mauritius has been ramping up its collection of unique reef fish from the island, as well as exploring unlikely habitats to search for new fish. For close to two years, I begged and pleaded with the Gurrobys to look for and find *Acanthurus polyzona*, with no real expectation that they would ever discover a honey pot where this very unusual species can be found.

After countless requests, this past summer the expert Mauritian fish collectors finally embarked on a tour of the island, exploring new locales and talking with local fishermen to find the "Convict Tang with more bars." Despite the Convict Tang being as ubiquitous in Mauritius as it is in many other coral reef regions of the world, the search for the Zebra Tang was not a straightforward undertaking, and it took a long time for the Gurrobys to zero in on an area where this venerable book fish can be found. Eventually, the elusive Zebra Tang was spotted, living not in a typical reefal environment, but near shore, along some well-trafficked roadways where it can sometimes be seen grazing on the rocks in shallow water. More reliably, the Zebra Tang can be found in small numbers patrolling large algae flats, often in the company of the more common Convict Tang.

Still far from common and arguably much rarer than the better known Gem Tang (also from Mauritius), it is now possible to obtain a Zebra Tang for one's home aquarium, although the few specimens that are collected are dispersed far and wide to satisfy a global demand. As you might have guessed, the Zebra Tang is very similar in appearance to the Convict Tang but with more stripes, a beautiful spotted belly, and almost tribal tattoo-like markings on the face. When it is small, the Zebra Tang doesn't look too different from the Convict Tang, but with age and more marking development, the fish really starts to come into its own. My own specimen of Zebra Tang has truly developed into a beautiful, eye catching fish, and I simply can't wait to see how it will look when it is fully grown at 5 to 6 inches.

The other two of my new fish faves are along the same lines—fish that look similar to classic aquarium fish but are inherently distinct. The Tiger Damselfish, *Chrysiptera annulata*, is an interesting species that is part of the genus that also includes popular favorites like the Starcki Damsel, the Pavo Damselfish, and a myriad of colorful blue and yellow species. At first glance, it is easy to mistake the Tiger Damselfish for a humbug of the *Dascyllus* genus, but it stays much smaller and remains rather mild-mannered compared to the ubiquitous three and four stripe humbugs. Better yet, the Tiger Damselfish keeps its very bright bars throughout its life but is currently still pretty rare in the aquarium trade.

I first encountered the Tiger Damselfish, a.k.a. the "footballer demoiselle," while snorkeling a near-shore reef in Mauritius. I might have seen this species in books before, but it wasn't fresh in my memory when I came across it in just a few feet of water. I instantly recognized it as a damselfish, but having never seen this species in

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The Tiger Damselfish has beautiful, broad black and white bars, a very pronounced pelvic fin, and very subtle hints of blue outlines. Image by Jake Adams.

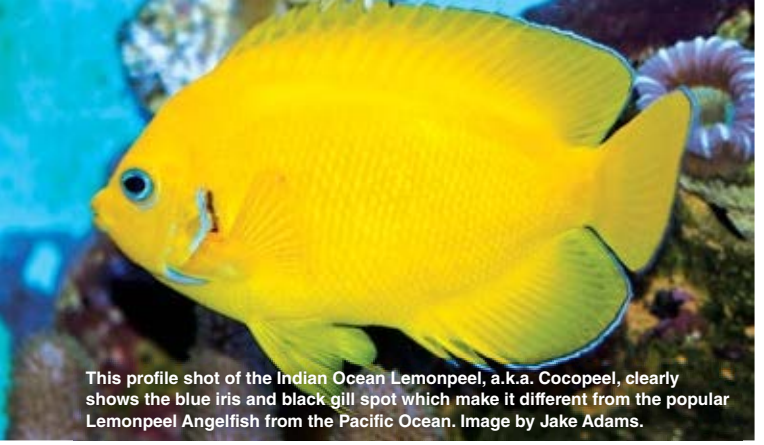
This full-blooded Pacific Lemonpeel Angelfish (*Centropyge flavissima*) shows the prominent blue ring around the eye, distinctly different from the Cocopeel's blue iris. Image by Jake Adams.

an aquarium before, I had no idea that it would stay small and cute even into adulthood. When I came up from this snorkeling outing, I immediately chided the Gurrobys for not collecting and exporting this fish that I had seen just a few short miles from their holding facility.

Fast forward a few weeks, and the first handful of Tiger Damselfish were already in the U.S. and ready to be observed under controlled aquarium conditions. Once I finally got my hands on one, I was amazed to discover that this fish is really cool! Not only does it have the bold black and white barring that originally grabbed my attention, but its body shape, fins, and face are equally remarkable. Huge black pectoral fins are flared from underneath the body of the Tiger Damselfish like giant rudders for steering. Notably, the alternating black and white stripes of the body culminate in a very cute, thin black stripe on the center of the face and snout, a feature that is unique and not found in humbugs or the closely related Tuxedo Damselfish, *Chrysiptera tricincta*.

As far as I can confirm, Tiger Damselfish are not rare, coming from a broad range of the Western Indian Ocean, including Madagascar, Mauritius, and Maldives, although the only aquarium specimens in the U.S. have come from the latter location. The Tiger Damselfish is one for the masses since it is colorful (in a black and white kind of way), hardy, and not nearly as aggressive as the superficially similar humbugs. Don't expect your local fish store to know what a Tiger Damselfish is yet, but hopefully with time, this species will gain more recognition and grace more than a few reef fish fanciers' tanks.

The Indian Ocean Lemonpeel, a.k.a. Cocopeel, is another one of those fish that is similar to an already familiar one. The Lemonpeel



This profile shot of the Indian Ocean Lemonpeel, a.k.a. Cocopeel, clearly shows the blue iris and black gill spot which make it different from the popular Lemonpeel Angelfish from the Pacific Ocean. Image by Jake Adams.

Angelfish, *Centropyge flavissima*, is a very popular marine aquarium fish that can be found over a wide range, from the Western Pacific Ocean all the way to French Polynesia. While many can recognize the various forms of Lemonpeel Angelfish (e.g., the black-tailed hybrids from Vanuatu and the orange "Orangepeels" from the eastern end of their range), the Indian Ocean Lemonpeel is different not only in its appearance but also in its isolation.

Cocopeels, as I affectionately like to call them, only come from Cocos and Keeling Islands in the Eastern Indian Ocean. The geographic separation of the Cocopeel from the more often seen Lemonpeel Angelfish consists of nearly all of Indonesia, and it has been suspected that it could be a separate species. But relatively recent genetic research has shown that it is in fact a good card-carrying *Centropyge flavissima*, even if its appearance is somewhat differentiated. Where a typical Lemonpeel has a golden-yellow body coloration with a prominent blue eye ring, the Cocopeel has a vivid yellow body coloration that is more like a Yellow Tang. Furthermore, the eye ring of a regular Lemonpeel Angelfish is replaced with a very blue iris, a small difference that amounts to a very distinguished-looking fish.

From across the room, you'd be hard pressed to tell the difference between the Lemonpeel and Cocopeel Angelfishes, but it's the minute differences that place this fish firmly in the territory of rare reef fish. Furthermore, it's not like you can just pick up a Cocopeel at your local fish store. They are only imported from Cocos Island alongside the famous Joculator Angelfish, *Centropyge joculator*. They are not nearly as affordable as a regular Lemonpeel Angelfish, and they are far fewer in number than the already scarce Joculators. Another neat fact about the Cocopeel is that it is the parent fish of the world-famous Tigerpyge hybrids that are occasionally collected in Western Indonesia. You can even see the telltale blue iris of the Cocopeel in Tigerpyge Angelfish specimens.

Many of the fish that pique my interest may be few and far between and sometimes seem out of reach for the casual home aquarist to acquire. But as these things often go, certain species of rare fish tend to become more readily available over time, and the price tends to drop, provided that the demand for these fish is sustained and that divers are incentivized to find a good source of healthy, sustainably caught specimens. With patience and persistence, and if you keep your eyes peeled and your ears close to ground, you too will be able to come across unique reef fish specimens such as these.

AQUARIUM PHOTOGRAPHY LIKE A PRO: GOING BEYOND AUTO (part 2)

SABINE PENISSON

How often have you wanted to capture a picturesque moment in your tank but couldn't manage to get the result you expected? The thumb-sized image shown on the screen of your camera looks quite nice momentarily, but once you open it in a larger format, you notice the blurry fish, dark surroundings, or grainy details. Suddenly, it doesn't look so good, and you're disappointed.

There are many little tips and tricks to help you capture bright, sharp images of your aquatic friends. None of them are difficult to understand, and they apply to 99 percent of all cameras.

In the first article of this series, we took a look at the common settings and functions found on most cameras. Now, in this second article, we'll discuss how to apply photographic techniques to the tricky optical environment of the aquarium, one which is too high in contrast to be correctly processed by the automatic settings of your camera.

A beautiful photograph is created when the shutter is triggered, not with retouching software. Photography is an art ruled by technique. It requires learning and mastering a large number of variables if you want to get the best results. In some ways, it's like an aquarium; there's no guarantee you will have the healthiest system just because you own the best equipment!

Here are some basic technical definitions used in this article:

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.

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.

Metering/Center-Weighted Average System: The 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.

TWO SETTINGS TO EXPLORE

Now you have the basics memorized but still don't really know what to do. Don't panic. For any given situation, you can anticipate the settings needed.

For a picture of a moving subject, even a fast one like a fish, it is appropriate to set the camera on Speed Priority mode. This allows you to choose the desired shutter speed and lets the processor automatically calculate the best diaphragm aperture to obtain the correct exposure of your subject.

A cardinalfish doesn't move the way a tang does, and you'll learn through practice what minimum shutter speeds you'll need for optimal detail. For slower fish species, a shutter speed of 1/80 to

1/125 of a second is often enough. For faster swimming species, such as wrasses and surgeonfish, you should increase the speed to 1/200 or 1/250 of a second to successfully freeze the subject's motion. At such a speed and without a flash, you will often get a very limited depth of field, depending on the ambient light available and the ISO chosen.

By contrast, still-subject photography demands precision. Just the opposite of the previous paragraph! So you will not be surprised to find that the settings are exactly reversed, too. It is best to select the Aperture Priority mode, which allows you to manually adjust the aperture for a greater or lesser depth of field. The camera then calculates the correct shutter speed to get the desired effect. For large subjects, such as full tank shots or coral arrangements, try the largest depth of field (DOF) possible to get the most detail from the foreground and background. To get a very sharply detailed subject detached dramatically from its surroundings, try a very shallow depth of field.

HELPFUL ACCESSORIES

There are two important accessories that will improve your photos: a TTL (through-the-lens) flash and a tripod. With a flash, you can set higher shutter speeds, which is very useful for capturing the movements of fish. You will appreciate its ability to bring out details like sparkling eyes and shiny scales. The main drawback is if it's used too frontally, the flash will flatten the angles, reducing the subtle light contrasts created by top lighting. The end result is a flat, cold image.

High contrast shots are likely to confound a camera's automatic settings.

The correct shutter and aperture settings are critical. The shutter speed for the top picture was not fast enough to get a sharp shot, so we added a flash to allow for more speed and a deeper depth of field.

A shallow depth of field clearly separates the subject from the background. Had I chosen a deeper depth of field, this red goby would have been almost invisible amongst the red gorgonians.

A camera's built-in flash is often unsuitable for aquatic photography. Most of the time, it will splash some ugly reflection over the glass on the front of the aquarium, making its use very tricky. I recommend that you buy an independent cobra flash controlled by infrared or cable link to the camera.

A successful macro shot.

The tripod is another critical accessory to own. With the help of a tripod or a Gorilla Pod (flexible hanging tripod), the flash can be freely positioned against the glass of the tank to avoid glare or on top of the tank to complement your aquarium lamp. With this item, hundreds of creative lighting possibilities can be achieved.

Certainly, putting your camera on a tripod limits the freedom of movement and prevents the spontaneity of composition. But it can also be your best friend for a number of reasons. First, it allows you to lower the shutter speed and optimize the depth of field for neat macro shots. This is very useful for small subjects where every millimeter counts. It will also prove essential for actinic-lit and low-light photography where a very slow shutter speed is used. Lastly, it can allow you to compose your desired frame, choose the settings, and then wait patiently for a fish to pass through the frame to press the shutter, all without getting sore arms!

COMPOSING THE FRAME

To go a bit more in-depth, let's talk about art. A good photographer must plan his or her image ahead of time. Academic rules of composition, known since the dawn of time in painting, are still relevant in digital imaging. Here's an example of an elementary, but none the less effective, rule. The eye of Western people is used to scanning space from left to right and from top to bottom (from the influence of the Latin alphabet). Your image will gain interest by using this reading direction. Instinctively, the human brain's attention is drawn to diagonal lines, and it translates them as movement. Photos using these lines in the composition catch the attention of the viewer and feel lively. Imbalances and off-centered subjects in the frame are also intriguing to the brain, whether we're conscious of it or not. These constitute some interesting paths to be explored in photography.

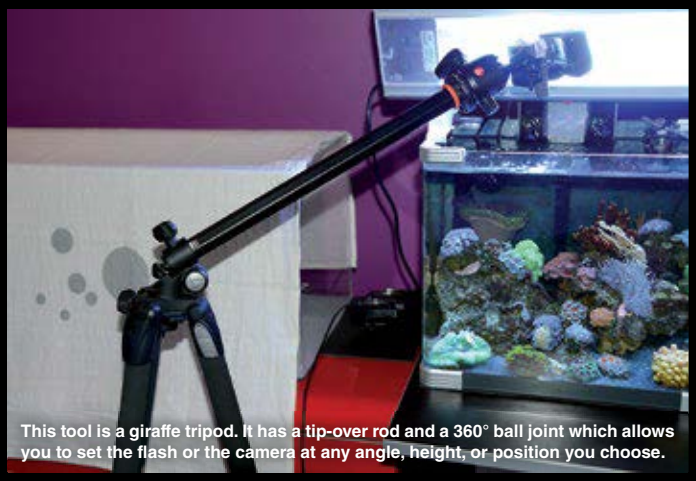
Conversely, a shot based on horizontal or vertical lines and centered composition gives a tranquil and calm feeling. These compositions are often used in landscape photography to evoke feelings of peace and solitude, but also a sense of power and strength. These are also the rules used to create the official portraits of illustrious people in history, who were portrayed in all their rigid majesty—facing forward and placed in the center of the image.

Management of three-dimensional space is important. In portrait photography, it is flattering to have a shallow depth of field, as it will highlight the main subject. Shallow depth of field also keeps details sharp in macro photography. In contrast, a large depth of field will be appreciated in panoramic photography. For the full tank shot, it will allow for greater detail in the rockwork structures and coral arrangements. The drawback of a deep depth of field is that it can appear static and flat rather than artistic looking.

MORE TIPS FOR AQUARIUM PHOTOGRAPHY

Finally, I will offer some specific pieces of advice to add to your new photography knowledge. Just mastering these tips might take your pictures from good to great.

Firstly, the most important thing is to understand that aquarium glass will distort the subjects within if the camera does not shoot through the least amount of glass possible. This phenomenon is inevitable in macro photography. To minimize distortion, align the planes of the lens and tank glass and shoot straight into the tank.



This tool is a giraffe tripod. It has a tip-over rod and a 360° ball joint which allows you to set the flash or the camera at any angle, height, or position you choose.

It is important to shoot in darkness. To take beautiful pictures of your tank, you must avoid light reflection. Close the blinds and curtains and turn off the lights in the room so that only the tank is lit. With an SLR camera, use the sun visors supplied with the lenses.

For full tank shots, push the ISO to the maximum acceptable noise level in order to best combine the highest shutter speed (to get sharp images of the fish, for example, 1/125 of a second) and the smallest aperture possible (to gain clarity on different fore- and backgrounds). The hardest challenge would be to get the right exposure, including all the nuances between the brightly lit upper area and the dark caves of the rockwork.

Diagonal lines in a composition convey a sense of movement.

An atypical framing distinguishes this shot and gives a powerful eloquence to the image. Don't hesitate to throw off the balance of the composition!

Use the center-weighted average measure in the camera's display, taking the lower third of the decor as the reference as this usually gives good results (due to this area's illumination relative to the entire tank). As illustrated, you will see bars to the left and to the right of the number zero. If you point your camera at a very bright area, the bars will go to the "+" side of the zero, indicating that there's too much light for the current exposure setting. If you point your camera at a very dark area, the bars will go to the "-" side of the zero, indicating that there's too little light for the current exposure setting.

Regarding photography with blue or actinic lights, you can use the same advice as for full tank shots, but add two constraints: the lack of ambient light and the problem of white balance. In order to highlight colors under blue or actinic lights, you won't be using a flash; it would be pointless.

Absolutely no other light source in the room is permissible, and the use of a tripod is highly recommended. Select the self-timer option (or use a remote control) to avoid a hand movement blur when pressing the shutter. Set a manual white balance to match the sensor to what you actually see (automatic white balance will be totally inaccurate in this lighting). The ISO value must be pushed to its maximum potential, taking into account the grain produced. The fish will probably look pretty fuzzy if you go below 1/30 of a second, but it is usually not very important as these photos are often intended to showcase the beautiful fluorescence of corals.

The last tips are for night photography. This is the perfect time to capture images of nocturnal scavengers and the deployment of feeding coral polyps. The tank is quiet, and another ecosystem appears.

Fluorescence captured under actinic lighting.

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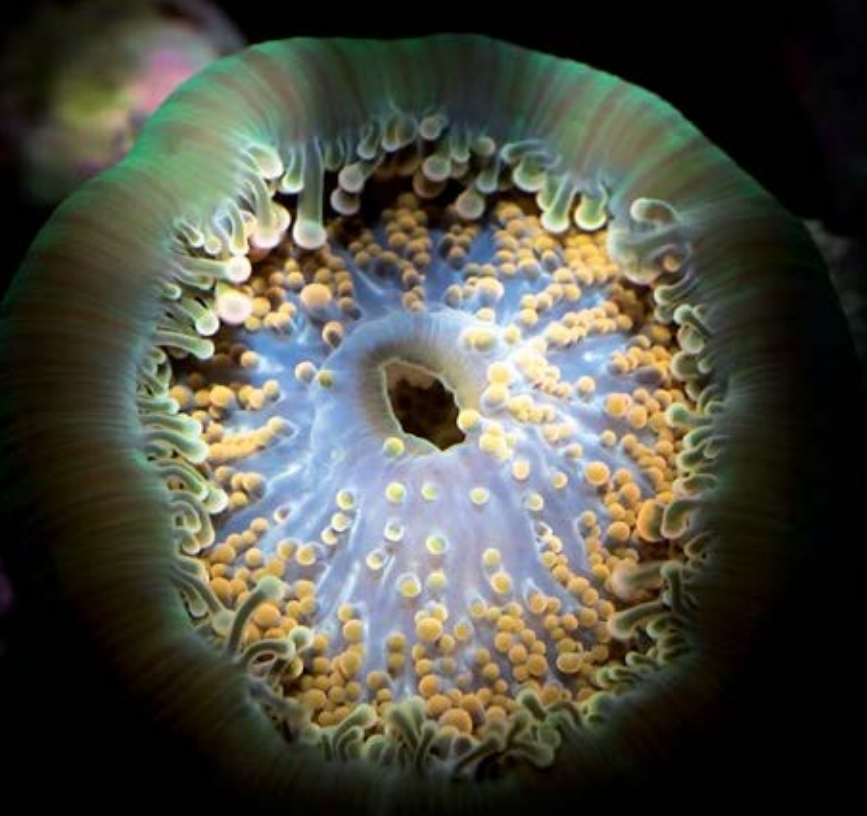

Night shots can be taken with a pocket torch as the only light source. The camera is set on a tripod with remote shutter, so you can put your full concentration into positioning the torch.

For these shots, work with a remote flash (placed up-close to the front glass or above the tank) or a torch (preferably an LED torch, which gives a fairly intense white light). Cut the water flow to best capture the long, hunting coral polyps. Set the camera on the tripod and, depending on the subject, use the self-timer if necessary. The camera should be set to manual mode, with a relatively low depth of field (e.g., f/5.6).

Night shots without flash, while using a torch as the sole light source, can be very creative. A torch sculpts subjects like no other. It is best to buy a waterproof lamp such as those made for diving and immerse it in the tank. A small pocket model will be more than enough, as these lamps are extremely powerful.

Now that you know all the basic settings of your camera and the way these settings dictate how your images will look, let's apply them. Practice again and again by shooting hundreds of images. Practice and repetition are the key to good photography when you're starting out. Try different settings, shoot, and compare the results. Once you know these basics by heart, you won't have to think about what settings apply to a certain circumstance; you'll just set them and shoot!

I wish you a lot of fun with your camera and tank and hope that these few hints prove useful in your photographic experiments! If you have specific images or problems you'd like help with, you can email me at Sabine@rhmag.com.

Don't be afraid to experiment; sometimes an unorthodox treatment is just what a picture needs!

TROUBLE-SHOOTING GUIDELINES

- If your image looks too dark, lower the shutter speed OR increase the aperture (with a lower value of f/) OR increase the ISO value.
- If your image looks dull/grayish, underexpose by 1/3 or 2/3 of a stop by using the exposure compensation OR increase the shutter speed and keep the same aperture OR decrease the aperture (by increasing the f/ value) and keep the same speed.
- If the moving subject shows motion blur lines, increase the shutter speed.
- If the subject is blurry without showing characteristic motion lines, it is focus blur. Adjust the focus (by choosing the single collimator option if needed).
- If the subject is still, like a coral, but looks blurry (because of the shaking of your hands when using a low shutter speed), use a tripod and a remote control.
- If your image looks noisy, reduce the ISO value.
- If you want sharper details around your subject in a close-up shot, increase the DOF by reducing the aperture size, and increase the shutter speed to better freeze any motion in the image.

Reef-Safe Pipefishes

TAMI WEISS

Pipefish are frequently overlooked by aquarists, either because they are assumed to be incompatible with reef aquariums or because they are overshadowed by their seahorse cousins. There are over 200 recognized species of pipefish in our oceans. Many are stunning, but most never make it into the hobby.

Carefully selected pipefish make outstanding aquarium inhabitants, and many thrive in reef tanks where their seahorse cousins would perish. This article is going to cover a few commonly available pipefish that are suitable for reef aquariums and how to best acclimate them to aquarium life.

FLAGTAIL PIPEFISH

Flagtail pipefish are some of the most brilliantly colored of all pipefish. Their name comes from the large, colorful tails they use both for swimming and as part of courtship and territorial displays. These pipefish often swim in mid-water, though they do like hideouts under overhangs and rocky crevices. Two genera are classified as flagtail pipefish, *Dunckerocampus* spp. and *Doryrhamphus* spp. They are mostly peaceful and often available. They also do well in most reef tanks, which is a huge plus for the aquarist who just wants to dabble in pipefish. Some of them are cleaners as well. Many swim upside down at least some of the time, making them entertaining and unique fish to watch.

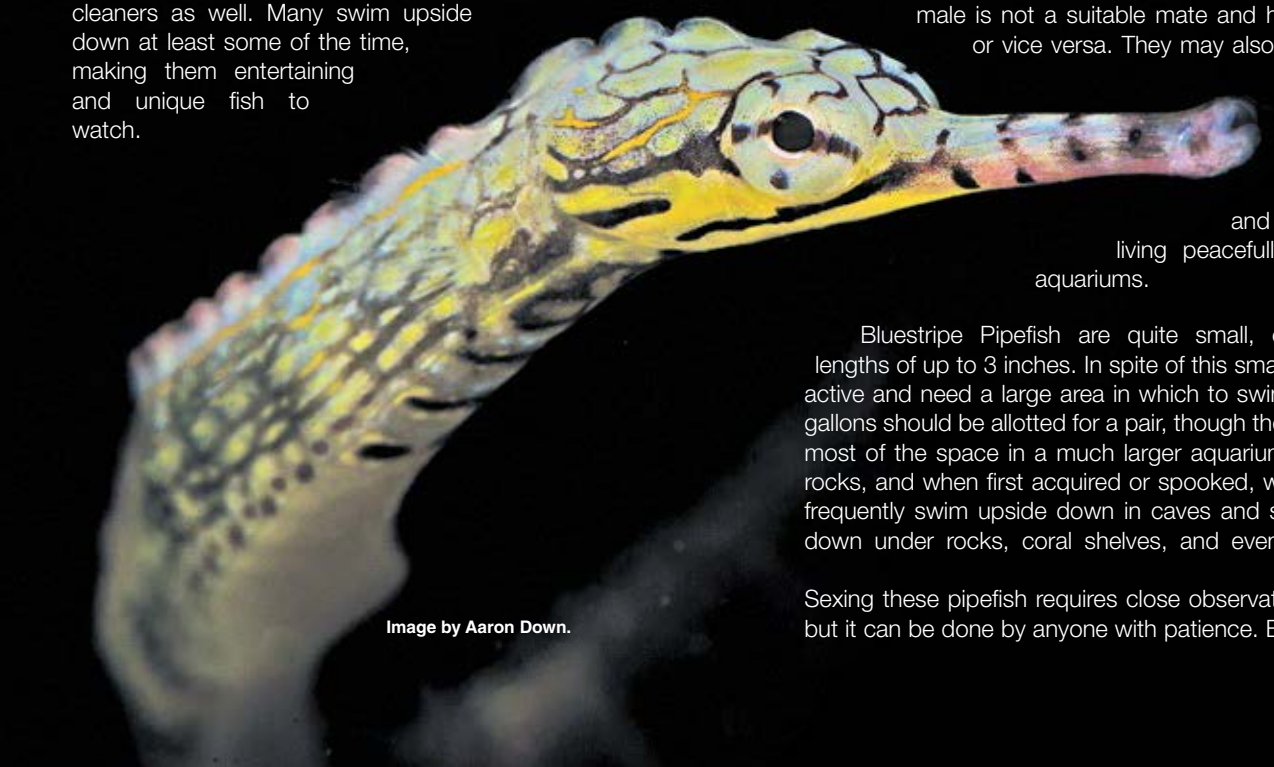

Image by Aaron Down.

Because pipefish are generally thought to be peaceful, hobbyists are often surprised to find out that flagtail pipefish can be quite aggressive towards one another. Different species show different levels of aggression, and some even live in groups for a while. But even those that are coexisting together may start fighting at any time. Aggression is inverse to size, with the smallest species being the most aggressive and the largest being the least. The good news is that this aggression is limited to other flagtail pipefish. They do not bother other fish, including dissimilar pipefish species.

Doryrhamphus spp. are probably the hardiest of the flagtail pipefish, with the Bluestripe Pipefish (*Doryrhamphus excisus*) being the number one choice for beginners. All flagtail pipefish do well in reef systems as long as they don't contain aggressive fish or stinging corals. Some aquarists report keeping Maxi-Mini Carpet Anemones or Bubble-Tip Anemones with these pipefish without incident.

Bluestripe Pipefish are probably the most well known for their assaults on conspecifics and similar species. Two males will almost always fight to the death, and even females have been known to fight. Size is often important. There should not be too much size difference between individuals you are planning to house together. A female placed with a much smaller male may decide the male is not a suitable mate and harass him to death, or vice versa. They may also harass other flagtail pipefish as well, though I've heard reports of Bluestripe Pipefish and Banded Pipefish living peacefully together in large aquariums.

Bluestripe Pipefish are quite small, only reaching adult lengths of up to 3 inches. In spite of this small size, they are quite active and need a large area in which to swim. A minimum of 30 gallons should be allotted for a pair, though they would happily use most of the space in a much larger aquarium. They hide among rocks, and when first acquired or spooked, will stay hidden. They frequently swim upside down in caves and sleep nestled upside down under rocks, coral shelves, and even cleaning magnets.

Sexing these pipefish requires close observation and a keen eye, but it can be done by anyone with patience. Because they tend to

A male Bluestripe Pipefish (*Doryrhamphus excisus*). Image by Sabine Penisson.

hide, your best chance is to ask fish store employees to catch them and place them in a specimen container to get a close-up view. Males have saw-like ridges on the top of their snouts, and their bellies are flat. If you can get a close look at a male, you will see the flaps of skin used to protect eggs. Females lack the ridges on the snout or have them to a much lesser degree. The overall shape of the female's body is slightly rounded.

Occasionally, I hear reports of an aquarist able to keep a male-female-female trio or a multiple female-only group of Bluestripe Pipefish together successfully. However, these situations are much rarer than encounters that end with aggression. Adding to the aquarist's frustration, these pipefish are very fast and very adept at hiding; it can be difficult to impossible to separate fighting Bluestripe Pipefish before a death occurs. If you feel you are unable to accurately sex them, it is best to house them singly.

Janss' Pipefish (*Doryrhamphus janssi*) are also good flagtail pipefish for the reef, but don't mix them with any other *Doryrhamphus* species. Janss' Pipefish are larger than Bluestripe Pipefish and are a little more laid back. They are still scrappy though; they get into conspecific conflicts and may go after *Dunckerocampus* spp. as well. Janss' Pipefish are known for their strange habit of spending most of the time swimming upside down.

Janss' Pipefish (*Doryrhamphus janssi*). Image by Marcelo V. Kitahara.

Dunckerocampus spp. flagtail pipefish are quite a beautiful group of pipefish. Two species are commonly available to aquarists, a third

infrequently, and a fourth species, while uncommon, has much potential for the aquarium. *Dunckerocampus* spp. are less aggressive than *Doryrhamphus* spp., sometimes allowing the aquarist to keep them in groups. However, handling stress in shipping is a big problem, seemingly more problematic than with *Doryrhamphus* spp. That being said, once they are established, they thrive in the reef aquarium.

The Banded Pipefish (*Dunckerocampus dactyliophorus*) is probably the most commonly available pipefish of this genus. They grow up to 7 inches and thus are the largest of the flagtail pipefish. They tend to come in to fish stores in pretty rough shape, but if the aquarist can get a healthy, eating specimen, they do quite well in aquariums. Unfortunately, many decline within a few days to a few weeks after acquisition, but having live food on hand can help transition them to life in captivity. Initially, expect them to only take live food, but try weaning them onto Nutramar Ova, Cyclop-eeze, and small *Mysis*, as long term success requires these fish to reliably eat non-living foods. Captive-bred Banded Pipefish are also becoming available, making success with them much more likely.

There are conflicting reports about aggression with Banded Pipefish. In the wild, they are often found living as pairs, but it's not uncommon to find groups living together. In the aquarium, they also frequently live quite happily in groups. Unfortunately, there are numerous accounts of two individuals deciding to spar, sometimes upon introduction and sometimes after months of cohabiting without problems. Closely watching for aggression in aquariums with multiple Banded Pipefish is advised; unlike Bluestripe Pipefish, they can usually be caught and separated quickly before aggression becomes too serious.

The Yellow Banded Pipefish (*Dunckerocampus pessuliferus*) is possibly the most spectacular flagtail pipefish, but of the various *Dunckerocampus* pipefish, this species doesn't have a particularly good record of survival in aquariums. One can start with healthy specimens, feed all the right foods, and the pipefish seem to be doing well, only to disappear weeks or months later. The reason for their poor survival isn't exactly clear. As handsome as they are, I would advise all but the most dedicated aquarists against keeping this species.

The Multibanded or Many-Banded Pipefish (*Dunckerocampus multiannulatus*) is not common in the hobby but is seen on occasion. It is similar to *Dunckerocampus pessuliferus* but has a white background instead of orange. It is so similar that the two are often confused, with *D. multiannulatus* mislabeled as *D. pessuliferus* at many wholesalers and fish stores. They are also often mislabeled with the wrong genus, such as *Doryrhamphus multiannulatus*.

Banded Pipefish (*Dunckerocampus dactyliophorus*). Image by Alex Varani.

Yellow Banded Pipefish, Dumaguete, Philippines. Image by Karen Honeycutt.

A female Redstripe Pipefish. Image by Jim Welsh.

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Scribbled Pipefish (*Corythoichthys intestinalis*). Image by Aaron Down.

This species will fight readily when two males are kept together, and there is little information on sexing.

The Redstripe Pipefish (*Dunckerocampus baldwini*) isn't commonly available, but thanks to pipefish breeder Jim Welsh, we now know these make good candidates for the home aquarium. Jim acquired a group for breeding purposes and thoroughly documented their acclimation to aquarium life as part of his successful breeding project. The wild caught adults transitioned to life in captivity readily. They are endemic to Hawaii, and local collectors are able to collect them for aquariums. They seem better adapted to captivity than other *Dunckerocampus* pipefish, but it may be due to shorter handling time from collection in Hawaii to our aquariums.

Messmate Pipefish (*Corythoichthys haematopterus*). Image by Paul Baldassano.

These pipefish also exhibit some aggression and fighting between males. They, like Bluestripe Pipefish, are tricky to sex. Males have very small bumps on their snouts and a yellow band under their jaws. These bumps are an order of magnitude smaller than the Bluestripe Pipefish, which is already difficult to sex. Because of the size of these features, it may require photographing and zooming in to sex these fish.

DRAGONFACE PIPEFISH

Dragonface pipefish (*Corythoichthys* spp.) are another popular genera of reef pipefish. Only three *Corythoichthys* species regularly make it into the hobby. Much of the dragonface pipefish's popularity seems to have arisen because they are thought to eat the red bugs that attack *Acropora* spp. corals. There are varying reports as to whether or not they actually do. Some aquarists report success in eradicating red bugs with dragonface pipefish while others note no change in the number of pests.

The three species of dragonface pipefish commonly available in the aquarium trade are the Network Pipefish (*Corythoichthys flavofasciatus*), the Scribbled Pipefish (*Corythoichthys intestinalis*), and the Messmate Pipefish (*Corythoichthys haematopterus*).

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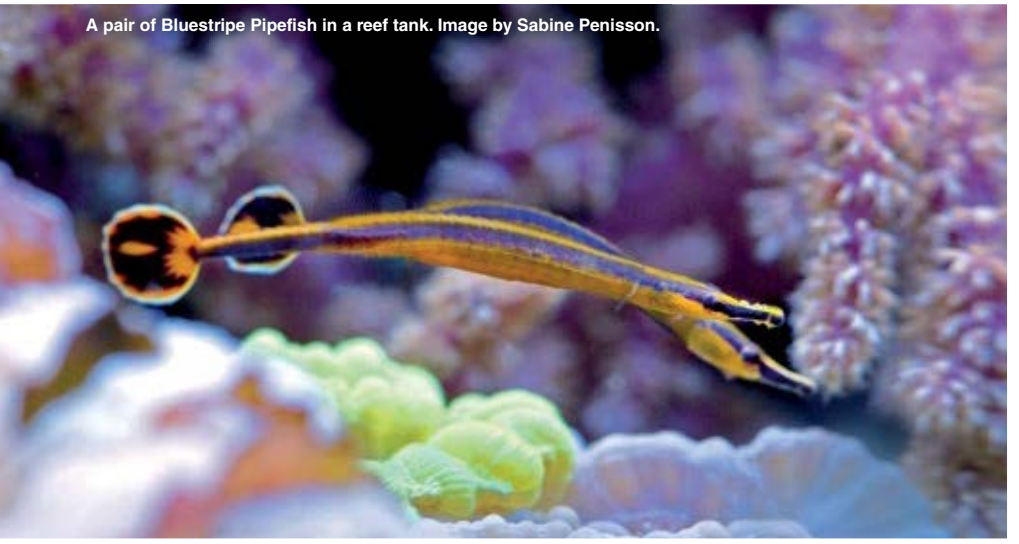
Network Pipefish (*Corythoichthys flavofasciatus*). Image by Sabine Penisson.

Don't expect to find them by those names; most vendors just label them as dragonface pipefish. Because of the similarity between species, it's entirely possible that many other *Corythoichthys* species are making it into the trade labeled as dragonface pipefish.

Fortunately, care is the same for all three species. Reports from aquarists suggest that *C. haematopterus* and *C. intestinalis* have better survival than *C. flavofasciatus*, though with the difficulty in species identification, it isn't possible to evaluate how accurate those claims are.

Dragonface pipefish need large aquariums with lots of macrofauna—such as copepods, amphipods, and isopods—to graze on. Ensuring you have enough pods in the aquarium to sustain these pipefish can be difficult. They rarely learn to take frozen food, and if they do, they need to be fed several times daily to subsist on this as their primary diet. A refugium is a must to keep these pipefish. Smaller aquariums can support dragonface pipefish if they are fed supplementally, but the supplemental feeding required is often more work than most aquarists would be willing to take on. It requires feeding newly hatched and enriched brine shrimp at least once a day (and possibly more) or a dedicated copepod culture to feed from. The occasional dosing of copepod starter cultures is inadequate as the sole food source for these fish.

Minimum tank size recommendations vary for these species. The two most common sizes recommended by reputable sources are 30 and 50 gallons. While both sizes are likely fine for physically accommodating this fish, they typically need a much larger-sized tank to ensure they have enough food to graze on. If you do not plan to feed supplementally with baby brine shrimp or cultured copepods daily, the minimum aquarium size should be considered 90 gallons for one pair. The 90-gallon minimum aquarium size isn't a hard rule; some aquariums this size may end up a barren wasteland if kept nutrient poor, while a smaller tank may be able to support dragonface pipefish if they are well fed and a rich refugium is attached.



A pair of Bluestripe Pipefish in a reef tank. Image by Sabine Penisson.

The best indicator of your ability to provide food for dragonface pipefish is to gauge the amount of live food naturally occurring in your aquarium. Perhaps the easiest way to do this is to check the aquarium at night using a flashlight. Look around the glass near the sandbed. If you see a large number of tiny dots hopping around the glass and sandbed, your tank can likely support these pipefish.

Dragonface pipefish get along quite well with each other. They prefer to spend their time in pairs. In the wild, large groups are often found aggregating together. In the home aquarium, if the food source can sustain them, a group of dragonface pipefish can live quite happily together. Pairs will frequently hang out side by side. They may wander apart from one another, only to decide they urgently need to find and check in with their mate a few minutes later (hint: it's adorable to watch).

PICKING YOUR PIPEFISH

When purchasing pipefish, there are a few things you can look out for to ensure you get healthy specimens. Pipefish are susceptible to bacterial infections, so look for areas of cloudy skin, fins, or eyes. Rapid breathing is frequently a sign of distress. Although rapid breathing can be situational (e.g., fear from recent acclimation), it can also be a sign of a bigger problem, such as parasites or bacterial infection.

Flagtail pipefish should be swimming above the substrate, not resting on the bottom. You want to pick pipefish that are actively eating (if possible, offer live brine shrimp). Some may take frozen food immediately. Their color should be vivid; dull coloration suggests a problem.

Dragonface pipefish should be moving around and looking actively at surfaces

nearby. It may be difficult to see if they are eating in a fish store because the pods they hunt are very tiny, but watch for individuals which are picking at the substrate or rocks. One condition that afflicts dragonface pipefish is that sometimes their mouths appear stuck open. It's not clear what causes this, but it is generally a sign that the fish is in ill health and should be avoided.

FEEDING AND SAFETY

One issue that many aspiring pipefish keepers face is that most aquariums do not produce enough food to feed pipefish naturally. This seems to be a fairly common problem. Unfortunately, it can take some time for the macrofauna to be decimated, and meanwhile, starvation may go unnoticed until it is too late. I recommend aquarists have at least a contingency plan in place if they need to supplementally feed their pipefish. In the case of flagtail pipefish, they can frequently be trained to take frozen foods.

For your best chance at success with any new pipefish coming into your care, plan in advance to have a few different live foods on hand. This is a good idea even if you've seen the pipefish eating frozen food before bringing it home. A change in environment can cause a setback that then requires live food to entice the pipefish to begin eating again. Newly hatched brine shrimp is a good starting diet for dragonface pipefish and some flagtail pipefish. Adult live brine shrimp should also be on hand for flagtail pipefish that aren't eating.

If you have the space to culture copepods, they are a great food for pipefish and can be a great addition to any reef aquarium. *Tisbe* spp. copepods are a fantastic option. Pelagic copepods, such as *Apocyclops panamensis* or *Acartia tonsa*, are great for flagtail pipefish as they swim mid-water. Reef *Mysis* can sometimes be acquired from fellow aquarists and added to the refugium to supply a small but steady quantity of *Mysis* to the display tank housing the pipefish.

Flagtail and dragonface pipefish tend to like crevices and other tight spaces. Overflows are particular hazards. Precautions should be taken to place screen or mesh guards over these whenever possible. If a pipefish goes missing, check the overflow and sump. I can't count the number of times I've found one that has managed to get around the guard and is hanging out in the overflow.

CONCLUSION

Pipefish are great reef fish and can be kept in many reef aquariums. A robust and varied supply of captive-bred pipefish would be ideal, as they would be less likely to have gone through the stress that wild pipefish do with capture and transportation. Unfortunately, to date, there are very few captive-bred pipefish, and these have mostly been produced by hobbyist breeders. Like any fish, there are various approaches that might result in the best success, and some species are better suited than others for a reef aquarium. If you are looking for something different for your reef tank, think pipefish!

A special thanks to Jim Welsh for his help with this article and for all the work he has done advancing captive pipefish breeding.

EXTREME AUTOMATION PART 2: INTERMEDIATE AUTOMATION PROJECTS

In the previous issue, we discussed some basic aquarium automation projects. In this second installment, we move on to intermediate projects. The idea behind this three-part series is to share what I have chosen to automate. I'll present an overview of how it was done, and you can 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's no way around it. Taking this 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 again. 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 any of the equipment can result in disastrous consequences. Plan your projects as best you can, taking into consideration any failures that can happen, how you can minimize their damage, or better still, how to prevent them altogether.

INTERMEDIATE AUTOMATION

• Alkalinity and Calcium Replenishment

To replenish the alkalinity and calcium that is consumed in the aquarium, I use dosing pumps to supply a two-part additive and kalkwasser. The main reason I went this route over a calcium reactor is pH related. The pH of my aquarium tends to be on the low side of the optimal range. During the summer and winter months, the house is sealed up tight, so between the kids and four-legged pets, the CO2 levels in the house run a little high, causing the tank's pH to drop. Using a calcium reactor would make the pH in the tank even lower than it already is.

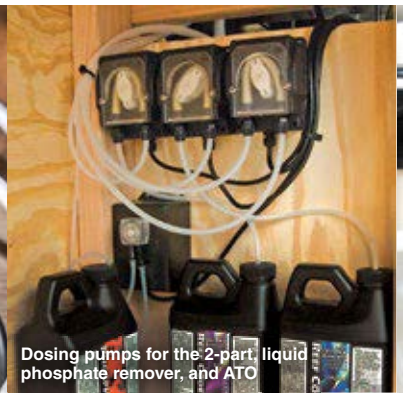
I primarily use kalkwasser to maintain alkalinity and calcium, but kalkwasser by itself is not enough to keep up with the full demand of the aquarium. I also have to use a two-part additive. The reason why I do use kalkwasser, even though it can't keep up with the demand of the aquarium, is for elevating my pH. Originally, I tried using kalkwasser for all of my top-off water. The issue I ran into was that my evaporation rate varied depending on the season. This would cause my alkalinity and calcium to fluctuate.

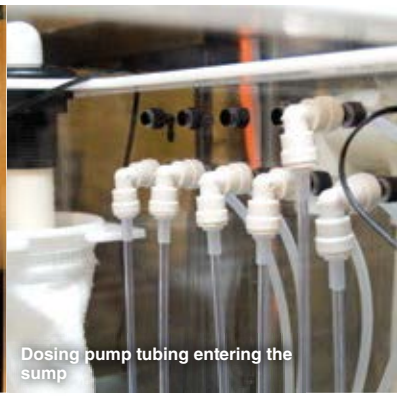
The solution was to dose a set amount of kalkwasser every 24 hours. The controller doses kalkwasser every 20 minutes. Should the pH of the aquarium rise above a preset high value, the kalkwasser dosing pump will not come back on until the pH drops back down. In addition, should the water level rise and trigger the high water point float switch, the kalkwasser dosing pump will stay off (and in both cases, I will receive an alarm email). Since I am relying on an accurate reading from the pH probe, I calibrate it every two weeks. This may seem excessive, but I rely on it both as a safety shut off and as a trigger for dosing the two-part additive.

Each component of the two-part additive is dosed twice per hour, alternating 15 minutes between the two components (calcium and


Kalkwasser vat


Kalkwasser dosing pump


Dosing pumps for the 2-part, liquid phosphate remover, and ATO


Dosing pump tubing entering the sump

carbonate). The amount added is determined by the pH of the aquarium. The higher the pH, the more calcium and carbonate is added and vice versa.

What I did to program this system was to take the pH range and break it down into five sections:

7.50 – 7.99
8.00 – 8.14
8.15 – 8.24
8.25 – 8.34
8.35 – 8.44

If the pH is in the second range (8.00-8.14), and it is 2:00 p.m., the dosing pump for the carbonate component comes on for X amount of time. Now let's jump ahead a few hours. It's now 4:00 p.m. and the pH is at 8.21. The carbonate component dosing pump is going to run for a little longer than it did at 2:00 p.m. The reason is because the pH of the aquarium has increased. In the winter, my aquarium can hit a pH of 8.5 while using the same amount of kalkwasser as I do in the summer (when my pH might top out at 8.35). I could cut the amount of kalkwasser that I add to the aquarium and increase the amount of two-part, but instead, I prefer to dose kalkwasser until the pH reaches the programmed high point and then add more two-part. If I didn't add more two-part, the alkalinity and calcium would drop, and given the pH level of my aquarium, it would drop pretty quickly.

Having the controller set up to dose this way is complex, and not everyone needs this much control. However, this level of automation allows me to keep a steady pH range with rock-solid alkalinity and calcium levels, resulting in faster coral growth. I rarely have to tweak the settings because of alkalinity or calcium drift. Just remember, the pH reading will be critical, so the probe must be cleaned and calibrated regularly.

• Automatic Water Exchange

Since building the automatic water exchange system approximately three years ago, I have only done four manual water changes. Doing a manual water change allows me to siphon out detritus, whereas employing an automated system can make that part of a water change difficult to do. I'll be honest. Since automating this task, I don't siphon out much detritus. I have the VorTech pumps switch over to constant 100 percent power to help with detritus, and sometimes when I stick my hand in the aquarium, I might fan the rockwork to free some up, but that's basically it.

Each day, the system performs a small water change (around 2 gallons) using two peristaltic tube pumps. The first pump brings old water from the sump down to the drain in the basement. After that pump turns off, there is a delay of a few minutes before the second pump turns on and pumps new salt water up from an automated mixing vat (to be discussed in the next issue). The drain and fill tubes are located next to each other in the sump, so to avoid draining the newly added water, I run the pumps alternately. This cycle happens multiple times per hour throughout the day.

In the past, I have tried using a dual head peristaltic pump, but I would run into issues with the amount of fluid each head pumped.

A LiterMeter III controls the pumps used for water exchange.

I found using two peristaltic pumps and calibrating them individually to be more consistent, but this also requires calibrating the pumps on a regular basis. The two pumps are calibrated differently because one pump stays on longer than the other due to that pump bringing fluid up from the basement against head pressure and the other pump pushing fluid down to the basement. I do not use dedicated float switches in the sump to start and stop the water exchange pumps as I have not had a need for them. I do use the high water level float switch along with the low water level float switch to shut down the pumps if the water level should rise or fall to a dangerous level.

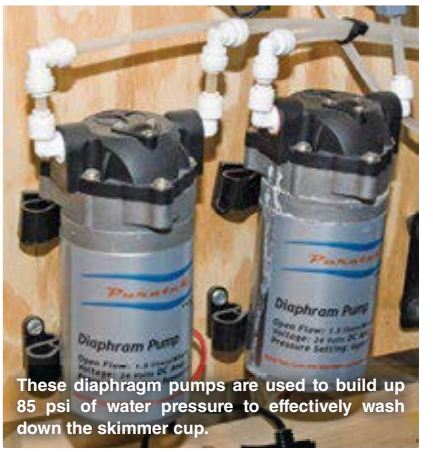
I also use two conductivity probes. One probe is located in the sump of the aquarium; the other probe is in the salt water mixing vat. If the water in the aquarium starts to drift away from 35.0 ppt, the water exchange system will shut down, and I will get an alarm email. If the salinity in the aquarium were to start to rise, it could be from too much salt water being pumped in. In that case, the high water level float switch in the sump would be triggered as well, shutting down all system pumps and the heater and turning on the EcoTechs for surface water agitation. Now if the salinity in the aquarium were to start to drop, the cause might be from the auto top-off (ATO) turning on too frequently because the water exchange pump is not pumping up enough new salt water. However, because the ATO system is programmed to anticipate this, the low water level switch would activate, causing all system pumps to shut down before the ATO system could cause the salinity to drop significantly (for more on the ATO system, see part 1 of this series in the Q1 2014 issue).

• Protein Skimmer Automation

Automating the cleaning of a protein skimmer really can be a worthwhile time saver, even if it doesn't seem so at first. Plus, the skimmer will constantly run at its maximum efficiency since the skimmer's neck will always be clean. Most commercial skimmer cleaners have a wiper that cleans the inside of the neck, but I decided to construct a pressurized wash system. I ended up building my own spray bar that is suspended from the top of the collection cup. The spray bar is made from ¼ inch RO tubing and is positioned so that it makes a complete circle around the top of the neck. To make the holes in the tube, I used a small hobby drill. I use a diaphragm pump to bring purified water up from the RO/DI water vat located in the basement and provide wash pressure of up to 85 psi to dislodge skimmate. I have my cleaner programmed


The tube mounted around the skimmer neck sprays highly pressurized water to clean the skimmer neck and cup.


The pressure switch will shut down the protein skimmer and its wash system if overflow is imminent.



These diaphragm pumps are used to build up 85 psi of water pressure to effectively wash down the skimmer cup.

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to turn on every four hours and stay on for two minutes at a time. Having this spray turn on every four hours means that the cleaner is washing away only four hours of build-up at a time. A second diaphragm pump brings the water and skimmate from the protein skimmer cup down to the drain in the basement.

For safety, I use a pressure switch inside the protein skimmer cup. If the skimmer cup should start to overfill, the pressure switch will shut down the skimmer along with the diaphragm pump that pumps water up to the skimmer cleaner. Let's imagine that something in the water caused the skimmer to start going crazy, and the collection cup started to fill up. Before it could start to overflow, the pressure switch would trigger, and the skimmer would shut down. I would get an alarm email, and the diaphragm pump that brings skimmate down to the drain in the basement would turn on for a few minutes. After the cup was drained, the protein skimmer would turn back on. If the skimmer cup got to the point where it was going to overflow again, the protein skimmer would again shut down, but this time it would stay in that position until I manually turned a virtual outlet back on. The only reason I use a pressure switch in the skimmer cup is because of the physical size of the cup; getting a float switch to fit is difficult.

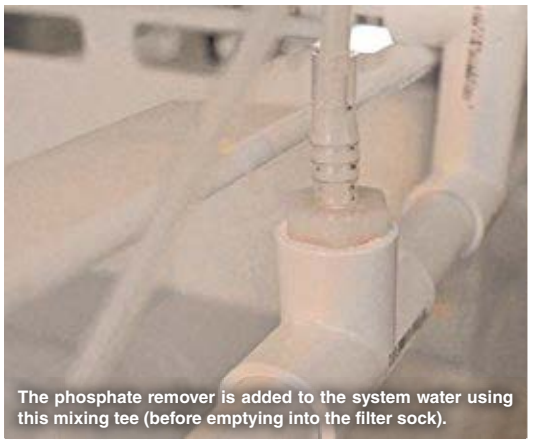
- Phosphate Control Automation

I like to feed my fish—a lot. And as you may or may not have noticed, I also like to keep angelfish. One of the reasons I like to feed so much is that it helps keep the angelfish from fighting. In an eight-hour photoperiod, my wife will feed three to four frozen cubes

This dosing pump is used to add the phosphate remover.

and the auto feeder will feed pellets five times. With all of that food comes a lot of phosphates and nitrates (more on nitrate removal in the next article). The most economical way for me to remove phosphates is with a liquid phosphate remover and granular ferric oxide (GFO). The liquid phosphate remover binds the bulk of the phosphate, which allows the GFO to finely polish the water.

To automate, I use a very slow peristaltic tube pump that pumps the phosphate remover into the top of a 1-inch PVC pipe. I also use



The phosphate remover is added to the system water using this mixing tee (before emptying into the filter sock).

The float switch is mounted near the top of the 5-micron filter sock.

a low gallon per hour water pump that pulls water from the skimmer compartment of the sump into the top of the same 1-inch PVC pipe. This allows plenty of contact time in the pipe before the mixture empties into a 5-micron filter sock next to the return pump. The filter sock doesn't let any of the bound flocculants pass, so the reaction is mainly restricted to the PVC pipe and filter sock. As a precaution, there is a float switch installed inside the filter sock. Should the water level rise in the sock and come close to overflowing, the float switch will be activated, the phosphate remover dosing system will shut down, and an alarm email will be sent.

The controller will turn on the water pump along with the peristaltic phosphate remover pump every other hour for 40 minutes. For example, at 1:00 p.m., both pumps will turn on and stay on for 40 minutes. The peristaltic pump will then turn off first at the 40-minute mark, with the water pump staying on for another four minutes before turning off. The pumps will then stay off until 3:00 p.m. when the process starts all over again. During the time the pumps for the phosphate control system are active, the ATO pump is kept off because the water level in the sump will drop slightly as water fills the PVC pipe and filter sock. After the pumps turn off, the water level in the sump returns to normal as the 5-micron filter sock drains.

That does it for this article. In the third and final article, we will discuss automating a batch-style denitrator, routing of purified RO/DI water to different vats, and an automated salt-mixing station.

A young grouper hides within a Pink Vase Sponge (*Niphates digitalis*).

REEF LIFE OF COZUMEL

TIM WONG

Surrounded by the Caribbean Sea, Cozumel's reefs provide great opportunities for both beginners and seasoned divers. Diving and snorkeling in Cozumel are some of its main attractions, and visitors arrive almost constantly into the city of San Miguel via plane, ferry, or cruise ship. In September of 2013, I made a trip to Cozumel and experienced some of the wonderful diving firsthand. Like many places on the Yucatan, there are abundant shops and some larger bars, restaurants, and stores. I highly recommend venturing outside of the main city of San Miguel to discover the local Maya ruins and miles of unmanicured beaches. Only one road circles the island once you leave town, so getting lost is difficult. All along the main road, you will find dive shops willing to take you out to awesome local dive sites. A quick online search will point you towards a reputable shop. The east side of the island is characterized by heavy surf, but the west side is much calmer and ideal for diving. Having been designated as a National Marine Park, the waters around Cozumel thrive with marine life. Despite storms like Hurricane Wilma in 2005, which had caused severe damage to the reefs, marine life here has rebounded, and evidence of past damage is now difficult to recognize under layers of new coral and sponge growth.

After a few days of adventuring around the island and nearby Playa Del Carmen on the Yucatan peninsula, we decided it was time to start diving. Out of convenience, we chose to go with our hotel's dive shop, Aquaworld, but we also heard good things about Scuba Club just up the road. In preparation for diving, I would advise getting to the shop early so that you have time to double-check your gear, weight, and photography equipment. If you are renting gear,

Grunts, wrasses, and damsels are common dive companions.

Airplane Wreck: 10-45 feet

For our first dive, we decided to do a shallow orientation dive right out from our hotel, the Park Royal, to see a local treat. Just offshore of Cozumel's El Cid Hotel lies a 40-passenger airplane sunk in 1977 for a movie production. Close to shore and relatively shallow at 10-45 feet, the site is an easy beach dive for beginners. The wreck lies on a sandy bottom with scattered aggregations of coral and gorgonians. Approaching the wreck, divers can expect to see schools of chubs, grunts, wrasses, and damselfish swimming among scattered coral mounds.

don't be afraid to ask for a different BCD (buoyancy control device), wetsuit, or regulator if you think the condition or fit of the gear assigned to you isn't what you're comfortable with. Every dive shop has its own personality, so take time to talk with some of the staff and fellow divers. I love asking questions about the potential dive sites, particular marine life to look out for, and what photography equipment I should plan on taking down with me. Although diving accidents in Cozumel are rare, it is highly recommended that divers consider purchasing accident or trip insurance from the Divers Alert Network (DAN). Once you have your safety and equipment considerations covered, don't forget to have fun!

A beautiful French Angelfish (*Pomacanthus paru*).

We spotted some decent-sized lobsters, a Yellow Stingray, and several invasive lionfish on our way to the dive site. Upon reaching the wreck, the scene is very much like one from a movie and provides plenty of wonderful photo opportunities. Care should be taken to not swim under overhanging parts of the plane since its structure has greatly deteriorated. In fact, it now lies in two separate parts. Close inspection of openings into the plane revealed a variety of invertebrates, Glasseye Snappers, and other fish seeking refuge. As a bonus, there's an awesome sunken anchor at the front of the airplane. Leaving the dive site, you will likely encounter parrotfish, Atlantic Blue Tangs, damselfish, wrasses, and other schooling fish.

The following morning, we were taken out on a nice boat with about 15 divers and four guides. Based on dive conditions and the overall experience level of our group, our dive sites were determined to be San Francisco Wall and Paradise Island.

A large Midnight Parrotfish (*Scarus coelestinus*) at San Francisco Wall.

San Francisco Wall: 60-80 feet

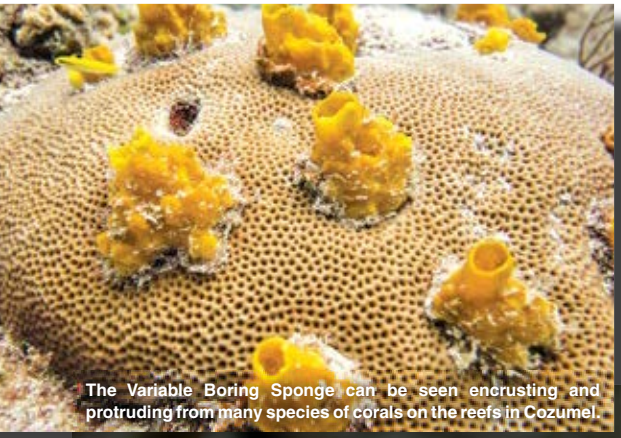
After a 35-minute boat ride, we arrived at our first dive site. Descending from the boat, we were greeted by an immense and steeply sloping wall of corals, gorgonians, and sponges. Many of the Barrel Sponges here were truly immense. This site also had an abundance of hydroids with powerful stings, so I would advise either wearing a full length rash guard or, better yet, avoiding direct contact altogether! Virtually all of the diving on Cozumel is drift diving, and the current along San Francisco

A basketball-sized colony of Grooved Brain Coral.

Wall was strong. It was easy to be distracted by fish, corals, or inverts, only to look upwards at a quickly approaching colony of fire coral or hydroids. At this site, we reached a maximum depth of 80 feet and saw a number of larger angelfish, Midnight Parrotfish, groupers, and our first Hawksbill sea turtle. Care should be taken to monitor your depth here since the current and orientation of the wall makes visual verification of your depth more difficult. Large schools of Blue Chromis damselfish could be seen swimming all over the reef. At this depth, a flash is necessary to bring out the warm colors of the reef in photos.

Paradise Island: 30-45 feet

Our second boat dive featured Paradise Island, a shallow, rocky reef at 40 feet surrounded by a sandy bottom. This site was great for looking at the small stuff such as crabs, brittle stars, and Christmas Tree Worms. Corals and fish showed more of their true colors, and flash wasn't necessary under the full sunlight. Here, hundreds of juvenile Creole Wrasses and Blue Chromis could be found in large schools swimming close to the reef. Careful observation of the sandy bottom revealed several small Yellow Stingrays and a Sharptail Eel. As with the other dive site, the current was strong here and moved at about the pace of an escalator. If you're into drift diving and don't mind letting the ocean do the work, then this is perfect! Staying stationary on the reef to capture a photo of shy and minute Christmas Tree Worms proved slightly more difficult but no less enjoyable. Large stony coral heads of *Porites* spp., brain coral, sponges, and gorgonians dominated this site.



The Variable Boring Sponge can be seen encrusting and protruding from many species of corals on the reefs in Cozumel.

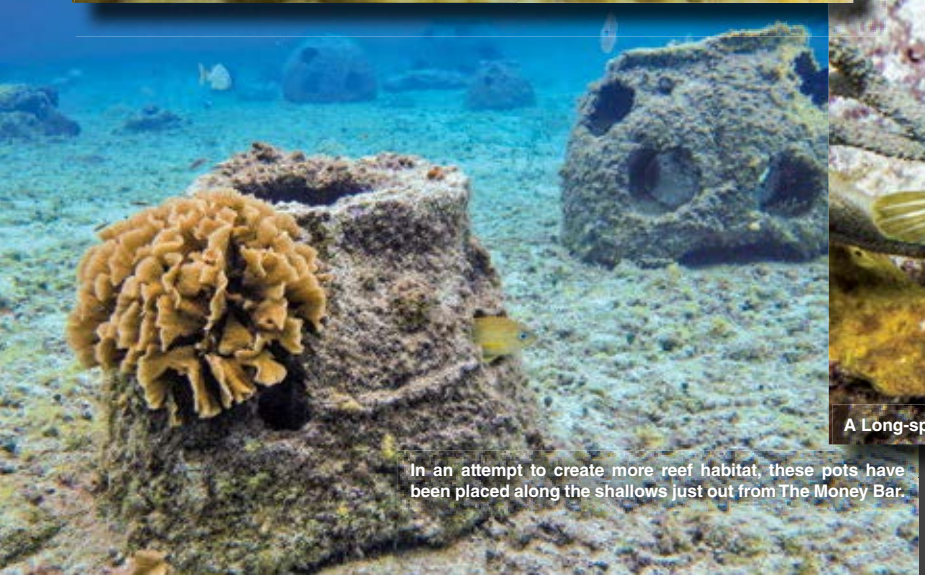
Christmas Tree Worms sport a vivid array of colors.

Dzul-Ha (The Money Bar): 5-15 feet

If diving isn't your thing, The Money Bar is one of the best spots for snorkeling from shore and is easily accessible via a cab ride since it's just south of town. You can rent snorkel gear and order drinks from the bar or nap in hammocks near the beach. At only 5-15 feet, there is a lot to see in the relatively shallow water. Much of the sandy bottom here is dotted with small coral heads and fields of gorgonians. Closer to shore, large pots have been strategically placed to form artificial reefs. A few corals and some invertebrates had colonized some of the pots, but most of the pots appeared to be either newly placed or unsuccessfully colonized. I was stung by a number of free-swimming hydroids at this site, so I would recommend wearing a full-length rash guard here (and anywhere around Cozumel if you find yourself prone to stings). I really enjoyed snorkeling at this site and spent several hours combing the sandy bottom and gorgonian beds photographing fish and invertebrate life.

If you haven't gotten your dive gear wet in the Caribbean, Cozumel has a lot of reef to offer to divers of all levels. Relatively accessible from Cancun and Playa Del Carmen, there's no reason not to spend a day or two on the island and enjoy the rich marine life it has to offer.

A Long-spine Porcupinefish (*Diodon holocanthus*) at San Francisco Wall.



In an attempt to create more reef habitat, these pots have been placed along the shallows just out from The Money Bar.

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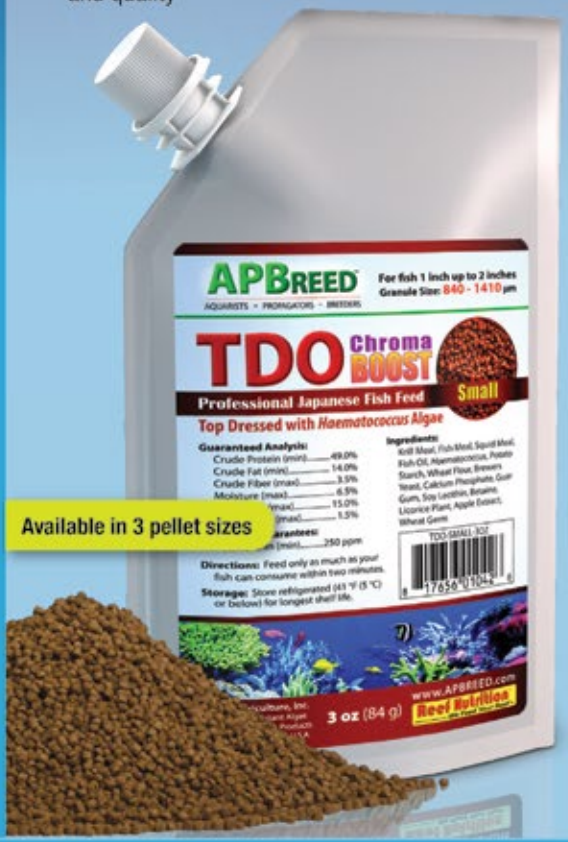

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